Review of Environmental Factors

January 2024 FINAL REPORT

WTP Raw Water Supply Lagoon

Prepared for PARKES SHIRE COUNCIL

Review of Environmental Factors – WTP Raw Water Supply Lagoon

Revision	Author/s	Internal Review	Date Submitted	Client Review and Approval	
				Name	Date
0.1	S Rivett, A Uhrig, J Sanderson	S Rivett; E Cotterill	29 April 2021	-	-
0.2 *Changes to terminology; consideration under the WM Act and LG Act included, additional consultation requirements included; changes to design incorporated.*	A Uhrig, J Sanderson	E Cotterill	17th August 2021	-	-
0.3 *updates to reflect new REF guidelines and project adjustments*	E Cotterill	-	4th August 2022	-	-
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Abbreviations

Abbreviation	Description
ABS	Australian Bureau of Statistics
ADD	Aboriginal Due Diligence
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
AOBV	Areas of Outstanding Biodiversity Value
AS	Australian Standard
ASC	Australian Soil Classification
ASS	Acid Sulfate Soils
AWS	Automatic Weather Station
BAM	Biodiversity Assessment Methodology
BC Act	*Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
BOS	Biodiversity Offset Scheme
BVM	Biodiversity Values Map
CEMP	Construction Environmental Management Plan
DCCEEW	Department of Climate Change, Energy, the Environment and Water (formerly DAWE)
DECC	Department of Energy and Climate Change
DEWHA	Department of the Environment, Water, Heritage and the Arts
DPI	Department of Primary Industries
DPE	Department of Planning and Environment (formerly OEH)
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
EPL	Environmental Protection Licence
FM Act	*Fisheries Management Act 1994*
GBD	General Biosecurity Duty
GHG	Green House Gas
HBT	Hollow Bearing Tree
HTE	High Threat Exotic
ICNG	Interim Construction Noise Guidelines
KFH	Key Fish Habitat
KTP	Key Threatening Process
LEP	Local Environmental Plan

Abbreviation	Description
LGA	Local Government Area
LLS Act	*Local Land Services Act 2013*
LLSA Act	*Local Land Services Amendment Act 2016*
MNES	Matters of National Environmental Significance
NPW Act	*National Parkes and Wildlife Act 1974*
NSW	New South Wales
OEH	Office of Environment and Heritage
PAD	Potential Archaeological Artefacts
PCT	Plant Community Type
PMO	Project Management Office
POEO Act	Protection of the Environment Operations Act 1997
PSC	Parkes Shire Council
PWSP	Parkes Water Sharing Plan
RCP	Representative Concentration Pathway
REF	Review of Environmental Factors
RF Act	*Rural Fires Act 1997*
RM	Rising Main
RWSL	Raw Water Supply Lagoon
SAII	Serious and Irreversible Impacts
SAP	Special Activation Precinct
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
TCP	Traffic Control Plan
TEC	Threatened Ecological Community
TEF	The Environmental Factor
TfNSW	Transport for New South Wales
TISEPP	*Transport and Infrastructure State Environmental Planning Policy 2021*
ToS	Tests of Significance
WM Act	*Water Management Act 2000*
WoNS	Weeds of National Significance
WTP	Waste Treatment Plant

Executive Summary

This Review of Environmental Factors (REF) has been prepared by The Environmental Factor (TEF), on behalf of Parkes Shire Council (PSC or Council). The report presents the findings of the investigations undertaken into the potential environmental impacts as a result of the proposed construction and operation of a Raw Water Supply Lagoon (RWSL) adjacent to the existing Water treatment Plant (WTP) to the north of Parkes, NSW (hereafter 'the Proposal').

This report has considered to the fullest extent possible the environmental impacts with potential to arise from the Proposal within the framework of Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), and has considered:

- Impacts on Matters of National Environmental Significance (MNES) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) (refer Section 6.1).
- Impacts on threatened species in accordance with s 7.8 of the *Biodiversity Conservation Act 2016* (BC Act) and Part 7A Division 12 of the *Fisheries Management Act 1994* (FM Act) (refer Sections 3.2.4, 3.2.5, 3.2.9, 3.2.11).
- Environmental impacts in accordance with s 5.5 of the EP&A Act and cl 171(2) of the *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation) (refer Sections 3.2.4 and Section 4).

This report identifies how the proposed concept design, including environmental safeguards to be implemented, could impact the surrounding environment. The study area is located within the locality of Parkes on the north eastern outskirts of the town. The RWSL would be located to the north of the WTP on Council-owned land, and would store and supply 'raw' water that has been pre-treated in lagoons adjacent to the Lachlan River.

Part of the proposed Lachlan Duplication Pipeline, the ~20 ML lagoon forms part of a broader program that aims to support greater water security within Parkes and throughout the central west region, particularly for Council's and other water utilities that are included in the Central NSW Joint Organisation (CNSWJO), as part of supporting critical drinking water security as well as planned developments to the west of Parkes, including the proposed future Special Activation Precinct (SAP) developments. The new system would provide an additional 6.3 GL of urban water, or its equivalent, per year to the districts' end users; as part of this, the RWSL will provide approximately 24 hours of security in the form of raw water to be treated to meet potable requirements for the Parkes township, and as such provide security in the face of potential system failure or other unexpected shortages.

The proposed RWSL also provides for more efficient water supply and allows Council greater operational flexibility on how the proposed SAP water supply will be issued depending on recipient use (i.e. direct from the supply lagoon or via treatment at the WTP). Predominantly, the RWSL allows for the continued supply of raw water to the WTP in the event the new pipeline requires repairs or maintenance.

Impacts to threatened species, populations or endangered ecological communities associated with the Proposal are minor, being associated with the clearing of approximately **2.72 ha** of Remnant and regenerating White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion, and a further **1.62 ha** of mixed planted and regenerating White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion, representing **2.4 %** of the overall native vegetation present within a 1.5 km radius of the site. The site connects with broader

extents of remnant vegetation across Golden Bar Hill to the east. No threatened flora species are considered likely to be significantly impacted by the proposed works. No Aboriginal or historical items identified via desktop investigations as occurring within close proximity to the study area are deemed at risk of being impacted during construction or operation of the RWSL. An Aboriginal Due Diligence (ADD) assessment was completed by OzArk Environment & Heritage (OzArk) in September 2022, with the assessment concluding the study area to have low archaeological potential due to previous disturbance of the ground surface and the low archaeological sensitivity of the landform. Furthermore, the undertaking of the due diligence process resulted in the conclusion that *"the proposed works will have an impact on the ground surface, however, no Aboriginal objects or intact archaeological deposits will be harmed by the proposal".*

The proposed RWSL is anticipated to have positive long-term socio-economic benefits for the local community through the provision of an additional ~20 ML of raw water to be used in times of drought, emergencies or equipment failure.

It has been determined (Maddocks, 2021) that the construction of the supply reservoir will require a water supply works approval under Part 3 of Chapter 3 of the WM Act notwithstanding the project is considered as an extension to the existing (approved) water treatment works. Although the lagoon is considered 'water reticulation work' (exempt) the land on which the lagoon is to be constructed is not the subject of a water use approval and so the exemption in regard to construction does not apply. Council is therefore in the process of applying for and obtaining a water supply work approval to meet their legislative obligations. As of August 2023, the process is underway.

Under Section 60 of the *Local Government Act 1993*, local water utilities are required to obtain ministerial approval for the construction or modification of water or sewage treatment works and for any significant modifications to or construction of dams and flood retention basins which could cause significant threat to public safety in the event of failure, regardless of the dam's height or storage volume. The Section 60 approval provides an independent assessment of the proposed works to ensure they are fit for purpose and provide robust, safe, cost-effective and soundly based solutions that meet public health and environmental requirements. The proposed RWSL installation requires approval as an extension of the existing WTP, Council is requesting an amendment to the existing approval, to incorporate the lagoon.

All work will be completed under the guidance of a Construction Environmental Management Plan (CEMP) to manage potential environmental impacts associated with the work. Once operational, the Proposal is not expected to cause any significant environmental or community impacts. The Proposed RWSL is anticipated to have positive socio-economic benefits for the local community, through the provision of improved water supply infrastructure, with an additional ~20 ML of raw water to be used in times of drought, emergencies or equipment failure. Given the nature, scale and extent of impacts, and assuming strict implementation of the environmental safeguards outlined in this REF, the Proposal is **unlikely to have a significant adverse impact** on the environment. It is considered that all matters affecting or likely to affect the environment by reason of the Proposal have been considered as required by s5.5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1 Introduction

The Environmental Factor (TEF) has been engaged by Parkes Shire Council (PSC) to undertake a Review of Environmental Factors (REF) to fully consider the environmental issues with the potential to arise from the proposed construction of a Raw Water Supply Lagoon (RWSL) adjacent to the existing Water treatment Plant (WTP) to the north of Parkes, NSW (hereafter 'the Proposal'). The Proposal forms an important part of the overarching Parkes Town Water Security Program (the Program).

The proposed ~20 ML lagoon would store 'raw' pre-treated (not potable) water pumped from the Lachlan River and other sources as needed. Flow would then gravitate from the RWSL to the WTP inlet works, where it would then undergo treatment so it can enter the potable water supply system. GHD completed a design and constraints report in March 2021 (GHD, 2021) which provide further details on the scope and background relating to the Proposal. Further updates have been made in August 2023 (Appendix A).

This report has considered to the fullest extent possible the potential environmental impacts with potential to arise from the Proposal within the framework of Division 5.1 of the of the Environmental Planning and Assessment Act 1979 (EP&A Act), and has considered:

- Impacts on Matters of National Environmental Significance (MNES) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) (refer Section 6.1, Appendix B).
- Environmental impacts in accordance with s 5.5 of the EP&A Act and cl 171(1) of the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation) (refer Sections 3.2.4 and 4)
- Impacts on threatened species in accordance with s 7.8 of *the Biodiversity Conservation Act 2016* (BC Act) and Part 7A Division 12 of the Fisheries Management Act 1994 (FM Act) (refer Sections 3.2.4, 3.2.5, 3.2.9, 3.2.11 and Appendix B).

Concept design plans have been provided to display the location of the Proposal and works methodology.

1.1 Site description

The subject site occurs north of the existing WTP on the outskirts of Parkes, NSW on Council owned land (refer Figure 2). Vegetation present within the subject site is comprised of mostly non-native degraded pasture, with a patch of remnant and regenerating native vegetation occurring to the east of the subject site, and another scattered patch of regenerating native vegetation to the west. No named waterways occur within the study area; however, the site does contain a drainage channel that has formed an eroded gully that runs parallel to the vegetation to the east of the site, spilling into the existing farm dam present towards the centre of the subject site. The next closest unnamed waterway occurs over 300 m further east of the site.

A review of the Biodiversity Values Map (BVM) accessed 22/08/2023 did not identify the study area as occurring within land mapped as containing Biodiversity Values. The closest Biodiversity Values are mapped as encompassing the Goobang Creek riparian zone, over 2 km to the east of the study area. A review of the Native Vegetation Regulatory (NVR) Mapping (DPE 2023) identifies the study area as occurring on unmapped land. There are however large parcels of land surrounding the study area mapped as excluded land on the NVR mapping (refer Appendix B).

1.2 Proposal Background

The Parkes Shire LGA is experiencing an increased water supply demand, arising from changing climatic conditions coupled with significant growth in the industrial and residential sectors. This has led PSC to propose undertaking a series of independent strategic water infrastructure initiatives aimed at supporting greater water security within Parkes and throughout the Central West region as part of the proposed future Special Activation Precinct (SAP) developments. This is known as the Parkes Water Security Program ('the Program').

The Program consists of a number of initiatives designed to increase water security without overly stressing the aquifer and riverine environments.

The proposed ~20 ML supply lagoon provides for more efficient water supply and drought security for the supply of town drinking water and allows Council greater operational flexibility on how the proposed SAP water supply will be issued depending on recipient use (i.e. direct from the supply lagoon or via treatment at the WTP). It also allows for the continued supply of raw water to the WTP in the event that the Lachlan River pipeline requires shutdown for unexpected repairs or maintenance.

The RWSL works are proposed to commence in mid-November 2023 with the works estimated to take approximately six (6) months. Works would be contained within Council owned land, with impacted lots identified in Table 2.

1.2.1 Proposal objectives

The primary goal of the project is to assist Council in providing greater water security within Parkes and throughout the Central West, through provision of a key piece of raw water supply infrastructure. The secondary objectives are to achieve this goal with minimal impact to native biota, neighbouring properties, and the surrounding environment. This would be executed through pre-commencement impact boundary delineation, careful design and construction methodology including pre-clearing surveys, and site inductions for work personnel, in combination with implementation of the Environmental Safeguards provided in this report (Refer Section 5 for summary of Environmental Safeguards).

The Proposal is consistent with the objectives of the Parkes Shire Community Strategic Plan titled '*Parkes Shire 2035+'*. Specifically, ***'Objective 3.4 – Our utilities well planned and efficiently managed'***. The strategic plans to meet this objective are identified as:

- 3.4.1 – Provide essential water and sewer infrastructure to meet the needs of our growing community
- 3.4.2 – Ensure effective collection and safe water treatment of wastewater, balancing the production of sustainable recycled water with return to the environment
- Ensure the optimisation of water consumption by promoting reuse opportunities and waste minimisation across the Parkes Shire

1.3 Terms and definitions

The terms and definitions used throughout this report are described in Table 1 below.

Table 1 Terms and definitions

Term	Definition
Subject site	The area to be directly affected by the Proposal, including earthworks and vegetation clearing. Includes: • A total direct impact footprint of maximum of **21.24 ha**.
Study area	Includes the subject site (as described above) and any proximal areas that could be potentially directly or indirectly impacted by the Proposal. For the purposes of this report the study area encompasses the subject site, and a 50 m buffer around the subject site measuring a combined total area **40.22 ha** (Figure 2).
The Locality	The area within 10 kilometres of the subject site.

2 Proposal Description

The proposed ~20 ML supply lagoon provides for more efficient water supply and drought security for drinking water, as well as allowing Council greater operational flexibility on how the proposed SAP water supply will be issued depending on recipient use (i.e. direct from the supply lagoon or via treatment at the WTP). It also allows for the continued supply of raw water to the WTP in the event the new pipeline requires repairs or maintenance.

The lagoon would be located to the north of the WTP on Council-owned land and would store water pumped from the Lachlan River. Flow would then gravitate from the lagoon to the WTP inlet works. A supply lagoon (rather than direct supply) is proposed for the following reasons (GHD, 2021):

- To provide transfer system redundancy in the event of pump failure (for the pumps transferring from the Lachlan River) to act as a buffer between the incoming flowrates and WTP requirements. This is useful in the following scenarios: WTP demand temporarily exceeds the Eugowra Road to Parkes system supply capacity
- Pumping stations can operate intermittently on solar power to fill the lagoon while a continuous water supply to the WTP is provided by the lagoon

The Proposal also includes development of a 'clean water' diversion drain, that will direct runoff from the above catchment safely around the outside of the proposed lagoon, to ensure the lagoon is not overfilled in times of high rainfall, and to help protect the quality of the raw water from potential contaminants, and to ensure structural stability of the area during both the construction and operational phases of project delivery. The drain is anticipated to be approximately 10 m wide, and rock lined to prevent erosion and dissipate flow velocities. It is expected that flows within the drain will be directed to a culvert to the immediate southwest of the lagoon, passing under an existing bike path in this location. From there, water will be directed into the existing swale drain which connects to stormwater management areas off Webb Street to the west of the WTP compound. Overflow from the lagoon is also expected to be directed this way, to avoid flooding of the downslope WTP compound. The following sections provide further detail on relevant aspects of the Proposal, including design development, options selection and proposed construction and operation activities as they apply to the proposed works. Concept drawings have been included as Appendix A. It is understood that the proposal will proceed as a DD&C contract, and that minor changes may be made to the design through this process.

Table 2 Site details

Site details	Description
Lot and DP	• Webb Street, Parkes NSW • Lot 7313 DP1143473 • Lot 920 DP750152 • Lot 20 DP1006244 • Lot 7018 DP1019803
Closest crossroad(s)	• Webb Street • Lorking Street
Land zoning	RU1 – Primary Production
IBRA region	NSW South Western Slopes

Site details	Description
IBRA sub region	Lower Slopes

2.1 Design principles

The core principles for the design and operation of the Proposal are to facilitate upgrades to the Parkes Shire's water supply infrastructure in line with the objectives of the PWSP, with minimal impact to the surrounding native biota, any sensitive receivers in proximity to the subject site and other water users. Best practice design principles will be implemented to ensure the Proposal is designed to meet appropriate engineering standards.

2.2 Justification for the proposed works

The proposed RWSL will act as a supply lagoon for raw 'pre-treated' water pumped from the Lachlan River. The proposed ~20 ML output is enough to supply the town with potable water during an emergency for a 24-hour period. The lagoon will also act as a safety net in case raw water is required elsewhere, saving the precious and costly potable water for community use.

2.3 Options considered

Several locations were investigated prior to choosing the proposed lagoon footprint. The current site was chosen for the following reasons:

- Occurs on Council owned land.
- The area has already been subject to clearing and has little remaining native vegetation/trees.
- The site is elevated above the WTP (allowing for gravity feed to the WTP). The proposed site grades down from north to south with grades around 9% in the vicinity of the lagoon site.

Whilst in the planning stages, Council operational staff requested that the proposed lagoon layout avoid or minimise the impact on the existing infrastructure and vegetation in the vicinity of the lagoon site, particularly the watermain to the southwest of the site, the public cycleway to the south of the site, and the vegetated area to the east of the site.

Council also noted there is opportunity to remove and overlay the existing stormwater dam at the proposed lagoon site. Removing and overlaying this existing stormwater dam is desirable as it allows the proposed lagoon to be moved further east, reducing potential impacts on the watermain and cycleway. Removing the existing dam also eliminates the need to consider and manage the risks of a second water supply facility at the site.

Council considered the following options for these works:

1. Proceed with the proposed RWSL construction as detailed in Appendix A.
2. Seek out an alternate location for the storage lagoon
3. Do nothing and connect the WTP directly to the Lachlan River pipeline.

Council elected to undertake Option 1, to proceed with the proposed RWSL above the existing WTP. Option 2 was rejected as an assessment of potential locations had already been completed and identified the current proposed location as optimal. Option 3 was rejected as the supply lagoon forms a critical component of water infrastructure for the community. Not proceeding with the Proposal is not considered a viable option. In

addition, Option 1 was considered the safest, most practical and economic option for the community, Council and its ratepayers.

2.4 Construction and Operation

The following sub-chapters describe the intended construction and operation methodologies that will be implemented as part of the Proposal.

2.4.1 Description of construction works

Council is proposing the following works:

- Establishment of work site including amenities, temporary fencing and signage
- Establish all weather access track through the site for transportation of excavated materials
- Establishment of environmental impact controls, including sediment and erosion controls
- Locate underground services; if services are within the subject site:
    - Trench and expose underground services and utilise hydrovac / vacuum excavation methodology to fully expose
    - Move underground services in consultation with relevant authorities if required
- Removal of vegetation where required
- Excavate the supply lagoon as per the specified grade.
- Transfer excavated material to construct dam wall.
- Transfer excess spoil material to the spoil disposal area using the approved access route through the site.
- Shape and batter back dam wall and soil disposal area as per design requirements.
- Complete additional shaping as required to achieve the correct levels and grade.
- Excavate trenches for the installation of new pipework using standard open trenching technique.
- Install new pipework, connect to existing system and backfill trenches with excavated materials.
- Install drainage system to maintain existing site drainage lines and flow parameters (to be completed as per final design specifications).
- Complete site rehabilitation works to stabilise all exposed soils (including dam wall and soil disposal mound).
- Once site is fully stabilised, remove all signage and ERSED control structures and complete site remediation works.

The construction team will be comprised of approximately up to ten (10) FTE people, plus ancillaries such as delivery drivers. Stockpiles, laydown areas, and construction offices and amenities as appropriate will be established within precleared areas as identified on Figure 2. The construction phase of the Proposal would include the activities outlined in Table 3.

Table 3 Types of work relevant to the Proposal

Types of works	Comments
Site preparation works	• Site demarcation. • Clearing of vegetation within the impact area. • Stockpiling and removal of waste green material. • Establishment of access routes for excavation and construction equipment, including placement of signage. • Establishment of layby areas, storage facilities and site office.

Types of works	Comments
Excavation	The current RWSL layout has a cut volume of approximately 41,700 m^3, fill volume of 6,800 m^3, and net volume of +34,900 m^3 (cut).
Vegetation Removal	Groundcover vegetation and some shrubs and trees present directly within the subject site will require removal, and/or will be impacted by machinery movement and trampling by personnel as part of lagoon construction.
Road Upgrade (access road)	The access road to the existing High-Level Reservoir (HLR) on Golden Bar Hill to the immediate east of the proposed RWSL location will be upgraded and improved as part of these works. Currently, access to the stormwater lagoon is via the bike path; it is anticipated that this will be upgraded to enable safe ingress and egress during construction, with the bike path reinstated post completion of the construction phase.
Site rehabilitation works	• Site restoration works to achieve correct levels to stabilise and prevent erosion. • Recycling/disposal of excess materials. • Spreading seed and planting trees to revegetate and stabilise exposed soils. • Monitoring of site to ensure revegetation measures are effective and no major erosion or long-term ecological damage occurs as a result of construction works.

2.4.2 Operation of the Proposal

The operational phase of the Proposal, considered as part of this REF, includes assessment of impacts associated with use of the RWSL once construction and site stabilisation works are complete, including maintenance and access, and any cumulative impacts the Proposal is likely to have on renewable and finite resources in terms of sustainability, ecology climate change and the surrounding community.

Once operational, the supply lagoon and spoil disposal area will be monitored regularly by Council staff to ensure site rehabilitation occurs and to complete any additional remediation works if erosion or migration of sediment occurs following rain events.

2.5 Environmental safeguards

Throughout the environmental impact assessment undertaken in relation to the above Proposal, potential impacts on the environment were identified in relation to the following environmental 'categories':

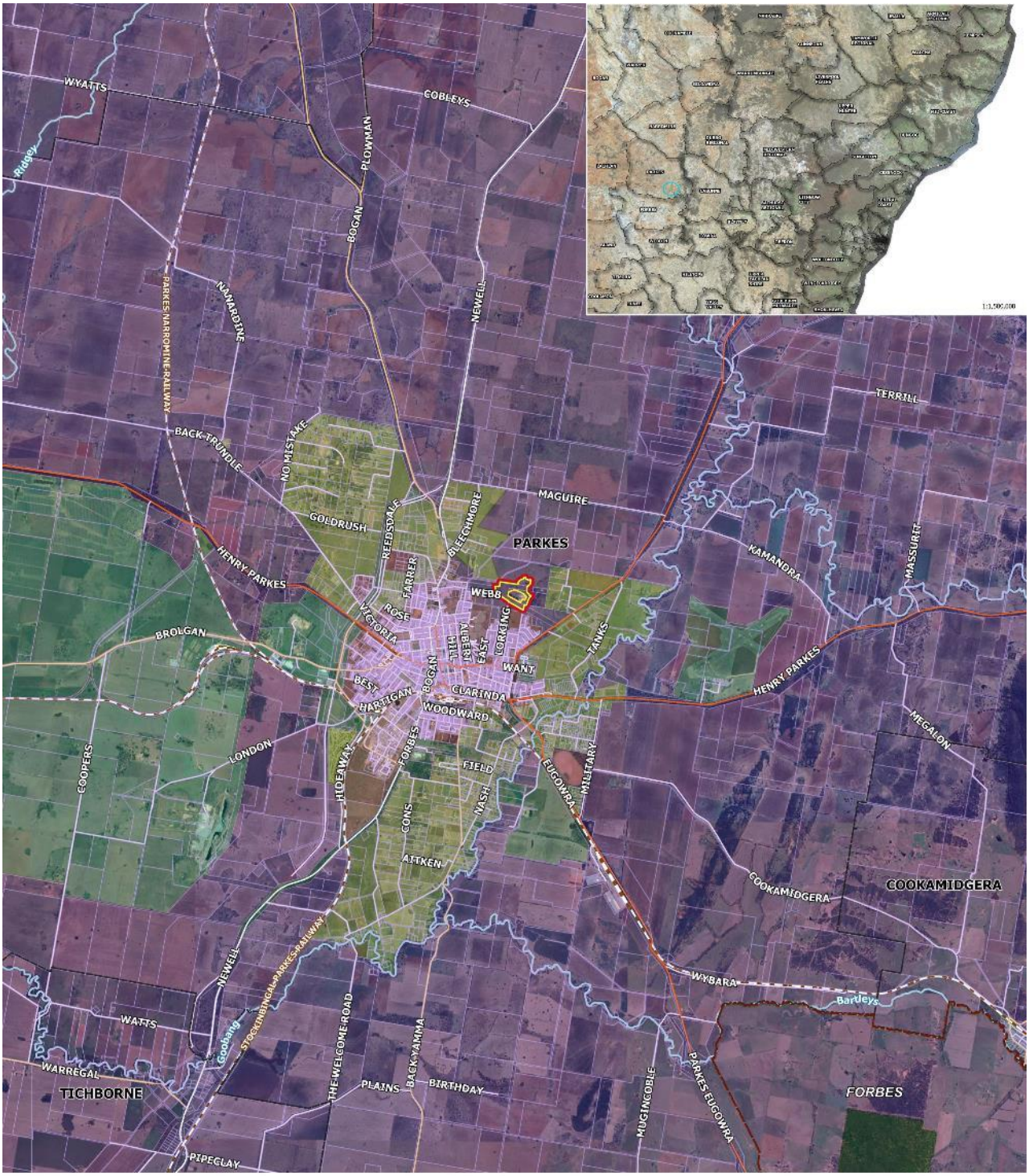
- Applicable Acts and legislation
- Soils and Erosion
- Waterways
- Noise and Vibration
- Air Quality and Odour
- Non-Aboriginal Heritage
- Aboriginal Heritage
- Biodiversity
- Traffic and Transport
- Socio-economic Considerations

- Waste and Resource Use
- Visual Amenity
- Climate Change

Environmental Safeguards were then developed to address each of the identified impacts, to ensure that the residual impact upon the environment would not be significant. These Safeguards act as 'conditions of consent' for the Proposal and **must be implemented** as part of Proposal delivery (summary of which is provided in Section 5). With these environmental protection measures, the Proposal does not have the potential to result in significant impacts within the above categories, which would have environmental, social and economic consequences for Council, as the consent authority for these works.

Additionally, all work will be completed under the guidance of a Construction Environmental Management Plan (CEMP) to manage and minimise potential environmental impacts, particularly ecological impacts, associated with the work. Once operational, the Proposal is not expected to cause any significant environmental or community impacts.

As the proposed works are to be progressed as a DD&C contract, further information relating to the proposed construction methodology will be determined and released as the works progress.



PSC WTP Raw Water Supply Lagoon - Regional Context and Land Zoning

N 0 1,200 2,400 3,600 m

1:100,000

Legend

Study Area
Subject Site
LGA Boundary
Suburb
Lot Boundary
Roads
Arterial Road
Local Road
Primary Road
Sub Arterial Road
Urban Service Lane
Railway
Waterways
Creek
Land Zoning
C1
E1
E4
MU1
R1
R5
RE1
RE2
REZ
RU1
RU5
SP1
SP2

Figure 1 Regional context and land zoning

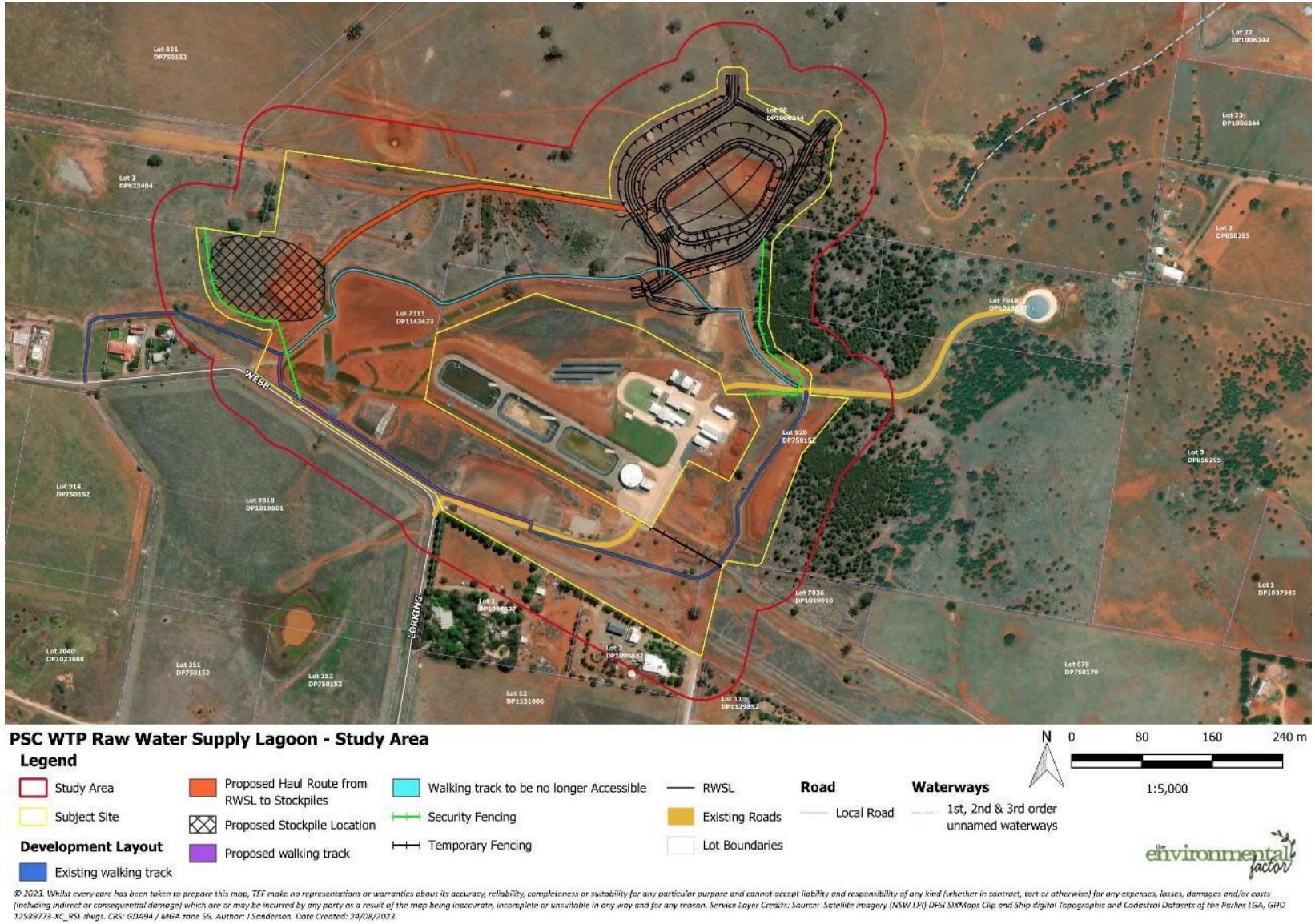


Figure 2 Study area and subject site

3 Legislative Context

The following legislation, policies and guidelines applicable to the REF have been reviewed, and the implications have been assessed accordingly as part of this REF.

3.1 Commonwealth (Federal) Legislation

3.1.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act ensures that actions likely to cause a significant impact on Matters of National Environmental Significance (MNES) undergo an assessment and approval process. Under the EPBC Act, an action includes a Proposal, undertaking or activity. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Government Minister for the Environment (the 'Minister').

MNES include:

- World Heritage properties
- National Heritage places
- Wetlands of international importance
- Listed threatened species and ecological communities
- Listed migratory species
- Commonwealth marine areas
- Nuclear actions
- A water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act has been addressed in the current assessment through:

- Desktop review to determine the MNES that are predicted to occur within the locality of the proposed scheme and hence could occur, subject to the habitats present.
- General field surveys for threatened biota and migratory species listed under the Act.
- Identification of suitable impact mitigation and environmental management measures for threatened biota, where required.
- Assessment of potential impacts on MNES, if appropriate.

Potential impacts on relevant MNES must be subject to Tests of Significance pursuant to the EPBC Act Significant Impact Guidelines (DEWHA 2009). If a significant impact is considered likely, a referral under the EPBC Act must be submitted to the Commonwealth Minister for Environment.

This REF assesses the likelihood of MNES occurring within the locality of the Proposal, and their potential to be impacted by the Proposal (refer Section 4.7 and Appendix B). Impact assessments conducted on threatened species and ecological communities listed as threatened under the EPBC Act concluded that no MNES are likely to be significantly impacted by the Proposal.

3.2 State (NSW) Legislation, Policies and Guidelines

3.2.1 Biodiversity Conservation Act 2016 (BC Act)

The purpose of the *Biodiversity Conservation Act 2016* (BC Act) is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. In particular, the purpose of the BC Act (see section 1.3 of the BC Act) includes:

- to conserve biological diversity at bioregional and State scales (including declared areas of outstanding biodiversity value (AOBV)),
- to assess the extinction risk of species and ecological communities,
- to identify key threatening processes,
- to slow the rate of biodiversity loss, and
- to conserve threatened species.

Section 7.2 and 7.8 of the BC Act states that the determining authority must consider whether the proposed activity:

- is to be carried out in a declared AOBV,
- exceeds the biodiversity offsets scheme threshold if the biodiversity offsets scheme applies to the impacts of the development on biodiversity values, and/or
- is likely to significantly affect threatened species, populations or ecological communities, or their habitats.

Section 7.3 of the BC Act sets out the tests for determining whether a proposed activity is, or is likely to significantly affect threatened species or ecological communities, or their habitats.

Areas of Outstanding Biodiversity Value (AOBV)

The Proposal does not propose works on a listed AOBV, and no significant impacts to any threatened species have been identified.

Biodiversity offsets scheme

This is addressed below in relation to the *Biodiversity Conservation Regulation 2017*.

Impacts to threatened species, populations or ecological communities, or their habitats

Section 4.7 of this REF addresses potential impacts to threatened species and Threatened Ecological Communities (TEC) covered under the BC Act. Section 4.7 and Appendix B finds that the Proposal is not likely to have a significant affect on threatened species, populations or ecological communities, or their habitats.

3.2.2 Biodiversity Conservation Regulation 2017 (BC Regulation)

The BC Regulation provides a number of considerations and practices to be implemented as part of the framework under the BC Act. For example, the BC Regulation:

- Establishes the Biodiversity Values Map that identifies land with high biodiversity value, as defined by clause 7.3(3) of the BC Regulation
- Identifies thresholds for the clearing of land mapped on the Biodiversity Values Map

- Identifies the threshold levels for when the Biodiversity Offsets Scheme (BOS) will be triggered,
- Outlines principles applicable to the determination of serious and irreversible impacts (SAII) to biodiversity values,
- Outlines rules that govern the types of offsets that can be used to meet an offset obligation under the BOS,
- Biodiversity certification criteria.

Section 6.2(e) of the BC Act provides that the proponent of an activity that is assessed under Division 5.1, Part 5 of the EP&A Act can voluntarily opt out of the BOS. As above, the Proposal is being assessed under Division 5.1 of the EP&A Act, and PSC is the proponent. PSC has elected to opt out of the BOS.

3.2.3 Crown Land Management Act 2016

The objectives of the *Crown Land Management Act 2016* (CLM Act) are:

a) To provide for the ownership, use and management of the Crown Land of NSW, and
b) To provide clarity concerning the law applicable to Crown Land, and
c) To require environmental, social, cultural heritage and economic considerations to be taken into account in decision-making about Crown Land, and
d) To provide for the consistent, efficient, fair and transparent management of Crown Land for the benefit of the people of New South Wales, and
e) To facilitate the use of Crown land by the Aboriginal people of New South Wales because of the spiritual, social, cultural and economic importance of land to Aboriginal people and, where appropriate, to enable the co-management of dedicated or reserved Crown land, and
f) To provide for the management of Crown land having regard to the principles of Crown land management.

Where work is proposed on Crown land, the proponent of the proposed activity, must, obtain a right of access to the Crown land in accordance with the CLM Act.

No work is proposed to be undertaken on Crown Land, therefore approval from the NSW Crown Lands Department (Crown Lands) **is not required**.

3.2.4 Environmental Planning and Assessment Act 1979 (EP&A Act) and Environmental Planning and Assessment 2021 (EP&A Regulation 2021)

The *Environmental Planning and Assessment Act 1979* (EP&A Act) forms the legal and policy platform for the assessment and approval of works in NSW and aims to ensure that public authorities examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment.

All development in NSW is assessed in accordance with the provisions of the EP&A Act and the *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation).

The Proposal is being assessed under Division 5.1 of the EP&A Act. In accordance with s 5.5 of the EP&A Act, an REF examines and takes into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the Proposal. In considering the likely impact of the Proposal on the environment, the REF must consider the environmental factors specified in the DPE Guidelines (which simply adopt the factors specified in clause 171(2) of the EP&A Regulation).

Section 5.1 of the EP&A Act defines 'determining authority' as follows:

'determining authority means a Minister or public authority and, in relation to any activity, means the Minister or public authority by or on whose behalf the activity is or is to be carried out or any Minister or public authority whose approval is required in order to enable the activity to be carried out.'

The EP&A Act's definition of 'public authority' (section 1.4) includes: *'(a) a public or local authority constituted by or under an Act'.*

For the purposes of the Proposal, Council is the determining authority in accordance with the EP&A Act.

The duties of the determining authority are set out in Division 5.1 of the EP&A Act. Section 5.5 requires that a determining authority *'…examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity.'*

Section 5.7 provides that a determining authority shall not approve or carry out an activity that is likely to significantly affect the environment, unless it has considered an environmental impact statement in respect of the activity.

In addition, if the Proposal was to be carried out on an area of outstanding biodiversity value (AOBV), or if the determining authority decides the Proposal would be likely to significantly affect a threatened species, population or ecological community or its habitat, then it must:

- obtain and consider a species impact statement; and
- obtain the concurrence of the Environment Agency Head;
  or
- obtain and consider a biodiversity development assessment report,

(section 7.8 and 7.12(3) BC Act).

This REF examines and considers to the fullest extent possible all matters affecting or likely to affect the environment under Division 5.1 of the EP&A Act.

This REF has identified that the Proposal is not likely to significantly affect the environment (Section 4), as such, PSC will not need to obtain and consider an Environmental Impact Statement (EIS) before it carries out the Proposal (s 5.7 of the EP&A Act).

3.2.5 Fisheries Management Act 1994 (FM Act)

The *Fisheries Management Act 1994* (FM Act) aims to conserve threatened species, populations and ecological communities of fish and marine vegetation native to NSW and to promote ecologically sustainable development, including the conservation of biological diversity. It also aims to reduce the threats faced by native fish and marine vegetation in NSW.

Section 220ZW of the FM Act provides the Secretary may grant a licence authorising a person to take action that is likely to result in one of the following:

a) harm to a threatened species, population or ecological community,
b) damage to a critical habitat,
c) damage to a habitat of a threatened species, population or ecological community.

Section 220ZZ of the FM Act states if the action proposed to be taken by the applicant is not on land that is critical habitat, and the application for a licence is not accompanied by a species impact statement, the Secretary must determine whether the action proposed is likely to significantly affect threatened species, populations or ecological communities, or their habitats.

For the purposes of Division 5.1 of Part 5 of the EP&A Act, if a significant impact on a threatened species, population or ecological community is likely, a species impact statement must be completed and consultation with the NSW Department of Primary Industries (Fishing and Aquaculture) is required (section 221ZX).

A permit under the FM Act is required for any work that involves:

- Activities involving dredging and reclamation work
- Activities temporarily or permanently obstructing fish passage
- Using explosives, electrical devices or other dangerous substances in a waterway
- Harming marine vegetation

Permits are required for works within a third order (or higher) streams (based on the Strahler system of stream order classification), and first and second order streams that are known or likely to be habitat for listed threatened species, populations or communities.

No explosives or electrical devices will be used as part of the Proposal and there are no mapped waterways or Key Fish Habitat (KFH) within the study area, (refer Figure 7). Therefore, a permit from DPI Fisheries **is not required**.

3.2.6 Heritage Act 1997 (Heritage Act)

The *Heritage Act* seeks to identify and protect items of cultural heritage value. The Heritage Council of NSW makes decisions about the care and protection of heritage places and items that have been identified as being significant to the people of NSW.

Automatic protection is afforded to 'relics' under the Heritage Act, defined as:

'any deposit, artefact, object or material evidence that—

(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and
(b) is of State or local heritage significance'.

Formerly the *Heritage Act* protected any 'relic' that was more than 50 years old. Now the age determination has been dropped from the *Heritage Act* and relics are protected according to their heritage significance assessment rather than purely on their age.

Excavation of land on which it is known or where there is reasonable cause to suspect that 'relics' will be exposed, moved, destroyed, discovered or damaged is prohibited unless ordered under an excavation permit (section 139 *Heritage Act*).

Local, and NSW State historic heritage registers were consulted as part of preparation of this REF (Section 4.5); no listed heritage sites were found within the study area and no sites were deemed at risk of damage from the Proposal.

3.2.7 Local Government Act 1993 – Section 60

A Council must not, except in accordance with the approval of the Minister for Water, Property and Housing do any of the following:

- construct or extend water treatment works; or
- provide for sewage from its area to be discharged, treated or supplied to any person.

Council would like the proposed RWSL installation to be granted approval to be included an extension of the existing WTP; as such, Council is requesting an amendment to the existing approval, to incorporate the lagoon.

An approval under section 60 l provides an independent assessment of the proposed works to ensure they are fit for purpose and provide robust, safe, cost-effective and soundly based solutions that meet public health and environmental requirements; noting there is no water treatment proposed as part of the RWSL.

Each proposed water or sewage treatment works project or activity requires an options study, concept design report and detailed design to be submitted to the NSW Department of Industry (DoI) for review. The information provided must clearly define the proposed activity and detail how the environment will be protected.

Discussions with DPE have indicated that they consider the RWSL to fall under the Section 60 approval system; Council is progressing the necessary assessments and will obtain approval prior to commencement of construction activities should this be required for the Lagoon.

3.2.8 Local Land Services Act 2013

The *Local Land Services Act 2013* (LLS Act) regulates the clearing of native vegetation on all land in NSW mapped as Category 2 – Regulated Land as mapped on the Native Vegetation Regulatory Map.

The *Local Land Services Amendment Act 2016* (LLSA Act), which amended the *Local Land Services Act 2013*, authorised the making of the *Land Management (Native Vegetation) Code 2018* (**Code**) (Div 5, Sch 1 of the LLSA Act). One of the aims of the Code is to authorise clearing of native vegetation on Category 2 regulated land under certain conditions and provide for the establishment and maintenance of set aside areas.

A review of the Native Vegetation Regulatory map (report generated 01/04/21) confirmed that the Study Area occurs on land mapped as unmarked / unclassified, Category 2 – Regulated Land. However, the clearing is to be carried out as part of an activity carried out by a determining authority, being PSC, after compliance with Part 5 of the EP&A Act, therefore the clearing is authorised under Division 3, 60O(b)(ii). Therefore, this has not been considered further within this report.

3.2.9 National Parks and Wildlife Act 1974 (NPW Act)

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the statutory protection of Aboriginal cultural heritage places, objects and features. This legislation aims to protect and preserve Aboriginal heritage values.

Part 6 of this Act refers to Aboriginal objects and places and prevents persons from impacting on an Aboriginal place or relic, without consent or a permit. The proposed works will not impact upon any Aboriginal sites, assuming the Environmental Safeguards as outlined in Section 4.6.4 are followed.

Appendix C and Section 4.6 of this REF further addresses potential impacts and assessment undertaken on Aboriginal Heritage associated with the proposed works.

3.2.10 NSW Biosecurity Act 2015 (Biosecurity Act)

The *Biosecurity Act 2015* (NSW) (**Biosecurity Act**) outlines mandatory measures that persons are to take with respect to biosecurity matters including the management of weeds (Schedule 1 Biosecurity Act). Under the Biosecurity Act, the responsibilities for weed management by public and private landholders are consistent, reflecting that weed management is a shared community responsibility. The Biosecurity Act introduces the legally enforceable concept of a General Biosecurity Duty (GBD) (Part 3 of the Biosecurity Act). Priority weeds are listed within Regional Strategic Weed Management Plans, however the GBD is not restricted to listed weeds.

The Biosecurity Act is administered by NSW Department of Primary Industries (DPI) which determines the weed species covered by regulatory tools including Prohibited Matters, Control Orders and Biosecurity Zones. Existing Local Control Authorities (Councils) continue to be responsible for enforcing weed legislation.

In addition, Forbes Shire Council is included in the Central West Regional Strategic Weed Management Plan 2023-2027 The plan outlines priority weeds for the local region and develops a cooperative and coordinated response for the removal and containment of target weed species.

Given the proximity of the Proposal to previously disturbed roadside vegetation, and agricultural land, it is anticipated that construction works as part of the Proposal have the potential to introduce and spread weed seeds/spores and water mould (e.g. *Phytophthora cinnamomi*). The preparation of a future CEMP will need include measures to ensure that the Proposal will adhere to both the Biosecurity Act and the requirements outlined in the Central West Regional Strategic Weed Management Plan 2023 – 2027 (Central West Local Land Services, 2022). Priority weeds observed on site are described in Section 4.7.

3.2.11 Protection of the Environment Operations Act 1997 (POEO Act)

The *Protection of the Environment Operations Act 1997* (POEO Act) is administered by the Environment Protection Authority (EPA), which is an independent statutory authority and the primary environmental regulator for NSW. The POEO Act regulates and requires licensing for environmental protection, including for waste generation and disposal, and for water, air, land and noise pollution.

The objects of this Act are as follows—

a) to protect, restore and enhance the quality of the environment in New South Wales, having regard to the need to maintain ecologically sustainable development,
b) to provide increased opportunities for public involvement and participation in environment protection,
c) to ensure that the community has access to relevant and meaningful information about pollution,
d) to reduce risks to human health and prevent the degradation of the environment by the use of mechanisms that promote the following—
    i. pollution prevention and cleaner production,
    ii. the reduction to harmless levels of the discharge of substances likely to cause harm to the environment,
    iii. the elimination of harmful wastes,
    iv. the reduction in the use of materials and the re-use, recovery or recycling of materials,
    v. the making of progressive environmental improvements, including the reduction of pollution at source,

vi. the monitoring and reporting of environmental quality on a regular basis,

e) to rationalise, simplify and strengthen the regulatory framework for environment protection,

f) to improve the efficiency of administration of the environment protection legislation,

g) to assist in the achievement of the objectives of the *Waste Avoidance and Resource Recovery Act 2001.*

The Proposal does not constitute activities that are likely to generate significant pollution; however, consideration of the prevention of water, air, land and noise pollution is provided herein (refer Sections 4.2, 4.3, 4.4 and 4.10).

3.2.12 Roads Act 1993

The *Roads Act 1993* regulates the use and management of public roads. Section 138 of the Roads Act requires that consent of the appropriate Roads Authority is obtained for certain work undertaken in, on or over a public road. Under Section 138 of the Roads Act:

1. A person must not—
    a. Erect a structure or carry out a work in, on or over a public road, or
    b. Dig up or disturb the surface of a public road, or
    c. Remove or interfere with a structure, work or tree on a public road, or
    d. Pump water into a public road from any land adjoining the road, or
    e. Connect a road (whether public or private) to a classified road,

Otherwise, than with the consent of the appropriate roads authority.

2. A consent may not be given with respect to a classified road except with the concurrence of Transport for New South Wales (TfNSW).

The Proposal does not involve any impact to a Classified Road as per the TfNSW Schedule of Classified Roads and Unclassified Regional Roads (identified as a *Main* Road). Therefore, a Section 138 application and concurrence with TfNSW is not required.

3.2.13 Rural Fires Act 1997 (RF Act)

The RF Act came into force in 1997 to establish the NSW RFS and define its functions; to make provisions for the prevention, mitigation and suppression of rural fires; to repeal the *Bush Fires Act 1949*; to amend certain other Acts; and for other purposes. The objectives of this Act are to provide:

a) For the prevention, mitigation and suppression of bush and other fires in local government areas and other parts of the State.

b) For the co-ordination of bush firefighting and bush fire prevention throughout the State, and

c) For the protection of persons from injury or death, and property from damage, arising from fires, and

d) For the protection of infrastructure and environmental, economic, cultural, agricultural and community assets from damage arising from fires, and

e) For the protection of the environment by requiring certain activities referred to in paragraphs (a)–(c1) to be carried out having regard to the principles of ecologically sustainable development described in section 6 (2) of the POEO Act.

Section 63(1) and 63(2) of the RF Act stipulate it is the duty of a public authority to take all practicable steps to prevent the occurrence of bush fires on, and to minimise the danger of the spread of a bushfire on or from any land vested in or under its control or management.

The study area is not mapped as being within a designated bushfire prone area. There are no applicable bushfire prone land requirements for the Proposal, as the Proposal relates primarily to water infrastructure. However, Council may consider restricting access to the subject site on High or greater fire risk days.

3.2.14 State Environmental Planning Policy (Transport and Infrastructure) (Transport and Infrastructure SEPP) 2021

The Transport and Infrastructure SEPP consolidates and repeals the provisions of 4 SEPPS, which includes the previous Infrastructure SEPP (ISEPP) 2007. The SEPP consolidation is administrative, and no policy changes have been made. It has been undertaken in accordance with section 3.22 of the EP&A Act. As with the previous version, the Transport and Infrastructure SEPP aims to facilitate the effective delivery of infrastructure across the State, including for:

- Flood mitigation work (Division 7, Section 2.56)
- Parks and other public reserves (Division 12, Section 2.73)
- Roads and road infrastructure facilities (Division 17, Section 2.109)
- Sewerage systems (Division 18, Section 2.126)
- Soil conservation works (Division 19, Section 2.133)
- Stormwater management systems (Division 20, Section 2.137)
- Water supply systems (Division 24, Section 2.159)
- Waterway or foreshore management activities (Division 25, Section 2.165)

Each section of the SEPP provides for development that is permitted without consent.

The Transport and Infrastructure SEPP aims to facilitate the effective delivery of infrastructure across the State. Section 2.159 states that:

(1) Development for the purpose of water reticulation systems may be carried out by or on behalf of a public authority without consent on any land.
(2) Development for the purpose of water storage facilities may be carried out without consent if it is carried out by or on behalf of-
    a. Any public authority on land in Zone RU1 Primary Production, Zone RU2 Rural Landscape, Zone SP1 Special Activities, Zone SP2 Infrastructure or an equivalent land zone use.

'Water reticulation system' and 'water storage facility' are defined in the Standard Instrument—Principal Local Environmental Plan 2006 to be a type of water supply system.

Section 2.159(6) states that a reference to development for the purpose of a water supply system of any kind includes a reference to development for any of the following purposes if the development is in connection with the water supply system—

(a) dams, reservoirs, weirs, levees, spillways and fishways,
(b) catchment management works,
(c) groundwater investigation works, groundwater bore stations, borefields, minewater works and the like,

(d) access ways,
(e) water intakes, pumping stations, pipelines, channels, tunnels, canals and aqueducts,
(f) gauging and monitoring equipment,
(g) power supply to the water supply system,
(h) hydro-electric power generation equipment and associated connections to the electricity network,
(i) construction works,
(j) emergency works and routine maintenance works,
(k) environmental management works,
(l) schemes for the reuse of water treatment residuals,
(m) maintenance depots.

The proposed works, which include construction of a raw water storage lagoon and the installation of pipework associated with water supply infrastructure on land zoned RU1, are appropriately characterised as development for the purpose of a water reticulation system under the Transport and Infrastructure SEPP. Pursuant to section 2.159(1) and 2.159(2), the proposed works can be carried out as activities under Division 5.1 of the EP&A Act without development consent.

The Proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not affect land or development regulated by the *Coastal Management Act 2016*, *State Environmental Planning Policy (Resilience and Hazards) 2021,* or *State Environmental Planning Policy (Precincts—Regional) 2021.*

3.2.15 Water Management Act 2000 (WM Act)

The *Water Management Act 2000* (WM Act), administered by the Water division of NSW Department of Industry, Skills and Regional Development, aims to ensure that water resources are conserved and properly managed for sustainable use benefiting both present and future generations. It provides formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for protection of catchment conditions.

No mapped waterways occur within the study area. Moreover, Council is exempt from s 91E(1) of the Act in relation to all controlled activities that it carries out in, on or under waterfront land (cl 38 *Water Management (General) Regulation 2011*).

The construction of the supply reservoir will require a water supply works approval under Part 3 of Chapter 3 of the WM Act notwithstanding the project is considered as an extension to the existing (approved) water treatment works. Although the lagoon may be considered 'water reticulation work', which would enable the lagoon to be used without a water supply works approval pursuant to cl 38(c) of the Water Management (General) Regulation 2018 (NSW), the land on which the lagoon is to be constructed is not the subject of a water use approval and so the exemption under cl 37(1)(c) of that Regulation in regard to construction does not apply. Council is therefore in the process of applying for and obtaining a water supply work approval to meet their legislative obligations. As of August 2023, the process is underway.

3.2.16 NSW Guidelines for Controlled Activities on Waterfront Land (NSW DPI 2012)

Any works proposed within the defined riparian zone of a creek are to be carried out in accordance with the WM Act. Works undertaken on waterfront land (i.e., near a river, lake or estuary) require a controlled activity approval under Section 91 of the WM Act, unless defined as exempt.

The study area is not located within a defined riparian zone. Furthermore, Councils, as a defined public authority, are exempt from the need to gain a controlled activity approval pursuant to clause 41 of the WM Regulation.

3.2.17 State Environmental Planning Policy (Biodiversity and Conservation) 2021

Chapter 3 of the State Environmental Planning Policy (Biodiversity and Conservation) 2021 applies to Koala habitat protection. This chapter of the Biodiversity and Conservation SEPP 2021 only applies to proposals under Part 4 'Development' of the EP&A Act. The Proposal is being assessed under Division 5.1 of the EP&A Act, therefore this chapter of the Biodiversity and Conservation SEPP does not apply to the Proposal and this has not been considered further in preparation of this REF.

However, the Koala is listed as an Endangered species under the BC Act and EPBC Act, and thus also requires assessment under these Acts. This has been undertaken in Section 4.7 and Appendix B. The Likelihood of Occurrence Assessment concluded that the risk of impact to this species as a result of the proposed works is Low, therefore a Test of Significance has not been completed for Koala.

3.3 Community and agency consultation

3.3.1 Stakeholder consultation

Council has implemented a detailed consultation plan for the broader Parkes Town Water Security Program proposals, including but not limited to the concurrent refurbishment of the Parkes Borefield, the augmentation of the LRPS and development of the pre-treatment plant, and the Lachlan Pipeline Duplication project. Council will continue to consult with water utilities, businesses, farming enterprises, landowners and residents with potential to be impacted by the Proposal. PSC's Engagement Consultant is conducting all required consultation pertaining to Proposal as part of the broader Program. Residents of the town will be sent correspondence detailing the scope of work and details on how to obtain results of the REF documents from Council's website should they wish.

3.3.2 Private landowner consent

It is noted in Section 3.3.1 of this REF that as the proposed works are appropriately characterised as development permissible without consent under Sections 2.159(1) and 2.159(2) of the Transport and Infrastructure SEPP (TISEPP Therefore, the Proposal can be undertaken as an activity under Division 5.1 of Part 5 of the EP&A Act, following assessment by Council in accordance with that Division, and landowner consent is not required under the *Environmental Planning and Assessment Act 1979.* Notwithstanding the above, the Proposal is to be undertaken on Council owned land.

Council intends to liaise with any landholders with potential to be impacted by the works to ensure adequate engagement is undertaken, and, where appropriate, rectification works are completed.

3.3.3 Mitigation of impacts during construction and operation

The consideration within this REF has concluded that negative socio-economic impacts are expected to be minimal, confined to the construction phase and are not likely to significantly negatively affect residents in proximity to the subject site. The review concluded the provision of improved water security infrastructure will result in overall positive socio-economic impacts resulting from the project. All construction works will

occur within Council-owned land, the closest streets are Webb St and Lorking Streets providing access for trucks and site traffic.

As noted in the Executive Summary, Section 2 'Proposal Description', Section 6 'Certification' and in the Environmental Safeguards developed for the Proposal (Section 5), all work will be completed under the guidance of a CEMP to manage and minimise potential environmental impacts associated with the work. Additionally, once operational, the Proposal is not anticipated to result in any additional ongoing significant environmental or community impacts, with positive outcomes predicted in the long term for Parkes.

Given this conclusion, the likely impacts on surrounding residents are anticipated to be limited to the construction period. The CEMP will list the responsibility of PSC, and the appointed Contractor(s) to develop and distribute notification to local residents before, during and after the construction period. The adequate notification period for residents is fourteen (14) days prior to works commencement.

Section 4 of this REF describes the site-specific environmental impacts and proposed environmental safeguards required to manage any impact during construction to be included in the CEMP.

Table 4 Proposed local resident notifications

Impact/mitigation	Stakeholder	Notifications
Noise, dust	Adjacent rural & residential landowners	• Notifications to adjacent landowners; traffic management plans, noise monitoring protocols, working hours.' • Person to person contact to notify rural landowners of any dust anticipated to settle in adjacent farm dams.
Traffic and access	Local traffic using Webb and Lorking Street	• Advertisement in local newspapers (Parkes Champion Post), social media and PSC website advising of changed traffic conditions and delivery of construction loads.
Public cycleway	Local cyclists using the bike path	• Advertisement in local papers advising of any temporary restrictions on the bike path usage and signage to advise cyclists to use caution during construction works
Working Hours	Local residents	• Letterbox drop of notification listing working hours, and measures to manage local impacts; lighting, truck deliveries and noise onsite.

3.3.4 Agency consultation and concurrent requirements

It is understood that Council will be undertaking all stakeholder engagement and community consultation activities internally, as per their community consultation plan. This includes liaison with DPE Water (formerly the NSW Natural Resources Access Regulator) pertaining to the water supply works approval under Part 3 of Chapter 3 of the WM Act to meet legislative requirements (refer Section 3.2.17).

3.3.5 Requirement to publicly display REF

As per the EP&A Regulation, determining authorities must keep the REF documentation including any appendices or addenda and make available for public access once a determination has been made. The EP&A Regulation Clause 171(4) requires the REF to be published on the determining authority's website or the NSW Planning Portal for an activity with:

- A capital investment value of more than $5 million or,

- An approval or permit for activity that requires approval under:
    - FM Act sections 144, 201, 205 or 219, or
    - Heritage Act 1977 section 57, or
    - *National Parks and Wildlife Act 1974* section 90 or
    - *Protection of the Environment operations Act 1997* sections 47-49 or 122, or
- If the determining authority considers it to be in the public interest.

There are allowances for exceptional circumstances where publication is not required; this is at the Planning Secretary's discretion. If the REF is to be published, the determining authority must place all relevant information on the determining authority's website or the NSW Planning Portal prior to the commencement of works.

Certain parts of the REF document may be sensitive, such as sensitive cultural information requested to be redacted by Aboriginal parties or cyber security impacts and mitigation measures. In these instances, the REF document content can be redacted where required. The REF document (excluding sensitive information) needs to be available online.

4 Environmental Assessment

This chapter describes the potential key environmental impacts associated with the Proposal, during both construction and operation, and the site-specific Environmental Safeguards which are to be implemented as part of the Proposal to ameliorate any potential impacts identified.

A summary of the Environmental Safeguards has been provided in Section 5.

4.1 Soils and Erosion

4.1.1 Existing environment

The study area contained good vegetative cover, with soils mostly intact and stable, with some erosion evident throughout the site, along deep channels directing surface water flows to the existing farm dam, and at the site of the existing dam wall (Plate 1 and Plate 2).

A detailed Geotechnical Investigation (GI) was undertaken by Macquarie Geotech, with the report finalised in July 2023 (refer Appendix D). The GI involved sampling and testing strata from three (3) boreholes and four (4) test pits covering the proposed RWSL footprint. The GI found the soils at the site to comprise predominantly topsoil overlying residual / extremely weathered soils that would be excavated with ease. No bedrock was encountered during the investigations.

The GI identifies the study area as having trafficable soils during dry periods, with the desiccation of exposed surfaces and large quantities of dust to be expected to be generated during dry periods under traffic. It is expected that following wet weather or inundation the soils will be soft and difficult to traverse, and drying out of these soils could potentially take several days to weeks to be able to accommodate construction traffic.

The following soil and landscape types are mapped as occurring across the broader locality:

NSW (Mitchell) Landscape Soils

The entire study area is classified as 'Goonumbla Hills' NSW (Mitchell) Landscape (). This landscape is described as having a general elevation of 290 – 290 m with a local relief of 70 m. The land is extensively cleared with thin brown structured loams on the hills merging with red-brown and red texture-contrast soils on the flats. These soils can be associated with waterlogging, low fertility and hard-setting surfaces. A small portion of the study area containing the pipes leading to the WTP consists of Jemalong Range and Slopes MLS.

Acid Sulphate Soils

Acid sulphate soils (ASS) are generally only considered a problem along coastal areas of NSW where ASL is <10 m and around wetlands of inland NSW. Inland ASS have also been associated with discharging saline groundwater, however, this occurrence is limited.

Figure 4 shows the ASS potential within the study area (SEED, 2021). The site and surrounding area is mapped a Bn(p4) ASS in inland lakes, waterways, wetlands and riparian lands. Bn(p4) denotes the following:

- B = a low probability of occurrence
- n = Sodosols, Chromosols and Dermosols
- (p) = potential ASS (sulphidic material)

- (4) = No necessary analytical data are available, and classifier has little knowledge or experience with ASS, hence classification is provisional.

The Macquarie Geotech GI confirms the study area is located within an area identified as having a low probability of acid sulphate soils.

Australian Soil Classification

Figure 5 shows the Australian Soil Classification (ASC, 2000) within 5 km of the study area. The subject site is mapped entirely as Chromosols. Chromosols are characterised as having a strong texture contrast between A and B horizons and are typically not strongly acid or sodic. These soils are widespread throughout Australia, and are widespread throughout Australia, and are amongst the most widespread soils used for Agriculture in Australia.

4.1.2 Potential Soils and Erosion Impacts – Construction

This Proposal is intended to proceed along with others within the Program. Each proposal is independent and may or may not proceed on its own merits, however there may be construction activities that occur in parallel, which could result in cumulative soil and erosion impacts. Given that PSC are responsible for all associated proposals, the construction impacts of this Proposal will be scheduled to minimise any cumulative effects of the separate proposals in the Program proceeding at the same time.

GHD (2021) determined that site investigation is required to determine the depth and condition of bedrock and confirm suitable excavation methods for the Proposal. GI testing and sampling was conducted by Macquarie Geotech on the 17th and 27th of October 2022, with the subsequent report finalised in July 2023. The GI report identifies the following recommendations / constraints:

Site Preparation

The base of the dam embankment should be stripped of all topsoil, silt, loose material, vegetable matter, and then scarified over its whole area. If rock is encountered under the embankment, appropriate measures should be taken to cut off seepage along the soil/rock contact and to prevent seepage in the rock joints coming into contact with the embankment soil. Such measures might involve the use of bentonite and a mortar or shotcrete blanket over the rock.

A cut-off trench or keyway should be constructed and taken down to a minimum of 600 mm into impervious soil or rock and backfilled with appropriate quality clay that is thoroughly compacted. It should extend for the length of the embankment including the hillside flanks.

Embankment Compaction

All fill material for the embankment should be placed in layers not greater than 150mm thick. The largest size particle should not be greater than 1/3 of the height of the lift (e.g. 50mm). Each layer should be thoroughly compacted before the next layer is placed. A suitable number of passes should be undertaken to achieve the required compaction effort.

The compaction effort achieved should be on average 98% Standard Maximum Dry Density (MDD). The minimum compaction effort should be 95% Standard MDD. If the range of compaction effort varies throughout the dam, then it can lead to the dam embankment settling to different degrees (differential settlement) causing the embankment of the dam to crack. This may ultimately lead to leakage and dam failure.

The material forming the embankment should be placed with sufficient moisture to ensure proper compaction. The moisture content should be in the range of –1% to + 3% of optimum moisture content (OMC).

Before each additional 150mm lift is added to the embankment, the preceding lift should be scarified to ensure that the two lifts are properly joined so that no natural paths for seepage are present that may result in dam failure.

The upstream and downstream batter slopes should be well compacted and trimmed to a slope batter of 1V:3H or as specified by the dam designer.

Re-use of site won material

The laboratory test results indicate that some of the soils at the site are dispersive. Dispersive soils are inherently unsuited to dam construction due to tunnel erosion or piping in dam walls. The likelihood of failure of dams built with dispersive soils depends on a number of factors including:

- The rate of first filling.
- The degree of compaction during construction.
- The dispersibility of materials used to construct the dam.
- The electrolyte content of the soil solution.
- The electrolyte concentration of the stored water.

Construction of earth dams with dispersive soils is usually possible if adequate compaction can be achieved (Bell and Maud 1994). Ritchie (1965) demonstrated that the degree of compaction within the dam wall is the single most important factor in reducing dam failure. The importance of other factors such as batter angle, rate of filling or moisture content during construction were all secondary to that of compaction. Dispersive soils can be difficult to compact as they lose strength rapidly at or above optimum moisture content, and thus may require greater compactive force if moisture contents are just dry of optimum (McDonald et al. 1981). A sheepsfoot roller is required to adequately compact dispersive soils as normal earth moving machinery cannot provide enough compactive force. Bell & Bryun (1997) and Bell and Maud (1994) suggest that dispersive clays must be compacted at a moisture content 1.5% to 2% above the optimum moisture content in order to achieve sufficient density to prevent piping (Elges 1985).

The risk of tunnel or piping failure in small earth dams can be minimised by a combination of control measures including:

- Adequate compaction.
- Chemical ameliorants e.g. gypsum, hydrated lime etc.
- Sand filters.
- Construction with non-dispersive clay.
- Topsoiling.

Construction with non-dispersive clay is recommended for the new dam and cut-off trench.

The Proposal includes surface soil disturbance, which increases the risk of erosion, and subsequent sediment migration across the landscape and into adjacent waterways. The duration and intensity of rainfall during and after works will greatly influence the potential impacts to soils and contingency planning and preparation will be required to ensure these risks are minimised.

High winds have the potential to create dust / sedimentation / deposition issues during the construction phase. There is potential for erosion if work sites are left exposed for long periods of time without adequate safety measures to prevent runoff / wind erosion.

The current layout has a cut volume of approximately 59,000 m^3, fill volume of 9,300 m^3, and net volume of approximately +50,000 m^3 (cut). Ideally the cut and fill volume would equate. However, due to site constraints, design parameters and avoiding excessive wall heights occupying the lagoon footprint (with reduced storage volume) an excess of cut material results. Opportunities for beneficial reuse and/or stockpiling onsite should be considered during the next project phase.

The use of fuels and chemicals, construction materials and wastes may also pollute soils on site.

Plate 1 Erosion adjacent the existing farm dam

Plate 2 Eroded drainage channels within the study area

4.1.3 Potential Soils and Erosion Impacts – Operation

Additional runoff of surface waters during rainfall events, which may concentrate flows and result in erosion and therefore sediment mobilisation, has potential to occur if drainage and runoff channels are poorly designed. Immediately following the completion of construction works and throughout the operation of the Proposal, regular checks would be required to ensure site rehabilitation works have been effective and erosion and sediment controls (including drainage) are holding. Where sediment runoff is noted, this must be ameliorated immediately. The Environmental Safeguards listed in Section 4.1.4 must be adhered to throughout the operational phase of the Proposal to minimise environmental harm and long term impacts to soils and erosion.

Table 5 Summary of soil and erosion impacts

Description	Y	N	Comments
Are there any known occurrences of salinity or acid sulfate soils in the area?	X		Yes, refer Figure 4. The study area is mapped as Bn(p4) – Low probability of occurrence

Description	Y	N	Comments
Does the Proposal involve the disturbance of large areas (e.g. >2 ha) for earthworks?	X		Vegetation clearing of groundcover and some shrubs and trees within subject site – total 21.24 ha.
Does the site have constraints for erosion and sedimentation controls such as steep gradients, narrow corridors or is located on private property?	X		Yes – steep lagoon wall. Large area of earthworks.

4.1.4 Environmental Safeguards – Soil and Erosion

The Environmental Safeguards for Soils and Erosion are considered part of the Proposal and must be implemented. Safeguards include:

Construction

- No vegetation outside the approved direct impact footprint is to be impacted or removed; vegetation that is not approved for clearance is to be protected to ensure soils are not exposed unnecessarily.
- Minimise the length of time that soils are exposed by stabilising as soon as practical by seeding, spreading mulch or installing erosion control blanket as appropriate.
- All areas where groundcovers/vegetation are required to be removed will require careful management during construction due to the higher erosion risks, including:
    - Erosion and sediment (ERSED) control measures are to be implemented and maintained to:
        - prevent sediment moving off-site and sediment laden water entering any drainage lines, drain inlets, or dams; and
        - reduce water velocity and capture sediment on site.
    - ERSED controls are to be installed prior to the commencement of works and checked and maintained on a regular basis (including clearing of sediment from behind barriers).
    - ERSED control measures are not to be removed until the works are complete, and areas are stabilised.
- Monitoring and response actions with regard to ERSED controls will be incorporated within the Construction Environmental Management Plan (CEMP) for the Proposal, to be enforced by the appointed Contractor.
- The maintenance of established stockpile sites during construction is to be in accordance with the Landcom/Department of Housing Managing Urban Stormwater, Soils and Construction Guidelines (the Blue Book) (Landcom 2004), including:
    - Stockpiles are recommended to be formed in accordance with the Blue Book Standard Drawing 4-1, and offsite/away from waterbodies.
    - Topsoil and subsoil are to be separated and protected from degradation, erosion or mixing with fill or waste. Materials are to be reused onsite where appropriate for infilling works, including re-spreading of topsoil as appropriate to enable rapid rehabilitation. Where onsite reuse cannot be accommodated, soil materials should be put to beneficial reuse elsewhere.
- If contaminated soils are encountered during construction, a site assessment is to be completed in accordance with Schedule A 'Recommended general process for assessment of site contamination' (NEPM 1999).

- If contaminated soils are encountered, they will be managed (and if necessary excavated, contained, treated and disposed of) in accordance with the law and relevant EPA and Council guidance.
- All chemical usage and storage during construction is to be in line with legislated requirements, to prevent Pollution of Land, which is prohibited under Section 142 A of the POEO Act.

Operation

- Monitoring of the site is to be undertaken to ensure ERSED controls remain in place until the site is re-stabilised, and to ensure no sediment is washed into any waterways following construction and before revegetation efforts are completed.
- Maintenance of vegetative cover on all exposed surfaces (not to be covered by road base/seal) to be undertaken to ensure the stability of soils on site into the future.
- Infill planting or additional spreading of appropriate native grass mixture and/or groundcover species to be undertaken until the entire site is stabilised.

Given the outlined environmental safeguards for Soils and Erosion are implemented and maintained, it is not anticipated that the Proposal would result in significant impacts to Soil and Erosion.

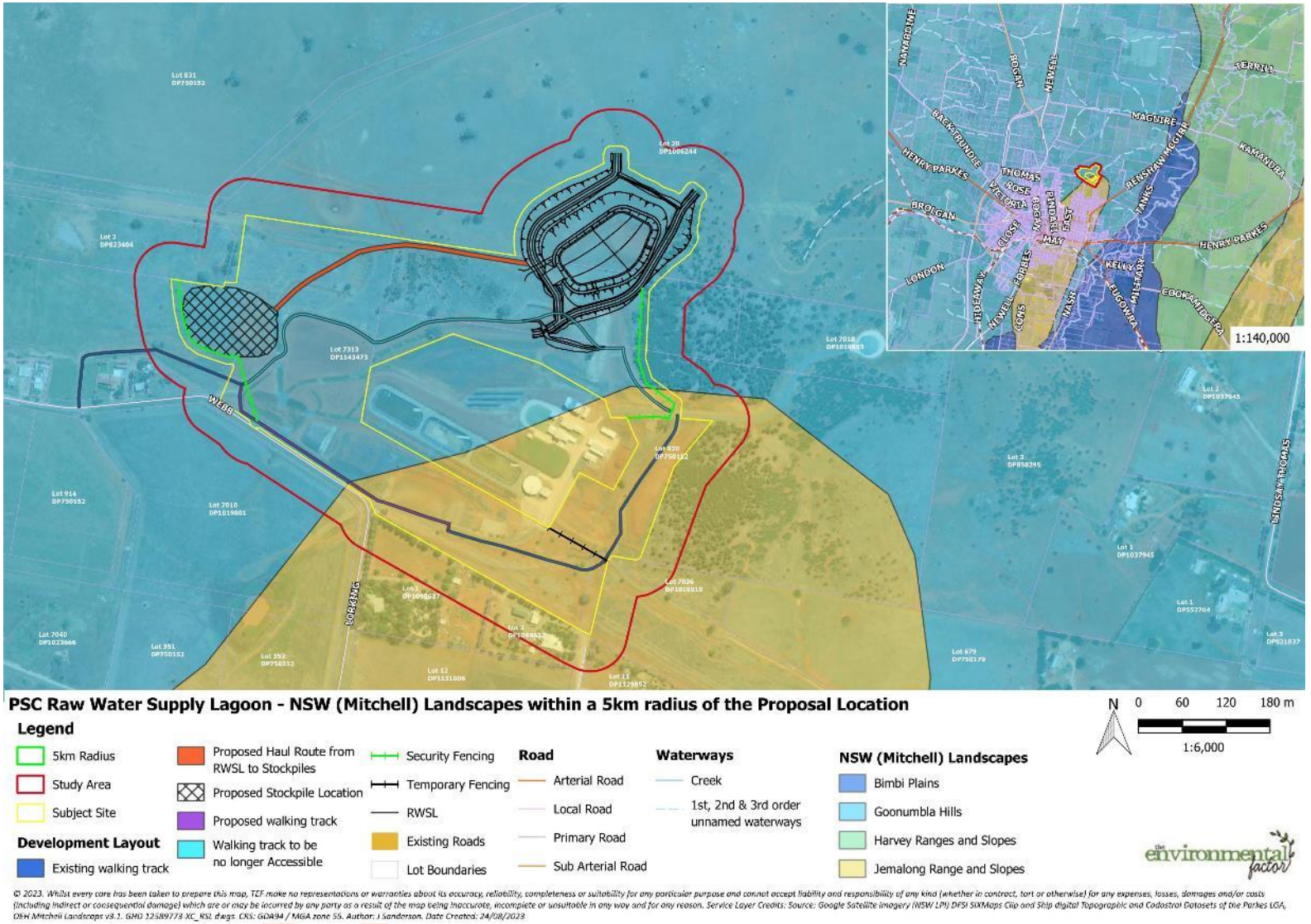
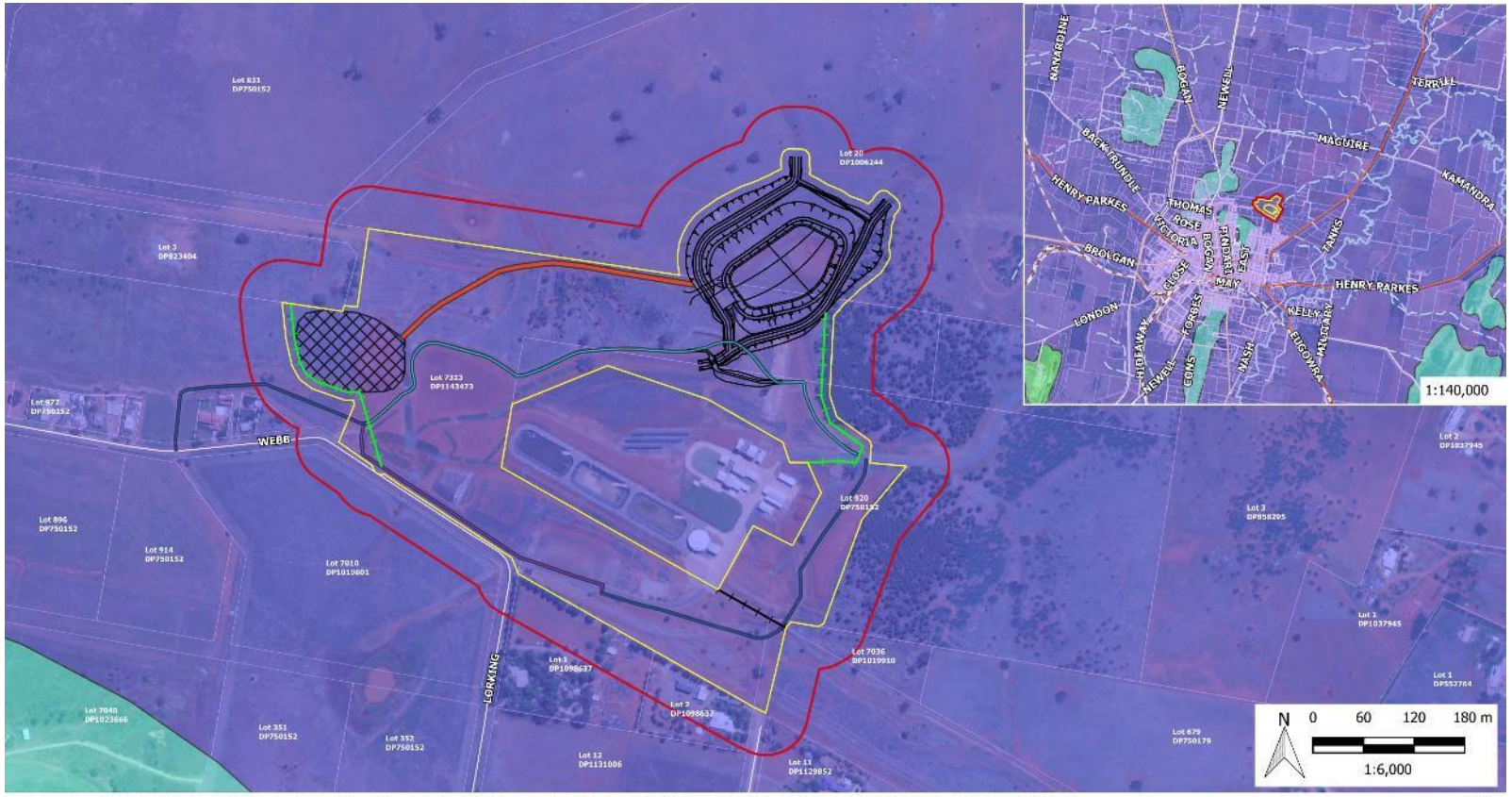


Figure 3 NSW (Mitchell) Landscapes within a 5km radius of the subject site

Figure 4 Acid Sulphate Soils within a 5km radius of the subject site



PSC Raw Water Supply Lagoon - Australian Soil Classifications within a 5km radius of the Proposal Location

Legend

- 5km Radius
- Study Area
- Subject Site

Development Layout

- Existing walking track
- Proposed Haul Route from RWSL to Stockpiles
- Proposed Stockpile Location
- Proposed walking track
- Walking track to be no longer Accessible
- Security Fencing
- Temporary Fencing
- RWSL
- Existing Roads
- Lot Boundaries

Road

- Arterial Road
- Local Road
- Primary Road
- Sub Arterial Road

Waterways

- Creek
- 1st, 2nd & 3rd order unnamed waterways

Australian Soil Classifications

- Chromosols
- Kandosols
- Not assessed

Figure 5 Australian Soil Classifications within a 5km radius of subject site

4.2 Surface and Groundwater

4.2.1 Existing environment

No named waterways occur within the study area, however the site does contain a drainage channel that has formed an eroded gully running parallel to the vegetation occurring to the east of the site, spilling into the existing farm dam present (Plate 3 and Plate 4). The next closest unnamed waterway occurs over 300 m further east of the site (Figure 7).

The nearest major permanent water source is Goobang Creek which is part of the overall Lachlan River catchment area, approximately 2.5 km from the study area. The study area is not recorded as containing shallow ground water resources that would be sensitive/ easily contaminated (Figure 7).

The existing farm dam onsite is located offline, i.e. no formed waterway supplies the dam, and no native riparian corridor exists on the dam. The dam is in a degraded condition with minimal fringing vegetation (*Persicaria sp*.), eroded banks, and no visible emergent vegetation.

Plate 3 Small dam currently onsite

Plate 4 Existing dam with degraded fringing vegetation and eroding banks

The Proposal is located within the Lachlan River catchment (refer Figure 6), which is identified as a major regulated river. There are a number of relevant water quality objectives that require consideration, including but not limited to: aquatic ecosystems; visual amenity; livestock water supply; homestead water supply; irrigation water supply; and drinking water at point of supply – groundwater.

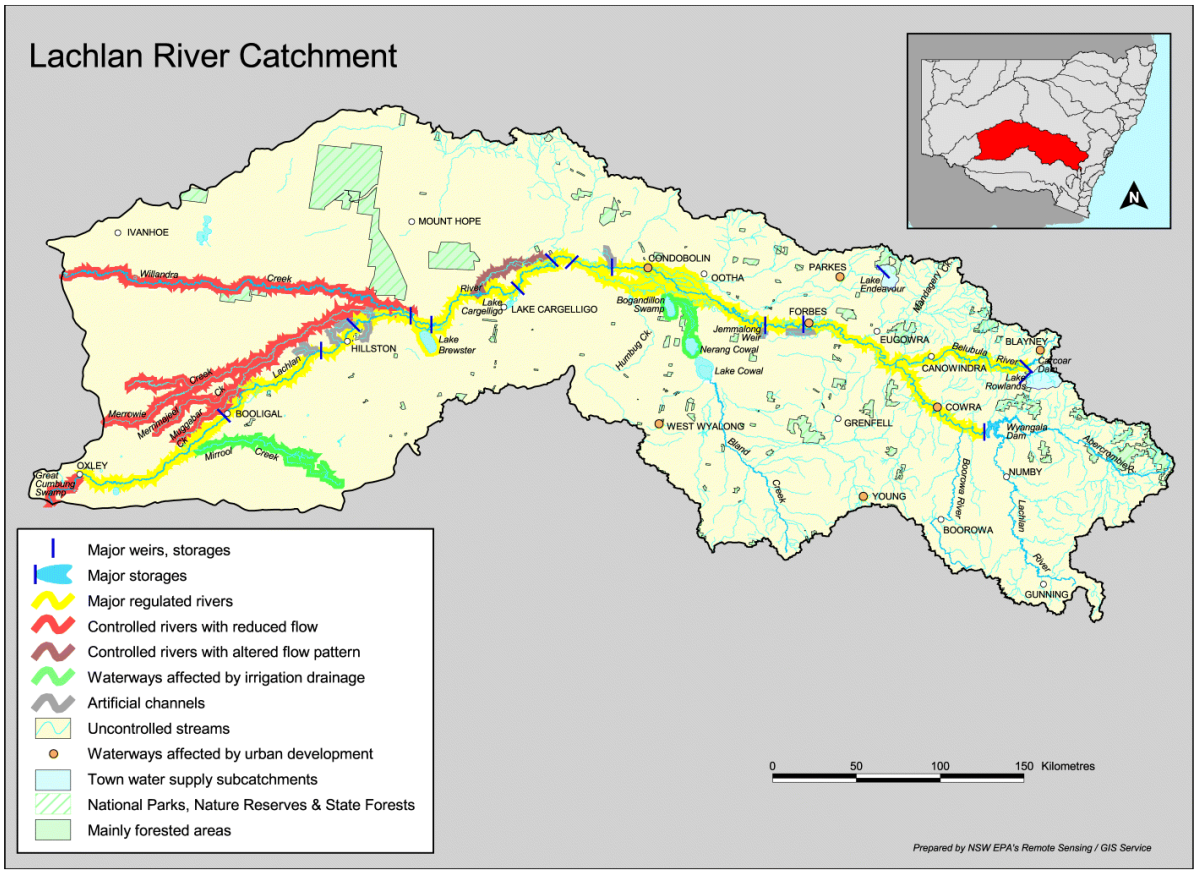


Figure 6 Lachlan River Catchment

4.2.2 Potential Surface and Groundwater Impacts – Construction

This Proposal is intended to proceed along with others within the Program. Each Proposal is independent and may or may not proceed on its own merits, however there may be construction activities that occur in parallel, which could result in cumulative surface and groundwater impacts. Given that PSC are responsible for all associated proposals, the construction impacts of this proposal will be scheduled to minimise any cumulative effects of the separate proposals in the Program proceeding at the same time.

The proposed lagoon location is in a gully north of the WTP. As such, overland flow through the dam site needs to be considered in the design plan as the construction of the lagoon will substantially affect the surface flows around the WTP. BG&E were engaged to undertake a stormwater assessment for the Proposal and work with the design team to ensure the lagoon was protected from the Probable Maximum Flood (PMF). This review and report included a site visit, background research use of hydraulic modelling and integration of results into the final design. The final report has been included in this REF as Appendix E. The report includes recommendations in Section 5 that should be considered by Council.

The catchment area upstream of the storage lagoon is approximately 9.5 ha and naturally runs downhill to the WTP below. If the interception drain is not constructed prior to commencement of works and adequately stabilised, the works site has potential to be inundated during times of high rainfall, with clean water becoming contaminated with sediments as runoff passes through the construction zone. These sediments have the potential to enter the stormwater system and enter waterways further down the catchment.

There is low risk of direct impact to waterways as a result of the proposed works, as no major waterways are in the vicinity of the study area. The main potential impact to waterways would arise from the potential for spills of fuels and other contaminants during construction which could enter runoff exiting the site and end up in adjacent dams and waterways via the stormwater system. Erosion off-site and disruption of unexpected groundwater also have the potential to impact waterways.

Potential impacts to downstream surface waters relate directly to erosion and increased sedimentation during construction, however nearby surface waters and dams are anticipated to remain unaffected, provided that the Safeguards outlined in Section 4.2.4 are adhered to.

There is also potential for spills of fuels and other contaminants arising from plant and machinery, which could enter surface waters during any works completed in proximity to drainage lines and waterways.

If ERSED control measures and best practice design principles are adhered to, impacts to surface waterways and groundwater as part of the operation of the RWSL are anticipated to be negligible.

4.2.3 Potential Surface and Groundwater Impacts – Operation

A 20 m spillway width was selected in the current Proposal design, as this size is considered a reasonable balance of spillway length and flow depth. It is noted that wide spillways are costly and can be difficult to locate, while narrow (and consequently deep) spillways can result in an uneconomical loss in storage volume. Potential operational risk of the 20 m wide spillway is the downstream rock apron or other scour protection device will need to be adequately sized to capture and dissipate flows to ensure prevention of erosion of the channel below the lagoon, in the case of a major spill. A concrete spillway chute and stilling basin is currently proposed.

Through the positioning of the drains around the Storage Lagoon, the natural runoff has been directed to the west away from the WTP facilities. This has an impact of reducing the water levels in the WTP by up to 0.17 m and 0.20 m in the 5% and 1% AEP events. With more flows sent westward there are increases on Webb Street downstream of the Basin of 0.02 m and 0.07 m in the 5% AEP and 1% AEP events due to the redirection of flows. This results in peak depths on Webb Street of 0.1 in the 5% AEP event and 0.11 in the 1% AEP event. The road remains classified as H1 – generally safe for people, vehicles and buildings as per ARR2019 guidelines.

A pipeline will deliver flows to the lagoon. This inlet pipeline will discharge into the lagoon in such a way that is to reduce the risk of scour. This headwall is to be located such that the inlet pipe is to remain near the embankment surface and reduce the risk of piping failure in the embankment.

Locating the discharge near the top of the embankment also reduces static lift variability when pumping and the opportunity for backflow through the inlet pipe at lower water levels (compared to locating the discharge near the base of the lagoon) (GHD, 2021).

If the required ERSED measures and best practice design principles that form part of this Proposal are adhered to, impacts to waterways as part of operation of the WTP Storage Lagoon would be negligible. While in operation, leakage from the HDPE liner would be assessed/managed using a leak detection system. The leak detection system consists of a series of (perforated) drainage pipes in free draining trench fill around the inside toe and across the base of the lagoon below the liner.

These pipes drain to a leak detection pit with a water level sensor at the base on the lagoon. This pit outlets to a leak detection pond, with a v-notch weir and level sensor; a water level sensor in the leak detection pit

would automatically record the water level and send this data to the onsite SCADA system so that in the event that the water level rises to a predetermined 'alarm level', an alarm would be raised, indicating either a potential leak in the liner, changes in the ground water conditions below the liner, or blockage of the outlet pipe (GHD, 2021). A visual inspection of the quality of water flowing over the v notch weir can also provide an indication of potential soil washout / erosion below the liner, thereby reducing operational risk of water pollution.

As part of the surveillance program for the lagoon, two standpipes have been included at two locations:

- One standpipe on the embankment crest adjacent to the highest embankment location
- The second standpipe at the outside toe of the embankment adjacent to the first standpipe

These standpipes would be dipped to measure groundwater levels and provide a sampling location for water quality if required. A level sensor at the lagoon would monitor lagoon water levels and provide pump start/stop inputs for the Lachlan River water transfer system, providing an additional operational checkpoint.

If ERSED measures and best practice design principles are adhered to, and the site is fully stabilised following construction works, impacts to waterways as part of operation of the Proposal are anticipated to be negligible.

Table 6 Waterways impacts summary (adapted from Div 1 (2.13) TISEPP 'Consultation Requirements')

Description	Y	N	Comments
Are the works located within or adjacent to a waterbody or wetland? Waters are defined under Protection of the Environment Operations Act 1997 and water land and wetlands under section 198A of the Fisheries Management Act 1994 and include rivers, streams, lakes, lagoons and constructed waterways, and dams.	X		Small farm dam on site, and existing eroded gully. No mapped waterways within study area
Is a Fisheries Permit required? Part 7 Fisheries Permits are automatically required for any third order (or higher) stream under the Fisheries Management Act 1994 (FM Act).		X	Works will not impact any 3rd order or higher waterways. Fisheries permit is not required.
Will the proposed works be undertaken on a bridge?		X	The Proposal does not include any bridgework
Are the works likely to require the extraction of water from a local water source (not mains)?	X		Yes, the project involves extraction of water from the Lachlan River to fill the supply lagoon.
Is the site identified as High or Moderate Groundwater Vulnerability?		X	No; refer Figure 7
Are the proposed works likely to have an effect on the surrounding water quality? This can include sediment migration, dust, and potential risks of fuel or chemical spills, to both surface and ground waters.	X		Potential for dust deposition in farm dams and sediment migration off-site is possible due to the large-scale works

Description	Y	N	Comments
Does the Proposal involve connection to, and use of a substantial volume of water from, any part of a water supply system owned by a Council?	X		The RWSL involves connection to the Parkes WTP, and the Lachlan Pipeline
Does the Proposal involve the connection to, and a substantial impact on the capacity of, any part of a sewerage system owned by Council		X	Proposal does not include any works on any part of a sewerage system owned by Council.
Is the Proposal likely to have a substantial impact on stormwater management services provided by Council		X	No, the study area occurs outside the urban area and does not include any modification to the Council managed stormwater system.
Are the works being carried out on flood liable land? (Written notification to the State Emergency Service may be required if the activity is a relevant provision under Division 1 (2.13) of the Transport and Infrastructure SEPP)		X	EPI mapping does not identify the study area as located in a flood area.
Is the Proposal being carried out on land that is within a coastal vulnerability area and is inconsistent with a certified coastal management program?		X	Works are not being carried out on land within a coastal vulnerability area.

4.2.4 Environmental Safeguards – Surface and Groundwater

The Environmental Safeguards for Surface and Groundwater are considered part of the Proposal and must be implemented. Safeguards include:

Construction

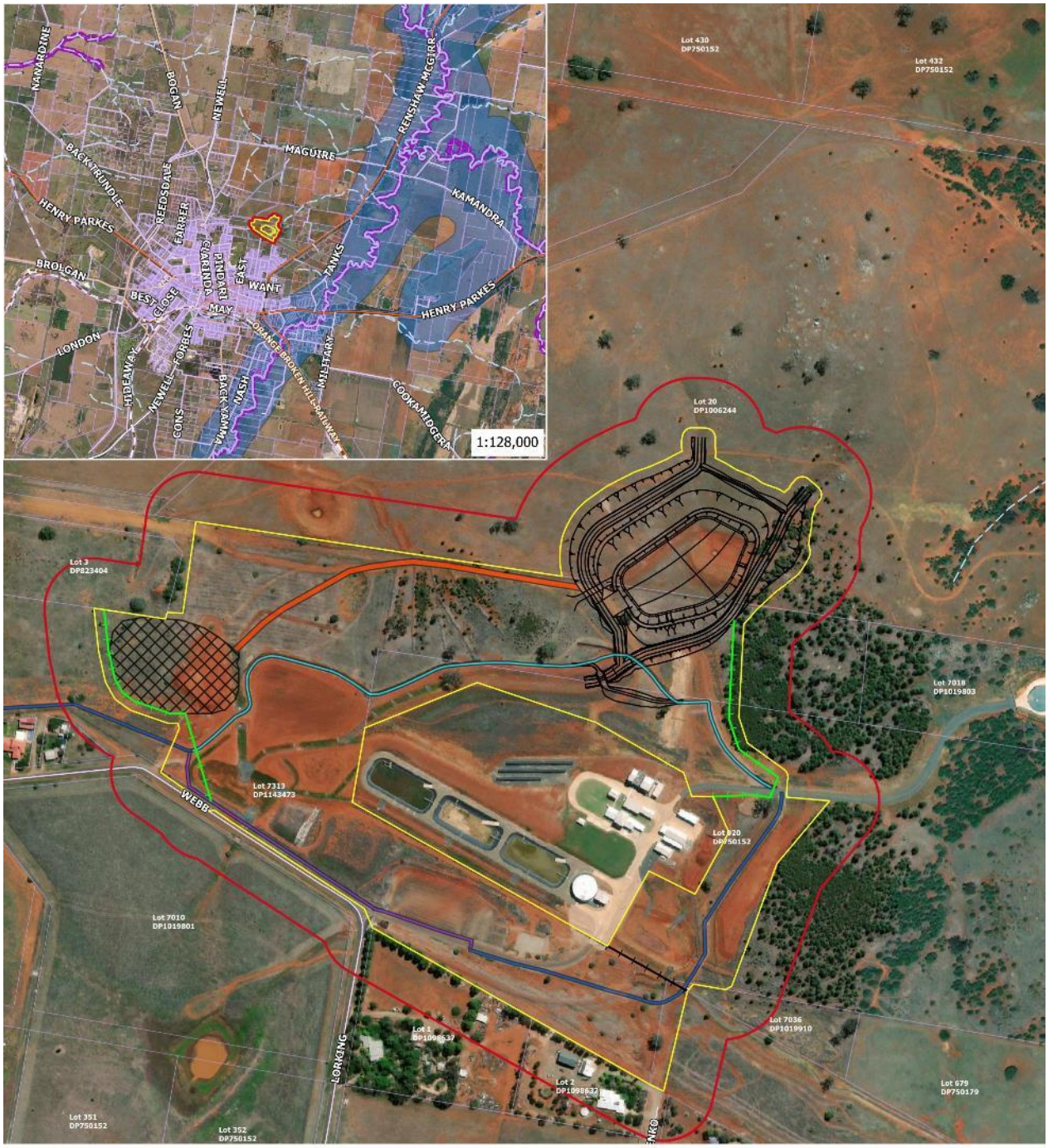
- The inception drain(s) should be sized to capture all flows up to and including the AFC event (AEP 1 in 100 years).
- Careful liner penetration detailing is required for the headwall, outlet pit, and any other liner penetrations to achieve a watertight connection and minimise the risk of leakage.
- Buried pipe checks should be undertaken to determine the magnitude of any additional loading on the pipe from construction vehicles or the lagoon embankment if located within the zone of influence.
- Embankment penetrations increase the risk of piping failure in the embankment. Free draining pipe bedding material and waterstops help reduce the risk of fine particle erosion and increase seepage path length to help reduce the risk of piping failure. Piping risks are not considered to be a potential cause of piping failure for an HDPE lined facility.
- Works to be completed in dry times (i.e. times of no current or predicted rainfall) to reduce the risk of pollutants and sediments being washed into nearby waterways or other surface waters.
- Appropriate erosion and sediment (ERSED) controls are to be installed and maintained during construction, to ensure sediment and pollutant laden surface water runoff does not enter adjacent waterways/drainage lines.

- Water moving through the site during construction is to be managed appropriately so as to prevent sediment migration and subsequent pollution of waters:
    - If 'dirty' site water is collected from within the direct impact footprint, it is to be redirected to filtration devices to trap sediments and other pollutants, and dissipate flow velocities, prior to discharging to the surrounding environment. Drainage and runoff should be controlled in such a way that no foreign substrates or materials leave the site.
    - 'Clean' water from outside the study area is to be diverted around the site, to avoid contamination and to prevent scour/erosion of the site during rainfall events during construction.
- All litter, including cigarette butts and food wrappers, is to be collected in a suitable receptacle and disposed of appropriately throughout the construction phase to ensure these do not end up polluting waters or aquatic environments.
- Re-fuelling of plant and equipment is to occur offsite, or in impervious bunded areas located a minimum of 40 metres from drains, drainage lines or dams.
- Vehicle wash-down and/or cement truck washout (if required) is to occur offsite unless it forms part of sediment control, where it is to occur in a suitably bunded area with controlled run-off.
- Monitoring of water quality is to be undertaken within culverts/waterways downstream of the site during and immediately following rainfall events, to identify if ERSED controls are functioning as intended. Visual inspections should be undertaken by an appropriately qualified person/s to determine if water is turbid, or if there is evidence of petrochemicals or other pollutants present as a consequence of construction activities.
- Segregate and stockpile topsoil removed from the area a minimum of 40 m from any waterway and on a flat, stable area. Use measures such as silt fences and holding ponds to prevent stockpile runoff from entering waterways.
- Biosecurity and water health protection measures should be implemented throughout the construction phase, including:
    - Machinery should arrive on site in a clean, washed condition, free of fluid leaks, pests and/or weeds/spores;
    - Regular weed control should be undertaken in disturbed areas throughout the construction period to prevent weed spread into waterways, if notifiable/listed weed material is present; and
    - Ensure all pesticide/herbicides used are registered for use within a waterway, as per NSW DPI guidelines. Alternatively, opt to remove weeds mechanically where possible.
- Spill response protocols for plant, equipment and chemicals used or stored on site during construction are to be available and accessible at all times to prevent and minimise potential for Pollution of Waters (s120 POEO Act).
- A Soil and Water Management Plan (SWMP) will be developed as part of the CEMP for the Proposal, detailing:
    - Water quality parameters to be adhered to (e.g. turbidity)
    - Appropriate monitoring locations and frequency
    - Location and types of ERSED controls
    - Proposed revegetation and stabilisation measures to be undertaken.

Operation

- Continue to undertake a water quality monitoring program in line with Council's requirements until all sites are completely stabilised; monitoring should include details of proposed baseline and downstream/lagoon quality following any heavy rainfall.
- Subject site rehabilitation, including removal of weeds and revegetation using appropriate native species, is to be undertaken to ensure soil stability and prevention of sediment runoff from the site into the future. Revegetation must be maintained with a survival rate of >80%, as detailed in the CEMP.
- Fauna (mainly bird) access to the lagoon is to be outlined in following stages and plans surrounding fauna management created (i.e. cover on lagoon or not).

Given the outlined environmental safeguards for Surface and Groundwater will be implemented and maintained, it is not anticipated that the Proposal would result in significant impacts to Surface and Groundwater.



PSC WTP Raw Water Supply Lagoon - Groundwater and Surface water within a 5km radius of the Proposal Location

Legend

- 5km Radius
- Study Area
- Subject Site

Development Layout

- Existing walking track
- Proposed Haul Route from RWSL to Stockpiles
- Proposed Stockpile Location
- Proposed walking track
- Walking track to be no longer Accessible
- Security Fencing
- Temporary Fencing
- RWSL
- Existing Roads
- Lot Boundaries

Road

- Arterial Road
- Local Road
- Primary Road
- Sub Arterial Road

Waterways

- Creek
- 1st, 2nd & 3rd order unnamed waterways
- Groundwater Vulnerability
- Riparian Lands Watercourses
- Key Fish Habitat

N 0 60 120 180 m

1:5,000

Figure 7 Groundwater and surface water within a 5km radius of the subject site

4.3 Noise and vibration

4.3.1 Existing environment

The subject site occurs to the north of the Parkes WTP and is surrounded by predominantly rural land to the north, the WTP compound to the south, and residential housing to the west. Background noise levels at the site typically arise from farming machinery and activities, local traffic, anthropogenic noises, livestock, wildlife and inclement meteorological conditions (rain and wind). The Existing WTP also produces localised noise. The site would be accessed via Webb Street, which is on the outskirts of Parkes; some residences occur along this road; however, none are in close proximity to the proposed work (closest is over 500 m away). Other sensitive receivers within a 1 km radius can be seen in Figure 8 and are not expected to be impacted by these works.

4.3.2 Potential noise and vibration impacts – Construction

This Proposal is intended to proceed along with others within the Program. Each proposal is independent and may or may not proceed on its own merits, however there may be construction activities that occur in parallel, which could result in cumulative noise and vibration impacts. Given that PSC are responsible for all associated proposals, the construction impacts of this Proposal will be scheduled to minimise any cumulative effects of the separate proposals in the Program proceeding at the same time.

Noise impacts during construction are anticipated to arise from increased heavy vehicle and plant movements; vegetation clearing and grubbing as required; excavators and other mechanical equipment including general engine noise and reverse alert beepers are expected as part of the construction phase.

Rock breaking and other large machinery may also cause increased noise levels. The Geotechnical Investigation conducted by Macquarie Geotech concluded that it is unlikely rock blasting would be required to achieve the required excavation depth. However, due to the rural location of the site and distance to nearby private residences, these noise impacts are unlikely to cause considerable disruption or constitute intrusive noise. The residences located to the southwest may experience minor noise disturbances, however most additional noise is likely to be minor and masked by the existing WTP noise.

These noise impacts are anticipated to be short in duration and confined to the construction phase. Assuming the mitigation measures outlined in Section 4.3.4 are adhered to and early and effective community consultation is carried out, the Proposal is unlikely to cause significant disruption or constitute intrusive noise. Native species that are nesting, breeding or fledging are at risk of disruption by the noise and vibration generated by the Proposal.

Noise impacts to the local community including private residences, and other sensitive receivers would be limited to standard working hours and construction activities would be completed in accordance with best practice methods as outlined in the Interim Construction Noise Guidelines (ICNG).

It is anticipated that the Proposal would be completed within the following hours:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 8:00am to 1:00pm
- Sunday and Public Holidays: no work

Generally, excessive noise impacts during construction would be intermittent and short-term.

Potential sensitive receivers should be consulted to ensure all potential disruptions and impacts are communicated and considered fully. Works and associated noise pollution should occur in line with the Protection of the Environment Operations (Noise Control) *Regulation 2017 and the Interim Construction Noise Guideline* (ICNG) (Department of Energy and Climate Change (DECC) 2009).

4.3.3 Potential noise and vibration impacts – Operation

The proposed RWSL is anticipated to create low noise levels during operation, adding marginally to the cumulative noise emitted from the WTP. The additional noise is not expected to significantly impact any residences in the locality. Ongoing maintenance activities and any future repair work do have to potential to generate noise as part of operations; however this is not anticipated to be significant.

Table 7 Summary of Noise and Vibration impacts

Description	Y	N	Comments
Are there any noise sensitive areas near the location of the proposed works? i.e., < 500m at nearest point, that may be affected by the works e.g. church, school, hospital, residences		X	Scattered residences occur surrounding the site (Figure 8)
Are the proposed works going to be undertaken during standard working hours detailed below? **Monday – Friday: 7:00am to 6:00pm** **Saturday: 8:00am to 1:00pm** **Sunday and Public Holidays: No work**	X		Proposed construction hours are as follows: • **Normal construction** □ Monday – Friday 7:00 am to 6:00 pm □ Saturday – 8:00 am to 1:00 pm □ Sundays and Public Holidays – No work
Is any explosive blasting required for the proposed works?		X	The need for blasting or rock breaking has been identified as unlikely.
Is there potential for ongoing operational noise to be generated post completion of works?	X		Yes, some ongoing noise will be generated, however this will not impact on any nearby sensitive receivers.

4.3.4 Environmental safeguards – Noise and Vibration

The Environmental Safeguards for Noise and Vibration are considered part of the Proposal and must be implemented. Safeguards include:

Construction

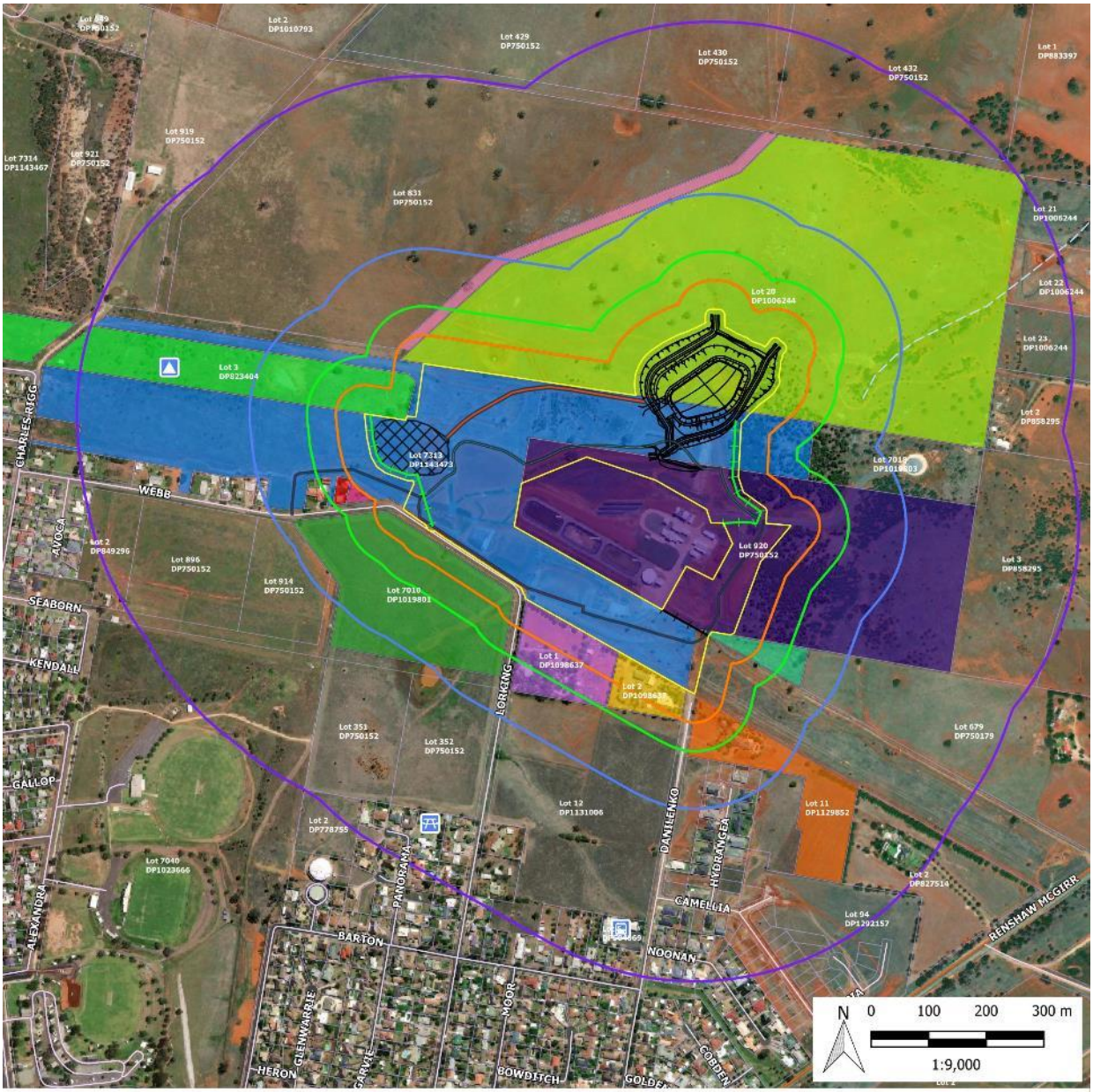
- Noise emissions should be considered in terms of the Interim Construction Noise Guideline (ICNG) (Department of Energy and Climate Change (DECC) 2009).
- Noise impacts to the local community will be limited to recommended standard working hours as detailed in the Interim Construction Noise Guideline 2009 (ICNG). All activities and Proposal works, including the arrival and departure of vehicles delivering or removing materials to or from the site, shall be carried out between the hours of:
    - 7:00am to 6:00pm Monday to Friday,
    - 8:00am to 1:00pm Saturdays, and
    - No work on Sundays and Public Holidays

- Communication of intentions and timeframes to sensitive receivers will be undertaken in order to minimise misconceptions, uncertainty and negative reactions to noise. The site supervisor should supply a contact number to aid in community liaison.
- All noise and vibration complaints are to be handled in a timely manner in accordance with requirements under the POEO Act.
- The appointed contractor will incorporate Noise and Vibration Management strategies in the CEMP, and suitably induct all staff operating machinery on the site to ensure the standard working hours are adhered to, and that machinery movement (revving, reverse beepers) is kept to a minimum. This management plan must include the general noise and vibration management practices (AS 2436-2010).
- Plant deliveries and site access will occur quietly and efficiently, with parking allowed only within designated areas located away from nearby sensitive receivers.
- Simultaneous operation of high-level noise generating machinery should be avoided by operating at contrasting times or increasing the distance between the plant and the nearest identified receiver.
- High noise generating activities, should be carried out in continuous blocks, not exceeding three (3) hours with a minimum respite period between blocks of one (1) hour.
- Low-pitch tonal beepers should be installed where possible and reversing minimised on site.
- All engine covers are to be closed and machines that are not in use, shut down.
- Where possible, high noise generating activities such as loading and unloading and material dumps should be located as far as possible from the nearest receptors.
- Works should be timed to avoid prime breeding season (Spring) for the majority of native species residing in the area, and excessive noise and vibration can impact upon native species breeding habits and life cycles.

Operation

- No further Safeguards were considered necessary for the operation phase of the Proposal. Operation of the RWSL is not likely to result in any significant ongoing noise impacts beyond general maintenance and repair works.

Given the outlined environmental safeguards for Noise and Vibration will be implemented and maintained, it is not anticipated that the Proposal would result in significant impacts to Noise and Vibration.



PSC WTP Raw Water Supply Lagoon - Sensitive Receivers and Potentially Interested Parties within a 500m Radius of the Proposal Location

Legend

- 50m Radius
- 100m Radius
- 200m Radius
- 500m Radius
- Study Area
- Subject Site

Development Layout

- Existing walking track
- Proposed Haul Route from RWSL to Stockpiles
- Proposed Stockpile Location
- Proposed walking track
- Walking track to be no longer Accessible
- Security Fencing
- Temporary Fencing
- RWSL
- Lot Boundaries

Road

- Arterial Road
- Local Road
- Urban Service Lane

Waterways

- 1st, 2nd & 3rd order unnamed waterways

Sensitive Receivers

- Ken Turner Park
- Parkes Rifle Range
- Western Road Liners

Potentially Interested Parties, impacted by the Proposal

- 1 DP1098637
- 1 DP1214413
- 1060 DP750152
- 1067 DP750152
- 11 DP1129852
- 2 DP1098637
- 20 DP1006244
- 3 DP823404
- 7010 DP1019801
- 7036 DP1019910
- 7313 DP1143473
- 920 DP750152

Figure 8 Sensitive receivers within a 500 m radius of the Proposal

4.4 Air quality

4.4.1 Existing environment

The Parkes region generally enjoys clean air; a lack of heavy industry and relatively low concentration of vehicles ensures that pollutant levels are relatively low. The primary air pollution emission sources that contribute to ambient air quality in the area include:

- Wind generated dust from exposed areas within the locality.
- Dust emissions from agricultural activities.
- Dust entrainment due to vehicle movements along unsealed and sealed town and rural roads with high silt loadings.
- Diesel and petrol fuel combustion emissions from road and non-road sources.
- Seasonal emissions from household wood burning.
- Episodic emissions from dust storms and vegetation fires (local and regional).

Long-term meteorological data for the surrounding area is available from the Bureau of Meteorology (BoM) operated Automatic Weather Station (AWS) at the Parkes Airport. The Parkes Airport AWS is located approximately 6 km east of Parkes and records observations of a range of meteorological data including temperature, humidity and rainfall, wind speed and wind direction.

Temperature data recorded at the Parkes Airport AWS indicates that January is the hottest month of the year, with a mean daily maximum temperature of 33.5°C. July is the coolest month with a mean daily minimum temperature of 2.4°C. February is the wettest month with an average rainfall of 65.8 mm falling over almost three (3) days. According to long-term records, there are on average 97 rain days per year, with a mean annual rainfall of approximately 647 mm. Parkes experiences a moisture deficit, with evaporation exceeding rainfall for all months, excluding June and July. The increased moisture deficit of the hotter months increases the dust erosion potentials of exposed areas and therefore has important implications for fugitive dust control during the construction phase of proposals.

During the survey period, conditions were warm, humid and cloudy, with a top of 23.6 degrees recorded on the 25th of March at Parkes Airport, the nearest weather station to the site. No Rain was recorded at the Parkes airport weather station on that day, nor was rain observed during the site visit (Table 9). Heavy rainfall had occurred in the days preceding the site inspection, and soils on site were observed to be damp and stable (not dusty).

Table 8 Weather conditions preceding, during and following field surveys (weather station:065103 Forbes Airport AWS)

Date	Temperature (˚C)		Rain (mm)	Max wind gust	
	Minimum	Maximum		Speed km/hr	Direction
20/03/2021	16.7	26.4	0	-	-
21/03/2021	18.3	23.7	3	48	ENE
22/03/2021	16.8	18.2	14.8	52	NE
23/03/2021	16.9	22.4	32.0	46	NE
24/03/2021	16.3	26.6	6	46	WSW

Date	Temperature (˚C)		Rain (mm)	Max wind gust	
	Minimum	Maximum		Speed km/hr	Direction
25/03/2021	**15.0**	**23.6**	**0**	**41**	**SW**
26/03/2021	7.2	23.3	1.2	26	SSW
27/03/2021	9.0	25.6	0	33	WSW
28/03/2021	9.1	24.1	0	37	SW
29/03/2021	6.9	23.8	0	41	SW
30/03/2021	9.0	25.6	0	31	SSE

4.4.2 Potential Air Quality impacts – Construction

This Proposal is intended to proceed along with others in the Program. Each proposal is independent and may or may not proceed on its own merits, however there may be construction activities that occur in parallel, which could result in cumulative air quality impacts. Given that PSC are responsible for all associated proposals, the construction impacts of this Proposal will be scheduled to minimise any cumulative effects of the separate proposals in the Program proceeding at the same time.

Potential impacts to air quality may arise from airborne dust particles generated during earthworks, stockpiling and managing topsoil, transport and handling of soils and equipment and the use of construction vehicles emitting exhaust fumes. The extent of air pollution generated during construction depends on a number of factors, including the type of machinery used, construction techniques, weather conditions and the cumulative effect of other construction activities in the near vicinity (e.g. agricultural activities such as ploughing or harvest). Due to the large-scale works, the impacts are anticipated to be of relatively long duration, however, with the implementation of prescribed environmental safeguards, are not expected to have a large or prolonged impact on air quality in the area.

The impacts, primarily associated with the construction of the RWSL which could result in fugitive dust emissions and air pollution from plant and other equipment and vehicles, are anticipated to be of relatively long duration and large scale. The GI conducted by Macquarie Geotech (Appendix D) identified the clays subgrades within the subject site to have low wet strength and poor subgrade strength, and the soils would therefore be trafficable during dry periods, with the potential for large quantities of dust to be generated during dry periods under traffic.

If not properly controlled, dust emissions could result in deposition on adjacent flora which can impact on species' ability to photosynthesize. Additionally, if not adequately controlled, fugitive dust can be transported long distances and impact upon sensitive receivers.

4.4.3 Potential Air Quality impacts – Operation

Air Quality in the area is not anticipated to create any additional impacts a result of the Proposal, post completion of the construction phase.

Table 9 Summary of Air Quality impacts

Description	Y	N	Comments
Are the proposed works likely to result in large areas (>2ha) of exposed soils?	X		It is anticipated that the Proposal will result in up to 21.24 ha soil disturbance.
Are there any dust sensitive receivers located within the vicinity of the proposed works (<500m away at nearest point) during the construction period (i.e., church, school, hospital, residences)?	X		Scattered residential dwellings occur within 500 m of the proposed works.
Is there likely to be an emission to air of dust, smoke, steam or vehicle emissions?	X		Yes, the study area and locality contain fine, friable soils likely to result in dust emissions once disturbed. These may be mitigated by use of a water cart or other dust suppressants, and through use of appropriately maintained machinery and vehicles that meet emissions standards

4.4.4 Environmental safeguards –Air Quality

The Environmental Safeguards for Air Quality are considered part of the Proposal and must be implemented. Safeguards include:

Construction

- Council must undertake community engagement and liaison, to set expectations for the works schedule and likely impacts arising as part of the works, particularly prior to works commencing.
- Daily visual construction dust monitoring should occur, with works to cease if dust plumes are occurring that have potential to impact areas outside the direct impact footprint.
- Speed limits of 40 km / hr or slower are to be enforced on access tracks and across the site during dry weather to keep dust to a minimum.
- An adequate water supply is to be provided on the construction site for effective dust/particulate matter suppression/mitigation. If synthetic dust suppressants are used, they must be biodegradable in nature and non-toxic for waterways.
- Earthworks and exposed areas/soil stockpiles are to be revegetated using appropriate native species to stabilise surfaces as soon as practicable to reduce risk of dust emissions from wind erosion.
- Only vegetation that has been approved for removal may be removed or otherwise impacted; intact vegetation stabilises soils and keeps dust to a minimum.
- Vegetation and other materials are not to be burnt on site, unless the vegetation material is a weed that prohibits transportation and disposal by other means.
- Vehicles transporting waste or other materials that may produce odours or dust are to be covered during transit.
- Tracking of machinery carrying soil/spoil through nearby townships is to be avoided where possible.
- Stockpiles or areas that may generate dust are to be managed to suppress dust emissions.
- Dampening of exposed soils will be undertaken during weather conditions conducive to visible dust formation.
- Construction plant and equipment will be maintained in a good working condition in order to limit impacts on air quality through vehicle emissions.

- Fuel operated plant and equipment will not be left idle when not in use.
- Regular site inspections will be undertaken as part of air quality monitoring, and inspection results recorded by Council's Principal Contractor.
- Any dust complaints received during construction will be duly investigated in accordance with Council's requirements under the POEO Act.
- Any exceptional incidents that cause dust and/or air emissions, either on or off site, will be recorded, and the action taken to resolve the situation recorded in the site management logbook.

Operation

- Any exposed areas revegetated during construction are to be monitored and maintained until the areas are fully stabilised to reduce risk of erosion and dust emissions, as well as dust settling on nearby native vegetation and waterbodies.

Given the outlined environmental safeguards for Air Quality will be implemented and maintained, it is not anticipated that the Proposal would result in significant impacts to Air Quality.

4.5 Non-Aboriginal heritage

4.5.1 Existing environment

Parkes has a rich cultural history, with a number of important stock routes passing through the town, as well as a history of gold mining and agriculture since the 1860's. The dominant land use throughout the Parkes region is agriculture including farming and grazing, which are fundamental to the local economy. Disturbance regimes associated with the land uses of the study area include agriculture including the existing stock dam, industry (the WTP), and residential dwellings.

Despite the Parkes region having a diverse and well recorded cultural history, a search of the Heritage Council of NSW administered heritage databases and the Parkes Local Environmental Plan (LEP) 2012 returned no records of historical heritage sites within 1.5 km radius of the study area.

A detailed non-Aboriginal heritage assessment was not conducted in preparing this REF.

4.5.2 Potential impacts to Non-aboriginal Heritage – Construction

Due to the recent and historic disturbance, including residential development, cropped land, road, and water infrastructure construction, it is highly unlikely that any items of non-Aboriginal Heritage would be discovered while constructing the RWSL and clearing the groundcover to allow for site preparation for the construction vehicles and machinery to accommodate the Proposal.

No impacts to known surrounding heritage sites are anticipated, as none occur within the direct impact zone (subject site) or within close proximity to the subject site. There is, however, always potential for the works to uncover unanticipated finds. The environmental safeguards outlined in Section 4.6.4 will provide additional protection measures to reduce the risk of harm to any such unanticipated finds.

4.5.3 Potential impacts to Non-Aboriginal Heritage - Operation

No impacts to non-Aboriginal heritage are anticipated in the operation phase of the Proposal.

Table 10 Non-Aboriginal Heritage impacts summary

Description	Y	N	Comments
Are there any items of non-Aboriginal heritage located within the vicinity (1km) of the proposed works?		X	None identified
If yes, list the item(s) and their heritage significance (i.e., s170 register, Council Register, State Heritage Register, National Heritage Register).	N/A		
Is the development on, or reasonably likely to have an impact on, a part of the Willandra Lakes Region World Heritage Property (if so, consultation is required with the World Heritage Advisory Committee and Heritage NSW),		X	Proposal is not located in proximity to the Willandra Lakes Region World Heritage Property
Is the Proposal likely to affect the heritage significance of a local heritage item, or of a heritage conservation area, that is not also a State heritage		X	No impacts are anticipated, as works are limited to the subject site where no heritage items occur

Description	Y	N	Comments
item, in a way that is more than minor or inconsequential?			
Is further assessment of the potential impact on a listed heritage item required? And has this assessment been provided along with written notification to the local Council for the area in which the heritage item is located?		X	No further assessment is required

4.5.4 Environmental safeguards – Non-Aboriginal Heritage

The Environmental Safeguards for Non-Aboriginal Heritage are considered part of the Proposal and must be implemented. Safeguards include:

- The proposed works must be contained to the area assessed during the construction. If the proposed location is amended, further archaeological assessment may be necessary to determine if the proposed works will impact any items of historical significance.
- If archaeological remains or items defined as relics under the NSW Heritage Act 1977 are uncovered during the works, all works must cease in the vicinity of the material/find and Council's Manager Strategic Planning and Environmental Officer are to be contacted immediately.
- Council's workers and all staff must be made aware of any heritage sites and places that occur within the area and all care must be taken to avoid interference with and damage to these sites.
- Any newly discovered heritage sites must be clearly fenced/flagged with removable flagging or other temporary means to delineate their presence and in order to prevent them being harmed during the construction process.

Given the outlined environmental safeguards for non-Aboriginal heritage will be implemented and maintained, it is not anticipated that the Proposal would result in significant impacts to Non-Aboriginal Heritage

4.6 Aboriginal heritage

4.6.1 Existing environment

The Wiradjuri are known to have permanently inhabited this area of the Central West for around 40,000 years or more, with the nearby Lachlan River serving as a significant and central feature to the First Nations people.

A search of the Aboriginal Heritage Information Management System (AHIMS) register was conducted on the 22nd of April 2021 () and found there to be no Aboriginal sites or objects located within 1 km of the study area. An ADD assessment was conducted by OzArk in September 2022 for the study area (Appendix C).

The study area includes land that has been disturbed in the past through ploughing, fencing, pipeline installation, road construction, grading, clearing and excavation. The ADD assessment identified the study area to have low archaeological potential due to previous disturbance of the ground and the low archaeological sensitivity of the landform. The undertaking of the due diligence process resulted in the conclusion that *"the proposed works will have an impact on the ground surface, however, no Aboriginal objects or intact archaeological deposits will be harmed by the proposal".* An Aboriginal Heritage Impact Permit (AHIP) is therefore not required.

Plate 5 Erosion and previous excavation at the existing dam

Plate 6 An area of previously disturbed ground

4.6.2 Potential Aboriginal Heritage Impacts – Construction

The level of disturbance (historic and recent) within the study area means that there is a very low chance of intact sub-surface deposits being present within the area. No previously undisturbed areas are to be impacted as part of works, however all personnel working on the site are to remain vigilant and aware of the potential presence of unexpected sub-surface artefacts and all Safeguards outlined in Section 4.6.4 are to be strictly adhered to.

4.6.3 Potential Aboriginal Heritage Impacts – Operation

No adverse impacts to places, artefacts or Aboriginal Heritage sites are expected during use/operation of the Proposal.

Table 11 Aboriginal Heritage impacts summary

Description	Y	N	Comments
Are the works likely to disturb previously undisturbed areas of the landscape? Check for good camping sites (flat, near water, availability of bush foods), mountain ridges, spurs or vantage points or rocky outcrops that may have ceremonial significance, and the presence of stone tools, shells or other evidence of human occupation.		X	Disturbance to previously undisturbed vegetated roadside corridor. This area has been assessed by OzArk in September 2022. ADD report provided as Appendix C.
Has an AHIMS register search been conducted?	X		Yes – refer Appendix C
Are there any known items of Aboriginal Heritage near the works area (< 1km)?		X	Nil
Is consultation with stakeholders required? E.g., the Local Aboriginal Land Council		X	No – The assessment determined that no harm to Aboriginal Heritage is anticipated provided Safeguards in Section 4.6.4 are adhered to.
Is a National Parks and Wildlife Act Section 90 Permit (Aboriginal Heritage Impact Permit – AHIP) required for Aboriginal items potentially impacted by the works?		X	No known Aboriginal Heritage items occur in the subject site, and subsequently none would be impacted as a result of the Proposal provided the safeguards outlined in this REF are adhered to.

4.6.4 Environmental Safeguards – Aboriginal Heritage

The Environmental Safeguards Aboriginal Heritage are considered part of the Proposal and must be implemented. Safeguards include:

Construction

- All land ground disturbance activities must be confined to within the subject site as this will eliminate the risk of harm to Aboriginal objects in adjacent landforms. Should the parameters of the Proposal extend beyond the assessed areas, then further archaeological assessment is required.
- All staff and contractors involved in the proposed work should be made aware of the legislative protection requirements for all Aboriginal sites and objects.
- All staff and visitors should be inducted to site to ensure they are aware of the possible presence of sensitive Aboriginal heritage items located within the vicinity of the work site, and the protective measures that should remain in place throughout the works.
- Should unanticipated archaeological material be encountered during site works, all work must cease and an archaeologist contacted to make an assessment of the find. Further archaeological assessment and Aboriginal community consultation may be required prior to the recommencement of works. Any objects confirmed to be Aboriginal in origin must be reported to Heritage NSW
- If during works Aboriginal artefacts or skeletal material are noted, all work should cease and the procedures in the Unanticipated Finds Protocol (Appendix 2 of the ADD) should be followed.

- If any human remains are found, all works should stop immediately, the site should be secured and NSW police contacted immediately.
- The information in the ADD meets the requirements of the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales. It should be retained as shelf documentation for five (5) years as it may be used to support a defence against prosecution in the event of unanticipated harm to Aboriginal objects.

Operation

No further Safeguards were considered necessary for the operation phase of the Proposal. Operation of the RWSL is not likely to result in any ongoing impacts to Aboriginal Heritage.

Given the outlined environmental safeguards for Aboriginal Heritage will be implemented and maintained, it is not anticipated that the Proposal would result in significant impacts to Aboriginal Heritage.

4.7 Biodiversity

A Flora and Fauna Assessment (FFA) has been prepared for these works (Appendix B) which provides extensive detail relating to the ecology present within the study area. The following is a brief summary of that report.

4.7.1 Existing environment

Vegetation present within the subject site was comprised of mostly non-native degraded pasture with a patch of remnant and regenerating native vegetation to the east of the subject site with another scattered patches of regenerating native vegetation further to the west. Where remnant native vegetation occurred, the original PCT was established based on the species assemblage present, soil characteristics, location within the landscape and PCTs mapped as occurring within the locality. No named waterways occur within the study area, however, the site does contain a drainage channel that has formed an eroded gully running parallel to the vegetation on the east of the site, spilling into the existing farm dam present within the centre of the site. The next closest unnamed waterway occurs over 300 m further east of the site.

The majority of the study area is located on unmapped land on the Native Vegetation Regulatory map, with large parcels of excluded land surrounding the study area (DPIE 2021). The study area was found to be weedy and degraded, with erosion evident throughout.

Ground-truthing of mapped vegetation for the site found two PCT's to be present:

- PCT 267 *White Box-White Cypress Pine-Western Grey Box shrub/grass/forb Woodland*
- PCT 0 Non-native / Exotic Vegetation

PCT 267 forms part of the W*hite Box-Yellow Box-Blakely's Red Gum Woodland and Derived Grassland* Threatened Ecological Community (TEC) listed as critically endangered under both the BC Act and EPBC Act.

The site and broader study area also support a range of habitats for native wildlife including some small woodland patches, a small dam, cleared agricultural land, drainage lines and culverts. These habitats can support the thoroughfare and habitation of a range of native fauna species. The study area is not well connected to intact remnant patches of vegetation, with only limited access to intact bushland to the east of the site. Patches of vegetation in the locality are interspersed with agricultural land, leaving poor habitat connectivity for terrestrial fauna. Terrestrial fauna movement is also somewhat restricted due to the presence of roads and some fences, with open spaces and infrastructure present in the immediate and broader locality.

A total of ten (10) threatened species and one (1) TEC were considered to have a moderate or higher likelihood of being impacted within the subject site, with Tests of Significance conducted for these species. Three (3) species of declared Priority Weed and/or Weeds of National Significance (WoNS) were also recorded as occurring on the site.

Further detail is provided in Appendix B.

4.7.2 Potential biodiversity impacts – construction

This Proposal is intended to proceed along with others within the Program. Each proposal is independent and may or may not proceed on its own merits, however there may be construction activities that occur in parallel, which could result in cumulative impacts to biodiversity. Given that PSC are responsible for all associated proposals, the construction impacts of this Proposal will be scheduled to minimise any cumulative effects of the separate proposals in the Program proceeding at the same time.

8.37 ha of native vegetation occurs within the study area, with the potential to be impacted by the proposed works. Of this, approximately **4.34 ha** of native vegetation may be directly impacted or removed, including mature trees and overstorey species, representing **2.4 %** of the overall native vegetation present within a 1.5 km radius of the site. The site has limited connectivity with broader extents of remnant vegetation. No habitat trees or other habitat features are expected to be impacted on.

The site also includes an existing farm dam, which is in degraded condition with minimal fringing vegetation (*Persicaria sp*.), eroded banks, and no visible emergent vegetation. It is possible that fauna utilise the dam for habitat, and foraging resources, as well resting (in the case of waterbirds); however, no evidence of this was observed on site during the survey. Consequently, impact arising from upgrading the dam to a much larger water storage body, are anticipated to be minimal.

A total of ten (10) threatened species and one (1) TEC were considered to have a moderate or higher likelihood of being impacted within the subject site from the proposed lagoon construction. However, some transient species of fauna, such as vagrant bird species, may also use the new water body on migratory journeys, which would be considered a positive impact, as a large waterbody would provide resting and foraging resources for migratory species.

No long-term effects are likely to be suffered by fauna due to the Proposal considering the existing nature of the site. Environmental safeguards set out as part of this Proposal (checking for animals present and adherence to clearing limits) will also reduce any potential impacts to individual fauna that may be present during construction works.

Indirect impacts caused by clearing and lagoon construction include increased noise and dust levels, potential erosion and runoff, and the introduction of weeds and other pathogens. Noise, dust and runoff have the potential to travel long distances and disrupt wildlife outside of the study area. Presence of vehicles, machinery and staff within and surrounding the study area may also increase localised disturbance to terrestrial species that feed or breed in the area. Sedimentation during clearing and lagoon construction works may migrate outside of the study area. Indirect impacts to vegetation communities within the study area may also occur through increased activity causing erosion, dust settling on foliage and potential for the introduction of weeds or other pathogens.

Provided appropriate safeguards are followed, indirect impacts resulting from the construction phase of the Proposal are predicted to be minor and short-lived in nature.

Through the Tests of Significance conducted, review of KTP's and field surveys and analyses, it was concluded that the Proposal is not likely to have a significant impact on any of the listed threatened biota likely to occur in the locality and at risk of being impacted by the Proposal.

4.7.3 Potential biodiversity impacts – operation

Potential long-term positive impacts during operation may arise from the installation of a large water body, attracting various wildlife species and changing the landscape to include a large lagoon.

The use of a cover over the lagoon to prevent water bird access and reduce evaporation was not considered as part of this REF.

Table 12 Biodiversity impacts summary

Description	Y	N	Comments
Are the proposed works likely to involve the removal, pruning or damage to any vegetation including, grass cover, shrubs, trees or Endangered Ecological Communities?	X		The Proposal would result in the clearing of potentially **4.34 ha** of native midstory and understory vegetation comprising a TEC. The vegetation is in moderate to good condition.
Please list the number of trees and/or hollows to be removed as part of the proposed works.	X		An area of **4.34 ha** containing both remnant and planted woodland would be removed as part of the proposed works.
Are the works taking place in a roadside area designated as high or medium conservation value vegetation?		X	N/A
Are there any threatened, endangered, or native flora and/or fauna located within the vicinity of the proposed works?	X		An area of **4.34 ha** containing both remnant and planted woodland would be removed as part of the proposed works. (see Appendix B).

4.7.4 Environmental safeguards - Biodiversity

The Environmental Safeguards for Biodiversity are considered part of the Proposal and must be implemented. Safeguards include:

Construction:

Timing of vegetation clearing

- Where practicable, it is recommended to time the works outside of key breeding (fledging of active nests/roosts) and winter torpor (microbat) seasons (approximately June to January) for species likely to utilise the site to avoid nest abandonment, injury or death to native fauna.

Habitat Removal

- Clearly delineate vegetation to be removed/retained with the assistance of an ecologist, or similarly qualified professional, and induct all site personnel as to the approved extent of clearing. Ensure that no clearing of vegetation occurs outside of the marked boundary.
- Where any trees or riparian vegetation requiring removal contain hollows, nests or other signs of occupation, a staged clearing approach must be undertaken where hollow limbs or nests are removed carefully and incrementally by a qualified tree surgeon/arborist, or qualified fauna spotter / catcher. Care should be taken to inspect limbs / nests for fauna prior to their removal.
- Prior to clearing, a preclearance survey should be undertaken including inspection of hollows and the farm dam to confirm occupation by fauna. Care should be taken to identify nests and/or roosting sites. If fauna habitat is present Council or Council's appointed contractor must contact the project ecologist for further advice prior to clearing.
- Ensure the presence of an ecologist or fauna spotter catcher at all times during pre-clearing and clearing activities to remove and relocate wildlife as necessary, and to attend to any wildlife that are injured as a result of works.
- Felled trees must be placed strategically and in proximity to the work site, either within the regenerating vegetation to the west, upslope of the proposed lagoon in eroded areas, or along Golden

Bar Hill to the east, to provide refuge and potential habitat in the understorey whilst ensuring no further damage to surrounding vegetation. Placement of logs and felled trees will also aid in the regeneration of the area.

- Where additional vegetation removal is proposed beyond that which is described within this report, this must first be assessed to consider the cumulative impacts against the approved clearance footprint, and if appropriate supervised by a qualified ecologist and Council's Environmental Officer.

Vegetation Protection

- Clearly delineate vegetation to be removed/retained with the assistance of an ecologist, or similarly qualified professional, and induct all site personnel as to the approved extent of clearing. Ensure that no clearing of vegetation occurs outside of the marked boundary.
- The presence of a suitably qualified arborist is recommended during earthworks occurring near retained trees to avoid rootzones impacts.
- Trees existing along gullies or eroded areas should be retained and protected, to ensure future erosion potential is minimised.

Rehabilitation

- Revegetation activities will be undertaken using native species sourced from local seed wherever possible. Areas to be re-seeded/planted may be marked in the project CEMP or Environmental Control Plan (ECP) as a record of rehabilitation efforts made. Vegetation cover should be returned to the site within a reasonably practicable timeframe post clearing to reduce soil exposure and loss.
- Inclusion of emergent and fringing vegetation along the lagoon wall and slopes, where access is not required for maintenance, is recommended to provide long-term stability of the site as well as replace habitats lost through the construction phase.

General

- Vehicles and machinery to enter from the WTP not to extend beyond the direct impact footprint and to remain on allocated access roads.
- Ensure vehicles and machinery are cleaned and checked for any traces of weeds, seeds and mud prior to entering work site.
- All soils to be stockpiled at designated stockpile locations in a cleared area, within pre-approved zones.
- Appropriate erosion and sediment migration reduction/control measures should be in place.
- Heavy vehicles are not to be parked under tree drip lines/ leaf canopy to avoid compaction of soil, which is damaging to mature native trees and can cause dieback or tree mortality.
- All machinery and vehicles are to be clean and inspected prior to arriving on-site to reduce the spread of weeds and disease (e.g. *Phytophthora cinnamomi*) to the site.
- Strict hygiene protocols must be followed to ensure that no environmental weeds are spread around during works or are introduced to site as a result of the proposed works. If weeds are accidentally transported to site, or identified during construction activities, all weed material should be immediately contained and removed from site. Conversely, machinery should be carefully cleaned prior to leaving the site, to ensure weed material is not transported offsite to other areas.
- Locate stockpile sites away from the proposed lagoon boundary, drainage lines and native vegetation. Ensure these are appropriately stabilized in accordance with the 'Blue Book' (Landcom 2004).

- Declared weeds must be managed according to requirements under the *Biosecurity Act 2015*. It is recommended that all Weeds of National Significance should be managed prior to commencement of construction activities to ensure they do not spread, and where possible eradicated.
- Due to the expected slope/steepness of the work site, fauna entrapment and drowning is a possible scenario throughout construction. Suitable fauna escape ladders/ ramps are to be installed overnight to allow any animals that fall into trenches/lagoon to escape. Additionally, any pits or trenches left open overnight should be checked each morning for fauna which may have become entrapped

Operation

- Ongoing monitoring of planted vegetation will be undertaken to ensure adequate survival rates and to identify whether infill plantings should be undertaken.

Given the outlined environmental safeguards for Biodiversity will be implemented and maintained, it is not anticipated that the Proposal would result in significant impacts to Biodiversity.

4.8 Traffic and Transport

4.8.1 Existing environment

The proposed RWSL would be situated north of the existing WTP, with access from Webb Street. Webb Street is on the urban fringe of Parkes, and residents along this road are accustomed to trucks, farm machinery, rural residents and service vehicles travelling along it. Webb Street transitions into Lorking Street where the road veers to the south, and continues on to service residences, meeting Barton Street in the residential area to the south.

An existing gravel walking / bike track traverses the study area. For the safety of users, this path would be closed along the section through the study area, and recreational users diverted around the site on an alternative existing track that follows the perimeter of the WTP (refer Figure 2). The alternative path will require maintenance including hardening with gravel, particularly along the section adjacent to Webb Street. Asbestos has previously been identified along the proposed route adjacent to Webb Street, therefore no excavation is to take place while constructing the alternative path. The preferred route is to keep walkers / bike riders off Webb street, as the road narrows in sections to a width not suitable to accommodate vehicles and recreational users safely.

Localised traffic management considerations will be adopted upon commencement of civil works, to manage traffic (motorised and non-motorised) movements during the construction of the RWSL to guide the safe delivery of the Proposal.

4.8.2 Potential traffic and transport impacts – Construction

The Proposal is intended to proceed along with others within the Program. Each Proposal is independent and may or may not proceed on its own merits, however there may be construction activities that occur in parallel, which could result in cumulative traffic and transport impacts. Given that PSC are responsible for all associated proposals, the construction impacts of this Proposal will be scheduled to minimise any cumulative effects of the separate proposals in the Program proceeding at the same time.

Machinery and construction vehicles may access the site from Renshaw McGirr Way (via Camellia Parade and Danilenko Street) or from the Newell Highway via Webb Streets. Webb Street is identified as a local road in a rural environment and does therefore not experience heavy traffic volumes and so is unlikely to require traffic control for entering or exiting vehicles.

The internal service road accessing the WTP and HLR will be used to access the proposed RWSL, and access may also be possible from the northwest via paddocks. All weather access is to be established for all routes where not already available.

The Proposal would also generate a number of medium to heavy vehicle movements through the transport of machinery, fuel, general provisions and materials across the duration of the project which are likely to have a minor increase in traffic pressure for the duration of the Proposal. Light vehicles would be required to transport staff to and from the subject site and would also be used in various roles on site. Light and heavy vehicles are expected to enter the proposed site compound and stockpile site location via the existing WTP access road.

4.8.3 Potential traffic and transport impacts – Operation

The Proposal is not anticipated to result in any operational impacts on traffic and transport beyond the current site conditions. A slight increase in service vehicles / personnel are expected during operation but this is unlikely to significantly impact on road users.

Table 13 Impacts to Traffic and Transport summary

Description	Y	N	Comments
Are the proposed works likely to result in major detours or disruptions to traffic flow (vehicular, cycle and pedestrian) or access to properties or businesses?		X	No disruption to traffic flow, but minor diversion for recreational users during the construction phase.
Will there be any permanent major detours made as a consequence of the works?		X	No permanent major detours will occur as a result of the Proposal.
Does the proposal involve excavation that is not minor or inconsequential of the surface of, or a footpath adjacent to, a road for which a Council is the roads authority under the Roads Act 1993 (if the public authority that is carrying out the development, or on whose behalf it is being carried out, is not responsible for the maintenance of the road or footpath)		X	Not anticipated; the path upgrade will not require excavation, rather an import of gravel to harden the surface.
Does the Proposal involve the installation of a temporary structure on, or the enclosing of, a public place that is under a Council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential		X	None anticipated.
Is the proposal likely to generate traffic that will strain the capacity of the road system in an LGA?		X	Proposal is anticipated to result in additional movement of construction vehicles during the construction phase. However, this is expected to be minor and confined to the construction period.

4.8.4 Environmental safeguards - Traffic and Transport

The Environmental Safeguards measures for Traffic and Transport are considered part of the Proposal and must be implemented. Safeguards include:

Construction

- Prior notice shall be given to residents to notify of the works to be completed, their timing and duration. Notification can be provided by various means including letterbox distribution, local paper, and through the PSC website. All consultation and notification should occur with enough time before works to allow residents to modify their travel plans if desired (1 – 2 weeks prior to commencement).
- Council's appointed contractor will consider the location of designated parking areas, stockpile locations, construction laydown sites, site offices, and access routes carefully in consideration of creating inconveniences to local residents, and to the other environmental constraints. Any areas

additional to those outside the mapped and considered areas as discussed within this REF will need to be assessed for additional and cumulative impacts prior to being established as part of the Proposal.

- A Traffic Control Plan (TCP) is to be developed in accordance with Australian Standards (AS 1742.3 – Traffic Control Devices for Works on Roads) and Roads and Maritime Traffic Control at Worksites manual to identify appropriate signage (and location) to advise motorist of upcoming changes in the road network. Any variation to the layout of the TCP on site is to be recorded and certified by accredited Roads and Maritime personnel.
- All road signs and marking will be in accordance with the TfNSW Guide to Signs and Markings; Australian Standards AS1742 and AS1743; and the Australian Roads Guide to Traffic Management.
- Traffic and transport complaints are to be monitored and addressed promptly where practicable.
- A Section 138 Permit under the *Roads Act 1993* will be obtained prior to construction activities commencing if required.

Operation

- Access roads will be maintained to enable safe ingress and egress for maintenance vehicles and personnel as required during routine operation of the RWSL.
- Access to the lagoon area for vehicles owned by the general public will be prevented for safety and water quality reasons, by way of bollards and / or locked gates.

Given the outlined environmental safeguards for Traffic and Transport will be implemented and maintained, it is not anticipated that the Proposal would result in significant impacts to Traffic and Transport.

4.9 Socio-economic considerations

4.9.1 Existing environment

Parkes LGA is a rural community with a population of approximately 14,361 people (ABS, 2021). In the 2021 Census, of the 14,361 people in the Parkes LGA, 50.2% were female and 49.8% were male. The median age of people in Parkes was cited as 41 years, and the average number of people per household was 2.4.

There were 6,528 people who reported being in the labour force in the week before the Census night in Parkes. Of these 60.5% were employed full time, 28.8% part time, and 5.1% were unemployed. The largest industry of employment is Copper Ore Mining, employing 5.0% of the workforce, followed by Aged Care Residential Services, employing 3.7%, and State Government Administration, employing 3.3% of the labour population.

The study area is surrounded by agricultural land and is on the outskirts of the township of Parkes. Cropping, grazing and other agriculture are the main uses in the surrounding landscape. A recreational bike/walking path cuts through the study area to the south of the subject site, beginning near Memorial Hill, connecting back to the town centre via Renshaw McGirr Way

There are a no private properties or driveways located within the study area (Figure 8).

4.9.2 Potential socio-economic impacts- Construction

This Proposal is intended to proceed along with others within the Program. Each proposal is independent and may or may not proceed on its own merits, however there may be construction activities that occur in parallel, which could result in cumulative socio-economic impacts. Given that PSC are responsible for all associated proposals, the construction impacts of this Proposal will be scheduled to minimise any cumulative effects of the separate proposals in the Program proceeding at the same time.

During the construction phase of the Proposal, it is expected that local contractors will be employed, with numbers and duration yet to be confirmed. The Proposal is being partly funded by Building Better Regions Fund, reducing the cost impost on local rate-payers, and it is also expected that any out of town workers will provide income to local cafes, businesses and accommodation providers during their stay.

No residences/residents will be directly impacted by construction of the RWSL, due to the relative isolation of the site, being surrounded by agriculture and paddocks. A man-proof fence will surround the lagoon, preventing access by the public for safety and water quality reasons. The existing bike/walkway path will be closed where it traverses the study area and diverted around the perimeter of the site. This closure and diversion are expected to be a temporary arrangement.

Employment of local sub-contractors to undertake works, and adequate consultation and discussion with local communities could have positive socio-economic impacts during the construction phase.

Further detail of predicted socio-economic impacts arising from Traffic and Transport (Section 4.8), Noise and Vibration (Section 4.3), Waste and Resource Use (Section 4.10) and impacts to Visual Amenity (Section 4.11) are discussed in other chapters of this report.

4.9.3 Potential socio-economic impacts – Operation

The operation of the RWSL, as part of the overarching Parkes Town Water Security Program is anticipated to provide positive socio-economic impacts during its operation as it provides the residents of Parkes with an upgraded water infrastructure that allows for greater operational flexibility.

The operational RWLS will be fenced with a permanent, man-proof fence to ensure the public cannot access it for safety and water quality reasons, reducing the risk of drowning or pollution of the water within the lagoon.

Table 14 Socio-economic impacts summary (adapted from Div.1, 2.13 TISEPP 'Consultation Requirements')

Description	Y	N	Comments
Are the proposed works likely to impact on local business, require any property acquisition, or alter any access or parking arrangements for properties (either temporarily or permanently)?		X	The works are relatively isolated and would result in only minor, short term impacts to local residents and businesses. The subject site is entirely within Council-owned land, and no private property acquisition is required. Local businesses and residences would benefit from the increased water security the RWSL will provide, as well as the temporary economic boost of patrons at local accommodation and food outlets
Is the development adjacent to land reserved under the National Parks and Wildlife Act 1974 or to land acquired under Part 1 of that Act (if so, consultation is required with the Office of Environment and Heritage)		X	Proposal is not adjacent to any land managed by National Parks.
Is the development on land in Zone C1 National Parks and Nature Reserves or in a land use zone that is equivalent to that zone, other than land reserved under the (if so, consultation is required with National Parks and Wildlife Act 1974 the Office of Environment and Heritage)		X	Proposal is not being completed on any land zoned C1.
Does the development comprise a fixed or floating structure in or over navigable waters (if so, consultation will be required with Transport for NSW)		X	Proposal does not involve any fixed or floating structures in or over navigable waters.
Is the development located on defence communications facility buffer land within the meaning of clause 5.15 of the Standard Instrument (if so, consultation is required with the Secretary of the Commonwealth Department of Defence, **Note—** **Defence communications facility buffer land is located around the defence communications facility near Morundah. See the Defence Communications Facility Buffer Map referred to**		X	Proposal is not being carried out on defence communications facility buffer land.

Description	Y	N	Comments
in clause 5.15 of Lockhart Local Environmental Plan 2012, Narrandera Local Environmental Plan 2013 and Urana Local Environmental Plan 2011			
Is the development on land in a mine subsidence district within the meaning of the Mine Subsidence Compensation Act 1961—(if so, consultation is required with the Mine Subsidence Board)		X	Proposal is not being carried out within a mapped mine subsidence district within the meaning of the *Mine Subsidence Compensation Act 1961*
Is the development within a Western City operational area specified in the Western Parkland City Authority Act 2018, Schedule 2 with a capital investment value of $30 million or more — (if so, consultation is required with the Western Parkland City Authority constituted under that Act)		X	Proposal is not being carried out within the Western City operational area.

4.9.4 Environmental safeguards – Socio-Economic Impacts

The Environmental Safeguards for Socio-Economic impacts are considered part of the Proposal and must be implemented. Safeguards include:

Construction

- Considerate construction practices are to be implemented at all times during works, including the construction site is to be left in a clean and tidy manner at the end of each workday, and noise, air quality and visual amenity impacts are to be kept to a minimum.
- All materials purchased for the Proposal are to be of highest quality and most sustainable as possible, to reduce impacts to community and ratepayers through replacement of low-quality or faulty equipment in the future.
- Quality assurance is to be applied to all aspects of the Proposal, including design and construction to ensure best value for the local community.
- Disruption of traffic/private property access is to be minimised wherever possible and clear communication and planning between construction crew and landowners is to be undertaken.
- Community engagement is to be undertaken to obtain feedback on concerns, and address issues as they arise.
- Construction machinery and work vehicles to be discretely parked when not in use to reduce visual impact and ensure safe pullover is available where possible.

Operation

- Reporting on the outcomes of the RWSL as part of overall increased water security for Parkes should be undertaken to ensure ratepayers and the wider community are kept informed of the water projects in the region.

Given the outlined environmental safeguards for Socio-economic impacts will be implemented and maintained, it is not anticipated that the Proposal would result in significant Socio-Economic impacts.

4.10 Waste and resource use

4.10.1 Existing environment

The subject site encompasses the existing WTP site, and includes a paddock with an existing farm dam, a small patch of native vegetation, and borders the WTP. Minimal anthropogenic disturbance in the form of discarded waste was observed on site and the area was generally considered to be tidy and free from rubbish and other wastes.

4.10.2 Potential waste and resource use – Construction

This Proposal is intended to proceed along with others within the Program. Each proposal is independent and may or may not proceed on its own merits, however there may be construction activities that occur in parallel, which could result in cumulative socio-economic impacts. Given that PSC are responsible for all associated proposals, the construction impacts of this Proposal will be scheduled to minimise any cumulative effects of the separate proposals in the Program proceeding at the same time.

Waste products generated by the construction phase of the project may include but are not limited to:

- Soil and spoil and, excess civil construction materials
- Excess civil construction materials
- Cleared vegetation
- Packaging, domestic and general waste
- Old pipes and concrete
- Fencing
- Chemical wastes.

During construction a small number of light vehicles and plant will be required to convey personnel to site and undertake the works (e.g., excavation, lifting/movement of equipment and materials). Where possible, local contractors will be engaged, and construction materials sourced from nearby fill and/or locally. Pollution and greenhouse gas (GHG) emissions from construction machinery/vehicles operating on site must also be reduced wherever possible to minimise cumulative impacts on climate and air quality.

Other than rock/fill materials and vegetative waste, most of the materials utilised in the works will be non-renewable, finite resources. Their use would diminish the availability of some resources for future use and contribute to pollution and greenhouse gas emissions through both direct use of fuels and the embodied energy used in their production, and in association with the disposal of related waste products. The use of fossil fuels would also contribute to impacts on climate and air quality.

Construction works would require the following resources:

- Concrete
- Steel pipe joints
- Water main / product pipe (material tbc)
- Select fill (where spoil is not suitable for reuse)
- Water (potable, raw and reclaimed effluent where appropriate / if available)

Any additional material that may be required would be sourced from legally operating commercial suppliers and manufacturers within the area and surrounding towns. Where feasible, material with recycled content will be prioritised and sourced.

Energy consumption associated with the proposed works would include electricity and gas/petroleum based fossil fuels. Electricity would be required to power site compounds and would be supplied from a portable generator. Fuel would also be required to power construction plant and other vehicles.

Any construction wastes/ contaminated materials will need to be handled carefully so as not to impact upon any sensitive environmental areas within the study area, and to ensure Council undertakes its responsibilities as environmental custodians, and to care for the health and safety of their employees, contractors and constituents. All wastes will be managed in accordance with the POEO Act and in accordance with EPA and Council guidelines.

In order to achieve higher levels of landfill diversion, it is critical to identify what materials can be recycled and where, so that appropriate arrangements can be made with service providers – other construction wastes may need to be transported farther afield to be recycled and avoid landfill. Regional collaboration amongst Council waste authorities and other industry partners may be required in order to maximise recycling and resource recovery efforts for the Proposal.

4.10.3 Potential waste and resource use – Operation

Wastes associated with maintenance and running equipment with the lagoon will be generated throughout the operational stages and are likely to include sediment within the lagoon and broken equipment items that will require maintenance/replacement.

Table 15 Waste Impacts summary

Description	Y	N	Comments
Are the proposed works likely to generate >200 tonnes of waste material (contaminated and /or non-contaminated material)?		X	No; most excavated material is anticipated to be reused in building the lagoon wall and backfilling the trenches after pipe installation has been completed. Some unsuitable soil will be left.
Are the proposed works likely to require a Licence from NSW EPA for waste?		X	No; the works do not and will not require significant ongoing discharges of waste to the environment.
Will the ongoing operation of the site post completion of works generate significant amount of waste?		X	Significant quantities of waste are not expected, unless the infrastructure is replaced in future.

4.10.4 Environmental safeguards – Waste and Resource Use

The Environmental Safeguards for Waste and Resource Use are considered part of the Proposal and must be implemented. Safeguards include:

- Resource management hierarchy principles are to be followed; namely, the avoidance, reduction, reuse and recycling of resources.
- If stockpile or laydown sites are required in locations that have not been considered as occurring within the impact footprint as part of this REF, additional approval/assessment may need to be sought prior to any clearing taking place.

- Requirements under the Landcom (2004) stockpile management procedure must be observed, including correct placement of earth banks (with sedimentation ponds) to divert water around stockpiles if placed on a slope, and/or filter fences erected below stockpiles to capture any sediment moving offsite.
- Bulk project waste (e.g. clean virgin excavated natural material or clean fill) sent to a site not owned by Council (excluding DPE licensed landfills) for land disposal is to have prior formal written approval from the landowner.
- Waste is not to be burnt on site and all general waste will be contained and disposed of at suitable waste facilities.
- Where possible, materials with recycled content will be sourced, and minimum quantities ordered to reduce wastage.
- If contamination is encountered during construction, a site assessment must be undertaken in accordance with the *Protection of the Environment Operations Act 1997* (POEO Act).
- Toilets will be provided for construction workers for the duration of the works to prevent human wastes entering the waterway.
- Waste management for construction projects should be undertaken in accordance with the NSW *Waste Avoidance and Resource Recovery Act 2001*. The objectives of the Act are:
    - To encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of Ecologically Sustainable Development (ESD),
    - To ensure that resource management options are considered against a hierarchy of the following order: Avoidance of unnecessary resource consumption, Resource recovery (including reuse, reprocessing, recycling and energy recovery), Disposal.
    - To provide for the continual reduction in waste generation,
    - To minimise the consumption of natural resources and the final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste,
    - To ensure that industry shares with the community the responsibility for reducing and dealing with waste,
    - To ensure the efficient funding of waste and resource management planning, programs and service delivery,
    - To achieve integrated waste and resource management planning, programs and service delivery on a State-wide basis,
    - To assist in the achievement of the objectives of the Protection of the Environment Operations Act 1997.
- Don't over-order – ensure quantities are carefully calculated and ordered so as to minimise waste. Where construction materials are leftover, these are to be beneficially used on other projects, or stored by Council until such a need arises.

Given the outlined environmental safeguards for Waste and Resource Use will be implemented and maintained, it is not anticipated that the Proposal would result in significant impacts to Waste and Resource Use.

4.11 Visual amenity

4.11.1 Existing environment

The study area is located in a rural area predominantly within cleared paddocks and some remnant vegetation. The area is not densely populated and located far enough out of town to limit interference with the public. The general amenity along Webb Street is pleasant with minimal litter and tidy properties.

Plate 7 Visual landscape at the existing farm dam location

Plate 8 Aerial view of existing WTP (photo credit C Uhrig)

4.11.2 Potential impacts to visual amenity - Construction

The Proposal is intended to proceed along with others within the Program. Each proposal is independent and may or may not proceed on its own merits, however there may be construction activities that occur in parallel, which could result in cumulative impacts to visual amenity. Given that PSC are responsible for all associated

proposals, the construction impacts of this Proposal will be scheduled to minimise any cumulative effects of the separate proposals in the Program proceeding at the same time.

During construction, the proposed works would affect the immediate visual environment by the presence of machinery, construction vehicles and equipment. The machinery and scale of works required for the RWSL construction are significant, however, are likely to impact on intermittent recreational users of the bike/walking path only, with no other nearby sensitive receivers present. Therefore, impacts on visual amenity are considered low.

4.11.3 Potential impacts to visual amenity – Operation

The lagoon site is situated behind the existing Parkes WTP and would not be visible from the road. The lagoon will be a large feature in the landscape, however due to its location and surroundings will not impose on the visual amenity of the broader area.

Table 16 Visual Amenity impacts summary table (adapted from Div (2.13) TISEPP 'Consultation Requirements')

Description	Y	N	Comments
Are the proposed works likely to have an impact on the visual amenity of the surrounding area? (i.e., removal of vegetation, stockpile sites, road widening etc.)	X		Due to the large scale of the project, there will be changes to the visual amenity of the site, however these are expected to impact on intermittent recreational users of the bike/walking path only, and are not expected to significantly impact on nearby residents.
Will the development increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (note – the Dark Sky Region is land within 200 km of the Siding Spring Observatory.		X	Proposal will not increase the amount of artificial light in the sky. No floodlights or installation of lighting included in the Proposal.

4.11.4 Environmental safeguards – Visual Amenity

The Environmental Safeguards for Visual Amenity impacts are considered part of the Proposal and must be implemented. Safeguards include:

- Considerate construction practices are to be implemented at all times, to ensure the works areas are neat and visually not offensive, including to be kept free from rubbish, and stockpile sites actively managed.
- No additional, unauthorised clearing or destruction of vegetation is to occur.
- Vehicles are to be parked in designated areas only.
- Cleared, bare patches of ground that form part of the works are to be revegetated and restored following cessation of works.
- Obvious and intrusive signs/machinery/equipment are to be removed from the site at the first opportunity.
- Appropriate consultation will continue to be undertaken to inform businesses and residents of planned works, timing, and potential visual impacts.

- Any complaints received regarding visual amenity at the site are to be dealt with and rectified as soon as possible.

Operation

- Man-proof fencing, access roads, spillways and drainage channels are to be maintained to ensure weeds do not overtake them, access is neat and tidy, and functionality of the lagoon and ancillary features is not compromised over time.
- Cleared, bare patches that form part of the works are to be revegetated and restored following cessation of works.
- Obvious and intrusive signs/machinery/equipment are to be removed from the site at the first opportunity.
- Any complaints received regarding visual amenity at the site are to be dealt with and rectified as soon as possible.
- Any impacts to property entrances, driveways or fencing are to be rectified in collaboration with the landholder/s as soon as possible, post completion of works in the vicinity.

Given the outlined environmental safeguards for Visual Amenity will be implemented and maintained, it is not anticipated that the Proposal would result in significant impacts to Visual Amenity.

4.12 Climate Change

Given projected changes to climate across the globe, and the potential impacts for construction and operation of activities that this potentially poses, consideration has been given to the existing climactic conditions of the Proposal location. This has been completed to enable a comparison of current conditions against projected future conditions under various emissions scenarios.

4.12.1 Existing environment

Long-term meteorological data for the surrounding area is available from the nearby Bureau of Meteorology (BoM) Parkes Airport weather station. The weather station is located approximately 8.5 km from the subject site and records observations of several meteorological data including temperature, humidity and rainfall, wind speed and wind direction.

Long-term climate statistics for the area are presented in Table 18. The area has a mild climate with an average annual maximum temperature of 24.0 degrees Celsius. January is the hottest month, with a mean maximum temperature of 33.8 degrees Celsius and July is the coldest month, experiencing a mean maximum temperature of 14.4 degrees Celsius.

Rainfall is typically uniform across the seasons, with some variability experienced from year to year. January is recorded as the wettest month with an average rainfall of 63.3 mm falling, with April the driest month at 34.2 mm. The yearly average stands at 630.5 mm of rain.

Table 17 Long-term climate averages at the closest weather station (Parkes Airport 065068)

Observation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean observations													
Maximum Temperature (°C)	33.8	32.0	28.8	24.3	19.0	15.2	14.4	16.0	20.2	24.4	28.4	31.2	**24.0**
Rainfall (mm)	63.3	58.8	54.8	34.2	46.1	52.4	47.1	43.6	43.4	51.8	58.2	53.5	**630.5**

Climate Change predictions

The NSW Government Office of Environment and Heritage (OEH) AdaptNSW division 'Climate Change snapshot' for Central West and Orana, states that the region is projected to continue to warm during the near future (2020 – 2039) and far future (2060 – 2079), compared to recent years (1990 – 2009). There is very high confidence that the average temperatures will increase across seasons. Warming is projected to be on average about 0.7°C in the near future, increasing to about 2.1°C in the far future. The number of hot days is projected to increase, and the number of cold nights is projected to decrease.

Climate change projections are presented for emission scenarios that will impact the degree to which the climate is altered in the future; each of these is referred to as a 'representative concentration pathway' (RCP), and is representative of the concentration of global GHG emissions in the atmosphere under different emissions scenarios. For example, if GHG emissions are mitigated and reduced, the scenario is for 'low emissions' and is referred to as RCP 2.6; conversely, if little effort is made to reduce emissions and the current scenario is continued globally, a 'high emissions' concentration is referred to as RCP 8.5, indicating a high

concentration of GHG emissions in the atmosphere moving forward, with potentially devastating impacts by the year 2100.

Under a high emissions scenario (RCP8.5), NSW and the ACT can expect an average annual temperature increase of around 1.4 - 2.3 °C, whereas large and sustained reductions in global GHG emissions (RCP2.6) reduce projected warming to around 0.7 - 1.4 °C. Specifically for Parkes, under emissions scenario RCP 8.5 for the projected time period of 2090, an increase in temperature of 4.2 °C is expected, combined with a drop of -12 % for rainfall (Climate Change in Australia, Analogues Explorer, 2021).

Parkes and Forbes currently experience an average of 20–30 hot days each year; an additional 20 to 30 hot days are projected for these areas.

Parkes, Forbes and Cowra are predicted to experience an increase in rainfall across Summer, Autumn and Winter, and a decrease in Spring; rainfall changes are associated with changes in extremes, such as floods and droughts. The changes to water quality, potential for erosion and sediment migration, damage to infrastructure and localized flooding complications are associated with these sudden or extreme changes.

The subject site does not occur within a designated bushfire prone area (NSW Rural Fire Service, 2021) however with a harsher fire-weather climate predicted in the future (high confidence), an additional 20 ML raw water supply in the area will help to ensure the safety of the community and provide secure access to potable water.

4.12.2 Potential impacts to climate change – Construction

This Proposal is intended to proceed along with others within the Program. Each proposal is independent and may or may not proceed on its own merits, however there may be construction activities that occur in parallel, which could result in cumulative air quality impacts. Given that PSC are responsible for all associated proposals, the construction impacts of this Proposal will be scheduled to minimise any cumulative effects of the separate proposals in the Program proceeding at the same time.

Throughout the construction phase of the project there will be use of in-demand materials. Use of these materials diminishes the availability of some resources for future use and contributes to pollution and GHG emissions through both direct use of fuels and the embodied energy used in the production of construction materials, and in association with the disposal of related waste products. The use of fossil fuels would also contribute to impacts on climate and air quality.

While these impacts would be negligible on global or national scales, efficient resource use should be adopted as a general operating principle, including use of locally sourced materials and locally based construction crews to reduce ‘carbon miles’ and increase efficiencies.

4.12.3 Potential impacts to climate change – Operation

Minimal impacts arising from climate change are expected during use/operation of the RWSL through maintenance and running of associated infrastructure. However, there is potential for heavier rainfall and associated surface water runoff and localized flooding, under the extreme scenarios predicted for the region. This may result in additional pressure on the lagoon and associated infrastructure, increasing the potential for failure of the lagoon wall, or more minor impacts such as scour and erosion of the spillway, downstream or upstream channels, and increased load on downstream stormwater management structures.

Similarly, increased hot days and evaporation may result in reduced storage capacity of the lagoon and / or increased burden on WTP infrastructure through additional water usage by the town (residences and businesses) and the proposed developments to the west of Parkes associated with the SAP.

4.12.4 Environmental safeguards – Climate Change

The Environmental Safeguards for Climate Change impacts are considered part of the Proposal and must be implemented. Safeguards include:

Construction

- Resource management hierarchy principles are to be followed:
    - Avoid unnecessary resource consumption as a priority.
    - Avoidance is followed by resource recovery (including reuse of materials, reprocessing, recycling and energy recovery); and
    - Disposal is undertaken as a last resort (in accordance with the Waste Avoidance & Resource Recovery Act 2001).
- Council may elect to make a contribution to an accredited carbon offset program to offset greenhouse gas emissions.
- Quality assurance and life cycle of materials are to be considered when purchasing, to ensure the newly built infrastructure is resilient and structurally sound.
- Local resources are to be used wherever possible, to reduce waste and increase efficiencies and to encourage local economies with fewer 'carbon miles'.

Operation

- Infrastructure to be maintained using a combination of traditional and soft engineering, to ensure additional carbon sequestration from living stabilisation measures, i.e. native plantings to stabilise the lagoon embankment and surrounding areas.
- RWSL and associated infrastructure to be monitored for damage after extreme weather events, to help prevent major failures occurring which would result in costly replacement and risk to human health and safety and infrastructure resilience.

Given the outlined environmental safeguards for Climate Change will be implemented and maintained, it is not anticipated that the Proposal would result in significant impacts to Climate Change

5 Summary of Environmental Safeguards

A summary of Environmental Safeguard for each environmental assessment chapter is provided in Table ##

Table 18 Summary of environmental safeguards

Environmental Section	Category	Mitigation measures	Responsibility and timing

Soils and Erosion	Construction	• No vegetation outside the approved direct impact footprint is to be impacted or removed; vegetation that is not approved for clearance is to be protected to ensure soils are not exposed unnecessarily.
		• Minimise the length of time that soils are exposed by stabilising as soon as practical by seeding, spreading mulch or installing erosion control blanket as appropriate.
		• All areas where groundcovers/vegetation are required to be removed will require careful management during construction due to the higher erosion risks, including:
		  ○ Erosion and sediment (ERSED) control measures are to be implemented and maintained to:
		  ▪ prevent sediment moving off-site and sediment laden water entering any drainage lines, drain inlets, or dams; and
		  ▪ reduce water velocity and capture sediment on site.
		  ○ ERSED controls are to be installed prior to the commencement of works and checked and maintained on a regular basis (including clearing of sediment from behind barriers).
		  ○ ERSED control measures are not to be removed until the works are complete, and areas are stabilised.
		• Monitoring and response actions with regard to ERSED controls will be incorporated within the Construction Environmental Management Plan (CEMP) for the Proposal, to be enforced by the appointed Contractor.
		• The maintenance of established stockpile sites during construction is to be in accordance with the Landcom/Department of Housing Managing Urban Stormwater, Soils and Construction Guidelines (the Blue Book) (Landcom 2004), including:
			Council and nominated contractor
			
			Pre-construction Construction

Environmental Section	Category	Mitigation measures	Responsibility and timing
		○ Stockpiles are recommended to be formed in accordance with the Blue Book Standard Drawing 4-1, and offsite/away from waterbodies. ○ Topsoil and subsoil are to be separated and protected from degradation, erosion or mixing with fill or waste. Materials are to be reused onsite where appropriate for infilling works, including re-spreading of topsoil as appropriate to enable rapid rehabilitation. Where onsite reuse cannot be accommodated, soil materials should be put to beneficial reuse elsewhere. • If contaminated soils are encountered during construction, a site assessment is to be completed in accordance with Schedule A 'Recommended general process for assessment of site contamination' (NEPM 1999). • If contaminated soils are encountered, they will be managed (and if necessary excavated, contained, treated and disposed of) in accordance with the law and relevant EPA and Council guidance. • All chemical usage and storage during construction is to be in line with legislated requirements, to prevent Pollution of Land, which is prohibited under Section 142 A of the POEO Act.	
	Operational	• Monitoring of the site is to be undertaken to ensure ERSED controls remain in place until the site is re-stabilised, and to ensure no sediment is washed into any waterways following construction and before revegetation efforts are completed. • Maintenance of vegetative cover on all exposed surfaces (not to be covered by road base/seal) to be undertaken to ensure the stability of soils on site into the future.	Council and nominated contractor Post-construction
Surface and Groundwater	General	• The inception drain(s) should be sized to capture all flows up to and including the AFC event (AEP 1 in 100 years). • Careful liner penetration detailing is required for the headwall, outlet pit, and any other liner penetrations to achieve a watertight connection and minimise the risk of leakage. • Buried pipe checks should be undertaken to determine the magnitude of any additional loading on the pipe from construction vehicles or the lagoon embankment if located within the zone of influence.	Council and nominated contractor Pre-construction Construction

Environmental Section	Category	Mitigation measures	Responsibility and timing

		• Embankment penetrations increase the risk of piping failure in the embankment. Free draining pipe bedding material and waterstops help reduce the risk of fine particle erosion and increase seepage path length to help reduce the risk of piping failure. Piping risks are not considered to be a potential cause of piping failure for an HDPE lined facility.
		• Works to be completed in dry times (i.e. times of no current or predicted rainfall) to reduce the risk of pollutants and sediments being washed into nearby waterways or other surface waters.
		• Appropriate erosion and sediment (ERSED) controls are to be installed and maintained during construction, to ensure sediment and pollutant laden surface water runoff does not enter adjacent waterways/drainage lines.
		• Water moving through the site during construction is to be managed appropriately so as to prevent sediment migration and subsequent pollution of waters:
		  ○ If 'dirty' site water is collected from within the direct impact footprint, it is to be redirected to filtration devices to trap sediments and other pollutants, and dissipate flow velocities, prior to discharging to the surrounding environment. Drainage and runoff should be controlled in such a way that no foreign substrates or materials leave the site.
		  ○ 'Clean' water from outside the study area is to be diverted around the site, to avoid contamination and to prevent scour/erosion of the site during rainfall events during construction.
		• All litter, including cigarette butts and food wrappers, is to be collected in a suitable receptacle and disposed of appropriately throughout the construction phase to ensure these do not end up polluting waters or aquatic environments.
		• Re-fuelling of plant and equipment is to occur offsite, or in impervious bunded areas located a minimum of 40 metres from drains, drainage lines or dams.
		• Vehicle wash-down and/or cement truck washout (if required) is to occur offsite unless it forms part of sediment control, where it is to occur in a suitably bunded area with controlled run-off.	

Environmental Section	Category	Mitigation measures	Responsibility and timing
		• Monitoring of water quality is to be undertaken within culverts/waterways downstream of the site during and immediately following rainfall events, to identify if ERSED controls are functioning as intended. Visual inspections should be undertaken by an appropriately qualified person/s to determine if water is turbid, or if there is evidence of petrochemicals or other pollutants present as a consequence of construction activities. • Segregate and stockpile topsoil removed from the area a minimum of 40 m from any waterway and on a flat, stable area. Use measures such as silt fences and holding ponds to prevent stockpile runoff from entering waterways. • Biosecurity and water health protection measures should be implemented throughout the construction phase, including: o Machinery should arrive on site in a clean, washed condition, free of fluid leaks, pests and/or weeds/spores; o Regular weed control should be undertaken in disturbed areas throughout the construction period to prevent weed spread into waterways, if notifiable/listed weed material is present; and o Ensure all pesticide/herbicides used are registered for use within a waterway, as per NSW DPI guidelines. Alternatively, opt to remove weeds mechanically where possible. • Spill response protocols for plant, equipment and chemicals used or stored on site during construction are to be available and accessible at all times to prevent and minimise potential for Pollution of Waters (s120 POEO Act). • A Soil and Water Management Plan (SWMP) will be developed as part of the CEMP for the Proposal, detailing: o Water quality parameters to be adhered to (e.g. turbidity) o Appropriate monitoring locations and frequency o Location and types of ERSED controls o Proposed revegetation and stabilisation measures to be undertaken.	

Environmental Section	Category	Mitigation measures	Responsibility and timing
	Operation	• Continue to undertake a water quality monitoring program in line with Council's requirements until all sites are completely stabilised; monitoring should include details of proposed baseline and downstream/lagoon quality following any heavy rainfall. • Subject site rehabilitation, including removal of weeds and revegetation using appropriate native species, is to be undertaken to ensure soil stability and prevention of sediment runoff from the site into the future. Revegetation must be maintained with a survival rate of >80%, as detailed in the CEMP. • Fauna (mainly bird) access to the lagoon is to be outlined in following stages and plans surrounding fauna management created (i.e. cover on lagoon or not).	Council and nominated contractor Post-construction
Noise and vibration	Construction	• Noise emissions should be considered in terms of the Interim Construction Noise Guideline (ICNG) (Department of Energy and Climate Change (DECC) 2009). • Noise impacts to the local community will be limited to recommended standard working hours as detailed in the Interim Construction Noise Guideline 2009 (ICNG). All activities and Proposal works, including the arrival and departure of vehicles delivering or removing materials to or from the site, shall be carried out between the hours of: o 7:00am to 6:00pm Monday to Friday, o 8:00am to 1:00pm Saturdays, and o No work on Sundays and Public Holidays • Communication of intentions and timeframes to sensitive receivers will be undertaken in order to minimise misconceptions, uncertainty and negative reactions to noise. The site supervisor should supply a contact number to aid in community liaison. • All noise and vibration complaints are to be handled in a timely manner in accordance with requirements under the POEO Act. • The appointed contractor will incorporate Noise and Vibration Management strategies in the CEMP, and suitably induct all staff operating machinery on the site to ensure the standard working hours are adhered to, and that machinery movement (revving, reverse beepers) is kept to a minimum. This management plan must include the general noise and vibration management practices (AS 2436-2010).	Council and nominated contractor Pre-construction Construction

Environmental Section	Category	Mitigation measures	Responsibility and timing
		• Plant deliveries and site access will occur quietly and efficiently, with parking allowed only within designated areas located away from nearby sensitive receivers. • Simultaneous operation of high-level noise generating machinery should be avoided by operating at contrasting times or increasing the distance between the plant and the nearest identified receiver. • High noise generating activities, should be carried out in continuous blocks, not exceeding three (3) hours with a minimum respite period between blocks of one (1) hour. • Low-pitch tonal beepers should be installed where possible and reversing minimised on site. • All engine covers are to be closed and machines that are not in use, shut down. • Where possible, high noise generating activities such as loading and unloading and material dumps should be located as far as possible from the nearest receptors. • Works should be timed to avoid prime breeding season (Spring) for the majority of native species residing in the area, and excessive noise and vibration can impact upon native species breeding habits and life cycles.	
	Operation	• No further Safeguards were considered necessary for the operation phase of the Proposal. Operation of the RWSL is not likely to result in any significant ongoing noise impacts beyond general maintenance and repair works.	
Air quality	General	• Council must undertake community engagement and liaison, to set expectations for the works schedule and likely impacts arising as part of the works, particularly prior to works commencing. • Daily visual construction dust monitoring should occur, with works to cease if dust plumes are occurring that have potential to impact areas outside the direct impact footprint. • Speed limits of 40 km / hr or slower are to be enforced on access tracks and across the site during dry weather to keep dust to a minimum.	Council and nominated contractor Pre-construction Construction

Environmental Section	Category	Mitigation measures	Responsibility and timing
		• An adequate water supply is to be provided on the construction site for effective dust/particulate matter suppression/mitigation. If synthetic dust suppressants are used, they must be biodegradable in nature and non-toxic for waterways. • Earthworks and exposed areas/soil stockpiles are to be revegetated using appropriate native species to stabilise surfaces as soon as practicable to reduce risk of dust emissions from wind erosion. • Only vegetation that has been approved for removal may be removed or otherwise impacted; intact vegetation stabilises soils and keeps dust to a minimum. • Vegetation and other materials are not to be burnt on site, unless the vegetation material is a weed that prohibits transportation and disposal by other means. • Vehicles transporting waste or other materials that may produce odours or dust are to be covered during transit. • Tracking of machinery carrying soil/spoil through nearby townships is to be avoided where possible. • Stockpiles or areas that may generate dust are to be managed to suppress dust emissions. • Dampening of exposed soils will be undertaken during weather conditions conducive to visible dust formation. • Construction plant and equipment will be maintained in a good working condition in order to limit impacts on air quality through vehicle emissions. • Fuel operated plant and equipment will not be left idle when not in use. • Regular site inspections will be undertaken as part of air quality monitoring, and inspection results recorded by Council's Principal Contractor. • Any dust complaints received during construction will be duly investigated in accordance with Council's requirements under the POEO Act.	

Environmental Section	Category	Mitigation measures	Responsibility and timing
		• Any exceptional incidents that cause dust and/or air emissions, either on or off site, will be recorded, and the action taken to resolve the situation recorded in the site management logbook.	
	Operational	• Any exposed areas revegetated during construction are to be monitored and maintained until the areas are fully stabilised to reduce risk of erosion and dust emissions, as well as dust settling on nearby native vegetation and waterbodies.	Council and nominated contractor Post-construction
Non-aboriginal heritage	General	• The proposed works must be contained to the area assessed during the construction. If the proposed location is amended, further archaeological assessment may be necessary to determine if the proposed works will impact any items of historical significance. • If archaeological remains or items defined as relics under the NSW Heritage Act 1977 are uncovered during the works, all works must cease in the vicinity of the material/find and Council's Manager Strategic Planning and Environmental Officer are to be contacted immediately. • Council's workers and all staff must be made aware of any heritage sites and places that occur within the area and all care must be taken to avoid interference with and damage to these sites. • Any newly discovered heritage sites must be clearly fenced/flagged with removable flagging or other temporary means to delineate their presence and in order to prevent them being harmed during the construction process.	Council and nominated contractor Pre-construction Construction
Aboriginal Heritage	Construction	• All land ground disturbance activities must be confined to within the subject site as this will eliminate the risk of harm to Aboriginal objects in adjacent landforms. Should the parameters of the Proposal extend beyond the assessed areas, then further archaeological assessment is required. • All staff and contractors involved in the proposed work should be made aware of the legislative protection requirements for all Aboriginal sites and objects.	Council and nominated contractor Pre-construction Construction

Environmental Section	Category	Mitigation measures	Responsibility and timing
		• All staff and visitors should be inducted to site to ensure they are aware of the possible presence of sensitive Aboriginal heritage items located within the vicinity of the work site, and the protective measures that should remain in place throughout the works. • Should unanticipated archaeological material be encountered during site works, all work must cease and an archaeologist contacted to make an assessment of the find. Further archaeological assessment and Aboriginal community consultation may be required prior to the recommencement of works. Any objects confirmed to be Aboriginal in origin must be reported to Heritage NSW • If during works Aboriginal artefacts or skeletal material are noted, all work should cease and the procedures in the Unanticipated Finds Protocol (Appendix 2 of the ADD) should be followed. • If any human remains are found, all works should stop immediately, the site should be secured and NSW police contacted immediately. • The information in the ADD meets the requirements of the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales. It should be retained as shelf documentation for five (5) years as it may be used to support a defence against prosecution in the event of unanticipated harm to Aboriginal objects.	
Biodiversity	Timing of vegetation removal	• Where practicable, it is recommended to time the works outside of key breeding (fledging of active nests/roosts) and winter torpor (microbat) seasons (approximately June to January) for species likely to utilise the site to avoid nest abandonment, injury or death to native fauna.	Council and nominated contractor Pre-construction Construction
	Tree removal	• Clearly delineate vegetation to be removed/retained with the assistance of an ecologist, or similarly qualified professional, and induct all site personnel as to the approved extent of clearing. Ensure that no clearing of vegetation occurs outside of the marked boundary. • Where any trees or riparian vegetation requiring removal contain hollows, nests or other signs of occupation, a staged clearing approach must be undertaken where hollow limbs or nests are removed carefully and incrementally by a qualified tree surgeon/arborist, or	Council and nominated contractor Pre-construction Construction

Environmental Section	Category	Mitigation measures	Responsibility and timing
		qualified fauna spotter / catcher. Care should be taken to inspect limbs / nests for fauna prior to their removal. • Prior to clearing, a preclearance survey should be undertaken including inspection of hollows and the farm dam to confirm occupation by fauna. Care should be taken to identify nests and/or roosting sites. If fauna habitat is present Council or Council's appointed contractor must contact the project ecologist for further advice prior to clearing. • Ensure the presence of an ecologist or fauna spotter catcher at all times during pre-clearing and clearing activities to remove and relocate wildlife as necessary, and to attend to any wildlife that are injured as a result of works. • Felled trees must be placed strategically and in proximity to the work site, either within the regenerating vegetation to the west, upslope of the proposed lagoon in eroded areas, or along Golden Bar Hill to the east, to provide refuge and potential habitat in the understorey whilst ensuring no further damage to surrounding vegetation. Placement of logs and felled trees will also aid in the regeneration of the area. • Where additional vegetation removal is proposed beyond that which is described within this report, this must first be assessed to consider the cumulative impacts against the approved clearance footprint, and if appropriate supervised by a qualified ecologist and Council's Environmental Officer.	
	Vegetation Protection	• Clearly delineate vegetation to be removed/retained with the assistance of an ecologist, or similarly qualified professional, and induct all site personnel as to the approved extent of clearing. Ensure that no clearing of vegetation occurs outside of the marked boundary. • The presence of a suitably qualified arborist is recommended during earthworks occurring near retained trees to avoid rootzones impacts. • Trees existing along gullies or eroded areas should be retained and protected, to ensure future erosion potential is minimised.	Council and nominated contractor Construction Post-construction
	Rehabilitation	• Revegetation activities will be undertaken using native species sourced from local seed wherever possible. Areas to be re-seeded/planted may be marked in the project CEMP or	Council and nominated contractor

Environmental Section	Category	Mitigation measures	Responsibility and timing
		Environmental Control Plan (ECP) as a record of rehabilitation efforts made. Vegetation cover should be returned to the site within a reasonably practicable timeframe post clearing to reduce soil exposure and loss. • Inclusion of emergent and fringing vegetation along the lagoon wall and slopes, where access is not required for maintenance, is recommended to provide long-term stability of the site as well as replace habitats lost through the construction phase.	Construction Post-construction
	General	• Vehicles and machinery to enter from the WTP not to extend beyond the direct impact footprint and to remain on allocated access roads. • Ensure vehicles and machinery are cleaned and checked for any traces of weeds, seeds and mud prior to entering work site. • All soils to be stockpiled at designated stockpile locations in a cleared area, within pre-approved zones. • Appropriate erosion and sediment migration reduction/control measures should be in place. • Heavy vehicles are not to be parked under tree drip lines/ leaf canopy to avoid compaction of soil, which is damaging to mature native trees and can cause dieback or tree mortality. • All machinery and vehicles are to be clean and inspected prior to arriving on-site to reduce the spread of weeds and disease (e.g. *Phytophthora cinnamomi*) to the site. • Strict hygiene protocols must be followed to ensure that no environmental weeds are spread around during works or are introduced to site as a result of the proposed works. If weeds are accidentally transported to site, or identified during construction activities, all weed material should be immediately contained and removed from site. Conversely, machinery should be carefully cleaned prior to leaving the site, to ensure weed material is not transported offsite to other areas. • Locate stockpile sites away from the proposed lagoon boundary, drainage lines and native vegetation. Ensure these are appropriately stabilized in accordance with the 'Blue Book' (Landcom 2004). • Declared weeds must be managed according to requirements under the *Biosecurity Act 2015*. It is recommended that all Weeds of National Significance should be managed prior to	Council and nominated contractor Construction

Environmental Section	Category	Mitigation measures	Responsibility and timing
		commencement of construction activities to ensure they do not spread, and where possible eradicated. • Due to the expected slope/steepness of the work site, fauna entrapment and drowning is a possible scenario throughout construction. Suitable fauna escape ladders/ ramps are to be installed overnight to allow any animals that fall into trenches/lagoon to escape. Additionally, any pits or trenches left open overnight should be checked each morning for fauna which may have become entrapped.	
	Operation	• Ongoing monitoring of planted vegetation will be undertaken to ensure adequate survival rates and to identify whether infill plantings should be undertaken.	Council
Traffic and Transport	Construction	• Prior notice shall be given to residents to notify of the works to be completed, their timing and duration. Notification can be provided by various means including letterbox distribution, local paper, and through the PSC website. All consultation and notification should occur with enough time before works to allow residents to modify their travel plans if desired (1 – 2 weeks prior to commencement). • Council's appointed contractor will consider the location of designated parking areas, stockpile locations, construction laydown sites, site offices, and access routes carefully in consideration of creating inconveniences to local residents, and to the other environmental constraints. Any areas additional to those outside the mapped and considered areas as discussed within this REF will need to be assessed for additional and cumulative impacts prior to being established as part of the Proposal. • A Traffic Control Plan (TCP) is to be developed in accordance with Australian Standards (AS 1742.3 – Traffic Control Devices for Works on Roads) and Roads and Maritime Traffic Control at Worksites manual to identify appropriate signage (and location) to advise motorist of upcoming changes in the road network. Any variation to the layout of the TCP on site is to be recorded and certified by accredited Roads and Maritime personnel. • All road signs and marking will be in accordance with the TfNSW Guide to Signs and Markings; Australian Standards AS1742 and AS1743; and the Australian Roads Guide to Traffic Management.	Council and nominated contractor Pre-construction Construction

Environmental Section	Category	Mitigation measures	Responsibility and timing
		• Traffic and transport complaints are to be monitored and addressed promptly where practicable. • A Section 138 Permit under the *Roads Act 1993* will be obtained prior to construction activities commencing if required.	
	Operation	• Access roads will be maintained to enable safe ingress and egress for maintenance vehicles and personnel as required during routine operation of the RWSL. • Access to the lagoon area for vehicles owned by the general public will be prevented for safety and water quality reasons, by way of bollards and / or locked gates.	Council Post-construction
Socio-economic	Construction	• Considerate construction practices are to be implemented at all times during works, including the construction site is to be left in a clean and tidy manner at the end of each workday, and noise, air quality and visual amenity impacts are to be kept to a minimum. • All materials purchased for the Proposal are to be of highest quality and most sustainable as possible, to reduce impacts to community and ratepayers through replacement of low-quality or faulty equipment in the future. • Quality assurance is to be applied to all aspects of the Proposal, including design and construction to ensure best value for the local community. • Disruption of traffic/private property access is to be minimised wherever possible and clear communication and planning between construction crew and landowners is to be undertaken. • Community engagement is to be undertaken to obtain feedback on concerns, and address issues as they arise. • Construction machinery and work vehicles to be discretely parked when not in use to reduce visual impact and ensure safe pullover is available where possible.	Council Prior to and throughout works
	Operation	• Reporting on the outcomes of the RWSL as part of overall increased water security for Parkes should be undertaken to ensure ratepayers and the wider community are kept informed of the water projects in the region.	Council Post-construction

Environmental Section	Category	Mitigation measures	Responsibility and timing

Waste and resources	Construction	• Resource management hierarchy principles are to be followed; namely, the avoidance, reduction, reuse and recycling of resources.
		• If stockpile or laydown sites are required in locations that have not been considered as occurring within the impact footprint as part of this REF, additional approval/assessment may need to be sought prior to any clearing taking place.
		• Requirements under the Landcom (2004) stockpile management procedure must be observed, including correct placement of earth banks (with sedimentation ponds) to divert water around stockpiles if placed on a slope, and/or filter fences erected below stockpiles to capture any sediment moving offsite.
		• Bulk project waste (e.g. clean virgin excavated natural material or clean fill) sent to a site not owned by Council (excluding DPE licensed landfills) for land disposal is to have prior formal written approval from the landowner.
		• Waste is not to be burnt on site and all general waste will be contained and disposed of at suitable waste facilities.
		• Where possible, materials with recycled content will be sourced, and minimum quantities ordered to reduce wastage.
		• If contamination is encountered during construction, a site assessment must be undertaken in accordance with the *Protection of the Environment Operations Act 1997* (POEO Act).
		• Toilets will be provided for construction workers for the duration of the works to prevent human wastes entering the waterway.
		• Waste management for construction projects should be undertaken in accordance with the NSW *Waste Avoidance and Resource Recovery Act 2001*. The objectives of the Act are:
		  ○ To encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of Ecologically Sustainable Development (ESD),
		  ○ To ensure that resource management options are considered against a hierarchy of the following order: Avoidance of unnecessary resource consumption, Resource recovery (including reuse, reprocessing, recycling and energy recovery), Disposal.
		  ○ To provide for the continual reduction in waste generation,
			Council and nominated contractor
			
			Pre-construction
			Construction

Environmental Section	Category	Mitigation measures	Responsibility and timing
		○ To minimise the consumption of natural resources and the final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste, ○ To ensure that industry shares with the community the responsibility for reducing and dealing with waste, ○ To ensure the efficient funding of waste and resource management planning, programs and service delivery, ○ To achieve integrated waste and resource management planning, programs and service delivery on a State-wide basis, ○ To assist in the achievement of the objectives of the Protection of the Environment Operations Act 1997. • Don't over-order – ensure quantities are carefully calculated and ordered so as to minimise waste. Where construction materials are leftover, these are to be beneficially used on other projects, or stored by Council until such a need arises.	
Visual amenity	Construction	• Considerate construction practices are to be implemented at all times, to ensure the works areas are neat and visually not offensive, including to be kept free from rubbish, and stockpile sites actively managed. • No additional, unauthorised clearing or destruction of vegetation is to occur. • Vehicles are to be parked in designated areas only. • Cleared, bare patches of ground that form part of the works are to be revegetated and restored following cessation of works. • Obvious and intrusive signs/machinery/equipment are to be removed from the site at the first opportunity. • Appropriate consultation will continue to be undertaken to inform businesses and residents of planned works, timing, and potential visual impacts. • Any complaints received regarding visual amenity at the site are to be dealt with and rectified as soon as possible.	Council and nominated contractor Pre-construction Construction

Environmental Section	Category	Mitigation measures	Responsibility and timing
	Operation	• Man-proof fencing, access roads, spillways and drainage channels are to be maintained to ensure weeds do not overtake them, access is neat and tidy, and functionality of the lagoon and ancillary features is not compromised over time. • Cleared, bare patches that form part of the works are to be revegetated and restored following cessation of works. • Obvious and intrusive signs/machinery/equipment are to be removed from the site at the first opportunity. • Any complaints received regarding visual amenity at the site are to be dealt with and rectified as soon as possible. • Any impacts to property entrances, driveways or fencing are to be rectified in collaboration with the landholder/s as soon as possible, post completion of works in the vicinity.	Council and nominated contractor Construction Post-construction
Climate Change	Construction	• Resource management hierarchy principles are to be followed: o Avoid unnecessary resource consumption as a priority. o Avoidance is followed by resource recovery (including reuse of materials, reprocessing, recycling and energy recovery); and o Disposal is undertaken as a last resort (in accordance with the Waste Avoidance & Resource Recovery Act 2001). • Council may elect to make a contribution to green power to offset greenhouse gas emissions. • Quality assurance and life cycle of materials are to be considered when purchasing, to ensure the newly built infrastructure is resilient and structurally sound. • Local resources, including local workforces, are to be used wherever possible, to reduce waste and increase efficiencies and to encourage local economies with fewer 'carbon miles'.	Council and nominated contractor Pre-construction Construction
	Operation	• Infrastructure to be maintained using a combination of traditional and soft engineering, to ensure additional carbon sequestration from living stabilisation measures, i.e. native plantings to stabilise the lagoon embankment and surrounding areas. • RWSL and associated infrastructure to be monitored for damage after extreme weather events, to help prevent major failures occurring which would result in costly replacement and risk to human health and safety and infrastructure resilience.	Council and nominated contractor Construction Post-construction

6 Consideration of State and Commonwealth Environmental Factors

This section considers the Proposal against key legislation and government policy. This section does not describe the legislation and policy in detail and guidance provided here does not constitute legal advice.

6.1 Matters of National Environmental Significance

Under the environmental assessment provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the following Matters of National Environmental Significance (MNES) are required to be considered to assist in determining whether the Proposal should be referred to the Australian Government Department of Climate Change, Energy, The Environment and Water (DCCEEW).

Table 19 Compliance with the EPBC Act

Factor	Impact
Any impact on a World Heritage property? **State whether the Proposal would impact on a World Heritage property.**	Nil
Any impact on a National Heritage place? **State whether or not the Proposal would impact on a National Heritage place.**	Nil
Any impact on a wetland of international importance?	Nil
Any impact on a listed threatened species or communities?	Yes. Not considered significant (see Appendix B
Any impacts on listed migratory species?	Unlikely, refer Appendix B
Any impact on a Commonwealth marine area?	Nil
Any impact on the Great Barrier Reef Marine Park?	Nil
Does the Proposal involve a nuclear action (including uranium mining)?	Nil
Additionally, any impact (direct or indirect) on Commonwealth land?	Nil

6.2 Compliance with the EP&A Regulation 2021 Checklist

The factors which need to be taken into account when considering all possible matters affecting or likely to affect the environment by reason of an activity are specified in the DPE Guidelines (which simply adopt the factors specified in clause 171(2) of the EP&A Regulation). Those factors have been taken into account when considering all matters affecting or likely to affect the environment by reason of the Proposal, and are summarised in Table 20.

Table 20 Summary of compliance with the EP&A Regulation 2021 checklist

Environmental Factor	Will there be an impact?	Comments
(a) Any environmental impact on a community?	Yes	Construction: diversion of recreational users on the path traversing the study area. Anticipated to be temporary. Operation: Positive outcomes for the community are anticipated, through upgraded water infrastructure.
(b) Any transformation of a locality?	Yes, minor	Construction: excavation and construction works for lagoon formation will cause localised impacts, not deemed significant. Operation: minimal transformation of small localised area for lagoon formation, not deemed significant.
(c) Any environmental impact on the ecosystems of a locality?	Yes, minor	Construction: minor impacts to flora and fauna and ecosystems at the site are expected. These are expected to be negligible if all the Environmental Safeguards are adhered to (Section 4.7.4). Operation: resumption of use of the sites as operational roads post completion of the construction phase is not expected to result in significant impacts to ecosystems in the locality, provided Environmental Safeguards are implemented.
(d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?	No	Construction: assuming all the Environmental Safeguards are adhered to, temporary reduction in aesthetic, scientific or other environmental quality of values of the locality are expected to be negligible. Operation: the use of the site is anticipated to be largely consistent with current conditions once operational, with a larger dam in place than the current arrangement.
(e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present generations?	No	Construction: The due diligence assessment concluded the proposed works will have an impact on the ground surface, however, assuming strict implementation of the safeguards outlined in this REF, no Aboriginal objects or intact archaeological deposits are likely to be harmed by the Proposal. If the construction methodology or assessment impact footprint (subject site) are amended, re-assessment of the potential impacts to Aboriginal heritage would be required (Section 4.5.4). Operation: no impacts on heritage items are considered likely as part of operation of the Proposal.

Environmental Factor	Will there be an impact?	Comments
(f) Any impact on habitat of any protected fauna (within the meaning of the National Parks and Wildlife Act 1974)?	Yes	Construction: potential for removal of some hollow bearing trees and foraging habitats; not deemed significant (Section 4.7). Operation: the use of the site is anticipated to be largely consistent with current conditions once operational.
(g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?	No	Construction: potential for impacts on flora and fauna through removal of habitat. Not deemed significant or likely to endanger any species. Operation: the use of the site is anticipated to be largely consistent with current conditions once operational.
(h) Any long-term effects on the environment?	No	Construction: removal of a small portion of habitat including shrubs, groundcovers and trees, however no long-term environmental effects anticipated from operation. Operation: the use of the site is anticipated to generate positive impacts for the environment once operational, through gravity fed, high quality raw water and operational flexibility / redundancy.
(i) Any degradation of the quality of the environment?	No	Construction: not expected. Operation: the use of the site is anticipated to be largely consistent with current conditions once operational in terms of quality.
(j) Any risk to the safety of the environment?	No	Construction: no risk to safety of the environment provided environmental safeguards are implemented. Operation: no risk to safety of the environment provided environmental safeguards are implemented.
(k) Any reduction in the range of beneficial uses of the environment?	Yes	Construction: The existing walking / bike path traversing the study area will be closed, which will impact on the range of beneficial uses of the area. Operation: The site will no longer be able to be used for agricultural stock watering purposes.
(l) Any pollution of the environment?	Yes, minor	Construction: potential for movement of sediment and other pollutants into waterways during construction works. Operation: potential for sediment to migrate into waterways due to removal of vegetation and loss of

Environmental Factor	Will there be an impact?	Comments
		ground stability, while controls establish. This is anticipated to be minor given the proposal design and Environmental Safeguards to be implemented.
(m) Any environmental problems associated with the disposal of waste?	No	Construction: not anticipated to generate large volumes of waste and so impact not deemed significant. Operation: not anticipated to generate waste and so impact not deemed significant.
(n) Any increased demands on resources, natural or otherwise which are, or are likely to become, in short supply?	Yes, minor	Construction: not anticipated to consume large volumes of finite resources and so impact not deemed significant. Operation: Use of river water from associated independent proposal, however, lagoon is only a mixing site, with no additional resources taken for this Proposal
(o) Any cumulative environmental effect with other existing or likely future activities?	Yes, minor	Construction: potential for cumulative impacts associated with other construction activities in the Program, with the Proposal anticipated to have localised, minor and short-term impacts on the environment assuming all Environmental Safeguards are implemented. Operation: site is anticipated to be largely consistent with current conditions once operational
(p) Any impact on coastal processes and coastal hazards, including those under proposed climate change conditions	No	Construction: not on the coast Operation: not on the coast
(q) Any applicable local strategic planning statement, regional strategic plan or district management plan made under Division 3.1 of the Act	Yes	PSC Community Strategic Plan: Parkes Shire 2035+. The CSP contains objective 3.41 – provide essential water and sewer infrastructure to meet the needs of our growing community.
(r) Any other relevant environmental factors	Minor; temporary	Construction: other factors considered include community and stakeholder consultation and property matters. Operation: no other factors have been considered other than those listed above.

7 Certification

This REF provides a true and fair review of the Proposal in relation to its likely effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the Proposal.

This report has been developed in accordance with the EP&A Regulation and the DPE Guidelines and demonstrates how the environmental factors specified in the DPE Guidelines (which simply adopt the factors specified in clause 171(2) of the EP&A Regulation) were taken into account when considering the likely impact of the Proposal.

The assessment has concluded that the proposed works as described in this REF, providing all proposed management measures and Safeguards are implemented, will not result in a significant impact on the environment. An Environmental Impact Statement (EIS) is not required.

The proposed works will not result in a significant impact on any declared critical habitat, threatened species, populations or ecological communities or their habitats. Therefore, a Species Impact Statement (SIS) is not required.

The proposed works are not being carried out on Commonwealth land, are unlikely to affect any Commonwealth land, or have any significant impact on any Matters of National Environmental Significance.

All proposed work contemplated as part of the Proposal will be completed under the guidance of a Construction Environmental Management Plan (CEMP) to manage and minimise potential environmental impacts, particularly ecological impacts, associated with the proposed work. Once operational, the Proposal is not expected to cause any significant environmental or community impacts.

I certify that I have reviewed and endorsed the contents of this REF document, and, to the best of my knowledge, it is in accordance with the EP&A Act, the EP&A Regulation and the DPE Guidelines approved under clause 170 of the EP&A Regulation, and the information it contains is neither false nor misleading.

Prepared by:	Reviewed and Endorsed for Certification by:
Name: Graham Stirling	Name: Emily Cotterill
Title: Project Manager and Environmental Consultant	Title: Director and Principal Consultant
Date: 17/01/2024	Date: 18/01/2024

Determiner declaration and approval

I have reviewed this REF and determine that the Proposal will not have a significant impact on the environment and can proceed subject to the controls outlined in this REF.

Name: Andrew Francis

Title: Director Infrastructure Sustainability

Date: 30 January 2024

8 References

BOM 2023 weather observations at Parkes Airport weather station

Climate Change in Australia, 2023; Climate Analogues https://www.climatechangeinaustralia.gov.au/en/projections-tools/climate-analogues/analogues-explorer/

DAWE 2023 Species Profile and Threats Databases

DAWE 2023 Protected Matters Search Tool for MNES listed under the EPBC Act. http://www.environment.gov.au/epbc/protected-matters-search-tool

DPI 2023 Priority Weeds of the Central West NSW WeedWise

DPI 2023 Weeds of National Significance NSW WeedWise

DPIE 2023 Areas of Outstanding Biodiversity register Area of Outstanding Biodiversity Value register | NSW Environment, Energy and Science

DPIE 2023 Biodiversity Values Map https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap

DPIE 2023 Key threatening processes http://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/about-threatened-species/key-threatening-processes accessed Feb 2021

DPIE 2023 SEPP Koala Habitat Protection 2020 Koala Habitat Protection SEPP - (nsw.gov.au)

DPIE 2023 NSW Government Vegetation Regulatory Map https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=NVRMap

DPIE 2023 Bionet Wildlife Atlas Threatened species records, which holds data from a number of custodians.

GHD 2021 Parkes Shire Council Eugowra Road to Parkes Water Upgrade WTP Storage Dam

Maddocks, 2021, Email letter regarding Water supply works approval requirement – WTP Raw Water Supply Reservoir.

New South Wales Flora online – PlantNET 2021 http://plantnet.rbgsyd.nsw.gov.au/floraonline.html

NSW LPI mapping https://maps.six.nsw.gov.au/, accessed March 2021

NSW OEH 2020 'Central West and Orana Climate Change Snapshot', Adapt NSW

NSW Planning and Environment Department 2018, planning portal http://www.planning.nsw.gov.au/ accessed August 2023

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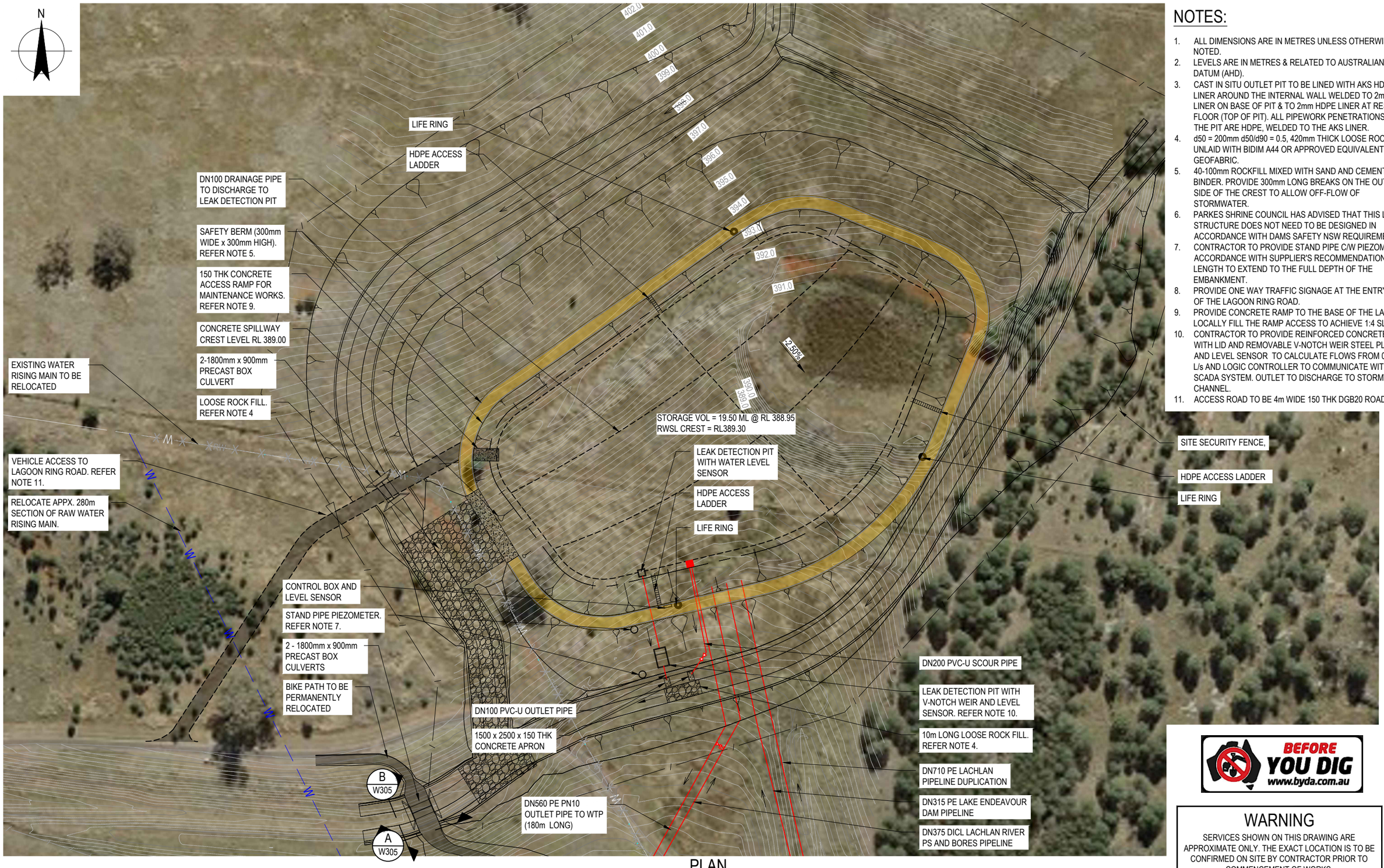
9 Appendices

Appendix	Description
Appendix A	Design Drawings
Appendix B	Flora and Fauna Assessment Report
Appendix C	Aboriginal Due Diligence Report
Appendix D	Geotechnical Investigation Report
Appendix E	Surface Water Management Report

Appendix A Design Drawings



NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. LEVELS ARE IN METRES & RELATED TO AUSTRALIAN HEIGHT DATUM (AHD).
3. CAST IN SITU OUTLET PIT TO BE LINED WITH AKS HDPE LINER AROUND THE INTERNAL WALL WELDED TO 2mm HDPE LINER ON BASE OF PIT & TO 2mm HDPE LINER AT RESERVOIR FLOOR (TOP OF PIT). ALL PIPEWORK PENETRATIONS INTO THE PIT ARE HDPE, WELDED TO THE AKS LINER.
4. d50 = 200mm d50/d90 = 0.5, 420mm THICK LOOSE ROCK UNLAID WITH BIDIM A44 OR APPROVED EQUIVALENT GEOFABRIC.
5. 40-100mm ROCKFILL MIXED WITH SAND AND CEMENT BINDER. PROVIDE 300mm LONG BREAKS ON THE OUTER SIDE OF THE CREST TO ALLOW OFF-FLOW OF STORMWATER.
6. PARKES SHRINE COUNCIL HAS ADVISED THAT THIS LAGOON STRUCTURE DOES NOT NEED TO BE DESIGNED IN ACCORDANCE WITH DAMS SAFETY NSW REQUIREMENTS.
7. CONTRACTOR TO PROVIDE STAND PIPE C/W PIEZOMETER IN ACCORDANCE WITH SUPPLIER'S RECOMMENDATIONS. BORE LENGTH TO EXTEND TO THE FULL DEPTH OF THE EMBANKMENT.
8. PROVIDE ONE WAY TRAFFIC SIGNAGE AT THE ENTRY POINT OF THE LAGOON RING ROAD.
9. PROVIDE CONCRETE RAMP TO THE BASE OF THE LAGOON. LOCALLY FILL THE RAMP ACCESS TO ACHIEVE 1:4 SLOPE.
10. CONTRACTOR TO PROVIDE REINFORCED CONCRETE PIT WITH LID AND REMOVABLE V-NOTCH WEIR STEEL PLATE AND LEVEL SENSOR TO CALCULATE FLOWS FROM 0.05 TO 5 L/s AND LOGIC CONTROLLER TO COMMUNICATE WITH SITE SCADA SYSTEM. OUTLET TO DISCHARGE TO STORMWATER CHANNEL.
11. ACCESS ROAD TO BE 4m WIDE 150 THK DGB20 ROAD BASE.

BEFORE YOU DIG www.byda.com.au

WARNING

SERVICES SHOWN ON THIS DRAWING ARE APPROXIMATE ONLY. THE EXACT LOCATION IS TO BE CONFIRMED ON SITE BY CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS.

PLAN

SCALE 1:1000

Rev	Description	Checked	Approved	Date
F	UPDATED ISSUE FOR TENDER	-	-	31.08.23
E	UPDATED ISSUE FOR TENDER	-	-	25.08.23
D	ISSUED FOR TENDER	-	-	08.08.23
C	DRAFT ISSUE	-	-	01.08.23
B	ISSUED FOR REVIEW	-	-	18.07.23
A	30% DETAILED DESIGN	-	-	07.10.22

Author J. REGLAMOS Drafting Check -
Designer L. CEDILLA Design Check -

0 10 20 30m
SCALE 1:1000 AT ORIGINAL SIZE

Parkes Shire Council
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Project No.

Client PARKES SHIRE COUNCIL

Project RAW WATER STORAGE LAGOON DETAIL DESIGN

Status PRELIMINARY Status Code

Drawing Title 20ML RWSL PLAN

Drawing No. 12589773-W300

Size A3

Rev F

Plot Date: 31 August 2023 - 2:47 PM Plotted by: Jeyzon Reglamos

File Name: C:\Users\jreglamos\ACCDocs\GHD Services Pty Ltd\12589773 - Lachlan Pipeline Duplication Detailed Design\01 WIP\01 WIP - Water\04 Drawings\12589773-W300.dwg

Appendix B Flora and Fauna Assessment Report

FLORA AND FAUNA ASSESSMENT

WTP Raw Water Supply Lagoon

FINAL September 2023

Prepared for:

PARKES SHIRE COUNCIL

WTP Raw Water Supply Lagoon – Flora and Fauna Assessment

Document Verification

Revision	Author/s	Review	Date submitted	Client Review and Approval	
				Name	Date
V_0.1	S Rivett, A Uhrig, J Sanderson	E Cotterill	9/04/2021		
V_0.2 Updated to include project title change and Section 60 approval consideration, and final design layout	K Farrel, J Sanderson	E Cotterill	12/09/2023	S Coates (PSC)	18/09/2023
V_1.0	G Stirling	E Cotterill	19/09/2023		

EnviroFact Pty Ltd, T/A The Environmental Factor
P.O. Box 268 Bathurst NSW 2795
ABN: 37 607 339 131
www.envirofact.com.au

This Report has been prepared by The Environmental Factor (TEF) on behalf of Parkes Shire Council (PSC or Council), to assess the ecological impacts arising from the proposal to construct a Raw Water Supply Lagoon (RWSL) to supply to their existing water treatment plant (WTP) as part of the Eugowra Road to Parkes Water Supply Upgrade Project in Parkes, NSW (the Proposal).

The purpose of this report is to document the biodiversity assets present on site, and to assess those that are likely to be impacted either directly or indirectly as a result of the Proposal, to support a Review of Environmental Factors (REF), Construction Environmental Management Plan (CEMP) and Environmental Control Plan (ECP) to be prepared for these works.

This document is not intended to be utilised or relied upon by any persons other than the Council and their appointed contractors nor to be used for any purpose other than that articulated above. TEF accepts no responsibility in any way whatsoever for the use of this report by any other persons or for any other purpose.

The information, statements, recommendations and commentary (together the "Information") contained in this report have been prepared by TEF on the basis of information provided by the Client and from material provided by the NSW department of Planning and the Environment (DPE) and the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) and through the survey process. This report has been developed in accordance with the NPWS Guidelines for Preparing a Review of Environmental Factors, developed by the DPE (2022). TEF has not sought any independent confirmation of the reliability, accuracy or completeness of this information. It should not be construed that TEF has carried out any form of audit of the information which has been relied upon.

Accordingly, whilst the statements made in this report are given in good faith, TEF accepts no responsibility for any errors in the information provided by the Client nor the effect of any such errors on the analysis undertaken, suggestions provided, or this report. Site conditions may change after the date of this report. TEF does not accept responsibility arising from, or in connection with, any change to the site conditions. TEF is also not responsible for updating this report if site conditions change.

Table of Contents

Tables, Figures and Plates

Abbreviations

Abbreviation	Description
APZ	Asset Protection Zone
AOBV	Areas of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Methodology
BC Act	*Biodiversity Conservation Act 2016*
BOS	Biodiversity Offset Scheme
CEMP	Construction Environmental Management Plan
DEE	Department of Environment and Energy
DPI	Department of Primary Industries
EEC	Endangered Ecological Community
EPWSUP	Eugowra Road to Parkes Water Supply Upgrade Project
EPA	Environmental Protection Agency
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
FFA	Flora and Fauna Assessment
FM Act	*Fisheries Management Act 1994*
HTE	High Threat Exotic
LEP	Local Environment Plan
MNES	Matters of National Environmental Significance
NSW	New South Wales
OEH	Office of Environment and Heritage
PAD	*Potential Archaeological Artefacts*
POEO Act	*Protection of the Environment Operations Act 1997*
PSC	Parkes Shire Council
TBC	To be confirmed
TEC	Threatened Ecological Community
TEF	The Environmental Factor
WoNS	Weed of National Significance
WTP	Water treatment plant

EXECUTIVE SUMMARY

The Environmental Factor (TEF) was commissioned by Parkes Shire Council (PSC or Council) to prepare a Flora and Fauna Assessment (FFA) to assess the ecological constraints and significance of the potential ecological impacts associated with the construction of a Raw Water Supply Lagoon (RWSL) to secure supply to the existing water treatment plant (WTP) (the Proposal), as part of the overarching Parkes Town Water Security Program (the Program) for the Parkes Shire, NSW.

Complementary to the proposed Lachlan Duplication Pipeline project, Council are looking to include a 20ML RWSL to be located on the existing WTP site. The proposed 20ML supply lagoon provides for more efficient water storage and supply and allows Council greater operational flexibility on how the proposed Special Activation Precinct (SAP) water supply will be issued depending on recipient use (i.e. direct from the storage lagoon or via treatment at the WTP). It also allows for the continued supply of raw water to the WTP in the event the new pipeline requires repairs or maintenance.

The study area is located within the locality of Parkes WTP off Webb Street, on the north-eastern outskirts of Parkes, NSW.

Ground-truthed vegetation mapped within the subject site is shown in Table 1 below.

Table 1 Summary of vegetation communities occurring within subject site

Vegetation type	Subject Site (ha)	Study Area (ha)
Mixed native and exotic grassland	7.26	11.42
PCTID 267 Remnant and regenerating White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	2.72	5.52
PCTID 267 Mixed planted and regenerating White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	1.62	2.86
PCTID 0 Non-native / Exotic vegetation	9.64	20.43
Total area impacted	**21.24**	**40.22**

The following ecological impacts area associated with the Proposal based on the current design:

- Direct impact to approximately **4.34 ha** of native vegetation, including removal of mature trees (note, this does not include the areas mapped as 'mixed native and exotic grassland').
- Indirect impacts to vegetation occurring within the study area through noise and activity disturbance which has the potential to lead to nest abandonment.
- Potential injury or mortality of small, terrestrial fauna within the Proposal footprint

Flora and fauna surveys, including habitat assessments and incidental flora and fauna recordings were completed during the site visit to identify important habitat components for any threatened species and ecological communities recorded, or that may occur, within the locality. Based on the desktop assessment, site visit, and habitat assessments undertaken, ten (10) threatened species and one (1) ecological community were considered as having a moderate – high likelihood of being impacted within the study area as a result of the proposal, including ten (10) species listed under the *Biodiversity*

Conservation Act 2016 (BC Act) and two (2) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), as follows:

- *Falco hypoleucos* (Grey Falcon) – Endangered under the BC Act, Vulnerable under the EPBC Act
- *Falco subniger* (Black Falcon) - Vulnerable under the BC Act
- *Circus assimilis* (Spotted Harrier) - Vulnerable under the BC Act
- *Hieaaetus morphnoides* (Little Eagle) - Vulnerable under the BC Act
- *Chthonicola sagittata* (Speckled Warbler) - Vulnerable under the BC Act
- *Climacteris picumnus* (Brown Treecreeper - eastern subspecies) - Vulnerable under the BC Act
- *Daphoenositta chrysopterus* (Varied Sittella) - Vulnerable under the BC Act
- *Stagonopleura guttata* (Diamond Firetail) - Vulnerable under the BC Act
- *Petroica phoenicea* (Flame Robin) – Vulnerable under the BC Act
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler) – Vulnerable under the BC Act
- White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland – Critically Endangered under the BC and EPBC Acts.

Tests of significance for the above species and TEC were prepared in accordance with Section 1.7 of the EP&A Act and the EPBC Act *Matters of National Environmental Significance – Significant Impact Criteria Guidelines* (DEWHA, 2009). These assessments have concluded that the Proposal is unlikely to have a significant negative effect on the threatened species with potential to occur within the impact footprint. Therefore, Species Impact Statements (SIS) and / or Referral to the Environment Minister is not required for this project.

Mitigation measures proposed for these works include ensuring vegetation clearing is restricted to pre-specified areas only, timing of clearing outside of key breeding times for species present, sediment and erosion control, stockpiling and earthworks in line with Blue Book requirements, and adherence to strict hygiene procedures.

1 INTRODUCTION

1.1 Overview

The Environmental Factor (TEF) was commissioned by Parkes Shire Council (PSC or Council) to prepare a Flora and Fauna Assessment (FFA) to assess the ecological constraints and significance of the potential ecological impacts associated with the construction of a Raw Water Supply Lagoon (RWSL) to secure supply to the existing water treatment plant (WTP) as part of the overarching Parkes Town Water Security Program (the Program) for the Parkes Shire, NSW (hereafter 'the Proposal').

This FFA has been prepared to assess the potential for impacts on ecological values, with particular emphasis on threatened ecological communities, populations and species listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The FFA has been undertaken in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation 2001* (EP&A Regulation). The Proposal is being determined within the framework of Division 5.1 of the of the Environmental EP&A Act via a separate Review of Environmental Factors (REF), which this report will support.

1.2 Terms and definitions

The terms described in Table 2 are used in this report, these can also be seen in Figure 1.

Table 2 Definitions

Term	Description
Subject site	The area to be directly affected by the Proposal, measuring **21.24 ha** in total.
Study area	Includes the subject site (as described above) and any proximal areas that could be potentially directly or indirectly impacted by the proposal. For the purposes of this report the study area has included a buffer of 50 m. Measuring a cumulative **40.22 ha** of which native vegetation equals **8.37 ha**.
Locality	The area within a 10-kilometre radius of the subject site.

1.3 Proposal description

As The proposed ~20 ML supply lagoon provides for more efficient water supply and drought security for drinking water, as well as allows Council greater operational flexibility on how the proposed SAP water supply will be issued depending on recipient use (i.e. direct from the supply lagoon or via treatment at the WTP). It also allows for the continued supply of raw water to the WTP in the event the new pipeline requires repairs or maintenance.

The lagoon would be located to the north of the WTP on Council-owned land and would store water pumped from the Lachlan River. Flow would then gravitate from the lagoon to the WTP inlet works. A supply lagoon (rather than direct supply) is proposed for the following reasons (GHD, 2021):

- To provide transfer system redundancy in the event of pump failure (for the pumps transferring from the Lachlan River) to act as a buffer between the incoming flowrates and

WTP requirements. This is useful in the following scenarios: WTP demand temporarily exceeds the Eugowra Road to Parkes system supply capacity.

- Pumping stations can operate intermittently on solar power to fill the lagoon while a continuous water supply to the WTP is provided by the lagoon.

The Proposal also includes development of a 'clean water' diversion drain, that will direct runoff from the above catchment safely around the outside of the proposed lagoon, to ensure the lagoon is not overfilled in times of high rainfall, and to help protect the quality of the raw water from potential contaminants, and to ensure structural stability of the area during both the construction and operational phases of project delivery. The drain is anticipated to be approximately 10 m wide, and rock lined to prevent erosion and dissipate flow velocities. It is expected that flows within the drain will be directed to a culvert to the immediate southwest of the lagoon, passing under an existing bike path in this location. From there, water will be directed into the existing swale drain which connects to stormwater management areas off Webb Street to the west of the WTP compound. Overflow from the lagoon is also expected to be directed this way, to avoid flooding of the downslope WTP compound. The following sections provide further detail on relevant aspects of the Proposal, including design development, options selection and proposed construction and operation activities as they apply to the proposed works. It is understood that the proposal will proceed as a DD&C contract, and that minor changes may be made to the design through this process.

1.4 Aims and scope of this report

The aims of this assessment are to:

- Identify the presence or likely presence of threatened species, populations and ecological communities and their habitats listed under the BC Act.
- Identify the potential for any Matters of National Environmental Significance (MNES) listed under the EPBC Act to occur within the Proposal footprint and/or to be indirectly impacted by the Proposal.
- Identify the potential impacts of the Proposal on threatened biota or migratory species and their habitats.
- Recommend mitigation and environmental management measures to avoid or minimise adverse impacts on threatened biota and biodiversity values, as appropriate, to facilitate the relevant planning approvals process.
- Assess the significance of impacts on threatened biota listed under the BC Act and identify the likely requirement or otherwise for further assessment and approvals under the EP&A Act.
- Assess the significance of impacts on MNES and identify the likely requirement or otherwise for further assessment and approvals under the EPBC Act.

The results of this assessment indicate whether the Proponent undertaking the development needs to complete a Species Impact Statement (SIS) for impacts to species or communities protected under NSW legislation, or a referral to the Minister for Environment (EPBC Act) for impacts to MNES, prior to determination of the Proposal through completion of the project Review of Environmental Factors (REF). The conclusions of this assessment are provided in Section 6 of this report.

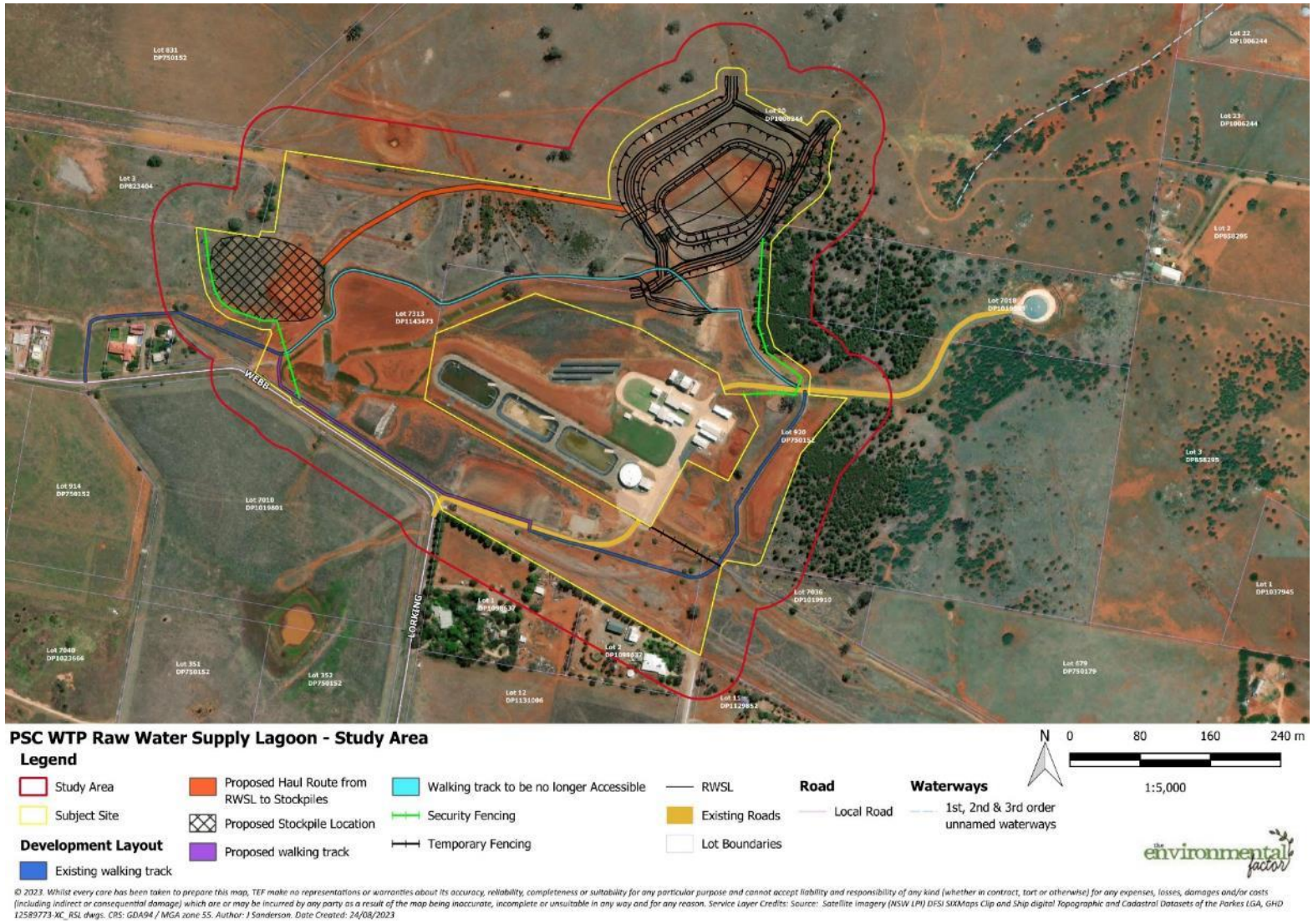


Figure 1 Subject site and study area

2 LEGISLATIVE CONTEXT

2.1 Commonwealth (Federal) Legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The purpose of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is to ensure that actions likely to cause a significant impact on 'matters of national environmental significance' undergo an assessment and approval process. Under the EPBC Act, an action includes a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things (DEWHA 2009). An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Government Minister for Sustainability, Environment, Water, Population and Communities (the 'Minister').

The EPBC Act identifies nine Matters of National Environmental Significance (MNES) as:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (Ramsar wetlands).
- Threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mining)
- A water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act has been addressed in the current assessment through:

- Desktop review to determine the MNES that are predicted to occur within the locality of the proposed scheme and hence could occur, subject to the habitats present.
- Targeted field surveys for threatened biota and migratory species listed under the Act.
- Identification of suitable impact mitigation and environmental management measures for threatened biota, where required.
- Assessment of potential impacts on MNES, if appropriate.

Potential impacts on relevant MNES must be subject to Tests of Significance pursuant to the EPBC Act Significant Impact Guidelines (DEWHA 2009). If a significant impact is considered likely, a referral under the EPBC Act must be submitted to the Commonwealth Minister for Environment.

Significant Impact Criteria Assessments (SICA) were completed for EPBC Act listed biota considered at risk of impact as part of the Proposal. These SICAs concluded that a significant impact is not likely for EPBC Act listed threatened biota (Appendix F).

2.2 NSW State Legislation

2.2.1 Biodiversity Conservation Act 2016 (BC Act)

The purpose of the *Biodiversity Conservation Act 2016* is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. In particular, the purpose of the BC Act (see Section 1.3 of the BC Act) includes:

- to conserve biological diversity at bioregional and State scales (including declared areas of outstanding biodiversity value (AOBV)),
- to assess the extinction risk of species and ecological communities,
- to identify key threatening processes,
- to slow the rate of biodiversity loss, and
- to conserve threatened species.

Section 7.2 and 7.8 of the BC Act states that the determining authority must consider whether the proposed activity:

- is to be carried out in a declared AOBV,
- exceeds the biodiversity offsets scheme threshold if the biodiversity offsets scheme applies to the impacts of the development on biodiversity values, and/or
- is likely to significantly affect threatened species, populations or ecological communities, or their habitats.

Section 7.3 of the BC Act sets out the tests for determining whether a proposed activity is, or is likely to significantly affect threatened species or ecological communities, or their habitats.

Implications for species and communities listed under the BC Act are addressed in Appendix E, and Section 5.

2.2.2 Biodiversity Conservation Regulation 2017 (BC Regulation)

The BC Regulation provides a number of considerations and practices to be implemented as part of the framework under the BC Act. For example, the BC Regulation:

- Establishes the Biodiversity Values Map that identifies land with high biodiversity value, as defined by clause 7.3(3) of the BC Regulation
- Identifies thresholds for the clearing of land mapped on the Biodiversity Values Map
- Identifies the threshold levels for when the Biodiversity Offsets Scheme (BOS) will be triggered,
- Outlines principles applicable to the determination of serious and irreversible impacts (SAII) to biodiversity values,
- Outlines rules that govern the types of offsets that can be used to meet an offset obligation under the BOS
- Biodiversity certification criteria.

Section 6.2(e) of the BC Act provides that the proponent of an activity that is assessed under Division 5.1, Part 5 of the EP&A Act can voluntarily opt out of the BOS. As above, the Proposal is being

assessed under Division 5.1 of the EP&A Act, and PSC is the proponent. PSC has elected to opt out of the BOS.

2.2.3 Environmental Planning and Assessment Act 1979 (EP&A Act) and Environmental Planning and Assessment Regulation (2021)

The *Environmental Planning and Assessment Act 1979* (EP&A Act) forms the legal and policy platform for the assessment and approval of works in NSW and aims to ensure that public authorities examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment.

All development in NSW is assessed in accordance with the provisions of the EP&A Act and the *Environmental Planning and Assessment Regulation 2021* (**EP&A Regulation**).

The Proposal is being assessed under Division 5.1 of the EP&A Act. In accordance with s 5.5 of the EP&A Act, an REF and supporting documents, including a FFA examines and takes into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the Proposal. In considering the likely impact of the Proposal on the environment, the REF and / or FFA must consider the environmental factors specified in the DPE Guidelines (which simply adopt the factors specified in clause 171(2) of the EP&A Regulation).

Section 5.1 of the EP&A Act defines 'determining authority' as follows:

'determining authority means a Minister or public authority and, in relation to any activity, means the Minister or public authority by or on whose behalf the activity is or is to be carried out or any Minister or public authority whose approval is required in order to enable the activity to be carried out.'

The EP&A Act's definition of 'public authority' (section 1.4) includes: *'(a) a public or local authority constituted by or under an Act'.*

For the purposes of the Proposal, Council is the determining authority in accordance with the EP&A Act.

The duties of the determining authority are set out in Division 5.1 of the EP&A Act. Section 5.5 requires that a determining authority *'…examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity.'*

Section 5.7 provides that a determining authority shall not approve or carry out an activity that is likely to significantly affect the environment, unless it has considered an environmental impact statement in respect of the activity.

In addition, if the Proposal was to be carried out on an area of outstanding biodiversity value (AOBV), or if the determining authority decides the Proposal would be likely to significantly affect a threatened species, population or ecological community or its habitat, then it must:

- obtain and consider a species impact statement; and
- obtain the concurrence of the Environment Agency Head;
  or
- obtain and consider a biodiversity development assessment report,

(section 7.8 and 7.12(3) BC Act).

As part of the consideration of impacts of a proposal on the environment under Division 5.1 of the EP&A Act, the significance of impacts on threatened species, populations and endangered ecological communities listed under the Biodiversity Conservation Act 2016 (BC Act) or Fisheries Management Act 1994 (FM Act) must be assessed as described below. Where a significant impact is likely to occur, a Species Impact Statement (SIS) must be prepared in accordance with the Secretary's Environmental Assessment Requirements, or a Biodiversity Development Assessment Report (BDAR) in accordance with the Biodiversity Offsets Scheme and Biodiversity Assessment Method

This FFA has been prepared to consider whether the Proposal would have a significant impact on the environment under Section 5.5 of the EP&A Act. Factors that need to be taken into account when considering the likely impact of an activity on the environment are outlined in clause 228 of the EP&A Regulation.

This FFA, together with the REF, has identified that the Proposal is not likely to significantly affect the environment; as such, Council will not need to obtain and consider an Environmental Impact Statement (EIS) before it carries out the project (s 5.7 of the EP&A Act).

Section 1.7 of the EP&A Act lists factors that must be considered in the determination of the significance of potential impacts of a proposed activity on threatened species, populations or ecological communities (or their habitats) listed under the BC Act and the FM Act. This Assessment of Significance is used to assist in the determination of whether a Proposal is 'likely' to impose 'a significant effect' on threatened biota and thus whether a Species Impact Statement (SIS) is required. Section 1.7 of the EP&A Act was addressed as part of the current assessment and tests of significance were completed for relevant threatened species and ecological communities that are likely to be affected by the Proposal. These assessments are included as Appendix E and Appendix F and conclude that a significant impact is unlikely.

2.2.4 Fisheries Management Act 1994 (FM Act)

The *Fisheries Management Act 1994* (FM Act) aims to conserve threatened species, populations and ecological communities of fish and marine vegetation native to NSW and to promote ecologically sustainable development, including the conservation of biological diversity. It also aims to reduce the threats faced by native fish and marine vegetation in NSW.

Section 220ZW of the FM Act provides the Secretary may grant a licence authorising a person to take action that is likely to result in one of the following:

a) harm to a threatened species, population or ecological community,
b) damage to a critical habitat,
c) damage to a habitat of a threatened species, population or ecological community.

Section 220ZZ of the FM Act states if the action proposed to be taken by the applicant is not on land that is critical habitat, and the application for a licence is not accompanied by a species impact statement, the Secretary must determine whether the action proposed is likely to significantly affect threatened species, populations or ecological communities, or their habitats.

For the purposes of Division 5.1 of Part 5 of the EP&A Act, if a significant impact on a threatened species, population or ecological community is likely, a species impact statement must be completed and consultation with the NSW Department of Primary Industries (Fishing and Aquaculture) is required (section 221ZX).

A permit under the FM Act is required for any work that involves:

- Activities involving dredging and reclamation work
- Activities temporarily or permanently obstructing fish passage
- Using explosives, electrical devices or other dangerous substances in a waterway
- Harming marine vegetation

Permits are required for works within a third order (or higher) streams (based on the Strahler system of stream order classification), and first and second order streams that are known or likely to be habitat for listed threatened species, populations or communities.

No explosives or electrical devices will be used as part of the Proposal and there are no mapped waterways or Key Fish Habitat (KFH) within the study area, (refer Figure 1). Therefore, a permit from DPI Fisheries **is not required**.

2.2.5 Local Government Act 1993 – Section 60

Ministerial approval is required for certain Council works and a Council must not, except in accordance with the approval of the Minister for Water, Property and Housing do any of the following:

- In relation to water treatment works – construct or extend any such works.
- As to sewage – provide for sewage from its area to be discharged, treated or supplied to any person.

Council would like the proposed RWSL installation has been granted approval to be included an extension of the existing WTP; as such, Council is requesting an amendment to the existing approval, to incorporate the lagoon.

The Section 60 approval provides an independent assessment of the proposed works to ensure they are fit for purpose and provide robust, safe, cost-effective and soundly based solutions that meet public health and environmental requirements; noting there is no water treatment proposed as part of the RWSL.

Each proposed water or sewage treatment works project or activity requires an options study, concept design report and detailed design to be submitted to the NSW Department of Industry (DoI) for review. The information provided must clearly define the proposed activity and detail how the environment will be protected.

Discussions with DPE have indicated that they consider the RWSL to fall under the Section 60 approval system; Council is progressing the necessary assessments and will obtain approval prior to commencement of construction activities should this be required for the Lagoon.

2.2.6 NSW Biosecurity Act 2015 (Biosecurity Act)

The *Biosecurity Act 2015* (NSW) (**Biosecurity Act**) outlines mandatory measures that persons are to take with respect to biosecurity matters including the management of weeds (Schedule 1 Biosecurity Act). Under the Biosecurity Act, the responsibilities for weed management by public and private landholders are consistent, reflecting that weed management is a shared community responsibility. The Biosecurity Act introduces the legally enforceable concept of a General Biosecurity Duty (GBD) (Part 3 of the Biosecurity Act). Priority weeds are listed within Regional Strategic Weed Management Plans, however the GBD is not restricted to listed weeds.

The Biosecurity Act is administered by NSW Department of Primary Industries (DPI) which determines the weed species covered by regulatory tools including Prohibited Matters, Control Orders and Biosecurity Zones. Existing Local Control Authorities (Councils) continue to be responsible for enforcing weed legislation.

Given the proximity of the Proposal to previously disturbed roadside vegetation, and agricultural land, it is anticipated that construction works as part of the Proposal have the potential to introduce and spread weed seeds/spores and water mould (e.g. *Phytophthora cinnamomi*). The preparation of a future CEMP will need include measures to ensure that the Proposal will adhere to both the Biosecurity Act and the requirements outlined in the Central West Regional Strategic Weed Management Plan 2023 – 2027 (Central West Local Land Services, 2022).

Priority weeds observed on site are outlined in Section 4.1.4

2.2.7 State Environmental Planning Policy (Biodiversity and Conservation) 2021

Chapter 3 of the *State Environmental Planning Policy* (Biodiversity and Conservation) 2021 applies to Koala habitat protection. This chapter of the Biodiversity and Conservation SEPP 2021 only applies to proposals under Part 4 'Development' of the EP&A Act. The Proposal is being assessed under Division 5.1 of the EP&A Act, therefore this chapter of the Biodiversity and Conservation SEPP does not apply to the Proposal and this has not been considered further in preparation of this FFA.

However, the Koala is listed as an Endangered species under the BC Act and EPBC Act, and thus also requires assessment under these Acts. Koala records occur within a 10 km radius of the study area. Minor occurrences of Schedule 2 feed trees (*Eucalyptus albens*), constituting less than 15 % of the upper or lower stratum of the site, occur on site. No Koalas, or signs of recent habitat use (e.g. scratchings or scats) were observed during the limited onsite survey. Consequently, the site is not considered to sufficiently meet the criteria of 'Potential Koala habitat' or 'Core Koala habitat' as defined under the SEPP.

Additionally, the Likelihood of Occurrence Assessment concluded that the risk of impact to this species as a result of the proposed works is Low, therefore a Test of Significance has not been completed for Koala.

2.2.8 Water Management Act 2000

The *Water Management Act 2000* (WM Act), administered by the Water division of NSW Department of Industry, Skills and Regional Development, aims to ensure that water resources are conserved and properly managed for sustainable use benefiting both present and future generations. It provides

formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for protection of catchment conditions.

Council is exempt from s 91E(1) under the WM Act for Proposals approved under Division 5.1 of the EP&A Act, in relation to all controlled activities that it carries out in, on or under waterfront land (cl 41 *Water Management (General) Regulation 2018*). While exempt, it is still recommended that Council be aware of the WM Act and adhere to the associated guidelines.

The study area contains no named or formed waterways, however the Proposal includes replacement of an existing farm dam with a 20 ML lagoon, and development of a clean water diversion drain. Consequently, consideration for preventing impacts to aquatic habitats and protecting water quality has been included in Section 5.1.3.

Upon review (Maddocks, 2021), it has been determined that the construction of the supply reservoir has the potential to require a water supply works approval under Part 3 of Chapter 3 of the WM Act notwithstanding the project is being considered as an extension to the existing (approved) water treatment works. Although the lagoon is considered 'water reticulation work' (exempt) the land on which the lagoon is to be constructed is not the subject of a water use approval and so the exemption in regard to construction does not apply. Council is therefore in the process of applying for and obtaining a water supply works approval to meet their legislative requirements.

3 METHODOLOGY

3.1 Desktop Review

A desktop assessment was undertaken to identify threatened flora and fauna species, populations and ecological communities listed under the BC Act, and MNES listed under the EPBC Act that may be affected by the Proposal. The results of the desktop assessment were then used to guide on site field investigations.

3.1.1 Database searches

Database records pertaining to the site and locality (i.e. 10 kilometre radius) were reviewed and included:

- DPIE Wildlife Atlas database for records of threatened species and endangered ecological communities listed under the BC Act that have been recorded within the locality of the subject site (DPIE 2021, data accessed 30th March 2021 and updated September 2023).
- Department of the Environment and Energy (DEE) Protected Matters Search Tool for Matters of National Environmental Significance (MNES) listed under the EPBC Act recorded or predicted to occur in the locality of the site (DAWE 2021, updated report generated 30th March 2021 and September 2023).
- OEH threatened species profiles online database (DPIE 2021; DPE 2023)
- DEE online species profiles and threats database (DAWE 2021; DCCEEW 2023).
- State Vegetation Type Map: Central Tablelands Region Version 0.1. VIS_ID 4778, to identify native vegetation types occurring within the study area and the likely presence of any threatened ecological communities (OEH 2019; DPE 2023).

Following collation of database records and species and community profiles, a 'likelihood of occurrence' assessment was prepared with reference to the broad habitats contained within the subject site (Appendix D). The assessment was further refined following field surveys and assessment of habitat present.

3.1.2 Vegetation mapping

GIS mapping was completed prior to surveys being undertaken to inform ecologists of the habitats and vegetation likely to be on site and to provide a visual representation of vegetation communities present within the study area, as well as any previous records of threatened species recorded.

3.2 Field survey

Two (2) TEF ecologists completed a site visit on the 25th of March 2021, accompanied by a PSC's Infrastructure Manager, Graeme Bayliss, who provided TEF staff with an overview of the site and described works to be undertaken. A detailed summary of onsite investigation can be found in Table 3.

A follow up site visit was completed on 21st July 2023 to survey the extended works area and include the construction laydown and access routes.

Table 3 Survey effort summary

Survey method	Effort
Fauna habitat assessments	Habitat assessments were conducted across the site. Tree hollows, water bodies, possible denning sites, leaf litter and other sites were inspected for their suitability as fauna habitat.
Random meander	Random plant samples of interest were taken opportunistically to develop a complete flora list within the study area.
Opportunistic bird surveys	All birds sighted or heard calling during diurnal field surveys and during travel to and from site were recorded.
Opportunistic general surveys	Any fauna or flora seen on site was recorded.
Habitat tree and hollow assessment.	Mature trees and those containing habitat features (hollows) were recorded using Avenza. These can be seen in Figure 3.
BAM plot	One BAM plot was completed to assess the mapped PCT.

3.2.1 Terrestrial flora survey

Area searches

The full length of the study area was surveyed on foot, with observations and records of flora species present made opportunistically. PCT's recorded for the site were translated into maps prior to field surveys and examined on site to determine if they matched. Dominant and key species were recorded in order to compare and assign the best-fit ground-truthed vegetation type.

Targeted flora surveys

Trees and plants of significance, including potential threatened species and introduced plants or weeds, were targeted, and specimens retrieved, in order to create a positive ID and confirm their presence within the study area. Where plants of interest were seen, a sample (buds/nuts) was taken, and its location noted.

3.2.2 Terrestrial fauna survey

Habitat Tree and Hollow Assessment

Habitat tree and hollow assessments on site included active searches for the following habitat features:

- Trees with bird nests or other potential fauna roosts
- Rock outcrops or overhangs providing potential shelter sites for fauna
- Burrows, dens and warrens, bridges, culverts and hollow-bearing trees for evidence (e.g. guano or bat droppings) of roosting microbats

- Hollow-bearing trees and logs which provide refuge, nest and den sites for a range of threatened fauna species
- Koala food trees and/or evidence of scratches or scats
- Distinctive scats or latrine sites, owl whitewash and regurgitated pellets under roost sites
- Tracks or animal remains
- Evidence of activity such as feeding scars, scratches and diggings
- Leaf litter and fallen timber were inspected for reptile habitat
- Presence of potential habitat for threatened frog species

Locations of important habitat features were recorded using Avenza and can be seen in Figure 3.

Opportunistic observations

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys; for instance, species utilising the study area identified through site or call identification, fallen timber scanned for reptiles, rock fragments and logs lifted to check for sheltering fauna and habitat trees and water bodies scanned for roosting birds.

3.3 Likelihood of occurrence of threatened biota

The likelihood of occurrence assessment, started during the desktop assessment phase, was refined based on the results of the field survey. The likelihood of threatened biota occurring in the Proposal footprint was assessed based on presence of records from the locality, species distribution and habitat preferences, and the suitability of potential habitat present in the subject site. The results of this assessment are provided in Appendix D.

3.4 Tests of Significance of Impacts

Tests of the likely significance of impacts resulting from the Proposal have been prepared in accordance with Section 1.7 of the EP&A Act and the *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DEWHA 2013) for threatened biota known or likely to occur within the Proposal footprint and with potential to be impacted by the Proposal, based on the results of the field survey. Assessments have only been undertaken for those species that may be impacted by the Proposal. These assessments are presented in Appendix E and Appendix F.

3.4.1 Survey conditions and limitations

Results from field investigations were influenced by timing and duration of surveys and weather conditions prior to, and during the surveys. Details of weather conditions recorded, and the limitations of the surveys undertaken, are outlined further below.

Survey conditions

During the survey period, conditions were warm, humid and cloudy, with a top of 23.6 degrees recorded on the 25th of March at Parkes Airport, the nearest weather station to the site. No rain fell on the day of the site visit. Further data on the weather conditions near the site on days preceding and following the site visit are included as Appendix G.

Survey limitations

As the project will be completed as a 'Design and Construct' tender, the exact impact footprint was not known at the time of survey. Consequently, TEF ecologists went outside the predicted footprint to capture constraints and to determine the PCT.

Given the limited survey effort, it is likely that some species that occur in the study area either permanently, seasonally or transiently were not detected during the survey. These species may include annual, ephemeral or cryptic flora and fauna species; nocturnal fauna; birds and frogs which call at other times of year; and mobile or transient fauna in general. The brief habitat assessment conducted allows for identification of habitat resources for such species, in order to assess their likelihood of occurring within the study area. As such, the survey was not designed to detect all species, rather to provide an overall assessment of the ecological values within the Proposal footprint. This information was used to predict potential impacts of the Proposal on ecological values and to develop a design and/or mitigation measures to specifically avoid impacts on threatened ecological communities and known and potential habitat for threatened species, where practicable.

4 RESULTS

4.1 Flora

4.1.1 Site description

The subject site occurs north of the existing WTP on the outskirts of Parkes, NSW. Vegetation present within the subject site was comprised of mostly non-native degraded pasture (Plate 1). A patch of remnant and regenerating native vegetation occurs to the east of the subject site with another scattered patch of regenerating native vegetation to the west (Figure 3). Where remnant native vegetation occurred the original PCT was established based on the species assemblage present, soil characteristics, location within the landscape and PCTs mapped as occurring within the locality. No named waterways occur within the study area, however the site does contain a drainage channel that has formed an eroded gully that runs parallel to the vegetation on the east of the site, spilling into the existing farm dam present within the middle of the subject site. The next closest unnamed waterway occurs over 300 m further east of the site.

The majority of the study area is located on unmapped land on the Native Vegetation Regulatory map, with large parcels of excluded land surrounding the study area (DPIE 2021).

4.1.2 Vegetation communities

Vegetation mapping of the study area and surrounding locality was investigated (sourced from OEH data portal 2019, State Vegetation Type Map: Central Tablelands Region Version 0.1. VIS_ID 4778). The results of this database search are presented in Figure 2. The mapping identifies the study area to be dominated by *Plains Grass Grassland on alluvia lmainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion* with some *Derived grassland of the NSW South Western Slopes* with adjacent vegetation to the east being PCT 267 *White Box - White Cypress Pine – Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion*. Field surveys identified inconsistencies with the mapped vegetation (Figure 2), identifying the majority of the site to be dominated by exotic/non-native vegetation.

Vegetation to the east of the site was determined to align with the mapped PCT 267, which was also found to occur to the west of the study area (Figure 3). This community was dominated by a dense stand of maturing *Callitris glaucophylla* (White Cypress Pine) with scattered *Eucalyptus albens* (White Box) occurring throughout. The understory was dominated by a mixture of native grasses and forbs including *Austrostipa aristiglumus* (Speargrass), *Enneapogon avenaceus* (Bottle Washers), *Paspalidium gracile* (Slender Panic), *Dichondra repens* (Kidney Weed), *Vittadinia cunneata* (Fuzzweed) and *Einadia nutans* and *E. trigonos*. This patch of vegetation contained medium to low weed invasion including *Tribulus terrestrus* (Cats Heads), *Petrorhagia nantuellei* (Proliferous Pink) and *Carthamus lanatus* (Saffron Thistle).

Open pasture areas contained scattered native species including *Brachychiton populneus* (Kurrajong) and *Eucalyptus albens* (White Box) with a groundcover dominated by exotic weed species including *Lepidium africanum* (Common Peppercress), *Polygonum aviculare* (Prostrate Knotweed), *Heliotropium* spp., (Heliotrope's), *Xanthium spinosum* (Bathurst Burr), and *Alternathra pungens* (Khaki Weed). Scattered occurrences of Weeds of National Significance (WONS) occurred across the site

including *Lycium ferocissimum* (African Boxthorn), and *Opuntia stricta* (Prickly Pear). *Hypericum perforatum* (St John's Wort), a high threat exotic, also occurred.

The dam located at the centre of the site was in a degraded state with limited native species present, including *Persicaria lapathifolia* (Pale Knotweed) and *Eleocharis plana* (Flat Spike-sedge). Exotic weed species present throughout the open pasture dominated the remainder of the vegetation.

The study area was found to be weedy and degraded, with erosion evident throughout.

Table 4 Summary of ground-truthed vegetation types to be impacted within the study area

Vegetation type	Subject Site (ha)	Study Area (ha)
PCTID 267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	0.97	1.99
PCTID 0 Non-native / Exotic vegetation	4.84	8.74
Total area impacted	**5.81**	**10.73**

Plate 1 non-native vegetation occurs throughout the majority of the subject site.

Plate 2 Eroded gullies throughout the study area

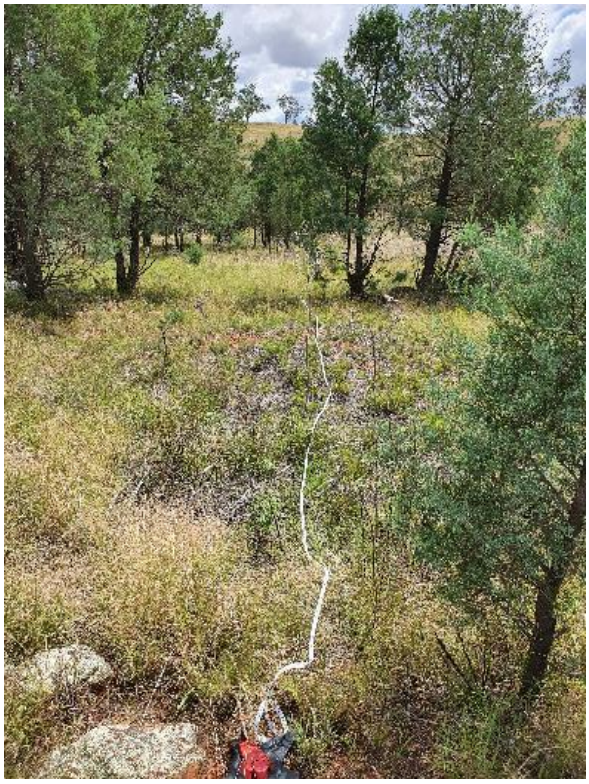


Plate 3 scattered white cypress pine to the east and west of the study area

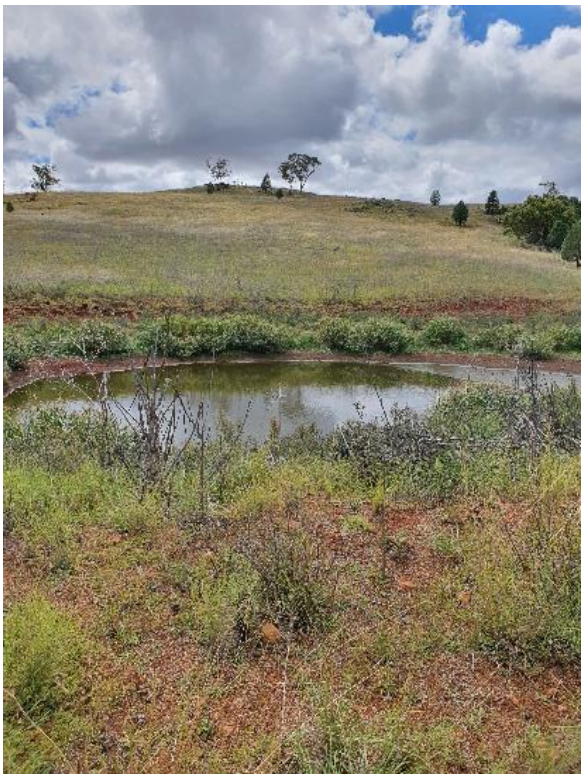


Plate 4 Existing dam on site with no emergent vegetation, and mixed native and non-native riparian vegetation

Plate 5 PCT 267 White Box - White Cypress Pine – Western Grey Box Woodland on the eastern extent of the study area

4.1.3 Flora species

Fifty-six (56) species of flora were recorded within the study area, comprising 57 % native to 43 % exotic species. The full list of species recorded during the current survey is presented as Appendix C.

No threatened flora species were recorded as occurring on the site. The vegetation present in the study area was in moderate to degraded condition. The site was dominated by exotic weed species throughout the open pasture and dam areas with scattered WONS throughout. Remnant and regenerating native overstorey and some groundcover species occurred throughout the pasture areas, with limited signs of grazing by native species present. Native vegetation to the east and west of the site offered a higher diversity of native species, with low to moderate weed invasion present throughout.

4.1.4 Declared and listed environmental weeds

Twenty-four (24) species of weed were found occurring across the study area. Of these, three (3) were Priority weed and / or Weed of National Significance (WoNS).

Table 5 WONS and priority listed weeds for the Central Tablelands recorded within the study area

Scientific Name	Common Name	Control Category
Lycium ferocissium	African Boxthorn	Prohibition on dealings Regional recommended measure

Scientific Name	Common Name	Control Category
		Weed of National Significance
Sorghum halepense	Johnson's Grass	Weed of National SIgnificance
Opuntia stricta	Prickly Pear	Prohibition on dealings *Must not be imported into the State or sold* Except for Opuntia ficus-indica (Indian fig) Weed of National Significance

4.2 Fauna

4.2.1 Fauna species

General fauna searches undertaken during the site visit detected a limited number of fauna species within the vicinity of the study area. Common birds were observed to be present, including Magpie (C*racticus tibicen*) and Australian Raven (*Corvus coronoides*), however no targeted bird survey was undertaken. Some macropod scat was observed within the open pasture area and woodland to the east of the study area, along with Rabbit (*Oryctolagus cuniculus*) scratchings. No other signs of fauna habitation were observed.

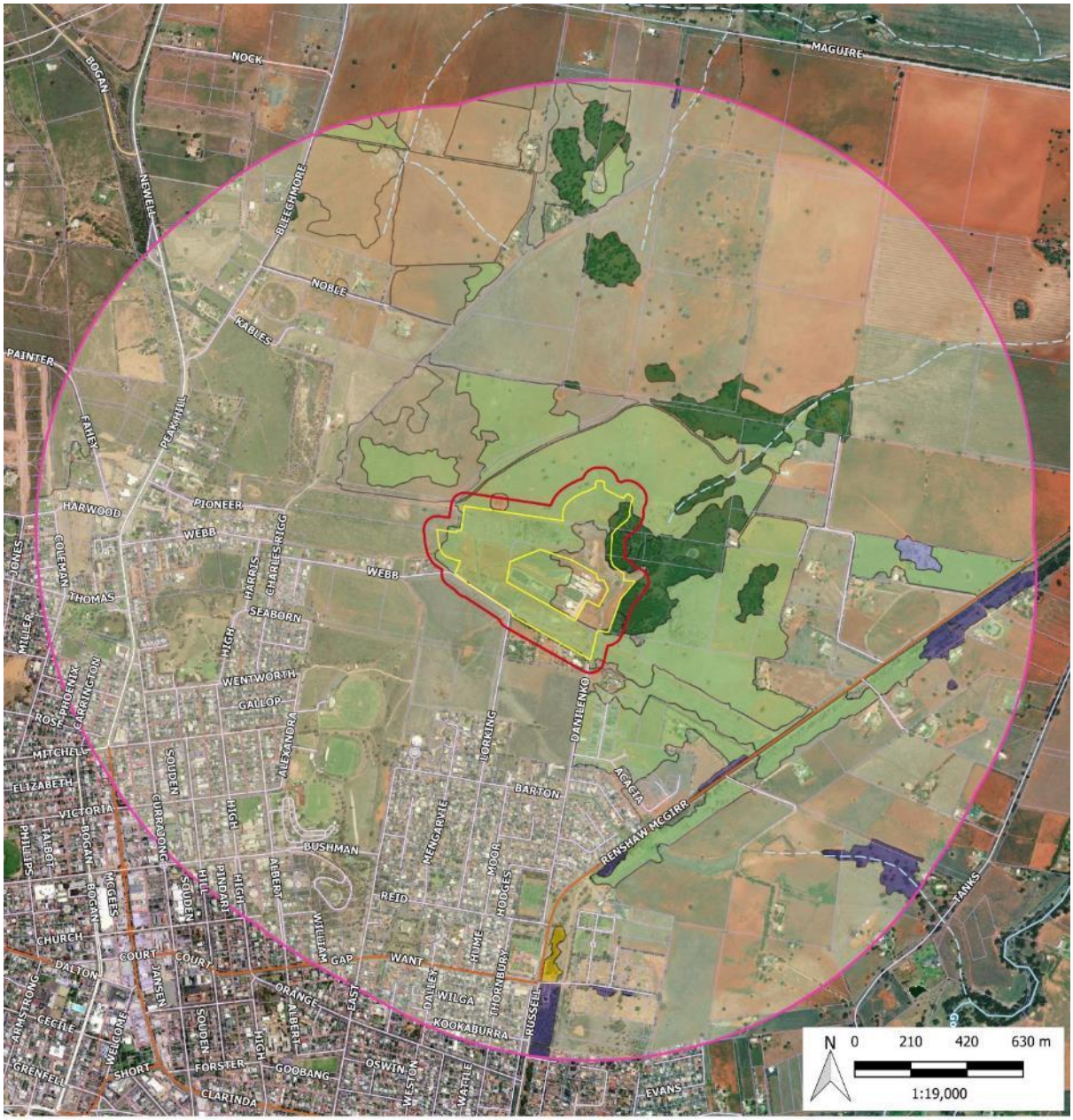
4.2.2 Fauna habitat

Twenty-one (21) species of threatened fauna have been recorded within the locality (Figure 4). The broader locality supports some habitat for native wildlife and is surrounded by remnant vegetation and patches of cleared agricultural land which would support the thoroughfare and habitation of a range of native fauna species. The area to the west and south is largely industrial and residential land. Habitat resources within the site and immediately east along the slopes of Golden Bar Hill include fallen logs, leaf litter, rocky outcrops, ephemeral creek lines, hollows, stags, culverts, and structurally diverse vegetation, offering potential suitable nesting, foraging and sheltering sites for a range of fauna species including reptiles, birds and small mammals present throughout the locality. Although the surrounding bushland was not extensively surveyed, some of these resources are likely to occur across the hillside. Fallen timber is a key foraging resource for many woodland birds including threatened species such as the Brown Treecreeper *(Climacteris picumnus*). Hollow logs provide shelter for a range of reptiles and ground dwelling mammals inhabiting the area. Mature hollow bearing trees and stags within the broader locality likely provide habitat resources for a range of species including microbats, parrots and owls, though none were recorded within the study area.

The main disturbances for fauna observed in the study area consisted of previous agricultural disturbance, nearby residential dwellings and industries, the bike path, the existing WTP, traffic and general farming practices in the broader locality.

4.2.3 Habitat trees

No hollow-bearing / habitat trees were recorded within the study area. Such trees provide potential nesting habitat for arboreal mammals and birds and their absence is indicative of previous disturbance/removal. Several mature and regenerating *Eucalyptus albens* trees as well as a *Brachychiton populneus* (Kurrajong) occurred within the subject site and will be impacted as part of works (Figure 3).



PSC WTP Raw Water Supply Lagoon - Plant Community Types within a 1.5km radius of the Proposal Location

Legend

- Study Area
- Subject Site
- Lot Boundaries

Road

- Arterial Road
- Local Road
- Primary Road
- Sub Arterial Road
- Urban Service Lane

Waterways

- Creek
- 1st, 2nd & 3rd order unnamed waterways

NSWStateVegetationTypes

- PCT 0 - Not native vegetation
- PCT 201 - Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion
- PCT 266 - White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT 267 - White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion
- PCT 45 - Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion
- PCT 76 - Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions

Figure 2 Mapped PCT's within 1.5 km of the proposal footprint

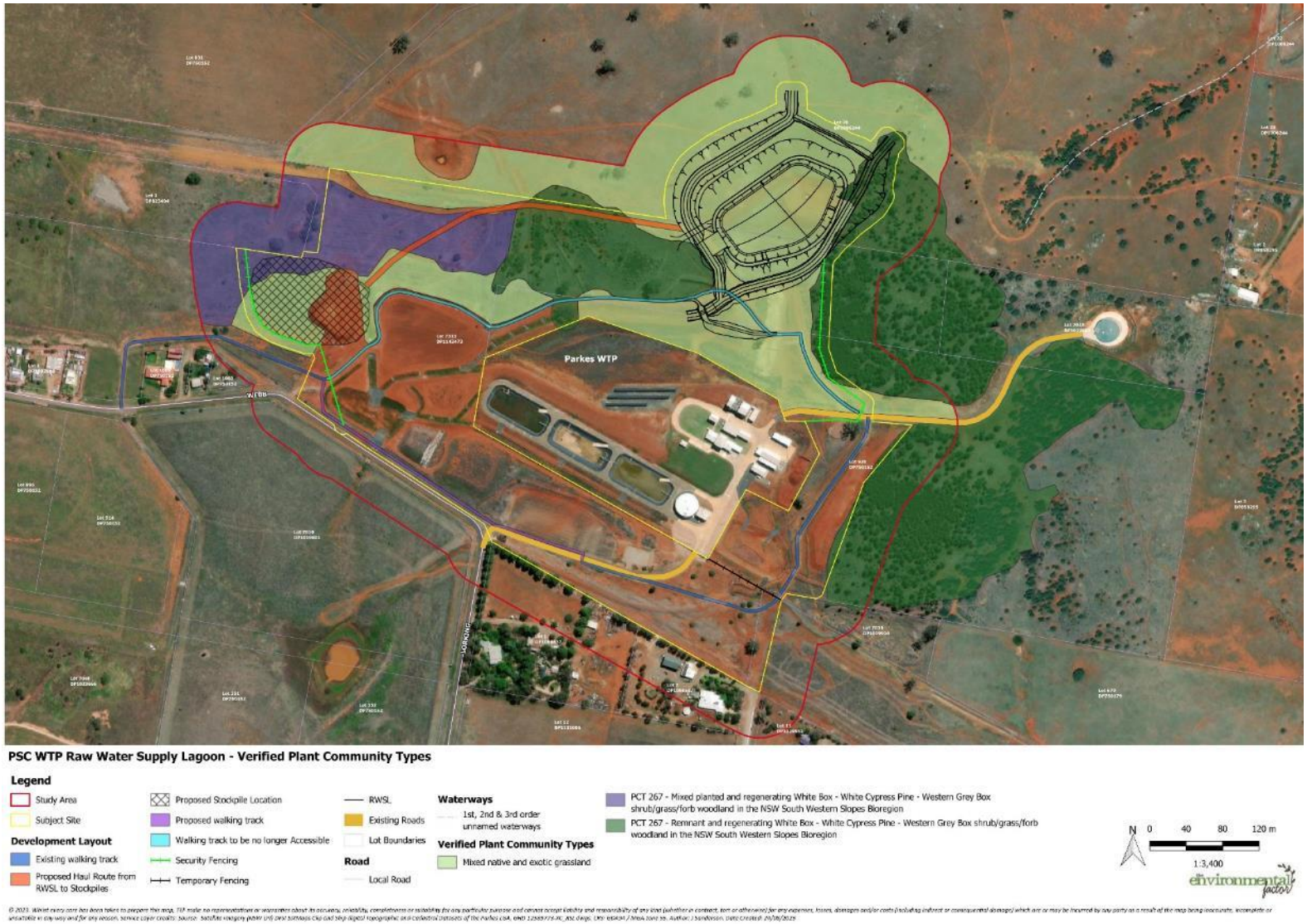


Figure 3 Survey effort and ground-truthed vegetation.

4.3 Conservation significance

4.3.1 Threatened ecological communities

Two (2) threatened ecological communities (TEC's) had the potential to occur within the study area:

- PCT 796 *Derived grassland of the NSW South Western* Slopes.
- PCT 267 *White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion*.

Of these, only PCT 267 was found to occur within the study area (Figure 3). This PCT forms part of the *White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions* Threatened Ecological Community (TEC) listed as critically endangered under both the *Biodiversity Conservation Act 2016* (BC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Tests of significance were completed Appendix E and Appendix F concluded that the works are unlikely to have a significant impact on this TEC.

4.3.2 Threatened species

No threatened species were recorded on site during surveys. A desktop assessment was undertaken to identify threatened flora and fauna species, populations and ecological communities listed under the BC Act, and Matters of National Environmental Significance (MNES) listed under the EPBC Act that may be affected by the Proposal.

For each species and ecological community, the specific habitat requirements have been considered in relation to the natural resources present within the study areas and described accordingly. Based on the presence or absence of important habitat resources required for each species, as well as the location of recent records, habitat connectivity, and the age of historical sightings, a likelihood of occurrence rating has been assigned to reflect the probability of whether each species will frequent and/or rely on resources within the study area (Appendix D).

Of these, a total of ten (10) threatened species and one (1) TEC were considered to have a moderate or higher likelihood of being impacted within the subject site (Table 6); consequently, Tests of Significance were conducted for these species (Appendix E and Appendix F).

Table 6 Threatened species and ecological communities with the potential to be impacted by the Proposal

Scientific Name	Common name	BC Act	EPBC Act
Predatory Birds			
Falco hypoleucos	Grey Falcon	E	V
Falco subniger	Black Falcon	V	
Hieaaetus morphnoides	Little Eagle	V	
Circus assimilis	Spotted Harrier	V	

Scientific Name	Common name	BC Act	EPBC Act
Woodland Birds			
Chthonicola sagittata	Speckled Warbler	V	
Climacteris picumnus	Brown Treecreeper (eastern subspecies)	V	
Daphoenositta chrysopterus	Varied Sittella	V	
Stagonopleura guttata	Diamond Firetail	V	
Petroica phoenicea	Flame Robin	V	
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland	Box Gum Woodland	CE	CE

4.3.3 Migratory species

Of the seventeen (17) listed migratory and marine species (PMST 2021) with the potential to occur within the locality, twelve (12) were considered to have the possibility of occurring following the field survey and habitat assessment (Table 15). Of these, none were considered at a moderate or higher risk of being impacted by the Proposal.

4.3.4 Other MNES

The listed additional Matters of National Environmental Significance (MNES), that are predicted to occur within the locality, are considered unlikely to be impacted by the Proposal.

The assessment (PMST 2021) indicates that there are four (4) Wetlands of International Importance (Ramsar) between 500 and 900 km away from the study area. No marine areas occur within proximity to the study area.

4.3.5 SEPP Koala Habitat Protection

The small patch of woodland within the study area is a dense stand of regenerating / maturing *Callitris glaucophylla* (White Cypress Pine) with scattered *Eucalyptus albens* (White Box) occurring throughout. *Eucalyptus albens* is listed under Schedule 2 of SEPP 2020. This species constituted less than 15% of total tree cover and was only found as two saplings and one mature individual within the subject site. No secondary feed trees were found to occur. No Koalas, or signs of recent habitat use (e.g. scratchings or scats) were observed. Five (5) historical Koala records occur within the Parkes LGA, none of which are within the locality (Figure 4). As such, it is unlikely that the koalas use the habitat resources within the subject site and they do not constitute Core Koala habitat as defined under the SEPP.

4.4 Habitat connectivity

The study area is not well connected to intact remnant patches of vegetation, with only some access to intact bushland to the east of the site (Figure 1). Patches of vegetation in the locality are interspersed with agricultural land, leaving poor habitat connectivity for terrestrial fauna. Terrestrial

fauna movement is also somewhat restricted due to the presence of roads and some fences, with open spaces and infrastructure present in the immediate and broader locality.

5 IMPACT ASSESSMENT

This Section assesses the potential impacts of the Proposal during construction and operation on flora and fauna and their habitats.

5.1 Direct impacts

5.1.1 Removal of flora species and vegetation communities

Approximately **8.37 ha** of native vegetation occurs within the study area, with the potential to be impacted by the proposed works. Of this, approximately **4.34 ha** of native vegetation may be directly impacted or removed, including mature trees and overstorey species. The site connects with broader extents of remnant vegetation. No threatened flora species are being impacted by the proposed works, and one TEC will be impacted.

5.1.2 Fauna habitat removal

A number of mature trees (Figure 3) will be impacted as part of the proposed works. A low density of secondary koala food tree species occurred (*E. albens*). However, no core Koala habitat was identified as occurring on the site.

No long-term effects are likely to be suffered by fauna due to the loss of this localised habitat considering the existing nature of the site, the relatively small areas of vegetation to be impacted, and the availability of other habitat within the locality. Appropriate mitigation measures (checking for animals present and adherence to clearing limits) will also reduce any potential impacts to individual fauna that may be present during construction works.

5.1.3 Aquatic habitats

The site includes an existing farm dam, which is in degraded condition with minimal fringing vegetation (*Persicaria sp*.), eroded banks, and no visible emergent vegetation. It is possible that fauna utilise the dam for habitat, and foraging resources, as well resting (in the case of waterbirds); however, no evidence of this was observed on site during the survey. Consequently, impact arising from upgrading the dam to a much larger water storage body, are anticipated to be minimal.

Transient fauna – mostly birds, may also use the new water body on migratory journeys, which would be considered a positive impact, as a large waterbody would provide resting and foraging resources for mitgratory species.

5.1.4 Habitat fragmentation

Clearing of vegetation around an existing dam is unlikely to markedly increase habitat fragmentation in the study area. The vegetation within the study area is not untouched and is subject to impacts from adjacent infrastructure and activities. The additional clearing of low-quality habitat is not expected to cause significant fragmentation. Some fragmentation will be exacerbated due to the splitting of the two patches of PCT 267 by the replacement of the existing dam with a much larger water body. This will cause minor impact to any non-aerial fauna.

5.1.5 Fauna injury and mortality

Increased fauna injury and mortality may occur as a result of interaction with new infrastructure and increased activity, road collisions with wildlife, animals becoming trapped in the lagoon during

construction and incidental impacts through heavy machinery. All mitigation measures outlined in Section 6 are to be adhered to, to reduce this threat.

5.2 Indirect impacts

Indirect impacts caused by clearing and lagoon construction include increased noise and dust levels, potential erosion and runoff, and the introduction of weeds and other pathogens.

Noise, dust and runoff have the potential to travel long distances and disrupt wildlife outside of the study area. Presence of vehicles, machinery and staff within and surrounding the study area may also increase localized disturbance to terrestrial species that feed or breed in the area. Sedimentation during clearing and lagoon construction works may migrate outside of the study area. Indirect impacts to vegetation communities within the study area may also occur through increased activity causing erosion, dust settling on foliage and potential for the introduction of weeds or other pathogens.

Provided appropriate safeguards are followed, indirect impacts resulting from the Proposal are predicted to be minor and short-lived in nature. Potential long-term indirect impacts during operation may arise from the installation of a large water body, attracting various wildlife and changing the landscape to include a lagoon.

5.3 Key threatening processes

A key threatening process (KTP) is defined under the BC Act as an action, activity or Proposal that:

- Adversely affects two (2) or more threatened species, populations or ecological communities.
- Could cause species, populations or ecological communities which are not currently threatened to become threatened.

There are currently thirty-eight (38) KTPs listed under the BC Act (DPIE 2021) eight (8) listed under the FM Act (DPIE 2021) and twenty-one (21) under the EPBC Act (DAWE 2021). Several KTPs are listed under more than one Act. Those KTPs potentially relevant to this Proposal are discussed in Table 7 below. The Proposal may exacerbate KTPs (as tabled below) and appropriate mitigation actions should be employed to minimise these impacts. Mitigation measures to limit the impacts of KTPs of relevance are discussed in Section 6.

Table 7 Key threatened processes relevant to the Proposal

KTP	Status	Comment
Clearing of native vegetation	BC Act; EPBC Act	The Proposal would result in the clearing of potentially **4.34 ha** of native midstory and understory vegetation. The vegetation is in moderate to good condition. The clearing of this vegetation would comprise an increase in the operation of this KTP. The CEMP would include measures to minimise impacts on native vegetation and potentially threatened flora and fauna.
Removal of dead wood and dead trees	BC Act	There are low to quantities of dead wood and dead trees scattered throughout the study area that would provide habitat resources for native fauna, including threatened species. The subject site also contains woody debris which would be removed as a result of the Proposal. The Proposal may increase the operation of this KTP.

KTP	Status	Comment
Invasion of plant communities by perennial exotic grasses	BC Act	There is the potential for perennial exotic grasses to further invade native vegetation through disturbance during construction of the Proposal. Mitigation measures outlined in Section 6 are likely to effectively limit the operation of this KTP.
Infection of native plants by *Phytophthora cinnamomi*	BC Act; EPBC Act	Construction activities have the potential to introduce the root-rot fungus *Phytophthora cinnamomi* into the broader study area, which could lead to dieback of vegetation. Mitigation measures are likely to effectively limit the operation of this KTP.
Introduction and establishment of Exotic Rust Fungi of the order *Pucciniales* pathogenic on plants of the family *Myrtaceae*	BC Act	Construction activities have the potential to introduce Myrtle Rust to the study area. Mitigation measures are likely to effectively limit the operation of this KTP.

5.4 Impacts on listed threatened biota

Currently, direct impacts are predicted to affect **10.79 %** (**4.34 ha**) of native vegetation within the study area, with the potential to impact ten (10) threatened species and one TEC listed under both the BC and EPBC Act.

Tests of Significance were completed for species listed under the BC Act that were considered likely to occur within, or be impacted by, the Proposal. A summary of the results of the Tests of Significance for threatened biota listed under the BC Act is provided in Table 8. The full assessments of significance for affected threatened biota listed under the BC Act are provided in Appendix E.

Table 8 Summary of Tests of Significance under the BC Act

Scientific Name	Common name	BC Act	Summary of Assessment of Significance
Predatory Birds			
Falco hypoleucos	Grey Falcon	E	No significant impact
Falco subniger	Black Falcon	V	No significant impact
Hieaaetus morphnoides	Little Eagle	V	No significant impact
Circus assimilis	Spotted Harrier	V	No significant impact
Woodland Birds			
Chthonicola sagittata	Speckled Warbler	V	No significant impact
Climacteris picumnus	Brown Treecreeper (eastern subspecies)	V	No significant impact
Daphoenositta chrysopterus	Varied Sittella	V	No significant impact

Scientific Name	Common name	BC Act	Summary of Assessment of Significance
Stagonopleura guttata	Diamond Firetail	V	No significant impact
Petroica phoenicea	Flame Robin	V	No significant impact
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	No significant impact
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland		CE	No significant impact

The results of the Significant Impact Criteria assessments for threatened species listed under the EPBC Act that were considered likely to occur or be impacted by the Proposal are provided in Table 9. The full assessments of significance for affected threatened biota listed under the EPBC Act are provided in Appendix F.

Table 9 Summary of Tests of Significance under the EPBC Act

Scientific Name	Common name	EPBC Act	Summary of Assessment of Significance
Falco hypoleucos	Grey Falcon	V	No significant impact
White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland		CE	No significant impact

6 MITIGATION MEASURES

The below mitigation measures have informed this assessment and are considered part of the scope of works. Consequently, the below measures will be included in the project Review of Environmental Factors (REF) as Environmental Safeguards, which will serve as conditions of consent for the works. Evidence, in the form of documentation and accurately kept records, must be collected to ensure these actions have been completed as part of the project.

Mitigation measures for construction of the Proposal are as follows:

Timing of Vegetation Clearing

- Where practicable, it is recommended to time the works outside of key breeding (fledging of active nests/roosts) and winter torpor (microbat) seasons (approximately June to January) for species likely to utilise the site to avoid nest abandonment, injury or death to native fauna.

Habitat Removal

- Clearly delineate vegetation to be removed/retained with the assistance of an ecologist, or similarly qualified professional, and induct all site personnel as to the approved extent of clearing. Ensure that no clearing of vegetation occurs outside of the marked boundary.
- Where any trees or riparian vegetation requiring removal contain hollows, nests or other signs of occupation, a staged clearing approach must be undertaken where hollow limbs or nests are removed carefully and incrementally by a qualified tree surgeon/arborist, or qualified fauna spotter / catcher. Care should be taken to inspect limbs / nests for fauna prior to their removal.
- Prior to clearing, a preclearance survey should be undertaken including inspection of hollows and the farm dam to confirm occupation by fauna. Care should be taken to identify nests and/or roosting sites. If fauna habitat is present the Council or Council's appointed contractor would contact the project ecologist for further advice prior to clearing.
- Ensure the presence of an ecologist or fauna spotter catcher at all times during pre-clearing and clearing activities to remove and relocate wildlife as necessary, and to attend to any wildlife that are injured as a result of works.
- Felled trees must be placed strategically and in proximity to the work site, either within the regenerating vegetation to the west, upslope of the proposed lagoon in eroded areas, or along Golden Bar Hill to the east, to provide refuge and potential habitat in the understorey whilst ensuring no further damage to surrounding vegetation. Placement of logs and felled trees will also aid in the regeneration of the area.
- Where additional vegetation removal is proposed beyond that which is described within this report, this must first be assessed to consider the cumulative impacts against the approved clearance footprint, and if appropriate supervised by a qualified ecologist and Council's Environmental Officer.

Vegetation Protection

- Clearly delineate vegetation to be removed/retained with the assistance of an ecologist, or similarly qualified professional, and induct all site personnel as to the approved extent of clearing. Ensure that no clearing of vegetation occurs outside of the marked boundary.
- The presence of a suitably qualified arborist is recommended during earthworks occurring near retained trees to avoid rootzones impacts.
- Trees existing along gullies or eroded areas should be retained and protected, to ensure future erosion potential is minimised.

Rehabilitation

- Revegetation activities will be undertaken using native species sourced from local seed wherever possible. Areas to be re-seeded may be marked in the project CEMP or Environmental Control Plan (ECP) as a record of rehabilitation efforts made. Vegetation cover should be returned to the site within a reasonably practicable timeframe post clearing to reduce soil exposure and loss.
- Inclusion of emergent and fringing vegetation along the lagoon wall and slopes, where access is not required for maintenance, is recommended to provide long-term stability of the site as well as replace habitats lost through the construction phase.

General

- Vehicles and machinery to enter from the WTP not to extend beyond the direct impact footprint and to remain on allocated access roads.
- Ensure vehicles and machinery are cleaned and checked for any traces of weeds, seeds and mud prior to entering work site.
- All soils to be stockpiled at designated stockpile locations in a cleared area, within pre-approved zones.
- Appropriate erosion and sediment migration reduction/control measures should be in place.
- Heavy vehicles are not to be parked under tree drip lines/ leaf canopy to avoid compaction of soil, which is damaging to mature native trees and can cause dieback or tree mortality.
- All machinery and vehicles are to be clean and inspected prior to arriving on-site to reduce the spread of weeds and disease (e.g. *Phytophthora cinnamomi*) to the site.
- Strict hygiene protocols must be followed to ensure that no environmental weeds are spread around during works or are introduced to site as a result of the proposed works. If weeds are accidentally transported to site, or identified during construction activities, all weed material should be immediately contained and removed from site. Conversely, machinery should be carefully cleaned prior to leaving the site, to ensure weed material is not transported offsite to other areas.
- Locate stockpile sites away from the proposed lagoon boundary, drainage lines and native vegetation. Ensure these are appropriately stabilized in accordance with the 'Blue Book' (Landcom 2004).
- Declared weeds must be managed according to requirements under the Biosecurity Act 2015. It is recommended that all Weeds of National Significance should be managed prior to commencement of construction activities to ensure they do not spread, and where possible eradicated.

- Due to the expected slope/steepness of the work site, fauna entrapment and drowning is a possible scenario throughout construction. Suitable fauna escape ladders/ ramps are to be installed overnight to allow any animals that fall into trenches/lagoon to escape. Additionally, any pits or trenches left open overnight should be checked each morning for fauna which may have become entrapped.

7 CONCLUSION

The study area includes areas of moderately degraded native vegetation and fauna habitats to the east and west, together with previously disturbed, non-native vegetation adjacent an existing WTP. Vegetation within the subject site is of poor to moderate quality with little suitable fauna habitat.

The following ecological impacts area associated with the Proposal based on the current design.

- Total impact area of **21.24 ha** with clearing / direct removal of up to **4.34 ha** of native vegetation, including mature trees.
- Indirect impacts to vegetation occurring within the study area through noise, dust settling and activity disturbance.
- Removal of an existing farm dam in degraded condition, and replacement with a large ~20 ML waterbody in the form of a Raw Water Supply Lagoon.
- Potential injury or mortality of small, terrestrial fauna within the Proposal footprint.

Based on the desktop assessment, site visit and habitat assessments undertaken, ten (10) threatened species and one TEC were considered as having the potential to be impacted as a result of the proposal, including ten (10)) species listed under the BC Act and three (3) listed under the EPBC Act, as follows:

- *Hieaaetus morphnoides* (Little Eagle) - Vulnerable under the BC Act
- *Falco hypoleucos* (Grey Falcon) - Endangered under the BC Act and Vulnerable under the EPBC Act
- *Falco subniger* (Black Falcon) - Vulnerable under the BC Act
- Circus assimilis (Spotted Harrier) - Vulnerable under the BC Act
- *Chthonicola sagittata* (Speckled Warbler) - Vulnerable under the BC Act
- *Climacteris picumnus* (Brown Treecreeper - eastern subspecies) - Vulnerable under the BC Act
- *Daphoenositta chrysopterus* (Varied Sittella) - Vulnerable under the BC Act
- *Petroica boodang* (Scarlet Robin) - Vulnerable under the BC Act
- *Stagonopleura guttata* (Diamond Firetail) - Vulnerable under the BC Act
- *Petroica phoenicea* (Flame Robin) - Vulnerable under the BC Act
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler) - Vulnerable under the BC Act
- White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland – Critically Endangered under the BC and EPBC Acts

Tests of significance for threatened species likely to be impacted by the Proposal were prepared in accordance with Section 1.7 of the EP&A Act and the EPBC Act *Matters of National Environmental Significance – Significant Impact Criteria guidelines* (DEWHA 2009), also known as Tests of Significance.

These Tests concluded that a significant impact to these species and community is **unlikely**. Consequently, neither participation in the Biodiversity Offset Scheme/preparation of a Species Impact Statement nor Referrals to the Minister are warranted.

Some secondary koala feed tree species will be impacted by the proposed works; however, no Core Koala habitat was identified as occurring on the site.

Specific mitigation measures are warranted to minimise the potential indirect impacts of the Proposal on the natural environment outside of the Proposal footprint during construction and operation. This would include preparing and implementing a CEMP, including outlining locations and methods for appropriate erosion, sediment, habitat management and biological control measures to minimise the potential for adverse impacts on adjoining habitats.

8 REFERENCES

BOM (2021) weather observations at Parkes airport weather station

DAWE 2021 Species Profile and Threats Databases

DAWE 2021 Protected Matters Search Tool for MNES listed under the EPBC Act. http://www.environment.gov.au/epbc/protected-matters-search-tool

DPI 2021 Priority Weeds of the Central Tablelands NSW WeedWise

DPI 2021 Weeds of National Significance NSW WeedWise

DPIE 2021 Areas of Outstanding Biodiversity register Area of Outstanding Biodiversity Value register | NSW Environment, Energy and Science

DPIE 2021 Biodiversity Values Map https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap

DPIE 2021 Key threatening processes http://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/about-threatened-species/key-threatening-processes accessed Feb 2021

DPIE 2021 SEPP Koala Habitat Protection 2020 Koala Habitat Protection SEPP - (nsw.gov.au)

DPIE 2021 NSW Government Vegetation Regulatory Map https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=NVRMap

DPIE (2021) Bionet Wildlife Atlas Threatened species records, which holds data from a number of custodians.

New South Wales Flora online – PlantNET 2021 http://plantnet.rbgsyd.nsw.gov.au/floraonline.html

9 APPENDICES

Appendix	Item
Appendix A	– Native Vegetation Regulatory Map
Appendix B	– Biodiversity Values Map
Appendix C	– Field data recorded during surveys
Appendix D	– Threatened Species Likelihood of Occurrence
Appendix E	– NSW Tests of Significance
Appendix F	– EPBC Act Significant Impact Criteria Assessments
Appendix G	– BOM Daily Weather Observations

Appendix A – Native Vegetation Regulatory Map

PSC WTP Raw Water Supply Lagoon - Native Vegetation Regulatory Map

Legend

- Study Area
- Subject Site

Development Layout

- Existing walking track
- Proposed Haul Route from RWSL to Stockpiles
- Proposed Stockpile Location
- Proposed walking track
- Walking track to be no longer Accessible
- Security Fencing
- Temporary Fencing
- RWSL
- Lot Boundaries

Road

- Arterial Road
- Local Road

Waterways

- 1st, 2nd & 3rd order unnamed waterways

Native Vegetation Regulatory Map (in force)

- Category 2 - Vulnerable Regulated Land
- Category 2 - Sensitive Regulated Land
- Category 2 - Sensitive & Vulnerable Regulated Land
- Land Excluded from Local Land Services Act 2013
- Werriwa & Monaro CEEC Advisory Layer

Appendix B – Biodiversity Values Map

PSC WTP Raw Water Supply Lagoon - Biodiversity Values Map

N

0 250 500 750 m

1:20,000

Legend

- Study Area
- Subject Site
- Lot Boundaries
- **Road**
  - Arterial Road
  - Local Road
  - Primary Road
- **Waterways**
  - Creek
  - 1st, 2nd & 3rd order unnamed waterways
- **Biodiversity Values**
  - Biodiversity Values

Appendix C – Field data recorded during surveys

Table 10 Flora recorded during surveys

Latin name	Common name	BAM	Exotic
Alternanthera pungens	Khaki weed		x
Austrostipa aristiglumis	Plains Grass	x	
Austrostipa scabra	Speargrass	x	
Bidens pilosa	Cobbler's Pegs		x
Boerhavia dominii	Tarvine		
Brachychiton populneus	Kurrajong		
Brassica oleracea	Wild Cabbage		x
Callitris glaucophylla	White Cypress Pine	x	
Carthamus lanatus	Saffron thistle	x	x
Cheilanthes sieberi		x	
Chondrilla juncea	Skeleton Weed		x
Conyza sp.	Fleabane		x
Cucumis myriocarpus	Paddy melon		x
Cymbopogon refractus	Barbed-wire Grass		
Datura stramonium	Common Thornapple		x
Desmodium varians	Slender Tick-trefoil	x	
Dichanthium sericeum	Queensland Bluegrass		
Dichondra repens	Kidney Weed	x	
Echium plantagineum	Paterson's Curse		x
Einadia nutans	Climbing Saltbush	x	
Einadia trigonos	Fishweed	x	
Eleocharis plana	Flat Spike-sedge		
Enneapogon avenaceus	Bottle Washers	x	
Eragrostis brownii	Brown's Lovegrass		

Latin name	Common name	BAM	Exotic
Eucalyptus albens	White Box	x	
Geijera parviflora	Wilga		
Geranium solanderi	Native Geranium		
Glycine clandestina		x	
Heliotropium amplexicaule	Heliotrope		x
Heliotropium europaeum	European heliotrope		x
Hypericum perforatum	St Johns Wort	x	x
Hypochaeris sp.	Flatweed	x	
Lepidium africanum			x
Lomandra filiformis	Wattle mat-rush		
Lycium ferocissium	African Boxthorn		WONS
Marrubium vulgare	White horehound		x
Medicago sp.	Medic		x
Oenothera biennis	Evening primrose		x
Opuntia stricta	Prickly Pear		WONS
Oxalis corniculata		x	x
Panicum effusum	Hairy Panic	x	
Paspalidium gracile	Slender Panic	x	
Persicaria lapathifolia	Pale Knotweed		
Petrorhagia nantuellei	Proliferous Pink	x	x
Polyganum aviculare	Wireweed		x
Portulaca oleracea	Pigweed		
Rytidosperma sp.	Wallaby Grass	x	
Sida corrugata	Corrugated sida	x	
Silybum marianum	Varigated thistle		x
Solanum conereum	Narrawa Burr	x	

Latin name	Common name	BAM	Exotic
Solanum nigrum	Blackberry Nightshade	x	
Sorghum halepense	Johnson's Grass		WONS
Tribulus terrestris	Cats Head	x	
Vittadinia cuneata	Fuzzweed	x	
Wahlenbergia communis	Tufted Bluebell		
Xanthium spinosum	Bathurst Burr		x

Note: Ex – Exotic/Introduced; WONS – Weeds of National Significance

Table 11 Fauna recorded during surveys

Taxa	Species Name	Common Name	Observation
Aves	*Corvus orru*	Crow	O/W
Aves	*Cracticus tibicen*	Australian Magpie	O

Note: * denotes threatened species

Appendix D – Threatened Species Likelihood of Occurrence

The below assessment includes national and state significant species from the following sources:

- Bionet Atlas of NSW Wildlife
- DAWE database (PMST search)
- Current survey
- Search area is 10 km radius.
- Not considered further pelagic seabirds, shorebirds, sandpipers, turtles, whales, sharks - no preferred marine or coastal habitat in study area.

All habitat information is taken from NSW DPIE and Commonwealth DAWE Threatened Species profiles (DPIE 2021, DAWE 2021) unless otherwise stated. The codes used in this table are:

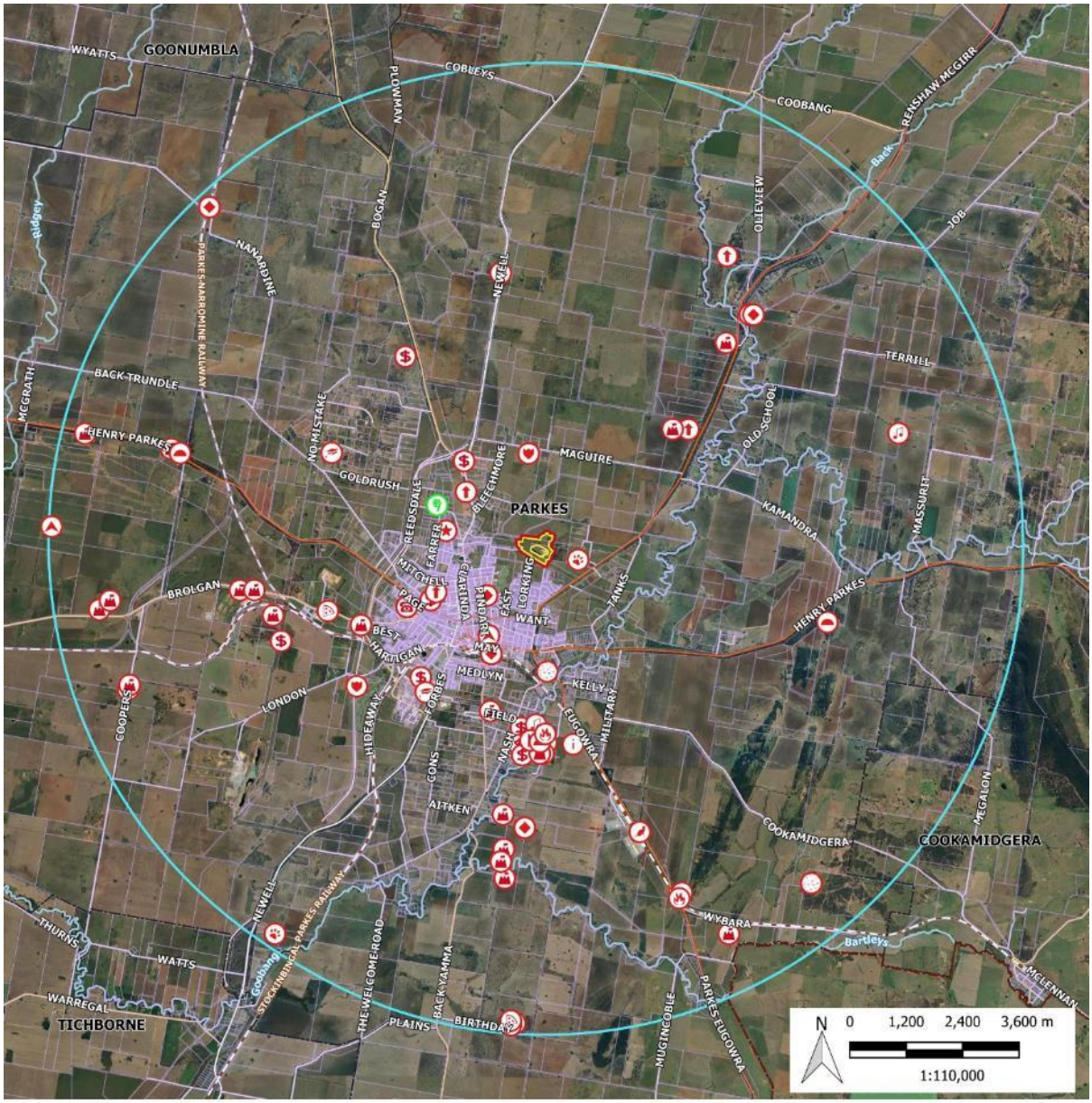
- CE – Critically Endangered
- E – Endangered
- V – Vulnerable
- EP – Endangered Population
- C – CAMBA
- J – JAMBA
- R – ROKAMBA
- CEEC – Critically Endangered Ecological Community
- EEC – Endangered Ecological Community

Table 12 Likelihood of occurrence definitions

Likelihood of occurrence	Definition
Known	Species recorded in the subject site.
Likely	Species previously recorded within a 10 kilometre radius of the subject site and suitable habitat occurs within the subject site.
Possible	Species previously recorded within a 10 kilometre radius of the subject site but only marginal suitable habitat recorded. OR Species not previously recorded within a 10 kilometre radius of the subject site, but the Proposal footprint is within the species known distribution and suitable habitat occurs within the subject site.
Unlikely	Species previously recorded within a 10 kilometre radius of the subject site but no suitable habitat recorded.
Nil	Species not previously recorded within a 10 kilometre radius of the subject site.

Table 13 Likelihood of impact definitions

Likelihood of impact	Definition
Nil	Species/ community will not be impacted by the Proposal.
Low	Species / community is unlikely to be impacted by the Proposal.
Moderate	Species / community is known or likely to occur within the study area however the Proposal does not impact on important habitat resources.
High	Species / community is known or likely to occur within the study area and the Proposal will impact on important habitat resources.



PSC WTP Raw Water Supply Lagoon - Threatened Species within a 10km radius of the proposal location

Legend

- 10km Radius
- Study Area
- Subject Site
- Lot Boundary

Roads

- Arterial Road
- Local Road
- Primary Road
- Sub Arterial Road
- Railway

Waterways

- Creek

Threatened Species

- Barking Owl
- Black Falcon
- Black-tailed Godwit
- Brown Treecreeper (eastern subspecies)
- Curlew Sandpiper
- Diamond Firetail
- Dusky Woodswallow
- Flame Robin
- Freckled Duck
- Grey Falcon
- Grey-crowned Babbler (eastern subspecies)
- Grey-headed Flying-fox
- Koala
- Little Eagle
- Little Lorikeet
- Little Pied Bat
- Magpie Goose
- Major Mitchell's Cockatoo
- Silky Swainson-pea
- Speckled Warbler
- Spotted Harrier
- Spotted-tailed Quoll
- Superb Parrot
- Turquoise Parrot
- Varied Sittella
- White-fronted Chat
- White-throated Needletail

Map is not for distribution

Figure 4 Threatened species recorded within 10 km of the study area

Table 14 Threatened biota likelihood of occurrence table

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
Birds							
Anthochaera phrygia	Regent Honeyeater		CE	The Regent Honeyeater is a migratory woodland bird moving across the landscape in response to climatic conditions and food availability. This species has only three key breeding locations. The closest breeding colony is located near the Capertee Valley. This species prefers Box-Ironbark woodland and riparian forests particularly habitats with mature trees, high canopy cover and abundance of mistletoes.	PMST	Possible	Low
Botaurus poiciloptilus	Australasian Bittern		E	Preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or	PMST	Unlikely	Nil

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				cutting grass (Gahnia) growing over a muddy or peaty substrate.			
Calidris ferruginea	Curlew Sandpiper	E	CE	Mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand.	BioNet / PMST	Unlikely	Nil
Chthonicola sagittata	Speckled Warbler	V		The Speckled Warbler occupies open Eucalypt woodlands with a grassy understory and often rocky outcrops. Relatively large undisturbed areas are required to sustain this species in an area.	BioNet	Possible	Moderate
Circus assimilis	Spotted Harrier	V		Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. Found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland	BioNet	Possible	Moderate

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				wetlands on terrestrial mammals (eg bandicoots, bettongs, and rodents), birds and reptiles. They build a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months.			
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V		The Brown Treecreeper maintains a territory in open woodland habitats (including Box-Gum Woodland). It prefers woodlands dominated by stringybarks and rough barked eucalypts with a grassy understory. It requires tree hollows in live and dead trees or stumps for nesting.	BioNet	Possible	Moderate
Daphoenositta chrysoptera	Varied Sittella	V		Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	BioNet	Possible	Moderate

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
Epthianura albifrons	White-fronted Chat	V		Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. Found in damp open grassland and wetland habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas.	BioNet	Unlikely	Low
Falco hypoleucos	Grey Falcon	E	V	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey (birds, especially parrots and pigeons, reptiles and mammals). It utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse.	BioNet/ PMST	Possible/Likely	Moderate
Falco subniger	Black Falcon	V		The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly	BioNet	Possible/Likely	Moderate

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				occurring in inland regions. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993).			
Glossopsitta pusilla	Little Lorikeet	V		In NSW Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. They are considered nomadic responding to food availability and highly gregarious often foraging in mixed flocks. They occur in dry, open eucalypt forests and woodlands using roadside vegetation. They rely on nectar and pollen, particularly on profusely-flowering eucalypts, melaleucas and mistletoes.	BioNet	Likely	Low
Grantiella picta	Painted Honeyeater		V	A nomadic species inhabiting Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing	PMST	Possible	Low

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema. Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.			
Hieraaetus morphnoides	Little Eagle	V		Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	BioNet	Possible	Moderate
Hirundapus cauacutus	White-throated Needletail		V	This species is almost exclusively aerial over a wide variety of habitats. Most common in coastal areas, less so inland.	BioNet/ PMST	Possible	Low
Lathamus discolor	Swift Parrot		CE	The Swift Parrot breeds in Tasmania and returns to the south-eastern mainland to forage over the cooler months (March – October). They move across the landscape to forage on lerp infestations or an abundance of eucalypt flowers.	PMST	Possible	Low

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				Preferred feed trees include Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon and E. albens.			
Leipoa ocellata	Malleefowl		V	The Malleefowl typically occupies mallee communities with a spinifex understory but occasionally uses woodlands with a denser understory. It requires light sandy loam soils with a diverse shrub and understory.	PMST	Nil	Nil
Limosa limosa	Black-tailed Godwit	V		Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Individuals have been recorded in wet fields and sewerage treatment works. Forages for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles in soft mud or shallow water. Roosts and loafs on low banks of mud, sand and shell bars.	BioNet	Unlikely	Low
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V		Inhabits a wide range of treed and treeless inland habitats, always within	BioNet	Likely	Low

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				easy reach of water. Feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines. Normally found in pairs or small groups, though flocks of hundreds may be found where food is abundant. Nesting, in tree hollows, occurs throughout the second half of the year; nests are at least 1 km apart, with no more than one pair every 30 square kilometres.			
Neophema pulchella	Turquoise Parrot	V		Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants or browsing on vegetable matter. Forages quietly and may be quite tolerant of disturbance. Nests in tree hollows, logs or posts, from August to December.	BioNet	Possible	Low

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
Ninox connivens	Barking Owl	V		Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance. Breeds in large old trees containing hollows.	BioNet	Likely	Low
Numenius madagascariensis	Eastern Curlew		CE	Generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. Forages in or at the edge of shallow water, occasionally	PMST	Unlikely	Low

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. It roosts on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves. May also roost on wooden oyster leases or other similar structures.			
Petroica phoenicea	Flame Robin	V		Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains). Often occurs in recently burnt areas; however, habitat becomes unsuitable as vegetation closes up following regeneration. In winter lives in dry forests, open woodlands and in	BioNet	Possible	Moderate

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				pastures and native grasslands, with or without scattered trees.			
Polytelis swainsonii	Superb Parrot	V	V	The Superb Parrot requires tree hollows to breed. They typically nest in colonies and return to the same location over generations. The closest known breeding colonies occur at Cowra. During the summer they return from wintering in northern NSW to breed, often in open box-woodland or isolated paddock trees. They may forage in grassy box woodland up to 10km from the nesting site.	BioNet/ PMST	Possible	Low
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V		Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. Feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses. Build and maintain several conspicuous, dome-shaped stick nests about the size of a football.	BioNet	Possible	Moderate

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
Rostratula australis	Australian Painted Snipe		E	The Australian Painted Snipe occupies wetland and swamp habitats, preferring the fringes of swamps and dams with a cover of grasses, lignum or open timber. Breeding occurs anytime during spring and summer when conditions are favourable. It nests on the ground amongst tall vegetation.	PMST	Possible	Low
Stagonopleura guttata	Diamond Firetail	V		Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season).	BioNet	Likely	Moderate
Stictonetta naevosa	Freckled Duck	V		Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral	BioNet	Possible	Low

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.			
Fish							
Maccullochella macquariensis	Trout Cod		E	The Trout Cod is endemic to the southern Murray-Darling river system, including the Murrumbidgee and Murray Rivers, and the Macquarie River in central NSW. Trout Cod tend to occupy areas which have lots of large in-stream woody debris or 'snags', which provide complex habitats for each stage of the species' life cycle.	PMST	Nil	Nil
Maccullochella peelii	Murray Cod		V	The Murray Cod is known to occur within the Macquarie River and Lachlan Rivers. They move upstream to breed in small, clear, rocky streams with a variety of riffle and pool structure. At other times of the year they occupy large, slow-flowing often silty rivers of the Murray-Darling Basin. During this time they prefer habitats that provide adequate shelter in	PMST	Nil	Nil

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				the form of deep holes vegetative cover, snags and overhanging vegetation.			
Macquaria australasica	Macquarie Perch		E	This species of freshwater fish inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems. This species is found in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas. The species requires clear water with deep, rocky holes with abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks.	PMST	Nil	Nil
Mammalia							
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	The Large-eared Pied Bat primarily roosts beneath cliff overhangs, within disused mine shafts and may use tree hollows. Only two maternity roosts are known to occur within NSW. This species requires a combination of sandstone cliff for	PMST	Unlikely	Nil

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				roosting habitat adjacent to Box-Gum Woodland or riparian corridors to provide appropriate foraging grounds.			
Chalinolobus picatus	Little Pied Bat	V		Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimbil box woodlands. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Can tolerate high temperatures and dryness but need access to nearby open water. Feeds on moths and possibly other flying invertebrates.	BioNet	Unlikely	Low
Dasyurus maculatus maculatus	Spotted-tail Quoll (SE Mainland Population)	V	E	The Spotted-tailed Quoll has been recorded across a variety of habitats including rainforest, heath, woodlands and riparian forests. They require den sites found amongst fallen logs, small caves, rocky outcrops or within tree hollows to shelter and breed. Females occupy home ranges up to 750 ha while males' territories can extend up to 3500 ha.	PMST	Unlikely	Nil

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	The South-eastern Long-eared Bat is known to occur throughout a variety of habitat types including Box-Gum, Ironbark and cypress pine woodlands. It relies on tree hollows to roost and breed.	PMST	Possible	Low
Phascolarctos cinereus	Koala	V	V	The Koala occupies open eucalypt woodlands and forests feeding exclusively on preferred feed trees.	BioNet / PMST	Possible	Low
Pteropus poliocephalus	Grey-headed Flying Fox	V	V	They Grey-headed Flying Fox roosts in conspicuous colonies often along watercourses. They forage on a range of fruits and blossoms travelling up to 50 km in an evening to feed.	BioNet / PMST	Likely	Low
Reptilia							
Aprasia parapulchella	Pink-tailed Worm-lizard	V	V	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (Themeda australis). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in	PMST	Unlikely	Low

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites.			
Flora							
Androcalva procumbens			V	Grows in sandy sites, often along roadsides. Recorded in Eucalyptus dealbata and Eucalyptus sideroxylon communities, Melaleuca uncinata scrub, under mallee eucalypts with a Calytrix tetragona understorey, and in a recently burnt Ironbark and Callitris area. Also in Eucalyptus fibrosa subsp. nubila, Eucalyptus dealbata, Eucalyptus albens and Callitris glaucophylla woodlands north of Dubbo. Other associated species include Acacia triptera, Callitris endlicheri, Eucalyptus melliodora, Allocasuarina diminuta, Philotheca salsolifolia, Xanthorrhoea species, Exocarpos cupressiformis, Leptospermum parvifolium and Kunzea parvifolia.	PMST	Possible	Low

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				Fruiting period is summer to autumn. Flowers from August to December.			
Austrostipa metatoris		V	V	Grows in sandy areas of the Murray Valley; habitats include sandhills, sandridges, undulating plains and flat open mallee country, with red to red-brown clay-loam to sandy-loam soils. Associated species include Eucalyptus populnea, E. intertexta, Callitris glaucophylla, Casuarina cristata, Santalum acuminatum and Dodonaea viscosa. Flowers in response to rain.	PMST	Unlikely	Low
Austrostipa wakoolica		E	E	Grows on floodplains of the Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils; habitats include the edges of a lignum swamp with box and mallee; creek banks in grey, silty clay; mallee and lignum sandy-loam flat; open Cypress Pine forest on low sandy range; and a low, rocky rise. Associated species include Callitris glaucophylla, Eucalyptus microcarpa, E. populnea, Austrostipa eremophila, A. drummondii, Austrodanthonia eriantha and Einadia	BioNet / PMST	Unlikely	Low

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				nutans. Flowers from October to December, mainly in response to rain.			
Prasophyllum petilum	Tarengo Leek Orchid		E	Grows in open sites within Natural Temperate Grassland at the Boorowa and Delegate sites. Also grows in grassy woodland in association with River Tussock Poa labillardieri, Black Gum Eucalyptus aggregata and tea-trees Leptospermum spp. near Queanbeyan and within the grassy groundlayer dominated by Kangaroo Grass under Box-Gum Woodland at Ilford (and Hall, ACT). Apparently highly susceptible to grazing, being retained only at little-grazed travelling stock reserves (Boorowa & Delegate) and in cemeteries (near Queanbeyan, Ilford and Hall). Flowers in October at Boorowa and Ilford, and December at sites near Queanbeyan and Delegate.	PMST	Unlikely	Nil
Prasophyllum sp. Wybong			CE	A perennial orchid, appearing as a single leaf over winter and spring. Flowers in spring and dies back to a dormant tuber over summer and autumn. Known to	PMST	Unlikely	Low – only small areas of potentially suitable habitat

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				occur in open eucalypt woodland and grassland.			for this species will be impacted.
Swainsona recta	Small Purple-pea	E	E	Grows in association with understorey dominants that include Kangaroo Grass Themeda australis, poa tussocks Poa spp. and spear-grasses Austrostipa spp. Plants die back in summer, surviving as a rootstocks until they shoot again in autumn. Generally tolerant of fire.	PMST	Possible	Low – only small areas of potentially suitable habitat for this species will be impacted.
Swainsona sericea	Silky Swainson-pea	V		Found in Natural Temperate Grassland and Snow Gum Eucalyptus pauciflora Woodland on the Monaro. Found in Box-Gum Woodland in the Southern Tablelands and South West Slopes. Sometimes found in association with Callitris spp.	BioNet	Unlikely	Low
Tylophora linearis		V	E	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla and Allocasuarina	PMST	Unlikely	Low

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				luehmannii. Also grows in association with Acacia hakeoides, Acacia lineata, Melaleuca uncinata, Myoporum species and Casuarina species. Flowers in spring, with flowers recorded in November or May with fruiting probably 2 to 3 months later.			
Endangered Ecological Communities							
Inland Grey Box (Eucalyptus microcarpa) Grassy Woodland and Derived Native Grasslands of South-eastern Australia		E	E	Eucalyptus microcarpa (Inland Grey Box), is often found in association with E.populnea subsp. bimbil (Bimble or Poplar Box), Callitris glaucophylla (White Cypress Pine), Brachychiton populneus (Kurrajong), Allocasuarina luehmannii (Bulloak) or E. melliodora (Yellow Box), and sometimes with E. albens (White Box). Shrubs are typically sparse or absent, although this component can be diverse and may be locally common, especially in drier western portions of the community. A variable ground layer of grass and herbaceous species is present at most	PMST / mapping	Nil	Nil

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				sites. At severely disturbed sites the ground layer may be absent.			
Poplar Box Grassy Woodland on Alluvial Plains			E	Poplar Box Grassy Woodland on Alluvial Plains covers native grassy eucalypt woodland where poplar/bimble box is the main tree canopy species present. Other tree species may occasionally occur depending on the characteristics of the site, these include Callitris glaucophylla (white cypress pine), Casuarina cristata (belah), Eucalyptus coolabah (coolibah), Eucalyptus largiflorens (black box), Eucalyptus melanophloia (silver-leaved ironbark), Eucalyptus microcarpa (inland grey box) and Eucalyptus pilligaensis (narrow-leaved grey box).	PMST	Nil	Nil
Weeping Myall Woodlands			E	Weeping Myall Woodlands occur in a range of forms from open woodlands to woodlands*, in which weeping myall (Acacia pendula) trees are the sole or dominant overstorey species. Although weeping myall trees are often the only tree species in these woodlands, other	PMST	Nil	Nil

Scientific Name	Common name	BC Act	EPBC Act	Habitat	Source	Likelihood of Occurrence within the Study Area	Likelihood of impact within the Study Area
				trees can occur in the overstorey of the ecological community			
White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland		CE	CE	White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland can occur as either grassland or woodland is characterised by a species diverse understory of grasses, herbs and sparse shrubs. Dominant canopy species include Eucalyptus albens, E. melliodora and E. blakelyi.	PMST / mapping	Known	High

Table 15 Migratory and Marine species likelihood of occurrence table

Scientific Name	Common Name	Comm. status	Habitat Association	Nature of Records	Likelihood of occurrence within subject site
Migratory and Marine					
Actitis hypoleucos	Common Sandpiper	-	In Australia, the Common Sandpiper is found in coastal or inland wetlands, both saline or fresh. It is found mainly on muddy edges or rocky shores. During the breeding season in the northern hemisphere, it prefers freshwater lakes and shallow rivers.	Species or species habitat may occur within area.	Possible
Apus pacificus	Fork-tailed Swift	-	Spends most of their time in the air and roosts on cliffs or walls.	Species or species habitat likely to occur within area.	Possible
Ardea alba	Great Egret	-	Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species, and roost at night in groups.	Species or species habitat likely to occur within area.	Possible
Ardea ibis	Cattle Egret	-	The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor. Will also forage at garbage dumps, and is often seen with cattle and other stock.	Species or species habitat may occur within area.	Possible

Scientific Name	Common Name	Comm. status	Habitat Association	Nature of Records	Likelihood of occurrence within subject site
Calidris acuminata	Sharp-tailed Sandpiper	-	The Sharp-tailed Sandpiper prefers the grassy edges of shallow inland freshwater wetlands. It is also found around sewage farms, flooded fields, mudflats, mangroves, rocky shores and beaches. Its breeding habitat in Siberia is the peat-hummock and lichen tundra of the high Arctic.	Species or species habitat may occur within area.	Possible
Calidris melanotos	Pectoral Sandpiper		These birds winter in Australia and forage on grasslands and mudflats, picking up food by sight, sometimes by probing. They mainly eat arthropods and other invertebrates.	Species or species habitat likely to occur within area.	Unlikely
Chrysococcyx osculans	Black-eared Cuckoo	-	The Black-eared Cuckoo is found in drier country where species such as mulga and mallee form open woodlands and shrublands. It is often found in vegetation along creek beds.	Species or species habitat likely to occur within area.	Unlikely
Gallinago hardwickii	Latham's Snipe	-	Latham's Snipe are seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture.	Species or species habitat may occur within area.	Possible
Haliaeetus leucogaster	White-bellied Sea Eagle	V	Habitats are characterised by large bodies of water- lakes, rivers, sea. Terrestrial and sea-side habitats need to have tall trees with emergent dead branches or tall nearby trees as ‘guard roosts’.	Species or species habitat likely to occur within area.	Possible

Scientific Name	Common Name	Comm. status	Habitat Association	Nature of Records	Likelihood of occurrence within subject site
Hirundapus caudacutus	White-throated Needletail	V	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	Species or species habitat likely to occur within area.	Possible
Myiagra cyanoleuca	Satin Flycatcher	-	In NSW widespread on and east of the Great Divide, sparsely scattered on the western slopes, very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, often near wetlands and watercourses. On migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Generally, not in rainforests.	Species or species habitat known to occur within area.	Possible
Merops ornatus	Rainbow Bee-eater	-	The Rainbow Bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels.	Species or species habitat may occur within area	Possible
Motacilla flava	Yellow Wagtail	-	The Yellow Wagtail is a rare visitor to Australia and may be recorded as a vagrant on occasion.	Species or species habitat may occur within area.	Nil

Scientific Name	Common Name	Comm. status	Habitat Association	Nature of Records	Likelihood of occurrence within subject site
Myiagra cyanoleuca	Satin Flycatcher	-	The Satin Flycatcher is found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests. This species returns to the south in winter to breed.	Species or species habitat may occur within area	Possible
Numenius madagascariensis	Eastern Curlew	CE	The Eastern Curlew is found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons. It is rarely found inland. The Eastern Curlew occurs only in our flyway, and about 75 per cent of the world's curlews winter in Australia.	Species or species habitat may to occur within area.	Nil
Pandion haliaetus	Osprey	-	Found in northern coastal areas – fish make up 99 % of their diet, water is therefore critical habitat.	Species or species habitat known to occur within area.	Unlikely
Rostratula benghalensis	Painted Snipe	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. Breeding is often in response to local conditions; generally occurs from September to December. Incubation and care of young is all undertaken by the male only. Forages nocturnally	Species or Species habitat likely to occur within area.	Possible

Scientific Name	Common Name	Comm. status	Habitat Association	Nature of Records	Likelihood of occurrence within subject site
			on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter.		

Appendix E – NSW Tests of Significance

TESTS OF SIGNIFICANCE FOR STATE LISTED THREATENED BIOTA

Section 1.7 of the EP&A Act lists considerations that must be taken into account in the determination of the significance of potential impacts of a proposed Proposal on 'threatened species, populations or ecological communities (or their habitats)' listed under the BC Act. The Test of Significance is used to determine whether a Proposal is 'likely' to impose 'a significant effect' on threatened biota and thus whether a Species Impact Statement (SIS) is required. Should the Test of Significance conclude that there is likely to be a 'significant effect' on a listed species, population or endangered ecological community, an SIS must be prepared or participation in the Biodiversity Offset Scheme.

Biodiversity Conservation Act 2016 Part 7.3 sets out the following Test of Significance considerations which must be addressed to determine whether a significant impact is likely to occur.

The following species are all listed under the BC Act and have been assessed:

Table 16 Species assessed under the BC Act

Scientific Name	Common name	BC Act	Summary of Assessment of Significance
Birds of Prey			
Falco hypoleucos	Grey Falcon	E	No significant impact
Falco subniger	Black Falcon	V	No significant impact
Hieaaetus morphnoides	Little Eagle	V	No significant impact
Circus assimilis	Spotted Harrier	V	No significant impact
Woodland Birds			
Chthonicola sagittata	Speckled Warbler	V	No significant impact
Climacteris picumnus	Brown Treecreeper (eastern subspecies)	V	No significant impact
Daphoenositta chrysopterus	Varied Sittella	V	No significant impact
Stagonopleura guttata	Diamond Firetail	V	No significant impact
Petroica phoenicea	Flame Robin	V	No significant impact
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	No significant impact
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland		CE	No significant impact

Birds of Prey:

i. Spotted Harrier, *Circus assimilis* - Vulnerable
ii. Grey Falcon, *Falco hypoleucos* - Endangered
iii. Black Falcon, *Falco subniger* - Vulnerable
iv. Little Eagle, *Hieaaetus morphnoides* – Vulnerable

These species have been grouped together based on similar habitat requirements.

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The Spotted Harrier, Grey Flacon, Black Falcon and Little Eagle all contain records within the locality. These species of bird of prey generally prefers open Eucalypt forest and woodland and will utilise open grassland, including exotic grassland areas. They nest in tall trees in remnant patches of vegetation and feed on mammals, birds and reptiles.

The site contains several small and scattered trees (6, see Figure 3) and woodland to the east and west of the study area, with the remainder constituting exotic grassland surrounded by residential and industrial area. Larger patches of higher quality woodland and grassland occur in the broader locality.

The proposal involves direct impact to **21.24 ha** of land, which is mostly exotic grassland and **4.34 ha** constitutes White-Box – White Cypress Pine – Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion.

One large mature *Eucalyptus albens* was noted as occurring within the subject site along with a number of *Eucalyptus albens* saplings. These mature white box may provide potential roosting habitat for these species at some stage in their life history, although due to the lack of surrounding mature trees, this individual tree is not likely to be a suitable nesting tree. Other vegetation within the subject site may provide perching platforms from which to hunt and open grassland provides potential feeding areas.

The subject site would only comprise a small proportion of potential marginal hunting habitat for these species, with areas of suitable roosting, foraging and breeding habitat present outside the study site within the immediate and broader locality. Surrounding agricultural properties and grasslands would constitute preferred feeding habitat for these species, and the potential nesting habitat adjacent the subject site will remain largely unaffected. Therefore, the proposal is deemed unlikely to place viable local populations of these species at risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable to these threatened species.

In relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

Potential habitat for these species includes the native woodland vegetation present within (**4.34 ha)** and adjacent the study area. Open grassland habitat within the subject site **(16.90 ha**) provides potential feeding habitat.

A total of **21.24** ha will be directly impacted by these works. The surrounding landscape supports further high-quality habitat for these species. As the exotic grassland also constitutes potential feeding habitat for this species, some fragmentation will occur. Although the proposed works will reduce the availability of habitat for these species, their highly mobile nature and large home ranges will mean that they will not be impacted by this fragmentation.

Large areas of suitable habitat for these species occur within the study area and broader locality. The proposed works are unlikely to impact the long-term survival of these species as there exists viable good quality habitat in the immediate vicinity of the study area.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The site does not support any declared registered areas of outstanding biodiversity value (formerly critical habitat).

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The following listed Key threatening processes have the potential to increase as a result of the proposal if appropriate safety measures are not implemented and adhered to.

- Clearing of native vegetation
- Invasion of plant communities by perennial exotic grasses
- Infection of native plants by *Phytophthora cinnamomi*.
- Introduction and establishment of Exotic Rust Fungi of the order Pucciniales, pathogenic on plants of the family Myrtaceae.

Conclusion

Given that only a proportionally small area of potential marginal foraging habitat is to be impacted, and the availability of other suitable habitat within the locality, the proposed works are unlikely to result in a significant impact on the Spotted Harrier, Grey Flacon, Black Falcon and Little Eagle such that these species are placed at further risk of extinction.

Woodland Birds:

i. Speckled Warbler, *Chthonicola sagittate* – Vulnerable
ii. Brown Treecreeper (eastern subspecies), *Climacteris picumnus* – Vulnerable
iii. Varied Sittella, *Daphoenositta chrysopterus* – Vulnerable
iv. Flame Robin, *Petroica phoenicea* – Vulnerable
v. Grey-crowned Babbler (eastern subspecies), *Pomatostomus temporalis temporalis* - Vulnerable
vi. Diamond Firetail, *Stagonopleura guttata* – Vulnerable

These species have been grouped together based on similar habitat requirements.

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The Woodland Birds identified above, rely on some resources within the habitat identified within the study area. These species utilize woodland areas and edges with diverse grassy and shrubby understorey for foraging and nesting opportunities. Insects are gleaned from the air, under bark, or within debris and fallen timber resources. Nesting occurs in trees or shrubs. Contiguous vegetation is preferred to allow ease of movement throughout home ranges and habitat resources, though marginal areas may be utilized opportunistically.

The site contains two patches of woodland at either end of the study area, with the remainder constituting exotic grassland, with a patch of cypress pine in a patch to the east. The trees on site were mapped and can be seen in Figure 3. The grassland/open area contained several weeds and lacked roosts and perches, however still contains potential foraging habitat.

The proposal involves an impact to approximately **21.24 ha** of which **4.34 ha** was considered native. A total of **8.37 ha** of native vegetation will sustain direct and indirect impacts, representing **0.78 %** of the total vegetation within a 1.5 km radius.

Stands of cypress pine and scattered paddock trees that occur within the subject site and study area will be removed and potential marginal foraging habitat removed. Habitat of higher quality and size exists surrounding the subject site and within the broader locality. Therefore, the proposal is deemed unlikely to place viable local populations of these species at risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable to these threatened species.

In relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

Potential habitat for these species includes the native woodland vegetation present to the east and west of the proposed site and exotic grassland throughout.

Areas of potential habitat occur throughout the locality. Approximately **7.26 ha** of potential marginal foraging habitat will be impacted by these works. The surrounding landscape supports further high-quality habitat for these species.

Further habitat fragmentation/isolation will not occur as the proposed works is to be undertaken in a predominantly cleared paddock which is already subject to impacts from the WTP and surrounding industry. Several trees (Figure 3) will be removed or impacted by the proposed works.

Large areas of suitable habitat for these species occur within the study area and broader locality. Impacts to this area of predominately exotic groundcover vegetation within a previously disturbed area is unlikely to impact the long-term survival of these species as the habitat to be removed is of moderate quality and other, more valuable resources remain within the vicinity, which will not be impacted as part of works.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The site does not support any declared Areas of Outstanding Biodiversity Value (formerly critical habitat).

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The following listed Key threatening processes have the potential to increase as a result of the proposal if appropriate safety measures are not implemented and adhered to.

- Clearing of native vegetation
- Invasion of plant communities by perennial exotic grasses
- Infection of native plants by *Phytophthora cinnamomi*.
- Introduction and establishment of Exotic Rust Fungi of the order Pucciniales, pathogenic on plants of the family Myrtaceae.

Conclusion

Given that only a proportionally small area of potential foraging habitat is to be impacted, and the availability of other suitable habitat within the locality, the proposed works are unlikely to result in a significant impact on these woodland bird species such that they are placed at further risk of extinction.

Ecological Communities

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Critically Endangered (Box Gum Woodland)

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

N/A

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Box Gum Woodland occurs as a small, degraded patch of PCT 267 at the western end and eastern sides of the proposed Lagoon footprint within the study area. This community is mapped as occurring in a number of discrete patches within the broader locality. The proposal is likely to directly impact on approximately **4.34 ha** of this community in the form of disturbance to groundcover and shrubs, and removal of a patch of regenerating White Cypress Pine, as well as one (1) mature and two (2) juvenile White Box. The area to be impacted constitutes approximately **12.17 %** of the extent of this community occurring within the broader locality.

The area of this community the be impacted occurs along the edges of a previously cleared agricultural paddock and is experiencing low diversity and weed encroachment due to disturbance from farm activity, grazing by native and exotic animals, and recreational users of Golden Bar Hill. A clump of White Cypress Pine trees will be removed as part of the project, along the eastern boundary of the subject site, as well as up to two (2) White Box saplings and one (1) large mature White Box tree. Thus, due to the small impact area for this PCT, it is deemed unlikely that this proposal will impact on the extent or composition of this endangered community such that its local occurrence is placed at risk of extinction.

The area of this community to be impacted contains high levels of weed encroachment, and the proposal will only impact on groundcover species with no overstorey species to be removed. Thus, it is deemed unlikely that this proposal will impact on the extent or composition of this critically endangered community such that its local occurrence is placed at risk of extinction.

In relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

The proposal is likely to impact on approximately **4.34 ha** of White Box – Yellow Box – Blakely's Red Gum Woodland community in the form of derived scrub/regenerating White Cypress Pine. Only (1) mature White Box tree will be removed. This are constitutes approximately **51.97 %** of the extent of this community occurring within the immediate study area. A larger patch of similar quality woodland occurs to the immediate east along Golden Bar Hill.

Further habitat fragmentation/isolation will not occur as the proposed works is to be undertaken within an existing predominately cleared agricultural paddock, with only localised impacts to native vegetation either side of the study area. Several White Cypress Pine trees and one (1) mature White Box will be removed or impacted as part of this proposal. Habitat that occurs in the locality is already bisected by the existing farm dam and cleared paddock.

Areas to be impacted form only a small fraction of the community occurring within the locality. Only groundcover species and some minor shrubs will be impacted with no overstorey species being impacted. Larger areas of suitable habitat occur directly adjacent the study area and within the broader locality. Impacts to small patches of degraded native vegetation either side of a highly modified paddock is unlikely to further fragment, modify, isolate, or remove these communities such that their long-term survival in the locality will be placed at further risk.

Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The site does not support any declared registered areas of outstanding biodiversity value (formerly critical habitat).

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The following listed Key threatening processes have the potential to increase as a result of the proposal if appropriate safety measures are not implemented and adhered to.

- Clearing of native vegetation
- Invasion of plant communities by perennial exotic grasses
- Infection of native plants by *Phytophthora cinnamomi*.
- Introduction and establishment of Exotic Rust Fungi of the order Pucciniales, pathogenic on plants of the family Myrtaceae.

Conclusion

Given that only a proportionally small area of Box Gum Woodland, predominantly comprised of exotic understorey species and regenerating White Cypress Pine, are to be impacted within the community, with limited removal of White Box trees, and the availability of other patches of higher quality community within the locality, the proposed works are unlikely to result in a significant impact on White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Grassland such that this community is placed at further risk of extinction.

Appendix F – EPBC Act Significant Impact Criteria Assessments

Assessments of significance have been provided for threatened biota of concern to provide an indication of the potential level of impact of the proposal based on past records and habitats present. The following assessments have relied on species habitat information and records available via OEH Saving Our Species, DEE SPRAT profiles unless otherwise stated.

The following species listed under the EPBC Act are included in these assessments:

Table 17 Species assessed under the EPBC Act

Scientific Name	Common name	EPBC Act	Summary of Assessment of Significance
Falco hypoleucos	Grey Falcon	V	No significant impact
White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland		CE	No significant impact

The Assessment of Significance concluded that a significant impact to these species is unlikely. Consequently, a Referral to the Minister is not warranted.

Grey Falcon, *Falco hypoleucos* - Vulnerable

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would:

Lead to a long-term decrease in the size of an important population of a species,

Grey Falcon has been recorded as occurring in the locality, however no important population is known to occur. Although up to seven (7) trees may be removed, only one of these (mature *E. albens*) is considered to be potential nesting tree. Good quality, more suitable habitat (along watercourses) occurs throughout the study area and broader locality and will not be impacted by the proposed works. The proposal is not anticipated to impact significantly on this species as to lead to a reduction in the species population size and may even act to encourage visitation to the new waterbody, as most prey consists of other birds.

Reduce the area of occupancy of the species,

Grey Falcon largely feeds within woodland areas and open grasslands and wooded watercourses. Given that only a small percentage of marginal foraging habitat for this species is to be impacted and given the availability of large tracts of suitable habitat within the immediate study area and broader locality, it is deemed the Proposal is unlikely to reduce the area of occupancy of this species in a manner that would further place it at risk of extinction.

Fragment an existing population into two or more populations,

No existing population is known to occur within the study area and the level of habitat fragmentation will not affect this highly mobile species.

Therefore, the Proposal is deemed unlikely to fragment an existing population of either species into two or more populations.

Adversely affect habitat critical to the survival of a species,

The habitat throughout the study area is not deemed critical to the survival of this species. Marginal hunting habitat will be impacted, however the preferred habitat of this species does not occur on site.

Large tracts of suitable habitat occur within the broader locality. Therefore, the Proposal is unlikely to adversely affect habitat that is critical to the survival of this species.

Disrupt the breeding cycle of a population,

The breeding cycle is unlikely to be affected due to works as long as the Mitigation measures are strictly adhered to.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline,

The removal of small trees and grassland within the study area will potentially decrease hunting opportunities for this species, however these are expected to be increased following installation of the lagoon. Large tracts of suitable habitat occur within the immediate vicinity. Therefore, it is deemed that the Proposal is unlikely to modify, destroy, isolate or decrease the available of quality habitat such that it places this species into further decline.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat,

The study area contains high levels of exotic weeds, including WONS. As long as mitigation measures are strictly adhered to, the extent of invasive species are expected to remain stable, or be reduced as a result of the proposed works.

Introduce disease that may cause the species to decline,

No evidence of existing disease was present within the study area during surveys. Mitigation measures have been stated to reduce the possibility of disease being introduced to the study area are a result of the proposed works. Therefore, as long as mitigation measures are strictly adhered to, no diseases are anticipated to become established as a result of the proposed works.

Interferes substantially with the recovery of the species.

Provided the works do not stray beyond the delineated study area and strict mitigation measures controlling the extent of clearing and on-site protocols are followed, this proposal is unlikely to substantially interfere with the recovery of this species.

Conclusion

Given the above, it is deemed unlikely that Grey Falcon will be significantly impacted by the proposed works.

Critically Endangered and Endangered Ecological Communities – *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland*

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it would:

Reduce the extent of an ecological community,

The proposal will result in the direct removal of approximately **4.34 ha** of the analogous community PCT 267 occurring in a degraded form. Direct impacts will be in the form of disturbance to groundcover and shrubs, and removal of a patch of regenerating White Cypress Pine, as well as one (1) mature and two (2) juvenile White Box. The area to be impacted constitutes approximately **12.17 %** of the extent of this community occurring within the broader locality. Therefore, it is not considered that the Proposal will reduce the extent of this community in any significant way such that it is further put at risk of extinction.

Fragment or increase fragmentation of an ecological community,

The area of this community to be impacted lies on the outskirts of the study area, which is not mostly cleared but would have historically linked the eastern and western patches. Two patches of this PCT (Figure 3) occur to the east and the west, and are already fragmented by the clear land that makes up the majority of the subject site. This Proposal will not further fragment this community as no large tracts of woodland are being removed.

Adversely affect habitat critical to the survival of an ecological community,

The patch of this community occurring within the subject site occurs as regenerating White Cypress Pine with a largely exotic understory and is part of a larger patch that extends to the east.

The habitat to be directly impacted is of low quality and does not contain mature eucalypt species. Therefore, it is deemed this Proposal will not adversely affect habitat critical to the survival of this species.

Modify or destroy abiotic (non-living) factors necessary for the community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns,

The proposal involve installation of a 20 ML lagoon, which will impact on the surface water and drainage within the area. Groundwater may potentially be impacted, however the expected works are unlikely to impact on this community. Therefore, it is deemed that the Proposal is unlikely to modify or destroy abiotic factors necessary for the community's survival.

Cause a substantial change in the species composition of an occurrence of the ecological community, including causing a decline or loss of functionally important species,

The community occurs as a degraded version with current and previous disturbance with high levels of weed encroachment evident. The proposal will see the removal of several white cypress pine, ground cover species and one mature and several saplings of *E. albens*. The vegetation to be removed

is mixed with exotics and of moderate quality, therefore, it is deemed unlikely this proposal will cause a substantial change in species composition for either community.

Cause a substantial reduction in the quality or integrity of an occurrence of the ecological community, including, but not limited to:

- **Assisting invasive species, that are harmful to the listed ecological community, to become established**

Invasive species, including listed WONS and other exotic grasses pervade the study area, and were noted as occurring within the area of ecological community. The proposal will remove many of the weeds occurring on site, and, if all mitigation measures are followed, will not spread these outside of the works area.

- **Causing regular mobilisation of fertilisers, herbicides, or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community**

Mitigation measures undertaken during construction will minizine any potential introduction of chemicals or pollutants as a result of the proposed works.

Interferes with the recovery of the ecological community.

Provided the works do not stray beyond the delineated study area and strict mitigation measures controlling the extent of clearing and on-site protocols are followed, this proposal is unlikely to substantially interfere with the recovery of this ecological communities.

Conclusion

Given the above, it is deemed unlikely that the White Box – Yellow Box – Blakely's Red Gum Woodland will be significantly impacted by the proposed works.

Appendix G – BOM Daily Weather Observations

Parkes, New South Wales
March 2021 Daily Weather Observations

Observations from Parkes Airport.

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Mo	13.8	35.0	0			WSW	54	14:32							33.4	16		W	33	1007.8
2	Tu			0						17.3	54		SW	15	1012.7	25.6	17		SW	19	1011.1
3	We		27.4							20.5	45		N	11	1013.8	26.2	18		WSW	13	1011.9
4	Th	9.7	27.9	0			SSW	43	15:15	18.0	66		N	9	1014.7	26.8	21		WSW	17	1010.8
5	Fr	7.7	27.9	0			SW	43	13:30	16.8	62		SW	17	1009.5	26.3	30		SW	28	1007.0
6	Sa	5.5	29.9	0			E	26	13:08	18.1	62		NNE	7	1009.7	27.4	25		WSW	6	1008.3
7	Su	14.7	31.9	0					09:10	20.5	55		NE	26	1012.4	29.6	29		NNW	24	1009.0
8	Mo	18.2	34.0	0			N	46	09:01	23.0	57		NNE	20	1010.7	30.4	24		WNW	17	1007.7
9	Tu	15.9	32.1	0			W	44	12:35	22.8	68		N	15	1013.6	30.5	27		WSW	31	1012.4
10	We	8.3	34.3	0			N	48	18:59	21.2	65		NE	7	1017.6	31.1	26		NNW	13	1014.4
11	Th	18.9	28.3	0			NNE	44	11:21	21.8	68		NNE	20	1018.7	22.8	75		NNW	15	1015.8
12	Fr	17.8	30.6	3.0			N	46	13:50	21.3	80		N	15	1017.1	28.4	48		NW	19	1014.0
13	Sa	18.3	34.2	0			SSW	61	21:54	24.8	65		NNE	20	1013.4	32.5	36		NNW	30	1009.5
14	Su	16.2	20.0	3.8			SSW	44	08:52	16.5	96		SSW	20	1013.8	18.7	60		S	24	1014.8
15	Mo	6.4	25.0	0					14:40	14.1	83		S	11	1020.6	24.3	29		SSE	17	1019.1
16	Tu	10.3	26.9	0			ENE	39	09:17	17.5	56		ENE	20	1023.4	25.9	33		E	20	1019.8
17	We	14.7	19.8	0			E	41	22:29	17.9	58		E	22	1021.5	16.6	89			Calm	1021.1
18	Th	15.2	22.3	10.0			ENE	37	17:42	15.6	98			Calm	1020.8	18.5	90		SSW	11	1019.4
19	Fr	15.4	28.6	17.2			E	48	16:25	21.0	63		ESE	24	1021.6	28.0	40		ESE	22	1019.8
20	Sa	16.7	26.4	0					16:45	19.3	70		SE	28	1019.8	25.3	54		SSE	26	1017.0
21	Su	18.3	23.7	3.0			ENE	48	09:55	21.8	68		NE	19	1018.7	21.0	80		ENE	15	1017.6
22	Mo	16.8	18.2	14.8			NE	52	16:17	17.7	88		ENE	20	1016.5	17.3	91		ENE	24	1013.0
23	Tu	16.9	22.4	32.0			NE	46	07:08	17.7	92		NE	28	1001.6	20.8	89		WNW	22	1000.0
24	We	16.3	26.6	6.0			WSW	46	14:33	18.2	85		W	9	1003.5	25.2	38		W	30	1001.7
25	Th	15.0	23.6	0			SW	41	16:43	16.8	89		WSW	17	1007.2	22.5	57		WSW	22	1007.2
26	Fr	7.2	23.3	1.2			SSW	26	12:56	13.5	90		NNE	7	1015.0	22.2	41		WSW	19	1012.4
27	Sa	9.0	25.6	0			WSW	33	15:43	15.0	75			Calm	1014.5	23.6	35		WSW	17	1012.2
28	Su	9.1	24.1	0			SW	37	13:21	16.0	80			Calm	1017.7	24.1	34		WSW	20	1016.1
29	Mo	6.9	23.8	0			SW	41	14:49	12.3	88			Calm	1020.8	22.9	39		SSW	17	1019.0
30	Tu	6.5	25.0	0			SSW	28	14:28	14.9	82		NE	6	1022.2	24.1	37		SW	13	1020.0
31	We	9.0		0						16.6	64		ENE	2	1023.2	24.8	27		S	20	1020.8
Statistics for the first 31 days of March 2021																					
	Mean	12.9	26.9							18.3	72			13	1015.5	25.1	43			19	1013.2
	Lowest	5.5	18.2							12.3	45			Calm	1001.6	16.6	16			Calm	1000.0
	Highest	18.9	35.0	32.0			SSW	61		24.8	98		#	28	1023.4	33.4	91		W	33	1021.1
	Total			91.0																	

Observations were drawn from Parkes Airport AWS {station 065068}

IDCJDW2106.202103 Prepared at 23:36 UTC on 31 Mar 2021

Parkes, New South Wales
July 2023 Daily Weather Observations

Observations from Parkes Airport.

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Sa	6.4	12.0	1.6			SW	35	12:50	8.5	100		WNW	15	1025.2	10.7	78		SSW	20	1024.3
2	Su	3.4	15.9	0.2			S	24	00:54	7.0	99			Calm	1031.6	14.7	51		SW	15	1029.8
3	Mo	2.6	16.9	0			NE	30	09:32	11.8	69		ENE	13	1030.6	15.5	61		NE	7	1025.7
4	Tu	9.6	14.1	7.0			NNE	37	11:05	12.1	96		NE	17	1019.1	12.4	99		NE	11	1013.4
5	We	11.3	12.8	8.0			W	26	14:00	11.6	99		W	15	1016.3	11.1	97		WSW	19	1015.3
6	Th	6.9	12.7	0.2			NNW	35	14:28	8.3	99		NNE	7	1016.6	9.8	89		NW	15	1012.5
7	Fr	6.4	11.3	3.2			SW	35	01:10	8.4	93		W	20	1016.2	10.8	77		WNW	17	1016.7
8	Sa	1.9	14.4	0			NNW	44	11:24	8.2	87		N	17	1019.8	13.1	67		WNW	15	1015.9
9	Su	1.9	14.7	0.2			SW	39	10:47	8.3	88		SW	11	1023.0	13.3	66		WSW	24	1021.9
10	Mo	8.3	14.4	0			SW	35	12:17	11.5	75		SW	9	1026.4	12.6	62		SSW	17	1025.0
11	Tu	4.8	15.0	0			SW	37	13:13	9.0	88		SW	7	1029.5	14.6	59		S	26	1027.5
12	We	-0.4	17.9	0			NNW	22	13:44	7.5	99			Calm	1030.7	15.8	61		SW	15	1027.9
13	Th	0.1	17.8	0.2			NW	31	12:13	7.7	99		NNE	6	1030.4	17.4	46		NNW	15	1027.3
14	Fr	0.3	18.2	0			NNW	35	12:11	9.2	87		NNE	6	1027.9	17.6	59		NNW	22	1024.6
15	Sa	5.3	18.2	0			N	39	10:09	11.2	77		N	20	1024.1	16.9	59		N	20	1021.4
16	Su	10.2	19.9	4.8			E	19	04:05	11.7	99			Calm	1028.2	18.3	53			Calm	1027.2
17	Mo	3.7	18.9	0.2			N	24	11:15	9.6	99			Calm	1030.3	18.5	57		NW	9	1027.0
18	Tu	2.1	17.3	0			NW	19	15:15	7.4	99		NE	6	1025.7	16.9	65		NNW	11	1021.8
19	We	-1.8	12.0	0			SSW	30	11:56	3.5	99		WSW	7	1025.9	11.4	54		SW	17	1023.6
20	Th	-4.0	14.3	0.2			N	31	11:22	3.2	92		S	13	1022.2	13.9	49		N	17	1017.7
21	Fr	3.1	13.3	1.6			SW	33	13:55	8.9	97			Calm	1020.5	11.7	62		SW	19	1020.2
22	Sa	-2.1	13.0	0.2			SW	30	15:14	1.8	99			Calm	1024.2	12.4	52		SSW	20	1022.3
23	Su	-2.1	13.6	0			SW	31	12:28	4.3	92			Calm	1024.5	12.7	53		SSW	20	1023.0
24	Mo	-2.4	16.3	0			SSW	24	14:16	4.3	99		SSW	6	1030.3	15.7	49		SSW	19	1029.5
25	Tu	-2.1	19.8	0			NNW	17	12:59	6.0	90			Calm	1035.9	18.8	39			Calm	1034.3
26	We	-0.4	18.8	0			NNW	24	12:40	9.8	94			Calm	1037.0	18.4	49		NW	9	1032.9
27	Th	0.2	19.2	0			NW	26	12:08	9.3	85			Calm	1032.3	18.4	49		NNW	13	1027.5
28	Fr	3.2	16.2	0			N	39	10:19	12.2	69		N	15	1025.4	14.9	72		NE	13	1022.7
29	Sa	6.0	20.2	0.4			N	24	12:28	11.3	99		ENE	11	1024.9	20.2	58		NNW	13	1021.8
30	Su	3.8	19.2	0.8			WNW	19	12:48	11.8	93		NE	6	1024.0	18.1	67		SW	9	1021.5
31	Mo	3.8	16.8	0.4			SW	30	12:34	9.3	100			Calm	1027.2	15.8	60		SSW	19	1025.2
Statistics for July 2023																					
	Mean	2.9	16.0							8.5	92			7	1026.0	14.9	61			15	1023.5
	Lowest	-4.0	11.3							1.8	69			Calm	1016.2	9.8	39			Calm	1012.5
	Highest	11.3	20.2	8.0			NNW	44		12.2	100		#	20	1037.0	20.2	99		S	26	1034.3
	Total			29.2																	

Observations were drawn from Parkes Airport AWS (station 065068)

IDCJDW2106.202307 Prepared at 16:00 UTC on 16 Sep 2023

Appendix C Aboriginal Due Diligence Report

View north across the study area

ABORIGINAL DUE DILIGENCE ASSESSMENT REPORT

PROPOSED PARKES RAW WATER STORAGE LAGOON

PARKES

OCTOBER 2022

Report prepared by

OzArk Environment & Heritage

for Parkes Shire Council

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DOCUMENT CONTROLS

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Acknowledgement

OzArk acknowledge the traditional custodians of the area on which this assessment took place and pay respect to their beliefs, cultural heritage, and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the Elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

EXECUTIVE SUMMARY

OzArk Environment & Heritage (OzArk) has been engaged by the Parkes Shire Council to complete an Aboriginal due diligence assessment for the proposed expansion of a raw water storage lagoon on the north side of the Parkes Water Treatment Plant (WTP). The proposed lagoon expansion is part of the Parkes Water Security Program which is a component of the Building Better Regions Fund for regional NSW.

The proposed expansion would see an existing dam widened on all sides to allow a greater volume of water to be stored. The study area for the assessment includes the existing dam and the surrounding midslope landform to the north of the existing Parkes WTP. The study area encompasses approximately 5.8 hectares of mostly cleared land with some isolated trees.

The visual inspection of the study area was completed by OzArk Archaeologists Harrison Rochford and Jordan Henshaw on 28 September 2022. Rob Clegg, Peter Clegg, and Mick Dunn of the Wiradjuri Council of Elders assisted with the inspection.

The visual inspection concluded that the study area has low archaeological potential due to previous disturbance of the ground surface and the low archaeological sensitivity of the landform.

The undertaking of the due diligence process resulted in the conclusion that the proposed works will have an impact on the ground surface, however, no Aboriginal objects or intact archaeological deposits will be harmed by the proposal. This moves the proposal to the following outcome:

> *Aboriginal Heritage Impact Permit (AHIP) application not necessary. Proceed with caution. If any Aboriginal objects are found, stop work, and notify Heritage NSW (02) 98738500 (heritagemailbox@environment.nsw.gov.au). If human remains are found, stop work, secure the site, and notify NSW Police and Heritage NSW.*

To ensure the greatest possible protection to the area's Aboriginal cultural heritage values, the following recommendations are made:

1) The proposed work may proceed at the study area without further archaeological investigation provided all ground disturbance is confined to the study area. Should the parameters of the proposal extend beyond the assessed areas, then further archaeological assessment may be required.

2) This assessment has concluded that there is a low likelihood that the proposed work will adversely harm Aboriginal cultural heritage items or sites. If during works, however, Aboriginal artefacts or skeletal material are noted, all work should cease and the procedures in the *Unanticipated Finds Protocol* (**Appendix 2**) should be followed.

3) Inductions for work crews should include a cultural heritage awareness procedure to ensure they recognise Aboriginal artefacts (see **Appendix 3**) and are aware of the

legislative protection of Aboriginal objects under the National Parkes and Wildlife Act 1974 and the contents of the *Unanticipated Finds Protocol.*

4) The information presented here meets the requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. It should be retained as shelf documentation for five years as it may be used to support a defence against prosecution in the event of unanticipated harm to Aboriginal objects.

CONTENTS

FIGURES

TABLES

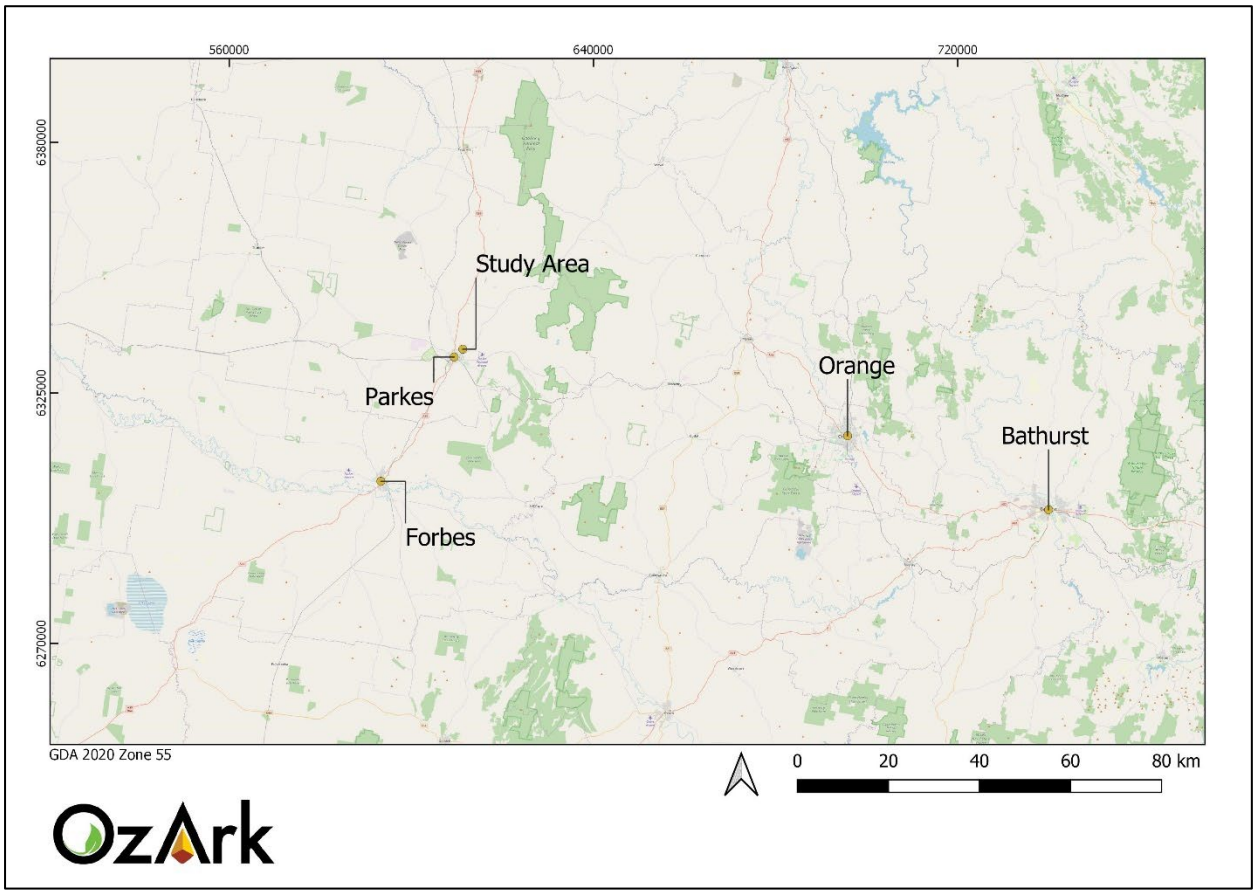
PLATES

1 INTRODUCTION

1.1 BRIEF DESCRIPTION OF THE PROPOSAL

OzArk Environment & Heritage (OzArk) has been engaged by Parkes Shire Council (the proponent) to complete an Aboriginal due diligence heritage assessment for the proposed Raw Water Storage Lagoon expansion (the proposal). The proposal is in the Parkes Shire Council Local Government Area (LGA) (**Figure 1-1**).

Figure 1-1. Map showing the location of the study area.

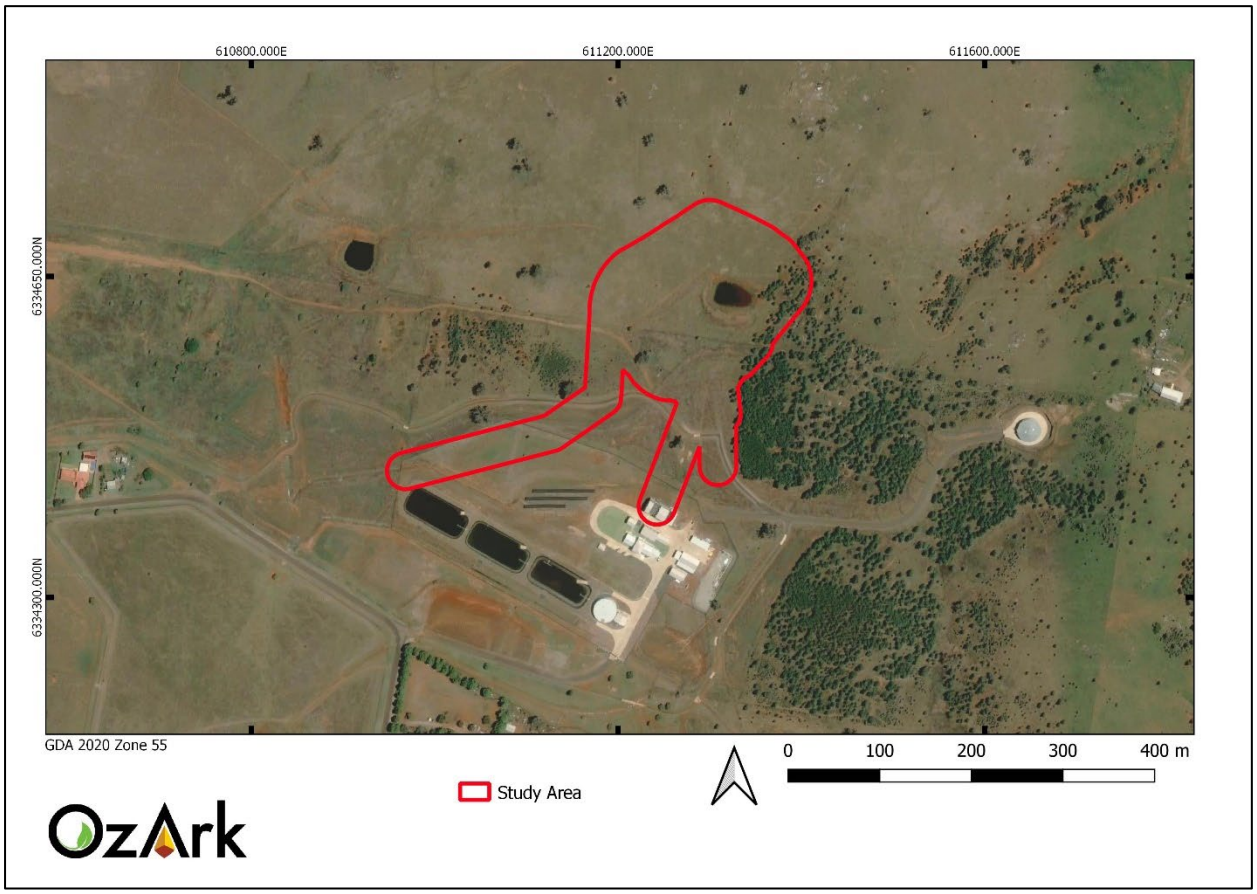


1.2 STUDY AREA

The study area is located on the northern side of the existing Parkes Water Treatment Plant (WTP) on the outskirts of Parkes in the Central West of NSW. Most of the site is a grass covered hillside which has been cleared of trees except for small sections of mature vegetation in the east of the study area. The site is situated approximately 2.5 kilometres (km) west of Goobang Creek.

The study area is shown on **Figure 1-2**.

Figure 1-2: Aerial showing the study area.



1.3 ASSESSMENT APPROACH

Aboriginal cultural heritage

The desktop and visual inspection component for the study area follows the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (due diligence; DECCW 2010). The field inspection followed the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales* (OEH 2011).

2 ABORIGINAL DUE DILIGENCE ASSESSMENT

2.1 INTRODUCTION

Section 57 of the National Parks and Wildlife Regulation 2019 (NPW Regulation) made under the *National Parks and Wildlife Act 1974* (NPW Act) advocates a due diligence process to determining likely impacts on Aboriginal objects. Carrying out due diligence provides a defence to the offence of harming Aboriginal objects and is an important step in satisfying Aboriginal heritage obligations in NSW.

2.2 DEFENCES UNDER THE NPW REGULATION 2019

2.2.1 Low impact activities

The first step before application of the due diligence process itself is to determine whether the proposed activity is a "low impact activity" for which there is a defence in the NPW Regulation. The exemptions are listed in Section 58 of the NPW Regulation (DECCW 2010: 6).

The proposed activities of Parkes Shire Council include excavation and earthworks that are not considered 'low impact activities' unless they can be considered the maintenance of pre-existing utilities (such as water storage works or irrigation infrastructure). As the proposed works will impact land adjacent to the existing infrastructure, this defence does not apply, and the due diligence process will be followed.

2.2.2 Disturbed lands

Relevant to this process is the assessed levels of previous land-use disturbance.

The NPW Regulation Section 58 (DECCW 2010: 18) define disturbed land as follows:

> *Land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable.*
>
> *Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure) and construction of earthworks.*

As sections of the proposed work are in landforms which contain established buildings, roads, and landscaped areas within the Parkes WTP, the proposed work is occurring in 'disturbed land' in some portions of the study area (**Figure 1-2** and **Plate 1**). These landforms were excluded from the due diligence process.

However, other portions of the study area are in areas where the land's surface has not been changed in a clear and observable manner and the due diligence process must be applied.

In summary, it is determined that the proposal must be assessed under the Due Diligence Code of Practice. The reasoning for this determination is set out in **Table 2-1**.

Figure 2-1: Portions defined as 'disturbed land' within the study area.

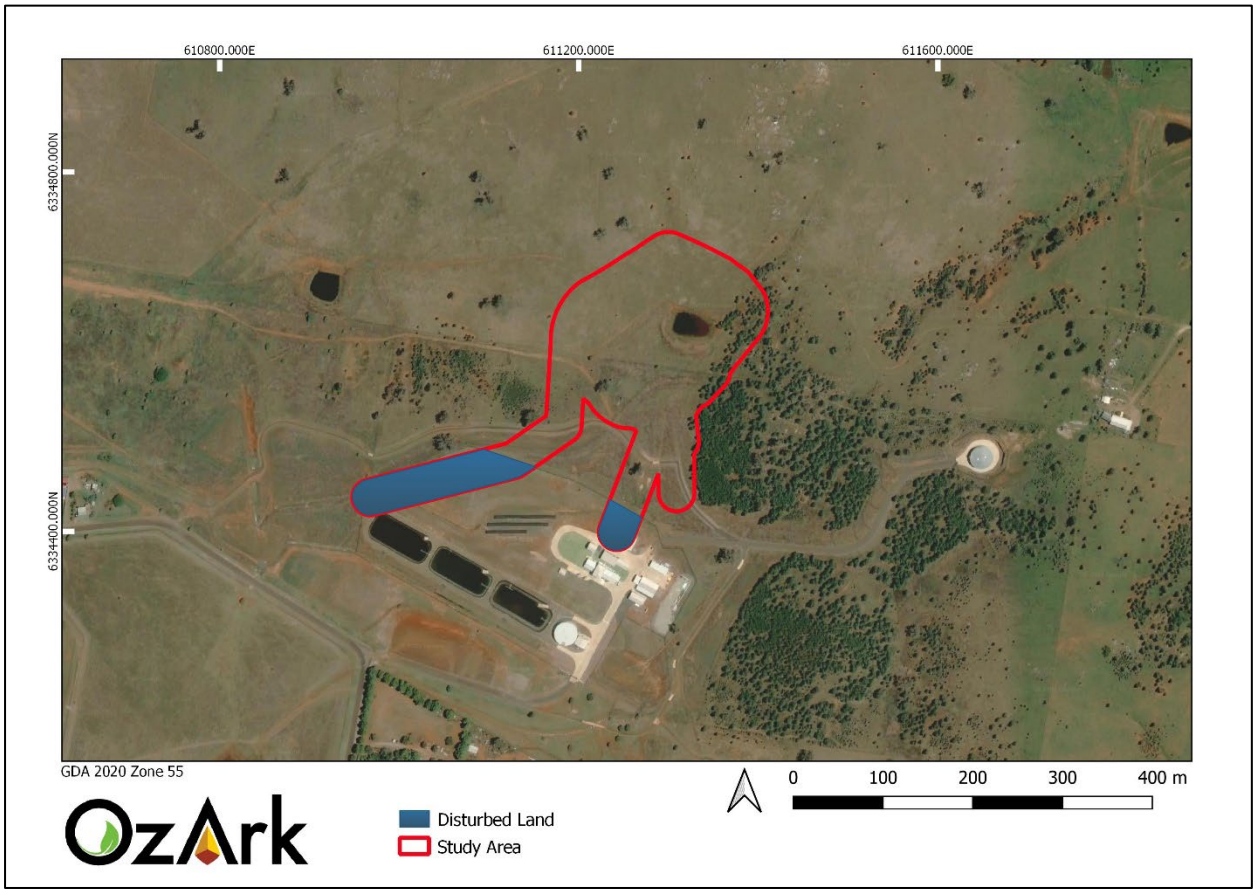


Table 2-1: Determination of whether Due Diligence Code of Practice applies.

Item	Reasoning	Answer
Is the activity to be assessed under Division 4.7 (state significant development) or Division 5.2 (state significant infrastructure) of the EP&A Act?	The proposal will be assessed under Part 5 of the EP&A Act.	No
Is the activity exempt from the NPW Act or NPW Regulation?	The proposal is not exempt under this Act or Regulation.	No
Do either or both apply: Is the activity in an Aboriginal place? Have previous investigations that meet the requirements of this Code identified Aboriginal objects?	The activity will not occur in an Aboriginal place. No previous archaeological investigations have assessed the entire study area.	No
Is the activity a low impact one for which there is a defence in the NPW Regulation?	The proposal is not a low impact activity for which there is a defence in the NPW Regulation.	No
Is the activity occurring entirely within areas that are assessed as 'disturbed lands?	The proposal is not entirely within areas of high modification.	No
Due Diligence Code of Practice assessment is required		

2.3 APPLICATION OF THE DUE DILIGENCE CODE OF PRACTICE TO THE PROPOSAL

To follow the generic due diligence process, a series of steps in a question/answer flowchart format (DECCW 2010: 10) are applied to the proposed impacts and the study area, and the responses documented.

2.3.1 Step 1

Will the activity disturb the ground surface or any culturally modified trees?

Yes, the proposal will impact the ground surface and may impact culturally modified trees.

The proposed work will involve test boring, ground disturbing excavations, and earthworks to widen the lagoon on all sides.

There is the potential for culturally modified trees to be impacted as trees may need to be cleared prior to the earthworks.

2.3.2 Step 2a

Are there any relevant confirmed site records or other associated landscape feature information on AHIMS?

No, there are no previously recorded sites within the study area.

A search of the Aboriginal Heritage Information Management System (AHIMS) on 15 September 2022 was undertaken over a 10 x 10 km search area centred on the study area (GDA Zone 55 Eastings: 606400–616400, Northings 6329403–6339400). The search returned 16 previously recorded Aboriginal sites within the search area, although none within the study area itself.

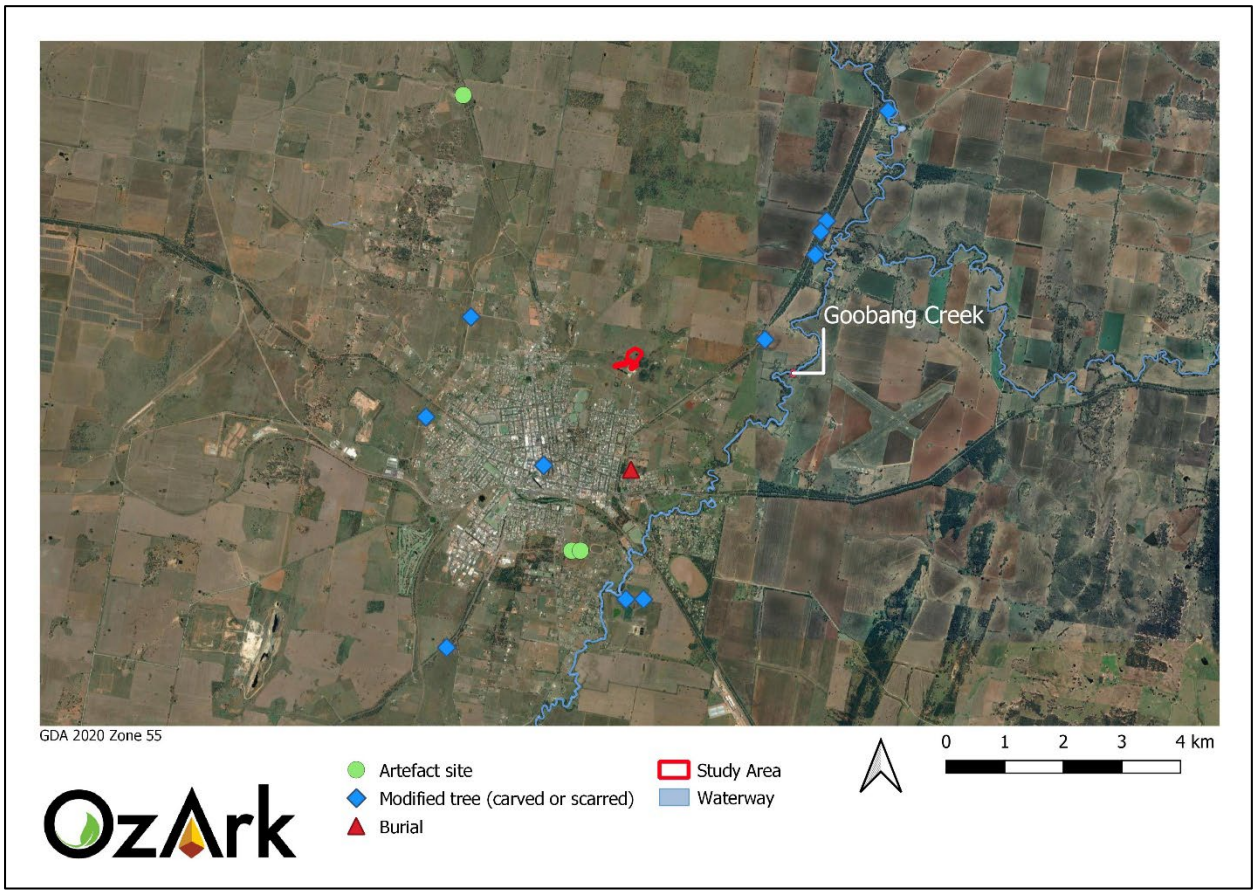
The two main types of sites recorded in the search area are culturally modified trees, and at a much lower frequency, artefact sites. One burial site has been recorded on the eastern side of the township of Parkes. **Table 2-2** shows the types of sites that are close to the study area and the full search results are provided in **Appendix 1**.

Figure 2-2 shows all previously recorded sites in relation to the study area. Many of the modified tree recordings are near Goobang Creek with a few scattered recordings of other site types around the town of Parkes.

Table 2-2: Site types and frequencies of AHIMS sites near the study area.

Site Type	Number	% Frequency
Modified Tree (carved or scarred)	12	75.00
Artefact site	3	18.75
Burial	1	6.25

Figure 2-2: Previously recorded sites in relation to the study area.



2.3.3 Step 2b

Are there any other sources of information of which a person is already aware?

No, there are no other sources of information that would indicate the presence of Aboriginal objects in the study area.

2.3.3.1 Ethnographic context

The study area is in the centre of Wiradjuri land. The Wiradjuri tribal area extends as far north as Gilgandra, as far east as Lithgow and as far west as Hay. It is the largest tribal and linguistic group in NSW by land size and incorporates a large portion of the central tablelands and central west regions of NSW (Horton 1996).

The Wiradjuri people were first encountered by colonial explorers such as Oxley and Cunningham in the early 1800s (Whitehead 2003). They found that Wiradjuri groups, such as the 'Bultje tribe' comprised up to 120 individuals and hunted emus, kangaroo, and possum for food. Fishing was also utilised to sustain the population with both mussels and freshwater fish being caught by the women of the tribe who used moveable dams made of grass to direct fish, making them easier to catch (Kass 2003:6).

2.3.3.2 Regional archaeological context

OzArk 2016

A 2016 study analysing site distribution across the central west region of NSW concluded that Aboriginal sites are more likely to be found in Channel and Floodplain landscapes (Mitchell 2002) and to a lesser degree in Slope landscapes. The study area is located within the Goonumbla Hills landscape (Mitchell 2002) and OzArk 2016 concluded that sites will be rare in these landscapes.

2.3.3.3 Archaeological assessments near the study area

Brayshaw 1993

Early archaeological surveys of the Parkes area conducted in the 1980s and 1990s indicate that Aboriginal sites have been located in landscapes like that of the study area. A report completed for the North Parkes Mine (NPM), located approximately 27 km northwest of the study area found that the most common site type in the region were artefact scatters (Brayshaw 1993).

OzArk 2015a

In 2015, OzArk undertook an assessment of multiple sites for the Parkes Water and Wastewater Augmentation Project (OzArk 2015a). The study concluded that Site 2 in Lot 920 DP750152 and adjacent to the study area, had been subject to moderate disturbances due to previous land clearing and livestock cultivation (OzArk 2015a:19). The study recorded no Aboriginal sites within the study area.

OzArk 2015b

The study area was located to the south of Parkes and concluded that the moderate hills and slopes present where unlikely to attract substantial Aboriginal occupation. It also found that previous activities such as land clearing and earthworks had occurred on the site (OzArk 2015b:15). No Aboriginal sites were recorded in the OzArk study. Like the area assessed for OzArk 2015b, the study area is in a sloping landform and previous land use including land clearing has impacted the soil profile. Based on the results of OzArk 2015b, this would indicate that the study area has a low archaeological potential.

Implications for the study area

The archaeological context indicates that the archaeological signature of Wiradjuri activity in the region of Parkes tends to comprise of modified trees, artefact scatters, and isolated finds. The results of other assessments in the areas indicate that the sloping landform of the study area does not have a high potential for sites, but if sites are recorded, the most likely site type would be artefact scatters. Assessments in adjacent landforms to the study area did not record Aboriginal sites and this result can also be extrapolated to the similar landforms in the study area.

No other known cultural values or Aboriginal sites pertaining directly to the location of the proposed work have been identified.

2.3.4 Step 2c

Are there any landscape features that are likely to indicate presence of Aboriginal objects?

No, portions of the study area do not contain landforms with identified archaeological sensitivity.

The site is not located within 200 m of a named water source, the closest being the Goobang Creek over 2 km to the east. This indicates that there is a lower likelihood of Aboriginal artefacts being present within the study area as it was not attractive for long-term habitation due to the challenges in obtaining water and the associated water reliant food sources such as fish and mammal species.

The study area is situated on the midslope of a hill. The sloping nature of the study area lowers its archaeological sensitivity as it is likely to have been less desirable for repeated camping when compared to flatter areas. Sloping landforms have also been impacted by soil loss following vegetation clearance and this would have moved items such as Aboriginal objects downslope and out of the study area. However, the low-gradient slopes would not have been an obstacle to the use of the study area and its resources in the past.

The study area is located within the Goonumbla Hills landscape (Mitchell 2002) which consists of Grey Box, Bimble Box, White Cypress, and Red Ironbark trees. This landscape type has been extensively cleared, grazed, and cultivated (Mitchell 2002:91).

The Cypress pines, Bimble and Grey Box trees are species known to have been modified by Aboriginal groups for their bark and wood. Red Ironbark is not a species used by Aboriginal groups in the same way. The White Cypress trees within the study area may have occurred since the land was cleared for agriculture and is unlikely to demonstrate any Aboriginal modification. The 12 previously recorded culturally modified trees in the AHIMS search suggest that modified trees may be recorded in the study area but will be rare given the previous land use and tree clearing.

The study area is more than 200 m from a water source and is within a moderate slope, and it is concluded that there are no sensitive landforms in the study area.

Although not required by the due diligence process, the proponent has elected to apply the precautionary principle and proceed to visual inspection of the study area (**Section 2.3.6**) to confirm the findings of the above desktop assessment.

2.3.5 Step 3

Can harm to Aboriginal objects or disturbance of archaeologically sensitive landscape features be avoided?

Yes. Known Aboriginal objects and identified landforms with archaeological sensitivity will not be harmed.

The AHIMS search confirms that there are no known AHIMS sites in the study area and no archaeologically sensitive landforms are present. While a visual inspection is not required under the Due Diligence Code of Practice, the proponent has elected to undertake a visual inspection to ensure Aboriginal objects are not harmed.

2.3.6 Step 4

Does a desktop assessment and visual inspection confirm that there are Aboriginal objects or that they are likely?

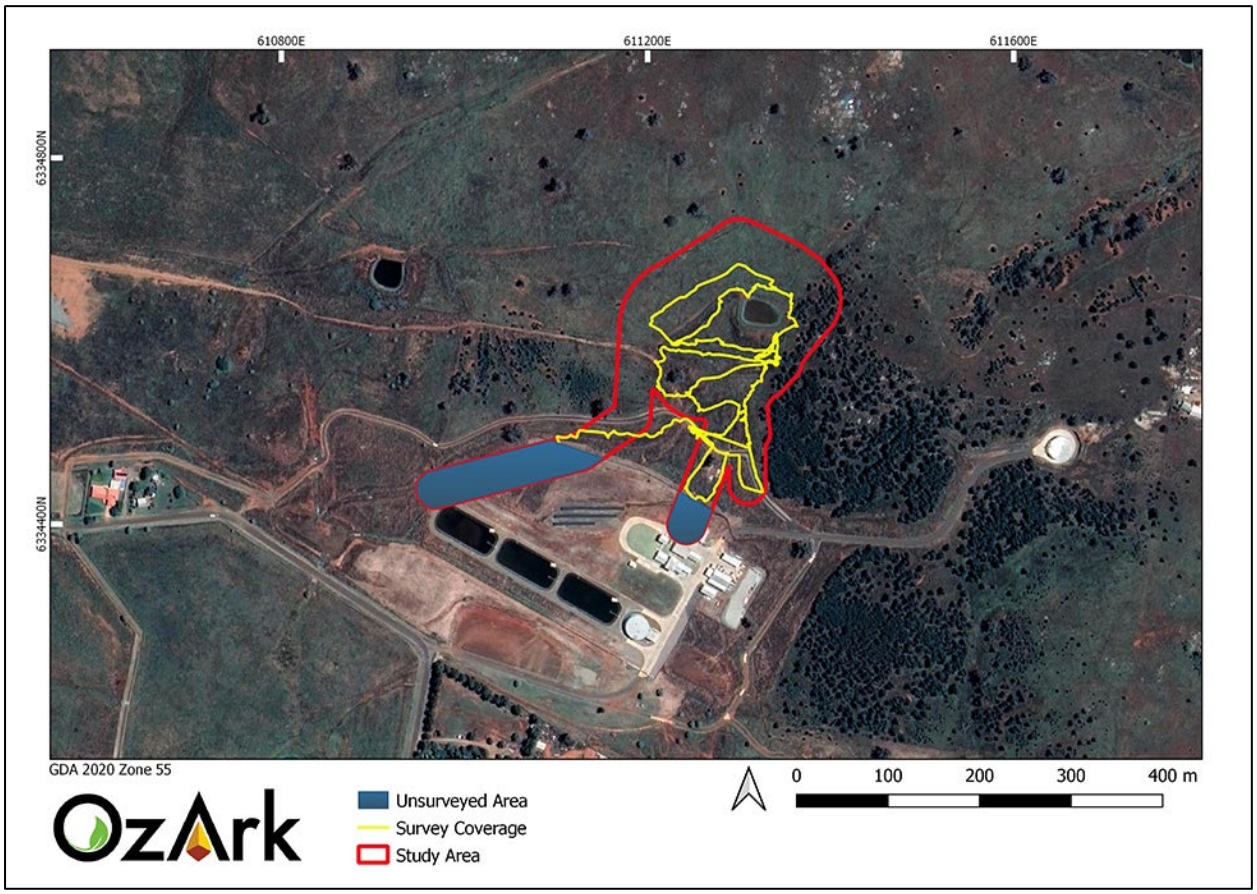
No, Aboriginal objects were not identified at the study area and the potential for any subsurface deposits was assessed to be low.

The visual inspection of the study area was undertaken by OzArk Project Archaeologists, Harrison Rochford and Jordan Henshaw on 28 September 2022. The two OzArk archaeologists were accompanied by Rob Clegg, Peter Clegg, and Mick Dunn of the Wiradjuri Council of Elders.

Ground Surface Visibility (GSV) was estimated at 5–10% across the study area (**Plate 2**). Exposures were present, offering much higher GSV, along the edge of the existing dam and footpaths. No factors significantly impeded the visual inspection.

The survey coverage represented on **Figure 2-3** only represents one of the five members of the visual inspection team as only one GPS was used throughout the day.

Figure 2-3: Survey coverage within the study area.



Discussion

Grey Box, Bimble Box and White Cypress trees were present within the study area, as noted in **Section 2.3.2**. However, no trees showed signs of cultural modification.

As predicted by the desktop analysis, the study area was assessed as having low archaeological potential. The absence of Aboriginal sites in the study area confirmed the predictive modelling that as the study area is distant to reliable water, it has a low likelihood for Aboriginal sites. In addition, the disturbances identified at the study area (**Plate 3**), including earthworks for the WTP and vegetation clearing, have reduced the likelihood for in situ Aboriginal objects, if they were present in the past.

2.4 CONCLUSION

The due diligence process has resulted in the outcome that an Aboriginal Heritage Impact Permit (AHIP) is not required. The reasoning behind this determination is set out in **Table 2-2**.

Table 2-2: Due Diligence Code of Practice application.

Step	Reasoning	Answer
Step 1 Will the activity disturb the ground surface or any culturally modified trees?	The proposed works will disturb the ground surface through machine operated excavations and potential vegetation clearing. The proposal will impact mature, native vegetation and therefore could harm culturally modified trees.	Yes
If the answer to Step 1 is 'yes', proceed to Step 2		
Step 2a Are there any relevant records of Aboriginal heritage on AHIMS to indicate presence of Aboriginal objects?	AHIMS indicated that there are no Aboriginal sites within the study area.	No
Step 2b Are there other sources of information to indicate presence of Aboriginal objects?	There are no other sources of information to indicate that Aboriginal objects are likely in the study area.	No
Step 2c Will the activity impact landforms with archaeological sensitivity as defined by the Due Diligence Code?	Landforms with identified archaeological sensitivity are not present.	No
If the answer to any stage of Step 2 is 'yes', proceed to Step 3		
Step 3 Can harm to Aboriginal objects listed on AHIMS or identified by other sources of information and/or can the carrying out of the activity at the relevant landscape features be avoided?	The proposal will not impact landforms with archaeological sensitivity as identified in the Due Diligence Code	No
If the answer to Step 3 is 'no', a visual inspection is required. Proceed to Step 4.		
Step 4 Does the visual inspection confirm that there are Aboriginal objects or that they are likely?	The visual inspection recorded no Aboriginal objects in the study area. No landforms within the study area were determined to have potential for subsurface deposits.	No
Conclusion		
AHIP not necessary. Proceed with caution.		

3 MANAGEMENT RECOMMENDATIONS

The undertaking of the due diligence process resulted in the conclusion that the proposed works will have an impact on the ground surface, however, no Aboriginal objects or intact archaeological deposits will be harmed by the proposal. This moves the proposal to the following outcome:

> *AHIP application not necessary. Proceed with caution. If any Aboriginal objects are found, stop work, and notify Heritage NSW (02) 9873 8500 (heritagemailbox @environment.nsw.gov.au). If human remains are found, stop work, secure the site, and notify NSW Police and Heritage NSW.*

To ensure the greatest possible protection to the area's Aboriginal cultural heritage values, the following recommendations are made:

1) The proposed work may proceed at the study area without further archaeological investigation provided all ground disturbance is confined to the study area. Should the parameters of the proposal extend beyond the assessed areas, then further archaeological assessment may be required.
2) This assessment has concluded that there is a low likelihood that the proposed work will adversely harm Aboriginal cultural heritage items or sites. If during works, however, Aboriginal artefacts or skeletal material are noted, all work should cease and the procedures in the *Unanticipated Finds Protocol* (**Appendix 2**) should be followed.
3) Inductions for work crews should include a cultural heritage awareness procedure to ensure they recognise Aboriginal artefacts (see **Appendix 3**) and are aware of the legislative protection of Aboriginal objects under the National Parkes and Wildlife Act 1974 and the contents of the *Unanticipated Finds Protocol.*
4) The information presented here meets the requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. It should be retained as shelf documentation for five years as it may be used to support a defence against prosecution in the event of unanticipated harm to Aboriginal objects.

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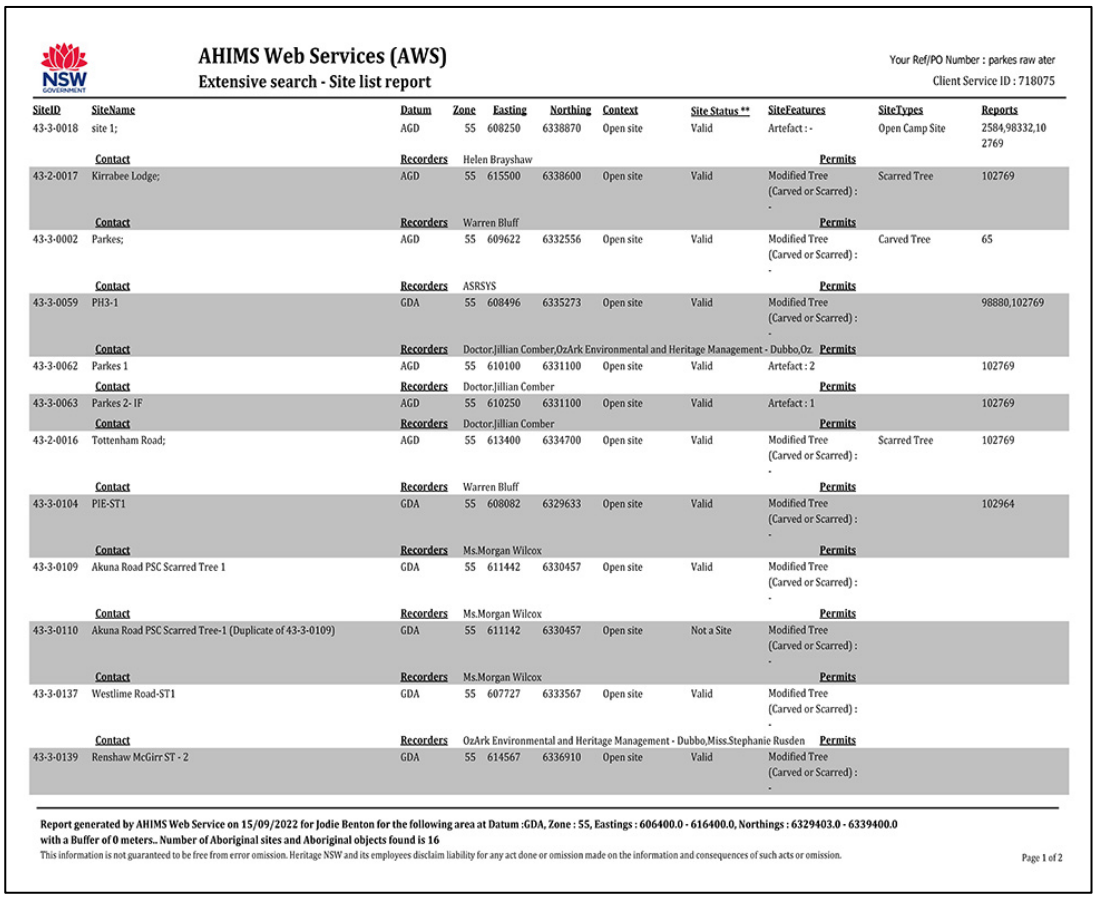
PLATES

Plate 1: View southwest showing the area defined as ‘disturbed land’.

Plate 2: View west across the study area showing the sloping nature of the site and low GSV.

Plate 3: View north showing a dam within the study area.

APPENDIX 1: AHIMS SEARCH RESULTS



AHIMS Web Services (AWS)
Extensive search - Site list report

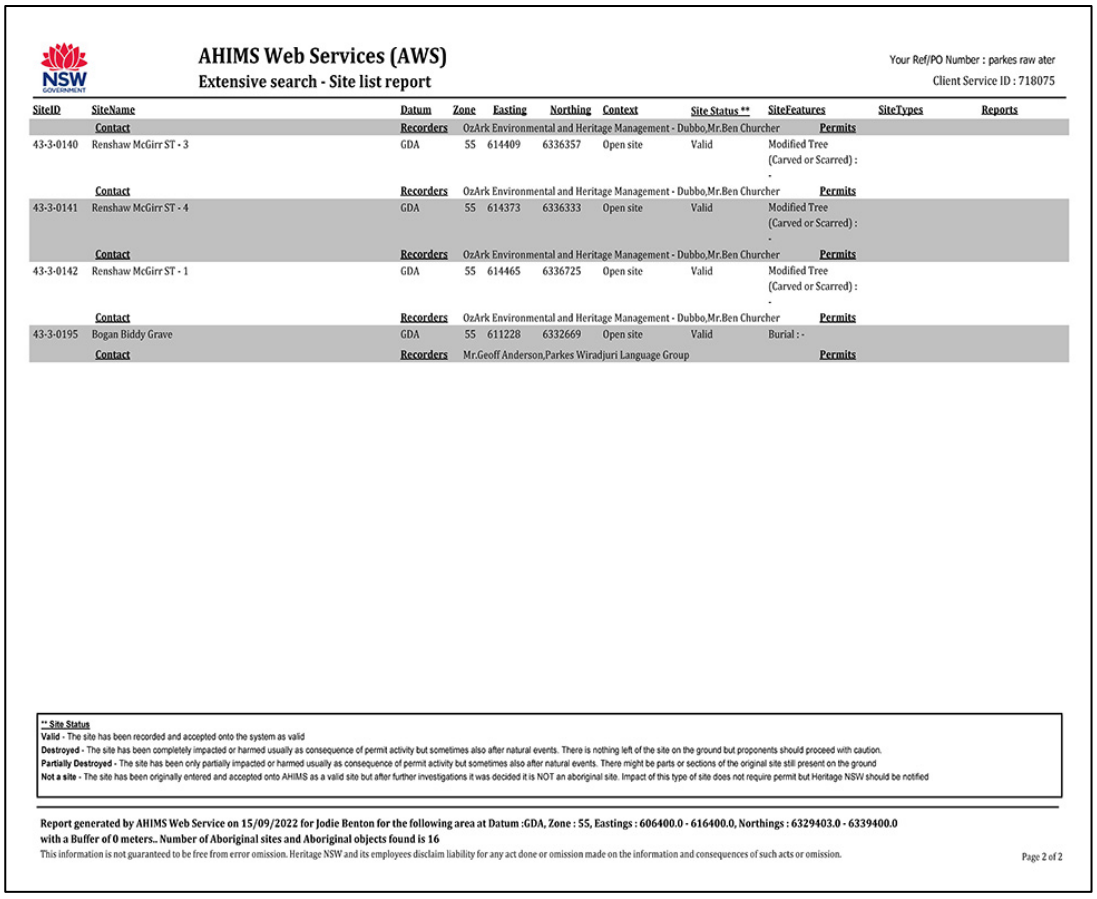
Your Ref/PO Number : parkes raw ater
Client Service ID : 718075

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
43-3-0018	site 1;	AGD	55	608250	6338870	Open site	Valid	Artefact : -	Open Camp Site	2584,98332,10 2769
	Contact	Recorders	Helen Brayshaw					Permits		
43-2-0017	Kirrabee Lodge;	AGD	55	615500	6338600	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	102769
	Contact	Recorders	Warren Bluff					Permits		
43-3-0002	Parkes;	AGD	55	609622	6332556	Open site	Valid	Modified Tree (Carved or Scarred) : -	Carved Tree	65
	Contact	Recorders	ASRSYS					Permits		
43-3-0059	PH3-1	GDA	55	608496	6335273	Open site	Valid	Modified Tree (Carved or Scarred) : -		98880,102769
	Contact	Recorders	Doctor,Jillian Comber,OzArk Environmental and Heritage Management - Dubbo,Oz					Permits		
43-3-0062	Parkes 1	AGD	55	610100	6331100	Open site	Valid	Artefact : 2		102769
	Contact	Recorders	Doctor,Jillian Comber					Permits		
43-3-0063	Parkes 2- IF	AGD	55	610250	6331100	Open site	Valid	Artefact : 1		102769
	Contact	Recorders	Doctor,Jillian Comber					Permits		
43-2-0016	Tottenham Road;	AGD	55	613400	6334700	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	102769
	Contact	Recorders	Warren Bluff					Permits		
43-3-0104	PIE-ST1	GDA	55	608082	6329633	Open site	Valid	Modified Tree (Carved or Scarred) : -		102964
	Contact	Recorders	Ms.Morgan Wilcox					Permits		
43-3-0109	Akuna Road PSC Scarred Tree 1	GDA	55	611442	6330457	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Ms.Morgan Wilcox					Permits		
43-3-0110	Akuna Road PSC Scarred Tree-1 (Duplicate of 43-3-0109)	GDA	55	611142	6330457	Open site	Not a Site	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Ms.Morgan Wilcox					Permits		
43-3-0137	Westlime Road-ST1	GDA	55	607727	6333567	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Miss.Stephanie Rusden					Permits		
43-3-0139	Renshaw McGirr ST - 2	GDA	55	614567	6336910	Open site	Valid	Modified Tree (Carved or Scarred) : -		

Report generated by AHIMS Web Service on 15/09/2022 for Jodie Benton for the following area at Datum :GDA, Zone : 55, Eastings : 606400.0 - 616400.0, Northings : 6329403.0 - 6339400.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 16

This information is not guaranteed to be free from error omission. Heritage NSW and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

Page 1 of 2



AHIMS Web Services (AWS)
Extensive search - Site list report

Your Ref/PO Number : parkes raw ater
Client Service ID : 718075

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.Ben Churcher					Permits		
43-3-0140	Renshaw McGirr ST - 3	GDA	55	614409	6336357	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.Ben Churcher					Permits		
43-3-0141	Renshaw McGirr ST - 4	GDA	55	614373	6336333	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.Ben Churcher					Permits		
43-3-0142	Renshaw McGirr ST - 1	GDA	55	614465	6336725	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.Ben Churcher					Permits		
43-3-0195	Bogan Biddy Grave	GDA	55	611228	6332669	Open site	Valid	Burial : -		
	Contact	Recorders	Mr.Geoff Anderson,Parkes Wiradjuri Language Group					Permits		

**** Site Status**
Valid - The site has been recorded and accepted onto the system as valid
Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.
Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground
Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 15/09/2022 for Jodie Benton for the following area at Datum :GDA, Zone : 55, Eastings : 606400.0 - 616400.0, Northings : 6329403.0 - 6339400.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 16

This information is not guaranteed to be free from error omission. Heritage NSW and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

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APPENDIX 2: ABORIGINAL HERITAGE: UNANTICIPATED FINDS PROTOCOL

An Aboriginal artefact is anything which is the result of past Aboriginal activity. This includes stone (artefacts, rock engravings etc.), plant (culturally scarred trees) and animal (if showing signs of modification; i.e. smoothing, use). Human bone (skeletal) remains may also be uncovered while onsite.

Cultural heritage significance is assessed by the Aboriginal community and is typically based on traditional and contemporary lore, spiritual values, and oral history, and may also consider scientific and educational value.

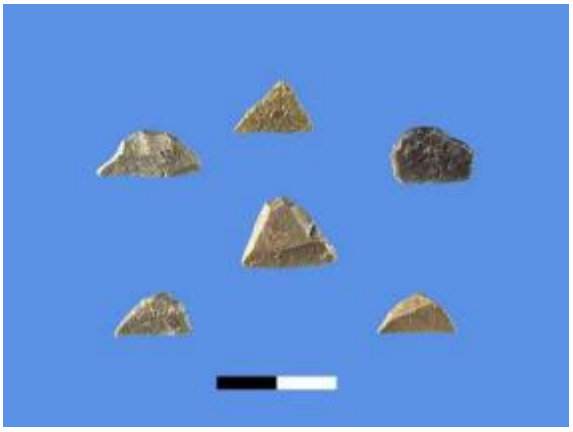
Protocol to be followed if previously unrecorded or unanticipated Aboriginal object(s) are encountered:

1. If any Aboriginal object is discovered and/or harmed in, or under the land, while undertaking the proposed development activities, the proponent must:
    a. Not further harm the object
    b. Immediately cease all work at the particular location
    c. Secure the area to avoid further harm to the Aboriginal object
    d. Notify Heritage NSW as soon as practical on (02) 9873 8500 (heritagemailbox @environment.nsw.gov.au), providing any details of the Aboriginal object and its location; and
    e. Not recommence any work at the particular location unless authorised in writing by Heritage NSW.
2. If Aboriginal burials are unexpectedly encountered during the activity, work must stop immediately, the area secured to prevent unauthorised access and NSW Police and Heritage NSW contacted.
3. Cooperate with the appropriate authorities and relevant Aboriginal community representatives to facilitate:
    a. The recording and assessment of the find(s)
    b. The fulfilment of any legal constraints arising from the find(s), including complying with Heritage NSW directions
    c. The development and implementation of appropriate management strategies, including consultation with stakeholders and the assessment of the significance of the find(s).
4. Where the find(s) are determined to be Aboriginal object(s), recommencement of work in the area of the find(s) can only occur in accordance with any consequential legal requirements and after gaining written approval from Heritage NSW (normally an Aboriginal Heritage Impact Permit).

APPENDIX 3: ABORIGINAL HERITAGE: ARTEFACT IDENTIFICATION

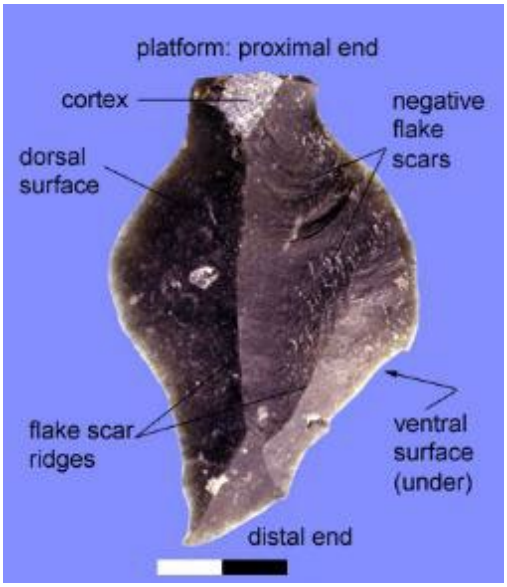
A retouched silcrete flake

A quartz flake



Microliths (scale = 1 cm)

Volcanic flakes



Flake characteristics (scale = 1 cm)

A mudstone/tuff core from which flakes have been removed

Appendix D Geotechnical Investigation Report

MACQUARIE GEOTECH

Parkes Water Security Program

Raw Water Storage Lagoon, Parkes

Geotechnical Investigation

Geotechnical Investigation Report

Job No.: B21615

Submitted to:

Parkes Shire Council

2 Cecile Street

Parkes NSW 2870

Attn: David Pearce

Report No.: B21615

Parkes Shire Council – Raw Water Storage Lagoon, Parkes

REVISION CONTROL

Revision	Date	Details	Prepared By	Reviewed By
00	08/02/2023	Draft	D. O'Donnell	D. Clarkson
01	17/07/2023	Final	D. O Donnell	D. Clarkson

MACQUARIE GEOTECH

Contents

Figures

Tables

Appendices

1 INTRODUCTION

At the request of Parkes Shire Council, Macquarie Geotechnical (MG) has carried out a geotechnical investigation for the proposed Raw Water Storage Lagoon, Parkes, NSW. The proposed works are part of the Parkes Water Security Program (PWSP). The objective of the investigation is to provide a geotechnical investigation report.

The comments and opinions expressed in this report are based on the ground conditions encountered during the site work and on the results of tests carried out in the field and in the laboratory. There may, however, be special conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report.

2 SCOPE OF INVESTIGATION

Undertake a desk study of the site to confirm the likely geological conditions of the site and to develop a geological model for the site.

Undertake Dial Before You Dig (DBYD) search.

Mobilisation of one drill rig. Drilling, logging and sampling of three boreholes as per Table 1 below.

Mobilisation of one excavator. Excavation, logging and sampling of four test pits as per Table 2 below.

Table 1: Borehole Scope

Hole ID	Eastings	Northings	RL (m AHD)	Depth (m)
SL5	611286	6334621	393	3.7
SL7	611249	6334561	388	4.0
SL8	611334	6334588	392	2.8

Table 2: Test Pit Scope

Hole ID	Eastings	Northings	RL (m AHD)	Depth (m)
TP02	611248	6334670	398	2.5
TP04	611231	6334585	391	2.3
TP06	611329	6334667	398	2.5
TP09	611350	6334605	395	2.2

Samples were taken at regular intervals and at every change of strata to allow for laboratory testing and returned to our NATA accredited laboratories in Bathurst and Sydney, NSW. Laboratory testing comprised the following:

- Three Atterberg Limits and Linear Shrinkage.
- One Falling Head Permeability.
- One Constant Head Permeability.
- Three Emerson Crumb Tests.

- One Pinhole Dispersion Test.
- Three Particle Size Distribution – Hydrometer.
- Three APHA 2510 & 2520-B Electrical Conductivity.
- Three Moisture Contents.

2.1 Site Description

The site is located approximately 2km northeast of Parkes CBD within the Parkes Shire local government area. The site location is shown in Figure 1 below.

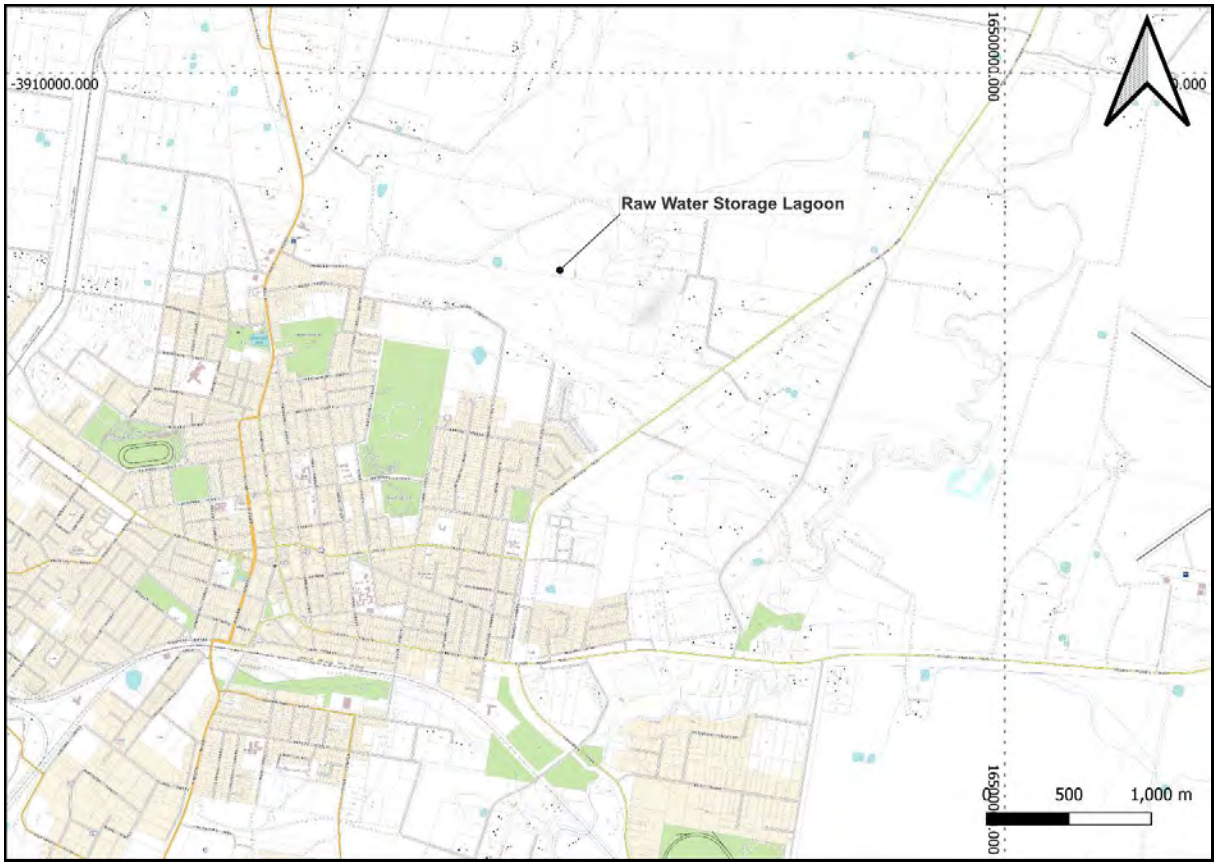


Figure 1: Site Location

2.2 Desk Study

A desk study was undertaken using readily available geological and geotechnical information and included the following:

- NSW Seamless Geology.
- ASRIS/CSIRO.
- Google Earth.
- NSW Department of Primary Industries – Groundwater Bore Data.
- Naturally Occurring Asbestos Hazard Maps.

2.3 Regional Geology

The NSW seamless geological map is shown in Figure 2 below, with NSW Groundwater Bore locations overlayed.

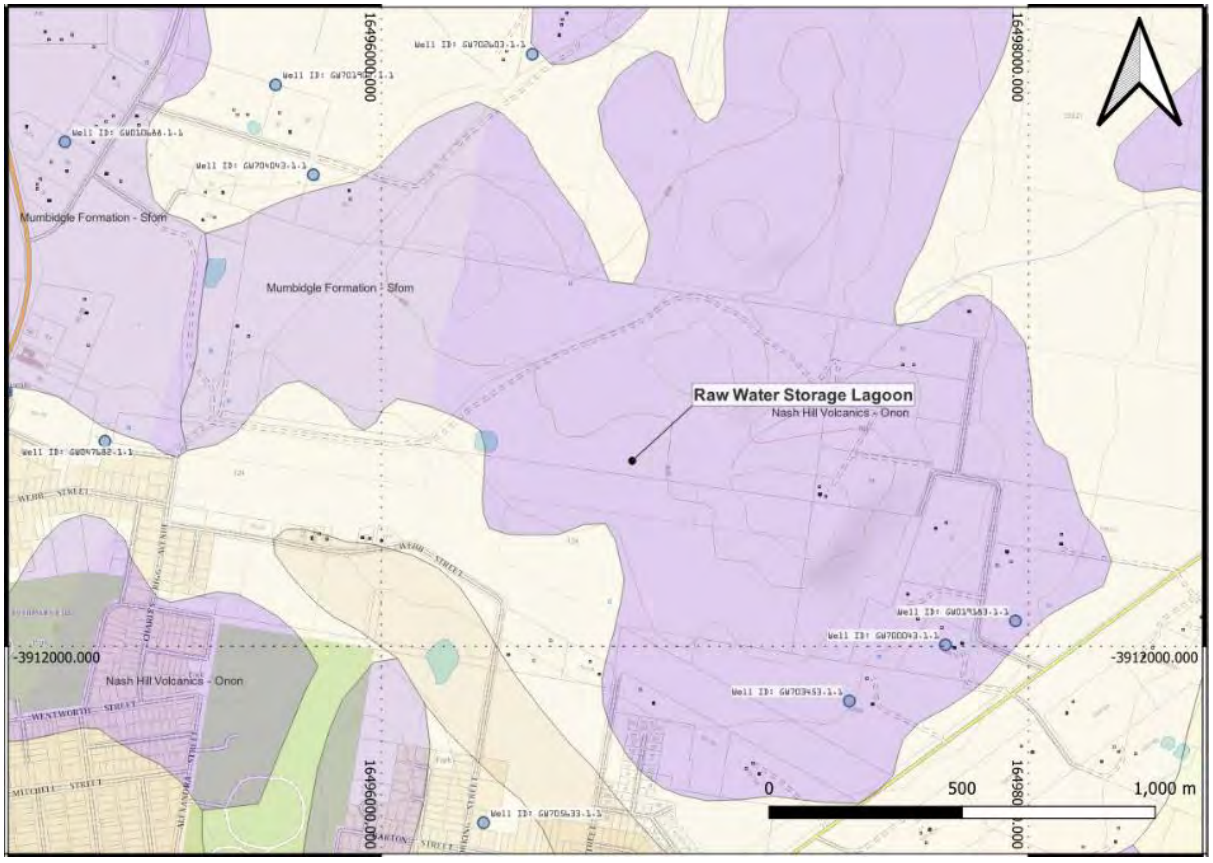


Figure 2: Seamless Geological Map Overlay

With reference to Seamless Geological map the site is underlain by the following:

Table 3: Summary of Geology

Geological Symbol	Group	Lithology
Onon	North Parkes Volcanic Group	Brecciated, plagioclase-phyric, clinopyroxene-phyric and non-porphyritic, variably vesicular basalt to andesite; mafic epiclastic sandstone.

2.3.1 Groundwater Bores

The groundwater data indicates the following ground conditions:

Table 4: Groundwater Data – GW019183

Depth (m)	Drillers Description
0.00 – 3.66	Red Clay
3.66 – 24.08	Rock

2.3.2 Acid Sulphate Maps

Reference is made to the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Atlas of Australian Acid Sulphate Soils and presented in Figure 3 below:

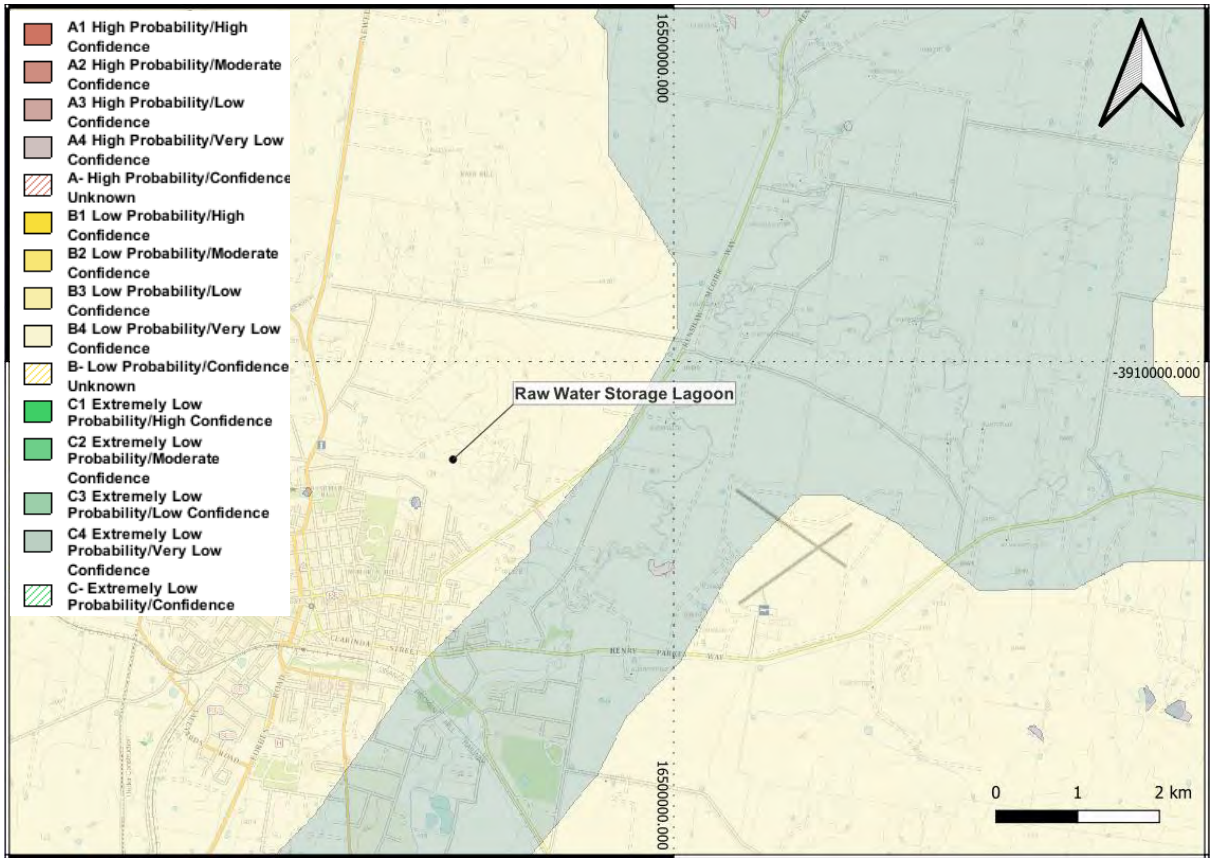


Figure 3: Acid Sulphate Risk Map – Raw Water Storage Lagoon

The acid sulphate risk map indicates a low probability of acid sulphate soils at the site.

2.3.3 Naturally Occurring Asbestos Maps

Reference is made to the NSW Department of Primary Industry Naturally Occurring Asbestos Hazard Maps and presented in Figure 4 below:

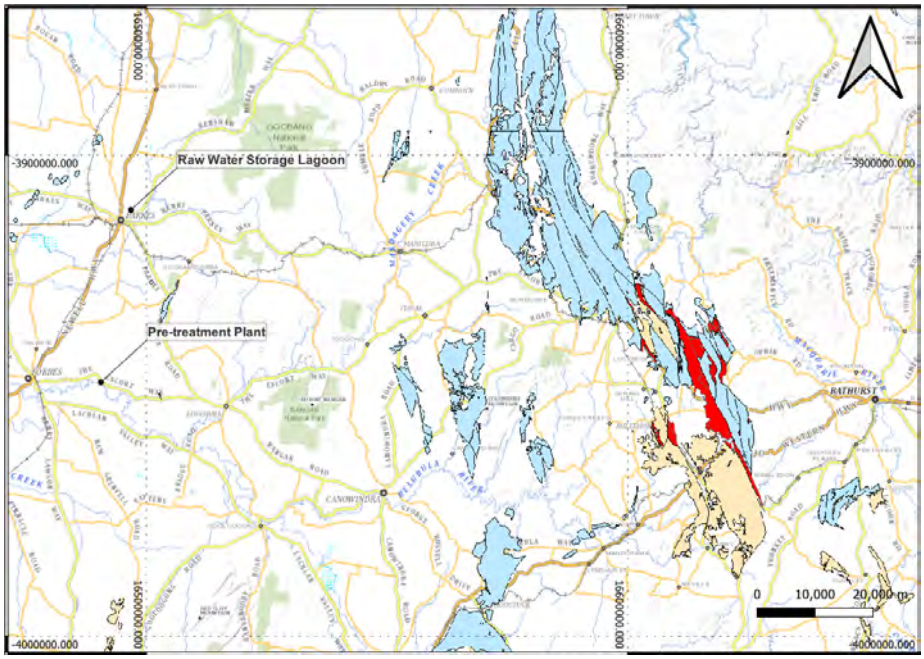


Figure 4: Naturally Occurring Asbestos Hazard Map

The Hazard Map indicates no known Naturally Occurring Asbestos (NOA) at the site.

2.3.4 Topography

The site is located in a hilly area with elevation ranging from 388m to 398m AHD.

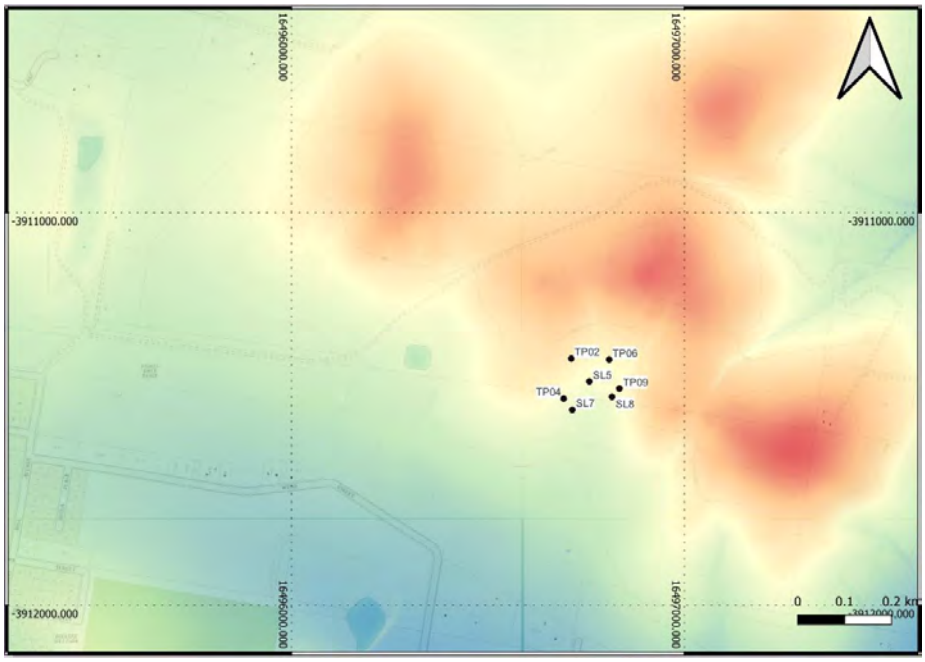


Figure 5: Digital Elevation Model

2.4 Fieldwork

Fieldwork was undertaken on the 17th and 27th October 2022 by a team of Drillers and Engineering Geologist from our Bathurst office. The fieldwork was undertaken in accordance with our proposal and AS1726 Geotechnical Site Investigation.

2.4.1 Service Location

Macquarie Geotechnical obtained underground services and utility plans through 'Dial Before You Dig (DBYD)' services.

2.4.2 GPS

All test locations were surveyed using a handheld GPS with co-ordinates recorded in MGA Zone 55 format and elevations in Australian Height Datum (AHD).

2.4.3 Boreholes

The boreholes were drilled at locations nominated by Parkes Shire Council and are summarised in Table 1.

A truck mounted Christi Rig was used to drill three boreholes to depths of up to 4.00m utilising 115mm diameter solid flight augers. In-situ testing comprised of Standard Penetration Tests (SPT) at each borehole.

The boreholes were backfilled with arising's on completion.

Borehole logs are presented in Appendix C.

2.4.4 Test Pits

A tracked 8 tonne excavator utilising a 900mm toothed bucket was used to excavate the four test pits to depths of up to 2.50m. In-situ testing comprised of Dynamic Cone Penetrometer (DCP) testing at each test pit location.

Upon completion of test pitting, excavations were backfilled with the excavated spoil material.

Test pit logs and photographs are presented in Appendix C.

2.5 Sampling

The sampling was undertaken in general accordance with AS1289 1.2.1 and based on that defined in the proposal and considered the engineering requirements of the investigation and the nature of the materials encountered.

2.6 In Situ Testing

In-situ testing as specified by the Client or our proposal was carried out in the exploratory holes in accordance with the techniques outlined in the relevant Australian Standards and Macquarie Geotechnical Quality procedures. The results are presented on the borehole and test pit logs in Appendix C.

2.6.1 Standard Penetration Testing

Standard Penetration Tests (SPT) were carried out in the boreholes with techniques outlined in AS1289 6.3.1 in order to determine the relative density and consistency of the strata encountered. The SPT "N" value (number of blows per 300mm penetration) or the blow count / penetration were recorded for each test.

2.6.2 Dynamic Cone Penetrometer Testing

Dynamic Cone Penetrometer (DCP) testing was carried out in the test pits with techniques outlined in AS1289 6.3.2 in order to determine the relative density and consistency of the strata encountered. The numbers of blows per 100mm penetration were recorded.

2.6.3 Pocket Penetrometer Testing

Pocket Penetrometer (PP) testing was carried out on SPT split spoon samples.

2.7 Laboratory Testing

The samples were returned to Macquarie Geotechnical NATA accredited laboratories for further assessment and testing. A summary of the laboratory tests is provided in Table 5 below.

Table 5: Summary of Laboratory Tests

Laboratory Test	Quantity
AS1289 3.1.1, 3.2.1, 3.3.1 Atterberg Limits	3
AS1289 3.4.1 Linear Shrinkage	3
AS 1289 6.7.2 & 2.1.1 Falling Head Permeability	1
AS 1289 6.7.3 Constant head Permeability	1
AS 1289 2.1.1 Moisture Content	3
AS 1289 3.8.1 Emerson Class Number of a Soil	3
AS1289 3.8.3 Pinhole Dispersion	1
AS1289.3.6.1 and 3.6.3 Particle Size Distribution with Hydrometer	3
APHA Soil Chemical Properties	3

3 FIELDWORK RESULTS

3.1 Borehole and Test Pit Summary

The subsurface conditions observed in all boreholes and test pits are broadly summarised in Table 6 below. Detailed descriptions of the strata can be found within the borehole and test pit logs provided in Appendix C.

Table 6: Borehole and Test Pit Summary

Unit	Name	Depth Range (m)	Maximum Thickness (m)	Material Description
1	Topsoil	0.00 – 0.20	0.20	Silty CLAY, Gravelly Silty CLAY
2	Residual / Extremely Weathered Soils	0.10 – 4.00	3.90	Silty CLAY, Gravelly Silty CLAY, Sandy Silty CLAY

3.2 Groundwater

The comments on groundwater are based on the observations made at the time of the investigation. Groundwater was not encountered in the boreholes or test pits.

Seasonal variation in groundwater may be encountered and shall be considered as part of the design process.

4 LABORATORY TEST RESULTS

The laboratory tests were carried out on the samples nominated by Macquarie Geotechnical. The test results are shown in Tables 7 to 9 below.

Table 7: Laboratory Test Results - Classification

Hole ID	Depth (m)	Sample Description (USCS)	Atterberg Limits			Linear Shrinkage (%)
			Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	
SL5	0.30 – 0.50	Gravelly Silty CLAY*	49	20	29	13.5
TP4	1.30 – 1.50	Gravelly Silty CLAY*	28	15	13	7.5
TP6	0.20 – 0.40	Silty CLAY*	46	21	25	13.0

Note: USCS – Unified Soil Classification System.
*Visual description.

Table 8: Laboratory Test Results – Soil Chemical Properties

Hole ID	Depth (m)	Sample Description*	Soil Chemical Properties (SCP)			
			pH	SO_4 (mg/kg)	Cl (mg/kg)	EC (µS/cm)
SL5	1.00 – 1.50	Gravelly Silty CLAY	-	-	-	173.6
SL7	1.00 – 1.50	Gravelly Silty CLAY	-	-	-	191.7
SL8	0.50 – 0.95	Gravelly Silty CLAY	-	-	-	202.5

Note: SO_4 – Sulphate, Cl – Chloride, EC – Electrical Conductivity.
*Visual description.

Table 9: Laboratory Test Results – Permeability and Dispersion

Hole ID	Depth (m)	Sample Description*	Falling Head Permeability (m/sec)	Constant Head Permeability (m/sec)	Emerson Class Number	Pinhole Dispersion
TP02	0.80 – 1.00	Gravelly Silty CLAY	5.0 E-10	-	-	-
TP09	0.50 – 0.70	Gravelly Silty CLAY	-	3.0 E-10	-	-
SL8	0.30 – 0.50	Gravelly Silty CLAY	-	-	4	-
TP4	1.30 – 1.50	Gravelly Silty CLAY	-	-	3	-
TP6	0.20 – 0.40	Silty CLAY	-	-	5	-
TP2	0.30 – 0.50	Silty CLAY	-	-	-	ND2

Note: * Visual description.

5 GEOTECHNICAL ASSESSMENT

5.1 Site Classification

The classification of a site involves a number of geotechnical factors such as depth of bedrock, the nature and extent of subsurface soils and any specific problems (slope stability, soft soils, filling, reactivity, etc).

In accordance with AS2870 2011 the proposed development site will have an anticipated surface movement (Ys) of 50 – 60mm and is classified as “Class H1-D”.

An appropriate footing system should be designed in accordance with the above code to accommodate these anticipated movements. The possibility of additional movements, due to abnormal moisture variations, should be minimised by proper "site management" procedures.

It should be noted that this assessment is based on site conditions being represented by the natural soil profile. Any change in conditions noted during development, including cut or fill should be referred to Macquarie Geotechnical for appropriate inspection and assessment.

The above classifications, based on AS2870 which relates to construction of residential dwellings, is not technically correct for the type of structures proposed and therefore it is given as a guide only with respect to soil reactivity.

5.2 Foundations

The investigation indicates that the ground conditions generally comprised of topsoil overlying residual / extremely weathered soils. Bedrock was not encountered.

5.2.1 Geotechnical Design Parameters

Based on our investigation, and our experience in this region, we recommend the following geotechnical design parameters:

Table 10: Estimated Geotechnical Engineering Parameters

Depth (m)	Soil Description	Unit Weight (KN/m^3)	Angle of Friction (Degrees)		Cohesion (KPa)		Concrete to Soil Friction Angle δ (degrees)
			Drained ϕ'	Undrained ϕ	Drained c'	Undrained Cu	
Varying Depth	Silty CLAY, Gravelly Silty CLAY - Firm	18	21	0	0	25	16
	Silty CLAY, Gravelly Silty CLAY - Stiff	19	26	0	0	50	20
	Silty CLAY, Gravelly Silty CLAY, Sandy Silty CLAY - Very Stiff	19	29	0	0	100	23
	Silty CLAY, Gravelly Silty CLAY, Sandy Silty CLAY - Hard	20	32	0	0	200	25

Table 11: Shallow Footing Bearing Pressures

Depth (m)	Soil Description	Allowable Bearing Pressure (KPa)	Ultimate Bearing Pressure (KPa)	Modulus of Subgrade Reaction (MN/m^3)
Varying Depth	Silty CLAY, Gravelly Silty CLAY - Firm	40	120	5
	Silty CLAY, Gravelly Silty CLAY - Stiff	85	255	10
	Silty CLAY, Gravelly Silty CLAY, Sandy Silty CLAY - Very Stiff	170	510	20
	Silty CLAY, Gravelly Silty CLAY, Sandy Silty CLAY - Hard	340	1020	40

Note: Preliminary design parameters to be confirmed by a detailed design analysis.

5.3 Foundation Settlements

For foundations bearing on natural soils (residual and extremely weathered soils) total and differential settlements are expected to be less than 25mm provided that the allowable bearing capacities are not exceeded.

5.4 Soil Dispersion

Based on the laboratory test results the soils varied from non-dispersive to dispersive.

6 EXCAVATION AND STABILITY

6.1 Soil

The soils at the site comprise predominately topsoil overlying residual / extremely weathered soils and should present no excavation difficulty. For temporary work conditions above groundwater level, benching or slope angles of 1V:1H is considered appropriate for the materials. For temporary work conditions below groundwater level excavation support will be required. For permanent conditions, slope angles of 1V:2H is considered appropriate.

6.2 Rock

Bedrock was not encountered in the boreholes or test pits.

7 EARTHWORKS

7.1 Site Preparation

The base of the dam embankment should be stripped of all topsoil, silt, loose material, vegetable matter, and then scarified over its whole area.

If rock is encountered under the embankment, appropriate measures should be taken to cut off seepage along the soil/rock contact and to prevent seepage in the rock joints coming into contact with the embankment soil. Such measures might involve the use of bentonite and a mortar or shotcrete blanket over the rock.

A cut-off trench or keyway should be constructed and taken down to a minimum of 600 mm into impervious soil or rock and backfilled with appropriate quality clay that is thoroughly compacted. It should extend for the length of the embankment including the hillside flanks.

7.2 Embankment Compaction

All fill material for the embankment should be placed in layers not greater than 150mm thick. The largest size particle should not be greater than 1/3 of the height of the lift (e.g. 50mm). Each layer should be thoroughly compacted before the next layer is placed. A suitable number of passes should be undertaken to achieve the required compaction effort.

The compaction effort achieved should be on average 98% Standard Maximum Dry Density (MDD). The minimum compaction effort should be 95% Standard MDD. If the range of compaction effort varies throughout the dam, then it can lead to the dam embankment settling to different degrees (differential settlement) causing the embankment of the dam to crack. This may ultimately lead to leakage and dam failure.

The material forming the embankment should be placed with sufficient moisture to ensure proper compaction. The moisture content should be in the range of –1% to + 3% of optimum moisture content (OMC).

Before each additional 150mm lift is added to the embankment, the preceding lift should be scarified to ensure that the two lifts are properly joined so that no natural paths for seepage are present that may result in dam failure.

The upstream and downstream batter slopes should be well compacted and trimmed to a slope batter of 1V:3H or as specified by the dam designer.

7.3 Re-use of Site Won Material

The laboratory test results indicate that some of the soils at the site are dispersive. Dispersive soils are inherently unsuited to dam construction due to tunnel erosion or piping in dam walls. The likelihood of failure of dams built with dispersive soils depends on a number of factors including:

- The rate of first filling.
- The degree of compaction during construction.
- The dispersibility of materials used to construct the dam.
- The electrolyte content of the soil solution.
- The electrolyte concentration of the stored water.

Construction of earth dams with dispersive soils is usually possible if adequate compaction can be achieved (Bell and Maud 1994). Ritchie (1965) demonstrated that the degree of compaction within the dam wall is the single most important factor in reducing dam failure. The importance of other factors such as batter angle, rate of filling or moisture content during construction were all secondary to that of compaction. Dispersive soils can be difficult to compact as they lose strength rapidly at or above optimum moisture content, and thus may require greater compactive force if moisture contents are just dry of optimum (McDonald *et al.* 1981). A sheepsfoot roller is required to adequately compact dispersive soils as normal earth moving machinery cannot provide enough compactive force. Bell & Bryun (1997) and Bell and Maud (1994) suggest that dispersive clays must be compacted at a moisture content 1.5% to 2% above the optimum moisture content in order to achieve sufficient density to prevent piping (Elges 1985).

The risk of tunnel or piping failure in small earth dams can be minimised by a combination of control measures including;

- Adequate compaction.
- Chemical ameliorants e.g. gypsum, hydrated lime etc.
- Sand filters.
- Construction with non-dispersive clay.
- Topsoiling.

Construction with non-dispersive clay is recommended for the new dam and cut-off trench.

7.4 Trafficability

The clay subgrades at the site have a low wet strength and poor subgrade strength. The site soils would be trafficable during dry periods. Some desiccation of exposed surfaces can be expected and large quantities of dust will be generated during dry periods under traffic. The soils will be soft and difficult to traverse following wet weather or inundation. Drying out of these soils could take several days or weeks before being able to accommodate construction traffic.

8 CONCLUSION

The findings of our report were based on our fieldwork, in-situ testing, laboratory testing and technical assessment for this site.

We trust the foregoing is sufficient for your present purposes, and if you have any questions please contact the undersigned.

Declan O'Donnell
Engineering Geologist
BSc (Geology) (Hons)

David Clarkson
Senior Geotechnical Engineer
BEng MSc MIEAust

Attached: Limitations of Geotechnical Site Investigation
References: Australian Standard 1726 – 2017 Geotechnical Site Investigations

LIMITATIONS OF GEOTECHNICAL SITE INVESTIGATION

Scope of Services

This report has been prepared for the Client in accordance with the Services Engagement Form (SEF), between the Client and Macquarie Geotechnical.

Reliance on Data

Macquarie Geotechnical has relied upon data and other information provided by the Client and other individuals. Macquarie Geotechnical has not verified the accuracy or completeness of the data, except as otherwise stated in the report. Recommendations in the report are based on the data.

Macquarie Geotechnical will not be liable in relation to incorrect recommendations should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed.

Geotechnical Investigation

Findings of Geotechnical Investigations are based extensively on judgment and experience. Geotechnical reports are prepared to meet the specific needs of individual clients. This report was prepared expressly for the Client and expressly for the Clients purposes.

This report is based on a subsurface investigation, which was designed for project-specific factors. Unless further geotechnical advice is obtained this report cannot be applied to an adjacent site nor can it be used when the nature of any proposed development is changed.

Limitations of Site investigation

As a result of the limited number of sub-surface excavations or boreholes there is the possibility that variations may occur between test locations. The investigation undertaken is an estimate of the general profile of the subsurface conditions. The data derived from the investigation and laboratory testing are extrapolated across the site to form a geological model. This geological model infers the subsurface conditions and their likely behavior with regard to the proposed development.

The actual conditions at the site might differ from those inferred to exist.

No subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

Time Dependence

This report is based on conditions, which existed at the time of subsurface exploration. Construction operations at or adjacent to the site, and natural events such as floods, or groundwater fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report.

Macquarie Geotechnical should be kept appraised of any such events, and should be consulted for further geotechnical advice if any changes are noted.

Avoid Misinterpretation

A geotechnical engineer or engineering geologist should be retained to work with other design professionals explaining relevant geotechnical findings and in reviewing the adequacy of their plans and specifications relative to geotechnical issues.

No part of this report should be separated from the Final Report.

Sub-surface Logs

Sub-surface logs are developed by geoscientific professionals based upon their interpretation of field logs and laboratory evaluation of field samples. These logs should not under any circumstances be redrawn for inclusion in any drawings.

Geotechnical Involvement During Construction

During construction, excavation frequently exposes subsurface conditions. Geotechnical consultants should be retained through the construction stage, to identify variations if they are exposed.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendations and should make their own enquiries and obtain independent advice in relation to such matters

Macquarie Geotechnical assumes no responsibility and will not be liable to any other person or organisations for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisations arising from matters dealt with or conclusions expressed in the report.

Other limitations

Macquarie Geotechnical will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

Other Information

For further information reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by the Institution of Engineers Australia, 1987.

Appendix A – Geotechnical Explanatory Notes

MACQUARIE GEOTECH

Geotechnical Explanatory Notes

Soil Description

In engineering terms soil includes every type of uncemented or partially cemented inorganic material found in the ground. In practice, if the material can be remoulded by hand in its field condition or in water it is described as a soil. The dominant soil constituent is given in capital letters, with secondary textures in lower case. The dominant feature is assessed from the Unified Soil Classification system and a soil symbol is used to define a soil layer as follows:

UNIFIED SOIL CLASSIFICATION

The appropriate symbols are selected on the result of visual examination, field tests and available laboratory tests, such as, sieve analysis, liquid limit and plasticity index.

USC Symbol	Description
GW	Well graded gravel
GP	Poorly graded gravel
GM	Silty gravel
GC	Clayey gravel
SW	Well graded sand
SP	Poorly graded sand
SM	Silty sand
SC	Clayey sand
ML	Silt of low plasticity
CL	Clay of low plasticity
OL	Organic soil of low plasticity
MH	Silt of high plasticity
CH	Clay of high plasticity
OH	Organic soil of high plasticity
Pt	Peaty Soil

MOISTURE CONDITION

Dry – Cohesive soils are friable or powdery
Cohesionless soil grains are free-running

Moist – Soil feels cool, darkened in colour
Cohesive soils can be moulded
Cohesionless soil grains tend to adhere

Wet – Cohesive soils usually weakened
Free water forms on hands when handling

For cohesive soils the following codes may also be used:

MC>PL Moisture Content greater than the Plastic Limit.
MC~PL Moisture Content near the Plastic Limit.
MC<PL Moisture Content less than the Plastic Limit.

PLASTICITY

The potential for soil to undergo change in volume with moisture change is assessed from its degree of plasticity. The classification of the degree of plasticity in terms of the Liquid Limit (LL) is as follows:

Description of Plasticity	LL (%)
Low	<35
Medium	35 to 50
High	>50

COHESIVE SOILS – CONSISTENCY

The consistency of a cohesive soil is defined by descriptive terminology such as very soft, soft, firm, stiff, very stiff and hard. These terms are assessed by the shear strength of the soil as observed visually, by the pocket penetrometer values and by resistance to deformation to hand moulding.

A Pocket Penetrometer may be used in the field or the laboratory to provide approximate assessment of unconfined compressive strength of cohesive soils. The values are recorded in kPa, as follows:

Strength	Symbol	Pocket Penetrometer Reading (kPa)
Very Soft	VS	< 25
Soft	S	20 to 50
Firm	F	50 to 100
Stiff	St	100 to 200
Very Stiff	VSt	200 to 400
Hard	H	> 400

MACQUARIE GEOTECH

COHESIONLESS SOILS – RELATIVE DENSITY

Relative density terms such as very loose, loose, medium, dense and very dense are used to describe silty and sandy material, and these are usually based on resistance to drilling penetration or the Standard Penetration Test (SPT) 'N' values. Other condition terms, such as friable, powdery or crumbly may also be used.

The Standard Penetration Test (SPT) is carried out in accordance with AS 1289, 6.3.1. For completed tests the number of blows required to drive the split spoon sampler 300 mm are recorded as the N value. For incomplete tests the number of blows and the penetration beyond the seating depth of 150 mm are recorded. If the 150 mm seating penetration is not achieved the number of blows to achieve the measured penetration is recorded. SPT correlations may be subject to corrections for overburden pressure and equipment type.

Term	Symbol	Density Index	N Value (blows/0.3 m)
Very Loose	VL	0 to 15	0 to 4
Loose	L	15 to 35	4 to 10
Medium Dense	MD	35 to 65	10 to 30
Dense	D	65 to 85	30 to 50
Very Dense	VD	>85	>50

COHESIONLESS SOILS PARTICLE SIZE DESCRIPTIVE TERMS

Name	Subdivision	Size
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	19 mm to 63 mm
	medium	6.7 mm to 19 mm
	fine	2.36 mm to 6.7 mm
Sand	coarse	600 μm to 2.36 mm
	medium	210 μm to 600 μm
	fine	75 μm to 210 μm

Rock Description

The rock is described with strength and weathering symbols as shown below. Other features such as bedding and dip angle are given.

ROCK QUALITY

The fracture spacing is shown where applicable and the Rock Quality Designation (RQD) or Total Core Recovery (TCR) is given where:

$$\text{RQD (\%)} = \frac{\text{Sum of Axial lengths of core > 100mm long}}{\text{total length considered}}$$

$$\text{TCR (\%)} = \frac{\text{length of core recovered}}{\text{length of core run}}$$

ROCK STRENGTH

Rock strength is described using AS1726 and ISRM – Commission on Standardisation of Laboratory and Field Tests, "Suggested method of determining the Uniaxial Compressive Strength of Rock materials and the Point Load Index", as follows:

Term	Symbol	Point Load Index $Is_{(50)}$ (MPa)
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1
High	H	1 to 3
Very High	VH	3 to 10
Extremely High	EH	>10

ROCK MATERIAL WEATHERING

Rock weathering is described using the following abbreviation and definitions used in AS1726:

Abbreviation	Term
RS	Residual soil
XW	Extremely weathered
DW	Distinctly weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
FR	Fresh

MACQUARIE GEOTECH

DEFECT SPACING/BEDDING THICKNESS

Measured at right angles to defects of same set or bedding.

Term	Defect Spacing	Bedding
Extremely closely spaced	<6 mm	Thinly Laminated
	6 to 20 mm	Laminated
Very closely spaced	20 to 60 mm	Very Thin
Closely spaced	0.06 to 0.2 m	Thin
Moderately widely spaced	0.2 to 0.6 m	Medium
Widely spaced	0.6 to 2 m	Thick
Very widely spaced	>2 m	Very Thick

DEFECT DESCRIPTION

Type:	Description
B	Bedding
F	Fault
C	Cleavage
J	Joint
S	Shear Zone
D	Drill break

Planarity/Roughness:

Class	Description
I	rough or irregular, stepped
II	smooth, stepped
III	slickensided, stepped
IV	rough or irregular, undulating
V	smooth, undulating
VI	slickensided, undulating
VII	rough or irregular, planar
VIII	smooth, planar
IX	slickensided, planar

The inclination if defects are measured from perpendicular to the core axis.

WATER


Water level at date shown


Partial water loss


Water inflow


Complete water loss

Groundwater not observed: The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.

Groundwater not encountered: The borehole/test pit was dry soon after excavation, however groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

MACQUARIE GEOTECH

Graphic Symbols for Soils and Rocks

Typical symbols for soils and rocks are as follows. Combinations of these symbols may be used to indicated mixed materials such as clayey sand.

Soil Symbols

Main components


CLAY - CL


CLAY - CH


SAND


GRAVEL


BOULDERS / COBBLES


TOPSOIL


SILT

Minor Components


Clayey


Silty


Sandy


Gravelly

Other


FILL


BITUMEN


CONCRETE

Rock Symbols

Sedimentary Rocks


SANDSTONE


SILTSTONE


CLAYSTONE, MUDSTONE


SHALE


LAMINITE


ASPHALT


LIMESTONE


CONGLOMERATE

Igneous Rocks


GRANITE


BASALT


UNDIFFERENTIATED IGNEOUS

Metamorphic Rocks


SLATE, PHYLLITE, SCHIST


GNEISS

QUARTZITE

MACQUARIE GEOTECH

Engineering Classification of Shales and Sandstones in the Sydney Region – A Summary Guide

The Sydney Rock Class classification system is based on rock strength, defect spacing and allowable seams as set out below. All three factors must be satisfied.

CLASSIFICATION FOR SANDSTONE

Class	Uniaxial Compressive Strength (MPa)	Defect Spacing (mm)	Allowable Seams (%)
I	>24	>600	<1.5
II	>12	>600	<3
III	>7	>200	<5
IV	>2	>60	<10
V	>1	N.A.	N.A.

CLASSIFICATION FOR SHALE

Class	Uniaxial Compressive Strength (MPa)	Defect Spacing (mm)	Allowable Seams (%)
I	>16	>600	<2
II	>7	>200	<4
III	>2	>60	<8
IV	>1	>20	<25
V	>1	N.A.	N.A.

MACQUARIE GEOTECH

UNIAXIAL COMPRESSIVE STRENGTH (UCS)

For expedience in field/construction situations the uniaxial (unconfined) compressive strength of the rock is often inferred, or assessed using the point load strength index (Is_{50}) test (AS 4133.4.1 – 1993). For Sydney Basin sedimentary rocks the uniaxial compressive strength is typically about 20 x (Is_{50}) but the multiplier may range from about 10 to 30 depending on the rock type and characteristics. In the absence of UCS tests, the assigned Sydney Rock Class classification may therefore include rock strengths outside the nominated UCS range.

DEFECT SPACING

The terms relate to spacing of natural fractures in NMLC, NQ and HQ diamond drill cores and have the following definitions:

Defect Spacing (mm)	Terms Used to Describe Defect Spacing[1]
>2000	Very widely spaced
600 – 2000	Widely spaced
200 – 600	Moderately spaced
60 – 200	Closely spaced
20 – 60	Very closely spaced
<20	Extremely closely spaced

[1]After ISO/CD14689 and ISRM.

ALLOWABLE SEAMS

Seams include clay, fragmented, highly weathered or similar zones, usually sub-parallel to the loaded surface. The limits suggested in the tables relate to a defined zone of influence. For pad footings, the zone of influence is defined as 1.5 times the least footing dimension. For socketed footings, the zone includes the length of the socket plus a further depth equal to the width of the footing. For tunnel or excavation assessment purposes the defects are assessed over a length of core of similar characteristics.

Source: Based on Pells et al (1978), as revised by Pells et al (1998).
Pells, P.J.N, Mostyn, G. and Walker, B.F. – Foundations on Sandstone and Shale in the Sydney Region. Australian Geomechanics Journal, No 33 Part 3, December 1998.

MACQUARIE GEOTECH

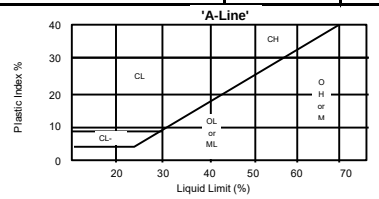
Summary of Soil Logging Procedures

Coarse Material: grain size - colour - particle shape - secondary components - minor constituents - moisture condition - relative density - origin - additional observations.

Fine Material: plasticity - colour - secondary components - minor constituents - moisture w.r.t. plasticity - consistency - origin - additional observations.

Guide to the Description, Identification and Classification of Soils

Major Divisions				SYMBOL	Typical Names
> 200mm	BOULDERS				
60 to 200mm	COBBLES				
COARSE GRAINED SOILS	More than 65% by dry mass less than 63mm is greater that 0.075mm	GRAVEL	More than 50% of coarse fraction > 2.36mm	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels.
		Gravelly Soils		GM	Silty gravels, gravel-sand-silt mixtures.
				GC	Clayey gravels, gravel-sand-clay mixtures
		SANDS	More than 50% of coarse fraction < 2.36mm	SW	Well-graded sands, gravelly sands, little or no fines.
				SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.
		Sandy Soils		SM	Silty sands, sand-silt mixtures.
				SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	More than 35% by dry mass less than 60mm is less than 0.076mm	Liquid Limit < 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
				OL	Organic silts and organic silty clays of low plasticity.
		Liquid Limit > 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS				Pt	Peat and other highly organic soils.



Grain sizes			
Gravel		Sand	
Coarse -	63 to 19mm	Coarse -	2.36 to 0.6mm
Medium -	19 to 6.7 mm	Medium -	0.6 to 0.21mm
Fine -	6.7 to 2.36mm	Fine -	0.21 to 0.075mm

GEOLOGICAL ORIGIN:-

Fill - artificial soils / deposits
Alluvial - soils deposited by the action of water
Aeolian - soils deposited by the action of wind
Topsoil - soils supporting plant life containing significant organic content
Residual - soils derived from insitu weathering of parent rock.
Colluvial - transported debris usually unsorted, loose and deposited

Field Identification of Fine Grained Soils - Silt or Clay?

Dry Strength - Allow the soil to dry completely and then test its strength by breaking and crumbling between the fingers.
High dry strength - Clays; Very slight dry strength - Silts.

Toughness Test - the soil is rolled by hand into a thread about 3mm in diameter. The thread is then folded and re-rolled repeatedly until it has dried sufficiently to break into lumps. In this condition inorganic clays are fairly stiff and tough while inorganic silts produce a weak and often soft thread which may be difficult to form and readily breaks and crumbles.

Dilatancy Test - Add sufficient water to the soil, held in the palm of the hand, to make it soft but not sticky. Shake horizontally, striking vigorously against the other hand several times. Dilatancy is indicated by the appearance of a shiny film on the surface of the soil. If the soil is then squeezed or pressed with the fingers, the surface becomes dull as the soil stiffens and eventually crumbles. These reactions are pronounced only for predominantly silt size material. Plastic clays give no reaction.

Descriptive Terms for Material Portions

COARSE GRAINED SOILS		FINE GRAINED SOILS	
% Fines	*Term/Modifier*	*% Coarse*	*Term/Modifier*
≤ 5	Omit, or use "trace"	≤ 15	Omit, or use "trace"
> 5, ≤ 12	"with clay/silt" as applicable	> 15, ≤ 30	"with sand/gravel" as applicable
> 12	Prefix soil as "silty/clayey"	> 30	Prefix as "sandy/gravelly"

Moisture Condition

for non-cohesive soils:

Dry -	runs freely through fingers.
Moist -	does not run freely but no free water visible on soil surface.
Wet -	free water visible on soil surface.

for cohesive soils:

MC > PL	Moisture content estimated to be greater than the plastic limit.
MC ~ PL	Moisture content estimated to be approximately equal to the plastic limit. The soil can be moulded
MC < PL	Moisture content estimated to be less than the plastic limit. The soil is hard and friable, or powdery.

The plastic limit (PL) is defined as the moisture content (percentage) at which the soil crumbles when rolled into threads of 3mm dia.

Consistency - For Clays & Silts

Description	*UCS(kPa)*	*Field guide to consistency*
Very soft	< 25	Exudes between the fingers when squeezed in hand
Soft	25 - 50	Can be moulded by light finger pressure
Firm	50 - 100	Can be moulded by strong finger pressure
Stiff	100 - 200	Cannot be moulded by fingers. Can be indented by thumb.
Very stiff	200 - 400	Can be indented by thumb nail
Hard	> 400	Can be indented with difficulty by thumb nail
Friable	-	Crumbles or powders when scraped by thumbnail

Relative Density for Gravels and Sands

Description	*SPT "N" Value*	*Density Index (ID) Range %*
Very loose	0 - 4	< 15
Loose	4 - 10	15 - 35
Medium dense	10 - 30	35 - 65
Dense	30 - 50	65 - 85
Very dense	> 50	> 85

MACQUARIE GEOTECH

Summary of Rock Logging Procedures

Description order: constituents - rock name - grain size - colour - weathering - strength - minor constituents - additional observations.
- minor constituents - moisture w.r.t. plasticity - consistency - origin - additional observations.

Definition - Sedimentary Rock

Conglomerate	more than 50% of the rock consists of gravel (>2mm) sized fragments
Sandstone	more than 50% of the rock consists of sand (0.06 to 2mm) sized grains
Siltstone	more than 50% of the rock consists of silt sized granular particles and the rock is not laminated
Claystone	more than 50% of the rock consists of clay or mica material and the rock is not laminated
Shale	more than 50% of the rock consists of clay or silt sized particles and the rock is laminated

Weathering

Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a change in volume but the soil has not significantly transported.
Extremely Weathered	EW	Rock is weathered to such an extent that it has 'soil' properties; ie. it either disintegrates or can be remoulded, in water.
Distinctly Weathered	DW	**Highly Weathered (HW)** - Rock is wholly discoloured and rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals **Moderately Weathered (MW)** - The whole of the rock is discoloured, usually by iron staining and bleaching. Shows little or no change in rock strength.
Slightly Weathered	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition or staining.

Stratification

thinly laminated	<6mm	medium bedded	0.2 - 0.6m
laminated	6 - 20mm	thickly bedded	0.6 - 2m
very thinly bedded	20 - 60mm	very thickly bedded	>2m
thinly bedded	60mm - 0.2m		

Discontinuities

order of description: depth - type - orientation - spacing - roughness / planarity - thickness - coating

	Type	Class	Roughness/Planarity	Class	Roughness/Planarity
B	Bedding	I	rough or irregular, stepped	VI	slickensided, undulating
F	Fault	II	smooth, stepped	VII	rough or irregular, planar
C	Cleavage	III	slickensided, stepped	VIII	smooth, planar
J	Joint	IV	rough or irregular, undulating	IX	slickensided, planar
S	Shear Zone	V	smooth, undulating		
D	Drill break				

Rock Strength

Term		Is (50)	Field Guide
		0.03	
Very low	VL		Material crumbles under firm blows with sharp end of pick; can be peeled with knive. Pieces up to 30mm thick can be broken by finger pressure.
		0.1	
Low	L		A piece of core 150 mm long x 50 mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
		0.3	
Medium	M		A piece of core 150 mm long x 50 mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.
		1	
High	H		A piece of core 150 mm long x 50 mm dia. core cannot be broken by unaided hands, can be slightly scratched or scored with knife.
		3	
Very High	VH		A piece of core 150 mm long x 50 mm dia. May be broken readily with hand held hammer. Cannot be scratched with pen knife.
		10	
Extremely High	EH		A piece of core 150 mm long x 50 mm dia. Is difficult to break with hand held hammer. Rings when struck with a hammer.

* - rock strength defined by point load strength (Is 50) in direction normal to bedding

Degree of fracturing

fragmented	The core is comprised primarily of fragments of length less than 20mm, and mostly of width less than the core diameter
highly fractured	Core lengths are generally less than 20mm - 40mm with occasional fragments.
fractured	Core lengths are mainly 30mm - 100mm with occasional shorter and longer lengths
slightly fractured	Core lengths are generally 300mm - 1000mm with occasional longer sections and shorter sections of 100mm -- 300mm.
unbroken	The core does not contain any fracture.

- spacing of all types of natural fractures, but not artificial breaks, in cored bores.

The fracture spacing is shown where applicable and the Rock Quality Designation is given by: RQD (%) = sum of unbroken core pieces 100 mm or longer

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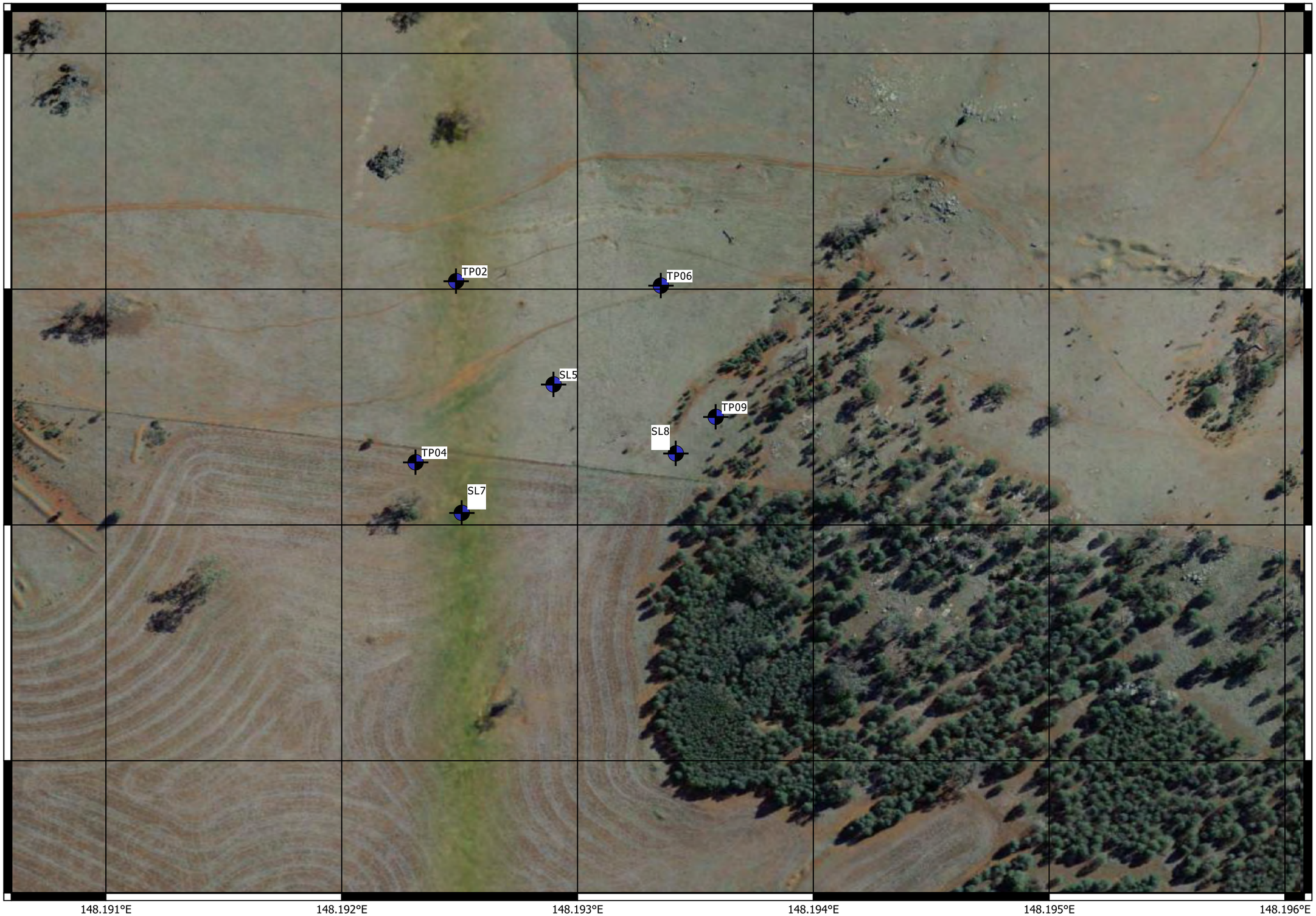
Appendix B – Site Plan



Legend

- Parkes test locations

NSW Six Map

MACQUARIE GEOTECH
3 Watt Drive, Bathurst NSW 2795
P: 02 6332 2011 F: 02 6334 4213 E: macgeo@macgeo.com.au

Client: Parkes Shire Council

Project: Raw Water Storage Lagoon

Location: Parkes NSW

Drawn: D. Onyeaka | Checked: C.Green | Date: 31/10/2022

0 25 50 75 100

Metres - Scale 1:1200

Vertical to Horizontal Scale 1 : 1
Co-ordinate Reference System - EPSG: 4326 WGS: 84

JOB NO B21615

Macquarie Geotechnical Ltd
Geotechnical Investigation Locality Map

Drawing Number: B21615 REV0

Appendix C – Borehole and Test Pit Logs

MACQUARIE GEOTECH

Borehole No.
SL5
Page 1 of 2

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	17/10/2022
Project Name:	Parkes BBRF	Completed:	17/10/2022
Hole Location:	Raw Water Storage Lagoon - Parkes	Logged By:	D.Onyeaka
Hole Coordinates:	611286.0 m E 6334621.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	393.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

Drilling Information									Soil Description			Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density / Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T			Not Observed	D 0.10-0.30 m					NA	TOPSOIL	NA	NA	TOPSOIL
				D 0.30-0.50 m					CL	Silty CLAY with gravel trace sand: low plasticity, dark brown; gravel fine to coarse grained, sub-angular to angular; sand fine grained; with rootlets <5mm.			RESIDUAL SOIL
									CI	Silty CLAY with gravel trace sand: low to medium plasticity, dark brown; gravel fine to coarse grained, sub-angular to angular; sand fine grained.		St to VSt	
										Gravelly Silty CLAY trace sand: medium plasticity, red, brown, orange; gravel fine to coarse grained, sub-angular to angular; sand fine grained.			
				D 1.00-1.50 m		392.0	1		CL-CI	Gravelly Silty CLAY with sand: low to medium plasticity, pale yellow, orange; gravel fine to coarse grained, sub-angular to angular; sand fine to coarse grained; [XW SANDSTONE].			EXTREMELY WEATHERED MATERIAL
				SPT 1.50-1.62 m 10/120mm HB					CL	Silty CLAY with gravel with sand: low plasticity, pale yellow, orange; gravel fine to coarse grained, sub-angular to angular; sand fine to coarse grained; [XW SANDSTONE].	w<PL		
				D 2.00-2.50 m		391.0	2					H	
				D 2.50-3.00 m									
				SPT 3.00-3.10 m 15/100mm HB		390.0	3						
				D 3.50-3.70 m									
						389.0	4			Hole Terminated at 3.70 m Practical Refusal			
						388.0	5						

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Plastic Limit
< PL
= PL
< PL

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	17/10/2022
Project Name:	Parkes BBRF	Completed:	17/10/2022
Hole Location:	Raw Water Storage Lagoon - Parkes	Logged By:	D.Onyeaka
Hole Coordinates:	611286.0 m E 6334621.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	393.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

SL5 Depth Range: 1.50 - 1.62 m

SL5 Depth Range: 3.00 - 3.10 m

MACQUARIE GEOTECH

Borehole No.
SL7
Page 1 of 3

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	17/10/2022
Project Name:	Parkes BBRF	Completed:	17/10/2022
Hole Location:	Raw Water Storage Lagoon - Parkes	Logged By:	D.Onyeaka
Hole Coordinates:	611249.0 m E 6334561.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	388.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

Drilling Information									Soil Description			Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density / Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T			Not Observed	SPT 0.00-0.45 m 5,4,8 N=12					NA	TOPSOIL	NA	NA	TOPSOIL
				D 0.10-0.50 m					CL-CI	Silty CLAY with gravel trace sand: low plasticity, brown; gravel medium to coarse grained, sub-angular to angular; sand fine grained.			RESIDUAL SOIL
									CI	Gravelly Silty CLAY trace sand: low to medium plasticity, brown; gravel fine to coarse grained, sub-angular to angular; sand fine to coarse grained.		St	
										Silty CLAY trace gravel: medium plasticity, orange brown; gravel fine to coarse grained, sub-angular to angular.			0.70: PP Samp =200 kPa
				D 1.00-1.50 m		387.0	1		CL	Gravelly Silty CLAY with sand: low plasticity, yellow orange; gravel fine to coarse grained, sub-angular to angular; sand fine to coarse grained.			EXTREMELY WEATHERED MATERIAL
				SPT 1.50-1.95 m 2,17,26 N=43									1.70: PP Samp =100 kPa
				D 2.00-2.50 m		386.0	2				w<PL		
				D 2.50-3.00 m								H	
				SPT 3.00-3.10 m 15/100mm HB		385.0	3						
				D 3.50-4.00 m		384.0	4			Hole Terminated at 4.00 m Practical Refusal			
						383.0	5						

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Plastic Limit
< PL
= PL
< PL

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	17/10/2022
Project Name:	Parkes BBRF	Completed:	17/10/2022
Hole Location:	Raw Water Storage Lagoon - Parkes	Logged By:	D.Onyeaka
Hole Coordinates:	611249.0 m E 6334561.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	388.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

SL7 Depth Range: 0.50 - 0.95 m

SL7 Depth Range: 1.50 - 1.95 m

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	17/10/2022
Project Name:	Parkes BBRF	Completed:	17/10/2022
Hole Location:	Raw Water Storage Lagoon - Parkes	Logged By:	D.Onyeaka
Hole Coordinates:	611249.0 m E 6334561.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	388.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

SL7 Depth Range: 3.00 - 3.10 m

MACQUARIE GEOTECH

Borehole No.
SL8
Page 1 of 2

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	17/10/2022
Project Name:	Parkes BBRF	Completed:	17/10/2022
Hole Location:	Raw Water Storage Lagoon - Parkes	Logged By:	D.Onyeaka
Hole Coordinates:	611334.0 m E 6334588.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	392.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

Drilling Information									Soil Description			Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density / Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T			Not Observed	D 0.10-0.30 m D 0.30-0.50 m SPT 0.50-0.95 m 3,6,5 N=11 D 1.00-1.50 m SPT 1.50-1.95 m 6,6,9 N=15		391.0 390.0	1 2		NA CL CI	TOPSOIL Gravelly Silty CLAY trace sand: low plasticity, dark brown; gravel fine to coarse grained, sub-angular to angular; sand fine grained; with rootlets <5mm. Gravelly Silty CLAY trace sand: low plasticity, dark brown; gravel fine to coarse grained, sub-angular to angular; sand fine grained. Gravelly Silty CLAY trace sand: medium plasticity, red, brown, orange; gravel fine to coarse grained, sub-angular to angular; sand fine grained.	NA w<PL	NA F to St St to VSt	TOPSOIL RESIDUAL SOIL 0.70: PP Samp =110 kPa 1.70: PP Samp =210 kPa
						389.0 388.0 387.0	3 4 5			Hole Terminated at 2.80 m Practical Refusal			2.80: Auger Refusal

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Plastic Limit
< PL
= PL
< PL

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	17/10/2022
Project Name:	Parkes BBRF	Completed:	17/10/2022
Hole Location:	Raw Water Storage Lagoon - Parkes	Logged By:	D.Onyeaka
Hole Coordinates:	611334.0 m E 6334588.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	392.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

SL8 Depth Range: 0.50 - 0.95 m

SL8 Depth Range: 1.50 - 1.95 m

MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP02
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611248.0, N: 6334670.0 (MGA94 Zone 55) | SURFACE ELEVATION : 398.00 (AHD)
EQUIPMENT TYPE : Komatsu 88MR | METHOD : Excavator Bucketrefer excavation information column
DATE EXCAVATED : 27/10/2022 | LOGGED BY : D.Onyeaka | CHECKED BY : D.O'Donnell

EXCAVATION INFORMATION | MATERIAL

METHOD	PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION (RL) DEPTH (M)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	DCP Blows/100mm	POCKET PENETRO-METER kPa	STRUCTURE & Other Observations
E	VE E F H	Not Observed	0.30m B 0.50m 0.80m B 1.00m 2.20m B 2.40m	0.0 397.5 0.5 397.0 1.0 396.5 1.5 396.0 2.0 395.5 2.5 3.0		NA CI CL	TOPSOIL Silty CLAY with gravel: low plasticity, dark brown; gravel fine to coarse grained, sub-angular to angular; with rootlets <5mm. 0.15m Silty CLAY trace sand: medium plasticity, orange, brown; sand fine grained. 0.70m Gravelly Silty CLAY with sand: low plasticity, orange, pale yellow; gravel medium to coarse grained, sub-angular to angular; sand fine to coarse grained. 2.50m Hole Terminated at 2.50 m Practical Refusal	NA w<PL	NA F to St VSt H	0 5 10 15 20	100 200 300 400	TOPSOIL 0.00: used toothless excavator bucket, 1500mm RESIDUAL SOIL 0.50: PP Samp =210 kPa 0.80: used toothed excavator bucket, 600mm

PHOTOGRAPHS
NOTES

METHOD
MB(*w*) Mud Bucket
TB(*w*) Toothed Bucket
ER(*w*) Ripper + bucket
EH(*w*) Hammer + bucket
w = width in mm

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet
M > PL - Moisture Content > Plastic Limit
M ~ PL - Moisture Content = Plastic Limit
M < PL - Moisture Content < Plastic Limit

CONSISTENCY/ RELATIVE DENSITY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

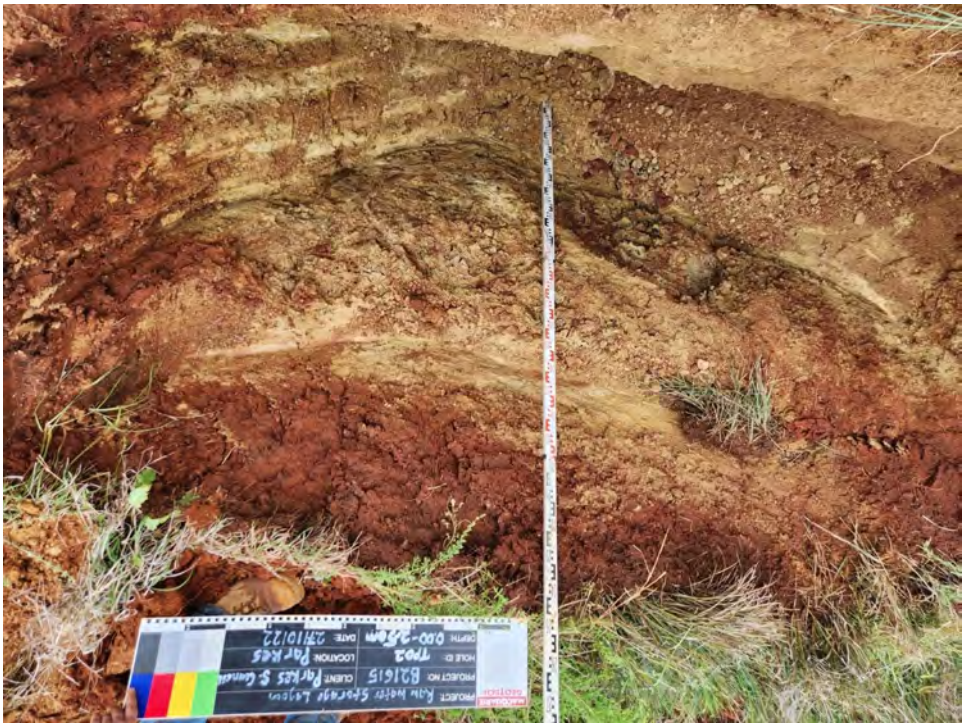
MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP02
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611248.0, N: 6334670.0 (MGA94 Zone 55)	SURFACE ELEVATION : 398.00 (AHD)	
EQUIPMENT TYPE : Komatsu 88MR	METHOD : Excavator Bucketrefer excavation information column	
DATE EXCAVATED : 27/10/2022	LOGGED BY : D.Onyeaka	CHECKED BY : D.O'Donnell



TP02 - 1 Depth Range: 0.00 - 2.50 m

TP02 - 2 Depth Range: 0.00 - 2.50 m

See Explanatory Notes for details of abbreviations & basis of descriptions.

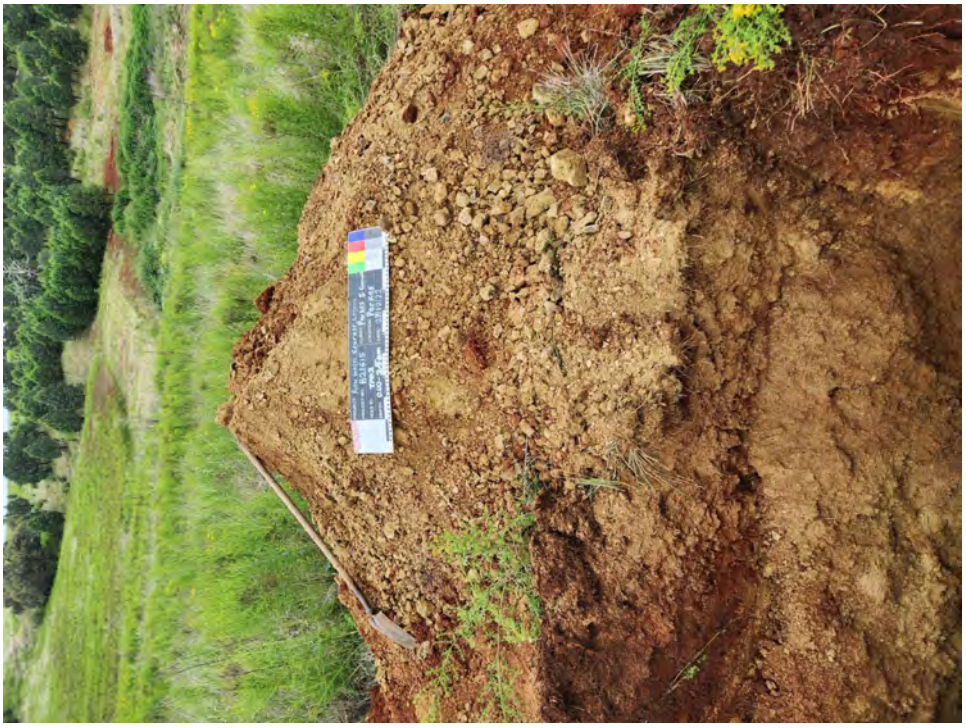
MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

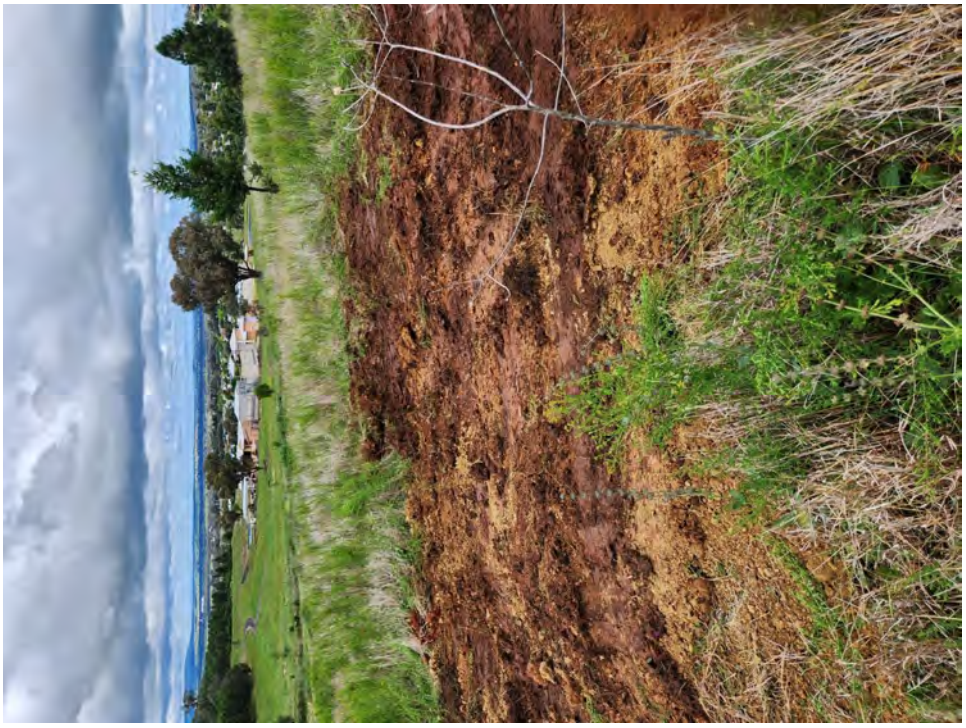
CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP02
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611248.0, N: 6334670.0 (MGA94 Zone 55)	SURFACE ELEVATION : 398.00 (AHD)
EQUIPMENT TYPE : Komatsu 88MR	METHOD : Excavator Bucketrefer excavation information column
DATE EXCAVATED : 27/10/2022	LOGGED BY : D.Onyeaka CHECKED BY : D.O'Donnell



TP02 - 3 Depth Range: 0.00 - 2.50 m



TP02 - 4 Depth Range: 0.00 - 2.50 m

See Explanatory Notes for details of abbreviations & basis of descriptions.

MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP04
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611231.0, N: 6334585.0 (MGA94 Zone 55) | SURFACE ELEVATION : 391.00 (AHD)
EQUIPMENT TYPE : Komatsu 88MR | METHOD : Excavator Bucketrefer excavation information column
DATE EXCAVATED : 27/10/2022 | LOGGED BY : D.Onyeaka | CHECKED BY : D.O'Donnell

EXCAVATION INFORMATION | MATERIAL

METHOD	PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION (RL) / DEPTH (M)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	MOISTURE CONDITION	CONSISTENCY / RELATIVE DENSITY	DCP Blows/100mm	POCKET PENETROMETER kPa	STRUCTURE & Other Observations
E	VE E F H	Not Observed	0.30m B; 0.50m; 1.30m B; 1.50m	390.5; 390.0; 389.5; 389.0; 388.5		NA; Cl; CL-Cl	TOPSOIL Gravelly Silty CLAY trace sand: low plasticity, dark brown; gravel fine to coarse grained, sub-angular to angular; sand fine grained; with rootlets <5mm. (0.10m)	NA	NA	0		TOPSOIL 0.00: used toothless excavator bucket, 1500mm
							Silty CLAY with gravel: medium plasticity, orange; gravel fine to coarse grained, sub-angular to angular; with roots.		St	5 10 15 20	100 200 300 400	RESIDUAL SOIL
											X	0.50: PP Samp =110 kPa
									St to VSt			
							Gravelly Silty CLAY with sand: low to medium plasticity, orange; gravel fine to coarse grained, sub-angular to angular; sand fine to coarse grained. (1.00m)	w<PL				1.10: used toothed excavator bucket, 600mm
									H			
							Hole Terminated at 2.30 m Practical Refusal (2.30m)					

PHOTOGRAPHS NOTES

METHOD
MB(*w*) Mud Bucket
TB(*w*) Toothed Bucket
ER(*w*) Ripper + bucket
EH(*w*) Hammer + bucket
w = width in mm

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet
M > PL - Moisture Content > Plastic Limit
M ~ PL - Moisture Content = Plastic Limit
M < PL - Moisture Content < Plastic Limit

CONSISTENCY/ RELATIVE DENSITY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

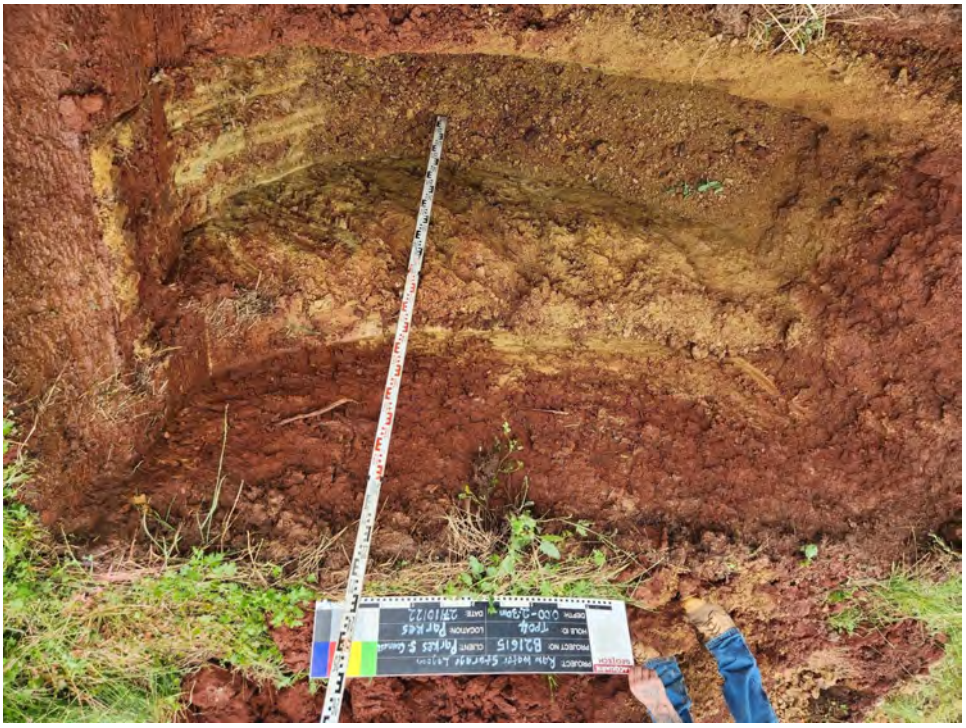
MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP04
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611231.0, N: 6334585.0 (MGA94 Zone 55)	SURFACE ELEVATION : 391.00 (AHD)	
EQUIPMENT TYPE : Komatsu 88MR	METHOD : Excavator Bucketrefer excavation information column	
DATE EXCAVATED : 27/10/2022	LOGGED BY : D.Onyeaka	CHECKED BY : D.O'Donnell



TP04 - 1 Depth Range: 0.00 - 2.30 m

TP04 - 2 Depth Range: 0.00 - 2.30 m

See Explanatory Notes for details of abbreviations & basis of descriptions.

MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP04
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611231.0, N: 6334585.0 (MGA94 Zone 55)	SURFACE ELEVATION : 391.00 (AHD)	
EQUIPMENT TYPE : Komatsu 88MR	METHOD : Excavator Bucketrefer excavation information column	
DATE EXCAVATED : 27/10/2022	LOGGED BY : D.Onyeaka	CHECKED BY : D.O'Donnell

TP04 - 3 Depth Range: 0.00 - 2.30 m

TP04 - 4 Depth Range: 0.00 - 2.30 m

See Explanatory Notes for details of abbreviations & basis of descriptions.

MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP06
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611329.0, N: 6334667.0 (MGA94 Zone 55) | SURFACE ELEVATION : 398.00 (AHD)
EQUIPMENT TYPE : Komatsu 88MR | METHOD : Excavator Bucketrefer excavation information column
DATE EXCAVATED : 27/10/2022 | LOGGED BY : D.Onyeaka | CHECKED BY : D.O'Donnell

EXCAVATION INFORMATION | MATERIAL

METHOD	PENETRATION (VE E F H)	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION (RL) / DEPTH (M)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	MOISTURE CONDITION	CONSISTENCY / RELATIVE DENSITY	DCP Blows/100mm (5 10 15 20)	POCKET PENETROMETER kPa (100 200 300 400)	STRUCTURE & Other Observations
E		Not Observed	0.20m B	398.0 / 0.0		NA	TOPSOIL Silty CLAY trace sand: low plasticity, dark brown; sand fine grained; with rootlets < 2mm.	NA	NA	0		TOPSOIL 0.00: used toothless excavator bucket, 1500mm
			0.40m	397.5 / 0.5			0.20m Silty CLAY trace sand: medium plasticity, orange; sand fine grained.		St		X	RESIDUAL SOIL 0.40: PP Samp =150 kPa
				397.0 / 1.0		CI						1.00: used toothed excavator bucket, 600mm
				396.5 / 1.5				w<PL	VSt			
			1.80m B				1.60m Sandy Silty CLAY: low plasticity, pale yellow, orange, dark grey; sand fine to coarse grained.					
			2.00m	396.0 / 2.0		CL			H			
				395.5 / 2.5			2.50m Hole Terminated at 2.50 m Practical Refusal					
				3.0								

PHOTOGRAPHS NOTES

METHOD
MB(*w*) Mud Bucket
TB(*w*) Toothed Bucket
ER(*w*) Ripper + bucket
EH(*w*) Hammer + bucket
w = width in mm

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet
M > PL - Moisture Content > Plastic Limit
M ~ PL - Moisture Content = Plastic Limit
M < PL - Moisture Content < Plastic Limit

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP06
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611329.0, N: 6334667.0 (MGA94 Zone 55)	SURFACE ELEVATION : 398.00 (AHD)	
EQUIPMENT TYPE : Komatsu 88MR	METHOD : Excavator Bucketrefer excavation information column	
DATE EXCAVATED : 27/10/2022	LOGGED BY : D.Onyeaka	CHECKED BY : D.O'Donnell

TP06 - 1 Depth Range: 0.00 - 2.50 m

TP06 - 2 Depth Range: 0.00 - 2.50 m

See Explanatory Notes for details of abbreviations & basis of descriptions.

MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP06
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SHEET :

POSITION : E: 611329.0, N: 6334667.0 (MGA94 Zone 55)	SURFACE ELEVATION : 398.00 (AHD)
EQUIPMENT TYPE : Komatsu 88MR	METHOD : Excavator Bucketrefer excavation information column
DATE EXCAVATED : 27/10/2022	LOGGED BY : D.Onyeaka CHECKED BY : D.O'Donnell

TP06 - 3 Depth Range: 0.00 - 2.50 m

TP06 - 4 Depth Range: 0.00 - 2.50 m

See Explanatory Notes for details of abbreviations & basis of descriptions.

MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP06
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611329.0, N: 6334667.0 (MGA94 Zone 55)	SURFACE ELEVATION : 398.00 (AHD)
EQUIPMENT TYPE : Komatsu 88MR	METHOD : Excavator Bucketrefer excavation information column
DATE EXCAVATED : 27/10/2022	LOGGED BY : D.Onyeaka CHECKED BY : D.O'Donnell

TP06 - 5 Depth Range: 0.00 - 2.50 m

See Explanatory Notes for details of abbreviations & basis of descriptions.

MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP09
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611350.0, N: 6334605.0 (MGA94 Zone 55)	SURFACE ELEVATION : 395.00 (AHD)
EQUIPMENT TYPE : Komatsu 88MR	METHOD : Excavator Bucketrefer excavation information column
DATE EXCAVATED : 27/10/2022	LOGGED BY : D.Onyeaka CHECKED BY : D.O'Donnell

EXCAVATION INFORMATION | MATERIAL

METHOD	PENETRATION VE E F H	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION (RL) DEPTH (M)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	DCP Blows/100mm 5 10 15 20	POCKET PENETRO-METER kPa 100 200 300 400	STRUCTURE & Other Observations
E		Not Observed	0.50m B	394.5 0.5		NA	TOPSOIL Gravelly Silty CLAY trace sand: low to medium plasticity, dark brown; gravel medium to coarse grained, sub-angular to angular; sand fine grained; with rootlets <5mm. 0.15m	NA	NA	0		TOPSOIL 0.00: used toothless excavator bucket, 1500mm
			0.70m				Silty CLAY with sand: medium plasticity, orange, brown, pale yellow; sand fine to coarse grained.					RESIDUAL SOIL
						CI			St to VSt			0.50: PP Samp =180 kPa
				394.0 1.0			1.00m					
							Sandy Silty CLAY with gravel: low plasticity, pale yellow, orange; sand fine to coarse grained; gravel medium to coarse grained, sub-angular to angular; with cobbles.	w<PL				1.10: used toothed excavator bucket, 600mm
			1.80m B	393.5 1.5		CL			VSt to H			
			2.00m	393.0 2.0			2.20m					
							Hole Terminated at 2.20 m Practical Refusal					
				392.5 2.5								
				3.0								

PHOTOGRAPHS NOTES

METHOD
MB(*w*) Mud Bucket
TB(*w*) Toothed Bucket
ER(*w*) Ripper + bucket
EH(*w*) Hammer + bucket
w = width in mm

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

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M - Moist
W - Wet
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M ~ PL - Moisture Content = Plastic Limit
M < PL - Moisture Content < Plastic Limit

CONSISTENCY/ RELATIVE DENSITY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

MACQUARIE GEOTECH

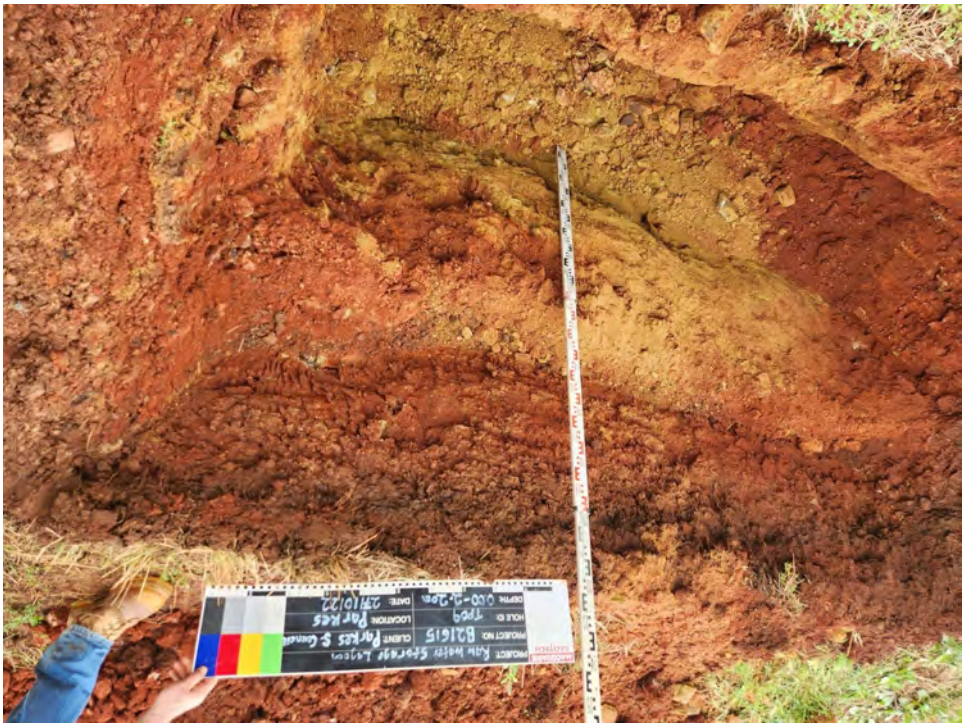
EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP09
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611350.0, N: 6334605.0 (MGA94 Zone 55)	SURFACE ELEVATION : 395.00 (AHD)
EQUIPMENT TYPE : Komatsu 88MR	METHOD : Excavator Bucketrefer excavation information column
DATE EXCAVATED : 27/10/2022	LOGGED BY : D.Onyeaka CHECKED BY : D.O'Donnell

TP09 - 1 Depth Range: 0.00 - 2.20 m



TP09 - 2 Depth Range: 0.00 - 2.20 m

See Explanatory Notes for details of abbreviations & basis of descriptions.

MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP09
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611350.0, N: 6334605.0 (MGA94 Zone 55)	SURFACE ELEVATION : 395.00 (AHD)
EQUIPMENT TYPE : Komatsu 88MR	METHOD : Excavator Bucketrefer excavation information column
DATE EXCAVATED : 27/10/2022	LOGGED BY : D.Onyeaka CHECKED BY : D.O'Donnell

TP09 - 3 Depth Range: 0.00 - 2.20 m

TP09 - 4 Depth Range: 0.00 - 2.20 m

See Explanatory Notes for details of abbreviations & basis of descriptions.

MACQUARIE GEOTECH

EXCAVATION - GEOLOGICAL LOG

CLIENT : Parkes Shire Council PROJECT : Parkes BBRF
LOCATION : Raw Water Storage Lagoon - Parkes

PIT NO : TP09
FILE / JOB NO : B21615
SHEET :

POSITION : E: 611350.0, N: 6334605.0 (MGA94 Zone 55)	SURFACE ELEVATION : 395.00 (AHD)
EQUIPMENT TYPE : Komatsu 88MR	METHOD : Excavator Bucketrefer excavation information column
DATE EXCAVATED : 27/10/2022	LOGGED BY : D.Onyeaka CHECKED BY : D.O'Donnell

TP09 - 5 Depth Range: 0.00 - 2.20 m

See Explanatory Notes for details of abbreviations & basis of descriptions.

Appendix D – Laboratoty Test Results

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-34**
Issue Number: 1
Date Issued: 13/12/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 1002
Sample Number: BTH-1002B
Date Sampled: 27/10/2022
Dates Tested: 15/11/2022 - 01/12/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **TP02 0.8-1.0m**
Material: B21615 Parkes Shire Council - Parkes BBRF

Falling Head Permeability (AS 1289 6.7.2 & 2.1.1)		Min	Max
Coefficient of Permeability (m/sec)	$5x10^{-10}$		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	2.00		
Optimum Moisture Content (%)	13.5		
Field Moisture Content (%)	12.4		
Sieve for Oversize (mm)	19.0		
Oversize Material (%)	4.7		
Placement Moisture Content (%)	13.5		
Laboratory Density Ratio (%)	149.7		
Laboratory Moisture Ratio (%)	99.7		
Surcharges and Pressure Applied	-		

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-34**
Issue Number: 1
Date Issued: 13/12/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 1002
Sample Number: BTH-1002D
Date Sampled: 27/10/2022
Dates Tested: 15/11/2022 - 06/12/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **TP04 1.3-1.5m**
Material: B21615 Parkes Shire Council - Parkes BBRF

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	28		
Plastic Limit (%)	15		
Plasticity Index (%)	**13**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**7.5**		
Cracking Crumbling Curling	Cracking		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	-		
Nature of Water	DISTILLED		
Temperature of Water (^{o}C)	17		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	11.2

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
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Issue Number: 1
Date Issued: 13/12/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 1002
Sample Number: BTH-1002E
Date Sampled: 27/10/2022
Dates Tested: 15/11/2022 - 06/12/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **TP06 0.2-0.4m**
Material: B21615 Parkes Shire Council - Parkes BBRF

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	46		
Plastic Limit (%)	21		
Plasticity Index (%)	**25**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**13.0**		
Cracking Crumbling Curling	Cracking		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	-		
Nature of Water	DISTILLED		
Temperature of Water (^{o}C)	17		

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
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Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-34**
Issue Number: 1
Date Issued: 13/12/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 1002
Sample Number: BTH-1002H
Date Sampled: 17/09/2022
Dates Tested: 15/11/2022 - 06/12/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **SL5 0.3-0.5m**
Material: B21615 Parkes Shire Council - Parkes BBRF

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	49		
Plastic Limit (%)	20		
Plasticity Index (%)	**29**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**13.5**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	23.3

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
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Report Number: **B22068-34**
Issue Number: 1
Date Issued: 13/12/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 1002
Sample Number: BTH-1002K
Date Sampled: 17/10/2022
Dates Tested: 15/11/2022 - 05/12/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **SL8 0.3-0.5m**
Material: B21615 Parkes Shire Council - Parkes BBRF

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**4 ***		
Soil Description	-		
Nature of Water	DISTILLED		
Temperature of Water (^{o}C)	17		
* Mineral Present	Carbonate		

SOIL CHEMICAL PROPERTIES REPORT

Client	Macquarie Geotechnical	**Source**	SL5 1.0-1.5m
Address	3 Watt Drive, Bathurst NSW,2795	**Sample Description**	-
Project	B21615-PSC-Parkes BBRF	**Report #**	BTH-1002I-SCP
Job #	B22068	**Lab #**	BTH-1002I

Test Procedure

☐	APHA 4500 H+B	pH
☐	APHA 4500 SO4 2-B	Sulphate
☐	APHA 4500 Cl-B	Chloride
☑	APHA 2510 & 2520-B	Electrical Conductivity
☐	AS 1012.20.1	Chloride and sulphate
☐	AS1289 4.2.1	Sulfate content of natural soil and groundwater
☐	AS1289 4.3.1	pH value of a soil - Electrometric method
☐	AS 1289 4.4.1	Electrical resistivity of a soil - Method for sands and granular material
☐	RMS T123	pH value of a soil - Electrometric method
☐	RMS T185	Resistivity of sands and granular road construction materials
☐	RMS T200	Chloride content of roadbase
☐	RMS T1010	Chlorides in soil
☐	RMS T1011	Sulphates in soil
☐	BS1377(1990 pt.3)	Water soluble sulphate content
☐	TAI B117*	Sulphides Present (*Not covered by NATA accreditation)
☐	In-house*	Resistivity calculated from Electrical Conductivity (*Not covered by NATA accreditation)

Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	27/10/2022
Preparation	Prepared in accordance with the test method	**Dates Tested**	30/11/2022

	pH	-
APHA 2510 & 2520-B	Electrical Conductivity (µS/cm)	173.6
	Chloride ion content (ppm)	-
	Chloride ion content (% w/w)	-
	Sulphate content (ppm)	-
	Sulphate content (% w/w)	-
	Mean Resistivity Ω.m	-
	(Resisitivity) Density ratio (R_D)	-
	(Resisitivity) Density index (I_D)	-
	Sulphides Present	-
	Sulphur Peroxide (% w/w)	-
	Resistivity (ohm m)	-

Notes

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
This document shall not be reproduced, except in full.
Results relate only to the samples tested.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Brad Morris

30/11/2022

Date:

Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

SOIL CHEMICAL PROPERTIES REPORT

Client	Macquarie Geotechnical	**Source**	SL7 1.0-1.5m
Address	3 Watt Drive, Bathurst NSW,2795	**Sample Description**	-
Project	B21615-PSC-Parkes BBRF	**Report #**	BTH-1002J-SCP
Job #	B22068	**Lab #**	BTH-1002J

Test Procedure

☐	APHA 4500 H+B	pH
☐	APHA 4500 SO4 2-B	Sulphate
☐	APHA 4500 Cl-B	Chloride
☑	APHA 2510 & 2520-B	Electrical Conductivity
☐	AS 1012.20.1	Chloride and sulphate
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☐	AS1289 4.3.1	pH value of a soil - Electrometric method
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☐	TAI B117*	Sulphides Present (*Not covered by NATA accreditation)
☐	In-house*	Resistivity calculated from Electrical Conductivity (*Not covered by NATA accreditation)

Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	27/10/2022
Preparation	Prepared in accordance with the test method	**Dates Tested**	30/11/2022

	pH	-
APHA 2510 & 2520-B	Electrical Conductivity (µS/cm)	191.7
	Chloride ion content (ppm)	-
	Chloride ion content (% w/w)	-
	Sulphate content (ppm)	-
	Sulphate content (% w/w)	-
	Mean Resistivity Ω.m	-
	(Resisitivity) Density ratio (R_D)	-
	(Resisitivity) Density index (I_D)	-
	Sulphides Present	-
	Sulphur Peroxide (% w/w)	-
	Resistivity (ohm m)	-

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Brad Morris

30/11/2022

Date:

Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

SOIL CHEMICAL PROPERTIES REPORT

Client	Macquarie Geotechnical	**Source**	SL8 0.5-0.95m
Address	3 Watt Drive, Bathurst NSW,2795	**Sample Description**	-
Project	B21615-PSC-Parkes BBRF	**Report #**	BTH-1002L-SCP
Job #	B22068	**Lab #**	BTH-1002L

Test Procedure

☐	APHA 4500 H+B	pH
☐	APHA 4500 SO4 2-B	Sulphate
☐	APHA 4500 Cl-B	Chloride
☑	APHA 2510 & 2520-B	Electrical Conductivity
☐	AS 1012.20.1	Chloride and sulphate
☐	AS1289 4.2.1	Sulfate content of natural soil and groundwater
☐	AS1289 4.3.1	pH value of a soil - Electrometric method
☐	AS 1289 4.4.1	Electrical resistivity of a soil - Method for sands and granular material
☐	RMS T123	pH value of a soil - Electrometric method
☐	RMS T185	Resistivity of sands and granular road construction materials
☐	RMS T200	Chloride content of roadbase
☐	RMS T1010	Chlorides in soil
☐	RMS T1011	Sulphates in soil
☐	BS1377(1990 pt.3)	Water soluble sulphate content
☐	TAI B117*	Sulphides Present (*Not covered by NATA accreditation)
☐	In-house*	Resistivity calculated from Electrical Conductivity (*Not covered by NATA accreditation)

Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	27/10/2022
Preparation	Prepared in accordance with the test method	**Dates Tested**	30/11/2022

	pH	-
APHA 2510 & 2520-B	Electrical Conductivity (µS/cm)	202.5
	Chloride ion content (ppm)	-
	Chloride ion content (% w/w)	-
	Sulphate content (ppm)	-
	Sulphate content (% w/w)	-
	Mean Resistivity Ω.m	-
	(Resisitivity) Density ratio (R_D)	-
	(Resisitivity) Density index (I_D)	-
	Sulphides Present	-
	Sulphur Peroxide (% w/w)	-
	Resistivity (ohm m)	-

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Brad Morris

30/11/2022

Date:

Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

Pinhole Dispersion Classification Report

Client	Parkes Shire Council	**Source**	TP02 0.30-0.50m
Address	Parkes NSW 2870	**Sample Description**	Silty CLAY
Project	B21615-Parkes Shire Council-BBRF	**Report No.**	S82216-PH
Job No.	S22105-2	**Sample No.**	S82216 (BTH-1002A)

Test Procedure ☑ AS1289 3.8.3 Soil classification tests - Dispersion - Determination of pinhole dispersion classification of a soil

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 27/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 16/12/2022

Pinhole Dispersion Results

Pinhole Dispersion Classification	**ND2 Completely Erosion Resistant**
Final Rate of Flow through specimen (ml/s)	2.92
Natural Moisture Content (%)	28.2
Test Moisture Content (%)	24.5
Test Wet Density (t/m^3)	1.962
Time Sample Cured in Soil Specimen Cylinder (Hours)	24
Method of Moisture Determination for Remoulding	Plastic Limit
Source of Water	Distilled
Hole Reformed at 50mm Head (Yes / No)	Yes

Notes

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Authorised Signatory:

Chris Lloyd

19/12/2022

Date:

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14 Carter St
Lidcombe NSW 2141

Particle Size Distribution with Hydrometer Report

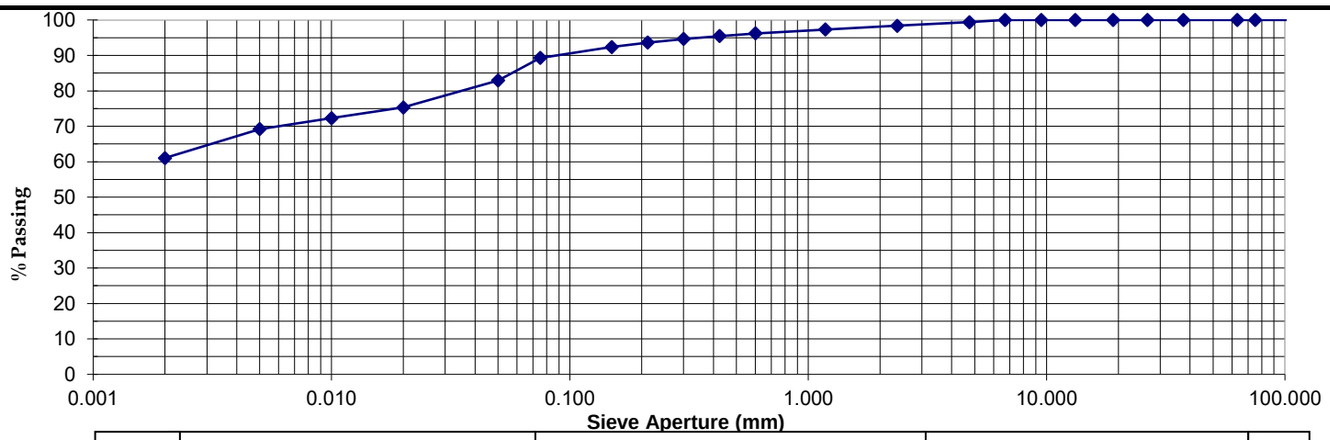
Client	Parkes Shire Council	**Source**	TP04 0.30-0.50m
Address	Parkes NSW 2870	**Sample Description**	Silty CLAY, trace of Sand and Gravel
Project	B21615-Parkes Shire Council-BBRF	**Report No**	S82217-HYD
Job No	S22105-2	**Lab No**	S82217 (BTH-1002C)

Test Procedure AS1289.3.6.3 Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer

AS1289.3.6.1 Determination of particle size distribution of a soil standard method sieving

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 27/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 26/11/2022



Clay	Silt	Sand	Gravel	Cobbles

Sieve Aperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	-		1.180	97	
75	-		0.600	96	
63	-		0.425	95	
37.5	-		0.300	95	
26.5	-		0.212	94	
19.0	-		0.150	92	
13.2	-		0.075	89	
9.5	-		0.050	83	
6.7	100		0.020	75	
4.75	99		0.010	72	
2.36	98		0.005	69	
			0.002	61	

Loss in Pre-treatment of Material (%):	0	Particle Density (t/m^3):	2.65
Method of Dispersion:	Sodium Hexametaphosphate / Sodium Carbonate	Assumed	
Method of Preparation:	As received from natural state	Hydrometer Type:	ASTM E100

Notes

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Particle Size Distribution with Hydrometer Report

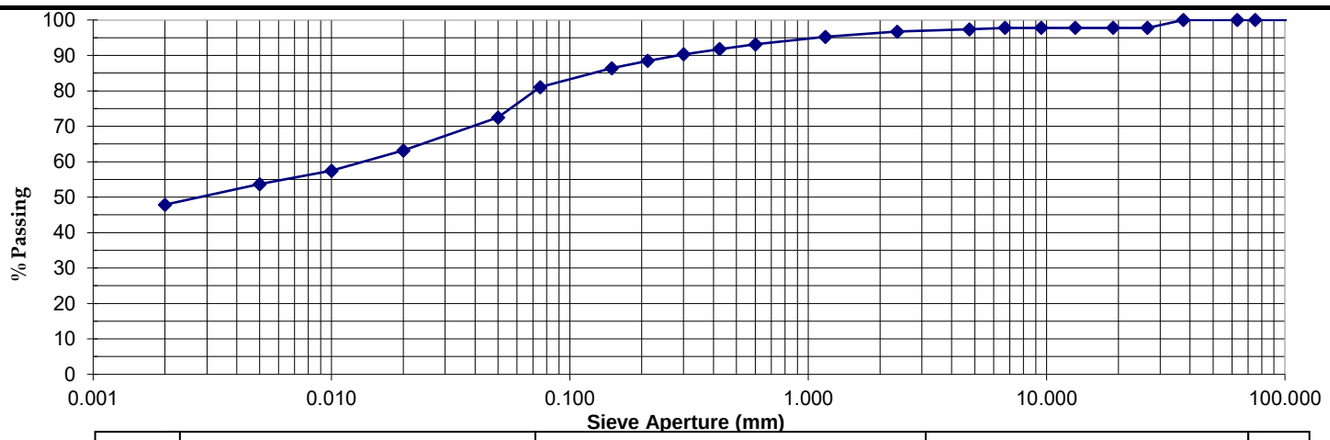
Client	Parkes Shire Council	**Source**	TP06 0.20-0.40m
Address	Parkes NSW 2870	**Sample Description**	Silty CLAY with Sand, trace of Gravel
Project	B21615-Parkes Shire Council-BBRF	**Report No**	S82218-HYD
Job No	S22105-2	**Lab No**	S82218 (BTH-1002E)

Test Procedure AS1289.3.6.3 Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer

AS1289.3.6.1 Determination of particle size distribution of a soil standard method sieving

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 27/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 28/11/2022



Clay	Silt	Sand	Gravel	Cobbles

Sieve Aperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	-		1.180	95	
75	-		0.600	93	
63	-		0.425	92	
37.5	100		0.300	90	
26.5	98		0.212	88	
19.0	98		0.150	86	
13.2	98		0.075	81	
9.5	98		0.050	72	
6.7	98		0.020	63	
4.75	97		0.010	57	
2.36	97		0.005	54	
			0.002	48	

Loss in Pre-treatment of Material (%):	0	Particle Density (t/m^3):	2.65
Method of Dispersion:	Sodium Hexametaphosphate / Sodium Carbonate	Assumed	
Method of Preparation:	As received from natural state	Hydrometer Type:	ASTM E100

Notes

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Lidcombe NSW 2141

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

Client	Parkes Shire Council	**Source**	TP09 0.50-0.70m
Address	Parkes NSW 2870	**Sample Description**	Gravelly Silty CLAY
Project	B21615-Parkes Shire Council-BBRF	**Report No**	S82219-MDD
Job No	S22105-2	**Sample No**	S82219 (BTH-1002F)

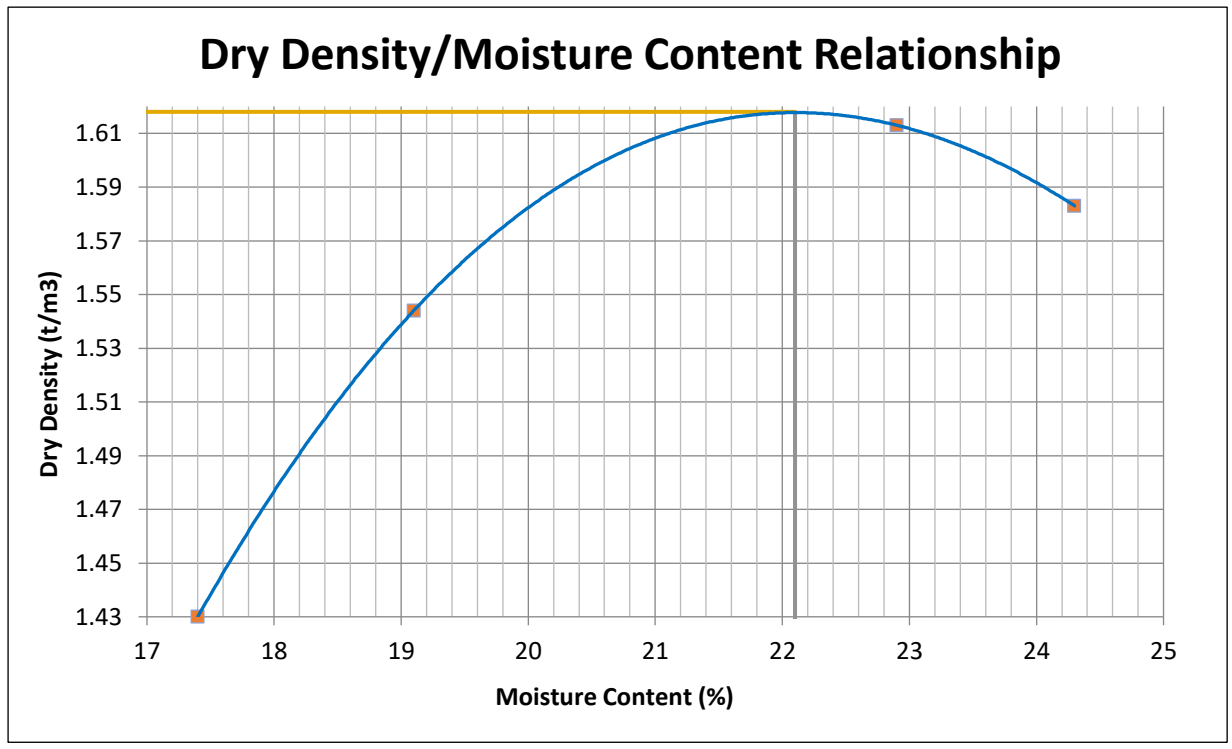
Test Procedure

☑ AS1289.5.1.1 Dry Density / Moisture Content Relationship - Standard Compaction

☑ AS1289.2.1.1 Moisture Content - Oven Drying Method (Standard Method)

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 27/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 28/11/2022



Maximum Dry Density (t/m^3)	1.618
Optimum Moisture Content (%)	22.1
Oversize Retained on 19mm sieve (%)	18.3
Oversize Retained on 37.5mm sieve (%)	7.5
Curing Time	101 hrs
Liquid Limit Determination	Technician Assessment

Notes

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11/01/2023

Date:

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Lidcombe NSW 2141

Permeability of Soil - Constant Head Method Using a Flexible Wall Permeameter Report

Client	Parkes Shire Council	**Source**	TP09 0.50-0.70m
Address	Parkes NSW 2870	**Sample Description**	Gravelly silty CLAY
Project	B21615-Parkes Shire Council-BBRF	**Report No**	S82219-TP
Job No	S22105-2	**Lab No**	S82219 (BTH-1002F)

Test Procedure	AS 1289 6.7.3 Determination of permeability of soil-Constant head method using a flexible wall permeameter		
Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	27/10/2022
Preparation	Prepared in accordance with the test method	**Date Tested**	19/12/2023

Test Details	
Specimen Type	Remoulded
Remoulding Details	100% of SMDD at 100% of SOMC
Tested Portion	-9.5 mm
Permeant Type	Sydney Tap Water

Specimen Details	
Percent Retained on 37.5 mm Sieve (%)	0
Maximum Dry Density (t/m^3)	1.62
Optimum Moisture Content (%)	22.1
Test Moisture Content (%)	22.1
Moisture Ratio (%)	100.0
Test Dry Density (t/m^3)	1.62
Density Ratio (%)	100.0
Specimen Length (mm)	70.1
Specimen Diameter (mm)	70.1
Length to Diameter Ratio	1.0

Test Data	
Confining Pressure (kPa)	550
Back Pressure (kPa)	500
Mean Effective Stress (kPa)	50
Coefficient of Permeability k(20) (m/second)	**3E-10**

Notes

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Alexandria NSW 2015

Particle Size Distribution with Hydrometer Report

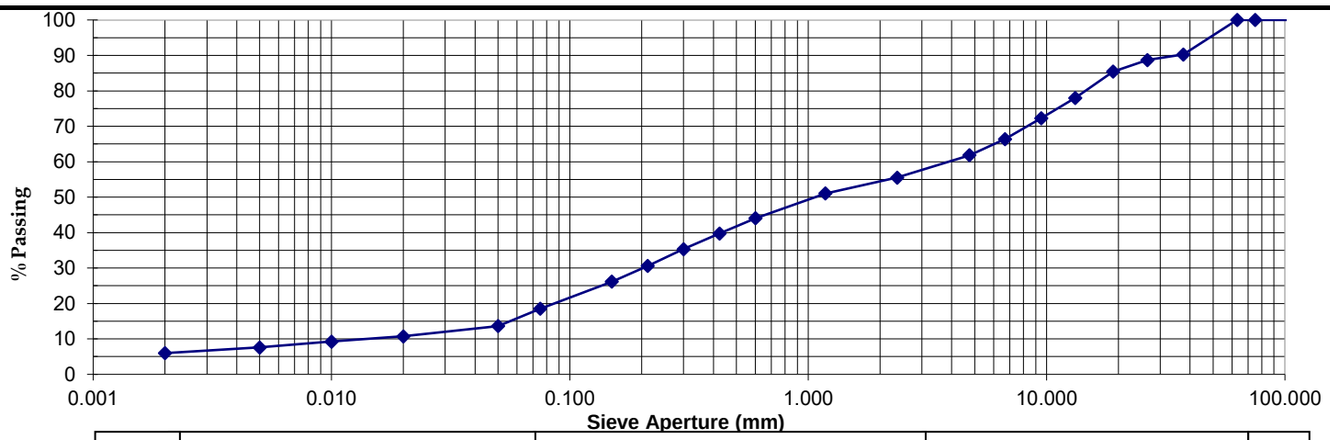
Client	Parkes Shire Council	**Source**	TP09 1.80-2.00m
Address	Parkes NSW 2870	**Sample Description**	Gravelly SAND with Silt and Clay
Project	B21615-Parkes Shire Council-BBRF	**Report No**	S82220-HYD
Job No	S22105-2	**Lab No**	S82220 (BTH-1002G)

Test Procedure AS1289.3.6.3 Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer

AS1289.3.6.1 Determination of particle size distribution of a soil standard method sieving

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 27/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 6/12/2022



Clay	Silt	Sand	Gravel	Cobbles

Sieve Aperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	-		1.180	51	
75	-		0.600	44	
63	100		0.425	40	
37.5	90		0.300	35	
26.5	89		0.212	31	
19.0	85		0.150	26	
13.2	78		0.075	19	
9.5	72		0.050	14	
6.7	66		0.020	11	
4.75	62		0.010	9	
2.36	56		0.005	8	
			0.002	6	

Loss in Pre-treatment of Material (%):	0	Particle Density (t/m^3):	2.65
Method of Dispersion:	Sodium Hexametaphosphate / Sodium Carbonate	Assumed	
Method of Preparation:	As received from natural state	Hydrometer Type:	ASTM E100

Notes

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Lidcombe NSW 2141

MOISTURE CONTENT TEST REPORT

Client	Parkes Shire Council	**Job #**	S22105-2
Address	Parkes NSW 2870	**Report #**	S82220-MC
Project	B21615-Parkes Shire Council-BBRF		

Test Procedure

- ☑ AS 1289 2.1.1 Determination of the moisture content of a soil - Oven drying method (Standard method).
- ☐ AS4133 1.1.1 Determination of the moisture content of rock - Oven drying method (standard method)
- ☐ RMS T120 Moisture content of road construction materials (Standard method)
- ☐ RMS T262 Determination of moisture content of aggregates (Standard method)

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 27/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 6/12/2022

Sample #	Source	Sample Description	Moisture Content %
S82220	TP09 1.80-2.00m	Gravelly SAND with Silt and Clay	**13.9**

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7/12/2022

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Appendix E Surface Water Management Report

Parkes Raw Water Storage Lagoon and Surface Water Management

Prepared for Parkes Shire Council

July 2023
Project Number SE22026

OPPORTUNITIES THROUGH EXCELLENCE

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Contents

Document Control				
Revision	Date	Prepared	Reviewed	Approved
A	11/07/2023	Scott Mortimer	Ivan Varga	Scott Mortimer

1. Introduction

1.1 Background of Works

Parkes Shire Council (PSC) is progressing with the design and construction of a new Raw Water Storage Lagoon near the existing Water Treatment Plant (WTP) located on the north side of Parkes. The construction of the lagoon will substantially affect the surface flows around the WTP.

The new WTP Raw Water Storage Lagoon will change the topography of the land near the WTP. As part of this change in topography stormwater modelling is required to ascertain whether the controls in place are adequate due to the addition of the Raw Water Lagoon. The Raw Water Lagoon has been designed to provide flood immunity up to the Probable Maximum Flood (PMF) to protect the partly treated water and lagoon structure from surface runoff flows coming from the surrounding catchment.

1.2 Scope of Works

BG&E were engaged to undertake the stormwater assessment for the Raw Water Storage Lagoon and work with the design team to ensure the lagoon was protected from the PMF. This work involved the following aspects:

1. A site visit was conducted on the 20th of September 2022 to familiarise with the local catchment and review existing stormwater infrastructure conditions
2. A review of background information relating to the proposed raw water storage lagoon and associated information relied upon to establish the hydraulic model to derive flood mitigation measures
3. A Rainfall-on-grid hydraulic model was established using TUFLOW software to derive design flow regime patterns for the 5%, 1% AEP and Probable Maximum Flood (PMF) events
4. The existing flood behaviour was determined in accordance with ARR2019 guidelines for design flood estimation
5. The design of the proposed raw water storage lagoon was incorporated and the associated drainage infrastructure to prevent local overland runoff entering the lagoon
6. Changes to flood behaviour downstream of the proposed lagoon as a result of the proposed design was quantified
7. Flood mitigation options to alleviate flood impacts on private properties downstream due to the proposed raw water lagoon works were investigated
8. The findings were documented, and a final mitigation solution suggested.

1.3 Data Collection and Review

The following data has been reviewed and utilised in the establishment of the flood model:

- Parkes Shire Council Water Treatment Plant - Stormwater Assessment & Western Basin Design Report (DGP Water, May 2017)
- Detail Design Drawings of Western Detention Basin (DGP, 2017)
- Raw Water Storage Lagoon footprint and 3D model (GHD, 2022)
- Proposed Drainage Channel and bund around Raw Water Lagoon (GHD, 2022)
- WTP Drawing and Culverts (PSC, 2022)
- Huntington Dam valve and Lorking Street Culvert photos (PSC, 2022)
- ELVIS LiDAR Data for Parkes township (ELVIS, 2022)
- Ground survey of the WTP precinct and surroundings (Arndell Surveying, October 2022)

2. Flood Model Build

This section describes the flood model build process and parameters adopted to establish the design flooding regime within the catchment that drains the WTP precinct.

2.1 Hydraulic Modelling

Hydraulic modelling was undertaken using TUFLOW. Tuflow is a 1D/2D hydrodynamic modelling software developed by BMT used in Australia and internationally to simulate complex flow behaviour in rural, urban and coastal floodplains. The flooding regime is estimated using a rectangular 2D grid with the incorporation of finer elements such as culverts, pits, pipes and narrow drainage channel in as 1D elements. The extent of the Tuflow model used in this analysis is depicted in

Figure 1. The model setup is summarised in Table 1.

Table 1: Tuflow Model Setup and adopted parameters

Parameter	Comment
Tuflow version	2020-10-AE HPC iSP
Adopted grid cell	A 2m model grid size with 1m sub-grid-sampling
Model Extent	**Refer in** Figure 1. Model covers an area of approximately 2.6km^2 covering the entire catchment of the WTP Storage Lagoon and extended downstream past Danilenko Street to observe any downstream effects.
Inflows	Rainfall on Grid applied with a 2d_rf layer consisting of the entire model extent.
Basins and Dams Initial Water Levels	All farm dams and detention basins were set to start full within the simulations to model the most conservative approach of no additional storage being available.
Culverts	Culverts were modelled as 1d network elements (1d_nwk) and were connected to the 2d domain. Culverts sizes and invert levels were provided from survey of the WTP and surrounding areas undertaken by PSC and the PSC township TUFLOW model where survey was not provided. The culverts were modelled as 0% blocked due to the low potential of debris from the land uses of the upstream areas.
Operation of Huntington Dam	Two 100 mm low flow pipes were left open throughout all simulations, this was based on advice from Council's operations team on how Huntington Dam is currently operated in a flood event.
Model Topography	Survey of the WTP, the surrounding basins, drains, and roads was provided by PSC. The surrounding landscape used 1 m LiDAR topographical information flown in 2013 sourced from Geosciences Australia.
Downstream Boundary Conditions	Set as HQ (Head vs Flow) boundary with respect to the slope of the terrain in the area

Manning's N is a coefficient which represents the roughness, or the friction applied to the rainfall runoff across the surface of the model which affects the velocity of runoff within the model. The higher the Manning's N number the more friction is being applied at the model cell. The Manning's N roughness of different areas were digitised from aerial imagery and set as per Table 2 for different land use types outlined in ARR2019.

Table 2: Model Roughness (Manning's N) Values

Terrain	Roughness (Manning's N)
Roads/Streets	0.020
Industrial Areas	0.150
Open Space	0.050

Terrain	Roughness (Manning's N)
Open Drain	0.030
Residential Areas	0.080
Medium Vegetation	0.060
Basins/Channels/Water	0.015
Grass Swales	0.035
Rock Protection	0.080
WTP Buildings	0.5
Future Development	0.75

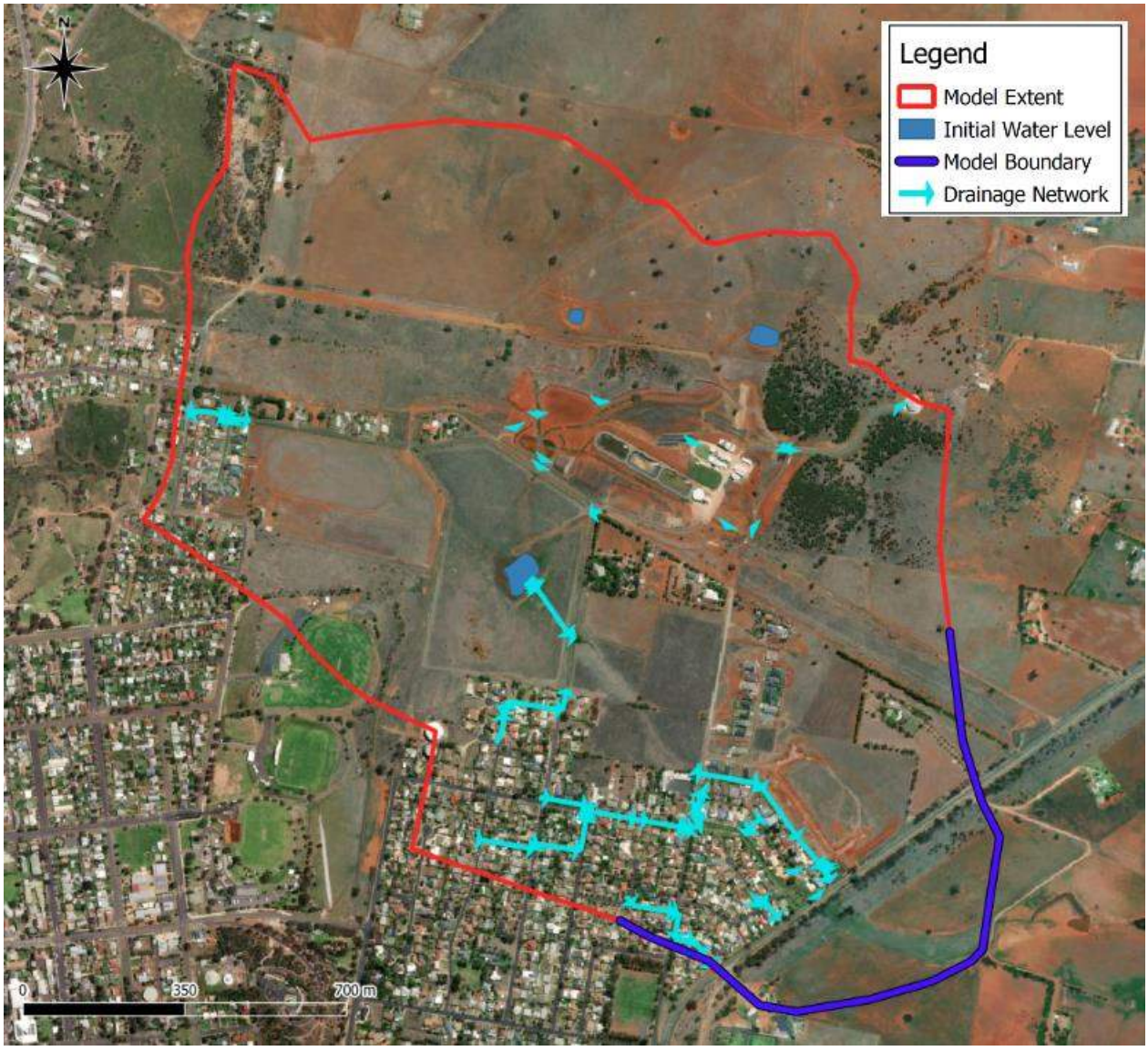


Figure 1: Tuflow model layout

3. Rainfall-On-Grid Modelling

A rainfall-on-grid approach was used for the hydraulic modelling utilising the hydraulic model build for the existing conditions as outlined in Section 2.

3.1 Digital Elevation Model (DEM) Conditioning

A process was undertaken to adjust the model DEM to account for rainfall losses. As the rainfall losses applied already account for depression storage, the model DEM was adjusted by filling in areas of depression storage to avoid duplicating rainfall losses.

3.2 Design Rainfall information

3.2.1 Rainfall losses

As per the ARR Data Hub NSW Specific Data, the nearby FFA-reconciled losses of an initial loss of 23.9 mm and continuing loss of 1.9 mm/hr from the Obley No.2 (421048) gauge was adopted. The catchment factors between the two adjacent catchments were similar allowing the adopting of these reconciled losses. For the PMF event an initial loss of 0 mm and continuing loss of 1 mm/hr was adopted. A medium pre-burst for the catchment was selected and this was applied to initial loss for each storm. The losses can be seen in Table 3.

Table 3: Catchment Losses

Event	Initial Loss (mm)	Continuing Loss (mm/hr)
1% AEP	23.9	1.9
5% AEP	23.9	1.9
PMF	0	1

The catchment initial losses were adjusted for the median pre-burst which was applied for each storm for 1 and 5% AEP events. Losses for durations less than 60 minutes have been interpolated to zero.

3.2.2 Areal Reduction Factor (ARF)

The total modelling area is 2.6km^2, however, the adopted ARF was based on area of 9.5 hectares – which is the contributing catchment to the raw water storage lagoon.

3.2.3 Temporal patterns

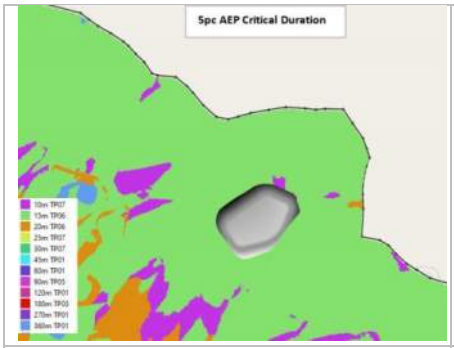
As per ARR2019, an ensemble approach was used to determine the critical duration and temporal pattern for each event. Point temporal patterns from the Murray Basin region were used for this assessment due to the site location and size of contributing catchment. For the 5% and 1% AEP, each duration from 15 mins up to 360 mins was run for all 10 temporal patterns. Longer than 360min events were not considered due to the small catchment size, and peak flows for the drains surrounding the storage lagoon were being determined.

3.2.4 Critical duration

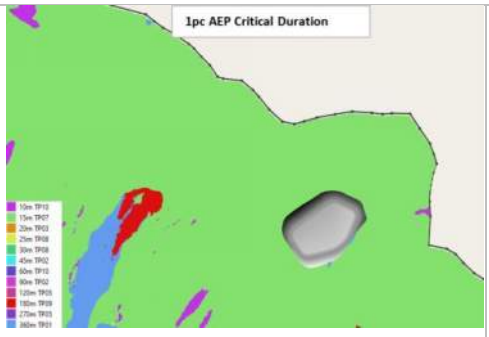
To determine the critical duration for the raw water storage lagoon the flow nearest to the area of interest was observed. Since the objective of the works was to size the diversion channels for the raw water storage lagoon the peak flows were needed. For each duration, the temporal pattern that generated the flow one above the median was selected. The flood levels for each of these storms were enveloped and the storm that generated the highest flood levels at our area of interest was selected as the critical. The critical storms duration and temporal pattern for each event is given below.

Table 4 – Critical Duration + Temporal Patterns

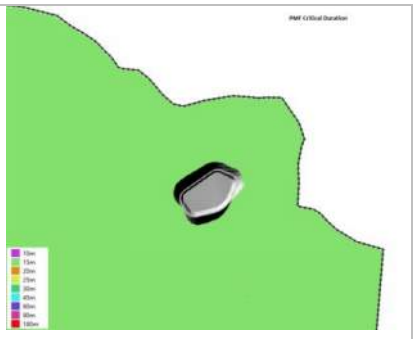
Event	Critical Duration (min)	Critical Temporal Pattern
1% AEP	15	TP07
5% AEP	15	TP06
PMF	15	GDSM



5% AEP Event Critical Durations



1% AEP Event Critical Durations



PMF Critical Durations

3.2.5 Intensity-Frequency-Duration (IFD) Data

The IFD data for the catchment was sourced from the Bureau of Meteorology (BOM) Design Rainfall Data System (2016). The rainfall depths applied for each duration are presented in Table 5 for the 5% and 1% AEP events.

Table 5: Design Rainfall Depths

Duration (mins)	5% AEP (mm)	1% AEP (mm)
1	3.83	5.21
2	6.54	8.85
3	8.97	12.1
4	11.1	15
5	13	17.6
10	20	27.2
15	24.7	33.6
20	28.2	38.4
25	30.9	42.2
30	33.2	45.3
45	38.3	52.2
60	42.1	57.2
90	47.5	64.3
120	51.6	69.6
180	57.8	77.6
270	64.8	86.5
360	70.4	93.5

3.2.6 Probable Maximum Precipitation calculation

The World Meteorological Organisation defines Probable Maximum Precipitation (PMP) as '*the greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of year'.* The PMP has been utilised in this study to derive the Probable Maximum Flood (PMF). The PMF is normally utilised in the design of large hydrological structures such as dams, or other type of infrastructure that would result in catastrophic consequences if flooded. In this project, the PMF has been utilised to design the drainage channel and bund around the proposed raw water lagoon.

The estimation of the PMP has been carried out in accordance with The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method (Bureau of Meteorology, 2003). This document outlines the procedure to estimate PMP for catchment areas up to 1,000 km^2 and storm duration limits of up to 6 hours along the tropical and subtropical areas of Australia.

The following parameters have been adopted to estimate the PMP for different storm durations relevant to the study area:

- 100% rough catchment
- Elevation adjustment factor – 1.00
- Moisture adjustment factor – 0.68

Table 6 PMP Rainfall Depths

Duration (minutes)	PMP Rainfall Depths (nearest 10mm)
15	170
30	240
45	300
60	350
90	450
120	520
150	580
180	640

4. Design Modelling

4.1 WTP Supply Lagoon

The TUFLOW model built for the existing case scenario was updated to include the design provided by GHD of the Raw Water Storage Lagoon. The drains surrounding the storage lagoon were sized to the PMF event, as the storage lagoon has a flood immunity of the PMF, to prevent surface runoff contamination into the partially processed drinking water. Several iterations were modelled in conjunction with GHD to optimise a solution for the surrounding drains and lagoon positioning. During these design iterations the flow of the storage lagoon spillway was added to the drains to account for the runoff from the lagoon. A figure of the final storage lagoon design can be seen in Figure 2.

Figure 2: WTP Raw Water Storage Lagoon Layout

The upstream catchment area of the storage lagoon is approximately 9.5 hectares and naturally runs downhill to the WTP below. Figures of the existing flooding scenario can be seen in Appendix A Figures 1 to 3. Through the positioning of the drains around the Storage Lagoon the natural runoff has been directed to the West away from the WTP facilities (Appendix A Figures 4 to 6). This has an impact of reducing the water levels in the WTP by up to 0.17 m and 0.20 m in the 5% and 1% AEP events. With more flows sent westward there are increases on Webb Street downstream of the Basin of 0.02 m and 0.07 m in the 5% AEP and 1% AEP events due to the redirection of flows. This results in peak depths on Webb Street of 0.1 in the 5% AEP event and 0.11 in the 1% AEP event. The road remains classified as H1 – generally safe for people, vehicles and buildings as per ARR2019 guidelines.

There are increases further downstream in the 1% AEP event with increases of 0.01 m on Lorking Street and increases of 0.01 m on the bus depot on Danilenko Street and affecting properties on the corner of Noonan Street and Danilenko Street. Figures of the Afflux of the GHD design can be seen in Appendix A Figures 16 to 17.

4.2 Flood mitigation options

With the redirection of the flows westward around the WTP, an investigation took place on potential flood mitigation options to prevent water level increases downstream and mitigate increases further. A series of options were initially modelled. A workshop was held with members of PSC to agree upon three options that would be assessed further. These three options were:

- Option 1: Management of Huntington Dam (emptying of the dam before large storm events) and raising Webb Street Basin bund by 0.5 m
- Option 2: Raising Huntington Dam existing bund and spillway by 0.5 m
- Option 3: Extending Webb Street Basin to the West

4.2.1 Management of Huntington Dam and raising Webb Street Basin by 0.5 m

Flows egress Huntington Dam via 3 outlet pipes: 2 x 100 mm diameter pipes with inverts at 356 and 355 m AHD and 1 x 300 mm pipe with an invert at the bottom of the dam at 352 m AHD. These all connect to a 300 mm diameter pipe which runs downstream to Lorking Street. Currently the 2 x 100 mm outlet pipes are always open, and the 300 mm closed meaning that the Dam is never completely empty. Simulations of the TUFLOW model were run to estimate the amount of time required to totally empty the Dam these can be seen below in Table 7.

Table 7: Time to Empty Huntington Dam

Pipes	Time to Empty Huntington Dam (hours)
2 x 100 mm	80 (to 355 m AHD – not completely empty)
1 x 300 mm, 2 x 100 mm	45
1 x 450 mm, 2 x 100 mm	18

By operating the 300 mm pipe at all points of time the Dam can be emptied in 45 hours, if a significant storm event is forecasted with a two-day warning period the flood storage behind the Dam could be utilised to a greater extent. By upgrading the 300 mm pipe and the connecting downstream 300 mm to Lorking Street to 450 mm pipes then the dam could be emptied in 18 hours. With a one day warning period of a severe weather event the Dam could be completely emptied to provide a large amount of storage to protect downstream areas. Currently when the dam is full before a storm event there is no benefit of having the dam in use, only the additional risk of a potential dam failure. By raising the Webb street Basin bund and spillway by 0.5 m this adds approximately an additional 1,500 m^3 of storage.

The flood modelling of this option can be seen in Appendix A for flood depths in Figures 7 to 9. There are increases of 0.02 m and 0.05 m in the 5% and 1% AEP events on Webb Street as the increased flood storage of Webb Street Basin does not account for the increased flows being sent West from the Raw Water Storage Lagoon, however these increases are less than if no mitigation works were to take place. There are decreases on Lorking Street of 0.05 and 0.11 on Lorking Street in the 5% and 1% AEP events as water is retained behind Huntington Dam. While there are also decreases on the bus depot at Danilenko Street by 0.05 m in the 1% AEP event. The afflux maps for this option can be seen in Figures 18 to 19 in Appendix A.

4.2.2 Raising Huntington Dam existing bund and spillway by 0.5 m

Earthworks were proposed at Webb Street Basin and Huntington Dam to raise the current bund heights by 0.5 m, this would increase the available flood storage behind both structures. The initial water level behind Huntington Dam was also raised by 0.5 m to simulate the dam being full in this raised scenario. Figures of the afflux can be seen in Appendix A Figures 20 to 21 for this scenario. There are increases on Webb Street of 0.02 and 0.05 in the 5% and 1% AEP events. There are decreases on Lorking Street of 0.01 and 0.02 in the 5% and 1% AEP events and in the 1% AEP event there are decreases of 0.01 m on the bus depot at Danilenko Street.

4.2.3 Extending Webb Street Basin to the West

The extension of Webb Street Basin further to the West adding approximately 5,000 m^3 was the proposed third option. Initially the expansion of Webb Street Basin was proposed to the east however due to the presence of an asbestos stockpile this has been moved to the West. There is a risk in this option that with further earthworks there is potential of asbestos being found in this area. Figure 3 shows the current known areas of asbestos, this sketch was provided from PSC.

Figure 3: WTP Asbestos Sketch

There are decreases on Webb Street of 0.04 and 0.05 in the 5% and 1% AEP events, this is due to the additional flood storage of the Webb Street Basin. There are decreases on Lorking Street of 0.01 and 0.01 in the 5% and 1% AEP events due to less flow reaching the basin and in the 1% AEP event there are decreases of 0.01 m on the bus depot at Danilenko Street. Afflux mapping showing these results can be seen in Figures 22 to 23 in Appendix A.

5. Conclusions and Recommendations

5.1 Conclusions

With the introduction of the WTP Raw Water Storage Lagoon, catchment flows that were previously flowing south through the WTP and the downstream properties are now being sent West towards Webb Street and Huntington Dam increasing the flooding depths on Webb Street. A series of options are proposed to negate these impacts. These are;

1. Management of Huntington Dam (emptying of the dam before large storm events) and raising Webb Street Basin bund by 0.5 m
2. Raising Huntington Dam existing bund and spillway by 0.5 m
3. Extending Webb Street Basin to the West

- The implementation of the Raw Water Lagoon will send flows previously travelling south through the WTP west to Webb Street Basin and Huntington Dam. This decreases flood levels in the WTP in flood events while increasing flood levels on Webb Street and Lorking Street.
- The most effective option is utilising the existing flood storage behind Huntington Dam through managing the dam and lowering the dam levels prior to flood events. With no additional investment through opening the 300 mm pipe flood levels downstream of Huntington Dam can be lowered.
- This has a positive impact of lowering flood levels on Lorking street, through the green field space downstream and all the way to the bus depot on Danilenko Street.
- Increasing the flood storage of Webb Street Basin reduces the impact on Webb Street from directing flows to the West from the Raw Water Storage Lagoon.

5.2 Recommendations

- The current assessment for the Raw Water Storage Lagoon and the potential mitigation options has been undertaken for the critical storms that provide the median peak flows at the Storage Lagoon. A further assessment would be recommended of these options in high volume events, to assess the effectiveness of these options in terms of flood storage, and critical storms for the greater catchment area.
- No consideration or assessment has been undertaken for the potential of scour risks in the designed channels of the Raw Water Storage Lagoon. This scour assessment should be included in future stages of the design.
- No dam break assessments have been undertaken for any of the proposed flood mitigation options, raising the bund heights of both Webb Street and Huntington Dam increases the risk to downstream properties in the event of a dam failure. A dam break assessment has not been undertaken to assess the difference in the risk to downstream properties, this should be undertaken if increasing the bund height to either dam is the chosen option.

6. References

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors). (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation.* Commonwealth of Australia.

DFSI Spatial. (May 2015). *Elevation data products specification and description. Source Airbourne Light Detecting and Ranging (LiDAR).* NSW Spatial Services.

ELVIS. (2020, June 25). *Elevation and Depth - Foundation Spatial Data*. Retrieved from https://elevation.fsdf.org.au/

Appendices

Appendix A - Flood Mapping

Legend

- Model Boundary
- Raw Water Storage Lagoon

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 1

Existing Scenario - 5% AEP Flood Depths
Existing Flooding Scenario

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

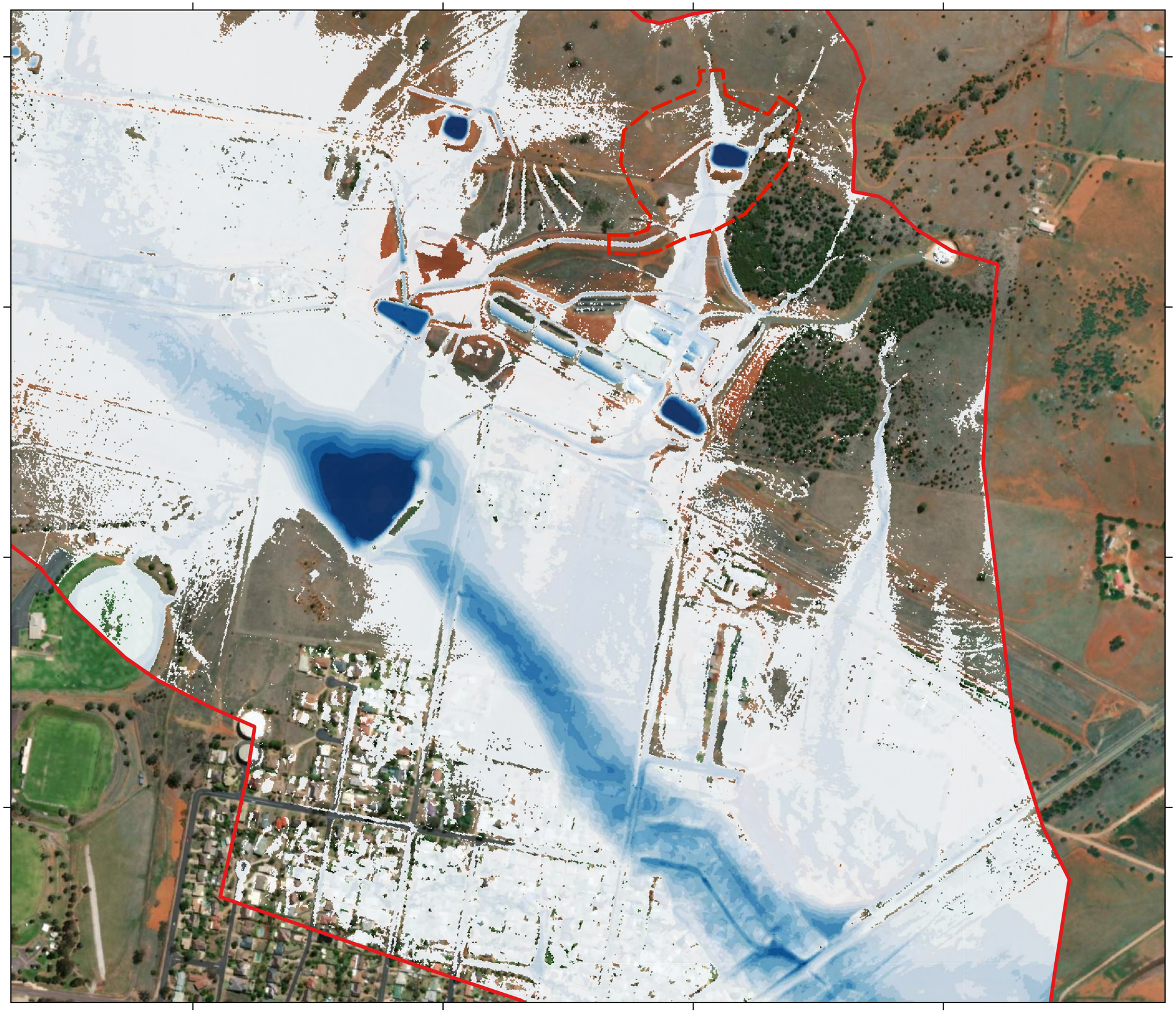
Raw Water Storage Lagoon

Figure 2

Existing Scenario - 1% AEP Flood Depths
Existing Flooding Scenario

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial



Legend

- Model Boundary
- Raw Water Storage Lagoon

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

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APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 3

Existing Scenario - PMF Flood Depths
Existing Flooding Scenario

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

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Legend

- Model Boundary
- Raw Water Storage Lagoon

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

DRAWN: SM
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APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 4

Design Scenario - 5% AEP Flood Depths
GHD Design

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

BG&E

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

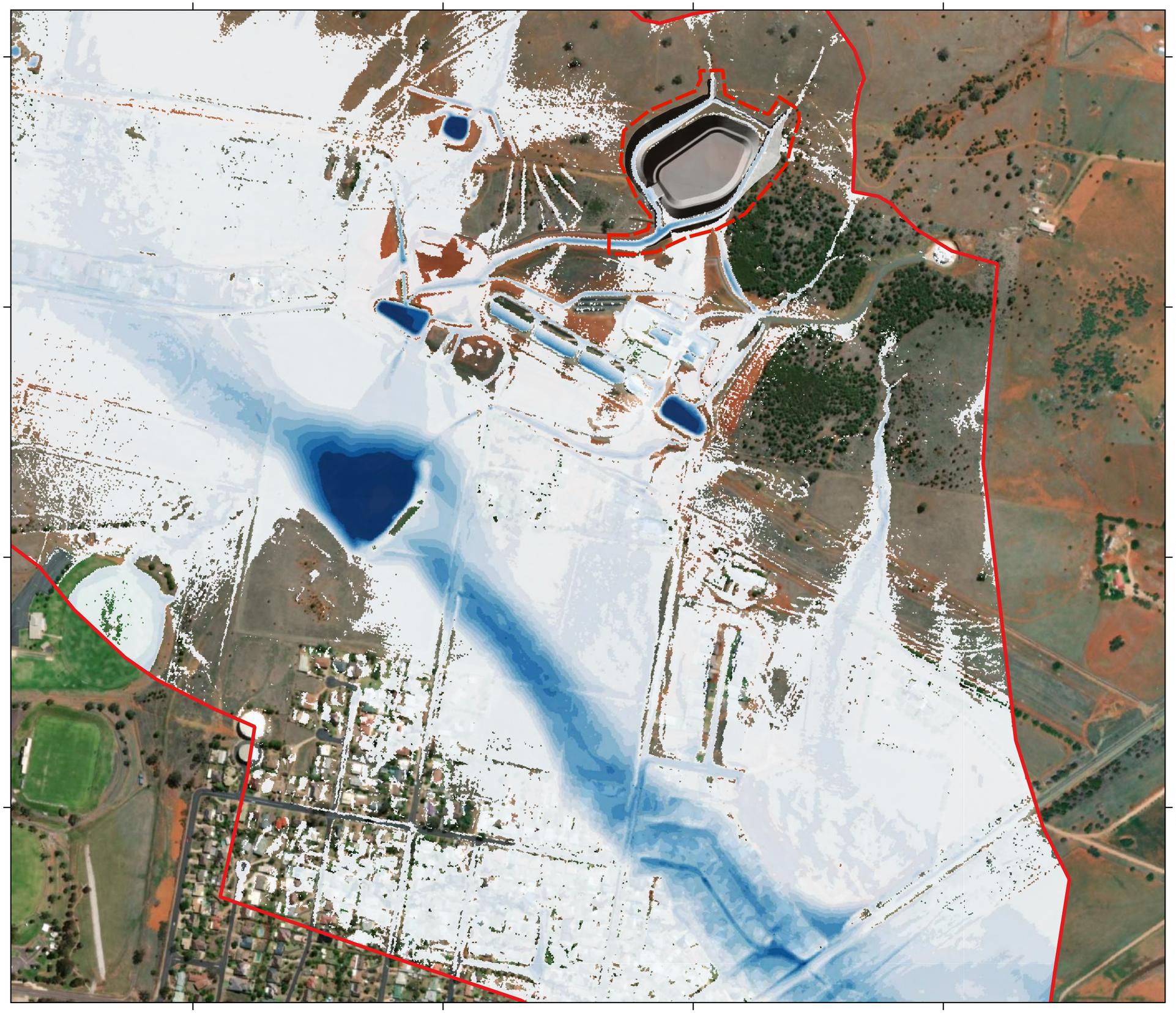
Raw Water Storage Lagoon

Figure 5

Design Scenario - 1% AEP Flood Depths
GHD Design

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial



Legend

- Model Boundary
- Raw Water Storage Lagoon

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 6

Design Scenario - PMF Flood Depths
GHD Design

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

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Legend

- Model Boundary
- Raw Water Storage Lagoon
- Earthworks
- Hungtington Dam

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 7

Option 1 - 5% AEP Flood Depths
Management of Huntington Dam and Raising of Webb Street bund by 0.5

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

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Legend

- Model Boundary
- Raw Water Storage Lagoon
- Earthworks
- Hungtington Dam

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

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REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 8

Option 1 - 1% AEP Flood Depths
Management of Huntington Dam and Raising of Webb Street bund by 0.5

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

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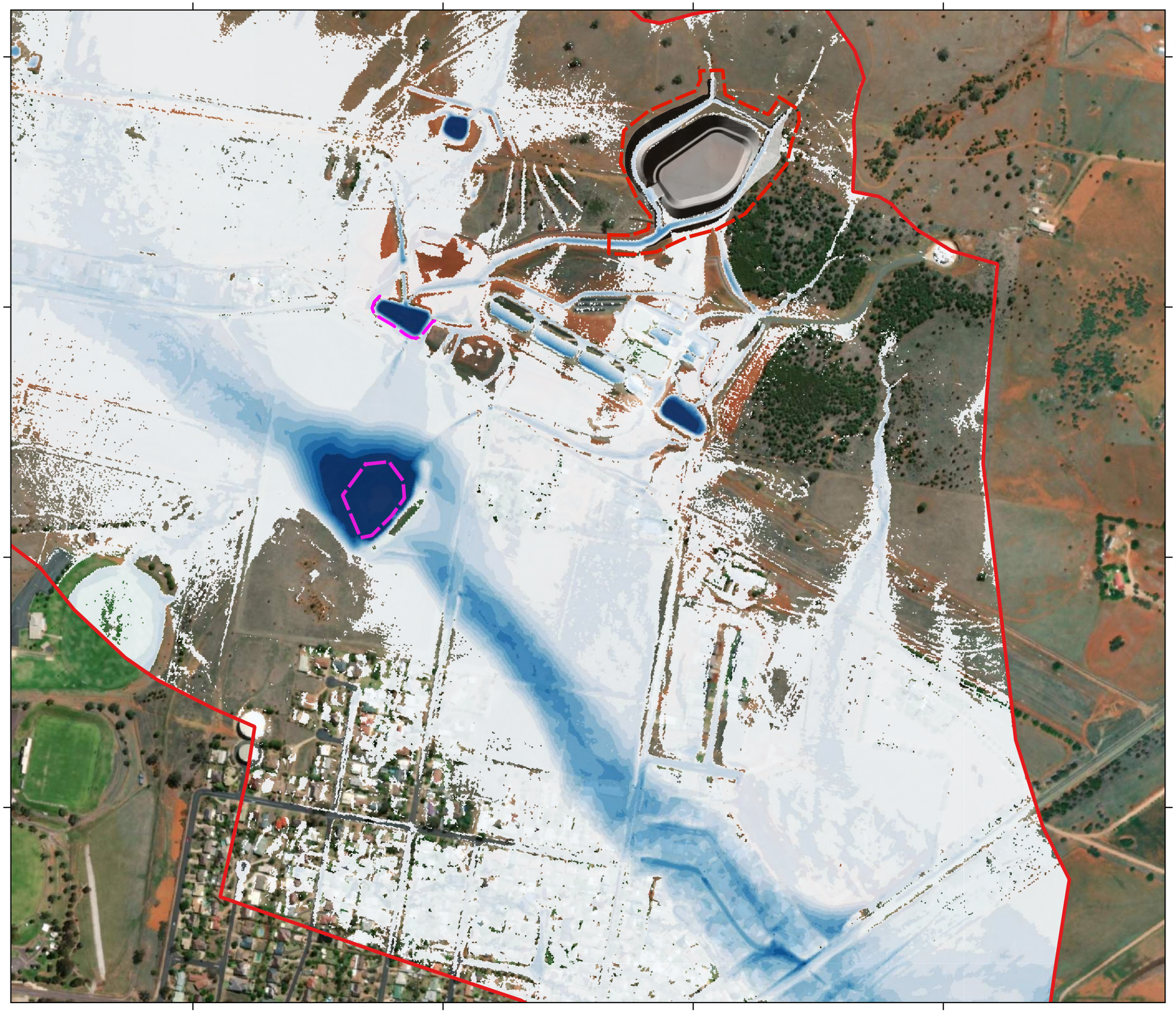

Legend

- Model Boundary
- Raw Water Storage Lagoon
- Earthworks
- Hungtington Dam

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 9

Option 1 - PMF Flood Depths
Management of Huntington Dam and Raising of Webb Street bund by 0.5

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

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Legend

- Model Boundary
- Raw Water Storage Lagoon
- Earthworks

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

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APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 10

Option 2 - 5% AEP Flood Depths
Raising Huntington Dam Bund and Spillway by 0.5 m

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon
- Earthworks

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

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REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

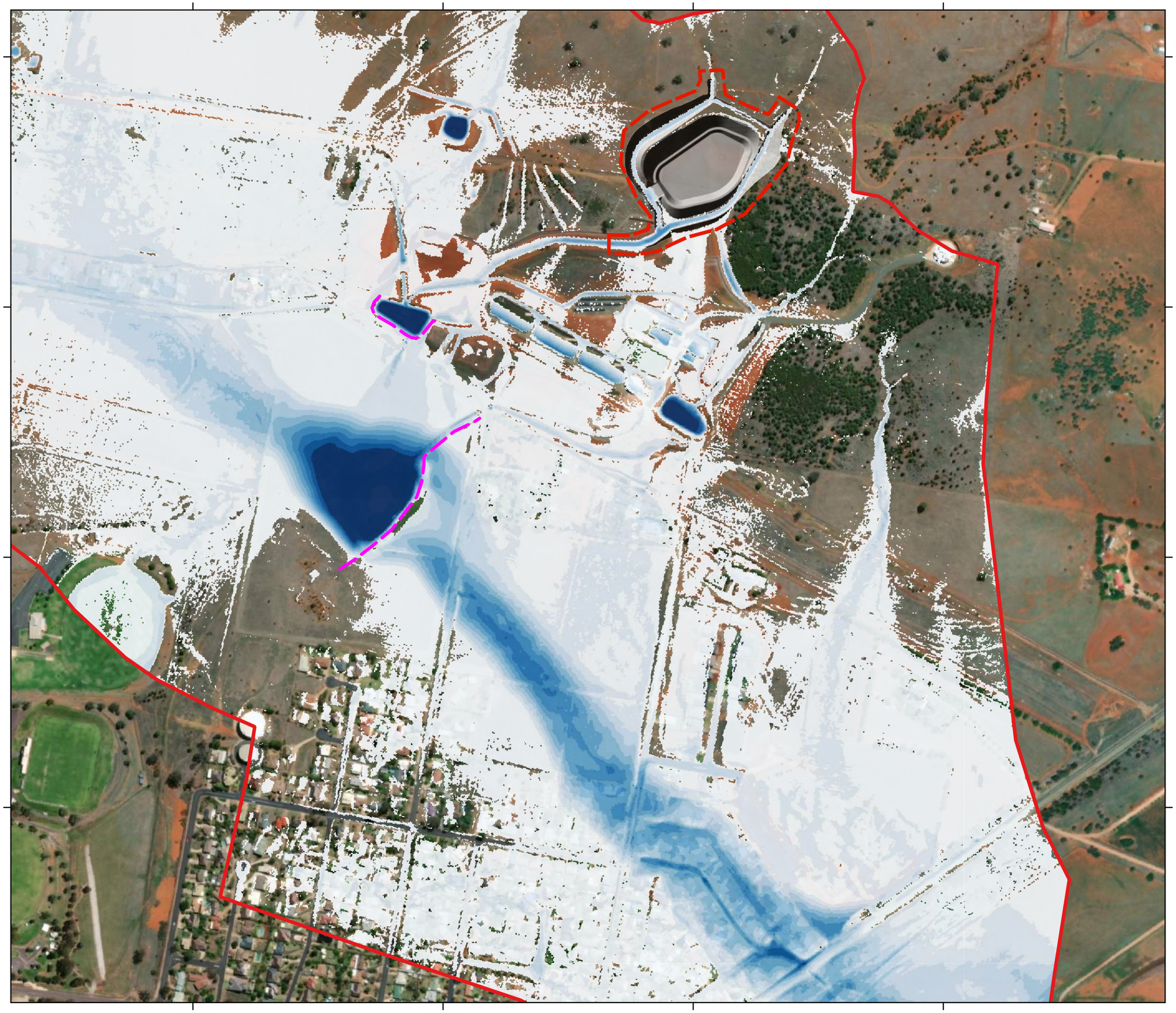
Raw Water Storage Lagoon

Figure 11

Option 2 - 1% AEP Flood Depths
Raising Huntington Dam Bund and Spillway by 0.5 m

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial



Legend

- Model Boundary
- Raw Water Storage Lagoon
- Earthworks

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

DRAWN: SM
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APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 12

Option 2 - PMF Flood Depths
Raising Huntington Dam Bund and Spillway by 0.5 m

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon
- BasinWorks

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 13

Option 3 - 5% AEP Flood Depths
Extending Webb Street Basin to the West

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon
- BasinWorks

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

BG&E

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

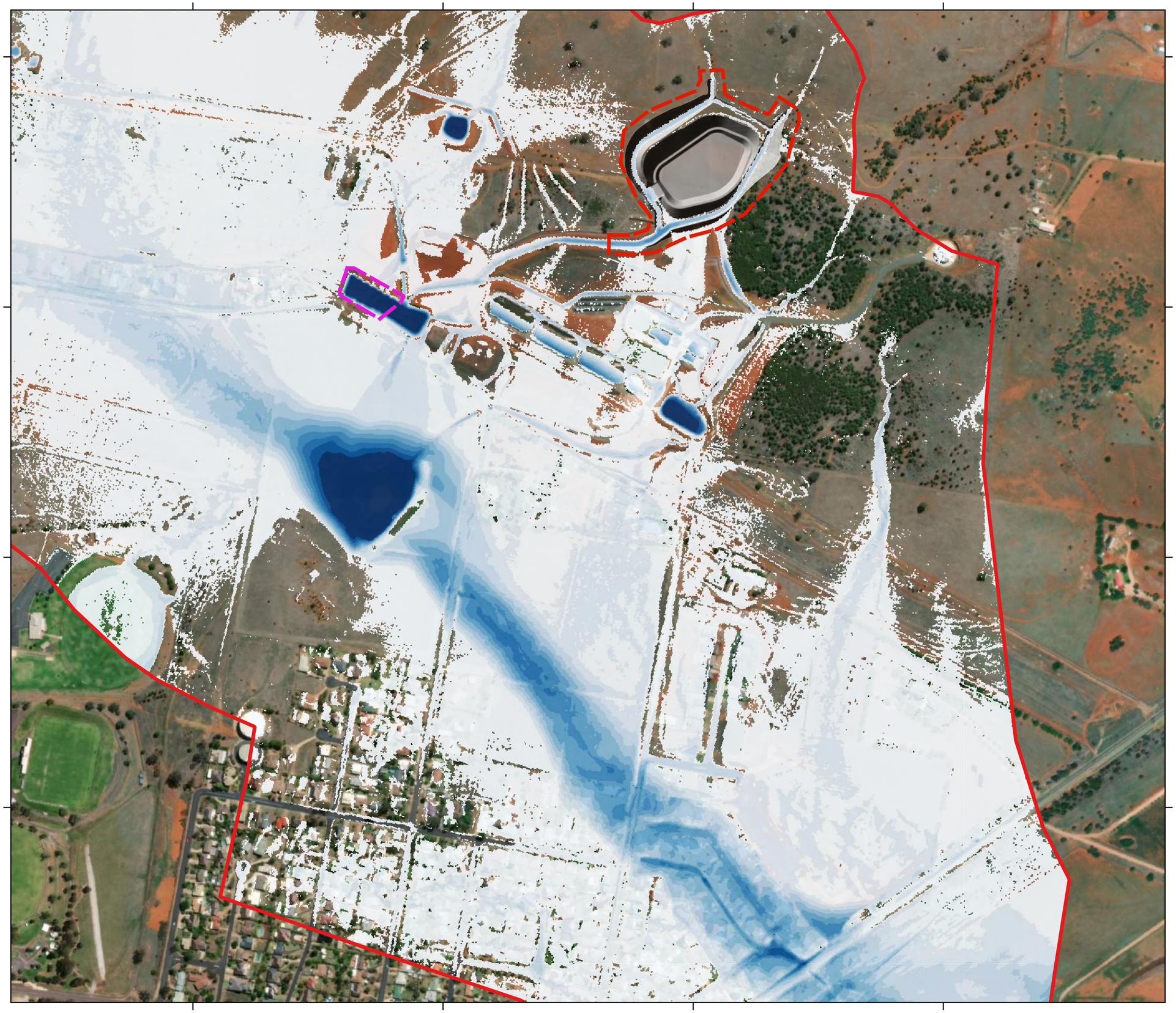
Raw Water Storage Lagoon

Figure 14

Option 3 - 1% AEP Flood Depths
Extending Webb Street Basin to the West

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial



Legend

- Model Boundary
- Raw Water Storage Lagoon
- BasinWorks

Flood Depth (m)

- <= 0.01
- 0.05 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- > 1.8

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 15

Option 3 - PMF Flood Depths
Extending Webb Street Basin to the West

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon

Water Level Difference (m)

- < -0.1
- -0.10 - -0.08
- -0.08 - -0.06
- -0.06 - 0.04
- -0.04 - -0.02
- -0.02 - -0.01
- No change (+/- 0.01)
- 0.01 - 0.02
- 0.02 - 0.04
- 0.04 - 0.06
- 0.06 - 0.08
- 0.08 - 0.10
- > 0.1

- Was Wet - Now Dry
- Was Dry - Now Wet

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

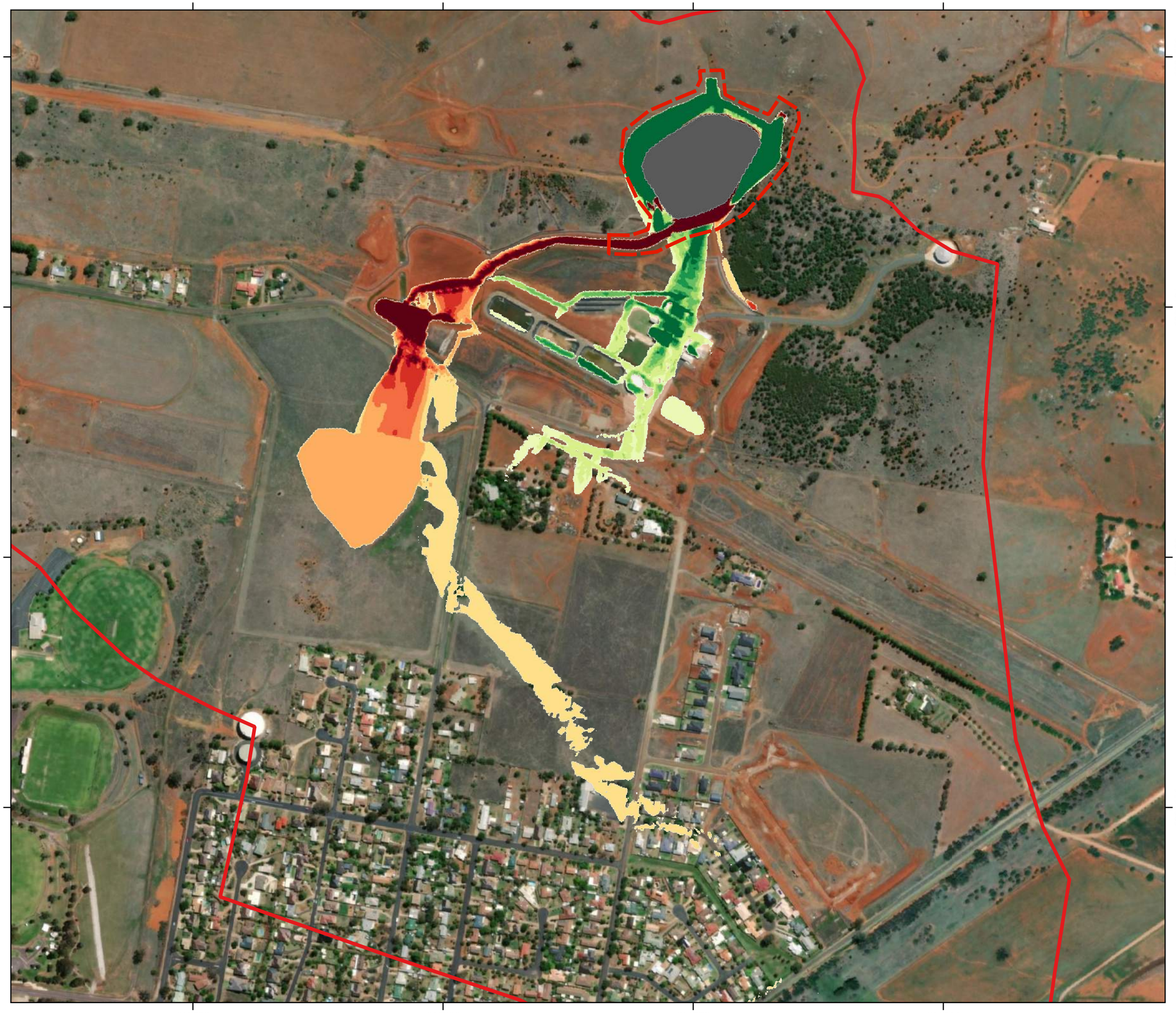
Raw Water Storage Lagoon

Figure 16

Design Scenario - 5% AEP Afflux
GHD Design

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial



Legend

- Model Boundary
- Raw Water Storage Lagoon

Water Level Difference (m)

- < -0.1
- -0.10 - -0.08
- -0.08 - -0.06
- -0.06 - 0.04
- -0.04 - -0.02
- -0.02 - -0.01
- No change (+/- 0.01)
- 0.01 - 0.02
- 0.02 - 0.04
- 0.04 - 0.06
- 0.06 - 0.08
- 0.08 - 0.10
- > 0.1

- Was Wet - Now Dry
- Was Dry - Now Wet

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 17

Design Scenario - 1% AEP Afflux
GHD Design

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon
- Hungtington Dam
- Earthworks

Water Level Difference (m)

- < -0.1
- -0.10 - -0.08
- -0.08 - -0.06
- -0.06 - 0.04
- -0.04 - -0.02
- -0.02 - -0.01
- No change (+/- 0.01)
- 0.01 - 0.02
- 0.02 - 0.04
- 0.04 - 0.06
- 0.06 - 0.08
- 0.08 - 0.10
- > 0.1

- Was Wet - Now Dry
- Was Dry - Now Wet

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 18

Option 1 - 5% AEP Afflux
Management of Huntington Dam and Raising of Webb Street bund by 0.5

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon
- Hungtington Dam
- Earthworks

Water Level Difference (m)

- < -0.1
- -0.10 - -0.08
- -0.08 - -0.06
- -0.06 - 0.04
- -0.04 - -0.02
- -0.02 - -0.01
- No change (+/- 0.01)
- 0.01 - 0.02
- 0.02 - 0.04
- 0.04 - 0.06
- 0.06 - 0.08
- 0.08 - 0.10
- > 0.1

- Was Wet - Now Dry
- Was Dry - Now Wet

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 19

Option 1 - 1% AEP Afflux
Management of Huntington Dam and Raising of Webb Street bund by 0.5

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon
- Earthworks

Water Level Difference (m)

- < -0.1
- -0.10 - -0.08
- -0.08 - -0.06
- -0.06 - 0.04
- -0.04 - -0.02
- -0.02 - -0.01
- No change (+/- 0.01)
- 0.01 - 0.02
- 0.02 - 0.04
- 0.04 - 0.06
- 0.06 - 0.08
- 0.08 - 0.10
- > 0.1

- Was Wet - Now Dry
- Was Dry - Now Wet

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 20

Option 2 - 5% AEP Afflux
Raising Huntington Dam Bund and Spillway by 0.5 m

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon
- Earthworks

Water Level Difference (m)

- < -0.1
- -0.10 - -0.08
- -0.08 - -0.06
- -0.06 - 0.04
- -0.04 - -0.02
- -0.02 - -0.01
- No change (+/- 0.01)
- 0.01 - 0.02
- 0.02 - 0.04
- 0.04 - 0.06
- 0.06 - 0.08
- 0.08 - 0.10
- > 0.1

- Was Wet - Now Dry
- Was Dry - Now Wet

0 50 100 150 200 m

N

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DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 21

Option 2 - 1% AEP Afflux
Raising Huntington Dam Bund and Spillway by 0.5 m

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon
- BasinWorks

Water Level Difference (m)

- < -0.1
- -0.10 - -0.08
- -0.08 - -0.06
- -0.06 - 0.04
- -0.04 - -0.02
- -0.02 - -0.01
- No change (+/- 0.01)
- 0.01 - 0.02
- 0.02 - 0.04
- 0.04 - 0.06
- 0.06 - 0.08
- 0.08 - 0.10
- > 0.1

- Was Wet - Now Dry
- Was Dry - Now Wet

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 22

Option 3 - 5% AEP Afflux
Extending Webb Street Basin to the West

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

Legend

- Model Boundary
- Raw Water Storage Lagoon
- BasinWorks

Water Level Difference (m)

- < -0.1
- -0.10 - -0.08
- -0.08 - -0.06
- -0.06 - 0.04
- -0.04 - -0.02
- -0.02 - -0.01
- No change (+/- 0.01)
- 0.01 - 0.02
- 0.02 - 0.04
- 0.04 - 0.06
- 0.06 - 0.08
- 0.08 - 0.10
- > 0.1

- Was Wet - Now Dry
- Was Dry - Now Wet

0 50 100 150 200 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 2/5/2023
PROJECT: Parkes Township Stormwater Modelling
CLIENT: PSC

Raw Water Storage Lagoon

Figure 23

Option 3 - 1% AEP Afflux
Extending Webb Street Basin to the West

DATUM GDA2020 / MGA zone 55

Aerial Imagery Source: Bing Aerial

At BG&E, we are united by a common purpose – we believe that truly great engineering takes curiosity, bravery and trust, and is the key to creating extraordinary built environments.

Our teams in Australia, New Zealand, South East Asia, the United Kingdom and the Middle East, design and deliver engineering solutions for clients in the Property, Transport, Ports and Marine, Water, Defence, Renewables and Resources sectors.

We collaborate with leading contractors, developers, architects, planners, financiers and government agencies, to create projects for today and future generations.

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