APPLICATION ON RE-NOTIFICATION – CROWN DEVELOPMENT

Applicant:	Hydrostor Australia Pty Ltd
Development Number:	455/V006/19
Nature of Development:	The 'Angas Advanced Compressed Air Energy Storage Facility' project would repurpose an existing mine shaft within the disused Angas Zinc Mine (owned by Terramin Australia Ltd) to create an air storage cavity 240 metres below ground, which would be connected to the surface via water and air supply lines. The facility would have a maximum capacity of 5MW and would connect to the electricity grid via underground cables along Callington Road to the Strathalbyn East Substation. Surface infrastructure would also include a switch yard and a reverse osmosis plant.
Type of development:	Crown sponsored development
Zone / Policy Area:	Primary Production Zone – Alexandrina Council Development Plan.
Subject Land:	2115 and 2133 Callington Road, Strathalbyn - Allotment 14, DP77134: CT 6032/127 and Allotment 11, DP 77134: 6032/124.
Contact Officer:	Lee Webb
Phone Number:	7109 7066
Start Date:	21 March 2019
Close Date:	**Friday 12 April 2019**

During the notification period, hard copies of the application documentation can be viewed at the Department of Planning, Transport and Infrastructure, Level 5, 50 Flinders Street, Adelaide during normal business hours. Application documentation may also be viewed during normal business hours at the Alexandrina Council office, 11 Cadell Street, Goolwa.

Written representations must be received by the close date (indicated above) and can either be posted, hand-delivered, faxed or emailed to the State Commission Assessment Panel (SCAP). A representation form is provided as part of this pdf document.

Any representations received after the close date will not be considered.

Postal Address:
The Secretary
State Commission Assessment Panel
GPO Box 1815
ADELAIDE SA 5001

Street Address:
Development Division
Department of Planning, Transport and Infrastructure
Level 5, 50 Flinders Street ADELAIDE

Email Address: scapreps@sa.gov.au
Fax Number: (08) 8303 0753

DEVELOPMENT ACT, 1993, S49/S49A – CROWN SPONSORED DEVELOPMENT
REPRESENTATION ON APPLICATION

Applicant:	Hydrostor Australia Pty Ltd
Development Number:	455/V006/19
Nature of Development:	The 'Angas Advanced Compressed Air Energy Storage Facility' project would repurpose an existing mine shaft within the disused Angas Zinc Mine (owned by Terramin Australia Ltd) to create an air storage cavity 240 metres below ground, which would be connected to the surface via water and air supply lines. The facility would have a maximum capacity of 5MW and would connect to the electricity grid via underground cables along Callington Road to the Strathalbyn East Substation. Surface infrastructure would also include a switch yard and a reverse osmosis plant.
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My name:_____

My phone number: _____

PRIMARY METHOD(S) OF CONTACT: Email address: _____

Postal address:_____

_____Postcode_____

You may be contacted via your nominated PRIMARY METHOD(S) OF CONTACT if you indicate below that you wish to be heard in support of your submission.

My interests are:
- [ ] owner of local property
- [ ] occupier of local property
- [ ] a representative of a company/other organisation affected by the proposal
- [ ] a private citizen

The address of the property affected is .....Postcode.....

The specific aspects of the application to which I make comment on are: .....

.....

.....

.....

.....

I
- [ ] wish to be heard in support of my submission
- [ ] do not wish to be heard in support of my submission

(Please tick one)

by
- [ ] appearing personally
- [ ] being represented by the following person : .....

(Cross out whichever does not apply)

Date: ..... Signature: .....

Return Address: The Secretary, State Commission Assessment Panel, GPO Box 1815, Adelaide, SA 5001 or scapreps@sa.gov.au

SECTION 49 & 49A – CROWN DEVELOPMENT
DEVELOPMENT APPLICATION FORM

PLEASE USE BLOCK LETTERS

COUNCIL: ALEXANDRINA COUNCIL

APPLICANT: HYDROSTOR AUSTRALIA PTY LTD

ADDRESS: L28, WESTPAC HOUSE,
91 KING WILLIAM ST, ADELAIDE, 5000

CROWN AGENCY: DPTI

FOR OFFICE USE

DEVELOPMENT No: _____

PREVIOUS DEVELOPMENT No: _____

DATE RECEIVED: / /

CONTACT PERSON FOR FURTHER INFORMATION

Name: CAMERON LEWIS

Telephone: +1-416-476-8215 [work] _____ [Ah]

Fax: _____ [work] _____ [Ah]

Email: cameron.lewis@hydrostor.ca

☐ Complying	Decision: _____
☐ Merit	Type: _____
☐ Public Notification	Finalised: / /
☐ Referrals	

NOTE TO APPLICANTS:

(1) All sections of this form must be completed. The site of the development must be accurately identified and the nature of the proposal adequately described. If the expected development cost of this Section 49 or Section 49A application exceeds $100,000 (excl. fit-out) or the development involves the division of land (with the creation of additional allotments) it will be subject to those fees as outlined in Item 1 of Schedule 6 of the *Development Regulations 2008*. Proposals over $4 million (excl. fit-out) will be subject to public notification and advertising fees.
(2) Three copies of the application should also be provided.

	Decision required	Fees	Receipt No	Date
Planning:				
Land Division:				
Additional:				
Minister's Approval				

EXISTING USE: ANGAS ZINC MINE (INDUSTRIAL)

DESCRIPTION OF PROPOSED DEVELOPMENT: COMPRESSED AIR ENERGY STORAGE FACILITY INCLUDING SURFACE AND SUBSURFACE INFRASTRUCTURE

LOCATION OF PROPOSED DEVELOPMENT: 2115 CALLINGTON ROAD

House No: _____ Lot No: ____ Street: _____ Town/Suburb: STRATHALBYN

Section No [full/part] _____ Hundred: STRATHALBYN Volume: 6032 Folio: 127

Section No [full/part] _____ Hundred: _____ Volume: _____ Folio: _____

LAND DIVISION:

Site Area [m^2] _____ Reserve Area [m^2] _____ No of existing allotments _____

Number of additional allotments [excluding road and reserve]: _____ Lease: **YES** ☐ **NO** ☐

DEVELOPMENT COST [do not include any fit-out costs]: $ 25M

POWERLINE SETBACKS: Pursuant to Schedule 5 (2a)(1) of the *Development Regulations 2008*, if this application is for a building it will be forwarded to the Office of the Technical Regulator for comment unless the applicant provides a declaration to confirm that the building meets the required setback distances from existing powerlines. The declaration form and further information on electricity infrastructure and clearance distances can be downloaded from the DPLG website (www.dac.sa.gov.au).

I acknowledge that copies of this application and supporting documentation may be provided to interested persons in accordance with the *Development Act 1993*.

SIGNATURE: _____ Dated: 18/01/2019

GOLDER

REPORT

Development Application
Angas A-CAES Project

Angas Zinc Mine, Strathalbyn

Submitted to:

Department of Planning, Transport and Infrastructure

On behalf of:
Hydrostor Australia

Submitted by:

Golder Associates Pty Ltd

118 Franklin Street Adelaide, South Australia 5000 Australia

+61 8 8213 2100

1791136-004-R-Rev0

18 January 2019

Distribution List

Department of Planning, Transport and Infrastructure

Hydrostor Australia

Golder Associates

Preface

This Development Application Report has been prepared by Hydrostor Australia in support of an application for statutory consents for the construction and operation of the Angas A-CAES Project at the Angas Zinc Mine in Strathalbyn.

The Project has been sponsored by the Department for Energy and Mining as a development of public infrastructure as required by Section 49 of the *Development Act 1993* (South Australia). This Development Application has been submitted to the Department of Planning Transport and Infrastructure for lodgement to the State Commission Assessment Panel.

The Development Application has been prepared in three volumes:

- Volume 1: Executive Summary
- Volume 2: Development Application Report
- Volume 3: Technical Appendices

The Development Application can be viewed during the statutory consultation period at the following locations:

Department of Planning, Transport and Infrastructure

77 Grenfell St

ADELAIDE SA 5001

Alexandrina Council

11 Cadell Street

GOOLWA SA 5214

VOLUME 1: EXECUTIVE SUMMARY

Project Overview

Hydrostor Australia Pty Ltd is proposing to develop, build and operate the Angas Advanced Compressed Air Energy Storage (A-CAES) Facility (the Project) at the Angas Zinc Mine (the Mine) in Strathalbyn, South Australia.

This Project will repurpose portions of the existing underground Mine as the A-CAES and demonstrate a reliable, economic energy storage solution providing flexible generation to support high penetration of renewable resources. In doing so, this Project will not only provide valuable grid services, but will demonstrate a low-impact, end-of-life use for decommissioned mine sites.

The proponent

This Development Application Report (DAR) has been prepared on behalf of the Applicant, Hydrostor Australia Pty Ltd, a wholly-owned subsidiary of Hydrostor Incorporated. Hydrostor Inc. and Hydrostor Australia Pty Ltd are hereinafter referred to jointly or separately as 'Hydrostor'.

Hydrostor is a private company headquartered in Toronto, Canada, and is the global leader in A-CAES. Hydrostor uses its proprietary, fuel-free (adiabatic) process and purpose-built underground air cavities or underwater air cavity to store energy.

Hydrostor offers a suite of intellectual property relating to all aspects of A-CAES and continues to develop its technology. Hydrostor is engaged globally with utilities and governments to provide A-CAES solutions to meet grid energy-storage requirements.

Hydrostor's first Australian office has been set up in Adelaide to facilitate construction and commissioning of the Project and other Australian projects.

Approvals pathway

This Development Application (DA) has been prepared for submission to the State Commission Assessment Panel (SCAP) and relevant referral bodies, pursuant to Section 49(1)(a) of the *Development Act 1993* (Development Act). In accordance with the Development Act, the Project, considered Public Infrastructure, has been granted Crown Sponsorship through the Department of the Premier and Cabinet (DPC).

In accordance with Section 49 (7d) of the Development Act, the Development Application (DA) will be publicly exhibited for at least 15 business days. This includes provision of the DA for public access at key local and State Government offices.

A report will be prepared by the SCAP, encompassing feedback from the referral agencies, and will be provided to the Minister for Planning for a final decision.

Project description

The Project will use the Hydrostor A-CAES system which includes a proprietary, isobaric, purpose-built underground air storage cavern positioned near a water reservoir. The system uses the hydrostatic pressure from a water-filled shaft to maintain a constant pressure (isobaric).

When the system is charging, electricity runs an air compressor, which converts the electrical energy into potential energy that is stored as compressed air in the air storage cavern. The heat generated when compressing the air is captured and stored in a thermal storage tank for use during generation—a process known as adiabatic CAES. This adiabatic compression increases the system's efficiency and eliminates the need for additional heat from fossil fuels (and the associated costs and emissions).

When charging, compressed air is piped from the surface into the air storage cavern, water is displaced out of the air storage cavern and the water reservoir level rises.

Once in the air storage cavern, the air can be stored until electricity is required. To satisfy the need for electricity, the system reverses the air flow, allowing hydrostatic pressure to force the air out of the air storage cavern and back to the surface where the stored heat is added back into the air stream. The now-heated air travels through a turbo-expander that drives a generator, which efficiently converts the energy stored in the air back into electricity for the consumer. When discharging, the air is displaced by water and the reservoir level lowers. The shaft remains flooded through charging and discharging and only the water reservoir level fluctuates.

The technology uses established components used in other industries/applications, including mining and natural gas.

Figure 1: A-CAES process overview

Surface Infrastructure

Proposed permanent surface infrastructure is shown in Figure 2 and will include:

- Water reservoir: with a capacity of approximately 13,000 m^3
- Electrical conversion plant: electrical drives (motors and generators), turbomachines (compressors and turbines), the electrical gear (switch gear, protection, etc.), and the cooling system
- Thermal management system: heat exchangers, heat transfer fluid, storage tanks (hot and cold), and associated pumps
- Water treatment package: includes Reverse Osmosis (RO) plant and make-up water tank for thermal system water requirements.

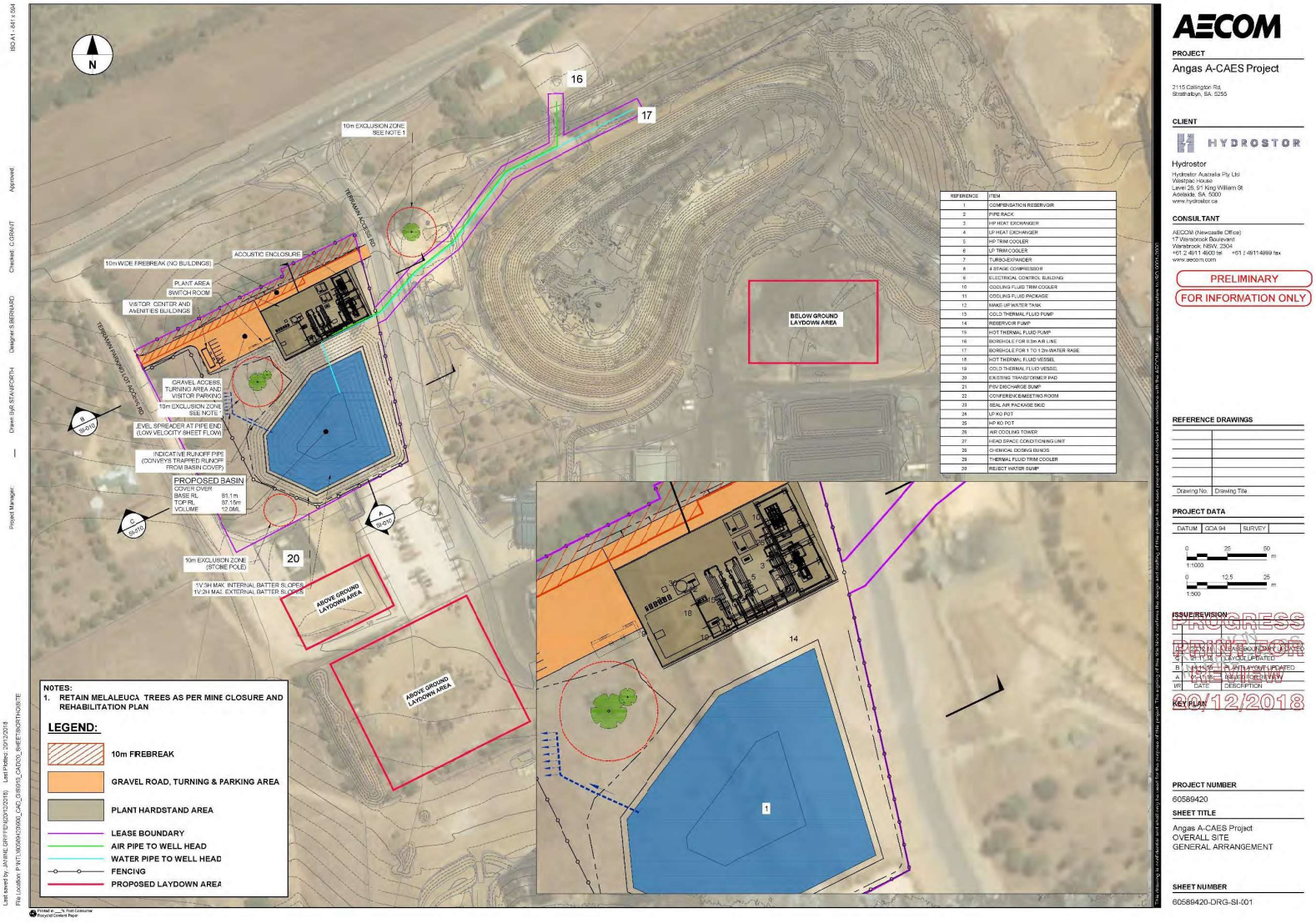

Figure 2: Surface infrastructure

Subsurface Infrastructure

The proposed subsurface infrastructure for this project includes:

- The air storage cavern
- An air line connecting the air storage cavern to the surface
- A water line connecting the air storage cavern to the water reservoir
- Underground electricity connection to the existing transformer.

Electrical Connections

The Project will be connected to SA Power Network's (SAPN) 66 kV sub-transmission network via underground cables to the 66 / 11 kV Strathalbyn East Substation.

Operation

Once operational, the facility will require one full time staff and additional maintenance and inspections by Hydrostor's operations specialists. Regular maintenance activities will occur during normal business hours. Infrequent maintenance and equipment replacement may require minor additional site support. The proposed layout includes site amenities to be used by operational staff including a visitor building, toilet facilities and provision for seven car parks.

Project benefits

The Project will demonstrate a new bulk energy storage solution to support the high penetration of renewable energy technologies into South Australia's electricity supply market, while maintaining grid stability, energy security and improving affordability.

The Project will operate as a dispatchable energy storage asset with a high degree of flexibility. The plant has the capability to provide optimised grid services, ongoing voltage support, and synchronous inertia.

The Project and associated introduction of the A-CAES technology to Australia will deliver several economic, environmental and social benefits to South Australia and wider Australia:

- Provides reliable, economic energy storage and flexible generation
- Supports a high penetration of renewable resources and reduces reliance on energy imports from Victoria
- Demonstrates a positive end-of-life use and re-purposes existing mining infrastructure
- Represents significant investment to the South Australia economy including direct and indirect economic benefits for the Strathalbyn area
- Highlight's South Australia as a leader in renewable energy and energy storage solutions
- Contributes to lowering electricity prices
- Demonstrates South Australia's commitment to a more efficient grid with higher renewable penetration.

Consultation

This DA and supporting information has been developed in consultation with the following State agencies:

- Department of the Premier and Cabinet (DPC; sponsoring agency)
- Department for Industry and Skills (DIS; case manager)
- Department of Energy and Mines (DEM)

- Department of Planning, Transport and Infrastructure (DPTI)
- Department of Environment and Water (DEW)
- Environment Protection Authority (EPA).

Hydrostor has also used the existing community consultation network (established by Terramin through the mining operations) to engage with the community. The Strathalbyn Community Consultative Committee (SCCC) has been the main conduit for Hydrostor to reach out to the community and welcome feedback on the proposed development. Hydrostor will continue to engage with the community through the SCCC regularly throughout construction and at appropriate times during operation of the Project.

Legislative considerations

While the DA will be assessed under the Development Act, it will need to comply with the existing licence conditions of the Mine under the *Mining Act 1978*.

The Project has been designed to ensure the conditions of the Mineral Lease, including the Mine Closure Plan and envisioned future land use are not compromised.

Potential project effects and considerations

Ecology

No native vegetation removal is required to facilitate the Project. Two heritage trees (both of which are remnant Dryland Tea Trees) exist near the Project site. A protection zone will surround the remnant vegetation during construction, operation and decommissioning to ensure these trees are not affected.

The proposed development is not expected to impact on fauna or significant fauna habitats at the site.

Management measures will be implemented through the Environmental Management Plan (EMP) to ensure impacts to native vegetation, fauna and fauna habitats are minimised.

Pest plants and animals

The Project has the potential to increase the spread of weeds through soil disturbance and access to the site from offsite vehicles.

The proposed development is not expected to impact on the occurrence of pest animals at the site.

Weed management measures will be implemented during construction and operation, in accordance with Terramin's existing Weed and Pest Management Plan.

Air quality

Minor amounts of dust will be generated temporarily during construction activities and will be managed through the EMP.

Operation of the facility will produce no emissions and there will be no ongoing impacts to air quality.

Noise

An Environmental Noise Assessment of the Project was undertaken (Appendix E) to assess the potential noise and vibration impacts.

The proposed facility includes an acoustic enclosure around the compressor and the expander, the two noisiest items of plant, to mitigate potential noise impacts. The modelling assumed the enclosure will be 11 m high, and will have a number of noise attenuating features, as detailed in Appendix E.

The noise criteria are expected to be exceeded at the residential building north east of the site (nearest sensitive receiver) (Figure 3). This receiver is owned by Terramin and can be vacated, if required, and leased by Hydrostor. Appropriate negotiations with Terramin and the existing tenants will be undertaken.

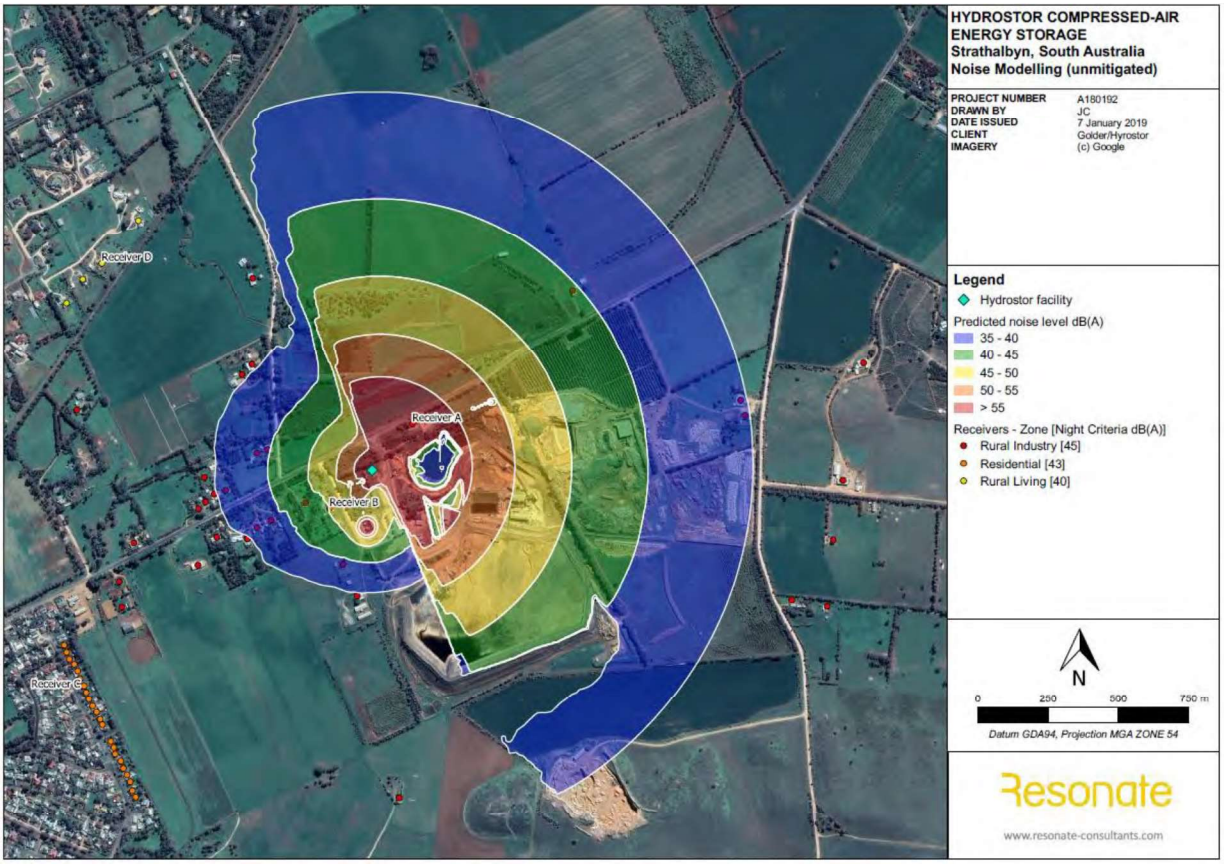

Figure 3: Noise contours

Vibration

During operation, the predicted peak particle velocity is expected to be less than the adopted criteria at all surrounding residential receiver locations and is not expected to generate levels of vibration which would exceed any of the relevant vibration criteria.

Construction phase vibration will be minor and temporary.

Surface water

For surface water management during mining activities, the Mine was categorised in two zones; the 'dirty zone' (DZ) and the 'clean zone' (CZ) (Figure 4). The DZ included majority of the Mine operations and was identified as a potentially contaminated area. Drainage infrastructure at the Mine site was set up such that surface water from the DZ is directed into the boxcut or raw water pond and surface water within the CZ is directed to bypass the DZ to natural/existing drainage lines. A sediment control system was installed throughout the CZ to slow the velocity of runoff water and settle sediments prior to it entering natural drainage lines.

The main Project infrastructure is within Terramin's allocated CZ. The construction and operation of the facility is not expected to have an adverse impact on surface water, either from contamination or sedimentation.

The Project will be designed to ensure surface water is diverted to the existing sediment control system to the east, or new sediment control infrastructure constructed to the west (along the western access track).

Surface water that accumulates on top of the reservoir cover will be discharged to a vacant area of the Project site. This water will be conveyed via a level spreader to slow the velocity of the runoff.

Temporary construction works will be undertaken in Terramin's allocated DZ including installation of water and air pipelines and access to the underground workings through the box cut. These works will not disturb the existing surface water management in this zone.

Construction activities will be managed in accordance with the EMP and the existing surface water monitoring commitments will continue, in accordance with the Closure Criteria including:

- Turbidity monitoring at existing remote telemetry stream gauge locations
- Surface water quality monitoring at the potential discharge point to the Angas River and an upstream location

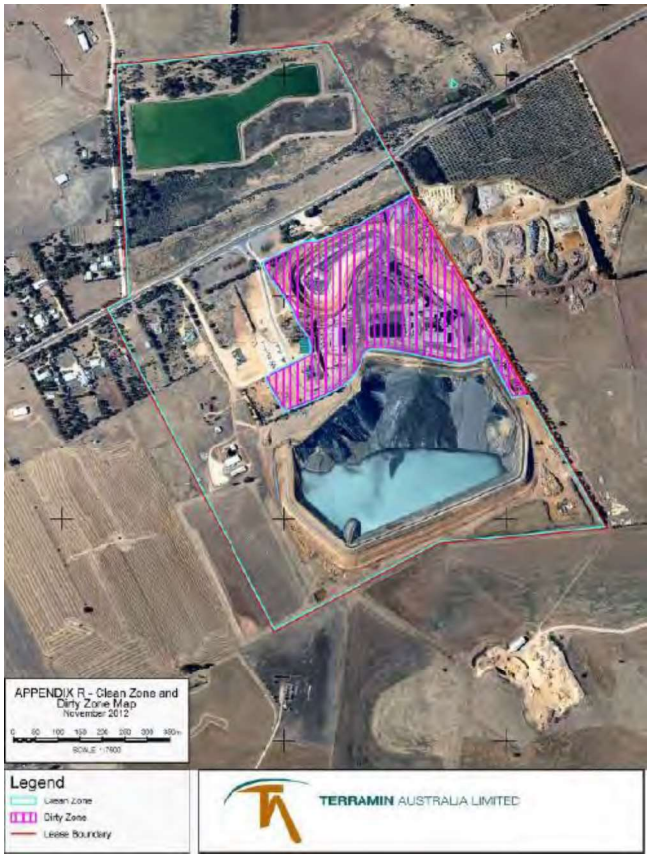

Figure 4: Terramin surface water management zones

Groundwater

Since operations ceased at the Mine, the box cut and underground mine workings have been inundated with water and will require dewatering to facilitate access to the decline. Groundwater pumped from the Mine during dewatering will be re-injected back into the groundwater aquifer. This is the same approach as was successfully implemented by Terramin from 2008 to 2013.

The dewatering will be undertaken independent of the DA, in accordance with the NRM Act and EP Act. The construction dewatering strategy developed includes initial dewatering at a high rate over a 4 month period, and continued dewatering over the 6 month construction period at a lower rate. Following construction, dewatering will continue for up to five years to maintain access for research, validation and monitoring. Water removed will be treated to appropriate quality and reinjected into eight appropriately sited reinjection wells.

Based on the existing data collected, and the additional modelling undertaken by Golder in consideration of the proposed dewatering and MAR strategy, the impacts to groundwater and freshwater ecosystems surrounding the Project are expected to be negligible based on the following:

- The dewatering and re-injection strategy is not expected to have a long-term impact on groundwater levels nor cause saline groundwater discharge to the Angas River
- Water will be monitored and treated (if required) prior to re-injection to match the background groundwater quality.
- No impacts to water quality are expected because of AMD mobilisation
- Well design will be assessed for new injection wells considering the risk of surface expression to any poorly sealed exploration holes, to ensure safe injection pressures will be achieved, preventing upward leakage of saline groundwater to the Tertiary Aquifer

Water removed from the box cut and mine void may require treatment to ensure there is no adverse impact from reinjecting. Treatment of water prior to reinjection will be undertaken using lamellar plate separators and/or an oxidative filtration system. Waste resulting from water treatment will be disposed offsite by an appropriately licenced contractor.

In addition to Terramin's water allocation (which will be temporarily transferred to Hydrostor), additional water allocations from the target aquifer will be sourced and temporarily transferred for the required construction dewatering volume. Based on information from the DEW, additional allocations are available for purchase.

Appropriate permits for installation of injection wells and for drainage into an aquifer will be obtained.

Following the construction and monitoring period, the mine decline will be reflooded and no further access to the underground workings will be required. Based on the results of the monitoring following Terramin's flooding of the Mine, this is not expected to cause adverse impacts to groundwater quality because of AMD mobilisation.

The accumulator and thermal store will be treated with shotcrete to ensure there is no interaction between the system and surrounding geology/groundwater aquifers.

Soil contamination

A Baseline Contamination Study, undertaken by Tonkin in 2005, indicated elevated concentrations of metals in some locations. Some activities during mining operations have the potential to have caused contamination at the Mine site. Terramin categorised the site in two zones; the CZ and the DZ Figure 4. Activities undertaken in the CZ during mining operations had a low potential of causing contamination. The DZ included majority of the Mine operations and was identified as a potentially contaminated area.

The Project is largely sited within the CZ and therefore has a low potential for encountering contaminated soil, other than the elevated metals identified in the baseline assessment. A Baseline Contamination Assessment is being undertaken by Hydrostor to document the contamination status of the Lease area and ensure it is suitable for the intended land use.

The risks of contamination because of the Project are considered low and associated with accidental spills during construction

The EMP and an Emergency Response Plan will be implemented by the construction contractor to ensure the risk of site contamination from construction activities is negligible.

The risk of contamination resulting from operational activities is considered negligible.

A contamination assessment will be undertaken by Hydrostor prior to construction and at the extinguishment of Hydrostor's Lease to ensure that the Project has not caused contamination and the site is suitable for the intended future land use. As part of the Lease agreement, Hydrostor will be required to remediate any contamination caused.

Traffic and transport network

Hydrostor engaged independent traffic planners and engineers to examine the suitability of the existing Mine access point in relation to the existing road network, as well as the condition and capability of the network to accommodate the predicted vehicle movements (Appendix D).

The majority of heavy vehicle movements in the construction period are expected to be via the Strathalbyn to Callington Road which joins the South Eastern Freeway at Callington. The South Eastern Freeway and Callington Road are both major transport routes and are registered as 26 m B-Double freight routes. These road networks have minimal residences and have accommodated heavy loads in the past, during development and operation of the Mine.

The Project will be accessed from the existing Mine access point located off Callington Road. The existing access point consists of a T-Junction with a channelised right turn lane and an auxiliary left turn lane into the site, which both comply with the minimum requirements stated in the Austroads Guide to Traffic Management Part 6 (2017) and Guide to Road Design Part 4A (2017) for the applicable design speed.

The minimum sight distance requirements for intersections are achieved at the existing access point including approach site distance, safe intersection sight distance and minimum gap sight distance, in accordance with Austroads Guide to Road Design Part 4A (2017).

The existing pavement at the access point was in generally good condition with minimal works required outside of general maintenance requirements.

Road conditions along Callington Road (i.e. access points, turning lanes etc.) will not be adversely impacted by the Project.

In the context of the existing traffic on Callington Road, construction of the Project is expected to have a short term and minimal impact on the traffic volumes. Although the traffic volumes and percentage of heavy vehicles may slightly increase on Callington Road, this is an existing gazetted freight route with minimal residences and generally good pavement conditions.

The increase in traffic due to operations is negligible (i.e. no more than one vehicle per day) and will access the site via the existing car park access point on the western boundary of the site.

Management of construction traffic will be considered within a Traffic Management Plan which will be developed and implemented by the construction contractor. Permanent signage to indicate the position of the Project access point will be considered to reduce the risk of vehicles missing the access point.

Appropriate approvals will be obtained from DPTI for oversize/overmass vehicles accessing the Project during construction.

Visual amenity

The Project is setback approximately 80 m from Callington road, behind existing vegetation screening. The siting of the proposed surface infrastructure behind the existing vegetation will ensure minimal adverse impact to visual amenity, specifically from Callington Road. Additional vegetation screening will be planted using local native species if required. External structures will be built of muted and natural colours to further minimise the potential visual impacts.

The reservoir will be constructed of earthen dam walls which will be revegetated with shallow rooted, local native species and is not expected to impact on the amenity of the area.

Construction will be undertaken generally during daylight hours, and therefore there will be no light spillage impacts to neighbouring sensitive receptors.

Summary

Hydrostor's proposal to bring A-CAES to South Australia will provide an alternative bulk energy storage solution that is relatively low cost, emission free and provides a positive end-of-life option for decommissioned mining assets.

The nature of Hydrostor's A-CAES development and siting at the Angas Zine Mine result in an inherently low environmental footprint. The Project and construction methodology have been designed to ensure potential risks can be adequately mitigated, including:

- Positioning the facility to avoid removal of native vegetation
- Noise attenuation measures on the above ground infrastructure to ensure no unacceptable impacts to the surrounding residents
- Siting the facility adjacent mining infrastructure and behind vegetation screening to protect the amenity of the area
- A dewatering and re-injection strategy that protects groundwater quality and quantity

The Project was also reviewed against Terramin's obligations under the Mining Act and the Alexandrina Council Development Plan, and there were no items identified that would preclude the development.

Hydrostor intends for this Project to be the first of many A-CAES Projects in South Australia and wider Australia, representing an important development for future investment. Hydrostor seeks Development Approval consent to enable procurement processes and ensure the Project's construction in 2019.

VOLUME 2: DEVELOPMENT APPLICATION REPORT

Glossary

AADT: Annual Average Daily Traffic volume

AAR: Aboriginal Affairs and Reconciliation

A-CAES: Advanced Compressed Air Energy Storage

AHD: Australian Height Datum

AMD: Acid Mine Drainage

ANZECC: Australia and New Zealand Environment and Conservation Council

ASD: Approach Site Distance

AUL: Auxiliary Left Turn Lane

AWE: Australian Water Environments

BAL: Bushfire Attack Level

bgl: below ground level

BOM: Bureau of Meteorology

BPA: Bushfire Protection Area

EMP: Environmental Management Plan

CHR: Channelised Right Turn Lane

CMP: Care and Maintenance Plan

DA: Development Application

DAR: Development Application Report

dB: decibels

DEM: Department of Energy and Mines

DEW: Department of Environment and Water

PDP: Preliminary Decommissioning Plan

DIS: Department for Industry and Skills

DPC: Department of the Premier and Cabinet

DPTI: Department of Planning, Transport and Infrastructure

EPA: Environment Protection Authority

EPBC: Environment Protection and Biodiversity Conservation Act

EPP: Environment Protection Policy

FCAS: Frequency Control Ancillary Services

FRA: Fractured Rock Aquifer

ha: Hectares

HDPE: High-Density polyethylene

km: kilometres

kV: kilovaults

kW: kilowatts

Leq : equivalent continuous sound level

L/s: litres per second

m: metres

MAR: Managed Aquifer Recharge

MCP: Mine Closure Plan

mg: milligram

MGSD: Minimum Gap Sight Distance

ML: megalitres

ML/d: megalitres per day

ML/s: megalitres per second

ML/y: megalitres per year

MW: megawatts

NEM: National Electricity Market

NRM: Natural Resource Management

PAF: Potentially Acid Forming

PEPR: Program for Environmental Protection and Rehabilitation

PDC: Principles of Development Control

PDP: Preliminary Decommissioning Plan

RO: Reverse Osmosis

ROM: Run of Mine

SAMDB: South Australian Murray Darling Basin

SAPN: SA Power Network

TMP: Traffic Management Plan

SCAP: State Commission Assessment Panel

SCCC: Strathalbyn Community Consultative Committee

SEIFA: Socio-Economic Index for Areas

SISD: Safe Intersection Sight Distance

SRAS: System Restart Ancillary Service

STED: Septic Tank Effluent Disposal

TSF: Tailing Storage Facility

TSL: thin spray-on liner

TSP: Total Suspended Particulate

WHO: World Health Organisation

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Dewatering report

APPENDIX G
Environmental Management Plan

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Important Information

1.0 GENERAL INFORMATION

1.1 Project Overview

Hydrostor Australia Pty Ltd is proposing to develop, build and operate the Angas Advanced Compressed Air Energy Storage (A-CAES) Facility (the Project) at the Angas Zinc Mine (the Mine) in Strathalbyn, South Australia (Figure 1).

At a large scale, A-CAES technology is one of the lowest cost energy storage solutions available on the market. It is also emissions-free and has an unlimited cycle life for over 30 years. This Project is intended to serve as a market demonstration site for widespread deployment of other A-CAES projects throughout South Australia.

The Project will use the existing mine decline to gain access to 240 m below ground level (bgl). There, the subsurface infrastructure will include an underground air storage cavern connected to the surface via water and air lines.

When the system is charging (i.e. at times of surplus energy on the grid), electricity runs an air compressor to pipe compressed air from the surface into the air storage cavern, displacing water up the shaft and into the surface reservoir. The heat generated when compressing the air is captured and stored as hot water in a thermal store for use in electricity generation.

When electricity is needed (i.e. at times of high energy demand on the grid), the system reverses the air flow allowing hydrostatic pressure to force the air out of the air storage cavern and back to the surface where the stored heat is added back into the air stream. The heated air travels through a turbo-expander that drives a generator, efficiently converting the stored energy back into electricity for the consumer.

The proposed Facility will consist of the following surface components:

- Water reservoir
- Plant and equipment hardstand including electrical conversion plant, thermal management system and an acoustic enclosure
- Office and visitor building with associated car parking.

The Project will repurpose portions of the existing underground Mine as the A-CAES system's air storage cavern. If an acceptable solution for underground thermal storage can be developed prior to construction, the thermal store will also be constructed in the existing Mine decline. However, for the purpose of this DA, above ground thermal storage has been assumed.

The Project will demonstrate a reliable, economic energy storage solution which provides flexible generation to support high penetration of renewable resources. In doing so, this Project will not only provide valuable grid services, but will demonstrate a low-impact, end-of-life use for decommissioned mine sites.

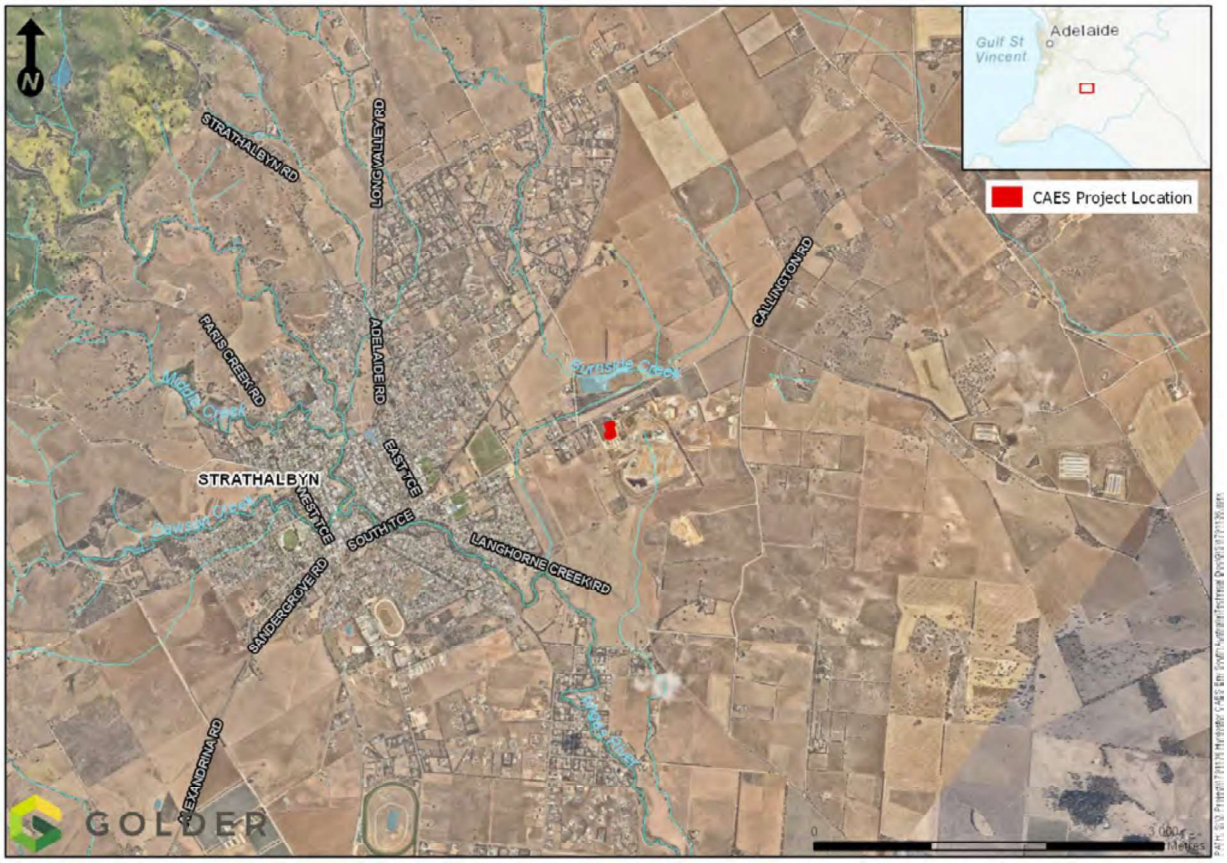

Figure 1: Project location

1.2 The proponent

This Development Application Report (DAR) has been prepared on behalf of the Applicant, Hydrostor Australia Pty Ltd, a wholly-owned subsidiary of Hydrostor Incorporated. Hydrostor Inc. and Hydrostor Australia Pty Ltd are hereinafter referred to jointly or separately as 'Hydrostor'.

Hydrostor is a private company headquartered in Toronto, Canada, and is the global leader in A-CAES. Hydrostor uses its proprietary, fuel-free (adiabatic) process and purpose-built underground air cavities or underwater air cavity to store energy.

Hydrostor offers a suite of intellectual property relating to all aspects of A-CAES and continues to develop its technology. Hydrostor is engaged globally with utilities and governments to provide A-CAES solutions to meet grid energy-storage requirements.

Hydrostor's first Australian office has been set up in Adelaide to facilitate construction and commissioning of the Project and other Australian projects.

1.3 Approvals pathway

Pursuant to Section 49(1)(a) of the *Development Act 1993* (Development Act), the Project is classified as Public Infrastructure, in that it is infrastructure, equipment, structures, works and other facilities used in or in connection with the supply of electricity. Section 7(d) applies to works that exceed $4 M.

The Project was granted Crown Sponsorship under Section 49 of the Development Act through the Department of the Premier and Cabinet (DPC) on 15 June 2018.

This DAR will be lodged with the South Australian Government through the State Commission Assessment Panel (SCAP) and referred to other government entities for review and comment as required.

In accordance with Section 49 (7d) of the Development Act, the Development Application (DA) will be publicly exhibited for at least 15 business days. This includes provision of the DA for public access at key local and State Government offices.

A report will be prepared by the SCAP, encompassing feedback from the referral agencies, and will be provided to the Minister for Planning for a final decision.

1.4 Consultation

This DA and supporting information have been developed in consultation with the following State agencies:

- Department of the Premier and Cabinet (DPC; sponsoring agency)
- Department for Industry and Skills (DIS; case manager)
- Department of Energy and Mines (DEM)
- Department of Planning, Transport and Infrastructure (DPTI)
- Department of Environment and Water (DEW)
- Environment Protection Authority (EPA).

Several other important stakeholders have been engaged throughout the Project inception and development phases, as detailed in Section 10.4 of this DAR.

1.5 Project timing

The State of South Australia has faced several challenges with the reliability of its electricity supply infrastructure in recent years. This proposed development has been established to support the Government of South Australia in improving the economics and reliability of the State's electricity supply.

To support the State's objectives, Hydrostor is seeking to secure Development Approval for the Project early 2019. This will allow for the procurement of long lead time items to facilitate Project commissioning as soon as possible in 2019.

1.6 Structure and content of this report

This DAR has been prepared to support the DA and assessment process.

The DAR is structured as follows:

- Strategic context: summarises project rationale and benefits
- Regulatory position: summarises the legislation relevant to the Project, existing conditions under the *Mining Act 1971*, and a discussion of the Project's alignment with the relevant the Alexandrina Council Development Plan.
- Project description: a description of the Project including subsurface and surface infrastructure
- Project interactions: a summary of the physical, cultural and biological environment and how the Project interacts with those elements, and the appropriate management strategies required

These sections will draw upon the extensive engagement and technical assessments undertaken to demonstrate the Project will make a positive contribution to the Strathalbyn area and greater South Australia without having adverse environmental or social impacts.

STRATEGIC CONTEXT

2.0 SITE SELECTION

Mine sites are considered highly suited to A-CAES projects as the infrastructure required to construct and operate the facility, as well as connect back into the grid, are generally already available including:

- Existing mine decline for construction of the air storage cavern
- Existing substation access
- Water supply
- Suitable access roads for large plant and machinery.

The application of A-CAES to an existing mine site is considered an important strategic step for Hydrostor to showcase a low impact, end-of-life land use of a mine, and the potential use of this technology during mining operations.

Several mine and greenfield sites were considered for siting the Project. The Angas Zinc Mine was selected as the most appropriate for the first South Australian A-CAES project based on the optimal depth of the existing decline, proximity to Adelaide and Terramin's attraction to the Project.

3.0 PROJECT RATIONALE

The Project will demonstrate a new bulk energy storage solution to support the high penetration of renewable energy technologies into South Australia's electricity supply market, while maintaining grid stability, energy security and improving affordability.

The Project will operate as a dispatchable energy storage asset with a high degree of flexibility. The plant has the capability to provide optimised grid services, ongoing voltage support, and synchronous inertia, as outlined in Table 1.

Table 1: Services provided by the Project

Service	Delivery mechanism
Load shifting	The Project can be used to shift electricity from periods of low market value to periods of high market value when demand is at its peak.
Frequency Control Ancillary Services (FCAS) contingency	This Project can respond to fluctuations in grid frequency associated with variability in electricity demand and supply by providing up to 3 MW of raise and 5 MW of lower FCAS contingency availability.
System Restart Ancillary Service (SRAS)	While the plant is not large enough to supply SRAS, this project will facilitate future full-scale projects that will be capable of providing this service, increasing competition in the market and lowering prices.
Voltage Support	While voltage support services are not in great demand at the location of the Project, the plant will be able to provide reactive voltage support to the grid and will facilitate future projects that will be used to provide voltage support services to South Australia's electricity network.
Network Support	While this is highly dependent on localised grid conditions, the Project is capable of providing local network support that could defer network augmentation needs. The ability of the system to supply synchronous inertia also ensures ongoing grid value that is already being codified in the National Electricity Market (NEM) and South Australia.

The sections below summarise how the Project is consistent with State and Commonwealth strategic priorities.

3.1 State Government strategic context

The South Australian Government has announced a plan which aims to deliver more jobs, lower costs and better services. The Project supports these objectives through:

- Regional investment providing employment opportunities
- Lowering electricity costs through providing additional electricity capacity during times of high demand
- Bulk energy storage to provide a reliable energy service

The ways in which the Project will assist the Government in achieving these and other policy goals are detailed in Table 2.

Table 2: State Government policy goals

Policy goal	CAES project support
Affordable energy	■ An affordable supply of electricity is essential for a strong economy. This project will be a critical component in the deployment of other Hydrostor projects across South Australia (and the rest of Australia) which will help in lowering electricity costs by providing additional capacity during times of high demand and, in turn, lowering power prices.
Reliable grid	■ Bulk storage solutions have become an important aspect of providing a reliable energy grid while supporting the increased deployment of renewable energy assets. This project is the first phase of a broader Australia strategy which will see larger projects deployed to provide power system security by delivering synchronous inertia.
Securing our future	■ The larger projects expected to follow this demonstration project will provide a large-scale storage solution for renewable energy so power is available when it is needed, beginning the transformation to next-generation renewable technology ■ Hydrostor's A-CAES is both fuel and emissions-free and thus ideally suited for providing firm electricity in a carbon constrained environment ■ This Project will have an operational life of 30 years or greater, representing a long-term investment to maintain low, stable, emission-free electricity prices in South Australia.
Recharging our regions	■ The Project represents a significant investment in South Australia. It is estimated that the project's local labour and equipment will result in an economic impact of $48 million including spin-off benefits. ■ The Project will provide 30 high quality jobs during construction and at least one during operation which will assist in attracting individuals and their families to the Strathalbyn area. This is anticipated to be the first of many Hydrostor projects in regional areas of South Australia with the additional projects expected to be larger in scale, providing greater employment opportunities and attracting more people to South Australia.
Apprenticeships and traineeships	■ This Project and those expected to follow will increase the demand for tradespeople to enable the timely completion of these projects and thus demand for apprenticeships.

Policy goal	CAES project support
Showcasing South Australia to the world	■ The Project represents an innovative energy storage solution that combines aspects of traditional fossil fuel electricity generation (i.e. turbine technology) with traditional mining techniques. This project represents an excellent opportunity to showcase technology innovation in the mining sector and enhance South Australia's already strong reputation in minerals and energy projects ■ It is intended that the project become an educational showcase demonstrating the innovative emissions-free energy storage ■ Hydrostor sees significant growth opportunities in South Australia and around the world. This project will allow South Australia to showcase to the world that it is open for business and will support the main Australian office of a growing international company.
Create jobs and unlock new economic activity in our regions	■ The Project is proposed to be located near Strathalbyn outside of Greater Adelaide and the associated employment will assist in attracting individuals and their families to the Strathalbyn area. The larger projects expected to follow this demonstration Project will provide further employment opportunities and attract more people to South Australia and particularly regional areas ■ The Project combines the skills used in traditional electricity generation with traditional mining techniques, it provides an excellent opportunity for individuals with those skill sets to participate in the emerging and high demand renewable energy and energy storage industries.

3.2 Commonwealth Government direction

The Department of the Environment and Energy has developed a plan, *Powering forward: a better energy future for Australia* (2017) which sets out the Government's priorities in providing an affordable and reliable energy system that will help meet international commitments. Three main issues are identified in the current energy market; affordability, reliability and emissions.

The Project provides solutions to the issues identified, as follows:

- Affordability: energy can be stored in times of low demand and provided to the grid during times of high demand, placing downward pressure on peak power prices and potentially reducing the need for curtailment charges
- Reliability: a dispatchable storage asset with a high degree of flexibility. The Project has the capability to provide optimised grid services, ongoing voltage support, and synchronous generation
- Emissions: bulk energy storage facilitates deployment of variable renewable energy to reduce emissions.

3.3 Summary of project benefits

As outlined in the sections above, the Project and associated introduction of the A-CAES technology to Australia will deliver several economic, environmental and social benefits to South Australia and wider Australia:

- Provides reliable, economic energy storage and flexible generation
- Supports a high penetration of renewable resources and reduces reliance on energy imports from Victoria
- Demonstrates a positive end-of-life use and re-purposes existing mining infrastructure
- Represents significant investment to the South Australia economy including direct and indirect economic benefits for the Strathalbyn area
- Highlight's South Australia as a leader in renewable energy and energy storage solutions
- Contributes to lowering electricity prices
- Demonstrates South Australia's commitment to a more efficient grid with higher renewable penetration.

THE PROJECT

4.0 SITE CONTEXT

The proposed project site is situated approximately 60 km south east of Adelaide, South Australia and 2.6 km from the town of Strathalbyn at the Angas Zinc Mine (the Mine).

The A-CAES facility will be within the parcel of land held under Certificate of Title (CT) Volume 6032 Folio 127, owned by Terramin. A temporary construction laydown area has been proposed for a portion of the substation land held under CT Volume 6032 Folio 124. The CTs are included in Appendix A.

The Project is within Terramin's Mining Lease (ML6229) and Terramin also owns the Extractive Mineral Licence (EML5325). Hydrostor has entered into a Lease Agreement with Terramin for the northern portion of the Mining Lease, to the south of Callington Road (Figure 2).

The existing decline (within the boxcut) will be temporarily used for access to construct the subsurface infrastructure and some areas outside of Hydrostor's Lease Area will also be used for installation of injection wells and material lay-down temporarily during construction.

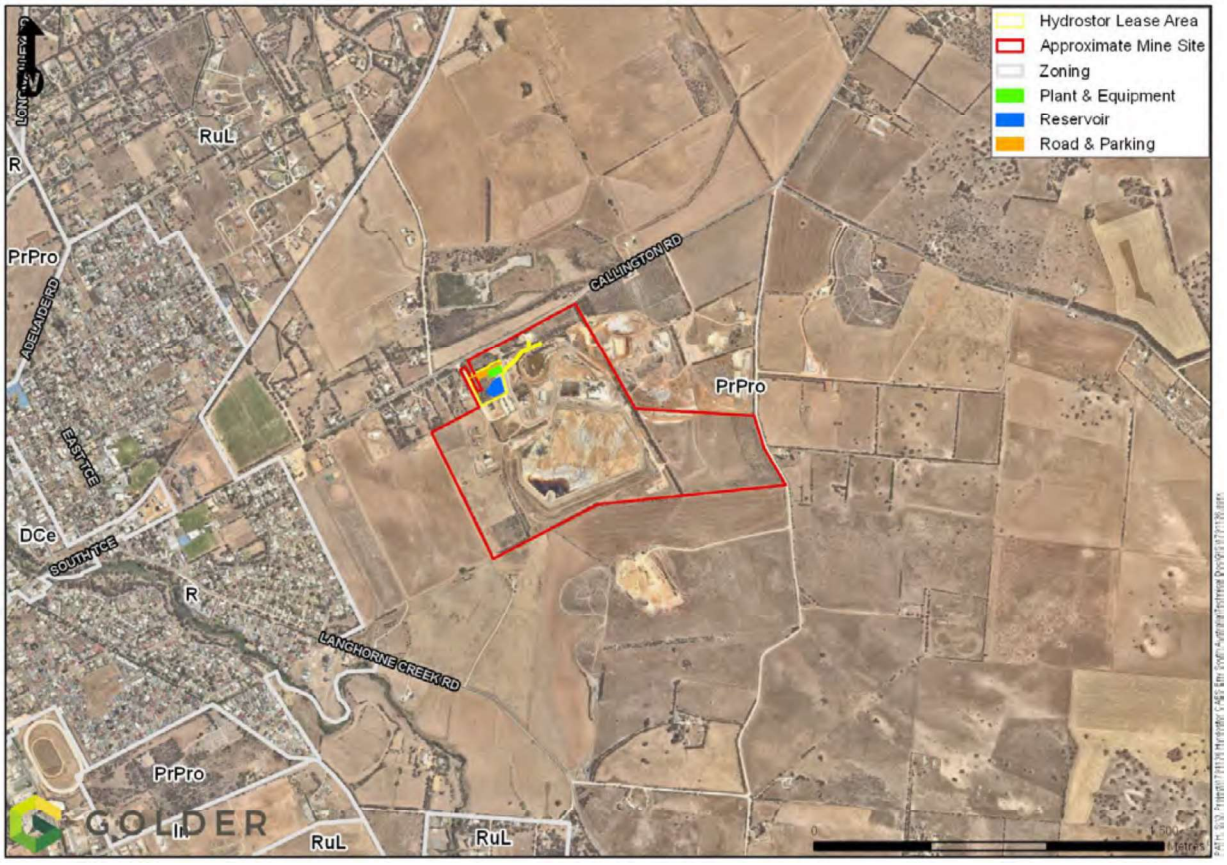

Figure 2: Angas Zinc Mine with Hydrostor's lease area and proposed Project footprint

4.1 Land use

4.1.1 The Project site

The Project site is within the Alexandrina Council. The site is zoned Primary Production under the Primary Production – Mining category within the Alexandrina Council Development Plan, consolidated 24 November 2016 (the Development Plan). Historically, the site was cleared to facilitate agricultural, quarrying and mining activities.

Between 2007 and 2013, the site was used for mining in accordance with the conditions issued in a Mining Lease. In 2013, the mine was placed in care and maintenance because of a prolonged drop in metal prices and the economic reserve being depleted.

Operation at the Mine included underground mine access and a mineral processing plant, located in what was previously a limestone quarry. A tailing storage facility (TSF) was located to the south of the mineral processing plant. Operational activities within the proposed Project site included car parking, a transformer, noise and visual bunding and hard waste storage (Figure 3).

Land use during care and maintenance phase has included maintenance and monitoring activities to minimise emissions from the mine site to potential receiving environments. The majority of the existing surface facilities remain onsite to allow for re-establishing mining activities if economic conditions allow.

As a part of its Mining Lease, Terramin has proposed future land uses once it has closed its operations and rehabilitated the land. Future land uses identified for the site include alternative Extractive Mineral Lease, industrial land use and some ecological outcomes including open grassland and woodland.

Figure 3: Mine operational land use

4.1.2 Surrounding lands

Land uses surrounding the Project site are shown on Figure 4. The Project site is surrounded by industrial, agriculture and rural residential zones.

The closest sensitive land uses are the residential properties adjacent to the west of the Project site. Residences within 400 m are owned by Terramin, and those at a greater distance are privately owned.

Historically, the surrounding land has been broadly cleared of native vegetation to facilitate agricultural developments. The Angas Creek exists approximately 1 km south west of the Project site.

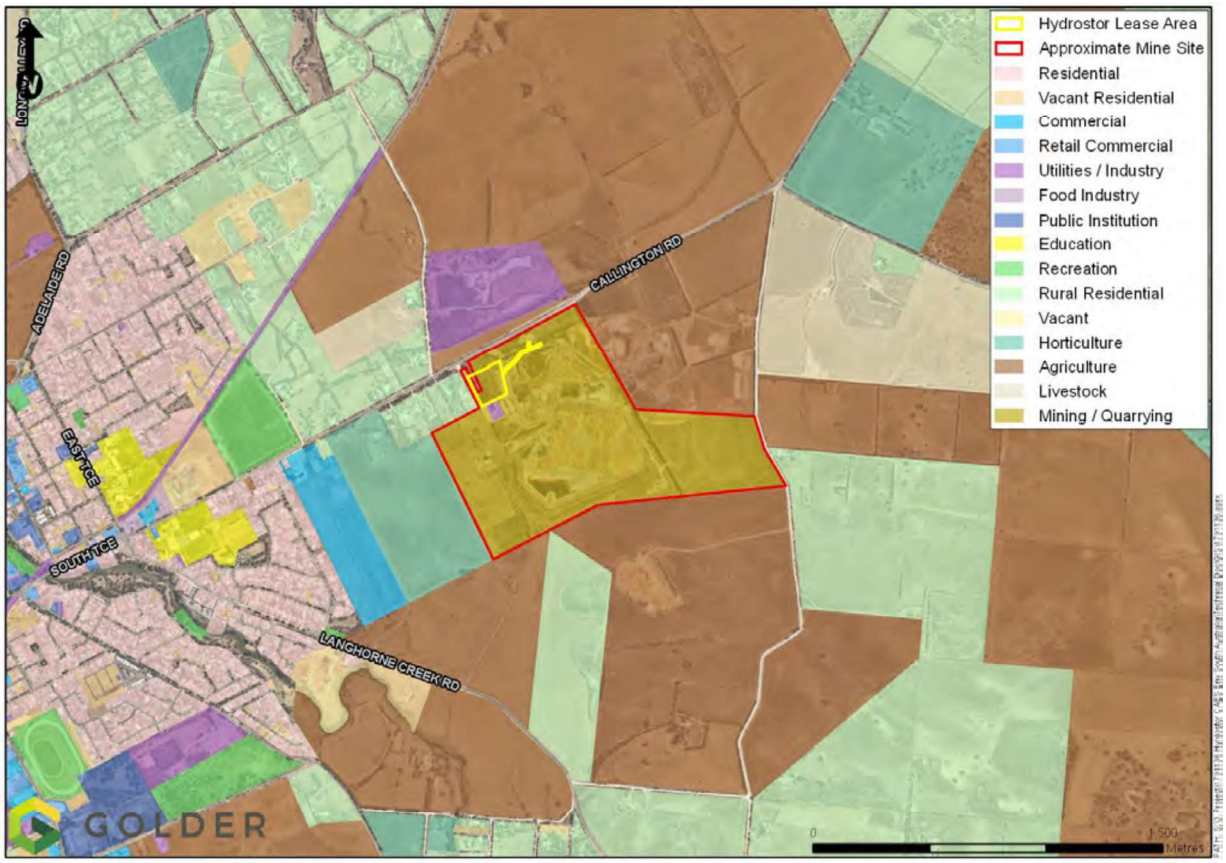

Figure 4: Surrounding land uses

5.0 PROJECT DESCRIPTION

5.1 Advanced Compressed Air Energy Storage

The Project will use the Hydrostor A-CAES system which includes a proprietary, isobaric, purpose-built underground air storage cavern positioned near a water reservoir. The system uses the hydrostatic pressure from a water-filled shaft to maintain a constant pressure (isobaric) during charge and discharge.

When the system is charging, electricity runs an air compressor, which converts the electrical energy into potential energy that is stored in compressed-air. The compressed-air stream is pressurised to the same level found in the air storage cavern.

The heat generated when compressing the air is captured and stored in a thermal storage tank for use during generation — a process known as adiabatic CAES. This adiabatic compression increases the system's efficiency and eliminates the need for additional heat from fossil fuels (and the associated costs and emissions).

When charging, compressed-air is piped from the surface into the air storage cavern, water is displaced out of the air storage cavern and the reservoir water level rises.

Once in the air storage cavern, the air can be stored until electricity is required. To satisfy the need for electricity, the system reverses the air flow, allowing hydrostatic pressure to force the air out of the air storage cavern and back to the surface where the stored heat is added back into the air stream. The now-heated air travels through a turbo-expander that drives a generator, which efficiently converts the energy stored in the air back into electricity for the consumer. When discharging, the air is displaced by water and the reservoir level lowers. The shaft remains flooded through charging and discharging and only the water reservoir level fluctuates.

The technology uses established components used in other industries/applications, including mining and natural gas with minimal environmental disturbances.

Figure 5: A-CAES process overview

5.2 Subsurface Infrastructure

The proposed subsurface infrastructure for this project includes:

- The air storage cavern
- An air line connecting the air storage cavern to the surface
- A water line connecting the air storage cavern to the water reservoir
- Underground electricity connection to the existing transformer.

The air storage cavern will be built using the existing mining decline, which will be sealed at the end of construction in accordance with the original mine closure plan. Following construction and an appropriate monitoring period, there will be no requirement for access the mining decline.

The air storage cavern and all connections to the surface will be sealed, preventing any transfer of water between the system and the surrounding geology.

Underground thermal storage is an emerging technology that is also being considered for this Project however, for the purpose of this DA, above-ground thermal storage has been assumed. If technical challenges can be overcome prior to construction, underground thermal storage will be built in the same way as the air storage cavern.

The boreholes required for the Project will be drilled and installed by a licenced driller in accordance with legislated standards. The dewatering and injection strategy is described in detail in Section 9.9.

5.3 Surface Infrastructure

Proposed permanent surface infrastructure is shown in Figure 6 and will include:

- Water reservoir: with a capacity of approximately 13,000 m^3
- Electrical conversion plant: electrical drives (motors and generators), turbomachines (compressors and turbines), the electrical gear (switch gear, protection, etc.), and the cooling system
- Thermal management system: heat exchangers, heat transfer fluid, storage tanks (hot and cold), and associated pumps
- Water treatment package: includes Reverse Osmosis (RO) plant and make-up water tank for thermal system water requirements

The surface water reservoir will be a High-Density polyethylene (HDPE) lined “Turkey Nest” style dam with a capacity of approximately 13,000 m^3. It will have an impermeable cover and a pump system to remove rainwater that accumulates on top of the reservoir cover. The reservoir will be designed and built in accordance with standard practice for water dams (*note: the reservoir is not defined as a large dam according to the Australian National Committee on Large Dams*).

The electrical conversion plant, electrical and controls module will be skid-mounted and installed on foundations appropriate to the geotechnical conditions of the site.

The thermal storage tanks will be horizontal bullets. Thermal fluid will be used is demineralised water with operating conditions between around 35^0C to 245^0C at 4500 kPa(a). The vessels will be mild steel with nitrogen blanketing and corrosion inhibitor dosing. The pressure in the system will be maintained by nitrogen injection and a venting system into a safe location. The vessels will have pressure relief valves and vacuum breakers installed to be set at the maximum and minimum design pressures. The thermal storage system will be installed on appropriately engineered footings.

The system will be installed with noise attenuation measures such as exhaust silencers and noise-attenuated enclosures as required.

The new RO plant will be installed to prepare thermal storage water, including a make-up water tank which will hold enough pre-treated fresh water to top up the thermal storage water without the need for downtime.

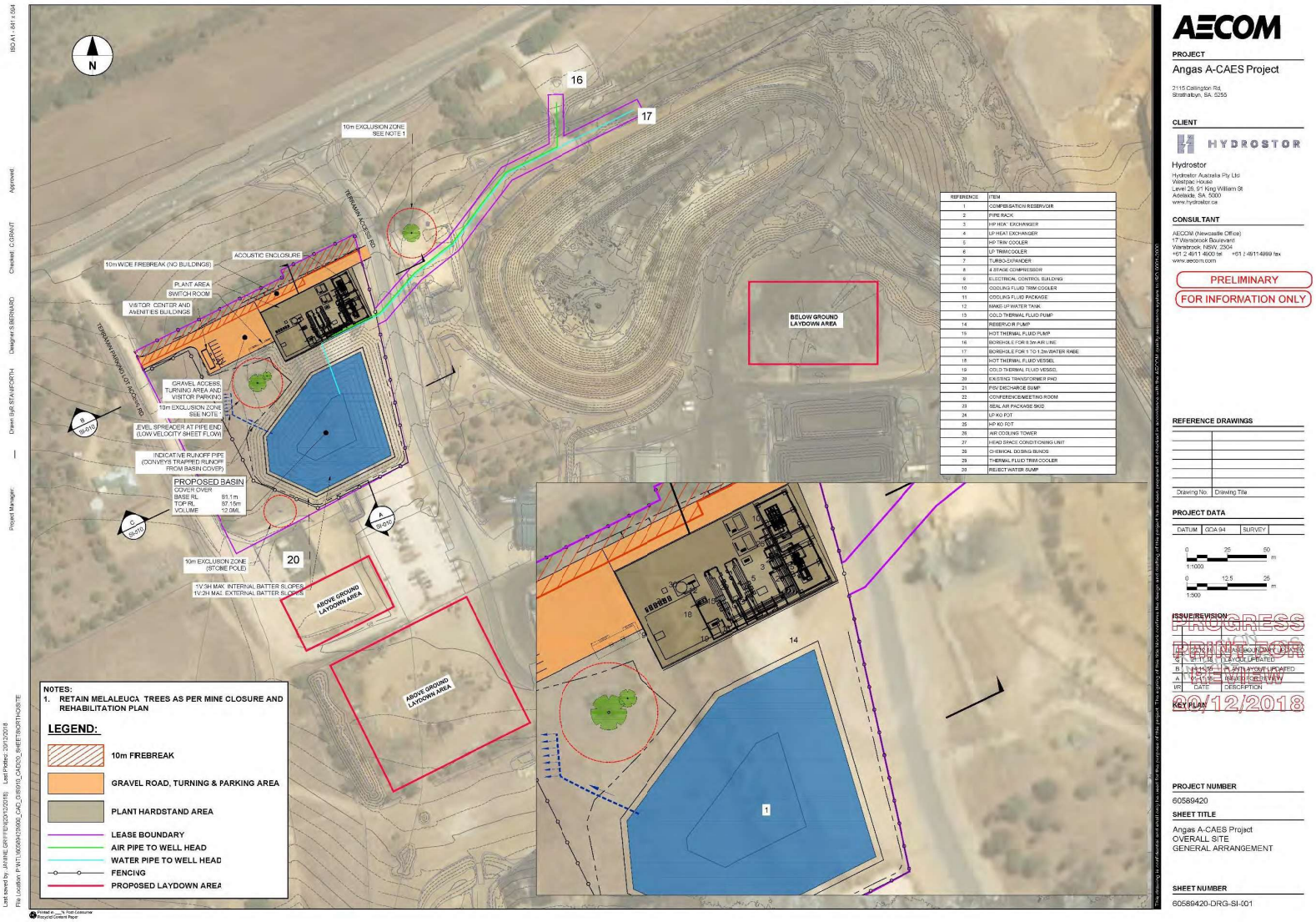

Figure 6: Surface infrastructure

5.4 Electrical Connections

The Project will be connected to SA Power Network's (SAPN) 66 kV sub-transmission network via underground cables to the 66 / 11 kV Strathalbyn East Substation.

5.5 Construction activities

The construction activities will generally include:

- dewatering and stabilisation of the mine void
- construction of the air storage cavern
- borehole drilling and trenching for water and air lines
- excavation and construction of the water reservoir
- Construction and installation of surface plant and machinery

Construction activities will be within general construction hours and night works are not expected.

5.5.1 Dewatering and stabilisation of the mine void

The existing decline and box cut will require dewatering and stabilisation to facilitate construction of the underground cavern. Dewatering is expected to take four months. To achieve the required timeframes, the dewatering will be undertaken prior to receiving Development Approval, under the provisions of the *Natural Resource Management Act 1994* (NRM Act) and *Environment Protection Act 1993* (EP Act).

A 10 inch bore with a submersible pump, well head rising main and appropriate accessories will be installed into the existing underground decline at a depth below the required working depth (i.e. >240 m bgl). The water that was in the decline will be treated to acceptable water quality and piped into water injection boreholes installed in appropriate locations surrounding the Mine, as outlined in the dewatering strategy (Section 9.9).

Once the mine decline and void dewatering activities are complete, the condition of the portal and decline will be assessed, and any support requirements will be installed to ensure that personnel are safe during construction. New portal support will be installed where required using a Bolting IT. Decline rehabilitation will likely use rockbolts, wire mesh, cable bolts, and reinstall all services/utilities. Some select areas may require shotcrete for additional support.

Mine ventilation will be re-established prior to re-entry into the Mine including using the existing 90 kW ventilation fan and installation of additional smaller primary and secondary fans, as required.

5.5.2 Air storage cavern

Construction of the air storage cavern will include the following:

- High-pressure grouting will be injected into the rock mass:
  - A production jumbo and compressor will be used to drill holes for injection
  - A grout pump will be used to inject the grout
- Shotcrete will be applied to the full perimeter of the excavation using an underground spray on pump (shotcrete unit) and an underground agitator
- A thin spray-on-liner (TSL) will be applied over the shotcrete using the shotcrete unit
- A secondary layer of shotcrete will be applied over the liner

- Bulkheads will be installed by installing a Clune frame, mesh, shade cloth and applying shotcrete in 1 m thick increments
- Instrumentation will be installed using the Bolting IT and routed to surface through the annulus of the water wells.

No waste rock is anticipated to be generated and there is no requirement for any material to be brought to surface from underground workings.

5.5.3 Water and air lines

The three bore holes required for the thermal storage will be between 10 inch and 20 inch in diameter and will be drilled using the pilot bit of a raise-bore or by using a conventional rotary drill rig. The air line will also be drilled using a raise-bore rig.

Drilling of the water conduit will require three stages:

1) A piling drill will drill and install a surface casing to create a foundation to support the raise-bore rig
2) An initial pilot drill hole will be drilled, intersecting the decline at the 255 m bgl
3) A reamer head will be connected underground to a drill stem.

After the bores are drilled, casings will be installed and grouted in-place.

5.5.4 Surface infrastructure

The reservoir will be a “Turkey Nest” HDPE lined dam. The reservoir will be constructed using material generated during excavation of the existing surface material. An impermeable cover designed for the Project will be installed on the surface of the reservoir.

The surface infrastructure will be delivered to site and will be skid-mounted and installed on foundations appropriate to the geotechnical conditions of the site.

The thermal storage construction will involve erecting pressure vessel tanks on appropriately designed footings. All structures and facilities will be designed in accordance with Australian design and safety standards.

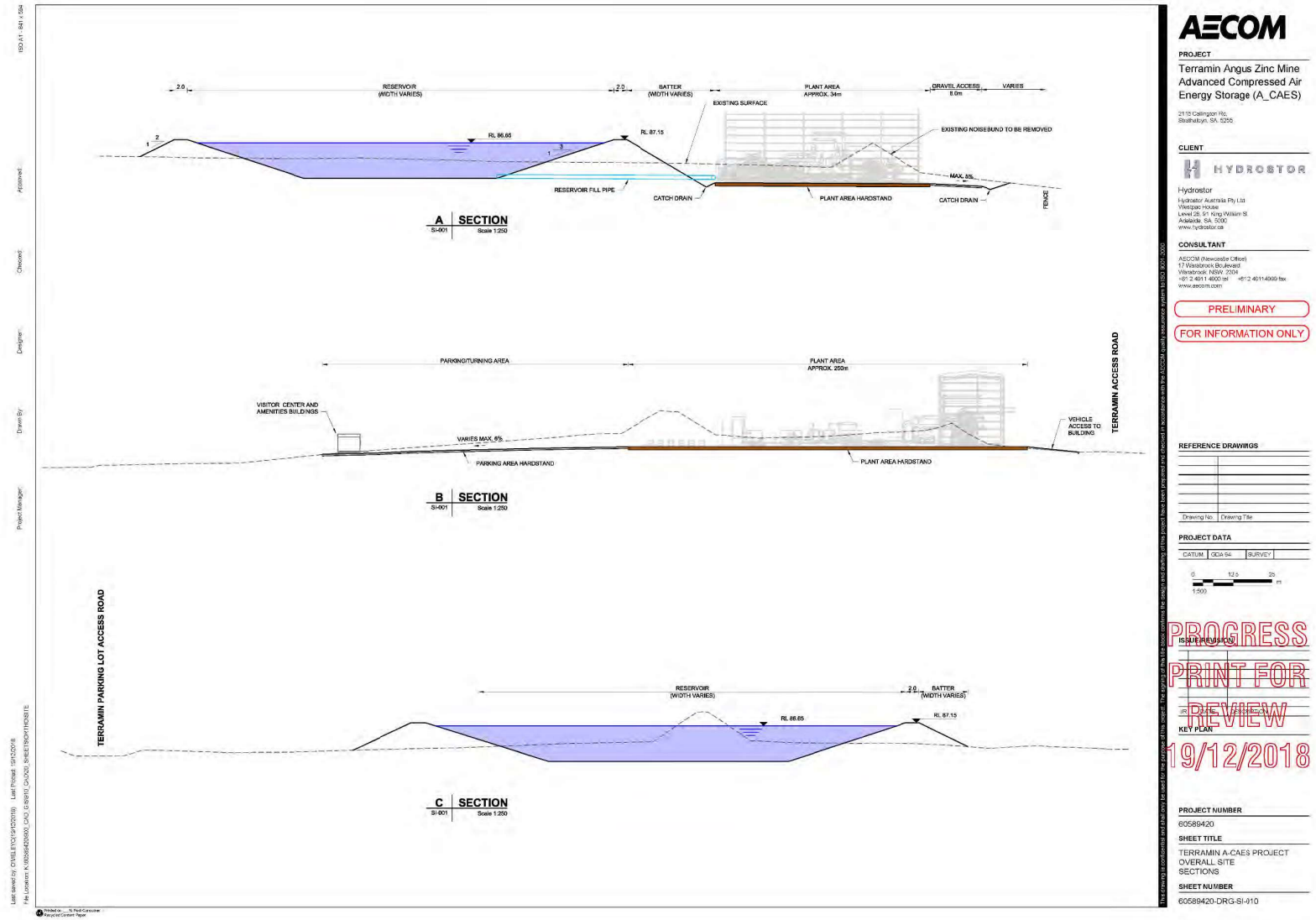

Figure 7: Cross section concept drawings of surface infrastructure

5.5.5 Temporary laydown areas

Three temporary laydown areas have been identified within areas previously disturbed by Terramin's operations (Figure 6) as follows:

- Above ground laydown south of the substation
- Above ground laydown further south within Terramin's existing laydown area
- Underground laydown area in the old Run of Mine (ROM) pad area.

5.5.6 Accommodation and site amenities

Local site personnel will be employed where possible. Where non-local personnel are required for specific roles, they will utilise existing accommodation in Strathalbyn or the surrounding area.

Temporary amenity facilities (i.e. site office and portable toilets) will be used during construction.

5.6 Operation

Once operational, the Facility will require one full time staff and additional maintenance and inspections by Hydrostor's operations specialists. Regular maintenance activities will occur during normal business hours. Infrequent maintenance and equipment replacement may require minor additional site support. The proposed layout includes site amenities to be used by operational staff including a visitor building, toilet facilities and provision for seven car parks.

5.7 Decommissioning

A Preliminary Decommissioning Plan (PDP), included in Appendix B, has been developed to describe a framework and strategies to facilitate a range of future land use options, at the extinguishment of Hydrostor's lease.

Detailed strategies for decommissioning will be progressively developed and outlined in the final decommissioning plan for the site. Final land use and closure criteria will incorporate closure objectives as negotiated between Hydrostor and the site owner, in consultation with the community and other relevant stakeholders.

The site will be left in a state that does not compromise safety or the environment. It is envisioned that all plant and equipment will be removed from the site and recycled or disposed of according to legislative requirements at the time of decommissioning.

A complete register of plant and equipment to be decommissioned and removed will be developed as part of the final decommissioning plan. Table 3 provides a preliminary list of the plant and equipment with proposed management actions.

Table 3: Preliminary register of plant and equipment

Plant/equipment	Proposed management action
Surface infrastructure	
Reservoir	Leave in place for future use (in consultation with land owner)
Electrical conversion plant	Removal - salvage
Cooling tower	Removal - salvage
Thermal storage tanks	Removal - salvage
Water tank	Leave in place for future use (in consultation with land owner)
Water treatment plant	Removal - salvage
Water pump	Leave in place for future use (in consultation with land owner)
Sub-surface infrastructure	
Underground cavern	Flooded as per the existing Mine Closure Plan for the Angas Zinc Mine.
Water and air pipes to cavern	Decommissioning by sealing with grout
Injection bores	Decommissioning by sealing with grout (unless otherwise required by land owner)
Underground pipework	Removal - salvage, recycle or dispose
Electrical cables	De-energise and remove

REGULATORY POSITION

6.0 RELEVANT LEGISLATION, PERMITS AND MINING LEASE CONDITIONS

Table 4 outlines the legislation relevant to the DA. All works will be compliant with the obligations of other South Australian and Commonwealth legislation relevant to development, including the Work Health and Safety Act 2012.

Table 4: Regulatory framework

State Department	Legislation	Policy scope	Relevance to the Project
Department for Energy and Mining (DEM)	*The Mining Act 1971*	DEM is responsible for the administration and management of mineral resources and regulation of South Australia's mineral exploration and mining sectors.	The site has an active Extractive Mineral Lease and Mineral Lease with associated licence conditions enforced by DEM. The licence conditions are adhered to through the implementation of the Program for Environmental Protection and Rehabilitation (PEPR), Care and Maintenance Plan and Mine Closure Plan (Section 6.1 and 6.2) The Project will need to ensure the conditions of the Mineral Lease are not compromised.
Department of Planning, Transport and Infrastructure (DPTI)	*Development Act 1993*	Provides a framework for planning and regulation of development in SA.	The DA will be assessed under Section 49 provisions of the Development Act with consideration of the Alexandrina Council Development Plan. The Project site will be accessed via an arterial road (Callington Road) and accordingly will be referred to the Commissioner of Highways (DPTI).
Environment Protection Authority	*Environment Protection Act 1993* (EP Act)	Provides a regulatory framework to protect SA's environment including land, air and water.	The DA must comply with the EP Act and relevant policies for protection of the environment throughout design, construction and operation.

State Department	Legislation	Policy scope	Relevance to the Project
Department of Environment and Water (DEW)- including Natural Resources South Australia Murray Darling Basin (SAMDB)	*Natural Resource Management Act 1994* (NRM Act) *Native Vegetation Act 1991*	Conservation, protection or management of natural assets including water.	The DA must demonstrate that the natural resources, and particularly water resources, will not be adversely impacted by the Project.
Safework SA	*Work Health and Safety Act 2012* and *Work Health and Safety Regulations 2012*	Provides the framework for managing workplace health and safety risks, and that legal responsibilities are met	Hydrostor will design, construct and operate the facility to ensure safety standards are met.

6.1 Mining Lease Conditions

Hydrostor is leasing land from Terramin at its Angas Zinc Mine which was approved under the Mining Act 1971. The Mining Act provides a two-stage assessment and approval process to enable mining operations to commence. The first is for the grant of a mineral tenement (ML or MPL). Following the grant of a mineral tenement, the tenement holder must have an approved Program for Environmental Protection and Rehabilitation (PEPR) in place to enable operations to commence. The purpose of the PEPR is to ensure the tenement holder achieves the construction, operational and mine completion environmental outcomes derived from the results of the mining lease application environmental impact assessment and/or PEPR review, and stakeholder consultation.

Environmental outcomes derived from the assessment of a lease application are generally specified in the schedules of the lease/licence. Terramin provided details in the PEPR that it will continue to be able to achieve those environmental outcomes throughout the whole-of-mine life. As such, Hydrostor will need to ensure that the Project does not interfere with the agreed lease conditions.

6.2 Program for Environment Protection and Rehabilitation

Terramin's PEPR (2017) provides specific commitments for the protection of the surrounding environment. The environmental aspects include:

- groundwater and surface water
- erosion, silt and stormwater
- topsoil
- vegetation clearance, fauna and weed management
- waste disposal and hazardous substances
- acid mine drainage and tailings management
- traffic
- noise and visual impact
- blasting
- public health and nuisance
- fire and public safety
- geotechnical stability
- Aboriginal heritage

In accordance with the Mining Lease Conditions, the mine was managed under a PEPR. The PEPR detailed the mining operations and existing environment; identifies the key environmental risks; and outlines community acceptable outcomes and measurement criteria that Terramin has committed to deliver.

The Outcome Measurable Criteria listed in the PEPR related to the operational phase of the mine and therefore, are not currently relevant. Independent of Hydrostor's lease, Terramin may seek approval to begin processing ore from Bird in Hand Mine at AZM. This would be assessed under the provisions of the Mining Act and will require a Miscellaneous Purpose Lease including the associated PEPR. The contents of these documents are expected to be consistent with historical lease conditions and the existing PEPR.

Currently the mine site is in care and maintenance phase and therefore managed in accordance with the measurable criteria and monitoring requirements of the Care and Maintenance Plan (CMP) (Terramin, 2014).

6.2.1 Care and maintenance

The Care and Maintenance phase includes maintenance and monitoring activities to minimise emissions from the mine site that may impact potential receiving environments and may compromise the mine closure process. Majority of the existing surface facilities will remain onsite during care and maintenance phase to allow for re-establishing mining activities if economic conditions allow. The general outcomes of the CMP are consistent with those in the PEPR where relevant, as listed in Table 5.

Assuming the mine site will remain in Care and Maintenance phase for at least another year (as confirmed by Terramin), the CMP will be relevant to the Hydrostor's lease area during construction of the Project. The potential for the Project to interact with the CMP outcomes has been assessed and summarised in Table 5. Where relevant, details on the interactions and measures to mitigate any risks are discussed further in the DA.

Table 5: CMP outcomes and Project interactions

CMP outcome	Project interaction	DA Reference
No adverse impact to the supply of water by the mining operations to existing users and water dependent ecosystems	Temporary groundwater dewatering and re-injection will be required during the early stages of the Project, as was undertaken during Mining operations. The dewatering and re-injection strategy has been designed to ensure no impact to groundwater and the Angas River. There will be no operational interaction between the Project and groundwater. Surface water monitoring at the Angas River as well as groundwater level/quality monitoring will continue during construction and operation of the Project.	Section 9.9
Stabilise disturbed areas and prevent sediment from leaving the site	The Project site surface will be temporarily disturbed during construction. Construction will be managed appropriately to prevent sediment from leaving the site. Permanent drainage infrastructure will be designed and constructed to mitigate the risk of soil erosion and sedimentation. Existing turbidity monitoring undertaken by Terramin will continue, in accordance with the Closure Criteria.	Section 9.8
Ensure that soil quality and quantity are protected	Hydrostor's lease conditions stipulate that there will be no impact to soil quantity and quality. No impacts are expected as a result of construction and operation of the Project, and unexpected impacts will be rectified if they occur.	Section 9.9
Avoid permanent loss of biodiversity through clearance of native vegetation	The Project does not require clearance of native vegetation.	Section 9.4
No water contaminated because of mining operations leaves the lease area and results in contamination of soil at mine closure within lease area	Water contamination is not expected. Hydrostor's lease conditions stipulate that there will be no impact to soil quantity including appropriate remediation if required. Appropriate response and reporting requirements to be adhered to in the event of an accidental spill.	Section 9.8 and Section 9.9
No contamination or pollution is caused by waste products and hazardous materials used in the mine operations	Waste and hazardous material will be appropriately managed and stored to prevent contamination. Appropriate response and reporting requirements to be adhered to in the event of an accidental spill.	Environmental Management Plan (EMP) (Appendix G)

CMP outcome	Project interaction	DA Reference
No contamination of natural water drainage systems, streams and rivers, groundwater, land and soils occurs either on or off site resulting from permanent disposal or temporary storage of mine or waste material	There will be no mine waste as a result of the of the Project.	N/A
No impacts offsite are caused by accidents, noise, dust and dragout by traffic from or to the mine site	Impacts to traffic, noise and dust are expected to be minor and temporary and will be managed during construction. Truck dragout will be managed through construction and appropriate clean-up response will be implemented. Appropriate traffic management and controls will be implemented to mitigate the risk of traffic accidents from site traffic.	Section 9.6, Section9.7 and Section 9.11
Ensure there will be no truck dragout on the Callington – Strathalbyn Road	Truck dragout will be managed through construction and an appropriate clean-up response will be implemented.	EMP (Appendix G)
No public nuisance impacts from noise emanating from the operating site	Minor, temporary construction noise is expected and will be managed throughout construction. Noise mitigation measures have been included in the design to ensure operational noise will be within appropriate limits.	Section 9.7
No public nuisance impacts from airblast and vibration caused by blasting	No air blasting will occur.	Section 9.7
No public health, loss of amenity and nuisance impacts to local residents from air emissions, dust and odour generated on site as a result of mining operations	Impacts to air quality as a result of dust will be minor and temporary and will be managed during construction. The facility will have no impact on air emissions and no odour generated from the operation.	Section 9.6
No unplanned fires on site and ensure control measures are in place to manage potential offsite impacts	Fire risk mitigation measures will be implemented during construction including appropriate emergency response procedures. The design of the facility includes a dedicated water supply and adequate access tracks for emergency vehicles.	Section 7.0
No public injuries or deaths resulting from unauthorised entry to the mine site	There will be no unauthorised access to the Project site during construction and operation.	N/A
Ensure that no damage occurs to third party infrastructure and no injuries/deaths result from collapse of the underground workings	Appropriate underground workings stabilisation will occur prior to construction personnel entering the mine void.	N/A

CMP outcome	Project interaction	DA Reference
	There will be no change to the mine backfill and therefore no change in the risk of subsidence occurring.	
Minimise the adverse visual impact and maintain a clean, rubbish free site	Based on the proposed additional infrastructure, the visual impact is expected to be minimal and will be reduced through Project design (i.e. building design/colour and vegetation screening). Waste will be appropriately managed.	Section 9.14
No nuisance, inconvenience or loss of amenity to any person beyond the mine site caused by external lighting	Construction will be undertaken during general construction hours and will not result in light spill to neighbouring residential properties. Operational lighting will be minimal and will not result in light spill to neighbouring residential properties.	Section 9.14
No net adverse impacts from the site operations on the native fauna on the lease area and adjacent areas	Risk to fauna is low and will be appropriately mitigated throughout construction. There will be no increase in risk to native fauna during operation.	Section 9.4
The lessee must minimise the spread of weeds and plant pathogens (including phytophthora) and ensure that all employees and contractors on-site are made aware of this requirement	The risk of spread of weeds and plant pathogens is low and will be mitigated during construction.	Section 9.5
No unauthorised disturbance to Aboriginal sites, remains or objects	There are no registered sites within the Mine site. Further, the Project is proposed for previously disturbed areas of the Mine site and therefore the risk of encountering Aboriginal sites, remains or objects is negligible.	Section 9.12

The site will be maintained in Care and Maintenance, until the decision is made re-open or close the mine, or the Mining Lease expires. When the mine is closed, or the Mining Lease expires, the site will be subject to the Mine Closure Plan (2017) (MCP) for final rehabilitation of the land affected by the Mine (Section 6.2.2).

6.2.2 Mine Closure Plan

Several of Terramin's lease conditions are specifically relevant to mine closure and post closure; and form the Closure Criteria for the Mine.

The Closure Criteria address the following environmental outcomes:

- Ensuring no adverse impact to the supply of water
- The stabilisation of disturbed areas and prevention of sediment transport
- The protection of soil quality and quantity
- Increase in biodiversity values through revegetation
- No contamination or pollution caused by waste products or hazardous materials resulting from mining operations
- Geotechnical stability.

The lease conditions and Closure Criteria have been considered in the assessment of the A-CAES project's environmental interactions to ensure protection of the environment to the satisfaction of State Agencies, and to assist Terramin in meeting its Closure Criteria. The Project has been assessed against the Closure Criteria to determine potential interactions and mitigation measures. As detailed in the assessment, monitoring requirements in accordance with the Closure Criteria have been proposed where required to ensure there is no adverse impact to the environmental outcomes including:

- Surface water turbidity monitoring at existing remote telemetry stream gauge locations
- Angas River water quality monitoring
- Groundwater level and quality monitoring
- Subsidence monitoring following decommissioning.

The Closure Criteria assessment is included in Appendix C and has been addressed further in the environmental and social interactions assessment.

7.0 PLANNING ASSESSMENT

While the Alexandrina Council will not formally assess the Project, it is important that the development aligns and acknowledges the Objectives and Principles of Development Control (PDC) in the relevant Development Plan. The Project is located within the Primary Production Zone of the Development Plan. The objectives and desired character of the zone are aimed towards protection of primary production and the scenic quality of rural areas.

The co-location of the Project with the Mine ensures that the desired character of the zone is protected while providing a bulk energy storage solution to the community and enhancing the use of existing infrastructure. The Project has been sited and design to have a negligible impact on the environment and amenity and ensures the scenic quality of the surrounding land is maintained.

The Objectives and Principles of Development Control (PDC) of the Development Plan that are considered relevant in the assessment of the proposed development are discussed in Table 6.

Table 6: Development Plan provisions

Development Plan Section	Summary of Objectives and Principles of Development Control (PDC)	Proposed development details
General section		
Hazards	Objective 2: Development located away from areas that are vulnerable to, and cannot be adequately and effectively protected from the risk of natural hazards PDC 4: Development should not occur on land where the risk of flooding is likely to be harmful to safety of damage property PDC 6: Development, including earthworks associated with development should not increase the risk of flooding of other land PDC 9: Development in a Bushfire Protection Area should be in accordance with those provisions of the *Ministers Code: Undertaking development in Bushfire Protection Areas* that are designated as mandatory for Development Plan Consent purposes. PDC 23: Development, including land division, should not occur where site contamination has occurred unless the site has been assessed and remediated as necessary to ensure that it is suitable and safe for the proposed use. PDC 24: Hazardous materials should be stored and contained in a manner that minimises the risk to public health and safety and the potential for water, land or air contamination	The Project is within an area of negligible flooding susceptibility. The reservoir is a "Turkey-Nest" style dam and therefore does not receive runoff during rainfall events. Direct rainfall which accumulates on the reservoir cover will be pumped and redistributed to surface water drainage pathways Appropriate standards for design and construction of the reservoir will be met. The Project is located within the Medium Risk area (see BPA Map Alex/4 Bushfire Protection Area) and will comply with the requirements for a bushfire attack level of BAL- 12.5. Infrastructure will be appropriately fire rated and installed to the relevant standards and guidelines. As a part of property preparedness against fires, all debris will be cleared from around buildings, inverters and transformers and firefighting equipment will be located within the electrical-conversion plant; and the electrical and controls module for emergency use. Vehicle access to and around the Project will be maintained during construction and operation of the Project. A Baseline Contamination Assessment will be undertaken prior to construction works to document the existing condition of the Project footprint. Appropriate remediation will be undertaken to ensure the site is suitable for the proposed land use. Hazardous materials will be appropriately stored and disposed of if required.

Development Plan Section	Summary of Objectives and Principles of Development Control (PDC)	Proposed development details
Industrial development	Objective 1: Industrial, warehouse, storage and transport distribution development on appropriately located land, integrated with transport networks and designed to minimise potential impact on these networks PDC 2: Any building or structure on or abutting the boundary of a non-industrial zone should be restricted to a height of 3 meters above ground level at the boundary and a plan projected at 31 degrees above the horizontal into the development site from that 3 metre height. PDC 3: Industrial development should enable all vehicles to enter and exit the site in a forward direction PDC 6: Industrial development should minimise significant adverse impact on adjoining uses due to hours of operation, traffic, noise, fumes, smell, dust, paint or other chemical over-spray, vibration, glare or light spill, electronic interference, ash or other harmful nuisance-creating impacts.	The co-location of the Project with existing mining infrastructure ensures that the traffic network and access requirements of the Development Plan are met. The Traffic Impact and Access Point Assessment (Appendix D) undertaken confirmed that the existing transport network and proposed construction access point is generally suitable for the Proposed development; and the Project will not have a significant impact on Callington Road. The proposed layout includes a minimum 20 m buffer between the infrastructure and the adjacent property boundary and will include sufficient car parking to meet the operational requirements. The Project is setback approximately 80 m from Callington road, behind existing vegetation screening, this distance is generally consistent with the setback of neighbouring properties. Potential impacts to neighbouring properties throughout construction, such as noise, fumes, dust, vibration and light spill will be managed through an Environmental Management Plan (EMP). The Project will inherently have a low impact on the surrounding properties during operation. Where necessary, additional measures have been built into the design to ensure the potential impacts to neighbouring properties is negligible including noise attenuation measures and infrastructure placement and lighting design to avoid light spill.
Infrastructure	Objective 1: Infrastructure provided in an economical and environmentally sensitive manner.	The co-location of the Project with existing mining infrastructure allows economic access to the required infrastructure with a minimal environmental impact. The Project will not require new access tracks, nor clearing of vegetation

Development Plan Section	Summary of Objectives and Principles of Development Control (PDC)	Proposed development details
	Objective 2: The visual impact of infrastructure facilities minimised. Objective 3: The efficient and cost-effective use of existing infrastructure. PDC 1: Development should only occur where it has access to adequate utilities and services, including electricity supply, water supply, drainage and stormwater systems, effluent disposal systems, formed all-weather public roads and telecommunications services. PDC 8: Utility and service infrastructure should be designed and located to minimise its visual and environmental impacts. PDC 9: Utilities and services, including access roads and tracks, should be sited on areas already cleared of native vegetation.	
Interface between Land Uses	Objective 1: Development located and designed to prevent adverse impact and conflict between land uses. Objective 2: Protect community health and amenity and support the operation of all desired land uses. Objective 3: Protect desired land uses from the encroachment of incompatible development.	The Project will inherently have a low impact on the amenity of the surrounding area during operation. Where necessary, additional measures have been built into the design to ensure the potential impact to neighbouring properties is negligible including noise attenuation measures infrastructure placement and lighting design to avoid light spill. Potential impacts to neighbouring properties throughout construction, such as noise, fumes, dust, vibration and light spill will be managed through an EMP (Appendix G).

Development Plan Section	Summary of Objectives and Principles of Development Control (PDC)	Proposed development details
	PDC 1: Development should not detrimentally affect the amenity of the locality or cause unreasonable interference through emissions (effluent, odour, smoke, fumes, dust or other airborne pollutants), noise, vibration, electrical interference, light spill, glare, hours of operation, traffic impacts. PDC 2: Development should be sited and designed to minimise negative impact on existing and potential future land uses considered appropriate in the locality. PDC 8: Development with the potential to emit significant noise (e.g. industry) should incorporate noise attenuation measures that prevent noise from causing unreasonable interference with the amenity of noise sensitive premises.	The Project is within an existing Mine site and will have no negative impact on the future land use options.
Natural Resources	Objective 1: Retention, protection and restoration of the natural resources and environment. Objective 2: Protection of the quality and quantity of South Australia's surface waters and underground waters. PDC 1: Development should be undertaken with minimum impact on the natural environment, including air and water quality, land, soil, biodiversity and scenically attractive areas.	The Project will not have an adverse impact on the natural environment as follows: ■ Air emissions are negligible ■ Dewatering design during construction will ensure no impact on water quality ■ Existing available water allocations will be acquired to ensure sustainable use of water resource during construction (for dewatering) ■ No vegetation or habitat disturbance ■ Introduction and spread of pest plants during construction will be managed through an EMP

Development Plan Section	Summary of Objectives and Principles of Development Control (PDC)	Proposed development details
		■ Principles of water sensitive design will be incorporated into the design including stormwater management systems, in accordance with available guidelines ■ Vegetation screening, and co-location with the Mine ensures negligible impact on the visual amenity of the area ■ No change to the general landform ■ Once constructed, the Project will be a closed system with no interaction with groundwater
Orderly and Sustainable Development	Objective 1: Orderly and economic development that creates a safe, convenient and pleasant environment in which to live Objective 3 & 4: Development that does not jeopardise the continuance of adjoining authorised land uses or prejudice the achievement of the provisions of the Development Plan PDC 7: Development should be located and staged to achieve the economical provision of public services and infrastructure and to maximise the use of existing services and infrastructure PDC 8: Where development is expected to impact upon the existing infrastructure network (including transport network), development should demonstrate how the undue effect will be addressed.	The Project will have no adverse impact on the proposed future land use of the Mine site, nor will it adversely impact surrounding properties or road network. The Project has been sited to use existing infrastructure with minimal impact to the environment and community.

Development Plan Section	Summary of Objectives and Principles of Development Control (PDC)	Proposed development details
Renewable Energy Facilities	Objective 1: Development of renewable energy facilities that benefit the environment, the community and the state Objective 3: Location, siting, design and operation of renewable energy facilities to avoid or minimise adverse impacts on the natural environment and other land uses.	The Project provides a bulk energy storage solution which will assist in increasing the reliability of the grid (especially with the increased penetration of renewable energy) and lowering energy prices. The siting and design of the Project ensures adverse impacts to the environment and surrounding land use are minimised.
Siting and visibility	Objective 1: Protection of scenically attractive areas, particularly natural, rural and coastal landscapes PDC 1: Development should be sited and designed to minimise its visual impact on the natural, rural or heritage character of the area; areas of high visual or scenic value, particularly rural and coastal areas PDC 2: Building should be sited in un-obstructive locations and, in particular, should be grouped together and be located in such a way as to be screened by existing vegetation when viewed from public roads	The siting of the Project at an existing Mine, location of the proposed components within the Mine site, and the design of surface infrastructure components will ensure minimal adverse impact to visual amenity. Particularly: ■ The surface infrastructure will be behind roadside vegetation screening and will be constructed of materials which blend in to the surrounding environment ■ There will be no change to the existing access tracks ■ Landscaping will be undertaken using local native species.
Waste	Objective 1: Development that, in order of priority, avoids the production of waste, minimises the production of waste, reuses waste, recycles waste for reuse, treats waste and disposes of waste in an environmentally sound manner.	The Project construction and operational environmental management plans will incorporate appropriate waste management procedures. Waste water resulting from dewatering will be reinjected into the source aquifer. The water quality will be tested and the water treated if required prior to reinjection. Waste resulting from water treatment will be collected by appropriately licenced contractors.

Development Plan Section	Summary of Objectives and Principles of Development Control (PDC)	Proposed development details
	Objective 2: Development that includes the treatment and management of solid and liquid waste to prevent undesired impacts on the environment including soil, plant and animal biodiversity, human health and the amenity of the locality. PDC 1: Development should be sited and designed to prevent or minimise the generation of waste (including wastewater) by applying the following waste management hierarchy in the order of priority as follows; avoiding, minimising, reusing, recycling, recovering, treating (to reduce potentially degrading impacts), disposing (in an environmentally sound manner) PDC 2: The storage, treatment and disposal of waste materials from any development should be achieved without risk to health or impairment of the environment. PDC 3: Development should avoid as far as practical, the discharge or deposit of waste (including wastewater) onto land or into any waters	Waste water, including from site amenities will be collected by appropriately licenced contractors.

Development Plan Section	Summary of Objectives and Principles of Development Control (PDC)	Proposed development details
Primary Production Zone		
	Objective 1: The long term continuation of primary production Objective 4: Protection of primary production from encroachment by incompatible land uses and protection of scenic qualities of rural landscapes Objective 6: Development that contributes to the desired character of the policy area. PDC 1: Industry and warehousing should only be developed if it supports primary production, processing, storage and distribution of local primary produce or products produced on the same site, and should be developed where: (b) it is unlikely to limit or inhibit the use of adjoining land for primary production (c) the particular use requires a site in proximity to a particular natural resource or other product or material sourced from the locality. (d) it will not result in the alienation of land or water resources identified as significant for primary production or ecological reasons (f) the capacity of the infrastructure, including roads, is capable of supporting the use without detriment to existing users.	While within the Primary Production Zone, the Project is sited within an existing industrial facility. The Project does not increase the footprint of the Mine, nor will it adversely impact on the surrounding land used for Primary Production. The Project siting and design ensures the scenic quality of the surrounding rural landscape is protected. The Project is sited to enhance the use of the Mine and the existing infrastructure available and not used to its full potential at the Mine. While the groundwater in the area is unlikely to be used for primary production due to its salinity, the Project has been designed to ensure no adverse impact to any water resource. The existing road network has been confirmed to be suitable for the proposed development, and the increased traffic volume associated with the development will not have a significant impact on the existing traffic or road infrastructure.

ENVIRONMENTAL AND SOCIAL INTERACTIONS

8.0 TECHNICAL STUDIES

The Project environmental and social assessment has been prepared to assess the potential impacts and proposed management and mitigation measures to ensure impacts are minimised to an acceptable level.

The existing environment at the Site has been characterised in detail as part of the Mine approval process and operational monitoring requirements. A review of the publicly available information was undertaken in the context of the proposed development, to assess the environmental and social risks and ensure effective management measures could be implemented to reduce or eliminate the risks. Where the available information was not sufficient to appropriately characterise the existing environment and potential Project interactions, technical studies were undertaken. Relevant technical reports are included in the following appendices:

- Appendix D: Traffic Impact and Access Point Assessment
- Appendix E: Environmental Noise Assessment
- Appendix F: Construction Dewatering and Recharge Requirements.

9.0 PHYSICAL AND BIOLOGICAL ENVIRONMENT

9.1 Climate

Information from the Bureau of Meteorology (BOM) indicated the annual average rainfall at Strathalbyn is 493 mm. Most of the rain falls in the winter months, at around 37% of the total annual precipitation. Relevant evaporation data indicated evaporation is greater than rainfall for most of the year, with rainfall being equal to or greater than evaporation between May and August (Figure 8).

Average temperatures over the year are significantly influenced by Strathalbyn's proximity to the coast resulting in cooler summers and warmer winters. In summer, average maximum temperatures at Strathalbyn vary between 26°C and 27°C with average minimum temperatures between 12°C and 14°C. During winter, average daily maximum temperatures vary between 15°C and 16°C, and the average minimum temperature is approximately 6°C.

Winds generally increase in the afternoon and directions vary according to season.

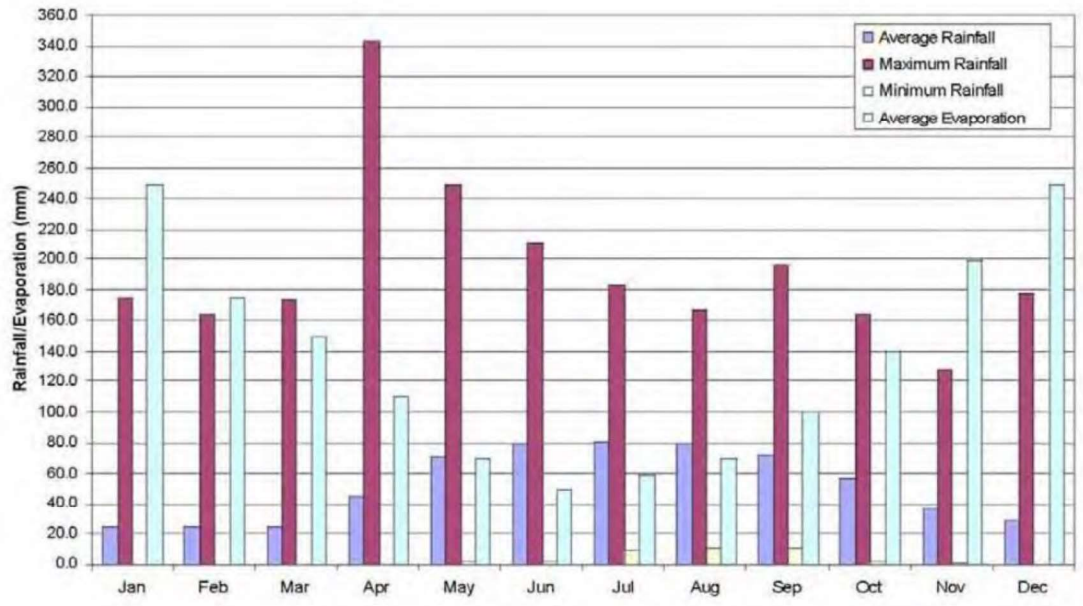

Figure 8: Average monthly rainfall and evaporation (*source: BOM)*

9.2 Topography and landform

The mine site elevation ranges between approximately 60 m and 88 m Australian Height Datum (AHD) (Figure 9). A ridge divides the Mining Lease in an approximate east/west direction to the South of Callington Road. The Project site is approximately at the top of this ridge at a maximum elevation of 87 m AHD and gently slopes to the north of this ridge to Callington Road. The elevation continues to fall to the north of the Mine site to the Septic Tank Effluent Disposal (STED) lagoons and Burnside Creek at approximately 74 m AHD.

Burnside River is a tributary to the Angas River, to the south west of the Mining Lease. The Angas River flows south and discharges to Lake Alexandrina near Milang. Despite its proximity to the Burnside Creek, the Project site is within an area of negligible flooding susceptibility.

The landscape is largely agricultural and therefore is mostly cleared of native vegetation.

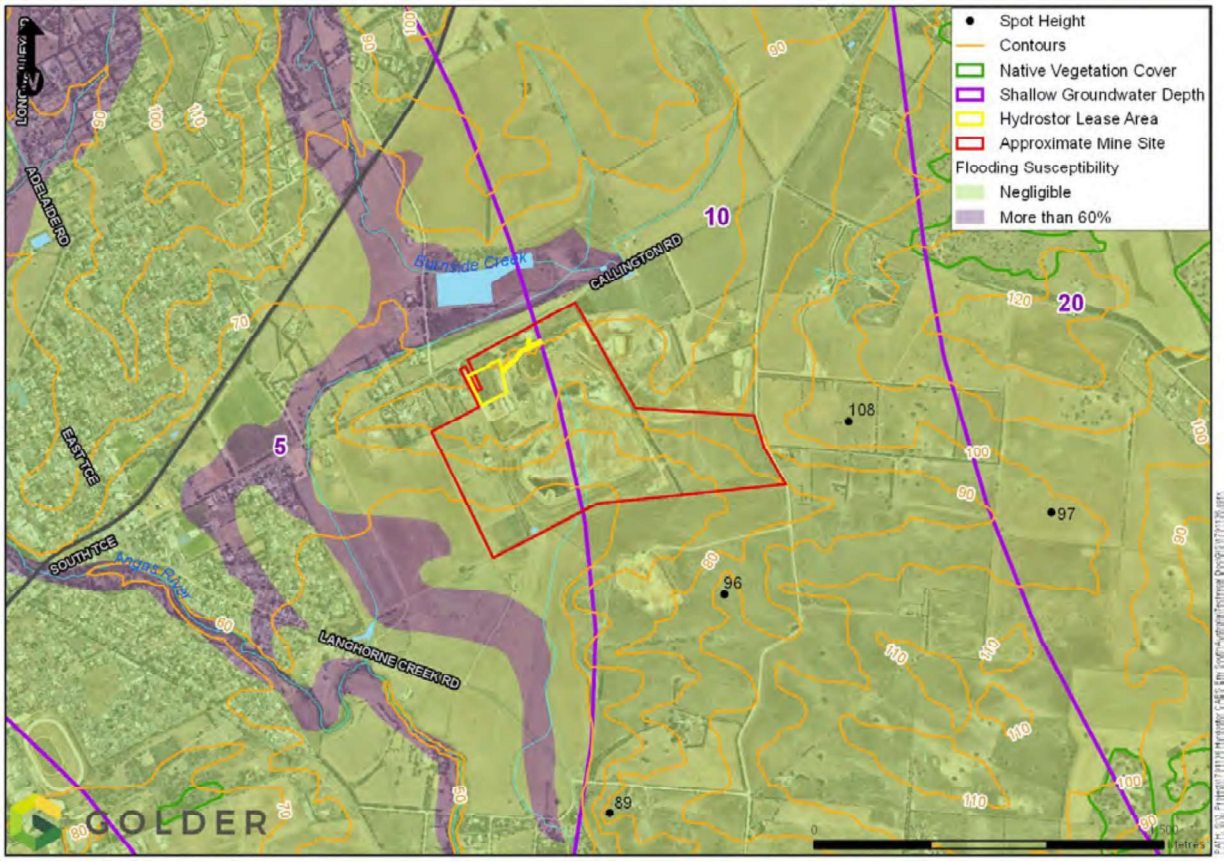

Figure 9: Topography and physical features

9.3 Regional geological setting, soils and seismicity

9.3.1 Geology

The underlying geology, as mapped by the Geological Survey of South Australia at a scale of 1:100,000 (Figure 10), indicates that the Mine is underlain by the Murray Group covering the northern portion, Blanchetown Clay in the south western corner and undifferentiated Quaternary rocks (shown as unnamed GIS unit) in other areas of the site. The Project site is underlain by limestone, sand and subordinate clay (the Murray Group) that overlie the Cambrian basement schists. The Tertiary sand and limestone form a ridge that runs east-west through the centre of the Mining Lease, rising to a height of approximately 80 m above sea level. The limestone and sand have historically been (and continue to be) quarried for road base and construction materials (Terramin, 2017).

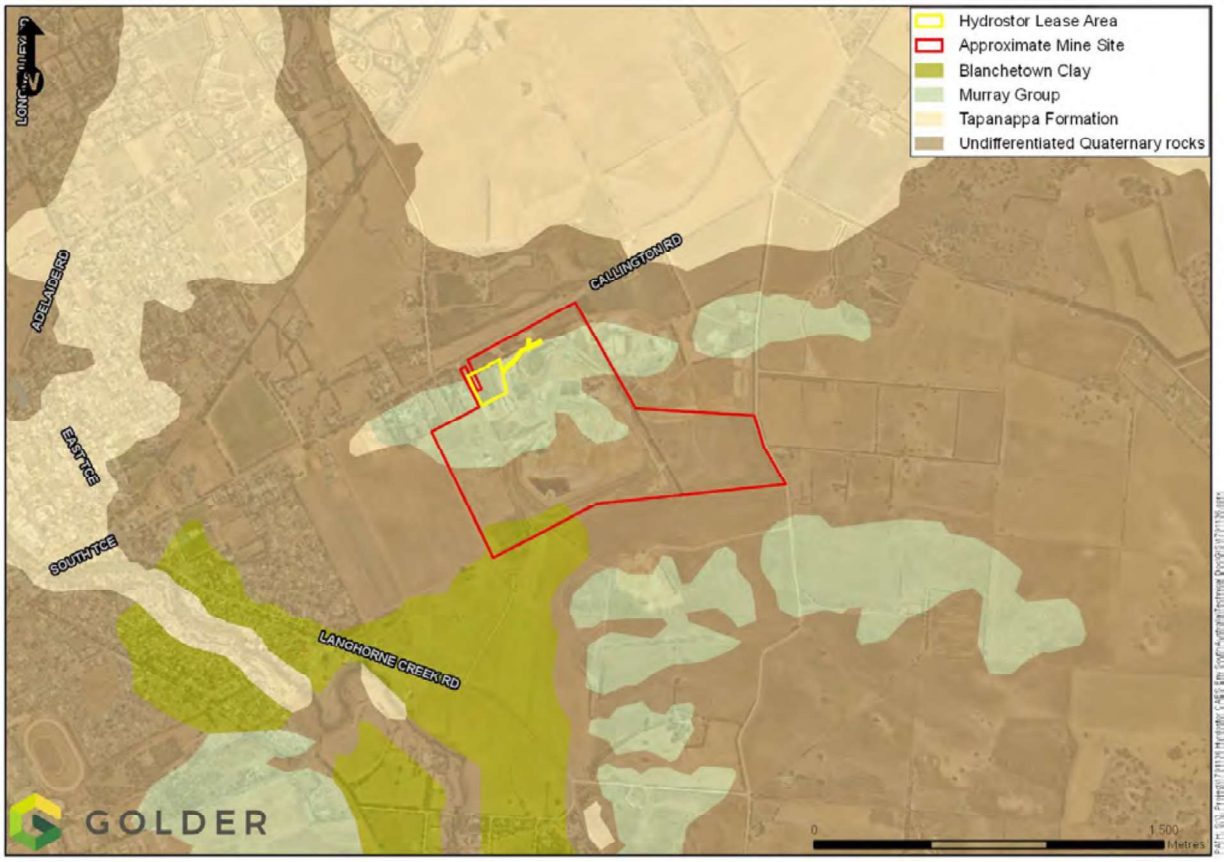

Figure 10: Regional geology

9.3.2 Soils

According to the soils association map, soil at the Project site is shallow calcareous loam on calcrete (Figure 11). In other areas of the Mine site, hard red-brown texture contrast soils with neutral to alkaline subsoil and deep hard gradational sandy loam are present.

The soil types at the Mine site were confirmed by Australian Water Environments (AWE) in 2005 through test pit and borehole logging prior to mining operations. In the central domain (including the Project site), calcareous soils were observed to occur over calcrete with white sandy loams on the hill slopes where calcrete was not present. Soil depth varied between 0.05 and 0.5 m and organic matter in the A horizon was observed to be sparse (Terramin, 2017).

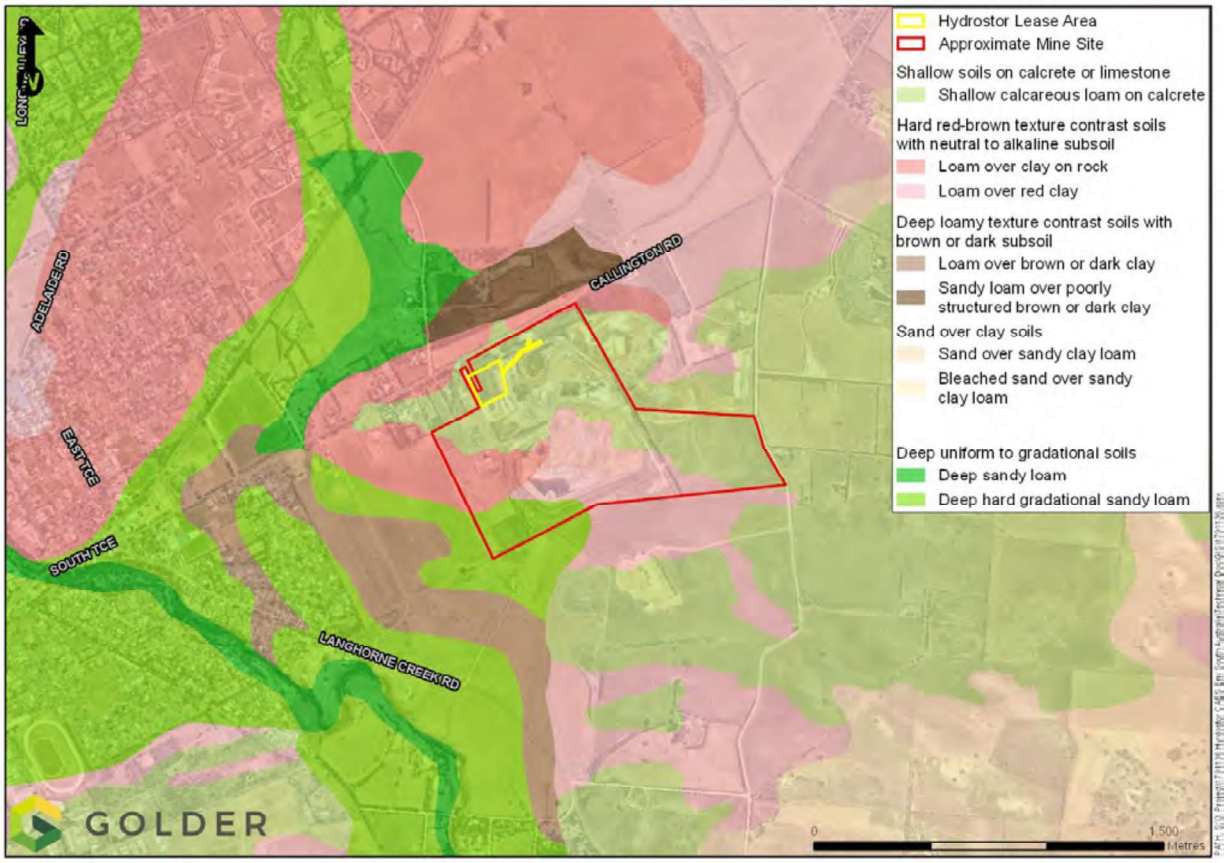

Figure 11: Regional soils

Seismicity

The Project site is within a relatively seismically active area (in Australian terms), with a moderate risk of a low order earthquake. Technical studies undertaken prior to mining operations indicated that the ground conditions were generally good to fair and the orebody and rock would be stable provided the specified span limitations and ground support were complied with (Terramin, 2017).

9.3.3 Potential interaction and management

The Project design and construction methodology will be dependent on the geological conditions, specifically the stability of the existing mine decline which will be used for temporary underground access and construction of the cavern.

The current Project design has responded to the known geological conditions as detailed in the Mine documentation (i.e. PEPR, Mine Closure Plan etc.). The design and construction methodology will be further refined based on investigations into the structural stability of the existing Mine decline.

9.4 Native flora and fauna

9.4.1 Flora

Baseline flora surveys were undertaken at the Mine site in July 2005 and December 2006, by Natural State Ltd. The surveys indicated that the Mine site had very little remnant vegetation prior to mining operations. Remnant vegetation included saltbush (mainly under planted trees), approximately 15 Dryland teatrees (*Melaleuca lanceolata)* and small patches of native grass. The locations of remnant and planted native vegetation mapped prior to the commencement of mining operations are presented on Figure 12.

Planted native vegetation was mapped along the northern and western boundaries of the Project site and two remnant Dryland teatrees were mapped within the Lease area. There was no native vegetation mapped within the Project footprint.

Removal of native vegetation during establishment and operation of the Mine was limited in extent and was offset through the implementation of a Revegetation Plan (Terramin, 2017). The existing native vegetation surrounding the Project site was retained during mining operations, including the two remnant Dryland teatrees.

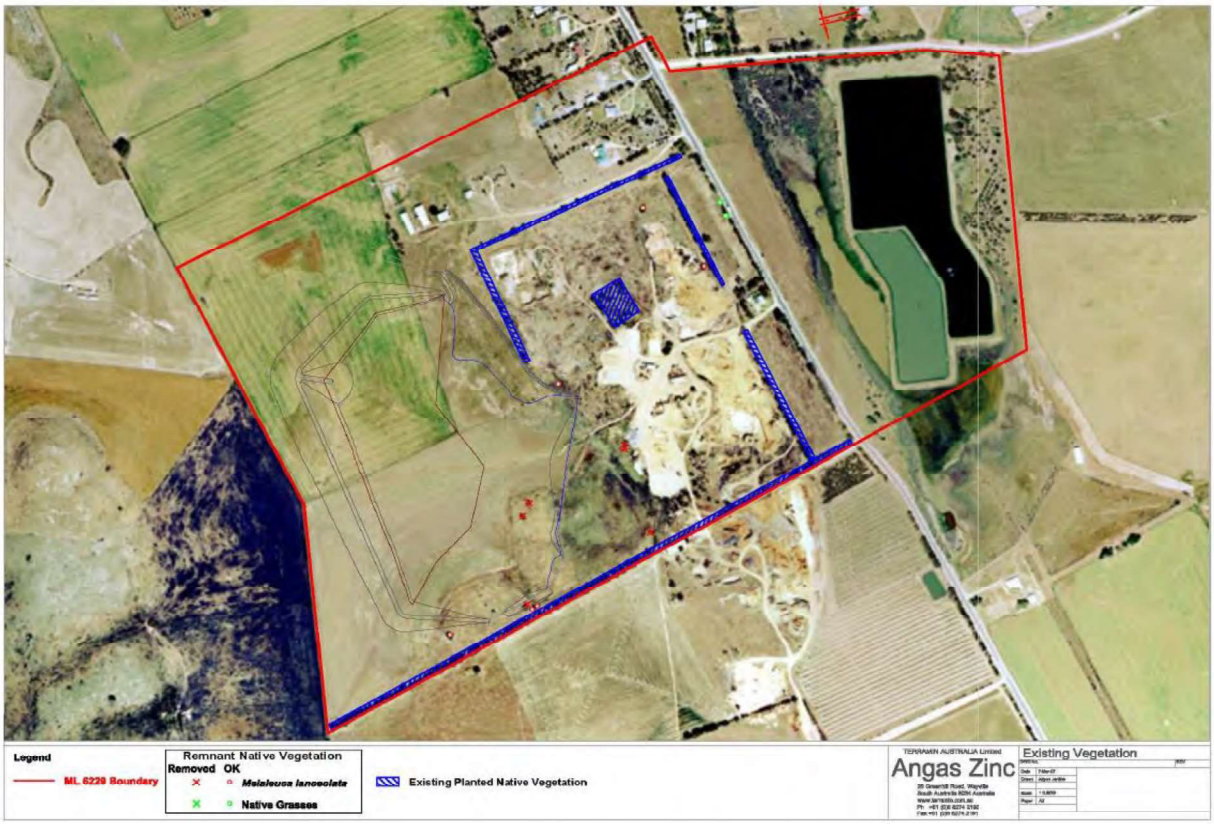

Figure 12: Existing site vegetation *(Source: Terramin Australia, 2017)*

9.4.2 Fauna

An opportunistic fauna survey was undertaken for the Mining Lease (including the Mine site and STED lagoon to the north) by Donato Environmental Services in 2006. A total of 51 vertebrate species were recorded including 46 birds, two amphibians, three terrestrial mammals and eight bat species.

Species typical of an agricultural landscape were recorded in the area surrounding the Project site including insectivorous bats and birds, amphibians and mammals.

The survey did not identify any protected species under the *National Parks and Wildlife Act 1972* at the Mine site. Three protected bird species were recorded at the STED Lagoons (north of Callington Road) including Australasian Shoveler, Blue-billed Duck and Crested Shrike-tit.

The habitats of the Mine site have been historically extensively cleared, however the Dryland teatrees and native and exotic grasslands would provide some habitat value.

9.4.3 Potential interaction and management

An *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* Protected Matters Report was generated for the site (including a 10 km buffer) on 8 February 2018. Based on a review of this report, no listed threatened, migratory or marine species, or threatened ecological communities were identified as likely to be impacted by the Project.

No native vegetation removal is required to facilitate the Project. A 10 m protection zone will be enforced surrounding the remnant vegetation (i.e. Dryland tea trees) during construction, operation and decommissioning.

The proposed development is not expected to impact on fauna or significant fauna habitats.

Management measures will be implemented during construction through the EMP to ensure impacts to native vegetation, fauna and fauna habitats are minimised.

9.5 Pest plants and animals

A few pest plants were identified in the flora survey undertaken in 2005, including seven Declared Plants under the NRM Act. Feral cats and foxes were also noted in the fauna survey in 2006.

A Weed and Pest Management Plan (Terramin, 2017) was developed by Care of Our Environment in July 2010, to be implemented throughout operation and Mine closure. The Weed and Pest Management Plan divided the Mine site into five zones. Weed and pest management activities assigned to the zone of the Project site focussed on spraying prior to any revegetation and spot spraying in areas already revegetated. The plan also included management measures for rabbit control within the Project site area.

Weed and pest surveys of the Mine site were undertaken annually by Terramin along designated transects. There were no transects in the Project site footprint. The Weed and Pest Survey 2015-2016 indicated that Horehound (a declared plant under the NRM Act) was recorded along the transect closest to the Project site.

9.5.1 Potential interaction and management

Construction activities have the potential to increase the spread of weeds through soil disturbance and access to the site by foreign vehicles.

The proposed development is not expected to impact on the occurrence of pest animals at the site.

Weed management measures will be implemented during construction and operation, in accordance with Terramin's current Weed and Pest Management Plan.

Weed management measures for implementation during construction will be documented in the EMP including:

- Management of entry/exit point (i.e. using a rumble pad) so that site soils (potentially containing weed propagules) are not tracked to or from the site
- Regular monitoring of weeds
- Progressive stabilisation/revegetation of disturbed areas
- Spot spraying where declared weeds (specifically Horehound) are identified.

Management measures during operation will include monitoring weeds and spot spraying declared weeds periodically.

9.6 Air quality

9.6.1 Baseline air quality

In 2006, Tonkin Consulting (Tonkin) investigated the baseline air quality at the Mine site, prior to mining operations (Terramin, 2017).

Based on wind directions in Strathalbyn being mainly southerly and south-westerly, the main areas likely to be affected by dust deposition originating from the Mine site were north, north-east and east of the quarry site. Dust deposition drops off quicker to the west of the site than to the east.

Ten sampling locations scattered to an 800 m radius around the Mine site were selected based on their likelihood to experience elevated levels of dust and lead deposition. Dust deposit gauges were deployed at these locations and the contents analysed monthly. A Hi-Vol air sampler was also deployed at the entrance to the Mine site and measured 24-hour average Total Suspended Particulate (TSP) at three-day intervals over an approximate three-month period.

The Hi-Vol results indicated that the 24-hour average TSP concentration exceeded the World Health Organisation (WHO) criteria of 120 mg/m^3 (adopted by SA EPA) on five occasions. Based on a review of the climatic conditions on these five days, Tonkin concluded that four of these exceedances were likely to be a result of the quarry or associated activities. The other exceedance was likely to be a result of ploughing and sowing in the surrounding paddocks. All other Hi-Vol dust samples were below 60 mg/m^3.

The monthly average dust fall measurements at the ten sites were generally reminiscent of light industrial levels (100-160 mg/m^2/day).

9.6.2 Air quality monitoring

To achieve the PEPR outcome of 'no public health, loss of amenity and nuisance impacts to local residents from air emissions, dust and odour generated on site as a result of mining operations', a dust monitoring program was implemented throughout mining operations.

The program included 11 static dust deposit gauges (monthly data) and 2 Hi-Vol dust samplers (continuous data) to measure dust and lead deposition. The criteria adopted by Terramin were as follows:

- TSP < 120 µg/m^3 per 24-hour period
- Lead < 0.5 µg/m^3 per 24-hour period
- PM_{10} < 50 µg/m^3 per 24-hour period (five exceedances allowed per year)

The monitoring was continued while the Mine was operational, and further investigation was undertaken, and controls put in place where a criterion was exceeded.

9.6.3 Potential interaction and management

Minor amounts of dust will be generated temporarily during construction activities and will be managed through the EMP.

Operation of the facility will produce no emissions and there will be no ongoing impacts to air quality.

9.7 Noise and vibration

An Environmental Noise Assessment of the Project was undertaken by Resonate Consultants Pty Ltd (Resonate) (Appendix E) to assess the potential noise and vibration impacts and recommend mitigation measures to ensure compliance with the relevant criteria can be achieved.

9.7.1 Adopted criteria

Noise

In accordance with the Development Plan, the noise from the Project has been assessed against the *SA Environment Protection (Noise) Policy* 2007 (Noise EPP).

The Noise EPP includes noise goals based on the zoning of the development and the closest noise affected premises in the relevant development plan. The Project is within the Primary Production zone with the nearest noise sensitive receivers in the Primary Production, Residential and Rural Living zones. These zones correspond to the "Rural industry", "Residential" and "Rural living" land use categories in the Noise EPP.

Based on the above, the environmental noise criteria listed in Table 7 have been adopted for this assessment.

Table 7: EPP noise criteria for receivers around the Project

Receiver zone	Noise emission criteria L_{eq}dB(A)	
	Day (7am to 10pm)	Night (10pm to 7am)
Rural industry	52	45
Residential	50	43
Rural living	47	40

In addition to the above, the Noise EPP requires the predicted night time noise level received in residential and rural living zones should not exceed 60 dB(A)L_{max}. Given the relatively consistent nature of noise emissions from the Project, design for compliance with night time L_{eq} will result in compliance with the 60 DB(A)L_{max} criterion.

Vibration

The criteria for vibration are those listed as follows:

- Human Comfort: Annex A of Australian Standard AS 2670.2-1990 *Evaluation of human exposure to whole-body vibration, Part 2: Continuous and shock-induced vibration in buildings (1 to 80*
- Building structures and underground infrastructure: German Standard DIN 4150-3 *Structural Vibration, Part 3 – Effects of Vibration on Structures*
- Electrical and communications infrastructure: Australian Coal Industry's Research Program (ACARP) Report *Effect of Blasting on Infrastructure, ACARP Project No C14057,* dated 20 October 2008.

9.7.2 Noise modelling

Noise emissions were modelled taking into consideration attenuation of noise sources due to distance; barrier effects from building topography etc.; air absorption; ground effects; and weather conditions. The most conservative weather conditions were used in this assessment to assess night time noise emissions.

The noise model included the following equipment:

- Cooling tower
- Heat exchange pumps
- Expander outlet (low pressure)
- Compressor outlet (low pressure)
- Transformer
- Compressor
- Turbine.

Overall source sound power levels were based on measurements from other Hydrostor Projects, and octave band spectral data was based on Resonate's database of noise levels from similar equipment.

The proposed facility includes an acoustic enclosure around the compressor and the expander, the two noisiest items of plant, to mitigate potential noise impacts. The modelling assumed the enclosure will be 11 m high, and will have a number of noise attenuating features, as detailed in Appendix E.

The modelling indicated that the predicted noise levels shown in Table 8, with noise criteria exceedances in bold. Noise contours showing predicted noise levels are presented on Figure 13.

The noise criteria are expected to be exceeded at the nearest receiver. This receiver is owned by Terramin and can be vacated if required.

Table 8: Predicted noise levels

Location	Noise criteria L_{eq}, DB(A)	Predicted noise level
Nearest receiver (Primary Production)- NE of the site	45	**60**
Second nearest receiver (Primary Production)- SW of the site	45	45
Worst case- residential	43	<35
Worst case- rural living	40	<35

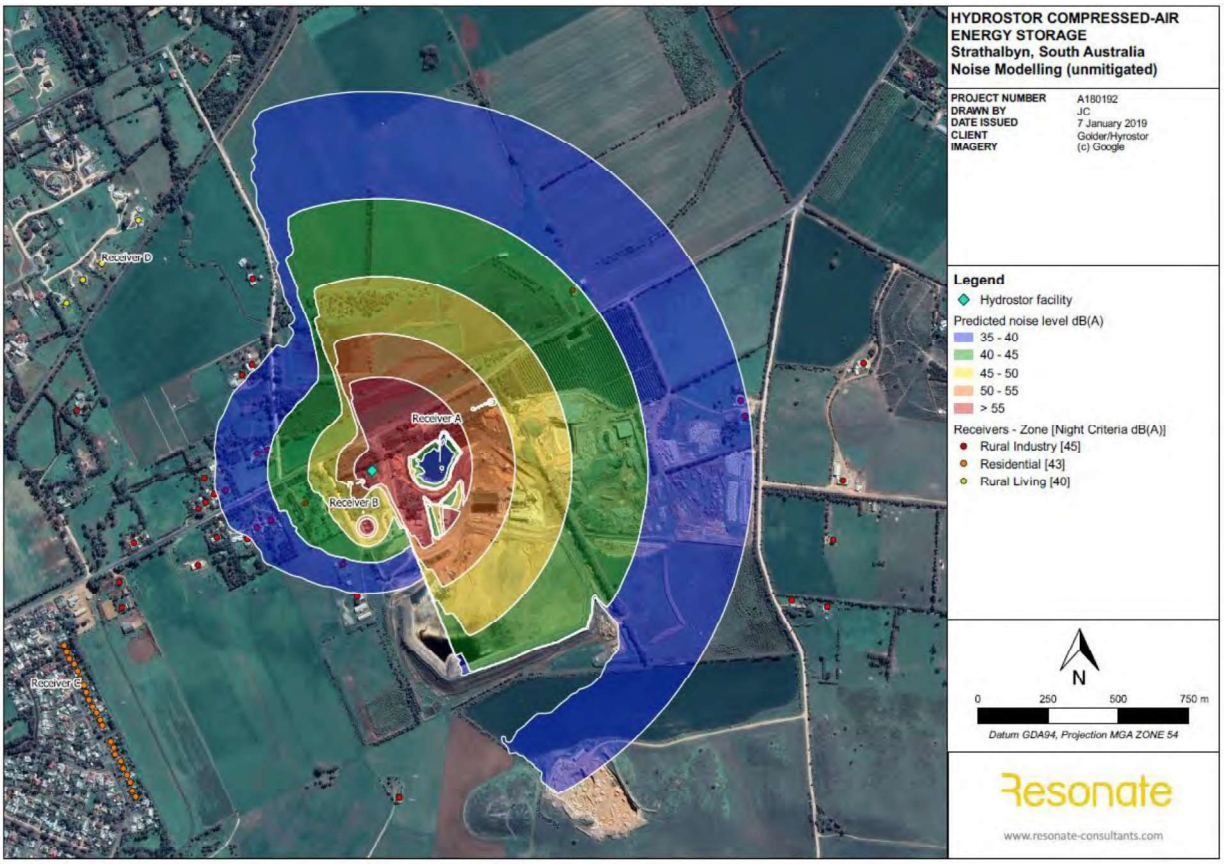

Figure 13: Noise contours

9.7.3 Vibration modelling

During operation, the predicted peak particle velocity is expected to be less than 0.2 mm/s at all surrounding residential receiver locations and is not expected to generate levels of vibration which would exceed any of the relevant vibration criteria.

Construction phase vibration will be minor and temporary.

9.7.4 Potential interaction and management

The Project design has incorporated noise mitigation measures for the compressor and the expander, the two noisiest items of plant which will ensure compliance with the relevant noise criteria at all surrounding non-associated receivers. The acoustic enclosure will be constructed in accordance with the recommended specifications listed in Appendix E.

The residential building north east of the site (nearest sensitive receiver), at which adopted noise criteria may be exceeded, is owned by Terramin and can be vacated, if required, and leased by Hydrostor. Appropriate negotiations with Terramin and the existing tenants will be undertaken.

Vibration levels from the operation of the facility are predicted to comply with the nominated vibration criteria at all surrounding receivers.

A Noise and Vibration Management Plan will be implemented during construction of the Project to ensure temporary construction impacts are minimised.

9.8 Surface water

The Mine is situated at the boundary of two catchments (referred to as the northern and southern catchments) that contribute to the Angas River (1.5 km south west of the site). The Project site is within the northern catchment which has a total area of approximately 730 ha. The northern catchment was characterised (Terramin, 2017) as extending to the east of the Mining Lease for approximately 2.5 km and to the north approximately 4 km.

9.8.1 Mine surface water management

For surface water management during mining activities, the Mine was categorised in two zones; the “dirty zone” and the “clean zone” (Figure 14). The “dirty zone” included majority of the Mine operations and was identified as a potentially contaminated area. Drainage infrastructure at the Mine site was set up such that surface water from the “dirty zone” is directed into the boxcut or raw water pond and surface water within the “clean zone” is directed to bypass the “dirty zone” to natural/existing drainage lines. Monitoring of the Angas River and Burnside Creek was undertaken to confirm surface water from the Mine was not adversely impacting surface water quality.

Additionally, the Tailing Storage Facility (TSF) and process ponds were designed to ensure zero discharge of contaminated waste.

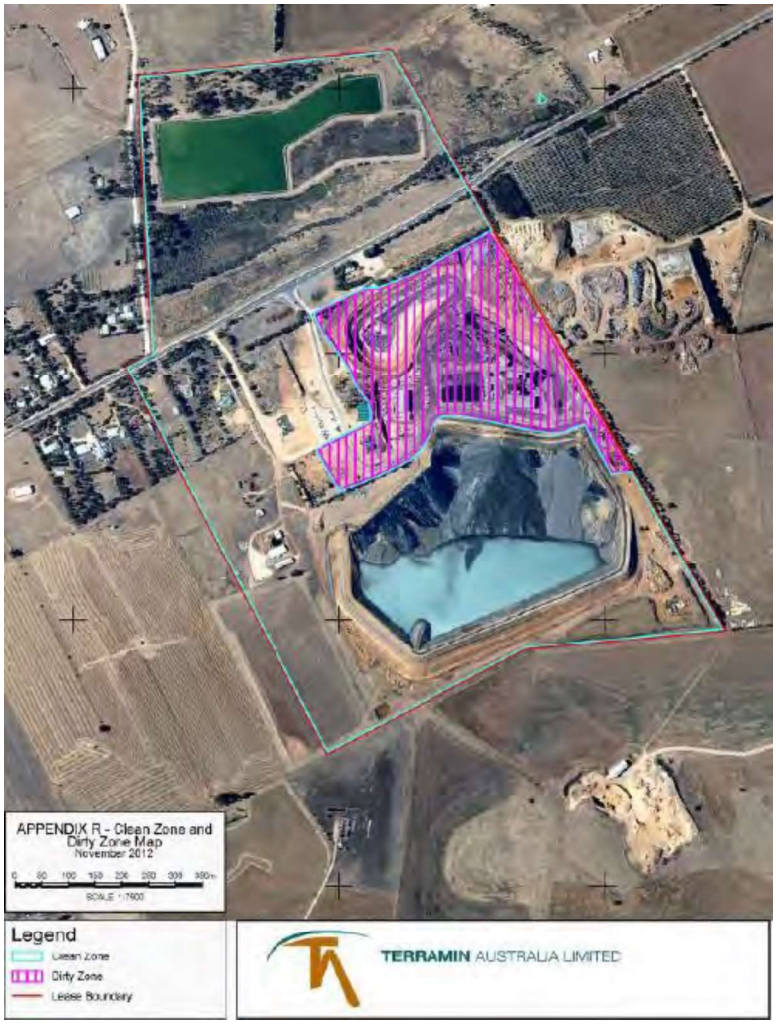

Figure 14: Terramin surface water management zones

A sediment control system was installed throughout the “clean zone” (Figure 15), and specifically at the front entrance and visitors viewing area, to slow the velocity of runoff water and settle sediments prior to it entering natural drainage lines. Surface water in the “clean zone” that does not exit through the front entrance is directed to a silt retention dam constructed south west of the TSF.

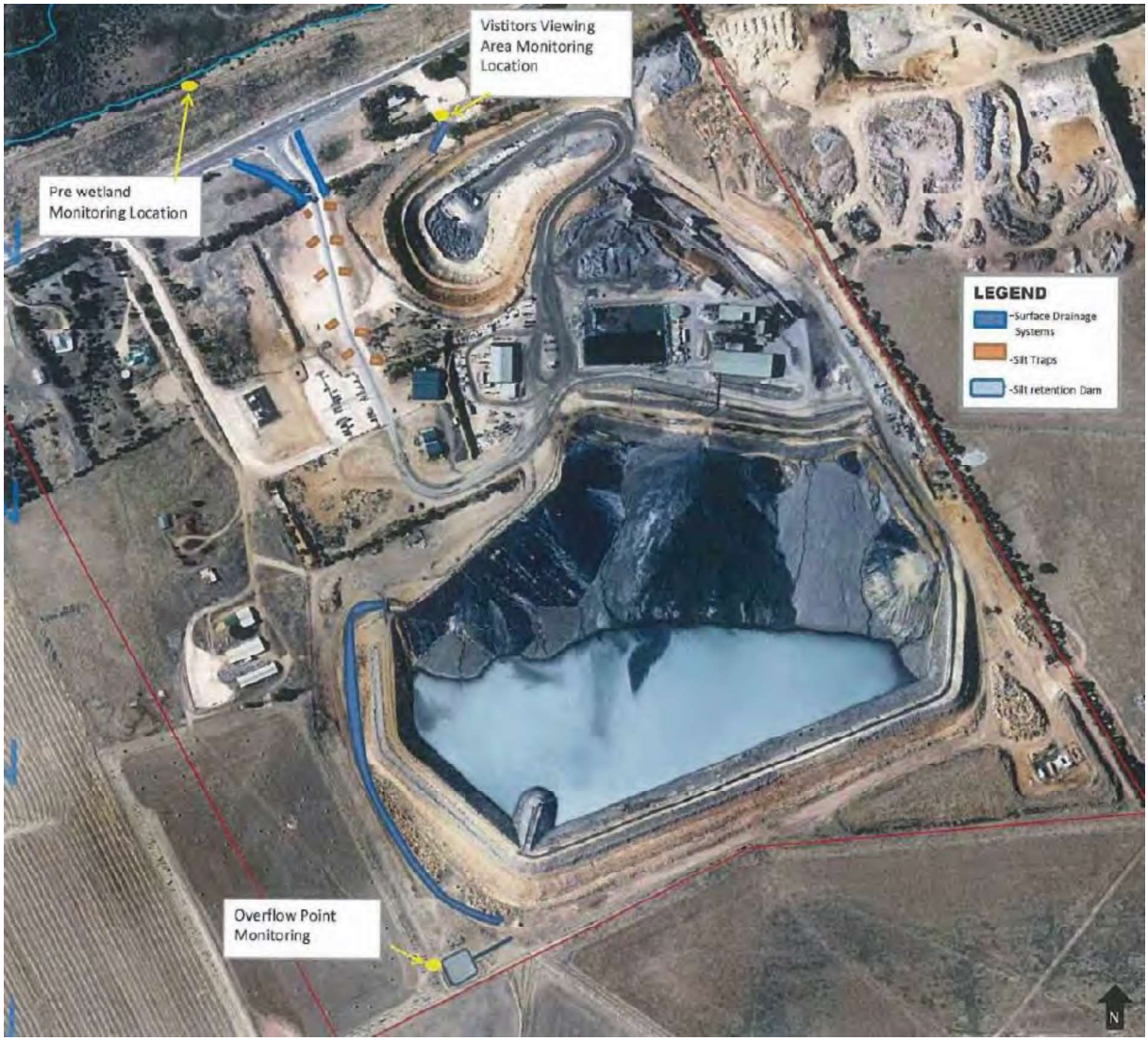

Figure 15: Stormwater management (*source: Terramin, 2017*)

9.8.2 Potential interaction and management

The main Project infrastructure is within Terramin’s allocated “clean zone”. The construction and operation of the facility is not expected to have an adverse impact on surface water, either from contamination or sedimentation.

The existing sediment control system will not be disturbed by the Project infrastructure. Runoff from the Project site will exit the Mine either via the existing sediment control system to the east, or new sediment control infrastructure constructed to the west (along the western access track).

Surface water that accumulates on top of the reservoir cover will be discharged to a vacant area of the Project site (Figure 6). This water will be conveyed via a level spreader to slow the velocity of the runoff.

Temporary construction works will be undertaken in Terramin's allocated "dirty zone" including installation of water and air pipelines and access to the underground workings through the box cut. These works will not disturb the existing surface water management in this zone.

Construction activities will be managed in accordance with the EMP and the existing surface water monitoring commitments will continue, in accordance with the Closure Criteria including:

- Turbidity monitoring at existing remote telemetry stream gauge locations
- Surface water quality monitoring at the potential discharge point to the Angas River and an upstream location.

9.9 Groundwater

Since operations ceased at the Mine, the box cut and underground mine workings have been inundated with water. Therefore, a large volume of water will need to be removed from the Mine and disposed of, prior to and during construction.

Dewatering was also required during mining activities. Detailed investigation and modelling was undertaken prior to mining activities to ensure the dewatering and water disposal strategy (through re-injection) would not adversely impact on the groundwater quantity and quality in the area, and the Angas River, approximately 1.5 km from the site. Monitoring of groundwater levels and quality was undertaken during and following mining activities to validate the model and confirm that the dewatering and re-injection was not having adverse impacts.

This information has been used to inform the Construction Dewatering and Recharge Requirements investigation for Hydrostor (Appendix F). The investigation was undertaken by Golder to summarise the history of the groundwater monitoring and impacts from mining operations; develop a dewatering and re-injection strategy for the Project; assess potential risks to groundwater and the Angas River; and ensure risks can be appropriately mitigated.

The detailed investigation and modelling is included in Appendix F. Below is a summary of the hydrogeology; mining operations; proposed dewatering and re-injection strategy; potential risks associated with the strategy; and proposed mitigation measures.

9.9.1 Hydrogeology

AWE undertook hydrogeological investigations at the Mine between 2005 and 2007 (Figure 16). Relevant information from these investigations regarding the hydrogeology of the area is summarised below.

- The main aquifers are shown on Figure 17 and include:
  - **Tertiary and Quaternary Sediments –** a shallow water table aquifer which ranges in thickness from 2.5 m to 27 m at the Mine. Drilling investigations conducted at the site indicated that aquifers occur in these sediments on a local and discontinuous basis only. The Tertiary and Quaternary water table aquifer is separated from the underlying fractured rock aquifer by a ~20 m thick layer of highly weathered and kaolinized metasediments, which behaves as a confining layer
  - **Fractured Cambrian Bedrock –**the Cambrian Fractured Rock Aquifer (FRA) represents the main groundwater-bearing zone occurring in discrete fractures from about 40 m to 70 m below ground level (bgl). There is some evidence of deeper water-transmitting fractures from about 100 to 125 m bgl. The fracture strike is slightly west of due north, with WNW – ESE, and NNE – SSW components; this fracture strike controls groundwater flow (preferential flow occurs along strike)

- Pre-mining elevation data from the monitoring wells within the Cambrian FRA (regional aquifer) indicated that groundwater flows across the site from north to south with a relatively gentle hydraulic gradient
- Groundwater salinity of the Cambrian FRA ranged from 13,000 mg/L to 22,500 mg/L and therefore represented an aquifer with few beneficial uses
- Acid base accounting undertaken on the material to be mined identified potentially acid forming (PAF) zones within the Mine, as well as indicating that waste rock was expected to be sulphidic and PAF. This indicated a potential for Acid Mine Drainage (AMD) mobilisation (which occurs because of oxidation of sulphidic rock via exposure to air, forming sulphuric acid) to occur and cause contamination to groundwater or surface water from acidity and dissolved metals.

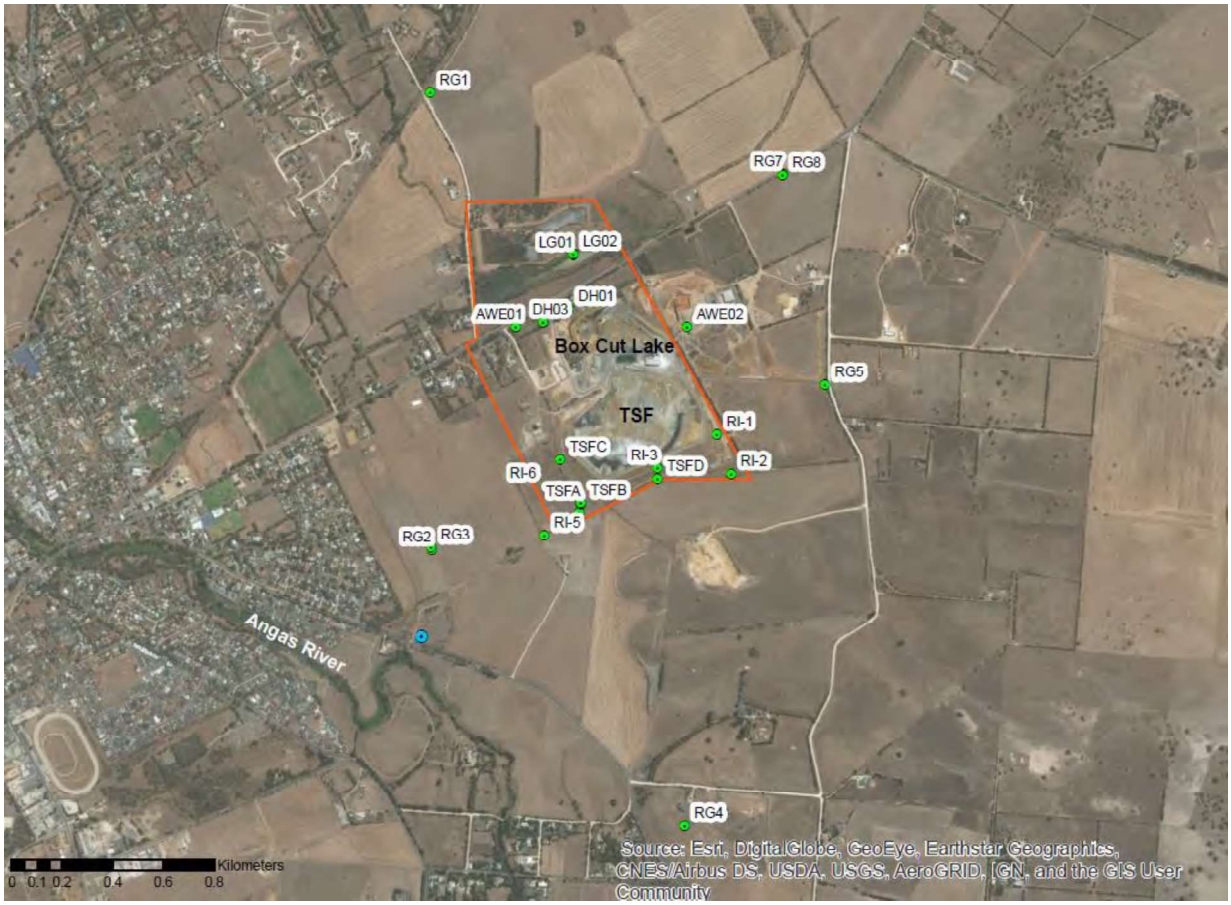

Figure 16: Groundwater investigation locations

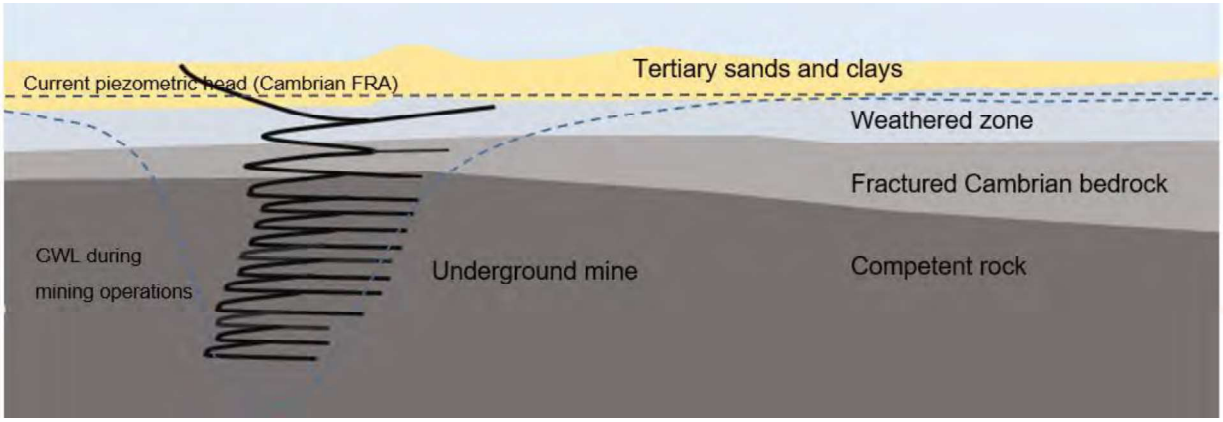

Figure 17: East to west conceptual geological section showing the mine decline

9.9.2 Groundwater management during mining

Mine operations started with development of the box cut in August 2007 and the decline in September 2008. The total underground development (tunnels) of the mine was more than 10 km to a total mine depth of 400 m bgl.

Mining was conducted below the water table in the Cambrian FRA and mine dewatering reduced the groundwater levels around the Mine using a Water Allocation equal to 271 ML/year. Groundwater pumped from the mine was injected back into the surrounding aquifer via Managed Aquifer Recharge (MAR). Terramin used up to six wells to inject up to 1.3 ML/d (15 L/s) of mine water.

The mine was put into care and maintenance in 2013. The stope voids created were subsequently backfilled using a mixture of cemented rockfill, loose rock fill or cemented tailings (paste) fill. Dewatering ceased, and the Mine was allowed to flood. Groundwater recovery was accelerated during the first year to reduce the effects of oxidation on wall rock and backfill (and potential subsequent AMD mobilisation) by flooding the mine void with groundwater pumped from the surrounding injection wells into the decline. After the first year, groundwater in the mine continued to rise from natural groundwater inflows.

9.9.3 Proposed dewatering and reinjection strategy

Construction dewatering strategy

As the underground mine and box cut are currently flooded, construction dewatering of the box cut and underground mine workings will be required over a 4 month period to enable access to the decline and allow construction of the underground infrastructure. Dewatering will be undertaken independently of the Development Approval, under the provisions of the NRM Act and EP Act.

Dewatering rates for this project will be higher at the beginning than those used during Mine dewatering, with a requirement for over pumping to remove standing water stored in the box cut and mine workings. Once this has been achieved, ongoing dewatering will be required during the construction phase to maintain groundwater levels beneath the construction depth (240 m bgl).

The total volume of water to be pumped from the mine has been estimated at 184 ML, plus an additional contribution of surface runoff and ongoing groundwater flows into underground mine workings (estimated at 0.74 ML/d).

Additional groundwater allocation is likely to be required during construction dewatering depending on what time in the water use year dewatering commences.

Operational dewatering requirements

After construction and commissioning of the Project, access to the underground cavern will be maintained for up to five years to allow for research, validation and monitoring activities. Continual dewatering of the Mine void will be required during this period. After a maximum of five years, the void will be flooded and sealed, and no further access will be required.

The volume pumped during operation will depend on the timeframe and is expected to be up to 270 MW per year. The current allocation will be sufficient for the ongoing operational dewatering.

Re-injection strategy

Groundwater pumped from the Mine during dewatering will be re-injected back into the surrounding Cambrian FRA using the same approach as was successfully implemented by Terramin from 2008 to 2013 (MAR). As such, the potential risks of the dewatering and MAR strategy on the groundwater and the Angas River are well understood.

The initial mine dewatering will occur over a period of 4 months which will require a dewatering and injection rate of 2.1 ML/d. Eight injection wells will be required to meet this dewatering demand (two existing wells and six new wells). Safe injection pressures will be assessed for the new injection wells to ensure there is no risk of surface expression to any poorly sealed exploration holes.

Once the standing water is pumped from mine void and box cut, ongoing mine dewatering at much lower rates will be required to maintain groundwater levels below the construction depth. Ongoing dewatering rates are expected to be in the order of 8.5 L/s (0.74 ML/d) and will require the use of less injection wells (or lower required injection rates per well).

Water will be monitoring and treated (if required) prior to re-injection to match the background groundwater quality.

9.9.4 Monitored risks from dewatering and MAR

The potential risks to groundwater and the Angas River were closely monitoring during and following mining operations, and were found to be negligible, as shown in Table 9.

Table 9: Risks monitored during and following mining operations and monitoring results

Potential risk	Monitoring result
Impacts of re-injection on groundwater levels and the potential for discharge of saline groundwater to the Angas River	Groundwater level monitoring undertaken at targeted locations between the Mine and Angas River showed a negligible groundwater level response to MAR in this area, indicating that the MAR operation was unlikely to have resulted in discharge of saline groundwater to the Angas River. Conversely, injection water tended to flow towards the underground mine and was maintained by a cone of depression (Terramin, 2017). The extent of the cone of depression was inferred to be < 1 km from the mine.
Impact of re-injection on groundwater quality and beneficial uses	No adverse groundwater quality impacts were detected. There were no groundwater users in the area.

Potential risk	Monitoring result
Potential for AMD mobilisation following mine closure and flooding of the backfilled Mine	Since the mine was put into care and maintenance in 2013, monitoring of water quality parameters including pH, sulphate and key metals at several underground sampling points following flooding of the mine indicated that water quality parameters remained stable and there was no adverse impact to water quality as a result of potential AMD mobilisation.
Upward leakage of saline water to the Tertiary Aquifer from over-pressurisation due to re-injection	The Tertiary water table aquifer is separated from the underlying fractured rock aquifer by a ~20 m thick layer of highly weathered and kaolinized metasediments, which behaves as a confining layer. Information provided by Terramin suggested that safe injection pressures were maintained in all injection wells during Mine operation which avoided upward leakage of saline groundwater water to the Tertiary Aquifer as a result of failure of the overlying confining layer (weathered zone).

9.9.5 Potential interaction and mitigation

Based on the existing data collected, and the additional modelling undertaken by Golder in consideration of the proposed dewatering and MAR strategy, the impacts to groundwater and freshwater ecosystems surrounding the Project are expected to be negligible based on the following:

- The dewatering and re-injection strategy is not expected to have a long-term impact on groundwater levels nor cause saline groundwater discharge to the Angas River
- Water will be monitored and treated (if required) prior to re-injection to match the background groundwater quality.
- No impacts to water quality are expected because of AMD mobilisation
- Well design will be assessed for new injection wells considering the risk of surface expression to any poorly sealed exploration holes, to ensure safe injection pressures will be achieved, preventing upward leakage of saline groundwater to the Tertiary Aquifer

Water removed from the box cut and mine void may require treatment to ensure there is no adverse impact from reinjecting. Treatment of water prior to reinjection will be undertaken using one of two options, depending on the level of contamination of the water extracted from the mine, as follows:

1) Treatment using Lamellar Plate Separators (LSP), similar to the type and size used to manage water treatment as part of the previous mining operations, sized and specified to meet the environmental discharge requirements for the dewatering activities
2) Treatment with an Oxidative Filtration System (OFS) which has the potential to provide a more effective and efficient means of water treatment.

The functional design goal of pre-injection water quality treatment to achieve final injectant water quality equal to ambient aquifer conditions or within agreed guideline values that reflect the environmental values of the targeted groundwater resource. Source water characterisation and treatment will likely need to be a dynamic and ongoing process as water quality may change as pumping from the mine void progresses.

Waste resulting from water treatment will be disposed offsite by an appropriately licenced contractor.

In addition to Terramin's water allocation (which will be temporarily transferred to Hydrostor), additional water allocations from the target aquifer will be sourced and temporarily transferred for the required construction dewatering volume. Based on information from the DEW, additional allocations are available for purchase.

Appropriate permits for installation of injection wells and for drainage into an aquifer will be obtained.

The air storage cavern will be treated with shotcrete to ensure there is no interaction between the system and surrounding geology/groundwater aquifers.

Groundwater level and quality monitoring will continue, in accordance with the Closure Criteria.

9.10 Soil contamination

A Baseline Contamination Study was undertaken by Tonkin in 2005 (Terramin, 2017) which involved sampling and analysis of a range of potential contaminants of concern. The results indicated concentrations of metals in some samples, specifically arsenic, lead, zinc, manganese and copper, exceeded the selected criteria. The sample collected near the Project footprint contained elevated concentrations of the metals listed. The Project site is within the footprint of the surface extension of the ore body, as was the case for the metal exceedances across the site (except for arsenic).

Some activities during mining operations have the potential to have caused contamination at the Mine site. Terramin categorised the site in two zones; the 'clean zone' and the 'dirty zone' Figure 14. Activities undertaken in the 'clean zone' during mining operations had a low potential of causing contamination. The 'dirty zone' included majority of the Mine operations and was identified as a potentially contaminated area.

9.10.1 Potential interaction and management

The Project is largely sited within the 'clean zone' and therefore has a low potential for encountering contaminated soil, other than the elevated metals expected to be naturally occurring due to the proximity to the surface extension of the ore body. A Baseline Contamination Assessment is being undertaken by Hydrostor to document the contamination status of the Lease area and ensure it is suitable for the intended land use.

The risks of contamination as a result of the Project are considered low and associated with the unlikely loss of containment/accidental spills only.

An EMP and Emergency Response Plan will be implemented to ensure the risk of site contamination from construction and operational activities is negligible.

A contamination assessment will be undertaken at the extinguishment of Hydrostor's Lease to ensure that the Project has not caused contamination and the site is suitable for the intended future land use. As part of the Lease agreement, Hydrostor will be required to remediate any contamination caused.

9.11 Traffic and transport network

Hydrostor engaged independent traffic planners and engineers to examine the suitability of the existing Mine access point in relation to the existing road network, as well as the condition and capability of the network to accommodate the predicted vehicle movements (Appendix D).

The majority of heavy vehicle movements in the construction period will be via the Strathalbyn to Callington Road which joins the South Eastern Freeway at Callington. This assumes that most construction components will be sourced from the Port Adelaide Region. Relatively high volumes of light traffic are also expected to be created through the construction period. This traffic is expected to access the site from the north east (via South Eastern Freeway/Callington Road) and from Strathalbyn to the south west (via Callington Road/Strathalbyn). A minor amount of operational traffic is expected, along these same traffic routes.

The South Eastern Freeway and Callington Road are both major transport routes and are registered as 26 m B-Double freight routes. These road networks have minimal residences and have accommodated heavy loads in the past, during development and operation of the Mine.

Based on data sources from Location SA Map Viewer, and presented by WGA (WGA, 2018), the existing Annual Average Daily Traffic volume (AADT) on Callington Road for 2018 was estimated to be 2,400. The percentage of heavy vehicles was 13.5 %.

The construction traffic will access the Project from the existing central Mine access point located off Callington Road. The existing access point consists of a T-Junction with a channelised right turn lane (CHR) and an auxiliary left turn lane (AUL) into the site.

The minor amount of operational traffic will access the site via the existing car park access point on the western boundary of the site. Given operational traffic will be trivial (i.e. no more than one vehicle per day), it has not been further assessed (*Note that Appendix D includes a higher number of operational traffic utilising the central Mine access point).*

9.11.1 Construction Traffic Access Assessment

The assessment indicated that the existing CHR and AUL comply with the minimum requirements stated in the Austroads Guide to Traffic Management Part 6 (2017) and Guide to Road Design Part 4A (2017) for the applicable design speed.

The minimum sight distance requirements for intersections are achieved at the existing access point including approach site distance (ASD), safe intersection sight distance (SISD) and minimum gap sight distance (MGSD), in accordance with Austroads Guide to Road Design Part 4A (2017).

The existing pavement at the access point was in generally good condition with minimal works required outside of general maintenance requirements.

9.11.2 Potential interaction and management

Road conditions along Callington Road (i.e. access points, turning lanes etc.) will not be adversely impacted by the Project.

Traffic will be generated through the approximate 8 month construction period including the following activities:

- Site preparation including delivery of site materials, temporary facilities and construction compounds
- Delivery of plant and machinery
- Delivery of equipment and materials
- Access to the site by construction personnel.

On average, an additional 64 equivalent vehicle trips are expected per day during construction including 60 light vehicle trips and 4 heavy vehicle trips.

In the context of the existing traffic on Callington Road, construction of the Project is expected to have a short term and minimal impact on the traffic volumes. Although the traffic volumes and percentage of heavy vehicles may slightly increase on Callington Road (Table 10), this is an existing gazetted freight route with minimal residences and generally good pavement conditions.

Table 10: Network traffic impact on Callington Road

AADT			Daily no. of heavy vehicles	
Existing	Forecast	Increase	Existing	Forecast
2,800	2,870	2.5%	324	324

Management of construction traffic will be considered within a Traffic Management Plan (TMP) developed and implemented by the construction contractor. The TMP will be used to ensure the safety of all road users and may include measures such as appropriate notice and signage during peak periods of construction.

Permanent signage to indicate the position of the Project access point will also be considered to reduce the risk of vehicles missing the access point.

Appropriate approvals will be obtained from DPTI for oversize/overmass vehicles accessing the Project during construction.

9.12 Heritage

9.12.1 Aboriginal heritage

A search of the Department of State Development Aboriginal Affairs and Reconciliation (DSD-AAR) register was undertaken prior to mining operations. The register had no entries for Aboriginal heritage sites within the Project (or greater Mine site) footprint. The Ngarrindjeri Heritage Committee was also invited to undertake a heritage survey of the Mine site, however they did not consider it necessary at the time.

9.12.2 European heritage

A number Local and State heritage listed (under *Heritage Places Act 1993*) features exist in Strathalbyn. The closest heritage listed place is more than 1.3 km from the Project site.

9.12.3 Potential interaction and management

The Project is not expected to have any interactions with Local or State heritage listed places.

Based on the Project being developed within the already disturbed Mine footprint, there is a low risk of encountering Aboriginal sites during construction and operation.

Site inductions, in accordance with the EMP, will include consideration of Aboriginal heritage, including indicators of encountering Aboriginal sites or artefacts, a ‘chance finds’ procedure and obligations under the Aboriginal Heritage Act 1988.

9.13 Native Title

There are no Native Title Claims or applications registered over the Mine site.

9.14 Visual amenity

The impact of the Project on visual amenity is expected to be minor based on the following:

- The Project is set back approximately 80 m from Callington road, behind existing vegetation screening
- The Project has been designed to concentrate the infrastructure in the eastern portion of the Project site, close to the Mine infrastructure, to minimise the potential visual impact.
- External structures will be less than 12 m in height and will be built of muted and natural colours
- The view of the infrastructure from Callington Road will be similar to that of an agricultural shed

- The reservoir will be constructed of earthen dam walls which will be revegetated with shallow rooted, local native species
- Construction will be undertaken generally during daylight hours, and therefore there will be no light spillage impacts to neighbouring sensitive receptors.

10.0 SOCIAL ENVIRONMENT AND CONSULTATION

10.1 Population of Strathalbyn

Strathalbyn lies at the eastern extent of the Fleurieu Peninsula and is known as an historic and picturesque township. The town is historically a rural centre for surrounding agricultural land and is in relatively close proximity to larger population centres such as Murray Bridge, Adelaide and Victor Harbor.

The general population statistics of Strathalbyn and the Alexandrina Council (Local Government area) are provided in Table 11 and compared to South Australia.

Table 11: General population statistics of Strathalbyn, Alexandrina Council and South Australia form Census (ABS, 2016)

	Strathalbyn	Alexandrina Council	South Australia
Population	6,504	26,792	1,676,647
Gender	3,417 female 3,091 male	13,271 female 12,601 male	850,652 female 825,995 male
Anchor employment industry	Health care Retail	Health care Agriculture, forestry and fishing	Health care
Labour force, (participation rate %)	2,499 (53.3)	2,445 (49)	806,589 (48.1)
Unemployment (Unemployment rate %)	156 (5.5)	624 (5.8)	60,488 (7.5)
Median age	45	51	38
Median weekly income (personal, $)	542	522	600

10.2 Socio-economic

The median weekly wage for people 15 years and over in Strathalbyn was $542, which is only slightly below the South Australian average ($600), and lower than the Australian average ($662).

The main employment industry (2016) in the Alexandrina Council as well as the Strathalbyn township was health care and social assistance. Other main industries included retail trade and construction.

The Socio-Economic Index for Areas (SEIFA) is a suite of four summary measures that have been created from 2011 Census data to investigate different variables of socio-economic conditions by geographic areas. The four SEIFA indices are:

- Index of Relative Socio-economic Advantage and Disadvantage: is a continuum of advantage (high values) to disadvantage (low values) and is derived from Census variables related to both advantage and disadvantage.
- Index of Relative Socio-economic Disadvantage: focuses primarily on disadvantage and is derived from Census variables such as low income, low educational attainment, unemployment, and dwellings without motor vehicles.
- Index of Economic Resources: focuses on financial aspects of advantage and disadvantage, using Census variables relating to residents' incomes, housing expenditure and assets.
- Index of Education and Occupation: includes census variables relating to the educational attainment, employment and vocational skills.

The Socio-Economic Indices for Alexandrina Council indicates a relatively low level of disadvantage when compared to South Australia. It ranks 42nd (out of 71) in the index of relative socio-economic disadvantage. Strathalbyn is also within the least disadvantaged areas of the Council.

10.3 Employment

The Project will require a workforce of approximately 30 full-time skilled employees during construction. Based on existing industries in the area, it is expected that majority of this workforce will come from the Strathalbyn district. Major centres such as Murray Bridge and Adelaide will provide a back-up source of employees for specific roles.

As this Project is intended to be a showcase of an alternative use for mining infrastructure, it is anticipated that it will be the first of many projects in regional areas of South Australia. Additional projects are expected to be larger in scale, providing greater employment opportunities and attracting more people to South Australia, and especially in regional areas which may be experiencing increased unemployment rates due to mining operations closing.

10.4 Engagement approach

Hydrostor has utilised the existing community consultation network, established by Terramin through the mining operations, to engage with the community. The Strathalbyn Community Consultative Committee (SCCC) has been the main conduit for Hydrostor to reach out to the community and welcome feedback on the proposed development. Hydrostor will continue to engage with the community through the SCCC regularly throughout construction and at appropriate times during operation of the Project.

Hydrostor has also undertaken extensive consultation with regulatory bodies (including DEM, DEW and EPA) to communicate the intent of the Project and to determine the key technical areas of interest. Discussions have included problem solving sessions to ensure Project design and risk mitigation measures adequately address the potential issues raised by the regulatory bodies with the aim of providing confidence that the Project team is committed to mutually beneficial outcomes.

11.0 CONCLUSION

Hydrostor's proposal to bring A-CAES to South Australia will provide an alternative bulk energy storage solution that is relatively low cost, emission free and provides a positive end-of-life option for decommissioned mining assets.

The nature of the development and siting at the Angas Zine Mine result in an inherently low environmental footprint. Where potential risks were identified through review of existing information, technical studies and liaison with regulators, the Project and construction methodology has been designed to ensure they can be adequately mitigated, including:

- Positioning the facility to avoid removal of native vegetation
- Noise attenuation measures on the above ground infrastructure to ensure no unacceptable impacts to the surrounding residents
- Siting the facility adjacent mining infrastructure and behind vegetation screening to protect the amenity of the area
- A dewatering and re-injection strategy that protects groundwater quality and quantity

The Project was also reviewed against Terramin's obligations under the Mining Act and the Alexandrina Council Development Plan, and there were no items identified that would preclude the development.

Hydrostor intends for this Project to be the first of many A-CAES Projects in South Australia and wider Australia, representing an important development for future investment. Hydrostor seeks Development Approval consent to enable procurement processes and ensure the Project's construction in 2019.

12.0 IMPORTANT INFORMATION

Your attention is drawn to the document – "Important Information", which is included in Appendix H of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

13.0 REFERENCES

Australia and New Zealand Environment and Conservation Council, National Water Quality Management Strategy, Paper No. 4, Volume 1, The Guidelines (2000)

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Terramin Australia Limited, Programme for Environmental Protection and Rehabilitation- Angas Zinc Mine (2017)

Signature Page

Golder Associates Pty Ltd

Hannah Keynes
Environmental Scientist

Lissa van Camp
Principal Environmental Consultant

HK/LvC/gp

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VOLUME 3: TECHNICAL APPENDICES

APPENDIX A

Certificate of Titles

Product	Register Search (CT 6032/127)
Date/Time	18/01/2019 11:17AM
Customer Reference	1791136
Order ID	20190118003795
Cost	$28.75

REAL PROPERTY ACT, 1886
South Australia

The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.

Certificate of Title - Volume 6032 Folio 127

Parent Title(s) CT 6016/975

Creating Dealing(s) RTC 11108379

Title Issued 23/03/2009 **Edition** 2 **Edition Issued** 13/05/2009

Estate Type

FEE SIMPLE

Registered Proprietor

TERRAMIN AUSTRALIA LTD. (ACN: 062 576 238)
OF LEVEL 22/91 KING WILLIAM STREET ADELAIDE SA 5000

Description of Land

ALLOTMENT 14 DEPOSITED PLAN 77134
IN THE AREA NAMED STRATHALBYN
HUNDRED OF STRATHALBYN

Easements

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED C FOR THE TRANSMISSION OF ELECTRICITY BY OVERHEAD CABLE (RTC 11108379)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED F FOR THE TRANSMISSION OF ELECTRICITY BY UNDERGROUND CABLE (RTC 11108379)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED D FOR DRAINAGE PURPOSES (RTC 11108379)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED D FOR SEWERAGE PURPOSES (RTC 11108379)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED D FOR WATER SUPPLY PURPOSES (RTC 11108379)

SUBJECT TO FREE AND UNRESTRICTED RIGHT(S) OF WAY OVER THE LAND MARKED D (RTC 11108379)

Schedule of Dealings

Dealing Number	Description
10716992	MORTGAGE TO INVESTEC BANK (AUSTRALIA) LTD.

Notations

Dealings Affecting Title NIL

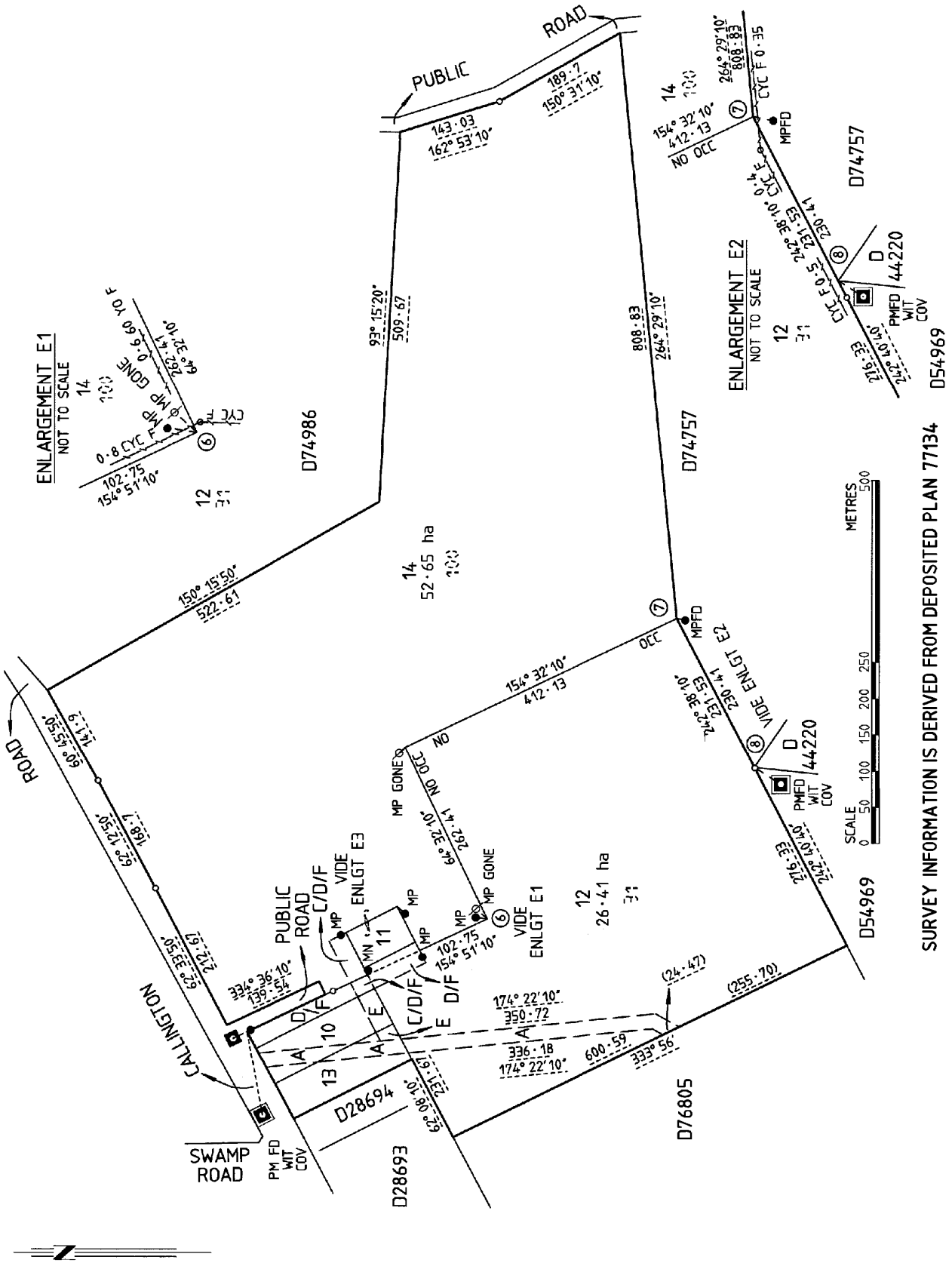
Priority Notices NIL

Notations on Plan NIL

Registrar-General's Notes

APPROVED FX57454

Administrative Interests NIL



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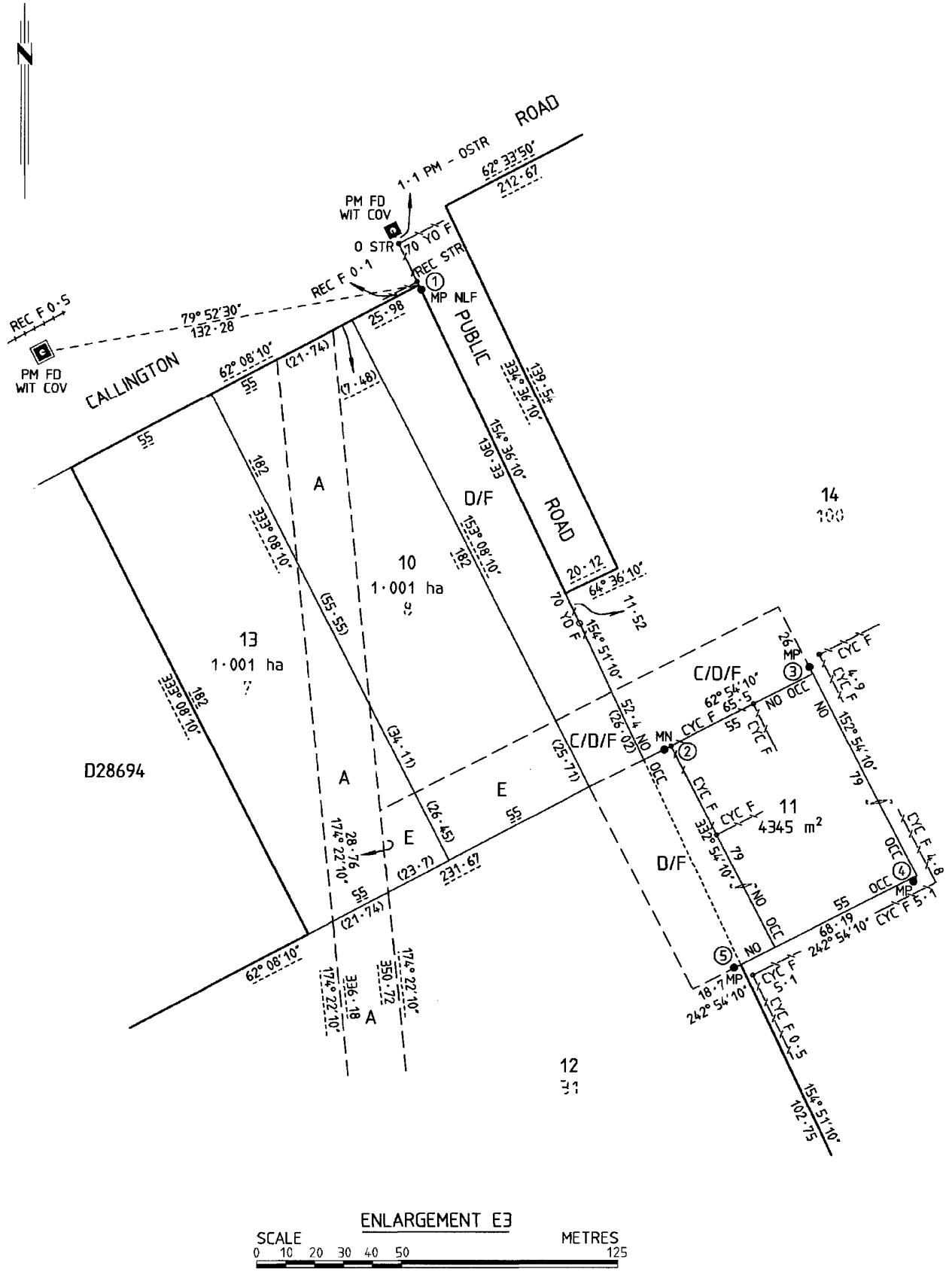
Date/Time	18/01/2019 11:17AM
Customer Reference	1791136
Order ID	20190118003795
Cost	$28.75



ENLARGEMENT E3

SCALE 0 10 20 30 40 50 METRES 125

Product	Register Search (CT 6032/124)
Date/Time	18/01/2019 11:20AM
Customer Reference	1791136
Order ID	20190118003861
Cost	$28.75

REAL PROPERTY ACT, 1886
South Australia

The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.

Certificate of Title - Volume 6032 Folio 124

Parent Title(s) CT 6016/975, CT 6017/399

Creating Dealing(s) RTC 11108379

Title Issued 23/03/2009 **Edition** 2 **Edition Issued** 09/05/2012

Estate Type

FEE SIMPLE

Registered Proprietor

CKI UTILITIES DEVELOPMENT LTD. (ACN: 090 718 880)
OF 1 ANZAC HIGHWAY KESWICK SA 5035
51 / 200 SHARE

PAI UTILITIES DEVELOPMENT LTD. (ACN: 090 718 951)
OF 1 ANZAC HIGHWAY KESWICK SA 5035
51 / 200 SHARE

SPARK INFRASTRUCTURE SA (NO. 1) PTY. LTD. (ACN: 091 142 380)
OF 1 ANZAC HIGHWAY KESWICK SA 5035
30 / 200 SHARE

SPARK INFRASTRUCTURE SA (NO. 2) PTY. LTD. (ACN: 091 143 038)
OF 1 ANZAC HIGHWAY KESWICK SA 5035
38 / 200 SHARE

SPARK INFRASTRUCTURE SA (NO. 3) PTY. LTD. (ACN: 091 142 362)
OF 1 ANZAC HIGHWAY KESWICK SA 5035
30 / 200 SHARE

Description of Land

ALLOTMENT 11 DEPOSITED PLAN 77134
IN THE AREA NAMED STRATHALBYN
HUNDRED OF STRATHALBYN

Easements

TOGETHER WITH EASEMENT(S) OVER THE LAND MARKED D FOR WATER SUPPLY PURPOSES (RTC 11108379)

TOGETHER WITH EASEMENT(S) OVER THE LAND MARKED D FOR SEWERAGE PURPOSES (RTC 11108379)

TOGETHER WITH EASEMENT(S) OVER THE LAND MARKED D FOR DRAINAGE PURPOSES (RTC 11108379)

TOGETHER WITH FREE AND UNRESTRICTED RIGHT(S) OF WAY OVER THE LAND MARKED D (RTC 11108379)

Schedule of Dealings

NIL

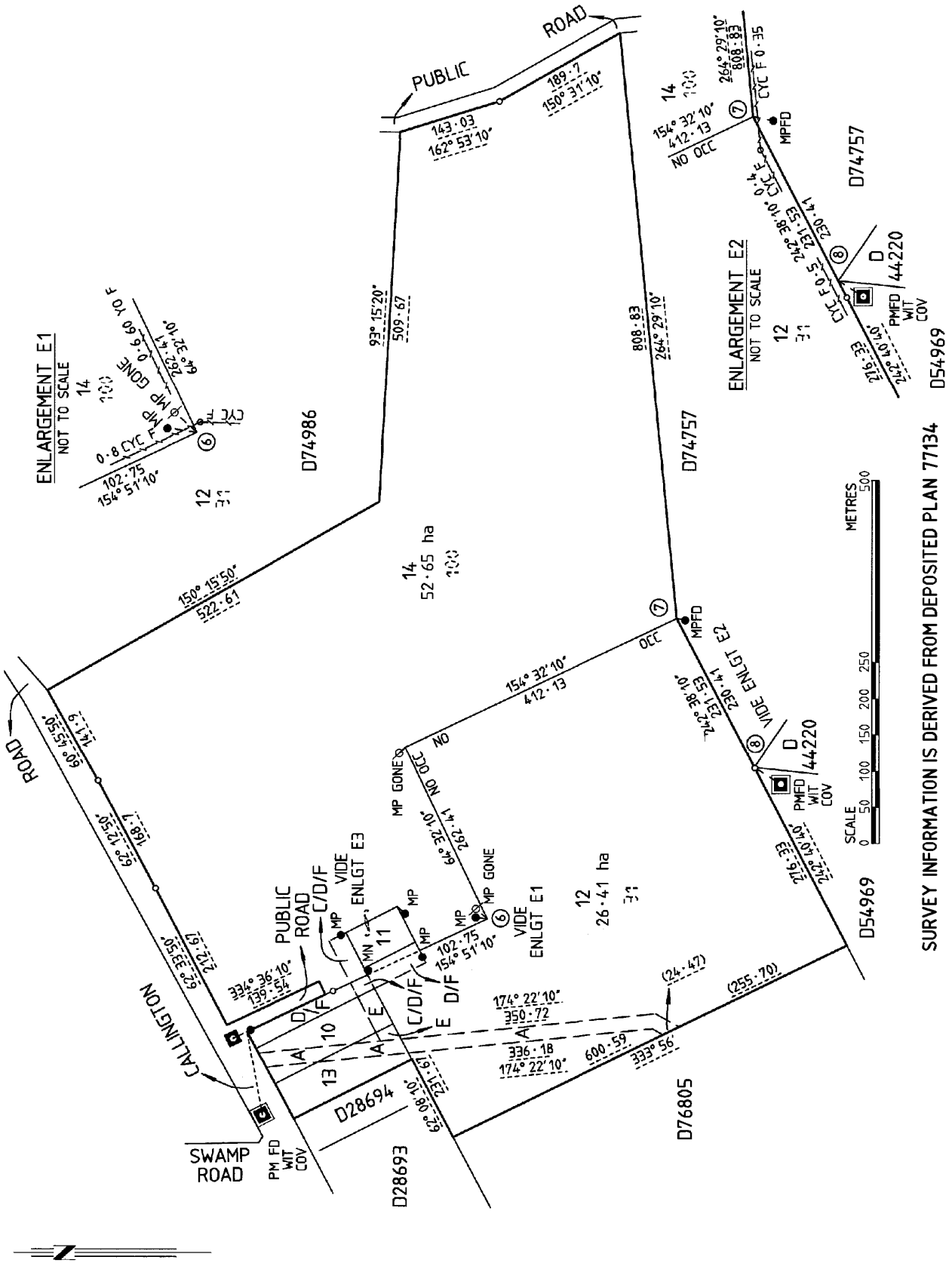
Notations

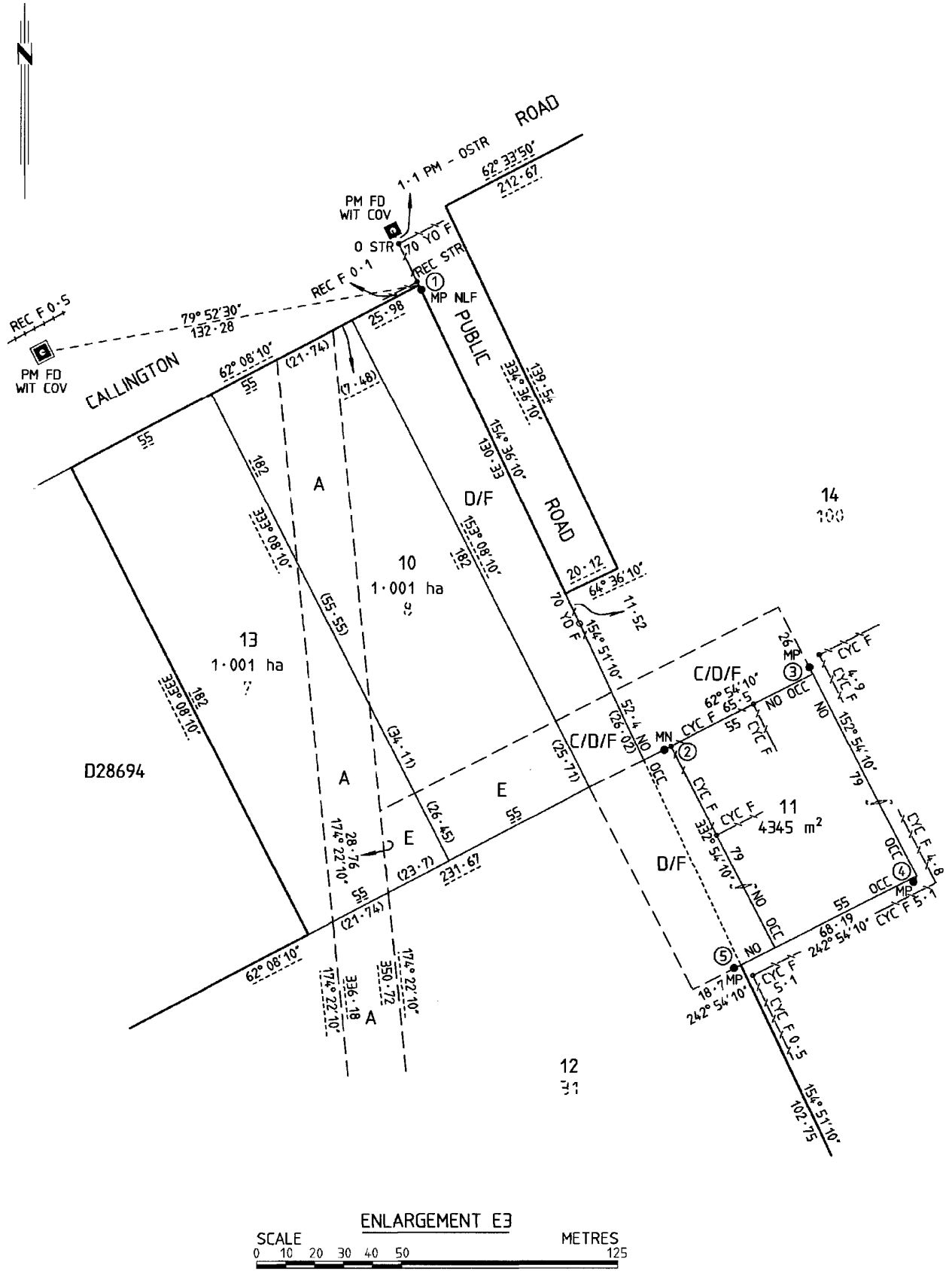
Dealings Affecting Title NIL

NIL

Priority Notices

Notations on Plan	NIL
Registrar-General's Notes	NIL
Administrative Interests	NIL





ENLARGEMENT E3

SCALE 0 10 20 30 40 50 METRES 125

APPENDIX B

Preliminary Decommissioning Plan

REPORT

Preliminary Decommissioning Plan
Angas A-CAES Project

Angas Zinc Mine, Strathalbyn

Submitted to:

Hydrostor Australia

Submitted by:

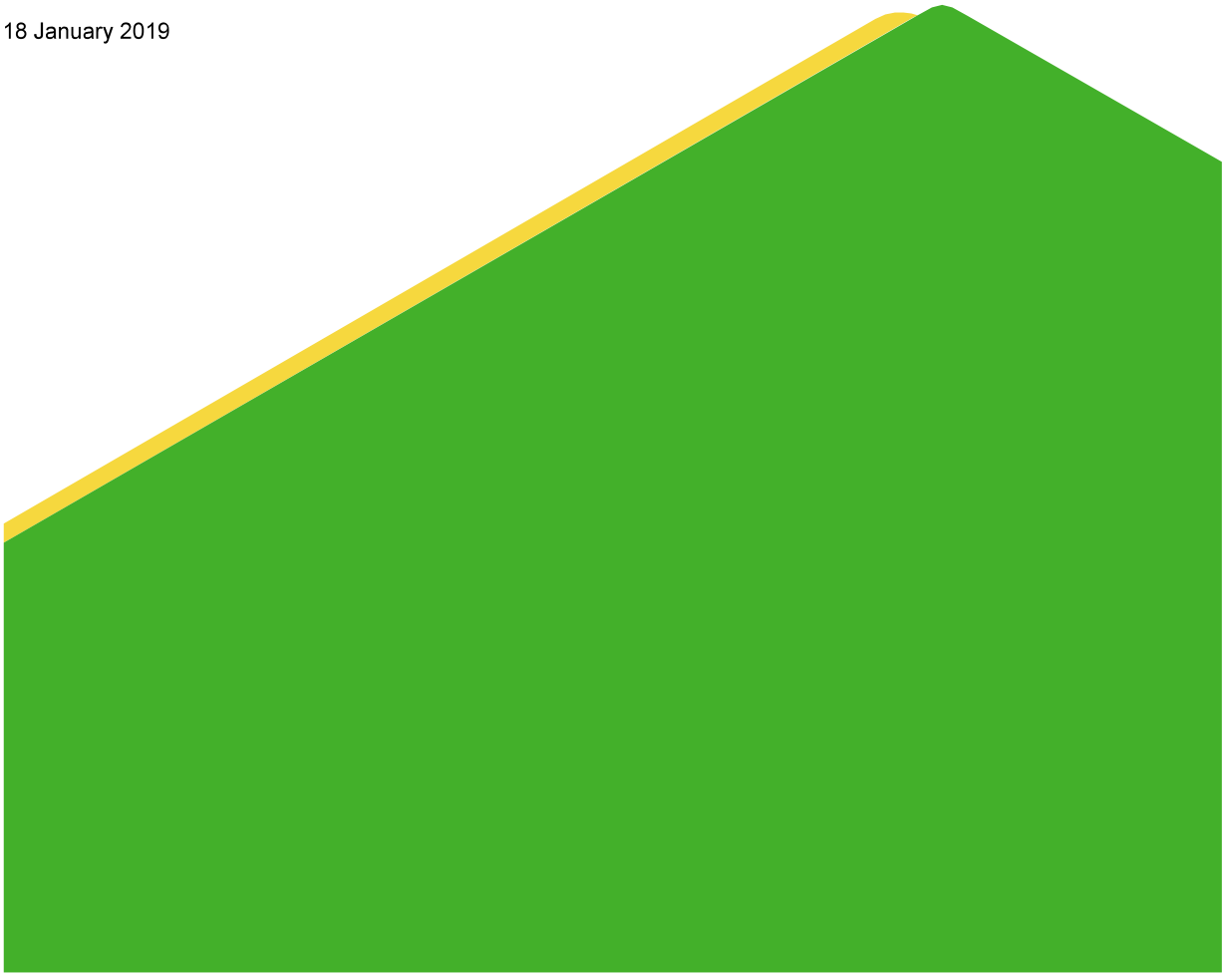
Golder Associates Pty Ltd

118 Franklin Street Adelaide, South Australia 5000 Australia

+61 8 8213 2100

1791136-007-R-Rev1

18 January 2019



Distribution List

1 e-copy: Hydrostor Australia

1 e-copy: AECOM

1 e-copy: Golder Associates

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TABLES

FIGURES

1.0 INTRODUCTION

Hydrostor Australia Pty Ltd is proposing to develop, build and operate the Angas Advanced Compressed Air Energy Storage (A-CAES) Facility (the Project) at the Angas Zinc Mine (the Mine) in Strathalbyn, South Australia.

This Preliminary Decommissioning Plan (PDP) has been prepared to describe the framework and strategies to facilitate a range of future land use options, at the extinguishment of Hydrostor's lease.

The broad objectives of the PDP are to:

- Protect the environment and public health and safety by using safe and responsible decommissioning practices
- Reduce or eliminate adverse environmental impacts post decommissioning
- Establish conditions to meet agreed land use options
- Provide an estimated schedule for life of plant.

The PDP will also be useful in forward planning for decommissioning and rehabilitation costing.

1.1 Approvals and legislation

The Project will be assessed under Section 49(1)(a) of the *Development Act* (Development Act) *1993*, including submission of a Development Application Report (DAR) to the South Australian Government through the State Commission Assessment Panel (SCAP).

This PDP will support the DAR in describing the final state of the land following extinguishment of Hydrostor's lease and guiding closure and rehabilitation commitments.

The Project's decommissioning will be in accordance with relevant legislation including:

- *Development Act 1993*
- *Environmental Protection Act 1993*
- *National Environment Protection (Assessment of Site Contamination) Measures 1999*
- *Work Health and Safety Act 2012*
- *National Electricity Rules, Version 107* (Australian Energy Market Commission, 2018).

The Project's decommissioning activities will also need to consider Terramin's closure obligations that have been developed in accordance with the *Mining Act 1971* (the Mining Act).

Terramin has developed a closure plan for the site which ensures that:

- Mining Lease conditions are satisfied
- The mine site including final landforms are chemically, geomorphologically, ecologically and structurally stable
- Risks to health and safety of the public and fauna are as low as reasonably practical
- Visual amenity is consistent with or improved compared to baseline conditions.

The decommissioning plan has been prepared in consideration of Terramin's closure commitments and will ensure the land use options protected through Mine closure are not compromised.

2.0 PROJECT DESCRIPTION

2.1 Location and land use

The Project is proposed for a portion of the Mine south of Callington Road, approximately 2.6 km north east of the Strathalbyn township.

The Project components will be situated in the north western corner of the Mine (Figure 1) which is currently used for car parking and includes a transformer, noise and visual bunding and hard waste storage.

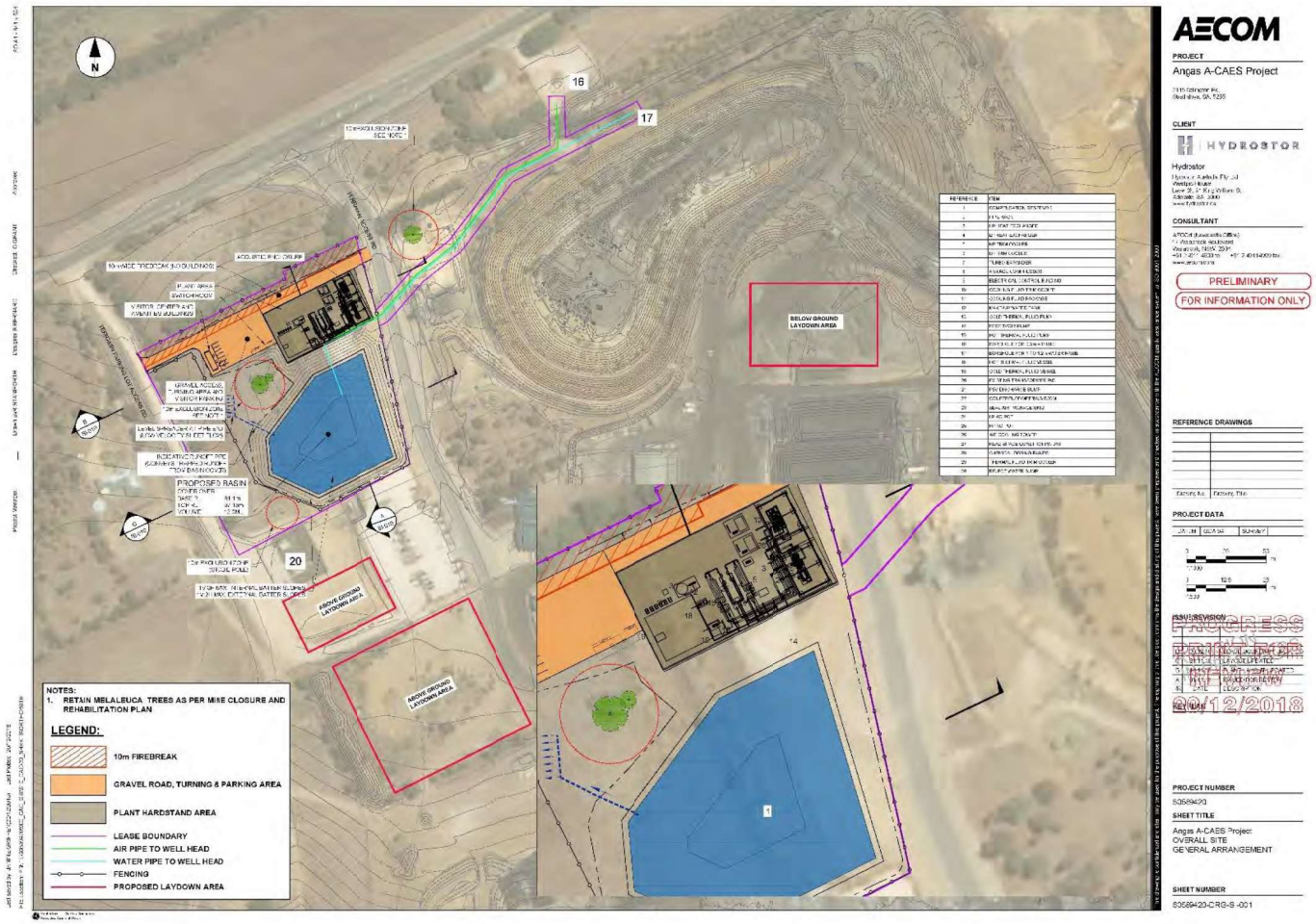

Figure 1: Site surface infrastructure and construction laydown areas

2.2 The Project

The project will use the existing mine decline to gain access to 240 m below ground level (bgl). There, the subsurface infrastructure will include an underground air storage cavern connected to the surface via water and air lines.

When the system is charging (i.e. at times of surplus energy on the grid), electricity runs an air compressor to pipe compressed air from the surface into the air storage cavern, displacing water up the shaft and into the surface reservoir. The heat generated when compressing the air is captured and stored as hot water in a thermal store for use in electricity generation.

When electricity is needed (i.e. at times of high energy demand on the grid), the system reverses the air flow allowing hydrostatic pressure to force the air out of the air storage cavern and back to the surface where the stored heat is added back into the air stream. The heated air travels through a turbo-expander that drives a generator, efficiently converting the stored energy back into electricity for the consumer.

2.2.1 Surface Infrastructure

Proposed permanent surface infrastructure will include:

- Water reservoir: with a capacity of approximately 13,000 m^3
- Electrical conversion plant: electrical drives (motors and generators), turbomachines (compressors and turbines), the electrical gear (switch gear, protection, etc.), and the cooling system
- Thermal management system: heat exchangers, heat transfer fluid, storage tanks (hot and cold), and associated pumps
- Water treatment package: includes Reverse Osmosis (RO) plant and make-up water tank for thermal system water requirements

2.2.2 Subsurface Infrastructure

The proposed subsurface infrastructure for this project includes:

- The air storage cavern
- An air line connecting the air storage cavern to the surface
- A water line connecting the air storage cavern to the water reservoir
- Underground electricity connection to the existing transformer
- Injection bores

3.0 PRELIMINARY DECOMMISSIONING PLAN

3.1 Decommissioning objective

The main objectives of the decommissioning activities are to ensure:

- Risks to the environment and health and safety of the public and fauna are as low as reasonably practical
- Visual amenity is consistent with or improved compared to baseline conditions.
- Future land use options identified in Terramin's Closure Plan are maintained

Detailed strategies for decommissioning will be progressively developed and outlined in the final decommissioning plan for the site. Final land use and closure criteria will incorporate closure objectives as negotiated between Hydrostor and the site owner, in consultation with the community and other relevant stakeholders.

The site will be left in a state that does not compromise safety or the environment. It is envisioned that all surface plant and equipment will be removed from the site and recycled or disposed of according to legislative requirements at the time of decommissioning.

3.2 Plant and equipment

The final decommissioning plan will include a technical specification for the demolition of plant and equipment in accordance with *Australian Standard (AS) 2601-2001 – The demolition of structures.* The standard sets out the requirements and provides best practise guidance on the planning procedures for the demolition of a structure.

A complete register of plant and equipment to be decommissioned and removed will be developed as part of the final decommissioning plan. Table 1 provides a preliminary list of the plant and equipment with proposed management actions.

Table 1: Preliminary register of plant and equipment

Plant/equipment	Proposed management action
Surface infrastructure	
Reservoir	Leave in place for future use (in consultation with land owner)
Electrical conversion plant	Removal - salvage
Cooling tower	Removal - salvage
Thermal storage tanks	Removal - salvage
Water tank	Leave in place for future use (in consultation with land owner)
Water treatment plant	Removal - salvage
Water pump	Leave in place for future use (in consultation with land owner)
Sub-surface infrastructure	
Underground cavern	Flooded as per the existing Mine Closure Plan for the Angas Zinc Mine.
Water and air pipes to cavern	Decommissioning by sealing with grout
Injection bores	Decommissioning by sealing with grout (unless otherwise required by land owner)
Underground pipework	Removal - salvage, recycle or dispose
Electrical cables	De-energise and remove

Following the removal of infrastructure, the site will be rehabilitated in accordance with the agreed land use scenario(s).

Environmental assessments will be undertaken as required including a soil contamination assessment and subsidence assessment to confirm the site's suitability for the proposed land use scenario, in accordance with SA EPA guidance.

3.3 Materials management

Visual inspection of the site will be carried out regularly to ensure waste materials are disposed of appropriately. Waste collection will be monitored on a weekly basis. Waste tracking documentation will be monitored monthly.

The management strategies for waste will include the following elements:

- Segregation of waste into separate waste streams for recycling or disposal
- Domestic and commercial waste will be periodically removed by a licensed contractor
- Segregation, storage and disposal of any hazardous materials in accordance with the appropriate Australian Standards.

3.4 Environmental management

The management measures implemented during construction will be employed during decommissioning to minimise the risk to the environment.

3.5 PDP review and scheduling

The PDP will be subject to internal review on a regular basis to ensure it remains relevant.

The final decommissioning plan will be prepared progressively and by no later than 12 months prior to decommissioning. The preparation of the plan will be undertaken in consultation with the community and State Government agencies.

Signature Page

Golder Associates Pty Ltd

Hannah Keynes
Environmental Scientist

Lissa van Camp
Principal Environmental Consultant

HK/LvC/gp

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APPENDIX C

Closure criteria

Lease Condition and Outcome	Closure criteria	CAES project interaction	Risk mitigation	Monitoring commitments and contingencies
Erosion				
19. Stabilise disturbed areas and prevent sediment from leaving the site and 7. Ensure the site is left in a stable, non-polluting state indefinitely and 16. Ensure there is no adverse impact to the supply of water by the lessees operations to existing users and water dependent ecosystems	During rainfall events which generate runoff (detected using remote telemetry stream gauges installed at the locations), three samples will be taken to measure turbidity at the pre-wetland location, visitors viewing area and at the overflow point of the silt retention dam (MCP, Appendix J) as per sampling method AS/NZS 5667.1:1998 standards to demonstrate that turbidity at the pre-wetland location, visitors viewing area and at the overflow point of the silt retention dam has not resulted from ML 6229. A paired t-test will demonstrate that turbidity at pre-wetland location, visitors viewing area and at the overflow point of the silt retention dam is not significantly greater (p-value ≤ t-test value) from the mean of the samples taken at Hogben (MCP, Appendix R) at that point in time over a consecutive period no less than 5 years.	The surface within Hydrostor's lease area will be temporarily disturbed during construction. Erosion and sedimentation is expected to be minor. Surfaces will be stabilised following construction and erosion/sedimentation is expected to be negligible during operation.	Environmental Management Plan including soil, erosion and drainage management to be implemented during construction. Disturbed surfces, including reservoir banks, will be suitably rehabilitated following construction Final site design will consider surface water flows and include appropriate drainage infrastructure.	Turbidity monitoring in the event of runoff to remote telemetry stream gauges. Drainage infrastructure to be reviewed if indicator criteria are exceeded.
19. Stabilise disturbed areas and prevent sediment from leaving the site and 21. Ensure stockpiles are protected from erosion	Photo monitoring of all topsoil stockpiles located on ML 6229 (MCP Appendix V) prior to surrender of lease demonstrates that all stockpiles have been used in rehabilitation activities.	No long term stockpiling is required	NA	NA
19. Stabilise disturbed areas and prevent sediment from leaving the site and 16. Ensure the site is left in a stable, non-polluting state indefinitely and 56. The Lessee must improve the visual amenity of the mine site in the long-term post mine closure	A report by an independent and suitably qualified expert (to DPC's satisfaction) will verify once prior to application for surrender that all available information and data from LIC E01, LIC E03, LIC E05 demonstrates that representative test sites on the boxcut and TSF areas have been rehabilitated to a safe, stable landform and have achieved, or by trends, may be confidently predicted to reach and pass sustainability thresholds as defined by Landscape Function Analysis (Sustainability thresholds for each parameter are interpreted as the points of maximum curvature on the sigmoidal curve shape as per Tongway and Hindley (2005).	No interaction with boxcut or TSF landform	NA	NA
19. Stabilise disturbed areas and prevent sediment from leaving the site	An independent and suitably qualified expert (to DPC's satisfaction) verifies once prior to application for surrender through data collected for LIC E03, LIC E05, that the box cut (Figure 6-5 on page 61) will be a geotechnically and erosionally stable landform in the long term by meeting the following performance design criteria: - rills or gullies do not exceed 300mm width and 350mm depth; and - 90% vegetation cover is achieved; and - DTM monitoring values are less than 2.206 Tonnes/ha/yr for 3 consecutive years	No interaction with boxcut landform	NA	NA
19. Stabilise disturbed areas and prevent sediment from leaving the site.	An independent and suitably qualified expert (to DPC's satisfaction) verifies once prior to application for surrender through data collected for LIC E04, LIC E06, LIC E07, that the TSF (Figure 6-5 on page 61) is an erosionally and geotechnically stable landform in the long term by meeting the following performance design criteria: - Rills and gullies do not exceed 200mm in width and 200mm depth; and - For the embankments rills and gullies not exceeding 250mm width by 250mm depth; and - 90% vegetation cover is achieved; and - DTM monitoring values are less than 2.206 Tonnes/ha/yr for 3 consecutive years.	No interaction with TSF landform	NA	NA
19. Stabilise disturbed areas and prevent sediment from leaving the site and 16. Ensure the site is left in a stable, non-polluting state indefinitely and 56. The Lessee must improve the visual amenity of the mine site in the long-term post mine closure	An independent and suitably qualified expert (to DPC's satisfaction) will verify in a report once at completion of construction works that the final box cut landform (Figure 6-5 on page 61) has been constructed to design (Section 6.5.5.1.2, & MCP, Appendix BZ Detailed Design, Construction Management Plan/ QA/QC).	No interaction with boxcut landform	NA	NA
19. Stabilise disturbed areas and prevent sediment from leaving the site and 16. Ensure the site is left in a stable, non-polluting state indefinitely and 56. The Lessee must improve the visual amenity of the mine site in the long-term post mine closure	An independent and suitably qualified expert (to DPC's satisfaction) will verify in a report once after completion of construction works that the TSF landform (Figure 6-5 on page 61) has been constructed to design (Section 6.6.7, & MCP Appendix AR and MCP Appendix BZ including Detailed Design, but not limited to Construction Management Plan/ QA/QC).	No interaction with TSF landform	NA	NA

Lease Condition and Outcome	Closure criteria	CAES project interaction	Risk mitigation	Monitoring commitments and contingencies
Geotechnical stability				
55. Ensure all underground voids are filled to the extent that subsidence cannot occur at any time after mine closure 53. Ensure that no damage occurs to third party infrastructure and no injuries/ deaths result from collapse of the underground workings. 52. The Lessee must, in constructing and operating the lease, and post mine closure, ensure that there are no public injuries/deaths resulting from unauthorized entry to the mine site 65. The Lessee must ensure that upon mine closure, the site is left in a stable, non-polluting state indefinitely post closure 67. The Lessee must ensure that upon mine closure, the decline under Strathalbyn - Callington Road is to be backfilled in a manner to ensure the long term integrity of the public road structure	Survey monitoring of mine void backfill to demonstrate >91% of mined production voids have been backfilled in accordance with PEPR methodology (MCP Section 6.4.5.1.2/ PEPR Section 3.7.2). This will be confirmed by an independent and suitably qualified expert (to DPC's satisfaction).	No mine void backfill will be removed to facilitate the project.	NA	NA
55. Ensure all underground voids are filled to the extent that subsidence cannot occur at any time after mine closure 53. Ensure that no damage occurs to third party infrastructure and no injuries/deaths result from collapse of the underground workings. 52. The Lessee must, in constructing and operating the lease, and post mine closure, that there are no public injuries/deaths resulting from unauthorized entry to the mine site 65. The Lessee must ensure that upon mine closure, the site is left in a stable, non-polluting state indefinitely post closure 67. The Lessee must ensure that upon mine closure, the decline under Strathalbyn - Callington Road is to be backfilled in a manner to ensure the long term integrity of the public road structure	An independent and suitably qualified expert (to DPC's satisfaction) report will demonstrate that the risk of subsidence has been managed for the prevention of surface subsidence after cessation of underground mine operation	No backfill will be removed to facilitate the project and no change to subsidence risk.	NA	NA
54. The Lessee must survey Callington Road prior to, during and post mining operations to ascertain if subsidence has occurred 65. The Lessee must ensure that upon mine closure, the site is left in a stable, non-polluting state indefinitely post closure	Surface survey monitoring will be undertaken every six months for the first year post underground mining cessation and annually thereafter at 24 fixed geotechnical survey stations located along Callington Rd and the STEDS pond (MCP, Appendix K). Survey monitoring will demonstrate - no differential settlement of less than 20mm between each of the three stobie poles used as survey monitoring points on Callington road, over a 3 year period immediately after the cessation of underground mining (Monitoring point 20, monitoring point 22 and 'stobie') (DPTI). - No movement greater than 100mm downward from the base coordinates located in the STEDS area (21 monitoring points) (MCP, Appendix N) detected for a period of no less than three years (DPTI).	No backfill will be removed to facilitate the project.	NA	6 monthly subsidence monitoring for first year following construction and annually thereafter in accordance with closure criteria
55. Ensure all underground voids are filled to the extent that subsidence cannot occur at any time after mine closure	An independent and suitably qualified expert (to DPC's satisfaction) conducts a construct to design audit of the vent rise plug against the design (MCP, Appendix AT and BU) and confirms vent rise has been backfilled and constructed to design specifications within three months of the completion of the vent rise being backfilled.	There will be no impact on the vent rise plug backfill and construction.	NA	NA
55. Ensure all underground voids are filled to the extent that subsidence cannot occur at any time after mine closure	An independent and suitably qualified expert (to DPC's satisfaction) conducts a construct to design audit of the decline plug against the design (MCP, Appendix AT and BU) and confirms decline has been backfilled and constructed to design specifications.	There will be no impact on the decline plug construction.	NA	NA

Lease Condition and Outcome	Closure criteria	CAES project interaction	Risk mitigation	Monitoring commitments and contingencies
Site contamination				
29. No contamination and pollution is caused by waste products and hazardous materials used in the mine operations *and* 20. Ensure that soil quality and quantity are protected. *And* 16. Ensure there is no adverse impact to the supply of water by the lessees operations to existing users and water dependent ecosystems *and* 25. No water contaminated as a result of mining operations leaves the lease area or results in contamination of soil at mine closure *and* 27. Ensure water discharged from the site is compliant with relevant environment protection policy under Environment Protection Act 1993 (SA) *and* 65. Ensure the site is left in a stable, non- polluting state indefinitely post-closure	Provision of a report once prior to entering closure monitoring phase by a suitably qualified site contamination consultant verifies that a site contamination assessment and if required remediation in accordance with the NEPM and relevant EPA guidelines for the central and southern domains (excluding the TSF) Figure 1-2 has occurred, ensuring there is no unacceptable risk to human health or the environment as a result of the contamination when compared with relevant baseline concentrations and relevant NEPM investigation levels.	CAES is non polluting facility and no hazardous materials will be produced Risk to soil and groundwater quality and quantity is low No water discharged from site Dewatering during construction will result in waste water that will be re-injected into the groundwater aquifer	Contamination prevention procedures through implementation of construction and operational environmental management plans. Appropriate reporting of environmental incidences. Water will be treated where required prior to re-injection to protect groundwater quality.	Appropriate baseline and post lease expiry contamination assessment (including rehabilitation if required) within areas used by Hydrostor.
29. No contamination and pollution is caused by waste products and hazardous materials used in the mine operations 16. Ensure there is no adverse impact to the supply of water by the lessees operations to existing users and water dependent ecosystems 25. No water contaminated as a result of mining operations leaves the lease area or results in contamination of soil at mine closure 27. Ensure water discharged from the site is compliant with relevant environment protection policy under Environment Protection Act 1993 (SA)	Triplicate surface water samples will be taken during rain events where there is a potential for discharge into the Angas River from ML 6229. Samples will be taken, as per AS/NZS 5667.1:1998, where the Angas River flows at one potential discharge location (Croser) and one upstream control sample point (Hogben) shown in MCP Appendix R. A paired t-test will demonstrate that potential contaminants (Pb, Zn, Cd, pH, TDS, SO4, EC and turbidity) at Croser are not significantly different (p-value ≤ t- test value) from the mean of the samples taken at Hogben at that point in time over a consecutive period no less than 5 years. If the samples at Croser are significantly different and greater than the mean of the triplicate samples from Hogben, verification will be undertaken to determine whether surface water is leaving ML6229. Sampling will cease if closure criteria CC SC01 has been satisfied and when the TSF has been rehabilitated as per the approved TSF closure design (CC TSF01). Sampling will be undertaken once if possible within a 24 month period prior to Mineral Lease surrender document submission.	The risk of contamination of surface water as a result of construction and operation is low.	Contamination prevention procedures through implementation of construction and operational environmental management plans. Appropriate reporting of environmental incidences.	Surface water monitoring in accordance with closure criteria.
Groundwater				
16. Ensure there is no adverse impact to the supply of water by the lessees operations to existing users and water dependent ecosystems and 25. No water contaminated as a result of mining operations leaves the lease area or results in contamination of soil at mine closure and 27. Ensure water discharged from the site is compliant with relevant environment protection policy under Environment Protection Act 1993 (SA) and 65. Ensure the site is left in a stable, non- polluting state indefinitely post-closure	An independent and suitably qualified expert (to DPC's satisfaction) will review all groundwater data (LIC MV01-03) geochemical groundwater data and numerical groundwater modelling (groundwater levels and water quality) developed for mine void recharge scenario, as detailed in MCP Appendix BJ to verify no adverse impact on water by mining operations to existing users and water dependent ecosystems by reviewing all data collected through LIC MV01-03 (MCP, appendix BJ) and all groundwater modelling (MCP appendix BX).	Dewatering during early stages of the Project will result in waste water that will be re-injected into the groundwater aquifer, as was undertaken during mining operations.	Groundwater modelling and resulting dewatering and re-injection plan will ensure groundwater quality is protected. Waste water will be treated to appropriate quality prior to re-injection.	Groundwater level and quality monitoring in accordance with closure criteria.

Lease Condition and Outcome	Closure criteria	CAES project interaction	Risk mitigation	Monitoring commitments and contingencies
Vegetation				
22. The Lessee must, in constructing and operating the lease, and post mine closure, avoid permanent loss of biodiversity through clearance of native vegetation.	An independent and suitably qualified expert (to DPC's satisfaction) verifies once 24 months before submission of surrender application through a report that representative test sites on SEB offset areas (MCP Appendix BV) have achieved or by trends may be confidently predicted to reach and pass sustainability thresholds as defined by Landscape Function Analysis (Sustainability thresholds for each parameter are interpreted as the points of maximum curvature on the sigmoidal curve shape as per Tongway and Hindley (2005) (MCP Appendix AM)).	Site is not within an SEB offset area- no clearance of vegetation required	NA	NA
22. The Lessee must, in constructing and operating the lease, and post mine closure, avoid permanent loss of biodiversity through clearance of native vegetation.	1. LFA on rehabilitated areas within the southern and central domains will be repeated annually following completion of rehabilitation earthworks and vegetation direct seeding for the first 5 years and then at a frequency recommended in the year 5 report. 2. LFA on rehabilitated areas within the southern and central domains will be repeated to confirm trend 24 months before submission of surrender application. 3. Once prior to application for surrender an independent and suitably qualified expert (to DPC's satisfaction) will verify through a report that representative test sites on rehabilitated areas within the southern and central domains (Appendix BV) have achieved or by trends may be confidently predicted to reach and pass sustainability thresholds as defined by Landscape Function Analysis (Sustainability thresholds for each parameter interpreted as the points of maximum curvature on the sigmoidal curve shape as per Tongway and Hindley (2005) (MCP Appendix AM)).	Site is not within a rehabilitated area- no clearance of vegetation required	NA	NA
22. The Lessee must, in constructing and operating the lease, and post mine closure, avoid permanent loss of biodiversity through clearance of native vegetation.	Audit of AZM SEB offset scheme by an independent and suitably qualified expert (to DPC's satisfaction) confirms the approval, clearance and offsetting has been achieved prior to surrender of Lease.	Site is not within an SEB offset area- no clearance of vegetation required.		
22. The Lessee must, in constructing and operating the lease, and post mine closure, avoid permanent loss of biodiversity through clearance of native vegetation.	Survey of heritage trees by an independent and suitably qualified expert (to DPC's satisfaction) demonstrates that heritage trees (MCP Appendix AD) have not been impacted by ML6229 activities through rehabilitation and closure phase	No impact on heritage trees.	Implementation of construction and operational environmental management plans to ensure appropriate awareness and delineation of heritage trees	Survey of heritage trees to be undertaken post construction and decommissioning of project
Visual impact				
57. The Lessee must improve the visual amenity of the mine site in the long term post mine closure	Upon completion of rehabilitation activities independent verification and a photo point assessment at ten locations (MCP Appendix H) will demonstrate that a visual amenity plan (developed in consultation with stakeholders and submitted to government) has been fully implemented.	The surface infrastructure will be set back from the road behind existing and new vegetation screening. The reservoir banks will be rehabilitated to improve the visual amenity.	Appropriate rehabilitation of disturbed areas and project design to consider visual amenity (i.e. building colour, new screening vegetation if required)	NA
64. The Lessee must ensure that upon mine closure, all plant and equipment (unless otherwise agreed with the Chief Inspector or Mines) is removed from the site	Upon completion of rehabilitation activities, a visual assessment of ML 6229 will demonstrate all metalliferous mining plant, equipment, infrastructure and rubbish has been removed from site (unless otherwise agreed with the Chief Inspector of Mines).	No impact on removal of metalliferous mining plant, equipment, infrastructure and rubbish. Project infrastructure will be removed during decommissioning	Implementation of a decommissioning plan	NA

Lease Condition and Outcome	Closure criteria	CAES project interaction	Risk mitigation	Monitoring commitments and contingencies
Acid Mine Drainage				
33. No contamination of natural water drainage systems, streams and rivers, groundwater, land and soils occurs either on or off site resulting from permanent disposal or temporary storage of mine ore or waste material.	An independent and suitably qualified expert (to DSD's satisfaction) will verify annually that the TSF Post Construction Monitoring Plan for the TSF (The TSF Monitoring Plan) (MCP Appendix BY) has been complied with and all data outlined in the TSF Monitoring Plan has been included as part of the report to demonstrate the TSF cover system is functioning as designed.	No interaction with the TSF	NA	NA
33. No contamination of natural water drainage systems, streams and rivers, groundwater, land and soils occurs either on or off site resulting from permanent disposal or temporary storage of mine ore or waste material.	Once prior to application of Lease surrender a final report including a calibrated cover model (based on data collected through LIC TSF06) by TSF cover system designer (AECOM) will be submitted to government to demonstrate that: the TSF Monitoring Plan (see LIC TSF06) has been adhered to; and the TSF cover system is performing as designed throughout 10 to 20 years and is expected to in the long term.	No interaction with the TSF	NA	NA
33. No contamination of natural water drainage systems, streams and rivers, groundwater, land and soils occurs either on or off site resulting from permanent disposal or temporary storage of mine ore or waste material.	Final audit report by TSF designer (ATC Williams) demonstrating that the TSF is functioning as designed once prior to application of Lease surrender.	No interaction with the TSF	NA	NA
33. No contamination of natural water drainage systems, streams and rivers, groundwater, land and soils occurs either on or off site resulting from permanent disposal or temporary storage of mine ore or waste material.	A TSF closure report by an independent and suitably qualified expert (the expert will be independent of the TSF designer or TSF cover system designer), as recommended by Terramin and as agreed by Government, will verify to the satisfaction of the Ministers delegate (acting reasonably): 1. that data has been collected as per TSF Post Construction Monitoring Plan for the TSF (The TSF Monitoring Plan) (MCP Appendix BY) and (as per LIC TSF06); and 2. that data collected as per TSF Post Construction Monitoring Plan for the TSF (The TSF Monitoring Plan) (MCP Appendix BY) and (as per LIC TSF06) demonstrates that the TSF cover system has functioned as designed for a minimum of 10 to 20 years (based on sufficient monitoring results covering climate variability and more frequent climate cycles) to achieve the outcome of no contamination of natural water drainage systems, streams and rivers, groundwater, land, soils and will continue to do so in the long term; and 3. that the calibrated cover model demonstrates (based on sufficient monitoring results covering climate variability and more frequent climate cycles) that the cover is performing as per the design to achieve the outcome of no contamination of natural water drainage systems, streams and rivers, groundwater, land, soils and will continue to do so in the long term. This report will be provided to Government for assessment once prior to application of Lease surrender. The scope of works for the aforementioned report will be agreed by Terramin and the Government and will reflect the requirements outlined in items 1-3 of TSF CC02. Note: Monitoring times above can be varied through a full PEPR review.	No interaction with the TSF	NA	NA
33. No contamination of natural water drainage systems, streams and rivers, groundwater, land and soils occurs either on or off site resulting from permanent disposal or temporary storage of mine ore or waste material.	Once, at completion of construction of TSF cover system, an independent and suitably qualified expert (to DPC's satisfaction) confirms through review of TSF detailed design and all relevant information, including but not limited to construction management plan (including QA/QC) and all other relevant information (instrument installation) that the TSF cover has been constructed to design.	No interaction with the TSF	NA	NA
69. Ensure that the area of the TSF and a 10m wide buffer on all sides is protected in perpetuity from development that may affect the integrity of the TSF design. This protection must include a caveat on the relevant freehold land title.*	Final binding agreement with the relevant SA Government entity (to the Minister's satisfaction) which may be registerable or noted on the relevant title(s) to protect the TSF and a 10m buffer from development as per Lease Condition 69. Final draft to be completed prior to surrender of lease (MCP Appendix AU), based upon CC TSF 01A, CC TSF 01B, CC TSF02 and TSF CC03 ,and then implemented post-closure.	No interaction with the TSF	NA	NA

Lease Condition and Outcome	Leading indicator Criteria	CAES project interaction	Risk mitigation	Monitoring commitments and contingencies
Erosion				
19. Stabilise disturbed areas and prevent sediment from leaving the site and 16. Ensure the site is left in a stable, non-polluting state indefinitely and 56. The Lessee must improve the visual amenity of the mine site in the long-term post mine closure	Rill and gully erosion will be monitored annually until LFA monitoring indicates sustainable land function, at all permanent Landscape Function Analysis (LFA) monitoring transects established post rehabilitation earthworks (MCP Appendix BV). LFA erosion monitoring methods will also be used to record width and depth of any rills or gullies to ensure they are not to exceed • 300mm width and 350mm depth (no mine waste material) • 200mm in width and 200mm depth (on the TSF cover system and spillway interface) • 250mm in width and 250mm depth (TSF embankments) This will be done until; 1) LFA monitoring indicates sustainable function (Sustainability thresholds for each parameter are interpreted as the points of maximum curvature on the sigmoidal curve shape as per Tongway and Hindley (2005). 2) Erosional features gullies and rills have not exceeded the defined extents LFA will be repeated annually for the first 5 years and then at a frequency recommended in the report provided at year 5. LFA will then be repeated to confirm trend 24 months before submission of surrender of Mining Lease document.	There are no LFA transects within Hydrostor's lease area. Final site design will consider surface water flows and include appropriate drainage infrastructure. Reservoir banks to be suitably rehabilitated following construction	NA	NA
19. Stabilise disturbed areas and prevent sediment from leaving the site and 16. Ensure the site is left in a stable, non-polluting state indefinitely and 56. The Lessee must improve the visual amenity of the mine site in the long-term post mine closure and 7. if requested by the Chief Inspector of Mines, undertake an independent audit of achievement of environmental outcomes by an independent and suitably qualified expert (to DSD's satisfaction) approved by the Chief Inspector of Mines.	Annual DTM (Digital Terrain Model)/DSM (Digital Surface Model) survey at 1:5000 resolution and visual inspection of the box cut (Figure 6-5 on page 61) demonstrates a stable landform and improvement to visual amenity and if rills or gullies are present, they do not exceed 300mm width and 350mm depth. Monitoring to cease once the 90% vegetation cover is achieved and erosion monitoring confirms a stable landform. See LIC E05.	No interaction with boxcut landform	NA	NA

Lease Condition and Outcome	Leading indicator Criteria	CAES project interaction	Risk mitigation	Monitoring commitments and contingencies
19. Stabilise disturbed areas and prevent sediment from leaving the site and 16. Ensure the site is left in a stable, non-polluting state indefinitely and 56. The Lessee must improve the visual amenity of the mine site in the long-term post mine closure and 7. if requested by the Chief Inspector of Mines, undertake an independent audit of achievement of environmental outcomes by an independent and suitably qualified expert (to DSD's satisfaction) approved by the Chief Inspector of Mines.	Annual DTM (Digital Terrain Model)/DSM (Digital Surface Model) survey at 1:5000 resolution and visual inspection of the TSF cover system and spillway cover interface (Figure 6-5 on page 61) demonstrates a stable landform and improvement to visual amenity by where rills or gullies are present, they do not exceed 200mm in width and 200mm depth. For the embankments rills and gullies not exceeding 250mm width by 250mm depth Monitoring to cease once the 90% vegetation cover is achieved and erosion monitoring confirms a stable landform. See LIC E06	No interaction with TSF landform	NA	NA
19. Stabilise disturbed areas and prevent sediment from leaving the site and 16. Ensure the site is left in a stable, non-polluting state indefinitely and 56. The Lessee must improve the visual amenity of the mine site in the long-term post mine closure and 7. if requested by the Chief Inspector of Mines, undertake an independent audit of achievement of environmental outcomes by an independent and suitably qualified expert (to DSD's satisfaction) approved by the Chief	Annual DTM (Digital Terrain Model)/DSM (Digital Surface Model) survey at 1:5000 resolution of the box cut (Figure 6-5 on page 61) demonstrates a stable landform and improved visual amenity by monitoring soil loss from erosion is within 20% or below the predicted volumes identified in the erosion report (MCP, appendix BO) which predicts for; Year 1- no veg cover 44.4 Tonnes/ ha/yr (based on max rainfall) Year 2-4 – partial veg cover 22.206 Tonnes /ha/yr (based on max rainfall) Year 5 – partial veg cover 2.206 Tonnes/ha/yr until 90% veg cover is achieved, then for 3 consecutive years monitoring values are within 20% or below 2.206 Tonnes/ha/yr.	No interaction with boxcut landform	NA	NA
19. Stabilise disturbed areas and prevent sediment from leaving the site and 16. Ensure the site is left in a stable, non-polluting state indefinitely and 56. The Lessee must improve the visual amenity of the mine site in the long-term post mine closure and 7. if requested by the Chief Inspector of Mines, undertake an independent audit of achievement of environmental outcomes by an independent and suitably qualified expert (to DSD's satisfaction) approved by the Chief Inspector of Mines.	Annual DTM (Digital Terrain Model)/DSM (Digital Surface Model) survey at 1:5000 resolution of the TSF cover system (Figure 6-5 on page 61) demonstrates a stable landform, limiting of off lease soil loss and improved visual amenity by monitoring soil loss from erosion is within 20% or below the predicted volumes identified in the erosion report (MCP, Appendix BO) which predicts for; Year 1- no veg cover 44.4 Tonnes/ ha/yr (based on max rainfall) Year 2-4 – partial veg cover 22.206 Tonnes /ha/yr (based on max rainfall) Year 5 – partial veg cover 4.152 Tonnes/ha/yr until 90% veg cover is achieved, then for 3 consecutive years monitoring values are within 20% or below 2.206 Tonnes/ha/yr	No interaction with TSF landform	NA	NA

Lease Condition and Outcome	Leading indicator Criteria	CAES project interaction	Risk mitigation	Monitoring commitments and contingencies
19. Stabilise disturbed areas and prevent sediment from leaving the site and 16. Ensure the site is left in a stable, non-polluting state indefinitely and 56. The Lessee must improve the visual amenity of the mine site in the long-term post mine closure and 7. if requested by the Chief Inspector of Mines, undertake an independent audit of achievement of environmental outcomes by an independent and suitably qualified expert (to DSD's satisfaction) approved by the Chief Inspector of Mines.	Annual detailed DEM/ UAV / laser survey at 1:5000 resolution of the TSF as a whole, including embankments, cover system and spillway cover interface (Figure 6-5 on page 61) to demonstrate a stable landform, prevention of off lease soil loss and improved visual amenity by monitoring soil loss from erosion is within 20% or below the predicted volumes identified in the erosion report (MCP, Appendix BO) which predicts for; Year 1- no veg cover 44.4 Tonnes/ ha/yr (based on max rainfall) Year 2-4 – partial veg cover 22.206 Tonnes /ha/yr (based on max rainfall) Year 5 – partial veg cover 2.206 Tonnes/ha/yr until 90% veg cover is achieved, then for 3 consecutive years monitoring values are within 20% or below 2.206 Tonnes/ha/yr	No interaction with TSF landform	NA	NA
Groundwater				
16. Ensure there is no adverse impact to the supply of water by the lessees operations to existing users and water dependent ecosystems *and* 25. No water contaminated as a result of mining operations leaves the lease area or results in contamination of soil at mine closure *and* 27. Ensure water discharged from the site is compliant with relevant environment protection policy under Environment Protection Act 1993 (SA) *and* 65. Ensure the site is left in a stable, non-polluting state indefinitely post- closure	Onsite Groundwater Levels: groundwater level (metres below ground level and mAHD) in Mine Void Entrance, DH2, DH3 and PF140 located on ML 6229 (Figure 6-32/MCP Appendix R) will be monitored quarterly during the first 12 months of recovery after underground operations cease to confirm cone of depression. Monitoring will reduce to biannually (every 6 months) for calibration purposes after the first 12 months of recovery after underground operations cease. Monitoring will cease with the achievement of CC MV01.	Dewatering during early stages of the Project will result in waste water that will be re-injected into the groundwater aquifer, as was undertaken during mining operations.	Groundwater modelling and resulting dewatering and re-injection plan, including water treatment where required, will ensure groundwater quality is protected. Waste water will be treated to appropriate quality prior to re-injection.	Groundwater level and quality monitoring in accordance with closure criteria.

Lease Condition and Outcome	Leading indicator Criteria	CAES project interaction	Risk mitigation	Monitoring commitments and contingencies
16. Ensure there is no adverse impact to the supply of water by the lessees operations to existing users and water dependent ecosystems and 25. No water contaminated as a result of mining operations leaves the lease area or results in contamination of soil at mine closure and 27. Ensure water discharged from the site is compliant with relevant environment protection policy under Environment Protection Act 1993 (SA) and 65. Ensure the site is left in a stable, non-polluting state indefinitely post- closure	Regional Groundwater Levels: Where land access is granted, the groundwater level (mAHD) in the five regional monitoring bores (RG1, RG2, RG3, RG4 and RG8) located on and adjacent to ML 6229 (Figure 7-1/MCP, Appendix R) will be monitored quarterly during the first 12 months of recovery after underground operations cease to confirm cone of depression. Monitoring will reduce to biannually (every 6 months) for calibration purpose after the first 12 months of recovery after underground operations cease to confirm cone of depression. Monitoring will cease with the achievement of CC MV01.	Dewatering during early stages of the Project will result in waste water that will be re-injected into the groundwater aquifer, as was undertaken during mining operations.	Groundwater modelling and resulting dewatering and re-injection plan, including water treatment where required, will ensure groundwater quality is protected. Waste water will be treated to appropriate quality prior to re-injection.	Groundwater level and quality monitoring in accordance with closure criteria.
16. Ensure there is no adverse impact to the supply of water by the lessees operations to existing users and water dependent ecosystems and 25. No water contaminated as a result of mining operations leaves the lease area or results in contamination of soil at mine closure and 27. Ensure water discharged from the site is compliant with relevant environment protection policy under Environment Protection Act 1993 (SA) and 65. Ensure the site is left in a stable, non-polluting state indefinitely post- closure	Groundwater Quality: Groundwater will be sampled biannually (every six months), as per AS/NZS 5667.1:1998, at four bores (DH2, DH3, PF140, Obs Bore Sth) located on ML 6229 (Figure 6-32/ MCP Appendix R) for; pH, EC, TDS, Zn, Pb, Cd, and SO_{2-} to demonstrate there is no adverse impact to the supply of water by the lessees operations to existing users and water dependent ecosystems. Any SO_{2-} concentration at the source (PF140) that is 50% in excess of the predicted concentration (Exceedance values table - GWMP (Appendix BJ, MCP)) will trigger a response from the Groundwater Management Plan. Any SO_{2-} concentration 50% greater than modelled at DH2, DH3 or Obs Bore South (Exceedance values table - GWMP (Appendix BJ, MCP)) will trigger a response from the Groundwater Management Plan (Appendix BJ). Monitoring will cease with the achievement of CC MV01.	Dewatering during construction will result in waste water that will be re-injected into the groundwater aquifer	Groundwater modelling and resulting dewatering and re-injection plan, including water treatment where required, will ensure groundwater quality is protected.	Groundwater level and quality monitoring following dewatering

APPENDIX D

Traffic impact and access point assessment

WALLBRIDGE GILBERT AZTEC

Hydrostor

Angas Zinc Mine Compressed-Air Energy Storage Project

TRAFFIC IMPACT & ACCESS POINT ASSESSMENT

Job No. ADL189276/ B
02 August 2018

Revision History

Rev	Date	Issue	Originator	Checker	Approver
A	20 July 2018	Draft	JKL	SS	JZ
B	2 August 2018	Revised	JKL	SS	JZ

CONTENTS

1 INTRODUCTION

1.1 BACKGROUND

Wallbridge Gilbert Aztec (WGA) has been engaged by Hydrostor Australia (Hydrostor) to undertake a traffic impact and access point assessment for a proposed Compressed-Air Energy Storage (CAES) facility to be located within the Terramin Australia Angas Zinc Mine in Strathalbyn, South Australia. The purpose of the assessment is to examine the suitability of the proposed access point in relation to the existing road network, the condition of the existing road network and its suitability to accommodate heavy vehicle movements and the proposed traffic demand, to support the Development Application with the State Commission Assessment Panel (SCAP).

1.2 PROJECT DESCRIPTION

1.2.1 General

The Angas Zinc Mine is located 2 km east of the town of Strathalbyn and approximately 60 km south of Adelaide as shown in Figure 1-1 below.

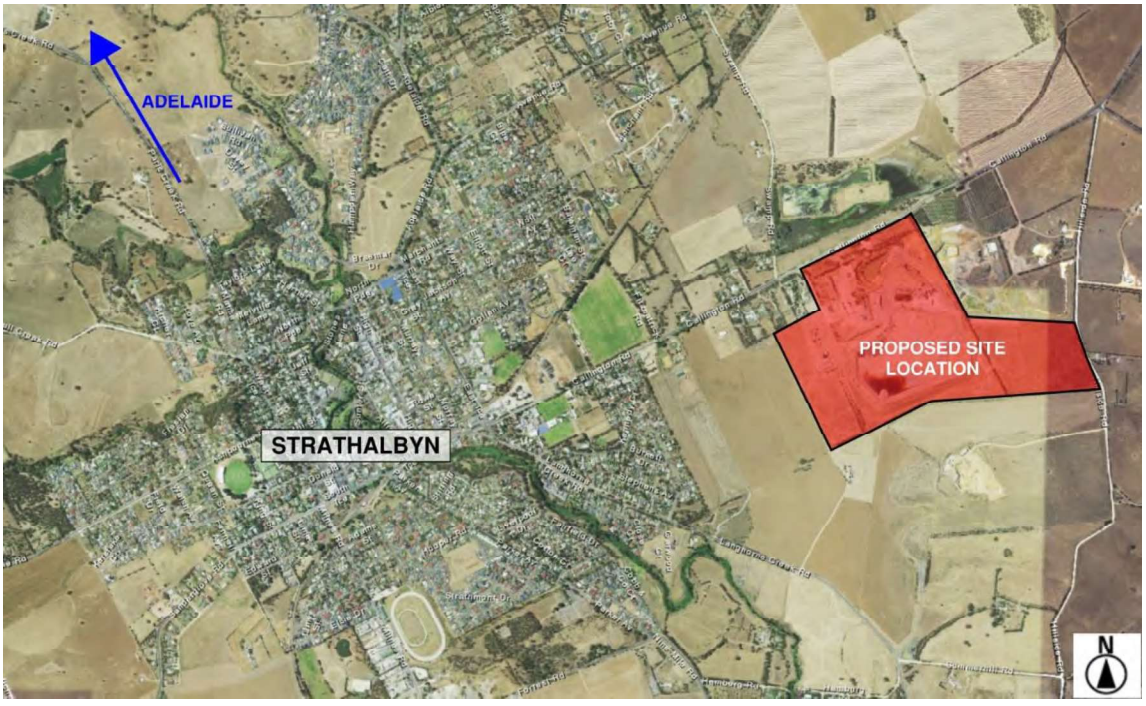

Figure 1-1 - *Site location of CAES facility*

Terramin Australia currently owns a Mining Lease (ML6229) to conduct mining operations on the site. The mine comprises a small underground mine and process plant, as well as a lined tailings storage facility.

1.2.2 Facility

The proposed CAES facility consists of infrastructure that is both above and below ground. Surface infrastructure includes an energy-conversion plant, electrical and controls module and a water reservoir. Underground infrastructure includes an underground cavern designed to store water and air. The mine will be accessed from an existing access road off Callington Road, as shown in Figure 1-2 below.

Figure 1-2 - *Proposed site layout*

1.3 SCOPE OF THE ASSESSMENT

The transportation of materials for the CAES facility will lead to a temporary increase in the number of heavy vehicles on surrounding roads and Hydrostor is seeking to ensure that the network and the proposed access point are in a suitable condition and appropriate to accommodate the anticipated volumes and the potential impact to amenity on the surrounding road network is minimised.

The assessment incorporates the following elements:

- Identification of proposed site access points
- Calculation of vehicle volumes likely to be generated by the proposed CAES facility
- Assessment of the current condition of the identified access points, identifying hazards and impediments to heavy vehicle movements and recommending treatments where required

1.4 INFORMATION SOURCES

A site assessment was undertaken on 21 June 2018 by WGA and incorporated reviewing the proposed access points. Information on projected vehicle volumes during the construction and operation periods has been provided by Hydrostor.

2 DEVELOPMENT ACCESS

2.1 GENERAL

It has been assumed that all vehicle movements will access the site from Callington Road, at the existing access point leading into the Angas Zinc mine, as shown in Figure 2-1.

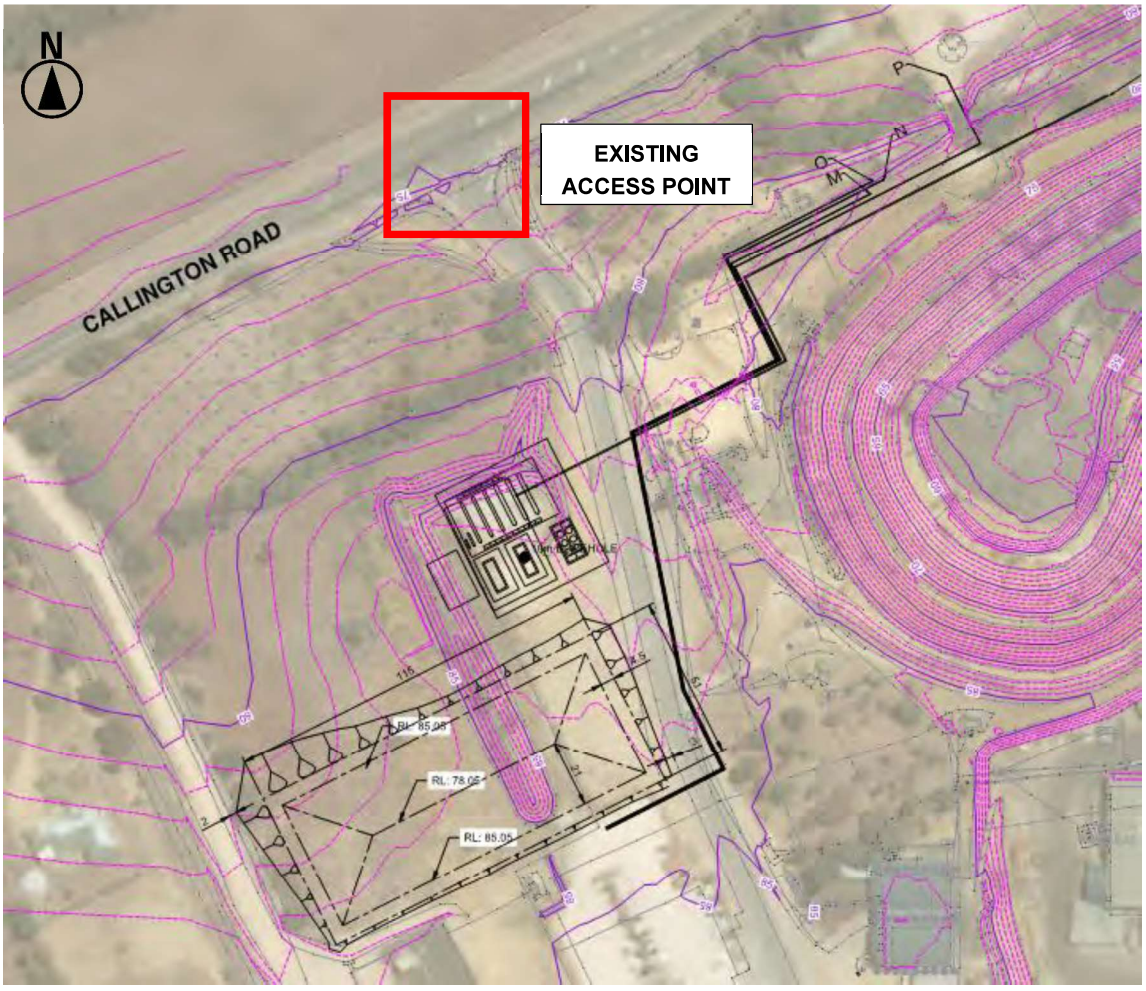

Figure 2-1 - *Proposed access point*

It is considered likely that the majority of heavy vehicle movements in the construction period will travel from the South Eastern Freeway in the north-east. This assumes that the majority of construction components will be sourced from the Port Adelaide region, which will then travel to the Strathalbyn region using the South Eastern Freeway. However, light vehicle movements during the operational period of the CAES are considered likely to generally be from the Strathalbyn region.

2.2 GAZETTED FREIGHT ROUTES

The gazetted freight routes in the vicinity of the Project have been obtained from the Department of Planning, Transport and Infrastructure (DPTI) RavNet website and are illustrated in Figure 2-2 below. Callington Road is a gazetted 26 m B-Double freight route (Performance Based Standard (PBS) Level 2A) providing access to the South Eastern Freeway in the north east.

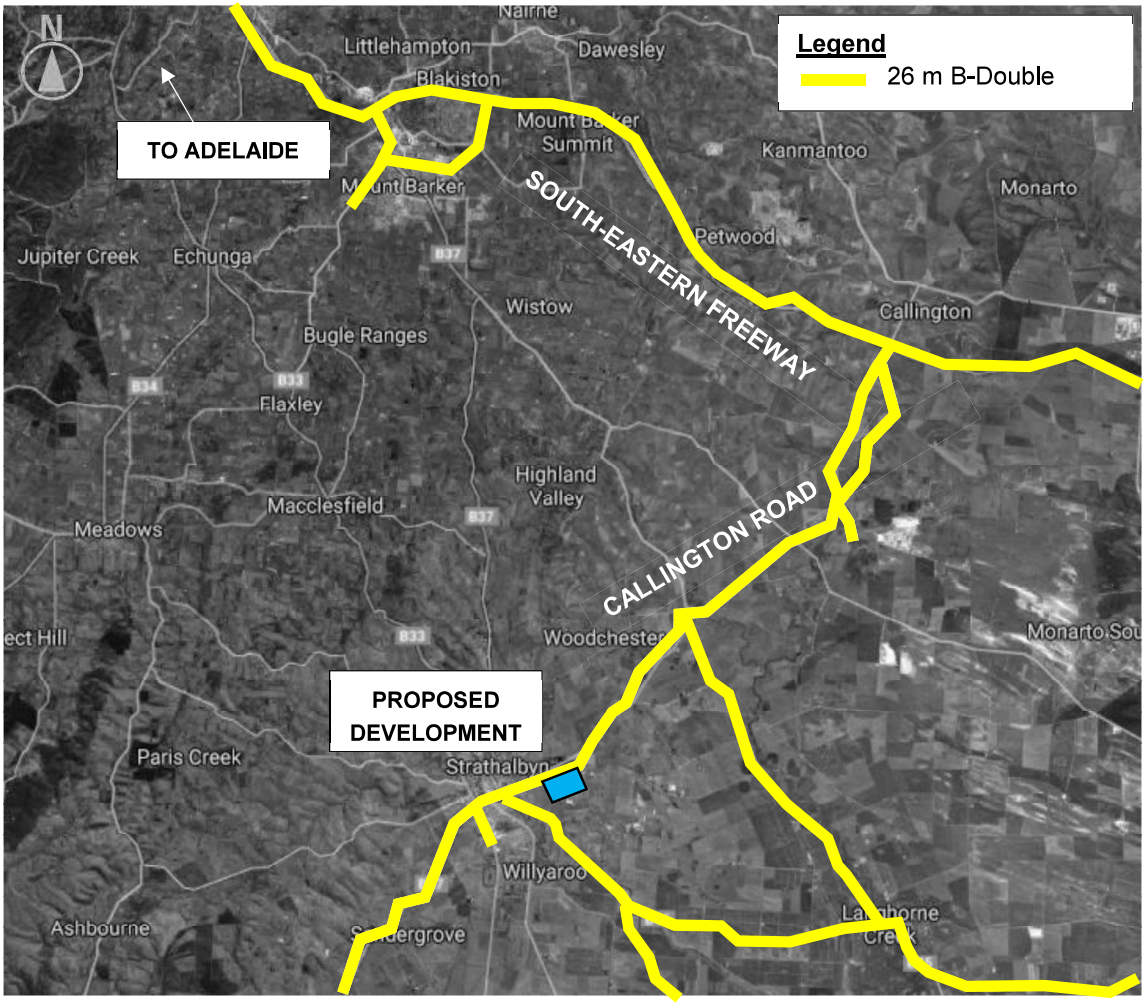

Figure 2-2 - *Gazetted freight routes*

3 VEHICLE VOLUMES

3.1 EXISTING TRAFFIC

Existing traffic volumes on Callington Road have been obtained from the SAViewer Website and are summarised in Table 3-1 below, including the Annual Average Daily Traffic Volume (AADT) and the percentage of heavy vehicles (%HV).

For the purpose of this report, the sourced traffic volumes have had an annual estimated growth rate of 2% applied to determine the likely traffic volumes in 2018. It is assumed that this growth rate is applicable to both heavy and light vehicles.

Table 3-1 – *Existing traffic volumes*

Road	Year of Count	AADT	%HV	Source	Predicted 2018 AADT
Callington Road	2014	2,200	13.5%	SAViewer Website	2,400

3.2 GENERATED TRAFFIC

3.2.1 General

Information on the amount and type of traffic expected to be generated by the construction of the CAES facility has been provided by Hydrostor. The majority of vehicle movements generated will be within (the approximate) eight month construction period, with minimal traffic expected to be generated by the site once operational.

3.2.2 Construction

A summary of estimated construction period volumes provided by Hydrostor is shown in Table 3-2, including an estimate of the average daily volume of vehicle trips based on an eight-month construction period. A standard 6 day working week was assumed when estimating the weekly traffic volumes.

The use of the term 'Trip' represents a one-way vehicular movement from one point to another. Therefore, a vehicle entering and leaving the CAES facility will correspond to two trips.

Table 3-2 - *Construction period traffic volumes*

Vehicle	Trips (Veh/Day)	Trips (Veh/Week)	Trips (Total Construction Period)
Heavy Vehicles	4	24	832
Light Vehicles	60	360	12,480
Total	**64**	384	**13,312**

It can be seen from information contained in Table 3-2 that the majority of movements to the site during the construction period are expected to be by light vehicles (approximately 94% of all trips).

The remaining trips will be generated by heavy vehicles, expected to be either 19.0 m semi-trailers or 26 m B-doubles.

It should be noted that Hydrostor has also indicated that a small number of components may require transport via an oversize/overmass vehicle to the site (2-3 over the construction period). It has been assumed that these vehicles will travel to the site via the South Eastern Freeway/Callington Road and permits will need to be obtained from DPTI prior to travel.

3.2.3 Operations

Hydrostor has advised that there will be minimal traffic during the operational period and that there will be a small workforce (approximately 5 people) that will maintain and operate the site daily. The operational traffic has therefore been calculated on this basis, assuming a 7 day working week. The expected movements and volumes are summarised in Table 3-3.

Table 3-3 - *Operational period traffic volumes*

Vehicle	Trips (Veh/Day)	Trips (Veh/Week)
Heavy Vehicles	0	1
Light Vehicles	10	70
Total	**10**	71

3.3 NETWORK TRAFFIC IMPACT

Table 3-4 and Table 3-5 show the estimated impact on the surrounding road network (Callington Road) resulting from the traffic to be generated by the development during the operational and construction phases. These volumes and percentages have been calculated on the assumption that the forecast traffic will be the sum of the existing traffic volume and 100% of the traffic trips generated by the CAES facility (that is, all generated traffic will access the site via the same route).

Table 3-4 - *Network traffic impact - construction*

Road	AADT			Daily Number of HV	
	Existing	Forecast	% Increase	Existing	Forecast
Callington Road	2,800	2,870	2.5	324	328

Table 3-5 - *Network traffic impact- operational*

Road	AADT			Daily Number of HV	
	Existing	Forecast	% Increase	Existing	Forecast
Callington Road	2,800	2,810	0.4	324	324

It can be seen from Table 3-4 and Table 3-5 that the traffic generated by the proposed CAES facility during the construction period will only increase the AADT on Callington Road by a small amount (in the order of 2.5%), and there will only be a small increase in the number of heavy vehicles. The increase in traffic volumes on Callington Road due to construction is therefore not expected to have a significant impact.

During the operational period, there would be very minimal impact on traffic volumes and no increase in heavy vehicle percentages.

3.4 SUMMARY

Although the traffic volumes and percentage of heavy vehicles may increase slightly along Callington Road during construction, the road itself is already a gazetted PBS Level 2A freight route (with minimal residences and generally good pavement condition) and as such the slight increase in traffic will have minimal impact.

The increase on all roads during the operational period is considered negligible due to the small volume of traffic generated.

4 ACCESS POINT ASSESSMENT

4.1 GENERAL

As discussed in Section 2.1, it is understood that the CAES facility will be accessed from an existing access point located off Callington Road. The existing access point consists of a T-junction with a channelised right turn lane (CHR) and an auxiliary left turn lane (AUL) into the site, as shown in Figure 4-1.

Figure 4-1 - *Site access point*

On 22 June 2018, WGA undertook a site assessment of the proposed access point, assessing:

- Typical road geometry;
- Signage;
- Pavement condition;
- Stormwater drainage; and
- Sight distance.

4.2 SIGNAGE

There is an existing sign associated with the existing access point located on the northern side of Callington Road at the access point. However, the sign is partly obstructed by vegetation, in particular from the eastern approach on Callington Road, as can be seen in Figure 4-2.

Figure 4-2 - *Signage associated with access point*

If the existing signage is to be retained to indicate the presence of the CAES access point, it is recommended that the vegetation is pruned/removed to provide clear indication of the site entry point to vehicles entering the site. Alternatively, an alternative sign could be erected in an unobstructed location. This will reduce the risk of vehicles (particularly heavy vehicles) missing the access point when travelling from the east along Callington Road and therefore attempting to perform a u-turn manoeuvre (not recommended due to narrow geometry and restricted sight lines on Callington Road to the west of the proposed access point).

Speed signage was observed on the approach to the access point from both directions along Callington Road. On the western approach, the sign is approximately 870 m from the access point and indicates a change in the speed limit from 50 km/h to 80 km/h. On the eastern approach, the speed sign is approximately 230 m from the access point and indicates a speed limit change from 100 km/h to 80 km/h. The speed limit on Callington Road adjacent the access point in both directions is therefore 80 km/hr.

4.3 GEOMETRY

At the vicinity of the access point, Callington Road is a dual-lane roadway with traffic travelling in both directions. There is a CHR and an AUL providing access to the Angas Zinc Mine, as well as a widened shoulder on the south-western corner providing additional protection to vehicles turning left out of the site. The widened sealed shoulder area is chevroned on the south-western corner, as seen in Figure 4-3, and has a relatively short taper at the western end.

Figure 4-3 - *Left turn (chevroned area) out of access point*

An assessment has been undertaken in accordance with the AUSTROADS warrants to determine whether the existing turning treatments are required for the proposed access point of the CAES facility. The assessment assumes that 50% of the development trips would be undertaking the turning movement in the same hour and a 10% peak hour factor on Callington Road (considered conservative). The assessment has been undertaken against the requirements of Figure 2.26 of AUSTROADS Guide to Traffic Management: Part 6: Intersections, Interchanges and Crossings, as shown in Figure 4-4.

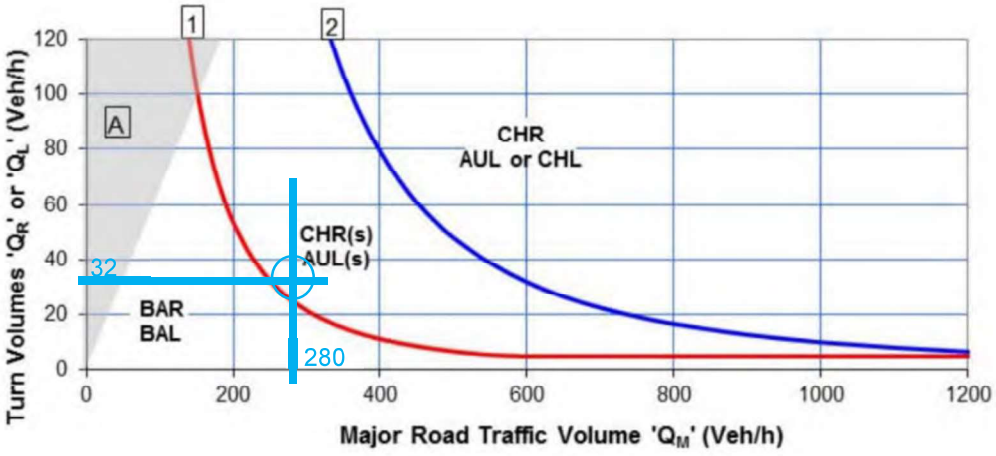

Figure 4-4 - *Warrant for Turn Treatment on Major Roads at Unsignalised Intersections (Source: AUSTROADS Guide to Traffic Management: Part 6)*

In accordance with the AUSTROADS warrants, an AUL(S) treatment is required at the intersection which is in accordance with the existing left turn treatment. In fact, the existing AUL, with a length of approximately 75 m, exceeds the minimum length (55 m) stated in AUSTROADS Guide to Road Design Part 4A Table 8.2 for a 90 km/hr design speed.

If all construction traffic was to turn right from Callington Road into the facility (highly unlikely), a CHR(S) would be warranted which is in accordance with what is currently provided at the access point. The currently provided lateral length of the CHR is 150 m, which once again exceeds the minimum requirement of 75 m for a CHR(S) with a design speed of 90 km/hr as per Table A4 of AUSTROADS Guide to Road Design Part 4.

At the location of the access point, the sealed carriageway width of Carrington Road is approximately 10 m with sealed shoulders of approximately 1 m width, and a two-way cross fall. The alignment of Callington Road is straight on approach to the access point, with the closest horizontal curve located approximately 380 m to the east. Callington Road rises to the west of the proposed access point, with the crest location approximately 500 m from the access point.

The existing access road has an approximate width of 16 m where it meets with Callington Road and the edges of the access point are delineated by approximately 3 m wide chevrons. The access road has a gentle upward gradient from Callington Road, as seen in Figure 4-5.

Figure 4-5 - *Configuration of access point*

4.4 PAVEMENT CONDITION

At the vicinity of the access point, Callington Road was observed to be surfaced with a thin bituminous surfacing. The seal was observed to be in average condition, with longitudinal cracking and small patches of crocodile cracking on the approach to the access point as shown in Figure 4-6.

Figure 4-6 - *Crocodile cracking on Callington Road*

Tyre marks were observed on the unsealed shoulder on the northern side of Callington Road adjacent the access point as shown in Figure 4-7.

Figure 4-7 - *Vehicle track marks off the sealed shoulder of Callington Road*

Tracking has been undertaken to confirm the B-double vehicles can undertake the right turn movement within the sealed carriageway, as shown in Figure 4-8, to confirm that the tyre marks are not caused by vehicles turning right onto Callington Road from the access point. It is considered unlikely that they are caused by right turn movements into the development, as signage indicating the access point is clearly visible from the western approach. The tyre marks are therefore considered likely to have been created by vehicles not associated with the development, such as vehicles undertaking u-turns or pulling over to the side of the road.

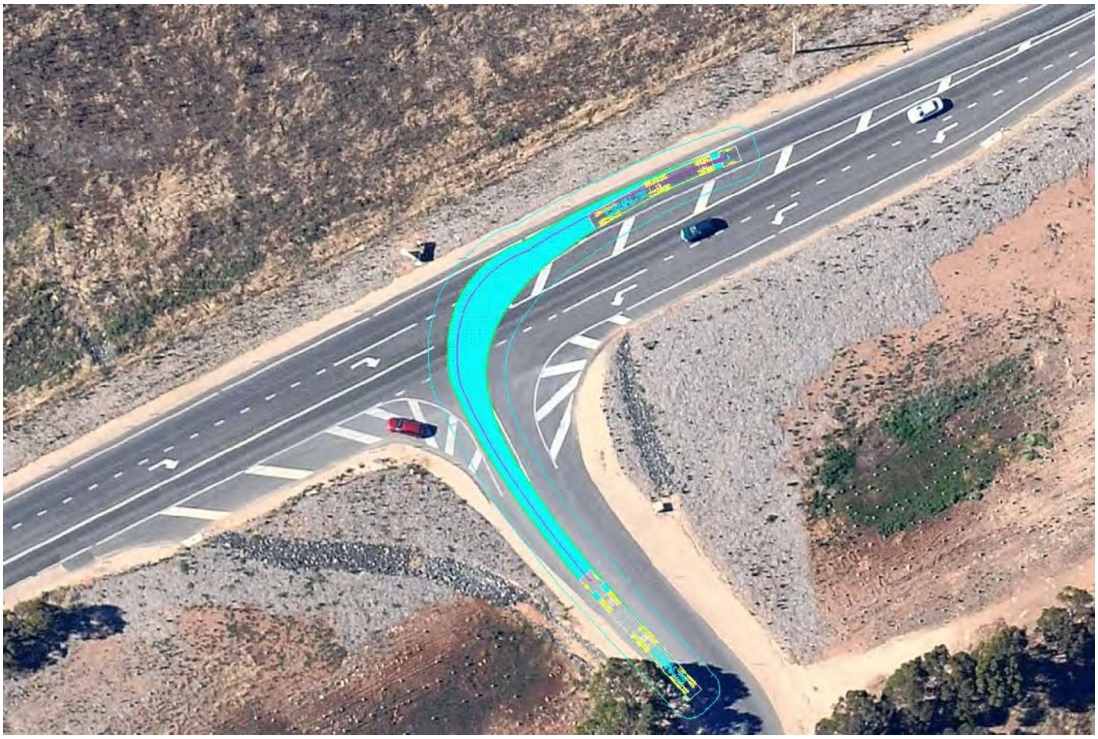

Figure 4-8 – *B-double tracking right from proposed access point*

The existing sealed access road was observed to be in generally good condition, with no major defects or deformations observed during the site assessment. However, some vehicle gauge marks such as those shown in Figure 4-9 were present across the proposed access point. These marks indicate that vehicles (likely heavy vehicles with a trailer) have scraped the pavement whilst turning right out of the facility. As the number of marks is minimal, it is considered that these are likely isolated incidents and no issues with ground clearance are envisaged. However, to confirm, a vertical change of grade assessment at this location could be considered prior to construction.

Figure 4-9 - *Gauge marks at the access point*

Due to the generally good condition of the existing pavement, there is expected to be minimal works required on the access point pavement during construction or operation of the site outside of general maintenance requirements.

4.5 STORMWATER DRAINAGE

At the access point, the two-way cross fall on Callington Road drains water away from the shoulders to shallow rollover kerbs on the southern side and to the verge on the northern side. The rollover kerbs drain away from the access point to side entry pits (SEPs) on both the western and eastern approaches, with silt and other material likely deposited by stormwater present along the lengths, as shown in Figure 4-10. These areas should therefore be monitored during construction to ensure that free flow paths are maintained to reduce the risk of material being washed into vehicle paths, with the asset owner notified if maintenance is required to be applied.

Figure 4-10 - *Silt and minor deformation along Callington Road*

Minor scour and deformation and silt deposits were also observed at the pavement joint between the access road and Callington Road, as shown in Figure 4-11 below. To protect the pavement from moisture ingress, consideration could be given to applying a crack sealant at this joint location or installation of a spoon drain.

Figure 4-11 - *Erosion across the face of the access point*

Rock-lined swales were also present on both sides of the access road on the approach to Callington Road, shown in Figure 4-12 .

Figure 4-12 - *Rock-lined swales alongside the access point*

4.6 SIGHT DISTANCE

Sight distance requirements for the proposed access point have been based on AUSTROADS Guide to Road Design Part 4A, which states that for property accesses, sight distances should desirably comply with the sight distance requirements for intersections i.e. approach sight distance (ASD), safe intersection sight distance (SISD) and minimum gap sight distance (MGSD).

4.6.1 Approach Sight Distance (ASD)

ASD is the minimum level of sight distance which must be available on the minor road approaches to all intersections to ensure that drivers are aware of the presence of an intersection. Figure 4-13 below provides a diagrammatic representation of ASD.

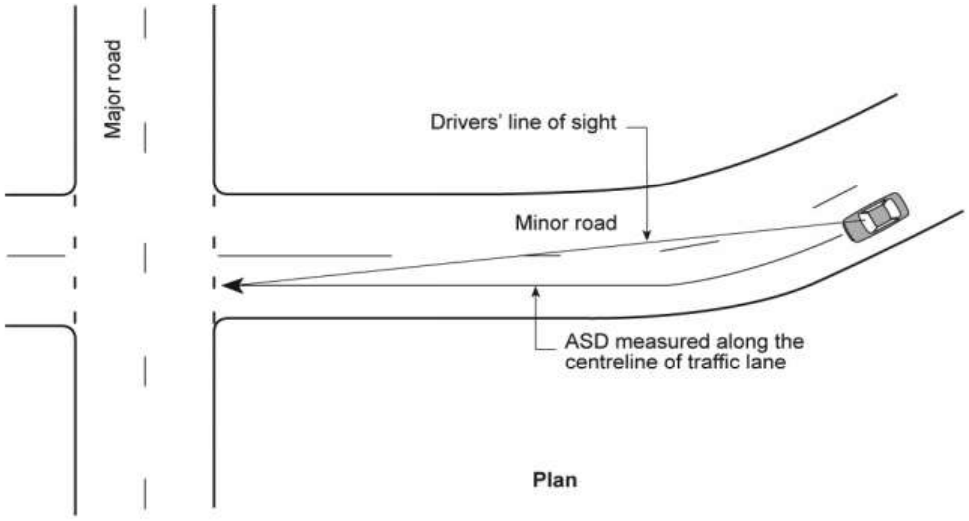

Figure 4-13 - *Approach Sight Distance*

For a design speed of 40 km/hr (assuming that vehicles will be restricted to travelling at a relatively slow speed within the site) and a reaction time of 2.0 seconds, the ASD required is 40 m (Table 3.1, AGRD 4A). This sight distance is achieved based on the current access road being retained. However, if it is desired to further improve approach sight distance, existing vegetation on the western side of the access point could be trimmed/removed to provide additional warning to approach vehicles of the upcoming junction.

4.6.2 Safe Intersection Sight Distance (SISD)

SISD provides sufficient distance for a driver of a vehicle on the major road to observe a vehicle on a minor road approach moving into a collision situation and to decelerate to a stop before reaching the collision point. Figure 4-13 below provides a diagrammatic representation of SISD.

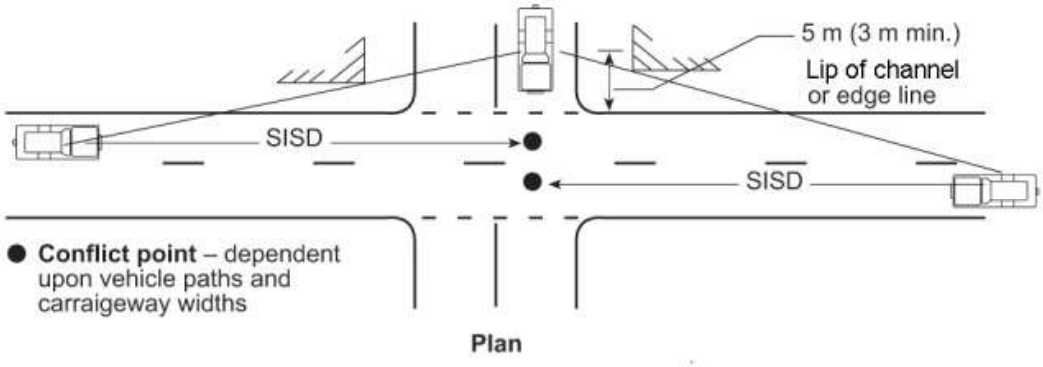

Figure 4-14 - *Safe Intersection Sight Distance*

For a design speed of 90 km/hr (10 km/hr above the posted speed limit of 80 km/hr) and a reaction time of 2.0 seconds, the SISD required is 214 m (Table 3.2, AGRD 4A). This is achieved at the current site access point in both directions, as summarised in Table 4-1.

Table 4-1- *Sight Distance at Callington Road*

Approach	Available Sight Distance	SISD Met?
Callington Road West	500 m	Yes
Callington Road East	400 m	Yes

4.6.3 Minimum Gap Sight Distance (MGSD)

MGSD is based on distances corresponding to the critical acceptance gap that drivers are prepared to accept when undertaking a crossing or turning manoeuvre at intersections.

For an approach speed of 90 km/hr (the maximum approach speed provided) and a critical gap acceptance time of 5 seconds, the required MGSD is 125 m (Table 3.5, AGRD 4A). This is achieved at the current site access point.

4.6.4 Summary

Table 4-2 below provides a summary of the sight distances at the proposed access point on Callington Road, with the required sight distances met against every criterion.

Table 4-2- *Summary of Sight Distance Requirements*

Sight Distance Requirement	Criteria Assessment
Approach Sight Distance (ASD)	Met at current access point location
Safe Intersection Sight Distance (SISD)	Met at current access point location
Minimum Gap Sight Distance (MGSD)	Met at current access point location

4.7 OVERSIZE VEHICLES

It is understood that a small number of oversize, and/or overmass vehicles will need to access the site during the construction period. No oversize/overmass vehicles were observed to be using Callington Road at the time of the site inspection and permits will need to be obtained during the construction period from DPTI for each specific vehicle prior to travel.

It is considered likely that the oversize/overmass vehicles will travel via the same route as the remainder of heavy vehicles (i.e. via the South Eastern Freeway and Callington Road). An alternative route could be to travel to Callington Road from the west via the South Eastern Freeway and Murray Bridge, utilising the DPTI oversize/overmass route network to travel to Murray Bridge from Port Adelaide (via the Sturt Highway).

There is not foreseen to be any major issues with these routes (it is likely that oversize/overmass components have travelled to the area previously), although the height/width restrictions of the adopted route will need to be considered as part of the permit process once the size and mass of the components are known. For example, consideration may need to be given to restrictions at the Heyson Tunnels (4.0 m width) and at existing bridges on Callington Road at Rodwell Creek and Bremer River.

4.8 SUMMARY

The assessment identified that the existing access point is considered suitable for the proposed site access point, with the following to be taken into consideration:

- If existing signage is to be retained to indicate the presence of the CAES access point, it is recommended that adjacent vegetation is pruned/removed to provide clear indication of the site entry point to vehicles entering the site. Alternatively, an alternative sign could be erected in an unobstructed location.
- Due to the generally good condition of the existing pavement, there is expected to be minimal works required on the access point pavement during construction or operation of the site outside of general maintenance requirements.
- To confirm that there are no issues with ground clearance at the access point, the vertical change of grade at this location could be assessed prior to construction.
- The existing rollover kerb areas on the southern side of the junction should be monitored during construction to ensure that free flow paths are maintained to reduce the risk of material being washed into vehicle paths, with the asset owner notified if maintenance is required to be applied.
- To protect the pavement from moisture ingress at the joint between the access road and Callington Road, consideration could be given to applying a crack sealant at this joint location or installation of a spoon drain.
- Minimum sight distance requirements are met for the proposed access point in accordance with AUSTROADS Guide to Road Design Part 4A. However, if it is desired to further improve approach sight distance, existing vegetation on the western side of the access point could be trimmed/removed to provide additional warning to approach vehicles of the upcoming junction.

5 SUMMARY

5.1 GENERAL

WGA has been engaged by Hydrostor to undertake a traffic impact and access point assessment for a proposed CAES facility to be located near Strathalbyn, South Australia. The purpose of the assessment is to examine the suitability of proposed access points in relation to the existing road network, the condition of the existing road network and its suitability to accommodate heavy vehicle movements and the proposed traffic demand to support the Development Application with SCAP.

5.2 IMPACT ON TRAFFIC

Based on estimated traffic volumes provided by Hydrostor, traffic generated by the CAES facility will have a minimal impact on traffic volumes along Callington Road. The majority of vehicle movements generated will be within the approximate eight month construction period, with minimal traffic expected to be generated by the site once operational.

Although the traffic volumes and percentage of heavy vehicles may increase slightly on Callington Road during construction, the road itself is already a gazetted freight route (with minimal residences and generally good pavement condition) and as such the slight increase in traffic (2.5% increase in AADT) will have minimal impact. The increase on all roads during the operational period is considered negligible due to the small volume of traffic generated.

There has been indication that oversize/overmass vehicles will be required during the construction period. Hydrostor will need to obtain permits during the construction period from DPTI for each specific vehicle prior to travel.

5.3 SITE ACCESS ASSESSMENT

The proposed site access point was assessed for suitability, with the following items assessed:

- Typical road geometry;
- Signage;
- Pavement condition;
- Stormwater drainage; and
- Sight Distance.

The assessment identified that the existing access point is considered suitable for the proposed site access point, with the following to be taken into consideration:

- If existing signage is to be retained to indicate the presence of the CAES access point, it is recommended that adjacent vegetation is pruned/removed to provide clear indication of the site entry point to vehicles entering the site. Alternatively, an alternative sign could be erected in an unobstructed location.
- Due to the generally good condition of the existing pavement, there is expected to be minimal works required on the access point pavement during construction or operation of the site outside of general maintenance requirements

- To confirm that there are no issues with ground clearance at the access point, the vertical change of grade at this location should be assessed prior to construction.
- The existing rollover kerb areas on the southern side of the junction should be monitored during construction to ensure that free flow paths are maintained to reduce the risk of material being washed into vehicle paths, with the asset owner notified if maintenance is required to be applied.
- To protect the pavement from moisture ingress at the joint between the access road and Callington Road, consideration could be given to applying a crack sealant at this joint location or installation of a spoon drain.
- Minimum sight distance requirements are met for the proposed access point in accordance with AUSTROADS Guide to Road Design Part 4A. However, if it is desired to further improve approach sight distance, existing vegetation on the western side of the access point could be trimmed/removed to provide additional warning to approach vehicles of the upcoming junction.

6 REFERENCES

- **Austroads, 2016.** Guide to Road Design, Part 3: Geometric Design
- **Austroads, 2017.** Guide to Road Design, Part 4: Intersections and Crossings - General
- **Austroads, 2017.** Guide to Road Design, Part 4A: Unsignalised and Signalised Intersections
- **Austroads, 2017.** Guide to Traffic Management, Part 6: Unsignalised and Signalised Intersections
- **Standards Australia, 2009.** Australian Standard 1742 Manual of Uniform Traffic Control Devices, Part 2: Traffic Control Devices for General Use

Sarah Shelton
CIVIL ENGINEER

Telephone: 08 8223 7433

Email: sshelton@wga.com.au

ADELAIDE
60 Wyatt St
Adelaide SA 5000
Telephone: 08 8223 7433
Facsimile: 08 8232 0967

MELBOURNE
Level 2, 31 Market St
South Melbourne VIC 3205
Telephone: 03 9696 9522

PERTH
634 Murray St
West Perth WA 6005
Telephone: 08 9336 6528

DARWIN
Suite 7/9 Keith Ln
Fannie Bay NT 0820
Telephone: 08 8941 1678
Facsimile: 08 8941 5060

WHYALLA
1/15 Darling Tce
Whyalla SA 5600
Phone: 08 8644 0432

WALLBRIDGE GILBERT AZTEC
www.wga.com.au
adelaide@wga.com.au

APPENDIX E

Noise and vibration assessment

Hydrostor Compressed Air Energy Storage

Environmental Noise and Vibration Assessment

A180192RP1 Revision B

Wednesday, 9 January 2019

Resonate

Document Information

Project	Hydrostor Compressed Air Energy Storage	
Client	Golder Associates	
Report title	Environmental Noise Assessment	
Project Number	A180192	
Author	Matthew Tripodi Acoustic Consultant p+61 8 8155 5888 m+61 437 885 388 matthew.tripodi@resonate-consultants.com	
Reviewed by	Jon Cooper	

Revision Table

Report revision	Date	Comments
0	23 August 2018	First issue
A	18 December 2018	Update based on revised layout
B	9 January 2019	Minor site revision

Glossary

A-weighting	A spectrum adaption that is applied to measured noise levels to represent human hearing. A-weighted levels are used as human hearing does not respond equally at all frequencies.
Characteristic	Associated with a noise source, means a tonal, impulsive, low frequency or modulating characteristic of the noise that is determined in accordance with the Guidelines for the use of the Environment Protection (Noise) Policy (Noise EPP) to be fundamental to the nature and impact of the noise.
Continuous noise level	A-weighted noise level of a continuous steady sound that, for the period over which the measurement is taken using fast time weighting, has the same mean square sound pressure as the noise level which varies over time when measured in relation to a noise source and noise-affected premises in accordance with the Noise EPP
Day	Between 7 am and 10 pm as defined in the Noise EPP
dB	Decibel—a unit of measurement used to express sound level. It is based on a logarithmic scale which means a sound that is 3 dB higher has twice as much energy. We typically perceive a 10 dB increase in sound as a doubling of that sound level.
dB(A)	Units of the A-weighted sound level.
Frequency (Hz)	The number of times a vibrating object oscillates (moves back and forth) in one second. Fast movements produce high frequency sound (high pitch/tone), but slow movements mean the frequency (pitch/tone) is low. 1 Hz is equal to 1 cycle per second.
Indicative noise level	Indicative noise level determined under clause 5 of the Noise EPP.
L_{90}	Noise level exceeded for 90 % of the measurement time. The L_{90} level is commonly referred to as the background noise level.
L_{eq}	Equivalent Noise Level—Energy averaged noise level over the measurement time.
L_{max}	The maximum instantaneous noise level.
Night	Between 10.00 p.m. on one day and 7.00 a.m. on the following day as defined in the Noise EPP
Noise source	Premises or a place at which an activity is undertaken, or a machine or device is operated, resulting in the emission of noise
Quiet locality	A locality is a quiet locality if the Development Plan provisions that make land use rules for the locality principally promote land uses that all fall within either or both of the following land use categories: (a) Residential; (b) Rural Living;

Resonate

Table of Contents

1 Introduction

Golder Associates has engaged Resonate Consultants to undertake an environmental noise and vibration assessment of the proposed Hyrostor Compressed-Air Energy Storage Project. The project uses advanced compressed air energy storage (A-CAES) technology to store energy and provide it back to the grid on demand. The compressed air is to be stored inside the Angas Zinc mine shaft, located just east of Strathalbyn, South Australia.

A noise and vibration assessment has been conducted for the development, based on the proposed equipment and layout of plant. As a result of the findings of the noise and vibration assessment, recommended mitigation measures have been provided such that compliance with relevant noise and vibration criteria can be achieved.

2 Proposed development

2.1 Location

The proposed development is located at the site of the Angus Zinc mine in Strathalbyn, South Australia. A location map showing the proposed site of the Hydrostor facility, the nearby noise sensitive receivers and the zoning is presented in Appendix A.

2.2 Operation

It is understood that the proposed development may operate at all hours of the day. This assessment has considered the night time operation of the Hydrostor facility, as noise and vibration criteria during this period are more onerous than during the day.

2.3 Proposed construction

An updated design for the proposed facility was provided by AECOM on 10 December 2018, with a minor revision to remove the head space conditioning unit received on 20 December 2018. The current proposal is for the compressor and expander (the two loudest items of plant) to be located within a 11 m high acoustically treated enclosure, with remaining items of plant located outside as presented in Figure 1.

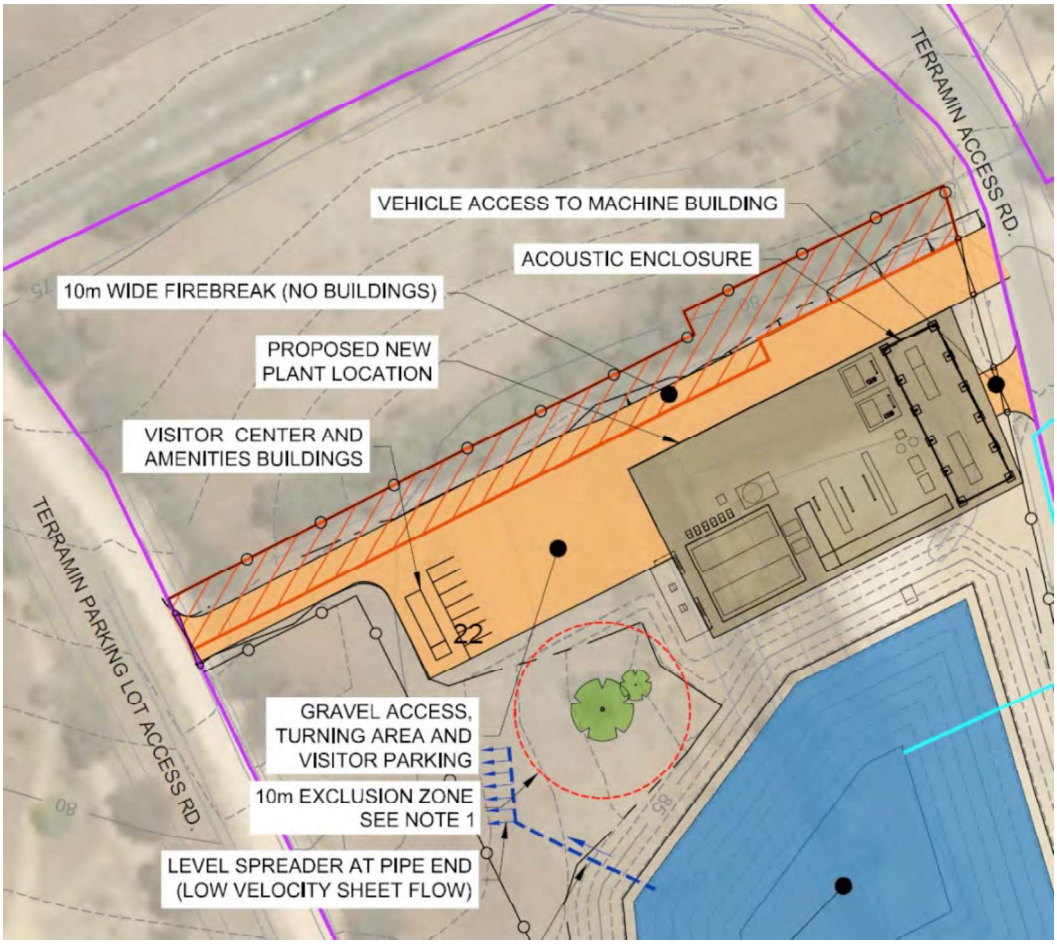

Figure 1 Proposed construction

3 Development Plan

The site is located within the Alexandrina Council area and so needs to have regard to the Alexandrina Council Development Plan. The zoning around the site based on the Development Plan is presented on the location map in Appendix A.

The proposed development is located east of Strathalbyn within Policy Area 9 and zoned as "Primary Production". This zone has the following key Objectives and Principles of Development Control (PDC's):

Objectives

Objective 1: The long term continuation of primary production.

Objective 2: Economically productive, efficient and environmentally sustainable primary production.

Objective 3: Allotments of a size and configuration that promote the efficient use of land for primary production.

Principles of Development Control

1 The following forms of development are envisaged in the zone:

- commercial forestry (except where located within the Hindmarsh Island Rural Policy Area 8)
- dairy farming (except where located within the Hindmarsh Island Rural Policy Area 8)
- farming
- horticulture (except where located within the Hindmarsh Island Rural Policy Area 8)
- tourist accommodation (including through the diversification of existing farming activities and conversion of farm buildings) (except where located within the Flood Policy Area 7)
- wind farms and ancillary development where located within Precinct 46 Wind Farms
- wind monitoring mast and ancillary development where located within Precinct 46 Wind Farms.

……

7 A dwelling should only be developed if:

a) there is a demonstrated connection with farming or other primary production

b) the location of the dwelling will not inhibit the continuation of farming, other primary production or other development that is in keeping with the provisions of the zone

c) it is located more than 500 metres from an existing intensive animal keeping operation unless used in association with that activity

d) it does not result in more than one dwelling per allotment.

Within the vicinity of the proposed facility is a "Residential" Zone. This zone has the following key Objectives and PDC's:

Objectives

Objective 1: A residential zone comprising a range of dwelling types, including a minimum of 15 per cent affordable housing.

Objective 2: Increased dwelling densities in close proximity to centres, public transport routes and public open spaces.

Objective 3: Development that contributes to the desired character of the zone.

Principles of Development Control

1 The following forms of development are envisaged in the zone:

- affordable housing
- domestic outbuilding in association with a dwelling
- dwelling
- dwelling addition
- small scale non-residential use that serves the local community, for example:
  - child care facility
  - health and welfare service
  - open space
  - primary and secondary school
  - recreation area
  - shop, office or consulting room
- supported accommodation.

Within the vicinity of the proposed facility is also a "Rural Living" zone. This zone has the following key Objectives and PDC's:

Objectives

Objective 1: A zone consisting of large allotments, detached dwellings and rural activities that do not adversely impact the amenity of the locality.

Principles of Development Control

1 The following forms of development are envisaged in the zone:

- detached dwelling
- domestic outbuilding in association with a detached dwelling
- domestic structure
- dwelling addition
- farming
- farm building
- stable.

The proposed development should also conform to the relevant council wide PDC's. The noise and vibration related PDC's are presented below:

Under the "Interface between Land Uses" Section:

1 Development should not detrimentally affect the amenity of the locality or cause unreasonable interference through any of the following:
(b) noise
(c) vibration

7 Development that emits noise (other than music noise) should include noise attenuation measures that achieve the relevant Environment Protection (Noise) Policy criteria when assessed at the nearest existing noise sensitive premises.

8 Development with the potential to emit significant noise (e.g. industry) should incorporate noise attenuation measures that prevent noise from causing unreasonable interference with the amenity of noise sensitive premises.

4 Noise criteria

4.1 Legislation

The general environmental duty in section 25 of the *Environment Protection Act 1993* (EP Act) states that:

> A person must not undertake an activity that pollutes, or might pollute, the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm.

Under the EP Act, pollution includes the emission of noise.

4.2 SA Environmental Protection (Noise) Policy

Part 4, Clause 18(1) of the *Environment Protection (Noise) Policy* 2007 (Noise EPP) states that:

> The general environmental duty under section 25 of the Act is satisfied in relation to noise from a noise source, insofar as the noise affects particular noise-affected premises, if the noise complies with the noise goals.

Principal of Development Control 7 of the Interface between Land Uses section of the development plan also specifically requires that noise from the development is assessed against the Environment Protection (Noise) Policy.

The noise goals in the Noise EPP are based on the zoning of the development and the closest noise affected premises in the relevant development plan. The land uses primarily promoted by the zones are used to determine the environmental noise criteria with the indicative noise factors shown in Table 1.

Table 1 Excerpt from Noise EPP (Table 2, subclause(1)(b))

Land use category	Indicative noise factor dB(A)	
	Day (7 am to 10 pm)	Night (10 pm to 7 am)
Rural living	47	40
Residential	52	45
Rural industry	57	50
Light industry	57	50
Commercial	62	55
General industry	65	55
Special industry	70	60

The subject site is located within the Alexandrina Council's "Primary Production" zone which based on the objectives and PDC's would be classified as a "Rural industry" land use category under the Noise EPP. The nearest noise sensitive receivers are located within the "Primary Production", "Residential" and "Rural Living" zones, which based on the Objectives and PDC's of the Development Plan have land use categories under the Noise EPP of "Rural industry", "Residential", and Rural living" respectively.

In accordance with Part 5 of the Noise EPP, the relevant criteria for this development will be the average of the relevant indicative noise factors of the source and receiver locations less 5 dB(A). The application of Part 5 results in environmental noise criteria as summarised in Table 2.

Table 2 EPP noise criteria for receivers around the Hydrostor project

Receiver zone	Noise emission criteria, L_{eq} dB(A)	
	Day (7 am to 10 pm)	Night (10 pm to 7 am)
Primary Production (Rural Industry)	52	45
Residential	50	43
Rural Living	47	40

In addition, the Noise EPP requires that for planning assessments, the predicted night time noise level received in "Residential" and "Rural Living" zones should not exceed 60 dB(A) L_{max}. We note that due to the relatively consistent nature of noise emissions from the proposed plant, design for compliance with the night time L_{eq} criteria in Table 2 will result in compliance with the 60 dB(A) L_{max} criterion.

Penalties can also be applied to a noise source for a variety of characteristics, such as impulsive, low frequency, modulating or tonal characters. For a characteristic penalty to be applied to a noise source it must be fundamental to the impact of the noise and dominate the overall noise impact. The application of character penalties is discussed further in the noise and vibration assessment section.

5 Vibration Criteria

Specific vibration criteria are not provided in the Alexandrina Council Development Plan, so the criteria below have been adopted as they are based on widely used Australian and International Standards.

5.1 Vibration Criteria for Human Comfort

Human comfort vibration targets are presented below for occupants of different building types. The targets are based on Annex A of Australian Standard AS 2670.2-1990 *Evaluation of human exposure to whole-body vibration, Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)*. Human comfort criteria should be achieved during the operational phase of the proposed development. If vibration levels are expected to exceed these limits during construction phase, it would then be appropriate to engage in community consultation.

Table 3 Human Comfort Vibration Criteria

Building usage and time period	Peak Particle Velocity (PPV) target, mm/s
Residential – Day and Shoulder	0.3 – 0.6
Residential – Night	0.2
Office – when in use	0.6
Workshop – when in use	1.2

The criteria presented above are conservative screening limits and it does not necessarily follow that an exceedance will result in disturbance. If an exceedance occurs and further investigation is warranted, then the frequency content of the vibration should be analysed against the curves for the different building usages presented in Figure 2.

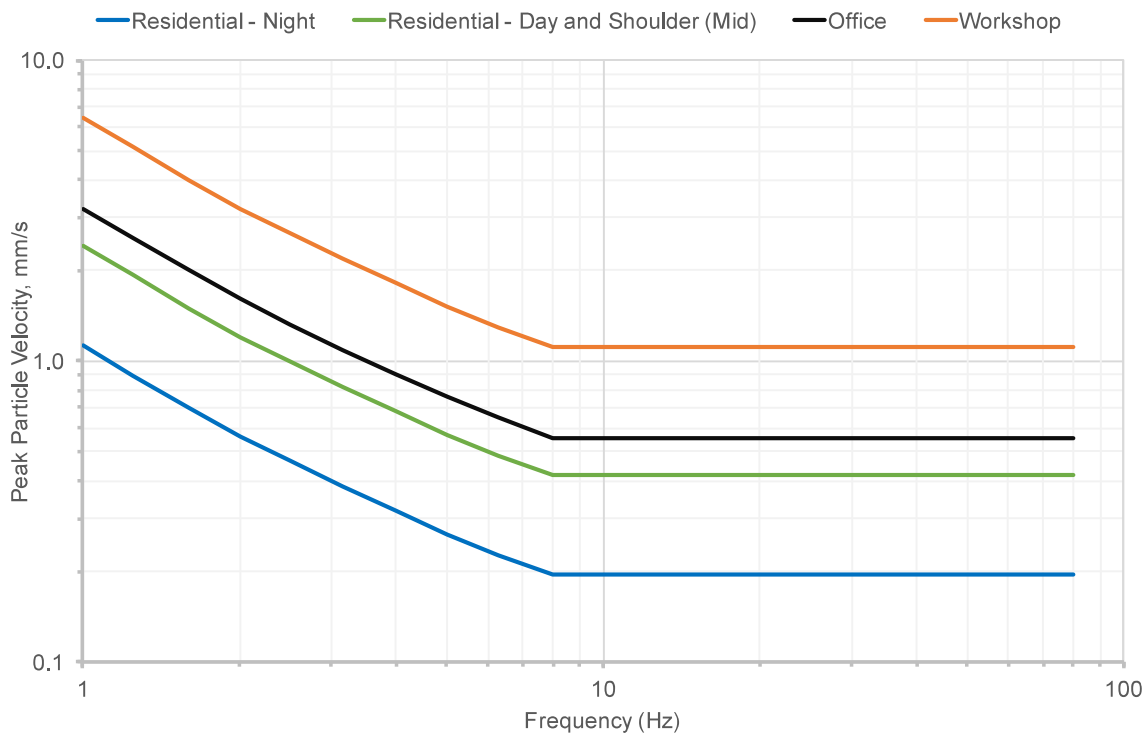

Figure 2 Human Comfort Vibration Criteria

5.2 Vibration limits for Structural Damage

Vibration limits apply at building structures and underground pipework. These limits should not be exceeded during the operation or construction works but are not as stringent as the human comfort criteria.

5.2.1 Buildings

German Standard DIN 4150-3 *Structural Vibration, Part 3 – Effects of Vibration on Structures* is widely used in South Australia for construction and infrastructure projects and so is adopted as a suitable reference for vibration limits to avoid cosmetic and structural damage to buildings. The following DIN 4150-3 limits are specified as PPV levels measured in any direction at or adjacent to the building foundation.

Table 4 Building Damage Vibration Limits

Type of building structure	Peak Particle Velocity (PPV) limit, mm/s
Commercial, industrial and similar buildings	20
Residential and similar structures	5
Heritage-listed structures	3

Where the limits above are not able to be reasonably complied with, then the frequency of the vibration may be considered. If the vibration has a dominant frequency higher than 10 Hz, then a higher vibration limit would apply in accordance with DIN 4150-3 as shown below:

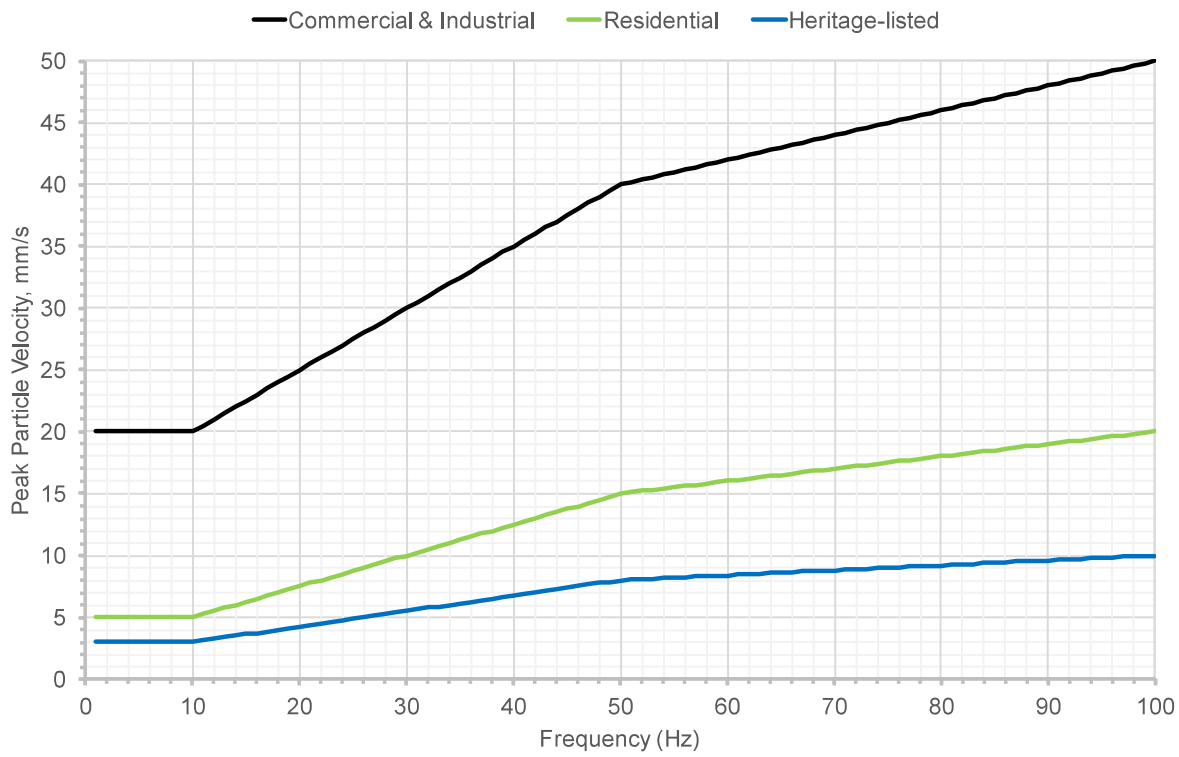

Figure 3 Building Damage Vibration Limits

DIN 4150-3 states that exposing buildings to vibration levels higher than that recommended above would not necessarily result in damage. Rather it recommends these values as maximum levels of short-term construction vibration at which experience has shown that damage that reduces the serviceability of structures will not occur due to vibration effects. The Standard considers a reduction in serviceability of the structure is deemed to have occurred if:

- Cracks form in plastered surfaces of walls
- Existing cracks in the building are enlarged
- Partitions become detached from loadbearing walls or floors.

5.2.2 Underground Infrastructure

The DIN 4150 also provides guidelines for the short-term vibration exposure of buried pipelines. The guidelines provide peak particle velocity (PPV) vibration limits applicable at the pipe surface in any of the three orthogonal directions (i.e. x, y, z). These limits are provided in Table 5.

Table 5 Underground Pipework Vibration Limits

Pipe material	Peak Particle Velocity (PPV) limit, mm/s
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
Masonry, plaster	50

It is noted that these limits are based on pipework built to modern construction standards. Where the integrity of the pipework is uncertain, further investigation may be required

5.2.3 Electrical and communications infrastructure

As construction activities may occur in close vicinity of existing electrical and communications infrastructure, the vibration goals presented in the Australian Coal Industry's Research Program (ACARP) Report *Effect of Blasting on Infrastructure, ACARP Project No C14057*, dated 20 October 2008 will be utilised (presented in Table 6).

Table 6 Suggested vibration limits near electrical and communications infrastructure

Pipe material	Peak Particle Velocity (PPV) limit, mm/s
Power lines – concrete and timber poles	100
Power lines – steel towers	100
Buried communication cables and pipelines	100

6 Noise and vibration assessment

6.1 Noise modelling

6.1.1 Modelling parameters

Noise emissions from site have been modelled in SoundPLAN Environmental Software v8.0 program, using the Conservation of Clean Air and Water in Europe (CONCAWE) algorithms. The model takes into consideration:

- attenuation of noise sources due to distance
- barrier effects from buildings, topography and the like
- air absorption
- ground effects
- weather conditions (wind speed, wind direction, time of day, and cloud cover)

CONCAWE has six different weather categories—CONCAWE weather category 1 represents weather conditions that are least conducive to noise propagation (best case situation with the lowest predicted noise levels), CONCAWE weather category 4 represents neutral weather conditions, and CONCAWE weather category 6 represents weather conditions that are the most conducive to noise propagation (the worst case situation with the highest predicted noise levels). In accordance with the Guidelines for the use of the Environmental Protection (Noise) Policy 2007, CONCAWE weather category 6 has been used this assessment, to assess night time noise emissions.

6.1.2 Noise sources

The noise model has included the equipment presented in Table 7. The overall source sound power levels (SWL) are based on information provided by Hydrostor, which we understand are based both on manufacturer data and measurements at their previous facilities. The octave band spectral data has been based on our databases of noise levels of similar equipment.

Table 7 Source sound power levels

Source Description	Qty.	SWL dB(A)	Octave band centre frequency, Hz, dB(Lin)							
			63	125	250	500	1000	2000	4000	8000
Cooling Tower	1	83	90	85	78	76	78	75	74	74
Heat Exchange Pumps (each)	3	87	80	82	83	81	81	81	78	65
Expander outlet (low pressure)	1	109	105	104	99	98	100	104	105	77
Compressor outlet (low pressure)	1	106	101	101	96	95	97	101	102	74
Transformer	1	90	69	77	85	87	79	77	69	65
Compressor	1	114	117	118	114	112	104	98	106	108
Expander	1	119	114	111	107	108	109	112	115	103

6.1.3 Noise mitigation measures

The proposed Hydrostor facility includes an acoustic enclosure around the two noisiest items of plant, which are the compressor and expander.

Noise modelling presented in this report is based on an enclosure with a height of 11m. The enclosure should be constructed using a minimum of 0.6mm thick Colorbond steel. In addition, the ceiling, the internal western and southern wall should be lined with a minimum of 12mm plywood, which forms a cavity with the Colorbond of at least 150mm on the walls and 200mm on the ceiling. Acoustic insulation which is 50mm thick and has a density of at least 11 kg/m^3 should be provided in the cavity formed between the Colorbond and plywood.

Roller doors to allow access into the enclosure should be positioned on the eastern side, so as to not degrade the attenuation towards the nearest receivers to the west. The expander outlet and the compressor inlets are to be ducted to the eastern side of this enclosure, to shield the nearer receivers to the west of the site.

To control the reverberant noise level within the enclosure two adjacent walls and the ceiling should be lined with a minimum of 75mm thick acoustically absorptive material. One example of an acoustically suitable material is Bradford Supertel 75mm Rm 2.2 with Ultraphon facing. A perforated metal facing with a minimum 20% open area may be included to provide mechanical protection.

6.2 Noise levels with mitigation in place

Noise contours showing the predicted noise levels based on the above source data and acoustic enclosure are presented in Appendix B, and a summary of the predicted noise levels at the nearest receptors within each of the zoning areas is presented in Table 8. The location of the receivers included in Table 8 is provided on the noise contour plot in Appendix B.

Table 8 Predicted Hydrostor noise levels

Location	Noise criteria, L_{eq}, dB(A)	Predicted noise level
Receiver A ("Primary Production") – NE of site	45	**60**
Receiver B ("Primary Production") – SW of site		45
Receiver C – "Residential"	43	<35
Receiver D – All "Rural Living"	40	<35

It is understood that Receiver A is associated with the site and may be vacated if required. This is expected to be required based on the modelling.

With the above noise mitigation measures in place it is not expected that any character penalties to account for tonal, low frequency, modulated or impulsive noise will be required, on the basis that the noise from the tonal turbine and compressor will be mitigated by the enclosure. The mitigation measures proposed above are predicted to result in compliance with the relevant noise criteria at all non-associated receivers around the site.

6.3 Vibration assessment

During normal operation the proposed development is predicted to be less than 0.2 mm/s at all surrounding residential receiver locations, so is not expected to generate levels of vibration which would exceed any of the relevant vibration criteria.

During construction phase a noise and vibration management plan should be adopted to mitigate potential short term noise or vibration impacts.

7 Summary

An environmental noise and vibration assessment has been conducted for the proposed Hydrostor Compressed-Air Energy Storage Project.

Criteria for this assessment have been based on the requirements of the Alexandrina Council Development Plan, and other relevant noise and vibration criteria, namely; the South Australian Environmental (Noise) Protection Policy (Noise EPP), DIN 4150-3 *Structural Vibration, Part 3 – Effects of Vibration on Structures* and Australian Standard AS 2670.2-1990 *Evaluation of human exposure to whole-body vibration, Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)*.

Noise levels were predicted at receivers around the site with only the compressor and expander within an acoustic enclosure, as is currently proposed. The predicted noise levels are in compliance with the noise criteria at all surrounding non-associated receivers, based on the enclosure construction as detailed in Section 6.1.3.

Vibration levels from the operation of the site are predicted to comply with the nominated vibration criteria at all surrounding receivers.

On the basis of this assessment, the site can be designed to achieve compliance with the noise and vibration requirements of the Alexandrina Council Development Plan and all nominated noise and vibration criteria.

Appendix A – Location map

HYDROSTOR COMPRESSED-AIR ENERGY STORAGE
Strathalbyn, South Australia
Zone Map

PROJECT NUMBER	A180192
DRAWN BY	JC
DATE ISSUED	7 January 2019
CLIENT	Golder/Hyrostor
IMAGERY	(c) Google

Legend

- Hydrostor facility

Receivers - Zone [Night Criteria dB(A)]

- Rural Industry [45]
- Residential [43]
- Rural Living [40]

Land Use Zones

- Primary Production
- Residential
- Rural Living

N

0 250 500 750 m

Datum GDA94, Projection MGA ZONE 54

Resonate

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Appendix B – Noise contour map

HYDROSTOR COMPRESSED-AIR ENERGY STORAGE
Strathalbyn, South Australia
Noise Modelling (unmitigated)

PROJECT NUMBER	A180192
DRAWN BY	JC
DATE ISSUED	7 January 2019
CLIENT	Golder/Hyrostor
IMAGERY	(c) Google

Legend

- Hydrostor facility

Predicted noise level dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- > 55

Receivers - Zone [Night Criteria dB(A)]

- Rural Industry [45]
- Residential [43]
- Rural Living [40]

N

0 250 500 750 m

Datum GDA94, Projection MGA ZONE 54

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APPENDIX F

Dewatering report

REPORT

Construction Dewatering and Recharge Requirements

Angas Zinc Mine, Strathalbyn

Submitted to:

Hydrostor
Suite 400- 82 Richmond Street E
Toronto ON
Canada

Submitted by:

Golder Associates Pty Ltd
118 Franklin Street Adelaide, South Australia 5000 Australia

+61 8 8213 2100

1898633-001-R-Rev1

18 January 2019

Distribution List

Hydrostor

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1.0 INTRODUCTION

Hydrostor proposes to develop an Advanced Compressed Air Energy Storage (A-CAES) facility at the Angas Zinc Mine (AZM), Strathalbyn, South Australia (refer to Figure 1).

The 5 Megawatt plant is expected to be operational in the first half of 2019. The project's costs will be reduced by making use of an underground cavern in the existing mine decline (Figure 2). The system utilises an isobaric purpose built underground cavern for air storage within the mine decline. During the charge cycle air is compressed and sent into the cavity, causing water to flow out via the supply line. Electricity is generated during the discharge cycle when heated air is released from the surface which drives a turbine, allowing water to flow into the cavity.

The AZM is owned by Terramin Australia Limited (Terramin). Zinc ore was mined from 2007 to 2013 using underground mining techniques. The ore body was accessed via a decline, through a 5 m x 5 m reinforced portal at the bottom of a box-cut. The mine was put into care and maintenance in 2013. At completion of mining in 2013, the underground mine and box cut was flooded with groundwater as part of the AZM closure strategy.

Construction dewatering is required to enable access to the decline and allow construction of the A-CAES system. Once the decline is dewatered construction is expected to take about 6 months. Groundwater pumped from the mine will be recharged back into the surrounding aquifer via a process known as Managed Aquifer Recharge (MAR). This process was successfully utilized by Terramin during their mining operation and as such the effects of proposed construction dewatering and injection on the aquifer are well understood. The majority of the injection wells used by Terramin have been decommissioned and as such new injection wells will need to be constructed to meet peak construction dewatering rates.

Since the mine closure, the quality of groundwater in the box cut and mine voids has the potential to be degraded due to oxidation of wall rock and backfill material, which will determine whether any pre-treatment is required prior to MAR.

1.1 Objectives

The overall objective of this assessment is to outline the dewatering and injection requirements during the construction of the A-CAES project. In particular:

- Estimate the construction dewatering volume and rates to enable construction of the A-CAES system within the mine decline.
- Estimate the number of injection wells needed to meet the construction dewatering rates.
- Determine the water quality of water within the underground mine and overlying box cut to establish whether any pre-treatment is required prior to injection.
- Assess the risk of upward leakage to the Angas River from MAR and determine whether this represents a constraint to injection rates.

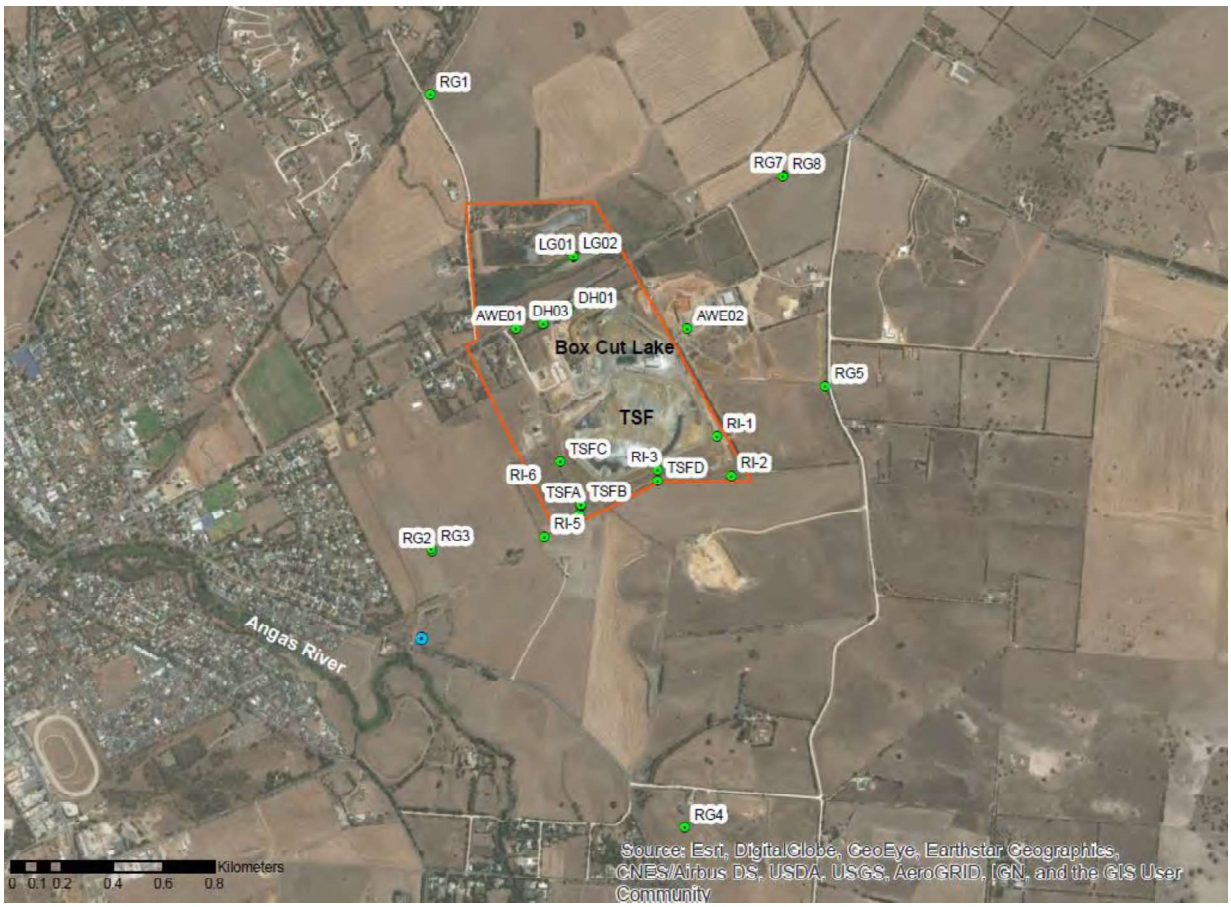

Figure 1: Site Location Plan

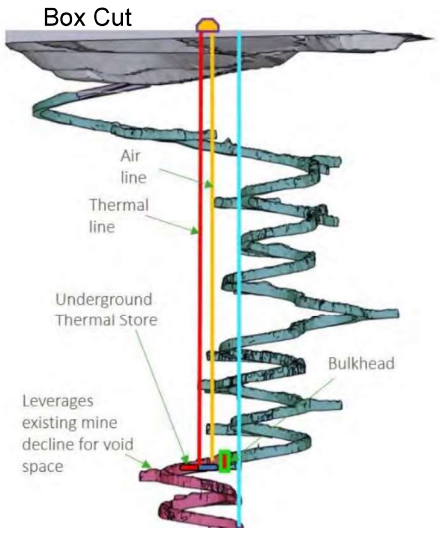

Figure 2: Project Concept

1.2 Scope of work

The following scope of work was undertaken to meet the above objectives.

- Estimated construction dewatering rates and volume based on the underground mine void size, historical groundwater seepage rates and the water balance of the box cut lake. Based on this, Golder calculated a range of construction dewatering lead times and pumping rates needed to achieve dewatering of the mine void to allow construction of the A-CAES system.
- Estimated the number of injection wells required to meet the dewatering demands for construction of the A-CAES system. This was based on the operational performance of the historic injection wells.
- Reviewed the water quality data of the box cut lake and underground mine water to assess whether water quality has altered post mining. Comparisons were made against the native groundwater quality and beneficial use criteria to identify if pre-treatment is required prior to injection.
- Consulted with the Department of Environment and Water (DEW) to present the above outcomes and identify any groundwater concerns that need to be addressed to support regulatory approvals and permitting of new injection wells for the project. From this discussion, DEW recommended that groundwater modelling be undertaken to assess the potential risk to the Angas River.
- Used an existing groundwater model, Golder assessed the risk of upward leakage to the Angas River from the underlying aquifer for a range of dewatering and injection scenarios.
- Prepared a technical report (this report) to support the application for drainage permits.

2.0 THE EXISTING ENVIRONMENT

2.1 Groundwater and surface water

The hydrogeology of the area is summarised below, with further detail provided in Terramin's Mine Closure Plan (Terramin, 2017) and supporting groundwater studies.

- The main aquifers are shown on Figure 3 and comprise of:
  - **Tertiary and Quaternary Sediments –** a shallow water table aquifer which ranges in thickness from 2.5 m to 27 m at the AZM. Drilling investigations conducted on site indicated that aquifers occur in these sediments on a local and discontinuous basis only. The Tertiary and Quaternary water table aquifer is separated from the underlying fractured rock aquifer by a ~20 m thick layer of highly weathered and kaolinized metasediments, which behaves as a confining layer
  - **Fractured Cambrian Bedrock –** referred to in this report as the Cambrian Fractured Rock Aquifer (FRA) represents the main groundwater-bearing zone occurs in discrete fractures from about 40 m to 70 m bgl. There is some evidence of deeper water-transmitting fractures from about 100 to 125 m bgl. The fracture strike is slightly west of due north, with WNW – ESE, and NNE – SSW components; this fracture strike controls groundwater flow (preferential flow occurs along strike);
- Pre-mining groundwater flow was in a southerly direction (Figure 3). This was based on limited monitoring records obtained at the time of drilling (between 2005 and 2007). Mine dewatering occurred from 2008 to 2013 which created a cone of depression around the mine. Since the AZM was put into care and maintenance in 2013, groundwater levels have recovered to near pre-mining elevations based on post-mining monitoring.
- Groundwater salinity of the fractured Cambrian FRA ranges from 13,000 mg/L to 22,500 mg/L and therefore represents an aquifer with few beneficial uses.
- There are no current groundwater users in the area, owing to high salinity which is also deterrent to future users of groundwater in this area.
- The Angas River is located ~1.5 km to the south east of the AZM (Figure 1). There is no conclusive evidence to suggest that the River receives groundwater at this location (Green *et al*, 2008), however surface water salinities recorded by Terramin were often brackish (2,000 mg/L to 3,000 mg/L), suggesting some groundwater interaction.

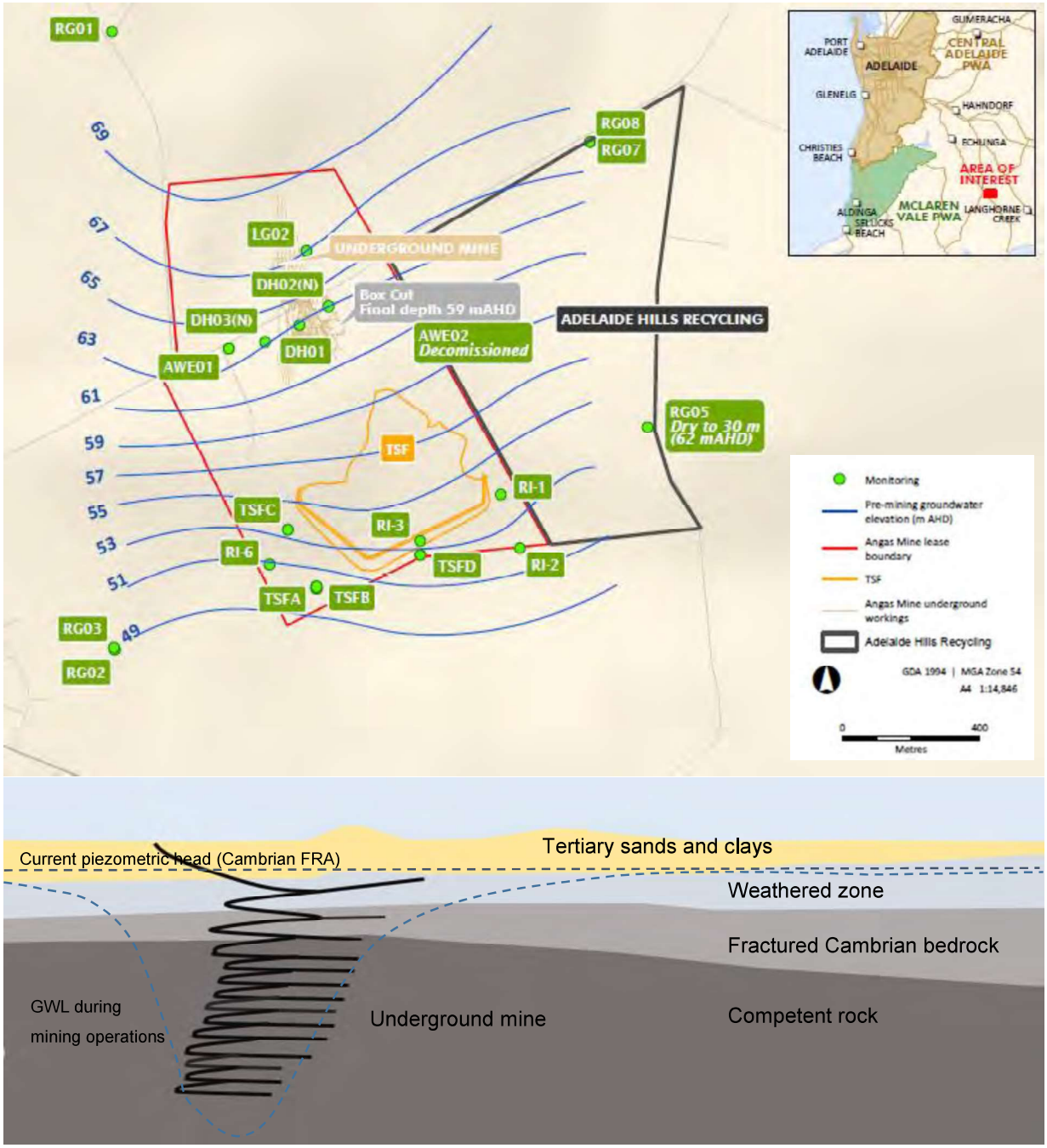

Figure 3: Hydrogeological setting showing pre-mining groundwater elevation (top) and east to west Conceptual geological cross section.

2.2 Past mining operations

Mine operations at the AZM started with development of the box cut in August 2007 and the decline in September 2008. The total underground development (tunnels) of the mine is in excess of 10 km to a total mine depth of 400 m bgl. The stope voids created were subsequently backfilled using a mixture of cemented rockfill, loose rock fill or cemented tailings (paste) fill.

Mining was conducted below the water table in the Cambrian FRA and mine dewatering reduced the groundwater levels around the mine. Groundwater pumped from the mine was injected back into the surrounding aquifer via MAR.

The mine was put into care and maintenance in 2013. Groundwater level recovery in the mine void was accelerated by flooding the underground mine with groundwater pumped from the injection wells. This was undertaken to limit the effects from oxidation of wall rock and backfill material which can lead to the generation of acid mine drainage.

2.3 Groundwater impact assessment from mining operations

A number of groundwater investigations and long-term groundwater monitoring have been undertaken to support the operation of the AZM and more recently for the closure of the mine (Terramin, 2017). As such, characterisation of the underlying aquifer and understanding of groundwater related risks which are also relevant to this project has already been performed.

The following provides a summary of the relevant groundwater related risks that were monitored during the mining operation and closure phases.

Mine dewatering impacts 2007 to 2013

- The onset of mine dewatering in 2007 (development of the box cut) and 2008 (commencement of the mine decline) caused a small cone of drawdown in the Cambrian FRA to develop around the mine, altering the groundwater flow direction toward the mine. The Tertiary Aquifer, where present above the mine, became dry during the mining phase.
- Average mine dewatering rates were in the order of 0.74 ML/d (8.5 L/s) over the mine life.
- The cone of depression was not detected in the outer regional 'RG' series monitoring wells (which target the uppermost water bearing zone of the FRA) and therefore the extent was inferred to be < 1 km from the mine.
- There are no groundwater users in the area.

Recharge impacts 2008 to 2013

- The MAR system was commissioned in 2008 and was utilised until 2013.
- Injection rates of up to 1.3 ML/d (15 L/s) was achieved over the mine life using up to 6 injection wells (known as RI-1 to RI-6) (Figure 3).
- There were no observed groundwater impacts resulting from MAR. Of particular interest was the risk of groundwater mounding from MAR and the thereby potential discharge of saline groundwater to the Angas River. Groundwater level monitoring undertaken at paired monitoring wells (RG2 - Tertiary aquifer and RG3 – Cambrian FRA) positioned between the closest distances between the injection wells and Angas River did not show any discernible groundwater level response (Figure 4) to MAR in this area, indicating that the MAR operation is unlikely to have resulted in groundwater level changes at Angas River and thereby additional groundwater discharge into the river. Instead injection water had a tendency to flow towards the underground mine and was maintained by the cone of drawdown (AGT, 2012).
- No adverse groundwater quality impacts were detected.

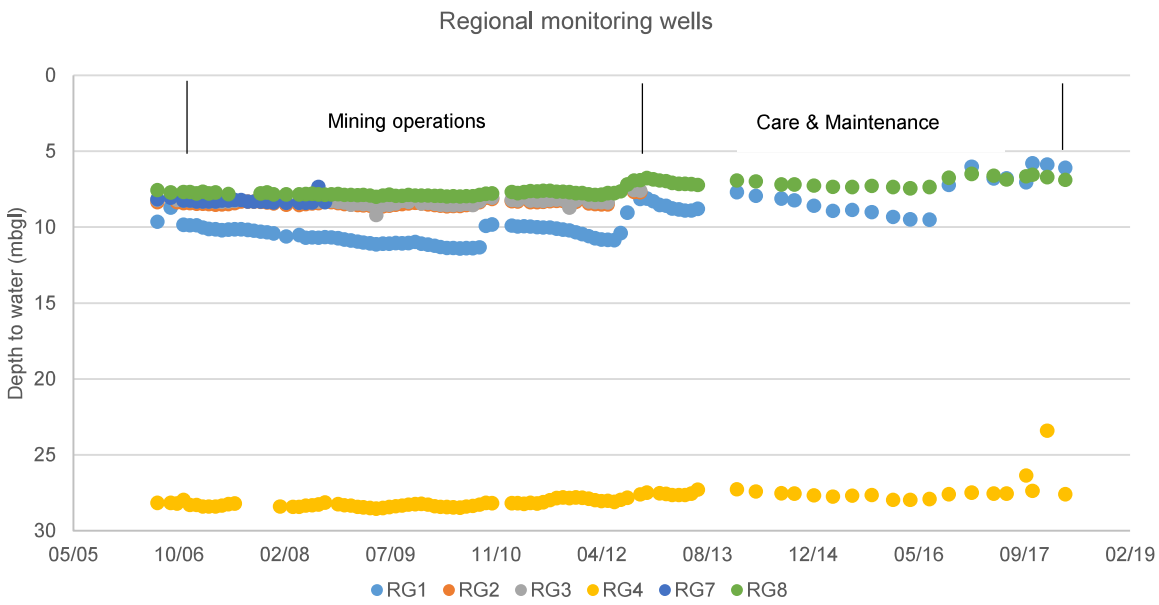

Figure 4: Hydrographs- Regional Monitoring Wells

Mine closure impacts 2013 to 2018

- The mine was put into care and maintenance in September 2013. To reduce the effects of oxidation on wall rock and backfill (and subsequent contaminant mobilisation), groundwater recovery was accelerated during the first year (October 2013 to October 2014) by flooding the mine void with groundwater pumped from the surrounding injection wells into the decline. After this time, groundwater in the mine continued to rise from natural groundwater inflows.
- The quality of water in the mine void was monitored at a number of underground sampling points (including the paste line ('PF140'), DH2 and DH3 – refer to Figure 3) to detect the risk of acid mine drainage (AGT, 2015b). Water quality parameters (pH, sulphate and key metals) were used as an indicator for this and have remained stable, indicating no detrimental change to water quality.
- Over time, groundwater levels recovered back to near pre-mining levels (Figure 5) and as such, the groundwater flow direction is expected to have generally returned back to pre-mining groundwater flow direction towards the south (as shown by pre-mining groundwater contours on Figure 3).

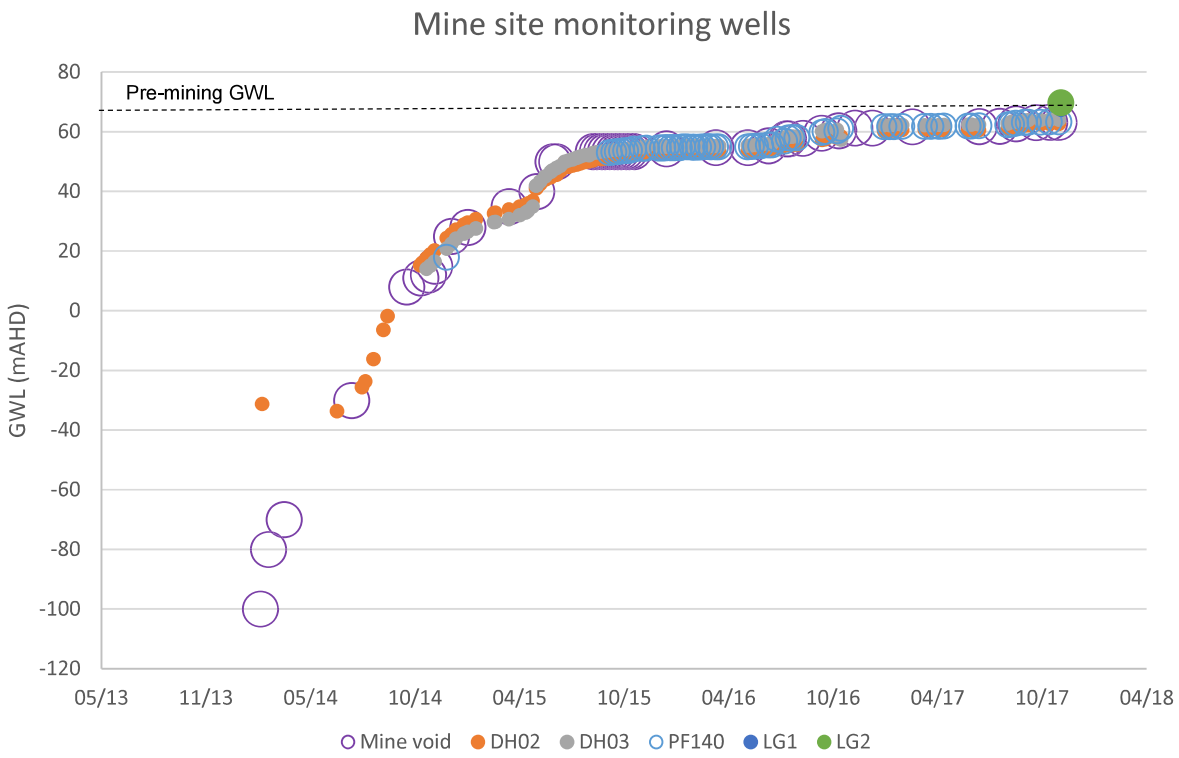

Figure 5: Post-mining Groundwater Level Recovery

3.0 MINE DEWATERING AND INJECTION RATES

3.1 Overview

The underground mine and box cut (containing the mine portal) was flooded with groundwater in October 2013 as part of the AZM closure strategy. For this project, dewatering of the mine is required to enable access to the decline and allow construction of the A-CAES system to take place over a 6 month period.

Groundwater pumped from the mine will be recharged back into the surrounding Cambrian FRA using MAR which was the same approach that was successfully used by Terramin from 2008 to 2013. As such, the effects of mine dewatering and MAR on the aquifers are well understood.

Mine dewatering rates for this project will be higher at the beginning, with a requirement for over pumping to remove standing water stored in the box cut and mine workings. Once this has been achieved, ongoing dewatering will be required during the remaining part of the construction phase to maintain groundwater levels beneath construction depth. Some disposal of stormwater runoff that flows into the box cut may also be required.

The capacity of the injection wells to inject mine water will need to match the above dewatering regime. Additional injection wells will be required to account for the initial over pumping needed to accelerate mine dewatering. Six injection wells were used during mining operations, of which four have been decommissioned (backfilled).

The assessment of dewatering and injection requirements for this project are outlined below.

3.2 Mine Dewatering Rates

The dewatering volume and rate to allow construction of the A-CAES system was determined based on the mine void size and mine inflow rates (measured during mining operations). Likewise, the ability of the aquifer to receive water was estimated based on the injection rates achieved during mining operations.

Available mine dewatering rates measured during mining operations are presented in Figure 6. Cumulative injection volumes are presented in Figure 7. Records prior to 2011 were not available, but the work of AGT, 2012 suggested that groundwater inflows prior to 2011 ranged from 7 L/s to 12 L/s (0.6 ML/d to 1.0 ML/d). By 2013, mine dewatering rates averaged 8.5 L/s (0.74 ML/d). Terramin has indicated that these values are likely to be higher (by at least 30%) than the expected groundwater inflows during the A-CAES construction dewatering due to the following reasons:

- During mining operations, there were groundwater inflows from uncapped exploration holes which have since been grouted.
- Excess water from drilling and paste backfill activities was introduced into the underground mine dewatering circuit.
- At the time when the mine was put into care and maintenance over 90% of mine voids had been back filled (Harris *et al* 2014) thereby sealing off zones of groundwater inflows.

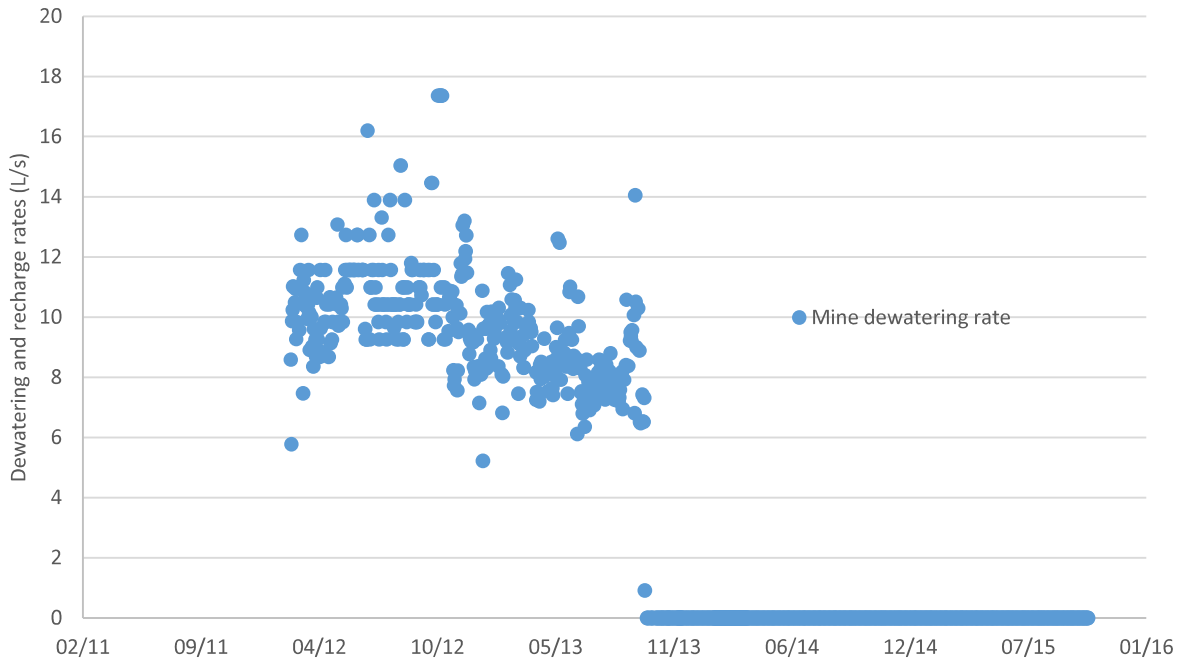

Figure 6: Measured Mine Dewatering Rates

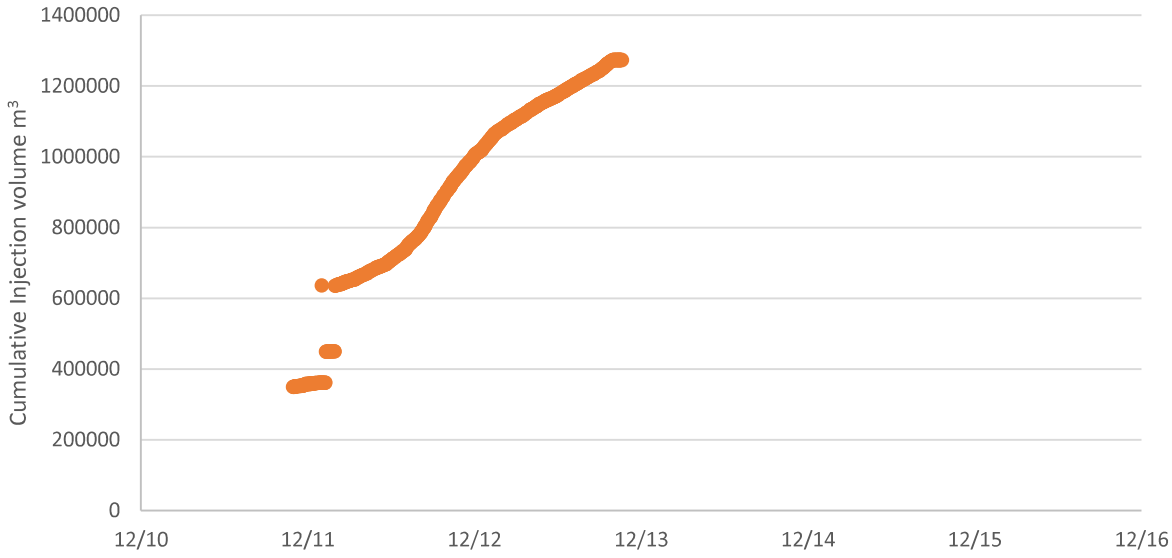

Figure 7: Cumulative Injection Volume

Construction dewatering will involve pumping water from the box cut and underground mine workings. There will be additional contributions from surface runoff into the box cut and ongoing groundwater inflows into the mine and these have also been factored in to our estimates.

The following lists the assumptions used in our dewatering calculations:

- The current volume of water in the box cut is 39 ML, with additional contribution of rainfall runoff into the box cut, which is assumed to be in the order of 0.5 L/s (corresponding to 7.8 ML over a 6 month period).
- The volume of the mine workings (stopes, decline, and level access) to the construction depth of 240 m is 145 ML. Supporting calculations are provided in Appendix A.
- We have assumed constant groundwater inflow rate of about 0.7 ML/d (8 L/s) which represents 30% of the maximum inflow rate (1 ML/d / 12 L/s) reached during mining operations.

Based on the above, the total volume of water to be pumped from the mine is 184 ML, plus an additional contribution of rainfall runoff and groundwater flows into underground mine workings (estimated at 0.74 ML/d). Maximum groundwater inflow rates may not be experienced until the dewatering target is reached, however to provide conservative dewatering estimates we have assumed that groundwater inflows of 0.74 ML/d after the box cut lake has been dewatered.

3.3 Injection rates

Terramin utilised up to 6 injection wells to inject up to 1.3 ML/d (15 L/s) of mine water. Four of the injection wells (RI1, RI4, RI5 and RI6) have been decommissioned (backfilled) and new injection wells will be required.

In fractured rock aquifers, the injection rate depends on the aquifer characteristics, such as location and extent of faults which can represent areas of secondary porosity with enhanced permeability. Therefore, injection rates of wells can vary considerably over short distances, which was also found to be apparent at AZM. Table 1 presents the tested and operational injection rates of the AZM recharge wells and indicates that the test injection rates varied from 0.4 L/s to 5 L/s between wells.

The expected injection rates of the new injection wells have been estimated based on the observed injections rates during the testing and operation (Table 1). Based on this it is reasonable to expect that the average injection rate of new wells installed at the site could be in the order of 0.27 ML/d/well (3 L/s/well).

Table 1: Tested and Operational Injection Rates.

Injection well	Injection rate tested during system commissioning (L/s)	Operational injection rate (L/s)
RI1 (backfilled)	3	12.7
RI2 (backfilled)	5	
RI3	2	
RI4	3	
RI5 (backfilled)	0.4	-
RI6 (backfilled)	3	-
Total injection L/s	16.4	12.7
Total injection ML/d	1.42	1.10
Average injection rate per well ML/d	0.28	0.27

3.4 Injection pressure

Safe injection pressures are deemed as pressure (p) that would avoid hydraulic failure of the overlying confining layer (weathered zone), which could result in upward leakage of saline groundwater water to the Tertiary Aquifer. The maximum pressure can conservatively be estimated from the formula:

$p < 15\ d$ (kPa) (NRMMC, 2009)

where d is the depth in metres from the land surface to the base of the aquitard overlying the aquifer (approximately 30 m at the site), which would result in a maximum allowable pressure of 450 kPa. Information provided by Terramin suggested that at times injection well (RI2) recorded pressures ranging from 14 kPa to 28 kPa (1.4 m to 2.8 m above ground surface) at 4 L/s, and that the drainage head in all other injection wells was maintained below ground surface. This is only less than 6% of the maximum allowable operational pressure to avoid hydraulic failure of the confining layer.

It is noted that the safe injection pressure of the well will depend on the well design, which need to be assessed for the new injection wells, where the risk of surface expression to any poorly sealed exploration holes need to be considered.

3.5 Estimated Dewatering and Injection Rates for Construction of A-CAES

The construction dewatering rates for this project will be higher at the beginning, with a requirement to remove water stored in the box cut and mine workings during the initial dewatering period to reach the target dewatering level. Once this has been achieved, ongoing dewatering will be required during the 6 month construction phase to maintain groundwater levels beneath the construction depth of 240 m.

The following outlines the estimated mine dewatering volumes and rates to dewater the mine to the target construction depth (Section 3.5.1) followed by ongoing dewatering rates needed to maintain groundwater levels below the construction depth during the construction phase (Section 3.5.2).

3.5.1 Initial Dewatering Rates and Lead Times

Using the above pumping and injection volumes in Sections 3.2 and 3.3, the initial dewatering and injection requirements for a range of dewatering lead times ranging from 2 to 6 months was calculated for consideration by Hydrostor.

Table 2 summarises the dewatering and injection rates and number of injection wells required to meet the initial dewatering requirement for varying dewatering lead time and indicates that the required number of injections wells could range between 6 and 14 injection wells depending on the duration of the initial dewatering period.

Of the dewatering scenarios presented to Hydrostor, the four month mine dewatering lead time was selected as their preferred option, as this timeframe aligns with project construction schedule and likely requires a lower number of injection bores than shorter mine dewatering lead-times

Table 2: Estimated dewatering and injection rates to dewater mine workings.

Dewatering lead time to allow access to decline (months)	Box Cut lake volume (ML)	Mine void volume (ML)	Additional inflows into box cut and mine void (ML)	Dewatering and injection rate (ML/d)	Number of injection wells to meet initial dewatering demand
6	39	144	110	1.6	6
4	**39**	**144**	**72**	**2.1**	**8**
3	39	144	55	2.6	10
2	39	144	44	3.8	14

3.5.2 Ongoing dewatering rates during construction phase

Once the standing water is pumped from mine void storage and dewatering target is reached, ongoing mine dewatering (albeit at much lower rates) will be required to maintain groundwater levels below the construction depth for the duration of the 6 month construction phase. During the construction period dewatering rates are expected to be in the order of 8.5 L/s (0.74 ML/d) and this will require the use of less injection wells (or lower required injection rate per well). Figure 8 presents the estimated daily dewatering rates to enable construction of the A-CAES system to take place.

3.5.3 Total Dewatering Volumes

The total water pumped and injected for the above dewatering lead times is presented in Figure 9 and is estimated to range between 350 ML and 410 ML depending on the dewatering (and construction) timeframe.

For the selected dewatering scenario (4-month mine dewatering lead time followed by 6 month construction), the total volume pumped from the groundwater system is estimated to be in the order of 390 ML.

Additional groundwater allocation will be required if all dewatering occurs within one water use year (between 1 July of any calendar year and 30 June of the following calendar year). Figure 9 shows that the current allocation of 271 ML/y (with an additional roll over credit of 27 ML for the 2019 water use year) will be reached with about 4 months of dewatering. The amount of additional allocation needed will depend on the project schedule when in the water use year dewatering commences.

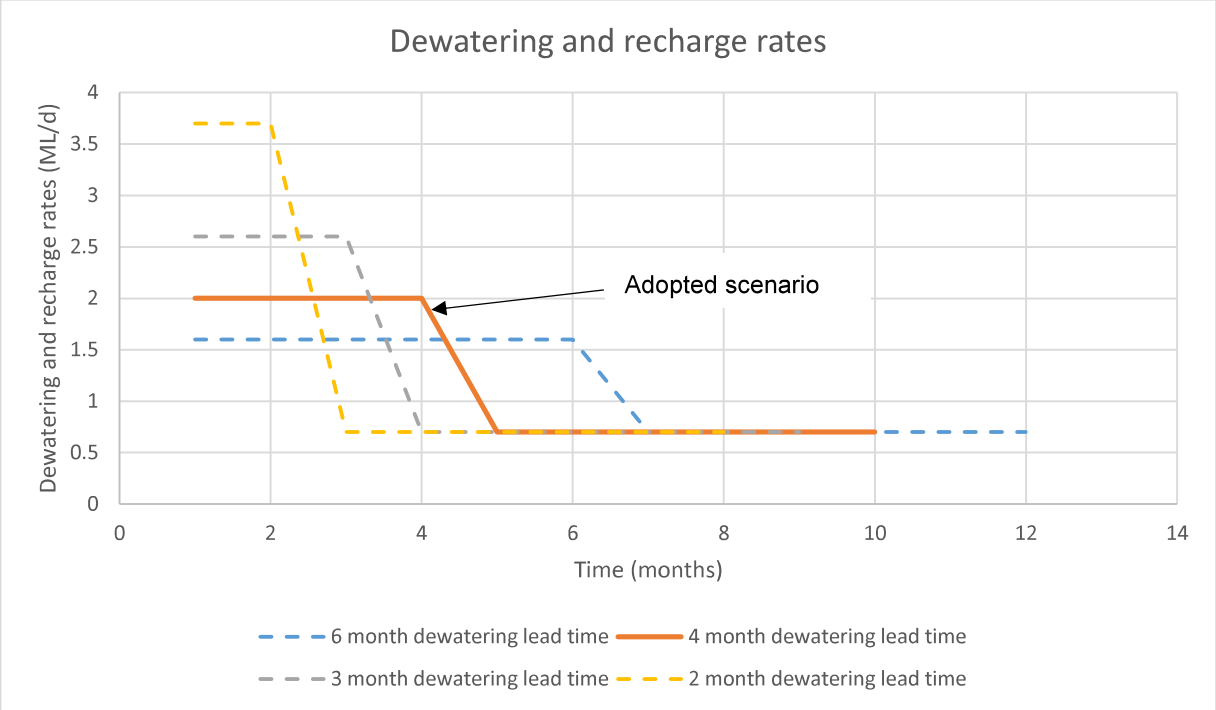

Figure 8: Estimated Daily Dewatering/Injection Rates for Different Initial Dewatering Periods

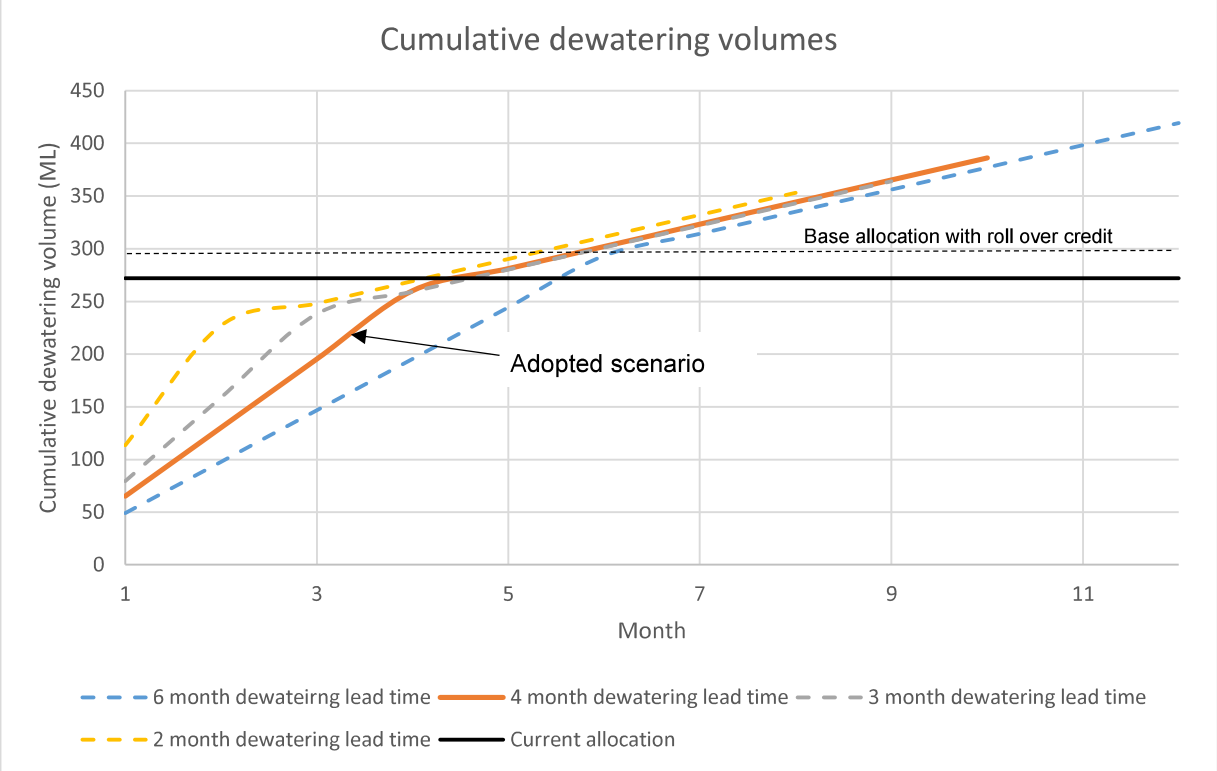

Figure 9: Total Dewatering and Injection Volumes

4.0 WATER QUALITY

4.1 Overview

The water currently within the box cut and mine workings had the potential to be affected by oxidation of the wall rock and backfill material (a process that can result in acid mine drainage). The extent of this will determine whether any pre-treatment is required prior to injection, however this risk was reduced by flooding the mine void with groundwater (described under Section 2.2 of this report).

The level of pre-treatment required depends on the water quality of the receiving aquifer and whether the injected water has the potential to down grade the beneficial use category of the receiving aquifer. Also of particular interest is understanding the risk of the recharge water reaching the Angas River over the long term (post injection).

The following section provides an assessment of the water quality in the box cut and mine workings to determine whether the water quality has changed. We have also compared water quality parameters against the native groundwater to provide an indication of whether any pre-treatment of the water may be required prior to injection.

4.2 Results

Since mine closure in 2013, particular attention was placed on monitoring the risk of acid mine drainage in and near the mine workings. Water quality parameters such as sulphide, pH and key metals were used as an indicator for this. Key sampling locations included:

- Box cut (1 sample) - water from the box cut lake.
- Mine void (6 samples) - water samples taken from the mine workings at different levels during filling.
- PF140 (14 samples) - water samples taken from the paste line which targets mine void a depth of 142 m bgl.
- DH02 (12 samples) and DH03 (4 samples) - wells which target the Cambrian FRA to depths of 115 m (DH02) and 116 m (DH03) in close proximity to the mine workings.

The above groundwater monitoring points monitor groundwater at discrete intervals in and near the mine voids and may not be representative of the larger body of water within the mine workings.

The quality of water to be injected has been derived from samples collected from the above sample locations since 2013. The results are presented in Table 3, together with background concentrations of the Cambrian FRA derived from regional monitoring wells (RG series) and injection wells (RI series). Background concentrations were established based on one sample collected from each well prior to injection and mining, respectively. ANZECC water quality guideline limits for freshwater ecosystems and primary industries (which may represent the beneficial use category for the Tertiary Aquifer) are also shown for reference.

Table 3: Water Quality

Parameter	Aquatic ecosystems	Primary industries	RI wells	RG wells	DH3			DH2			Mine Void Pond	Box cut	PF140		
					Latest	Min	Max	Latest	Min	Max			Latest	Min	Max
pH Value								6.85	6.82	9.76	6.99	6.54	8.37	7.55	8.37
Electrical Conductivity					16800	14700	16800	23800	15400	29200	13800	22000	15400	14200	18000
Total Dissolved Solids		2500 to 10,000	13,000 to 24,500 (average = 17,860	13,722	10100	8820	10100	16100	10500	16400	9260	13900	9130	8430	10700
Turbidity					10.4	4.5	47.6	150	51.2	385	23.1			11.5	159
Bicarbonate Alkalinity as CaCO3						524	560	196	169	482	32	12	789	654	875
Carbonate Alkalinity as CaCO3						<1	<1	<1	<1	550	<1	<1	31	31	31
Hydroxide Alkalinity as CaCO3						<1	<1	<1	<1	0	<1	<1	<1	<1	<1
Total Alkalinity as CaCO3						524	560	196	196	719	32	12	820	654	875
Sulfate as SO4 -		1000			1090	1070	1120	2990	1550	3070	2020	3030	789	789	1110
Chloride						4910	5300	7890	4700	8570	4300	6530	4850	4620	5820
Calcium Diss		1000				65	68	297	2	297	437	596	146	74	146
Magnesium Diss		2000				207	215	298	16	374	132	221	211	121	211
Potassium Diss						73	74	123	71	123	99	163	98	51	98
Sodium Diss						3270	3320	6000	3800	6000	2710	3950	3550	2920	3760
Arsenic Diss	0.024	0.5 to 5	0.001 to 0.003			0.003	0.004		<0.001	0.001		<0.001	0.005	0.004	0.005
Cadmium Diss	0.0002	0.01	<0.005 to 0.002			0.0007	0.0014		<0.0001	0		0.0158	<0.0001	0.0001	0.0001
Copper Diss	0.0014	0.4 to 5	<0.003 to 0.027			0.001	0.003		<0.001	0.004		0.002	<0.001	<0.001	0.001
Iron Diss		not toxic	1.57 to 3			-	-		0.11	1.65		7.17	<0.05	0.15	0.15
Lead Diss	0.0034	0.1	<0.005 to 0.01			<0.001	<0.001		<0.001	0		<0.001	0.002	0.002	0.002

Parameter	Aquatic ecosystems	Primary industries	RI wells	RG wells	DH3			DH2			Mine Void Pond	Box cut	PF140		
Manganese Diss	1.9	not toxix	0.125 to 0.30			0.12	0.126		0.001	1.9		3.46	0.293	0.293	0.352
Selenium Diss	0.011	0.02	<0.001 to <0.003			<0.01	<0.01		<0.01	0		<0.01	<0.01	<0.01	<0.01
Zinc Diss	0.008	20	0.01 to 0.056			0.176	0.379		0.007	0.031		17.8	0.008	0.008	0.016
Arsenic Tot				0.01	0.006	0.005	0.036	0.003	<0.001	0.005	0.003	<0.001	0.017	0.005	0.023
Cadmium Tot				0	0.0009	0.0007	0.0012	<0.0001	0.0001	0.002	0.0418	0.017	0.0013	0.0002	0.0689
Chromium Tot	0.001	1		0.0214	<0.001	<0.001	0.052		<0.001	0.012				0.005	0.017
Copper Tot					0.003	0.003	0.013	<0.001	<0.001	0.059	0.004	0.002	0.074	0.003	0.206
Iron Tot					0.85	0.85	5.96	74.6	33.9	438	0.56	9.93	6.72	0.09	12.3
Lead Tot				0.04	0.024	0.02	0.09	<0.001	<0.001	0.099	0.173	0.013	0.611	0.012	3.24
Manganese Tot					0.134	0.134	0.19	3.5	0.694	10.2	2.46	3.46	0.349	0.317	2.8
Selenium Tot				0.03	<0.01	0.02	0.02	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc Tot				0.31	0.274	0.274	0.569	2.19	0.144	2.19	30.1	18.4	0.678	0.036	34.8
Fluoride						4.3	4.6	1	0.2	1.4	0.5	0.8	4.3	3.9	4.8
Nitrite + Nitrate as N			<0.005 to 0.146			0	0		0	0	0.09	0.04	-		0
Total Kjeldahl Nitrogen as N						1.1	1.1		1.2	1.2	4.9	6.5	-		0
Total Nitrogen as N						1.1	1.1		1.2	1.2	5	6.5	-		0
Total Phosphorus as P			0.24			0.09	0.09		0.05	0.05	0.07	0.2	-		0
Nitrate as N	0.7	90													
Nitrite as N		9													

Results in Table 3 show the mine water quality is comparable to the receiving aquifer in terms of salinity and most water quality parameters, but notable differences in some samples include:

- Elevated cadmium (0.0158 mg/L) in the box cut (one sample) with respect to native groundwater (0.0002 mg/L) and ANZECC guideline limit for freshwater ecosystems.
- High concentrations of dissolved zinc (17.8 mg/L) and manganese (3.4 mg/L) in the box cut with respect to native groundwater, but below ANZECC guideline criteria for primary industries.
- Elevated concentrations of dissolved Zinc (0.17 to 0.379 mg/L at one location DH3) with respect to native groundwater (0.01 mg/L) and ANZECC guideline limits for freshwater ecosystems, however all other samples from DH02 and PF140 revealed concentrations below background limits.
- Elevated concentration of chromium in one sample only from DH3, with other samples including the most recent sample revealing levels below the detection limit (<0.001 mg/L).

4.3 Water Treatment

The above results indicate that the water in the box cut is likely to require some treatment prior to injection. Whilst samples collected from the underground mine water via DH02, D03, mine void and PF140 suggest groundwater quality has remained stable, ongoing sampling of the extracted water should be undertaken during the construction dewatering to ensure the water quality is suitable for reinjection.

Discussions with Terramin indicate that reduction of the above metals (to background concentrations), could be achieved using HB50 lamella plated silt separator clarifiers. There are currently two clarifiers on site which are capable to treat to a rate of 0.96 ML/d each (1.92 ML/d in total). The clarifiers were used during operation of the reverse osmosis unit and shut down in October 2013 and have not been used since. Figure 10 shows the dewatering rates together with current onsite treatment capacity. For shorter dewatering lead time, additional treatment capacity will be required.

Golder understand that Hydrostor are planning to treat water extracted from the mine via lamellar plate separators (LPS) and/or an oxidative filtration system (OFS). The final treatment system design will be predicated on additional testing. The OFS would manage the removal of heavy metals and has an advantage of maintaining through-flow rates (inflow and out flow rates are equal). Filters are planned to be back-flushed as required to the old AZM Run of Mine (ROM) area for evaporation.

The functional design goal of pre-injection water quality treatment systems is understood to be achieving final injectant water quality equal to ambient aquifer conditions or within agreed guideline values that reflect the environmental values of the targeted groundwater resource.

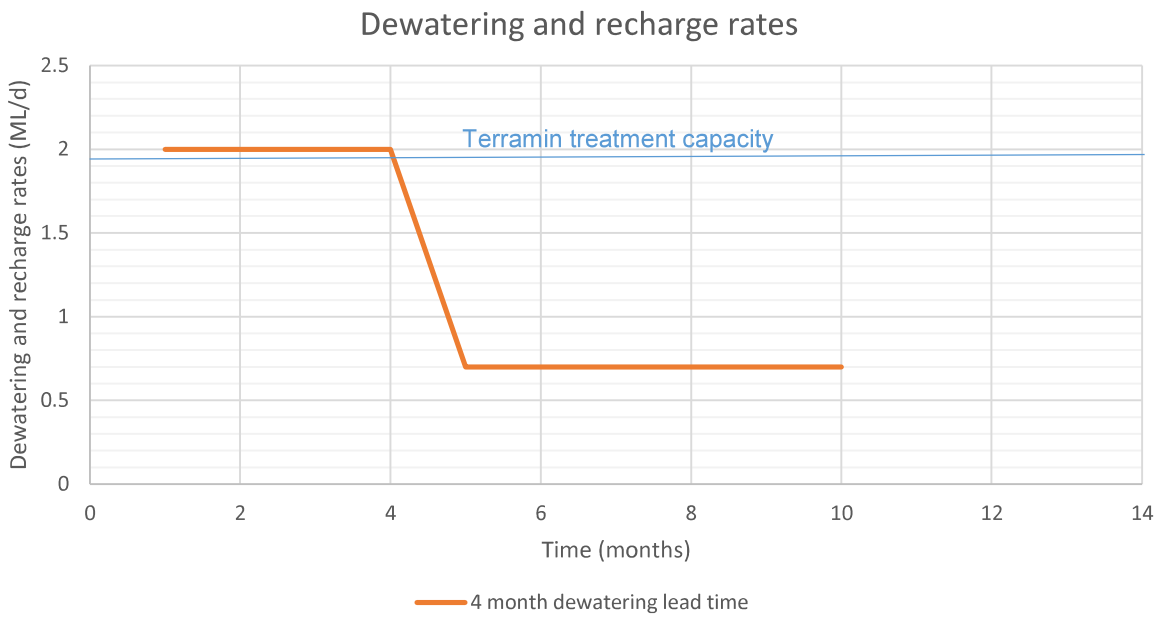

Figure 10: Dewatering Options and Current Onsite Treatment Capacity

5.0 GROUNDWATER IMPACT ASSESSMENT

5.1 Overview

Confined aquifers subject to high injection pressure can result in upward leakage to overlying aquifers and connected watercourses. Rising groundwater levels can result in discharging saline groundwater to watercourses, which can impair their function.

During consultation with DEW, upward leakage of saline groundwater into the Tertiary Aquifer and the Angas River from groundwater mounding was identified as a risk. The Angas River is located approximately 750 m to the south of the Mining Lease.

This risk to the Angas River was previously assessed by groundwater modelling for a total average injection rate of 1.3 ML/d (AGT, 2012). The risk was determined to be very low and upward leakage to the Tertiary aquifer was not detected in groundwater monitoring wells (RG2 -Tertiary, RG3 - weathered Cambrian and RG4 - weathered Cambrian - Figure 4) during the mining operations (2008 - 2013) where monitoring results indicated that groundwater levels and salinity remained stable (Appendix BI AZM Closure Phase GWMP). The reason for this is considered to be due to the thickness of the confining layer (extremely weathered basement) that separates the fresh Cambrian FRA and Tertiary Aquifers and low operating pressures of the injection wells. However, as injection rates will likely be temporarily higher (2.1 ML/d) than those achieved during mining operations (0.74 ML/d to 1 ML/d), groundwater modelling was undertaken to re-assess the risk of leakage to the Angas River at higher injection rates.

Where possible, new injection wells should be placed further from the Angas River to further reduce this risk of mounding and upward leakage.

5.2 Model objective

The objective of model simulations was to assess the risk of upward leakage to the Angas River from mine the reinjection of mine water and to determine whether this posed a constraint to injection rates.

Modelling was not undertaken to assess the head rise of individual injection wells as these have not been drilled and this requires further evaluation.

5.3 Model limitations

The model includes a simplistic representation of the mine void and groundwater system and was not used to assess the mine dewatering requirements for the Project which are described in Section 3. This was due to the simplistic manner in which the underground mine void, backfill and fracture networks are represented in the model.

The injection wells simulated by the model have not been drilled and locations have not been confirmed. The head rise simulated by the model for an individual injection well is therefore indicative. In reality the injection heads will be subject to the well location (spacing) and aquifer characteristics (such as the location and extent of faults which can represent areas with enhanced permeability). These aspects will be evaluated during drilling. For example, if zones of higher transmissivity are encountered (higher than modelled values), this will allow higher rates of injection and promote the lateral spreading of recharge water rather than excessive head rise.

5.4 Model development

The AZM groundwater model used for this assessment is primarily based on the model used for the AZM closure impact assessment (AGT, 2012; 2015a). This model, through a number of upgrades had been modified/improved from the original AZM model that was developed in 2006 by Australian Water Environments (AWE,2006). Ongoing investigations and groundwater monitoring have been used to improve

the model in terms of conceptual behaviour and calibration. Transient calibrations have performed on a number of occasions during the mine life, viz:

- during mining operations, using mine dewatering records (AGT, 2011 and AGT, 2012); and
- during mine closure using groundwater recovery records (AGT, 2013 and AGT 2015).

Transient calibration using injection data (injection rates and groundwater levels) has not been performed due to the lack of operational and monitoring data (i.e. no well pressure records or deep monitoring wells).

The details of model development and calibration can be found in the above mentioned reports but can be summarised as follows:

- Four layers, three dimensional flow, hydraulic (groundwater level) and solute transport model.
- Layers 1 to 4 represent (in order):
  - Quaternary and Tertiary sediments (Layer 1).
  - Weathered bedrock of low permeability (Layer 2).
  - Fractured Cambrian bedrock, containing the underground workings (Layer 3).
  - Deeper bedrock below the underground mine workings (Layer 4).
- The numerical model domain covered an area of 25.7 km^2, extending from Easting / Northing (308000, 6100020) to (313113, 6094995) with the AZM lease located essentially centrally.
- Layer 3 model aquifer properties were highly zoned, including representation of bedrock fractures and the mine void (both done with cell zones of increased hydraulic conductivity, specific yield, specific storage and effective porosity).
- The model mine void was simplistic, represented by a strip of cells in the third model layer of dimension (X, Y, Z) of 12.5 m wide x 100 m long x 290 m deep; with the applied specific yield of 0.61, to achieve the resulting model mine void volume.

5.5 Model validation

Validation of the transient calibration performed in 2015 was undertaken by comparing recent groundwater level monitoring data against model predictions of post mining recovery. This was performed for monitoring wells with post mine closure groundwater level data. The results are presented in Appendix B and indicate that groundwater levels continue to plot along the predicted trend.

5.6 Dewatering and injection scenario

Model scenarios involved assigning new injection wells to the Cambrian FRA (Model Layer 3) at the locations of redundant injection wells (RI-1 to RI-6) plus at four nominal locations surrounding the mine (to represent new injection wells which are yet to be constructed).

Mine dewatering and injection was simulated for two phases:

- Phase 1: dewatering of the box cut lake and mine workings to allow access to mine decline for dewatering lead time of 4 months; followed by
- Phase 2: ongoing dewatering over a period of 6 months for A-CAES construction.

The dewatering and injection scenarios simulated by the model are summarised in Table 4.

Table 4: Model Simulations

Phase 1: Dewatering of mine workings		Phase 2: Construction of ICAES		Number of injection wells
Months	Rate (ML/d)	Months	Rate (ML/d)	
4	2.1	6	0.74	8

Model simulations started on October 2013 (model time 1 day) which coincides with the end of mining operations and start of groundwater recovery. Dewatering and injection for A-CAES development was simulated at model time 1918 days (January 2019) to roughly coincide with Hydrostors project schedule. Table 5 shows the model time steps for mine dewatering and injection scenario.

Table 5: Model schedule for scenario 1

From	To	Phase
1/10/2013	31/12/2018	Post mine dewatering (start of groundwater recovery)
1/01/2019	30/04/2019	Phase 1: Mine dewatering
1/05/2019	31/11/2019	Phase 2: A-CAES construction
1/12/2019	31/12/2029	Recovery

5.7 Model simulation results

Groundwater Elevation

Simulated groundwater levels for the Cambrian FRA (model Layer 3) at the end of phase 1 and phase 2 dewatering and injection are presented on Figure 11 (groundwater elevation contours) and Figure 12 (hydraulic head for injection well RI6). Note, only the results of Scenarios 1 and 3 are shown on Figure 11 as they represent low and high injection intensities and therefore scenario 2 results (mid case) are not shown.

During phase 1 injection, artesian heads (RL 110 m AHD to RL 120 m AHD) are temporally reached in the vicinity of the injection wells. The hydraulic head rapidly recedes (becoming sub-artesian) after the onset of phase 2 injection (Figure 12).

The extent of artesian conditions was simulated to extend about 500 m to the south and 300 m to the east and west of the injection wells.

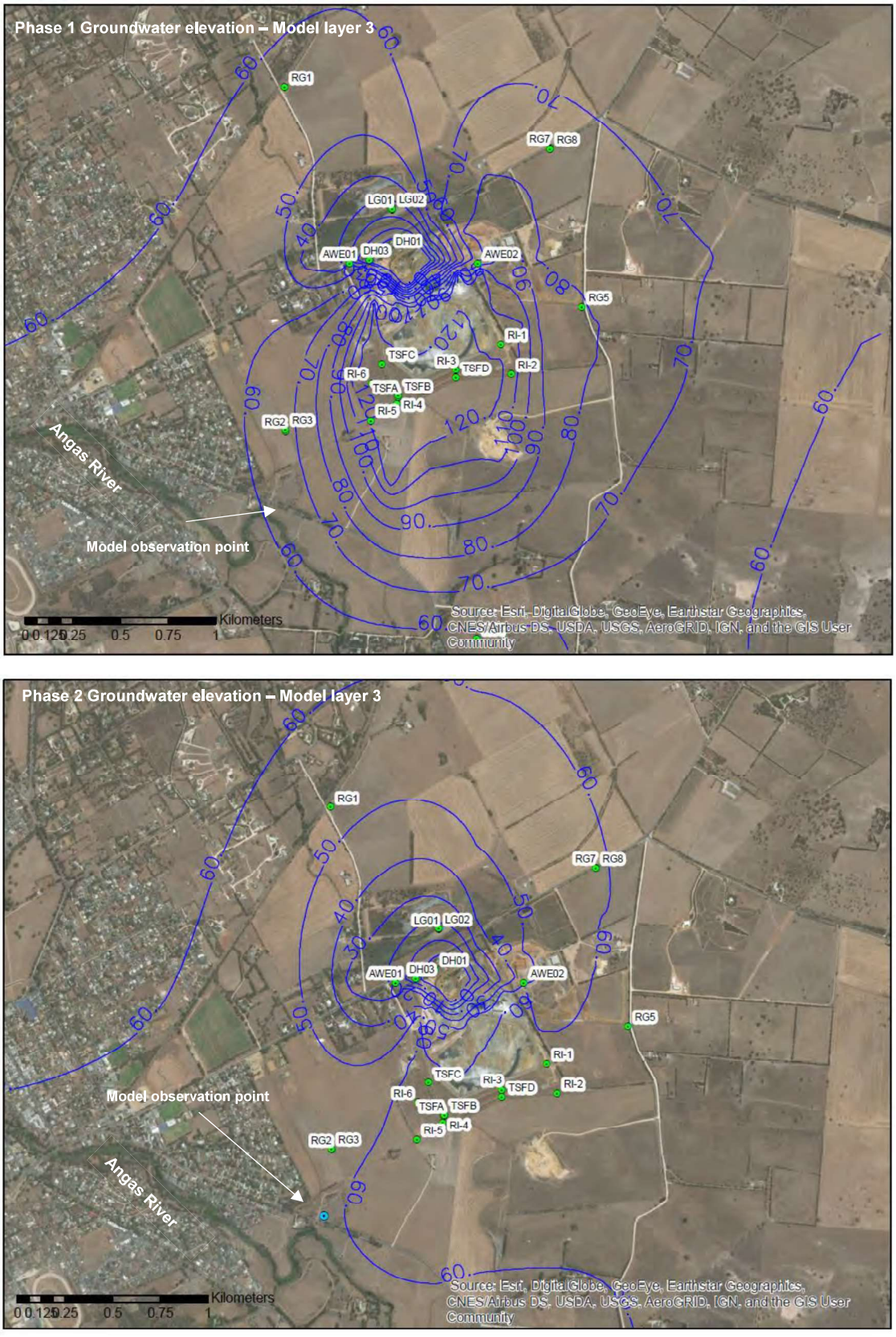

Figure 11: Simulated Heads (m AHD) at the end of Phase 1 and Phase 2 Dewatering and injection.

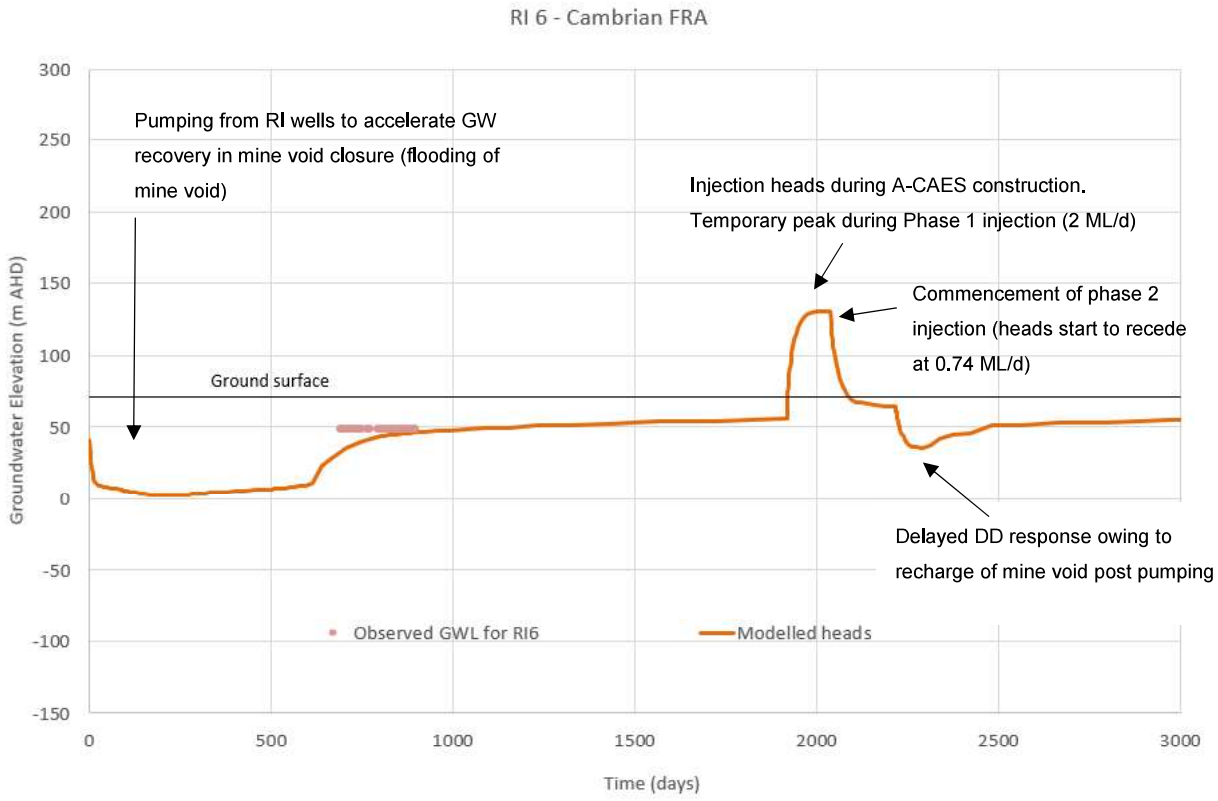

Figure 12: Simulated injection head at injection well RI6

Upward leakage to the Angas River

The risk to the Angas River was assessed by showing model fluxes into river cells (Figure 13) and predicated groundwater levels in the Cambrian FRA and Tertiary aquifer (Figure 14) at model observation point placed near the Angas River (see Figure 11 for location).

Figure 13 shows no evidence of head rise or leakage into the river from injection. The 4.5 km reach behaved as a slightly gaining stream, which ranged from 0.35 L/s (20 m^3/day) at the start of the model simulation, increasing slightly to 0.4 L/s (25 m^3/day) by the end of model simulations. This represents a total baseflow increase of 0.05 L/s over the entire reach.

Figure 14 shows a temporary rise of 8 m in piezometric head beneath the Angas River, whilst no water table rise is predicted to occur in the Tertiary Aquifer.

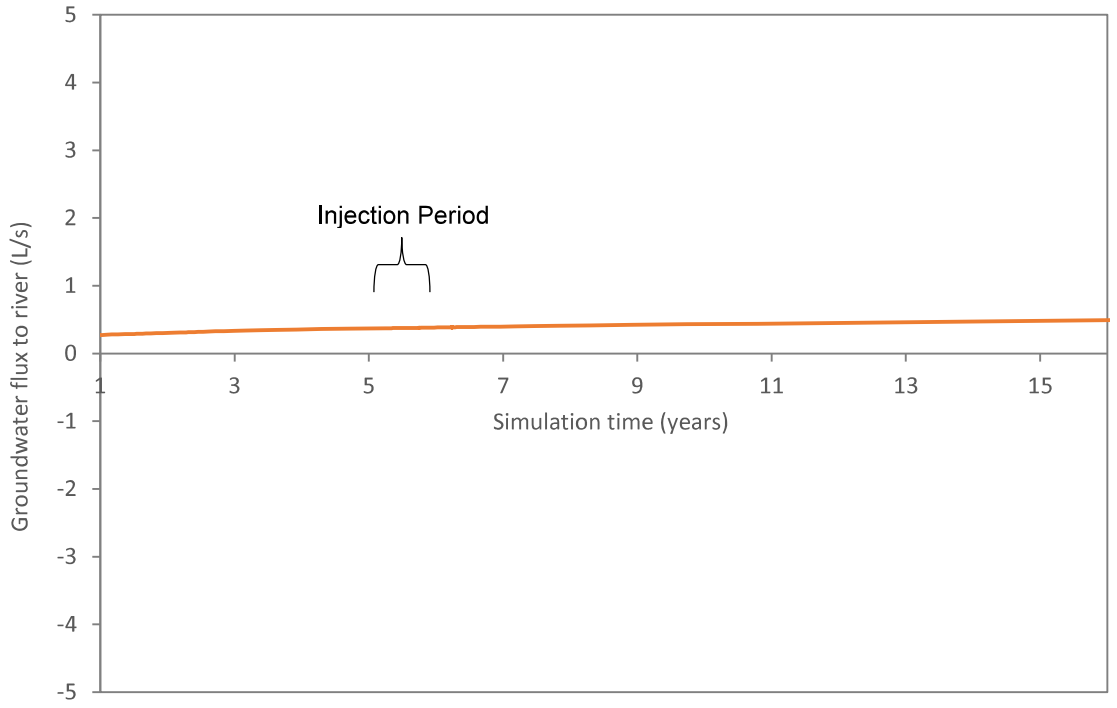

Figure 13: simulate river flux

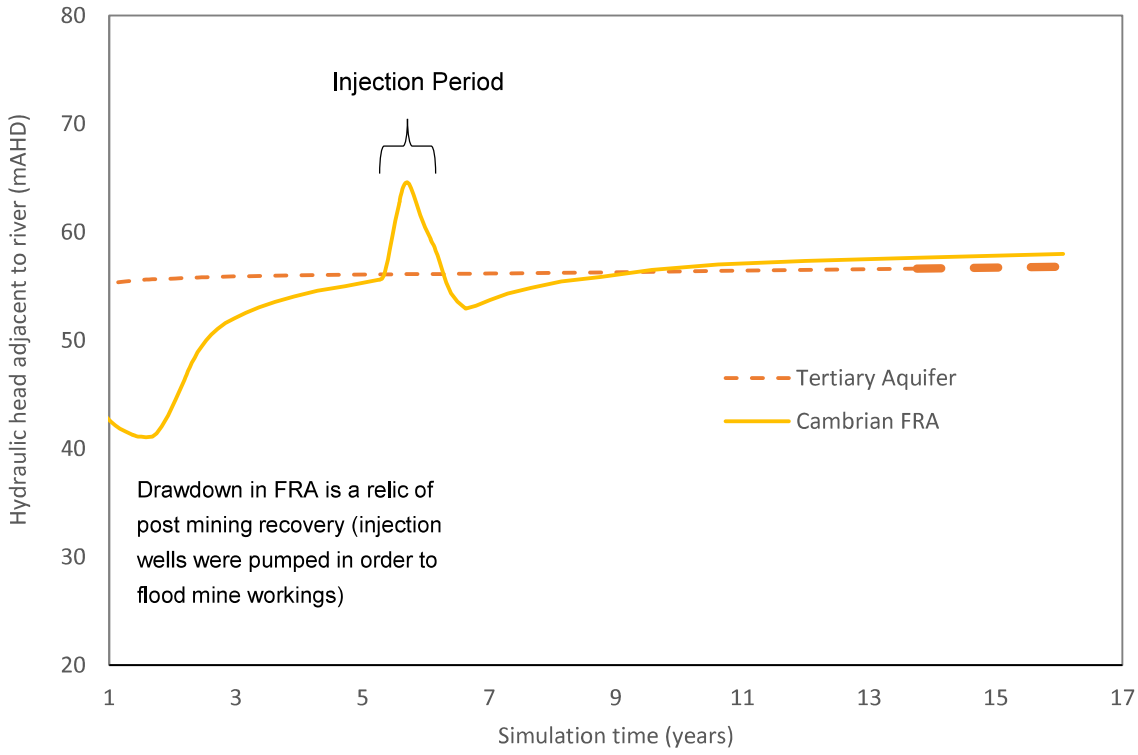

Figure 14: Simulated groundwater levels for the Tertiary Aquifer for an observation well placed next to the Angas River

6.0 UNCERTAINTY AND PROJECT RISKS

The key areas of technical uncertainty and risk identified during this study are provided below, however these are expected to be reduced as part of the ongoing work program.

Table 6: Key project risks and recommendations.

Uncertainty / Project risk	Recommendation
Higher dewatering and injection rates than expected, thereby requiring additional injection wells and groundwater allocation.	Conservative estimates of mine dewatering rates have been provided, however additional capacity should be built into the injection well field to accommodate higher rates of disposal.
Exceedance of annual groundwater allocation due to the above or due to longer construction period arising from unforeseen circumstances.	Explore whether external groundwater allocations are available for temporary transfer.
Water quality of mine void is substantially poorer than samples collected from DH2, DH3, and PF140 requiring additional treatment capacity.	Ongoing testing be conducted on water extracted from the mine void during construction dewatering to ensure that suitable water quality for aquifer re-injection can be maintained. Source water characterisation and treatment will likely need to be a dynamic and ongoing process as water quality may change as pumping from the mine void progresses.
Over pressurisation of the aquifer or clogging of injection wells resulting in reduced injection rates.	The capacity of injection wells and technical uncertainty surrounding safe injection pressures will be assessed during the installation of new injection wells. New injection wells should be adequately spaced and target zones of high permeability to promote lateral spreading of injection water and reduce cumulative effects of pressure.
Upward leakage to the Tertiary Aquifer or though exploration holes which have been inadequately sealed	As above.

7.0 CONCLUSIONS

The main conclusions from this study are summarised in Table 6 and include.

- The stored volume of water to be pumped from the box cut and mine was estimated to be in the order of 180 ML, plus additional contributions from flows into the box cut and underground mine workings (0.73 ML/d).
- The initial dewatering rates required to enable construction of the A-CAES system vary according to dewatering lead times. Short dewatering lead times will require higher pumping rates which will also require a greater number of injection wells.
- For a four month mine dewatering lead time, about 8 injection wells will be required to meet the initial dewatering demands. Every effort should be made to position new injection wells in areas of highest permeability to reduce groundwater mounding and hydraulic heads. The presence of exploration holes (which may not be adequately sealed) needs to be considered when identifying injection sites.
- Additional groundwater allocation will be required if dewatering and injection occurs within one water use year (between 1 July of any calendar year and 30 June of the following calendar year). The volume of additional allocation needed will depend on when in the water use year dewatering commences.
- The water within the box cut contains elevated concentrations of zinc, cadmium and chromium, which will likely require treatment prior to injection. It is also recommended that ongoing testing be conducted on water extracted from the mine void during construction dewatering to ensure that suitable water quality for aquifer re-injection can be maintained. Hydrostor are planning to treat water extracted from the mine via lamellar plate separators (LPS) and/or an oxidative filtration system (OFS). The final treatment system design will be predicated on additional testing.
- Groundwater modelling indicated that salinity risk to the Angas River from upward leakage is low and is unlikely to pose a constraint to injection. However ongoing groundwater monitoring is recommended to detect changes to groundwater level near the Angas River in both the Tertiary Aquifer and FRA.

Table 7: Summary of Mine Dewatering and Injection Requirements

Mine dewatering lead time (months)	Maximum dewatering rate (ML/d)	Number of injection wells required to meet initial dewatering demand	Addition allocation ML (in excess of 299 ML)	Additional treatment required	Salinity Risk to the Angas River
4	2.0	~8	Yes (up to 90)*	Yes	No

*Depends on dewatering start time in water use year

8.0 IMPORTANT INFORMATION

Your attention is drawn to the document – "Important Information", which is included in Appendix C of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

10.0 REFERENCES

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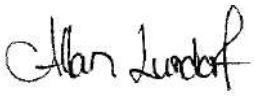
Signature Page

Golder Associates Pty Ltd



Jason van den Akker
Principal hydrogeologist

Allan Lundorf
Principal

JvdA/AL/jd

A.B.N. 64 006 107 857

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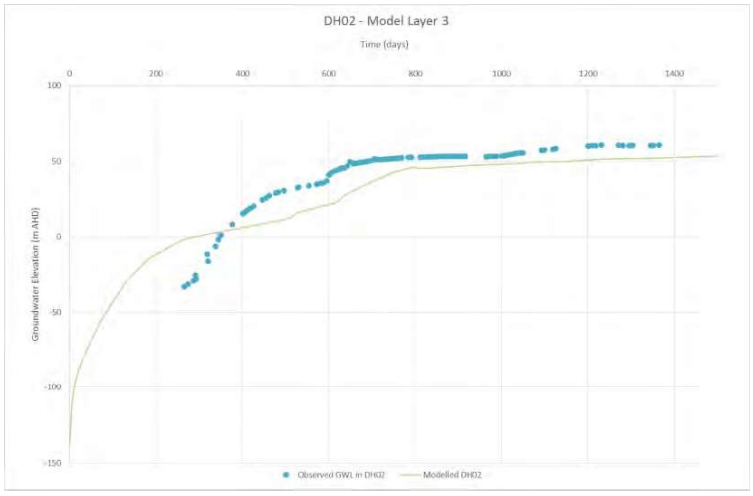
APPENDIX A

Mine void calculations

Stope Void to 260 L				
Lode	**Mined (m^3)**	**Filled (m^3)**	**% Filled**	**Unfilled (m^3)**
Stopes	345,576	321,803	93%	23,772
Raises	3,590	433	12%	3,157
Level Access	103,373	30,228	29%	73,145
Decline	45,045	462	1%	44,583
Total	497,583	352,927	**71%**	**144,657**

APPENDIX B

Transient calibration validation


DH02 - Model Layer 3
Time (days)
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400
600
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1000
1200
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50
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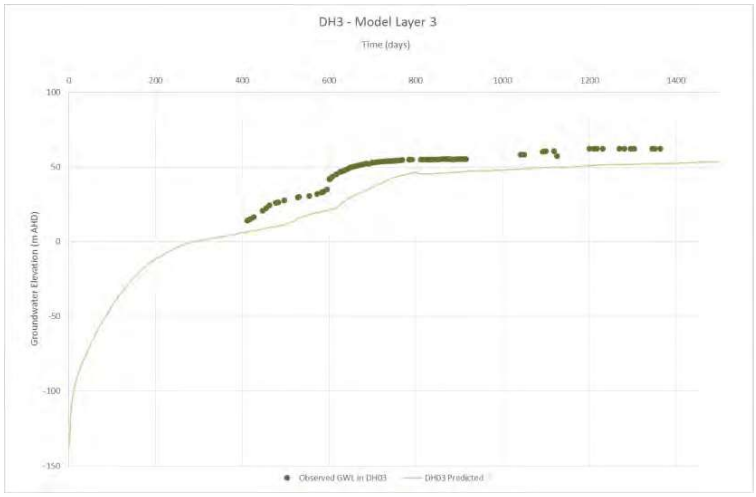
Groundwater Elevation (m AHD)
Observed GWL in DH02
Modelled DH02


DH3 - Model Layer 3
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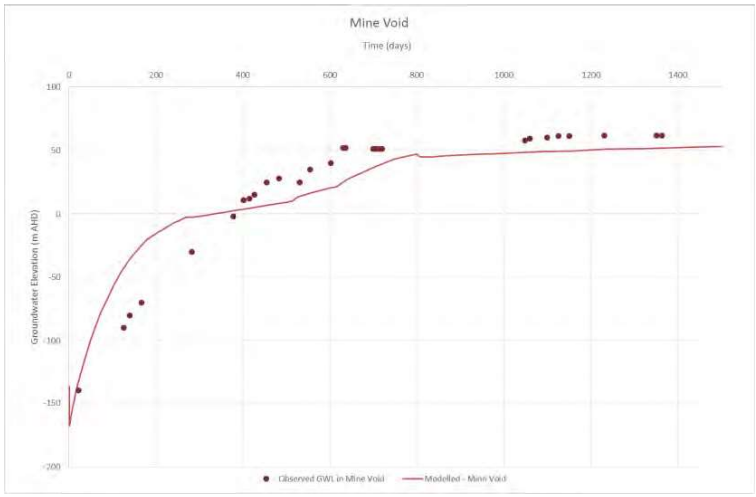
Groundwater Elevation (m AHD)
Observed GWL in DH03
DH03 Predicted


Mine Void
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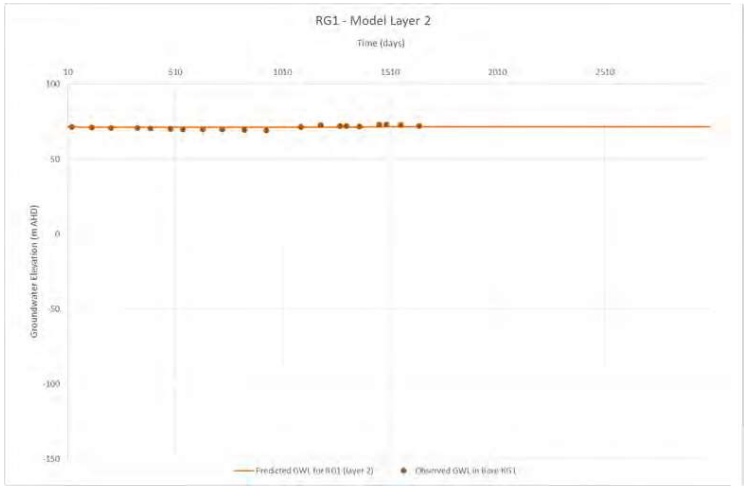
Groundwater Elevation (m AHD)
Observed GWL in Mine Void
Modelled - Mine Void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Time (days)
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2010
2510
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-100
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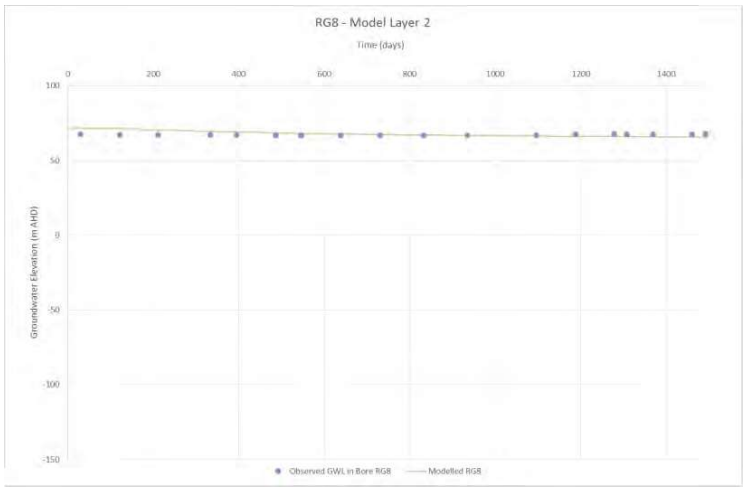
Groundwater Elevation (m AHD)
Predicted GWL for RG1 (layer 2)
Observed GWL in Bore RG1


RG8 - Model Layer 2
Time (days)
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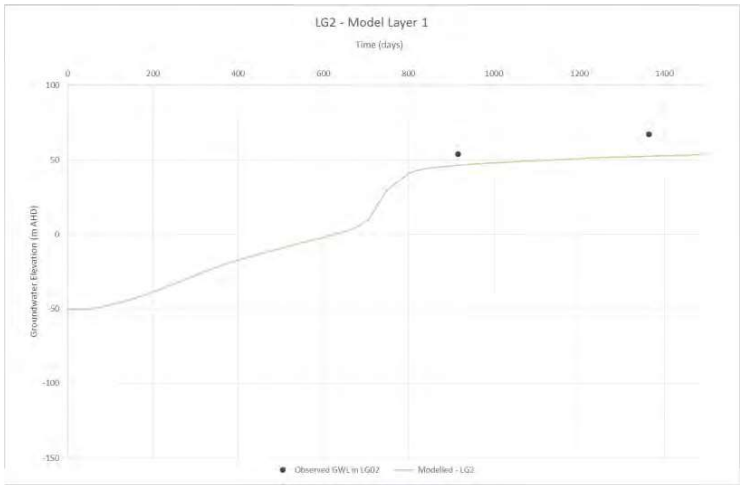
Groundwater Elevation (m AHD)
Observed GWL in Bore RG8
Modelled RG8


LG2 - Model Layer 1
Time (days)
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Groundwater Elevation (m AHD)
Observed GWL in LG02
Modelled - LG2


TSF D - Model Layer 1
Time (days)
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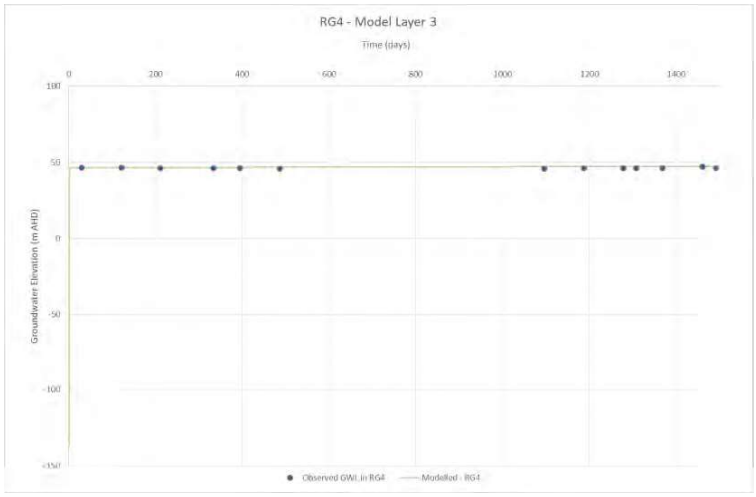
Groundwater Elevation (m AHD)
Observed GWL TSF D
Modelled - TSF D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Time (days)
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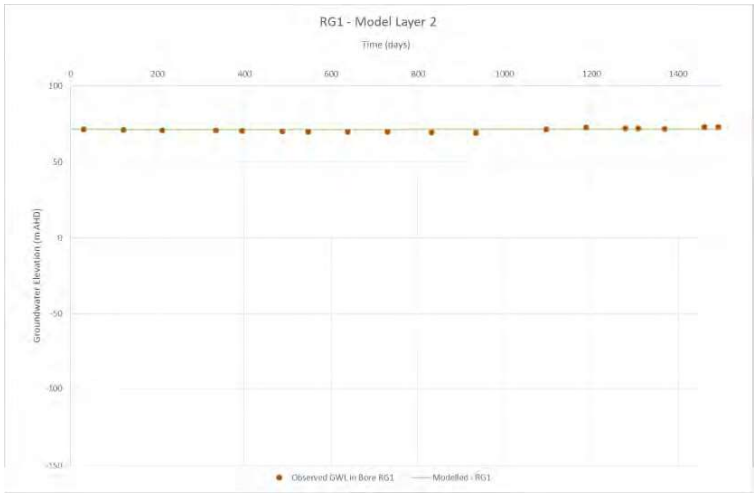
Groundwater Elevation (m AHD)
Observed GWL in RG4
Modelled - RG4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Time (days)
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1000
1200
1400
100
50
0
-50
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-150
Groundwater Elevation (m AHD)
Observed GWL in Bore RG1
Modelled - RG1

APPENDIX C

Important Information

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

This Report is provided for use solely by Golder's Client and persons acting on the Client's behalf, such as its professional advisers. Golder is responsible only to its Client for this Report. Golder has no responsibility to any other person who relies or makes decisions based upon this Report or who makes any other use of this Report. Golder accepts no responsibility for any loss or damage suffered by any person other than its Client as a result of any reliance upon any part of this Report, decisions made based upon this Report or any other use of it.

This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification

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APPENDIX G

Environmental Management Plan

REPORT

Scope Environmental Management Plan
Angas A-CAES Project

Angas Zinc Mine, Strathalbyn

Submitted to:

Hydrostor Australia

Submitted by:

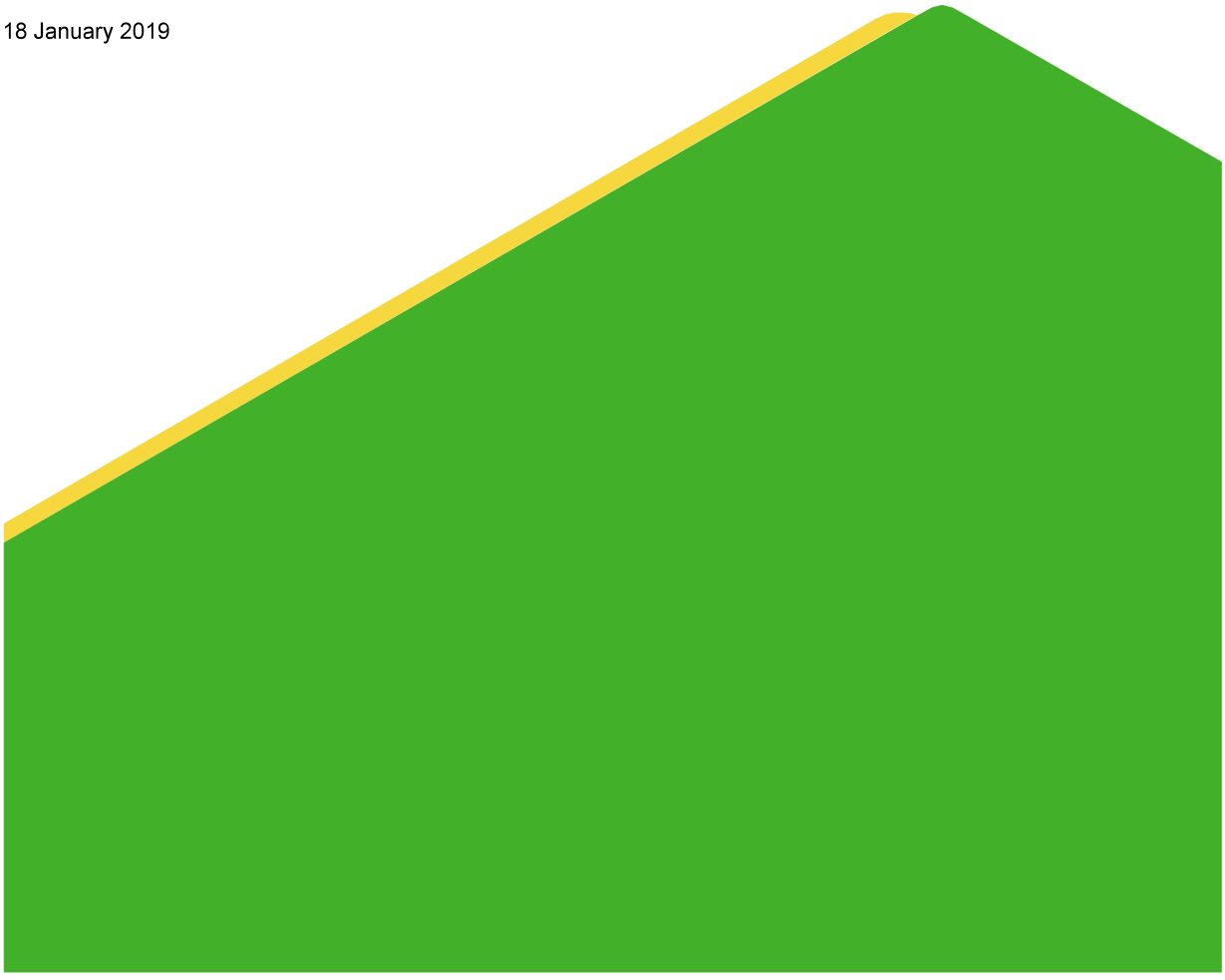
Golder Associates Pty Ltd

118 Franklin Street Adelaide, South Australia 5000 Australia

+61 8 8213 2100

1791136-008-R-Rev1

18 January 2019



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TABLES

FIGURES

1.0 INTRODUCTION

Hydrostor Australia Pty Ltd is proposing to develop, build and operate the Angas Advanced Compressed Air Energy Storage (A-CAES) Facility (the Project) at the Angas Zinc Mine (the Mine) in Strathalbyn, South Australia.

The project will use the existing mine decline to gain access to 240 m below ground level (bgl). There, the subsurface infrastructure will include an underground air storage cavern connected to the surface via water and air lines.

When the system is charging (i.e. at times of surplus energy on the grid), electricity runs an air compressor to pipe compressed air from the surface into the air storage cavern, displacing water up the shaft and into the surface reservoir. The heat generated when compressing the air is captured and stored as hot water in a thermal store for use in electricity generation.

When electricity is needed (i.e. at times of high energy demand on the grid), the system reverses the air flow allowing hydrostatic pressure to force the air out of the air storage cavern and back to the surface where the stored heat is added back into the air stream. The heated air travels through a turbo-expander that drives a generator, efficiently converting the stored energy back into electricity for the consumer.

Environmental risks and potential impacts have been assessed for the Project considering the proposed construction and operational activities and with input from technical studies including a Traffic Impact and Access Point Assessment, Environmental Noise Assessment and Construction Dewatering and Recharge Requirements Report. This Scope Environmental Management Plan (EMP) has been produced to provide a management framework and potential mitigation measures for impacts to the environment throughout the Project.

The proposed site layout is shown in Figure 1.

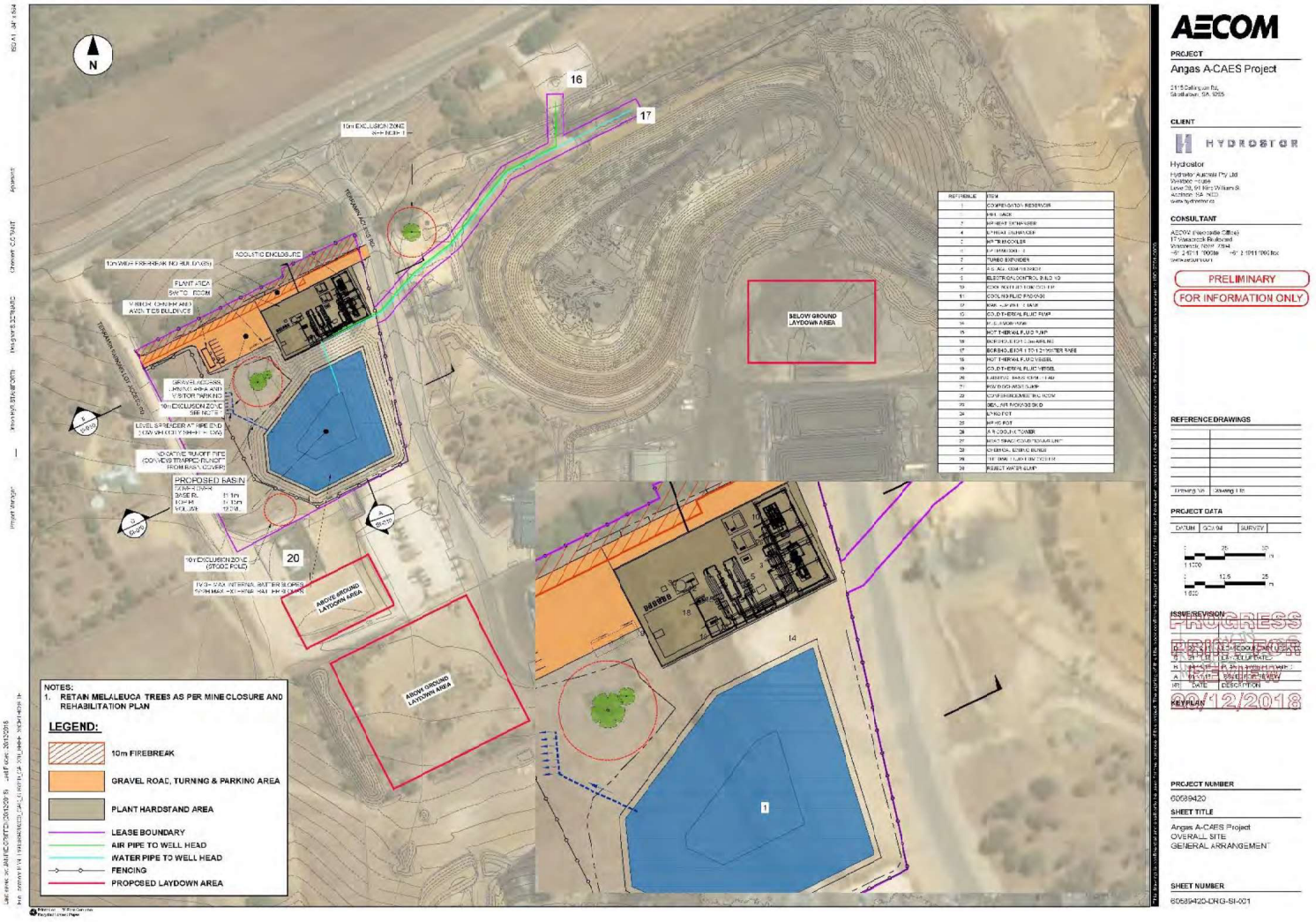

Figure 1: Proposed Project layout

1.1 Purpose

Protection of the environment and community during construction and operation is important to ensure that Hydrostor's reputation as a responsible developer is maintained and the conditions of the Mining Lease existing over the site are not compromised by the development.

The purpose of this EMP is to:

- Provide a framework to provide measures to reduce potential environmental impacts of the Project
- Define objectives and measurable targets associated with the significant environmental aspects of the Project
- Document the policies, processes and procedures to manage and control the environmental aspects and impacts (using a risk management approach); legislative requirements; approval conditions; and other relevant environmental obligations
- Allocate responsibilities for ensuring the effective implementation of these policies, processes and procedures
- Describe how the environmental management performance will be monitored and reviewed to drive continuous improvement.

The EMP will be used as a basis for the Contractor's Environmental Management Plan (CEMP), developed by the selected construction contractor for the construction phase of the project. It will also be used as the basis for ensuring appropriate management of relevant environmental issues during the operational phase.

2.0 REGULATIONS AND COMPLIANCE

2.1 Relevant legislation and permits

Table 1: Project approval requirements

Relevant Legislation	Approval Authority	Type of approval	Responsibility and timing
Development Act 1993 (Development Act)	State Commission Assessment Panel (SCAP)	Development Approval A Development Application will be submitted to SCAP for assessment	Hydrostor Prior to construction
Environment Protection Act 1993 (EP Act)	South Australia Environment Protection Authority	No specific approval permits- all activities onsite must comply with the EP Act	Hydrostor and contractors Throughout construction and operation
Natural Resource Management Act 1994 (NRM Act)	Department of Environment and Water (DEW)- including Natural Resources South Australia Murray Darling Basin (SAMDB)	Well construction permits Drainage permits (for Managed Aquifer Recharge during dewatering) Water allocation	Hydrostor Prior to well installation and dewatering Prior to dewatering
Native Vegetation Act 1991		No requirement for removal of vegetation and therefore no permit required. Protection of significant trees required	Hydrostor during construction and operation
The Mining Act 1971 (Mining Act)	Department for Energy and Mining (DEM)	No specific approval permits- work to be undertaken to not compromise Mining Lease (or a future Miscellaneous Purpose Lease) conditions under the Mining Act.	Hydrostor and contractors

2.2 Management responsibilities and general duties

The Project will be undertaken in a manner that addresses the requirements of the EP Act general environmental duty, specifically:

A person must not undertake an activity that pollutes, or might pollute, the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm.

Table 2 identifies the key stakeholders for the project, their representative(s) and the respective roles and responsibilities.

Table 2: Project responsibilities

Stakeholder	Role	Responsibilities	Contact details
Principal – Hydrostor	Principal Site Owner	▪ Overarching responsibility for the project ▪ Implementation of the EMP during operation ▪ Site inspections and auditing of site works against the EMP to ensure appropriate measures are implemented ▪ Management of Stakeholder engagement	To be confirmed
Construction Contractor	Environmental Manager	▪ Developing a CEMP in accordance with this EMP ▪ Ensuring compliance with the CEMP ▪ Undertaking the required construction monitoring and reporting ▪ Responding where mitigating measures during construction are not adequate or where the EMP/CEMP requires amendments	To be confirmed
	Project Manager	▪ Delivery of the construction of the Project ▪ Engaging contractors to implement the construction works ▪ Control of site operations during construction ▪ Ensuring overall works compliance with the CEMP	To be confirmed

2.3 Training and awareness

2.3.1 Inductions

Prior to commencement on site, all project personnel will undergo a Site Induction covering awareness of quality, safety, site rules and administration; and environmental issues and measures specific to this project. The induction may include, but not be limited to:

- Purpose, objective and key issues of the EMP/CEMP
- Conditions of environmental licences, permits and approvals
- Emergency response procedures and reporting processes for environmental incidents
- Site-specific issues such as location of refuse bins, refuelling and maintenance of vehicles, plant and equipment
- Aboriginal heritage issues, including identification of heritage sites and procedures for discovery of heritage sites
- Management of dust from construction activities
- Management of construction noise and vibration
- Contamination management procedure
- Protection of significant trees
- Soil erosion and drainage management measures.

Induction records will be kept confirming that all relevant personnel have been appropriately inducted. Inductions will be updated as required, i.e. when significant changes occur on site or within the environmental management framework of the project.

2.3.2 Construction Pre-starts and Toolbox talks

In addition to the site inductions, pre-start talks will be undertaken at the beginning of each day of construction activities (before work commences). Environmental issues will be raised and discussed at these meetings, as required.

Records of Toolbox talks and the issues discussed will be retained.

2.4 Emergency contacts

Organisation		Contact Details
Hydrostor		TBA
Construction Contractor		TBA
CFS – Strathalbyn		(08) 8536 2220
Natural Resource Centre- Strathalbyn		(08) 8536 5600
Wildlife hotline (Fauna Rescue SA)		(08) 8289 0896
Environment Protection Authority		(08) 8204 2004
Underground Services	AAPT	1800 786 306
	APA SA	1800 427 532
	NBN Co SA/NT	1800 626 762
	Nextgen NCC-SA	1800 032 532
	Optus and/or Uecomm SA	1800 505 777
	PIPE Networks SA	1800 201 100
	SA Power Networks	131 366
	SA Water	(08) 7424 1117
	SEA Gas	1800 103 542
	Telstra SANT	Submit Form via DB4YD website
	Vocus Communications	1800 262 663

3.0 ENVIRONMENTAL MANAGEMENT

3.1 Key environmental aspects

This EMP provides strategies for the management of potential impacts associated with the Project. The EMP strategies address the following environmental aspects:

- Flora and fauna (Section 3.2.1)
- Surface water management (Section 3.2.2)
- Air quality, noise and vibration (Section 3.2.3)
- Contamination (Section 3.2.4)
- Heritage (Section 3.2.5)
- Waste management (Section 3.2.7).

In addition to the aspects listed above, additional management measures will be detailed in separate management plans for specific risks in the construction and operational phases, as listed below and described in Section 3.3:

- Project health and safety
- Dewatering management.

3.2 Management strategies

3.2.1 Flora and fauna

The Project footprint is within an already disturbed area of the Mine and therefore, there is not expected to be a significant impact to flora and fauna.

Revegetated areas are present around the Project site, however, are not expected to be impacted by the construction activities. Two heritage trees (Dryland teatrees) exist in close proximity to project infrastructure and will require delineation and protection.

Horehound is a declared plant under the *Natural Resources Management Act 2004* and has been identified near the Project site.

Tables 3, 4 and 5 outline potential impacts to native vegetation and fauna, as well as those associated with weeds and pests and mitigating measures to minimise these impacts.

Table 3: Native vegetation management

Aspect	Clarification
Environmental Objectives	Minimise adverse impacts to existing native vegetation Comply with the obligations under the *Native Vegetation Act 1991* and Mining Lease conditions.
Potential Impacts	Damage to remnant vegetation (heritage trees) Disturbance of existing vegetation at the site
Mitigation Measures	▪ Induct all site personnel to provide an understanding of the relevant vegetation protection issues ▪ Delineate an exclusion zone around heritage trees to ensure they are protected ▪ Restrict vehicle movement to defined tracks and access/egress points. ▪ Restrict vehicle movement and machinery disturbance from within and around existing vegetation.

Table 4: Fauna management

Aspect	Clarification
Environmental Objectives	Minimise adverse impacts to fauna and habitats.
Potential Impacts	▪ Increased potential for collision with vehicles due to increased traffic in the site area.
Mitigation Measures	▪ Induct all site personnel to provide an understanding of the fauna potentially present ▪ Minimise vehicle movement and machinery disturbance within and around retained vegetation ▪ Dedicate vehicle movement to defined tracks. ▪ Contact the relevant authority in the event of encountering trapped or injured fauna.

Table 5: Weed and pest management

Aspect	Clarification
Environmental Objectives	Prevent the spread of pest plants and animals. Comply with the NRM Act
Potential Impacts	Spread of weeds through Project activities including surface disturbance and traffic movement. Site-based waste attracting pest animals.
Mitigation Measures	▪ Induct all site personnel to provide an understanding of the declared plants present onsite and requirements of the NRM Act. ▪ Movement, control and destruction of declared plants to be in accordance with the NRM Act. This includes obtaining appropriate approvals prior to transporting declared plants on public roads. ▪ Management of entry/exit point (i.e. using a rumble pad) so that site soils (potentially containing weed propagules) are not tracked to or from the site ▪ Ensure imported fill is clean and free of weed propagules. ▪ Restrict vehicle access to defined tracks and access/egress points. ▪ Regular monitoring of weeds. ▪ Progressive stabilisation/revegetation of disturbed areas. ▪ Spot spraying where declared weeds (specifically Horehound) are identified. ▪ Implementation of Terramin's Weed and Pest Management Plan throughout operations ▪ Ensure waste is appropriately stored to discourage pest animals. This includes covering putrescible and organic storages

3.2.2 Surface water management

The construction and operation of the facility is not expected to have an adverse impact on surface water, either from contamination or sedimentation.

The existing sediment control system will not be disturbed by the Project construction and operational infrastructure (Figures 2 and 3).

The Project and construction methodology will be designed to ensure surface water in the “clean zone” is diverted to the existing or new drainage lines within this zone (Figure 3) and runoff in the “dirty zone” is retained within this zone.

Surface water that accumulates on top of the reservoir cover will be discharged to a vacant area of the Project site. This water will be conveyed via a level spreader to slow the velocity of the runoff.

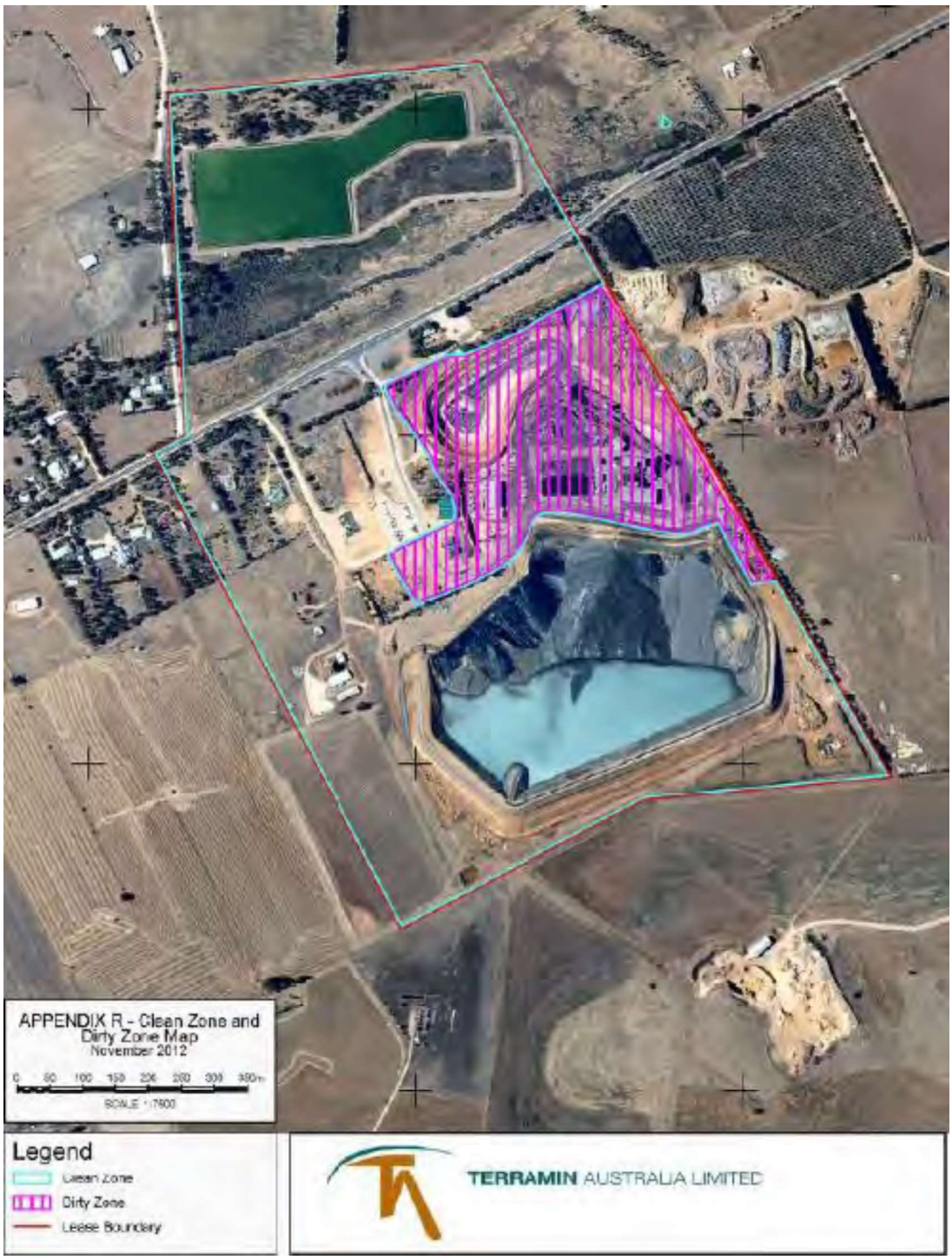

Figure 2: Angas Zinc Mine- clean and dirty zones for surface water runoff

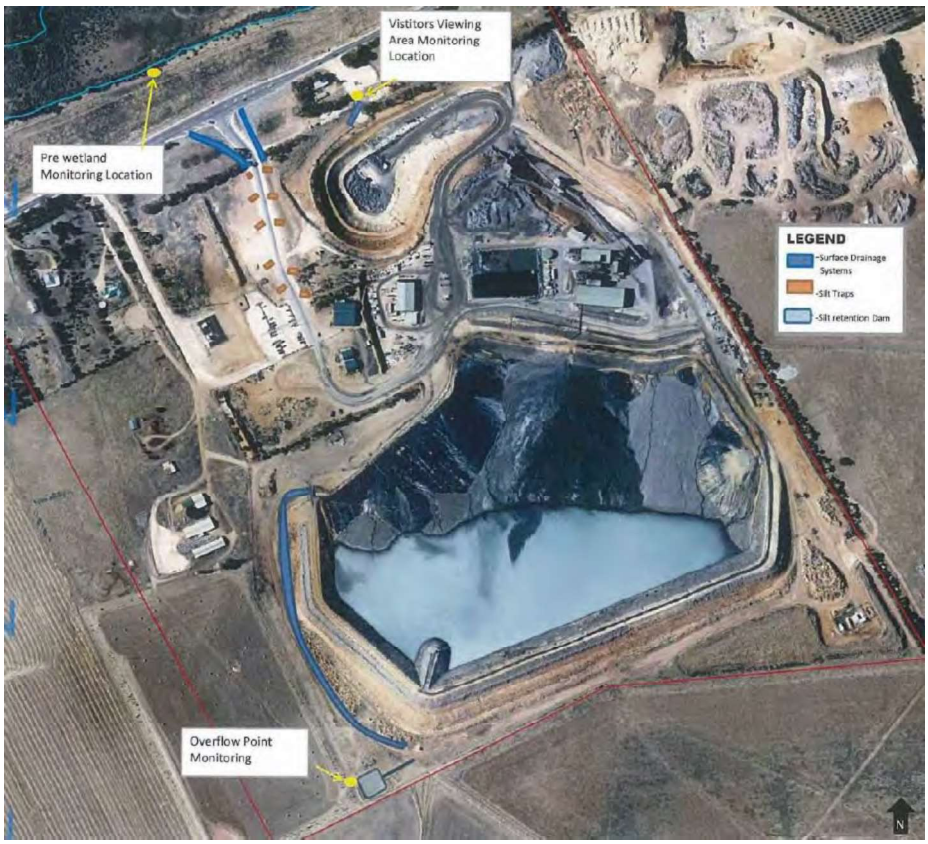

Figure 3: Surface water drainage infrastructure

While it is not expected that runoff from the site will have a significant impact on any surface water drainage pathways, to mitigate any potential impacts the management measures listed in Table 6 should be implemented during construction.

Table 6: Surface water management

Aspect	Clarification
Environmental Objectives	Minimise erosion of soils and protect surface water drainage pathways. Comply with Mining Lease conditions
Potential Impacts	Increased erosion due to soil cover disturbance and changes to surface water flow patterns. Decrease in surface water quality.
Mitigation Measures	▪ Induct all site personnel to provide an understanding of the issues associated with surface water and the management zones and strategies in place. ▪ Progressive stabilisation of soil and areas disturbed by earthworks using vegetation (hydro seeding), matting and various other techniques. ▪ Soil to be stockpiled away from drainage pathways. ▪ Treatment measures such as sediment fences, silt socks and temporary swales and basins placed to manage erosion and drainage. These should be used in sequence where sediment loads are expected to be high.

Aspect	Clarification
	▪ Prevent contaminants including waste, fuels, sediment and other potentially contaminated runoff from entering surface water drainage pathways using measures including containment, bunding, cover, separation buffers and spill response and clean up contingencies. ▪ Control the entry and exit of stormwater runoff from work areas including to divert clean stormwater away from and around materials storage areas. ▪ Stop work in the event of encountering potentially contaminated soil and reassess site drainage to ensure sediments from potentially contaminated soils are contained.
Monitoring requirements	Terramin's existing surface water monitoring commitments will continue throughout construction and operation, in accordance with the Closure Criteria including: ▪ Turbidity monitoring at existing remote telemetry stream gauge locations ▪ Surface water quality monitoring at the potential discharge point to the Angas River and an upstream location

3.2.3 Air quality, noise and vibration

The Project activities are not expected to have a significant adverse impact on air quality. Dust levels are likely to increase as a result of construction and may have a minor impact on residents in close proximity to the site.

Operation of construction plant and machinery will cause a noticeable level of noise during construction activities, which may have a minor impact on the residents in close proximity to the Project site.

Vibration impacts are expected to be minor.

Engagement with local community, and the residents near the Project site, will be undertaken prior to starting and during construction works.

Operational air quality, noise and vibration impacts are expected to be negligible.

Table 7 outlines the potential impacts to air quality and measures to minimise these impacts.

Table 8 summarises the potential impacts as a result of the increase in noise and vibration and mitigating measures to minimise these impacts.

Table 7: Air quality management

Aspect	Clarification
Environmental Objectives	Minimise impacts to air quality such as dust, vehicle emissions and odours. Comply with the National Environment Protection (Ambient Air Quality) Measure 1998 and SA EPA guidance.
Potential Impacts	Increased levels of dust generated during construction activities. Increased level of vehicle emission and particles by plant machinery.

Aspect	Clarification
Mitigation Measures	▪ Induct site personnel to provide an understanding of the issues associated with air quality management and the mitigating strategies in place. ▪ Maintain plant machinery and equipment for efficient operation and minimise engine idle times and queuing. ▪ Designated vehicle access routes and protocols to be determined and communicated to all contractors. ▪ Covering or wetting-down soil and construction material stockpiles to minimise dust mobilisation. ▪ Stop work in areas where construction activities are generating unacceptable levels of dust. ▪ Minimise use of on-site cutting and grinding. Where used, employ equipment and techniques such as dust extractors and surface wetting to minimise dust. Consider use of specific plant such as wet cutting saws, vacuum extraction or block/slab splitters. ▪ Regularly water exposed surfaces, including exposed stockpiles and unsealed roadways, or seal high use access tracks to suppress dust generation. ▪ Maintain transparent communication lines for community members to contact the Construction Manager (or delegate).

Table 8: Noise and vibration management

Aspect	Clarification
Environmental Objectives	Comply with the *Environment Protection (Noise) Policy 2007,* SA EPA guidance and general environmental duty of care regarding construction noise. Comply with legislative and regulated construction vibration levels.
Potential Impacts	Increase in noise and vibration causing nuisance to residences near the site. Potential structural damage to buildings near the site due to increased vibration from construction machinery.
Mitigation Measures	▪ Induct all site personnel to provide an understanding of the issues associated with noise and vibration management and the mitigating strategies in place. ▪ Ensure EPA approvals for night works are obtained if required. ▪ Conduct property condition surveys where requested prior to and after construction activities to manage potential impacts from construction vibration. ▪ Machinery at the site to operate in accordance with relevant sections of the SA *Environment Protection (Noise) Policy 2007* and the SA EPA Noise Information Sheet (2014). ▪ Proactive noise control strategies if required, such as shielding for compressors, power generators and other fixed plant; and temporary acoustic barriers or enclosures. ▪ Substitution of alternative processes if excessive noise or vibration is produced. ▪ Truck movements to be limited to the designated freight route. ▪ All vehicles and equipment will be appropriately serviced and maintained. ▪ Ongoing communication with the community regarding times of excessive noise or vibration if required.

3.2.4 Contamination

A baseline soil contamination assessment has been undertaken prior to construction works beginning, identifying areas of contamination that require additional management. Surplus soil requiring offsite disposal is not expected.

A risk to groundwater exists from potential contamination associated with dewatering of the Mine and reinjection to the shallow aquifer. A specific Dewatering Management Plan will be developed to ensure protection of groundwater during dewatering and reinjection.

Table 9 outlines the potential impacts associated with contamination as a result of Project activities and measures to minimise these impacts.

Table 9: Contamination management

Aspect	Clarification
Environmental Objectives	Comply with *Environment Protection Act 1993* and relevant SA EPA Guidelines. Minimise adverse impacts to soil and groundwater as a result of contamination. Comply with Mining Lease Conditions.
Potential Impacts	Accidental spills causing contamination. Contaminated soil mixing with 'clean' soil, further contaminating the site. Stockpiled contaminated soil becoming airborne or entering surface water drainage pathways. Water reinjected into the shallow aquifer causing contamination.
Mitigation Measures	▪ Induct site personnel to provide an understanding of the issues associated with contamination management and the mitigating strategies in place. ▪ Spill kits to be available on site. ▪ Hazardous materials to be appropriately stored on sealed areas with bunding, and away from drainage pathways. ▪ Refuelling to be undertaken on sealed areas away from drainage pathways. ▪ Mixing of soil types to be avoided (i.e. contaminated/non-contaminated). ▪ Material removed from the site to landfill, or for reuse at another site, will be done so in accordance with SA EPA regulatory requirements. ▪ Only clean materials will be imported to the site. ▪ Soil or other material spilled onto roadways having originated from vehicles to be removed. ▪ Surface water management controls to be put in place, as described in Section 3.2.2. ▪ Air quality controls to be put in place, as described in Section 3.2.3. ▪ Dewatering Management Plan to be followed during dewatering and reinjection including specifically, monitoring and treatment of extracted water to background levels prior to re-injection. ▪ Emergency response plan to be followed for accidental spills.
Monitoring requirements	Terramin's existing groundwater monitoring commitments will continue throughout construction and operation including groundwater level and quality monitoring in accordance with Closure Criteria.

3.2.5 Aboriginal heritage

Based on the site having been previously disturbed, the Project site and construction activities are considered low risk in relation to Aboriginal heritage.

Table 10 outlines the potential impacts to Aboriginal heritage because of Project activities and measures to minimise these impacts.

Table 10: Aboriginal heritage management

Aspect	Clarification
Environmental Objectives	Minimise impacts to Aboriginal sites. Comply with the South Australian Aboriginal Heritage Act 1988.
Potential Impacts	Disturbance of Aboriginal sites or objects within the project site.
Mitigation Measures	▪ Site personnel to be inducted to the site, including providing an understanding of the cultural heritage considerations associated with the project, including examples of indications of potential cultural significance. ▪ If suspected Aboriginal heritage items, including stone artefacts, hearths or burials are exposed during excavations, work will stop immediately and the Principal and an appropriately qualified Heritage Consultant will be contacted. ▪ Works must cease until direction has been provided by an appropriately qualified Heritage Consultant, and/or appropriate authorities. ▪ If human skeletal remains are found, these must be immediately reported to the Strathalbyn Police Station and Division of State Aboriginal Affairs (if suspected to be of Aboriginal origin).

3.2.6 Waste management

A variety of wastes, both potentially hazardous and non-hazardous and including general refuse, may be produced during construction and operational activities.

The waste hierarchy will be implemented during all activities at the site, as practicable.

Table 11 outlines the potential impacts of waste as a result of Project activities and measures to minimise these impacts.

Table 11: Waste management

Aspect	Clarification
Environmental Objectives	Prevent negative environmental impacts associated with construction waste. Prevent waste from impacting on land and surface water. Comply with *Environment Protection Act 1993* and relevant SA EPA Guidelines.
Potential Impacts	Inappropriate storage and disposal of waste impacting on land and surface water. Accumulation of pest animals.

Aspect	Clarification
Mitigation Measures	▪ Site personnel inductions to include appropriate storage (including separation) and disposal/recycling of waste. ▪ Work areas to be maintained in a neat and orderly manner. ▪ Waste will be disposed of regularly by the persons/organisation undertaking the activities, with appropriate signage and separation of hard organic material from putrescible organic material. ▪ Off-site waste disposal will be in accordance with SA EPA and Zero Waste SA guidelines/requirements.

3.3 Separate management plans

The following aspects will be detailed in separate management plans developed by the contractor and its subcontractors, as required.

3.3.1 Health and safety

Health and safety documentation for public safety will be developed by the Contractor including an Emergency Response Plan (ERP). The ERP will be developed in collaboration with the Country Fire Service and will include details such as:

- Health and safety inductions for site staff, contractors and visitors
- Roles and responsibilities
- Muster point locations
- Bushfire emergency procedures including access and watering points
- Locations of, and access to fire extinguishers, spill kits and other necessary emergency equipment
- Incident reporting requirements.

3.3.2 Dewatering management

A Dewatering Management Plan is to be prepared by specialist Hydrogeologists based on information collected during the detailed design phase and will include details such as:

- Roles and responsibilities
- Expected quality and quantity of extracted water
- Options for reuse/disposal of extracted water
- Water quality monitoring requirements and trigger levels
- Dewatering schedule
- Contingency plan and incident reporting.

4.0 INCIDENT PLAN

A contingency plan is provided to guide site personnel if environmental concern is raised during Project activities.

Examples of events that warrant concern could include (but is not limited to):

- Chemical spills
- Encountering potential Aboriginal artefacts
- Community complaints
- Encountering trapped or injured fauna.

The following contingency plan will be followed:

1) **Stop Work:** where required, works will cease in the area of the environmental issue, or entire site (depending on severity of the event)
2) **Secure the Area:** the area will be made safe. This could include the following:
   - Containment of chemicals
   - Containment of contaminated water to prevent runoff going offsite.
   - Flagging off areas
3) **Communicate:** the incident will be communicated as soon as practicable to the Principal and any relevant authorities
4) **Resolve:** the offending activity will not continue until the issue/concern has been resolved, corrective actions have been put in place, and the Principal has given approval to proceed.

5.0 MONITORING, REPORTING AND REVIEW

Reporting requirements, site inspections and any audits of compliance with the EMP will be in accordance with Hydrostor's requirements.

Signature Page

Golder Associates Pty Ltd

Hannah Keynes
Environmental Scientist

Lissa van Camp
Principal Environmental Consultant

HK/LvC/gp

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APPENDIX H

Important Information

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

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The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

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Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

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