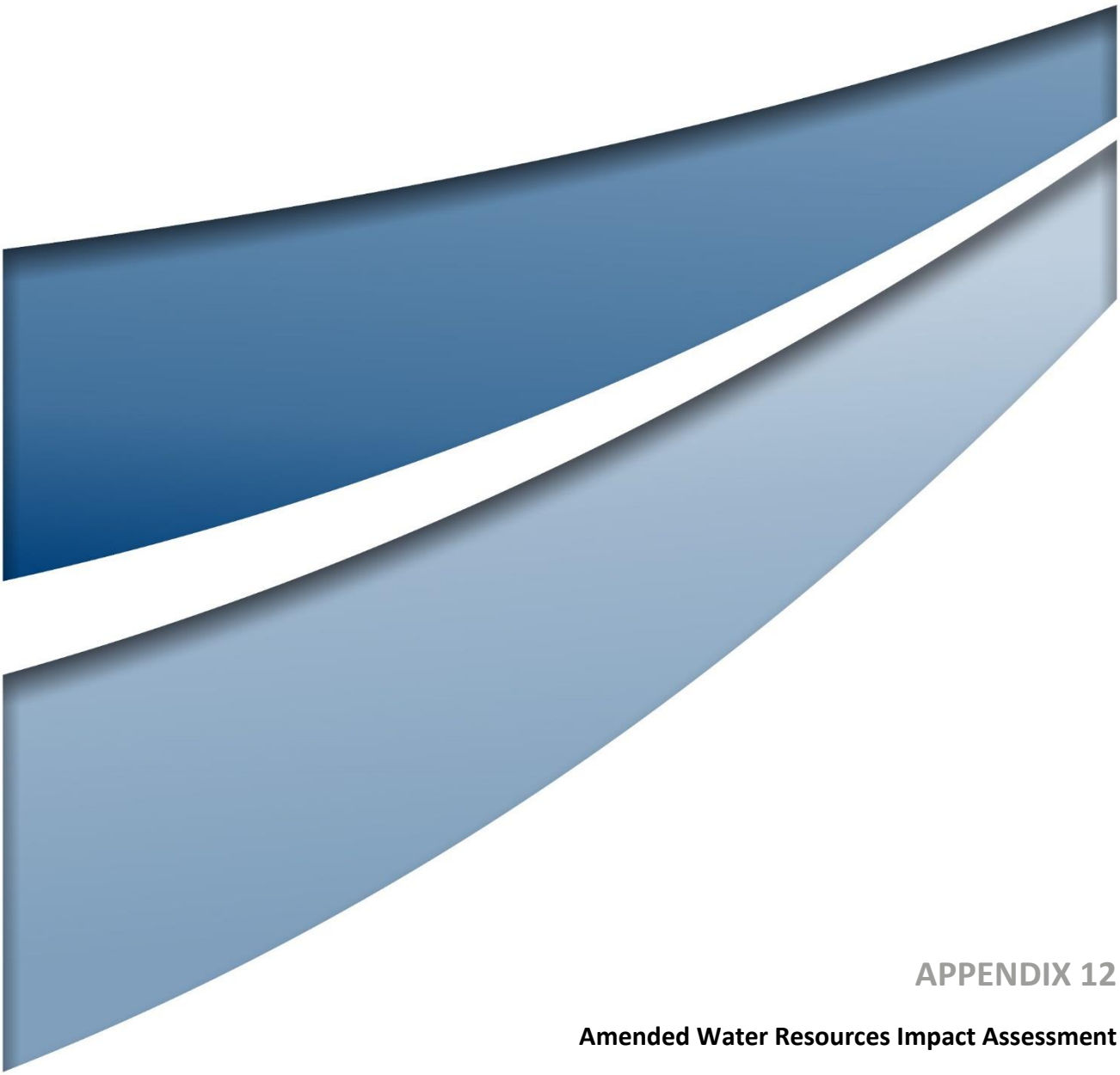


APPENDIX 12

Amended Water Resources Impact Assessment

TALLAWANG SOLAR FARM

Water Resources Impact Assessment
Addendum

FINAL

May 2024

TALLAWANG SOLAR FARM

Water Resources Impact Assessment Addendum

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
RES Australia Pty Limited

Project Director: Malinda Facey
Project Manager: Marion O'Neil
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Report No. 21139/R21
Date: May 2024

Environmental & Social Consultants

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

Disclaimer

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final	Melissa Swan	07 May 2024	Malinda Facey	07 May 2024

Glossary and Abbreviations

Term/Abbreviation	Definition
AEP (Annual Exceedance Probability)	Annual Exceedance Probability. The change of a flood of a given or large size occurring in any one year, usually expressed as a percentage. In this study AEP has been used consistently to define the probability of occurrence of flooding. The following relationships between AEP and ARI applies to this study (ARR, 2019).
AHD	Australian Height Datum. A common national surface level datum approximately corresponding to mean sea level.
Amended Project	The Amended Project includes the elements of the Project as described in the EIS as well as changes which have been made largely in response to submissions on the EIS. These include: • Introduction of a 400-person Temporary Workers Accommodation (TWA) facility • Updated treatment for the proposed intersection upgrade on the Castlereagh Highway • Removal of proposed 13 km overhead TRANSMISSION LINE traversing through Barneys Reef Wind Farm • Increased BESS capacity • Minor layout refinements within already disturbed areas • Minor Project Area boundary adjustment.
ARR	Australian Rainfall and Runoff. Guidelines prepared by the Institute of Engineers Australia for the estimation of design floods.
ASS / PASS	Acid Sulphate Soils or Potential Acid Sulphate Soils.
BESS	Battery Energy Storage System.
CEMP	Construction Environmental Management Plan.

Frequency Descriptor	EY	AEP (%)	AEP (1 in x)	ARI
Very frequent	12			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.50
	1	63.2	1.58	1.00
Frequent	0.69	50.00	2	1.44
	0.5	39.35	2.54	2.00
	0.22	20.00	5	4.48
	0.2	18.13	5.52	5.00
	0.11	10.00	10.00	9.49
Infrequent	0.05	5.00	20	20.0
	0.02	2.00	50	50.0
	0.01	1.00	100	100
Rare	0.005	0.50	200	200
	0.002	0.20	500	500
	0.001	0.10	1000	1000
	0.0005	0.05	2000	2000
Extremely Rare	0.0002	0.02	5000	5000
			↓	
Extreme			PMP	

Term/Abbreviation	Definition
Development footprint	The maximum extent of ground disturbance associated with the construction and operation of the Project. The development footprint would cover an area of approximately 1,016 ha within the Amended Project Area.
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
Environmental Impact Statement (EIS) Project	The proposed Tallawang Solar Farm as described within the EIS.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
Flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future, and continuing risks. They are described below: • Existing flood risk: the risk a community is exposed to as a result of its location on the floodplain. • Future flood risk: the risk a community may be exposed to as a result of new development on the floodplain. • Continuing flood risk: the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.
Flood storage areas	Those parts of the floodplain that are important for the temporary storage of floodwaters during passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.
Floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is flood prone land.
GW	Gigawatt.
GWh	Gigawatt-hour.
Hazard	A source of potential harm or situation with a potential to cause loss. In relation to this manual the hazard is flooding which has the potential to cause damage to the community.
Hydrology	The study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
ICNIRP	International Commission on Non-Ionizing Radiation Protection.
Associated Dwelling	Dwelling located on land owned by landholders associated with the Project.
Associated landholder	A landholder whose property would have Project infrastructure located on it.
kL	Kilolitre, one thousand litres.
km	Kilometres.

Term/Abbreviation	Definition
kV	Kilovolt.
m AHD	Metres Australian Height Datum (AHD).
m/s	Metres per second. Unit used to describe the velocity of floodwaters.
m^3/s	Cubic metres per second or “cumecs”. A unit of measurement of creek or river flows or discharges. It is the rate of flow of water measured in terms of volume per unit time.
MDBA	Murray-Darling Basin Authority.
MHRDC	Maximum Harvestable Right Dam Capacity.
ML	Megalitre, one million litres.
MW	Megawatt.
Non-associated dwelling	Dwelling located on land owned by landholders not associated in the Project.
Non-associated landholder	A landholder whose property is located in proximity to the Amended Project Area but would not have Project infrastructure located on it. Potential impacts to non-associated landholders are investigated in the EIS.
NVR Map	Native Vegetation Regulatory Map.
PMF (Probable maximum flood)	The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The probable maximum flood defines the extent of flood prone land, that is, the floodplain.
Amended Project Area	The total area in which the Project would be developed. The Amended Project Area covers approximately 1,300 ha.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual, it is the likelihood of consequences arising from the interaction of floods, communities, and the environment.
Runoff	The amount of rainfall which ends up as a streamflow, also known as rainfall excess.
Scour	Erosion by mechanical action of water, typically of soil.
Sensitive receiver	Non-associated dwellings in proximity to the Project Area that may be sensitive to noise, visual, traffic and other impacts. Potential impacts to sensitive receivers are investigated in the EIS.
Solar farm site	The parcels of land where the solar farm would be located.
TUFLOW	TUFLOW is a computer program which is used to simulate free-surface flow for flood and tidal wave propagation. It provides coupled 1D and 2D hydraulic solutions using a powerful and robust computation. The engine has seamless interfacing with GIS and is widely used across Australia.
WAL	Water Access License.
WSP	Water Sharing Plan.

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Appendix B Wastewater Management Options Report
Appendix C Water Demand and Resource Assessments
Appendix D Draft Soil and Water Management Plan

1.0 Introduction

RES Australia Pty Ltd (RES) is seeking to develop the proposed Tallawang Solar Farm (the Project) in the Central West region of New South Wales (NSW), approximately 8 kilometres (km) northwest of Gulgong within the Mid-Western Local Government Area (LGA) (refer to **Figure 1.1**).

An Environmental Impact Statement (EIS), including a Water Resources Impact Assessment (WRIA, 2022), was submitted to the former Department of Planning and Environment (DPE) (now the Department of Planning, Housing and Infrastructure (DPHI)), and publicly exhibited in late 2022. During the exhibition period, 70 submissions were made on the Project.

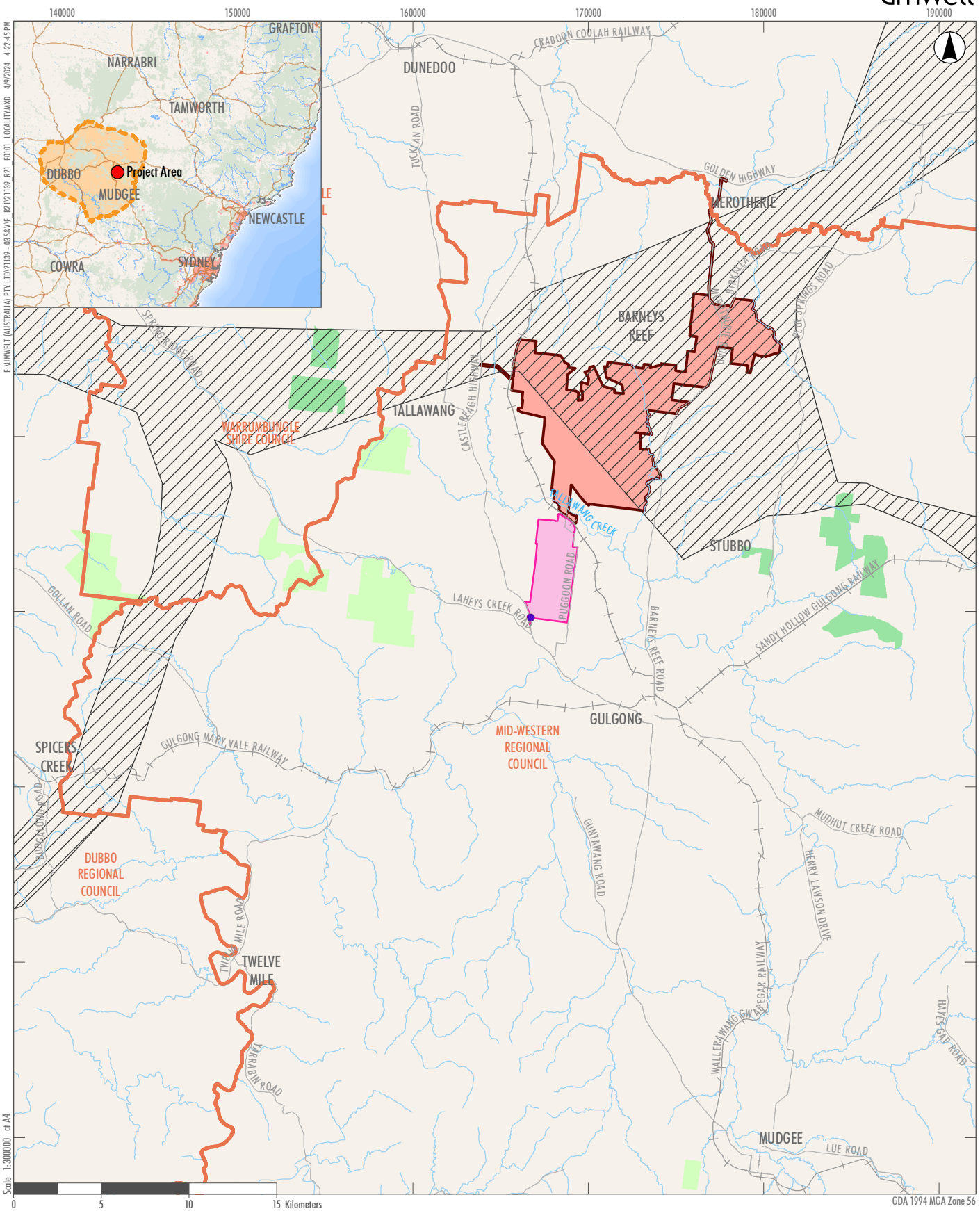
The Project, as exhibited in the EIS, included the construction, operation, and decommissioning of a 500 megawatt (MW) solar farm with a Battery Energy Storage System (BESS) of approximately 200 MW/400 MW-hours, a 330 kilovolt (kV) overhead transmission line of approximately 13 km long and associated infrastructure which will connect the Project to the national electricity grid. The EIS Project's conceptual layout is included in **Figure 2.1**. One onsite switchyard and a 330 kV substation was proposed, at two possible locations within the solar farm and BESS development area (refer to **Figure 2.1**) and it was anticipated that the final location of the onsite switchyard and substation would be determined during detailed design.

Following analysis of the EIS submissions, RES undertook a thorough review of the Project's design and layout. As a result, RES is proposing to amend the Project as presented in the EIS in response to concerns raised in the EIS submissions and based on further consultation with agencies, landholders and key stakeholders. The proposed amendments include the introduction of a 400-person Temporary Workers Accommodation (TWA) facility, removal of the proposed overhead electricity transmission line, BESS capacity increase and an updated treatment design for the proposed intersection upgrade at the new site access on the Castlereagh Highway (the Amended Project). Some minor layout refinements and readjustment of the Project Area boundary and development footprint are also proposed as part of the amended Project.

Umwelt has reviewed the Project amendments to assess whether the changes have a material impact on the outcomes of the WRIA. This is an Addendum to the WRIA, which presents a summary of the review and assessment of the Amended Project. More specifically, this assessment presents an update of potential water resource related impacts as a result of the following components of the Amended Project:

- increased water demand during the Amended Project's construction period, including potable and non-potable water demand for the construction and operation of the TWA facility
- potential for onsite wastewater management and disposal via land at the TWA facility
- adjustment of the development footprint, including a number of additional waterway crossings.

The conceptual layout for the Amended Project is shown in **Figure 2.2**.



Legend

- Tallawang Solar Farm Project Area
- Barneys Reef Wind Farm Project Area
- Indicative Proposed Central West Orana REZ Transmission Corridor
- Indicative Central-West Orana Renewable Energy Zone
- Access Point
- Local Government Area Boundary
- State Forest
- National Parks (NPWS Estate)
- Road
- Drainage Line
- Railway Line

FIGURE 1.1

Locality Map

Image Source: Data source: DSFI (2024), RES (2024)

1.1 Purpose and Scope of this Report

The focus of the WRIA Addendum has been to provide an updated assessment of potential impacts on water resources as a result of the Amended Project, in and around the Amended Project Area. The scope of this report therefore includes:

- updated assessment in a manner consistent with the Secretary's Environmental Assessment Requirements (SEARs) issued for the Project, on the following:
    - flooding (including modelling for 5%, 1%, 0.5%, 0.2% Annual Exceedance Probability (AEP) and the Probable Maximum Flood (PMF))
    - groundwater levels
    - potential impacts and mitigation measures for erosion and sedimentation
    - surface and groundwater quality
    - water users
    - water sourcing and licensing.
- identification of any additional mitigation and management measures to minimise potential impacts of the Amended Project on water and soil resources.

The WRIA Addendum should be read in conjunction with the original WRIA as only changes in the Amended Project design since EIS submission are assessed in this report.

1.2 Statutory Context, Policy and Guidelines

This report has been prepared in accordance with the following guidelines and legislative requirements:

- NSW Water Management Act 2000 (WM Act).
- NSW *Water Act 1912* (Water Act).
- Relevant Water Sharing Plans within the Amended Project Area.
- Groundwater:
    - NSW State Groundwater Policy Framework Document and component policies (DPIE).
    - NSW Aquifer Interference Policy 2012 (DPIE).
    - National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC).
- Flooding:
    - Floodplain Development Manual (OEH).
    - Floodplain Risk Management Guideline (OEH).

- Australian Rainfall and Runoff Guidelines 2019.

- Surface Water:
  - NSW State Rivers and Estuary Policy (DPIE Water).
  - NSW Government Water Quality and River Flow Objectives at [http://www.environment.nsw.gov.au/ieo/].
  - Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC, 2006).
  - National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ).
  - Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DECC, 2008).
  - Managing Urban Stormwater: Soils and construction (Landcom).
  - Technical Guidelines: Bunding and Spill Management (EPA).
  - NSW Guidelines for Controlled Activities (Various) (DPIE).
  - NSW Water Quality Objectives (DECCW, 2006).
  - ANZECC (2000) Guidelines for Fresh and Marine Water Quality.
  - Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (DECC, 2004).

- Guidelines for Controlled Activities on Waterfront Land: There a number of guidelines for Controlled Activities under the WM Act, developed by the former NSW Office of Water (now DPHI – Water).
  - Guidelines for riparian corridors on waterfront land.
  - Guidelines for instream works on waterfront land.
  - Guidelines for vegetation management plans on waterfront land.
  - Guidelines for watercourse crossings on waterfront land.
  - Controlled Activities on Waterfront Land: Controlled activity exemptions on waterfront land.

The hydrological assessment was undertaken in accordance with the ARR2019 and with consideration of the relevant provisions of the NSW *Floodplain Development Manual* (2005). The mapping within the ARR2019 is consistent with the NSW *Floodplain Development Manual* (2005) but provides additional detail and updated recommendations on hazard category thresholds.

There are no specific floodplain risk management plans prepared by Mid-Western Regional Council which cover the Amended Project Area. The most recent floodplain risk management plan prepared within Mid-Western Regional Council is the *Floodplain Risk Management Study and Floodplain Risk Management Plan for Kandos and Rylstone* (2017). This document uses the NSW Government's *Floodplain Development Manual* (2005) to characterise and map flood hazard. The hydrological assessment has used updated guidance from ARR2019 to characterise and map Flood Hazard which Mid-Western Regional Council is expected to use in their future floodplain risk management plans.

There are no Rural Floodplain Management Plans covering the Amended Project Area, but the analysis and reporting carried out in the hydrological assessment is in line with guidance from ARR2019 and is consistent with the expectations of a Rural Floodplain Management Plan.

1.3 Submissions on the EIS

An EIS for the Project was submitted to DPHI during August 2022. Public exhibition of the EIS took place between 28 October 2022 and 24 November 2022. A total of six (6) submissions out of 70 were received relating to water. A Submissions Report was prepared to provide a summary of the actions since exhibition, detail the comments provided in the public submissions phase of the EIS, analyse the submissions and offer a detailed response to each submission. Where required, the submissions relating to water have been addressed within this WRIA Addendum. A summary of the submissions as relating to water and how they have been addressed is presented in **Appendix A**.

2.0 Project Description

2.1 EIS Project

The Project as presented in the EIS proposed to include the construction, operation and decommissioning of a 500 MW solar farm, 200 MW/400MWh BESS and associated infrastructure (such as operations and maintenance buildings, temporary construction compound, security fencing), civil works (such as intersection works on the Castlereagh Highway, some vegetation clearing and drainage line crossings) and electrical infrastructure (including a new onsite substation and a new overhead electricity transmission line). The Project's conceptual layout is provided in **Figure 2.1**.

A comparison between the Project as presented in the EIS and the amended Project is provided in **Table 2.2**.

2.2 The Amended Project

The Tallawang Solar Farm project remains generally as described in Section 3 of the EIS. However, some key design amendments have been made to the Project in response to public and agency submissions received during the exhibition period and based on further consultation with agencies, affected landholders and stakeholders more broadly. These include:

- Introduction of a 400-person Temporary Workers Accommodation (TWA) facility
- Updated treatment for the proposed intersection upgrade on the Castlereagh Highway
- Removal of proposed 13 km overhead line traversing through Barneys Reef Wind Farm
- Increased BESS capacity
- Minor layout refinements within already disturbed areas
- Minor Project Area boundary adjustment.

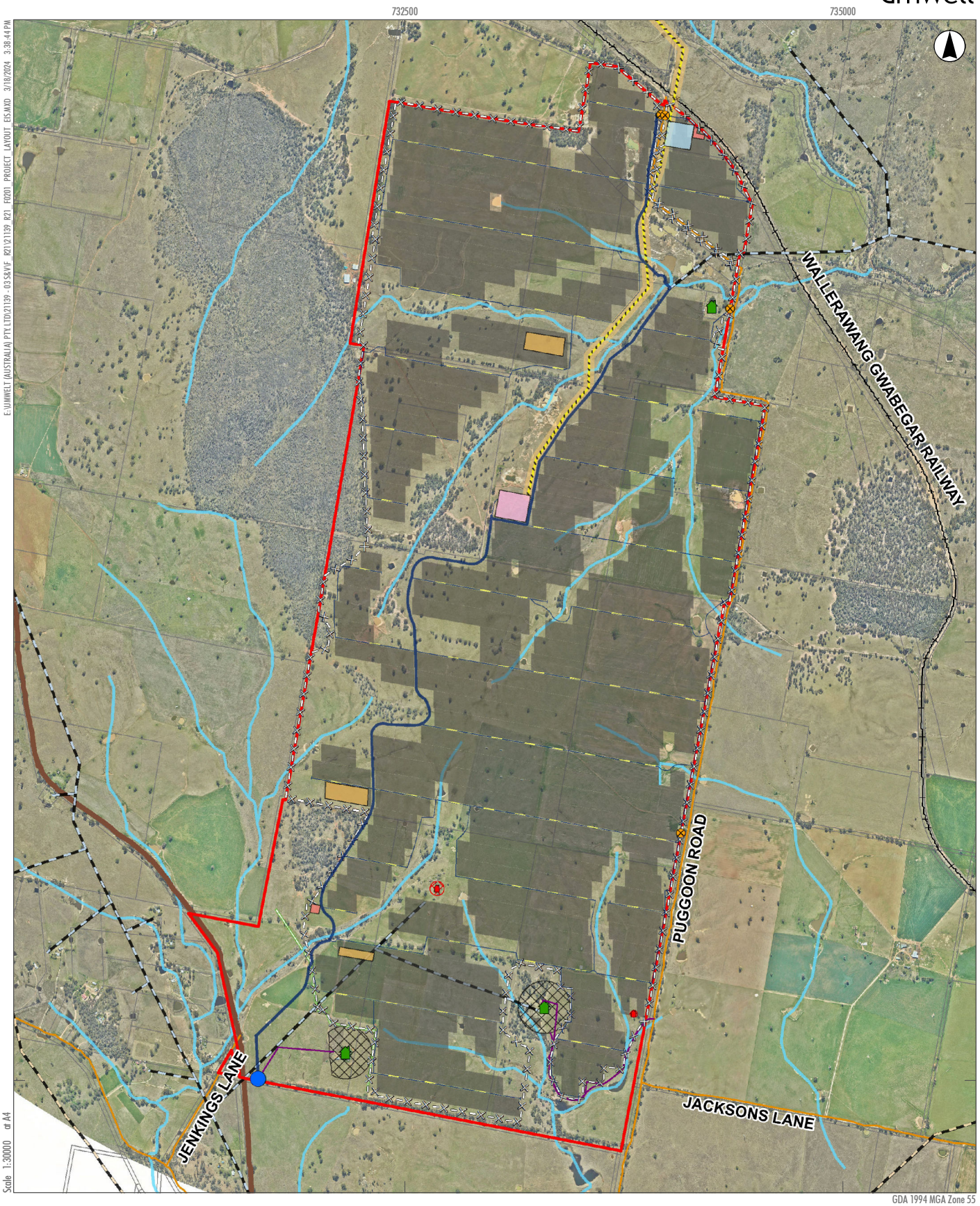
No other project amendments have been made. These amendments are described in more in the Amendment Report (Umwelt, 2024a). The Amended Project's conceptual layout is provided in **Figure 2.3**.

A comparison between the Project as presented in the EIS and the amended Project is provided in **Table 2.2**.

Table 2.1 Comparison between the Project as presented in the EIS and the amended Project

Project Element	EIS Project	Amended Project
Project area	Approximately 1,370 ha	Approximately 1,300 ha
Development footprint	Approximately 866 ha	Approximately 1,016 ha
Schedule of lands	The Project comprises (wholly or partly) 35 cadastral lots	The Project comprises (wholly or partly) 19 freehold cadastral lots
Project access	Project access will be via the Castlereagh Highway at a newly proposed access point from a local gravel road directly south of the Project Area	No change
Intersection upgrade	A short Channelised Right turn (CHR) and an Auxiliary Left turn (AUL) treatment on the Castlereagh Highway	A standard (full sized) CHR & AUL treatments on the Castlereagh Highway
Targeted capacity (solar)	500 MW (AC)	No change
Targeted capacity (BESS)	200 MW / 400 MW-h (DC)	500 MW / 1000 MW-h
Grid connection	A new 330 kV transmision line is proposed to connect the Project to the proposed CWO-REZ Transmission Line via the NSW Government's proposed switching station to be located on the adjacent Barneys Reef Wind Farm project (as shown on **Figure 2.2**)	The Project's grid connection will be via the proposed CWO Transmission Project being developed by the Energy Corporation of NSW (EnergyCo) and the new 330 kV transmission line is no longer proposed as part of this SSD application
BESS design	DC-coupled battery storage units will be distributed throughout the Project Area, adjacent to the inverters	No change
Substation	One onsite 330 kV substation and switchyard proposed at two possible locations ie. a northern and central location as shown on **Figure 1.1**	One onsite 330 kV substation proposed at a central location, as shown on **Figure 2.3**
Photovoltaic modules	Approximately 1,136,400 bifacial solar PV solar panels in 2P configuration, arranged in a series of rows utilising east-west single-axis tracking with row spacing of up to 12 m and maximum height of 5 m at full tilt	No change

Project Element	EIS Project	Amended Project
Temporary ancillary infrastructure	Temporary ancillary facilities required during construction would typically include: • site compound including storage area, offices and meeting room, ablution facilities, canteen and car parking • laydown areas involving areas suitable for storing plant and equipment, and deliveries including solar panels and cable drums, and areas to support waste management activities (e.g. cardboard and timber)	No change
Water use and supply	• **Construction** - Estimated water use would be approximately 206 ML • **Operation** - Approximately 3.4 ML per year to be required for ongoing maintenance activities such as washing of the PV solar panels, amenities and potable purposes by operational staff as well as for livestock grazing within the solar farm and BESS development area	• **Construction** - Estimated water use for the construction period would be 301 ML, consisting of 246 ML of non-potable water use and 55 ML potable water use. • **Operation** – No change
Traffic movements	Project transport will be via road from the Port of Newcastle, via the Golden Highway and then the Castlereagh Highway to the Project Area	No change
Workforce numbers	• **Construction** - Approximately 270 direct full time equivalent (FTE) and 430 indirect FTE jobs (Ethos Urban, 2022). At the Project's peak construction (for up to 6 months) this is expected to increase to about 580 direct FTE jobs (Ethos Urban, 2022) • **Operation** - Up to 7 direct FTE and 20 indirect FTE jobs	• **Construction** – Approximately 380 FTE jobs, with up to 420 workers on site during peak construction • **Operation** – no change
Construction period	• Up to 34 months	• Up to 36 months
Construction timing	Commence Q2 2024	Commence Q4 2026
Workers Accommodation	Dispersed across nearby towns and villages within the Mid-Western and Warrumbungle LGA's	Provision of an onsite TWA facility
Project life	35 years	No change



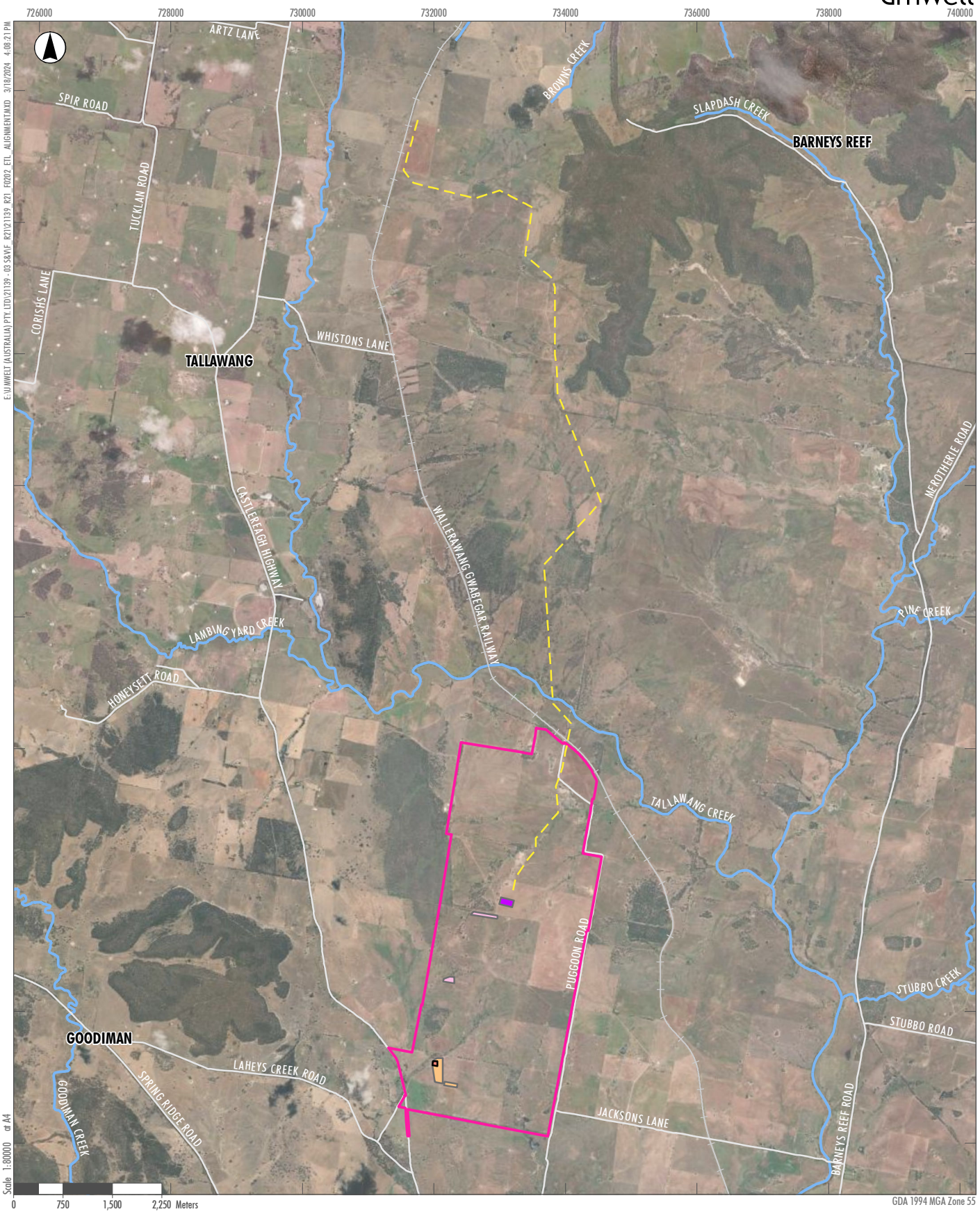
Legend

- Primary Project Access
- Secondary Access
- Proposed Single Axis Tracker
- Bess and DC-DC Coupled PCs with Hardstanding
- Proposed Access Track
- Proposed O&M Facility
- Proposed Substation Central
- Proposed Substation North
- Temporary Construction Compound & Laydown
- Proposed Landowner Access Track
- Proposed Transmission Line
- Proposed Transmission Line Buffer, 30m
- Proposed Landscaping Area
- Involved Dwelling
- Dwelling Exclusion Zone
- Cultural Heritage Huts
- Cultural Heritage Huts Exclusion Zone
- Water Course
- State Road
- Local Road
- 22kV Distribution Line (To Be Rerouted Where Necessary)
- Security Fence
- Project Area Boundary
- NSW Cadastre (2021-11-02)

FIGURE 2.1

EIS Project Development Footprint

Image Source: RES (2021)



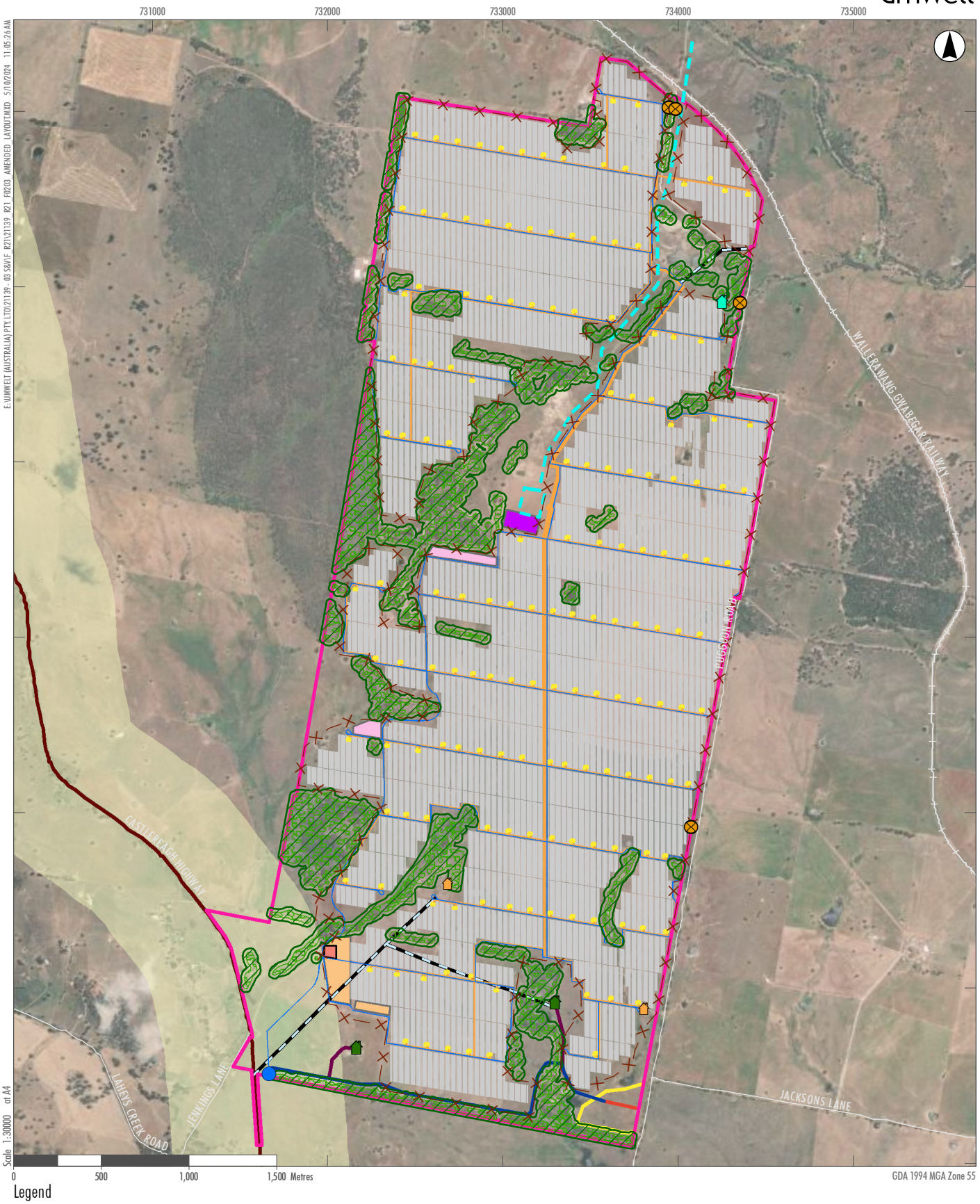
Legend

- Tallawang Solar Farm Project Area
- Construction Compound
- Temporary Laydown
- Proposed O&M Facility
- Proposed Substation
- Proposed HV Powerline
- Road
- Railway
- Watercourse

FIGURE 2.2

Proposed ETL Alignment

Image Source: ESR Basemap Data source: RES Australia (2024), NSW DFSI (2022)



Legend

- Project Area Boundary
- Proposed Single Axis Tracker
- Temporary Workers Accommodation (TWA)
- BESS and DC-DC Coupled PCS with Hardstanding
- Proposed Medium Voltage Reticulation
- Proposed Access
- Construction Compound
- Temporary Laydown
- Proposed O&M Facility
- Proposed Substation
- Grid Connection Infrastructure (proposed by EnergyCo)
- Primary Project Access
- Secondary Access
- Security Fence
- Proposed Landowner Access Track
- Temporary Workers Accommodation (TWA) Access
- Proposed Post Construction Landowner Access Track
- Involved Dwelling
- Involved, Unoccupied Dwelling
- Native vegetation (Umwelt)
- Native Vegetation Buffer, 20m
- Local Road
- State Road
- State Road (Highway) Buffer 500m
- 22kV Distribution Line (to be rerouted where necessary)

FIGURE 2.3

Amended Project Layout

Image Source: ESRI Basemap Data source: NSW DFSI (2022), RES (2024)

3.0 Existing Environment

There have been no changes to the existing environment since the completion of original WRIA (Umwelt, 2022). Refer to Section 2 of the original WRIA.

4.0 Changes to Water Supply, Licensing and Wastewater Management

4.1 Proposed Water Supply and Use

Updated water demand requirements for the construction of the Amended Project have been estimated by icubed Consulting (refer **Appendix C**). During construction, water would primarily be used for pavement construction, solar footing construction, dust suppression, and potable water for the workforce. The associated water demand would likely be in the order of 301 megalitres (ML) (consisting of approximately 246 ML of non-potable water and approximately 55 ML of potable water) for the 36-month construction period.

During operations, approximately 3.4 ML per year would be required for ongoing maintenance activities such as washing of the PV solar panels, amenities, and potable purposes by operational staff. Washing of the panels would not require any detergent or cleaning agents.

4.2 Water Source Options

Further to the above, icubed Consulting was commissioned by RES to investigate suitable water supply options for the Amended Project (refer **Appendix C**).

The following water supply options are available:

- Potable water –
    - Ulan Water is located approximately 35 km east of the Amended Project Area and has been identified as the local contract supplier. Initial discussion with Ulan Water has confirmed that potable water supply is available with quantities dependent on timing, supply and availability.
    - Lake Windemere is approximately 75 km south of the Amended Project Area and is currently at 93% capacity (WaterNSW, 2024a).
- Non-potable water –
    - Ulan Water is available for non-potable water supply. Initial discussion with Ulan Water confirmed that non-potable water supply is available with quantities dependent on timing supply and availability.
    - sourcing treated grey water and recycled wastewater.
    - onsite boreholes and property owners' dams. One groundwater bore (GW0805247) is located within the Amended Project Area adjacent to and east of Castlereagh Highway. The bore is described as drilled to 42 m in depth and for stock and domestic water supply purposes. The last recorded groundwater depth was recorded as 12 m below ground on 15/02/2013 (WaterNSW, 2024b).

- local dams owned by property owners. The maximum harvestable right for all dams within the Amended Project Area was estimated to be 91 ML, making on-site storage a viable option.

In addition, options for water conservation, specifically alternatives and initiatives to minimise potable and non-potable water demand, were investigated. Initiatives included the use of polymers in dust suppression, rainwater collection, employing recycled water in construction, leak detection and repair, and implementing education and awareness programs to promote responsible water usage among workers. Overall, by implementing these alternatives and initiatives, the Tallawang Solar Farm can significantly reduce water demand, conserve water resources, and promote sustainable water practices.

4.3 Wastewater Management

The TWA facility, which covers an area of approximately 5 ha, is proposed to be located in the southeastern corner of the site (Lot 4, DP750762). A dedicated access is proposed to the TWA site via an internal all-weather track, via the Project's primary access point off the Castlereagh Highway (refer **Figure 2.3**). The TWA facility will include administration offices, approximately 400 self-contained rooms, kitchens, dining facilities, laundry, and recreational facilities. As the TWA site does not have existing sewage reticulation, RES investigated a number of options for wastewater treatment and/or management as part of the Amended Project.

A Wastewater Management Options report has been prepared by Decentralised Water Australia (DWA) (2024) to evaluate the feasible options for the management of sewage generated by the TWA facility and is included in **Appendix B**. The report discusses the site, soil, and local environmental constraints to inform the suitability for land based on-site wastewater systems and if appropriate, inform the design, location and operation of the system.

It is estimated that the TWA facility will produce a peak wastewater flow of 150 L/equivalent population (EP)/day equivalent to 57 kL/day (DWA, 2024). An equivalent population (EP) has been estimated based on an occupancy of 1 EP per bedroom with additional EP included for day workers (DWA, 2024).

DWA identified three (3) potential wastewater management solutions for the TWA facility. These are:

- Option 1: Full on-site wastewater management via an advanced secondary treatment system with land application / reuse via surface spray irrigation.
- Option 2: Full on-site wastewater management via a primary treatment system with land application and treatment with Wisconsin Mounds.
- Option 3: Discharge to waters via a tertiary package treatment plant.

The following preliminary investigations were undertaken by DWA to inform the development of these high-level options:

- Desktop Land Capability Assessment (LCA) for effluent management within the TWA site to identify suitable land and appropriate loading rates and setback distances for effluent irrigation and land application.
- Development of a design basis for wastewater volumes to assist in water and nutrient balance modelling that informs effluent management options.

- Completion of long-term continuous daily water and nutrient balance modelling using Model for Effluent Disposal by Land Irrigation (MEDLI, Queensland Government - Department of Environment and Science) to develop preliminary effluent storage, land area requirements and evaluate the ecosystem and human health protection performance of land application options.
- Sizing of Wisconsin Mound land application systems in accordance with AS1547:2012 and NSW requirements.
- Based on an evaluation of the TWA occupancy profile and local land capability and receiving environment constraints DWA considers Option 1 - Wastewater treatment provided by an on-site advanced secondary treatment system with land application / reuse via surface spray irrigation of surrounding pasture, pursuant to Section 68 of the Local Government Act 1993, to be the preferred effluent management strategy (DWA, 2024).
- In order to meet the water quality objectives at receiving surface and groundwaters, a minimum storage capacity of 500 kL is required for treated effluent (DWA, 2024). This will enable an irrigation strategy that applies effluent at a long-term rate of 2.85mm/day with irrigation shut off during rainfall events greater than 10mm, to achieve the required pollutant reduction (DWA, 2024).

The system will be designed and installed in a modular fashion that aligns with the design capacity of treatment modules (such as 20 KL/d capacity). This would enable system capacity to be ramped up and back down as the workers population peaks and drops down during construction.

In addition, RES has had discussions with Dubbo Regional Council to receive the wastewater at one of the sewage treatment plants within the Dubbo Regional LGA, subject to further discussions with Council.

4.4 Water Licensing Requirements

Consistent with the original WRIA, two water sharing plans apply to the Amended Project Area:

- Water Sharing Plan for the Macquarie Bogan Unregulated and Alluvial Water Sources 2012
- *NSW Murray Darling Basin Fractured Rock Groundwater Sources 2020* (Lachlan Fold Belt Murray Darling Basin Groundwater Source) (DPIE, 2022).

Groundwater in the northern half of the Amended Project Area and surrounding the Amended Project Area creek systems are noted in the Mid-Western Regional LEP as 'Groundwater Vulnerability'.

The Lachlan Fold Belt MDB is described as a fractured rock aquifer system where groundwater occurs mainly within the fractures and joints. Aquifer usage is relatively limited however there are some areas of intense groundwater utilisation due to locally favourable groundwater availability and water quality. A total of 78,313 entitlement shares are managed under the water sharing plan for the Lachlan Fold Belt for the 2024/2025 year with the majority used for irrigation purpose (WaterNSW, 2024c).

There are approximately 35 farm dams within the Amended Project Area used for livestock water points. Most of the dams are relatively small ranging in capacity between roughly 20 kL and 0.5 ML, with the largest dam in the Amended Project Area estimated at between 3 and 5 ML and the next two largest estimated around 1 ML. An example farm dam in the Amended Project Area is shown in **Figure 4.1**.

These existing dams are unlikely to be licenced as they are likely to capture water under a harvestable right. The total capacity of all dams on a property allowed under the harvestable right is called the Maximum Harvestable Right Dam Capacity and the Maximum Harvestable Right Dam Capacity for the Amended Project Area has been calculated as 91 ML (based on an Amended Project Area of 1,300 ha) (WaterNSW, 2024c). It is expected that the existing dams have a total capacity of less than 95 ML, suggesting no change in licencing would be required. The total dam capacity should be confirmed prior to construction.

A desktop review of water access licenses on the NSW Water Register undertaken during March 2024 indicated that there are no existing groundwater access licenses for the Amended Project Area (WaterNSW, 2024d). Should the Amended Project use water from groundwater bores, approval for Water Access Licences (WAL) would be required under the NSW Water Management Act 2000, and groundwater use will need to be within licensing requirements.

No change to the natural surface waterway outlets from the Amended Project Area is being proposed. The Amended Project's layout has considered the larger farm dams and have an exclusion zone of up to 40 m around these, as illustrated in **Figure 2.3**.

No water discharge is proposed as part of the Amended Project.



Figure 4.1 A farm dam within the Project Area

5.0 Flood Assessment Methodology

5.1 Modelling Approach

A flood investigation was undertaken for 5%, 1%, 0.5% and 0.2% Annual Exceedance Probability (AEP) events and the Probable Maximum Flood (PMF) for the EIS Project as part of the original Water Resources Impact Assessment (WRIA) (Umwelt, 2022). AEP is a measure of the likelihood a flood level or flow will be equalled or exceed in any given year. The PMF is the largest flood that could be conceivably expected to occur at a particular location, usually estimated from Probable Maximum Precipitation (PMP).

Hydraulic modelling of the Project Area was completed using a two-dimensional (2D) TUFLOW flood model for the original WRIA (Umwelt, 2022). No changes were made to the model for the completion of this WRIA Addendum. The TWA site and TWA access track location was included in the original modelling. An assessment of the potential flood impacts on the TWA site and access is included in **Section 7.2** below.

6.0 Flood Modelling Results and Discussion

6.1.1 Overview and Flood Hazard Classifications

The flood model results provide the distribution of peak flood level, depth, velocity, and hazard across the Project Area for each modelled design magnitude flood event. Note that areas where the modelled flood depths are less than 5 cm have been filtered from the results.

The flood mapping and discussion of the flood conditions for each design event are discussed in the original WRIA (Umwelt, 2022).

As part of the original WRIA, the flood hazard of the Project Area was assessed in accordance with ARR 2019, which defines six hazard categories as presented in **Table 6.1**. The combined flood hazard curves are presented in **Figure 6.1**.

Table 6.1 Hazard Classification (ARR, 2016)

Hazard Vulnerability Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)	Description
H1	D*V ≤ 0.3	0.3	2.0	Generally safe for vehicles, people and buildings.
H2	D*V ≤ 0.6	0.5	2.0	Unsafe for small vehicles.
H3	D*V ≤ 0.6	1.2	2.0	Unsafe for vehicles, children, and the elderly.
H4	D*V ≤ 1.0	2.0	2.0	Unsafe for vehicles and people.
H5	D*V ≤ 4.0	4.0	4.0	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
H6	D*V ≥ 4.0	-	-	Unsafe for vehicles and people. All building types considered vulnerable to failure.

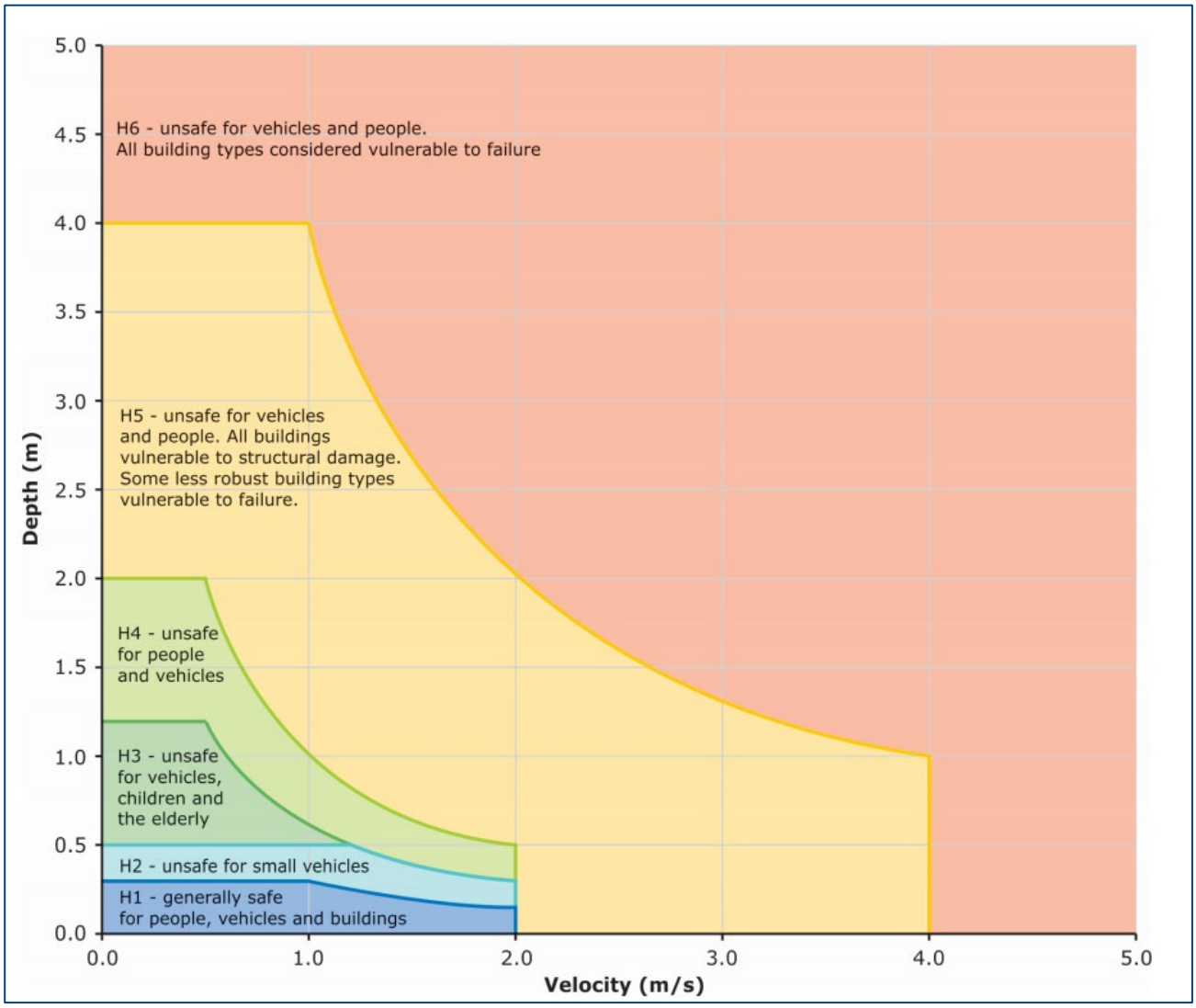


Figure 6.1 Combined Flood Hazard Curves (Smith et al. 2014)

6.1.2 Substation

A review of the flood modelling results from the original WRIA (Umwelt, 2022) show that the location of the central substation within the Amended Project Area are predicted to be free from flooding up to and including the 0.2 % AEP flood event.

6.1.3 Temporary Workers Accommodation Facility

The TWA facility, which covers an area of approximately 5 ha, is proposed to be located in the southeastern corner of the site (Lot 4, DP750762). Access to the TWA site will be via the Project's primary access via the Castlereagh Highway, along in internal access track through the solar farm site that will traverse two first order watercourses and one second order watercourse.

A review of the flood modelling results from the original WRIA (Umwelt, 2022) shows that the TWA site is not impacted by flooding up to the 1 % AEP event. Minor flooding (flood depths < 0.1 m) was predicted within the model in a small area within the southeastern corner of the TWA site in the 1% AEP event and up to the 0.2 % AEP event. Modelled flood extents increased in this area in the PMF event, with modelled flood depths increasing up to 0.3 m.

The flood modelling results further show that the TWA access through the solar farm site is not impacted by flooding up to the 0.2% AEP event with flooding occurring only at the waterway crossings. Flood depths at the waterway crossings were modelled to be between 0.1 m to 1.0 m within the watercourses for the 1 % AEP event.

6.1.4 Site Access

The Amended Project Area will have primary access from the Castlereagh Highway (via a local gravel road directly south of the Project) and four alternate (secondary) access locations on the eastern side of the Project Area via Puggoon Road. The TWA facility will also have a dedicated emergency access via Puggoon Road. These alternate access locations would only be utilised for stock movements and in case of emergencies.

A review of the modelling results from the original WRIA (Umwelt, 2022) show that the Project primary access via Castlereagh Highway is of low flood risk and predominately not impacted by flooding, making the Amended Project compatible with the Flood Hazard of the land. Castlereagh Highway to the north of the Jenkins Lane may experience flooding during a 1% AEP event with a flooding depth of up to 0.3 m. The alternate access points off Puggoon Road are not inundated up to a 1 % AEP event with up to 0.3 m flood depths predicted at the waterway crossings.

7.0 Assessment of Potential Impacts

A risk assessment was undertaken for the EIS Project to identify and assess the potential water resources related risks associated with the Project. The risk assessment is provided in Appendix B of the original WRIA and has adopted the Risk Assessment Framework set out in *Australian Standard/New Zealand Standard (AS/NZS) ISO 31000:2018 Risk Management – Principles and Guidelines* (2018). A review of this risk assessment has been undertaken with consideration of the proposed Amended Project and it is considered that risks captured within the original risk assessment are still applicable to the Amended project and no additional risks have been identified.

Based on a review of the flood modelling (**Section 6.0**) and the risk assessment completed for the original WRIA, the Amended Project has the potential to impact on water resources in the following manner:

- impacts to surface water quality on receiving and downstream waterways
- impacts to flooding, including flow rates, velocities, and depths
- impact on water supply
- impacts to groundwater, including impacts to downstream users and GDEs.

7.1 Surface Water Quality

There are no anticipated changes to the potential surface water quality impacts as described within the original WRIA (Umwelt, 2022) outside of those detailed below.

7.1.1 Construction and Decommissioning

Potential water quality impacts during the construction and decommissioning of the Amended Project include:

- Soils would be disturbed within the Amended Development Footprint (which is slightly larger and includes the TWA site and TWA access), involving minor vegetation removal, excavation works and stockpiling of materials, which can potentially lead to sediments and/or pollutants mobilising in runoff and entering local waterways
- Accidental spills, such as hydraulic oil and fuels, from equipment or vehicles as well as concrete spills, building materials and chemicals
- Construction of additional waterway crossings.

A draft Soil and Water Management Plan (SWMP) has been prepared for the Amended Project in accordance with industry standards including the guideline, *Managing Urban Stormwater: Soils and Construction (Landcom 2004)* in response to DPHI Water's submission. A copy of the SWMP is provided in **Appendix D**.

Stormwater runoff at the TWA site will be managed during construction as proposed through the Stormwater Management Report prepared by Mott Macdonald (2024) (refer **Appendix D**). More specifically, this will involve diverting upstream flows via swales around the proposed TWA facility to maintain the existing drainage in the local region. Runoff at the TWA facility will be managed via overland swales and/or piped crossing network to a sediment basin. The basin design would be designed for Type D (dispersible) soil to flocculate and settle before passing over an overflow weir. This will allow particulate matter to be captured before entering streams in smaller and frequent storm events. A sediment basin with a minimum volume of 528 m^3 (see Appendix D of the Stormwater Management Report for calculations of minimum basin sizing) is to be used to capture and maintain stormwater on site. In addition, sediment fences, straw bale check dams, and a temporary site entrance will be used to manage erosion control throughout the TWA site.

The proposed TWA access track is approximately 2.25 km long, starting at the Project's primary access point on the Castlereagh Highway and traversing through the solar farm site. The access track will be an all-weather road of approximately 8 m wide and will be designed to accommodate B-triple vehicles with a minimum curve radius of 15 m.

Three waterway crossings have been identified along this alignment, requiring single or multi-barrel reinforced concrete pipe (RCP) culvert installations based on flood depth assessments. The number of culverts and their sizes will be determined during detailed design following site investigations.

Furthermore, all waterway crossings will be designed and constructed in compliance with the Department of Primary Industries, Office of Water, *Guidelines for riparian corridors on waterfront land and Guidelines for watercourse crossings on waterfront land*.

With implementation of management and mitigation measures outlined in the original WRIA (Umwelt, 2022) as well as additional measures outlined in **Section 8.0**, surface water quality impacts resulting from the construction and decommissioning of the Amended Project are expected to be negligible.

7.1.2 Operation

Potential water quality impacts during the operation of the Amended Project would include:

- stormwater runoff from impervious surfaces within the Amended Development Footprint resulting in localised erosion
- accidental spills or discharge through use and storage of chemicals such as fuel
- use of herbicides for vegetation control
- potential discharge (via land application) from on-site wastewater facility at the TWA facility.

As part of the implementation of the SWMP during the operation of the Amended Project, it is further proposed that swales and downstream sediment basin implemented for the construction of the TWA facility be converted to a rain garden. Swales will be seeded or grassed. This is in line with guidance from Mid-Western Regional Council's 'Stormwater to Smartwater'.

Should an on-site wastewater treatment system be installed at the TWA facility, the following measures, as proposed by DWA (2024), would be implemented to achieve the required wastewater quality:

- a minimum of 500 kl storage for treated effluent
- surface irrigation (typically moveable impact spray 'pods' or similar on 600 mm risers) of a total area covering 2 ha
- tipping bucket rain gauge to cease irrigation when rain exceeds 10mm
- long term irrigation rate of 2.85 mm/day.

With the implementation of the management and mitigation measures outlined in the original WRIA as well as additional measures in **Section 8.0**, surface water quality impacts during the operational phase are expected to be negligible.

7.2 Flooding

The 5%, 1%, 0.5% and 0.2% Annual Exceedance Probability, and Probable Maximum Flood were assessed using flood depth, velocity, and hazard levels as part of the original WRIA (Umwelt, 2022). Review of the modelling results shown the Amended Project Area to be of low flood risk with minimal risk to changes in internal or external waterway flows. For the full flood impact assessment refer to the original WRIA (Umwelt, 2022).

Access points to the Amended Project Area were predicted to be of low flood risk. Design of waterway crossings for the access point and crossings within the Amended Project Area will be undertaken at the detailed design phase.

Access tracks and cable reticulation are the only works proposed within the watercourses and no other artificial structures are planned to be installed in the waterways within the Amended Project Area. Where waterway crossings (i.e., culvert crossings or causeways) are required, these would be designed and constructed in compliance with the Department of Primary Industries (Office of Water) *Guidelines for riparian corridors on waterfront land* (2012) and *Guidelines for watercourse crossings on waterfront land* (2012). There is only one 3rd order stream within the Amended Project Area, to the west of the TWA facility (along the southern boundary). A setback of more than 40 m to the PV panels and other Project infrastructure has been adopted in the design layout to minimise potential impacts.

As discussed in **Section 6.1.3**, the proposed TWA site is unlikely to be impacted by flooding up to the 1% AEP event, with minor flooding (< 0.1 m) predicted within a small area within the southeastern corner of the TWA site. The TWA access route through the solar farm site is unlikely to be impacted by flooding up to the 0.2% AEP event, with flooding occurring only at waterway crossings. To ensure safety of occupants of the TWA facility it is recommended that a flood emergency preparedness plan be developed prior to occupation of the TWA which addresses safe access and egress from the site in the event of a flood.

7.3 Impact on Water Supply

7.3.1 Construction and Decommissioning

As discussed in **Section 4.1**, updated water demand requirements have been estimated for the construction of the Amended Project. The associated water demand would likely be in the order of 301 megalitres (ML) for the 36-month construction period.

Water may be sourced from Ulan Water or Lake Windemere (subject to a water use license). Non-potable water may also be sourced from farm dams or licensed groundwater bores located within the Amended Project Area, where appropriate and available. A water sourcing strategy will be developed so that water used during the construction phase does not cause issues to adjacent landowners or other stakeholders. RES is committed to not draw water from Mid Western Regional Council via third party water providers and will continue to consult with Council regarding suitable water sources.

The use of any farm dams during construction and decommissioning would be agreed with the landholder. The estimated maximum harvestable right dam capacity would not be exceeded.

The use of any bore water during construction and decommissioning would be agreed with the landholder and Water Access Licences (WAL) would need to be confirmed and/or obtained as discussed in **Section 4.2**. The licensed water use (if available) would not be exceeded.

Based on the above, it is anticipated that the Amended Project's proposed water use during construction and decommission would not have a negative impact on water supply to the Amended Project Area and the region.

7.3.2 Operation

During operations, approximately 3.4 ML per year would be required for ongoing maintenance activities such as washing of the PV solar panels, amenities, and potable purposes by operational staff. The same construction water supply options will apply for the operational phase of the Amended Project.

7.4 Groundwater Impacts

7.4.1 Construction and Decommissioning

Impacts to groundwater resources including Groundwater Dependent Ecosystems (GDEs) and bore users are not expected given the groundwater table is unlikely to be intercepted during Project construction and the relatively deep depth to groundwater at the Amended Project Area based on available information (the last recorded groundwater depth of groundwater bore GW0805247, which is located within the Amended Project Area, was 12 m below ground level on 15/02/2013 – refer to Section 2.5 and Section 2.6 of the original WRIA (Umwelt, 2022) means that any hydrocarbon/chemical spills are unlikely to infiltrate to the groundwater table.

Should the final Project design identify that construction activities will result in the interception of the groundwater table, an assessment of impacts will be undertaken, and appropriate management measures be developed to mitigate any potential impacts.

7.4.2 Operation

Impacts to groundwater resources including GDEs and bore users during operation are not expected given that the groundwater table will not be intercepted during operation (refer to **Section 7.4.1**).

8.0 Management and Mitigation Measures

Table 8.1 presents the proposed additional measures to be implemented as part of the Amended Project to manage and minimise impacts on water resources. These proposed additional measures will be implemented in addition to those presented in the original WRIA (Umwelt, 2022).

Table 8.1 Management and Mitigation Measures relating to Water Resources

No	Management and mitigation measure	Timing
1	Implementation of Soil and Water Management Plan prepared for the Amended Project	Prior to and during construction During operation
2	Implementation of site specific stormwater management controls for the construction and operation of the TWA facility	Prior to and during construction During operation
3	Advanced secondary treatment system with land application to include the following: • a minimum of 500 kl storage for treated effluent • surface irrigation (typically moveable impact spray 'pods' or similar on 600 mm risers) of a total area covering 2 ha • tipping bucket rain gauge to cease irrigation when rain exceeds 10 mm • long term irrigation rate of 2.85 mm/day	During operation
4	A flood emergency preparedness plan will be prepared for the TWA facility including consideration of evacuation protocols prior to operation of the facility	Prior to Operation
5	A water sourcing strategy will be developed in consultation with Mid Western Regional Council. RES is committed to not draw water from Mid Western Regional Council via third party water providers	Prior to construction

9.0 Conclusion

This Amended Water Resources Impact Assessment has reviewed information and data to understand the potential impacts of the Amended Project on water resources within the Amended Project Area and surrounds.

Similar to the EIS Project, the potential impacts associated with the construction, operation and decommissioning phases for the Amended Project can be appropriately managed through implementation of a range of conventional mitigation measures. In summary:

- The potential for discharge of sediments and the resulting impact on the receiving environment surface water quality during ground disturbance activities (construction and decommissioning) will be managed through appropriate construction management planning including best practice erosion and sediment control measures.
- Potentially adverse impacts on the receiving environment surface water quality during the operational phase will be addressed through development of an operational management plan. This will include the development and appropriate maintenance of a suitable ground cover around solar panels, and grassed table drains near access tracks to minimise the potential for erosion and export of sediment. Additional measures for the treatment of stormwater quality are not considered necessary.
- The flood risk assessment completed for the original WRIA (Umwelt, 2022) was reviewed with reference to the Amended Project and the Amended Project Area was found to be a low risk of flooding for both the existing and Climate Change conditions.
- The results of the flood impact assessment have shown that the Amended Project Area, including the TWA area is located outside areas of major flood hazard. A review of the modelling results from the original WRIA (Umwelt, 2022) show that the Project primary access via Castlereagh Highway is of low flood risk and predominately not impacted by flooding, making the Amended Project compatible with the Flood Hazard of the land.
- Minimal changes to the land topography, impervious fraction and therefore runoff and groundwater infiltration are expected due to the nature and extent of proposed infrastructure for the Amended Project. If the above recommendations outlined in **Section 8.0**, as well as those set out in the original WRIA (Umwelt, 2022) are met and a relevant set of construction and operation Management Plans (to be approved prior to construction/operation commencement) are developed, the Amended Project is not likely to have any major residual impacts on surface or ground water.
- The potential for adverse impacts on the receiving environment surface water quality from point sources such as chemical storage and on-site wastewater treatment (septic tanks to service the operations and maintenance buildings and on-site Wastewater Management via an advanced secondary treatment system with land application / reuse via surface spray irrigation for the TWA facility) will be mitigated through design and will be operated to comply with relevant Australian Standards and local planning requirements.

- Water sources would be confirmed during detailed design phase and in consultation with Mid Western Regional Council, suppliers and landholders and will be subject to availability. Furthermore, RES is committed to not draw water from Mid Western Regional Council via third party water providers. A water sourcing strategy will be developed so that water used during the construction phase does not cause issues to adjacent landowners or other stakeholders. The use of any bore water during construction and decommissioning would be agreed with the landholder and Water Access Licences (WAL) would need to be confirmed and/or obtained.

No constraints were identified within the Amended Project Area that would prevent the Amended Project from meeting the requirements of the local and state planning requirements.

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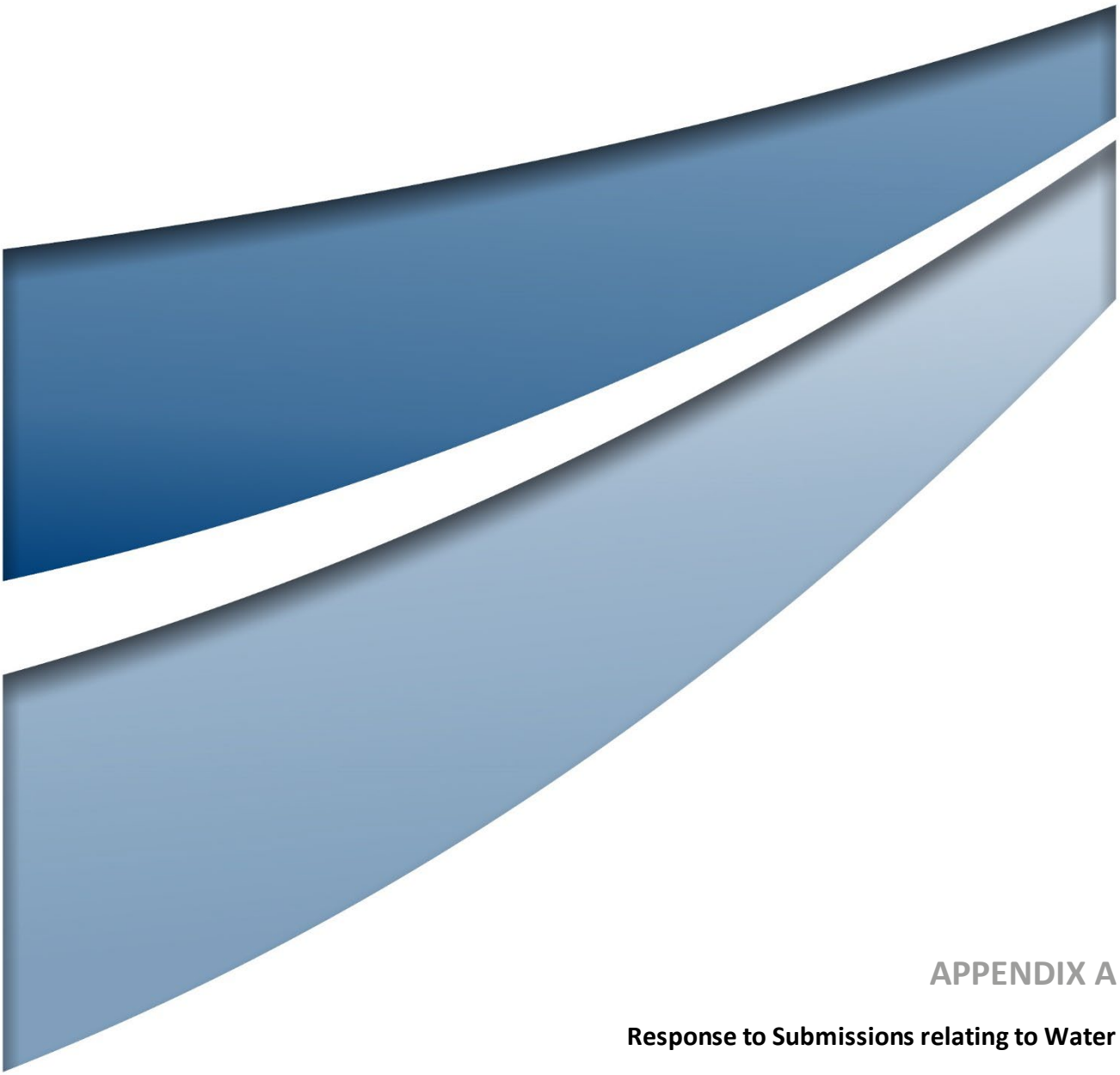
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APPENDIX A

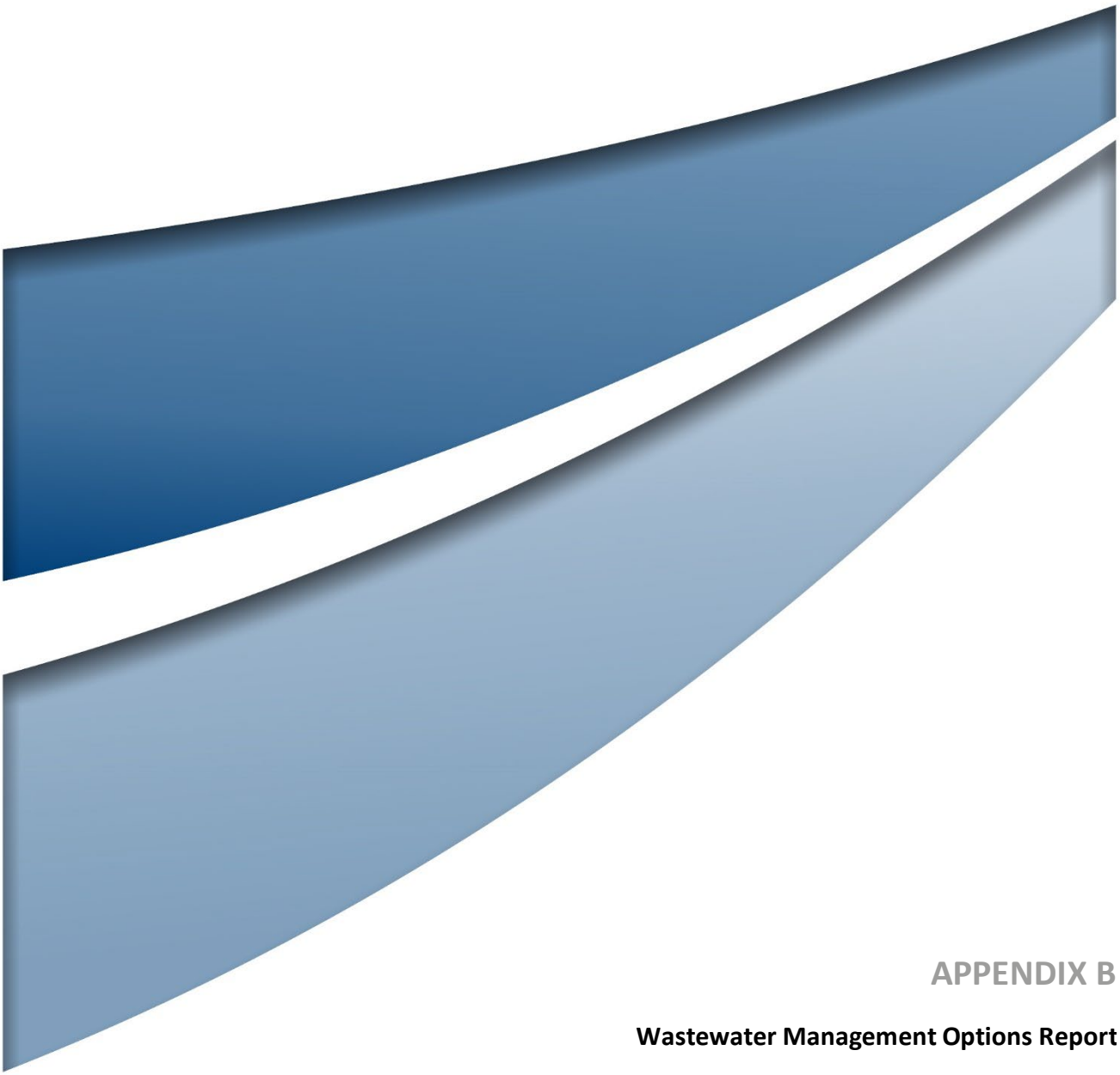
Response to Submissions relating to Water

Table A.1 Response to Submissions relating to Water

Item	Submission	Response
Crown Lands		
1	It is noted that waterway known as Tallawang Creek is within the project area (refer **Figure 3.2** indicative Transmission Line Alignment on page 84 of the EIS). Information on water boundary determination can be found on the Crown Lands website - https://www.crownland.nsw.gov.au/resources/water-boundary-determination. Should it be determined that the waterway is Crown waterway within the site and proposal area, and encroachment is required, authority to access and/or use the Crown waterway will be required.	The EIS identified that the Project would require access over Tallawang Creek for the purposes of the proposed overhead transmission line. However, recent amendments to the Project (as mentioned in **Section 2.2** and detailed in Section 3 of the Amendment Report) have removed the overhead transmission line from the Project as this is now the responsibility of the electricity network operator. As a result, the Amended Project will no longer require access over Tallawang Creek.
DPHI Water		
2	**<u>Water Supply</u>** ***Recommendation*** – Prior to Determination The proponent should confirm the source(s) and associated volumes required for the projects' water demands. ***Explanation*** The proponent indicates an agreement has been made with a local commercial supplier to provide water for the project but notes there is the possibility of the use of farm dams or licenced groundwater bores. Confirmation on the agreed volume with the supplier is requested to confirm water availability for the project. Should farm dams or bores be required to meet water demands, assessment of the suitability of these is required, including how this would impact their current licencing arrangements (noting that amendments may be required to the existing approvals).	Refer to **Section 4.0**

Item	Submission	Response
3	**<u>Impact to watercourses</u>** ***Controlled Activities*** ***Recommendation*** – Prior to Determination The proponent should confirm that the 2nd order watercourse in the south-eastern part of the site has been provided with a setback in accordance with the Guidelines for Controlled Activities. ***Explanation*** The EIS notes the setback of 40m from watercourses with biodiversity values. While this generally appears to have been applied, confirmation is requested that a setback for the 2nd order watercourse in the south-eastern part of the site has been provided in accordance with the Guidelines for Controlled Activities.	As discussed in **Section 2.2,** several amendments are proposed to the Project layout and development footprint that were presented in the EIS. The Amended Project Layout provides setback distances (ranging from 10m to 40m) around watercourses with biodiversity value. In particular, the 2nd order and 3rd order watercourses within the south-eastern part of the Amended Project Area have been provided with a setback in accordance with the *Controlled Activities – Guidelines for riparian corridors on waterfront land* (DPHI, 2022) (i.e. a buffer of at least 20 m from the edge of the creek channel). For an illustration of this, refer to **Figure 4.2** of the Submissions Report (Umwelt, 2024b).
4	**<u>Management of Soil and Water Impacts</u>** ***Soil and Water Management Plan and Erosion and Sediment Control Plan*** ***Recommendation*** – Post Approval The proponent should prepare the Soil and Water Management Plan and an Erosion and Sediment Control Plan in accordance with industry standards including the guideline, Managing Urban Stormwater: Soils and Construction (Landcom 2004).	A draft Soil and Water Management Plan (SWMP) has been prepared for the Amended Project in accordance with industry standards including the guideline, *Managing Urban Stormwater: Soils and Construction (Landcom 2004).* A copy of the SWMP is provided in **Appendix D** of this report.
Mid Western Regional Council		
5	**<u>Wastewater</u>** **SEWERAGE DISPOSAL** It is recognised that sewage will be pumped out and disposed of at a Mid-Western Regional Council facility. Council would need to confirm staging and estimated construction staff to calculate whether Gulgong Sewage Treatment Plant have capacity to accept this additional inflow. Council request the proponent consult with Council in regard to this matter prior to determination. However, it is possible the treatment facilities will not have adequate capacity to take in waste.	RES has continued to consult with Mid-Western Regional Council regarding the concerns raised in their submission. Based on advice provided by Mid-Western Regional Council during the development of the AES, the proposed TWA facility will include an onsite sewage treatment plant for the treatment and disposal of sewage. This is further detailed in **Section 4.2**. An assessment of the potential impacts associated with the onsite sewage treatment plant is provided in Section 6 of the Amendment Report. It is likely that a septic system would be installed for the operational amenities. This would be constructed and managed in accordance with the relevant Mid-Western Regional Council requirements.

Item	Submission	Response
6	**WATER SUPPLY** Council request a quality assurance program (QAP) for the treatment and provision of water to workers is provided. If the proponent wishes to draw from Council's water supply consultation with Council in regards to this matter is required prior to determination. The proponent further notes water will be sourced via a local provider. Council seeks clarification as to who the provider will be and notes the use of Council supplied local portable water is not supported.	Water usage and sources for the Amended Project is detailed in **Section 4.0**.



APPENDIX B

Wastewater Management Options Report

DECENTRALISED WATER AUSTRALIA



Wastewater Management Options Report – Tallawang Solar Farm

Umwelt Pty Ltd

Final Report

23/04/2024

DOCUMENT CONTROL

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Document Reference	R.0736.001.02_TallawangSolarFarm_WOR_Final
Report Type	Non-domestic Report
Title	Wastewater Management Options Report – Tallawang Solar Farm
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Client	Umwelt Pty Ltd
Client Contact	Marion O'Neil
Client Reference	21139

REVISION/CHECKING

REVISION HISTORY	DATE	CHECKED BY		ISSUED BY
R.0736.001.00	21/12/23	AW	BAA	
R.0736.001.01	18/03/24	AW	BAA	
R.0736.001.02	23/04/24	AW	BAA	

Acknowledgement

DWA acknowledges the Traditional Custodians throughout Australia and their continuing connection to land, water, culture, and community, and pays respect to their Elders past, present and future.

Limitations Statement

This report and the associated services performed by Decentralised Water Australia (DWA) relate solely to the scope, budget, time, and access constraints as set out in the engagement agreement and quotation between DWA and the Client. DWA accept no liability for any use or reliance on this Report for any purpose not documented in this agreement and quotation by the Client. It has been prepared for the exclusive use of the Client and DWA accepts no liability for any use of or reliance upon this report by any third party.

The outcomes and recommendations contained in this report may have relied upon a range of information and data sources including information and discussions with the client, field investigations (limited to those described in this report), publicly available information and other sources. DWA have not verified the accuracy of third-party data and any inaccuracies or inadequacies may influence the accuracy of our findings. Similarly, both the inherent variability of environmental and ground conditions and the passage of time can lead to changes in ground conditions and other factors which may affect the accuracy of our findings. The Client should seek advice from DWA on the accuracy of findings after more than six months has passed or where changes in relevant conditions are known to have occurred. Data and information collected during field investigations should not be taken as accurate and complete for all depths and locations across the site.

The report and services have been completed in accordance with relevant industry standards, guidelines, and government legislation as of the date of publication unless stated otherwise. Where an engineering design is included, this design has been based on site and construction plans as provided by the Client and/or their representative and documented in the report. DWA accepts no liability for the impact of any changes to site conditions and / or building layout and extents on our design where DWA were not notified of the changes prior to completing our services. Additional costs may be incurred where work has already been completed.

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Executive Summary

The Tallawang Solar Farm (TSF) project involves the construction and operation of a 500-megawatt solar farm and battery energy storage system within the Central West Orana Renewable Energy Zone located in the Mid-Western Council Local Government Area.

The initial phase of the TSF project involves the construction of a temporary accommodation facility (TWA) and ancillary infrastructure which will accommodate up to a maximum of 400 persons during peak construction. Each of the 56 modular accommodation structures proposed contain eight individual self-contained rooms with each room containing a bedroom space and separate bathroom. Ancillary structures supporting operation of the construction camp include kitchen and dining, wet mess, recreational rooms, gym, laundries, and administration. A carpark is also proposed to the north of the accommodation precinct. The construction phase is estimated to take 35-months during which the workforce will gradually increase to a maximum number of workers between months 16 and 22 after which the workforce will then reduce with increased tapering towards the end of the construction period. Following completion of construction, the TWA facility will be dismantled and removed.

This report documents the outcomes of an evaluation of feasible on-site wastewater options for the management of sewage generated by the TWA. Key tasks that were addressed during the project included: site, soil and environmental characteristics, regulatory and approval pathways, development of a robust wastewater design basis, identification of feasible options for the conveyance and management of effluent from the STP, and identification of land requirements for effluent management (if applicable).

A desktop evaluation of site, soil and environmental features as relating to On-site Wastewater Management was undertaken largely based on Australian Standard AS/NZS 1547:2012 domestic onsite wastewater management. Site, soil, and environmental information was obtained from several sources including NSW State Agency websites, Bureau of Meteorology (BoM) and current project specific reports. The evaluation identified several important characteristics relevant to the wastewater servicing options assessment including the availability of land, existing vegetation, proximity of watercourses and sensitive receptors and the soil/water regime.

A wastewater design basis was developed to identify wastewater flows and loads from the TWA facility. The design basis was used to inform system component sizing. It is accepted that design wastewater quantity is typically derived from site and development features such as water supply source, wastewater generating activity and the level of occupancy. In this situation, the construction workforce is the predominant driver to

wastewater generation with occupancy directly related to the number of workers as derived from the number of available bedrooms within the camp. A peak daily wastewater flow of 57kL is estimated with influent characteristics like that of domestic wastewater expected. The total wastewater volume expected across the life of the construction period is estimated at 34ML.

The initial screening phase of the options assessment considered several solutions ranging from discharge to waters, full on-site wastewater management via a range of treatment technologies and partial on-site wastewater management. These options were shortlisted to three (3) feasible on-site wastewater management solutions for further development and analysis. These are:

- Option 1: Full On-site Wastewater Management via an advanced secondary treatment system with land application / reuse via surface irrigation.
- Option 2: Full On-site Wastewater Management via a primary treatment system with land application and treatment with Wisconsin Mounds.
- Option 3: Discharge to waters via a tertiary package treatment plant.

The help inform further development of the 3 high-level options, the following preliminary investigations were completed.

- Desktop Land Capability Assessment (LCA) for effluent management within the construction camp area to identify suitable land and appropriate loading rates and setback distances for effluent irrigation and land application.
- Development of a design basis for wastewater volumes to assist in water and nutrient balance modelling that informs effluent management options.
- Completion of long-term continuous daily water and nutrient balance modelling using Model for Effluent Disposal by Land Irrigation (MEDLI, Queensland Government - Department of Environment and Science) to develop preliminary effluent storage, land area requirements and evaluate the ecosystem and human health protection performance of land application options.
- Sizing of Wisconsin Mound land application systems in accordance with AS1547:2012 and NSW requirements.

MEDLI results predicted that the proposed irrigation strategy resulted in no overflow from effluent storage, negligible nutrient export and no indicators of waterlogging or salinity impacts (note that further detail would be subject to additional investigation and design work).

A qualitative analysis of the 3 options considered advantages, disadvantages, and approval pathway however development of budget estimate capital expenditure (CAPEX), operation expenditure (OPEX) and net present value (NPV) was not a scope task. The outcomes from the options evaluation ae presented in the table below.

Based on the outcomes from the high-level evaluation, DWA consider that a secondary treatment to irrigation of surrounding pasture option (Option 1) is the preferred on-site effluent management strategy. The soils and climate are well suited to effluent reuse by irrigation, subject to achievement of the nominated nutrient concentrations in effluent.

An irrigation strategy that applies effluent at a long-term rate of 2.85mm/day with irrigation shut off during rainfall events greater than 10mm was predicted to achieve the required pollutant reduction and ensure water quality objectives are met at receiving surface and groundwaters. This option will require a minimum 500kL of treated effluent storage. For conservatism, MEDLI modelling assumed the peak camp occupancy occurred for a 60-year climate period. It is possible for the effluent irrigation system to be designed and installed in a modular fashion which can align with the design capacity of treatment system modules. This would then enable system capacity to be ramped up and down as the workforce population changes.

Outcomes of Wastewater Management Options Evaluation

Option	Advantages	Disadvantages	Approval Pathway	Outcome
Option 1 **Secondary Treatment to Surface Irrigation**	- Relatively conventional effluent quality requirements. - Lower risk and uncertainty around cost and regulatory approval. - Likely to be the lowest cost option (CAPEX and OPEX). - Adaptable to varying and uncertain effluent volumes.	- Largest (feasible) land area requirement. - Will require on-going maintenance of irrigation infrastructure and pasture.	**Local Council** On-site sewage management system via Section 68 of *Local Government Act 1993*.	Recommended option
Option 2 **Primary Treatment to Wisconsin Mounds**	- Simple, very low maintenance treatment and effluent management option. - Low energy demand.	Upon investigation it was determined that site topography is such that the necessary lineal metres of mound (1,000m) could not feasibly be constructed within the immediate available area (mounds need to be generally constructed parallel with elevation contours). On this basis the cost of construction is unlikely to be justified by the reduced footprint. Other disadvantages include the following. - Higher construction risk and cost. - Less suited to a temporary camp. - Less suited to a modular configuration.	**Local Council** On-site sewage management system via Section 68 of *Local Government Act 1993*.	Determined to be unfeasible.
Option 3	- No land area requirement for effluent management.	- Significant ecology and hydrology assessment requirements.	**EPA** Environment Protection Licence	Not preferred

Option	Advantages	Disadvantages	Approval Pathway	Outcome
Tertiary Treatment for Discharge to Waters		- Higher cost, operationally complex treatment requirements. - Uncertainty around EPA licence (EPL) requirements and timelines. - Local hydrology constraints may require discharge point to be a distance from site. - Likely to still require some storage to limit peak discharges due to hydrology.		

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1 Introduction

Decentralised Water Australia has been engaged by Umwelt (Australia) Pty Ltd to prepare a Wastewater Management Options Report for the Tallawang Solar Farm temporary workers accommodation (TWA) facility.

1.1 Project Background

The Tallawang Solar Farm project involves the construction and operation of a 500-megawatt solar farm and battery energy storage system within the Central West Orana Renewable Energy Zone located in the Mid-Western Council Local Government Area.

The initial phase of the project involves the construction of a temporary accommodation facility and ancillary infrastructure which will accommodate up to a maximum of 400 persons at peak construction. The solar farm project's construction phase is estimated to take 35-months after which the TWA facility will be dismantled and removed.

1.2 Purpose and Key Project Tasks

The purpose of this report is to evaluate and document feasible options for the management of sewage generated by the TWA with consideration of site, soil and environmental characteristics.

Key project tasks include:

- Obtain, evaluate, and consider site, soil and environmental characteristics relevant to the project.
- Evaluate and consider key regulatory pathways relating to on-site wastewater management.
- Develop a robust wastewater design basis for the construction camp including wastewater flows and loads.
- Develop and evaluate suitable effluent quality criteria for sewage treatment plant.
- Prepare indicative sizing for key system components to enable understanding of land requirements, siting constraints and relationship with other development variables.
- Identify and evaluate potential feasible options for the conveyance and management of effluent from the STP including key risks and opportunities.
- Identify land requirements for effluent management (if applicable) and options for integration into the development or otherwise.

- Document the project outcomes in a report.

1.3 Site and Construction Camp Information

The Tallawang Solar Farm is proposed in the Central West region of New South Wales (NSW), approximately 8 kilometres (km) northwest of Gulgong within the Mid-Western Local Government Area (LGA). The site footprint, which covers an area of approx. 1,300Ha, lies within the Central West Orana Renewable Energy Zone (CWO REZ), established under the NSW Government's Electricity Strategy (2021).

The solar farm TWA, which covers an area of approx. 5Ha, is proposed to be in the southeastern corner of the site (Lot 4, DP750762). Primary access to the camp is off a local un-serviced road directly south of the solar farm site, via Castlereagh Highway. The camp will include administration offices, 400 self-contained rooms, kitchens, dining facilities, laundry, and recreational facilities.

The location of the site and TWA are shown in Figures 1 and 2. An indicative layout for the TWA is provided in Appendix 1.



Figure 1 Site Locality Plan

0 0.5 1 1.5 km

Project: 0736
Drawn: 18/03/2024
Revision: 01



Figure 2 TWA Locality Plan (Indicative)

0 50 100 150 m

Project: 0736
Drawn: 23/04/2024
Revision: 02

2 Evaluation of Site, Soil and Environmental Characteristics

A desktop evaluation of site, soil and environmental features as relating to On-site Wastewater Management was undertaken largely based on AS/NZS 1547:2012, Section 5.2 and Appendices B and C. The broad goal of the evaluation was to collect sufficient information about the site, soil, and local environmental constraints to inform the suitability for land based on-site wastewater systems and if appropriate, inform the design, location, and operation of the system.

The overall aims of the assessment are to:

- Provide sufficient information for deciding the suitability and feasibility of the allotment for an on-site system,
- Provide detailed site-specific information identifying the site-and-soil characteristics to be considered when selecting and designing the on-site system,
- Identify, analyse, and evaluate any risks posed by site-and-soil characteristics which might compromise the long-term effectiveness of the on-site system,
- Identify, analyse, and evaluate any risks of contamination of groundwater or surface water and of associated health risks, and
- Develop and refine measures required to reduce and monitor identified risks that can be considered in the design phase of the study.

Information used in this report was obtained from several sources including:

- NSW Planning Portal Spatial Viewer.
- NSW Government eSpade (Planning, Industry and Environment 2023).
- Bureau of Meteorology (BoM).
- Tallawang Solar Farm – Soil, Land and Agricultural Assessment (Report 21139/R10, Umwelt (Australia) Pty Ltd, June 2022).
- Tallawang Solar Farm – Water Resources Impact Assessment (Report 21139/R07, Umwelt (Australia) Pty Ltd, August 2022).

2.1 Site and Environmental Characteristics

Site assessment observations were determined based on AS1547, Section 5.2 (Site and Soil Evaluation). The evaluation utilised methodologies and procedures from Appendices B, C and D of AS1547 as well as the NSW Environment and Health Protection Guidelines, Section 4.3.3, and Table 4 (Site Assessment: Rating for On-site Systems). Observations were contained within and immediately surrounding the camp boundary.

Results and corresponding outcomes from the site assessment are presented in Table 1.

Table 1 Desktop Site Assessment

Site Feature	Resource or Literature Based Result	Assessed Constraint Classification	Project Consideration
Flood influence	Refer Tallawang Solar Farm – Water Resource Impact Assessment, August 2022 (21139/R07).	Moderate limitation	Ensure that the selection, design, and location of the On-site Wastewater Management System are consistent with adopted flood levels for the 1% (openings and electricals) and 5% (effluent management area).
Exposure	High sun and wind	Minor limitation	Minimal impact on selection and design
Slope %	0 - 6	Minor limitation	Minimal impact on selection and design
Landform	Predominantly a waning divergent landform. Waning slope slows run-off, but divergence aids the spread of run-off.	Minor limitation	Minimal impact on selection and design
Run-on and seepage	None, low	Minor limitation	Minimal impact on selection and design
Vegetation	Grass cover (assumed)	Minor limitation	Minimal impact on selection and design
Watercourses and waterbodies	**Watercourses**: Several 1st and 2nd order ephemeral watercourses are in proximity to the north and west	Moderate limitation	The level of treatment and effluent management

Site Feature	Resource or Literature Based Result	Assessed Constraint Classification	Project Consideration
	of the camp boundary. These watercourses eventually discharge to Wialdra Creek located approx. 3.2km south of the camp boundary. **Waterbodies**: two marked perennial waterbodies are in proximity to the northern and western camp boundaries. The waterbodies are connected via a non-perennial watercourse. A smaller unconnected waterbody is located 90m south of the camp boundary.		approach will need to consider potential impacts on watercourses waterbodies. Perform modelling as required.
Sensitive receptors (other)	An area of terrestrial biodiversity as designated by the Mid-Western Regional Local Environmental Plan (2012) is mapped. The area is located along the southern and western camp boundaries.	Moderate limitation	Provide a satisfactory setback between the effluent management area and receiving receptor with reference to applicable standards and guidelines.
Soil water regime	Soils within the Potential Effluent Management Area (PEMA) are weakly to moderately pedal sandy loams and sandy clays with moderate soil water storage capacity and moderate permeability.	Moderate limitation	Consider level of treatment and effluent manage approach and design to manage poorer soil water regimes. Adopt conservative design loading rate (DLR) to ensure adequate hydraulic performance.
Acid Sulfate Soils[1]	N/A	Minor limitation	Minimal impact on selection, design, and construction

[1] NSW Government eSpatial Planning Viewer

Site Feature	Resource or Literature Based Result	Assessed Constraint Classification	Project Consideration
Biodiversity Values Map[2]	No biodiversity values mapped	Minor limitation	Minimal impact on selection, design, and construction
Drinking Water Catchment[1]	No	Minor limitation	Minimal impact on selection and design

2.1.1 Groundwater

The hydrogeology of the site is predominantly located within fractures in deeper rock within the Lachlan Fold Belt (Umwelt 2023a). Aquifers with sufficient yield for significant use are typically localised. There are no registered groundwater bores within 1km of the Potential Effluent Management Area (PEMA). Standard effluent management practices should be adequate to ensure that these fractured rock aquifers are protected.

In addition, Umwelt (2023b) report that the site is predominantly underlain by alluvium and colluvium derived from the Gulgong and Rouse Granites. The alluvial material near streamlines is likely to feature localised unconfined aquifers with connectivity to the ephemeral and perennial waterways and associated Groundwater Dependent Ecosystems (GDEs).

Any proposed effluent irrigation or land application systems will need to adopt appropriate hydraulic, nutrient and pathogen loading rates in addition to setback distances from watercourses to ensure adequate GDE protection.

[2] NSW Government Biodiversity Values Map and Threshold Tool



Figure 3 Site Assessment Plan (Broader Site)

0 200 400 600 m

Project: 0736
Drawn: 21/11/2023
Revision: 00



Figure 4 Site Assessment Plan (TWA)

Project: 0736
Drawn: 21/11/2023
Revision: 00

2.2 Soil Characteristics

The broader project site is characterised by several soil landscapes as mapped on the Soil Landscapes of the Dubbo 1:250 000 Sheet (Murphy and Lawrie, 1998) including Tucklan (tk), Home Rule (hr) and Rouse (rs).

The construction camp area is located primarily within the Home Rule landscape which exhibits the following characteristics:

- Undulating low hills of sediments derived from the Gulgong and Rouse Granites.
- Relief is between 30 - 60m with slopes of 4 - 8%.
- The landscape is mainly Siliceous Sands (Uc1.42) and Earthy Sands (Uc4.21; Uc4.32) on upper and mid-slopes with bleached sands (Uc2.21; Uc2.22), yellow Podzolic soils (Dy2.41; Dy2.21) and yellow Solodic soils (Dy3.13; Dy3.42) on lower slopes and flats. Layered Siliceous Sands can be found in some larger drainage lines.
- Limitations can include very low fertility; low available water holding capacity; acidic surface soils; seasonal waterlogging; sodic subsoils in lower slopes; high permeability on mid to upper slopes; and moderate to high erosion hazard under cultivation.

Detailed soil information was obtained from several sources including project reports and eSPade (NSW Government). A summary of the soil profile information for two test pits located closest to the construction camp is presented in Table 2 with the location of the data shown in Figure 5. Detailed soil test pit information can be found in Appendix 1

Table 2 Summary of Soil Characteristics

Test Pit	Depth (mm)	Texture[3]	Structure[4]	Colour
BH09	0 – 100	Sandy silt (3)	Soft firmness, weak strength and low plasticity	Very dark greyish brown
	100 – 450	Silty sand (6)	Soft firmness, weak strength and low plasticity	Light yellowish brown
	450 – 800	Sandy clay (5)	Medium firmness, medium strength and medium plasticity	Brown
Profile 87	0 – 300	Sandy Loam (2)	Single grain	Brown
	300 – 760	Sandy clay loam (4)	Weak	Reddish brown with no mottles
	760 - 1000	Sandy clay (5)	Weak	Yellowish red (reddish brown) with no mottles.

[3] Soil category in brackets
[4] Structure was not reported as part of field investigations so comparable geotechnical characteristics have been noted.



Figure 5 Soil Bore or Profile Locations

0 250 500 750 m

Project: 0736
Drawn: 6/11/2023
Revision: 00

2.3 Site and Soil Summary

A summary of the important site and soil constraints to on-site wastewater management are provided in Table 3.

Table 3 Summary of Constraints to On-site Wastewater Management

Constraint	Observation	Potential Controls
Available Land	The TWA covers an area of approx. 5Ha with the footprint of the buildings and infrastructure covering approx. 4Ha. The Potential Effluent Management Area (PEMA) located outside the TWA footprint covers ~2.1Ha (after consideration of appropriate buffers).	Identify and confirm effluent quality, effluent storage and effluent management approaches that align with available land and with consideration of soil and environmental features. Complete necessary environmental assessments to determine sustainability, environmental and human health objectives can be achieved at the required project duration.
Vegetation	A marked terrestrial biodiversity area is located between the site boundary and southern TWA boundary. A 20m buffer either side of the biodiversity area has been applied which provides the delineation for the camps southern boundary.	Confirm buffer distance to vegetation receptors are appropriate to provide a satisfactory level of protection.
Watercourses and sensitive receptors	Marked but un-named non-perennial watercourse and waterbodies traverse the northwest camp boundary. The direction of flow is to the southwest then south to Wialdra Creek located 3.2km from the camp boundary. The marked vegetated areas are likely to be considered an ecological receptor.	Consider a high level of treatment such as advanced secondary treatment (potentially with nutrient reduction). Undertake an environmental assessment to determine expected impact that includes detailed receiving environment impact modelling.
Soil water regime	Weakly to moderately pedal sandy loams and sandy clays with moderate soil water storage capacity and moderate permeability.	Manage through effluent quality selection. Perform modelling to determine sustainable application rates and groundwater protections.

3 Wastewater Design Basis

This section documents the outcomes of the wastewater design basis. The design basis discusses and documents the potential wastewater flows and loads from the construction camp.

3.1 Wastewater Generation

It is accepted that design wastewater quantity is typically derived from site and development features such as water supply source, wastewater generating activity and the level of occupancy. In this situation, the construction workforce is the predominant driver to wastewater generation with occupancy directly related to the number of workers as derived from the number of available bedrooms within the camp. Consideration must also be given to the nature (frequency) of the occupancy as this can influence the system selection and design. The design basis for the proposed wastewater management treatment system has therefore been developed based on the proposed development, nature of occupancy and the available water source. Information summarising the wastewater generation is presented in Section 3.2.

Evaluation of the wastewater quality (influent) and adoption of a suitable effluent quality are important considerations in the selection and design process. Effluent quality is typically evaluated and determined during the Land Application Area (LAA) selection and design processes being influenced by site, soil, environmental and development features. The process can be iterative where several system type/design and effluent quality scenarios need to be tested to achieve a satisfactory outcome. The adopted wastewater and effluent quality criteria are discussed further in Section 3.3.

3.1.1 TWA and Workforce

The predominant feature of the TWA are the accommodation buildings with each modular structures containing eight individual self-contained rooms. A total of 400 rooms within 56 modular buildings is proposed. Each accommodation room contains a bedroom space and separate bathroom. Ancillary structures supporting operation of the construction camp include kitchen and dining, wet mess, recreational rooms, gym, laundries, and administration. The source of the camp water supply is to be determined in consultation with Mid-Western Regional Council.

The TWA facility will be operational for the duration of the construction phase of the solar farm project which is estimated at 35 months. The construction workforce will gradually increase from approx. 10 workers in the first few months to a maximum of 420 workers between months 16 and 22. During the maximum workforce period, 400 workers will be

housed on-site at the TWA facility with 20 workers housed locally. The workforce will then gradually reduce with increased tapering towards the end of the construction period.

3.2 Wastewater Quantity

A conservative wastewater design flow allowance has been selected with consideration to the nature of the development and accommodation type. An equivalent population (EP) has been estimated based on an occupancy of 1 EP per bedroom with additional EP included for day workers. Monthly workforce data across the duration of construction has been provided by the client with an actual occupancy of 95% assumed.

A summary of the design wastewater flows used in design calculations are outlined in the following tables with workforce data summarised in Table 6 and Figure 6.

Table 4 Peak Wastewater Flow

Peak Monthly Workforce	Occupancy Factor[5]	Adopted Peak EP	Adopted Daily Wastewater Flow	Peak Design Wastewater Flow
400[6]	95%	380	150L/EP/Day	57kL/day
Description/Comments:				

Table 5 Wastewater Inflow/Outflow Statistics

Design Scenario	Daily Wastewater Inflow (kL/day)
Average Annual	26.4
Median	12.8
75th %ile	57.0
90th %ile	57.0
Maximum	57.6

[5] The occupancy factor considers workforce variability.
[6] Total peak workforce is 420 of which 400 will be accommodated within the TWA.

Table 6 Workforce and Wastewater Data

Month	Actual Workforce	Assumed EP	% of Peak EP	Wastewater Flow (kL/Month)
1	10	9.5	2	43
2	10	9.5	2	44
3	15	14	4	66
4	30	29	7	128
5	41	39	10	181
6	72	68	17	308
7	57	54	14	252
8	62	59	15	274
9	74	70	18	295
10	122	116	29	539
11	208	198	50	889
12	320	304	76	1414
13	337	320	80	1441
14	357	339	85	1577
15	404	384	96	1785
116	420	399	100	1796
17	420	399	100	1855
18	420	399	100	1796
19	420	399	100	1855
20	420	399	100	1855
21	420	399	100	1676
22	420	399	100	1855

Month	Actual Workforce	Assumed EP	% of Peak EP	Wastewater Flow (kL/Month)
23	416	395	99	1778
24	419	398	100	1851
25	408	388	97	1744
26	393	373	94	1736
27	378	359	90	1670
28	357	339	85	1526
29	272	258	65	1202
30	140	133	33	599
31	90	86	21	398
32	58	55	14	256
33	30	28	7	120
34	20	19	5	88
35	10	9.5	2	43
36	10	9.5	2	44
37	10	9.5	2	43
38	10	9.5	2	44
39	10	9.5	2	44
40	10	9.5	2	43
41	10	9.5	2	44
42	8	7.6	2	34
43	5	4.8	1	22

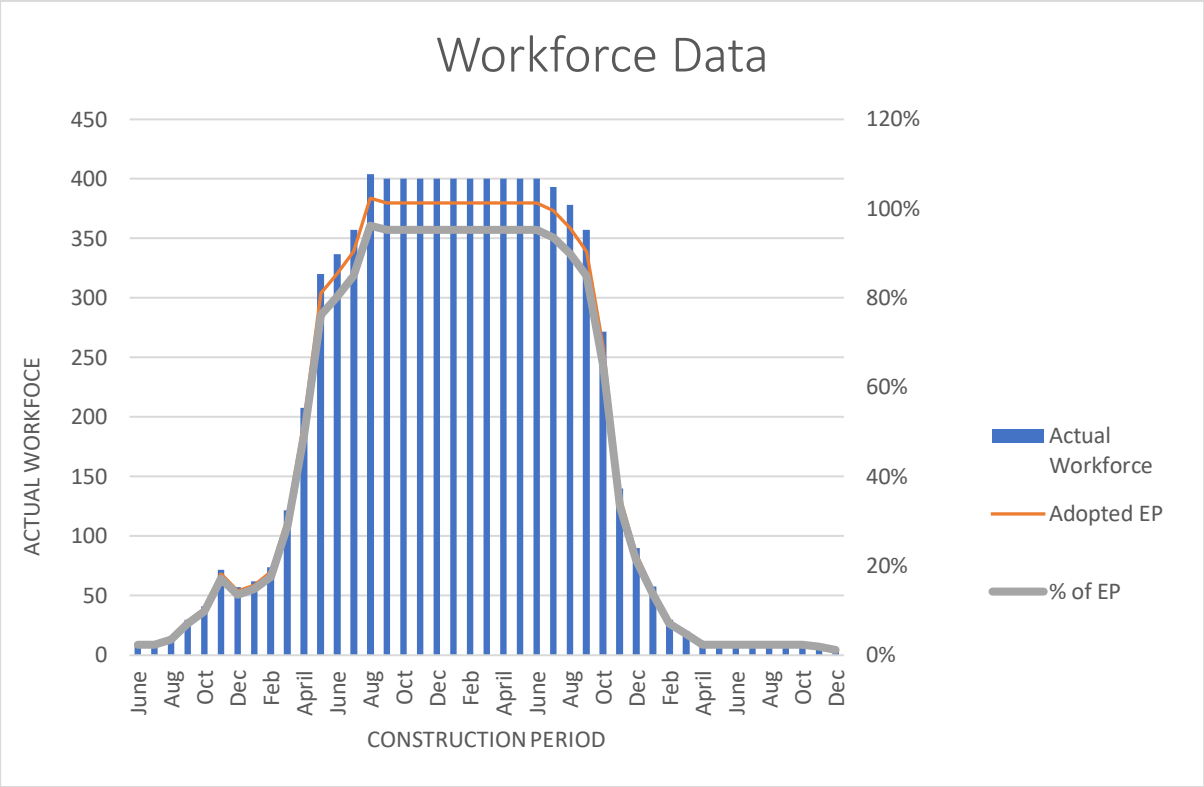


Figure 6 Workforce Data During Construction Period

3.2.1 Treatment Capacity Versus Effluent Storage

Using the peak wastewater flow of ~57kL/Day, several treatment system sizes, flow balance (effluent storage) and land application area scenarios were tested to determine an optimal approach. As an example, if the treatment capacity was capped at 46kL/day, an effluent storage volume in the order of 10ML would be required to manage the flows across the construction period. Under this scenario it can be determined that effluent storage provides for the ability to manage the flows with a smaller treatment plant (reduced cost) however the maximum storage capacity is utilised only for quite a small period when the construction workforce is reducing. This can be seen in Figure 7 below.

While the area of available land and ability of the soils to sustain effluent application are considerations and to some degree constraints, it can be shown that a more optimal approach can be achieved through management of peak flows through an equivalent level of treatment rather than the use of significant flow balancing capacity. This approach also provides additional advantages as discussed in Section 4.2 and 4.3 below.

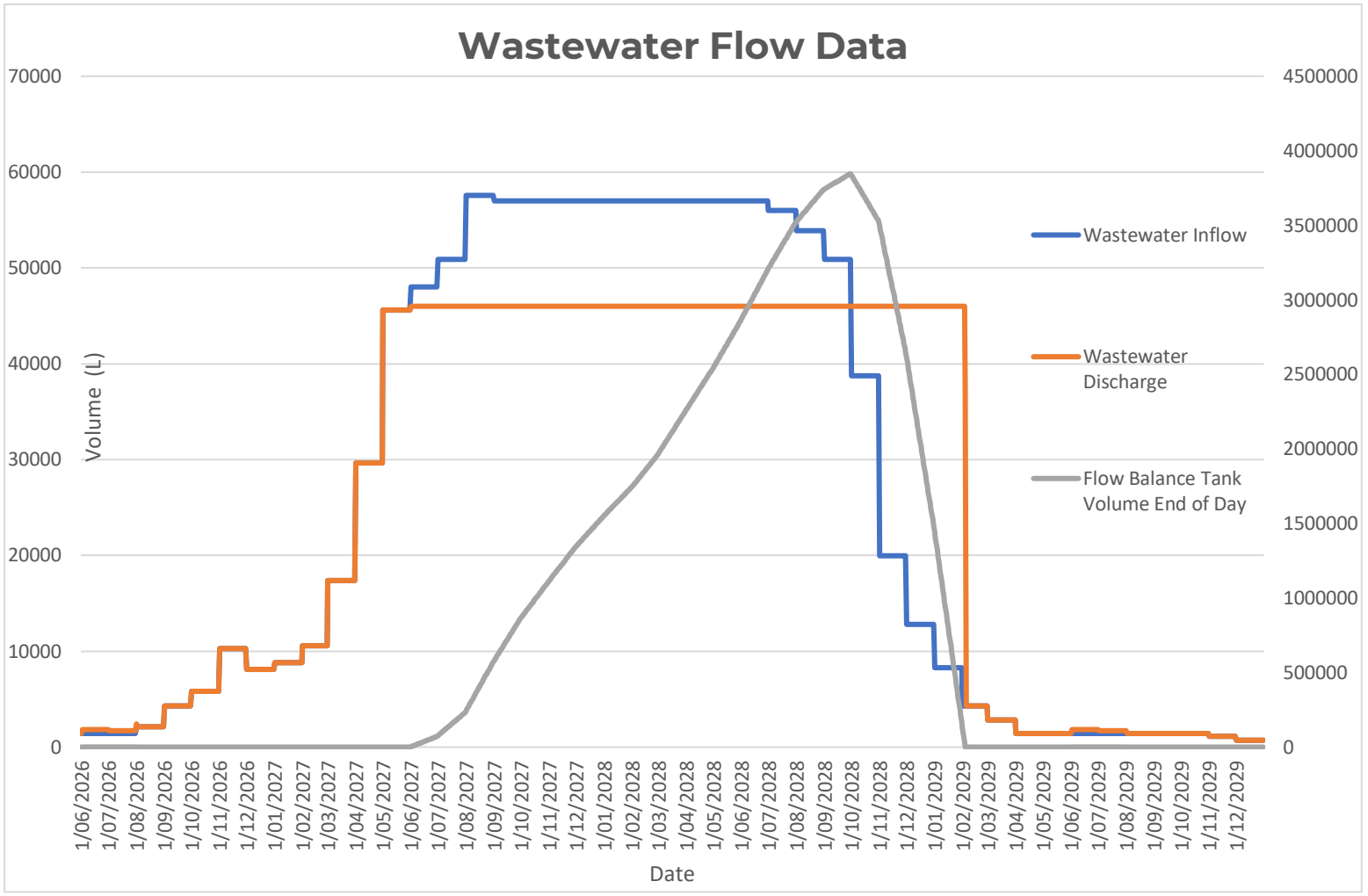


Figure 7 Treatment Capacity (46kL/day) Vs Effluent Storage Example

3.3 Wastewater Quality

Detailed evaluation of the selection, capacity and design of the treatment system is outside the scope of this report however evaluation and adoption of key wastewater quality and capacity parameters form critical inputs to the project.

Wastewater characteristics from the camp are assumed to be comparable to that of domestic wastewater. Wastewater and effluent quality criteria adopted for this project are presented in Table 7.

Table 7 Wastewater and Effluent Quality Criteria

Parameter	Assumed Influent Wastewater Value[7]	Adopted Effluent Value[8]
Biochemical Oxygen Demand	150 – 750mg/L	<30mg/L
Total Suspended Solids	150 – 750mg/L	<20mg/L
Total Nitrogen	20 – 150mg/L	20mg/L
Total Phosphorus	6 – 25mg/L	20mg/L
Faecal Coliforms	10^4 – 10^{10}cfu/100mL	<30cfu/100mL

[7] Australian Standard AS1546.3 (2017) 90th percentile.
[8] Based on secondary effluent quality however dependent on system supplier.

4 Options Assessment

4.1 Initial Screening

An initial screening process of potential wastewater management solutions for the site is summarised in Table 8. The considered solutions include discharge to waters, full on-site wastewater management via a range of treatment technologies and partial on-site wastewater management. These options were shortlisted to three (3) feasible on-site wastewater management solutions for further development and evaluation.

Table 8 Outcomes of Initial Screening Process

Option No.	Potential Servicing Option	Option Summary	Progress
1	Connection to sewer	Sewer is not available to the property.	No
2	Surface irrigation	This is a commonly utilised wastewater management option suitable for secondary and advanced secondary treated effluent. This system is typically suited for sites that are not constrained by sensitive receiving environments, have sufficient depth of soil of a suitable category and a relatively gentle ground slope (<10%). The use of spray irrigation provides a cost-effective land application method in comparison to other methods but does require greater consideration of wet weather management.	Yes
3	Sub-surface irrigation	This is a commonly utilised wastewater management option suitable for secondary and advanced secondary treated effluent. Application of effluent within the soil can provide an enhanced level of treatment performance through additional soil biochemical processes. This method is suited to a broad range of soil and slope characteristics subject to satisfactory assessment, design, and construction.	No

Option No.	Potential Servicing Option	Option Summary	Progress
		Depth to seasonal watertable while an important consideration can be less critical due to the shallow application position and lower areal loading rate. Climatic factors for this approach are not as significant. The cost for sub-surface irrigation is significantly greater than that of surface irrigation when implementing over larger areas.	
4	Wisconsin mound	This is a proven wastewater management option for sites constrained by seasonally or permanently elevated water table, low-lying land, or shallow soil depths. This method is suitable for slopes up to 15%. Can provide an enhanced level of wastewater treatment as the effluent moves through the mound media. Wisconsin mounds have typically smaller footprints than irrigation systems however the capital costs are typically higher. Requires the importation of a specified sand media that may be difficult to source locally.	**Yes**
5	Effluent pump out (full)	Effluent pump out systems provide a '*last resort*' solution for sites which do not have sufficient land to manage wastewater on-site. Whilst these systems do typically provide significantly lower capital expenditure costs, the ongoing operational costs of pump out are often very costly. Given the peak wastewater loads expected during full camp occupancy the costs are likely to be prohibitive even over the relative short duration of the project. Given the projected sewage volumes, it would also be necessary to confirm with Mid-Western Regional Council that the local Sewage Treatment Plant has capacity to accept the project volumes for a short period. This option is not considered a feasible solution and has not been considered further.	**No**
6	Hybrid system – partial on-site management and partial effluent pump-out	A hybrid approach involving treatment and land management in conjunction with tanker removal may be a feasible option given the workforce characteristics over the construction period.	**No**

Option No.	Potential Servicing Option	Option Summary	Progress
		This would likely involve construction of lesser effluent management infrastructure (which will in turn requires less land) to manage up to a nominated flow volume (e.g. 70%). Effluent pump out would be used to manage volumes above 70% of design subject to the capacity of Mid-Western Regional Council infrastructure to accept the flows and loads. This option is likely to have a comparable capital cost to a full on-site effluent management approach but require less land area for effluent management. The trade-off being potentially higher operational costs for tanker removal of effluent volumes beyond the nominated treatment capacity.	
7	Discharge to waters	Discharge to waters treatment systems are beneficial solutions for sites with large wastewater flows and insufficient land available for land treatment of effluent. Treatment of wastewater to a high standard is required before discharge to a receiving environment. Requires substantial environmental assessment to determine design wastewater characteristics. Local hydrology creates some uncertainty around an acceptable discharge point and some level of flow control may be required to mitigate ecohydrology impacts. Given the confined area available for on-site wastewater management, this option has been taken further as a potential solution. This option would require and Environment Protection Licence under the POEO Act 1997.	**Yes**

4.2 Potential Wastewater Management Solutions

As outlined in Table 8, DWA have identified three (3) potential wastewater management solutions for the site. These are:

- Option 1: Full On-site Wastewater Management via an advanced secondary treatment system with land application / reuse via surface irrigation.
- Option 2: Full On-site Wastewater Management via a primary treatment system with land application and treatment with Wisconsin Mounds.
- Option 3: Discharge to waters via a tertiary package treatment plant.

An overview of each option is provided in Table 9.

The following preliminary investigations were undertaken by DWA to inform the development of these high-level options.

- Desktop Land Capability Assessment (LCA) for effluent management within the construction camp area to identify suitable land and appropriate loading rates and setback distances for effluent irrigation and land application (Refer to Section 2).
- Development of a design basis for wastewater volumes to assist in water and nutrient balance modelling that informs effluent management options.
- Completion of long-term continuous daily water and nutrient balance modelling using Model for Effluent Disposal by Land Irrigation (MEDLI, Queensland Government - Department of Environment and Science) to develop preliminary effluent storage, land area requirements and evaluate the ecosystem and human health protection performance of land application options.
- Sizing of Wisconsin Mound land application systems in accordance with AS1547:2012 and NSW requirements.

The details of MEDLI modelling (Option 1) and design sizing of Option 2 can be found in Appendix 2. MEDLI results predict that the proposed irrigation strategy ensures no overflow from the 500kL storage, negligible nutrient export and no indicators of waterlogging or salinity impacts. Further details would be subject to additional investigation and design work.

Table 9 Summary of Shortlisted Options

Feature	Option 1 Secondary Treatment to Surface Irrigation	Option 2 Primary Treatment to Wisconsin Mound	Option 3 Tertiary Treatment to Waterway Discharge
Treatment **(Effluent Quality)**	**90th % Concentrations** BOD_5: 20 mg/L TSS: 30 mg/L TN: 20 mg/L TP: 2 mg/L E. coli: 30 cfu/100ml	Primary treatment via large Septic Tanks.	Subject to detailed receiving environment investigation. Typically, tertiary with nutrient reduction and disinfection.
Treated Effluent Storage Requirements	500kL	None (subject to fitting 1000 lineal metres of Mounds on site)[8].	Subject to ecohydrological investigations. Likely to require 200 - 500kL.
Effluent Management	Surface irrigation (typically moveable impact spray 'pods' or similar on 600mm risers) with a total area covering 2ha. Tipping bucket rain gauge to cease irrigation when rain exceeds 10mm. Long term irrigation rate of 2.85mm/day.	1,000 lineal metres (8m wide) of Wisconsin Mounds constructed parallel with elevation contours within the PEMA[9].	Discharge to receiving water with adequate baseflow to ensure water quality and hydrologic impacts are acceptable under POEO Act 1997. Likely Wialdra Creek (possible easement).
Regulatory Pathway	Local Council (S68 of Local Government Act).		Environmental Protection Licence (EPL) under the *Protection of the Environment Operations Act 1997 (POEO).* Chapter 3 of POEO addresses Environment Protection Licences with Section 43 listing the types of licences that may be

[9] Preliminary investigations indicate a maximum of 750 lineal metres is technically feasible but remains marginal (45kL/day receiving capacity). This would require 3-4 ML of effluent storage.

Feature	Option 1 Secondary Treatment to Surface Irrigation	Option 2 Primary Treatment to Wisconsin Mound	Option 3 Tertiary Treatment to Waterway Discharge
			issued. An EPL may be issued '*to control the carrying out of non-scheduled activities for the purpose of regulating water pollution resulting from any such activity, as referred to in section 122 (S43(d))*'.
Operation & Maintenance Burden	Moderate	Low	Moderate to High

4.3 Options Analysis

DWA have provided a qualitative analysis of the above-mentioned options in Table 10. The analysis does not currently include development of budget estimate capital expenditure (CAPEX), operation expenditure (OPEX) and net present value (NPV) as this was not included in the scope of this investigation however this can be completed if required. This analysis is based on a preliminary level of investigation and design and as such further work will be required to provide a quantitative, structured options comparison should this be deemed necessary in future. There are also several additional environmental investigations which may be required to further refine options or confirm feasibility and the basis for regulatory approval.

The location and an approximation of the available land considered suitable for effluent management (PEMA) and indicative effluent storage for the recommended option is provided in Figure 8 below.

Table 10 Wastewater Management Options Evaluation

Option	Advantages	Disadvantages	Approval Pathway	Outcome
Option 1 **Secondary Treatment to Surface Irrigation**	- Relatively conventional effluent quality requirements. - Lower risk and uncertainty around cost and regulatory approval. - Likely to be the lowest cost option (CAPEX and OPEX). - Adaptable to varying and uncertain effluent volumes.	- Largest (feasible) land area requirement. - Will require on-going maintenance of irrigation infrastructure and pasture.	**Local Council** On-site sewage management system via Section 68 of *Local Government Act 1993*.	Recommended option

Option	Advantages	Disadvantages	Approval Pathway	Outcome
Option 2 **Primary Treatment to Wisconsin Mounds**	- Simple, very low maintenance treatment and effluent management option. - Low energy demand.	Upon investigation it was determined that site topography is such that the necessary lineal metres of mound (1,000m) could not feasibly be constructed within the immediate available area (mounds need to be generally constructed parallel with elevation contours). On this basis the cost of construction is unlikely to be justified by the reduced footprint. Other disadvantages include the following. - Higher construction risk and cost. - Less suited to a temporary camp. - Less suited to a modular configuration.	**Local Council** On-site sewage management system via Section 68 of *Local Government Act 1993*.	Determined to be unfeasible.
Option 3 **Tertiary Treatment for Discharge to Waters**	- No land area requirement for effluent management.	- Significant ecology and hydrology assessment requirements. - Higher cost, operationally complex treatment requirements. - Uncertainty around EPA licence (EPL) requirements and timelines. - Local hydrology constraints may require discharge point to be a distance from site. - Likely to still require some storage to limit peak discharges due to hydrology.	**EPA** Environment Protection Licence	Not preferred



Figure 8 Potential Land Available for Effluent Management

Project: 0736
Drawn: 23/04/2024
Revision: 02

5 Key Outcomes

A range of potential effluent management options have been investigated and evaluated based on the proposed TWA occupancy profile and local land capability and receiving environment constraints. Based on this high-level evaluation, DWA consider Option 1, secondary treatment to irrigation of surrounding pasture, to be the preferred effluent management strategy. The soils and climate are well suited to effluent reuse by irrigation, subject to achievement of the nominated nutrient concentrations in effluent.

An irrigation strategy that applies effluent at a long-term rate of 2.85mm/day with irrigation shut off during rainfall events greater than 10mm was predicted to achieve the required pollutant reduction to ensure water quality objectives are met at receiving surface and groundwaters. This will require a minimum 500kL of treated effluent storage. For conservatism, MEDLI modelling assumed the peak camp occupancy occurred for a 60-year climate period.

It is recommended that the effluent irrigation system be designed and installed in a modular fashion that aligns with the design capacity of treatment modules (say 20kL/day capacity). This would then enable system capacity to be ramped up and back down as the worker population changes.

6 References

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Appendix 1 Site and Soil Assessment Information

Table 11 Details of Soil Profile Characteristics

Test Pit	Depth (mm)	Texture[10]	Structure	Colour	Coarse Fragments	Chemical/Physical Characteristics			
						ECe[11]	ESP[12]	EAT[13]	pH
BH06[14]	0 – 150	Clayey Silt	Low firmness, weak strength, medium plasticity, and high moisture content	Dark reddish brown	Traces of gravel	Non-saline	Non-sodic	Slightly dispersive	Slightly acidic
	150 – 300	Gravely Silty Clay	Medium firmness, medium strength, medium plasticity, and saturated moisture content	Very dark brown	Fine to medium gravel fragments	Non-saline	Non-sodic	Slightly dispersive	Slightly acidic
	300 - 450	Clay	Very firm, high strength, high plasticity, and medium moisture content	Yellowish brown	Low levels of coarse fragments	Non-saline	Non-sodic	Slightly dispersive	Slightly alkaline
BH09[14]	0 – 100	Sandy Silt	Soft firmness, weak strength and low plasticity	Very dark greyish brown	High level of coarse fragments	Non-saline	Non-sodic	Slightly dispersive	Moderately acidic

[10] Soil category in brackets.
[11] Electrical Conductivity (equivalent)
[12] Exchangeable Sodium Percentage
[13] Emerson Aggregate Test
[14] Tallawang Solar Farm – Soil, Land and Agricultural Assessment Report (Umwelt, 2022, R21139/R10)

Test Pit	Depth (mm)	Texture[10]	Structure	Colour	Coarse Fragments	Chemical/Physical Characteristics			
						ECe[11]	ESP[12]	EAT[13]	pH
	100 – 450	Silty Sand	Soft firmness, weak strength and low plasticity	Light yellowish brown	High fine gravel	Non-saline	Non-sodic	Slightly dispersive	Moderately acidic
	450 – 800	Sandy clay	Medium firmness, medium strength and medium plasticity	Brown	Minor gravel fragments	Non-saline	Non-sodic	Moderately dispersive	Slightly acidic
Profile 87[15]	0 – 300	Sandy Loam (2)	Single grain	Brown	10-20% Common	-	-	-	Slightly acidic
	300 – 760	Sandy clay loam (4)	Weak	Reddish brown with no mottles	10-20% Common	-	-	-	Slightly acidic
	760 – 1000	Sandy clay (5)	Weak	Yellowish red (reddish brown) with no mottles.	10-20% Common	-	-	-	Moderately acidic
Profile 13[15]	0 – 20	Fine sandy loam (3)	Single grain	Brown with no mottles	N/A	-	-	-	Neutral
	20 – 200	Fine sandy loam (3)	Weak	Brown with no mottles	2-10% Few	-	-	-	Slightly acidic

[15] Source: eSpade (NSW Government)

Test Pit	Depth (mm)	Texture[10]	Structure	Colour	Coarse Fragments	Chemical/Physical Characteristics			
						ECe[11]	ESP[12]	EAT[13]	pH
	200 – 1200	Sandy Loam (2)	Weak	Strong brown or reddish yellowish (orange) with no mottles.	10-20% Common	-	-	-	Moderately acidic

hr HOME RULE



SUMMARY

409 km² undulating low hills. Sediment derived from the Gulgong and Rouse Granites. Relief 30 - 60 m; slopes 4 - 8%. Mainly Siliceous Sands (Uc1.42) and Earthy Sands (Uc4.21; Uc4.32) on upper and mid-slopes. Bleached sands (Uc2.21; Uc2.22), Yellow Podzolic Soils (Dy2.41; Dy2.21) and yellow Solodic Soils (Dy3.13; Dy3.42) on lower slopes and flats. Layered Siliceous Sands in some larger drainage lines.

LIMITATIONS

Very low fertility; low available waterholding capacity; acidic surface soils; seasonal waterlogging; sodic subsoils in lower slopes; high permeability on mid to upper slopes; moderate to high erosion hazard under cultivation.

LOCATION

Located to the east and north of Gulgong.

CLIMATIC ZONE

Zone 3C (Edwards 1979).

TOPOGRAPHY

Undulating low rises ranging from 420 - 500 m elevation. Slopes are gently inclined 4 - 8%, with slopes from 2000 - 6000 m long. Local relief varies from 30 - 60 m. Drainage lines are 300 - 1000 m apart.

NATIVE VEGETATION

A grey gum, narrow-leaved red ironbark woodland community. A riverine community of river she-oak and rough-barked apple is common along perennial streams and main drainage lines.

GEOLOGY/GEOMORPHOLOGY

Geological Zone	Siliceous Granites
Geological Units	Quaternary alluvium (Cza) and the Gulgong and Rouse Granite
Parent Rocks	Gulgong and Rouse Granite (siliceous)
Parent Materials	Alluvium and colluvium derived from the Gulgong and Rouse Granites

LAND USE

Grazing on improved and unimproved pastures.

EXISTING LAND DEGRADATION

Minor sheet erosion with moderate to severe gully erosion. Some areas of very severe gully erosion.

INCLUDED SOIL LANDSCAPES

Rouse **(rs)**; Dexter **(dx)**; Gulgong **(gu)**.

SOIL QUALITIES AND LIMITATIONS

Soil Fertility - chemical

Soil fertility is very low and surface soils are acidic.

Soil Fertility - physical

The fragile, light textured surface soils are susceptible to soil structure degradation including surface sealing and low infiltration, although the loose sand surface soils are not. Waterholding capacity is low to very low; profile permeability is high to very high. Subsoils do not restrict root growth but they are often shallow and very sandy. Yellow Solodic Soils have very low permeability and very low waterholding capacity. Root growth is severely restricted in the subsoils of the yellow Solodic Soils.

SOILS

Siliceous Sands

Topsoil

Loose brown to dark brown loamy sand; small angular stones of quartz and felspar; pH 6.0; to 10 - 35 cm depth. Clear change to—

Subsoil

Bright brown to reddish-brown, loose clayey sand; small stones of quartz and orthoclase felspar; pH 7.0.

Earthy Sands

Topsoil

Hardsetting brown to dark brown changing to pale brown sandy loams; pH 7.0; to 40 cm depth. Gradual change to—

Subsoil

Yellowish-brown sandy loam to loamy sand; coherent; pH 7.5.

Yellow Solodic Soils/Soloths

Topsoil

Hardsetting brown to dull yellowish-orange to dull yellowish-brown, massive sandy loam to fine sandy loam; pH 6.0 - 8.5; to 40 cm depth.

Subsoil

Mottled dull yellowish-orange to bright yellowish-brown sandy clay; moderate structure, coarse columnar; pH 6.0 - 8.5; to 150 cm depth.

Bleached Sands

Topsoil

A_1 horizon. Dark brown to dull brown sandy loam or loamy sand; weakly structured to single-grained. Clear boundary to—

A_2 horizon. Pale brown to bleached sandy loam or loamy sand, single-grained or massive. Sharp boundary to—

Subsoil

B_{21} horizon. Yellowish-brown loamy sand to sandy loam with grey mottles; coherent and weakly structured; extends to 100 cm; cemented pans may be present.

Erosion Hazard

Erosion hazard is high when surface cover is low or flows are concentrated. Erosion control requires maintaining surface cover to minimise runoff and may require the construction of strategic earthworks in flow lines. Soils in drainage depressions are highly susceptible to gully erosion without adequate protection from high runoff.

Salinisation

Low levels of soil salinity are apparent and common across the landscape. Landform elements affected include drainage lines, depressions, footslopes, lower slopes and more rarely, mid and upper slopes.

Foundation Hazard

Very sandy soils and loose sand of low wet bearing strength are limitations to foundations. Areas of salinity will affect foundations.

Landscape Limitations

The slopes are sufficient to be a moderate to high erosion hazard when surface cover is low. Soils on mid to upper slopes tend to be sandy and very permeable, while those in depressions have dense sodic subsoils with very low permeability causing perched watertables in winter.

Urban Capability

Generally suitable for urban development but care needs to be taken to minimise runoff onto the highly erodible subsoils in depressions. Low wet bearing strength may be a localised problem for foundations. Areas of salinity will affect foundations.

Rural Capability

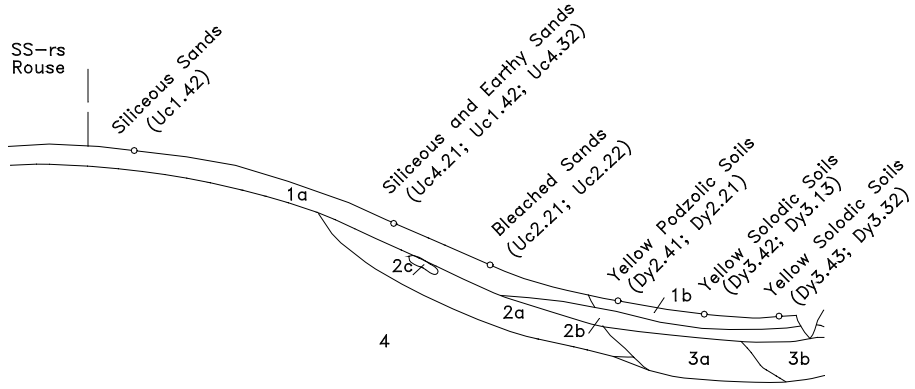
Land is largely suitable for grazing (Classes IV and V), but there are areas of lesser slope that are suitable for cropping (Class III).

Soil Conservation Earthworks

Sandy soils and low clay content will limit the number of sites suitable for earthworks. Earthworks built in sandy soils are likely to be permeable, and could be susceptible to slumping if large heads of water are held against the wall. In drainage depressions and lower slopes, the subsoils are more clayey but are sodic, dispersible and probably tunnelling susceptible when a head of water is held against the wall.

RECOMMENDATIONS FOR SUSTAINABLE LAND USE

Land is mainly suitable for grazing on native/volunteer pastures. Acidic surface soils restrict introduction of sown pastures. Grazing rates should be adjusted to maintain ground cover for erosion control and maximising water use. Trees should be strategically planted to maximise water use.



1a. Weakly structured dark brown to brown loamy sand to sandy loam.
1b. Massive dull yellowish brown–orange sandy loam.
2a. Bright brown clayey sand to sandy loam.
2b. Dull yellow–orange, sometimes bleached sandy loam.
2c. Hard siliceous pan.
3a. Structured bright yellowish brown sandy clay.
3b. Mottled yellowish brown (sometimes bleached) sandy to medium clay.
4. Quaternary alluvium and colluvium largely derived from Gulgong & Rouse Granites.

■ ***Distribution diagram of Home Rule soil landscape illustrating the occurrence and relationship of dominant soil materials.***

SUMMARY TABLE FOR THE MAIN SOILS OF HOME RULE SOIL LANDSCAPE		
	Siliceous Sands	**Yellow Solodic Soils**
Dominance	Co-dominant	Co-dominant
Landform element	Crests, mid to upper slopes	Lower slopes
Surface condition	Loose	Hardsetting
Drainage	Excessively well-drained	Imperfectly drained
Soil permeability	High	Slow
Watertable depth	>150 cm	>150 cm
Available waterholding capacity	Low	Moderate to low
Depth to bedrock	100 - 300 cm	150+ cm
Flood hazard	Nil	Low
pH (topsoil)	Slightly acidic	Slightly acidic to neutral
Fertility (chemical)	Low	Low
Expected nutrient deficiencies	N, P	N, P
Soil salinity	Low	Low to moderate
Erodibility (topsoil)	Moderate	High
Erodibility (subsoil)	Moderate	High
Erosion hazard	High	High to very high
Structural degradation hazard	Low	High
Land capability classification	III, VI	IV, V, VI
USCS (subsoil)	CL, SM, SP, SW	CL, SC
Shrink-swell potential	Low	Moderate
Mass movement hazard	Low	Low

NSW SOIL AND LAND INFORMATION SYSTEM



Soil Profile Report

SITE DETAILS

Site Location:	Profile 87
Profile Details:	Soil Landscapes of the Dubbo 1:250 000 Sheet Survey (1004749), Profile 87, collected from a batter by Mr Robbie Economos on 13 August, 1986
Map Reference:	MGA Grid Reference: Zone 55, 732963E, 6420334N. 8733 COBBORA (1:100000) map sheet.
Physiography:	dry sclerophyll forest on coarse-acidic lithology and used for volun./native pasture. Slope 6.0% (estimated), elevation 415.0 m, aspect north. profile is well drained, erosion hazard is moderate, and no salting evident
Vegetation/Land Use:	limited clearing at the site, used for volun./native pasture, with improved pasture in the general area
Surface Condition:	expected to be hard set when dry, ground cover is 30%
Erosion/Land Degradation:	moderate; wind erosion at site is none; sheet erosion at site is minor, partly stabilised; scald erosion at site is partly stabilised; no salting evident
Soil Hydrology:	profile is well drained, , run on is moderate and runoff is moderate
Soil Type:	Incomplete
Base of observation:	
Profile Field Notes:	Geology- granite adamellite granodorite-gulgong granite. Non-weathered coarse fragments also present in each layer and on surface. Previously within 'COBBORA MAP-DUBBO SOIL SURVEY' survey (1000301), profile number 10.

SOIL DESCRIPTION

Layer 0

0.00 - 0.00 m

	Coarse Fragments:	igneous, abundant (50-90%), quartz, dispersed, weakly weathered, sub-angular, angular, fine gravel (2-6 mm),
Layer 1	Horizon: A	
0.00 - 0.30 m	Texture:	coarse sandy loam
	Colour:	brown (7.5YR 4/4) [moist] with no recorded mottles
	Structure:	single grained (fabric is sandy)
	Coarse Fragments:	common (10-20%), igneous, dispersed, weakly weathered, sub-angular, angular, fine gravel (2-6 mm),
	Pans:	not evident
	Segregations:	not evident,
	Soil fauna:	Activity is nil

	Cracks/Macropores:	Cracks are nil, macropores are nil
	Moisture/Consistence:	moderately moist, slightly sticky, texture modifier test result was no change, disruptive test result was very weak force, shearing test result was brittle,
	Field chemical tests:	Field pH is 6.5 (Raupach),
	Sample taken:	unspecified
	Lower Boundary:	smooth gradual (50-100 mm) boundary to ...
Layer 2	Horizon: B1	
0.30 - 0.76 m	Texture:	coarse sandy clay loam
	Colour:	reddish brown (dull reddish brown) (5YR 4/4) [moist] with no recorded mottles
	Structure:	weak pedality (5 - 10 mm, fabric is sandy), ped coatings are none
	Coarse Fragments:	common (10-20%), igneous, dispersed, weakly weathered, sub-angular, angular, fine gravel (2-6 mm), gravel (6-20 mm),
	Pans:	not evident
	Segregations:	few (2-10%), organic, nodules, medium (2-6 mm), coarse (6-20 mm),
	Soil fauna:	Activity is nil
	Cracks/Macropores:	Cracks are nil, macropores are nil
	Moisture/Consistence:	moderately moist, non-sticky, texture modifier test result was no change, disruptive test result was very weak force, shearing test result was brittle,
	Field chemical tests:	Field pH is 6.5 (Raupach),
	Sample taken:	unspecified
	Lower Boundary:	smooth gradual (50-100 mm) boundary to ...
Layer 3	Horizon: B2	
0.76 - 1.00 m	Texture:	sandy clay
	Colour:	yellowish red (reddish brown) (5YR 4/6) [moist] with no recorded mottles
	Structure:	weak pedality (5 - 10 mm, also 2 - 5 mm, fabric is sandy), ped coatings are none
	Coarse Fragments:	igneous, common (10-20%), quartz, dispersed, weakly weathered, sub-angular, angular, fine gravel (2-6 mm),
	Pans:	not evident
	Segregations:	few (2-10%), organic, nodules, medium (2-6 mm), coarse (6-20 mm),
	Soil fauna:	Activity is nil
	Cracks/Macropores:	Cracks are nil, macropores are nil
	Moisture/Consistence:	moderately moist, non-sticky, texture modifier test result was no change, disruptive test result was very weak force, shearing test result was brittle,
	Field chemical tests:	Field pH is 6.0 (Raupach),
	Sample taken:	unspecified
	Layer Notes:	Sand fraction coarse.

LABORATORY TESTS

None available

For information on laboratory test data and units of measure, please see: Soil survey standard test methods

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NSW SOIL AND LAND INFORMATION SYSTEM

Soil Profile Report

SITE DETAILS

Site Location:	Profile 13
Profile Details:	Soil Landscapes of the Dubbo 1:250 000 Sheet Survey (1004749), Profile 194, collected from a batter by Mr John Lawrie on 18 February, 1985
Map Reference:	MGA Grid Reference: Zone 55, 733113E, 6419484N. 8733 COBBORA (1:100000) map sheet.
Physiography:	woodland grass understorey on coarse-acidic lithology and used for volun./native pasture. Slope 2.0% (estimated). Surface condition is self mulched, profile is poorly drained, erosion hazard is moderate, and no salting evident
Vegetation/Land Use:	extensive clearing and cleared, no cultivation at the site, used for volun./native pasture, with improved pasture in the general area
Surface Condition:	self mulched when described, ground cover is 80%
Erosion/Land Degradation:	moderate; wind erosion at site is minor, partly stabilised; sheet erosion at site is minor, partly stabilised; scald erosion at site is partly stabilised; no salting evident
Soil Hydrology:	profile is poorly drained, no free water and runoff is low
Soil Type:	Incomplete
Base of observation:	
Profile Field Notes:	Depth to bedrock 1.42m. Uniform chocolate soil on Gulgong granite. Previously within 'Dubbo Soil Landscapes survey (1001038), profile number 13.

SOIL DESCRIPTION

Layer 0

0.00 - 0.00 m

Layer 1	Horizon: A	
0.00 - 0.02 m	Texture:	fine loamy sand
	Colour:	brown (7.5YR 4/3) [moist] or brown (7.5YR 4/3) [dry] with no recorded mottles
	Structure:	single grained (granular, < 2 mm, also granular, < 2 mm, fabric is sandy), ped coatings are none
	Pans:	not evident
	Segregations:	not evident,
	Roots:	few (1-10/10x10cm) (Root size <1 mm), few (1-10/10x10cm) (Root size 1-2 mm),
	Soil fauna:	Activity is nil

	Cracks/Macropores:	Cracks are nil, macropores are nil
	Moisture/Consistence:	disruptive test result was very weak force, shearing test result was brittle,
	Field chemical tests:	Field pH is 7.0 (pH meter),
	Sample taken:	unspecified
	Layer Notes:	Normal plastic. Porous peds.
	Lower Boundary:	irregular clear (20-50 mm) boundary to ...
Layer 2	Horizon: A1	
0.02 - 0.20 m	Texture:	fine sandy loam
	Colour:	brown (7.5YR 4/4) [moist] or brown (dull brown) (7.5YR 5/3) [dry] with no recorded mottles
	Structure:	weak pedality (columnar, 5 - 10 mm, also polyhedral, 2 - 5 mm, fabric is earthy), ped coatings are none
	Coarse Fragments:	few (2-10%), as parent material, dispersed, strongly weathered, sub-angular, gravel (6-20 mm),
	Pans:	not evident
	Segregations:	not evident,
	Roots:	none (Root size <1 mm), none (Root size 1-2 mm),
	Soil fauna:	Activity is nil
	Cracks/Macropores:	Cracks are nil, macropores are nil
	Moisture/Consistence:	disruptive test result was moderately weak force, shearing test result was brittle,
	Field chemical tests:	Field pH is 6.5 (pH meter),
	Sample taken:	unspecified
	Layer Notes:	Normal plastic. Porous peds.
	Lower Boundary:	irregular clear (20-50 mm) boundary to ...
Layer 3	Horizon: B1	
0.20 - 1.20 m	Texture:	sandy loam
	Colour:	strong brown (brown) (7.5YR 4/6) [moist] or reddish yellow (orange) (7.5YR 6/6) [dry] with no recorded mottles
	Structure:	weak pedality (2 - 5 mm, also 2 - 5 mm, fabric is sandy), ped coatings are none
	Coarse Fragments:	common (10-20%), as parent material, dispersed, strongly weathered, sub-angular, coarse gravel (20-60 mm),
	Pans:	not evident
	Segregations:	not evident,
	Roots:	common (10-25/10x10cm) (Root size <1 mm), common (10-25/10x10cm) (Root size 1-2 mm),
	Soil fauna:	Activity is nil
	Cracks/Macropores:	Cracks are nil, macropores are nil
	Moisture/Consistence:	disruptive test result was moderately weak force, shearing test result was brittle,
	Field chemical tests:	Field pH is 6.0 (pH meter),
	Sample taken:	unspecified
	Layer Notes:	Porous peds.
	Lower Boundary:	irregular clear (20-50 mm) boundary to ...
Layer 4		

- m

Colour:	colour not recorded with no recorded mottles
Structure:	weak pedality
Soil fauna:	Activity is nil
Cracks/Macropores:	Cracks are nil, macropores are nil

LABORATORY TESTS

None available

For information on laboratory test data and units of measure, please see: Soil survey standard test methods

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Appendix 2 Design Calculations and Modelling Results

Wisconsin Mound Sizing Sheet

Project	736
Address	Tallawang Solar Farm
Date	21/12/23

Input Cells
Calculation
Output

Notes	Site Data	Symbol	Value	
	Daily wastewater load (L/day)	W	60000	
	Effluent Quality (P = primary, S = secondary)	Q	Primary	
	Soil texture (topsoil)		3 Loam	
1	Soil depth to limiting layer (m)	SD	1.60	
2	Natural slope across basal area (%)	NS	0.5	
3	Natural slope in radians (rad)	a	**0.0**	
4	Recommended basal loading rate (mm/day)	BLR	16.0	
5	Recommended linear loading rate (L/m/day)	LLR	60.0	
6	Recommended minimum separation from limiting layer (m)	SLL	**1.0**	
7	Sand loading rate at gravel-sand interface (mm/day)	SLR	**35.0**	
	Calculations	**Symbol**	**Formula**	**Value**
8	Recommended mound batter slope (H:V) (e.g. 3, 2.5)	BS	nominated	3.00
	Batter slope in radians (rad)	f		**0.32**
	Gravel bed dimensions:			
	Length (m)	B	W / LLR	**1000.00**
	Width (m)	A	LLR / SLR	**1.71**
	Thickness (m)	F	nominated	0.30
9	Minimum capping over gravel at the edges (m)	G	nominated	0.15
10	Topsoil cover all over (m)	C	nominated	0.10
11	Recommended minimum sand depth (upslope) (m)	D_u	SLL - SD; min. 0.6 for primary effluent (0.4 for secondary)	**0.60**
	Downslope mound fill depth (m)	D_d	D_u + (NS ´ A)	**0.61**
	Fill depth at centre of gravel bed (m)	D_c	(D_u + D_d) / 2	**0.60**
12	Theoretical capping depth at centre of peaked mound (m)	P_1	G + [(A/2) / BS]	**0.44**
	Acceptable minimum capping depth for a slightly rounded crest (	P	nominated	0.30
	Total mound height for a perfectly peaked mound (m)	H_1	D_c + P_1 + F	**1.34**
	Total mound height with minimum capping depth (m)	H	D_c + P + F	**1.20**
13	Upslope mound width, from geometry (m)	I_g	geometric calculation	**3.10**
14	Upslope mound width, from hydraulics (m)	I_h	If NS=0, I_h=(LLR/BLR-A)/2, IF NS>0, calc. I from geometry	**n/a**
15	Upslope mound width - larger of I_g and I_h (m)	I		**3.10**
	Endslope mound width, from geometry (m)	K	BS ´ (D_c + F + G)	**3.16**
16	Downslope mound width, from geometry (m)	J_g		**3.22**
17	Minimum downslope mound width, from hydraulics (m)	J_h	If NS=0, J_h=I_h If NS>0, J_h=(LLR / BLR) - A	**2.04**
18	Downslope mound width - larger of J_g and $J_{h\ (m)}$	J		**3.22**
	Mound Dimensions (all in m)			
	Absorption Bed Dimensions			
	Absorption bed width:	A		**1.7**
	Absorption bed length:	B		**1000.0**
	Absorption bed thickness:	F		**0.3**
	Absorption bed area:			**1714.3**
	Mound Dimensions			**35.0**
	Basal width:	W	I + A + J	**8.0**
	Basal length:	L	B + (2 ´ K)	**1006.3**
	Total height:	H	D_c + P + F	**1.2**
	Basal area:	m2		**8092.7**
	Upslope mound width:	I		**3.1**
	Downslope mound width:	J		**3.2**
	Endslope mound width:	K		**3.2**

Soil bore logs and test results were taken from Umwelt soil investigation for BH09 and Soil Landscape information.

MEDLI Modelling Soil Profile Inputs

	Soil Layer				Source
Parameter	1	2	3	4	
Soil Layer Thickness (mm)	100	350	250	900	Soil Log
Air Dry (% v/v)	*4*				
Lower Storage Limit (% v/v)	9	7	19	19	MEDLI Technical Manual, (Hazelton and Murphy)
Drained Upper Limit (% v/v)	19	18	29	29	MEDLI Technical Manual, (Hazelton and Murphy)
Total Porosity (% v/v)	43	40	50	50	MEDLI Technical Manual
Saturated Water Content (% v/v)	**39.99**	**37.2**	**46.5**	**46.5**	
Bulk Density (g/cm3)	1.4	1.4	1.4	1.4	
Saturated Hydraulic Conductivity (mm/hr)	100.0	120.0	8.3	**0.20**	MEDLI Technical Manual (assumed conservative amount)
Texture/Structure	***Sandy silt***	***Silty Sand***	***Sandy Clay***	***Sandy Clay***	Soil Log
Additional Details	*Moderate structure*	*Moderate structure*	*Moderate structure*	*Moderate structur*	Soil Log

3.3

Note- Air Dry only needs to be defined for the top soil layer - sets the minimum moisture content of the soil

2.5

Saturated water content = 0.93 * Total Porosity

MEDLI REPORT - FULL RUN

Enterprise: **0736 Tallawang Solar Farm Construction Camp**

Description:
Surface Irrigation with tank wet weather storage

Client: **Umwelt**

MEDLI User: BEN-SP6\benas

Scenario Details:
Model to test the sustainability of a 3 mm/day long term irrigation rate with irrigation shut off (via rain gauge) when rain exceeds 10mm. Also used to size a wet weather storage tank and determine the maximum daily application rate based on permeability and soil water storage capacity.

DESCRIPTION

Climate Data: Tallawang_MEDLI_-32.30_149.50, -32.3°, 149.5°

Run Period: 01/01/1970 to 31/12/2019 50 years, 0 days

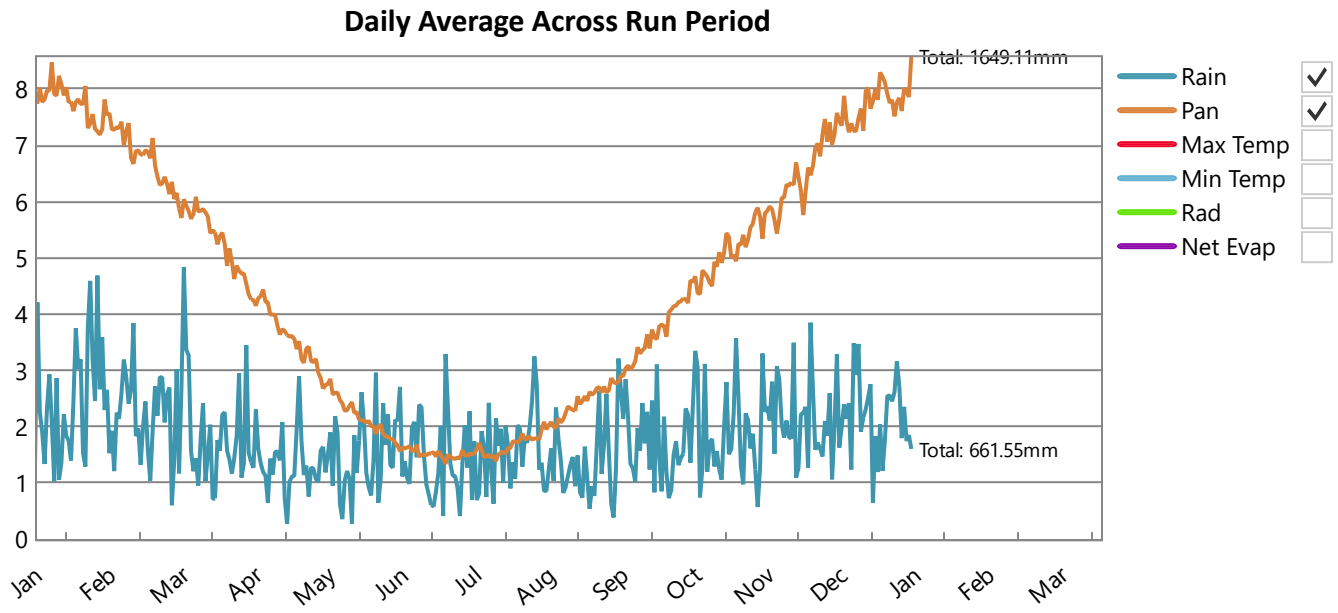
Climate Statistics:

	5th Percentile	50th Percentile	95th Percentile
Rainfall (mm/year)	387	662	981
Pan Evaporation (mm/year)	1412	1654	1902

Climate Data:

Chart Table

Monthly Daily

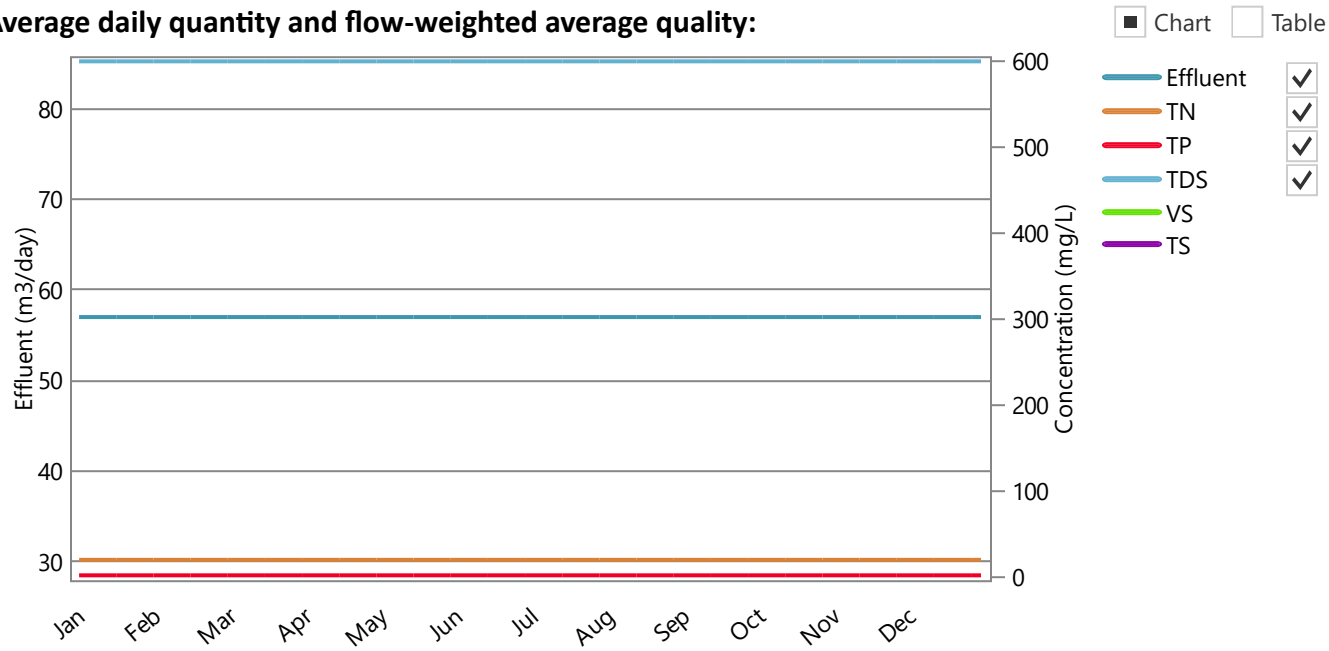


DESCRIPTION

Effluent type: New Generic System

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: **20818.68 m3/year** or 57.00 m3/day (Min-Max: 57.00 - 57.00)

Flow-weighted average (minimum - maximum) daily effluent quality entering pond system:

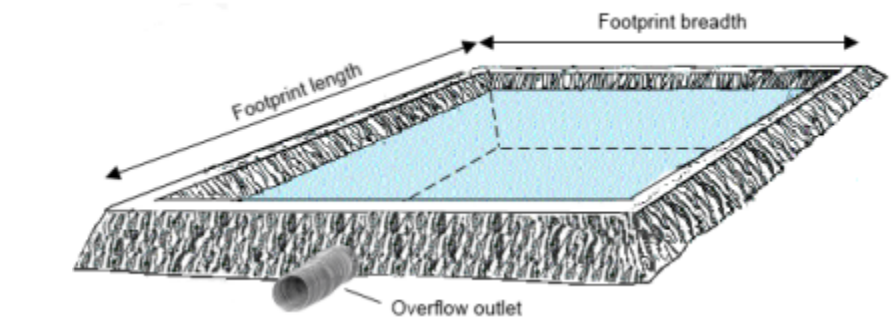
	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	20.00 (20.00 - 20.00)	416.37 (416.10 - 417.24)
Total Phosphorus	2.00 (2.00 - 2.00)	41.64 (41.61 - 41.72)
Total Dissolved Salts	600.00 (600.00 - 600.00)	12491.21 (12483.00 - 12517.20)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

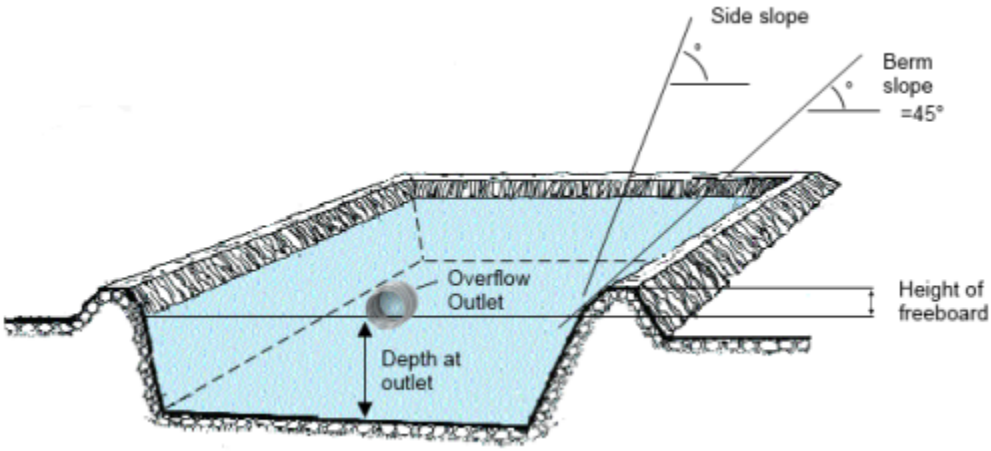
DESCRIPTION

Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (m3)	500.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	2.00
Maximum water surface area (m2)	459.65
Pond footprint length (m)	32.32
Pond footprint width (m)	17.16
Pond catchment area (m2)	554.61
Average active volume (m3)	27.02





Irrigation pump limits:

Minimum pump rate limit (ML/day)	0.00
Maximum pump rate limit (ML/day)	1.00

Shandying water:

Annual allocation of fresh water available for shandying (m3/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

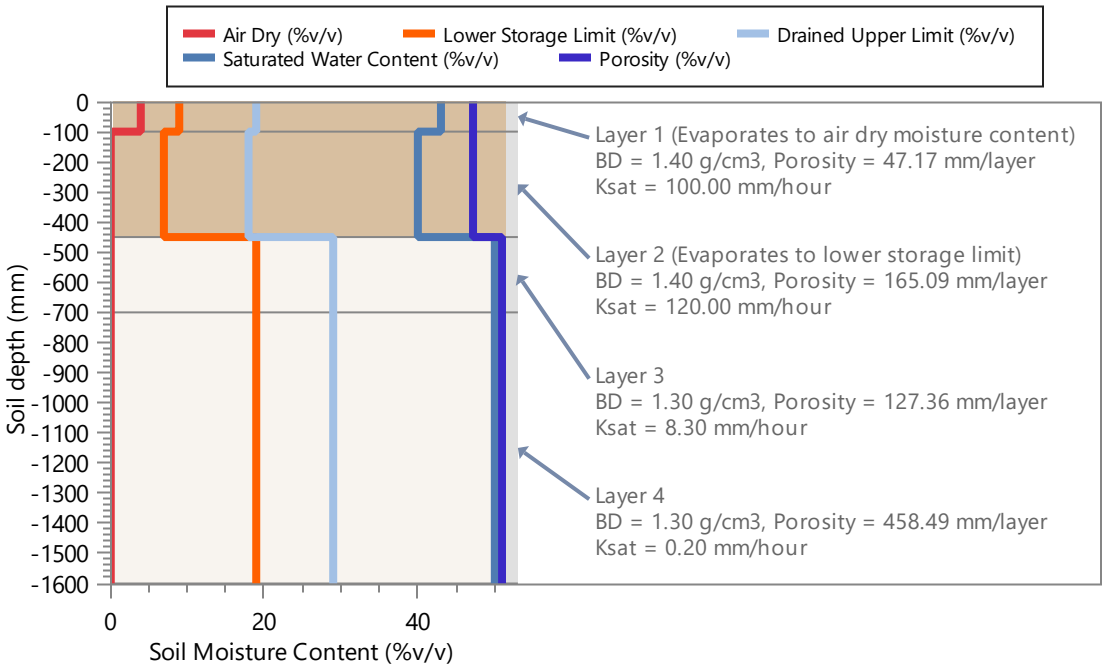
DESCRIPTION

Land: New Paddock

Area (ha): 2.00

Soil Type: Tallawang, 1600.00 mm defined profile depth

Profile Porosity (mm)	798.11
Profile saturation water content (mm)	758.00
Profile drained upper limit (or field capacity) (mm)	415.50
Profile lower storage limit (or permanent wilting point) (mm)	252.00
Profile available water capacity (mm)	163.50
Profile limiting saturated hydraulic conductivity (mm/hour)	0.20
Surface saturated hydraulic conductivity (mm/hour)	100.00
Runoff curve number II (coefficient)	100.00
Soil evaporation U (mm)	8.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Lucerne (Winter Active) Pasture

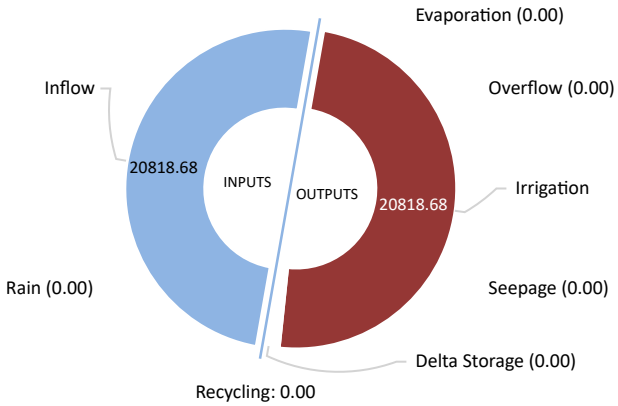
Average monthly cover (fraction) (minimum - maximum)	0.67 (0.62 - 0.70)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.9 x Pan coefficient 0.85)	0.77
Total plant cover (both green and dead) left after harvest (fraction)	0.75
Maximum potential root depth in defined soil profile (mm)	1600.00
Salt tolerance	Moderately sensitive
Salinity threshold EC sat. ext. (dS/m)	1.50
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.07

PERFORMANCE

Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: **500 m3**

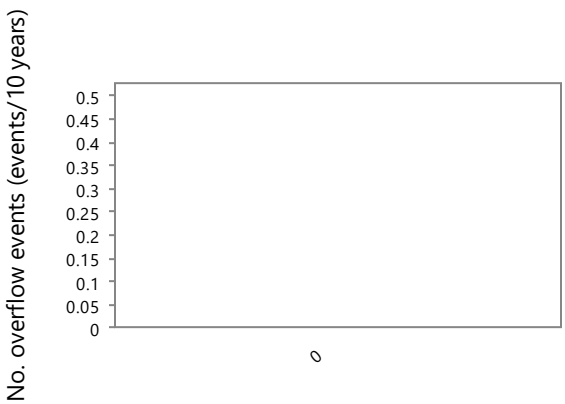
Pond System Water Balance (m3/year)



Name	Value
Rain	0.00
Inflow	20818.68
Recycling	0.00
Evaporation	0.00
Overflow	0.00
Irrigation	20818.68
Seepage	0.00
Delta Storage	0.00

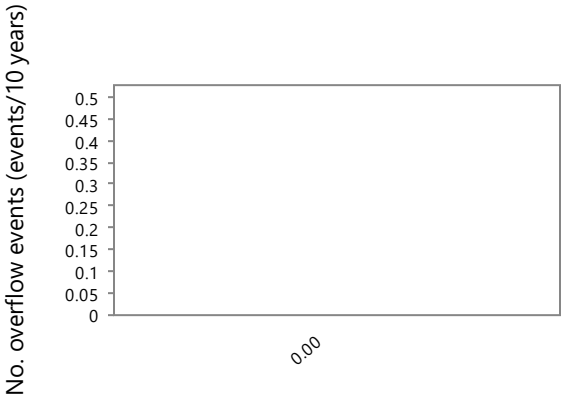
Overflow Diagnostics

Volume of overflow (m3/year)	0.00
No. days pond overflows (days/year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% reuse (fraction)	1.00



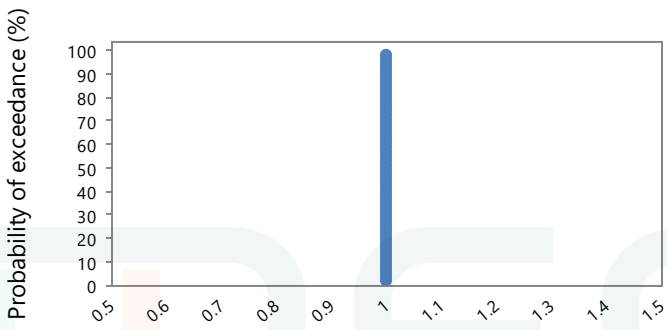
Overflow event duration exceeded (days)

Export plot



Overflow volume exceeded (m3)

Export plot



Annual reuse (fraction)

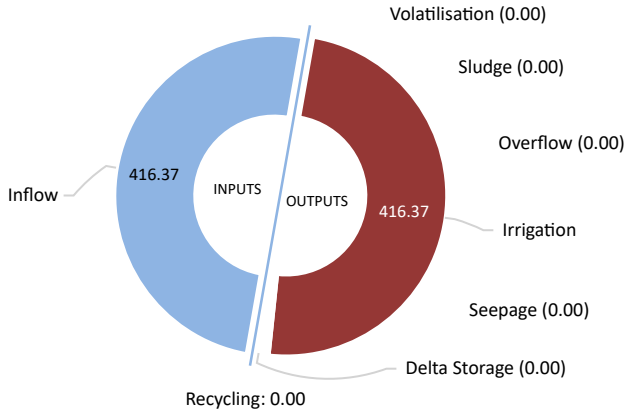
Export plot

PERFORMANCE

Pond System Performance - Nutrient: 1 closed storage tank

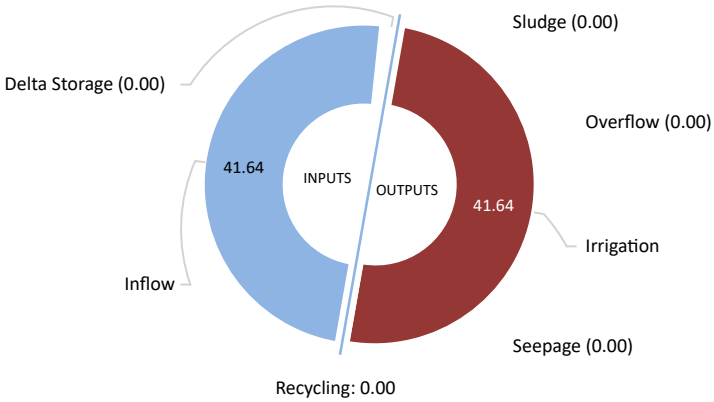
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



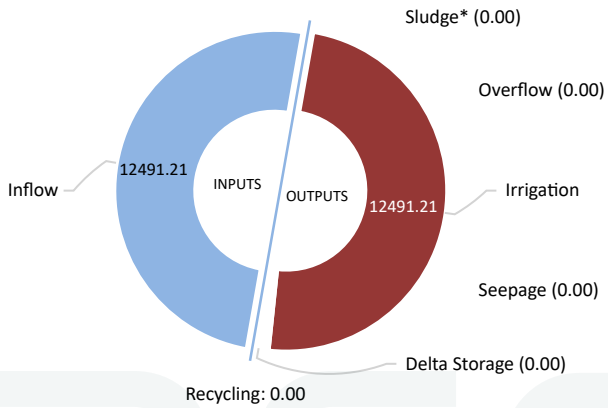
Name	Value
Inflow	416.37
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	416.37
Seepage	0.00
Delta Storage	0.00

Phosphorus Balance (kg/year)



Name	Value
Inflow	41.64
Recycling	0.00
Sludge	0.00
Overflow	0.00
Irrigation	41.64
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)



Name	Value
Inflow	12491.21
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	12491.21
Seepage	0.00
Delta Storage	0.00

* Salt removal in sludge is not calculated from the pond salt balance. However if salt could be assumed to be present in the sludge at the same concentration as in the pond supernatant (up to a maximum of salt added in inflow) - then salt accumulation in the sludge could be 0.00 kg/year

Pond System Sludge Accumulation: 0.00 kg dwt/year

PERFORMANCE

Pond System Performance - Nutrient: 1 closed storage tank

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	20.00
Average phosphorus concentration of pond liquid (mg/L)	2.00
Average salinity of pond liquid (dS/m)	0.94

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	N.D.*
Final phosphorus concentration of pond liquid (mg/L)	N.D.*
Final salinity of pond liquid (dS/m)	N.D.*

* Not determined. Pond is empty.

PERFORMANCE

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (m3/year)	20818.68
Average Shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	20818.68
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 m3/year is exceeded (fraction of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (fraction of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation Quality:

Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	20.00
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	19.60
Average phosphorus concentration of irrigation water (mg/L)	2.00
Average salinity of irrigation water (dS/m)	0.94

Irrigation Diagnostics:

Proportion of Days rain prevents irrigation (fraction)	0.06
Proportion of Days irrigation occurs (fraction)	0.94

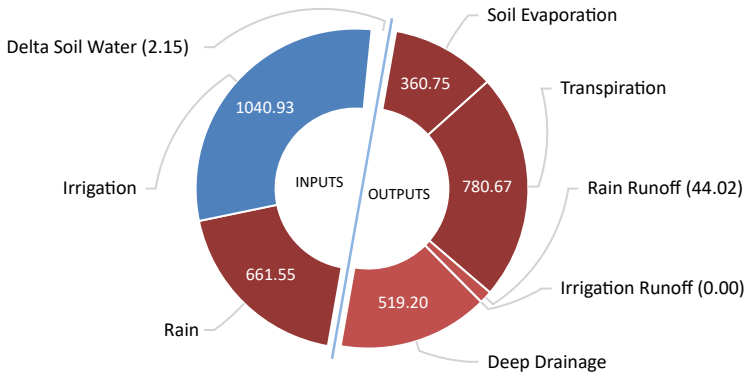
PERFORMANCE

Land Performance - Soil Water

Paddock: New Paddock, 2 ha
Soil Type: Tallawang, 163.50 mm PAWC at maximum root depth

Land Water Balance (mm/year):

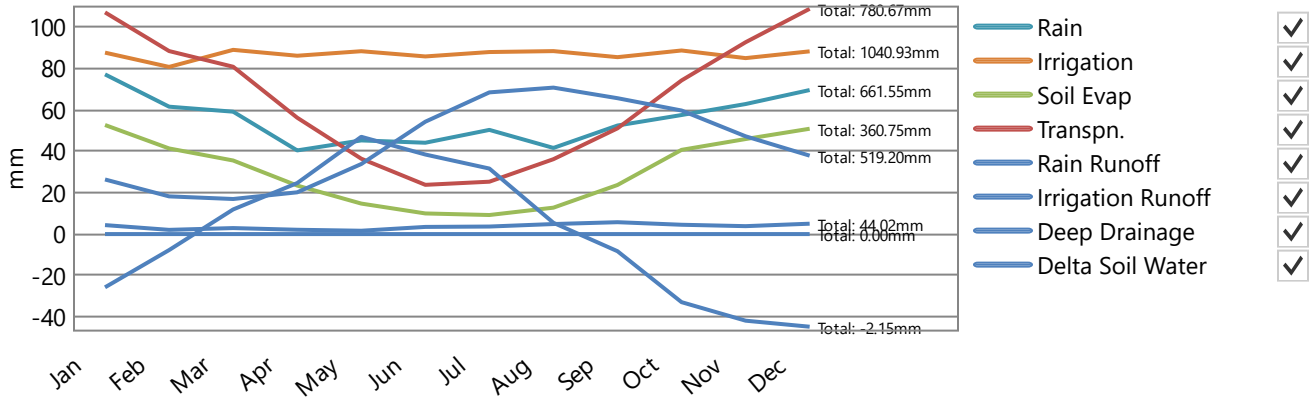
mm/year % Total inputs



Name	Value
Rain	661.55
Irrigation	1040.93
Soil Evaporation	360.75
Transpiration	780.67
Rain Runoff	44.02
Irrigation Runoff	0.00
Deep Drainage	519.20
Delta Soil Water	-2.15

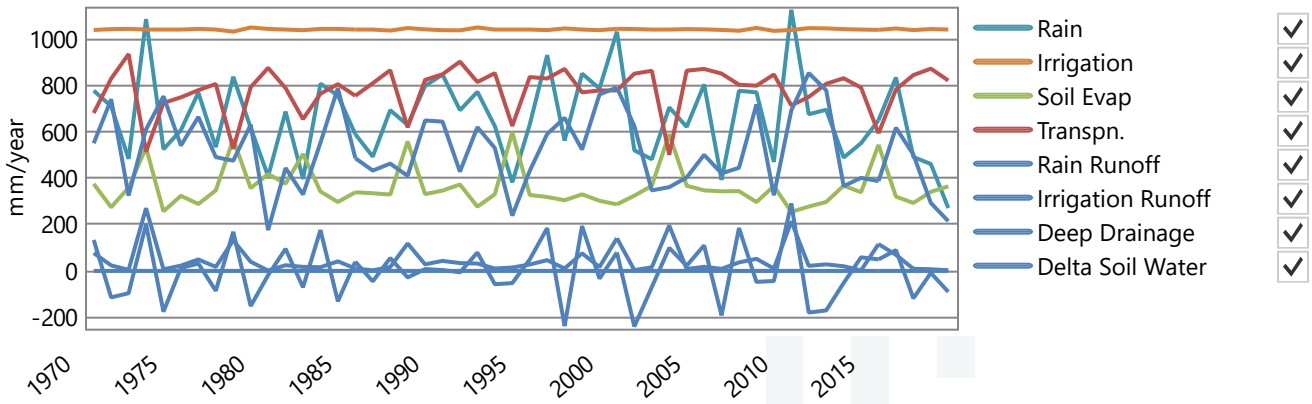
Average Monthly Totals (mm):

Chart Table



Average Annual Totals (mm/year):

Chart Table



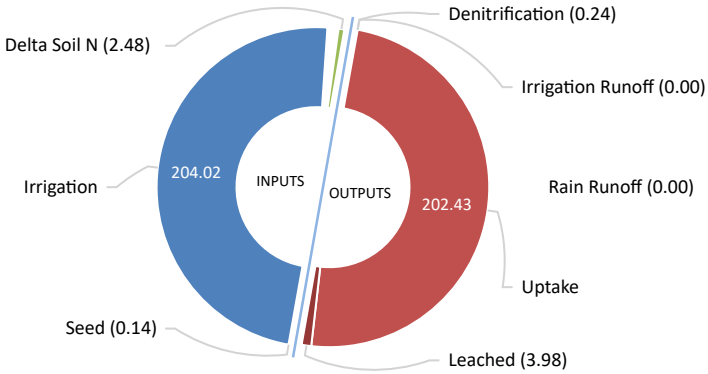
PERFORMANCE

Land Performance - Soil Nutrient

Paddock: New Paddock, 2 ha **Soil Type**: Tallawang

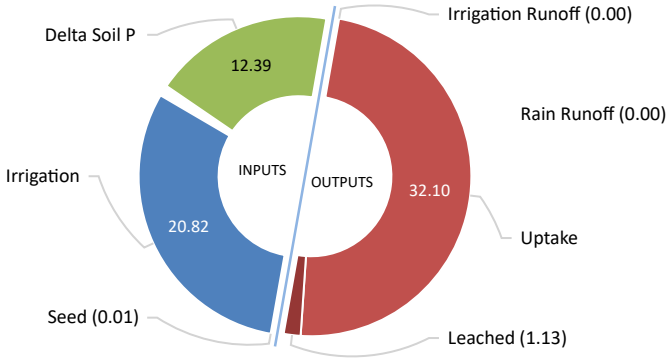
Irrigation ammonium volatilisation losses (kg/ha/year): 4.16
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.10

Land Nitrogen Balance (kg/ha/year)



Name	Value
Seed	0.14
Irrigation	204.02
Denitrification	0.24
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	202.43
Leached	3.98
Delta Soil N	-2.48

Land Phosphorus Balance (kg/ha/year)



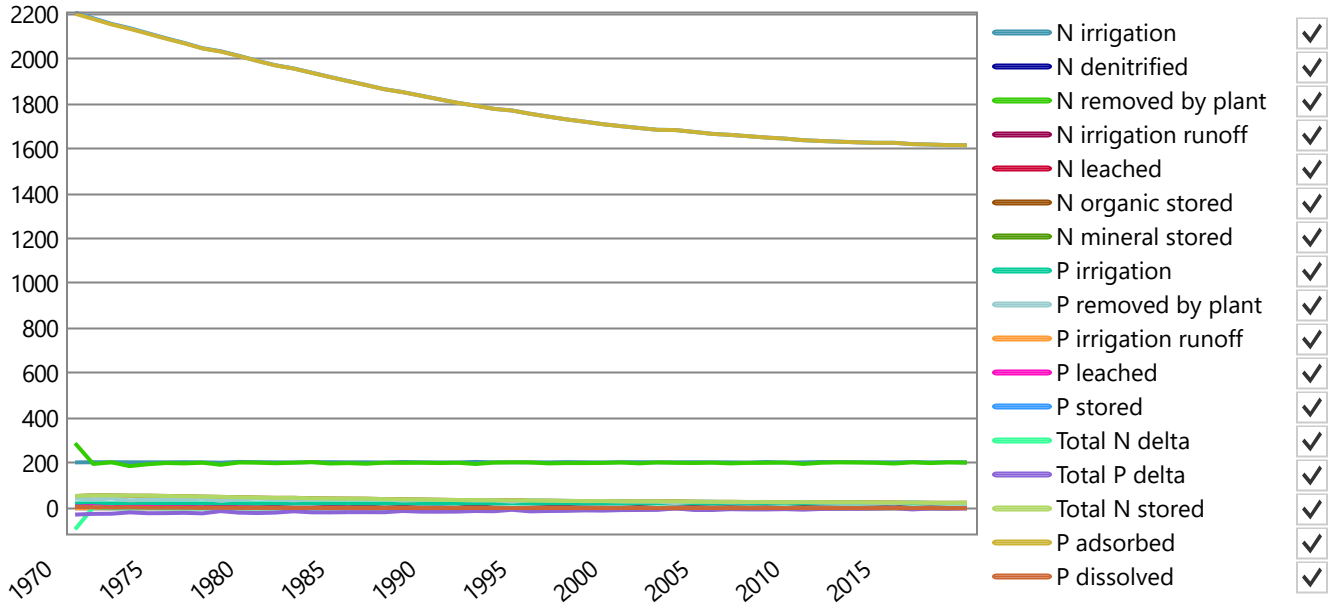
Name	Value
Seed	0.01
Irrigation	20.82
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	32.10
Leached	1.13
Delta Soil P	-12.39

PERFORMANCE

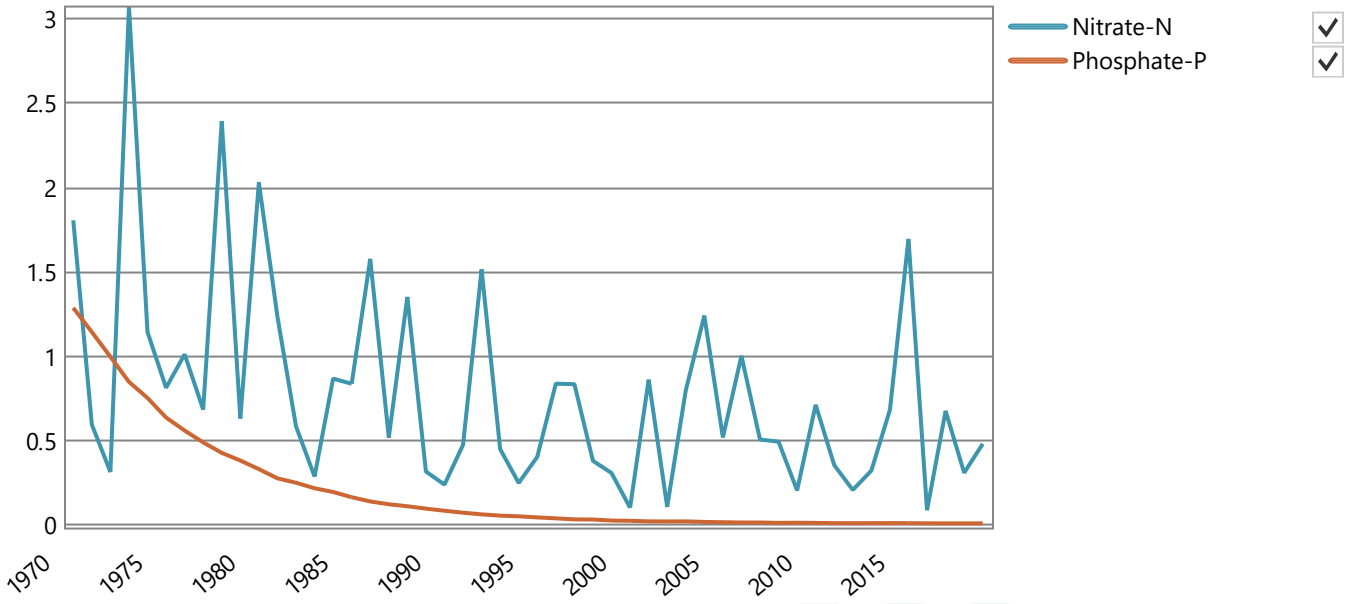
Land Performance - Soil Nutrient

Paddock: New Paddock, 2 ha **Soil Type**: Tallawang

Annual Nutrient Totals (kg/ha):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

Plant Performance and Nutrients

Paddock: New Paddock, 2 ha **Soil Type**: Tallawang

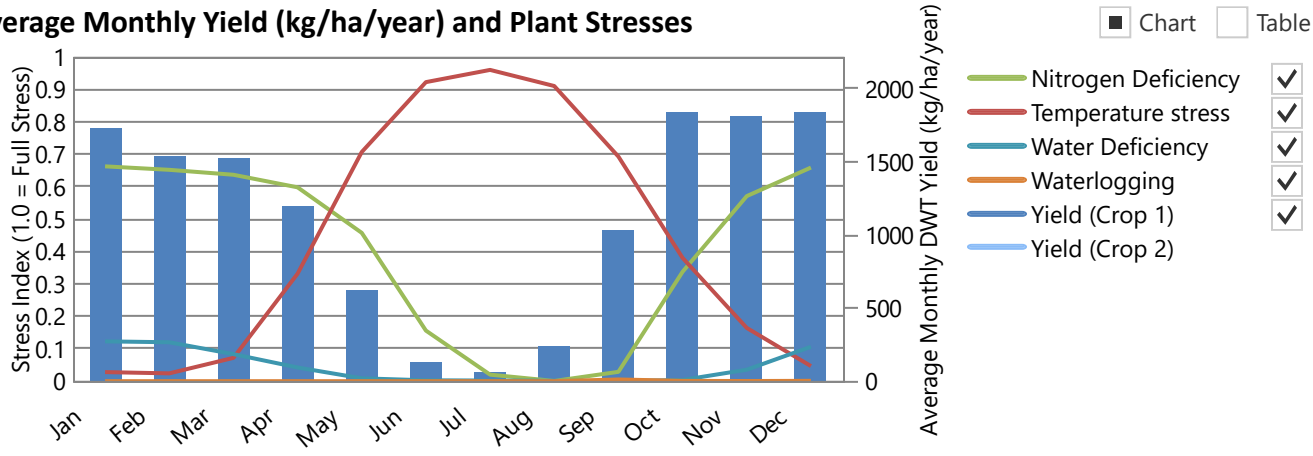
Plant: Continuous Lucerne (Winter Active) Pasture

Average annual shoot dry matter yield (kg/ha/year)	13629.43 (11079.46 - 14979.54)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.67 (0.62 - 0.70)
Average monthly root depth (mm) (minimum - maximum)	1531.39 (1404.97 - 1600.00)

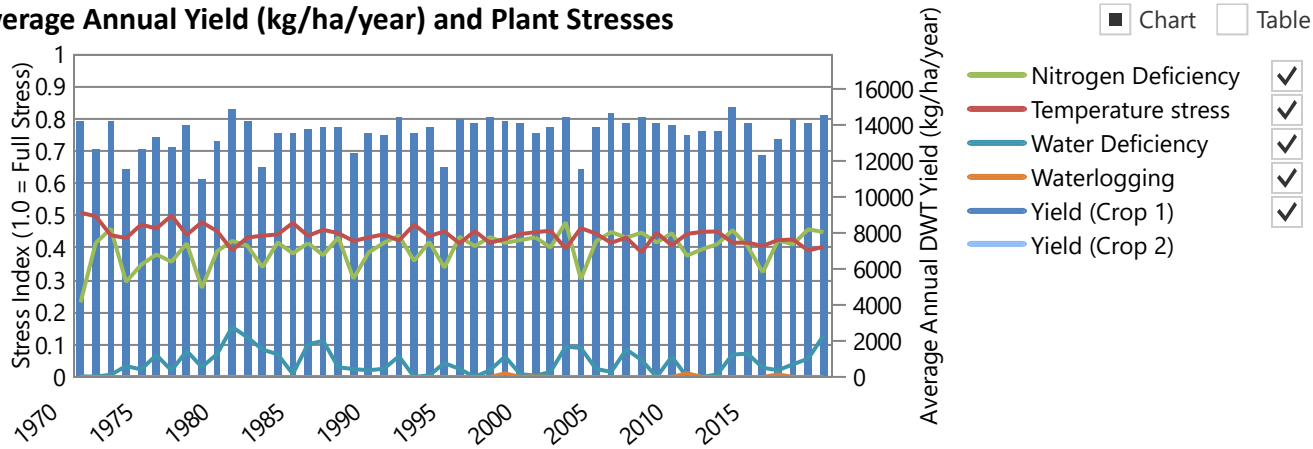
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/ha/year)	202.43 (186.98 - 288.89)
Average annual net phosphorus removed by plant uptake (kg/ha/year)	32.10 (20.78 - 42.71)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.02 - 0.02)
Average annual shoot phosphorus concentration (fraction dwt)	0.002 (0.002 - 0.003)

Average Monthly Yield (kg/ha/year) and Plant Stresses



Average Annual Yield (kg/ha/year) and Plant Stresses



No. of harvests/year: 7.32 (normal), 0.14 (forced by crop death due to frosting (0.14))
No. days without crop/year (days/year): 1.26 due to frosting (0.82), temperature stress - not frost (0.44)

PERFORMANCE

Land Performance

Paddock: New Paddock, 2 ha **Soil Type**: Tallawang

Plant: Continuous Lucerne (Winter Active) Pasture

Salt tolerance	Moderately sensitive
Salinity threshold EC sat. ext. (dS/m)	1.50
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.07
No. years assumed for leaching to reach steady-state (years)	10.00

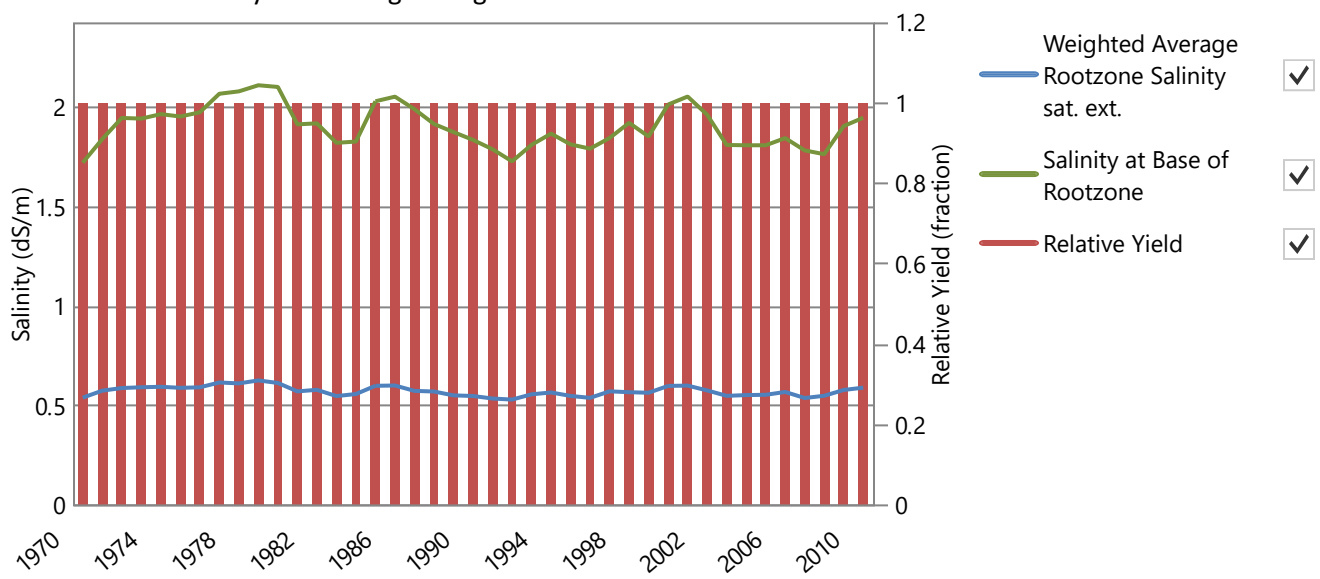
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.60
Salt added by rainfall (kg/ha/year)	118.57
Average annual effluent salt added & leached at steady state (kg/ha/year)	6364.17
Average leaching fraction based on 10 year running averages (fraction)	0.47
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.57
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	1.90
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

Average Annual Rootzone Salinity and Relative Yield:

Chart Table

All values based on 10 year running averages



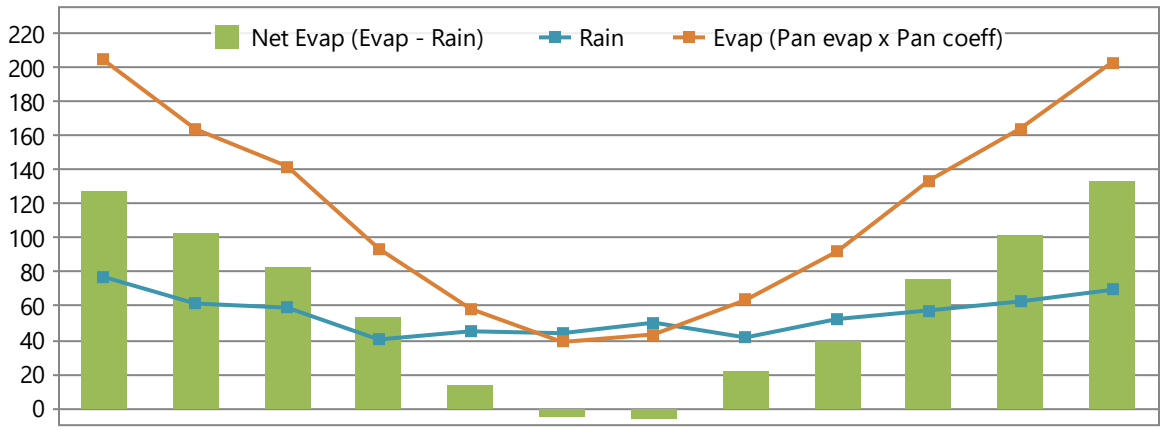
DIAGNOSTICS

Sustainability Diagnostics: 0736 Tallawang Solar Farm Construction Camp

Averaged Historical Climate Data Used in Simulation (mm)

Location: Tallawang_MEDLI_-32.30_149.50, -32.3°, 149.5°

Run Period: 01/01/1970 to 31/12/2019 50 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	77.1	61.5	59.1	40.4	45.2	44.1	50.3	41.6	52.4	57.5	62.8	69.6	661.5
Evap	204.4	163.9	142.1	93.7	58.4	38.9	43.4	63.6	92.1	133.7	164.3	203.2	1401.7
Net Evap	127.3	102.4	83.0	53.3	13.2	-5.2	-6.9	22.0	39.7	76.2	101.5	133.7	740.2
Net Evap/day	4.1	3.6	2.7	1.8	0.4	-0.2	-0.2	0.7	1.3	2.5	3.4	4.3	2.0

DIAGNOSTICS

Sustainability Diagnostics: 0736 Tallawang Solar Farm Construction Camp

Pond System: 1 closed storage tank

New Generic System - 20818.68 m3/year or 57.00 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.24 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	20.00 (20.00 - 20.00)	416.37 (416.10 - 417.24)
Total Phosphorus	2.00 (2.00 - 2.00)	41.64 (41.61 - 41.72)
Total Dissolved Salts	600.00 (600.00 - 600.00)	12491.21 (12483.00 - 12517.20)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

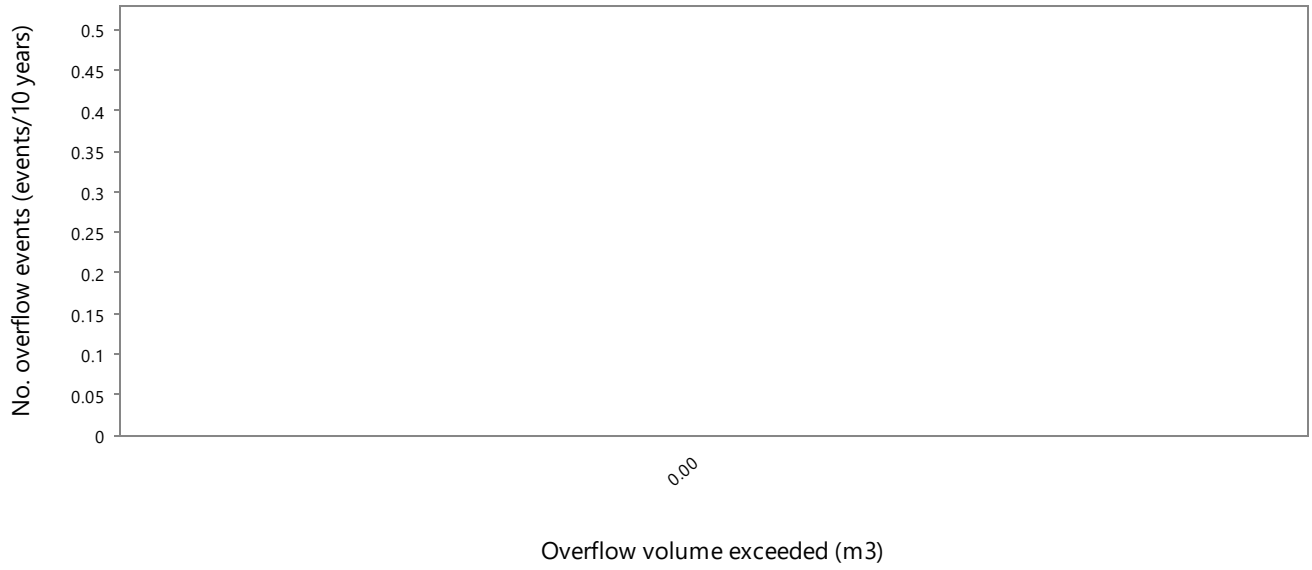
Last pond (Wet weather store): 500.00 m3

Theoretical hydraulic retention time (days)	8.77
Average volume of overflow (m3/year)	0.00
No. overflow events per year exceeding threshold* of 0.23 m3 (no./year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% effluent reuse (fraction)	1.00
Average salinity of last pond (dS/m)	0.94
Salinity of last pond on final day of simulation (dS/m)	0.94
Ammonia loss from pond system water area (kg/m2/year)	0.00

* The threshold is the volume equivalent to the top 1 mm depth of water of a full pond

Overflow exceedance:

Chart Table



Export plot

DIAGNOSTICS

Sustainability Diagnostics: 0736 Tallawang Solar Farm Construction Camp

Irrigation Information

Irrigation: 2 ha total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/ha/year
Total irrigation applied (m3)	20818.68	10409.34
Total nitrogen applied (kg)	408.05	204.02
Total phosphorus applied (kg)	41.64	20.82
Total salts applied (kg)	12491.21	6245.60

Shandying

Annual allocation of fresh water for shandying (m3/year)	0.00
Average Shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation is prevented when triggered (fraction)	0.06
Proportion of Days irrigation occurs (fraction)	0.94

DIAGNOSTICS

Sustainability Diagnostics: 0736 Tallawang Solar Farm Construction Camp

Paddock Land: New Paddock: 2 ha

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Irrigation triggered when soil water deficit reaches 0.00 mm and rainfall is less than or equal to 10.00 mm
Irrigate a fixed amount of 3.35 mm each day
Irrigation window from 1/1 to 31/12 including the days specified
A minimum of 0 days must be skipped between irrigation events

Soil Water Balance (mm): Tallawang, 163.50 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	77.1	61.5	59.1	40.4	45.2	44.1	50.3	41.6	52.4	57.5	62.8	69.6	661.5
Irrigation	87.6	80.7	88.9	86.1	88.3	85.8	87.9	88.3	85.4	88.6	85.0	88.2	1040.9
Soil Evap	52.7	41.3	35.5	23.4	14.7	10.0	9.2	12.8	23.7	40.7	45.9	50.9	360.7
Transpn.	107.0	88.4	80.8	56.2	36.4	23.8	25.3	36.2	51.1	74.2	92.6	108.8	780.7
Rain Runoff	4.3	2.0	2.9	2.1	1.6	3.5	3.6	4.9	5.7	4.5	3.8	5.0	44.0
Irr. Runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drainage	26.4	18.2	16.9	20.2	33.8	54.2	68.4	70.7	65.6	59.7	47.2	37.9	519.2
Delta	-25.7	-7.7	11.9	24.6	47.0	38.4	31.6	5.4	-8.3	-32.9	-41.8	-44.7	-2.2

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/ha/year)	204.02
Average annual soil nitrogen removed by plant uptake (kg/ha/year)	202.43
Average annual soil nitrogen removed by denitrification (kg/ha/year)	0.24
Average annual soil nitrogen leached (kg/ha/year)	3.98
Average annual nitrate-N loading to groundwater (kg/ha/year)	3.98
Soil organic-N kg/ha (Initial - Final)	42.00 - 24.11
	106.25 - 0.03
Average nitrate-N concentration of deep drainage (mg/L)	0.77
Max. annual nitrate-N concentration of deep drainage (mg/L)	3.07

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/ha/year)	20.82
Average annual soil phosphorus removed by plant uptake (kg/ha/year)	32.10
Average annual soil phosphorus leached (kg/ha/year)	1.13
Dissolved phosphorus (kg/ha) (Initial - Final)	4.74 - 0.03
Adsorbed phosphorus (kg/ha) (Initial - Final)	2230.57 - 1615.54
Average phosphate-P concentration in rootzone (mg/L)	0.15
Average phosphate-P concentration of deep drainage (mg/L)	0.22
Max. annual phosphate-P concentration of deep drainage (mg/L)	1.29
Design soil profile storage life based on average infiltrated water phosphorus concn. of 1.26 mg/L (years)	12.89

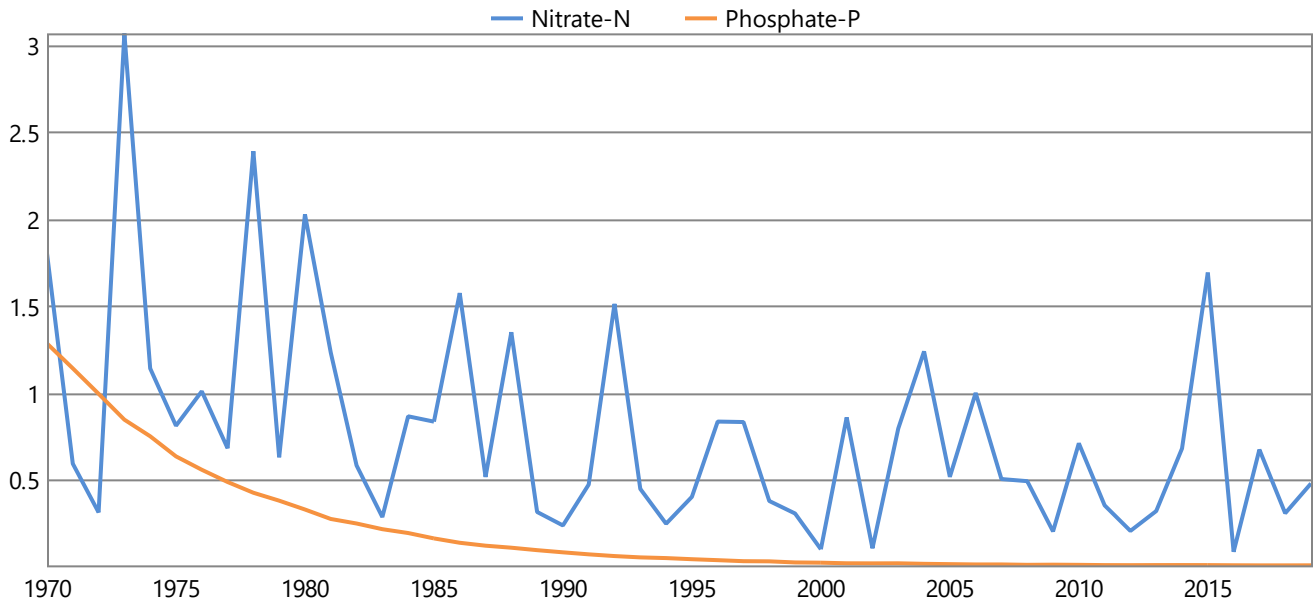
DIAGNOSTICS

Sustainability Diagnostics: 0736 Tallawang Solar Farm Construction Camp

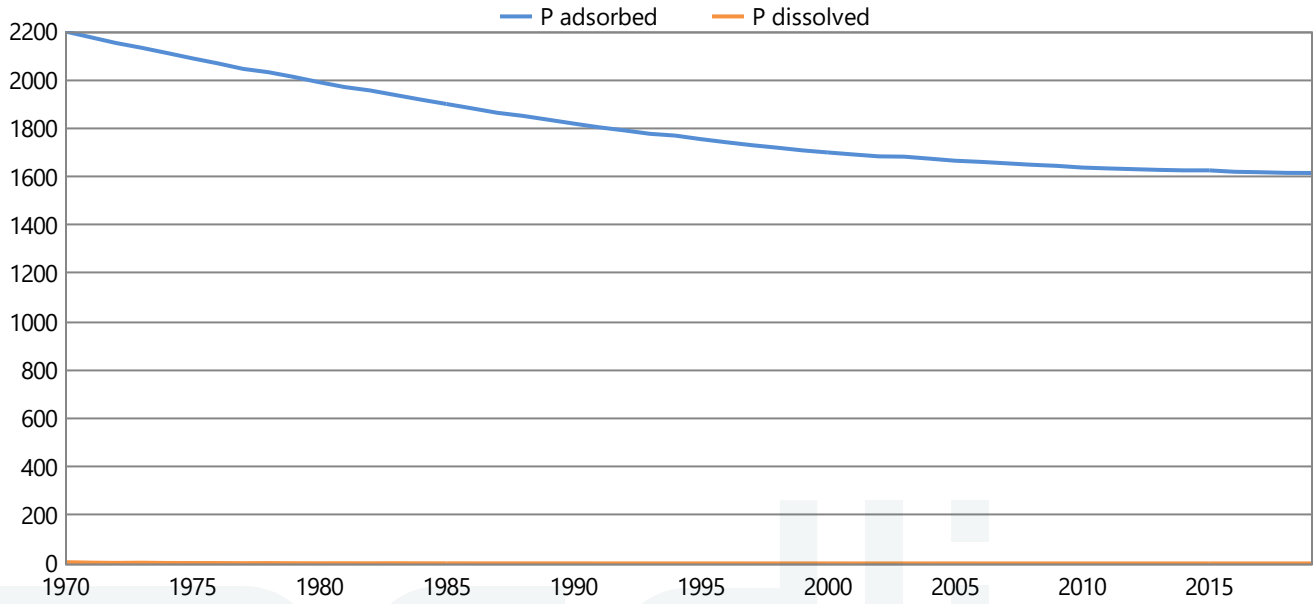
Paddock Land: New Paddock: 2 ha

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/ha)



DIAGNOSTICS

Sustainability Diagnostics: 0736 Tallawang Solar Farm Construction Camp

Paddock Plant Performance: New Paddock: 2 ha

Average Plant Performance (Minimum - Maximum): Continuous Lucerne (Winter Active) Pasture

Average annual shoot dry matter yield (kg/ha/year)	13629.43 (11079.46 - 14979.54)
Average monthly plant (green) cover (fraction)	0.67 (0.62 - 0.70)
Average monthly crop factor (fraction)	0.51 (0.47 - 0.54)
Total plant cover (both green and dead) left after harvest (fraction)	0.75
Average monthly root depth (mm)	1531.39 (1404.97 - 1600.00)
Average number of normal harvests per year (no./year)	7.32 (6.00 - 8.00)
Average number of normal harvests for last five years only (no./year)	7.40
Average number of crop deaths per year (no./year)	0.14 (0.00 - 1.00)
Average number of crop deaths for last five years only (no./year)	0.20
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.40 (0.23 - 0.48)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.03 (0.00 - 0.11)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.96 (0.85 - 1.00)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.04 (0.00 - 0.12)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.01)
No. days without crop/year (days)	1.26

Soil Salinity - Plant salinity tolerance: Moderately sensitive

Assumes 1.0 dS/m Electrical Conductivity = 640 mg/L Total Dissolved Salts

All values based on 10 year running averages

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.60
Salt added by rainfall (kg/ha/year)	118.57
Average annual effluent salt added & leached at steady state (kg/ha/year)	6364.17
Average leaching fraction based on 10 year running averages (fraction)	0.47
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.57
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	1.90
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

DIAGNOSTICS

Run Messages

Messages generated when the scenario was run:

Full run chosen

Appendix 3 Construction Camp Layout



E:\UMWELT (AUSTRALIA) PTY LTD\21139 - 03 S&WF_R17\21139_R17_0302_TWA_LAYOUT.MXD 4/9/2024 11:45:00 AM

Scale 1:4000 at A4

0 50 100 150 Metres

GDA 1994 MGA Zone 55

Legend

- Project Area Boundary
- Temporary Workers Accommodation (TWA)
- TWA Conceptual Layout
- Local Road

FIGURE 3.2

TWA Facility Layout

Image Source: ESRI Basemap Data source: NSW DFSI (2022), RES (2024)

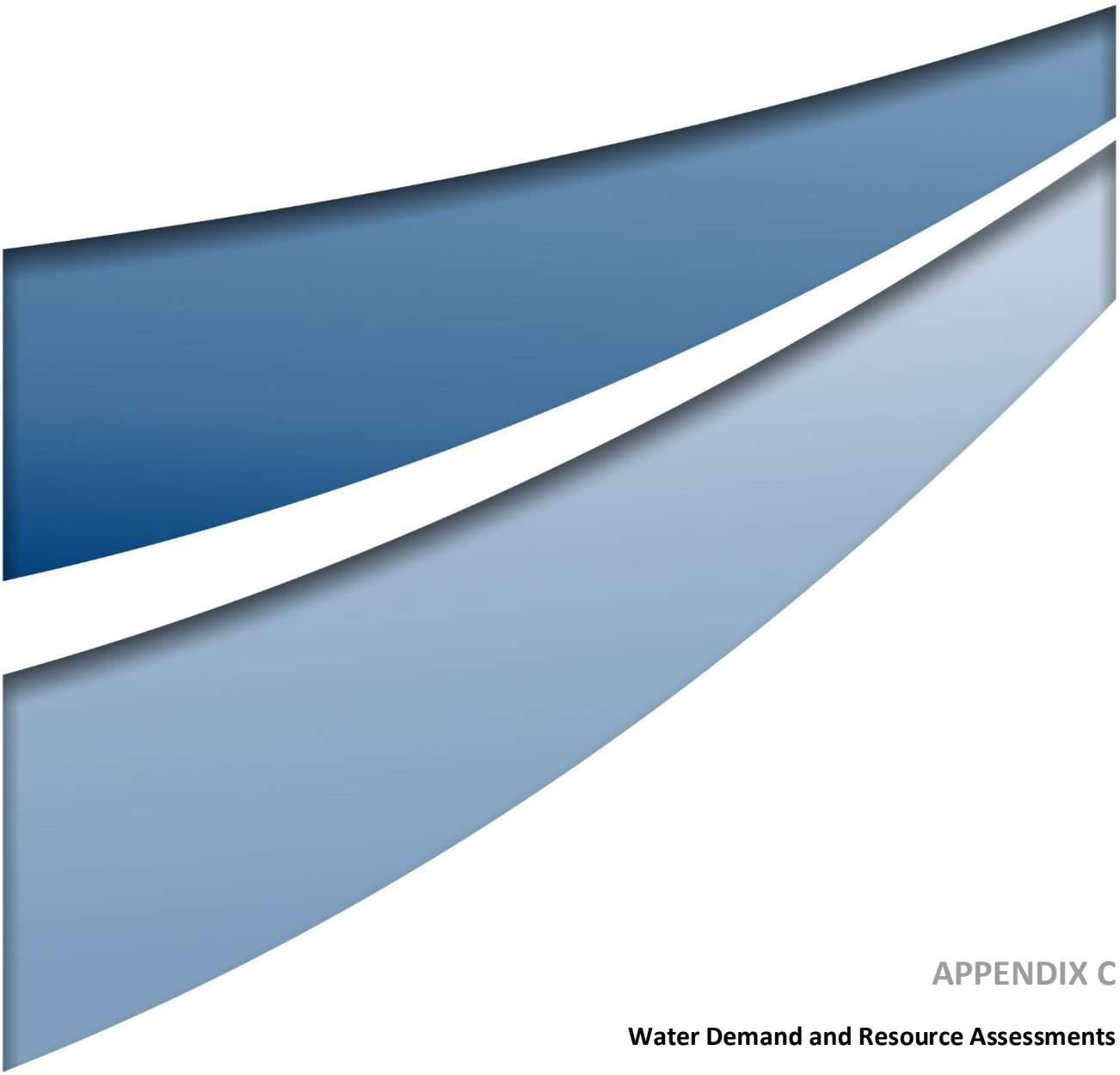
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(02) 4962 2067

www.decentralisedwater.com.au



APPENDIX C

Water Demand and Resource Assessments

WATER RESOURCE ASSESSMENT

TALLAWANG SOLAR FARM

Prepared for:



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Prepared By	**James Davis**
Released By	**Travis Smith**
Job Number	**20-010**
Date	22/03/2024
Document Name	**20-010 - Tallawang Solar Farm - [D] - Water Resource Assessment.docx**
Version	**D**

Document Revision History

Version	Revision History
A	**Draft Issued to Client**
B	**Revision Issued to Client**
C	**Amended based on client comments**
D	**Amended based on client comments**

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1 Introduction

icubed Consulting has been commissioned to investigate the construction and operational water resource requirements for the Tallawang Solar Farm. This assessment will employ the quantities outlined in the report *20-010 – Tallawang Solar Farm – [D] – Water Demand Assessment*. These requirements have been established to show the additional water demand imposed by the solar farm's construction and does not include the existing water demands of the site / current infrastructure. The Water Resource Assessment will primarily be conducted as a desktop study, supplemented by discussions with landowners and potential water suppliers, to confirm water resource availability, quality, and quantity. The aim is to identify suitable water sources that can meet the needs of the Tallawang Solar Farm, ensuring no negative impacts on adjacent landowners, stakeholders, and the environment. Additionally, resource sourcing near the project site and minimizing traffic movements are high-priority considerations.

The Tallawang Solar Farm is approximately 80km east of Dubbo and 15km north of Gulgong. The project is located within the Mid-West Regional Council area and the Central West Orana Renewable Energy Zone (REZ). The current description of the project suggests that the solar farm is expected to output a capacity of 500MW produced by various arrays of solar panels, interconnected via a series of unsealed access tracks with the necessary drainage infrastructure. These tracks are assumed to combine to a net internal length of 44km. The current solar farm boundary is depicted in Figure 1.

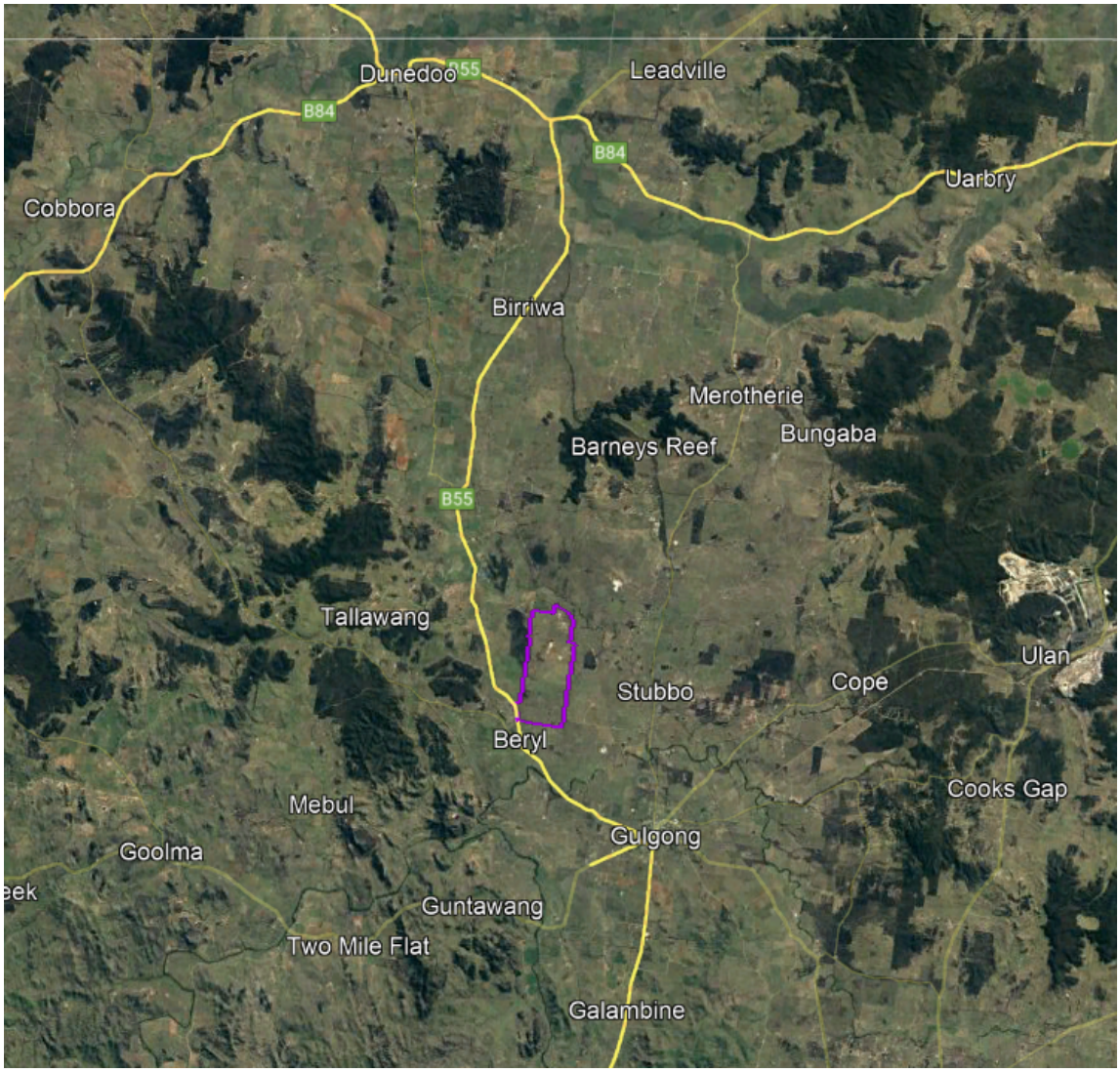


Figure 1: Tallawang Solar Farm Geographic Location
Source: Google Earth, 2023

RES has conducted a desktop study and determined that no existing groundwater access licenses are available for the Project Area, according to WaterNSW (2022). icubed will undertake a Water Resource Assessment to investigate available and potential water sources in greater depth. It is important to note that icubed will not be responsible for preparing any applications required for Water Access Licenses (WAL).

A key focus of the assessment will be the study of potable water supply options and potential volumes to meet the water needs of the workforce accommodation. The study assumes approximately 36 months to supply water to a construction camp near the development. The final location of the camp is currently unspecified. The report will include details of potential contract water suppliers and an evaluation of their capacity to provide sufficient water for the project. Other options for water sourcing such as onsite dams / bores and sourcing from local towns/private water suppliers will also be included. It should be noted that any agreements to procure water will be the responsibility of RES, with icubed providing support.

The report will also provide a draft Quality Assurance Program (QAP) for the treatment and provision of water to workers. This program will outline the necessary measures to ensure the quality and safety of the potable water supply. Discussions with the Mid-Western Regional Council have been conducted to explore the potential use of town water as an option, at this point council is not allowing the use of town water for these purposes. This will include identifying the supply capacity and any necessary agreements or arrangements that need to be made. The report will provide options that have been considered as alternatives to potable water use. These alternatives may include using non-potable water sources for certain purposes or implementing water conservation measures. The assessment will outline any initiatives that have been considered to minimize the anticipated potable water demand. These may include water-efficient practices, recycling, or reuse of water, or implementing technologies that reduce water consumption.

2 Water Demand Assessment

The water demand assessment, outlined in document *20-010 – Tallawang Solar Farm – [D] – Water Demand Assessment* has outlined the specific water quantities required for the construction of the Tallawang Solar Farm. It has been determined that the major sectors for water consumption are the construction of tracks, ancillary pads and footings, dust suppression, and potable water for the workforce. Table 1 and Table 2 below outline the potable and non-potable water demand quantities for these given sectors.

Table 1: Estimates of Potable Water Demand

Water Consumption	Water Consumption Volume (ML)	Type / Quality
Workforce	54.42	Potable

Table 2: Estimates of Non-Potable Water Demand

Water Consumption	Water Consumption Volume (ML)	Type / Quality
Construction - Tracks	5.761	Non-potable
Construction - Ancillary Pads	4.696	Non-potable
Construction - Dust Suppression	233.8	Non-potable
Construction – Concrete batching*	1.5	Non-potable
Fire Fighting Water	0.04	Non-potable
Net Non-Potable Demand	245.74	Non-potable

3 Potable Water Supply

The supply of potable water is a necessary part of the water demand for any FIFO construction project, potable water is a critical factor for sustaining a workforce. As shown in *20-010 – Tallawang Solar Farm – [E] – Water Demand Assessment* it can be expected that large quantities of water will be used throughout the project, however not all applications demand potable water. Non-potable water will be implemented throughout the project to minimise costs and relieve strain on water sourcing. For example, purposes such as track construction and dust control offer opportunities to employ the use of non-potable water. This is further discussed in section 7. This approach promotes sustainability and responsible resource management, aligning with the broader goal of preserving our precious water supplies for both current and future generations.

Ulan Water is the local contract water supplier in the vicinity of the Tallawang Solar Farm Project. Ulan Water is located approximately 30 minutes from the main site entrance, as shown below in Figure 2. As previously stated in the water demand assessment and Table 2 they can be expected to require a total of 54,420kL of potable water. This correlates to an average consumption of 1,512kL of potable water per month (across the 36-month duration as provided by Elecnor), with an anticipated maximum of 2,898kL of potable water over a one-month duration.

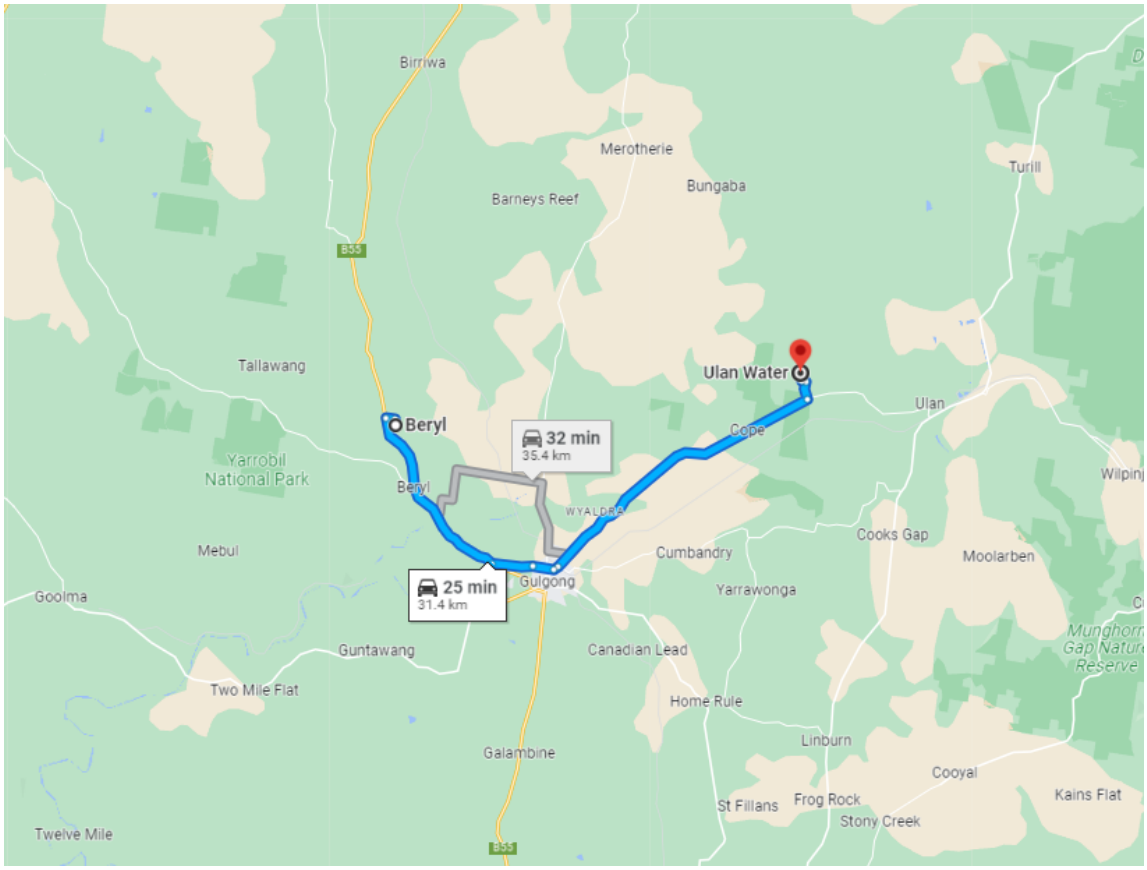


Figure 2: Ulan Water Travel Route
Source: Google Maps, 2023

Ulan Water have provided a rate for potable water of $1,000 + GST per 30,000L (Onsite). The costs for Potable Water Supply based on the current rate is provided in Table 3.

Table 3: Potable Water Sourcing Costs – Ulan Water

Water Type	Cost Per 30kL	Total Required Litres (kL)	Total Cost
Potable Water	$1,000	54,420	$1,814,000

Contact information for Ulan Water is provided in detail below.

For further information as to water sourcing from Ulan Water, contact details are listed below.

Webpage: https://www.ulanwater.com/
Contact: 02 6373 4733
admin@ulanwater.com
Location: 1599 Cope Rd, Cope, NSW 2852

4 Non-Potable Water Supply

Non-potable water (not fit for human consumption) can be applied across a wide range of applications across the Tallawang Solar Farm project. Effective implementation of non-potable water (i.e. treated grey water and recycled wastewater) allows for the possibility of reducing strain on costs and sourcing surrounding water demand for the project.

With effective planning and consideration, non-potable water can be used throughout the project in various areas of construction. This includes applications such as the construction of internal tracks, ancillary pads, and solar array footings. Furthermore, non-potable water is applicable in dust suppression.

As detailed in document *20-010 – Tallawang Solar Farm – [E] – Water Demand Assessment* 245.74ML of non-potable water can be expected as a requirement for the Tallawang Solar Farm. These quantities have been further expanded to better represent the expected demand for non-potable water across the project duration. This is shown below in Table 4. Construction durations have been determined from the resource histogram as provided by Elecnor: *Tallawang – Resources Histogram Elecnor*.

Table 4: Core Water Demand Sectors - Quantities

Water Application	Net Quantity (ML)	Avg. Monthly Quantity (kL)	Duration (Months)
Construction - Tracks	5.761	250.5	23
Construction - Ancillary Pads	4.696	234.8	20
Construction - Dust Suppression	233.8	8,350	28
Construction – Concrete batching*	1.5	115.4	13
Fire Fighting Water	0.04	40	1
Net Non-Potable Demand	245.74	7,182.4	36

Ulan Water have provided a rate for non-potable water of $1,000 + GST per 30,000L (Onsite). The costs for Potable Water Supply based on the current rate is provided in Table 5.

Table 5: Non-Potable Water Sourcing Costs – Ulan Water

Water Type	Cost Per 30kL	Total Required Litres (kL)	Total Cost
Non-Potable Water	$240	245,740	$1,965,920

Ulan water details as stated previously.

5 Local Dams / Bores

Boreholes and local dams present an opportunity for sourcing and storage of quantities of non-potable water on the Tallawang Solar Farm site. The use of these methods minimises the requirement to externally source non-potable water, hence reducing the required number of external vehicle movements and traffic disruptions. These two water-sourcing options will be further assessed throughout this section. Figure 3 below shows the NSW harvestable rights areas as specified by the NSW government.

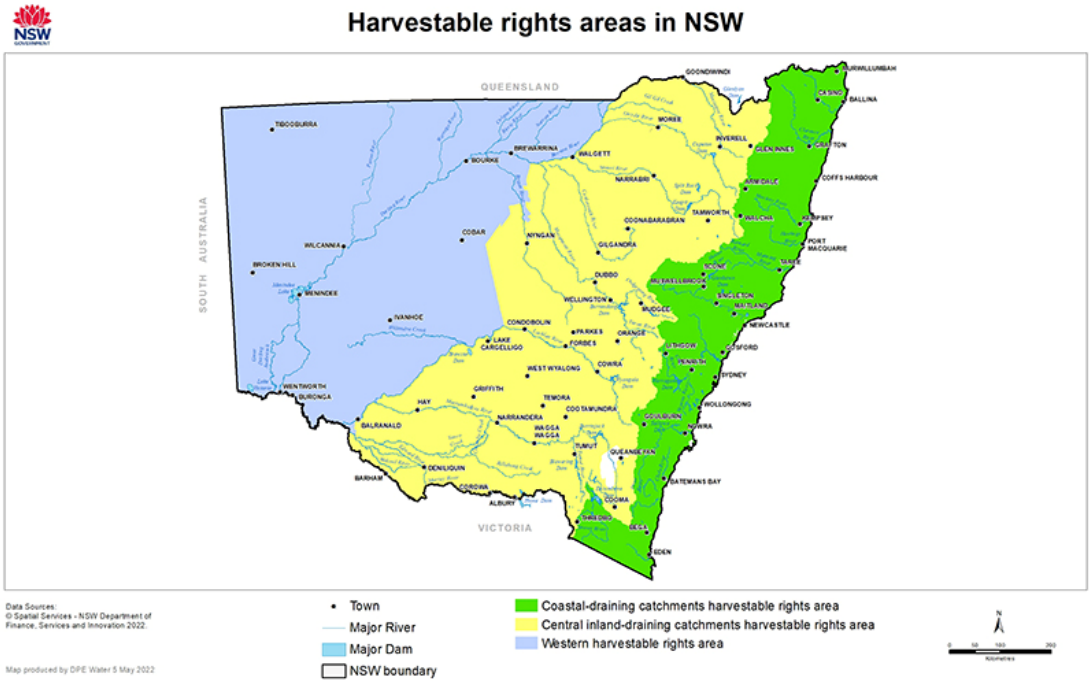


Figure 3: NSW Water Harvestable Rights Areas
Source: NSW Gov., 2022

5.1 Boreholes

Sourcing water via boreholes potentially offers a solution for internally accessing non-potable water. Bore water presents an option for onsite water sourcing that is regarded as cost-effective, sustainable and convenient. It will be important to carefully assess the water quality, comply with regulations, and produce a water management plan to avoid negative environmental and social impacts. It's advisable to consult with local water authorities and environmental experts to make an informed decision. Landowners' dams present an option for storing excess bore water which may then be used during peak consumption periods, more detail is discussed in section 5.2. With proper planning and implementation, boreholes have the potential to provide a reliable and long-term water source.

A map of all local boreholes sourced from the Bureau of Meteorology is depicted in Figure 4 in combination with the boreholes located on-site (depicted in Figure 5). These two maps show that only a singular borehole is located within the site boundary, specifically in the southwest of the site positioned near the major site access point. The Bureau of Meteorology identifies this bore as GW805247.1.1 According to the Bureau of Meteorology this bore has a depth of approximately 42m, was drilled on 15/02/2013, and has the purpose of supplying water, no water level is stated. This bore is not listed for commercial or industrial use.

The landowner has noted that the bore could produce up to 50,000 litres per day however this cannot be verified.

It will be required that an application is made if bore water is to be collected on-site as a means of water supply. Applications can be made via the WaterNSW BLR bore application website. This is available via: https://www.waternsw.com.au/customer-services/your-account/blr-bore-application
Further contact information is available at: enquiries@waternsw.com.au
1300 662 077

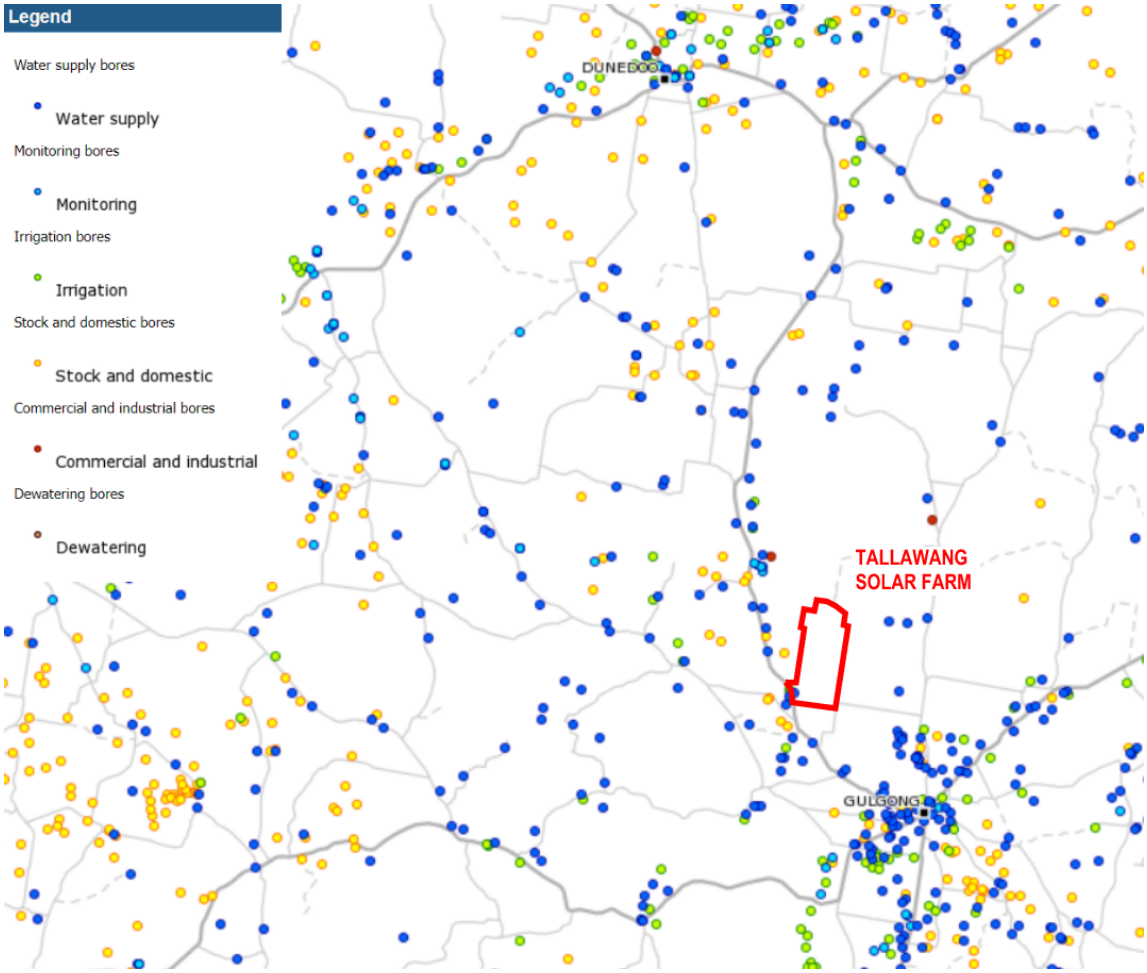


Figure 4: Map of Boreholes in Local Region
Source: Bureau of Meteorology, 2023

Another option is to source water from one of the local bores already dedicated to commercial and industrial use. There are two bore options situated near the Tallawang Solar Farm.

The first possibility is located approximately 10km north of the main site entrance, following the Castlereagh Hwy northwest. The Bureau of Meteorology states that this bore has the bore ID: GW802464.1.1 with a bore depth of 105m. It appears that this bore is owned by the Tallawang Mine, operated by Sibelco. Sibelco is currently rehabilitating this old Magnetite mine. Mining and material processing ceased at this location in 2016 to be the rehabilitation of this land which commenced on the 1st of August 2022. In a publicly accessible rehabilitation program: *Tallawang Magnetite Mine Rehabilitation Management Plan_v3*, it appears that Sibelco is still able to extract 2ML per annum from this bore (as per restrictions), however in the past this number has sat at 10ML per annum (see page 6 of the Rehabilitation report). Page 32 of this report appears to provide further information suggesting that Sibelco intend to keep this water supply bore access license valid and intact.

see*: https://assets-eu-01.kc-usercontent.com/54dbafb3-2008-0172-7e3d-74a0128faac8/52c355ca-b410-45fe-b16a-8323bf4426aa/Tallawang%20Magnetite%20Mine%20Rehabilitation%20Management%20Plan_v3.pdf).*

The commercial and industrial bore located approximately 10km to the northeast of the Tallawang Solar Farm does not appear to be still in operation, however, the Bureau of Meteorology does not specify its operational status. Not much data was available about this bore, however, it was determined that it is located at – Latitude: -32.224544, Longitude: 149.53672. This bore was drilled in 1986, to a depth of 25m, its bore ID is GW063013.1.1. Access from the site to this bore is possible via the northern secondary access point via approximately 10km of unsealed road. Alternatively, access is possible via the Castlereagh Hwy travelling southeast out of the primary site entrance and then north along Barneys Reef Rd (25km) – note road upgrades may be required throughout this route.

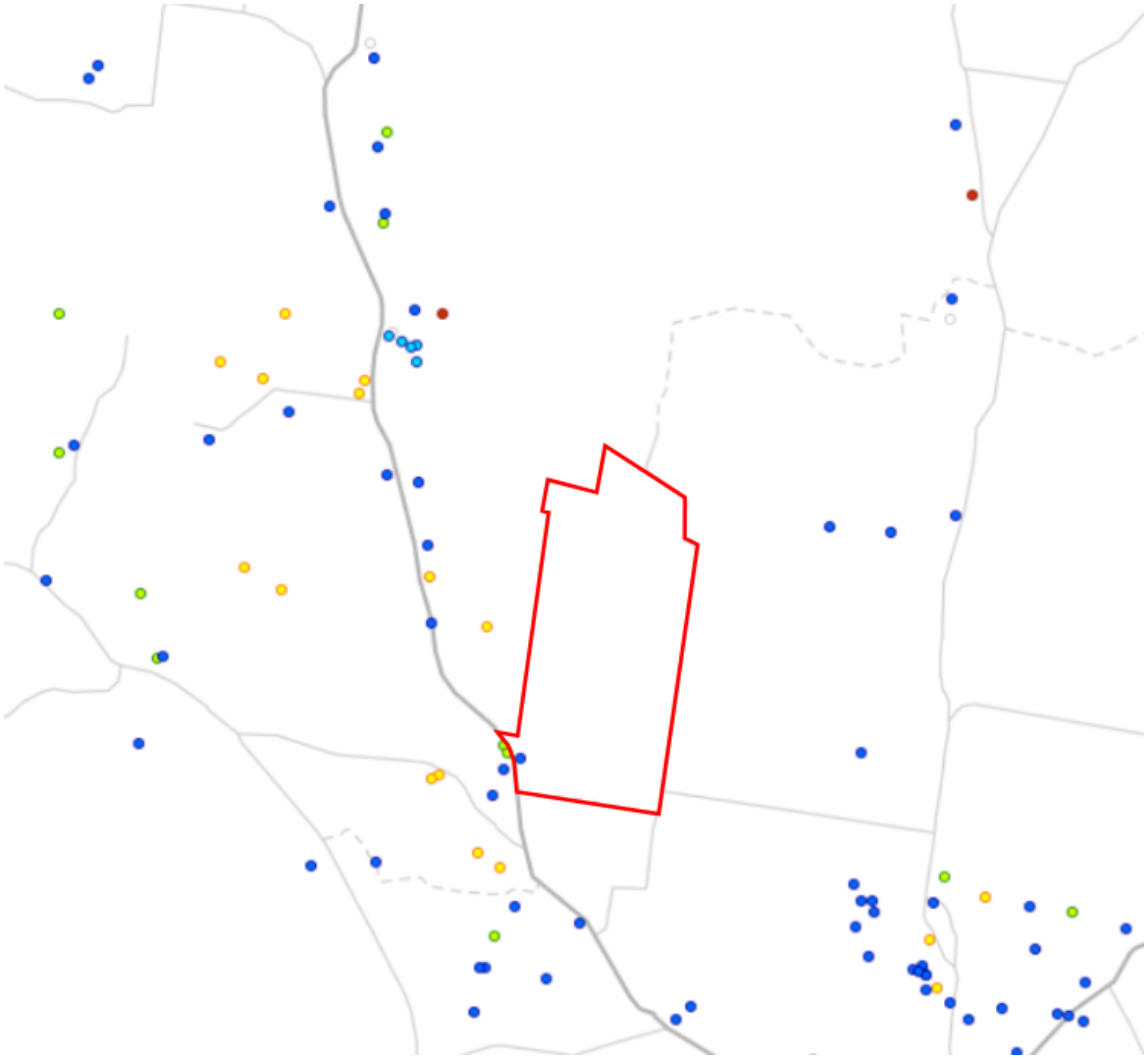


Figure 5: Boreholes Located on Site
Source: Google Earth, 2023

5.2 Local Dams

The possibility of sourcing water via local property owners' dams can offer a viable solution in certain regions. It relies on the presence of private dams owned by individuals or communities, which can serve as potential water sources and storages. However, the feasibility of utilizing such dams is dependent on numerous factors. These include the size, capacity, and location of the dams, as well as their suitability for storing and supplying water. Additionally, legal and regulatory considerations impact the ability to access and use water from private dams. Collaborative efforts between local property owners, relevant authorities, and water management experts are crucial to assess the potential for utilizing these dams as water sources while ensuring sustainable water management practices.

It is important to consider the harvestable rights allowed within the project to determine the limits surrounding the extent to which water can be sourced and stored on local property owners' dams. Firstly, the harvestable rights listed below in Figure 6 should be considered as they impose restrictions on the quantity of water that can be captured and used for 'any purpose'. This map shows that the site is located within the Central inland-draining catchments harvestable rights area. The NSW government states for this region: "up to 10 per cent of the average annual regional rainfall runoff may be captured and used for any purpose."

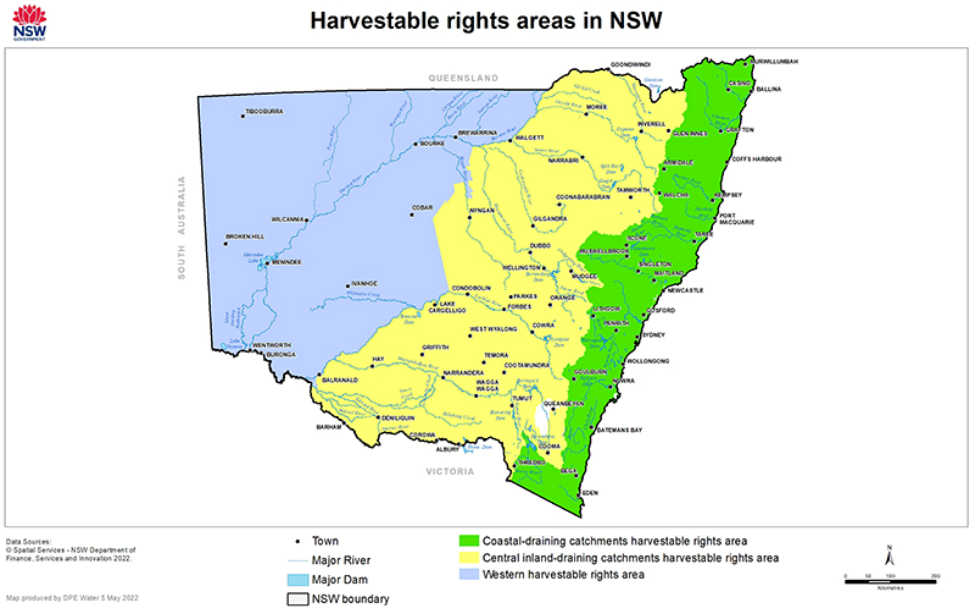


Figure 6: NSW Water Harvestable Rights Areas
Source: NSW Gov., 2022

Property size also comes into effect when determining the maximum harvestable right. icubed Consulting has taken the approximate extent of the project boundary under the landowners as 13km^2. The WaterNSW maximum harvestable rights calculator states that via these parameters, over the project location, the combined maximum dam capacity of all harvestable right dams across the total land holding is 91ML. This takes into account all dams that can be developed across the site. There is no constraint on the number of times the dam can be emptied and refilled by rainfall runoff annually.

This quantity shows that storage of water in landholders' dams represents the potential to hold a significant quantity of the net required water demand. As such it is encouraged that to address water supply challenges, increasing the capacity of dams in the preliminary stages of project development will enable the site to potentially store a larger volume of water on-site. This could accommodate water pumped from bores (potentially 50kL per day). Collection of water from bores during periods of lower demand would enable the stored water to then later be utilized to meet increased water requirements in later months when demand is higher.

6 Mid-West Regional Council

The site is situated within the district of the Midwest Regional Council. Council water sources include the nearby town of Gulgong, located approximately 8km to the southeast of the site or 9 minutes away from the town centre. Gulgong receives its water supply from the Cudgegong River / Dam also known as Lake Windamere. Another option for water collection is Dunedoo, although it is a smaller town and situated farther away from the project's main entrance, falling within the Warrumbungle Shire Council's district. Water-sourcing interest has been placed on Gulgong due to its greater practicality and proximity.

6.1 Discussion with Council

The current position of council is that they will not allow the use of their water facilities or any third-party private operators who obtain water from them to be used for our solar farm.

6.2 Contact for Council:

Mid-Western Regional Council: 02 6378 2850
council@midwestern.nsw.gov.au
109 Herbert St, Gulgong, NSW 2852
https://www.midwestern.nsw.gov.au/Home

WaterNSW: 1300 662 077
enquiries@waternsw.com.au
1PSQ, Level 14, 169 Macquarie Street Parramatta, NSW 2150
https://www.waternsw.com.au/water-services/water-delivery

AvData: 02 6262 8111
mail@avdata.com.au
Unit 9C 189 Flemington Rd, Mitchell, ACT 2911
https://avdata.com.au/

7 Alternatives / Initiatives to Minimise Water Demand

The purpose of this section of the report is to investigate a variety of options for reducing the demand for water consumption. This may be accomplished by several means; however, the goal is to primarily reduce water consumption where possible and minimise the need for importing potable water. The core aim is to save on costs and demand for water consumption where possible. This section of the report will investigate options for alternatives in dust suppression and initiatives for saving water such as recycled water in construction, rainwater collection, leak and detection repair, and finally education and awareness programs.

7.1 Alternatives in Dust Suppression

As detailed in *20-010 Tallawang Solar Farm – [E] – Water Demand Assessment* and once again in Table 2, the water demand for dust suppression will embody a significant proportion of the required water for the Tallawang Solar Farm, specifically this quantity has been approximated to be 233.8ML of water across the duration of the project. It can be concluded that efforts should be made to reduce this quantity as there is potential to make significant water conservations. Furthermore, this quantity will cost $1,870,400 if sourced from Ulan Water.

Several options are available for water conservation in dust suppression. Promising aspects of water conservation to be explored include the use of polymers in dust suppression, the limiting of vehicle movements across the site and finally using lower categories of water (i.e. using recycled water / non-potable water where possible).

7.1.1 Polymers in Dust Suppression

The use of polymers as a supplement within dust suppression offers an opportunity for minimising the required volume of water expected for the Tallawang Solar Farm. Polymers provide an alternative to traditional dust suppression methods. Where traditionally dust suppression involves large quantities of water, polymers can be applied to reduce the necessary water application for effective suppression.

Polymers provide extended periods of dust control by forming strong bonds between soil particulates (particle agglomeration) to reduce airborne dust emissions. These polymers that cause agglomeration enhance the material properties and improve the soil's ability to attract and retain water within the soil, above that of conventional water-based suppression. Furthermore, polymer usage is both beneficial to erosion prevention and minimising dust generation. The output of polymer application also produces a more durable surface than traditional methods.

Several environmental benefits and drawbacks also surround the use of polymers in dust suppression. Polymers have low levels of toxicity and are biodegradable. These properties minimise the potential harm to ecosystems and human health, leading to a low ecological disturbance. If polymers are to be employed as the means of dust suppression, environmental monitoring programs may be established to ensure that polymer runoff does not impact local ecological systems. Polymer runoff may interfere with the 'wettability' of the surface layer. The recommended dust suppression polymers all comply with Australian Environmental standards, note it is important to select the correct polymer for the given site conditions such as climate, humidity, expected rainfall, soil conditions, road design, etc.

7.1.2 Dust Suppression Polymer Suppliers

This section details various dust suppression polymer suppliers. This is inclusive of general information about the nature of each option, costs where possible, and other applicable notes as detailed by the supplier. Through discussion with the various suppliers, a more precise quote and recommendation can be determined once geotechnical work is completed about the design and composition of the tracks. The following information only contains the primarily recommended polymer as stated by the supplier, however, each supplier does sell a selection of other suppression polymers suited for various applications and conditions. Appendix C – Dust Suppression Polymers contains further information about the nature of each product through brochures and general information provided. This section does not detail the possibility of reducing labour costs by reducing the requirement for dust suppression or shipping costs to attain the polymers. The application of polymers has been stated following the recommendations made by suppliers.

Calculation assumptions:

- 44km: total road length.
- 10km suppression length (assumed length of road subject to heavy traffic at any given time).
- 8m application width: Note 6m application width would suffice reducing the required polymer volume by 1/4.
- Required suppression area: 80,000m^2 (0.008ha).
- Total suppressed site area: 352,000m^2 (0.0352ha).
- Suppression duration of 28 months: 121 weeks.

VITAL CHEMICAL – Vital Bon-Mat HR

- Environmentally friendly, biodegradable.
- Curing time is hours.
- Available in 1000L IBC and 21,500L Bulk Bladder.
- Available in green or neutral colour to hide signs of application and maintain the normal look of the road.
- Shelf life of 12 months.

- Vital Chemical recommends an onsite analysis by their technical representatives to ensure optimum application. They do not supply a standard application rate or dilution ratio.

Contact:

07 3288 3500
enquiries@vitalindustries.com.au
170 Bellwood St, Darra QLD 4076
https://vitalindustries.com.au/contact/

Further Information:

https://vitalindustries.com.au/product/vital-bon-matt-hr/

ERIZON – RoadBond Mg

- Environmentally friendly, biodegradable.
- Works better on prepared surfaces where loose material is minimal.
- Standard application is through a water truck and dribble bar.
- Better seal is achieved if a slurry is made with the road surface and polymer.
- No curing time necessary.
- Erizon states 4 – 6 months of longevity between coats.

- Cost: $2950 for 1kL IBC.
- Taking conservative estimates, using the product guide specified by Erizon in their application guide, it has been estimated that the Tallawang Solar Farm project would require 320kL.
- Net estimated cost of RoadBond Mg: $944,000.
- Due to the high cost, Erizon presents itself as an option as a supplement to reduce water demand, however, RoadBond Mg does increase the cost of suppression.

Contact:

1300 182 182 or 02 9190 6671
info@erizon.com.au
Emu Plains NSW 2750
https://www.erizon.com.au/contact/

Further Information:

https://www.erizon.com.au/product/roadbond/

GLOBAL ROAD TECHNOLOGY (GRT) – GRT: 7000

- Environmentally friendly, biodegradable.
- Remains “rural/natural” road look.
- Depending on traffic, the coat will last 12 - 52 weeks, maintenance coats are applied on an “as needs” basis, however, the first maintenance coat should be applied within 2-6 weeks.
- GRT advises consultation with pavement designer for sub-base, base depths, surface material and other road conditions.
- Standard application is through a water truck and dribble bar.
- Better seal is achieved if a slurry is made with the road surface and polymer.
- Recommended that post application, the mix is allowed time to conglomerate and dry before surface use.

- Cost: $3750 per 1kL IBC.
- Taking conservative estimates, using the product guide specified by GRT in their application guide, it has been estimated that the Tallawang Solar Farm project would require 291kL.
- Net estimated cost of GRT7000: $1,091,250.
- Due to this significant cost, GRT presents itself as an option as a supplement to reduce water demand, however, GRT7000 does increase the cost of suppression.

Contact:

7 5567 8550
headoffice@globalroadtechnology.com
32 / 3-15 Jackman St, Southport QLD 4215
https://globalroadtechnology.com/contact-grt/

Further Information:

https://globalroadtechnology.com/grt7000/

WET EARTH – DustWorxGX

- Environmentally friendly, biodegradable.
- Standard application is through a water truck and dribble bar.
- Available in containers from 25L to 1000L.
- Offers increased ground compaction.
- DustWorxGX can be applied as a substitute to reduce watering frequency by 50% in a 1:5,000 dilute mix, another option is to apply DustWorxGX in a 1:500 mix for 1 to 2 days with no need for additional dust control, finally the product can be applied as 300mL/m^2 initially followed by 50mL/m^2 throughout use for 1 – 2 month dust suppression.
- Through phone conversation with Wet Earth, they have recommended that if the product is to be implemented the diluted mix should be applied. This method is most applicable to the constant changing of work areas and minor tracks in use. Wet Earth believes this to be the most cost-effective option for reducing water demand.

Applying Wet Earth's recommendation to apply to dilute mix to reduce watering frequency by 50%.

- Required water quantity for dust suppression: 233.8ML.
- Current cost for water sourcing: $437,129 – note this cost via council.
- Applying the 1:5,000 dilute mix, the required quantity of DustWorxGX is 46.75kL.
- Wet Earth has quoted $4250 for an IBC (quoted freight at $1130 per IBC).
- This requires that $199,750 be spent on dust suppression polymers (not including freighting).
- And $218,565 be spent on sourcing 116.9ML of non-potable water for dust suppression (cost sourced via council).
- The new cost for dust suppression is now $418,315 (not including freight). Due to this similar cost, this method is only applicable for reducing water consumption and is not beneficial financially. Does not include costs for importing polymer, water cost estimates sourced via council

Contact:

02 6062 3300
sales@wetearth.com.au
13 Glen Avon Tce, Wodonga VIC 3690
https://www.wetearth.com.au/content/contact.asp

Further Information:

https://www.wetearth.com.au/Product/ProductDetail.asp?lngProductID=665

7.1.3 Limiting vehicle movements where possible to minimise the required dust suppression.

Another possibility for minimising the water demand regarding dust suppression lies in limiting vehicle movements across the site where possible. In general vehicle moments on unpaved / unsealed roads and surfaces generate significant quantities of dust. By minimising vehicle movement across the site and restricting areas frequently driven, the length of the road requiring suppression is limited thus reducing the required water. icubed Consulting recommends that a plan is established to restrict vehicle movements across the site (i.e. construction plan considers the requirement for dust suppression). Other vehicle techniques can include strategies such as enforcing vehicle speed limits to reduce dust generated.

7.1.4 Use of Non-Potable / Recycled Water

Dust suppression presents itself as an opportunity to employ the use of non-potable water instead of potable water. Non-potable water, such as recycled water or harvested rainwater, can be a sustainable alternative to potable water sources, conserving valuable freshwater resources and minimising strain on sourcing potable (drinking) water. Non-potable water, while not suitable for human consumption, can still effectively dampen surfaces and control dust emissions. Implementing non-potable water systems for dust suppression can involve capturing and treating water from various sources, such as wastewater treatment plants or on-site collection systems. The employment of non-potable water allows for the recycling of wastewater from the site to a standard where it is safe to work with, but excess cost need not be spent on filtering the water to a potable standard. Furthermore, sourcing additional water from recycling water onsite minimises the quantity required to be imported simplifying shipment logistics. Further detail on the opportunity to employ recycled water in the construction of the Tallawang Solar Farm is presented in section 7.2.

7.2 Recycled Water in Construction

The following comments have been produced under the assumption that the Tallawang Solar Farm is to construct its solar panel footings on site, however, icubed Consulting has recognized that the current site plan (*04651-RES-IMP-DR-PT-001*) does not contain a concrete batch plant, regardless methods stated are still applicable.

The current estimate for water use associated with infrastructure construction is 1,459.5kL as detailed in *20-010 Tallawang Solar Farm – [D] – Water Demand Assessment* and once again in Table 2. The quality of water used in concrete construction requires that of a higher standard than that associated with earthworks construction, water will primarily need to be sourced from offsite to meet the quality standards required for concrete construction.

One approach for reducing this water demand is using recycled water from within the batch plant, such as from the wash down of agitator trucks following concreting. This approach needs to be actively managed to ensure that quality remains suitable. If implemented appropriately, recycling water presents an opportunity to reduce external water demand associated with solar array footing construction. Further discussions with the nominated concrete supplier will help in understanding how this may be successfully implemented on the project.

7.3 Rainwater Collection

Rainwater collection presents a valuable opportunity to harness a sustainable water source for the Tallawang Solar Farm. Implementation of rainwater collection systems such as rooftop catchment over the camp roofing and establishing agreements with landowners on the possibility of purchasing rainwater from any existing systems presents the possibility to source additional non-potable water on site and alleviate stress on external sourcing. This water can easily be implemented into most non-potable applications such as dust suppression and vehicle / equipment washing.

7.4 Leak Detection and Repair

Onsite leak detection and repair of water storage systems play a crucial role in ensuring efficient water management and minimizing water loss. Detecting and promptly repairing leaks within these storage systems is vital to prevent wastage and preserve water resources. Undetected leaks can result in significant water loss over time, leading to increased costs, strain on external water supplies, and potential environmental impacts. Onsite leak detection measures, such as regular inspections, monitoring systems, and other leak detection technologies, enable early identification of leaks, allowing for timely repairs. By promptly addressing leaks, water usage can be optimised, reducing the strain of operational expenses and the necessary sourcing of water. icubed Consulting recommends establishing a leak detection and repair plan to address this issue in the instance it arises.

7.5 Education and Awareness Programs

Water conservation education and awareness programs hold significant importance for promoting responsible water usage and fostering a culture of sustainability within the workplace. Education and awareness programs should be established across the site to encourage workers to participate in following sustainable practices – examples may include encouraging short showers and immediately reporting any spotted water leaks. Education and awareness programs help to preserve resources, increase operational efficiency, improve water consumption behaviours, and improve reputation with stakeholders (i.e. landowners). It is recommended that workshops are held with workers in combination with onsite signage to promote sustainable water practices to workers.

8 Quality Assurance Program (QAP)

A draft quality assurance program (QAP) for the treatment and provision of water to workers has been completed to assist RES. This can be found in Appendix A – QAP for Treatment and Provision of Water to Workers. To produce a new copy of a QAP see:

https://www.health.nsw.gov.au/environment/water/Pages/private-supplies.aspx

9 Conclusion

icubed Consulting has been commissioned to investigate the construction and operational water resource requirements. This assessment stems from the water demand quantities outlined in the report *20-010 – Tallawang Solar Farm – [D] – Water Demand Assessment* using these quantities to assess supply solutions and resource conservation options. These requirements have been established to show the additional water demand imposed by the solar farm's construction and does not include existing water demands of the site / current infrastructure. Suitable water-sourcing options to meet the demands of the Tallawang Solar Farm have been further summarized in the comments below.

In conclusion, the water resource assessment conducted by icubed Consulting for the Tallawang Solar Farm project has identified and evaluated various water-sourcing options to meet the project's water demands. The assessment focused on both potable and non-potable water supply options while considering sustainability, practicality, and minimizing environmental impacts.

For potable water supply, Ulan Water, located approximately 30 minutes from the site, has been identified as the local contract supplier. As stated in the water demand assessment it is expected that approximately 51.394ML of potable water will be required for the site construction – an average monthly requirement of 1,512kL over the anticipated 36-month construction period.

Non-potable water was identified as the major sector for water consumption in the water demand assessment: *20-010 – Tallawang Solar Farm – [D] – Water Demand Assessment*. It was concluded that its applications include but are not limited to the construction of tracks, footings, ancillary pads, and dust suppression. Ulan Water is also available for non-potable water supply. It has been stated that non-potable water should be used where possible to save on costs and sourcing issues. Non-potable water can also be sourced for treated grey water and recycled wastewater which in turn will enhance the sustainability of the construction phase of the project.

The assessment also considered onsite non-potable water supply options, including boreholes and property owners' dams. While there is only one borehole within the project boundary it is not listed for industrial / commercial use. Further comments were made in section 5.1. Additionally, local dams owned by property owners offer another opportunity for non-potable water sourcing and storage. The maximum harvestable right for all dams within the project boundary was estimated to be 91ML(This does not indicate the existing dam capacity, only the allowable storage capacity, additional dams would need to be constructed to achieve this), making on-site storage a viable option. Further methods for effective usage of local dams are outlined in section 5.2.

Water sourcing from the Mid-West Regional Council in Gulgong was investigated and council have confirmed that direct or indirect supply of potable or non-potable will not be allowed. Initial discussion with UlanWater has confirmed that both Potable and Non-Potable water supply is available with quantities dependant on the timing, supply and availability.

Section 7 detailed the options for water conservation, specifically alternatives and initiatives to minimising water demand. The aim is to reduce water consumption and minimize the need for importing water. Initiatives included the use of polymers in dust suppression, rainwater collection, employing recycled water in construction, leak detection and repair, and implementing education and awareness programs to promote responsible water usage among workers. To minimize the demand for potable water, several alternatives and initiatives were explored. The report highlights that dust suppression accounts for most of the water demand at the solar farm. To address this, several alternatives are suggested, as further detailed in section 7.1. Section 7.3 outlines the possibility of additional rainwater collection to reduce the imported demand for

non-potable water. Finally, the importance of leak detection and repair was stated alongside education and awareness programs as initiatives for water conservation. Overall, by implementing these alternatives and initiatives, the Tallawang Solar Farm can significantly reduce water demand, conserve water resources, and promote sustainable water practices.

The information in this section has been summarised in Table 6.

Table 6: Summary of Water Demand and Resources Available

Water Demand	
Net Potable Demand	Total Water Consumption = 51.39ML Average Monthly Water Consumption = 1,512kL Peak Monthly Water Consumption = 2,898kL
Net Non-Potable Demand	Total Water Consumption = 245.74ML Including a Dust Suppression Component = 233.8ML
Water Resource	
UlanWater	Required water resources are available dependant on with quantities dependant on the timing, supply and availability. Non-council Potable Water sources are available subject to the above caveats.
Dams	91ML of storage can be maintained on the site at any given time from Dams, with annual water generated depending on rainfall.
Bores	Based on landowner correspondence, 50kL per day can be drawn from the bore, resulting in an annual figure of 17.8ML. This has not been verified and no Water Licence currently exists.
Alternative Treatments	The Dust Suppression water resource which accounts for approx. 95% of non potable water can be eliminated via use of Polymers.

Finally, the report has included a draft Quality Assurance Program (QAP) to ensure the treatment and provision of safe and quality potable water to the workforce (see Appendix A – QAP for Treatment and Provision of Water to Workers). Collaboration with relevant authorities, such as the Mid-West Regional Council and WaterNSW, will be crucial to address water sourcing and quality assurance requirements.

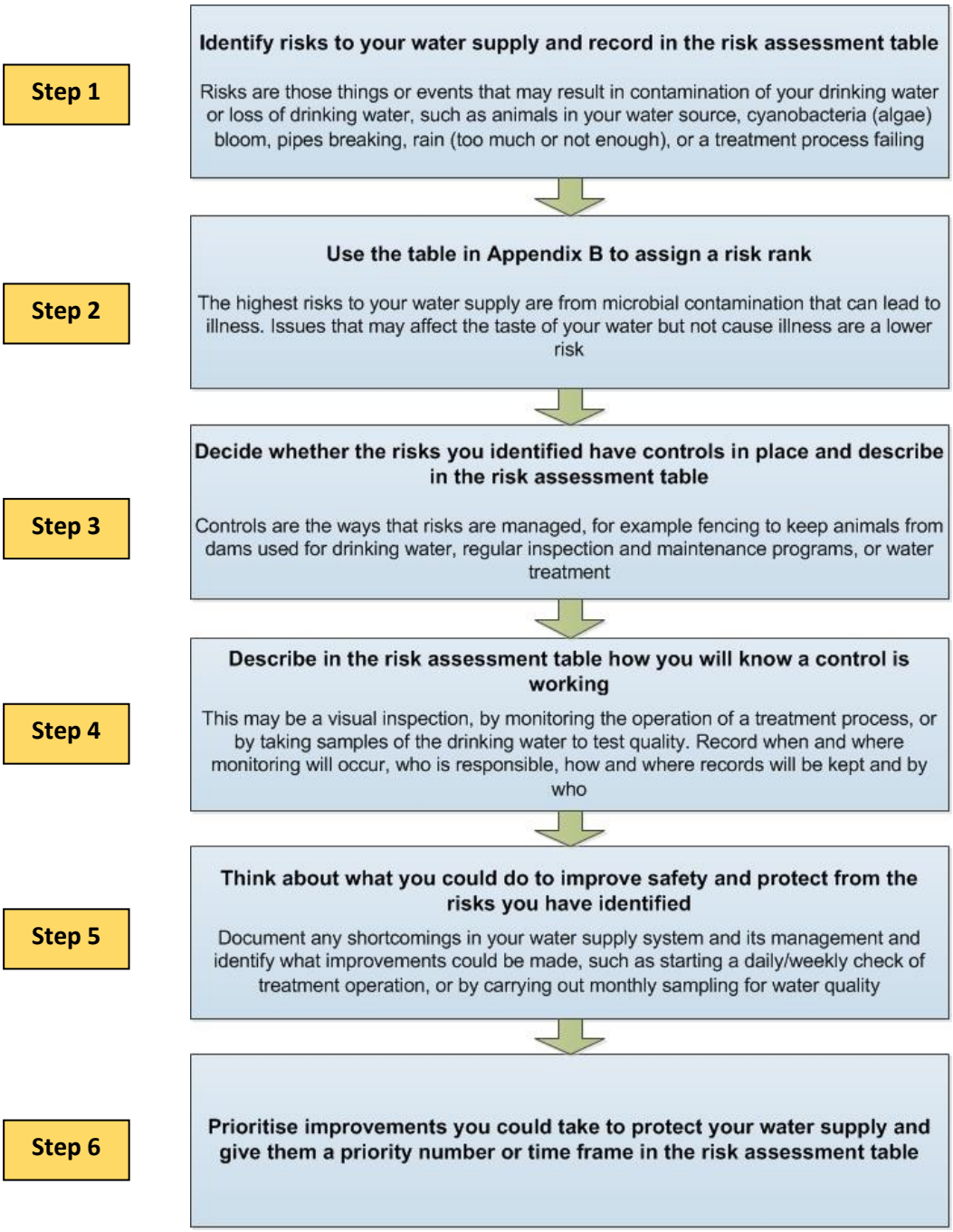
10 Appendix A – QAP for Treatment and Provision of Water to Workers

Shown overleaf.

Q4 Describe the risks to your water supply system and how they are monitored and controlled

Record your risks in the Water Supply Risk Assessment table (on page 8). Add as many lines as you need for your water supply following the six steps below.

A simple way to document any potential risks to your water supply is to make notes while drawing the water supply system for Q3. A list of common risks, controls and risk rankings to refer to are at **APPENDIX B**: Example water quality risks, control measures and risk rank.



Please update your risks table if:

- ***you become aware of a risk to your water supply that you have not recorded, and/or***
- ***you have made improvements or changes to your water supply system.***

Water Supply Risk Assessment Table (refer to APPENDIX B: Example water quality risks, control measures and risk rank to help fill out risks that you think relate to your water supply)

Step 1	Step 2	Step 3		Step 4	Step 5	Step 6
Risk to water supply	**Risk Rank**	**Is the risk controlled?**	**If Yes, describe control?**	**How is control monitored?**	**How can safety be improved?**	**Timeframe for improvements**
	☐High ☐Medium ☐Low	☐Yes ☐No ☐Partly				
	☐High ☐Medium ☐Low	☐Yes ☐No ☐Partly				
	☐High ☐Medium ☐Low	☐Yes ☐No ☐Partly				
	☐High ☐Medium ☐Low	☐Yes ☐No ☐Partly				

Q5 Public Health Regulation checklist

Please complete the below table to make sure that the rest of your QAP addresses sections of the Public Health Regulation relevant to your water supply.

Question	Tick box	If yes, fill out these tables	If no, please explain
Do you carry out inspections and/or maintenance of your water supply?	☐Yes ☐No	5.1 Planned water supply system inspection and maintenance program	
Do you record your inspection and maintenance activities?	☐Yes ☐No	5.2 Water supply system inspection and maintenance records	
Does your water supply have mechanical equipment (this could be pumps, filters, parts, chemicals or treatment systems)?	☐Yes ☐No	5.3 Equipment details	
Do you have written instructions from the manufacturer?	☐Yes ☐No	Attach to QAP	
Do you have signs about the safety of drinking water?	☐Yes ☐No	5.4 Sign posting	
Do you carry out any tests on your water (this could be checking UV is on, chlorine levels, any laboratory tests)?	☐Yes ☐No	5.5 Water quality monitoring program	
Do you record your test results?	☐Yes ☐No	5.6 Water quality test results and attach laboratory reports to QAP	
Do you top up your water supply with carted water?	☐Yes ☐No	5.7 Records of water provided by a water carter	
Do you record any carter water delivery?	☐Yes ☐No	5.7 Records of water provided by a water carter	
Do you have plans in case of emergencies?	☐Yes ☐No	6.1 Contingency plan	
Do you have emergency contacts?	☐Yes ☐No	6.2 Emergency contacts	
Do you record any problems or emergencies when/if they happen?	☐Yes ☐No	6.3 Incident records	

Q6 Describe Your Management Actions and Record Keeping

Regular inspection and maintenance is essential to maintaining a well-functioning and safe water supply.

Please complete the following tables about your water supply system inspection and maintenance records, processes, equipment and results.

5.1 Planned water supply system inspection and maintenance program

Please complete the below table about items that will be inspected and maintained. Examples of inspections are included in **APPENDIX C**: Suggested water supply system inspections.

Please add extra rows if required.

What will be inspected and maintained?	How often? (frequency or dates)	Person responsible for inspections and maintenance	Any equipment or procedures needed?

5.2 Water supply system inspection and maintenance records

Record every time a supply system item is inspected or maintained.

Please add extra rows if required.

Date and time	What was inspected?	Notes	Actions to be taken	Person responsible

5.3 Equipment details

Record details of pumps, parts, treatment systems and chemicals.
Include details of manufacturers, supplier and repairers. The manufacturer's written instructions should be attached to your QAP.
Please add extra rows if required.

Part / Equipment	Manufacturer	Supplier / Repairer contact details

5.4 Sign posting

Please provided details of any signs used to communicate with customers. Signs may be permanent or temporary (such as during a problem or incident). Examples of warning signs can be found in the *NSW Private Water Supply Guidelines*.
Signs must be checked to ensure they are present and able to be read. See

APPENDIX D: Examples of warning signs where water is not being monitored, treated and/or treated for examples of signs.

Please add extra rows if required.

Sign location	Sign wording	Status	Inspection date	Any action taken
		☐Permanent ☐Temporary		
		☐Permanent ☐Temporary		
		☐Permanent ☐Temporary		

5.5 Water quality monitoring program

Complete the below table on what will be monitored, when, where and by who.
Refer to the *NSW Private Water Supply Guidelines* for information on developing a monitoring program which is suitable for your system.
Please add extra rows if required.

What is to be monitored?	How often are tests to be taken? (frequency or dates)	Location of tests	Person responsible for performing the test	Equipment and procedures needed for performing the test

5.6 Water quality test results

Keep this table as a record of testing. Record each time water is tested, detailing what was tested, when, results and actions in the below table. Attach any laboratory reports to your QAP.
Please add extra rows if required.

Date and time	Where was test taken from?	Type of test taken	Test Result	Any action taken	Person Responsible

5.7 Records of water provided by a water carter

Record each time drinking water is provided by a water carter and added into the water supply system in the below table.

Please add extra rows if required.

Date and time	Name and details of water carter	Volume of water purchased

5.8 Chlorination records

If chlorine is used, record the details in the table below.

For guidance on the safe use of chlorine see Chapter 5 of the *NSW Private Water Supply Guidelines*.

Please add extra rows if required.

Date and time	Volume of water treated (litres)	Amount of chlorine added	Free chlorine test result (mg/L)*	Person responsible

*mg/L = milligrams per litre, this is the same as ppm (parts per million)

Q6 Describe your contingency and emergency planning

In this section, please document what would happen:

- if there was a problem with an important part of the water supply system
- in response to a failed water quality test
- in response to customer complaints regarding water quality
- in response to any other issue
- to ensure all people responsible for the water supply system have the knowledge and skills to run the system, e.g. training temporary managers

Refer to:

-
- **APPENDIX E: What is a water quality incident?**
- Factsheet on managing water quality incidents: http://www.health.nsw.gov.au/environment/water/Pages/private-supplies.aspx

Your local Public Health Unit should be contacted if something goes wrong with your water supply.

6.1 Contingency plan

Please add extra rows if required.

Issue	Likely actions that could be taken

6.2 Emergency contacts

Please record details of who to contact in an emergency, who to call for advice and important local contractors. Keep these in an easily accessible place.

Please add extra rows if required.

Contact	Name	Phone number
Public Health Unit		1300 066 055
Local Council		
Plumber		
Tank Cleaner		
Water Carter		
Chlorine Supplier		
Electrician		

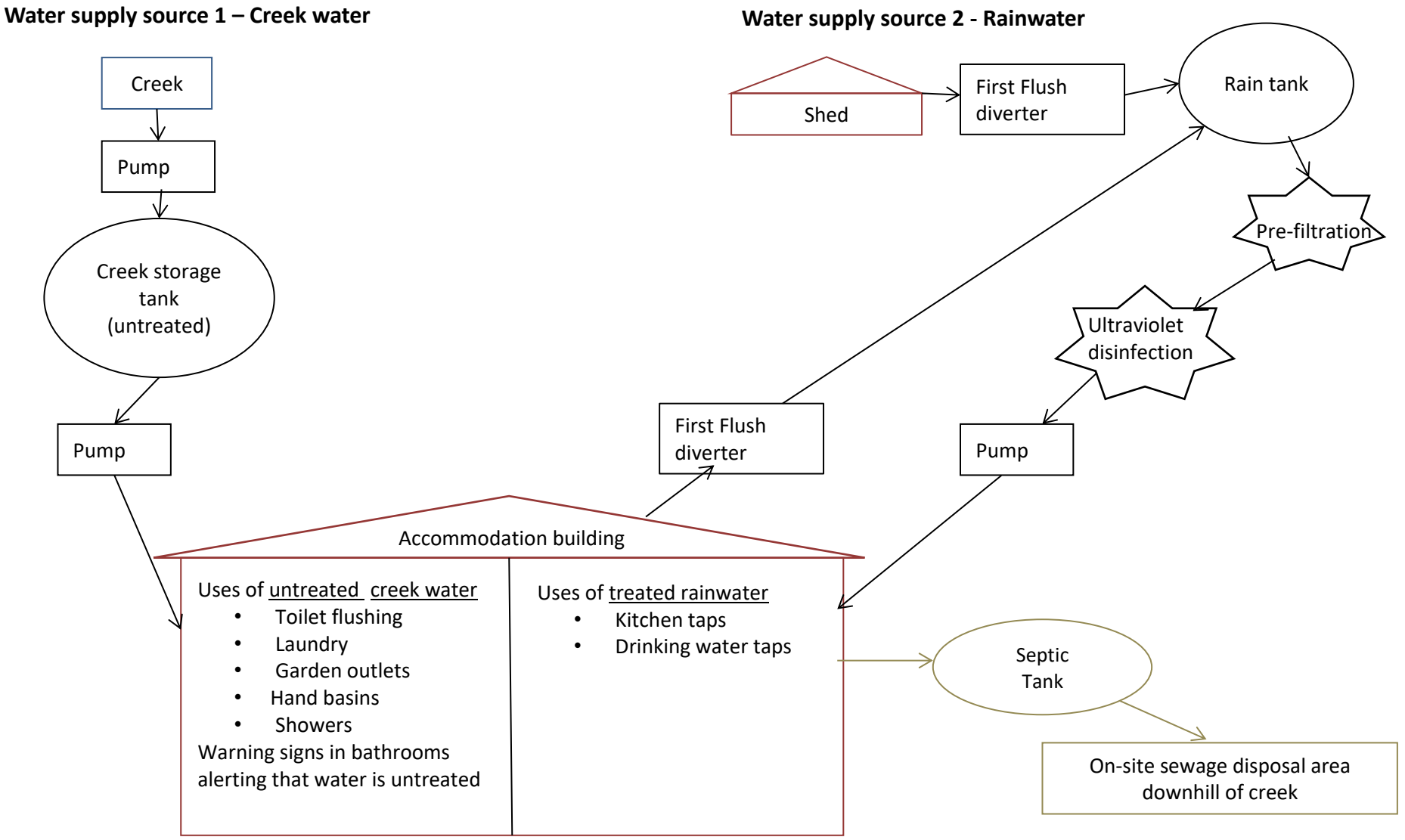
6.3 Incident records

Please record any customer complaints, incidents, issues, problems or emergencies that have occurred and what was done to fix the situation. These issues are important as they can impact water quality.

Please add extra rows if required.

Date and time	Incident	Notes and corrective actions	Person Responsible

APPENDIX A: Sample diagram of a water supply system



APPENDIX B: Example water quality risks, control measures and risk rank

Component	Potential source of contamination	Control measures	Risk rank
Water Source			
Rain water	Roof and gutters (animal droppings) that may cause disease	• First flush device • Regular cleaning of roof and gutters • Removal of overhanging branches • Regular inspections • Water treatment (disinfection)	High
Rain water	Roof and gutters (build-up of leaves, dirt) causing taste and odour	• First flush device • Regular cleaning of roof and gutters • Removal of overhanging branches • Regular inspections • Water treatment (filtration)	Low
Rain water	Roof and gutters contaminated with ash from bushfire causing taste and odour	• First flush device • Water treatment (filtration)	Low
Rain water	Roof and gutters contaminated with chemicals from over spraying or spray drift	• First flush device • Water treatment (filtration)	Medium
Rain water	Roof material (e.g. lead-based paint, lead flashing, bitumen-containing products, treated timber, peeling paint) that may cause chemical contamination	• Don't collect water from roofs painted with lead paint, bitumen or with lead flashing • Remove or treat lead flashing • Seal any exposed treated timber • Test the water for chemicals and treat if necessary (filtration)	Medium
Rain water	Water carting required due to low water level	• Use a water carter with a QAP that is known by their local council	Low
Surface water (dams, creeks and rivers)	Surrounding land use (e.g. farming, wildlife, vermin, urban areas, sewage discharges) that may cause disease	• Protect surface water source against livestock (fencing), septic tanks/sewage overflows • Water treatment (filtration and disinfection)	High
Surface water	Surrounding land use (e.g. industry, farming, mining) that may cause chemical contamination	• Protect water source from runoff (maintain bank vegetation, be aware of upstream activates) • Test the water for chemicals and treat if necessary (filtration)	Medium
Surface water	Animal and human activities in the water that may cause disease	• Fence water storage or off-take area • Don't permit swimming or public access near off-take area • Water treatment (filtration and disinfection)	High

Component	Potential source of contamination	Control measures	Risk rank
Surface water	Algal blooms (cyanobacteria) that may be toxic making water unsuitable to use for any purpose	• Protect water source from runoff (maintain bank vegetation, be aware of upstream activates) • Assist water movement (aerator pumps in dams) • Cease use of water and speak with PHU for advice • Have contingency plans in place for alternative water sources such as water carting and bottled water • Have signs reading to advise the public not to use algal affect water •Have water treatment in place if water source is prone to algal blooms (filtration and chlorination)	High
Groundwater (bore, well, spring)	Surface water seepage into bore	• Raise bore heads above ground level and mound up ground around bore head • Ensure bore covers and casing are intact • Regular inspections	Medium
Groundwater	Groundwater is influenced by surface water which may lead to contamination that may cause disease	• Ensure bores are drilled and cased following standards and requirements • Ensure bore covers and casing are intact • Regular inspections • Observe groundwater levels during rain to assess influence • Seek expert advice • Water treatment (filtration and disinfection)	High
Groundwater	Sub-surface contamination (e.g. from farming, septic systems, sewage) that may cause disease	• Extract groundwater from places where sub-surface contaminants are unlikely (deep, away from other land uses) • Groundwater source is at least 200 metres from any wastewater disposal systems • Water treatment (disinfection)	High
Groundwater	Sub-surface contamination (natural or from industry, mining) that may cause chemical contamination or taste and odour	• Be aware of other land uses that may contaminant the groundwater • Test the water for chemicals and treat if necessary	Medium
Water Storage and Distribution			
Tank	Insect, birds, vermin and animals in system	• Screen all inlets and outlets to the tank • Regular inspections of tank, roof and gutters	High
Tank	Build up of sludge in tank, dirt in inlet strainers or insect screens	• Regular inspection, cleaning and maintenance program	Medium
Tank	Tank materials (e.g. pH of water in concrete tanks, high metals from metallic tanks)	• Materials in contact with water comply with relevant Australian Standards • Chemical adjustment of pH in new concrete tanks may be necessary	Medium
Plumbing	Backflow water (e.g. from animal water troughs)	• Backflow prevention device	Medium
Plumbing	Pump and plumbing materials	• All materials in contact with water comply with AS/NZS 4020:2005	Low

Component	Potential source of contamination	Control measures	Risk rank
Plumbing	Leaching from bore casings, pipes or plumbing materials	• All materials in contact with water comply with AS/NZS 4020:2005 Flush standing water at irregularly used fixtures	Medium
Pumps	Pump failure leading to low or no water (could cause dirty water by stirring sediment in tanks/pipes or no water supply)	• Have contingency plans in place for pump failure e.g. emergency electrician contact • When water supply is returned to normal flush system to ensure clean water is reaching taps • Have contingency plans in place for alternative water supply e.g. bottled water or water carting	Low
Water Treatment			
Filters	Wrong filter type used causing taste and odour	• Ensure filters are certified for taste and odour removal (NSF42) • Check manufacturer has evidence to support claims	Low
Filters	Wrong filter type used which may not protect from contamination that may cause disease	• Ensure filters are certified for microbial reduction (NSF53) with appropriate filter pore size • Check manufacturer has evidence to support claims	High
Filters	Filters used outside of operating limits or expired which may not protect from contamination that may cause disease	• Ensure filters are certified (AS/NZS4348, 3497, Watermark®) • Use a certified plumber for installation • Follow manufacturer guidance for operating requirements • Follow manufacturer guidance for maintenance and filter replacement	High
UV Disinfection	UV system used outside of operating limits, UV lamp not replaced after prescribe operating hours or UV protective sleeve dirty, which may prevent disinfection of the water that may cause disease	• Use certified UV system (AS/NZS4348, 3497, Watermark®) • Use a certified plumber for installation • Install pre-filter to ensure water is less than 1 NTU turbidity • Follow manufacturer written instructions for operating requirements • Follow manufacturer written instructions for replacement of UV lamp • Follow manufacturer written instructions for routine cleaning and maintenance of the UV lamp protective sleeve	High
UV Disinfection	UV system not operating satisfactorily which will not protect from contamination that may cause disease	• Carry out daily check of UV lamp operation and record inspection time and date • Follow manufacturer written instructions for operating requirements • Follow manufacturer written instructions for maintenance and UV lamp replacement • Have contingency plans in place for alternative water supply in case of power failure e.g. bottled water • Keep spare UV lamp and protective sleeve	High

Component	Potential source of contamination	Control measures	Risk rank
Chlorine disinfection	Not achieving 0.5 mg/L free chlorine after dosing which may not protect from contamination that may cause disease	• Check use by dates of chlorine, may be expired and lower in strength • Use fresh chlorine • Follow procedures in Private Water Supply Guidelines, check calculations • Install pre-filter to ensure water is less than 1 NTU turbidity • May be contamination present in tank or pipes consuming chlorine – inspect for vermin access • Have contingency plans in place for inadequate chlorine disinfection and/or vermin e.g. boiling water or bottled water, signs	High

APPENDIX C: Suggested water supply system inspections

A range of inspections may need to be conducted on different parts of the water supply system. Possible inspections include:

Water source—river, creek, dam and bore water

- Check upstream for contamination (monthly or after heavy rains)
- Check upstream during warmer months for blue-green algae blooms (weekly)
- Check the intake area (monthly)
- Check the fenced livestock area (monthly)
- Check well head is secure and free from water (monthly or after heavy rains)
- Check maintenance and operation of pump (annually)

Tank

- Check inlet and outlet screens (3 monthly)
- Check access covers (3 monthly)
- Clear strainer for debris (3 monthly and also after heavy rains)
- Check presence of mosquito larvae in tank water (3 monthly)
- Check structural condition (annually)
- Check sludge level and internal cleanliness (every 2 years or as required)
- Check roof condition and ensure no overhanging trees (3 monthly)

Distribution system

- Check plumbing/piping is fully operational and well-maintained (annually)
- Check treatment system is operating as per manufacturers written instructions
- Replace filters (as per manufacturer's advice or earlier if a decrease in water flow is noticed)
- Test chlorine level is at or above 0.5 mg/L (regularly as per *Private Water Supply Guidelines*)
- Check UV lamp is operating (daily)
- Check UV lamp protective sleeve is visually free from scum (as per manufacturer written instructions)
- Replace UV lamp (as per manufacturer written instructions)
- Follow manufacturer written instructions on routine maintenance of UV system
- Other treatment (as per manufacturer written instructions)

APPENDIX D: Examples of warning signs where water is not being monitored, treated and/or treated

Example 1 - Water quality advice sign (in each room and all outlets in public areas)

WATER QUALITY ADVICE

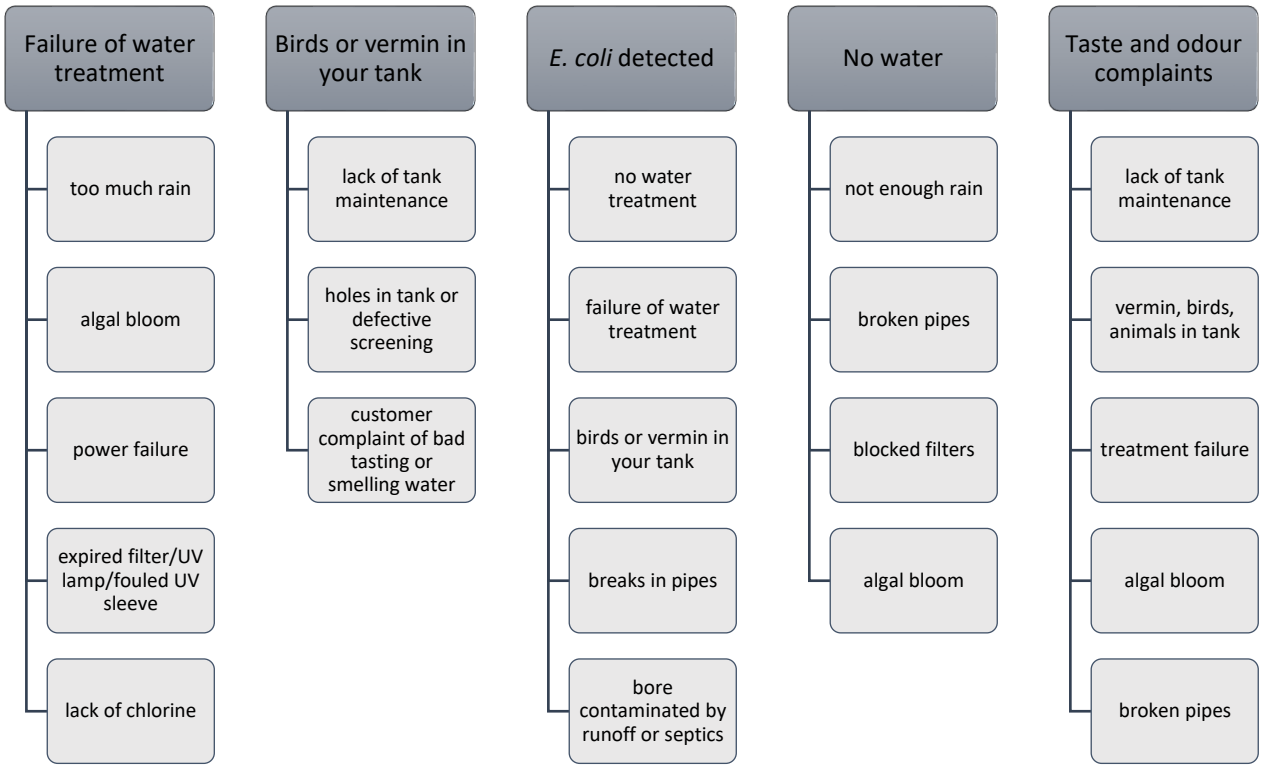
The drinking water here is not monitored or treated
Water quality may not meet health guidelines

Example 2 - Rainwater sign (prominently displayed at the property so that consumers know rainwater is used)



APPENDIX E: What is a water quality incident?

An incident is when something happens to make your water unsafe, or if test results show *E. coli*. This means you are providing water to the public that might make them ill, you can't provide any water, or your customers are complaining about your water. The **below diagram** shows some types of incidents, what can cause each incident, and what to investigate.



How to prevent and manage incidents

It is important to prepare and plan for incidents and emergencies before they happen.

- Make sure your QAP is up to date and accurately reflects how your water system works in real life. Make sure all people in your business responsible for the water supply understand the role they play in protecting public health.
- If you have a tank, have a plan to manage holes or evidence that birds or vermin can, or have entered, (i.e. information on how to treat your water with chlorine).
- Make sure your emergency contact list is up to date so you can call a plumber or electrician to fix broken pipes, fix failed water treatment, or clean a contaminated tank.
- Contact your local public health unit to talk with an environmental health officer when an incident occurs and if there is an ongoing risk from your drinking water.
- If you regularly test your water for *E. coli*, ask the laboratory to contact you straight away if *E. coli* is found so you can act quickly to protect people from getting sick.
- Have safe water such as bottled water readily available, kettles to boil water and the name of a local water carter that is registered with the local council on hand.
- Have signs available, or download them from http://www.health.nsw.gov.au/environment/water/Pages/private-supplies.aspx, to warn people about the water during an incident. Know where you need to put signs to make sure everyone knows what to do.
- Write down everything that happened and what steps your took to return your water supply to its safe operation so you can learn and make future improvements if needed.

11 Appendix B – 20230719 – Mid-Western Regional Council – Water Fill Station Fact Sheet

Shown overleaf.

Rural Water Fill Stations

Rural Water Fill Stations provide emergency potable water access for rural residents living in the Mid-Western Region. Customers can apply to Council for access to the stations, which are available 24 hours a day, seven days a week once registered.

HOW TO ACCESS

To improve emergency water access for rural residents, Council recently upgraded Rural Water Filling Stations in Mudgee, Gulgong and Rylstone. These new filling stations provide more ensured emergency potable water access for rural residents, faster flow rates and reduced fill times.

The new Water Fill Stations have an outlet of either 25mm (per existing) or a larger outlet of 50mm for higher flow rates. Residents can only access the Water Fill Stations by registering with Council. Registration is free to rural residents. Simply fill in the online form at *midwestern.nsw.gov.au/ruralwaterfill*

Once registered, residents with email will have access via the Smart City Control App (*https://app.smartcitycontrol.com.au/*) and those without email will receive a swipe card.

HAVEN'T REGISTERED YET?

Scan the QR code to complete your registration online.



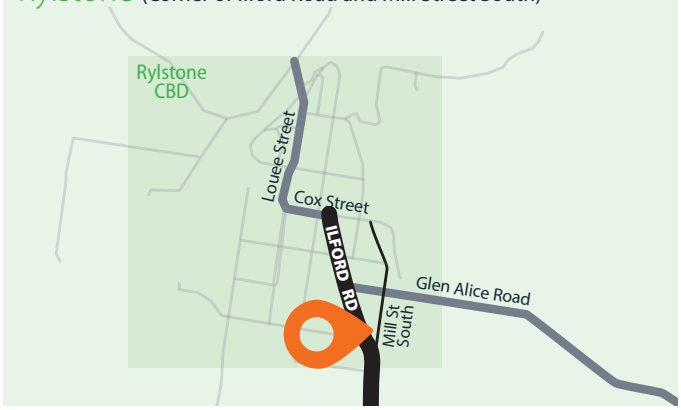
LOCATIONS

One fill point Two fill points

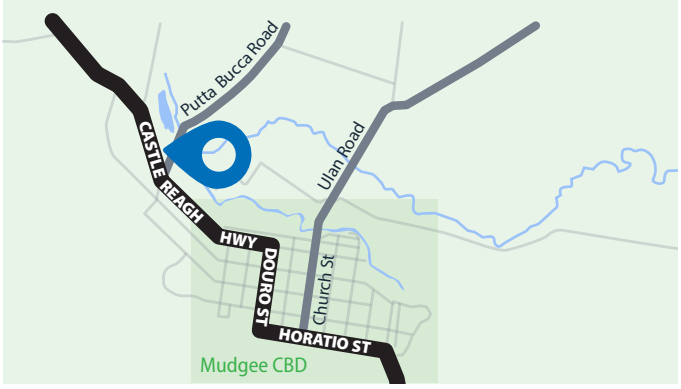
Gulgong (Corner of Saleyards Lane and Spring Creek Road)



Rylstone (Corner of Ilford Road and Mill Street South)



Mudgee (Castlereagh Highway, opposite Putta Butta intersection)

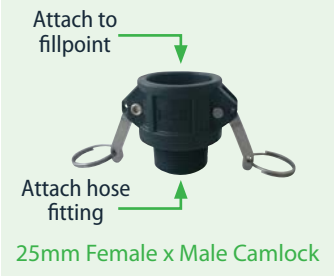


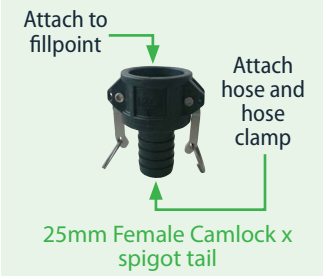
Mid-Western Regional Council PO Box 156, Mudgee NSW 2850 | +61 2 6378 2850 | council@midwestern.nsw.gov.au

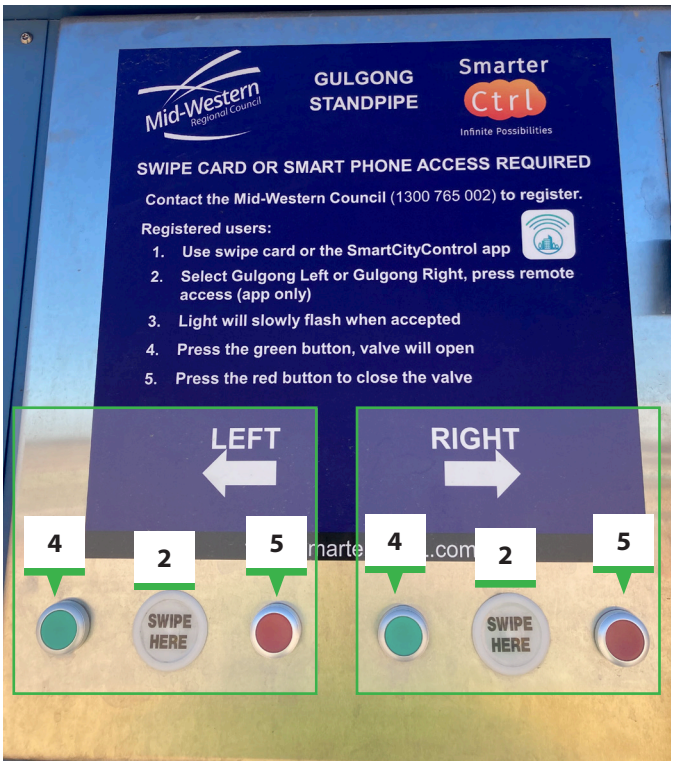
WHAT YOU'LL NEED TO CONNECT

To use Rural Customer water filling stations, customers will need a connection suitable to match either 25mm or 50mm male camlock fitting. Camlock adapters can be sourced from hardware or plumbing stores, and connect to existing hoses used for the previous fill points.





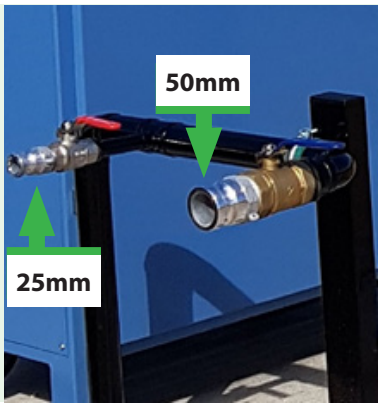




TO FILL YOUR TANK

1. Connect

Securely connect one end of your hose to the Water Filling Station either 50mm or 25mm Camlock coupling and the other end to the inlet on your tank.



2. Swipe

Swipe your access card or use the SmartCityControl app.

3. Select

Select the standpipe name, as displayed on the fill point. The light will flash slowly when accepted.

4. Open valve

Press the green button on the console and the valve will open. Ensure the gate valve by the connection point is also set to open.

5. Close valve

When filling is complete, be sure to press the red button to close the valve. This will log you out of your account.

6. Disconnect

Disconnect all fittings from fill station and your tank. Take care to avoid spillage.

7. Exit

Be aware of other vehicles or pedestrians and exit the fill point safely.

FOR MORE INFORMATION Visit Council's website *midwestern.nsw.gov.au* or email *council@midwestern.nsw.gov.au*

DISCLAIMER The information contained in this fact sheet is general in nature and should not be relied upon as the complete source of information to be considered. This document is not intended as a substitute for consulting relevant legislation or for obtaining appropriate professional advice relevant to your particular circumstances.

12 Appendix C – Dust Suppression Polymers

12.1 Vital Chemical

Shown overleaf.

Vital Bon-Matt HR



Heavy duty dust suppression technology designed for all mining, civil, construction and unsealed public road surfaces, where strong binding and durable surface conditions are required.

PROUDLY AUSTRALIAN MADE & OWNED

An environmentally sound formulation for efficient dust control and stabilisation, Vital Bon-Matt HR is a heavy duty, robust and concentrated formulation. Designed for use on all unsealed roads, high traffic access roads and hardstand and laydown areas.

- Highly efficient dust control
- Long-term cost savings
- Improved visibility and safety
- Reduced water cart usage
- Significant water savings
- Increased surface longevity
- Cures in hours, will not remobilise
- Certified as non-hazardous
- Durable, long lasting stabilisation

Vital Chemical



Vital Chemical formulate, manufacture and provide
best value solutions focused on delivering
social, environmental and economic benefits.

Proven | Trusted | Sustainable | Australian

Infrastructure Sustainability Council MEMBER

ISupply MEMBER

1800 2 VITAL

vitalindustries.com.au

© Vital Chemical Pty Ltd

Product Data Sheet
Vital Bon-Matt HR

Description

A water-based, heavy duty and robust polymer emulsion designed for high volume roads and areas of high velocity concentrated flow. Applications on areas requiring strong and durable conditions such as civil, construction, mining and regional council roads. ***Vital Bon-Matt HR*** is a concentrated liquid emulsion which is diluted with water prior to application to create long-term binding, stabilisation and surface sealing.

Recommended Applications

All high traffic unsealed road surfaces requiring dust control, stabilisation including haul roads, civil construction, unsealed roads, traffic areas, long-term sealing and areas exposed to high velocity water flow.

Suitable for use on all traffic areas and areas of harsh environmental conditions.

Features

- Highly effective dust abatement
- High wind speed resistance
- High volume traffic resistance
- Highly effective erosion control and stabilisation
- Long-term capping
- Immobile once cured
- A strong, durable and flexible veneer over the applied surface
- An environmentally safe product with inert degradation products
- High molecular weight polymers

Specifications

Appearance	WHITE LIQUID	**Solubility (water)**	SOLUBLE
Odour	SLIGHT ODOUR	**Vapour pressure**	NOT AVAILABLE
Flammability	NON FLAMMABLE	**Upper explosion limit**	NOT RELEVANT
Flash point	NOT RELEVANT	**Lower explosion limit**	NOT RELEVANT
Boiling point	NOT AVAILABLE	**Partition coefficient**	NOT AVAILABLE
Melting point	NOT AVAILABLE	**Autoignition temperature**	NOT AVAILABLE
Evaporation rate	NOT AVAILABLE	**Decomposition temperature**	NOT AVAILABLE
pH	7.0 – 9.5	**Viscosity**	NOT AVAILABLE
Vapour density	NOT AVAILABLE	**Explosive properties**	NOT AVAILABLE
Specific gravity	1.04 (Approximately)	**Oxidising properties**	NOT AVAILABLE
		Odour threshold	NOT AVAILABLE
		% Volatiles	NOT AVAILABLE

Application Methods

Vital Bon-Matt HR is applied via water cart dribble bar, spray nozzle systems, side spray or hand held hose.

It is preferable for road areas to be dressed prior to application for product longevity.

Water carts should be semi-filled with water prior to the addition of the ***Vital Bon-Matt HR*** concentrate. This order of filling assists mixing of product and water within the cart and ensures the concentrate does not fill the sprayer lines and dribble bar.

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vitalindustries.com.au

Dilution Rates

Due to numerous variables associated with surface composition and the level of control required, it is not practical to list a standard application rate. Onsite analysis and assessment by our *Technical Representatives* will ensure the optimum application is employed for each individual site.

A generalised surface coverage of diluted product equates to: **1L solution : 1m² surface**

Maintenance

Maintenance will vary according to road or site specifications. Once effectiveness is reduced, more dilute ***Vital Bon-Matt HR*** applications can be employed if required.

Cleaning of Water Cart and Pumps

Water cart pumps and application devices must be flushed with water immediately after ***Vital Bon-Matt HR*** application runs.

Shelf Life

Vital Bon-Matt HR should be stored at a temperature of min. +5°C to max. +45°C. Shelf life is approximately 12 months.

Vital Bon-Matt HR must be kept in closed drums/containers or closed tanks. Containers must be closed tightly to avoid contact with air, which can contribute to product contamination.

Do not keep pre-diluted product for longer than 2 days as the shelf life is drastically reduced once contaminants (such as water) are introduced.

Packaging

Vital Bon-Matt HR is supplied in 20L drums, 1,000L IBCs and bulk volumes.

Precautions

Vital Bon-Matt HR contains no hazardous substances requiring labelling. For more information, refer to Safety Data Sheet.

For any further product or application advice or instruction, contact Vital Chemical Pty Ltd.

Ensure product concentrate or solution is not sprayed, applied or enabled to enter waterways and water systems.

Contractors must undertake appropriate risk assessments to ensure the safe delivery of the product to the application area.

STATEMENT OF RESPONSIBILITY

The technical information and application advice given in the **Vital Chemical Pty Ltd** publication are based on the present state of our best scientific and practical knowledge. As the information herein is of a general nature, no assumption can be made as to a product's suitability for a particular use or application and no warranty as to its accuracy, reliability or completeness either expressed or implied is given other than those required by law. The user is responsible for checking the suitability of products for their intended use.

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NOTE

Field service where provided does not constitute supervisory responsibility. Suggestions made by ***Vital Chemical Pty Ltd*** either orally or in writing may be followed, modified or rejected by the owner, engineer or contractor since they, and not ***Vital Chemical Pty Ltd***, are responsible for carrying out procedures appropriate to a specific application.

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12.2 Erizon

Shown overleaf.

RoadBond®

Dust Suppression for Trafficked Areas

Superior dust suppression for unsealed roads in any environment



A product by

ERIZON

Australian Environmental Solutions

Certified System™ Quality ISO 9001 SAI GLOBAL

Certified System™ Environment ISO 14001 SAI GLOBAL

Certified System™ OHS ISO 45001 SAI GLOBAL

RoadBond® Mg



Introducing RoadBond® Mg

RoadBond® Mg is a highly effective dust suppression and stabilization product for unsealed roads. Immediately effective upon application, this hygroscopic solution is designed to absorb moisture from the ambient surroundings and agglomerate soil fines, creating a compacted and durable layer. Resistant to traffic wear and continually effective, RoadBond® Mg results in a significant reduction of fugitive dust emissions.

Containing proprietary additives that inhibit corrosion, this common issue, often associated with alternative products, is eliminated. With RoadBond® Mg you can feel confident knowing that your plant equipment and on-site vehicles are protected, and their working life maintained.



Application

RoadBond® Mg is supplied in liquid form and is either applied directly onto the road surface or mixed in during grading. No specialized equipment is required as existing water carts can be used although if you prefer, RoadBond® Mg can be applied by one of our certified partners.

An application of between 1 – 2 L per square meter is required to maintain effective dust control for up to 12 months. Additional top up applications can be made using a half strength solution and the road can be reworked as needed without loss of effectiveness. 1 load of RoadBond® Mg saves up to 240 loads of water on average.

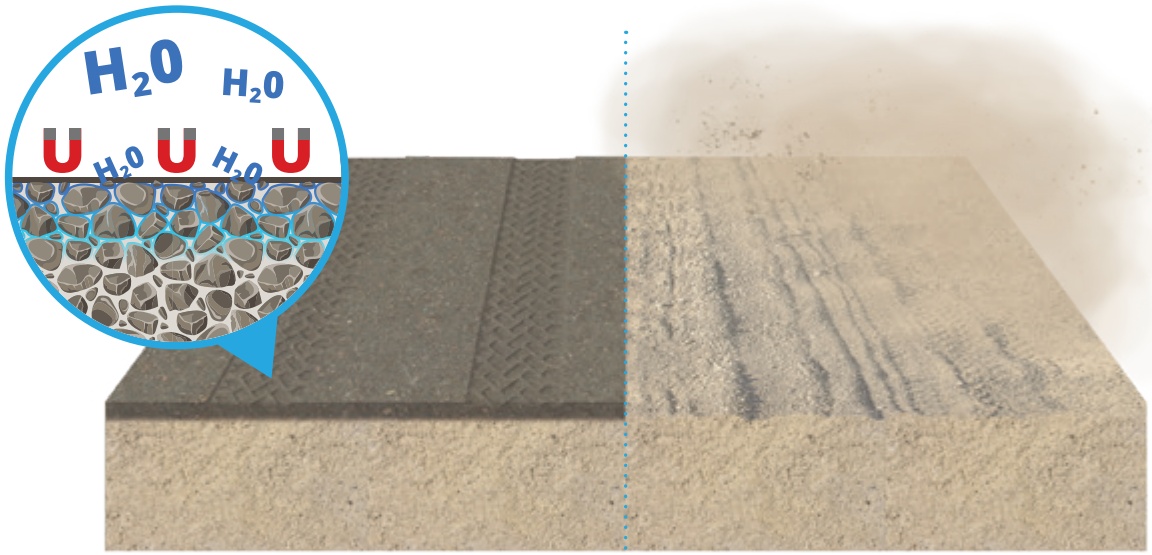
Benefits of RoadBond® Mg

RoadBond® Mg works well in humid and rainy climates as the hygroscopic properties pull moisture from the atmosphere to stop the dust from drying out and becoming airbourne.

RoadBond® Mg works best on prepared surfaces where loose material is minimal.

- Eliminates the need for water
- Reduces dust immediately
- Hygroscopic properties
- Naturally derived product
- Anti-corrosion Additives
- Imroved soil compaction
- Use existing equipment
- Cost effective

How RoadBond® Mg works



Treated

RoadBond® Mg penetrates the surface and draws moisture to form a coat, agglomerating loose soil particles together resulting in a reworkable dust-free layer. The treated area is ready for use with no curing time necessary.

Untreated

Haul roads are prone to generating dust due to wind erosion and vehicular traffic, especially in dry climates. Over time, the surface becomes less stable and poses adverse mechanical, environmental and health concerns.

RoadBond® Li



Introducing RoadBond® Li

RoadBond® Li is a naturally derived, biopolymer dust suppressant sourced from the wood pulping industry. It is applied to the substrate as a liquid and as it dries it glues together loose particles, preventing dust liftoff and keeping the road base in good condition. This sticky quality stops fugitive dust emissions and helps to stabilize and compact the road base over time. At lower dosages it will work as a dust suppressant and at higher dosages the road base stabilization effect starts to become apparent.

RoadBond® Li is produced using a relatively mild process, resulting in a product with a neutral pH close to 7. The already minor corrosive issues associated with lignosulfonates becomes essentially non-existent. Environmentally sound and with a low impact on infrastructure, RoadBond® Li is an economical and effective tool to fight dust.



Application

RoadBond® Li is supplied as a liquid in either IBCs or bulk tanks and is ready to be applied directly to the surface. Existing infrastructure such as water carts with a spray bar can be used, or one of our certified application partners can be arranged.

An application of up to one litre per square meter is enough for dust suppressant properties while closer to two litres per square meter is required for road base stabilization, in which case RoadBond® Li can also be mixed in while grading.

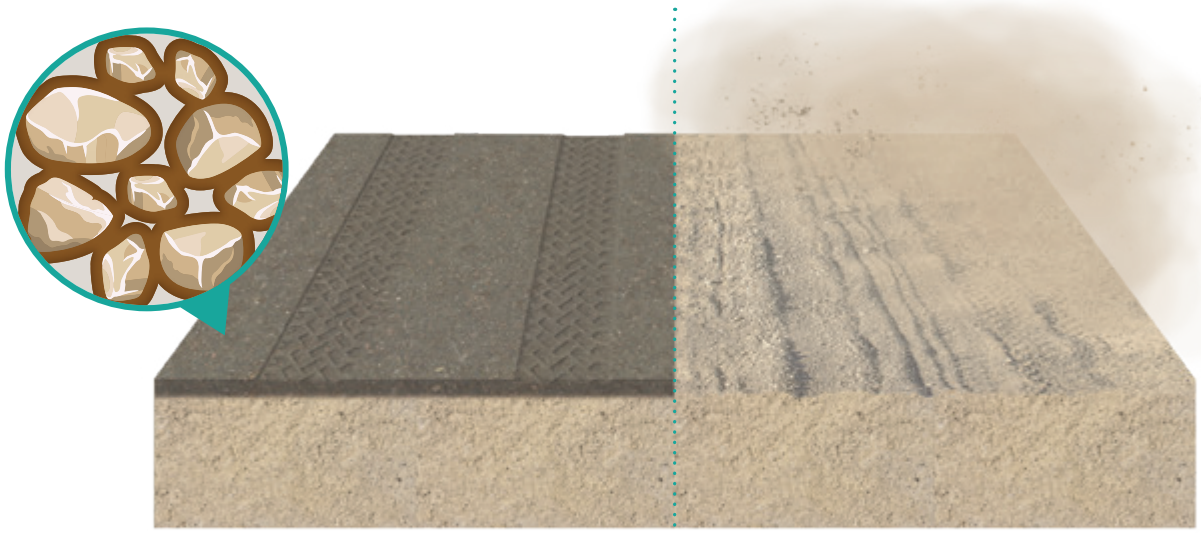
Eight proven benefits of RoadBond® Li

Effective dust suppression immediately on application, RoadBond® Li Works especially well in dry, arid conditions where fine dust is an issue.

This naturally derived product can be used on unsealed and ungraded roads and provides improved stability.

- Eliminates the need for water
- Reduces dust immediately
- Works in dry arid climates
- Naturally derived product
- Non-corrosive
- Works with or without graded surface
- Use existing equipment
- Cost effective

How RoadBond Li works



Treated

RoadBond® Li provides a long lasting barrier, binding fine soil particles together resulting in a reworkable dust-free layer. The treated area is ready for use with no curing time necessary.

Untreated

Haul roads are prone to generating dust due to wind erosion and vehicular traffic, especially in dry climates. Over time, the surface becomes less stable and poses adverse mechanical, environmental and health concerns.









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RoadBond® is formulated to meet the highest standards of environmental efficiency

Scan me



100% Success Rate Guaranteed

SUPPLY

Our products and services are supported by the expertise and consultation of our specialist team of agronomists, horticulturalists and soil scientists. RoadBond® is made with the highest quality materials which are extensively tested for safety and performance on some of the most depleted and degraded soils in Australia. We are confident you will achieve project success first time.

APPLY

Our highly trained technicians utilise specialist equipment to apply products with precision and accuracy, meeting Australian Safety, Environmental and Quality standards. Surpassing this, our ability to utilise drone technology for the application of solutions improves the quality and efficiency of our operations. Each project comes with a tailored Quality Management Plan and an Inspection & Test Plan (ITP) to identify and record project specifications and requirements.

GUARANTEE

Our scientifically developed solutions and expert application methods enable us to deliver an end-to-end solution which makes this guarantee possible. Each project solution is tailored for specific site requirements and longevity targets which requires a tailored guarantee to ensure success for your project.

Australian Owned & Made

ERIZON
Australian Environmental Solutions

Call **1300 182 182**
or visit **erizon.com.au**

Certified System Quality ISO 9001 SAI GLOBAL
Certified System Environment ISO 14001 SAI GLOBAL
Certified System OHS ISO 45001 SAI GLOBAL

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ERIZON®

Australian Environmental Solutions

Capability Statement



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Company Overview



We are Erizon.

Industry leaders in large-scale mining and civil environmental solutions including rehabilitation, revegetation, dust suppression and erosion control, Australia-wide.

With over 25 years of experience in our field, our products and techniques show proven success in the most demanding environments Australia has to offer. Our unique approach engages teams of experts from across the fields of science, engineering, project management and cutting-edge technology.

Taking the time to fully understand the variables and characteristics of each project we undertake ensures our continued performance success, with guarantees of up to 24 months. This culminates in our steadfast Supply, Apply, Guarantee.

Erizon is certified for safety, environmental and quality management systems to ISO and Australian Standards. We operate a Vision Zero policy framework, ensuring the safety of our staff and our partners.

With the ability to mobilise rapidly from depots in each state and territory in Australia, the Erizon team are ready when you are.

Certified System
Quality
ISO 9001
SAI GLOBAL

Certified System
Environment
ISO 14001
SAI GLOBAL

Certified System
OHS
ISO 45001
SAI GLOBAL

VISION ZERO
ZERO IN ON SAFETY

Our Difference



SUPPLY

APPLY

GUARANTEE

Erizon's services are supported by the expertise and consultation of our experienced, specialist team of agronomists, horticulturalists, and soil scientists. All Erizon products are developed and made in Australia, with rigorous and extensive performance testing applied. These products are designed to complement our unique Australian environment and landscapes, including the most depleted and degraded soils in the country.

Our highly trained technicians utilise state-of-the-art equipment to apply products with precision and accuracy, while our use of drones radically improves the quality and efficiency of our operations. With a tailored Quality Management Plan and Inspection & Test Plan (ITP) we identify and record project specifications and requirements. Everything we do meets Australian Safety, Environmental and Quality standards.

At Erizon, we understand the need for a customised approach to each project. Site requirements, sustainability targets and specific objectives are paramount in helping us guarantee our client's goals. With our scientifically developed solutions, tailored to your project's purpose, and expert, modernised application methods, we will deliver a seamless end-to-end service, which makes guarantees possible.

Our Core Values

Safety

Protecting the health, safety, and welfare of our team, including clients, contractors and visitors, and the safe management and sustainability of the environment, are paramount in everything we do. The success of our projects relies on and reflects this.

Innovation

As an industry leader, we strive to constantly innovate to improve performance and guarantee results - keeping pace with modern technologies in the industry allows us to do so. We research, develop and implement cutting-edge solutions backed by science.

Excellence

Our business is not just about providing a solution that works. We build long-lasting partnerships with our clients, ensuring a quality service prior, during, and post-project, paving the way for a successful working relationship with a focus on excellence.

Vison Zero

At the heart of Erizon is Vision Zero, our primary safety strategy. Vision Zero creates a workplace culture where safety is our number one priority and 'zero' becomes the only acceptable number for accidents or fatalities in the workplace.

Regular training, protocols and service exercises ensure the maintenance of the correct safety methods and that certifications are being performed and align with the AS/NZS 4801:2001. Additionally, our safety and environmental systems are regularly audited by our clients in high-risk industries to ensure that we are compliant with their WHSEQ requirements.

VISION ZERO

ZERO IN ON SAFETY



Efficiency

With the ability to deploy from depots across the country, we execute a swift response, even in Australia's most remote areas. The capacity of our state-of-the-art equipment, technology and expert technicians allows us to maximise project efficiency.



Integrity

At Erizon, we conduct business with the utmost professionalism and ethics. We believe in fulfilling our duties to the highest moral standards and value transparency, honesty, and ethicality in all interactions with our clients, personnel, contractors, and the public.



One team

The Erizon workplace is wholly inclusive, with the safety and well-being of our team a priority. Our customer-centric approach is comprehensively upheld. That way, we can understand the unique needs our clients and ensure that their satisfaction is our number one priority.

Our Approach

Environment

Erizon is committed to delivering personalised sustainability services that focus on innovative, practical and economical solutions built for the unique Australian environment. An integral part of our approach to each project, comprehensive environmental planning means every aspect of our activities, operations and decision-making processes are meticulously considered.

Quality

Being on the forefront of industry developments means that, at Erizon, we guarantee the highest quality products and services for our clients. Everything we do meets the Australian Safety, Environmental and Quality standards, and our tailored Quality Management Plan and Inspection & Test Plan (ITP) helps us maintain long-term successes.

Communication

Effective communication is a crucial tool in driving our achievements. At Erizon, we know we work better together. We have created a workplace dynamic where two-way communication is key in every facet of what we do. This is equally dedicated to open and clear communication with our clients.

Expertise

The foundations of our tailored client solutions are supported by our team of experts. Our experienced crew are passionate about continuing to hone their craft. With awareness and appreciation of new and innovative solutions to optimise results in our service offering, we stay pioneers of environmental expertise.

Our Services



Dust Suppression

The leading-edge technologies we use for dust suppression will not only save water but can also dramatically minimise site activity and the time, money and energy spent on project management tasks. You are guaranteed immediate control and instant results upon application of Erizon products.

Hydromulching

Damaged and depleted soils require more than conventional methods to achieve sustainable growth. Through the application of world-class growth mediums, we can support faster vegetation growth while minimising erosion.

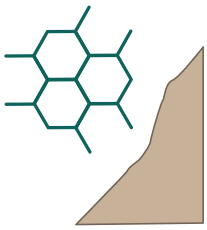


Hydroseeding

Hydroseeding is an efficient and cost-effective technique for revegetating large areas. Our specially designed hydroseeding equipment allows the operator to agitate the mixture to ensure even and constant mixing of ingredients, maximising erosion protection and soil stabilisation.

Soil Stabilisation

Mining, construction and infrastructure developments may disturb the soil and compromise its stability and ability to support vegetation growth. Erizon rehabilitate such areas and apply the most effective topsoil alternative suitable for your project landscape.

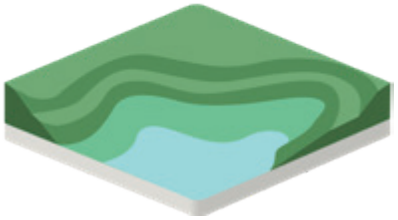


Erosion Control Blanket

Erosion control projects can be challenging work. There are substantial safety risks to staff in the installation of traditional erosion control matting products, particularly when there are steep inclines involved. Our innovative EcoArmour®, designed and made in Australia, allows for safe and effective installation with a guaranteed lifespan of up to 20 years.

Mine Site Rehabilitation

Each rehabilitation project requires a customised solution, tailored to site-specific requirements and your goals. Erizon's effective solutions ensure your goals at met, while ensuring the sustainability and longevity of your project.



RIZON



Trial Testing

Envizo is our latest software developed to assist in determining the best solution for revegetation projects. The trial testing looks at variables such as seed types, mulch application rates and soil amendments. While the technology provides 24/7 real-time performance indicators including live video and reporting data.

Drone Services

Erizon has been at the forefront of using drones to improve safety, efficiency, and cost-effectiveness within the environmental industry. Our drone services include:

- **Aerial Spraying**
- **Aerial Seeding**
- **3D Mapping**
- **LiDAR Scanning**
- **Plant Health Monitoring**



Soil Testing

Soil analysis is the first step to any successful soil management and hydroseeding project. It gives critical information about the biochemical composition and physical properties of a piece of land, ensuring we provide a favourable growing environment.



Erizon's Revegetation Process

From meeting environmental remediation requirements, controlling erosion, reducing land degradation, and enhancing and re-establishing Australia's unique landscapes, the benefits of revegetation are many.

However, revegetation projects in damaged landscapes following construction or mining activities in Australia can be challenging. At Erizon, our proven 8-step revegetation process, tailored to your site-specific requirements and project goals, can effectively reverse the adverse impacts of clearing and disturbance, ensuring successful rehabilitation.



1. Soil testing and analysis

Attending the site in person to collect soil samples allows our team to better understand rehabilitation needs, noting soil type, landscape, prior land use and early species considerations.

2. Drone surveying

A 3D survey is undertaken of the proposed revegetation site to accurately measure the area size and map it to a high degree of detail for quality, planning and analysis purposes

3. Identify best plant species

Identifying the plant species appropriate for the specific site you want to revegetate is imperative. Erizon considers the revegetation purpose, natural habitat, and native and local plants for potential use.

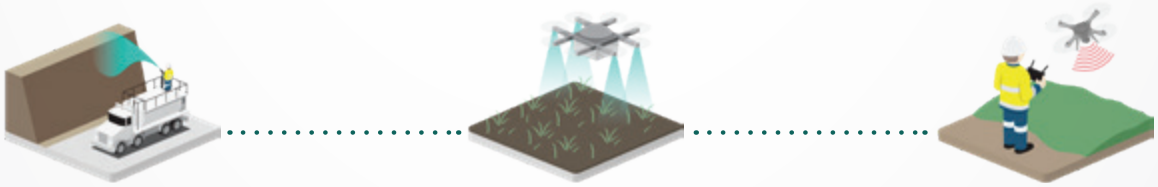


4. Tailor the best solution

Our experts craft the best solution for your project based on the site analysis. We consider erosion control and product effectiveness, including the ability to facilitate growth and the functional longevity required.

5. Soil amendment application

Damaged and depleted soils will require a site-specific amendment program to sustain long-term growth. This step is vital to establish the optimal foundation for a successful revegetation project.



6. Hydromulch and seed application

Our highly trained technicians prepare and apply the tailored solution using specialised HydroRig equipment. Each vehicle is equipped with internally agitating tanks to achieve a consistent slurry which is sprayed via roof-mounted cannon or hose.

7. Drone spraying

Once solutions are applied and seeding is complete, Erizon creates a timeline to ensure the continued care of the site. After 4-8 weeks, we use the latest drone technology to apply fertiliser, trace elements and soil probiotics to targeted areas of the site.

8. Post-project monitoring

Monitoring and maintenance are vital to ensure the ongoing success of your revegetation project. Erizon use the drone sensor, and imaging technology to accurately report on the progress of vegetation health.

Plant and Equipment

All Erizon's plant and equipment is mine compliant and maintained according to manufacturer specifications and requirements to ensure Vision Zero safety levels and reliability during operation. Erizon ensures that all plant and equipment are thoroughly cleaned before and after each project to eliminate cross-contamination of solution materials.



HydroRigs

A game-changer in revegetation, our HydroRigs allow us to apply solutions in a fast and efficient manner, covering up to 50,000 square metres per day. Our machines are designed to optimise efficiency and effectiveness by providing unparalleled coverage of extensive areas and difficult terrains. Featuring hydraulic cannons, an extendable hose reel reaching up to 400 metres, and in-built agitators to maintain a uniform solution application.

Low Ground Pressure Equipment

While our standard HydroRigs are suitable for most sites, we are also equipped to perform on soft and challenging terrain, such as tailings storage facilities (TSFs).



7-9 PSI Tracked HydroRig

The addition of rubber tracks to our HydroRigs increases safety and accuracy, and reduces costs compared to alternative methods, such as aerial application by air tractor or helicopter. These tracks are engineered to be quickly installed on-site and used to provide greater traction, floatation and reduced compaction.



4-6 PSI LBC HydroTrailer

Our low bearing capacity (LBC) HydroTrailer is a specially developed low ground pressure system. This system, a HydroRig is mounted on a purpose-built trailer with LBC capabilities, which is then towed by a mine-spec, wide-tracked tractor. The tracked tractor has the capability of extending its track width past that of the trailer tracks, which will reduce compaction and degradation of the TSF surface.



1-3 PSI Snowgroomer

Our Prinoth Beast Snow Groomer provides a much safer way to tow the tracked HydroRig with it's extremely low ground pressure footprint of 1 PSI. This equipment has been specifically engineered to allow flexibility with multiple application solution options for areas that require minimal ground pressure traffic.

Revegetation Solutions

Successfully revegetating damaged landscapes following construction or mining activities can be particularly tricky in Australia's diverse environments. Hydroseeding and hydromulching have proven to be effective strategies for revegetating and stabilising batters. However, distinct soils and weather conditions across the country mean there is no 'one-size-fits-all' solution for every revegetation and erosion control project. Erizon are here to help find the right solution for your project.

GoSeed® Advanced Hydroseeding

GoSeed® is an advanced hydroseeding product, scientifically developed to deliver superior germination rates and added seed protection to achieve denser vegetation. It contains beneficial microbes carefully selected by soil scientists to optimise conditions for growth.

EnviroSprout™ Hydromulching HGM

EnviroSprout™ is a hydraulic growth medium designed to revegetate large areas using a one-step process. EnviroSprout™ drastically increases plant strike rate and vegetation density over hydroseeding alone. Thermally refined wood fibres and microbial amendments promote soil health, optimise germination, help water infiltration, and allow a consistent release of nutrients for long-term sustainable plant growth.

EnviroLoc® Hydromulching BFM

EnviroLoc® is a bonded fibre matrix solution for revegetating areas with challenging growth conditions. The two-step application provides enhanced seed mix protection from fauna and harsh weather conditions, providing an optimal germination environment. The higher application rate of thermally refined wood fibres provides optimal temperature stablisation and increased moisture retention levels. Proprietary binders and tackifiers make EnviroLoc® ideal for revegetating on steep slopes and uneven terrain.





EnviroSoil®
Topsoil Alternative

EnviroSoil® is a hydraulically applied topsoil alternative. Active components include thermally refined organic fibres, high carbon, natural soil conditioners, seaweed extracts and mineral blends, including basalt and microbial inoculants. When combined, these ingredients work symbiotically to improve the growing conditions of the rhizosphere.

Envirosoil® is designed for challenging areas where existing soil is severely damaged and lacks essential nutrients and bioactivity after being disturbed by development.

EnviroLoc®
Airfield Hydromulching BFM

Based on the market-leading EnviroLoc® BFM, the airfield variant introduces an airport grade polymer blend to achieve immediate erosion control against jet blast, whilst still creating a high-performing growth medium matrix.

The flexible, yet stable matrix immediately bonds to the surface while the combination of thermally refined wood fibres and biopolymers provide greater water holding capacity for more complete germination and faster establishment of vegetation.



Dust Suppression Solutions

Erizon continue to be market leaders in dust suppression solutions for over 25 years for commercial mining, civil, oil and gas, environmental and infrastructure projects Australia-wide. We utilise advanced dust suppression methods that consistently achieve better results, are environmentally friendly, and offer higher functional longevity.

The best type of dust control solution for your site will depend on a host of site-specific variables, such as the time available to establish vegetation, micro-climate, seasonal conditions, soil type, the area topography, drainage and project duration.

We effectively tailor a solution to solve the most complex dust abatement issues. Our methods create durable, water-resistant, and environmentally friendly surface crusts over dust, soil and aggregate. We also offer dust control solutions to cater to sites suited for vegetation growth.

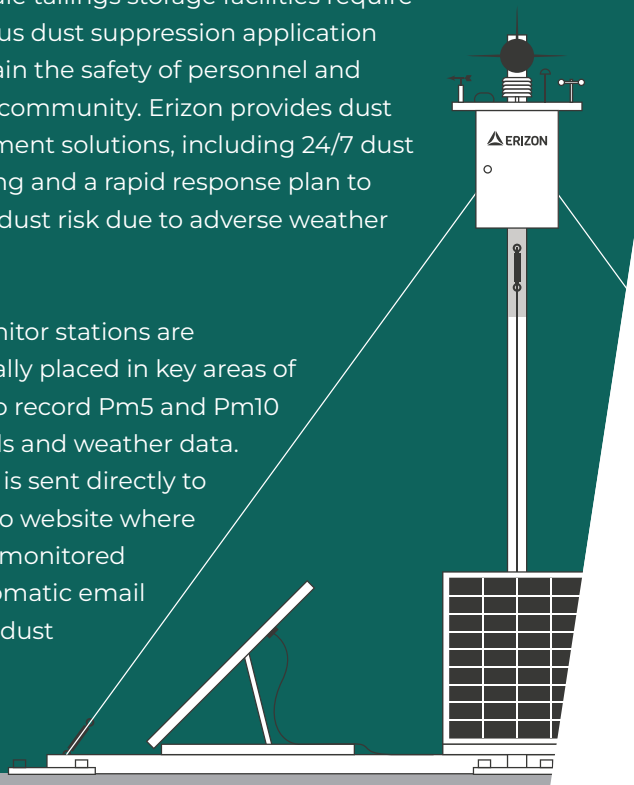
The cutting-edge technologies we use for dust suppression will dramatically minimise site activity and the time, money and energy spent on project management tasks, while consistently achieving the best results.



Dust Monitoring

Large-scale tailings storage facilities require continuous dust suppression application to maintain the safety of personnel and the local community. Erizon provides dust management solutions, including 24/7 dust monitoring and a rapid response plan to mitigate dust risk due to adverse weather events.

Dust monitor stations are strategically placed in key areas of the site to record Pm5 and Pm10 dust levels and weather data. This data is sent directly to the Envizo website where it can be monitored with automatic email alerts for dust events.



SuppressX®
Dust Suppression & Erosion Control

Perfect for non-trafficked areas, SuppressX® is ideal for all forms of substrate, including tailings, ash dams, and stockpiles. The flexible crust is composed of unique microscopic cross-linked superabsorbent polymers that bind fine particles, providing immediate dust suppression without changing the overall composition of the substrate.



HydroBond®

Dust Suppression for Revegetation

As well as providing immediate dust suppression, HydroBond®'s specialist blend of polymers and additives form a permeable biodegradable crust when applied that increases the treated soil's water retention capacity and prevents the leaching of essential nutrients. It works with all soil and sand types and is perfect for when dust is the immediate concern, but longer-term revegetation is the goal.

RoadBond®

Dust Suppression for Trafficked Areas

Developed and extensively tested to withstand the harsh conditions of sites operating in the mining, resources, and infrastructure industries. RoadBond® is a highly effective dust suppression and surface stabilisation product for unsealed roads. Immediately effective upon application, this hygroscopic solution is designed to absorb moisture from the ambient surroundings and agglomerate soil fines, creating a compacted and durable layer. Resistant to traffic wear and continually effective, RoadBond® results in a significant reduction of dust emissions.

FibreLoc®

Wood fibre Mulch for Dust Suppression

Designed for uneven terrains and dynamic substrates, FibreLoc® is an advanced dust suppression product scientifically engineered to withstand the harshest conditions where polymer solutions aren't suitable. The interlocking organic wood fibres and sustainable binders form a flexible blanket that can resist high salinity levels such as those found on tailings storage facilities.

Once applied, FibreLoc® provides functional longevity of up to 24 months.

Erosion Control Solutions

Our erosion control solutions are designed to withstand Australia's harshest climates. They can stabilise almost any type of surface and bind to the substrate in a matter of hours, providing immediate erosion control.

Compared to conventional erosion control blankets, such as geo-fabric, our erosion control solutions are safer to apply and are proven to be more effective and cost-effective, as they can last 20 years.

EcoArmour®
Erosion Control Blanket

EcoArmour® is a synthetic erosion control blanket that will combat the most diverse environments and weather – from dry, arid conditions to torrential wind and rain events. EcoArmour® binds effectively to different substrates, including soil, clay, rock, shale, weathered concrete, sand, and sandy loam, while also meeting all relevant transport and main roads specifications.



Drone Services



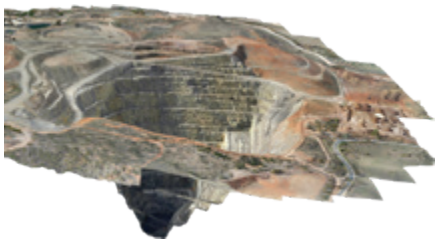
Aerial Spraying

With the ability to cover varied and uneven terrain, drones are quickly becoming the ultimate precision spraying tool. Targeting specific areas where treatment of fertiliser and soil ameliorants is necessary, aerial spraying can treat an area up to 40 times faster than manual spraying operations. For projects that require extended flight times, hybrid drones that utilise an onboard generator can be deployed.



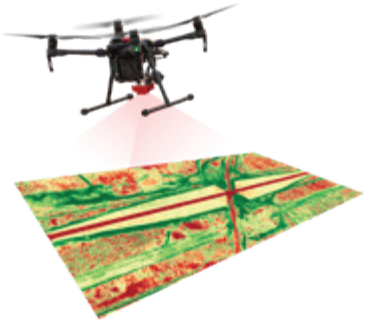
Aerial Seeding

Drone seeding is an extremely cost-effective, efficient solution for aerial seeding during large-scale revegetation projects. Erizon's drones allow seeds and nutrients to be placed exactly where needed. The manoeuvrability of the UAV (Unmanned Aerial Vehicle) allows our pilot to service isolated or difficult access areas. We can adjust the flight speed, altitude, and feed rates to meet the required radius and density of the spread.



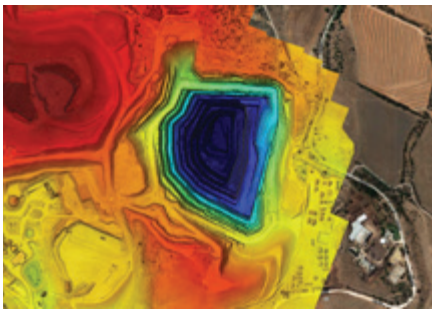
3D Mapping

When you need a site survey, accuracy is vital. Using drones with high-resolution cameras and sophisticated photogrammetry software allows our team to create a detailed 3D model of your site. This map contains exact and reliable data that can be used to plan and execute projects efficiently. Compared to traditional methods, drone-enabled mapping provides a faster and safer way to assess large and challenging areas.



Plant Health Monitoring

To ensure the success of your revegetation project, consistent monitoring is required. Erizon offers drone-enabled plant health monitoring. The ultra-precise data provided can help you identify subtle issues you may be unaware of, help you gain deeper insights, make informed strategic decisions, and allow you to recalibrate your strategy, if necessary.



LiDAR Scanning

Erizon's drones equipped with LiDAR cameras use laser measurement to help you compute distances that conventional light can't. Through LiDAR (Light Detection and Ranging) you can acquire high-precision data while reducing processing time and your time in the field. Precise 3D data can be achieved, even with challenging weather and lighting conditions.

Customised Trials



Rehabilitating large areas can be an uncertain process, especially in harsh environments with varying conditions.

Damaged and depleted soils require a deeper understanding of the available options before healthy and sustainable long-term growth is possible. An early miscalculation could result in a costly and timely exercise in the long run. This understanding paved the way for Erizon to develop a service that can dramatically increase project success with revegetation trial development and real-time performance monitoring technology.

Trial

A custom trial area will give you the best possible insights into the most effective methods for project success. Multiple zones within a test area can show you the effectiveness of a range of variables such as seed type, irrigation rates, products, product application rates, as well as product combination options. The results of this trial will inform you of the most effective solution possible with more accurate cost estimations.

Monitor Performance

Envizo is a performance monitoring system that collects data, allowing our team and clients 24/7 remote access to a full range of performance indicators. These can include temperature, humidity, soil moisture levels, average rainfall and much more. Live video and reporting capabilities allow our team to accurately study the behaviour of each test configuration to define the best possible solution for the overall revegetation project.

Perfect and Implement

Once the trial is complete, you have full access to a comprehensive report analysing the trial period. From here, we can design the perfect, sustainable solution for your project.



envizo
Real-time Performance Monitoring

Our Clients


BHP


Delta
electricity


Rirratjingu
Aboriginal
Corporation


NEWCREST
MINING LIMITED


THIESS


synergy


RioTinto


GLENCORE


agl


GHD


ALCOA


lendlease


Downer
Relationships creating success


FlindersPower


V/Line


ventia


Australian Government
Department of Defence


JLL


HILLGROVE
RESOURCES


BROADSPECTRUM


COLEMAN
RAIL



1300 182 182

info@erizon.com.au
erizon.com.au

12.3 Global Road Technology – GRT

Shown overleaf.

Polymer Sealing Dust Control

GRT7000

Environmentally friendly and sustainable roads



PRODUCT FEATURES:

- Easy application through existing water trucks - just add water
- Robust product characteristics allow it to be applied across a diverse range of industries
- Immediate cost benefits compared to continually watering
- Long-term cost benefits from reduced windborne material loss
- Improved health and safety on site - better visibility and reduced dust related respiratory risks
- Biodegradable, sustainable & safe for the environment



Certified System™
Quality
ISO 9001
SAI GLOBAL

A specially formulated liquid polymer, GRT7000 is a key solution that dries clear, and is environmentally friendly.

Engineered for use in civil construction, it can act as a clear polymer sealant as well as a high performing stabilization agent.

GRT7000 works by physically and chemically bonding soil or pavement particles leading to improved compressive strengths, high tensile resilience, and water impermeability.

IMPROVE SAFETY - PREVENT AIRBORNE DUST - SAVE WATER

CONTACT GRT: (07) 5667 8550 | globalroadtechnology.com

Designed & built in Australia

AUSTRALIAN MADE

GRT: 7000

GRT:7000 is used to seal the surface of granular pavement layers. It is a liquid polymer that is sprayed onto the surface of a road and has been designed to provide a tough surface seal as an alternative to traditional sealing products such as bitumen.

It is an environmentally friendly, ultimately bio-degradable, polymer-based product, that has been independently tested for both toxicity and for its performance as a wearing surface (rolling resistance and skid resistance). It can be used to seal a stabilised pavement, or to a graded and compacted road base surface. It is a more robust material than bitumen in that it will bind and seal much lower quality materials than a bitumen spray seal can handle and adhere to.

GRT:7000 is favoured when a client is looking for a road that is waterproof and dust free, but still has the aesthetic appeal of an unsealed "rural/natural" looking road.

GRT:7000 will provide a waterproof, dust free surface with an aesthetically pleasing clear finish. Depending on traffic, a coat will last from 12-52 weeks – with maintenance coats to be applied on an "as needs" basis. This solution is perfect when access to water and/or equipment for dust suppression and road maintenance is at a distance where it is uneconomical to manage with spraying water and continually grading the road.

Consultation with a pavement designer is advised for sub-base, and base depths that will be determined by factors such as road surface material, environmental conditions, drainage and slope of road.

Application Technique 1 - GRT: 7000 Surface Polymer Seal

1.0 Assumptions and considerations

This application option is preferred for unsealed roads where a single application is desired. The section of road should be prepared beforehand with a motor grader to ensure the removal of potholes, ruts, and corrugations. To get the best results, it is important to get GRT:7000 product penetrating as much as possible into the base material.

1.1 Testing for dilution and application rates

The application rate will be determined by in the porosity of the surface material. The best outcome is for the product to be applied in a single pass as once the product is bonded into the soil it becomes hydrophobic and will repel further water absorption. Advantages of single application include less time for road delays, labour costs and plant/equipment.

Test absorption with a 1L bucket of water, at a dilution mix of 1:1 (1 part product to 1 part water). Pour this over a $1m^2$ patch of the graded road. The idea is to flood to area with product (*Image 1.2*), so take this into consideration when advising water cart driver, the correct rate of speed for application. If the product mix sits on the surface with little visible absorption, a single pass is recommended. If the dilution mix absorbs ready into the base, there is high porosity, and the probability will be a requirement of a second dose. Adjust the dilution accordingly to 1:2 and for allow for two passes.

Note: Allow the first pass to dry before repeating the application.

1.2 How to apply

Application is done using a standard water truck with a gravity fed dribble bar or sprayer at the correct speed to achieve application rate of around 1L/m^2. This water cart is then followed closely behind by a multi wheeled (PTR) pneumatic tyred roller (*image 1.3*). This multi tyred roller is the preferred equipment to achieve density and smoothness while allowing for the best penetration of the product into the road surface material. It also conforms to the road surface better than a drum. The polymer seal achieved should be around 10 mm.



Image 1.1 Grade Road/Yard



Image 1.2 Distribute GRT: 7000


Image 1.3 Pneumatic tyred roller followed behind

***

Application Technique 2 - GRT: 7000 Wearing Course Slurry Seal

2.0 Assumptions and considerations

Wearing course slurry technique is a preferred option for smaller stretches of road, yards, or carparks. It is more labour intensive as it requires greater precision in application. The result will be a more robust surface suitable to heavy vehicle activity, especially turning points. The wearing course layer of up to 25mm can be achieved.

The section of road/yard should be prepared beforehand with a grader ensure the removal of potholes, ruts, and corrugations. This should also be compacted top ensure any stones are pushed below the surface. In-situ material can be used or a road base such as 2.3 gravel can be spread at a depth determined by the pavement designer.

Then, the addition of approximately 20 mm of crusher dust or similar is required to achieve a smoother surface and bind together the fines on the surface.

2.1 How to apply

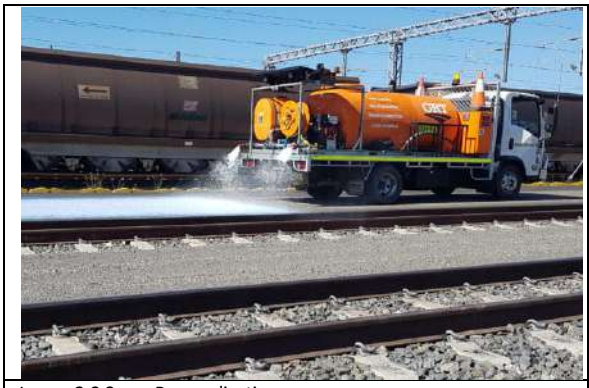

Image 2.0 Spray Bar application


Image 2.1 Via hose

Application of the product can be done through a spray bar or dribble from water cart/trailer (*image 2.0*) or through a gravity fed hose (*image 2.1*). The idea is to flood the area with product to ensure good penetration into the crusher dust. The desired result is to aim for 750ml of product per m^2 with a dosage application of $3L/m^2$. Dilution rate of 1:3 (1 part product to 3 parts water).



Image 2.2 Agitate into surface using rakes



Image 2.4 Motorised Single Drum Pedestrian Roller

The process of agitation by using a rake allows mixing the product in-situ prior to compacting with a roller. The additional step of raking the surface after the initial distribution of the product to ensure the best penetration to a depth of approximately 20mm to 25mm. GRT:7000 is an air-drying product, and hence the depth of 25mm (approx. 1 inch) is recommended as anything deeper does not tend to dry.

Once the surface is dried, it can be trafficked.

Maintenance Coats

We recommend the first maintenance coat for a permanent/long term project be after 2-6 weeks. This allows for the wearing course to be trafficked and any loose fines can be rebound to the surface. Allow 0.15L/m2 at a dilution mix ratio of 1:4 (1 part product to 4 parts water). This can simply be dispensed through the dribble bar of a water truck. Once dried, it can be trafficked.

Ongoing maintenance: Follow up applications should be on an as needs basis at same rate - 0.15L/m2 at a mix ratio of 1:4 (1 part product to 4 parts water).

1.5 Patching any failure points.

GRT: 7000 is a polymer and is accumulative in nature. Any pavement will be subject to areas of failure due to turn points of trucks and forklifts. Repair is easily done by creating slurries made of base material with some fines, and GRT: 7000, in a wheelbarrow that can be shovelled onto any affected area and compacted.

Further details: Please feel free to contact me by email toby@globalroadtechnology.com with any questions.

Yours Sincerely,
Toby Clarke
Business Development Manager

GRT

Erosion Control

GRT: Enviro Binder

The proven and effective way to control erosion and dust worldwide

PRODUCT FEATURES:

- Tough, long lasting dust and erosion control
- Environmentally friendly and safe for workers
- Proven in the field, verified in the lab
- Cost effective erosion control for batters, stockpiles, embankments and table drains



Certified System
Quality
ISO 9001
SAI GLOBAL

GRT: Enviro-Binder is a unique polymer based product that provides erosion control results for up to 12 to 24 months.

To make protecting your site even easier, GRT has specialised polymer application trailers & pumps for hire or purchase.

STOP EROSION - STOP DUST - PROTECT THE ENVIRONMENT

Contact GRT: (07) 5667 8550 | globalroadtechnology.com

Designed & Built in Australia

AUSTRALIAN MADE

12.4 Wet Earth

Shown overleaf.

DustWorx® GX

Haul Road Dust Suppressant



Features

- Concentrated liquid polymer solution
- Non-gelling polymers bind the dust particles
- Low dosage rates
- Higher dosage rates improve performance
- Applied with standard water cart equipment
- Non corrosive
- Excellent freeze-thaw stability
- Compatible with most water sources
- 100% environmentally safe
- Available in containers from 25 litres to 1,000 litres

Benefits

- Low application rates achieve immediate results
- Reduced road dust
- Reduced road watering requirements – better water cart efficiency
- Increased ground compaction
- Reduced road maintenance requirements – less grading required
- Low cost solution
- Easier and safer to use than powdered polymers
- Non-gelling so easily dilutes in water

Applications

DustWorx® GX can be used as an low dosage additive to water carts as part of ongoing haul road dust management or as a high dose application for longer term (up to 2 month) dust control of haul and LV roads.

DustWorx® GX can also be used as a crusting agent for stockpiles and tailings dams.

Dilution Rates

- 1:5,000 to reduce watering frequency (eg 50%) for haul roads
- 1:500 and apply at 1L per m2 for 1 to 2 days dust control with additional no watering
- 300ml per m2 (initial application & 50ml per m2 ongoing) for 1-2 month dust control
- 30ml to 40ml per m2 when used as a crusting agent for up to 6 months dust control of non-traffic areas

www.wetearth.com.au
ABN: 50 147 891 496
13 Glen Avon Terrace Wodonga VIC 3690
ph: +61 2 6062 3300

DustWorx GX

APPLICATION GUIDE

To begin you need

- DustWorx GX
- An empty (or partially filled) water tank
- An appropriate method / plan to transfer or pump DustWorx GX into the water tank
- A suitable water supply to fill the tank (Note: water should be of reasonable quality)

Product blending

1. Add water into the tank to approximately ¼ or 25% of capacity
2. Add the DustWorx GX to the tank
3. Add the balance of the water required to fill the tank

It is also possible to add the DustWorx GX into the water flow going into the tank using a dosing system.

Pumping

The concentrated DustWorx GX is very viscous (~1500 cP) so any pump needs to be able to handle this viscosity. This requires a positive displacement pump and larger than normal piping to minimise friction losses. The following are some of the pump options that can be used:

- Piusi Garda 2 Gear Pump - 12vDC, good for solar/battery systems – 5.5 litres per min
- MixRite TF25 – Water driven proportional dosing, no power required – 23 litres per min
- Progressive Cavity Pumps – eg Mono CP800 – 46 litres per min
- Diaphragm Pumps
- Gear Pumps – eg Tuthill or Gorman Rupp
- Peristatic or Hose Pumps

Things to note

- DustWorx GX should be stored in a cool (0 to 35 degree C) and dry place out of direct sunlight to maximise its performance.
- Once diluted in water DustWorx GX is not viscous (like some other polymer solutions) so can be easily applied through any conventional water cart or water spray system without the risk of blocking pumps or nozzles.
- DustWorx GX can also be dosed inline directly to sprays as it mixes easily in water and does not require time to activate.

For more information and to obtain the Material Safety Data Sheet please contact Wet Earth.

© Wet Earth 2020

SAFETY DATA SHEET

NAME: DUSTWORX GX

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

COMPANY NAME: Wet Earth Pty Ltd (ABN 50 147 891 496)
ADDRESS: 13 Glen Avon Terrace,
Wodonga, VIC, 3690, Australia
EMERGENCY PHONE: 0402 429797
PHONE: 02 6062 3300
FAX: 02 6100 9271
EMAIL: sales@wetearth.com.au

PRODUCT NAME: DustWorx GX
SYNONYMS: GX

USE:
- Dust Suppressant
- Water Extender
- Soil Stabiliser
- Crusting agent

2. HAZARD IDENTIFICATION

NON-HAZARDOUS substance. NON-DANGEROUS GOODS. According to GHS Criteria, and ADG Code.

RISK PHRASES	None under normal operating conditions	
LABEL ELEMENTS	Hazard pictogram(s):	None.
	Signal word:	None.
	Hazard statement(s):	None.
	Precautionary statement(s):	None.
	Additional elements:	None.
OTHER HAZARDS	Spills produce extremely slippery surfaces.	

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 – Substances
Not applicable, this product is a mixture.

3.2 – Mixtures
This product is a mixture.

Hazardous components
Contains no reportable hazardous substances.

4. FIRST AID MEASURES

SWALLOWED	Rinse mouth with water. Do not induce vomiting. Get medical attention immediately.
EYES	Rinse thoroughly with plenty of water, also under the eyelids for at least 15 minutes. In case of persistent eye irritation, get medical attention.
SKIN	Wash off immediately with soap and plenty of water and remove contaminated clothes. In case of persistent skin irritation, consult a physician.
INHALED	Move to fresh air immediately. No hazards which require special first aid.
ADVICE TO DOCTOR	Treat according to symptoms.

5. FIRE-FIGHTING MEASURES

SUITABLE EXTINGUISHING MEDIA	Water, Water spray, Foam, Carbon dioxide (CO2), Dry powder.
HAZARDS FROM COMBUSTION PRODUCTS	None known.
PRECAUTIONS FOR FIRE FIGHTERS & SPECIAL PROTECTIVE EQUIPMENT	Spills produce extremely slippery surfaces. Wear self-contained breathing apparatus and protective suit.
SPECIFIC HAZARDS	Spills produce extremely slippery surfaces.

6. ACCIDENTAL RELEASE MEASURES

EMERGENCY PROCEDURES	No special precautions required. Do not contaminate water. Keep people away from spill/leak.
METHODS AND MATERIALS FOR CONTAINMENT AND CLEAN UP	Do not flush with water. Dam up. Soak up with inert absorbent material. If liquid has been spilt in large quantities clean up promptly by scoop or vacuum. Keep in suitable and closed containers for disposal. After cleaning, flush away traces with water.

7. HANDLING AND STORAGE

PRECAUTIONS FOR SAFE HANDLING	Renders surfaces extremely slippery when spilled.
CONDITIONS FOR SAFE STORAGE	Keep container tightly closed. Freezing will affect the physical condition and may damage the material. Incompatible with oxidizing agents.
INCOMPATIBILITIES	Oxidizing Agents.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

OCCUPATIONAL EXPOSURE	None.
ENVIRONMENTAL EXPOSURE	Do not allow uncontrolled discharge of product into the environment.
ENGINEERING CONTROLS	Use local exhaust if misting occurs. Natural ventilation is adequate in absence of mists.
PERSONAL PROTECTION	RESPIRATORY PROTECTION In case of insufficient ventilation wear suitable respiratory equipment. HAND PROTECTION Rubber gloves. EYE PROTECTION Safety glasses with side-shields. Do not wear contact lenses where this product is used. SKIN AND BODY PROTECTION Chemical resistant apron or protective suit if splashing or repeated contact with solution is likely.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Clear to slightly yellow viscous liquid
ODOUR:	Slight.
pH:	6 -9
VAPOUR PRESSURE (mmHg):	2.3 kPa @ 20^{o}C
VAPOUR DENSITY:	Equivalent to water (-0.8 g/L)
BOILING POINT/RANGE:	> 100^{o}C
FREEZING/MELTING POINT:	< 5
SOLUBILITY:	Completely miscible in water.
SPECIFIC GRAVITY (water = 1)	1.0 – 1.4
FLAMMABILITY:	Not applicable.
FLASH POINT:	Does not flash.
BULK VISCOSITY (CPS):	See technical bulletin
OTHER PROPERTIES:	Not expected to be oxidising based on the chemical structure.

10. STABILITY AND REACTIVITY

STABILITY	Stable.
MATERIALS TO AVOID	Incompatible with oxidising agents.
HAZARDOUS DECOMPOSITION PRODUCTS	Thermal decomposition may produce Carbon oxides (COx) Nitrogen oxides (NOx). Hydrogen cyanide (hydocyanic acid) may be produced in the event of combustion in an oxygen deficient atmosphere.

11. TOXICOLOGICAL INFORMATION

Information on the product as supplied:

Acute oral toxicity:	LD50/oral/rat > 5000 mg/kg.
Acute dermal toxicity:	LD50/dermal/rat > 5000 mg/kg.
Acute inhalation toxicity:	Testing by the inhalation route is inappropriate because expose of humans via inhalation is unlikely: the substance has no vapour pressure and there is practically no exposure to inhalable aerosols.
Skin corrosion/irritation:	Not expected to be irritating.
Serious eye damage/eye irritation:	Not expected to be irritating.
Respiratory/skin sensitisation:	Not sensitising.
Mutagenicity:	Not mutagenic.
Carcinogenicity:	Not carcinogenic.
Reproductive toxicity:	Not toxic for reproduction.
STOT – single exposure:	No known effects.
STOT – repeated exposure:	No known effects.
Aspiration hazard:	No hazards resulting from the material as supplied.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Information on the product as supplied:

Acute toxicity to fish:	LD50/Oncorhynchus mykiss/96 hours > 100 mg/L.
Acute toxicity to invertebrates:	EC50/Daphnia/48 hours > 100 mg/L.
Acute toxicity to algae:	IC50/Algae/72 hours > 100 mg/L.
Chronic toxicity to fish:	No data available.
Chronic toxicity to invertebrates:	No data available.
Toxicity to microorganisms:	No data available.
Effects on terrestrial organisms:	No data available.
Sediment toxicity:	No data available.

12.2 Persistence and degradability

Information on the product as supplied:

Degradation:	Not readily biodegradable.
Hydrolysis:	Does not hydrolyse.
Photolysis:	No data available.

12.3 Bio accumulative potential

Information on the product as supplied:

The product is not expected to bio accumulate.

Partition co-efficent (Log Pow):	< 0
Bioconcentration factor (BCF):	No data available.

12.4 Mobility in soil

Information on the product as supplied:

No data available.

12.5 Other adverse effects

None.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHODS	In accordance with local, state and federal regulations. Can be landfilled or incinerated, when in compliance with local regulations.
SPECIAL REQUIREMENTS FOR LANDFILL OR INCINERATION	Rinse empty containers with water and use the rinse water to prepare the working solution. Can be landfilled or incinerated, when in compliance with local, state and federal regulations.

14. TRANSPORT INFORMATION

Land transport (ADG): Not classified.	**Sea transport (IMDG):** Not classified.	**Air transport (IATA):** Not classified.

NON-DANGEROUS GOODS. No special transport requirements necessary.

15. REGULATORY INFORMATION

Australia (AICS): All components of this product are either listed on the inventory or are exempt from listing.

16. OTHER INFORMATION

PREPARATIONS AND REVISIONS	This SDS was prepared/reviewed in accordance with the following: Model Work Health and Safety Regulation & Code of Practise of Safety Data Sheets for Hazardous Chemicals. **Version 1.2 supersedes all other versions.**

This SDS summarises our best knowledge of the health and safety hazard information of the product and how to safely handle and use the product in the workplace. It should be read taking into account how the product is handled in your particular situation and how it is used in conjunction with other products. This is the last page of the SDS.

WATER DEMAND ASSESSMENT

TALLAWANG SOLAR FARM

Prepared for:



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Prepared By	**James Davis**
Released By	**Travis Smith**
Job Number	**20-010**
Date	22/03/2024
Document Name	**20-010 - Tallawang Solar Farm - [E] - Water Demand Assessment.docx**
Version	**E**

Document Revision History

Version	Revision History
A	**Draft Issued to Client**
B	**Revised Draft Issued to Client**
C	**Revision Issued to Client**
D	**Amended based on client comments**
E	**Amended based on client comments**

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1 Introduction

icubed Consulting has been commissioned to investigate the water resource requirements for the construction of the Tallawang Solar Farm. These requirements have been established to show the additional water demand imposed by the solar farm's construction and does not include existing water demands of the site / current infrastructure. This report will contain the estimated quantities and qualities of water required for the project's construction including both permanent elements (PV Array, substation, etc.) and temporary elements (Accommodation Camp, laydown area, etc.)

The Tallawang Solar Farm is approximately 80km east of Dubbo and 15km north of Gulgong. This locates the project within the Mid-West Regional Council area and the Central West Orana Renewable Energy Zone (REZ) in NSW. The current description of the project suggests that the solar farm is expected to output a capacity of 500MW produced by an array of solar panels, interconnected via a series of unsealed access tracks with the necessary drainage infrastructure. These tracks are assumed to combine to a net internal length of 44km. The current solar farm boundary is depicted in Figure 1.

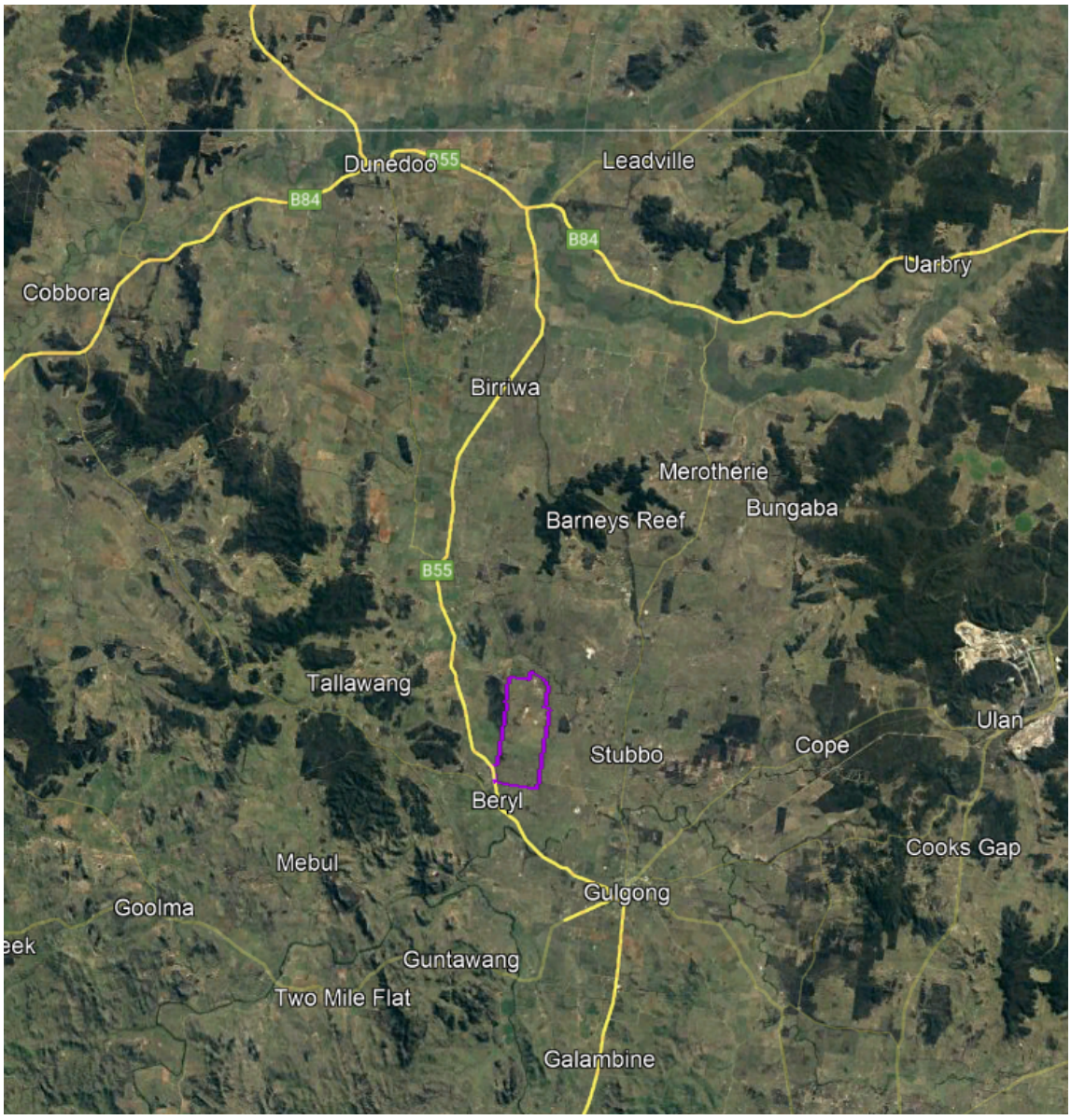


Figure 1: Tallawang Solar Farm Geographic Location
Source: Google Earth, 2023

As per email correspondence on 13/03/2023, RES established its own anticipated water quantities for the construction of the Tallawang solar farm. icubed Consulting has been commissioned to provide additional information as to anticipated quantities making separate estimations to confirm the existing data.

icubed has identified that significant quantities of water will be required for access tracks, ancillary pads, footing quantity estimates, dust suppression and potable water for the construction workforce. To better evaluate these quantities icubed will employ the use of the current provided plan of the solar farm *04651-RES-IMP-DR-PT-001*.

2 Expected Material Quantities

Preliminary estimated quantities for the construction of the civil components of the project have been assessed to establish the likely demand for water. Material demand has been assessed for the major track, minor tracks, O&M facility, internal substations, and construction compound / laydown area. Material demand for the panel footing construction has also been assessed based on the specified footing size provided by RES. The following details the preliminary estimated quantities for the project construction.

2.1 Earthworks Pavement Material

Site geometry has been gathered from the provided site plan *04651-RES-IMP-DR-PT-001*.

The elements detailed include:

O&M Facility
Consists of Sheds, Offices, Hardstands, Carparks and Maneuvering Areas
Internal Substation
Consists of Electrical Infrastructure, Access Roads, a Switchroom and Control Room.
Construction Compound
Consists of Sheds, Offices, Hardstands, Carparks and Maneuvering Areas
Temporary Laydown Area
Consists of Hardstands
Accommodation Compound
Consists of Accommodation, Offices, Mess, Gym, Helipad, other support buildings, Carparks and Maneuvering Areas

2.1.1 Access Tracks

The preliminary layout of the access track network contains approximately 44km of track length to sufficiently form access routes to solar farm infrastructure and solar panel arrays. Noting the limited availability of geotechnical information within the site at the time of writing, a pavement course thickness of 500mm has been assumed for the major access track and 300mm course thickness has been applied to all minor access tracks and hardstand formations as a conservative estimate. While this may be reduced during the detailed design phase of the project, it is a conservative assumption that serves to provide an allowance for additional pavement requirements at areas such as intersection widenings and pavement course thickening at locations with weaker subgrade material.

Table 1 provides a summary of the geometric assumptions associated with the pavement quantity estimates for access track and hardstand construction.

Table 1: Access Track and Hardstand Geometrical Parameters

Major Tracks	
Total Track Length	7.3km
Track Width	6.0m (Typ.) – Traffic Lane (5.0m trafficable)
Pavement Thickness	500mm
Minor Tracks	
Total Track Length	36.6km
Track Width	5.0m
Pavement Thickness	300mm

2.1.2 Ancillary Pads

Ancillary pad construction for supporting infrastructure / services within the project also needs to be considered when establishing earthworks pavement material demand / estimated water demand. This section of the report will assess the requirements for construction compounds / laydown areas, O&M facilities, accommodation compound and substation facility benches. The anticipated ancillary pad requirements are shown in Table 2.

Table 2: Ancillary Pad Dimensions and Parameters

Bench	Area (m^2)	Pavement Thickness (m)
O&M Facility	4,550	0.3
Internal Substation	46,250	0.3
Construction Compound	35,300	0.3
Temporary Laydown Area	55,600	0.3
Accommodation Compound	67,000	0.3

Areas for these pads is based on the dimension provided on RES drawing 04651-RES-IMP-DR-PT-001.

2.1.3 Pavement Material Quantity Estimates

Using the above information as the basis for the assessment, overall crushed rock pavement demands for the construction phase of the project have been estimated as well as an assessment of volume (m^3), the overall tonnage of gravel (t) and the water demand during placement (kL). A density of 2.2t/m^3 has been assumed for the gravel. Water demand for pavement construction has been assumed at 7.5% of total material volume, not including dust suppression (water requirements will be discussed further in Section 0 of the report).

Table 3: Pavement Material Quantity Estimates

Infrastructure	Quantity (m^3)	Water (kL)	Gravel Mass (t)
Major Track	21,900	1,642.5	48,180
Minor Track	54,900	4,117.5	120,780
Net Track	**76,800**	**5,760**	**168,960**
O&M Facility	1,365	102.375	3,003
Internal Substation	13,875	1,040.625	30,525
Construction Compound	10,590	794.25	23,298
Temporary Laydown Area	16,680	1,251	36,696
Accommodation Compound	20,100	1,507.5	44,220
Net Ancillary Pads	**62,610**	**4,695.75**	**137,742**
TOTAL	**139,410**	**10,455.75**	**306,702**

2.2 Solar Footing Construction Materials

This section has been input to represent the water requirements necessary for RES to undertake onsite batching for the required solar panel footings, however, it is icubed Consulting's understanding that this shall not be the case. As such these figures will not be included in the final estimate of the required water Quantity.

Consideration should be taken into the water demand for producing the concrete footings required for the solar panel arrays. Noting the constituents for concrete production, footing construction will require the importation of cement, aggregates, sand, and water. Under the site plan provided by RES (*04651-RES-IMP-DR-PT-001*), it has been estimated that the approximate net area covered by the solar array is 10km^2 of which RES has stated that approximately 30% will require a 'typical' footing.

Assumptions have been established to estimate quantities for the required pile footings. The following states the assumptions made as conservative parameters.

- *Piles are pre-drilled and filled with stabilised sand.*
- *Holes are 3m deep, diameter of 250mm*, volume ~ 0.1472 cu.m.
- *Concrete mix requires 200L water to 1 cubic meter of fill.*

Elecnor's estimates suggest that approximately 48,650 footings are expected for the Tallawang Solar Farm. This is based on 12 piles per 3-string tracker – 28 modules per string, 575Wp modules. The previous assumptions require 30L of water per footing. It is estimated that if onsite batching was to be undertaken, it would require 1,459.5kL of water.

Concrete will be included in the final summary but with be tagged with an * to denote that the water will not need to be directly sourced.

2.1 Fire Fighting Water

A firefighting strategy will be required to be prepared for the development; however allowance has been made for 40,000L to be maintained onsite for the purpose of this assessment.

3 Water Demand

This section of the report has been constructed to summarize the final expected water demand for the construction of the project, providing details on estimated quantities of both potable and non-potable water requirements. This will be used as the foundation for the water resource assessment. Table 4,

Table 5 and Table 6 detail the anticipated water demand associated with the project's construction phase (refer to section 2.1), water demand for dust suppression and workforce demand at construction compounds. Data for project duration and size of the workforce has been collected from the schedule provided by Elecnor – *Tallawang – Resources Histogram Elecnor*.

The following assumptions have been made regarding the projects water demand:

Pavement Construction:

- *7.5% water application per m^3 pavement placement*

Dust Suppression:

- *4.0L/m^2/day (as specified by Elecnor, suggested by RES)*
- *Assume 10 km in use at any time, 8m application width.*
- *Assume 48 working construction weeks per year, 6 days per week.*
    - *30 months of construction*

Construction compound:

- *30L/day per person*
- *Conservative average 220 full-time personnel for 36 working months, working 6 days per week (as provided by Elecnor resource histogram)*

Accommodation Camp:

- *200L/day per person*
- *Conservative average 220 full-time personnel for 36 working months, staying 7 days per week (as provided by Elecnor resource histogram)*

Fire Fighting:

- *40,000L Storage*

Noting the above, the following quantities have been established for water demand:

Table 4: Water Demand for Pavement Construction

	Pavement Quantity (m^3)	Water Application (%)	Water (kL)
Pavement Construction	139,410	7.5	10,455.75

Note: As per Table 3.

The water demand for dust suppression includes several specific assumptions as stated below:

- 30 months of dust suppression, determined from Elecnor Histogram – *Tallawang – Resources Histogram Elecnor*. (including ACEREZ Commissioning)
- Assume 1 major track in use and 2 minor tracks throughout the project.
- Note: Additional water consumption for field irrigation is not included in the estimate, assumed as already included in current onsite water consumption.

Table 5: Water Demand for Dust Suppression

	Track Use	Width of Application	Application Months	Num. Application Days	Rate (kL/m²/day)	Water (kL)
Dust Suppression	10,000m	8m	30	782	0.004	**250,240**

** The potential water demand for dust suppression has considerable variability depending on the climatic conditions in the lead-up to and during construction. During periods of low rainfall, water demand can be considerably higher, and consideration should be given to the use of alternative dust surfactants such as polymers or magnesium chloride.*

The potable water quantities listed below incorporates the estimated potable water demand. This includes water demand for workforce drinking, showering, washing, etc. It is worth noting that the maximum workforce size anticipated to be on-site for a month is 420 personnel. Whilst the average monthly water demand for potable water is anticipated to be 1,512kL, the maximum monthly water quantity is 2,898kL.

Table 6: Potable Water Demand

	Workforce	Demand (L/day)	Duration (days)	Water (kL) (Potable)
Construction Compound	220	30	939	6,199.0
Accommodation Camp	220	200	1035	48,218.8

The quantities in Table 4, Table 5 and Table 6 depict the 4 major water expenditures for the project – pavement construction, solar footing construction, dust suppression, and potable water for the workforce. These quantities estimate that the project will require 245,740kL of non-potable water and 54,417.8kL of potable water (a total of 300.158ML). Shown below in Table 7 and Table 8 are the major sectors of water consumption as anticipated for the Tallawang Solar Farm Project.

Table 7: Estimates of Potable Water Demand

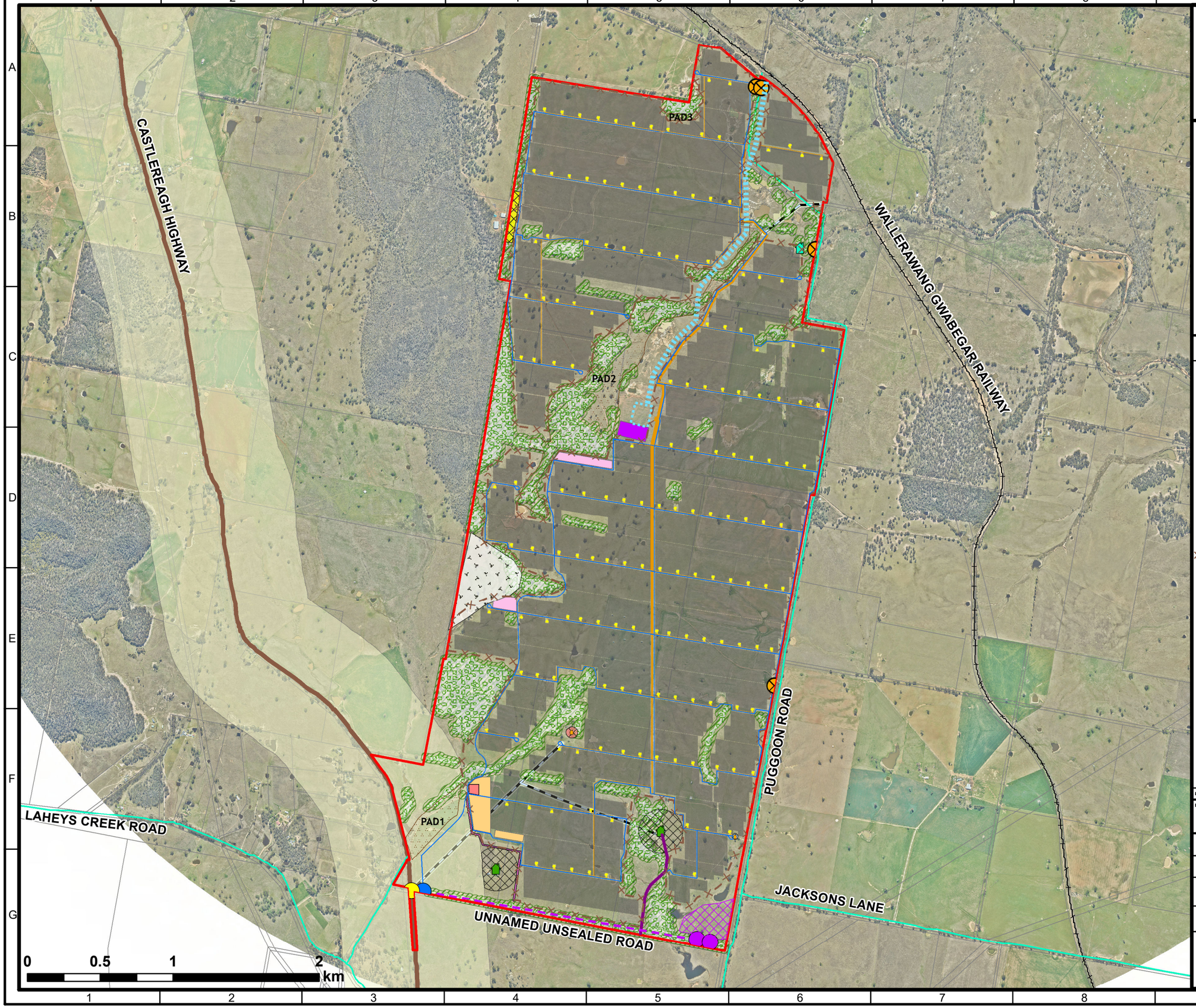
Water Consumption	Water Consumption Volume (ML)	Type / Quality
Workforce	**54.42**	**Potable**

Table 8: Estimates of Non-Potable Water Demand

Water Consumption	Water Consumption Volume (ML)	Type / Quality
Construction - Tracks	5.761	Non-potable
Construction - Ancillary Pads	4.696	Non-potable
Construction - Dust Suppression	233.8	Non-potable
Construction – Concrete batching*	1.5	Non-potable
Fire Fighting Water	0.04	Non-potable
Net Non-Potable Demand	**245.74**	**Non-potable**

4 Appendix A – RES Site Plan *04651-RES-IMP-DR-PT-001*.

Shown overleaf.



TALLAWANG SOLAR FARM

FIGURE 2.1

SITE LAYOUT WITH CONSTRAINTS

SOURCE DATA © NEW SOUTH WALES CROWN
(SPATIAL SERVICES, DEPARTMENT OF CUSTOMER SERVICE)

N

- PROPOSED SINGLE AXIS
- ACCOMMODATION CAMP
- BESS AND DC-DC COUPLED PCS WITH HARDSTANDING
- PROPOSED MV RETICULATION
- PROPOSED ACCESS
- ACCOMMODATION ACCESS (PROPOSED SEALED ROAD)
- PROPOSED O&M FACILITY
- CONSTRUCTION COMPOUND
- TEMPORARY LAYDOWN
- PROPOSED SUBSTATION
- GRID CONNECTION INFRASTRUCTURE
- PRIMARY PROJECT ACCESS
- PROPOSED INTERSECTION UPGRADE
- SECONDARY ACCESS
- ACCOMMODATION CAMP ACCESS
- SECURITY FENCE
- INDICATIVE LANDOWNER ACCESS
- PROPOSED LANDSCAPING AREA
- INVOLVED DWELLING
- INVOLVED, UNOCCUPIED DWELLING
- DWELLING EXCLUSION ZONE
- LANDOWNER EXCLUSION ZONE
- NATIVE VEGETATION (UMWELT)
- NATIVE VEGETATION BUFFER, 20m
- ROCKY OUTCROP
- CULTURAL HERITAGE HUT (UMWELT)
- CULTURAL HERITAGE HUT BUFFER, 20m
- CULTURAL HERITAGE HUT BUFFER, 40m
- CULTURAL HERITAGE AREA (UMWELT)
- STATE ROAD
- LOCAL ROAD
- STATE ROAD (HIGHWAY) BUFFER, 500m
- 22kV DISTRIBUTION LINE (TO BE REROUTED WHERE NECESSARY)
- PROJECT AREA BOUNDARY
- NSW CADASTRE (2022-10-06)

N.B. LAYOUT IS INDICATIVE AND SUBJECT TO CHANGE, BUT WILL GENERALLY BE IN ACCORDANCE WITH THE DRAWING.

LAYOUT DWG	N/A	LAYOUT NO.	INFRASTRUCTURE12_20231010

DRAWING NUMBER

04651-RES-IMP-DR-PT-001

SCALE - 1:25,000 @ A3

COORDS

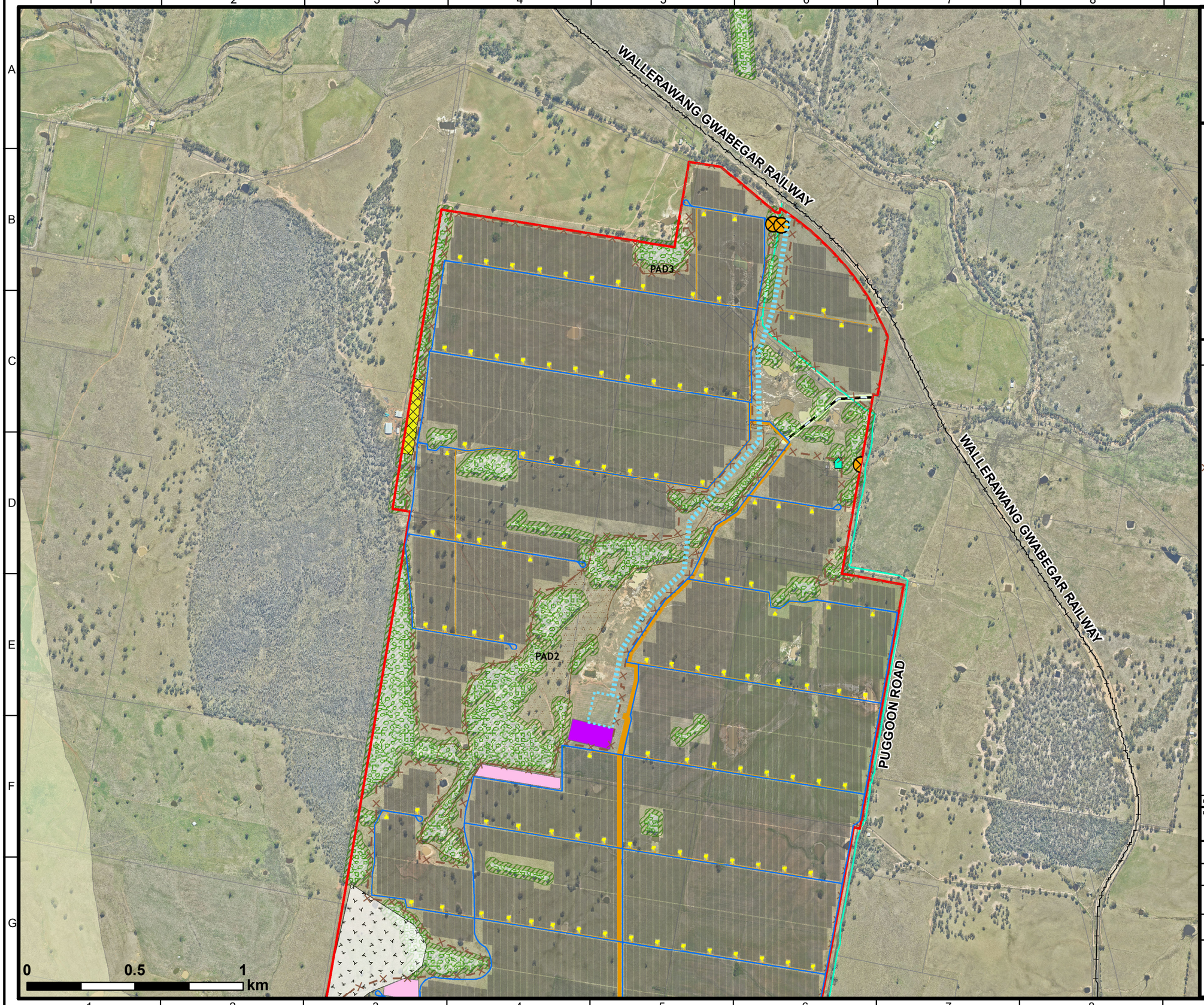
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165 WALKER STREET,
NORTH SYDNEY, NSW 2060

EMAIL: info-australia@res-group.com



TALLAWANG SOLAR FARM

FIGURE 2.1

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PAD2

PAD1

PUGGOON ROAD

JENKINGS LANE

UNNAMED UNSEALED ROAD

JACKSONS LANE

0 0.5 1 km

TALLAWANG SOLAR FARM

FIGURE 2.1

SITE LAYOUT WITH CONSTRAINTS

SOURCE DATA © NEW SOUTH WALES CROWN
(SPATIAL SERVICES, DEPARTMENT OF CUSTOMER SERVICE)

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- BESS AND DC-DC COUPLED PCS WITH HARDSTANDING
- PROPOSED MV RETICULATION
- PROPOSED ACCESS
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- PROPOSED O&M FACILITY
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- TEMPORARY LAYDOWN
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- SECONDARY ACCESS
- ACCOMMODATION CAMP ACCESS
- SECURITY FENCE
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- CULTURAL HERITAGE HUT BUFFER, 20m
- CULTURAL HERITAGE HUT BUFFER, 40m
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LAYOUT DWG	N/A	LAYOUT NO.	INFRASTRUCTURE12_20231010

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JENKINGS LANE

UNNAMED UNSEALED ROAD

CASTLEREAGH HIGHWAY

0 0.1 0.2 km

TALLAWANG SOLAR FARM

FIGURE 2.1

SITE LAYOUT WITH CONSTRAINTS

SOURCE DATA © NEW SOUTH WALES CROWN
(SPATIAL SERVICES, DEPARTMENT OF CUSTOMER SERVICE)

N

- PROPOSED ACCESS
- ACCOMMODATION ACCESS (PROPOSED SEALED ROAD)
- PRIMARY PROJECT ACCESS
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LAYOUT DWG	LAYOUT NO.
N/A	INFRASTRUCTURE12_20231010

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5 Appendix B – Tallawang – Resources Histogram Elecnor

Shown overleaf.

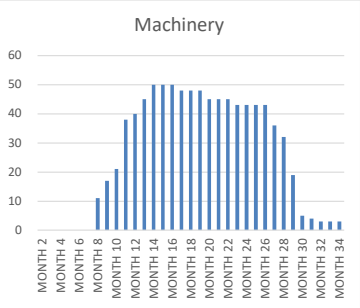
Total power solar	652 MWp
Total power BESS	1000 MWh
Module power	570 Wp
Construction months	36 Months

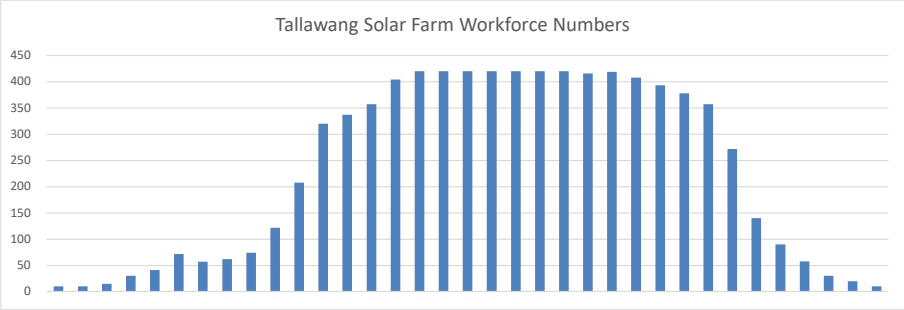
Updated 2/11/23 by Tim for planning RTS submission. Change from 23-10-(

RES - TALLAWANG SOLAR AND BESS FARM

RESOURCES HISTOGRAM

N°	Description	MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6	MONTH 7	MONTH 8	MONTH 9	MONTH 10	MONTH 11	MONTH 12	MONTH 13	MONTH 14
1	MACHINERY														
1.1	TRUCK CRANE	0	0	0	0	0	0	0	5	5	6	7	7	7	7
1.2	FORKLIFT/ TELEHANDLER	0	0	0	0	0	0	0	6	12	15	15	15	15	20
1.3	EXCAVATORS	0	0	0	0	0	0	0	0	0	0	8	10	15	15
1.4	RAMMING MACHINE	0	0	0	0	0	0	0	0	0	0	8	8	8	8
2	DIRECT LABOUR														
2.1	DIRECT LABOUR	10	10	15	15	15	20	25	27	34	42	42	45	45	45
3	INDIRECT LABOUR														
3.1	EARTHWORKS	0	0	0	0	0	0	0	0	0	0	10	12	18	18
3.2	FENCING	0	0	0	0	6	12	12	15	15	15	15	15	15	15
3.3	ROADS	0	0	0	15	20	20	20	20	15	15	20	20	20	20
3.4	FOUNDATIONS	0	0	0	0	0	0	0	0	0	0	0	0	0	10
3.5	MV TRENCHES	0	0	0	0	0	0	0	0	0	10	15	15	15	15
3.6	LV TRENCHES	0	0	0	0	0	0	0	0	0	15	35	35	35	35
3.7	RAMMING	0	0	0	0	0	0	0	0	0	0	12	12	18	18
3.8	STRUCTURE ASSEMBLY	0	0	0	0	0	0	0	0	0	0	0	40	40	40
3.9	MODULES ASSEMBLY	0	0	0	0	0	0	0	0	0	0	0	25	25	35
3.10	MODULES INTERCONNECTION	0	0	0	0	0	0	0	0	0	0	0	15	15	15
3.11	LV LAYING	0	0	0	0	0	0	0	0	0	0	24	36	36	36
3.12	MV LAYING	0	0	0	0	0	0	0	0	0	0	10	15	15	15
3.13	SCB INSTALLATION	0	0	0	0	0	0	0	0	0	5	5	5	10	10
3.14	INVERTERS AND DC/DC CONVERTERS INSTALLATION	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.15	BATTERY RACKS INSTALLATION	0	0	0	0	0	0	0	0	10	20	20	30	30	30
3.16	SCADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.17	CCTV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.18	COMMISSIONING	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Accomodation camp	0	0	0	0	0	20	20	0	0	0	0	0	0	0
Total		10	10	15	30	41	72	57	62	74	122	208	320	337	357



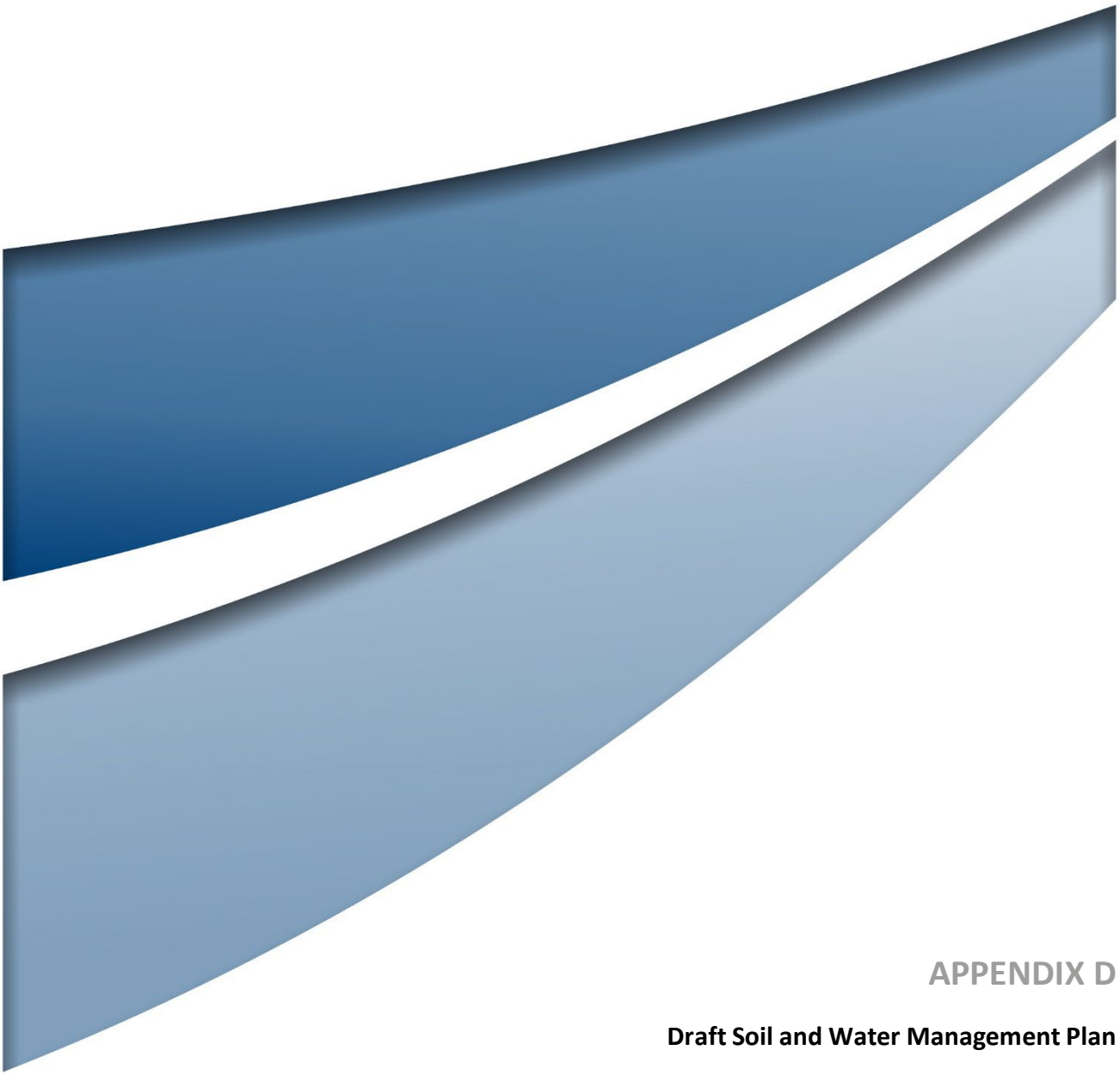


024 version by incorporating 1000MWh of BESS and 36 months constructions

MONTH 15	MONTH 16	MONTH 17	MONTH 18	MONTH 19	MONTH 20	MONTH 21	MONTH 22	MONTH 23	MONTH 24	MONTH 25	MONTH 26	MONTH 27	MONTH 28	MONTH 29	MONTH 30	MONTH 31	MONTH 32	MONTH 33	MONTH 34
7	7	5	5	5	5	5	5	5	5	5	5	5	5	3	1	1	1	1	1
20	20	20	20	20	20	20	20	20	20	20	20	15	15	12	2	2	2	2	2
15	15	15	15	15	12	12	12	10	10	10	10	8	4	1	1	1	0	0	0
8	8	8	8	8	8	8	8	8	8	8	8	8	8	3	1	0	0	0	0
45	45	45	45	45	45	45	45	45	45	45	45	45	40	30	15	15	15	15	10
18	18	18	18	18	15	15	15	8	8	8	8	5	2	1	1	1	0	0	0
15	12	12	12	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	20	20	15	15	10	10	10	10	8	8	8	0	0	0	0	0	0	0	0
10	14	14	14	14	14	14	14	14	14	14	14	10	0	0	0	0	0	0	0
15	15	15	15	15	15	15	15	15	15	15	15	15	12	9	0	0	0	0	0
35	35	35	35	35	35	35	35	35	35	35	35	35	35	15	0	0	0	0	0
18	21	21	21	21	21	21	18	18	18	12	12	12	12	12	6	2	0	0	0
60	60	60	60	60	60	60	60	60	60	60	40	40	40	40	40	20	0	0	0
50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	25	20	20	0	0
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	5	5	0	0
36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	9	0	0	0	0
15	15	15	15	15	15	15	15	15	15	15	15	15	15	4	0	0	0	0	0
10	10	5	10	5	10	5	10	5	10	5	10	5	5	5	5	5	0	0	0
6	12	12	12	12	12	12	12	12	12	12	12	12	12	6	0	0	0	0	0
30	30	35	35	16	24	29	27	30	30	30	30	30	30	20	0	0	0	0	0
6	12	12	12	12	12	12	12	12	12	12	12	12	12	4	4	4	0	0	0
0	0	0	0	21	21	21	21	21	21	21	21	21	21	5	0	0	0	0	0
0	0	0	0	10	10	10	10	15	15	15	15	20	20	20	20	18	18	15	10
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
404	**420**	**420**	**420**	**420**	**420**	**420**	**420**	**416**	**419**	**408**	**393**	**378**	**357**	**272**	**140**	**90**	**58**	**30**	**20**

Internal calcs	Current	timate required	
	400MWh	1000MWh	Total froma bove
Workers	226	565	566
Months	15	20	
workers/month	15.0666667	28.25	

MONTH 35	MONTH 36
1	1
2	2
0	0
0	0
5	5
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
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APPENDIX D

Draft Soil and Water Management Plan

umwelt
Environmental & Social Consultants

SOIL AND WATER MANAGEMENT PLAN

Tallawang Solar Farm

FINAL

May 2024

SOIL AND WATER MANAGEMENT PLAN

Tallawang Solar Farm

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
RES Australia Pty Limited

Project Director:	Malinda Facey
Project Manager:	Marion O'Neil
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Report No.	21139/R16
Date:	May 2024

Environmental & Social Consultants

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Acknowledgement of Country

RES Australia and Umwelt would like to acknowledge the traditional custodians of the Tallawang Solar Farm Project Area – the Wiradjuri people - and pay respect to their cultural heritage, beliefs and continuing relationship with the land.

We pay our respect to the Elders – past, present and future – for they hold the memories, traditions, culture and hopes of Aboriginal people in the area. We thank the Registered Aboriginal Parties, their families and elders for their engagement in this project.

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final V1	Melissa Swan	7 May 2024	Malinda Facey	7 May 2024

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1.0 Introduction

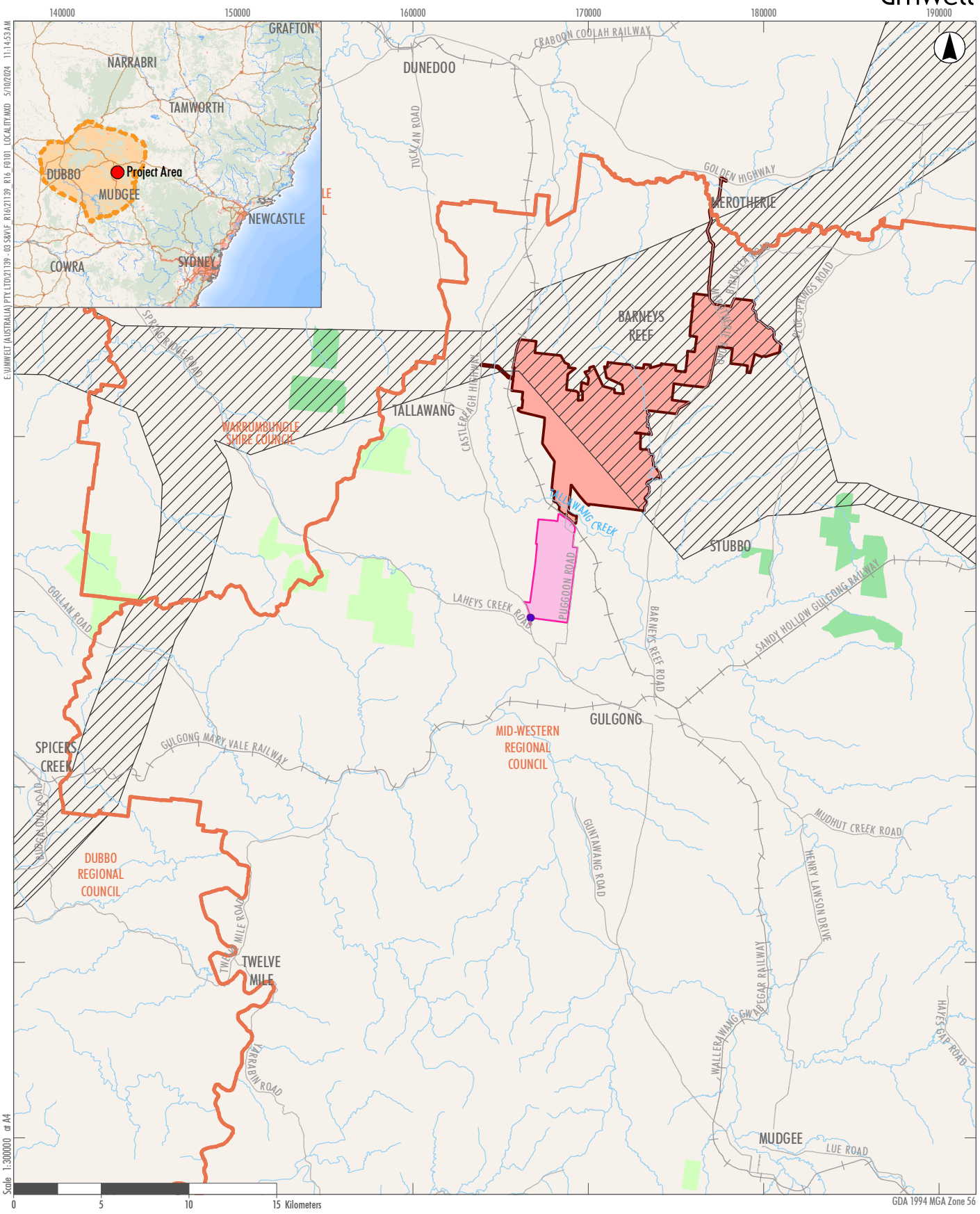
1.1 Background

RES Australia Pty Ltd (RES) is proposing to develop the Tallawang Solar Farm (the Project) to generate solar renewable energy to supply the people of New South Wales (NSW). The Project is located within the Mid-Western Regional Local Government Area (LGA) of NSW, approximately 8 kilometres (km) northwest of Gulgong adjacent to the Castlereagh Highway. The Project's location and regional context is presented in **Figure 1.1**. The Project is strategically situated within the Central West Orana Renewable Energy Zone.

The Project will include the construction, operation and decommissioning of a 500 megawatt (MW) solar farm with a 500 MW Battery Energy Storage System and associated infrastructure, including a temporary workers accommodation (TWA) facility, ancillary construction facilities, operations and maintenance buildings, internal access roads, civil works, and intersection upgrade works on the Castlereagh Highway to allow for Project access. The Project's conceptual layout is provided in **Figure 1.2**.

The Project Area includes four freehold properties and some parcels of Crown Land ('paper roads'), covering an area of approximately 1,300 hectares (ha). These properties are primarily utilised for cropping and grazing activities. The Project will have a total development footprint of approximately 1,016 ha.

This Soil and Water Management Plan (SWMP) has been prepared as requested by NSW Department of Planning, Housing and Infrastructure (DPHI) Water in submissions relating to the Project Environmental Impact Statement (EIS) completed for the Project, in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Volume 2C Unsealed Roads* (DECC, 2008) (hereafter referred to as the 'Blue Book').



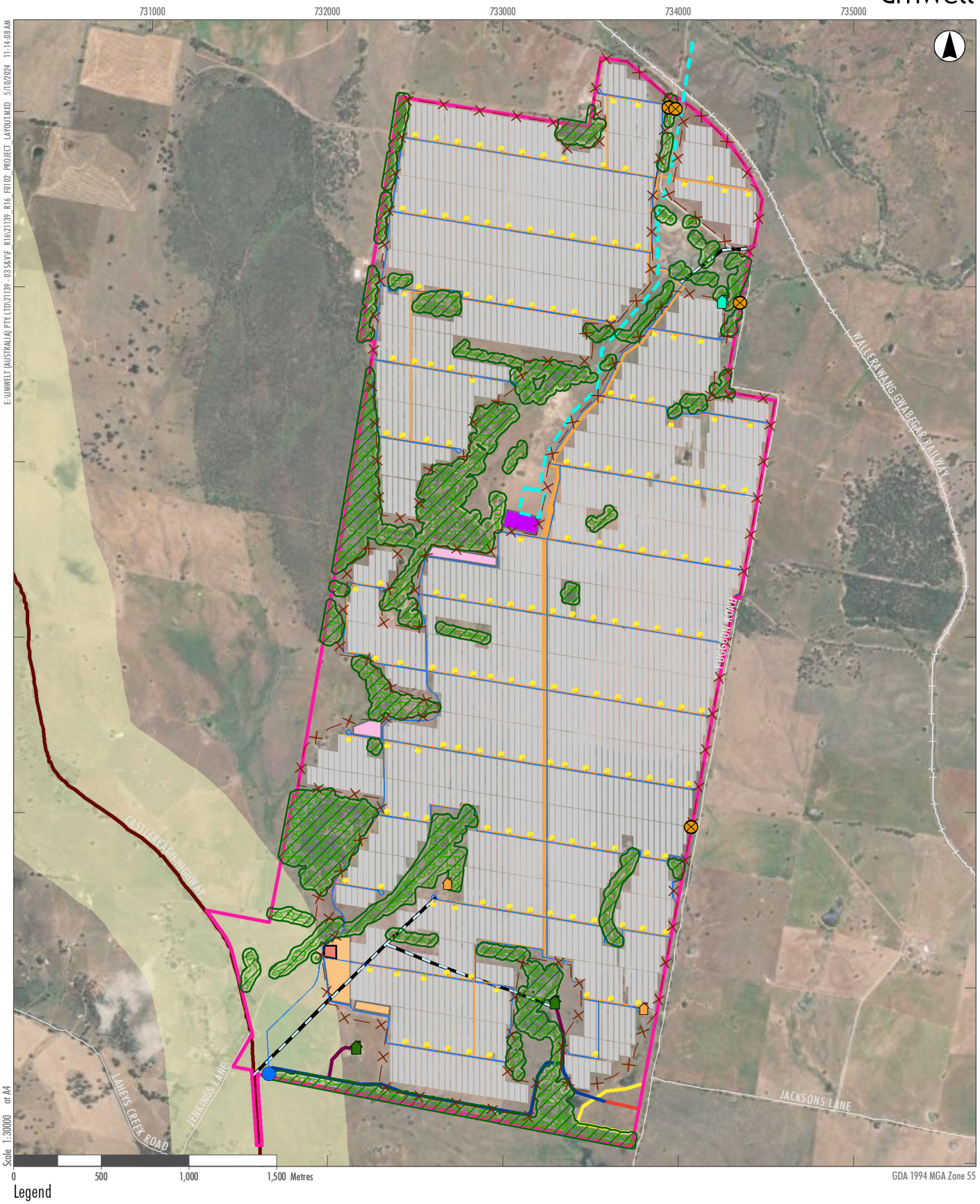
Legend

- Tallawang Solar Farm Project Area
- Barneys Reef Wind Farm Project Area
- Indicative Proposed Central West Orana REZ Transmission Corridor
- Indicative Central-West Orana Renewable Energy Zone
- Access Point
- Local Government Area Boundary
- State Forest
- National Parks (NPWS Estate)
- Road
- Drainage Line
- Railway Line

FIGURE 1.1

Locality Map

Image Source: Data source: DSFI (2024), RES (2024)



Legend

- Project Area Boundary
- Proposed Single Axis Tracker
- Temporary Workers Accommodation (TWA)
- BESS and DC-DC Coupled PCS with Hardstanding
- Proposed Medium Voltage Reticulation
- Proposed Access
- Construction Compound
- Temporary Laydown
- Proposed O&M Facility
- Proposed Substation
- Grid Connection Infrastructure (proposed by EnergyCo)
- Primary Project Access
- Secondary Access
- Security Fence
- Proposed Landowner Access Track
- Temporary Workers Accommodation (TWA) Access
- Proposed Post Construction Landowner Access Track
- Involved Dwelling
- Involved, Unoccupied Dwelling
- Native vegetation (Umwelt)
- Native Vegetation Buffer, 20m
- Local Road
- State Road
- State Road (Highway) Buffer 500m
- 22kV Distribution Line (to be rerouted where necessary)

FIGURE 1.2

Project Layout

Image Source: ESRI Basemap Data source: NSW DFSI (2022), RES (2024)

1.2 Purpose and Scope

This SWMP details the existing environment for the Project Area, the Project site constraints, anticipated level construction staging, and general erosion and sediment controls (ESCs) that are anticipated to be required for all stages of Project construction. Given the Project is currently in the approvals phase with detailed Project design and construction staging yet to be finalised, this SWMP should be considered a preliminary and conceptual document that will be updated prior to construction when detailed Project design and construction staging yet to be finalised.

The purpose of this SWMP is to:

- identify site constraints associated with the existing soil and water environment
- specify the appropriate design standard for erosion and sediment controls based on the anticipated soil, weather and construction conditions
- ensure erosion and sediment control requirements, site constraints and key environmental issues are considered and managed for the Project
- enable soils to be managed appropriately during the construction of the Project to mitigate potential environmental impacts from erosion and sedimentation
- ensure chemicals (e.g. hydrocarbons) and other potential pollution sources (e.g. concrete agitator washout) are managed to minimise the risk of release/spills to the environment
- be flexible and adaptive to accommodate any changes in site conditions and address any ESCs found to be ineffective in meeting performance standards.

Any revision to this SWMP and the ESCP drawings, or the preparation of additional ESCP drawings, will be undertaken and/or reviewed and approved by a specialist soil conservationist (e.g. CPESC) and RES in consultation with construction personnel.

This SWMP should be read in conjunction with any associated and relevant plans that are to be developed for the Project, such as a Project Construction Environmental Management Plan (CEMP), a Vegetation Management Plan (VMP) and engineering design specifications/drawings. Furthermore, a site specific Stormwater Management Plan has been developed by Mot MacDonald for the TWA facility within the Project Area, provided in **Appendix A**, and should be read in conjunction with this SWMP.

This SWMP has been reviewed and approved by Melissa Swan, Certified Professional in Erosion and Sediment Control (CPESC), CPESC number 8954.

2.0 Existing Environment

2.1 Catchment, Topography and Drainage

The Project Area is located within the Macquarie-Bogan Rivers System, in the lower catchment of Tallawang Creek, with Slapdash Creek to the east and Wialdra Creek to the south. Tallawang Creek is located to the north of the Project Area (refer to **Figure 2.1**). These waterways discharge to Cudgegong River, around 8 km southwest of the Project Area.

The topography (refer to **Figure 2.1**) of the Project Area is gently undulating with higher ground to the west, rising to above 520 m AHD and falling to approximately to around 430 m AHD to the east. Within the Project Area, streams there are a number of unnamed ephemeral streams, predominantly first or second based on the Strahler stream ordering system and generally without a well-defined drainage channel.

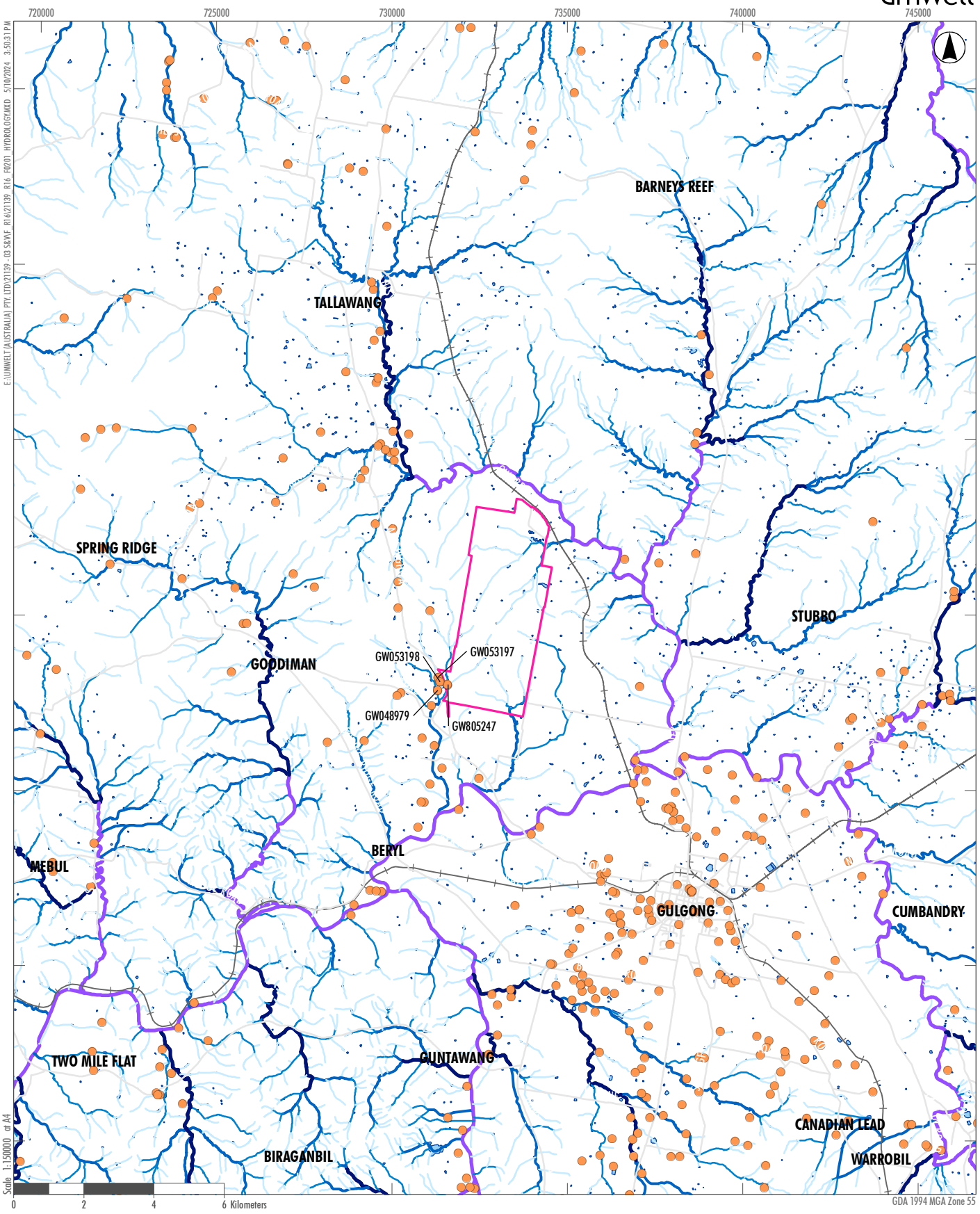
A Water Resources Impact Assessment was undertaken by Umwelt (2022b) for the 5%, 1%, 0.5% and 0.2% Annual Exceedance Probability (AEP) (20-year, 100-year, 200-year and 500-year Average Recurrence Intervals (ARI), respectively) flood events. The assessment concluded the Project Area has a low flood risk, is located outside areas of major flood hazard and there is minimal risk of changes in internal or external waterway flows associated with the Project.

2.2 Groundwater

Groundwater resources within the Project Area are managed under the Water Sharing Plan (WSP) *NSW Murray Darling Basin Fractured Rock Groundwater Sources* (DPIE, 2022). The Project Area is located within the *Lachlan Fold Belt Murray Darling Basin (Lachlan Fold Belt MDB) Groundwater Source*. The Lachlan Belt MDB aquifer supports a number of identified high priority groundwater dependent ecosystems (GDEs) and springs (DPIE, 2019). High potential groundwater dependent ecosystems (GDEs) were identified approximately 400 m north of the Project Area (at the Tallawang Creek watercourse) and moderate-low potential GDEs were identified within the Project Area (BOM, 2017).

Groundwater in the northern half of the Project Area and surrounding the Project Area creek systems are identified in the Mid-Western Regional LEP as 'Groundwater Vulnerability'. One groundwater bore (GW0805247) is located within the Project Area adjacent to and east of Castlereagh Highway. This is a stock and domestic water supply bore with a drilled depth of 42 m. The last recorded groundwater depth was recorded as 12 m below ground on 15/02/2013 (WaterNSW, 2021).

Project construction activities are not expected to intercept the groundwater table (Umwelt, 2022b).



Legend

- Tallawang Solar Farm Project Area
- Dam/Waterbody
- Road
- Railway
- Groundwater Monitoring Bores

Strahler Stream Ordering

- 1
- 2
- 3
- 4
- ≥ 5

FIGURE 2.1

Hydrological Context

Image Source: ESR Basemap Data source: RES Australia (2021), NSW DFSI (2020)

2.3 Soils

The soil landscapes for the Project Area have been sourced from the Seed Dataset provided by the Department of Planning (DPE, 2021). A review of the data did not indicate the likelihood of Acid Sulphate Soils (AAS) within the Project Area.

The majority of the Project Area is located within the 'Home Rule' soil landscape (SI5504hr), which is described as undulating low hills, with sediment derived from the Gulgong and Rouse Granites, located to the east and north of Gulgong (Murphy and Lawrie, 1998). This soil landscape is characterised as having low fertility, acidic topsoils, sodic subsoils and moderate to high erosion hazard where low ground cover exists and flows are concentrated (Murphy and Lawrie, 1998). Some existing minor sheet erosion with moderate to severe gully erosion is present within this soil landscape and may be susceptible to tunnelling due to the sodic, dispersible soils (Murphy and Lawrie, 1998).

The southwest region of the Project Area is located within the 'Tucklan' soil landscape (SI5504tk) and is described as undulating low hills, consisting of andesite, basalt and associated shale, tuff and siltstone (Murphy and Lawrie, 1998). This soil landscape is characterised as having a moderate to high erosion hazard, moderate fertility and moderate to high waterholding and shrink-swell potential (Murphy and Lawrie, 1998). The topography of the soil landscape with the long and steep slopes results in a high erosion hazard potential.

Table 2.1 presents the relevant modelled soil properties sourced from the Seed Dataset (DPE, 2021).

Table 2.1 Modelled Soil Properties

Parameter	Value	
	0 – 30 cm Depth	30 – 100 cm Depth
Soil Erodibility, k factor (as used in the Revised Universal Soil Loss Equation (RUSLE))	0.03 – 0.06	
Clay Percentage	14 – 36%	24 – 46%
Silt Percentage	11 – 26%	10 – 24%
Sand Percentage	40 – 66%	27 – 53%
pH (CaCl2)	4.67 – 5.90	4.90 – 6.60
Electrical Conductivity (dS/m)	0.05 – 0.14	0.05 – 0.22
Cation Exchange Capacity ($cmol_c/kg$)	7 – 24	9 – 30
Soil Organic Carbon	0.72 – 1.84%	0.28 – 0.65%
Exchangeable Sodium Percentage (ESP)	2.23 – 5.90%	3.40 – 8.10%

Soil testing was completed for the Project Area, including for pH, electrical conductivity, ESP and cation exchange capacity, refer to the *Soil, Land and Agriculture Assessment report* (Umwelt, 2022a) for more information. The soil test results are comparable to the values obtained from the Seed Dataset (DPE, 2021) detailed in **Table 2.1**.

Based on the modelled soil properties in **Table 2.1**, the Project soils are considered to:

- consist of fine textured topsoils and subsoils

- be moderately erodible
- be slightly to moderately acidic
- be non-saline
- consist of slightly sodic subsoils (ESP > 6%) that are expected to be dispersive
- Consist of topsoil with low to medium fertility, indicated by a low to medium CEC and low to medium soil organic carbon percentage.

2.4 Water Quality

2.4.1 Water Quality Objectives

The NSW Water Quality Objectives (WQOs) have been developed to guide plans and actions to achieve healthy waterways. The WQOs are based on measurable environmental values (EVs) for protecting aquatic ecosystems, recreation, primary industries, drinking water and industrial water (ANZECC & ARMCANZ, 2000). The Project Area is located within the Macquarie-Bogan River Catchment and the WQOs considered relevant to this SWMP are presented in **Table 2.2**.

Table 2.2 Relevant Water Quality Objectives (ANZECC & ARMCANZ, 2000)

Parameter	Units	Water Quality Objective
pH	-	6.5 to 8.0
Salinity (Electrical Conductivity)	µS/cm	30 to 350
Turbidity	NTU	2 to 25
NOx	mg/L	0.015
Total Phosphorus (TP)	mg/L	0.02
Total Nitrogen (TN)	mg/L	0.25
Visual clarity and colour	-	Natural visual clarity should not be reduced by more than 20%. Natural hue of the water should not be changed by more than 10 points on the Munsell Scale. The natural reflectance of the water should not be changed by more than 50%.
Surface films and debris	-	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour.

2.5 Climate

The closest weather station located approximately 6.7 km southeast of the Project Area boundary is at the Gulgong Post Office (Station 62013). The Rainfall data recorded at the Gulgong Post Office was sourced from the Bureau of Meteorology (BoM, 2023) website and is presented in **Table 2.3**.

Table 2.3 Average Monthly Rainfall

Month	Average Rainfall Depth (mm)[1]
January	70.4
February	61.7
March	57.3
April	44.4
May	44.5
June	50.3
July	49.2
August	45.8
September	47.2
October	55.8
November	60.6
December	67.2

[1] *Source: Gulgong Post Office BoM Station 62013 Climate Statistics (1881 – 2022)*

Table 2.4 presents the Australian Rainfall and Runoff 1987 Intensity Frequency Duration (IFD) rainfall intensities sourced from the BoM website (BoM, 2023) for the Project site.

Table 2.4 Project Site Intensity Frequency Duration Rainfall Intensities (mm/h)

Duration	1 year	2 years	5 years	10 years	20 years	50 years	100 years
5 min	64.7	84.5	111	128	151	183	209
6 min	60.2	78.6	103	119	140	170	194
10 min	49.1	64.0	83.5	96.0	113	136	155
20 min	35.9	46.7	60.2	68.9	80.6	96.9	110
30 min	29.1	37.7	48.4	55.2	64.5	77.2	87.4
1 h	19.4	25.1	31.9	36.2	42.1	50.3	56.8
2 h	12.3	15.9	20.2	22.9	26.5	31.5	35.5
3 h	9.35	12.1	15.3	17.3	20.0	23.8	26.8
6 h	5.77	**7.44**	9.4	10.6	12.3	14.6	16.4
12 h	3.56	4.59	5.79	6.54	7.56	8.97	10.1
24 h	2.18	2.81	3.54	3.99	4.61	5.47	6.14
48 h	1.3	1.67	2.09	2.36	2.72	3.22	3.62
72 h	0.93	1.19	1.49	1.68	1.94	2.29	2.58

2.6 Site Constraints

The following constraints with regards to erosion and sediment control were identified for the construction phase of the Project:

- Works on Waterfront Land:

- In NSW waterfront land is defined as being the bed and bank of a river, lake or estuary and land within 40 m of the highest bank of a river, lake or estuary. While a setback of 40 metres to the PV panels has been adopted for the Project design, access tracks and cabling will be constructed on waterfront land and therefore is classified as soil loss Class 6 (i.e. very high erosion hazard) by the 'Blue Book' (refer to **Section 3.1.2**)

- Dispersive soils:
  - As indicated in **Section 2.3,** subsoils are expected to be dispersive. Dispersive soils are highly susceptible to rilling on slopes and in drains, tunnel erosion and cause high levels of turbidity in stormwater runoff.

- No-go zones and exclusion zones:
  - Setbacks and exclusion zones have been advised for endangered ecological communities and cultural heritage sites present within the Project Area.

3.0 Design Standard

The design standards have been based on the anticipated soil, climate conditions and construction conditions, a sensitive receiving environment and an expected duration of disturbance of 34 months.

3.1 Erosion Controls

3.1.1 Erosion Hazard Assessment

All works undertaken within the watercourse alignments and within 40 m of the top of bank are considered to be on waterfront land and have a very high erosion hazard (soil loss class 6). An erosion hazard assessment has been undertaken for other Project Area lands in accordance with Chapter 4.4.1 of Volume 1 of the 'Blue Book'. The R-factor (rainfall erosivity) for the site was calculated using Equation (2) in Appendix A of Volume 1 of the 'Blue Book':

$$R = 164.74 \times 1.1177^{S} \times S^{0.6444}$$

where,

S is the 2 year, 6 hour duration storm event intensity (from Table 2.3) 7.44 mm/h

$$R = 164.74 \times 1.1177^{7.44} \times 7.44^{0.6444}$$

$$\boldsymbol{R = 1374.0}$$

Plotting the site slope, measured to be approximately 2% from Project Area contours and R-factor on Figure 4.6 of Volume 1 of the 'Blue Book' determines whether the site has a high or low erosion hazard. **Figure 3.1** presents the erosion hazard assessment plot which demonstrates that the Project site areas outside of waterfront land have a low erosion hazard. As such, enhanced erosion control measures are not required in these areas.

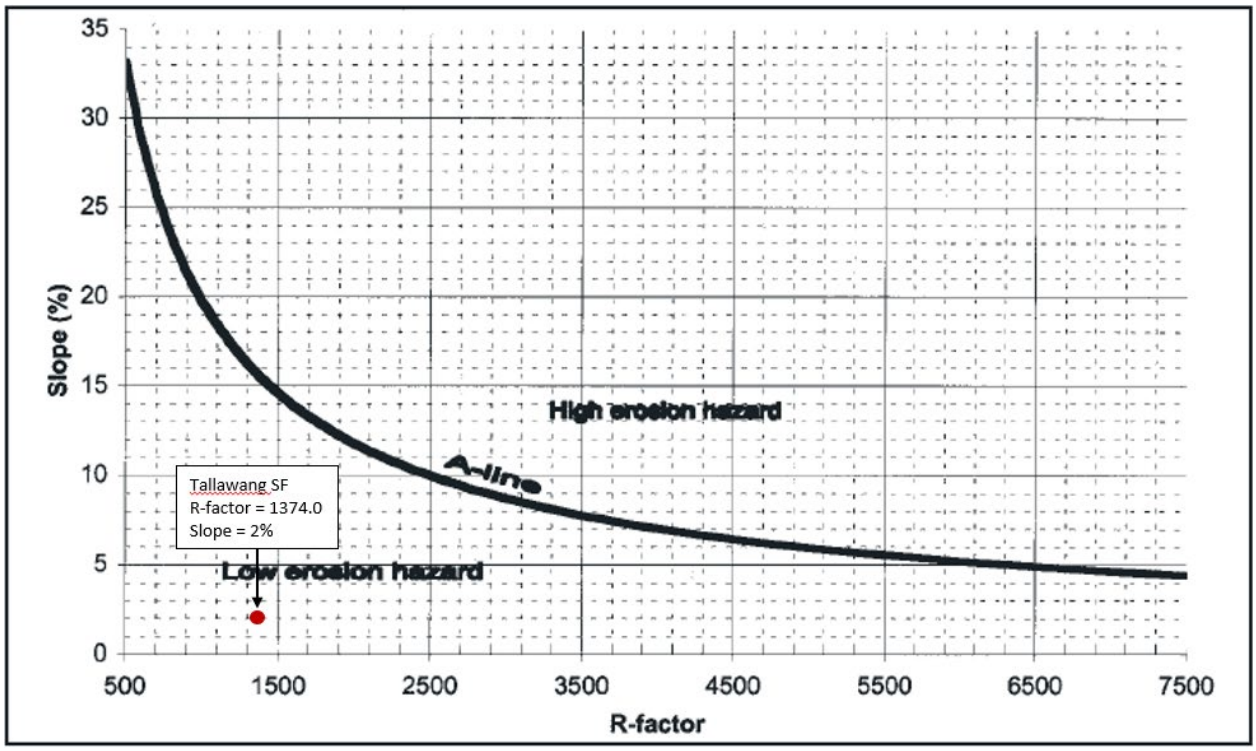


Figure 3.1 Erosion Hazard Assessment Plot

3.1.2 Soil Loss Class

An estimate of the annual soil loss class for the Project Area may be calculated using the Revised Universal Soil Loss Equation (RUSLE) and Table 4.2 of Volume 1 of the 'Blue Book'. The annual Project site soil loss has been estimated using RUSLE as follows:

$$A = R \times k \times LS \times C \times P$$

where,

		Value	Units
A	is the annual soil loss rate	to be calculated	tonnes/ha/year
R	is the annual average rainfall erosivity calculated based on the 2 year, 6 hour duration ARI storm event intensity (refer to **Section 3.1.1**)	1,374	-
k	is the soil erodibility (refer to **Table 2.1**, k value increased by 20% to account for dispersive subsoils as per 'Blue Book')	0.072	-

LS	is the slope length gradient factor sourced from Table A1 of *Managing Urban Stormwater Volume 1* (Landcom, 2004) and is dependent on the maximum slope length (use 80 m) and gradient (2%, refer to **Section 3.1.1**)	0.41	-
C	is the ground cover factor sourced from Figure A5 of *Managing Urban Stormwater Volume 1* (Landcom, 2004) (assume worst case)	1.0	-
P	is the erosion control practise factor sourced from Table A2 of *Managing Urban Stormwater Volume 1* (Landcom, 2004) and is dependent on level of compaction and roughness of the disturbed surface (assume compacted and smooth)	1.3	-

$$A = 1{,}374 \times 0.072 \times 0.41 \times 1.0 \times 1.3$$

$$\boldsymbol{A = 53\ \frac{tonnes}{ha.year}}$$

According to Table 4.2 of Volume 1 of the 'Blue Book' the Project Area (excluding waterfront land) is classified as Soil Loss Class 1 and has a very low erosion hazard. Figure 4.9 of Volume 1 of the 'Blue Book' (Landcom, 2004) shows that the Project site is located in Rainfall Distribution Zone 7. Table 4.3 of Volume 1 of the 'Blue Book' indicates that no construction works timing restrictions apply for sites in Rainfall Distribution Zone 7 with Soil Loss Class 1.

However, the 'Blue Book' recommends that timing restrictions apply to Soil Loss Class 6 lands in Rainfall Distribution Zone 7 (i.e. in this case works in watercourses and up to 40 m) as indicated in **Table 3.1**.

Table 3.1 Timing Restrictions for Soil Loss Class 6 in Rainfall Distribution Zone 7[1]

Half of Month	1st	2nd
January	Yes	Yes
February	Yes	Yes
March	Yes	Yes
April	No	No
May	No	No
June	No	No
July	No	No
August	No	No
September	No	No
October	Yes	Yes
November	Yes	Yes
December	Yes	Yes

[1] *Sourced from Table 4.3 of Managing Urban Stormwater Volume 1 (Landcom, 2004) for Rainfall Zone 7.*

Where scheduling of works to avoid works on waterfront land during high rainfall erosivity is not possible or is impractical, erosion control measures should be implemented to ensure disturbed lands have C-factors less than 0.1 (i.e. more than approximately 60% ground cover) when the three-day forecast indicates that rain is likely. Management regimes should be established to ensure that the site can be stabilised (i.e. C-factor 0.1 or less) within 24 hours if the forecast is incorrect. Measures to achieve a C-factor of 0.1 or less are further detailed in **Section 4.6**.

3.1.3 Drainage Controls

All temporary drainage controls are to be designed to have a non-erosive hydraulic capacity to convey runoff from a 10-year critical duration ARI storm event, as per the Table 6.1 of the 'Blue Book' Volume 2C.

3.2 Sediment Controls

The 'Blue Book' requires that sediment basins are used when the soil loss rate exceeds 200 tonnes/year for the total area to be disturbed. Based on a soil loss rate estimated using the RUSLE (refer to **Section 3.1.2**) the estimated annual soil loss for the main project disturbance areas are presented in **Table 3.2**.

Table 3.2 Soil Loss Rate Estimates

Project Area	Approximate Catchment (ha)	Maximum Slope of Disturbed Catchment	Annual Soil Loss (tonnes/year)
Solar Farm Access Roads	14.215	2%	749.5
Transformer Access Roads	11.665	2%	615.1
Construction Laydown Area - North	2.333	3%	195.0
Construction Laydown Area – Central west	2.358	7%	533.7
Construction Laydown Area - South	1.0	3%	83.6
Substation Central	2.771	3%	231.6
O&M Facility - South	0.249	4%	29.1

As shown in **Table 3.2** annual soil loss rates exceed the threshold of 200 tonnes/year for the access roads for the solar farm and the transformer, as well as for the central west construction laydown area and central substation area. The development of the access tracks for both the solar farm and the transformer are to be staged and will therefore minimise the area of disturbance at any one time to 3.75 ha and therefore will not require a sediment basin. The staging of the access tracks is further detailed in **Section 4.0**.

However, the central west construction laydown area and central substation area will be required to install and maintain a sediment basin downslope of the disturbance area, in accordance with the 'Blue Book' (Landcom, 2004). Design and maintenance of the sediment basin is detailed in **Section 3.2.1** and **Section 6.2.1**.

3.2.1 Sediment Basin Design

As indicated in **Table 3.2**, a sediment basin is required for the construction of the construction laydown area and central substation area located within the central and central west region of the Project Area. The design standard for a sediment basin at the construction laydown area (based on Blue Book design criteria) assuming fine/dispersive soils (worst case) and a soil hydrologic group of D (worst case, high runoff potential) is presented in **Table 3.3**.

Table 3.3 Sediment Basin Design Standard

Basin Type	Duration of Disturbance	Storm Event[1]	Storm Event Rainfall Depth (mm)[2]	Volumetric Runoff Coefficient (Cv)[3]	Sediment Basin Embankment & Spillways[1]	Sediment Zone Capacity
D	< 6 months	5 day 80th percentile	22.8	0.50	20-year ARI	6 months soil loss as calculated by RUSLE
D	6 – 12 months	5 day 85th percentile	28.4	0.56	50-year ARI	

[1] Sourced from Table 6.1 of the 'Blue Book' Volume 2C Unsealed Roads
[2] 5 day rainfall depth for Dubbo sourced from Table 6.3a of Volume 1 of the 'Blue Book'
[3] Refer to Table F2 of Volume 1 of the 'Blue Book'

The sediment basin is to have a fixed staff gauge installed to clearly indicate the maximum allowable sediment storage level, the design settling zone level and the spillway invert level.

3.2.2 Sediment Basin Capacities

The volume of the sediment basin is the combination of the settling zone and the storage zone. The settling zone capacity is the water zone within the basin and is determined from the y-percentile, 5-day rainfall depth. The storage zone capacity is the sediment zone within the basin and is derived based on the soil loss calculated for a specified time frame (6 months has been adopted for the Project).

$$Settling\ Zone\ Type\ D/F\ = 10 \times Cv \times A \times R$$

where,

10 is a unit conversion factor

Cv is a volumetric runoff coefficient, defined as that proportion of rainfall that runs off as stormwater

A is the catchment area of the basin (hectares)

R is the 5-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events

$$Sediment\ Zone\ Type\ F/D = \frac{0.17 \times A\ (R \times K \times LS \times 1.3 \times 1.0)}{1.3}$$

where,

0.17 one sixth of the computed average annual soil loss

1.3 bulk density of the deposited sediment

A disturbed catchment area (hectares)

R & **K** RUSLE factors for the site

LS RUSLE factor for the site assuming an 80-metre slope length

The minimum conceptual volumes for the sediment basin designs detailed in **Table 3.3** are presented in **Table 3.4**.

Table 3.4 Minimum Conceptual Sediment Basin Capacities

Basin	Basin Type	Duration of Disturbance	Storm Event[1]	Settling Zone Volume (m^3)	Sediment Storage Zone (m^3)	Total Volume (m^2)
Sediment Basin 1	D	< 6 months	5 day 80th percentile	301	205	506
Sediment Basin 1	D	6 – 12 months	5 day 85th percentile	375	205	580
Sediment Basin 2	D	< 6 months	5 day 80th percentile	354	30	384
Sediment Basin 2	D	6 – 12 months	5 day 85th percentile	354	89	443

[1] *Sourced from Table 6.1 of the 'Blue Book' Volume 2C Unsealed Road.*

It is noted that while the duration of the construction phase is expected to be approximately 36 months, following initial clearing and stripping, the laydown area will stabilised with compacted hardstand material with a low erodibility. As such, the disturbance duration is likely to be less than 6 months.

3.2.3 Temporary Sediment Control Measures

Sediment basins for the Project will be designed as per **Table 3.3** and **Table 3.4**, in accordance with the 'Blue Book' and all other temporary sediment controls will be designed to be structurally sound during a 10-year ARI storm event *Volume 2C Unsealed Roads* (Landcom, 2004).

4.0 Erosion and Sediment Controls

Supervisory staff involved in the works are to ensure that all employees and contractors working on the Project understand and follow the requirements of this SWMP and the progressive ESCPs.

4.1 General Conditions

All ESCs are to be installed, managed and maintained in accordance with the 'Blue Book' (Landcom, 2004) to:

- prevent sediment moving off-site and sediment laden water entering any watercourse, drainage line, or drain inlet
- reduce water velocity and capture sediment on site
- minimise the amount of material transported from site to surrounding pavement surfaces
- divert clean water around site.

Additional ESC measures must be implemented and a revised SWMP must be submitted for approval in the event that site conditions change significantly from those considered within this SWMP or the implemented works fail to achieve the desired objective of preventing environmental harm.

Where there is a high probability that serious or material environmental harm may occur as a result of sediment leaving the site, a new or amended SWMP must be submitted for approval. Only those works necessary to minimise or prevent environmental harm shall be conducted on-site prior to approval of the new or amended SWMP.

In circumstances where it is considered necessary to prepare an amended SWMP, and where the delivery of such an amended SWMP is not imminent, then all necessary new or modified erosion and sediment control works must be in accordance with the 'Blue Book' (Landcom, 2004). Upon approval of the amended SWMP, all works must be implemented in accordance with the amended plan.

There is to be no release of dirty water into drainage lines and/or waterways. Dirty water captured in excavations will be utilised for construction water demands (e.g. dust suppression) within the Project site disturbance boundary or be removed by a suitably licenced waste contractor.

4.2 General Site Management

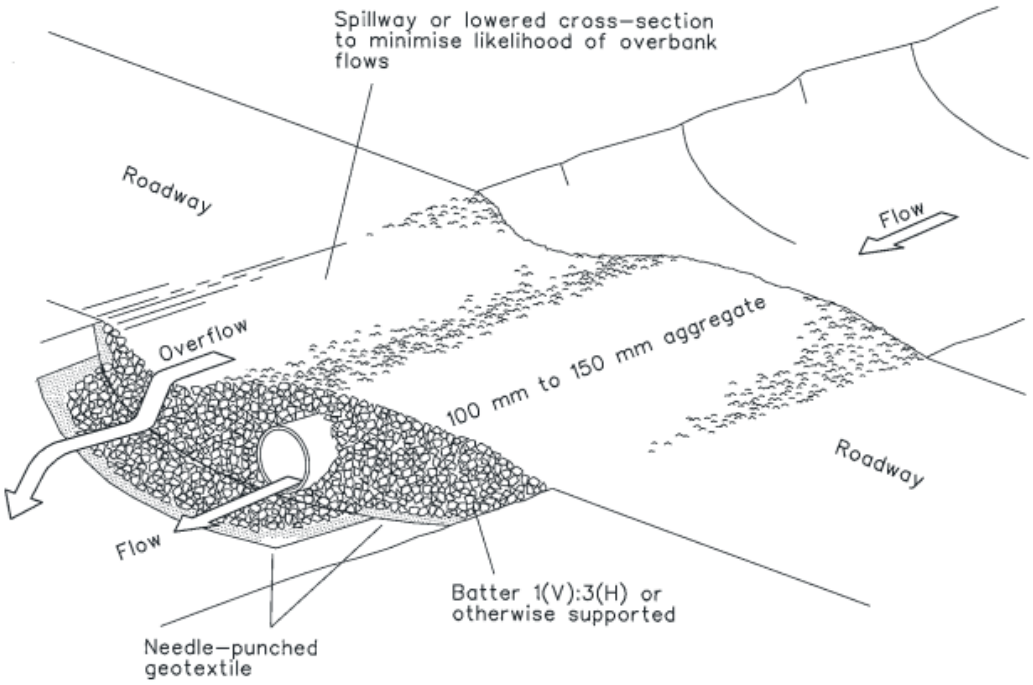
1. No ground disturbance (other than disturbance for the installation of required ESCs) is to occur until the ESCs required by the relevant progressive ESCP for each stage of works are installed and functional.
2. To minimise ground disturbance, construction activities including vehicle and machinery movements, stockpiling, temporary vehicle parking and material laydown will be restricted to designated work areas.
3. All fuels, chemicals and liquids are to be stored in an impervious bunded area, a minimum of 50 m away from:

- rivers, creeks or any areas of concentrated water flow
- flooded or poorly drained areas
- slopes above 10%.

4. Concrete wash-out bunds lined with plastic sheeting will be provided and sign posted to ensure they are clearly identified by contractors and concrete agitator/pump drivers. No concrete wash-out is to occur within 50 m of drainage lines or waterways.
5. Refuelling of plant and equipment that can readily be relocated will be undertaken remotely from waterfront land. For plant and equipment that requires refuelling on waterfront land appropriate controls are to be implemented including:
   - placement of filter socks around area that could potentially be impacted by fuel spills.
   - ensuring spill kits are present during refuelling.
   - ensuring an appropriate number of trained personnel are available during refuelling to monitor for spills and respond rapidly to contain a spill.
6. Emergency spill kits are to be kept on site at all times. All workers are to be made aware of the location of the spill kits and trained in their use.
7. Site spoil must be disposed of in accordance with an approved Construction Environment Management (CEMP) Plan and/or Waste Management Plan (WMP).
8. Ensure a suitable stock of consumable erosion and sediment control products (e.g. geotextile, sediment fence) is available on site to ensure repairs to ESCs can be made promptly and temporary stabilisation measures can be implemented under wet weather provisions.

4.3 Temporary Access Tracks

1. All access is to be controlled on the site and vehicles and plant will be kept to well defined access tracks to minimise ground disturbance and compaction.
2. Access tracks on waterfront land are to be surfaced to achieve a C-factor of 0.1 or less. A stone mulch surface (e.g. gravel) applied at a rate of 330 tonnes/ha (33 kg/m^2) will achieve a C-factors of approximately 0.05 (International Erosion Control Association (IECA), 2008).
3. Temporary drainage line crossings along access roads shall be constructed as per 'Blue Book' standard drawing *SD 5-1 Temporary Waterway Crossings* (refer to **Appendix B**) for minor drainage lines/depressions.



Construction Notes

1. Prohibit all traffic until the access way is constructed.
2. Strip any topsoil and place a needle-punched textile over the base of the crossing.
3. Place clean, rigid, non polluting aggregate or gravel in the 100 mm to 150 mm size class over the fabric to a minimum depth of 200 mm.
4. Provide a 3-metre wide carriageway with sufficient length of culvert pipe to allow less than a 3(H): 1 (V) slope on side batters.
5. Install a lower section to act as an emergency spillway in greater than design storm events.
6. Ensure that culvert outlets extend beyond the toe of fill embankments.

TEMPORARY WATERWAY CROSSING **SD 5-1**

Figure 4.1 Erosion and Sediment Control During Temporary Waterway Crossings

Source: Managing Urban Stormwater Volume 1 (Landcom, 2004)

4.4 Work in Waters and on Waterfront Land

1. Detailed site and works specific progressive ESCPs are to be prepared for all works in waters and on waterfront land with the aim of achieving “no visible turbid plumes reaching the waterway”.

2. When working near riparian vegetation or water land these areas need to be identified and appropriately delineated as “No Go” areas (with the aim of avoiding harm to these areas). Harm to riparian vegetation or waterfront land outside of the approved disturbance boundary is not permitted and any harm caused is to be documented and reported to the DPI Fisheries contact officer. Any harm caused is to be restored in accordance with directions provided by the DPI Fisheries contact officer.

3. Material storage and stockpiling is not to be undertaken on waterfront land or riparian vegetation. Stockpiling must be undertaken in a manner to avoid harm to these types of vegetation or water land. Stockpiles should also be located 10 metres away from adjacent waterfront land. Stockpiles are to be managed as detailed in **Section 4.5**.

4. On completion of the works the site is to be rehabilitated and stabilised including:

    a. surplus construction materials and temporary structures (other than erosion and sediment control devices that should be maintained in proper working order until the site is adequately stabilised) installed during the course of the works are to be removed.

    b. replanting the disturbed area with native endemic riparian vegetation.

4.5 Soil and Stockpile Management

1. Topsoil should be stripped while in a moist condition to maintain soil structure. If the soil is too dry the soil will be pulverised, if the soil is too wet it may lead to clodding and hardsetting.

2. Avoid mixing topsoil with subsoil during stripping and stockpiling.

3. Topsoil should be preserved on site for reuse during the site stabilisation stage.

4. Topsoil is to be stockpiled at heights no greater than 2 m to assist in maintaining seed viability and avoid compaction of topsoil stockpiles as far as practicable to maintain soil structure.

5. Topsoil should ideally be reapplied within 12 months of stripping and as such, the staging of works to allow progressive site rehabilitation is of significant importance to successful revegetation.

6. Ensure any viable noxious plant parts are not transported off-site by mobile plant and other equipment or trucked off-site as with excess spoil without appropriate treatment. Site spoil will be lawfully disposed of in a manner that does not result in ongoing soil erosion or environmental harm.

7. Spoil is to be placed in designated stockpile locations within the project disturbance boundary at locations determined by the site superintendent. Stockpiles are to have sediment fencing installed on the downslope side and a clean water diversion bund installed on the upslope side as in accordance with ‘Blue Book’ standard drawing *SD4-1 Stockpiles* (refer to **Appendix B**) to protect from run-on water.

8. Where soil material is suspected of contamination it will be classified in accordance with the NSW Environment Protection Authority (EPA) *Waste Classification Guidelines Part 1: Classifying Waste* prior to disposal. Contaminated material is to be disposed of at an appropriately licensed waste management

facility in accordance with an approved Construction Environment Management (CEMP) Plan and/or Waste Management Plan (WMP).

9. All stockpiles are to be placed in designated locations within the Project site disturbance limits at locations identified on the progressive ESCPs (refer to **Appendix B**).

10. Ensure stockpiles of erodible material that have the potential to cause environmental harm if displaced are:

    a. appropriately protected from wind, rain, concentrated surface flow and excessive up-slope stormwater surface flows.

    b. constructed on the contour at least 2 m (preferably 5 m) away from high erosion hazard areas, particularly areas of likely concentrated water flows, e.g. roads, slopes steeper than 10% etc.

    c. located within areas of degraded land (where possible), on slopes of less than 10% and at least 40 m away from any concentrated water flows, flood-prone or poorly drained areas, contaminated ground, archaeological sites or heritage items.

    d. stabilised to achieve a C-factor of 0.1 (60% ground cover) if the stockpiles are to be in place for more than 10 days. Ground cover may be achieved by applying various measures including those provided in *Table A3* and *Table A4* of *Managing Urban Stormwater Volume 1* (Landcom, 2004) (refer to **Appendix B**).

11. Soils shall be removed from stockpiles in a manner that avoids mobile plant traffic on the stockpile and soils shall be re-spread in the reverse sequence to its removal, i.e. subsoil replaced prior to topsoil replacement.

12. Dispersive subsoils are to be covered with a minimum 200 mm layer of non-dispersive topsoil following disturbance.

4.6 Drainage and Erosion Controls

4.6.1 General

1. Wherever reasonable and practicable, “clean” surface waters must be diverted away from sediment control devices and any untreated, sediment-laden waters.

2. Limit construction equipment activity to disturbed areas. Minimise disturbance and retain as much existing ground cover as practicable. The disturbance boundary is to be clearly delineated with construction fencing or barrier tape.

3. Slopes subject to sheet flow are to be limited to a maximum length of 80 m.

4. When utilising rolled erosion control products (RECPs) for stabilisation, they shall be installed in accordance with ‘Blue Book’ standard drawing *SD 5-2 RECP: Sheet Flow* (refer to **Appendix A**) for areas subject to sheet flow and *SD 5-7 RECP Concentrated Flow* (refer to **Appendix B**) for areas subject to concentrated flow.

4.6.2 Waterfront Land

1. All works on waterfront land should be informed by a progressive ESCP to detail specific measures and staging for the particular works being undertaken.

2. Works on waterfront land should be undertaken during periods of low rainfall erosivity (refer to **Table 3.1)** wherever practicable.

3. Where scheduling of works on waterfront land during low rainfall erosivity is not possible or is impractical, erosion control measures should be implemented to ensure disturbed lands have C-factors of 0.1 or less (i.e. approximately 60% ground cover or more) when the three day forecast indicates that rain is likely. Management regimes should be established to ensure that the site can be stabilised (i.e. C-factor 0.1 or less) within 24 hours.

4. *Table A3* and *Table A4 of Volume 1* of the 'Blue Book' (refer to **Appendix B**) provide guidance on stabilisation measures to achieve desired C-factors.

4.7 Sediment Control

1. All runoff from the works is to be passed through sediment controls.

2. Sediment traps should be located as close to the source of the sediment as practicable.

3. Sediment basins are to be installed and maintained in accordance with the requirements of this SWMP and the 'Blue Book' (Landcom, 2004).

4. Sediment removed from any trapping device is to be disposed of in locations where further erosion and consequent pollution to downslope lands and waterways will not occur.

5. Temporary soil and water management structures are to be removed only after the Project site is stabilised appropriately in accordance with the requirements of this SWMP and the 'Blue Book' (Landcom, 2004).

6. Sediment control devices must be de-silted and made fully operational as soon as reasonable and practicable after a sediment-producing event or when the sediment trapped exceeds 30% of the sediment control device capacity.

7. Materials, whether liquid or solid, removed from sediment control devices during maintenance or decommissioning, must be disposed of in a manner that does not cause ongoing soil erosion or environmental harm and in accordance with an approved Construction Environment Management (CEMP) Plan and/or Waste Management Plan (WMP).

4.8 Trenching

1. Avoid trenching in areas where water flow is likely to concentrate. Alternatively, schedule work during periods when rainfall erosivity is low.

2. Ensure trench widths and depths are the minimum necessary. Limiting the width of the disturbed area within the easement is an important management tool, particularly in sensitive environments.

3. Divert surface water away from trench openings.

4. Use sandbags as plugs or bulkheads across trench inverts to shorten the length of sediment-laden water flow in the trench.

5. Leave excavations open for the minimum practical time (try to limit the time trenches are left open to fewer than three days). Avoid opening trenches whenever the risks of storms are high.

6. Organise service installations to enable progressive backfilling.

7. Ensure plugs, collars or trench stops are employed to control tunnel erosion after backfilling is completed (refer to **Figure 4.2**).

8. Due to the likely dispersivity of the Project Area subsoils, appropriate amelioration of the soil (based on advice from a suitably qualified and experienced soil specialist) is to be undertaken to stabilise the soil and reduce the risk of tunnel erosion.

9. Provide an appropriate allowance for settling of uncompacted backfill material (e.g. 10%) (refer to **Figure 4.2**).

10. After backfilling, remove excess or unsuitable spoil from the site. Then, replace topsoil and vegetate (if area is to be vegetated) to match surrounding ground levels and vegetation species as soon as possible.

Different measures need to be considered for trenches running:

- across grade (where the trench runs parallel with the surrounding contours)
- down grade (where the trench runs perpendicular to the surrounding contours)
- obliquely across grade.

Trenches running across grade

Soil from the trench excavation should be placed and compacted on the uphill side of the trench to form an earth bank (refer to **Figure 4.2**) to prevent polluted stormwater from accumulating by directing water around and away from the open trench.

The earth banks should be placed and formed so that they effectively act as catch drains that do not trap pools of water at their bases or cause erosion at their outlets.

Trenches running down grade

Adequate measures should be taken to capture any sediment-laden waters downstream. These measures may include a silt fence erected on the downstream side, or trench stops (refer to **Figure 4.3**).

Care should be taken in the backfilling operation to prevent the trench operating as a subsoil drain. The backfill should therefore be properly compacted and trench stops installed across the trench line where gradients are steep (refer to **Figure 4.3**).

Trenches running obliquely across grade

Where the trench will run obliquely across the grade, soil from the excavation should be heaped on the uphill side of the trench to form an earth bank as for trenches running across grade. Trench stops may also be required.

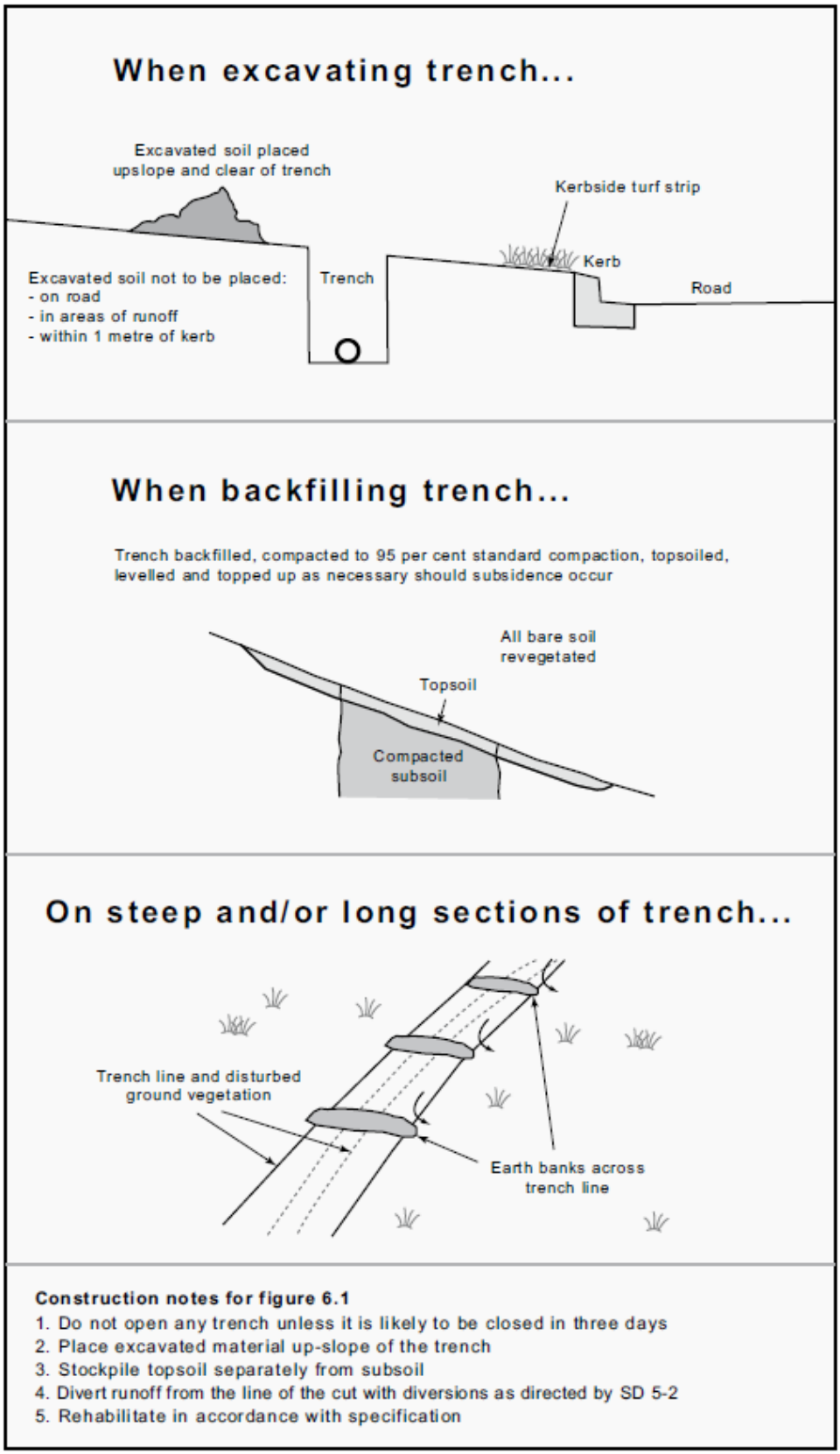


Figure 4.2 Erosion and Sediment Control During Trenching

Source: Managing Urban Stormwater Volume 2A Installation of Services (DECC, 2008)

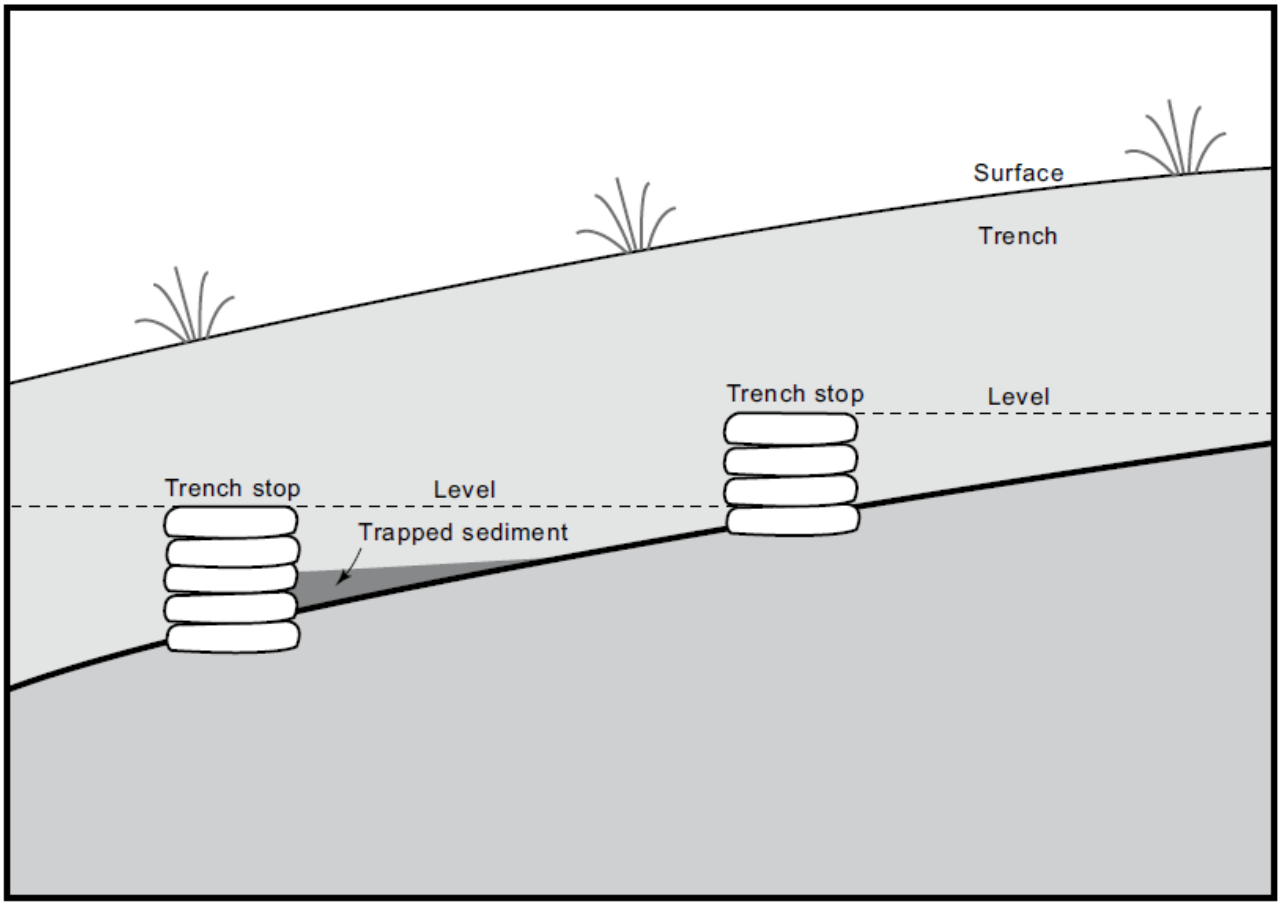


Figure 4.3 Typical Trench Stop Detail

Source: Managing Urban Stormwater Volume 2A Installation of Services (DECC, 2008)

4.9 Dust Suppression

1. Where construction works generate dust, all reasonable and practicable measures are to be undertaken to prevent dust.
2. Areas are to be stripped progressively and only where it is necessary for works to occur.
3. Disturbed areas are to be stabilised to a C-factor of less than 0.15 (e.g. greater than 50 percent grass cover) on all lands, stockpiles and other exposed materials scheduled to remain unattended for more than 20 working days.
4. Disturbed areas are to be dampened with a light water spray as required.
5. Vehicle movements are to be restricted to designated access roads.
6. All loads are to be covered when transporting material where practical.

4.10 Site Stabilisation

Successful site stabilisation by revegetation is largely dependent on appropriate soil management during the land clearing stage of works and therefore adherence to the soil and stockpile management measures

outlined in **Section 4.5** is of significant importance. Landscaping will be undertaken by RES, who will select appropriate pasture species for site stabilisation.

1. Following completion of land shaping, site stabilisation should achieve a C-factor of 0.1 (i.e. 60% ground cover) within 20 working days and a program of works set in motion to reduce the C-factor permanently to less than 0.05 (i.e. 70% ground cover) within a further 60 days.

2. Temporary site stabilisation procedures will commence at least 30 days prior to any nominated site shutdown dates. At least 70% stable cover on all unstable and/or disturbed soil surfaces must be achieved prior to the start of a shutdown. The stabilisation works must not rely upon the longevity of non-vegetated erosion control blankets, or temporary soil binders. Refer to *Table A3* and *D1* of the 'Blue Book' (Landcom, 2004) (refer to **Appendix B**) for recommendations. Specific site shutdown progressive ESCPS will be developed for all key areas.

3. Stabilise permanent drainage diversions and concentrated flow paths which are not to be sealed (e.g. concreted drains) but only subject to infrequent channelised flows as follows:

    a. Apply a 75 mm layer as recommended in *Appendix C* (page C.25 of Book 2) of *Best Practice Erosion and Sediment Control* (IECA, 2008) of topsoil and fertilise (if required).

    b. Seed with groundcover species containing sterile cover crop species (e.g. oats and Japanese millet as outlined in *Table 9.4* of the 'Blue Book' to rapidly establish groundcover) and, where feasible, indigenous grass species (which take longer to establish) endemic to the area for drains that will remain following the completion of construction activities or non-invasive exotic species for drains that will be removed during site rehabilitation.

    c. Cover with jute mat as per 'Blue Book' standard drawing *SD 5-7 RECP: Concentrated flow* (refer to **Appendix B).**

    d. Spray apply anionic bitumen emulsion at a rate of 1.2 litres/m^2.

4. Following installation of underground services, trenches will be backfilled with non-dispersive soils or soils will be ameliorated with appropriate techniques.

5. Lands recently established with grass species will be watered regularly until an effective cover has been properly established and plants are growing vigorously. Watering should be with low pressure sprays to avoid washing away any mulch cover that has been applied.

6. All ESC measures will be maintained in a functioning condition during construction until all construction activities are complete and full stabilisation of the site is achieved.

5.0 Works Staging

Table 5.1 presents a high-level overview of the construction works staging, the typical activities that will be undertaken in each stage and the anticipated ESCs to be implemented at each stage. Detailed works staging will be included in the progressive ESCPs as they are prepared.

Due to the annual soil loss calculated for the solar farm and transformer access roads exceeding 200 tonnes/year, the development of all access roads must not exceed 3.75 ha of disturbance at any one time, to avoid the requirement of a sediment basin. The 3.75 ha of disturbance of access tracks will be stabilised and secure before disturbance for the access tracks can progress.

Table 5.1 Construction Works Staging

Stage	Approximate Timing	Activities	Erosion and Sediment Controls

6.0 Inspection and Maintenance

6.1 Inspection and Monitoring

1. Inspection and Test Plans (ITPs) are to be developed for each of the progressive ESCPs developed throughout the duration of the Project. ITPs ensure all aspects of the Project ESCP are implemented at the appropriate stage in the Project and that all required ESC measures are in place prior to progression to the next stage of works. The ITP nominates witness points for activities that are to be observed by a nominated representative (e.g. Construction Manager) and hold points that represent stages in the Project beyond which works cannot proceed until the stated activity has been completed.
2. Regular inspections are to be undertaken by personnel with:
    a. an understanding of the local environmental values that could be impacted by the works;
    b. a good working knowledge of the Project ESCs; and
    c. a good working knowledge of the correct installation, operational and maintenance requirements for the Project ESCs.
3. If a discharge of dirty water occurs, the Construction Manager is to be notified as soon as practicable and the incident investigated to identify appropriate corrective actions or updates to ESC measures are required.
4. Weekly inspections of all sediment controls are to be undertaken to identify any unexpected off site sediment release or controls that require repairment.
5. Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) in the downslope drainage channels and outflows from clean water diversions is to be undertaken weekly, after rainfall events of greater than 10 mm in 24 hours and as required to identify any potential spills or deficient erosion and sediment controls.
6. All ESCs are to be inspected:
    a. Daily for works on waterfront land.
    b. Weekly for all other areas.
    c. prior to forecasted rainfall events greater than or equal to 10 mm in a 24-hour period.
    d. after rainfall events greater than or equal to 10 mm in a 24-hour period or runoff generating rainfall.
7. All inspections are to be documented on Inspection checklists and all actions identified are to be closed out within a reasonable and practical time frame. The Inspection checklist is to include:
    a. recording the condition of every sediment control employed
    b. recording maintenance requirements (if any) for each sediment control
    c. recording the volumes of sediment removed from sediment retention systems, where applicable

d. recording the site where the sediment is disposed

e. the results of all routine ESC inspections will be recorded on relevant Inspection checklists. Inspection checklists shall be copied and forwarded to the Project Engineer and Project Environmental Representative and maintained in the Project document system

f. Non-conformance reports (NCRs) will be prepared for ESCs that are not in proper working order (structural), not being adhered (practises/procedural) or ineffective. The NCRs will document the details of the non-conformance, any short term mitigation measures implemented (if any) and recommended long term mitigation measures (if required).

6.2 Site Maintenance

1. All ESCs, including drainage control measures, must be maintained in proper working order at all times during their operational lives. All ESCs will be maintained in a functioning condition during construction until all construction activities are completed, and full stabilisation of the site is achieved.

2. Sediment removed from sediment traps and places of sediment deposition must be disposed of in a lawful manner that does not cause ongoing soil erosion or environmental harm.

3. Required repairs to all controls are to be undertaken immediately where practical. Ensure controls are put back in place if they are moved for any reason.

4. All sediment fences and detention systems are to be kept in good working condition. In particular, attention is to be given to:

   a. recent works to ensure they have not resulted in diversion of sediment laden water away from them

   b. degradable products (e.g. sediment fence) to ensure they are replaced as required

   c. sediment removal as required.

6.2.1 Sediment Basin Maintenance

The Project Area sediment basin will be managed as follows:

- dewatered to restore the settling zone capacity within five days from the conclusion of a runoff generating storm event. Captured dirty water will be utilised for construction demands and is not to be discharged offsite

- If captured runoff is in surplus to operational demands, flocculate, as per Appendix E of the 'Blue Book' (Landcom, 2004) to achieve <50 mg/L TSS and apply as irrigation at a rate that does not generate runoff to undisturbed areas within the Project Area. Captured dirty water is not to be discharged offsite

- sediment is to be removed routinely (when sediment levels reach 30% of sediment zone storage capacity where possible) to ensure sediment storage levels do not exceed the sediment storage zone design capacity.

7.0 Revision and Update of SWMP

This SWMP is to be updated prior to construction when detailed Project design and construction staging yet to be finalised and as required thereafter if the site conditions change or if installed controls are not operating effectively. Additional erosion and/or sediment control works are to be constructed as may become necessary to ensure the desired protection is given to downslope lands and waterways, i.e. making ongoing changes to this SWMP where it proves inadequate in practice or is subject to changes in conditions at the work site or elsewhere in the catchment.

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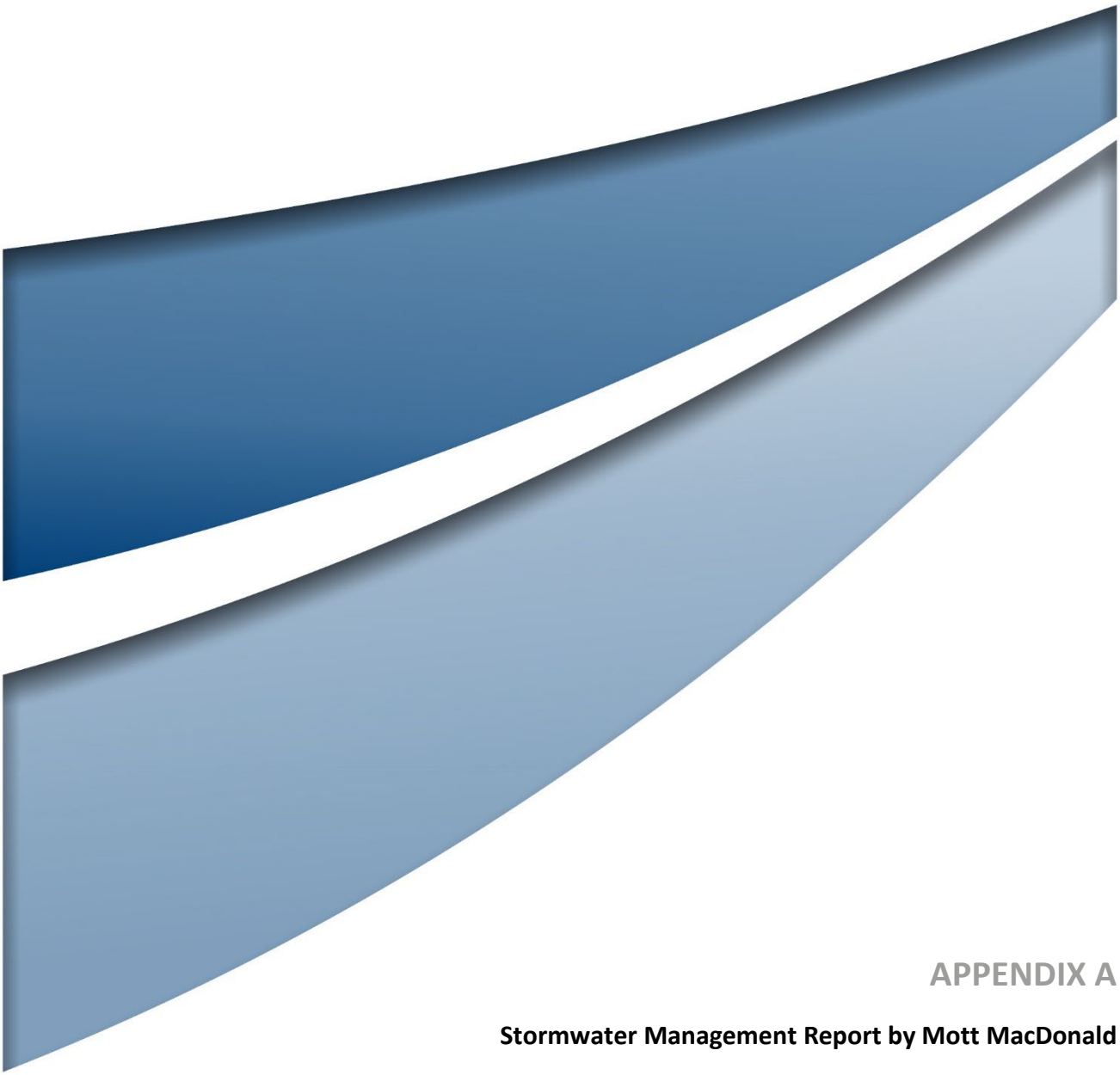
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APPENDIX A

Stormwater Management Report by Mott MacDonald

MOTT MACDONALD

TALLAWANG SOLAR FARM

Proposed Temporary Workers Accommodation and Carpark
Tallawang, NSW

DA Submission

Revision: P3
Date: 30/04/2024

DRAWING NO.	DRAWING TITLE
MMD-101773-C-DR-S1-C-0001	Cover Sheet
MMD-101773-C-DR-S1-C-0005	General Arrangement Plan
MMD-101773-C-DR-S1-C-0010	Soil and Water management Plan
MMD-101773-C-DR-S1-C-0011	Soil and Water management Details
MMD-101773-C-DR-S1-C-0020	Earthworks Cut and Fill Plan



LOCALITY PLAN
NOT TO SCALE

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Rev	Date	Description	Ch'k'd	App'd
P3	30/04/24	ISSUE SSDA APPROVAL		
P2	24/01/24	ISSUE SSDA APPROVAL		
P1	19/12/23	ISSUE SSDA APPROVAL		

SCALE

CLIENT
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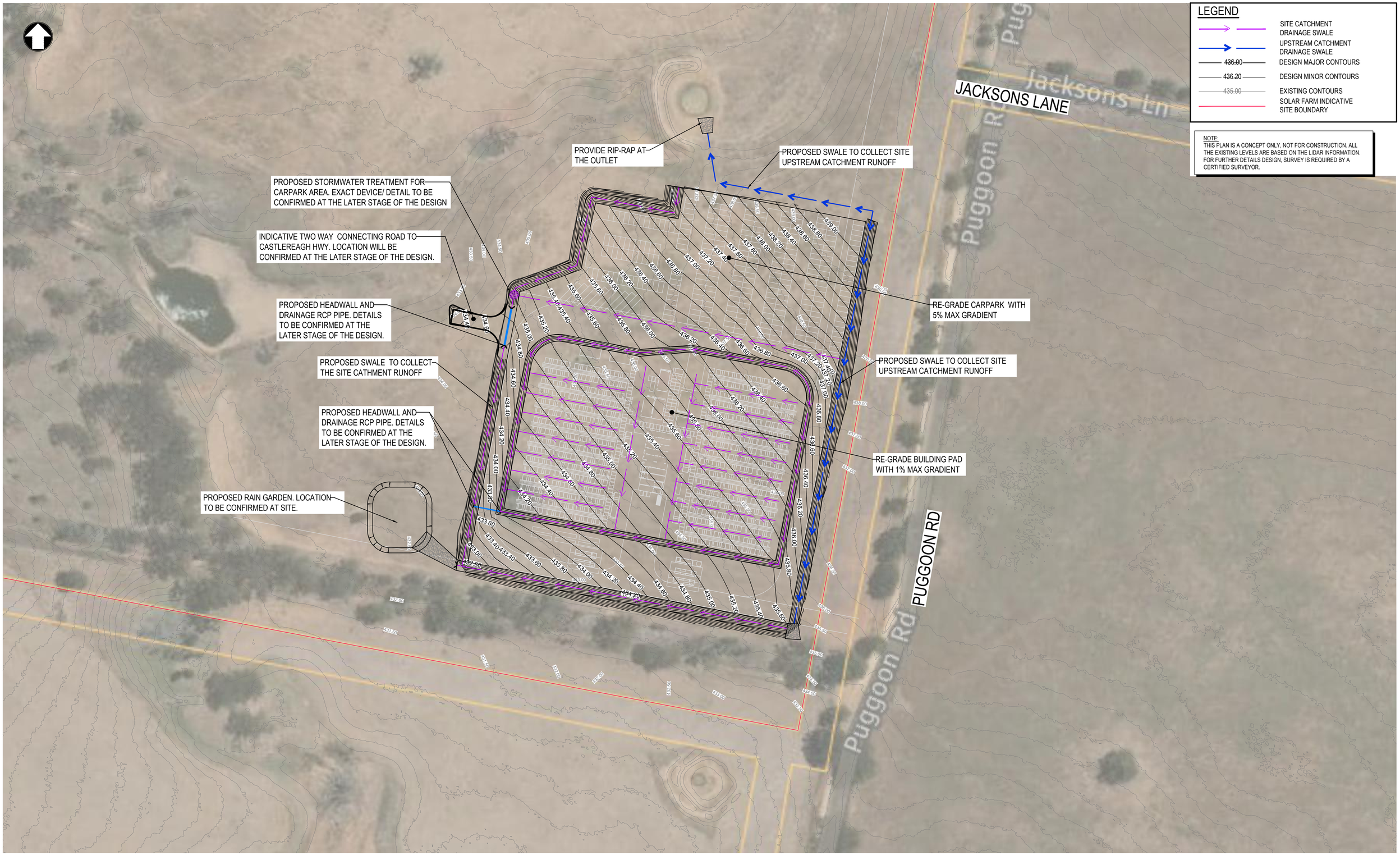
TITLE
Tallawang Solar Farm
Temporary Workers Accommodation
Tallawang, NSW
Cover Sheet

DRAWING INFORMATION
Drawn: K.Hasan
Designed: K.Hasan
Checked: N.Rouggos
Approved: B.Soo
Revision: P3
Status: FOR APPROVAL
Security: STD

DRAWING NUMBER
MMD-101773-C-DR-S1-C-0001

ISO A1 594 x 841mm

FILE LOCATION: C:\12dS\data\MottMacSYN\101773-Tallawang Solar Farm_145\01 WIP\CIVIL\02 CAD\DRGs\DA\MMD-101773-C-DR-S1-C-0001.dwg Apr 30, 2024 - 11:39AM HAS104577



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GENERAL ARRANGEMENT PLAN

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P3	30/04/24	ISSUE SSDA APPROVAL		
P2	24/01/24	ISSUE SSDA APPROVAL		
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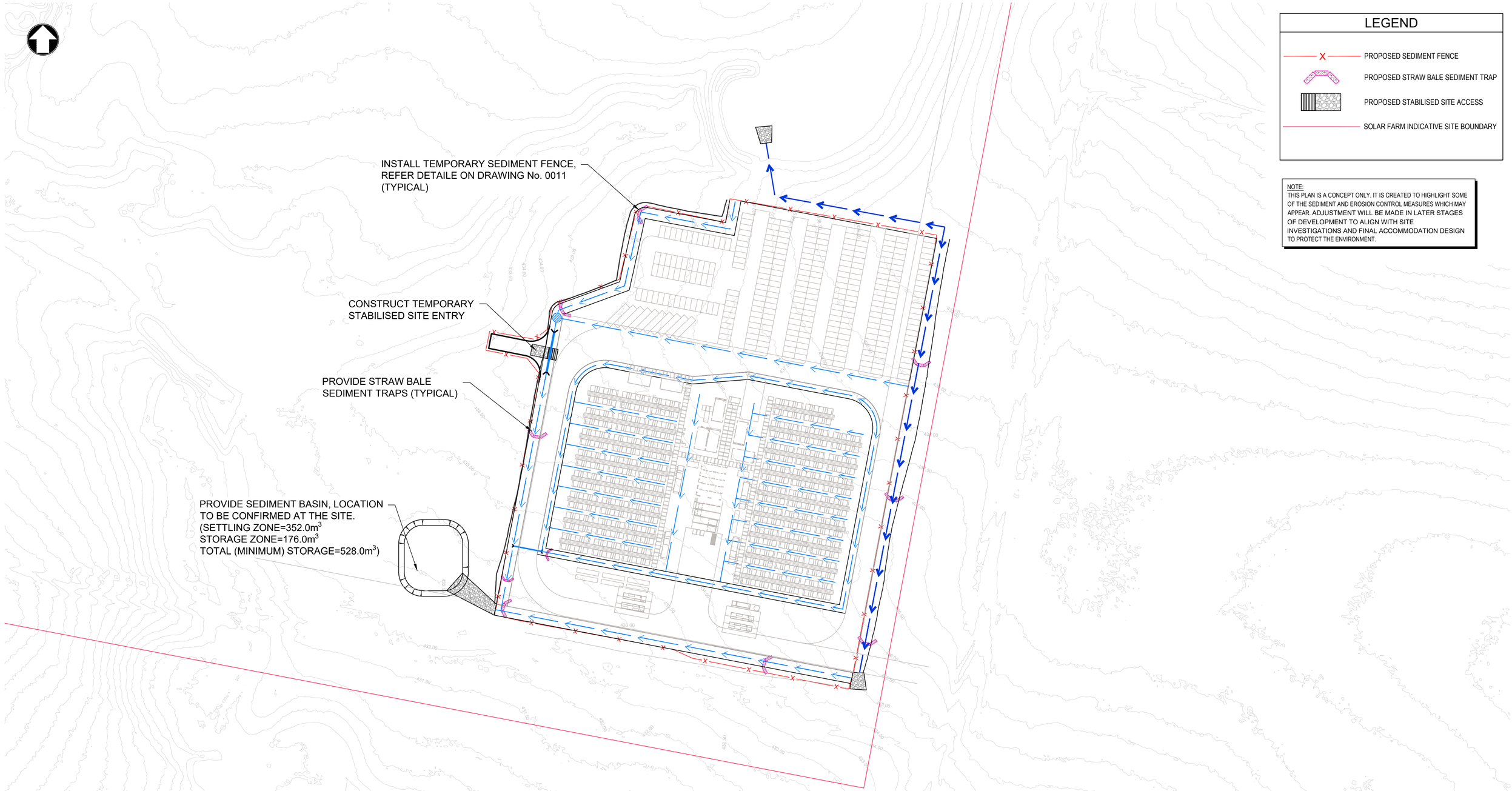
TITLE
Tallawang Solar Farm
Temporary Workers Accommodation
Tallawang, NSW
General Arrangement Plan

DRAWING INFORMATION
Drawn: K.Hasan
Designed: K.Hasan
Checked: N.Rouggos
Approved: B.Soo
Revision: P3
Status: FOR APPROVAL
Security: STD

DRAWING NUMBER
MMD-101773-C-DR-S1-CC-0005

ISO A1 594 x 841mm

FILE LOCATION: C:\12dS\data\MottMacSYN\101773-Tallawang Solar Farm_145\01 WIP\CIVIL\02 CAD\DRGs\DA\MMD-101773-C-DR-S1-C-0005.dwg Apr 30, 2024 - 4:14PM HAS104577



LEGEND

- PROPOSED SEDIMENT FENCE
- PROPOSED STRAW BALE SEDIMENT TRAP
- PROPOSED STABILISED SITE ACCESS
- SOLAR FARM INDICATIVE SITE BOUNDARY

NOTE:
THIS PLAN IS A CONCEPT ONLY. IT IS CREATED TO HIGHLIGHT SOME OF THE SEDIMENT AND EROSION CONTROL MEASURES WHICH MAY APPEAR. ADJUSTMENT WILL BE MADE IN LATER STAGES OF DEVELOPMENT TO ALIGN WITH SITE INVESTIGATIONS AND FINAL ACCOMMODATION DESIGN TO PROTECT THE ENVIRONMENT.

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SOIL AND WATER MANAGEMENT PLAN

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P2	24/01/24	ISSUE SSDA APPROVAL		
P1	19/12/23	ISSUE SSDA APPROVAL		

SCALE
1:1000 (0, 50m, 100m)

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TITLE
Tallawang Solar Farm
Temporary Workers Accommodation
Tallawang, NSW
Soil and Water Management Plan

DRAWING INFORMATION
Drawn: K.Hasan
Designed: K.Hasan
Checked: N.Rouggos
Approved: B.Soo
Revision: P3
Status: FOR APPROVAL
Security: STD

DRAWING NUMBER
MMD-101773-C-DR-S1-CC-0010

ISO A1 594 x 841mm

FILE LOCATION: C:\12dS\data\MottMacSYN\101773-Tallawang Solar Farm_145\01 WIP\CIVIL\02 CAD\DRGs\DA\MMD-101773-C-DR-S1-C-0010-0011.dwg Apr 30, 2024 - 4:03PM HAS104577

SOIL AND WATER MANAGEMENT NOTES

GENERAL INSTRUCTIONS

SWM01 THESE PLANS PRESENT A CONCEPTUAL SOIL AND WATER MANAGEMENT PLAN (SWMP) ONLY AND SHOWS A POSSIBLE WAY OF MANAGING SOIL AND EROSION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE ESTABLISHMENT AND MANAGEMENT OF THE SITE AND PREPARING A DETAILED PLAN AND OBTAINING APPROVAL FROM THE RELEVANT AUTHORITY PRIOR TO THE COMMENCEMENT OF ANY WORKS.

SWM02 THIS PLAN IS TO BE READ IN CONJUNCTION WITH THE ENGINEERING PLANS AND ANY OTHER PLANS, WRITTEN INSTRUCTIONS, SPECIFICATION OR DOCUMENTATION THAT MAY BE ISSUED AND RELATING TO DEVELOPMENT OF THE SUBJECT SITE.

SWM03 THE CONTRACTOR WILL ENSURE THAT ALL SOIL AND WATER MANAGEMENT WORKS ARE CONSISTENT WITH 'MANAGING URBAN STORMWATER - SOILS AND CONSTRUCTION' - ALSO KNOWN AS 'THE BLUE BOOK'.

SWM04 ALL BUILDERS AND SUB-CONTRACTORS SHALL BE INFORMED OF THEIR RESPONSIBILITIES IN MINIMISING THE POTENTIAL FOR SOIL EROSION AND POLLUTION TO DOWNSLOPE LANDS AND WATERWAYS.

EROSION CONTROL

SWM05 WATER SHALL BE PREVENTED FROM ENTERING THE PERMANENT DRAINAGE SYSTEM UNTIL SEDIMENT CONCENTRATION IS LESS THEN OR EQUAL TO 50MG/L, IE THE CATCHMENT AREA HAS BEEN PERMANENTLY LANDSCAPED AND / OR ANY LIKELY SEDIMENT HAS BEEN FILTERED THROUGH AN APPROVED STRUCTURE.

SWM06 ANY SAND USED IN THE CONCRETE CURING PROCESS (SPREAD OVER THE SURFACE) WILL BE REMOVED AS SOON AS POSSIBLE AND WITHIN 10 WORKING DAYS FROM PLACEMENT.

SWM07 ACCEPTABLE RECEPTORS WILL BE CONSTRUCTED FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER.

SWM08 'SEDIMENT' FENCING WILL BE INSTALLED AS INDICATED ON THE PLANS AND AT THE DIRECTION OF SITE SUPERINTENDENT TO ENSURE CONTAINMENT OF SEDIMENT. THE SEDIMENT FENCING WILL OUTLET OR OVERFLOW UNDER STABILISED CONDITIONS INTO THE SEDIMENT BASIN, TO SAFELY CONVEY WATER INTO A SUITABLE FILTERING SYSTEM SHOULD THE PORES IN THE FABRIC BLOCK.

SWM09 STOCKPILES SHOULD NOT BE LOCATED WITHIN 5M OF TREES AND HAZARD AREAS, INCLUDING LIKELY AREAS OF CONCENTRATED OR HIGH VELOCITY FLOWS SUCH AS WATERWAYS, DRAINAGE LINES, PAVED AREAS AND DRIVEWAYS. WHERE THEY ARE WITHIN 5M FROM SUCH AREAS, SPECIAL SEDIMENT CONTROL MEASURES SHOULD BE TAKEN TO MINIMISE POSSIBLE POLLUTION TO DOWNSTREAM WATERS. MEASURES SHOULD ALSO BE APPLIED TO PREVENT THE EROSION OF THE STOCKPILE.

SWM10 ALL CUT AND FILL BATTERS ARE TO BE SEEDED AND MULCHED WITHIN 14 DAYS OF COMPLETION OF FORMATION.

SWM11 ANY EXISTING TREES WHICH FORM PART OF THE FINAL LANDSCAPING PLAN WILL BE PROTECTED FROM CONSTRUCTION ACTIVITIES BY-

a. PROTECTING THEM WITH BARRIER FENCING OR SIMILAR MATERIALS INSTALLED OUTSIDE THE DRIP LINE,
b. ENSURING THAT NOTHING IS NAILED TO THEM,
c. PROHIBITING PAVING, GRADING, SEDIMENT WASH OR PLACING OF STOCKPILES WITHIN THE DRIP LINE EXCEPT UNDER THE FOLLOWING CONDITIONS,

(I) ENCROACHMENT ONLY OCCURS ON ONE SIDE AND NO CLOSER TO THE TRUNK THAN EITHER 1.5 METRES OR HALF THE DISTANCE BETWEEN THE OUTER EDGE OF THE DRIP LINE AND THE TRUNK, WHICH EVER IS THE GREATER,

(II) A DRAINAGE SYSTEM THAT ALLOWS AIR AND WATER TO CIRCULATE THROUGH THE ROOT ZONE (E.G. A GRAVEL BED) IS PLACED UNDER ALL FILL LAYERS OF MORE THAN 300 MILLIMETRES DEPTH

(III) CARE IS TAKEN.

SWM12 DURING WINDY WEATHER, LARGE DISTURBED UNPROTECTED AREAS SHOULD BE KEPT MOIST (NOT WET) BY SPRINKLING WITH WATER TO KEEP DUST UNDER CONTROL.

SWM13 TEMPORARY PROTECTION FROM EROSIVE FORCES WILL BE UNDERTAKEN ON LANDS WHERE FINAL SHAPING HAS NOT BEEN COMPLETED BUT WORKS ARE UNLIKELY TO PROCEED FOR PERIODS OF TWO MONTHS OR MORE (EG. ON TOPSOIL STOCKPILES). THIS MAY BE ACHIEVED WITH A VEGETATIVE COVER. A RECOMMENDED LISTING OF PLANT SPECIES FOR TEMPORARY COVER IS -

I) AUTUMN/WINTER SOWING - OATS/RYECORN AT 20 KG/HA
- JAPANESE MILLET AT 10 KG/HA

II) SPRING/SUMMER SOWING - JAPANESE MILLET AT 20 KG/HA
- OATS/RYECORN AT 10 KG/HA

SWM14 DIVERSION BANKS / CHANNELS WILL BE REHABILITATED AS SOON AS POSSIBLE AND WITHIN 5 WORKING DAYS FROM THEIR FINAL SHAPING. OTHER THAN IN THE WINTER MONTHS, SUITABLE MATERIALS INCLUDE TURF GRASSES SUCH AS COUCH OR KIKUYU. DURING WINTER, OR AT OTHER TIMES WHEN TEMPORARY REHABILITATION (MORE THAN 3 MONTHS) IS REQUIRED, IT IS SUGGESTED THAT HESSIAN CLOTH IS USED BUT ONLY IF TACKED WITH APPROPRIATE PEGS AND AN ANIONIC BITUMEN EMULSION. FOOT AND VEHICULAR TRAFFIC SHOULD BE KEPT AWAY FROM THESE AREAS.

SWM15 UNDERTAKE SITE DEVELOPMENT WORKS IN ACCORDANCE WITH THE ENGINEERING PLANS. WHERE POSSIBLE, PHASE DEVELOPMENT SO THAT LAND DISTURBANCE IS CONFINED TO AREAS OF WORKABLE SIZE.

CONSTRUCTION SEQUENCE

SWM16 WHERE PRACTICAL, THE SOIL EROSION HAZARD ON THE SITE SHOULD BE KEPT AS LOW AS POSSIBLE. TO THIS END, WORKS SHOULD BE UNDERTAKEN IN THE FOLLOWING SEQUENCE -

(I) INSTALL INLET SEDIMENT TRAPS TO ALL GULLY PITS FRONTING THE SITE,

(II) INSTALL A 1.8M CHAIN WIRE FENCE AROUND THE BOUNDARIES AND ATTACH HESSIAN CLOTH OR SIMILAR TO IT ON THE WINDWARD SIDE (TIES AT THE TOP, CENTRE AND BOTTOM AND AT 1M INTERVALS OR AS INSTRUCTED BY THE SUPERINTENDENT),

(III) INSTALL GEOFABRIC SEDIMENT FENCE AND SEDIMENT TRAPS AROUND ALL PERMANENT STORMWATER RETICULATION STRUCTURES AS SHOWN ON THE PLAN,

(IV) CONSTRUCT STABILISED CONSTRUCTION ENTRANCE AS SHOWN ON THE PLAN OR TO LOCATION AS DETERMINED BY SUPERINTENDENT,

(V) INSTALL DIVERSION BANKS ALONG THE BOUNDARY WHERE REQUIRED, REHABILITATE DISTURBED LANDS DOWNSLOPE FROM THE BASINS WITHIN 20 WORKING DAYS,

(VI) ENSURE THAT THE SEDIMENT BASIN IS DIRECTED ONTO A TURFED AREA AND DRAINS TO A SUITABLE LOCATION. A TEMPORARY STORMWATER LINE MAY BE NECESSARY TO CONVEY THE FLOWS TO THIS LOCATION. CONSTRUCT DIVERSION CHANNELS AT THE BOUNDARY TO DRAIN INTO THE SEDIMENT BASIN AS SHOWN ON PLANS,

(VII) AT COMPLETION STABILISE SITE AND DECOMMISSION SEDIMENT BASIN AND ALL EROSION CONTROL DEVICES.

SWM17 TEMPORARY SOIL AND WATER MANAGEMENT STRUCTURES WILL BE REMOVED ONLY AFTER THE LANDS THEY ARE PROTECTING ARE REHABILITATED.

SWM18 FINAL SITE LANDSCAPING WILL BE UNDERTAKEN AS SOON AS POSSIBLE AND WITHIN 20 WORKING DAYS FROM COMPLETION OF CONSTRUCTION ACTIVITIES.

SITE INSPECTION AND MAINTENANCE

SWM19 AT LEAST WEEKLY AND AFTER EVERY RAIN FALL EVENT, THE CONTRACTOR WILL INSPECT THE SITE AND ENSURE THAT -

(i) DRAINS AND ALL SEDIMENT CONTROL DEVICES OPERATE EFFECTIVELY AND INITIATE REPAIR OR MAINTENANCE AS REQUIRED,

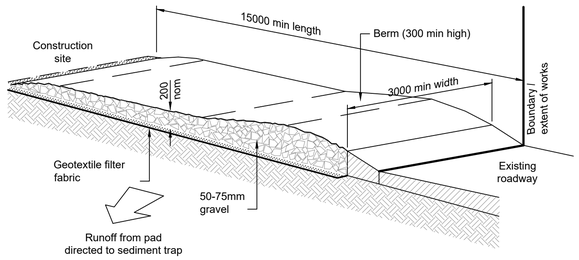
(II) RECEPTORS FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER ARE TO BE EMPTIED AS NECESSARY. DISPOSAL OF WASTE SHALL BE IN A MANOR APPROVED BY THE SUPERINTENDENT,

(III) SPILLED SAND (OR OTHER MATERIALS) IS REMOVED FROM HAZARD AREAS, INCLUDING LIKELY AREAS OF CONCENTRATED OR HIGH VELOCITY FLOWS SUCH AS WATERWAYS, GUTTERS, PAVED AREAS AND DRIVEWAYS,

(IV) SEDIMENT IS REMOVED FROM BASINS AND / OR TRAPS WHEN LESS THAN 20M³ OF TRAPPING CAPACITY REMAIN PER 1000M² OF DISTURBED LANDS, AND / OR LESS THAN 500MM DEPTH REMAINS IN THE SETTLING ZONE. ANY COLLECTED SEDIMENT WILL BE DISPOSED IN AREAS WHERE FURTHER POLLUTION TO DOWN SLOPE LANDS AND WATERWAYS IS UNLIKELY,

(V) REHABILITATED LANDS HAVE EFFECTIVELY REDUCED THE EROSION HAZARD AND INITIATE UPGRADING OR REPAIR AS APPROPRIATE.

SWM20 THE CONTRACTOR SHALL PROVIDE ALL MONITORING CONTROL AND TESTING.

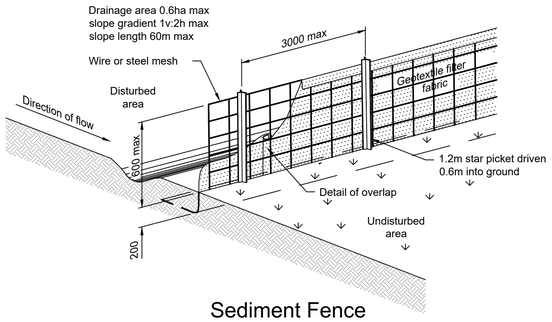


Temporary Site Entrance

NTS

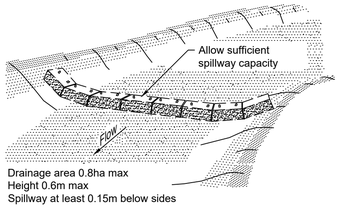
Maintenance

- The temporary access shall be maintained in a condition that prevents tracking or flowing of sediment onto public rights of way,
- This may require periodic top dressing with additional gravel as conditions demand and repair and/or cleanout of any measures used to trap sediment,
- All sediment spilled, dropped, washed or tracked onto public rights of way must be removed immediately.



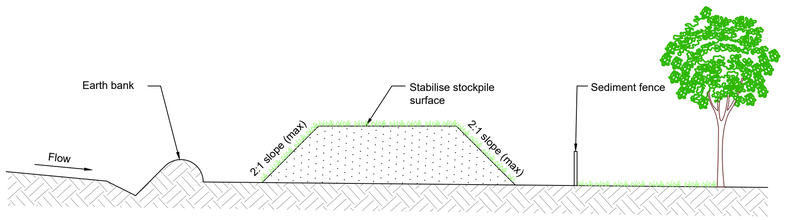
Sediment Fence (Geotextile Filter Fabric)

NTS



Check Dam - Straw Bale

NTS

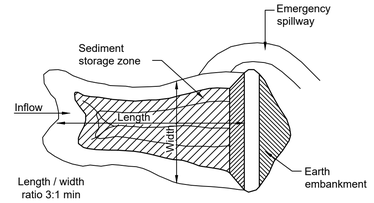


Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds
3. Where there is sufficient area, topsoil stockpiles shall be less than 2m in height
4. Where there are to be in place for more than 10 days, stabilise following the approved escp or swmp to reduce the c-factor to less than 0.10
5. Construct earth banks (standard drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (standard drawing 6-8) 1m to 2m downslope

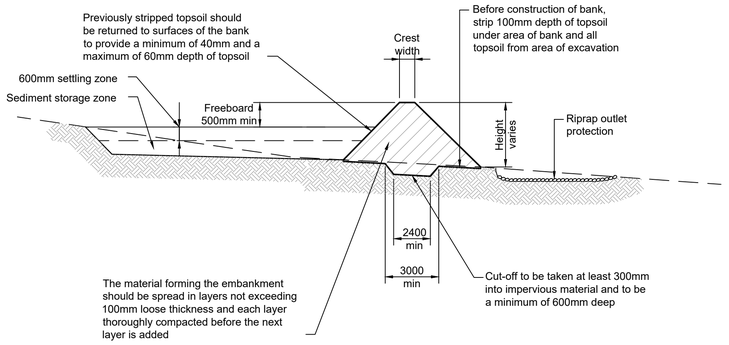
Stockpiles

NTS



Sediment Basin (Typical) Plan - Type D and F Soils

NTS



Sediment Basin (Typical) Cross Section - Type D and F Soils

NTS

SOIL AND WATER MANAGEMENT DETAILS

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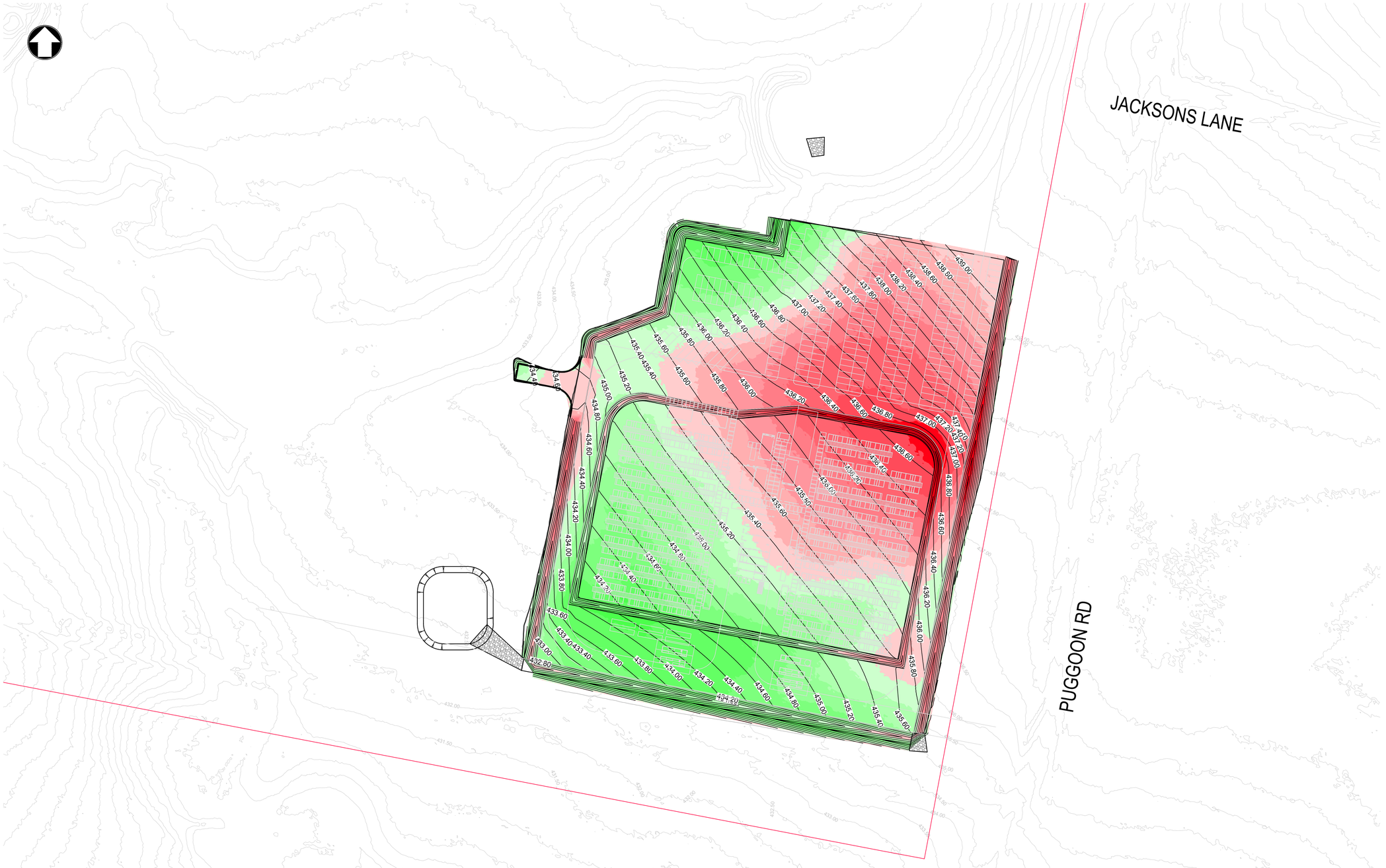
TITLE
Tallawang Solar Farm
Temporary Workers Accommodation
Tallawang, NSW
Soil and Water management Details

DRAWING INFORMATION
Drawn: K.Hasan
Designed: K.Hasan
Checked: N.Rouggos
Approved: B.Soo
Revision: P3
Status: FOR APPROVAL
Security: STD

DRAWING NUMBER
MMD-101773-C-DR-S1-CC-0011

ISO A1 594 x 841mm

FILE LOCATION: C:\12dS\data\MottMacSYN\101773-Tallawang Solar Farm_145\01 WIP\CIVIL\02 CAD\DRGs\DA\MMD-101773-C-DR-S1-C-0010-0011.dwg Apr 30, 2024 - 4:03PM HAS104577



CUT AND FILL VOLUMES (APPROX):

CUT = - 12,529 m³
FILL = 10,935 m³
BALANCE = -1,594 m³ (CUT)

ALLOWANCES USED IN CALCULATIONS:

1. DOES NOT ALLOW BOXING DEPTH FOR BUILDING AND CARPARK AREA.
2. DOES NOT ALLOW FOR STRIPPING & REPLACEMENT OF TOPSOIL.
3. DOES NOT ALLOW FOR EXCAVATION OF DRAINAGE CULVERT TRENCHES.
4. DOES NOT ALLOW FOR AND UNSUITABLE MATERIAL FOUND ANYWHERE ON SITE.
5. DESIGN CONTOURS AND CUT AND FILL HATCH SHOWN IN THIS PLAN ARE THE FINAL SURFACE.

CUTFILL DEPTH RANGE					
Lower_value		Upper_value		Colour	
-9.9	m	-2.0	m		
-2.0	m	-1.8	m		
-1.8	m	-1.6	m		
-1.6	m	-1.4	m		
-1.4	m	-1.2	m		
-1.2	m	-1.0	m		
-1.0	m	-0.8	m		
-0.8	m	-0.6	m		
-0.6	m	-0.4	m		
-0.4	m	-0.2	m		
-0.2	m	0	m		
0	m	0.2	m		
0.2	m	0.4	m		
0.4	m	0.6	m		
0.6	m	0.8	m		
0.8	m	1.0	m		
1.0	m	1.2	m		
1.2	m	1.4	m		
1.4	m	1.6	m		
1.6	m	1.8	m		
1.8	m	2.0	m		
2.0	m	9.9	m		

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EARTHWORKS CUT AND FILL PLAN

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TITLE
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Temporary Workers Accommodation
Tallawang, NSW
Earthworks Cut and Fill Plan

DRAWING INFORMATION
Drawn: K.Hasan
Designed: K.Hasan
Checked: N.Rouggos
Approved: B.Soo
Revision: P3
Status: FOR APPROVAL
Security: STD

DRAWING NUMBER
101202-MMD-SK-XX-DRG-C-020

ISO A1 594 x 841mm

FILE LOCATION: C:\12dSl\data\MottMacSYN\101773-Tallawang Solar Farm_145\01 WIP\CIVIL\02 CAD\DRGs\DA\MMD-101773-C-DR-S1-C-0020.dwg Apr 30, 2024 - 4:18PM HAS104577

MOTT MACDONALD

Tallawang Solar Farm

Temporary Workers Accommodation Stormwater Management Report

May 2024

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Tallawang Solar Farm

Temporary Workers Accommodation Stormwater Management Report

May 2024

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	15/01/24	A. Bayhan	N.Rouggos	N.Rouggos	'Draft Issue' for Review/Comment
B	24/01/24	A. Bayhan	N.Rouggos	N.Rouggos	Final Issue
C	01/05/24	K.Hasan	B.Soo	B.Soo	Final Issue

Information class: Standard

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1 Project Description

This stormwater management report has been produced to support the Amendment Report for the Tallawang Solar Farm project. This report includes the review of existing conditions, proposed erosion and settlement control during construction and during operation water management and quality for a Temporary Workers Accommodation (TWA) onsite as shown in Figure 2-1

The TWA is proposed to be constructed on an overall site of approximately 7 hectares with the proposed facility being approximately 4 hectares in area. Refer to Figure1.1 for proposed location and development. The exact size and layout for the TWA facility is subject to detailed design.

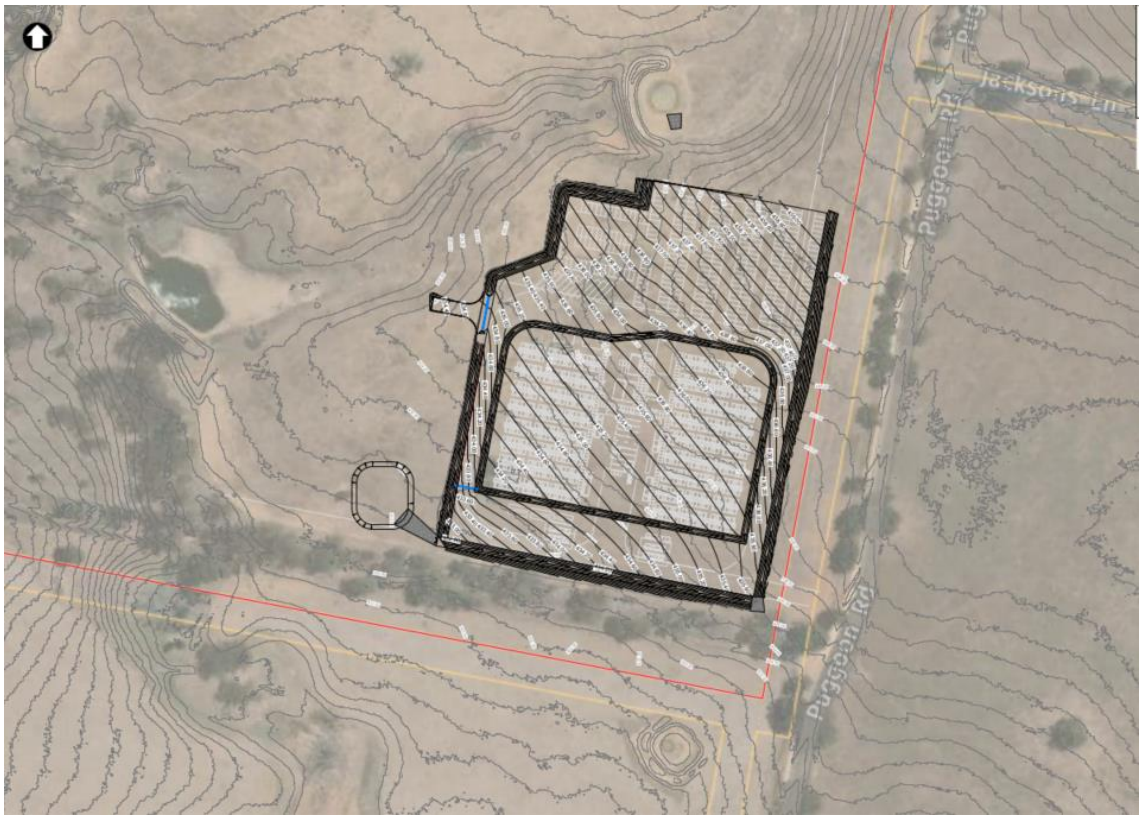


Figure 1-1: Proposed Accommodation Camp General Arrangement Plan

The sections below detail both the criteria and proposed management of stormwater during construction and post construction/ during operation (which is assumed to be approximately three years). At the end of construction, the site will be remediated. The exact details of this remediation will be confirmed during detailed design of the camp; although the intention is to remediate the site to a state that reduces any change to the current conditions.

2 Existing Condition

2.1 Existing Site Conditions

The Tallawang Solar Farm project area exists within the Macquarie-Bogan Rivers System within the Central West region of New South Wales, in the lower catchment of Tallawang Creek, with Slapdash Creek to the east and Wialdra Creek to the south. Tallawang Creek is located to the north of the Project Area. These waterways discharge into the Cudgegon River, around 8km south-west of the Project Area. The TWA will discharge through various streams to the Cudgegon River. Refer to Tallawang Solar Farm Water Resource Impact Assessment by Umwelt for further details.

2.1.1 Rainfall Inputs

Intensity-Frequency Duration (IFD) data was extracted from the Bureau of Meteorology 2016 ARR IFD to determine rainfall burst depths for the modelled AEP. A consistent design rainfall was adopted (i.e., no spatial variation) given the size of the local catchment. The Probable Maximum Precipitation (PMP) was estimated using the Generalised Short Duration Method (GSDM Method) (BOM, 2003).

Table 2-1: Design Rainfall Depths (mm) for Various Events Durations and AEPs

AEP (1: Y)	30 min	1.5 hr	2.0 hr	3.0 hr	6.0 hr	9.0 hr	12.0 hr	18.0 hr	24.0 hr
2	13.4	16	18	20.9	23.2	26.8	31	34.3	39.7
5	14.9	17.9	20	23.3	25.8	29.8	34.4	38.2	44.2
10	19.6	23.4	26.2	30.4	33.6	38.7	45	50.1	58.5
20	22.8	27.2	30.5	35.2	38.9	44.7	52	58.3	68.1
50	26.1	31.1	34.7	40	44	50.4	58.7	66.1	77.7
100	30.4	36.2	40.2	46.2	50.7	57.8	67.6	76.7	90.8
200	33.9	40.1	44.5	50.9	55.6	63.4	74.2	84.8	100.4
500	38.2	45.3	50.2	57.2	62.5	71.1	83.6	95.9	114.9

2.2 Summary of existing conditions

- The temporary workers accommodation area has a low risk of flooding for both the existing and climate change conditions.
- The flood impact assessment has shown the TWA is not located within a major flood hazard zone. Peak stormwater discharges from the TWA site for impervious areas may increase slightly across the site.
- No constraints were identified within the accommodation camp area that would prevent the project from meeting the requirements of the local and state planning requirements.

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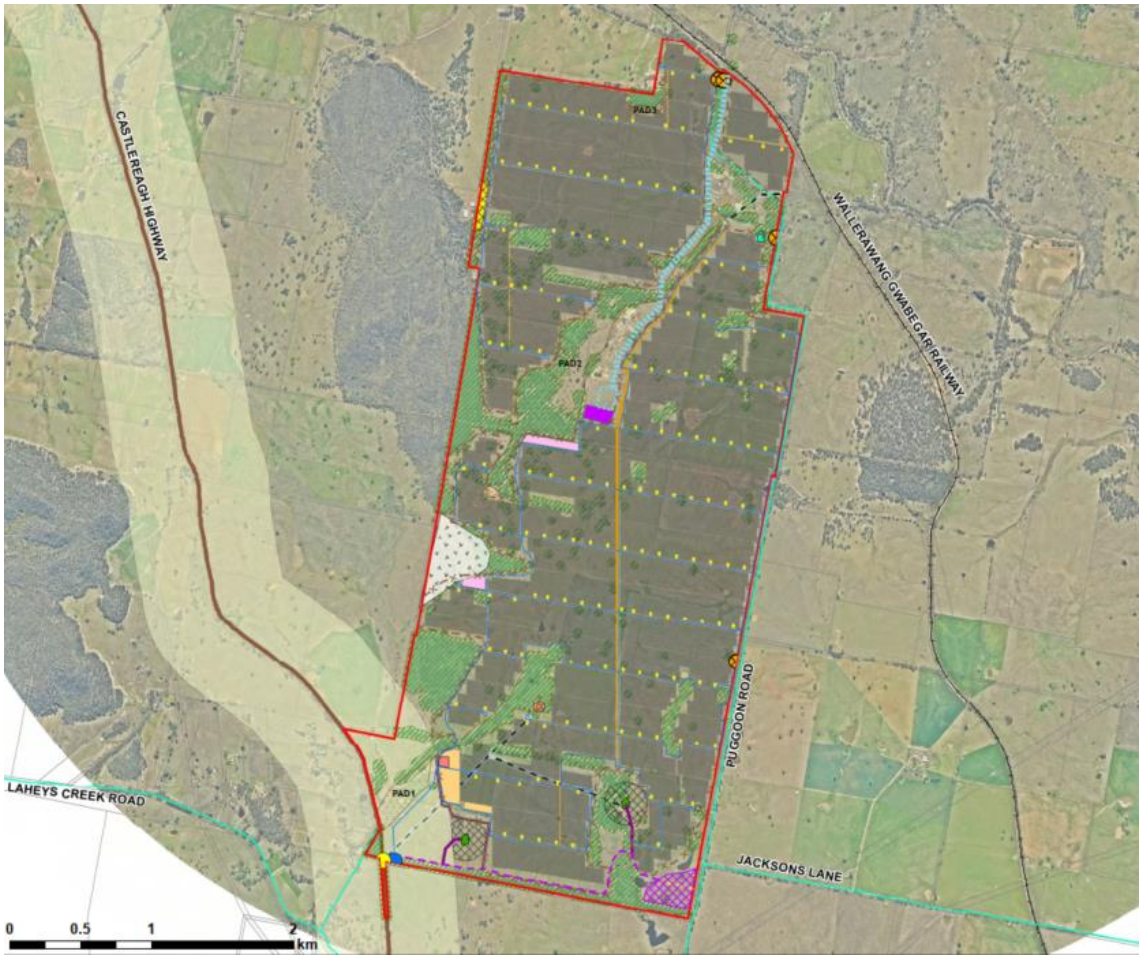


Figure 2-1: Location and Local Context[1]

[1] Site Constraints (Figure 2.1) Site Layout with Constraints

3 Proposed Drainage

3.1 Proposed Drainage Management (During Construction)

The proposal is to have upstream flows diverted via swales around the proposed TWSA maintaining the existing drainage in the local region.

Stormwater will be managed on site using overland swales/ piped crossing network to a sediment basin. The basin design is design for Type D (dispersible) soil to flocculate and settle before passing over an overflow weir. This will allow particulate matter to be captured before entering streams in smaller and frequent storm events. A sediment basin with a minimum volume of 528m^3 (see Appendix for calculations of minimum basin sizing) is to be used to capture and maintain stormwater on site.

In addition to the basin sediment fences, straw bale check dams, and a temporary site entrance will be used to manage erosion control throughout the site. In addition, temporary dust management is provided by the contractor in line with planning requirements.

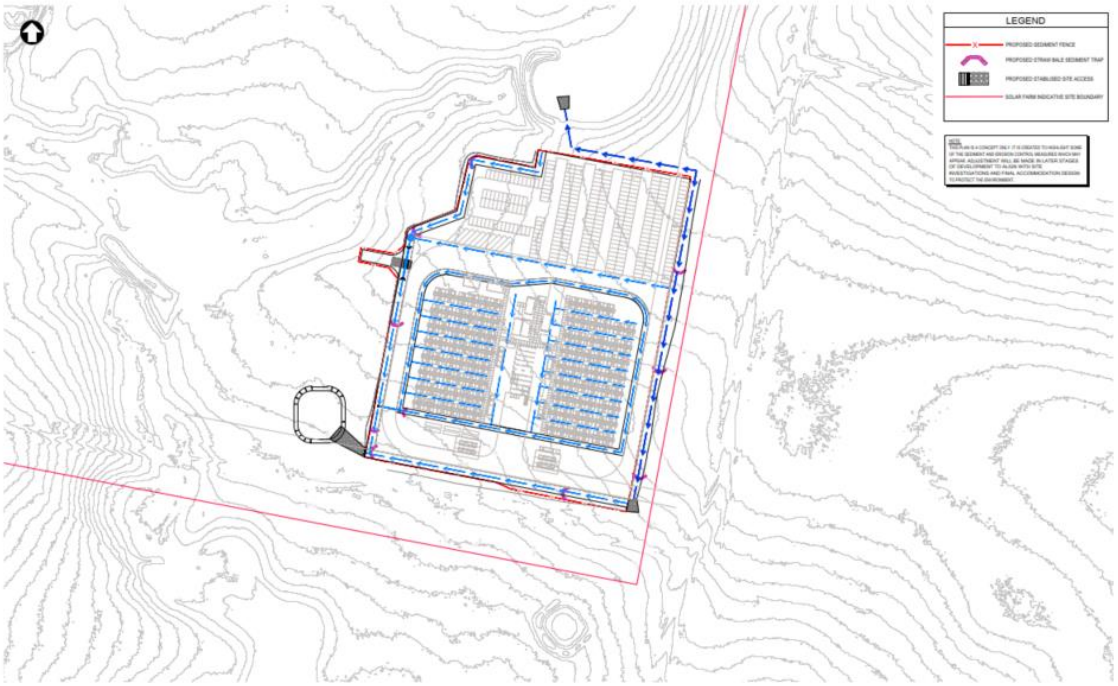


Figure 3-1: Soil and Water Management Plan

3.2 Proposed Drainage Management (Post Construction/ Operation)

Post construction stormwater management it is proposed that flow paths developed during the 'during construction' phase using swales (which are to be seeded/ grassed) and proposed basin downstream of the site will be maintained and converted to a rain-garden.

The benefits of maintaining and utilising grassed swales and raingarden on site will promote of infiltration reducing stormwater peak flows and discharge volumes on site and removing a portion of sediments, suspended solids and attached nitrogen and phosphorus.

Flows on site are proposed to be diverted dependent on catchment area. Clean flows upstream of the proposed development will be diverted upstream around the site with developed flows

through grassed swales to the raingarden. Refer to Figure 3-2 for details for the TWA proposed drainage management.

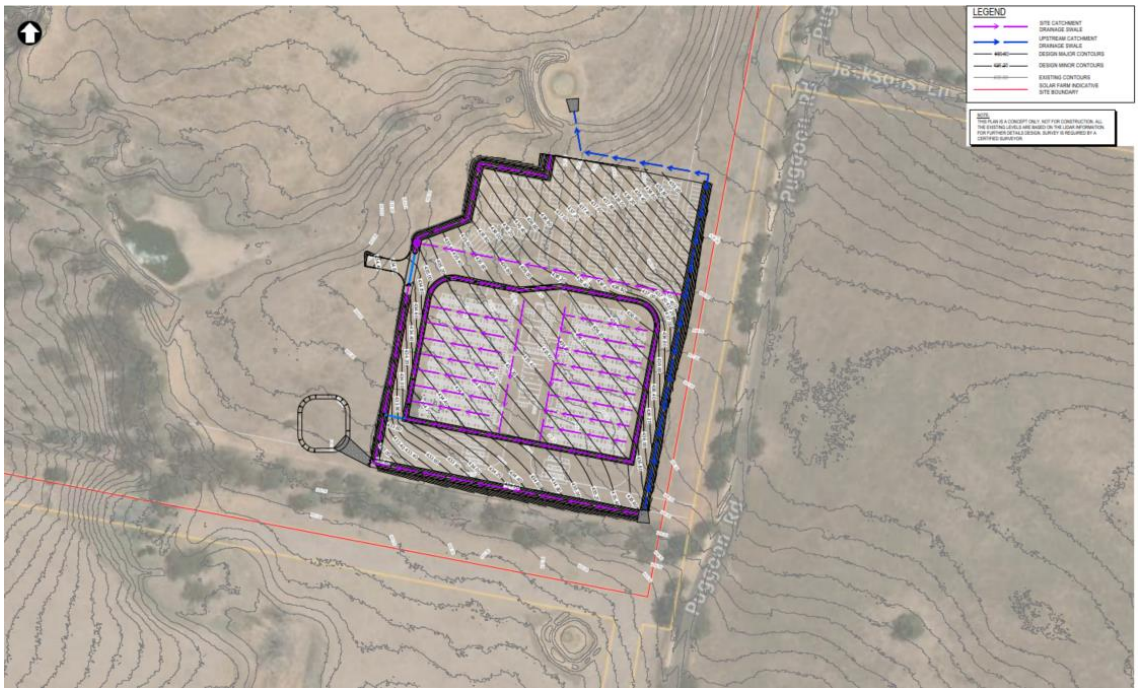


Figure 3-2: Proposed Drainage Management

3.3 Stormwater Discharge Quality and Quantity

The Mid-Western Council 'Stormwater to Smartwater' provides guidance on council's preference for tertiary treatment and erosion and control measures.

In line with guidance the proposal for the TWA site is to use both grassed swales and conversation of the sediment basin to rain-garden to meet councils' requirements. The discharge point from the raingarden will match the existing flow path toward the existing farm dam. The exact size and details will be subject to detailed design.

The increase in runoff due to the increase in non-permeable areas will be minimal due to the size of the site within the entire regional catchment and hence no specific detention is proposed.

Appendix A – Sediment Basin Calculation

Reference Material

Extracted from *Managing Urban Stormwater: Soils and Construction – Volume 1 (4th Edition).*

Table 6.1 Summary of selected sediment basin types and design criteria

Soil Type	Soil characteristics	Treatment process	Basin design capacity	
			Settling zone	Sediment storage zone
Type D (dispersible)	10 percent or more of the soil materials are dispersible. Particle size is irrelevant	Aided flocculation in wet basins	Capacity to contain all runoff expected from the y percentile, x-day rainfall depth where, depending on the sensitivity of the receiving waters and/or the duration that the structure is in use: x is 2, 5, 10 or 20-days y is the 75th, 80th, 85th or 90th percentile	Normally taken as 50 percent of the capacity of the settling zone. However, it can be taken as two months soil loss as calculated by the RUSLE
Type C (coarse)	Less than 33 percent finer than 0.02 mm and less than 10 percent of the soil materials are dispersible	Rapid settling in wet or dry basins	Surface area of 4,100 $m^2/m^3/sec$ in the 3-month ARI flow, minimum depth of 0.6m, and length:width ratio of >3:1	Normally taken as 100 percent of the capacity of the settling zone. However, it can be taken as two months soil loss as calculated by the RUSLE
Type F (fine)	33 percent or more of the particles are finer than 0.02 mm and less than 10 percent of the soil materials are dispersible	Slow settling in wet basins	Capacity to contain all runoff expected from the y percentile, x-day rainfall depth where, depending on the sensitivity of the receiving waters and/or the duration that the structure is in use: x varies between 2 and 20 days y is the 75th, 80th, 85th or 90th percentile	Normally taken as 50 percent of the capacity of the settling zone. However, it can be taken as two months soil loss as calculated by the RUSLE

(i) Normally, sediment basins where the soils are *Type D* or *Type F* are sized as follows:

V = settling zone + sediment storage zone (Table 6.1)

(i) The settling zone capacity designed to capture *Type D* and *Type F* soils can be determined from the y-percentile, 5-day rainfall depth, i.e.

Settling Zone $_{Type\ D/F}$ = 10 x Cv x A x R $_{(y\ \%ile,\ 5\ day)}$

where:

- 10 is a unit conversion factor
- C_v is a volumetric runoff coefficient, defined as that proportion of rainfall that runs off as stormwater[13]
- A is the catchment area of the basin (hectares)
- $R_{(y\ \%ile,\ 5\ day)}$ is the 5-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events. This figure can be determined from Appendix L. Rainfall depths corresponding to management periods more and less than 5 days can be adopted, as site characteristics allow and as detailed previously

The volumetric runoff coefficient should be derived from Appendix F.

(f) Unless Council's Stormwater Management Plan states differently:[11]

(i) on most sites the 75th percentile storm depth is recommended for use if the duration of disturbance is likely to be six months or less, while the 80th percentile storm depth is recommended if the duration of disturbance is likely to be more than six months;

(ii) where receiving waters are considered particularly sensitive, either by the development proponent/designer, local council or other consent authority, a higher level of protection can be provided, e.g.: the 80th percentile storm depth is recommended for use if the duration of disturbance is likely to be six months or less, while the 85th percentile storm depth is recommended if the duration of disturbance is likely to be more than six months.

Longer term land disturbances, such as waste depots, extractive sites and some road construction activities, warrant alternate levels of protection, as defined in relevant sections of Volume 2.

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Data for Stormwater storage calculations

To calculate the stormwater storage requirements, the following standards and assumptions were used within the calculations. Considering the existing conditions and the Sediment and Erosion Control Plan a Basin in accordance with Guideline: *Managing Urban Stormwater: Soils and Construction – Volume 1 (4th Edition),* and Warrumbungle Shire Council's Development Control Plan is to be proposed, calculated, and developed. This is to ensure all local council and standard discharge water quality and quantity requirements were met.

Data used for design includes:

- Geotechnical information extracted from the report on Preliminary Geotechnical Investigation: Proposed Solar Farm Castlereagh Highway, Tallawang: Project 206153.00 August 2022 (R.001.Rev0)

  (NOTE: Assumption has been made as there is no specific testing at the TWA site, that geotechnical conditions are consistent in line with other data without solar farm area. This assumption will be confirmed post DA with further development during detailed design/ construction).
- A disturbed area of 47,684m^2 (conservatively using 48,000m^2 (Refer to Soil and Water Control Plan by Mott MacDonald – MMD-101773-C-DR-S1-CC-0010).
- Geotechnical Inputs include soil types Clayey Sand and Silty Clay, Log (3) – Most Relevant and Log (7) – Close Log, and Advise on Soil Erosion – Emerson Class of < 3 (Very High to High Potential for erosion and have a 'Dispersive Nature'.
- *Managing Urban Stormwater: Soils and Construction – Volume 1 (4th Edition).*
  - Table 6.1 - Type D (dispersible) soil.
  - Type D soil classification described as 'dispersible', the total storage = settling zone x 1.5 (requires flocculation), with the settling zone equating to 10 x Cv x A x R (y %ile, 5 day)
    - Cv= 0.39 (Using R value listed in table F2, Design Rainfall depth mm (<20) and Soil Hydrologic Group D)
    - A = 4.8ha
    - R value, Location to determine the 75th%/5 day = Dubbo = 18.8mm (Assumed less than 6 months of disturbance)

Storage Minimum Requirements

Using the above calculations and formulas to determine the minimum storage requirements for the site.

47,684m^2 (conservatively using 48,000m^2) of disturbed area

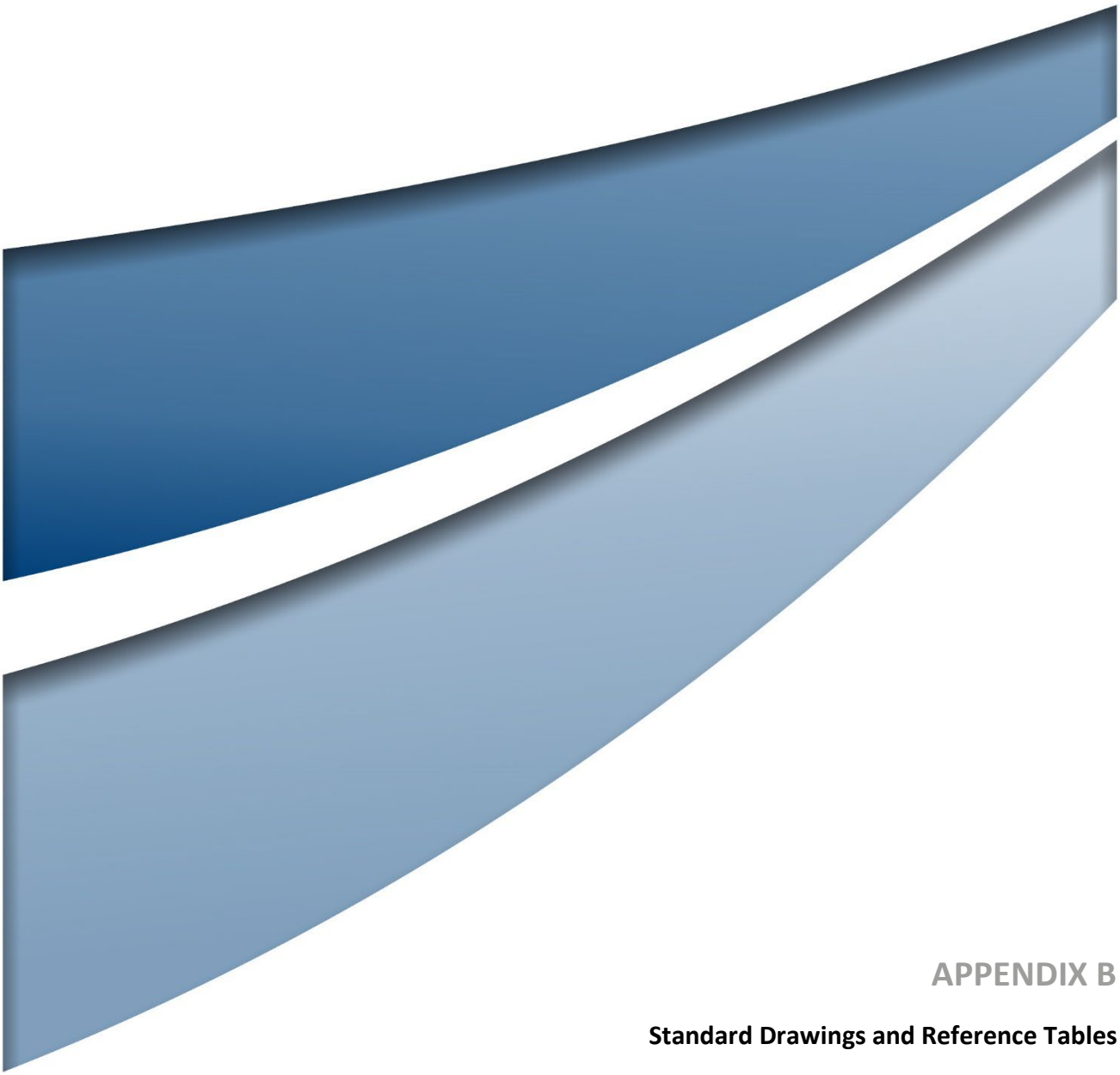
Settling Zone = 10 x 0.39 x 4.8 x 18.8 = 352m^3

Storage Zone = ½ x 352m^3 = 176m^3

TOTAL (MINIMUM) STORAGE = **528m^3**

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APPENDIX B

Standard Drawings and Reference Tables

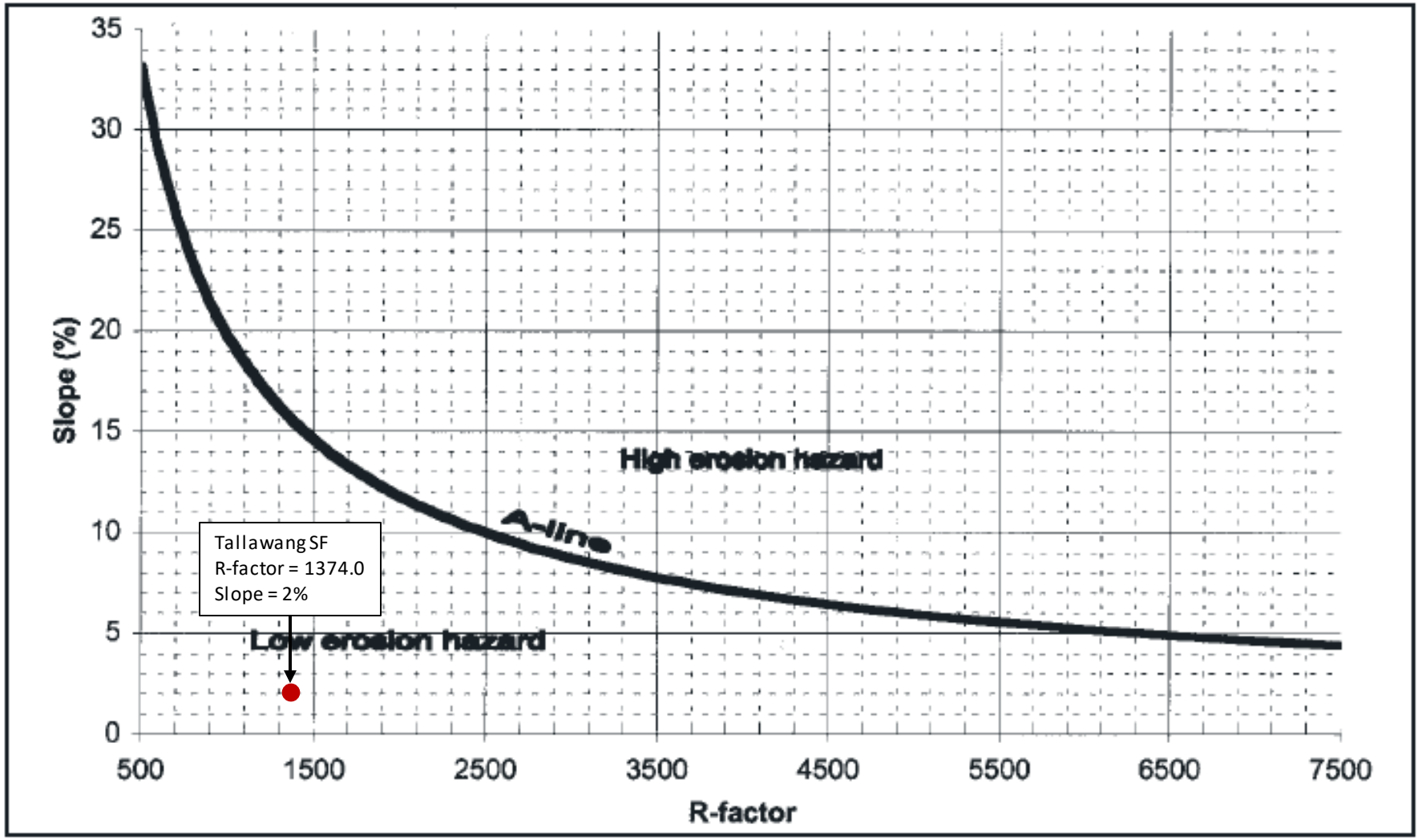


Figure 4.6 Assessment of potential erosion hazard

Table 4.2 The Soil Loss Classes (adapted from Morse and Rosewell, 1996)

Soil Loss Class	Calculated soil loss (tonnes/ha/yr)	Erosion hazard
1	0 to 150	very low
2	151 to 225	low
3	226 to 350	low-moderate
4	351 to 500	moderate
5	501 to 750	high
6	751 to 1,500	very high
7	>1,500	extremely high

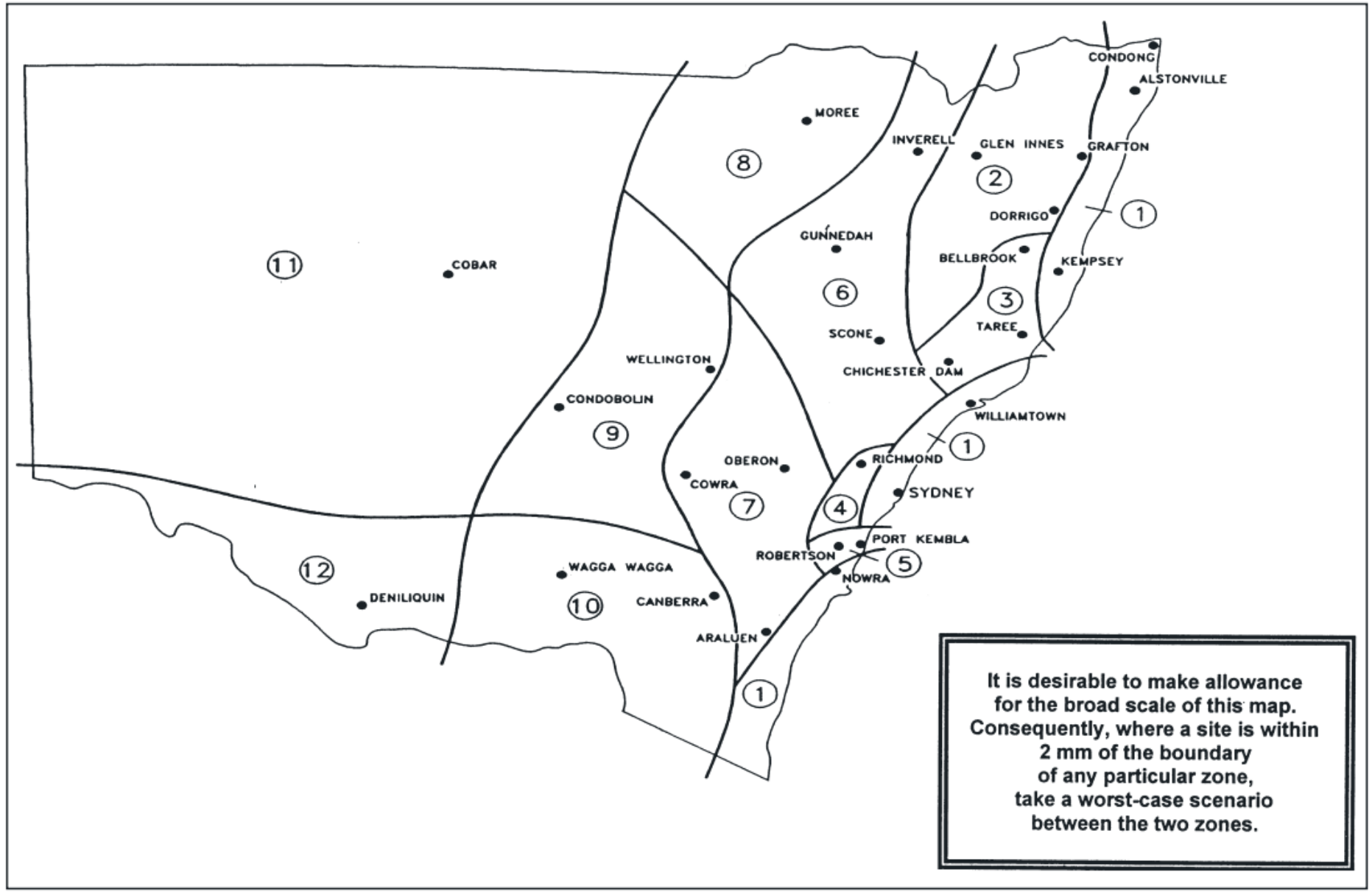
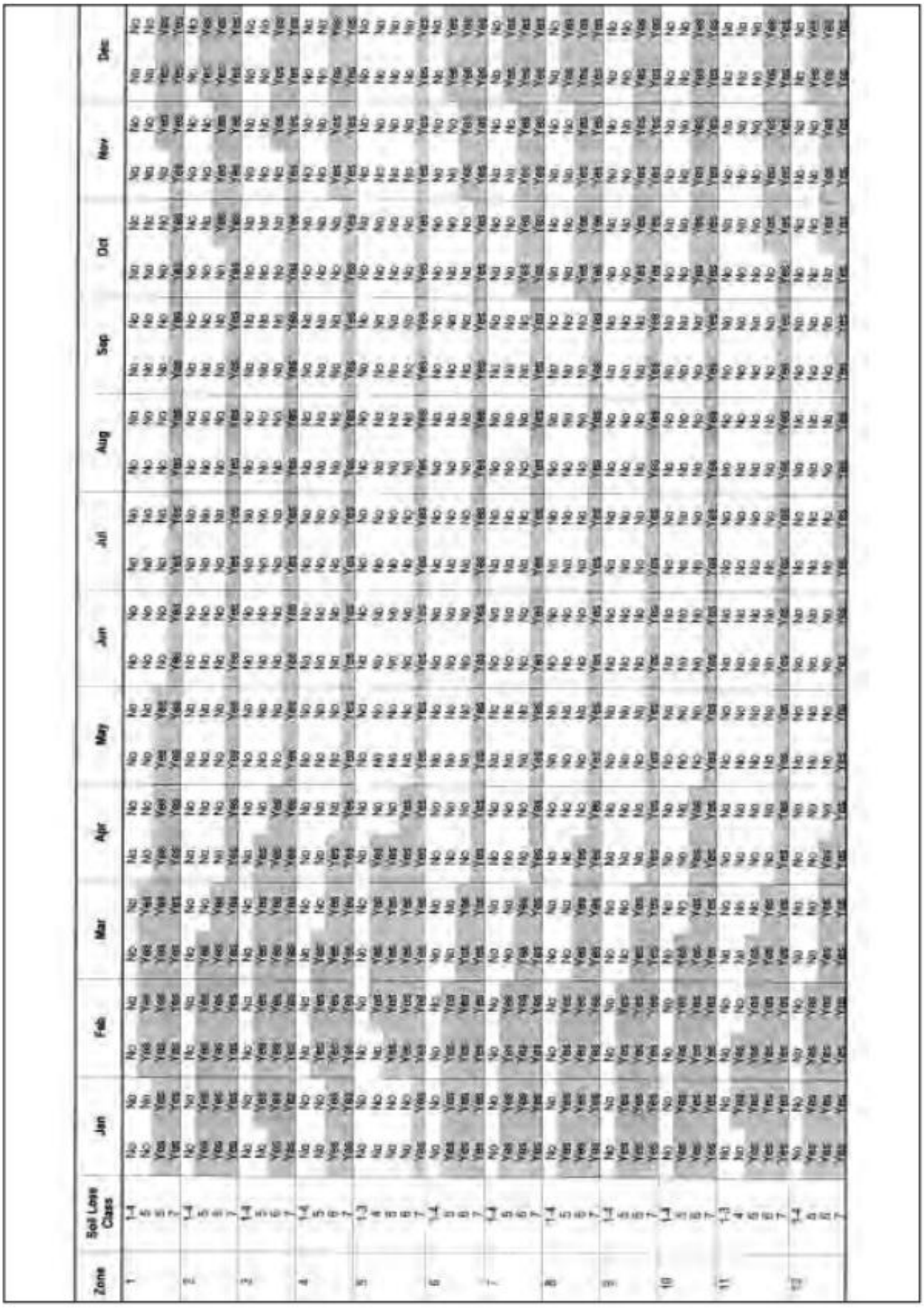


Figure 4.9 Rainfall distribution zones in New South Wales (Rosewell and Turner, 1992)

Table 4.3 Lands where special erosion control measures apply



3. Sediment Basin Spillway Design

Structure Details

Structure Name	SB1	SB2					Auto-filled from Worksheet 1
Catchment Area (ha)	2.358	2.358					Auto-filled from Worksheet 1
Time of concentration (tc)	5	5					Auto-calculated assuming tc is halved

Rainfall Intensities (IFD Values)

1 year, tc							Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2 year, tc							
5 year, tc							
10 year, tc							
20 year, tc							
50 year, tc							
100 year, tc							
C_{10} runoff coefficient							Use AR&R or Table F3, pg F-6
Design ARI event (select):	100	100	100	100	100	100	Select design ARI (years) from dropdown
Frequency Factor	1.2	1.2	1.2	1.2	1.2	1.2	Auto-filled based on selected ARI
Flow Calculation							Auto-calculated based on selected ARI

4. Volume of Type C (Coarse) Sediment Basins

Type C Basin Design Criteria

Structure Name	SB1	SB2					Auto-filled from Worksheet 1
Catchment Area (ha)	2.358	2.358					Auto-filled from Worksheet 1
Sediment type (C, F or D)	F	F					Auto-filled from Worksheet 1
Design rainfall event							Choose design event from dropdown
Flow volume (m^3/s)							Calculated from IFD values above
Area Factor	4100	4100	4100	4100	4100	4100	Default is 4,100. See pg 6-12
Depth of settling (water zone) (m)	0.6	0.6	0.6	0.6	0.6	0.6	Minimum is 0.6m (pg 6-12)

Type C Basin Volume Calculations

Basin Surface Area (m^2)	Not Type C	Not Type C	Not Type C	Not Type C	Not Type C	Not Type C	Auto-calculated
Settling (water) zone volume (m^3)	Not Type C	Not Type C	Not Type C	Not Type C	Not Type C	Not Type C	Auto-calculated
Storage (soil) zone volume (m^3)	Not Type C	Not Type C	Not Type C	Not Type C	Not Type C	Not Type C	Auto-calculated
Total basin volume (m^3)	Not Type C	Not Type C	Not Type C	Not Type C	Not Type C	Not Type C	Auto-calculated

Basin Shape

Enter length:width ratio	3	3	3	3	3	3	E.g. for 3:1 (L:W) enter 3.
Length (m)	N/A	N/A	N/A	N/A	N/A	N/A	These figures should be taken as a guide only. Detailed calcs might be required.
Width (m)	N/A	N/A	N/A	N/A	N/A	N/A	

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