Flood and Groundwater Assessment Report

ACEnergy BESS – 3 Turton Place, Murrumbateman, NSW

ACEnergy Pty Ltd

26 April 2024

Document Status

Version	Doc type	Reviewed by	Approved by	Date issued
V01	Final	Lachlan Inglis	Lachlan Inglis	26/04/2024

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1 INTRODUCTION

1.1 Overview

ACEnergy Pty Ltd are proposing to construct a Battery Energy Storage System (BESS) at 3 Turton Place, Murrumbateman, NSW (the Subject Site). The study objective is to better understand the flooding mechanisms, groundwater conditions and potential development risks within and surrounding the proposed BESS, particularly across the location where the BESS infrastructure is proposed to be constructed. This site is referred to as 'the Subject Site' within this report. The report presents the flood modelling assumptions and results together with a groundwater investigation of the Subject Site.

1.2 Objectives

To provide ACEnergy Pty Ltd with a better understanding of the Subject Site's inundation risk and the developments potential to impact groundwater availability and quality, the following tasks were completed:

- Review of existing flood and groundwater information.
- Development of a 2D (Two-Dimensional) hydraulic flood model (using TUFLOW) Rain-on-Grid (RoG) methodology to assess flood risk from stormwater runoff.
- Preliminary hydrogeological assessment to determine groundwater level and any potential groundwater and surface water interactions at the Subject Site.
- Provision of high-level recommendations for any mitigation or design alterations which may be required to reduce potential risks associated with flooding, drainage and groundwater.

Existing groundwater studies applied to the broader region and specific no studies were available for the Subject Site. An existing flood study is available for the study area and is discussed in Section 2.1.

1.3 Site

The Subject Site is located approximately 3 km east of the Murrumbateman Township in Eastern NSW, located at 3 Turton Place, Murrumbateman, NSW (Figure 1-1).

The site facility is proposed to be installed on gradually sloping terrain. The topography varies from 605.2 m AHD in the southeast to 602.1 m AHD in the northwest of the Subject Site (Figure 1-3). The terrain slopes towards the northwest with a slope of approximately 1.5%. The site is bounded by surrounding farmland and agricultural properties.

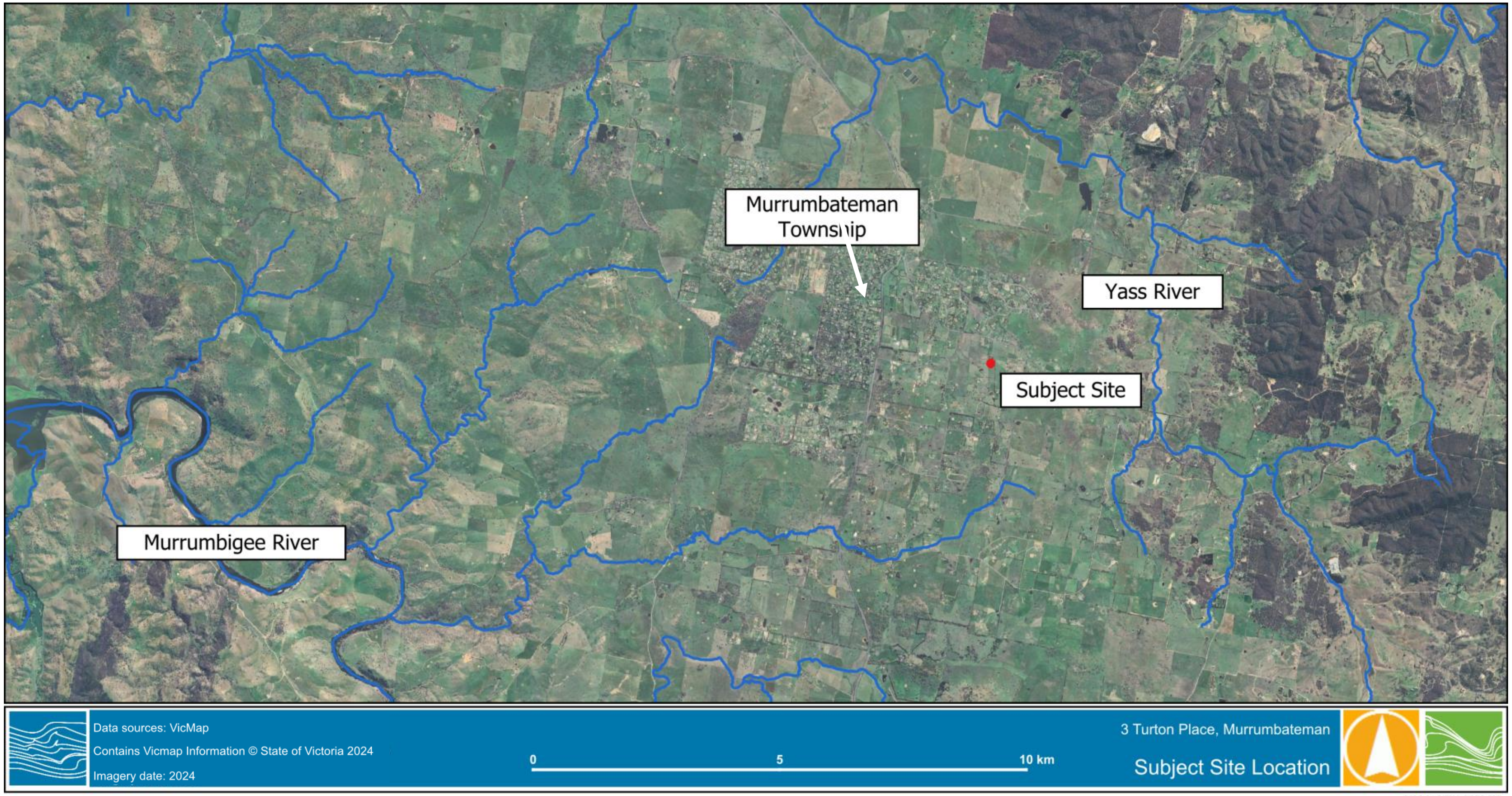

FIGURE 1-1 SUBJECT SITE LOCATION

FIGURE 1-2 SUBJECT SITE – ZOOMED IN

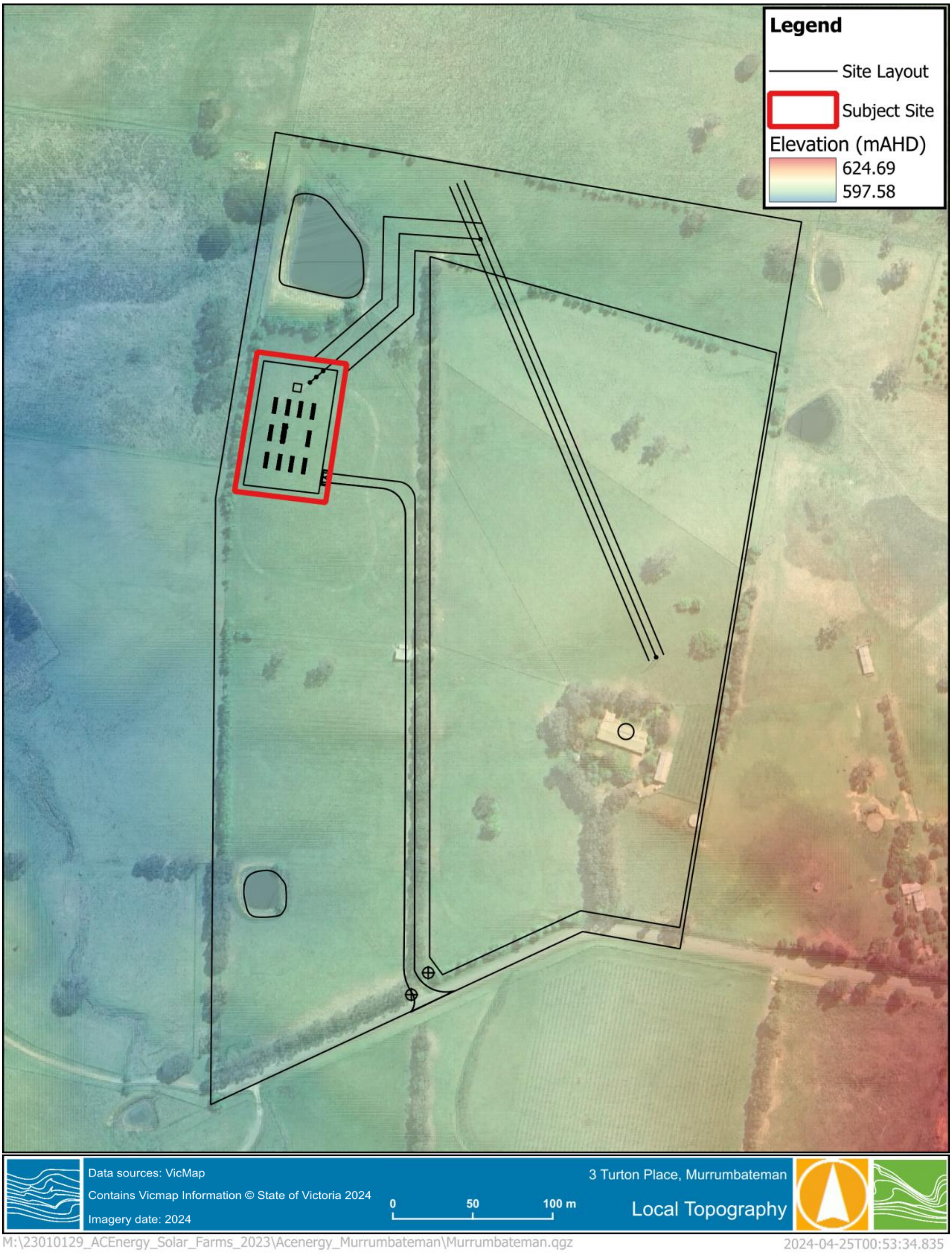

FIGURE 1-3 SUBJECT SITE TOPOGRAPHY

2 FLOODING

2.1 Previous Flood Study

The Murrumbateman, Bowning, Bookham and Binalong Flood Study – Addendum Report[1] was conducted for Yass Valley Council in 2020. The 1% AEP flood depth mapping which covers the Subject Site is presented in Figure 2-1. Based on the Addendum Report, the site is located adjacent to overland flow during a 1% AEP event from the Unnamed Tributary catchment which flows through the existing dam in the north of the site. This flow path is consistent with the flood mapping discussed in Section 2.

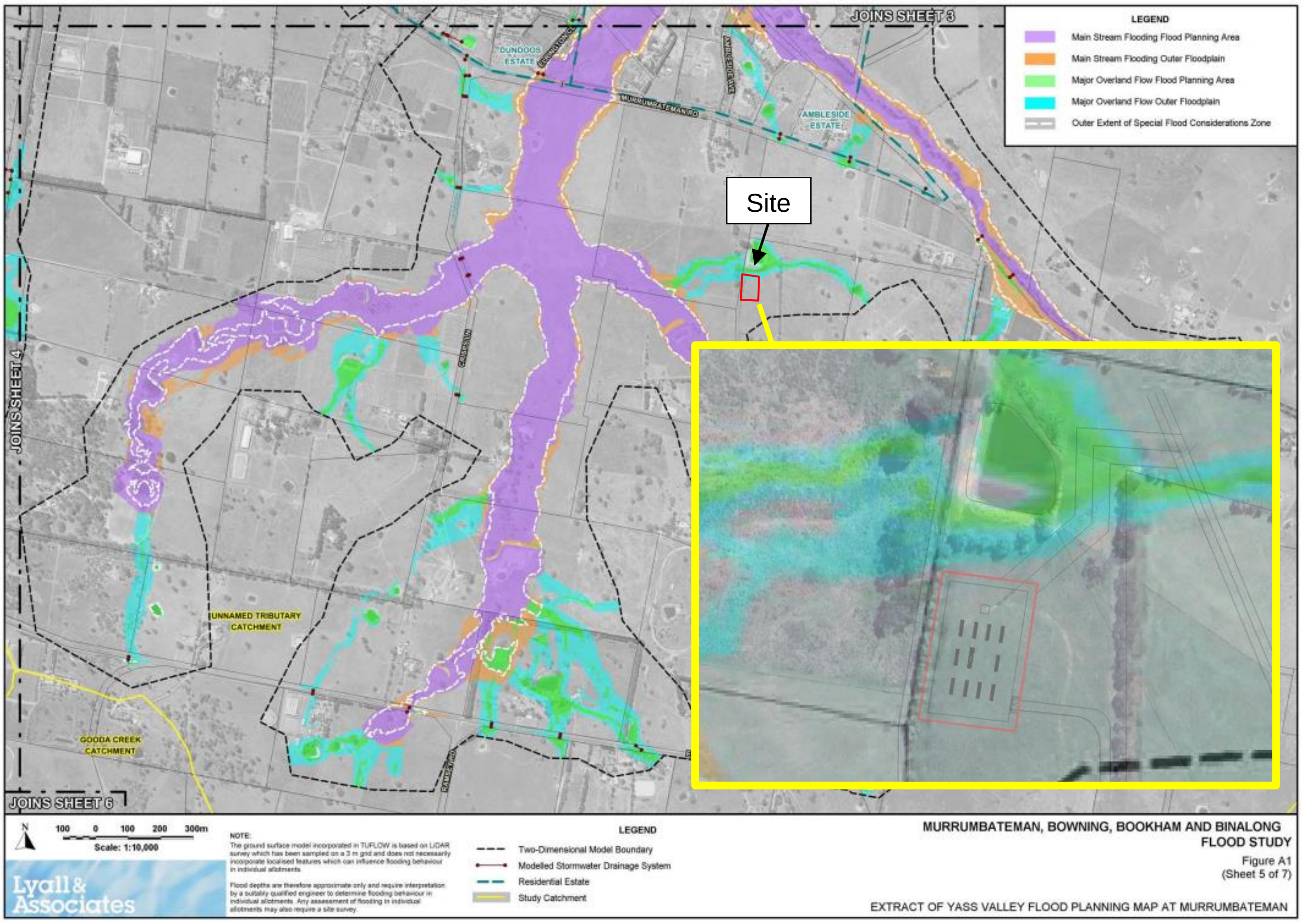

FIGURE 2-1 MURRUMBATEMAN, BOWNING, BOOKHAM AND BINALONG FLOOD STUDY 1% DEPTH (SOURCE: YASS VALLEY COUNCIL)

[1] Retrieved from https://flooddata.ses.nsw.gov.au/flood-projects/murrumbateman-bowning-bookham-and-binalong-flood-study-addendum-report

2.2 Methodology

A two-dimensional Rain on Grid (RoG) hydraulic modelling approach was employed for the hydraulic modelling component of this investigation. The model has generally been developed inline with Australian Rainfall and Runoff (ARR) 2019 guidelines[2] and simulated using TUFLOW hydraulic flood modelling software. Simulations were completed using TUFLOW Build 2023-03-AB Single Precision with HPC (Highly Parallelised Computations) solution scheme on a GPU solver.

The RoG methodology is extensively used for flood mapping of urban and rural areas. It allows for a comprehensive flood risk assessment by identifying overland flow paths based on the topography dataset as illustrated in the flow chart in Figure 2-2.

- The rainfall layer, which consists of one single rainfall polygon over the model extent was produced in a GIS package.
- Hyetographs (rainfall depth timeseries) were created for a range of design rainfall AEP (Annual Exceedance Probability) events and durations using QGIS TUFLOW plugin and the 2016 Bureau of Meteorology Intensity Frequency Duration (IFD) at the centroid of the catchment. These were applied to the TUFLOW model to represent catchment rainfall under various durations for the 1% AEP design storm.

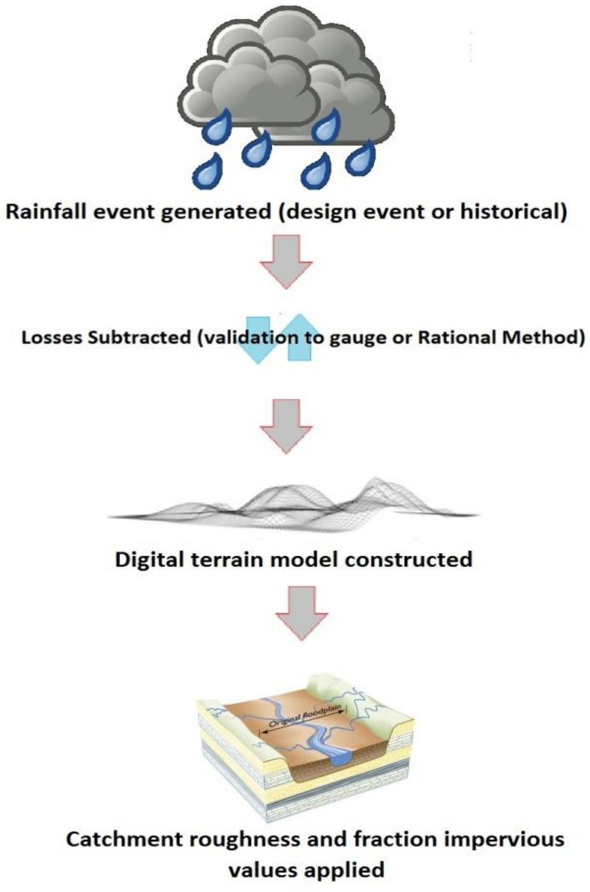

FIGURE 2-2 RAINFALL ON GRID MODELLING APPROACH

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[2] Retrieved from http://book.arr.org.au.s3-website-ap-southeast-2.amazonaws.com/

A new hydraulic model was constructed using land use, cadastral, topography and aerial photography datasets to identify different land uses which are represented from a hydrologic and hydraulic perspective as surface roughness and initial and continuing loss values.

The upstream catchment and wider area were modelled to ensure all runoff from the upstream catchment was captured. The TUFLOW model set-up and model extent is presented in Figure 2-3.

FIGURE 2-3 TUFLOW MODEL SETUP

2.2.1 Rainfall

Understanding historical rainfall seasonality and long-term trends is critical to surface water and groundwater investigations. Historical rainfall data was taken from the SILO database[4] for the grid point nearest to the study area (latitude -35.00 and longitude 149.05). The dataset covers a 67-year period from 1957 to 2024, which is adequate to identify longer-term rainfall trends.

The mean annual rainfall is 702.1 mm/yr, with monthly average rainfall ranging between 47.0 mm in April and 71.3 mm in October (Figure 2-4). Annual rainfall is highly variable and Figure 2-5 shows periods of both above and below-average rainfall over the nearly 67-year period. The above-average rainfall is interpreted from the cumulative deviation from the mean monthly rainfall (CDMMR) (Figure 2-3), which identifies when rainfall has trended above average (inclining line) or below average (declining line). Above-average rainfall periods were noted between approximately 1958-1965, 1970-1980, 1985-2000 and from 2020-2024. Several below-average rainfall periods are noted between approximately 1965-1970, 1980-1985 and 2000-2010.

[4] https://www.longpaddock.qld.gov.au/silo/

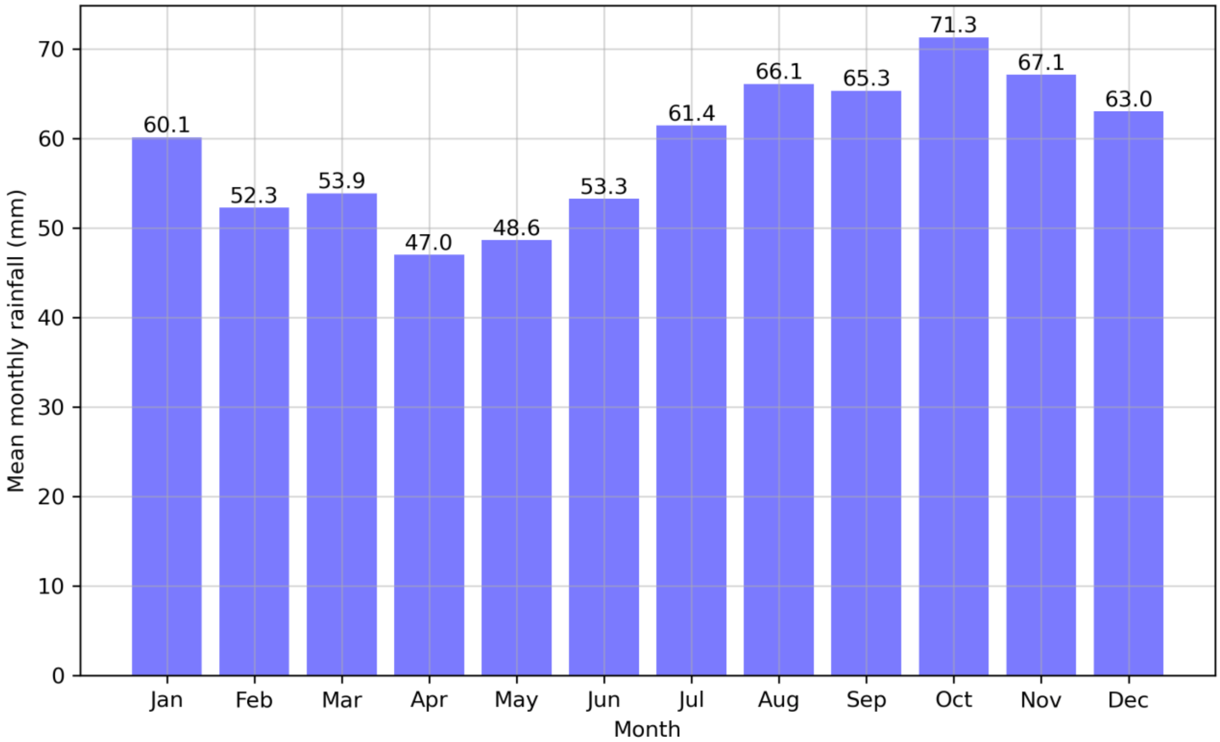

FIGURE 2-4   MONTHLY AVERAGE RAINFALL FROM 1957-2024

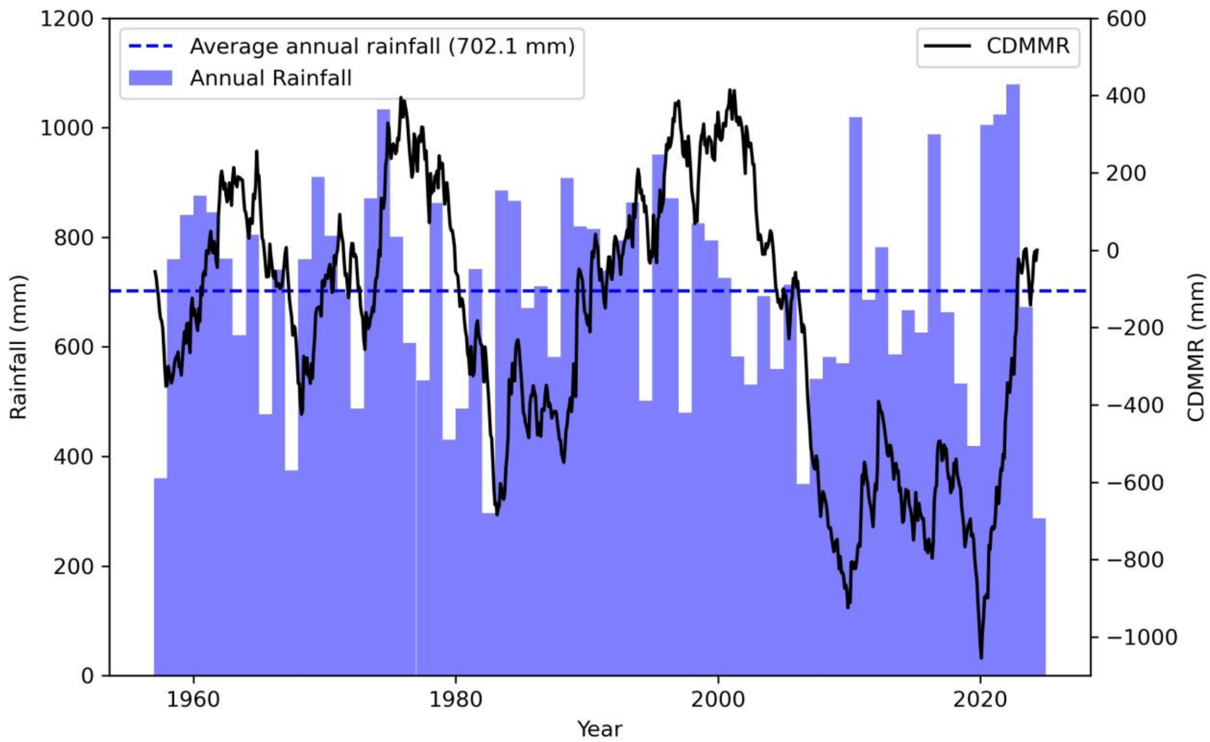

FIGURE 2-5   AVERAGE ANNUAL RAINFALL AND THE CUMULATIVE DEVIATION FROM MEAN MONTHLY RAINFALL (CDMMR) BASED ON DATA AVAILABLE FROM 1957-2024

2.2.2 Digital Elevation Model, Losses and Hydraulic Roughness

A Digital Elevation Model (DEM) was generated from 1 m resolution LiDAR, supplied by NSW Spatial Services via Geoscience Australia's Elevation Information System (ELVIS)[5].

Table 2-1 summarises the rainfall losses and hydraulic roughness used for the hydraulic modelling as per the land use types within the model. These values were adopted based on Water Technology's experience with RoG models in the surrounding area. Figure 2-6 shows the TUFLOW materials layer.

A check was also undertaken to test the sensitivity of continuing loss values adopted. It was found that reducing the losses by 50% for the critical duration (1% AEP, 360 minutes, TP06) had negligible impacts on the flood extent and maximum flood depths (<2cm) around the Subject Site.

TABLE 2-1 MODEL PARAMETERS

Land use types	Material Code	Manning's 'n' (roughness)	Initial loss (mm)	Continuing loss (mm/hr)
Residential – Rural	102	0.150	14	2
Open Pervious Area	108	0.040	14	2
Paved Roads/Carparks	114	0.025	1	0.5

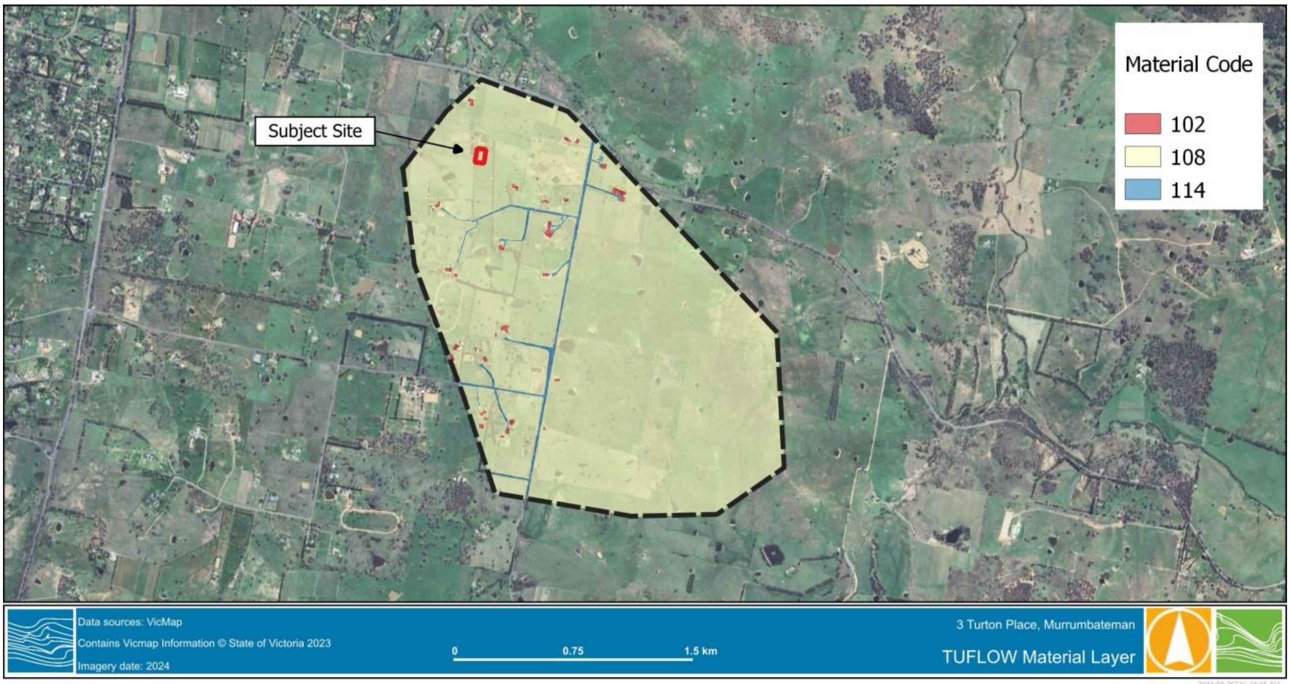

FIGURE 2-6 TUFLOW MODEL MATERIALS LAYER

2.2.3 Boundaries

A tailwater (2D TUFLOW 'HQ') boundary was set and extended around the downstream model extent to allow overland flow to freely drain out of the model, with a constant slope of 0.5%.

[5] https://elevation.fsdf.org.au/

2.2.4 TUFLOW Model Checks

- The following checks were undertaken on the TUFLOW model parameters and outputs:
  - 2D timestep: The adaptive 2D timestep drops to a minimum of 0.5 seconds. A 'Classic' TUFLOW model would be expected to have a timestep no less than ¼ of the grid size (3 m), i.e. 1.25 seconds, with a healthy HPC model no lower than a tenth of this figure. Hence, the adopted timestep is within the recommended range.
  - Model mass errors: The mass errors for all models were less than 1% and within the recommended range.
  - Errors and warning messages: No errors were found within the model and all warnings were reviewed and either acceptable or fixed, if required.

2.2.5 Critical Duration and Temporal Pattern Assessment

The model was simulated for the following 1% AEP design storm durations; 3, 6, 12, & 24 hours, using three ARR 2019 temporal patterns representative of front, mid and back loaded storm events.

Results were processed to select the combination of durations and temporal patterns resulting in the maximum flood depths throughout the catchment and covering the site. This is a conservative method of identifying areas prone to flooding in a 1% AEP event. The modelled durations and temporal patterns are shown in Table 2-2.

TABLE 2-2 MODELLED DURATION AND TEMPORAL PATTERN

AEP Event	1%
Durations	3, 6, 12, & 24 hours
Temporal Pattern	TP02, TP04, TP06

2.3 Flood Hazard Classification

Floods can be hazardous, producing harm to people, damage to infrastructure and potentially loss of life. In examining potential flood hazard there are several factors to be considered, as outlined in ARR 2019 (Book 6 Chapter 7)[6]. An assessment of flood hazard should consider:

- Velocity of floodwater.
- Depth of floodwater.
- Combination of velocity and depth of floodwater.
- Isolation during a flood.
- Effective warning time.
- Rate of rise of floodwater.

The flood hazard at the site was assessed in accordance with ARR2019, which defines six hazard categories. The combined flood hazard curves are presented in and vulnerability thresholds classifications are tabulated in Table 2-3.

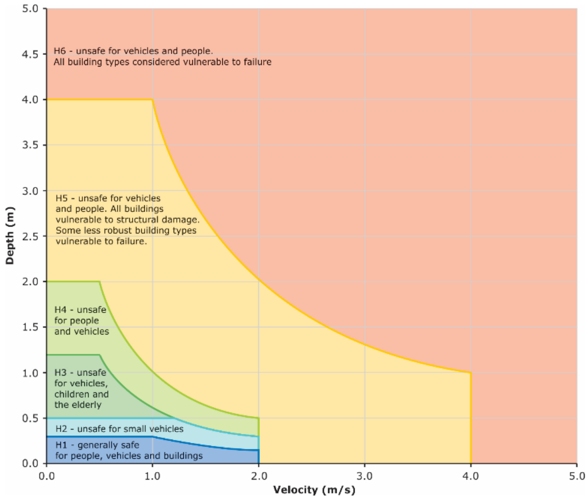

FIGURE 2-7 FLOOD HAZARD CURVES

[6] http://book.arr.org.au.s3-website-ap-southeast-2.amazonaws.com/

TABLE 2-3 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.

2.4 Results

The existing conditions 1% AEP depth, velocity and flood hazard results are shown from Figure 2-8 to Figure 2-10. The flood depth map was filtered for small depths (below 0.02 m) and puddles less than 100m^2 removed.

The following observations can be made for the 1% AEP storm event:

- The maximum depth within the Subject site is approximately 80 mm. The main flow path is shallow sheet flow, from the east of the site. Water ponds around the dam to the north of the Subject Site with a small flow path through the northeast corner of the site.
- Modelled peak velocities within the proposed facilities extent are generally less than 0.2 m/s with some small areas between 0.50 – 0.55 m/s in the northeast corner of the site.
- A flood hazard map was created from the product of both depth and velocity as described in the previous section. The Subject Site and proposed location of the facilities is all classified as H1 'Generally safe for vehicles, people, and buildings'. This is to be expected of shallow water, ponding across the site rather than traversing it. To the north of the site, the dam has flood hazard up to H3 due to the greater depths within the dam.

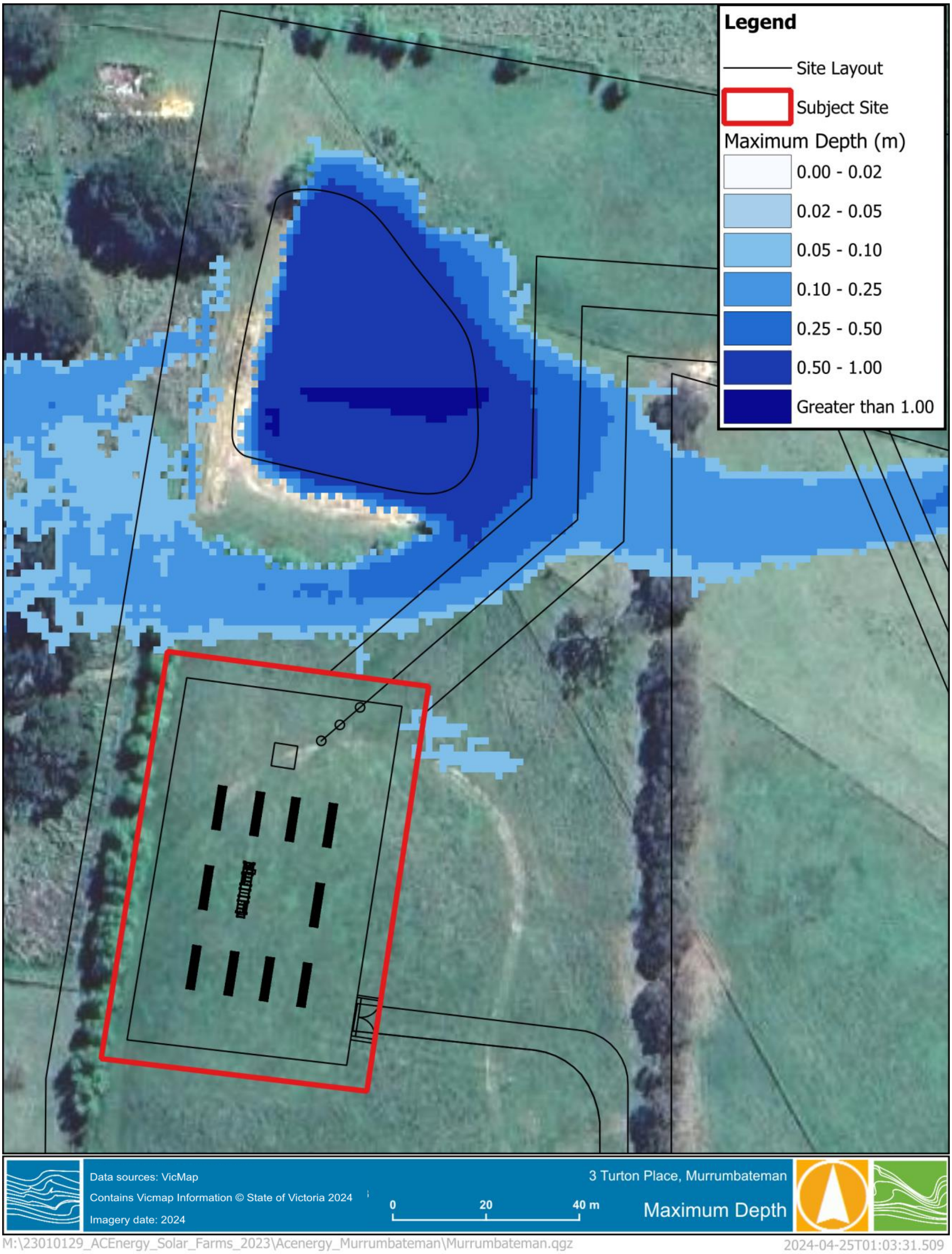

FIGURE 2-8 1% AEP MAXIMUM FLOOD DEPTH (DEPTHS BELOW 0.02M NOT SHOWN)

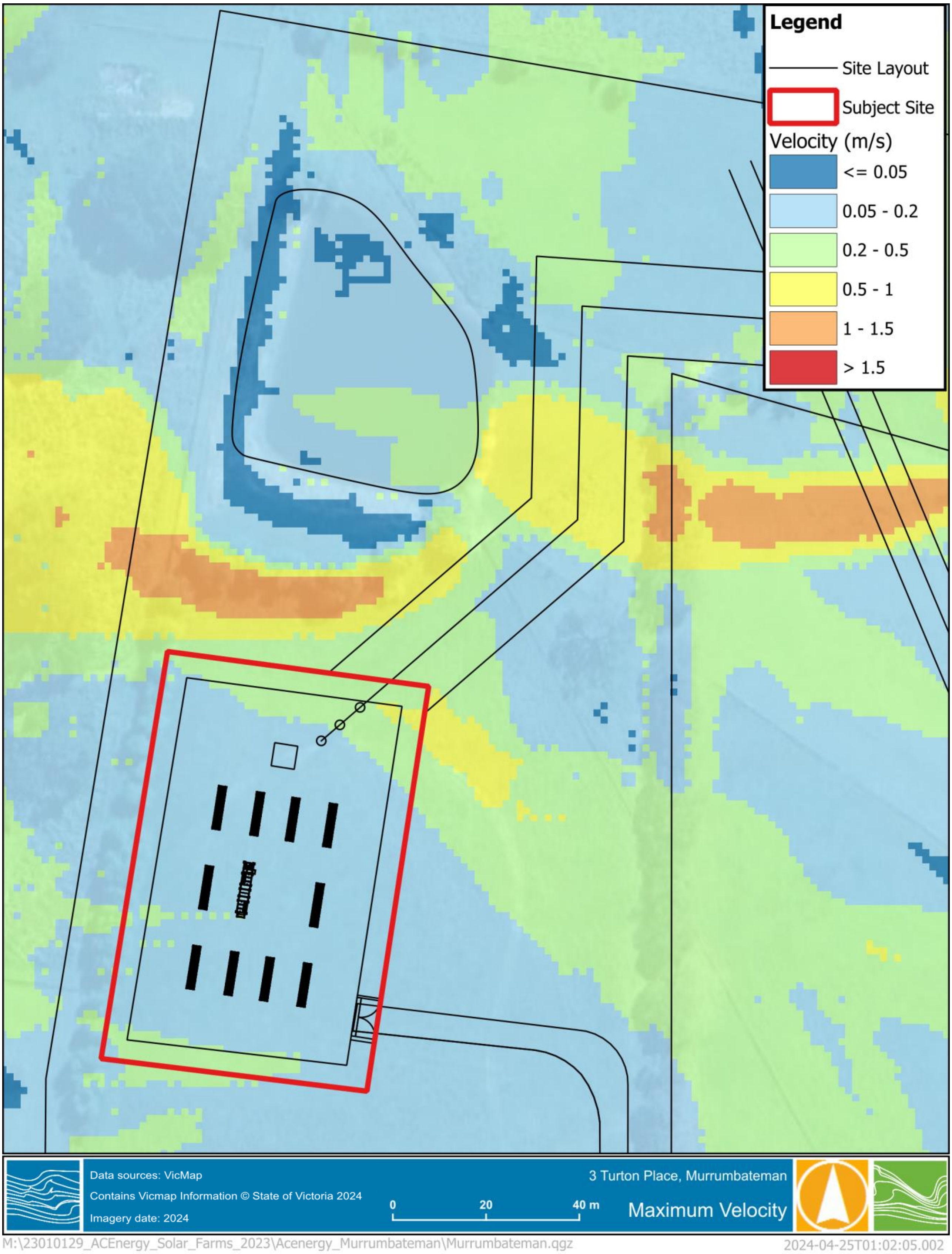

FIGURE 2-9 1% AEP MAXIMUM FLOOD VELOCITY

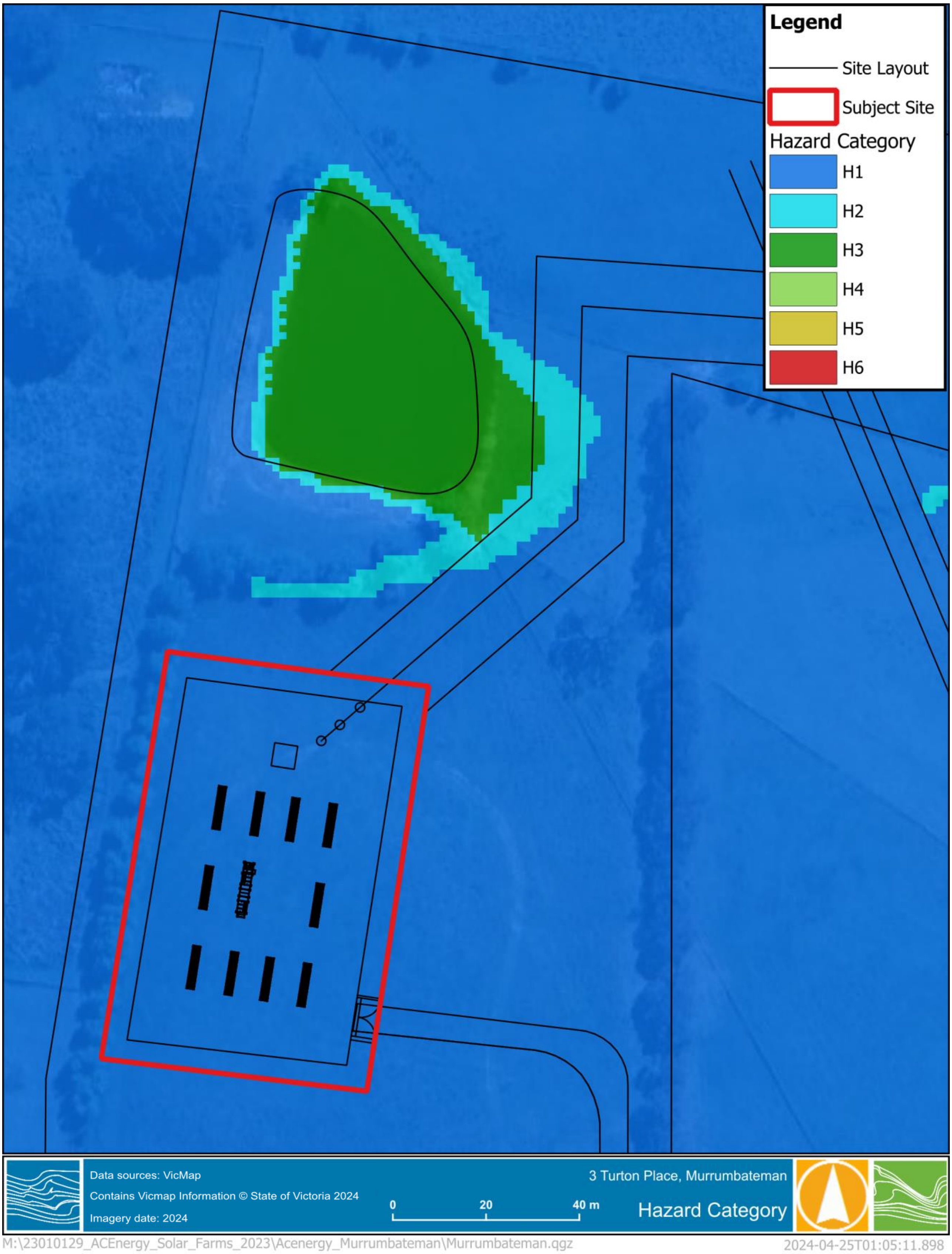

FIGURE 2-10 1% AEP MAXIMUM FLOOD HAZARD

3 GROUNDWATER

The Subject Site is not located within a "groundwater vulnerable" area according to the NSW Department of Planning and Environment's (DPEs) Groundwater Vulnerability mapping[7]. The Yass Valley Local Environmental Plan 2013 requires an assessment of groundwater vulnerability to maintain hydrological function of key groundwater systems and protect vulnerable resources from depletion and/or contamination due to the proposed development. Although the Subject Site is not located within a groundwater vulnerable area, a groundwater vulnerable area is mapped approximately 2 km south of the Subject Site, and therefore this assessment will assess potential impacts to that identified area. This preliminary hydrogeological assessment considers key components of the groundwater system to develop a hydrogeological conceptual model (Section 3.1) that was used to inform a groundwater vulnerability assessment (Section 3.2).

The following factors were considered as part of this groundwater vulnerability assessment:

- The likelihood of groundwater contamination.
- Impacts on groundwater-dependent ecosystems.
- The cumulative impact on the groundwater system (including impacts on nearby groundwater extraction for a potable water supply or stock water supply.
- Any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.
- Groundwater abstraction

3.1 Hydrogeological Conceptualisation

Geology of the Subject Site was determined from the NSW Geoscience website MinView[8], with the whole site underlain by quaternary age alluvial and residual deposits, including saprolite, developed by the weathering of older underlying formations. The deeper geology of the area is associated with the Douro Group within the Lachlan Fold Belt. Immediately underlying the Subject Site are the Hawkins Volcanics, which may comprise porphyritic, limestone, mudstone and breccia units[6]. While to the east and north of the Subject Site are Mount Ainslie Volcanics, which comprise porphyry and shale units.

Groundwater information (i.e. bore information, geology, water levels, yields and salinity) were collated from the Bureau of Meteorology (BoM) Groundwater Explorer[9] and from the WaterNSW Realtime Data web portal[10] within a 1 km radius of the Subject Site (Table 3-1 and Figure 3-2). The geological log from the bore GW047516, which is the closest bore to the Subject Site at approximately 200 m west-southwest (Figure 3-2), indicates a thin (0.3 m) layer of topsoil over 6.4 m of clay, over 31.4 m of granite to the termination depth of 38.1 m below ground level (mbgl). Bores GW047293 (300m south) and GW417023 (350m north) also reported over 6m of clay at the surface, suggesting that the Subject Site is underlain by a thick layer of clay.

The remainder of the identified bores within 1 km of the Subject Site all indicate a similar geology of a thin topsoil over several metres of clay over bedrock. The local geological descriptions conform with the broader geological descriptions of superficial deposits and clay derived from weathering over granites of the Douro Group.

[7] https://datasets.seed.nsw.gov.au/dataset/epi-groundwater-vulnerability
[8] MinView | Regional NSW | Mining, Exploration and Geoscience
[9] http://www.bom.gov.au/water/groundwater/explorer/map.shtml
[10] https://realtimedata.waternsw.com.au/water.stm

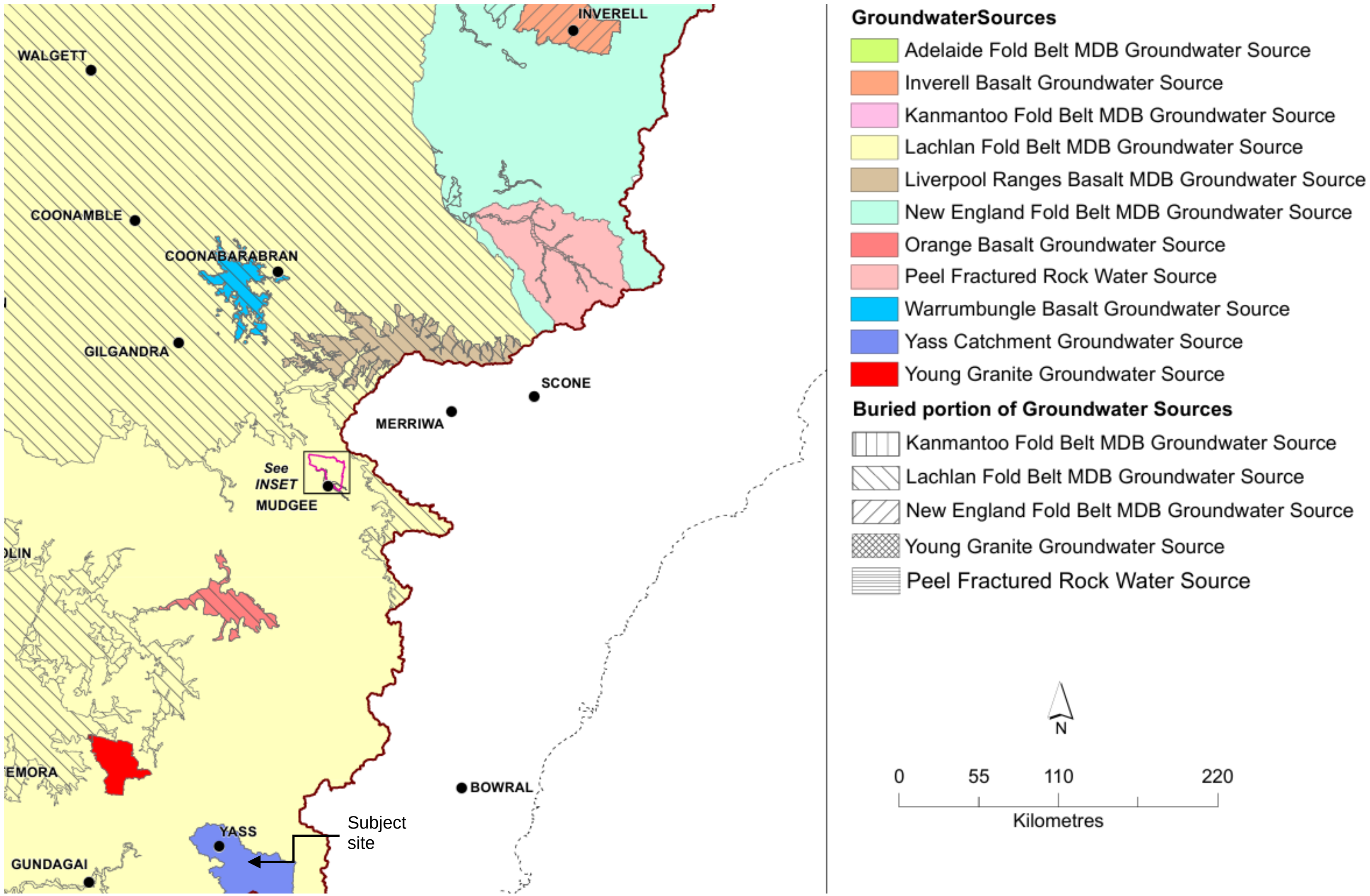

FIGURE 3-1 MURRAY-DARLING BASIN FRACTURED ROCK WATER RESOURCE PLAN GROUNDWATER RESOURCE UNITS (2022)

TABLE 3-1 COLLATED BORE INFORMATION FOR BORES IN CLOSE PROXIMITY (APPROXIMATELY 1 KM) OF THE SUBJECT SITE.

Bore ID **Use** **Location** (Purpose)	**Total depth (m)**	**Screen interval(s) (m)**	**Lithology description**	**Standing water level (mBGL)**	**Yield (L/s)**	**TDS (mg/L)**
GW047516 Irrigation 200m west	38.1	NA	0.0-0.3m Topsoil 0.3-6.7m Clay 6.7-38.1m Granite	NA	NA	NA
GW047293 Irrigation 300m south	45.7	9.1-19.8 26.8-28.9	0.0-0.3m Topsoil 0.6-6.9m Clay 6.9-19.8m Granite decomposed water supply 19.8-45.7m Granite porphyry water supply	3.0	0.91 3.64	Good
GW046695 Domestic/stock 600m east	79.90	36.6-37.2 68.0-69.2	0.0-1.5m Topsoil/subsoil 1.5-7.9m Clay sandy 7.9-10.3m Porphyry decomposed 19.8-45.7m Porphyry water supply	36.6 13.7	0.01 0.05	1,001- 3,000
GW020873 Stock 800m northwest	28.7	9.4-9.4 23.8-23.8 28.7-28.7	0..0-7.92m Clay some sand 7.92-28.65m Granite water supply	NA NA 7.9	NA 0.42 0.48	
GW417023 Domestic/stock 350m north	120	90.0-91.0	0.0-9.0m Clay 9.0-120.0m Shale	24.0	0.44	NA
GW400709 Domestic/stock 750m northwest	36.0	18.00-2.0 32.0-34.0	0.0-3.0m Topsoil, clay 3.0-1.0m Soft decomposed granite 10.0-36.0m Granite, highly fractured	6.0	0.51 7.6	NA
GW401759 Test bore 750m northwest	60.0	14.0-18.0 20.0-24.0 24.0-30.0 46.0-48.0 56.0-59.0	0.0-3.0m Clay 3.0-60.0m Weathered dense, volcanic	0.85	0.5 1.6 0.7 1.5 2.5	1,000

Bore ID Use Location (Purpose)	Total depth (m)	Screen interval(s) (m)	Lithology description	Standing water level (mBGL)	Yield (L/s)	TDS (mg/L)
GW058339 Test bore 750m northwest	61.0	19.8-25.9	NA	NA	NA	NA
GW400773 Domestic/stock 900m northwest	30.0	17.0-19.0 23.0-23.2	0.0-1.0m Topsoil 1.0-6.0m Clay 6.0-19.0m Decomposed granite 19.0-30.0m Granite	1.0	1.01 0.25	NA
GW009136 NA 750m west	39.0	NA	0.0-4.88m Clay 4.88-39.0m Porphyry	NA	NA	NA
GW416988 Domestic/stock 650m west	25.0	NA	NA	20.0	20.0	NA
GW417529 400m east	No records					
GW401258 400m east	No records					
GW402406 Domestic/stock 400m east	NA	NA	NA	NA	2.1	NA
GW067430 Domestic/stock /irrigation 650m east	No records					
GW056823 Domestic/stock /irrigation 750m east	23.0	20.0-23.0	0.0-23.0m Granite decomposed water supply	1.0	1.0	NA
GW400739 Domestic/stock /irrigation 800m east	76.0	14.0-14.5 59.0-59.3 67.0-67.2	0.0-3.0m Clay 3.0-16.0m Sandy clay 16.0-23.0m decomposed basalt 23.0-76.0m Hard basalt	3.0	0.44 2.27 0.07	Good

Bore ID **Use** **Location** (Purpose)	**Total depth (m)**	**Screen interval(s) (m)**	**Lithology description**	**Standing water level (mBGL)**	**Yield (L/s)**	**TDS (mg/L)**
GW064561 Domestic/stock 900m east	24.0	18.0-18.5	0.0-1.0m Topsoil 1.0-3.0m Decomposed granite 3.0-24.0m Granite	NA	4.4	NA

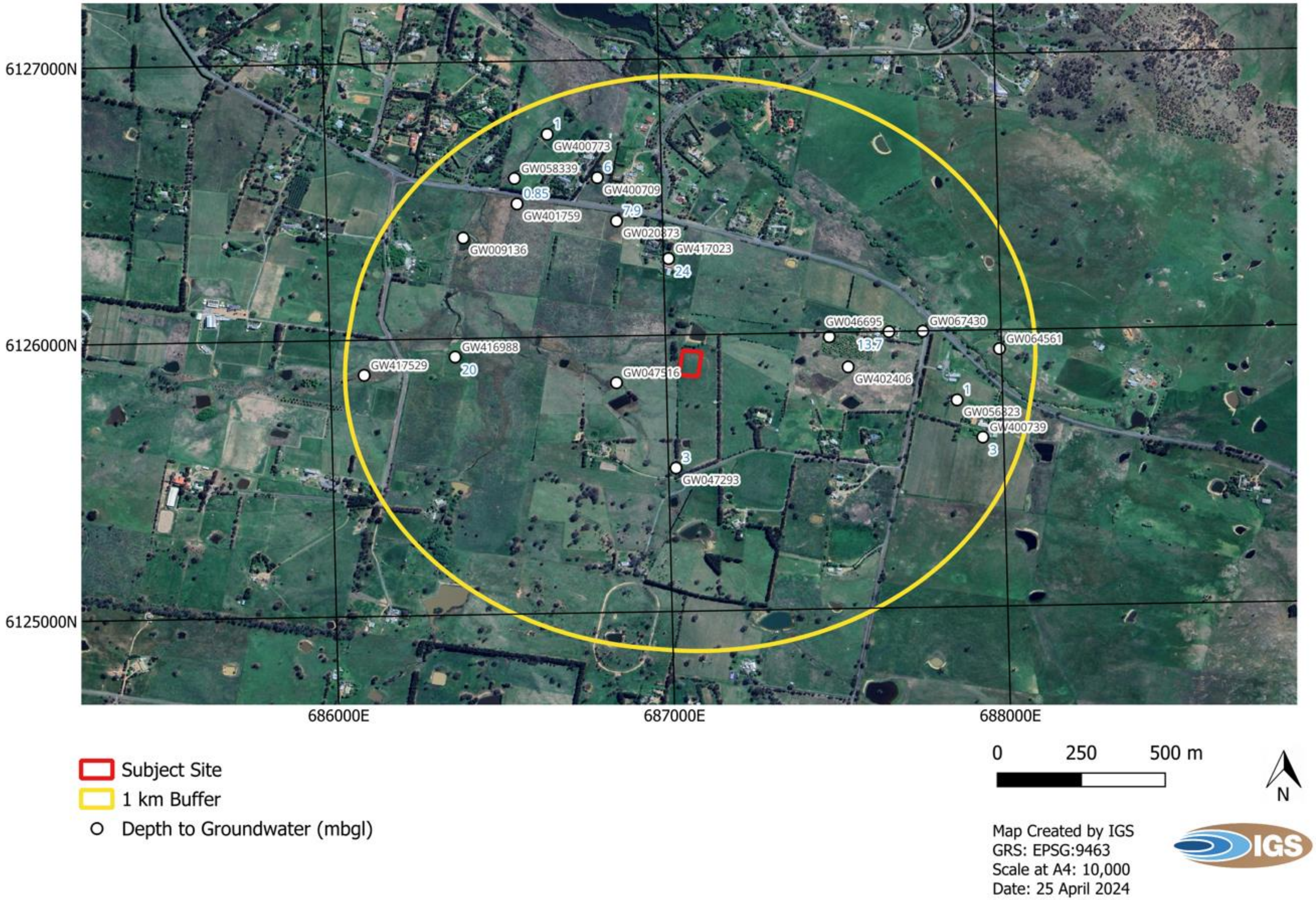

FIGURE 3-2 AVAILABLE GROUNDWATER BORES WITH GROUNDWATER LEVELS IN BLUE

3.1.1 Groundwater Quality and Use

There are limited water quality datasets available in the area around the Subject Site with only two reported qualitative salinity results and two quantitative salinity results. Bores GW046695 and GW401759 reported salinities of 1,000 mg/L to 3,000 mg/L, indicating water is suitable for stock and irrigation uses. Bores GW047293 and GW400739 reported salinity of ‘good’; however, it was not reported if the ‘good’ definition related to stock water use or potable water use.

Based on the available data it is considered that the local groundwater quality at the site is brackish and only suitable for irrigation or stock water uses.

3.1.2 Groundwater levels

As shown in Table 3-1, water levels have been recorded from <1.0-36.0 mBGL within 1 km of the Subject Site, however, the closest (300m south) bore location generally reported water levels of 3 mbgl. The shallowest water levels were reported in bores a minimum of 750m from the Subject Site. Most of the bores identified within 1 km of the Subject Site have screened sections at depths greater than 9 mbgl, indicating that groundwater generally occurs in the Douro Group volcanics beneath the shallow clay layers that are present. There are no telemetered monitoring bores within 10 km of the site which does not allow for any groundwater levels timeseries to be investigated. However, it is expected that groundwater levels will fluctuate over the course of a year with the highest groundwater levels expected in late spring and the lowest in late autumn.

3.1.3 Acid Sulfate Soils

The Subject Site is not located in an area identified as having acid sulfate soils according to the NSW Planning, Industry and Environment (DPIE) webapp, eSpade[11].

3.1.4 Groundwater Management

Groundwater use at the Subject Site is managed under the Water Sharing Plan for the NSW Murray Darling Basin (MDB) Fractured Rock Groundwater Sources 2020 (reference)[12], and specifically provisions for Yass Catchment Groundwater Source (Figure 3-1). It is understood that there will be no groundwater abstraction or dewatering occurring at the Subject Site during any phase and therefore no groundwater licence will be required.

3.1.5 Groundwater-Surface water interactions and Groundwater Dependent Ecosystems

Groundwater-surface water interactions are expected to be limited, given that few natural surface water bodies are near the Subject Site and reported water levels close to the site i.e. within 750m, were reported at a minimum depth of 3 mbgl and are beneath a thick layer of clay. It is noted, however, that tree’s may have root systems that would extend deeper than 3 mbgl and draw water from beneath the clay layer. The GDE atlas[13] was queried to locate terrestrial, aquatic or subterranean GDEs near the Subject Site (Figure 3-3). The closest terrestrial GDEs are located 2 km to the west and 3 km to the east with both described as having a ‘Low potential for groundwater interaction’ and therefore due to the distance and low interaction potential they are not considered a risk.The GDE Atlas identified that the closest aquatic GDEs are located approximately between 2.5 km south and 3.5 km eastand are associated with Gooda Creek,Murrumbateman Creek and Broken Dam. The aquatic GDEs are reported as having a “High or moderate potential for groundwater interaction”, with Broken Dam identified as the GDE with the Moderate ranking.

[11] eSPADE v2.2 (nsw.gov.au)
[12] sl-2020-0348 (nsw.gov.au)
[13] http://www.bom.gov.au/water/groundwater/gde/

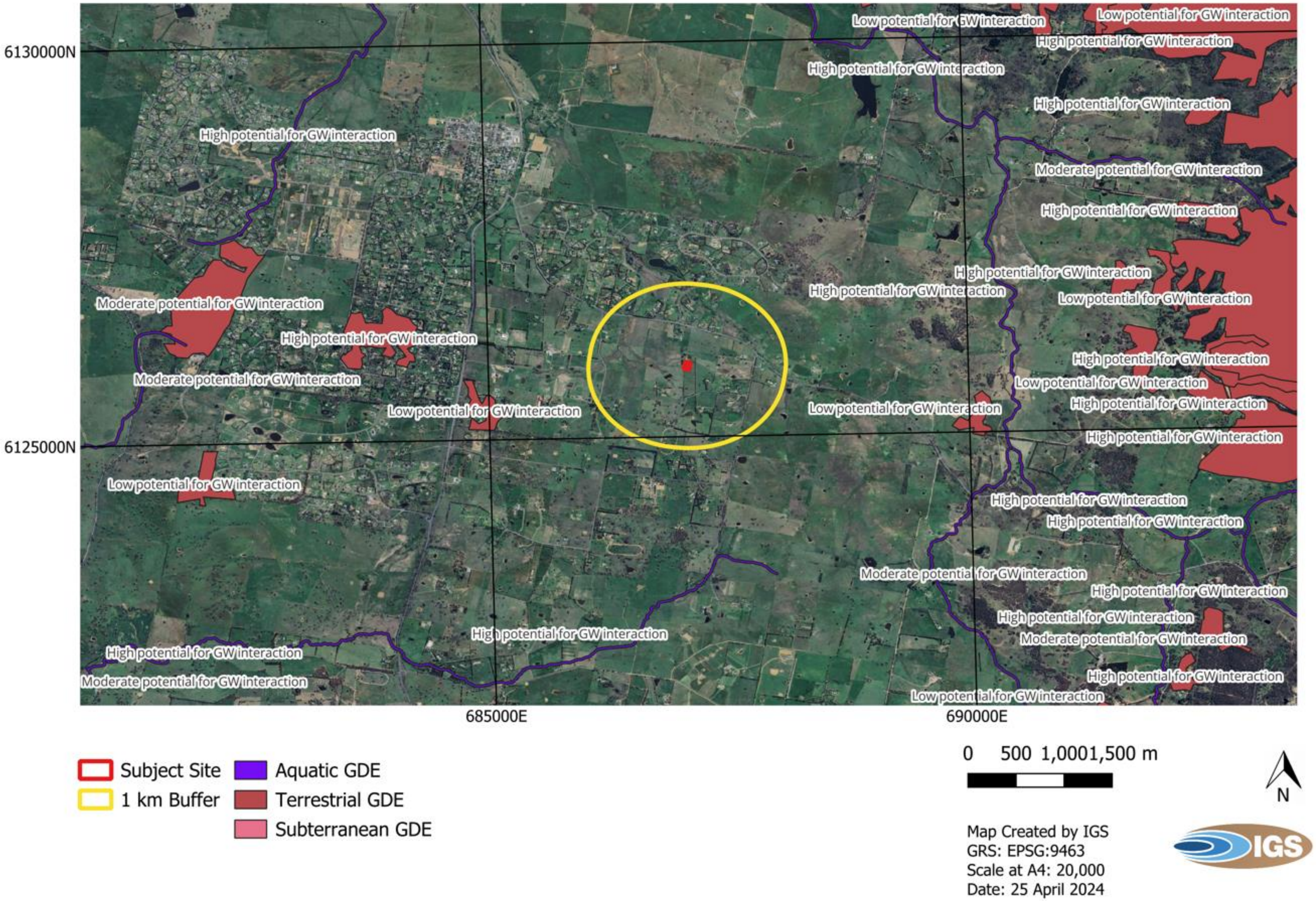

FIGURE 3-3 GROUNDWATER-DEPENDENT ECOSYSTEMS NEAR THE SUBJECT SITE FROM THE GDE ATLAS LABELLED WITH THE POTENTIAL FOR GROUNDWATER INTERACTION

3.2 Groundwater Vulnerability Assessment

3.2.1 Likelihood of contamination

It is understood that during construction, there will be no significant stored volumes of chemicals or fuels and no refuelling or washing of vehicles. Therefore, the potential risks of contamination would be from minor fuel or hydraulic hose leaks, which are expected to be less than 100 L. These leaks would be managed via spill kits and mechanical removal of impacted soils until clean/non-odorous soils are observed. Therefore, due to the small volumes of potential sources and the reported thickness (>5 m) of clay in the bores logs located within 300 m of the Subject Site which is assumed to be consistent with the Subject Site, acting as a barrier to vertical migration of contaminants, the Subject Site is considered to have a negligible risk of contaminating and reducing groundwater quality for any local users or GDEs associated with the local groundwater.

Once operational, potential contaminant sources include leakage of chemicals from batteries; however, the batteries will be lithium-ion phosphate, which does not contain heavy metals and is considered to be the safest batteries in the industry. In the unlikely event of battery failure, the units are self-contained, with anti-leak connections, limiting any potential for contamination release. Further, as the batteries are in IP54 rated self-contained units, the opportunity for external water to interact with the internal battery and therefore the batteries are not considered a significant source of contamination. This is also demonstrated in Section 2.4, with limited surface water flow paths determined by the surface water modelling.

Potential battery fires are expected to be contained within the individual units, as each unit has internal fire-suppression systems, including flammable gas, smoke and thermal sensors, pressure release systems and aerosol fire extinguishing systems. Therefore, the risk from small individual fires is not considered significant. However, should a larger fire occur necessitating the use of large volumes of external water and fire-fighting chemicals, then there would be a low risk to groundwater from the infiltration of fire-fighting liquids to the shallow aquifer. However, as discussed, the thick clay layer beneath the Subject Site would reduce any downward migration to the underlying groundwater system and therefore, even in this scenario, the risk of contamination to groundwater is considered minimal.

Up to 100 L of fuel will be stored onsite, which is a potential source of contamination. However, standard management practices are in place to ensure that the fuel is stored in a bunded enclosure with a minimum of 110% of the stored volume to ensure the bund can contain the entire volume of the stored fuel. Therefore, it is expected that the risk of fuel leak will be minimal.

A 900 mm deep oil bund will be constructed, which could be a source of contamination. However, with the bund constructed to the current standards with regular inspection and maintenance, it is not considered to be a significant source of contamination.

IGS have been informed that no chemicals, other than what has been discussed above, will be stored on the Subject Site that would be considered a source of contamination. No dangerous goods will be stored onsite.

The risk of aquifer contamination associated with the proposed development during construction and operation is considered low due to the Subject Site only storing a small volume of bunded fuel and no other sources of contamination during operation and no stored materials or refuelling/maintenance or washdowns etc. occurring during construction and therefore having no sources onsite. Further, the locally thick clay layer will retard vertical migration through the unsaturated zone allowing time for removal of any spills to occur and be made good before contact with the groundwater at approximately 3 mbgl.

The water table/aquifer is unlikely to be encountered, based on the water levels from the closest bores to the Subject Site. Shallow groundwater < 1mbgl has been reported in bore over 700 m from the site, and therefore, there is a potential for groundwater in the local area to be shallower. It is anticipated that during construction, due to the thick clay layer and shallow trench depths of <1 m, groundwater is unlikely to be encountered, eliminating the potential for the creation of a pathway for contamination through the thick clay layer.

It is recommended, however, that a shallow bore be sunk on the Subject Site to approximately 5 mbgl to determine the exact geology and water level at the site and water level measurements be taken at the end of winter to determine the highest water levels likely to be encountered.

3.2.2 Potential adverse impacts on groundwater dependent ecosystems and groundwater abstraction

The development is not expected to have any adverse impacts on GDEs. No mapped GDEs are within the Subject Site, therefore no GDEs will be directly damaged during construction. Terrestrial GDEs are located 2 km west and 3 km east of the development and are described as having "Low potential for groundwater interaction". Therefore, due to the distance from Subject Site and low potential for groundwater interaction the terrestrial GDEs are not considered to be at risk from the development, as there is negligible risk to groundwater quality and no risk to groundwater levels, due to no groundwater abstraction, from the development.

The identified aquatic GDEs are located between 2.5 km south and 3.5 km east from the Subject Site and are described as having either "high or moderate potential for groundwater interaction". However, The GDE Atlas describes aquatic GDEs as "ecosystems that rely on surface expression of groundwater". As there will be no groundwater abstraction at the Subject Site during any phase, there will be no change to groundwater levels related to the Subject Site. Therefore, groundwater-surface expression will not be impacted and therefore no risk is expected to the aquatic GDEs.

As discussed, the local trees, which are not explicitly identified as GDEs may have root systems that will penetrate the thick clays to the water table. Therefore, there is a potential for local tress to be impacted should groundwater contamination occur. However, as discussed it is considered unlikely that groundwater contamination would occur due to the low volumes of source chemicals and the expected thick layer of clay at the Subject Site.

There are no subterranean GDEs reported within 10 km of the Subject Site and, therefore, no risk.

Locations of groundwater abstraction points are not released for public access in NSW, and therefore, no comment can be made on potential impacts to groundwater quality in local abstraction bores. However, as there is considered negligible risk of contamination to groundwater during construction and general operation of the BESS, and there will be no groundwater abstraction during any point of construction or operation, the risk to groundwater abstraction bores near the Subject Site is considered negligible.

3.2.3 Cumulative impact on the development on groundwater

The development is not extracting water from groundwater systems during operations and is therefore will not impact the quantity of water in the local groundwater system.

3.2.4 Mitigation measures

Mitigation measures are focused primarily on preventing chemical spills from reaching the groundwater system in the unlikely event of leakage. Mitigation measures include:

- Drilling of a soil bore to 5 mbgl on the Subject Site to understand the exact geology and water levels during winter at the.
- Self-bunded battery storage units.
- Self-bunded fuel storage areas.

- Regular maintenance and inspection of fuel bund, oil bund and battery storage units.
- Development of site management plans detail responses to leaks such as spill kits, removal and appropriate testing and disposal of impacted soils and options for installing groundwater monitoring bores in the case of a significant fire or unexpected leak.
- If possible, excavating during summer or autumn will further reduce the already low likelihood of intersecting groundwater during the shallow excavations.

An onsite soil bore should be drilled to ensure that the information available during this desktop study is accurate and to confirm or otherwise that the site is underlain by thick clays and to further understand the local water table and if there is any fluctuation of the water table after winter rains.

Currently, based on the understanding that groundwater near the site is at least 3 mbgl and the clays extend over the site, then groundwater monitoring is not required during the construction and operation of the facility as groundwater is unlikely to be encountered; however, should the onsite soil bore identify shallow groundwater or an absence of clay at the Subject Site then groundwater monitoring bores may be required.

In the future if a significant release or major fire occurred, then bores should be installed to determine the local groundwater flow direction and then up- and downgradient bores of the Subject Site should be constructed to determine if any impacts have migrated to the locally groundwater.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Surface Water

The flood investigation provided within this report provides flood mapping for the proposed BESS facility at 3 Turton Place, Murrumbateman, NSW. A 2D hydraulic flood model was developed in line with the latest flood modelling software; industry standards (i.e. BoM IFD and ARR 2019 guidelines) and the latest available 1 metre LiDAR dataset (NSW Spatial Services) for the 1% AEP design storm event.

The flood modelling and mapping undertaken as part of this investigation confirmed that there are no significant overland flow paths across the site with peak flood depths below 80 mm across the area of interest. Maximum flood velocities are all low, between 0.05 – 0.55 m/s, resulting in the site being classified as flood hazard H1 (generally safe for people, vehicles and buildings).

The Murrumbateman, Bowning, Bookham and Binalong Flood Study – Addendum Report was conducted for Yass Valley Council in 2020. The 1% AEP flood depth mapping covers the Subject Site. Based on the Addendum Report, the site is located adjacent to overland flow during a 1% AEP event from the Unnamed Tributary catchment which flows through the existing dam in the north of the site. This flow path is consistent with the flood mapping discussed in Section 2.

Based on the findings of the flood modelling it is recommended to set critical infrastructure to be a minimum of 150 mm above the existing ground level to reduce the risk associated with stormwater runoff impacting infrastructure. Importing fill to raise the areas where infrastructure is to be located is not likely to increase flood levels on neighbouring properties, however, should be tested within the hydraulic model at a further design stage once the final layout is available.

4.2 Groundwater

Based on the understanding of the local hydrogeological regime and site operations during construction and operation, it is considered that there is negligible risk to groundwater or GDEs. This conclusion is derived from:

- No significant volumes of potential contaminants will be stored on the Subject Site during construction and operation phases and the small volumes that will be stored shall be appropriately bunded and infrastructure maintained.
- The battery units are self-contained and will control any potential leaks. There is no opportunity for leaching of metals due to the containment and lack of water in the battery units.
- Excavations will be shallow, <1 m deep and groundwater is unlikely to be encountered and no dewatering or abstraction will occur. Summer or autumn excavations will further reduce the potential for intersecting groundwater during excavations.
- Depth to groundwater, based on available data, is generally >3 m (at bores located within 400 m of the Subject Site) and is beneath a thick clay layer, reducing the risk of infiltration to groundwater. However, recent water level data is not available and may change the risk assessment if it were found to be shallower on the Subject Site or the expected clay layer was not present.
- Mapped GDEs are all >2 km or more away and are unlikely to be impacted in the unlikely occurrence of groundwater contamination. As there will be no groundwater abstraction at the Subject Site the GDEs will not be impacted by changes in groundwater levels due to onsite activities.
- Site management plans will provide details on the clean-up of small spills via spill kits and soil removal.
- A shallow bore on the Subject Site to confirm site conditions is recommended.

Therefore, groundwater monitoring is not considered necessary at the Subject Site unless there is a major fire where fire-fighting water or chemicals are used, or another unforeseen leak occurs outside the expected small volumes of stored fuel. Should a major fire or other event occur, then groundwater monitoring wells should be located up and down-gradient of the site and down-gradient to determine any impacts to groundwater.

REFERENCES

New South Wales Department of Planning and Environment (2020). Water Sharing Plan for the NSW Murray-Darling Basin Fractured Rock Groundwater Sources (report sl-2020-0348)

New South Wales Government (2013). Yass Valley Local Environmental Plan.

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