135 Badgerys Creek Road, Bradfield

Surface Water and Groundwater Assessment

Bradfield Corporation Pty Ltd

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Document Tracking

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Acknowledgements

This document has been prepared by Eco Logical Australia Pty Ltd with support from Bradfield Corporation Pty Ltd.

Abbreviations

Abbreviation	Description
AEP	Annual exceedance probability
BCS	Biodiversity, Conservation and Science Group (DCCEEW)
DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
DCP	Development Control Plan
EIS	Environmental Impact Statement
ELA	Eco Logical Australia Pty Ltd
FM Act	*Fisheries Management Act 1994*
GDE	Groundwater Dependent Ecosystem
KFH	Key Fish Habitat
PCT	Plant Community Type/s
PMF	Probable maximum flood
SEPP	State Environmental Planning Policy
SSD	State Significant Development
SSDA	State Significant Development Application
WAL	Water Access License
WM Act	*Water Management Act 2000*
WM Regulation	*Water Management (General) Regulation 2018*

Executive Summary

This Surface Water and Groundwater Assessment has been prepared on behalf of the Bradfield Corporation Pty Ltd (the Applicant) by Eco Logical Australia Pty Ltd. It is submitted to the Department of Planning, Housing and Infrastructure (DPHI) in support of a State Significant Development Application (SSDA) on the land at 135 Badgerys Creek Road, Bradfield (the site).

The Surface Water and Groundwater Assessment was undertaken to address the Secretary's Environmental Assessment Requirements (SEARs) and regulatory advice issued for the project relating to surface and ground waters. This report is suitable to support development of an Environmental Impact Statement (EIS) for lodging with the project SSDA.

Based on Strahler stream order classification, there are two first order and one second order surface water flow paths within the site. Only one of which is classified as a river after desktop and site assessment. The unnamed drainage lines converge near the central southern site boundary and subsequently flow into to another second order unnamed drainage before discharging to third order Moore Gully, which flows from west to east towards Thomsons Creek approximately 400 m south of the site. Due to the presence of surface water drainage paths within the site, potential impacts from the project on both aquatic and riparian habitat and surface water quality have been considered.

Assessment of groundwater resources indicates that the regional aquifer underlying the site is part of the Upper South Creek Hydrogeological Landscape and is typically greater than 10 metres below ground level (mBGL) based on a review of available surrounding groundwater bore data. However, site geotechnical investigations identified the presence of shallow groundwater within clay lenses at approximately 1.5 mBGL in the drainage lines and at approximately 5 to 7 mBGL in the weathered siltstone. Given the groundwater depth and use identified surrounding the site, potential impacts from the project to third-party bore users as well as groundwater level, pressure and quality have been assessed. In addition, potential impacts to groundwater dependent ecosystems (GDEs) have been independently assessed.

This report concludes that **potential impacts to surface water receptors**, including aquatic and riparian ecological communities, has been assigned a **moderate** preliminary risk of impact rating due to potential short-term impacts from construction activities, which may cause increased erosion and sedimentation of waterways at and downstream of the site.

Potential impacts to the identified potential groundwater receptors are assessed as **low** based upon both regional and site-specific groundwater observation data from monitoring bores. Data suggest that shallow groundwater underlying the site occurs as localised waterlogging of clay along the main drainage line and in the weathered siltstone.

Dewatering volumes will need to be estimated when sufficient data has been collected to determine if a WAL (water access license) is required. The extent and location of potential terrestrial and aquatic GDEs either upstream of the site or greater than 2 km downstream suggests that potential impacts to GDEs from site activities is similarly low.

Based on results of the impact assessment, the proposed development warrants approval subject to the implementation of appropriate construction and operational phase impact mitigation measures, including implementation of a stormwater management plan and appropriate erosion and sedimentation control measures.

Following the implementation of the above mitigation measures, the residual risk would be considered low for the site.

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1. Introduction

Eco Logical Australia Pty Ltd (ELA) was engaged by Bradfield Corporation Pty Ltd (Bradfield Corporation) to undertake a Surface Water and Groundwater Assessment for the proposed State Significant Development (SSD) at 135 Badgerys Creek Road, Bradfield New South Wales (NSW) 2556 (the 'site') under SSD-77458970 (Figure 1-2 and Figure 1-1).

1.1. Site description

The site is located at 135 Badgerys Creek Road, Bradfield and is approximately 2.02ha in area. It is legally described as Lot 7 DP 243457 and is located approximately 250m to the future Bradfield Metro Station and 4 km to the Western Sydney Airport. An aerial image of the site is provided in Figure 1-1 .

The site shares a western frontage with Badgerys Creek Road. The eastern boundary of the site adjoins the State government-led Bradfield City Centre which is set to be a vibrant 24/7 global city, driving advancements in industry and will support 10,000 more homes and 20,000 new jobs in Western Sydney.

As defined by the Aerotropolis Precinct Plan, the site is located within the Aerotropolis Core Precinct which is envisioned as an attractive place for workers, residents and visitors. The Aerotropolis Core Precinct will leverage the positive economic impact of the adjacent Western Sydney Airport and Bradfield City Centre. It will attract business hubs, research and development, professional services and creative industries in addition to providing residential development within walking distance of the Bradfield Metro station and proximity to blue and green infrastructure.

Figure 1-1 Site Aerial Map (Source: Nearmap / edited by Ethos Urban)

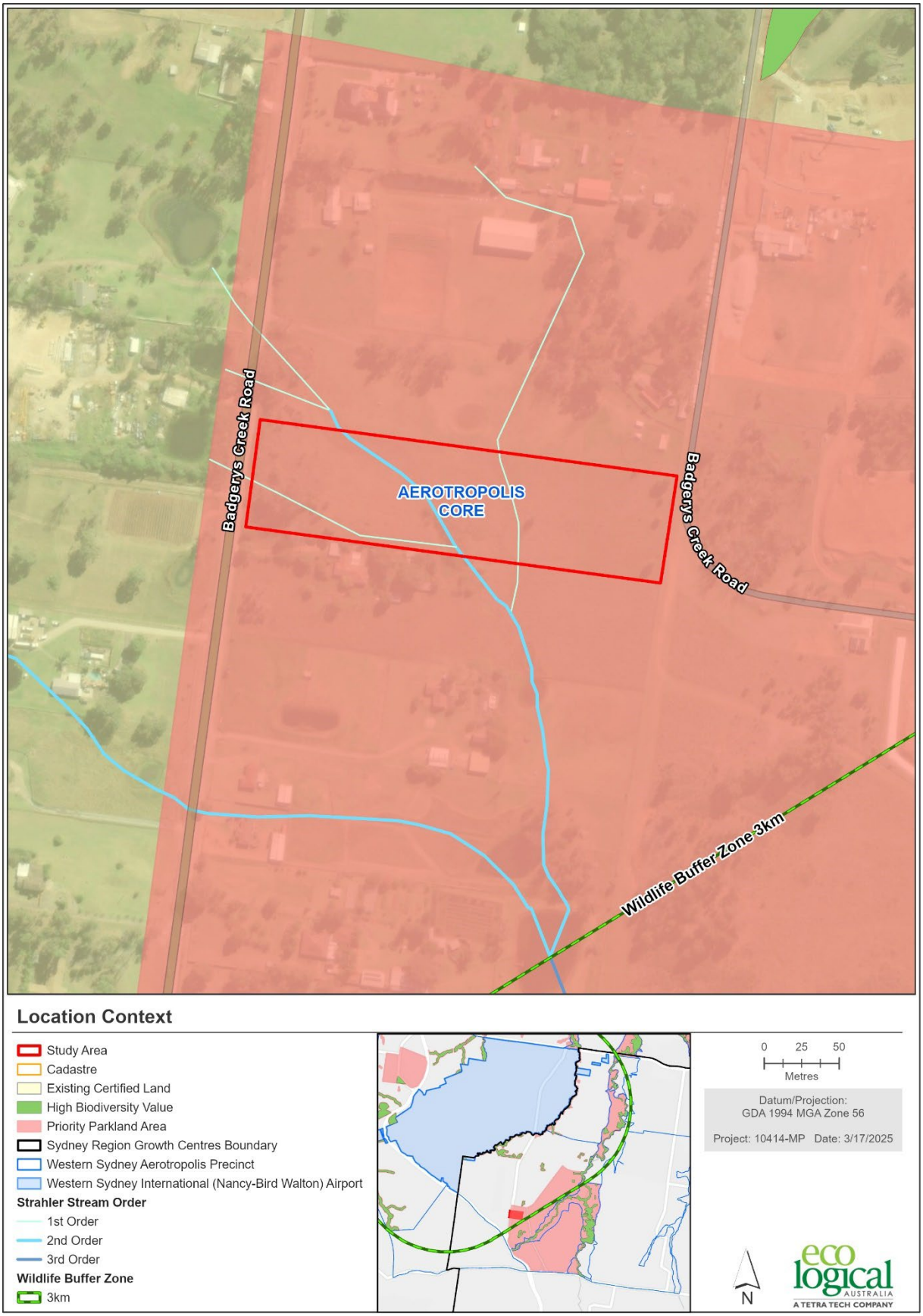

Figure 1-2 Location Context

1.1.1. Proposed development

The proposed development will seek consent for the redevelopment of the site, comprising:

- Enabling works including vegetation removal and earthworks;
- The construction of three buildings, comprising:
    - Residential use, including approximately 400 apartment units;
    - Hotel use, including approximately 450 hotel rooms;
    - Commercial use, including supermarket, food and drink and other commercial uses;
    - Medical centre use;
    - Childcare centre use;
- Construction of two basement structures, including approximately 800 carparking spaces;
- Public domain upgrades, including:
    - Construction of an internal road;
    - A public plaza;
- Rehabilitation and augmentation of the existing riparian corridor;
- Landscaping embellishments on the ground level and within the built form; and
- Services augmentation as required.

Refer to the Environmental Impact Statement (EIS) for a detailed summary of the proposed development.

1.2. Scope and aims of report

The Surface Water and Groundwater Assessment was undertaken to assess potential impacts to water environments as a result of the proposed development footprint (Figure 1-3). This report is suitable to support development of an Environmental Impact Statement (EIS) for lodging with a state significant development application (SSDA).

This report provides the following information on the study area to address key requirements defined in the *Planning Secretary's Environmental Assessment Requirements* (SEARs) (SSD-77458970, dated 30 January 2025) and additional SEARs advice issued by WaterNSW (dated 17 December 2024):

- Mapping of rivers, streams, wetlands, estuaries, acid sulphate soils (ASS), groundwater and groundwater dependent ecosystems (GDEs).
- Description of background conditions for water resources likely to be affected by the development, including existing surface and groundwater conditions and volume, frequency and quality of discharges at proposed intake and discharge locations.
- Assessment of potential impacts from the development on hydrologic regime of downstream reivers, wetlands, estuaries, marine waters and floodplain areas.
- Assessment of potential impacts from the development to downstream water-dependent fauna and flora including GDEs.
- Measures to mitigate potential impacts to surface and groundwater during construction and operational activities.

1.2.1. Secretary's Environmental Assessment Requirements

In accordance with section 4.39 of the Environmental Planning & Assessment Act 1979 (EP&A Act), SEARs for SSD 77458970 were issued on 30 January 2025. This report has been prepared to respond to the relevant issued SEARS, as set out in the Table 1-1 below.

Table 1-1 Relevant Secretary's Environmental Assessment Requirements and advice

	SEARs Request	Response / Location in report
SEARs (SSD 77458970, dated 30 January 2025)		
Surface water	Assess potential impacts on surface water resources (quality and quantity) including related infrastructure, hydrology, dependent ecosystems, drainage lines, downstream assets and watercourses.	Section 4.1
Groundwater	Assess potential impacts on groundwater resources in accordance with the *Groundwater Guidelines.*	Section 4.2
WaterNSW (Request for SEARs, dated 17 December 2024)		
-	Include measures to address potential soil erosion, overland flow and water quality impacts within and surrounding the site.	Section 5

It is noted that although this Surface Water and Groundwater Assessment includes consideration of flood characteristics, waterway health and stormwater management in the overall impact assessment, SEARs requirements issued specifically for these items by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) Biodiversity, Conservation and Science (BCS) Group are not explicitly addressed in this report, but are covered in other technical assessments concurrently being undertaken to support the EIS and SSDA for the project.

Figure 1-3 Location

2. Statutory context

The following legislation and policies have been considered in this assessment:

- *Environmental Planning and Assessment Act 1979* (EP&A Act)
- *Water Management Act 2000* (WM Act)
- Water Sharing Plan for the NSW *Murray Darling Basin Fractured Rock Groundwater Sources 2020*
- NSW Aquifer Interference Policy (AIP) 2012
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems
- National Water Quality Management Strategy (NWQMS) Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ) 2018
- NSW State Groundwater Policy Framework
- Environmental Protection Authority (EPA) Guidelines for the Assessment & Management of Groundwater Contamination
- State Environmental Planning Policy (Planning Systems) 2021 – Schedule 1 (29)
- State Environmental Planning Policy (Precincts – Western Parkland City) 2021 – Chapter 4 – Western Sydney Aerotropolis
  - Western Sydney Aerotropolis Development Control Plan

Further details on key legislation are provided below.

2.1. Environmental Planning and Assessment Act 1979

All developments in NSW are assessed in accordance with the provisions of the EP&A Act and the *Environmental Planning and Assessment Regulation 2021*. The EP&A Act provides a system for environmental planning and assessment, including approvals and environmental impact assessment requirements for proposed developments. Implementation of the EP&A Act is the responsibility of the Minister for Planning, statutory authorities and local councils.

2.2. Water Management Act 2000

The WM Act aims to protect and use NSW water in a way that is sustainable and holistic, which will help present generations without harming the ability of future generations to satisfy their needs. The NSW DCCEEW – Water Group administers licencing and approvals for controlled activities on 'waterfront land', which is defined as the land 40 m from the highest bank of a river, lake or estuary published on the Department's website (*Water Management (General) Regulation 2018 hydroline spatial data 1.0*), known as the 'hydroline'. Apart from the exceptions stated in Schedule 4, Part 2 of the *Water Management (General) Regulation 2018*, controlled activities are:

- The construction of buildings or carrying out of works
- The removal of material or vegetation from land by excavation or any other means
- The deposition of material on land by landfill or otherwise
- Any activity that affects the quality or flow of water in a water source.

The WM Act also recognises the need to allocate and provide water for the environmental health of the State's rivers and groundwater systems, whilst also providing licence holders with more secure access to water and greater opportunities to trade water through the separation of water licences from land. The main tools within the WM Act for managing the State's water resources are Water Sharing Plans (WSPs), which establish rules for sharing water between different water uses such as

town supply, rural domestic supply, stock watering, industry and irrigation and ensure that water is provided for the health of the system.

2.2.1. Water Sharing Plans

The project is situated with the Greater Metropolitan Region, with surface waters covered by the Greater Metropolitan Region Unregulated River Water Sources Sharing Plan 2023 and specifically rules relating to the Upper Wianamatta-South Creek Management Zone (Rule summary sheets for the Greater Metropolitan Region Unregulated River Water Sources 2023 (nsw.gov.au)) and groundwater managed through rules relating to the Sydney Basin Central Groundwater Source of the Greater Metropolitan Region Groundwater Sources 2023 Water Sharing Plan (sl-2023-328 (nsw.gov.au)) (DPIE Water, 2023).

2.2.2. Aquifer Interference Policy

The *Aquifer Interference Policy 2012* (AIP, 2012) was established under the WM Act to define the assessment process for development applications in terms of their potential impacts on aquifers, to clarify the requirements for obtaining water licenses for aquifer interference activities and to define the considerations for assessing potential impacts on key water-dependent assets. The AIP focuses on activities that remove water from aquifers for non-water supply purposes.

The WM Act defines an aquifer interference activity as that which involves any of the following:

- *The penetration of an aquifer*
- *The interference with water in an aquifer*
- *The obstruction of the flow of water in an aquifer*
- *The taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations*
- *The disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations*.

The AIP clarifies water licensing requirements and details how these potential interference activities will be assessed under relevant planning and approvals processes. The policy provides 'minimal impact considerations' to evaluate potential impacts on groundwater levels, pressures, and quality for different categories of groundwater sources. The policy also includes provisions for water to take from a source following the cessation of the aquifer interference activity.

The 'minimal impact considerations' provided in the AIP have been developed for impacts on groundwater sources, connected water sources and their dependent ecosystems, culturally significant sites and water users. These considerations are defined for 'highly productive' and 'less productive' groundwater sources, both of which are further grouped into categories according to aquifer type (e.g., alluvial, coastal sands, fractured rock, etc.). Two levels of 'minimal impact considerations' are provided, and if the predicted impacts are less than the Level 1 impact considerations, the impacts from the Project would then be considered acceptable. If the predicted impacts are greater than the Level 1 considerations, studies would be required to fully assess these impacts and potentially apply mitigation measures which may include provision of water access licencing or make-good actions.

There is the possibility that construction and operational activities on site may involve the penetration of an aquifer, the interference with water in an aquifer and/or the obstruction of the flow of water in an aquifer. This report considers whether the minimal impact considerations under the WM Act are exceeded and whether a full assessment of the activity is required.

2.3. Risk Assessment Guidelines for Groundwater Dependent Ecosystems

The Risk Assessment Guidelines for Groundwater Dependent Ecosystems were developed by NSW Office of Water (Department of Primary Industries) to define and delineate GDEs based on a standardised Risk Analysis Framework for potential GDEs in coastal NSW, including in the greater Hawkesbury-Nepean River catchment area where the site is located.

2.4. National Water Quality Management Strategy

The *National Water Quality Management Strategy (NWQMS) Australian Guidelines for Fresh and Marine Water Quality* (ANZECC/ARMCANZ, 2018) provides default guideline and trigger threshold values for various analytes in fresh and marine surface and groundwater to provide an assessment, management and protection framework for aquatic and marine ecosystems.

2.5. State Groundwater Policy Framework

The NSW state groundwater policy framework includes strategies, laws, policies, plans, guidelines and processes that apply to management of groundwater resources in NSW. Some key documents which apply to this assessment include the *NSW Groundwater Strategy* (NSW Department of Planning and Environment, 2022), *Guide to Groundwater Resources in NSW* (NSW Department of Planning and Environment, 2023b) and *Guide to Groundwater Management in NSW* (NSW Department of Planning and Environment, 2023c). The framework defines groundwater resources, access rights, potential impacts and sustainable management strategies that apply to groundwater in NSW.

2.6. Guidelines for the Assessment and Management of Groundwater Contamination

The *Guidelines for the Assessment and Management of Groundwater Contamination* (NSW Environment Protection Authority, 2007) outlines a framework for assessing and managing groundwater contamination in NSW. The assessment guidelines references the *National environment protection (assessment of site contamination) measure* (National Environment Protection Council, 1999) and *NSW Contaminated Land Act* (NSW Government, 1997), which further define default guideline values for assessment of groundwater impacts.

2.7. State Environmental Planning Policy (Biodiversity and Conservation) 2021

The development site is located within the Hawkesbury Nepean Catchment in accordance with Chapter 6 of the State Environmental Planning Policy (Biodiversity and Conservation) 2021. Therefore, general development controls under Division 2 (clauses 6.6 – 6.10) apply:

- Water quality and quantity – the effect on the quality of water entering a natural waterbody will be as close as possible to neutral or beneficial, and the impact on water flow in a natural waterbody will be minimised.
- Aquatic ecology – the development is to have minimal impacts, whether direct, indirect or cumulative, to adjacent and downstream waterbodies and wetlands.
- Flooding – the development, if flooded, is not to release pollutants or obstruct natural flows to nearby wetlands and riverine ecosystems.
- Recreation and public access – foreshore access is not to cause an adverse impact on natural waterbodies, watercourses, wetlands or riparian vegetation.

- Total catchment management – the consenting authority must consult with downstream Councils before granting development consent.

2.8. State Environmental Planning Policy (Precincts – Western Parkland City)

The *State Environmental Planning Policy (Precincts – Western Parkland City)* and *Western Sydney Aerotropolis Precinct Plan 2023* outline objectives and requirements for the protection of waterways and water resources within Western Sydney Aerotropolis. The SEPP includes provisions to consider development in flood-prone areas and along drainage lines alongside potential impacts from development on water quality, riparian lands and watercourses and aquatic habitat. Assessment of the proposal against requirements of the Precinct Plan is provided in Section 4 of this report.

2.9. Western Sydney Aerotropolis Phase 2 Development Control Plan

Section 4.3 of the Western Sydney Aerotropolis Phase 2 DCP provides commentary on stormwater management and water quality targets for developments in the Aerotropolis precinct. Specifically, discussion of requirements for permeable surfaces and implementation of stormwater management suggests that targets may be reduced from original requirements outlines in the SEPP so long as waterway health targets remain satisfied. Importantly, the waterway health targets in the Phase 2 DCP remain consistent with original targets. Further details and guidance to ensure stormwater management meets waterway health targets are provided in a separate document titled *Technical guidance for achieving Wianamatta-South Creek stormwater management targets*, which should be used to support development of Water Sensitive Urban Design strategies and support SSDA submissions.

3. Existing Environment

3.1. Land use

The site is located at 135 Badgery's Creek Road, Bradfield NSW. The area is zoned under the *State Environmental Planning Policy (Precincts – Western Parkland City) 2021* (Western Parkland City SEPP). The entirety of the proposed development area comprising the site is zoned as Mixed Use (MU). The existing site surface comprises heavily modified landscape with large, cleared areas with some patches of natural vegetation.

The surrounding land use was determined using the NSW Planning Portal (accessed 6 May 2025) and the *Western Sydney Aerotropolis Precinct Plan* (NSW Department of Planning and Environment, 2023):

- North – MU zoned land with some residential properties interspersed with open space modified landscape and Enterprise (ENT) zoned land approximately 250 m north of the site.
- East – MU zoned land labelled as Bradfield City Centre, a major mixed-use development.
- South – MU zoned land with some residential properties interspersed with open space modified landscape and Environment and Recreation (ENZ) zoned land approximately 350 m south of the site.
- West – Badgerys Creek Road and ENT zoned land with mixed residential and some commercial properties interspersed with open space modified landscape.

3.2. Climate and rainfall

Based on average climate data from the nearest Bureau of Meteorology (BoM) weather station at Badgerys Creek AWS (station 067108), located approximately 2.7 km north of the site, the average annual temperature since 1995 near the project site is between 17.6°C (July) to 30.0°C (January) (BoM, 2025) as shown in Figure 3-1.

The average rainfall is 719.3 mm/year, with an average of 69 days a year experiencing more than 1 mm of rainfall. Typically, the highest rainfall is during February and March (average of 106 mm rainfall), while July is typically the driest month (average of 33 mm rainfall) (BoM, 2025), as shown in Figure 3-1. Larger rainfall events have occurred more frequently in recent years, with the maximum daily rainfall of 200 mm recorded on 10 February 2020 as shown in Figure 3-2.

Based on a review of BoM average areal actual evapotranspiration data, annual evapotranspiration is approximately 700 mm, similar to average annual rainfall. Monthly average evapotranspiration is typically lowest in June, July and August (average of 20 mm/month) and highest in January (up to 100 mm). Monthly rainfall generally exceeds evapotranspiration at the site in all months except October to January (see Figure 3-1). It is noted that areal potential evaporation may be much higher, up to 1600 mm/year however, as the site does not contain any open water bodies aside from natural drainage flow paths, it is unlikely that significant pan evaporation will occur.

Based on a review of climate data for the site, surface water runoff may occur at any time of year, with intermittent flow through natural drainage features likely from February to September.

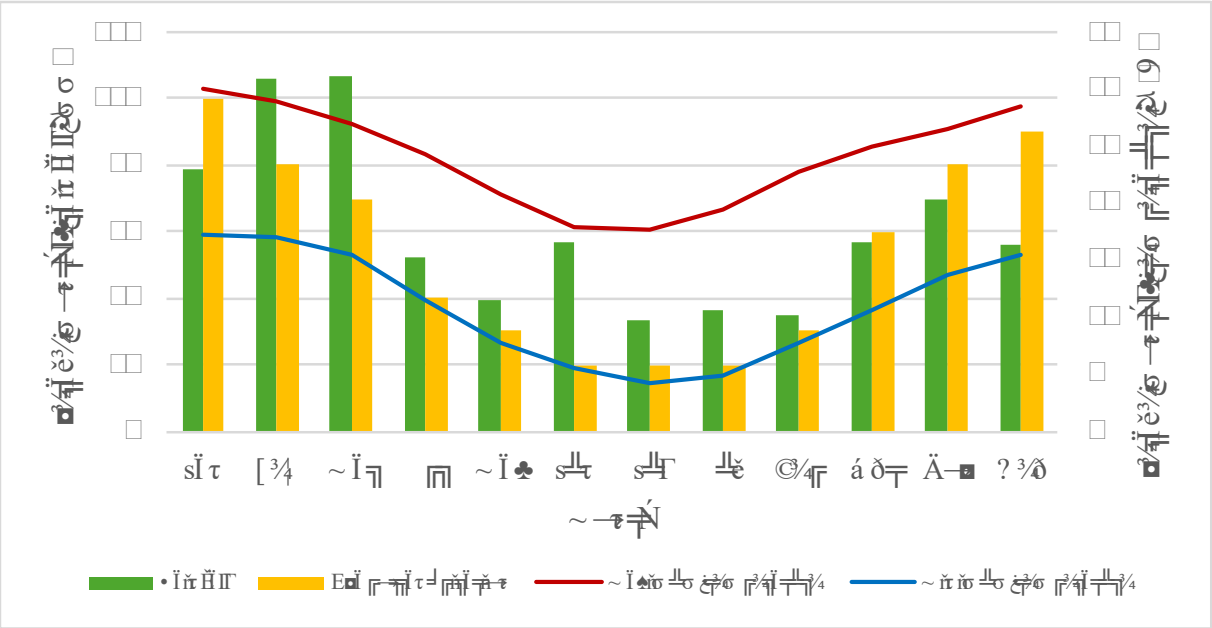

Figure 3-1 Badgerys Creek monthly climate statistics (BoM station 067108)

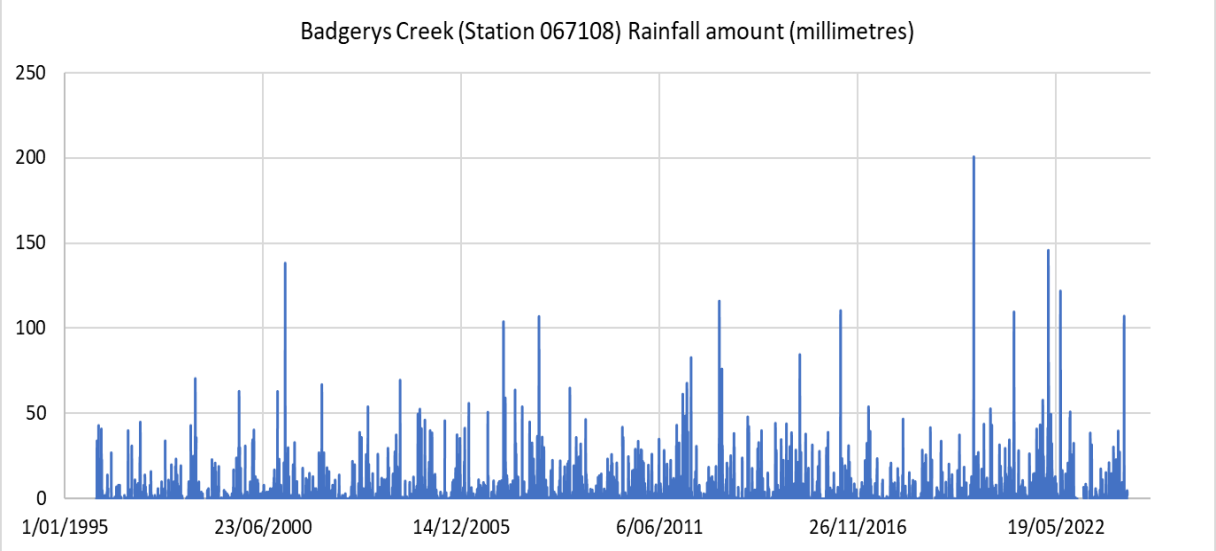

Figure 3-2 Badgerys Creek daily rainfall (BoM station 067108)

3.3. Topography and drainage

The site is located within the broader Wianamatta-South Creek catchment. The Aerotropolis Precinct Plan acknowledges that this catchment is the most degraded catchment in the Hawkesbury-Nepean River system due to historical vegetation clearing, agriculture and urbanisation. Increased urbanisation will further degrade the waterways if stormwater and flooding regimes are not managed through an integrated approach. The site is not within the Greater Sydney drinking water catchment area (Water NSW, 2024).

The regional and local topography data were assessed to determine the contributing runoff catchment, waterways and drainage features for the site. Catchment and subcatchment delineation were based on a 1m LiDAR digital elevation model (DEM) surface terrain dataset obtained from the Australian Government's Intergovernmental Committee on Surveying and Mapping (ICSM) Elevation and Depth – Foundation Spatial Data (ELVIS) website.

The site elevation ranges from approximately 75 m relative Australian Height Datum (m AHD) in the southern central portion of the site to 82 m AHD in the northwestern corner of the site adjacent Badgerys Creek Road. The topography indicates a gentle slope to the from both the eastern and western portions of the site towards the southern central site boundary where three minor drainage lines are present as discussed below.

Based on regional and local catchment delineation and a review of the local drainage lines (NSW MinView, accessed 8 May 2025) the primary surface water features relevant to the site, classified using the Strahler stream order classification system, are three first to second order unnamed drainage lines that flow through the site generally from north to south before converging with a second order unnamed stream approximately 250 m south of the site. This drainage line converges with third order Moore Gully to form a fourth order stream approximately 400 m south of the site. Moore Gully subsequently discharges to fifth order Thompsons Creek approximately 850 m south-east of the site before flowing north-east into sixth order South Creek approximately 2.2 km north-east of the site.

South Creek converges with fourth order Badgerys Creek approximately 8.4 km further downstream to the north of the site. The confluence of sixth order South Creek and fourth order Cosgroves Creek is approximately 10.7 km north of the site. Sixth order South Creek subsequently flows into the Hawkesbury River, classified as a ninth order stream, approximately 37 km north of the site.

Key characteristics of the primary drainage features within the site are summarised in Table 3-1.

Table 3-1 Drainage features

Drainage	Reach ID	Strahler stream order	Catchment area (ha)	Discharges to
Unnamed	1A	1	2.36	Reach 2A near southern site boundary
Unnamed	2A	2	6.95	Moore Gully ~400 m south of site, then Thompsons Creek ~850 m south-east
Unnamed	1B	1	4.21	Reach 2A ~30 m south

In addition to identified drainage line features, up to nine earthen surface water storage dams are present within approximately 250 m of the site boundary, with three located downstream of identified on-site drainage features. No dams are present within the site however, potential impacts to downstream dams are considered to be surface water features warranting impact assessment (Section 4).

Topography and key water features, including drainages classified by Strahler stream order and the dams, are presented in Figure 3-3.

3.3.1. Drainage feature validation

Presence of on-site surface water drainage features including the three primary flow paths discussed above was confirmed through a site visit undertaken on 8 April 2025. It was noted that only the southern portion of reach 2A had a defined bank and moderate condition floodplain vegetation (PCT 3975). Drainage line 1A had no defined stream or floodplain vegetation present (EcoLogical Australia, 2025) and is not shown as a drainage line under the PMF (probable maximum flood) event, therefore it has been excluded from this assessment. The actual channel bank locations were slightly different than publicly available stream mapping data as shown in Figure 3-3.

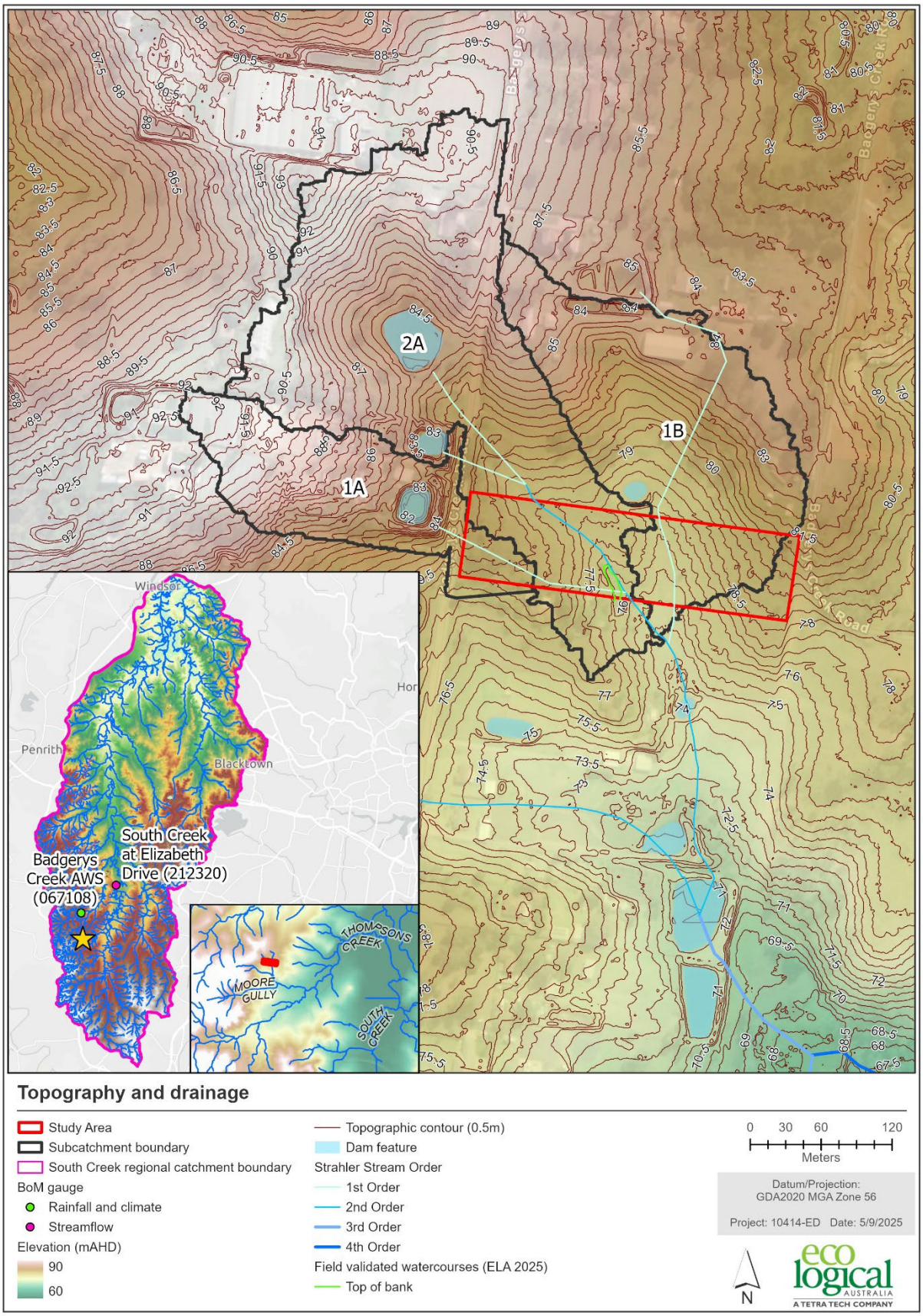

Figure 3-3 Topography and drainage

3.3.2. Surface water flow and historical regional flood events

The nearest streamflow gauge to the site is South Creek at Elisabeth Drive (station 212320) located approximately 6.4 km north-east of the site. Historical streamflow data from 1970 to present indicates an average annual discharge at South Creek in this location of approximately 12,000 ML, noting several acute historical flood events within the greater Wianamatta-South Creek regional catchment, with daily flow reaching up to a maximum of 185 m³/s in May 1988 as shown in Figure 3-4. Fluctuations in flow are typically associated with rainfall events as shown in Figure 3-5, noting that localised intense rainfall may also result in high localised flows.

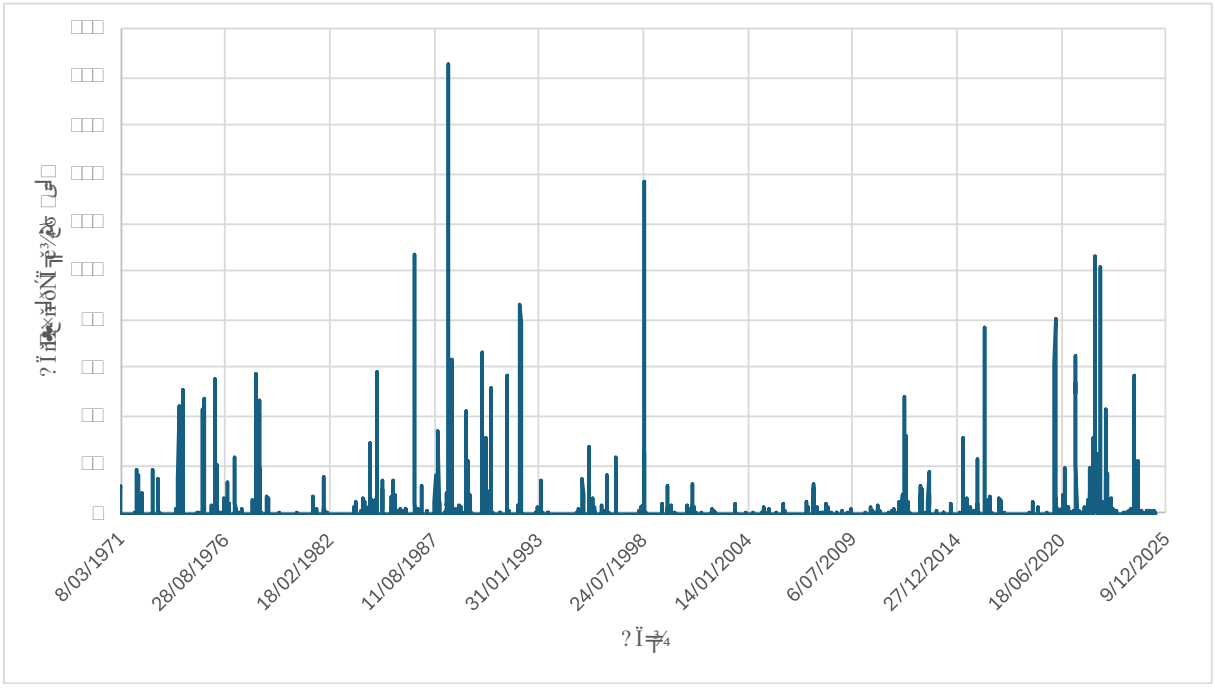

Figure 3-4 South Creek at Elizabeth drive historical daily streamflow (BoM station 212320)

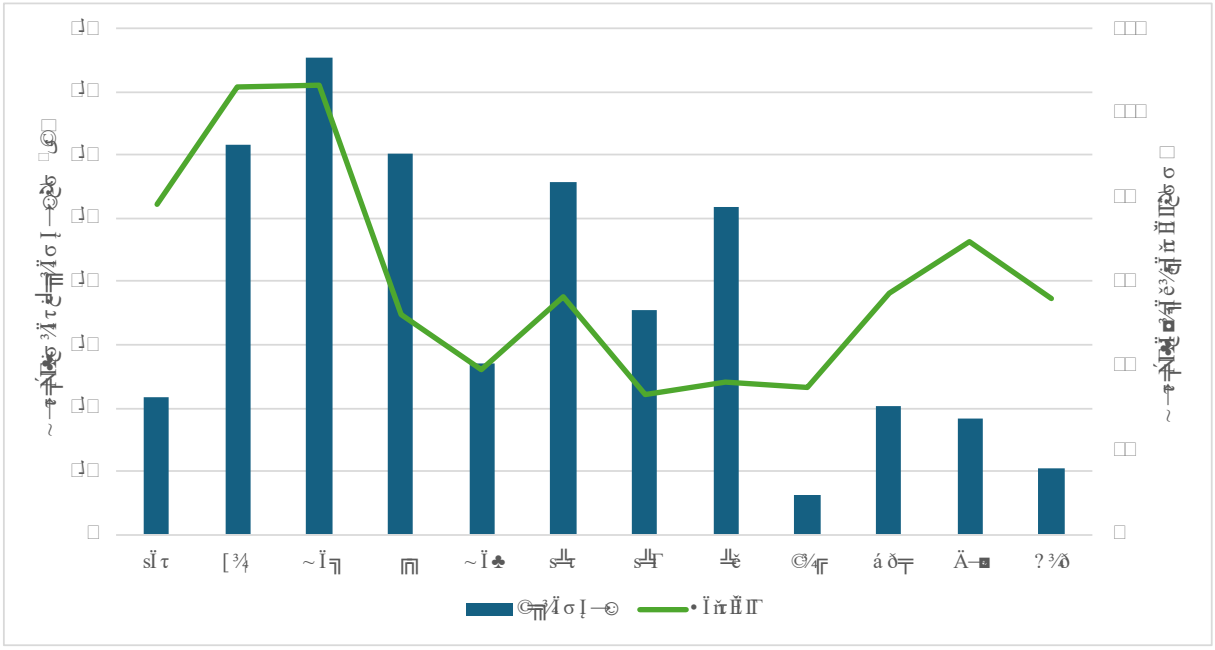

Figure 3-5 South Creek upper catchment average monthly streamflow to rainfall comparison

3.3.3. Site surface flow hydrology

As there are no streamflow gauges located within the upper reaches of the South Creek catchment, including along any first to fifth order drainages such as the unnamed features within the site, Moore Gully or Thomsons Creek, historical flood events at the site remain unknown. The unnamed drainages that cross the site are ephemeral and even under probable maximum flood (PMF) events show peak depths of less than 1 m and velocities of less than 1.5 m/s as shown in Figure 3-6 and Figure 3-7.

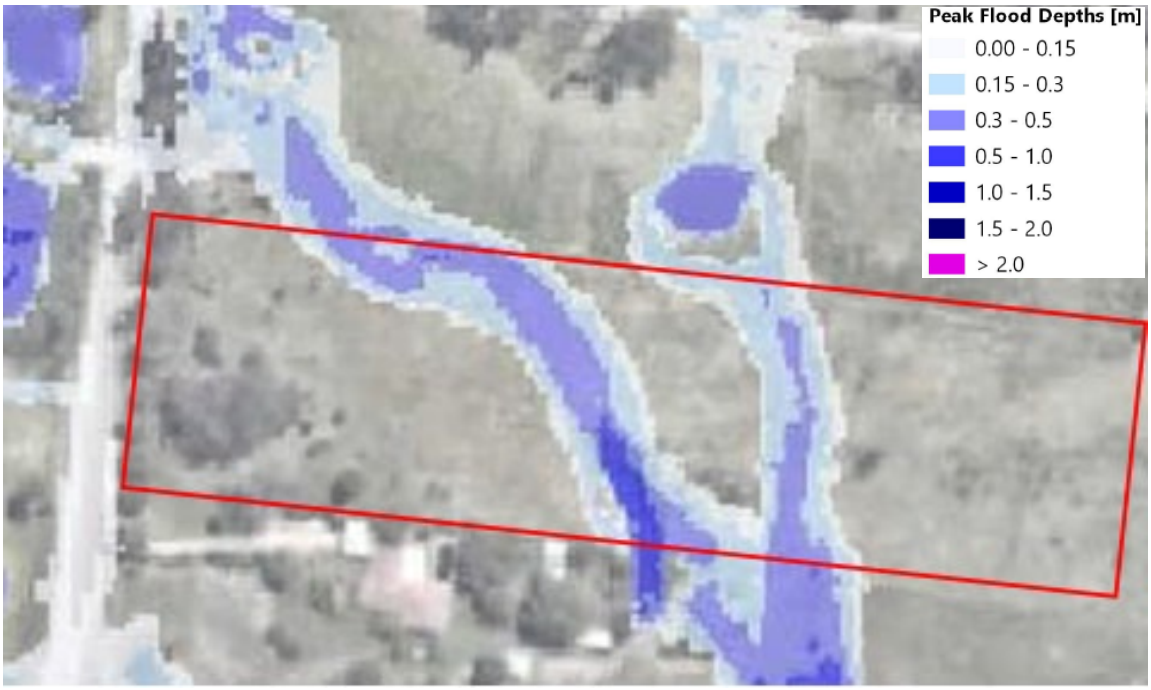

Figure 3-6 PMF maximum modelled flood depth (Worley, 2024)

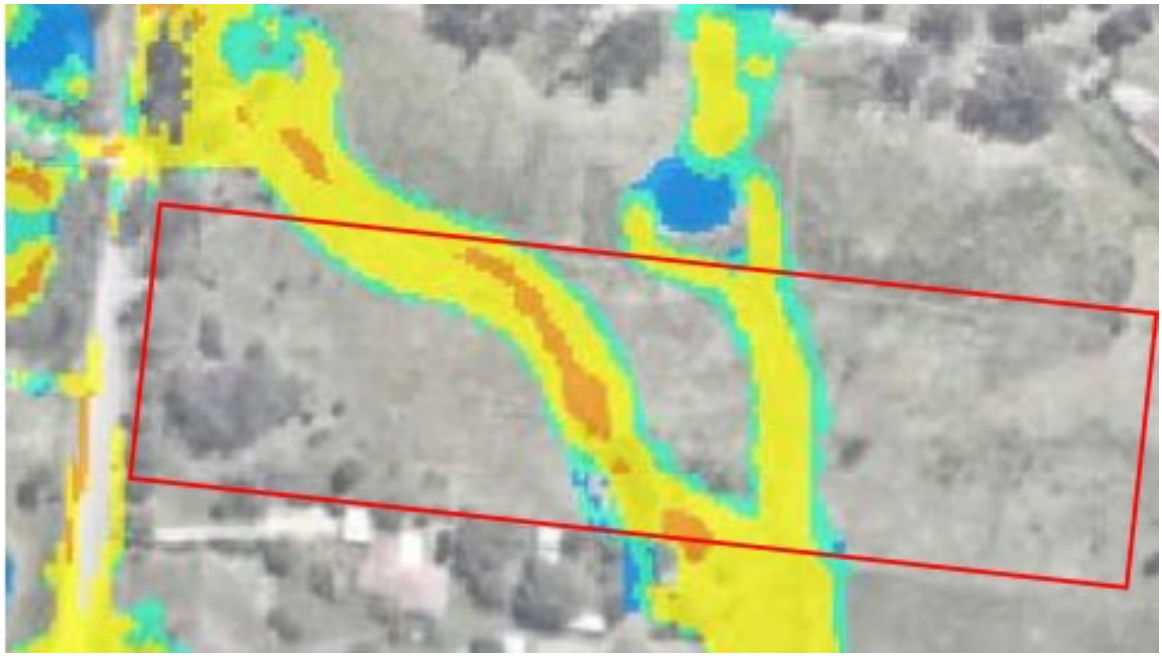

Figure 3-7 PMF maximum modelled flood velocity (Worley, 2024)

Considering on-site channel validation, observations of morphology and surrounding potential floodplain vegetation, likelihood of significant flooding at the site is considered low. The relatively low flows recorded at the sixth order South Creek gauge at Elizabeth Drive located 6.4 km north-east and downstream of the site, as discussed in Section 3.3.2, further support this assumption.

However, previous flood studies undertaken for the greater catchment area indicate that the site may be flood prone during significant rainfall events. Inundation for the 1 % AEP event is shown in Figure 3-8 and is mainly confined to the channels as assessed by the Riparian Assessment (EcoLogical Australia, 2025) with areas of inundation up to 0.3 m outside these channels. It is noted that flows are not evident under the 1% AEP or the PMF event along Reach 1A.

Figure 3-8 1% AEP flood depth, existing conditions (ADP, 2025)

3.4. Soils

3.4.1. Soil landscape

The Soil Landscapes of the Penrith 1:100,000 scale sheet Australian Soil Classification (ASC) classification for soils at the site is sodic Kurosols of the Blacktown soil landscape, which are associated with gently undulating rises on Wianamatta Group shales with soils here typically being shallow to moderately deep (>100 cm) (SEED, 2010). The identified soil type typically has the following key characteristics:

- Colour can be red, brown or mottled.
- Distinct contrast between loamy surface horizon and underlying clayey subsurface.
- Can be strongly acidic with pH as low as 4.5.
- Grain size is typically moderately fine to fine texture and is associated with low permeability leading to slow infiltration and rate of water transmission to depths below subsurface horizons.
- Can be prone to erosion.

The Blacktown soil landscape changes to natric Kurosols (sodic soils with a distinct high exchangeable sodium percentage illuviated clay horizon) and Soloths approximately 200 m south (downstream) of the site within Moore Gully and Thompsons Creek floodplains. Soils here are characterised by clay layers near the surface underlain by extremely low permeability or nearly impervious material and can also be acidic throughout their profile (SEED, 2010).

Soil landscape units at the site and surrounds are presented in Figure 3-9.

3.4.2. Acid sulphate soils

A review of the Atlas of Australian ASS administered by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) indicates ASS at the site is classified as ‘extremely low probability of occurrence’ however subclassification indicates that potential ASS may occur due to presence of sulphidic material associated with ASS in inland lakes, waterways, wetlands and riparian zones. The classification of ASS at the site notes that ‘no necessary analytical data are available and classifier has little knowledge or experience with ASS, hence classification is provisional’. Available ASS mapping for the site is presented in Figure 3-9.

3.4.3. Erodibility and salinity

Based on a review of the Modelled Hillslope Erosion over New South Wales 2023 dataset, annual bare soil erosion at the site is likely to exceed 20 t/ha and may reach up to 70 t/ha. Considering the low permeability soil type and size of the site (approximately 2 ha), erosion potential at the site is approximately 30 – 105 m^3 soil per year. However, it is noted that erodibility is reduced by presence of existing vegetation on the site and considering proposed layout design assuming incorporation of appropriate erosion mitigation measures (NSW Department of Climate Change, Energy, the Environment and Water, 2023).

Soil salinity potential at the site is classified as moderate, with downstream soils increasing to high and/or known salinity within Moore Gully and Thomsons Creek floodplain approximately 200 m south of the site.

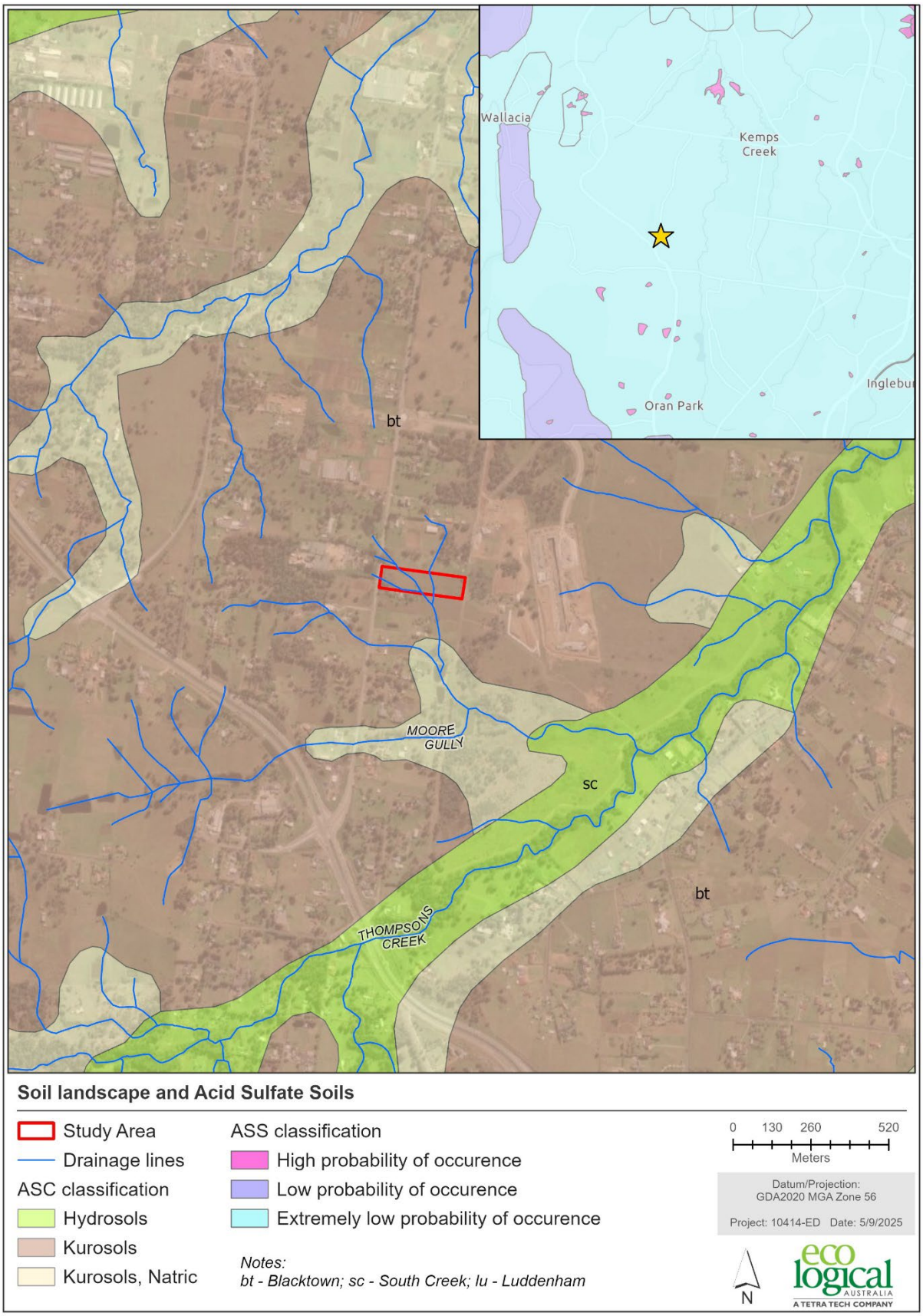

Figure 3-9 Soil landscape and ASS

3.5. Geology

The Penrith 1:100,000 Geological series sheet map (Geoscience NSW, 1991) indicates that the surface geology underlying the site is dominated by the Triassic period Bringelly Shale (Rwb) of the Wianamatta Group. The Bringelly Shale is described as shale and carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff.

3.6. Hydrogeology

The Site is located within the Upper South Creek (USC) Hydrogeological Landscape (HGL), characterised by low groundwater gradient and extensive shallow saline groundwater. High base flow Electrical Conductivity (EC) and Chloride-dominant high EC (>4.8 ds/m) is common (NSW Government Environment and Heritage, 2024a) (NSW Government Environment and Heritage, 2024c). The USC HGL is typically defined by low and undulating hills underlain by Triassic shale and sandstone, moderate slope (<20%) and absence of alluvial plains. The key aquifer properties are summarised in Table 3-2, with hydrogeological mapping presented in Figure 3-10.

Table 3-2 Upper South Creek HGL general aquifer properties

Aquifer property	Description
Type	Unconfined to semi-confined in fractured rock along structures Vertical and lateral flow components Local perching above clay-rich layers (seasonal)
Hydraulic conductivity	Moderate Range: $<10^{-2}$ – 10 m/day
Transmissivity	Low to moderate Range: <2-20 m^2/day
Specific yield	Low to moderate Range: <5-15%
Salinity	Brackish to saline range: >4.8 dS/m
Depth to water table	Intermediate range: 2–6 m

3.6.1. Groundwater use

Based on a review of the BoM Groundwater Explorer online database, 32 bores are located within a 5 km radius of the site (noting one has been removed) as shown in Figure 3-10. Of these, 28 were drilled in the USC HGL. Eight are permitted for domestic household use (six within USC HGL), one for industry, one for irrigation (both located outside of USC HGL), one for water supply and 16 for monitoring with the remaining four of unknown use. The maximum drilled depth within the USC HGL was 330 metres below ground level (mBGL), with nine bores drilled to depths >100 mBGL and 22 drilled to <50 mBGL suggesting that at least two separate aquifers (one shallower and one deeper) are present within the vicinity of the site.

Based on the groundwater uses identified, both human-health and ecological protection have been considered in assessment of potential groundwater impacts.

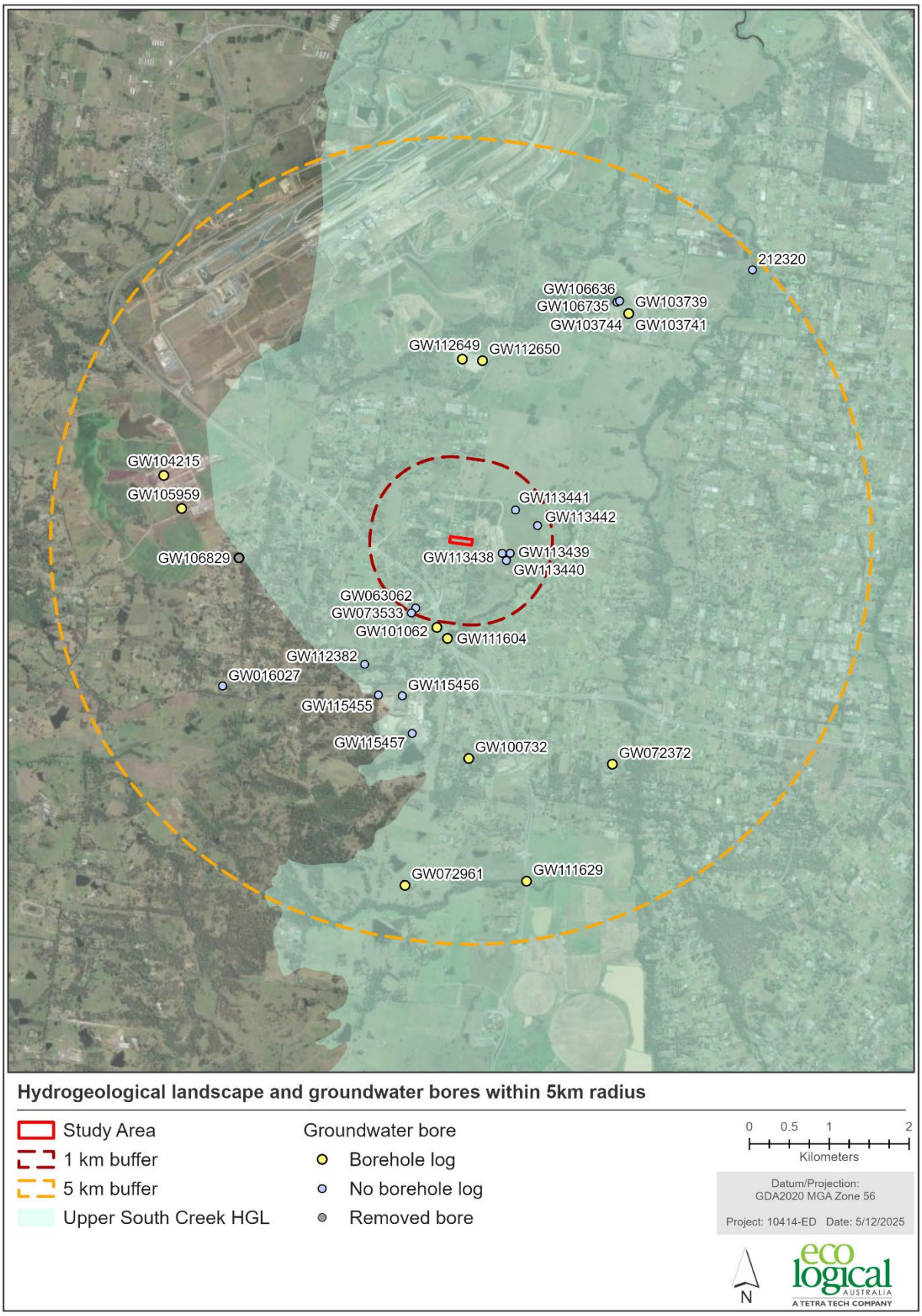

Figure 3-10 Hydrogeological landscape and groundwater bores

3.6.2. Regional groundwater data

Borehole logs describing drilling details and lithology were available for 17 bores within a 5 km radius of the site (one of which has since been removed). Recorded observations generally matched expected lithology based on the underlying regional geology and HGL identified in the vicinity of the site, comprising silty clays, siltstone, claystone, sandstone and weathered shale (Bringelly shale). No standing water level (SWL) data or salinity data were available for review. However, water strike information indicates that regional groundwater levels are variable, ranging from approximately 7 to 80 mBGL, and appear to mirror surface topography with shallower groundwater present near surface drainage features noting that available data indicates that groundwater appears to be relatively shallower to the north (downstream) of the site.

Although groundwater levels at the site are likely similar to regionally recorded SWLs, the data variability and proximity of bores does not enable accurate extrapolation of groundwater levels at the site. Table 3-3 presents available groundwater data.

Table 3-3 Groundwater bore data

Bore ID	Latitude	Longitude	Drilled depth (m)	Drilled date	Purpose[1]	DTW[2] (mBGL)
GW063062	-33.9307	150.7245	151	1/01/1989	HUSE	n/a
GW073533	-33.9312	150.7239	330	1/01/1990	HUSE	n/a
GW072961	-33.9619	150.7222	100	3/03/1995	HUSE	>10
GW072372	-33.9488	150.7507	228	9/26/1994	HUSE	~80
GW100732	-33.9478	150.7312	138	1/17/1997	HUSE	~60
GW101062	-33.9329	150.7273	220	9/09/1997	HUSE	24
GW106735	-33.8966	150.7527	-	Unknown	INDS	n/a
GW103739	-33.8979	150.7542	32.98	4/06/2001	MON	>10
GW103743	-33.8979	150.7542	27.25	4/12/2001	MON	>10
GW103744	-33.8979	150.7542	32.78	4/10/2001	MON	7
GW103741	-33.8979	150.7542	27.15	4/18/2001	MON	~7
GW103742	-33.8979	150.7542	23.93	4/19/2001	MON	7
GW103740	-33.8979	150.7542	32	4/11/2001	MON	>9
GW111629	-33.9618	150.7387	10	8/22/2011	MON	7
GW111604	-33.9342	150.7287	20	8/25/2011	MON	>10
GW112650	-33.9029	150.7343	30.7	4/24/2012	MON	>10
GW113442	-33.9217	150.7413	6	12/15/2012	MON	n/a
GW112649	-33.9027	150.7315	30.12	4/24/2012	MON	>10
GW115457	-33.9448	150.7237	40	4/03/2013	MON	n/a
GW113439	-33.9247	150.7375	12.2	12/13/2010	MON	n/a
GW113440	-33.9255	150.7369	12.1	12/14/2010	MON	n/a
GW113441	-33.9198	150.7383	12.2	12/15/2010	MON	n/a
GW113438	-33.9247	150.7364	12.2	12/13/2010	MON	n/a
GW112382	-33.9369	150.7174	7	1/01/1924	SUP	n/a
212320	-33.8933	150.7711	0	Unknown	UNK	n/a
GW106636	-33.8965	150.753	0	11/16/2005	UNK	n/a
GW115456	-33.9405	150.7224	0	Unknown	UNK	n/a
GW115455	-33.9404	150.7375	0	Unknown	UNK	n/a
GW104215	*-33.9151*	*150.6908*	*222.5*	*3/08/2002*	*HUSE*	*Unknown*
GW016027	*-33.939*	*150.6981*	*18.2*	*Unknown*	*IRAG*	n/a
GW105959	*-33.9188*	*150.6931*	*337*	*12/10/2002*	*IRAG*	*Unknown*

1 HUSE = home use/domestic; INDS = industrial; IRAG = irrigation; MON = monitoring; SUP = water supply; UNK = unknown
2 DTW – depth to groundwater, from water strike information as recorded on borehole drilling logs where available
Italicised = bore is located within 5 km radius of site but outside of USC HGL

Shallow groundwater sources found within Alluvial sediments of the Upper South Creek HGL are dominated by clay rich soils, that are noted as cause for seasonal waterlogging. Alluvial sediments located near drainage features have a lack of sandy or gravel sediments, resulting in compartmentalised shallow groundwater lenses, with limited lateral extents.

3.6.3. Site groundwater observations

Depths to groundwater varies across the site from 1.52 m in the drainage channel (2A) to 7.43 m in the northeastern corner. The Geotechnical staff recorded groundwater depths during site visit undertaken on 8th of May 2025 are presented in Table 3-4. Locations of the bores are presented in Figure 3-11. Groundwater levels in all wells fell between the two sampling events, stable water levels and seasonal variations could not be determined in this monitoring round.

Table 3-4: Groundwater depths

Borehole ID	Groundwater depth			Screened material
	6th May 2025 (mBGL)	8th May 2025 (mBGL)	Change m	
BH1M	4.58	4.66	0.08	SW-FR Siltstone
BH2M	4.44	5.36	0.92	DW-SW Siltstone
BH3M	1.52	1.62	0.1	DW Siltstone
BH5M	6.36	7.43	1.07	DW-FR Siltstone
BH6M	4.16	5.25	1.09	SW-FR Siltstone

DW= Distinctly weathered, SW = slightly weathered, FR=fresh

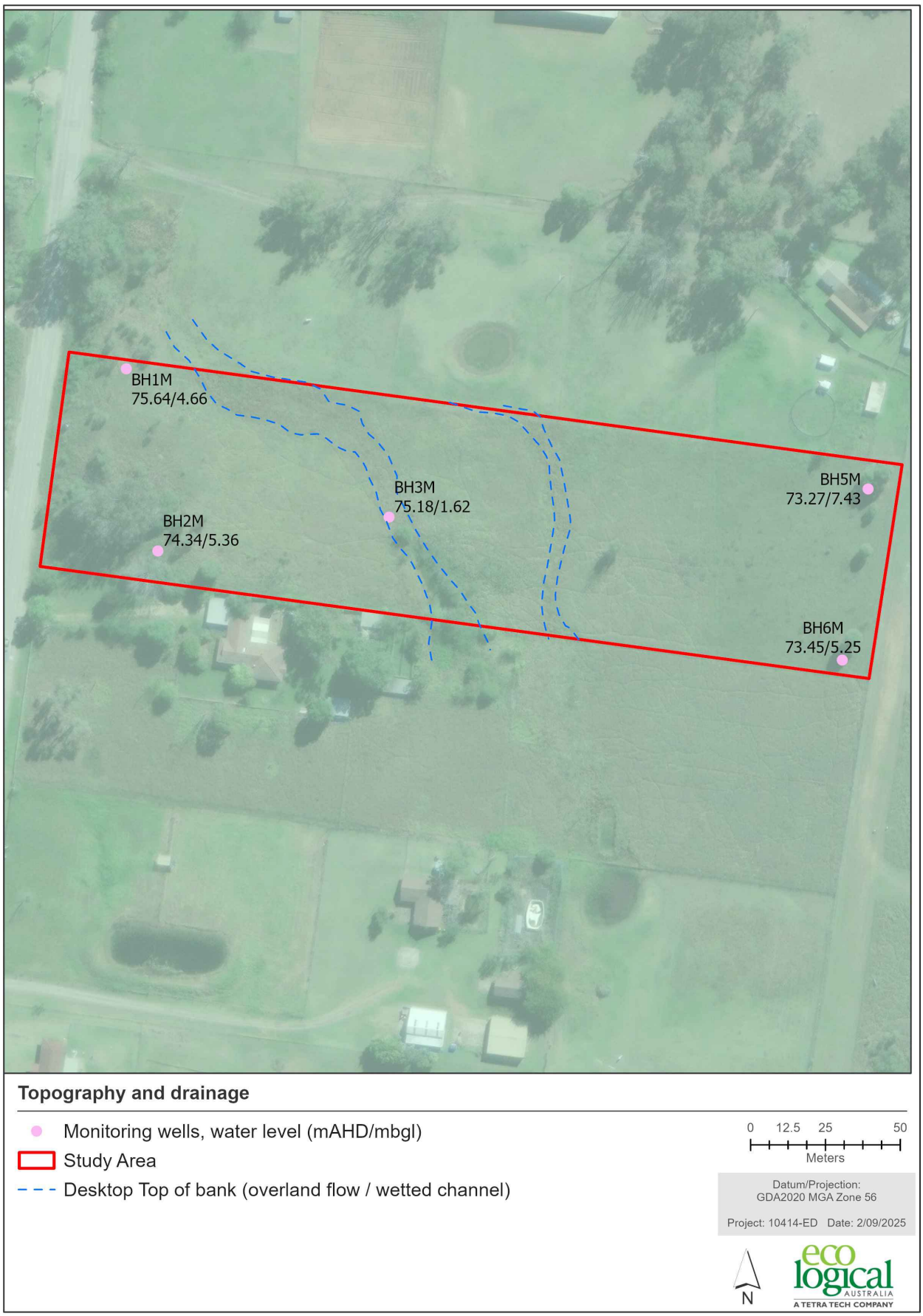

Figure 3-11 Groundwater monitoring bores

Fractured Rock groundwater sources within fractured rock of the Upper South Creek HGL are predominantly found within lateral shale layers, vertical interbedded shale/sandstone fracturing, or at the shale/sandstone interface. Aquifers within the fractured rock are considered poor due to being localised (occur over limited extents) and are brackish to saline.

3.6.4. Groundwater Dependent Ecosystems

Policy design in NSW aims at balancing the safeguarding of GDEs in WSPs with licensed water users' needs, focusing largely on high priority GDEs. GDEs may include:

- Aquifer ecosystems (stygofauna)
- Cave and karst systems (which may contain aquatic and terrestrial GDEs)
- Base flow stream ecosystems
- Terrestrial vegetation
- Groundwater dependent wetlands
- Great Artesian Basin springs
- Estuarine and marine ecosystems.

Current guidance for identification of individual GDEs in NSW recommends assessment of the high ecological value aquatic ecosystem (HEVAE) GDE score data, publicly available through the NSW SEED portal *HEVAE Vegetation Groundwater Dependent Ecosystems Value in NSW map* (NSW Department of Climate Change Energy, the Environment and Water, 2025)). The HEVAE GDE score is calculated using the probability of groundwater dependence, based on vegetation species and depth to groundwater and a further assessment of the communities with a “high or very high” GDE probability based on the community’s diversity and ecological importance.

The resulting HEVAE GDE scores classify the ecological value of groundwater dependent vegetation communities, ranging from very low to very high. GDEs with very high and high value are given high priority in WSPs. The identified very high and high value GDEs within 1 km of the site boundary and their HEVAE categories are indicated in Figure 3-12, noting that no GDEs were identified within the site.

Although Thomsons Creek, located approximately 750 m south-east of the site, was identified as a high potential HEVAE GDE, the Bom GDE atlas identified South Creek as the only high potential Aquatic GDE, situated approximately 2.3 km east as shown in Figure 3-13. West of the site across Badgerys Creek Rd there is an area identified as a high potential Terrestrial GDE as shown in Figure 3-14.

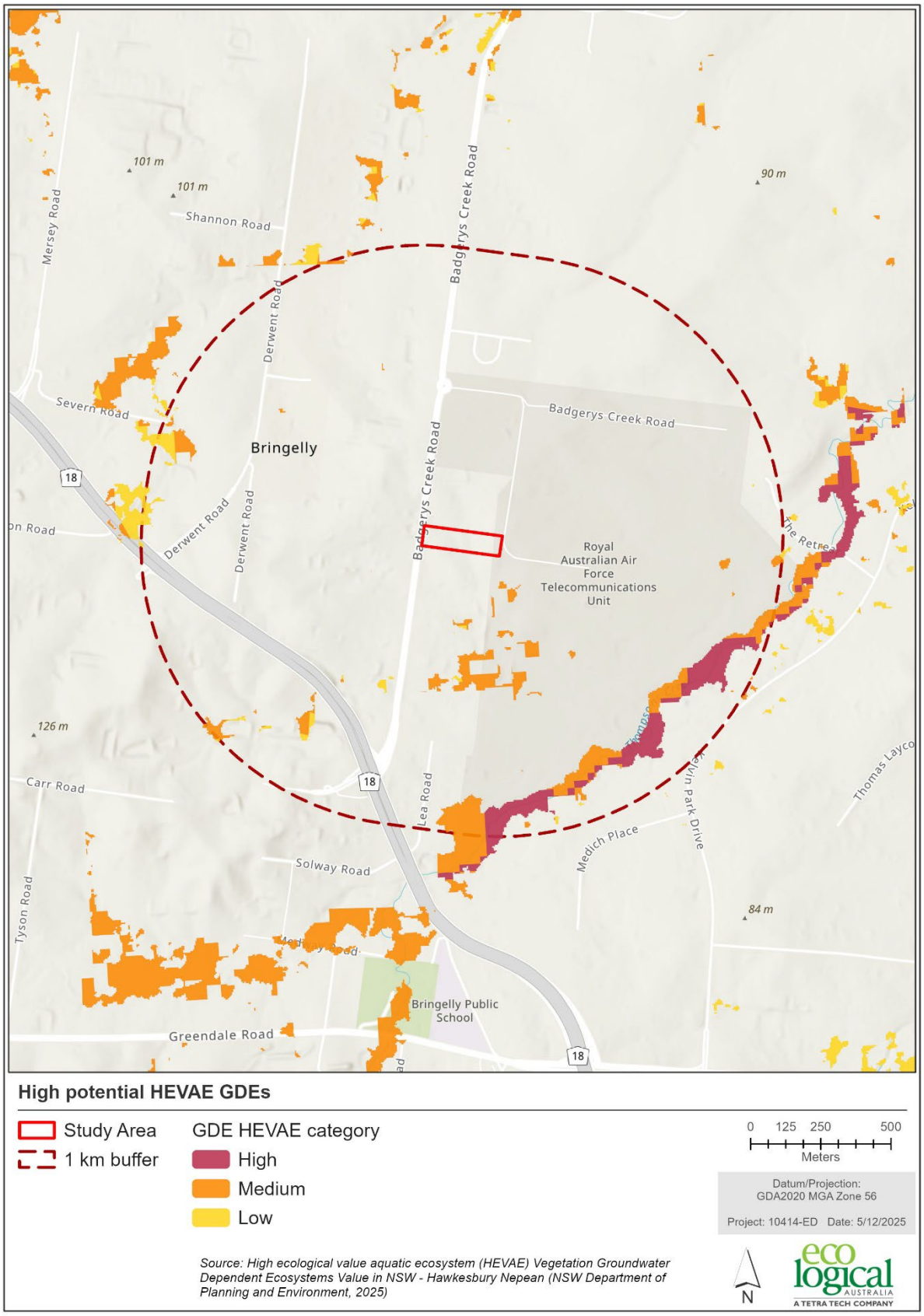

Figure 3-12 High potential HEVAE GDEs

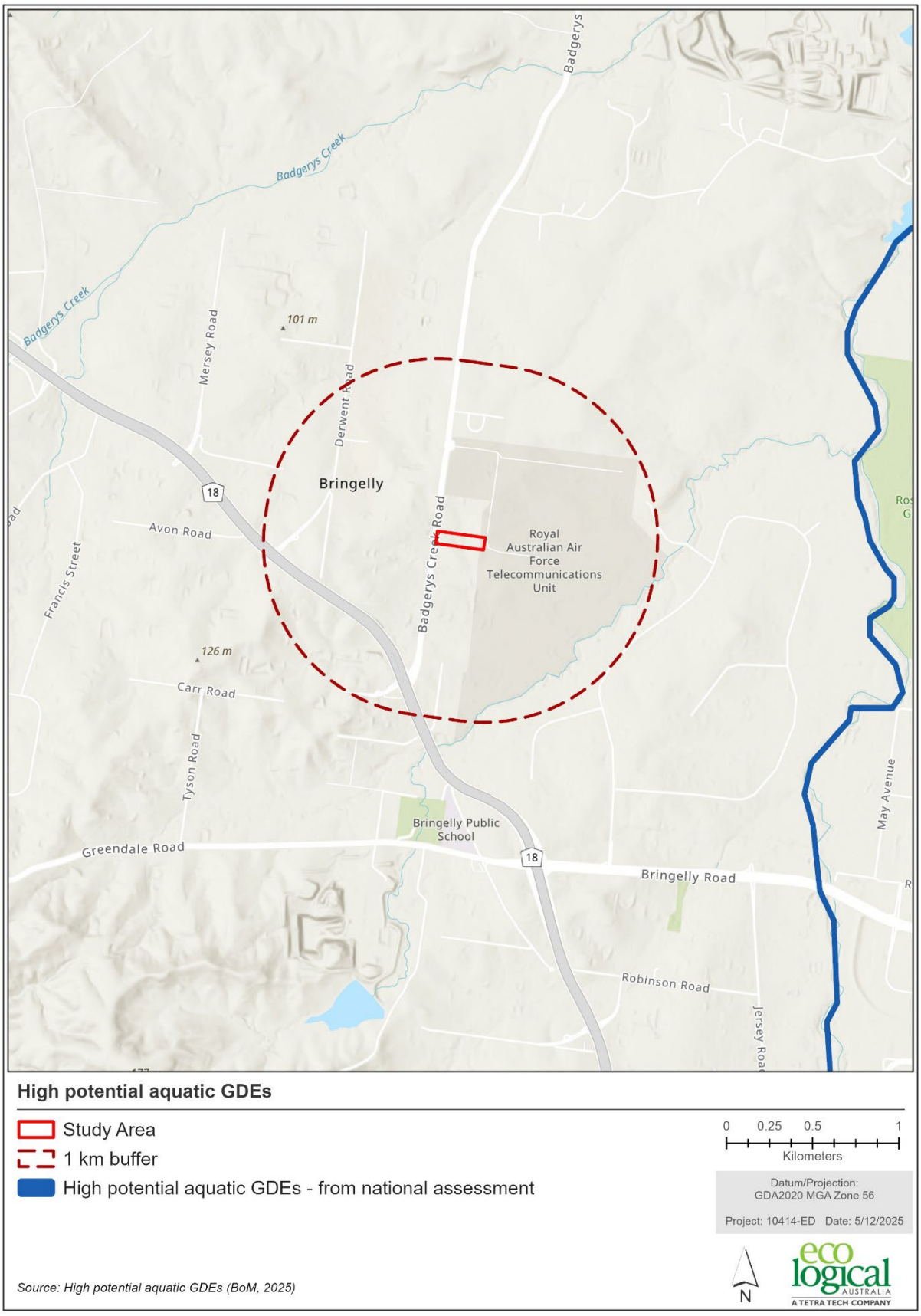

Figure 3-13 High potential aquatic GDEs (BoM)

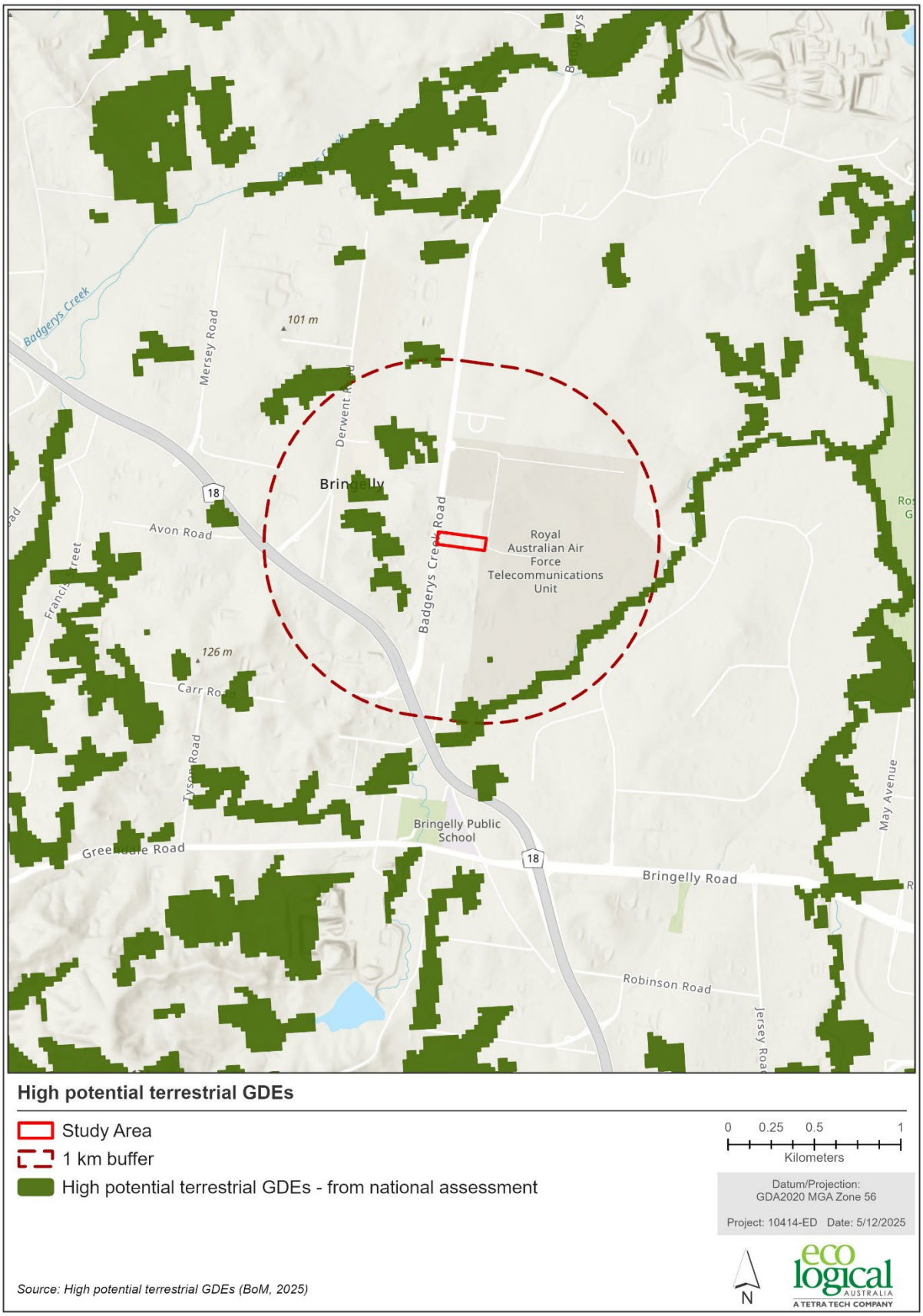

Figure 3-14 High potential terrestrial GDEs (BoM)

4. Impact assessment

4.1. Surface water assessment

The Project site is located within the greater Hawkesbury-Nepean River Catchment (21,000 km^2) (DPIE, 2025). Although major rivers within the catchment, including the Nepean, Wollondilly and Coxs Rivers, are important water supply catchments to Sydney, the site is located outside of the Sydney water supply catchment boundary.

However, Project development and operational activities have the potential to impact local surface water features including aquatic and riparian ecological communities and water quality within and downstream of the site (Section 3.3).

4.1.1. Potential impacts to aquatic and riparian ecological communities

Project activities have potential to impact aquatic and riparian ecological communities through reduction of habitat and/or water quality due to erosion, sedimentation, contamination and/or encroachment on habitat zones. It is noted that the most significant drainage line reach 2A will be maintained as green space however reach 1B will be diverted north of the site to join 2A approximately 50 m upstream of its original convergence (Figure 4-1), these flow paths and riparian buffer zones, may be impacted in the short term by construction activities, ongoing impacts may occur due to the diversion of reach 1B. As there is little evidence of any flows along reach 1A no impacts are considered. Afflux mapping (Figure 4-2) of existing and proposed conditions show that under the 100yr AEP event conditions return to pre-existing conditions 50m downstream of the site boundary.

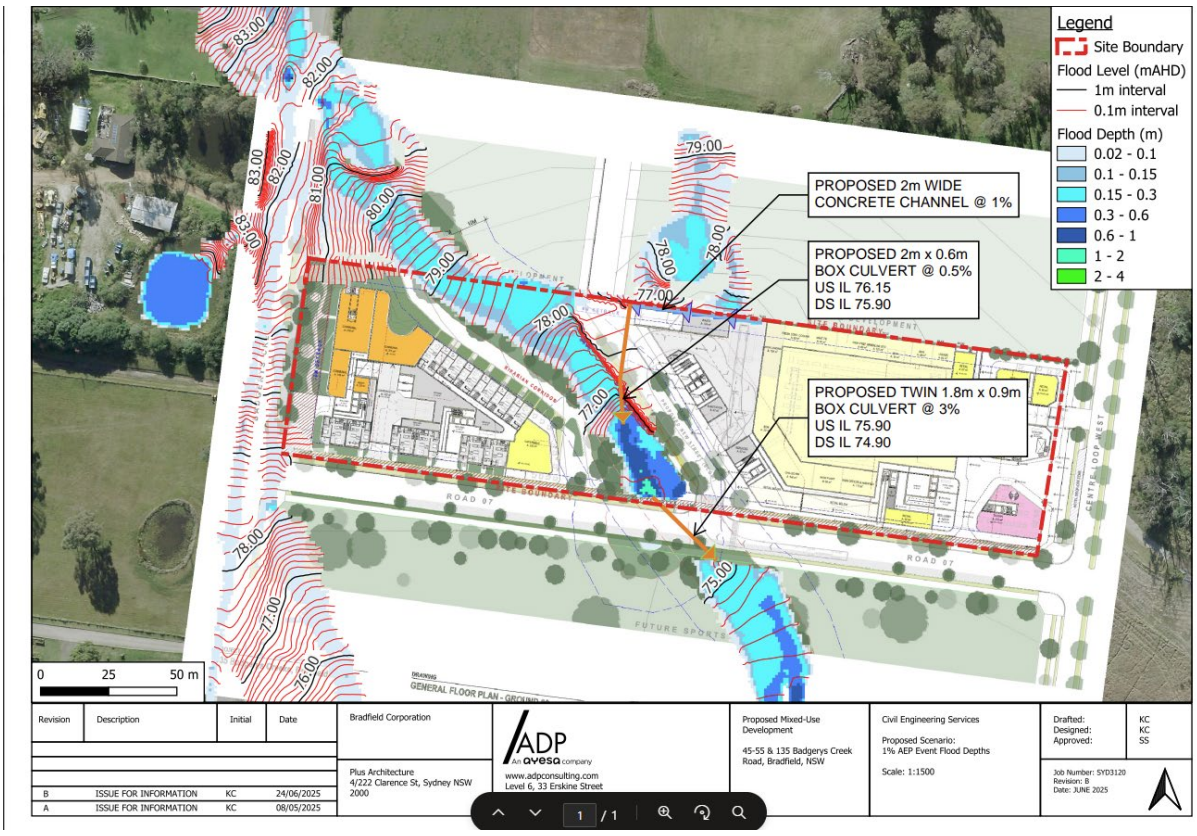

Figure 4-1 1% AEP Inundation Depth

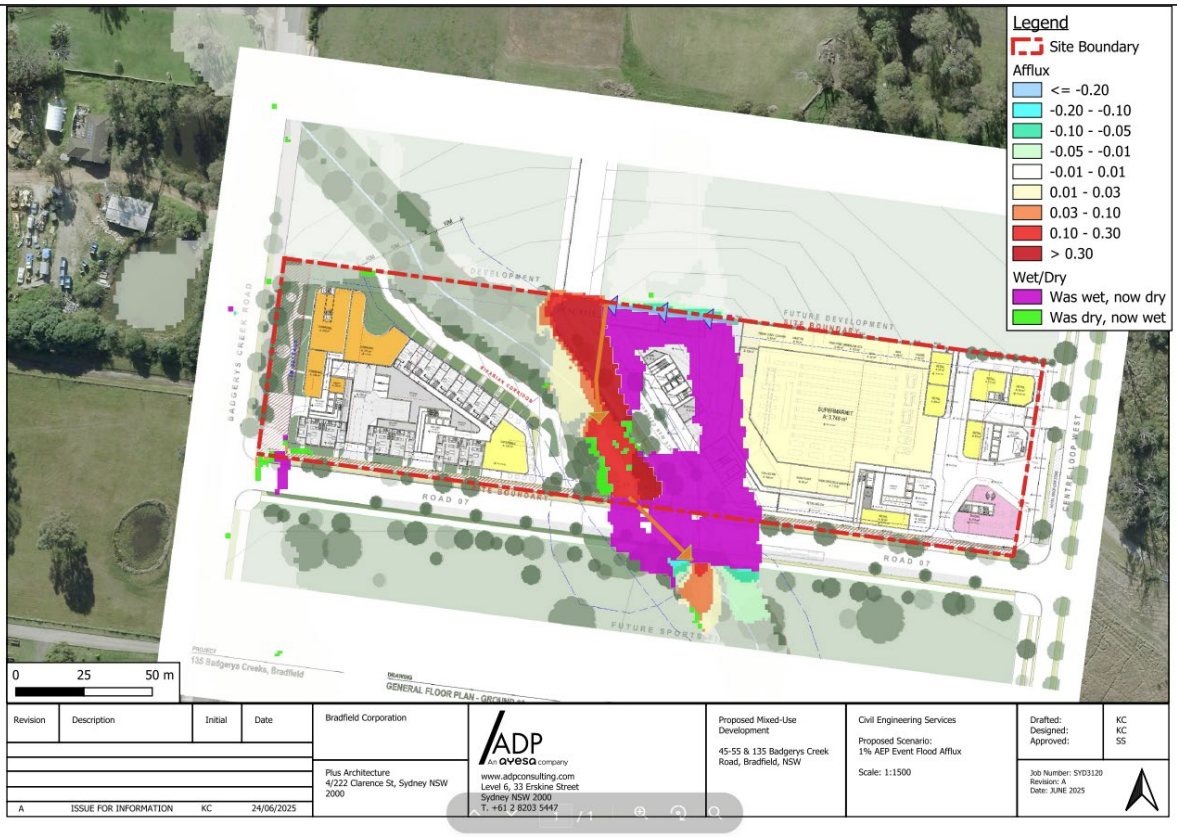

Figure 4-2 Afflux 100 yr event, existing and proposed conditions (ADP, 2025)

Note, the 1% AEP inundation depth and afflux results presented in Figure 4-1 and Figure 4-2 above are based on the proposed design layout at the time of modelling. Results based on 100% design are presented in ADP's hydrology assessment report.

4.1.2. Potential impacts to surface water quality and quantity

Construction and operational activities are likely to affect local hydrology. Stormwater collected from impervious surfaces on site should be collected in basins, existing dams, and constructed/re-constructed wetlands for attenuation of peaks flows and treatment before discharge to natural waterways Short-term impacts are likely during the construction phase as dams, basins and wetlands are removed and constructed and corresponding drainages modified.

4.2. Groundwater assessment

4.2.1. Potential impacts to third-party users

The closest registered bore identified using the BoM Groundwater Explorer, is located approximately 400 m east (downstream of the site). This bore along with four others located downstream of the site within 1 km are listed as monitoring bores, and are not likely to be used for consumption, irrigation or other domestic purposes based on their government database listing. One additional bore located within a 1 km radius of the site is listed for home (domestic) use but is considered unlikely to be impacted by site activities due to its location upstream of the site to the south-west.

4.2.2. Potential impacts to terrestrial GDEs

As there are no there are no GDEs classified as high or very high potential by either the HEVAE or the BoM GDE atlas within the site, the risk of impacts to GDEs are considered to be low. It is noted that high potential terrestrial GDEs were identified within a 1 km radius of the site both west (upstream)

and south-east (downstream). However, the minimal groundwater interference anticipated during construction, also suggests a low risk to any potential terrestrial GDEs surrounding the site.

Risk of impact to aquatic GDEs are considered negligible due to proximity of the site to the only identified aquatic GDE South Creek, located greater than 2 km from the site.

4.2.3. Potential impacts to water table level and pressure

The site topography has a gentle slope toward the south-east. Regional groundwater levels from available borehole logs for bores drilled within a 5 km radius indicate values ranging from approximately 7 to 80 mBGL.

Groundwater levels recorded during geotechnical works are presented in Table 3-4 and range from 1.62 mBGL in the creek to 7.43 mBGL on the northwestern corner of the site. Water levels in all wells fell during the monitoring round, with the water level in BH2M, BH5M and BH6M falling by approximately one meter. BH1M and BH3M were more stable with only 0.1 m or less change over the two days. Additional higher frequency monitoring (e.g. daily manual dips and/or hourly datalogger recordings) may be warranted to determine a stable water level and seasonal variations and to provide a better understanding of groundwater flow processes.

Ei Australia's Geotechnical report indicates that the expected excavation depth is between 6 and 11 mBGL (ei Australia, 2025). There for there it is likely that the excavations will intersect the water table, and dewatering will be required during construction. Dewatering estimates should be calculated once stable water levels and cut and fill diagrams available. A review of monitoring data once stable water level data is obtained may inform an update of the impact assessment presented in this report.

Water levels in BH1M and BH3M are the most stable and are either in, or in close proximity (25.5 m), of the main drainage channel and in the channel. As there is a significant difference in the water levels in proximity to the channel and away from the channel it is likely that the higher water levels are due to water logging of the clay rather than an extensive shallow groundwater lens. The lack of consistency across the site indicates that the groundwater sources are not well connected across the site.

4.2.4. Potential impacts to groundwater quality

Groundwater quality monitoring has not been undertaken at site, however based upon the HGL at the site, it is expected that groundwater quality is brackish to saline (NSW Government Environment and Heritage, 2025).

Fuels and lubricants will be used on site during construction activities and pose a potential risk of contamination to groundwater in the event of a spill. Contaminants in the soil may also be mobilised during rainfall events and may potentially enter the groundwater system, potentially impacting groundwater quality for third party groundwater users, GDEs and/or aquatic habitats.

It is important that Industry Standard spill minimisation and response procedures are followed, which will reduce and minimize any potential groundwater contamination during construction.

4.3. Impact assessment summary

The surface water and groundwater impact assessments were undertaken based on information and data derived from public data records and information acquired during this assessment. A summary of identified potential surface water and groundwater receptors relevant to the site and the potential impacts are presented in Table 4-1.

Table 4-1 Potential surface water and groundwater impacts

Potential impact	Potential receptor	Potential exposure pathway/impact	Preliminary risk of impact rating
SW1	Aquatic and riparian ecological communities	Degradation of aquatic and riparian habitat and/or direct exposure to impacted surface water resulting in disease or death	Moderate – short-term impacts from construction activities may occur, but are likely to recover without intervention following cessation of construction
SW2	Surface flow hydrology	Changes in flow direction and magnitude as a result of drainage 1B being diverted and a reduction in infiltration rates across the site	low – changes to flow paths on site is expected but impacts are unlikely to extend downstream.
SW3	Surface water quality	Reduction in surface water quality due to sedimentation or erosion, changes in connected surface water flows, infiltration rates, or water take	Moderate – short-term impacts from construction activities may occur, but are likely to recover without intervention following cessation of construction
GW1	Third party bore users	Human, livestock and/or domestic source users of impacted groundwater resulting in illness or death	Low – unlikely due to current groundwater use listed on government database. May increase if this is found to be inaccurate
GW2	Terrestrial GDEs	Deterioration in the health of GDE vegetation communities due to reduction in groundwater levels or quality	Low – no identified HEVAE high or very high potential category GDE within a 500 m buffer of the site. BOM did not identify any high potential GDE within the site No aquatic GDEs identified within a 1 Km buffer of the site
GW3	Water table	Reduction in water table level due to changes in connected surface water flows, infiltration rates or water take	Low/moderate – natural recharge due to local infiltration is likely to be minor across the site due to high clay contents of soils and the maintenance of the primary channel (2A) ion the site. The amount and extent of dewatering is unlikely to be significant but cannot be determined at this stage. Higher frequency, longer term monitoring data would be required to reduce this uncertainty
GW4	Water pressure	Reduction in the water pressure due to changes in connected surface water flows, infiltration rates or water take	Low/moderate – project activities are unlikely to encounter groundwater to the extent that will cause deleterious changes to groundwater pressure outside of the site boundary but these cannot be quantified at this stage.
GW5	Groundwater quality	Reduction in groundwater quality due to changes in connected surface water flows, infiltration rates, water take or leaching of saline soils	Low – due to the quality of groundwater in the HGL which is already moderately brackish

Potential impacts to surface water and associated potential impact receptors including aquatic and riparian ecological communities has been assigned a **moderate** preliminary risk of impact rating due to potential short-term impacts from construction activities, which may cause increased erosion and sedimentation. Impacts to the hydrology of the site are unlikely to have a significant impact on the catchment downstream of the site.

Potential impacts to the identified potential groundwater impact receptors are assessed as **low** based upon both regional and site-specific groundwater observation data from geotechnical bores and monitor wells suggests that shallow groundwater is likely to be associated with waterlogged clay soils in close proximity to surface water features. Deeper water levels may be intercepted in the weathered

siltstone and is likely to be perched groundwater. Interception of perched groundwater lenses may require dewatering during construction and depending on the volume required may constitute a **moderate** impact to groundwater level. Estimates of dewatering based on stable water levels including seasonal fluctuations should be included in the Groundwater Seepage Analysis proposed in the Geotechnical Investigation (ei Australia, 2025). The results of this estimate will inform the requirements for an application for a water licence, if dewatering is <3 ML per year an exemption can be applied for under the WM Act, and impacts would be considered low.

Impact management strategies for potential surface water and groundwater impacts are discussed in Section 5.

5. Impact mitigation measures

Several impact mitigation and management measures are suggested based on the potential impacts identified and in consideration of legislative requirements and best practice guidelines.

5.1. Licences and permits

Groundwater data suggests that proposed earthworks will potentially result in minor aquifer interference however, it is possible that dewatering volumes may exceed 3 ML per year. Once stable groundwater values and excavation depths can be determined dewatering estimates should be determined and if >3 ML per year a WAL may be required.

Under the WM Act, if groundwater is intercepted a WAL must be obtained prior to any water take occurring unless an exemption under Clause 7 of Schedule 4 of the Water Management (General) Regulation 2018 applies. An exemption may be available if water take is less than or equal to 3 ML per water year, subject to the development meeting other exemption requirements, such as: the water is not taken for consumption or supply; the person claiming the exemption keeps a record of the water taken under the exemption and provides this to the Minister within 28 days of the end of the water year; and the records are kept for 5 years.

If dewatering requirements are less than 3 ML/year, it is likely that the Project will be applicable for a WAL exemption for aquifer interference activities (the WaterNSW fact sheet is provided in Appendix A). If this is deemed suitable, the proponent is required to record the water taken under exemption on the approved recording and reporting form.

The proponent will also need to record the authority under which the water is being taken, for example water supply work approval (WSWA), licence under the Water Act 1912, development consent, complying development or an approval exemption under legislation (WaterNSW, 2024).

5.2. AIP Level 1 minimal impact considerations criteria

Based on the groundwater impact assessment summarised in Section 4, potential impacts to groundwater will not exceed the Level 1 impact considerations under the AIP as defined for 'less productive' alluvial aquifers. That is, the Project areas pose less than a minimal impact to groundwater resources and associated dependencies and any potential impacts are therefore acceptable under the AIP and does not trigger referral under the WM Act.

Any temporary impacts during construction will be managed through sound practice and monitored through the Construction Environmental Management Plan (CEMP).

5.3. Earthworks considerations

Construction phase management measures that should be incorporated into the CEMP and implemented include:

- Utilisation of low impact construction techniques, such as limiting works to the immediate construction area and using designated laydown areas, to minimise soil disturbance.
- Appropriate stockpile management and earthworks in accordance with EPA (2024) 1834.1 *Civil construction, building and demolition* guidelines, including designation of laydown areas, utilisation of bunding, silt fences and/or erosion control blankets to minimise sediment transport in event of rainfall and surface water runoff.

- Sediment and erosion control measures, such as silt fences, bunding and/or sediment traps, upstream and downstream of structure construction locations to intercept external flows, prevent siltation of shallow groundwater and prevent sedimentation in designated downstream waterways.
- Stormwater and wastewater management measurements including separation of clean and dirty surface water areas to avoid and minimise potential downstream impacts from discharges within the development Site:
    - implementation of drainage systems to reduce potentially impacted stormwater infiltration into groundwater
    - use of permeable surfaces where possible (i.e. access tracks, substation) to promote natural infiltration of clean surface water.
- Spill prevention measures for hazardous materials including fuels and lubricants used during construction activities to prevent contamination (see Section 5.4).
- Management of temporary sewage systems in accordance with Industry Standard to prevent and respond to potential spills or overflows.

Additional operations phase impact mitigation measures may include:

- Re-vegetation of disturbed areas to stabilise soil and minimise potential erosion and sedimentation.
- Implementation of a comprehensive Stormwater Management Plan for the Site based on final detailed and operational design to adequately control runoff and reduce sediment loads that may affect potential receptors within and hydraulically downgradient of the Site.
- Utilisation of retention ponds or other stormwater management infrastructure to manage peak flows and mitigate potential impacts to water quality.
- Maintenance of management infrastructure to ensure ongoing suitability and effectiveness.

5.4. Contamination mitigation

Fuels and lubricants will be used on site during construction activities and pose a potential risk of contamination to surface water and groundwater in the event of a spill. Contaminants in the soil may also be mobilised during rainfall events and may potentially enter the groundwater system, potentially impacting groundwater quality for third party groundwater users, GDEs and/or aquatic habitats.

Management of temporary sewage systems established onsite for the duration of the Project also pose a risk to surface water quality should spills occur.

It is important that Industry Standard spill minimisation and response procedures are followed, which will reduce and minimize any potential contamination during construction.

5.5. Flow management

Stormwater management systems should be utilized to attenuate increased peak flows from surrounding impervious surfaces on site. Detention and retention basins maybe implanted for the purpose and sized to cap peak flow to pre-development volumes.

6. Management consideration and recommended actions

Potential impacts to surface water and associated potential impact receptors including aquatic and riparian ecological communities has been assigned a moderate preliminary risk of impact rating due to potential short-term impacts from construction activities, which may cause increased erosion and sedimentation.

Potential impacts to the identified potential groundwater impact receptors are assessed as low/moderate based upon both regional and site-specific groundwater observation data from geotechnical bores, which suggests that shallow groundwater underlying the site occurs as localised waterlogging of clay as well as shallow groundwater lenses. To further refine this assessment stable water levels and excavation depths are required to estimate dewatering requirements. The extent and location of potential terrestrial and aquatic GDEs either upstream of the site or greater than 2 km downstream suggests that potential impacts to GDEs from site activities is similarly low.

A summary of surface and groundwater management considerations is provided in Table 6-1. It is assumed residual risk is low if an appropriate stormwater management plan is adopted.

Table 6-1 Management actions

Management Issue	Preliminary risk of impact rating	Management action/s
SW1 - Aquatic and riparian ecological communities	Moderate	Implementation of an appropriate stormwater management and monitoring plan, as required, which may include comparison to relevant guideline values for protection of freshwater ecological communities
SW2 - Surface water hydrology	Low	Implementation an appropriate stormwater management plan, with measures such as detention basins to attenuate peak flows.
SW3 - Surface water quality	Moderate	Implementation of erosion and sedimentation control measures and an appropriate stormwater management plan Follow the Industry Standard spill minimisation and response procedures, which will reduce and minimize any potential surface water contamination during construction
GW1 - Third party bore users	Low	Implementation of an appropriate stormwater management and monitoring plan, including comparison to relevant recreational guideline values. Estimate dewatering volumes and area of influence.
GW2 - Terrestrial GDEs	Low	No specific management actions required as identified terrestrial GDEs are located either upstream of the site or greater than 2 km away
GW3 - Water table	Low/moderate	Monitor groundwater level and estimate dewatering requirements to refine impact assessment and determine management actions
GW4 - Water pressure	Low/moderate	Monitor for groundwater level during geotechnical investigations Implementation of an appropriate stormwater management and monitoring plan, including comparison to relevant recreational guideline values Treated stormwater will be directed to existing drainage where possible to limit changes in stream bed infiltration
GW5 - Groundwater quality	Low	Monitor for groundwater level during any further geotechnical investigations and site excavations. Where the water table is intersected by excavations, monitoring should be undertaken to ensure the cumulative impact of dewatering is not more than 10% of natural variability within 40m of the high priority GDEs. Treated stormwater will be directed to existing drainage where possible to limit changes in stream bed infiltration Follow the Industry Standard spill minimisation and response procedures, which will reduce and minimize any potential groundwater contamination during construction

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Appendix A Water Access Licence Exemption Fact Sheet