

Chapter 14
Water resources

ESMERALDA GRAPHITE PROJECT

aarc ENVIRONMENTAL SOLUTIONS
APEM Group

GRAPHINEX

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Glossary, acronyms and abbreviations

Acronym or Abbreviation	Meaning
AARC	AARC Environmental Solutions Pty Ltd
ACH Act	*Aboriginal Cultural Heritage Act 2003*
AEP	Annual Exceedance Probability
AGMG	Australian Groundwater Modelling Guidelines
AHD	Australian Height Datum
ANZG	Australian and New Zealand Guidelines
BOM	Bureau of Meteorology
BPESC	Best Practice Erosion and Sediment Control
CHMP	Cultural Heritage Management Plan
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEHP	Department of Environment and Heritage Protection
DES	Department of Environment and Science
DESI	Department of Environment, Science and Innovation
DETSI	Department of the Environment, Tourism, Science and Innovation
DLGWV	Department of Local Government, Water and Volunteers
DNRME	Department of Natural Resources, Mines and Energy
DNRMMRRD	Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development
DRDMW	Department of Regional Development, Manufacturing and Water
DSITI	Department of Science, Information Technology and Innovation
EA	Environmental Authority
EC	Electrical conductivity
EFO	Environmental Flow Objectives
EIS	Environmental Impact Statement
EP Act	*Environmental Protection Act 1994*
EP Regulation	Environmental Protection Regulation 2019
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*

Acronym or Abbreviation	Meaning
EPM	Exploration Permit for Minerals
EPP	Environmental Protection Policy
ERA	Environmentally Relevant Activity
ESCP	Erosion and Sediment Control Plan
EV	Environmental Values
EVT	Evapotranspiration
GAB	Great Artesian Basin
GABORA	Great Artesian Basin and Other Regional Aquifers
GDE	Groundwater Dependent Ecosystems
GES	General Ecological Significance
GRF	Gilbert River Formation
GWDB	Groundwater database
IECA	International Erosion Control Association
KL	Kilolitres
LOM	Life-of-mine
MAW	Mine affected water
mbGL	Metres below Ground Level
MIA	Mine infrastructure areas
ML	Mining Lease
MLA	Mining Lease Application
MNES	Matters of National Ecological Significance
MR Act	*Mineral Resources Act 1989*
MSES	Matters of State Ecological Significance
PDD	Pit Dewatering Dam
PWD	Process Water Dam
QLD	Queensland
QWQG	Queensland Water Quality Guidelines 2009
RCH	Recharge
RE	Regional Ecosystems
REMP	Receiving Environment Monitoring Program
RMS	Root mean squared

Acronym or Abbreviation	Meaning
RNTBC	Registered Native Title Bodies Corporation
ROP	Resource Operations Plan
SDAP	State Development Assessment Provisions
SILO	Scientific Information for Land Owners
SRMS	Scaled root mean squared
SWL	Standing Water Level
TEC	Threatened Ecological Community
TOR	Terms of Reference
TSF	Tailings Storage Facilities
UWIR	Underground Water Impact Report
VM Act	*Vegetation Management Act 1999*
WMP	Water Monitoring Program
WMS	Water Management System
WQO	Water Quality Objectives
WRD	Waste rock dump

14 Water resources

QLD Aus Graphite Pty Ltd (Graphinex) is seeking approval to develop the Esmeralda Graphite Project (the Project), involving mining of the Esmeralda Granite Unit and on-site concentration of graphite ore on Mining Lease Applications (MLA) 100431 and MLA 100430.

This chapter describes the existing water resources associated with surface water, groundwater, and water-related cultural values, within and around the Project and the mine water management system required to support mining operations, manage mine affected water and protect downstream environmental values. This chapter will also identify potential impacts to surface water and groundwater from the Project and the required mitigation measures proposed to minimise adverse impacts.

To assess the Project's potential impacts, a range of technical studies were undertaken:

- Surface Water Impact Assessment (Appendix K), prepared by Engeny;
- Groundwater Impact Assessment (Appendix L), prepared by Hydrogeologist;
- Geochemistry Assessment of Mine Materials and Tailings (Appendix U), prepared by RGS;
- Terrestrial Ecology Assessment (Appendix E), prepared by AARC Environmental Solutions (AARC);
- Aquatic Ecology Assessment (Appendix D), prepared by AARC; and
- Stygofauna Assessment (Appendix F), prepared by EcoLogical.

Per the Terms of Reference (TOR) structure, surface water, and groundwater quality have been addressed separately in Chapter 15, Water Quality. The assessment of flooding and regulated dams is addressed in detail in Chapter 16, Flooding and regulated structures.

14.1 Legislation and Policy

14.1.1 Commonwealth Legislation

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

The Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for the management and protection of national and international important flora, fauna and ecological places defined as Matters of National Environmental Significance (MSES). Any action with the potential for a significant impact on these MNES must be referred to the Australian Government Environment Minister and may require approval under the EPBC Act. On 23 June 2025, the Project was determined 'not a controlled action' (EPBC reference 2025/10140) and therefore no further assessment is required under the EPBC Act.

14.1.2 State Legislation

14.1.2.1 Environmental Protection Act 1994

The objective of the *Environmental Protection Act 1994* (QLD) (EP Act) and its associated regulations and policies is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. This principle is commonly referred to as ecologically sustainable development. The EP Act addresses the following areas that are relevant to the Project:

- notifiable activities, as listed in Schedule 3 of the EP Act;

- environmental protection policies for water and wetland biodiversity, noise and air which are intended to enhance or protect Queensland's environment and list relevant environmental outcomes and performance criteria;
- Prescribed Environmentally Regulated Activities defined within the EP Act and listed in schedule 2 of the Environmental Protection Regulation 2019;
- The EP Act defines resource activities listed in schedule 21 part 1 of the Planning Regulation 2017 for exempt clearing work;
- Environmental Authorities (EAs) required to carry out an Environmental Relevant Activity (ERA) including a resource activity, and which will include conditions that will regulate the Project; and
- duties of care associated with environmental harm.

14.1.2.2 *Environmental Protection Regulation* (EP Regulation)

The Environmental Protection Regulation (EP Regulation) 2019 further defines specified environmental objectives and performance outcomes for key environmental aspects. The Water and Wetlands environmental objectives and performance outcomes are summarised in Section 14.2.1.

14.1.2.3 Water Act 2000

The *Water Act 2000* (Qld) (Water Act) provides the framework for sustainably managing Queensland's water resources and quarry material, by establishing a system for planning, allocating and using water, and allocating quarry material and riverine protection. The purpose of the Water Act also includes securing water supply and managing demand for the south-east Queensland region and other designated regions and managing impacts on underground water caused by exercising underground water rights by the resource sector.

Under the Water Act, a person must not take or interfere with water unless authorised under the Water Act, or another act. There are a number of declared watercourses that intersect the MLA areas that are subject to the provisions of the Water Act.

A riverine protection permit may be required where vegetation is a watercourse will be destroyed; material will be excavated; or fill is required to be placed in a watercourse, such as for bank stabilisation. An exemption may apply where the holder has an EA (for a resource activity) under the EP Act, and the area of disturbance is less than 0.5 ha.

14.1.2.4 *Mineral Resources Act 1989* (MR Act)

The *Mineral Resources Act 1989* (MR Act) entitles the holder of a mining lease to take or interfere with underground water as part of approved mining operation. This entitlement is termed the mining lease holder's 'underground water rights'. Groundwater that is taken or interfered with while exercising the underground water rights is termed 'associated water'. The holder of a mining lease or mineral development licence is entitled to use associated water for any purpose. In order to exercise the underground water rights for the project, the proponent must:

- apply for an EA under the EP Act;
- comply with the notification requirements under Section 334ZP(6) of the MR Act by notifying the Department of Environment, Science, Tourism and Innovation (DETSI) of the exercise of its underground water rights; and
- comply with its monitoring and reporting obligations under Section 334ZP(5) of the MR Act and Chapter 3 of the Water Act. Section 334ZP(5) of the MR Act requires that the volume of associated water taken is measured and reported. The proponent's obligations under Chapter 3 of the Water Act would include undertaking baseline assessments of the groundwater regime and water supply bores, providing ongoing assessment and reporting of groundwater take and, where necessary, entering into 'make good agreements' with owners of affected water supply bores.

In accordance with the requirements of the MR Act the proponent will notify DETSI of its exercise of underground water rights on the Project site immediately after it starts exercising the rights. The proponent will report the annual associated water volume taken to the Department of Resources in accordance with the Queensland guideline - Q*uantifying the volume of associated water taken under a mining lease or mineral development licence* (Department of Natural Resources, Mines and Energy, 2020).

14.1.3 Policies, plans and guidelines

14.1.3.1 Water Plan (Gulf) 2007

Water resources within the Norman River Catchment are managed under the Water Plan (Gulf) 2007 (the Plan). The purposes of the plan are defined as:

- to define availability of water in the plan area;
- to provide a framework for sustainably managing water and the taking of water;
- to identify priorities and mechanisms for dealing with future water requirements;
- to provide a framework for establishing water allocations to take supplemented surface water;
- to provide a framework for reversing, where practicable, degradation of natural ecosystems;
- to regulate the taking of overland flow water; and
- to regulate the taking of groundwater.

The Plan defines Environmental Flow Objectives (EFOs) which define the flow conditions which must be maintained at defined management nodes in the Gulf basin. EFOs are defined for a range of conditions including flow volume, flow duration, low flow, medium to high flow and wet season flow events. The nearest flow monitoring node is 7 which is the Flinders River at Walkers Bend gauging station.

The Plan area also divides the area into three groundwater management areas called the Great Artesian Basin Groundwater Management Area, the Nicholson Groundwater Management Area and the Einasleigh Groundwater Management Area. However, the Plan applies only to underground water that is not Great Artesian Basin (GAB) water in the plan area. As the principal groundwater resource at the Project site, the Gilbert River Formation (GRF), is GAB water managed under the GABORA Water Plan 2017, the Water Plan (Gulf) 2007 is not relevant to groundwater impacts of the Project due to the absence of Cainozoic aquifers in the project area.

14.1.3.2 Gulf Resource Operations Plan 2010

The Gulf Resource Operations Plan (ROP) 2010 is a document prepared to outline strategies for the implementation of the Plan. The Gulf ROP regulates water allocations and licensing within the Gulf basin. The ROP sub-divides the Gulf Basin into water management areas and zones. The Project is located within the Norman River Water Management Area.

14.1.3.3 Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017

Groundwater resources for the Project are within the Hooray groundwater unit and the Carpentaria South Gilbert River Aquifer sub-area are managed under the Water Plan (Great Artesian Basin and Other Regional Aquifers) (GABORA) 2017 (Figure 14-1). The purpose of the GABORA Plan is defined as:

- to define availability of water in the plan area;
- to provide framework for sustainably managing water and the taking of water in the plan area;
- to identify priorities and mechanisms for dealing with future water requirements; and

- to provide a framework for reversing, if practicable, the degradation of groundwater-dependent ecosystems.

The GABORA Plan's main outcomes are to allocate (using water permits and licenses) and manage water in a way to mitigate the impact on groundwater-dependent ecosystems due to taking and interfering with water. The GABORA Plan aims to achieve a sustainable balance between the following outcomes:

- to protect the flow of water to groundwater-dependent ecosystems that support significant cultural or environmental values;
- to protect the continued use of authorisations to take or interfere with water;
- to maintain, and if practicable increase, water pressure in aquifers to preserve the supply of water to bores;
- to make water available for future development and social and cultural activities that depend on water, including for the aspirations of Aboriginal peoples and Torres Strait Islanders;
- to encourage the efficient use of water by requiring water bores to have watertight delivery systems or be controlled; and
- to facilitate the operation of efficient water markets and opportunities for the temporary or permanent movement of water.



Figure 14-1: Project locality - GABORA

14.1.3.4 Environmental Protection (Water and Wetland Biodiversity) 2019

The Environmental Protection Policy (Water and Wetland Biodiversity) (EPP) is subordinate legislation under the EP Act. The purpose of the EPP is to identify environmental values (EV) and associated water quality objectives (WQO) associated with Queensland waters and aquifers. Queensland waters include water in rivers, streams, wetlands, lakes, groundwater aquifers, estuaries and coastal areas.

The Project is located within the Norman River sub-catchment of the Gulf Rivers basin. A program to define EVs and WQOs for the Norman River sub-catchment has not currently been completed and therefore EVs and WQOs are not currently scheduled under the EPP.

The Project also lies within the Cape York Southern Basin area under the EPP, for which no formal WQOs have been established for either surface water or groundwater.

14.1.3.5 Great Artesian Basin and Other Regional Aquifers Water Management Protocol 2017

The Great Artesian Bains and Other Regional Aquifers Water Management Protocol (The Protocol) 2017 is a document prepared to implement parts of the GABORA Plan 2017. The protocol regulates groundwater allocations and licensing as well as protection and monitoring of groundwater-dependent ecosystems within the Plan area.

14.1.3.6 Water Act monitoring and reporting obligations

According to the guidelines (DES, 2021) in conjunction with the mining lease application process, the Proponent must prepare and submit an initial Underground Water Impact Report (UWIR). It mainly describes the groundwater take due to mining and any associated impacts over a three-year period. The UWIR will also include a process for annual review and reporting. The initial UWIR will be prepared in accordance with Section 376 of the Water Act and the DETSI guideline *Underground water impact reports and final reports* (the UWIR guideline) (DES, 2021), where relevant.

14.2 Surface water

This Section assesses the existing EVs of surface water, potential impacts of the Project, and the mitigation and management measures that will be implemented to minimise any impacts.

Surface water quality, including existing environment, potential impacts, and corresponding mitigation, monitoring, and management measures are detailed in Chapter 15, Water Quality.

14.2.1 Environmental objectives

This Section has been prepared to enable an assessment of surface water environmental objectives and associated performance outcomes prescribed in the Project TOR and stated in Schedule 8, Part 3, Division 1 of the EP Regulation. Specifically, the Project will achieve item 3 of the performance outcome for each of the surface water environmental objectives in satisfaction of Section 2 (4) of Schedule 8 to the EP Regulation, as follows:

- the water performance outcomes will be achieved because the Project will be operated in a way that achieves all the following:
    - there is no actual or potential discharge to waters of contaminants that may cause an adverse effect on an environmental value from the operation of the activity.
    - the storage and handling of contaminants will include effective means of secondary containment to prevent or minimise releases to the environment from spillage or leaks;
    - contingency measures will prevent or minimise adverse effects on the environment due to unplanned releases or discharges of contaminants to water;

- the activity will be managed so that stormwater contaminated by the activity that may cause an adverse effect on an environmental value will not leave the site without prior treatment;
- the disturbance of any acid sulphate soil, or potential acid sulphate soil, will be managed to prevent or minimise adverse effects on environmental values;
- acid producing rock will be managed to ensure that the production and release of acidic waste is prevented or minimised, including impacts during operation and after the environmental authority has been surrendered;
- any discharge to water or a watercourse or wetland will be managed so that there will be no adverse effects due to the altering of existing flow regimes for water or a watercourse or wetland;
- the activity will be managed so that adverse effects on environmental values are prevented or minimised;

- the Project will achieve item 2 of the wetlands performance outcomes because it will be managed in a way that:
  - there will be no potential or actual adverse effect on a wetland as part of carrying out the activity; and
  - the activity will be managed in a way that prevents or minimises adverse effects on wetlands.

The assessment presented in this Section and in the relevant appendices demonstrates how the Project will achieve the performance outcome for each surface water environmental objective.

Groundwater, regulated by the GABORA Plan, is proposed as the water source for the Project. Groundwater is described in Section 14.3, and the environmental values of the GABORA Plan are described in Section 14.3.2.1.

14.2.2 Existing environment

14.2.2.1 Environmental values

As noted in Section 14.1.3.4, there are no prescribed EVs for the Norman River catchment under current legislation guidelines or policies. The Surface Water Impact Assessment (Appendix K) considered the following values (Table 14-1) to be relevant for the Project surface waters, based on all available information and legislative requirements.

Table 14-1: Summary of surface water environmental values

Environmental Value	Description
Aquatic Ecosystem.	There are no published ecosystem condition categories for the waterways surrounding the Project under the EPP or other Queensland guidelines, such as the Queensland Water Quality Guidelines 2009 (QWQG). Having regard to the aquatic ecosystem classification frameworks provided in the EPP, the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG), and the QWQG, the waterways surrounding the Project are likely to be classified as 'slightly to moderately disturbed'. This reflects the surrounding land use, which comprises pastureland, including native pastures and areas of current or potential sown pastures. These areas are therefore modified (i.e. not high value waters) but are unlikely to be sufficiently impacted to be considered highly disturbed.

Environmental Value	Description
Aquaculture and human consumption	The closest surface water entitlement on the Norman River is located 170 km downstream of the Project. The water obtained by the existing surface water entitlements and blended with Artesian Bore water are treated and used to supply Normanton and Karumba Townships (Carpentaria Shire Council 2025).
Agriculture	There are two existing surface water entitlements authorised under the Plan on the Norman River, 170 km downstream of the Project that have an authorised purpose for 'any' purpose.
Recreational uses	Flow within the Borer River is seasonal; however, segregated waterholes within the river channel can persist for longer periods of time into the dry season without additional inflows. It is not known if the Borer River is used for recreational use; however, it is possible that, when water persists within the channel, recreational purposes would include activities such as swimming (primary recreational use) and fishing (secondary recreational use).
Drinking water	The Glenore weir is located 170 km downstream of the Project and is used for drinking water supplies to the townships of Normanton and Karumba
Visual Recreation	It is considered that Borer River provides aesthetic quality or recreational fishing for visual recreational use.
Cultural and spiritual values	It is possible that the waterways provide cultural and spiritual value.

14.2.2.2 Regional and local hydrology

The Project is located in Northern Queensland within the Norman River Catchment area, which drains north to the Gulf of Carpentaria (Figure 14-2). The Norman River Basin has a total catchment of 49,000 km^2 with the main rivers being the Norman River, Clara River and Yappar River. The Norman Basin catchment and its sub-catchments are presented in Figure 14-3.

Local Catchment

The Project is located immediately north of Warrigal Creek and the Borer River and has an unnamed waterway (stream order 3) flowing through the northern extent of the proposed MLA. The Borer River/ Warrigal Creek is a tributary of the major Clara River, a stream order 6 watercourse with a sub catchment area of 2275 km^2. Table 14-2 summarises the waterways in the MLA areas. The key watercourses in the area surrounding the Project are described in the following subSections.

Table 14-2: Waterways in the vicinity of the MLA areas

Waterway	Stream order	Catchment area near the MLA areas (Km2)	Proximity to Project
Unnamed Waterway (reports to Warrigal Creek/Borer River)	3	115	Flows through the MLA areas
Warrigal Creek	5	1,127	Flows through the SW corner of EPM 28274

Waterway	Stream order	Catchment area near the MLA areas (Km2)	Proximity to Project
Borer River	5	178 (plus Warrigal Creek)	Flows through the SW corner of EPM 28274
Clara River	6	2,275	5 km south
Yappar River	6	2,498	18 km east and north

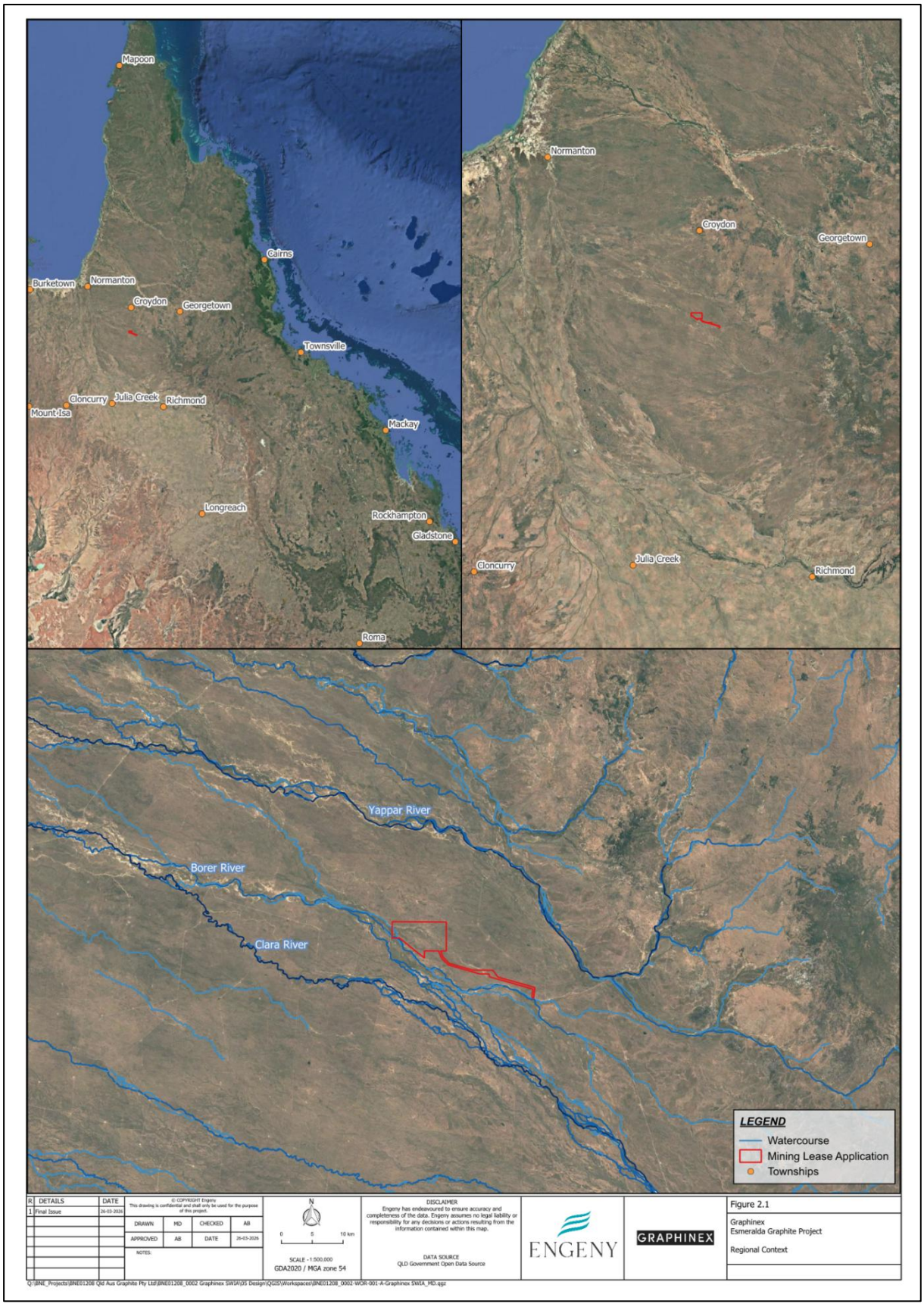


Figure 14-2: Regional context

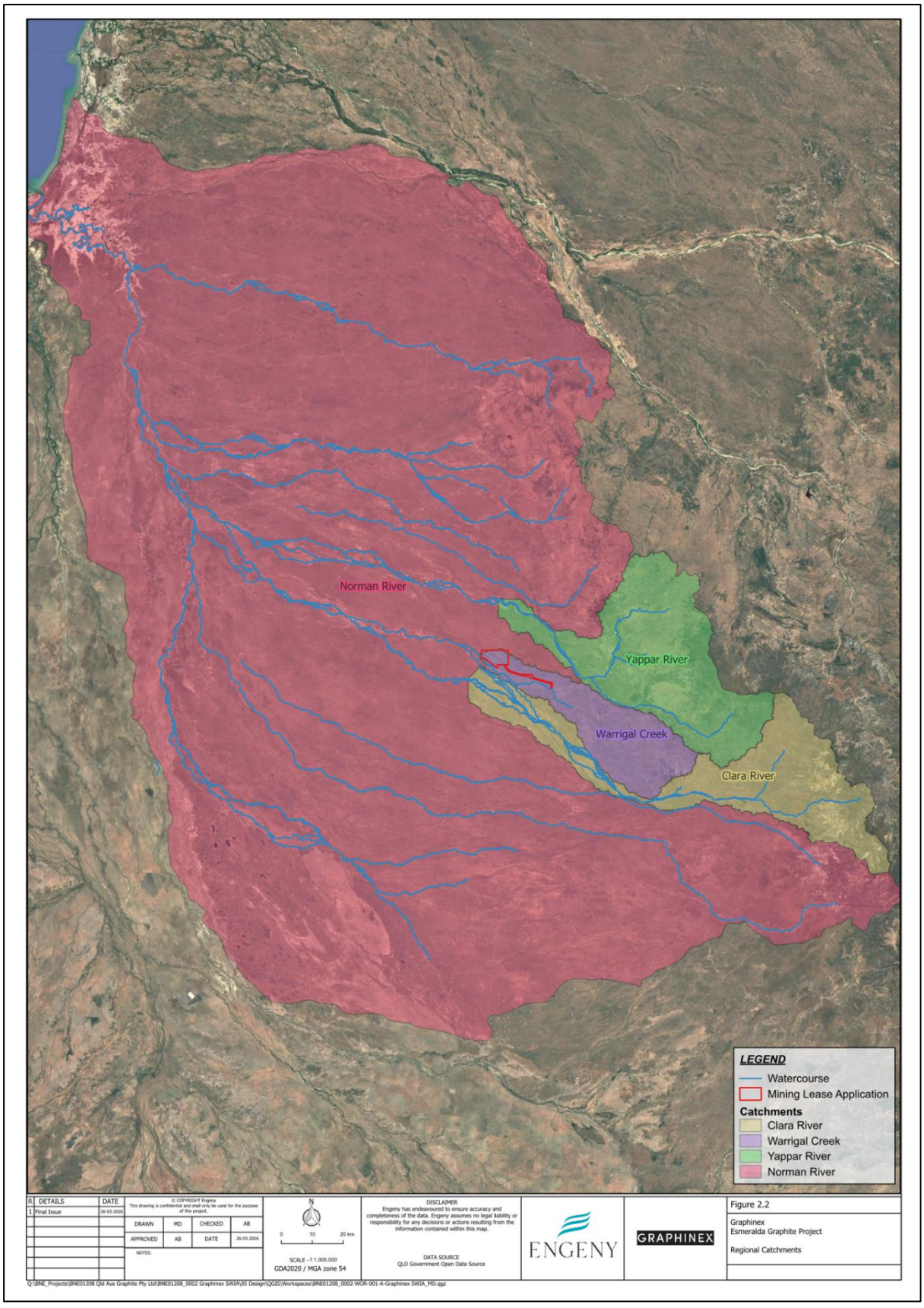


Figure 14-3: Regional catchments

Norman River

The Norman River, a significant QLD river, is defined as a watercourse under the Water Act 2000 and has a catchment area of approximately 49,000 km$^{2.}$

Norman River flows through the townships of Normanton and Karumba before its outlet to the Gulf of Carpentaria. The river flows in a generally north-westerly direction with the headwaters originating on the western slopes of the Great Dividing Range around Bellfield. The Norman River joins with the Clara River around 100 km downstream of the Project. Other major tributaries of Norman River Include Yappar River (14km north of the site), Belmore Creek (originating in the Croydon township) and Spear Creek.

Norman River at Glenore Weir gauge station (915017A) is the only open streamflow gauging station which operates within the Norman River Catchment. This station is owned and managed by the Department of Regional Development, Manufacturing and Water (DRDMW). This gauging station is located 170 km downstream of the Project and shown in Figure 14-4.

The gauge started operation in 1974, was inactive between 1999 – 2021 before reopening in 2022. Flow duration curves for this gauging station is shown in Figure 14-5.

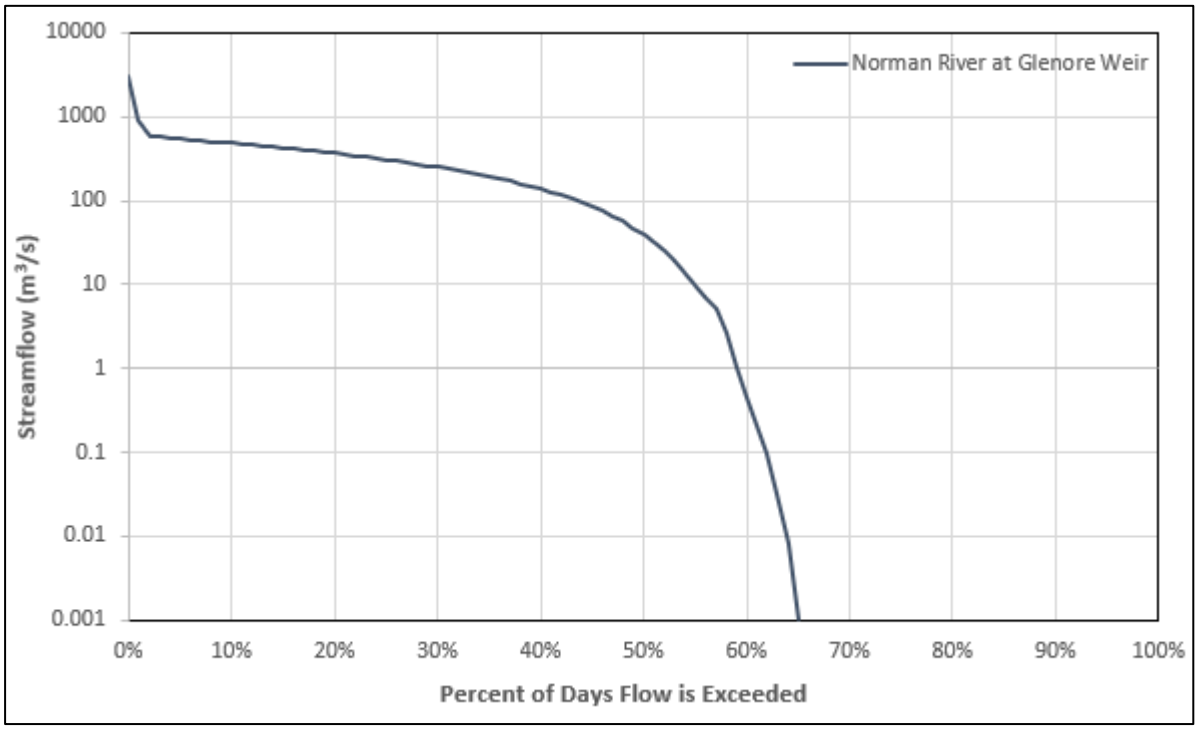


Figure 14-4: Norman River flow duration curve (Streamflow Gauge 916001B)

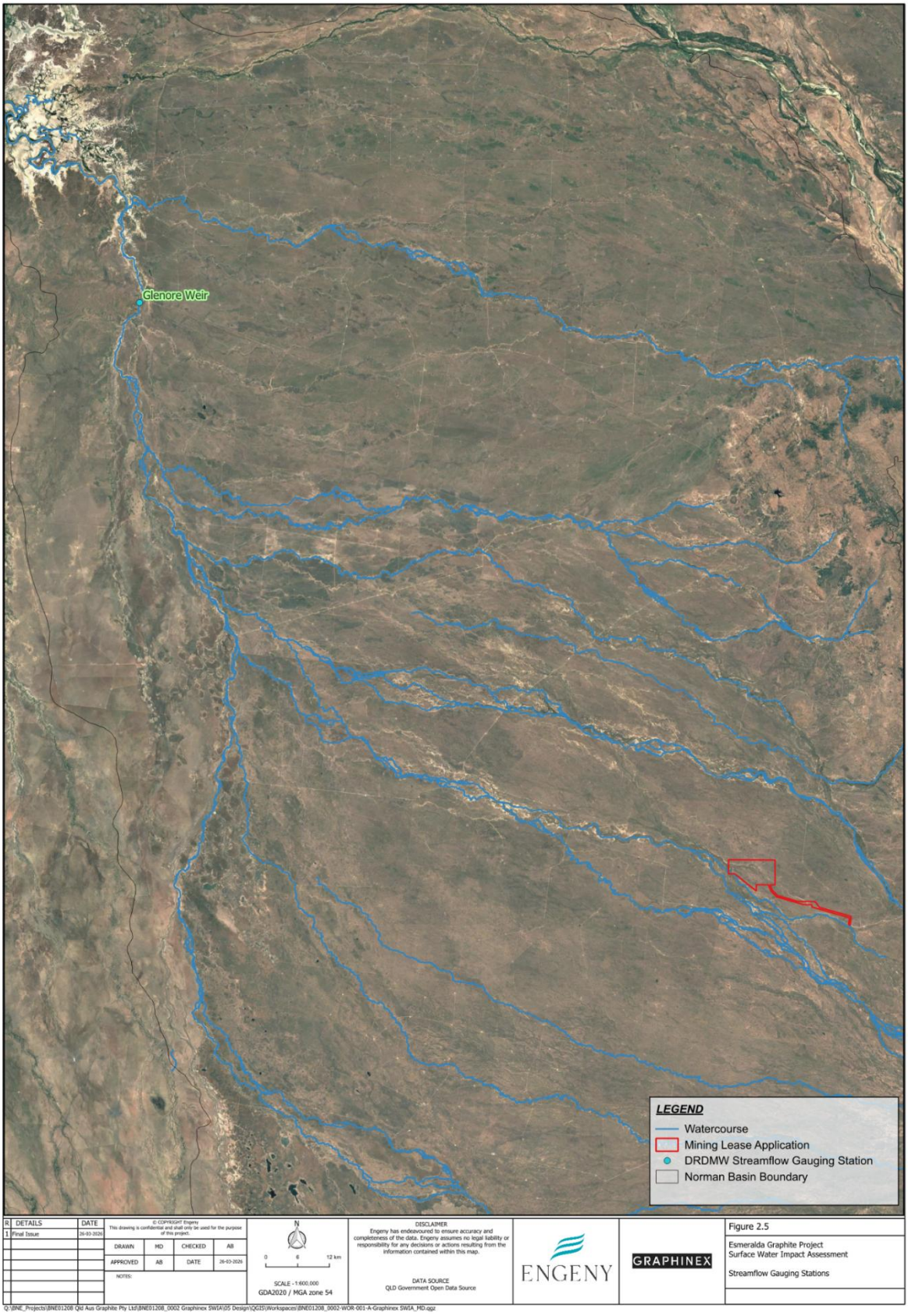


Figure 14-5: Streamflow gauging stations

Warrigal Creek and Borer River

The Project is located immediately north of Warrigal Creek and the Borer River. Warrigal Creek, traverses through the western edge of the MLA, joining Borer River 9km downstream of the site and has a catchment area of 1,127 km^2. Multiple braided channels make up the Warrigal Creek, covering a width of 120 m. Typically 2 m in depth, the creek is shallow and not defined by high banks. The Borer River is formed from an anabranch of the Clara River, a stream order 6 watercourse with a sub catchment area of 2275 km^2, which flows towards Warrigal Creek. Borer River joins with Clara River 50 km downstream of the site before converging into Norman River.

Unnamed waterways

There is one unnamed waterway within the Project's MLA boundary. The stream order 3 waterway tracks north westerly through the central line of the MLA (Figure 14-6). The waterway is defined as a watercourse under the Water Act 2000 and is ephemeral with flow generally occurring following moderate rainfall events.

Wetlands

The Map of Queensland wetland environmental values identified several GES wetlands intersecting the Project area. These included both palustrine and riverine wetlands (DNRMMRRD 2026). Palustrine wetlands are primarily vegetated (with more than 30% emergent vegetation) non-riverine or non-channel environments of less than eight hectares. This includes billabongs, swamps, bogs, springs, soaks and similar features (DETSI 2013b). In comparison, riverine wetlands include all wetland and deepwater habitat that occurs within a channel. The channels can be naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water. This includes rivers, streams, creeks, brooks, rivulets, canals, channels, and watercourses and tributaries (DETSI 2023).

Regional ecosystems associated with wetlands and waterways

In the Project area, Warrigal creek and the unnamed tributary of Warrigal creek are vegetated with River Red Gum (*Eucalyptus camaldulensis*) woodland to low woodland, with *Melaleuca* spp. along them. There are some areas of River Red Gum (*Eucalyptus camaldulensis*) low woodland, with Broad-leaved Paperbark (*Melaleuca viridiflora*), often in the smaller channels.

The wetlands are mapped as seasonal swamps with either Coolibah (*Eucalyptus microtheca*) and Broad-leaved Paperbark (*Melaleuca viridiflora*) woodland in closed depressions on alluvial plains, or Broad-leaved Paperbark (*Melaleuca viridiflora*) low woodland in shallow closed depressions on sand sheets (Table 14-3, Figure 14-7).

Table 14-3: Regional Ecosystems analogous with Wetlands in the study area

RE	Description	VM Act status	Wetland association
RE 2.3.26a	River Red Gum (*Eucalyptus camaldulensis*) woodland to low woodland, with *Melaleuca* spp., on fringes and in channels of minor watercourses	Least concern	Riverine
RE 2.3.26c	River Red Gum (*Eucalyptus camaldulensis*) low woodland, with Broad-leaved Paperbark (*Melaleuca viridiflora*), on fringes of minor watercourses in broad sand sheets	Least concern	Riverine
RE 2.3.55d	Seasonal swamp (wooded). Broad-leaved Paperbark (*Melaleuca viridiflora*) low woodland in shallow closed depressions on sand sheets	Least concern	Palustrine
RE 2.3.61c	Seasonal swamp (wooded). Coolibah (*Eucalyptus microtheca*) and Broad-leaved Paperbark (*Melaleuca viridiflora*) woodland in closed depressions on alluvial plains	Least concern	Palustrine

Flooding

The Project is located on the northern side of the Warrigal Creek main channel, while the stream order 3 unnamed waterway flows to the west, north of the pit. The surface topography is generally flat, although the land near the MLA areas slopes northwest at an average grade of 0.2%.

Flooding at the Project location is dominated by breakout flooding from the northern banks of Warrigal Creek and the Borer River which are influenced by flooding interactions with other major waterways. Other key breakout flooding interactions relevant to the Project location are from Yapper River into Warrigal Creek (22 km and 40 km upstream of the Project) and from the Clara River into the Norman River (66 km upstream of the Project).

Flooding and associated risks are detailed further in Chapter 16, Flooding and regulated structures.

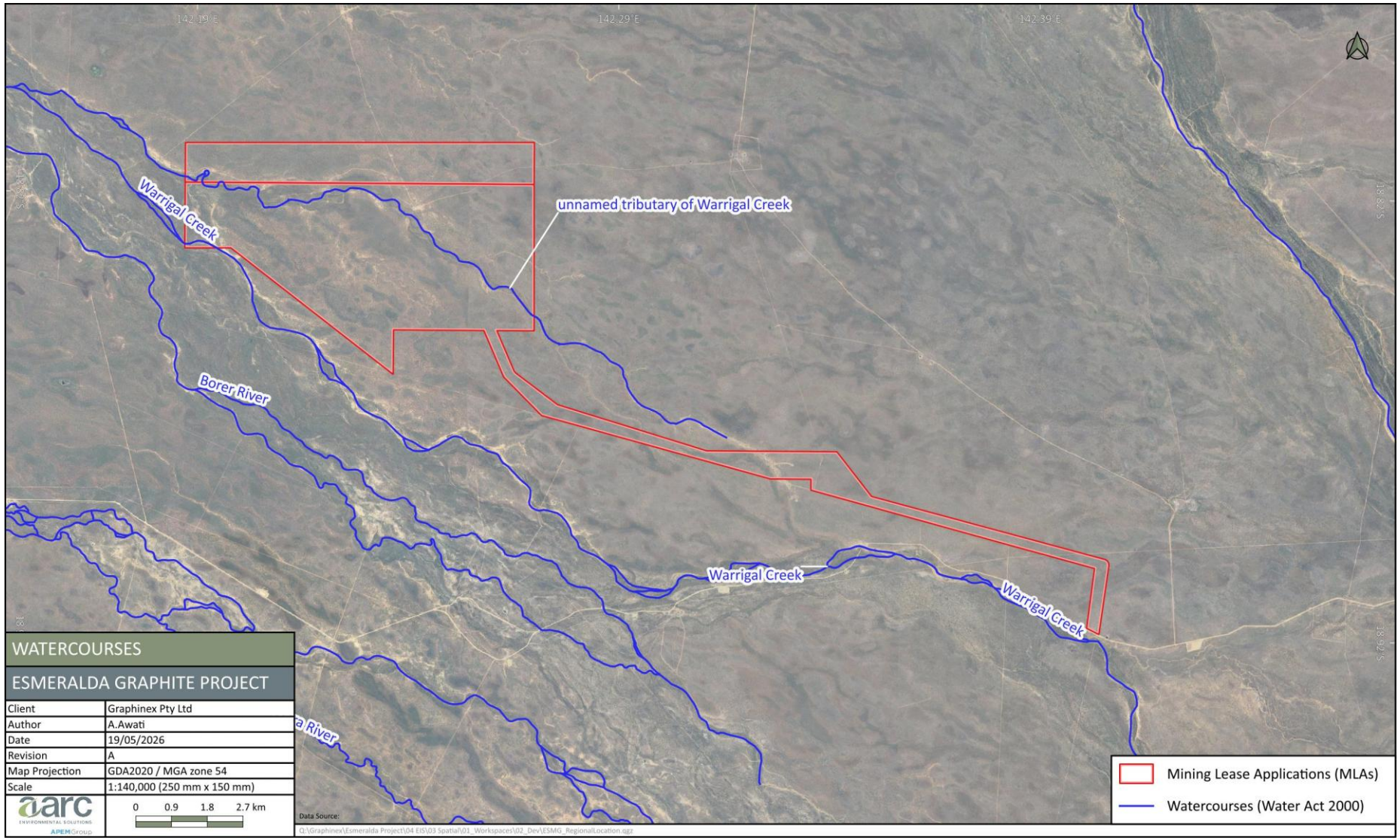


Figure 14-6: Unnamed tributary of Warrigal Creek

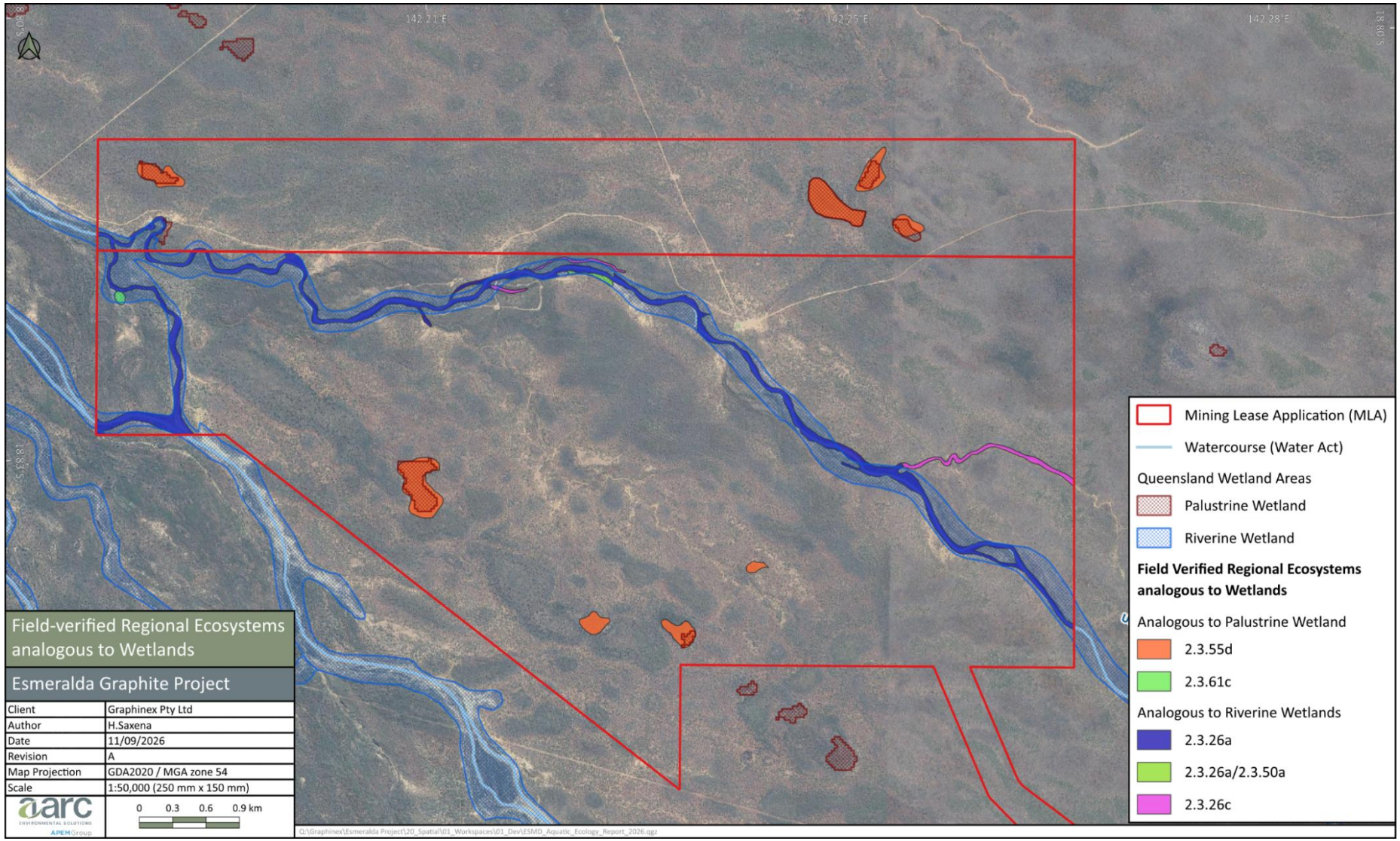


Figure 14-7: Wetlands

14.2.2.3 Regional surface water use

There are two existing water licences downstream of the Project in the Norman River Catchment. The two licences are attached to the same property (8/NM142) and are located approximately 170 km downstream of the Project. The licences are held by Carpentaria Shire Council and authorise the impoundment and use of un-supplemented water from the Glenore Weir mainly for potable supply purposes. The existing licences have a combined annual entitlement (Annual Volumetric Limit) of 4,100 ML/and are authorised for any use. On this basis, it is likely that some of the surface water taken under these licenses is used for agricultural purposes, including grazing and farm supply. The details of these licences are presented in Table 14-4. Meanwhile, the Project will be the only mining operation located in the Borer River catchment. However, several approved, active and inactive mineral mines occur in nearby catchments.

Table 14-4: Details of existing surface water licences

Authorisation number	Authorisation type	Management subgroup	Management group	Authorised purpose	Location (Lot/plan)	Annual Volumetric Limit (ML)
176322	Licence to take water	Norman River Catchment	Gulf Water Resources Plan Area	Any	8/NM142	4,100 The daily volumetric limit that may be taken under this licence is 17.2 megalitres
613666	Licence to interfere by impounding – Embankment or Wall	Norman River Catchment	Gulf Water Resources Plan Area	Impound water	8/NM142	

14.2.2.4 Cultural and spiritual

Aboriginal intangible heritage places along rivers are locations that hold significant cultural, spiritual, and historical value for Aboriginal communities in Australia. These places are often linked to oral traditions, ancestral stories, and practices that are passed down through generations. While tangible heritage refers to physical sites such as rock art, sacred objects, and structures, intangible heritage refers to the practices, knowledge, rituals, and cultural meanings associated with a place.

Rivers are especially important in Aboriginal culture, as they are seen not only as natural resources but as sites of spiritual and ancestral significance. The intangible heritage associated with rivers involves a variety of customs, rituals, and stories that connect Aboriginal people to the land, water, and their ancestors. These include, but are not limited to, that:

- Many rivers can be central to the Dreaming (or Dreamtime) stories of Aboriginal people. The Dreaming is the foundation of Aboriginal spiritual beliefs, describing the creation of the world, the formation of landscapes, and the actions of ancestral beings. Rivers are often seen as physical representations of these stories.
- Rivers can also often be used as sites for rituals, ceremonies, and spiritual practices. These ceremonies are integral to Aboriginal social and cultural life, and they vary between groups.
- Many rivers have cultural associations with healing practices, both physical and spiritual. The water from certain rivers is believed to have healing powers, and specific plants or minerals found along the banks of rivers may be used for medicinal purposes. These practices are deeply tied to Aboriginal knowledge systems and are passed on through cultural transmission.
- River systems can also be linked to art and creative expression. Aboriginal art often incorporates natural elements like water, animals, and plants that are found along rivers. Songs, dances, and paintings may reflect the spiritual and cultural significance of these waterways.

These intangible elements of Aboriginal heritage are essential in maintaining cultural identity and connection to the land, ensuring that practices, knowledge, and stories are preserved across generations.

There are no known cultural or Indigenous heritage sites within the MLA areas. The land on which the Project is situated is subject to an active Native Title Claim (Tagalaka People #2 – Tribunal ID QCD2012/013) (Figure 14-8). The relevant Native Title Representative Body is the Tagalaka Aboriginal Corporation Registered Native Title Bodies Corporation (RNTBC).

14.2.2.5 Fish passage values

Watercourses within the Project area that are considered to be waterways providing fish passage value were identified in Appendix D, Aquatic Ecology Assessment. The waterways include:

- Warrigal Creek and one minor waterway associated with Warrigal Creek (stream order 4) (in the far west of the Project area) – is classified as having a high value to fish movement;
- an unnamed stream order 3 waterway (tributary of Warrigal Creek) is classified as having a moderate value to fish movement; and
- the remaining unnamed stream order 2 waterways (tributaries of Warrigal Creek) are classified as having a low value to fish movement.

The identification of waterways providing fish passage value is summarised in Chapter 18, Flora and Fauna, Section 18.5.2.3.

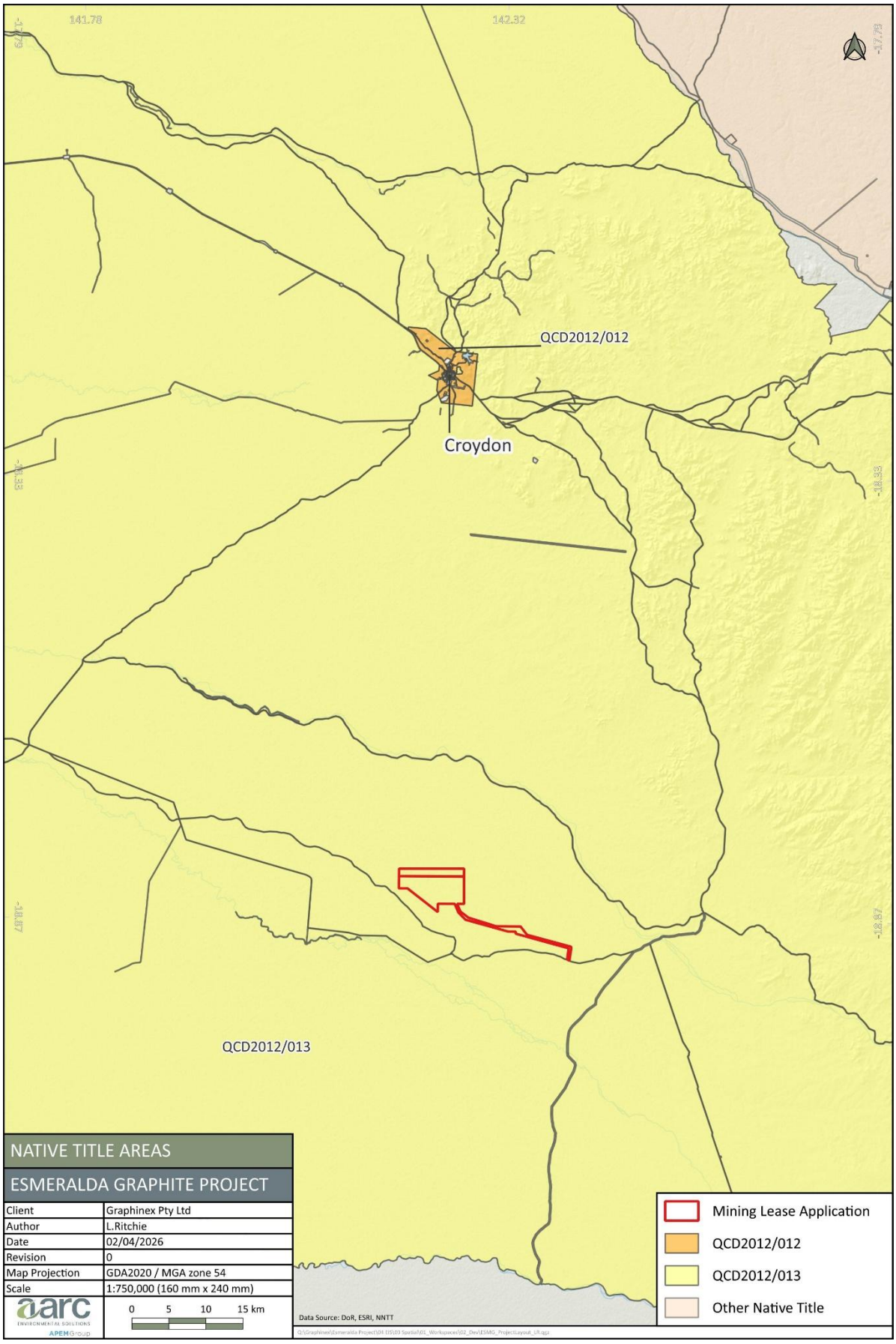


Figure 14-8: Native title areas

14.2.3 Water management system

A Water Management System (WMS) has been developed for the Project to protect the environmental values of the receiving environment while ensuring water is managed efficiently and responsibly throughout the life of the operation. The WMS provides the framework for controlling runoff, maintaining water supply reliability, and minimising potential impacts to surrounding surface water systems.

The WMS also aligns with the purposes of the Plan by sustainably managing overland flow, minimising impacts to natural ecosystems, and supporting equitable access to water resources.

This Section outlines:

- the objectives of the system;
- managed water types;
- proposed management infrastructure;
- site water balance;
- site water requirements; and
- water supply.

14.2.3.1 Water management system objectives

The objectives of the water management system (WMS) are to minimise the capture of clean surface water from external catchments, prevent uncontrolled releases of mine affected water, maintain operational water supply demands and maximise the recycle and reuse of site water. The WMS is also intended to maintain pit dewatering requirements and ongoing operational functionality of the mine.

The proposed WMS will manage separation of the following water types:

- Mine affected water (MAW) - water which has interacted with mining activities consistent with the MAW definition from the Queensland Model Mining Conditions (DESI, 2024). This includes water runoff and groundwater collected within the mining pit, recycled water from the processing plant, runoff from mine infrastructure areas (MIA) and decant water in the tailings storage facilities.
- Sediment Water—rainfall and runoff generated by disturbed landforms including waste rock dumps, pre-cleared areas and rehabilitation that is not yet established. To be considered sediment water and not MAW, this water must not contain elevated concentrations of contaminants, other than suspended solids, and must be treated through the erosion and sediment control system.
- Clean Water— runoff from undisturbed or established rehabilitation areas.
- Raw water – untreated water supplied from an external water supply.
- Potable water - treated water suitable for human consumption.

The proposed WMS achieves separation and management of these water types through a combination of clean water diversion drains, dedicated mine affected water storages, sediment basins and water recycling infrastructure. Clean water is diverted around disturbed areas to minimise runoff entering operational areas and site storages, while mine affected water is contained within dedicated storages for reuse across the Project. Sediment water generated from disturbed landforms is captured and treated through sediment control infrastructure prior to reuse or controlled management.

Additional measures include recirculation of process water within the processing circuit, recovery of tailings decant water for reuse, provision of a dedicated raw water dam to supply operational demands, and preferential reuse of mine affected water and sediment water for activities such as processing and dust

suppression. Progressive rehabilitation and stabilisation of spoil dumps and mine infrastructure areas also form part of the WMS by reducing long-term sediment generation and improving runoff quality over time.

14.2.3.2 Water management infrastructure

To achieve the WMS objectives described in Section 14.2.3.1, a range of water management structures have been proposed to manage the different water types onsite. The layout of proposed infrastructure for the Project is shown in Figure 14-9. Water management infrastructure will be developed primarily during the construction phase and utilised for the life of the Project. Water management infrastructure will be decommissioned at the end of the mine life, except for when an agreement for retained infrastructure is in place. The proposed water management infrastructure is summarised in Table 14-5.

Additional information regarding the sizing and design requirements of this proposed infrastructure are included in in Appendix K, Surface Water Impact Assessment.

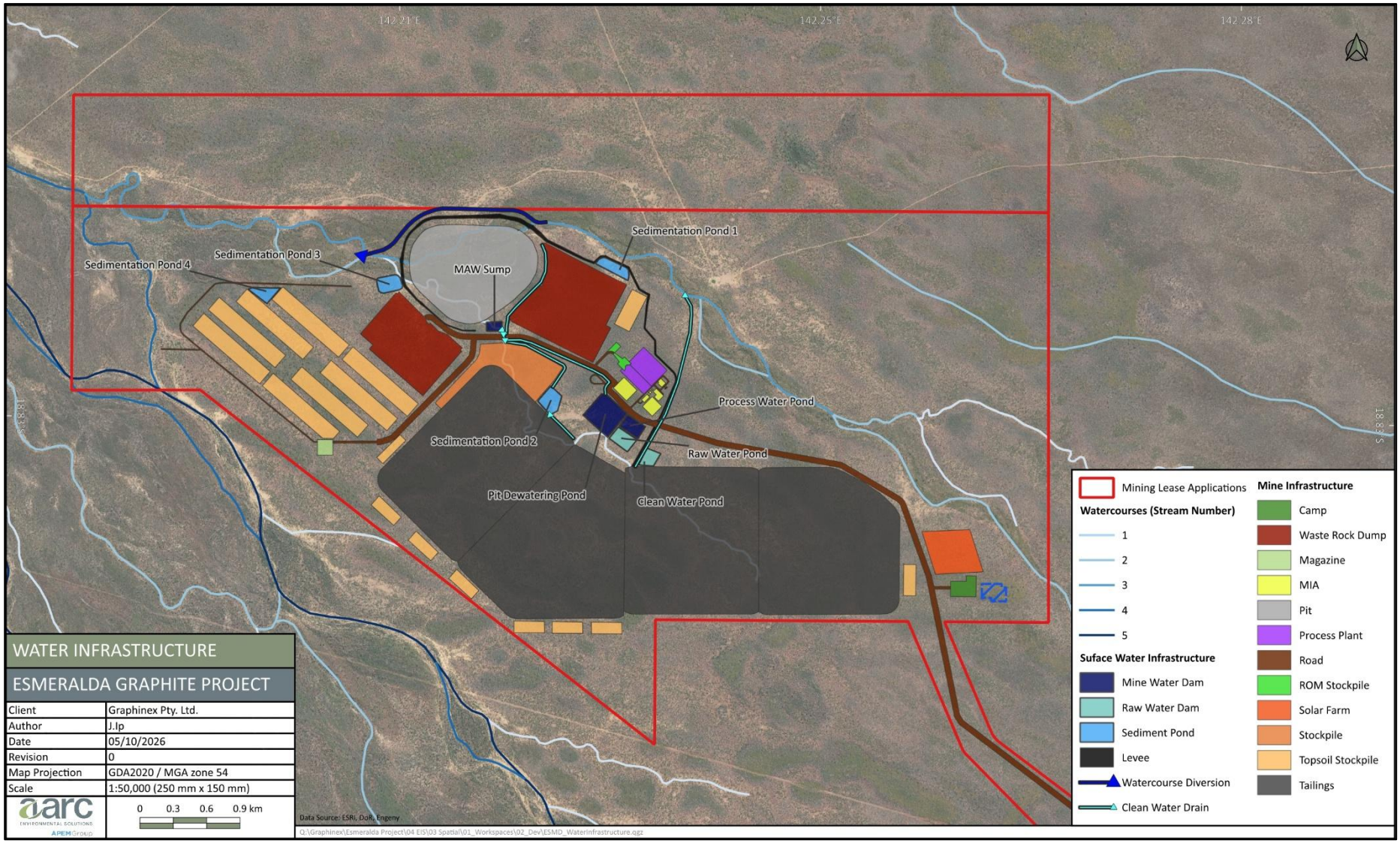


Figure 14-9: Water management infrastructure

Mine water dams

MAW will be managed through three mine water storages that will contain surface water runoff and groundwater collected within the mining pit, recycled water from the processing plant, and runoff from the MIAs, described further in Table 14-5.

Water collected within the pits from rainfall runoff and groundwater ingress is dewatered to the Pit Dewatering Dam (PDD) which is then transferred to Process Water Dam (PWD) for use in the processing plant. As a second priority, supernatant water from tailings deposition and rainfall is pumped from the Tailings Storage Facilities (TSFs) to the Pit Dewatering Dam (PDD). These MAW storages have been sized to enable continuous dewatering of the TSFs and the mining pit.

The PWD and PDD overtop to the MAW sump, a small storage that recirculates MAW back to the PDD, which improves pit operability. In the event of significant rainfall, the MAW sump ultimately overtops to the pit, preventing uncontrolled environmental release. Catchment areas contributing to each storage is summarised in Table 14-6.

The Engeny (2026) GoldSim water balance model of this MAW infrastructure concludes that no predicted spills of mine water to the receiving environment are likely to occur over the life of the Project. The assessment of the mine water system is further discussed in Chapter 15, Water Quality.

Table 14-5: Mine water storages

ID	Description	Full supply volume	Estimated maximum embankment height
Process Water Dam	Lined excavated storage within the processing plant area used to supply process water demands and receive recycled water flows from the plant. The process water dam will also capture runoff from the plant area and receive pump inflows from the other site storages to maintain supply to water demands.	400 ML	0.5m for spillway freeboard
Pit Dewatering Dam	Excavated storage used for pit dewatering and supply of water to the process plant via the PWD. The PDD capacity has been sized to maximise pit dewatering and pumping of MAW from the TSFs.	200 ML	0.5m for spillway freeboard
MAW Sump	The MAW sump collects run off from the ore stockpile area and any overtopping flows from the PWD and PDD. The sump acts to improve pit operability by collecting runoff and dewatering of waters draining from the stockpile area towards the pit.	100 ML	Nil

Table 14-6: Site storage catchment area (hectares)

Land use	Year 2	Year 10	Year 15	Year 20	Year 30	Year 42	Year 53
Hardstands	63.6	63.6	61.8	61.8	61.8	61.8	61.8
Natural	820.7	674.7	527.1	270.7	251.2	250.6	247.3

Land use	Year 2	Year 10	Year 15	Year 20	Year 30	Year 42	Year 53
Pit	23.2	61.9	72.6	72.6	79.3	45.2	-
Rehab	11.3	18.2	33.7	33.5	44.7	79.6	844.8
Tailings	141.1	271.9	432.1	565.0	565.0	565.0	-
WRD	156.8	204.7	217.3	217.4	218.9	218.9	77.4
Total Area	**1216.8**	**1295.0**	**1344.7**	**1221.0**	**1221.0**	**1221.1**	**1231.3**

Sediment ponds

Four sedimentation ponds are proposed as part of the erosion and sediment control system to manage runoff generated from disturbed areas of the Project (Figure 14-9). Based on the assessment completed by Engeny (2026), the catchment areas contributing to these sedimentation ponds and the predicted runoff water quality are consistent with the definition of sediment water rather than MAW. Accordingly, runoff captured within these storages is not required to be managed as MAW under the proposed WMS.

Sedimentation pond 1 has a maximum operating capacity of 60 megalitres (ML) and receives runoff from the northeast waste rock dump catchment. The pond is confined behind the flood protection levee, with discharges reporting to the mining pit. Sedimentation pond 3 has a maximum operating capacity of up to 80 ML,receives runoff from the northwest waste rock dump catchment and discharges to the stream order 3 waterway downstream of the proposed diversion.

Sedimentation pond 4 is located within the western portion of the site and captures runoff generated from the topsoil stockpile areas prior to discharge to the stream order 3 waterway downstream of the proposed diversion. Sedimentation pond 4 has a storage capacity of 60 ML.

Sedimentation pond 2 captures runoff from disturbed and natural catchments within the central portion of the site. Due to the local topography, runoff captured within this pond reports internally to the mining pit, which forms the downstream topographical low point, and therefore no external release pathway is present. Sedimentation pond 2 has a storage capacity of 94 ML.

In addition to sediment control functions, the sedimentation ponds will provide supplementary support to the site water management system by retaining water for reuse in operational activities, including dust suppression and processing demands, reducing reliance on the external raw water supply system.

The sedimentation ponds will be entirely excavated with an excavated spillway channel as the flat grade of the topography does not allow for an embankment containment dam. The dams will include a drain inlet with suitable erosion protection. A typical section of the sediment dams concept design is shown in Figure 14-10. Additional details include:

- Sedimentation pond 1 will be constructed behind the flood protection levee and be formed with a 3m high embankment.
- Sedimentation pond 2 will be mostly excavated (3m below ground) and incorporate a small embankment for spillway freeboard.
- Sedimentation pond 3 will incorporate a 1.7m high embankment and a by-wash spillway around the western side of the dam.

- Sedimentation pond 4 will incorporate a small embankment around the northern side of the dam with impoundment excavation.
- All sediment dams will have a spillway with 1% AEP flood capacity.

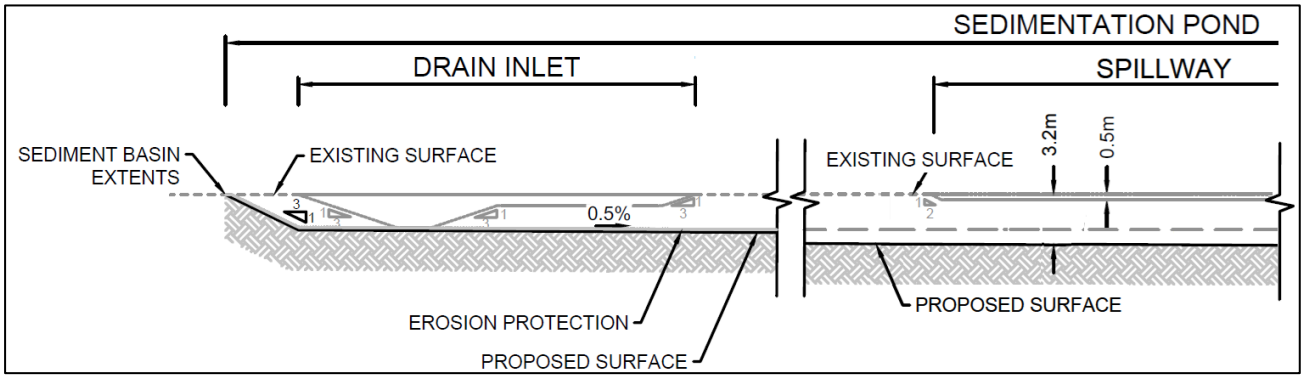


Figure 14-10: Sediment dam typical section

Raw water system

Two raw water storages have been designed for the Project to meet processing demands (Figure 14-9). The Raw Water Dam is proposed for storage of rainfall, as well as supplementary pumped inflows from the Clean Water Sump. The Raw Water Dam has been sized to store 200 ML of rainfall.

The Clean Water Sump is proposed to be located on the overland catchment diversion drain. The sump collects runoff from upstream natural catchments. The sump is designed to have a spillway, which in rainfall events greater than the 50% annual exceedance probability (AEP) 24hr storm, allows outflow towards the clean water diversion drain, ultimately entering unnamed stream order waterway 3. Water collected in the sump is pumped to the Raw Water dam.

Tailings storage facilities

The Project includes four tailings storage cells which operate independently (Figure 14-9). The cells will sequentially be used for the deposition of tailings fines and recovery of water to supply water demands. Tailings cells 1 to 3 will be removed and rehabilitated as part of the pit backfill for mine closure. Tailings Cell 4 will be capped and remain in place at closure. The cells all overflow towards the mining pit and do not discharge from site. Further detail regarding the design specification and operation of the tailing storage cells are included in Chapter 15, Water Quality

Clean water management

Overland flows from clean catchments will be diverted to reduce clean catchment runoff from entering the active mining pit and the mine water management system (Figure 14-9). Clean water will be diverted using diversion drains and bunds that will redirect overland drainage around the active mining operations. There are two clean water drains including:

- The Central Clean Water Drain and bund which diverts a smaller tributary that flows towards the pit extent eventually flowing into the stream order 3 waterway to the northeast.
- Minor overland catchment diversion drains and bunds which will be used to redirect undefined overland paths away from infrastructure areas and water storages.

The clean water diversions will be designed and constructed to divert the 0.1% AEP flood event with a 500mm freeboard above the design flood height.

Flood protection

The project disturbance and infrastructure will be located within the 0.1% AEP flood extent from Warrigal Creek/Borer River and the local stream order 3 waterway passing through the site. A flood protection levee is proposed to wrap around the northern and eastern extents of the project to provide 0.1% AEP flood immunity (Figure 14-9). The first three years will include a temporary section of levee located between the southern bank of the stream order 3 waterway and the mining pit extent. After the first 3 years of the Project, the watercourse diversion for the stream order 3 waterway will be constructed and the levee will be completed around the entire ultimate mining pit extent. The flood protection levee will remain in place until the end of mining. It is detailed further in Chapter 16, Flooding and Regulated Structures.

Watercourse diversions

The stream order 3 waterway will be intercepted by the mining pit in year four of the Project. This waterway is considered a determined watercourse under the Water Act 2000 and therefore requires a permanent watercourse diversion as part of the Project development.

The watercourse diversion and the flood protection levee will be constructed in approximately year 3, prior to the pit intercepting the watercourse. The watercourse diversion design and details are provided in the functional design report for the Project EIS (Engeny 2026b) and is discussed further in Chapter 16, Flooding and regulated structures.

The diversion will collect the existing waterway, east of the pit and divert it around the pits northern extent to tie back into the original waterway. The diversion is designed in accordance with the *Guidelines for permanent watercourse diversions to maintain the existing hydrology, hydraulic, geomorphic and ecological features of the existing waterway* (DNRME, 2019). The diversion will remain at closure and will be approved under the future Environmental Authority for the Project.

14.2.3.3 Water supply requirements

The proposed life of mine (LOM) is approximately 65 years, including construction (2 years), operation (53 years), and final rehabilitation (10 years). The average annual water demand for the Project is shown in Table 14-7. Water demands for the Project include:

- construction of infrastructure, including dust suppression, washdown, earthworks, civil works, firewater system, and commissioning;
- potable water supply to meet the needs of the workers;
- operation of the mine, including mineral processing, dust suppression (stockpiles, transfer stations, and roads), tailings management, equipment and vehicle washdown; and
- Final rehabilitation and closure activities, including dust suppression.

Table 14-7: Project net water demand

Water Demands	Description	Average annual consumption
Construction	• Civil construction works including: o Roads and hardstand pads o Levees and dam embankments	225 ML
Process plant water	• Ore Feed • Tailings	654.5 ML

Water Demands	Description	Average annual consumption
Dust suppression	• Dust suppression	368.8 ML
Potable water	• Miscellaneous water usage at: o Workshops o Administration areas	18.25 ML

14.2.3.4 Surface water modelling

To assess surface water impacts, an operational water balance model was developed by Engeny (2026) (Appendix K, Surface Water Impact Assessment) using GoldSim modelling software. The model was used to assess the performance of the water management system and potential impacts associated with the Project. Key model outputs used to assess the water management system include:

- containment performance of key water storages;
- pit inundation frequency, volume, and duration;
- water supply demands and shortfalls;
- external water supply requirements; and
- changes to streamflow regime in surrounding waterways.

A proposed schematic of the water management system is provided in Figure 14-11. The water balance model replicates the transfer rates and destinations of the schematic. The model input parameters (e.g. climate inputs, catchment conditions, groundwater ingress and quality) are detailed in Appendix K, Surface water Impact Assessment and is summarised below.

- Potable water demands have been assumed to be a constant 50 KL per day for the project.
- Inflows to the open pit is estimated to average between 250-513ML/year, with the peak reaching approximately 2964 ML/year in year 5.
- No seepage losses were modelled from the mine water storages as it is expected they will be constructed to minimise seepage losses for the containment of MAW.

The model was run with a daily timestep as a probabilistic simulation for a period of 50 years, for the operational life of the mine. The model was simulated for 136 realisations stepping through 50-year sequences of the 136 years of available climate data for the mine site (1889 to 2026).

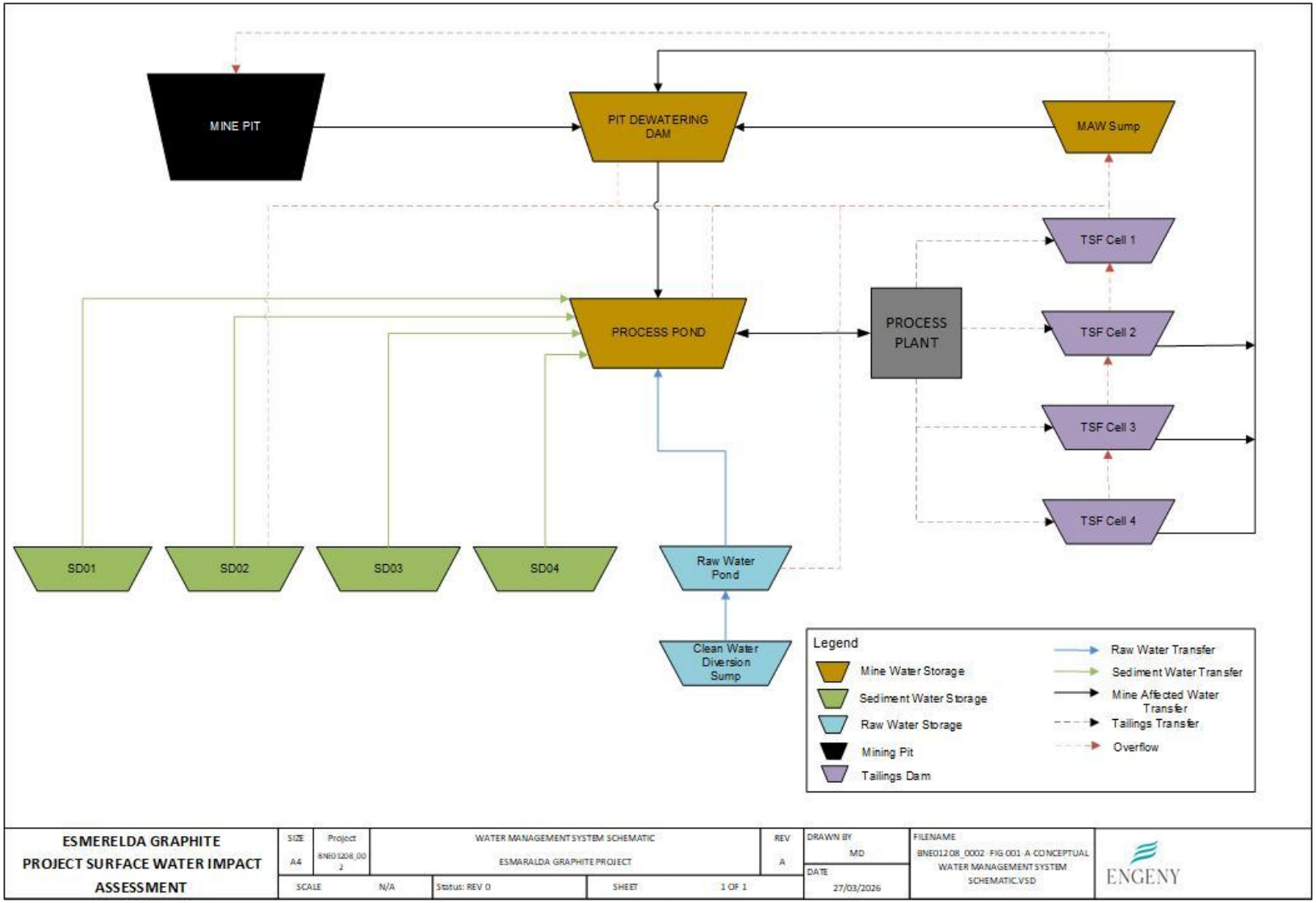


Figure 14-11: Water management system schematic

Water management system performance

The average annual water balance provides an indication of the interaction between the mine plan and the water demands and supply. The key outcomes from the average annual water balance include:

- the water management system has been modelled to have no annual shortfalls to supply water demands in 95% of years during mine operation years.
- Shortfalls slightly increase after year 48, with approximately 10% of years experiencing some shortfall to supply water demand.
- The site water balance is slightly negative in the last few years of the Project, which will assist in reducing MAW inventories leading up to closure.
- Rainfall and runoff volumes are highest when all TSFs are operational due to the greater proportion of disturbed land use. Whilst the rehabilitation and pre-mining catchment areas have similar total catchment areas, the natural/rehabilitated land use has high associated losses.
- Rainfall and runoff collected in site storages accounts for, on average, 52% of total water inflows to the system with the remainder being supplied from groundwater inflows to the mine pit and tailings supernatant water.
- Process water demands are the largest system outflow followed by evaporation.

The Project average annual water balance (inflows and outflows) for the key mine plan stages is summarised in Table 14-8.

Table 14-8: Average annual water balance (ML/year)

Inflow/Outflow	**Year 2**	**Year 10**	**Year 15**	**Year 20**	**Year 30**	**Year 42**	**Year 49**	**Year 53**
Direct rainfall	362	339	377	488	487	435	146	130
Rainfall runoff	644	1,003	1,346	1,655	1,654	1,597	726	599
Pumpable groundwater from mining pit	1,453	1,162	915	659	671	531	[1]	[1]
Tailings water recovery	735	1,375	1,382	1,382	1,385	1,403	167	167
Total inflows	**3,193**	**3,879**	**4,020**	**4,185**	**4,196**	**3,967**	**1,039**	**896**
Evaporation	1,179	1,228	1,401	1,771	1,790	1,549	527	467
Seepage	0	0	0	0	0	0	0	0
Project water demands (gross)	1,579	2,565	2,572	2,463	2,463	2,481	592	592
Sediment dam overflow	24	41	33	30	25	15	0	0
Mine water storage overflows	0	0	0	0	0	0	0	0
Total outflows	**2,781**	**3,834**	**4,005**	**4,264**	**4,278**	**4,045**	**1,119**	**1,059**
Balance	**412**	**45**	**14**	**-79**	**-81**	**-78**	**-80**	**-163**

14.2.4 Potential impacts

The Project has the potential to impact surface water resources through changes to local hydrology, surface water flow regimes, flood behaviour and the interception of runoff within the Project water management system. Potential impacts are primarily associated with the construction and operation of the open cut mining pit, waste rock dumps (WRDs), sediment dams, levees, waterway diversions and associated mine infrastructure.

Engeny's (2026) GoldSim water balance modelling and surface water assessments identified that potential impacts are expected to be largely localised and managed through the proposed water management infrastructure, operational controls and progressive rehabilitation measures. The assessment identified the following potential impacts to surface water resources:

- impacts to streamflow in minor local drainage paths downstream of the Project;
- impacts on streamflow volumes and duration due to runoff capture within the Project water management system;
- impacts to flood flows and flood behaviour in surrounding waterways;
- temporary impacts associated with overtopping of sediment dams during large rainfall events;
- potential impacts associated with waterway barrier works and modifications to drainage connectivity; and
- cumulative impacts associated with existing and proposed developments within the surrounding catchments.

The following Sections provide a detailed assessment of the identified potential impacts to surface water resources. Predicted impacts to surface water quality are described separately in Chapter 15, Water Quality.

14.2.4.1 Impacts to streamflow and runoff volumes

The Project will intercept and retain runoff from disturbed areas within the mine water management system, including runoff reporting to sediment dams, mine water storages and the mining pit. As a result, the Project has the potential to reduce streamflow volumes and alter the duration and frequency of flows within minor local drainage lines downstream of the MLA areas.

The reduction in downstream runoff is primarily associated with:

- capture and retention of runoff from disturbed mine infrastructure areas;
- evaporation losses from mine water storages and sediment dams;
- retention of runoff within the mining pit; and
- reuse of captured water for operational demands within the processing plant and site water management system.

Engeny's (2026) GoldSim modelling indicates that the Project is expected to intercept a maximum catchment area of 13.4 km^2 during operations. This represents approximately 12% of 115 km^2 catchment of the unnamed stream order 3 tributary and approximately 1.2% of the 1,127 km^2 Warrigal Creek catchment. Streamflow volumes are expected to broadly reduce in proportion to the reduction in contributing catchment area.

The reductions in flow volumes and duration are not expected to materially alter the frequency and duration of flow events, reflecting the ephemeral flow characteristics of the local waterways. The resulting reduction in streamflow is therefore expected to have a negligible impact on the streamflow characteristics of the unnamed stream order 3 tributary.

Furthermore, the reduction in catchment during the Project's operational phase is not expected to materially affect water availability for existing licensed surface water users as the closes license is located on the Norman River at Glenore Weir, approximately 170 km downstream of the Project.

At closure, the affected catchment area will be reinstated through backfilling of the mining pit and rehabilitation of the remaining landform. Progressive rehabilitation will reduce long-term runoff interception by re-establishing stable landforms and promoting infiltration and revegetation over the life of the Project.

14.2.4.2 Waterway barrier works and drainage modifications

The Project includes the construction of a permanent diversion of a tributary of Warrigal Creek, flood levees and upgrades to existing crossings associated with mine infrastructure and haul road access. These works have the potential to alter local drainage connectivity, flow conveyance and hydraulic behaviour within the surrounding catchment. Potential impacts associated with waterway barrier works include:

- localised changes to flow velocities and drainage patterns;
- temporary disruption to hydraulic connectivity during construction activities;
- local scour or erosion associated with altered flow paths; and
- impacts to fish passage and aquatic connectivity.

The assessment of potential impacts to fish passage values is detailed in Appendix D, Aquatic Ecology Assessment and described in Chapter 18, Section 18.6.1.3. The proposed diversion and associated infrastructure will be designed to maintain hydraulic capacity and minimise impacts to existing drainage behaviour where practicable. The diversion design incorporates a low-flow channel and broader flood conveyance channel to maintain connectivity during both low-flow and flood conditions. Flood levees and crossing upgrades will also be designed in accordance with the relevant Queensland Government requirements, including the Accepted development requirements for waterway barrier works and State code 18: Constructing or raising waterway barrier works in fish habitats. A description of how the proposed potential fish passage impacts will be mitigated is described in Chapter 18, Section 18.6.5.11.

Based on the proposed design controls and the relatively small scale of the affected waterways, impacts associated with waterway barrier works are expected to be localised and manageable. The proposed works on waterways providing fish passage are assessed to not result in a significant residual impact (refer to Chapter 18, Section 18.7.3).

14.2.4.3 Mine water dam overflows

Mine water storages associated with the Project have been designed to operate as a closed system, with all overflows directed internally to the mining pit. The mining pit has sufficient available storage capacity to contain overflow volumes generated during extreme rainfall events.

As no routine off-site discharge from mine water storages is proposed, impacts to downstream surface water resources associated with mine water dam overflows are expected to be minimal. The internal containment strategy substantially reduces the likelihood of uncontrolled releases to receiving waterways and minimises the potential for changes to downstream flow conditions associated with mine-affected water releases.

The performance of the mine water management system has been assessed through GoldSim water balance modelling, which indicates that the proposed storage capacities are sufficient to manage operational water demands and extreme rainfall events throughout the Project life.

14.2.4.4 Sediment dam overflows

Sediment dams are proposed to capture runoff from disturbed areas, including WRDs, haul roads, topsoil stockpiles and other mine infrastructure areas. Sediment dams 1-3 have been designed to contain runoff from the 10% AEP, 24-hour rainfall event, including allowance for sediment storage.

During larger rainfall events, overtopping of some sediment dams may occur. GoldSim modelling undertaken by Engeny (2026a) indicates that overtopping frequencies vary between the proposed sediment dams depending on contributing catchment characteristics and operational staging.

Sediment dams 1 and 2 have a maximum annual overtopping frequency <10%, increasing towards the end of the Project life due to rehabilitation of the TSFs and reduced water demands. Overflows from these dams are captured within the MAW sump and mining pit and pumped back to the PDD to supply demands.

Sediment dam 3 has a maximum annual overtopping frequence of < 10% during high operating years of 1-53, with a higher overflow frequency modelled during rehabilitation.

Sediment Dam 4 has a high overflow probability of above 50%; however, it receives runoff from a low sediment generating catchment and therefore has been designed accordingly.

As stated in Section 14.2.3.2, Sediment dams 3 and 4 overflow to the stream order 3 tributary downstream of the proposed watercourse diversion

During overtopping events, coarse sediments will continue to settle as water flows through the dam reservoirs, providing residence time. Sediment dams will be designed to incorporate overflow control structures and scour protection measures to minimise erosion and maintain stable discharge conditions during overtopping events.

Progressive rehabilitation of disturbed areas over the Project life is expected to reduce sediment generation and improve runoff conditions within contributing catchments. Monitoring of overtopping events and sediment dam performance will also be undertaken to validate design assumptions and support adaptive management measures where required.

14.2.4.5 Cultural Heritage

Potential impacts to surface and groundwater resources used for cultural heritage activities may occur from mining activities in the area.

Changes to waterways may alter the perception and cultural significance of certain sites for Indigenous communities. Changes could have implications for the cultural practices, traditions, and values associated with these elements. To the extent possible, the Project has been designed to avoid impacts to waterways.

The Water Plan (Gulf) 2007 includes provisions for Indigenous water reserves and allows First Nations peoples to take or interfere with water for traditional or cultural purposes without an entitlement. The Project does not propose the use of unallocated water under the Water Plan (Gulf) 2007, however will protect the uses and aspirations of relevant water resources for Aboriginal and Torres Strait Islander peoples through Project management strategies.

The likelihood of any potential impacts to cultural heritage values is low as there are no known cultural or Indigenous heritage sites within the MLA areas.

14.2.4.6 Cumulative impacts

The Project is located within a catchment with limited existing or proposed mining development. The Croydon Gold Mine, located approximately 70 km north of the Project, is the only other known mining operation within the broader Norman River catchment.

Given the relatively limited scale of mining activity within the surrounding region, cumulative impacts to surface water resources are expected to be negligible. The Project is not anticipated to result in a material cumulative reduction in regional streamflow volumes, flood conveyance or downstream water availability when considered in combination with existing land uses and developments.

Accordingly, cumulative impacts to surface water resources are considered low and are not expected to materially affect the hydrological function of the broader receiving catchments.

14.2.5 Mitigation, monitoring and management

Mitigation, monitoring and management measures relating to terrestrial and aquatic ecosystems, water quality, and flooding are detailed in the following chapters:

- Chapter 17, Flora and Fauna;
- Chapter 15, Water Quality;
- Chapter 16, Flooding and regulated structures; and
- Chapter 21, Hazards Health and Safety.

The site water management system has been specifically designed to minimise impacts to the surrounding environment and water resources in the region.

14.2.5.1 Water management plan

The primary purpose of a mining project water management plan is to examine and address all issues relevant to the importation, generation, use, and management of water on a mining project in order to minimise the quantity of water that is contaminated and released by and from the project (DEHP 2012).

A water management plan detailing site water management infrastructure, maintenance requirements and containment performance standards will be prepared in accordance with EA conditions. This document will provide a structure for achieving the adequate protection of EVs. The water management plan will document the likelihood and consequence of risks to EVs within and around the Project as well as the management controls in place to reduce risks to an acceptable level.

The water management plan is expected to address the following aspects of site water management:

- Background information and description of site activities relevant to water management including:
    - Identified environmental values and water quality objectives of the receiving waterways.
    - Description of receiving waterways.
    - Description of the local and regional groundwater aquifers.
    - Water quality monitoring of the receiving waterways and groundwater aquifers used to establish baseline conditions.
    - Description of current and historical mining and associated activities.
    - Site climate conditions.
- Description of contaminant sources for the different water sources and uses associated with the project.
- Water management system including:
    - Objectives of water management system.
    - Site storages details and locations.
    - Transfer infrastructure.
    - Identification of bulk water storages.
    - Proposed actions to maintain water infrastructure.
    - Actions required to maintain required freeboard in containment structures.
- Site water balance details including:
    - Details of major water inflow and outflow mechanisms.
    - Water balance model development including:
        - Details of calibration of runoff parameters.
        - Key input assumptions.
    - Water balance forecast results.

- Details of water quality monitoring plan and monitoring outcomes.
- Emergency and contingency planning.
- Assignment of responsibility for water management plan actions.

The water management plan will be updated annually prior to the wet season (November) for the life of the Project. This will enable identification of changes to the water management system and the site water balance and allow implementation of mitigation measures to prevent impacts to receiving EVs. The update process will identify risks associated with the water management system and feedback to infrastructure and operational management improvements.

14.2.5.2 Streamflow monitoring

Streamflow gauging will be required during the operational phase of the Project to assess impacts and to allow for ongoing refinement of surface water models. A streamflow gauge will be installed during Project construction to collect site-specific streamflow data, with monitoring targeting the local stream order 3 tributary as well as Warrigal Creek/Borer River. No site-specific streamflow monitoring data is currently available for the Project catchment. The streamflow data collected during Project operations will support future model calibration and refinement, and the development of the permanent watercourse diversion.

14.2.5.3 Water storage monitoring

Routine sampling of the site water storages will be conducted monthly to track water quality trends in the storages and allow review of risks to environmental harm. Sampling of water storages will also be completed during overflow events to determine the concentration and quantity of released contaminants to allow investigation into the extent of environmental harm. Project water storage infrastructure will be sampled for the water quality parameters presented in Chapter 15, Water Quality. Water levels in the storages will be monitored by the automatic monitoring and alert system proposed for the Project which will capture real time water levels in storages with trigger alarms.

14.2.5.4 Water monitoring program

A water monitoring program (WMP) is one of the key controls for the ongoing performance assessment of the site and identification of potential impacts. The aim of the WMP is to identify and quantify potential impacts on the receiving waters during operations and assess the adequacy and improvements to the mitigation measures.

The WMP will be developed based on the receiving waters EVs and the potential impacts of the Project determined from the Surface Water Impact Assessment (Appendix K) and the Groundwater Impact Assessment (Appendix L). The WMP will provide the following:

- identification of EVs for receiving waters that could be potentially affected by water releases from the Project;
- measurable indicators and associated water quality objectives (WQOs) to maintain or enhance the identified EVs;
- suitable test sites within the receiving waters that could be potentially impacted by water releases (downstream monitoring locations);
- suitable upstream control sites to establish background conditions for assessment of potential impacts at the downstream monitoring locations; and
- methods for assessing impacts at the downstream sites against the WQOs and upstream monitoring locations (control sites).

The monitoring strategy for surface water is discussed in detail in Chapter 15, Water Quality.

14.2.5.5 Erosion and sediment control plan

An erosion and sediment control plan (ESCP) detailing design and maintenance requirements will be prepared in accordance with EA requirements, to manage erosion and sediment control measures implemented in association with the Project.

Management of erosion and sediment control will be undertaken in accordance with the Best Practice Erosion and Sediment Control (BPESC) guideline (IECA 2018), which provides guidance on sediment basin sizing and operation. The ESCP will define the following aspects of the erosion sediment control requirements for the Project:

- limiting disturbance to prevent sediment runoff generation;
- erosion control measures such as revegetation and rehabilitation, aimed to prevent soil erosion from disturbed areas;
- documenting soil types and disturbed catchment areas on the site and their potential for sediment generation;
- design and management of drainage control measures to prevent erosion from concentrated flows and manage the flow of both clean water and sediment runoff;
- erosion and sediment control requirements associated with temporary disturbance and construction activities;
- design and management of sediment dams including dewatering and desilting requirements and the use of suitable construction materials; and
- water quality testing of sediment dams to assess their performance and inform continual improvements of the erosion and sediment control system.

14.2.5.6 Receiving environment monitoring program

A receiving environment monitoring program (REMP) will be developed to monitor, identify, and assess any impacts to the EVs, water quality and flows within the receiving environment over the Project life. The REMP will require annual monitoring and reporting and analysis of long-term trends and potential impacts. Outcomes of the monitoring programs will inform further mitigation measures and remediation of existing mitigation measures as required.

The REMP will be developed to include the following:

- Background information and descriptions of:
    - Site location and history.
    - Catchment and watercourses.
    - Regional and local land use.
    - Local climate conditions.
    - Receiving environment EVs and WQOs.
- Monitoring aspects which are expected to include stream flow, surface water and sediment quality, ecology, and habitat.
- Monitoring methodology in accordance with the Queensland Monitoring and Sampling Manual (DES 2018)
- Monitoring locations and selection of sites including consideration of temporal variation.

14.2.5.7 Cultural Heritage Management Plan

A Cultural Heritage Management Plan (CHMP) is being developed and will be finalised prior to any construction activities. It will provide the Project with guidelines to manage potential impacts to cultural heritage values, including those that may occur within or adjacent to waters in the MLA areas.

Any development activities that affect alter waterways will be carefully evaluated to determine their potential impact on the cultural heritage values of the area. This evaluation will ensure that the Project does not compromise the integrity of any significant cultural sites or the connection of Aboriginal peoples to the land and waters, respecting their cultural heritage and ensuring its protection.

To ensure the protection of cultural heritage, any uncovered artefacts or sites will undergo detailed assessment by an appropriate Aboriginal Party or a suitably qualified professional. Appropriate processes will be in place to manage and preserve the identified values.

The proposed management controls will be designed to meet the objectives of the *Aboriginal Cultural Heritage Act 2003* (ACH Act), ensuring that the scope and nature of the Project do not compromise the cultural heritage significance of any heritage places or areas.

14.3 Groundwater

This Section describes the assessment of the existing environmental values, potential impacts of the Project, and the mitigation and management measures that will be implemented to minimise any impacts to groundwater. In drafting of this chapter, the following groundwater related policy and guidance have been considered, where appropriate:

- Water – EIS information guideline (ESR/2020/5312);
- Groundwater Dependent Ecosystems – EIS information guideline (ESR/2020/5301);
- Application requirements for activities with impacts to water (ESR/2015/1837);
- Stormwater and environmentally relevant activities (ESR/2015/1653); and
- Requirements for site-specific and amendment applications – underground water rights (ESR/2016/3275).

The Groundwater Impact Assessment (Appendix L) has been peer reviewed by David Whitting. The peer review is provided in Appendix R, Groundwater Impact Assessment Peer Review.

Groundwater quality, including existing environment, potential impacts, and corresponding mitigation, monitoring, and management measures are detailed in Chapter 15, Water Quality.

14.3.1 Environmental objectives

This Section has been prepared to enable an assessment of groundwater environmental objectives and associated performance outcomes prescribed in the Project TOR and stated in Schedule 8, Part 3, Division 1 of the EP Regulation; specifically, that the construction and operation of the Project will meet the following objectives and performance outcomes.

- no direct or indirect release of contaminants to groundwater from the operation of the activity;
- no actual or potential adverse effect on groundwater from the operation of the activity; and
- to prevent or minimise adverse effects on groundwater or any associated surface ecological systems.

The TOR further requires that Section 126A of the EP Act be addressed. Section 126A relates to applications for an EA involving the exercise of underground water rights and requires a description of the proposed exercise of underground water rights, the areas in which underground water rights are to be exercised, the affected aquifers, anticipated impacts on EVs of groundwater, and mitigation measures to manage the anticipated impacts.

14.3.2 Existing environment

14.3.2.1 Environmental values

As stated in Section 14.1.3.4, the Project is located in the Cape York Southern Basin and is not included in Schedule 1 of the EPP and therefore does not have prescribed EVs and WQOs.

For the purposes of this assessment the groundwater resource EVs for the Project have been considered as those attributes of the groundwater systems, within the potential impact area, that are sufficiently important to be protected or enhanced. The EVs for groundwater resources to be enhanced or protected in the Project are considered in Table 14-9.

Based on the assessment, from a hydrogeological perspective, the groundwater resource EVs to be protected by the Project are recognised as drinking water and stock watering.

Table 14-9: Summary of groundwater environmental values

Environmental Value	Description
Aquatic Ecosystem.	Groundwater Dependant Ecosystems (GDEs) represent ecosystems that rely wholly or partially on groundwater to maintain ecological function and EVs. Desktop reviews and field investigations identified no mapped aquatic or terrestrial GDEs within the MLA areas, with the nearest mapped GDE features located approximately 24 km to 32 km away. Although low and moderate potential GDEs are mapped within and adjacent to the MLA areas, investigations indicate these features are extremely unlikely to be groundwater dependent due to the absence of shallow groundwater, dry and unsaturated sediments, groundwater depths of approximately 10 mbGL (metres below ground level), and the ephemeral nature of local drainage features. Stygofauna assessments also identified no evidence of suitable habitat or stygofauna presence within the MLA areas.
Aquaculture and human consumption	No groundwater resources within the MLA areas are currently identified as supporting aquaculture or human consumption. Desktop reviews identified no springs or permanent groundwater surface expressions within or surrounding the MLA areas, with the nearest mapped springs located more than 30 km away. Available groundwater quality data indicate groundwater is generally fresh and slightly alkaline; however, the limited number of existing groundwater supply bores within the region are primarily associated with monitoring and stock watering purposes rather than potable or aquaculture supply.
Agriculture	Groundwater within the MLA areas is primarily associated with stock watering and monitoring purposes. A desktop review identified 19 registered groundwater bores within 10 km of the MLA areas, including existing groundwater supply bores completed within the GRF. Available water quality data indicate groundwater is generally fresh and slightly alkaline, suggesting it may be suitable for limited agricultural uses, including stock watering. The Proponent is also currently engaged in an agreement to subdivide the underlying Esmeralda Station, which will include ownership of the registered bores within the MLA areas.
Recreational uses	There are no springs, permanent groundwater surface expressions, or groundwater-fed water features identified within or surrounding the MLA areas that would support recreational use. Local drainage features are ephemeral and do not receive groundwater baseflow, and there is no evidence to suggest groundwater is directly used for recreational or aesthetic purposes within the MLA areas.
Drinking water	Available groundwater quality data indicate groundwater within the MLA areas is generally fresh and slightly alkaline, with recorded electrical conductivity levels ranging from 680 µS/cm to 1,310 µS/cm. While this suggests groundwater may be of a quality potentially suitable for human consumption, groundwater resources within the MLA areas are currently associated with monitoring and stock watering purposes rather than potable supply. No registered groundwater bores within the MLA areas are known to be used for drinking water supply.

Environmental Value	Description
Visual Recreation	This category of environmental value is considered not applicable to groundwater within the MLA areas.
Cultural and spiritual values	Desktop reviews and field investigations identified no springs, seeps, or permanent groundwater surface expressions within or surrounding the MLA areas. Accordingly, there is no evidence to suggest groundwater resources within the MLA areas support identified cultural or spiritual environmental values.

14.3.2.2 Geology and structure

The Project is located within an area of Cainzoic and Mesozoic cover sequences. At the surface, unconsolidated Quaternary alluvium and semi-consolidated Tertiary sediments form the uppermost units. Quaternary alluvium has been assessed to be locally constrained to the beds and banks of watercourses and major drainage features, with drilling within the proposed open cut pit and broader MLA areas confirming there is no Quaternary alluvium present within the MLA areas.

Regionally, the Wallumbilla Formation comprises very fine-grained mudstones and siltstones that are distinctly grey to black in colour. While absent within the MLA areas, the Wallumbilla Formation occurs within some neighbouring third-party groundwater supply bores included in the Project monitoring network, as well as other more distal registered groundwater supply bores. The regional extent of the Wallumbilla Formation relative to the Project area is shown in Figure 14-14. This extent, as used in the groundwater modelling assessment, is sourced from Smerdon *et al.*(2012).

The Cainozoic sediments overlie the Mesozoic sediments of the Carpentaria Basin, a sedimentary basin that was deposited between the Cretaceous and Jurassic time periods. The Carpentaria Basin is a significant groundwater basin in regional Queensland, consisting of sandstone, siltstones, and shales of the GRF.

The Carpentaria Basin strata are underlain by Permian and Mesoproterozoic aged igneous and metamorphic basement rocks. The basement rocks are laterally extensive, expected to occur to significant depth, and host the orebody proposed to be mined as part of the Project. These basement rocks are typically intersected at a depth of approximately 50 mbGL or an elevation of around 70 mAHD.

There are no know faults mapped within the overburden sequence (GRF or Tertiary sediments). Therefore, there is no impact on the shallow overburden groundwater regime due to faults or geological structures. The regional and site stratigraphy are summarised in Table 14-10, while the surface geology and solid geology is shown in Figure 14-12 and Figure 14-13, respectively.

Table 14-10: Site and regional stratigraphy

Age	Formation	Average thickness at MLA areas (m)	Lithological Description
Quaternary	Alluvium	0^	clay, silt, sand and gravel; flood-plain alluvium
Tertiary	Claraville Beds	10	clayey quartzose sand and sandy mud; minor gravel
Cretaceous/Jurassic	Wallumbilla Formation	0	marine grey mudstone and siltstone
	Gilbert River Formation	40	coarse sandstone, interbedded with grey shale
Permian and Mesoproterozoic	Basement Rock	*	granites, volcanics and metamorphic rocks

^ Drilling within the extent of the proposed open cut pit and within the Proejct area has confirmed the absence of Quaternary Allumvium.
* Expected to occur to a significant depth .

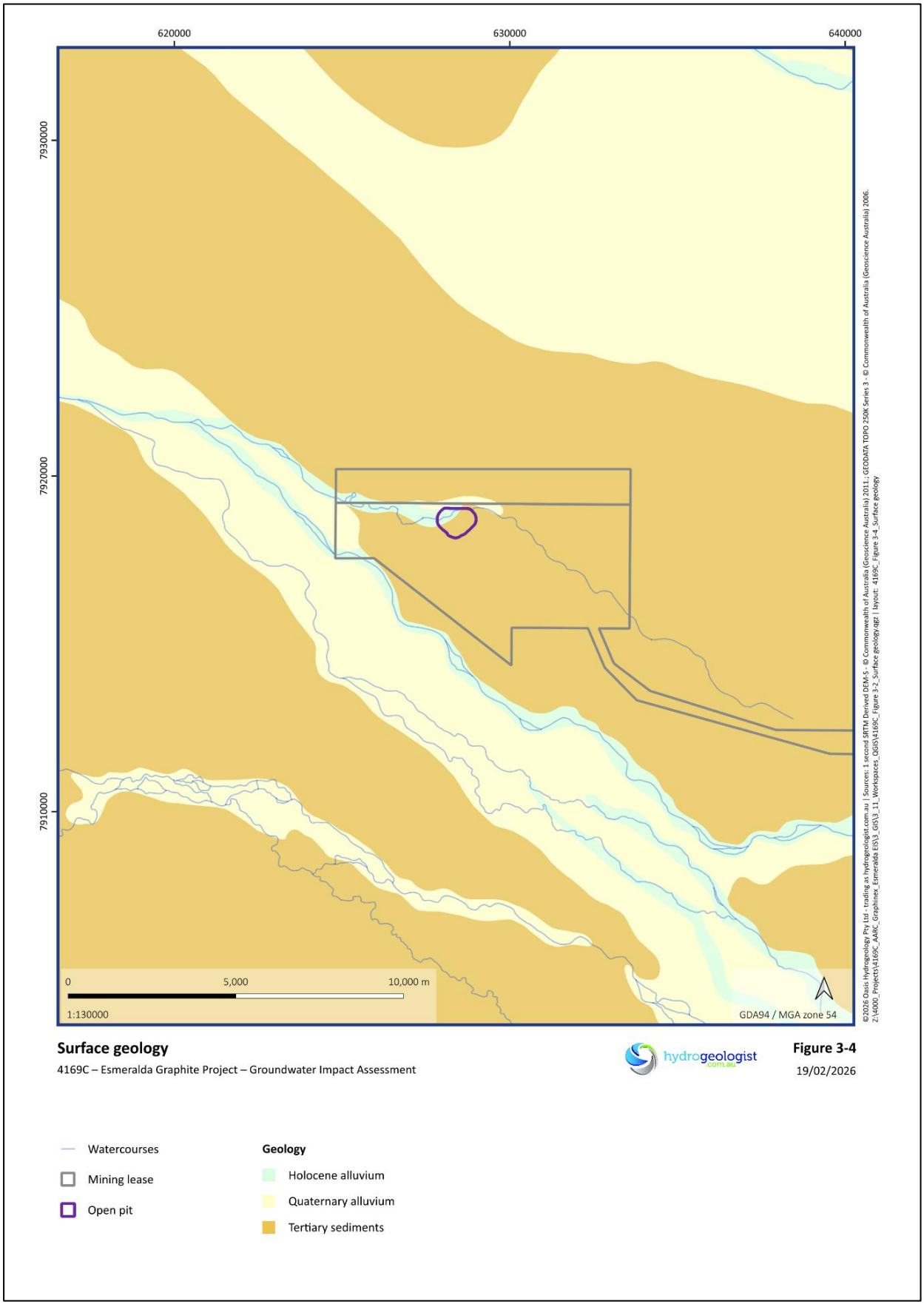


Figure 14-12: Surface geology

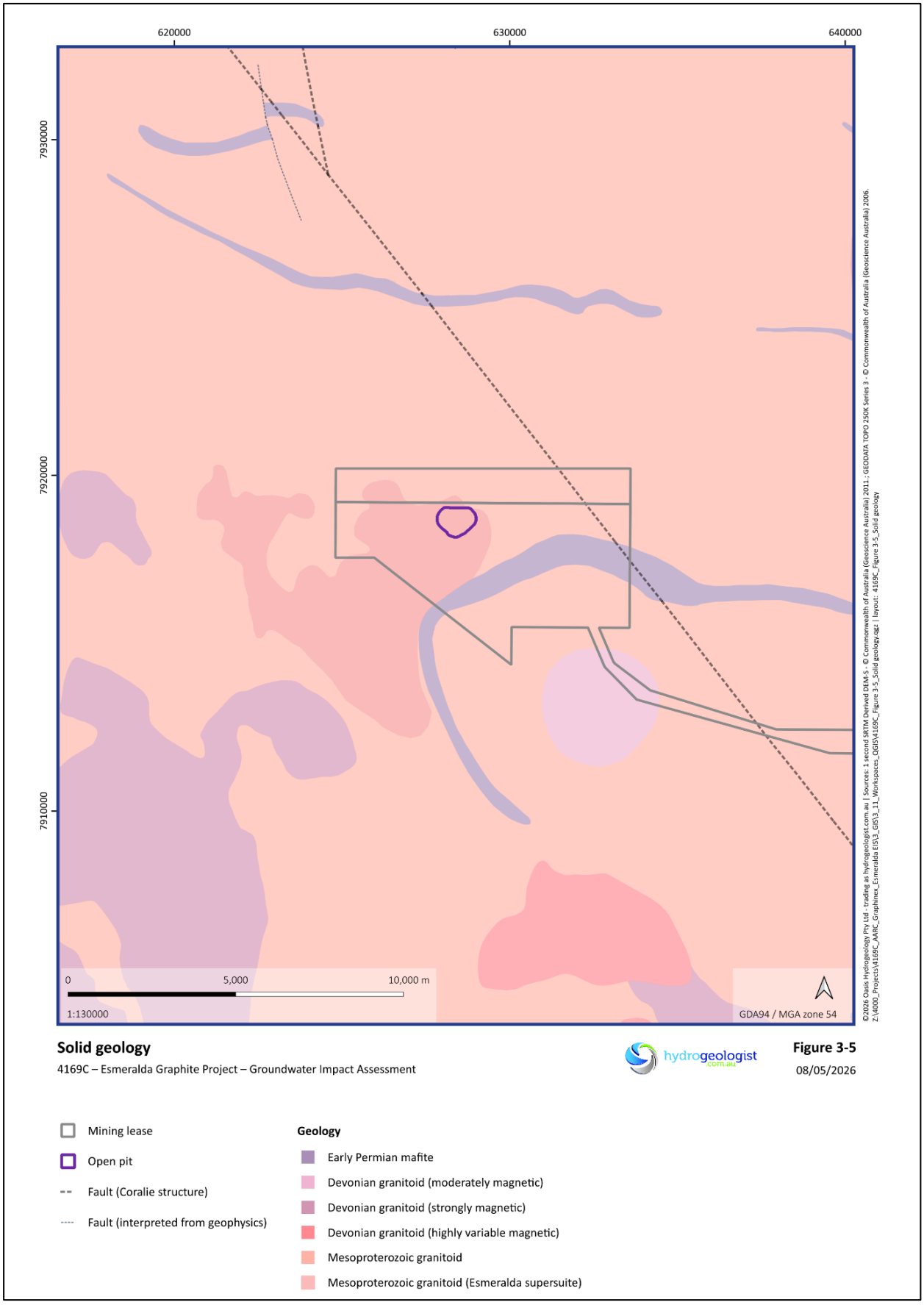


Figure 14-13: Solid geology

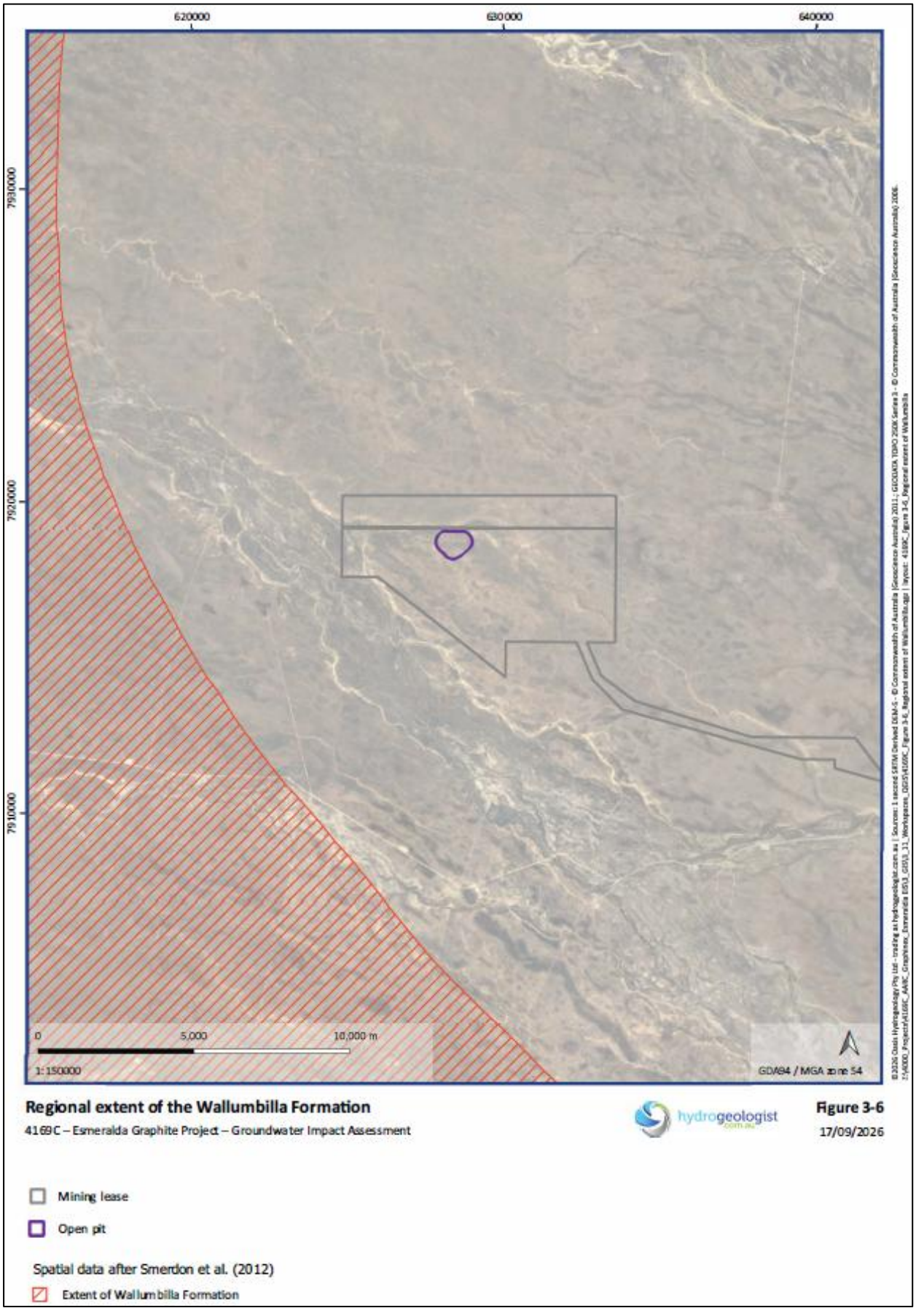


Figure 14-14: Regional extent of the Wallumbilla Formation

14.3.2.3 Hydrogeological conceptual model

To support the development of the numerical groundwater model and assessment of potential Project impacts, a hydrogeological conceptual model was developed based on the available hydrogeological information and investigations undertaken as part of the Groundwater Impact Assessment (Appendix L).

A cross-section of the conceptual model is presented in Figure 14-15, with the cross-Section location shown in Figure 14-16.

The conceptualisation indicates that the Tertiary sediments are consistently dry within the MLA areas, although where saturated outside the MLA areas they are considered to form a low permeability unconfined aquifer.

The GRF is interpreted as a moderate to high permeability regional aquifer and represents the only laterally continuous aquifer beneath the MLA areas, forming the primary groundwater bearing unit encountered within monitoring bores. Regionally, the GRF is considered a confined aquifer where overlain by the Wallumbilla Formation; however, due to the absence of the Wallumbilla Formation within the MLA areas, the GRF is locally interpreted as an unconfined aquifer. Heterogeneity within each hydrostratigraphic unit results in local variations in hydrogeological conditions and groundwater behaviour.

The underlying Permian and Mesoproterozoic igneous and metamorphic basement rocks are generally of very low permeability, with groundwater occurrence restricted to localised joints and fractures associated with secondary permeability and porosity. These basement rocks are therefore considered to act as a basal aquitard. Groundwater levels across the wider study area generally occur between 6 mbGL and 20 mbGL, with an average depth to groundwater of approximately 10 mbGL.

No regional faulting is interpreted within the Project area, and no faulting with significant displacement has been observed. Exploration drilling has identified a number of local scale joints and fractures, with associated observations of slickensides and clay gouge. These joints and fractures have been identified in drill core samples and are associated with local scale deformation with minimal displacement. These localised joints and fractures are discontinuous and cannot be traced between nearby drillholes. The presence of these joints and fractures are likely to locally influence hydraulic conductivity and storage properties of the basement rocks, however as these features are discontinuous, they are not expected to influence groundwater conditions at a larger (pit) scale.

The groundwater table broadly reflects topography, with regional groundwater flow inferred to occur from the east southeast to west northwest. Recharge to the GRF occurs from outcrop areas located approximately 25 km east of the MLA areas, with additional localised recharge occurring during the wet season. Groundwater monitoring data indicates only minor groundwater level responses during the 2025/2026 wet season relative to the comparatively static conditions observed during the dry season. The groundwater table does not intersect the ground surface within the MLA areas, including within watercourses and drainage features, and therefore does not provide baseflow contributions to creeks within the MLA areas.

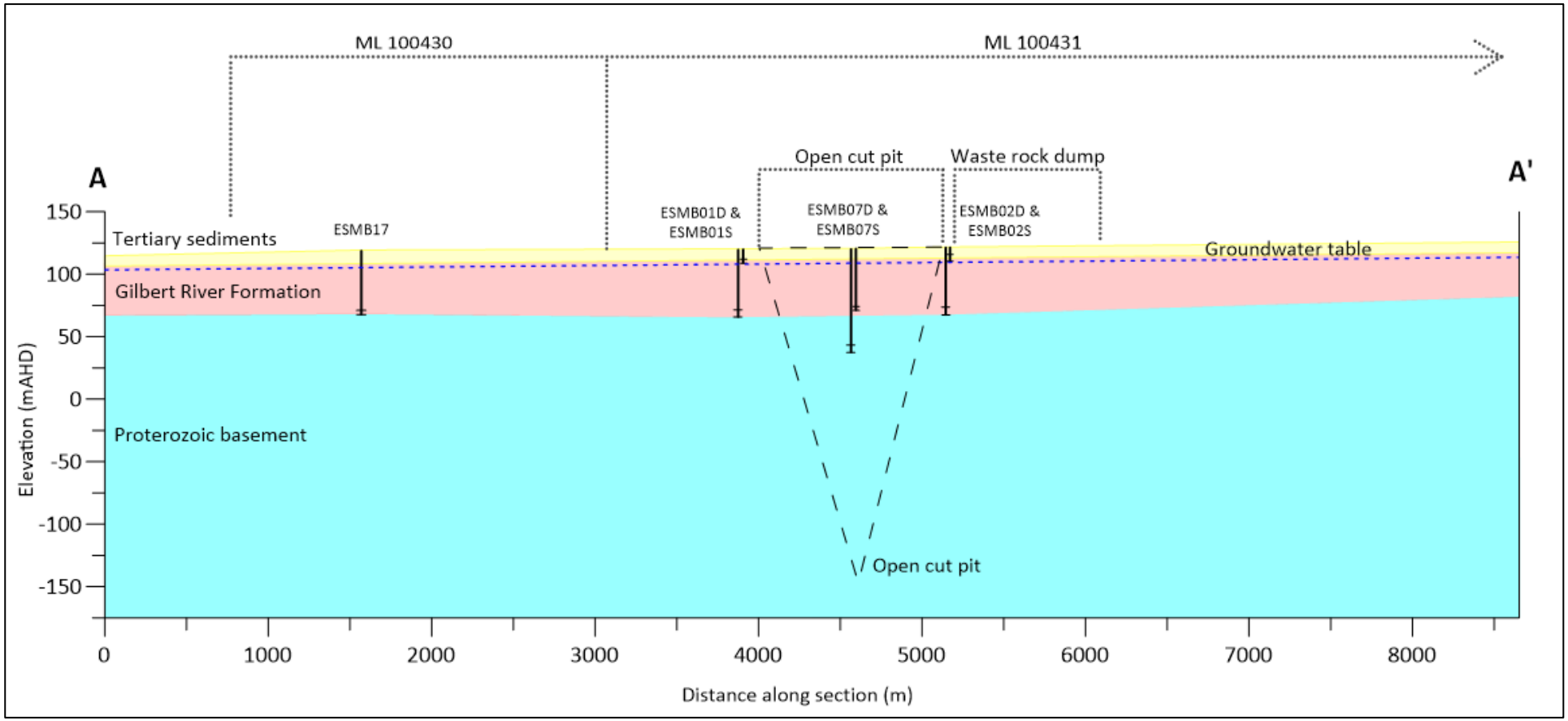


Figure 14-15: Conceptual groundwater model

14.3.2.4 Baseline groundwater conditions

A hydrogeological site investigation program was undertaken between July 2024 and September 2025 to characterise groundwater conditions within and adjacent to the MLA areas. The site investigation program is detailed further in the Groundwater Impact Assessment (Appendix L).

Monitoring bores to support this investigation program were installed within the key hydrogeological units, including six (6) bores within the Tertiary sediments, seven (7) bores within the GRF and one bore into the Proterozoic basement. The locations of the monitoring bores installed are shown in Figure 14-16, while the bore details are summarised in Table 14-11.

The groundwater monitoring bore network provides spatial coverage for investigation of groundwater monitoring within and adjacent to the orebody. The monitoring bores were generally installed as nested pairs in the Tertiary sediments and the GRF in order to characterise groundwater conditions in the shallowest water bearing strata.

Five (5) landholder groundwater supply bores were included in the groundwater monitoring network. These landholder groundwater supply bores are called Pelican, Rowe 1, Rowe 2, Rowe 3 and Rowe 4. These bores are located on the Esmeralda Station.

The monitoring data collected from the Project groundwater monitoring network specifically includes high-frequency wet and dry season groundwater measurements/samples in order to enhance the conceptual understanding of the seasonal nature of groundwater level and quality fluctuations in the MLA areas and its surrounds.

Table 14-11: Summary of monitoring bore construction details

Bore	Easting GDA94, Zone 54	Northing GDA94, Zone 54	Hydrostratigraphic unit	Elevation (mAHD)	Casing height (maGL)	Hole depth (mbGL)	Screen interval (mbGL)
ESMB01S	627798	7918997	Tertiary sediments	120.549	0.70	11	8.5 - 11
ESMB01D	627804	7918987	Gilbert River Formation	120.491	0.71	60	49 - 55
ESMB02S	629007	7918705	Tertiary sediments	122.370	0.57	12	6 - 12
ESMB02D	629007	7918702	Gilbert River Formation	122.367	0.75	60	49 - 55
ESMB03	627462	7918188	Tertiary sediments	121.755	0.69	10	7 - 10
ESMB04S	627861	7918550	Tertiary sediments	119.810	0.70	10	7 - 10
ESMB04D	627850	7918563	Gilbert River Formation	119.891	0.50	51	46 - 49
ESMB05S	628485	7918127	Tertiary sediments	120.747	0.62	10	7 - 10
ESMB05D	628499	7918142	Gilbert River Formation	120.382	0.47	53	49 - 52
ESMB06S	628552	7919064	Tertiary sediments	120.108	0.65	10	7 - 10
ESMB06D	628536	7919065	Gilbert River Formation	120.355	0.41	51	47 - 50
ESMB07S	628401	7918643	Gilbert River Formation	121.213	0.49	54	47 - 50
ESMB07D	628411	7918654	Basement rock	121.316	0.79	84	78 - 84
ESMB17	625543	7919486	Gilbert River Formation	117.183	0.66	52	46 - 49
Pelican	649647	7909961	Gilbert River Formation	155.050	0.97	Unknown	Unknown

Bore	Easting GDA94, Zone 54	Northing GDA94, Zone 54	Hydrostratigraphic unit	Elevation (mAHD)	Casing height (maGL)	Hole depth (mbGL)	Screen interval (mbGL)
Rowe 1 (RN171489)	643470	7914726	Gilbert River Formation	145.320	0.57	57	52 - 57
Rowe 2 (RN109343)	638819	7919903	Gilbert River Formation	138.800	0.44	46	39 - 46
Rowe 3 (RN157196)	629441	7921126	Gilbert River Formation	122.800	0.92	59	42 - 54
Rowe 4	632968	7925635	Gilbert River Formation	128.050	0.28	Unknown	Unknown

maGL – metres above ground level
mbGL – metres below ground level

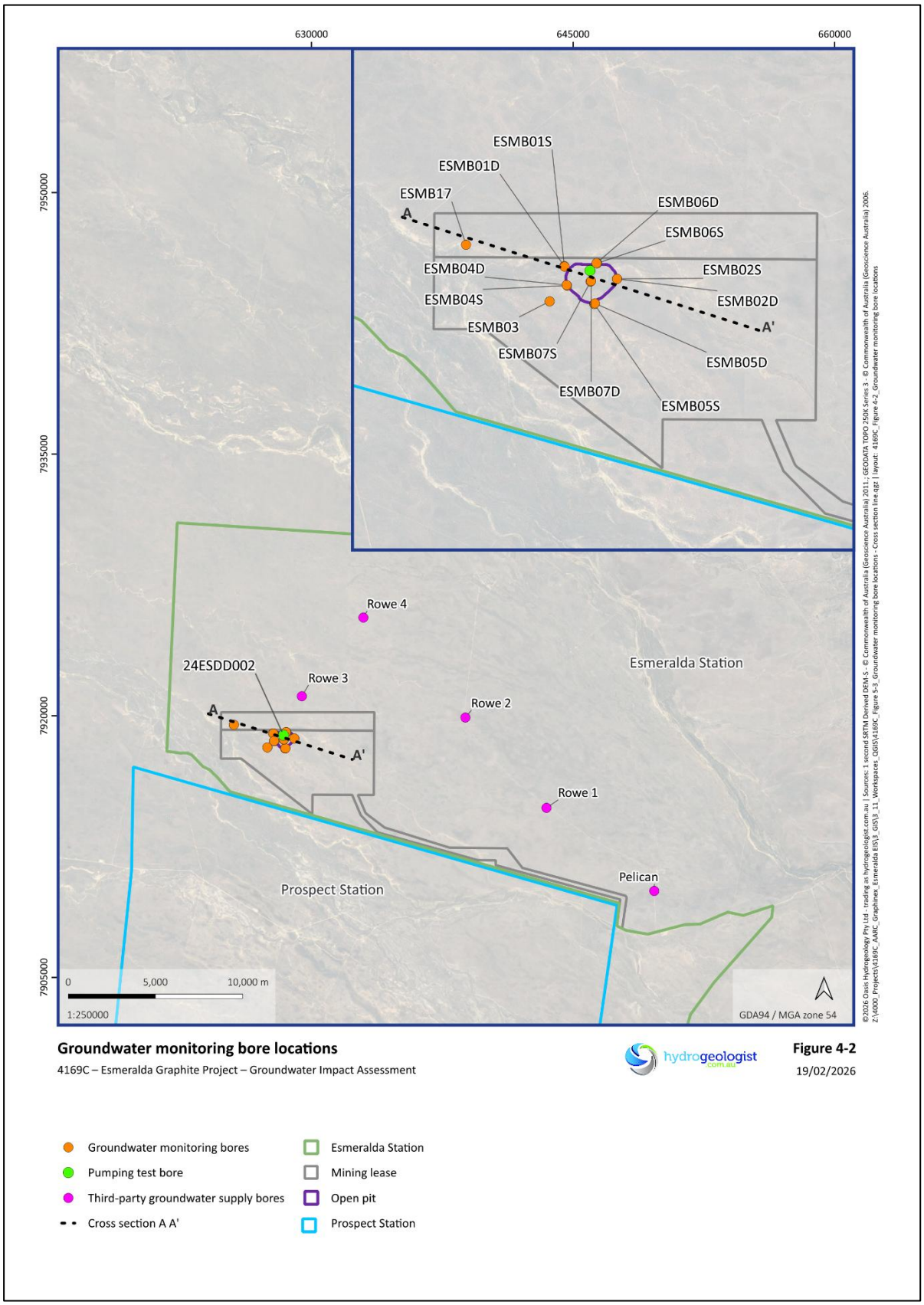


Figure 14-16: Groundwater monitoring bore locations

Hydraulic properties

Falling head test utilising three different methods (Hvorslev, Bouwer Rice or Thiem Equation), were undertaken to provide estimates of hydraulic conductivity values. These tests were conducted at the monitoring bores listed in Table 14-12 (except for the ones reported as dry). The results of these tests are shown in Table 14-13. Standing water levels indicate that most of the shallow bores (except ESMB05S) screened in the Tertiary sediments were dry at the time of testing, whereas deeper bores screened in the GRF and basement rock contained groundwater.

Observations from the falling head testing and analysis indicate that:

- Groundwater occurs within low (less than 0.1 m/d) to moderate (0.1 to 1 m/d) permeability formation across the MLA.
- Measured hydraulic conductivity for the monitoring bores screened over the Tertiary sediments (ESMB 05S) is low and ranges from 0.002 m/d to 0.004 m/d. The hydraulic conductivity indicates a highly heterogeneous, clay-dominant profile. Whilst the Tertiary sediments are not locally saturated in the MLA areas, they are assessed as a low permeability, unconfined aquifer.
- Measured hydraulic conductivity for the monitoring bores screened over the GRF (ESMB01D, ESMB02D, ESMB04D, ESMB05D, ESMB06D, ESMB07S, and ESMB17) ranges between 0.006 m/d and 0.84 m/d and has a transmissivity of 1.6 m^2/d. This range suggests a high degree of variability within the GRF; however, in general the GRF has relatively low hydraulic conductivity/transmissivity indicating that the GRF is a low-permeability aquifer. The GRF is generally regarded as a regional confided aquifer; however, given the lack of a local confining layer, and that the shallow Tertiary sediments are unsaturated, the GRF is assessed locally as an unconfined aquifer.
- The Proterozoic basement (ESMB07D) has a very low hydraulic conductivity of 0.00056 m/day, reflecting the massive nature of the Proterozoic basement.

Overall, the results suggest a groundwater system characterised by relatively low to moderate hydraulic conductivity across the MLA areas.

A pumping test was undertaken at an existing exploration drill hole, 24ESD002, by the Proponent between 20 and 23 October 2025. A 72-hour constant rate pumping test (at 0.75 L/s), including recovery monitoring, was completed to assess aquifer behaviour and response to sustained pumping within the geological units intersected by the bore. A maximum drawdown of 27.3 m was observed during the constant rate pumping test. The groundwater level in the exploration drill hole recovered back to within 1 m of the pre-test level 30 minutes into the recovery period.

A transmissivity of approximately 1.6 m²/day was derived from the constant rate pumping test analysis. This transmissivity value is consistent with the range of hydraulic conductivity values obtained from falling head testing within the GRF when converted to an equivalent bulk hydraulic conductivity. The pumping test interpretation assumed an effective aquifer thickness of approximately 50 m, resulting in an equivalent hydraulic conductivity of approximately 0.03 m/day. This value lies within the range of hydraulic conductivity values derived from falling head testing in the GRF and is considered representative of the lower to mid-range permeability observed across the MLA areas.

Table 14-12: Summary of falling heads test

Bore	Easting	Northing	Formation	Date of test	Standing water level (mTOC)
ESMB01S	627798	7918997	Tertiary sediments	14 August 2024	Dry
ESMB01D	627804	7918987	Gilbert River Formation	14 August 2024	7.66
ESMB02S	629007	7918705	Tertiary sediments	14 August 2024	Dry

Bore	Easting	Northing	Formation	Date of test	Standing water level (mTOC)
ESMB02D	629007	7918702	Gilbert River Formation	14 August 2024	10.51
ESMB03	627462	7918188	Tertiary sediments	17 September 2025	Dry
ESMB04S	627861	7918550	Tertiary sediments	16 September 2025	Dry
ESMB04D	627850	7918563	Gilbert River Formation	16 September 2025	6.64
ESMB05S					
ESMB05D	628499	7918142	Gilbert River Formation	17 September 2025	7.8
ESMB06S	628552	7919064	Tertiary sediments	18 September 2025	Dry
ESMB06D	628536	7919065	Gilbert River Formation	18 September 2025	7.65
ESMB07S	628401	7918643	Gilbert River Formation	17 September 2025	8.36
ESMB07D	628411	7918654	Proterozoic basement	18 September 2025	56.1
ESMB17	625543	7919486	Gilbert River Formation	19 September 2025	15.16

Table 14-13: Hydraulic conductivity results

Bore	Formation	Hydraulic conductivity (m/day)		
		Hvorslev	Bouwer Rice	Thiem Equation (Steady-State Radial Flow to a Well)
ESMB01D	Gilbert River Formation	0.57	0.53	
ESMB02D	Gilbert River Formation	0.012	0.011	
ESMB04D	Gilbert River Formation	0.110	0.102	
ESMB05S	Tertiary sediments	0.004	0.002	
ESMB05D	Gilbert River Formation	0.83	0.78	
ESMB06D	Gilbert River Formation	0.044	0.041	
ESMB07S	Gilbert River Formation	0.69	0.64	
ESMB07D	Proterozoic basement			0.00056*
ESMB17	Gilbert River Formation	0.0066	0.0058	

* Results for ESMB07D are likely influenced by a SWL that is slowly recovering. Regardless, the slow groundwater level recovery at this bore demonstrates low hydraulic conductivity.

Groundwater recharge and discharge

Based on the hydrogeological conceptual model described in Section 14.3.2.3, Hydrogeologist (2026) has made the following observation regarding groundwater recharge and discharge around the MLA areas.

Recharge to the Tertiary sediments is expected to occur primarily via direct rainfall infiltration; however, manual readings and logger readings of monitoring bores constructed within the Tertiary sediments (ESMB01S, ESMB02S, ESMB03, ESMB04S, ESMB05S, ESMB06S) over the monitored period between September 2024 and November 2025 were consistently dry with no observed water levels recorded. The absence of persistent shallow groundwater within the Tertiary sediments indicates that rainfall infiltration is largely retained within the unsaturated zone or lost to evapotranspiration, rather than contributing to a sustained local groundwater table in the shallow strata (Hydrogeologist 2026).

Recharge to the GRF is inferred to occur regionally where the formation is at outcrop or where it is close to surface. Such conditions occur a significant distance (30 to 40 km) to the east and south-east of the MLA areas. Within the MLA areas, the GRF is overlain by the unsaturated Tertiary sediments, limiting direct local recharge.

A groundwater recharge response was observed in the majority of GRF monitoring bores during the 2025/2026 wet season which indicates recharge to groundwater where the GRF is at outcrop. The rate of recharge in the GRF appears to be relatively high as groundwater within it is generally fresh. The estimated recharge to the GRF ranges from 1.25% to 2.5% of annual rainfall.

The estimated recharge for the Proterozoic basement ranges from 2% to 4% of annual rainfall. However, the groundwater quality in the Proterozoic basement is expected to be highly influenced by the overlying GRF, and hence the calculated recharge rates to the Proterozoic basement are not considered representative.

Groundwater discharge from the MLA areas occur primarily via lateral sub-surface flow towards the northwest within the GRF. The Tertiary sediments do not contribute to lateral discharge given they are demonstrably dry and unsaturated. The Wallumbilla Formation and Proterozoic basement act as aquitards and do not represent significant discharge pathways.

Furthermore, regionally, there appears to be widespread, vertical upward leakage of groundwater from the GAB in areas where semi-confined to confided conditions exist.

The groundwater table does not intersect the ground surface within the MLA areas, including within watercourses and drainage features. Warrigal Creek and the Borer River are ephemeral drainage features that flow only in direct response to rainfall events and do not receive groundwater baseflow.

No natural groundwater discharge features such as springs or seepages are present within or near the MLA areas. The nearest GAB spring occurs approximately 28 km to the northeast, and the nearest groundwater dependent ecosystem spring is located approximately 25 km to the east.

Groundwater level and flow

As noted above, groundwater within the MLA areas occur almost exclusively within the GRF.

The depth to groundwater is shown in Figure 14-18 and corresponds to the groundwater table elevation contours presented in Figure 14-17. The groundwater table is generally between 6 and 10 mbGL within the MLA areas. The depth to groundwater along the watercourses and drainage features within the MLA areas is typically between 6 to 10 m below the bed of the watercourses and drainage features that occur within the MLA areas.

The groundwater table elevation in the MLA areas is between 105 mAHD in the northwest of the MLA areas and 120 mAHD in the southeast. Groundwater flows, within the Project MLA areas, from the east southeast to the west northwest towards the Gulf of Carpentaria. The groundwater elevation and flow directions are generally consistent with the observed data (see Figure 14-19). Regional groundwater flow is inferred to generally follow surface topography, with flow directed from east southeast to the west northwest, consistent with regional drainage patterns. Regional groundwater elevations have been recorded between 125 mAHD in the southeast to 100 mAHD in the northwest of the Project site.

Groundwater level monitoring indicates generally stable conditions with minimal seasonal or long-term fluctuation, although a clear groundwater recharge response was observed in the majority of GRF monitoring bores during the 2025/2026 wet season. This seasonal rise is consistent with the conceptual understanding of recharge to the GRF.

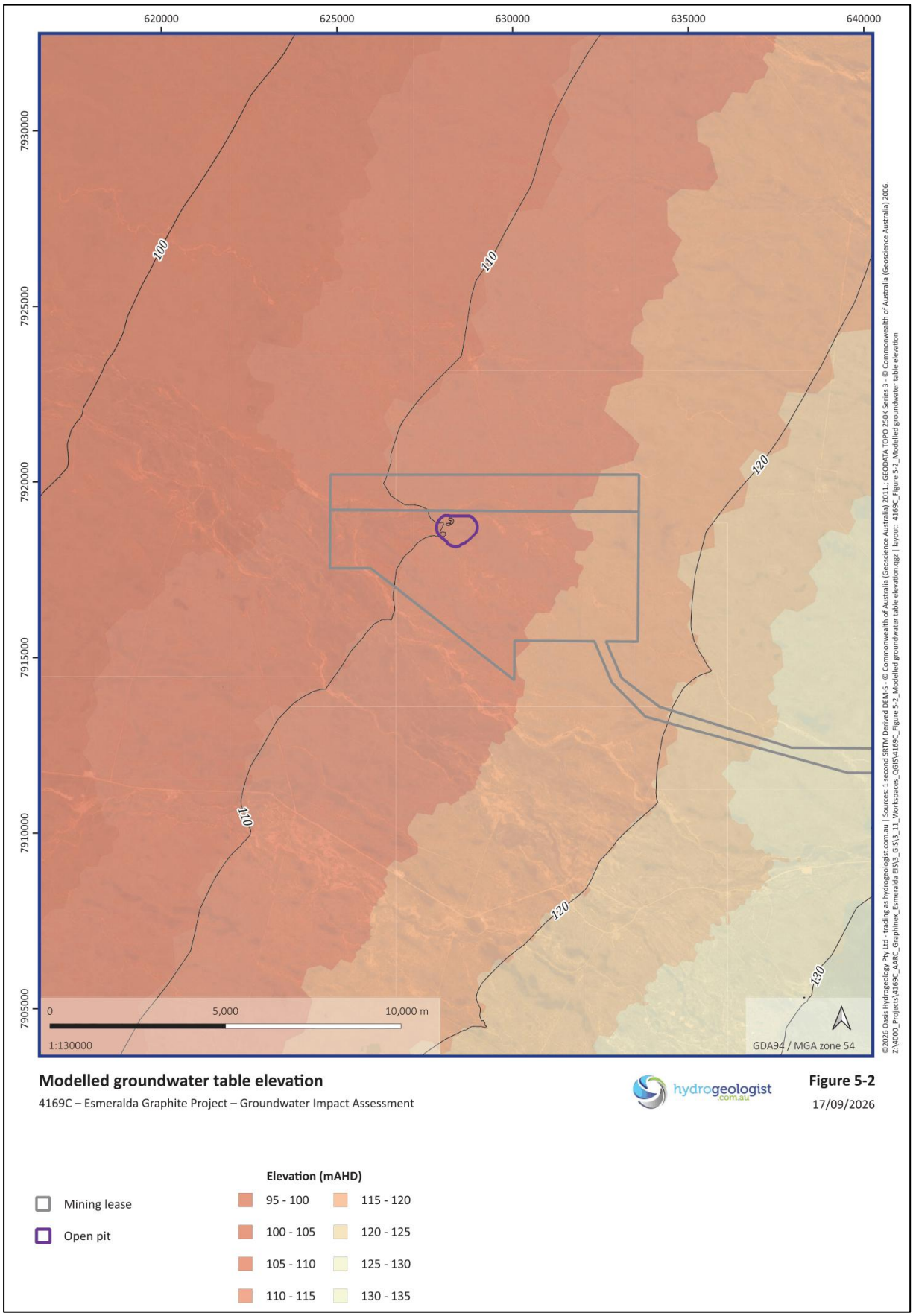


Figure 14-17: Groundwater table elevation

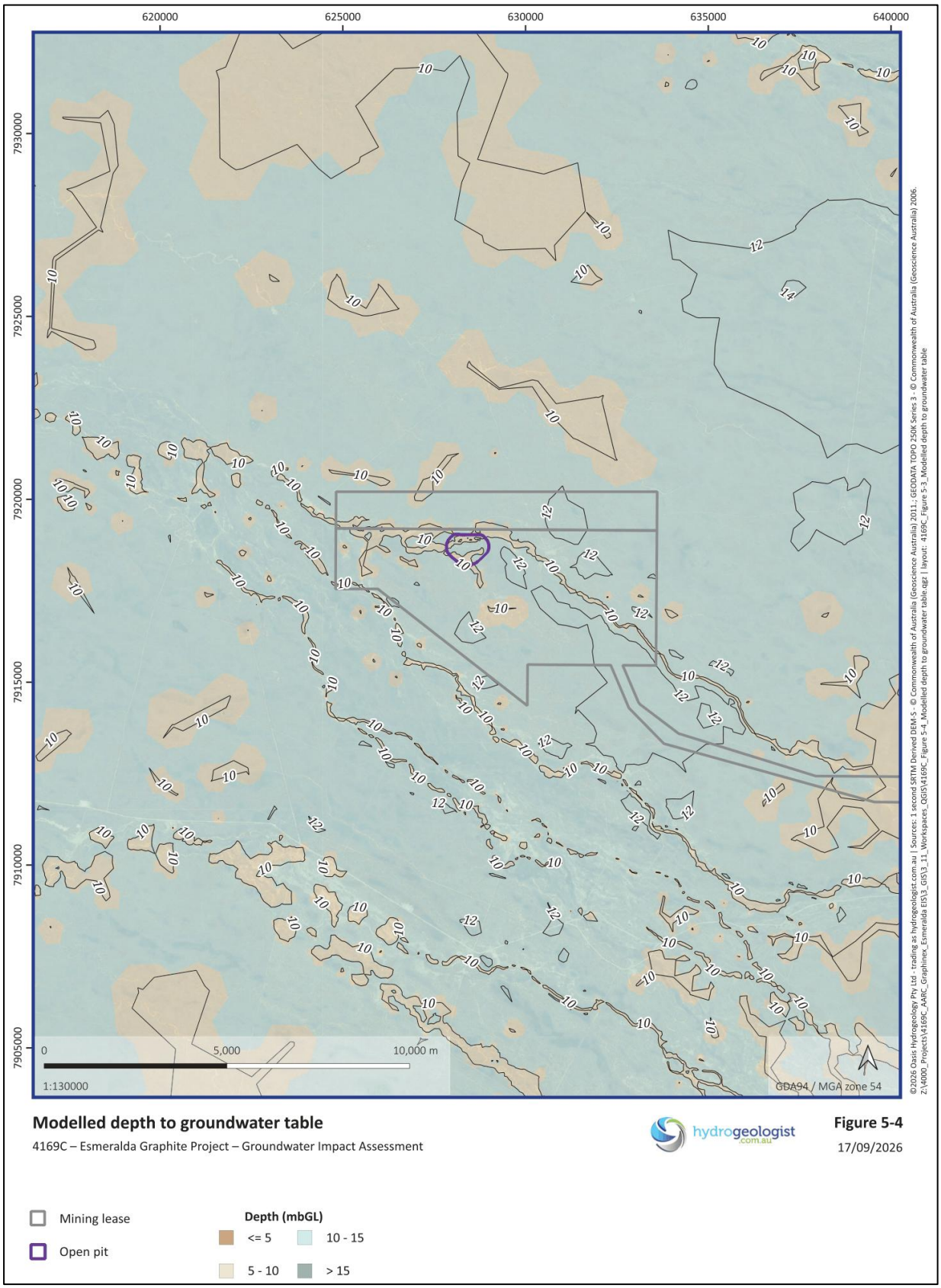


Figure 14-18: Depth to groundwater table

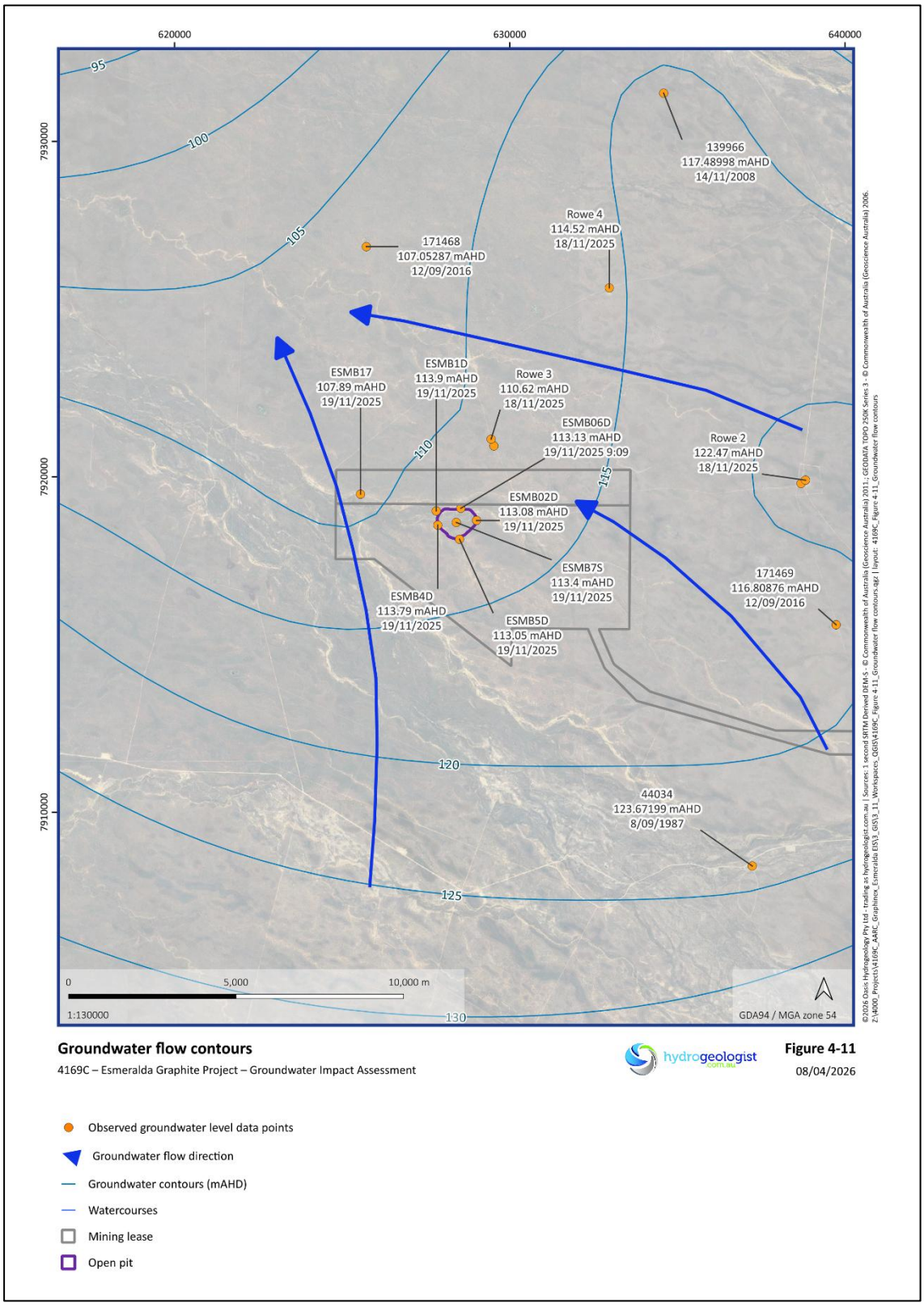


Figure 14-19: Groundwater flow contours

Available groundwater level data from manual readings and automatic logger readings are shown in the monitoring bore hydrographs which are included below as Figure 14-20 to Figure 14-27.

Groundwater level observations include:

- Monitoring bores constructed within the Tertiary sediments (ESMB01S, ESMB02S, ESMB03, ESMB04S, ESMB05S, ESMB06S) were consistently dry and no observed water levels were available
- Logger monitoring data for bores ESMB01D, ESMB02D, ESMB04D, ESMB05D, ESMB06D and ESMB07S constructed within the GRF show groundwater elevations ranging from approximately 112.6 to 114.5 mAHD (Figure 14-20 to Figure 14-25). The logger data shows generally stable conditions, with a minor recharge response observed in January 2026. The local observed rainfall over this period is not significant, indicating that the recharge is occurring in the GRF outcrop area to the east.
- Logger monitoring data for bore ESMB07D screened within the GRF (Figure 14-26) shows groundwater elevations ranging from approximately 113.6 to 114.2 mAHD. The logger data shows generally stable conditions, with a minor upward trend. The two sharp drops in the groundwater level data in November and December 2025 are related to groundwater sampling events whereby the groundwater level takes approximately one week to recover. This response to groundwater sampling indicates relatively low permeability in the Proterozoic basement
- Logger monitoring data for bore ESMB17 screened within the GRF (Figure 14-27) shows groundwater elevations ranging from approximately 108 to 113.2 mAHD. Logger data shows an initial offset or step change in the early part of the logger record; however subsequent readings were stable around 113 mAHD.

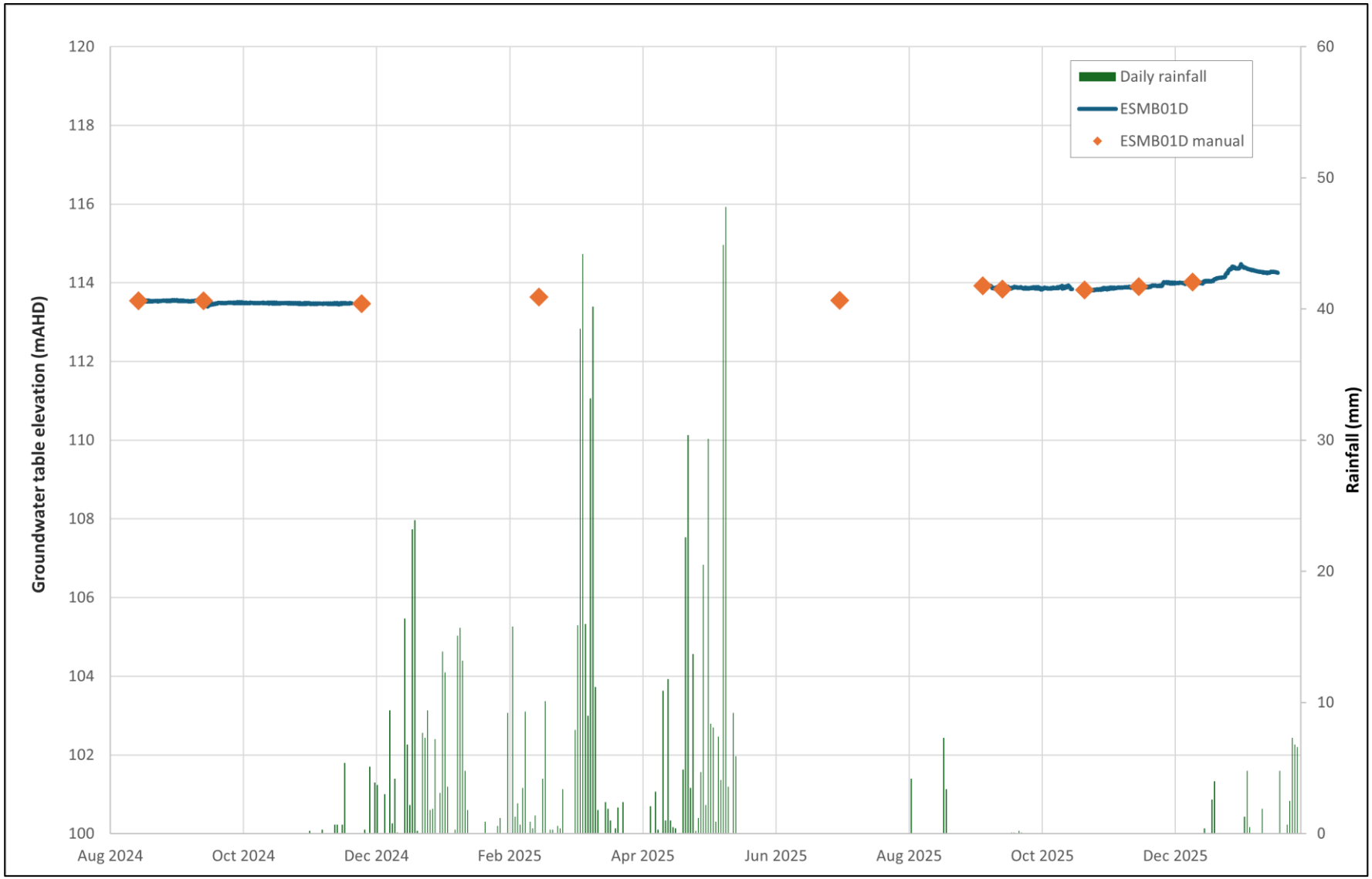


Figure 14-20: ESMB01D hydrograph

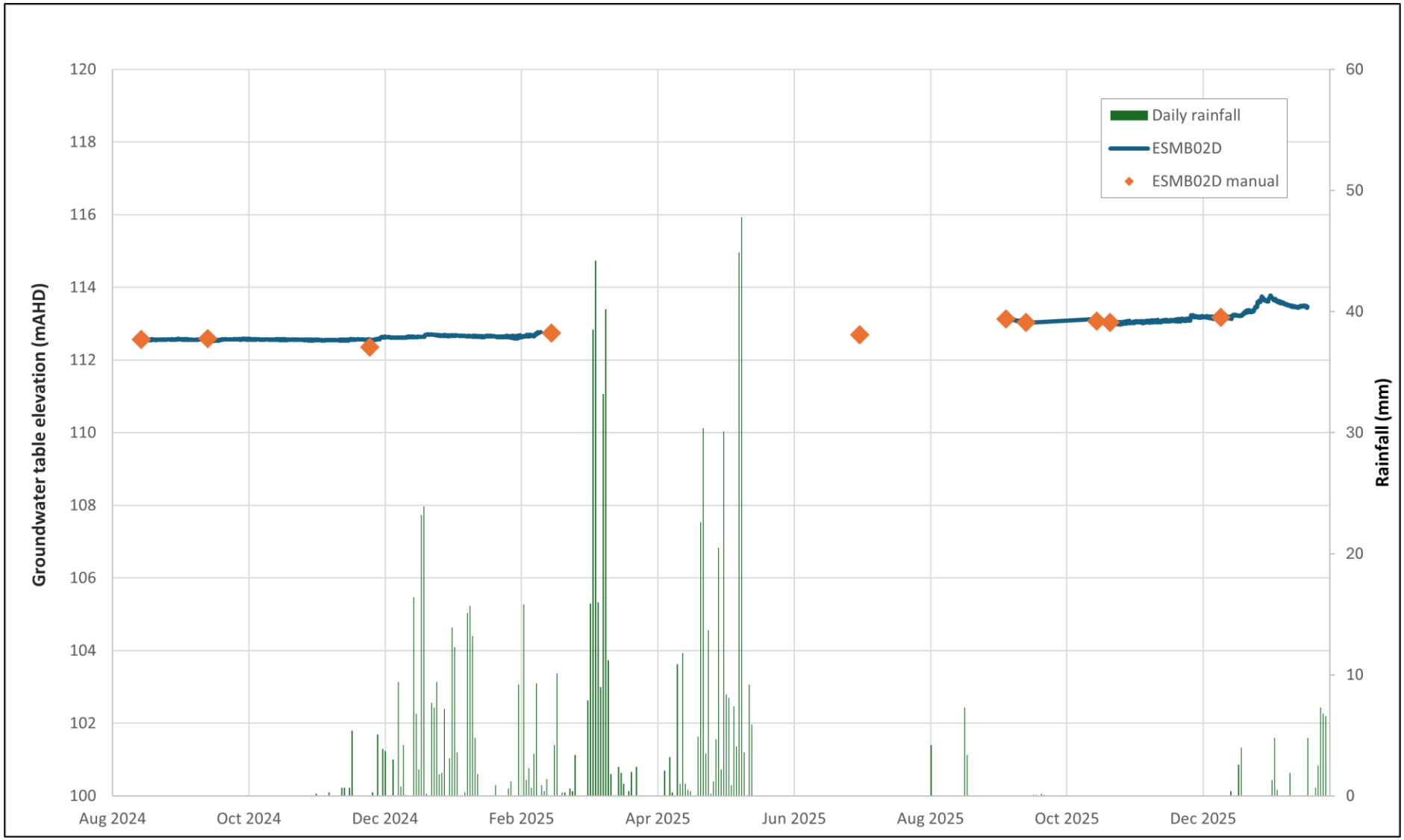


Figure 14-21: ESMB02D hydrograph

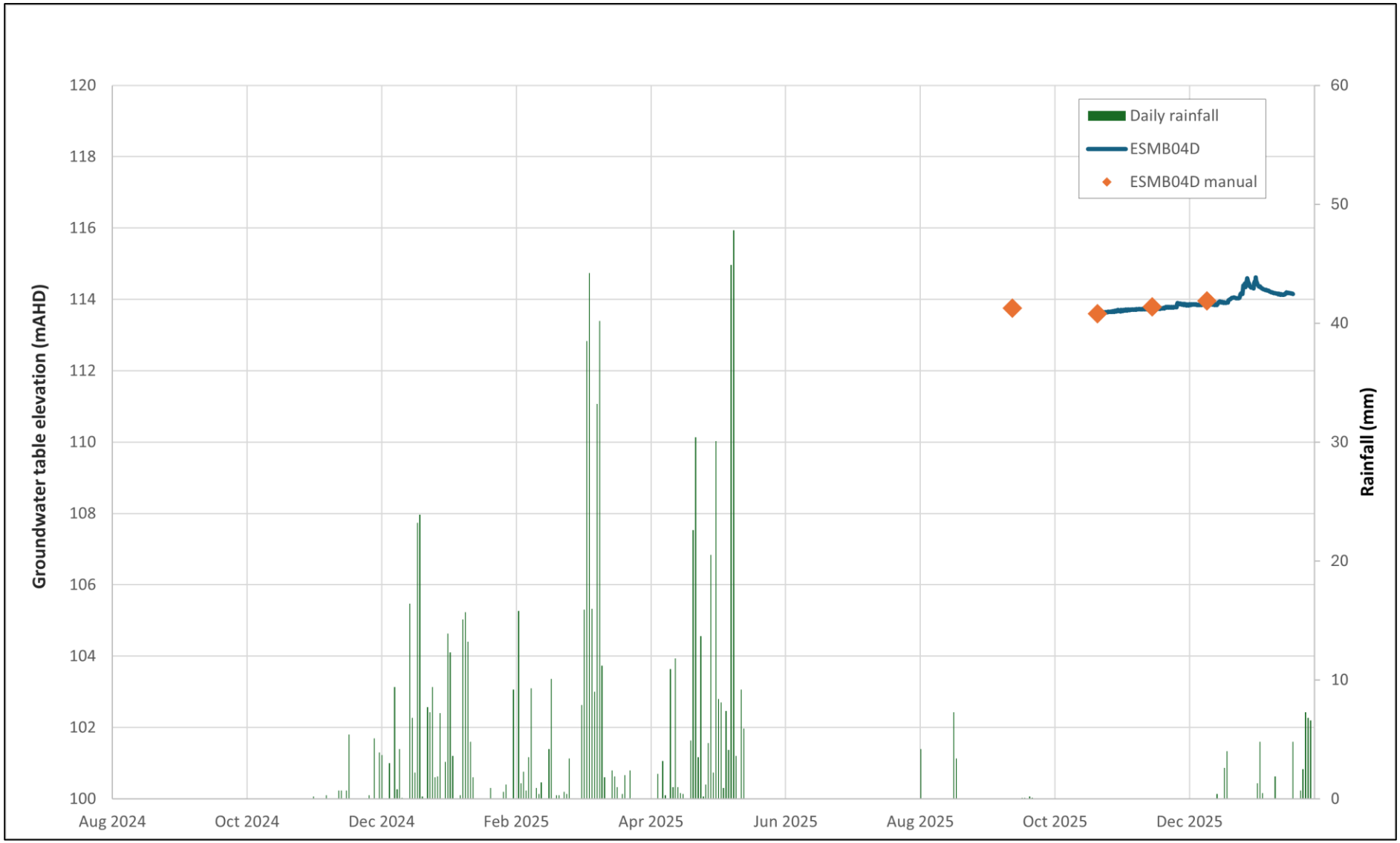


Figure 14-22: ESMB04D hydrograph

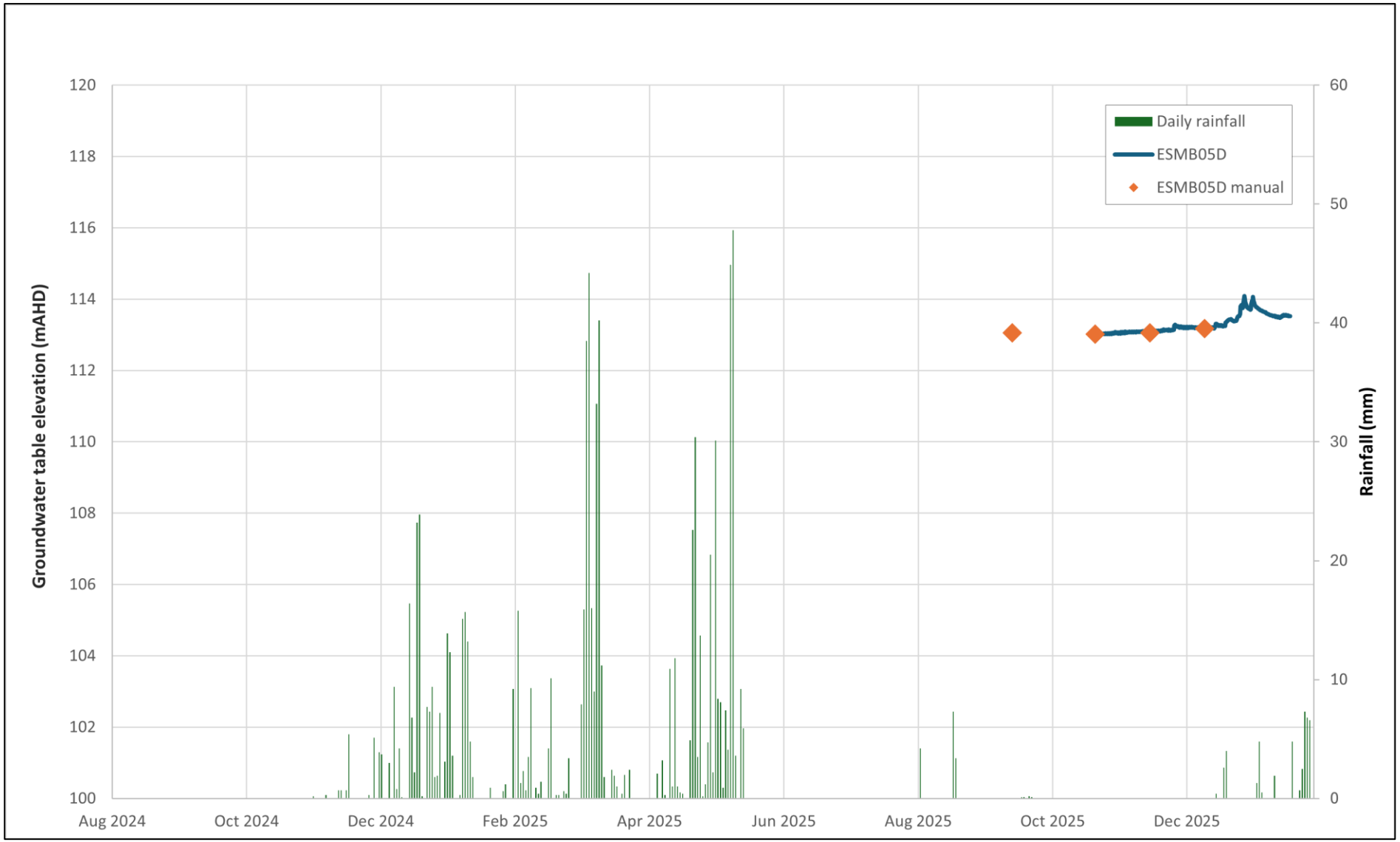


Figure 14-23: ESMB05D hydrograph

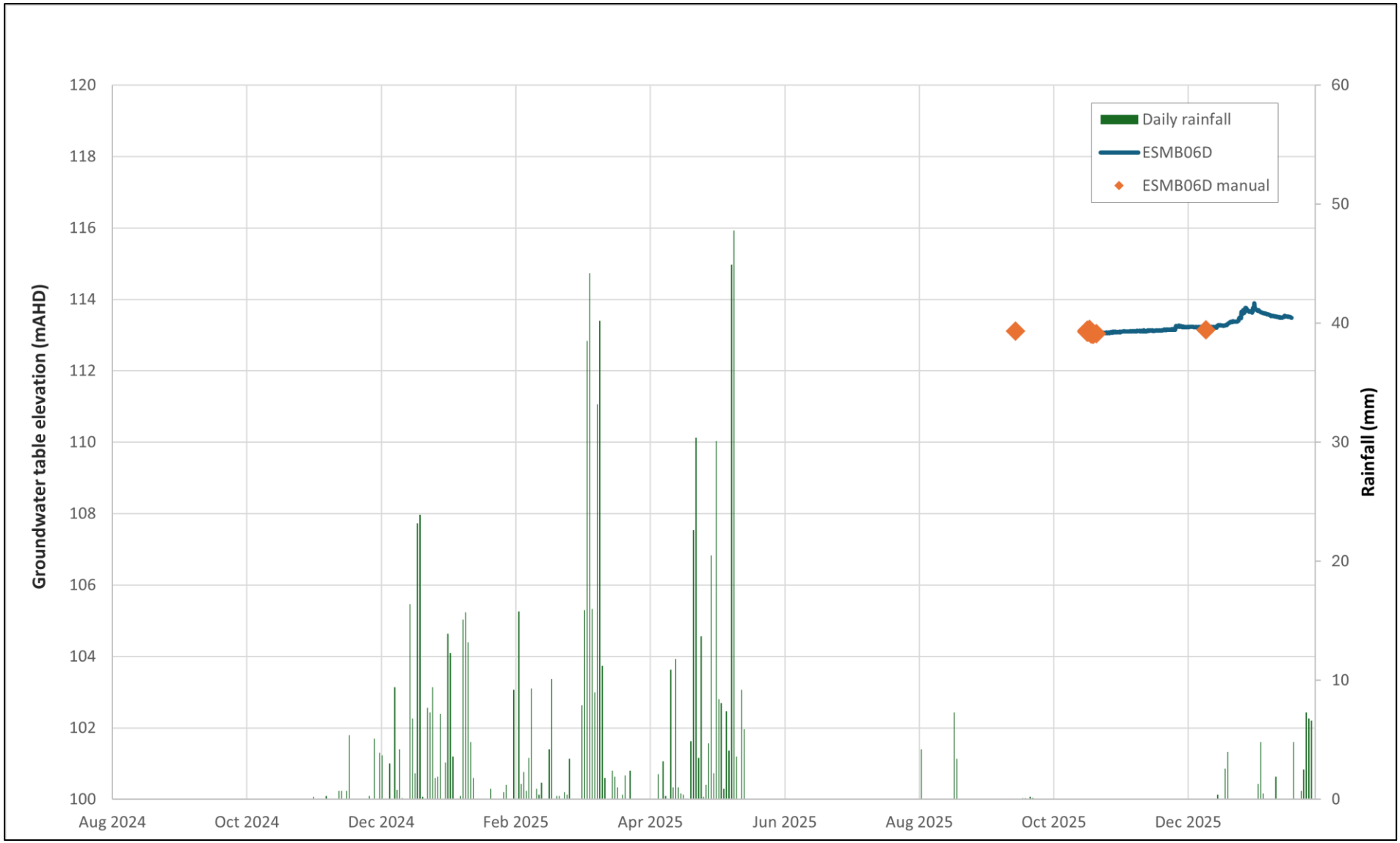


Figure 14-24: ESMB06D hydrograph

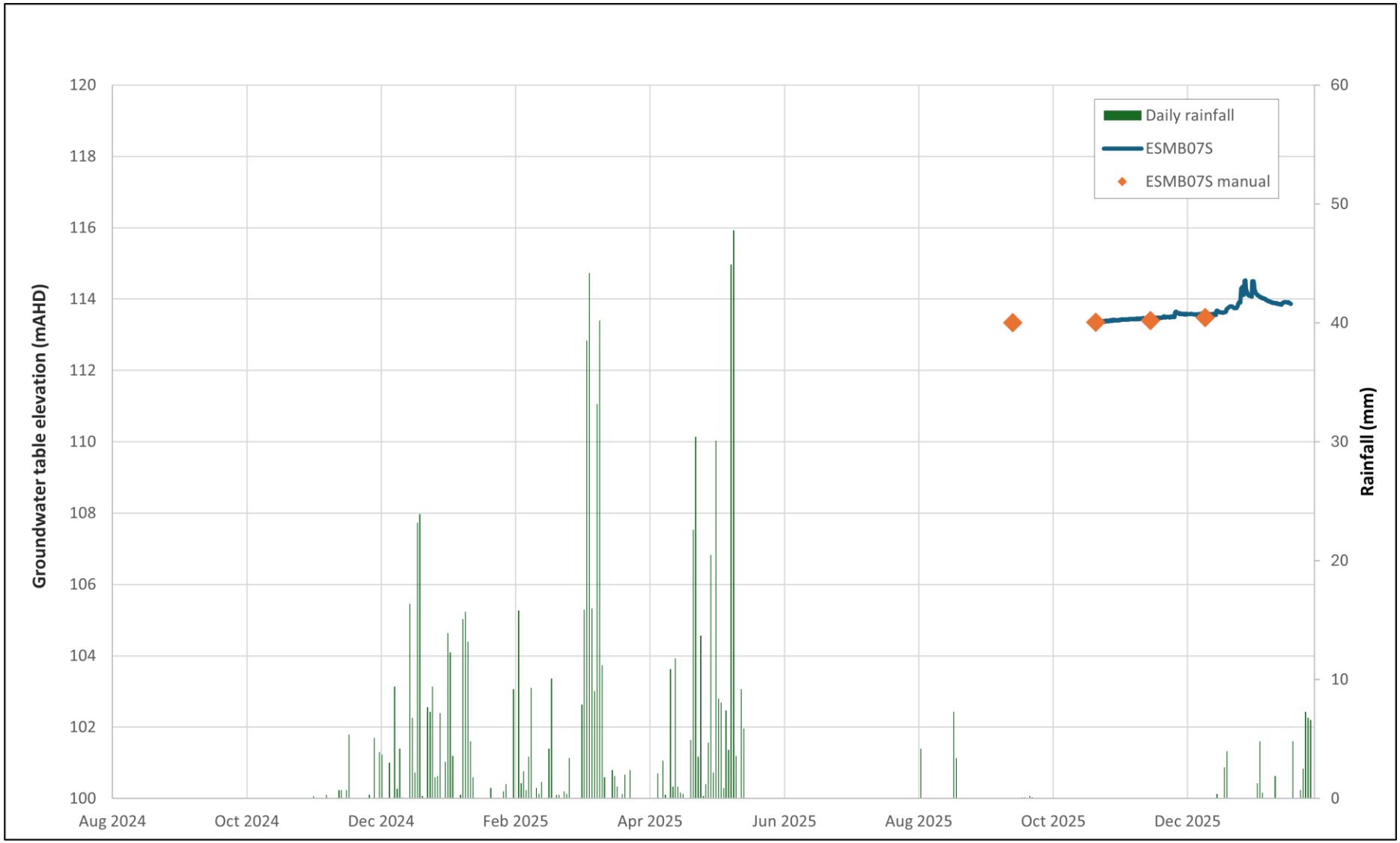


Figure 14-25: ESMB07S hydrograph

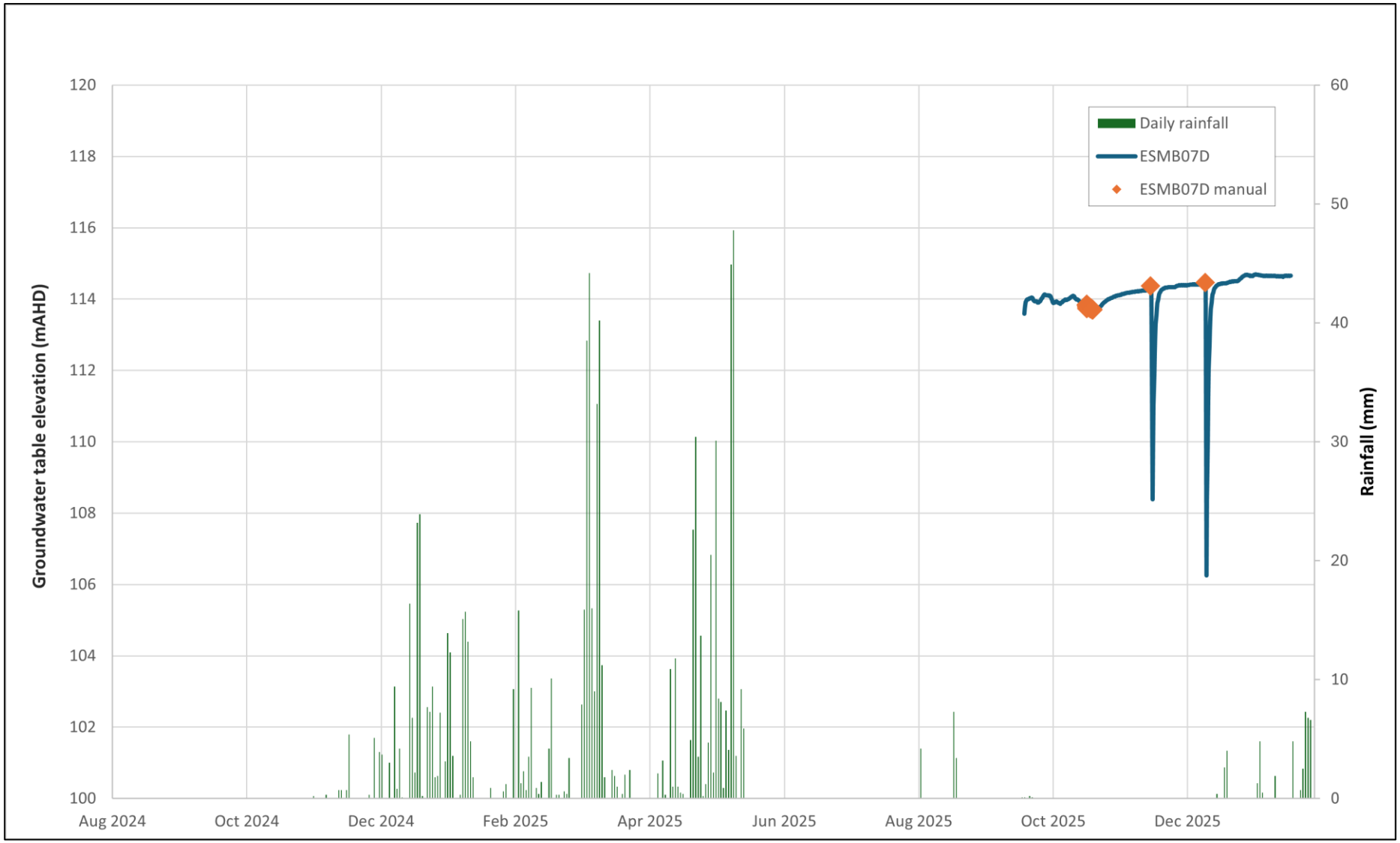


Figure 14-26: ESMB07D hydrograph

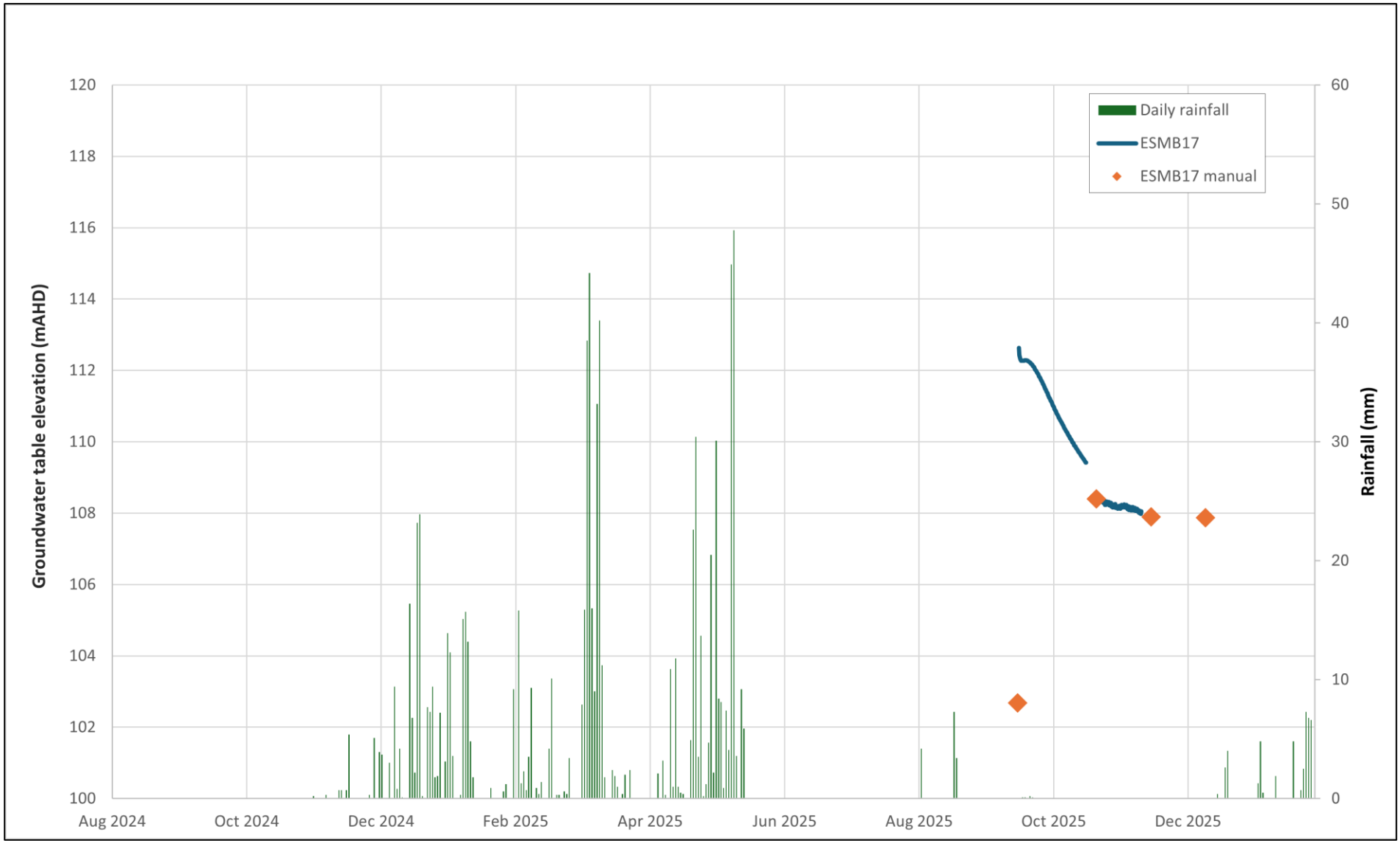


Figure 14-27: ESMB17 hydrograph

Groundwater quality

The groundwater quality in the relevant aquifers is summarised below, and detailed further in Chapter 15, Water Quality.

Groundwater quality in the MLA areas is typically fresh with minor occurrence of brackish groundwater in the vicinity.

Baseline groundwater EC within the GRF ranges from 800 µS/cm to 3,250 µS/cm. The relatively low salinity is a result of the recharge rate to the GRF. Groundwater pH in the GRF ranges from 7.0 to 9.2, indicating neutral to slightly alkaline groundwater. Groundwater within the GRF typically has low concentrations of dissolved and total metals.

As discussed above, the Tertiary sediments are demonstrably dry and unsaturated within the MLA areas, hence there is no baseline groundwater quality for this shallow formation.

Groundwater within the Proterozoic basement is fresh, with EC of 970 µS/cm to 1,140 µS/cm. However, the groundwater quality in the Proterozoic basement is derived from limited data and is expected to be highly influenced by the overlying GRF. The low salinity likely reflects shallow mixing with the overlying GRF rather than direct recharge to the basement. Within the Proterozoic basement, pH is 9.3, reflecting slightly alkaline conditions. Groundwater within the Proterozoic basement has low concentrations of dissolved and total metals.

Further sampling events will be required before site-specific trigger values can be developed and implemented as part of the Project EA.

14.3.2.5 Water dependent assets

Groundwater users

Hydrogeologist (2026) conducted a desktop review using data from third-party registered groundwater bores within approximately 10 km of the MLA areas. Information obtained from the Department of Local Government, Water and Volunteers (DLGWV) groundwater database (GWDB), identified that 19 registered groundwater bores were within 10 km of the MLA areas. A summary of the data collected from the bores is provided in Table 14-14, and shown in Figure 14-28. The 19 registered bores comprise:

- eleven (11) sub-artesian groundwater monitoring bores associated with the Project; and
- a total of eight (8) registered bores listed as existing groundwater supply bores constructed within the GRF.

A bore census showed that there are no unregistered third-party groundwater supply bores located on either the Prospect Station or Esmeralda Station.

The Proponent is currently engaged in an agreement to subdivide the underlying Esmeralda station and will take ownership of the bores within the subdivision area.

Table 14-14: Registered bore details and water quality details

Registered Bore	Drilled Date	Easting (GDA94 Z54)	Northing (GDA94 Z54)	Aquifer	Type	Original bore name	Status	Screen/open-hole		pH (pH units)	EC (µs/cm)	Date of sampling
								From	To			
5714	1-Jan-1935	632357	7910231	-	Sub-artesian monitoring	Prospect	existing	-	105.15	8.4	1310	08/08/1997
10791	8-Dec-1946	620900	7919210	Gilbert River Formation	Artesian monitoring	Lilly	existing	86.9	109.8	8.5	680	08/09/1987
72210	1-Jan-1987	625587	7910918	-	Sub-artesian monitoring	Lucky Creek	existing	-	-	-	-	-
92367	-	631349	7908759	-	Sub-artesian	Homestead	existing	-	-	-	-	-
109343	29-Sep-2002	638688	7919805	Gilbert River Formation	Sub-artesian	Rowe 2	existing	39	46.5	-	-	-
157196	24-Sep-2013	629524	7920923	Gilbert River Formation	Sub-artesian	-	existing	42	54	-	-	-
157437		625490	7919501	-	-	Lilly	existing	-	-	-	-	-
171468	12-Sep-2016	625719	7926865	Gilbert River Formation	Sub-artesian	-	existing	60	93	-	-	-
208359	24-Jul-2024	627798	7918997	-	Sub-artesian monitoring	-	existing	8.50	11.5	-	995	24/07/2024
208360	25-Jul-2024	627804	7918967	-	Sub-artesian monitoring	-	existing	49	55	-	987	25/07/2024
208361	28-Jul-2024	627804	7918967	-	Sub-artesian monitoring	-	existing	49	55	-	992	28/07/2024

Registered Bore	**Drilled Date**	**Easting (GDA94 Z54)**	**Northing (GDA94 Z54)**	**Aquifer**	**Type**	**Original bore name**	**Status**	**Screen/open-hole**		pH (pH units)	EC **(µs/cm)**	**Date of sampling**
								From	**To**			
208362	28-Jul-2024	627252	7918970	-	Sub-artesian monitoring	-	abandoned and destroyed	-	-	-	-	-

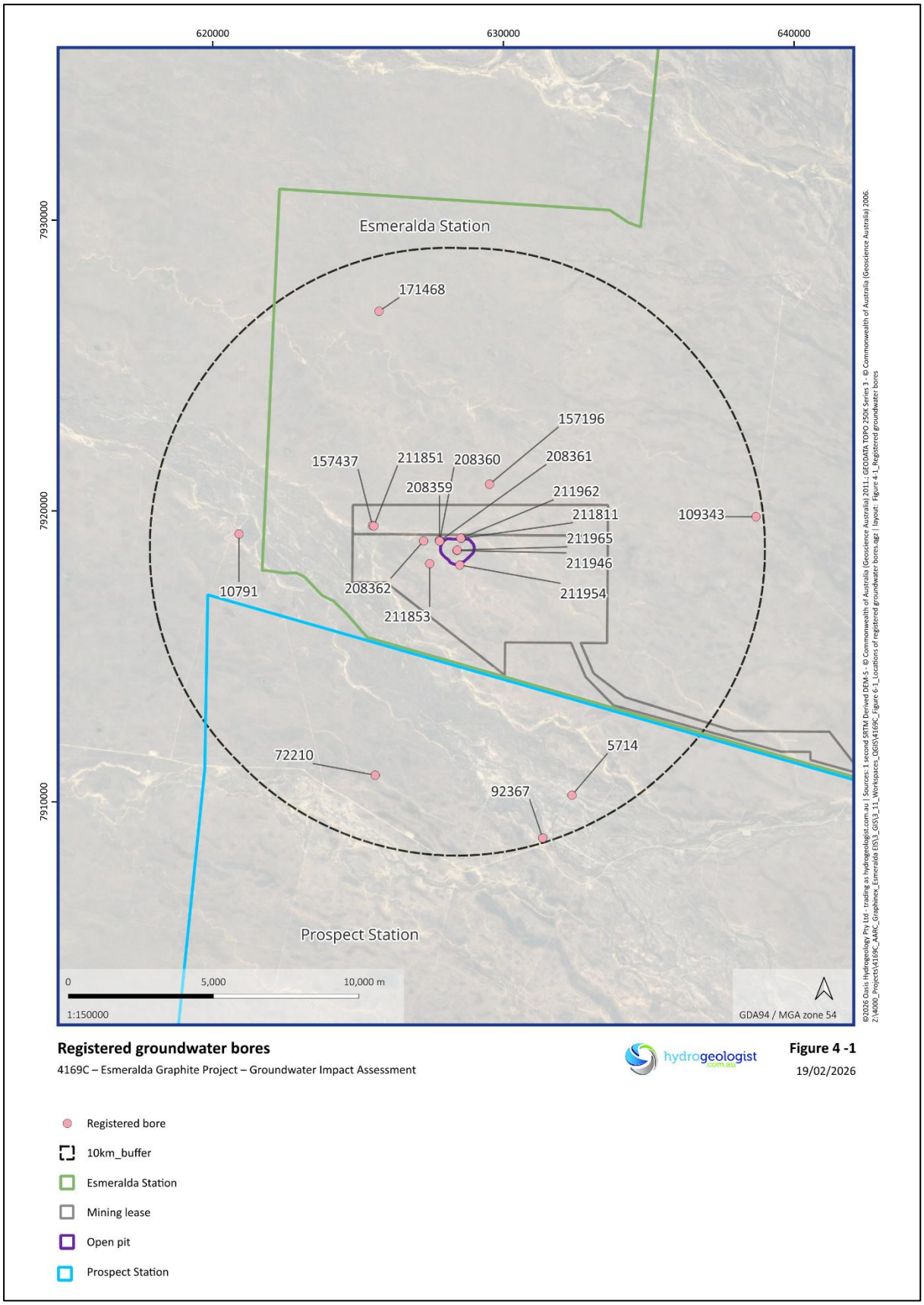


Figure 14-28: Registered groundwater bores

Springs

A desktop review of mapped springs and on-ground observation was conducted as part of the Terrestrial Ecological Baseline Report (Appendix E). A EPBC Act Protected Matters Search Tool identified an endangered 'community of native species dependent on natural discharge of groundwater from the Great Artesian Basin' TEC to potential occur within the local area. This TEC is defined as a combination of native species, not necessarily linked to an RE.

Field surveys completed by AARC between 2024 and 2025 confirmed that of the nine distinct vegetation communities in the MLA areas, none were associated with springs or the natural discharge of groundwater from the GAB. From on-ground observations, AARC (2026) concluded that there are no natural discharges of groundwater within or immediately surrounding the study area. This includes springs, mound springs, mud springs, boggomoss springs, spring pools or groundwater seeps. Consequently, no vegetation associated with the fore-mentioned TEC was identified within the proposed disturbance area during the surveys, and as such the Project is not likely to impact this TEC.

Groundwater dependent ecosystems

AARC (2025) identified thirteen regional ecosystems (comprising 15 RE sub-types) within the proposed MLA, including vegetation communities dominated by eucalyptus, melaleuca and acacia species. Key canopy species recorded across the Project area are presented in Table 14-15.

The BOM GDE Atlas classifies riparian habitats associated with Warrigal Creek, the Borer River and the unnamed tributary (RE2.3.26a) as having a "Moderate Potential" for aquatic GDEs (BOM, 2025). In addition, several wetland depressions mapped as RE2.3.55d and an isolated patch of RE2.3.61 were identified as "Low Potential" aquatic GDEs. Terrestrial GDE mapping is concentrated predominantly south of Warrigal Creek, with additional scattered areas across the MLA areas categorised as having "High", "Moderate" or "Low" potential (BOM, 2025). A mapped potential GDEs based on the BoM GDE Atlas is shown in Figure 14-29. The nearest mapped spring complex occurs approximately 18 km north-east of the Project area, with more extensive spring groupings located approximately 50 km to the south (DCCEEW, 2023) (Figure 14-30). Given the separation distance from the Project area, potential impacts to the spring systems are considered unlikely.

Watermark Eco (2026) completed targeted field investigations of areas identified within the GDE Atlas as potential aquatic or terrestrial GDEs. The assessment found no evidence that woody vegetation within the Project area relies directly on groundwater to sustain transpiration during dry seasonal conditions. Instead, vegetation was observed to depend on moisture retained within the vadose zone. Wetland depressions (RE2.3.55d) and ephemeral drainage habitats (RE2.3.26a) were found to retain moisture for extended periods due to the capture and infiltration of surface water, although this moisture availability decreases during prolonged dry conditions. Temporary saturation within swamp wetland soils was interpreted as short-term perched moisture rather than true groundwater conditions, and these systems were therefore not considered to function as GDEs. In ephemeral drainage lines, perched groundwater may develop seasonally within alluvial sands overlying impermeable basement rock following wet season recharge events. Riparian vegetation may opportunistically utilise this shallow perched groundwater when present; however, these conditions diminish rapidly as seasonal drying occurs, resulting in vegetation reverting to reliance on soil moisture storage within the vadose zone.

Table 14-15: Major canopy species within the MLA and surrounds.

Eucalyptus species (species / common name)
Corymbia grandifolia (large-leaf cabbage gum), *Eucalyptus camaldulensis* (river red gum), *Eucalyptus microtheca* (coolibah), *Corymbia polycarpa* (long-fruited bloodwood), *Corymbia setosa* (rough-leaved bloodwood)
Melaleuca species (including other Myrtaceae genera shrubs)
Melaleuca viridiflora (Broad-leaved tea tree), *Melaleuca fluviatilis* (weeping paperbark), *Melaleuca citrolens* (gulbarn), *Astermyrtus symphiocarpa* (liniment bush)
Acacia species and other species

Eucalyptus species (species / common name)
Acacia holosericea (silver-leaved wattle), *Acacia leptocarpa* (slender-fruited wattle), *Acacia platycarpa* (ghost wattle), *Acacia torulosa* (Torulosa wattle), *Erythrophloeum chlorostachys* (Cooktown ironwood), *Grevillea striata* (beefwood)

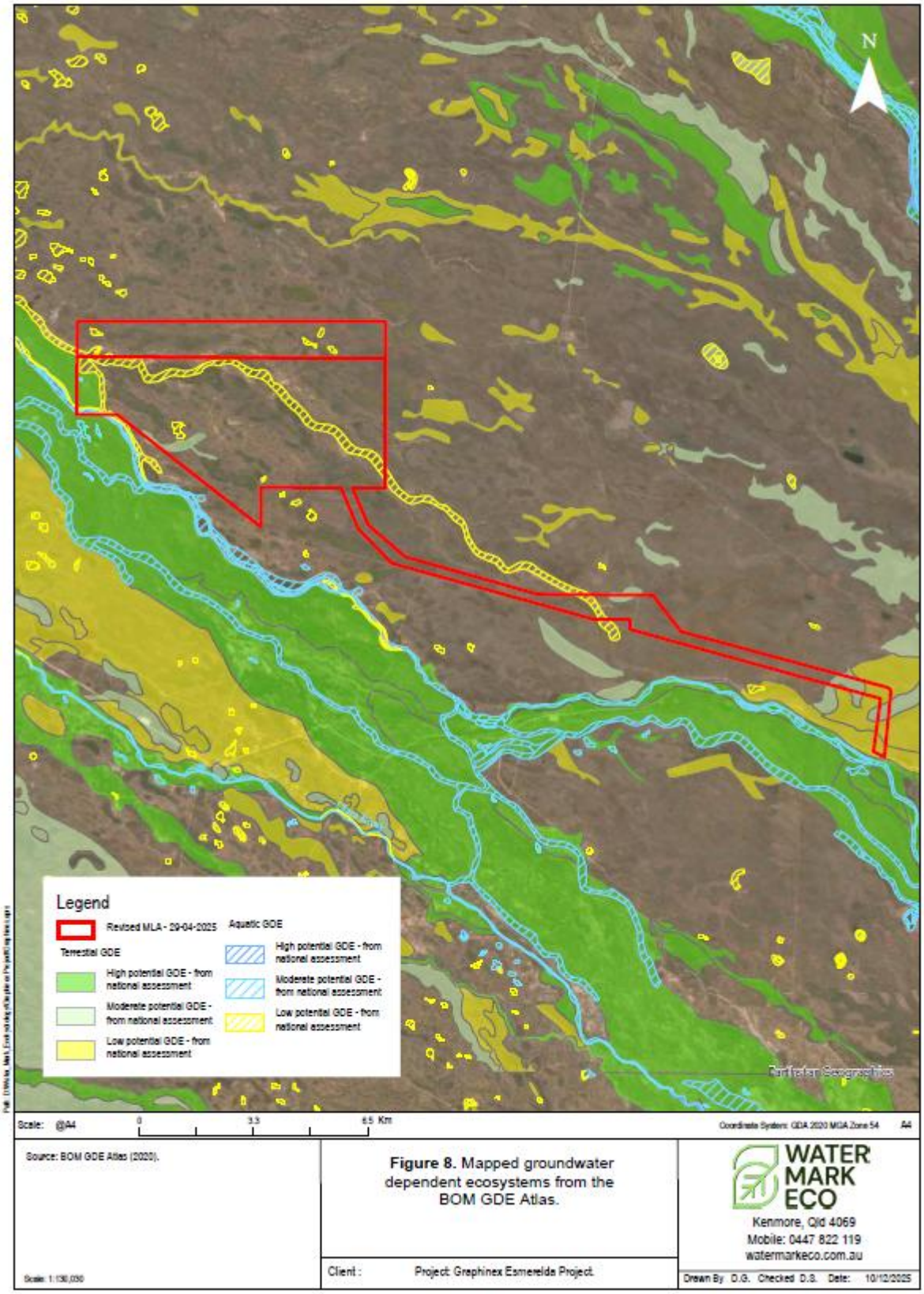


Figure 14-29: Mapped groundwater dependent ecosystems from the BOM GDE Atlas.

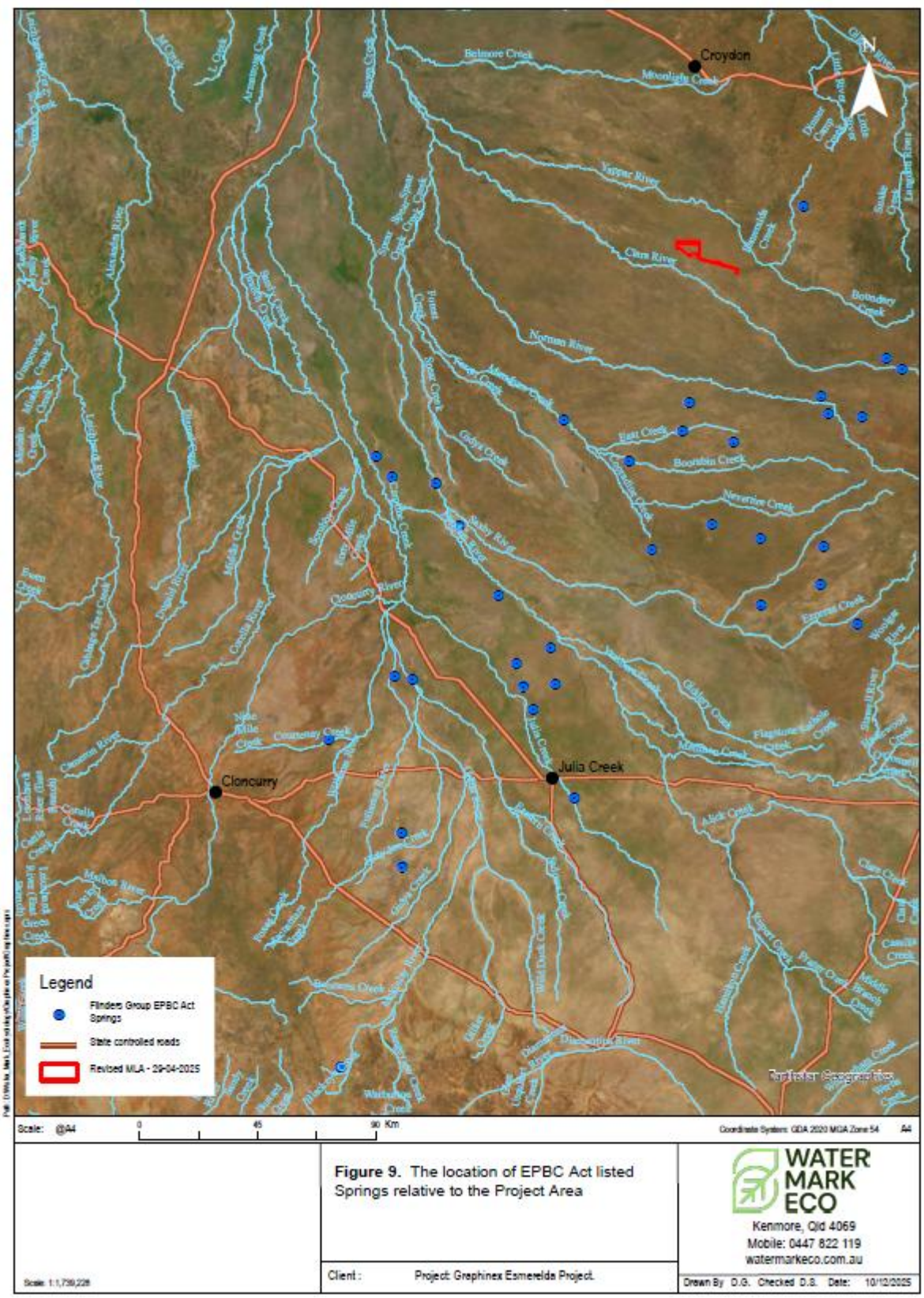


Figure 14-30: The location of EPBC Act listed Springs relative to the Project Area

Stygofauna

EcoLogical Australia (2026) undertook a stygofauna assessment for the Project based on desktop review, assessment of groundwater monitoring data and targeted field sampling. No known records of stygofauna occur within or near the MLA area, with the closest recorded specimens identified from limestone and karst-associated systems at Chillagoe and Lawn Hill, located approximately 290 km north-east and 430 km west of the MLA areas, respectively.

Field investigations included sampling of 12 groundwater bores across the MLA areas. Shallow bores within the Tertiary sediments were dry at the time of survey. With no stygofauna were recorded during sampling of the GRF aquifer. While several monitoring bores were younger than the six-month colonisation period recommended in DSITI (2015), they were sampled to improve spatial coverage and increase the available groundwater physico-chemical dataset.

EcoLogical Australia (2026) concluded that the likelihood of stygofauna occurring within the Project area is low due to a combination of environmental and hydrogeological constraints. These include the limited thickness and intermittent saturation of the alluvium, elevated groundwater temperatures and pH within the GRF, and the potentially limited degree of sandstone fracturing required to provide suitable pore space and connectivity for subterranean fauna movement and groundwater-dependent food webs. The absence of stygofauna during field sampling further supports the conclusion that the MLA areas is unlikely to support stygofauna habitat.

Stygofauna are discussed further in Chapter 18 – Flora and Fauna, and Appendix F, Stygofauna Assessment.

14.3.3 Groundwater modelling

Hydrogeologist (2026) developed a 3D numerical groundwater model to predict the effects of the project on groundwater levels, flow and distribution within and surrounding the MLA areas. The modelling software MODFLOW-USG (Panday et al. 2015) was used to simulate the groundwater conditions for the Project. MODFLOW-USG is widely accepted by hydrogeologists and groundwater modelling specialists to be suitable for predicting impacts associated with open cut mining projects.

The Australian Groundwater Modelling Guidelines (Barnett *et al.* 2012) was also considered throughout the modelling process to ensure that the model aligns with current industry best practice and suitably fulfils the stated model objectives.

The objectives of the groundwater flow model included:

- predicting changes to local and regional groundwater flow regimes;
- predicting project-specific effects on groundwater resources, users and the environment;
- estimating groundwater inflow into mining operations;
- assessing potential for cumulative drawdown on groundwater resources, users and the environment; and
- addressing regulatory requirements in relation to groundwater modelling.

14.3.3.1 Project scenario

The groundwater impact assessment has assessed the Project as described in this EIS.

The Project targets a resource base consisting of a granite hosted ore body of approximately 150 m thickness, located beneath approximately 70 to 100 m of overburden. The Project involves the development of the Project mining area. Mining will be undertaken using open cut mining equipment and methods. Ore will be mined to an approximate maximum depth of 250 mbGL (approximately -157 mAHD). Open cut mining operations will involve dewatering of the open cut pit to allow for safe operations.

Five-yearly operational pit shells have been analysed, from Year 0 through to Year 45. From Year 35, in-pit waste backfill commences whereby ex-pit tailings will be progressively reclaimed to backfill the pit void to

approximately 42 mAHD. In approximately Year 46, after a capping layer is installed on top of the tailings, waste rock from the TSFs and out of pit waste rock dumps will also be used to backfill the pit void, bringing it to approximately at or slightly above pre-mining surface level.

This assessment has assumed the conservative scenario whereby the Year 45 pit shell is maintained until Year 53 of mining operations. Effectively extending the dewatering and depressurisation process in the open pit void and providing a worst-case scenario in terms of impact on the groundwater regime.

To consider the impact of the pit post-closure, it is noted that the backfilled final void will gradually fill with groundwater over time, and a groundwater table will re-establish in the backfilled void. As there will be no pumping or evaporative losses from the backfilled void, the groundwater levels in the backfilled void are expected to recover to pre-mining groundwater levels. The surface infiltration into the backfilled void is expected to be minimal and similar to the pre-mine, background recharge rates. The backfill material (both the tailings and waste rock) will be in hydraulic connection with the surrounding groundwater system including the Gilbert River Formation. Groundwater levels will continue to recover until regional groundwater flow is established within and around the backfill material.

Two post closure scenarios were developed to assess the recovery rates in the backfilled void. The first scenario assumed the open pit void is fully backfilled with tailings (represented by relatively low hydraulic conductivity and low storage properties), the second scenario assumes the open pit void is fully backfilled with waste rock (represented by relatively high hydraulic conductivity and high storage properties). In reality, the open pit void will be backfilled with a combination of these materials (including a low permeability capping layer) as detailed above, and hence these scenarios provide a plausible range of the likely groundwater level recovery in the backfilled void.

14.3.3.2 Model extent

The Hydrogeologist (2026) model domain covered an area of 4,027 km^2. The numerical model area is approximately 62 km long (on a north-south axis) and 89 km wide (on an east west axis) (Figure 14-31). The model extents include the entire MLA areas and its surrounds, all relevant surface water catchment areas, and key groundwater recharge and discharge zones. A conservative approach has been used in setting the model boundary conditions to ensure that the Project's potential effects on groundwater are not unduly constrained by the model setup. The numerical model boundary is located outside the limit of the predicted Project effects.

The numerical groundwater model was based on the conceptual groundwater model, described in Section 14.3.2.3, and the supporting data collected from the desktop study and groundwater site investigation. Six model layers were used to represent the key hydrostratigraphic units within the model domain as well as the base of mining. Each model layer is divided into a detailed mesh of approximately 29,753 cells. The model layers are detailed further in Appendix L, Groundwater Impact Assessment.

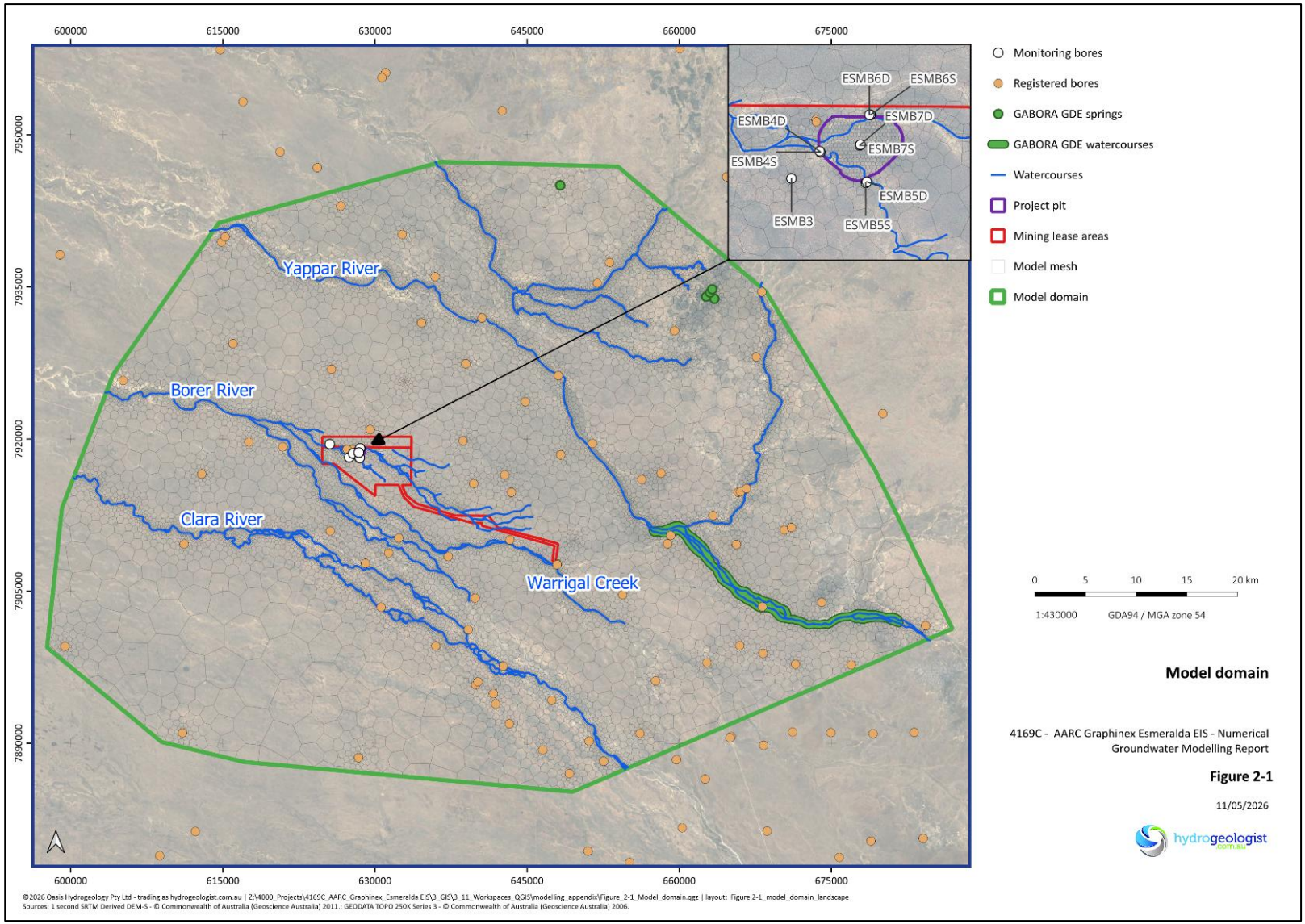


Figure 14-31: Model domain

14.3.3.3 Recharge and evapotranspiration

The MODFLOW Recharge (RCH) package was used to apply recharge to all cells across model layer 1. Recharge was specified as a proportion of rainfall specified for each stress-period. Three recharge zones are defined within the model domain, representing distinct surficial zones for which recharge rates were calibrated. The zones are shown in Figure 14-32, and described as:

- Zone 1: GRF intake beds;
- Zone 2: Regional diffuse recharge; and
- Zone 3: Watercourses.

Evapotranspiration was applied using the MODFLOW Evapotranspiration (EVT) package. EVT was applied as zones, consistent with the recharge zonation detailed above. The pan evapotranspiration rate and pan evapotranspiration factor were initially set to 2070 mm/year and 80% across all zones and corresponds with the long-term average of the SILO dataset. Extinction depths and pan evaporation factors for each zone were then updated through model calibration.

14.3.3.4 Model calibration

Model calibration is the process of adjusting model parameters (hydraulic properties and boundary conditions) so that the model replicates the observed behaviour of the groundwater system. The quality of the calibration is assessed by comparing observed data with simulated results at corresponding times. Calibration of the Project model was undertaken using PEST++ Iterative Ensemble Smoother (PESTPP-IES; White et al. 2020). PESTPP-IES is a widely adopted parameter estimation framework for groundwater modelling.

The model has been appropriately calibrated to transient conditions based on the following criteria:

- the conceptual model for groundwater flow has been honoured by the calibration; and
- quantitative calibration metrics (e.g., residual errors) are within guideline-recommended ranges (Barnett et al., 2012).

A transient calibration was carried out on the groundwater flow model using 152 groundwater levels from 47 observation sites including the Project groundwater monitoring network and data from surrounding pastoral bores. A detailed description of the calibration method is provided in the Groundwater Impact Assessment (Appendix L).

The quality of the calibration was evaluated using quantitative and qualitative measures, including the scaled root mean squared (SRMS) error. The SRMS error is a useful descriptor of goodness of fit when the objective is to fit historical measurements of heads. It is summarised as the root mean squared divided by the range of measured heads and expressed as a percentage, with weighting introduced as necessary to account for different levels of confidence in different measurements.

The calibration achieved a weighted SRMS error of 3.09% which is well below the target performance measure of 10% recommended by the AGMG and demonstrates a very good fit to the weighted groundwater level observations used in the calibration. Furthermore, the calibrated groundwater levels, vertical gradients and flow patterns replicate measured data and groundwater trends.

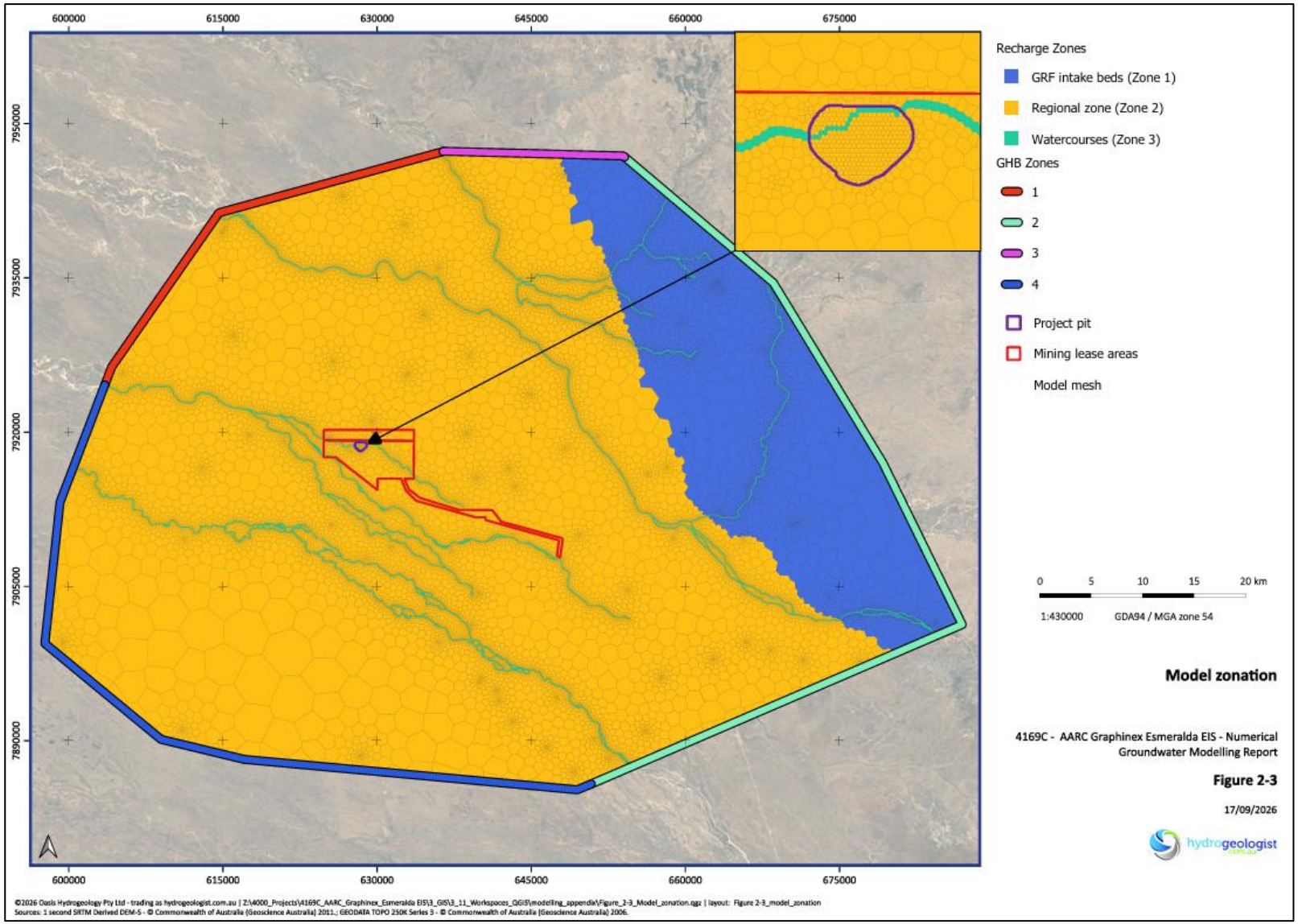


Figure 14-32: Model zonation

14.3.3.5 Predictive modelling

Two transient predictive model scenarios were developed to assess the potential effects of the Project on the surrounding groundwater system. These scenarios are the:

- No mining scenario - a hypothetical case representing future conditions in the absence of mining activities; and
- Project scenario - includes the proposed development of the Esmeralda Graphite Project.

These scenarios were developed to provide predictions of:

- Groundwater level drawdown (relative to the pre-mining initial water level) at the end of mining.
- Post-mining groundwater level recovery, for a period up to 1,000 years post-mining.
- Groundwater inflow rates to the mine at annual intervals during the active mining phase. At the end of mining the pit is completely backfilled (no residual void remains).

14.3.3.6 Confidence classification

The model confidence level classification has been assessed against criteria outlined in the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). The detailed assessment is represented in Table 14-16. The assessment indicates that while the model satisfies a large portion of Class 3 requirements (50%) and some Class 2 requirements (21%), the model is considered Class 1 due to the presence of Class 1 components.

Table 14-16: Assessment of model confidence level classification

Component	Class 3 requirement	Evidence demonstrated in this model	Confidence level achieved
Data	Spatial and temporal distribution of groundwater head observations adequately define groundwater behaviour, especially in areas of greatest interest and where outcomes are to be reported.	Adequate distribution of observation targets around Project site and regionally across the model domain. Targets from 18 August 2024 until 23 November 2025.	Class 3
	Spatial distribution of bore logs and associated stratigraphic interpretations clearly define aquifer geometry.	Layer geometry is informed by 57 bore logs distributed evenly across the model domain.	Class 3
	Reliable metered groundwater extraction and injection data is available.	N/A. No significant groundwater extraction or injection has taken place in the model area.	N/A
	Rainfall and evaporation data is available	SILO rainfall and evaporation data available from 1889 to present.	Class 3
	Streamflow and stage measurements are available with reliable baseflow estimates at a number of points	True. Water courses across model domain are ephemeral (see conceptual model in accompanying groundwater report).	Class 3
Calibration	Adequate validation is demonstrated.	Mass balance errors are negligible cumulatively and for every time step. Budgets are consistent with the conceptual model and groundwater head contours conform with conceptual understanding of flow directions.	Class 3
	Scaled RMS error or other calibration statistics are acceptable.	SRMS is below the 10% threshold recommended by Australia Groundwater Modelling Guidelines (Barnett et al., 2012)	Class 3
	Long-term trends are adequately replicated where these are important.	15 months of observation data is not sufficient to establish long-term trends. Additionally, the prevalence of flat modelled groundwater levels indicates that more long-term data with adequate responses to climate conditions is needed to improve the model performance	Class 1
	Seasonal fluctuations are adequately replicated where these are important.	Seasonal fluctuations are not captured by model hydrographs.	Class 1

Component	Class 3 requirement	Evidence demonstrated in this model	Confidence level achieved
	Transient calibration is current, i.e. uses recent data.	True. Calibration data is available from 18 August 2024 until 23 November 2025.	Class 3
	Model is calibrated to heads and fluxes.	Model is calibrated to heads only.	Class 2
	Observations of the key modelling outcomes dataset is used in calibration.	True. The key modelling outcome (groundwater heads) is used as the calibration target.	Class 3
Prediction	Length of predictive model is not excessive compared to length of calibration period.	Predictive model time frame is more than 10 times the duration of the transient calibration (1.3-year calibration period vs 53-year predictive period).	Class 1
	Temporal discretisation used in the predictive model is consistent with the transient calibration.	False. Temporal discretisation in predictive model (annual) is not the same as that used in calibration (monthly).	Class 2
	Level and type of stresses included in the predictive model are within the range of those used in the transient calibration.	Partially satisfied. Climate stresses are within ranges of transient calibration data. However, mining stresses are non-existent for the transient calibration period.	Class 2
	Model validation suggests calibration is appropriate for locations and/or times outside the calibration model.	True	Class 3
	Steady-state predictions used when the model is calibrated in steady-state only.	N/A	N/A
Key indicator	Key calibration statistics are acceptable and meet agreed targets.	True. Key calibration statistics are within acceptable ranges.	Class 3
	Model predictive time frame is less than 3 times the duration of transient calibration.	Predictive model time frame is more than 10 times the duration of the transient calibration (1.3 year calibration period; 53 year predictive period).	Class 1
	Stresses are not more than 2 times greater than those included in calibration.	Partially satisfied. Climate stresses are within ranges of transient calibration data. However, mining stresses are non-existent for the transient calibration period.	Class 2

Component	Class 3 requirement	Evidence demonstrated in this model	Confidence level achieved
	Temporal discretisation in predictive model is the same as that used in calibration.	False. Temporal discretisation in predictive model (annual) is not the same as that used in calibration (monthly).	Class 2
	Mass balance closure error is less than 0.5% of total.	True. Mass balance error is less than 0.5% for each time step and cumulatively over the model duration.	Class 3
	Model parameters consistent with conceptualisation.	True. Budget rates and parameterisation are consistent with the hydrogeological conceptual model presented in the accompanying groundwater report.	Class 3
	Appropriate computational methods used with appropriate spatial discretisation to model the problem.	True. MODFLOW-USG and PESTPP-IES are industry standard software for groundwater model simulation and calibration. Cell refinement in key areas (i.e. Project site and along watercourses and at bores) with coarser spatial discretisation elsewhere is appropriate for representing the Project.	Class 3
	The model has been reviewed and deemed fit for purpose by an experienced, independent hydrogeologist with modelling experience.	Model has been reviewed by third party (HydroAlgorithmics)	Class 3

14.3.4 Potential impacts

Potential impacts on groundwater environmental values in the context of groundwater resources are detailed in this Section. Predicted impacts to groundwater quality are described further in Chapter 15, Water Quality.

14.3.4.1 Predicted groundwater inflows

Associated water is groundwater that is taken or interfered with in the process of carrying out an authorised resource activity. This includes water intersected by mining and dewatered from the pit to allow continued mining activities.

Modelled groundwater inflow rates to the Project mining area are summarised in Table 14-17 and shown in Figure 14-33 . Groundwater inflows are predicted to peak in mine year 5 at approximately 13,750 m^3/day (5,024 ML per annum).

Following this peak, inflow rates are predicted to decrease over the life of the Project, to a rate of approximately 1,500 m^3/day (550 ML per annum) at the end of the Project mining operations.

The fluctuations observed in the predicted mine inflows are largely related to the mine schedule that was represented in the numerical model. The mine plan was provided by the Proponent in a series of five-yearly pit shells. These five-yearly pit shells were then processed to reflect an annual progression of mining. Hence, the modelled groundwater inflow rates to the Project mining area generally show an increase in inflow every five years. This reflects more of a modelled artefact, and in reality, the groundwater inflows to the open pit are likely to be more of a gradual increase or decrease, rather than a substantial increase every five years (e.g. the predicted inflow in year 5 of operations). The five-yearly pit shells also included the backfilled surface proposed by the Proponent, hence the inflow predictions account for the progressive backfilling during the later stages of mine development.

The actual volume of groundwater pumped from the Project mining area (pit de-watering) will be less than that predicted by the numerical model, as a component of the groundwater will be lost to evaporation and as entrained moisture in the mined ore and overburden.

As the final pit void will be backfilled, groundwater take will cease at the completion of mining and backfill (approximately year 53) to ensure safe operations.

Table 14-17: Summary of annual groundwater inflow to the open pit void

Project year	ML/annum	Project year	ML/annum
1	1823	28	692
2	1404	29	682
3	1243	30	1083
4	1181	31	721
5	5024	32	680
6	1258	33	659
7	1087	34	639
8	1068	35	624
9	1560	36	612
10	1770	37	602

Project year	ML/annum	Project year	ML/annum
11	1047	38	614
12	946	39	608
13	979	40	624
14	1012	41	588
15	1332	42	578
16	881	43	572
17	815	44	568
18	773	45	565
19	739	46	561
20	712	47	557
21	690	48	552
22	671	49	549
23	654	50	545
24	639	51	541
25	626	52	538
26	614	53	536
27	603		

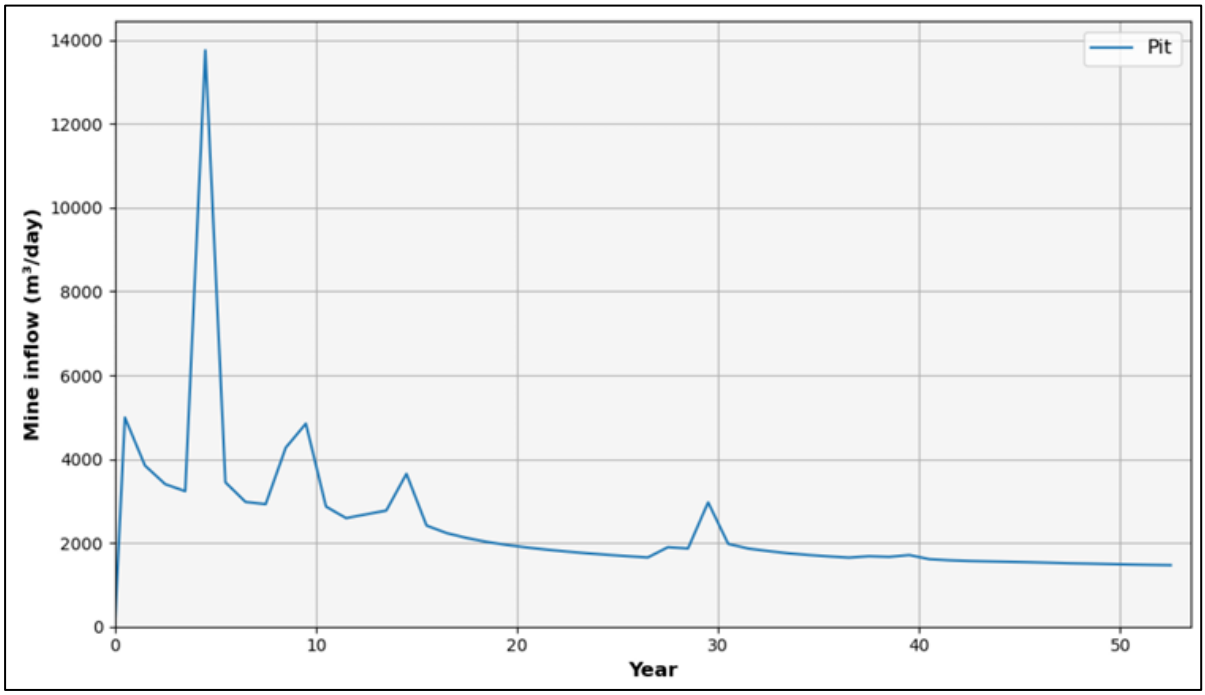


Figure 14-33: Predicted groundwater inflow to the open pit void

14.3.4.2 Water supply

The construction and operation of the Project will source of water from advance and sustained pit dewatering abstracted to enable the mining operations, in addition to water recovered from the processing circuit and tailings or water management infrastructure.

Mining activities, supported by pit-dewatering, will extend below the regional groundwater table and are predicted to result in groundwater drawdown within the GRF aquifer. During operations, groundwater inflows to the mine are predicted to average approximately 890 ML/year, with a peak inflow of approximately 5,024 ML/year in year 5. As the final void will be backfilled following cessation of mining, no ongoing groundwater take is predicted post-closure.

Surface water modelling completed by Engeny (2026) indicates that the proposed water management system for the project is expected to maintain sufficient operational water supply throughout the majority of the mine life, with no median annual water shortfalls predicted during operational years. Minor shortfalls of less than 1.5% are only predicted late in the mine life when only the final tailings storage facility remains operational.

Captured rainfall runoff and direct rainfall are predicted to contribute approximately 62% of total site water inflows on average, with the remaining inflows sourced from groundwater inflows to the mining pit and recovery of tailings water. The Project water balance therefore demonstrates a sustainable reliance on internal water recycling and runoff capture to support operational water demands.

14.3.4.3 Predicted groundwater level drawdown

The potential impact of the Project activities on groundwater drawdown has been extracted from the numerical groundwater model (Appendix L, Groundwater Impact Assessment). The maximum predicted drawdown in the GRF extends radially to a maximum distance of 3000 m from the open pit crest to the south and east, and up to 2800 m from the open pit crest to the north, and up to 1500 m from the open pit crest to the west. Predicted drawdown ranges from approximately 1 m at the outer extent of the drawdown zone to up to 50 m adjacent to the pit. The maximum predicted drawdown in the GRF is shown in Figure 14-34.

Hydrogeologist (2026) adopted a conservative approach by defining the drawdown extent using the maximum predicted groundwater level reduction at any time during the mine life, rather than only at the completion of mining.

Drawdown impacts on third-party groundwater users

Eight of the third-party registered bores identified within approximately 10 km of the Project operations are constructed within the GRF and are used for stock watering. Of these, one registered existing, groundwater supply bore (RN157196, also known as Rowe 3) is located within the extent of maximum predicted drawdown in the GRF as shown in Figure 14-34. Maximum predicted drawdown at this bore is 1.6 m at RN157196. This bore is currently located on the Esmeralda Station, however through the subdivision of this station and transfer of ownership of the land underlying the project to the Proponent this bore will cease to be a third-party groundwater bore.

The Proponent has obligations under Chapter 3 of the Water Act 2000 to undertake baseline assessments of any third-party groundwater supply bores which may be impacted by the Project, and where necessary, entering into make good agreements with owners of affected groundwater supply bores.

The remaining registered groundwater supply bores identified within 10 km of the MLA areas are located outside the predicted drawdown extent and are not expected to be impacted by Project dewatering. No groundwater supply bores targeting the shallow groundwater table have been identified within 10 km of the MLA areas, as all registered bores are constructed within the GRF.

The GRF exhibits variable but generally low to moderate permeability, which limits the lateral transmission of drawdown beyond the immediate MLA areas. As described in 14.3.2.4, the rate of recharge within the GRF is relatively high, ranging from 1.25% to 2.5%, which supports aquifer recovery following cessation of mining.

The risk and magnitude of mining related groundwater impacts on registered bores and groundwater levels in the GRF is low.

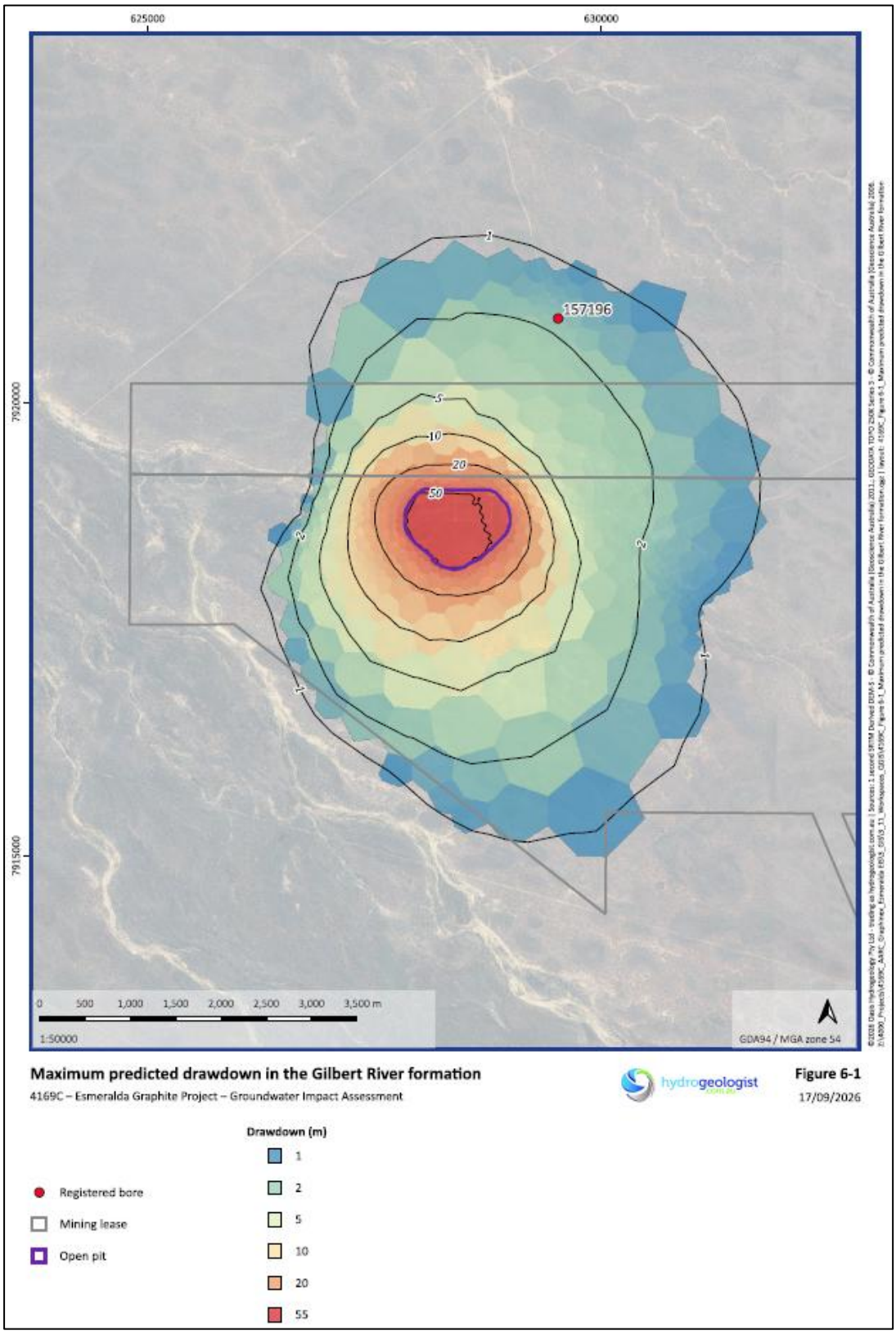


Figure 14-34: Maximum predicted drawdown in the GRF

Drawdown impacts on groundwater dependent ecosystems

Hydrogeologist (2026) and Watermark Eco (2026) concluded that the Project is unlikely to result in significant impacts to GDEs. Groundwater modelling predicts drawdown within the GRF aquifer extending up to approximately 3 km from the open pit crest; however, field investigations and ecohydrological assessments indicate that the mapped terrestrial and aquatic ecosystems within the Project area are not reliant on the deeper groundwater system predicted to experience drawdown.

Watermark Eco (2026) determined that vegetation communities across the Project area predominantly rely on soil moisture stored within the vadose zone rather than direct groundwater uptake. Wetland depressions and ephemeral drainage features were found to retain moisture seasonally through infiltration and temporary perched saturation associated with rainfall and surface water flows, rather than through sustained groundwater interaction. Although ephemeral perched groundwater may occur within some drainage line sands following wet season recharge, these conditions are transient and diminish during dry periods, with vegetation reverting to reliance on stored soil moisture.

Groundwater monitoring and hydrogeological investigations identified a deeper sub-artesian groundwater system within the GRF; however, no evidence was identified to indicate hydraulic connectivity between this aquifer and the rooting depth of vegetation communities or aquatic habitats. Accordingly, Hydrogeologist (2026) concluded that predicted groundwater drawdown within the GRF is unlikely to affect the function or persistence of terrestrial or aquatic GDEs within the Project area (Figure 14-35 and Figure 14-36).

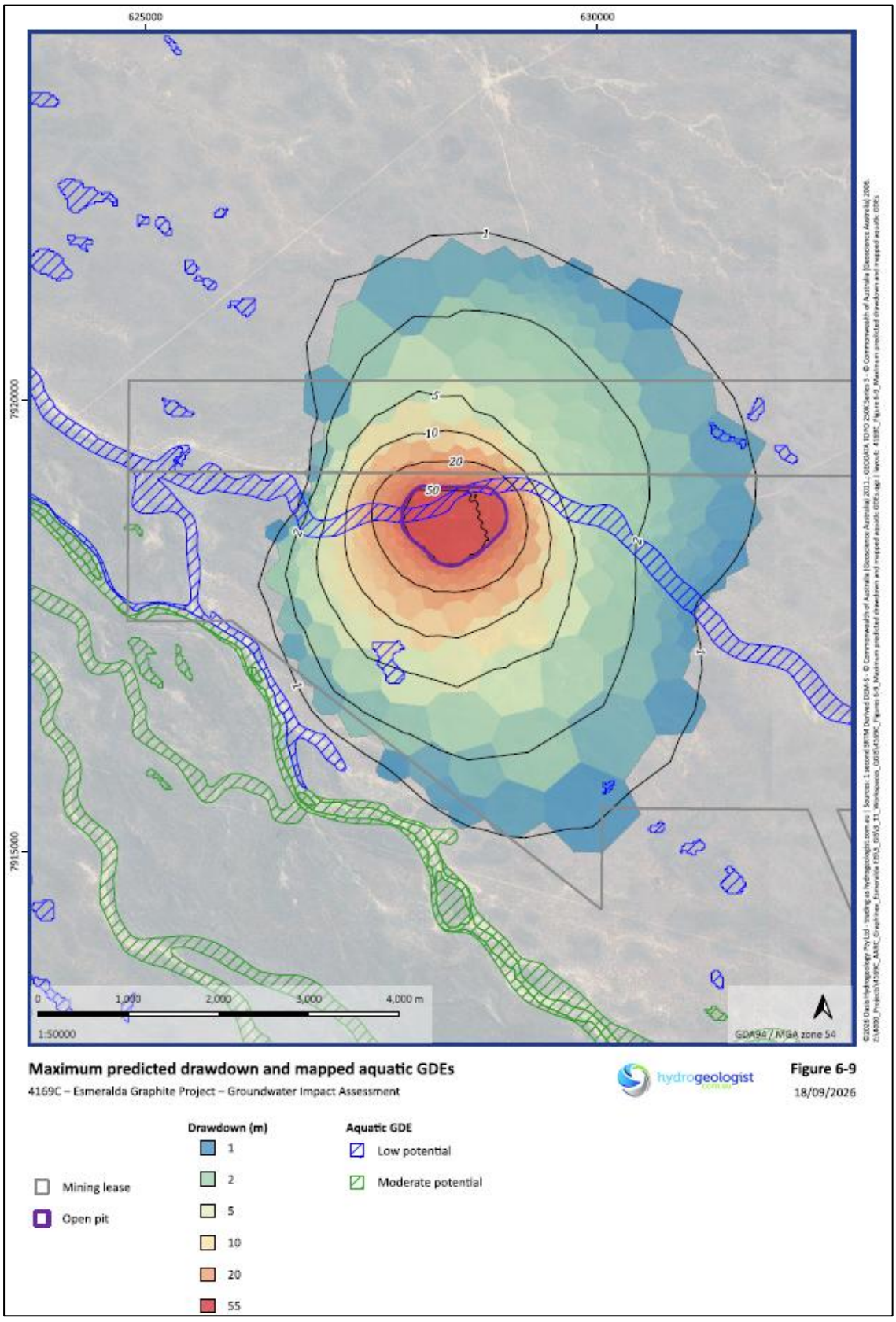


Figure 14-35: Maximum predicted drawdown and mapped aquatic GDEs

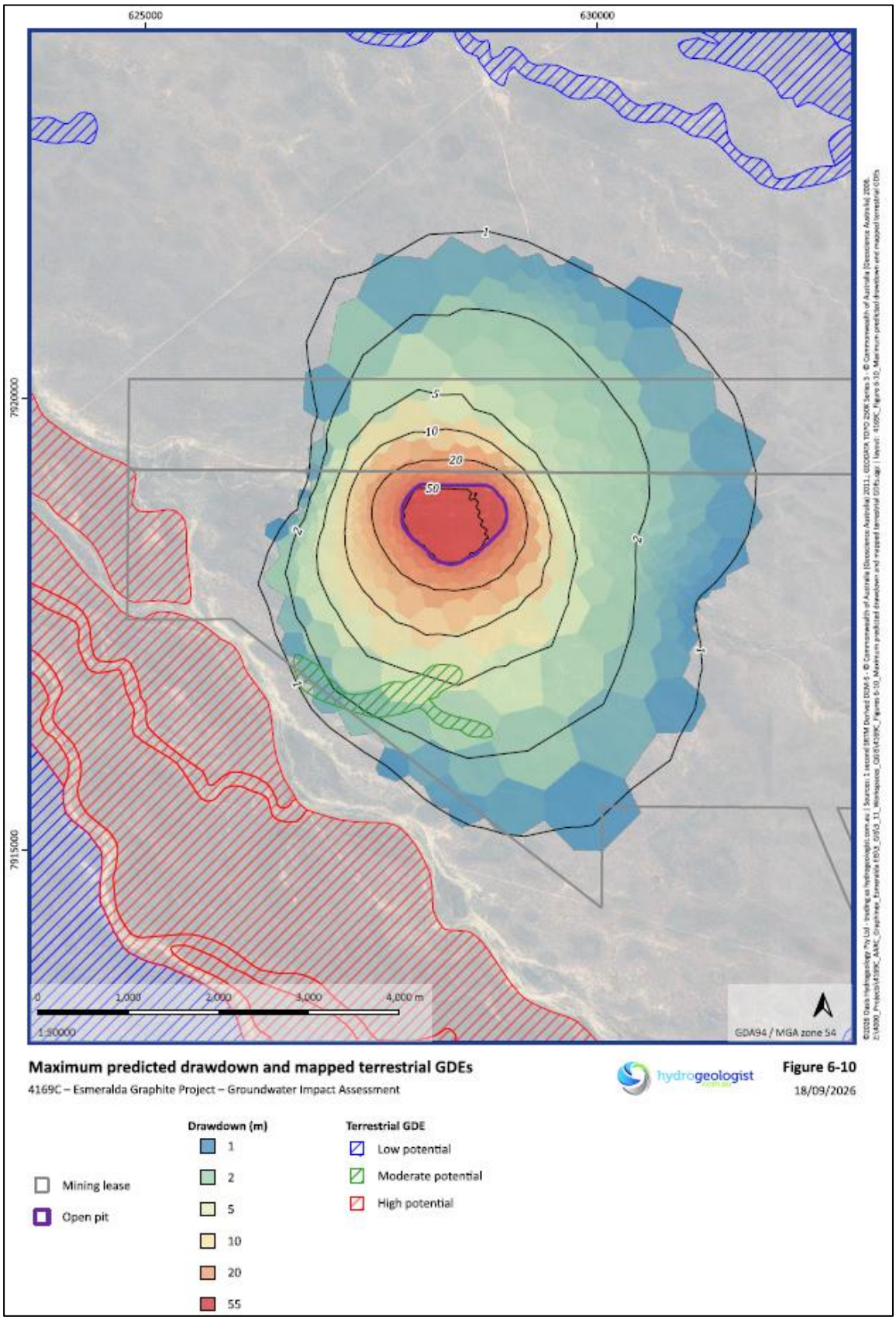


Figure 14-36: Maximum predicted drawdown and mapped terrestrial GDEs

Drawdown impacts on springs

Hydrogeologist (2026) and Watermark Eco (2026) concluded that impacts to springs associated with the Project are unlikely. The nearest mapped spring complex is located approximately 18 km north-east of the Project area, with more extensive spring systems occurring approximately 50 km to the south. Predicted groundwater drawdown associated with mining is confined and extends a maximum of approximately 1.5 km to 3 km from the open pit crest, remaining well separated from known spring features.

Hydrogeological investigations also indicate that the groundwater system affected by mining is a deeper sub-artesian aquifer within the GRF, with no evidence of hydraulic connectivity to regional spring systems. Based on the predicted extent of drawdown, the separation distance to mapped springs, and the regional hydrogeological setting, the Project is not expected to result in measurable impacts to spring flow, spring persistence or associated spring-dependent ecological values.

Both the GABORA GDE springs and the GDE watercourse shown in Figure 14-30 are located well outside of the maximum predicted drawdown extent of the Project (Figure 14-34).

Post-mining groundwater levels

Post mining, the open pit void will be entirely backfilled with tailings and waste rock, and no residual void will remain.

For modelling purposes, two post closure scenarios were developed to assess the recovery rates in the backfilled void. The first scenario assumed the open pit void is fully backfilled with tailings (represented by relatively low hydraulic conductivity and low storage properties), the second scenario assumes the open pit void is fully backfilled with waste rock (represented by relatively high hydraulic conductivity and high storage properties). In reality, the open pit void will be backfilled with a combination of these materials (including a low permeability capping layer) as detailed above, and hence these scenarios provide a plausible range of the likely groundwater level recovery in the backfilled void.

Post mining, groundwater inflow from the GRF will contribute to the groundwater level recovery, along with a minor contribution from the basement rock, the Tertiary sediments and surface infiltration to the backfilled final void.

As there will be no pumping or evaporative losses from the backfilled final void, the groundwater levels in the backfilled final void are expected to recover to pre-mining groundwater levels and a groundwater table will establish in the backfilled final void. The backfill material will be in hydraulic connection with the surrounding groundwater system including the GRF once the water level has recovered.

Hydrogeologist (2026) modelling of post closure groundwater level recovery also considered the two post-closure scenarios mentioned above, which identifies that groundwater levels in the backfilled final void recover to approximately 113 mAHD around 100-150 years post closure (Figure 14-38), with the pre-mining groundwater flow directions re-established. Groundwater levels 1000-years post mining are shown in Figure 14-37. Both scenarios achieve the same water level equilibrium.

Throughout this recovery phase, the pit continues to behave as a sink, with groundwater flowing inward from surrounding aquifers until hydraulic equilibrium is reached. In the long-term, the backfilled void will act as a flow through system, maintaining groundwater flow conditions that are in hydraulic connection with the GRF.

Particle tracking was carried out using the post mining numerical groundwater model. Particles were placed in the GRF around the perimeter of the final void pit crest and along a downgradient line parallel to the regional groundwater flow contours (Figure 14-37) to simulate the direction of groundwater flow. The movement of the particles from the end of mining occurs towards the backfilled final pit void. This movement occurs within the area of maximum predicted drawdown in the GRF (Figure 14-34). The particle tracking was carried out for both the tailings backfill scenario and waste rock backfill scenario described above.

Once recovery in the backfilled final pit void is generally complete (within approximately 100 to 150 years post mining), the particles then migrate slowly to the west northwest following the regional hydraulic gradient. The particle tracking shows that the particles remain well within the Project MLs after 1,000 years post mining.

Those particles that originated around the perimeter of the final void pit crest migrate approximately 100 m from the pit crest (to the west northwest).

Advective transport calculations show that the groundwater movement from the backfilled pit void through the GRF to the northwest would occur over extremely long timescales. The calculated advective travel time is approximately 5,000 years for a 1 km path length, demonstrating that groundwater migration from the backfilled pit void would take place over millennial timescales (Hydrogeologist 2026).

The potential for the Project to impact groundwater environmental values as a result of the planned disposal of tailings and waste rock within the backfilled final void is discussed in RGS (2026a) and Chapter 15, Water Quality.

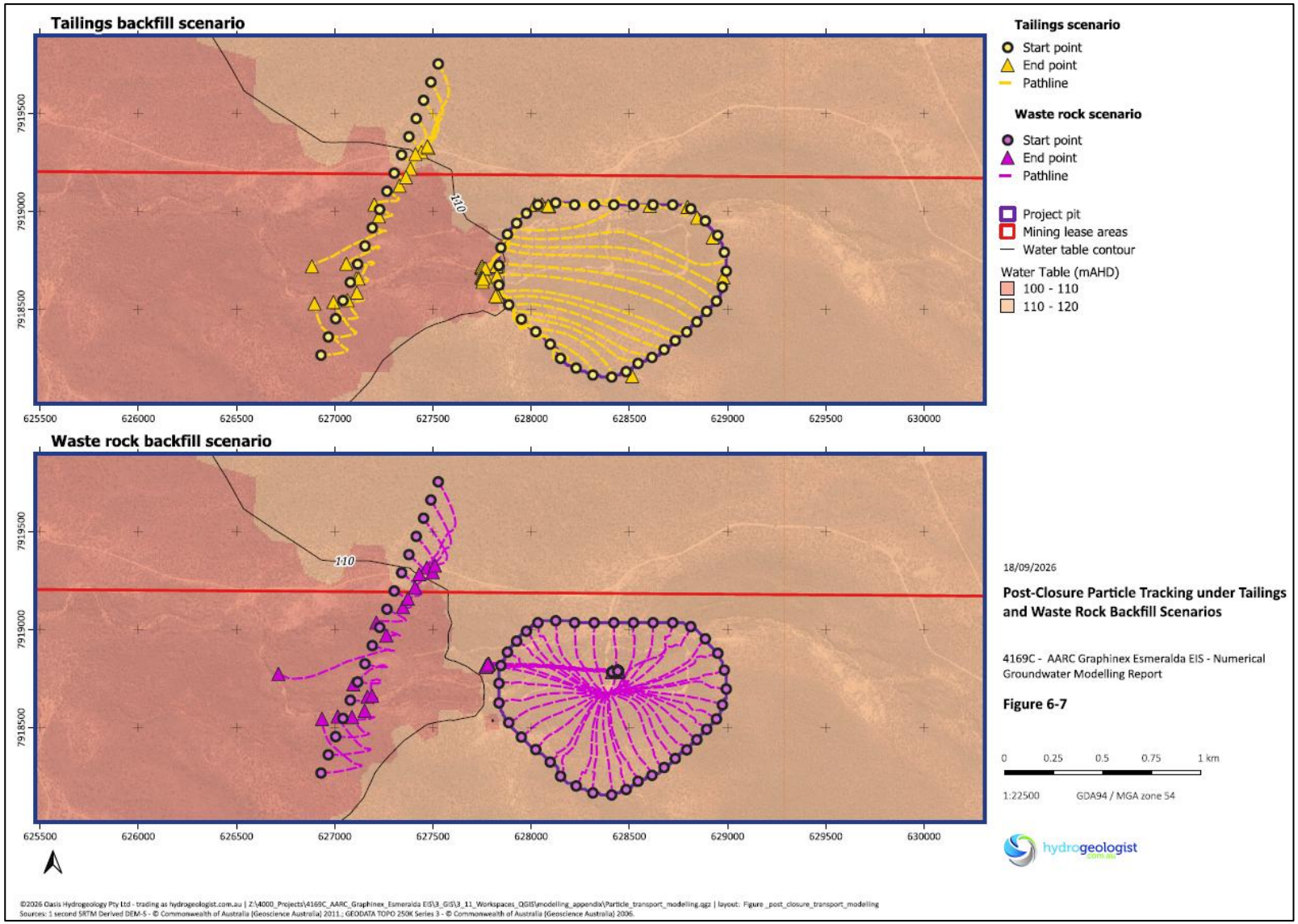


Figure 14-37: Post closure particle tracking

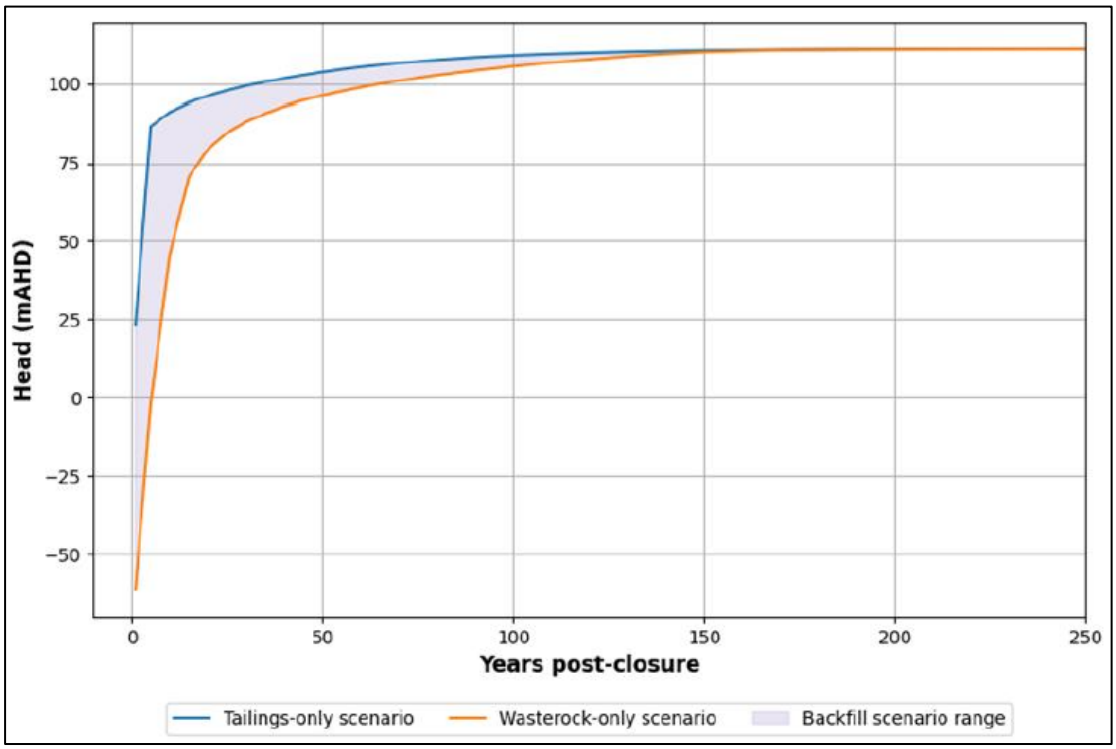


Figure 14-38: Groundwater level recovery within the backfilled pit void

14.3.4.4 Cumulative Impacts

A review of the MLA areas indicates no potential existing or proposed projects in the vicinity of the Project which may be impacted by the Project, or which may contribute to groundwater impacts. Hence there are no expected inter- or intra-Project cumulative impacts for the Project on relevant environmental values.

14.3.5 Mitigation, monitoring and management measures

14.3.5.1 Groundwater monitoring program

Groundwater monitoring will be undertaken in general accordance with the Queensland Government Monitoring and Sampling Manual and the Groundwater Sampling and Analysis - A Field Guide 2nd Edition. This program will be supervised and undertaken by a suitably qualified person. The groundwater monitoring program includes the following objectives:

- establishing monitoring sites that are located downgradient of potential sources;
- establishing monitoring sites capable of monitoring groundwater flow paths between sources and receptors;
- establishing a long-term dataset that represents baseline groundwater information (i.e. baseline groundwater level and quality conditions);
- allowing the ability to confirm model predictions of groundwater levels and drawdown resulting from Project mining activities; and
- allowing the ability to assess whether there is potential for environmental harm.

Bores within the disturbance footprint will be maintained and monitored, until their removal is required for operations and Project development.

The existing groundwater monitoring network comprises 14 site-specific groundwater monitoring bores and five landholder bores (Figure 14-16). Groundwater level dataloggers are installed in all the site-specific groundwater monitoring bores and will be downloaded at a minimum on a quarterly basis.

Additional monitoring bores will be installed, with the indicative locations detailed in Table 14-18 and shown in Figure 14-39. The new proposed locations include bores beyond the immediate pit area to monitor the extent of groundwater drawdown at varying distances from the pit and provide data for ongoing validation of groundwater model predictions. Additional monitoring is also proposed in the vicinity of the TSFs and WRD to monitor groundwater quality associated with these facilities. Bores will target stratigraphy across the Tertiary alluvium, Gilbert River Formation, and Proterozoic basement.

As part of the TSF monitoring network, nine groundwater monitoring bores are proposed around the perimeter of the TSF with six bores within the Tertiary sediments, and three deeper bores proposed within the GRF. These bores will be established prior to TSF operation, with the exception of the proposed upgradient and downgradient monitoring bores associated with TSF4, which will be installed approximately two years prior to construction of TSF3. The monitoring bores will be located to:

- establish monitoring sites that are located downgradient of the TSF;
- establish monitoring sites capable of monitoring groundwater flow paths between the TSF and potential shallow receptors; and
- provide the ability to assess whether there is potential for environmental harm.

The proposed locations in Figure 14-39 are indicative and may be refined based on site access, local geological and hydrogeological conditions, and further technical assessment.

Table 14-18: Proposed additional monitoring bore details

Hole ID	Easting (MGA94 Zone 54)	Northing (MGA94 Zone 54)	Nominal depth (m)	Target stratigraphy
North_GRF_East	629848	7919385	50	Gilbert River Formation
North_GRF_West	626984	7919193	50	Gilbert River Formation
North_WRD	627417	7918261	50	Tertiary sediments
North_GRF_Centre	628534	7919344	50	Gilbert River Formation
North_TSF_GRF	630519	7916903	50	Gilbert River Formation
South_TSF_GRF	632380	7915535	50	Gilbert River Formation
North_Prot	628595	7919340	100	Proterozoic basement
South_Prot	627933	7917268	100	Proterozoic basement
TFS_MB1	627379	7916777	10	Tertiary sediments
TFS_MB2	627990	7917325	10	Tertiary sediments
TFS_MB3	629649	7915106	10	Tertiary sediments
TFS_MB4	632414	7915597	10	Tertiary sediments

Hole ID	Easting (MGA94 Zone 54)	Northing (MGA94 Zone 54)	Nominal depth (m)	Target stratigraphy
TFS_MB5	630484	7916899	10	Tertiary sediments
TFS_MB6	628416	7915706	10	Tertiary sediments
TFS_MB7	627379	7916777	50	Gilbert River Formation

The groundwater monitoring bore locations provide targeted and continuous data of the regional groundwater regime, with suitable spatial variation. If mining activities interfere or destroy an existing monitoring bore, a suitable replacement monitoring bore will be drilled and the monitoring program updated. Where access to a third-party monitoring bore is no longer available, alternative monitoring arrangements will be established to maintain appropriate spatial coverage and continuity of the monitoring program.

For the groundwater monitoring network to be effective and fit for purpose its monitoring locations have the following objectives:

- monitoring sites will be suitably designed and constructed to provide representative groundwater data;
- monitoring sites will be located within the predicted maximum zone of drawdown in order to validate the groundwater drawdown predictions of the approved mining activity;
- monitoring sites will be spatially distributed around the MLA areas in order to have a robust understanding of groundwater drawdown effects from approved mining activities; and
- monitoring sites that are representative of groundwater table conditions in order for effects of drawdown to be assessed on the shallow groundwater regime.

Groundwater monitoring bores will be decommissioned as part of the rehabilitation and decommissioning phase of the Project, at the point where groundwater quality monitoring is no longer required. The North_TSF_GRF monitoring bore associated with the TSF will be retained following closure to monitor groundwater quality associated with TSF 4.

Once monitoring is no longer required, groundwater monitoring bores will be decommissioned. The decommissioning process typically involves:

- removal of bore infrastructure such as pumps, casing, headworks, and surface fittings;
- backfilling of the borehole with clean, inert materials (e.g drill cuttings or sand) up to a specified depth;
- scaling of the bore by installing bentonite and/or cement grout plugs to prevent vertical leakage between aquifers and to protect groundwater resources from surface contamination; and
- final surface restoration, which may include capping and reinstating the land surface to match surrounding conditions.

This methodology ensures that redundant bores do not act as a preferential pathway for contaminant movement or compromise the integrity of aquifers post-closure.

Water quality specific mitigation, monitoring and management measures are detailed further in Chapter 15, Water Quality.

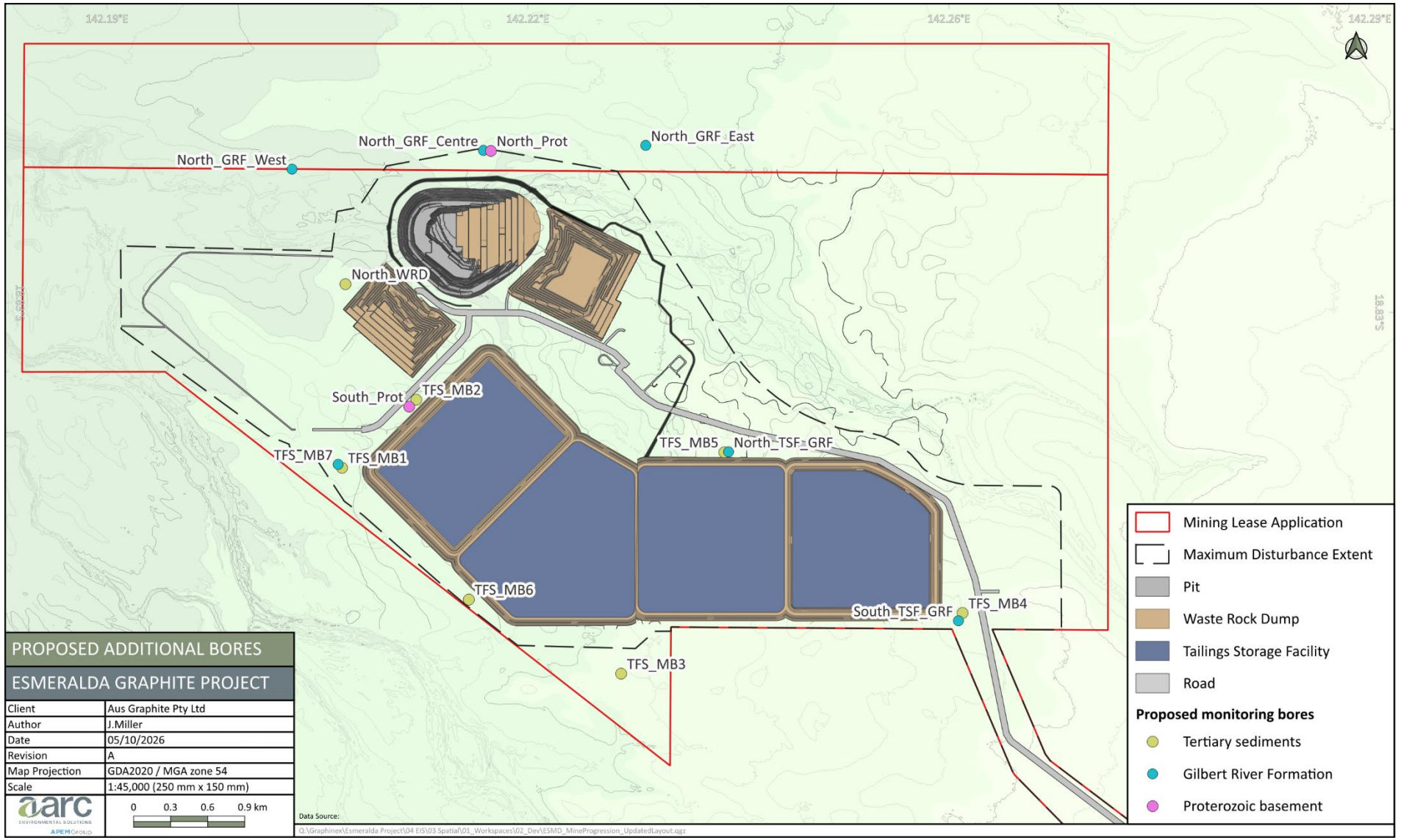


Figure 14-39: Proposed additional monitoring bores

Documentation and reporting

All documentation relating to groundwater monitoring will be kept on archive and be readily accessible to facilitate data analysis in relation to adopted assessment criteria. Data will include (but may not be limited to):

- field data sheets (including purge records, equipment calibration certificates);
- laboratory documentation (chain of custody form, sample receipt notification, laboratory certificates);
- photographs of monitoring bores; and
- monitoring reports prepared within 4 weeks of receipt of analytical data.

A monitoring report will include:

- tabulated monitoring data and laboratory analytical reports;
- quality assurance/quality control validation;
- a comparison of groundwater quality with groundwater quality limits;
- a comparison of groundwater level data with drawdown trigger level threshold;
- figures including inferred groundwater flow direction;
- interpretation of data trends over time; and
- recommendations (if required) for revisions to the monitoring program.

Storage and publishing of monitoring data

A groundwater database will be maintained including groundwater level and quality data against which any potential changes to groundwater can be monitored during subsequent mining operations and into closure.

Due to the low risk and magnitude of impact on third-party bores, GDEs and stygofauna, no additional mitigation or management measures are proposed.

14.3.5.2 Adaptive management strategy

The following section summarises the proposed framework for an adaptive groundwater management strategy, proposed to assist with the management and mitigation of drawdown. The framework of the adaptive management strategy includes the following components which will be defined in the EA.

Drawdown

The current groundwater monitoring network is considered fit for purpose for this assessment and will form the basis for ongoing drawdown monitoring and management through the life of the Project. The groundwater monitoring network may be regularly amended to ensure it remains representative of groundwater conditions and remains fit for purpose.

Monitoring of groundwater levels from the groundwater monitoring network will enable natural groundwater level fluctuations (such as responses to rainfall recharge) to be distinguished from potential groundwater level impacts (drawdown) due to dewatering/depressurisation resulting from proposed mining activities.

Many of the site-specific monitoring bores are situated adjacent to the predicted drawdown zone. Groundwater level data from all monitoring bores within the groundwater monitoring network will be assessed for comparison between actual and modelled drawdowns. This comparison and assessment will be completed in consideration of the DSITI (2017) guidelines for using monitoring data to assess groundwater quality and potential environmental impacts. This assessment will allow for verification of the numerical model predictions. Regular comparisons of the groundwater level observations against the modelled predictions to verify that observations are consistent with model outputs should be undertaken.

14.4 TOR Reconciliation table

Terms of reference - Content requirements of the EIS		EIS Section
Section 14 - Water resources		
14.1	The following guidance is relevant for the assessment of water resources: (a) Queensland Government, Water – EIS information guideline, ESR/2020/5312 (b) Queensland Government, Groundwater dependent ecosystems – EIS information guideline, ESR/2020/5301 (c) Queensland Government, Application requirements for activities with impacts to water, ESR/2015/1837 (d) Queensland Government, Stormwater and environmentally relevant activities, ESR/2015/1653 (e) Queensland Government, Our policies (website), available at: www.dlgwv.qld.gov.au/about-us/our-policies (f) Queensland Government, Requirement for site-specific and amendment applications underground water rights – Guideline, ESR/2016/3275.	Section 14
Water resources - Existing environment		
14.2	Describe the legislative context for water resources in the project footprint and surrounding area, including the Water Act 2000, provisions (e.g. outcomes, strategies and objectives) of the relevant water plan(s), water management protocols and other relevant water planning instruments relevant to the project.	Section 14.1
14.3	Describe, map and illustrate water features within the existing surface water environment in the project footprint, surrounding area and potential impact area including: (a) natural, modified, ephemeral and perennial waterways, watercourses, drainage features, lakes (including waterholes, lagoons, wetlands and swamps) and springs (b) drainage patterns, catchments, stream order, sediment processes and geomorphology (c) hydrology and streamflow characteristics, including the frequency, duration and magnitude of flow events, and seasonal variations (supported by site-specific hydrological modelling) (d) flooding and overland flow patterns, including flood-prone or low-lying land within the project footprint (e) waterways providing for fish passage, and natural or artificial waterway barriers (f) alterations or interferences with the flow regime, including impoundments (dams, weirs, etc.) diversions, levees and stormwater management systems (g) groundwater-surface water interactions, including identification of waterways as gaining or losing streams, and potential for groundwater baseflow to other water features (e.g. wetlands) (h) current and potential surface water uses and users, including supported environmental values (e.g. aquatic ecosystem health), licenced and unlicenced abstraction (including location, purpose and volumes where relevant) their existing condition and the streamflow required to support uses and users	Section 14.2.2

Terms of reference - Content requirements of the EIS		EIS Section
	(i) the significance of water features within the local and regional surface water environment (j) the sensitivity of the surface water environment to change, particularly within the context of project-related changes.	
14.4	Describe, map and illustrate the existing groundwater environment within the project footprint, surrounding area and potential impact area, including for each relevant groundwater formation: (a) its nature, type, geology/lithology, stratigraphy, thickness and depth (b) its hydraulic properties, vertical and horizontal connectivity (including inter-aquifer connectivity, groundwater-surface water interaction and barriers to flow) and the effects of geological structures (e.g. faults and dykes) (c) hydrostratigraphical characteristics including groundwater flow, recharge and discharge, current and historical groundwater levels (supported by hydrographs), seasonal variations and other trends, contours and flow directions (d) current and potential groundwater uses and users, including supported environmental values (e.g. GDEs, water supply bores, etc.), authorised (licenced and unlicenced) abstraction (including purpose and volumes where relevant), location and source of existing groundwater supply facilities (e.g. bores or wells) and the groundwater levels required to support uses and users (e) its significance within the local and regional environment (f) its sensitivity to change, particularly within the context of project-related impacts.	Section 14.3.2
14.5	Develop an ecohydrological conceptual model using illustrations, maps and cross-Sections that represents the groundwater and surface water components and how they interact with ecological and human uses and users within the project footprint, surrounding area and potential impact area in consideration of the Information Guidelines Explanatory Note – Using impact pathway diagrams based on ecohydrological conceptualisation in environmental impact assessment.	Section 14.3.3
14.6	Describe investigation and monitoring programs to support characterisation of the existing water environment (including sediment), and demonstrate that it is supported by sufficiently robust site-specific data, and is in accordance with relevant guidelines and best practice by: (a) justifying the number and spatial extent of monitoring locations (including reference locations), relevant to the existing environment and proposed project activities or infrastructure (b) justifying the frequency and duration of monitoring periods (c) providing monitoring bore stratigraphy and drilling logs (d) describing monitoring and sampling methods and equipment (e) describing any limitations of the monitoring network or dataset (e.g. reliance on third party access) and how and when these limitations will be addressed (f) justifying the representativeness and suitability of the monitoring network to characterise the existing environment, establish baseline conditions (including natural variations) and monitor project-related impacts.	Section 14.2.5.4 Section 14.3.2.4 Section 14.3.5.1

Terms of reference - Content requirements of the EIS		EIS Section
Water resources - Impact assessment		
14.7	Identify the location of all project activities, disturbance footprint and infrastructure in relation to the existing water environment.	Section 14.2.2.4
14.8	Describe and map project water management infrastructure including water storages, regulated structures, inundation areas, drains, diversions, levees, water treatment plant, water pipelines, irrigation areas, discharge points and monitoring points. Provide the flow rate and dimensions of water flow diversions and the dimensions and volumes of impoundments.	Section 14.2.2.4
14.9	Describe the project's water supply requirements for each stage of the project. Identify and evaluate all water supply options for the project, including any options available under the relevant water plan. Detail the source(s)/location(s), type(s) (e.g. potable, raw), volumes required, storage locations, security, availability and quality of supply, expected rates of usage and water treatment requirements.	Section 14.2.3.3
14.10	Describe any temporary or permanent watercourse diversion and include scaled plans and cross-Sections of the proposed diversion. Demonstrate how the proposed functional design of any diversion would address the key principles and achieve each of the outcomes of Works that interfere with water in a watercourse for a resource activity—watercourse diversions authorised under the Water Act 2000 in sufficient detail to facilitate assessment.	Section 14.2.3.2
14.11	Describe the project's direct and indirect water take/interference, including groundwater dewatering, and alteration of drainage characteristics (e.g. diversion or interception of waterways or overland flow) to facilitate project water management.	Section 14.2.3.3 Section 14.3.4.2 Section 14.3.4.3
14.12	Provide a detailed water balance for the project across all project stages. Include groundwater collected during dewatering, and management of incident rainfall on disturbed areas such as spoil piles. Quantify the water balance analysis including evaporative and seepage losses from relevant infrastructure. Identify quantities of water the project will require to release and any proposed measures to reduce the volume of water to be released (suitability and quantities used for dust suppression, irrigation, evaporation, etc.).	Section 14.2.3.4
14.13	Describe and map any waterway barrier works that may interfere with fish passage. Include any upstream inundation areas caused by project infrastructure; and impacts to downstream flow regimes that may impact fisheries resources that are reliant on environmental flows. Measure and document the main channel and bankfull widths of each impacted waterway at representative points throughout the impacted area.	Section 14.2.4.1
14.14	Describe and map any activities or disturbance in, or within 40 metres of, the bed and banks of a watercourse, lake or spring as defined by the Water Act. Describe, map and justify the extraction of materials obtained from the bed and banks of the watercourse, lake or spring. Describe any exemptions or approvals that may be required for these activities and provide the relevant information.	Chapter 18, Flora and Fauna
14.15	Describe the proposed water supply and direct and indirect water usage/interference, including the details and timing of relevant authorisations and approvals (e.g. allocations, licences, agreements, exemptions, unallocated water). Identify the water that is regulated under the relevant legislative instruments, and how it applies/does not apply to the project. Describe how the project, including proposed authorisations and approvals for all project stages (including post-closure), would address and satisfy the relevant criteria in the Water Act 2000 and the relevant water plan(s).	Section 14.2.3.3 Section 14.2.2.3

Terms of reference - Content requirements of the EIS		EIS Section
14.16	If seeking unallocated water as a water supply for the project, as either surface water under the Water Plan (Gulf) 2007 and/or groundwater under the Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017, describe how the project meets the requirements for releasing strategic or state reserve unallocated water under the respective water plan, including: (a) eligibility requirements for accessing strategic or state reserve unallocated water (b) the availability of water in the plan area for the proposed purpose (c) the efficiency of existing and proposed water use practices (d) the impact of the proposed taking of water may have on existing authorisations in the plan area, as well as other known potential projects in the immediate and surrounding area (e) the availability of an alternative water supply for the purpose of which the water is required, including why alternatives are not suitable for the project (f) the impact the proposed taking and use of water may have on natural ecosystems and the environmental outcomes of the water plan (g) impact the proposed taking and use of water may have on cultural and spiritual values under the cultural outcomes of the plan.	N/A
14.17	Supported by hydrological modelling, prepare a detailed water balance for the project including for each stage of the project, considering temporary and long-term water requirements. Identify and assess the impacts of project activities, disturbance and infrastructure on surface water resources, existing or potential water users and uses, and relevant environmental values. Analyse and describe the significance of direct, indirect and cumulative impacts on water features, hydrology and flow characteristics, drainage patterns, sediment processes, geomorphology, groundwater-surface water interactions, and the environmental values supported by these features and characteristics (e.g. dry season refugia, recreation facilities). Analyse and describe the significance of impacts in the context of local and regional water resources, and with reference to provisions of the relevant water plan(s), water management protocols and other water planning instruments relevant to the project.	Section 14.2.3.4
14.18	Develop a numerical groundwater model in accordance with the relevant guidelines that: (a) is consistent with the ecohydrological conceptual model (b) predicts project-only and cumulative groundwater changes to: (i) groundwater drawdown or pressure changes in affected formations (ii) groundwater flows, inter-aquifer connectivity, recharge and discharge (iii) groundwater-surface water connectivity (iv) groundwater uses and users (c) simulates groundwater impacts for the life of project and post closure, with sufficient timeframe to assess long term impacts, evaporation losses from a residual void and potential plume behaviour and aquifers recovery (d) connects model outputs to groundwater monitoring design and defines adaptive management strategies (e.g. drawdown thresholds or contaminant concentrations) (e) is peer reviewed by an independent third-party specialist, and accompanied by a peer review report	Section 14.3.3 Section 14.3.3.3

Terms of reference - Content requirements of the EIS		EIS Section
	(f) is accompanied by a numerical model report that details all relevant parameters, conditions and assumptions used.	
14.19	Supported by numerical groundwater modelling, identify and assess the impacts of project activities, disturbance and infrastructure on groundwater resources and environmental values. Analyse and describe the significance of direct and indirect impacts on aquifers and other relevant groundwater units, including groundwater levels and pressure, groundwater flows, inter-aquifer connectivity, recharge and discharge, groundwater-surface water connectivity, and the environmental values supported by these features and characteristics (e.g. GDEs, water supply bores, etc.). Analyse and describe the significance of impacts in the context of local and regional water resources, and with reference to provisions of the relevant water plan(s) and other relevant water planning instruments relevant to the project.	Section 14.3.3.3
14.20	Provide an assessment against the relevant prescribed solution(s) for any area of regional interest impacted by the project, if relevant.	N/A
Water resources - Mitigation measures		
14.21	Provide a project water management strategy (including site layout and conceptual plans) that details stormwater and wastewater management systems and structures including any significant diversion or interception of overland flow, capacity of onsite detention systems, details of water sensitive urban design measures, sediment basins, discharge locations, and measures to treat, reuse or dispose of water. Demonstrate that project water management systems have been designed to minimise the likelihood of uncontrolled discharges and avoid or minimise impacts to the receiving environment.	Section 14.2.5.1
14.22	Describe proposed measures to avoid, minimise, mitigate or offset the predicted impacts to surface water and groundwater resources, existing or potential water users and uses, and relevant environmental values. Demonstrate how proposed measures are consistent with best practice environmental management.	Section 14.2.5 Section 14.3.5
14.23	Demonstrate how the proposed project will meet the environmental objectives and performance outcomes in Schedule 8 of the EP Regulation.	Section 14.2.1 Section 14.3.1
14.24	Describe how the achievement of water resources objectives in relevant water plan(s) would be monitored, audited, reported, and how corrective/preventative actions and continual improvement would be managed. Provide measurable criteria, standards and/or indicators that will be used to assess the condition of environmental values and the receiving water environment.	Section 14.2.5.4 Section 14.3.5.1
14.25	Provide an assessment against SDAP State code 10: Taking or interfering with water for any assessable operational works that take or interfere with water required for the project, including construction activities, if relevant.	N/A
14.26	Provide an assessment against SDAP State code 15: Removal of quarry material from a watercourse or lake for any assessable operational works required for the project, including construction activities, if relevant.	N/A
14.27	Provide an assessment against SDAP State code 20: Referable dams for any assessable operational works requiring the development of a referable dam required for the project, if relevant.	N/A
Water-related cultural values		
Water-related cultural values - Existing environment		

Terms of reference - Content requirements of the EIS		EIS Section
14.28	Discuss Aboriginal peoples' cultural and spiritual values and water-related cultural use as relevant to the project and recognised under the Human Rights Act 2019.	Section 14.2.2.4
Water-related cultural values - Impact assessment and mitigation measures		
14.29	Describe the project's potential impacts on water-related cultural values, uses and aspirations of water resources for Aboriginal peoples, including consideration for cultural outcomes of the relevant water plans.	Section 14.2.4.5
14.30	Describe how water-related cultural values, uses and aspirations of water resources for Aboriginal peoples will be protected and/or promoted through water allocation and management strategies, relevant to the project.	Section 14.2.5.7
14.31	Where country may be affected by existing or proposed projects in the area, assess the cumulative impacts of these projects on the water-related cultural values, uses and aspirations linked to water for Aboriginal peoples.	Section 14.2.4.6