
Technical report 11

Groundwater impact assessment



Groundwater impact assessment

Hunter Transmission Project

Prepared for the Energy Corporation of NSW

July 2025

Groundwater impact assessment

Hunter Transmission Project

the Energy Corporation of NSW

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Glossary

Term	Definition
Access tracks	Temporary and permanent tracks used to access the project. Refer to <i>Chapter 4 – Project description</i> of the EIS for further details.
Bayswater Power Station	Existing power station at Bayswater, owned by AGL.
Bayswater South switching station	The new switching station that would be constructed south of Bayswater Power Station.
Construction impact area	The area that would be directly impacted by the construction of the project, including (but not limited to) transmission towers and lines, stringing sites, access roads, access tracks, substations, switching stations, adjustments and upgrades to existing lines, communications infrastructure, temporary worker accommodation, construction support sites, laydown areas and utility adjustments.
Construction access routes	Roads used by construction vehicles (light and heavy).
Construction support site	An area used as the base for construction activities, usually for the storage of plant/equipment and materials, processing facilities (concrete batching, aggregate crushing, grinding and screening), maintenance facilities/workshops, staff facilities, firefighting equipment, helicopter landing pad and support facilities, access and parking and wastewater treatment. Some construction support sites would also include temporary worker accommodation. Construction support sites are discussed in <i>section 4.3.5</i> of the EIS.
Critical State significant infrastructure (CSSI) application area	The critical State significant infrastructure (CSSI) application for the HTP covers 5 local government areas (Muswellbrook, Singleton, Cessnock, Central Coast and Lake Macquarie).
Cumulative impact	The combined impacts of the project on a matter with other relevant future projects.
Disturbance area	This is used primarily to assess potential impacts on biodiversity values in <i>Technical Report 1 – Biodiversity development assessment report</i> . Includes the following categories: • Disturbance area A • Disturbance area A (centreline) • Disturbance area B • Disturbance area HZ.
Disturbance area A	The area where vegetation would be completely removed. It includes areas at and around transmission towers (including tower pads and batters), stringing sites, laydown areas, switching stations, substation upgrades, construction support sites, new and upgraded access tracks and road upgrades. Impacts within this area would include sub-surface disturbance from construction activities such as grading, excavation, and full tree removal. With the exception of areas that only require temporary disturbance (i.e. temporary access tracks and stringing sites), this area would also be subject to ongoing maintenance during operation (including vegetation removal to ground level) for operational and safety requirements (including bushfire).
Disturbance area A (centreline)	A 20 m wide centreline area between transmission towers where all vegetation would be removed to ground level during construction. This area would also be subject to ongoing maintenance during operation (i.e. removal to maintain vegetation clearance requirements) for operational and safety requirements (including bushfire).

Term	Definition
Disturbance area B	The area within the transmission line easement, excluding disturbance area A and disturbance area A (centreline), where partial clearing would be undertaken. Removal of vegetation (including trees) would be required if there is a risk of vegetation exceeding the designated clearance heights. These heights are set for operational and safety requirements, including bushfire risk management (indicatively 13.5 m below the conductors at maximum operating temperature). Vegetation with mature growth heights up to 2 m can remain, while vegetation exceeding 2 m will be managed to maintain these clearance heights. This area would be subject to ongoing maintenance during operation.
Disturbance area hazard tree zone (HZ)	Hazard trees are those that have the potential to pose a risk to safe operation of the transmission line by falling onto the transmission towers, conductors and associated infrastructure within the easement. A hazard tree zone has been identified in limited areas on either side of the transmission line easement through LiDAR analysis of tree heights and topography. Hazard tree management would occur during operation to maintain safe operating clearances for the conductors and tower structures. The hazard tree zone will be inspected for trees in the height range of 20 m or more, which is typically in the high-risk category. High-risk category trees will be assessed for structural instability and managed according to the risk present, including tree removal if required.
EnergyCo	The Energy Corporation of New South Wales constituted by section 7 of the <i>NSW Energy and Utilities Administration Act 1987</i> as the NSW Government-controlled statutory authority appointed as the infrastructure planner under the <i>NSW Electricity Infrastructure Investment Act 2020</i> responsible for the delivery of NSW's REZs. The proponent for the HTP.
Eraring Power Station	Existing power station at Eraring operated by Origin Energy.
Exclusion zone	A safe clearance area around the transmission line and towers to protect public safety, the network and to maintain access to the asset. It delineates the area where most land use activities are prohibited. The zone is located within the easement and is defined according to the operational voltage and design of the infrastructure.
Hunter Transmission Project (HTP) or project	The HTP as described in <i>Chapter 4 (Project description)</i> of the EIS and identified in the overview figures of the EIS.
HTP corridor	Comprises: - the transmission line corridor connecting Bayswater South switching station to Olney switching station - the transmission line corridor connecting the Bayswater South switching station to the existing 500 kV transmission line near Bayswater Power Station - the transmission line corridor connecting the Olney switching station to the existing 500 kV transmission line between Eraring and Kemps Creek. The HTP corridor is around 140 m wide.
HTP North, HTP Central and HTP South	3 geographical zones defined as: - HTP North – Bayswater to Broke includes the Bayswater Power Station, major coal mining complexes in the Upper Hunter Valley, Mount Thorley Industrial Estate, Singleton Military Area, and several rural properties generally on the alluvial floodplains of the Hunter River - HTP Central – Pokolbin to Corrabare includes the Pokolbin and Corrabare State forests and the rural residential areas between these forests at Cedar Creek, Millfield and Laguna - HTP South – Olney to Eraring includes the Watagan and Olney State forests, Watagans National Park, the residential areas in Martinsville and Cooranbong, and Eraring Power Station.
Laydown areas	Established to allow for flexibility in construction and to minimise the need for vehicle movements to and from the construction support sites. These would act as temporary staging, storage, and complex plant/equipment setup areas. They would also act as traffic control nodes during construction of the HTP.

Term	Definition
No clearing zone	Areas within the transmission line easement where vegetation removal is not required. These areas would occur where there is sufficient separation of 10m or more between the maximum operating temperature conductor position and the existing vegetation. This area is excluded from the disturbance area.
Olney switching station	The new switching station that would be constructed in Olney State Forest.
Operation impact area	The area that would be occupied by permanent components of the project and/or maintained, including transmission line easements, transmission lines and towers, substations, switching stations, communications infrastructure, maintenance facilities, permanent access roads to substations and switching stations and access tracks to the transmission line easement.
Pre-construction minor works	Activities with a low potential to impact the environment that may be permissible in advance of construction and without the requirement for an approved environmental management strategy/construction management plan.
Project impact area	The area that has been assumed for the purpose of the EIS to be directly affected by the construction and operation of the project. It includes the indicative location of project infrastructure, the area that would be directly disturbed during construction and any easement required during operation.
(the) proponent	The Energy Corporation of NSW (EnergyCo).
Refinement	A change that fits within the limits set by the project description contained in the EIS for the HTP and does not change what the proponent is seeking approval for and/or does not require an amendment to the application for the HTP.
Renewable Energy Zone (REZ)	A geographic area identified and declared by the NSW Government as a Renewable Energy Zone.
Stringing site	Used for the preparation, assembly and operation of stringing equipment to connect the transmission line to the towers. Stringing sites would be positioned along the HTP corridor. On other transmission projects, they may be referred to as 'brake and winch' sites.
Substation	A facility used to increase or decrease voltages between incoming and outgoing lines (e.g. 330 kV to 500 kV).
Switching station	A facility used to connect 2 or more distinct transmission lines of the same designated voltage.
Temporary worker accommodation	Temporary accommodation that would be erected and used during construction to house the construction workforce. Worker accommodation would be located at some construction support sites.
Transgrid	Preferred network operator for the HTP.
Transmission line easement	An area surrounding and including the transmission lines which is a legal proprietary right and allows for ongoing access and maintenance of the transmission lines. Landowners can typically continue to use most of the land within transmission line easements, subject to some restrictions for safety and operational reasons.
Transmission tower	For 500kV transmission lines, this is typically a free-standing steel lattice structure (suspension or tension tower). Transmission towers for the HTP would generally be up to 85 m high.

Abbreviations

µS/cm	microsiemens per centimetre
AIP	NSW Aquifer Interference Policy
BoM	Bureau of meteorology
BoM GDE Atlas	Groundwater Dependent Ecosystem Atlas
CCSI	critical State significant infrastructure
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
DPHI	NSW Department of Planning, Housing and Infrastructure
EIS	Environmental impact statement
EnergyCo	The Energy Corporation of NSW
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GDE	Groundwater dependent ecosystem
GDE Risk Assessment Guidelines	Risk Assessment Guidelines for Groundwater Dependent Ecosystems
Groundwater Assessment Toolbox	Groundwater Assessment Toolbox for Major Projects in NSW
Fractured and Porous Rock WSP	<i>Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016</i>
ha	hectares
HEVAE	high ecological value aquatic ecosystems
HVO	Hunter Valley Operations
HTP, the project	Hunter Transmission Project
km	kilometres
kV	kilovolt
L/s	litres per second
m	metres
mAHD	metres Australian height datum
mbgl	metres below ground level
m/d	metre per day
ML	megalitre
mm	millimetre
MNES	matters of national environmental significance
NOW	NSW Office of Water

NSW	New South Wales
NSW EPA	NSW Environment Protection Authority
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
REZ	Renewable Energy Zone
r_0	radius of influence
SEARs	Secretary's environmental assessment requirements
SSD	State significant development
SSI	State significant infrastructure
S_y	specific yield
Unregulated and Alluvial WSP	<i>Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2022</i>
WAL	water access licence
Water Quality Guidelines	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
WM Act	<i>NSW Water Management Act 2000</i>
WM Regulation	Water Management (General) Regulation 2018
WSP	water sharing plan

Executive summary

ES1.1 Introduction

The Hunter Transmission Project (HTP, the project) involves the construction of a new overhead 500 kilovolt (kV) transmission line of around 110 kilometres connecting the existing 500 kV transmission line at Bayswater to the existing 500 kV transmission line in the Olney State Forest near Eraring in the Hunter region of New South Wales (NSW).

Due to its strategic importance, the NSW Minister for Planning and Public Spaces has declared the HTP to be critical State significant infrastructure (CSSI) under the [NSW Environmental Planning and Assessment Act 1979](#) (EP&A Act).

Under this process, the Energy Corporation of NSW (EnergyCo, the proponent) is required to prepare an environmental impact statement (EIS) in accordance with the [NSW Environmental Planning and Assessment Regulation 2021](#). This Groundwater Assessment accompanies the EIS for the HTP and addresses the [Secretary's environmental assessment requirements](#) (SEARs) issued on 13 August 2024.

The HTP includes:

- a new overhead 500 kilovolt (kV) double circuit transmission line of around 110 kilometres
- 2 new switching stations (Bayswater South and Olney)
- upgrades to the existing Bayswater and Eraring substations
- adjustments and upgrades to existing transmission lines
- property adjustment works to facilitate access to the transmission lines and switching stations
- utility adjustments required for the construction of the transmission network infrastructure
- ancillary works to support construction including road upgrades, establishment of new access tracks and upgrades to existing access tracks, construction support sites (some with temporary worker accommodation), and other construction facilities such as laydown areas.

ES1.2 Assessment methodology

The groundwater study area encompasses the project impact area with a 1-kilometre buffer. This is a suitable area to characterise the existing hydrogeological environment, as it is wider than the predicted extent of any potential impacts of the project on local groundwater sources, and groundwater sensitive receivers.

The assessment of the project-related impacts on groundwater resources and groundwater users considers the requirements of the *Water Management Act 2000* (WM Act), relevant water sharing plans (WSPs) and the *NSW Aquifer Interference Policy* (AIP) (DPI 2012).

To assess potential groundwater risks resulting from the project, the following has been undertaken:

- a desktop review of existing and available information to describe the existing groundwater environment, including publicly available databases relevant to climate, geology and hydrogeology to identify registered groundwater bores and groundwater dependent ecosystems (GDEs) and to characterise groundwater flows within the groundwater study area

- development of a site conceptual model, characterising the existing hydrogeological and groundwater conditions in the study area. The hydrogeological conceptual site model describes the key processes and mechanisms in the hydrological and hydrogeological environment (*see section 5.7*)
- assessment of potential risks to sensitive groundwater environments including GDEs and groundwater users from construction and operation of the project (*see Chapter 6 (Assessment of potential impacts)*)
- qualitative assessment of potential impacts to sensitive receivers from the construction and operation of the project relying on the assessment criteria documented in the AIP (DPI 2012) (*see section 6.2*)
- Identification of potential mitigation measures to avoid, mitigate and manage any potential impacts of the project to groundwater sources, their dependent ecosystems and groundwater users (*see Chapter 8 (Management)*).

ES1.3 Existing environment

ES1.3.1 Groundwater systems

The groundwater study area is in the Hunter region of the Permo-Triassic Sydney Geological Basin, which includes the following main groundwater systems that are generally defined by their host geology and hydrogeological properties:

- Local, shallow groundwater hosted by unconsolidated Quaternary Alluvium associated with the Hunter River and its tributaries in the Hunter Valley floor
- Local to regional groundwater systems associated with the Triassic aged porous sedimentary rock units (Narrabeen Group and the Hawkesbury Sandstone), comprising sandstones and siltstones. These units outcrop in the elevated terrains of the State Forests, forming the south-western boundary of the Hunter Valley
- Local to regional groundwater systems associated with the Permian aged porous sedimentary rock units, comprising sandstones, siltstones and coal measures. The central Hunter Valley floor comprises exposed sedimentary Permian rocks which are overlain by sedimentary Triassic rocks in southwest, and in parts by local shallow alluvium in association with the Hunter River and its tributaries.

ES1.3.2 Hydrogeology

The groundwater study area covers three groundwater sources managed under two WSPs, as follows:

- The Hunter Regulated River Alluvial Water Source and Lower Wollombi Brook Water Source within the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2022*. Groundwater within this WSP is classified by the AIP as highly productive
- The Sydney Basin-North Coast Groundwater Source within the *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016*. Groundwater within this WSP is classified by the AIP as less productive.

ES1.3.3 Sensitive receiving environments

There are 24 registered groundwater bores within the project impact area (including two exploration bores listed as abandoned), with uses across six different licence types; dewatering (1), exploration (2), irrigation (4), monitoring (15), stock and domestic (1), and unknown (1). Two bores within the unknown licence category are listed as abandoned groundwater exploration bores. There are a large number of monitoring bores, assumed to be associated with the mining activity in the area.

The Groundwater Dependent Ecosystem Atlas (BoM GDE Atlas) (Bureau of Meteorology 2018), and from the High Ecological Value Aquatic Ecosystems (HEVAE) GDE Atlas (DEECCW 2024) identifies:

- low, medium and high potential GDEs mapped in the HEVAE dataset predominantly associated with the Hunter River and its tributaries within the alluvial groundwater system
- minor occurrences of GDEs mapped in the lower lying reaches of the Triassic units of the Triassic and Permian sedimentary rock groundwater systems.

There are no high priority culturally significant sites listed in the schedules of the Hunter Unregulated and Alluvial Water Sources WSP and North Coast Fractured and Porous Rock Groundwater Sources WSP.

One groundwater-related culturally significant site (the Wishing Well) was identified within the project impact area. It is located at a major bend in Martinsville Hill Road at the western end of main gully in Wishing Well Forest Park. The site was a once important and well-used spring (Biosis, 2024). However, construction of the project would destroy this heritage item through its removal, and as such, the potential groundwater impacts to this item have not been contemplated as part of this assessment. The assessment of the potential impacts to this item have been considered in the Historic heritage impact statement (Biosis, 2024) (*Technical Report 7 - Historic heritage impact statement*).

ES1.4 Potential impacts during construction

Most potential groundwater related impacts would take place during the project construction phase. Potential impacts to groundwater from construction of the project may include:

- incidental groundwater take during the construction of the transmission line footings at locations that intercept the water table
- changes to groundwater quality, with potential localised changes to groundwater quality from:
 - accidental spills of hazardous materials/chemicals and/or the generation of liquid waste resulting in the contamination of groundwater
 - disturbance of existing contaminated groundwater and/or soils
- accidental damage to the existing landholder bores within the project impact area. There are 24 registered bores identified within the project impact area (including 2 bores listed as abandoned); however, with the implementation of mitigation measures identified in *Chapter 8 (Management)*, impacts are not expected
- temporary reduction in the availability of groundwater at existing groundwater bores from the lowering of groundwater caused by construction of the transmission line footings.

A review of potential groundwater drawdown associated with construction indicates there are no drawdown impacts expected at any high priority GDEs, listed under the WSPs within which the project is located.

The establishment and use of construction support sites are not anticipated to intercept, penetrate or take water from groundwater systems.

ES1.5 Potential impacts during operation

No groundwater take for water supply or incidental uses would occur during project operation.

There would be only minor potential for contamination incidents during the HTP operation relating to accidental spills of hazardous materials and/or chemicals, which would potentially result in the contamination of groundwater. Similar to the construction phase, this would be dependent on the type and extent of contamination, hydrogeological characteristics and management measures.

Small scale changes in flow paths may occur, up to a maximum 2.1 metres, where concrete footings for transmission towers intercept the groundwater table. This is not expected to obstruct or alter local and regional groundwater flow paths. Any potential reductions in recharge from the creation of transmission towers and permanent infrastructure are considered insignificant given the scale of the regional groundwater systems.

ES1.6 Aquifer interference policy – minimal impact considerations

Assessment of the project against the NSW AIP (DPI 2012) level 1 minimal impact criteria concludes:

- the potential project groundwater level drawdown is less than the AIP level 1 minimal impact considerations
- there is no drawdown expected at high priority GDEs
- there would be no change to the existing groundwater quality or beneficial use category.

Therefore, these impacts are assessed as being negligible and acceptable level 1 minimal impacts under the AIP.

ES1.7 Management and mitigation measures

Mitigation measures to avoid or minimise potential impacts to groundwater and groundwater users from the construction and operation of the project are listed in Table ES1. These mainly focus on the project construction phase, given this is when potential impacts to groundwater are most likely to occur. These measures would be included in environmental management plans as part of the HTP Environmental Management Strategy. Specifically, a soil and water management plan will be developed for the project, outlining site specific surface water and groundwater measures to be implemented to prevent potential negative impacts to water resources during the construction and operational phases.

Mitigation measures in other technical papers that are relevant to the management of groundwater include:

- Surface water impact assessment (*Technical Report 10 – Surface water impact assessment*) – surface water, specifically measures which address surface water quality impacts and captured groundwater from excavations
- Contamination preliminary site investigation (*Technical Report 13 - Contamination preliminary site investigation*) – hazards, specifically measures relating to the storage of fuel and oil within the construction disturbance area and accidental disturbance of contaminated material
- Preliminary risk screening (*Technical Report 15 - Preliminary risk screening*) – hazards, specifically measures relating to the storage of fuel and oil within the construction impact area and accidental disturbance of contaminated material.

Table ES1 **Proposed mitigation measures - groundwater**

ID	Project element	Issue	Mitigation measure	Timing
GW1	Construction impact area	Damage and/or removal of existing landholder bores	Bores within the construction impact area will be clearly demarcated to protect the infrastructure from accidental damage. In the instance that accidental damage does occur, make good provisions will apply in accordance with the minimal impact criteria listed in the AIP. This will likely include replacement of a bore in a similar nearby location in consultation with landowners.	Construction
GW2	Incidental groundwater take	Lowering of groundwater levels	All groundwater allocations will be extracted in accordance with the conditions of project approval and where required, associated water access licence(s). Where groundwater is encountered during excavations, any dewatered volumes will be recorded and managed in accordance with the requirements of the <i>WM Act</i>, WM Regulation and project consent conditions.	Construction

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1 Introduction

The Hunter Transmission Project (HTP, the project) involves the construction of a new overhead 500 kilovolt (kV) transmission line of around 110 kilometres connecting the existing 500 kV transmission line at Bayswater to the existing 500 kV transmission line in the Olney State Forest near Eraring in the Hunter region of New South Wales (NSW).

Due to its strategic importance, the NSW Minister for Planning and Public Spaces has declared the HTP to be critical State significant infrastructure (CSSI) under the [NSW Environmental Planning and Assessment Act 1979](#) (EP&A Act).

Under this process, the Energy Corporation of NSW (EnergyCo, the proponent) is required to prepare an environmental impact statement (EIS) in accordance with the [NSW Environmental Planning and Assessment Regulation 2021](#).

This groundwater assessment accompanies the EIS for the HTP and addresses the [Secretary's environmental assessment requirements](#) (SEARs) issued on 13 August 2024 (see Table 1.1).

In addition to the SEARs, advice from several government agencies was received on the HTP. Agency advice relevant to, and considered in, this groundwater assessment is provided on the [Major Projects website](#) maintained by the NSW Department of Planning, Housing and Infrastructure (DPHI).

Table 1.1 HTP SEARs – Groundwater

HTP SEARs:

- An assessment of the impacts of the project on groundwater aquifers and groundwater dependent ecosystems having regard to the *NSW Aquifer Interference Policy* (AIP) and relevant Water Sharing Plans (WSPs).

1.1 Related reports

Other technical papers prepared in support of the EIS that are relevant to this groundwater assessment include:

- Biodiversity development assessment report (WSP 2024b) (*Technical Report 1 - Biodiversity development assessment report*): details the potential groundwater dependent ecosystems relevant to the project, and their potential reliance on groundwater
- Surface water impact assessment (EMM 2024b) (*Technical Report 10 - Surface water impact assessment*): documents the hydraulic context of the project, including a surface water quality assessment.

2 The Hunter Transmission Project

The Hunter Transmission Project (HTP, the project) is critical State significant infrastructure (CSSI). It must be built by the end of 2029 to protect energy security in NSW as the remaining coal-fired power stations close.

The HTP includes:

- a new overhead 500 kilovolt (kV) double circuit transmission line of around 110 kilometres (the HTP corridor)
- 2 new switching stations (Bayswater South and Olney)
- upgrades to the existing Bayswater and Eraring substations
- adjustments and upgrades to existing transmission lines
- property adjustment works to facilitate access to the transmission lines and switching stations
- utility adjustments required for the construction of the transmission network infrastructure
- ancillary works to support construction including road upgrades, establishment of new access tracks and upgrades to existing access tracks, construction support sites (some with temporary worker accommodation), and other construction facilities such as laydown areas.

The new transmission line would transport electricity generated in the Central-West Orana and New England Renewable Energy Zones (REZs). It would connect the existing 500 kV transmission line at Bayswater to the existing 500 kV transmission line in the Olney State Forest near Eraring. This would strengthen the State's core electricity grid and supply clean and reliable energy to NSW consumers for generations to come.

The HTP involves development across 5 local government areas (Muswellbrook, Singleton, Cessnock, Central Coast and Lake Macquarie). Most of this development would be concentrated in and around the HTP corridor.

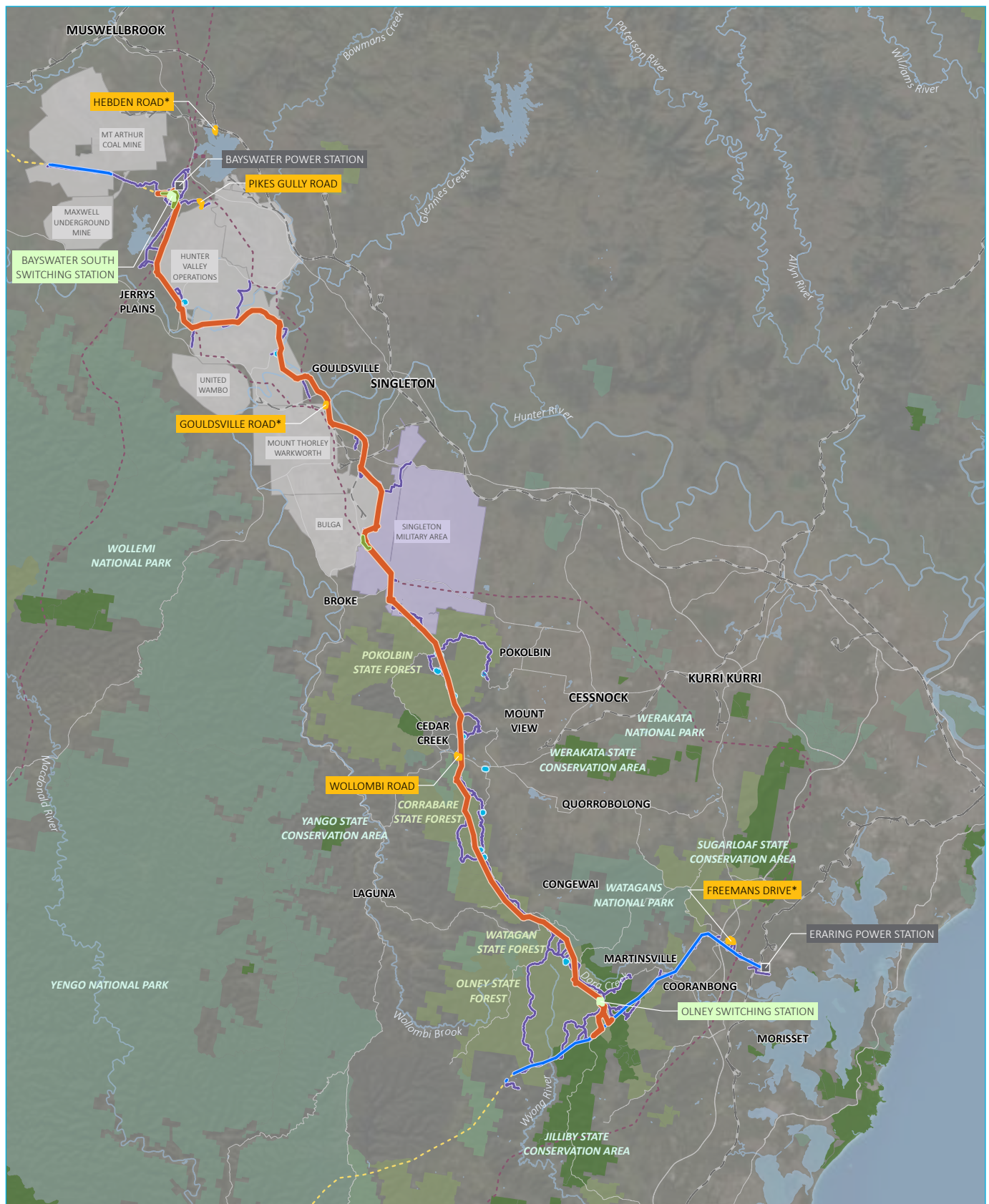
An overview of the HTP is provided in Table 2.1 and shown in Figure 2.1. The key project elements are shown in Figure 2.2.

Further details are provided in *Chapter 4 (Project description)* of the HTP environmental impact statement (EIS).

Table 2.1 **Project overview**

The project	• The critical State significant infrastructure application for the HTP covers 5 local government areas • Most development would be concentrated in and around the HTP corridor. Some ancillary development such as construction support sites and temporary worker accommodation, road upgrades and laydown areas would be outside the HTP corridor
Project impact area	• The area that has been assumed for the purpose of this EIS to be directly affected by the construction and operation of the project. It includes the indicative location of project infrastructure, the area that would be directly disturbed during construction and any easement required during operation.
Construction and operation	• Construction impact area around 2351 ha • Operation impact area around 1261 ha
Disturbance area	• Disturbance area around 1266 ha • Disturbance area A around 683 ha • Disturbance area A (centreline) around 214 ha • Disturbance area B around 367 ha • Disturbance area HZ around 1.84 ha
New transmission line and transmission towers	• Overhead 500 kV double circuit transmission line of around 110 km between Bayswater South 500 kV switching station and Olney 500 kV switching station • Steel lattice towers generally up to 85 m high and that are spaced anywhere between 75 m to around 1.3 km apart (typically between 300 m and 600 m) • 500 kV transmission lines with a minimum ground clearance of 13.5 m • Ancillary infrastructure such as earth wire and communications systems • Construction easement of around 140 m wide • Operational easement around 70 m wide
Switching stations/ substation works	• New Bayswater South 500 kV switching station – construction impact area around 26.6 ha • Modifications at the existing Bayswater 500 kV/330 kV substation within the existing footprint • New Olney 500 kV switching station – construction impact area around 20 ha • Augmentation and modifications at the existing Eraring 500 kV/330 kV substation, including installation of 2 new transformers
Adjustments and crossings - existing transmission lines	• Adjustments to existing double circuit 500 kV transmission lines: – Line 5A1 and 5A2: Eraring – Kemps Creek 500 kV at Ravensdale to connect to the new Olney 500 kV switching station – Line 5A3: Bayswater – Mt Piper 500 kV at Bayswater to connect to the new Bayswater South 500 kV switching station – Line 5A4: Bayswater – Wollar 500 kV at Bayswater to connect to the new Bayswater South 500 kV switching station • Adjustments to existing double circuit 330 kV transmission lines: – Line 31: Bayswater – Regentville 330 kV – Line 32: Bayswater – Sydney West 330 kV – Line 81: Newcastle – Liddell 330 kV • Crossing of existing double circuit 330 kV transmission lines: – Line 31: Bayswater – Regentville 330 kV at Bayswater – Line 32: Bayswater – Sydney West 330 kV at Bayswater – Line 81: 330 kV: Newcastle – Liddell 330 kV at Lemington and again at the Singleton Military Area • Line 82: 330 kV: Tomago – Liddell 300 kV at Warkworth and again at the Singleton Military Area

Upgrades – existing transmission lines and towers	• Upgraded earth wire on Line 5A3 and Line 5A4 • Upgraded earth wire and communications systems on Line 5A1 and Line 5A2 • Tower strengthening on various existing towers on Line 5A1, Line 5A2, Line 5A3 and Line 5A4
Road works	• Modifications to the existing public road network • New and upgraded access tracks for construction and operation
Construction support sites	• Five construction support sites: Hebden Road, Pikes Gully Road, Gouldsville Road, Wollombi Road and Freemans Drive • Helicopter pads (helipads) indicatively at: Hebden Road, Pikes Gully Road, Gouldsville Road and Freemans Drive
Ancillary sites	• Laydown areas, which would be established to allow for flexibility in construction and to minimise the need for vehicle movements to and from the construction support sites
Utility adjustments	• Third party utility works including gas, telecommunications, water, sewer and stormwater
Timing	• Construction to start in 2027 • Operation by end of 2029



KEY

Project impact area

- HTP corridor
- Switching station
- Construction support site (*with temporary worker accommodation)
- Laydown area
- Adjustment to existing transmission line
- Upgrades to existing transmission line
- Access track

Existing environment

- Power station
- 330 kV transmission line
- 500 kV transmission line
- Railway
- Major road
- Named watercourse

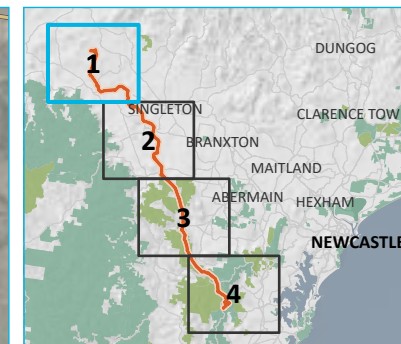
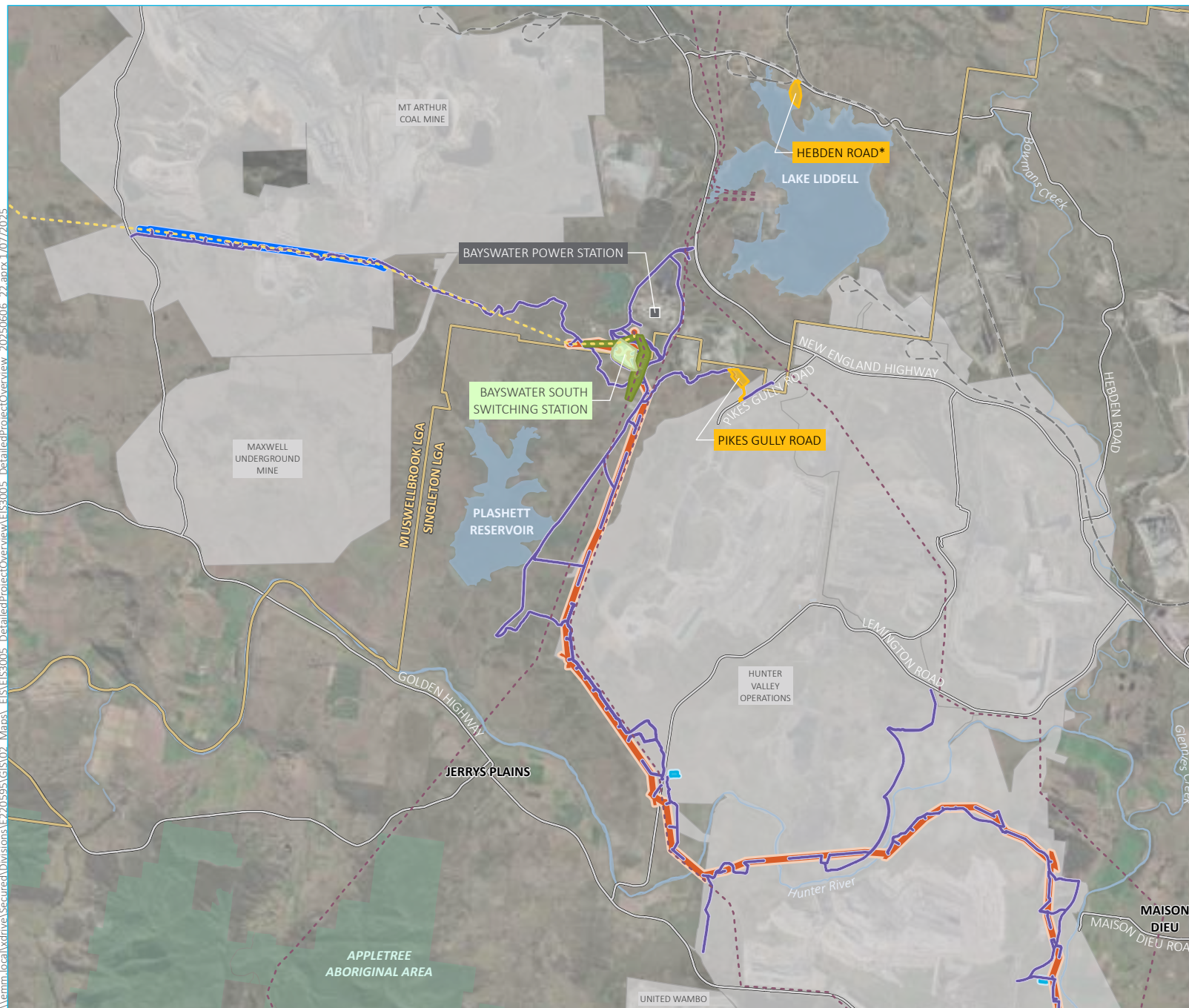
Named waterbody

- NPWS reserve
- State conservation area
- State forest
- Defence
- Mining

Project overview

Hunter Transmission Project Groundwater Assessment Figure 2.1

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KEY

Project impact area

- HTP corridor
- Bayswater South switching station
- Construction support site (*with temporary worker accommodation)
- Laydown area
- Adjustment to existing transmission line (lines 31 and 32)
- Upgrades to existing transmission line (lines 5A3 and 5A4)
- Access track

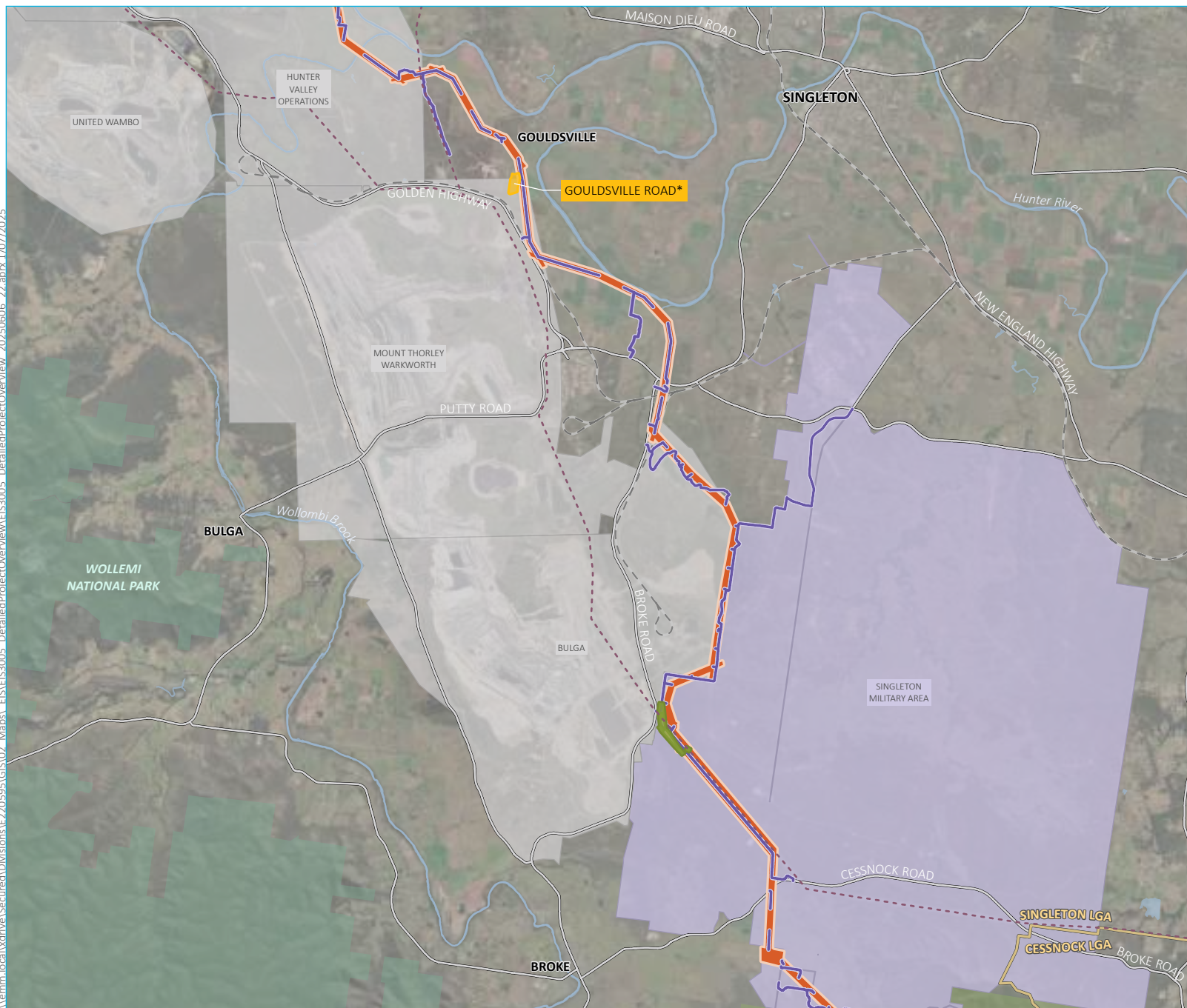
Existing environment

- Power station
- 330 kV transmission line
- 500 kV transmission line
- Railway
- Major road
- Named watercourse
- Named waterbody
- NPWS reserve
- Mining
- Local government area

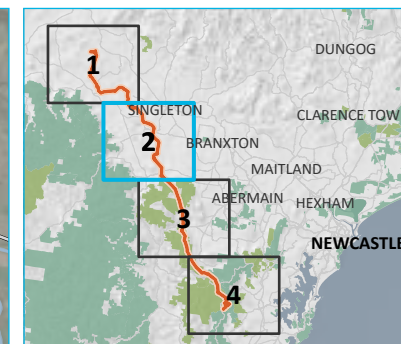
Key project elements Map 1 of 4

Hunter Transmission Project
Groundwater Assessment
Figure 2.2

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Source: EMM (2025); Beca (2025); ESRI (2025); DCSSS (2024); FCNSW (2022); ABS (2021); DFSI (2017); GA (2009)



KEY

Project impact area

HTP corridor

Construction support site (*with temporary worker accommodation)

Adjustment to existing transmission line (line 81)

Access track

Existing environment

330 kV transmission line

Railway

Major road

Named watercourse

Named waterbody

NPWS reserve

State forest

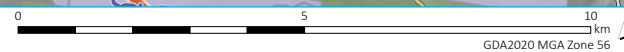
Defence

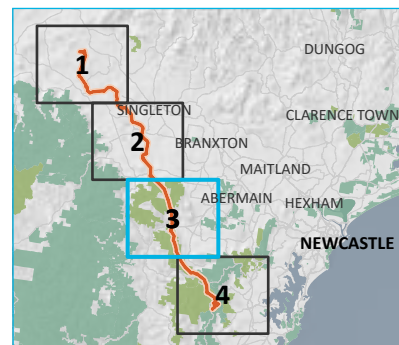
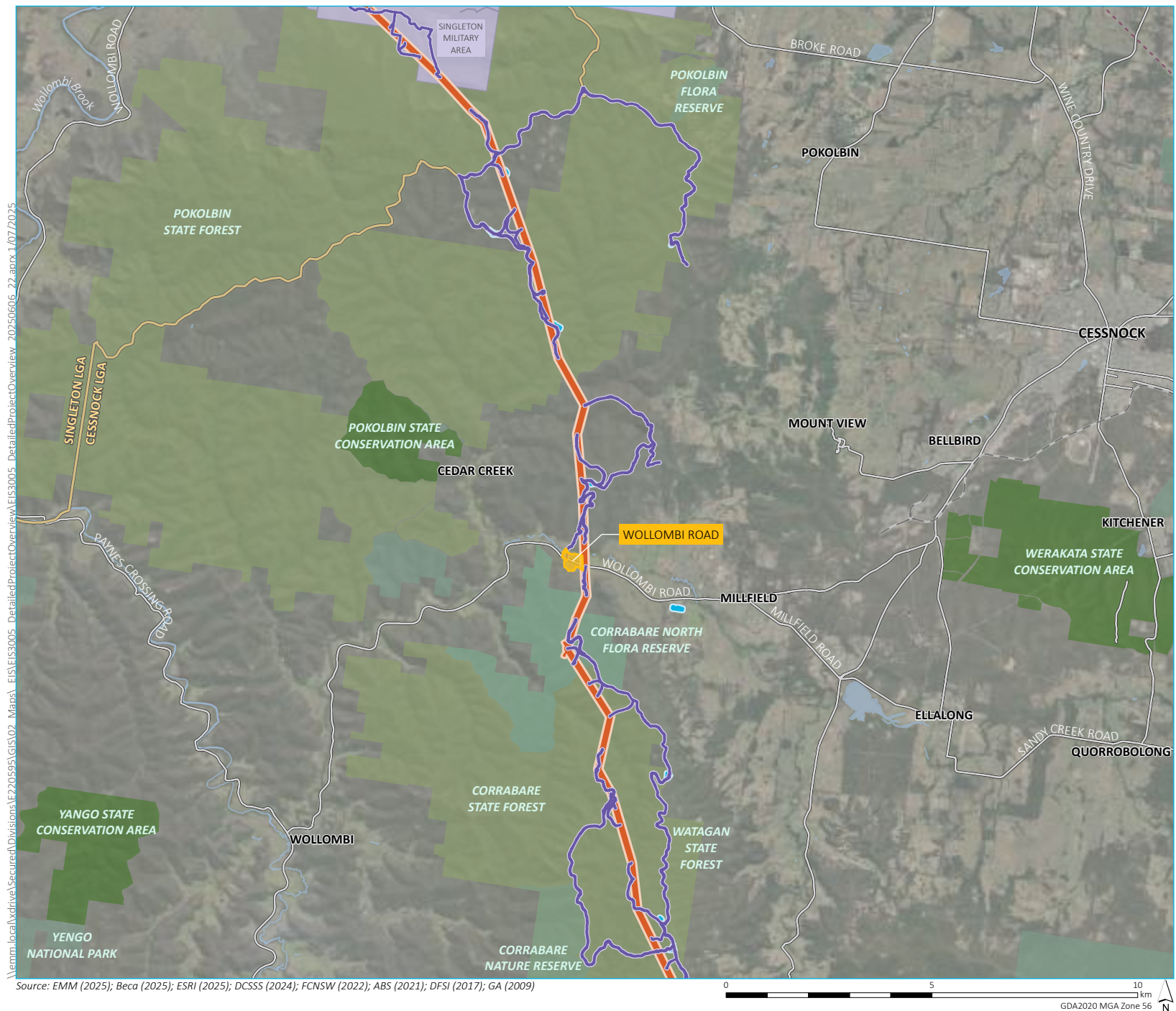
Mining

Local government area

Key project elements
Map 2 of 4

Hunter Transmission Project
Groundwater Assessment
Figure 2.2

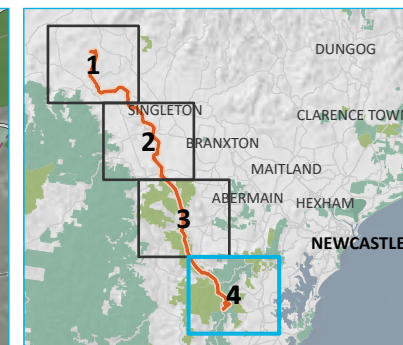
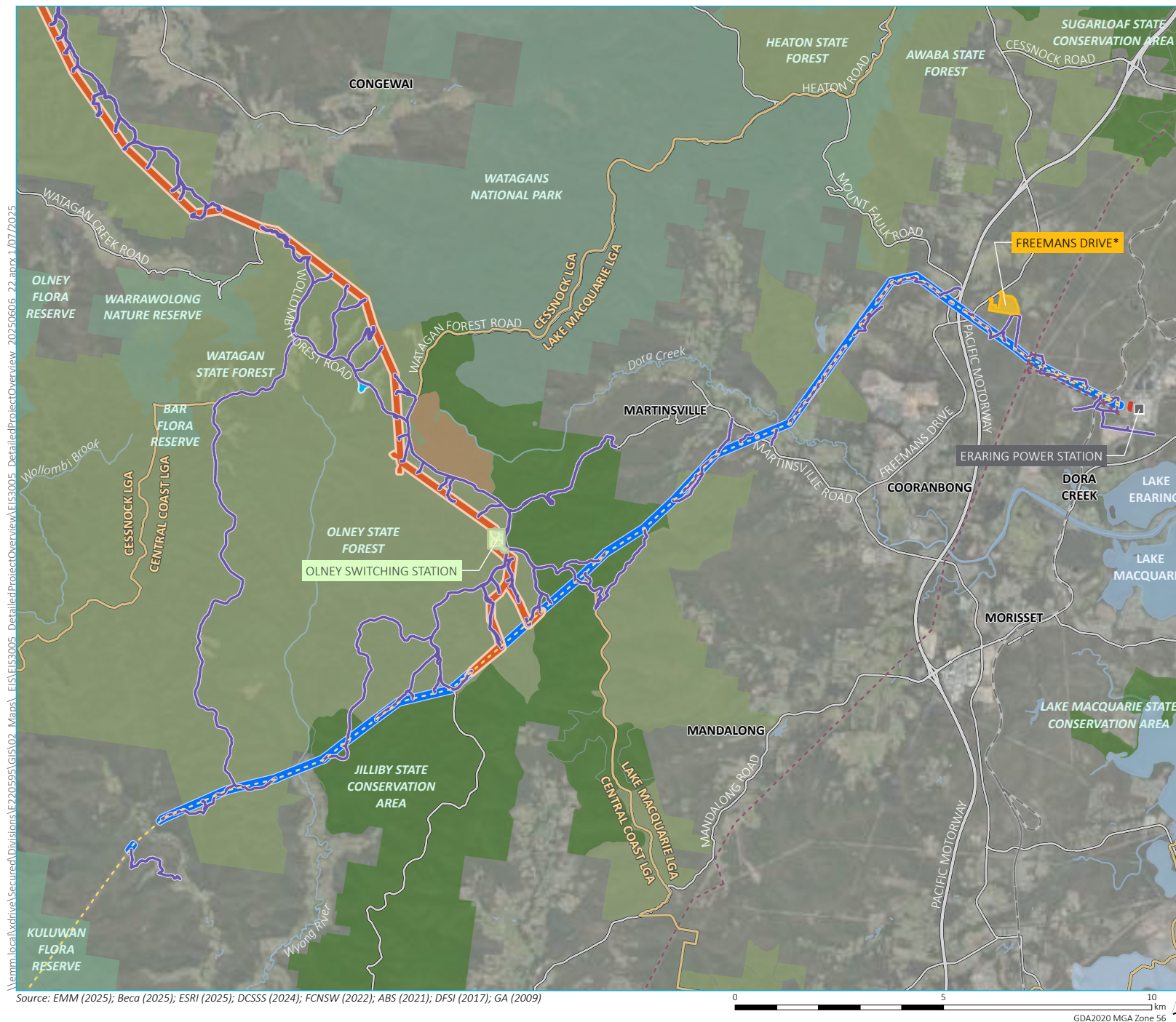




- KEY**
- Project impact area
 - HTP corridor
 - Construction support site (*with temporary worker accommodation)
 - Laydown area
 - Access track
 - Existing environment
 - 330 kV transmission line
 - Railway
 - Major road
 - Named watercourse
 - Named waterbody
 - NPWS reserve
 - State conservation area
 - State forest
 - Defence
 - Local government area

Key project elements
Map 3 of 4

Hunter Transmission Project
Groundwater Assessment
Figure 2.2



KEY

Project impact area

- HTP corridor
- Olney switching station
- Construction support site (*with temporary worker accommodation)
- Laydown area
- Eraring Substation upgrade
- Upgrades to existing transmission line (lines 5A1 and 5A2)
- Access track

Existing environment

- Power station
- 330 kV transmission line
- 500 kV transmission line
- Railway
- Major road
- Named watercourse
- Named waterbody
- NPWS reserve
- State conservation area
- State forest
- Recreation area
- Local government area

Key project elements
Map 4 of 4

Hunter Transmission Project
Groundwater Assessment
Figure 2.2

2.1 Construction methods relevant to the assessment of potential construction groundwater impact

2.1.1 Transmission tower foundation construction

Transmission line tower foundations would typically consist of pile foundations. Some alternative tower foundations may be required at targeted locations due to the anticipated geotechnical conditions (such as areas of unconsolidated fill within mining lease areas or alluvium within the floodplain) and/or due to being located within areas of steep terrain. Tower piles would typically consist of bored, cast in-situ piles with reinforced concrete. Pile depths and diameters would vary depending on the type of tower, depth at which rock is encountered and the geotechnical conditions encountered during construction. Pile depths would typically range from between 9.5 to 21 metres below ground level (mbgl) and range in diameter between 500 and 1200 millimetres.

Groundwater is expected to be encountered during piling for tower foundations at some locations, most commonly within the Hunter Valley floor and floodplains. It is assumed that dewatering of the piles would occur once, during the concrete pour process, with concrete being poured into the excavated pile and water removed from the pile as it is displaced by the concrete.

Subsurface excavations for the construction of other project infrastructure are considered unlikely to intercept groundwater, given their shallow nature and the depth of groundwater in these locations. In particular, this has been reviewed for the Olney and Bayswater substations, and the maximum excavation depths for both substations are above the expected water table.

2.1.2 Construction water supply

It is estimated that a total of 790 megalitres per year of water would be required for the construction of the project. This includes 85 megalitres per year of potable water that would be required for amenities at the accommodation facilities and construction compounds, as well as for concrete batching activities. Non-potable water sources will be prioritised for the remaining 705 megalitres per year of water demand for construction activities such as dust suppression, road construction, landscaping and earthworks.

A range of water supply options have been identified and considered in terms of suitability to support the construction of the project, and to demonstrate that there is enough supply in the market to meet the estimated project water demand during construction. These water supply options are described in detail in *Chapter 4 (Project description)* of the HTP EIS. A combination of water sources would be required to meet the total potable and non-potable water demand. The available water supply volumes for each of these water sources would be confirmed as part of the future detailed design and construction planning phases of the project.

Potable water at accommodation facilities and construction compounds would be supplied by Hunter Water Corporation or Singleton Council via a new direct connection to existing reticulated water systems or via standpipes and transported to water use locations by water tankers.

Non-potable water sources would include:

- reuse of construction water, this would be prioritised and would include incidental catchment runoff captured by sediment basins and groundwater inflows into subsurface excavations below the water table
- recycled wastewater from wastewater treatment facilities
- reuse of mine water from mining operations in the vicinity of the project, subject to negotiation with mine operators to determine availability, water quality and access requirements

- water extraction from surface water sources, with preference given to water supply locations with existing infrastructure, subject to agreement with relevant stakeholders. This could include the Hunter River which would be accessed via the Mount Thorley Joint Venture water supply scheme
- water extraction via existing licensed groundwater bores, particularly in areas where access to alternative water sources is restricted.

Groundwater supply bores are further discussed in *section 2.1.2i*. The other water supply options are further discussed in the Surface water assessment (EMM 2024b) (*Technical Report 10 - Surface water impact assessment*).

i Use of groundwater via existing licensed groundwater bores

As part of the project's water supply strategy, where feasible and reasonable, extraction of groundwater from existing licensed sources would be considered as a potential source of construction water. Preliminary desktop investigations have identified that there is up to 5500 megalitres per year of entitlements from active, non-mining licensed groundwater bores within 5 kilometres of the project impact area. These licenses are largely assigned for irrigation or farming purposes.

Should the construction contractor (once appointed) enter negotiations for the temporary use of any existing groundwater bores with the licence holder(s), the authorised use of these existing licenced groundwater bores would be converted to cover the intended use for construction water supply. The water entitlements associated with the respective water access licences (WALs) would be available for use as part of construction water supply, should they become available for use.

While ordinarily a change in the water use purpose would require approval from the NSW Department of Climate Change, Energy, the Environment and Water, the project has been declared SSI under section 5.12(4) and section 5.13 of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) by the NSW Minister for Planning and Public Spaces in July 2022. By virtue of the SSI declaration, a water use approval under section 89 of the *NSW Water Management Act 2000* is not required for the project in the event that this water supply option is pursued.

3 Legislation, policies, plans and guidelines

3.1 Commonwealth legislation

3.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places which are defined as ‘matters of national environmental significance’ (MNES) as well as impacts to Commonwealth land.

The EPBC Act is relevant to the groundwater assessment of the Hunter Transmission Project (HTP, the project) in instances where impacts from construction and/or operation of the project occur at locations where groundwater is shown to support MNES, such as groundwater dependent ecosystems (GDEs).

The HTP is likely to be a controlled action under the EPBC Act because it could have a significant impact on several listed threatened species or communities, which is one of the 9 MNES, as well as impacts to the Singleton Military Area, which is Commonwealth land.

Under section 68 of the EPBC Act, the Energy Corporation of NSW (EnergyCo) has referred the HTP to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) to confirm whether it is a controlled action. The project was declared a controlled action on 3 February 2025 under section 133 of the EPBC Act. The project will be assessed under the NSW bilateral agreement, which enables the project to be assessed by NSW on behalf of the Australian Government.

3.2 NSW Legislation

3.2.1 Water Management Act 2000 and Water Management (General) Regulation 2018

The primary legislation for managing water resources in NSW is the NSW *Water Management Act 2000* (WM Act), which provides for sustainable and integrated management of the State’s water for the benefit of both present and future generations. Relevant to the project, it sets the framework for sharing the state’s water resources, statutory rights, licences and approvals that allow for taking and using of water, including surface water and groundwater. It also establishes the mechanisms for acquiring licences and approvals, and for trading licences and the water allocations associated with these. The WM Act must be administered in accordance with, and so as to promote, its broad ranging water management principles set out in section 5.

The WM Act is supported by the Water Management (General) Regulation 2018 (WM Regulation). The regulation specifies important procedural and technical matters related to the administration of the WM Act and also specifies exemptions from licensing and approvals requirements provided for under the WM Act. Under the WM Act, unless authorised under a basic landholder right or exempt under the WM Regulation, it is an offence to take water from a water source without an access licence, and to construct or use a water supply work and to use water on land without a water supply work approval and a water use approval. Again, unless exempt, it is also an offence to erect a building, carry out a work, remove or deposit material, or carrying out any other activity that affects the quantity or flow of water in a water source in, on or under waterfront land without a controlled activity approval.

An amendment to the WM Regulation, which came into effect on 6 June 2025 provides an exemption from requiring a water access licence (WAL) for groundwater take in connection with the construction of essential infrastructure by a public authority. The exemption applies to the project as electricity generation, transmission and distribution is defined to be essential infrastructure and EnergyCo is a public authority. While a WAL is no longer required, mandatory recording and reporting requirements for groundwater take still apply under this exemption.

Approved State significant development (SSD) and State significant infrastructure (SSI) projects do not require water supply work, water use or controlled activity approvals under the WM Act, in accordance with section 4.41(g) and section 5.23(g) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The intent of these exemptions is for the proponent to avoid the need to seek duplicate assessment and approvals. This exemption applies to the project. However, there remains a requirement that all approval related works and activities be adequately assessed to DCCEEW's satisfaction as part of this project impact assessment process. This ensures the construction and use of works adequately considers and mitigates potential impacts on water sources and dependent ecosystems or on access to water by other authorised water users.

3.2.2 Water sharing plans

Water sharing plans (WSPs) are statutory documents developed under the WM Act that establish the rules for the sustainable sharing of water between the environment and water users, and between different types of water use at a water source scale and for specific water resource types (regulated rivers, unregulated rivers and groundwater).

WSPs provide a legal basis for sharing of water between the environment and consumptive purposes. Long-term average annual extraction limits are set by WSPs to define the limit of water that can sustainably be taken for all purposes. Sharing of water is prioritised for the environment, with planned environmental water prescribed under the rules of a WSP to protect the fundamental health of a river or aquifer and the ecosystems that depend on it. Requirements for unlicensed basic landholder rights and licensed water users are also specified within WSPs.

Amongst licensed water users, priority is given to water utilities and licensed domestic and stock use ahead of commercial purposes such as irrigation and mining. The WSPs contain rules that determine and share the water available for take from time to time for different categories of use. They also set the rules for managing water in licence accounts, for trading licence entitlements and allocations, and for managing the works used to take licensed water.

Groundwater across the project impact area is administered under the following WSPs:

- *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2022* (Unregulated and Alluvial WSP). Groundwater is contained in the unconsolidated alluvial (Cenozoic) sediments associated with rivers and coastal floodplains of the Hunter River catchment. The water sources include:
 - a) all surface water and water occurring on the surface of the ground in estuaries
 - b) all groundwater contained in Cenozoic sediments, other than the following:
 - i) water to which the WSP for the North Coast Coastal Sands Groundwater Sources 2016 applies
 - ii) water contained in the Hunter Coastal Floodplain Alluvial Groundwater Source
 - iii) water contained in the Hunter Regulated River Alluvial Water Source
 - iv) water contained in the Lake Macquarie Coastal Floodplain Alluvial Groundwater Source.
- *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016* (Fractured and Porous Rock WSP). The relevant water source is the Sydney Basin–North Coast Groundwater Source, within which groundwater is contained in Triassic-aged porous sedimentary sandstone and siltstone rock units, and Permian-aged porous sedimentary sandstone, siltstone and coal measures rock units.

The groundwater sources include all water contained within all aquifers below the surface, except where the Fractured and Porous Rock WSP underlies the alluvial sediments mapped in the Unregulated and Alluvial WSP.

Table 3.1 shows the WSPs and water sources in the vicinity of the project impact area, with their locations shown in Figure 3.1. Total aquifer access licence entitlement shares in the relevant water sources are also shown in Table 3.1. There are other smaller areas of alluvium within the assessment areas; however, these have not been considered further due to their relatively small extent and paucity of aquifer access licence entitlements.

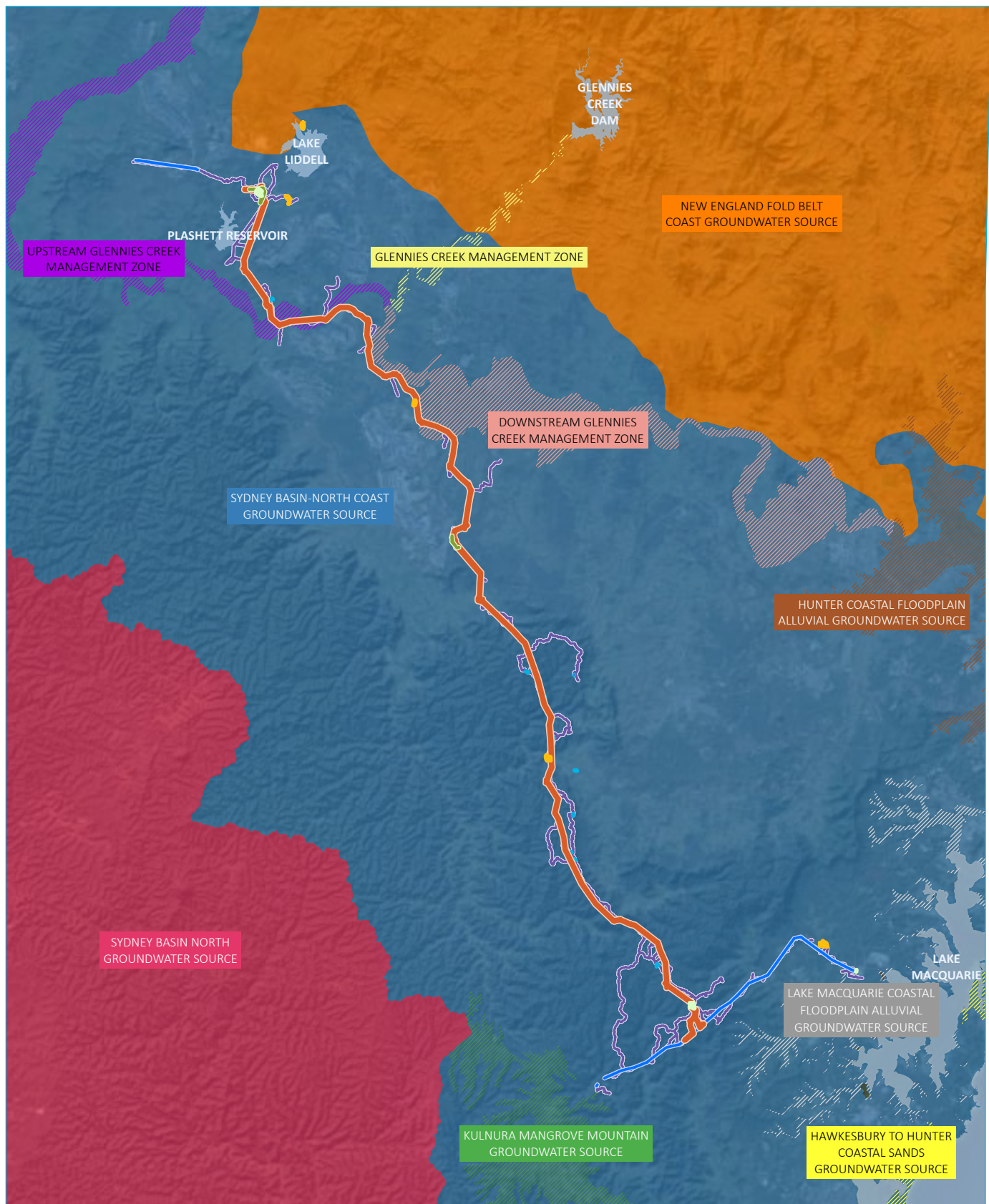
Table 3.1 Groundwater entitlement and licensing overview

WSP	Groundwater source	Management zone	Entitlement in aquifer access licence WAL category (shares)	Number of licences in aquifer access licence WAL category
Fractured and Porous Rock WSP	Sydney Basin-North Coast Groundwater Source	N/A	68,283.5	173
Unregulated and Alluvial WSP	Hunter Regulated River Alluvial Water Source	Upstream Glennies Creek	15,937	127
		Downstream Glennies Creek	7599	91
	Lower Wollombi Brook Water Source	N/A	3745	42

Notes: 1. For all these water sources, trade to or from another water source is prohibited.
N/A = no management zone.

3.2.3 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) administered by the NSW Environment Protection Authority (EPA) is the key piece of environment protection legislation. The POEO Act enables the government to set protection of the environment policies that provide environmental standards, goals, protocols and guidelines. Established to prevent the degradation of the environment, the POEO Act regulates air and water pollution, noise control and waste management for projects. Section 120 of the POEO Act makes it an offence to cause water pollution.



Source: EMM (2025); Beca (2025); DPIE (2024); ABS (2021); DCSSS (2024); ESRI (2024); GA (2009); DPE (2024)

KEY

- HTP corridor
- Switching station
- Construction support site
- Laydown area
- Adjustment to existing transmission line
- Upgrades to existing transmission line
- Access track
- Named waterbody
- Greater Metropolitan Region Groundwater WSP
- Sydney Basin North Groundwater Source

North Coast Fractured and Porous Rock Groundwater WSP

- Kulnura Mangrove Mountain Groundwater Source
- New England Fold Belt Coast Groundwater Source
- Sydney Basin-North Coast Groundwater Source

North Coast Coastal Sands Groundwater WSP

- Hawkesbury to Hunter Coastal Sands Groundwater Source

Hunter Unregulated and Alluvial WSP

- Hunter Coastal Floodplain Alluvial Groundwater Source
- Lake Macquarie Coastal Floodplain Alluvial Groundwater Source

Hunter Regulated River Alluvial Water Source

- Downstream Glennies Creek Management Zone
- Glennies Creek Management Zone
- Upstream Glennies Creek Management Zone

Groundwater water sharing plan boundaries

Hunter Transmission Project
Groundwater Assessment
Figure 3.1



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3.3 Relevant NSW policies

3.3.1 NSW Aquifer Interference Policy 2012

The NSW *Aquifer Interference Policy* (AIP) (DPI 2012) sets out the role and requirements of the Minister administering the WM Act in the water licensing and assessment processes for aquifer interference activities. The WM Act defines an aquifer interference activity as an activity involving any of the following:

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

The AIP specifically refers to ‘take’ that is ‘required to allow for the effective and safe operation of an activity’, regardless of whether the water taken will be used. The take, use and incidental interception of groundwater must be licensed. The AIP states that, unless specifically exempt, a WAL is required under the WM Act where any act by a person carrying out an aquifer interference activity causes:

- the removal of water from a water source
- the movement of water from one part of an aquifer to another part of an aquifer
- the movement of water from one water source to another water source, such as:
 - from an aquifer to an adjacent aquifer
 - from an aquifer to a river/lake, or
 - from a river/lake to an aquifer.

The AIP specifies that the project licensing requirement should consider adjacent and overlying water sources. Should the project cause water to inflow and subsequently take from an adjacent water source, a licence for that volume is required from that adjacent water source.

AIP Fact Sheet 3 (DPI 2013) provides guidance on licensing and accounting for water take. Water can be taken directly from a groundwater or surface water source, for example via a pump (in a river or an excavated area) or bore. It can also be taken indirectly when an aquifer interference activity causes water to flow from another connected surface water or groundwater source. Flows induced from other water sources also constitute take of water. In all cases, WALs are required to account for the take from all individual water sources.

The WM Act requires that there be ‘no more than minimal harm’ done to a water source or its dependent ecosystems as a result of an aquifer interference activity. The minimal impact considerations are defined in the AIP.

The AIP defines water sources as being either ‘highly productive’ or ‘less productive’ based on levels of salinity and average available yields. Specifically, highly productive groundwater sources have a measurement of total dissolved solids less than 1500 milligrams per litre and can sustain yields greater than 5 litres per second; less production groundwater sources have a measurement of total dissolved solids greater than 1500 milligrams per litre and cannot sustain yields greater than 5 litres per second.

The AIP categorises water sources by lithological character or hydrostratigraphic unit, being one of alluvium, coastal sand, porous rock or fractured rock, and identifies thresholds for minimal impact considerations. Based on the NSW Government's mapped areas of groundwater productivity in NSW, the project impact area is predominantly within a 'less productive' porous rock and alluvial sources. This is relevant for the porous and fractured rock Permian groundwater systems, the porous and fractured rock Triassic groundwater systems and most of the alluvial groundwater systems. There is some alluvial groundwater mapped as 'highly productive' immediately adjacent to the Hunter River, however based on yield data this may be erroneous.

For each category of water source, the AIP identifies thresholds for minimal impact considerations. These thresholds relate to impacts on the watertable, water pressure and water quality, and are ranked as being either 'level 1 minimal impact' or 'level 2 exceeding minimal impact'. The minimal impact criteria relevant to the assessment of the project are outlined in *section 4.6.1*.

3.4 Relevant guidelines

3.4.1 Groundwater Assessment Toolbox for Major Projects in NSW

DPE Water (now NSW DCCEEW) has developed a *Groundwater Assessment Toolbox for Major Projects in NSW* (Groundwater Assessment Toolbox) (DPE Water 2022a), which aims to create a collaborative, transparent and enabling environment for the preparation and review of groundwater assessments for major projects in NSW. The documents provide a framework to investigate, assess the impacts on, manage and monitor groundwater resources and their interaction with surface water resources within the footprint of a major project.

The Groundwater Assessment Toolbox is a complementary guidance document that comprises the following documents:

- *Guidelines for Groundwater Documentation for SSD/SSI Projects* (DPE Water 2022b)
- *Minimum Requirements for Groundwater Modelling* (DPE Water 2022c)
- *Cumulative Groundwater Impact Assessment Approaches* (DPE Water 2022d).

These documents denote the role of the NSW Government in project assessment, and the continuation of guidance on and review of post-approvals monitoring and management plans, and compliance reporting.

3.4.2 Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Water Quality Guidelines) (ANZECC & ARMCANZ 2018) describe the water quality objectives for marine and freshwater environments, aquatic ecosystems, primary industries, and recreational water. These guidelines provide an agreed framework to assess water quality in terms of whether the water is suitable for a range of environmental values.

An environmental and community value is defined in the Water Quality Guidelines as a particular value or use of the environment that is important for a healthy ecosystem or for public benefit, health, safety or welfare, and requires protection from the effects of stressors. For groundwater systems, the term 'beneficial use' is also often used to describe environmental and community values. For each catchment in NSW, the Government has endorsed the community's environmental values for water, known as 'Water Quality Objectives'.

Environmental and community values recognised by the Water Quality Guidelines are listed in Figure 3.2.

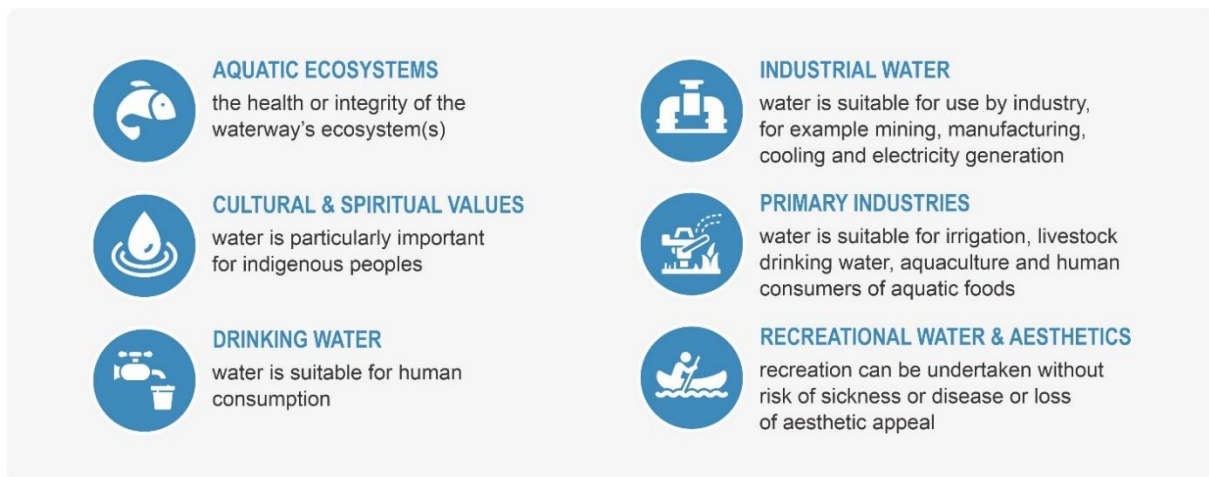


Figure 3.2 Environmental and community values

Groundwater in the groundwater study area has the following environmental and community values:

- aquatic and terrestrial ecosystems potentially relying on groundwater
- potential cultural and spiritual values, with no known cultural or spiritual relationships
- industrial water
- primary industries
- recreational water and aesthetics.

3.4.3 Risk assessment guidelines for groundwater dependent ecosystems

The *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (NSW Office of Water (NOW) 2012) (GDE Risk Assessment Guidelines) are the NSW requirements for assessment and management of groundwater dependent ecosystems (GDEs) under the WM Act. The dictionary to the Greater Metropolitan Region Groundwater Sources WSP provides that:

groundwater dependent ecosystems include ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater.

The GDE Risk Assessment Guidelines provide that GDEs:

explicitly include any ecosystem that uses groundwater at any time or for any duration in order to maintain its composition and condition.

An ecosystem's dependence on groundwater can be variable, ranging from partial and infrequent dependence (i.e. seasonal or episodic (facultative)) to total continual dependence (entire/obligate) (see Figure 3.3).

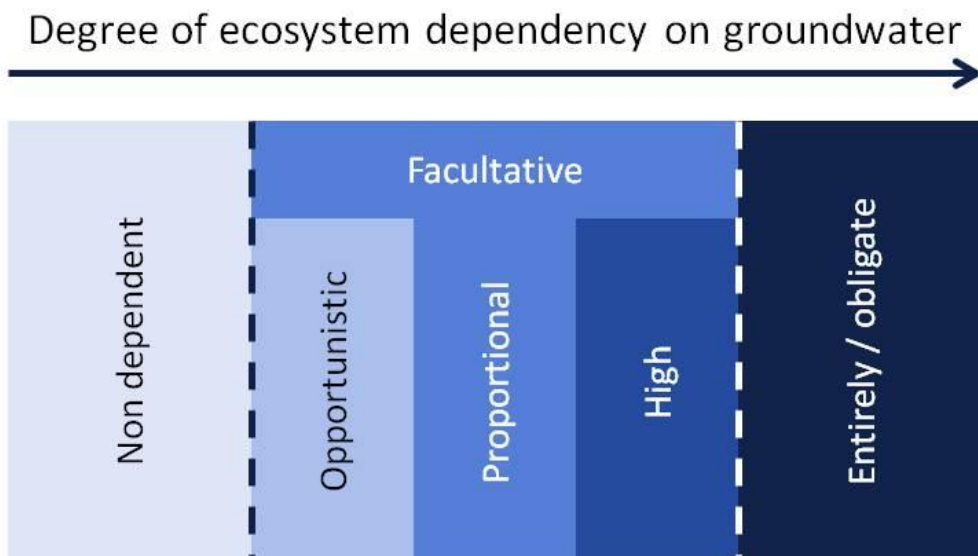


Figure 3.3 **Groundwater dependent ecosystem level of dependence on groundwater**

The GDE Risk Assessment Guidelines require the following risk factors to be considered in the assessment:

- impacts to groundwater quantity: reductions in fluctuations in groundwater levels and/or pressure, reductions in seasonal baseflow conditions
- impacts to water quality: changes in water quality that may impact any beneficial uses of the system
- impacts to aquifer integrity: changes to geological structure supporting a GDE, including timeframe and severity of impacts
- impacts to the biological integrity of the GDE: species diversity or composition, dieback of vegetation, increased exotic species or removal/alteration of habitat.

The risk assessment approach considers the risk of impact as well as the ecological value of the GDE to determine the overall risk.

The Biodiversity development assessment report (WSP 2024b) (*Technical Report 1 - Biodiversity development assessment report*) prepared to support the EIS for the project details the potential GDEs relevant to the project, and their potential reliance on groundwater.

4 Assessment methodology

4.1 Study area

The study area for the groundwater assessment encompasses a 1-kilometre-wide buffer. This is a suitable area to characterise the existing hydrogeological environment, and is wider than the predicted extent of any potential impacts of the Hunter Transmission Project (HTP, the project) on local groundwater sources, or groundwater sensitive receivers.

4.2 Overview

To assess potential groundwater risks resulting from the project a desktop assessment of groundwater impacts has been undertaken. This has included:

- a review of publicly available data and reports relating to groundwater to develop an understanding of the existing hydrogeological environment of the groundwater study area (defined in *section 4.3*)
- development of a site conceptual hydrogeological model (see *section 5.7*)
- identification of potential risks to sensitive groundwater sensitive receivers , which includes potential groundwater drawdown within locations that support groundwater dependent ecosystems (GDEs), culturally significant sites and groundwater users (see *section 6.1* and *section 6.2*)
- qualitative assessment of the potential impacts to groundwater sensitive receivers from construction and operation of the project (see *section 6.1* and *section 6.2*).
- identification of potential mitigation measures to avoid, mitigate and manage any potential impacts of the project to groundwater sources, their dependent ecosystems and groundwater users (see *section 8*).

4.3 Review of groundwater-related data sources

Available desktop information has been used to inform the groundwater setting of the groundwater study area and the assessment of groundwater impacts. This included a review of publicly available data, reports and databases. The groundwater datasets that were reviewed are provided in Table 4.1.

Table 4.1 Data sources

Parameter	Data source
Climate	• Bureau of Meteorology (BoM), Broke weather station (number 61100)
Geology	• NSW seamless geology layer (Department of Regional New South Wales 2022) • <i>1:250,000 Singleton Geological Map</i> (Geological Survey of NSW 1969) • <i>Hunter Coalfield Regional Geology 1:100,000</i> scale map, (NSW Department of Mineral Resources 1993)
Groundwater systems	• Water sharing plans (WSPs) for the project impact area • Published literature including <i>Hydrogeochemistry of the upper Hunter River valley</i> (Kellet 1987) and <i>Mid Hunter Groundwater Study</i> (EMM 2015)
Groundwater levels and flow	• WaterNSW groundwater database (NSW Mining, Exploration and Geoscience 2023) • Published literature including <i>Mt Arthur Coal Modification 2, Groundwater Assessment Report</i> (SRL 2023)

Parameter	Data source
Hydraulic properties	- WaterNSW groundwater database (NSW Mining, Exploration and Geoscience 2023) - Literature values from <i>Physical and Chemical Hydrogeology</i> textbook (Domenico and Schwartz 1998)
Groundwater quality	- WaterNSW groundwater database (NSW Mining, Exploration and Geoscience 2023) - Published literature including <i>Hydrogeochemistry of the upper Hunter River valley</i> (Kellet 1987) and <i>Mid Hunter Groundwater Study</i> (EMM 2015)
Groundwater users	- National Groundwater Information System (NGIS) database (BoM 2022) - WSPs for the project impact area - High ecological value aquatic ecosystems (HEVAE) groundwater dependent ecosystem (GDE) atlas (DEECCW 2024) - Groundwater Dependent Ecosystem Atlas (BoM GDE Atlas) (Bureau of Meteorology 2018)

4.4 Development of a site conceptual hydrogeological model

A hydrogeological conceptual site model describes the key processes and mechanisms in the hydrological and hydrogeological environment. It is based on hypotheses and assumptions built on general hydrogeological or hydrological principles. The conceptual model further develops the site hydrogeological setting, forming the basis of assumptions adopted during impact assessment.

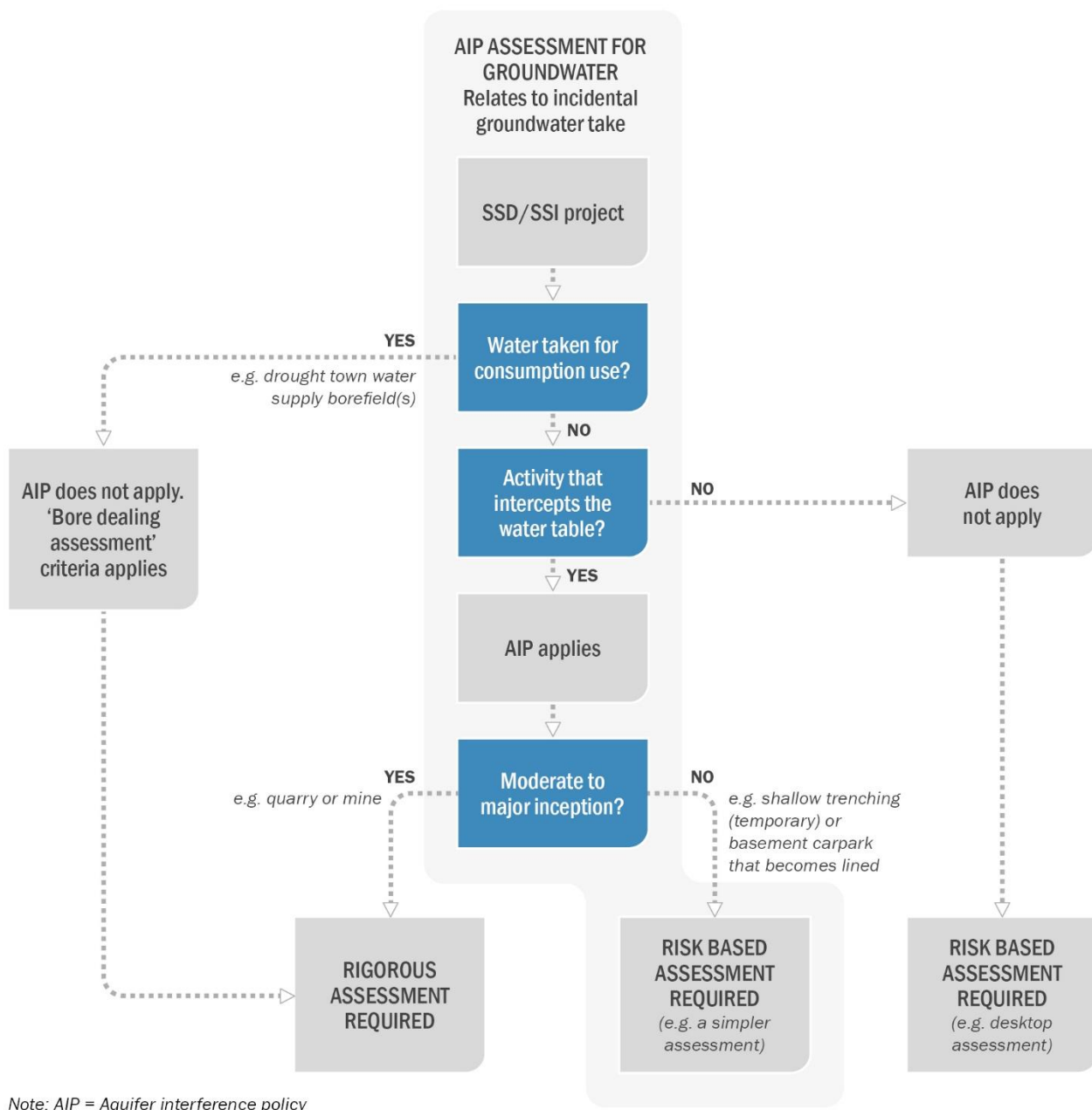
4.5 Groundwater impact assessment approach

The groundwater impact assessment aims to identify the potential impacts to groundwater sensitive receivers that may occur from construction and/or operation of the project. The key impact assessment considerations of the groundwater impact assessment are:

- potential impacts to groundwater level and quantity as a result of incidental groundwater take during construction
- potential impacts to groundwater quality during construction and operation
- potential impacts to groundwater flow paths during construction and operation.

The assessment of the project related impacts on groundwater resources and groundwater users follows the workflow outlined in the Groundwater Assessment Toolbox (DPE Water 2022a), which has been reproduced in Figure 4.1. Based on this workflow this groundwater impact assessment includes a simple risk-based assessment, prepared in accordance with the requirements of the NSW *Aquifer Interference Policy* (AIP) (DPI 2012) for the potential impacts associated incidental groundwater take (i.e. groundwater removed from transmission tower footings).

The AIP impact assessment criteria is described in *section 3.3.1*.



Source: Groundwater Assessment Toolbox (DPE Water 2022a)

Figure 4.1 Workflow to select groundwater assessment requirements

The Groundwater Assessment Toolbox (DPE Water 2022a) refers to the National Water Commission (Moran et al. 2010) guidelines and risk framework for the assessment of local and cumulative effects on groundwater systems. This framework defines the following four possible direct groundwater effects arising from a project:

- altered groundwater quantity (i.e. groundwater levels, pressures and fluxes)
- altered groundwater quality (i.e. concentration of salts and other important water quality constituents)
- altered surface water – groundwater interaction
- physical disruption or removal of aquifers (i.e. from the excavation of transmission tower footings).

Direct effects to groundwater encompass the changes to physical and/or quality aspects of groundwater due to water supply or aquifer interference activities, or the changes to the physical characteristics of aquifers affected by these activities. Direct effects can result in adverse or beneficial impacts on receivers.

The framework uses a source-pathway-analysis that describes how water affecting activities might impact sensitive groundwater receivers. For an effect to occur to a sensitive water receiver, a pathway must exist between a water affecting activity and a receiver. Risks are characterised by making an informed decision as to the potential for adverse effects to impact sensitive groundwater receiver because of project related activities, while also considering the AIP.

Indirect effects to groundwater are impacts to groundwater users or receivers that arise in response to direct effects (Moran et al. 2010). The potentially sensitive groundwater receivers that have been identified include:

- landholder bores utilising groundwater
- ecosystems that potentially rely on groundwater (including riparian terrestrial vegetation and aquatic ecosystems)
- watercourses, drainage lines, creeks and springs that receive baseflow from groundwater.

The assessment of potential receiver exposure to adverse changes in the groundwater regime (quantity, quality, groundwater and surface water interactions, and physical disruption of aquifers) requires:

- knowledge of the location of sensitive receivers within the landscape, particularly in relation to the location and area of influence of water affecting activities
- an understanding of the receivers' reliance on groundwater (e.g. depth to watertable, groundwater flux to baseflow-fed streams, groundwater quality to meet beneficial purposes)
- an understanding of the spatial and temporal scale of direct groundwater effects at the location of sensitive receivers.

An overview of the assessment application for the different potential groundwater impacts is provided in Table 4.2.

Table 4.2 **Groundwater impacts and applicable criteria**

Potential impacts	Assessable under AIP
Impacts to groundwater level and quantity – incidental take from construction activities	✓
Impacts to groundwater quality	✓
Impacts to groundwater flow paths	X

4.6 Assessment criteria

4.6.1 Aquifer Interference Policy

For each lithological category (i.e. hydrostratigraphic unit) of water source, the AIP identifies thresholds for minimal impact considerations. These thresholds relate to impacts on the watertable, water pressure and water quality (generally watertable or pressure declines or water quality degradation), and are ranked as being either 'level 1 minimal impact' or 'level 2 exceeding minimal impact'. The definition of 'minimal impact' is outlined in a series of tables which demonstrate how the criteria are applied for different types of water sources and for different sensitive receivers (i.e. other users and ecosystems). The applicable minimal impact considerations for relevant water sources are shown in Table 4.3, Table 4.4 and Table 4.5, and have been developed for impacts on groundwater sources, connected water sources, and their dependent ecosystems, culturally significant sites and water users. Reference to groundwater yield data indicates that the groundwater systems in the study area would be considered 'less productive' based on the criteria outlined in *section 3.3.1*, noting there may be areas in the alluvium considered to be 'highly productive'. This assessment has conservatively assessed the alluvial groundwater sources against the highly productive minimal impact considerations.

If the impact of an activity is assessed as being level 1 minimal impact, then the project is considered to have impacts that are acceptable. Where the predicted impacts exceed the level 1 minimal impact thresholds then this is considered as having impacts outside the range of acceptability, and extra monitoring or mitigation or remediation would be required during construction or operation. Where impacts are predicted to be 'greater than minimal impact' and the long-term viability of the water-dependent asset is compromised, the impact is subject to make good provisions.

Table 4.3 Minimal impact criteria for ‘less productive’ porous and fractured rock water sources

Groundwater source	Management zone	Watertable	Water pressure	Water quality
Sydney Basin-North Coast Groundwater Source	N/A	- Less than or equal to 10% cumulative variation in the watertable, allowing for typical climatic ‘post-WSP’ variations, 40 m from any: - high priority GDE, or - high priority culturally significant site listed in the schedule of the relevant WSP - a maximum of a 2 m decline cumulatively at any water supply work. - If more than 10% cumulative variation in the watertable, allowing for typical climatic ‘post-WSP’ variations, 40 m from any: - high priority GDE, or - high priority culturally significant site listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister’s satisfaction that the variation would not prevent the long-term viability of the dependent ecosystem or significant site. If more than a 2 m decline cumulatively at any water supply work then make good provisions should apply.	- A cumulative pressure head decline of no more than 2 m, at any water supply work. - If the predicted pressure head decline is greater than requirement 1 above, then appropriate studies are required to demonstrate to the Minister’s satisfaction that the decline would not prevent the long-term viability of the affected water supply works unless make good provisions apply.	- Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. - If condition 1 is not met then appropriate studies would need to demonstrate to the Minister’s satisfaction that the change in groundwater quality would not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.

Source: AIP (DPI Water 2012b)

Table 4.4 Minimal impact criteria for ‘less productive’ alluvial water sources

Groundwater source	Management zone	Watertable	Water pressure	Water quality
1. Hunter Regulated River Alluvial water source	1. Upstream Glennies Creek	1. Less than or equal to 10% cumulative variation in the watertable, allowing for typical climatic ‘post-WSP’ variations, 40 m from any:	1. A cumulative pressure head decline of not more than 40% post WSP pressure head above the base of the water source to a maximum of a 2 m decline, at any water supply work.	1(a). Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.
2. Lower Wollombi Brook water source	2. Downstream Glennies Creek 3. N/A	a) high priority GDE, or b) high priority culturally significant site listed in the schedule of the relevant WSP c) a maximum of a 2 m decline cumulatively at any water supply work. 2. If more than 10% cumulative variation in the watertable, allowing for typical climatic ‘post-WSP’ variations, 40 m from any: a) high priority GDE, or b) high priority culturally significant site listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister’s satisfaction that the variation would not prevent the long-term viability of the dependent ecosystem or significant site. If more than a 2 m decline cumulatively at any water supply work then make good provisions should apply.	2. If the predicted pressure head decline is greater than requirement 1 above, then appropriate studies are required to demonstrate to the Minister’s satisfaction that the decline would not prevent the long-term viability of the affected water supply works unless make good provisions apply.	1(b). No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity. Redesign of a highly connected surface water source that is defined as a reliable water supply is not an appropriate mitigation measure to meet considerations 1(a) and 1(b) above. 2. If condition 1(a) is not met then appropriate studies would need to demonstrate to the Minister’s satisfaction that the change in groundwater quality would not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works. If condition 1(b) is not met, then appropriate studies are required to demonstrate to the Minister’s satisfaction that the River Condition Index category of the highly connected surface water source would not be reduced at the nearest point to the activity.

Source: AIP (DPI Water 2012), with reference to mining related works removed

Table 4.5 Minimal impact criteria for ‘highly productive’ alluvial water sources

Groundwater source	Management zone	Watertable	Water pressure	Water quality
1. Hunter Regulated River Alluvial water source	1. Upstream Glennies Creek	1. Less than or equal to 10% cumulative variation in the watertable, allowing for typical climatic ‘post-WSP’ variations, 40 m from any:	1. A cumulative pressure head decline of not more than 40% post water sharing plan pressure head above the base of the water source to a maximum of a 2 m decline, at any water supply work.	1(a). Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.
2. Lower Wollombi Brook water source	2. Downstream Glennies Creek	a) high priority GDE, or		
	3. N/A	b) high priority culturally significant site listed in the schedule of the relevant WSP		1(b). No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity. Redesign of a highly connected surface water source that is defined as a reliable water supply is not an appropriate mitigation measure to meet considerations 1(a) and 1(b) above.
		c) a maximum of a 2 m decline cumulatively at any water supply work.	2. If the predicted pressure head decline is greater than requirement 1 above, then appropriate studies are required to demonstrate to the Minister’s satisfaction that the decline would not prevent the long-term viability of the affected water supply works unless make good provisions apply.	2. If condition 1(a) is not met then appropriate studies would need to demonstrate to the Minister’s satisfaction that the change in groundwater quality would not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.
		2. If more than 10% cumulative variation in the watertable, allowing for typical climatic ‘post-WSP’ variations, 40 m from any:		
		a) high priority GDE, or		
		b) high priority culturally significant site listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister’s satisfaction that the variation would not prevent the long-term viability of the dependent ecosystem or significant site.		
		If more than a 2 m decline cumulatively at any water supply work then make good provisions should apply.		If condition 1(b) is not met then appropriate studies are required to demonstrate to the Minister’s satisfaction that the River Condition Index category of the highly connected surface water source would not be reduced at the nearest point to the activity.

Source: AIP (DPI Water 2012), with reference to mining related works removed

4.7 Predictions of incidental take during project construction

Incidental groundwater take is expected during subsurface excavations below the water table, particularly during the construction of transmission line tower footings. Subsurface excavations for the construction of other project infrastructure are considered unlikely to intercept groundwater, given their shallow nature and the depth of groundwater in these locations. In particular, this has been reviewed for the Olney and Bayswater South switching stations, and the maximum excavation depths for both substations are above the expected water table.

The key assumption in the calculation of the potential incidental groundwater take was that there was no continuous groundwater removal during construction and, therefore, the volume of groundwater ingress did not exceed the excavation dimensions below the water table. The calculation of the potential groundwater ingress for the tower footings is, therefore, that of a cylinder, where both the median and 10th percentile water (i.e. shallower) levels were applied to account for the height of the cylinder.

$$\text{Equation 1: } V = \pi r^2 h$$

Each transmission tower location was assigned a groundwater hydrostratigraphic unit (i.e. alluvium in the upper Hunter Valley, alluvium in the central Hunter Valley, Permian sedimentary rock and Triassic sedimentary rock) based on the underlying geological unit. This informed the groundwater level depth with the water levels applied presented in Table 5.2 (see *section 5.3*) in the absence of site-specific data. The applicable WSP was also documented for each transmission tower.

The excavation parameters for each transmission tower below the groundwater level are detailed in Table 4.6.

Table 4.6 Excavation parameters below the groundwater level

Foundation design	Minimum diameter	Maximum diameter	Minimum depth	Maximum depth
Transmission towers	1.1 m	2.1 m	9.5 m	16.5 m

4.7.1 Predictions of Incidental groundwater take drawdown

Analytical equations were used to approximately calculate drawdown during the project construction phase, where the interception of groundwater is expected due to excavations.

The effective radius (r_o) was calculated using a rearranged version of the Jacob method (Kruseman and de Ridder 1994), defined as:

$$r_o = \sqrt{\frac{2.25 \times k \times (h_o - h_w) \times t}{S_y}}$$

Where:

t (day) = time since pumping or inflow started

S_y = specific yield

k (m/d) = hydraulic conductivity

h_o (m) = height of the groundwater level above the base of the aquifer

h_w (m) = base of excavation (maximum possible depth)

r_o (m) = radius of drawdown

The maximum parameters were applied and are detailed in Table 4.7.

Table 4.7 **Incidental groundwater take parameters and radius of drawdown**

Hydrostratigraphic unit	K (m/d)	h_0	h_w	t (days)	S_y	r_0 (m)
Alluvium in the upper Hunter Valley (near Singleton)	1	22	16.5	1	0.1	16
Alluvium in the central Hunter Valley (near Broke)	1	25	16.5	1	0.1	18
Permian sedimentary rock	0.05	19	16.5	1	0.24	2
Triassic sedimentary rock	0.05	15	16.5	1	0.24	1

4.7.2 Limitations and assumptions

The assumptions for this assessment included the following:

- there is no ongoing take or dewatering of excavations. Groundwater is removed from the excavation once prior to the installation of the transmission tower leg
- this is a high level, order of magnitude assessment. Site specific groundwater level information was not available and groundwater level information was taken from groundwater bores report cards. This has resulted in simplified groundwater levels across the project impact area which may result in over-estimated or under-estimated actual groundwater inflow rates
- values of hydraulic conductivity and specific yield were taken from published literature (Kruseman and de Ridder 1994) in the absence of site data
- cumulative drawdown was not calculated for each tower pad as the drawdown is minor in comparison to regional depressurisation from open cut and underground mining in the Hunter Valley.

5 Existing environment

The Hunter Transmission Project (HTP, the project) corridor runs mostly through power station, mining and government land between Bayswater and Broke in the upper Hunter region. It then traverses the Pokolbin, Corrabare, Watagan and Olney State forests in the lower Hunter region (see Figure 2.2).

The proposed new transmission line would connect the new the Bayswater South switching station to the existing 500 kilovolt (kV) transmission line near the Baywater Power Station and the new Olney switching station to the existing 500 kV transmission line between Eraring and Kemps Creek.

5.1 Groundwater systems

The groundwater study area is located in the Hunter region of the Permo-Triassic Sydney Geological Basin, which includes the main groundwater systems that are generally defined by their host geology and hydrogeological properties listed below. The approximate location of these groundwater systems is presented in Figure 5.1.

5.1.1 Shallow alluvial groundwater systems

The shallow alluvial groundwater systems comprise local, shallow groundwater systems hosted by unconsolidated Quaternary Alluvium associated with the Hunter River and its tributaries in the Hunter Valley floor. Hydraulic connectivity between the local alluvial groundwater and surface water systems is expected. These deposits typically comprise basal gravels and boulders overlain by an upwards-fining sequence of sands, silts and clays.

In the local alluvial systems, groundwater flow occurs in the pore spaces between alluvial sediments. Groundwater is often in hydraulic connection with adjacent water courses such as the Hunter River and its tributaries in the Hunter Valley floor within the groundwater study area. The Quaternary sediments associated with the Hunter River and its tributaries form the most productive source of groundwater within the Hunter Valley in terms of yield and water quality (Kellet 1987). However, water quality can be highly variable and can receive contributions from the underlying moderately brackish to saline Permo-Triassic sequences (EMM 2015). Around Morisset at the southernmost extent of the project, the alluvium is more sand dominated, but groundwater quality can be influenced by saline intrusion.

5.1.2 Triassic porous and sedimentary rock groundwater systems

Triassic porous and sedimentary rock groundwater systems are local to regional groundwater systems associated with the Triassic aged porous sedimentary rock units (Narrabeen Group and the Hawkesbury Sandstone), comprising sandstones and siltstones. These units outcrop in the elevated terrains of the State forests, forming the south-western boundary of the Hunter Valley. The project intersects these groundwater systems in the southern half of the groundwater study area, south of the Singleton Military Area.

The Triassic sediments in the southern half of the HTP corridor, which includes the Narrabeen Group and the Hawkesbury Sandstone, outcrop in the elevated terrains of the Hunter Valley south-western margin. Groundwater within the Triassic strata flows within rock mass pore spaces and secondary openings, although secondary openings (i.e. fractures, faults) are typically less common than the underlying Permian units. Groundwater yields are often low (i.e. less than 5 litres per second) but can have localised fluctuations which are largely determined by weathered and fractured zones. Groundwater extraction from the Triassic units is often limited by fracture size and connection between fractures, and in many cases, bores are pumped dry (DPI Water 2016).

5.1.3 Permian porous and sedimentary rock groundwater systems

Permian porous and sedimentary rock groundwater systems are local to regional groundwater systems associated with the Permian aged porous sedimentary rock units, comprising sandstones, siltstones and coal measures. The central Hunter Valley floor comprises exposed sedimentary Permian rocks which are overlain by sedimentary Triassic rocks in southwest, and in parts by local shallow alluvium in association with the Hunter River and its tributaries. The project intersects these groundwater systems in the northern half of the study area.

In the northern half of the HTP corridor groundwater in the Permian strata flows within rock mass pore spaces and secondary openings (i.e. fractures, faults, etc.), and has a significant storage volume due to the overall thickness and extent of the unit. However, the groundwater within these rocks is of limited use due to poor water quality and typical low yields, although there can be areas of local enhancement through folding and fracturing. The Permian sedimentary rock groundwater system is defined by a greater portion of coal, shale and siltstone than the Triassic sedimentary rock units, which are dominated by sandstone. The Permian sediments include the Greta Coal Measures, Maitland Group, Wittingham Coal Measures and the Wollombi Coal Measures.



Source: EMM (2025); Beca (2025); DCSSS (2024); RNSW (2024); ESRI (2024)

KEY

Geological outcrop

- Quaternary
- Triassic
- Permian
- Carboniferous

Project impact area

- HTP corridor
- Switching station
- Construction support site
- Laydown area
- Adjustment to existing transmission line
- Upgrades to existing transmission line
- Access track

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody

Groundwater features

Hunter Transmission Project
Groundwater Assessment
Figure 5.1

5.2 Recharge and discharge

Groundwater recharge and discharge mechanisms within the groundwater study area are described in Table 5.1.

Table 5.1 Groundwater recharge and discharge mechanisms

Groundwater system	Recharge	Discharge
Alluvial	Loss from watercourses (including the Hunter River and associated tributaries), overland flow and direct rainfall recharge, upwards vertical discharge from underlying sedimentary groundwater systems	Baseflow contributions to connected watercourses, and landholder abstraction
Permian sedimentary systems	Direct rainfall recharge at outcrop or subcrop	Upwards vertical leakage to overlying alluvium, discharge to underground mine voids, seep or spring discharge, and mine and landholder abstraction
Triassic sedimentary systems	Direct rainfall recharge at outcrop or subcrop	Seep or spring discharge, and landholder abstraction

5.3 Groundwater levels and flow

Groundwater flows from a high hydraulic head to a low hydraulic head. Regional groundwater within the Permian Coal Measures flows in a southerly direction, with local modifications due to the influence of mining activities (SLR 2023). Alluvial groundwater follows a muted reflection of topography and streamflow, and thus the alluvial groundwater flow direction is also towards the south, consistent with flow in the Hunter River. Groundwater flow in the Triassic porous rocks is expected to radially flow off the elevated ridgelines/plateaus.

Approximate depths to groundwater in the study area were obtained from registered bore data accessed via the publicly available WaterNSW real time data source and are tabulated in Table 5.2. The data shows that the depth to groundwater in the alluvium is shallower around Broke than in the central Hunter Valley.

Table 5.2 Approximate depths to groundwater within the groundwater study area

Groundwater system in study area	Number of bores reviewed	10 th percentile water level (mbgl ¹)	90 th percentile water level (mbgl)	Median water level (mbgl)
Alluvium in the upper Hunter Valley (near Singleton)	25	5.2	11.9	9.5
Alluvium in the central Hunter Valley (near Broke)	16	1.8	4.6	2.8
Permian sedimentary systems	37	7.6	35.6	16.8
Triassic sedimentary systems	6	11.8	30.5	17.3

Notes: mbgl metres below ground level

Temporal groundwater level data was obtained from the publicly available WaterNSW real time data source, comprising 9 groundwater monitoring bores, with an approximate 20-year monitoring period until mid-2021. A composite hydrograph for alluvial groundwater systems is presented in Figure 5.2 and a composite hydrograph for the Permian sedimentary rock groundwater systems is presented in Figure 5.3, individual hydrographs are included in *Appendix A (Hydrographs)*. The bore locations are included in Figure 5.4, there are no bores targeting the Triassic porous rock units with publicly available data. Both hydrographs include cumulative deviations from the mean rainfall data, showing above and below average rainfall as increasing and decreasing trends respectively. Rainfall was obtained from the Bureau of Meteorology (BoM) Broke weather station (number 61100). No government monitoring bores have been drilled into the Triassic as this area is not affected by mining and industrial activities, hence it does not receive the same scrutiny.

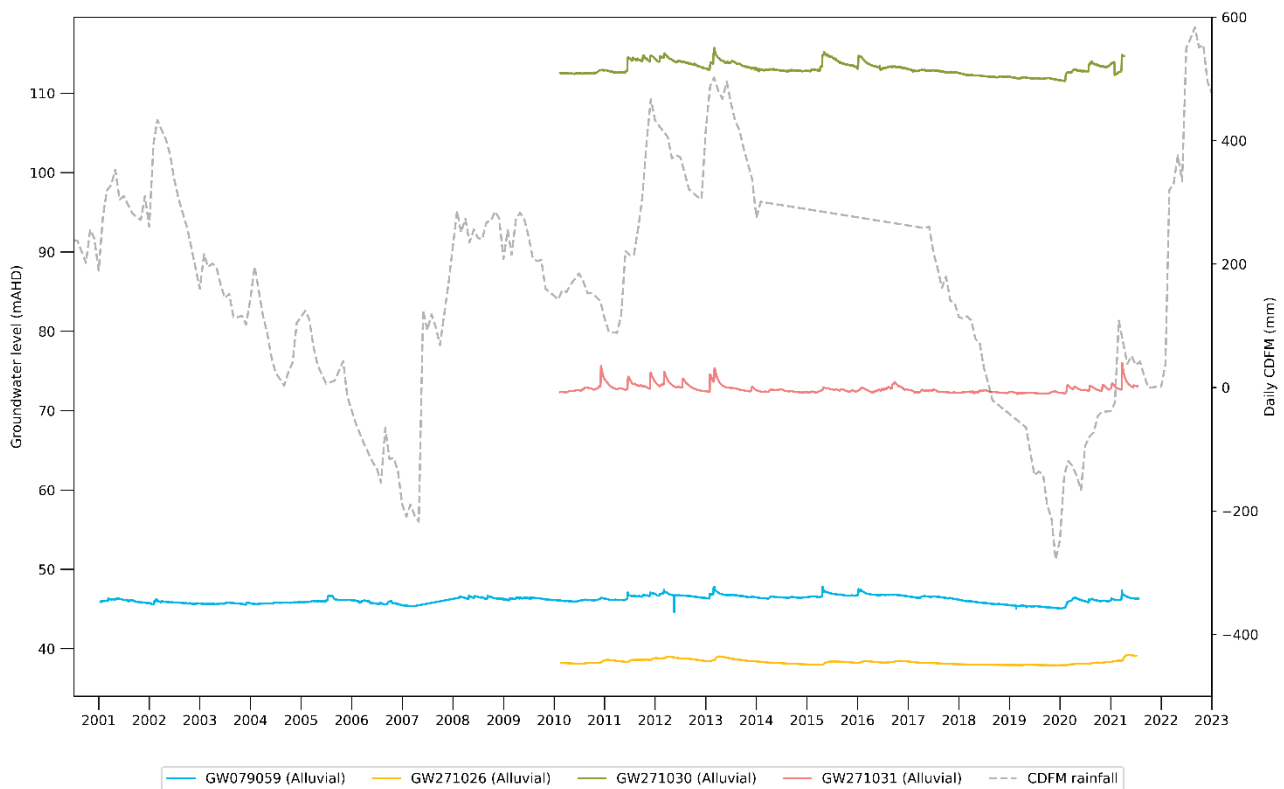


Figure 5.2 Regional hydrograph for alluvial groundwater systems in the groundwater study area

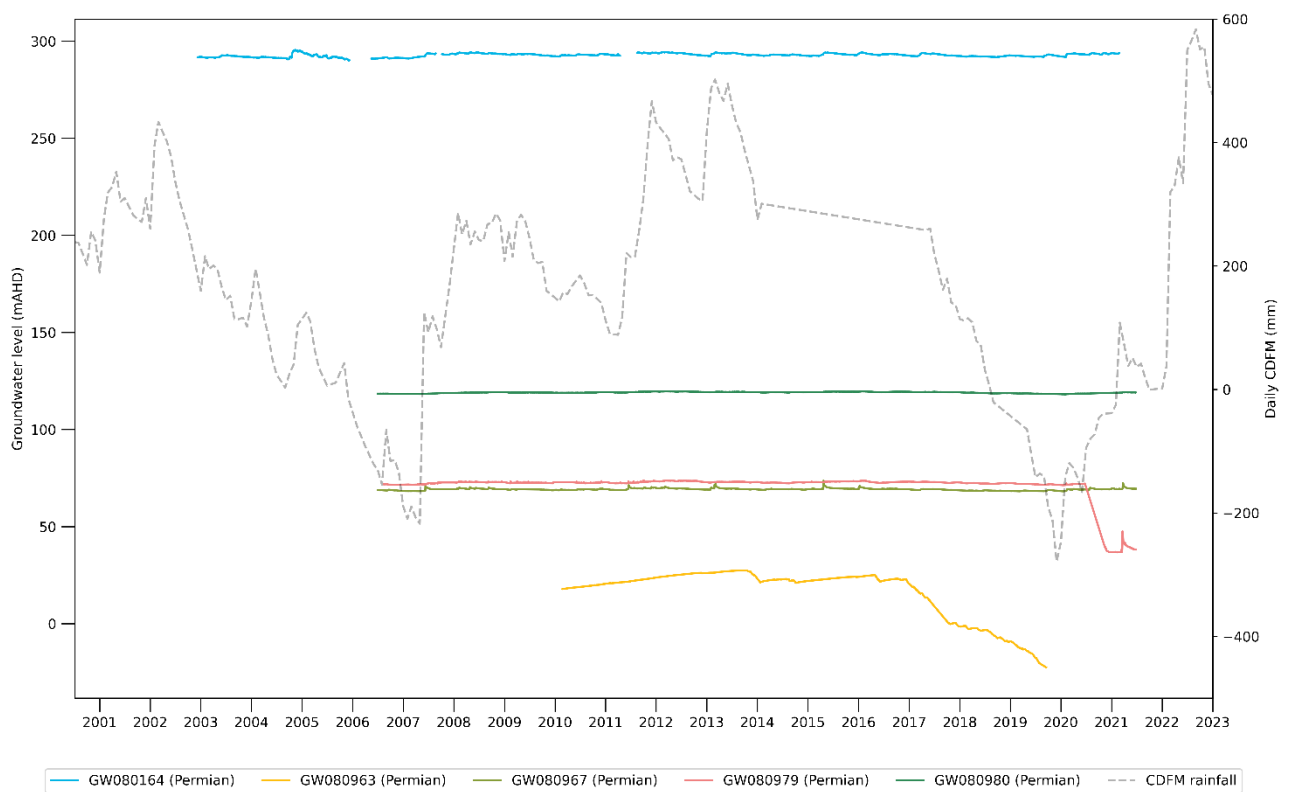
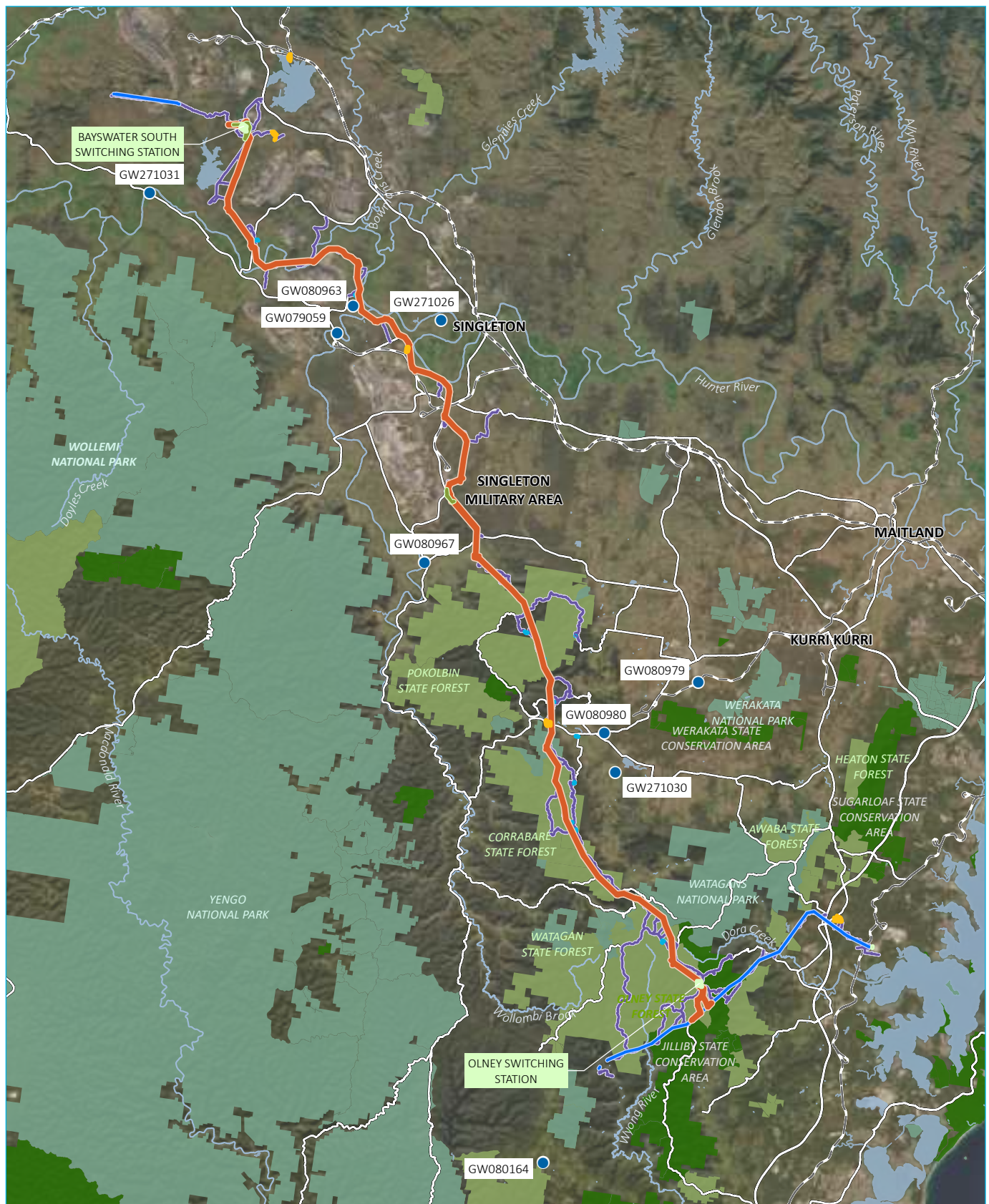


Figure 5.3 Regional groundwater hydrograph for Permian sedimentary rock groundwater systems in the groundwater study area



KEY

● Groundwater monitoring bore

Project impact area

HTP corridor

Switching station

Construction support site

Laydown area

Adjustment to existing transmission line

Upgrades to existing transmission line

Access track

Existing environment

— Rail line

— Major road

— Named watercourse

— Named waterbody

NPWS reserve

State conservation area

State forest

Regional groundwater
monitoring bores

Hunter Transmission Project
Groundwater Assessment
Figure 5.4

The alluvial hydrographs indicate that:

- all locations respond immediately to direct rainfall recharge (by up to 3 metres), although monitoring bore GW271026 (4 kilometres east of the project impact area, near Singleton) shows a more muted response to rainfall recharge
- all locations respond to long term rainfall patterns, with a distinct lowering of groundwater levels between 2016 and 2019 when rainfall was consistently below average and drought conditions were observed, and a recovery of groundwater levels from 2020 due to sustained higher rainfall recharge.

The Permian sedimentary rock hydrographs indicate that:

- no locations show immediate and direct response to rainfall recharge, rather there is a muted response to cumulative rainfall trends
- the influence of landholder and/or mine groundwater abstraction is apparent at monitoring bore GW08979 (in Cessnock and approximately 13 kilometres from the construction disturbance area) and monitoring bore GW080963 (in Warkworth and approximately 650 metres from the construction disturbance area), as seen by declining groundwater levels. Monitoring bore GW080963 is adjacent to the Mt Thorley Warkworth and Hunter Valley Operations mining complexes.

5.4 Hydraulic properties

Information on groundwater hydraulic properties has been sought from publicly available data sources and is presented in Table 5.3. The WaterNSW groundwater database (NSW Mining, Exploration and Geoscience 2023) was searched to identify yield records of private landholder bores located within the study area. Hydraulic conductivity measurements have been obtained from published literature (Domenico and Schwartz 1998).

The reported yields are comparable for the different groundwater systems, with the greatest range in yields observed in the alluvial groundwater system. The alluvium also had the greatest range of hydraulic conductivity measurements. Hydraulic conductivity is expected to be lower in the Triassic and Permian sedimentary systems, although high flows could be recorded at the intersection of fractures or other structural features creating rock openings.

Table 5.3 Hydraulic properties

Groundwater unit	Published minimum hydraulic conductivity (m/d)	Published maximum hydraulic conductivity (m/d)	Datapoint count	Yield minimum (L/s)	Yield maximum (L/s)	Yield average (L/s)
Alluvium (upper and central Hunter Valley)	8×10^{-7}	8×10^5	51	0.01	26.5	2.2
Triassic sedimentary system	8×10^{-7}	1×10^{-3}	10	0.1	10	1.8
Permian sedimentary system	8×10^{-7}	1×10^{-3}	73	0.1	8.8	2.7

Notes: Hydraulic conductivity values sourced from Domenico and Schwartz 1998 for coarse sand, clay, sandstone and siltstone.

m/d = metres per day

L/s = litres per second

5.5 Groundwater quality

Groundwater quality data was obtained from published sources including the WaterNSW groundwater database (NSW Mining, Exploration and Geoscience 2023), and the *Bioregional Assessment for the Hunter* (Department of Agriculture, Water and the Environment 2019).

The salinity for each groundwater systems is generally:

- Alluvium: marginal to brackish in the Hunter Valley but can be fresher at the base of the Triassic units around Congewai Creek Alluvium and adjacent to the Hunter River where the effects of river recharge and mixing are more evident
- Triassic in the State forests: fresh in recharge areas to marginal brackish in downgradient areas
- Permian in the Hunter Valley: brackish to moderately saline, particularly for coal seams. The Permian groundwater systems generally have the highest salinity, which is influenced by the low permeability and the limited flushing or through-flow of groundwater through these rocks (EMM 2015) (Mackie 2009).

Electrical conductivity ranges are provided in Table 5.4 with data obtained from registered bore data accessed via the publicly available WaterNSW real time data source.

Table 5.4 Published electrical conductivity data

Groundwater system	Salinity	Electrical conductivity range
Alluvium in the upper Hunter Valley (near Singleton)	Marginal	1400–2100 $\mu\text{S}/\text{cm}$
Alluvium in the central Hunter Valley (near Broke)	Fresh to brackish	800–5500 $\mu\text{S}/\text{cm}$
Permian sedimentary systems	Brackish for sandstone/siltstone Moderately saline for coal seams	4800 $\mu\text{S}/\text{cm}$ for sandstone/siltstone 12,000 $\mu\text{S}/\text{cm}$ for coal seams
Triassic sedimentary systems	Fresh to marginal	500–1600 $\mu\text{S}/\text{cm}$

Note: $\mu\text{S}/\text{cm}$ microsiemens per centimetre

The literature review indicates for the Permian and Triassic systems groundwater is slightly acidic with a pH of around 5.5 to 6.5 (DPI Water 2016). Bore logs indicate coal seam pH is alkaline (i.e. between 8.1 to 9.5 pH units) (EMM 2019).

5.6 Groundwater users and sensitive receivers

5.6.1 Landholder bores

Groundwater users within the groundwater study area include landholders (residential, commercial and industrial, and/or government) accessing and/or monitoring groundwater via a bore or other licensed groundwater works, and groundwater dependent ecosystems (GDEs).

Based on the National Groundwater Information System database (BoM 2022), accessed in July 2025, there are 232 groundwater bores listed within the groundwater study area described as active, in use, functioning, non-functioning, proposed or unknown (conservatively assumed to be active for the purpose of this groundwater assessment). Of the 232 groundwater bores listed within the groundwater study area, 24 are within the project impact area (including 2 exploration bores listed as abandoned). The listed purpose and number of bores identified is documented in Table 5.5 with bore locations shown in Figure 5.5. There are a large number of monitoring bores, assumed to be associated with the mining activity in the area.

Table 5.5 Registered bores and licence types

Licence type	Number of bores within groundwater study area	Number of bores within the project impact area
Commercial and Industrial	3	0
Dewatering	2	1
Exploration	4	2
Irrigation	30	4
Monitoring	140	15
Stock and Domestic	11	1
Unknown	18	1
Water Supply	24	0
Total	232	24

5.6.2 Groundwater dependent ecosystems

GDEs can include terrestrial vegetation (i.e. wetlands, shrubs/trees with deep rooting depths), aquatic communities (plant and animal species occupying watercourses that receive groundwater), and subterranean systems (i.e. stygofauna in karst and fractures in rock), which at some point utilise groundwater. A GDE may be entirely dependent on groundwater for survival or may use groundwater opportunistically for a supplementary source of water. The Biodiversity development assessment report (*Technical Report 1 - Biodiversity development assessment report*) assesses the project's potential impacts on GDEs.

Information on GDEs was sought from the water sharing plans (WSPs), which includes schedules with lists of high priority GDEs, the Groundwater Dependent Ecosystem Atlas (BoM GDE Atlas) (Bureau of Meteorology 2018), and from the high ecological value aquatic ecosystems (HEVAE) GDE atlas (DEECCW 2024).

Within the project impact area, the following mapped GDEs are present and shown on Figure 5.5:

- high priority GDEs mapped in the *Hunter Unregulated and Alluvial Water Sources WSP* and *North Coast Fractured and Porous Rock Groundwater Sources WSP* taken as a subset of the GDE HEVAE data (this approach was confirmed by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW), Groundwater Planning group)

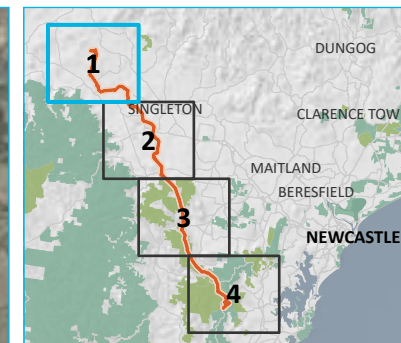
- low, medium and high potential GDEs mapped in the HEVAE dataset predominantly associated with the Hunter River and its tributaries, and in the lower lying reaches of the Triassic groundwater system. These GDE are considered to have some reliance on groundwater baseflow contributions
- low potential terrestrial GDEs mapped in the BoM dataset predominantly along the Hunter Valley floor and the adjacent Pokolbin, Corrabare and Olney State forests, and medium potential terrestrial GDEs associated with the Hunter River and its tributaries
- moderate to high potential aquatic GDEs potential aquatic GDEs associated with the Hunter River and its tributaries mapped in the BoM dataset.

5.6.3 Culturally significant sites

There are no high priority culturally significant sites listed in the schedules of the Hunter Unregulated and Alluvial Water Sources WSP and North Coast Fractured and Porous Rock Groundwater Sources WSP.

One groundwater-related culturally significant site was identified within the project impact area; 'The Wishing Well' listed on the National Parks and Wildlife Services (NPWS) Historical Heritage Information Management System (HHIMS) site, Osf 26. The Wishing Well is located at a major bend in Martinsville Hill Road at the western end of main gully in Wishing Well Forest Park. The project is located within the curtilage of the heritage item at its current location and the is expected to be permanently removed to accommodate the project. The site was a once important and well-used spring. Further information is provided in the Historic heritage impact statement (Biosis 2024) (*Technical Report 7 – Historic heritage impact statement*).

As construction of the project would destroy this heritage item through its removal, the potential groundwater impacts to this item have not been contemplated as part of this assessment. The assessment of the potential impacts to this item have been considered in the Historic heritage impact statement (Biosis 2024) (*Technical Report 7 - Historic heritage impact statement*).



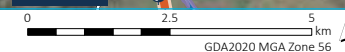
- KEY**
- High priority HEVAE GDE
 - Medium and high potential aquatic GDE
 - Medium and high potential terrestrial GDE
 - Landowner borehole
 - Dewatering
 - Exploration
 - Irrigation
 - Monitoring
 - Project impact area
 - HTP corridor
 - Bayswater South switching station
 - Construction support site
 - Laydown area
 - Adjustment to existing transmission line (lines 31 and 32)
 - Upgrades to existing transmission line (lines 5A3 and 5A4)
 - Access track
 - Existing environment
 - Rail line
 - Major road
 - Named watercourse
 - Named waterbody
 - NPWS reserve (see inset)
 - State forest (see inset)

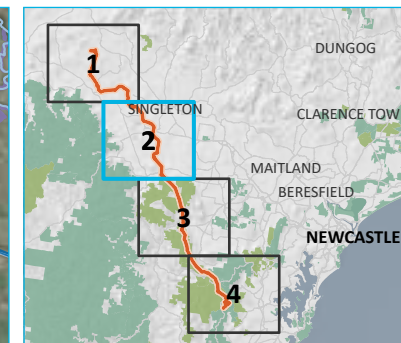
Groundwater users
Map 1 of 4

Hunter Transmission Project
Groundwater Assessment
Figure 5.5



Source: EMM (2025); WaterNSW (2024); BOM (2024); DCSSS (2024); ESRI (2024)





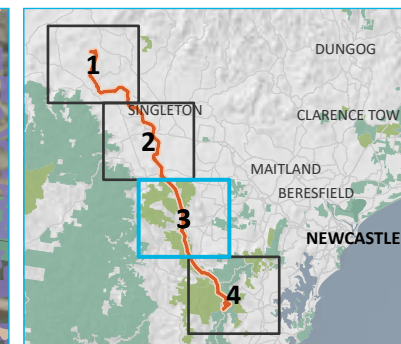
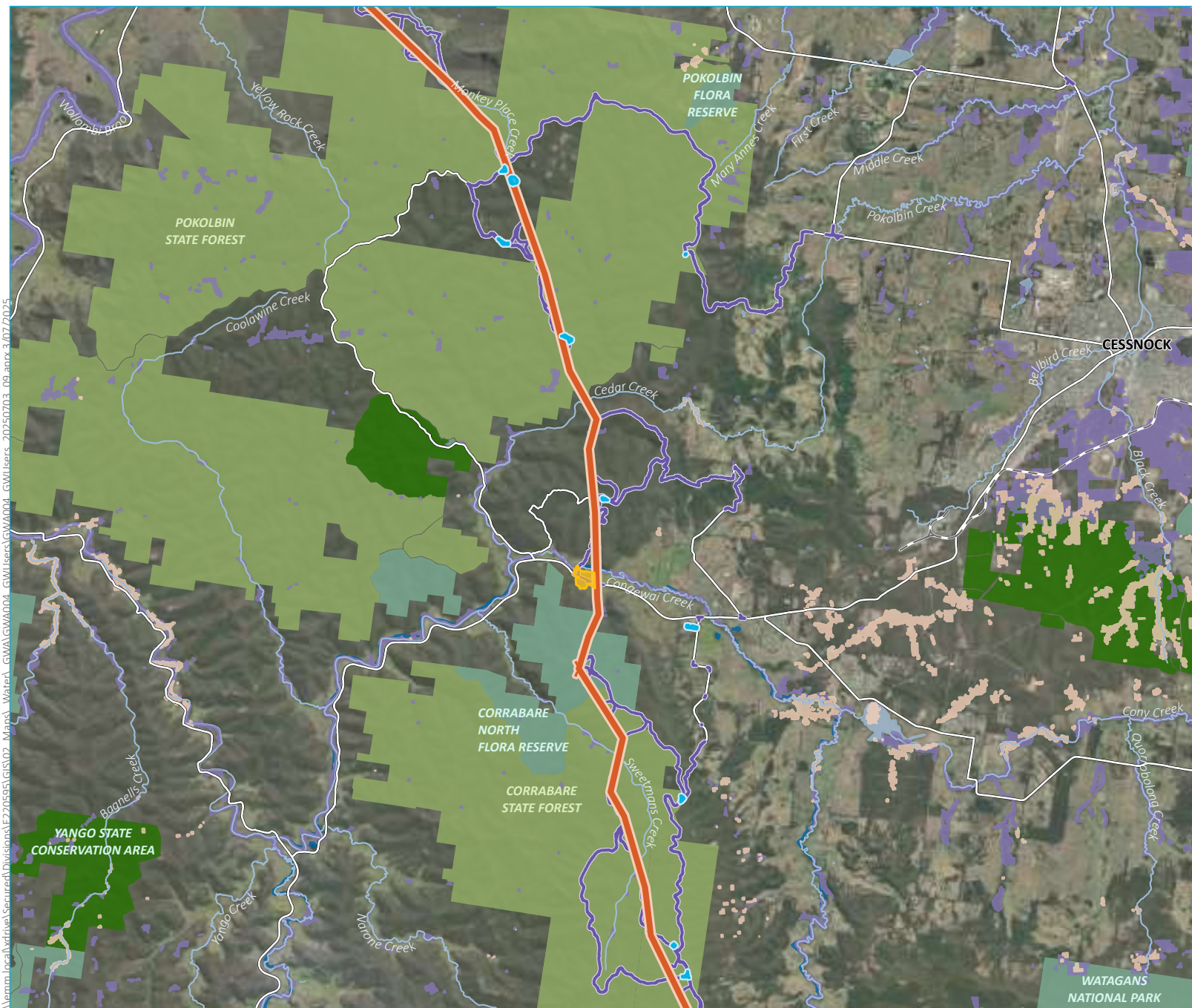
KEY

- High priority HEVAE GDE
- Medium and high potential aquatic GDE
- Medium and high potential terrestrial GDE
- Landowner borehole
 - Exploration
 - Irrigation
 - Monitoring
 - Stock and domestic
 - Unknown
- Project impact area
 - HTP corridor
 - Construction support site
 - Adjustment to existing transmission line (line 81)
 - Access track
- Existing environment
 - Rail line
 - Major road
 - Named watercourse
 - Named waterbody
 - NPWS reserve (see inset)
 - State forest (see inset)

Groundwater users
Map 2 of 4

Hunter Transmission Project
Groundwater Assessment
Figure 5.5





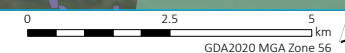
- KEY**
- High priority HEVAE GDE
 - Medium and high potential aquatic GDE
 - Medium and high potential terrestrial GDE
 - Project impact area
 - HTP corridor
 - Construction support site
 - Laydown area
 - Access track
 - Existing environment
 - Rail line
 - Major road
 - Named watercourse
 - Named waterbody
 - State conservation area
 - NPWS reserve (see inset)
 - State forest (see inset)

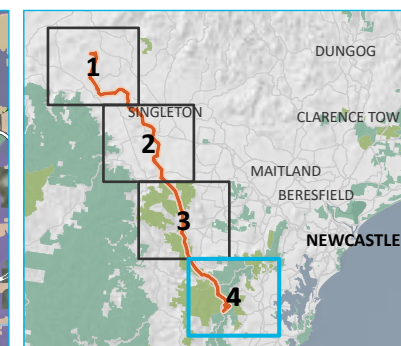
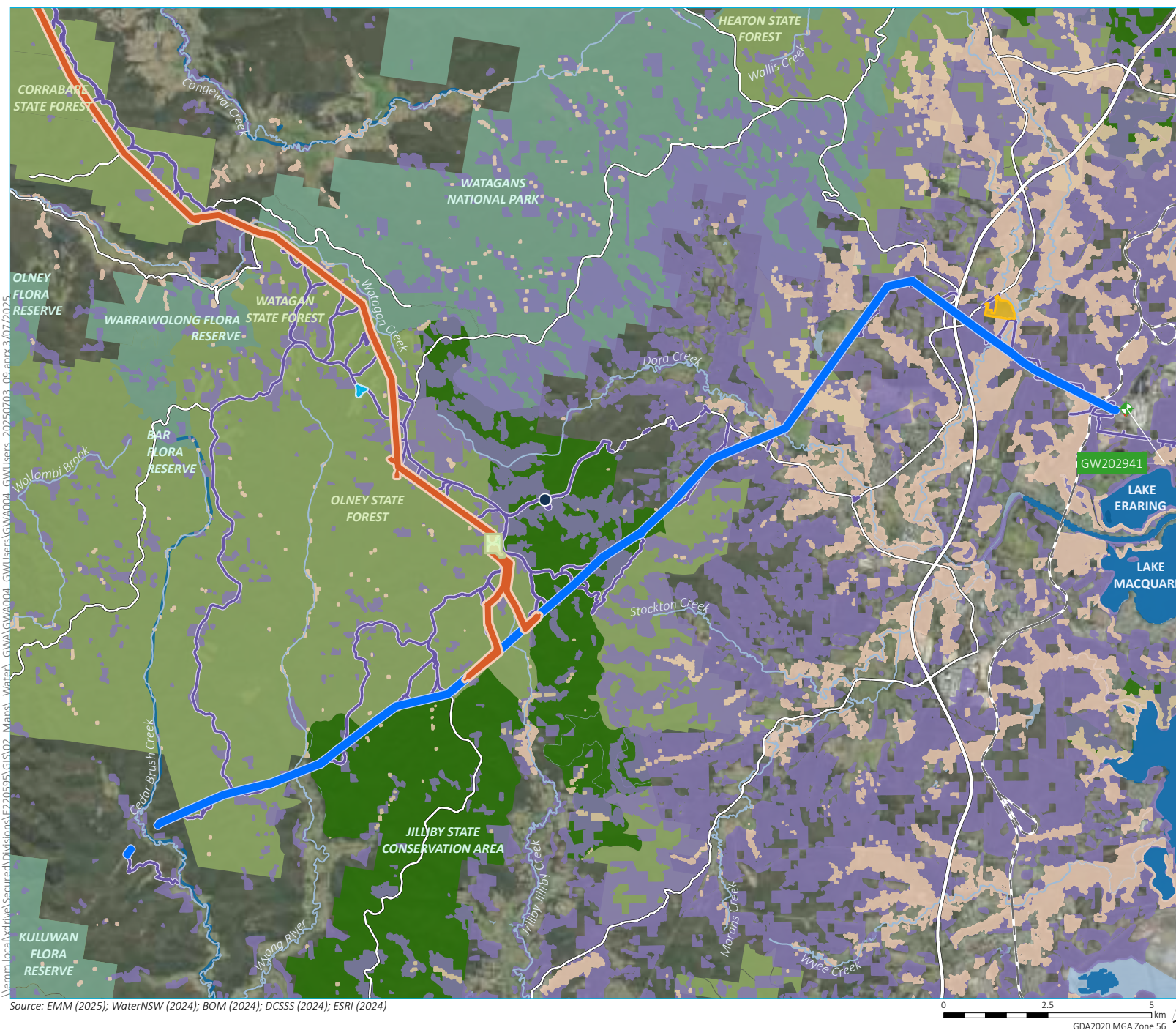
Groundwater users
Map 3 of 4

Hunter Transmission Project
Groundwater Assessment
Figure 5.5



Source: EMM (2025); WaterNSW (2024); BOM (2024); DCSSS (2024); ESRI (2024)





- KEY**
- Culturally significant site- groundwater related
 - High priority HEVAE GDE
 - Medium and high potential aquatic GDE
 - Medium and high potential terrestrial GDE
 - Landowner borehole
 - Monitoring
 - Project impact area
 - HTP corridor
 - Olney switching station
 - Construction support site
 - Laydown area
 - Eraring Substation upgrade
 - Upgrades to existing transmission line (lines 5A1 and 5A2)
 - Access track
- Existing environment**
- Rail line
 - Major road
 - Named watercourse
 - Named waterbody
 - State conservation area
 - NPWS reserve (see inset)
 - State forest (see inset)

Groundwater users
Map 4 of 4

Hunter Transmission Project
Groundwater Assessment
Figure 5.5

5.7 Hydrogeological conceptual site model

A hydrogeological conceptual site model describes the key processes and mechanisms in the hydrological and hydrogeological environment. It is based on hypotheses and assumptions built on general hydrogeological or hydrological principles. The conceptual model further develops the site hydrogeological setting, forming the basis of assumptions adopted during impact assessment. The hydrogeological conceptual site model overview is provided in Table 5.6 and represented graphically in Figure 5.6.

Table 5.6 Summary of hydrogeological characteristics

Component	Alluvial groundwater system	Triassic and Permian sedimentary rock groundwater systems
Aquifer description	Unconsolidated alluvial deposits, adjacent to Hunter River and tributaries. Local groundwater system with variable depth and thickness	Permian and Triassic sedimentary rock, regional systems
Recharge	- Loss from watercourses - Overland flow and direct rainfall recharge - Upwards vertical discharge from underlying groundwater systems	Predominantly via direct rainfall recharge at outcrop and subcrop
Discharge	- Groundwater baseflow contributions to connected watercourses - Landholder abstraction	- Seep/spring discharge - Landholder abstraction - Leakage to overlying alluvium
Hydraulic characteristics	- Hydraulic conductivity: 8×10^{-7} to 8×10^5 m/d - Average yield: 2.2 L/s	- Hydraulic conductivity: 8×10^{-7} to 8×10^{-3} m/d - Average yield: 1.8 L/s (Triassic) to 2.7 L/s (Permian)
Groundwater levels	- Highly responsive to direct rainfall recharge - Up to 3 m fluctuation due to direct rainfall recharge - Declines during drought conditions	- Declines in response to mine dewatering - Muted, gradual response to rainfall recharge
Groundwater flow	Intergranular primary permeability	Groundwater is predominantly associated with fracture (secondary) permeability and porosity, with groundwater flow in the Permian also occurring in the rock mass pore spaces
Groundwater flow directions	- Muted reflection of topography - Largely to the southeast, consistent with the Hunter River	Local groundwater flow towards alluvium/watercourses and regional flow towards the southeast
Groundwater quality	Marginal to brackish but can be fresh near watercourses	- Triassic: fresh in recharge areas to marginal brackish in downgradient areas - Permian: brackish to moderately saline, particularly for coal seams
GDEs	Low, medium and high potential GDEs mapped in the HEVAE dataset predominately associated with the Hunter River and its tributaries	Minor occurrences of GDEs mapped in the lower lying reaches of the Triassic units
Landholder bores	Registered landholder bores targeting the alluvial groundwater for stock and domestic purposes	Registered bores mainly associated with mine compliance monitoring.

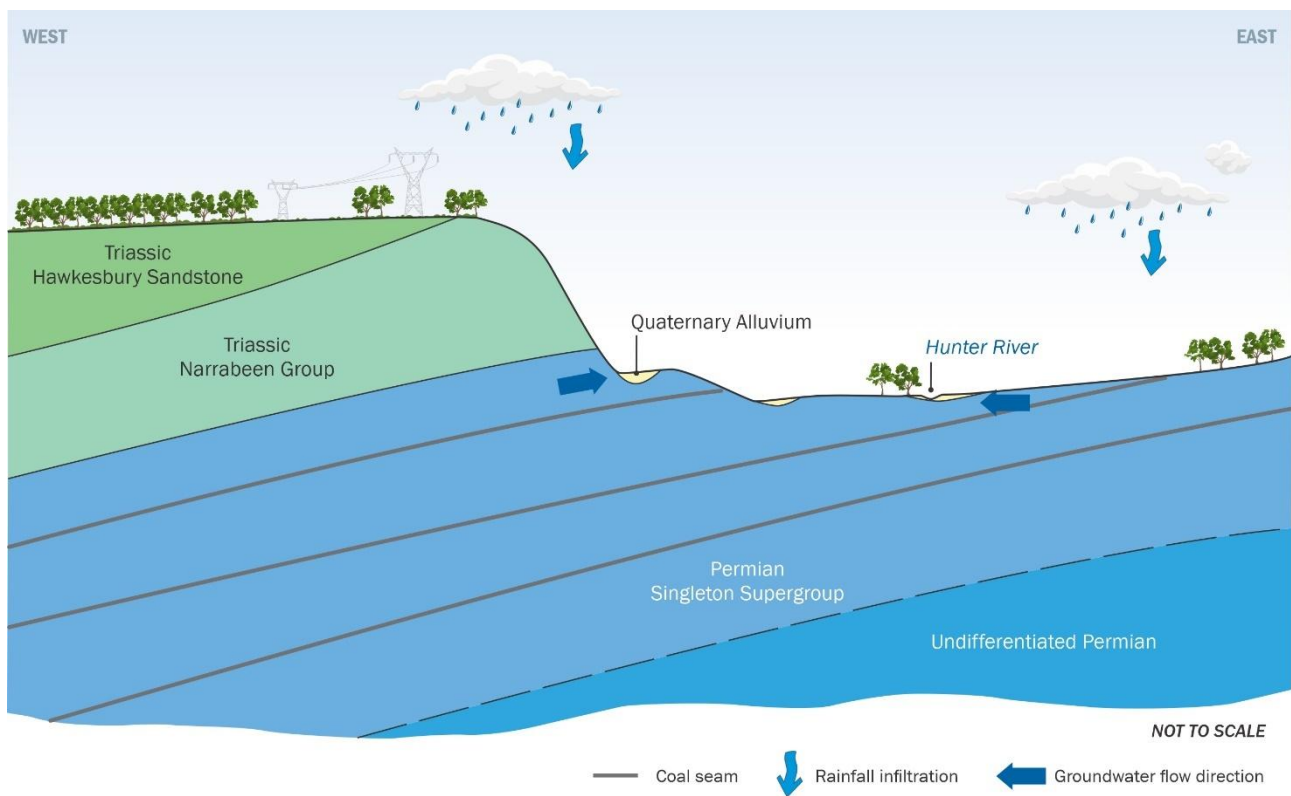


Figure 5.6 Hydrogeological conceptual site model

6 Assessment of impacts

The potential for groundwater impacts to occur would be higher during construction of the Hunter Transmission Project (HTP, the project). Ongoing impacts to groundwater would not occur during operation of the project.

Construction of the project has the potential to directly and/or indirectly affect groundwater as a result of:

- subsurface excavations below the water table where there could be potential for minor incidental groundwater take as the excavations are dewatered
- construction, laydown and other work areas where there could be potential for project construction activities to result in changes to groundwater quality from groundwater contamination
- potential physical removal of landholder bores to facilitate the construction of the project, or damage to landholder bores as a result of project construction activities such as vehicle and plant movement, and earthworks.

The construction and use of ancillary above ground facilities (i.e. works that are not anticipated to intercept, penetrate or take water from the local groundwater systems) are not considered to impact the groundwater systems as they would be above the water table. This includes work pad areas, construction compounds, accommodation camps and access tracks. These activities are therefore not assessed further.

The use of existing groundwater bores for construction water supply has been considered as part of the construction water supply strategy for the project. Any use of groundwater for construction water supply would be undertaken in line with their existing licensed water take volumes. As such, no additional water take is proposed, therefore no additional assessment is required. Should existing groundwater bores be pursued as a water supply option by the construction contractor (once appointed), the use of the bores would be in negotiation with the licence holder(s). The licence purpose of any groundwater bores intended for use would be updated to construction water supply and any use of the bores would be in accordance with the license conditions linked to the bores. Furthermore, no groundwater take, for water supply or incidental, is expected to occur during project operation.

Potential groundwater impacts arising through the construction and operation of the project are summarised in Table 6.1.

Table 6.1 **Potential impacts from groundwater affecting activities**

Water affecting activity	Potential impact	Project phase	Receivers potentially impacted	Likelihood and consequence
Groundwater quantity				
Transmission tower footing and gantry excavations, dewatering below the water table and where there is localised, incidental interception of groundwater	Groundwater level decline	Construction	Third party landholder bores Groundwater dependent ecosystems (GDEs) Culturally significant sites	Likely to occur. Could result in localised, temporary groundwater drawdown
Other project excavations below the water table where there may be interception of shallow groundwater, including construction support facilities and switching stations	Groundwater level decline	Construction	Third party landholder bores GDEs Culturally significant sites	Other project excavations are unlikely to be below the water table. Could result in localised, temporary groundwater drawdown
General construction and use of large hardstand areas or compaction of underlying soils which reduces potential groundwater recharge (i.e. accommodation camps, laydown areas) and/or vegetation clearing causing a reduction in groundwater recharge	Groundwater level decline	Construction and operation	Third party landholder bores GDEs Culturally significant sites	Unlikely to cause significant reductions in groundwater recharge given the size of the activities relative to the recharge areas
Groundwater quality				
Chemical and fuel spills or leaks at construction sites, roads and laydown areas causing short-term release of contaminants	Groundwater quality impacts	Construction and operation	Third party landholder bores GDEs Culturally significant sites	Possible, but unlikely to cause significant harm with appropriate management measures in place
Surface water-groundwater interaction				
No project activities affecting potential surface water and groundwater interactions are expected	-	-	-	-
Physical disruption or removal of aquifers				
Construction of transmission tower foundations or other infilled excavations have the potential to change groundwater flow directions	Changes to groundwater flow directions	Construction and operation	Third party landholder bores GDEs Culturally significant sites	Unlikely to cause significant change, i.e. will be experienced at a very localised scale only

6.1 Assessment of potential construction impacts

6.1.1 Impacts to groundwater quantity and levels

Desktop based calculation of groundwater inflows to transmission tower and gantry excavations below the groundwater table were undertaken. Subsurface excavations for the construction of other project infrastructure are considered unlikely to intercept groundwater, given their shallow nature and the depth of groundwater in these locations. In particular, this has been reviewed for the Olney and Bayswater switching stations, and the maximum excavation depths for both switching stations are above the expected water table.

The results of desktop-based calculations of groundwater inflows to transmission tower and gantry excavations below the groundwater table are included in Table 6.2 for each management zone under the relevant Water Sharing Plan. The base case uses the average groundwater levels specific to the hydrostratigraphic unit and the sensitivity case uses the 10th percentile groundwater levels specific to the hydrostratigraphic unit (refer *section 4.7*).

The predicted drawdown extent was assessed from publicly available data and geotechnical testing for the depth to groundwater. Calculated predicted maximum groundwater drawdown extended approximately 18 metres in the alluvium, and 2 metres in the Permian and Triassic sedimentary rock units (refer *section 4.7.1*). The amount of drawdown is estimated to be minor and in the case of the alluvium would recover quickly due to the inherent higher hydraulic conductivity and the very short duration of the incidental take. Other project related excavations (e.g. support facilities and/or switching stations at Bayswater South and Olney) are not expected to intercept groundwater based on the publicly available depths to groundwater.

The water take occurs as a result of excavations below the water table, no additional pumping or dewatering is proposed. Construction of the footings would displace the water and discharge it at ground level. Mitigation measures associated with this activity are addressed in *Chapter 8 (Management)*. Measures to be implemented during construction which address captured groundwater from excavations are detailed in the Surface water impact assessment (*Technical Report 10 - Surface water impact assessment*).

Table 6.2 Incidental groundwater take volumes for construction of transmission line towers

Water sharing plan	Water source	Management zone	Hydrostratigraphic unit	Groundwater take	
				Base case	Sensitivity case
Unregulated and Alluvial WSP	Hunter Regulated River Alluvial Water Source	Downstream Glennies Creek	Alluvium	0.3 ML	0.5 ML
		Upstream Glennies Creek	Alluvium	0.4 ML	0.8 ML
	Lower Wollombi Brook Water Source	N/A	Alluvium	0.1 ML	0.2 ML
Fractured and Porous Rock WSP	Sydney Basin-North Coast Groundwater Source	N/A	Permian and Triassic sedimentary rock (porous)	0.5 ML	7.0 ML
Total (rounded to the nearest ML)				1.3 ML	8.5 ML

Note: ML megalitre

6.1.2 Impacts to groundwater quality

Construction could impact groundwater quality as a result of accidental spills of hazardous materials/chemicals and/or the generation of liquid waste resulting in the contamination of groundwater. Construction could also disturb existing contaminated groundwater and/or soils.

The potential impacts to groundwater from the above would vary depending on the type and extent of any contamination event, if not managed appropriately. The extent and degree of potential groundwater contamination is dependent on factors such as geology, depth to groundwater, the infiltration capacity/permeability of the hydrogeology and the presence, properties and characteristics of a potential pollutant. Potential groundwater contamination incidences, if they were to occur, are expected to be minor and localised to within the construction areas with the implementation of management measures, as described in *Chapter 8 (Management)*.

6.1.3 Changes to groundwater flow paths

Where concrete footings for transmission towers intercept the groundwater table, small scale changes in flow paths may occur, up to a maximum 2.1 metres which is the diameter of straight sided and undercut footings. This is not expected to obstruct or alter local and regional groundwater flow paths. The construction and use of ancillary above ground facilities, including switching stations at Bayswater South and Olney, would not impact the groundwater systems as they are expected to be above the water table.

Furthermore, any potential reductions in recharge from the creation of construction camps, buildings and laydown areas, etc. are considered to be insignificant given the scale of the regional groundwater systems.

6.1.4 Impacts to groundwater sensitive receivers

i Impacts to landholder bores

a Physical removal or damage to landholder bores

Registered landholder bores within the project impact area were assessed via desktop review to determine if any bores require removal. The existing bores within the construction impact area are included in Table 6.3.

There are 24 bores within the project impact area (as shown on Figure 6.1 and detailed in Table 6.3) (including 2 exploration bores listed as abandoned). These are at an increased risk of damage as a result of project construction activities such as vehicle and plant movement, vegetation clearing activities and earthworks. No groundwater bores within the project impact area are expected to be removed for construction and/or operation of the project. Appropriate mitigation measures listed in *Chapter 8 (Management)* would be implemented on a site-specific basis to prevent damage to the water supply infrastructure. Bore removal is possible to allow construction and the establishment of permanent project infrastructure. Any bores not required to be removed during construction, would be clearly demarcated.

Table 6.3 Existing licensed groundwater bores located within the project impact area

Bore ID	Bore purpose
GW014211	Irrigation, privately owned
GW015099	Irrigation, privately owned
GW017888	Unknown
GW030731	Abandoned
GW030737	Abandoned
GW038527	Private bore
GW053931	Irrigation
GW058500	Stock and domestic, privately owned, approval number: 20WA215331
GW067101	Monitoring, government owned
GW201215	Monitoring, Hunter Valley Operations (HVO) owned
GW201216	Monitoring, HVO owned
GW201218	Monitoring, HVO owned
GW201230	Dewatering, HVO owned
GW201260	Monitoring, Mt Thorley owned
GW201499	Private monitoring
GW201500	Private monitoring
GW201501	Private monitoring
GW201502	Private monitoring
GW202941	Private monitoring
GW203423	Private monitoring
GW203429	Unknown
GW203463	Private monitoring
GW203509	Monitoring, HVO owned
GW203514	Unknown

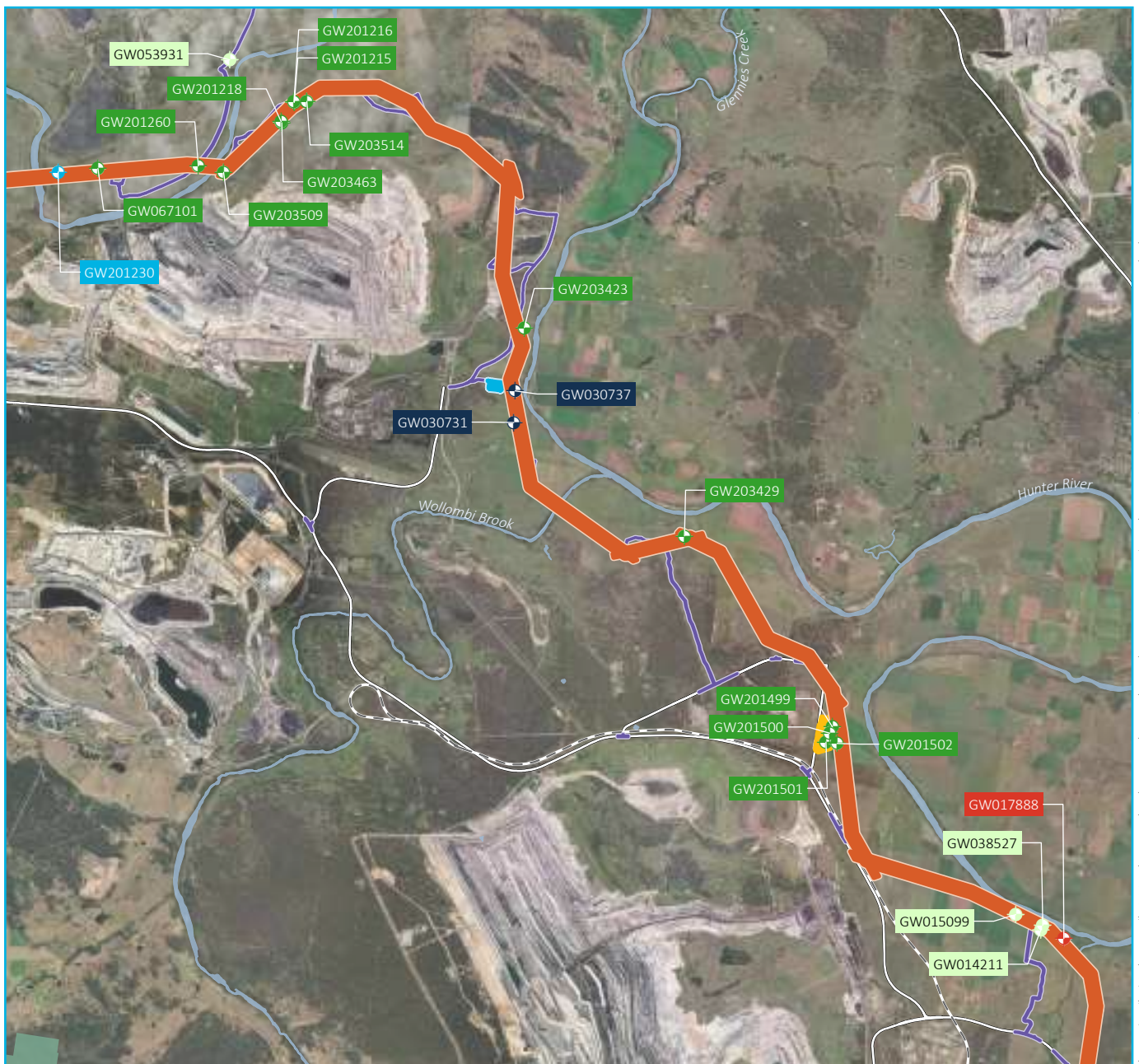
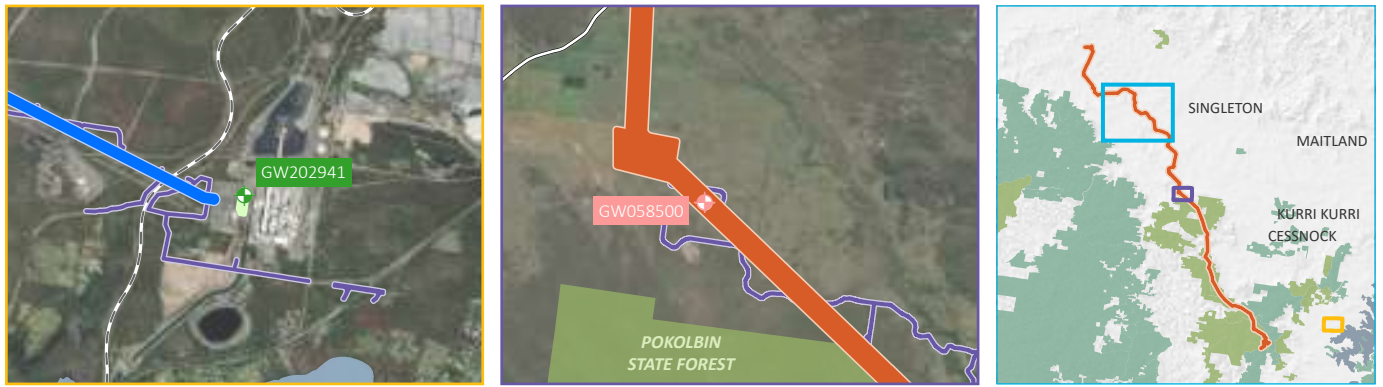
b Groundwater level drawdown at landholder bores

There are four existing landholder bores within 18 metres of indicative transmission towers or gantry locations. This distance is considered to be the maximum expected drawdown radius associated with incidental take during construction of transmission towers in the alluvial groundwater system.

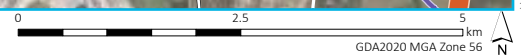
These bores are listed in Table 6.4, and are all either monitoring or dewatering bores (i.e. not water supply bores). These bores are also shown in Figure 6.1.

Table 6.4 **Landholder bores potentially impacted by HTP drawdown**

Bore ID	Bore purpose	Approximate distance to project feature (m)
GW201230	Dewatering, Hunter Valley Operations (HVO) owned	10
GW201502	Monitoring bore, privately owned	3
GW203429	Monitoring bore, mine (unknown) owned	6
GW201215	Monitoring, HVO owned	16



Source: EMM (2025); Beca (2025); BOM (2024); DCSSS (2024); ESRI (2024)



KEY

Borehole type

- Dewatering
- Exploration
- Irrigation
- Monitoring
- Stock and domestic
- Unknown

Project impact area

- HTP corridor
- Construction support site
- Laydown area
- Access track
- Existing environment
- Rail line
- Major road
- Named watercourse
- Named waterbody

NPWS reserve

- State forest

INSET KEY

- HTP corridor
- NPWS reserve
- State forest

Potentially impacted bores

Hunter Transmission Project
Groundwater Assessment
Figure 6.1



ii Impacts to groundwater dependent ecosystems

A review of potential drawdown associated with the use of groundwater bores for incidental groundwater take during construction indicates there are no drawdown impacts expected at any high priority listed GDEs. Potential drawdown impacts to terrestrial vegetation are discussed in the Biodiversity development assessment report (WSP 2024b) (*Technical Report 1 - Biodiversity development assessment report*).

There are high ecological value aquatic ecosystems (HEVAE) and Bureau of Meteorology (BoM) medium and high probability mapped aquatic and terrestrial GDEs within 18 metres of transmission towers and gantry in the central Hunter Valley floor in association with the Hunter River and its tributaries. This is the maximum predicted distance where temporary and minimal drawdown could occur in association with incidental take would occur in the shallow alluvial groundwater system.

There are also HEVAE and BoM medium and high probability mapped aquatic and terrestrial GDEs within 2 metres of transmission towers in the Olney State Forest. This is the maximum predicted distance where temporary and minimal drawdown could occur in association with incidental take in the Permian Porous and sedimentary rock groundwater system.

Direct impacts to GDEs are addressed in the Biodiversity development assessment report (WSP 2024b) (*Technical Report 1 - Biodiversity development assessment report*).

iii Impacts to culturally significant sites

Construction of the project would destroy the Wishing Well culturally significant site and as such, the potential groundwater impacts to this item have not been contemplated as part of this assessment. The assessment of the potential impacts to this item have been considered in the Historic heritage impact statement (*Technical Report 7 – Historic heritage impact statement*).

6.2 Assessment of potential operation impacts

There would be only minor potential for contamination incidents during the HTP operation relating to accidental spills of hazardous materials and/or chemicals resulting in the contamination of groundwater. Similar to the construction phase, this would be dependent on the type and extent of contamination, hydrogeological characteristics and management measures.

Small scale changes in flow paths may occur, up to a maximum 2.1 metres, where concrete footings for transmission towers intercept the groundwater table. This is not expected to obstruct or alter local and regional groundwater flow paths. Any potential reductions in recharge from the creation of transmission towers and permanent infrastructure are considered to be insignificant given the scale of the regional groundwater systems.

6.3 Assessment of potential cumulative impacts

Potential cumulative groundwater impacts could relate to combined groundwater level drawdown. However, the potential drawdown from the project is localised and temporary, and insignificant in comparison to the regional groundwater depressurisation from the Hunter Valley open cut and underground mines. The proposed water supply bores have been previously assessed and licensed, and no additional impacts are expected. Therefore, there are no cumulative groundwater impacts expected as a result of the project.

7 Aquifer interference policy – minimum impact considerations

The NSW *Aquifer Interference Policy* (AIP) (DPI 2012) provides a framework to assess groundwater impacts of aquifer interference activities on groundwater resources and define minimal impact considerations to ensure no more than minimal harm occurs to key water dependent assets. This document provides guidance for the assessment of groundwater impacts to water supply works, culturally significant sites and groundwater dependent ecosystems (GDEs). If a potential impact is less than the level 1 minimal impact considerations, then this impact would be considered to be acceptable. Assessment of the Hunter Transmission Project (HTP, the project) against the criteria documented in the AIP concludes:

- the potential HTP groundwater level drawdown is less than the AIP level 1 minimal impact considerations
- there is no drawdown expected at high priority GDEs, which is less than the AIP level 1 minimal impact considerations
- there are no high priority culturally significant sites listed in the relevant water sharing plans (WSPs) that would require assessment against the AIP minimal impact considerations
- there is not expected to be any change to the existing groundwater quality or beneficial use category, which is less than the AIP level 1 minimal impact considerations.

Therefore, these impacts are assessed as being acceptable level 1 minimal impacts under the AIP.

Additional groundwater impacts, not assessed under the AIP, include:

- potential, negligible short-term drawdown at high ecological value aquatic ecosystems (HEVAE) and Bureau of Meteorology (BoM) GDE locations, discussed further in the Biodiversity development assessment report (WSP 2024b) (*Technical Report 1 - Biodiversity development assessment report*)
- potential, negligible short-term drawdown at mine monitoring and dewatering bores
- potential removal of or damage to landholder bores within the project impact area (26 bores have been identified). Any damage or physical removal of private and/or mine owned bores will be compensated and, in the case of water supply and irrigation bores, further make-good measures may be implemented (refer to *Chapter 8 (Management)*).

Potential impacts to groundwater systems and groundwater users resulting from the project are presented graphically in Figure 7.1.

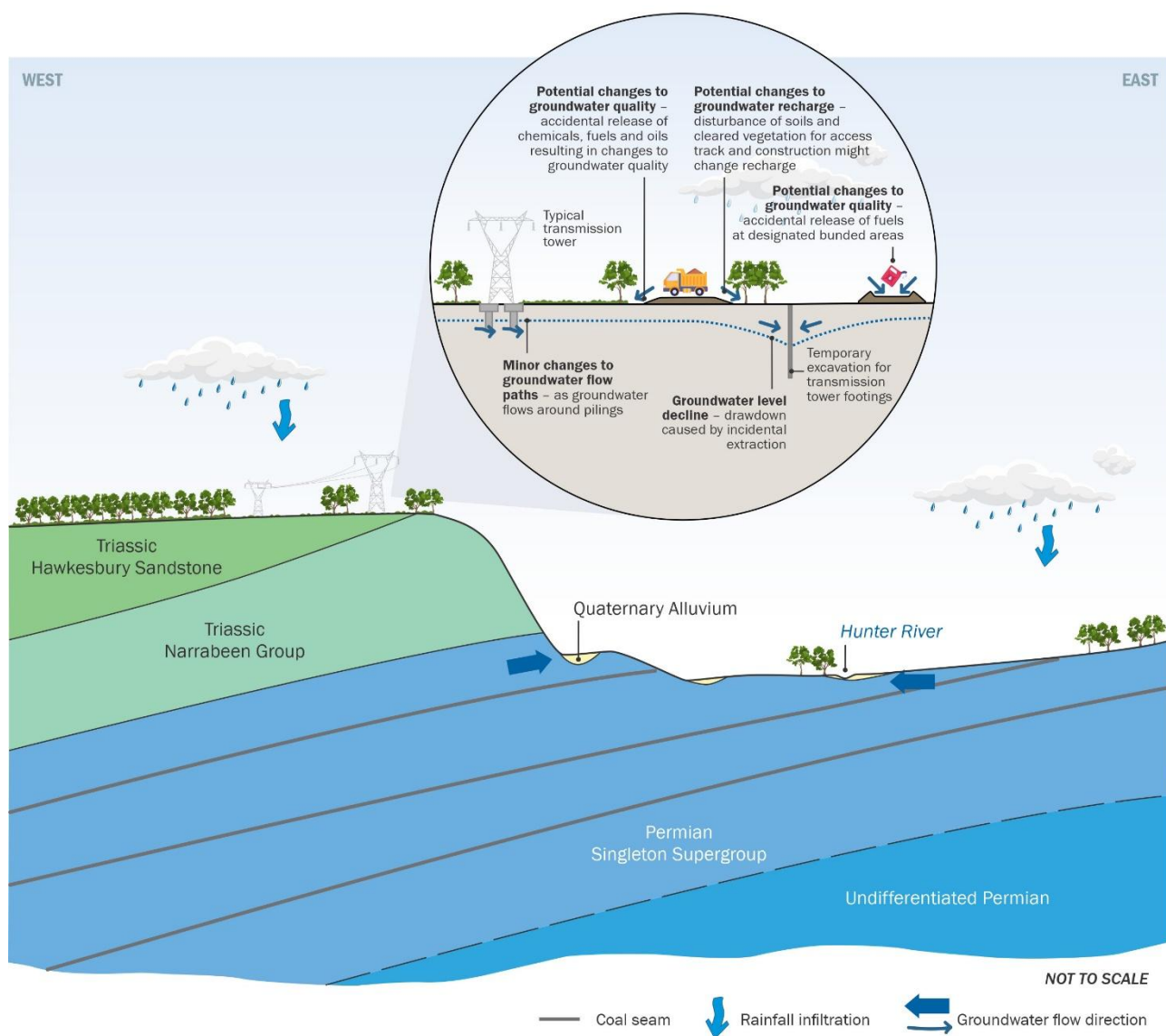


Figure 7.1 **Hydrogeological conceptual site model – potential project impacts**

8 Management

Mitigation measures to avoid or minimise potential impacts to groundwater and groundwater users during construction and operation of the Hunter Transmission Project (HTP, the project) are listed in Table 8.1. These mainly focus on the project construction phase and will be included in the issue-specific environmental management plans for the HTP.

Specifically, a soil and water management plan will be developed for the project, which will outline site specific surface water and groundwater measures to be implemented to prevent potential negative impacts to water resources during the construction and operational phases.

Mitigation measures in other technical papers that are relevant to the management of groundwater include:

- surface water impact assessment (*Technical Report 10 - Surface water impact assessment*) – surface water, specifically measures which address surface water quality impacts and captured groundwater from excavations
- contamination preliminary site investigation (*Technical Report 13 - Contamination preliminary site investigation*) – hazards, specifically measures relating to the storage of fuel and oil within the construction disturbance area and accidental disturbance of contaminated material
- preliminary risk screening (*Technical Report 15 - Preliminary risk screening*) – hazards, specifically measures relating to the storage of fuel and oil within the construction impact area and accidental disturbance of contaminated material.

Table 8.1 Proposed mitigation measures - groundwater

ID	Project element	Issue	Mitigation measure	Timing
GW1	Construction impact area	Damage and/or removal of existing landholder bores	Bores within the construction impact area will be clearly demarcated to protect the infrastructure from accidental damage. In the instance that accidental damage does occur, make good provisions will apply in accordance with the minimal impact criteria listed in the <i>NSW Aquifer Interference Policy (AIP)</i>. This will likely include replacement of a bore in a similar nearby location in consultation with landowners.	Construction
GW2	Incidental groundwater take	Lowering of groundwater levels	All groundwater allocations will be extracted in accordance with the conditions of project approval and where required, associated water access licence(s). Where groundwater is encountered during excavations, any dewatered volumes will be recorded and managed in accordance with the requirements of the <i>NSW Water Management Act 2000 (WM Act)</i>, <i>Water Management (General) Regulation 2018 (WM Regulation)</i> and project consent conditions.	Construction

8.1 Groundwater licensing

8.1.1 Existing groundwater bores

Should the construction contractor (once appointed) enter negotiations for the temporary use of any existing groundwater bores with the licence holder(s), the authorised use of these existing licenced groundwater bores would be converted to cover the intended use for water supply. The existing water entitlements associated with the respective water access licences (WALs) would be available for use as part of construction water supply, should they become available for use.

While ordinarily a change in the water use purpose would require approval from the NSW Department of Climate Change, Energy, the Environment and Water, the project has been declared State significant infrastructure (SSI) under section 5.12(4) and section 5.13 of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) by the NSW Minister for Planning and Public Spaces in July 2022. By virtue of the SSI declaration, a water use approval under section 89 of the WM Act is not required for the project in the event that this water supply option is pursued.

8.1.2 Incidental groundwater take

The project is exempt from requiring a WAL for the incidental water take under the WM Regulation (refer to *section 3.2.1*). This includes the inflow of groundwater into transmission tower excavations and any other potential temporary excavations that extend below the water table. The project will be required to record and report the water take as per the WM Regulation; this includes reporting the take within 28 days of each water year finishing.

9 Conclusion

Within the groundwater study area there are 3 groundwater systems defined by their host geology and hydrogeological properties: local, shallow groundwater hosted by unconsolidated Quaternary Alluvium, local to regional groundwater systems associated with the Triassic aged porous sedimentary rock units, and the Permian aged porous sedimentary rock units.

Most of the potential groundwater impacts would take place during the construction phase. The following impacts to groundwater are possible during construction:

- incidental groundwater take during the construction of the transmission line footings at locations that intercept the water table
- changes to groundwater quality, with potential localised changes to groundwater quality from:
 - accidental spills of hazardous materials/chemicals and/or the generation of liquid waste resulting in the contamination of groundwater
 - disturbance of existing contaminated groundwater and/or soils
- accidental damage to the existing landholder bores within the project impact area. There are 24 registered bores identified within the project impact area (including 2 exploration bores listed as abandoned); however, with the implementation of mitigation measures identified in *Chapter 8 (Management)*, impacts are not expected
- temporary reduction in the availability of groundwater at existing groundwater bores from the lowering of groundwater caused by construction of the transmission line footings.

During the projects operational phase there will be no groundwater take, however there are minor potential for contamination incidents relating to accidental spills of hazardous materials and/or chemicals resulting in the contamination of groundwater.

Assessment of the project against the criteria listed in the NSW *Aquifer Interference Policy* (AIP) (DPI 2012) concludes:

- the potential HTP groundwater level drawdown is less than the AIP level 1 minimal impact considerations
- there is no drawdown expected at high priority groundwater dependent ecosystems (GDEs), which is less than the AIP level 1 minimal impact considerations
- there are no high priority culturally significant sites listed in the relevant water sharing plans (WSPs) that would require assessment against the AIP minimal impact considerations
- there is not expected to be any change to the existing groundwater quality or beneficial use category, which is less than the AIP level 1 minimal impact considerations.

Therefore, these impacts are assessed as being negligible and acceptable level 1 minimal impacts under the AIP.

Additional groundwater impacts, not assessed under the AIP include:

- potential, negligible short-term drawdown at high ecological value aquatic ecosystems (HEVAE) and Bureau of Meteorology (BoM) GDE locations, discussed further in the Biodiversity development assessment report (WSP 2024b) (*Technical Report 1 - Biodiversity development assessment report*)
- potential, negligible short-term drawdown at mine monitoring and dewatering bores

- potential removal of or damage to landholder bores within the project impact area (24 bores have been identified). Any damage or physical removal of private and/or mine owned bores will be compensated and, in the case of water supply and irrigation bores, further make-good measures may be implemented.

A soil and water management plan will be developed for the project, outlining site specific surface water and groundwater measures implemented to prevent potential negative impacts to water resources during the construction and operational phases. This will document the handling and storage of fuels, oils and other potential liquid contaminants to avoid potential groundwater quality impacts, and the measures taken for protection of bores within the construction impact area.

The project is exempt from licensing incidental water take, namely the inflow of groundwater into transmission tower excavations and any other potential excavations that extend below the water table. Monitoring and reporting requirements still apply.

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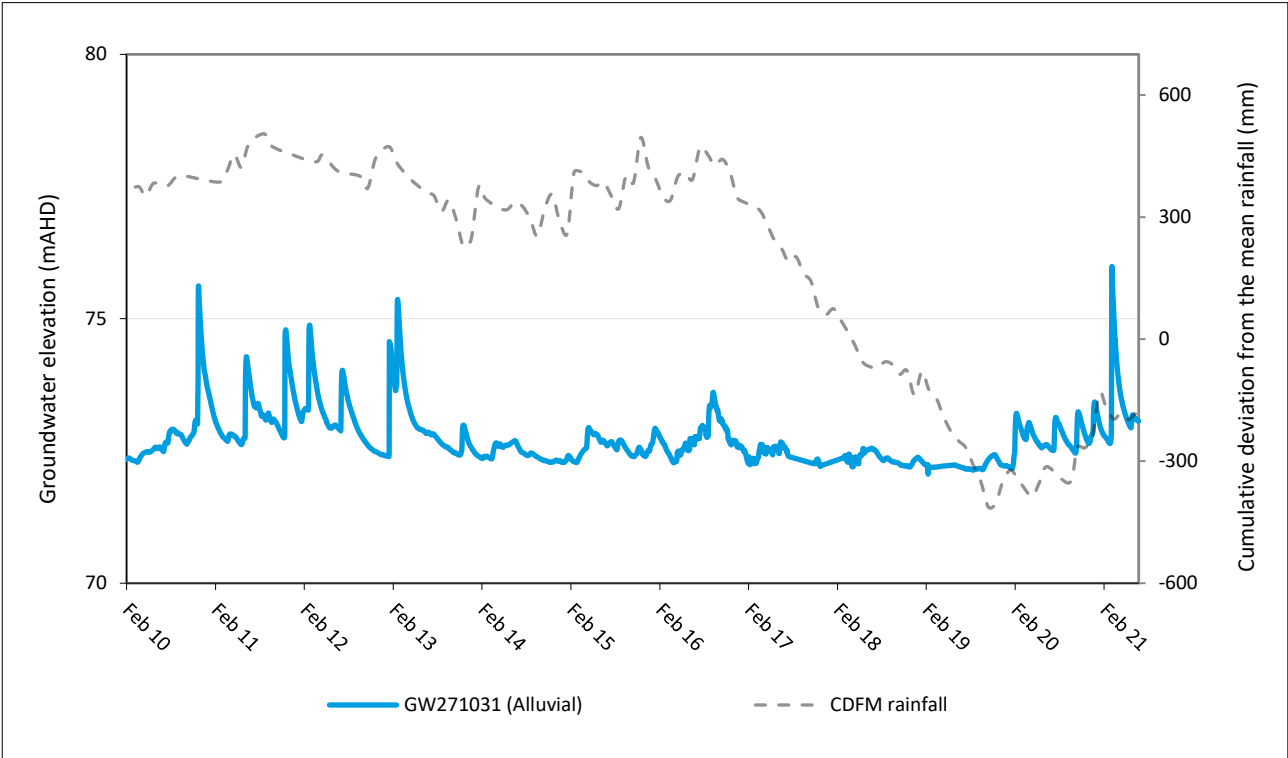
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Appendix A

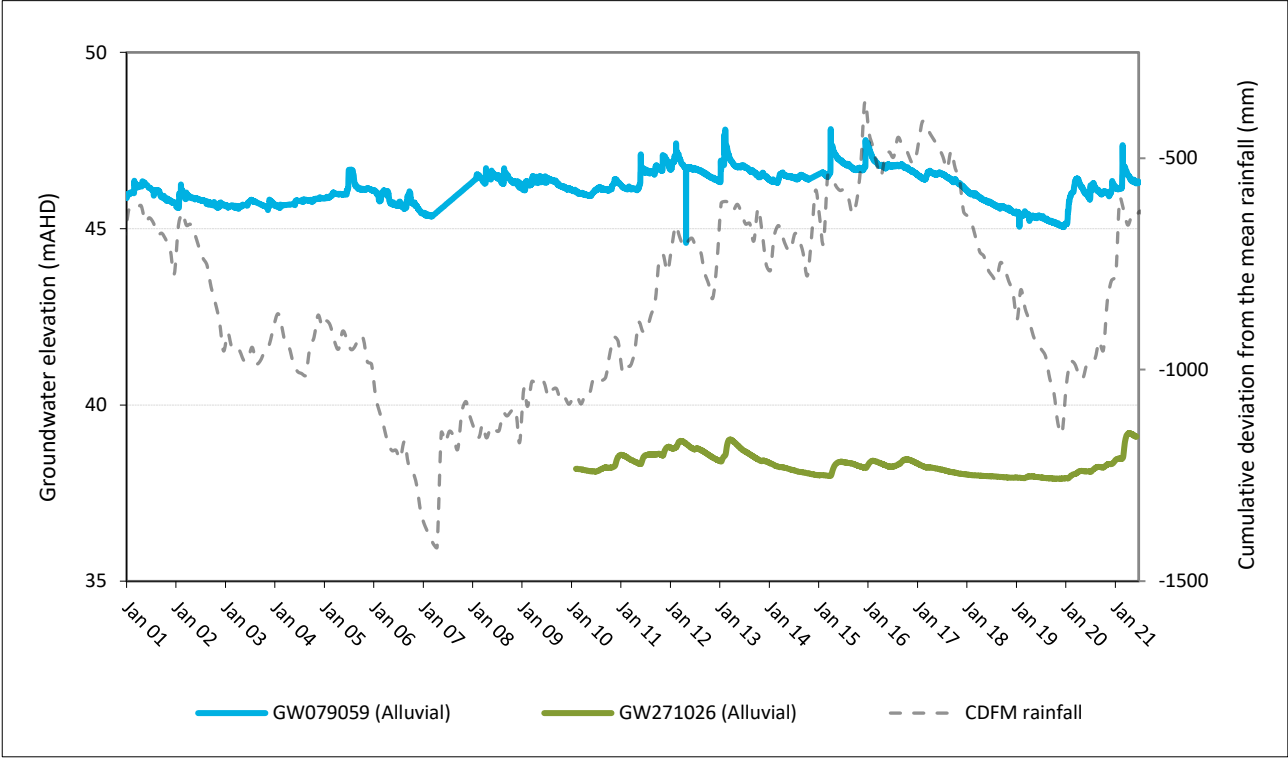
Hydrographs

A.1 Alluvial hydrographs



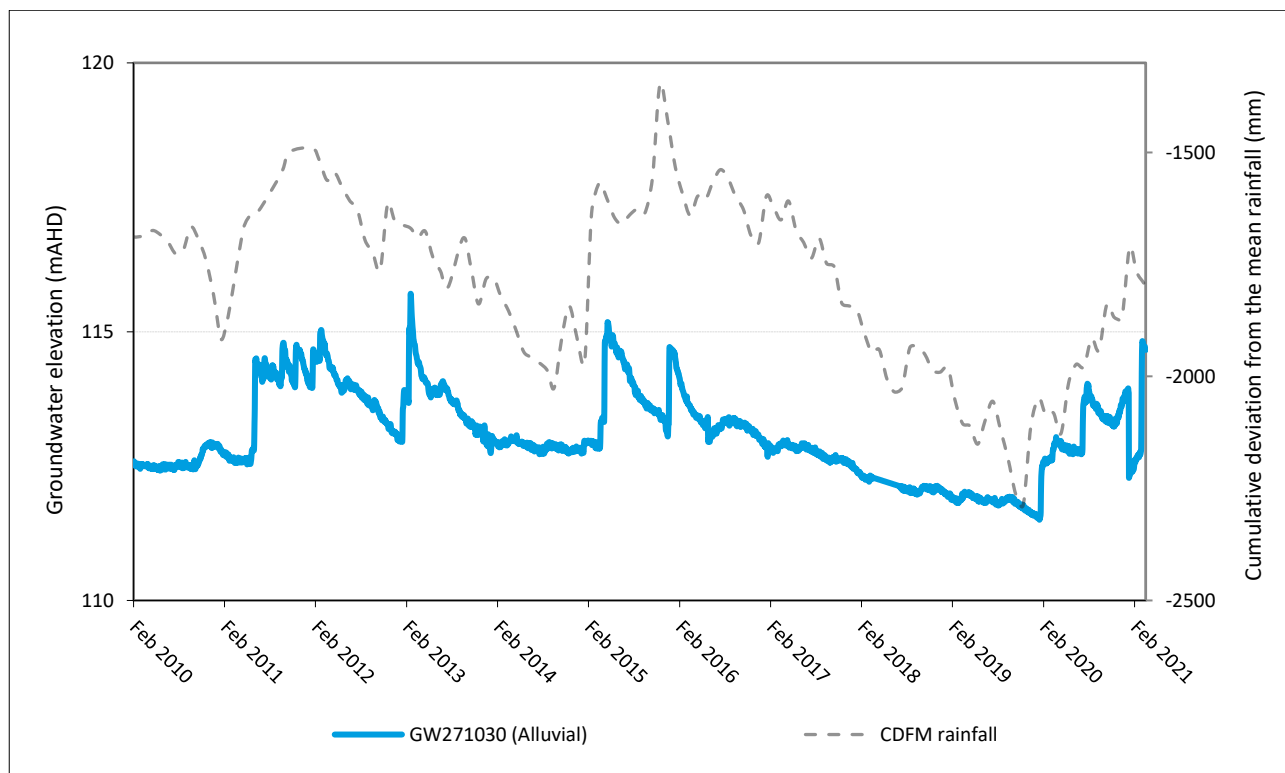
Notes: Climate data from Doyles BoM station (61130)

Figure A.1 GW271031 hydrograph



Notes: Climate data from Bulga BoM station (61191)

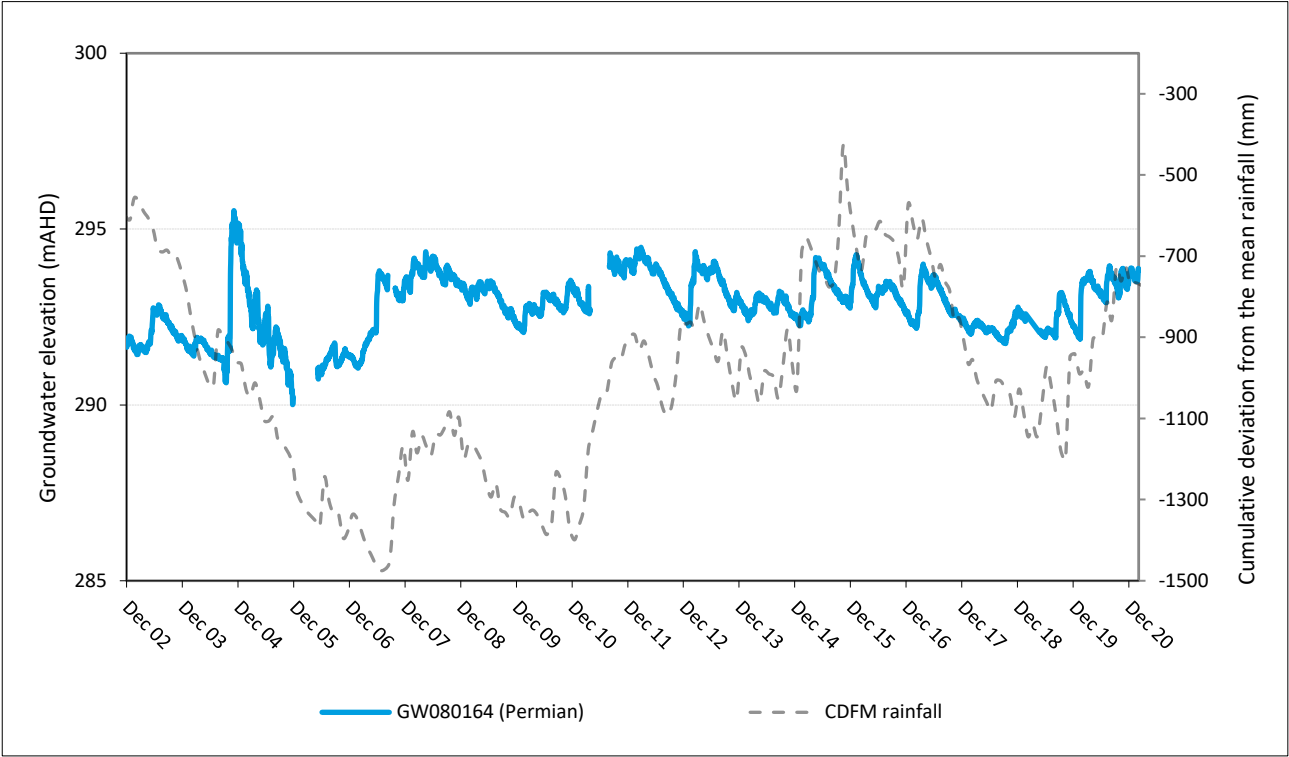
Figure A.2 GW079059 and GW271026 hydrograph



Notes: Climate data from Congewai BoM station (61152)

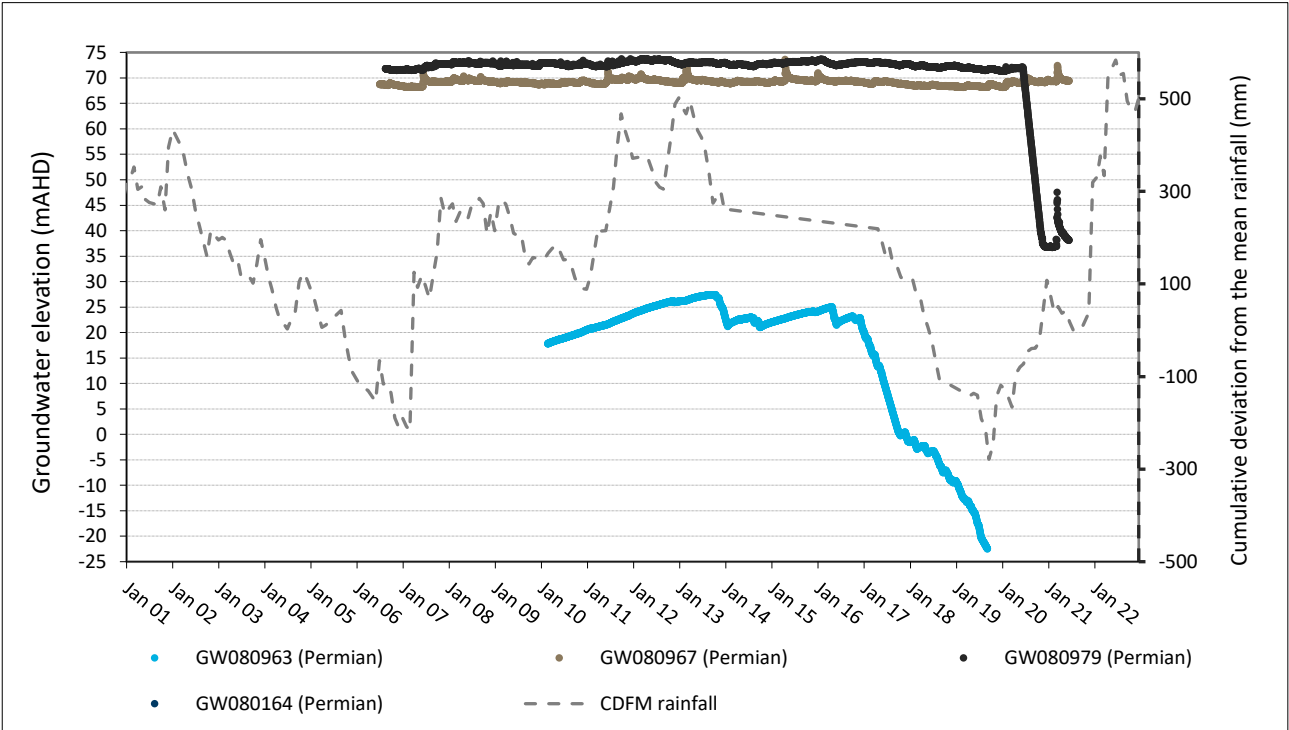
Figure A.3 GW271030 hydrograph

A.1 Permian hydrographs



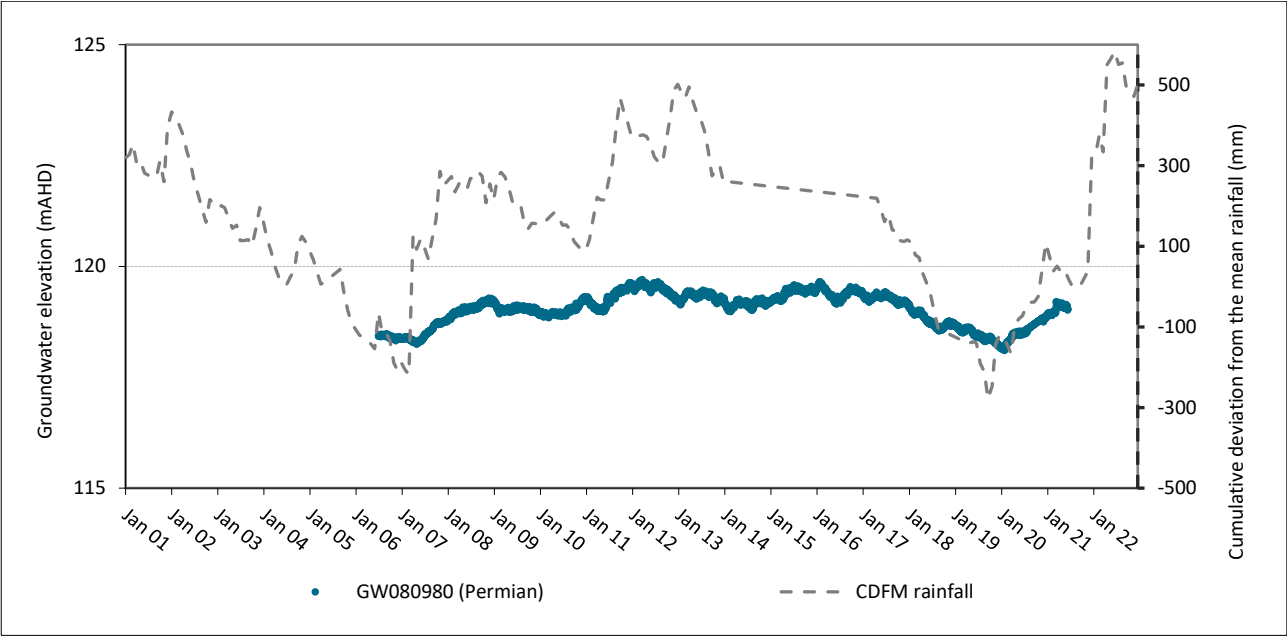
Notes: Climate data from Kulnura BoM station (61394)

Figure A.4 GW080164 hydrographs



Notes: Climate data from Broke BoM station (61100)

Figure A.5 GW080963, GW080967, GW080979, GW080164 hydrograph



Notes: Climate data from Broke BoM station (61100)

Figure A.6 GW080980 hydrograph

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