Appendix R

Preliminary Stormwater Management Plan

Tarong West Wind Farm

Preliminary Stormwater Management Plan

20-Dec-2023

Doc No. 60704414-RP-WR-0001-0

aecom.com

Delivering a better world

Tarong West Wind Farm

Preliminary Stormwater Management Plan

Client: RES Australia Pty Ltd

ABN: 55 106 637 754

Prepared by

AECOM Australia Pty Ltd,

20-Dec-2023

Job No.: 60704414

Quality Information

Document Tarong West Wind Farm – Preliminary Stormwater Management Plan

Ref 60704414

Date 20-Dec-2023

Originator Priyam Awotar

Checker/s Alexander Karrasch

Verifier/s Federico Groppa

Revision History

Rev	Revision Date	Details	Approved	
			Name/Position	Signature
0	20-Dec-2023	Final	Jared Brook Project Manager	

Professional Registration

This document includes professional services that require approval from a registered professional.

Registration Scheme	Discipline / Area of Practice	Name of Registered Professional*	Signature	Registration No.	Date
RPEQ	Civil	Federico Groppa		16164	19/12/2023

* The registered professional must be the originator of this work or have provided direct supervision to the originator.

Table of Contents

Executive Summary i
1.0 Introduction 4
1.1 Project Overview 4
1.2 Scope and Purpose of Stormwater Assessment 7
2.0 Relevant Legislation 8
2.1 Environmental Protection Act 1994 (Qld) 8
2.1.1 Environmental Protection (Water and Wetland biodiversity) Policy 2019 8
2.2 Water Act 2000 8
2.2.1 Water Plan (Burnett Basin) 2014 8
2.2.2 Water Regulation 2016 8
2.3 Nature Conservation Act 1992 8
2.4 Planning Act 2016 9
2.4.1 State Development Assessment Provisions (Version 3.0) 9
2.5 Fisheries Act 1994 10
2.5.1 Fish Passage and Waterway Barrier Works 10
2.6 Regional Planning Interests Act 2014 10
3.0 Surface Water Environment 12
3.1 Existing Site Drainage 12
3.2 Watercourses and Waterways 13
3.3 Land Use 17
3.3.1 Historical 17
3.3.2 Current 17
3.4 Water Quality 17
3.4.1 Environmental Values 17
3.4.2 Water Quality Guidelines 18
3.5 Water Quality Objectives 18
4.0 Baseline Environmental Characterisation 19
4.1 Climate 19
4.2 Surface Water Hydrology 21
4.3 Flood Review 23
4.4 Fluvial Geomorphology 26
4.5 Riparian Vegetation 26
4.6 Surface Water Quality 27
5.0 Surface Water Impacts 28
5.1 Stormwater Quality 28
5.2 Stormwater Quantity 28
5.3 Water Supply Options 29
5.3.1 Construction Water Supply 29
5.3.2 Operational Water Supply 30
5.4 Potential Impacts to Identified Environmental Values 31
5.5 Risk Assessment and Mitigation Measures 31
6.0 Erosion and Sediment Control 37
6.1 General Principles 37
6.2 Identified Risks 37
6.3 Design Aspects 38
6.4 Construction ESCP 38
6.5 Site Operations ESCP 38
6.6 Decommissioning 38
7.0 Conclusions 39
8.0 References 40

Executive Summary

AECOM Australia Pty Ltd (AECOM) was engaged by RES Australia Pty Ltd (RES) to prepare a preliminary stormwater assessment for the proposed Tarong West Wind Farm (the Project). This report presents the findings of a desktop stormwater assessment undertaken for the Project. The stormwater assessment has used the performance outcomes (PO) (PO7 and PO8) of State Code 23: Wind Farm Development (State Code 23) of the State Development Assessment Provisions (SDAP). The assessment also considers the updated infrastructure layout provided to AECOM in August 2023.

The Project will be established over freehold rural properties, State land and reserves, totalling approximately 17,500 ha (Project Site) The overall Planning Corridor area will total 1,953 ha with a maximum clearing footprint of 1,062 ha. The Project Site is crossed by several existing roads including Ironpot road, Kingaroy Burrandowan Road, Glenrocks Road, Jumma Road and Greystonlea Jumma Road.

The Project will involve the construction and operation of a wind farm consisting of up to 97 wind turbine generators (WTGs) with an overall rated capacity of up to 437 megawatts (MW) of clean and renewable electricity to supply to the National Electricity Market (NEM). The planning corridor includes the proposed WTGs, access tracks, underground cables, overhead lines and other associated infrastructure. Except for where there are WTG towers and associated infrastructure, the existing land will continue to be used for rural purposes including grazing livestock and cropping.

The Project Site, and surrounding region has a highly undulated terrain with the primary industry considered to be agricultural, mainly livestock. The site is considered to be relatively dense with vegetation in the more undulated areas, and relatively clear in the lower lying flatter terrain areas.

Surface water environmental values (EVs) associated with the Project and immediate surrounds include:

- aquatic ecosystems
- cultural and spiritual values
- drinking water
- farm supply
- human consumption
- industrial use
- irrigation
- primary recreation
- secondary recreation
- stock watering
- visual appreciation.

The potential impacts on stormwater discharge quantity and quality as a result of the Project arise from a range of activities associated with the construction, operation and decommissioning phases. The potential impacts are outlined and summarised in Table 1. It is noted that following the implementation of the appropriate mitigation measures, the potential impacts risks to surface water are considered low with regards to the quantity or quality of stormwater discharging from the site to receiving waters, in compliance with the requirements of PO7 and PO8 of State Code 23.

Table 1 Summary of Potential Impacts and Mitigation Measures

Potential Impact to Surface Water	Project Phase			Mitigation Measure
	Con	Ops	Dec	
Discharge of sediments (both air and water-borne) from exposed ground resulting in localised adverse impacts on receiving environment surface water quality.	✓	×	✓	• An Erosion and Sediment Control Plan (ESCP) will be developed for the Project which will detail methods for minimising sediment-laden runoff in accordance with Best Practice Erosion and Sediment (BPESC) guidelines (IECA Best Practice Erosion and Sediment Control – For Construction and Building Sites, 2008). • Project detailed design will aim to minimise disruption of natural drainage patterns and water flows; and construction activities within and/or adjacent to waterways will be minimised as much as feasibly possible to reduce any disturbance to those waterways. • Where vegetation clearing is unavoidable a stormwater management plan will be prepared in accordance with section 2.3 of the Queensland Urban Drainage Manual demonstrating that the clearing has been minimised and appropriate measures have been included to ensure the protection of bank stability, water quality and habitat. • Water will be used for dust suppression to minimise airborne contaminants. • Additional covering of sediments and materials during storm events to reduce sediment heavy runoff.
Discharge of stormwater from the Project resulting in localised adverse impacts on receiving environment surface water quality.	×	✓	×	• An ESCP will be developed for the Project which will detail methods for minimising sediment-laden runoff in accordance with best practice guidelines. • The plan will include a stormwater management plan prepared in accordance with section 2.3 of the Queensland Urban Drainage Manual (2017).
Discharge of stormwater from the Project resulting in localised adverse impacts on receiving environment surface water geomorphology and aquatic habitat. (e.g. stream bank erosion and scouring from concentrated discharge of stormwater)	✓	✓	×	• Project detailed design will aim to minimise disruption of natural drainage patterns and water flows. • Construction activities within and/or adjacent to waterways will be minimised as much as feasibly possible to minimise disturbance to those waterways. • An ESCP will be developed for the Project which will detail methods for minimising runoff impacts in accordance with Best Practice Erosion and Sediment (BPESC) guidelines (IECA Best Practice Erosion and Sediment Control – For Construction and Building Sites, 2008). • The ESCP will detail methods for minimising runoff impacts in accordance with best practice guidelines. The plan will include a stormwater management plan prepared in accordance with section 2.3 of the Queensland Urban Drainage Manual to ensure that Project drainage works aim to minimise potential impacts on receiving environment aquatic habitat and geomorphology.

Potential Impact to Surface Water	Project Phase			Mitigation Measure
	Con	Ops	Dec	
Restriction of fish passage (e.g. through velocity increases) due to waterway crossings	✓	✓	×	• Creek crossings will be designed and constructed in accordance with *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018) which provides accepted development requirements for low-impact development activities such as temporary works, bed level crossings and culverts. Where the design provisions of DAF (2018) cannot be met, a development permit for operational work for waterway barrier works will be sought. In complying with legislated requirements, the impact to fish passage is expected to be minimal.
Spills/leaks from chemical (e.g. fuel and oil) storage areas or substation areas into surface water bodies resulting in localised adverse impacts on receiving environment surface water quality.	✓	✓	✓	• Chemicals and fuels such as coolants and hydrocarbons will be stored in accordance with relevant Australian Standards to ensure that any spillages are contained. • The requirement for additional stormwater quality controls for Project substation areas (such as bunding, oil separators, etc.) will be determined, and if required, designed and operated in accordance with relevant guidelines and standards.
Untreated discharges from onsite waste water treatment facilities into surface water environment.	✓	✓	✓	• During construction, the temporary construction compound is anticipated to be supported by portable ablutions facilities with containment systems for removal from site by an appropriately licenced waste contractor. Port-a-loos are additionally anticipated to support the construction of the Project and will again be managed through containment and trucking of waste from the Project site. • The operations and maintenance facility will have an on-site septic system in accordance with relevant Australian Standards and statutory requirements. • Effluent will be removed from site and disposed in a suitable facility by a licenced operator. • The decommissioning of an installed septic system will be subject to relevant workplace health and safety and plumbing guidance in place at the time decommissioning commences.
Discharge of stormwater from the Project site following decommissioning resulting in localised adverse impacts on receiving environment surface water quality and/or quantity.	×	×	✓	• Following the decommissioning phase of the Project, it is assumed that land use will return to a similar use to pre-development (grazing). • Mitigation measures are therefore not considered necessary post decommissioning.

1.0 Introduction

1.1 Project Overview

This preliminary stormwater management plan presents the findings of a desktop assessment undertaken for the proposed Tarong West Wind Farm (the Project), located to the west of Kingaroy, Queensland. The stormwater assessment has considered performance outcomes (PO7 and PO8 of State Code 23): Wind Farm Development (State Code 23) of the State Development Assessment Provisions (SDAP).

The Project Site is located within the Burnett River Basin. The Boyne River and its associated tributaries, Ironpot Creek, Boughyard Creek, Jumma Creek, Mannueum Creek and Middle Creek traverse the Project Site. Existing roads include Ironpot road, Kingaroy Burrandowan Road, Glenrocks Road, Jumma Road and Greystonlea Jumma Road.

The Project will involve the construction and operation of a wind farm consisting of 97 wind turbine generators (WTGs) with an overall rated capacity of up to 437 megawatts (MW) of clean and renewable electricity to supply to the National Electricity Market (NEM). The Project will be established over freehold rural properties, State land and reserves, totalling approximately 17,500 ha (Project Site). The overall Planning Corridor area will total 1,953 ha with a maximum clearing footprint of 1,062 ha. The planning corridor includes the proposed WTGs, access tracks, underground cables, overhead lines, and other associated infrastructure. Except for where there are WTG towers and associated infrastructure, the existing land will continue to be used for rural purposes including grazing livestock and cropping.

Following approval of the wind farm, further detailed site investigations will be undertaken to determine the exact location of the WTGs and all other infrastructure within the approved planning corridor. To accommodate on-site constraints, the WTGs and ancillary infrastructure may move up to 100 metres (m) from the original proposed locations. The micro-siting process allows for further consideration of physical, environmental and geotechnical conditions.

The Project is anticipated to start construction in 2024. The Project will be constructed as a single stage and be completed within approximately 30 months (subject to detailed design and weather).

The location of the site is shown in Figure 1. The proposed layout of the site is shown in Figure 2. Following approval of the Project, detailed design will be completed by the appointed Engineering Procurement and Construction (EPC) contractor and will be based on the scope of work, preliminary site studies and Development Approval provided by RES Australia Pty Ltd.

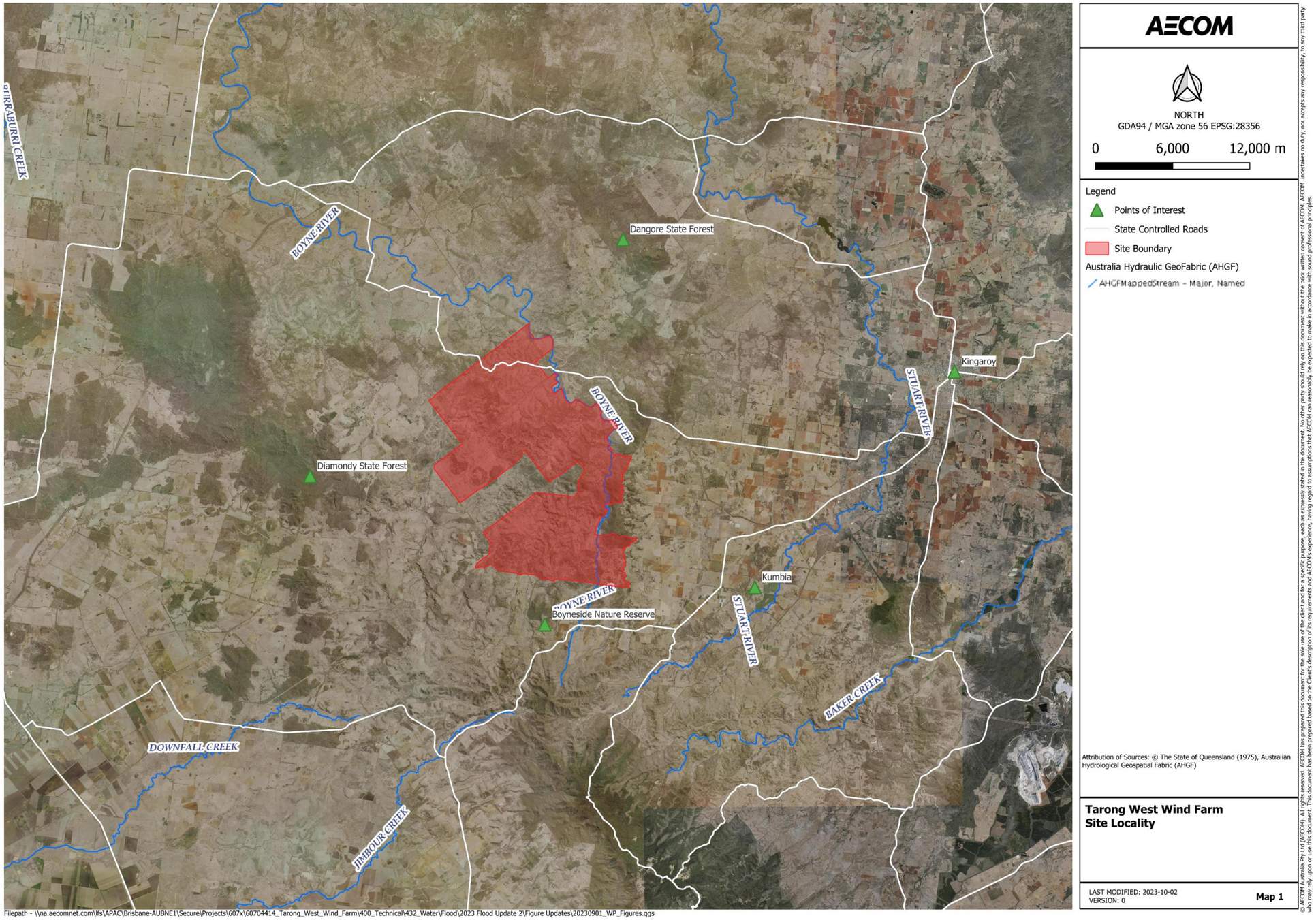


Figure 1 Locality

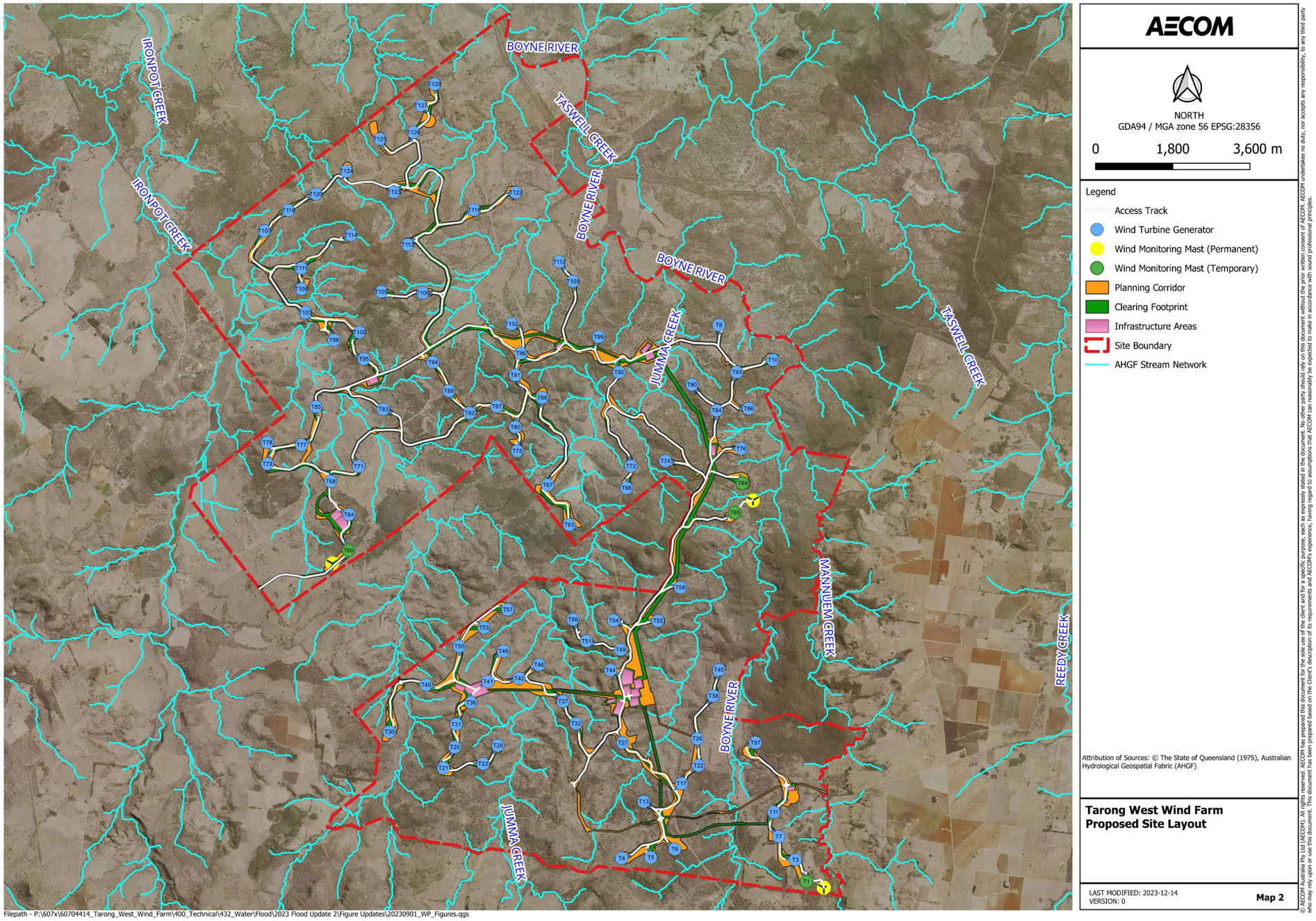


Figure 2 Proposed Project Layout

1.2 Scope and Purpose of the Stormwater Assessment

AECOM Australia Pty Ltd (AECOM) was engaged by RES to undertake the following:

- Identify all watercourses and other surface water bodies within and adjacent to the study area.
- Identify any environmental values and water quality objectives related to the surface water environment.
- Where applicable data are available, assess baseline water quality, hydrological and geomorphic character of the surface water environment.
- Identify potential changes to stormwater discharge from the site resulting from development of the proposed wind farm.
- Assess potential impacts from the Project (though discharge of stormwater, watercourse crossings, etc.) on the surface water environment (water quality, stream flows, stream geomorphic stability).
- Where required, identify strategies to minimise and manage any potentially adverse impacts resulting from the discharge of stormwater from the site to the surface water receiving environment.

The surface water assessment consisted of a desktop analysis to:

- Assess surface water environmental values for each site based on existing documentation (such as the Environmental Protection (Water and Wetland Biodiversity Policy 2019) (DES, 2019).
- Describe the water quality objectives for watercourses in the study area as per the Environmental Protection (Water and Wetland Biodiversity) Policy 2019, Queensland Water Quality Guidelines (2019) and the ANZECC (2018) guidelines.
- Utilise GIS and other existing information sources (including field photographs where available) to assess the baseline geomorphic character and riparian health of the study area's watercourses.
- Using the Floodcheck website, other publicly available data sources and the Tarong West Wind Farm Flood Assessment (AECOM, 2023) to review flooding potential for the site.
- Conduct a qualitative assessment of the potential sources of contaminants in stormwater draining from the site.
- Use environmental risk assessment methodology to assess potential impacts and associated risks and identify residual impacts after implementation of suitable mitigation measures.

2.0 Relevant Legislation

2.1 Environmental Protection Act 1994 (Qld)

The *Environmental Protection Act 1994* (EP Act) aims to:

- Protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).

The primary instrument by which surface water management is achieved under the EP Act is the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP Water 2019; refer to Section 2.1.1). The EP Act is administered by the State of Queensland.

The following regulations and policies are also relevant under the EP Act:

- Environmental Protection (Water and Wetland Biodiversity) Policy 2019.
- Environmental Protection Regulation 2019.

2.1.1 Environmental Protection (Water and Wetland biodiversity) Policy 2019

The Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP Water 2019) defines the Environmental Values (EVs) to be enhanced or protected and outlines the indicators and water quality guidelines to be utilised for protecting those values. Water Quality Objectives (WQOs) for specific catchments are listed within Schedule 1.

The Project Site is located in the Wide Bay Burnett Region (i.e. the Burnett Basin), specifically located in the upper reaches of the Boyne River. Detailed EVs and WQOs for the Wide Bay Burnett Region have not yet been developed, thus default values had to be utilised for the Project. Relevant EVs and WQOs for the Project are presented in Sections 3.4 and 3.5.

2.2 Water Act 2000

The *Water Act 2000* (Water Act) provides a framework to deliver sustainable water planning, allocation management and supply processes to provide for the improved security of water resources in Queensland. The Water Act and its instruments are administered by the State of Queensland. Water Plan (WP) and Water Regulation (WR) are governed by the Water Act.

The WP establishes a framework for sharing water between human consumptive needs and EVs. The WR is developed in parallel with the WP and provides a framework by which objectives from the WP are implemented, including water allocations and administrative directions.

2.2.1 Water Plan (Burnett Basin) 2014

The Project Site is located within the Burnett Basin. The Boyne River is the major watercourse that traverses through the Project Site and thus is subjected to the provisions outlined in the *Water Plan (Burnett Basin) 2014*. The WP provides a 'framework for sustainably managing water and the taking of water'.

2.2.2 Water Regulation 2016

The *Water Regulation 2016* provides guidance for watercourse identification and has provisions for the use of water resources (such as water sharing and water licensing rules, and the establishment of water authorities and supply schemes). Multiple watercourses traverse the Project Site; however, it is understood that the works will not control the flow of or impede the flow of water in the Boyne River or any of its aforementioned tributaries within the planning corridor. As a result, no assessment under the *Water Regulation 2016* is required at this stage of the Project. If the Project design requires waterway diversion or obstruction of flow an assessment will need to be conducted.

2.3 Nature Conservation Act 1992

The objective of the *Nature Conservation Act 1992* is to conserve nature while allowing for human use values, such as those described in Section 3.3 of the Act.

- The involvement of indigenous people in the management of protected areas in which they have an interest under Aboriginal tradition of Island custom.
- The use and enjoyment of protected areas by the community.
- The social, cultural and commercial use of protected areas in a way consistent with the natural and cultural and other values of the areas.

As a component of the natural landscape, surface waters are considered to be inherently linked with these values. Areas that are usually protected by this Act may include for example, national parks, dedicated conservation areas, wilderness areas, or forest reserves. Referring to Figure 1, no areas were identified within the planning corridor, however Boyneside Nature Refuge is situated approximately 2.5 km south of the Project Site.

2.4 Planning Act 2016

The *Planning Act 2016* (Planning Act) is the principal item of legislation regulating both development assessment and planning in Queensland. Under this Act, Planning Instruments (PI) are used as a common scheme for public authorities to adhere to when assessing development applications.

Local planning schemes made under the Planning Act guide and regulate the planning, design, delivery and management of developments in their region including the stormwater related aspects of development. The *South Burnett Regional Planning Scheme (Version 2017 V1.4)* is the relevant planning scheme applying to the development, noting a major amendment to V2.0 is currently in progress.

A Wind Farm application is assessed against State Code 23 of the SDAP and is not subject to the requirements of local planning schemes. Some consideration can be given to strategic outcomes, purpose statement of the zone and any overlay applying to the land as per local planning schemes.

2.4.1 State Development Assessment Provisions (Version 3.0)

The SDAP provides assessment benchmarks for the assessment of development applications involving the State Assessment and Referral Agency (SARA). SARA uses SDAP to deliver a coordinated whole of government approach to the state's assessment of development applications.

SDAP is a performance-based code that regulates specific outcomes, rather than regulating development through prescription. Applicants are required to address criteria to demonstrate the way in which development manages impacts on a matter of state interest. The Project requires assessment against State Code 23 of the SDAP.

State Code 23 provides performance outcomes that should be complied with in order to demonstrate compliance with the code. Table 2 details performance outcomes and acceptable outcomes relevant to this report.

Table 2 State Code 23 - Performance Outcomes and Acceptable Outcomes

Performance Outcome	Acceptable Outcome
Water quality	
PO7 Development maintains the water quality of receiving waters.	No acceptable outcome is prescribed.
Natural drainage patterns	
PO8 Development maintains the natural drainage patterns on the site by protecting: 1. bank stability by limiting bank erosion. 2. water quality objectives by filtering sediments, nutrients and other pollutants. 3. aquatic habitats.	No acceptable outcome is prescribed.

Performance Outcome	Acceptable Outcome
4. terrestrial habitats.	

As the design of the Project progresses, the following will be prepared and certified by an RPEQ to meet the Performance Outcomes PO7 and PO8 of State Code 23 which are of relevance to this report:

- An erosion and sediment control plan in accordance with the best practice principles contained in the International Erosion Control Association (IECA) Best Practice erosion and sediment control document, which will supersede the current Conceptual Erosion and Sediment Control Plan (AECOM, 2023)
- A stormwater management plan in accordance with section 2.3 of the Queensland Urban Drainage Manual (2017) and with the best practice principles contained in the International Erosion Control Association (IECA) Best Practice erosion and sediment control document, which will supersede the current Preliminary stormwater management plan (AECOM, 2023 (this document)).

2.5 Fisheries Act 1994

The *Fisheries Act 1994* (Fisheries Act) sets out Fisheries Queensland's responsibilities for the economically viable, socially acceptable and ecologically sustainable development of Queensland's fisheries resources. The Act also contains provisions for the definition of a waterway and includes a river, creek, stream, watercourse or inlet of the sea.

2.5.1 Fish Passage and Waterway Barrier Works

Waterway barrier works may inhibit the free movement of fish along waterways and onto floodplains which is an essential requirement for the survival and productivity of many species. Relevant Project waterway barrier works include maintenance, replacement or construction of culverts or bed level crossings.

Queensland waterways have been colour-coded along their length to show the level of risk (DAF, 2021) of adverse impact from instream barriers on fish movement. The colour codes are:

- green – low risk
- amber – moderate risk
- red – high risk
- purple – major risk.

The different coloured zones (refer Figure 3 for the Project Site waterways) provide guidance on the requirements for accepted development under the Fisheries Act. If the works cannot comply with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018), the *Planning Act 2016* considers waterway barrier works as assessable development and a development permit for operational work for waterway barrier works is required.

2.6 Regional Planning Interests Act 2014

The *Regional Planning Interests Act 2014* (RPI Act) identifies and protects areas of Queensland that are of regional interest. In doing this, the RPI Act seeks to manage the impact and support coexistence of resource activities and other regulated activities in areas of regional interest.

The Project will not involve any regulated activities as listed under Section 11 of the RPI Act and therefore does not apply to the proposed development.

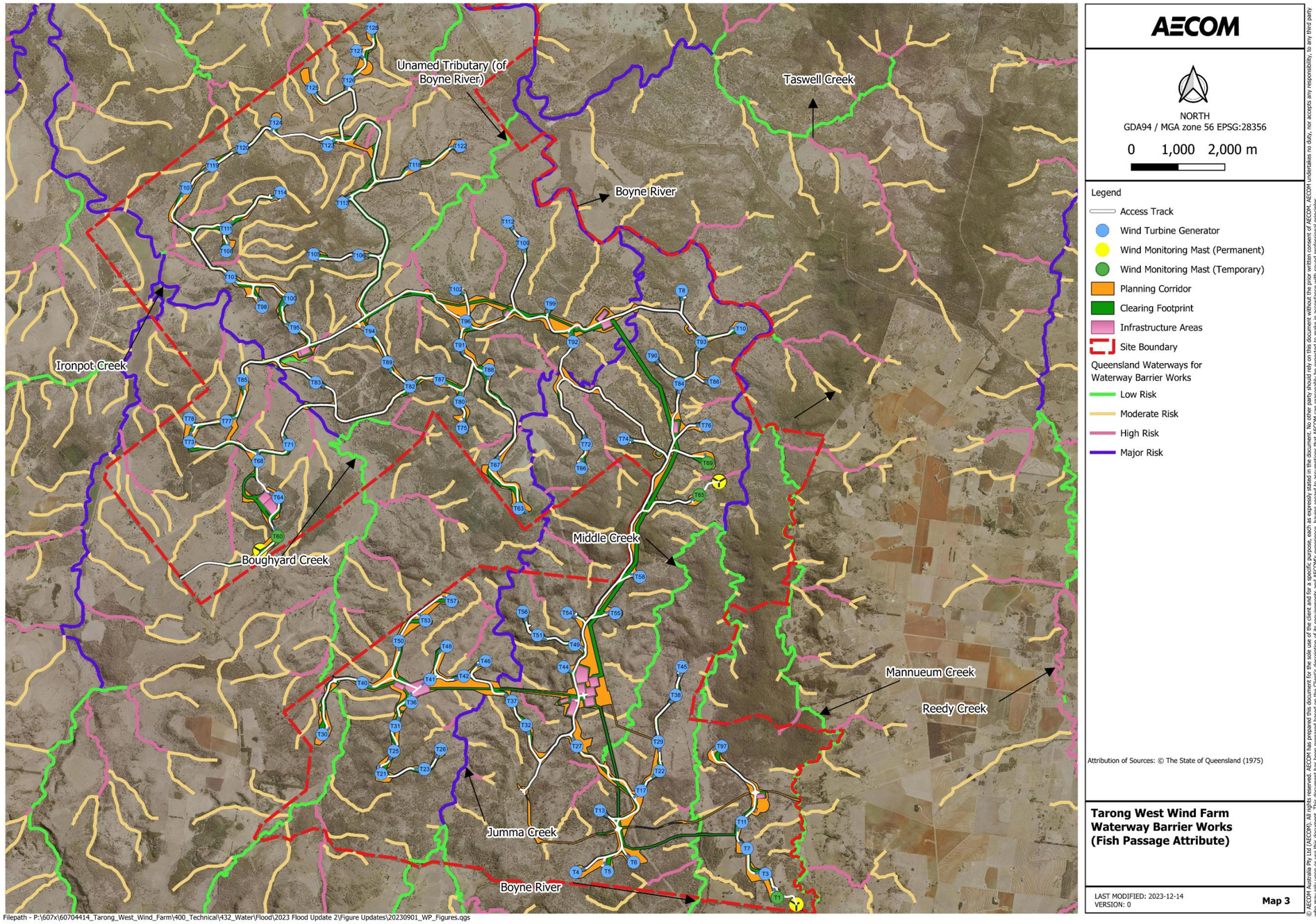


Figure 3 Waterway Barrier Works

3.0 Surface Water Environment

3.1 Existing Site Drainage

The Project is located in the upper headwaters of the Boyne River. Catchment areas for the site location are shown in Figure 4. Defined watercourses and drainage paths are shown in Figure 5.

The majority of the site comprises drainage paths and gullies located in hilly areas, which report to a series of creeks and rivers, as listed in Table 3. These drainage paths and gullies are considered to be ephemeral, with flow occurring intermittently proceeding rainfall.

Table 3 Defined Watercourses interacting with site infrastructure

Creek / River	Receives Water From	Flows to	Proposed Crossings	Infrastructure in direct catchment
Ironpot Creek	Drainage Paths, Gullies and Boughyard Creek	Boyne River	No proposed crossings	Yes (Minor)
Boughyard Creek	Drainage paths and Gullies	Ironpot Creek	Three access track crossings are proposed	Yes
Jumma Creek	Drainage Paths and Gullies	Boyne River	Three access track crossings are proposed to traverse Jumma Creek.	Yes
Middle Creek	Drainage Paths and Gullies	Boyne River	No proposed crossings	Yes
Boyne River	Drainage Paths and Gullies, Mannuem Creek, Middle Creek, Jumma Creek, Ironpot Creek	Burnett River	One access track crossing is proposed	Yes
Mannuem Creek	Drainage Paths and Gullies	Boyne River	No proposed crossings.	Yes (Minor)
Unnamed Tributary of Boyne River	Drainage Paths and Gullies	Boyne River	No proposed crossings.	Yes (Minor)

Ultimately, stormwater drainage will discharge from the Project Area via two main watercourses, which are Ironpot Creek and the Boyne River.

Ironpot Creek ultimately reports to Boyne River and subsequently the Burnett River. The Boyne River system is a major tributary of the Burnett basin which has an approximate area of 2,496 km² (DES, 2013, formally DEHP) which makes up approximately 8% of the 32,220 km² Burnett Basin.

Elevations across the Project Site ranges from approximately 950 mAHD to 350 mAHD and is considered highly undulated as seen in the aerial imagery. The median elevation across the Project Site catchment is approximately 470 m AHD. The land use within the Project Site is considered to be agricultural and likely to be mainly used for grazing due to the undulation. Significant areas of remnant or regrowth vegetation are predominately restricted to the elevated peaks and steep-sided valley slopes.

3.2 Watercourses and Waterways

The planning corridor encompasses a number of watercourses and their contributing catchments (Refer Figure 4 and Figure 5) and therefore the majority of infrastructure is unlikely to be planned in a way that avoids the aforementioned waterways unless existing road infrastructure permits otherwise.

The Watercourse Identification Map (WIM) identifies seven mapped watercourses (defined by the Water Act 2000): the Boyne River, Jumma Creek, Mannuem Creek, Middle Creek, Ironpot Creek and Boughyard Creek and the Unnamed Tributary of Boyne River. All these waterways are reported to have stream orders of 4 or above. These watercourses are within the Project Site and align with those major risk waterways for waterway barrier works (mapped as purple in Figure 3). As such, the appropriate approvals and management strategies will need to be obtained and developed where these watercourses have the potential to be impacted due to the windfarm's development.

As seen in Figure 3 and Figure 5, the watercourses and waterways through the Project Site are complex and branch around a number of the proposed WTG locations. Due to the complex nature of the streams and the placement of the WTGs, it is expected that some locations will require waterways to be crossed to access these WTGs.

Figure 4 also outlines the different inflow locations from the hydraulic models to adequately represent the flooding behaviour of the site for the 20%, 1% and 0.5% AEP events. In addition to this, Figure 6 describes the key crossings which were identified as part of the flooding assessment. Significant transverse and longitudinal drainage features, or floodways, will be required to manage the overland flow paths reporting to proposed access tracks. Crossings of drainage paths and creeks will need to be adequately considered during detailed design.

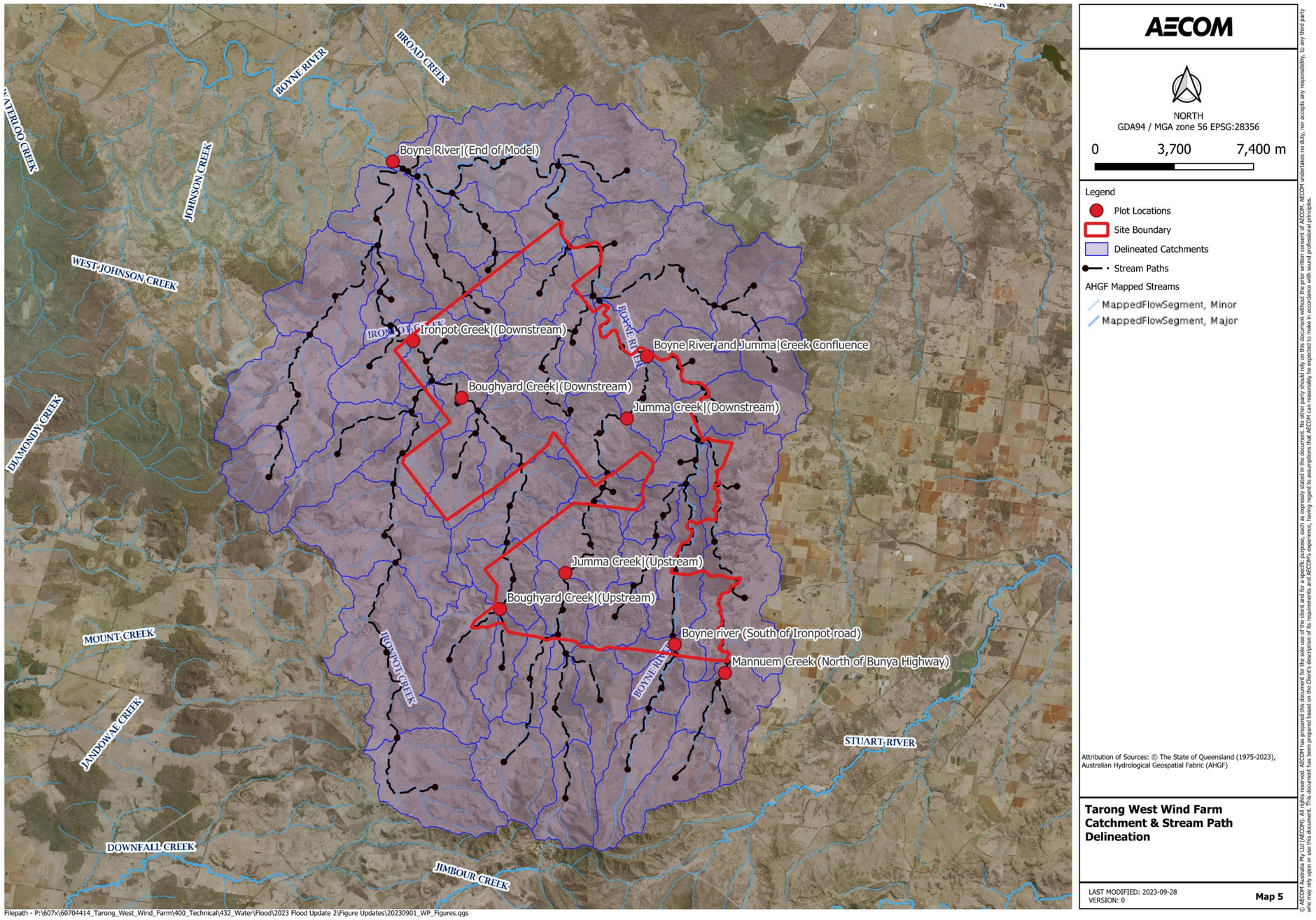


Figure 4 Catchment Delineation

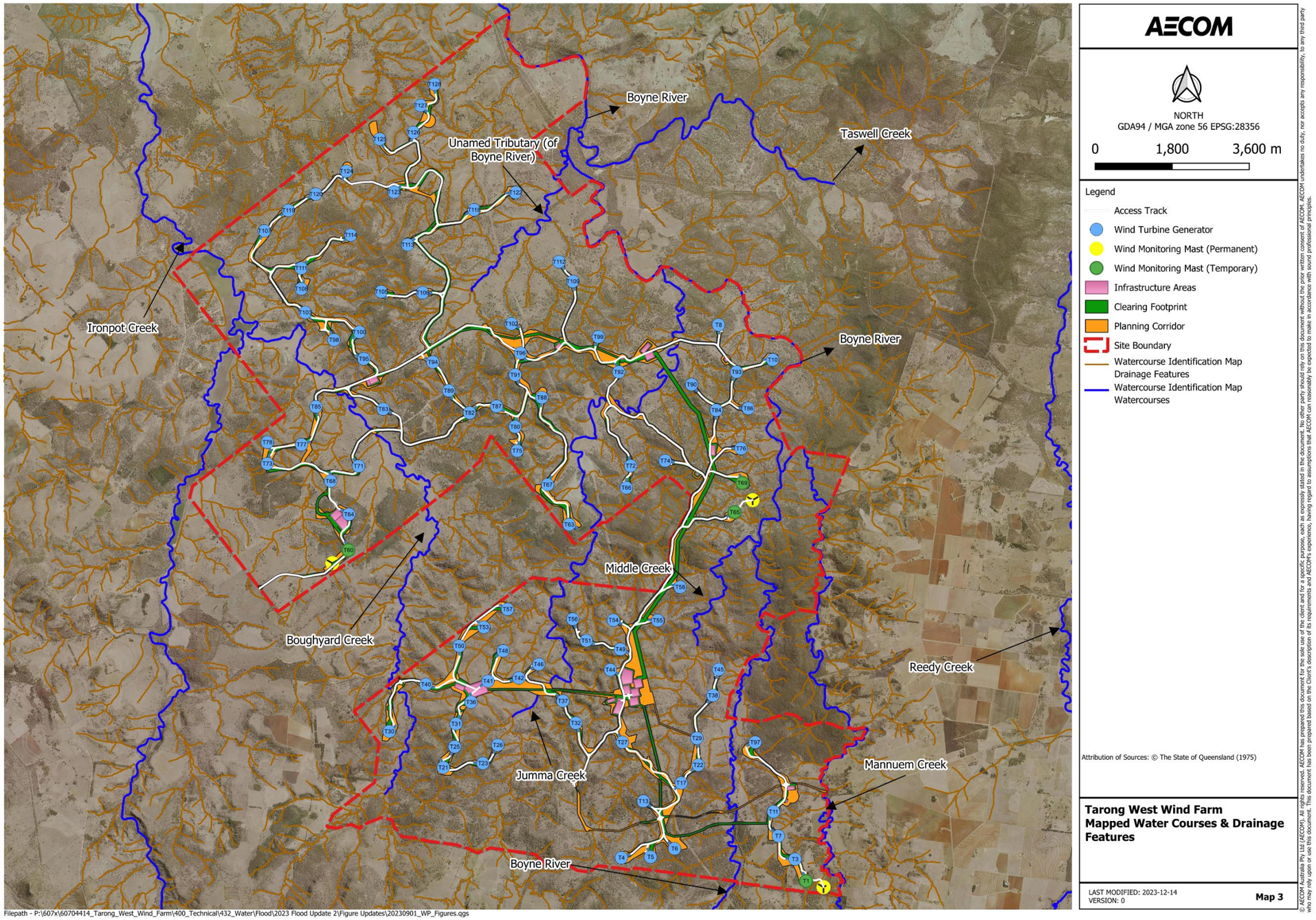
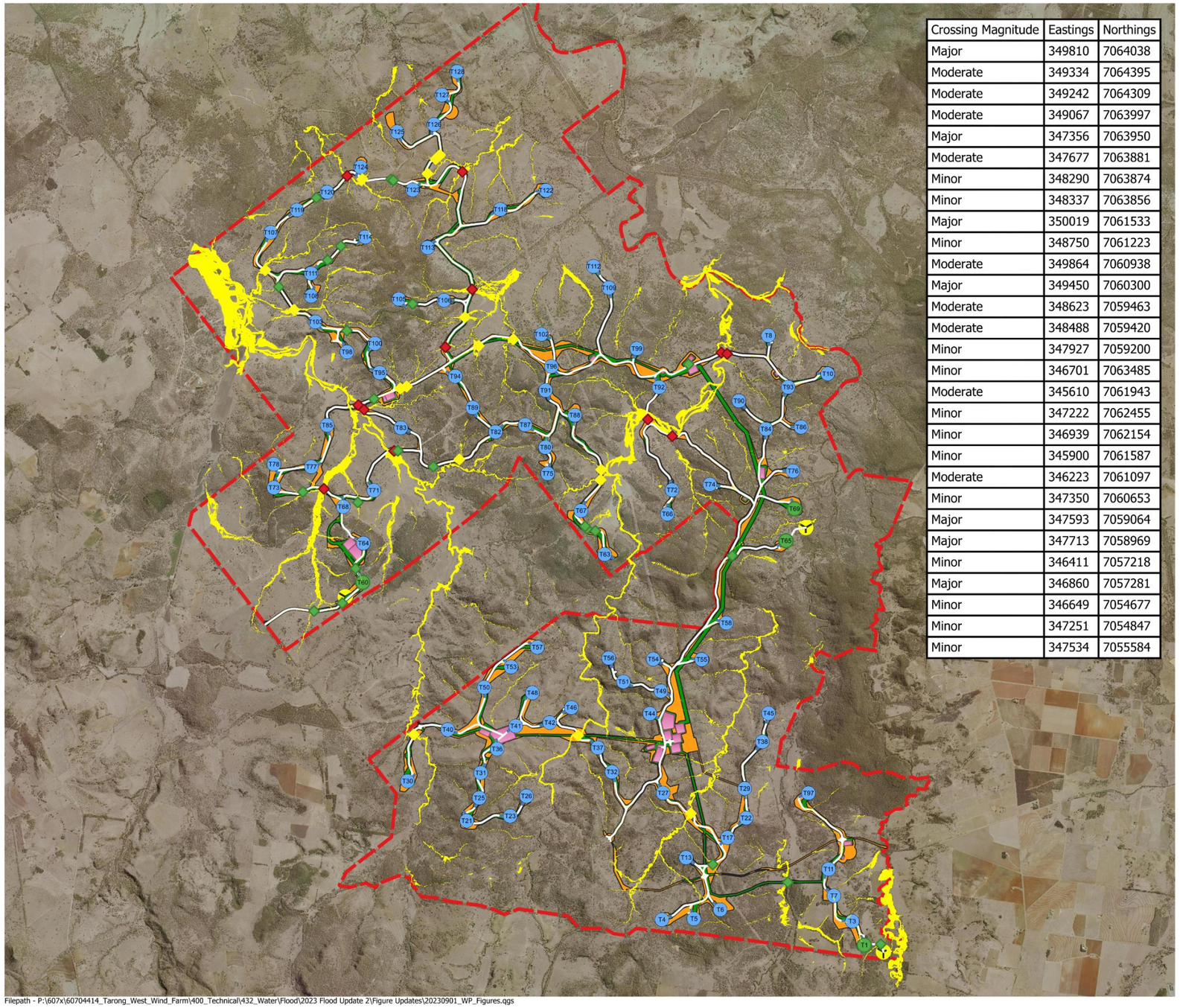


Figure 5 Watercourses



Crossing Magnitude	Eastings	Northings
Major	349810	7064038
Moderate	349334	7064395
Moderate	349242	7064309
Moderate	349067	7063997
Major	347356	7063950
Moderate	347677	7063881
Minor	348290	7063874
Minor	348337	7063856
Major	350019	7061533
Minor	348750	7061223
Moderate	349864	7060938
Major	349450	7060300
Moderate	348623	7059463
Moderate	348488	7059420
Minor	347927	7059200
Minor	346701	7063485
Moderate	345610	7061943
Minor	347222	7062455
Minor	346939	7062154
Minor	345900	7061587
Moderate	346223	7061097
Minor	347350	7060653
Major	347593	7059064
Major	347713	7058969
Minor	346411	7057218
Major	346860	7057281
Minor	346649	7054677
Minor	347251	7054847
Minor	347534	7055584

AECOM

NORTH
GDA94 / MGA zone 56 EPSG:28356

0 1,800 3,600 m

Legend
- Access Track
- Wind Turbine Generator
- Wind Monitoring Mast (Permanent)
- Wind Monitoring Mast (Temporary)
- Planning Corridor
- Clearing Footprint
- Infrastructure Areas
- Site Boundary
- 1% AEP Outcome
- > 0.1m Flow Depth

Affected Crossings
- Major
- Moderate
- Minor

Attribution of Sources: © The State of Queensland (1975), Australian Hydrological Geospatial Fabric (AHGF)

Tarong West Wind Farm
Affected Crossings

LAST MODIFIED: 2023-12-14
VERSION: 0

Filepath - P:\607x\60704414_Tarong_West_Wind_Farm\400_Technical\432_Water\Flood\2023 Flood Update 2\Figure Updates\20230901_WP_Figures.qgs

Figure 6 Key crossings

3.3 Land Use

3.3.1 Historical

The Project Site is located within the South Burnett Regional Council Local Government Area. The area includes townships such as Proston, Murgon, Wondai, Kingaroy, Darli and Nanango. Agriculture and agriculture related industries are considered to be the main economic driver for this area with mining and resources, engineering and tourism similarly supporting the area (South Burnett Regional Council Community Plan, 2011).

3.3.2 Current

Land use across the Project Site is considered to be agricultural, primarily for livestock. In general, the floodplain areas adjacent to the main watercourses are low lying and clear of vegetation of either side of the watercourse. Some areas are dense with vegetation and generally coincide with the steeper terrain areas.

As previously identified in Section 2.2.1 the Project Site is subject to water management through the Water Plan (Burnett Basin) (QLD Gov, 2014).

3.4 Water Quality

3.4.1 Environmental Values

The Project Site is located within the Wide Bay Burnett Region for Environmental Values and water quality planning under the Environmental Protection (water and wetland biodiversity) Policy 2019. Currently this region's Environmental Values (EVs) and Water Quality Objectives (WQOs) are still under development. As the area has no EVs, default environmental values are used and refined to the particular area as indicated by the Receiving Environment Monitoring Program (REMP) guideline (DES, 2014) under the EPP 1994. Additionally, the supporting WQOs to protect the EVs are not yet determined for the Burnett Basin and thus stringent values are derived from a series of documents outlined in the REMP guideline (DES, 2014).

The relevant Environmental Values for the Project are outlined in Table 4.

Table 4 Environmental Values Relevant to the Tarong West Wind Farm Project

Environmental Value	Boyne River - Surface Waters	Boyne River - Groundwater
Aquatic ecosystems (incorporating Habitat value)	✓	✓
Irrigation	✓	✓
Farm supply (e.g. fruit, washing, milking sheds, intensive livestock yards)	✓	✓
Stock watering (e.g. grazing cattle)	✓	✓
Aquaculture	✓	✓
Human consumption (e.g. of wild or stocked fish)	✓	-
Primary recreation (fully immersed in water e.g. swimming)	✓	✓
Secondary recreation (possibly splashed with water, e.g. sailing)	✓	-
Visual appreciation (no contact with water, e.g. picnics)	✓	-
Drinking water (raw water supplies taken for drinking)	✓	✓
Industrial use (e.g. power generation, manufacturing, road maintenance)	-	✓
Cultural and spiritual values	✓	✓

✓ - denotes EVs relevant to the Project

3.4.2 Water Quality Guidelines

The REMP guideline (DES, 2014) outlines the following set of water quality guidelines that are to be used to derive the WQOs in lieu of existing WQOs:

- Environmental Protection (Water and Wetland Biodiversity) Policy 2019 Schedule 1
- Queensland Water Quality Guidelines (QWQG) Version 3 (DES 2009a)
- The National Water Quality Management Strategy (NWQMS) Guidelines, including:
  - Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ 2018)
  - Australian Drinking Water Guidelines (NHMRC and NRMMC 2011)
  - Guidelines for Managing Risks in Recreational Water (NHMRC 2008)

In addition, the REMP guideline also indicates that the default level of protection should be for aquatic ecosystems. The default level of management and/or protection for the Project Site is that of a 'slightly-moderately disturbed' (SMD) aquatic ecosystem. The guidelines that were adopted for the WQOs have been obtained from "*Australian and New Zealand Water Quality guidelines for fresh and marine water quality*" developed by the Australia and New Zealand Environment and Conservation Council. (ANZECC, 2018).

3.5 Water Quality Objectives

WQOs are defined under the Water Act and EPP Water and Wetland Biodiversity (2019) for the purpose of protecting the identified EVs for a particular receiving environment. The WQOs utilised for this assessment are derived from "*Australian and New Zealand Water Quality guidelines for fresh and marine water quality*", in particular '*Table 3.3.4 Default trigger values for physical and chemical stressors for tropical Australia for slightly disturbed (SD) ecosystems*' and 'Table 3.3.5 ranges of default trigger values for conductivity (EC, salinity), turbidity and suspended particulate matter (SPM) indicative of slightly disturbed ecosystems in tropical Australia'. The WQOs are summarised in Table 5.

Table 5 Relevant Aquatic Ecosystem WQOs for Boyne River Catchment (Slightly Disturbed) (ANZECC, 2018)

Water Quality Objectives	Units	ANZECC (2000) Default Value (SD)
Ammonia N	µg/L	6
Oxidised N	µg/L	30
Total Nitrogen	µg/L	150
Filterable Reactive Phosphorus	µg/L	5
Total Phosphorus	µg/L	10
Chlorophyll-a	µg/L	N/A[a]
Dissolved Oxygen	(% sat)	90 - 120
Turbidity	NTU	2 – 15
Suspended Solids	mg/L	<40[b]
pH		6.0 – 7.5
Conductivity (EC)	µS/cm	250
Sulphate	mg/L	<1000[c]

Notes:

a. Monitoring of periphyton and not phytoplankton biomass is recommended in upland rivers — values for periphyton biomass (mg Chl-a m-2) to be developed.

b. Value is based on physico-chemical stressor guidelines for the protection of aquaculture species.

c. Value based on concern for livestock drinking water quality.

4.0 Baseline Environmental Characterisation

4.1 Climate

Based on the Köppen Classification system, the climate for the Project Site is located within the subtropical zone (moderately dry winter).

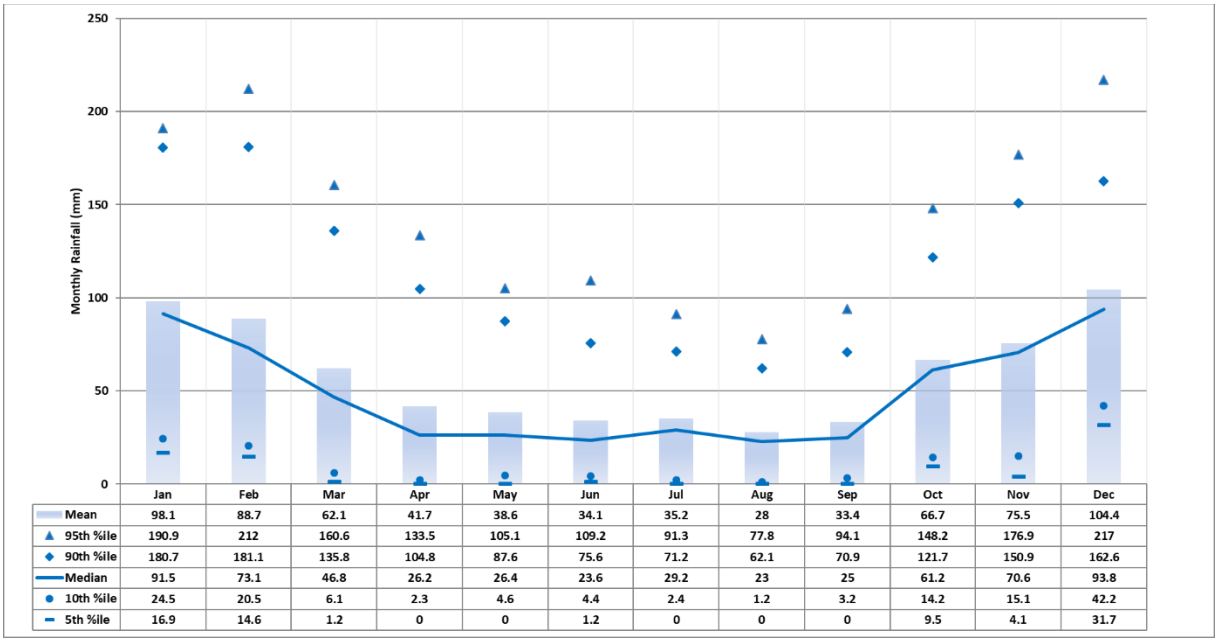
Figure 7 presents rainfall data from the Bureau of Meteorology (BoM) weather station at Warragai rainfall station (040246) which is located approximately 1.5 km west of the north-western boundary of the Project Site and is at an elevation of 444 mAHD.

Figure 7 shows monthly rainfall at Warragai Station for the period of record (1924 – 2019). This table shows that rainfall is seasonally distributed with a distinct wet season typically present from October through March, and a drier season extending from April through September.

The median rainfall received during the wet season (typically taken as 1st November – 30th April) is approximately 400 mm; and makes up approximately 70 % of the median yearly rainfall. The data shows that the wet season is highly variable in its rainfall distribution with some discrepancies between the mean, median and upper and lower percentiles. The median monthly rainfall for the dry season (typically, 1st May – 31st October) is approximately 26 mm, with August being the driest month in the year.

Figure 8 shows intensity-frequency-duration (IFD) data for the Project Site as per Australian Rainfall and Runoff (ARR) 2016 utilising the catchments centroid.

The closest open weather station (temperature) for the Project Site is located at Kingaroy Airport (Station Number 040922) which is located approximately 35 km to the east of the Project Site. The mean daily maximum summer temperatures are approximately 30°C and approximately 20°C during winter.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	98.1	88.7	62.1	41.7	38.6	34.1	35.2	28	33.4	66.7	75.5	104.4
95th %ile	190.9	212	160.6	133.5	105.1	109.2	91.3	77.8	94.1	148.2	176.9	217
90th %ile	180.7	181.1	135.8	104.8	87.6	75.6	71.2	62.1	70.9	121.7	150.9	162.6
Median	91.5	73.1	46.8	26.2	26.4	23.6	29.2	23	25	61.2	70.6	93.8
10th %ile	24.5	20.5	6.1	2.3	4.6	4.4	2.4	1.2	3.2	14.2	15.1	42.2
5th %ile	16.9	14.6	1.2	0	0	1.2	0	0	0	9.5	4.1	31.7

Figure 7 Monthly Rainfall (mm) for Warragai Station (1924-2019 (current) Data)

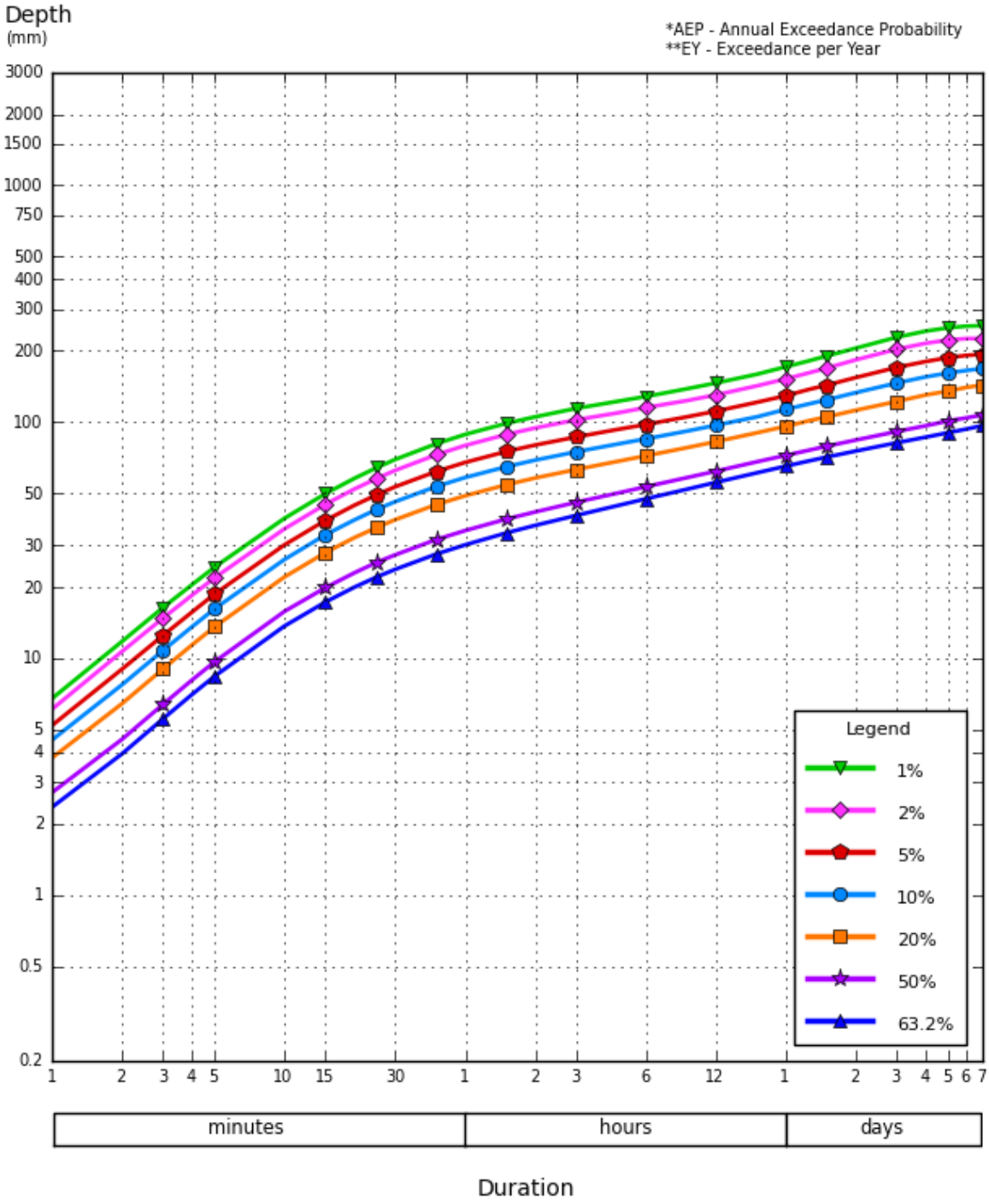


Figure 8 Intensity Frequency Duration Chart for Project Site Centroid (151.50, -26.61) (BoM, 2019)

4.2 Surface Water Hydrology

As the location of the Project Site is in the upper portions of the Burnett Basin and is relatively close to the basin boundary there is no publicly available streamflow data through the Project's footprint. The closest publicly available stream gauge is situated further downstream on the Boyne River. The gauge is currently open with data from the gauge extracted from the Queensland Government's Water Monitoring Information Portal (WMIP) in order to develop a high-level characterisation of the streamflow within the region.

The gauging station (GS) is located on the Boyne River at Carters (GS 136315A) and is approximately 35 km from the Project Site boundary. The catchment for GS 136315A is reported as 1,617 km² which is approximately 2.3 times the size of the catchments assessed in the hydrological model (Refer Figure 4: 693 km²).

Figure 9 and Figure 10 respectively show median monthly discharge and daily flow duration for the Boyne River at Carters (GS 136315A). From the figures, the following information was interpreted:

- Mean daily discharge for the gauging station has a similar seasonal trend to the monthly rainfall at Warragai Station. The month of January has highest average flow of 4.9 m³/s
- In the dry season August is reported to have the lowest mean daily flow of 0.2 m³/s and the lowest maximum daily flow of 27m³/s. This is similar to rainfall data reported at the Warragai Station.
- Flow conditions are considered to be ephemeral with cease to flow conditions occurring on approximately 60% of all days (Figure 10).

While the data presented in Figure 9 and Figure 10 provides context and understanding of flood behaviours in the downstream vicinity of the Project Site, it is noted that the characteristics of the catchments traversed by the planning corridor differ significantly to that of the gauged catchment. They key differences include:

- The gauge is located on flatter terrain downstream of several confluences, where the channel is of higher stream order with a significantly larger contributing catchment area. This varies to the Project Site where drainage paths are typically narrow and steep, of low stream order and minimal catchment area.
- The gauged catchment area is 2.3 times the size of the Project Site catchment.

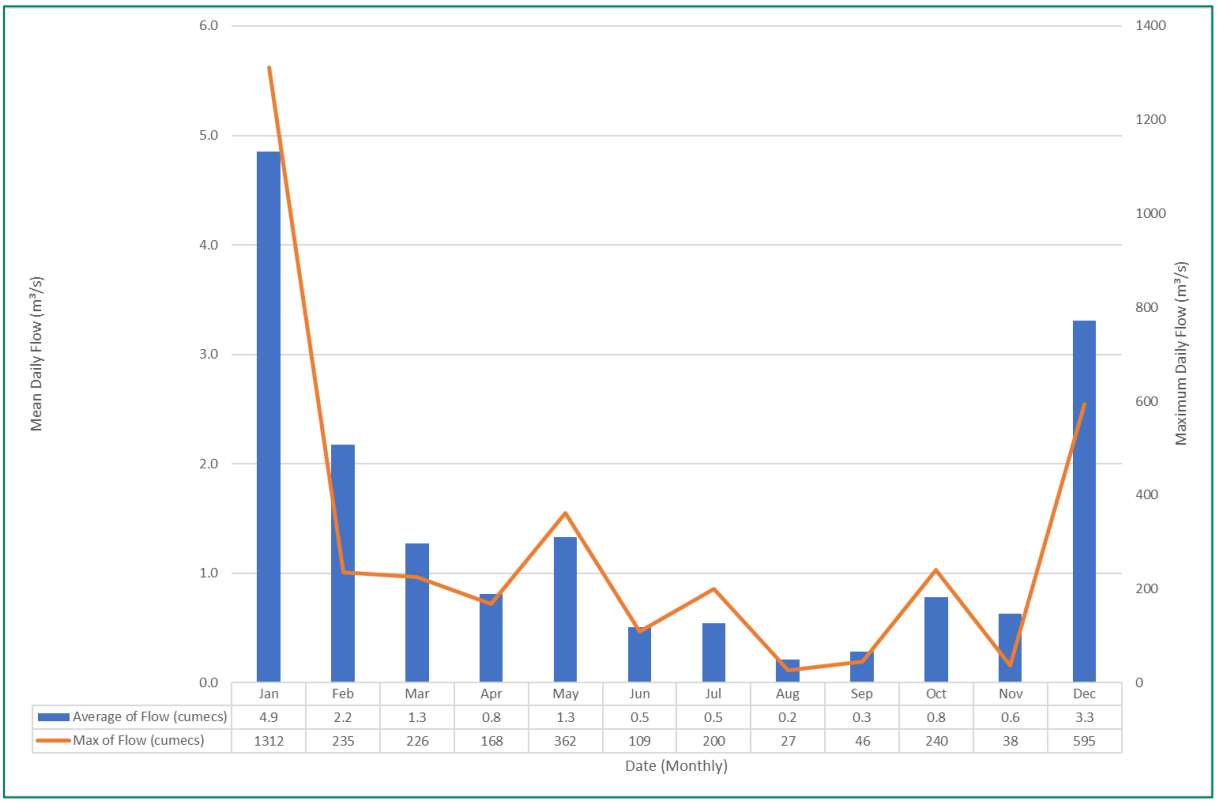


Figure 9 Mean Monthly Discharge for Boyne River at Carters (GS 136315A)

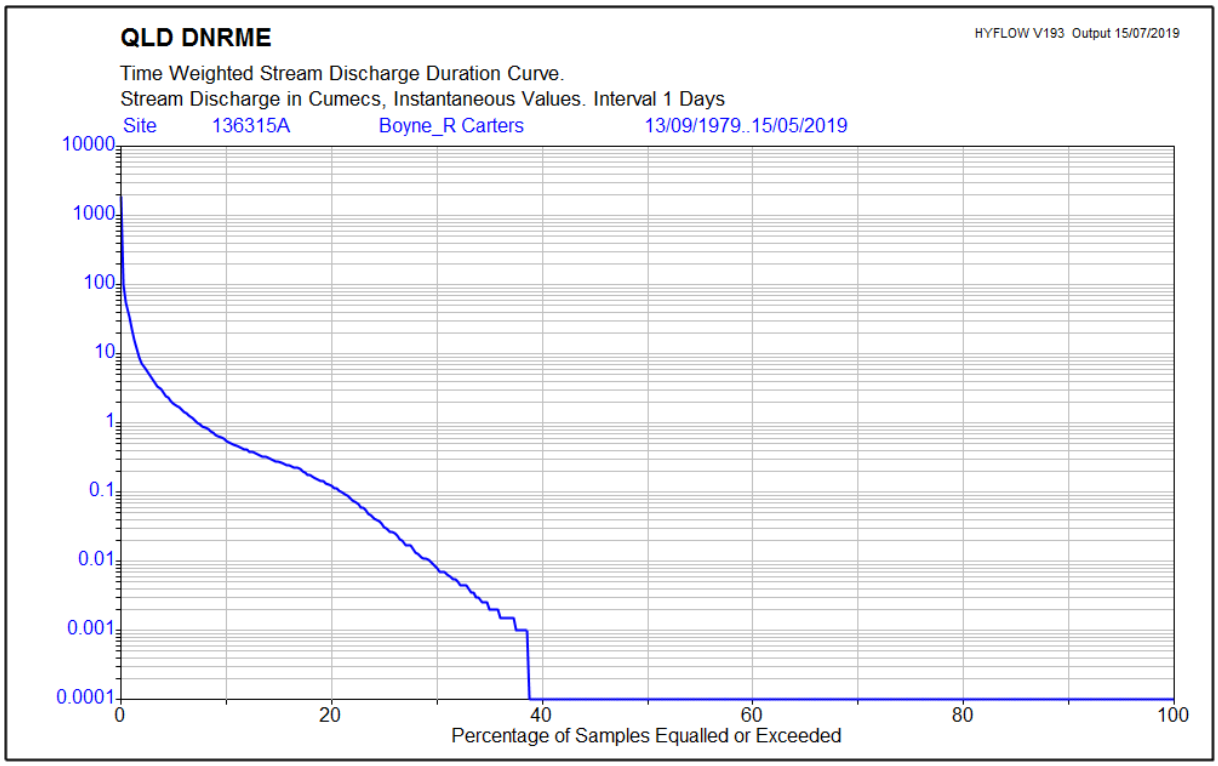


Figure 10 Daily Flow Duration Plot for Boyne River at Carters (GS 136315A)

4.3 Flood Review

A review of the flood data for the Project Site consisted of a review of the Flood Assessment conducted by AECOM (2023) and a desktop assessment through the Department of Resources (DOR) Floodcheck web service. The Tarong West Find Farm Flood Assessment referred to in this report is annexed to this Preliminary Stormwater Management Plan. The information obtained from the review is as follows:

Queensland Floodplain Assessment Overlay (QFAO) (DNRME, 2013)

The Queensland Floodplain Assessment Overlay (QFAO) represents a floodplain area within drainage sub-basins in Queensland. The overlay represents at risk areas that may be subjected to inundation due to a flood event. The data set was last updated in February of 2019 and is shown relevant to the planning corridor in Figure 11.

The following comments were made from a review of the overlay:

- The QFAO flood extents traverse through the Project Site, with a number of the WTG locations close to the extents of the overlay.
- The QFAO represents a floodplain area within drainage sub-basins in Queensland. It has been developed for use by local governments as a potential flood hazard area. It represents an estimate of areas potentially at threat of inundation by flooding. The data has been developed through a process of drainage sub-basin analysis utilising data sources including 10 metre contours, historical flood records, vegetation and soils mapping and satellite imagery. This data represents an initial assessment and will be subject to refinement by respective Local Government Authorities. The QFAO does not utilise any calculations, modelling or any particular flood event and therefore is used as a first pass or comparison assessment only (Tarong West Wind Farm Flood Assessment (AECOM, 2023)).

AECOM conducted a flood assessment for the proposed Tarong West Wind Farm which incorporated the updates to access track and infrastructure layout. Details of the full assessment can be found in Tarong West Wind Farm Flood Assessment (AECOM, 2023), with the 1% AEP results briefly discussed below in reference to Figure 11.

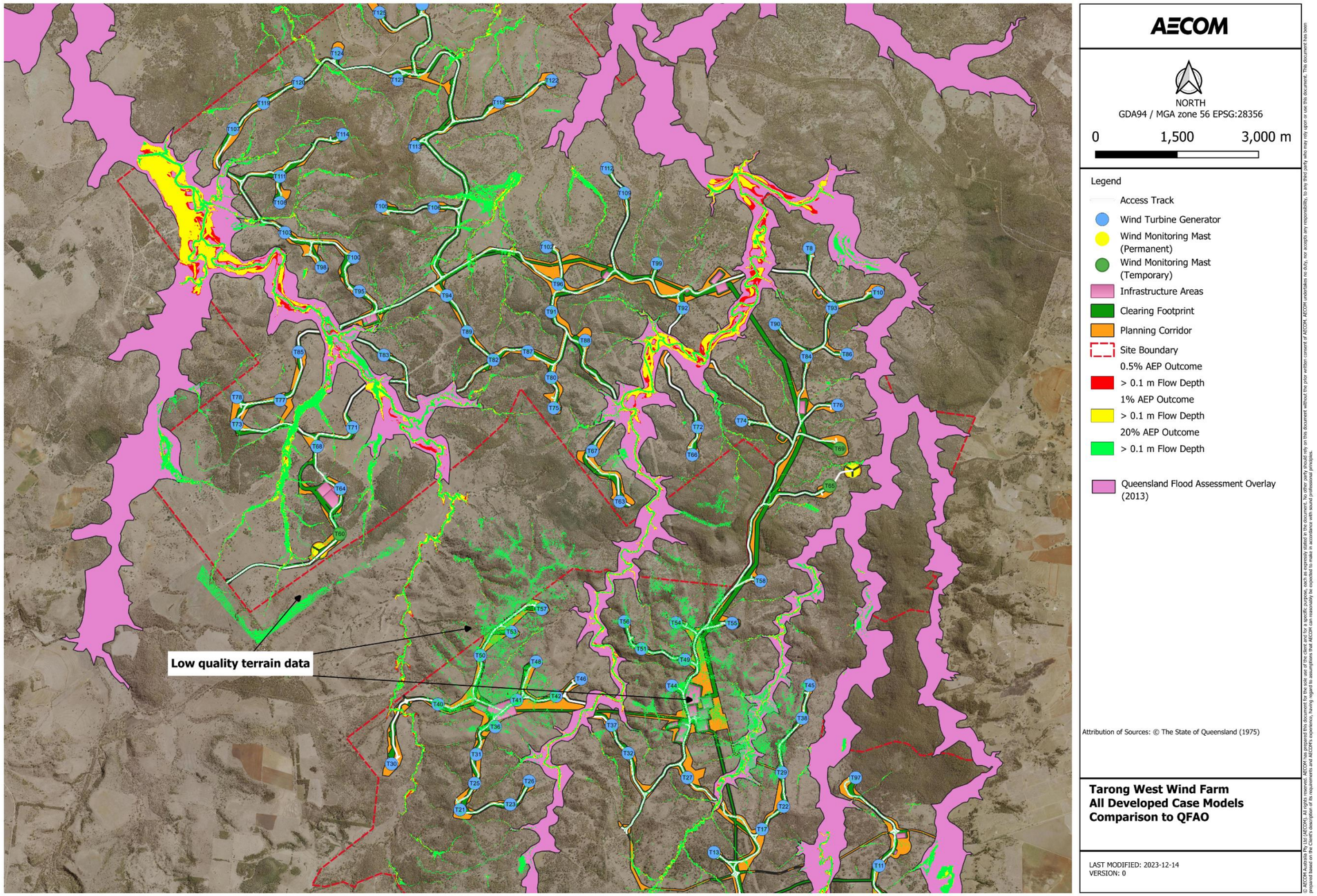
- The flood modelling results indicate that the 1% AEP flood extents traverse through the Project Site, however the extent of the flooding is much smaller than the QFAO
- The flood assessment highlights areas of flooding which are not considered in the QFAO and this allows a more detailed assessment of the flooding expected to occur within the planning corridor. The flood assessment incorporates the updated access track and infrastructure layout provided to AECOM in August 2023.

Queensland flood mapping program flood investigation Burnett Basin (2015)

This dataset was created through the Queensland Flood Mapping Program and is relevant for the 1% AEP event for the Burnett Basin. This dataset was created by the Department of Natural Resources, Mines and Energy (DNRME) and is specific for the Burnett Basin. The following comments were made from a review of the data set (Refer Figure 11, Figure 12):

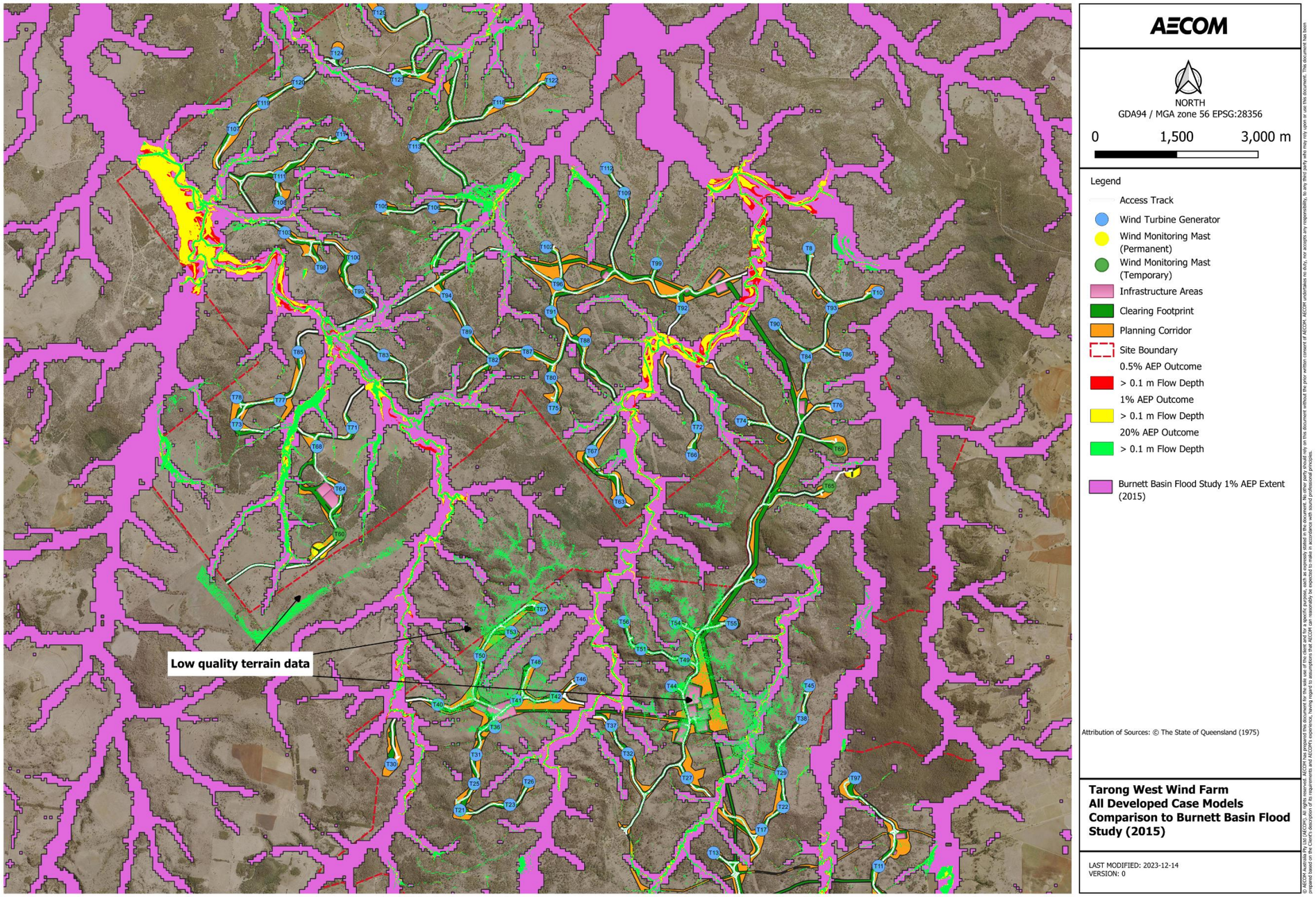
- The flood modelling results indicate that the 1% AEP flood extents traverse through the Project Site and with some streams in contact with Project infrastructure.
- The data is presented as a 75 m grid and is considered less accurate for the flood extents, as a result this overlay is considered to be very conservative.
- Main streamflows are indicative of what was modelled in the Flood Assessment conducted by AECOM (2023).

A review of all flood data indicates that flooding is expected to occur in all major waterways and watercourses within the Project Site under the 1% AEP event. The flood extents are considered to mainly reside in the main watercourses with overland flooding more prominent in the downstream components of the Boyne River, Jumma Creek and Ironpot Creek. Potential flooding impacts relating to Mannueum Creek running south east of the Project boundary have also been assessed. Impacts to the proposed WTGs and infrastructure under the 1% AEP are considered unlikely however the proposed track layout indicates potential inundation by a number of waterways.



Filepath - P:\607x\60704414_Tarong_West_Wind_Farm\400_Technical\432_Water\Flood\2023 Flood Update 2\Figure Updates\20230901_WP_Figures_2.qgs

Figure 11 1% AEP Extent: QFAO Overlay & AECOM (2023)



Filepath - P:\607x\60704414_Tarong_West_Wind_Farm\400_Technical\432_Water\Flood\2023 Flood Update 2\Figure Updates\20230901_WP_Figures_2.qgs

Figure 12 1% AEP Extent Burnett River Study & AECOM (2023)

4.4 Fluvial Geomorphology

There are several headwater tributaries that are key waterways through the Project Site that intersect the Boyne River which traverses the eastern side of the Project Site. These include:

- Boughyard Creek
- Ironpot Creek
- Jumma Creek
- Middle Creek
- Mannuem Creek
- and several minor tributaries.

Across the Project Site, the following observations are relevant in terms of the fluvial geomorphology:

- The convoluting drainage network consists of long, moderately steep waterways falling toward the larger high flow Boyne River, which has similar characteristics however, is a well-defined channel. The flood plains for all waterways are typically very narrow with the exception of Ironpot Creek which has a wider flood plain due to being situated in a relatively flatter terrain compared to the rest of the Project Site.
- The Project Site is classified into two areas:
  - The eastern portion is relatively hilly, undulated and predominantly dense with tree vegetation.
  - The western portion of the Project Site is generally the opposite, with a lower density of vegetation and a lower-lying terrain.
- Channel stability varies across the Project Site with some exposed areas more susceptible to erosion than others in many of the aforementioned creeks. Generally, bank instability coincides with areas where vegetation is absent, there is a significant change in the direction of flow and/or where the floodplain isn't well-elevated and thus overbank flow occurs on a more frequent basis. As stream erosion capacity increases, the most likely channel morphology progresses from: scour depressions; scour ponds and extended ponds gullying. Channel equilibrium relies on many variables including stream flow, vegetation health, and sediment supply and transport. The presence of ponds is commonly associated with channel incision progressing downstream, and or sedimentation from upstream.
- It appears that clearing of the landscape within the Project Site over the years has been kept to a minimum. However, this is difficult to assess as the Project Site is so large. A review of historic aerial photography suggests that the general density of vegetation and land space clearance has been kept relatively consistent over the last couple of decades.
- Land use across the Project Site currently consists of livestock grazing on native vegetation, with some open paddocks that are likely used for cropping due to the corrugated nature of the topsoil. The flatter lowland areas typically adjacent to the larger watercourses are typically clear of vegetation on at least one side of the major waterway. Significant foliage representing a medium density forest is prominent in some areas. Foliage density tends to increase as the terrain increases on those areas considered to be less accessible due to the steep gradient.

4.5 Riparian Vegetation

Riparian vegetation varies in consistency across the Project Site. In the elevated upper headwater reaches, main channels and tributaries typically flow through relatively well-treed catchments particularly where the steep-sided valleys have resulted in lower levels of clearing. In these areas riparian vegetation is typically continuous both longitudinally and laterally.

As key drainage paths across the Project Site drop from the elevated highland areas into the cleared low-lying areas of the catchments, the main channels typically widen toward the end of the catchment, however the immediate riparian vegetation remains consistent.

4.6 Surface Water Quality

No direct water quality measurements or qualitative water quality information is available for any watercourses that reside within the Project Site. The nearest publicly available water quality data is from the Boyne River DNRME stream gauge at Carters (GS 136315A). Although this gauge is located approximately 35 km downstream of the Project boundary there is likely to be some similarities for the upstream water quality. A summary of the water quality characteristics at Boyne River at Carters (GS 136315A) is presented in Table 6.

Table 6 Water Quality Data for DNRME Stream Gauge Boyne River at Carters (136315A)

Water Quality Data	Units	Maximum Result	Median Result	Minimum Result
Nitrate as NO_3	mg/L	12	1	0
Total Nitrogen	mg/L	1.8	0.585	0.4
Total Phosphorus	mg/L	0.4928	0.0825	0.049
Dissolved Oxygen	mg/L	9.8	6.5	5.4
Turbidity	NTU	338	14	1
Suspended Solids	mg/L	2500	20	2
pH		8.5	7.8	6.99
Salinity	µS/cm	1670	1050	150
Sulphate	mg/L	23	7	1.4

5.0 Surface Water Impacts

5.1 Stormwater Quality

Stormwater runoff from key Project infrastructure including hardstand associated with each WTG, access roads, substations, power supply infrastructure and site infrastructure is not expected to contain significant levels of contamination. Concentrated runoff from key planning corridor areas may have the potential to cause erosion and increase levels of suspended solids, adsorbed metals and nutrients.

Appropriate erosion and sediment control measures will need to be designed in future project stages and implemented as required, to ensure stormwater discharging from the Project site post-development is of a quality that will not impact the surface water receiving environment, which is currently considered to be 'Slightly Disturbed' (DES, 2015). Considering the current information on proposed Project infrastructure, treatment and/or detention of stormwater for the removal of sediments and gross pollutants prior to the release to the environment are not likely to be required; however, this is subject to change pending additional information regarding additional infrastructure required for completion of the Project.

Project infrastructure associated with the use and storage of chemicals and fuels, such as substations and construction compounds, may have additional potential to cause an adverse impact on receiving environment water quality. Therefore, where required, all onsite storage, use and disposal of potentially hazardous material will be in accordance with relevant guidelines and Australian Standards.

5.2 Stormwater Quantity

Development of the Project Site with the proposed infrastructure will result in a minor increase of imperviousness within each of the identified sub-catchments. Thus, the current stormwater runoff behaviour is likely to experience minor changes due of key Project structures such as WTG hardstands, substations, and office/warehouse facilities. These changes are not expected to significantly change the magnitude or critical duration of peak flows within the Project Site.

To quantify the variation in flow through the sub-catchments in the Project Site under fully developed conditions, a hydrological model was developed using the runoff-routing program RORB. The development of the RORB hydrological model is detailed in the Flood Assessment (AECOM, 2023). The RORB software allows the user to simulate the flow characteristics through the Project Site's waterways using the current conditions and by increasing the imperviousness of the Project Site's catchments. The two main waterways and their respective catchments used to assess the change in flow characteristics for the Project Site are Ironpot Creek and Boyne River.

The RORB model was developed for these waterways and tailored to allow the addition of impervious areas to their respective catchments based on the proposed layout of all infrastructure. Utilising intensity rainfall duration data and temporal patterns from the 2016 IFD from BOM and the Australian Rainfall and Runoff Guideline (ARR 2019), was applied to estimate peak flows from each creek for a range of Annual Exceedance Probability (AEP) events for the current conditions. The developed conditions replicating an increase in imperviousness were applied to the RORB model and several developed case storm event simulations were conducted.

Table 7 Comparison of Peak Flow Estimates

Creek	Catchment Area (km^2)	Increase in Impervious Area	Critical Duration
Ironpot Creek	87.0	0.8%	6 hours
Boyne River	170.7	1.3 %	2 hours

The peak flows estimated for both existing and developed case conditions and the relative changes are summarised in Table 8.

Table 8 Comparison of Peak Flow Estimates

Creek	AEP Event	Existing Case (m^3/s)	Developed Case (m^3/s)	Percentage Increase
Ironpot Creek	50%	118.7	119.1	0.3%
	20%	196.5	196.9	0.2%
	10%	251.5	252.0	0.2%
	5%	306.8	307.4	0.2%
	2%	384.1	384.6	0.1%
	1%	446.6	447.1	0.1%
Boyne River	50%	389.0	390.9	0.5%
	20%	605.7	608.5	0.5%
	10%	774.6	777.3	0.4%
	5%	920.8	923.7	0.3%
	2%	1093.3	1096.1	0.3%
	1%	1218.9	1221.6	0.2%

Consequently, mitigation measures to control the volume and timing of stormwater discharge from the Project are unlikely to be necessary, considering the small additional volume of stormwater discharged in the context of the receiving environment catchments.

5.3 Water Supply Options

5.3.1 Construction Water Supply

Water will need to be sourced for numerous elements of the Project during the construction phase. The water supply requirements are currently not well understood and will be estimated as Project design progresses. The final water source for construction will be progressed in consultation with the preferred EPC Contractor. An onsite and / or local water source (e.g. water bore subject to relevant licencing and approvals) will be prioritised to minimise the construction water transportation requirements for the Project.

Some of the key construction water demands include the following:

- dust suppression/washdowns
- bulk earthworks and material conditioning
- vegetation re-establishment
- concrete batching (onsite batching plant).

In addition, a supply of water will be required onsite to support fire risk management activities. During construction it is considered that the quality of water required will determine the suitability of the water supply option. Concrete batching facilities will require higher quality of water than other aspects of the Project such as dust suppression and vehicle washdown.

In order to meet Australian Drinking Water Standards, it is anticipated a potable supply of water will be trucked to the site to support the site welfare facilities.

A number of potential water source options have been considered for the Projects water demands, including:

- surface water supply from local stock dams through landholder negotiation
- construction of new surface water dams

- groundwater supplied under permit from existing local registered bores or new bores under a short-term permit
- a surface water licence or permit to extract water from a river, farm dams or other water source
- import water from bulk water supplier (i.e. Sunwater).

Stock dams and the construction of new surface water dams are not anticipated to be feasible due to the water requirements of the Project and existing agricultural land use.

It is considered that using groundwater through an existing bore or under a short-term temporary water permit may be suitable depending on factors such as bore yield and its intended use. A review of the DoR's groundwater data base indicates a total of thirteen existing (and active) bores within the perimeter of the Project Site, with at least 15 additional bores within 1 km of the Project boundary. A summary of the registered bores located proximate to proposed site infrastructure is presented in Table 9.

Table 9 DoR Registered Bore Summary

BORE ID	Status	Role	Recorded Yield (L/s)*
144790	Existing	Water Supply	1.00
110940	Existing	Water Supply	31.57
185801	Existing	Water Supply	0.88
185802	Existing	Water Supply	0.33
185803	Existing	Water Supply	0.52
185292	Existing	Water Supply	0.2
185796	Existing	Water Supply	6.5
121841	Existing	Water Supply	2.27
135708	Existing	Water Supply	0.53
135706	Existing	Water Supply	0.56
127676	Existing	Water Supply	0.36
127891	Existing	Water Supply	0.36
37141	Existing	Unknown	Unknown

*Yields recorded are either aquifer yield, design yield or maximum reported yield.

From the bore summary, a number of the aforementioned bores may be suitable for some of the uses that may allow non-potable water, such as dust suppression and earthworks. The water supply options will be finalised during detailed design of the Project and confirmed prior to construction.

Given the simplicity of the Project's water management requirements, the current level of design and water volume is subject to ongoing refinement.

5.3.2 Operational Water Supply

Project water demands during operations are expected to be minimal and likely to be satisfied through the use of rainwater tanks, onsite dam(s) or water-truck deliveries. Operational water supply options will be subject to ongoing refinement as the Project progresses through detailed design and confirmed prior to construction. If dust does present an issue during dry periods during operation, it may still be necessary to wet down roads with watercarts.

Given the limited requirement for operational water supply and the current level of design progression, an operational site water balance is not considered necessary. Any construction and/or operation of onsite dam(s) would be subject to any relevant approvals under the Planning Act and the Water Act which regulate the taking, using or interference of overland flows and watercourses.

It is also noted that decommissioning would use the same water source as the operational supply, pending demand and approvals.

5.4 Potential Impacts to Identified Environmental Values

Site activities and water-related discharges with the potential to impact the identified surface water EVs (refer to Section 3.4) include:

Construction Phase:

- Discharge of sediments and associated contaminants (both air and water-borne) from exposed ground resulting in adverse impacts on receiving environment surface water quality. Key activities include:
  - Vegetation and topsoil clearance as well as any surface infrastructure preparation – access tracks, concrete batching facilities, power supply infrastructure and WTGs with their hardstands.
  - Earthwork and excavation activities
    - Power supply or water supply trenching
    - Works associated with clearance and preparation – batching plants, laydown areas, WTGs and hardstands, etc.
    - Drainage infrastructure
    - Watercourse crossings and access track footprints
- Waterway crossings:
  - Water diversion or flow restriction during crossing construction
  - Changes in geomorphology and/or riparian vegetation resulting in erosion or scouring during or post construction.
  - Removal of riparian vegetation
- Accidental release of hazardous chemicals or materials.

Operational Phase:

- Increased stormwater runoff magnitudes from an increase of imperviousness across the site.
- Any onsite wastewater discharges
- Accidental release of hazardous chemicals or materials (i.e. those used in substations or WTGs))
- The presence of waterway crossings.

Decommissioning Phase:

- Earthworks associated with decommissioning of onsite infrastructure.
- Accidental release of hazardous chemicals or materials.
- Stormwater runoff from exposed areas prior to re-establishment of vegetation.

Based on the proposed Project layout, there may be some requirement to divert surface waters, however this will be confirmed as the Project progresses through the detailed design stage. Alternatively, hydraulic structures may be implemented and will be confirmed as the design progresses.

5.5 Risk Assessment and Mitigation Measures

The Risk Assessment Framework set out in Australian Standard/New Zealand Standard (AS/NZS) ISO 31000:2009 Risk Management – Principles and Guidelines (2009) was adopted for this report.

Criteria used to rank the likelihood and consequences of potential impacts and how they are combined to determine the level of impact are set out in Table 10 through to Table 12 below. The classifications (major, high, moderate, low or negligible) for significance of an impact are as follows:

- **Major** significance of impact - arises when an impact will potentially cause irreversible or widespread harm to an EV that is irreplaceable because of its uniqueness or rarity. Avoidance through appropriate design responses is the only effective mitigation.

- **High** significance of impact - occurs when the proposed activities are likely to exacerbate threatening processes affecting the intrinsic characteristics and structural elements of the EV. While replacement of unavoidable losses is possible, avoidance through appropriate design responses is preferred to preserve its intactness or conservation status.
- **Moderate** significance of impact - although reasonably resilient to change, the EV would be further degraded due to the scale of the impact or its susceptibility to further change. The abundance of the EV ensures it is adequately represented in the region, and that replacement, if required, is achievable.
- **Low** significance of impact - occurs where an EV is of local importance and temporary and transient changes will not adversely affect its viability provided standard environmental management controls are implemented.
- **Negligible** significance of impact - impact on the EV will not result in any noticeable change in its intrinsic value and hence the proposed activities will have negligible effect on its viability. This typically occurs where the activities occur in industrial or highly disturbed areas.

Mitigation measures were applied to the potential (unmitigated) impacts to identify the residual (mitigated) impacts as shown in Table 13. It is noted that only the *magnitude* of the impact can be modified by the implementation of mitigation measures, i.e. the *sensitivity* remains unchanged.

Table 10 Description of Sensitivity Criteria

Sensitivity	Description
High	• The EV is listed on a recognised or statutory state, national or international register as being of conservation significance. • The EV is intact and retains its intrinsic value. • The EV is unique to the environment in which it occurs. It is isolated to the affected system/area which is poorly represented in the region, territory, country or the world. • It has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the EV. Project activities would have an adverse effect on the value.
Moderate	• The EV is recorded as being important at a regional level, and may have been nominated for listing on recognised or statutory registers. • The EV is in a moderate to good condition despite it being exposed to threatening processes. It retains many of its intrinsic characteristics and structural elements. • It is relatively well represented in the systems/areas in which it occurs but its abundance and distribution are limited by threatening processes. • Threatening processes have reduced its resilience to change. Consequently, changes resulting from Project activities may lead to degradation of the prescribed value. • Replacement of unavoidable losses is possible due to its abundance and distribution.
Low	• The EV is not listed on any recognised or statutory register. It might be recognised locally by relevant suitably qualified experts or organisations e.g., historical societies. • It is in a poor to moderate condition as a result of threatening processes which have degraded its intrinsic value. • It is not unique or rare and numerous representative examples exist throughout the system / area. • It is abundant and widely distributed throughout the host systems / areas. • There is no detectable response to change or change does not result in further degradation of the EV. • The abundance and wide distribution of the EV ensures replacement of unavoidable losses is achievable.

Table 11 Description of Magnitude Criteria

Magnitude	Description
High	• An impact that is widespread, long lasting and results in substantial and possibly irreversible change to the EV. Avoidance through appropriate design responses or the implementation of site-specific environmental management controls are required to address the impact.
Moderate	• An impact that extends beyond the area of disturbance to the surrounding area but is contained within the region where the Project is being developed. The impacts are short term and result in changes that can be ameliorated with specific environmental management controls.
Low	• A localised impact that is temporary or short term and either unlikely to be detectable or could be effectively mitigated through standard environmental management controls.

Table 12 Significance Assessment Matrix

Magnitude of Impact	Sensitivity of Environmental Value		
	High	**Moderate**	**Low**
High	Major	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Negligible

Table 13 Risk Assessment and Mitigation Measures

Potential Impact to Surface Water	Project Phase			Relevant Environmental Value/s	Pre-Mitigated Impact			Mitigation Measure	Residual (Mitigated) Impact	
	Con	Ops	Decom		Sensitivity	Magnitude	Significance		Magnitude	Significance
Discharge of sediments (both air and water-borne) from exposed ground resulting in localised adverse impacts on receiving environment surface water quality.	✓	×	✓	• Aquatic ecosystems • Cultural and spiritual values • Drinking water • Farm supply • Human consumption • Industrial use • Irrigation • Primary recreation • Secondary recreation • Stock watering • Visual appreciation	Moderate	Moderate	Moderate	• An ESCP will be developed for the Project which will detail methods for minimising sediment-laden runoff in accordance with Best Practice Erosion and Sediment (BPESC) guidelines (IECA Best Practice Erosion and Sediment Control – For Construction and Building Sites, 2008). • Project detailed design will aim to minimise disruption of natural drainage patterns and water flows; and construction activities within and/or adjacent to waterways will be minimised as much as feasibly possible to reduce any disturbance to those waterways. • Where vegetation clearing is unavoidable a stormwater management plan will be prepared in accordance with section 2.3 of the Queensland Urban Drainage Manual demonstrating that the clearing has been minimised and appropriate measures have been included to ensure the protection of bank stability, water quality and habitat. • Water will be used for dust suppression in order to minimise airborne contaminants. • Additional covering of sediments and materials during storm events to reduce sediment heavy runoff.	Low	Low
Discharge of stormwater from the Project resulting in localised adverse impacts on receiving environment surface water quality.	×	✓	×	• Aquatic ecosystems • Cultural and spiritual values • Drinking water • Farm supply • Human consumption • Industrial use • Irrigation • Primary recreation • Secondary recreation • Stock watering • Visual appreciation	Moderate	Moderate	Moderate	• An ESCP will be developed for the Project which will detail methods for minimising sediment-laden runoff in accordance with best practice guidelines. • A stormwater management plan prepared in accordance with section 2.3 of the Queensland Urban Drainage Manual (2017).	Low	Low
Discharge of stormwater from the Project resulting in localised adverse impacts on receiving environment surface water geomorphology and aquatic habitat (e.g. stream bank erosion and scouring from concentrated discharge of stormwater).	✓	✓	✓	• Aquatic ecosystems • Cultural and spiritual values • Drinking water • Farm supply • Human consumption • Industrial use • Irrigation • Primary recreation • Secondary recreation • Stock watering • Visual appreciation	Low	Moderate	Low	• Project detailed design will aim to minimise disruption of natural drainage patterns and water flows. • Construction activities within and/or adjacent to waterways will be minimised as much as feasibly possible to minimise disturbance to those waterways. • An ESCP will be developed for the Project which will detail methods for minimising runoff impacts in accordance with Best Practice Erosion and Sediment (BPESC) guidelines (IECA Best Practice Erosion and Sediment Control – For Construction and Building Sites, 2008). • The ESCP will detail methods for minimising runoff impacts in accordance with best practice guidelines. The plan will include a stormwater management plan prepared in accordance with section 2.3 of the Queensland Urban Drainage Manual (2017) to ensure that Project drainage works aim to minimise potential impacts on receiving environment aquatic habitat and geomorphology.	Low	Negligible
Restriction of fish passage (e.g. through velocity increases) due to waterway crossings.	✓	✓	✓	• Aquatic ecosystems	Moderate	Moderate	Moderate	• Creek crossings will be designed and constructed in accordance with *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2017) which provides accepted development requirements for low-impact development activities such as temporary works, bed level crossings and culverts. Where the design provisions of DAF (2017) cannot be met, a development permit for operational work for waterway barrier works will be sought. In complying with legislated requirements, the impact to fish passage is expected to be minimal.	Low	Low

Potential Impact to Surface Water	Project Phase			Relevant Environmental Value/s	Pre-Mitigated Impact			Mitigation Measure	Residual (Mitigated) Impact	
	Con	Ops	Decom		Sensitivity	Magnitude	Significance		Magnitude	Significance
Spills/leaks from chemical (e.g. fuel and oil) storage areas or substation areas into surface water bodies resulting in localised adverse impacts on receiving environment surface water quality.	✓	✓	✓	• Aquatic ecosystems • Cultural and spiritual values • Drinking water • Farm supply • Human consumption • Industrial use • Irrigation • Primary recreation • Secondary recreation • Stock watering • Visual appreciation	Low	Moderate	Low	• Chemicals and fuels such as coolants and hydrocarbons will be stored in accordance with relevant Australian Standards to ensure that any spillages are contained. • The requirement for additional stormwater quality controls for Project substation areas (such as bunding, oil separators, etc.) will be determined, and if required, designed and operated in accordance with relevant guidelines and standards.	Low	Negligible
Untreated discharges from onsite waste water treatment facilities into surface water environment.	✓	✓	×	• Aquatic ecosystems • Cultural and spiritual values • Drinking water • Farm supply • Human consumption • Industrial use • Irrigation • Primary recreation • Secondary recreation • Stock watering • Visual appreciation	Moderate	Moderate	Moderate	• During construction, the temporary construction compound is anticipated to be supported by portable ablutions facilities with containment systems for removal from site by an appropriately licenced waste contractor. Port-a-loos are additionally anticipated to support the construction of the Project and will again be managed through containment and trucking of waste from the Project site. • The operations and maintenance facility will have an on-site septic system in accordance with relevant Australian Standards and statutory requirements. • Effluent will be removed from site and disposed in a suitable facility by a licenced operator. • The decommissioning of an installed septic system will be subject to relevant workplace health and safety and plumbing guidance in place at the time decommissioning commences.	Low	Low
Discharge of stormwater from the Project site following decommissioning resulting in localised adverse impacts on receiving environment surface water quality and/or quantity.	×	×	✓	• Aquatic ecosystems • Cultural and spiritual values • Drinking water • Farm supply • Human consumption • Industrial use • Irrigation • Primary recreation • Secondary recreation • Stock watering • Visual appreciation	Low	Low	Negligible	• Following the decommissioning phase of the Project, it is assumed that land use will return to a similar use to pre-development (grazing). • Mitigation measures are therefore not considered necessary post decommissioning.	Low	Negligible

6.0 Erosion and Sediment Control

6.1 General Principles

The proposed site development involves a distributed layout across a large site domain. Accordingly, the implementation of erosion and sediment control practices across the development is a key environmental risk mitigation approach.

In Australia, the Best Practices in Erosion and Sediment Control (BPESC) outlines the development, implementation, instatement and monitoring requirements for Erosion and Sediment Control Plans (ESCPs) developed by Suitably Qualified Persons (SQP's).

Best practice management of sites involves both erosion and sediment control measures, executed via an ESCP.

To support the progressive inclusion of ESC planning throughout the project life-cycle, a Conceptual ESCP has been developed (AECOM, 2023b).

6.2 Identified Risks

The proposed site development has the following potential risks associated with ESC:

Table 14 Identified Erosion and Sediment Risks

Phase	Risks	Overall Goal
Construction Period	• Disturbance of soils, vegetation over the proposed infrastructure areas (access tracks, infrastructure areas). • Disturbance of temporary construction areas, such as laydowns. • Increased traffic within the site area.	• Minimise the potential for temporary site works to mobilise sediment. • Capture any sediment generated from construction activities. • Construction of a site which minimises the potential for sediment mobilisation.
Site Operation	• Blockage of hydraulic features due to sedimentation • Risk of progressive scour and erosion of exposed cuts/benches, pads, surfaces. • Potential for erosion caused by site vehicles and on-site construction plant and works	• Minimise erosion and sediment issues across the Project duration. • Maintenance and management of stormwater network features, predominantly associated with proposed access tracks. • Minimise and manage ongoing ESC risks posed by site vehicles.
Decommissioning	• Sediment erosion risks associated with removal of hardstand and access track areas • Sediment mobilisation associated with revegetation areas. • Increased traffic within the site area.	• Manage erosion risks until a stable, non-eroding rehabilitated condition is achieved.

6.3 Design Aspects

The proposed development design is expected to involve the following aspects, to reduce the potential of the site to generate and mobilise sediment:

- Access tracks and hardstand areas are proposed to be formed with a suitable pavement material, that is generally stable to dusting effects.
- Batter slopes of landform features, are proposed to be formed with either:
  - a topsoil layer, to allow vegetation establishment to prevent sediment mobilisation; or
  - rock armouring, suitably placed to limit sediment mobilisation
- Stormwater drains are proposed in association with proposed access tracks, and infrastructure areas. Culverts resulting in concentrated flow are proposed to be formed with outlet rock armour pads, to mitigate erosion potential.

6.4 Construction ESCP

The key risk associated with ESC arise during the construction phase, related to the initial disturbance of infrastructure footprint, in particular:

- Establishment of proposed access tracks
- Establishment of infrastructure area and WTG hardstand areas
- Temporary development of laydown and construction areas, and subsequent removal.

The EPC contractor is proposed to enact a Construction ESCP prepared consistent with the BPESC (AustIECA, 2008). The Construction ESCP will be executed through the CEMP.

Typical measures expected to be enacted are as follows:

- Development of ESC sequencing, such that erosion and sediment control measures are instated prior to any significant construction works
- Implementation of ESC devices, such as silt fencing, sediment traps, stormwater drains and other measures
- Dust suppression

6.5 Site Operations ESCP

The ongoing management of the site will operate according to an ESCP developed for the Project lifecycle.

Ongoing ESC management is expected to comprise:

- Management of the stormwater network, including ongoing inspection, monitoring and if necessary, remediation. The stormwater network is expected to comprise:
  - Longitudinal and transverse drainage of the proposed access tracks
  - Local drains for infrastructure areas
- Management of road pavement surfaces, hardstand areas and batter slopes.
- Monitoring of drainage paths in proximity to site infrastructure, and remedial works, if required.

6.6 Decommissioning

Decommissioning of the site will operate according to an ESCP specific to the decommissioning and rehabilitation program. The execution of the ESCP will depend upon the parties involved in the decommissioning program, which is likely to involve an EPC contractor.

7.0 Conclusions

This study has reviewed a number of sources of information in order to develop an understanding of the potential stormwater discharge impacts from the Project to the receiving surface water environment. The assessment evaluates the potential water quality and quantity impacts associated with the construction, operation and decommissioning of the Tarong West Wind Farm and how these impacts can be appropriately managed through several mitigation measures. To summarise:

- As the design of the Project progresses a stormwater management plan will be developed to meet the Performance Outcomes PO7 and PO8 of State Code 23 and in accordance with section 2.3 of the Queensland Urban Drainage Manual (2017).
- The potential for discharge of sediments and the resulting impact on the receiving environment surface water quality during ground disturbance activities (construction and decommissioning) will be managed through the development of an ESCP. The plan will be developed as the Project design progresses and will detail appropriate construction management and planning including best practice erosion and sediment control measures in accordance with IECA Best Practice Erosion and Sediment Control – For Construction and Building Sites, 2008. The size of Project is likely to result in progressive design and construction and this will also be reflected in the ESCP which will also continue to be refined throughout this process.
- Potentially adverse impacts on the receiving environment surface water quality during the operational phase will be addressed through development of an Operational Environmental Management Plan (OEMP). The OEMP will include a site stormwater management plan prepared in accordance with the Queensland Urban Drainage Manual (2017) to ensure that Project:
    - Detailed design will aim to minimise disruption of natural drainage patterns and water flows.
    - Drainage works will aim to minimise potential impacts on receiving environment aquatic habitat and geomorphology.
    - Maintenance activities within and/or adjacent to waterways will be minimised as much as feasibly possible to minimise disturbance to those waterways.
- Changes to stormwater runoff and quality resulting from hardstand infrastructure such as concrete batching plants, WTG hardstands, office infrastructure, etc is expected to be minor due to the dispersion of the infrastructure across the Project Site, as well as the minor increases in imperviousness and the unlikely exposure of contaminants to the receiving environment.
- The potential for adverse impacts on the receiving surface water environment quality from potential contamination sources (i.e. admix, fuels, coolants, concrete additives, etc) will be mitigated through the appropriate design and operation of chemical storages that adhere to relevant Australian Standards and standard industry practice.
    - Additional measures for the treatment of stormwater quality are not considered necessary as runoff is not expected to contain contaminants likely to adversely affect relevant environmental values.
- Where required, creek crossings will aim to be constructed and designed in accordance with the DAF accepted development requirements, which exist for low-risk development activities such as temporary works, bed level crossings and culverts on red, amber and green creeks. Where the design provisions of DAF (2017) cannot be met, a development permit for operational work for waterway barrier works will be sought. In complying with legislated requirements, the impact to fish passage is expected to be minimal.

Following the implementation of mitigation measures as described both above and in Table 13, the risk posed to the surface water environment is considered **LOW**.

8.0 References

AECOM (2023b). Tarong West Wind Farm – Flood Assessment, AECOM Australia Pty Ltd, October 2023 (DRAFT), Brisbane

AECOM (2023c). Tarong West Wind Farm – Conceptual Erosion and Sediment Control Plan, AECOM Australia Pty Ltd, October 2023 (DRAFT), Brisbane

ANZECC/ARMCANZ (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, 2018, Canberra.

Australian Rainfall and Runoff (ARR, 2019), Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia.

Department of Agriculture and Fisheries (DAF), 2021, Guide to determining waterways *Queensland Waterways for Waterway Barrier Works spatial data layer, version 2.0,* Queensland.

Department of Agriculture and Fisheries (DAF), 2018, Accepted Development Requirements for Operational Work that is Constructing or Raising Waterway Barrier Works, Qld Department of Agriculture and Fisheries (DAF), effective 01 October 2018.

Department of Environment and Science (DES), 2013, Burnett Drainage Basin — facts and maps, viewed 12 February 2020, https://wetlandinfo.des.qld.gov.au/wetlands/facts-maps/basin-burnett/

Department of Environment and Science (DES), 2014. Receiving Environment Monitoring Program guideline - For use with Environmental Relevant Activities under the Environmental Protection Act (1994). Brisbane: Department of Environment and Science, Queensland Government

Department of Environment and Science (DES), 2019 Environmental Protection (Water and Wetland Biodiversity) Policy 2019, Queensland Government.

Department of Infrastructure, Local Government and Planning (DILGP), 2018, State Code 23: Wind farm development. Version 3.0 effective February 2022.

Department of Natural Resources, Mines and Energy (DNRME), 2019, FloodCheck online tool, accessed online 12 February 2020, https://www.business.qld.gov.au/running-business/support-assistance/mapping-data-imagery/maps/flood-mapping

Queensland Government, 2014, Water Plan (Burnett Basin) 2014, Queensland Department of Natural Resources, Mines and Energy. Current as at 2 September 2017.

Environmental Protection Act 1994 (EP Act), Queensland Government, current as 9 December 2019.

International Erosion Control Association (IECA), 2008, Best Practice Erosion and Sediment Control – For Construction and Building Sites, Published 2008)

Institute of Public Works Engineering Australasia (IPWEAQ), 2016, Queensland Urban Drainage Manual (QUDM) 4th Edition, IPWEAQ. Published 2017

South Burnett Regional Council, 2021, Planning Scheme 2017 V1.4, South Burnett Regional Council Planning Scheme, viewed 15 September 2022 https://www.southburnett.qld.gov.au/downloads/file/1980/south-burnett-regional-council-planning-scheme-version-1-4

Water Act, 2000, Queensland Government. Reprinted 18 June 2021