Appendix F
Construction Environmental Management Plan

Prepared for Borumba PHES Project

Borumba Pumped Hydro Energy Storage Project – Exploratory Works Construction Environmental Management Plan

DOCUMENT NUMBER: BR-NA-NON-EMG-PLN-00001

OCTOBER 2025

Contents

1. Introduction 1
   1.1 Background 1
   1.2 Purpose and objectives 2
   1.3 Distribution 2
   1.4 Revision 3
   1.5 Potential Project impacts 3
2. Project components 5
   2.1 Activity schedule for Exploratory Works Project components 7
   2.2 Working hours 8
3. Legislative context 10
   3.1 Commonwealth legislation 10
   3.2 State legislation 10
   3.3 Approval, licences and permits 11
4. Environmental management system 13
   4.1 Queensland Hydro environmental policy 13
   4.2 Queensland Hydro environmental management system 13
   4.3 Contractor and subcontractor management 13
   4.4 Hold points 14
   4.5 Environmental objectives and targets 14
   4.6 Management plan structure 14
   4.7 Environmental work method statement 15
   4.8 Site environmental plans 16
   4.9 Roles and responsibilities 16
   4.10 Competence, training and awareness 18
   4.11 Communication 19
   4.12 Emergency and incident planning 19
   4.13 Monitoring and inspections 20
   4.14 Records and reporting of environmental activities 21
   4.15 CEMP and supporting plan revision 22
   4.16 Non-conformance management 22
   4.17 Document control and records 22
5. Impact assessment 24
   5.1 Risk assessment methodology 24
   5.2 Risk assessment 25
6. Environmental management measures 26
   6.1 Mitigation measures 26

References 28
Appendix A – Activity Summary
Appendix B – Indicative unexpected finds procedures
Appendix C – Cultural Heritage
Appendix D – Air Quality
Appendix E – Noise and Vibration
Appendix F – Bushfire Management
Appendix G – Preliminary Erosion and Sediment Control Plan
Appendix H – Spoil Management Plan

Appendix I – Waste Management Plan
Appendix J – Flora and Fauna Management Plan
Appendix K – Water Management Plan

Figures

Figure 1: Exploratory Works Project footprint 6

Tables

Table 1: Exploratory Works Project anticipated schedule 7
Table 2: Local planning scheme approvals subject to the works regulation for the Exploratory Works 10
Table 3: Summary of key approvals required for the Exploratory Works as of October 2025 11
Table 4: Likelihood rating 24
Table 5: Consequence rating 24
Table 6: Risk rating matrix 25
Table 7: Risk assessment locations 25
Table 8: Mitigation measure locations 26

Acknowledgement of Country

In the spirit of reconciliation, Queensland Hydro acknowledges the Traditional Custodians of Country throughout Queensland and, in particular the lands, skies and waters on which we operate. We celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands, skies and waters of Queensland.

Queensland Hydro pays respect to Elders past and present honouring their continuing spiritual and cultural connections to Country.



Document Control

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Revision	Revision Date	Description of Changes
A	Jan 2023	Initial draft
B	Aug 2023	Revised draft
1	Jul 2024	Revised draft – change in works
2	Dec 2024	Update to address comments from DCCEEW
3	Jan 2025	Changes to document control template

Due for Revision: 1 year(s) from Approved Date (or as required)

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Project name: Borumba Pumped Hydro Energy Storage (PHES) Project - Exploratory Works (EPBC 2023/09461)

Project location: Bella Creek Road & Borgan Road, Lake Borumba, Queensland

Queensland Hydro Pty Ltd

ABN: 81 661 444 515

Declaration of accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed:

Full name:

Organisation:

Date:

Acronyms and abbreviations

Term	Description
ACM	Asbestos containing material
ATV	All-terrain vehicles
BTEX	Benzene, toluene, ethylbenzene, xylene
Borumba PHES Project	Borumba Pumped Hydro Energy Storage Project
CEMP	Construction Environmental Management Plan
CSEP	Communications and Stakeholder Engagement Plan
DCP	Dynamic cone penetrometer
DETSI	Department of Environment, Science, Tourism and Innovation
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DWATSIPM	Department of Women, Aboriginal and Torres Strait Islander Partnerships and Multiculturalism
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EMS	Environmental management system
ERA	Environmentally relevant activity
ESCP	Erosion and Sediment Control Plan
EWA	Early Works Agreement
EWMS	Environmental work method statements
FFMP	Flora and Fauna Management Plan
GDE	Groundwater dependent ecosystem
ILUA	Indigenous Land Use Agreement
km	Kilometre
m	Metre
ML	Megalitres
MNES	Matters of national environmental significance
MW	Megawatt
MWh	Megawatt-hour
NML	Noise management levels
OCP	Organochlorine pesticides
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PHES	Pumped Hydro Energy Storage
SEP	Site Environmental Plans
TCLP	Toxicity characteristic leaching procedure
TEC	Threatened ecological communities
TPH	Total petroleum hydrocarbons

1. Introduction

1.1 Background

Queensland Hydro is the proponent of the Borumba Pumped Hydro Energy Storage (PHES) Project. The Borumba PHES Project is a 2,000 megawatt (MW), 48,000-megawatt hour (MWh), hydroelectric scheme to store, generate and supply energy through a pumped hydroelectric structure linked to the existing Lake Borumba in the Gympie and Somerset Regional Council local government areas.

The Borumba PHES Project is located within the Gympie and Somerset Regional Council local government areas, approximately 13 kilometres (km) southwest of the township of Imbil, 48 km southwest of Gympie, and 180 km northwest of Brisbane.

The Borumba PHES Project requires the completion of Exploratory Works to confirm the suitability of the Borumba PHES Project. The purpose of the Borumba PHES Project – Exploratory Works (the Exploratory Works Project) is to undertake and facilitate critical technical investigations required to confirm the suitability of the Borumba PHES Project location and design. The information obtained from the investigations is crucial to the Borumba PHES Project, as it will determine whether the Borumba PHES Project can proceed or if material changes to the reference design are necessary. The technical information needed primarily comprises geological investigations at the proposed locations of the:

- reservoir dam foundations – to be verified by geotechnical boreholes, test pits and seismic lines (geophysics)
- underground tunnels and caverns – to be verified by geotechnical exploratory tunnel drilling and geotechnical boreholes.

The Exploratory Works, relevant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) controlled action, comprise the following components:

- Geotechnical investigations including test pits, boreholes (deep and shallow, including some conversion to groundwater monitoring bores) and geophysics
- Spoil disposal:
  - Tunnel spoil disposal area
  - Kingaham spoil disposal area
- Site access:
  - new access tracks
  - upgrades to existing tracks
  - Kingaham Creek bypass (realignment of a section of Bella Creek Road)
- Other supporting infrastructure:
  - civil construction compound
  - temporary water infrastructure
- Exploratory tunnel infrastructure:
  - dual exploratory tunnels
  - staging pad
  - portal pad
  - portal access track
  - explosive store
  - explosive store access track.

This Construction Environmental Management Plan (CEMP) outlines how impacts were first avoided through the design development, and where avoidance was not possible, identifies management measures to minimise and mitigate impacts on environmental, social, and cultural heritage values. This CEMP will be implemented for the duration of the Exploratory Works Project. The Exploratory Works Project's design, construction and operational processes have, and will follow the environmental mitigation hierarchy (i.e. avoid, minimise, mitigate, offset) and align with all relevant Australian standards and environmental legislation and policies.

1.2 Purpose and objectives

The purpose of this CEMP is to describe how Queensland Hydro will manage and/or reduce potential impacts to environmental values from Exploratory Works Project activities. Due to the nature of the works and ongoing activities planned, this CEMP applies to all Exploratory Works relevant to the action, including operational phases as relevant (e.g. operation of the spoil disposal areas).

This CEMP outlines how Queensland Hydro will achieve environmental outcomes for the Exploratory Works by providing a structured approach to ensure appropriate mitigation measures and controls are implemented.

The CEMP and supporting plans will incorporate conditions associated with all approvals, licences and permits obtained for the Exploratory Works Project, once received.

The objectives of this CEMP are to:

- identify potential impacts to environmental values identified within and adjacent to the Exploratory Works Project footprint
- outline key roles and responsibilities throughout implementation of this CEMP
- identify measures to minimise and mitigate the identified potential impacts to environmental values, providing an overarching document that specifies the location of all measures (referencing relevant plans).

This CEMP is a live document and will be reviewed and updated before and during the Exploratory Works Project.

This CEMP includes:

- requirements associated with statutory approvals and applicable laws
- issue-specific environmental management plans
- roles and responsibilities
- communication requirements
- induction and training requirements
- procedures for monitoring and evaluating environmental performance, and for corrective action
- reporting requirements and record keeping
- procedures for emergency and incident management
- procedures for audit and review.

1.3 Distribution

The contractor's environmental manager will coordinate the preparation, review and distribution, as appropriate, of the environmental documents, including environmental approvals and authorities, management plans (including CEMP and associated subplans), and other records required under Section 4.17. During construction, environmental documents will be stored at the site office and can be accessed on request to the Environmental Manager.

The CEMP will be made available to all personnel and subcontractors by hard copy or through the project document control system. An electronic copy will be available on the Borumba PHES Project website. This document is uncontrolled when printed.

The copy approved by Queensland Hydro will be distributed to:

- Queensland Hydro's representative
- Queensland Hydro's environmental manager
- the contractor's project manager
- the contractor's environmental manager
- the environmental representative (or equivalent).

1.4 Revision

Refinements to the Exploratory Works Project may occur during detailed design or changed circumstances throughout construction. Design changes or changes in scope will be communicated to the contractor's environmental manager either through formal change processes or via informal communications.

Proposed changes would be assessed by the contractor for consistency against the approved Exploratory Works scope. The contractor's environmental manager will undertake an assessment of the proposed changes for potential impacts and compare them to the proposed impacts for the relevant assessed and approved works, which may be identified in a subordinate CEMP prepared by the contractor.

Once prepared, consistency assessments will be submitted to Queensland Hydro for determination by Queensland Hydro's Representative. Changes that are not consistent with the approved CEMP (or supporting plans) will require approval from the parties below if:

- Significant impact – major alterations to the approved scope or level of environmental impact will need to be approved by the Federal Department of Climate Change, Energy, the Environment and Water (DCCEEW) prior to construction works occurring.
- Minor impact – changes that are minor changes to the approved scope or have a minor level of impact will be reviewed for consistency against approved management plans. This review process will be completed and approved by Queensland Hydro.

If the document review process identifies any issues or items within the documents that are either redundant or in need of updating, it is the responsibility of the contractor's environmental manager to prepare the revised documents in communication with Queensland Hydro. The CEMP and supporting plans would be updated to incorporate any additional potential environmental impacts or management measures that resulted from the proposed changes.

The revised document will then be issued to Queensland Hydro for certification / acceptance of the changes. Changes that are not minor will require approval from DCCEEW.

Any changes to the CEMP and / or subplans will require review and acceptance by Queensland Hydro prior to submission to the DCCEEW. Revised versions of the CEMP will be distributed in accordance with Section 1.3.

1.5 Potential Project impacts

If not appropriately avoided, minimised or managed, the Project may have direct and indirect environmental impacts on threatened species and communities, as well as surrounding environments, including the following key impacts:

- Direct and indirect impacts to flora individuals and flora and fauna habitat and fauna injury or death due to vegetation clearing
- Loss and/or reduction in the populations of threatened flora and fauna species, and displacement of fauna from the area, as a result of vegetation clearing for surface Project works, as well as potentially due to the associated increased noise and dust generation onsite
- Loss of habitat for aquatic flora and fauna, removal of aquatic flora individuals and aquatic fauna injury or death due to physical disturbance of the bed and banks of Yabba Creek, Sandy Creek and Kingaham Creek and the construction of waterway crossings.
- Temporary barriers to aquatic fauna movements and water flows due to the construction of waterway crossings
- Disturbance of the soil associated with vegetation clearing and earthworks for surface Project works, concentrating runoff and causing soil erosion and resulting in changes to water quality (e.g. increased turbidity and sedimentation) within waterways near the Project
- Changes to water quality, such as increases in turbidity, sediment loads, and concentrations of nutrients and metals, due to the construction of waterway crossings and runoff from Project works occurring near waterways or drainage lines that require vegetation removal and ground disturbance
- Contamination of waterways through any discharge of surface/ground water collected during project work or the accidental release of fuel, oil, waste or other chemicals from the Project site
- Potential to disturb/encounter contaminated land associated with identified contamination sources including livestock dips (further detail is provided in the Spoil Management Plan in Appendix H)

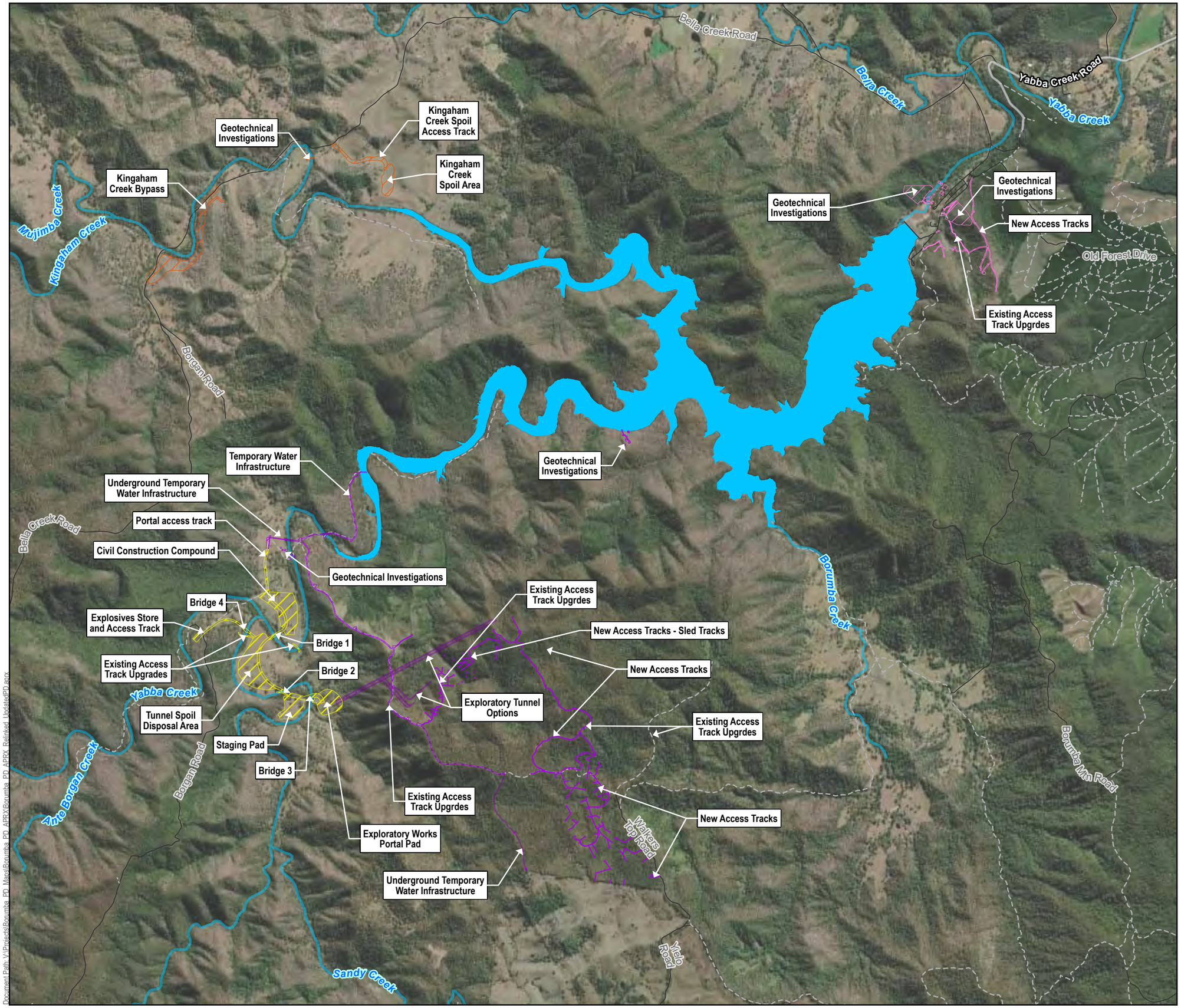
- Direct groundwater take or groundwater drawdown associated with exploratory tunnel drilling, leading to a short-term reduction in water availability to potential groundwater dependent ecosystems (GDEs) in the vicinity of the exploratory tunnel drilling
- Air quality (dust) impacts due to exploratory tunnel drilling, vegetation clearing, geotechnical investigations (particularly where large areas of the ground surface require preparation) and general vehicle and machinery movements onsite
- Noise and vibration impacts, particularly due to earthworks and drilling and blasting activities and the general use of heavy machinery and vehicles onsite
- Visual impacts, primarily as a result of vegetation clearance and ground disturbance/preparation for geotechnical investigations in an otherwise vegetated landscape
- Increased occurrence of bushfire or altered bushfire regimes due to increased human activity and use of flammable materials onsite
- Disturbance of areas or items of cultural heritage significance
- Increased occurrence of weeds, pests and disease in the vicinity of Project works due to increased human activity and vehicle movements onsite, particularly in areas that were previously undisturbed.

The impacts summarised above are further discussed in Section 5 of the Borumba PHES Project – Exploratory Works Preliminary Documentation. Strategies to address impacts are provided in Section 6 of the Borumba PHES Project – Exploratory Works Preliminary Documentation and Section 6 of this management plan.

2. Project components

The Exploratory Works Project comprises technical investigations for a proposed PHES Project. It is solely focused on these technical investigations. The Exploratory Works components addressed in this CEMP are summarised in Figure 1.

The construction activities associated with the Exploratory Works Project components are summarised in Appendix A. The summaries provide a description of the activities' construction methodology, general plant / equipment, locations and key risks; location of mitigation measures is also highlighted within the summary.



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Queensland Hydro

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LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads
- Lake Borumba (FSL 135.01m AHD)

Exploratory Works Project

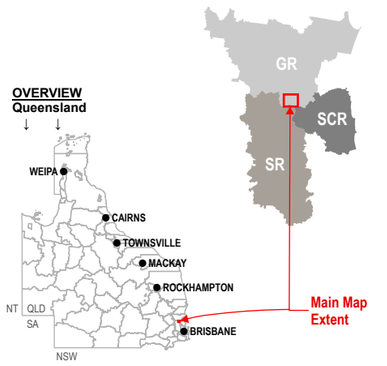
Project Footprint by Work Area

- Area 1 - Borumba Dam
- Area 2 - Kingaham Creek
- Area 3 - Walkers Top
- Area 4 - Borgan

Project Component - Underground

- Area 3 - Walkers Top

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



Data Sources:

1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
3. Watercourses © State of Queensland (Department of Natural Resources, Mines and Energy) 2022
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Exploratory Works Project
Preliminary Documentation

EXPLORATORY WORKS FOOTPRINT

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 29/09/2025
REVISION:	A

FIGURE 1

2.1 Activity schedule for Exploratory Works Project components

Table 1 outlines the Exploratory Work Project components, anticipated scheduling, and life of the component. The works will largely be completed between December 2024 (subject to approvals) and October 2026.

Table 1: Exploratory Works Project anticipated schedule

Project components	Time period within which works are anticipated to occur		Life of component^	Anticipated timing and duration of associated clearing
	Start date	End date		
Geotechnical investigations				
All areas	Mar 2026	Oct 2027	16 months	Clearing will occur progressively, with each investigation site cleared before drilling/excavation and after an access track is established. Sites will be stabilised and where applicable rehabilitated once the investigation at that site is complete. Geotechnical investigations at Kingaham Creek will be undertaken within the footprint of proposed infrastructure.
Spoil disposal				
Kingaham Creek spoil disposal area	Jan 2027	Dec 2027	Permanent	Clearing for the spoil area will take approximately six months within this 12 month period.
Tunnel spoil disposal area	Jan 2027	Jun 2030	Permanent	Clearing will be completed in less than two weeks and take place within this 12 month period.
Site access				
Kingaham Creek bypass	Jan 2027	Dec 2027	Permanent	Clearing will be completed in less than two weeks and take place within this 12 month period.
Construction of new and upgrade to existing access tracks at Borumba Dam to service geotechnical investigations	Mar 2026	Aug 2027	10-16 months (some permanent) *	Construction of new access tracks and existing track upgrades will occur in stages. Tracks will be rehabilitated progressively, once geotechnical investigations are completed the track may be decommissioned.
Construction of new and upgrade existing access tracks at Walkers Top to service geotechnical investigations	Mar 2026	Aug 2027	10-16 months (some permanent) *	Construction of new access tracks and existing track upgrades will occur in stages. Tracks will be rehabilitated progressively, once geotechnical investigations are completed the track may be decommissioned.

Project components	Time period within which works are anticipated to occur		Life of component^	Anticipated timing and duration of associated clearing
	Start date	End date		
Other supporting infrastructure				
Temporary water infrastructure	Mar 2026	Dec 2029	24 months	Clearing for each component will be completed in less than two weeks.
Civil construction compound	Mar 2026	Feb 2029	24 months	Construction to be staged, with clearing for each section as required and undertaken over 24 months within this 36 month period.
Exploratory tunnel and supporting infrastructure				
Explosive store	Jun 2027	Jun 2030	24 months	Construction will occur over two months within this 36 month period, with clearing expected to be completed in less than four weeks.
Portal pad and staging area, portal access track	Jul 2027	Jun 2030	22 months	Construction will occur over four months within this 36 month period, with clearing expected to be completed in less than four weeks.
Tunnelling works[#]	Jul 2027	Jun 2030	Permanent	Tunnelling works will be underground and take 12-18 months. Clearing associated with tunnelling will occur during construction of the portal pad. Tunnelling would commence after the explosive store and portal pad, staging area and portal access track are complete.

2.2 Working hours

Works for most Project components are expected to occur predominantly during standard construction hours over a seven-day work week with a rotating roster. However, some works outside of standard hours are expected during the Project. These include the activities associated with the exploratory tunnel and associated enabling works (e.g. shotcrete batching, spoil relocation and management), and some geotechnical drilling investigations (e.g. deep boreholes). Work outside of standard hours is expected to occur 24 hours a day, seven days per week with a rotating roster where it is necessary for some activities i.e. drilling and tunnelling.

The construction program for the Project will be based on the following standard construction hours (unless approved otherwise):

- General construction/surface works activities:
  - Monday to Sunday, 6.30 am to 6.00 pm
  - No work on public holidays.
- Geotechnical drilling:
  - Monday to Sunday, 6.00 am to 6.00 pm for boreholes less than 200 m deep (with some exceptions)
  - 24 hours a day, 7 days a week for boreholes equal to or more than 200 m deep and shallower boreholes by exception.
- Underground construction activities (including blasting) and associated enabling works
  - 24 hours a day, 7 days a week.

Works outside of the above listed construction hours may occur during the Project. Reasons for this may include:

- movement of staff, as well as arrival and departure of construction staff during shift changes
- transport, assembly, or decommissioning of oversized plant, equipment, components or structures

- delivery of ‘in time’ material such as concrete, steel, and other construction materials delivered to site by heavy vehicles
- works that require continuous construction support such as continuous concrete pours, pipe-jacking or other forms of ground support necessary to avoid a failure or construction incident
- on site movements of heavy plant, materials and equipment
- works in a road reserve
- traffic control crews, including large truck mounted crash attenuator vehicles, medium rigid vehicles, and lighting towers
- emergency works and incident response including tow-trucks for light, medium, and heavy vehicles
- alternative construction rosters to suit delivery or in response to industrial relations issues
- various low-intensity activities.

Where work outside the standard hours (including night works) is required for additional activities, the works will only proceed on an as required basis and with the appropriate approval.

3. Legislative context

A preliminary register of regulatory and other requirements for the Exploratory Works Project has been compiled and will be retained as a live register (as per ISO 14001:2015) during the Exploratory Works. The register will be reviewed at regular intervals by the contractor and Queensland Hydro (for example, during management reviews), and updated with any applicable changes as required.

Any changes made to the regulatory requirements and/or approvals register will be communicated to the wider Exploratory Works Project team, including contractors, through toolbox talks and specific training.

3.1 Commonwealth legislation

The EPBC Act is the central piece of environmental legislation in Australia, designed to protect and manage nationally and internationally significant flora, fauna, ecological communities, and heritage places. Its primary purpose is to ensure the protection of the environment, particularly matters of national environmental significance, such as World Heritage properties, national heritage places, wetlands of international importance, nationally threatened species and ecological communities, migratory species, and marine areas.

The Act establishes a framework for assessing the environmental impacts of an action that has been determined to be a controlled action, promoting the conservation of biodiversity, and ensuring sustainable development. It also provides mechanisms for cooperation between the federal, state, and territory governments and includes provisions for community involvement in environmental decision-making processes.

The Exploratory Works Project was determined to be a controlled action (EPBC 2023/09461) under the EPBC Act on 30 March 2023. This CEMP focuses on the management of potential impacts to MNES and will be updated to incorporate any conditions or commitments applied through the EPBC Act referral and assessment process.

Preliminary activities not included in the existing EPBC controlled action may be subject to other approvals and will require decommissioning unless otherwise required. Management of these activities will also be in accordance with this CEMP.

3.2 State legislation

Relevant legislation associated with environmental management for the Exploratory Works components is identified within relevant supporting plans. A Works Regulation has also been made under the *State Development and Public Works Organisation Act 1971* for components of the Exploratory Works Project, as discussed in further detail below.

3.2.1 Regulation works

In September 2024, a works regulation for the Borumba PHES project exploratory works was made, directing Queensland Hydro, as a local body, to undertake works, as described in the Borumba Pumped Hydro Energy Storage Project Exploratory Works – Geotechnical and Investigations project report.

The works regulation removed the requirement for approvals to be assessed under the local government planning scheme for relevant exploratory works activities. Local planning scheme approvals that were relevant to this scope of works and are not required due to the works regulation are identified in Table 2. Consistent with the Planning Regulation 2017, this will be managed through the Office of the Coordinator-General, including the approval of third-party certified environmental management plans.

Table 2: Local planning scheme approvals subject to the works regulation for the Exploratory Works

Planning Scheme	Approval	Applicable Works
Gympie Regional Planning Scheme (under *Planning Act 2016*)	Operational works for excavation and fill	Geotechnical investigations, access tracks, portal pad, tunnelling, staging pad, explosive store, civil construction compound, security access control, and temporary water infrastructure

Planning Scheme	Approval	Applicable Works
	Material change of use for medium or high impact industry (storage of explosives)	Construction of the explosive store
Gympie Regional Planning Scheme (Temporary Local Planning Instrument) (under the *Planning Act 2016*)	Vegetation clearing	Geotechnical investigations, access tracks, portal pad, staging pad, explosive store, civil construction compound, security access control, and temporary water infrastructure
Somerset Regional Planning Scheme (under the *Planning Act 2016*)	Operational works for excavation and fill	Construction of access tracks and the security access control
	Vegetation clearing	Construction of access tracks and the security access control

3.3 Approval, licences and permits

A high-level summary of the key approvals required for the Exploratory Works is provided in Table 3. Note that this table does not provide a complete list of all approvals required for the Exploratory Works.

Table 3: Summary of key approvals required for the Exploratory Works as of October 2025

Legislation	Approval	Exploratory Work Component(s)	Relevant Management Plan
Commonwealth			
Environment Protection and Biodiversity Conservation Act 1999	EPBC referral and assessment	All works except geotechnical investigations in previously disturbed areas (e.g. on existing tracks, subject to past clearing)	CEMP Preliminary Erosion and Sediment Control Management Plan Spoil Management Plan Waste Management Plan Water Management Plan Biosecurity Management Plan (to be developed) Flora and Fauna Management Plan
State			
Fisheries Act 1994	Operational works for waterway barrier works	Crossings of Sandy Creek	Water Management Plan Preliminary Erosion and Sediment Control Plan Flora and Fauna Management Plan
Vegetation Management Act 1999[1]	Relevant purpose determination (22A) Operational works for vegetation clearing	Vegetation clearing for geotechnical investigations, site access, portal pad, staging area, explosive store, civil construction compound, spoil disposal areas, and temporary water infrastructure	Flora and Fauna Management Plan
Nature Conservation Act 1992	Protected Plant permits and Species Management Program (high and low risk of impact)	Vegetation clearing for geotechnical investigations, site access, portal pad,	Flora and Fauna Management Plan

Legislation	Approval	Exploratory Work Component(s)	Relevant Management Plan
		staging area, explosive store, civil construction compound, spoil disposal areas, and temporary water infrastructure	
	Section 34 – Works in Resources Reserve	Works in Conondale Resources Reserve	Biosecurity Management Plan (condition of approval) Rehabilitation Management Plan (condition of approval) CEMP as approved by Queensland Parks and Wildlife Service in Section 34 Authority
Forestry Act 1959	Section 35 – State Forest Occupation Permit Permit to traverse	Works in Imbil State Forest (Lot 135 on FTY1911)	Flora and Fauna Management Plan CEMP as approved in Section 35 Occupation Permit
Forestry Act 1959	Permit to traverse	Use of existing roads within Imbil State Forest (Lot 135 on FTY1911)	Nil
Planning Act 2016	Material change of use for a hazardous chemical facility	Explosive store	Nil
Water Act 2000	Riverine Protection Permits	Crossings of Yabba Creek and Sandy Creek Geotechnical drilling	Flora and Fauna Management Plan Preliminary Erosion and Sediment Control Plan
Water Act 2000	Operational works: taking water or interfering with water	Geotechnical drilling	Water Management Plan
Environmental Protection Act 1994 (EP Act)	Soil disposal permit	Removal, treatment, or disposal of contaminated soil, if required	Spoil Management Plan Waste Management Plan
Environmental Protection Act 1994	Environmental Authority for an environmentally relevant activity (ERA 16)	Tunnelling (extraction and screening)	Spoil Management Plan

3.3.1 Standard, policies and guidelines

Compliance standards, policies and guidelines relevant to the Exploratory Works are detailed in the respective CEMP supporting plans. The requirements of these standards have been considered in the preparation of the CEMP and will be considered by the contractor during the preparation of the Environmental Work Method Statements and CEMP revision.

4. Environmental management system

4.1 Queensland Hydro environmental policy

Management measures to avoid and minimise impacts on environmental, social and cultural heritage values will be implemented for all phases of the Exploratory Works Project. The Exploratory Works Project will follow the environmental mitigation hierarchy (i.e. avoid, minimise, mitigate, offset) and align with all relevant Australian standards and environmental legislation and policies, including, but not limited to:

- ISO 14001:2015 – Environmental management systems
- ISO 45001:2018 – Occupational health and safety management systems
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth)
- *Environmental Protection Act 1994* (Qld).

Queensland Hydro has followed the environmental mitigation hierarchy by implementing measures to avoid or reduce potential impacts associated with the Exploratory Works Project. For the planning phase of the Exploratory Works, this has included:

- locating works components in previously disturbed (e.g. grazing paddocks) in the first instance, and avoiding areas where clearing would be required
- co-locating Exploratory Works Project infrastructure and activities with the proposed Borumba PHES Project footprint to reduce additional disturbance, wherever possible
- reviewing environmental values for the works area and relocating Exploratory Works Project components to avoid sensitive values.

Some of the key design considerations for the Exploratory Works Project included:

- restricting the footprint to what is anticipated to be required to undertake the works in a safe and efficient manner
- restricting the footprint to minimise the extent of disturbance to vegetation and habitat while also targeting cleared areas and utilising existing tracks, including minimising disturbance in sensitive areas such as:
  - habitat for critically endangered, endangered and vulnerable flora and fauna species
  - riparian vegetation
  - steep slopes
  - in-stream habitats
- allowing for the installation of scour protection measures around culvert entrances and exits, on disturbed stream banks, and around waterfront land to avoid erosion.

4.2 Queensland Hydro environmental management system

Queensland Hydro will utilise an environmental management system (EMS) that aligns with the Australian standard ISO 14001:2015.

All plans will be stored and available for reference as per ISO 14001:2015.

4.3 Contractor and subcontractor management

The CEMP for the Exploratory Works has been prepared to incorporate the relevant licences, permits and approvals for the works once available.

The environmental policy will be displayed at the site office and communicated to all workers and staff through mandatory environmental induction training. The policy (refer to Section 4.1) contains Queensland Hydro's commitment to the use of the environmental mitigation hierarchy.

The CEMP identifies the following for contractors and subcontractors:

- regulatory requirements and compliance
- resources, responsibilities and authority
- training and awareness

- monitoring and inspections
- revision of the CEMP and supporting plans
- environmental management actions.

4.4 Hold points

The contractor is responsible for the development of a Hold Point procedure and subsequent forms. The contractor will provide a detailed schedule of works for Queensland Hydro to review and identify specific approvals that are required prior to the commencement of work. The works will not commence until the Hold Point has been approved / released by Queensland Hydro.

4.5 Environmental objectives and targets

Environmental objectives and targets have been identified for the assessment of environmental performance and/or activities associated with the Exploratory Works Project. These align with the Queensland Hydro environmental policy (as described in Section 4.1) and will identify the efficacy of management measures identified in this CEMP and supporting plans.

The environmental objectives for the Exploratory Works Project include:

- implementing an EMS that is consistent with ISO 14001:2015
- complying with all environmental approvals for the Exploratory Works Project
- improving environmental performance throughout the implementation of the Exploratory Works.

The performance of the Exploratory Works against the objectives and targets will be documented in the construction compliance reports and will be informed by:

- inspections
- compliance reporting
- management reviews
- risk registers
- audits
- incident registers.

4.6 Management plan structure

This CEMP forms the overarching environmental management plan to be implemented throughout Exploratory Works activities. As part of this, Queensland Hydro has prepared supporting plans for:

- erosion and sediment control
- spoil management
- waste management
- flora and fauna management
- water management.

Other plans will also be prepared. The plans outline the requirements that must be implemented or further refined during the Exploratory Works Project. Following engagement of construction contractors, work specific management plans (including a CEMP and supporting plans) must be prepared by the contractor and approved by Queensland Hydro prior to commencement of works. All contractor management plans will sit underneath this overarching CEMP and must be compliant with the requirements outlined within this document and associated plans.

4.6.1 Biosecurity management framework

Queensland Hydro has in place a biosecurity management plan for the works currently being undertaken onsite and is in the process of developing a Biosecurity Management Framework for the Project. The purpose of this framework is to provide sound management of biosecurity matters through the implementation of appropriate

management practices and compliance with the General Biosecurity Obligations and other requirements of the Queensland *Biosecurity Act 2014*. The framework will aim to:

- Provide controls and procedures are implemented during construction activities to avoid, minimise or manage potential adverse impacts from biosecurity matter.
- Facilitate appropriate measures are implemented to comply with the General Environmental Duty under the *Environmental Protection Act 1994*, General Biosecurity Obligation under the *Biosecurity Act 2014* and Queensland Hydro Procedures.
- Nominate the Project's monitoring and reporting requirements in relation to biosecurity matter.
- Monitor the effects of management and mitigation measures.
- Provide the framework for a biosecurity monitoring programme to be developed, implemented and audited so that Project-related impacts on local stakeholders and the environment can be avoided, or minimised and managed.
- Establish a framework and guidance document to support the development of the scope specific biosecurity management plans

Scope specific biosecurity management plans will be developed for specific work areas or land parcels and managed by the Queensland Hydro and/or the contractor. At a minimum the Scope Specific Biosecurity Management Plans must meet the following requirements:

- Details of the Biosecurity Matters including photos, location of Biosecurity Matter infestations, the Biosecurity Matter category and respective Management Measures.
- Weeds and infestations shall be determined based off scope specific weed audits, carried out by suitability qualitied professionals.
- Weed locations and densities shall be captured in GIS to enable Queensland Hydro to collate in a central database.
- Location of applicable biosecurity management zone boundaries (external and project internal zones) in relation to Work under the Contract (including ancillary activities such as water source, stockpile sites, gravel sources, Deposition Areas).
- Identify movement of Biosecurity Matter carriers across biosecurity zone boundaries and Biosecurity Instrument Permit details pertaining to these movements.
- Management Measures for preventing the spread of Biosecurity Matters within Site and out of the Site.
- Measures to exclude access to known areas of Biosecurity Matter infestation such as flagging
- Location of clean-down facility (if temporary clean down bay is to be constructed on Site, specify design and maintenance requirements)
- Specific Monitoring procedures for biosecurity matters (method, timing, frequency, duration, parameter to be monitored, criteria / outcome measured against).
- Pesticide treatment schedule addressing method of control, chemicals, locations, timing of works.
- Note where required, biosecurity management shall occur at least 2 weeks prior to works commencing on site.

4.7 Environmental work method statement

The contractor will be required to prepare environmental work method statements (EWMS) for high-risk activities for inclusion within their CEMP. As a minimum, these will need to include:

- drilling and blasting
- plant refuelling
- water management
- access road and bridge
- chemical storage and handling
- spoil management
- tunnelling
- watercourse crossings

- vegetation clearing and grubbing
- directional drilling.

The EWMS will provide a high-level summary of the key elements, processes and assumptions for that aspect of the Exploratory Works. The EWMS will be specifically designed to communicate requirements, actions, processes and controls to construction personnel using written instructions including:

- work methodology
- waste storage
- restricted areas
- safety, environment and quality
- risk management.

The EWMS will be approved by Queensland Hydro prior to commencement of works. They will also be reviewed and revised as necessary during the implementation of the works.

4.8 Site environmental plans

Site Environmental Plans (SEPs) are documents that provide a detail of environmental constraints, physical protection measures, restricted areas and other key management measures to minimise impacts from the Exploratory Works on the environment. The SEPs also identify the key controls specific to the construction area. SEPs are prepared to display site specific constraints and key environmental management measures. SEPs will be prepared for all work areas prior to commencing Exploratory Works activities.

Environmental constraints maps (hard copy and GIS) will document the location and extent of environmental and socially sensitive areas including vegetation, heritage, sensitive receivers, waterways, etc. The mapping will provide a simple but effective tool to identify key risk areas and to promote ongoing communication to construction personnel throughout the Exploratory Works. The mapping will be managed separately to this CEMP and therefore, changes to the mapping will not require this CEMP to be updated.

4.9 Roles and responsibilities

Control of review and amendments and authority for CEMP implementation, including maintenance of environmental records, will be the responsibility of the contractor's project manager, construction manager, and environmental management representative.

All personnel will be responsible for environmental compliance during the Exploratory Works.

Anticipated environmental responsibilities for the contractor's roles associated with the Exploratory Works are identified below.

4.9.1.1 Project manager

The environmental responsibilities of the project manager include (but are not limited to) the following:

- ensuring works comply with regulatory requirements and environmental objectives
- ensuring the CEMP (and supporting plans) can be implemented with allocated resources (i.e. environmental objectives are not placed secondary to Exploratory Works activities)
- ensuring monitoring and corrective actions are implemented
- reviewing and incorporating changes to CEMP and supporting plans
- ensuring all training requirements are completed
- stopping Exploratory Works activities if a significant impact to environment is likely from work activities.

4.9.1.2 Construction manager

The environmental responsibilities of the construction manager include (but are not limited to) the following:

- ensuring the CEMP and supporting plans are fully implemented
- ensuring works comply with regulatory requirements and environmental objectives

- implementing environmental controls with identification of environmental risk (alongside implementing the CEMP and supporting plans)
- providing support to the environmental representative to ensure environmental objectives are met
- stopping Exploratory Works activities if a significant impact to environment is likely.

4.9.1.3 Environmental management representative

The environmental responsibilities of the environmental management representative include (but are not limited to):

- providing direction on environmental matters to all relevant parties associated with the Exploratory Works
- producing and maintaining a register of management plans associated with activities (including previous environmental reports)
- ensuring the CEMP and supporting plans are fully implemented
- carrying out weekly inspections of environmental control measures (i.e. erosion and sediment control measures and any implemented exclusion or buffer zones) during the Exploratory Works
- reviewing the CEMP and supporting plans to identify where environmental performance may be improved and updating plans and/or measures to obtain required performance measure
- preparing monthly compliance reporting that identifies environmental management measures and any improvements undertaken as part of the CEMP and supporting plans review
- preparing and facilitating environmental inductions for site personnel
- providing input to weekly toolbox and daily pre-start meetings as required
- stopping Exploratory Works activities if a significant impact to environment is likely from work activities, specifically if Exploratory Works activities have capacity to produce non-conformities with plans
- reporting any environmental incidents.

4.9.1.4 Exploratory Works Project and site engineers

The environmental responsibilities of the Exploratory Works Project and site engineers include (but are not limited to):

- ensuring works are carried out in accordance with the CEMP and supporting plans
- implementing environmental controls and identifying additional environmental risk (i.e. alongside implementing the CEMP and supporting plans)
- allocating resources and responding to environmental incidents to enact control measures
- reporting activities where actual or risk of harm is identified and advising the project manager, construction manager or environmental representative.

4.9.1.5 Site supervisor

The environmental responsibilities of the site supervisor include (but are not limited to):

- ensuring all works comply with work statements and records of works are maintained
- ensuring site inductions have been undertaken by all Exploratory Works personnel
- where required, undertaking or liaising with the environmental representative to confirm environmental risk assessment of works before commencement
- incorporating and maintaining effective environmental controls
- reporting on activities that may result, or have resulted, in an environmental incident
- ceasing activities where actual or risk of harm is identified and advise the project manager, construction manager or environmental representative
- attending, investigating and reporting on environmental incidents.

4.9.1.6 All personnel (including subcontractors)

The environmental responsibilities of all personnel (including subcontractors) include:

- complying with relevant section/s of the CEMP (work statements and controls)

- participating in and complying with environmental management requirements identified during induction, and toolbox and pre-start meetings
- reporting any potential environmental incidents to the site supervisor to limit potential impact and allow corrective measures to be applied
- ceasing activities where actual or risk of harm is identified and advising the project manager, construction manager or environmental representative.

4.10 Competence, training and awareness

Environmental training will be provided, principally through a compulsory environmental induction, along with regular toolbox and pre-start meetings.

Coordination of environmental training will be the responsibility of the environmental management representative (refer to Section 4.9.1.3).

4.10.1 Environmental induction

All personnel conducting activities on site will be required to attend a compulsory environmental induction before commencing any activities. Facilitation of environmental inductions will be the responsibility of the environmental management representative and will cover the requirements of Exploratory Works activities under the CEMP. At a minimum, the induction will address:

- purpose and objectives of the CEMP and supporting plans
- cultural heritage duty of care
- general environmental duty and duty to notify under the EP Act
- relevant legislation and approvals
- high-risk activities and identified environmental management measures
- relevant matters of national environmental significance
- areas of environmental significance associated with works
- general information regarding environmental constraints
- specific management measures requirements and responsibilities for implementation
- potential consequences of not meeting environmental responsibilities
- incident responses and reporting requirements.

A record of all staff, subcontractors and visitors who attend the environment inductions will be maintained and kept on site, including names, dates, trainer and training provided.

As part of ongoing reviews associated with the CEMP, the environmental management representative may implement amendments to the induction as required. Any amendments to the induction will be forwarded to personnel who have already completed the prior induction. This is expected to be facilitated through updates to site personnel via toolbox or pre-start meetings.

4.10.2 Daily pre-start meetings

The site supervisor is expected to conduct a daily pre-start meeting with the site workforce before work commences each day. This will include, at minimum:

- planned activities for the day
- relevant environmental management measures
- any work area restrictions (i.e. high risks areas / exclusion and buffer zones)
- safe work practices.

The environmental component of the daily pre-start meetings will be determined by the site supervisor and environmental personnel and will include any environmental issues that could potentially be impacted by, or impact on, the day's activities. As such, daily pre-start meetings will briefly reiterate any environmental receptors of concern and relevant sections of environmental management measures for the day.

Daily pre-start attendance is mandatory (for relevant workforce members) for the duration of the Exploratory Works and attendees will be required to sign an attendance register that is recorded and maintained as part of a compliance register.

4.10.3 Toolbox talks, training and awareness

Weekly toolbox meetings will be used to ensure all relevant parties associated with construction will be aware of environmental constraints associated with Exploratory Works activities. The toolbox meetings will also allow for continued updates on any relevant changes (upon CEMP or supporting plan revision).

Facilitation of the toolbox meetings is the responsibility of the environmental management representative.

The toolbox meetings will consist of details of plans (namely environmental receptors of concern and incident management). As such, the toolbox meetings will be tailored to relevant activities and site locations relevant to upcoming works.

All personnel working on site will receive training (principally via the environmental induction) to ensure awareness of environment protection requirements for the Exploratory Works. Site-specific training will be provided to personnel engaged in activities or areas of higher risk (e.g. those working in areas of proximity to sensitive flora and fauna receptors).

Relevant environmental issues include (but are not limited to):

- erosion and sedimentation control
- contaminated spoil or land
- dewatering
- emergency and spill response
- Indigenous and non-Indigenous heritage
- threatened species, threatened ecological communities (TECs), clearing controls and vegetation protection
- weed management
- dust control.

Toolbox talk attendance is mandatory for the duration of the Exploratory Works and attendees will be required to sign an attendance register that is recorded and maintained as part of a compliance register.

4.11 Communication

The use of environmental inductions, daily pre-start meetings and weekly toolbox meetings is expected to form most verbal internal communications detailing environmental aspects of the Exploratory Works. As a mandatory component for contractors and subcontractors, these are expected to form the basis of training and information sharing.

Written communication frameworks, when available, including contact numbers and telephone numbers will be provided via inductions.

Internal communication will be maintained throughout all levels and functions (as required) to ensure that environmental management measures are implemented where required. This is expected to be a key driver in achieving environmental outcomes associated with the Exploratory Works.

The weekly toolbox meetings are a key driver in providing a platform for formal and informal internal communication between the environmental management representative and other site personal to review environmental performance, advise on environmental matters and to receive key feedback from site personal directly associated with the Exploratory Works activities.

All internal and external communication with all stakeholders including the public, DCCEEW and government agencies will be done in accordance with the Communications and Stakeholder Engagement Plan (CSEP).

4.12 Emergency and incident planning

An emergency and incident planning framework will be produced prior to onsite works and will include as a minimum:

- Borumba PHES emergency response plan
- key emergency personnel including specific responsibilities and contact number
- external agency contacts
- potential emergencies and incidents (including current management measures)
- classification of environmental incidents, and legal requirements for reports and notifying external agencies.

Control of environmental emergencies and incidents will be coordinated through an incident reporting framework. Incident management is expected to cover the following incidents (if they occur):

- spills of fuels, oils, chemicals and other hazardous materials
- potential contamination of waterways or land
- non-compliance with approval conditions
- validated complaints
- unauthorised clearing of vegetation
- accidental starting of a fire or a fire breaking out of containment
- unauthorised dumping of waste
- works that occur outside of standard construction hours without prior approval.

All site personnel will be required to report any environmental incidents or breaches of approvals to Queensland Hydro.

All site personnel will be required to report any environmental incidents to the environmental management representative when becoming aware of the incident. The environmental management representative will then be required to report, within no later than 24 hours, the incident including the event, its nature and circumstances in which the event happened. In the instance site personnel are not able to contact the environmental management representative in a timely manner, the site personnel will be required to provide notice to DETSI.

Under the requirements for the duty to notify of environmental harm (Section 320 of the EP Act), environmental incidents that cause or threaten to cause serious environmental harm or material harm must be reported within 24 hours to the Department of Environment, Science, Tourism and Innovation (DETSI). Notifications can be made to DETSI by email or phone.

4.13 Monitoring and inspections

4.13.1 Environmental inspections

Weekly environmental inspections will be undertaken with a particular focus on work in areas near environmentally sensitive receptors. Inspections will include site preparedness for adverse weather conditions, including adequacy of environmental controls and availability of emergency equipment.

Prior to undertaking environmental inspections, the following will be addressed and documented within the contractor's CEMP:

- what is to be inspected
- when the inspection is to occur
- who is to carry out the inspection
- how inspections are to be recorded.

Copies of all environmental inspection reports prepared by the contractor's environmental management representative will be kept with the project records and closed out within appropriate timeframes (i.e. replacement of erosion and sediment control as soon as possible). A project register will be developed to track actions and relevant close out.

In addition to environmental inspections, tracking forms will be developed for implementing a checklist system to monitor requirements (under specific plans) and for record keeping. These will consist of the following:

- weekly environmental inspection checklists
- dewatering activity logging

- daily site report (daily diary)
- vegetation clearing tracking (including permits for clearance) through post-clearance reports
- materials tracking
- unexpected finds (cultural heritage and threatened species) reporting
- excavation logging
- access to restricted areas, along with the relevant monitoring and reporting.

In addition to weekly environmental inspections, the environmental management representative will undertake inspections post rainfall. The post-rainfall inspections will be undertaken after more than 25 millimetres (mm) of rain in a 24-hour period (either from the nearest Bureau of Meteorology rainfall station or via onsite rainfall gauging). The inspection and records will follow those of the weekly environmental inspection tracking.

The inspection forms will identify compliance or issues for rectification and include signoff on actioned rectifications. In the instance that rectifications are to be actioned between inspections, adequate recording of when items are to be actioned is expected to be maintained and subsequently actioned.

4.13.2 Environmental monitoring

Monitoring will be undertaken to validate the impacts predicted for the Exploratory Works Project, and to measure the efficacy of environmental controls and the implementation of this CEMP. The monitoring requirements are included in the relevant environmental management plans and will be undertaken by person who are suitably trained, qualified and experienced.

Environmental monitoring will be conducted for ongoing Exploratory Works to ensure objectives within the plans are met. Monitoring requirements for each environmental aspect are detailed in the relevant plans provided in Appendix C to Appendix K.

4.13.3 Auditing

During the Exploratory Works, audits will be completed to assess compliance with environmental requirements identified within this CEMP and the supporting plans. Audits will consist of internal audits and external independent audits.

Internal audits will be conducted quarterly for the duration of the Exploratory Works by the environmental management representative. An independent audit will occur once a year during the Exploratory Works, conducted by an appropriately qualified third party.

The audits will assess compliance of site activities with any imposed conditions and objectives and management measures identified within the CEMP and supporting plans. Results from audits will be documented in a report and provided to the management team for discussion and action.

4.14 Records and reporting of environmental activities

The environmental management representative is responsible for maintaining all environmental management documents and records. The documents and records that require maintenance include:

- all site monitoring, inspection and compliance reports/records
- correspondence with regulatory authorities
- environmental induction records
- CEMP and supporting plans (as standalone)
- reportable incidents and non-conformances
- records of reviews and actionable items including review meeting minutes
- minutes of CEMP and EMS review meetings and evidence of any action taken
- environmental method statements.

4.14.1 Monthly Reports

Monthly reports will be prepared by the environmental management representative and will include the following:

- The outcomes of monitoring undertaken during the preceding month
- The weekly environmental inspections
- Summary of complaints received (e.g. noise) and actions taken to address the complaint
- Any reportable incidents and non-conformances that occurred and corrective actions implemented
- Results from environmental audits and reviews undertaken.

4.15 CEMP and supporting plan revision

The need for revision of the plans for the Exploratory Works is to be assessed in the following events:

- identification of new risks
- changes to project description and construction methodology
- instances of non-compliance with plans
- instances of environmental incidents requiring reporting
- complaints
- audit (either internal or by external parties)
- annual review.

The review process thresholds are in place to ensure the CEMP is appropriate for specific works that are occurring within the site (including but not limited to disturbance footprints).

If the review process identifies sections or supporting plans that require updating, the responsibility lies with the environmental officers to assist in preparing the revised documents. All revisions of this CEMP or supporting plans need to be issued to the project manager and relevant environment staff for approval of changes before the revised CEMP can be implemented.

All environmental plans are live and able to be amended with review processes. Noting this, only the construction environmental management representative has the authority, with final approval from Queensland Hydro, to change environmental management documentation.

4.16 Non-conformance management

Where non-conformances with environmental management measures are identified, corrective measures will be implemented. Corrective measures include revision of the existing CEMP and/or supporting plans, the implementation of on-ground corrective measures as preventative measures, and/or further implementation of competence, training and awareness measures.

Non-conformances will be principally identified from self-reporting (via onsite workers), through site inspections conducted by the environmental management representative or by verified complaints. The performance indicators and triggers for corrective actions are outlined within the relevant plans provided in Appendix C – Appendix K. Anticipated corrective actions have also been identified, though these will be reviewed and updated as necessary in response to non-conformances.

Site personnel can stop non-conforming activities in consultation with the environmental management representative or construction manager. Corrective and preventative actions must be implemented if a non-conformance is identified. Non-conformances will be documented by the environmental management representative including the non-conformance issue, monitoring undertaken (if required), corrective actions, timing of corrective action implementation and ongoing responsibilities. As corrective actions are expected to be completed after the corrective action is proposed, regular review of actionable items is the responsibility of the environmental management representative. Where non-conformances result in environmental incidents or harm, the respective regulatory authority will be notified.

4.17 Document control and records

The Contractor shall maintain all records generated because of environmental management and make these available on request. These shall include:

- training records

- incident reports
- audit and inspection forms
- monitoring results
- non-conformances
- volume of waste to landfill, waste recycled and waste disposed of offsite.

The contractor's environmental management representative will coordinate the preparation, review and distribution, as appropriate, of the environmental documents listed above. During construction, environmental documents will be stored at the main site office and can be accessed on request to the contractor's environmental management representative.

A document and data control procedure will be implemented to control the flow of documents and data within the contactor's teams and between the contractor and the Queensland Hydro, stakeholders and sub-contractors.

Documents and data that are to be issued and liable to change will be controlled to ensure that they are approved before issue and that the current issue or revision is known to and available to those requiring them. Controlled documents and data will be uniquely identified and will bear a defined revision number recorded on each page of the document.

New revisions will be distributed in accordance with Queensland Hydro's document control procedures and the distribution identified in Section 1.3. Data will be issued on a revision basis only. Obsolete documents and data may be kept for contractual or other reasons but will be clearly marked 'superseded'.

5. Impact assessment

Potential impacts associated with the Exploratory Works may result from a variety of direct and indirect impact pathways including:

- disturbance of the soil associated with vegetation clearing for surface works, including various pads, geotechnical investigations and access tracks
- disruption of ecological values and potential contamination resulting from blasting activities
- construction of waterway crossings and runoff from works occurring near waterways or drainage lines
- disturbance of existing contaminated areas
- accidental release of fuel, oil, waste or other chemicals
- discharge of surface/ground water collected during work activities (including from stormwater runoff from works areas, or wastewater from geotechnical investigation activities)
- runoff from spoil stockpiles, which may be contaminated
- direct extraction of water from a waterbody, disturbing the sediment or lowering the lake water level
- fugitive dust emissions from site activities (e.g. vegetation removal or construction of access tracks and hardstand areas) causing dust nuisance or human health impacts.

5.1 Risk assessment methodology

The risk assessment methodology for the Project has been adapted from the DCCEEW Environmental Management Guidelines (DCCEEW, 2024) A qualitative risk assessment has been completed for Exploratory Works components and their anticipated impacts on relevant environmental aspects. The risk assessment identifies the likelihood (Table 4) and potential consequence (Table 5) of the impacts and then calculates a final risk rating based on the consequence (Table 6). The risk rating assessment was used to qualify risk pre- and post-management of the potential impacts identified in Table 6.

Table 4: Likelihood rating

Quantitative measure of likelihood*	
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the project
Possible	Might occur during the life of the project
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances

* How likely will this event / issue occur after control strategies have been put in place

Table 5: Consequence rating

Qualitative measure of consequence*	
Minor	Minor incident of environmental damage that can be reversed
Moderate	Isolated but substantial instance of environmental damage that could be reversed with intensive efforts
High	Substantial instances of environmental damage that could be reversed with intensive effort
Major	Major loss of environmental amenity and real danger of continuing environmental damage
Critical	Severe widespread loss of environmental amenity and irrecoverable environmental damage

* Rating of the consequence/result if this issue does occur

Table 6: Risk rating matrix

Risk	Consequence				
	Minor	Moderate	High	Major	Critical
Highly likely	Medium	High	High	Severe	Severe
Likely	Low	Medium	High	High	Severe
Possible	Low	Medium	Medium	High	Severe
Unlikely	Low	Low	Medium	High	High
Rare	Low	Low	Low	Medium	High

5.2 Risk assessment

The location of a detailed risk assessment for the specific environmental aspects is shown in Table 7.

Table 7: Risk assessment locations

Environmental Element	Plan Location	Plan Title	Plan Section
Cultural heritage^	-	-	-
Air quality	Appendix D	-	-
Noise and vibration	Appendix E	-	-
Bushfire	Appendix F	-	-
Erosion and sediment	Appendix G	Preliminary Erosion and Sediment Control Plan (PESCP)	Appendix A
Spoil	Appendix H	Spoil Management Plan	5
Waste	Appendix I	Waste Management Plan	3
Flora and fauna	Appendix J	Flora and Fauna Management Plan (FFMP)	Appendix H of the Preliminary Documentation
Water	Appendix K	Water Management Plan	5

^ Cultural heritage risks have been assessed elsewhere. There is also an Early Works Agreement in place between Kabi Kabi and Qld Hydro and an Indigenous Land Use Agreement (ILUA).

6. Environmental management measures

The design associated with the Exploratory Works has actively sought to avoid, minimise and / or mitigate impacts to environmental values during the initial concept and design phases. These standard measures to avoid in the first instance have included:

- strategically locating the works in already cleared or degraded areas
- relocating the portal pad from an area of lowland rainforest TEC to a disturbed area
- minimising the creation of new tracks through repurposing existing tracks including within the buffer area of the TECs.

6.1 Mitigation measures

Where impacts were unable to be avoided through design development and planning, a risk assessment was undertaken to determine the level of impact. It was identified that there are a variety of different pathways through which the Exploratory Works may lead to impacts on environmental values. A range of management measures will be employed to mitigate the impacts to these values.

Once construction contractors are appointed, additional mitigation measures will be investigated including:

- use of alternative drilling techniques to minimise the clearing, including the size and type of the drill rigs and supporting equipment and machinery
- use of micrositing of tracks and drills pads with the intent to avoid threatened flora species or breeding places or foraging habitat (e.g. greater glider feed trees or dens).

Further the Exploratory Works Project will result in the removal of cattle and associated impacts from Queensland Hydro land, thus removing grazing pressures, which are a known threat to a number of MNES present in the area.

The mitigation measures associated with the risks identified in Section 5 are shown in Table 8.

Table 8: Mitigation measure locations

Environmental Aspect	Plan Location	Plan Title	Plan Section
Cultural heritage*	Appendix C	-	-
Air quality*	Appendix D	-	-
Noise and vibration*	Appendix E	-	-
Bushfire*	Appendix F	-	-
Erosion and sediment	Appendix G	PESCP	Appendix A
Spoil	Appendix H	Spoil Management Plan	6
Waste	Appendix I	Waste Management Plan	4
Flora and fauna	Appendix J	Flora and Fauna Management Plan	6
Water	Appendix K	Water Management Plan	4

* Management measures are stated with Appendices C – F.

The risk ratings shown within the supporting plans provide a summary of the revised risk based on the implementation of the mitigation measures. Environmental management actions will be underpinned by ongoing records (identified in Section 4.17) including:

- all site monitoring, inspection and compliance reports/records
- correspondence with regulatory authorities
- environmental induction records
- reportable incidents and non-conformances
- records of reviews and actionable items including review meeting minutes

- minutes of CEMP and EMS review meetings and evidence of any action taken
- environmental method statements.

References

DAWE, 2022. Conservation Advice for *Phascolarctos cinereus* (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory. Commonwealth Department of Agriculture, Water and the Environment (now DCCEEW).

DAWE, 2022a. Conservation Advice for *Potorous tridactylus tridactylus* (northern long-nosed potoroo). Commonwealth Department of Agriculture, Water and the Environment (now DCCEEW).

DAWE, 2022b. Conservation Advice for *Petaurus australis australis* (yellow-bellied glider (south-eastern)). Commonwealth Department of Agriculture, Water and the Environment.

DCCEEW, 2008. Approved Conservation Advice for *Plectranthus torrenticola*. Commonwealth Department of Climate Change, Energy, the Environment and Water.

DCCEEW, 2008a. Approved Conservation Advice for *Sophora fraseri*. Commonwealth Department of Climate Change, Energy, the Environment and Water.

DCCEEW, 2022. Conservation Advice for *Calyptorhynchus lathami lathami* (South-eastern Glossy Black Cockatoo). Commonwealth Department of Climate Change, Energy, the Environment and Water.

DCCEEW, 2022a. Conservation Advice for *Petauroides volans* (greater glider (southern and central)). Commonwealth Department of Climate Change, Energy, the Environment and Water.

DCCEEW, 2022b. Approved Conservation Advice for the Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions. Commonwealth Department of Climate Change, Energy, the Environment and Water.

DSEWPaC, 2011. Conservation advice for the Lowland Rainforest of Subtropical Australia.

McDonald, J, 2012. Australian nursery industry myrtle rust management plan. Nursery and Garden Industry Australia, Sydney. Available at: https://www.ngiq.asn.au/wp-content/uploads/Myrtle-Rust-Management-Plan-2012-Final.pdf.

Peeters, P J and Butler, D W, 2014. *Wet Sclerophyll Forest Regrowth Benefits - Management Guideline*. Department of Science, Information Technology, Innovation and the Arts.

The National Lantana Management Group, 2009. Draft Plan to Protect Environmental Assets from Lantana. Department of Employment, Economic Development and Innovation, Yeerongpilly, Queensland.

TSSC, 2001. Conservation Advice *Pteropus poliocephalus* (Grey-headed Flying-fox). Threatened Species Scientific Committee established under the *Environment Protection and Biodiversity Conservation Act 1999*

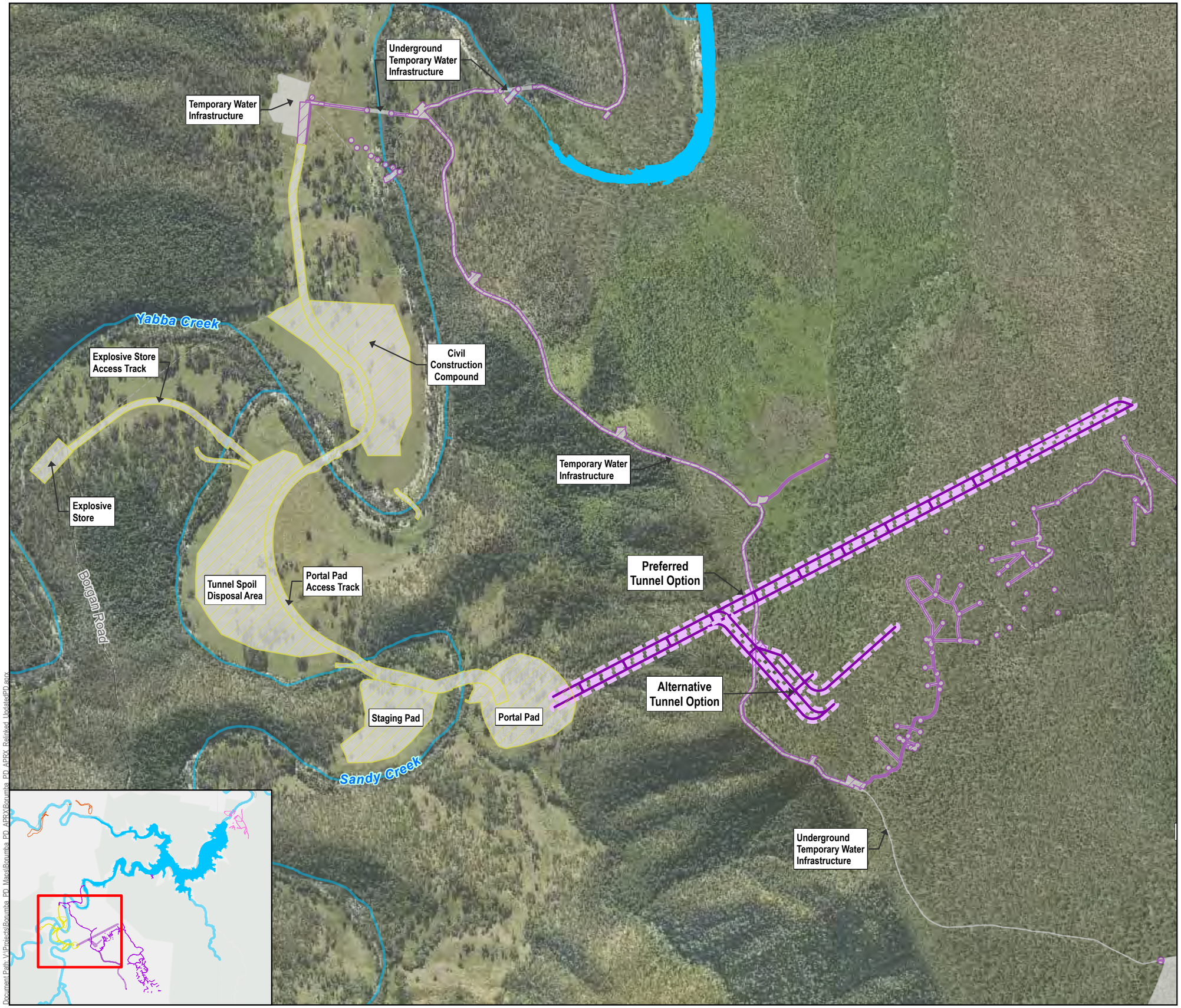
TSSC, 2020. Conservation Advice *Rhodamnia rubescens* Scrub Turpentine. Threatened Species Scientific Committee established under the *Environment Protection and Biodiversity Conservation Act 1999*.

Appendix A – Activity Summary

Table A-1 provides a general description of the activities required to complete each project component. The locations of the Project components and key elements associated with the activities are shown in the Figures 4 – 8 respectively.

Table A-1: Activities associated with Exploratory Works Project components

	Appendix	Exploratory Works Project Components				
		Exploratory Tunnel	Geotechnical Investigations	Spoil Transport and Disposal	Site Access	Other Supporting Infrastructure
High risk environmental method work statement						
Drilling and blasting	N/A	X				
Plant refuelling	N/A	X	X	X	X	X
Water management	N/A	X	X	X	X	
Access road and bridge	N/A	X	X	X	X	X
Chemicals handling and storage	N/A	X	X			
Spoil management	N/A	X	X	X	X	X
Tunnelling (not applicable to this CEMP)	N/A	X				
Watercourse crossing	N/A				X	X
Vegetation clearing and grubbing	N/A	X	X	X	X	X
Directional drilling	N/A					X
General Tasks						
Mobilisation and demobilisation to and from site	A-1	X	X	X	X	X
Site establishment		X	X	X	X	X
Establishment of environmental controls		X	X	X	X	X
Material management (i.e. storage of plant / equipment, materials)		X	X	X	X	X
Survey		X	X		X	X
Construction / Investigation Activities						
Construction of portal pad	A-2	X		X	X	X
Tests pits	A-3		X	X	X	
Boreholes	A-4		X	X	X	
Geophysics	A-5		X		X	
Stockpiling (temporary)	A-6	X	X	X	X	X
General earthworks	A-7	X	X	X	X	X
Road realignment construction	A-8			X	X	
Installation of new / upgrade existing access tracks	A-9			X	X	
Installation of temporary water infrastructure	A-10			X	X	X
Construction of staging pad	A-11	X	X			X
Construction of civil construction compound	A-12				X	X



Queensland Hydro

GDA2020 MGA Zone 56

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LEGEND

- Watercourses
- Local Roads
- Tracks
- Lake Borumba (FSL 135.01m AHD)

Exploratory Works Project

- Project Area

Project Footprint by Work Area

- Area 3 - Other Activities
- Area 4 - Other Activities

Project Component - Underground

- Area 3 - Exploratory Tunnel Options

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional

OVERVIEW
Queensland



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Exploratory Works Project
Preliminary Documentation

EXPLORATORY TUNNELS OVERVIEW (AREA 3 - WALKERS TOP AND AREA 4 - BORGAN)

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FIGURE A-1

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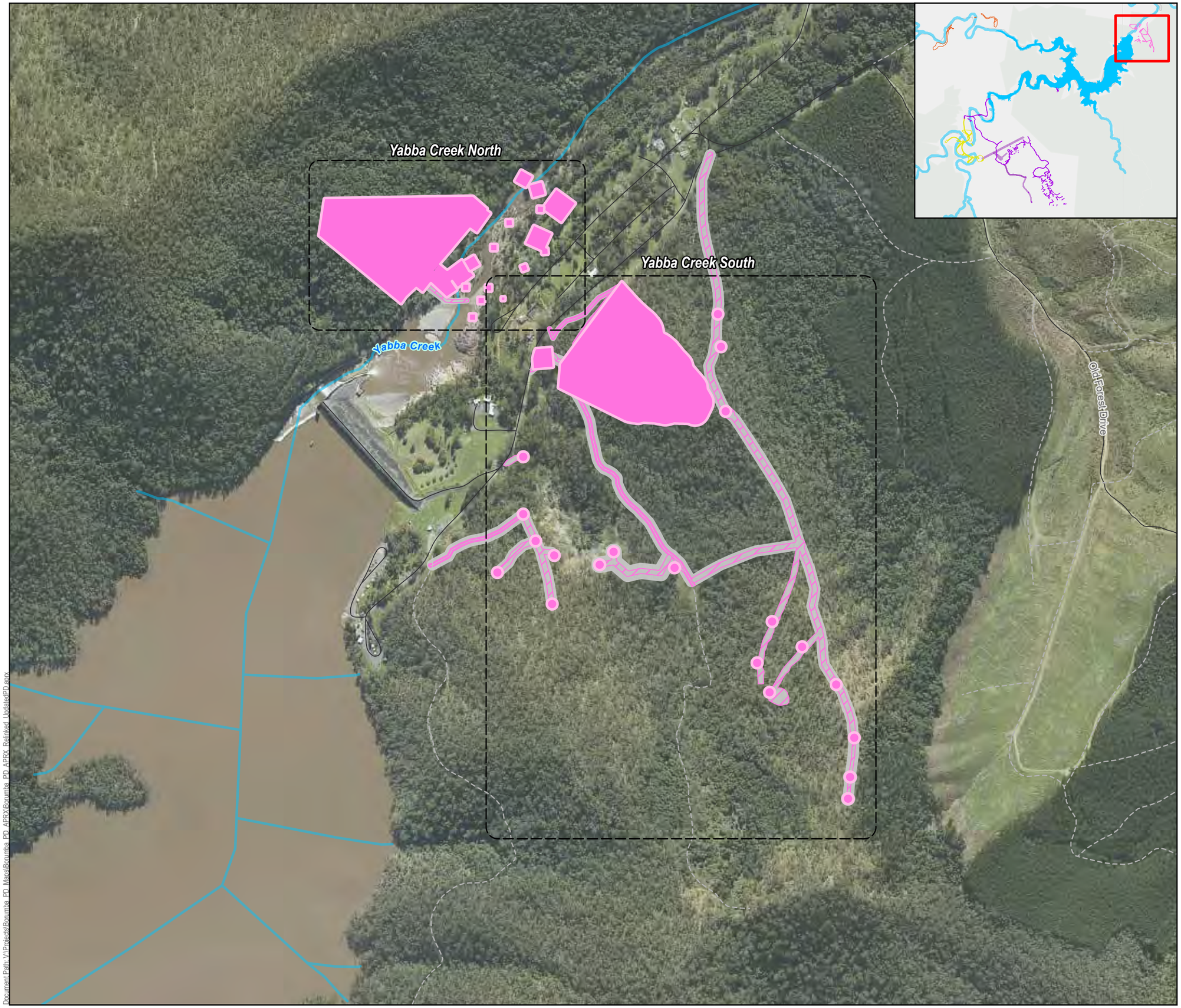

Queensland Hydro

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LEGEND

- Watercourses
- Local Roads
- Tracks

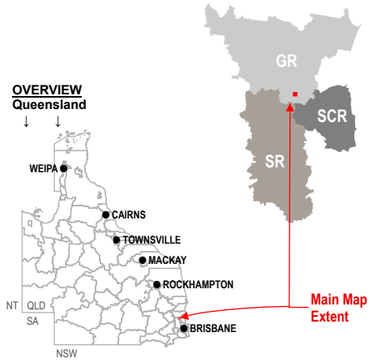
Exploratory Works Project

- Project Area

Project Footprint by Work Area

- Area 1 - Geotechnical Investigations
- Area 1 - Other Activities

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



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Exploratory Works Project
Preliminary Documentation

ANTICIPATED GEOTECHNICAL INVESTIGATION SITES IN AREA 1 (BORUMBA DAM)

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FIGURE A-2a

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LEGEND

- Watercourses
- Local Roads
- Tracks

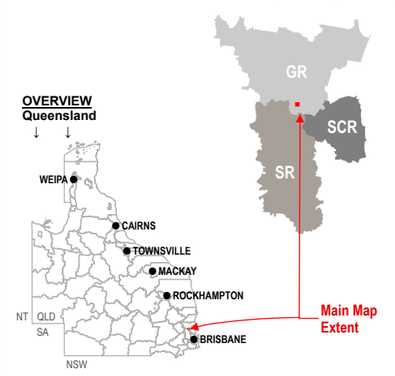
Exploratory Works Project

- Project Area

Project Footprint by Work Area

- Area 2 - Geotechnical Investigations
- Area 2 - Other Activities

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



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Exploratory Works Project
Preliminary Documentation

ANTICIPATED GEOTECHNICAL INVESTIGATION SITES IN AREA 2 (KINGAHAM CREEK)

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FIGURE A-2b

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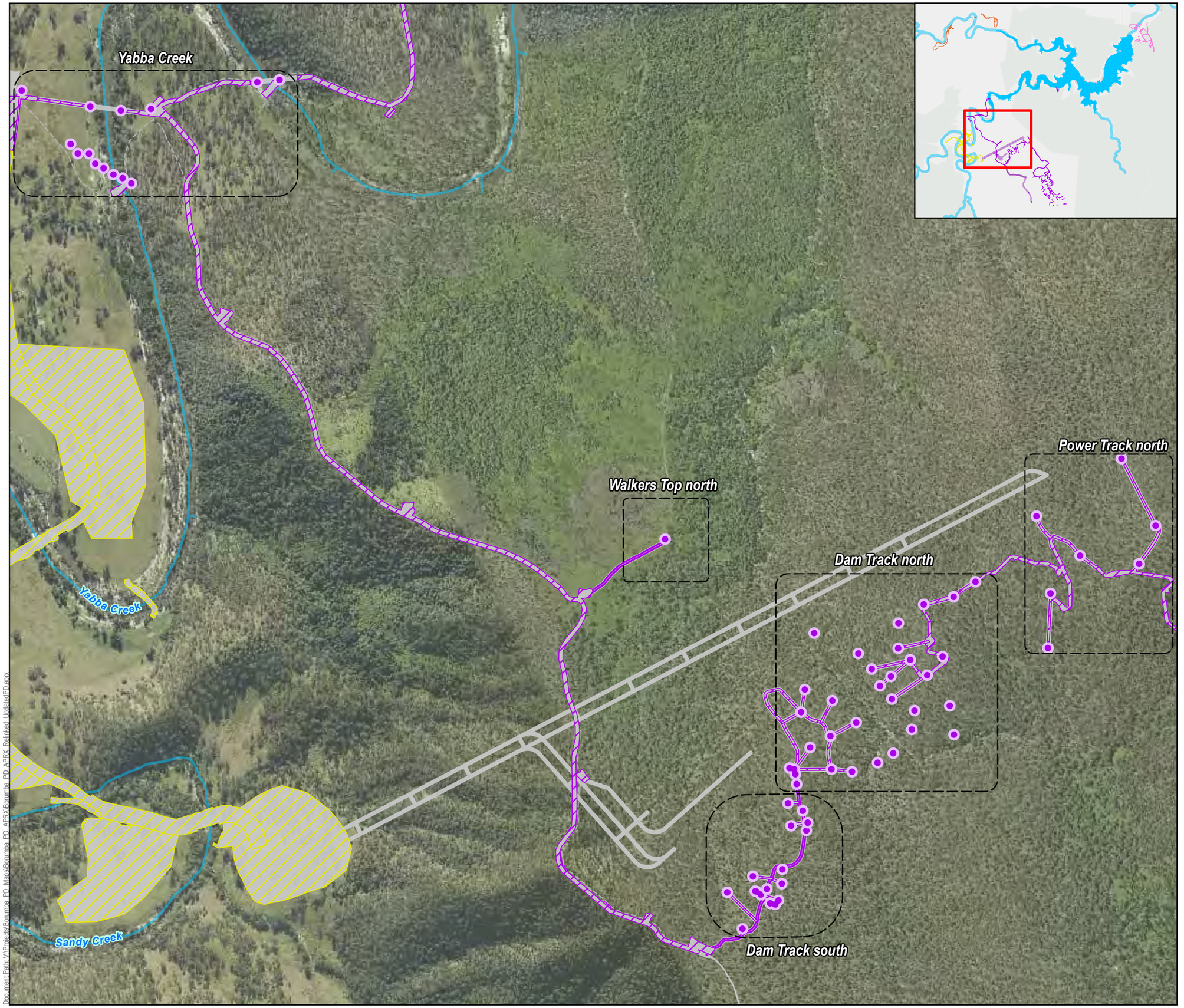

Queensland Hydro

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LEGEND

- Watercourses
- Tracks

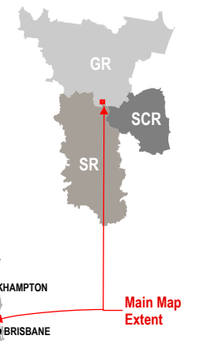
Exploratory Works Project

- Project Area

Project Footprint by Work Area

- Area 3 - Geotechnical Investigations
- Area 3 - Other Activities
- Area 4 - Other Activities

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland

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Exploratory Works Project
Preliminary Documentation

ANTICIPATED GEOTECHNICAL INVESTIGATION SITES IN AREA 3 (WALKERS TOP)

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FIGURE A-2c

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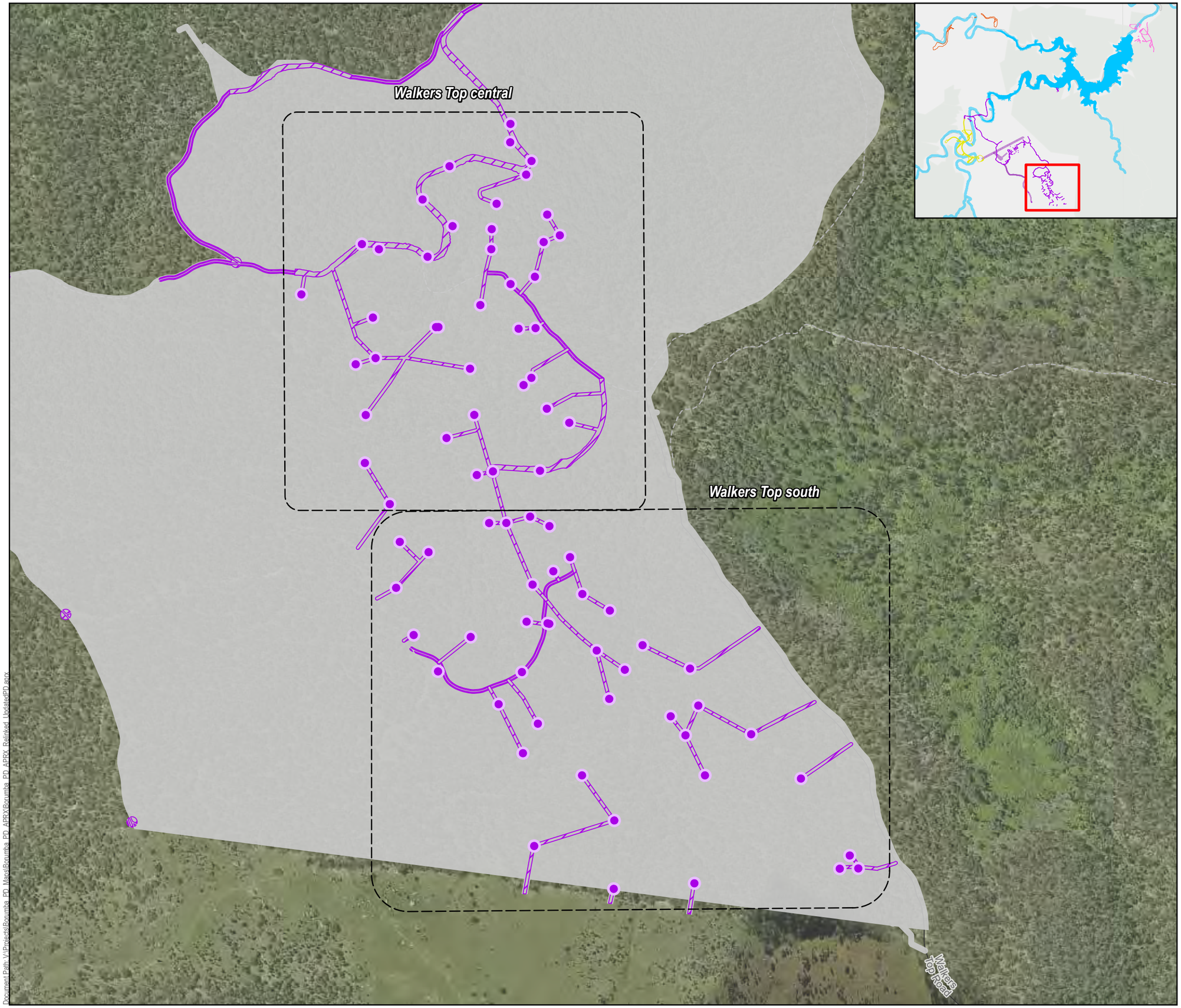

Queensland Hydro

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LEGEND

Local Roads

Tracks

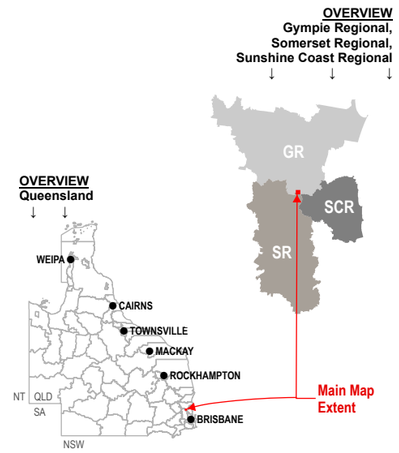
Exploratory Works Project

Project Area

Project Footprint by Work Area

Area 3 - Geotechnical Investigations

Area 3 - Other Activities



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Exploratory Works Project
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ANTICIPATED GEOTECHNICAL INVESTIGATION SITES IN AREA 3 (WALKERS TOP)

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FIGURE A-2d

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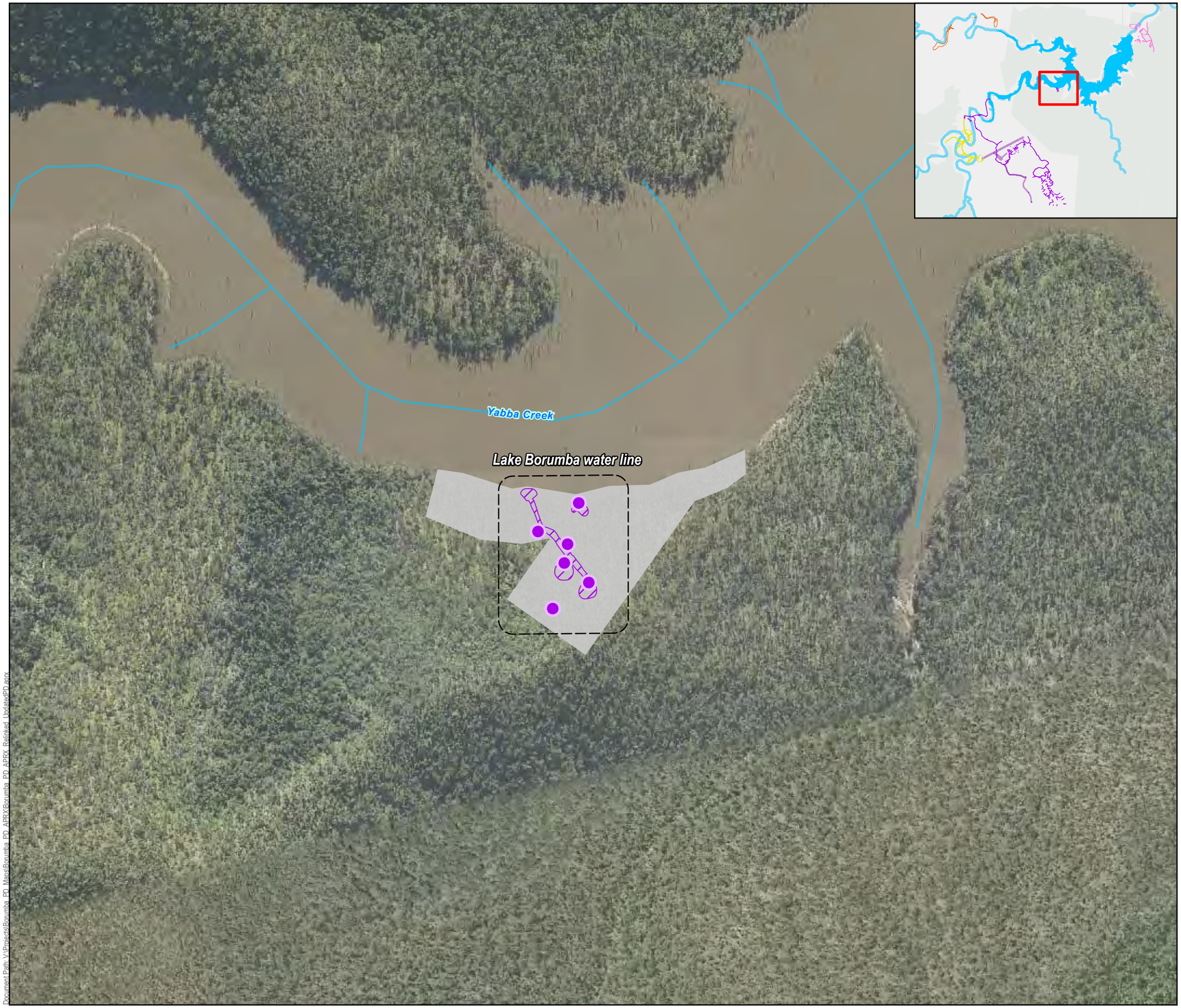

Queensland Hydro

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LEGEND

Watercourses

Exploratory Works Project

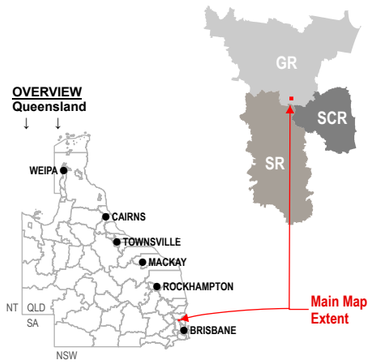
Project Area

Project Footprint by Work Area

Area 3 - Geotechnical Investigations

Area 3 - Other Activities

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



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Exploratory Works Project
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ANTICIPATED GEOTECHNICAL INVESTIGATION SITES IN AREA 3 (WALKERS TOP)

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FIGURE A-2e

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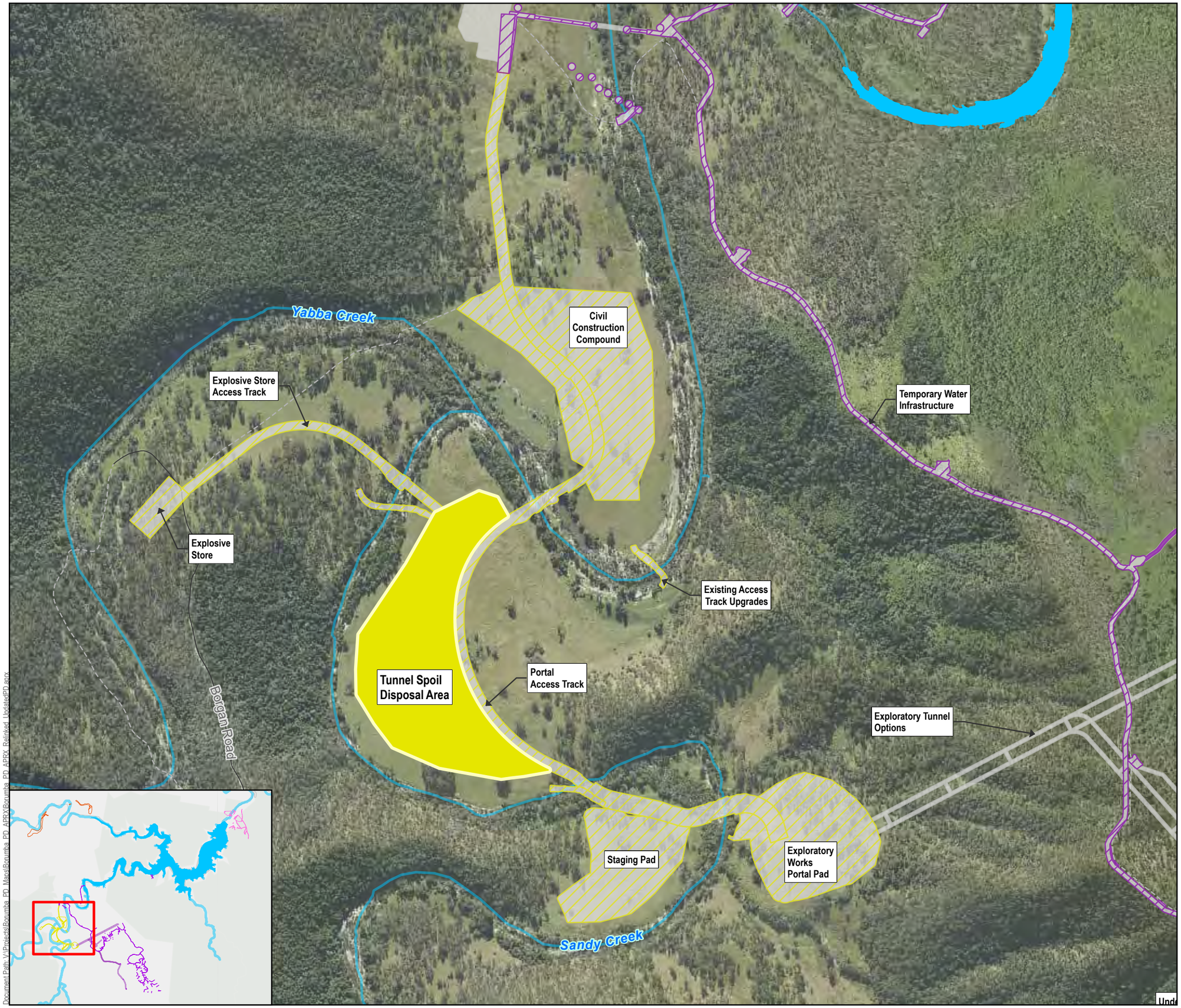

Queensland Hydro

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LEGEND

- Watercourses
- Local Roads
- Tracks
- Lake Borumba (FSL 135.01m AHD)

Exploratory Works Project

- Project Area

Project Footprint by Work Area

- Area 3 - Other Activities
- Area 4 - Tunnel Spoil Disposal Area
- Area 4 - Other Activities

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland



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Exploratory Works Project
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TUNNEL SPOIL DISPOSAL AREA (AREA 4 - BORGAN)

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LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE A-3

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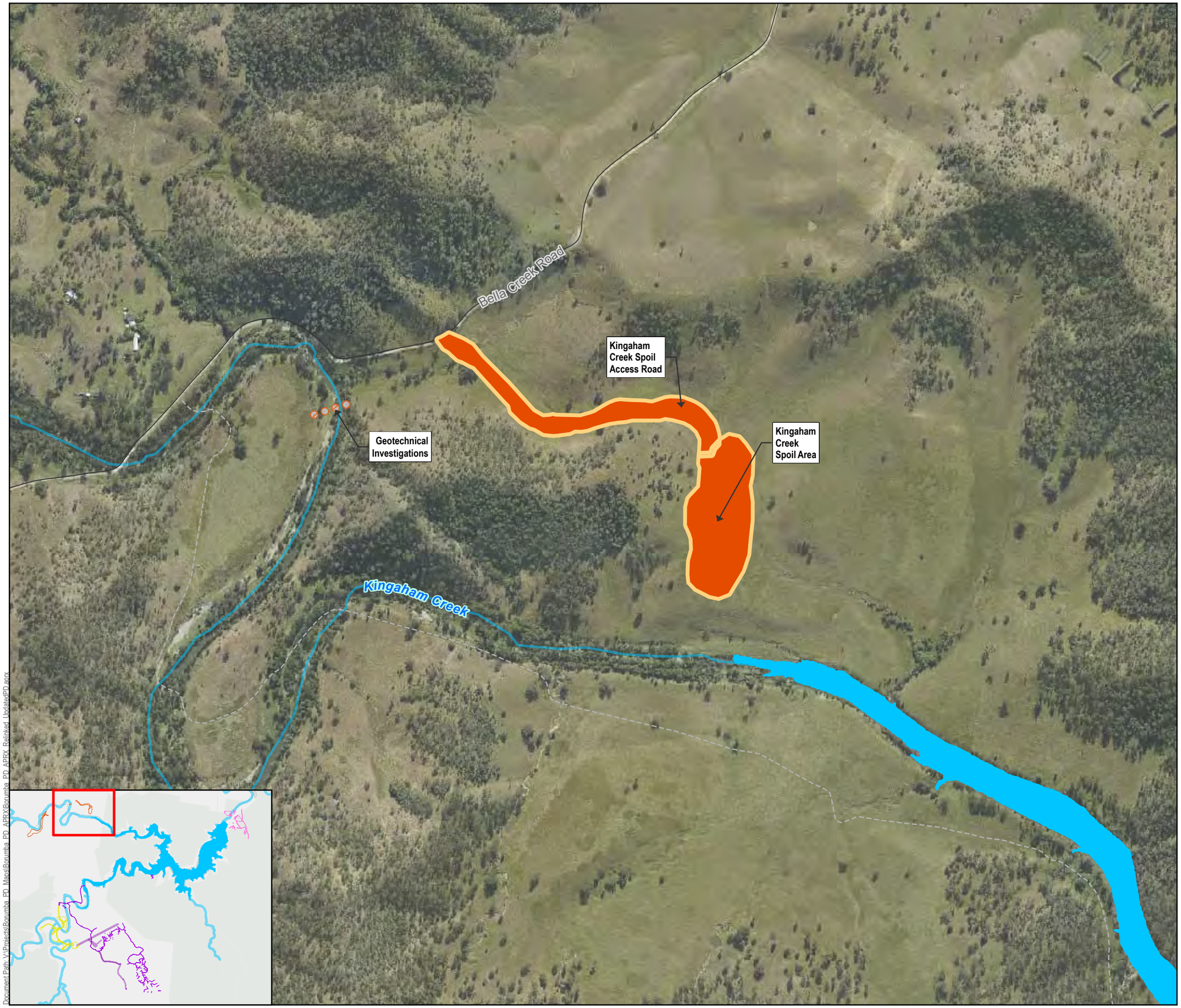

Queensland Hydro

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LEGEND

- Watercourses
- Local Roads
- Tracks
- Lake Borumba (FSL 135.01m AHD)

Exploratory Works Project

- Project Area

Project Footprint by Work Area

- Area 2 - Kingaham Creek Spoil Area and Access Road
- Area 2 - Other Activities

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland



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Exploratory Works Project
Preliminary Documentation

KINGAHAM SPOIL DISPOSAL AREA (AREA 2 - KINGAHAM CREEK)

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LAST MODIFIED:	NC17428, 1/10/2025
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FIGURE A-4

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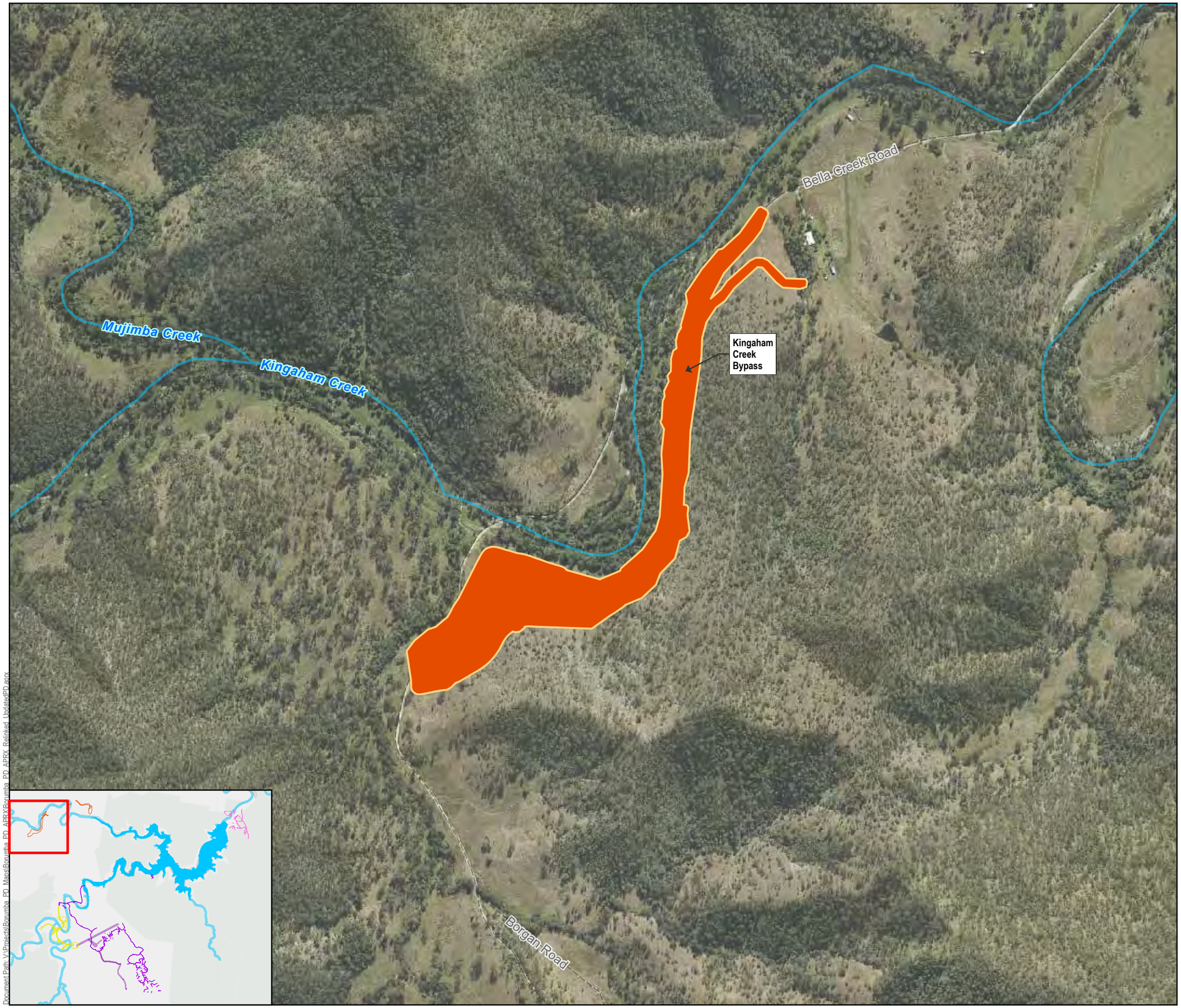

Queensland Hydro

GDA2020 MGA Zone 56

0 100 200 m

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LEGEND

- Watercourses
- Local Roads
- Tracks

Exploratory Works Project

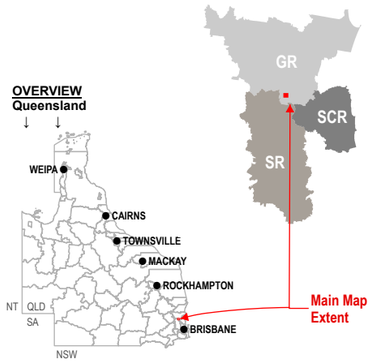
Project Footprint by Work Area

- Area 2 - Kingaham Creek Bypass

Project Area by Work Area

- Area 2 - Kingaham Creek Bypass

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland

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Exploratory Works Project
Preliminary Documentation

KINGAHAM CREEK BYPASS (AREA 2 - KINGAHAM CREEK)

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REVISION:	A

FIGURE A-5

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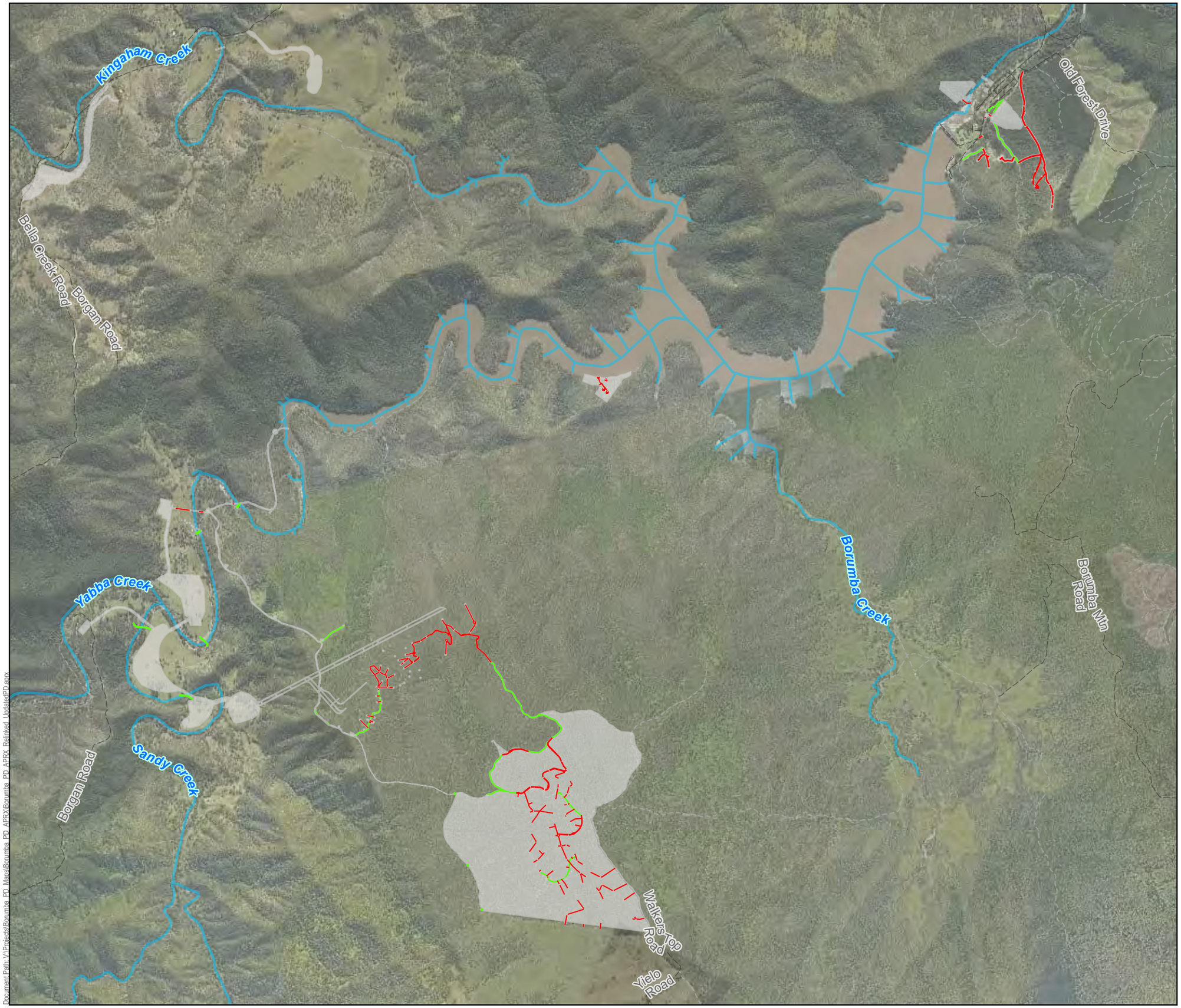

Queensland Hydro

GDA2020 MGA Zone 56

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LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads

Exploratory Works Project

- Project Area

Project Footprint – Access Tracks

- Existing Tracks Upgrades
- New Access Tracks

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland



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Exploratory Works Project
Preliminary Documentation

INDICATIVE ACCESS TRACKS OVERVIEW

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE A-6a

Document Path: V:\Projects\Boumba_PD_Maps\Boumba_PD_APRX\Boumba_PD_APRX_Relinked_UpdatedPD.aprx



Queensland Hydro

GDA2020 MGA Zone 56

N

0 30 60 90 100 200 m

1:5,000 (when printed @ A3)

LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads

Exploratory Works Project

Project Footprint by Work Area

- Area 1 - Existing Tracks to be Upgraded
- Area 1 - New Tracks
- Area 1 - Other Activity

Project Area by Work Area

- Area 1 - Borumba Dam

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland



Data Sources:
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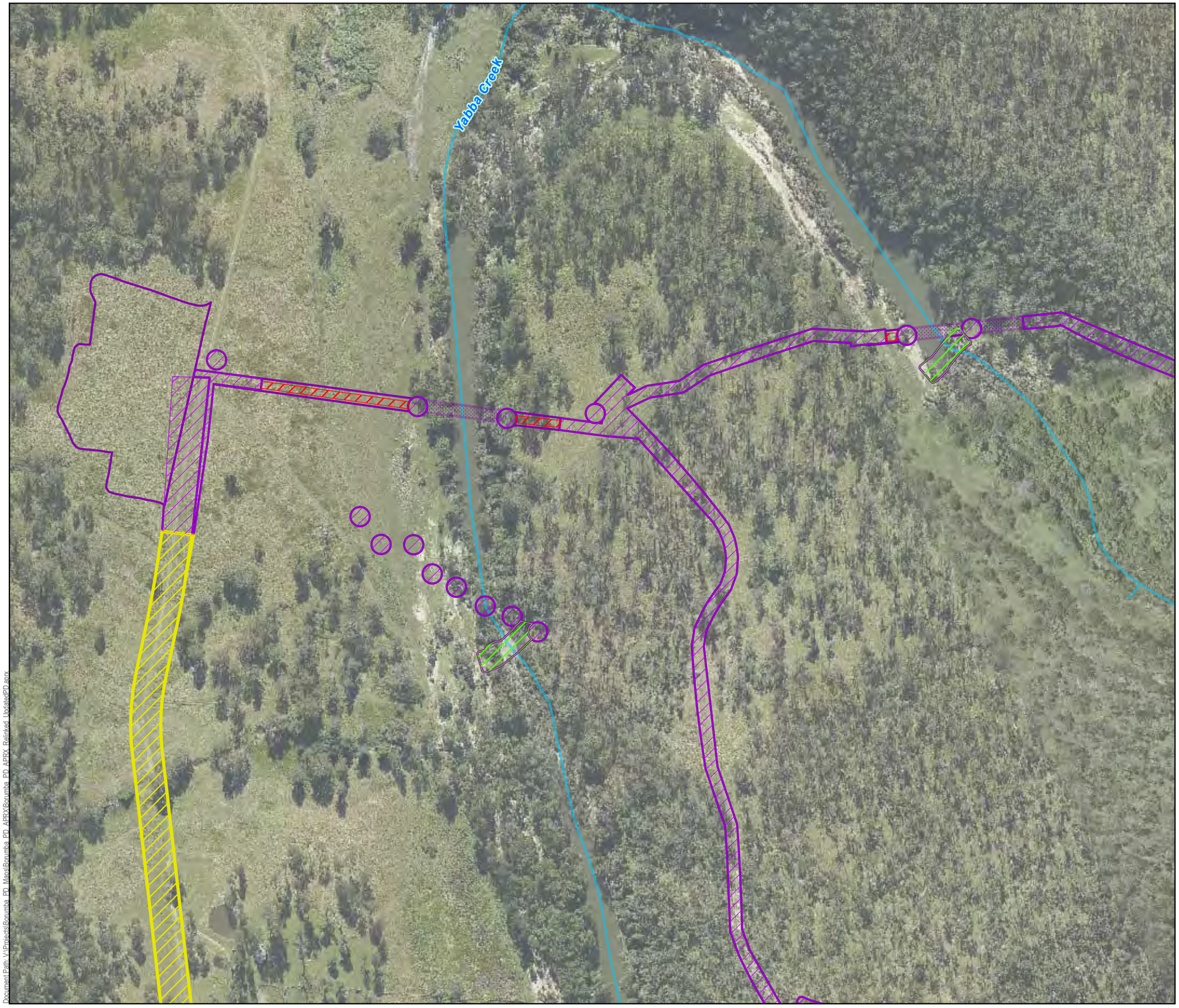
Exploratory Works Project
Preliminary Documentation

INDICATIVE ACCESS TRACKS AREA 1 - BORUMBA DAM

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE A-6b

Document Path: V:\Projects\Borumba_PD_Mans\Borumba_PD_APRX\Borumba_PD_APRX_Relinked_UpdatedPD.aprx



Queensland Hydro

GDA2020 MGA Zone 56

N

0 20 40 60 80 100 m

1:3,000 (when printed @ A3)

LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads

Exploratory Works Project

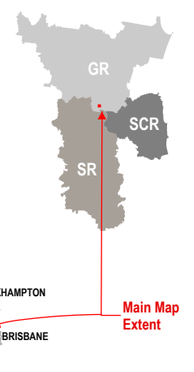
Project Footprint by Work Area

- Area 3 - Existing Tracks to be Upgraded
- Area 3 - New Tracks
- Area 3 - Other Activity
- Area 4 - Other Activity

Project Area by Work Area

- Area 3 - Walkers Top
- Area 3 - Walkers Top (Underground)
- Area 4 - Borgan

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland

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Exploratory Works Project
Preliminary Documentation

INDICATIVE ACCESS TRACKS AREA 3 - WALKERS TOP (YABBA CREEK)

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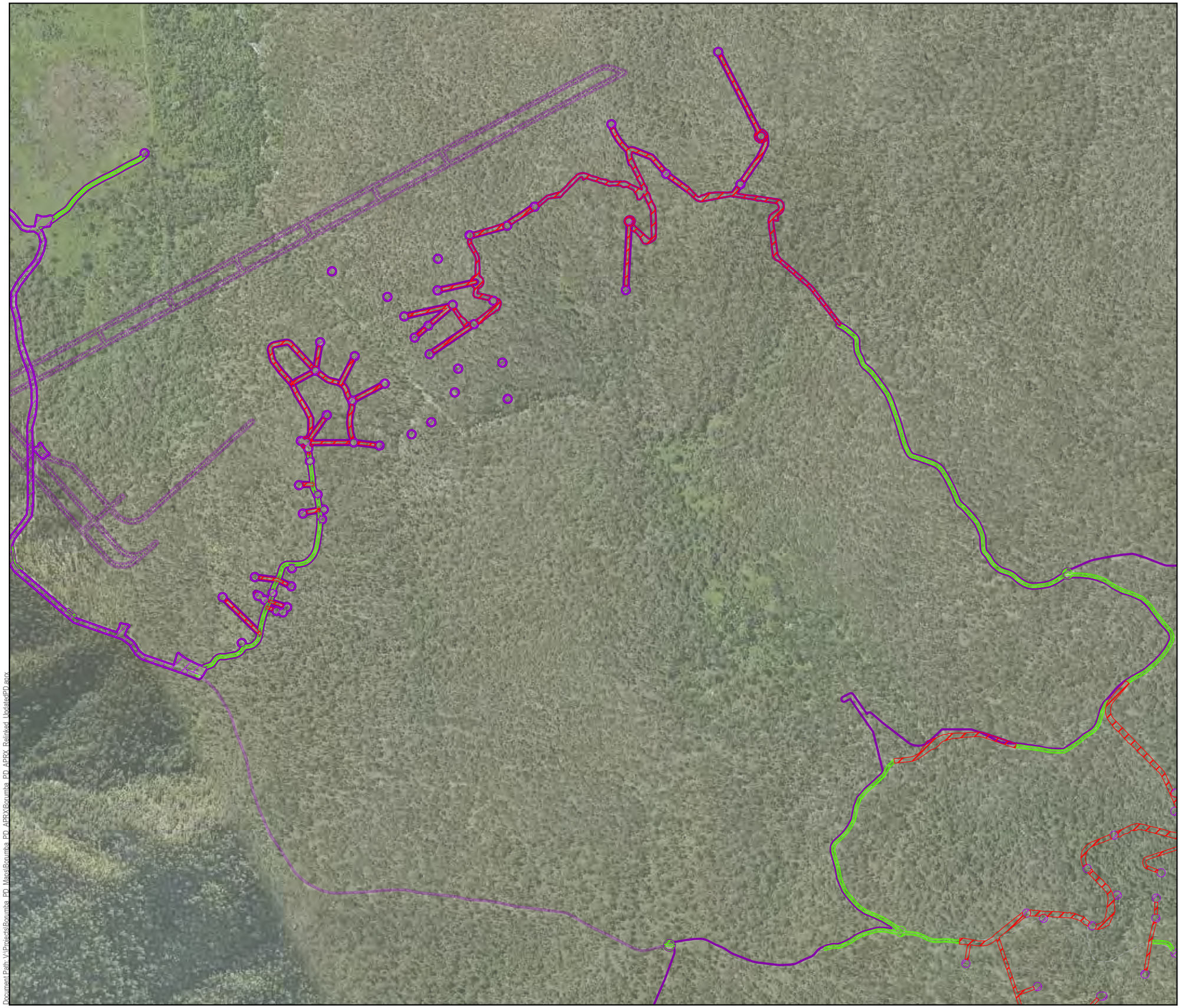
CREATED BY:	BM
LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE A-6c

Document Path: V:\Projects\Boumba PD_Mans\Boumba PD_APRX\Boumba_PD_APRX_Relinked_Updated\PD.aprx



Queensland Hydro

GDA2020 MGA Zone 56

0 50 100 200 200 300 m

1:7,000 (when printed @ A3)

LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads

Exploratory Works Project

Project Footprint by Work Area

- Area 3 - Existing Tracks to be Upgraded
- Area 3 - New Tracks
- Area 3 - Other Activity

Project Area by Work Area

- Area 3 - Walkers Top
- Area 3 - Walkers Top (Underground)

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland



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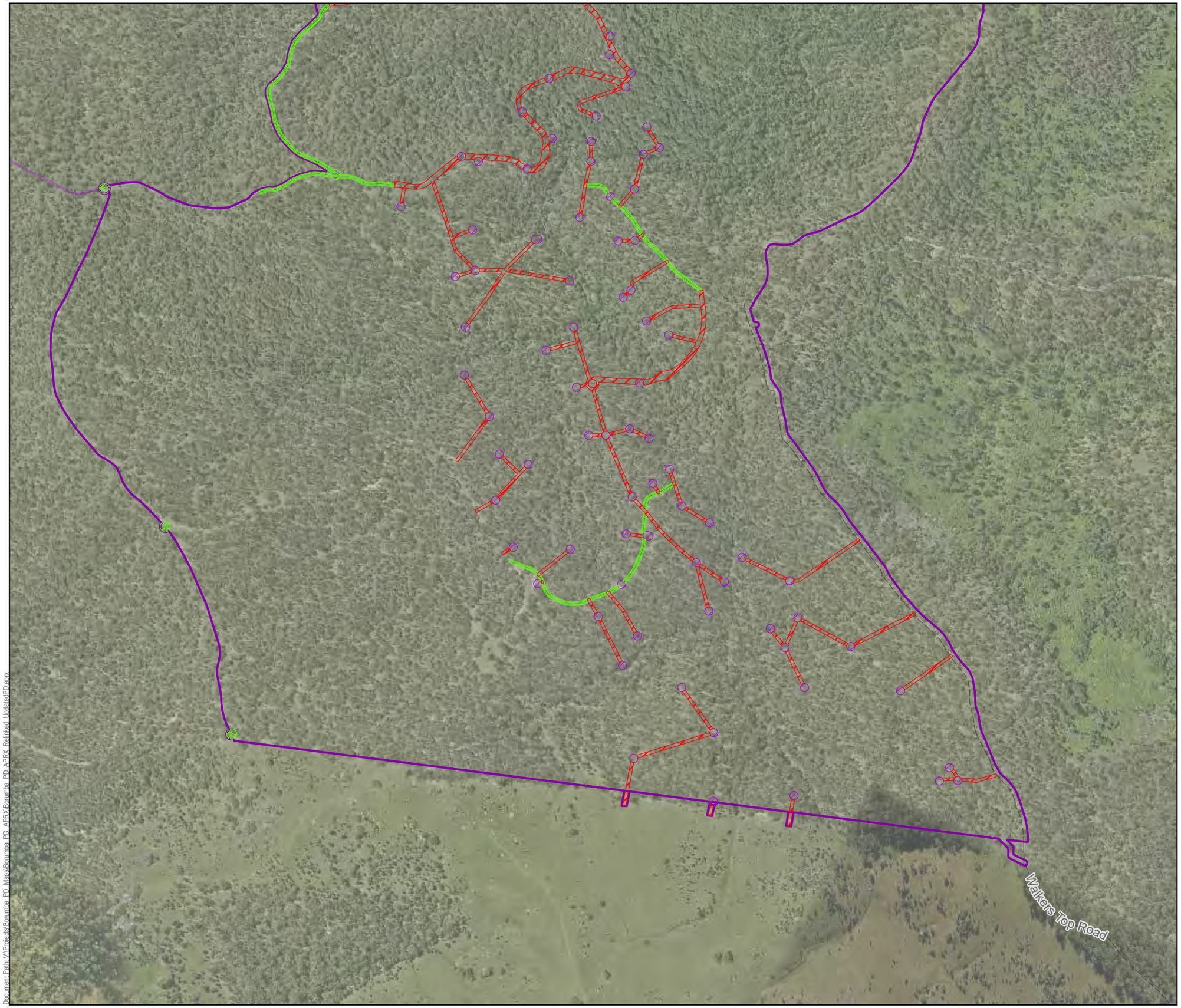
Exploratory Works Project
Preliminary Documentation

INDICATIVE ACCESS TRACKS AREA 3 - WALKERS TOP (NORTH)

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE A-6d

Document Path: V:\Projects\Boumbia_PD_Mapsl\Boumbia_PD_APRX\Boumbia_PD_APRX_Relinked_UpdatedPD.aprx



Queensland Hydro

GDA2020 MGA Zone 56

N

0 50 100 200 200 300 m

1:7,000 (when printed @ A3)

LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads

Exploratory Works Project

Project Footprint by Work Area

- Area 3 - Existing Tracks to be Upgraded
- Area 3 - New Tracks
- Area 3 - Other Activity

Project Area by Work Area

- Area 3 - Walkers Top
- Area 3 - Walkers Top (Underground)

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland



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Exploratory Works Project
Preliminary Documentation

INDICATIVE ACCESS TRACKS AREA 3 - WALKERS TOP (SOUTH)

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE A-6e

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Queensland Hydro

GDA2020 MGA Zone 56

N

0 20 40 60 80 100 m

1:3,000 (when printed @ A3)

LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads

Exploratory Works Project

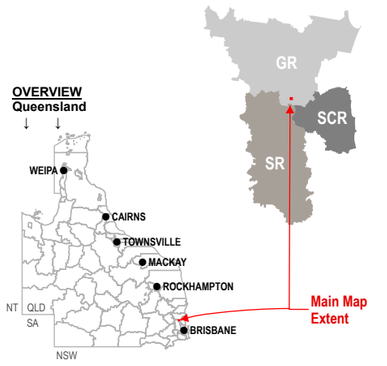
Project Footprint by Work Area

- Area 3 - New Tracks
- Area 3 - Other Activity

Project Area by Work Area

- Area 3 - Walkers Top

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



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2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
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Exploratory Works Project
Preliminary Documentation

INDICATIVE ACCESS TRACKS AREA 3 - WALKERS TOP (LAKE BORUMBA WATER LINE)

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE A-6f

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Queensland Hydro

GDA2020 MGA Zone 56

0 20 40 60 80 100 m

1:3,000 (when printed @ A3)

LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads

Exploratory Works Project

Project Footprint by Work Area

- Area 4 - Existing Tracks to be Upgraded
- Area 4 - Other Activity

Project Area by Work Area

- Area 4 - Borgan

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland



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Exploratory Works Project
Preliminary Documentation

INDICATIVE ACCESS TRACKS
AREA 4 - BORGAN

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE A-6g

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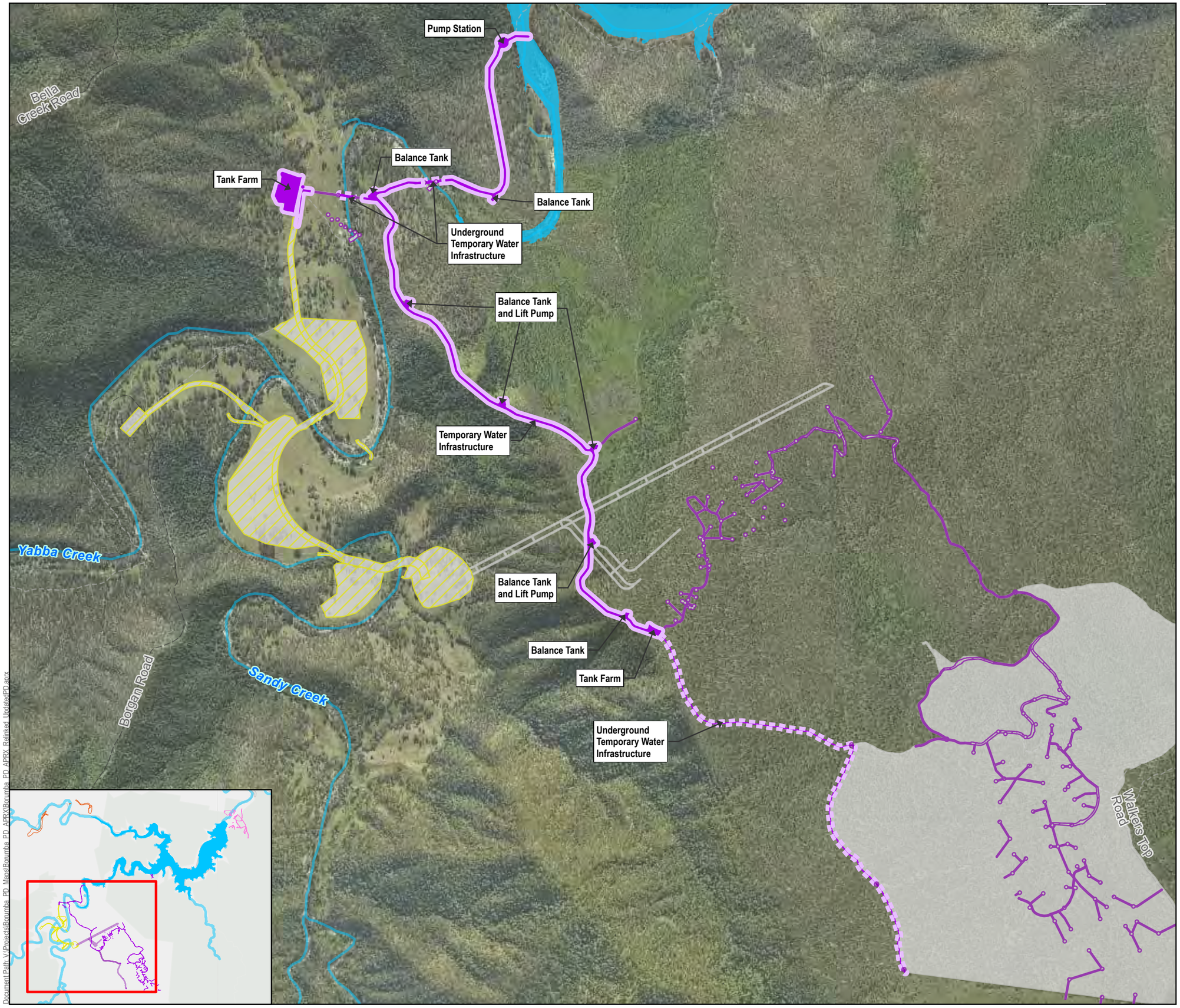

Document Path: V:\Projects\Borumba_PD_Maps\Borumba_PD_APRX\Borumba_PD_APRX_Relinked_Updated\PD.aprx

Queensland Hydro

GDA2020 MGA Zone 56

N

0 200 400 m

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LEGEND

- Watercourses
- Local Roads
- Tracks
- Lake Borumba (FSL 135.01m AHD)

Exploratory Works Project

- Project Area

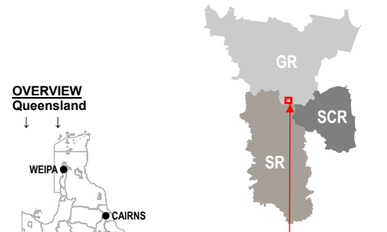
Project Footprint by Work Area

- Area 3 - Temporary Water Infrastructure
- Area 3 - Other Activities
- Area 4 - Other Activities

Project Component - Underground

- Area 3 - Temporary Water Infrastructure

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland



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Exploratory Works Project
Preliminary Documentation

TEMPORARY WATER INFRASTRUCTURE (AREA 3 - WALKERS TOP)

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE A-7

A-1 General tasks

GENERAL

Description

Activities that will generally be required for all tasks across the Exploratory Works Project.

Sub-Activities

- Mobilisation and demobilisation to and from site
- Site establishment (i.e. establishment of fencing, facilities and lighting (including utilities)
- Establishment of environmental controls
- Material management (i.e. storage of plant, equipment and materials)
- Survey

Plant and Equipment

- Flatbeds
- Trucks (i.e. bogies, concrete, water, fuel etc)
- Light vehicles
- Hand tools
- Forklift / telehandler
- Bobcat
- Excavator
- Survey equipment

Impacted Lots / Parcel

- 1723L37994
- 16LX1925
- 132LX2385
- 1LX2754
- 3LX2754
- 20LX2359
- 64LX2110
- 1RP194600 (in part, noting that some activities on this lot, which are not shown in this variation request, remain excluded from the controlled action)
- 135FTY1911 (Imbil Sate Forest)
- 3AP2765 (Conondale Resources Reserve)
- 6AP2765 (Conondale Resources Reserve)
- Yabba Creek, Kingaham Creek, Sandy Creek (watercourse)
- Borgan Road, Bella Creek Road (road)

Refer to Figure 1 for the general location of all tasks required as part of the Exploratory Works.

Key Risks

- Spread of weed and pest species (i.e. contaminated plant / equipment mobilising to site / spreading pest species during stockpiling / movement of spoil)
- Material management (i.e. segregation of materials etc.)
- Spills (i.e. leaks, refuelling / maintenance activities or sewage)
- Erosion and sediment transport
- Engagement of suitably qualified contractors

Note*:* A detailed 'Risk Assessment' and the relevant 'Mitigation Measures' associated with environmental aspects impacted by this activity are shown in Appendix B – Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

A-2 Construction and Operation of the Portal Pad

PORTAL PAD

Description

The creation of a suitable work pad is required to enable the exploratory tunnel to commence. This space is required at the entrance of the exploratory tunnel portal for:

- heavy plant and equipment park up
- raw water supply and compressed air infrastructure
- temporary stockpile of excavated material, if not directly removed by truck
- temporary water storage pond and water treatment and filtration equipment
- sediment basin
- a generator with fuel storage
- ventilation equipment.

The portal pad will be sized to support the tunnel and blasting activities and will comprise of a 100 m x 120 m flat pad, not including the temporary water storage area or sediment basin. However, as the pad is in steep terrain, the disturbance footprint (encompassing the cut batters) will be larger than the final pad size. The total disturbance area will be approximately 5.9 ha. This includes an allowance of 40 m x 40 m for the temporary water storage pond located adjacent to the portal pad. The portal pad has a 50 m setback distance from the nearest watercourse (Sandy Creek), except where an allowance has been made for access to the creek from the portal pad.

Maintenance facilities and other supporting activities are expected to be situated at the staging pad due to the limited space available at the portal pad.

The portal pad will be constructed primarily in cut using standard earthmoving equipment. The total area suitable for the portal pad has been optimised based on engineering design development related to the portal face. As geotechnical information is received, the design will be further refined and area associated with the portal face modified to best suit the infrastructure.

Topsoil will be stripped and stored in a stockpile at the tunnel spoil disposal area. Overburden material (other than rock) will be dug by excavator and loaded into dump trucks (either articulated dump trucks or rigid body trucks) for removal. Weathered rock will be ripped by dozer while non-rippable rock will be loosened by drill-and-blast methods before being excavated and removed. Excavated material will be used in the construction of the staging pad (refer to description of the staging pad below) and potentially other areas of the Exploratory Works Project depending on the materials suitability.

As the excavation for the portal pad increases in depth, the near-to-vertical face where the tunnel entrances (portals) are to be located will be supported by a grid of shotcrete and rock bolts. Compacted gravel will be placed on the surface of the portal pad to provide all weather access. Once completed, the portal pad will have a supported rock face and portal established that will be fit for purpose for the exploratory tunnel.

A catch drain will be constructed at the high side of the portal excavation to capture runoff water and divert it around the portal pad. Erosion and sediment controls will be installed on the low side of the pad to control sediment and water from the pad.

An Evaporation Basin and an Evaporator System will be established at the spoil stockpile site north of the Explosive Magazine Road. The basin will be fully lined to ensure compliance with environmental standards.

A temporary water storage pond will provide approximately 5 megalitres (ML) of water storage directly adjacent to the portals. This is intended to be used for the day-to-day management of water requirements associated with the drill and blast tunnelling operations.

Water management infrastructure is proposed to be located across the portal pad and staging pad, with water from the exploratory tunnel excavation initially directed to a basin at the portal pad. Water will then be transferred to a water treatment plant for treatment to meet the required standard for the proposed reuse or release to the environment. Excess water (i.e. not required for reuse) will be treated to an appropriate standard for release to the environment from the portal pad area.

The water treatment plant will be capable of treating water to the required standards (e.g. reverse osmosis treatment plant) and have a capacity of approximately 100 L/s to allow for typical inflow fluctuations.

PORTAL PAD

Sub-Activities

- Vegetation clearing and grubbing
- Excavation
- Sample collection and analysis
- Water treatment
- Backfill and compaction (where necessary)
- Geotechnical investigations

Plant and Equipment

- Generator
- Pumps
- Bulldozer
- Hand tools
- Trucks (i.e. articulated, bogies)
- Excavators
- Drill machine (i.e. to establish blast holes and for retention work (rock anchors))
- Backhoe
- Dynamic cone penetrometer (DCP)

Impacted Lots / Parcel

- 1723L37994
- 16LX1925

Refer to Figure A-1 for the general location of the portal pad required as part of the Exploratory Works

Key Risks

- Identification / presence of contaminated materials
- Stockpiling of materials (appropriate segregation where required)
- Erosion and sediment transport
- Smothering of native vegetation during stockpiling activities
- Spread of weed and pest species (i.e. contaminated plant / equipment mobilising to site / spreading pest species during stockpiling / movement of spoil)

Note*:* A detailed 'Risk Assessment' and the relevant 'Mitigation Measures' associated with environmental aspects impacted by this activity are shown in Appendix B – Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

A-3 Test pits

TEST PITS

Description

Test pits will be established to investigate near surface geological conditions, particularly soil and rock composition, strength, weathering and excitability. Typically, test pits will be located along existing access tracks or new access tracks constructed as part of the borehole drilling works.

The disturbance footprint of the test pits will include an approximately 1 m wide by 4-5 m long test pit, where the topsoil will physically be removed. Some benching to maintain safety excavation entry practices may expand the width of some test pits up to 3 m. Where possible, the excavated material will be stockpiled on the access track to avoid additional disturbance. The stockpile area would be approximately 5 m x 5 m. The surface underneath the stockpile will be disturbed during the backfill operation (material would be scooped up from the surface). If the excavator or backhoe cannot be parked on the access track, an additional disturbance footprint of approximately 3 m x 6 m may be required. The typical maximum disturbance area for all activities associated with establishing a single test pit is 58 m^2. Parking will preferentially be in an area that does not require clearing, but vegetation trimming may be necessary to ensure safe access.

It is anticipated that test pits will be excavated using a tracked excavator or rubber-tyred backhoe fitted with a standard, general purpose toothed bucket. A ripping tyne attachment may be required where rock or hard strata is encountered. Test pits will be excavated to refusal, limit of practical excavator reach, significant water ingress, or collapse of the excavation walls. Each excavator will complete one test pit before shifting to the next. It is assumed that each test pit will take approximately 3 hours to complete, including backfilling of the pit.

The depth of excavation will generally be restricted to 3 m to 5 m depending on the type and size of the plant used for excavation. The excavated material will be placed adjacent to the excavation, as long as it does not compromise the stability of the excavation, with rough separation of stockpiles based on the depth of removal. Any topsoil layers (if present) will be kept separate to allow this material to be placed at surface to encourage vegetation regrowth.

DCP testing will be undertaken adjacent to each test pit to aid in assessment of the consistency and relative density of the subsurface materials. DCP testing will be conducted to a maximum probable depth of 3 m, or to prior refusal.

Test pits will be backfilled as soon as possible in compacted layers, with the excavated spoil placed in reverse order to match the in-situ strata as best as practicable.

Sub-Activities

- Vegetation clearing and grubbing
- Excavation
- Sample collection and analysis
- Backfill and compaction (where necessary)

Plant and Equipment

- 5t – 10t excavator
- Backhoe

Impacted Lots / Parcel

- 16LX1925
- 132LX2385
- 1LX2754
- 64LX2110
- 1723L37994
- 3LX2754
- 135FTY1911 (Imbil Sate Forest)
- 3AP2765 (Conondale Resources Reserve)
- 6AP2765 (Conondale Resources Reserve)

TEST PITS

- Bella Creek Road (road)

Key Risks

- Identification / presence of contaminated materials
- Stockpiling of materials (appropriate segregation where required)
- Erosion and sediment transport
- Smothering of native vegetation during stockpiling activities
- Spread of weed and pest species (i.e. contaminated plant / equipment mobilising to site / spreading pest species during stockpiling / movement of spoil)

Note*:* A detailed 'Risk Assessment' and the relevant 'Mitigation Measures' associated with environmental aspects impacted by this activity are shown in Appendix B– Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

A-4 Boreholes

BOREHOLES

Description

Geotechnical boreholes will be used investigate subsurface geological and geotechnical conditions and to develop an appropriate ground model. The ground model will include geological, geotechnical and groundwater information and will be used to inform the design of the Main Works. The total number of boreholes required is dependent on the results from initial drilling.

Boreholes will be classified into four main categories based on the available access and terrain at the drill location. These categories are identified below:

- On track
- Off track – flat / near flat
- Off track – moderate slope
- Off track – steeply sloped.

The geotechnical boreholes will be drilled with either track mounted or truck mounted drilling rigs, depending on the individual borehole requirements and specific site constraints. Use of all-terrain vehicles (ATV) or other vehicles that require a smaller disturbance footprint is also being considered for drilling at some locations. Drilling in soils is done by using a V-bit or tungsten-carbide (TC)-bit auger or rotary drilling method.

Each borehole will require a drill pad (up to 16 m in diameter) or a level working platform. These may be located on an existing access track, in previously cleared or modified areas, or in vegetated areas. In the first instance, the preference is to locate drill pads on access tracks or in areas that do not require clearing (i.e. where there are no trees). However, due to the limited road and track network on site, boreholes will be required in areas off existing tracks.

The size and type of drill pad will be subject to ground conditions (in particular the terrain). Ground surface levelling is generally required to achieve suitable gradients for a drill rig. Vegetation clearing will also be required where drill pads extend outside an existing track or a borehole is in a vegetated area. Construction of safety bunds will be required where equipment is in proximity to slopes, or where there is a plant/personnel interface.

Within the drill site, different levels of ground disturbance may be required, ranging from grass or vegetation slashing, temporary placement of vehicles, water tanks or other stationary equipment on grass/vegetation to scraping or removal of vegetation and the construction of access pads and tracks using compacted gravel material.

Sub-Activities

- Vegetation clearing and grubbing
- General earthworks
- Boring
- Sample collection and analysis
- Backfill and compaction (where necessary)

Plant and Equipment

- Bore machine (truck mounted or on tracks)
- 5t – 10t excavator
- Compactor (i.e. roller)
- Truck (i.e. water or vacuum)
- Dynamic cone penetrometer

Impacted Lots / Parcel

- 16LX1925
- 132LX2385
- 3LX2754
- 1LX2754
- 1723L37994
- 64LX2110
- 135FTY1911 (Imbil Sate Forest)
- 3AP2765 (Conondale Resources Reserve)
- 6AP2765 (Conondale Resources Reserve)

BOREHOLES
• Yabba Creek, Kingaham Creek, Sandy Creek (watercourses) Refer to Figure A-2 for the general locations of boreholes required as part of the Exploratory Works
Key Risks • Erosion and sediment transport • Generation of wastewater from groundwater intrusion • Identification of contaminated water / spoil • Spread of weed and pest species (i.e. contaminated plant / equipment mobilising to site / spreading pest species during stockpiling / movement of spoil)

Note*:* A detailed 'Risk Assessment' and the relevant 'Mitigation Measures' associated with environmental aspects impacted by this activity are shown in Appendix B– Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

A-5 Geophysics

GEOPHYSICS

Description

Geophysical surveys may be used in areas with challenging terrain to assess subsurface properties in a way that minimises environmental impact. The techniques involve the use of portable equipment and non-invasive probing, suitable for sensitive areas and are highly adaptable.

Geophysical survey lines are commonly used to map the depth to bedrock and inform material properties of the subsurface materials. Survey lines include but are not limited to the use of seismic and electromagnetic energy sources. On land, the survey line is developed using geophones installed in an array along a predefined profile. The geophones are inserted into the ground by a few centimetres (similar to a tent peg) and record the response from the energy source. The array typically comprises a cable with connected geophones (nominally spaced every 2-5 m, with a spike that is approximately 10 cm long and up to 2 cm in diameter), laptop and tools to read the response (e.g. a seismograph for seismic surveys), and the energy signal source. This method does not involve significant disturbance or excavation of the ground beyond placement of the apparatus. The energy source is typically in the form of a sledgehammer, with a sound exposure level of approximately 110 db at distance of 1 m. Similarly geophysical surveys can be completed over water, using an airgun as the energy source (70 db output confined to area approximately 10 m from source).

Geophysical surveys involve pushing the geophones into the existing surface soil profile at regular and evenly spaced intervals (based on the cable spacing). Generally, a small area of bare earth will be cleared at each geophone location (approximately 0.3 m x 0.3 m). Surveys are then conducted by generating energy into the ground. For example, for a seismic survey is conducted by generating a series of seismic events, produced by an acoustic source, which are commonly in 20 second bursts. Acoustic energy is imparted to the subsurface by means of a sledgehammer striking a metal plate (approximately 1 m x 1 m x 0.02 m). The test may be conducted by moving the source location along the geophone array, and some additional clearing may be required at each source location to ensure an uninterrupted contact between the steel plate and surface level. Seismic lines can typically be orientated to avoid established shrubs and trees, as well as other site features.

Geophysical surveys are adopted to provide information on the subsurface where intrusive investigation is not possible (i.e. due to terrain) or to gap fill between intrusive investigations. Best results are provided when there are some intrusive investigations to provide data calibration, otherwise the results are indicative only and prone to misinterpretation.

Sub-Activities

- Vegetation clearing and grubbing
- General earthworks
- Installation of geophones

Plant and Equipment

- 5t – 10t excavator
- Seismic survey equipment
- Hand tools

Impacted Lots / Parcel

- 16LX1925
- 132LX2385
- 3LX2754
- 1LX2754
- 1723L37994
- 64LX2110135FTY1911 (Imbil Sate Forest)
- 3AP2765 (Conondale Resources Reserve)
- 6AP2765 (Conondale Resources Reserve)
- Yabba Creek, Kingaham Creek, Sandy Creek (watercourses)

GEOPHYSICS

Key Risks

- Impact to vegetation
- Impact to items of cultural / Indigenous heritage
- Spread of weed and pest species (i.e. contaminated plant / equipment mobilising to site / spreading pest species during stockpiling / movement of spoil)

Note*:* A detailed 'Risk Assessment' and the relevant 'Mitigation Measures' associated with environmental aspects impacted by this activity are shown in Appendix B– Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

A-6 Stockpiling (temporary)

STOCKPILING

Description

Spoil and material generated from activities such as test pits, directional drilling, tunnelling and vegetation clearing will be transported and stockpiled in designated areas. The sites will be stabilised and rehabilitated in accordance with any approval conditions and the rehabilitation strategy for the area.

General activities within these sites will include the unloading, segregation and storage of material. Excavators, dozers and water carts will be used to process and manage materials. Due to the nature of tunnelling and directional drilling activities, it is anticipated that some material will be transported in a muck or slurry state. The disposal site will have bunded areas which will allow this material to dry out prior to stockpiling the material.

Two spoil disposal areas are proposed; the tunnel spoil disposal area for stockpiling of approximately 395,000 m^3 of excavated material from tunnel drilling, and the Kingaham spoil disposal area for the disposal of approximately 95,000 m^3 of material generated from the Kingaham Creek bypass.

The tunnel spoil disposal area is of sufficient size to allow for material to be segregated for contamination testing before being placed in the stockpiles. The proposed design of the stockpile is to a height of 5 m, with a maximum height of 7 m possible with appropriate management measures (e.g. stabilisation, water management). While not expected, a maximum height of 7 m would allow the tunnel spoil area to accommodate up to 160,000 m^3 of additional excess spoil if required. The spoil stockpile has been designed to allow a 50 m buffer to the riparian zone of Yabba Creek and Sandy Creek.

Sizing for the tunnel spoil disposal area also allows for water management (e.g. sediment basins, water treatment) and vehicle washdown and hardstand areas.

Sizing for the Kingaham spoil disposal area also allows for water management (e.g. sediment basins, water treatment) and vehicle washdown and hardstand areas. The current design of the Kingaham spoil disposal stockpile is to a height of 5 m, with a maximum height of 7 m possible with appropriate management measures (e.g. stabilisation, water management). If needed, a further 200,000 m^3 can be placed in this area, as the design footprint is larger than is currently required and the height of the area can be adjusted.

Sub-Activities

- Geotechnical investigations
- Vegetation clearing and grubbing
- Spoil / material management
- Water management (sediment basins, water treatment)
- Vehicle washdown and hardstand areas

Plant and Equipment

- 20 – 30t excavator
- Dozer
- Truck (i.e. bogies, water carts etc.)

Impacted Lots / Parcel

- 1723L37994
- 1RP98849

Refer to Figure A-3 and Figure A-4 for the general location of temporary stockpiles required as part of the Exploratory Works.

Key Risks

- Identification / presence of contaminated materials
- Stockpiling of materials (appropriate segregation where required)
- Erosion and sediment transport
- Spread of weed and pest species (i.e. contaminated plant / equipment mobilising to site / spreading pest species during stockpiling / movement of spoil)

Note*:* A detailed 'Risk Assessment' and the relevant 'Mitigation Measures' associated with environmental aspects impacted by this activity are shown in Appendix B– Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

A-7 Explosive store

Explosive store

Description

The explosive store will store explosive materials used for the exploratory tunnel drill-and-blast operations.

The explosive store will be 130 m x 60 m, including a fire break, and is positioned to meet relevant Australian Standards and legislative compliance requirements for safety. The infrastructure requirements for the explosive store will be confirmed by the tunnelling contractor.

The earthworks, including ground preparation and levelling works, for the explosive store pad and access track will be undertaken prior to the storage facilities being constructed on the pad. The facilities will comprise one or more lockable sheds with nominally 1.8 m fauna exclusion fencing around the perimeter.

Sub-Activities

- Geotechnical investigations
- Vegetation clearing and grubbing
- Topsoil stripping
- Ground surface treatment
- Excavation
- Backfill and compaction (where necessary)

Plant and Equipment

- 10t – 30t excavator
- Backhoe
- Compactor (i.e. rollers, plate compactor)

Impacted Lots / Parcel

- 3LX2754

Refer to Figure 1 for the location of the explosive store and access track.

Key Risks

- Identification / presence of contaminated materials
- Stockpiling of materials (appropriate segregation where required)
- Erosion and sediment transport
- Smothering of native vegetation during stockpiling activities
- Removal of vegetation
- Spread of weed and pest species (i.e. contaminated plant / equipment mobilising to site / spreading pest species during stockpiling / movement of spoil)

Note*:* A detailed 'Risk Assessment' and the relevant 'Mitigation Measures' associated with environmental aspects impacted by this activity are shown in Appendix B– Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

A-8 Road Realignment

ROAD REALIGNMENT

Description

The proposed realignment of an approximately 1.4 km long section of Bella Creek Road will result in a change in land use. It will be dual lane, have a minimum running width of 7 m and be designed to meet relevant Austroads standards. Geotechnical works, which do not form part of the action, are currently proposed to confirm the construction methodology and the alignment, with excess material to be stockpiled on cleared land for future use on the lot.

The realignment will impact on existing freehold land, with the new section of road to be dedicated as a road under the *Land Act 1994* (Qld) and form part of the local road network managed by the local road authority (i.e., Gympie Regional Council).

No homes or significant private infrastructure are currently identified as being impacted by the road realignment for the Exploratory Works Project. In addition, no significant public infrastructure is currently identified as being directly impacted by the Exploratory Works Project.

The construction of the Kingaham Creek bypass will be predominately in cut material. Controlled blasting will be used in rocky areas as needed. Material will be stockpiled at the Kingaham spoil disposal area. Erosion control measures, including silt fences and coir logs, will be implemented as needed to minimise sediment transport.

Bulk earthworks will be carried out using suitable machinery based on the findings from site geotechnical bore investigations. Drainage systems will be installed to manage water flow and prevent erosion, utilising ditches and culverts to collect surface runoff. The road subgrade will be prepared through compaction to achieve the required density, with stabilisation techniques applied as necessary based on the outcomes of the geotechnical investigations.

Road design will include an aggregate base which will be compacted to create a stable foundation for the pavement, with quality control measures in place to ensure compliance with specifications. The road surface will then be constructed using asphalt or concrete, in accordance with the detailed road design, Austroads road design guidelines and Australian Standards.

Additional supporting infrastructure, such as retaining walls for slope stability, will be determined if required based on the results of the geotechnical investigations. Road safety features, including guardrails and signage, will be installed according to Austroads road design guidelines. Finally, road batter slopes will be revegetated as required to enhance stability and prevent erosion.

Sub-Activities

- Vegetation clearing and grubbing
- Excavation (i.e. cut and fill)
- General earthworks
- Paving

Plant and Equipment

- 5t – 10t excavator
- Trucks (i.e. bogies, water)
- Compactor (i.e. roller, plate compacter etc)

Impacted Lots / Parcel

- 64LX2110

Refer to Figure A-5 for the general locations of road realignment works required as part of the Exploratory Works

Key Risks

- Stockpiling of materials (appropriate segregation where required)
- Clearing of vegetation
- Erosion and sediment transport
- Smothering of native vegetation during stockpiling activities
- Spread of weed and pest species (i.e. contaminated plant / equipment mobilising to site / spreading pest species during stockpiling / movement of spoil)

Note*:* A detailed ‘Risk Assessment’ and the relevant ‘Mitigation Measures’ associated with environmental aspects impacted by this activity are shown in Appendix B– Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

A-9 Access tracks (new and upgrades to existing)

ACCESS TRACK (NEW AND UPGRADE TO EXISTING)

Description

Existing tracks will be upgraded to ensure they are suitable for the current and future operational requirements. Where feasible to do so, existing track alignments will be maintained.

Where existing tracks do not meet operational requirements or no tracks exists, new tracks will be constructed and maintained to meet operational requirements.

In many instances, only minor work that does not affect vegetation will be required to improve the useability and grade of existing tracks for project construction traffic (e.g., re-surfacing). However, some existing track sections require more intensive works (e.g., widening) to allow for their use as part of the Exploratory Works Project.

The requirements for new access tracks to geotechnical investigation sites will depend on the borehole category, as follows:

- Off track (flat/near flat) – The access track will follow the shortest and straightest possible route to the investigation site, within the existing constraints (e.g. terrain, vegetation, ground conditions). Where possible, the track will be formed by only trimming grass to create a clear access route. If this is not possible (e.g. due to softer ground), vegetation and topsoil will be removed and the surface assessed further. It will then be left as is if the surface can sustain minor traffic or covered with a layer of compacted gravel material. Environmental controls will be implemented along the track.
- Off track (moderate slope) – To meet safety requirements, these tracks will likely require cutting into the slopes, removal of topsoil material, and placement and compaction of gravel material. Small culverts or gabion baskets will be installed in gullies to prevent damage to the track during heavy rain events. If the track cannot be constructed within the requirements of typical vehicles, tracked equipment may be used to access the borehole. Environmental controls will be implemented along the access track.
- Off track (steeply sloped) – Safe access is a primary consideration in steeply sloped areas. Tracked equipment is expected to be at or beyond their limit in these areas, so alternative methods such as sled/rail, rope, staircases, or scaffolding access. Sled/rail access is proposed for most steep geotechnical investigation sites.

The typical design criteria for the proposed new standard access tracks are:

- 4 m wide single traffic lane
- 6 m cleared width (traffic lane +1 m each side)
- maximum vertical grade of 25%
- gravel sheeting 4 m wide x 250 mm thick where vertical grade of the track alignment is 10% to 25%, or in areas found to be slippery when wet
- un-sheeted (natural ground) where the vertical grade of the track alignment is 0% (flat) to 10% grade.

Sub-Activities

- Vegetation clearing and grubbing
- Excavation (i.e. cut and fill)
- Importation and exportation of material

Plant and Equipment

- 5t – 30t excavator
- Compactor (i.e. roller or plate compactor)
- Grader
- Trucks (i.e. bogies, asphalt, concrete, water)

Impacted Lots / Parcel

- 1723L37994
- 16LX1925
- 132LX2385
- 3LX2754
- 1LX2754
- 1RP98849
- 1RP194600

ACCESS TRACK (NEW AND UPGRADE TO EXISTING)

- 135FTY1911 (Imbil State Forest)
- Yabba Creek, Sandy Creek (watercourse)

Refer to Figure A-6 for the general locations of access track construction and upgrades required as part of the Exploratory Works

Key Risks

- Identification / presence of contaminated materials
- Stockpiling of materials (appropriate segregation where required)
- Erosion and sediment transport
- Removal of vegetation
- Smothering of native vegetation during stockpiling activities
- Spread of weed and pest species (i.e. contaminated plant / equipment mobilising to site / spreading pest species during stockpiling / movement of spoil)
- Disturbance of adjacent sensitive receptors including National Park, State Forest and residential dwellings

Note*:* A detailed 'Risk Assessment' and the relevant 'Mitigation Measures' associated with environmental aspects impacted by this activity are shown in Appendix B– Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

A-10 Temporary water infrastructure

TEMPORARY WATER INFRASTRUCTURE

Description

Water is required for the exploratory tunnel and geotechnical drilling, civil construction works, and site facilities. Potable water for site facilities will be brought in by truck. Water for drilling and construction works does not need to be potable, with untreated (raw water) suitable for:

- operation of drilling rigs associated with the geotechnical borehole drilling
- operation of drilling rigs associated with the exploratory tunnelling
- dust suppression and materials moisture conditioning associated with the surface civil earthworks (roads and tracks).

Raw water will be sourced from Lake Borumba and/or groundwater ingress during the exploratory tunnelling. Water sourced from Lake Borumba will be supplied via temporary water infrastructure that includes pumps, pipelines, and storage tanks. It is proposed that the water pipeline will be predominately buried with some sections above ground around tank farms and at pump stations. The pipeline is designed to largely follow existing tracks from the upper section of Lake Borumba, then west to Borgan Road and south along Walkers Top Road. The water pipeline may also be extended to the portal pad and water management infrastructure within the footprint of the proposed portal access track.

The pipeline is expected to be approximately 300 mm in diameter. It will be shallow buried (approximately 400 mm cover to the ground surface, 600 mm cover under trafficked areas) to prevent ‘snaking’ of the pipeline from expansion and contraction due to temperature changes and protect the pipeline in the event of bushfire. The proposed design includes burying the pipeline beside Walkers Top Road from its start to near the intersection with the Dam Track. After the intersection with the Dam Track, where the terrain is flatter, the pipeline will be buried under the centre of Walkers Top Road.

Water may also be sourced from Lake Borumba boat ramp using a water truck or removable pump, or from contingency water bores installed for the Project.

Sub-Activities

- Vegetation clearing and grubbing
- Excavation
- Sample collection and analysis
- Backfill and compaction (where necessary)

Plant and Equipment

- 5t – 10t excavator
- Backhoe
- Dynamic cone penetrometer

Impacted Lots / Parcel

- 3LX2754
- 20LX2359
- 1LX2754
- 16LX1925

Refer to Figure A-7 for the general locations of temporary water infrastructure works required as part of the Exploratory Works.

Key Risks

- Erosion and sediment transport
- Spread of weed and pest species

Note: A detailed ‘Risk Assessment’ and the relevant ‘Mitigation Measures’ associated with environmental aspects impacted by this activity are shown in Appendix B– Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

A-11 Staging pad

STAGING PAD

Description

A staging pad is proposed to be located adjacent to the portal access crossing track, near the portal pad. The staging pad will support underground exploratory tunnelling operation and includes:

- plant and equipment maintenance facilities
- concrete batching plant
- raw materials stockpiles (for concrete production)
- potable water storage
- materials and consumables laydown and storage
- self-contained workforce amenities (office, crib sheds, ablutions)
- generator with fuel storage.

The staging pad will comprise an approximately 150 m x 195 m flat pad plus three water storage tanks (approx. 60 m diameter by 3 m tall, 18 ML volume capacity), in an area that is largely cleared with a setback distance of 50 m from Sandy Creek. The terrain at the pad location is relatively flat, so the disturbance area (encompassing the fill batters) is only slightly larger than the infrastructure footprint (total disturbance area of 4.6 ha).

The pad will be constructed primarily in fill, using excavated material from the portal pad. Topsoil will be stripped and stockpiled at the tunnel spoil disposal area. Material (consisting of rock material, and other than rock material) will be delivered by dump truck (either articulated dump trucks or rigid body trucks), spread by dozer and placed by compactor. Compacted gravel will be placed on the pad to provide all weather access.

A catch drain will be constructed at the high side of the pad to capture and divert runoff around the pad. Erosion and sediment control devices will also be installed around the perimeter of the pad to control sediment and water from the pad. Exposed fill surfaces will be covered (e.g., topsoil and re-grassed).

Sub-Activities

- Geotechnical investigations
- Vegetation clearing and grubbing
- Excavation
- Compaction and retention works
- Water management
- Concrete batching
- Amenities

Plant and Equipment

- Generator
- Excavator
- Bulldozer
- Backhoes
- Compaction and retention equipment

Impacted Lots / Parcel

- 16LX1925
- Borgan Road (road)

Refer to Figure A-1 for the general locations of the staging pad required as part of the exploratory works.

Key Risks

- Identification / presence of contaminated materials
- Stockpiling of materials (appropriate segregation where required)
- Erosion and sediment transport
- Concrete batching management
- Smothering of native vegetation during stockpiling activities
- Spread of weed and pest species (i.e. contaminated plant / equipment mobilising to site / spreading pest species during stockpiling / movement of spoil)

Note*:* A detailed ‘Risk Assessment’ and the relevant ‘Mitigation Measures’ associated with environmental aspects impacted by this activity are shown in Appendix B– Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

A-12 Civil construction compound

CIVIL CONSTRUCTION COMPOUND

Description

A civil construction compound will be installed on lot 3LX2754 (owned by Queensland Hydro), to the north and west of Yabba Creek and between Borgan Road and Walkers Top Road.

The civil construction compound will comprise a flat pad and be located in an area that is largely cleared. The terrain at the pad location is relatively flat so the disturbance area for construction will be only slightly larger than the pad.

Topsoil and vegetation will be stripped and stockpiled at the tunnel spoil disposal area for future use, though it is likely most material will be disposed of in accordance with the *Biosecurity Act 2014* due to the prevalence of giant rat's tail grass (*Sporobolus pyramidalis*) in this area. Fill material will likely be sourced from the construction of the portal pad. Material (consisting of rock and material 'other than rock') will be delivered by dump truck (either articulated dump trucks or rigid body trucks), spread by dozer and placed by compactor. Compacted gravel will be placed to provide all weather access.

A catch drain will be constructed at the high side of the pad to capture and divert runoff around the compound. Erosion and sediment control devices will also be installed around the perimeter to control sediment.

Fencing types that are to be employed are based on the suitability to the surrounding environment and policy requirements. A fauna exclusion fence will be installed around the perimeter of the civil construction compound.

Sub-Activities

- Geotechnical investigations
- Vegetation clearing and grubbing
- Excavation
- Compaction and retention (where necessary)

Plant and Equipment

- Excavator
- Trucks
- Bulldozer
- Backhoe
- Hand tools

Impacted Lots / Parcel

- 3LX2754

Refer to Figure 1 for the general location of civil construction compound required as part of the exploratory works

Key Risks

- Identification / presence of contaminated materials
- Stockpiling of materials (appropriate segregation where required)
- Erosion and sediment transport
- Smothering of native vegetation during stockpiling activities
- Spread of weed and pest species (i.e. contaminated plant / equipment mobilising to site / spreading pest species during stockpiling / movement of spoil)

Note*:* A detailed 'Risk Assessment' and the relevant 'Mitigation Measures' associated with environmental aspects impacted by this activity are shown in Appendix B– Appendix K. The potential impacts (inclusive of risks and mitigation measures) are assessed under the overarching Project Component for this activity.

Appendix B – Indicative unexpected finds procedures

B-1 Contaminated land

The Unexpected Finds Procedure for Contamination must be followed where unexpected contamination or asbestos (or suspected contamination; which may include naturally occurring sources) is excavated or otherwise discovered. In accordance with Environmental Management Measures, this indicative unexpected find procedure has been prepared with consideration of the *Managing contaminated land guideline* (Queensland Government 2024). Details of potentially contaminated areas and management recommendations are outlined in the Spoil Management Plan (Appendix H) and the Waste Management Plan (Appendix I).

B-1-1 Likelihood of contamination

The following indicates the presence of potentially contaminated material; where material is uncovered which displays some or all these characteristics, stop works and notify the Site Supervisor:

- Unusual odour from soils that are not detected in other similar areas.
- Discolouration or staining of soil or rock.
- Seepage of unusual liquids from soil or rock.
- Unusual odours, sheen or colour on groundwater and/or surface water.
- Unexpected underground storage tanks, buried drums or machinery, etc.
- Potential asbestos containing materials.

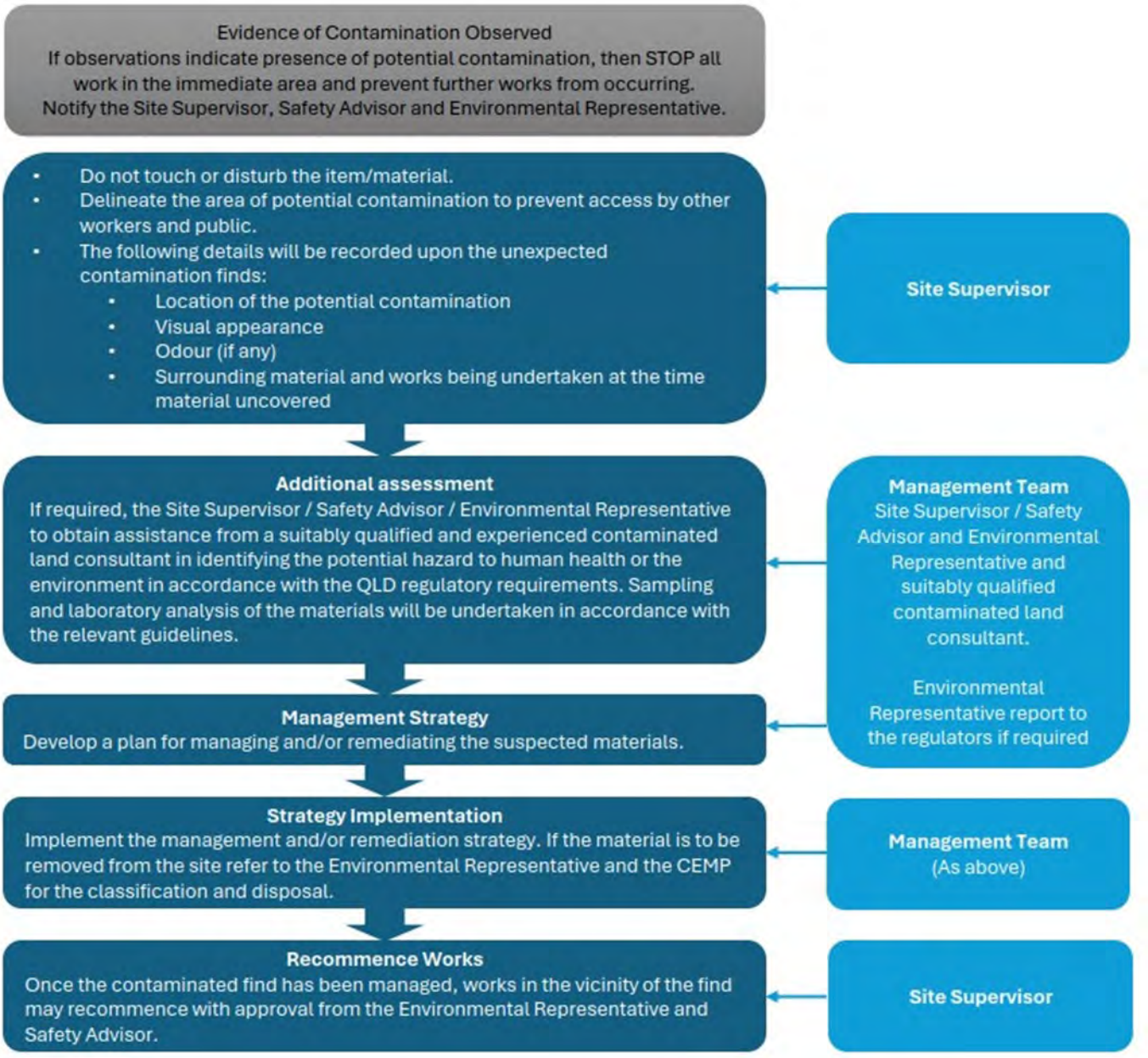
Where these factors are identified, the material is possibly contaminated and the flowchart is to be followed.

B-1-2 Asbestos

An unexpected asbestos find occurs when asbestos containing materials (ACM) are found on site. In the event of an unexpected asbestos find, the required steps include, but may not be limited to, the following along with the flowchart provided below:

- The area is to be demarcated, works in the area to cease and workers warned.
- Notify the safety advisor and contractor's environmental manager.
- Ensure the soil and potential asbestos remain damp with dust suppression or covered where water cannot be accessed.
- Arrange for testing of the suspected ACM and monitoring of the area by approved subcontractors (if required).
- An asbestos removalist is to be engaged to provide recommendations to treat the area, as required.
- A clearance certificate is required from the asbestos removalist to confirm that the area is to be made safe.

The environmental management representative will be consulted prior to any material being removed off-site to ensure it is classified in accordance with the Queensland Government (2017), as amended 2019, Model Operating Conditions, ERA 60 – Waste disposal requirements. Refer to the flow chart for clear steps to follow.



B-1-3 Assessment of unexpected find

The sampling strategy for the characterisation and validation of an ‘unexpected find’ must be prepared by a suitably qualified specialist and in accordance with requirements of the consent and regulatory guidelines. The intent of the sampling is to determine the nature of the substance/material found and whether is it hazardous. It should then be determined if the substance/material exists in concentrations which could cause an unacceptable risk to human health and/or the environment.

B-1-4 Validation sampling of unexpected finds

Validation inspection and possible sampling/analysis is required to be undertaken to demonstrate that unexpected finds have been managed to a standard suitable for the proposed land use. In the event unexpected contaminated material is found, the following sampling schedule outlined in Table B-1 will be followed.

Table B-1: Validation sampling and analytical scheduling

Validation Area	Sampling Frequency	Analytes
Excavations formed by the removal of unexpected finds	Minimum of 1 validation sample per 10 m linear of wall and 1 m depth, minimum of 1 validation sample per 100 m^2 area for the base (10 m grid).	As appropriate, based on the characteristics of the find
Contaminated material requiring disposal offsite	To be determined based on circumstances	TPH/BTEX, PAHs, heavy metals, OCP/PCBs, asbestos and TCLP (if required), or as appropriate based on the characteristics of the find
Residual soils underneath stockpiles where contaminated material has been stored	Minimum of 1 sample per 10 m grid	As appropriate, based on the characteristics of the find

Note: All samples analysed for asbestos validation / re-use purposes will be 500 mL samples in accordance with WA DOH (2009) guidelines and analysed in accordance with AS 4964-2004. Asbestos samples for waste disposal purposes will be 50 g samples.

B-1-5 Remediation or removal from site

Contaminated material must be documented, and the quantities determined. A suitably qualified specialist must advise on the appropriate action to be taken. Any material identified as contaminated must be disposed of in accordance with the EP Act and its associated regulations. A Soil Disposal Permit must be obtained prior to removal of the contaminated material from the Exploratory Works Project.

B-2 Indigenous and cultural heritage

This section outlines the indicative unexpected finds protocol to be applied during Exploratory Works. The unexpected finds protocol should be applied to the discovery of previously unidentified items or objects of Indigenous or archaeological significance found within the project area, in addition to human remains.

The procedures shown below must occur in accordance with the Kabi Kabi and Queensland Hydro Early Works Agreement (EWA); refer to Appendix C.

B-2-1 Cultural heritage, Indigenous or archaeological finds

If any item or object of non-Indigenous, Indigenous or archaeological significance are found, the following steps must be undertaken:

- **STOP WORKS –** immediately cease all works and do not move or disturb the find.
- **NOTIFY –** notify the Project Manager, Kabi Kabi representative, and Department of Women, Aboriginal and Torres Strait Islander Partnerships and Multiculturalism (DWATSIPM) immediately to arrange for representatives to inspect the project site. If human remains are found, the QLD Police must also be notified. Notification of indigenous heritage must be reported to DWATSIPM's Cultural Heritage Unit via email to cultural.heritage@dwatsipm.qld.gov.au or phone 1300 378 401. Notification of any non-indigenous heritage must be by email to Archaeology@detsi.qld.gov.au or phone 13QGOV (13 74 68).
- **MANAGE –** management may involve securing the find by erecting a no-go zone, e.g. a 10 m buffer area around the suspected item or object. An online 'notification of a discovery' form[1] must be completed for discovery of potential historical archaeology under the *Queensland Heritage Act 1992*.
- **ASSESS –** finds must not be moved until they are assessed by a qualified archaeologist. Non-indigenous finds must not be disturbed for 20 business days unless written permission is received sooner.
- **REPORT –** the Environmental Representative or Project Manager will be responsible for completing any reporting requirements.

B-2-2 Human remains

In the event human remains are found, the following steps must be undertaken:

- **STOP WORKS –** immediately cease all works and do not move or disturb the remains.
- **NOTIFY -** notify the Queensland Police on 000 as soon as practicable and provide details of the remains and the location.
- **RECOMMENCEMENT –** works are not to recommence unless authorised in writing by the Kabi Kabi representative, and DWATSIPM.

[1] Notification of a discovery | Environment, land and water | Queensland Government

Appendix C – Cultural Heritage

Kabi Kabi and Queensland Hydro have executed an EWA which outlines the cultural heritage assessment process for the Exploratory Works and will constitute 'another agreement' for the purposes of section 23(3)(a)(iii) of the *Aboriginal Cultural Heritage Act 2003*. Key potential cultural heritage impacts, recommended management actions, and responsibility for undertaking actions have been identified for Exploratory Works as presented in Table C-1. Cultural heritage risk has been assessed through specific cultural heritage documentation.

Table C-1: Summary of impact and control measures for Indigenous cultural heritage

Potential impact or opportunity	Mitigation measure / requirement	Responsibility
GENERAL		
Adverse impact to any known cultural heritage receptors within disturbance footprint	Develop and implement a ground disturbance and access request and approval process to ensure all activities are assessed regarding cultural heritage matters before undertaking works. Provide a process for conditions to be applied to any approval to undertake ground disturbing work. Prepare detailed documentation of any agreed management or mitigation measures in respect of identified cultural heritage which will or may be impacted by the Project.	Project manager, project/site engineer, environmental management representative
Misidentification of cultural heritage values and ongoing cultural heritage strategy	Continue regular meetings with representatives of the Kabi Kabi Peoples Aboriginal Corporation (Kabi Kabi) and advisors to ensure comprehensive provision of information. Involvement of Kabi Kabi representatives in on-ground assessment and/or avoidance surveys for all ground disturbing activities.	Project manager, project/site engineer, environmental management representative
Mismanagement of unexpected finds	Implement an unexpected finds (new discovery) procedure and have this procedure specified in all work packages / ground disturbing activity tasks undertaken by Queensland Hydro personnel or contractors. This will be in accordance with the requirements detailed in the Early Works Agreement. If a new discovery is identified during Exploratory Works, different procedures are required for identified Kabi Kabi representatives and for non-Kabi Kabi representatives. When there are Kabi Kabi representatives present, the Kabi Kabi representatives shall follow their procedures regarding how to manage the new discovery. This may include the following: • at the sole discretion of Kabi Kabi representatives, taking steps to relocate the new discovery to a nearby location away from the required works and confirming to the nominated responsible person that the works can resume • advising that no work can continue in the immediate vicinity of the new discovery, until it is technically assessed and a formal agreement on how to manage the new discovery has been reached • establishing a physical barrier (e.g. tape or flagging) around the location of the new discovery and the site being documented in GIS to inform future planned works • working with Kabi Kabi representatives to agree on how the new discovery will be managed and the implications for the Exploratory Works • the Queensland Hydro cultural heritage team will advise the project delivery team of any new site restrictions or requirements relevant to the new discovery.	Project manager, project/site engineer, environmental management representative

Potential impact or opportunity	Mitigation measure / requirement	Responsibility
	Where the identification of a new discovery or potential new discovery is undertaken by a person who is not a Kabi Kabi representative, the following process shall be followed: • any person working on the Exploratory Works who suspects that an object or feature may have Aboriginal Cultural Heritage significance shall immediately notify the site supervisor or the nominated contractor responsible person of the new discovery • the site supervisor or the nominated contractor responsible person shall immediately instruct and ensure that works cease in the vicinity of the new discovery such that no works can impact the new discovery • the site supervisor or the nominated contractor responsible person will photograph the new discovery and where necessary establish a physical barrier (e.g. tape or flagging) around the location and document in GIS to inform future planned works • the site supervisor or the nominated contractor responsible person will make contact as soon as is reasonably practicable with the Queensland Hydro cultural heritage team to advise on the known details, including location of the new discovery • the Queensland Hydro cultural heritage representative shall contact Kabi Kabi representatives and commence engagement and liaison about the new discovery. No work that could disturb the new discovery shall recommence until the Queensland Hydro cultural heritage representative has provided written advice regarding recommencement.	
PERFORMANCE INDICATORS		
No places or items of cultural heritage significance are disturbed without consultation and approval from the indigenous representatives.		All personnel
MONITORING AND REPORTING		
Monitoring will be undertaken in accordance with all requirements specified by the Kabi Kabi in the EWA and ILUA, or as otherwise agreed.		Cultural heritage team / Kabi Kabi
Daily visual site inspections will monitor disturbance footprints and ensure clearing limits are not being exceeded.		Environmental management representative
Reporting will follow the unexpected finds procedure noted above.		All personnel
TRIGGER FOR CORRECTIVE ACTIONS		
Unplanned disturbance of items or places of cultural heritage significance		Site supervisor
Exceeding the clearing limits / disturbance footprint		Site supervisor
CORRECTIVE ACTIONS		
In the event of a non-conformance occurring, the Kabi Kabi will be notified immediately and the current mitigation and management measures reviewed and amended accordingly.		Cultural heritage team / Kabi Kabi
Any damaged flagging tape or fencing will be repaired to prevent further impacts outside approved disturbance limits.		Site supervisor
Disturbance of any areas outside the dedicated footprint will be reinstated as soon as possible.		Site supervisor

Appendix D – Air Quality

The air quality risks with potential to result from the Exploratory Works Project have been assessed in accordance with the risk assessment methodology outlined in Section 5.1. The outcomes of the assessment are presented in Table D-1 where the overall risk for air quality is rated as low due to the lack of sensitive receptors adjacent to the proposed activities. The air quality risks identified generally relate to all project components as outlined below, though the risk varies depending on the activity and has been specified in Table D-1:

- adverse impact to sensitive receptors (community) surrounding the disturbance footprint, primarily though dust generation during earthworks and vehicle movements
- Adverse impacts to surrounding vegetation through dust deposition
- localised diesel generation from machinery.

A range of environmental requirements and control measures have been identified to ensure that the air quality impacts resulting from the Exploratory works, as identified in Table D-1, are appropriately managed. Safeguards and management measures will be implemented to avoid, minimise or manage impacts to air quality, as detailed in Table D-2. The mitigation measures are generally considered to be applicable to all project components and risks and have therefore been presented in a single summary table. Monitoring requirements and corrective actions relevant to management of flora and fauna are contained in the FFMP in Appendix J.

Table D-1: Air quality risk assessment

Project component	Description	Risk level (without controls)			Risk level (after controls as identified in Table D-2)		
		Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Geotechnical investigations							
Geotechnical investigations	Test pits to obtain geotechnical information necessary to inform the Borumba PHES Project design.	Likely	Moderate	Medium	Possible	Minor	Low
	Boreholes (deep and shallow, including some conversion to groundwater monitoring bores)	Likely	Minor	Low	Possible	Minor	Low
Spoil disposal							
Tunnel spoil disposal area, Kingaham spoil disposal area	Dedicated area for disposal of spoil material from exploratory tunnel, geotechnical drilling and stockpiling of topsoil.	Likely	Moderate	Medium	Possible	Moderate	Medium
Site access							
Kingaham Creek bypass	Realignment of a section of Bella Creek Road (Kingaham Creek bypass)	Likely	High	High	Possible	Moderate	Medium
New/ upgraded access tracks	New access tracks and upgrades to existing tracks, including multiple waterway crossings, to enable access to geotechnical investigation and exploratory tunnel drilling sites	Likely	Minor	Low	Possible	Minor	Low
Other supporting infrastructure							
Temporary water infrastructure, explosive store, civil construction compound	Construction of temporary water infrastructure, explosive store, civil construction compound (laydown area).	Likely	Moderate	Medium	Possible	Moderate	Medium

Project component	Description	Risk level (without controls)			Risk level (after controls as identified in Table D-2)		
		Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Exploratory tunnel infrastructure							
Dual exploratory tunnels	Exploratory drilling of dual tunnels to the powerhouse cavern from the portal pad following the proposed tunnel alignment.	Possible	Minor	Low	Unlikely	Minor	Low
Staging area, portal pad	Construction of a portal pad and staging area	Possible	Minor	Low	Possible	Minor	Low

Table D-2: Air quality environmental management measures

Mitigation Measure / Requirement	Responsibility
GENERAL	
Training will be provided to all project personnel, including relevant sub-contractors on air quality control practices and the requirements from this plan through inductions, toolboxes and targeted training.	Contractor
Air quality control measures from this plan will be included in relevant site environmental documents including for example, EWMS and/or SEPs.	Contractor
Construction activities will be modified, reduced or controlled during high or unfavourable wind conditions if they have a potential to increase off-site dust generation.	Contractor
Control measures including water carts, sprinklers, sprays, temporary stabilisation, compaction, and soil binders will be utilised where applicable to control dust emissions. The frequency of use will be modified to accommodate prevailing conditions.	Contractor
Waste will be segregated and collected on a regular basis to ensure odours associated with waste are minimised.	Contractor
Works will be undertaken to ensure that no offensive odours are emitted from the site.	Contractor
There will be no burning off of waste.	Contractor
Spraying of herbicides, aerosols or other chemicals will not be undertaken in unsuitable weather i.e. high wind.	Contractor
Stormwater, recycled water or other water sources shall be used, where feasible and reasonable, for dust control.	Contractor
Disturbed areas will be progressively stabilised or rehabilitated as reasonable and feasible, including rehabilitation with native species and sterile non-natives.	Contractor
VEHICLE MOVEMENT AND LOADING / UNLOADING OF EXCAVATED MATERIAL	
Measures will be implemented to minimise dust, soil or mud from being deposited from vehicles onto public roads. This will be achieved by implementing mitigation measures such as rumble grids and large aggregate at entry/exit points. Manual cleaning will also be carried out where appropriate.	Contractor
Water carts will be utilised where required, to control dust emissions on unsealed haul roads.	Contractor
Speed limits will be implemented across the Exploratory Works footprint to minimise dust generation from vehicle movements.	Contractor
Soil binders will be used as an additional suppressant on unsealed haul roads and surfaces as required. The frequency of use will be modified to accommodate prevailing conditions and regularity of dust causing activity.	Contractor
All loaded haulage trucks on public roads will be covered when transporting materials.	Contractor
Hardstand areas and surrounding public roads will be cleaned, as required, using methods such as brooms, bobcat attachments or street sweepers.	Contractor
EXCAVATED ROCK EMPLACEMENT AREAS	
Exposed surfaces, with no scheduled work for two weeks or greater, will be treated to minimise dust generation.	Contractor
Water carts and/or sprays will be used on the emplacement area to minimise dust generations as necessary and practicable.	Contractor
Compaction of materials on the emplacement area will occur to minimise the potential for wind erosion.	Contractor
PLANT AND EQUIPMENT	

Mitigation Measure / Requirement	Responsibility
Haul trucks and plant equipment will be switched off when not in use for periods of more than 30 minutes.	Contractor
Construction plant, vehicles and machinery will be maintained in accordance with manufacturer's specifications to ensure that emissions do not exceed DETSI regulations.	Contractor
Any plant, equipment or machinery will be immediately switched off should there be visible signs of smoke emissions from equipment/machinery.	Contractor
Public roads will be inspected at main entry and exit points to and from areas where construction activities are taking place.	Contractor
CONSULTATION AND COMPLAINTS MANAGEMENT	
Residents / sensitive receivers will be notified of construction activities that are likely to affect their air quality amenity. Information provided will include: • The types of activities to be undertaken. • The timing of activities including expected start and finish. • The location of activities. • Details of the community information line and how to make an enquiry and / or complaint.	Contractor / community engagement team
All complaints will be managed in accordance with the CSEP.	Contractor / community engagement team
PERFORMANCE INDICATORS	
No identified dust nuisance reported.	Contractor
Any identified non-conformance actioned within 7 days of identification.	Contractor / environmental officer
MONITORING AND REPORTING	
Air quality monitoring will be undertaken in accordance with requirements outlined within the EP Act and the *Environmental Protection Regulation 2019*. The Air Quality Monitoring Program will be implemented for the duration of the works and will generally accord with the National Environmental Protection (Ambient Air Quality) Measures.	Contractor / environmental officer
A meteorological station will be installed to enable the monitoring of weather prior to and during Exploratory Works activities. Weather forecast will be reviewed on a daily basis and appropriate measures implemented where unfavourable weather conditions (dry weather, strong winds) are anticipated.	Contractor / environmental officer
Visual inspections of dust will be conducted daily.	Contractor
TRIGGER FOR CORRECTIVE ACTION	
Dust complaint received.	Contractor / environmental officer
Monitoring levels exceeding the requirements of the Environmental Protection (Air) Policy 2019 or relevant licence / approval conditions.	Contractor / environmental officer
Visual inspections indicate mitigation measures are not effective i.e. dust plumes observed.	Contractor / environmental officer
CORRECTIVE ACTIONS	
Review causes of dust, existing controls and increase frequency of dust suppression to manage dust nuisance.	Contractor

Appendix E – Noise and Vibration

The risk of noise and vibration impacts resulting from the Exploratory Works Project has been assessed in accordance with the risk assessment methodology outlined in Section 5.1. The outcomes of the risk assessment are presented in Table E-1.

Noise and vibration assessments reviewed the predicted noise and vibration levels against the locations of sensitive receptors. This concluded that with mitigation in place (required at Kingaham Creek bypass only) all criteria are expected to be complied with. The highest risk associated with noise and vibration is disturbance to fauna species during tunnelling and blasting activities. The noise and vibration risks identified generally relate to all project components as outlined below, though the risk varies depending on the activity and has been specified in Table E-1:

- increased noise levels at sensitive receptors (community) surrounding the disturbance footprint
- increased vibration levels at sensitive receptors (community) surrounding the disturbance footprint
- disturbance of fauna during Exploratory Works activities.

Table E-1: Noise and vibration risk assessment

Project component	Description	Risk level (without controls)			Risk level (after controls as identified in Table E-2)		
		Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Geotechnical investigations							
Geotechnical investigations	Test pits to obtain geotechnical information necessary to inform the Borumba PHES Project design.	Possible	Moderate	Medium	Possible	Minor	Low
	Boreholes (deep and shallow, including some conversion to groundwater monitoring bores)	Possible	Minor	Low	Possible	Minor	Low
Spoil disposal							
Tunnel spoil disposal area, Kingaham spoil disposal area	Dedicated area for disposal of spoil material from exploratory tunnel, geotechnical drilling and stockpiling of topsoil.	Likely	Moderate	Medium	Possible	Moderate	Medium
Site access							
Kingaham Creek bypass	Realignment of a section of Bella Creek Road (Kingaham Creek bypass)	Likely	Moderate	Medium	Possible	Moderate	Medium
New/ upgraded access tracks	New access tracks and upgrades to existing tracks, including multiple waterway crossings, to enable access to geotechnical investigation and exploratory tunnel drilling sites	Likely	Minor	Low	Likely	Minor	Low
Other supporting infrastructure							
Temporary water infrastructure, explosive store, civil construction compound	Construction of temporary water infrastructure, explosive store, civil construction compound (laydown area).	Likely	Moderate	Medium	Possible	Moderate	Medium

Project component	Description	Risk level (without controls)			Risk level (after controls as identified in Table E-2)		
		Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Exploratory tunnel infrastructure							
Dual exploratory tunnels	Exploratory drilling of dual tunnels to the powerhouse cavern from the portal pad following the proposed tunnel alignment.	Likely	High	High	Likely	Moderate	Medium
Staging area, portal pad	Construction of a portal pad and staging area	Likely	Moderate	Medium	Possible	Moderate	Medium

A range of general environmental requirements and control measures have been identified to ensure that the noise impacts resulting from the Exploratory Works, as identified above, are appropriately managed. Safeguards and management measures will be implemented to avoid, minimise or manage noise and vibration impacts across the Exploratory Works Project. The Exploratory Works will generally accord with the noise management levels (NML) identified within the *Interim Construction Noise Guidelines* (ICNG 2009).

Specific safeguards and management measures to address the impacts to the surrounding environment as a result of activities generating noise and vibration are outlined in Table E-2. The mitigation measures are generally considered to be applicable to all project components and risks and have therefore been presented in a single summary table. Monitoring requirements and corrective actions relevant to management of flora and fauna are contained in the FFMP in Appendix J.

Table E-2: Noise and vibration management measures

Mitigation Measure / Requirement	Responsibility
GENERAL	
Training will be provided to all project personnel, including relevant sub-contractors on noise and vibration management practices including the out of hours work procedure and the requirements from this plan through inductions, toolboxes and targeted training.	Contractor
Relevant noise and vibration management measures from this plan will be included in site environmental documents including for example, EWMS and/or SEPs.	Contractor
A pre-condition inspection for each public utility, structure, heritage item and building will be carried out where: • Blasting operations are within 250 metres • Piling activities are within 100 metres • Excavation by hammering or ripping is within 100 metres • Vibratory compactor >7 tonne plant is within 50 metres • Vibratory compactor <7 tonne plant is within 25 metres • Demolition of structures is within 50 metres. Where the risk of damage to an item is assessed to be low, the requirement for a pre-condition inspection may be waived with the approval of Queensland Hydro.	Contractor
A pre-condition survey of heritage items and other potential vibration sensitive receivers will be undertaken in the blast offset zone identified around the tunnel excavation portal or road works blasting locations.	Contractor
Maintain a site activity log, recording the type of activities occurring during various times of the day to assist with retrospective investigation of community complaints.	Contractor
Noise monitoring during the commencement of high-risk activities (i.e. Blasting and piling) will be undertaken to determine if actual construction noise levels are above NMLs. If NMLs are exceeded, plant, equipment and methodologies will be reviewed against other reasonable and feasible mitigation measures to reduce construction noise levels to at or below NML's. Where these cannot be further reduced: • road construction will be limited to standard hours only where there are noise affected residents, or • a negotiated agreement will be entered into with the affected residents.	Contractor
PROCEDURES AND PLANS	
Any proposal to undertake works outside of the approved working hours will be subject to the processes and assessment requirements contained in the out of hours works procedure, which will be developed by the construction contractor.	Contractor
Residents and sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the CSEP. All complaints received will be managed in accordance with the CSEP.	Contractor
PLANT AND EQUIPMENT	

Mitigation Measure / Requirement	Responsibility
Where practicable, noise generating equipment will be strategically positioned to take advantage of natural screening from geographical features or other structures to reduce the transmission of noise between work sites and receiver locations.	Contractor
Where feasible and reasonable, noisy equipment and/or construction processes will be substituted by alternative low noise emitting equipment and/or construction process.	Contractor
Offset distance between high vibration plant items and nearby vibration sensitive receivers will be maximised where practicable.	Contractor
All construction plant and equipment used on the site will be, in addition to other relevant requirements: • Fitted with properly maintained noise suppression devices in accordance with the manufacturer's specifications. • Maintained in an efficient condition. • Operated in a proper and efficient manner	Contractor
Vibration testing shall be conducted on high-risk vibratory plant during the commencement of high-risk activities to assess whether the safe buffer distances adopted are adequate based on site conditions to protect identified sensitive areas and heritage items.	Contractor
If construction activities approach 25 m from structures or heritage items, work practices will be reviewed to avoid any damage. Where safe working distances need to be encroached, real-time vibration monitoring with audible and visual alarms (warning lights) will be undertaken at structures and heritage items so actual vibration can be monitored and managed appropriately.	Contractor
WORKING HOURS	
Construction works associated with the Project will only be undertaken during the following approved hours, except as approved otherwise through the out of hours works procedure: • General construction activities: – 6:30am to 6:00pm Monday to Sunday • All activities relating to tunnelling works: – 24 hours a day, 7 days a week	Contractor
Works outside of the above hours will only be undertaken in the following circumstances: • for delivery of materials required outside these hours by the Police or other authorities for safety reasons, or • where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm, and • works approved under an Out-of-Hours Work Procedure • emergency works that are required to avoid of the loss of life or to prevent damage to property.	Contractor
CONSULTATION AND COMPLAINTS MANAGEMENT	
Residents / sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the Communication Strategy. Information provided will include: • The types of activities to be undertaken. • The timing of activities including expected start and finish. • The location of activities. • Details of the community information line and how to make an enquiry and / or complaint.	Contractor / community engagement team
All complaints, including those related to property damage, will be managed in accordance with the CSEP.	Contractor / community engagement team

Mitigation Measure / Requirement	Responsibility
PERFORMANCE INDICATORS	
No noise or vibration complaint received.	Contractor
Any identified non-conformance actioned within 7 days of identification.	Contractor / environmental officer
MONITORING AND REPORTING	
Noise and vibration monitoring will be undertaken in accordance with the mitigation measures outlined above. A construction noise and vibration monitoring program will be developed by the contractor indicating monitoring frequency, location and how the results of this monitoring are recorded.	Contractor / environmental officer
Noise and vibration monitoring will be undertaken during tunnel blasting in accordance with the Blasting Procedure or Blasting Management Plan to be developed by the Contractor and submitted to Queensland Hydro for approval.	Contractor / environmental officer
TRIGGER FOR CORRECTIVE ACTION	
Noise or vibration complaint received.	Contractor / environmental officer
Noise monitoring indicates management measures are not fully effective.	Contractor / environmental officer
Exceedance of the noise or vibration requirements outlined in the EP Act, *Interim Construction Noise Guidelines* (ICNG 2009) or relevant licence conditions.	Contractor / environmental officer
CORRECTIVE ACTIONS	
Review noise management measures to determine if additional noise management controls are required and update management plans as required.	Contractor
Where vibration impacts result in ongoing complaints, management measures will be reviewed which may include modification to construction methods.	Contractor

Appendix F – Bushfire Management

Fire is a natural part of the Australian landscape, and most vegetation communities are adapted to periodic fires. However, changes in the natural fire regime may result in changes in the species composition and / or structure of the vegetation. The increased presence of construction vehicles and personnel in the Exploratory Works footprint may increase fire risk through use of machinery that may generate sparks, use of flammable liquids and idling vehicles being present in areas of ground vegetation.

The bushfire risks associated with the Exploratory Works Project have been assessed in accordance with the risk assessment methodology outlined in Section 5.1. All Project components are considered to have the same risks, at various degrees of impact with and without controls. The risk level of the below risks before and after implementation of controls have been assessed for each project component in Table F-1:

- idling vehicles near grass initiating a bushfire
- spill of flammable chemicals
- combustion of stockpiled materials
- changes to natural bushfire regime caused by construction vehicles and personnel, impacting flora and fauna in the area

Destruction of site buildings and surrounding properties as a result of increased bushfires. The outcomes of the risk assessment are presented in Table F-1.

Table F-1: Bushfire risk assessment

Project component	Description	Risk level (without controls)			Risk level (after controls as identified in Table F-2)		
		Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Geotechnical investigations							
Geotechnical investigations	Test pits to obtain geotechnical information necessary to inform the Borumba PHES Project design.	Possible	Moderate	Medium	Unlikely	Minor	Low
	Boreholes (deep and shallow, including some conversion to groundwater monitoring bores)	Unlikely	Moderate	Low	Unlikely	Minor	Low
Spoil disposal							
Tunnel spoil disposal area, Kingaham spoil disposal area	Dedicated area for disposal of spoil material from exploratory tunnel, geotechnical drilling and stockpiling of topsoil.	Possible	High	Medium	Possible	High	Medium
Site access							
Kingaham Creek bypass	Realignment of a section of Bella Creek Road (Kingaham Creek bypass)	Possible	High	Medium	Possible	Moderate	Medium
New/ upgraded access tracks	New access tracks and upgrades to existing tracks, including multiple waterway crossings, to enable access to geotechnical investigation and exploratory tunnel drilling sites	Possible	Moderate	Medium	Unlikely	Minor	Low
Other supporting infrastructure							
Temporary water infrastructure, explosive store, civil construction compound	Construction of temporary water infrastructure, explosive store, civil construction compound (laydown area).	Possible	Major	High	Possible	High	Medium

Project component	Description	Risk level (without controls)			Risk level (after controls as identified in Table F-2)		
		Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Exploratory tunnel infrastructure							
Dual exploratory tunnels	Exploratory drilling of dual tunnels to the powerhouse cavern from the portal pad following the proposed tunnel alignment.	Unlikely	High	Medium	Unlikely	Moderate	Low
Staging area, portal pad	Construction of a portal pad and staging area	Possible	Moderate	Medium	Unlikely	Minor	Low

Management measures to address the potential impacts associated with bushfire are outlined in Table F-2. The measures presented in the table are generally considered applicable to all project components. A specific Bushfire Management Plan will also be prepared by the contractor.

Table F-2: Bushfire management measures

Mitigation Measure / Requirement	Responsibility
GENERAL	
Training will be provided through inductions and toolboxes to all project personnel, including relevant sub-contractors, on bushfire management practices and procedures to be implemented in the event of an emergency.	Contractor / Environmental officer
The Emergency Response Plan will be implemented in the event of an uncontrolled fire, including evacuation procedures to dedicated assembly areas.	Contractor
For “hot-work” activities, a risk assessment will be completed considering forecast weather, fire hazard ratings and site conditions.	Contractor
Plant and machinery will be switched off when not in use	All site personnel
Vehicles may not idle or be parked in areas of long grass.	All site personnel
Access tracks, fence lines and cleared overhead powerline easements will be maintained and used as firebreaks within the Project footprint and regularly maintained during clearing and construction activities.	Contractor
Smoking is not permitted on site, except within designated areas within site offices.	All site personnel
Asset protection zones will be implemented around the construction compound, staging pad, and laydown areas to manage fuel loads, as appropriate.	Contractor
Fuel loads across the Exploratory Works will be monitored and appropriately managed through activities such as weed management, slashing and low intensity burns.	Contractor
The proposed construction pads will have the required minimum level of stored, dedicated, on-site water supply for fire-fighting purposes, in the form of at least one 5,000 L tanks per site. The water tank must have suitable connection for fire-fighting purposes and comply with the AS2304:2011 “Water Tanks for Fire Protection Systems”.	Contractor
PERFORMANCE INDICATORS	
Conformance with hot-work risk assessments.	Contractor
No unactioned items associated with weekly visual monitoring.	Environmental officer
No uncontrolled bushfires.	All personnel
MONITORING	
Monthly assessment of fuel loads will be undertaken during the construction of the Project.	Contractor
Monthly audit of hot-work risk assessments.	Contractor
During construction phase and bushfire season, the fire danger status will be monitored daily through the Rural Fire Service website.	Contractor
TRIGGER FOR CORRECTIVE ACTION	
Activity conducted without a hot-work risk assessment, or non-conformance with the outcomes of the assessment.	Contractor
Unplanned and uncontrolled bushfire.	Contractor
CORRECTIVE ACTIONS	
If fuel loads have increased following heavy rainfall, control methods will be implemented as required (i.e. weed control or cool burns).	Contractor

Mitigation Measure / Requirement	Responsibility
Review and update hot-work risk assessment as necessary.	Contractor
Prescribed burns are to be conducted based on present fuel load and ecosystem.	Contractor

Appendix G – Preliminary Erosion and Sediment Control Plan

Prepared for the Borumba PHES Project

Borumba Pumped Hydro Energy Storage Project – Exploratory Works Preliminary Erosion and Sediment Control Sub-plan

DOCUMENT NUMBER: BR-NA-NON-EMG-PLN-00003

OCTOBER 2025

Contents

Acronyms and abbreviations iii

1. Introduction 1
   1.1 Background 1
   1.2 Plan purpose and objectives 1
   1.3 Environmental management 2
2. Regulatory requirements and compliance 3
3. Existing environment and potential impacts 5
   3.1 Technical studies 5
   3.2 Soil landscapes 5
   3.3 Land resources and spoil management 7
   3.4 Surface water 8
   3.5 Groundwater 10
4. Erosion and sediment control management planning principles 12
5. Mitigation and management measures 13
   5.1 Mitigation measures identified in soils assessment 13
   5.2 Conceptual Erosion and Sediment Control Plan 14
   5.3 Primary and Progressive ESCPs 15
   5.4 Proposed control measures 16
   5.5 Sediment controls 21
   5.6 Dust suppression 22
   5.7 Dirty water treatment and discharge requirements 23
   5.8 Rainfall preparation procedure 23
   5.9 Site inspection, monitoring and maintenance 23
6. Reporting 25
   6.1 Continual improvement and meeting the requirements of the environmental documents. 25
7. References 26

Appendix A - Risk assessment and controls
Appendix B - Erosion and sediment control planning tools
Appendix C - Standard ESCP drawings
Appendix D - Example site ESCP
Appendix E - Preliminary ESCP for temporary bridges and bed level crossing

Figures

Figure 1: Exploratory Works footprint 4

Tables

Table 1: Erosion risk rating based on average monthly rainfall depth at BoM Imbil Post Office weather station 6
Table 2: RUSLE calculations 6
Table 3: Standard erosion and sediment controls 16
Table 4: Examples of minimum sediment control standards based on soil loss 17

Acknowledgement of Country

In the spirit of reconciliation, Queensland Hydro acknowledges the Traditional Custodians of Country throughout Queensland and, in particular the lands, skies and waters on which we operate. We celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands, skies and waters of Queensland.

Queensland Hydro pays respect to Elders past and present honouring their continuing spiritual and cultural connections to Country.



Acronyms and abbreviations

Term	Description
AHD	Australian Height Datum
BGL	Below ground level
Borumba PHES Project	Borumba Pumped Hydro Energy Storage Project
CEMP	Construction Environmental Management Plan
CESCP	Conceptual Erosion and Sediment Control Plan
ESC	Erosion and sediment control
ESCP	Erosion and Sediment Control Plan
EIS	Environmental impact statement
EP Act	*Environmental Protection Act 1994*
EPP (Water)	Environmental Protection (Water Wetland) Policy 2019
GED	General environmental duty
IECA	International Erosion Control Association
km	Kilometre
LIDAR	Light detection and ranging
PESCP	Preliminary Erosion and Sediment Control Plan
RUSLE	Revised universal soil loss equation
TSS	Total suspended solids

1. Introduction

1.1 Background

Queensland Hydro is the proponent of the Borumba Pumped Hydro Energy Storage (PHES) Project. The Borumba PHES Project is a 2,000 megawatt (MW), 48,000-megawatt hour (MWh), hydroelectric scheme to store, generate and supply energy through a pumped hydroelectric structure linked to the existing Lake Borumba in the Gympie and Somerset Regional Council local government areas.

The Borumba PHES Project is located within the Gympie and Somerset Regional Council local government areas, approximately 13 kilometres (km) southwest of the township of Imbil, 48 km southwest of Gympie, and 180 km northwest of Brisbane.

The Borumba PHES Project requires the completion of Exploratory Works to confirm the suitability of the Borumba PHES Project. The purpose of the Borumba PHES Project – Exploratory Works (the Exploratory Works Project) is to undertake and facilitate critical technical investigations required to confirm the suitability of the Borumba PHES Project location and design. The information obtained from the investigations is crucial to the Borumba PHES Project, as it will determine whether the Borumba PHES Project can proceed or if material changes to the reference design are necessary. The technical information needed primarily comprises geological investigations at the proposed locations of the:

- reservoir dam foundations – to be verified by geotechnical boreholes, test pits and seismic lines
- underground tunnels and caverns – to be verified by geotechnical exploratory tunnel drilling and geotechnical boreholes.

The Exploratory Works, relevant to the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) controlled action, comprise the following components:

- geotechnical investigations including test pits, boreholes (deep and shallow, including some conversion to groundwater monitoring bores) and seismic lines
- spoil disposal:
  - tunnel spoil disposal area
  - Kingaham spoil disposal area
- site access:
  - new access tracks
  - upgrades to existing tracks
  - Kingaham Creek bypass (realignment of a section of Bella Creek Road)
- other supporting infrastructure:
  - civil construction compound
  - temporary water infrastructure
- exploratory tunnel infrastructure:
  - dual exploratory tunnels
  - staging pad
  - portal access track
  - explosive store and access track.

The Construction Environmental Management Plan (CEMP) for the Exploratory Works Project provides a detailed description of the Exploratory Works and associated activities – refer to Section 2 of the CEMP.

The location and footprint of the Exploratory Works is illustrated in Figure 1.

1.2 Plan purpose and objectives

This Preliminary Erosion and Sediment Control Plan (PESCP) has been prepared to inform the control of erosion and sediment during the Exploratory Works Project. It outlines the methodology to be adopted for the assessment

and implementation of erosion and sediment control measures in accordance with the principles of the International Erosion Control Association (IECA) Best Practice Erosion and Sediment Control publication (IECA, 2008).

The PESCP will include the following components, addressing the principles of sediment and erosion control and planning that need to be adopted in future design and construction phases:

- risks associated with geotechnical investigations (boreholes, test pits), exploratory tunnel drilling, access tracks, and supporting infrastructure
- Exploratory Works Project construction boundary catchments and their associated erosion hazard
- site constraints that limit the implementation of appropriate erosion and sediment control (ESC) measures
- any sensitive receiving environments that will receive stormwater discharge from the Exploratory Works, including but not limited to:
  - environmentally sensitive areas (e.g. threatened ecological communities, areas of known threatened species populations, waterways, wetlands etc.)
  - lands protected under environmental legislation and planning instruments
  - land protected under *Nature Conservation Act 1992* (Qld).

A number of assessments are currently being undertaken across the Borumba PHES Project footprint and surrounding areas in support of the environmental impact statement for the Main Works. This information will be used to further inform the PESCP, especially the soil assessment, in accordance with relevant guidelines and procedures.

The PESCP is a live document and will be updated as required during the Exploratory Works Project to reflect updates to the site investigation findings and program.

1.3 Environmental management

The overall approach to environmental management for the Exploratory Works Project is described in the CEMP. The CEMP provides a framework for a comprehensive, integrated approach to environmental management during implementation of the Exploratory Works.

The PESCP forms part of Queensland Hydro's environmental framework as described in the CEMP, however it is intended to provide guidance for development of future ESC plans, rather than being a specific management plan. It has been prepared for the Exploratory Works and does not apply to the Main Works component of the Borumba PHES Project.

2. Regulatory requirements and compliance

Stormwater runoff from construction sites has a high potential to cause water contamination and/or environmental harm. Under section 440ZG of the *Environmental Protection Act 1994* (Qld) (EP Act) it is an offence to unlawfully deposit a prescribed water contaminant in or in such a way where it could reasonably enter waters (i.e. waterways and Lake Borumba, which is a key water-related risk from the Exploratory Works Project), a roadside gutter or stormwater drain. Prescribed water contaminants are listed in Schedule 10 of the Environmental Protection Regulation 2019 and include cement, concrete, clay, sediment, stones and plaster, among other construction related materials.

It is the responsibility of the proponent and the construction site contractor to take all reasonably practicable measures to prevent or minimise environmental harm to uphold the General Environmental Duty (GED) under section 319 of the EP Act. The assessment of reasonably practicable measures in relation to stormwater runoff is required when determining if an offence may have occurred and if the GED has been upheld.

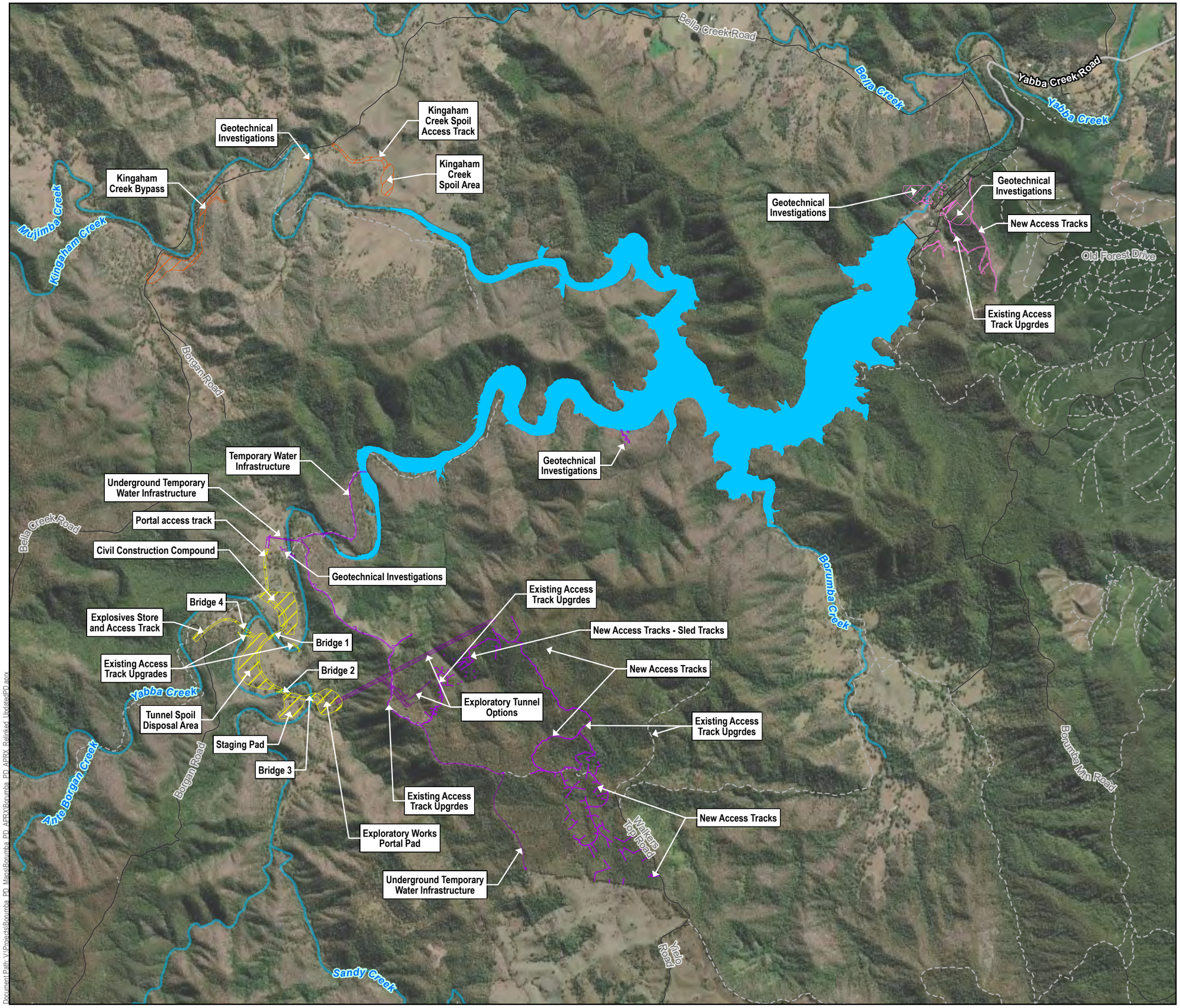
The Environmental Protection (Water Wetland) Policy 2019 (EPP (Water)) provides environmental values and water quality objectives for Queensland waters. These are utilised when determining environmental harm and to inform other statutory and non-statutory decisions. These water quality objectives also assist in identifying whether environmental values are protected. These values and objectives will be utilised when determining risk of environmental harm from water releases or run-off, and ensure that appropriate erosion and sediment controls are implemented.

Further to this, the Exploratory Works Project is located in a water supply buffer area and as such, consideration will also be given to the Seqwater Development Guidelines Water Quality Management in Drinking Water Catchments (2017), which outlines outcomes for development and activities in water supply buffer areas with the intent of maintaining or improving water quality, flow regimes, environmental values, and the physical integrity of natural processes to protect drinking water supply.

When implemented, the practices described in this PESCP guide will help achieve water quality objectives and management goals as defined in the Water Management Sub-plan, which in turn will help protect or enhance environmental values.

The information provided in this report is based on:

- desktop assessment of publicly available sources
- Borumba PHES Project Soils Assessment Technical Report (Attexo, 2022)
- consultation with proponent stakeholders.



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LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads
- Lake Borumba (FSL 135.01m AHD)

Exploratory Works Project

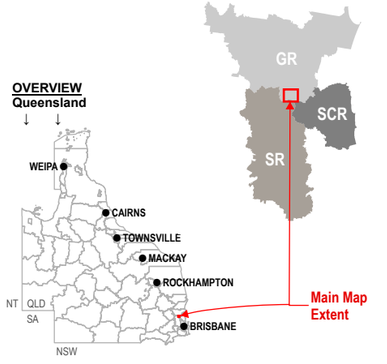
Project Footprint by Work Area

- Area 1 - Borumba Dam
- Area 2 - Kingaham Creek
- Area 3 - Walkers Top
- Area 4 - Borgan

Project Component - Underground

- Area 3 - Walkers Top

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



Data Sources:

1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
3. Watercourses © State of Queensland (Department of Natural Resources, Mines and Energy) 2022
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Exploratory Works Project
Preliminary Documentation

EXPLORATORY WORKS FOOTPRINT

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 29/09/2025
REVISION:	A

FIGURE 1

3. Existing environment and potential impacts

This section provides a description of the environmental values that may be impacted by the erosion and sedimentation that occur as a result of Exploratory Works Project activities. A risk assessment was undertaken for the potential erosion and sedimentation impacts that are not addressed in other management plans, in accordance with the methodology outlined in Section 5.1 of the CEMP and is provided in Appendix A.

3.1 Technical studies

Multiple technical studies were undertaken in 2022 to inform the Borumba PHES Project's Detailed Analytical Report and Front End Engineering Design. Although the studies were designed to assess the Borumba PHES Project as a whole, the study area included the Exploratory Works Project footprint. Further studies have subsequently been undertaken for the Borumba PHES Project environmental impact statement (EIS).

Findings from initial technical studies were used to inform this PESCP and subsequent studies will inform future revisions.

3.2 Soil landscapes

3.2.1 Existing environment

A review of all publicly available soils data indicates there are significant soils data gaps for the Exploratory Works Project footprint, with the only information available consisting of continental scale soils mapping from the Atlas of Australian Soils (Northcote et al, 1960-68) (at a scale of 1:2,000,000) for most of the Borumba PHES Project footprint, and the Queensland Government's Land Resource Area mapping[1] (at a scale of 1:250,000) for the southern part of the upper reservoir. The lack of detail and resolution of this base data also flows through into the spatial accuracy and confidence of all soil properties and interpreted products within the Exploratory Works Project footprint.

Land resource surveys, with similar environmental domains, that contain the most relevant information on the likely soil types, their distribution in the landscape and their properties were identified and used in the soils assessment.

The rock units associated with the major soil disturbance activities are the Amamoor beds (DCa), Quaternary Alluvium (Qa), Marumba beds (Pm) and Tungi Creek Granodiorite (Rgt).

The soils within the Amamoor beds occur on sedimentary rocks dominated by chert as gradational to uniform soils (Dermosols and Tenosols) and texture contrast soils (Chromosols). Within the Qa, the soils are likely to range from sandy Rudosols associated with recent channel deposits, Dermosols on the alluvial plains and terraces with texture contrast soils of either Chromosols or Sodosols. In the Marumba beds the soils range from texture contrast soils (Sodosols, Kurosols and Chromosols) to gradational soils (Dermosols) and shallow rocky soils (Rudosols) depending on the lithology.

The steep slopes in the area increases the risk of erosion if vegetation cover is removed, and the soil disturbed. Gully erosion exists on slopes above Lake Borumba on the Kingaham Creek and Borumba Creek incoming channels. Gully erosion is most likely due to land management pressures and dispersive subsoils.

3.2.1.1 Borumba PHES Project Soils Assessment Technical Report findings

A Soils Assessment Technical Report was written as a baseline for the Detailed Analytical Report (DAR) for the Borumba PHES Project (Attexo, 2022); it includes a gap analysis and recommendations for future soil survey work. This report is central to the current understanding of erosion and sediment risk for the Borumba PHES Project and Exploratory Works. It is the key reference document for this PESCP. Additional studies and ground investigations are currently being undertaken to support the EIS for the Main Works Project.

The soils assessment concluded that soil erosion is a process that already exists in the Exploratory Works Project catchment, and if construction works are not managed appropriately, the Exploratory Works Project presents a risk of potential soil loss with associated impacts to waterways . The inherent soil erosion hazard is due to factors such

[1] Land resource areas series - Dataset - Open Data Portal | Queensland Government

as rainfall (amount and intensity), topography (slope and shape of land), cover (bare soil, grass cover and/or trees), soil properties (such as structure, texture and sodicity) and the characteristics of the regolith.

The report highlights the focus on rainfall to be used to assess the risk of erosion at different times of the year. Imbil is the closest township with an extended record of Bureau of Meteorology (BoM) data (Imbil Post Office weather station #040099). The annual mean rainfall is 1,181.2 mm, with the highest mean rainfall occurring in February (176.5 mm) and the lowest mean rainfall occurring in August (38.5 mm). Imbil's mean monthly rainfall data and erosion risk ratings, based on the IECA Best Practice Erosion and Sediment Control publication (IECA, 2008), are presented in Table 1.

Soil loss estimates for construction activities have been calculated using the revised universal soil loss equation (RUSLE) in Table 2.

Table 1: Erosion risk rating based on average monthly rainfall depth at BoM Imbil Post Office weather station

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean rainfall depth (mm)	175.5	176.5	148.2	89.2	71.0	64.5	49.6	38.5	40.5	84.6	97.8	146.6	1,181.2
Erosion risk rating*	H	H	H	M	M	M	L	L	L	M	M	H	-

* Erosion risk rating: L = Low, M = Medium, H = High

Table 2: RUSLE calculations

RUSLE parameters	1% slope	3% slope	6% slope	10% slope	20% slope
Rainfall erosivity (R-factor)	3,830	3,830	3,830	3,830	3,830
Soil erodibility (K-factor)	0.04	0.04	0.04	0.04	0.04
Slope length (m)	80	80	80	80	80
Slope gradient (%)	1	3	6	10	20
Length/gradient (LS-factor)	0.19	0.65	1.47	2.81	7.32
Erosion control practice (P-factor)	1.3	1.3	1.3	1.3	1.3
Ground cover (C-factor)	1	1	1	1	1
Soil loss (tonnes/ha/year)	38	130	293	559	1458
Soil loss class*	1	1	3	5	5
Soil loss (m^3/ha/year)	30	100	225	430	1,122

* Erosion risk category based on soil loss class: 1 = Very Low, 2 = Low, 3 = Low-Moderate, 4 = Moderate, 5 = High, 6 = Very High and 7 = Extremely High / Severe

3.2.2 Potential impacts

The following are a range of risks and potential impacts identified for the Exploratory Works Project:

- There is a potential soil erosion risk and related sedimentation impacts associated with construction activities. Construction activities that clear vegetation, disturb the soil or concentrate runoff water have the potential to cause soil erosion and sedimentation. A soil erosion risk assessment was undertaken, which identifies some of the main erosion risk factors. Gully erosion is a risk for the Exploratory Works Project, based on the presence of dispersive soils.

- The main consequences of erosion are loss of topsoil/subsoil and degraded water quality. Loss of topsoil and subsoil will reduce the ability to reinstate disturbed areas following completion of construction, thus exacerbating erosion impacts in the longer term. Erosion also causes visual impacts, particularly where revegetation cannot be achieved because of loss of topsoil. Severe erosion may also destabilise structures such as roads.
- Within Lake Borumba, water quality issues may arise in areas where soils are disturbed and erosion occurs adjacent to the reservoir (e.g. during construction of the temporary water infrastructure), washing soils into the water. Clearing of vegetation in the water storage areas, depending on how it was undertaken, could also disturb soils and cause erosion. This would result in:
  - Increased suspended solids and increased turbidity in the water body. Colloidal clays from dispersive soils have the potential to stay in suspension for long periods of time.
  - Transport of nutrients into Lake Borumba, which may create conditions suitable for algal blooms.
- Sediment released into the creeks upstream of Lake Borumba from soil disturbance associated with the Exploratory Works Project (e.g. construction of pads, stockpiling) may wash into the upper reaches of Lake Borumba. It may also be deposited in the stream beds, resulting in changes to the aquatic ecosystems, particularly streambed flora and fauna distribution/occurrence.
- Construction activities including trafficking of soil and soil handling during earthworks have the potential to degrade the quality of the soil resource. Soil degradation can result in poor rehabilitation outcomes, bare ground and increased risk of erosion and sedimentation.

3.3 Land resources and spoil management

3.3.1 Existing environment

Accurate light detection and ranging (LIDAR) data has been obtained for the Exploratory Works Project footprint. Generally, the surrounds of Lake Borumba are quite rugged and relatively inaccessible with the elevation ranging from about 120 m Australian Height Datum (AHD) up to 550 m AHD.

There are a range of geological rock units mapped in the area. However, this mapping has not yet been confirmed by geotechnical investigations, and geotechnical specialists have indicated there is potential for the mapping to be incorrect.

Soils vary from sandy loams to light to medium clays. Most of the Exploratory Work Project is located in areas that may contain soils with sodic subsoils that are highly erodible if exposed. Acid sulfate soils have not been encountered during the soil investigations undertaken in support of the EIS or during geotechnical works and as such, are highly unlikely to be present in the Exploratory Works footprint.

Strategic cropping areas under the *Regional Planning Interests Act 2014* (Qld) are mapped on Kingaham Creek and Yabba Creek, within and surrounding the Exploratory Works Project footprint.

There are no current mining leases, mining lease applications, key resource areas, or petroleum or gas pipelines within the Exploratory Works footprint. However, there are three historical mining leases relevant to the Survey area: ML231555 on lot 3LX2754, ML231568 on lot 3LX2754 and ML3717 on 3LX2754.

There are no lots listed on the contaminated land register and three lots are listed on the environmental management register that intersect with the Exploratory Works footprint:

- Lot 3LX2754 is listed for the notifiable activity of mineral processing
- Lot 1723L37994 is listed for the notifiable activity of livestock dip or spray race
- Lot 135FTY1911 is listed for two notifiable activities:
  - petroleum product or oil storage
  - waste storage, treatment, or disposal.

Although the EMR listing of Lot 3LX2754 is for the notifiable activity of mineral processing, there were other potential sources for contamination including a livestock dip/spray race and a homestead.

A preliminary contaminated land investigation of the proposed stockpile area and the portal pad on Lot 1723L37994 was undertaken in August 2023, in accordance with relevant Australia standard, guidelines, and procedures. In total, 79 soil samples collected from 40 sites were analysed, with no exceedances of the adopted human health and ecological site assessment criteria recorded.

3.3.2 Potential impacts

Areas of known contamination will be avoided, where possible. However, the Exploratory Works Project may disturb or otherwise interact with land that is already contaminated, or the works may lead to new contamination. Potential sources of contamination associated with Exploratory Works include:

- dangerous goods storage and use (such as diesel and drilling fluids)
- sewage contaminants associated with site office amenities, noting that all sewage is proposed to be trucked offsite
- general waste
- generation of spoil material which may include acid rocks, natural asbestos and/or naturally radioactive material
- dust generation
- erosion.

Potential pathways for contaminants to reach sensitive receptors include:

- physical disturbance leading to mobilisation via rainfall and runoff
- spills or leaks directly into Lake Borumba or watercourses
- migration of contaminants (including sediment and toxicants) due to erosion and surface water runoff/discharges
- importation of contaminated material that has the potential to affect soil, surface water and/or groundwater.

The following Exploratory Works activities are expected to generate spoil:

- geotechnical investigations – spoil from drilling and test pits
- establishing access tracks – spoil from construction works
- upgrading access roads – spoil from construction works
- exploratory drilling – spoil from tunnel excavations and ground-levelling required for associated components (i.e. spoil disposal areas, portal pad and staging area)
- installation of temporary water infrastructure (pump pads, tanks, temporary pipeline) – spoil from installation of infrastructure
- civil construction compound – spoil from ground-levelling and building foundations
- explosive store (magazine) – spoil from ground-levelling and store foundations.

Refer to Section 4 and Table 1 of the Spoil Management Sub-plan for a detailed description of spoil generating activities.

3.4 Surface water

3.4.1 Existing environment

The Borumba PHES Project is in the Upper Mary River sub-basin of the Mary Basin. Water in the Mary Basin is managed and allocated under the Water Plan (Mary Basin) 2024.

Lake Borumba stores water for drinking as well as irrigation as part of the Mary Valley irrigation scheme. Borumba Dam is operated by Seqwater.

Waterways in the basin range from ephemeral creek systems to permanent flowing rivers and creeks. The major waterways in or near the Exploratory Works Project footprint include Yabba Creek, Kingaham Creek, Borumba Creek and Sandy Creek. Each of these creeks are defined watercourses under the *Water Act 2000* (Qld) (Water Act). Unmapped watercourses are also located throughout the Exploratory Works Project footprint. Unnamed tributaries of Bella Creek, which are mapped as drainage features, also intersect the Exploratory Works Project footprint where upgrades are proposed to Bella Creek Road.

A Surface Water and Sediment Quality Monitoring Program has been implemented to collect monthly background surface water and sediment quality data relative to the Exploratory Works Project (further detail is provided in the Water Management Sub-plan, Section 3.1.2.1). This background data will be used to derive percentile estimates for interim guidelines, noting limited historical data exists for the majority of waterways intersected by the Exploratory Works. Comparisons to these interim guidelines (once derived) will allow for qualification of both the potential impacts to receiving surface water features, and the efficacy of environmental controls implemented as per the CEMP Plan for Civil Works for the Exploratory Works Project.

Sampling locations were nominated upstream and downstream of potentially impacted areas, including in Yabba Creek (both upstream and downstream of Lake Borumba), Kingaham Creek, Borumba Creek and Sandy Creek.

Surface water parameters monitored at each site include physicochemical parameters (pH, electrical conductivity, dissolved oxygen, turbidity, total dissolved solids, total suspended solids (TSS), chlorophyll α etc), nutrients, metals (total and dissolved), hydrocarbons, oil and grease, herbicides and *Escherichia coli* bacteria and microbiology. Sediment samples are analysed for a similar set of parameters including physicochemical parameters, nutrients, metals (Total and 1M HCl Extractable), hydrocarbons, and oil and grease.

The current sampling frequency and location selection will be adjusted as ongoing data becomes available and the Exploratory Works Project commences construction.

In the absence of interim guidelines, data was initially screened against the Australian and New Zealand guidelines for fresh and marine water quality (2018) 95% species protection, Australian Drinking Water Guidelines (NHMRC, 2011), and others as described in the Mary River environmental values and water quality objectives (DERM, 2010).

The following observations were recorded in the November and December 2023 results:

- Concentrations higher than the relevant guidelines were recorded for aluminium (dissolved), copper (dissolved), iron (total), manganese (total and dissolved) at the majority of sites.
- Ammonia, total nitrogen and total phosphorus concentrations were higher than the relevant guidelines at most sites in November and December. Nitrate+nitrite were also higher than the guideline at most sites in December.
- Total suspended solids (TSS) were higher than the guideline at most sites in Sandy Creek and Yabba Creek.
- *E. coli* bacteria was higher than the guideline at all sites.

Further water quality sampling was undertaken from February to May 2024, including at two additional sampling sites previously not accessible. The following observations were recorded:

- Occasional exceedances of DO and chlorophyll- α at most sampling locations.
- Exceedances of TSS were detected at several locations, including upper reservoir within the proposed raised full supply level, downstream at Lake Borumba, Yabba Creek and far downstream of Mary River near Miva.
- Exceedances of chromium (total), zinc (total and filtered), nickel (total and filtered), copper (total and filtered), manganese (total and filtered) at most sampling locations.
- *Escherichia coli* bacteria exceedances were recorded at most locations during the surveys conducted to date.
- Ammonia and total nitrogen exceeded the relevant water quality objectives at the majority of locations during four rounds of sampling, except Borumba Creek.

3.4.2 Potential impacts

Overall, the potential direct and indirect impacts from the Exploratory Works Project on surface water include:

- increased turbidity and sedimentation due to clearing, earthworks and movement of vehicles/plant within and near waterways (e.g. during construction of waterway crossings)
- increase in concentrations and load of sediment, nutrients and metals entering waterways through runoff from disturbed areas (e.g. during construction of the portal pad) including disturbance of unidentified contaminated land
- production of tannins from mulch during clearing
- potential contamination of waterways through the accidental release of sewage, grey water, seepage from tunnelling, fuel, oil, waste or other chemicals
- alteration of surface and subsurface flows that could cause disturbances to hydrology and hydraulics

- increased velocities within drainage lines and waterways as a result of hardstands and changes to catchment areas
- decrease in water availability due to water take from Yabba Creek (Lake Borumba) to support geotechnical investigations and related construction activities.

3.5 Groundwater

3.5.1 Existing environment

There are currently no requirements to manage groundwater take volumes within or surrounding the Borumba PHES Project footprint under the Water Plan (Mary Basin) 2024. The nearest location with management of groundwater take is the Cooloola Sandmass, which is about 45 km east, and not connected from a groundwater perspective.

There are no registered groundwater bores in the vicinity of the Borumba PHES Project upstream of Borumba Dam, but there are five registered bores within 5 km downstream and a number around Imbil. Groundwater is not currently used within the Exploratory Works Project footprint or the Borumba PHES Project area but is more extensively used in the broader region.

The geological units of the study area (AGE, 2022) can be grouped into the following general hydrostratigraphic units based on their ability to store and transmit groundwater:

- quaternary alluvium – forms a relatively thin aquifer system where it occurs along Yabba Creek and its tributaries
- regolith – a thin and variably permeable weathered rock at the surface, which generally does not form aquifers due to limited saturated thickness
- fractured rock aquifer – comprising all other bedrock units, which generally do not form aquifers but can have limited water yields from localised storage when faults and fractures are present within the rock mass.

Based on data from preliminary geotechnical studies, groundwater levels near the proposed new Borumba Dam wall range from 7.85 m below ground level (BGL) to 33 m BGL. At the saddle dam sites for the proposed upper reservoir, groundwater ranged from 6.55 to 10.25 m BGL (AGE, 2022).

There are insufficient groundwater level observations to accurately produce a groundwater table contour, however the groundwater table is likely to mirror topography, with groundwater flows generally draining towards creeks and valleys. No preferential flow paths due to geological structures are evident based on the available water level data (AGE, 2022).

A hydrogeological fieldwork program commenced in September 2023, which will address many of the identified data gaps identified in the groundwater assessment. The fieldwork program included the drilling and construction of 22 monitoring bores. The works also included hydraulic testing and installation of telemetry monitoring equipment.

The following preliminary observations were made from the laboratory analysis of groundwater data collected during the construction of the boreholes and initial sampling round between September 2023 and April 2024:

- Groundwater quality in the vicinity of the proposed lower reservoir is classified as freshwater, with total dissolved solids concentrations consistently <800 mg/L. This correlates with elevated concentrations of chloride exceeding the long term irrigation ANZECC guidelines.
- Groundwater quality in the vicinity of the proposed upper reservoir varies between freshwater and brackish water which correlates with elevated chloride concentrations exceeding the ANZECC long term irrigation guidelines in all samples. Elevated sodium concentrations were also observed in several of these samples.
- Water from monitoring bores generally had low concentrations of nutrients, except for concentrations of total nitrogen and total phosphorous in some samples in the vicinity of the proposed lower reservoir exceeding the long-term irrigation Australian and New Zealand Environment and Conservation Council guidelines in September 2023, and two boreholes (UR01-MB011 and UR01-MB013) having consistently elevated ammonia concentrations, ranging between 6 and 136 mg/L, exceeding the National Health and Medical Research Council drinking water guidelines.
- Elevated concentrations of total aluminium, arsenic, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel and vanadium in several samples in both the proposed upper and lower reservoir areas. Elevated uranium was also observed in some samples in the proposed upper reservoir area.

- Comparison of total and dissolved metal results showed that most concentrations decreased significantly in the dissolved fraction, confirming that the majority of total metals are attached to suspended materials in the water and suggesting that filtration would improve water quality in most cases. However, elevated concentrations of dissolved arsenic, total chromium, manganese, and nickel were observed in some samples
- Total concentrations for multiple metals were higher than freshwater aquatic ecosystem guidelines[2] and / or drinking water guidelines (NHMRC, 2011) at all bores at different times.

3.5.2 Potential impacts

Construction phase impacts on groundwater values of the area relate mainly to change in groundwater levels and potential availability to receptors, and to a lesser degree, groundwater quality. Provided that the proposed mitigation measures are implemented successfully, the construction phase of the Exploratory Works Project presents a low to medium residual risk to the groundwater values of the area. The key groundwater impacts are discussed below:

- Construction of the dual exploratory tunnels will include some dewatering of the Marumba beds aquifer, which will create localised groundwater impacts. The impacts are likely limited in extent but there will be a risk of short-term reduced water availability to potential groundwater dependent ecosystems and threatened ecological communities, limited to the areas above and immediately surrounding the tunnels.
- Discharged dewatering water can potentially be contaminated (deeper aquifer may have higher salinity than shallow aquifer) during construction activities and disposal of this water will require management.
- Introduction of contaminants to the aquifer associated with the explosives, for example ammonium nitrate and lead.
- Oxidation of exposed bedrock, resulting in natural chemical changes within the host rock. Net Acid Generation testing has classified the rock from 20 samples as non-acid generating.
- Potential leakage of oils, lubricants and fuels from construction vehicles and at workshop areas.
- Exposure of the aquifer to contaminants via infiltration from surface infrastructure or runoff. Identified contaminant sources include diesel storage tanks, cement and fly ash stockpiles and ablution facilities (noting all sewage is proposed to be trucked offsite).
- A reduction in groundwater levels and flows, and offsite discharge of water containing sediment from dewatering activities.
- Reduced recharge to the aquifer due to creation of hardstand areas associated with the spoils stockpile, support and staging area, portal pad, etc., which could also result in a localised reduction in baseflow seepage to the creeks.

[2] Australian and New Zealand guidelines for fresh and marine water quality (2018) and National Health and Medical Research Council Australian Drinking Water Guidelines (2011, v3.8 updated September 2022)

4. Erosion and sediment control management planning principles

The primary management tool for managing the potential soil and water impacts that may occur from the Exploratory Works Project is the development and implementation of an ESCP. The ESCP must include the following key practices:

- erosion control – minimising the extent and duration of soil disturbance, including promptly stabilising disturbed soils, and maximising protective groundcover – by use of both natural and artificial material as necessary
- drainage control – controlling water movement onto and within the site (including managing the discharge rates, flow velocities and discharge points), which may include the diversion and management of clean water away from the work site
- sediment control – maximising sediment retention on site.

The ESCP also develops design guidance to provide for the following principles:

- integration of the ESC measures on site during the construction and operational phases
- review and amendment of the ESCP if the implemented controls and measures do not meet the stated objectives
- maintenance of all permanent and temporary ESCP measures so that they always meet design capacities
- monitoring of the ESCP's performance against the required performance standard
- a defined maintenance and rehabilitation program, early works phase, and post-development and operational formation, where relevant.

The proposed ESCP must be tailored to the specifics of the work stages (e.g. land clearing, construction activities, ancillary infrastructure etc.) and in line with the design information developed through the design and then construction life cycle.

ESCPs can be presented as a series of plans and diagrams, showing the development site with the location of all temporary and permanent erosion controls. This should include where data has been confirmed for an estimation of soil loss using the revised universal soil loss equation (RUSLE) for pre- and post-development conditions. The factors (e.g. C-factor, R-Factor, P-Factor etc.) used for soil loss modelling must be described, and sources documented in the assessment.

Due to the nature of the Exploratory Works Project, it is likely that each catchment will have its own high level plan that features specific Exploratory Works Project elements. Future ESCPs will focus on sub-catchments with further tailoring of design for controls and measures that are provided in further details such as Level 2 ESCP.

5. Mitigation and management measures

Given the catchments and the disturbed areas proposed for the Exploratory Works Project, there will be requirement for temporary construction sediment management measures. These will be as per the Blue Book (Landcom, 2004) Volumes 1 and 2D, and IECA standards, which are referred to in Queensland's Procedural guide, releases to waters from land development sites and construction sites 2500 m^2 and greater.

For each of the construction catchments, Type 2 standard control measures (such as sediment fence, sediment sumps/traps, compost mulch etc.) should be applied. These will be used to treat sediment-laden construction water prior to reuse or discharge.

The portal pad and staging area will feature sediment basins and temporary water storage areas to manage water from tunnelling operations.

Based on desktop environmental settings, additional ESC planning will be required for access roads, material emplacement areas and the following creek crossings:

- Yabba Creek and Sandy Creek upstream of Lake Borumba (specifically, the water intake pump and pipeline at Yabba Creek, one temporary bridge crossing Yabba Creek for the portal pad access road and three temporary bridge crossings of Sandy Creek).
- New bed level crossing of Yabba Creek (±300 m downstream of the Borumba Dam wall (geotechnical drilling).

These areas represent high erosional risk and planning of work with seasonal rainfall must be considered. Where vegetation clearance is proposed to be undertaken in areas with slopes greater than 3%, these areas are also considered high risk, and must be managed accordingly. In this case, the primary objective of ESCs will be to maximise protection of terrestrial and aquatic habitats to:

- maintain the viability of the native riparian vegetation to provide suitable habitat for terrestrial and aquatic fauna
- provide bank stability
- protect water quality.

During the Exploratory Works Project, the CEMP is required to include Progressive ESCPs, as sub-plans, outlining controls to implement during earthworks within each of the work site catchments:

- controls shown on the ESCP are to be installed unless otherwise noted
- the ESCP is to be revised when required (e.g. change in construction methods and/or site conditions).

The potential for impacts on soil and water will depend on a number of factors. Primarily, impacts will be dependent on the nature, extent and magnitude of construction activities and their interaction with the natural environment.

The following key management strategies are actions that will assist in developing suitable environmental controls across the Exploratory Works Project that will evolve with design, and develop with construction methods:

- minimising extent and duration of disturbance
- controlling stormwater flows onto, through and from the site
- using erosion control measures to prevent onsite damage
- using sediment control measures to prevent offsite damage
- stabilising disturbed areas quickly
- inspecting and maintaining control measures.

These strategies will be adopted and implemented as described in the following sections.

5.1 Mitigation measures identified in soils assessment

The following are a range of mitigation measures identified for the Borumba PHES Project in the Soils Assessment Technical Report (Attexo, 2022):

- To minimise soil erosion and sediment transport, ESCPs should be developed and implemented as part of construction for high-risk activities. ESCPs should be prepared by a Certified Professional in Erosion and Sediment Control and in accordance with Best Practice Erosion and Sediment Control (IECA, 2008). In addition, ESCPs will need to be submitted to Queensland Hydro for approval prior to commencement of construction.

- Soils with dispersible subsoils have been identified as likely to occur throughout the Borumba PHES Project footprint and particular attention to soil erosion control measures is required in these soils. Strategies to minimise risk include limiting their disturbance, use of gypsum and covering dispersive material (e.g. buried under a minimum of 100 mm layers of non-dispersive soils before placing any revegetation or erosion control measures).
- To minimise erosion in or adjacent to the proposed Exploratory Works Project footprint, it is recommended that soil disturbance is minimised and clearing methods of blading and grubbing are avoided where possible. Staging of the works will reduce the impact on water quality at any one time. High risk activities near watercourses should also be scheduled, where practicable, to avoid the summer months where high intensity storms are more prevalent.
- To minimise the potential for the works to degrade the quality of the soil resource, appropriate soil testing and soil management measures should be developed and implemented.

5.2 Conceptual Erosion and Sediment Control Plan

Developing appropriate mitigation commences with a Conceptual Erosion and Sediment Control Plan (Conceptual ESCP). This stage is to establish the following data and constraints based on the detail of the Exploratory Works Project that is available in the early development planning and design cycle. Concept ESCPs will be prepared as needed for particular work components within the Exploratory Works footprint. Each Concept ESCP will review and consider the following as relevant.

5.2.1 Adequate data is obtained to allow appropriate site planning and design

- The extent and complexity of data collection will be commensurate with the potential environmental risk, and the extent and complexity of the proposed soil disturbance.
- Potential site constraints and zones of high or extreme erosion hazard will be identified early in the planning phase.
- A Conceptual ESCP will be prepared if the construction activities are deemed to represent a high to extreme erosion hazard.

5.2.2 Review soil disturbance footprint

- The development should be appropriately integrated into the existing site conditions, including the existing topography, such that the need for extensive land reshaping and surface modifications is minimised.
- Wherever reasonable and practicable, ‘cut and fill’ construction practices should not be employed on land slopes equal to or steeper than 20%.
- The staging and layout of the development components should not cause unnecessary soil disturbance if an alternative staging or layout (which reduces the potential environmental harm) is available that achieves the same or equivalent works outcomes at a reasonable cost.

5.2.3 Review the risk of environmental harm occurring during the Exploratory Works

- Potential high-risk construction activities will be identified during planning.
- Essential ESC measures will be appropriately integrated into the planning and design.
- Adequate space should be provided for the construction and maintenance of essential ESC measures at each Exploratory Works Project construction site.
- The works should avoid the placement of critical structures or buildings within the lowest land elevation within any sub-catchment if it would prevent the construction and effective operation of essential ESC measures throughout the works period.
- Ongoing erosion problems at the inlet and outlet of permanent drainage systems (pipes or channels) are minimised.
- The development incorporates current best practice stormwater quality controls for the operational phase.
- The design and layout appropriately recognises and integrates identified site constraints.
- To the maximum degree reasonable and practicable, disturbance of deep-rooted vegetation on slopes susceptible to mass movement should be minimised, if not totally avoided.

5.2.4 Review the risk of environmental harm to downstream waterways

- All reasonable and practicable measures should be taken to minimise changes to the natural water cycle (including volume, frequency, duration and velocity of stormwater runoff) during the works.
- The number of temporary and permanent watercourse crossings should be reduced to the minimum necessary.

5.3 Primary and Progressive ESCPs

Some impacts on soil and water attributable to the Exploratory Works Project are anticipated. Relevant aspects and the potential for related impacts will be considered in future risk assessments and adopted in the development and revision of the CEMP. A Primary and Progressive ESCP is anticipated to be required to address risks. These will be based on this Preliminary ESCP and concept ESCPs prepared for the particular component of works.

The Primary ESCP will contain detailed background information, risk assessment and discussion, while a series of subordinate Progressive ESCPs will provide up-to-date detail regarding location and installation of control measures.

Progressive ESCPs are typically developed as the details are refined and as site conditions evolve and flow paths are changed. Over the course of the Exploratory Works Project, a series of Progressive ESCPs are likely to be required to address all stages of the work and to provide the necessary levels of flexibility and detailed catchment-by-catchment response to performance and review. The following steps should be undertaken prior to construction within each designated catchment area:

- A Progressive ESCP should be prepared that details the controls and management actions implemented to minimise soil and water impacts for construction staging and at specific discharge points, and revised as necessary.
- Specific ESCPs for the soil disposal areas will be prepared in accordance with the requirements of this plan.
- Site personnel charged with the responsibility for implementation of the Progressive ESCP should have appropriate knowledge and experience in ESC management in accordance with the Best Practice Erosion and Sediment Control (IECA, 2008).
- Where permitted by design and site space, a clean water diversion bank or similar should be constructed at the top of the activity zone or catchment to divert offsite water (clean water) around the area of disturbance (refer to Appendix D for further details regarding how typical offsite water diversions may be constructed).

Where required, install sediment containment measures (e.g. excavated sumps, sediment fence, sandbag traps) to treat runoff from the disturbed catchment area. Placement of these control measures is restricted to the available space within the Exploratory Works Project boundary. Where space is restricted by approved Project boundaries, the capacity of sediment containment measures may be reduced by separating the catchment into smaller portions by way of diversion banks or temporary cut drains.

5.3.1 Construction activities

During construction associated with the Exploratory Works Project, there would be potential for sediment and nutrient-laden runoff from areas disturbed by construction to impact water quality in Yabba Creek, Sandy Creek, and their tributaries. Common areas that present a high risk of soil erosion and resulting environmental impacts include areas of concentrated flows and locations where surface gradients and slope lengths combine to increase the erosive potential of stormwater runoff. During the construction phase these locations would typically include:

- vegetation clearing limits particularly around existing creeks/floodway (e.g. for waterway crossings)
- road cuttings and embankments
- in-stream features within creeks and riparian corridors (i.e. temporary crossings).

General construction activities that have the highest risk of sedimentation and erosion impacts include:

- construction within or adjacent to waterways (i.e. Yabba Creek, Sandy Creek)
- general earthworks, including clearing of vegetation (terrestrial and riparian), stripping of topsoil, filling for embankments, and excavations for access tracks and the portal pad
- transportation of cut and/or fill and spoil materials
- stockpiling of material including topsoil and spoil

- movement of heavy vehicles across exposed earth.

The activities and risks being undertaken at each works component location will be considered when determining the appropriate control measures to be implemented through the Primary and Progressive ESCPs.

5.4 Proposed control measures

Construction planning aims to minimise the risk of environmental harm occurring during the construction phase. The design standard of drainage and ESCs are to comply with the requirements of the relevant conditions of approval, or where such a condition of approval does not exist, are designed in accordance with current best practice.

The level of information and detail supplied in the ESCP should be commensurate to the potential environmental risk and the complexity of the proposed works, and of sufficient clarity to allow onsite personnel to appropriately implement the plan.

5.4.1 Standard controls

The following ESCs are indicative of controls to be used to manage soil and water impacts during the Exploratory Works Project. Table 3 details the relevant section from the Soils and Construction Volume 1 (Landcom, 2004) and Volume 2D (DECC, 2008). Relevant drawings referred to are detailed in Appendix C. Controls should be implemented where appropriate and maintained to ensure proper function. Selection of control measures requires the following:

- identifying the problem (i.e. erosion or sedimentation) to be managed
- where the problem is erosion, identifying whether it is caused by raindrop impact or concentrated flow
- where the problem is sedimentation, identifying if sediment is conveyed by sheet or concentrated flow
- selecting the appropriate techniques depending on the identified specific nature of the problem.

Table 3: Standard erosion and sediment controls

Standard ESC typical drawings	Drawing reference
Earth bank (low flow)	SD 5-5
Earth bank (high flow)	SD 5-6
Earth basin – wet	SD 6-4
Concentrated flow (batter chute)	SD 5-7
Mesh and gravel inlet filter	SD 6-11
Geotextile inlet filter	SD 6-12
Stabilised site access	SD 6-14
Stockpiles	SD 4-1
Rock check dams	SD 5-4
Sediment fence	SD 6-8
Sediment traps at drop inlets	C5

Control measures are to be applied for the Exploratory Works Project in accordance with Best Practice Erosion and Sediment Control (Appendix I – Instream Works, Appendix J – Road and Rail construction, Book 4 - Design Fact Sheets) (IECA, 2008) and IECA Best Practice Erosion and Sediment Control Appendix P – Pipeline Construction (IECA, 2015), as relevant to the work type.

Table 4 shows examples of the minimum sediment control measures based on soil loss thresholds outlined in Best Practice Erosion and Sediment Control (IECA, 2008).

Table 4: Examples of minimum sediment control standards based on soil loss

Control type	Default/example treatment measure
Type 3	Sediment fence, U-shape sediment trap, modular sediment trap
Type 2	Filter tube dam, rock filter dam, sediment weir, compost mulch, berm, U-shape sediment trap with floc bloc if required
Type 1	Sediment basin sized accordingly

5.4.2 Basin locations and discussion

The portal pad and staging pad are located on steep terrain and will feature sediment basins and temporary water storage areas.

A temporary water storage pond will provide approximately 5 megalitres of water storage directly adjacent to the portals. This is intended to be used for the day-to-day management of water requirements associated with the drill and blast tunnelling operations.

Water from the tunnelling operation (e.g. drilling water and groundwater seepage) will be transferred via a laminar clarifier or similar to treat coarser sediment before being discharged into a dirty water basin for temporary storage. Solids may also be dewatered using a belt filter press or dewatering bags made of geotextile before water is transferred to the dirty water basin. Water from the dirty water basin will be transferred to the water treatment plant for treatment. Treated water will be discharged via pump and pipeline to storage tanks for reuse. Sludge (rock particles and fines) will periodically be removed from the dirty water basin and stored in the spoil disposal areas.

Water required for use in tunnel drilling operations will be sourced from the treated water storage on the portal pad. If necessary, additional water may be supplied by truck from the temporary water infrastructure (Tank Farm 1) or the storage tanks at the staging pad. Clean water will be used to support the Project activities where possible. However, it is noted that water with a high mineral content containing nitrates from the use of emulsion explosives can be reused underground as service water.

If the ingress of water into the tunnel (from underground aquifers via fissures and fractures in the rock) exceeds the consumption of water, then excess water will be sent from the temporary water storage pond to the water storage tanks at the staging pad. It has been assumed that groundwater ingress, post underground grouting, will occur at a rate of 2 litres per second per kilometre. This will be confirmed as the groundwater assessment progresses and water balance modelling for the exploratory tunnels is refined.

Where water ingress into the tunnels exceeds the capacity of the storage tanks (e.g. in large rainfall event), alternative disposal methods will be utilised (e.g. release to the environment, trucking offsite, irrigation, additional storage at another location). All releases to the environment will be in accordance with relevant approval conditions, including applicable water quality guidelines.

Other measures may also be employed to reduce sediment pollution, including progressive excavation work methods (exposed areas versus total area) that may reduce the need and volume of the sediment sumps.

5.4.3 Staging of erosion and sediment controls

Works are to be staged in the appropriate order for each component of the Exploratory Works Project (as defined for delivery), with the relevant ESCs implemented before and during each component as identified below:

- Ensure site boundary limits and no-go areas are defined – install site barrier fencing (or alternative measures) where suitable. Refer to access control notes in Section 5.4.4. There is to be no disturbance of any kind to the vegetation outside the Project footprint.
- Establish stabilised temporary site access/egress points (SD 6-14 in Appendix C), using rumble grids or similar. Refer to access control notes in Section 5.4.4. Locations shown on the plans are indicative only and can be moved to suit. However, note that in doing so, other surrounding ESCPs must still be implemented to same effect.
- Continue using existing track layout for site facilities (e.g. car parking, hardstand laydown) and avoid any further ground disturbance until sediment, drainage and erosion controls are in place as outlined below. The principle of

minimum disturbance to existing vegetation to be implemented with no-go zones isolated with appropriate barriers and signage.

- Clean and dirty water or construction runoff to be separated.
- Where required, sediment basins and clean and dirty water drains to be constructed immediately.
- Temporary ESCs to be installed before site disturbance, where reasonable and feasible.
- Runoff control from formations/tops of fills to sediment basins to be via one or a combination of fill shaping, diversion drains/banks, earth bunds along top edges of fill batters, discharging to batter drains etc.
- Install sediment fences, traps and sediment filter outlets (i.e. rock filter outlets or modular sediment traps). This includes installing stabilised outlet points. Refer to the sediment control notes (Section 5.5) and to the drawings in the ESCPs for details.
- Install containment/diversion bunds (or equivalent) and stabilise by covering with fabric (or similar). In locations where there is a fence or wall present, the wall can be used in place of containment bunds if the wall is sealed underneath so water cannot flow through.
- The onsite team is to ensure compliance with the proposed slope lengths (refer to Section 5.5.2).
- Disturbed areas should be progressively stabilised (e.g. final design treatments such as concrete or revegetation). Where disturbed areas are not being worked for long periods (>30 days), temporary stabilisation treatments are to be considered, especially during summer (December – February).
- Establish a stockpile area(s) and separate materials if required in accordance with the stockpiling notes (Section 5.4.5).
- For internal access roads/tracks (e.g. truck access road), if required, stabilise in accordance with engineering specifications (e.g. compacted earth with road base and spray seal finish). To improve and lengthen surface stability trafficable polymers are to be applied to the surfaces (e.g. Vital Bon-Matt HR or similar).
- Following the above steps and once all relevant approvals have been granted, ground works can commence to establish site facilities (e.g. material storage, workshop, site office, waste skip, concrete aggregate and concrete pump wash out).
- All surfaces excluding the immediate earthworks (cut/excavation works) are to be maintained as stabilised hardstand surfaces. In locations where hardstand surfaces are not formed, or to improve and lengthen surface stability, trafficable polymers are to be applied to surfaces (e.g. Vital Bon-Matt HR or similar).
- Dewatering of excavations, etc. to be conducted as per the requirements of the dirty water treatment and discharge requirements in Section 5.7.
- The tracking of mud/soil material onto local roads to be monitored and controlled (e.g. shaker/rumble grids, manual wheel washing, street sweeper etc.).
- Dust to be controlled on site and along unsealed roads with controls such as water carts and/or limiting vehicle speeds.
- Temporary controls to be inspected regularly with maintenance/repairs undertaken as required, particularly after rain events.

5.4.4 Access control

- Clearly delineate clearing boundaries and exclusion (‘no-go’) zones in areas adjacent to the Exploratory Works Project footprint. Clearing boundaries are as per the Exploratory Works Project footprint and have been determined based on the current design and construction methodology. Queensland Hydro will work with contractor(s) to avoid or minimise the impacts. No-go zones are shown on Figure 4 of the Flora and Fauna Management Plan and will include:
  - Conondale National Park
  - Conondale Resources Reserve (outside the areas approved for clearing)
  - threatened ecological communities and the buffer areas which directly adjoin the work front
  - areas of known threatened flora species populations
  - buffer zones around active breeding places for threatened species (an ecologist will determine the extent of the buffer area, considering the species and stage of breeding)
  - limits of instream works to minimise additional disturbance to the waterway

  - areas identified as biosecurity risks adjacent to the Exploratory Works Project footprint, where feasible and practical
  - buffer zones around populations of flora adjacent to the Exploratory Works Project footprint that are infected by Myrtle rust
  - 50 m buffer between the tunnel spoil disposal area and Yabba Creek and Sandy Creek, and 50 m between the Kingaham spoil disposal area and Kingaham Creek
  - exploratory works offset areas.
- Flagging tape, barricade fencing, fluorescent marker, signage or a combination of these measures will be installed for the no-go zones, prior to clearing commencing, to ensure personnel and vehicle(s) stay within the approved Exploratory Works Project footprint, avoiding contravention of disturbance limits.
- Barrier fencing is also to be used at the discretion of the site manager to delineate other no-go areas.
- Barrier fencing for ESC purposes can be simply made from tape or flagging around star pickets or stakes. Alternatively, sediment fences, site security/safety fence or chain wire fences can be used for this purpose if preferred. Existing fences and/or site fluffing can also be used where they are present in the relevant locations.
- Stabilised site access points (SD 6-14 in Appendix C) are to be provided in all locations where construction vehicles enter and exit the works onto public roads.
- Barrier and sediment fencing are to be used to ensure that all vehicles leaving the site pass over a stabilised access point to minimise bogginess in these areas and minimise sediment tracking onto public roads.
- Clearing boundary maps (hardcopy and soft copy) and georeferencing is to be provided to contractors and personnel will only be allowed on foot, on a limited case by case basis (i.e. to maintain the exclusion barrier), beyond the boundary of the exclusion ('no-go') zones.

5.4.5 Spoil Disposal areas

- The 50 m buffer between the spoil disposal areas and Yabba Creek, Sandy Creek and Kingaham Creek must be maintained.
- Topsoil will be progressively stripped from the site footprint and stockpiled in a long narrow windrow along the tunnel spoil area's western edge and the Kingaham spoil area's eastern and southern edge, creating a bund to contain future blasted rock material.
- A catch drain will be constructed at the high side of the tunnel area stockpile to capture runoff and divert it around the stockpile. ESC devices will also be installed to control runoff and sediment.
- No drainage lines or waterways are within the Kingaham spoil area.
- The topsoil will be reused in covering and revegetating the finished spoil stockpiles.
- ESC will be implemented to ensure that spoil placed in the spoil disposal areas remains within its required bounds and does not enter Sandy Creek, Yabba Creek or Kingaham Creek or adjacent drainage lines via runoff. These measures may include sediment fencing, coir logs, catch drains, and rock check dams. Other mitigation measures proposed to manage spoil and stockpiles are in Section 5.4.6.

5.4.6 Soil management and stockpiling

- Stockpile areas are to be established within the staged locations specified in the Exploratory Works Project plans. If additional or alternative locations for stockpiling are required, then they are to be subject to approval by Queensland Hydro before establishment. All stockpiles should incorporate clearly defined access controls and comply with the regulations outlined below. Progressive management plans are to detail the required ESCs for each stockpile area.
- All stockpiles are to be constructed and maintained generally in accordance with SD 4-1 (Appendix C).
- Potentially contaminated materials are not to be stockpiled with un-contaminated materials or on un-contaminated surface areas. Separate stockpile areas are to be established to ensure this. All stockpiles must have sediment fencing or equivalent installed downslope as per SD 4-1 (Appendix C).
- Different material types (e.g. mulched vegetation, topsoil, subsoil and other materials) are to be stockpiled separately wherever possible.

- Soil stockpiles are to be stabilised to achieve a C–factor (ground cover) of 0.1 (i.e. equivalent to 60% grass cover) within 10 days of formation using a temporary soil stabiliser (e.g. Vital Bon-Matt P74-VR1/Stonewall), geotextile, jute matting or equivalent.
- Topsoil stockpile should be constructed to no more than 3 m high wherever possible, noting that within the spoil disposal areas the design height is to 5 m with a maximum height of 7 m possible with appropriate management measures.
- Stockpiles should be battered down to a maximum slope of 2:1 wherever possible.

5.4.7 Stabilisation

- Undertake progressive stabilisation of disturbed ground surfaces as they are completed rather than at the end of the works program.
- Final stabilisation is to achieve the C–factor (ground cover) detailed in Table B-2 (Appendix B).
- Final rehabilitation is to be accordance with the landscaping/rehabilitation plans as outlined in the Decommissioning and Rehabilitation Strategy.
- Areas to be revegetated are to be topsoiled first using the topsoil stripped during the initial stages of works (if suitable) or using approved imported topsoil. Refer to SD 4-2 (Appendix C) for instructions regarding topsoil replacement.
- Appropriate seedbed preparation should be carried out when revegetating lands.
- Jute mesh, erosion control matting, soil stabilisers (e.g. Vital Bon-Matt Stonewall), hydro mulching or an appropriate alternative approved by Queensland Hydro should be used to provide suitable ground cover until vegetation is established.
- Temporary diversion drains are to be stabilised to achieve the C-factors (ground cover) as detailed in Table B-2 (Appendix B), using jute matting, geotextile fabric, rock, or turf reinforcement mats etc.
- Refer to engineering drawings for any permanent drain size lining detail, if applicable.
- Refer to the stockpiling notes (Section 5.4.5) for stabilisation requirements of stockpiles and Table B-2 .
- As surfaces are stabilised (at least 90% of any finished area has at least 70% ground cover), temporary ESC structures and water management structures can be removed (e.g. sediment fence and diversion drains).
- Temporary stabilisation on high-risk areas will be undertaken prior to rainfall in accordance with the rainfall preparation procedure notes (Section 5.8).
- Highly trafficable areas (i.e. site access roads) will be stabilised where reasonable and feasible with suitable material such as densely graded base, roadbase, gravel or Dustex to minimise erosion and provide stability to vehicle movements. In catchments not draining to a sediment basin or sump (i.e. areas shown as stabilised/sealed), stabilisation of roads and site compound surfaces is essential.

5.4.8 Works in waterways

Works in waterways will be conducted in accordance with the regulatory requirements for riparian zones as per the conditions of approval and CEMP. The following measures must be included in the planning to avoid or minimise erosion and any adverse impact on water quality and riparian fauna and flora:

- planning the works to avoid, where practicable, any activities in aquatic habitats for matters of national environmental significance during breeding seasons
- properly protecting and signposting as environmentally sensitive areas, all waterways in or adjacent to the Exploratory Works that are excluded from the work areas
- minimising riparian vegetation removal where practicable and restricting access to the waterways to the minimum amount of bank length required for the activity
- retaining stumps in riparian zones and aquatic habitats, where practicable, to reduce the potential for bank erosion
- carrying out any refuelling of plant and equipment, chemical storage and decanting at least 50 m away from aquatic habitats unless otherwise approved by Queensland Hydro.

5.4.9 Temporary waterway crossings

Where fish and aquatic habitat are present, the preferred type of watercourse crossing will be designed with consideration of the presence of existing barriers to fish passage both upstream and downstream of the proposed crossing. Temporary waterway crossings must maintain the flow in the waterway, and be designed, constructed and maintained in accordance with the requirements of the Blue Book (Landcom, 2004) and the Accepted development requirements for operational work that is constructing or raising waterway barrier works (DAF, 2018) and/or the relevant conditions of approval.

Instream works areas must be isolated before instream works commence. Exclusion ('no-go') zones will be installed around the works. Bed level crossings will be constructed using large, clean rock to minimise sedimentation within the watercourse. Works near waterways will then need to be stabilised or progressively rehabilitated as soon as possible.

Proposed ESC measures for the construction of temporary bridges on Yabba and Sandy Creek are shown in Appendix E.

5.5 Sediment controls

There is a potential soil erosion risk, and related sedimentation impacts, associated with the Exploratory Works Project. Activities that clear vegetation, disturb the soil, or concentrate runoff water have the potential to cause soil erosion and sedimentation. Sediment controls must be identified and installed before commencement of each section of works. The following standard sediment controls must be considered and adapted to suit each catchment as required to meet the objectives of the ESCP:

- Install sediment fencing in accordance with SD 6-8 (Appendix C).
- Sediment fences must be firmly trenched into the ground for their entire length.
- If sediment fences cannot be trenched into the ground (i.e. if hardstand/pavement surfaces are present) sediment fences can be secured by placing tightly abutting sandbag or coir logs over the fabric to hold it down.
- Tightly abutting gravel bags, coir logs or sandbags can also be used in place of sediment fencing where sediment fencing cannot be installed (i.e. on hardstand areas or constantly changing areas)
  - however, gravel bags and sandbags are to be a minimum of 2 bags high and consideration should be given to ongoing traffic and construction movements to avoid damaging the bunds.
- Sediment fences are to be held up by securing to star pickets placed at a maximum of 2.5 m intervals where practicable, alternatively they can be securely attached to site security fencing.
- Sediment fences must include small 'returns' at maximum 20 m intervals (see SD 6-8 in Appendix C) to minimise the risk of water flowing along the fence rather than through the fence
  - sandbag bunds can be used for this purpose if desired.
- If available, mulch may be used in 200 mm high rows instead of sandbags to break up and achieve slope lengths.

5.5.1 Sediment traps/rock filter dams/modular sediment traps

- Sediment traps are to be formed as a sump (detention storage area) with sediment filter outlet.
- Sediment trap sumps may be split throughout the catchment as long as the filter outlets remain as to what is specified within this PESCP for each overflow point.
- Sediment sump sizing details are to be specified on the ESCP.
- Install the filter outlets as either a rock filter or a modular sediment trap in accordance with sizing and details shown on the ESCP.
- Rock filter dam outlets (if adopted) are to be installed in accordance with IECA 2008 (e.g. Standard drawing Rock Filter Dam 01 and 02).
- Modular traps (if adopted) are to be built as either two sediment fences with straw bales between, or as two sediment fences with 15 to 25 mm aggregate fill in between.
- If the above filter outlets cannot be constructed due to site/construction conditions, tightly abutting coir logs or gravel filled bags are to be used as the filter outlet. Ensure the coir logs/bags are securely held in place.

- All filter outlet structures are to be built to incorporate a primary outlet (weir overflow/spillway) to ensure overflows are controlled and are stable.
- It is recommended that gypsum is placed at the inlets to the sediment traps prior to rainfall to help pre-heat site water.
- Sediment is to be removed from sediment traps and filter outlets regularly and filter aggregate/fabric/straw bales replaced as required.

5.5.2 Slope lengths

Where practicable, slope lengths are to be restricted to 80 m intervals or smaller across all exposed surfaces before and during rainfall.

Diversion bunds/drains, low flow earth banks (SD 5-5 in Appendix C) or sandbags/equivalent should be installed before rainfall events to achieve this where required. However, slope lengths are often naturally minimised due to the topography of the works and in this case additional slope breaks may not be necessary.

Batter chutes are to be provided at regular intervals down batters as fills are formed – locations and details to be provided within Progressive ESCPs.

5.5.3 Sediment basins

As detailed in Section 5.4.2, a sediment basin is proposed at the portal pad location.

The size and location of additional construction sediment basins will be included in the earthworks design for catchments where soil loss is predicted (based on RUSLE) to exceed 150 tonnes per annum and in accordance with the conditions of approval. Catchment size and soil loss will be reviewed throughout construction based on maximising capture of runoff from construction areas. A register that details basin inspections, maintenance, discharge volumes and dates, flocculation details, discharge-water quality and volumes of sediment removed will be maintained.

Sediment basins will be cleaned out and/or discharged whenever the accumulated sediment exceeds 60% of the sediment storage capacity. Before discharging to the environment, water will be treated and tested to the standard that achieves the *Mary River Environmental Values and Water Quality Objectives*. Access to basins to allow cleaning out will be maintained in all weather conditions.

5.5.4 Flocculation

Where flocculation is necessary to settle suspended sediments in the basins, the proposed flocculant or coagulant will be applied as the flocculating agent to settle the sediments within 24 hours of the conclusion of each rain event causing runoff wherever possible. Before applying a flocculating agent, the amount of the agent that is appropriate for the volume to be treated, the sediment type and the prevailing weather conditions will be determined.

5.6 Dust suppression

Dust suppression should be carried out wherever necessary to minimise sediments becoming airborne due to wind erosion.

During the Exploratory Works, raw water for dust suppression will be sourced from Lake Borumba and/or groundwater ingress during the exploratory tunnelling, subject to meeting water quality criteria. Water sourced from Lake Borumba will be supplied via temporary water infrastructure that includes pumps, pipelines, and storage tanks. A dust suppressant management system (e.g. Vital Bon-Matt Stonewall, Dustex, Dustguard, or equivalent) may also be identified as necessary. Implementation of said system would be subject to approval by the site Environmental Manager prior to starting Exploratory Works.

Temporary stabilisers (e.g. Vital Bond-Matt P47-VR1/Stonewall), geotextile, jute matting or equivalent can be used in non-trafficked areas to assist with dust control.

Wherever practicable, designated access roads are to be stabilised with crushed rock, aggregate, road base, a trafficable soil stabiliser or equivalent to assist with dust control on these surfaces.

5.7 Dirty water treatment and discharge requirements

Water accumulation in sediment traps, sumps, trenches, excavations or in any other low points on site can either be:

- re-used for dust suppression or construction purposes, provided that it meets relevant water quality criteria
- pumped into a tank, truck or other holding area for later treatment
- treated (if required) and tested in-situ, then released off site once it meets the required water quality discharge criteria (see below).

Any such discharge of water from the Exploratory Works Project (i.e. where water is moved off site once it meets the required water quality discharge criteria) and any active discharge of water from the Exploratory Works (i.e. where water is moved off site via direct action such as pumping rather than flowing off the work sites as a result of heavy rainfall) is to achieve:

- 50 mg/L or less TSS or laboratory correlated NTU
- pH 6.5 to 8.5
- no visible trace of oils or grease.

Discharge of any water to the environment or for reuse on site is to be managed through an approved procedure as determined by Queensland Hydro and in accordance with relevant State approvals.

Sediment traps must be emptied within five (5) calendar days of rainfall event. This includes treating water and testing to confirm adequate quality, dewatering and, if required, de-silting.

These dewatering requirements apply to water accumulating in any sort of excavation, trench or other ponded water body on the site.

If water is going to be used within the site for dust-suppression or construction purposes and will drain back into the sediment capture system, it may not require treatment. Water with a high mineral content containing nitrates from the use of emulsion explosives can be reused underground as service water.

5.8 Rainfall preparation procedure

The weather forecast is to be monitored regularly (at least daily and hourly when rainfall is imminent) by the construction contractor's site manager and Environmental Manager (or their representative/s).

The sump and containment wall available capacity is to have set design criteria as specified by Queensland Hydro. They are to be sized to appropriately manage the expected rainfall (in accordance with construction detail).

Prior to forecast rainfall (>50% chance of 10 mm or more over 24 hours), the following should occur:

- all exposed batters not draining to a sediment basin or sump (i.e. exposed site compound surfaces or batter surfaces) are to be stabilised with temporary ground covers (i.e. Vital Bon-Matt P47-VR1/Stonewall, geotextile or black plastic or equivalent)
- batter chutes and check dams are to be installed (if not already in place), with Progressive ESCPs to detail batter chute locations.

Prior to forecast rainfall (>50% chance of 25 mm or more over 24 hours), the following should occur:

- slope breaks to be pushed up or cut in across large, exposed areas to slow down flows and minimise erosion – refer to slope lengths notes (Section 5.5.2) for details
- additional bunds and sumps/traps to be installed for general works areas where required to separate catchments and minimise reliance on sediment ponds, with Progressive ESCPs to show details.

5.9 Site inspection, monitoring and maintenance

Regular site inspections are to be conducted by the site's Environmental Manager (or their representative) at least weekly during normal construction hours:

- prior to forecast rainfall of 25 mm or more over 24 hours
- daily during rain events (if safe to do so)

- within 24 hours of the cessation of a rain event that causes runoff (if safe to do so).

Inspections should include documenting any urgent repair, maintenance or improvement works. Records are to be kept including details of actions and their close outs, including:

- sediment or rocks tracked from the site should be removed from public roads as soon as possible after rainfall, sediment accumulated in trapping devices (e.g. in sediment fences) should be removed to a secure location where it can't wash or blow off site (preferably to an active stockpile)
- weather conditions will be monitored and daily rainfall recorded
- safe storage areas for wastes, fuels, excess concrete and other potential contaminants are to be delineated by the site supervisor
- adequate supplies of erosion control measures (e.g. geofabric rolls, filter socks or similar) are to be maintained onsite for rapid deployment as required
- if required, water treatment chemical(s) and equipment are to be maintained onsite
- dust suppression is to be undertaken as required to minimise the risk of offsite dust impacts.

Additional ESCs will be installed as necessary to ensure satisfactory outcomes in keeping with conditions and best-practice Blue Book guidelines (Landcom, 2004).

This PESCP will be updated or Progressive ESCPs prepared as required e.g. following a change in construction methods and/or site conditions.

6. Reporting

6.1 Continual improvement and meeting the requirements of the environmental documents.

This PESCP will be reviewed and, if necessary, updated whilst activities involving excavated material at Exploratory Work Project sites are being performed. It will be updated to reflect site investigation findings, program developments, changes in law, changes in guidelines, comments and feedback by regulatory agencies, and when the plan is identified to require development, amendment or updating.

Audits shall be undertaken to assess the effectiveness of ESC management measures, compliance with this PESCP, CESCPs and Progressive ESCPs, the conditions of the approvals, licences and guidelines.

7. References

AGE. (2022). *Borumba Pumped Hydro Project - Groundwater Assessment Technical Report.* AGE.

Attexo. (2022). *Borumba Dam Pumped Hydro Project - Soils Assessment Technical Report.* Attexo.

DAF. (2018). *Accepted development requirements for operational work that is constructing or raising waterway barrier works.* Department of Agriculture and Fisheries.

DECC. (2008). *Managing Urban Stormwater: Soils and construction - Volume 2D Main Road Construction.* Department of Environment and Climate Change.

DERM. (2010, July). *Environmental Protection (Water) Policy 2009 - Mary River environmental values and water quality objectives.* Retrieved from Department of Environment and Science: https://environment.des.qld.gov.au/__data/assets/pdf_file/0031/87565/mary-river-ev-2010.pdf

IECA. (2008). *Best Practice Erosion and Sediment Control.* IECA Australasia.

IECA. (2015). *Best Practice Erosion and Sediment Control - Appendix P.* IECA Australasia.

Landcom. (2004). *Managing Urban Stormwater: Soils and Construction .* Landcom.

NHMRC. (2011). *National Water Quality Management Strategy - Australian Drinking Water Guidelines.* National Health and Medical Research Council.

Northcote et al. (1960-68). *Atlas of Australian Soils.* CSIRO.

Appendix A -
Risk assessment and controls

Table A-1 identifies the risks described further in Section 3 of this PESCP and Table A-2 summarises the proposed mitigation and management measures / methods to address the risks. All works will require assessment against the methods and requirements outlined in Section 5 to determine necessary plans to be developed and accompanying mitigation measures to be implemented. This includes preparation and implementation of a Concept ESCP, Primary and Progressive ESCPs, rainfall preparation procedure and control measures including basins, staging, access control, stockpiling management, stabilisation, dust suppression, dirty water treatment and sediment controls, as further discussed in Section 5.

All ESC management and mitigation measures will be underpinned by the broader measures, training, monitoring, recording and reporting requirements outlined in section 4 – Environmental Management System – of the CEMP.

Table A-1: Risk assessment

Project component	Description	Risk (erosion and sedimentation)	Risk level (without controls)			Risk level (post controls as identified in Table A-2)		
			Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Geotechnical investigations								
Geotechnical investigations	Test pits to obtain geotechnical information necessary to determine the suitability of the Borumba PHES Project location and support the detailed design.	• Erosion and sedimentation of existing areas as a result of vegetation removal and earthworks associated with geotechnical investigations • Loss of topsoil/subsoil • Degraded water quality in downstream areas from sediment-laden runoff • Sediment released into the creeks upstream of Lake Borumba from soil disturbance associated with the Exploratory Works Project (e.g. construction of pads) may wash into the upper reaches of Lake Borumba. It may also be deposited in the stream beds, resulting in changes to the aquatic ecosystems, particularly streambed flora and fauna distribution/occurrence.	Likely	Moderate	Medium	Possible	Minor	Low
	Boreholes (deep and shallow, including some conversion to groundwater monitoring bores)	• Erosion and sedimentation of existing areas as a result of vegetation removal and earthworks associated with geotechnical investigations • Loss of topsoil/subsoil • Degraded water quality in downstream areas from sediment-laden runoff • Sediment released into the creeks upstream of Lake Borumba from soil disturbance associated with the Exploratory Works Project (e.g. construction of pads) may wash into the upper reaches of Lake Borumba. It may also be deposited in the stream beds, resulting in changes to the aquatic ecosystems, particularly streambed flora and fauna distribution/occurrence.	Likely	Minor	Low	Possible	Minor	Low
Spoil disposal								
Tunnel spoil disposal area, Kingaham spoil disposal area	Dedicated area for disposal of spoil material from exploratory tunnel and technical drilling and stockpiling of topsoil.	• Construction activities including trafficking of soil and soil handling during earthworks have the potential to degrade the quality of the soil resource. Soil degradation can result in poor rehabilitation outcomes, bare ground and increased risk of erosion and sedimentation. • Impacts to surface and groundwater from erosion and sedimentation affecting local water quality. • Inadequate erosion control and containment of spoil. • The spoil stockpile carries contamination risk and sampling to date suggests this primarily relates to certain metals. Potential for contaminants to be transported offsite if not properly contained. These risks are addressed in the Spoil Management Sub-plan (Appendix H of the CEMP).	Likely	Major	High	Possible	High	Medium
Site access								
Kingaham Creek bypass	Realignment of a section of Bella Creek Road (Kingaham Creek bypass) and vehicle movements along Bella Creek Road.	• Loss of topsoil/subsoil • Degraded water quality in downstream areas from sediment-laden runoff downslope from the works • Erosion and sedimentation of existing areas as a result of vegetation removal and earthworks.	Likely	Moderate	Medium	Possible	Moderate	Medium
New/ upgraded access tracks	New access tracks and upgrades to existing tracks, including multiple waterway crossings, to enable access to geotechnical investigation and exploratory tunnel drilling sites	• Disturbance of creek/watercourse sediment mobilising particles, impacting water quality. • Changes to surface water flow regime. • Waterway crossings impacting aquatic MNES (from increased sedimentation, clearing and bank erosion etc.)	Likely	High	High	Possible	Moderate	Medium
Other supporting infrastructure								

Project component	Description	Risk (erosion and sedimentation)	Risk level (without controls)			Risk level (post controls as identified in Table A-2)		
			Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Temporary water infrastructure, staging pad, civil construction compound	Construction of temporary water infrastructure, staging pad, civil construction compound (laydown area).	• Construction activities including trafficking of soil and soil handling during earthworks have the potential to degrade the quality of the soil resource. Soil degradation can result in poor rehabilitation outcomes, bare ground and increased risk of erosion and sedimentation • Impacts to surface and groundwater from erosion and sedimentation affecting local water quality. • Inadequate erosion control and containment of spoil • Within Lake Borumba, water quality issues may arise in areas where soils are disturbed and erosion occurs adjacent to the reservoir (e.g. during construction of the temporary water infrastructure), washing soils into the water. Clearing of vegetation in the water storage areas, depending on how it was undertaken, could also disturb soils and cause erosion. This would result in: – Increased suspended solids and increased turbidity in the water body. Colloidal clays from dispersive soils have the potential to stay in suspension for long periods of time. – Transport of nutrients into Lake Borumba, which may create conditions suitable for algal blooms	Likely	High	High	Possible	Moderate	Medium
Exploratory tunnel infrastructure								
Dual exploratory tunnels	Exploratory drilling of dual tunnels to the powerhouse cavern from the portal pad	• Discharge from dewatered groundwater causing erosion and sedimentation issues if not properly contained and managed during tunnelling. These risks are addressed in the Water Management Sub-plan (Appendix K of the CEMP).	Likely	Moderate	Medium	Possible	Minor	Low
Portal pad	The construction of a portal pad	• Impacts to surface water quality (nearby watercourse, downstream) from runoff and sedimentation, impacting turbidity, salinity, dissolved oxygen etc. (this risk relates to all clearing activities and runoff from all Exploratory Works Project surfaces.) • Impacts to surface water quality (nearby watercourse, downstream) from contamination (fuel, oil or chemical spills, leaks, reaching surface and groundwater) if inadequate erosion and sediment control is implemented. • Discharge of surface water (e.g. sediment-laden runoff) collected during construction and use of pad	Likely	High	High	Possible	Minor	Low

Table A-2: Mitigation measures to address potential risks

Impact	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
Geotechnical investigations							
Test pits	Site/project engineer	• Spoil contained in dedicated stockpiles, environmental values (i.e. water quality) maintained – no impact from erosion and sedimentation from stockpiled materials. • All materials contained and stockpiled within approved Exploratory Works Project disturbance footprint. • Any contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Plan, Appendix I to the CEMP). • Prompt reinstatement and rehabilitation of disturbed areas.	• Install erosion and sediment controls as per this PESCP (Section 5). • Temporary stockpiling within approved disturbance footprint (work area) and prompt removal to SDA. • Contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). • Stockpiling topsoil and subsoil separately on either side of the test pit, and backfilling test pits with the stockpiled subsoil and topsoil, in the correct sequence, as soon as practicable. • Erosion prevention on sloping ground by installing drainage structures that minimise surface water flow into the excavation. Topsoil and subsoil stockpiles can be used to divert water around the excavation.	• Zero community complaints related to erosion and sedimentation. • Zero serious environmental incidents related to erosion and sedimentation. • No material impact to environment outside of approved disturbance footprints.	• Daily site report (daily diary). • Otherwise as per CEMP.	• Community complaint received • Serious environmental incident related to erosion • Evidence of erosion occurring outside the disturbance footprint	• Revise erosion and sedimentation controls. • Remediation if required. • Otherwise as per CEMP.
Boreholes	Site/project engineer	• Prompt reinstatement of spoil following completion of testing to allow for site rehabilitation. No evidence of investigation activity/drilling at each location following completion of testing and reinstatement of spoil/rehabilitation.	• Install suitable erosion and sediment controls around geotechnical boreholes and pads, in accordance with controls within this PESCP. • Clean rock fill only to be used for geotechnical pads within the waterway corridor. • Reinstate spoil into boreholes as soon as practicable. Prompt removal of any excess spoil off site, to allow for site rehabilitation/revegetation.	• Zero community complaints related to erosion and sedimentation. • Zero serious environmental incidents related to erosion and sedimentation. • No material impact to environment outside of approved disturbance footprints.	• Daily site report (daily diary). • Otherwise as per CEMP.	• Community complaint received • Serious environmental incident related to erosion • Evidence of erosion occurring outside the disturbance footprint	• Remediation if required. • Otherwise as per CEMP.
Spoil disposal							
Tunnel spoil disposal area, Kingaham spoil disposal area	Site/project engineer, environmental management representative	• Spoil contained in dedicated stockpiles, environmental values (i.e. water quality) maintained – no impact from erosion and sedimentation from stockpiled materials. • All materials contained and stockpiled within approved Exploratory Works Project disturbance footprint. • Any contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Plan, Appendix I to the CEMP).	• The 50 m buffer between the spoil disposal areas and Yabba Creek, Sandy Creek and Kingaham Creek must be maintained • Topsoil must be progressively stripped from the site footprint and stockpiled in a long narrow windrow along the tunnel spoil area's western edge and the Kingaham spoil area's eastern and southern edge, creating a bund to contain future blasted rock material • A catch drain is to be constructed at the high side of the tunnel area stockpile to capture runoff and divert it around the stockpile. ESC devices will also be installed to control runoff and sediment • The topsoil must be reused in covering and revegetating the finished spoil stockpiles where suitable	• Zero community complaints related to spoil. • Zero serious environmental incidents related to spoil, handling and disposal. • Maintain complete segregation and signage of spoil stockpiles. • No material impact to environment outside of approved disturbance footprints. No spoil leaving approved work area/footprint, other than via truck. • Water quality of adjacent creeks and drainage lines	• Daily site report (daily diary). • Weekly environmental inspection. • Otherwise as per CEMP.	• Community complaint received • Serious environmental incident related to spoil handling and disposal • Evidence of disturbance outside the footprint • Exceedances of water quality objectives in adjacent creeks or drainage lines	• Dust suppression. • Revise erosion and sedimentation controls. • Returning of spoil, to designated storage area. • Additional testing of spoil material, ad hoc as required. • Remediation if required. • Otherwise as per CEMP.

Impact	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
		• Prompt reinstatement and rehabilitation of disturbed areas.	• ESC will be implemented to ensure that spoil placed in the spoil disposal areas remains within its required bounds and does not enter Sandy Creek, Yabba Creek or Kingaham Creek or adjacent drainage lines via runoff. These measures may include sediment fencing, coir logs, catch drains, and rock check dams. • Stockpile areas are to be established within the staged locations specified in the Exploratory Works Project plans. If additional or alternative locations for stockpiling are required, then they are to be subject to approval before establishment. All stockpiles should incorporate clearly defined access controls and comply with the regulations outlined below. Progressive management plans are to detail the required ESCs for each stockpile area • All stockpiles are to be constructed and maintained generally in accordance with SD 4-1 (Appendix C) • Different material types (e.g. mulched vegetation, topsoil, subsoil and other materials) are to be stockpiled separately wherever possible • Soil stockpiles are to be stabilised to achieve a C–factor (ground cover) of 0.1 (i.e. equivalent to 60% grass cover) within 10 days of formation using a temporary soil stabiliser (e.g. Vital Bon-Matt P74-VR1/Stonewall), geotextile, jute matting or equivalent • Topsoil stockpile should be constructed to no more than 3 m high wherever possible • Stockpiles should be battered down to a maximum slope of 2:1 wherever possible.	remains within the water quality objectives.			
Site access							
New access tracks, upgrades to existing access tracks	Site/project engineer, environmental management representative	As for test pits above.	As for test pits above.	• Zero community complaints related to erosion and sedimentation. • Zero serious environmental incidents related to erosion and sedimentation. • No material impact to environment outside of approved disturbance footprints. • No material leaving approved work area/footprint, other than via truck.	• Daily site report (daily diary). • Otherwise as per CEMP.	• Community complaint received • Serious environmental incident related to erosion • Evidence of erosion and/or material outside the disturbance footprint	• Dust suppression. • Revise erosion and sedimentation controls. • Returning of material, to designated storage area. • Remediation if required. • Otherwise as per CEMP.
Kingaham Creek bypass	Site/project engineer, environmental	As for test pits above.	As for test pits above.	• Zero community complaints related to erosion and sedimentation.	• Daily site report (daily diary). • Otherwise as per CEMP.	• Community complaint received • Serious environmental	• Dust suppression. • Revise erosion and sedimentation controls.

Impact	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
	management representative			• Zero serious environmental incidents related to erosion and sedimentation. • No material impact to environment outside of approved disturbance footprints. • No material leaving approved work area/footprint, other than via truck. • Water quality of adjacent creeks and drainage lines remains within the water quality objectives.		incident related to erosion • Evidence of erosion and/or material outside the disturbance footprint • Exceedances of water quality objectives in adjacent creeks or drainage lines	• Returning of material, to designated storage area. • Remediation if required. • Otherwise as per CEMP.
Exploratory tunnel infrastructure							
Dual exploratory tunnels	Construction manager, site/project engineer, environmental management representative	• Minimal dust impacts and no community complaints regarding dust. • Spoil contained in stockpiles, environmental values (i.e. water quality) maintained – no impact from erosion and sedimentation from spoil. • All spoil contained and stockpiled within approved Exploratory Works Project disturbance footprint. • Any contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP).	• Dust suppression with watering if required. Minimal handling of spoil. Revise work plans if high winds anticipated. • Install erosion and sediment controls as per this PESCP. • Temporary stockpiling within approved disturbance footprint (work area) and prompt removal to SDA. • Contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). • Management measures as outlined in Section 5	• Zero community complaints related to erosion and sedimentation. • Zero serious environmental incidents related to erosion and sedimentation. • No material impact to environment outside of approved disturbance footprints. • No material leaving approved work area/footprint, other than via truck. • Maintenance of water egress.	• Daily site report (daily diary). • Weekly environmental inspection. • Otherwise as per CEMP and relevant sub-plans.	• Community complaint received • Serious environmental incident related to erosion • Evidence of erosion and/or material outside the disturbance footprint • Uncontained / uncontrolled water egress observed	• Dust suppression. • Revise erosion and sedimentation controls. • Returning of material, to designated storage area. • Remediation if required. • Otherwise as per CEMP.
Staging pad, portal pad, explosive store	Construction manager, site/project engineer, environmental management representative	• Minimal dust impacts and no community complaints regarding dust. • Spoil contained in stockpiles, environmental values (i.e. water quality) maintained – no impact from erosion and sedimentation from spoil. • All spoil contained and stockpiled within approved Exploratory Works Project disturbance footprint. Any contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP).	• Dust suppression with watering if required. Minimal handling of spoil. Revise work plans if high winds anticipated. • Install erosion and sediment controls as per this PESCP. • Temporary stockpiling within approved disturbance footprint (work area) and prompt removal to SDA. • Contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). • Management measures as outlined in Section 5	• Zero community complaints related to erosion and sedimentation. • Zero serious environmental incidents related to erosion and sedimentation. • No material impact to environment outside of approved disturbance footprints. • No material leaving approved work area/footprint, other than via truck. • Water quality of adjacent creeks and drainage lines remains within the water quality objectives.	• Daily site report (daily diary). • Weekly environmental inspection. • Otherwise as per CEMP and relevant sub-plans.	• Community complaint received • Serious environmental incident related to erosion • Evidence of erosion and/or material outside the disturbance footprint • Exceedances of water quality objectives in adjacent creeks or drainage lines	• Dust suppression. • Revise erosion and sedimentation controls. • Returning of spoil, to designated storage area. • Remediation if required. • Otherwise as per CEMP.

Impact	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
Other supporting infrastructure							
Civil construction compound, temporary water infrastructure	Construction manager, site/project engineer, environmental management representative	• Minimal dust impacts and no community complaints regarding dust. • material contained in stockpiles, environmental values (i.e. water quality) maintained - no impact from erosion and sedimentation from spoil. • All material contained and stockpiled within approved Exploratory Works Project disturbance footprint. • Any contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP).	• Dust suppression with watering if required. Minimal handling of spoil. Revise work plans if high winds anticipated. • Install erosion and sediment controls as per this PESCP. • Temporary stockpiling within approved disturbance footprint (work area) and prompt removal to SDA. • Contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). • Management measures as outlined in Section 5	• Zero community complaints related to erosion and sedimentation. • Zero serious environmental incidents related to erosion and sedimentation. • No material impact to environment outside of approved disturbance footprints. • No material leaving approved work area/footprint, other than via truck. • Water quality of adjacent creeks and drainage lines remains within the water quality objectives.	• Daily site report (daily diary). • Weekly environmental inspection. • Otherwise as per CEMP and relevant sub-plans.	• Community complaint received • Serious environmental incident related to erosion • Evidence of erosion and/or material outside the disturbance footprint • Exceedances of water quality objectives in adjacent creeks or drainage lines	• Dust suppression. • Revise erosion and sedimentation controls. • Returning of spoil, to designated storage area. • Remediation if required. • Otherwise as per CEMP.
Works in waterways, including temporary waterway crossings	Construction manager, site/project engineer, environmental management representative	• All material contained within approved Exploratory Works Project disturbance footprint. • All works undertaken in accordance with identified ESCPs and relevant development approvals.	The following measures must be included in the planning to avoid or minimise erosion and any adverse impact on water quality and riparian fauna and flora including: • planning the works to avoid, where practicable, any activities in aquatic habitats and riparian zones • properly protecting and signposting as environmentally sensitive areas, all waterways in or adjacent to the Exploratory Works that are excluded from the work areas • minimising riparian vegetation removal where practicable and restricting access to the waterways to the minimum amount of bank length required for the activity • retaining stumps in riparian zones and aquatic habitats, where practicable, to reduce the potential for bank erosion • Bed level crossings will be constructed using large, clean rock to minimise sedimentation within the watercourse • Install erosion and sediment controls as per this PESCP.	• No material impact to environment outside of approved disturbance footprints. • No material leaving approved work area/footprint, other than via truck. • Water quality of waterways remains within the water quality objectives.	• Daily site report (daily diary). • Weekly environmental inspection. • Otherwise as per CEMP and relevant sub-plans.	• Evidence of erosion and/or material outside the disturbance footprint • Exceedances of water quality objectives in waterway	• Revise erosion and sedimentation controls • Remediation if required. • Otherwise as per CEMP.

Appendix B -
Erosion and sediment control planning tools

Table B-1: Erosion Hazard Assessment Form (IECA, 2008)

Condition	Points	Score	Trigger value
Average Slope Of Disturbance Area [1] • not more than 3% [3%. 33H:1V] • more than 3% but not more than 5% [5% = 20H:1V] • more than 5% but not more than 10% [10% = 10H:1V] • more than 10% but not more than 15% [15%. 6.7H:1V] • more than 15%	0 1 2 4 6		**4**
Soil Classification Group (AS1726) [2] • GW, GP, GM, GC • SW, SP, OL, OH • SM, SC, MH, CH • ML, CL, or if *imported fill* is used, or if soils are untested	0 1 2 3		
Emerson (Dispersion) Class Number [3] • Class 4, 6, 7, or 8 • Class 5 • Class 3, (default value if soils are untested) • Class 1 or 2	0 2 4 6		**6**
Duration of Soil Disturbance [4] • not more than 1 month • more than 1 month but not more than 4 months • more than 4 months but not more than 6 months • more than 6 months	0 2 4 6		**6**
Area of Disturbance [5] • not more than 1000 m2 • more than 1000 m2 but not more than 5000 m2 • more than 5000 m2 but not more than 1 ha • more than 1 ha but not more than 4 ha • more than 4 ha	0 1 2 4 6		**4**
Waterway Disturbance [6] • No disturbance to a watercourse, open drain or channel • Involves disturbance to a constructed open drain or channel • Involves disturbance to a natural watercourse	0 1 2		**2**
REHABILITATION METHOD [7] Percentage of area (relative to total disturbance) revegetated by seeding without light mulching (i.e. worst-case revegetation method). • not more than 1% • more than 1% but not more than 5% • more than 5% but not more than 10% • more than 10%	0 1 2 4		

Condition	Points	Score	Trigger value
Receiving Waters [8] • Saline waters only • Freshwater body (e.g. creek or freshwater lake or river)	0 2		
Subsoil Exposure [9] • No subsoil exposure except of service trenches • Subsoils are likely to be exposed	0 2		
External Catchments [10] • No external catchment • External catchment diverted around the soil disturbance • External catchment not diverted around the soil disturbance	0 1 2		
Road Construction [11] • No road construction • Involves road construction works	0 2		
pH of Soils to be Revegetated [12] • more than pH 5.5 but less than pH 8 • other pH values, or if soils are untested	0 1		
Total Score [13]			

Table B-2: Stabilisation requirements and treatment methods

During Demolition - Temporary Stabilisation (During periods or site shutdown when works are on hold)				
Lands	**Stabilisation Measurement**	**Timeframes**	**Treatments Methods - Products**	**Remarks**
High-risk areas; Batters, steep slopes (>30%), works in and around waterways, surfaces around culvert headwalls	C-factor = 0.1 (60%a grass cover or equivalent ground cover[3]).	Applies prior to rainfall and after 10 working days of inactivity (even though works might continue later)	Soil binder (i.e. Vital Bon-Matt P47-VR1/Stonewall or equivalent)	• stabilise all exposed surfaces by spraying surfaces with Vital P47-VR1/Stonewall or equivalent • application rate = 1L/m^2 of diluted Vital mixture. • reapply\maintain as necessary to ensure required cover is provided.
			Geotextile, jute matting, black plastic or equivalent.	• Cover all exposed soils. • Reapply/maintain as necessary to assure the required cover is provided.
All lands (including waterways and stockpiles)	C –factor = 0.15 (50% grass cover or equivalent ground cover)	Applies after 20 working days of inactivity (even though works might continue later)	Soil binder (i.e. Vital Bon-Matt P47-VR1/Stonewall or equivalent.	• Spray all stockpiled surfaces with Vital Bon-Matt P47-VR1/Stonewall or equivalent. • Vital dilution rate = 1:10 (Vital:Water). • Application = 1m^2 of diluted Vital mixture. • Re-apply/maintain as necessary (approx. every 3/6 months without suitable vegetation cover) to ensure the required cover is provided.
			Geotextile, jute matting, black plastic or equivalent.	• Cover all exposed soils. • Reapply/maintain as necessary to assure the required cover is provided.

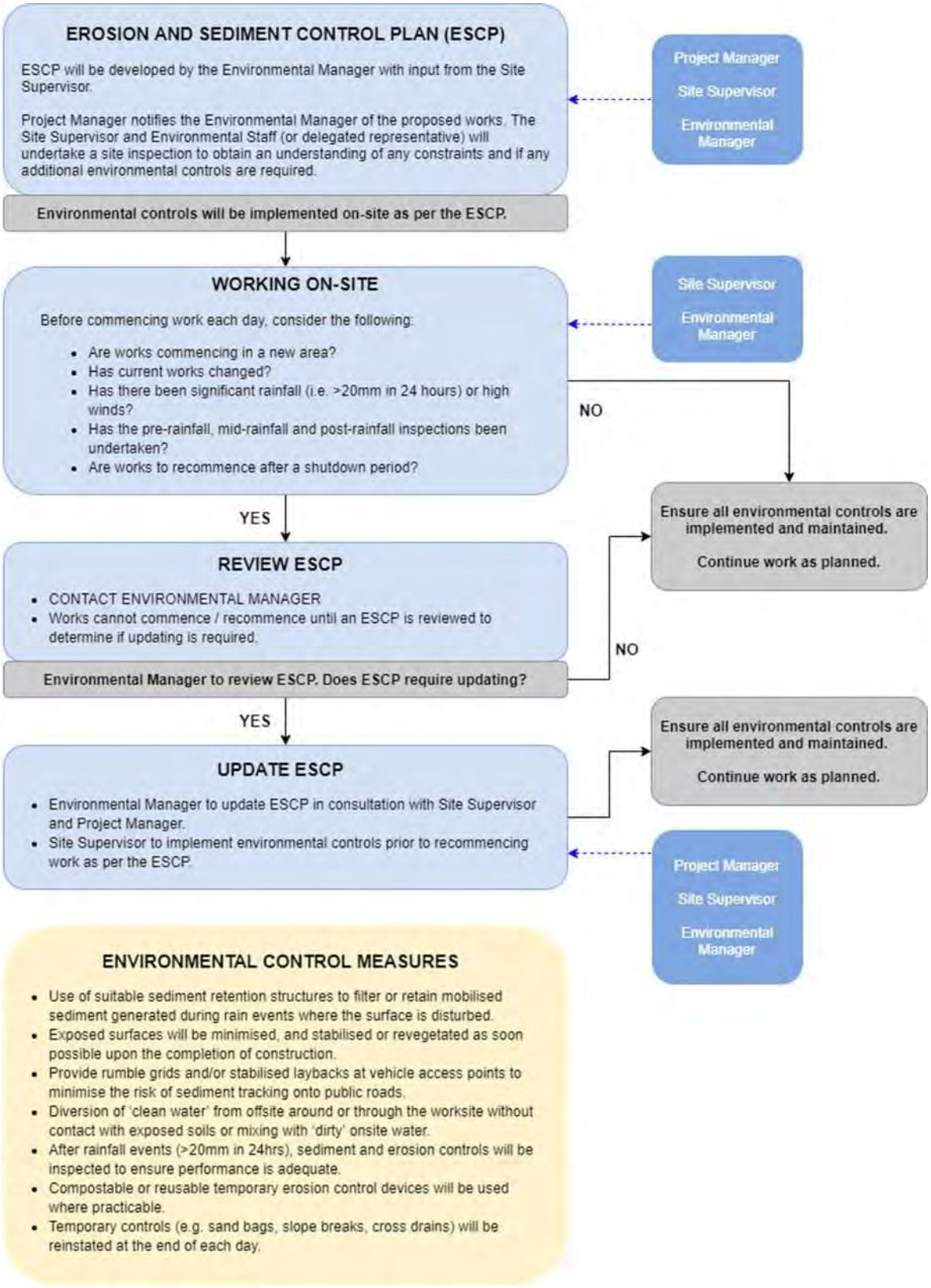


Figure B-1: ESCP workflow and responsibilities for contractors

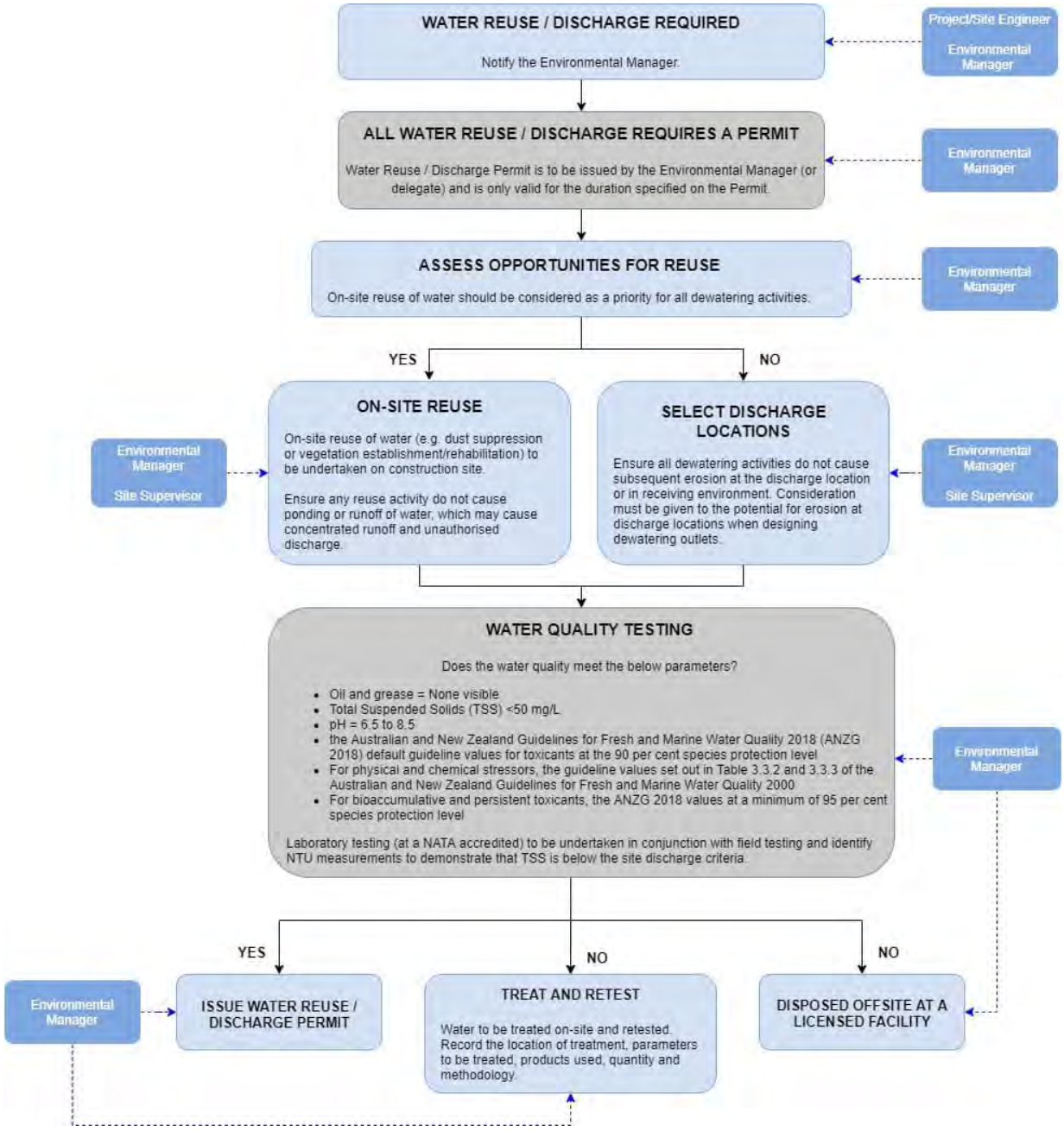
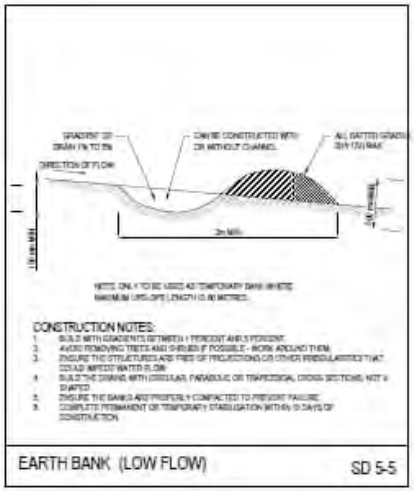
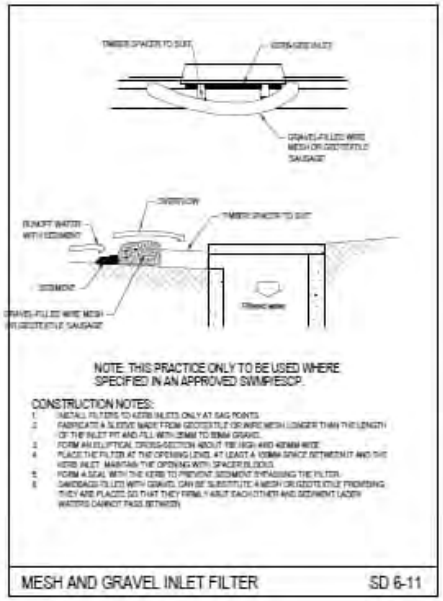


Figure B-2: Contractor water release protocols which will be subject to change with approval conditions

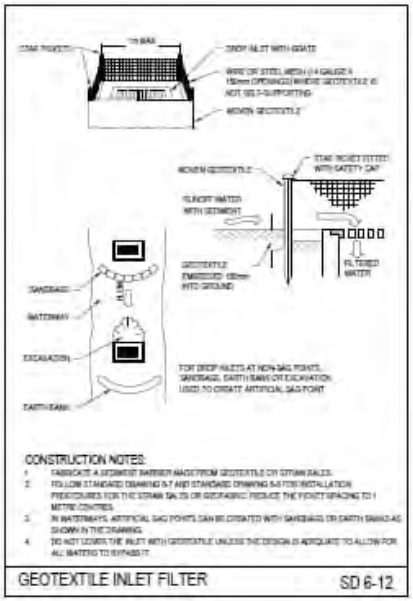
Appendix C -
Standard ESCP drawings



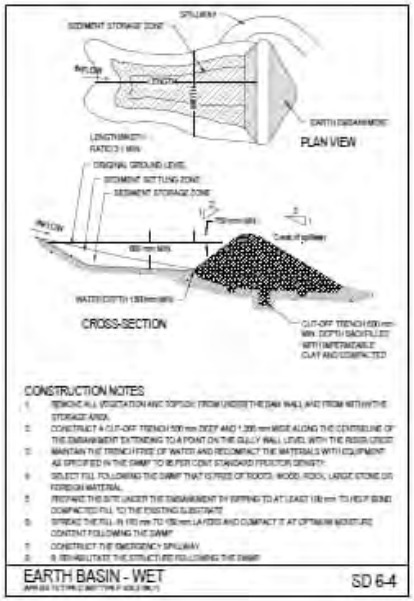
EARTH BANK (LOW FLOW) SD 5-5



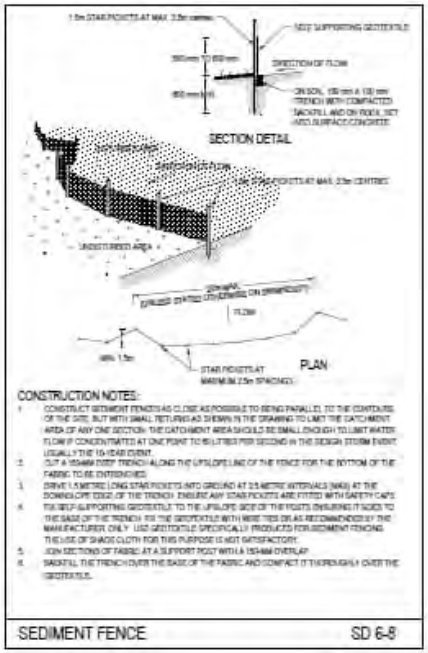
MESH AND GRAVEL INLET FILTER SD 6-11



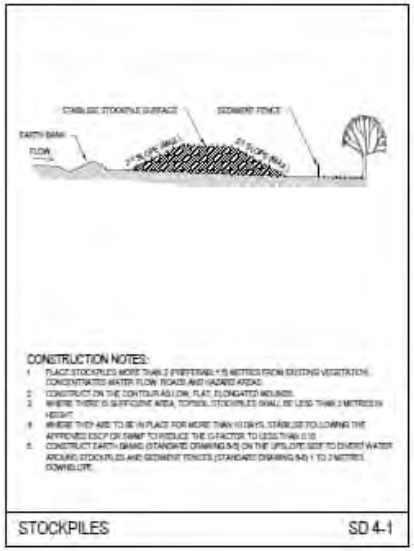
GEOTEXTILE INLET FILTER SD 6-12



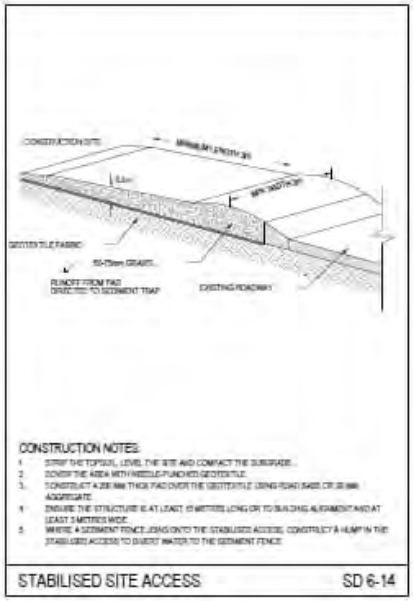
EARTH BASIN - WET SD 6-4



SEDIMENT FENCE SD 6-8

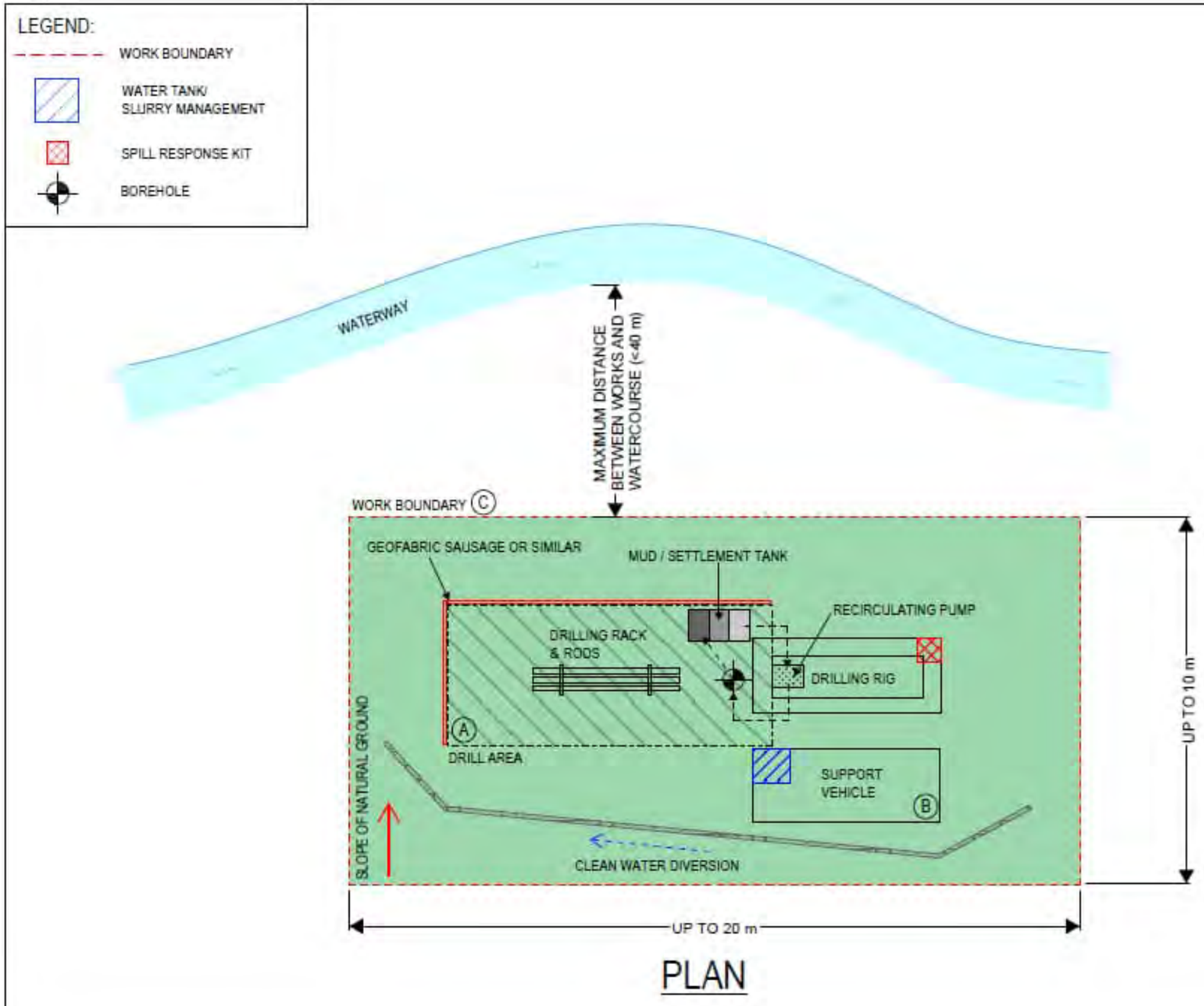


STOCKPILES SD 4-1



STABILISED SITE ACCESS SD 6-14

Appendix D -
Example site ESCP



GENERAL NOTES:

1. SITE INDUCTION FOR ALL FIELD PERSONNEL ACCESSING WORK AREA FOR SITE SPECIFIC ENVIRONEMENTAL CONSTRAINTS.
2. VISITORS TO CONFIRM SITE ACCESS WITH SIM PRIOR TO ARRIVAL.
3. SITE DISTURBANCE IS TO BE RESTRICTED TO THE IMMEDIATE WORK ZONE WHERE POSSIBLE.
4. AN ADEQUATELY STOCKED SPILL KIT IS TO BE MAINTAINED ON SITE AT ALL TIMES.
5. ALL DISTURBED GRASS AREAS TO BE RESTORED / STABILISED AT COMPLETION OF SITE WORKS USING EITHER TURF OR A STERILE SEED MIX.
6. ALL SITES TO BE ASSESSED FOR POTENTIAL SOURCE OF CONCENTRATED SURFACE WATER FLOWS ENTERING THE SITE. IN THE EVENT OF ACTUAL OR ANTICIPATED SURFACE WATER FLOWS, A CLEAN WATER DIVERSION IS TO BE CONSTRUCTED FROM SANDBAGS OR SIMILAR TO MINIMISE SURFACE WATER RUNOFF PASSING THROUGH THE ACTIVE SITE. TO BE IMPLEMENTED DURING OR PRIOR TO PERIODS OF HEAVY RAINFALL WHERE SURFACE RUNOFF IS OCCURRING OR IS LIKELY TO OCCUR. TO BE REMOVED AT COMPLETION OF GEOTECH WORKS.
7. NO MATERIALS ARE TO REMAIN ON-SITE AT THE COMPLETION OF DRILLLING. FOR SOME GEOTECHNICAL HOLES, IT MAY BE PERMISSIBLE FOR SOME EXCESS SPOIL TO BE REPLACED BACK DOWN HOLE. ALL EXCESS WASTE MATERIALS TO BE DISPOSED OF OFF-SITE.

(A) WHEN WORKING ON HARDSTAND / GRASSED AREAS TARPONLINE OR GEOFABRIC TO BE PLACED BELOW DRILL AREA.

(B) SETUP OF SUPPORT VEHICLE OR VISTOR VEHICLES TO BE DETERMINED BASED ON SITE SPECIFIC RESTRICTIONS AND ACCESS.

(C) TEMPORARY FENCING, WHERE NECESSARY, WILL BE SET UP AROUND EACH WORK AREA TO PROVIDE A SECURE WORK ZONE.

Figure D-1: Typical drilling pad and ESCP notes

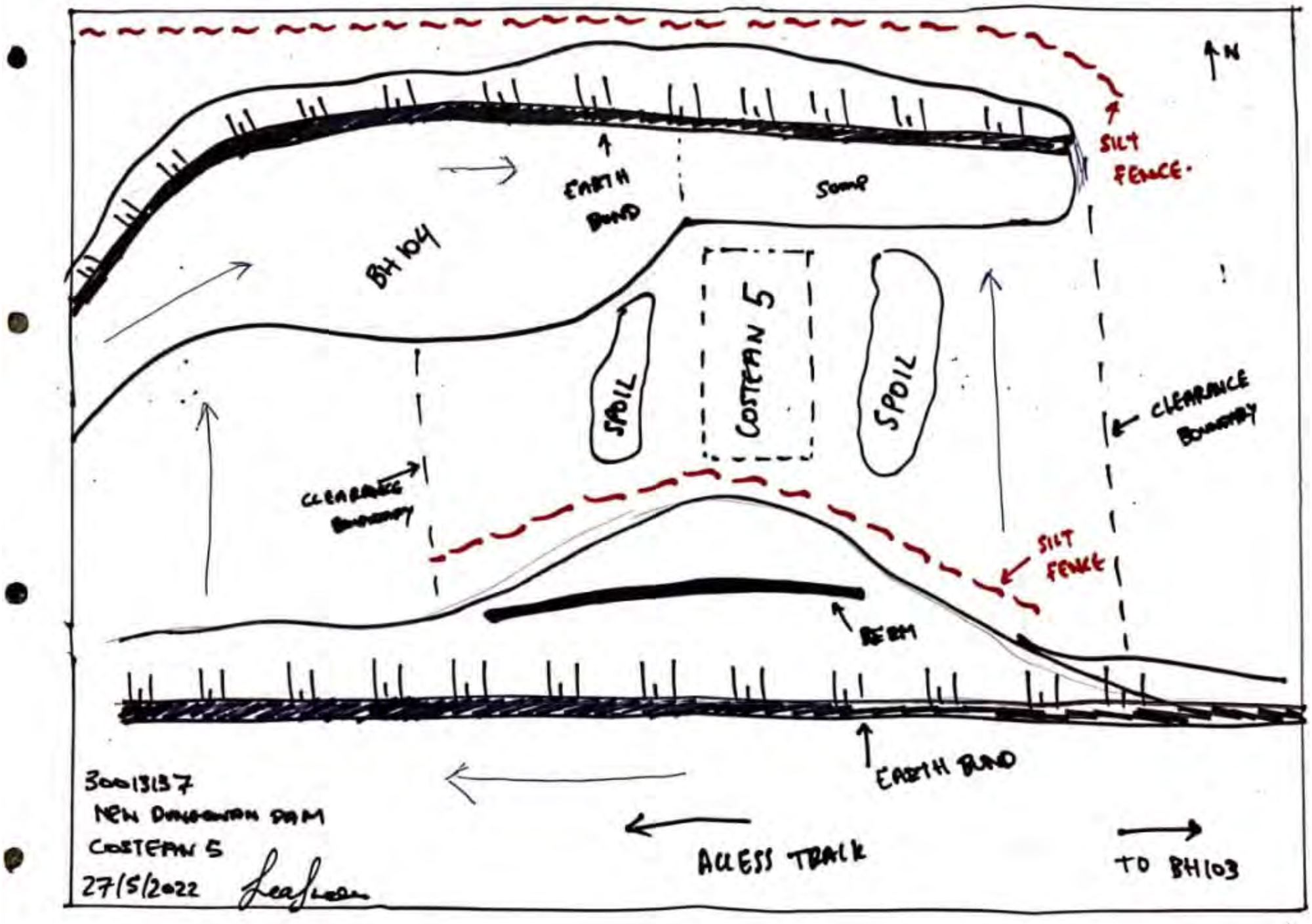


Figure D-2: Typical Progressive ESCP and site drawing and notes

Appendix E -
Preliminary ESCP for temporary bridges and bed level crossing

General Notes:

1) THE FOLLOWING PLANS ARE CONCEPTUAL IN NATURE AND NOT TAILORED TO INDIVIDUAL BRIDGE LOCATIONS.
2) THE FOLLOWING PLANS MAY NOT BE SUITABLE FOR ALL LOCATIONS AND ADDITIONAL SITE INVESTIGATION WILL BE REQUIRED TO DETERMINE FINAL DESIGN OF ESC PLAN/S. ALL CONTROLS ARE TO BE INSTALLED AS PER IECA DRAWINGS (THESE CAN BE PROVIDED)
3) FINAL LOCATION AND SIZING OF ESC CONTROLS WILL BE SPECIFIC TO EACH BRIDGE LOCATION AND REPORTING CATCHMENT SIZE.
4) ALL ENVIRONMENTALLY SENSITIVE AREA ADJACENT TO THE SITE THAT ARE EXCLUDED FROM SITE WORK TO BE SIGNPOST
5) VEGETATION TO BE MAINTAINED ALONG BANKS OF CREEK AS LONG AS PRACTICALLY FEASIBLE
6) HIGH RISK INSTREAM WORKS (STREAM DIVERSION, BRIDGE PILLING AND ABUTMENT) TO BE PLANNED ONLY WITHIN THE DRY PERIOD AS SPECIFIED IN THE REPORT IN ACCORDANCE WITH APPENDIX I OF IECA 2008
7) TEMPORARY WORK PLATFORMS TO BE INSTALLED WITH MINIMAL DISTURBANCE TO CREEK BANKS. ALL ACCESS TO WORKS WITHIN CREEK TO BE PROVIDED VIA TEMPORARY PLATFORM (NOT FROM EXISTING BANK)
8) PROMPTLY REHABILITATION OF DISTURBED AREAS TO BE CARRIED OUT
9) STREAM DIVERSION TO BE CARRIED OUT BEFORE PILING WORK TO MINIMISE DISTURBANCE TO WATERWAY (EXISTING DIVERSION CHANNEL). IF DE-WATERING REQUIRED IT MUST BE DONE AS PER IECA 2008.
10) PRIOR TO DIVERTING LOW FLOW, CHANNEL BED AND BATTER STABILISATION TO BE COMPLETED.
11) ALL SPOIL MATERIALS REMOVED FROM CREEK BED (SOLID OR LIQUID) NEED TO BE DIRECTLY LOADED AND TRANSPORTED OFFSITE AND LAWFULLY DISPOSED IN A MANNER THAT DOES NOT CAUSE ONGOING SOIL EROSION OR ENVIRONMENTAL HARM.
12) ALL EROSION AND SEDIMENT CONTROL TREATMENT DEVICES TO BE INSPECTED (MAINTENANCE AND REPAIRS TO BE COMPLETED AS REQUIRED):
    a. AT LEAST DAILY WHEN RAINFALL IS OCCURRING (WHEN IT IS SAFE TO DO SO)
    b. AT LEAST WEEKLY (EVEN IF WORK IS NOT HAPPENING ON SITE) TO ENSURE THAT THEY ALL OPERATIONAL AND HAVE NOT ACCUMULATE EXCESSIVE SEDIMENT VOLUME
    c. WITHIN 24 HOURS PRIOR TO FORECASTED RAINFALL
    d. WITHIN 18 HOURS OF RAINFALL EVENT OF SUFFICIENT INTENSITY TO CAUSE RUNOFF.
    e. THE INSPECTIONS MUST BE UNDERTAKEN IN A SYSTEMATIC FASHION ON SITE AND RECORDED
        i. INSTALLATION / REMOVAL OF ANY EROSION AND SEDIMENT CONTROL DEVICES.
        ii. THE CONDITION OF EACH DEVICE WITH COMMENT ON CONTINUED EFFECTIVENESS.
        iii. CIRCUMSTANCES CONTRIBUTING TO DAMAGE TO ANY DEVICES.
        iv. STORAGE CAPACITY AVAILABLE IN POLLUTION DEVICES AND SEDIMENT DEVICES.
        v. TIME, DATE, VOLUME AND TYPE OF ANY ADDITIONAL FLOCCULANTS OR CHEMICALS USED WITHIN THE CATCHMENT AREA.
        vi. THE VOLUME OF SEDIMENT REMOVED FROM RETENTION DEVICES AND LOCATION OF DISPOSAL.
        vii. MAINTENANCE OR REPAIR WORKS REQUIRED OR UNDERTAKEN. INSPECTIONS SHOULD BE SIGNED, DATED AND KEPT ON SITE AND MADE AVAILABLE ON REQUEST TO COUNCIL OR OTHER RELEVANT STATUTORY UTHORITY. THE CONTRACTOR IS TO HAVE ON SITE AT ALL TIMES, SUFFICIENT ADDITIONAL MATERIAL TO CONDUCT REPAIRS TO ANY AND ALL DEVICES WITHOUT EXCESSIVE DELAY. SHOULD THE NEED ARISE. THE CONTRACTOR SHALL PROVIDE AS O MINIMUM THE TEMPORARY CONTROL MEASURES AS DETAILED ON DESIGN DRAWINGS.

General Notes (cont.):

13) CLEAN WATER FLOW TO BE MAINTAINED, MAXIMISING SEPERATION OF 'CLEAN' AND 'DIRTY' WATER AS MUCH AS POSSIBLE.

14) PRIOR TO ANY CONSTRUCTION WORK OR STORING OF MATERIALS ON SITE, THE CONTRACTOR SHALL:

a. OBTAIN ALL NECESSARY PERMITS, LICENSES AND APPROVALS.

b. SCHEDULE AND HOLD A PRE-CONSTRUCTION MEETING WITH THE LOCAL AUTHORITY.

c. INSTALL THE SEDIMENT CONTROL DEVICE AT ENTRY AND EXIT POSITIONS. CLEARLY MARK THE LOCATION OF ACCESS ROADS AND STORAGE AREAS.

d. ERECT THE ESC TREATMENT MEASURES AS INDICATED ON THE ATTACHED PLAN AND TO THE PERIMETER OF ALL PROPOSED TEMPORARY STOCKPILE LOCATIONS.

e. ESTABLISH A DISPOSAL SITE FOR TRAPPED SEDIMENT (IF REQUIRED).

f. ANY CHEMICAL OR FUEL / OIL STORED ON SITE SHALL BE STORED UNDER COVER IN A BUNDED AREA OR PLACED SUFFICIENTLY ABOVE THE GROUND LEVEL TO PRECLUDE CONTAMINATING OF SURFACE WATER.

15) MATERIALS REMOVED FROM DEVICES MUST BE DISPOSED OF IN A MANNER APPROVED BY COUNCIL THAT DOES NOT CAUSE POLLUTION.

16) WORN, DAMAGED OR OTHERWISE DEFECTIVE MATERIALS AND COMPONENTS ARE TO BE REPAIRED, REFURBISHED AND REPLACED AS NEEDED.

17) BULK EARTHWORKS ARE TO BE UNDERTAKEN TO MINIMIZE THE EXPOSURE TIME OF BORE SOIL AREAS. FILL AREAS CUT AND FILL BATTERS THAT HAVE BEEN COMPLETED SHALL BE GRASSED AND STABILIZED AS EARLY AS PRACTICAL IN THE CONSTRUCTION PERIOD.

18) THE EXPECTED CONSTRUCTION PROCEDURE FOR THE SEDIMENT AND EROSION CONTROL SYSTEM DURING CONSTRUCTION IS AS OUTLINED:

a. ALL EXCAVATED MATERIAL IS TO REMAIN ON SITE, PREFERABLY IN THE TEMPORARY STOCKPILE AREA IF THERE IS ONE.

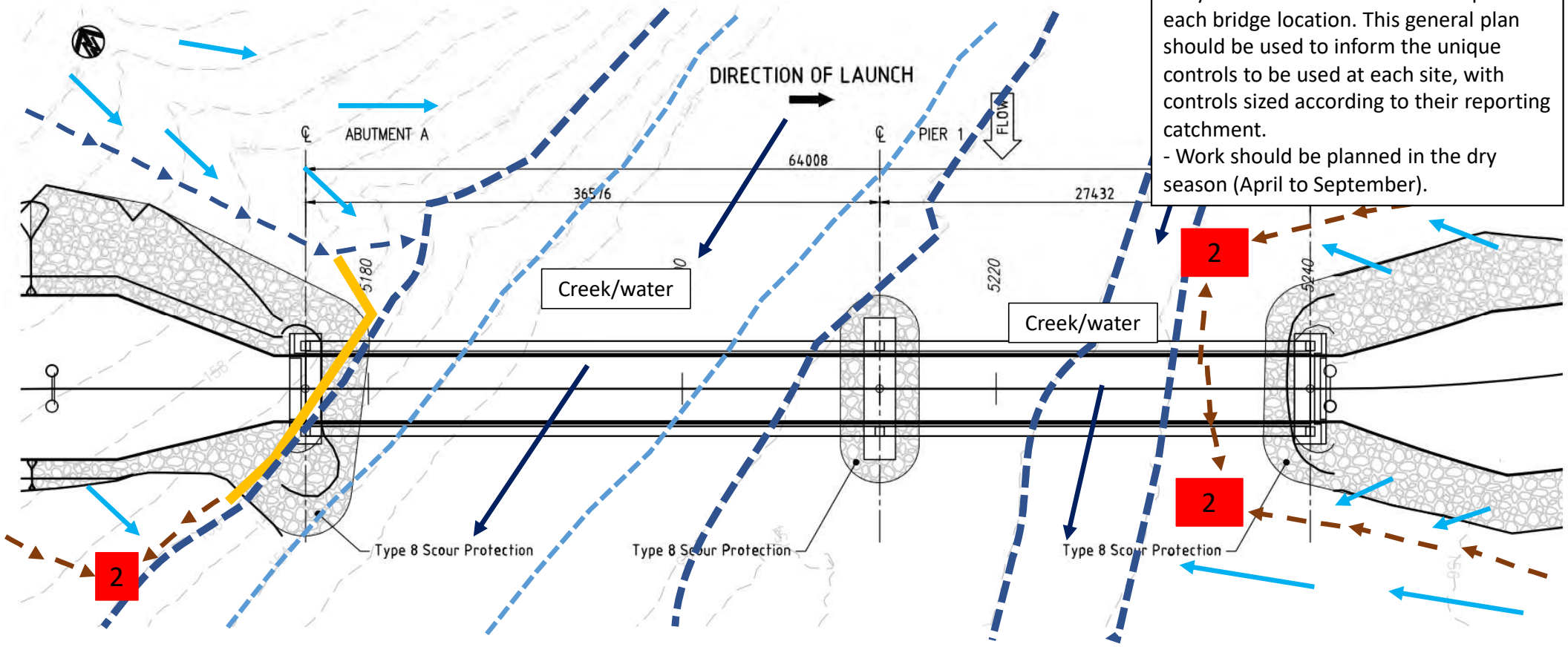
b. ALL ADDITIONAL STOCKPILE AREAS ARE TO HAVE APPROPRIATE ESC DEVICE INSTALLED DOWN SLOPE AS PER ESCP.

c. STABILIZATION SUCH AS SEEDING, TURF, MULCH OR EROSION MAT IS TO BE PROVIDED TO ALL EXPOSED SOIL SURFACES. NEW SLOPES AND SERVICES TRENCHES IN A TIMELY MANNER, UPON COMPLETION OF WORKS ANDAS DIRECTED BY THE SUPERINTENDENT.

d. ESTABLISHMENT OF 80% GROSS COVER OF CONSTRUCTION SITE AREA PRIOR TO "OFF MAINTENANCE INSPECTION.

19) ON COMPLETION OF SITE WORKS THE EROSION AND SEDIMENT CONTROL DEVICES ARE TO REMAIN IN OPERATION UNTIL THE EXPOSED EARTH SURFACES ARE SEEN TO BE WELL ESTABLISHED AND STORMWATER DISCHARGE FROM THE SITE EXHIBITS NO SEDIMENT EROSION UNDER NORMAL RAINFALL CONDITIONS. ON THE REMOVAL OF SEDIMENT AND EROSION CONTROL DEVICES, BORE SOIL AREAS ARE TO BE TURFED OR GRASS SEEDED AND MAINTAINED UNTIL ESTABLISHED.

General Bridges ESC Plan

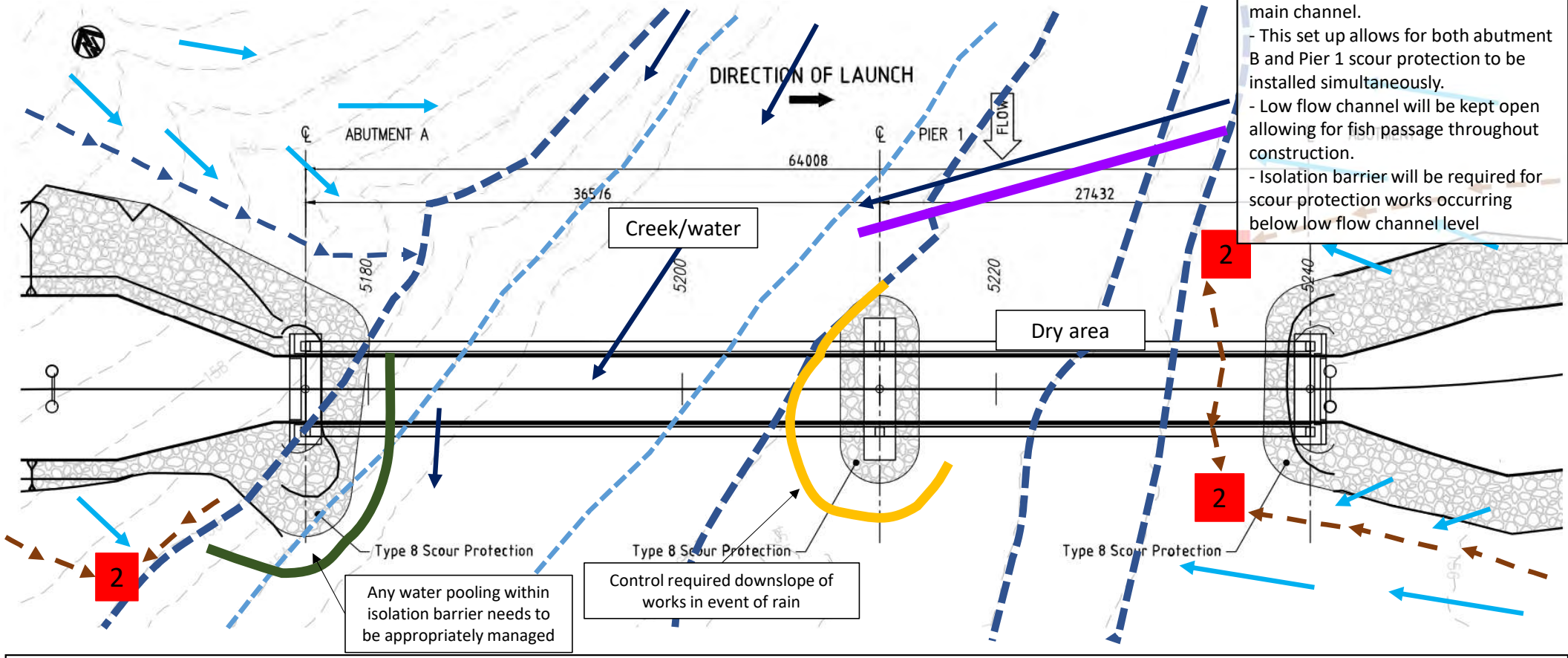


Notes:
- The location of RFDs, clean water and dirty water diversions will be unique for each bridge location. This general plan should be used to inform the unique controls to be used at each site, with controls sized according to their reporting catchment.
- Work should be planned in the dry season (April to September).

Legend:

- Clean water diversion
- Dirty water diversion
- 2 Type 2 control
- Geo-wrapped rock bund
- Overland waterflow direction
- Instream waterflow direction
- Main channel levels
- Low flow channel levels

Scour protection install (below main channel and low flow channel water levels) Option 1



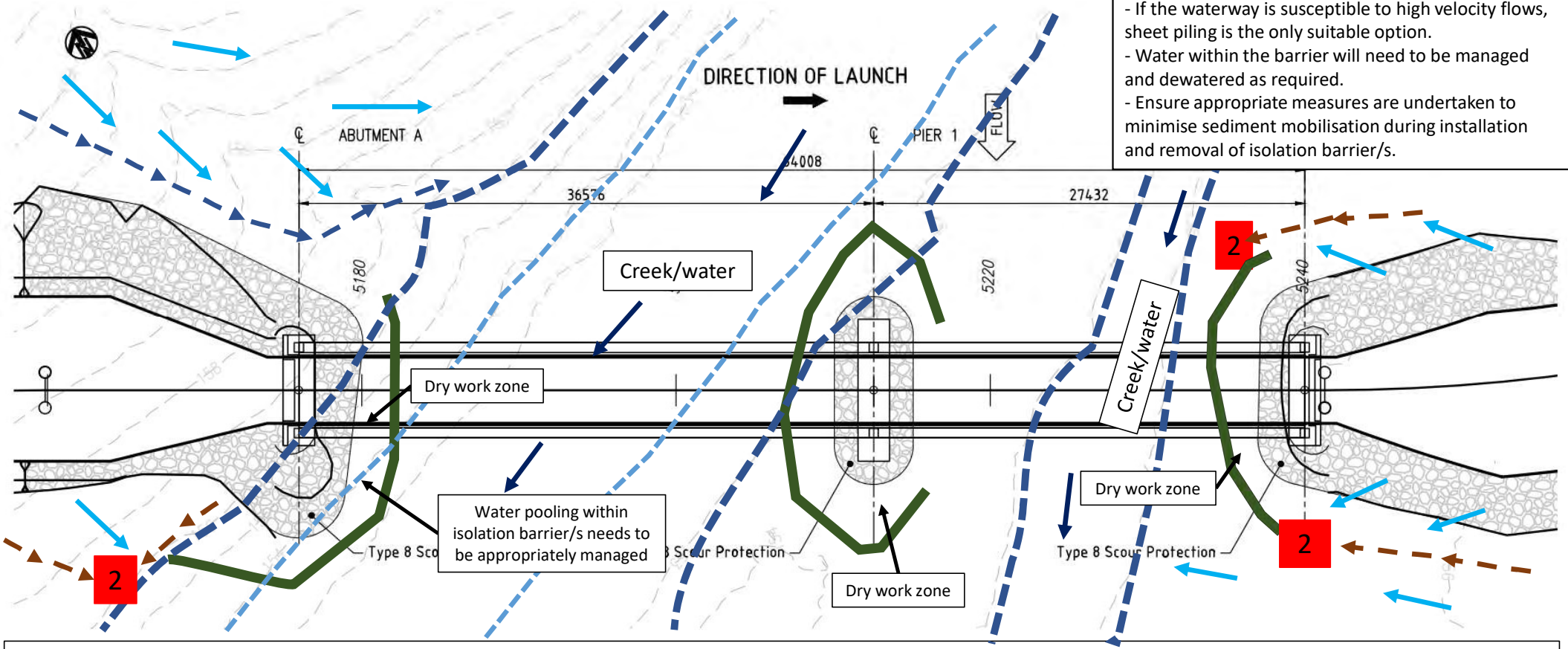
Notes:
- Upstream bund / coffer dam installed to divert high flows into into main channel.
- This set up allows for both abutment B and Pier 1 scour protection to be installed simultaneously.
- Low flow channel will be kept open allowing for fish passage throughout construction.
- Isolation barrier will be required for scour protection works occurring below low flow channel level

Legend:

- Clean water diversion
- Dirty water diversion
- Geofabric-wrapped earth bund
- 2 Type 2 control
- Geofabric-wrapped rock bund
- Isolation barrier
- Overland waterflow direction
- Instream waterflow direction
- Main channel levels
- Low flow channel levels

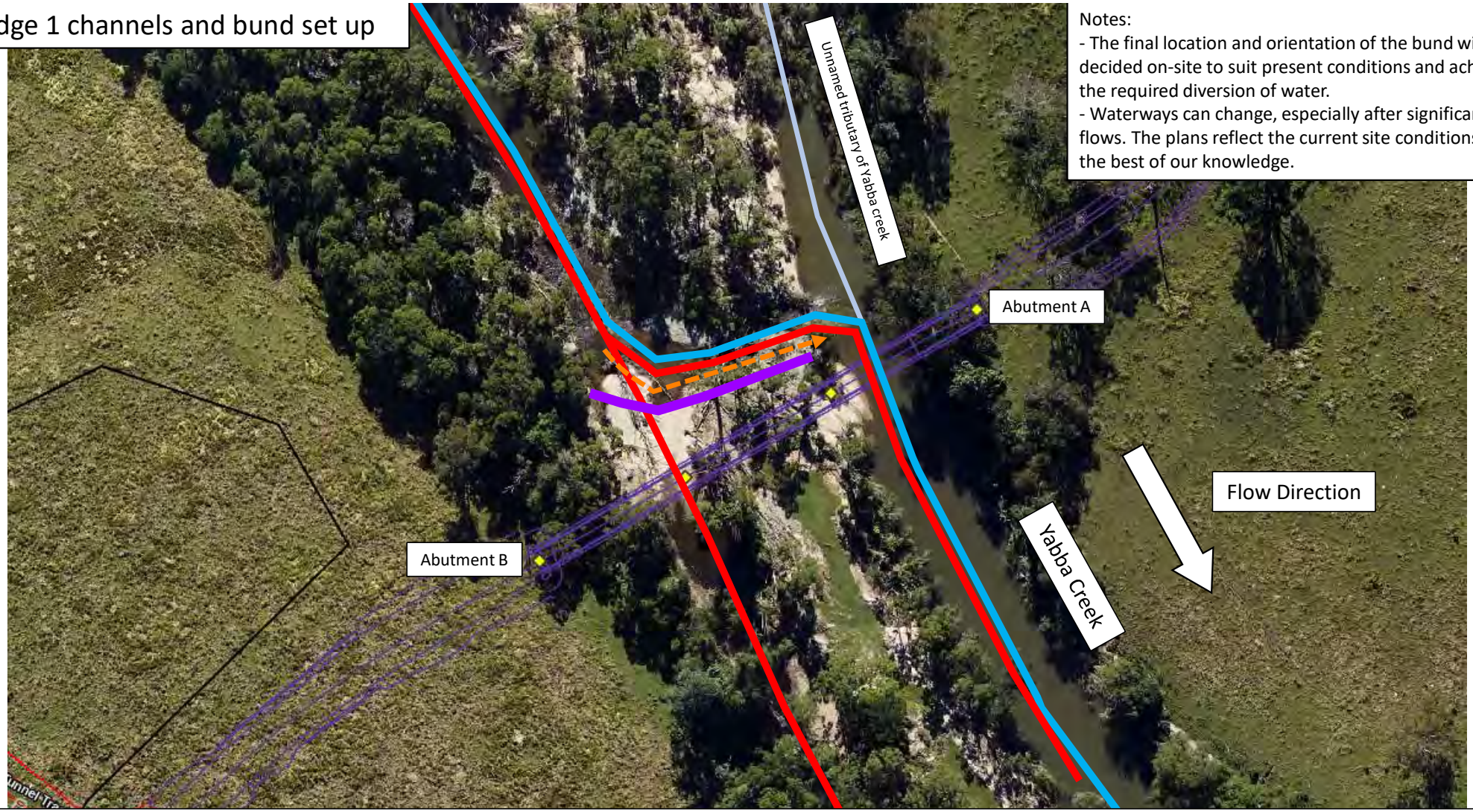
Scour protection install (below main channel and low flow channel water levels) Option 2

Notes:
- Sheet piling/isolation barrier set up. Refer to IECA drawing for additional details.
- If the waterway is susceptible to high velocity flows, sheet piling is the only suitable option.
- Water within the barrier will need to be managed and dewatered as required.
- Ensure appropriate measures are undertaken to minimise sediment mobilisation during installation and removal of isolation barrier/s.



Legend:
- Clean water diversion
- Dirty water diversion
- Low flow channel levels
- 2 Type 2 control
- Sheet piling set up/isolation barrier
- Overland waterflow direction
- Instream waterflow direction
- Main channel levels

Bridge 1 channels and bund set up

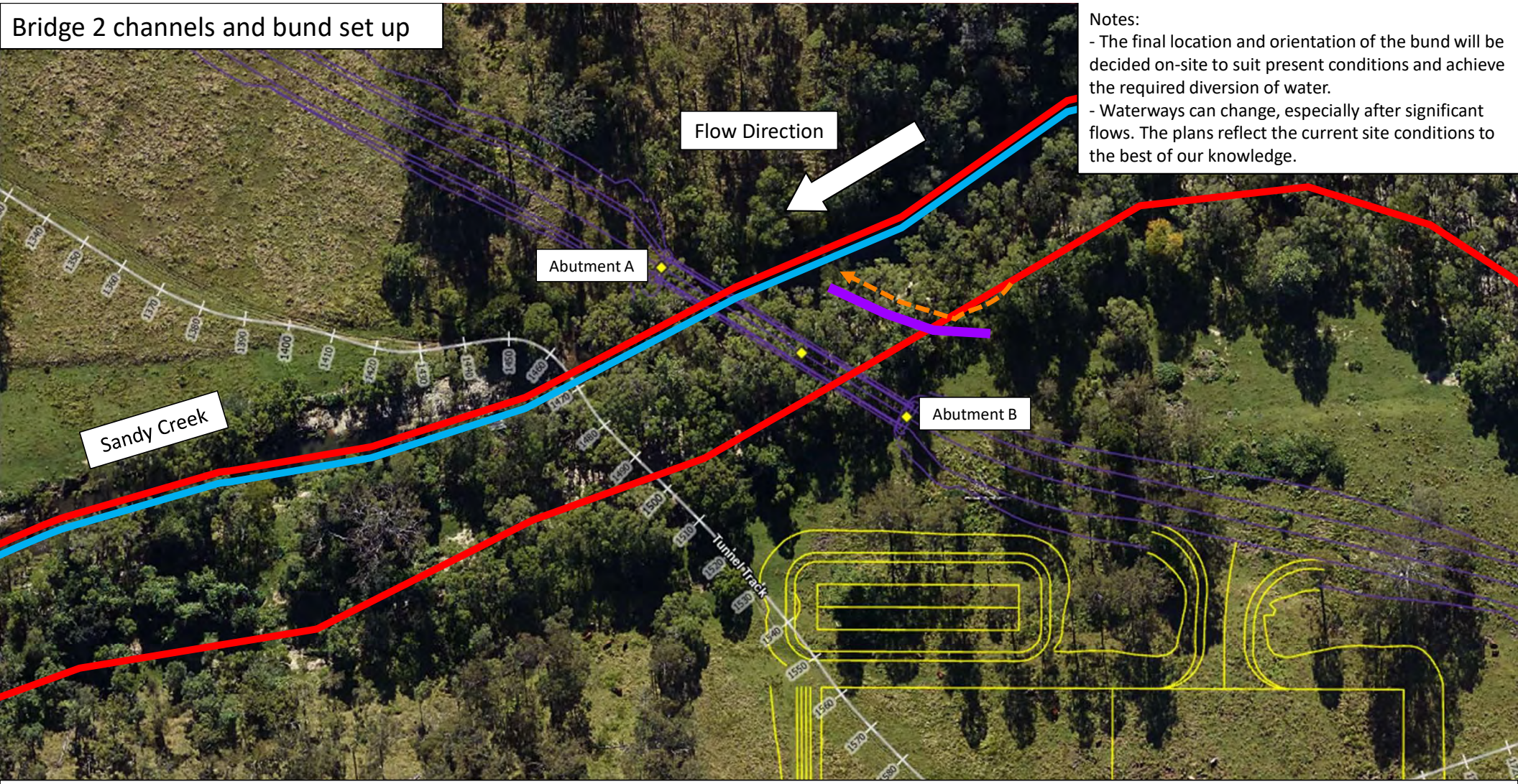


Notes:
- The final location and orientation of the bund will be decided on-site to suit present conditions and achieve the required diversion of water.
- Waterways can change, especially after significant flows. The plans reflect the current site conditions to the best of our knowledge.

Legend:

Main channel/s | Low flow channel/s | Cofferdam/geo-wrapped earth bund | Diverted flow

Bridge 2 channels and bund set up

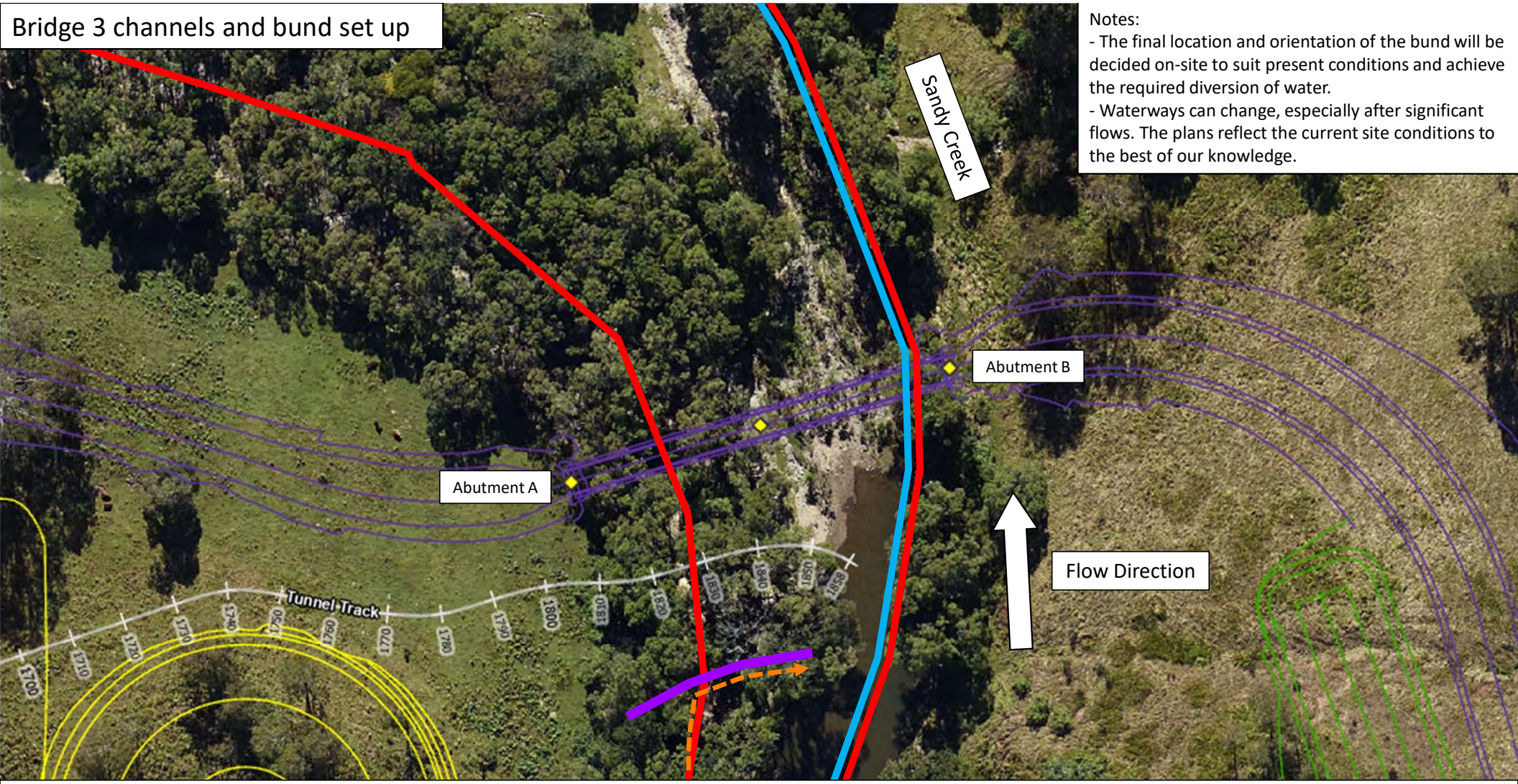


Notes:
- The final location and orientation of the bund will be decided on-site to suit present conditions and achieve the required diversion of water.
- Waterways can change, especially after significant flows. The plans reflect the current site conditions to the best of our knowledge.

Legend:

Main channel/s | Low flow channel/s | Cofferdam/geo-wrapped earth bund | Diverted flow

Bridge 3 channels and bund set up

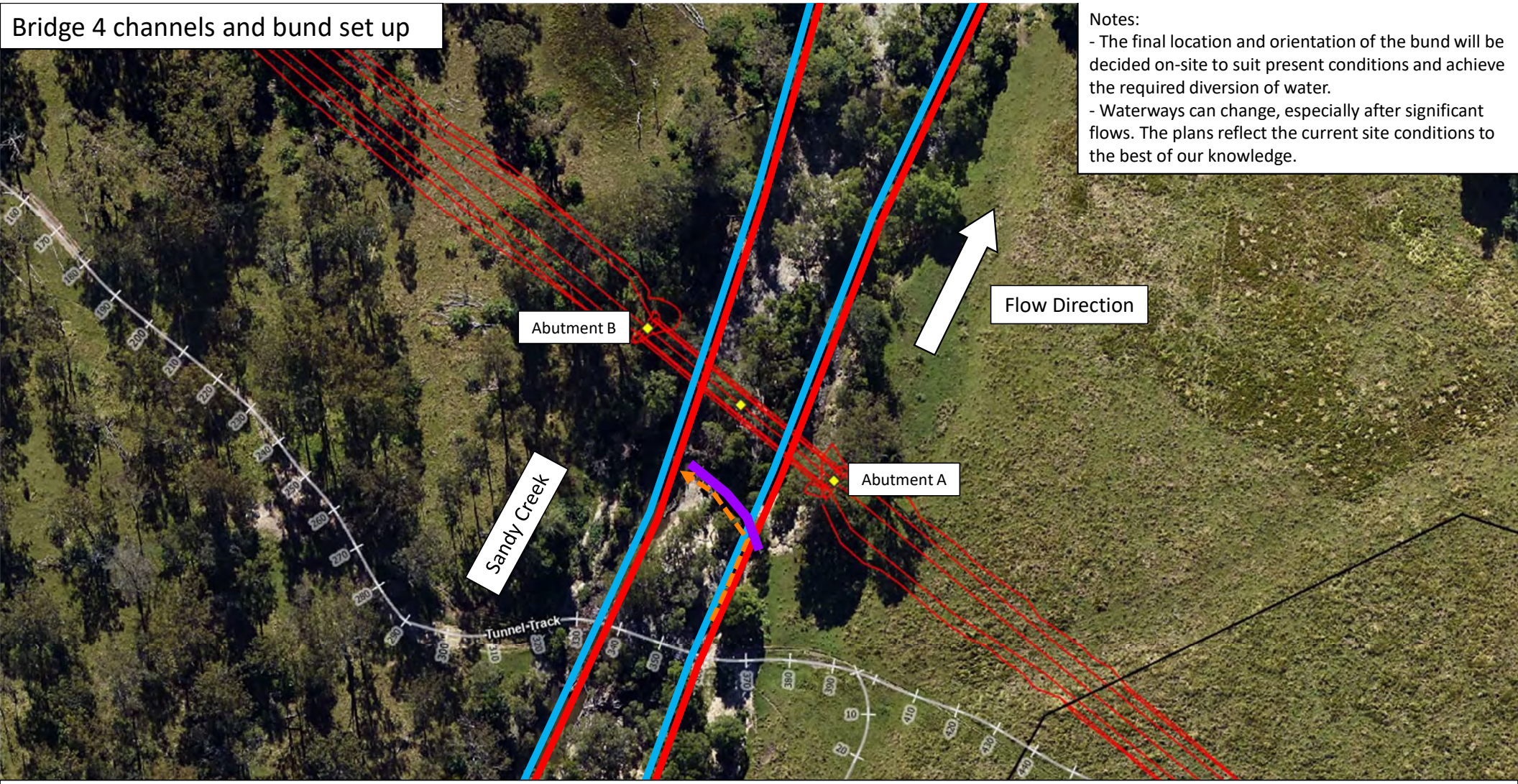


Notes:
- The final location and orientation of the bund will be decided on-site to suit present conditions and achieve the required diversion of water.
- Waterways can change, especially after significant flows. The plans reflect the current site conditions to the best of our knowledge.

Legend:

Main channel/s | Low flow channel/s | Cofferdam/geo-wrapped earth bund | Diverted flow

Bridge 4 channels and bund set up



Notes:
- The final location and orientation of the bund will be decided on-site to suit present conditions and achieve the required diversion of water.
- Waterways can change, especially after significant flows. The plans reflect the current site conditions to the best of our knowledge.

Legend:

Main channel/s

Low flow channel/s

Cofferdam/geo-wrapped earth bund

Diverted flow

General Notes:

- The following plans are conceptual in nature and may not be suitable for all locations. Additional site investigation may be required to determine the final design of the ESC plan/s.
- All controls are to be installed as per IECA drawings.
- The use of gypsum is also recommended to be spread in catchments prior to significant rain, to aid in the dropping out of finer sediments, reducing potential water quality impacts downstream.
- Clean rock/material is to be used for all ESC controls.
- Works are to be scheduled and completed during expected periods of low flow and when the upstream dam is not releasing water (if possible).
- Silt curtains are not designed to be used in areas of high flow – therefore they may not be feasible in some locations.
- Disturbance footprint is to be kept as minimal as possible.
- Any exposed banks/subsoils from earthworks are to be sprayed with soil binder or covered with geofabric.
- Disturbed areas are to be reinstated to a pre-disturbed state i.e., replace topsoil, and apply hydromulch. All placed rock/material is to be removed.
- All required and relevant permits and approvals are to be obtained prior to commencing works.
- It is assumed that clean access (e.g., sealed road, rock sheeted track) is maintained for vehicles entering the creek work area. If unsealed access is used, the use of a wheel wash is recommended – especially during periods of wet weather.

For geotechnical drilling:

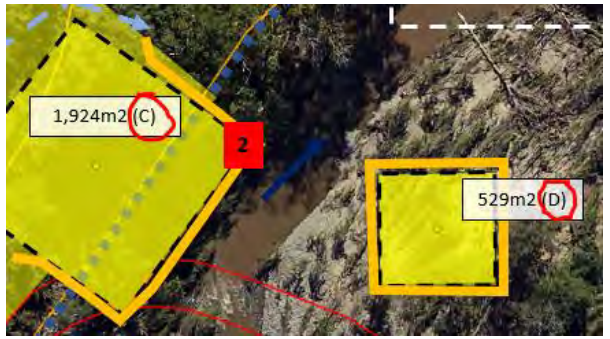
- This plan has been created specifically for boreholes within the waterway banks requiring earthworks/a disturbance footprint to undertake the drilling (indicated by yellow polygon)
- Geotech drilling rigs have a standard ESC set up which is to be used at all locations (refer to Technical Memorandum) to control unexpected release of drilling muds.
- It is highly recommended geofabric is placed over the drill pad footprint to capture any minor drilling mud spills that may occur

Calculation notes:

- All calculation values (RUSLE) were adopted at a higher rate to best account for worst possible scenario
- The calculations apply for up to a 3-month period (indicated by QH) up to November only. Updated plans will be required if disturbances go beyond this November and/or 3 months.

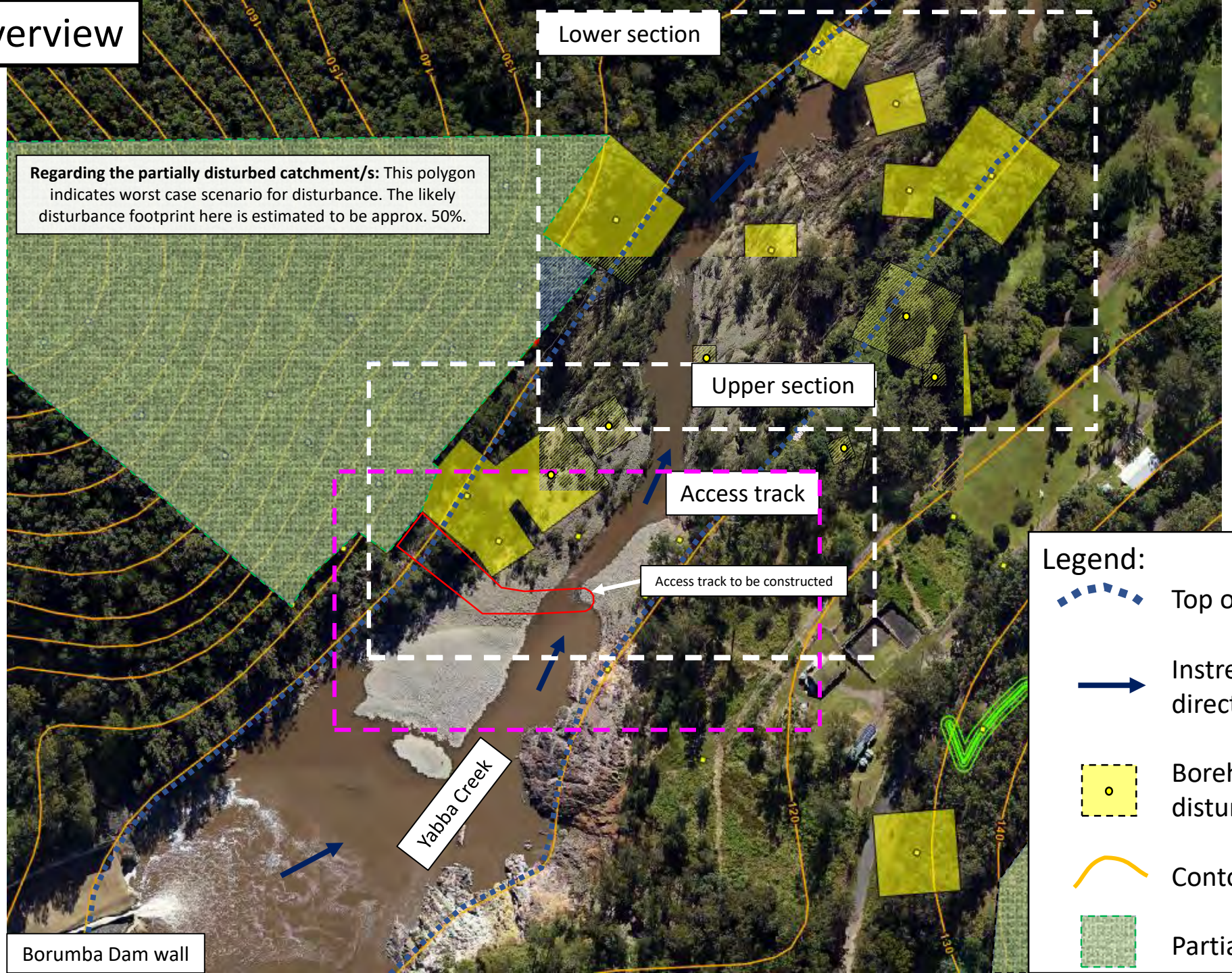
CATCHMENT ID	AREA (HA)	R	K	SLOPE LENGTH (m)	SLOPE (%)	LS	P	C	A (t/ha/yr)	A (t/yr)	CONTROL
size A	0.34	735	0.060	80	8.0	2.05	1.3	1.00	118	40	TYPE 2
size B	0.24	735	0.060	80	8.0	2.05	1.3	1.00	118	28	TYPE 2
size C	0.19	735	0.060	80	8.0	2.05	1.3	1.00	118	22	TYPE 2
size D	0.05	735	0.060	80	8.0	2.05	1.3	1.00	118	6	TYPE 3

Catchment ID sizes indicated on borehole footprints:

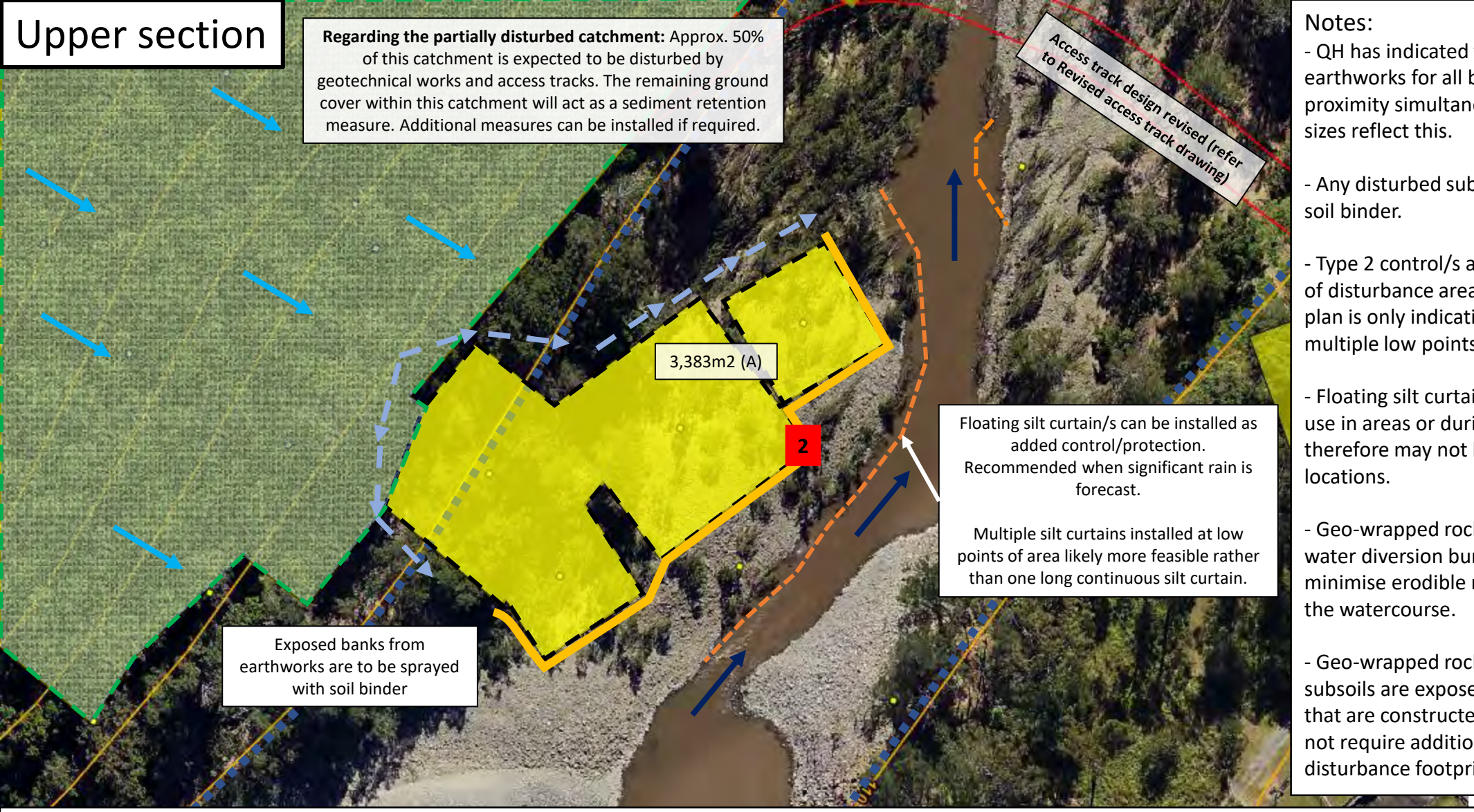


R VALUE INPUT	
I - 2 YEAR, 6 HOUR (MM/HR)	MANUAL INPUT
	735
	735
	735
	735

Section overview



Upper section



Notes:

- QH has indicated that they propose to undertake earthworks for all boreholes within close proximity simultaneously, therefore catchment sizes reflect this.

- Any disturbed subsoils are to be sprayed with soil binder.

- Type 2 control/s are to be installed at low point of disturbance area. The location provided on the plan is only indicative – multiple may be needed if multiple low points exist.

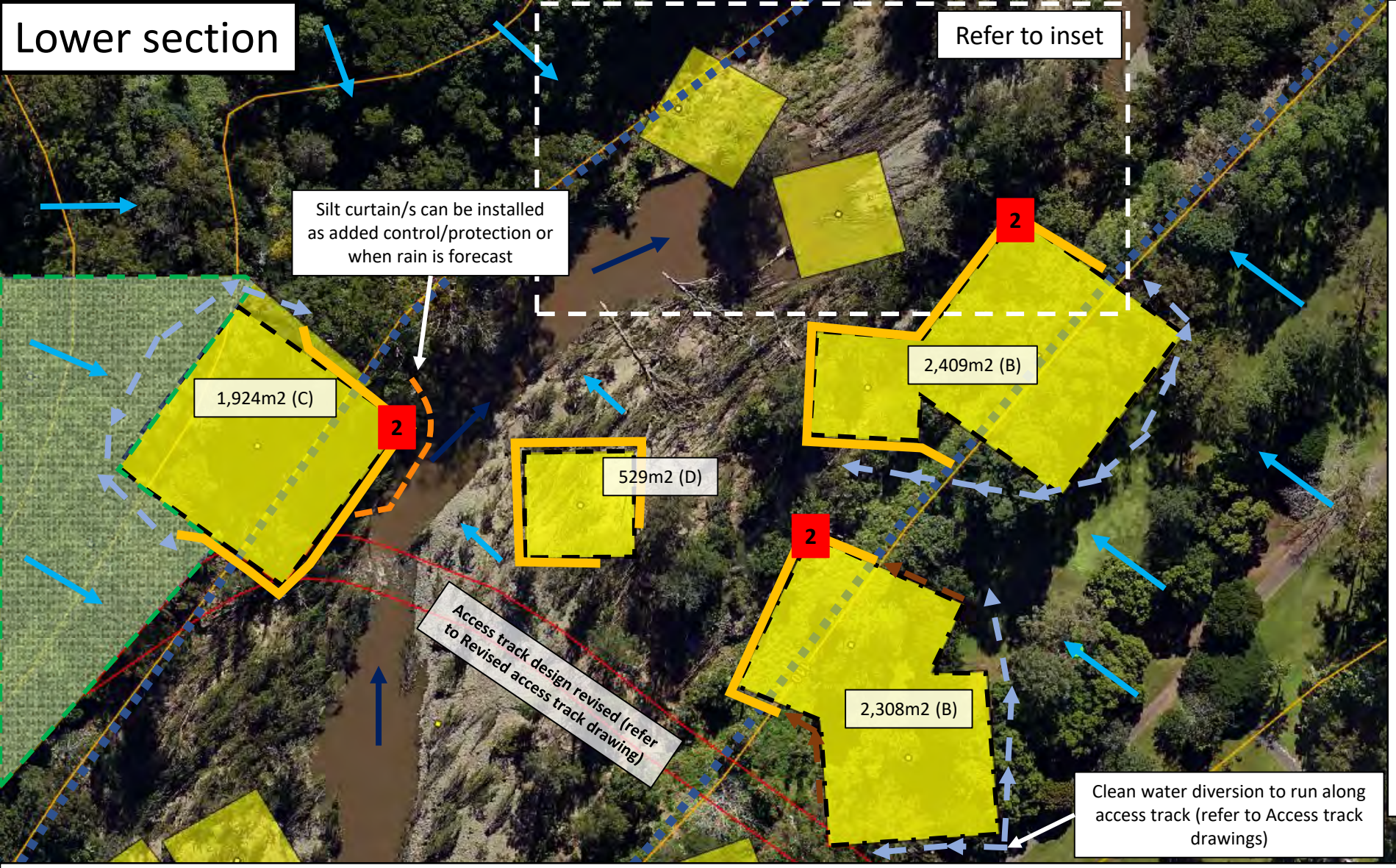
- Floating silt curtains are not recommended for use in areas or during periods of high flow, therefore may not be may not be suitable in all locations.

- Geo-wrapped rock bunds are utilised over dirty water diversion bunds within the creek banks to minimise erodible material introduction within the watercourse.

- Geo-wrapped rock bund/s are only required if subsoils are exposed by earthworks i.e., drill pads that are constructed entirely out of clean rock do not require additional controls to account for the disturbance footprint.

Legend:

- Clean water diversion
- Dirty water diversion
- Borehole and disturbance/clearing footprint
- 2 Type 2 control
- Geo-wrapped rock bund
- Contour lines (10m)
- Overland waterflow direction
- Instream waterflow direction
- Top of bank
- Silt curtain
- Partially disturbed catchment



Notes:

- QH has indicated that they propose to undertake earthworks for all boreholes within close proximity simultaneously, therefore catchment sizes reflect this.

- Any disturbed subsoils are to be sprayed with soil binder.

- Type 2 control/s are to be installed at low point of catchment, location on plan is only indicative.

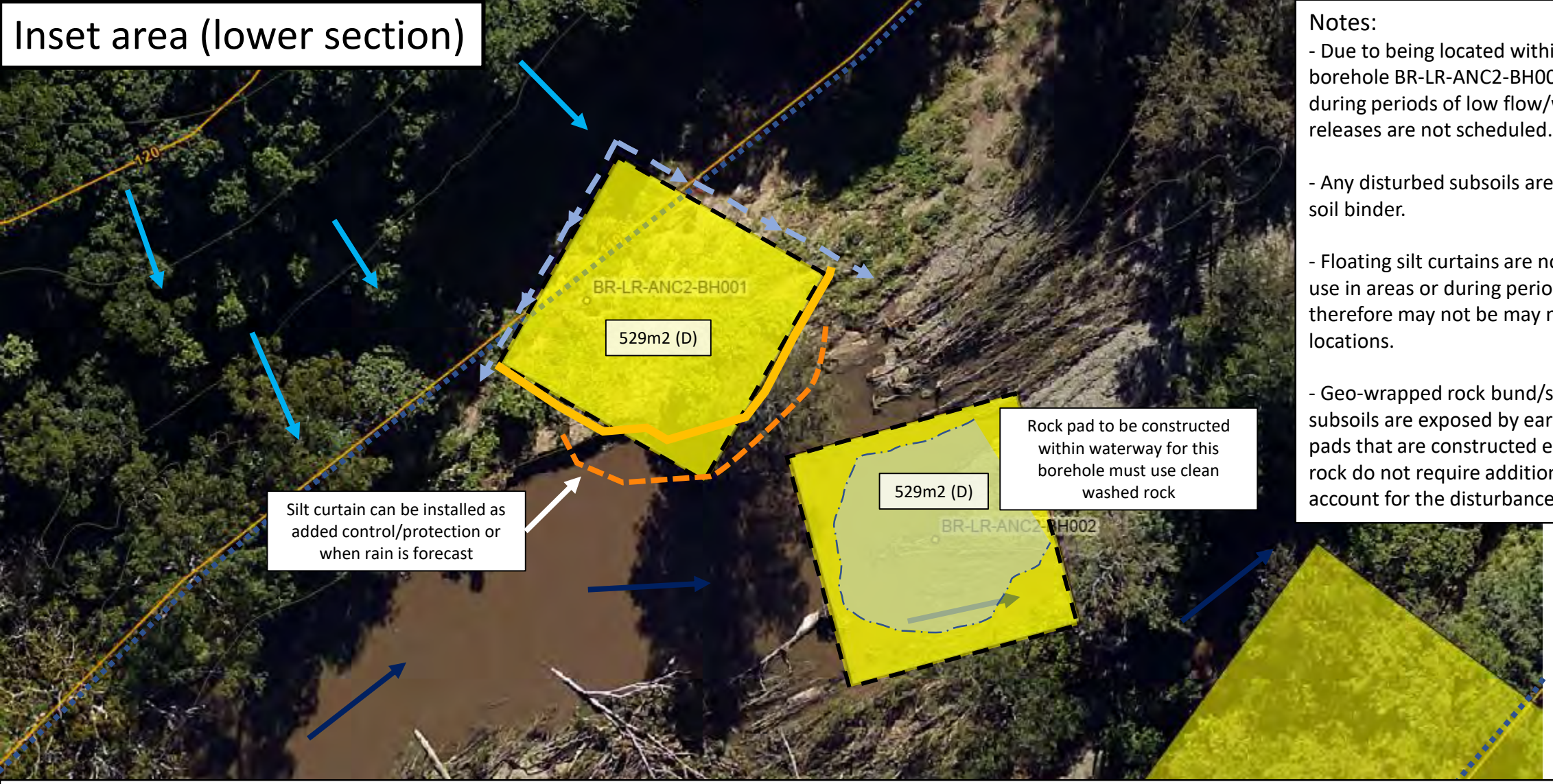
- Geo-wrapped rock bunds are utilised over dirty water diversion bunds within the creek banks to minimise erodible material introduction within the watercourse. Geo-wrapped bunds are also cleaner and easier to remove once works are complete.
- Geo-wrapped rock bund/s are only required if subsoils are exposed by earthworks i.e., drill pads that are constructed entirely out of clean rock do not require additional controls to account for the disturbance footprint.

- Floating silt curtains are not recommended for use in areas subject to high flow or during periods of high flow, therefore may not be may not be suitable in all locations.

Legend:

- Clean water diversion
- Dirty water diversion
- Borehole and disturbance/clearing footprint
- 2 Type 2 control
- Geo-wrapped rock bund
- Contour lines (10m)
- Overland waterflow direction
- Instream waterflow direction
- Top of bank
- Silt curtain
- Partially disturbed catchment

Inset area (lower section)



Notes:

- Due to being located within the waterway, borehole BR-LR-ANC2-BH002 must be drilled during periods of low flow/when significant dam releases are not scheduled.

- Any disturbed subsoils are to be sprayed with soil binder.

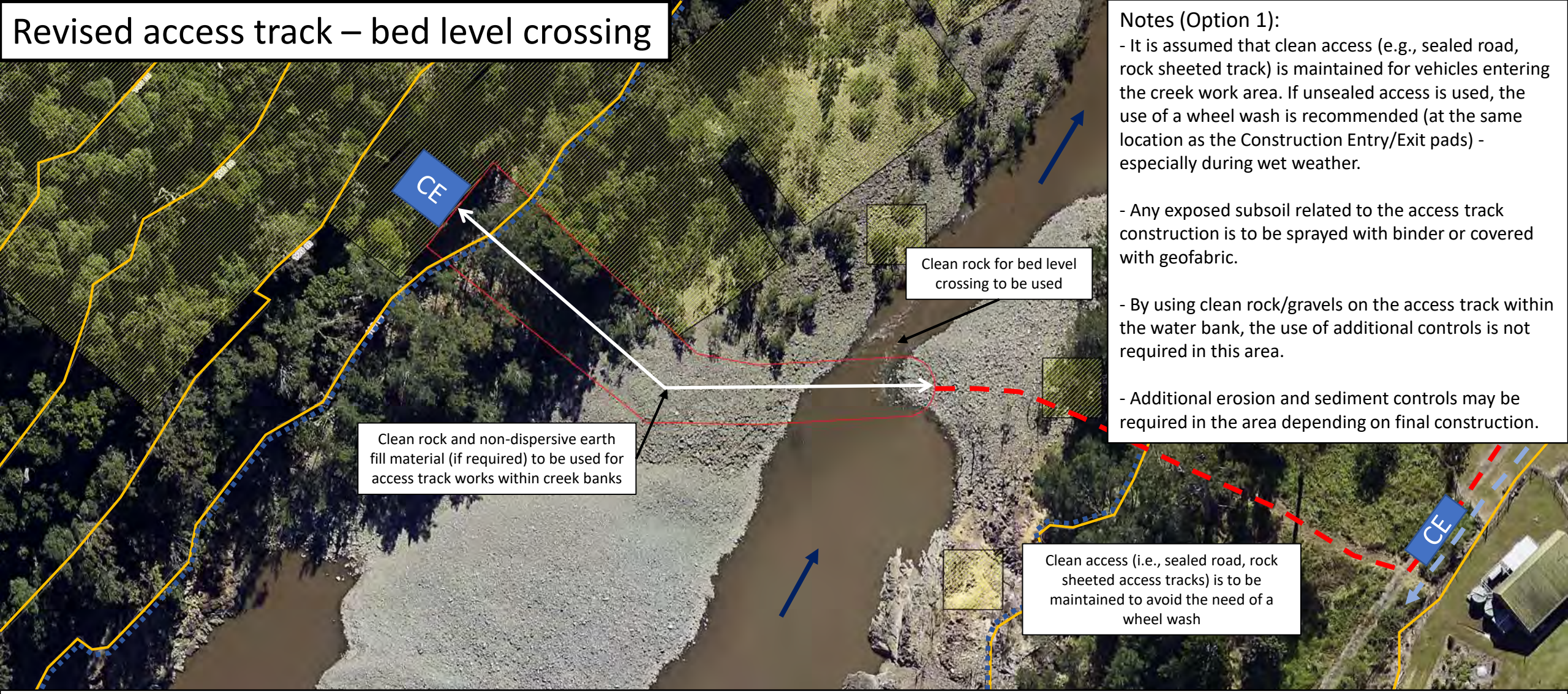
- Floating silt curtains are not recommended for use in areas or during periods of high flow, therefore may not be may not be suitable in all locations.

- Geo-wrapped rock bund/s are only required if subsoils are exposed by earthworks i.e., drill pads that are constructed entirely out of clean rock do not require additional controls to account for the disturbance footprint.

Legend:

- Clean water diversion
- Dirty water diversion
- Borehole and disturbance/clearing footprint
- 2 Type 2 control
- Geo-wrapped rock bund
- Overland waterflow direction
- Instream waterflow direction
- Contour lines (10m)
- Contour lines (5m)
- Top of bank
- Silt curtain
- Rock pad

Revised access track – bed level crossing



Notes (Option 1):

- It is assumed that clean access (e.g., sealed road, rock sheeted track) is maintained for vehicles entering the creek work area. If unsealed access is used, the use of a wheel wash is recommended (at the same location as the Construction Entry/Exit pads) - especially during wet weather.

- Any exposed subsoil related to the access track construction is to be sprayed with binder or covered with geofabric.

- By using clean rock/gravels on the access track within the water bank, the use of additional controls is not required in this area.

- Additional erosion and sediment controls may be required in the area depending on final construction.

Legend:

CE Construction Entry/Exit pad

Top of bank

Clean water diversion

Instream waterflow direction

Assumed existing access track

Contour lines (10m)

Queensland Hydro

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Appendix H – Spoil Management Plan

Prepared for the Borumba PHES Project

Borumba Pumped Hydro Energy Storage Project – Exploratory Works Spoil Management Plan

DOCUMENT NUMBER: BR-NA-NON-ESM-PLN-00001
OCTOBER 2025

Contents

Acronyms and abbreviations iii

1. Introduction 1
   1.2 Plan purpose and objectives 3
2. Regulatory requirements and compliance 4
3. Sources of spoil 5
4. Preliminary investigation results 10
   4.1 Previous investigation 10
   4.2 Future investigation 11
5. Risk assessment 13
6. Mitigation measures 16
7. Managing, handling and reuse of materials 21
   7.1 Stockpiling 22
   7.2 Spoil disposal areas 22
   7.3 Spoil classification 23
   7.4 Material recycling and disposal 25
   7.5 Regulated waste 26
8. Tracking and assurance 27
9. Verification 28
10. Program for strategy implementation 29
11. Quantities, measurement and reporting 30
    11.1 Continual improvement and meeting the requirements of the environmental documents. 30

References 31

Figures

Figure 1: Exploratory Works footprint 2
Figure 2: Spoil disposal areas 6
Figure 3: Waste and resource management hierarchy 21

Tables

Table 1: Sources of spoil 8
Table 2: Risk assessment 14
Table 3: Risk controls 17
Table 4: Waste classification categories and proposed reuse target 23

Acknowledgement of Country

In the spirit of reconciliation, Queensland Hydro acknowledges the Traditional Custodians of Country throughout Queensland and, in particular the lands, skies and waters on which we operate. We celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands, skies and waters of Queensland.

Queensland Hydro pays respect to Elders past and present honouring their continuing spiritual and cultural connections to Country.



Acronyms and abbreviations

Term	Description
ANC	Acid neutralising capacity
ASS	Acid sulfate soil
BoM	Bureau of Meteorology
Borumba PHES Project	Borumba Pumped Hydro Energy Storage Project
CEMP	Construction Environmental Management Plan
CLR	Contaminated land register
DETSI	Department of Environment, Tourism, Science and Innovation
ESC	Erosion and sediment control
ESCP	Erosion and Sediment Control Plan
EIL	Ecological Investigation Level
EIS	Environmental impact statement
EMR	Environmental management register
EPA	Environmental Protection Agency (Victoria)
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPP (Water)	Environmental Protection (Water and Wetland) Policy 2019
ERSED	Erosion and Sediment
ESCP	Erosion and Sediment Control Plan
FEED	Front End Engineering Design
GED	General environmental duty
HIL	Health Investigation Level
IECA	International Erosion Control Association
km	Kilometre
ML	Mega litres
MWh	Megawatt hour
NAPP	Net acid production potential
NAG	Net acid generation
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure
NOA	Naturally occurring asbestos
PASS	Potential acid sulfate soil
PESCP	Preliminary Erosion and Sediment Control Plan
PHES	Pumped Hydro Energy Storage Project
RUSLE	Revised universal soil loss equation
SDA	Spoil disposal area
TSS	Total suspended sediment

1. Introduction

1.1 Background

Queensland Hydro is the proponent of the Borumba Pumped Hydro Energy Storage (PHES) Project. The Borumba PHES Project is a 2,000 megawatt (MW), 48,000-megawatt hour (MWh), hydroelectric scheme to store, generate and supply energy through a pumped hydroelectric structure linked to the existing Lake Borumba in the Gympie and Somerset Regional Council local government areas.

The Borumba PHES Project is located within the Gympie and Somerset Regional Council local government areas, approximately 13 kilometres (km) southwest of the township of Imbil, 48 km southwest of Gympie, and 180 km northwest of Brisbane.

The Borumba PHES Project requires the completion of Exploratory Works to confirm the suitability of the Borumba PHES Project. The purpose of the Borumba PHES Project – Exploratory Works (the Exploratory Works Project) is to undertake and facilitate critical technical investigations required to confirm the suitability of the Borumba PHES Project location and design. The information obtained from the investigations is crucial to the Borumba PHES Project, as it will determine whether the Borumba PHES Project can proceed or if material changes to the reference design are necessary. The technical information needed primarily comprises geological investigations at the proposed locations of the:

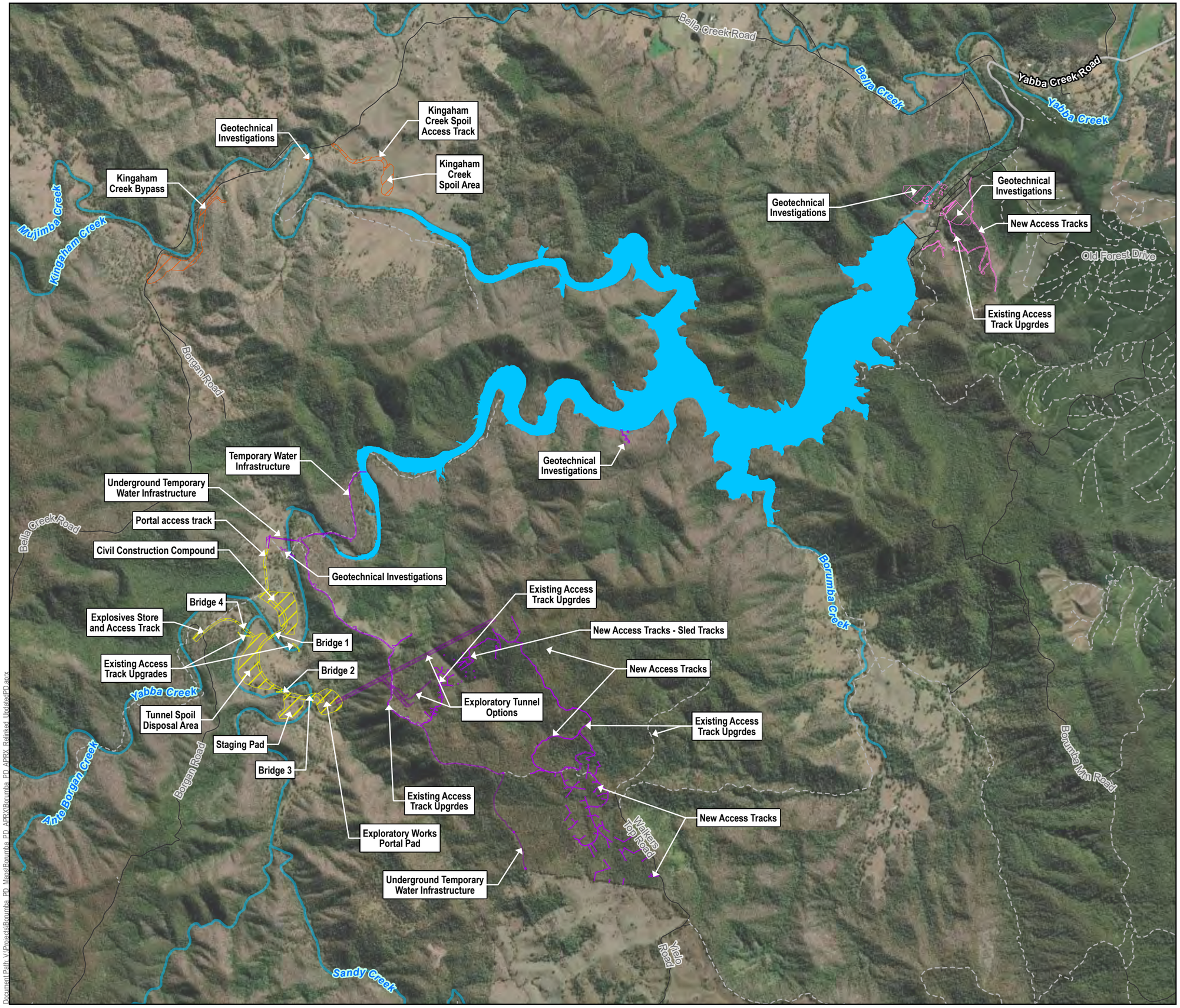
- reservoir dam foundations – to be verified by geotechnical boreholes, test pits and seismic lines
- underground tunnels and caverns – to be verified by geotechnical exploratory tunnel drilling and geotechnical boreholes.

The Exploratory Works, relevant to the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) controlled action, comprise the following components:

- Geotechnical investigations including test pits, boreholes (deep and shallow, including some conversion to groundwater monitoring bores) and seismic lines
- Spoil disposal:
  - Tunnel spoil disposal area
  - Kingaham spoil disposal area
- Site access:
  - new access tracks
  - upgrades to existing tracks
  - Kingaham Creek bypass (realignment of a section of Bella Creek Road)
- Other supporting infrastructure:
  - civil construction compound
  - temporary water infrastructure
- Exploratory tunnel infrastructure:
  - dual exploratory tunnels
  - staging pad
  - portal access track
  - explosive store and access track.

The Construction Environmental Management Plan (CEMP) for the Exploratory Works Project provides a detailed description of the Exploratory Works and associated activities – refer to Section 2 and relevant appendices of the CEMP.

The location and footprint of the Exploratory Works are illustrated in Figure 1.



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LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads
- Lake Borumba (FSL 135.01m AHD)

Exploratory Works Project

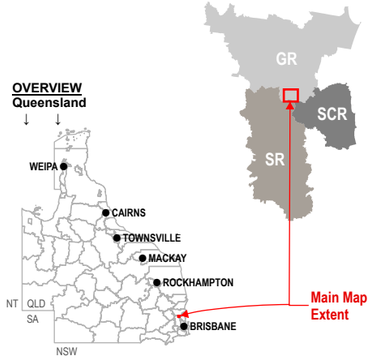
Project Footprint by Work Area

- Area 1 - Borumba Dam
- Area 2 - Kingaham Creek
- Area 3 - Walkers Top
- Area 4 - Borgan

Project Component - Underground

- Area 3 - Walkers Top

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



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Exploratory Works Project
Preliminary Documentation

EXPLORATORY WORKS FOOTPRINT

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 29/09/2025
REVISION:	A

FIGURE 1

1.2 Plan purpose and objectives

This Spoil Management Plan has been prepared to guide the management of spoil during the Exploratory Works. The objective of this Spoil Management Plan is to describe how the Exploratory Works Project proposes to manage impacts during the handling, transport, and emplacement of spoil, and maximise the beneficial use of spoils.

The key objectives of this plan are to:

- detail the strategy for identifying and handling contaminated material during the Exploratory Works Project
- detail the process for updating the quantities of materials for beneficial reuse, recycling and disposal from the Exploratory Works Project
- minimise spoil removal and associated impacts on construction personnel/activities and the environment
- provide a method for reporting and updating this plan
- provide appropriate measures to avoid or minimise impacts associated with spoil management.

Spoil is defined as natural rock, soil or other material that is brought up through the process of excavation. Spoil that is contaminated will be managed in accordance with the CEMP and, if required, disposed of in accordance with the Waste Management Plan.

The Spoil Management Plan is a live document and will be updated as required (in accordance with Section 11.1) during the Exploratory Works Project to reflect updates to the site investigation findings and program.

1.3 Environmental Management

The overall approach to environmental management for the Exploratory Works Project is described in the CEMP. The CEMP provides a framework for a comprehensive, integrated approach to environmental management during implementation of the Exploratory Works.

The Spoil Management Plan forms part of Queensland Hydro's environmental framework as described in the CEMP. It has been prepared for the Exploratory Works and does not apply to the Main Works component of the Borumba PHES Project.

2. Regulatory requirements and compliance

The following Queensland legislation is particularly relevant to this Spoil Management Plan:

- *Biosecurity Act 2014 (Queensland)*
- *Environmental Protection Act 1994 (Queensland)*
- Environmental Protection (Air) Policy 2019 (Queensland)
- *Planning Act 2016 (Queensland)*
- State Planning Policy 2017 (Queensland Department of State Development, Infrastructure and Planning)
- *Work Health and Safety Act 2011 (Queensland)*
- *Waste Reduction and Recycling Act 2011 (Queensland).*

Depending on detailed work activities and spoil volumes and type generated, legislative requirements – requiring approval and/or notification – may be triggered under these acts and regulations. Queensland Hydro are seeking an environmental authority for Environmentally Relevant Activity (ERA) 16 – extractive and screening activities which will contain conditions relating to stockpiling activities. Clarification on the specific applicable triggers, approvals and notification requirements for additional activities shall be sought by the contractors engaged in Exploratory Works, as works planning progresses. Queensland Hydro will obtain or ensure that contractors have the relevant licences, permits and approvals as required by law and maintain them as required throughout the delivery phase of the Exploratory Works Project.

This Spoil Management Plan should be read in conjunction with the Waste Management Sub-Plan, Appendix I to the CEMP, which guides the handling and disposal of contaminated spoil (as waste).

3. Sources of spoil

The Exploratory Works activities that are anticipated to require excavation and generate spoil comprise:

- geotechnical investigations: spoil from test pits, boreholes
- spoil disposal: levelling of the tunnel spoil and Kingaham spoil disposal areas in preparation for receiving spoil
- site access:
  - construction works to establish new or upgrade existing access tracks
  - construction works for the Kingaham Creek bypass
- other supporting infrastructure:
  - civil construction compound – ground-levelling and building foundations
  - temporary water infrastructure – installation of pump pads, tanks, temporary pipeline etc.
- exploratory tunnel infrastructure:
  - excavations and ground-levelling required for associated components (i.e. portal pad and staging area)
  - explosive store (magazine) – ground-levelling and store foundations.

Excavated material includes all material below the existing ground surface directly required for the construction of the temporary and permanent structures, such as shafts, tunnels, retaining structures and building foundations (excluding vegetation and topsoil materials, man-made items including footings, and material resulting from minor works).

An estimated total of 490,000 cubic metres (m^3) of excavated waste rock material (500 mm minus material) that cannot be reused onsite (e.g. in the proposed rehabilitation works for reprofiling) is expected to be generated from the Exploratory Works Project, comprising:

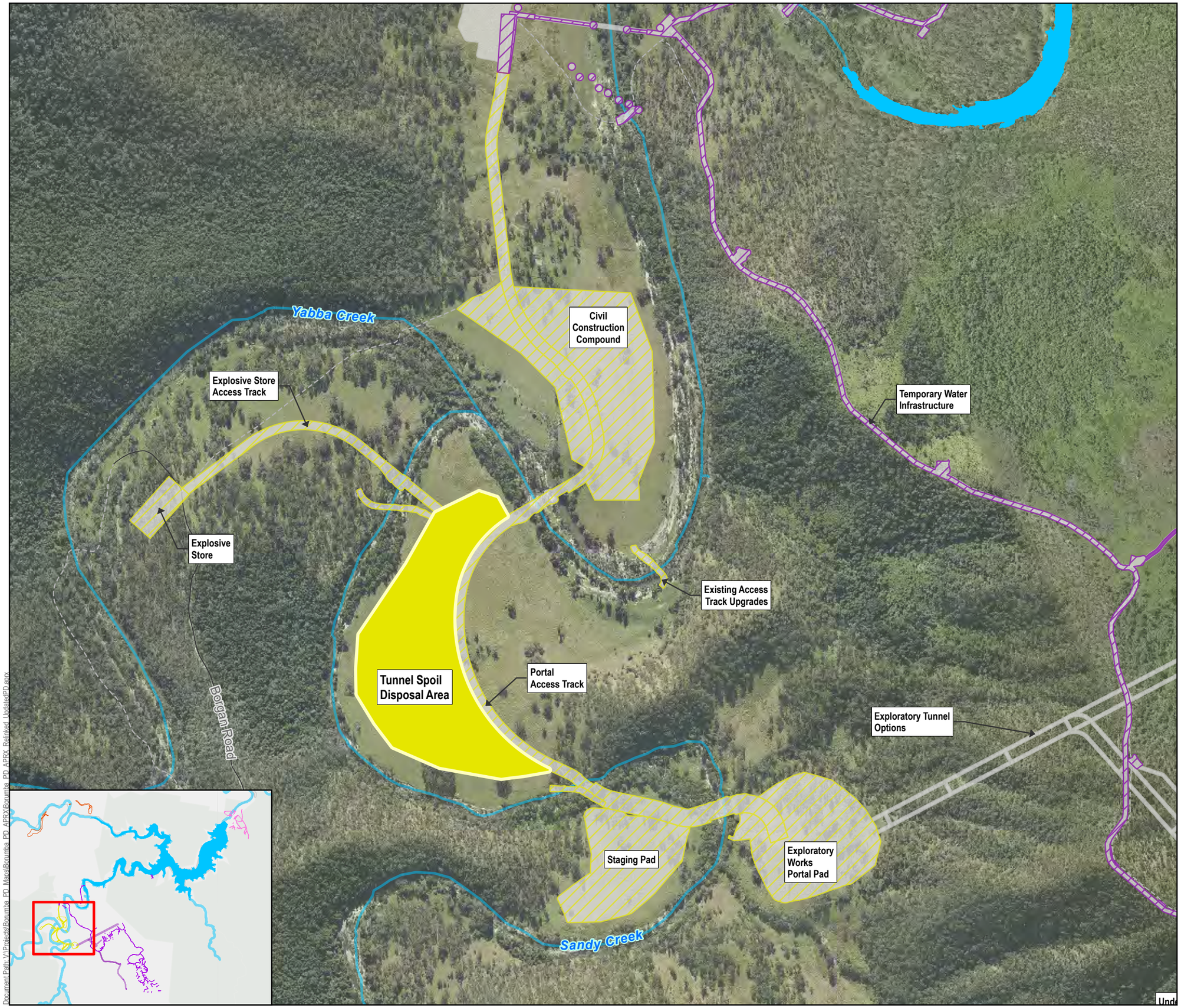
- 395,000 m^3 from the exploratory tunnel drilling
- 95,000 m^3 from the construction of the Kingaham Creek bypass.

Approximately 300,000 m^3 of excess material is expected to be reused as embankment fill, with the remainder to be reused rehabilitation works or in some instances stockpiled.

The volume of material will be confirmed during the geotechnical investigations and tunnelling, including the volume of material that is considered to be waste. As such the tunnel spoil disposal area and associated stockpile has been designed to accommodate up to 160,000 m^3 of additional spoil if required, and the design of the civil construction compound can also accommodate extra fill from excess material.

Table 1 includes a comprehensive list of potential spoil-generating activities that will be undertaken as part of the Exploratory Works. Note that details on specific site activities are yet to be established – this Spoil Management Plan has been completed based on general assumptions regarding the Exploratory Works activities and risks associated with similar projects.

The spoil disposal areas are shown in Figure 2.



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LEGEND

- Watercourses
- Local Roads
- Tracks
- Lake Borumba (FSL 135.01m AHD)

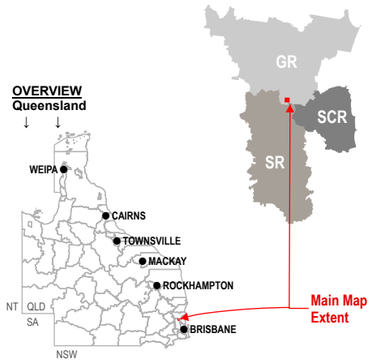
Exploratory Works Project

- Project Area

Project Footprint by Work Area

- Area 3 - Other Activities
- Area 4 - Tunnel Spoil Disposal Area
- Area 4 - Other Activities

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland

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Exploratory Works Project
Preliminary Documentation

TUNNEL SPOIL DISPOSAL AREA (AREA 4 - BORGAN)

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LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE 2a

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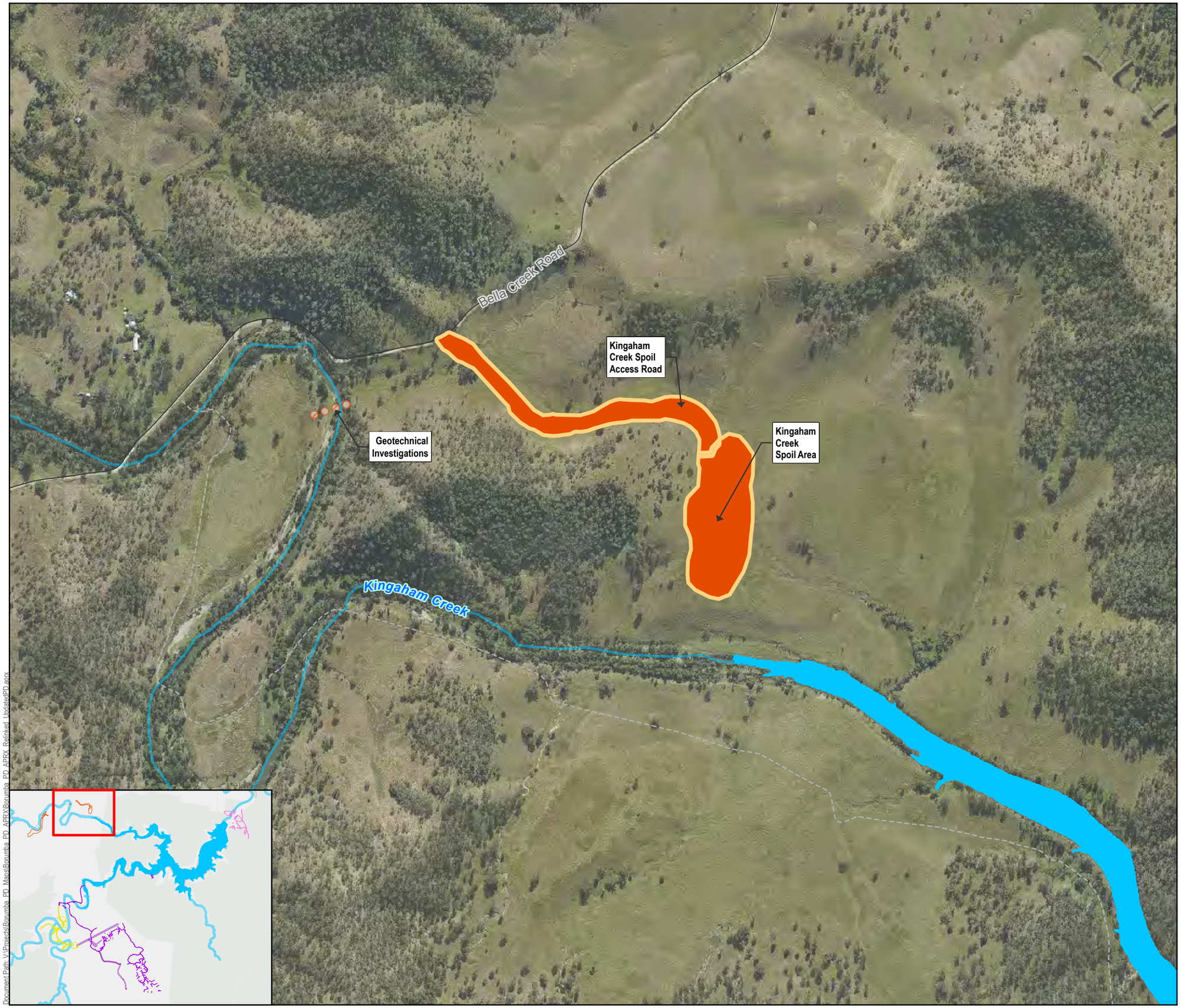

Queensland Hydro

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LEGEND

- Watercourses
- Local Roads
- Tracks
- Lake Borumba (FSL 135.01m AHD)

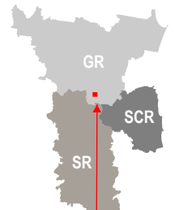
Exploratory Works Project

- Project Area

Project Footprint by Work Area

- Area 2 - Kingaham Creek Spoil Area and Access Road
- Area 2 - Other Activities

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



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Exploratory Works Project
Preliminary Documentation

KINGAHAM SPOIL DISPOSAL AREA (AREA 2 - KINGAHAM CREEK)

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CREATED BY:	BM
LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE 2b

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Table 1: Sources of spoil

Exploratory Works activities	Details	Excavation element	Associated lots	Locations	Estimated quantity
Geotechnical investigations					
Geotechnical investigations	Drilling, test pits	Spoils from drilling, test pits	3AP23765, 1723L37994, 64LX2110, 3LX2754, 16LX1925, 1LX2754, 135FTY1911, 132LX2385, 20LX2359, 1RP98849, 1RP194600, road parcels and watercourse parcels	Various locations throughout the Exploratory Works Project area, with a focus on critical infrastructure such as the new lower dam, tunnelling, Kingaham Creek bypass and the upper reservoir dams	To be determined as dependent on civil works at each borehole location. Noting that some locations may not require any earthworks.
Spoil disposal					
Tunnel spoil disposal area	Establishing spoil stockpile area	Establishing stockpile area to receive spoil material	1732L37994, road parcel	Off Borgan Road near Sandy Creek and Yabba Creek confluence	To be determined – the total footprint for the spoil disposal area is estimated at 11.6 ha.
Kingaham spoil disposal area	Establishing spoil stockpile area	Establishing stockpile area to receive spoil material	1RP98849, Bella Creek Road parcel	South of Bella Creek Road near Kingaham Creek	To be determined – the total footprint for the spoil disposal area is estimated at 3.9 ha.
Site access					
Establishing access tracks	Establishing new and upgrading existing tracks	Spoils from surface stripping for construction works	3AP23765, 1723L37994 135FTY1911, 1RP194600, 16LX1925, 1LX2754, 20LX2359, 3LX2754, 132LX2385, 1RP98849, road parcels and watercourse parcels	Potential access tracks across the site	To be determined – the total length of new and upgraded tracks is approximately 18.49 km, but surface stripping may not be required in all locations.
Kingaham Creek bypass	Realignment of a section of Bella Creek Road	Spoils from surface stripping for construction works	Bella Creek Road parcel, 64LX2110	Bella Creek Road and south of the existing Bella Creek Road to avoid Kingaham Creek	Estimated removal of 95,000 m^3 of material that cannot be reused.

Exploratory Works activities	Details	Excavation element	Associated lots	Locations	Estimated quantity
Other supporting infrastructure					
Temporary water infrastructure (pump pads, tanks, temporary pipeline)	Pump pads, tanks, temporary pipeline	Spoils from surface stripping for construction works	3LX2754, 20LX2359, 1LX2754, 16LX1925, 1723L37994	Along Walkers Top Road and within Lake Borumba	To be determined – the footprint of the temporary water infrastructure is approximately 4.9 ha.
Civil construction compound	Establishing a laydown area	Spoil from surface stripping	3LX2754	East of the confluence between Sandy Creek and Yabba Creek	Negligible – the pad will be constructed with reused spoil. The surface footprint for the civil construction compound is approximately 11 ha.
Exploratory tunnel infrastructure					
Exploratory drilling	Tunnelling	Spoils from excavations (tunnelling) and surface stripping for construction works	1LX2754, 16LX1925, 1723L37994	The proposed portal lower staging area and portal platform	Approximately 395,000 m^3 of loose materials will be generated.
Portal pad, staging area	Establishing a laydown area	Spoils from surface stripping	16LX1925, 1723L37994	East of the confluence between Sandy Creek and Yabba Creek	Negligible – the design of the pads aims to have a cut fill balance.
Explosive store	Establishing explosive store	Spoils from surface stripping for building foundations	3LX2754	Between the proposed portal platform and portal lower staging area	To be determined – the footprint for the explosive store is approximately 0.8 ha

4. Preliminary investigation results

4.1 Previous investigation

Known spoil and waste constraints associated with the Borumba PHES Project have been identified and documented in the following environmental assessment reports, which included one desktop study and limited field investigations:

- (Epic Environmental, 2022). Borumba Pumped Hydro Project (BPHP) Contamination Technical Report. BC220033.01
- (ENGEO, 2022). Borumba Pumped Hydro Energy Storage (PHES) Project, Lake Borumba, Queensland. Geotechnical Investigation. 19754.000.001
- (SMEC, 2024). Borumba Pumped Hydro Energy Storage (BPHES) Project Preliminary Site (Contamination) Investigation.

The geotechnical study during the early work stage undertook soil and rock analysis including the collection of 36 samples for analysis of metals, acid mine drainage, asbestos (presence/absence for free fibres), and radioactivity (gross alpha and beta) to provide a preliminary assessment of the suitability of material for reuse in the construction. Samples were submitted to a National Association of Testing Authorities (NATA) accredited environmental laboratory for analysis. The investigations and results are preliminary only and works and management measures will be revised as required to address the results of ongoing site investigations.

4.1.1 Metals results

A total of 16 samples were analysed for 15 metals (arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, vanadium, and zinc) from 10 locations.

Results were compared against the following screening levels to gain a preliminary understanding of the suitability of soil/rock for reuse from a contamination perspective and the potential for impacts on sensitive receptors:

- Victoria (VIC) Environmental Protection Agency (EPA), Publication 1828.2 Waste disposal categories – characteristics and thresholds: Table 3 – Fill material contamination total concentration upper limit
- New South Wales (NSW) EPA, Resource Recover Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014, The excavated natural material order 2014: Table 4
- National Environment Protection Council (NEPC), NEPM Health Investigation Levels for Residential Land Use, Table 1A(1) HILs Res A Soil.

Concentrations reported in the soil/rock samples collected were below the screen levels. However, the concentration of cadmium from LQ-BH001 1.00-1.45 and LQ-BH001 4.00-4.08, and the concentration of nickel from NB-BH003 14.5-14.93 exceeded the NSW 2014 Excavated Natural Material (Absolute Max) values, and the concentration of copper from NB-BH003 14.5-14.93 exceeded VIC EPA 1828.2 Fill material upper limit and NSW 2014 Excavated Natural Material (Max Average) values.

A preliminary contaminated land investigation of the proposed stockpile area and the portal pad on Lot 1723L37994 was undertaken in August 2023 in accordance with relevant Australia standards, guidelines, and procedures. Noting that this lot is listed on the environmental management register (EMR), notifiable activity of livestock dip or spray race however no evidence of a cattle dip or spray race was identified.

In total 79 soil samples collected from 40 sites were analysed with no exceedances of the adopted human health and ecological site assessment criteria recorded (SMEC, 2024).

While lot 16LX1925 is not listed on the EMR, a notifiable activity – presence of a livestock dip has been confirmed. Surface sampling of this area indicated no visual or olfactory evidence of contamination and no exceedances of adopted assessment criteria. It was concluded that this area is a very low risk.

4.1.2 Geochemical results

A total of 20 samples were analysed for net acid production potential (NAPP), net acid generation (NAG), and acid neutralising capacity (ANC) from nine locations.

Results were compared with the following screening levels to gain a preliminary understanding of the soil/rock for reuse from a geochemical perspective:

- Commonwealth of Australia, 2016 Leading Practice Sustainable Development Program for the Mining Industry. Prevention of Acid and Metalliferous Drainage, Table 5 – Preliminary screening criteria based on NAPP and NAG test data.

Given that all the NAPP results were negative and NAG pH values were above 4.5, all 20 samples were classified as non-acid-forming material.

4.1.3 Asbestos results

A total of six samples at the lower and upper dam sites were analysed for asbestos-present identification (ENGEO, 2023). No asbestos was detected in the samples collected and analysed for the presence of asbestos fibres.

Asbestos was also not detected in the 79 samples collected from 40 sites during the preliminary contaminated land investigations undertaken by SMEC in August 2023.

The presence of serpentinite, which is mapped in the Exploratory Works Project area, can correlate with the presence of naturally occurring asbestos. Initial testing of soil outside the Project area has found naturally occurring asbestos. Additional analysis for asbestos will be undertaken within the Project area before activities begin and as the works progress.

4.1.4 Radionuclides activity gross alpha and beta

A total of 13 samples were analysed for gross alpha and beta from the saddle dam, new Borumba Dam wall and parapet wall footprints.

Gross alpha values ranged between <500 and 1,410 becquerel (Bq)/kg, and gross beta values ranged between <500 and 1,110 Bq/kg.

4.2 Future investigation

Completing in-situ waste classifications will be beneficial in reducing the need to temporarily stockpile contaminated materials on the Exploratory Works Project site, before offsite disposal. Additionally, the in-situ classification will allow strategic planning of excavation to minimise the risk of occupational health exposure and environmental harm. Further, the in-situ classification will be used to ensure waste streams are appropriately segregated to avoid cross contamination (to the greatest extent possible) for reuse or offsite disposal.

Further contamination site investigations will be undertaken during Exploratory Works for the potentially contaminated sites, specifically within the EMR listed land:

- Lot 3LX2754 is listed for the notifiable activity of mineral processing
- Lot 135FTY1911 is listed for two notifiable activities:
  - petroleum product or oil storage
  - waste storage, treatment, or disposal
- Lot 1723L37994 is listed for livestock dip or spray race, but it is noted that there is no dip or spray race present on this lot.

These investigations shall follow a sampling analysis and quality plan developed and prepared based on the nature and extent of potential contamination from existing information.

In addition, contaminated land investigations and soil assessments are currently being undertaken in support of the environmental impact statement for the Borumba PHES Project – Main Works. The findings of these studies will also be used to inform updates to this management plan.

If any soil/rock is to be excavated and beneficially reused within the Exploratory Works Project footprint, it will be stored and treated onsite. However, in some instances the material will be transported by a licensed waste disposed company to a licensed waste facility. Soil/rock, surface water and groundwater in the proposed disturbance site should meet the sampling frequency/analytical requirements outlined in the NEPM (NEPC, 2013) and AS4482.1-2005.

The future investigation would be undertaken to include sufficient sampling to enable in-situ waste classifications for material associated with bulk excavations at the specified excavation sites (to the extent possible). Where applicable, the detailed site investigation shall include:

- identification of the type, extent and concentration of contaminants of concern
- information on the potential effects of contaminants on identified receptors
- offsite impacts on soil, sediment and biota (where applicable)
- the adequacy and completeness of all information available to be used in making decisions on remediation (including excavated material reuse, recycling and disposal) and site management
- identification of preferred options for remediation and/or site management.

5. Risk assessment

Potential impacts and associated risks for spoil are detailed in Table 2. The qualitative risk was assessed using the methodology outlined in section 5.1 of the CEMP.

Table 2: Risk assessment

Project component	Description	Risk (spoil)	Risk level (without controls)			Risk level (post controls as identified in Table 3)		
			Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Geotechnical investigations								
Geotechnical investigations	Test pits to obtain geotechnical information necessary to determine the suitability of the Borumba PHES Project location and support the detailed design.	• Spoil from test pits and temporary storage at site, backfilling. • Spoil from site preparation, with temporary storage at site, filling trucks and haulage to spoil disposal areas. • Dust/impacts to air, impacting on sensitive receptors, either directly from spoil handling and stockpiling, or from transport/haulage. • Erosion and runoff from temporary stockpiles, sediment loading to creeks/waterways. Acidifying impacts from acidic spoil. Increased turbidity of local surface water from sedimentation. • Inappropriate temporary stockpiling of spoil soil outside of approved footprint, impacting visual amenity, and terrestrial ecological values. • Potential generation of contaminated spoil, either from existing contamination or spoil contaminated with oils/leaks or spills from works. • Spreading of weeds through spoil movement.	Likely	Moderate	Medium	Unlikely	Minor	Low
	Boreholes (deep and shallow, including some conversion to groundwater monitoring bores)	• Spoil generated from drilling. Temporary storage at site and backfilling of material where suitable. • Some potential for impacts as above if spoil is not reinstated in borehole, but on a smaller scale.	Possible	Minor	Low	Rare	Minor	Low
Spoil disposal								
Tunnel spoil disposal area, Kingaham spoil disposal area	Dedicated areas for disposal of spoil material from exploratory tunnel and technical drilling and stockpiling of topsoil.	• Vegetation spoils present fire hazard (fuel source). • Contamination of surface and groundwater from stockpiling of contaminated spoil. • Mixing of spoil stockpiles (contaminated and non-contaminated, inert with acidifying, subsoil and topsoil etc.), reducing use/availability of spoil and viability of Rehabilitation and Decommissioning Strategy. • Unlined, contaminated spoil leaching to soil and groundwater. • Dust/impacts to air, impacting on sensitive receptors, either directly from spoil handling and stockpiling, or from transport/haulage. • Erosion and runoff from temporary stockpiles, sediment loading to creeks/waterways. Acidifying impacts from acidic spoil. Increased turbidity of local surface water from sedimentation. • Inappropriate temporary stockpiling of spoil soil outside of approved footprint, impacting visual amenity, and terrestrial ecological values.	Likely	Major	High	Possible	Moderate	Medium
Site access								
New/upgraded access tracks and roads,	New access tracks and upgrades to existing tracks, including waterway crossings, to enable access to geotechnical investigation and exploratory tunnel drilling sites.	• Spoil from road works. • Risk as for test pits above.	Likely	Moderate	Medium	Unlikely	Moderate	Low
Kingaham Creek bypass	Realignment of a section of Bella Creek Road (Kingaham Creek bypass)	• Spoil from road works. • Risk as for test pits above.	Likely	Moderate	Medium	Unlikely	Moderate	Low
Other supporting infrastructure								
Temporary water infrastructure, civil construction compound	Construction of a temporary water pipeline required to support project water requirements and construction	• Spoil from site preparation, excavated areas for installation of water infrastructure, with temporary storage at site, filling trucks and haulage to spoil disposal areas. • Risk as for test pits above.	Likely	Moderate	Medium	Unlikely	Moderate	Low

Project component	Description	Risk (spoil)	Risk level (without controls)			Risk level (post controls as identified in Table 3)		
			Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
	of a civil construction compound (laydown area).							
Exploratory tunnel infrastructure								
Dual exploratory tunnels	Exploratory drilling of dual tunnels to the powerhouse cavern from the portal pad following the proposed tunnel alignment.	• Spoil from excavations (tunnelling), with temporary storage at site, filling trucks and haulage to spoil disposal areas. • Mobilisation of sediment into waterways from spoil generation and uncontained cuttings/spoil. • Potential generation of contaminated spoil from spoil contaminated with oils/leaks or spills from works. • Dust/impacts to air, impacting on sensitive receptors, either directly from spoil handling and stockpiling, or from transport/haulage. • Erosion and runoff from temporary stockpiles, sediment loading to creeks/waterways. Acidifying impacts from acidic spoil. Increased turbidity of local surface water from sedimentation. • Inappropriate temporary stockpiling of spoil soil outside of approved footprint, impacting visual amenity, and terrestrial ecological values. • Spreading of weeds through spoil movement.	Likely	High	High	Unlikely	Moderate	Low
Staging pad, explosive store	Construction of a staging pad and explosive store.	• Spoil from site preparation, with temporary storage at site, filling trucks and haulage to Spoil disposal areas. • Risk as for test pits above.	Likely	Moderate	Medium	Unlikely	Moderate	Low
Portal pad	Construction of a portal pad.	• Spoil from site preparation, with temporary storage at site, filling trucks and haulage to spoil disposal areas. • Dust/impacts to air, impacting on sensitive receptors, either directly from spoil handling and stockpiling, or from transport/haulage. • Erosion and runoff from temporary stockpiles, sediment loading to creeks/waterways. Acidifying impacts from acidic spoil. Increased turbidity of local surface water from sedimentation. • Inappropriate temporary stockpiling of spoil soil outside of approved footprint, impacting visual amenity, and terrestrial ecological values. • Potential generation of contaminated spoil, either from existing contamination or spoil contaminated with oils/leaks or spills from works. • Spreading of weeds through spoil movement.	Likely	Moderate	Medium	Unlikely	Moderate	Low

6. Mitigation measures

Mitigation measures for the risks listed in Table 2 are outlined in Table 3.

Sections 7-11 of this Spoil Management Plan expand on the mitigation measures listed in Table 3, to provide more detail and guidance.

All spoil management and mitigation measures will be underpinned by the broader measures, training, monitoring, recording and reporting requirements outlined in section 4 – Environmental Management System – of the CEMP.

Table 3: Risk controls

Impact	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
Geotechnical investigations							
Test pits	Site/project engineer	Minimal dust impacts and no community complaints regarding dust. Spoil contained in stockpiles, environmental values (i.e. water quality) maintained – no impact from erosion and sedimentation from spoil. All spoil contained and stockpiled within approved Exploratory Works Project disturbance footprint. Any contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Plan, Appendix I to the CEMP). Weeds treated/spread minimised. Prompt reinstatement of spoil following completion of testing to allow for site rehabilitation.	Dust suppression with watering if required. Minimal handling of spoil. Revise work plans if high winds anticipated. Erosion and sediment control as per Preliminary ESCP, Appendix G of the CEMP, including preparation and implementation of the primary and progressive ESCPs. Temporary stockpiling within approved disturbance footprint (work area) and prompt removal to SDA. Contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). Management of acidifying spoil and spoil classified in accordance with Section 7.3. Weed monitoring and treatment of large infestations of spoil, if required. Management measures as outlined in Section 7 to Section 11. Stockpiling topsoil and subsoil separately on either side of the test pit, and backfilling test pits with the stockpiled subsoil and topsoil, in the correct sequence, as soon as practicable. Erosion prevention on sloping ground by installing drainage structures that minimise surface water flow into the excavation where appropriate. Topsoil and subsoil stockpiles can be used to divert water around the excavation.	Zero community complaints related to spoil. Zero serious environmental incidents related to spoil, handling and disposal. No material impact to environment outside of approved disturbance footprints. No spoil leaving approved work area/footprint, other than via truck. Water quality of adjacent creeks and drainage lines remains within the water quality objectives.	Daily site report (daily diary). Otherwise as per CEMP.	Community complaint received relating to spoil. Serious environmental incident related to spoil Evidence of spoil material or disturbance outside the footprint Exceedances of water quality objectives in adjacent creeks or drainage lines	Revise erosion and sedimentation controls. Returning of spoil, to designated storage area. Remediation if required. Otherwise as per CEMP.
Boreholes	Site/project engineer	Prompt reinstatement of spoil following completion of testing to allow for site rehabilitation. No evidence of investigation activity/drilling at each location following completion of testing and reinstatement of spoil/rehabilitation.	Reinstate spoil into boreholes as soon as practicable. Prompt removal of any excess spoil off site, to allow for site rehabilitation/revegetation.	Zero community complaints related to spoil. Zero serious environmental incidents related to spoil, handling and disposal. No material impact to environment outside of approved disturbance footprints.	Daily site report (daily diary). Otherwise as per CEMP.	Community complaint received relating to spoil. Serious environmental incident related to spoil Evidence of spoil material or disturbance outside the footprint	Returning of spoil, to designated storage area. Remediation if required. Otherwise as per CEMP.
Spoil disposal							
Tunnel spoil disposal area, Kingaham spoil disposal area	Site/project engineer, environmental	As for test pits.	Dust suppression with watering if required. Minimal handling of spoil. Revise work plans if high winds anticipated.	Zero community complaints related to spoil.	Daily site report (daily diary).	Community complaint received relating to spoil.	Dust suppression.

Impact	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
	management representative		Limiting heights of stockpiles to 5 m where possible, with a maximum height of 7 m. Erosion and sediment control as per Preliminary ESCP, Appendix G of the CEMP, including preparation and implementation of the primary and progressive ESCPs. Temporary stockpiling within approved disturbance footprint (work area) and prompt removal to SDA. Contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). Management of acidifying spoil and spoil classified in accordance with Section 7.3. Weed monitoring and treatment of large infestations of spoil, if required. Management measures as outlined in Section 7 to Section 11. Erosion prevention on sloping ground by installing drainage structures that minimise surface water flow into the excavation. Topsoil and subsoil stockpiles can be used to divert water around the excavation.	Zero serious environmental incidents related to spoil, handling and disposal. Maintain complete segregation and signage of spoil stockpiles. No material impact to environment outside of approved disturbance footprints. No spoil leaving approved work area/footprint, other than via truck. Water quality of adjacent creeks and drainage lines remains within the water quality objectives.	Weekly environmental inspection. Otherwise as per CEMP.	Serious environmental incident related to spoil Inspections identify combined stockpiles or improper/missing signage Evidence of spoil material or disturbance outside the footprint Exceedances of water quality objectives in adjacent creeks or drainage lines	Revise erosion and sedimentation controls. Returning of spoil, to designated storage area. Additional testing of spoil material, ad hoc as required. Remediation if required. Otherwise as per CEMP.
Site access							
New access tracks, upgrades to existing access tracks	Site/project engineer, environmental management representative	As for test pits.	Dust suppression with watering if required. Minimal handling of spoil. Revise work plans if high winds anticipated. Erosion and sediment control as per Preliminary ESCP, Appendix G of the CEMP, including preparation and implementation of the primary and progressive ESCPs. Temporary stockpiling within approved disturbance footprint (work area) and prompt removal to SDA. Contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). Management of acidifying spoil and spoil classified in accordance with Section 7.3. Weed monitoring and treatment of large infestations of spoil, if required. Management measures as outlined in Section 7 to Section 11. Erosion prevention on sloping ground by installing drainage structures that minimise surface water flow into the excavation. Topsoil and subsoil stockpiles can be used to divert water around the excavation.	Zero community complaints related to spoil. Zero serious environmental incidents related to spoil, handling and disposal. No material impact to environment outside of approved disturbance footprints. No spoil leaving approved work area/footprint, other than via truck. Water quality of adjacent creeks and drainage lines remains within the water quality objectives.	Daily site report (daily diary). Otherwise as per CEMP.	Community complaint received relating to spoil. Serious environmental incident related to spoil Evidence of spoil material or disturbance outside the footprint Exceedances of water quality objectives in adjacent creeks or drainage lines	Dust suppression. Revise erosion and sedimentation controls. Returning of spoil, to designated storage area. Remediation if required. Otherwise as per CEMP.

Impact	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
Kingaham Creek bypass	Site/project engineer, environmental management representative	As for test pits above.	Dust suppression with watering if required. Minimal handling of spoil. Revise work plans if high winds anticipated. Erosion and sediment control as per Preliminary ESCP, Appendix G of the CEMP, including preparation and implementation of the primary and progressive ESCPs. Temporary stockpiling within approved disturbance footprint (work area) and prompt removal to SDA. Contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). Management of acidifying spoil and spoil classified in accordance with Section 7.3. Weed monitoring and treatment of large infestations of spoil, if required. Management measures as outlined in Section 7 to Section 11. Erosion prevention on sloping ground by installing drainage structures that minimise surface water flow into the excavation. Topsoil and subsoil stockpiles can be used to divert water around the excavation.	Zero community complaints related to spoil. Zero serious environmental incidents related to spoil, handling and disposal. No material impact to environment outside of approved disturbance footprints. No spoil leaving approved work area/footprint, other than via truck. Water quality of adjacent creeks and drainage lines remains within the water quality objectives.	Daily site report (daily diary). Otherwise as per CEMP.	Community complaint received relating to spoil. Serious environmental incident related to spoil Evidence of spoil material or disturbance outside the footprint Exceedances of water quality objectives in adjacent creeks or drainage lines	Dust suppression. Revise erosion and sedimentation controls. Returning of spoil, to designated storage area. Remediation if required. Otherwise as per CEMP.
Exploratory tunnel infrastructure							
Dual exploratory tunnels	Construction manager, site/project engineer, environmental management representative	Minimal dust impacts and no community complaints regarding dust. Spoil contained in stockpiles, environmental values (i.e. water quality) maintained – no impact from erosion and sedimentation from spoil. All spoil contained and stockpiled within approved Exploratory Works Project disturbance footprint. Any contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). Weeds treated/spread minimised	Dust suppression with watering if required. Minimal handling of spoil. Revise work plans if high winds anticipated. Erosion and sediment control as per Preliminary ESCP, Appendix G of the CEMP. Temporary stockpiling within approved disturbance footprint (work area) and prompt removal to SDA. Contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). Management of acidifying spoil and spoil classified in accordance with Section 7.3. Weed monitoring and treatment of large infestations of spoil, if required. Management measures as outlined in Section 7 to Section 11.	Zero community complaints related to spoil. Zero serious environmental incidents related to spoil, handling and disposal. No material impact to environment outside of approved disturbance footprints. No spoil leaving approved work area/footprint, other than via truck. Water quality of adjacent creeks and drainage lines remains within the water quality objectives.	Daily site report (daily diary). Weekly environmental inspection. Otherwise as per CEMP.	Community complaint received relating to spoil. Serious environmental incident related to spoil Evidence of spoil material or disturbance outside the footprint Exceedances of water quality objectives in adjacent creeks or drainage lines	Dust suppression. Revise erosion and sedimentation controls. Returning of spoil, to designated storage area. Remediation if required. Otherwise as per CEMP.
Staging pad, portal pad, explosive store	Construction manager, site/project engineer, environmental	Minimal dust impacts and no community complaints regarding dust.	Dust suppression with watering if required. Minimal handling of spoil. Revise work plans if high winds anticipated.	Zero community complaints related to spoil.	Daily site report (daily diary). Weekly	Community complaint received relating to spoil.	Dust suppression.

Impact	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
	management representative	Spoil contained in stockpiles, environmental values (i.e. water quality) maintained – no impact from erosion and sedimentation from spoil. All spoil contained and stockpiled within approved Exploratory Works Project disturbance footprint. Any contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). Weeds treated/spread minimised	Erosion and sediment control as per Preliminary ESCP, Appendix G of the CEMP. Temporary stockpiling within approved disturbance footprint (work area) and prompt removal to SDA. Contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). Management of acidifying spoil and spoil classified in accordance with Section 7.3. Weed monitoring and treatment of large infestations of spoil, if required. Management measures as outlined in Section 7 to Section 11.	Zero serious environmental incidents related to spoil, handling and disposal. No material impact to environment outside of approved disturbance footprints. No spoil leaving approved work area/footprint, other than via truck. Water quality of adjacent creeks and drainage lines remains within the water quality objectives.	environmental inspection. Otherwise as per CEMP.	Serious environmental incident related to spoil Evidence of spoil material or disturbance outside the footprint Exceedances of water quality objectives in adjacent creeks or drainage lines	Revise erosion and sedimentation controls. Returning of spoil, to designated storage area. Remediation if required. Otherwise as per CEMP.
Other supporting infrastructure							
Civil construction compound, temporary water infrastructure	Construction manager, site/project engineer, environmental management representative	Minimal dust impacts and no community complaints regarding dust. Spoil contained in stockpiles, environmental values (i.e. water quality) maintained - no impact from erosion and sedimentation from spoil. All spoil contained and stockpiled within approved Exploratory Works Project disturbance footprint. Any contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). Weeds treated/spread minimised	Dust suppression with watering if required. Minimal handling of spoil. Revise work plans if high winds anticipated. Erosion and sediment control as per Preliminary ESCP, Appendix G of the CEMP. Temporary stockpiling within approved disturbance footprint (work area) and prompt removal to SDA. Contamination identified, delineated, and properly treated or disposed of (in accordance with regulatory requirements - see the Waste Management Sub-plan, Appendix I to the CEMP). Management of acidifying spoil and spoil classified in accordance with Section 7.3. Weed monitoring and treatment of large infestations of spoil, if required. Management measures as outlined in Section 7 to Section 11. Water management as outlined in the Water Management Sub-Plan (Appendix K of the CEMP).	Zero community complaints related to spoil. Zero serious environmental incidents related to spoil, handling and disposal. No material impact to environment outside of approved disturbance footprints. No spoil leaving approved work area/footprint, other than via truck. Water quality of adjacent creeks and drainage lines remains within the water quality objectives.	Daily site report (daily diary). Weekly environmental inspection. Otherwise as per CEMP.	Community complaint received relating to spoil. Serious environmental incident related to spoil Evidence of spoil material or disturbance outside the footprint Exceedances of water quality objectives in adjacent creeks or drainage lines	Dust suppression. Revise erosion and sedimentation controls. Returning of spoil, to designated storage area. Remediation if required. Otherwise as per CEMP.

7. Managing, handling and reuse of materials

Queensland Hydro will reduce the amount of spoil generated through design optimisation. The material will only be excavated where required to enable the Exploratory Works, and will maximise the reuse of suitable spoil on site where possible to reduce the overall volume of material requiring placement.

All the spoil will be managed in accordance with the waste hierarchy documented within the Queensland Waste Management Resource Recovery Strategy. The Queensland Hydro spoil management approach is focused on the top two levels of the hierarchy (avoid and reduce waste and reuse waste). The hierarchy is illustrated in Figure 3.

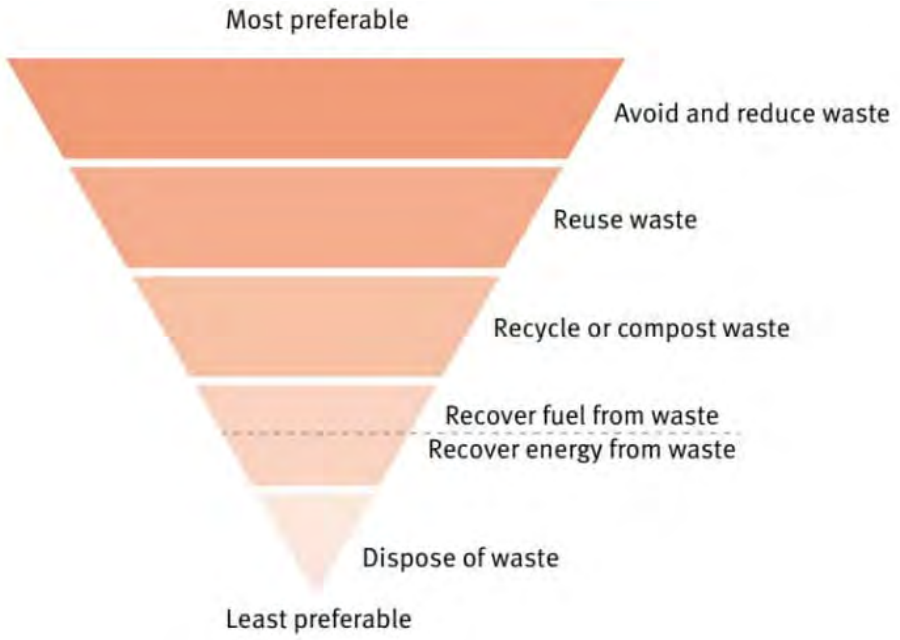


Figure 3: Waste and resource management hierarchy

The excavation, handling, mass haul, stockpiling and treatment of contaminated materials will be performed in accordance with the CEMP and this Spoil Management Plan. Construction techniques and methods will be employed to retain the delineation of material types (identified through in-situ classification) during excavation as far as practicable. Shaft excavation (and other vertical excavations) can achieve a high degree of segregation for delineated materials; however, full segregation of differing material types during full-face, horizontal excavations will not be achievable. Construction techniques and methods will be employed to maximise delineation and segregation, but a minimum extent of unavoidable blending is anticipated, and the assumptions will be included in a specific excavation site register as required.

Excavated material from the Exploratory Works Project will be managed in stockpiles and segregated by material type. Stockpile management practices will be implemented in accordance with any approval conditions and requirements and the following general principles:

- Erosion and Sediment Control Plans (ESCPs) will be prepared and implemented in advance of stockpiling
- the ESCPs will detail soil and water management measures to minimise soil erosion and the discharge of sediment and other pollutants to land and/or waters
- controls will be installed around all stockpiles that are in place for more than 10 days to prevent wind and water erosion
- dust management measures (including for vehicle movements associated with stockpiling activities) will be implemented
- materials will not be stockpiled within the tree protection zone of trees to be retained.

Following classification, stockpiles with different material designations (waste classification categories or uses) will be segregated, ensuring adequate physical separation and/or barriers to avoid cross-contamination. Stockpile information will be recorded, including material designation/classification and key dates (commencement, treatment, additional testing etc.). Following treatment and/or testing, additional material will not be added to stockpiles pending receipt and assessment of results, retreatment of material, and/or the reuse or disposal of the material in the stockpile.

Additional stockpile control measures may be required for some excavated material. These will be implemented upon further investigation. For contaminated material stockpiles, additional mitigations will be considered to address material specific impacts (e.g., guard layers to prevent leaching into the underlying material, covers or windbreaks to prevent dusting, drainage/treatment and deodorising of waterlogged material).

Further detailed contamination site investigation shall include an assessment of the suitability of reuse and recycling of excavated material. Excavated material that cannot be used efficiently and beneficially on site will be sent for offsite disposal in accordance with the waste classification. Continued assessment of reuse and recycling options will occur throughout the excavation phase to ensure that emerging and new reuse, recycle and disposal options are considered where available.

7.1 Stockpiling

The proposed location of the spoil disposal areas is on Lot 1723L37994 and Lot 1RP98849 – see Figure 2. The sites will be progressively stripped and opened to receive spoil. ESCP measures will be placed around the spoil sites to avoid contamination of Yabba Creek, Sandy Creek and Kingaham Creek. The spoil sites will likely be progressively profiled, and measures put in place as appropriate to manage dust generation and sedimentation (e.g. covers, revegetation).

Temporary stockpiles will be used to enable ex-situ testing and manage material flows across the Exploratory Works Project. All stockpiles shall be designed and managed to implement ESCP measures, maintaining clearance for operation and site major infrastructure, and away from ecologically sensitive areas, with minimum disturbance to existing vegetation.

Material which has been assessed as not suitable for reuse on land or cannot be reused onsite or offsite will be stockpiled onsite in the spoil disposal areas.

7.2 Spoil disposal areas

7.2.1 Tunnel spoil disposal area

The spoil disposal area allows for the disposal of approximately 395,000 m^3 of excavated waste rock material (500 mm minus material) expected to be generated from the exploratory tunnel drilling and civil works that cannot be reused onsite (e.g. in proposed rehabilitation works such as reprofiling). Approximately ~300,000 m^3 of additional excess material from the works may be reused as embankment fill, with the remainder to be reused in rehabilitation works or in some instances stockpiled. The type of material will need to be considered to avoid large rocks protruding post rehabilitation. The volume of material will be confirmed during the geotechnical investigations and tunnelling, including the volume of material that is considered to be waste.

The spoil area is of sufficient size to allow for material to be segregated for contamination testing before being placed in the stockpiles.

Initially, the spoil area will be accessed to stockpile topsoil. The spoil area will then be used to stockpile blasted rock removed from the exploratory tunnel. The spoil stockpile will be progressively installed as the exploratory tunnelling progresses, with testing and management as follows:

- forward probing will be undertaken during tunnelling with cores extracted for geotechnical testing before blasting to enable avoidance of acid-forming rock
- stockpile material will be spot tested for acid sulfate soil (ASS), potential acid sufate soil (PASS), potential acid forming rock, and contaminants
- material found to contain contaminants will be removed offsite and taken to a licensed facility for disposal
- material found to be free of contaminants will be combined into the main spoil stockpile, with material shaped to blend into the natural contours of the surrounding land as far as possible

- the material within the stockpile may be processed (crushed) and used for sheeting of access tracks around the site or used in rehabilitation activities
- as material within the stockpile reaches the designed stockpile height, that area of the stockpile will be profiled and covered (e.g., topsoil and seeded with an approved grass seed) to mitigate dust pollution and run-off.

The proposed design of the stockpile is to a height of 5 m with a maximum height of 7 m possible with appropriate management measures (e.g. stabilisation, water management). While not expected, a maximum height of 7 m would allow for the tunnel spoil area to accommodate up to 160,000 m^3 of additional excess spoil if required.

7.2.2 Kingaham spoil disposal area

A second spoil disposal area is proposed to be located on Lot 1RP98849 owned by Department of Local Government, Water and Volunteers (formerly Department of Regional Development, Manufacturing and Water), off Bella Creek Road. The spoil area is positioned close to the proposed Kingaham Creek bypass, to increase operational efficiencies and avoid the need for laden vehicles to travel through the switchback on Borgan Road. The access road is aligned to reduce the extent of vegetation clearing.

The Kingaham spoil disposal area will be approximately 200 m by 40 m to allow for the disposal of an estimated 95,000 m^3 of material generated from the construction of the Kingaham Creek bypass that cannot be reused onsite. The material placed in this area would be:

- general soil excavated from the Kingaham Creek bypass
- rock excavation from the Kingaham Creek bypass.

Initially, the spoil area will be accessed to stockpile topsoil. The spoil area will then be progressively installed as the construction of the road realignment progresses.

The current design of the stockpile is to a height of 5 m, with a maximum height of 7 m possible with appropriate management measures (e.g. stabilisation, water management). There is capacity for additional excess materials to be incorporated into the civil construction compound pad. If needed, a further 200,000 m^3 can be placed in this pad, as the design footprint is larger than is currently required and the height of the pad can be adjusted.

7.3 Spoil classification

Further waste classification will be undertaken during the excavation of spoil to provide validation and appropriate detail for waste management, such as waste segregation requirements and the verification of the volume and in situ waste classifications prior to offsite disposal. This shall be described in a remediation plan for the area (where or if required). The remediation plan will be developed based on the confirmation of the final design and be informed by the geotechnical investigations / in situ sampling complete as part of the Exploratory Works.

Excavations are anticipated to generate the streams listed in Table 4, noting that additional categories may be required (e.g., based on the outcome of site investigation, updates to environmental policies etc.). To ensure proper management, spoil needs to be classified to determine the appropriate disposal methods, if required.

Queensland Hydro will continue to examine opportunities to reuse spoil during the Exploratory Works and future Borumba PHES Project. Reuse targets will be identified in a future revision of this plan and be updated regularly based on the design and continued site investigations.

Table 4: Waste classification categories and proposed reuse target

Material category	Criteria	Disposal methods and responses
Unrestricted spoils (clean earth, defined under the Queensland *Environmental Protection Act 1994,* Schedule 1	• clean earth means '*any natural substance found in the earth that is not contaminated with waste or a hazardous contaminant*'	• reuse on site where possible (i.e. not contaminated with waste or a hazardous contaminant) • offsite reuse where possible
Not regulated waste/general waste (lowest risk)	• Environmental Protection Regulation 2019, schedule 9 thresholds for solid tested waste and waste that is not regulated waste	• reuse on site where possible based on the current and future land use • offsite reuse based on the current and future land use

Material category	Criteria	Disposal methods and responses
	• QLD DETSI Overview of regulated waste categorisation information sheet Appendix 3: Categorisation thresholds for solid tested waste not regulated	• onsite remediation and reuse where possible • offsite disposal
Category 2 regulated waste (moderate risk)	• Environmental Protection Regulation 2019, schedule 9 types of regulated waste • QLD DETSI Overview of regulated waste categorisation information sheet Appendix 3: Categorisation thresholds for solid tested waste Category 2 regulated waste	• onsite remediation and reuse where possible • stockpile onsite (temporary) and manage in accordance with the Waste Management Sub-Plan • offsite disposal at an approved facility
Category 1 regulated waste (highest risk)	• Environmental Protection Regulation 2019, schedule 9 types of regulated waste • QLD DETSI Overview of regulated waste categorisation information sheet Appendix 3: Categorisation thresholds for solid tested waste Category 1 regulated waste	• onsite remediation and reuse where possible • offsite disposal at an approved facility
Potentially contaminated soils	• Section 739 of the *Environmental Protection Act 1994,* which preserves the former sections 424 and 425 of the same Act, requiring a disposal permit to remove and treat or dispose of contaminated soil from land on the EMR • QLD DETSI Disposal permit to remove, treat and dispose of contaminated soil Guideline • Any spoils from the EMR listed lots of the Exploratory Works Project (refer Section 4.2)	• detailed site investigation by suitable qualified person prior to bulk excavation to understand the contamination status of the spoil, and category based on the results • remediate based on a remediation plan (if required) and reuse on site where possible • stockpile onsite (temporary) and manage in accordance with the Waste Management Sub-Plan • offsite disposal under soil disposal permits at an approved facility if required
Acid sulfate soils	• 0.03 % reduced inorganic sulfur content of the soil	• remediate based on a remediation plan or acid sulphate soil management plan and reuse on site where possible • offsite reuse • offsite disposal at an approved facility
Acid-forming rock	• Preventing acid and metalliferous drainage Table 5: Preliminary screening criteria based on NAPP and NAG test data	• detailed site investigation prior to bulk excavation to understand the spoil • develop an acid mine drain management plan if required • reuse on site where possible (best to be placed under water) • remediate on site and reuse where possible • onsite disposal • offsite disposal

Material category	Criteria	Disposal methods and responses
Naturally occurring asbestos (NOA) material, which is likely to be a hazardous contaminant under the *Environmental Protection Act 1994,* Schedule 4	• *Environmental Protection Act 1994,* Schedule 4 defines hazardous contaminant as: *a contaminant, other than an item of explosive ordnance, that, if improperly treated, stored, disposed of or otherwise managed, is likely to cause serious or material environmental harm because of—* *(a) its quantity, concentration, acute or chronic toxic effects, carcinogenicity, teratogenicity, mutagenicity, corrosiveness, explosiveness, radioactivity or flammability; or* *(b) its physical, chemical or infectious characteristics.*	• detailed site investigation prior to bulk excavation to understand the spoil • fibrous minerals management plan or similar for locations where NOA is found to occur • offsite disposal

7.4 Material recycling and disposal

7.4.1 Beneficial reuse

Wherever possible beneficial reuse of materials will be incorporated in to decommissioning and rehabilitation works. This may include but it not limited to the following:

- reuse of spoil rock to stabilise areas around and within the exploratory tunnel
- reuse of spoil and spoil rock in the establishment of drill pads for the geotechnical works
- reuse of spoil rock as rip rap in watercourses and drainage lines
- reuse of material in road works
- reuse of topsoils for land reformation and in rehabilitation works
- provision of material as fill to local landholders and other stakeholders.

Spoil reuse targets have been identified across material categories expected from design. Reuse categories are linked to spoil contamination risk and provisional potential reuse targets have been identified for each category as below:

- unrestricted spoil – 100%
- other clean earth – 80%
- non-regulated waste/general waste – 25%
- category 2 regulated waste – 10%
- category 1 regulated waste – 0%
- potentially contaminated soils – 50%
- acid sulfate soils – 20%
- acid-forming rock – 20%
- naturally occurring asbestos material – 0%.

7.4.2 Resource recovery

As mentioned above, all the spoil will be managed in accordance with the waste hierarchy documented within the Queensland Waste Management Resource Recovery Strategy. The Queensland Hydro spoil management approach is focused on:

- avoid and reduce waste
- reuse waste.

To manage waste effectively throughout the Exploratory Works Project, Queensland Hydro will establish a set of internal spoil recycling targets. Note that the reuse of spoil on site and/or off site will be subject, where applicable, to approval.

7.4.3 Offsite disposal

During excavations, materials that are contaminated and not suitable for remediation and onsite storage will be loaded directly onto licensed transport vehicles for appropriate offsite disposal. Stockpiling of contaminated soils will be avoided where possible via the in-situ waste classification of potentially contaminated materials to remove all such materials identified. The tunnel spoil disposal area is of sufficient size to allow for material to be segregated for contamination testing before being placed in the stockpiles as needed.

7.5 Regulated waste

Types of regulated waste and default categorisation are listed in Schedule 9 of Environmental Protection Regulation 2019, sections 42 and 43, and Schedule 19, Part 2, definitions attribute table, substance table and threshold table.

Hazardous waste shall be handled and disposed of in accordance with approved disposal methods by Workplace Health and Safety Queensland.

Both regulated waste and hazardous waste shall be managed according to the Waste Management Plan and disposed of in accordance with the *Environmental Protection Act 1994*.

8. Tracking and assurance

All waste classifications will be documented and linked to the tracked waste as part of a waste tracking register. All of this waste documentation shall be made available to the Queensland Government approved contaminated land auditor and included in validation reports prior to the auditor statement being approved by the auditor. Records to be kept include recordings detailing the beneficial reuse of spoil either on site or at offsite locations, waste disposal permits, and waste dockets for any spoil disposed of at landfill sites.

9. Verification

Verification surveillance activities by independent certifiers shall be performed during work for the identification and handling of spoils from the Exploratory Works Project.

The following information shall be made available to the independent site auditor for verification purposes during the Exploratory Works Project (subject to suitable notice periods):

- volume and mass of waste (detailed site investigations, waste classification reports, specified excavation site model and register)
- disposal site records (e.g. landfill dockets, gatekeeper records)
- licensed landfill licences
- names and addresses of disposal locations
- disposal permits
- waste tracking register for each load including reference to waste classification reports
- transport company information including licensed truck registrations
- date transported off site and date and time received by landfill facility.

10. Program for strategy implementation

A key program requirement is the inclusion of detailed site contamination investigations within the design investigation program. These investigations will include an enhanced sampling program, targeting in-situ waste classification for all excavation elements at Exploratory Works sites.

To assist with managing spoil risks associated with the Exploratory Works Project, a training plan shall be developed by the contractors that identifies training requirements for each role within the Exploratory Works Project in general accordance with the CEMP. Environmental induction should cover the topics of:

- contaminated land
- acid sulfate soils
- acid mine drainage
- waste classification
- duty to notify
- general environmental duty.

Toolbox talks on site should also be used as a method of raising awareness and educating personnel on issues related to all aspects of construction, including environmental issues. Toolbox talks can be used to ensure environmental awareness continues throughout the construction phase of the temporary coach terminal.

11. Quantities, measurement and reporting

Quantities listed in Table 2 are provisional. The table will be updated following the completion of the continued investigations and the specified excavation site model.

The contractors will maintain a live database to track handling and disposal of spoil from the Exploratory Works Project. The database shall include all site data, electronic transport data and offsite receival data and data will be matched to verify a closed circuit of waste removal, transport and receipt. Quantities from the database will be captured fortnightly in order to update the specified excavation site actual quantities. The report will be produced fortnightly containing the specified excavated site actual quantities to date and will be provided to the independent site auditor. Access will also be provided to the captured database to support verification.

Following the approval conditions, contractors will regularly provide to Queensland Hydro in the first instance, the following records:

- records of all samples taken, and testing carried out on spoils
- the specified excavation site actual quantities to date
- records of the weight of, and spoils contained within, each load leaving the site
- classification certificates and tip dockets for all spoil disposed of offsite
- reconciliation of the cumulative specified excavation site actual quantities for material categories against the specified excavation site base quantities, specified excavation site maximum quantity, specified excavation site target cost and specified excavation site target price for a specified excavation site
- details of any unexpected materials, or excavated material quantities.

Additionally, records of all treatments carried out on spoils before reuse or disposal will be provided regularly. Any unexpected spoils encountered during excavation within the Exploratory Works Project will be subject to the unexpected find protocol and shall be reported accordingly.

11.1 Continual improvement and meeting the requirements of the environmental documents.

This Spoil Management Plan will be reviewed and, if necessary, updated whilst activities involving excavated material at Exploratory Works sites are being performed. It will be updated to reflect site investigation findings, program developments, changes in law, changes in guidelines, comments and feedback by regulatory agencies, and when the plan is identified to require development, amendment or updating.

Audits shall be undertaken to assess the effectiveness of spoil management measures, compliance with this SMP, the conditions of the approvals, licences and guidelines.

References

Commonwealth of Australia. (2016). *2016 Leading Practice Sustainable Development Program for the Mining Industry.* Commonwealth of Australia.

ENGEO. (2022). *Borumba Pumped Hydro Energy Storage (PHES) Project, Lake Borumba, Queensland. Geotechnical Investigation. 19754.000.001.* ENGEO Australia Pty Ltd.

ENGEO. (2023). *Geotechnical Investigation - Borumba Pumped Hydro Energy Storage (PHES) Project, Lake Borumba.* Report prepared for SMEC.

Epic Environmental. (2022). *Borumba Pumped Hydro Project (BPHP) Contamination Technical Report BC220033.01.* Brisbane: Epic Environmental.

NEPC. (2013). *NEPM 2013 Health Investigation Levels for Residential Land Use.* National Environment Protection Council.

SMEC. (2024). *Borumba Pumped Hydro Energy Storage (BPHES) Project Preliminary Site (Contamination) Investigation.*

VIC EPA. (n.d.). *Publication 1828.2 Waste disposal categories – characteristics and thresholds.* VIC EPA.

Appendix I – Waste Management Plan

Prepared for the Borumba PHES Project

Borumba Pumped Hydro Energy Storage Project – Exploratory Works Waste Management Plan

DOCUMENT NUMBER: BR-NA-NON-EWA-PLN-00001

OCTOBER 2025

Contents

1. Introduction 1
   1.1 Background 1
   1.2 Plan purpose and objectives 2
   1.3 Environmental Management 2
2. Regulatory requirements and compliance 4
   2.1 Environmental Protection Act 1994 4
   2.2 Waste Reduction and Recycling Act 2011 4
3. Risk assessment 6
4. Mitigation and management measures 9
5. Waste management 13
   5.1 Waste hierarchy 13
   5.2 Waste classification 16
   5.3 Regulated and hazardous waste 16
   5.4 Waste generation 16
   5.5 Waste systems 18
   5.6 Waste handling 23
   5.7 Waste storage 23
   5.8 Waste collection and disposal 23
   5.9 Sewage collection and disposal 24
   5.10 Management of geotechnical drill cuttings and slurry/mud 24
   5.11 Management of tunnelling materials 24
   5.12 Waste tracking and assurance 25
6. References 26

Figures

Figure 1: Exploratory Works footprint 3
Figure 2: Waste and resource management hierarchy 13

Tables

Table 1: Risk assessment 7
Table 2: Risk controls register 10
Table 3: Waste streams 16
Table 4: Waste management and disposal systems 19
Table 5: Waste management facilities 24

Acknowledgement of Country

In the spirit of reconciliation, Queensland Hydro acknowledges the Traditional Custodians of Country throughout Queensland and, in particular the lands, skies and waters on which we operate. We celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands, skies and waters of Queensland.

Queensland Hydro pays respect to Elders past and present honouring their continuing spiritual and cultural connections to Country.



Acronyms and abbreviations

Term	Description
Borumba PHES Project	Borumba Pumped Hydro Energy Storage Project
CEMP	Construction Environmental Management Plan
DETSI	Department of Environment, Tourism, Science and Innovation
EP Act	*Environmental Protection Act 1994*
EOW	End of waste
km	Kilometre
m	Metre
PHES	Pumped Hydro Energy Storage Project
SDA	Spoil disposal area
WRR Act	*Waste Reduction and Recycling Act 2011*

1. Introduction

1.1 Background

Queensland Hydro is the proponent of the Borumba Pumped Hydro Energy Storage (PHES) Project. The Borumba PHES Project is a 2,000 megawatt (MW), 48,000-megawatt hour (MWh), hydroelectric scheme to store, generate and supply energy through a pumped hydroelectric structure linked to the existing Lake Borumba in the Gympie and Somerset Regional Council local government areas.

The Borumba PHES Project is located within the Gympie and Somerset Regional Council local government areas, approximately 13 kilometres (km) southwest of the township of Imbil, 48 km southwest of Gympie, and 180 km northwest of Brisbane.

The Borumba PHES Project requires the completion of Exploratory Works to confirm the suitability of the Borumba PHES Project. The purpose of the Borumba PHES Project – Exploratory Works (the Exploratory Works Project) is to undertake and facilitate critical technical investigations required to confirm the suitability of the Borumba PHES Project location and design. The information obtained from the investigations is crucial to the Borumba PHES Project, as it will determine whether the Borumba PHES Project can proceed or if material changes to the reference design are necessary. The technical information needed primarily comprises geological investigations at the proposed locations of the:

- reservoir dam foundations – to be verified by geotechnical boreholes, test pits and seismic lines
- underground tunnels and caverns – to be verified by geotechnical exploratory tunnel drilling and geotechnical boreholes.

The Exploratory Works, relevant to the action, comprise the following components:

- Geotechnical investigations including test pits, boreholes (deep and shallow, including some conversion to groundwater monitoring bores) and seismic lines
- Spoil disposal:
  - tunnel spoil disposal area
  - Kingaham spoil disposal area
- Site access:
  - new access tracks
  - upgrades to existing tracks
  - Kingaham Creek bypass (realignment of a section of Bella Creek Road)
- Other supporting infrastructure:
  - civil construction compound
  - temporary water infrastructure
- Exploratory tunnel infrastructure:
  - dual exploratory tunnels
  - staging pad
  - portal pad
  - portal access track
  - explosive store and access track.

The Construction Environmental Management Plan (CEMP) for the Exploratory Works Project provides a detailed description of the Exploratory Works and associated activities – refer to Section 2 of the CEMP. Note that this Waste Management Sub-plan does not specifically address waste generated by preliminary activities that are not part of the *Environmental Protection and Biodiversity Act 1999* (EPBC Act) controlled action. Waste generated by these preliminary activities will be managed in accordance with relevant State legislation.

The location and footprint of the Exploratory Works is illustrated in Figure 1.

1.2 Plan purpose and objectives

Waste materials generated during the Exploratory Works Project are a potential source of environmental harm through improper handling, storage, transport and disposal. The risks associated with waste materials will require appropriate planning and management throughout the Exploratory Works Project.

The purpose of this Waste Management Plan is to provide a guideline for responsible management of waste generated during the Exploratory Works Project. It is a live document and will be updated as required during the Exploratory Works Project to reflect updates to the site investigation findings and program.

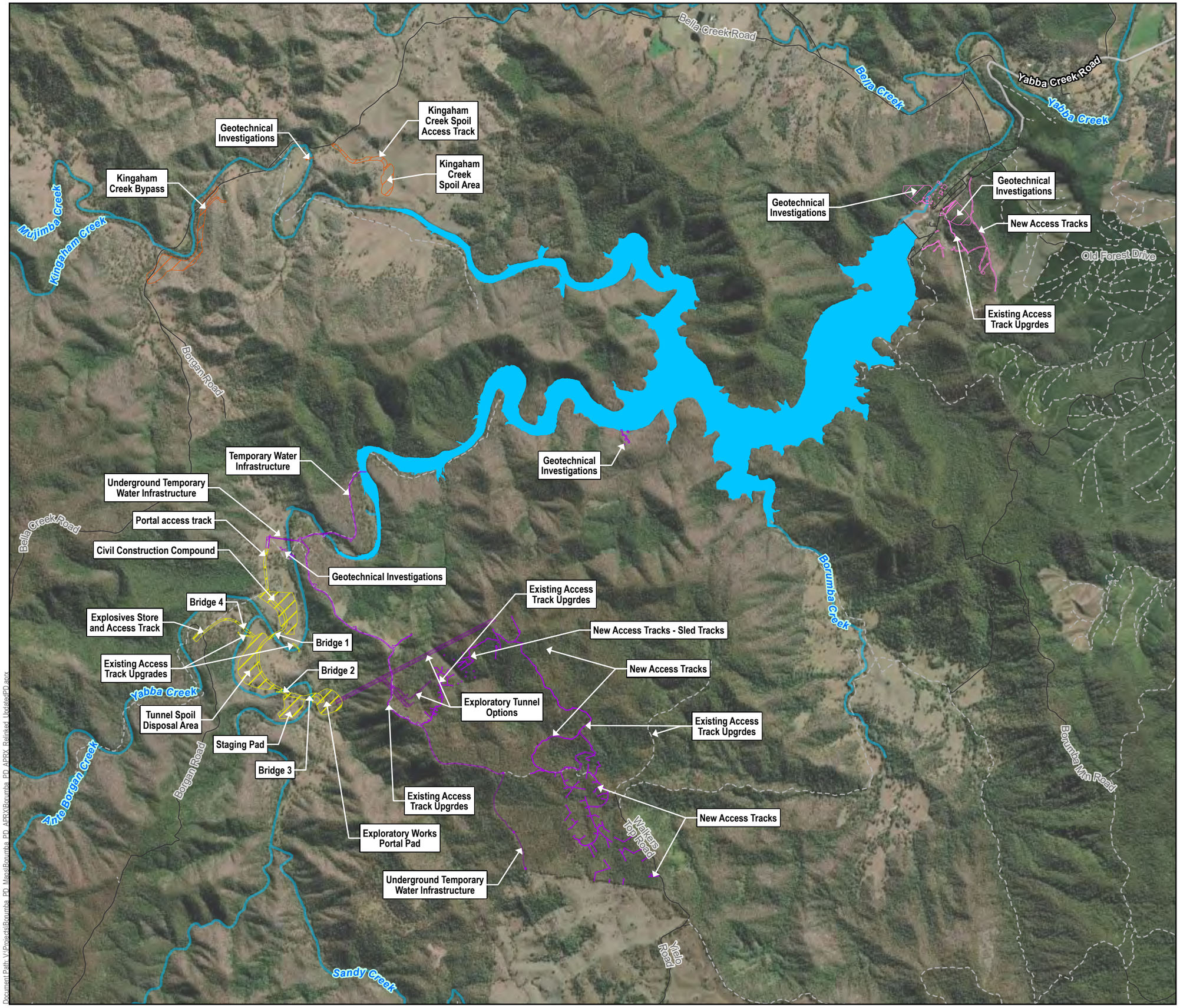
In support of the objective of this document – the proper handling, storage, transport and disposal of waste – this document identifies the:

- risks, risk levels and mitigation measures for waste generation and handling from the Exploratory Works Project
- key and likely waste streams generated during the Exploratory Works Project
- waste management system to be followed, based on a standard waste management hierarchy
- waste handling measures including measures to be undertaken while handling waste materials on-site
- waste storage criteria for different waste storage areas
- acceptable waste disposal, describing licensed waste facilities for disposal of separated waste materials.

1.3 Environmental Management

The overall approach to environmental management for the Exploratory Works Project is described in the CEMP. The CEMP provides a framework for a comprehensive, integrated approach to environmental management during implementation of the Exploratory Works.

The Waste Management Sub-plan forms part of Queensland Hydro's environmental framework as described in the CEMP. It has been prepared for the Exploratory Works and does not apply to the Main Works component of the Borumba PHES Project.



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Queensland Hydro

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LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads
- Lake Borumba (FSL 135.01m AHD)

Exploratory Works Project

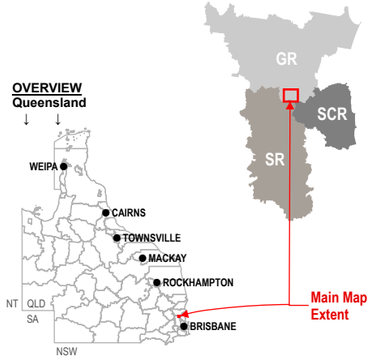
Project Footprint by Work Area

- Area 1 - Borumba Dam
- Area 2 - Kingaham Creek
- Area 3 - Walkers Top
- Area 4 - Borgan

Project Component - Underground

- Area 3 - Walkers Top

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



Data Sources:

1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
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Exploratory Works Project
Preliminary Documentation

EXPLORATORY WORKS FOOTPRINT

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 29/09/2025
REVISION:	A

FIGURE 1

2. Regulatory requirements and compliance

The following Queensland legislation is particularly relevant to this Waste Management Sub-plan:

- *Environmental Protection Act 1994* (EP Act) and Environmental Protection Regulation 2019 (EP Regulation)
- *Waste Reduction and Recycling Act 2011* and Waste Reduction and Recycling Regulation 2023.

Depending on detailed work activities and waste generated, legislative requirements – requiring approval and/or notification – may be triggered under these acts and regulations. Queensland Hydro are seeking an environmental authority for Environmentally Relevant Activity (ERA) 16 – extraction and screening. Clarification on the specific applicable triggers, approvals and notification requirements for any additional activities will be sought by the contractors engaged in Exploratory Works, as works planning progresses. Queensland Hydro will obtain or ensure that contractors have the relevant licences, permits and approvals as required by law and maintain them as required throughout the Exploratory Works Project.

This Waste Management Sub-plan should be read in conjunction with the Spoil Management Sub-Plan, Appendix H to the CEMP, which guides the handling and management spoil material.

2.1 Environmental Protection Act 1994

All persons have a general environmental duty under the *Environmental Protection Act 1994* (EP Act) to not carry out any activity that causes, or is likely to cause, environmental harm unless the person has an authority to do so or has taken all reasonable and practicable measures to prevent or minimise the harm.

Regarding waste, under the EP Regulation, 'waste' is made up of general waste and regulated waste. Regulated waste requires a higher level of management to prevent environmental harm. The Environmental Protection Regulation 2019 includes a risk-based waste classification framework, where regulated waste is classified as either:

- category 1 regulated waste (highest risk)
- category 2 regulated waste (moderate risk)
- not-regulated waste/general waste (lowest risk).

The regulated waste classification provisions in the EP Regulation are used to identify and appropriately manage the risks associated with various wastes and related waste management activities. Schedule 9 of the EP Regulation provides a list of regulated wastes and their default category. Waste generators are responsible for classifying their waste into a risk-based category by either:

- adopting a default waste category from Part 1 of Schedule 9 of the EP Regulation
- organising sampling and testing of their waste by an appropriately qualified person to demonstrate an appropriate risk-based category in accordance with section 43 of the EP Regulation – see the ‘overview of regulated waste categorisation guideline’ (document reference ESR/2019/4749), which outlines this process.

2.2 Waste Reduction and Recycling Act 2011

The *Waste Reduction and Recycling Act 2011* (WRR Act) contains a suite of measures to reduce waste generation and landfill disposal, and encourage recycling. It establishes a framework to modernise waste management and resource recovery practices, promote waste avoidance and reduction and encourage resource recovery in Queensland. Key provisions of the WRR Act include:

- a levy on waste delivered to waste disposal sites
- requirements for Queensland Government agencies and local governments to prepare waste management plans
- offences relating to littering and illegal dumping
- requirements for making end of waste codes and granting end of waste approvals.

Key features of the framework implemented under the WRR Act Waste Reduction and Recycling Regulation 2023, include:

- providing a framework for the effective operation of a state waste levy
- describing waste reporting requirements
- setting standards, controls or procedures for the manufacture, generation, sale, use, transport, receival, storage, treatment, or disposal of waste.

The Exploratory Works Project must comply with these requirements.

The end of waste (EOW) framework under Chapters 8 and 8A of the WRR Act promotes resource recovery opportunities and provides an opportunity to maximise resource reuse and minimise waste.

Under the EOW framework, a waste can be approved as a 'resource' if the Department of Environment, Tourism, Science and Innovation (DETSI) considers that it meets specified quality criteria for specified use prior to it going to a nominated end user. If a waste is approved as an EOW resource under the WRR Act, it is no longer considered a waste for the purposes of the WRR Act, so long as it is used in accordance with the requirements of the applicable EOW approval or a code.[1]

Benefits of operating under an EOW code may include:

- less regulation for the reuse of waste (e.g. approvals relating to regulated waste are not required)
- volumes of waste disposed to landfill are reduced, reducing the cost associated with disposal
- costs from using raw materials may be reduced
- reuse of the waste may have a monetary value.

However, there are no existing EOW codes that would support the treatment of waste from the Exploratory Works Project as a resource.

Compliance is required with the WRR Act and its provisions, with the Waste Reduction and Recycling Regulation 2023 providing a regulatory mechanism for the implementation of the WRR Act; however, note that no approvals need to be sought for the Exploratory Works Project under the WRR Act.

[1] Any person who generates or possesses a waste can become a registered resource producer if they wish to use, sell or give away the waste as a resource under an EOW code. An EOW code applies to each person who is registered for the code (registered resource producer). A person may supply, or use, a waste as a resource under an EOW code provided they have registered with and/or notified DESI (i.e. become a registered resource producer and/or resource user) and comply with the requirements of the EOW code. The registered resource producer must ensure that the resource supplied under an EOW code adheres to the quality standard and other requirements stated in the code. Current EOW codes – e.g. for concrete, solid and washout – are listed here: https://www.business.qld.gov.au/running-business/environment/waste-management/regulated-waste/eow-codes#current-codes

3. Risk assessment

Potential impacts and associated risks for waste are detailed in Table 1. The qualitative risk was assessed using the methodology outlined in Section 5.1 of the CEMP.

Table 1: Risk assessment

			Risk level (without controls)			Risk level (after controls as identified in Table 2)		
Project component	**Description**	**Risk (Waste)**	**Likelihood**	**Consequence**	**Risk Rating**	**Likelihood**	**Consequence**	**Risk Rating**
Geotechnical investigations								
Geotechnical investigations	Test pits to obtain geotechnical information necessary to inform the Borumba PHES Project design.	• Contractors' rubbish generation. • Waste vegetation, soil and spoil management and offsite disposal. • Inappropriate storage or stockpiling of surplus soil and other organic material. • Leaks or spills of contaminating wastes. • Stockpiling or disposal of waste out of approved footprint. • Impacts to flora and fauna, visual amenity and, particularly in the case of watercourses, possible contamination and degradation of environmental values for users.	Likely	Moderate	Medium	Unlikely	Minor	Low
	Boreholes (deep and shallow, including some conversion to groundwater monitoring bores)	• Contractors' rubbish generation. Generation of drill muds/cuttings, going to environment if not contained. • Leaks or spills of contaminating wastes.	Possible	Minor	Low	Unlikely	Minor	Low
Spoil disposal								
Tunnel spoil disposal area, Kingaham spoil disposal area	Dedicated area for disposal of spoil material from exploratory tunnel, bypass excavation geotechnical drilling and stockpiling of topsoil.	• Contractors' rubbish generation. • Waste vegetation, soil and spoil management and offsite disposal. • Inappropriate storage or stockpiling of surplus soil and other organic material. • Leaks or spills of contaminating wastes. • Stockpiling or disposal of waste out of approved footprint. • Impacts to flora and fauna, visual amenity and, particularly in the case of watercourses, possible contamination and degradation of environmental values for users. • See Spoil Management Sub-plan (Appendix H of the CEMP) for additional detail.	Likely	High	High	Possible	High	Medium
Site access								
Kingaham Creek bypass	Realignment of a section of Bella Creek Road (Kingaham Creek bypass)	• Contractors' rubbish generation. • Waste vegetation, soil and spoil management and offsite disposal. • Inappropriate storage or stockpiling of surplus soil and other organic material. • Leaks or spills of contaminating wastes (oils, fuels). • Stockpiling or disposal of waste out of approved footprint. • Impacts to flora and fauna, visual amenity and, particularly in the case of watercourses, possible contamination and degradation of environmental values for users.	Likely	Minor	Medium	Unlikely	Moderate	Low
New/ upgraded access tracks	New access tracks and upgrades to existing tracks, including multiple waterway crossings, to enable access to geotechnical investigation and exploratory tunnel drilling sites	• Contractors' rubbish generation. • Waste vegetation, soil and spoil management and offsite disposal. • Inappropriate storage or stockpiling of surplus soil and other organic material. • Leaks or spills of contaminating wastes (oils, fuels). • Stockpiling or disposal of waste out of approved footprint. • Impacts to flora and fauna, visual amenity and, particularly in the case of watercourses, possible contamination and degradation of environmental values for users.	Likely	Minor	Medium	Unlikely	Moderate	Low
Other supporting infrastructure								
Temporary water infrastructure, staging pad, explosives store, civil construction compound	Construction of temporary water infrastructure, staging pad, explosives store, civil construction compound (laydown area).	• Contractors' rubbish generation. Waste vegetation, soil and spoil management and offsite disposal. • Inappropriate storage or stockpiling of surplus soil and other organic material. • Generation and/or storage of hazardous waste (used oils, lubricants, paints etc.). Leaks or spills of contaminating waste. • Generation of spoil (displaced topsoil and subsoil). Inappropriate storage or stockpiling of surplus soil and other organic material.	Likely	Moderate	Medium	Unlikely	Moderate	Low

Project component	Description	Risk (Waste)	Risk level (without controls)			Risk level (after controls as identified in Table 2)		
			Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
		• Stockpiling or disposal of waste out of approved footprint. • Impacts to flora and fauna, visual amenity and, particularly in the case of watercourses, possible contamination and degradation of environmental values for users. • Pollution leaching into environment, impacting groundwater or surface water environmental values. • Improper disposal of hazardous waste, leading to contamination and generation of contaminated soil/environmental pollution.						
Exploratory tunnel infrastructure								
Dual exploratory tunnels	Exploratory drilling of dual tunnels to the powerhouse cavern from the portal pad following the proposed tunnel alignment.	• Generation of large quantities of spoil (rock, mud), with inappropriate handling, storage or disposal. • Mishandling of contaminated spoil. • Refer to the Spoil Management sub-plan (Appendix H of the CEMP) for detail regarding impacts from mismanagement of inert and contaminated spoil. • Disposal of quantities of spoil outside of the approved soil disposal area, impacting visual amenity, and terrestrial ecological values, where outside of any approved disturbance footprint. • Mismanagement and mishandling of contaminated spoil, including any potential acid sulphate soil/actual acid sulphate soil material would potentially impact downstream surface water values and quality.	Possible	High	Medium	Unlikely	Moderate	Low
Staging area, portal pad	Construction of a portal pad and staging area	As for ‘other supporting infrastructure’.	Likely	Moderate	Medium	Unlikely	Moderate	Low

4. Mitigation and management measures

Mitigation measures for the risks listed in Table 1 are outlined in Table 2.

Section 5 of this Waste Management Plan expands on the mitigation measures listed in Table 2, to provide more detail and guidance. These are provided in each section as follows:

- 5.5 Waste systems
- 5.6 Waste handling
- 5.7 Waste storage
- 5.8 Waste collection and disposal
- 5.9 Wastewater and sewage collection and disposal
- 5.10 Management of geotechnical drill cuttings and slurry/mud
- 5.11 Management of tunnelling materials
- 5.12 Waste tracking and assurance.

All waste management and mitigation measures will be underpinned by the broader measures, training, monitoring, recording and reporting requirements outlined in Section 4 – Environmental Management System - of the CEMP.

Table 2: Risk controls register

Project component	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
Geotechnical investigations							
Test pits to obtain geotechnical information necessary to inform the Borumba PHES Project design.	Site/project engineer	• No rubbish or waste leaving designated storage and handling containers/area. • No leaks or spills/generation of contaminated soil. Hazardous waste segregated and contained in bunded/storage with secondary containment and removed by licensed contractor. • Removal of all waste by licensed contractor for disposal offsite.	• All construction wastes will be recorded and separated, and stored in a designated storage area, for licensed removal and disposal. • Fuel/chemical storage areas will have suitable controls to ensure that spills / run-off does not impact surrounding environment (i.e. primary / tertiary bunds, covering materials etc.) • Waste disposal (especially food waste) will be removed from site regularly to discourage presence of pest fauna. • Licensed and documented waste removal and disposal. • Management measures as outlined in Sections 5.1-5.10.	• >90% waste segregation achieved at point of segregation and disposal. • Zero serious environmental incidents related to waste, handling and disposal. • No impact to environment outside of approved disturbance footprints (rubbish, spoil leaving site boundaries, otherwise than via licensed handler).	• Daily site report (daily diary). • Otherwise as per CEMP.	• Segregation below target during audit • Serious environmental incident related to waste handling and disposal • Environmental impact observed outside approved footprint	• Returning of waste, spoil, to designated storage area. • Remediation if required. • Otherwise as per CEMP.
Boreholes (deep and shallow, including some conversion to groundwater monitoring bores)	Site/project engineer	• No rubbish or waste leaving designated storage and handling containers/area. • No leaks or spills/generation of contaminated soil. Hazardous waste segregated and contained in bunded/storage with secondary containment and removed by licensed contractor. • Removal of all waste by licensed contractor for disposal offsite.	• As above.	• >90% waste segregation achieved at point of segregation and disposal. • Zero serious environmental incidents related to waste, handling and disposal. • No impact to environment outside of approved disturbance footprints (rubbish, spoil leaving site boundaries, otherwise than via licensed handler).	• Daily site report (daily diary). • Otherwise as per CEMP.	• Segregation below target during audit • Serious environmental incident related to waste handling and disposal • Environmental impact observed outside approved footprint	• Returning of waste, spoil, to designated storage area. • Remediation if required. • Otherwise as per CEMP.

Project component	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
Spoil disposal							
Tunnel spoil disposal area, Kingaham spoil disposal area	Site supervisor, environmental management representative	• No rubbish or waste leaving designated storage and handling containers/area. • Removal of all waste by licensed contractor for disposal offsite.	• As above, including management measures as outlined in sections 5.1-5.11.	• >90% waste segregation achieved at point of segregation and disposal. • Zero serious environmental incidents related to waste, handling and disposal. • No impact to environment outside of approved disturbance footprints (rubbish, spoil leaving site boundaries, otherwise than via licensed handler). • See Spoil Management Sub-plan (Appendix H of the CEMP).	• Daily site report (daily diary). • Weekly environmental inspection. • Otherwise as per CEMP.	• Segregation below target during audit • Serious environmental incident related to waste handling and disposal • Environmental impact observed outside approved footprint	• Returning of waste, spoil, to designated storage area. • Remediation if required. • Otherwise as per CEMP.
Site access							
Kingaham Creek bypass	Site/project engineer	• No rubbish or waste leaving designated storage and handling containers/area. • Removal of all waste by licensed contractor for disposal offsite. • Material for stockpiling contained and sent to spoil disposal area (SDA).	• As above, including management measures as outlined in sections 5.1-5.9.	• >90% waste segregation achieved at point of segregation and disposal. • Zero serious environmental incidents related to waste, handling and disposal. • No impact to environment outside of approved disturbance footprints (rubbish, spoil leaving site boundaries, otherwise than via licensed handler).	• Daily site report (daily diary). • Otherwise as per CEMP.	• Segregation below target during audit • Serious environmental incident related to waste handling and disposal • Environmental impact observed outside approved footprint	• Returning of waste, spoil, to designated storage area. • Remediation if required. • Otherwise as per CEMP.
New/upgraded access tracks	Site/project engineer	• No rubbish or waste leaving designated storage and handling containers/area. • Removal of all waste by licensed contractor for disposal offsite. • Material for stockpiling contained and sent to SDA.	• As above, including management measures as outlined in sections 5.1-5.9.	• >90% waste segregation achieved at point of segregation and disposal. • Zero serious environmental incidents related to waste, handling and disposal. • No impact to environment outside of approved disturbance footprints (rubbish, spoil leaving site boundaries, otherwise than via licensed handler).	• Daily site report (daily diary). • Otherwise as per CEMP.	• Segregation below target during audit • Serious environmental incident related to waste handling and disposal • Environmental impact observed outside approved footprint	• Returning of waste, spoil, to designated storage area. • Remediation if required. • Otherwise as per CEMP.
Other supporting infrastructure							
Temporary water infrastructure, staging pad, explosives store civil construction compound	Construction manager, site/project engineer, environmental management representative	• No rubbish or waste leaving designated storage and handling containers/area. • No leaks or spills/generation of contaminated soil. Hazardous waste	• As above, including management measures as outlined in sections 5.1-5.9.	• >90% waste segregation achieved at point of segregation and disposal. • Zero serious environmental incidents related to waste, handling and disposal. • No impact to environment outside of approved	• Daily site report (daily diary). • Otherwise as per CEMP.	• Segregation below target during audit • Serious environmental incident related to waste handling and disposal • Environmental impact observed outside approved footprint	• Returning of waste, spoil, to designated storage area. • Remediation if required. • Otherwise as per CEMP.

Project component	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
		segregated and contained in bunded/storage with secondary containment and removed by licensed contractor. • Removal of all waste by licensed contractor for disposal offsite. • Material for stockpiling contained and sent to SDA.		disturbance footprints (rubbish, spoil leaving site boundaries, otherwise than via licensed handler).			
Exploratory tunnel infrastructure							
Dual exploratory tunnels	Site/project engineer, environmental management representative	• No rubbish or waste leaving designated storage and handling containers/area. • No leaks or spills/generation of contaminated soil. Hazardous waste segregated and contained in bunded/storage with secondary containment and removed by licensed contractor. • Material for stockpiling contained and sent to SDA • Removal of all waste by licensed contractor for disposal offsite.	• All construction wastes will be recorded and separated, and stored in a designated storage area, for licensed removal and disposal. • Fuel/chemical storage areas will have suitable controls to ensure that spills / run-off does not impact surrounding environment (i.e. primary / tertiary bunds, covering materials etc.) • Waste disposal (especially food waste) to be removed from site regularly to discourage presence of pest fauna. • Licensed and documented waste removal and disposal. • Management measures as outlined in sections 5.1-5.11.	• >90% waste segregation achieved at point of segregation and disposal. • Zero serious environmental incidents related to waste, handling and disposal. • No impact to environment outside of approved disturbance footprints (rubbish, spoil leaving site boundaries, otherwise than via licensed handler). • Compliance with requirements of Spoil Management Sub-plan.	• Daily site report (daily diary). • Weekly environmental inspection. • Otherwise as per CEMP.	• Segregation below target during audit • Serious environmental incident related to waste handling and disposal • Environmental impact observed outside approved footprint • Non-compliance with requirements of Spoil Management Sub-plan identified	• Returning of waste, spoil, to designated storage area. • Remediation if required. • Otherwise as per CEMP.
Portal pad, staging area	Construction manager, site/project engineer, environmental management representative	• No rubbish or waste leaving designated storage and handling containers/area. • Removal of all waste by licensed contractor for disposal offsite. • Material for stockpiling contained and sent to SDA.	• As above, including management measures as outlined in sections 5.1-5.9.	• >90% waste segregation achieved at point of segregation and disposal. • Zero serious environmental incidents related to waste, handling and disposal. • No impact to environment outside of approved disturbance footprints (rubbish, spoil leaving site boundaries, otherwise than via licensed handler).	• Daily site report (daily diary). • Weekly environmental inspection. • Otherwise as per CEMP.	• Segregation below target during audit • Serious environmental incident related to waste handling and disposal • Environmental impact observed outside approved footprint	• Returning of waste, spoil, to designated storage area. • Remediation if required. • Otherwise as per CEMP.

5. Waste management

5.1 Waste hierarchy

Waste associated with the Exploratory Works Project will be managed in accordance with the 'waste and resource management hierarchy' as outlined under Part 3, Division 2, Section 9 of the WRR Act. The 'waste and resource management hierarchy' identifies the preferred order in which waste and resource management options shall be considered. The hierarchy is illustrated in Figure 2.

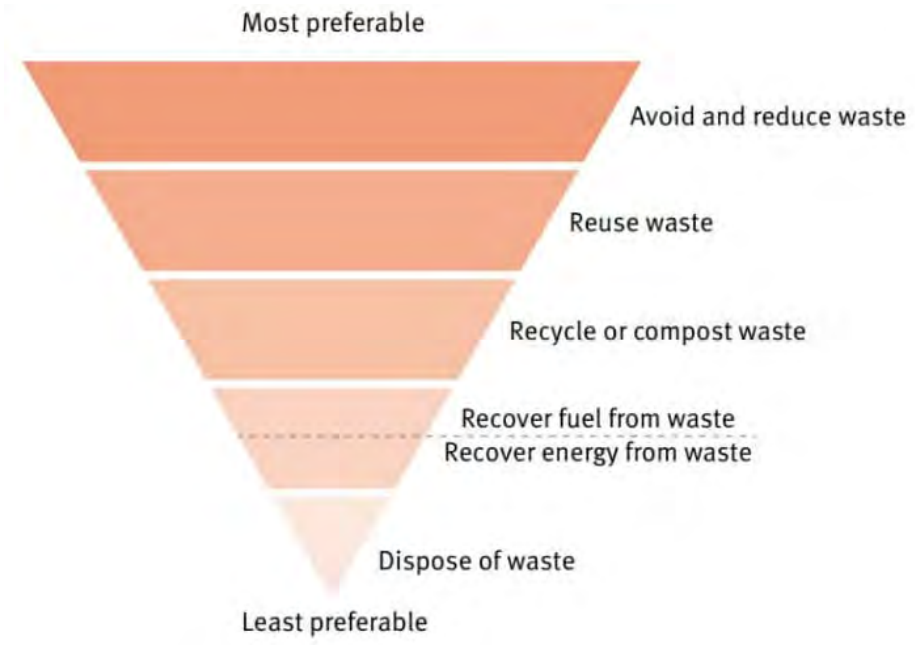

Figure 2: Waste and resource management hierarchy

Queensland Hydro will manage the Exploratory Works Project in accordance with the waste management hierarchy to:

- mitigate risk of environmental harm from generation, storage, transport and disposal of waste materials
- minimise waste generation and disposal throughout all stages of the Exploratory Works Project lifecycle through application of the waste management hierarchy.

5.1.1 Avoid and reduce

The following strategies for avoiding and reducing (where avoidance is not possible) waste generation include:

- Identify the types and quantities of packaging materials required prior to ordering/purchasing to minimise wastage.
- Procurement of materials to favour suppliers who can reduce bulk packaging and minimise waste generation.
- Develop and implement arrangements with suppliers to return unused construction materials to the supplier.
- Proactive coordination of site activities (where possible) to minimise waste by utilising unused materials.
- Earthworks to minimise the demand for imported fill or the need to export/dispose of excess spoil.
- Store supplies in a secure location that is protected from the weather.
- Laydown areas to be kept tidy and organised so that items stored are not damaged and can be readily and safely accessed when needed by the construction operation.
- Undertake refuelling and maintenance activities within designated bunded areas to minimise the potential for soil and water contamination from these activities.

- Implement Exploratory Works Project office sustainability measures through the selection of energy and resource efficient goods and equipment (e.g., low wattage fluorescent lighting, inverter air conditioning, insulation panelling to reduce energy consumption, waterless urinals, foot pedal or automatic shutoff hand waste basins and rainwater harvesting to reduce water consumption) where practicable.
- Where reasonable and practicable, order goods in bulk to minimise packaging waste, and where practicable, return packaging materials to the supplier.

5.1.2 Reuse

The following reuse strategies (e.g. the identification of waste materials that would otherwise be destined for landfill disposal) have been identified:

- Educate staff to identify opportunities for reuse, where practicable.
- Identify and implement strategies for the reuse of waste products generated during construction.
- Where reasonable and practicable, vegetation cleared for the Exploratory Works Project, including mulch, will be stockpiled for reuse in landscaping purposes.
- Spoil is to be reused in rehabilitation works or stockpiled and rehabilitated as a landscape feature.
- Collection, and where applicable treatment, of groundwater egress during tunnel works, for reuse during tunnel construction, for dust suppression and landscaping works.
- Where reasonable and practicable, provide for the re-use of:
  - excavated material as fill at approved fill sites
  - concrete formwork throughout the Exploratory Works Project
  - reinforced steel structures in the Exploratory Works Project
  - structures, including culverts, cabling, poles and similar infrastructure.

Spoil reuse targets have been identified across material categories expected from design. Reuse categories are linked to spoil contamination risk and provisional potential reuse targets have been identified for each category as below:

- unrestricted spoil – 100%
- other clean earth – 80%
- non-regulated waste/general waste – 25%
- category 2 regulated waste – 10%
- category 1 regulated waste – 0%
- potentially contaminated soils – 50%
- acid sulfate soils – 20%
- acid-forming rock – 20%
- naturally occurring asbestos material – 0%.

5.1.3 Recycle

It is anticipated that a portion of all construction materials can be recycled, with the following recycling strategies identified:

- Consider using materials and products that have a recycled content wherever cost / performance competitive, and where environmentally preferable to the non-recycled alternative.
- Recovering solvents, metals, batteries or oil and re-using them for a secondary purpose.
- Recyclable building wastes will be collected separately and re-used or recycled, for example:
  - wood from concrete formwork will be recovered and reused
  - scrap steel and off-cuts will be recycled
  - pallets for re-use or recycling
  - plastics will be recycled

  - paper and cardboard for re-use or recycling.
- Collect empty oil and fuel drums and other containers for return to licensed recycling facilities. This is to be done by a licensed contractor.
- Provide separate recycling bins, skips and storage areas for recyclable materials at all construction worksites for construction-specific waste materials and general refuse.

5.1.4 Recover

The following strategies for the recovery of waste during construction have been identified:

- Recovery of fixtures, such as lights and other electrical fittings, doors, wash basins, toilets, windows and sheds, through sales and / or charity organisations.

5.1.5 Waste treatment

The Exploratory Works Project design includes measures to treat waste onsite including:

- Water treatment is part of the design to support the tunnelling activities. Excess water will be captured by a drainage system and transferred for treatment (e.g., by laminar clarifier or similar). The treated water is expected to be reused on site including for the tunnelling activities, dust suppression works and landscaping. Further detail on water management is provided in The Water Management Sub-Plan (Appendix K to the CEMP).
- Where contaminated materials are encountered, this may necessitate remediation in accordance with a pre-established remediation plan before any subsequent rehabilitation efforts can commence.

A temporary water storage pond will provide approximately 5 megalitres of water storage directly adjacent to the portals. This is intended to be used for the day-to-day management of water requirements associated with the drill and blast tunnelling operations. Dirty water from the tunnelling operation (e.g., drilling water and groundwater seepage) will be discharged by a laminar clarifier or similar to treat coarser sediment prior to being discharged into the dirty water compartment of the temporary water storage pond. Water sourced from the dirty water compartment will be treated and then directed into the clean water compartment of the water storage pond for reuse. Sludge (rock particles and fines) from this treatment process, will periodically be removed and stored in the tunnel spoil disposal area. Excess water from the clean water compartment will be diverted to the water storage tanks located at the staging pad via pump and pipeline.

Water required for use in tunnel drilling operations will be sourced from the clean water compartment of the temporary water storage pond on the portal pad. If necessary, additional water will be supplied by truck from the temporary water infrastructure (Tank Farm 1) or from the storage tanks located at the staging pad. Clean water may be used to support the construction activities including the batching plant, dust suppression, vehicle washdowns, or in rehabilitation works. It is noted that water with a high mineral content containing nitrates from the use of emulsion explosives can be reused underground as service water.

If the ingress of water into the tunnel (from underground aquifers via fissures and fractures in the rock) exceeds the consumption of water, then excess water will be sent from the temporary water storage pond to the water storage tanks at the staging pad. It has been assumed that groundwater ingress, post underground grouting, will occur at a rate of two litres per second per kilometre. This will be confirmed as the groundwater assessment progresses and water balance modelling for the exploratory tunnels is refined. Where water ingress into the tunnels exceeds the capacity of the storage tanks (e.g. in large rainfall event), alternative disposal methods will be utilised (e.g. trucking offsite, irrigation, additional storage at another location). Discharge to land or water will only occur if absolutely necessary and in accordance with relevant approval conditions.

Spoil will be classified and stockpiled onsite in accordance with the Spoil Management Sub-plan, then rehabilitated in accordance with the Rehabilitation Management Plan (to be prepared as a requirement of the Exploratory Works Decommissioning and Rehabilitation Strategy). Noting that contaminated material may be remediated in accordance with a relevant remediation plan prior to rehabilitation.

5.1.6 Residual

Waste that cannot be reused, recycled, recovered or treated must be disposed of in appropriately licensed commercial landfill sites and sewage treatment systems.

5.2 Waste classification

Waste materials have been identified based on proposed methods and materials to be used during the Exploratory Works Project. The waste materials have been classified in accordance with the 'Overview of regulated waste classification information sheet' (DESI, 2022), as far as practical, to align with the relevant elements of the Exploratory Works from which they are anticipated to be generated.

All waste generated throughout the works will be assessed and classified accordingly, with regulated wastes managed as discussed in Section 5.3. Contractors will be required to identify the likely waste streams, classification, testing requirements and treatment when additional details are confirmed. Waste streams and their reuse, recycling and disposal considerations will be included in the contractor's management plans and communicated to the workforce.

5.3 Regulated and hazardous waste

Hazardous materials and potential sources of hazardous wastes will be documented, and a register of hazardous and regulated waste updated and maintained as required. The register will be updated for each new hazardous material introduced on site.

Hazardous waste shall be handled and disposed of in accordance with approved disposal methods by Workplace Health and Safety Queensland.

Types of regulated waste and default categorisation are listed in Schedule 9 of the EP Regulation, sections 42 and 43, and Schedule 19, Part 2, definitions attribute table, substance table and threshold table.

Both regulated waste and waste containing hazardous contaminants shall be managed and disposed of in accordance with the EP Act, EP Regulation and relevant Australian Standards and guidelines. This will include the segregation of the material onsite, disposal by a licensed subcontractor to a licensed offsite facility for reuse/recycling or disposal. This will also include notifying DETSI of the presence of a hazardous contaminant if it is identified as likely to cause environmental harm.

5.4 Waste generation

Details of identified waste streams (non-exhaustive list) expected to be generated during implementation of the Exploratory Works Project are outlined in Table 3. Generally, potential resource impacts fall under a limited number of categories including wastage of resources, missed opportunities to salvage or re-use resources, generation of avoidable wastes and contamination. Waste generation volumes will be calculated upon the finalisation of the design of the Exploratory Works Project.

The EP Regulation includes a risk-based waste classification framework where regulated waste is classified as either:

- Category 1 regulated waste (highest risk)
- Category 2 regulated waste (moderate risk)
- Non-regulated waste/general waste (lowest risk).

Table 3: Waste streams

Waste stream	Description and source of waste	Quantity
Non-regulated waste		
Green waste	Clearing of vegetation at pad sites for exploratory drilling, access tracks, etc.	Moderate
Packaging materials	Delivery of construction materials in pallets, crates, cartons, plastics, wrapping materials etc.	Low
Cardboard and paper	Materials used and disposed of at site offices, accommodation facilities etc.	Low

Waste stream	Description and source of waste	Quantity
Food scraps/ kitchen waste	Work sites	Low
General/recyclable wastes	General/recyclable wastes generated by workers (e.g., glass bottles, cans, single use plastics, sanitary waste etc.)	Low
Excavation waste/ spoil	Uncontaminated spoil generated during drilling operations, trenching, levelling etc.	Moderate
Drilling cuttings from geotechnical investigations	Drill cuttings, small fragments of subsurface rock that break in the drilling fluid.	Low
Construction materials (steel, timber, concrete, asphalt. electrical cabling, etc.)	Construction waste generated during construction of access tracks, portal pads etc.	Low
Spare parts	Excess machine parts from maintenance activities	Low
Wastewater	Groundwater inflow into tunnels and surface water / stormwater runoff from construction sites.	Moderate
Spoil from the tunnelling works	Topsoil and rock generated from the tunnelling works	High
Other	Any waste stream not included in this assessment will be stored and handled as dictated by the waste hierarchy described in Section 5.1 and in accordance with the Environmental Protection Regulation 2019.	Low
Regulated waste (category 1 and 2)		
Oils, lubricants, diesel etc	Spill over or excess oils and lubricant collected for machine maintenances.	Low
Excavation waste / spoil	Contaminated spoil and acid rock generated during drilling operations, trenching, tunnelling etc.	Low
Filters and tyres Oily air filters	Infield servicing and maintenance of construction vehicles and equipment.	Low
Sewage	Greywater and sewage from site offices and ablutions.	Moderate
Batteries	Batteries used in vehicles and construction equipment.	Low
Washdown water	Washdown of construction vehicles and wheel wash sites.	Low
Wastewater	Water contaminated by hydrocarbons and other chemicals.	Low
Drill muds and wastewater (contaminated)	Dirty water and residual drill cuttings from the geotechnical investigations and from tunnelling operations.	Moderate
Spill kits	Hydrocarbon spill clean-up kit materials, cleaning/ maintenance rags.	Low
Contaminated land	Soil disturbed by earthworks on a property listed on the Environmental Management Register (EMR), contaminants identified on a property that is not on the EMR, sediment in sediment retaining structures contaminated with hydrocarbon or heavy metal (or other) pollutants) or when investigations identify contamination (e.g. naturally occurring asbestos).	Low

5.5 Waste systems

The following waste management strategy will be implemented during the Exploratory Works Project, where possible, to reduce disposal in landfill by maximising waste avoidance, resource recovery, reuse and recycling as established by the waste hierarchy. Waste generation can be avoided/ minimised by:

- considering waste generated from the various activities
- calculating bill of quantities appropriately to prevent over ordering of materials (i.e. concrete, steel)
- selecting materials that result in less residual waste and contain minimal packaging
- providing for recycling as well as general waste collection.

The waste generated (after minimisation) can be reused, wherever possible, by identifying, separating, and storing reusable materials. These materials can then be considered for on-site or off-site reuse applications. If the waste materials cannot be reused and can be recycled, systems shall be ensured for separation and processing of recyclable material on-site or off-site. Waste materials that cannot be avoided, minimised, reused or recycled will be transported off-site for landfilling (Section 5.8).

Table 4 presents waste management and disposal systems for waste categories identified above.

Table 4: Waste management and disposal systems

Waste category	Storage of waste	On site treatment or use (if possible)	Disposal (contractor or landfill site)
Green waste	Temporarily stockpiled on or off site prior to mulching/reuse.	Reuse onsite in rehabilitation works. Weeds and other affected material to be managed in accordance with the *Biosecurity Act 2014.* Some felled trees to be placed on the ground as habitat.	Surplus material transported for green waste processing.
Packaging materials	Stored with general waste.	Recyclables separated and materials reused where possible.	Residual waste transported to appropriate landfill by a waste contractor. Recyclables transported to suitable facility.
Cardboard and paper	In clearly labelled recycling bins.	Recyclables separated where possible and taken to appropriate facility.	Recyclables transported to suitable facility.
Food scraps/ kitchen waste	In clearly labelled bins (food waste/organics).	None	Transported to facility for composting if available, otherwise transported to landfill for disposal by a waste contractor.
General/recyclable wastes	Stored with general waste. Clearly labelled bins to be provided for site workers.	Recyclables separated where possible.	Residual waste transported to appropriate landfill by a waste contractor. Recyclables transported to suitable facility.
Excavation waste/ spoil	Temporarily stockpiled on or off site prior to reuse.	Suitable spoil to be reused for Exploratory Works activities where appropriate.	Unusable spoil taken to appropriate construction and demolition facility for processing and/or reuse.
Drilling cuttings from geotechnical investigations	Drilling fluids will be recirculated within purpose-built mud tanks, allowing sediments and cuttings to settle out. Vacuum trucks or similar will be used to remove dirty water and cuttings from mud tanks for disposal. Transported to the spoil disposal areas and stockpiled (as long as not contaminated). Excess drill cuttings to be placed neatly around the disturbed borehole site, within an area protected with silt fencing.	Where suitable to be reused for Exploratory Works activities where appropriate. Test and treat water before any release back into the environment, ensuring all water quality criteria specified in the Exploratory Works Project CEMP and conditions of approval are met.	Contaminated materials to be managed in accordance with below.

Waste category	Storage of waste	On site treatment or use (if possible)	Disposal (contractor or landfill site)
Construction materials (steel, timber, concrete, asphalt etc.)	Stored in dedicated stockpiles / bins depending on the material.	Reuse any materials where possible. Materials to be separated, including any recyclables. Surplus material may be returned to provider.	Removed by waste contractor to a facility for processing construction and demolition materials, including recycling and reprocessing.
Spare parts	Stored in an accessible location for reuse.	Reuse for future maintenance operations.	Transported to recycling facility or as a last resort, landfill where unable to be reused.
Wastewater	Pumped into holding tanks or turkey's nest (or similar).	Treated and tested for suitability for reuse onsite or discharge to site.	If quality meets criteria, reused or discharged to land on site. Where not suitable, disposal offsite at a suitable facility.
Spoil from the tunnelling works	Residual material coming out of the tunnelling operation will be placed at the tunnel spoil disposal area, with topsoil and at risk material to be segregated. Dirty water coming out of the tunnelling operation (e.g., drilling water and groundwater seepage) will be stored at the portal pad and the staging area.	Solid material will be tested prior to stockpiling to identify at risk material. Dirty water to be treated (by laminar clarifiers, hydro cyclones or similar) at the portal pad with treated water discharged into the clean water compartment of a temporary water storage pond. Sludge (rock particles and fines) from treatment and from the dirty water compartment will be transported to the tunnel spoil disposal area.	Contaminated material will be managed as per the below, taken to appropriate facility for treatment and/or disposal.
Regulated waste			
Oils, lubricants, diesel etc	Store in accordance with Australian Standard AS1940 The storage and handling of flammable and combustible liquids (Australian Standards, 2004).	Manage in accordance with Australian Standard AS1940.	Collected waste oils taken by licenced contractor to appropriate facility for treatment.
Contaminated excavation waste / spoil	Stored in accordance with relevant Australian Standards and Methods approved by Workplace Health and Safety	Treated onsite for reuse and/or appropriately stockpiled.	Hazardous material will be taken by a licenced contractor to appropriate facility for treatment and/or disposal.

Waste category	Storage of waste	On site treatment or use (if possible)	Disposal (contractor or landfill site)
	Queensland and relevant legislation.		
Filters and tyres Oily air filters	Stored in separated stockpiles with clear signage.	Separated ready for recycling / disposal. Oily materials will be treated as hazardous waste.	Licenced contractor to transport to appropriate facility for recycling or if not possible, disposal.
Sewage	Collected and stored in holding tanks and pumping stations.	None	Transported by a licenced contractor to nearest wastewater treatment plants (Imbil and Kilcoy) for treatment and disposal.
Batteries	Store in a bunded area or container with proper signage.	None	Licenced contractor to transport to a battery recycling facility or other suitable disposal facility.
Washdown water	Holding tanks and pumping stations.	None	Transported to appropriate licensed facility for treatment and disposal.
Wastewater	Holding tanks, sedimentation ponds.	Water treatment plant and reused onsite for landscaping, dust suppression and tunnelling.	Transported to appropriate licensed facility for treatment and disposal.
Drilling slurry/ muds	Drilling fluids will be recirculated within purpose-built mud tanks, allowing sediments and cuttings to settle out. Vacuum trucks or similar will be used to remove dirty water and cuttings from mud tanks for disposal. Slurry may also be stored in basins on site to promote evapotranspiration and solidify waste stream.	The dried drilling mud can be mixed with excavated spoil and reused on site (only if drilling fluids do not contain chemical compounds that will damage receiving environment).	If slurry contains chemicals that are damaging to receiving environment, the waste stream must be safely stored and transported to a disposal facility.
Spill kits	Segregated in bins/skips specific for oily rags/ materials, etc. in accordance with AS1940 The storage and handling of flammable and combustible liquids (Australian Standards, 2004).	Treated as a potential hazardous waste, handled and stored so that contamination does not occur.	Removed by a licensed specialist hazardous waste contractor for offsite treatment/disposal.
Contaminated land	Bunded stockpile for treatment / disposal or direct haul to waste disposal facility.	Remediate based on a remediation plan (if required) and reuse on site where possible.	Offsite disposal under soil disposal permit at an approved facility if required.

Waste category	Storage of waste	On site treatment or use (if possible)	Disposal (contractor or landfill site)
	Detailed site investigation by suitable qualified person prior to bulk excavation to understand the contamination status of the spoil, and category based on the results.	Stockpile onsite.	

5.6 Waste handling

Waste produced during all Exploratory Works Project activities shall be handled in adherence with the following measures:

- assigning secure location for storage of re-usable and recyclable materials on-site
- ensuring all bins, skips and stockpiles are clearly labelled for recycling and waste disposal
- engaging appropriate waste and recycling contractors for removal of materials from the site
- monitoring collected wastes for leakages or contamination
- posting clear signage for directing staff to appropriate stockpiles and recycling receptacles
- training all site personnel and subcontractors regarding the waste management systems in place for the Exploratory Works Project
- maintaining waste records of materials being transported to facilities for processing, recycling, and disposal
- hazardous material will be handled in accordance with the relevant legislation and Australian Standards such as Australian Standard AS1940: The storage and handling of flammable and combustible liquids (Australian Standards, 2004).

5.7 Waste storage

Waste storage areas shall be assigned for all collected waste materials and recyclables. The designated area(s) shall have proper signage to identify the area to site personnel. Stockpile size will be managed by regular removal of waste materials from site. Work plans will allow for waste storage areas to be re-established at an alternative location where necessary to cater for changes to the location of Exploratory Works Project.

The waste storage area need not be enclosed by a secure fence, however bins and skips will be covered, where possible, to prevent odour, vermin, littering and vandalism. Appropriate sediment control and stormwater control measures will be implemented in and around the storage area to minimise the risk of environmental harm.

Contaminated or hazardous waste will be stored in a secure area, in appropriate containers with proper signage.

Waste classified as ‘regulated waste’ will be securely handled and stored in accordance with the Exploratory Works Project and legislative requirements. Waste fuel, oils and other hazardous chemicals will be stored in well ventilated, bunded areas prior to removal by licensed waste contractors.

For example, oils will be stored and handled in accordance with the Australian Standard AS1940: The storage and handling of flammable and combustible liquids (Australian Standards, 2004).

Spoil and topsoil are to be stockpiled onsite in the spoil disposal areas and mitigation measures for dust control and surface water management will be implemented as per the Spoil Management Sub-plan (Appendix H of the CEMP). Vegetation is to be stockpiled along the edge of the clearing tracks and well pads for reuse in the rehabilitation works.

The waste storage area will be regularly serviced to avoid overflowing spills, while the wastewater treatment system for the tunnelling has been designed with emergency capacity.

5.8 Waste collection and disposal

A suitably licensed waste collection contractor will be engaged to collect and remove general waste materials (waste and recyclable materials) from the waste storage area.

Various waste disposal and recycling facilities are in the Gympie and Sunshine Coast Council areas. The closest landfill accepting commercial and industrial waste is Gympie Waste Management Facility. Other council operated facilities and their service offerings are summarised in the Table 5.

Regulated waste will also be collected and disposed of by a suitably licensed contractor. Disposal will be at an appropriate facility (e.g. WestRex Wacol Hazardous Waste and Oily Water Treatment Facility).

Table 5: Waste management facilities

Council area	Facility	Landfill	Resource recovery	Commercial access
Gympie	Gympie Waste Management Facility	Yes	Yes	Yes – subject to prior agreement with Council
Sunshine Coast	Nambour Landfill and Resource Recovery Centre	Yes	Yes	Yes
Noosa	Noosa Resource Recovery Centre	No	Yes	Yes – subject to prior agreement with Council
Brisbane	WestRex Wacol Hazardous Waste and Oily Water Treatment Facility	No	Yes (some)	Yes

5.9 Sewage collection and disposal

Waste generated by preliminary activities that are not part of the controlled action are not addressed in this management plan. Nevertheless, it is noted that all sewage will be collected and transported by a licenced contractor to the nearest wastewater treatment plant, with plants located at Imbil and Kilcoy. Further consultation with Gympie Regional Council and Urban Utilities will be required regarding the management of wastewater and sewage. Consultation with Unity Water may be considered in the event that agreement cannot be reached with Gympie Regional Council.

5.10 Management of geotechnical drill cuttings and slurry/mud

Wastewater and drilling muds generated during geotechnical drilling works shall be captured in purpose built mud tanks to separate liquids from solids, and managed by:

- Disposal in the designated spoil disposal areas if characteristics are suitable (i.e., there is no contamination)
- If required due to regulated waste (typically Category 2), disposal offsite at a lawful receiving facility (e.g., due to drilling fluid selection)
- Testing and treating water before any release back into the environment (if this becomes a suitable option), ensuring all water quality criteria specified in the Exploratory Works Project CEMP are achieved. Specific detail regarding water management is provided in the Water Management Sub-plan (Appendix K of the CEMP).

5.11 Management of tunnelling materials

Material and water generated during tunnelling operations will be managed as follows:

- Solid material (500 mm minus shot rock) coming out of the tunnelling operation will be placed in a temporary stockpile on the portal pad (~500 m^3) before transport to the spoil area or taken directly to the spoil area for testing prior to disposal. Testing will be undertaken for acid sulfate soil, potential acid forming rock and contaminants in accordance with the Spoil Management Sub-plan. Material will be stockpiled in the spoil disposal area or taken to an appropriate off-site facility if required (e.g., if contaminated)
- Dirty water from the tunnelling operation (e.g., tunnelling water and groundwater seepage) will be discharged to a laminar clarifier or similar to treat coarser sediment prior to being discharged into the dirty water compartment of the temporary water storage pond. Clean water from the dirty water compartment will be directed into the clean water compartment of the water storage pond for reuse. Excess water from the clean water compartment will be diverted to the water storage tanks located at the staging pad via pump and pipeline. Discharge to land or water will only occur if absolutely necessary and in accordance with relevant approval conditions. Water will be treated to meet the relevant water quality objective prior to release or reuse on site
- Sludge (rock particles and fines) from treatment and from the dirty water compartment, will periodically be removed by truck or similar to the spoil disposal areas.

5.12 Waste tracking and assurance

Under the EP Regulation, waste tracking obligations apply to a waste generator, waste transporter and waste receiver.

All defined trackable wastes generated during the Exploratory Works Project will be tracked in accordance with the requirements of the EP Regulation. This will include the completion of waste tracking certificates for the collection, transport and management of trackable or regulated wastes.

A waste management register will also be maintained for the Exploratory Works Project and as a minimum, the register will include:

- date of waste collection
- waste type
- waste classification
- quantity
- management method (re-use, re-cycle, disposal etc.)
- waste contractor.

Regular audits of waste facility receipts will be undertaken, and cross referenced with the waste facility. All of this waste documentation shall be made available to a Queensland Government approved contaminated land auditor and included in validation reports prior to the auditor statement being approved by the auditor.

6. References

Australian Standards (2004) Australian Standards such as Australian Standard AS1940: The storage and handling of flammable and combustible liquids

DESI (2022) Overview of regulated waste classification information sheet

DESI (2024) EOW guideline (ESR/2016/3323)

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Appendix J – Flora and Fauna Management Plan

Prepared for the Borumba PHES Project

Borumba PHES Project – Exploratory Works Flora and Fauna Management Plan

DOCUMENT NUMBER BR-NA-NON-EFF-PLN-00001

OCTOBER 2025

Contents

Document Control v

Acronyms and abbreviations vi

1. Introduction 1
   - 1.1 Background 1
   - 1.2 Project location 3
   - 1.3 Potential Project impacts 3
   - 1.4 Plan purpose and objectives 4
   - 1.5 Relationship to CEMP 4
2. Environmental management roles and responsibilities 5
   - 2.1 Roles and responsibilities 5
   - 2.2 Reporting 5
   - 2.3 Adaptive approach to management 5
   - 2.4 Inductions and training 5
   - 2.5 Pre-start briefing 6
   - 2.6 Incident management 6
   - 2.7 Emergency response 6
3. Regulatory framework 7
4. Ecological values 9
   - 4.1 Flora 9
   - 4.2 Fauna 20
5. Impacts and risks 23
   - 5.1 Direct impacts to individual MNES and their habitat 23
   - 5.2 Habitat loss 25
   - 5.3 Habitat fragmentation 25
   - 5.4 Injury or mortality 25
   - 5.5 Reduced air quality 25
   - 5.6 Noise and vibration 26
   - 5.7 Light emissions 26
   - 5.8 Hazardous materials 26
   - 5.9 Surface water and groundwater 26
   - 5.10 Erosion and sedimentation 27
   - 5.11 Dust 27
   - 5.12 Bushfire 27
   - 5.13 Pests and weeds 28
   - 5.14 Disease 28
6. Impact avoidance, minimisation and mitigation 29
   - 6.1 General flora and fauna management measures 29
   - 6.2 Specific management measures – EPBC Species 57
7. References 70

Appendix A - Koala fencing

Appendix B - Biosecurity Act Restricted Matters

Appendix C - Fauna species listed under the NC Act known or likely to occur

Appendix D - Tree hollow replacement strategy

Appendix E - Potential impacts and associated risks for the Exploratory Works Project

Appendix F - Specific management measures – NC Act listed species

Figures

Figure 1: Exploratory Works footprint 2
Figure 2: Vegetation communities 11
Figure 3: Threatened ecological communities within the Exploratory Works footprint 14
Figure 4: Exclusion and buffer zones 33
Figure 5: Example of fauna exclusion fencing, including unclimbable sheeting on the habitat side of the fence 37
Figure 6: Proposed Exploratory Works Project fauna fencing 38
Figure 7: Plastic mesh and pegs that can be used to protect turtle nests from predators 41
Figure 8: Turtle nest protection installation method (Greening Australia, 2015) 42
Figure 9: Example of turtle exclusion fencing 42

Tables

Table 1: Legislation and approval/permitting requirements of relevance to the Exploratory Works Project 7
Table 2: Ground-truthed regional ecosystems in the Exploratory Works Survey area 9
Table 3: Threatened flora species known or likely to occur within or immediately adjacent to the Exploratory Works Project footprint 19
Table 4: Significant invasive plants and animal species recorded within the study area 19
Table 5: Threatened fauna species known or likely to occur within or immediately adjacent to the Exploratory Works Project footprint 20
Table 6: Introduced fauna in the study area 21
Table 7: Direct impacts to threatened ecological communities 24
Table 8: Direct impacts to threatened fauna under the EPBC Act 24
Table 9: Direct impacts to threatened flora under the EPBC Act 24
Table 10: Contact details for care of injured wildlife 44
Table 11: General flora and fauna management measures 48
Table 12: Specific management measures for EPBC Act listed matters 58

Acknowledgement of Country

In the spirit of reconciliation, Queensland Hydro acknowledges the Traditional Custodians of Country throughout Queensland and, in particular the lands, skies and waters on which we operate. We celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands, skies and waters of Queensland.

Queensland Hydro pays respect to Elders past and present honouring their continuing spiritual and cultural connections to Country.



Document Control

Version	Amendment
A	Initial draft
B	Updated for Preliminary Documentation submission
1	Updated to address design changes
2	Updated to DDCEEW feedback
3	Updated to address design changes

Project name: Borumba Pumped Hydro Energy Storage (PHES) Project - Exploratory Works (EPBC 2023/09461)

Project location: Bella Creek Road & Borgan Road, Lake Borumba, Queensland

Queensland Hydro Pty Ltd

ABN: 81 661 444 515

Declaration of accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed:

Full name:

Organisation:

Date:

Acronyms and abbreviations

Term	Description
Biosecurity Act	*Biosecurity Act 2014* (Queensland)
Borumba PHES Project	Borumba Pumped Hydro Energy Storage Project
CEMP	Construction Environmental Management Plan
DETSI	Department of Environment, Tourism, Science and Innovation (Queensland)
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EWP	Elevating work platform
Exploratory Works Project	Borumba PHES Project Exploratory Works
FFMP	Flora and Fauna Management Plan
FSC	Fauna spotter/catcher
GDE	Groundwater dependent ecosystem
km	Kilometre
Lowland Rainforest TEC	Lowland Rainforest of Subtropical Australia
m	Metre
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
MW	Megawatt
MWh	Megawatt hours
NC Act	*Nature Conservation Act 1992* (Queensland)
PHES	Pumped Hydro Energy Storage
QPWS	Queensland Parks and Wildlife Service
RE	Regional ecosystem
SMP	Species management program
SRI	Significant residual impact
Subtropical Eucalypt TEC	Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions
TEC	Threatened ecological community
VM Act	*Vegetation Management Act 1999* (Queensland)
WoNS	Weed of national significance

1. Introduction

1.1 Background

Queensland Hydro is the proponent of the Borumba Pumped Hydro Energy Storage (PHES) Project. The Borumba PHES Project is a 2,000 megawatt (MW), 48,000-megawatt hour (MWh), hydroelectric scheme to store, generate and supply energy through a pumped hydroelectric structure linked to the existing Lake Borumba in the Gympie and Somerset Regional Council local government areas.

The Borumba PHES Project is located within the Gympie and Somerset Regional Council local government areas, approximately 13 kilometres (km) southwest of the township of Imbil, 48 km southwest of Gympie, and 180 km northwest of Brisbane.

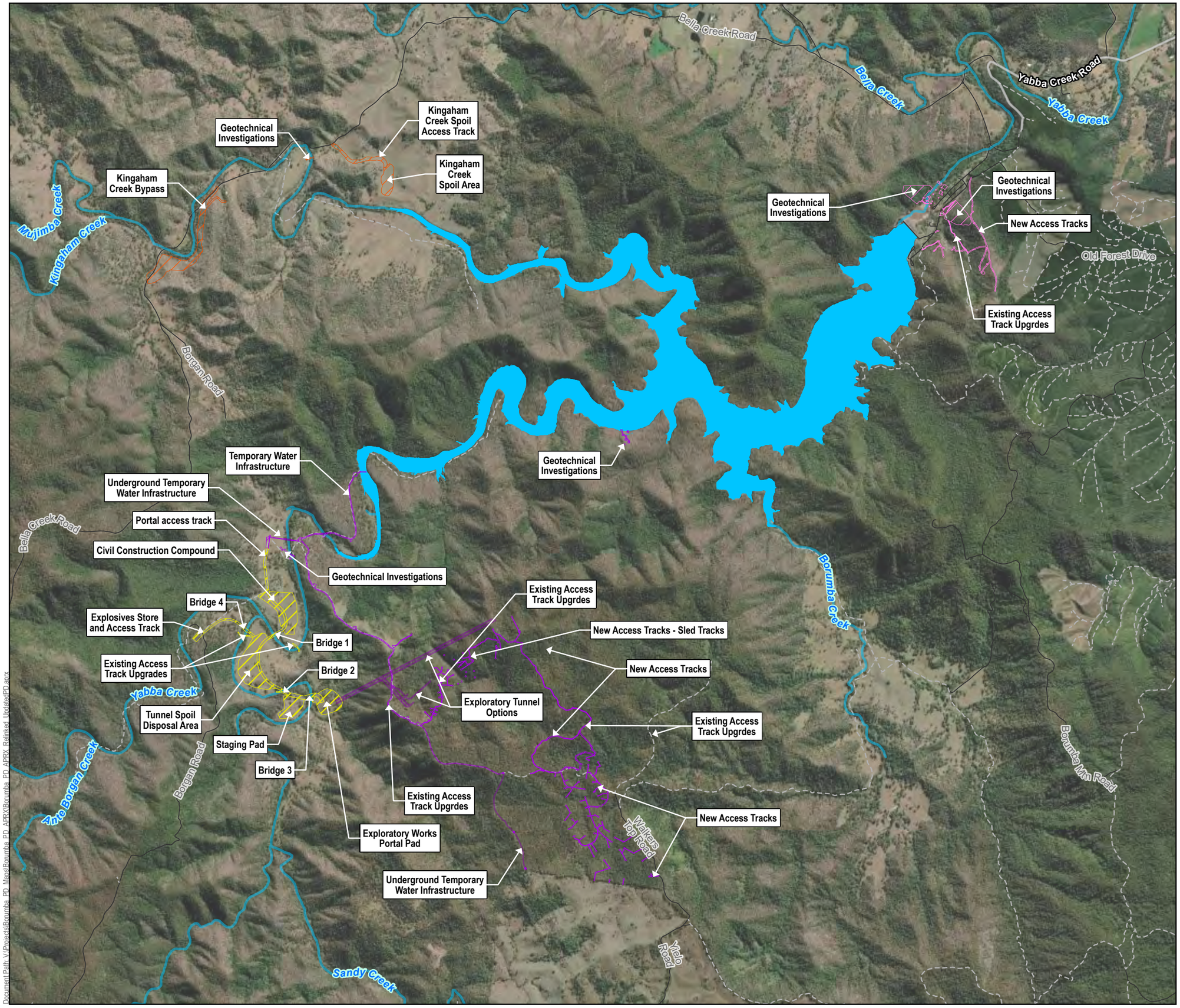
The Borumba PHES Project requires the completion of Exploratory Works to confirm the suitability of the Borumba PHES Project. The purpose of the Borumba PHES Project – Exploratory Works (the Exploratory Works Project) is to undertake and facilitate critical technical investigations required to confirm the suitability of the Borumba PHES Project location and design. The information obtained from the investigations is crucial to the Borumba PHES Project, as it will determine whether the Borumba PHES Project can proceed or if material changes to the reference design are necessary. The technical information needed primarily comprises geological investigations at the proposed locations of the:

- reservoir dam foundations – to be verified by geotechnical boreholes, test pits and geophysics
- underground tunnels and caverns – to be verified by geotechnical exploratory tunnel drilling and geotechnical boreholes.

The Exploratory Works, relevant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) controlled action, comprise the following components:

- geotechnical investigations including test pits, boreholes (deep and shallow, including some conversion to groundwater monitoring bores) and seismic lines
- spoil disposal:
  - tunnel spoil disposal area
  - Kingaham spoil disposal area
- site access:
  - new access tracks
  - upgrades to existing tracks
  - Kingaham Creek bypass (realignment of a section of Bella Creek Road)
- other supporting infrastructure:
  - civil construction compound
  - temporary water infrastructure
- exploratory tunnel infrastructure:
  - dual exploratory tunnels
  - staging pad
  - portal pad
  - portal access track
  - explosive store and access track.

Figure 1 illustrates the Exploratory Works Project location and footprint.



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Queensland Hydro

GDA2020 MGA Zone 56

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LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads
- Lake Borumba (FSL 135.01m AHD)

Exploratory Works Project

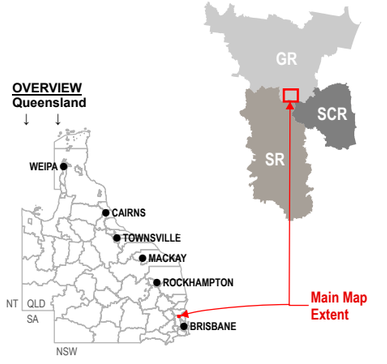
Project Footprint by Work Area

- Area 1 - Borumba Dam
- Area 2 - Kingaham Creek
- Area 3 - Walkers Top
- Area 4 - Borgan

Project Component - Underground

- Area 3 - Walkers Top

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



Data Sources:

1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
3. Watercourses © State of Queensland (Department of Natural Resources, Mines and Energy) 2022
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Exploratory Works Project
Preliminary Documentation

EXPLORATORY WORKS FOOTPRINT

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 29/09/2025
REVISION:	A

FIGURE 1

1.2 Project location

The Exploratory Works Project is located primarily to the south of Borumba Dam on Yabba Creek in the upper Mary River Basin, approximately 258 km from the tidal barrage and 318 km from the river mouth. Yabba Creek discharges into the Great Sandy Strait, a Ramsar wetland, and the UNESCO Great Sand Biosphere Reserve. The nearshore coastal environment also includes the Great Sandy Marine Park, Fraser Island, and sensitive estuarine and freshwater ecosystems.

The region surrounding the Exploratory Works Project is characterised by a mixture of State Forest (Imbil State Forest and Yabba State Forest), National Park (Conondale National Park), agricultural land (predominantly grazing operations) and scattered residential dwellings/outbuildings. The wider boundaries of the Borumba PHES Project are also situated near the peaks of Mount Kandanga (557 metres (m)) to the north, Mount Borumba (624 m) to the south and Yabba Range to the west.

1.3 Potential Project impacts

On 30 March 2023, a delegate for the Commonwealth Minister for the Environment and Water determined the Exploratory Works Project to be a controlled action (EPBC 2023/09461) to be assessed by Preliminary Documentation.

The relevant controlling provisions under the EPBC Act for the Exploratory Works Project are threatened species and communities (Sections 18 and 18A of the EPBC Act).

If not appropriately managed, the Exploratory Works Project may have direct and indirect environmental impacts on protected and native flora and fauna species and ecological communities, including:

- Direct and indirect impacts to flora individuals and flora and fauna habitat and fauna injury or death due to vegetation clearing.
- Loss and/or reduction in the populations of threatened flora and fauna, and displacement of fauna from the area, as a result of vegetation clearing for surface Project works, as well as potentially due to the associated increased noise and dust generation onsite.
- Loss of habitat for aquatic flora and fauna, removal of aquatic flora individuals and aquatic fauna injury or death due to physical disturbance to the bed and banks of Yabba Creek, Sandy Creek and Kingaham Creek and the construction of waterway crossings.
- Temporary barriers to aquatic fauna movements due to the construction of waterway crossings.
- Disturbance of the soil associated with vegetation clearing for surface Project works, concentrating runoff and causing soil erosion and resulting in changes to water quality (e.g. increased turbidity and sedimentation) within waterways near the Exploratory Works Project.
- Changes to water quality, such as increases in turbidity, sediment loads, and concentrations of nutrients and metals, due to the construction of waterway crossings and runoff from Project works occurring near waterways or drainage lines that require vegetation removal and ground disturbance.
- Contamination of waterways through any discharge of surface/ground water collected during project work or the accidental release of fuel, oil, waste or other chemicals from the Exploratory Works Project site.
- Direct groundwater take or groundwater drawdown associated with exploratory tunnel drilling, leading to a short-term reduction in water availability to potential groundwater dependent ecosystems (GDEs) in the vicinity of the exploratory tunnel drilling.
- Air quality (dust) impacts due to exploratory tunnel drilling, vegetation clearing, geotechnical investigations (particularly where large areas of the ground surface require preparation) and general vehicle and machinery movements onsite.
- Noise and vibration impacts, particularly due to earthworks and drilling and blasting activities and the general use of heavy machinery and vehicles onsite.
- Visual impacts, primarily as a result of vegetation clearance and ground disturbance/preparation for geotechnical investigations in an otherwise vegetated landscape.
- Increased occurrence of bushfire or altered bushfire regimes due to increased human activity and use of flammable materials onsite.

- Increased occurrence of weeds, pests and disease in the vicinity of the Exploratory Works Project due to increased human activity and vehicle movements onsite, particularly in areas that were previously undisturbed.

The impacts summarised above are further discussed in Section 5 of the Borumba PHES Project – Exploratory Works Preliminary Documentation and Section 5 of this Flora and Fauna Management Plan (FFMP). Strategies to avoid, mitigate and manage impacts are provided in Section 6 of the Borumba PHES Project – Exploratory Works Preliminary Documentation and Section 6 of this FFMP.

1.4 Plan purpose and objectives

This FFMP outlines Queensland Hydro's strategy for the mitigation and management of impacts to ecological values, particularly relevant threatened species and communities under the EPBC Act and where applicable, threatened, special least concern and colonial breeding species under the *Nature Conservation Act 1992* (NC Act) that may be directly or indirectly impacted by the Exploratory Works Project.

This FFMP describes activities required to manage any vegetation clearing associated with the Exploratory Works Project, to maintain retained vegetation, and restore vegetation and habitat in temporarily disturbed areas.

Specifically, the objectives of this FFMP are to:

- minimise potential impacts to native vegetation communities and threatened flora species identified within and adjacent to the Exploratory Works Project footprint
- minimise potential impacts to native and threatened fauna species and associated habitats identified within and adjacent to the Exploratory Works Project footprint
- identify appropriate actions for avoidance, mitigation, and management of potential impacts to native vegetation communities and threatened flora, native and threatened fauna species and their associated habitats, and to maintain these ecological values within and adjacent to the Exploratory Works Project footprint.

1.5 Relationship to CEMP

Clearing activities and Exploratory Works activities have the potential to impact local flora and fauna populations. This FFMP outlines Queensland Hydro's strategy for the mitigation and management of impacts to environmental values that may be impacted by the Exploratory Works Project.

The FFMP forms part of Queensland Hydro's environmental framework as described in the Construction Environmental Management Plan (CEMP). It has been prepared for the Exploratory Works Project and does not apply to the Main Works Project. The Main Works Project is the PHES Project, including the power infrastructure (powerhouse, water and access tunnels), an upper reservoir, and a lower reservoir (Lake Borumba). The Borumba PHES Project refers to the 2,000 MW, 48,000 MWh hydroelectric scheme linked to the existing Borumba dam (Lake Borumba), and includes the geotechnical investigations (the Exploratory Works Project, the action that this FFMP has been prepared for) and construction and operation of the PHES (Main Works).

2. Environmental management roles and responsibilities

2.1 Roles and responsibilities

All personnel involved with the Exploratory Works Project are responsible for working in accordance with this FFMP and are required to identify potential environmental impacts and implement and maintain control measures, procedures, and constraints accordingly.

2.2 Reporting

Any threatened fauna injuries or mortalities relating to matters of national environmental significance (MNES) will be recorded and reported to the Department of Climate Change, Energy, the Environment and Water (DCCEEW).

Independent of reporting obligations under the EPBC Act, Queensland Hydro will also meet reporting requirements under State legislation. This includes maintaining an electronic Animal Breeding Place Register in accordance with the approved Species Management Program (SMP) – high risk of impact under the NC Act.

A record of all species handled by the fauna spotter catcher (FSC) will be provided to Queensland Hydro by the engaged FSC on a regular basis.

Injuries or fatalities to wildlife that are Matters of State Environmental Significance (MSES) will also be recorded and reported to the Queensland Department of Environment, Tourism, Science and Innovation (DETSI).

2.3 Adaptive approach to management

To maintain relevance and effectiveness, this FFMP will be subjected to periodic reviews and amendments throughout the life of the Exploratory Works Project to ensure that mitigation/management measures remain effective. It is recommended that this document be reviewed, amended, and subsequently discussed with DCCEEW (if necessary):

- if there is a modification of the schedule, design, or construction methods
- if more than one incident occurs and additional measures are required to minimise further impacts to flora and fauna communities and species
- if a legislative change or modification of best practice methods affects the currency of this document
- on an annual basis.

A compliance register will be developed to track how commitments are being achieved. This compliance register will include document tracking for all reporting required, along with how data and reporting is stored and disseminated.

2.4 Inductions and training

All personnel involved in the development and operational stages of the Exploratory Works Project will undergo site induction training relating to biodiversity management issues within the Exploratory Works Project footprint. These inductions must include:

- objectives of this FFMP and associated controls (i.e., hygiene control, sequential clearing method)
- information and general descriptions provided about vegetation communities, threatened flora and fauna, and known weeds and pests
- restricted areas such as exclusion zones, buffer zones and other restricted areas
- procedures for responding to environmental incidents and emergencies
- environmental obligations for individuals and organisation
- responsibilities for environmental monitoring and reporting.

2.5 Pre-start briefing

All site personnel will be briefed on environmental requirements daily prior to commencing activities, focusing on practical measures. Briefings should include a summary of any changed environmental conditions, updates on vegetation clearing demarcations, recent flora and fauna sightings around operational areas and updates on vehicle speed limits.

2.6 Incident management

An incident investigation procedure and reporting form will be developed by the construction contractor as part of the Exploratory Works Project CEMP.

2.7 Emergency response

An Emergency Response Plan will be developed as part of the CEMP and will include measures around emergencies directly related to vegetation.

3. Regulatory framework

Table 1 outlines the environmental and planning legislative requirements for the Exploratory Works Project and provides an overview of the Commonwealth and State legislation relevant to this FFMP. The environmental and planning statutory requirements are current as of the date of this report. Note that other approvals not specifically relevant to flora and fauna but applicable to the Exploratory Works Project are excluded from Table 1.

Table 1: Legislation and approval/permitting requirements of relevance to the Exploratory Works Project

Legislation	Relevance to Exploratory Works Project	Approval or permitting requirements/ obligations
Commonwealth legislation		
Environment Protection and Biodiversity Conservation Act 1999	On 30 March 2023, a delegate for the Commonwealth Minister for the Environment and Water determined the Project to be a controlled action (EPBC 2023/09461) to be assessed by Preliminary Documentation. The relevant controlling provisions under the EPBC Act for the Exploratory Works Project are threatened species and communities (Sections 18 and 18A of the EPBC Act). Environmental offsets will be required in accordance with the EPBC Act Environmental Offset Policy for significant residual impacts (SRIs) to listed matters of national environmental significance (MNES).	• Approval as a controlled action under the EPBC Act.
State (Queensland) legislation		
Planning Act 2016 and *Vegetation Management Act 1999*	The clearing of native vegetation (unless in a protected area as defined under the NC Act is assessable development and requires development approval unless an accepted development vegetation clearing code applies and the works comply, or the operational work is exempt clearing work (e.g., geotechnical works where clearing is less than 100 m^2).	• Operational Works development permit for clearing native vegetation (Category B), unless the clearing is exempt under schedule 21 of the Planning Regulation.
Nature Conservation Act 1992	The purpose of the NC Act is for the conservation of nature and the protection of wildlife and its habitat. All plants that are native to Australia are protected plants under the NC Act which also regulates the clearing of protected plants 'in the wild' that are listed as critically endangered, endangered, vulnerable or near threatened.	• Clearing Permit (Protected Plants) • Species Management Program (high risk and low risk) • An authority under s34 of the NC Act for structures, major works and long-term activities – required to enable geotechnical investigations to be undertaken within the Conondale Resources Reserve.
Environmental Offsets Act 2014	Environmental offsets may be required if SRIs to listed matters of state environmental significance (MSES) are identified. The Exploratory Works Project footprint includes the following MSES: wildlife habitat, regulated vegetation, connectivity areas, waterways and protected areas.	• Significant impacts to MSES that are not offset through Commonwealth processes will be addressed through relevant state approvals processes.
Biosecurity Act 2014	The *Biosecurity Act 2014* (Biosecurity Act) prohibits or restricts the introduction and spread of declared plant and animal pests within Queensland and establishes a General Biosecurity Obligation which requires all people in	• Compliance with the general biosecurity obligation.

Legislation	Relevance to Exploratory Works Project	Approval or permitting requirements/ obligations
	Queensland (including corporations) to ensure they do not spread a pest, disease or a contaminant.	
Water Act 2000	It is an offence to destroy vegetation, excavate or place fill in a watercourse, lake or spring without a riverine protection permit (unless works comply with the relevant exemption requirements.	• Riverine protection permits for excavation, placement of fill and the destruction or removal of vegetation within a watercourse.
Forestry Act 1959	The *Forestry Act 1959* provides for the management, silvicultural treatment, and protection of State forests Construction activities and access roads may be required in Imbil State Forest. Section 35 of the Forestry Act allows the chief executive of the Department of Environment, Tourism, Science and Innovation (DETSI) to grant permits to occupy land within a state forest, timber reserve or forest reserve.	• Section 35 occupation permit within a state forest, timber reserve or forest reserve. • Permit to traverse a state forest area.
Local frameworks		
Gympie Regional Council Planning Scheme Somerset Region Planning Scheme	The Exploratory Works Project will include excavation and fill and clearing of native vegetation. Works covered by the works regulation made under the SDPWO Act are exempt from approval under the Gympie Regional Council and Somerset Region Planning Schemes.	• Undertake works in accordance with the works regulation.

4. Ecological values

4.1 Flora

Flora and vegetation surveys were undertaken to assess the location, extent and condition of vegetation communities across the Exploratory Works Project study area. The surveys were conducted to identify threatened flora species and their preferred habitat types in accordance with the Queensland regional ecosystem (RE) framework and criteria for threatened ecological communities (TECs) listed under the EPBC Act.

4.1.1 Regional ecosystems

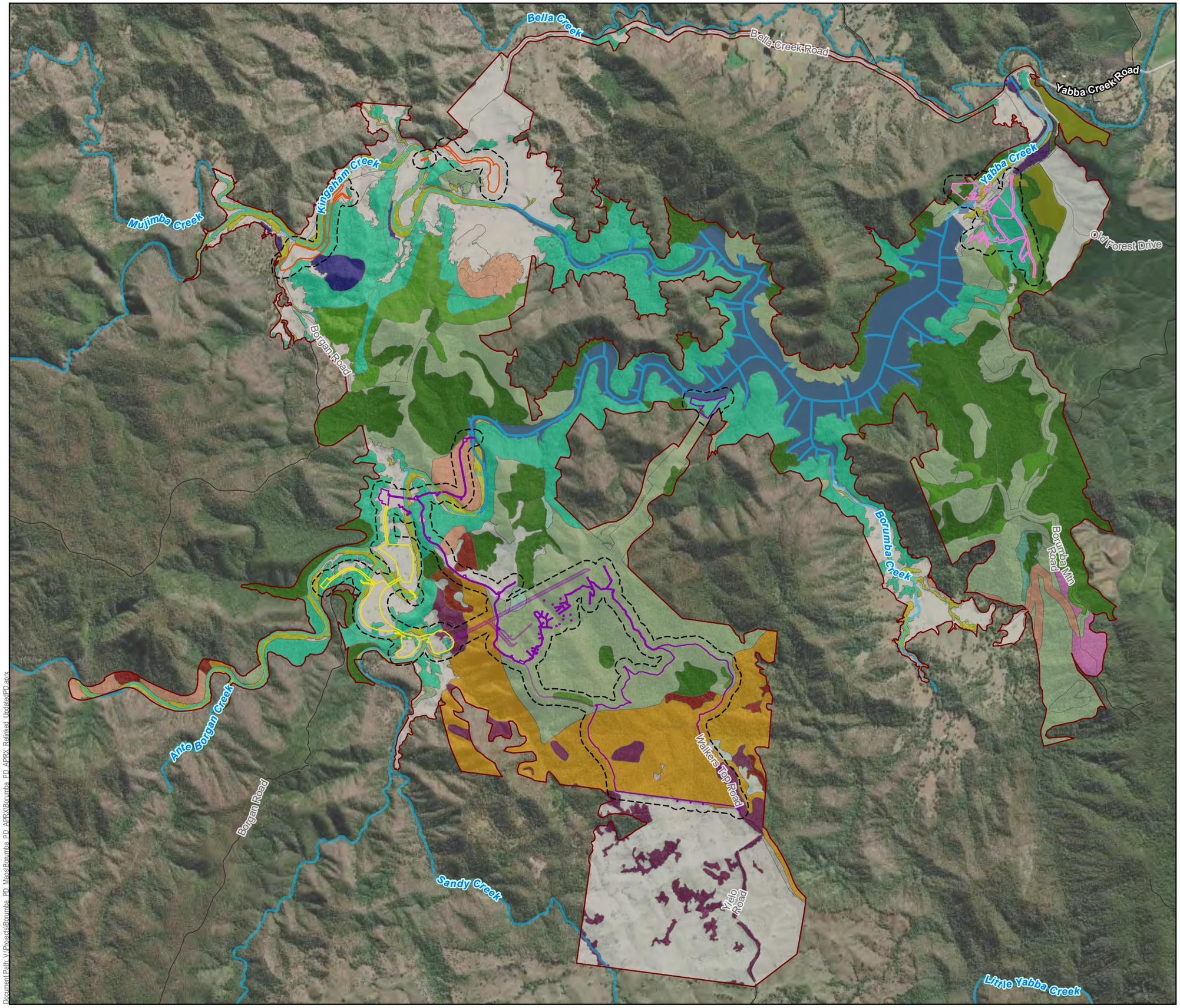
A total of 25 unique REs and high value regrowth (HVR) vegetation communities have been mapped as present on the Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development Vegetation Management Supporting Map. The REs and HVR were confirmed in the field via Quaternary surveys and were found to be generally consistent with the Vegetation Management Supporting Map; however, there were small and large scale deviations in the extent of REs and localised variations in canopy species dominance. All mapped polygons of HVR were confirmed in the field as meeting remnant status.

A total of 12 ground-truthed REs are present within the Exploratory Works Survey area. These communities have been described in Table 2 and are shown in Figure 2.

Table 2: Ground-truthed regional ecosystems in the Exploratory Works Survey area

RE	Short Description	Status (VM Act)
12.3.1a	Gallery rainforest (notophyll vine forest) on alluvial plains	Endangered
12.3.7	*Eucalyptus tereticornis, Casuarina cunninghamiana* subsp. *cunninghamiana* +/- *Melaleuca* spp. fringing woodland. Some areas qualify as Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions TEC.	Least Concern
12.11.3	*Eucalyptus siderophloia, E. propinqua* +/- *E. microcorys, Lophostemon confertus*, *Corymbia intermedia, E. acmenoides* open forest on metamorphics +/- interbedded volcanics.	Least Concern
12.11.9	*Eucalyptus tereticornis subsp. tereticornis or E. tereticornis subsp. basaltica open forest on metamorphics +/- interbedded volcanics, usually on ridges, crests and upper slopes*	Of Concern
12.11.10	Notophyll vine forest +/- *Araucaria cunninghamii* on metamorphics +/- interbedded volcanics.	Least Concern
12.11.14	*Eucalyptus crebra, E. tereticornis, Corymbia intermedia* woodland on metamorphics +/- interbedded volcanics.	Of Concern
12.11.15	*Eucalyptus tereticornis, Corymbia intermedia* open woodland with *Xanthorrhoea johnsonii* understorey on serpentinite	Of Concern
12.12.12	*Eucalyptus tereticornis, Corymbia intermedia, E. crebra +/- Lophostemon suaveolens* woodland on Mesozoic to Proterozoic igneous rocks	Of Concern
12.12.15	*Corymbia intermedia* +/- *Eucalyptus propinqua, E. siderophloia, E. microcorys*, *Lophostemon confertus* open forest on Mesozoic to Proterozoic igneous rocks.	Least Concern
12.12.15b	*Lophostemon confertus* open forest +/- *Eucalyptus microcorys, E. siderophloia, E. carnea, E. propinqua* and vine forest species often present in understorey. Occurs in gullies and exposed ridges on Mesozoic to Proterozoic igneous rocks often amongst vine forest	Least Concern
12.12.16	Notophyll vine forest on Mesozoic to Proterozoic igneous rocks.	Least Concern

RE	Short Description	Status (VM Act)
12.12.23	*Eucalyptus tereticornis* subsp. *tereticornis* or *E. tereticornis* subsp. *basaltica* +/- *E. eugenioides* woodland to open forest on crests, upper slopes and elevated valleys and plains on Mesozoic to Proterozoic igneous rocks.	Least Concern
Non-remnant	Predominantly comprises cleared pasture, not representative of remnant or regrowth vegetation.	N/A



Queensland Hydro

GDA2020 MGA Zone 56

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LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads

Exploratory Works Project

Project Area by Work Area

- Area 1 - Borumba Dam
- Area 2 - Kingaham Creek
- Area 3 - Walkers Top
- Area 3 - Walkers Top (Underground)
- Area 4 - Borgan

Survey Areas

- Exploratory Works Survey Area
- Borumba PHES Survey area

Ground-truthed regional ecosystems

- RE 12.3.1a
- RE 12.3.7
- RE 12.8.16
- RE 12.11.1
- RE 12.11.3
- RE 12.11.3a
- RE 12.11.9
- RE 12.11.10
- RE 12.11.15
- RE 12.11.14
- RE 12.12.12
- RE 12.12.15
- RE 12.12.15b
- RE 12.12.16
- RE 12.12.23
- Non-remnant
- Plantation
- Water

Data Sources:

1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
3. Watercourses © State of Queensland (Department of Natural Resources, Mines and Energy) 2022
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Exploratory Works Project
Preliminary Documentation

VEGETATION

PROJECT #:	30032677/30032772
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REVISION:	A

FIGURE
2

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4.1.2 Threatened Ecological Communities

Field surveys verified the presence of two TECs in the vicinity of the Exploratory Works Project footprint:

- Lowland Rainforest of Subtropical Australia, which is listed as critically endangered under the EPBC Act (Lowland Rainforest TEC)
- Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions, which is listed as endangered under the EPBC Act (Subtropical Eucalypt TEC).

4.1.2.1 Lowland Rainforest of Subtropical Australia TEC

There are several patches of the Lowland Rainforest of Subtropical Australia TEC patches within the Exploratory Works Survey area; however, only a single patch of the Lowland Rainforest of Subtropical Australia TEC is present within the Project footprint at Area 1 – Borumba Dam.

A total of 632.4 ha of the field validated TEC is present in the Borumba PHES Survey area. Within the Project footprint, 2.5 ha of the field validated TEC is present (patch YC4), while 33.5 ha of the TEC is present within the Exploratory Works Survey area across 16 patches. The 16 patches that intersect the Exploratory Works Survey area[1] (Figure 3) and their total TEC patch size (including areas outside the Exploratory Works Survey area) are as follows:

- Patch BR1 – total patch size is 52.5 ha
- Patch SC2 – total patch size is 9.8 ha
- Patch YC1 – Total patch size 22.7 ha
- Patch YC2 – Total patch size 91.4 ha
- Patch YC3 – total patch size is 6.7 ha
- Patch YC4 – Total patch size 4.8 ha
- Patch YC5 – Total patch size 10.5 ha
- Patch YC6 – Total patch size 22.5 ha
- Patch YC7 – Total patch size 9.2 ha
- Patch WT1 – Total patch size 16.1 ha
- Patch WT2 – total patch size is 2 ha
- Patch WT3 – Total patch size 4.4 ha
- Patch WT4 – Total patch size 45.4 ha
- Patch WT5 – Total patch size 20.8 ha
- Patch WT6 – Total patch size 5.4 ha
- Patch WT7 – Total patch size 6.0 ha.

Surveys were undertaken within the Lowland Rainforest of Subtropical Australia TEC to assess the condition of the vegetation and confirm if the vegetation community also meets the condition thresholds, which identified that all patches achieved a Condition class of either A or B.

Several known threats to the Lowland Rainforest TEC are present in the study area including livestock grazing, weeds such as *Lantana camara,* and disease such as myrtle rust (*Austropuccinia psidii*). Myrtle rust affects plants in the Myrtaceae family, including those found in the Lowland Rainforest TEC (TSSC, 2011). Lantana and myrtle rust were observed in broad areas in the study area, including in patches of the Lowland Rainforest TEC. Grazing cattle are being destocked from land managed by Queensland Hydro. Fire has also had a significant influence on the vegetation communities on Queensland Hydro land including the reduction and severance of a patch of Lowland Rainforest TEC adjacent to Walkers Top Road.

[1] This is the area surveyed by ecologists to gather ecological data for the Main Works and Exploratory Works Projects. It includes the Exploratory Works Survey area. The Exploratory Works Survey area is the area surveyed by ecologists to gather ecological data, and typically extends 100 m either side of the Exploratory Works Project area to capture environmental values both within, adjacent to or surrounding the Exploratory Works Project area.

4.1.2.2 Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions TEC

The Eucalypt dominated forests and woodlands on alluvial flats habitat type is widely distributed within the Borumba PHES Survey area and the Exploratory Works Survey area. A total of 14 ha of the field validated TEC is present within the Borumba PHES Survey area. The TEC is not present within the Project footprint, however 4.6 ha of the TEC has been recorded within the Exploratory Works Survey area across two patches, as follows:

- Patch BC1 – 4.5 ha
- Patch SC1 – 3.6 ha.

The surveys identified that the two patches (BC1 and SC1) of the Subtropical Eucalypt Floodplain TEC meet the minimum condition thresholds, achieving Condition Classes A2 and B3. Patches of the Eucalypt dominated woodlands and forests habitat type that did not conform to the condition thresholds generally did not meet the minimum ground cover species richness or number of very large or large trees.

Several known threats to the Subtropical Eucalypt TEC are present in the study area including clearing, livestock grazing and weeds. Clearing and grazing severity was high in some areas where vegetation had been cleared to the stream bank and movement of cattle was evident along stream banks. Weed severity was generally low, though *Lantana camara* was noted in several areas. Large areas have been cleared for grazing along the upper reaches of the creeks. Grazing cattle have been destocked from land managed by Queensland Hydro.

Queensland Hydro

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LEGEND

- Watercourses
- Local Roads
- State Controlled Roads

Exploratory Works Project

- Project Area

Project Footprint by Work Area

- Area 1 - Borumba Dam
- Area 2 - Kingaham Creek
- Area 3 - Walkers Top
- Area 4 - Borgan

Survey Areas

- Exploratory Works Survey Area
- Borumba PHES Survey Area

Ground-truthed threatened ecological communities

- Lowland Rainforest of Subtropical Australia
- 50m buffer for lowland rainforest of subtropical Australia
- Subtropical eucalypt floodplain forest and woodland
- 50m buffer for Subtropical eucalypt floodplain

Data Sources:

1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
3. Watercourses © State of Queensland (Department of Natural Resources, Mines and Energy) 2022
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Exploratory Works Project
Preliminary Documentation

THREATENED ECOLOGICAL COMMUNITIES OVERVIEW

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REVISION:	A

FIGURE 3a

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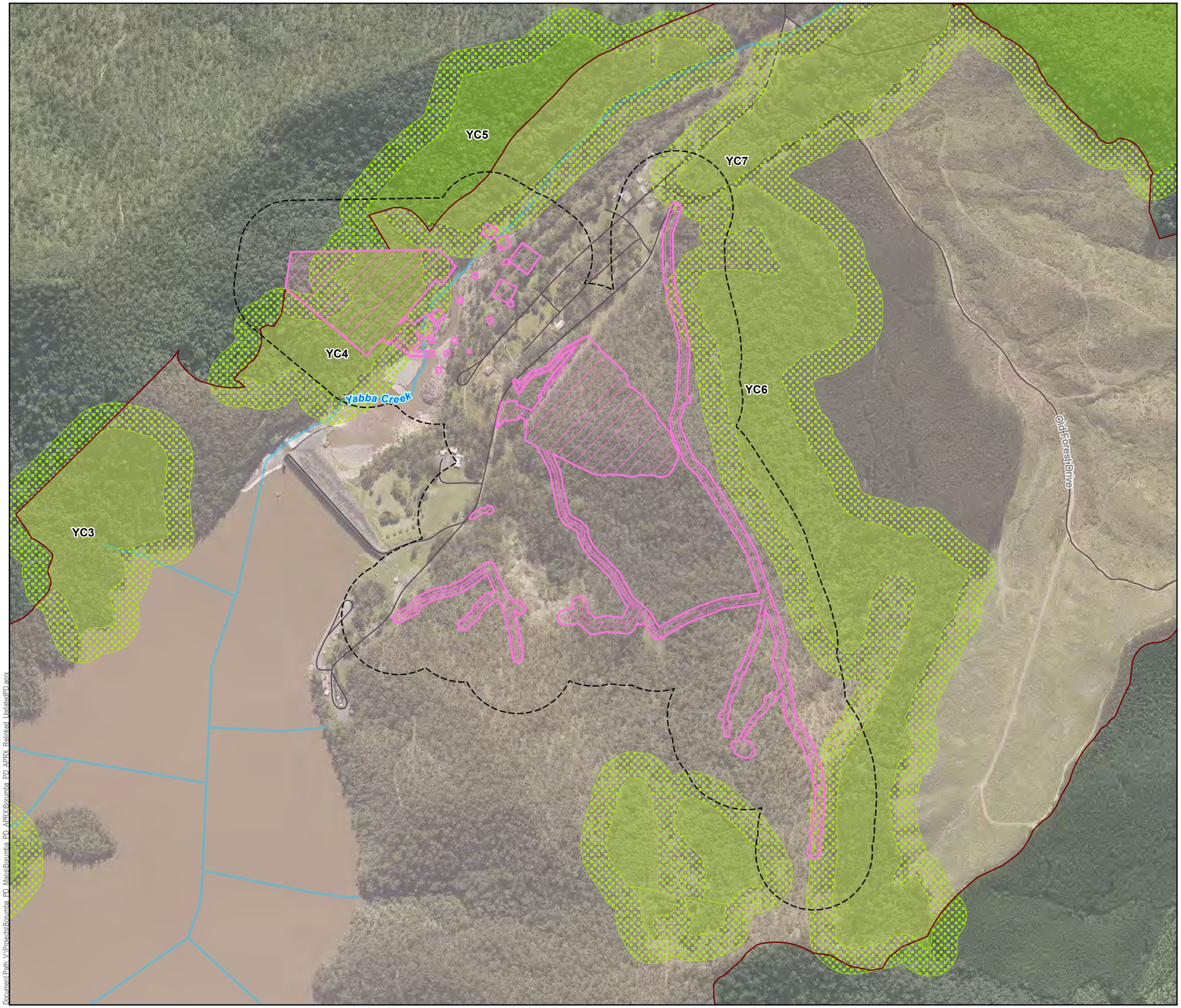

Queensland Hydro

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LEGEND

- Watercourses
- Local Roads

Exploratory Works Project

Project Footprint by Work Area
- Area 1 - Borumba Dam

Project Area by Work Area
- Area 1 - Borumba Dam

Survey Areas
- Exploratory Works Survey Area
- Borumba PHES Survey Area

Ground-truthed threatened ecological communities
- Lowland Rainforest of Subtropical Australia
- 50m buffer for lowland rainforest of subtropical Australia

Data Sources:

1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
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Exploratory Works Project
Preliminary Documentation

THREATENED ECOLOGICAL COMMUNITIES AREA 1 - BORUMBA DAM

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LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE 3b

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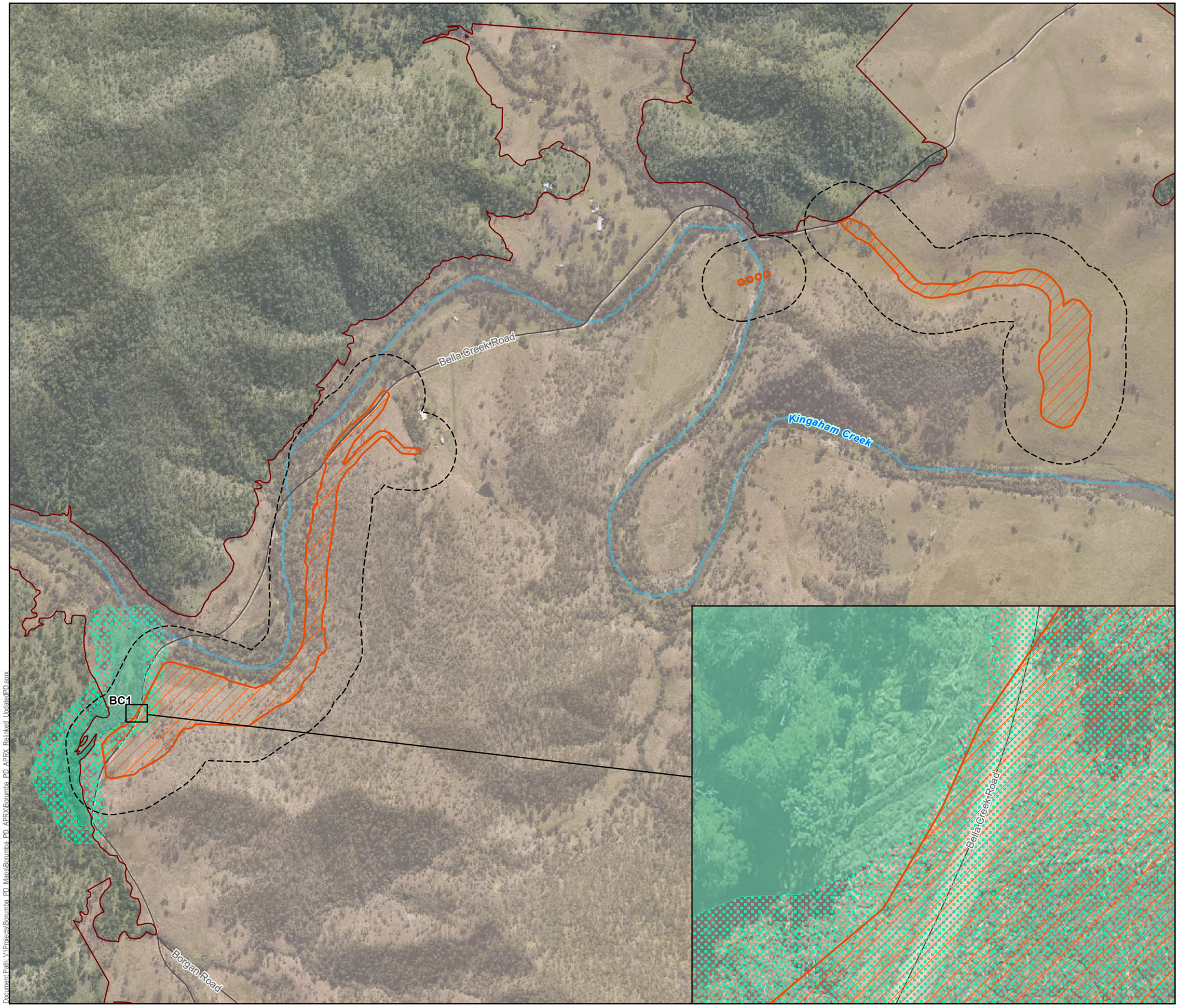

Queensland Hydro

GDA2020 MGA Zone 56

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LEGEND

Watercourses

Local Roads

Exploratory Works Project

Project Footprint by Work Area

Area 2 - Kingaham Creek

Project Area by Work Area

Area 2 - Kingaham Creek

Survey Areas

Exploratory Works Survey Area

Borumba PHES Survey Area

Ground-truthed threatened ecological communities

Subtropical eucalypt floodplain forest and woodland

50m buffer for Subtropical eucalypt floodplain

Data Sources:

1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
3. Watercourses © State of Queensland (Department of Natural Resources, Mines and Energy) 2022
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Exploratory Works Project
Preliminary Documentation

THREATENED ECOLOGICAL COMMUNITIES
AREA 2 - KINGAHAM CREEK

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REVISION:	A

FIGURE 3c

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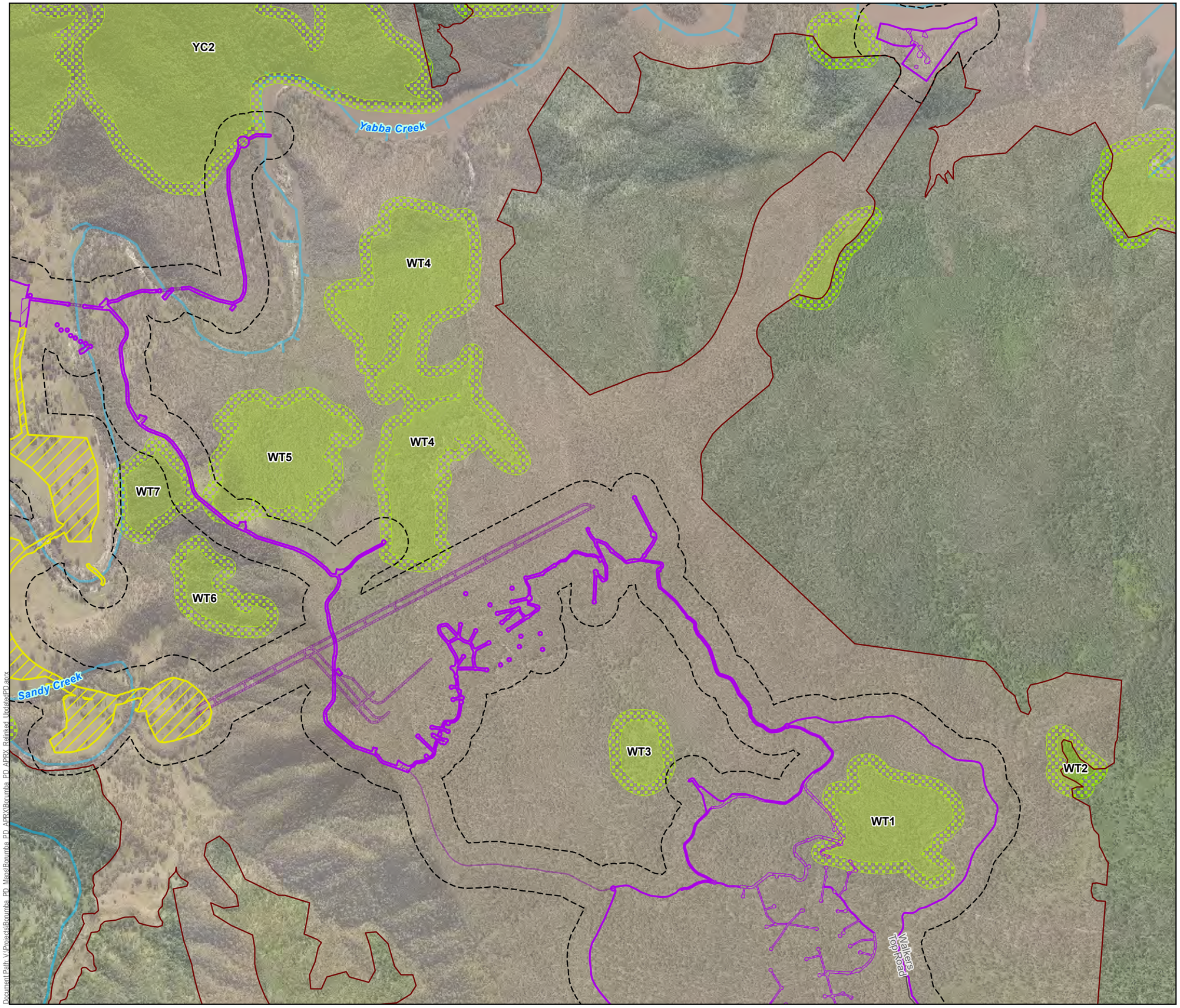

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Queensland Hydro

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LEGEND

- Watercourses
- Local Roads

Exploratory Works Project

Project Footprint by Work Area
- Area 3 - Walkers Top
- Area 4 - Borgan

Project Area by Work Area
- Area 3 - Walkers Top
- Area 3 - Walkers Top (Underground)
- Area 4 - Borgan

Survey Areas
- Exploratory Works Survey Area
- Borumba PHES Survey Area

Ground-truthed threatened ecological communities
- Lowland Rainforest of Subtropical Australia
- 50m buffer for lowland rainforest of subtropical Australia

Data Sources:
1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
3. Watercourses © State of Queensland (Department of Natural Resources, Mines and Energy) 2022
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Exploratory Works Project
Preliminary Documentation

THREATENED ECOLOGICAL COMMUNITIES AREA 3 - WALKERS TOP

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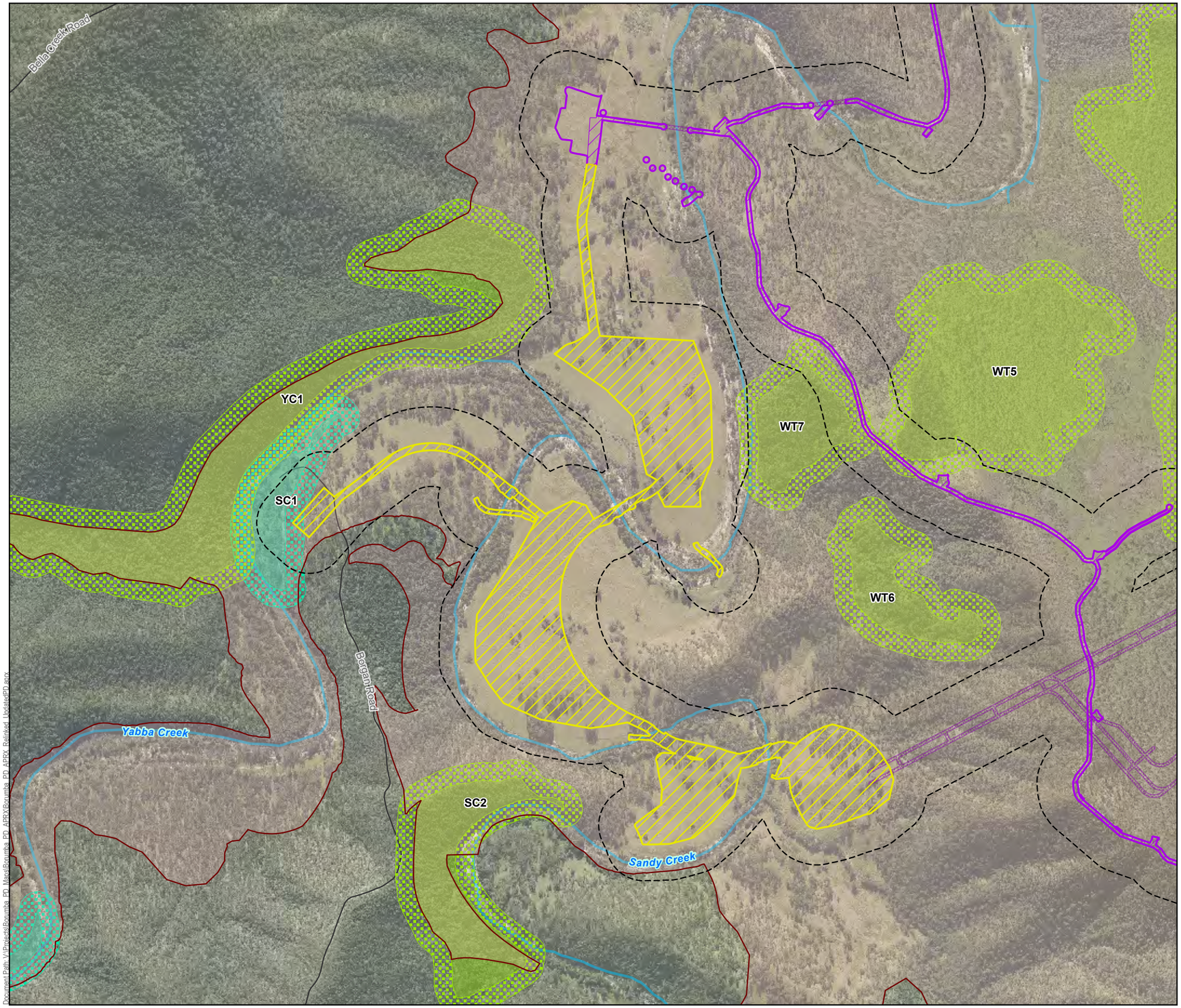
FIGURE 3d



Queensland Hydro

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LEGEND

Watercourses
Local Roads

Exploratory Works Project

Project Footprint by Work Area
- Area 3 - Walkers Top
- Area 4 - Borgan

Project Area by Work Area
- Area 3 - Walkers Top
- Area 3 - Walkers Top (Underground)
- Area 4 - Borgan

Survey Areas
- Exploratory Works Survey Area
- Borumba PHES Survey Area

Ground-truthed threatened ecological communities
- Lowland Rainforest of Subtropical Australia
- 50m buffer for lowland rainforest of subtropical Australia
- Subtropical eucalypt floodplain forest and woodland
- 50m buffer for Subtropical eucalypt floodplain

Data Sources:
1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
3. Watercourses © State of Queensland (Department of Natural Resources, Mines and Energy) 2022
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Exploratory Works Project
Preliminary Documentation

THREATENED ECOLOGICAL COMMUNITIES
AREA 4 - BORGAN

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FIGURE 3e

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4.1.3 Threatened flora

More than 500 flora species were recorded in the Borumba PHES survey area, of which nine are threatened flora protected under the EPBC Act. Threatened flora that may be directly or indirectly impacted by the Exploratory Works Project are shown in Table 3.

Table 3: Threatened flora species known or likely to occur within or immediately adjacent to the Exploratory Works Project footprint

Scientific name	Common name	EPBC status	NC Act status
Bosistoa transversa	three-leaved bosistoa	Vulnerable	Least concern
Coleus omissus	-	Endangered	Endangered
Coleus torrenticola	silver coleus	Endangered	Endangered
Floydia praealta	ball nut	Vulnerable	Vulnerable
Gossia hilli	-	Not listed	Critically endangered
Gossia inophloia	-	Not listed	Critically endangered
Gossia puncata	-	Not listed	Critically endangered
Leichhardtia coronata	slender milkvine	Not listed	Vulnerable
Macadamia integrifolia	macadamia nut	Vulnerable	Vulnerable
Macadamia ternifolia	small-fruited Queensland nut	Vulnerable	Vulnerable
Rhodamnia dumicola	rib-fruited malletwood	Not listed	Endangered
Rhodamnia rubescens	scrub turpentine	Critically endangered	Critically endangered
Rhodomyrtus psidioides	native guava	Critically endangered	Critically endangered
Sophora fraseri	brush sophora	Vulnerable	Vulnerable
Symplocos harroldii	hairy hazelwood	Not listed	Vulnerable

4.1.4 Restricted and prohibited weed species

A broad range of invasive animals and plants are already established within and surrounding the study area. In total, 52 invasive plant species were recorded in the study area during field surveys. Of these, eight species are listed as Category 3 Restricted Plants under the Biosecurity Act, five of which are also listed as Weeds of National Significance (WoNS) (Table 4). Lantana and cat's claw creeper are widespread; however, they generally occur in higher density within rainforest and wet sclerophyll communities where clearing or natural disturbance has resulted in opportunities for these species to rapidly colonise exposed areas.

Four aquatic invasive plants also listed as either Category 3 Restricted Plants or WoNS have been recorded from the study area. Appendix B includes a description of the categories for restricted plants under the Biosecurity Act.

Table 4: Significant invasive plants and animal species recorded within the study area

Species	Restricted Plant / WoNs
Terrestrial	
Camphor laurel (*Cinnamomum camphora*)	Category 3 Restricted Plant
Cat's claw creeper (*Dolichandra unguis-cati*)	Both
Chinese celtis (*Celtis sinensis*)	Category 3 Restricted Plant
Parthenium (*Parthenium hysterophorus*)	Category 3 Restricted Plant
Lantana (*Lantana camara*)	Both
Prickly pear (*Opuntia stricta*)	Both
Rat's tail grasses including *Sporobolus fertilis, Sporobolus natalensis* and *Sporobolus pyramidalis*	Category 3 Restricted Plant

Species	Restricted Plant / WoNs
Sicklepod (*Senna tora*)	Category 3 Restricted Plant
Aquatic	
Cabomba (*Cabomba caroliniana*)	Both
Water hyacinth (*Eichhornia crassipes*)	Category 3 Restricted Plant
Hymenachne (*Hymenachne amplexicaulis*)	WoNS
Salvinia (*Salvinia molesta*)	Both

4.2 Fauna

Survey effort has covered what comprises the Exploratory Works Project footprint and the Exploratory Works Survey area (100 m buffer on the Exploratory Works Project footprint), and a much broader area, which extends beyond the Exploratory Works Survey area and is largely associated with the Borumba PHES Project. The survey effort undertaken within the Exploratory Works Survey area is important for assessing the direct and indirect impacts that may be anticipated to occur as a result of the Exploratory Works Project on threatened species. The survey effort beyond the boundary of the Exploratory Works Survey area is important for contextualising the potential impacts of the Exploratory Works Project on threatened species by providing habitat information and additional species occurrence observations.

Section 4.1 and Appendix M of the Borumba PHES Project – Exploratory Works Preliminary Documentation provides further details of the desktop and field survey methods and results for the Exploratory Works Project.

4.2.1 Threatened fauna

Fauna surveys recorded more than 200 fauna species within the Borumba PHES survey area, of which, 12 are listed under the EPBC Act. Table 5 lists threatened fauna species known or likely to occur within or immediately adjacent to the Exploratory Works Project footprint, that may be directly or indirectly impacted.

Fauna species that are listed under the NC Act that were recorded in the Borumba PHES survey area, or are considered likely to occur, are identified in Appendix C.

Table 5: Threatened fauna species known or likely to occur within or immediately adjacent to the Exploratory Works Project footprint

Species	EPBC Act status	NC Act status
Fish		
Australian lungfish, *Neoceratodus forsteri*	Vulnerable	Vulnerable
Mary River cod, *Maccullochella mariensis*	Endangered	Endangered
Turtles		
Mary River turtle, *Elusor macrurus*	Endangered	Critically endangered
White-throated snapping-turtle, *Elseya albagula*	Critically endangered	Critically endangered
Birds		
Black-breasted button-quail, *Turnix melanogaster*	Vulnerable	Vulnerable
Glossy black-cockatoo, *Calyptorhynchus lathami lathami*	Vulnerable	Vulnerable
Plumed frogmouth, *Podargus ocellatus plumiferus*	Not listed	Vulnerable
Powerful owl, *Ninox strenua*	Not listed	Vulnerable
Mammals		
Greater glider, *Petauroides volans volans*	Endangered	Endangered
Grey-headed flying-fox, *Pteropus poliocephalus*	Vulnerable	Least concern

Species	EPBC Act status	NC Act status
Koala (Combined pop. Of QLD, NSW, ACT), *Phascolarctos cinereus*	Endangered	Endangered
Long-nosed potoroo (Northern), *Potorous tridactylus tridactylus*	Vulnerable	Vulnerable
Yellow-bellied glider (Southern Subsp.), *Petaurus australis australis*	Vulnerable	Vulnerable
Amphibians		
Giant barred frog, *Mixophyes iteratus*	Vulnerable	Vulnerable
Tusked frog, *Adelotus brevis*	Not listed	Vulnerable

Threatened fauna for which suitable habitat was also observed, noting that these species are consider possible to occur:

- Australian painted snipe (*Rostratula australis*) – listed as 'endangered' under the EPBC Act and NC Act
- Coxen's fig-parrot (*Cyclopsitta diophthalma coxeni*) – listed as 'critically endangered' under the EPBC Act and NC Act
- northern quoll (*Dasyurus hallucatus*) – listed as 'endangered' under the EPBC Act and 'least concern' under the NC Act
- spotted-tail quoll (*Dasyurus maculatus maculatus*) – listed as 'endangered' under the EPBC Act and NC Act.

4.2.2 Introduced fauna

A total of 14 pest species were recorded during field surveys and are listed in Table 6. Eight of these species are listed as Restricted Matters under the Biosecurity Act. There are also threat abatement plans and national action plans to assist with managing some of these species. Appendix B includes a description of the categories for restricted matters under the Biosecurity Act.

Table 6: Introduced fauna in the study area

Common name	Scientific name	Relevant threat abatement plan or national action plan	Restricted matter category under the Biosecurity Act
Terrestrial species			
Cane toad	*Rhinella marina*	Threat Abatement Plan for the biological effects, including lethal toxic ingestion, caused by cane toads	-
Cat	*Felis catus*	Threat Abatement Plan for predation by feral cats	3, 4, and 6
Cattle	*Bos taurus*	-	-
Dog	*Canis familiaris dingo*	National Wild Dog Action Plan 2020-2030	3, 4, 5, and 6
European brown hare	*Lepus europaeus*	Threat abatement plan for competition and land degradation by rabbits	-
Pig	*Sus scrofa*	National Threat Abatement Plan for predation, habitat degradation, competition and disease transmission by feral pigs National Feral Pig Action Plan	3, 4, and 6
Rabbit	*Oryctolagus cuniculus*	Threat abatement plan for competition and land degradation by rabbits	3, 4, 5, and 6

Common name	Scientific name	Relevant threat abatement plan or national action plan	Restricted matter category under the Biosecurity Act
Red fox	*Vulpes vulpes*	Threat Abatement Plan for predation by European red fox	3, 4, 5, and 6
Rusa deer / red deer	*Cervus timorensis* / *Cervus elaphus*	National Feral Deer Action Plan 2023-2027	3, 4, and 6
Aquatic species			
Mosquitofish	*Gambusia holbrooki*	-	6 and 7
Tilapia	*Oreochromis mossambicus*	-	3, 5, 6 and 7
Guppy	*Poecilia reticulata*	-	-
Swordtail	*Xiphophorus helleri*	-	-
Platy	*Xiphophorus maculatus*	-	-

5. Impacts and risks

The Exploratory Works Project has the potential to impact numerous terrestrial ecology values through:

- temporary or permanent loss of breeding, foraging and sheltering habitat and microhabitat features for native fauna such as tree hollows, coarse woody debris, complex rock fissures and outcrops, and leaf litter
- habitat fragmentation, edge effects and reduced connectivity
- creation of barriers to fauna movement
- increased competition between fauna from habitat loss
- fauna injury or mortality during vegetation clearing
- injury or mortality due to vehicle strike
- land degradation through increased erosion and sedimentation processes
- wildlife disturbance due to dust, noise, light and vibration emissions
- habitat degradation from dust deposition on vegetation
- potential spills of hazardous materials
- introduction or increased prevalence of pests and weeds due to increased vehicle movements and vegetation clearing
- increased risk of bushfire due to potential ignition sources altering natural fire regimes that can change the ecological function and structure of vegetation communities and be harmful for native fauna.

An aquatic ecology assessment undertaken within the Exploratory Works Project study area also identified potential impacts to aquatic ecology values through:

- physical disturbance of watercourse bed and banks by instream and bank works resulting in:
  - the loss of habitat through both direct (footprint disturbance) and indirect (sedimentation) pathways, includes habitat for listed threatened fish and turtles
  - damage and or death of aquatic fauna during instream construction
  - barriers to movement of aquatic fauna
  - introduction and spread of aquatic weeds either through vehicles, watercraft, machinery, and/or other construction equipment
- changes to water quality associated with:
  - clearing and construction (increase in suspended sediments)
  - release of wastewaters generated from spills, and leaks from holding areas and construction equipment, inundation of contaminated sites and/or the use of contaminated fill during construction
  - flow and water management, which may result in the loss and/or reduction of feeding, nesting, and spawning resources, such impacts are associated with temporary instream infrastructure
- increased fishing pressures resulting from recreational fishing by construction workers.

Potential impacts and associated risks (pre-management measures) with the relevant components of the Exploratory Works Project are detailed in Appendix E. The qualitative risk was assessed using the methodology outlined in Section 5.1 of the CEMP.

The assessment of risks and required mitigation measures are in the sections that follow the table.

A risk assessment of the Project's potential impacts on MNES was also undertaken in accordance with the Environmental Management Plan Guidelines (Department of Climate Change, Energy, the Environment and Water, 2024) and is included in Appendix H of the Preliminary Documentation.

5.1 Direct impacts to individual MNES and their habitat

Table 7, Table 8 and Table 9 below identify the direct impacts to MNES and their habitat as a result of the Exploratory Works Project. Noting that protected plant surveys and pre-clearance surveys are ongoing, and micro-siting activities have not been undertaken and as such the final number of impacted plants could potentially change.

Table 7: Direct impacts to threatened ecological communities

Threatened ecological community	Impacts (ha)
Lowland Rainforest TEC	2.5
Subtropical Eucalypt TEC	0

Table 8: Direct impacts to threatened fauna under the EPBC Act

Fauna	Impacts to habitat (ha)
Fish	
Australian lungfish, *Neoceratodus forsteri*	0.2 foraging 0.3 spawning and foraging
Mary River cod, *Maccullochella mariensis*	0.2 foraging 0.2 spawning and foraging
Turtles	
Mary River turtle, *Elusor macrurus*	0.5 foraging 0.1 nesting
White-throated snapping-turtle, *Elseya albagula*	0.5 foraging 0.1 nesting
Birds	
Black-breasted button-quail, *Turnix melanogaster*	0.2 suitable
Glossy black-cockatoo, *Calyptorhynchus lathami lathami*	27.8 breeding 0.1 foraging
Mammals	
Greater glider, *Petauroides volans volans*	35.2 denning/foraging
Grey-headed flying-fox, *Pteropus poliocephalus*	38 foraging
Koala (combined pop. Of QLD, NSW, ACT), *Phascolarctos cinereus*	35.3 breeding and foraging 52.3 sheltering and dispersal
Long-nosed potoroo (Northern), *Potorous tridactylus tridactylus*	38 suitable
Yellow-bellied glider (Southern Subsp.), *Petaurus australis australis*	35.3 denning
Amphibians	
Giant barred frog, *Mixophyes iteratus*	0.6 suitable

Table 9: Direct impacts to threatened flora under the EPBC Act

Flora	Number of individuals likely to be impacted	Impacts (ha) to 'known habitat'	Impacts (ha) to 'potential habitat'
Bosistoa transversa, three-leaved bosistoa	0	0	7.3
Coleus omissus	0	0	1.1
Coleus torrenticola, silver coleus	1	0.3	5.8
Floydia praealta, ball nut	0	0	2.7
Macadamia integrifolia, macadamia nut	0	0	2.7
Macadamia ternifolia, small-fruited Queensland nut	0	0	2.7

Flora	Number of individuals likely to be impacted	Impacts (ha) to 'known habitat'	Impacts (ha) to 'potential habitat'
Rhodamnia rubescens, scrub turpentine	1	0.7	31.9
Rhodomyrtus psidioides, native guava	0	0	10
Sophora fraseri, brush sophora	5	0.3	16.8

5.2 Habitat loss

The Exploratory Works footprint encompasses areas of remnant and non-remnant vegetation comprising the following habitat types:

- notophyll vine forests on foothills and ranges
- moist to dry open woodlands on metamorphic and volcanic rocks
- dry to moist eucalypt woodlands and open forests on undulating to hilly terrain of metamorphic and volcanic rocks
- eucalyptus open forest and woodlands on drainage lines and alluvial plains
- non-remnant pasture
- plantation
- water.

Considering the threatened flora and fauna species recorded during the field assessments across the Exploratory Works Project, it is possible that the works will result in a loss of suitable habitat for some of these species. Vegetation clearing will potentially reduce breeding, foraging and sheltering habitat for terrestrial flora and fauna species, and the process of vegetation clearance has the potential to result in injury to or mortality of native fauna species.

5.3 Habitat fragmentation

Terrestrial habitat connectivity may be reduced by the Exploratory Works Project due to small scale linear clearing, which may hinder fauna movements between areas of retained remnant vegetation. Habitat fragmentation will be more prominent where clearing corridors are wider and where this clearing affects larger patches of vegetation. Clearing linear corridors through habitats also has the potential to isolate plant populations by causing barriers to the dispersal of seeds and fruit, and to increase edge effects (additional light entering the forest, weed encroachment, increased feral animal abundance and increased risk of bushfire), thereby reducing the ecological functioning of those areas.

5.4 Injury or mortality

The Exploratory Works Project will increase the likelihood of direct fauna injury or mortality occurring during vegetation clearing (e.g. through removal of mature trees) and vehicle collisions. Mortality from tree clearing is a greater risk for nocturnal arboreal mammals and hollow nesting bird species.

Excavations will be required as part of the Exploratory Works Project to collect the geotechnical data needed to support the development and design of the Borumba PHES Project. Trenches may also be required and will involve removal of ground vegetation, soil and rock which provide fauna habitat (e.g. denning sites in rocky areas). During trenching activities there is potential for fauna to fall into and become trapped in open trenches, where they may perish or become subject to increased predation risk.

Increased traffic around the Exploratory Works Project has the potential to kill or injure fauna if collisions occur. Some ground-dwelling or slow-moving species may be particularly susceptible to these impacts.

5.5 Reduced air quality

Potential impacts related to air quality during construction could include:

- the impact of dust emissions generated from construction activities, particularly vehicle movements on unsealed roads, land clearing, drilling and blasting, earthmoving, material handling and surface preparation and stockpiling material (wind erosion)
- gases generated by fuel combustion from numerous sources such as oxides of nitrogen, carbon monoxide, sulphur dioxide, fine particulate matter, trace amounts of volatile organic compound
- fugitive emissions from fuels, chemicals, oils, and greases stored at construction sites
- odour emissions from disturbance of contaminated land and asphalt laying activities.

5.6 Noise and vibration

Noise may adversely affect fauna by interfering with communication (e.g. territorial bird song), masking the sound of predators and prey, causing avoidance reactions and displacement from habitat. Construction noise will be generated during the Exploratory Works Project by vehicles, machinery and drill and blast activities for the exploratory tunnel (noting the tunnel excavation will be at a sub-surface depth of more than 100 m below ground after the first month) and will vary from short intermittent bursts of noise from operational activities to more persistent noises from generators. Whilst these disturbances may only be temporary, the generation of construction noise has the potential to force resident fauna species to relocate.

Vibration from vehicles and equipment may also cause temporary disturbance to ground-dwelling fauna, and displacement or structural damage to suitable fauna habitat (i.e. rock or log piles). Blasting will also be required for construction of the exploratory tunnel, and obligate cave-dwelling bats would be particularly susceptible to vibration impacts from blasting.

5.7 Light emissions

Artificial lighting from infrastructure and machinery required to support the Exploratory Works Project may also impact fauna within and adjacent to the Exploratory Works Project. Artificial lighting can have a range of impacts which can vary from species to species including:

- affecting natural circadian rhythms of local fauna populations
- leading to certain species avoiding areas of habitat that they previously relied upon for foraging/dispersal activities
- leading to an increase in the risk of predation for some fauna species
- potential disruption to breeding and migratory patterns of some species or cause general disorientation.

Conversely, some species such as nocturnal reptiles, frogs and bats may congregate at artificial light sources to feed on insects attracted to the light.

5.8 Hazardous materials

The Exploratory Works Project has the potential to lead to accidental releases of hazardous materials from construction sites, such as fuels and oils from vehicles and machinery. These hazardous materials can lead to localised soil contamination and contamination of water resources, which in turn can cause injury, reduced vigour or mortality to flora and fauna. The severity of the impact is dependent on the location and magnitude of the release.

5.9 Surface water and groundwater

Operational activities could lead to the following potential impacts to surface water systems:

- increased soil erosion and resultant sedimentation of nearby waterways due to vegetation clearing and general soil handling/earthwork activities
- increased suspended solids and turbidity (colloidal clays can take a long time to settle out of the water column)
- transport of nutrients into the dam which may create conditions suitable for algal blooms
- sediment may also be deposited in the stream beds, changing the aquatic habitat

- contamination associated with accidental spillage, leakage or general release of contaminants from equipment and Exploratory Works Project activities including explosives used in tunnelling and drill fluids used in geotechnical boring, wastewater from tunnel excavation and accidental spillage of fuels or oils
- significant rainfall event during construction, causing erosion and sedimentation, resulting in localised reduction in water quality.

Potential groundwater impacts of the Exploratory Works Project include:

- groundwater drawdown associated with the exploratory tunnel, reducing availability for potential GDEs which may also provide habitat for MNES
- potential contamination of the aquifer from use of explosives and due to oxidation within the tunnel during drilling and poor quality leachate from spoils, stockpile materials (cementitious material and fly ash), ablution facilities, fuel storage tanks and explosives
- potential reduction in groundwater recharge from paving over recharge areas.

5.10 Erosion and sedimentation

Vegetation clearing, earthmoving and general construction activities may all result in an increase to natural erosion and sedimentation within and adjacent to the Exploratory Works Project footprint. This increased erosion and sedimentation could potentially have localised impacts upon water quality and flow rates within the vicinity of the Exploratory Works Project.

During construction activities, sediment may be mobilised and transported by surface water during rainfall events and at bed-level creek crossings, ultimately discharging into watercourses and drainage lines and potentially reducing water quality in downstream aquatic habitats. Increased suspended sediments can reduce light penetration into the water column, reducing photosynthesis of aquatic macrophytes and decreasing dissolved oxygen levels. Watercourses within the Exploratory Works Project footprint include both permanent and ephemeral features, which may be at higher risk of these impacts.

Changes to hydrological dynamics across the Exploratory Works Project footprint may occur through alteration of surface flows and stormwater runoff as a result of excavations and changes in surface treatments, including obstruction of flow. This can result in scouring or waterlogging occurring in some areas.

The accidental release of pollutants (including leaks and other uncontrolled releases) into the surrounding environment and waterways has the potential to degrade aquatic habitat quality in and adjacent to the Exploratory Works Project footprint and impact vegetation communities and fauna utilising these areas. This includes direct toxic impacts on fauna from ingestion or inhalation. Without mitigation, contaminants may enter waterways including oily wastewater (from heavy equipment cleaning), contaminated runoff from chemical or fuel storage areas and general washdown water.

5.11 Dust

Increased dust from vegetation clearing, earthworks and vehicle movements during construction has the potential to temporarily and locally impact flora and fauna values in the vicinity of the Exploratory Works Project footprint. Excess generation of dust and subsequent deposition on leaves can impair plant photosynthesis and productivity, resulting in reduced habitat quality for fauna. Increased dust can also impact on respiratory systems of fauna, alter soil properties impacting on plant species assemblages and reduce water quality in aquatic habitats. Dust is expected to only be a potential issue during vegetation clearing and construction.

5.12 Bushfire

Fire is a natural part of the Australian landscape, and most vegetation communities are adapted to periodic fires. However, changes in the natural fire regime may result in changes in the species composition and / or structure of the vegetation. The increased presence of construction vehicles and personnel in the Exploratory Works Project footprint may increase fire risk through use of machinery that may generate sparks, use of flammable liquids and idling vehicles being present in areas of ground vegetation.

5.13 Pests and weeds

The Exploratory Works Project has the potential to increase the abundance of pest flora and fauna in and adjacent to the Exploratory Works Project footprint and facilitate dispersal to previously unaffected areas. Movement of vehicles, equipment and personnel throughout the Exploratory Works Project footprint is the key vector of transmission, in particular vehicles and equipment sourced from regions beyond the Exploratory Works Project footprint which may introduce new species. Many weed species thrive on disturbed ground and will rapidly colonise disturbed areas in advance of native species recolonisation. Seeds and fruits have the potential to be spread by clearing activities and vehicle movement, whilst establishment into new areas is highly likely after heavy rainfall as several thousand seeds can be produced per square metre that can remain viable for several years.

Increased pest flora abundance has adverse impacts on native vegetation and biodiversity, as well as potential negative economic effects on local land uses such as grazing activities. Operational activities may also increase pest fauna abundance in and adjacent to the Exploratory Works Project. This can lead to increased competition with, and predation of native fauna. In addition, habitat degradation may occur through vegetation trampling (e.g. feral pig wallowing). Creation of new access points into areas of intact vegetation may create pathways for feral fauna species to disperse. Uncontained waste sources may also attract feral fauna such as wild dogs. However, Queensland Hydro is destocking cattle from its property, which will remove the threat of habitat disturbance from cattle grazing and trampling.

5.14 Disease

Myrtle rust was observed throughout the study area including on most records of scrub turpentine (*Rhodamnia rubescens*). These records were observed in vegetated areas away from roadsides, indicating that the spread of the fungus is likely not being spread by purely anthropogenic means. Myrtle rust is also relevant for the native guava (*Rhodomyrtus psidioides*). The records of this species identified near the Exploratory Works Project footprint showed no obvious signs of infection.

The Exploratory Works Project could spread myrtle rust into areas of previously uninfected habitat, potentially infecting scrub turpentine (*Rhodamnia rubescens*) and native guava (*Rhodomyrtus psidioides*) plants, preventing them from flowering or fruiting, and therefore reproducing.

6. Impact avoidance, minimisation and mitigation

Queensland Hydro has implemented the avoid, minimise, mitigate, manage hierarchy in developing the concept design for the Borumba PHES Project, which has informed the extent and location of the Project elements required for the Exploratory Works Project. In addition, the Exploratory Works Project has also undergone refinement in line with the avoid, minimise, mitigate and manage hierarchy.

Some of the key design considerations implemented for the Exploratory Works Project include:

- Locating Exploratory Works Project components in previously disturbed areas (e.g. grazing paddocks) and utilising existing roads and access tracks in the first instance to avoid sensitive environmental values such as the following, wherever practicable:
  - TECs and vegetation within 50 m of TECs
  - habitat for threatened species
  - riparian vegetation
  - steep slopes and
  - in-stream habitats.
- Minimising additional disturbance to sensitive environmental values through restricting the Exploratory Works Project footprint to the areas required to undertake the works in a safe and efficient manner and:
  - co-locating Exploratory Works Project infrastructure and activities with the proposed Borumba PHES Project footprint
  - utilising alternative methods and equipment for geotechnical investigations such as drilling multiple boreholes from a single drill pad and transporting equipment on sled tracks down steep terrain
  - utilising alternative methods for exploratory tunnel excavation (i.e. diamond probe drilling ahead of drill and blast activities)
  - utilising a submersible pump (with a float) design for raw water extraction (ahead of a fixed pump) and direction drilling for pipeline crossings of Yabba Creek (ahead of laying the pipeline on the creek bed)
  - utilising bridges for crossings (ahead of bed-level crossings) at Yabba Creek and Sandy Creek.

In preparation for the Exploratory Works, Queensland Hydro has destocked cattle from its property, which will remove the threat of habitat disturbance from cattle grazing and trampling in the future.

Following this process, mitigation and management measures have been designed to firstly avoid impacts on MNES and their habitats and secondly, where impacts are unavoidable, to minimise direct and indirect impacts on MNES. The scale and extent of the mitigation measures in this FFMP are reflective of the extent to which the target species may occur within the Exploratory Works Project footprint.

Section 6.1 outlines general flora and fauna management measures that will be implemented to avoid and minimise and mitigate impacts to threatened flora and fauna and their associated habitat.

Additional control measures have been developed, where required, for MNES identified in Section 6.2. Similarly, additional control measures for species listed under the NC Act are summarised in Appendix F.

6.1 General flora and fauna management measures

The following strategies, as described in further detail below, will be implemented across the Exploratory Works Project footprint for the duration of Exploratory Works Project activities:

- hygiene protocols
- pre-clearance surveys
- micro-siting
- establishment of restricted areas such exclusion zones and ‘buffer zones, including fauna exclusion fencing
- sequential clearing method
- unexpected threatened species finds procedure
- weed management
- vehicle operation and management.

Site personnel will be made aware of the other management plans that have been developed for the Exploratory Works Project, as relevant management/mitigation measures and corrective actions could be defined in these documents.

Flora and fauna management measures that address specific impacts are summarised in Table 11.

6.1.1 Hygiene protocols

It is critical that new or existing weeds (such as *Lantana camara* and *Sporobolus pyramidalis*) are not introduced and spread into unaffected areas, especially the transfer of weeds from the Exploratory Works Project footprint into surrounding national parks, State forests and pastoral properties. Whilst invasive weeds are the primary focus for these hygiene controls, various pests and diseases have also been listed as threatening processes for the threatened flora and fauna species identified within the Exploratory Works Project study area, and therefore also require effective management where necessary.

The following hygiene protocols will be implemented across the Exploratory Works Project to help avoid the spread of weeds, pests and diseases:

- vehicles and machinery are to be washed down at an appropriate washdown facility regularly during works, especially when transferring between dirty areas and clean areas and when working in areas where weed or pathogen infestations are known. A washdown bay will be provided on site and the location will be clearly identified for all personnel to use.
- vehicles and machinery are to be certified weed free before commencing work on site (via Weed Hygiene Declarations)
- clothing, shoes and other equipment are to be cleaned regularly between activities, especially when leaving an area and starting work in a new area, and before leaving known weed infested areas
- soil, gravel or fill from infected areas should not be moved to uncontaminated areas, unless absolutely necessary
- appropriate waste disposal system: strategies or facilities to contain contaminated materials and disposal away from adjacent native vegetation and waterways
- training and inductions are to be provided for contractors and workers about the importance of pest and weed control, including a briefing on appropriate hygiene measures
- decontamination practices will be implemented for all personnel upon entering the site, when working within a known contaminated area within the site, and prior to exiting the contaminated area. To reduce the transfer of weed vegetation, seed, mud or soil material, the following decontamination procedure at washdown bays is recommended:
  - position vehicle/equipment safely and ensure stability (i.e. brakes applied)
  - remove excessive debris (i.e. mud, branches) for appropriate disposal using a dry-cleaning method before wet where possible (e.g. scrape off mud before pressure hose applied)
  - detach/removal items or parts and decontaminate individually as required
  - start top-down of vehicle or equipment
  - vehicles and equipment with moving parts (i.e. wheels, trays, buckets) will need to be removed to access all areas.
  - the use of a wet decontamination procedure may also be required, which involves the application of disinfectant/detergent and leave for appropriate contact time (usually 10 minutes) then rinse with clean water.
  - if other techniques (e.g. heat, fumigation for tools, equipment and other things) are required, ensure exposure requirements are met as required by disease/pest guidelines.

6.1.2 Pre-clearance surveys

Pre-clearance surveys will be undertaken by a suitably qualified ecologist and/or a FSC with the aim to:

- identify, map and mark out known and newly identified threatened flora records within the exploratory works project footprint
- identify, map and mark out potential fauna breeding/roosting habitat trees
- identify, map and mark out tree hollows inhabited, or potentially inhabited by threatened species
- identify, map and mark out sap trees (with any type of sap scar)
- identify, map and mark out active roosts, nests and turtle nesting sites
- identify, map and mark out suitable habitat outside of the exploratory works project footprint for relocation of fauna and proposed actions for replacement of hollows (refer to Appendix D)
- identify, map and mark out evidence of threatened species presence within the exploratory works project footprint, including determination of the distribution and density of affected species.
- identify, map and mark out weeds
- identify, map and mark out flora populations infected by Myrtle rust
- identify, map and mark out restricted areas such as exclusion zones
- inform micro-siting of the works
- advise construction contractors as to best practice approach to avoiding impacts on breeding places and fauna species.

Trees with hollows will be spray-painted with a different symbol and/or colour to quickly identify the relevant matter, e.g. breeding/roosting habitat tree for a particular species.

Where not in use and where possible, hollows will be 'blocked' to prevent entry of the hollow for breeding. The suitably qualified FSC must be satisfied that the installation will not trap any wildlife in the structure and be regularly inspected and maintained to prevent injury to wildlife or wildlife re-entry.

Within one week of commencing construction activities, a suitably qualified FSC will begin relocating fauna. This will be done to reduce the overall risk of injury or fatality to species during clearing activities and will focus on active nests and roosts within the Exploratory Works Project footprint. Fauna relocation will involve relocating active nests/roosts and any individuals including dependent young/eggs to identified suitable habitat outside of the Exploratory Works Project footprint.

Immediately prior to any clearing, a suitably qualified FSC will check areas for presence of any native fauna (i.e. reptiles under fallen logs), and breeding places (i.e. nests and burrows). Infrared-drones will be used in certain areas to detect greater gliders and koalas. Micro-siting as discussed below will be implemented and where this is not possible, fauna and breeding places encountered will be relocated or otherwise managed in accordance with the species specific requirements.

If within the footprint, the suitably qualified FSC will monitor the breeding place until the individuals have moved out of the area of their own accord or the breeding site is relocated in accordance with permit conditions, or as otherwise directed by the suitably qualified FSC. The location of relocated breeding places and fauna will depend on the location of suitable habitat (for each species) and will factor in the anticipated carrying capacity of recipient sites. The location of the breeding place and release point for fauna will be recorded and where necessary an exclusion zone established, with this to be recorded in the relevant register and depicted on the relevant maps.

6.1.3 Micro-siting

Works will be micro-sited to minimise clearing of:

- known records of threatened plants
- newly identified threatened plant records
- dense overhanging riparian vegetation, where possible
- hollow-bearing trees, particularly large hollow-bearing trees >50 cm DBH where possible
- koala feed trees, where possible

- large sap trees (V notched feeding trees), where possible.

Micro-siting will initially be informed by the pre-clearance survey works identified in Section 6.1.2, with clearing extents to be marked out onsite, in consultation with the principal contractor.

6.1.4 Restricted areas

Clearing boundaries to be applied to site works will align with the Exploratory Works Project footprint determined based on the current design and construction methodology.

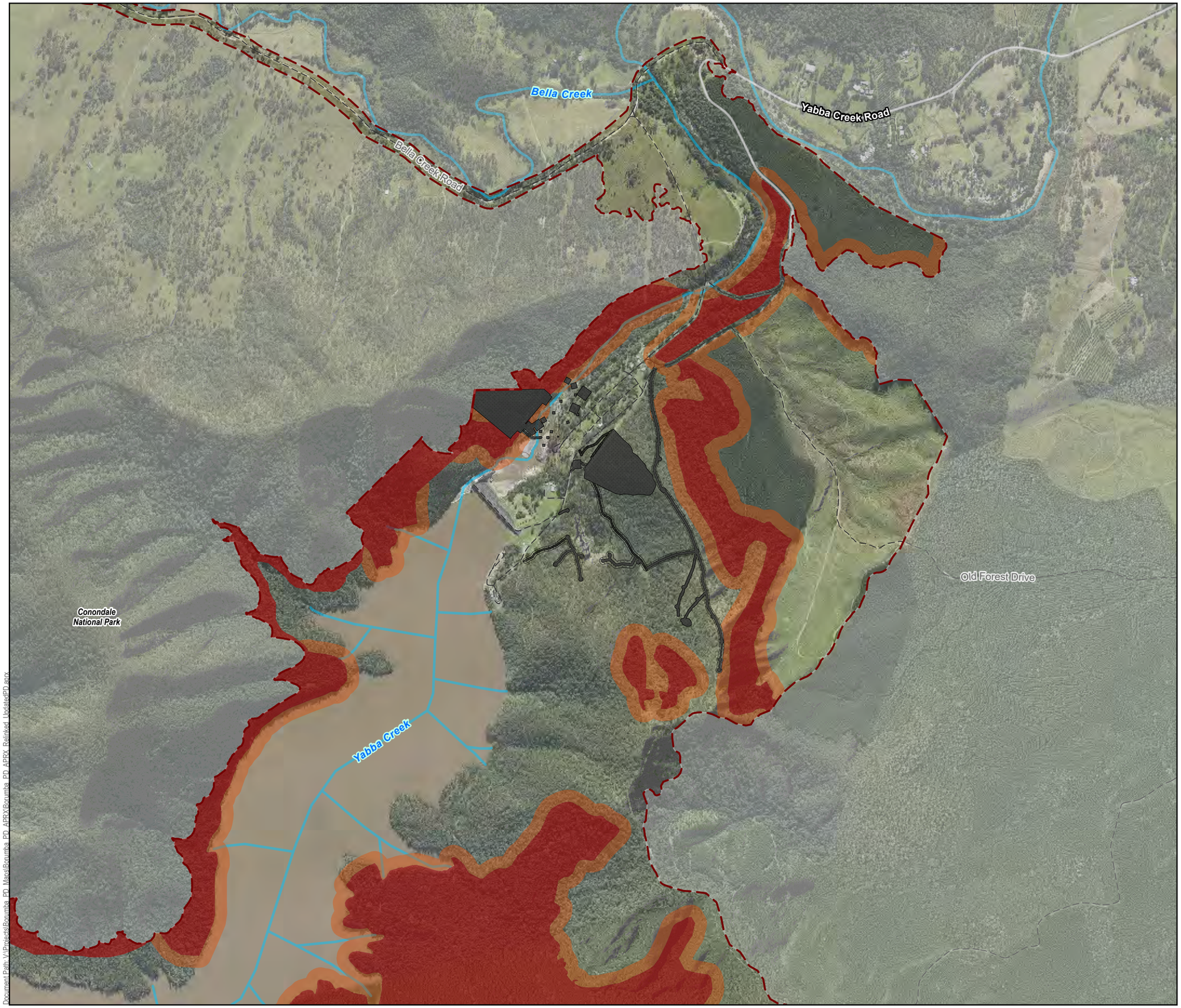
Restricted areas such as exclusion and buffer zones will be established as part of the Exploratory Works zones is to protect MNES and their habitat in the vicinity of the Project footprint. These zones are shown in Figure 4 and defined as follows:

- Exclusion zones – Areas where no Project works, including clearing, will occur. They comprise areas of national park, sections of Conondale Resources Reserve lots where no works are proposed, and areas with specific values such as TECs, known populations of native guava and *Coleus torrenticola*, and their 'known' habitat, within the Borumba PHES Survey area.
- Buffer zones – Areas where clearing is preferably avoided or, if unavoidable, to be minimised. They comprise TEC buffer zones and areas with known populations of scrub turpentine and brush sophora and their 'known habitat' within the Borumba PHES Survey area.

Other restricted areas, including exclusion and buffer zones, are expected be established during the Exploratory Works in response to the outcomes of on-going site assessments and pre-clearance surveys. In addition to the protection of the environmental values associated with exclusion and buffer zones, restricted areas may also be established to protect or prevent the disturbance of culturally sensitive areas, existing contamination from past activities, breeding places for threatened species, trees containing koalas, areas beyond the limit of clearing, or other matters. For example, if a turtle nest is identified during a pre-clearance survey, a restricted area will be established around the nest to prevent access and implement protective measures in accordance with the FFMP.

Clearing boundary maps (hardcopy and soft copy) and georeferencing are to be provided to contractors and personnel will only be allowed on foot, on a limited case by case basis (i.e. to maintain the exclusion barrier), beyond the boundary of the exclusion zones.

Prior to the commencement of construction, flagging tape, barricade fencing, fluorescent markers, signage, or a combination of these measures will be installed to clearly delineate exclusion zones and clearing boundaries. This will avoid unnecessary clearing and ensure personnel and vehicle(s) stay within the approved Exploratory Works Project footprint, avoiding contravention of disturbance limits. Flagging tape, fencing, fluorescent markers and signage will be inspected daily and any damaged fencing, missing flagging tape or fluorescent markers will be repaired to ensure they remain in serviceable condition.



Queensland Hydro

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LEGEND

- Watercourses
- Local Roads
- State Controlled Roads

Exploratory Works Project

- Project Footprint
- Project Area
- Borumba PHES Survey Area
- Exclusion Zones
- Buffer Zones
- Beyond Borumba PHES Survey Area

Note: This figure shows exclusion and buffer zones for the Exploratory Works Project only. These zones are not relevant the Main Works Project.

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland



Data Sources:
1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
3. Watercourses © State of Queensland (Department of Natural Resources, Mines and Energy) 2022
4. Cadastre © State of Queensland (Department of Natural Resources, Mines and Energy) 2024
5. Basemap World Light Gray Canvas Base @ Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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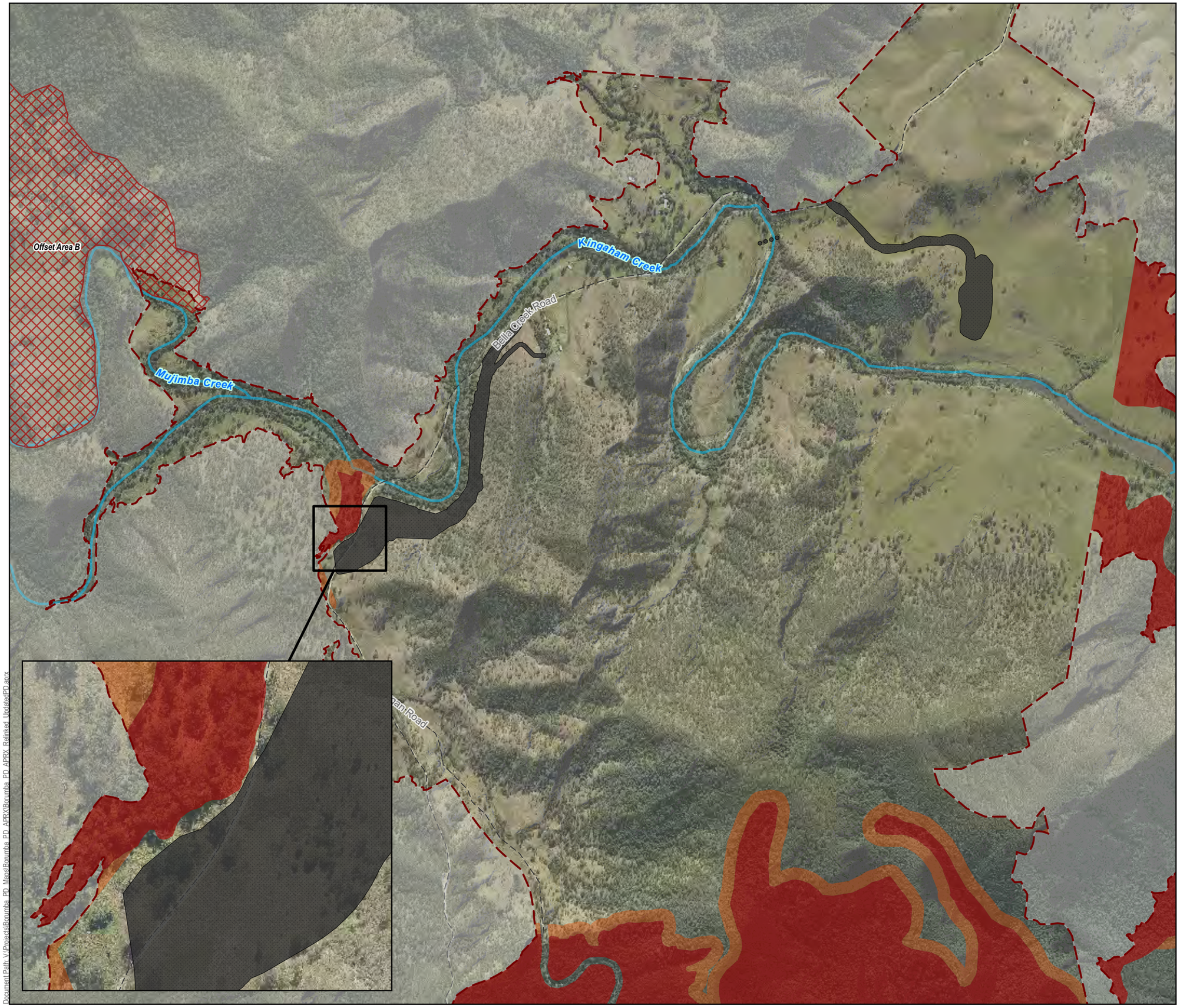
Exploratory Works Project
Preliminary Documentation

EXCLUSION AND BUFFER ZONES (AREA 1 - BORUMBA DAM)

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 3/10/2025
REVISION:	B

FIGURE 4a

Document Path: V:\Projects\Borumba_PD_Maps\Borumba_PD_APRX\Borumba_PD_APRX_Relinked_UpdatedPD.aprx



Queensland Hydro

GDA2020 MGA Zone 56

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LEGEND

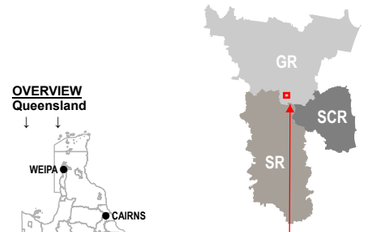
- Watercourses
- Local Roads

Exploratory Works Project

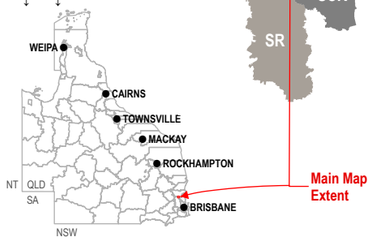
- Project Footprint
- Project Area
- Borumba PHES Survey Area
- Exclusion Zones
- Exclusion Zone (Offset Area)
- Buffer Zones
- Beyond Borumba PHES Survey Area

Note: This figure shows exclusion and buffer zones for the Exploratory Works Project only. These zones are not relevant the Main Works Project.

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland



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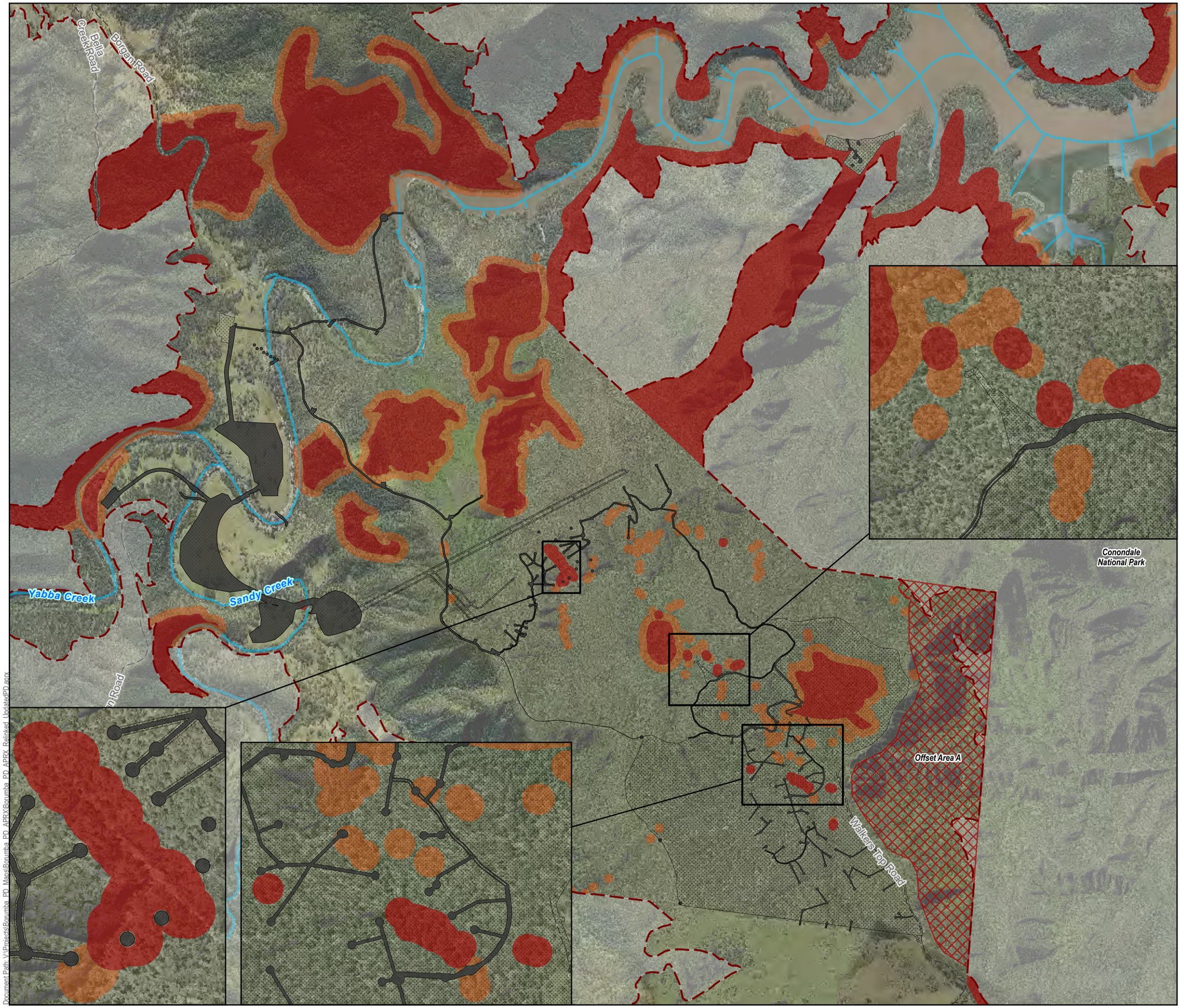
Exploratory Works Project
Preliminary Documentation

EXCLUSION AND BUFFER ZONES (AREA 2 - KINGAHAM CREEK)

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 3/10/2025
REVISION:	A

FIGURE 4b

Document Path: V:\Projects\Borumba_PD_Maps\Borumba_PD_APRX\Borumba_PD_APRX_ReLinked_Update\PD.aprx



Queensland Hydro

GDA2020 MGA Zone 56

0 300 600 m

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LEGEND

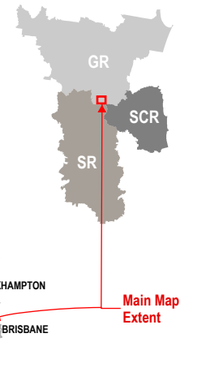
- Watercourses
- Local Roads

Exploratory Works Project

- Project Footprint
- Project Area
- Borumba PHES Survey Area
- Exclusion Zones
- Exclusion Zone (Offset Area)
- Buffer Zones
- Beyond Borumba PHES Survey Area

Note: This figure shows exclusion and buffer zones for the Exploratory Works Project only. These zones are not relevant the Main Works Project.

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland

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Exploratory Works Project
Preliminary Documentation

EXCLUSION AND BUFFER ZONES (AREA 3 - WALKERS TOP AND AREA 4 - BORGAN)

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LAST MODIFIED:	NC17428, 3/10/2025
REVISION:	A

FIGURE 4c

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6.1.5 Fauna exclusion fencing

6.1.5.1 Ground-dwelling terrestrial fauna

Fauna exclusion fencing will be installed at the civil construction compound, where there is a high level of regular vehicle and plant activity and stockpiled materials that could be attractive as refuge sites that pose an ongoing safety risk to (primarily) terrestrial fauna (Figure 5).

As most of the works will occur in an area mapped as koala (*Phascolarctos cinereus*) habitat, fencing will align with the Koala Sensitive Design Guideline: A guide to koala-sensitive design measures for planning and development activities (DES, 2022). Best practice measures, which will be determined by the construction contractor, may include:

- Fencing material consisting of brick, metal sheeting, Perspex or timber fencing with no gaps between palings creates a smooth unclimbable surface to koalas
- Fencing supports and posts are located within the zone where koalas are being excluded, or they are fitted with a koala shield
- Unclimbable sheeting (metal or Perspex) 600 mm or greater in width is retrofitted to the fencing and gates to prohibit climbing by koalas. The top of the sheeting is 1.5 m from the ground to prohibit koalas jumping up and grabbing the fencing material above the sheeting
- Sheeting is fitted to fencing material at a height that is comfortable for a koala jumping from the fence to the ground. For example, 1.8 m high fencing should fit sheeting at 0.9 m to 1.5 m off the ground, not at the top of the 1.8 m high fence
- Fencing is flush with a cement edging on the ground or retrofitted with additional wire to prohibit erosion and washouts where gaps under the fence will allow egress by koalas
- Particular attention needs to be paid to gates to ensure it is not a point of entry for koalas, either when left open or where the gates provide gaps
- Fencing is installed with a skirt of chain mesh (permanent) or corflute (temporary) of minimum 1.0 m width, that is fixed to the base of the fence (up to 300 mm) with the remainder resting on the ground, prohibiting the pushing or digging under the fence by animals. This is particularly necessary where the ground is uneven, or undulating or temporary/construction fencing is erected
- Fencing has a 90 degree return of at least 50 m in length at the fencing boundaries to encourage koalas back into the bushland and not onto the road or other unsafe environment where the fence ends. Ideally the end of the return is angled back into the patch of habitat
- floppy top fencing – previously used in New South Wales (NSW Road and Maritime Services is now installing chain link with metal panel in preference to floppy-top fencing).
- Trees and shrubs are excluded from within 3 of the fence and tree canopies of trees adjacent to the fence are trimmed to remove links to tree canopies on the other side of the fence.

Fauna exclusion fencing will also likely follow the Queensland Government, Department of Transport and Main Roads Standard Drawing SD1603 (Koala Proof Fencing) (Appendix A).

Figure 6 shows the proposed locations of fauna exclusion fencing, as well as fencing around construction compounds and cattle exclusion fencing to be applied across the Exploratory Works Project.

Fauna exclusion fencing will be inspected and maintained as required.



Figure 5: Example of fauna exclusion fencing, including unclimbable sheeting on the habitat side of the fence



Queensland Hydro

GDA2020 MGA Zone 56

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LEGEND

Watercourses

Exploratory Works Project

Project Area by Work Area

- Area 3 - Walkers Top
- Area 3 - Walkers Top (Underground)
- Area 4 - Borgan

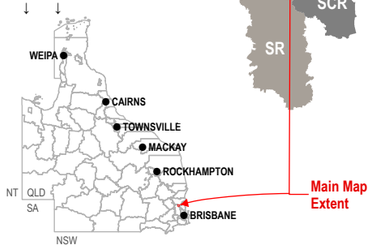
Fencing

- Barbed Wire
- Fauna Exclusion Fencing
- Standard Gate

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



OVERVIEW
Queensland



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Exploratory Works Project
Preliminary Documentation

FENCING
AREA 4 - BORGAN

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LAST MODIFIED:	NC17428, 1/10/2025
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FIGURE
6a

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Queensland Hydro

GDA2020 MGA Zone 56

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LEGEND

Watercourses

Exploratory Works Project

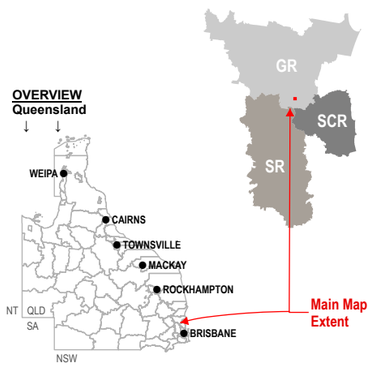
Project Area by Work Area

Area 1 - Borumba Dam

Fencing

Temporary Construction Fencing

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



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Exploratory Works Project
Preliminary Documentation

FENCING
AREA 1 - BORUMBA DAM

PROJECT #:	30032677/30032772
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REVISION:	A

FIGURE
6b

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6.1.5.2 Aquatic fauna

The siting and the location of the f\watercourse crossings have aimed to avoid areas of known nesting/spawning habitat for threatened and conservation significant fauna, through the use of existing tracks and/or directional drilling under the watercourse or stringing over the watercourse.

In the first instance, construction works for the Exploratory Works Project will target avoidance of breeding periods for the aquatic species identified in this plan, noting that due to the number of species present, breeding periods cover the majority of the year. Where this is not practicable due to project scheduling or design constraints, mitigation measures will be implemented, including:

- Review the time of year and assess which species have the potential to be breeding
- Conduct pre-clearing surveys to determine whether breeding is occurring for any species. This will include inspection for burrows, fresh turtle tracks, etc.
- No bank disturbance will be undertaken until a suitably qualified person has checked the banks for threatened fauna and fauna burrows in the direct construction area. Inspections of the creeks upstream will also be conducted for a minimum of 30 m upstream and downstream.

Identified nesting areas will be fenced prior to the nesting season. Any active turtle nests identified during pre-clearance surveys will be mapped and marked out. An exclusion zone around the instream works will prevent personnel, vehicles and machinery from approaching active turtle nests. Nests will also be protected from predators by fixing 70-100 cm plastic or wire mesh covers with 5-10 cm grid-size over nests, which will be kept in place with turf pegs, tent pegs or something suitably similar (Figure 7, (DAWE, 2020)). The nest will be positioned in the centre of the mesh. The plastic mesh covers will prevent predators from burrowing, while allowing emerging hatchlings to pass through the mesh. Mesh covers over turtle nests are regularly used in conservation efforts and are proven to be effective at protecting them from predators.

Fauna exclusion fencing (Figure 9) appropriate for turtles will be installed perpendicular to the water's edge along the banks between instream works areas and nesting reaches. This will minimise safety risks to threatened turtle species by preventing turtles from accessing the construction areas.

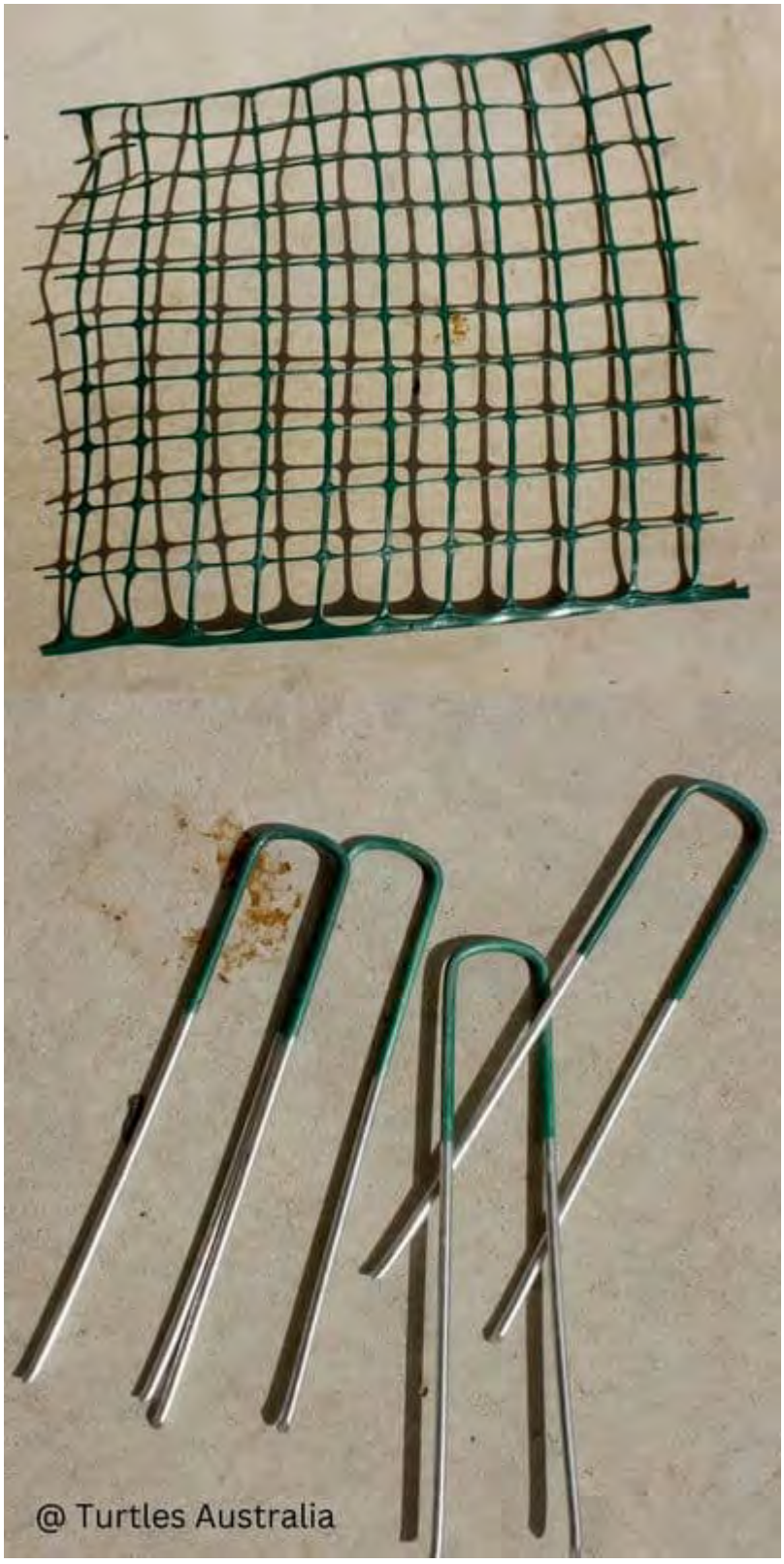

Figure 7: Plastic mesh and pegs that can be used to protect turtle nests from predators



Figure 8: Turtle nest protection installation method (Greening Australia, 2015)



Figure 9: Example of turtle exclusion fencing

6.1.6 Sequential clearing method

The intent behind sequential vegetation clearing is to provide any remaining threatened fauna a safe avenue through which they can self-relocate during clearing operations. Ideally these avenues should be connected to surrounding suitable habitat, however for fragmentated landscapes it could just be into an area with no operational activities. The suitably qualified FSC on site will be made aware of any vegetation clearance and maintenance activities to ensure that a pre-clearance survey is undertaken to identify the most appropriate clearing direction.

All machinery used must be able to fell or remove vegetation in a controlled manner (i.e. any machinery that simply fells trees without any ability to control the velocity in which vegetation impacts the ground should not be used). Ideally, an excavator should be used in the first stage of clearing to remove the undergrowth vegetation. Communication via a two-way radio should be maintained between the FSC and excavator operator at all times during clearing activities. This is essential in the event the FSC needs to capture any fauna that has been disturbed from the clearing operations but also from a health and safety perspective for the FSC.

Where habitat trees have been identified by the FSC and where safe to do so, hollows and nests will be inspected using a cherry picker, elevated work platform, tree climber or drone for presence of fauna prior to any clearing (a certified arborist may be required on site to help facilitate this process).

Sequential clearing will be implemented in accordance with the Nature Conservation (Koala) Conservation Plan 2017, including the following:

- Clearing of vegetation must be undertaken in a manner that allows fauna to move out of the clearing area of their own accord
- Where a site is less than three hectares, qualified ecologist and a licensed FSC will ensure that:
  - Clearing will be undertaken in a staged manner which ensures fauna are provided enough time to move out of the site without human intervention
  - any tree in which a koala is present, or has a crown overlapping a tree where a koala is present, is not cleared until the koala is confirmed to have moved out of the clearing area
  - appropriate habitat links are maintained within the clearing site and between the site and its adjacent areas, to allow animals living on the site to move out of the site
- If the clearing area if greater than 3 ha the following will be undertaken:
  - clearing will be carried out in stages
  - if less than 6 ha, no more than 50% of the area will be cleared in one stage
  - if more than 6 ha, no more than 3 ha or 3% of the area (whichever is the greater) will be cleared in one stage
- Between each stage and the next there is at least one period of 12 hours (starting at 6pm on a day and ending at 6am on the following day) during which no trees are cleared on the site; and
- While the clearing is being undertaken, the clearing must be carried out in a way that ensures appropriate habitat links are maintained within the area being cleared and the adjacent area to ensure any animals occupying the site can safely move off of the site; and
- Any tree in which a koala is present, or has a crown overlapping a tree where a koala is present, is not cleared until the koala is confirmed to have moved out of the clearing area. Only sick or injured koalas will be moved as the process of relocation is stressful and can cause the koala to become sick.

Under Part 3, Section 11 of the Koala Conservation Plan, a person that is undertaking clearing in a koala habitat area (refer to 3.1) that involves the clearing of koala habitat trees with a trunk diameter of more than 10 centimetres at 1.3 metres above the ground, must ensure the clearing is carried out in the presence of a koala spotter. This requirement must be complied with irrespective of any approvals or exemptions offered under other legislation.

Additionally, clearing will be undertaken in the following manner:

- Trees will be felled away from retained areas of vegetation. Where trees unavoidably fall into retained areas, they will be left in-situ to mimic natural tree fall and provide habitat for ground-dwelling fauna
- Micro-habitats (i.e., hollow logs and branches, rocks) where practicable, will be moved into adjacent habitat.
  - Trees with hollows suitable for targeted threatened fauna (refer to Appendix D) will be cleared using the following actions:

- Procedures will be put in place to ensure impacts are minimised through retention of the hollow-bearing trees or nesting places for another 24-48 hours while adjacent trees are cleared. This will provide opportunity for species to vacate the area overnight. Where physically practical, the FSC will check trees to ensure the animals have vacated.
- If animals have vacated the hollows, where practicable these should be sealed off to prevent the animals from returning to the hollow.
- If targeted threatened fauna is located within a hollow, if the animal can be safely removed, the FSC will obtain the animal in a safe and ethical manner and retain in a crate in a cool, quiet location until dusk when it will be released into suitable habitat, preferably in close proximity to where the animal was identified (unless unsafe to do so)..
- Once the hollow entrance has been secured, if practicable to do so the entire hollow can be removed below the cavity where the tree or tree limb remains solid. To prevent damaging the hollow, it will be carefully lowered to the ground.
- Any harvested hollow limbs found to contain fauna will be placed in a cool, quiet location until dusk when the hollow entrance can be re-opened to allow fauna to emerge on their own.
- Trees with small hollows should be cleared using the “slow drop” method. Before clearing, the trunk will be tapped softly to encourage any remaining threatened fauna to leave the hollows. This will be repeated several times. The tree will then be brought down slowly by the machine and mulch put underneath to soften the fall. The FSC will then complete an inspection to ensure no threatened fauna remain in the hollow.
- Where practicable, threatened fauna (and other fauna) will be caught and released into suitable habitat as soon as possible. The release of relocated fauna will depend on the location of suitable habitat (for each species) and will factor in the anticipated carrying capacity of recipient sites. The location of the release point for fauna will be recorded and where necessary an exclusion zone established, with this to be recorded in the relevant register and depicted on the relevant maps.
-
- Hollows acquired will be inspected by a suitably qualified person for integrity and dimensions, salvaged and installed on suitable trees in accordance with Offset Area Management Plan and the hollow replacement strategy in Appendix D.

The suitably qualified FSC will monitor for any injured threatened fauna or abandoned offspring, Injured fauna will handled in accordance with the Code of Practice—Care of sick, Injured or Orphaned Protected Animals in Queensland (Department of Environment and Science, 2020), including any onsite triage and transportation to established wildlife hospitals such as those at Eumundi or Beerwah or taken to Queensland and/or taken them to the nearest local vet/wildlife carer listed in Table 10 for treatment.

Woody debris, hollow logs and rock piles will be retained for use in rehabilitation wherever possible. Locations where hollows and other habitat features are relocated (temporary and/or permeant) are to be recorded and entered into the relevant register.

Table 10: Contact details for care of injured wildlife

Business	Contact details
Wildlife Rehabilitation Centre at Eumundi	1411 Eumundi Noosa Rd, Eumundi QLD 4562 (07) 5442 8057
ANARRA	288 Greendale Rd, Glastonbury QLD 4570 (07) 5484 9111
Sunshine Coast Vets	13 Reserve Street, Pomona QLD 4568 (07) 5485 0088
Kenilworth Veterinary Surgery	(07) 5472 3085
Wildcare Emergency Hotline	(07) 5527 2444
Wildlife Volunteers Association Inc (WILVOS)	(07) 5441 6200

Australia Zoo Wildlife Hospital	Wildlife emergency hotline: 1300 369 652 Phone: +61 7 5436 2097

6.1.7 Unexpected threatened species finds procedure

Pre-clearance surveys will be undertaken by a suitably qualified ecologist and will include identification of conservation significant flora and fauna within the Exploratory Works Project footprint. If an unexpected conservation significant flora or fauna species is identified within the footprint for an activity during site works, the procedure described below will be followed. The unexpected threatened species finds procedure has been adapted from the Biodiversity Guidelines: Protecting and managing biodiversity on road and traffic authority projects[2].

An impact assessment consistent with impact assessments in the Preliminary Documentation will be completed for any new unexpected threatened species identified during the Exploratory Works Project. The FFMP and CEMP will also be updated to address management of the species with consideration given to relevant threats to the species and the potential impacts of the Exploratory Works Project. This may include consideration of additional offsets for SRIs to any threatened species found that have not previously been identified during surveys for the Exploratory Works Project.

Stop work and hold point

- Personnel to notify Site Supervisor and other workers in the immediate area.
- Site Supervisor to notify the Environmental Manager.
- Environmental Manager to notify the Client and Project Ecologist / Fauna Spotter Catcher.
- Stop Exploratory Works Project activities within 100 m of the record.

Fence off and redirect

- Site Supervisor to demarcate and prevent access to the area to reduce impact on the threatened species and redirect works to an alternate area where practicable.

Record and assess

- Environmental Manager to arrange for ecologist to complete a significant impact assessment and develop management options including options to avoid clearing.
- If a significant impact is likely or the species is a new find for the Exploratory Works Project, consult with DCCEEW and DETSI. Obtain relevant approvals, licences, or permits as required.
- If a significant impact is not likely / impacts can be avoided, implement management measures and controls as recommended by the ecologist.

Release hold point

- If a significant impact is likely, only resume once advice is sought and necessary approvals, licences and permits are obtained, and once the Environmental Manager deems the site is safe to commence work and releases the hold point.
- If a significant impact is not likely to occur, recommence work and maintain regular inspections once management measures and controls are removed and the Environmental Manager deems the site is safe to work in and releases the hold point.

Monitor and inform

- Maintain regular inspections for threatened species.
- Relevant information on the species will be included in the induction and a toolbox talk will be given to discuss the outcome.

[2] Roads and Traffic Authority (RTA) New South Wales (NSW) (2011) Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects. New South Wales Government. Retrieved from https://www.dcceew.gov.au/sites/default/files/env/consultations/86a0e23b-c4b0-466c-8b61-4403ea27436c/files/e2021-0190-biodiversity-guidelines-rta.pdf

Report

- Environmental Manager to record and document the unexpected find.
- The Exploratory Works Project Ecologist will prepare an impact assessment in the Preliminary Documentation (PD) for the species if it was deemed likely to have a significant impact. Regardless of whether the impact was deemed likely or not likely, the Exploratory Works Project Ecologist will include species descriptions and management measures for the threatened species in the CEMP. The FFMP will also be reviewed and amended as required.
- Should any *Macadamia* spp. be identified during the course of the works, the observation will be reported to the Macadamia Conservation Trust, to allow the Trust to map the individual(s). In the case of clearing, the Trust will be permitted to take cuttings for propagation and relocation of that genotype as a mitigation action.

6.1.8 Weed management

Pre-clearance surveys will identify weeds. High risk weeds (weeds that are present within the Exploratory Works Project area and are easily spread, such as rat's tail grasses (including *Sporobolus fertilis, Sporobolus natalensis* and *Sporobolus pyramidalis*) and Cat's claw creeper *(Dolichandra unguis-cati*)) and areas with large infestations will be treated prior to clearing.

Weed species listed in Section 4.1.4 will be appropriately managed.

Only herbicides approved by Seqwater will be used, and herbicides will only be used by appropriately trained and qualified personal with an approved Safety Data Sheet to be listed in the CEMP.

Herbicides will not be used to treat weeds where the Exploratory Works Project footprint overlaps with TECs and/or the TEC buffer zones, as spray drift from weed management has been identified as a threat to TEC survival. For areas where the Exploratory Works Project footprint overlaps with a TEC or a TEC buffer zone, weeds in these areas will be managed through alternative methods (i.e. mechanical removal or manual removal by hand).

Queensland Hydro will regularly inspect access tracks and Exploratory Works Project areas for the presence of any new weed species. If new weeds are observed, management actions will be implemented to minimise their dispersal around the Exploratory Works Project footprint and hygiene controls will be reviewed.

Any fill brought in for works or transferred within the works area must be free of invasive plant material.

A Weed and Pathogens Register will be developed and maintained by Queensland Hydro for the duration of the Borumba PHES Project to record weed species present and weed control activities undertaken.

Biosecurity management will be undertaken in accordance with the Obligations of the Biosecurity Act and the Borumba PHES Project's Biosecurity Management Plan, including appropriate disposal of weed material.

6.1.9 Vehicle operation and management

Site vehicle access will be restricted to existing roads and tracks once access tracks are in place.

All vehicles will travel at slow speeds (40 km/h) through the site. Additional speed reductions will be implemented around construction compounds.

Speed limit signage will be placed at the entrance to the site and other key access tracks. Wildlife crossing warning signs and wildlife threshold markings will be installed along access roads and tracks in accordance with the *Queensland Manual of Uniform Traffic Control Devices – Part 2: Traffic control devices for general use* (TMR, 2023).

Vehicles will be prohibited from idling or parking in areas of long grass and tyres will be regularly cleaned to reduce wheel entrained dust emissions or consider use of vibration grids.

A temporary vehicle washdown facility is in place at the Borgan site compound. Proprietary wheel wash systems and washdown bays will be constructed at each the Borgan and Yielo Road Access Control points (not part of the EPBC controlled action).

6.1.10 Summary of general management measures

Table 11 summarises general flora and fauna management measures that will be implemented across the Exploratory Works Project.

The flora and fauna management measures described in Table 11, which include measures such as hygiene protocols, pre-clearance surveys, fauna fencing, micro-siting, progressive clearing, weed management, erosion and sediment control, and vehicle management measures, are all standard mitigation measures regularly implemented successfully across a wide range of construction activities (including Exploratory Works) to manage, mitigate, and minimise impacts on the environment. Their effectiveness at mitigating environmental impacts is well established and referred to in a range of MNES Conservation Advice, guidelines, and policies under the EPBC Act. In this regard, their effectiveness as suitable and appropriate mitigation measures is well understood and there is minimal risk in their implementation or success as mitigation measures.

Table 11: General flora and fauna management measures

Impact	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria[3]	Monitoring	Trigger for corrective action	Corrective actions
Habitat loss / vegetation clearing	• Construction Manager • Environmental Manager • Ecologist • Fauna Spotter Catcher	• Restrict clearing to the minimum necessary to complete the works • Pre-clearance surveys: – Known threatened species records to be demarcated on site as early as possible – To occur a minimum of 30 m upstream and downstream of creeks prior to bank or instream disturbance • Clearly mark the boundaries of the 50 m buffer zone around all patches of TEC • Micro-siting, exclusion buffer zones – Riparian areas near work areas will be marked as either exclusion or buffer zones • Standing dead trees and stags with hollows, or deeply fissured or cracked bark, will be retained where possible unless they are a safety or fire hazard.	• No exceedance of clearing limits for flora/ fauna habitat or TECs through Exploratory Works Project timeframes. • All works undertaken in Conondale Resources Reserve are in accordance with the relevant Queensland Parks and Wildlife Service (QPWS) permit. • No incursion/clearing in exclusion or buffer zones, unless authorised. • Rehabilitation of geotechnical investigation works area is undertaken where clearing has occurred and the area is not proposed for further work during main works • Clearing in accordance with the approval conditions associated with protected plant clearing permit.	• Post-clearance report of vegetation clearing limits • Monitoring will be undertaken daily during clearing then at least fortnightly during operations to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • Visual inspections noting: – evidence of dust deposition on plants – plant health generally (evidence of dead/dying individuals, flowering, seeding, etc) – evidence of disturbance/ maintenance of buffers and exclusion zones • Daily inspection of TECs next to works areas. • Quarterly internal audit. • Yearly audit.	• Exceeding clearing limits for flora/ fauna habitat or TECs. • Unauthorised incursion/clearing in exclusion zones and 'buffer zones. • No/delayed rehabilitation of geotechnical investigation works areas.	• Develop and apply an adaptive management protocol which allows for adaptation of management measures as long as milestone/completion criteria are still met. • Inspect and repair damaged fencing or signage; replace any flagging tape or respray fluorescent marker. • Review clearing methods using the adaptive management approach mentioned in point 1 and update as required to minimise the potential for reoccurrence. • Once geotechnical investigation works are complete, the area will be rehabilitated in accordance with the Decommissioning and Rehabilitation Strategy and maintained and monitored until the rehabilitation works have reached a self-sustaining stage. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Action any identified non-conformance within 7 days of identification.
	• Sequential clearing method where possible – All clearing activities will be overseen by a suitably qualified FSC	• No significant impact to any additional MNES fauna species which can be directly attributable to the Exploratory Works Project (excludes MNES fauna which are likely to be significantly impacted by the Exploratory Works Project). • No additional impact on already identified MNES	• Daily inspections and monitoring of clearing activities will be undertaken to ensure clearing has been undertaken in approved boundaries and limits. • Visual inspections noting: – evidence of dust deposition on plants – plant health generally (evidence of dead/dying individuals, flowering, seeding, etc)	• Significant impact on additional MNES fauna species which can be directly attributable to the Exploratory Works Project • Additional impact on already identified MNES	• Develop and apply an adaptive management protocol which allows for adaptation of management measures as long as milestone/completion criteria are still met. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Review clearing methods using the adaptive management approach mentioned in point 1 and update as required to minimise the potential for reoccurrence.

[3] Performance criteria referring to 'significant impact' on MNES has the same meaning as 'significant impact' defined in the Significant Impact Guidelines 1.1 – MNES.

Impact	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria[3]	Monitoring	Trigger for corrective action	Corrective actions
				– evidence of disturbance/ maintenance of buffers and exclusion zones • Daily inspection of TECs next to works areas. • FSC will keep a record of any fauna relocated during clearing activities. • Quarterly internal audit. • Yearly audit.		• Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Any fauna injuries or deaths are required to be reported firstly to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. The cause of injury or death will be investigated, and any required changes will be implemented. • Any injured fauna should be taken to the nearest suitable vet or wildlife carer for treatment. • Action any identified non-conformance within 7 days of identification.
		• Unexpected threatened species finds procedure (see section 6.1.7)	• No newly identified MNES flora in the footprint are cleared. • No significant impact to any additional MNES fauna species which can be directly attributable to the Exploratory Works Project (excludes MNES fauna which are likely to be significantly impacted by the Exploratory Works Project).	• Quarterly internal audit. • Yearly audit.	• Newly identified MNES flora in the footprint are cleared. • Significant impact on additional MNES fauna species which can be directly attributable to the Exploratory Works Project	• Implementation of the unexpected threatened species finds procedure • If any new threatened species not discussed in this FFMP are identified, works will cease immediately, and DETSI and DCCEEW will be notified and this FFMP will be updated to incorporate additional mitigation and management measures as required. • Action any identified non-conformance within 7 days of identification.
		• Waterway crossings – Designing and constructing waterway crossings in accordance with Riverine Protection Permit expectations (though exemptions from the need to obtain the permit may be available) and waterway barrier works approval or Accepted Development Requirements, as appropriate. This includes bridges, piling pads, bed level crossings, culvert crossings and potentially pipe crossings – Stabilising or progressively rehabilitating cleared areas near waterways as soon as possible. – Isolating instream work areas before instream works begin. – Establish exclusion and buffer zones around works. – Bailey bridges will be designed to minimise changes to water depth,	• No significant impact to any additional MNES fauna species which can be directly attributable to the Exploratory Works Project (excludes MNES fauna which are likely to be significantly impacted by the Exploratory Works Project).	• Monitoring will be undertaken to ensure restricted areas are appropriately demarcated and signage remains in serviceable condition. • Visual inspections noting: – evidence of dust deposition on plants – plant health generally (evidence of dead/dying individuals, flowering, seeding, etc) – evidence of disturbance/ maintenance of buffers and exclusion zones.	• Restricted area fencing and signage in not in serviceable condition • Decrease in plant health from dust deposition. • Disturbance within buffers and exclusion zones. • Significant impact on additional MNES fauna species which can be directly attributable to the Exploratory Works Project	• Inspect and repair any damaged restricted area fencing; replace any flagging tape or respray fluorescent marker. • If plant health is impacted by dust, increase dust management measures e.g. water carts and assess the need for rehabilitation works • if clearing has extended outside the approved disturbance limits, a record must be taken of the incident and an investigation leading to corrective action will occur. • Action any identified non-conformance within 7 days of identification.

Impact	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria[3]	Monitoring	Trigger for corrective action	Corrective actions
		velocity and flow, preserving aquatic habitat – Temporary piling pads for bridge construction will be installed in a manner that maintains fish passage through the waterway – Bed level crossings will be designed to avoid vertical drops between upstream and downstream reaches, avoiding barriers to movement. – Disturbed areas will be rehabilitated post-construction.		• Daily inspection of TECs next to works areas. • Quarterly internal audit. • Yearly audit.		
		• Destocking cattle to remove impacts associated with trampling and grazing	• Cattle removed from site and fencing installed to prevent re-entry	• Maintain regular inspections for cattle. • Quarterly internal audit. • Yearly audit.	• Cattle observed within site • Fencing damaged or not installed to prevent re-entry.	• Attract cattle with lick, molasses and salt and relocate them into nearby cattle yards.
Injury or mortality	• Construction Manager • Environmental Manager • Fauna Spotter Catcher	• Pre-clearance surveys – To occur within 30 m upstream and downstream of riparian clearing activities. – Active breeding or nesting sites will be marked and mapped. • Sequential clearing where possible • Undertake a pre-start toolbox at commencement of works to inform the work party of potential threatened species presence in the area • If a threatened species is sighted within 50 m of vegetation clearing activities: – Stop clearing works until a suitably qualified ecologist or FSC is consulted and advises on next steps. – Animal to be left to self-disperse or unless otherwise directed by FSC. – Undertake a pre-start toolbox with workers to inform the work party of threatened species presence in the area. – EPBC species specific requirements are provided in Table 12 • If a threatened species is sighted within 50 m of a non-vegetation clearing activity: – Notification is to be provided to the environmental officer which shall include, GPS / general location, adjacent work operations and any movement observations (is it stagnant, moving direction etc). Visual monitoring of the animal shall occur until advised by environmental officer. – Based on ongoing risk from proposed works and animal	• No incursion/clearing in exclusion and buffer zones, unless authorised. • No injury or mortality to threatened fauna species • No significant impact to any additional MNES fauna species which can be directly attributable to the Exploratory Works Project (excludes MNES fauna which are likely to be significantly impacted by the Exploratory Works Project).	• FSC will keep a record of any fauna relocated during clearing activities. • Quarterly internal audit. • Yearly audit.	• Unauthorised incursion/clearing in exclusion and buffer zones. • Injury or mortality to threatened fauna species. • Significant impact on additional MNES fauna species which can be directly attributable to the Exploratory Works Project	• Review incident to confirm cause and review site protocols and update as required to minimise the potential for reoccurrence. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes. • Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. • Erect temporary fauna exclusion fencing with signage • Action any identified non-conformance within 7 days of identification.

Impact	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria[3]	Monitoring	Trigger for corrective action	Corrective actions
		behaviour, environmental officer may request works stop. Works shall recommence following advice from a suitably qualified ecologist or FSC. – Undertake a pre-start toolbox with workers to inform the work party of threatened species presence in the area. • Works within riparian systems will be conducted outside of the breeding season of aquatic species, where possible.				
		• Fauna exclusion fencing (refer to Figure 6) • Fauna exclusion fencing specific to turtles and the giant barred frog will be installed around instream and riparian zones, preventing access to construction areas. – Daily inspections of fenced areas within riparian areas to identify adult or hatchling turtles and giant barred frogs.	• No injury or mortality to threatened fauna species • No significant impact to any additional MNES fauna species which can be directly attributable to the Exploratory Works Project (excludes MNES fauna which are likely to be significantly impacted by the Exploratory Works Project).	• Maintain regular inspections of fauna exclusion fencing. • Quarterly internal audit. • Yearly audit.	• Injury or mortality to threatened fauna species. • Significant impact on additional MNES fauna species which can be directly attributable to the Exploratory Works Project	• Review incident to confirm cause and review site protocols and update as required to minimise the potential for reoccurrence. • Repair damaged fauna exclusion fencing. • Action any identified non-conformance within 7 days of identification.
		• Vehicle operation and management – All vehicles associated with clearing and construction activities will travel at slow speeds to minimise the chance of any fauna strikes occurring. – Speed limit signage will be placed at the entrance to the site and other key access tracks. – Signage to be erected notifying users of species observed in the area. – Undertake a prestart toolbox with workers to inform the work party of presence of animals in the area – Vehicles will only traverse bed level crossings when low flows permit, allowing visual inspection of any conservation significant aquatic fauna species present – Where individuals are present, vehicles will not traverse the bed level crossing until the individual moves upstream/downstream. – No off-track driving permitted, reducing accidental harm.	• No injury or mortality to threatened fauna species • No significant impact to any additional MNES fauna species which can be directly attributable to the Exploratory Works Project (excludes MNES fauna which are likely to be significantly impacted by the Exploratory Works Project).	• Vehicle speed limits will be monitored and enforced. • Quarterly internal audit. • Yearly audit.	• Injury or mortality to threatened fauna species. • Significant impact on additional MNES fauna species which can be directly attributable to the Exploratory Works Project	• Review incident to confirm cause and review site protocols and update as required to minimise the potential for reoccurrence. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes. • Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. • Action any identified non-conformance within 7 days of identification.
Reduced air quality	• Construction Manager • Environmental Manager	• Dust suppression – Areas which have potential to generate airborne dust will be wetted down regularly or covered wherever practicable. • Environmental management and reinstatement	• No identified nuisance dust reported.	• Daily dust suppression will be implemented as required. • Monitor dust levels and effectiveness of mitigation measures. • Monitor weather daily.	• Complaint received in relation to dust. • Evidence of dust deposition on plants causing health impacts to individual plants. • Decrease in plant health via evidence of	• Increase frequency of dust suppression if dust nuisance is observed by site construction or environmental manager or if a complaint is received. • Action any identified non-conformance within 7 days of identification.

Impact	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria[3]	Monitoring	Trigger for corrective action	Corrective actions
		– Any areas where Exploratory Works activities are completed and no longer required including geotechnical investigation sites will be reinstated as soon as practicable and allowed to naturally regenerate. – Spraying of herbicides, aerosols and other chemicals to be undertaken in suitable weather conditions (i.e. low wind speed).		• Visual inspections noting: – evidence of dust deposition on plants – plant health generally (evidence of dead/dying individuals, flowering, seeding, etc) – evidence of disturbance/ maintenance of buffers, and exclusion zones • Visual inspections for plants well removed from disturbance areas will be weekly or monthly, decided by the ecologist. • Visual inspections for TECs at the work front will be on the daily inspection checklist. • Quarterly internal audit. • Yearly audit.	dead/dying individuals, irregular growth, leaf desiccation, leaf drop. • Evidence of disturbance within buffers and exclusion zones.	• Review incident to confirm cause and review site protocols and update as required to minimise the potential for reoccurrence.
		• Vehicle operation and management – Low speed limits will be implemented across the Exploratory Works footprint to minimise dust generation. – Machinery and vehicle tyres will be regularly cleaned to reduce wheel entrained dust emissions or consider use of vibration grids.	• No significant impact to any additional MNES fauna species which can be directly attributable to the Exploratory Works Project (excludes MNES fauna which are likely to be significantly impacted by the Exploratory Works Project).	• Vehicle speed limits will be monitored and enforced. • Quarterly internal audit. • Yearly audit.	• Significant impact on additional MNES fauna species which can be directly attributable to the Exploratory Works Project	• Increase frequency of dust suppression if dust nuisance is observed by site construction or environmental manager or if a complaint is received. • Action any identified non-conformance within 7 days of identification. • Review incident to confirm cause and review site protocols and update as required to minimise the potential for reoccurrence.
Noise and vibration	• Construction Manager • Environmental Manager • Fauna spotter catcher	• Undertake works outside of breeding periods specified for relevant species, where possible. Where not possible, the following will be implemented in relation to noise and vibration impacts: – Minimise noise and vibration during night hours. – Review the time of year and assess which threatened species have the potential to be breeding. – Conduct pre-clearance surveys to determine whether breeding is occurring for any species. If an active breeding site of a listed threatened species is identified during pre-clearance surveys, the suitably qualified FSC will map and mark out the location of the breeding site.	• No impact to breeding site unless otherwise approved within 200 m of works. • No significant impact to any additional MNES fauna species which can be directly attributable to the Exploratory Works Project (excludes MNES fauna which are likely to be significantly impacted by the Exploratory Works Project).	• Monitor noise and vibration levels during construction where there is potential for works to impact a known breeding place. • FSC will keep a record of any fauna relocated during drilling/blasting activities. • Quarterly internal audit. • Yearly audit.	• Unapproved impact to known breeding place within 200 m of works. • Significant impact on additional MNES fauna species which can be directly attributable to the Exploratory Works Project	• If a noise or vibration exceedance of acceptable limits is observed, an investigation will be undertaken to determine what additional controls can be put in place or if alternative methods can be implemented, under the guidance of the suitably qualified FSC. • Action any identified non-conformance within 7 days of identification. • Review incident to confirm cause and review site protocols and update as required to minimise the potential for reoccurrence.

Impact	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria[3]	Monitoring	Trigger for corrective action	Corrective actions
		– Use the smallest machinery required to safely complete the work. – No blasting or other high intensity vibratory works (i.e. piling) will be undertaken within 200 m of known active breeding sites during breeding seasons for threatened species specified in Table 12 unless otherwise approved by an experienced ecologist. – The breeding site potentially impacted by noise or vibration shall be inspected by the suitably qualified FSC during the works to confirm they are not having an adverse impact on the breeding place. If within the footprint, the suitably qualified FSC will monitor the breeding place until the individuals have moved out of the area of their own accord or the breeding site is relocated in accordance with Rehabilitation/Damage Mitigation Permit conditions, or as otherwise directed by the suitably qualified FSC. – Where shallow tunnelling is necessary, activities will be temporary (i.e., under 1 month duration) and/or transition to deeper depths where vibration will no longer impact species. Dampening fences will be installed at sites expected to generate significant noise (i.e. drilling and tunnelling sites).				
Light emissions	• Construction Manager • Environmental Manager	• Construction hours – Construction activities will be limited to daytime hours wherever practicable; especially for instream works. • Lighting design and requirements – Minimal lighting will be required around buildings at night. – Lighting will be designed in accordance with the National Light Pollution Guidelines for Wildlife (DCCEEW, 2023). This includes directional lighting (shielding where possible), limiting blue, violet or ultraviolet lights, limiting intensity and managing timing where possible. – Orange or amber-hued lighting will be required for night work sites instead of bright white lights, where safety allows.	• No impact to breeding sites within 50 m of works. • No significant impact to any additional MNES fauna species which can be directly attributable to the Exploratory Works Project (excludes MNES fauna which are likely to be significantly impacted by the Exploratory Works Project).	• Monitor light levels during construction where there is potential for works to impact threatened fauna species or known breeding places. • Quarterly internal audit. • Yearly audit.	• Impact to known fauna breeding sites within 50 m of works. • Significant impact on additional MNES fauna species which can be directly attributable to the Exploratory Works Project	• Review direction, timing, shielding and type of lights where levels are deemed to be above acceptable limits. • Action any identified non-conformance within 7 days of identification. • Review incident to confirm cause and review site protocols and update as required to minimise the potential for reoccurrence.

Impact	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria[3]	Monitoring	Trigger for corrective action	Corrective actions
Surface water and groundwater	• Construction Manager • Environmental Manager	• Implement the CEMP and associated management plans including: – Erosion and Sediment Control Management Plan – Groundwater Monitoring and Management Plan (to be developed) – Spoil Management Plan. • Water quality risks will be managed through controls for: – Erosion and sedimentation – Weed and pest species – Leaks and spills of hazardous material and waste • Water management infrastructure will be implemented to capture and treat potentially contaminated water from tunnelling and associated spoil activities, including: – A water treatment plant to treat water to relevant environmental standards, including for release into the Yabba Creek catchment – Basins to store and separate dirty and clean water, mitigating the risk of accidental discharge to the environment.	• All works are undertaken in accordance with the: – CEMP – Erosion and Sediment Control Management Plan – Water Management Plan – Spoil Management Plan. • No significant impact to any additional MNES fauna species which can be directly attributable to the Exploratory Works Project (excludes MNES fauna which are likely to be significantly impacted by the Exploratory Works Project).	• As per the: – CEMP – Erosion and Sediment Control Management Plan – Water Management Plan – Spoil Management Plan.	• Works are not undertaken in accordance with the: – CEMP – Erosion and Sediment Control Plan – Water Management Plan – Spoil Management Plan.	• Corrective actions as per the: – CEMP – Erosion and Sediment Control Plan – Water Management Plan – Spoil Management Plan. • Review incident to confirm cause and review site protocols and update as required to minimise the potential for reoccurrence.
Hazardous materials	• Construction Manager • Environmental Manager	• Implement the CEMP and associated management plans including: – Waste Management Plan – Spoil Management Plan.	• No release of contaminants and hazardous material to receiving environment	• As per the: – CEMP – Waste Management Plan – Spoil Management Plan.	• Release of contaminants and hazardous material to receiving environment	• Corrective actions as per the: – CEMP – Waste Management Plan – Spoil Management Plan. • Review incident to confirm cause and review site protocols and update as required to minimise the potential for reoccurrence.
Erosion and sedimentation	• Construction Manager • Environmental Manager	• Implement the CEMP and Erosion and Sediment Control Plan.	• No significant impact to any additional MNES fauna species which can be directly attributable to the Exploratory Works Project (excludes MNES fauna which are likely to be significantly impacted by the Exploratory Works Project).	• Daily weather observation checks to identify high-risk rain events. • As per the: – CEMP – Erosion and Sediment Control Management Plan.	• Works are not undertaken in accordance with the Erosion and Sediment Control Plan • Significant impact on additional MNES fauna species which can be directly attributable to the Exploratory Works Project	• Corrective actions as per the: – CEMP – Erosion and Sediment Control Plan. • Review incident to confirm cause and review site protocols and update as required to minimise the potential for reoccurrence.
Bushfire	• Construction Manager • Environmental Manager	• Site management – Smoking is not permitted on site. – Fuel loads across the Exploratory Works will be monitored and appropriately managed through activities such as weed management, slashing and low intensity burns. – Access tracks, fence lines and cleared overhead powerline	• Conformance with hot-work risk assessments. • No unactioned items associated with weekly visual monitoring.	• Monthly assessment of fuel loads will be undertaken during the construction on the Exploratory Works Project. • During construction phase and bushfire season, the fire danger status will be monitored	• Non-conformance with hot-work risk assessments • Bushfire started as a direct result of works.	• If fuel loads have increased following heavy rainfall, control methods will be implemented as required (i.e. weed control or cool burns). • Prescribed burns are to be conducted based on present fuel load and ecosystem. • Action any identified non-conformance within 7 days of identification.

Impact	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria[3]	Monitoring	Trigger for corrective action	Corrective actions
		easements will be maintained and used as firebreaks. – For "hot-work" activities, a risk assessment will be completed considering forecast weather, fire hazard ratings and site conditions. • Vehicle operation and management – Vehicles may not idle or be parked in areas of long grass. • Implement the Bushfire Management Plan and Site Emergency Response Plan outlined in the CEMP in the event of an uncontrolled fire.		daily through the Rural Fire Service website. • As per the Bushfire Management Plan and Site Emergency Plan outlined in the CEMP. • Quarterly internal audit. • Yearly audit.		• Review incident to confirm cause and review site protocols and update as required to minimise the potential for reoccurrence. • Review Bushfire Management Plan and Site Emergency Response Plan outlined in the CEMP and update as required to minimise the potential for reoccurrence.
Pest, weeds and disease	• Construction Manager • Environmental Manager	• Develop and implement a site wide biosecurity management plan • Weed management, such as pre-clearance surveys to identify weeds and treating infestations prior to clearing to reduce the spread of weed and seed. • Site vehicle access will be restricted to existing roads and tracks.	• No introduction and establishment of WoNS and Restricted plants listed under the Biosecurity Act during Exploratory Works Project. • Weed hygiene declarations and certificates. • No new infestations of pests attributable to the Exploratory Works Project.	• Active Weed Register will be developed and maintained for the duration of the Exploratory Works Project. • Weekly environmental inspection tracking. • Weed Hygiene Declaration to be checked for all material brought onto site. • Quarterly internal audit. • Yearly audit.	• During the course of the Exploratory Works Project, weeds are introduced and/or become established in areas where they were previously not observed. • New infestations of pest fauna species directly attributable to the Exploratory Works Project.	• Ensure biosecurity measures such weed washdown, monitoring of machinery movement between high biosecurity risk areas is being monitored and managed. Action any identified non-conformance within 7 days of identification. • Review weed control measures to confirm cause and review protocols and update as required to minimise the potential for reoccurrence.
		• Training and inductions to be provided to employees and contractors on weed spread, risks and management procedures. • Implement biosecurity hygiene protocols e.g. weed certification of vehicles entering site, use of vehicle washdown procedures • Site vehicle access will be restricted to existing roads and tracks.	• No introduction and establishment of weeds (particularly crofton weed, lantana and mistflower) during Exploratory Works Project timeframes. • Weed hygiene declarations and certificates. • No new infestations of pests attributable to the Exploratory Works Project.	• Regular auditing of Hygiene Control implementation. • Quarterly internal audit. • Yearly audit.	• During the course of the Exploratory Works Project, weeds are introduced and/or become established in areas where they were previously not observed. • New infestations of pest fauna species directly attributable to the Exploratory Works Project.	• Increase Hygiene Control requirements if vehicles or equipment are likely to introduce or spread new weeds or facilitate the spread of disease. • Action any identified non-conformance within 7 days of identification. • Review hygiene control measures to confirm cause and review protocols and update as required to minimise the potential for reoccurrence.
		• Implement the Waste Management Plan including regularly removing waste (especially food waste) from site.	• No new infestations of pests attributable to the Exploratory Works Project.	• As per the Waste Management Plan. • Quarterly internal audit. • Yearly audit.	• New infestations of pest fauna species directly attributable to the Exploratory Works Project.	• Implement additional pest fauna management measures where controls do not appear to be adequate. • Action any identified non-conformance within 7 days of identification. • Review waste management procedures to confirm cause and update as required to minimise the potential for reoccurrence.
		• Implement the Biosecurity Management Plan that will outline appropriate thresholds for management action linked to the level of activity of pest animals. The plan	• No new infestations of pests attributable to the Exploratory Works Project.	• As per the Biosecurity Management Plan. • Quarterly monitoring of cameras.	• New infestations of pest fauna species directly attributable to the Exploratory Works Project.	• Review and update the Biosecurity Management Plan if evidence of increased predation or pests is observed.

Impact	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria[3]	Monitoring	Trigger for corrective action	Corrective actions
		will include measures for trapping and controlling pest animals in accordance with relevant threat abatement plans. • Installing 70 – 100 cm plastic or wire mesh covers with a 5-10 cm grid size over identified Mary River turtle and White-throated snapping turtle nests – Mesh to be secured to prevent predator access but grant passage to hatchlings.		• Install cameras along access tracks to monitor pest fauna traffic. • Quarterly internal audit. • Yearly audit.		• Implement additional pest fauna management measures where controls do not appear to be adequate. • Action any identified non-conformance within 7 days of identification.
National Park	• Construction Manager • Environmental Manager	• No works within the Conondale National Park. Works are limited to within the Conondale Resources Reserves and in accordance with the conditions of any Authority issued by the QPWS.	• All works undertaken under QPWS permit for Conondale Resources Reserve. • No exceedance of clearing limits. • No incursion/clearing in exclusion zones.	• Ensure National Park boundaries are clearly defined and marked as no-go areas. • Quarterly internal audit. • Yearly audit.	• Works are undertaken within Conondale National Park. • Exceedance of clearing limits within Conondale Resources Reserve. • Incursion/clearing in exclusion zones.	• Ensure the restrictions on National Park access are included and communicated in site inductions and start-up meetings. • Action any identified non-conformance within 7 days of identification. • Review access restrictions and clearing procedures to confirm cause and update as required to minimise the potential for reoccurrence.

6.2 Specific management measures – EPBC Species

Table 12 outlines specific management measures related to each MNES that will be implemented to avoid and minimise and mitigate impacts to EPBC listed flora, fauna and threatened ecological communities. These measures have been developed using known habitat requirements, threats known to be present in the study area and available published literature.

The MNES avoidance and management measures described in Table 9, which include measures such as avoidance, minimising impacts, hygiene protocols, pre-clearance surveys, exclusion and fauna fencing, micro-siting, progressive clearing, weed management, erosion and sediment control, and vehicle management measures, are all standard avoidance and mitigation measures regularly implemented successfully across a wide range of construction activities (including Exploratory Works) to manage, mitigate, and minimise impacts on the environment. Their effectiveness at mitigating environmental impacts is well established and referred to in a range of MNES Conservation Advice, guidelines, and policies under the EPBC Act. In this regard, their effectiveness as suitable and appropriate mitigation measures is well understood and there is minimal risk in their implementation or success as mitigation measures.

References are provided for avoidance and mitigation measures that are not mentioned in relevant Conservation Advice, guidelines or policies citing their likelihood of effectiveness. In particular, references citing the effectiveness of supplementary hollows for gliders and Glossy black-cockatoo are provided in the hollow mitigation strategy.

Table 12: Specific management measures for EPBC Act listed matters

MNES	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria	Monitoring	Trigger for corrective action	Corrective actions
Threatened ecological communities						
Lowland Rainforest of Subtropical Australia	• Construction manager, site/project engineer, environmental management representative	• Apply a 50 m buffer zone to all patches of TEC to protect the root zone of edge trees and protect the TEC from Exploratory Works activities. • Establish an exclusion/buffer zones around the Exploratory Works Project footprint within the buffer zone and at the boundaries of the 50 m buffer zone around all patches of TEC near the Exploratory Works Project footprint. • Actively monitor and manage weeds (avoiding spraying herbicides) adjacent to Exploratory Works activities. • Ecologist to be present where infrastructure is being established in and adjacent to TEC patches to ensure that works are micro-sited and activities avoid clearing TEC vegetation.	• No incursion/clearing in exclusion or buffer zones, , unless authorised.. • No exceedance of clearing limits through Exploratory Works Project timeframes. • Weed hygiene of machinery maintained and recorded through declarations and certificates.	• Monitoring will be undertaken to ensure exclusion/buffer zones fencing and signage remains in serviceable condition. • Visual inspections noting: – evidence of dust deposition on plants – plant health generally (evidence of dead/dying individuals, flowering, seeding, etc) – evidence of disturbance/ maintenance of buffers and exclusion zones. • Daily inspection of TECs next to works areas prior to works commencing, during works and after works are completed.	• Unauthorised incursion/clearing in exclusion/buffer zones. • Exceedance of clearing limits (Table 7) through Exploratory Works Project. • Introduction and establishment of WoNs and Restricted plants listed under the Biosecurity Act in the TEC during Exploratory Works Project.	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Action any identified non-conformance within 7 days of identification.
Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland	• Construction manager, site/project engineer, environmental management representative	• Apply a 50 m buffer zone to all patches of TEC to protect the root zone of edge trees and protect the TEC from Exploratory Works activities. • Establish an exclusion/buffer zones around the Exploratory Works Project footprint within the buffer zone and at the boundaries of the 50 m buffer zone around all patches of TEC near the Exploratory Works Project footprint. • Actively monitor and manage weeds (avoiding spraying herbicides) adjacent to Exploratory Works activities. • Ecologist to be present where infrastructure is being established in and adjacent to TEC patches to ensure that works are micro-sited and activities avoid clearing TEC vegetation.	• No incursion/clearing in exclusion zones, unless authorised. • No exceedance of clearing limits through Exploratory Works Project timeframes. • Weed hygiene declarations and certificates.	• Monitoring will be undertaken to ensure exclusion/buffer zones fencing and signage remains in serviceable condition. • Visual inspections noting: – evidence of dust deposition on plants – plant health generally (evidence of dead/dying individuals, flowering, seeding, etc) – evidence of disturbance/ maintenance of buffers and exclusion zones. • Daily inspection of TECs next to works areas prior to works commencing, during works and after works are completed.	• Unauthorised incursion/clearing in exclusion/buffer zones. • Exceedance of clearing limits (Table 7) through Exploratory Works Project timeframes. • Introduction and establishment of WoNs and Restricted plants listed under the Biosecurity Act in the TEC during Exploratory Works Project.	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Action any identified non-conformance within 7 days of identification.
Threatened flora						
Native guava (*Rhodomyrtus psidioides*)	• Site/project engineer, environmental management representative	• Myrtle rust management – Installing exclusion/buffer zones around populations adjacent to the Exploratory Works Project footprint infected by myrtle rust to	• No incursion/clearing in exclusion zones or buffer zones, unless authorised. • No exceedance of clearing limits	• Monitoring will be undertaken to ensure exclusion/buffer zones fencing and signage remains in serviceable condition. • Daily visual inspections of records next to works areas	• Unauthorised incursion/clearing in exclusion/buffer zones. • Exceedance of clearing limits (Table 9) • No clearing of newly identified MNES flora.	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Increase Hygiene Control requirements if vehicles or

MNES	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria	Monitoring	Trigger for corrective action	Corrective actions
Scrub turpentine (*Rhodamnia rubescens*)		avoid contaminating clothing, vehicles, machinery or equipment. – Hygiene protocols to prevent spread to areas outside the Exploratory Works Project footprint. – Annual fungicide treatment regime for plants in or within 50 m of the Exploratory Works Project footprint. – Gather and store seeds (if available) to secure genetic diversity for future populations.	• No newly identified MNES flora in the footprint are cleared. • Clearing in accordance with the approval conditions associated with protected plant clearing permit. • Weed hygiene declarations and certificates.	noting plant health generally (evidence of myrtle rust infection if not previously identified, dead/dying individuals, flowering, seeding, etc).		equipment are found to spread disease. • Action any identified non-conformance within 7 days of identification.
Brush sophora (*Sohpora fraseri*) Native guava (*Rhodomyrtus psidioides*) Scrub turpentine (*Rhodamnia rubescens*) *Coleus torrenticola* Ball nut (*Floydia praealta*)	• Site/project engineer, environmental management representative	• Establish exclusion and buffer zones as appropriate at least 30 m from known records or around the Exploratory Works Project footprint where the species is recorded to avoid accidental clearing and minimise indirect impacts.	• No incursion/clearing in exclusion or 'buffer zones, unless authorised. • No exceedance of clearing limits. • No newly identified MNES flora in the footprint are cleared. • Clearing in accordance with the approval conditions associated with protected plant clearing permit.	• Monitoring will be undertaken to ensure exclusion/buffer zones fencing and signage remains in serviceable condition. • Daily visual inspections of records next to works areas noting: – evidence of dust deposition on plants – plant health generally (evidence of dead/dying individuals, flowering, seeding, etc) – evidence of disturbance/ maintenance of buffers and exclusion zones.	• Unauthorised incursion/clearing in exclusion or buffer zones. • Exceedance of clearing limits (Table 9). • Clearing of newly identified MNES flora. • Introduction and establishment of WoNs and Restricted plants listed under the Biosecurity Act during Exploratory Works Project timeframes.	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Action any identified non-conformance within 7 days of identification.
Austral toadflax (*Thesium australe*) Blotched sarcochilus (*Sarcochilus weinthalii*) Hairy-joint grass (*Arthraxon hispidus*) Nightcap coleus (*Coleus nitidus*) Quassia (*Samadera bidwillii*)	• Site/project engineer, environmental management representative	• Update significant impact assessment if records of these species are found during pre-clearance surveys. • Establish exclusion/buffer zones at least 30 m from known records, if they are identified in pre-clearance surveys, or around the Exploratory Works Project footprint where the species is recorded to avoid accidental clearing and minimise indirect impacts.	• No incursion/clearing in exclusion/buffer zones, unless authorised. • No exceedance of clearing limits. • No newly identified MNES flora in the footprint are cleared. • Clearing in accordance with the approval conditions associated with protected plant clearing permit.	• Monitoring will be undertaken to ensure exclusion/buffer zones fencing and signage remains in serviceable condition. • Daily visual inspections of records next to works areas noting: – evidence of dust deposition on plants – plant health generally (evidence of dead/dying individuals, flowering, seeding, etc) • evidence of disturbance/ maintenance of buffers and exclusion zones.	• Unauthorised incursion/clearing in exclusion/buffer zones. • Exceedance of clearing limits (Table 9) • Clearing of newly identified MNES flora. • Introduction and establishment of WoNs and Restricted plants listed under the Biosecurity Act during Exploratory Works Project timeframes.	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Action any identified non-conformance within 7 days of identification.
Threatened fauna – Birds						
Glossy black-cockatoo (*Calyptorhynchus lathami lathami*)	• Construction manager, site/project engineer, environmental management representative	• Minimise works in Glossy black-cockatoo habitat during the breeding period (March to September).	• No incursion/clearing in exclusion/buffer zones, unless authorised. • No exceedance of clearing limits	• Monitoring will be undertaken to ensure exclusion/buffer zones fencing and signage remains in serviceable condition.	• Unauthorised incursion/clearing in exclusion/buffer zones. • Exceedance of clearing limits (Table 8)	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker.

MNES	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria	Monitoring	Trigger for corrective action	Corrective actions
		• Pre-clearance surveys will identify, map and mark out large hollow-bearing trees and hollows that could be used or are actively used by Glossy black-cockatoos. • Where not in use hollows that meet the species' requirements will be 'blocked' to prevent breeding during Exploratory Works activities. When Exploratory Works activities are completed in the area, blocked hollows will be reopened as part of site reinstatement / rehabilitation activities. • Minimise clearing hollow-bearing trees and large trees (i.e. >50 cm DBH in case hollows are not visible). • Works around active breeding locations will be halted until the animals have moved on or individuals can be safely relocated in accordance with Rehabilitation/Damage Mitigation Permit conditions, or as otherwise directed by the suitably qualified FSC. • . Works will be moved to alternative locations if these options are not possible. • Trees with active breeding activities will be recorded in the Animal Breeding Place Register discussed in the Exploratory Works SMP and reported to the department as required. • Exclusion and/or buffer zones to be established around known active breeding sites. • Exclusion and/or buffer zones to be maintained until bird fledges. • Implement the hollow replacement strategy in Appendix D. • Any additional management measures outlined for this species in the SMP should also be implemented.	• Limited clearing of large hollow-bearing trees, identified during pre-clearance surveys. • No loss of individuals during the construction works • No displacement of breeding individuals during the construction works	• FSC will keep a record of any fauna relocated during clearing activities. • Monitoring replacement hollows as per Appendix D.	• Injury or death of individuals during the construction works • Displacement of breeding individuals during the construction works	• Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes. • Action any identified non-conformance within 7 days of identification.
Black-breasted button-quail, *Turnix melanogaster*	• Site/project engineer, environmental management representative	• Works will be undertaken outside of breeding periods (September to April-May), where possible. • The pre-clearance surveys are to include searches for	• No incursion/clearing in exclusion or buffer zones, unless authorised. • No exceedance of clearing limits • No loss of individuals during the construction works	• Monitoring will be undertaken to ensure exclusion/buffer zones fencing and signage remains in serviceable condition.	• Unauthorised incursion/clearing in exclusion or buffer zones. • Exceedance of clearing limits (Table 8) • Injury or death of individuals during the construction works	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record

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		black-breasted button-quail ground nests. • Clearing will be carried out sequentially which will include the use of a FSC and retention of potential nesting habitat overnight to allow individuals to move on their own accord. This process will significantly mitigate potential impacts associated with clearing provided that procedures are followed and spotters are allowed ample opportunity to check areas prior to construction. Potential nest sites will be marked and inspected for the presence. • Lantana control at forest edge margins of areas known or likely to support black-breasted button-quail will be minimised, with clearing in these areas using a staged approach that will aim to remove lantana over several phases. • Healthy individuals will be captured and released, while any injured birds will be taken to a vet for treatment. • Staff will be educated on the potential presence of black-breasted button-quail. • Off-track driving will not be permitted and reduced speed limits will be enforced near suitable habitat, with appropriate signage on site. • Exclusion and/or buffer zones to be established around known active breeding sites. Exclusion and buffer zones to be maintained until bird fledges, unless otherwise directed by the suitably qualified FSC.		• FSC will keep a record of any fauna relocated during clearing activities.		must be taken of the incident and an investigation will occur. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes. • Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. • Action any identified non-conformance within 7 days of identification.
Australian painted snipe (*Rostratula australis*) Coxen's fig-parrot (*Cyclopsitta diophthalma coxeni*)	• Site/project engineer, environmental management representative	If any Australian painted snipe or Coxen's fig-parrot are recorded during pre-clearance surveys the following actions will be undertaken: • significant impact assessments will be updated and provided to DCCEEW for approval. • Additional species-specific management measures will	• No incursion/clearing in exclusion and buffer zones, unless authorised. • No exceedance of clearing limits • No loss of individuals during the construction works.	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities.	• Unauthorised incursion/clearing in exclusion and buffer zones. • Exceedance of clearing limits (Table 8) • Injury or death of individuals during the construction works	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Temporarily disturbed areas that are no longer required to be cleared will be assessed

MNES	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria	Monitoring	Trigger for corrective action	Corrective actions
		be developed and added to this management plan. • Exclusion and/or buffer zones to be established around any active breeding sites within the Project area. Exclusion and/or buffer zones to be maintained until bird fledges, unless otherwise directed by the suitably qualified FSC.				for restoration and revegetation. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes. • Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. Action any identified non-conformance within 7 days of identification.
Threatened fauna – Mammals						
Greater glider, *Petauroides volans* Yellow-bellied glider (southern subspecies), *Petaurus australis australis*	• Construction manager, site/project engineer, environmental management representative	• Minimise works in glider habitat during the breeding period (spring – summer). • Pre-clearance surveys will identify, map and mark out large hollow-bearing trees, and hollows that could be used or are actively used by greater gliders and/or yellow-bellied gliders. • Where not in use, hollows that meet the species' requirements will be 'blocked' to prevent breeding during Exploratory Works activities. When Exploratory Works activities are completed in the area, blocked hollows will be reopened as part of site reinstatement / rehabilitation activities. • Additional pre-clearance for the yellow-bellied glider will include the mapping of all sap trees (with any type of sap scar) to account for the wide variety of sap groove patterns and aid in identifying suitable habitat for the species • For the greater glider, additional pre-clearance surveys employing the use of infrared-drone technology will be undertaken to identify greater glider individuals prior to the commencement of clearing. • Avoid clearing large trees (>30 cm DBH) and sap trees, where possible.	• No incursion/clearing in exclusion and buffer zones, unless authorised. • No exceedance of clearing limits • No loss of individuals during the construction works • Limited clearing of large hollow-bearing trees, identified during pre-clearance surveys.	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities. • Monitoring replacement hollows as per Appendix D.	• Authorised incursion/clearing in exclusion and buffer zones. • Exceedance of clearing limits (Table 8) • Injury or death of individuals during the construction works	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes. • Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. • Action any identified non-conformance within 7 days of identification.

MNES	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria	Monitoring	Trigger for corrective action	Corrective actions
		• Works around active breeding locations will be halted until the animals have moved on or individuals can be safely relocated in accordance with Rehabilitation/Damage Mitigation Permit conditions, or as otherwise directed by the suitably qualified FSC. • Trees with confirmed breeding activities will be recorded in the Animal Breeding Place Register discussed in the Exploratory Works SMP and reported to the department as required. • Establish exclusion and/or buffer zones around active breeding trees. Exclusion and buffer zones to be maintained until fauna disperse. • Implement the hollow replacement strategy in Appendix D. • Wherever possible, the use of barbed wire fencing will be avoided across the Exploratory Works. Any additional management measures outlined for this species in the SMP should also be implemented.				
Grey-headed flying-fox, *Pteropus poliocephalus*	• Construction manager, site/project engineer, environmental management representative	• Establish exclusion and buffer zones around Exploratory Works Project footprint to avoid accidental clearing of habitat. • If a camp / roost site is identified within the Exploratory Works footprint, operational activities in these areas are to cease immediately and DETSI/DCCEEW are to be notified immediately.	• No incursion/clearing in exclusion and buffer zones, unless authorised. • No exceedance of clearing limits. • No significant impact to grey-headed flying-fox as a result of the Exploratory Works Project	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition.	• Unauthorised incursion/clearing in exclusion and buffer zones. • Exceedance of clearing limits • Injury or death of individuals during the construction works • Significant impact to grey-headed flying-fox as a result of the Exploratory Works Project	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes. • Take any injured fauna to the nearest suitable vet or wildlife carer for treatment.

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						• Action any identified non-conformance within 7 days of identification.
Koala, *Phascolarctos cinereus*	• Construction manager, site/project engineer, environmental management representative	• Install fauna exclusion fencing around civil construction compound, explosives magazine store, and if required the portal pad and exploratory tunnel. • Pre-clearance surveys will identify, map and mark out evidence of koala presence. • Additional pre-clearance surveys employing the use of infrared-drone technology will be undertaken to identify koala individuals prior to the commencement of clearing. • A suitably qualified FSC will be present during clearing as per the *Nature Conservation (Koala) Conservation Plan 2017*. • Clearing in accordance with the sequential clearing method in Section 6.1.6, including allowing koalas to naturally move from the clearing footprint in preference to active relocation. • Exploratory Works Project activities will implement relevant measures and principles identified in the Koala Sensitive Design Guideline (DES, 2022).	• No incursion/clearing in exclusion or buffer zones, unless authorised. • No exceedance of clearing limits. • No loss of individuals during the construction works	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities.	• Unauthorised incursion/clearing in exclusion and buffer zones. • Exceedance of clearing limits • Injury or death of individuals during the construction works	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes. • Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. • Action any identified non-conformance within 7 days of identification.
Long-nosed potoroo (northern), *Potorous tridactylus tridactylus*	• Construction manager, site/project engineer, environmental management representative	• Minimise clearing of mature trees known to be associated with Mycorrhizal fungi – the preferred food of the long-nosed potoroo. • Pre-clearance surveys will identify potential and actively used breeding habitat. • Establish exclusion (and buffer zones around the Exploratory Works Project footprint and identified active breeding habitat. • Lantana control at forest edge margins of areas known or likely to support long-nosed potoroo will be minimised, with clearing in these areas using a staged approach that will aim to remove lantana over several phases. •	• No incursion/clearing in exclusion or buffer zones, unless authorised. • No exceedance of clearing limits. • No significant impact on native fauna populations directly attributable to the Exploratory Works Project	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities.	• Unauthorised incursion/clearing in exclusion and buffer zones. • Exceedance of clearing limits • Injury or death of individuals during the construction works	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury

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						or death and implement any required changes. • Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. • Action any identified non-conformance within 7 days of identification.
Northern quoll (*Dasyurus hallucatus*) Spotted tail quoll (SE mainland population), *Dasyurus maculatus maculatus*	• Construction manager, site/project engineer, environmental management representative	• Pre-clearance surveys will identify potential and active breeding habitat. • Establish exclusion and buffer zones around the Exploratory Works Project footprint and identified active fauna breeding habitat. • Clearing in accordance with the sequential clearing method in Section 6.1.6, including allowing quolls to naturally move from the clearing footprint in preference to active relocation. • Salvage and relocate large logs from clearing areas to adjacent habitat provide potential shelter sites and, if large enough, potential den sites (see Section 6.1.6).	• No incursion/clearing in exclusion and buffer zones, unless authorised. • No exceedance of clearing limits • No loss of individuals during the construction works • No significant impact on native fauna populations directly attributable to the Exploratory Works Project	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities. • Maintain regular inspections of fauna exclusion fencing.	• Unauthorised incursion/clearing in exclusion/buffer zones. • Exceedance of clearing limits • Injury or death of individuals during the construction works	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes. • Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. • Action any identified non-conformance within 7 days of identification.
Threatened fauna – Reptiles						
Mary River turtle, *Elusor macrurus* White-throated snapping-turtle, *Elseya albagula*	• Construction manager, site/project engineer, environmental management representative	• Avoid construction on creek banks with dense overhanging riparian vegetation, where possible to retain suitable breeding places. • Bridge design does not impede environmental flows, including any temporary works (i.e. conforms to the Accepted development requirements for operational work that is constructing or raising waterway barrier works (DAF, 2018). • Minimise instream and riparian works during breeding seasons (October to January for Mary River turtle, March to August for white-throated snapping turtle). • If it is not possible to undertake works outside breeding seasons, pre-clearance surveys upstream and downstream from the works area will identify, map	• No incursion/clearing in exclusion/buffer zones, unless authorised. • No exceedance of clearing limits. • No loss of individuals during the construction works • No destruction of nesting areas during the construction works • No significant impact on threatened aquatic fauna populations directly attributable to the Exploratory Works Project	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities. • Maintain regular inspections of fauna exclusion fencing.	• Unauthorised incursion/clearing in exclusion/buffer zones. • Exceedance of clearing limits (Table 8) • Injury or death of individuals during the construction works • Destruction of nesting areas during the construction works • Significant impact on threatened aquatic fauna populations directly attributable to the Exploratory Works Project	• Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes.

MNES	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria	Monitoring	Trigger for corrective action	Corrective actions
		and mark out turtle nesting sites. • No bank disturbance will be undertaken until a suitably qualified person has checked the banks for fauna and nesting sites. A minimum of 30 m upstream and downstream of creeks will be inspected. • Fauna exclusion fencing to be installed at creek banks around key nesting reaches and turtle nesting sites with areas to be maintained until turtles emerge which can exceed 80 days depending on weather conditions and disperse or they can be safely relocated. • Should turtle nests be found in areas at risk of disturbance, relocation by qualified and experienced freshwater turtle ecologists will be considered in accordance with best practice protocols and in consultation with DCCEEW, DETSI, Kabi Kabi, and other relevant stakeholders. • Erect physical structures (70-100 cm square plastic mesh covers, 5-10cm grid-size over nests) around key nesting reaches to prevent nesting turtles from accessing the construction areas. • Nesting banks are/will be fenced to reduce access and trampling by cattle and other fauna. • Establish exclusion and/or buffer zones around instream works to limit disturbance to the waterway. • Conduct daily inspections of fenced areas to inspect for adult and hatching turtles.				• Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. • Action any identified non-conformance within 7 days of identification.
Threatened fauna – Fish						
Australian lungfish, *Neoceratodus forsteri* Mary River cod, *Maccullochella mariensis*	• Construction manager, site/project engineer, environmental management representative	• Avoid construction on creek banks with dense overhanging riparian vegetation, where possible to retain suitable breeding places. • Where avoiding creek banks with dense overhanging riparian vegetation is not possible, clearing of this vegetation will be minimised	• No incursion/clearing in exclusion/buffer zones. • No exceedance of clearing limits • No loss of individuals during the construction works • No significant impact on threatened aquatic fauna populations directly	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities.	• Unauthorised incursion/clearing in exclusion/buffer zones. • Exceedance of clearing limits (Table 8) • Injury or death of individuals during the construction works • Significant impact on threatened aquatic fauna populations directly	• Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker.

MNES	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria	Monitoring	Trigger for corrective action	Corrective actions
		and preference given to trimming rather than complete removal in adjacent areas. • Bridge design does not impede environmental flows, including any temporary works (i.e. conforms to the Accepted development requirements for operational work that is constructing or raising waterway barrier works (DAF, 2018). • Design of works in the vicinity of waterways (e.g. bridges) will avoid direct impact to known breeding sites. • Conduct works during dry/low flow periods, where possible. • Minimise instream and riparian works during breeding seasons (August to December for Australian lungfish and August to October for Mary River cod). • If it is not possible to undertake works outside breeding seasons, pre-clearance surveys upstream and downstream from the works area will identify, map and mark out potential and active breeding habitat. • No bank disturbance will be undertaken until a suitably qualified person has checked the banks for suitable breeding places. A minimum of 30 m upstream and downstream of the Exploratory Works Project in creeks will be inspected. • Exclusion and/or buffer zones to be installed around active breeding places and around instream works to limit disturbance to the waterway. • Aquatic fauna salvage is to be undertaken during instream activities in accordance with the Department of Agriculture and Fisheries Guidelines for Fish Salvage factsheet.	attributable to the Exploratory Works Project		attributable to the Exploratory Works Project	• Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes. • Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. • Action any identified non-conformance within 7 days of identification.
Threatened fauna – Amphibians						

MNES	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria	Monitoring	Trigger for corrective action	Corrective actions
Giant barred frog, *Mixophyes iteratus*	• Construction manager, site/project engineer, environmental management representative	• Avoid construction on overhanging banks or steep banks of large pools, where possible to retain suitable breeding places. • Bridge design does not impede environmental flows, including any temporary works (i.e. conforms to the Accepted development requirements for operational work that is constructing or raising waterway barrier works (DAF, 2018). • Design of works in the vicinity of waterways (e.g. bridges) will avoid direct impact to known breeding sites, where possible. • Conduct works during dry/low flow periods where possible. • Conduct instream and riparian works outside the breeding season (spring to autumn), where possible. • If it is not possible to undertake works outside breeding seasons, pre-clearance surveys upstream and downstream from the works area will identify, map and mark out potential and active breeding habitat. • No bank disturbance will be undertaken until a suitably qualified person has checked the banks for threatened fauna and suitable breeding places. A minimum of 30 m upstream and downstream of the Exploratory Works Project in creeks will be inspected. • Establish an exclusion and/or buffer zone around instream works to limit disturbance to the waterway. • Where adult frogs have previously been recorded and/or found and relocated outside the Exploratory Works Project footprint, temporary frog exclusion fencing will be installed for the duration of works to prevent re-entry to the works area. – Eggs of the applicable frog species and, if possible, the substrate upon which the eggs are attached will be removed and placed in	• No incursion/clearing in exclusion/buffer zones, unless authorised. • No exceedance of clearing limits • No loss of individuals during the construction works • No significant impact on threatened amphibian populations directly attributable to the Exploratory Works Project	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities.	• Unauthorised incursion/clearing in exclusion/buffer zones. • Exceedance of clearing limits (Table 8) • Injury or death of individuals during the construction works • Significant impact on threatened amphibian populations directly attributable to the Exploratory Works Project	• Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Report any fauna injuries or deaths to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. Investigate the cause of injury or death and implement any required changes. • Take any injured fauna to the nearest suitable vet or wildlife carer for treatment. • Action any identified non-conformance within 7 days of identification.

MNES	Responsibility	Management/mitigation measures	Milestone/performance/completion criteria	Monitoring	Trigger for corrective action	Corrective actions
		a suitable container with water sourced from the location of the eggs. Once removed, the eggs and substrate are to be immediately relocated to suitable habitat. The substrate upon which the eggs have been laid is to be affixed in the relocated habitat to minimise potential for the substrate to become un-useable. Locations where frogs are to be recorded and entered into the relevant register. • Suitable habitat is to be identified by the suitably qualified and licensed FSC, who is also responsible for the removal and relocation of the eggs. The location of the eggs identified and the location of the release site are to be recorded via GPS and included in the reporting. • All handling and management of amphibian species will be undertaken in accordance with the Technical Manual - Interim hygiene protocols for handling amphibians (DEHP, no date).				

7. References

Berris, K., Barth, M., & Mooney, T. (2022). The influence of surrounding habitat, behaviour and interspecific competition on nestbox use by endangered Glossy Black Cockatoos (Calyptorhynchus lathami halmaturinus). *Ibis*. doi:10.1111/ibi.13091

Central Coast Council. (2016). *Guideline for the Relocation of Large Tree Hollows.* Wyong: Central Coast Council.

Churchill, S. (1998). *Australian Bats (1st Ed).* Sydney: New Holland Publishers.

Commander, L., Coates, D., Broadhurst, L., Offord, C., Makinson, R., & Matthes, M. (2018). *Guidelines for the Translocation of Threatened Plants in Australia, 3rd edtion.* Australian Network for Plant Conservation.

DAF. (2018, October 1). Accepted development requirements for operational work that is construction or raising waterway barrier works.

DAWE. (2020, December). National Recovery Plan for the white-throated snapping turtle (Elseya albagula). Retrieved from https://www.dcceew.gov.au/sites/default/files/documents/national-recovery-plan-white-throated-snapping-turtle.pdf

DCCEEW. (2022). Approved Conservation Advice for the Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions. Canberra. Retrieved from http://www.environment.gov.au/biodiversity/threatened/communities/pubs/179-conservation-advice.pdf

DCCEEW. (2022). Conservation Advice for Calyptorhynchus lathami lathami (south-eastern glossy black cockatoo). Canberra, ACT, Australia.

DCCEEW. (2022). Conservation Advice for Petauroides volans (greater glider (southern and central)). Canberra. Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/254-conservation-advice-05072022.pdf

DCCEEW. (2023, May). *National Light Pollution Guidelines for Wildlife.* Retrieved from Department of Climate Change, Energy, the Environment and Water: https://www.dcceew.gov.au/sites/default/files/documents/national-light-pollution-guidelines-wildlife.pdf

DEHP. (no date). Techincal manual - Interim hygiene protocol for handling amphibians.

Department of Climate Change, Energy, the Environment and Water. (2024). *Environmental Management Plan Guidelines.*

DES. (2017). Retrieved from Guide to determining terrestrial habitat quality - Methods for assessing habitat quality under the.

DES. (2020). *Flora Survey Guidelines – Protected Plants. Queensland Government.* Department of Environment and Science, Queensland Government.

DES. (2022). Aquatic Ecology EIS Information Guidline.

DES. (2022, December). *Koala Sensitive Design Guideline.* Retrieved from Department of Environment and Science: https://www.des.qld.gov.au/policies?a=272936:policy_registry/koala-sensitive-design-guideline.pdf

DEWHA. (2010a). *Survey Guidelines for Australia's Threatened Birds.* Department of the Environment, Water, Heritage and Arts, Commonwealth of Australia.

DEWHA. (2010b). *Survey Guidelines for Australia's Threatened Bats.* Department of the Environment, Water, Heritage and Arts, Commonwealth of Australia.

DEWHA. (2010c). *Survey guidelines for Australia's threatened frogs.* Department of the Environment, Water, Heritage and Art, Commonwealth of Australia.

DoE. (2015). *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act.* Department of the Environment, Commonwealth of Australia.

DSEWPaC. (2011). Approved Conservation Advice for the Lowland Rainforest of Subtropical Australia. Canberra. Retrieved from http://www.environment.gov.au/biodiversity/threatened/communities/pubs/101-conservation-advice.pdf

DSEWPaC. (2011). Survey guidelines for Australia's threatened fish: Guidelines for detecting fish listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

DSEWPaC. (2011). Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

DSEWPC. (2011). *Survey Guidelines for Australia's Threatened Mammals. .* Department of Sustainability, Environment, Water, Population and Communities, Commonwealth of Australia. .

Ellis, M., Taylor, J., & Rhind, S. (2022). Creating entrances to tree cavities attracts hollow-dependent fauna: proof of concept. *Restoration Ecology, 30*(8).

Eyre, T., Ferguson, D., Hourigan, C., Smith, G., Mathieson, M., Kelly, A., . . . Rowland, J. (2018). *Terrestrial Vertebrate Fauna Survey Assessment Guidelines for Queensland. .* Department of Environment and Science, Queensland Government.

Eyre, T., Kelly, A., Neldner, V., Wilson, B., Ferguson, D., Laidlaw, M., & Franks, A. (2015). *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2.* Brisbane: Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts.

Ezzy, B. (2024). Pers. Comms.

Franks, A., & Franks, S. (2006). *Nest Boxes for Wildlife: A Practical Guide.* Melbourne: Blooming Books.

Garnett, S., Pedler, L., & Crowley, G. (1999). The breeding biology of the glossy black-cockatoo Calyptorhynchus lathami on Kangaroo Island, South Australia. *Emu - Austral Ornithology, 99*(4), 262-279. doi:10.1071/MU99032

GBCCSC. (2024). *Nesting Boxes for Glossy Black Cockatoos*. Retrieved from Glossy Black Cockatoo Conservation Sunshine Coast: https://bushlandconservation.com.au/glossy-black-cockatoo-conservation-sunshine-coast/nesting-boxes-for-gbc/

Greening Australia. (2015, January 16). Turtle nest protected.

Griffiths, S. (2019). Preliminary investigations into the effectiveness of chainsaw-carved hollows. *Proceedings of the 20th National Street Tree Symposium* (pp. 49-55). TREENET.

Griffiths, S., Lentini, P., Semmens, K., Watson, S., Lumsden, L., & Robert, K. (2018). Chainsaw-carved cavities better mimic the thermal properties of natural tree hollows than nest boxes and log hollows. *Forests, 9*(235). doi:10.3390/f9050235

Griffiths, S., Semmens, K., Watson, S., & Jones, C. (2020). Installing chainsaw-carved hollows in medium-sized live trees increases rates of visitation by hollow-dependent fauna. *Restoration Ecology, 28*(5), 1225-1236.

HollowHog. (2021). Retrieved from HollowHog: https://www.hollowhog.com.au/

Honey, R., McLean, C., Murray, B., Callan, M., & Webb, J. (2021). Choice of monitoring method can influence estimates of usage of artificial hollows by vertebrate fauna. *Australian Journal of Zoology, 69*(1), 18-25. doi:10.1071/ZO21012

Hourigan, C. (2012). *Glossy black-cockatoo, Calyptorhynchus lathami. Targeted species survey guidelines. .* Brisbane: Queensland Herbarium, Department of Environment and Science.

Hydrobiology. (2022). *Aquatic Ecology Borumba Pumped Hydro Project.* Hydrobiology Pty Ltd 2022.

Hydrobiology. (2023). *Aquatic Ecology Interim Data Report.* Hydrobiology Pty Ltd 2023.

Knight, A., & Leck, J. (2023). *Evaluation of Habitat recovery for hollow-dependent fauna – regional-scale solutions for long term resilience.* North Coast Regional Landcare. Gulbali Institute and North Coast Regional Landcare Network.

LSJ. (2025). *Artificial nest boxes for Black Cockatoos*. Retrieved from Landcare Serepntine-Jarrahdale: https://landcaresj.com.au/cockatubes-saving-black-cockatoos/

Lugg, W. &. (2017). *Optimal survey designs for environmental DNA sampling.* Methods in Ecology and Evolution.

Makinson, R., Pegg, G., & Carnegie, A. (2020). *Myrtle Rust in Australia - a National Action Plan.* Canberra: Australian Plant Biosecurity Science Foundation.

Nelder, V., Wilson, B., Dillewaard, H., Ryan, T., Butler, D., McDonald, W., . . . Appelman, C. (2020). *Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.1.* Queensland Hervarium Queensland Department of Environment and Science.

Nest Box Tales. (no date). *Black Cockatoo*. Retrieved from Nest Box Tales: https://nestboxtales.com/nest-box-designs/black-cockatoo/

Nottidge, B. (2024). Pers. Comm.

Phillips, S. &. (2011). *The Spot Assessment Technique: A tool for determining localised levels of habitat use by Koalas Phascolarctos cinereus.* Australian Zoologist.

Qld Hydro. (2023). *Borumba Dam Pumped Storage Hydro – Exploratory Works: Matters of National Environmental Significance.* Queensland Hydro.

Qld Hydro. (2023b). *Borumba Dam Pumped Storage Hydro – Exploratory Works: Offset strategy.* Queensland Hydro.

RMS. (2014). *Nest Box Management Plan (Sections 4 & 5) – Woolgoola to Ballina Pacific Highway upgrade. .* Prepared by Parsons Brinckerhoff for Roads and Maritime Services.

RMS. (2017). *Foxground and Berry bypass Princes Highway upgrade – Nest Box Management Plan. .* Sydney: Roads and Maritime Services.

Rueegger, N. (2017). Artificial tree hollow creation for cavity-using wildlife - Trialling an alternative method to that of nest boxes. *Forest Ecology and Management, 405*, 404-412. doi:10.1016/j. foreco.2017.09.062

Terry, W., Goldingay, R., & van der Ree, R. (2021). Can chainsaw carved hollows provide an effective solution to the loss of natural tree cavities for arboreal mammals? *Forest Ecology and Management, 490*(119122).

The National Lantana Management Group. (2009). *Draft Plan to Protect Environmental Assets from Lantana.* Yeerongpilly, Queensland: Department of Employment, Economic Development and Innovation.

TMR. (2023, November). Queensland Manual of Uniform Traffic Control Devices - Part 2: Traffic control devices for general use.

TSSC. (2011). Commonwealth Listing Advice on Lowland Rainforest of Subtropical Australia. Canberra. Retrieved from http://www.environment.gov.au/biodiversity/threatened/communities/pubs/101-listing-advice.pdf

Umwelt. (2022a). *Borumba Pumped Hydro Project Terrestrial Ecology Technical Report.* Umwelt Australia Pty Ltd 2022.

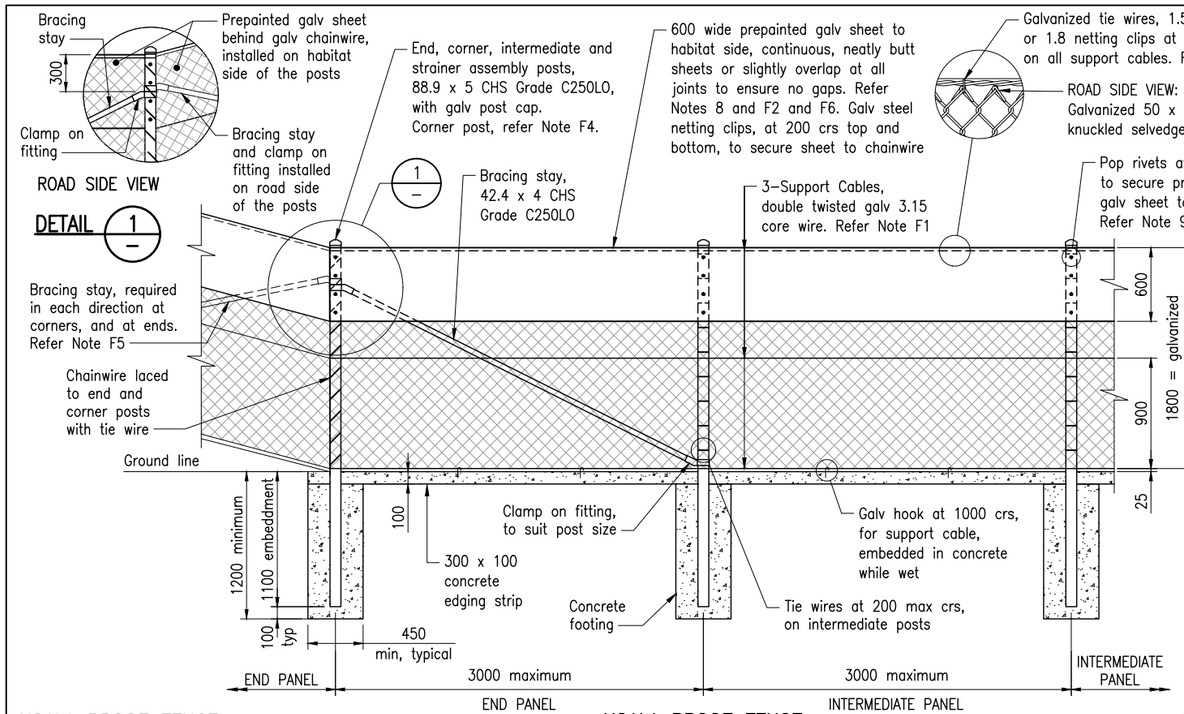
Umwelt. (2022b). *Briefing Note – Exploratory Works Ecological Surveys.* Umwelt Australia Pty Ltd 2022.

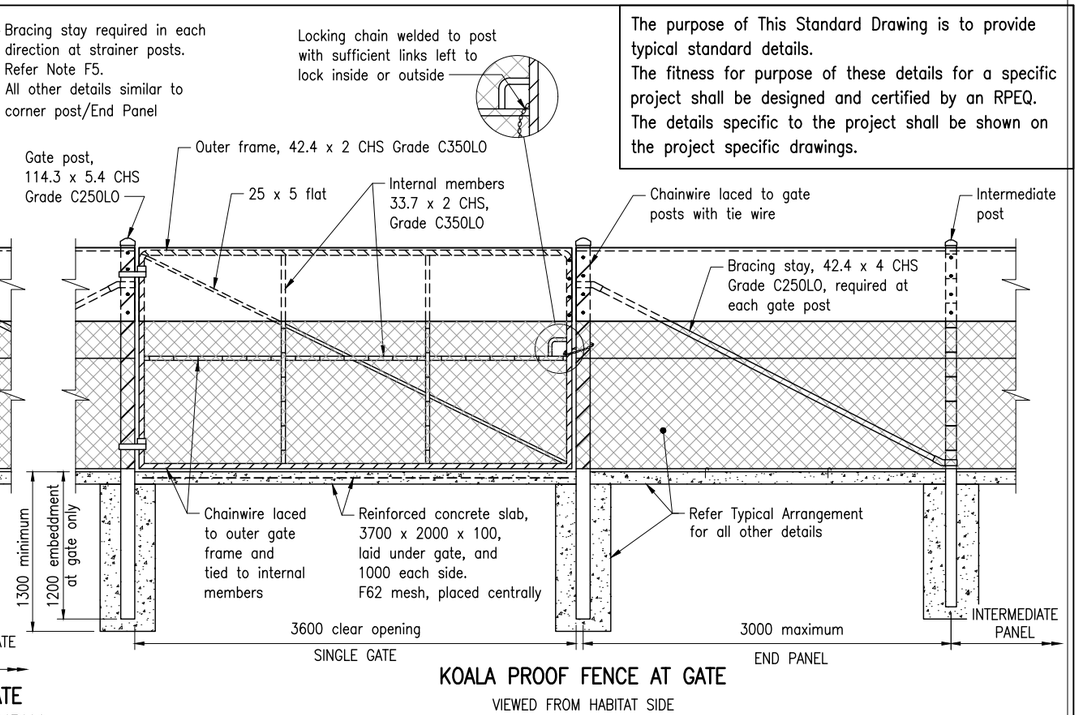
Umwelt. (2023). *Field Survey Summary Report - Borumba Dam Pumped Hydro: Spring and Summer Ecological Surveys.* Umwelt Australia Pty Ltd 2023.

WWF. (2023). *Greater glider families move into hi-tech nest boxes*. Retrieved from WWF Australia: https://wwf.org.au/news/2023/greater-glider-families-move-into-hi-tech-nest-boxes/

Appendix A - Koala fencing

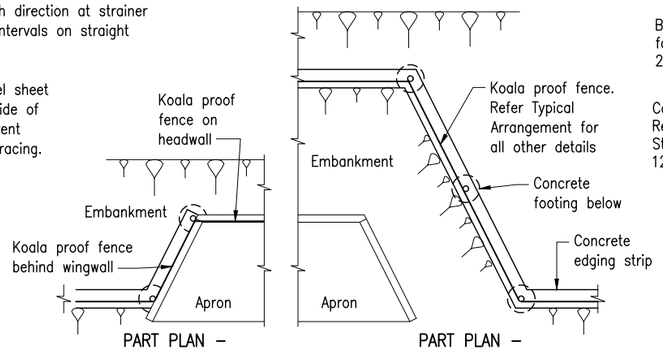
The purpose of This Standard Drawing is to provide typical standard details.
The fitness for purpose of these details for a specific project shall be designed and certified by an RPEQ.
The details specific to the project shall be shown on the project specific drawings.

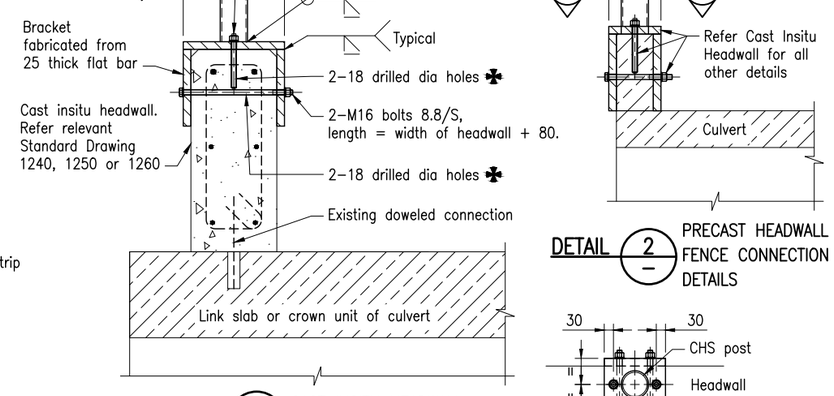


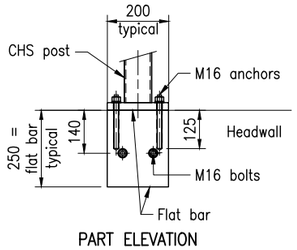


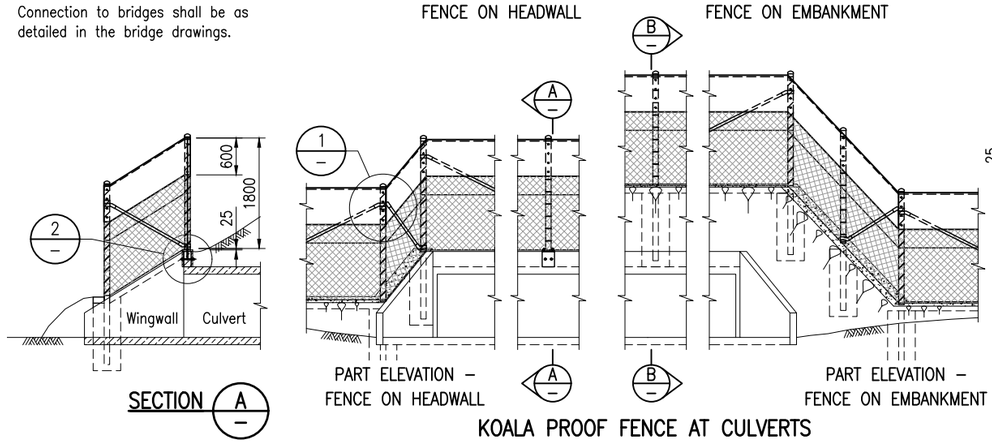
KOALA PROOF FENCE:

F1. BLACK PVC COATED galvanized chainwire, core wire, tie wire and support cables shall be used where the fence is located adjacent to pedestrian or bikeway areas.
F2. PREFINISHED/ PREPAINTED GALVANIZED STEEL SHEET shall be coloured on both sides, as nominated in the project specific documentation. The nominated colour to face the road.
F3. SELVEDGES: Knuckled selvedges shall be used at top and bottom.
F4. CORNER POSTS shall be adopted where the change in angle in horizontal alignment exceeds 20 degrees.
F5. STRAINER POST: Provide bracing stays in each direction at strainer post between 2 intermediate panels at 150 intervals on straight lengths of fence.
F6. FENCE INSTALLATION REQUIREMENTS:
Chainwire, with the prepainted galvanized steel sheet outermost, shall be located on the habitat side of the posts (not on the roadway side) to prevent koalas climbing the CHS posts, stays, and bracing.
Ensure any gaps between koala fencing and adjacent structures are narrow enough to prevent koalas passing through.
If the koala fence is to connect to other structures, the asset owner's permission shall be sought.
All dimensions shall be verified on site prior to fabrication of steel components for connections to culvert headwalls.
Connection to bridges shall be as detailed in the bridge drawings.









NOTES:

1. SCOPE: This Standard Drawing provides details of koala proof fencing for TMR projects, and shall be constructed in accordance with MRTS14.
2. WIND DESIGN LOADS shall comply with AS/NZS 1170.2.
   Design ultimate wind load V = 51 m/s.
3. CONCRETE shall be in accordance with MRTS70. Concrete strength N32/20.
4. REINFORCING STEEL shall be in accordance with MRTS71, Standard Drawing 1044 and AS/NZS 4671. Mesh Grade D500L.
5. STEELWORK shall be fabricated to the requirements of MRTS78.
   CHS shall be Grade C250LO for fence posts and stays, and Grade C350LO for gates, to AS 1163.
   Flat bar shall be Grade 300 to AS/NZS 3679.1.
   Bolts Class 8.8, nuts Class 8 and washers for Class 8.8 bolts to AS/NZS 1252.
   All nuts shall be snug tight in accordance with AS 4100.
   Galvanized fencing wire, tie/lacing wire and galvanized chainwire shall conform to AS 2423.
   All bolts and nuts shall be hot dip galvanised to AS 1214.
   All other steelwork shall be hot dip galvanized to AS/NZS 4680.
   Prior to galvanizing all weld splatter and welding slag shall be removed.
7. WELDING symbols to AS 1101.3. All welding shall be to AS/NZS 1554.1.
   All welds except location tack welds shall be SP category.
   Welding consumables shall be controlled hydrogen type G493 to AS/NZS ISO 14341–B or T493 to AS/NZS ISO 17632–B.
8. PREFINISHED/ PREPAINTED GALVANIZED STEEL SHEET shall be 0.4mm BMT to AS 2728.
9. POP RIVETS with aluminium shell, steel stem (large flanged) maximum grip 9.5mm, drill bit No 11 (4.9mm), shall be used.
10. DIMENSIONS are in millimetres.

REFERENCED DEPARTMENTAL SPECIFICATIONS:
MRTS14 Road Furniture
MRTS70 Concrete
MRTS71 Reinforcing Steel
MRTS78 Fabrication of Structural Steelwork

Department of Transport and Main Roads

FENCING

KOALA PROOF FENCE AND GATE

Queensland Government

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A3
Not to Scale

Standard Drawing No
1603
Date 7/2021

A | B | C

Appendix B - Biosecurity Act Restricted Matters

The *Biosecurity Act 2014* (Qld) assigns categories assigned to restricted matters, which have a significant impact on human health, social amenity, the economy or the environment. There are seven categories, each placing restrictions on how to manage the restricted matter or requiring specific actions to be undertaken to minimise spread and adverse impacts as described in Table B-1.

Table B-1: Restricted matters categories

Category	Examples of restricted matters	Action
1	Red imported fire ants, electric ants, Asian honey bees, and certain animal diseases, aquatic diseases and pathogens.	Must be reported to an inspector within 24 hours.
2	Certain noxious fish, weeds and pest animals such as spotted gar and red-eared slider turtle.	Must be reported to an inspector or authorised person within 24 hours.
3	Weeds, pest animals and noxious fish (e.g. gambusia, dingoes, yellow crazy ants).	Must not distribute this restricted matter. This means it must not be given as a gift, sold, traded or released into the environment unless the distribution or disposal is authorised in a regulation or under a permit.
4	Specific weeds, pest animals and noxious fish such as the bitou bush, feral pig or giant cichlid.	Must not move this restricted matter to ensure that it does not spread into other areas of the state.
5	Weeds, pest animals and noxious fish such as Mexican feather grass, rabbits and carp.	Must not possess or keep this restricted matter under your control. These pests have a high risk of negatively impacting on the environment. You may only keep this restricted matter under a permit of the *Biosecurity Act 2014* or another Act.
6	Invasive animals such as feral deer, foxes, rabbits and wild dogs and noxious fish such as carp, gambusia and tilapia.	Must not feed this category of restricted matter. Feeding this restricted matter may cause their numbers to increase and negatively impact the economy or the environment. Feeding for the purpose of preparing for or undertaking a control program is exempted.
7	Noxious fish such as carp, weatherloach, climbing perch, gambusia and tilapia.	Must kill the restricted matter and dispose of the carcass by burying the whole carcass (no parts removed) in the ground above the high tide water mark or placing it in a waste disposal receptacle.

Appendix C - Fauna species listed under the NC Act known or likely to occur

Fauna species that are listed under the NC Act that were recorded in the study area, or are considered likely to occur, are identified in Table C-1.

This includes a total of 22 microbat species, including:

- four species that are well-known to roost and breed in caves
- sixteen species that definitely roost and breed in tree hollows (Churchill, 1998)
- two species that are known to roost in both caves and tree hollows.
- None of the recorded microbat species are listed as threatened, but all are colonial breeding species (Table C-1).

Additionally, four colonial-breeding bird species were also recorded in the study area, with a further two species considered as likely to occur (Table C-1).

Table C-1: Other fauna species known or likely to occur within or immediately adjacent to the Exploratory Works Project footprint

Species	EPBC Act status	NC Act status
Monotremes		
Platypus, *Ornithorhynchus anatinus*	Not listed	Special Least Concern
Short-beaked echidna, *Tachyglossus aculeatus*	Not listed	Special Least Concern
Colonial bats		
White-striped free-tail bat, *Austronomus australis*	Not listed	Least concern
Gould's wattled bat, *Chalinolobus gouldii*	Not listed	Least concern
Chocolate wattled bat, *Chalinolobus morio*	Not listed	Least concern
Hoary wattled bat, *Chalinolobus nigrogreseus*	Not listed	Least concern
Little pied bat, *Chalinolobus picatus*	Not listed	Least concern
Eastern false pipistrelle, *Falsistrellus tasmaniensis*	Not listed	Least concern
Little bent-wing bat, *Miniopterus australis*	Not listed	Least concern
Large bent-wing bat, *Miniopterus orianae oceanensis*	Not listed	Least concern
East coast freetail bat, *Mormopterus norfolkensis*	Not listed	Least concern
Southern myotis, *Myotis Macropus*	Not listed	Least concern
Long-eared bat, *Nyctophilus* sp.	Not listed	Least concern
Northern free-tailed bat, *Ozimops lumsdenae*	Not listed	Least concern
Ride's free-tailed bat, *Ozimops ridei*	Not listed	Least concern
Eastern horseshoe bat, *Rhinolophus megaphyllus*	Not listed	Least concern

Species	EPBC Act status	NC Act status
Yellow-bellied sheath-tailed bat, *Saccolaimus flaviventris*	Not listed	Least concern
Greater broad-nosed bat, *Scoteanax ruepellii*	Not listed	Least concern
Little broad-nosed bat, *Scotorepens greyii*	Not listed	Least concern
Eastern broad-nosed bat, *Scotorepens orion*	Not listed	Least concern
Central-eastern broad-nosed bat, *Scotorepens* sp.	Not listed	Least concern
Large forest bat, *Vespadelus darlingtoni*	Not listed	Least concern
Eastern forest bat, *Vespadelus pumulis*	Not listed	Least concern
Eastern cave bat, *Vespadelus troughtoni*	Not listed	Least concern
Colonial birds – recorded in the study area		
Rainbow bee-eater, *Merops ornatus*	Listed marine[4]	Least concern
Striated pardalote, *Pardalotus striatus*	Not listed	Least concern
Tree martin, *Petrochelidon nigricans*	Listed marine[1]	Least concern
Welcome swallow, *Hirundo neoxena*	Listed marine[1]	Least concern
Colonial birds – likely to occur		
Spotted pardalote, *Pardalotus punctatus*	Not listed	Least concern
Fairy martin, *Petrochelidon ariel*	Not listed	Least concern

[4] General measures have been included to address these species, however detailed measures have not been included as they are not a controlling provision for the action

Appendix D - Tree hollow replacement strategy

D-1 Threatened species and use of hollow-bearing trees

Greater gliders (*Petauroides volans*), yellow-bellied gliders (*Petaurus australis australis*) and glossy black-cockatoos (*Calyptorhynchus lathami lathami*) have been observed in the Exploratory Works Project study area during ecology surveys for the Borumba PHES project. Within the study area, surveys also confirmed the presence of suitable hollow-bearing trees that may provide denning habitat for these species. In areas of denning habitat, gliders may utilise several different hollows with selection and usage varying each night.

Gliders and glossy-black cockatoos require hollows of different specifications such as the size and depth of hollows, preferred tree species and location in the landscape. A brief summary of the hollow requirements for each target species is included in Table D-1 below. Greater gliders and yellow-bellied gliders have similar requirements and are therefore combined in the table.

The hollow entrance specification for greater glider and yellow-bellied gilder is 10 cm which is consistent with the conservation advice for greater glider and literature for yellow-bellied glider, which has a mean hollow entrance of 10.6 cm.

Table D-1: Denning habitat requirements for target species

Species	Preferred denning trees		Preferred hollow specifications		Additional considerations
	Genera or species	Minimum DBH (cm)	Minimum entrance diameter (cm)	Minimum height of hollow above ground (m)	
Greater glider and yellow-bellied glider	*Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*	50 [a]	10 [b]	8 [c]	• Minimum hollow depth of 30 cm [c] • Located within areas mapped as habitat for the species
Glossy-black cockatoo	Prefers *Eucalyptus* spp.	60 [d]	15 [d]	8 [d]	• Located within areas mapped as breeding habitat for the species • Hollows are located in branches >30 cm in diameter [d] • Angle of trunk or branch not more than 45° from vertical [d] • Within 1.5 km of permanent water source and within 1.2 km of foraging habitat [d]

[a] (DCCEEW, 2022)
[b] (DCCEEW, 2022)
[c] (Hofman, Gracanin, & Mikac, 2023)
[d] (DCCEEW, 2022)

D-2 Hollow mitigation strategy

While the Exploratory Works Project will avoid clearing suitable hollow-bearing trees as far as possible, though some suitable hollow-bearing trees may be unavoidable. These trees will be cleared in accordance with the sequential clearing method described in Section 6.1.6. Clearing procedures will be designed to avoid and minimise impacts on arboreal fauna that may be utilising tree hollows and maximise salvage of suitable hollows.

To mitigate the loss of these denning resources, Queensland Hydro proposes to record during pre-clearance surveys the characteristics of any suitable hollows that are to be lost (such as size of hollow, height, aspect, tree species and applicable target fauna species), and then identify and replace hollows for the relevant species that meet the requirements described in Table D-1:. The replacement of hollows has been proposed as a 'good-faith' measure to mitigate the loss of denning resources, and is not intended as a measure to reduce residual impacts on threatened species. Measures developed specifically to reduce residual impacts on threatened species are detailed in Section 7 of the Borumba PHES Project – Exploratory Works Preliminary Documentation.

Replacement hollows will be installed in land adjacent to the Exploratory Works Project footprint in areas of contiguous suitable habitat that are to be retained into the future (including outside of areas to be developed for the Main Works Project) and managed by Queensland Hydro. This will ensure the replacement hollows won't be disturbed by future works, have good connectivity for the species to other areas of habitat, and access will be available for maintenance and monitoring.

Case studies suggest that glossy black-cockatoos readily use nest boxes (Berris, Barth, & Mooney, 2022) and there are results coming out of nest box programs in central Queensland, NSW and Victoria where greater gliders are successfully using replacement hollows including salvaged natural hollows, and installed nest boxes made from recycled plastic and plywood. In February and April 2022, 120 nest boxes were installed in fire-affected forests in Tallaganda National Park and state forest in NSW and a further 114 near Bendoc in East Gippsland, Victoria by World Wind Fund for Nature (WWF). It has been found that greater gliders are using the installed boxes. Some boxes were found supporting up to three gliders. These are likely to be a mating pair and an immature offspring (WWF, 2023). In central Queensland, over 18 months of nest box monitoring has found a number of individual greater glider in boxes, as well as female greater gliders and their young (Nottidge, 2024). Monitoring has also shown greater gliders to be using all nest box designs (Ezzy, 2024). Other studies have shown gliders tend to prefer salvaged hollows or carved hollows (DCCEEW, 2022; DCCEEW, 2022; Griffiths S. , 2019; Terry, Goldingay, & van der Ree, 2021).

D-2-1 Hollow replacement types

The first preference will be to 'salvage' the natural hollow from the tree once it is felled and attach it to a host tree. Note that larger salvaged hollows (entrance diameter >10 cm) will be prioritised at the offset site. Any salvaged hollows not used at the offset site including smaller salvaged hollows (entrance diameter <10 cm) will be installed in contiguous habitat adjacent to the Exploratory Works Project footprint.

The benefit of natural hollows is that they:

- Are in a natural formed shape
- Have good thermal properties
- Are robust and will last a long time in nature.

The second preference is to create carved (e.g. chainsaw, entrance-drilling or using the HollowHog Tool) hollows. The benefit of carved hollows is that they provide a more stable thermal environment that is comparable to natural hollows (Griffiths, et al., 2018). They may also better mimic the physical appearance of a natural hollow, allow easy access and provide less exposure to predators compared to typical nest boxes (Terry, Goldingay, & van der Ree, 2021).

The third preference is the use of built boxes that are designed to cater for the target species and be installed using the specifications summarised in Section D-1. Built boxes can be built to required sizes and specifications, they can be painted white with heat reflective paint to keep them cooler in hot temperatures, and they are light and more easily installed. Recycled plastic boxes can last up to 30 years.

There will be two nest box designs used – one for large gliders (greater gliders and yellow-bellied gliders) and one for glossy black-cockatoos.

Glider nest boxes

A concern with nest boxes for gliders is that their construction is not appropriate to maintain the required thermal environment (Griffiths, et al., 2018). The nest boxes to be built and used for gliders use an improved design that allows for appropriate thermoregulation.

The design of nest boxes suitable for both yellow-bellied and greater gliders (larger gliders) will include:

- inner width/height of 250x300 mm
- depths of 400 mm
- entrance diameter of 100 mm
- rear entranced to face the host tree trunk
- minimum height above ground of 8 m.

CYPLAS boxes will be used in first instance. Other nest box designs that are shown to be effective on other projects may be trialled as the Project progresses such as Birch Plywood boxes.

CYPLAS boxes are made from 100% recycled high density polyethylene and Queensland Cypress installed with the 'Habisure System' (Franks & Franks, 2006) to prevent tree damage (Figure D-1). These boxes are termite and rot proof and have a lifespan of at least 30 years.



Figure D-1: Cyplas™ rear entry Greater Glider nest box (Hollow Log Homes, 2024)

Glossy black-cockatoo nest boxes

The design of glossy black-cockatoo nest boxes will include:

- inner width/height of 280x970 mm;
- depths of 350 mm;
- entrance diameter of 200 mm, centre of hole 140 mm from the top of panel;
- drainage holes in each corner of the base (Nest Box Tales, no date).

There is also potential to use different nest box types. These include:

1. Plywood boxes – traditional nest box style with lid and front entrance (Figure D-3). Installed with the 'Habisure System' (Franks & Franks, 2006).
1. Cockatube nest boxes – designed by Landcare Serpentine-Jarradale, the Cockatube is an artificial cylindrical nesting box, measuring 375 mm in diameter and 1200 mm in depth. The base of the Cockatube has holes for drainage and wood chips for eggs, as well as a ladder to assist fledglings in leaving the nest. This design is often comprised of either PVC and/or recycled plastic (Figure D-5) (GBCCSC, 2024) (LSJ, 2025). This design has been used successfully as part of the Glossy Black Cockatoo Recovery Program at Kangaroo Island (Figure D-4). This design is also available in a 100% recycled household plastic PVC pipe fabrication (GBCCSC, 2024).



Figure D-3: Glossy black-cockatoo plywood nest box (GBCCSC, 2024)



Figure D-4: PVC pipe nest box (GBCCSC, 2024)

D-2-2 Implementing replacement hollows

Pre-clearance surveys will be completed approximately three months (where possible) prior to clearing commencing so there is adequate time to finalise the number of replacement hollows required and install a proportion of the replacement hollows (e.g. carved hollows and nest boxes) prior to clearing.

All suitable hollows that meet the requirements in Table D-1 will be replaced on a 1:1 basis at a minimum.

This ratio is consistent with a number of other nest box programs that have been implemented for infrastructure projects including by the Department of Transport for NSW.

Queensland Hydro will aim to install 50% of replacement hollows (carved hollows and nest boxes) one month prior to clearing. The intent of installing replacement hollows prior to any vegetation clearance is to increase initial hollow availability and allow time for potentially displaced individuals to utilise replacement hollows (Griffiths, Semmens, Watson, & Jones, 2020; Knight & Leck, 2023).

As this needs to be undertaken prior to clearing and therefore before natural hollows can be salvaged from the clearing area, the pre-replacement strategy will primarily consist of nest boxes with the addition of some carved hollows where appropriate.

D-3 Installation methods

D-3-1 General requirements for all types

Replacement hollows will be placed in host trees located as near as possible to the cleared hollow-bearing tree and in areas that will not be impacted by the Borumba PHES Project, assuming it proceeds. A suitably qualified ecologist will supervise the installation of replacement hollows in accordance with this plan. The ecologist, in consultation with an arborist, would identify and decide the host trees taking into account information within this plan as well as the following factors:

- selecting larger trees (>30cm dbh with sufficient canopy cover (eg ~20 %)) for host trees where possible;
- selecting trees that do not already support suitable hollows to provide supplementary denning in these areas;
- selecting trees of the genera known to be utilised by the target species (e.g. Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia);
- selecting healthy trees that are structurally sound;
- consideration of location of habitat connectivity, and food resources in relation to replacement hollow location;
- placement at least 8 m above ground;
- placement in areas with limited artificial light sources;
- generally orientated between northwest and east to avoid hot afternoon sun and the dominant direction of severe storms.

All nest boxes will be installed in accordance with best practices, maximising the potential for uptake by their respective target species. For example, nest boxes may be installed ‘rear-facing’, and will not be mounted in tree species that are subject to decorticating and/or shedding large strips of bark, which may obscure and/or block the nest box entrance over time.

D-3-2 Natural salvaged hollows

According to some literature, salvaged hollows are more likely to be utilised than artificial nest boxes. Monitoring of relocated hollows and large nest boxes designed for owls placed at Wadalba, NSW showed that the relocated hollow received more regular activity and use over the winter period from multiple species including sulphur-crested cockatoo, barn owl, common brushtail possum, Australian king parrot, sugar glider, feather-tailed glider, galah and southern boobook (Central Coast Council, 2016).

Salvaged hollows will be installed during the clearing phase. They will be cut from the cleared hollow-bearing tree and retained for relocation. Some hollows that are salvageable may only provide the hollow ‘shell’ and require a cap to be placed at either end with an entrance hole to be created. Marine grade plywood should be used as a minimum for any capping requirements and be sealed with waterproofing to prevent warping and splitting.

The process of installing salvaged hollows will be done via an elevating work platform (EWP). Given the terrain of the Exploratory Works Project study area, areas accessible by EWPs are likely to be limited to level ground or near access tracks. Therefore, salvaged hollows will be placed on host trees in areas accessible by EWP.

Appropriate fixing methods to the recipient tree are required to prevent or minimise impacts to the health and structural integrity of the recipient tree and ensure a safe and long-term outcome (Figure D-5). The procedure involves:

- the placement of the salvaged hollow into a selected host tree through the use of an appropriately sized crane to lift the section
- tree climbers will guide the placement of the section onto the supporting branch with assistance from the EWP, where it is feasible and practical (sufficient space between trees and not steeply sloped land) to do so (Figure D-6)
- screw galvanised builders strapping around both components including host tree and hollow
- or use steel cable and turnbuckles
- timber blocks and particle board are used to protect the live tree (Central Coast Council, 2016).

There are two methods for fixing the salvaged hollow to the host tree depending on the weight and size of the section. All fasteners and hardware used to affix the section to the recipient tree are to be suitable for external use. (e.g. galvanised, stainless steel, brass).



Figure D-5: Salvaged hollow attached to recipient tree



Figure D-6: EWP to attach a salvaged hollow to recipient tree

D-3-3 Carved hollows

Carved hollows can be created using the HollowHog tool (HollowHog, 2021), chainsaws (Rueegger, 2017; Griffiths, et al., 2018; Terry, Goldingay, & van der Ree, 2021) or entrance-drilling to access existing voids/decay in tree stems (Ellis, Taylor, & Rhind, 2022).

Carved hollows will be created prior to commencement of clearing and will mimic the general characteristics of preferred hollows for the target species (Table D-1:).

Carved hollows will be created by a tree climber using the HollowHog tool (HollowHog, 2021). The HollowHog tool has minimal impact on a tree compared to chainsaw-carved hollows. An entry hole at least 5 cm in diameter is created and then a larger hollow is carved within the tree (Figure D-7). Alternatively, an arborist would inspect potential host trees and identify suitable host trees with existing voids/decay for the tree climber to create hollow entrances using the HollowHog tool. An entry modifier will be installed to ensure the tree does not close over the entry (Figure D-8).



Figure D-7: Cross-section of carved hollow created by the HollowHog tool (HollowHog, 2021)



Figure D-8: Entry modifier added to HollowHog-created hollow (HollowHog, 2021)

Chainsaw-carved hollows will be created by an arborist with appropriate training and safety accreditation. A faceplate will be cut from the front surface removed from the tree and retained for reattachment. The hollow will be carved into the tree in a manner that maintains the structural integrity and health of the tree (Figure D-9). The faceplate will be reattached over the carved hollow and fixed in place with screws (Terry, Goldingay, & van der Ree, 2021; Honey, McLean, Murray, Callan, & Webb, 2021).

Figure D-9 shows the steps involved in the construction of chainsaw-carved hollows in a live tree: (a) faceplate is removed, (b) plunge cuts are made, (c) grid removed to create hollow, (d) an entrance hole cut into the back of the hollow, and (e) faceplate reattached with metal screws (Honey, McLean, Murray, Callan, & Webb, 2021).



Figure D-9: Chainsaw-carved hollow

D-3-4 Nest boxes

All nest boxes are to be installed prior to the start of clearing.

Nest boxes will be attached to trees using the Habisure System (Franks & Franks, 2006) (Figure D-10). This attachment method is recommended as it allows for at least one metre of diameter growth of the host tree before adjustment is required. Bolting or screwing nest boxes to trees is not recommended due to increased damage to trees and a comparatively short lifespan.

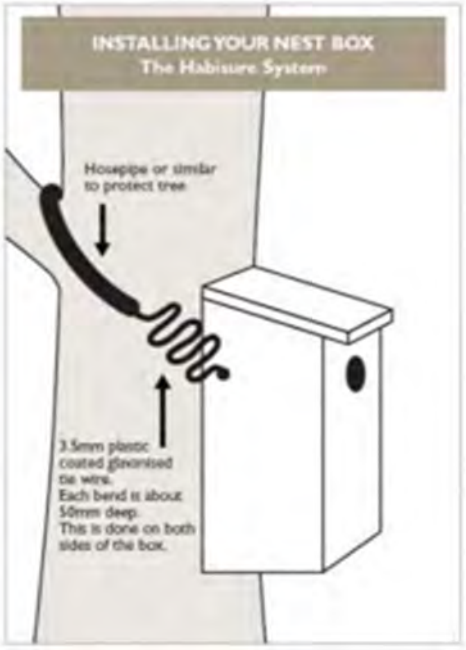

Figure D-10: Habisure system of nest box attachment (Franks & Franks, 2006)

Additional details for installing glider nest boxes

Nest boxes will be installed using the general installation method and considering the following factors:

- the fixing arrangements for glider nest boxes with rear facing entrance holes will allow spaces between the nest boxes and trees for fauna to access the nest box (RMS, 2017);
- nest boxes should generally be orientated between northwest and east to avoid hot afternoon sun and the dominant direction of severe storms. Rear entranced glider boxes will have limited aspect-related issues (RMS, 2014).

Additional details for installing glossy black-cockatoo nest boxes

Glossy black-cockatoo nest boxes will be installed only to replace cleared trees with hollows that meet the relevant hollow specifications listed in Table D-1:, which will be confirmed by an ecologist.

Nest boxes will be placed within 1.5 km of a permanent water source and within 1.2 km of foraging habitat to maintain clusters of nests in the landscape (Garnett, Pedler, & Crowley, 1999).

D-4 Monitoring, maintenance and reporting

D-4-1 Monitoring and maintenance

Monitoring replaced hollows is required to assess their effectiveness in uptake by the target species and to ensure their integrity is not compromised by weather events and/or wound-wood growth on trees (for carved hollows), or if non-target species are using them.

Monitoring will be undertaken by suitably qualified ecologists every six months for the first two years. At least one round of monitoring will take place between March to August during the glossy black-cockatoo breeding season when they are more likely to use the replaced hollows (Hourigan, 2012). Gliders will likely use the replaced hollows for denning year-round. After the initial two years of more intensive monitoring, ongoing monitoring will occur annually for one to two years post completion of construction.

Visual inspections will be used to monitor every replaced hollow or nest box and collect data. The monitoring will be conducted by a suitably experienced ecologist that can identify the target species and will likely be done via camera mounted to extension pole (for boxes around 8m) or tree climbing and EWPs for higher boxes.

An ecologist will visually inspect each replaced hollow and collect the following information:

- date and time of inspection

- climatic conditions during inspection
- replaced hollow ID number label
- person undertaking the monitoring
- tree species
- height and aspect in tree
- confirmation on whether the replaced hollow is being used by fauna or there is evidence of use
- species using the replaced hollow (photo taken)
- if the replaced hollow is unoccupied, notes relating to evidence of fauna usage
- condition of the replaced hollow including signs of deterioration
- note any maintenance that is required
- changes to the surrounding landscape.

If monitoring identifies signs of deterioration or presence of exotic or pest species, replaced hollows will require maintenance and will be addressed as soon as practical to ensure replaced hollows are suitable for target species.

D-4-2 Reporting

All breeding places for these species that will be impacted by the Exploratory Works Project will be recorded in an electronic Animal Breeding Place Register in accordance with the SMP under the NC Act.

Monitoring results will be reported to the Project Environment Manager following each round of monitoring. The monitoring report will summarise all of the information gathered as outlined above for each box and compare results from previous monitoring rounds.

Appendix E -
Potential impacts and associated risks for the Exploratory Works Project

Project component	Description	Risk	Likelihood	Consequence	Outcome
Exploratory tunnel	Portal pad, explosives store and associated access tracks	Impacts to threatened species	Likely	Major	High
		Habitat loss	Highly likely	High	High
		Habitat fragmentation	Likely	Moderate	Medium
		Injury or mortality	Likely	Moderate	Medium
		Reduced air quality	Possible	High	Medium
		Noise and vibration	Highly likely	High	High
		Light emissions	Highly likely	High	High
		Hazardous materials	Likely	High	High
		Surface water and groundwater	Likely	High	High
		Erosion and sedimentation	Likely	High	High
		Dust	Highly likely	Minor	Medium
		Bushfire	Possible	High	Medium
		Pests and weeds	Likely	High	High
	Tunnelling works	Impacts to threatened species	Unlikely	Moderate	Low
		Habitat loss	Unlikely	Minor	Low
		Habitat fragmentation	Unlikely	Minor	Low
		Injury or mortality	Likely	Moderate	Medium
		Reduced air quality	Possible	High	Medium
		Noise and vibration	Highly likely	High	High
		Light emissions	Likely	Minor	Low
		Hazardous materials	Highly likely	High	High
		Surface water and groundwater	Highly likely	Major	Severe

Project component	Description	Risk	Likelihood	Consequence	Outcome
		Erosion and sedimentation	Possible	High	Medium
		Dust	Likely	Moderate	Medium
		Bushfire	Unlikely	High	Medium
		Pests and weeds	Unlikely	High	Medium
Geotechnical investigations	Test pits	Impacts to threatened species	Possible	High	Medium
		Habitat loss	Unlikely	Moderate	Low
		Habitat fragmentation	Unlikely	Moderate	Low
		Injury or mortality	Possible	Moderate	Medium
		Reduced air quality	Possible	Moderate	Medium
		Noise and vibration	Possible	Moderate	Medium
		Light emissions	Unlikely	Moderate	Low
		Hazardous materials	Possible	Minor	Low
		Surface water and groundwater	Likely	Moderate	Medium
		Erosion and sedimentation	Possible	Moderate	Medium
		Dust	Likely	Moderate	Medium
		Bushfire	Possible	High	Medium
		Pests and weeds	Likely	High	High
	Boreholes (deep and shallow, including some conversion to groundwater monitoring bores)	Impacts to threatened species	Unlikely	Moderate	Low
		Habitat loss	Unlikely	Moderate	Low
		Habitat fragmentation	Unlikely	Moderate	Low
		Injury or mortality	Possible	Moderate	Medium
		Reduced air quality	Possible	Minor	Low

Project component	Description	Risk	Likelihood	Consequence	Outcome
		Noise and vibration	Likely	Minor	Low
		Light emissions	Likely	Moderate	Medium
		Hazardous materials	Possible	Moderate	Medium
		Surface water and groundwater	Likely	High	High
		Erosion and sedimentation	Possible	Moderate	Medium
		Dust	Likely	Minor	Low
		Bushfire	Possible	Moderate	Medium
		Pests and weeds	Likely	High	High
Spoil disposal areas (tunnel spoil disposal area, Kingaham spoil disposal area)	Dedicated areas for disposal of spoil material from exploratory tunnel and technical drilling and stockpiling of topsoil.	Impacts to threatened species	Possible	High	Medium
		Habitat loss	Possible	High	Medium
		Habitat fragmentation	Possible	Moderate	Medium
		Injury or mortality	Possible	High	Medium
		Reduced air quality	Likely	High	High
		Noise and vibration	Likely	Moderate	Medium
		Light emissions	Possible	Moderate	Medium
		Hazardous materials	Likely	High	High
		Surface water and groundwater	Likely	High	High
		Erosion and sedimentation	Likely	High	High
		Dust	Likely	High	High
		Bushfire	Possible	High	Medium
		Pests and weeds	Likely	High	High
Site access	Realignment of a section of Bella Creek Road	Impacts to threatened species	Possible	High	Medium

Project component	Description	Risk	Likelihood	Consequence	Outcome
	(Kingaham Creek bypass)	Habitat loss	Possible	High	Medium
		Habitat fragmentation	Possible	High	Medium
	New access tracks and upgrades to existing tracks, including multiple waterway crossings, to enable access to geotechnical investigation and exploratory tunnel drilling sites Supporting Infrastructure	Injury or mortality	Likely	High	High
		Reduced air quality	Likely	High	High
		Noise and vibration	Likely	High	High
		Light emissions	Likely	High	High
		Hazardous materials	Highly likely	High	High
		Surface water and groundwater	Likely	High	High
		Erosion and sedimentation	Likely	High	High
		Dust	Likely	High	High
		Bushfire	Possible	High	Medium
		Pests and weeds	Likely	High	High
	Temporary water infrastructure	Impacts to threatened species	Likely	High	High
		Habitat loss	Likely	High	High
		Habitat fragmentation	Likely	High	High
		Injury or mortality	Possible	High	High
		Reduced air quality	Possible	Moderate	Medium
		Noise and vibration	Likely	High	High
		Light emissions	Possible	Moderate	Medium
		Hazardous materials	Likely	High	High
		Surface water and groundwater	Likely	High	High
		Erosion and sedimentation	Likely	High	High

Project component	Description	Risk	Likelihood	Consequence	Outcome
		Dust	Likely	Moderate	Medium
		Bushfire	Possible	High	Medium
		Pests and weeds	Likely	High	High
Other supporting infrastructure	Staging pad	Impacts to threatened species	Possible	High	Medium
		Habitat loss	Likely	Moderate	Medium
		Habitat fragmentation	Likely	Moderate	Medium
		Injury or mortality	Possible	High	Medium
		Reduced air quality	Likely	Moderate	Medium
		Noise and vibration	Likely	High	High
		Light emissions	Likely	High	High
		Hazardous materials	Likely	High	High
		Surface water and groundwater	Possible	Moderate	Medium
		Erosion and sedimentation	Likely	High	High
		Dust	Highly likely	High	High
		Bushfire	Possible	Moderate	Medium
		Pests and weeds	Likely	High	High
	Civil construction compound (laydown area)	Impacts to threatened species	Possible	High	Medium
		Habitat loss	Possible	Moderate	Medium
		Habitat fragmentation	Likely	Moderate	Medium
		Injury or mortality	Possible	High	Medium
		Reduced air quality	Likely	High	High
		Noise and vibration	Likely	High	High
		Light emissions	Likely	Moderate	Medium

Project component	Description	Risk	Likelihood	Consequence	Outcome
		Hazardous materials	Highly likely	High	High
		Surface water and groundwater	Likely	High	High
		Erosion and sedimentation	Likely	High	High
		Dust	Likely	High	High
		Bushfire	Possible	Moderate	Medium
		Pests and weeds	Likely	High	High

Appendix F -
Specific management measures – NC Act listed species

Species	Responsibility	Additional control measures	Milestone/completion criteria	Monitoring	Corrective actions
Birds					
Plumed frogmouth, *Podargus ocellatus plumiferus*	• Construction manager, site/project engineer, environmental management representative	• Clearly delineate clearing boundaries and 'restricted areas with flagging tape, barricade fencing, fluorescent marker or signage prior to clearing commencing to avoid unnecessary clearing and to ensure personnel and vehicle stay within the approved footprint, avoiding contravention of disturbance limits. • Install cameras along access tracks to monitor pest fauna traffic, including feral pigs and cats. • A Biosecurity Management Plan will be developed following Exploratory Works Project approval. The Biosecurity Management Plan will include appropriate thresholds for management action, linked to the level of activity of pest species. • Conduct works outside the breeding period (May – June) where possible. Where this is not possible, the following will be implemented: – Establish a exclusion zone and/or buffer zone around active nests and erect appropriate signage if it is possible to wait until breeding is finished or complete works without impacting the breeding place. Where this is not possible, relocate offspring with nest – Engage a suitably qualified spotter-catcher to monitor for abandoned offspring and take to an authorised wildlife carer.	• No incursion/clearing in exclusion and buffer zones, unless authorised. • No exceedance of clearing limits for fauna habitat through Exploratory Works Project timeframes. • No significant impact on native fauna populations directly attributable to the Exploratory Works Project	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities.	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Action any identified non-conformance within 7 days of identification.
Powerful owl, *Ninox strenua*	• Construction manager, site/project engineer, environmental management representative	• Conduct pre-clearing surveys, mark trees currently being utilised and if required relocate to suitable areas directly adjacent the footprint individuals and offspring encountered. • Pre-clearance surveys will be conducted by a suitability qualified person to identify any areas currently being utilised. Trees with potential breeding hollows will be marked for inspection (prior to and during clearing operations). • Where not in use, the hollow will be 'blocked' to prevent breeding. • Avoid the removal of hollow-bearing trees and large trees (i.e. >50 cm DBH in case hollows are not visible) to the fullest extent possible. Trees with hollows that cannot be avoided will be placed on the ground to create fauna habitat where suitable (i.e. where limbs can be removed and relocated). • Works around active breeding locations will be halted until the animals have moved on or can be safely relocated. Works will be moved to alternative locations if these options are not possible.	• No incursion/clearing in exclusion and buffer zones, unless authorised. • No exceedance of clearing limits for fauna habitat through Exploratory Works Project timeframes. • Wherever practicable, minimise the clearing of large hollow-bearing trees, identified during pre-clearance surveys. • No significant impact on native fauna populations directly attributable to the Exploratory Works Project	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities. • Monitoring replacement hollows as per Appendix D.	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Any fauna injuries or deaths are required to be reported firstly to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. The cause of injury or death will be investigated, and any required changes will be implemented. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Action any identified non-conformance within 7 days of identification.
Mammals					
Short-beaked echidna, *Tachyglossus aculeatus*	• Construction manager, site/project engineer, environmental management representative	Aim to conduct clearing works outside the breeding period (August – February) where possible with project scheduling and design. Where this is not possible, the following will be implemented: • Suitably qualified ecologists or fauna spotter catchers are to conduct pre-clearing surveys to locate burrows within 30 m of the works • Hollow logs will be relocated to adjacent habitat areas prior to clearing commencing • If a nursery burrow is detected that appears to be active, an assessment of the development stage of the young will be undertaken using a borescope or similar alternative	• No incursion/clearing in exclusion and buffer zones, unless authorised. • No exceedance of clearing limits for fauna habitat through Exploratory Works Project timeframes. • No significant impact on native fauna populations directly attributable to the Exploratory Works Project	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities. • Monitoring replacement hollows as per Appendix D.	• Any fauna injuries or deaths are required to be reported firstly to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. The cause of injury or death will be investigated, and any required changes will be implemented. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Action any identified non-conformance within 7 days of identification.

Species	Responsibility	Additional control measures	Milestone/completion criteria	Monitoring	Corrective actions
		• Where individuals or nursery burrows are found and it is not possible to stop works, relocate individuals to suitable areas directly adjacent the footprint, or take to an authorised wildlife carer • The suitably qualified spotter-catcher is to monitor for abandoned offspring and take to an authorised wildlife carer.			
Platypus, *Ornithorhynchus anatinus*	• Construction manager, site/project engineer, environmental management representative	• Design of works in the vicinity of waterways (e.g. bridges) will avoid direct impact to known breeding sites. Where this is not possible, the mitigation and management measures identified in the below sections will be implemented. • Install appropriate erosion and sediment control (e.g. sediment fences). Buffer zones have been implemented around the spoil disposal areas to minimise runoff into Yabba Creek, Sandy Creek and Kingaham Creek. • Size erosion and sediment control components and water recycling/reuse components with appropriate redundancy/buffer capacity as determined by Queensland Hydro. • Select machinery and equipment that is likely to result in the lowest impact to the surrounding area. • Bund stockpiles. • Pre-works surveys to be undertaken in the vicinity of waterways to inspect for nesting sites. • Undertake earthworks during periods of low rainfall and low flow (e.g. dry season) where possible. Where this is not possible due to project scheduling, the following will be implemented: – Employ sediment and erosion control measures on site through implementation of an Erosion and Sediment Control Plan – Review these to ensure they are adequate for the conditions and implement additional measures where required. • Works will target instream and bank-disturbing works outside the platypus breeding period (August to January). Where this is not possible due to project scheduling or design constraints, the following mitigation measures will be implemented: – A pre-clearance survey will be undertaken by an ecologist or the Project fauna spotter catcher experienced in platypus surveys, or with other suitably qualified fauna spotter catcher's under their supervision. – The survey will be undertaken within one (1) week prior to commencement of works on site. – Detailed searches should occur within a 30 m buffer to the works area. The surveys shall be conducted when water levels are low where possible to increase the likelihood of observing a burrow. Given the high density of weeds along the banks, some hand removal may be required to assist with targeted searches. – Surveys should be undertaken at dusk or dawn (typical of platypus ecology). – If a burrow is detected, an assessment of possible length and depth will be undertaken using a borescope (or similar). The Project fauna spotter catcher will determine if the burrow is active or empty.	• No incursion/clearing in exclusion and buffer zones, unless authorised.. • No exceedance of clearing limits for fauna habitat through Exploratory Works Project timeframes. • No significant impact on native fauna populations directly attributable to the Exploratory Works Project	• Monitoring will be undertaken to ensure exclusion and buffer zones fencing and signage remains in serviceable condition. • FSC will keep a record of any fauna relocated during clearing activities.	• Inspect and repair damaged fencing; replace any flagging tape or respray fluorescent marker. • Where clearing extends outside the approved disturbance limits, a record must be taken of the incident and an investigation will occur. • Temporarily disturbed areas that are no longer required to be cleared will be assessed for restoration and revegetation. • Any fauna injuries or deaths are required to be reported firstly to the Exploratory Works Project Environmental Manager and then DETSI and/or DCCEEW if it involves a threatened species. The cause of injury or death will be investigated, and any required changes will be implemented. • Fuel or chemical spills are to be bunded and cleaned as soon as possible in accordance with the Exploratory Works Project CEMP. • Action any identified non-conformance within 7 days of identification.

Species	Responsibility	Additional control measures	Milestone/completion criteria	Monitoring	Corrective actions
		– If works are undertaken during the breeding season, the Project fauna spotter catcher must advise the person in charge of this species management program of the most appropriate course of action in accordance with this SMP. – If dewatering is required, fauna exclusion fencing (similar to sediment fencing or plastic sheeting) will be erected to delineate the Project area and prevent animals from moving into construction site. A fauna spotter catcher with experience in platypus management must be present during dewatering. – If a burrow is found within the construction zone during dewatering, the Project fauna spotter catcher will need to act immediately to determine if the burrow is active or empty. – If breeding platypus are present in a burrow, the following measures will be implemented: – Avoid the area and not disturb the breeding female/lactating with offspring. No works to occur in this area or within 30 m of the burrow – Fauna spotter catcher to monitor until breeding and rearing is finished and offspring become completely independent – A wildlife carer with experience in Platypus should be notified up to two (2) weeks prior to the preclearance survey and commencement of works. – Restrict clearing to the minimum area necessary to complete the works. To ensure the boundaries are not exceeded, no-go zones are to be established before commencing works. – Target periods of low rainfall and low flow for earthworks activities where possible. Where this is not possible due to project scheduling, the following will be implemented: – Employ sediment and erosion control measures on site through implementation of an Erosion and Sediment Control Plan – Review these to ensure they are adequate for the conditions and implement additional measures where required. – Leave temporary erosion control measures in place following construction until bare soil has stabilised / progressive rehabilitation is implemented. – Rehabilitate all disturbed areas to achieve stable and sustainable soil cover and minimise sediment run off. – Where possible, construction on creek banks with dense overhanging riparian vegetation should be avoided to retain suitable breeding places. Where avoidance is not possible, clearing of this vegetation will be minimised and preference given to trimming rather than complete removal in adjacent areas. – Waterway crossings to ensure they do not impede environmental flows, including any temporary works (i.e. to conform with the Accepted development requirements for operational work that is constructing or raising waterway barrier works (DAF, 2018)). – Minimise noise and vibration during night hours – No blasting or other high intensity vibratory works will be undertaken within 200 m of known active breeding sites during breeding seasons unless otherwise approved by a noise/vibration specialist and experienced ecologist..			

Species	Responsibility	Additional control measures	Milestone/completion criteria	Monitoring	Corrective actions
Amphibians					
Tusked frog, *Adelotus brevis*	• Construction manager, site/project engineer, environmental management representative	• As per giant barred frog (*Mixophyes iteratus*), refer to Section 6.2	• As per giant barred frog (*Mixophyes iteratus*), refer to Section 6.2	• As per giant barred frog (*Mixophyes iteratus*), refer to Section 6.2	• As per giant barred frog (*Mixophyes iteratus*), refer to Section 6.2

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Appendix K – Water Management Plan

Queensland Hydro

Prepared for the Borumba PHES Project

Borumba Pumped Hydro Energy Storage Project – Exploratory Works Water Management Plan

DOCUMENT NUMBER: BR-NA-NON-ECT-PLN-00001

OCTOBER 2025

Contents

1. Introduction 1
   1.1 Background 1
   1.2 Plan purpose and objectives 2
   1.3 Environmental Management 2
2. Regulatory requirements and compliance 3
   2.1 Environmental Protection Act 1994 3
   2.2 Environmental Protection (Water and Wetland Biodiversity) Policy 2019 3
   2.3 Fisheries Act 1994 3
   2.4 Water Act 2000 3
3. Existing environment and Exploratory Works Project water use requirements 5
   3.1 Water environment 5
   3.2 Project water use 11
4. Overview of potential impacts to water 13
   4.1 Impact sources 13
   4.2 Potential impacts to groundwater 16
   4.3 Inherent Project risks for water 16
   4.4 Risk analysis for impacts to water quality and protected species 18
5. Risk assessment 20
6. Mitigation and management measures 23
   6.1 Water consumption, generation, segregation, storage and reuse 28
   6.2 Water quality management infrastructure 29
   6.3 Water quality objectives 30
   6.4 Standard mitigation measures for water 31
   6.5 Water quality monitoring 33
7. References 34

Figures

Figure 1: Exploratory Works footprint 1
Figure 2: Mary River Catchment 6
Figure 3: Watercourses and wetlands 7

Tables

Table 1: Hydrostratigraphic units 8
Table 2: Exploratory Works within or adjacent to surface water bodies 13
Table 3: Risk assessment 21
Table 4: Risk controls 24
Table 5: Basic water quality management infrastructure 30

Acknowledgement of Country

In the spirit of reconciliation, Queensland Hydro acknowledges the Traditional Custodians of Country throughout Queensland and, in particular the lands, skies and waters on which we operate. We celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands, skies and waters of Queensland.

Queensland Hydro pays respect to Elders past and present honouring their continuing spiritual and cultural connections to Country.



Acronyms and abbreviations

Term	Description
Borumba PHES Project	Borumba Pumped Hydro Energy Storage Project
CEMP	Construction Environmental Management Plan
DETSI	Department of Environment, Tourism, Science and Innovation
EIS	Environmental impact statement
EP Act	*Environmental Protection Act 1994*
EV	Environmental values
km	Kilometre
MNES	Matters of national environmental significance
MP	Management plan
NAG	Net acid generation
PHES	Pumped Hydro Energy Storage
WQO	Water quality objectives

1. Introduction

1.1 Background

Queensland Hydro is the proponent of the Borumba Pumped Hydro Energy Storage (PHES) Project. The Borumba PHES Project is a 2,000 megawatt (MW), 48,000-megawatt hour (MWh), hydroelectric scheme to store, generate and supply energy through a pumped hydroelectric structure linked to the existing Lake Borumba in the Gympie and Somerset Regional Council local government areas.

The Borumba PHES Project is located within the Gympie and Somerset Regional Council local government areas, approximately 13 kilometres (km) southwest of the township of Imbil, 48 km southwest of Gympie, and 180 km northwest of Brisbane.

The purpose of the Exploratory Works is to undertake and facilitate critical technical investigations to confirm the suitability of the Borumba PHES Project location and design. Investigation is particularly required in areas where key subsurface infrastructure will be constructed due to limited technical geological information currently available posing considerable project risk.

The Exploratory Works, relevant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) controlled action, comprise the following components:

- geotechnical investigations including test pits, boreholes and geophysics
- spoil disposal:
  - tunnel spoil disposal area
  - Kingaham spoil disposal area
- site access:
  - new access tracks
  - upgrades to existing tracks
  - Kingaham Creek bypass (realignment of a section of Bella Creek Road)
- other supporting infrastructure:
  - civil construction compound
  - temporary water infrastructure
- exploratory tunnel infrastructure:
  - dual exploratory tunnels
  - portal pad and access track
  - water management infrastructure
  - staging pad
  - explosive store and access track.

The Construction Environmental Management Plan (CEMP) for the Exploratory Works Project provides a detailed description of the Exploratory Works and associated activities – refer to section 2 of the CEMP.

The location and footprint of the Exploratory Works is illustrated in Figure 1.

Queensland Hydro

GDA2020 MGA Zone 56

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LEGEND

- Watercourses
- Local Roads
- Tracks
- State Controlled Roads
- Lake Borumba (FSL 135.01m AHD)

Exploratory Works Project

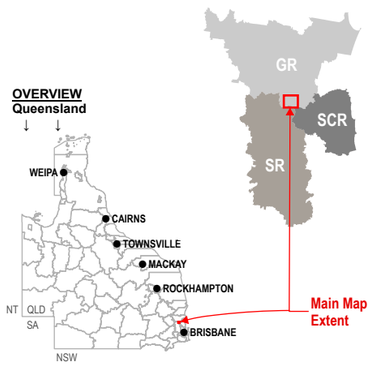
Project Footprint by Work Area

- Area 1 - Borumba Dam
- Area 2 - Kingaham Creek
- Area 3 - Walkers Top
- Area 4 - Borgan

Project Component - Underground

- Area 3 - Walkers Top

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



Data Sources:
1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
3. Watercourses © State of Queensland (Department of Natural Resources, Mines and Energy) 2022
4. Cadastre © State of Queensland (Department of Natural Resources, Mines and Energy) 2024
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Exploratory Works Project
Preliminary Documentation

EXPLORATORY WORKS FOOTPRINT

PROJECT #:	30032677/30032772
CREATED BY:	BM
LAST MODIFIED:	NC17428, 29/09/2025
REVISION:	A

FIGURE 1

Document Path: V:\Projects\Borumba PD_Maps\Borumba PD_APRX\Borumba PD_APRX_Reinket_UpdatedPD.aprx

1.2 Plan purpose and objectives

This Water Management Plan (MP) has been prepared to guide the management of water (generation, use, reuse) and impacts to water (watercourses, groundwater) during the Exploratory Works.

Water management measures are required to ensure the quality and environmental values of the water environment are protected, and water consumption and reuse are optimised across the Exploratory Works.

This Water MP is a live document and will be updated as required during the Exploratory Works Project to reflect updates to the site investigation findings and program.

1.3 Environmental Management

The overall approach to environmental management for the Exploratory Works Project is described in the CEMP. The CEMP provides a framework for a comprehensive, integrated approach to environmental management during implementation of the Exploratory Works.

The Water MP forms part of Queensland Hydro's environmental framework as described in the CEMP. It has been prepared for the Exploratory Works and does not apply to the Main Works component of the Borumba PHES Project.

2. Regulatory requirements and compliance

The following Queensland legislation is particularly relevant to this Water Management Plan:

- *Environmental Protection Act 1994* (EP Act), Environmental Protection (Water and Wetland Biodiversity) Policy 2019
- *Fisheries Act 1994*
- *Water Act 2000*.

Depending on detailed work activities and the impacts to/from water, legislative requirements – requiring approval and/or notification – may be triggered under these acts and regulations. Clarification on the specific applicable triggers, approvals and notification requirements shall be sought by the contractors engaged for the Exploratory Works Project, as works planning progresses. Queensland Hydro will obtain or ensure that contractors have the relevant licences, permits and approvals as required by law and maintain them as required throughout the delivery phase of the Exploratory Works Project.

2.1 Environmental Protection Act 1994

All persons have a general environmental duty under the EP Act to not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonably practicable measures to prevent or minimise the harm. This includes harm to water bodies – quality, values and ecosystems.

2.2 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The Environmental Protection (Water and Wetland Biodiversity) Policy 2019 provides a framework for:

- identifying environmental values (EVs) and management goals (quantitative measures or narrative statements that may be used to assess whether EVs are maintained) for Queensland waters and wetlands
- stating water quality guidelines and water quality objectives (WQOs) to enhance or protect the EVs
- providing a framework for making consistent, equitable and informed decisions about waters
- monitoring and reporting on the conditions of waters.

See Section 6.3 for a discussion of the WQOs relevant to the waterways intersecting the Exploratory Works Project. The current relevant document for WQOs under this legislation is the ‘Environmental Protection (Water) Policy 2009 Mary River environmental values and water quality objectives’.

2.3 Fisheries Act 1994

Multiple crossings of waterways mapped for fish passage under the *Fisheries Act 1994* are proposed for the Exploratory Works Project. Under the *Planning Act 2016*, the construction or raising of a waterway barrier is assessable development and requires development approval unless works comply with the accepted development requirements for the works prescribed under the *Fisheries Act 1994*.

This will be required for the construction of temporary bridges across Yabba Creek and Sandy Creek for the Exploratory Works Project, where they do not meet the criteria in the Department of Agriculture and Fisheries ‘What is not a waterway barrier’ fact sheet.

2.4 Water Act 2000

2.4.1 Operational work for taking or interfering with water in a watercourse, lake, or spring.

Water will be required for Exploratory Works Project activities and will be sourced from Lake Borumba or Yabba Creek. A contract is in place to purchase water from Seqwater through a River Supply Contract (medium priority allocation). Additionally, Queensland Hydro has obtained a water permit from the Department of Local Government, Water and Volunteers for interim water needs.

2.4.2 Excavation, placement of fill and the destruction or removal of vegetation within a watercourse – Riverine Protection Permit.

A riverine protection permit (or compliance with the riverine protection permit exemption requirements) is required before excavating, placing fill, or destroying vegetation in any watercourse, lake or spring.

Removal of vegetation and extraction of materials will be required for the construction of waterway crossings for Exploratory Works access tracks. A riverine protection permit will be required for some of these crossing locations, and the works may also constitute assessable development requiring development approval, unless otherwise exempt under the *Planning Act 2016*.

3. Existing environment and Exploratory Works Project water use requirements

3.1 Water environment

3.1.1 General description

The Exploratory Works Project is located in the Upper Mary River sub-basin of the Mary Basin (Figure 2), which is a Great Barrier Reef Catchment. Lake Borumba is a reservoir in the Yabba Creek sub-catchment; it is managed by Seqwater and is used to supply water for drinking and irrigation. Water in the Mary Basin is managed under the Water Plan (Mary Basin) 2024, which is subordinate to the *Water Act 2000* and works within the catchment must be consistent with the Seqwater Development Guidelines for Water Quality Management in Drinking Water Catchments 2017 (Seqwater Development Guidelines) (refer to section 2 for more information).

Yabba Creek joins the Mary River 31.1 km downstream of Borumba dam. It is approximately 226 km to the tidal barrage near Maryborough and approximately 238 km in total to reach the boundary of the Great Sandy Strait Ramsar wetland (Figure 3).

Stream flow in the Mary Basin:

- is highly seasonal
- varies considerably from year to year
- generally corresponds with rainfall, with the wet season occurring between December and March.

Lake Borumba stores drinking and irrigation water for the Mary Valley irrigation scheme, and provides a diverse array of recreational opportunities, including fishing, paddle craft, sailing, motorised water sports and camping.

Waterways in the Mary basin range from ephemeral creek systems to permanent flowing rivers and creeks. The waterways in or near the Exploratory Works footprint range from Strahler order 1 to order 6 streams.

The major waterways in the vicinity of the Borumba PHES Project and the Exploratory Works include: Yabba Creek, Bella Creek, Kingaham Creek, Borumba Creek, and Sandy Creek.

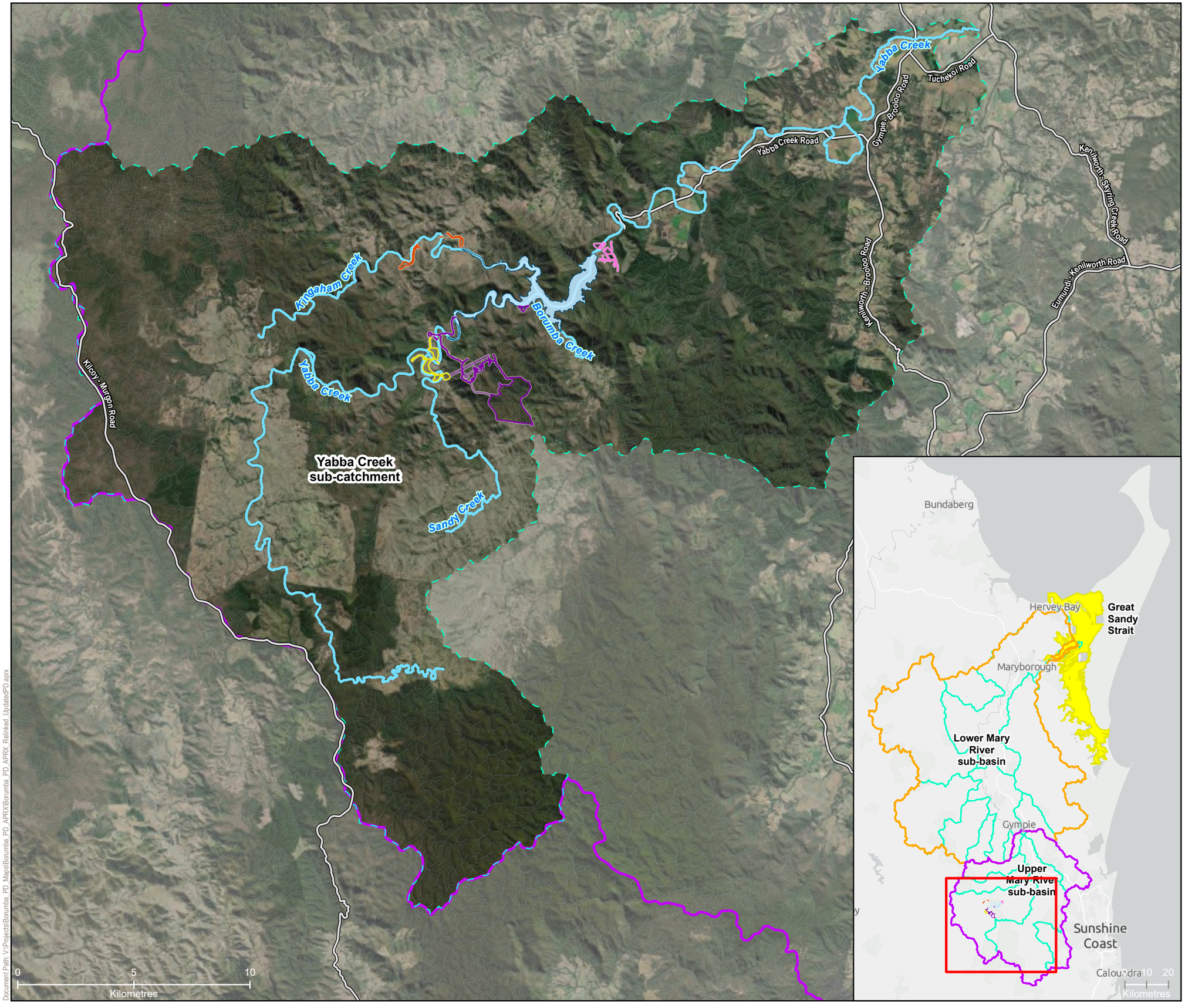
There is limited groundwater information for the Exploratory Works Project area; however, a hydrogeological fieldwork program that included construction of 22 monitoring bores commenced in September 2023. The works incorporated hydraulic testing and installation of telemetry monitoring equipment. A conceptual hydrogeological model has been developed for the Borumba PHES Project and numerical modelling is currently in progress.

There are no registered groundwater bores in the vicinity of the Exploratory Works upstream of Borumba dam, but there are five registered bores within 5 km downstream and a number around Imbil. Groundwater is not used in the vicinity of the Exploratory Works Project, but is more extensively used in the broader region.

The geological units of the study area can be grouped into three general hydrostratigraphic units based on their ability to store and transmit groundwater and also on the degree of weathering in bedrock (Table 1). The conceptual hydrogeological model indicates that groundwater is available from an aquifer associated with alluvial deposits on Yabba Creek and its tributaries. Away from the Quaternary alluvium, groundwater occurs in discontinuous aquifers with limited yields.

Based on data from preliminary geotechnical studies, groundwater levels near the proposed new Borumba dam wall (approximately 300 m downstream of the existing dam wall) range from 2.4 m below ground level to 37.3 m below ground level. At the saddle dam sites for the proposed upper reservoir, groundwater ranged from 4.9 m to 30.5 m below ground level (AGE, 2024).

There are currently insufficient groundwater level observations to accurately produce a groundwater table contour, but the groundwater table is likely to mirror topography, with groundwater flows generally draining towards creeks and valleys. No preferential flow paths due to geological structures are evident based on the available water level data.



Queensland Hydro

GDA2020 MGA Zone 56

(scale displayed on each map view)

LEGEND

- Lake Borumba (FSL 135.01m AHD)
- Watercourse

Exploratory Works Project

Project Area by Work Area

- Area 1 - Borumba Dam
- Area 2 - Kingaham Creek
- Area 3 - Walkers Top
- Area 3 - Walkers Top (Underground)
- Area 4 - Borgan

Sub-basin

- Lower Mary River
- Upper Mary River

Sub-catchment

- Mary Basin sub-catchments

Conservation Park Zone

- Great Sandy Strait Conservation Park Zone

Data Sources:

1. State controlled roads - Queensland © State of Queensland (Department of Transport and Main Roads) 2020
2. Roads (QRT) @ © State of Queensland (Department of Resources) 2021
3. Site Layout Items FEED 2 @ AFRY, Feb 2023 and GHD Nov 2022, SMEC 2024
4. Watercourses and Cadastre © State of Queensland (Department of Natural Resources, Mines and Energy) 2021
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Exploratory Works Project
Preliminary Documentation

MARY RIVER CATCHMENT

PROJECT #:	30032677
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LAST MODIFIED:	NC17428, 7/10/2025
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FIGURE 2

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Queensland Hydro

GDA2020 MGA Zone 56

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LEGEND

- State Controlled Roads
- Local Roads
- Tracks
- Lake Borumba (FSL 135.01m AHD)
- High Ecological Significance Wetlands

Watercourse identification map [Water Act 2000]

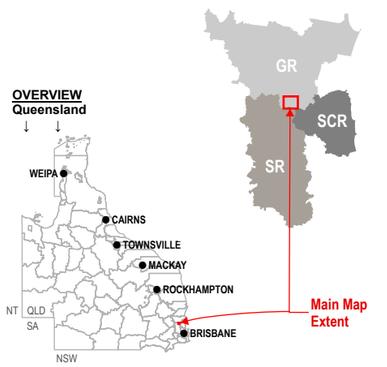
- Watercourse
- Drainage feature

Exploratory Works Project

Project Area by Work Area

- Area 1 - Borumba Dam
- Area 2 - Kingaham Creek
- Area 3 - Walkers Top
- Area 3 - Walkers Top (Underground)
- Area 4 - Borgan

OVERVIEW
Gympie Regional, Somerset Regional, Sunshine Coast Regional



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2. Site Layout Items @ SMEC/ GHD / AFRY, 2022-2023
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Exploratory Works Project
Preliminary Documentation

WATERCOURSES AND WETLANDS

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LAST MODIFIED:	NC17428, 1/10/2025
REVISION:	A

FIGURE 3

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Table 1: Hydrostratigraphic units

Hydrostratigraphic unit	Classification	Dominant lithology	Description
Quaternary alluvium and colluvium	Aquifer	Clay, silt, sand, and gravel; flood-plain alluvium	Forms a relatively thin aquifer system where it occurs along Yabba Creek and its tributaries
In-situ regolith – Residual soil to highly weathered rock	Limited aquifer	Unconsolidated, in situ weathered material that is variably weathered to clayey material which forms a cap over the underlying bedrock.	Forms a thin and variably permeable, residual soil to highly weathered rock at the surface. They generally do not form continuous aquifers due to limited and variable saturated thickness.
Fractured rock aquifer – Moderately weathered to fresh rock	Fractured rock aquifer	Marumba Beds Mudstone, sandstone, conglomerate, rhyolite	They generally do not form significant aquifers but can have limited water yields from localised storage when faults and fractures are present within the rock mass.
		Amamoor Beds Mudstone, slate, basic metavolcanics, chert, schist, jasper, greywacke	
		Tungi Creek Granodiorite Biotite-hornblende granodiorite; hornblende-biotite granite	
		Mount Mia Serpentinite Serpentinite and serpentinite matrix melange with blocks of serpentinite, mafic greenschist, and locally phyllite; sporadic inclusions of blueschist, quartz-mica schist, marble, and quartzite; rare inclusions of gabbro, amphibolite, lherzolite, wehrlite.	
		Anderson Creek Phyllite Polydeformed phyllite	

3.1.2 Existing water quality

Several studies have been undertaken to support the assessment of surface and ground water for the Borumba PHES Project:

- Hydrobiology (2022). Borumba Dam Pumped Hydro Project – Detailed Analytical Report, Water and Sediment Quality Assessment.
- Hydrobiology (2022). Aquatic Ecology – Borumba Pumped Hydro Project. Report prepared for Queensland Hydro.
- AGE (2022). Borumba Pumped Hydro Project Groundwater Assessment Technical Report.
- Epic Environmental (2022). Desktop assessment; Contamination Technical Report.
- Attexo (2022). Soils Assessment Technical Report.
- ENGEO Australia Pty Ltd (2022). Borumba Pumped Hydro Energy Storage (PHES) Project, Lake Borumba, Queensland. Geotechnical Investigation. 19754.000.001 (included because they analysed the encountered rock strata for contamination).

Each report undertook an extensive review of existing information, designed a field sampling program, and in the case of Hydrobiology (both reports), undertook one round of field survey prior to preparing a technical report. After reporting, Hydrobiology undertook a further round of survey for both surface water quality and aquatic ecology and reported it in interim reports (the intention being to update the technical report with all relevant information for inclusion in a future environmental impact statement (EIS) for the Borumba PHES Project Main Works).

Surface and ground water quality monitoring is ongoing, as well as telemetry monitoring of electrical conductivity and water levels for groundwater.

3.1.2.1 Surface water

A Surface Water and Sediment Quality Monitoring Program has been implemented to collect background surface water and sediment quality data relative to the Exploratory Works Project. Water quality sampling is also being undertaken for the Borumba PHES Project EIS. Where appropriate, background data will be used to derive percentile estimates for interim project specific guidelines, noting limited historical data exists for most waterways intersected by the Exploratory Works Project. Comparisons to existing WQOs and/or these interim guidelines (if derived) will allow for qualification of both the potential impacts to receiving surface water features, and the efficacy of environmental controls implemented for the Exploratory Works Project.

The field programs sample approximately 30 sites that are upstream, within and downstream of Lake Borumba, including multiple tributaries and the area of the proposed upper reservoir. The frequency of sampling at each location has varied subject to land access and other Project related requirements.

Sampling locations were nominated upstream and downstream of potentially impacted areas for the Exploratory Works Project and Borumba PHES Project, including in Yabba Creek (both upstream and downstream of Lake Borumba), Kingaham Creek, Bella Creek and Sandy Creek.

Surface water parameters monitored monthly[1] at each site include physicochemical parameters (pH, electrical conductivity, dissolved oxygen, turbidity, total dissolved solids, total suspended solids, chlorophyll α), nutrients, metals (total and dissolved and *Escherichia coli* bacteria and microbiology (select locations only). Hydrocarbons, oil and grease, and herbicides and pesticides analysis is also undertaken on surface water samples every six months, with the analysis frequency reduced after following three rounds of no detections for these parameters.

Sediment samples are collected and analysed every six months for a similar set of parameters including physicochemical parameters, nutrients, metals, hydrocarbons, and oil and grease.

The current sampling frequency and location selection will be adjusted as ongoing data becomes available and the Exploratory Works Project continues.

The sampling results were compared to the relevant water quality objectives and default guideline values from Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) for 95% species protection, Australian Drinking Water Guidelines (NHMRC, 2011), and others as described in the Mary River environmental values and water quality objectives (DERM, 2010), which are part of the Environment Protection

[1] At the time this version was prepared.

(Water and Wetland Biodiversity) Policy 2019. The following general observations were made based on data recorded between November 2023 and May 2024, with respect to the initial guideline values:

- Dissolved oxygen, pH and chlorophyll α were noted to be outside the guideline values at a number of locations in multiple sampling events
- Exceedances of total suspended solids were detected at several locations, including upper reservoir within the proposed raised full supply level, downstream at Lake Borumba, Yabba Creek and far downstream of Mary River near Miva. These mostly occurred in November and December 2023, which could be attributed to rain events prior to sample collection in these months.
- Exceedances of aluminium (total), copper (filtered), iron (total) and manganese (total and filtered) were noted at the majority of locations across all rounds. Exceedances of nickel and zinc were also noted in some locations on certain rounds. Exceedances of chromium (total); zinc (total and filtered), nickel (total and filtered), copper (total and filtered), manganese (total and filtered) at most of the sampling locations.
- Ammonia (as N) and total nitrogen exceeded the adopted guideline value at most locations during most rounds. Nitrate + nitrite exceedances were also noted in some locations. Exceedances of total phosphorus were also noted, with the majority of exceedances occurring in November and December 2023.
- *Escherichia coli* bacteria exceedances were recorded at most locations where it was analysed during the surveys to date.

3.1.2.2 Groundwater quality

The following preliminary observations were made from the laboratory analysis of groundwater data collected during the construction of the boreholes and initial sampling round between August 2023 and March 2024:

- Groundwater quality in the vicinity of the proposed lower reservoir is classified as freshwater, with total dissolved solids concentrations consistently <800 mg/L. This correlates with elevated concentrations of chloride exceeding the long term irrigation ANZECC guidelines.
- Groundwater quality in the vicinity of the proposed upper reservoir varies between freshwater and brackish water which correlates with elevated chloride concentrations exceeding the ANZECC long term irrigation guidelines in all samples. Elevated sodium concentrations were also observed in several of these samples.
- Water from monitoring bores generally had low concentrations of nutrients, except for concentrations of total nitrogen and total phosphorous in some samples in the vicinity of the proposed lower reservoir exceeding the long-term irrigation Australian and New Zealand Environment and Conservation Council guidelines in September 2023, and two boreholes (UR01-MB011 and UR01-MB013) having consistently elevated ammonia concentrations, ranging between 6 and 136 mg/L, exceeding the National Health and Medical Research Council drinking water guidelines.
- Elevated concentrations of total aluminium, arsenic, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel and vanadium in several samples in both the proposed upper and lower reservoir areas. Elevated uranium was also observed in some samples in the proposed upper reservoir area.
- Comparison of total and dissolved metal results showed that most concentrations decreased significantly in the dissolved fraction, confirming that the majority of total metals are attached to suspended materials in the water and suggesting that filtration would improve water quality in most cases. However, elevated concentrations of dissolved arsenic, total chromium, manganese, and nickel were observed in some samples.
- Total concentrations for multiple metals were higher than freshwater aquatic ecosystem guidelines[2] and / or drinking water guidelines (NHMRC, 2011) at all bores at different times.

3.1.2.3 Potential contamination

A preliminary contaminated land assessment included searches of the Department of Environment, Tourism, Science and Innovation (DETSI) Environmental Management Register and Contaminated Lands Register. There are no lots listed on the contaminated land register and as of December 2023 three lots are listed on the environmental management register that intersect with the Exploratory Works footprint:

[2] Australian and New Zealand guidelines for fresh and marine water quality (2018) and National Health and Medical Research Council Australian Drinking Water Guidelines (2011, v3.8 updated September 2022)

- Lot 3LX2754 is listed for the notifiable activity of mineral processing (noting a livestock dip and spray race are present)
- Lot 1723L37994 is listed for the notifiable activity of livestock dip or spray race
- Lot 135FTY1911 is listed for two notifiable activities:
  - petroleum product or oil storage
  - waste storage, treatment, or disposal.

All mining activity is historical (generally several decades). Including other nearby mine workings, the metals sought were gold, silver, manganese and nickel.

The water pipeline (part thereof), tunnel spoil disposal area, portal pad and access track and the construction compound are located on the same lots as those listed as potentially contaminated. However, the actual sites of potential contamination are discrete areas that are easily identified and avoided.

A site contamination investigation completed in July 2023 targeted the tunnel spoil disposal area and portal pad on Lot 1723L37994. Fifteen sites at the portal pad and 25 sites at the tunnel spoil disposal area were sampled using a hand auger to a depth of 1 m or refusal. Samples were collected at the surface (0-0.15 m), 0.5 m and 1.0 m with additional samples collected where the change in lithology and/or potential contamination was observed. Analysis of the samples found no sign of contamination, with all results except for metals below the laboratory limit of reporting, and the concentrations of all metals lower than the relevant ecological and human health criteria (SMEC, 2023). It was also confirmed that no livestock dip or spray race is present on this lot.

Additional contaminated land assessments are currently being undertaken in accordance with relevant guidelines and procedures for the Exploratory Works Project (targeted investigation on Lot 3LX2754) and across the Borumba PHES Project footprint in support of the EIS. This information will be used to inform management strategies for the Exploratory Works Project (e.g., need for soil disposal permits and treatment of spoil).

A geotechnical report completed by ENGEO (2022) noted that while concentrations of the tested suite of metals were generally below any guideline, some samples contained cadmium, nickel or copper which were above levels wherein the material was considered safe for reuse as fill. This relates well to the surface water and sediment quality results, and suggests those results are based on the natural geology of the underlying rock rather than sources of anthropogenic contamination.

To characterise spoil material, a total of 20 samples were analysed by ENGEO for net acid production potential, net acid generation and acid neutralising capacity in rock from nine locations. All samples were classified as non-acid-forming material. Therefore, there are no concerns in relation to the management of acid drainage from spoil stockpiles.

Geochemistry analysis of the geotechnical boreholes is currently planned as part of the future geotechnical investigations, including recently constructed boreholes. In addition, geochemistry analysis of excavated material will be undertaken progressively during the tunnelling works. This information will inform management measures such as the segregation, storage and treatment of the material at the tunnel spoil disposal area.

Further, the presence of a livestock dip has been confirmed on lot 16LX1925, though this land parcel is not listed on the EMR. Preliminary investigations have been undertaken in this area and have not identified any contaminants that exceeded adopted assessment criteria to date.

3.2 Project water use

Water is required during the Exploratory Works for civil/construction use, exploratory tunnel and geotechnical drilling, and site facilities.

Potable water for site facilities will be brought in by truck. Water for drilling/tunnelling and construction works does not need to be potable, with untreated (raw) or minimally treated water suitable for:

- operation of drilling rigs associated with the geotechnical borehole drilling
- exploratory tunnelling activities (including batching plant operation)
- dust suppression and materials moisture conditioning associated with the surface civil works (roads, tracks, stockpiles etc.).

Raw water will be sourced from the upper reaches of Lake Borumba, Yabba Creek, and/or groundwater ingress during the exploratory tunnelling.

Water sourced from Lake Borumba will be supplied via temporary water infrastructure that includes pumps, pipelines and storage tanks, or water trucks.

4. Overview of potential impacts to water

4.1 Impact sources

Potential sources of impacts to water quality include:

- disturbance of the soil associated with vegetation clearing for pads, tunnelling, stockpiles, laydown areas, geotechnical investigations and access tracks
- construction of waterway crossings and runoff from works occurring near waterways or drainage lines
- disturbance of existing contaminated areas
- accidental release of fuel, oil, waste or other chemicals
- discharge of surface/ground water collected during Exploratory Works Project (including from stormwater runoff from works areas, or water from tunnelling or geotechnical activities)
- runoff from spoil stockpiles, which may be contaminated.

The works will occur in several small sub-catchments a short distance upstream of and flowing into Lake Borumba, and also immediately downstream of Borumba dam in the Yabba Creek catchment.

Exploratory Works activities located in and adjacent to surface water bodies could disturb soils, leading to sediments being transported into watercourses and Lake Borumba. This could potentially increase concentrations of turbidity and suspended solids in the water column, degrading water quality values. The Exploratory Works Project components within or adjacent to surface water bodies are listed in Table 2.

Table 2: Exploratory Works within or adjacent to surface water bodies

Surface water body	Location and description of Exploratory Works	
	Within / crossings	Adjacent
Lake Borumba	Nil	• Geotechnical drilling on the southern side of the lake within Seqwater Reserve
Yabba Creek and Sandy Creek upstream of Lake Borumba	• Water intake pump in Lake Borumba and two pipeline crossings of Yabba Creek • One temporary bridge crossing Yabba Creek for the portal pad access track • Three Sandy Creek temporary bridge crossings including explosive store access track and portal pad access track • Four temporary culvert crossings and bed-level crossings associated with bridge construction • Two temporary bed-level crossings over Yabba Creek	• Portal pad • Staging pad • Tunnel spoil disposal area • Explosive store • Civil construction compound • Temporary water infrastructure
Yabba Creek approx. 250 m downstream of the Borumba dam wall	• Geotechnical drilling • New bed-level crossing	• Geotechnical drilling • New and existing access tracks
Kingaham Creek	• Geotechnical drilling	• Kingaham spoil disposal area • Road realignment

Operational activities as part of the above works could lead to the following potential impacts to water:

- increased soil erosion and resultant sedimentation of nearby waterways due to vegetation clearing and general soil handling/earthwork activities
- increased suspended solids and turbidity (colloidal clays can take a long time to settle out of the water column)

- transport of nutrients into the dam which may create conditions suitable for algal blooms
- sediment may also be deposited in the stream beds, changing the aquatic habitat
- contamination associated with accidental spillage, leakage or general release of contaminants from equipment and Exploratory Works activities including:
  - explosives used in tunnelling and drill fluids used in geotechnical boring
  - wastewater from tunnel excavation
  - accidental spillage of fuels or oils.

4.1.1 Exploratory tunnels

The contractor will conduct geotechnical probe drilling in advance of tunnel excavation to obtain information on the geotechnical conditions to be encountered, enabling design of the tunnel support structure, installation of the groundwater management systems and understanding of the rock quality.

Selection of drilling fluids and muds will be authorised by Queensland Hydro and detailed as part of contractor selection process. Drilling water will be recycled in sealed sumps that retain cuttings and drilling fluids.

The exploratory tunnels will be constructed using drill and blast techniques. The exploratory tunnel operation will require water for the underground probe drilling, for batching shotcrete and general plant maintenance. Raw water will be indirectly sourced from Lake Borumba and stored in water tanks.

The contractor will construct storage ponds on the portal pad (or nearby) to store dirty water from their drilling operations and utilise a water treatment plant to minimise the amount of make-up water required each day. Any groundwater seepage in the tunnel will be collected and reused to the greatest extent possible, depending on quality. Dewatering water may be contaminated (water in the deeper aquifer may have higher salinity than in the shallow aquifer) during drilling activities.

4.1.2 Borehole drilling

Fluids used during drilling will be in accordance with the Minimum Construction Requirements for Water Bores in Australia (NUDLC, 2020). The document states “Chemicals and other drilling fluid additives that could leave a residual toxicity should not be added to any drilling fluids or cement slurries (i.e. grouts) used to drill and complete any water bore”. As such the drilling fluid shall be made of natural biodegradable polymers, inert muds, mixed, cleaned and recycled through above ground tanks. Drilling fluid waste will be temporarily captured in 1,000 L water storage pods at each drill site, which will either be removed from the site or emptied by vacuum truck before testing and appropriate disposal (e.g. on site in spoil disposal areas, offsite at a licensed facility).

4.1.3 Test pits

Test pits are small, shallow back-hoe created excavations that are opened and closed within about three hours, so are unlikely to lead to water quality issues. Typically, test pits will be located along existing access tracks or new access tracks constructed as part of the borehole drilling works. They are unlikely to intercept groundwater and any rainwater captured will be allowed to evaporate or will be removed by vacuum truck and disposed of in the same manner to that of borehole drilling wastewater.

4.1.4 Bridges and watercourse crossings

A temporary bridge is required across Yabba Creek to access the exploratory tunnel portal pad. It is planned as a single lane, multi-span Bailey bridge structure. The design of the bridge substructure is expected to comprise concrete cast in-situ abutments founded on concrete bored piers constructed on each bank of the creek. Three additional temporary bridges are required to cross Sandy Creek to access the portal pad and the explosives store.

Temporary waterway crossings of Yabba Creek will be required to facilitate vehicle access along existing tracks and support bridge construction. This will involve upgrading existing bed level crossings through the temporary installation of gravel, concrete bed level crossings or culverts. The type of temporary crossing installed will be determined by the expected traffic volume at the crossing (i.e. gravel to be used where vehicle crossings are infrequent, and concrete or culvert crossings to be installed where there are frequent vehicle crossings).

A temporary, bed level crossing of Yabba Creek is proposed approximately 250 m downstream of the existing Borumba dam wall to enable access for the proposed geotechnical drilling in Conondale Resources Reserve on the northern side of the creek.

Two crossings of Yabba Creek will be required for the temporary water infrastructure pipeline. These may be directional drilled under the waterway or suspended overhead via a temporary steel bridging structure.

4.1.5 Spoil disposal areas

4.1.5.1 Tunnel spoil disposal area

A spoil disposal area is proposed to be located off the portal access road a short distance from Yabba Creek. The proposed spoil disposal area is approximately 11.6 ha in size (~9.1 ha for stockpiling and 2 ha for water management and hardstand areas), to allow for disposal of approximately 395,000 m^3 of excavated loose waste rock material expected to be generated from the exploratory tunnel drilling. Drill cuttings and slurry from exploratory and geotechnical drilling will also be placed in the spoil disposal area. Minor earthworks would be required to prepare the area, including the removal of a small number of trees, ground clearance works and ground levelling to prepare the area to receive spoil material. The stockpile area developed gradually from south to north.

The proposed design of the stockpile is to a height of 5 m with a maximum height of 7 m possible with appropriate management measures (e.g. stabilisation, water management). It is proposed to be lined with a Bentofix NSP 4900 or equivalent below a geogrid layer While not expected, a maximum height of 7 m would allow the tunnel spoil area to accommodate up to 160,000 m^3 of additional excess spoil if required.

A buffer zone of 50 m will be applied to ensure that the spoil disposal area is located a sufficient distance from Yabba Creek and Sandy Creek. Temporary stormwater management and erosion and sediment control will adhere to IECA best practice and be certified by an appropriately qualified Certified Professional in Erosion and Sediment Control. A longitudinal cut-off drain will be installed to minimise surface water runoff and erosion on the portal access track, which is adjacent to the tunnel spoil area. Internal drainage channels will flow directly to lined basins with secondary drains outside the spoil area confinement bunds. Water from the spoil pads will be directed to pump wells for pumping to the water treatment plant. An evaporation basin and an evaporator system may be established to support the management of runoff from the stockpile via erosion and sediment controls.

It is anticipated that cells will be created within the spoil disposal area to contain drill cuttings and slurry. The rock mass would act to retain the fines but allow the water to filter out. The water would then be captured in a sediment dam and re-purposed for construction works or dust suppression on tracks if not contaminated. Contaminated water will be diverted for treatment on-site or disposed of in accordance with the Waste Management Plan.

Incoming spoil material will be initially segregated from the main spoil stockpile while contamination testing results are obtained. There is also an area set aside for the segregation of potential acid rock spoil. Testing for metals will also be undertaken. Should acid sulphate soils, potential acid sulphate soils or contaminated material be found, it will be removed from site and disposed of at an authorised facility or, if appropriate, treated on site.

At the completion of the Exploratory Works, if the Borumba PHES Project does not proceed, the spoil material will be shaped to blend into the natural contours of the surrounding land and kept away from existing drainage features. The spoil material will be stabilised using appropriate methods as defined in the finalised Erosion and Sediment Control Plan (e.g., geofabric).

4.1.5.2 Kingham spoil disposal area

A second spoil disposal area is proposed to be located on Lot 1RP98849 owned by the Department of Local Government, Water and Volunteers off Bella Creek Road. The spoil area is positioned close to the proposed Bella Creek Road realignment (Kingaham Creek bypass), to increase operational efficiencies and avoid the need for laden vehicles to travel through the switchback on Borgan Road.

The Kingaham spoil disposal area will be approximately 200 m by 40 m to allow for the disposal of approximately 95,000 m^3 of material expected to be generated from the construction of the Kingaham Creek bypass that cannot be reused onsite. The material placed in this area would be:

- general soil excavated from the Kingaham Creek bypass
- rock excavation from the Kingaham Creek bypass.

The current design of the stockpile is to a height of 5 m, with a maximum height of 7 m possible with appropriate management measures (e.g. stabilisation, water management). If needed, a further 200,000 m^3 can be placed in this pad, as the design footprint is larger than is currently required and the height of the pad can be adjusted.

The spoil area is also of sufficient size to allow for material to be segregated for contamination testing before being placed in the stockpiles. The spoil stockpile has been located to allow a minimum 50 m buffer to the riparian zone of Kingaham Creek and is above the 1% Annual Exceedance Probability (AEP).

Should the Borumba PHES Project not proceed, the revegetated stockpile will be left in place. The spoil material will be shaped to blend into the natural contours of the surrounding land, vegetated and kept away from existing drainage features.

4.2 Potential impacts to groundwater

A description of the groundwater environment and a risk assessment considering potential impacts of the Exploratory Works Project to groundwater (and associated values) has been undertaken by AGE (2023). A brief summary is provided below.

Exploratory Works will not change groundwater recharge or flows that would affect the Yabba Creek catchment. Therefore, the works are not expected to significantly impact on hydrology in the Yabba Creek catchment.

Horizontal directional drilling (if this is the selected method of installation) of the water pipeline at the two Yabba Creek crossings could potentially affect the alluvium. However, the impact to groundwater flow and quality is unlikely to be significant due to the dimensions of the pipeline, length of the crossing, and temporary nature of the water infrastructure.

Potential sources of leachate into aquifers from Exploratory Works activities include spoil placed at the spoil disposal areas, and explosives and oxidation of exposed bedrock in the exploratory tunnel.

Spoil placed at the spoil disposal areas could potentially produce poor-quality leachate that seeps into shallow groundwater aquifers. A geotextile liner will be placed at the spoil disposal areas to prevent seepage of leachate into the aquifer. Therefore, potential impacts on groundwater quality are unlikely.

4.3 Inherent Project risks for water

A water quality risk assessment was completed for the Exploratory Works (refer to Appendix G of the Preliminary Documentation). A number of factors affect the inherent risk associated with components of the works, primarily location, extent, type of activity and duration of the activity.

4.3.1 Location and extent

The proximity of works relative to sensitive receptors leads to greater inherent risks in some locations than others. Some examples are provided below.

Geotechnical investigation works related to the proposed upper reservoir are often at the very upper limit of this relatively small sub-catchment, being related to proposed saddle dams. The majority of the proposed access tracks relate to reaching these locations. The proposed upper dam wall is on an intermittent headwater stream that includes a series of significant downstream steps that form waterfalls/pools during periods of flow. Water enters Lake Borumba in the upper third of the storage. No fish or turtle species have been recorded near the proposed upper reservoir despite multiple surveys. This area is therefore inherently lower risk from a water quality or threatened aquatic species perspective.

Conversely, components of the Exploratory Works Project proposed below the existing Borumba dam are relatively close to and within Yabba Creek, which is essentially a permanently flowing watercourse where threatened aquatic species are known to live. It is therefore inherently of high risk. The extent of works here relates largely to geotechnical and groundwater bores for the location of the proposed new dam wall and means to access the sites of investigation. A temporary (two to six months duration) bed level watercourse crossing is required along with modifications to existing access tracks and new access tracks. Any water quality impacts generated by works upstream of the dam or adjacent to the lake that enter and manage to pass through the lake via outlet releases, may add to the level of impacts at these downstream areas.

There are a series of activities proposed for the area just upstream of Lake Borumba and relatively close to, and at times crossing, Yabba Creek, Sandy Creek or Kingaham Creek (i.e., portal pad, spoil disposal areas, staging pad, civil construction compound, raw water intake and distribution system, bridges and access tracks, and geotechnical investigations). The proposed disturbance areas are individually small but cumulatively significant. Suitable habitat for threatened aquatic species is known to occur within these creeks, with some species recorded near crossing locations. These locations/activities are inherently of high risk.

With respect to the second example (Yabba Creek downstream of Borumba dam), it is noted that the length of Lake Borumba is approximately 10 km and it holds nearly 46 gigalitres of water at full supply level. Substantial dilution of any contaminants originating from the upstream activities could be expected as they entered firstly the watercourses, then Lake Borumba, particularly if they entered slowly, or intermittently or during flood events. The latter would be expected with any leaching of contaminants (if present) from the spoil stockpiles. Lake Borumba does assist water quality management in this way, it supplies the downstream Yabba Creek and Mary River, and is a headwater storage of the Mary Valley Water Supply Scheme, so the quality of water released from it is important. Some settling of sediment in the Lake Borumba storage could be expected, but the dam is bottom release, that is, it does not have a multi-level offtake, so water nearest the bottom must be released. It is therefore important that erosion and sedimentation is controlled as much as possible at the source.

During periods of low flow, including when Borumba dam is releasing water at low-levels (which during normal times would likely be clear water), any suspended sediment released from downstream work sites would move slowly and would be quickly diluted by the clear water released from the dam, and downstream tributaries (of which there are several, commencing with Bella Creek, which enters a short distance below the dam). Any impact would be unlikely to extend beyond Imbil Weir. In higher runoff periods the suspended sediment would be expected to travel further and to mix with suspended sediment generated from other sources. The Exploratory Works Project's contribution to the total suspended sediment load of the Mary River or reaching the coast is expected to be minimal at those times because:

- As a proportion of the total area of existing disturbed land in the catchment (comprising grazing, cropping, forestry with potential for clearing or replanting cycles, small scale but multiple rural or urban building and construction sites, road and bridge works etc.), the area disturbed by the Exploratory Works Project would be negligible.
- The Exploratory Works Project will be subject to rigorous management to control and/or limit runoff and the release of suspended sediments, where and such a standard may not apply to other disturbed areas in the catchment.

The extent of impact related to activities also varies, for example each geotechnical or groundwater borehole will be drilled in a specific location, affect a relatively small area and management measures will be applied to each specific site, but there are many such sites across the works area with several being active at any one time. There is only one tunnel portal, two spoil disposal areas, and one fixed location of raw water extraction. The management measures proposed by Queensland Hydro have been tailored to the circumstances of the particular activities and locations. Progressive rehabilitation of areas after works have been completed is important to ensure that they do not contribute to sediment loads on an ongoing basis.

4.3.2 Type of activity

For most activities, the impact pathway relates to rainfall induced runoff resulting in movement of coarse and fine sediment toward and within watercourses. The coarse sediment is likely to be deposited near the point of generation (particularly with erosion and sediment control procedures in place) while the finer sediment may result in increased suspended sediment loads and turbidity over greater distances. This risk relates to all clearing activities and runoff from all Exploratory Works Project surfaces.

Some activities have the additional risk of contamination by contained or leached chemical constituents. The explosives used in tunnelling and the drill fluids used in geotechnical drilling are other potential sources of contamination. Wastewater from tunnel excavation may also contain contaminants. These are largely removed by the settling and treatment, which occurs in the water management process, and the contaminants are removed when the sludge is extracted from the dirty storage and settlement basins for testing and appropriate disposal.

The other contamination risk relates to accidental spillage of contaminants such as fuels or oils. This could occur in any location where machinery or fuel storage is present and is most likely to be low volume related to a failing oil seal or overflow during refuelling, but could potentially be larger (e.g., storage tank failure or vehicle accident).

Contamination by bio-available nutrients could occur if wastewater from worker facilities was to be treated and disposed of on-site, but this is not the case and otherwise the nutrient content of general runoff water is likely to be low and the nutrients will largely be in particulate form.

Raw water extraction from Lake Borumba is a different form of potential impact. There will be minor disturbance of bank and bed sediments during installation but the area will be isolated. The extraction could theoretically disturb lake sediments though the pump will draw from near the surface and the site was selected to provide ample depth to allow for lake water level fluctuations. The low water level cut off reduces the risk of disturbing bottom sediments. The pumping rate will also be kept low to limit any entrainment. The review of gauging data suggests the impact of extraction on lake water levels will be minimal. As such, extraction is extremely unlikely to impact on lake water quality and given the cut off threshold, will not be occurring during a period of drought.

4.3.3 Duration

The overall duration of the Exploratory Works is 18 to 24 months including mobilisation and demobilisation. Impacts related to the works will essentially end either:

- when rehabilitation is completed successfully, or
- when superseded by main works associated with the Borumba PHES Project.

Within the works period, the duration for which individual activities may cause impacts varies from less than a day (individual test pits) to days (the period from when a track or pad is cleared before it is capped with gravel or other material), weeks (individual geotechnical drilling sites), to the full duration of works (water extraction from Lake Borumba, tunnelling, spoil stockpiling, runoff from gravel sealed pads and tracks etc.).

However, the duration of potential runoff events must be superimposed on the overall duration of works in order to determine the duration of any potential water quality events.

Works are planned to encompass two wet seasons. Based on the Imbil Forestry gauge, which has 89 years of records, the mean number of rain days (being >1 mm of rain) per month during the wet season is 8-9 days, while in the dry season is 4-5 days (with ramping up or down either side). As mean rainfall per month in the wet season ranges between approximately 100 and 145 mm, it indicates that rainfall is of short duration, but relatively intense, which will lead to runoff. Dry season mean monthly rainfall is much lower, between approximately 30 and 80 mm, so is less intense and less likely to lead to runoff. What this suggests is that runoff events are likely to be uncommon during the drier months and of low total volume. During the wet season, events can be more intense and last longer, but the number of days without overland flow contributing to water quality events is likely to be substantially higher than the number of days with. As such, the duration of a water quality event related to runoff is likely to be measured in days, with substantial periods of no runoff in between events. These comments are based on mean figures whereas very intense storm events are known in the catchment, as are prolonged and repeated periods of heavy rain and flooding, including during the traditional dry season (e.g., 2022).

4.4 Risk analysis for impacts to water quality and protected species

A water quality risk assessment (Appendix G of the Preliminary Documentation) was prepared for the Exploratory Works Project generally in accordance with the Environmental Management Plan Guidelines (DCCEEW, 2024), particularly the sections on ‘Potential environmental impacts and risks’ and ‘Evaluating risk’.

With respect to impacts related to water quality, the most at risk threatened species are aquatic species listed as Matters of National Environmental Significance (MNES):

- Australian lungfish (*Neoceratodus forsteri*)
- Mary River cod (*Maccullochella mariensis*)
- Mary River turtle (*Elusor macrurus*)
- white-throated snapping turtle (*Elseya albagula*).

The area in which potential impacts were assessed for the water quality risk assessment is within the range of any of the threatened species in the catchment; noting that any impacts of the works can only affect Yabba Creek, Sandy Creek and to a lesser degree the Mary River main channel, they cannot affect any other tributaries where the threatened species are known to occur. The Great Sandy Strait Ramsar wetland was also included as a

relevant MNES in the water quality risk assessment. A short length of Kingaham Creek above Lake Borumba was also included.

Impacts to threatened species and communities via water quality would be regarded as an indirect impact, because water quality serves as a potential impact pathway between Exploratory Works Project activities and the relevant MNES species.

The works activities that could lead to such runoff or contamination include:

- disturbance of the soil associated with vegetation clearing for surface Exploratory Works, including various pads, geotechnical investigations and access tracks
- construction of waterway crossings (bed level and culverts) and runoff from works occurring near waterways or drainage lines
- disturbance of existing contaminated areas
- accidental release of fuel, oil, waste or other chemicals
- discharge of surface/ground water collected during project work (including from stormwater runoff from works areas, or wastewater from tunnelling or geotechnical activities
- runoff from spoil stockpiles, which may be contaminated
- direct extraction of water from a watercourse, disturbing the sediment or lowering the lake water level.

The water quality risk assessment determined the risks to water quality within creeks and Lake Borumba near and downstream of works are Low, except with respect to:

- potential contamination from the operation of the spoil disposal areas
- potential impacts from sedimentation and nutrient release.

These were determined as Medium risk (lower end) due to the consequence of the potential impact, with potential to be reduce the likelihood of the risk occurring through the implementation of management strategies.

5. Risk assessment

Potential impacts and associated risks for water are detailed in Table 3. The qualitative risk was assessed using the methodology outlined in section 5.1 of the CEMP.

Table 3: Risk assessment

Project component	Description	Risk (Water)	Risk level (without controls)			Risk level (post controls as identified in Table 4)		
			Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Geotechnical investigations								
Geotechnical investigations	Test pits to obtain geotechnical information necessary to determine the suitability of the Borumba PHES Project location and support the detailed design.	• Changes to surface water flow regime in nearby watercourse. • Impacts to surface water quality (nearby watercourse, downstream) from runoff and sedimentation, impacting turbidity, salinity, dissolved oxygen etc. (this risk relates to all clearing activities and runoff from all Exploratory Works Project surfaces). • Impacts to surface water quality (nearby watercourse, downstream) from contamination (fuel, oil or chemical spills, leaks, reaching surface and groundwater). • Impacts to surface water quality (nearby watercourse, downstream) from introduction of acidifying minerals/acid sulphate soils. • Discharge of surface water (e.g. sediment-laden runoff) collected during construction and use of pad. • Breach of temporary water storages (e.g. turkey nest dams), discharging to environment.	Likely	Moderate	Medium	Possible	Minor	Low
	Boreholes (deep and shallow, including some conversion to groundwater monitoring bores)	• Drilling fluids/waste and drill cuttings not contained and disposed of, acting as a source of contamination, impacting local water quality. • Use of chemicals and other drilling fluid additives that could leave a residual toxicity in groundwater intercepting boreholes.	Likely	Minor	Low	Unlikely	Minor	Low
Spoil disposal								
Tunnel spoil disposal area, Kingaham spoil disposal area	Dedicated area for disposal of spoil material from exploratory tunnel and technical drilling and stockpiling of topsoil.	• Impacts to surface and groundwater from leaching and contamination, erosion and sedimentation affecting local water quality. • Inadequate erosion control and containment of spoil. • The spoil stockpile carries contamination risk and sampling to date suggests this primarily relates to certain metals and nitrogen. These risks are addressed in the Spoil Management Sub-plan (Appendix H of the CEMP) and Preliminary Erosion and Sediment Control Plan (Appendix G of the CEMP).	Likely	Major	High	Possible	High	Medium
Site access								
Kingaham Creek bypass	Realignment of a section of Bella Creek Road (Kingaham Creek bypass) and vehicle movements along Bella Creek Road.	• Impacts to surface water quality (nearby watercourse, downslope) from runoff and sedimentation, impacting turbidity, salinity, dissolved oxygen etc. • Impacts to surface water quality (nearby watercourse, downslope) from contamination (fuel, oil or chemical spills, leaks reaching surface water).	Likely	Moderate	Medium	Possible	Minor	Low
New/upgraded access tracks	New access tracks and upgrades to existing tracks, including multiple waterway crossings, to enable access to geotechnical investigation and exploratory tunnel drilling sites	• Impacts to surface water quality (nearby watercourse, downslope) from runoff and sedimentation, impacting turbidity, salinity, dissolved oxygen etc. • Impacts to fish passage and other aquatic fauna. • Disturbance of creek/watercourse sediment mobilising particles, impacting water quality. • Impacts to surface water from contamination (fuel, oil or chemical spills or leaks) during construction and from vehicle movements	Likely	High	High	Possible	Moderate	Medium
Other supporting infrastructure								

Project component	Description	Risk (Water)	Risk level (without controls)			Risk level (post controls as identified in Table 4)		
			Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Temporary water infrastructure, staging pad, civil construction compound	Construction of temporary water infrastructure, staging pad, civil construction compound (laydown area).	• Changes to surface water flow regime in nearby watercourse • Impacts to surface water quality (nearby watercourse, downstream) from runoff and sedimentation, impacting turbidity, salinity, dissolved oxygen etc. (this risk relates to all clearing activities and runoff from all Exploratory Works Project surfaces). • Impacts to surface water quality (nearby watercourse, downstream) from contamination (fuel, oil or chemical spills, leaks, reaching surface and groundwater). • Impacts to surface water quality (nearby watercourse, downstream) from introduction of acidifying minerals/acid sulphate soils. • Discharge of surface water (e.g. sediment-laden runoff) collected during construction and use of pad. • Breach of temporary water storages (e.g. turkey nest dams), discharging to environment.	Likely	High	High	Possible	Minor	Low
Exploratory tunnel infrastructure								
Dual exploratory tunnels	Exploratory drilling of dual tunnels to the powerhouse cavern from the portal pad	• Changes to groundwater regime (drawdown affecting level, flow). • Discharge of groundwater collected during tunnelling. • Contamination associated with the explosives used in tunnelling contaminating surface and groundwater (nitrogen).	Likely	Moderate	Medium	Possible	Minor	Low
Portal pad	The construction and operation of a portal pad	• Changes to surface water flow regime in nearby watercourse. • Impacts to surface water quality (nearby watercourse, downstream) from runoff and sedimentation, impacting turbidity, salinity, dissolved oxygen etc. (this risk relates to all clearing activities and runoff from all Exploratory Works Project surfaces). • Impacts to surface water quality (nearby watercourse, downstream) from contamination (fuel, oil or chemical spills, leaks, reaching surface and groundwater). • Impacts to surface water quality (nearby watercourse, downstream) from introduction of acidifying minerals. • Discharge of surface water (e.g. sediment-laden runoff) collected during construction and operation of pad • Breach of temporary water storages (e.g. turkey nest dams), discharging to environment	Likely	High	High	Possible	Minor	Low

6. Mitigation and management measures

Mitigation measures for the risks listed in Table 3 are outlined in Table 4.

This section of the Water Management Plan expands on the mitigation measures listed in Table 4, to provide more detail and guidance. These are detailed in each section, as follows:

- 6.1 Water consumption, generation, segregation, storage and reuse
- 6.2 Water quality management infrastructure
- 6.3 Water quality objectives
- 6.4 Standard mitigation measures for water
- 6.5 Water quality monitoring.

All water management and mitigation measures will be underpinned by the broader measures, training, monitoring, recording and reporting requirements outlined in Section 4 – Environmental Management System of the CEMP.

See also the Preliminary Erosion and Sediment Control Plan, Appendix G to the CEMP, which is applicable to the mitigation of the risks to water quality outlined in this sub-plan.

Table 4: Risk controls

Project component	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
Geotechnical investigations							
Test pits to obtain geotechnical information necessary to determine the suitability of the Borumba PHES Project location and support the detailed design.	Site/project engineer	• Protection of local water bodies – environmental value, water quality objectives, and water quality. • Protection of conservation significant aquatic flora and fauna.	• Management measures as outlined in sections 6.1-6.5. This includes monthly water quality monitoring as a continuation of existing background sampling. • Establish background water quality to be maintained and define relevant WQOs/guidelines. • Progressive reinstatement/rehabilitation of disturbed areas, including backfilling of geotechnical investigation sites as soon as they are completed to minimise duration of exposed surfaces. • Development and implementation of all plans required in the Preliminary ESCP (Appendix G to the CEMP).	• WQOs of local water bodies maintained. • Zero serious environmental incidents related to water, e.g. segregation, containment, and discharge. • No significant impact to environment outside of approved disturbance footprints. • No uncontrolled discharge of contaminated water to environment. • Integrity of erosion and sediment control infrastructure is maintained. No instances of silting, cracking, erosion etc. not being addressed in a timely manner.	• Daily site report (daily diary). • Continuation of surface water quality monitoring program already established. • Visual monitoring to determine no impact to local waterways (turbidity, oil/grease, rubbish etc.) through weekly environmental inspections. • Otherwise as per CEMP.	• WQOs not met • Failure in water management infrastructure causes serious environmental incident • Evidence of significant impact to the environment outside of approved disturbance footprint • Uncontrolled release of contaminated water to the environment • ESC found to be deficient during inspections or audits	• Remediation (e.g. water treatment, re-vegetation) if required. • Assessing and repairing or amending ESC controls in place. • Contain uncontrolled releases and treat / test water until relevant criteria have been met • Otherwise as per CEMP.
Boreholes (deep and shallow, including some conversion to groundwater monitoring bores)	Site/project engineer	• Protection of local water bodies – environmental value, water quality objectives, and water quality. • Protection of conservation significant aquatic flora and fauna.	• Management measures as outlined in sections 6.1-6.5. This includes monthly water quality monitoring as a continuation of existing background sampling. • Progressive reinstatement/rehabilitation of disturbed areas, including backfilling of geotechnical investigation sites to the pre-drilling state as soon as they are completed. • Development and implementation of all plans required in the Preliminary ESCP (Appendix G to the CEMP). • Recirculating of drilling muds with containment of drilling muds and disposal offsite as required, where onsite treatment and reuse is not possible.	• WQOs of local water bodies maintained. • Zero serious environmental incidents related to water, e.g. segregation, containment, and discharge. • No significant impact to environment outside of approved disturbance footprints. • No uncontrolled discharge of contaminated water to environment. • Integrity of erosion and sediment control infrastructure is maintained. No instances of silting, cracking, erosion etc. not being addressed in a timely manner.	• Daily site report (daily diary). • Continuation of surface water quality monitoring program already established. • Visual monitoring to determine no impact to local waterways (turbidity, oil/grease, rubbish etc.) through weekly environmental inspections. • Otherwise as per CEMP.	• WQOs not met • Failure in water management infrastructure causes serious environmental incident • Evidence of significant impact to the environment outside of approved disturbance footprint • Uncontrolled release of contaminated water to the environment • ESC found to be deficient during inspections or audits	• Remediation (e.g. water treatment, re-vegetation) if required. • Assessing and repairing or amending ESC controls in place. • Contain uncontrolled releases and treat / test water until relevant criteria have been met • Otherwise as per CEMP.
Spoil disposal							
Tunnel spoil disposal area, Kingaham spoil disposal area	Site supervisor, environmental management representative	• Protection of local water bodies – environmental value, water quality objectives, and water quality. • Protection of conservation significant aquatic flora and fauna.	• Management measures as outlined in sections 6.1-6.5. This includes monthly water quality monitoring as a continuation of existing background sampling. • Testing of material as it arrives in the spoil disposal	• WQOs of local water bodies maintained. • Zero serious environmental incidents related to water, e.g. segregation, containment, and discharge. • No significant impact to environment outside of	• Daily site report (daily diary). • Continuation of surface water quality monitoring program already established. • Visual monitoring to determine no impact to local waterways (turbidity,	• WQOs not met • Failure in water management infrastructure causes serious environmental incident • Evidence of significant impact to the environment	• Remediation (e.g. water treatment, re-vegetation) if required. • Assessing and repairing or amending ESC controls in place. • Contain uncontrolled releases and treat / test

Project component	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
			areas, including from the exploratory tunnel, to determine any acid sulphate soils, potential ASS or contaminants. • Development and implementation of all plans required in the Preliminary ESCP (Appendix G to the CEMP). • See also: Spoil Management Sub-plan (Appendix H of the CEMP).	approved disturbance footprints. • No uncontrolled discharge of contaminated water to environment. • Integrity of erosion and sediment control infrastructure is maintained. No instances of silting, cracking, erosion etc. not being addressed in a timely manner. • Works undertaken in accordance with all approval conditions.	oil/grease, rubbish etc.) through weekly environmental inspections. • Otherwise as per CEMP.	outside of approved disturbance footprint • Uncontrolled release of contaminated water to the environment • ESC found to be deficient during inspections or audits • Breach of approval conditions	water until relevant criteria have been met • Otherwise as per CEMP.
Site access							
Kingaham Creek bypass	Site/project engineer	• Protection of local water bodies – environmental value, water quality objectives, and water quality. • Protection of conservation significant aquatic flora and fauna. • Preserve fish passage.	• Management measures as outlined in sections 6.1-6.5. This includes monthly water quality monitoring as a continuation of existing background sampling. • Wherever possible, access road/track running surfaces are to be stabilised with crushed rock, aggregate, road base, a trafficable soil stabiliser or equivalent. In catchments not draining to a sediment basin or sump, stabilisation of roads and site compound surfaces is essential. • Development and implementation of all plans required in the Preliminary ESCP (Appendix G to the CEMP).	• WQOs of local water bodies maintained. • Zero serious environmental incidents related to water, e.g. segregation, containment, and discharge. • No significant impact to environment outside of approved disturbance footprints. • No uncontrolled discharge of contaminated water to environment. • Integrity of erosion and sediment control infrastructure is maintained. No instances of silting, cracking, erosion etc. not being addressed in a timely manner. • Works undertaken in accordance with all approval conditions.	• Daily site report (daily diary). • Continuation of surface water quality monitoring program already established. • Visual monitoring to determine no impact to local waterways (turbidity, oil/grease, rubbish etc.) through weekly environmental inspections. • Otherwise as per CEMP.	• WQOs not met • Failure in water management infrastructure causes serious environmental incident • Evidence of significant impact to the environment outside of approved disturbance footprint • Uncontrolled release of contaminated water to the environment • ESC found to be deficient during inspections or audits • Breach of approval conditions	• Remediation (e.g. water treatment, re-vegetation) if required. • Assessing and repairing or amending ESC controls in place. • Contain uncontrolled releases and treat / test water until relevant criteria have been met • Otherwise as per CEMP.
New/ upgraded access tracks	Site/project engineer	• Protection of local water bodies – environmental value, water quality objectives, and water quality. • Protection of conservation significant aquatic flora and fauna. • Preserve fish passage.	• Management measures as outlined in sections 6.1-6.5. This includes monthly water quality monitoring as a continuation of existing background sampling. • Wherever possible, access road/track running surfaces are to be stabilised with crushed rock, aggregate, road base, a trafficable soil stabiliser or equivalent. In catchments not draining to a sediment basin or sump, stabilisation of roads and site compound surfaces is essential. • Development and implementation of all plans required in the Preliminary	• WQOs of local water bodies maintained. • Zero serious environmental incidents related to water, e.g. segregation, containment, and discharge. • No significant impact to environment outside of approved disturbance footprints. • No uncontrolled discharge of contaminated water to environment. • Integrity of erosion and sediment control infrastructure is maintained. No instances of silting, cracking, erosion etc. not being addressed in a timely manner.	• Daily site report (daily diary). • Continuation of surface water quality monitoring program already established. • Visual monitoring to determine no impact to local waterways (turbidity, oil/grease, rubbish etc.) through weekly environmental inspections. • Otherwise as per CEMP.	• WQOs not met • Failure in water management infrastructure causes serious environmental incident • Evidence of significant impact to the environment outside of approved disturbance footprint • Uncontrolled release of contaminated water to the environment • ESC found to be deficient during inspections or audits • Breach of approval conditions	• Remediation (e.g. water treatment, re-vegetation) if required. • Assessing and repairing or amending ESC controls in place. • Contain uncontrolled releases and treat / test water until relevant criteria have been met • Otherwise as per CEMP.

Project component	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
			ESCP (Appendix G to the CEMP). • Compliance with requirements of Riverine Protection Permits.	• Works undertaken in accordance with all approval conditions.			
Other supporting infrastructure							
Temporary water infrastructure, staging pad, civil construction compound	Construction manager, site/project engineer, environmental management representative	• Protection of local water bodies – environmental value, water quality objectives, and water quality. • Protection of conservation significant aquatic flora and fauna. • Minimise water consumption and maximise reuse.	• Implement water management infrastructure to divert clean water around work areas and contain sediment-laden runoff. • Separation of water streams. Ongoing monitoring/testing as required to establish water quality for use/reuse/discharge. • Sizing, construction and maintenance of all erosion and sediment control to protect local water bodies. • Minimising/avoiding disturbance to riparian zones (especially of Yabba Creek and Sandy Creek). • Fuel/chemical storage areas to have suitable controls to ensure that spills / run-off does not impact surrounding environment (i.e. primary / tertiary bunds, covering materials etc). • Management measures as outlined in sections 6.1-6.5. This includes monthly water quality monitoring as a continuation of existing background sampling. • Compliance with requirements of Riverine Protection Permits.	• WQOs of local water bodies maintained. • Zero serious environmental incidents related to water, e.g. segregation, containment, and discharge. • No significant impact to environment outside of approved disturbance footprints. • No uncontrolled discharge of contaminated water to environment. • Integrity of erosion and sediment control infrastructure is maintained. No instances of silting, cracking, erosion etc. not being addressed in a timely manner. • Works undertaken in accordance with all approval conditions.	• Daily site report (daily diary). • Continuation of surface water quality monitoring program already established. • Visual monitoring to determine no impact to local waterways (turbidity, oil/grease, rubbish etc.) through weekly environmental inspections. • Otherwise as per CEMP.	• WQOs not met • Failure in water management infrastructure causes serious environmental incident • Evidence of significant impact to the environment outside of approved disturbance footprint • Uncontrolled release of contaminated water to the environment • ESC found to be deficient during inspections or audits • Breach of approval conditions	• Remediation (e.g. water treatment, re-vegetation) if required. • Assessing and repairing or amending ESC controls in place. • Contain uncontrolled releases and treat / test water until relevant criteria have been met • Otherwise as per CEMP.
Exploratory tunnel infrastructure							
Dual exploratory tunnels	Site/project engineer, environmental management representative	• Protection of local water bodies – environmental value, water quality objectives, and water quality. • Protection of conservation significant aquatic flora and fauna. • Minimise water consumption and maximise reuse. • Maintain groundwater regime - flow and level.	• Inflow control measures including grouting of fractures and cementation of the tunnel. • Implement water management infrastructure to divert clean water around work areas and contain sediment-laden runoff. • Separation of water streams. Ongoing monitoring/testing as required to establish water quality for use/reuse/discharge. • Sizing, construction and maintenance of all erosion and sediment control to protect local water bodies.	• WQOs of local water bodies maintained. • Zero serious environmental incidents related to water, e.g. segregation, containment, and discharge. • No significant impact to environment outside of approved disturbance footprints. • No uncontrolled discharge of contaminated water to environment. • Integrity of erosion and sediment control infrastructure is maintained. No instances of silting, cracking, erosion etc. not	• Daily site report (daily diary). • Groundwater level and quality monitoring • Visual monitoring to determine no impact to local waterways (turbidity, oil/grease, rubbish etc.) through weekly environmental inspections. • Otherwise as per CEMP.	• WQOs not met • Failure in water management infrastructure causes serious environmental incident • Evidence of significant impact to the environment outside of approved disturbance footprint • Uncontrolled release of contaminated water to the environment • ESC found to be deficient during inspections or audits • Breach of approval conditions	• Remediation (e.g. water treatment, re-vegetation) if required. • Assessing and repairing or amending ESC controls in place. • Contain uncontrolled releases and treat / test water until relevant criteria have been met • Otherwise as per CEMP.

Project component	Responsibility	Environmental outcome	Management/mitigation measures	Milestone/ performance/ completion criteria	Monitoring	Trigger for corrective action	Corrective actions
			• Minimising/avoiding disturbance to riparian zones (especially of Yabba Creek and Sandy Creek). • Fuel/chemical storage areas to have suitable controls to ensure that spills / run-off does not impact surrounding environment (i.e. primary / tertiary bunds, covering materials etc). • Management measures as outlined in sections 6.1-6.5. This includes monthly water quality monitoring as a continuation of existing background sampling. • Capture and segregation of water streams based on quality, with tanks or lined containment, for reuse in tunnelling or other activities.	being addressed in a timely manner. • Water streams suitably segregated and contained. • Works undertaken in accordance with all approval conditions.			
Portal pad	Construction manager, site/project engineer, environmental management representative	• Protection of local water bodies – environmental value, water quality objectives, and water quality. • Protection of conservation significant aquatic flora and fauna. • Minimise water consumption and maximise reuse.	• Implement water management infrastructure to divert clean water around work areas and contain sediment-laden runoff. • Separation of water streams. • Ongoing testing as required to establish water quality for use/reuse/discharge. • Sizing, construction and maintenance of all erosion and sediment control to protect local water bodies. • Minimising/avoiding disturbance to riparian zones (especially of Yabba Creek and Sandy Creek). • Fuel/chemical storage areas to have suitable controls to ensure that spills / run-off does not impact surrounding environment (i.e. primary / tertiary bunds, covering materials etc). • Management measures as outlined in sections 6.1-6.5.	• WQOs of local water bodies maintained. • Zero serious environmental incidents related to water, e.g. segregation, containment, and discharge. • No significant impact to environment outside of approved disturbance footprints. • No uncontrolled discharge of contaminated water to environment. • Integrity of erosion and sediment control infrastructure is maintained. No instances of silting, cracking, erosion etc. not being addressed in a timely manner. • Water streams suitably segregated and contained. • Works undertaken in accordance with all approval conditions.	• Daily site report (daily diary). • Groundwater level and quality monitoring • Visual monitoring to determine no impact to local waterways (turbidity, oil/grease, rubbish etc.) through weekly environmental inspections. • Otherwise as per CEMP.	• WQOs not met • Failure in water management infrastructure causes serious environmental incident • Evidence of significant impact to the environment outside of approved disturbance footprint • Uncontrolled release of contaminated water to the environment • ESC found to be deficient during inspections or audits • Breach of approval conditions	• Remediation (e.g. water treatment, re-vegetation) if required. • Assessing and repairing or amending ESC controls in place. • Contain uncontrolled releases and treat / test water until relevant criteria have been met • Otherwise as per CEMP.

6.1 Water consumption, generation, segregation, storage and reuse

The Exploratory Works Project is committed to maximising the reuse and recycling of water, which is achieved by segregating and storing water types (streams) according to their origin and quality. There are several water streams that will require management – segregation, separate storage etc. – on site for the duration of the Exploratory Works Project:

- Stormwater – this refers to surface water runoff from areas disturbed by construction (i.e. water directed to sediment basins) and clean surface runoff around construction areas (i.e. clean water diversions)
- Wastewater (groundwater) – this refers to the groundwater encountered during tunnelling and excavation activities
- Construction water – this refers to the water supply system used for construction and tunnelling activities on the surface and in the tunnel and includes the extraction of water from Lake Borumba and the reuse of intercepted groundwater
- Drilling fluids – used throughout the drilling to aid in flushing cuttings from the hole, lubricating/cooling the drill bit, and stabilising the borehole walls
- Wastewater (sewage and grey water) – this refers to sewage and grey water generated from workers. Wastewater will be trucked out from the small crib / ablutions potable building belly tank. Porta-Loos will be used and serviced by approved contractor
- Potable water – this refers to water that has been treated to a potable water standard (i.e. drinking water).

Stormwater will be managed by means of water management infrastructure for the portal pad and other construction footprints/laydown areas. It will include appropriate drains, traps and silt fences as required to comply with the IECA guidelines. See Section 6.2 for more details. Catch drains will be constructed at the high side of work areas to capture and divert runoff around pads and work areas. Exposed fill surfaces will be covered as soon as practicable to minimise the generation of sediment-laden water.

Water is required for construction of access tracks and roads (dust suppression and material conditioning), exploratory tunnel drilling and geotechnical drilling. Raw water (construction water) will be sourced from the upper reaches of Lake Borumba using a submersible pump. During tunnelling, intercepted groundwater will also provide raw water supply for construction activities.

Drilling fluids (comprising water and biodegradable liquid polymers) are required for the geotechnical drilling to aid in flushing cuttings from the hole, lubricating/cooling the drill bit, and stabilising the borehole walls. Water is anticipated to be sourced from the upper reaches of Lake Borumba (Yabba Creek arm) and pumped into holding tanks along Walkers Top Road for access during drilling. Drilling fluids will be recirculated within purpose-built mud tanks during the drilling, which will allow sediments and cuttings to settle out. Vacuum trucks or similar will be used to remove dirty water and cuttings from the mud tanks for appropriate disposal. Clean water (non-potable) will be stored in tanks at the site for drilling and excavation and refilled as required.

Water from the tunnelling operation (e.g. drilling water and groundwater seepage) will be transferred via a laminar clarifier or similar to treat coarser sediment before being discharged into a dirty water basin for temporary storage. Solids may also be dewatered using a belt filter press or dewatering bags made of geotextile before water is transferred to the dirty water basin. Water from the dirty water basin will be transferred to the water treatment plant for treatment. Treated water will be discharged via pump and pipeline to storage tanks for reuse. Sludge (rock particles and fines) will periodically be removed from the dirty water basin and taken to the spoil disposal area for testing and disposal.

Water required for use in tunnelling operations will be sourced from the treated water storage on the portal pad. If necessary, additional water may be supplied from the temporary water infrastructure (Tank Farm 1) or storage tanks at the staging pad. Clean water will be used to support the Project activities where possible. It is noted that water with a high mineral content containing nitrates from the use of emulsion explosives can be reused underground as service water.

If the ingress of water into the tunnel (from underground aquifers via fissures and fractures in the rock) exceeds the consumption of water, then excess water will be sent from the temporary water storage pond to the water storage tanks at the staging pad. It has been assumed that groundwater ingress, post underground grouting, will occur at a rate of 2 litres per second per kilometre. This will be confirmed as the groundwater assessment progresses and water balance modelling for the exploratory tunnels is refined.

Where water ingress into the tunnels exceeds the capacity of the storage tanks (e.g. in large rainfall event), alternative disposal methods will be utilised (e.g. evaporation, release to the environment, trucking offsite, irrigation, additional storage at another location). All releases to the environment will be in accordance with relevant approval conditions, including applicable water quality guidelines.

6.2 Water quality management infrastructure

A holistic approach for water management is proposed, with infrastructure to be established for the management of groundwater ingress into the exploratory tunnels and site runoff. This will accommodate the collection, distribution and treatment of water for reuse or release to the environment. The reuse of water will be prioritised and maximised during the Project, with proposed options for reuse including, but not limited to:

- recirculation within the underground drill and blast operations
- dust suppression across the Project area
- shotcrete production
- geotechnical drilling
- irrigation
- potable water (drinking) for site facilities.

Figure 4 shows a schematic of the proposed water management process. The primary infrastructure for ensuring water quality impacts are minimised includes:

- stormwater infrastructure such as diversion (catch) drains and sediment traps to intercept overland flow, to minimise sediment-laden water generation
- bunding
- tanks and lined water storages, for separating and holding clean and contaminated water
- a water treatment plant
- erosion and sediment control infrastructure (detailed in the Preliminary Erosion and Sediment Control Plan, Appendix G to the CEMP).

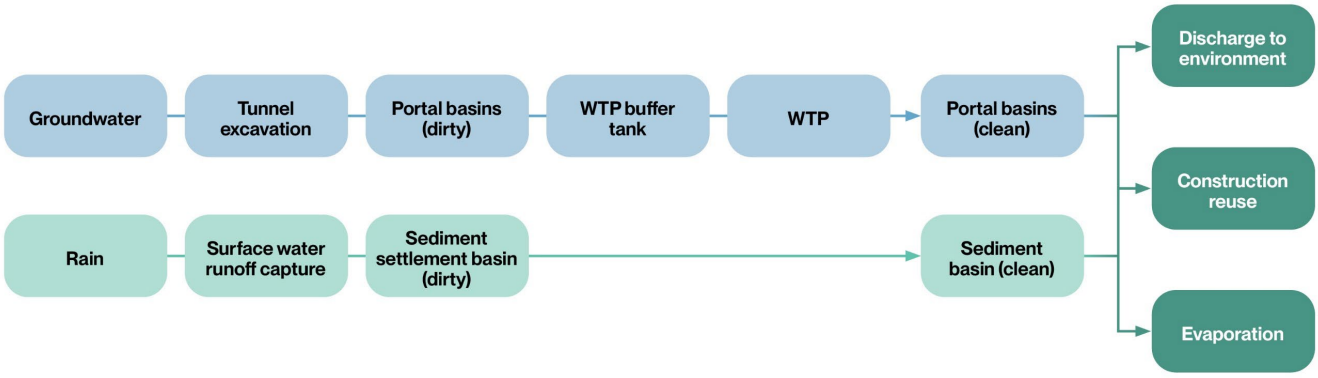

Figure 4: Water management schematic

Water management infrastructure is proposed to be located across the portal pad and staging pad, with water from the exploratory tunnel excavation initially directed to a basin at the portal pad. Water will then be transferred to a water treatment plant for treatment to meet the required standard for the proposed reuse or release to the environment. Excess water (i.e. not required for reuse) will be treated to the appropriate Mary River Basin catchment/sub-catchment water standards as outlined by the Mary River Environmental Values and Water Quality Objectives .

The water treatment plant will be capable of treating water to the required standards (e.g. reverse osmosis treatment plant) and have a capacity of approximately 100 L/s to allow for typical inflow fluctuations. It is expected to be situated on the portal pad.

Stormwater is proposed to be managed in separate storage basins to limit or prevent any contamination by operational water, thereby reducing treatment requirements. Stormwater that exceeds the basin capacity will be incorporated into the operational water management. Stormwater management will be designed in accordance with Stormwater and Environmentally Relevant Activities guideline produced by the Queensland Department of the Environment, Tourism, Science, and Innovation (DETSI). Queensland Hydro's proposed system is based on a 24-hour storm event with an average recurrence interval (ARI) of 1 in 5 years This design will help mitigate the risk of erosion and sedimentation, protecting both the site and surrounding areas from potential runoff impacts.

Examples of specific water quality infrastructure for Exploratory Works Project components are listed in Table 5.

Contingency measures to manage water during storm events that exceed the design capacity of the storage basins include multiple tank farms with contingent water capacity, mechanical evaporation, water treatment plant, temporary water infrastructure to enable water transfer, and water evaporation pond(s). HumeCeptors or similar will also be used in basins to remove hydrocarbons and suspended solids in runoff from the staging pad and portal areas.

Sediment traps must be emptied within five calendar days of a rainfall event. This includes de-silting if required with the material going to the spoil disposal areas. These de-watering requirements also apply to dirty water accumulating in any sort of excavation, trench, or other ponded water body on the site. Such water can either be reused for construction purposes; pumped into a tank, truck or other holding area for later treatment; treated (If required) and tested in situ, then released to land (including for dust suppression) once it meets the required water quality criteria (see below).

Table 5: Basic water quality management infrastructure

Exploratory Works Component	Management and control measures
Spoil disposal areas	• Sediment control devices will be implemented • Clean runoff will be diverted away from the soil disposal areas.
Explosive store	• Hazardous materials will be bunded • Clean runoff will be diverted away from the explosive store.
Portal pad	• Clean runoff will be diverted away from the portal pad • Sediment control devices will be implemented • Water from the tunnel will be diverted to dirty water basin and tested. The basin will be periodically cleaned and sludge disposed of appropriately. Contaminated water will be diverted to water storage tanks at the staging pad.
Staging area	• Clean runoff will be diverted away from the staging area • Sediment control devices will be implemented • All contaminant containment facilities will be bunded.
Exploratory tunnels	• Inflow control measures including grouting of fractures and cementation of the tunnel • Groundwater emanating from the tunnel will be diverted to a dirty water containment dam and routinely tested for contaminants. The dirty water dam will be periodically cleaned and sludge disposed in tunnel spoil disposal area • Contaminated water will be diverted to a water treatment plant (RO Plant or similar) for treatment before transfer to storage tanks for reuse or release to the environment • A suitably licenced waste collection contractor will be engaged to collect and remove general waste materials.

6.3 Water quality objectives

A Surface Water Monitoring Program has been implemented to collect background surface water quality data relative to the Exploratory Works Project. This background data will be used to derive interim guidelines, where appropriate, noting limited historical data exists for the waterways intersected by the Exploratory Works. Comparisons to these interim guidelines (if derived) and/or existing WQOs will allow assessment of both the potential impacts to surface water, and the efficacy of environmental controls implemented as per the CEMP for the Exploratory Works Project.

Sampling sites are located upstream and downstream of potentially impacted areas, including in Yabba Creek (both upstream and downstream of Lake Borumba), Kingaham Creek, Borumba Creek and Sandy Creek. As results become available the sampling frequency and location selection will be reviewed and adjusted if required. The monitoring program is ongoing.

Surface water parameters monitored at each site include physicochemical parameters, nutrients, metals (total and dissolved), hydrocarbons, oil and grease, herbicides and pesticides, and *Escherichia coli* bacteria and microbiology.

In the absence of project specific water quality guidelines, appropriate interim objectives shall be sourced from (in order of priority):

- the Mary River environmental values and water quality objectives defined under the Environment Protection (Water and Wetland Biodiversity) Policy 2019 (DERM, 2010)
- Australian and New Zealand guidelines for fresh and marine water quality (2018) 95% species protection
- Seqwater Development Guidelines for Water Quality Management in Drinking Water Catchments 2017
- Australian Drinking Water Guidelines (NHMRC, 2011).

Any active discharge of water from the Exploratory Works Project (i.e. where water is moved offsite via direct action such as pumping rather than flowing off the works as a result of heavy rainfall) is to achieve:

- 50 mg/L or less TSS (total suspended sediment)
- pH 6.5 to 8.5
- no visible trace of oils or grease.

6.4 Standard mitigation measures for water

Standard mitigation measures for water management and impact mitigation across the Exploratory Works Project include:

- Minimising the ground disturbing footprint wherever possible, including utilising existing access tracks.
- Clearing in accordance with established environmental management guidelines.
- Placing infrastructure and investigation sites away from known or possible sources of contamination (e.g., cattle dips).
- Implementing erosion and sediment control measures tailored to each disturbance area with particular attention to soils with dispersive subsoils, including limiting disturbance, the use of gypsum, and covering of dispersive material.
- Sizing erosion and sediment control components and water recycling/reuse components with appropriate redundancy/buffer capacity.
- Maintaining the erosion and sediment control components via regular removal of water after storm events and de-silting.
- Maintaining a register that details sediment basin inspections, maintenance, discharge volumes and dates, flocculation details, discharge-water quality and volumes of sediment removed.
- Scheduling works near waterways to avoid the summer months where practicable, and otherwise avoiding periods of forecast rain.
- Avoiding fresh disturbance, and stabilising sites where necessary, in periods when heavy rain is forecast (rainfall preparation procedure).
- Wherever possible, access road/track running surfaces are to be stabilised with crushed rock, aggregate, road base, a trafficable soil stabiliser or equivalent. In catchments not draining to a sediment basin or sump, stabilisation of roads and site compound surfaces is essential.
- Testing of material as it arrives in the spoil disposal areas, including from the exploratory tunnel, to determine any acid sulfate soil, potential ASS or contaminants. If found, removing contaminated material from site and disposing at an appropriate authorised site.
- Designing and constructing waterway crossings in accordance with riverine protection permit expectations (though exemptions from the need to obtain the actual permit may be available), *Fisheries Act 1994* performance

outcomes, and the 'Accepted development requirements for operational work that is constructing or raising waterway barrier works' (DAF 2018).

- Stabilising or progressively rehabilitating cleared areas near waterways as soon as possible.
- Isolating instream work areas using erosion control measures such as silt curtains or floating booms before instream works begin.
- Installing erosion and sediment control in locations where overland flow (runoff) could directly enter a waterway.
- Implementing best practice storage and handling of hazardous materials.
- Having spill clean-up kits readily available for any spilled fuel, oils or other contaminants.
- Implementing a buffer zone around the spoil disposal areas so spoil is located a sufficient distance from the riparian zone of Yabba Creek, Sandy Creek and Kingaham Creek.
- Maximising reuse of Borumba PHES Project footprints and infrastructure.
- Maximising water recycling to minimise the draw on Lake Borumba and minimise the volume of wastewater to be disposed.
- Where possible, restricting water extraction to rates and times that will cause minimal disturbance within the Lake Borumba.
- Progressive reinstatement/rehabilitation of disturbed areas, including backfilling of geotechnical investigation sites to the pre-drilling state as soon as they are completed.
- Locating works outside the 1% Annual Exceedance Probability flood extent.

These are design-based or physical on-site measures that aim to avoid or reduce the potential to generate an impact, and to minimise the extent or duration of impact should it occur.

Temporary geotechnical work locations will be reinstated to their original landform, stabilised to prevent any erosion, and allowed to naturally regenerate.

Construction activities that clear vegetation, disturb the soil or concentrate runoff water have the potential to cause soil erosion and sedimentation. Erosion and sedimentation are key sources of water pollution for the Project. The Preliminary Erosion and Sediment Control Plan, Appendix G to the CEMP, will help manage risks from erosion and sediment mobilisation.

Gully erosion is a risk for the Exploratory Works Project based on the likely presence of dispersive soils. Further, construction activities including transport of soil and soil handling during earthworks have the potential to degrade the quality of the soil resource. Soil degradation can result in poor rehabilitation outcomes, bare ground and increased risk of erosion and sedimentation. Common areas that present a high risk of soil erosion and resulting environmental impacts include areas of concentrated flows and locations where surface gradients and slope lengths combine to increase the erosive potential of stormwater runoff. These locations would typically include:

- vegetation clearing limits particularly around existing creeks / floodway (e.g. for waterway crossings)
- road cuttings and embankments
- in-stream features within creeks and riparian corridors (i.e. temporary crossings at Yabba Creek and Sandy Creek).

Erosion control measures that will be implemented in areas of erosion risk are described in the Exploratory Works Project Preliminary Erosion and Sediment Control Plan (Appendix G of the CEMP). Key measures are listed below:

- designing and constructing waterway crossings in accordance with riverine protection permit expectations (though exemptions from the need to obtain the permit may be available) and 'Accepted development requirements for operational work that is constructing or raising waterway barrier works' (DAF 2018)
- implementing a buffer zone around the spoil disposal areas to maintain a sufficient distance from Yabba Creek and Sandy Creek
- avoiding grubbing clearing methods (where possible) to reduce direct mobilisation of soil and contaminants
- implementing soil erosion control measures for soils with dispersible subsoils, including limiting disturbance and the use of gypsum and covering of dispersive material
- sizing erosion and sediment control components and water recycling / reuse components with appropriate redundancy/buffer capacity as determined by Queensland Hydro

- maintaining the erosion and sediment control components via regular removal of water after storm events and de-silting
- maintaining a register that details sediment basin inspections, maintenance, discharge volumes and dates, flocculation details, discharge-water quality and volumes of sediment removed will be maintained.

6.5 Water quality monitoring

The effectiveness of the management measures outlined in this Water Management Plan will be assessed through continual groundwater and surface water monitoring throughout the lifespan of the Exploratory Works Project.

6.5.1 Surface watery quality monitoring

Surface water quality monitoring will be a continuation of the monitoring program outlined in section 3.1.2.1, which is currently being undertaken for the Borumba PHES Project. Site specific monitoring may also be undertaken by the principal contractors.

6.5.2 Groundwater monitoring

A groundwater monitoring program has been designed in conformance with the Monitoring and Sampling Manual (DES, 2018) and Using Monitoring Data to Assess Groundwater Quality and Potential Environmental Impacts by DES (2021). The program is currently being implemented. A Groundwater Monitoring and Management Plan will be prepared by the contractor, including a requirement for monitoring to continue throughout the Exploratory Works Project.

In principle, the groundwater monitoring aims to detect groundwater impacts, so that appropriate trigger action response plans can be implemented, causes investigated, and effectiveness of the management plan evaluated. This may necessitate revision of groundwater controls to reduce impacts.

6.5.3 Reporting

In accordance with Section 4.14 of the CEMP all monitoring records and analysis results will be maintained and made available for the Project team.

7. References

AGE. (2022). Borumba Pumped Hydro Project Groundwater Assessment Technical Report.

AGE. (2023). Borumba Dam Exploratory Works EPBC Referral – Groundwater Impact Assessment.

AGE. (2024). Borumba PHES – EIS Groundwater Assessment.

ANZG (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.

Attexo (2022). Soils Assessment Technical Report.

DAF (2018). Accepted development requirements for operational work that is constructing or raising waterway barrier works. Fisheries Queensland. State of Queensland.

DCCEEW (2024) Environmental management plan guidelines

DERM (2010). Environmental Protection (Water) Policy 2009: Mary River environmental values and water quality objectives, Basin no. 138 including all tributaries of the Mary River.

Epic Environmental (2022). Desktop assessment; Contamination Technical Report.

Hydrobiology (2022). Aquatic Ecology – Borumba Pumped Hydro Project. Report prepared for Queensland Hydro.

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