BIODIVERSITY MANAGEMENT PLAN – TAHMOOR SOUTH DOMAIN – LONGWALLS SOUTH 1A – SOUTH 6A

Tahmoor Coal Pty Ltd

Document Control

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1 Introduction

1.1 Background

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing underground coal mine located approximately 80 kilometres (km) south-west of Sydney in the Southern Coalfields of New South Wales (NSW). Tahmoor Mine surface facilities are situated between the towns of Tahmoor and Bargo within the Wollondilly Local Government Area (LGA). The mine has previously extracted longwalls to the north and west of the surface facilities and has been operating continuously since 1979 when coal was first mined using bord and pillar mining methods, followed by longwall mining methods since 1987.

The location of Tahmoor Mine in the regional context is shown in **Figure 1.**

Tahmoor Mine produces a primary hard coking coal product and a secondary higher ash coking coal product that are used predominantly for coke manufacture for steel production. Extracted coal is processed on site at the coal handling and preparation plant (CHPP) and coal clearance facilities prior to transportation via rail to Port Kembla and Newcastle for Australian domestic and export customers.

An Environmental Impact Statement (EIS) was exhibited in early 2019 to gain approval for the Tahmoor South Coal Project, which involves use of the existing surface infrastructure and the expansion of underground longwall mining to the south of the existing workings (referred to as the Tahmoor South Domain). Tahmoor Coal subsequently revised the proposed mine design and submitted amended development applications on two occasions (in February and August 2020). In April 2021, Tahmoor Coal received Development Application Approval (State Significant Development (SSD) 8445) for the extraction of up to 4 Mtpa of Run-of-mine (ROM) coal, with a total of up to around 33 Mt of ROM coal proposed to be extracted over a 10-year period.

The Tahmoor South Domain is located south of the Bargo River and east of Remembrance Driveway and the township of Bargo. Longwall mining would be used to extract coal from the Bulli coal seam within the bounds of Consolidated Coal Lease (CCL) 716 and CCL 747. Twelve longwalls are proposed in this domain which are divided into a series of six northern (A series) and six southern (B series) longwalls. The A series, Longwalls South 1A to South 6A (LW S1A-S6A), are the focus of the current Extraction Plan application.

The location of LW S1A-S6A and associated Study Area are illustrated in **Figure 2.**

1.2 Purpose

This Biodiversity Management Plan (BMP) has been prepared to support an Extraction Plan for the secondary extraction of coal from LW S1A-S6A.

The purpose of this management plan is to provide a framework for Tahmoor Coal personnel to ensure that compliance is achieved with relevant internal and external regulatory requirements related to aquatic and terrestrial ecology monitoring and management within the Extraction Plan Study Area (**Figure 2**). The plan ensures that impacts on the environment and community are minimised and managed within a structured framework.

This plan is to ensure compliance with Development Consent (SDD 8445) (the Consent) Condition C8.

1.3 Scope

The Study Area applicable to this management plan consists of a combination of the predicted 20 millimetre (mm) Total Subsidence Contour and the 35° Angle of Draw Line as shown in **Figure 2**. Relevant environmental features within a 600 metre (m) buffer from extraction that could be susceptible to far-field or valley related movements have also been included for consideration.

The Project is defined as the extraction of coal from LW S1A-S6A. The EIS Project Area referred to in this document is the Project Area previously addressed by Niche (2018a, 2018b), which encompasses the LW S1A-S6A Study Area.

1.4 Preparation of this Management Plan

This BMP has been prepared by Niche Environment and Heritage Pty Ltd (Niche) on behalf of Tahmoor Coal.

Jessie Bear (Niche Ecology Consultant, BNatSc (Adv)(EnvMgt)) has been endorsed by the Department of Planning, Industry and Environment (DPIE, now the Department of Planning and Environment (DPE)) as a suitability qualified ecologist to prepare this management plan.

1.5 Plan and Structure

The structure of this BMP has been summarised in **Table 1** below.

Table 1 Structure of BMP

Section	Content
1Introduction	Overview of BMP, purpose and scope.
2 Planning	Requirements for this BMP, legislative context and summary of stakeholder consultation. Addresses specific requirements set by Development Consent SSD 8445, EIS Commitments, Leases, Licences, and regulatory requirements
3 Existing Environment	Description of the existing terrestrial and aquatic ecological environment relevant to this BMP.
4 Predicted Surface Impacts and Environmental Consequences	Summary of the predicted subsidence impacts and environmental consequences to aquatic and terrestrial ecology from the extraction of LW S1A-S6A for terrestrial and aquatic biodiversity values, sourced from the Terrestrial and Aquatic Biodiversity EIS Reports. These details have been refined to the Study Area and updated based on a review of relevant updated expert reports.
5 Subsidence Monitoring Program	Details of the monitoring program or potential subsidence-related impacts to aquatic and terrestrial ecology, detailing performance measures and indicators.
6 Subsidence Management Strategies	Avoidance measures including mine design considerations, minimisation and mitigation measures including management and remediation and subsequent follow-up of actions taken. Summary of the TARP, contingency plan and adaptive management strategies.
7 Implementation and Reporting	Outlines the strategies for implementation and reporting of this document, as well as processes associated with the reporting of incidents, auditing and roles and responsibilities.
8 Review and Improvement	Provides document information and process for review of the BMP.
Appendix A	Provides Trigger Action Response Plans (TARPs) to be implemented to manage and protect aquatic and terrestrial ecology within the Study Area.

This management plan has been prepared based on the contents of the following technical reports:

- Tahmoor South Project: Biodiversity Assessment Report (Niche, 2018a) (Appendix K of the EIS);
- Tahmoor South Project: Aquatic Ecology Impact Assessment (Niche, 2018b) (Appendix K of the EIS);
- Tahmoor South Project: Biodiversity Assessment Report of the Amended Project (Niche, 2020a) (Appendix E of the First Amendment of the EIS);
- Tahmoor South Project: Aquatic Ecology Impact Assessment of the Amended Project (Niche, 2020b) (Appendix F of the First Amendment of the EIS);
- Tahmoor South Project: Biodiversity Assessment Update (Niche, 2020c) (Appendix E of the Second Amendment of the EIS);

- Tahmoor South Project: Aquatic Ecology Impact Assessment of the Amended Project (Niche, 2020d) (Appendix F of the Second Amendment of the EIS);
- Terrestrial Ecology Monitoring Report – Spring 2020-Autumn 2021 riparian vegetation and amphibian baseline monitoring (Niche, 2021a);
- Terrestrial Ecology Monitoring Report – Spring 2021 riparian vegetation and amphibian baseline monitoring 2021 (Niche, 2022a).
- Aquatic Monitoring Report – Spring 2019-Autumn 2020 (Niche, 2020e);
- Aquatic Monitoring Report – Spring 2020-Autumn 2021 (Niche, 2021b);
- Aquatic monitoring report – Spring 2021-Preliminary results (Niche, 2022b);
- Tahmoor South Project Surface Water Baseline Study (Hydro Engineering & Consulting (HEC), 2018) (Appendix J of the EIS);
- Tahmoor South Project Surface Water Baseline Study (HEC, 2020a) (Appendix D of the second amendment of the EIS);
- Tahmoor South Project Amendment – Surface Water Impacts (HEC, 2020b);
- Tahmoor South Project – Longwalls 101 to 109 (MSEC, 2018) (Appendix F of the EIS);
- Tahmoor South Project – Amendment Report for Longwalls 101A to 108B (MSEC, 2020a) (Appendix B of the First Amendment of the EIS); and
- Tahmoor South Project – Second Amendment Report for Longwalls 101A to 106B (MSEC, 2020b) (Appendix B of the Second amendment of the EIS).

1.6 The Relationships with other Management Plans

Consent condition C8 of Development Application Approval (SSD 8445) stipulates the need for an extraction plan, an overarching plan that is to include a:

- Subsidence Monitoring Plan;
- Built Features Management Plan;
- Water Management Plan;
- Biodiversity Management Plan (this plan);
- Land Management Plan;
- Heritage Management Plan;
- Public Safety Management Plan;
- Trigger Action Response Plan/s; and
- Contingency Plan.

In addition, this management plan includes relevant information from the following general management plans (not prepared as part of the LW S1A-S6A Extraction Plan) to ensure consistency between the management plans.

- Tahmoor Coal Water Management Plan, prepared in accordance with Condition B34; and
- Tahmoor Coal Biodiversity Management Plan, prepared in accordance with Condition B38.

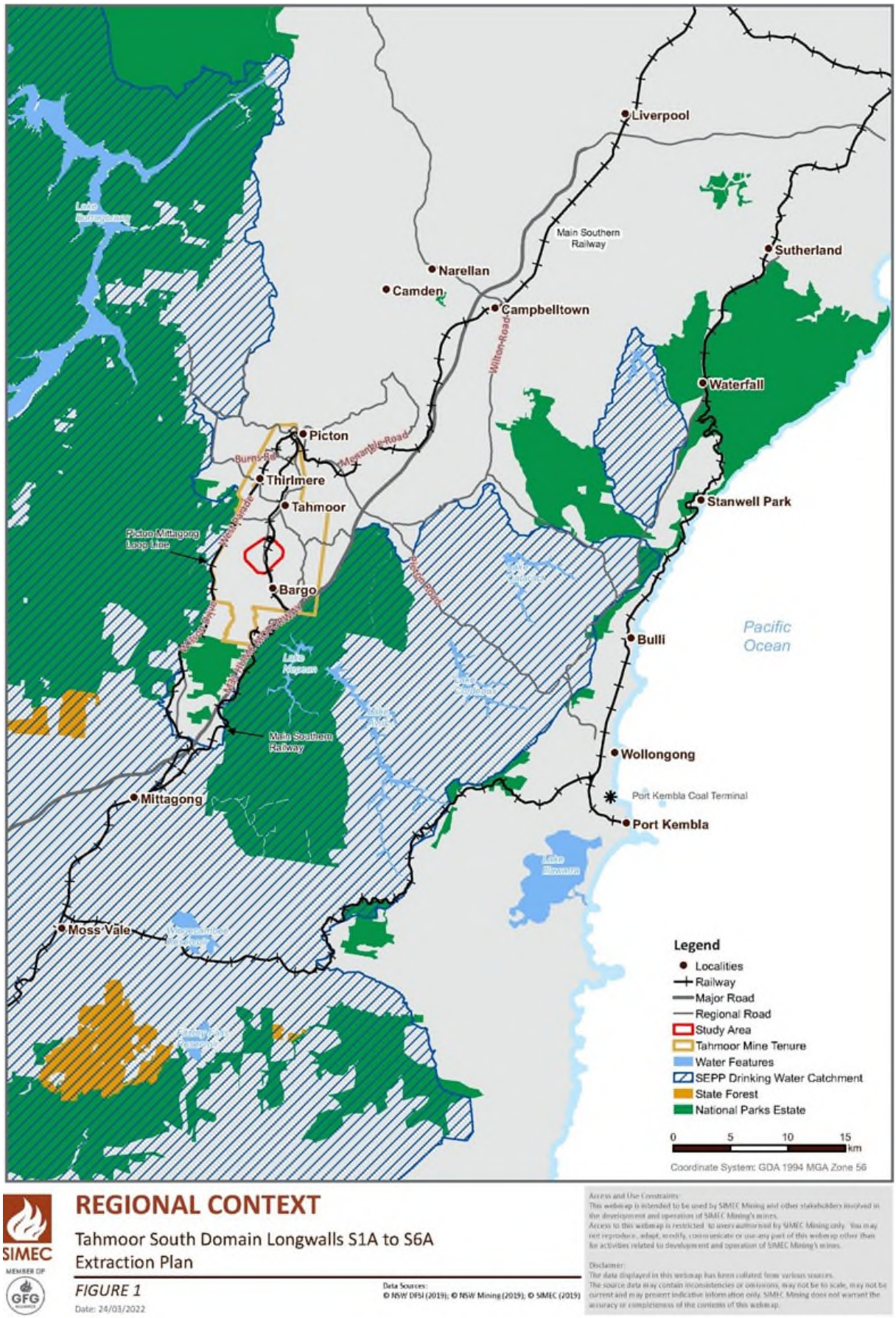

Figure 1 Regional Context

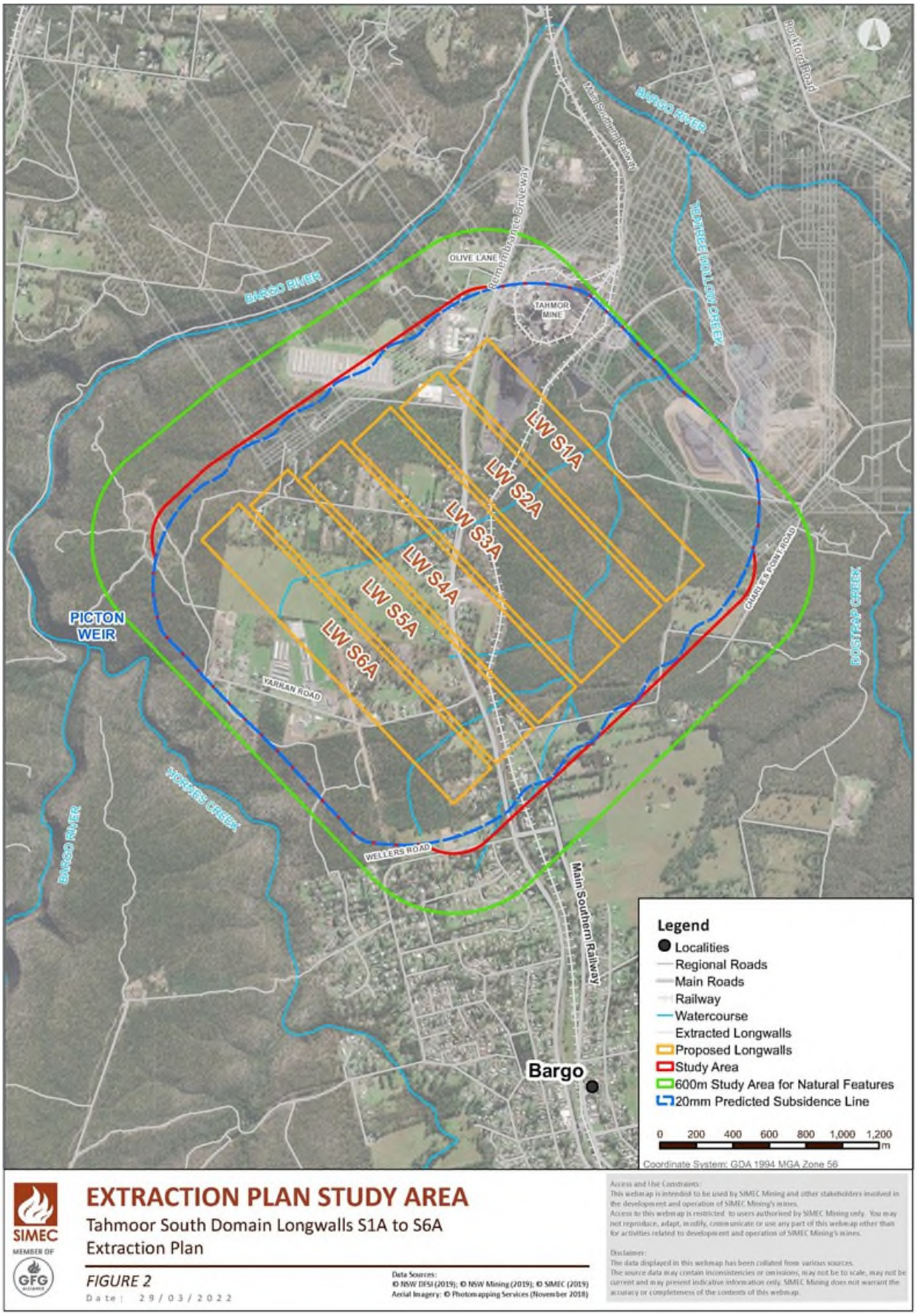

Figure 2 Extraction Plan Study Area

2 Regulatory Requirements

2.1 Project Approval

2.1.1 Development Consent Conditions

2.1.1.1 Extraction Plan Requirements

Tahmoor Coal's operations are conducted in accordance with applicable Commonwealth and State environmental, planning, mining safety and natural resource legislation. A register of relevant environmental legislative and regulatory requirements is maintained by Tahmoor Coal in a compliance database.

LW S1A-S6A will be extracted in the Tahmoor South mining area under Development Consent SSD 8445, as discussed further in Section 3.2.1 of the Extraction Plan Main Document. SSD 8445 provides the conditional planning approval framework for mining activities in the Tahmoor South Domain to be addressed within an Extraction Plan and supporting management plans. Conditions relevant to this management plan from SSD 8445 are detailed in **Table 2.**

Table 2 Key Conditions from SSD 8445 regarding Biodiversity

<table>
<tr><th>Condition Reference</th><th>Condition Requirement</th><th>Where Addressed</th></tr>
<tr><td>C1</td><td>SUBSIDENCE
Performance Measures – Natural and Heritage Features etc.
The Applicant must ensure that the development does not cause any exceedances of the performance measures in Table 7.</td><td rowspan="2">Section 5, Section 6, Appendix A</td></tr>
<tr><td>Excerpt from Table 7</td><td>Table 7: Subsidence impact performance measures – natural and heritage features etc
<table>
<tr><th>Feature</th><th>Performance Measures</th></tr>
<tr><td colspan="2">Biodiversity</td></tr>
<tr><td>Threatened species, threatened populations, or endangered ecological communities</td><td>• No greater subsidence impacts or environmental consequences than predicted in the EIS; and
• Negligible impacts on threatened species, populations or communities due to remediation of subsidence cracking.</td></tr>
<tr><td>Aquatic habitat</td><td>Negligible environmental consequences to aquatic and riparian ecosystems beyond those predicted in the EIS.</td></tr>
</table>
Notes for Table 7 (C1):
Notes:
• These performance measures apply to all mining taking place after the date of this consent.
• The Applicant is required to define more detailed performance indicators (including impact assessment criteria) for each of these performance measures in the various management plans that are required under this consent (see condition CB).</td></tr>
<tr><td>C2</td><td>Performance Measures – Natural and Heritage Features etc.
Measurement and monitoring of compliance with performance measures and performance indicators in this consent is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans and monitoring programs. In the event of a dispute over the appropriateness of proposed methods, the Planning Secretary will be the final arbiter.</td><td>Section 5, Subsidence Management Plans for built features</td></tr>
</table>

Condition Reference	Condition Requirement	Where Addressed
C8	**Extraction Plan** The Applicant must prepare an Extraction Plan for all second workings on the site of the development to the satisfaction of the Planning Secretary. Each Extraction Plan must:	Noted. This management plan is part of the LW S1A-S6A Extraction Plan Application.
C8I	provide revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed mining covered by the Extraction Plan, incorporating any relevant information obtained since this consent;	**Section 4**
C8(f)	describe in detail the performance indicators to be implemented to ensure compliance with the performance measures in Table 7 and Table 8, and manage or remediate any impacts and/or environmental consequences to meet the rehabilitation objectives in condition B56;	**Section 5.1, Section 5.3, Section 6**
C8(g)(iv)	Biodiversity Management Plan which is consistent with the Biodiversity Management Plan required under condition B38:	This management plan
	• has been prepared in consultation with BCS;	**Section 2.4**
	• establishes baseline data for existing habitat within the subsidence area, including water table depth, vegetation condition, stream morphology, key fish habitat and threatened species habitat; and	**Section 3**
	• provides for the adaptive management of potential impacts and environmental consequences of the proposed second workings on aquatic and terrestrial flora and fauna, with a specific focus on threatened species, populations and their habitats, EECs/CEECs and water dependent ecosystems;	**Section 5, Section 6, Appendix A**
C8(g)(viii)	Trigger Action Response Plans addressing all features in Table 7 and Table 8, which contain:	**Section 6.3, Appendix A**
	• appropriate triggers to warn of increased risk of exceedance of any performance measure;	
	• specific actions to respond to high risk of exceedance of any performance measure to ensure that the measure is not exceeded;	
	• an assessment of remediation measures that may be required if exceedances occur and the capacity to implement the measures; and	
	• adaptive management where monitoring indicates that there has been an exceedance of any performance measures in Table 7 and/or Table 8, or where any such exceedance appears likely; and	**Section 6.5**
C8(g)(ix)	Contingency Plan that expressly provides for:	**Section 6.3.6**, **Appendix A**
	• adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Table 7 and/or Table 8, or where any such exceedance appears likely;	**Section 6.5**
	• an assessment of remediation measures that may be required if exceedances occur and the capacity to implement those measures;	**Section 6.2**, **Section 6.5**
C8(i)	include a program to collect sufficient baseline data for future Extraction Plans.	**Section 5.4**
E4	**Adaptive Management** The Applicant must assess and manage development-related risks to ensure that there are no exceedances of the criteria and performance measures in this consent. Any exceedance of these criteria or performance measures constitutes a breach of this consent and may be subject to offset or other provisions as specified in this consent and/or penalty or offence provisions under the EP&A Act or EP&A Regulation. Where any exceedance of these criteria or performance measures has occurred, the Applicant must, at the earliest opportunity:	**Section 6.5**

Condition Reference	Condition Requirement	Where Addressed
	(a) take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur; (b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of actiol(c) within 14 days of the exceedance occurring (or other timeframe agreed by the Planning Secretary), submit a report to the Planning Secretary describing these remediation options and any preferred remediation measures or other course of action; and (d) implement reasonable remediation measures as directed by the Planning Secretary.	

2.1.1.2 Management Plan Requirements

Condition E5 of the Consent outlines the general requirements for all management plans. **Table 3** outlines the requirements under this condition and identifies where these requirements have been addressed.

Table 3 Management Plan Requirements

Condition Reference	Condition Requirement	Where Addressed
E5	Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	Noted.
(a)	a summary of relevant background or baseline data;	**Section 3**
(b)	details of:	(Not applicable)
(b)(i)	the relevant statutory requirements (including any relevant approval, licence or lease conditions);	**Sections 2.1**, **2.2** and **2.3**
(b)(ii)	any relevant limits or performance measures and criteria; and	**Section 5.1 and 5.2**
(b)(iii)	the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	**Section 5.1 and 5.2**, **Section 6.3**, **Appendix** A
(c)	any relevant commitments or recommendations identified in the document/s listed in conlion A2(c);	**Section 2.1.2**
(d)	a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	**Section 6.2**
(e)	a program to monitor and report on the:	(Not applicable)
(e)(i)	impacts and environmental performance of the development; and	**Section 4**
(e)(ii)	effectiveness of the management measures set out pursuant to condition E5(d);	**Section 6.2**
(f)	a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	**Section 6.3.6**, **Appendix A**
(g)	a program to investigate and implement ways to improve the environmental performance of the development over time;	**Section 6.3.6**, **Section 6.5.1**
(h)	a protocol for managing and reporting any:	(Not applicable)
(h)(i)	incident, non-compliance or exceedance of any impact assessment criterion or performance criterion;	**Section 7**
(h)(ii)	complaint; or	**Section 7**
(h)(iii)	failure to comply with other statutory requirements;	**Section 7**
(i)	public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	**Section 7**

Condition Reference	Condition Requirement	Where Addressed
(j)	a protocol for periodic review of the plan.	**Section 7**

2.1.2 EIS Commitments

Condition A2(g) of the Consent states that the development may only be carried out generally in accordance with the EIS. The relevant EIS documents include:

- Tahmoor South Project Environmental Impact Statement, Volumes 1 and 7, dated January 2019;
- Tahmoor South Project Amendment Report, including Appendices A to R and response to submissions, dated February 2020;
- Tahmoor South Project Second Amendment Report, Appendices A to O and response to submissions, dated August 2020; and
- Additional information responses dated 14 September 2020 (including Appendices A to L), 23 October 2020 and 4 November 2020.

EIS commitments relevant to this management plan and the extraction of LW S1A-S6A are outlined in **Table 4**. These EIS commitments do not include commitments that are covered by the SSD 8445 Conditions of Consent.

Table 4 EIS Commitments

EIS Reference	Commitment	Where Addressed
AE-2	**Aquatic ecology** Potential impact: Impacts to aquatic ecology as a result of longwall mining and mining induced subsidence Management and mitigation measures: Undertake monitoring of macroinvertebrates for a baseline of two years prior to longwall extraction. The monitoring program may require adding or relocating sites according to the final mine plan and using the same sampling methods as used in the aquatic monitoring conducted to date.	**Section 3.2, Section 4.2, Section 5.2** and **Appendix A.**
AE-3	**Aquatic ecology (existing commitment)** Potential impact: Impacts to aquatic ecology as a result of longwall mining and mining induced subsidence Management and mitigation measures: Implement a BACI (Before After Control Impact) designed monitoring program to compliment the baseline information collected and to assess monitoring impacts in an adaptive management framework.	**Section 3.2, Section 4.2, Section 5.2** and **Appendix A.**
358/SAR	**Terrestrial ecology** T–ansmission lines - the proposed transmission lines has been revised to maximise the existing cleared land, road and existing easement as much as practical. Clearing is therefore only required where vegetation encroaches on the proposed transmission line easement. The installation of the transmission line has also been designed to avoid direct impact to threatened flora by: ● Engaging a suitably qualified ecologist to be present during clearing associated with the transmission line easement to: ● clearly mark the threatened plants to ensure that the contractors avoid impacts during clearing event; and	No site disturbance works required for this Extraction Plan. Refer to the overarching Biodiversity Management Plan for the Tahmoor South Project (Section 5.2.5).

EIS Reference	Commitment	Where Addressed
	• be present during the installation of the power poles to safeguard against direct impacts to the threatened plants. The transmission line will require on-going maintenance, such as slashing of vegetation within the easement to a height of 2 m. Given the plants will not grow above 2 m in height, the long-term maintenance slashing is unlikely to impact the ”hreatened plants."	

2.1.3 EPBC Act Approval Conditions

Conditions relevant to this management plan from the approval (EPBC 2017/8084) granted by DAWE for the Tahmoor South Project are outlined in **Table 5**.

Table 5 EPBC Act Approval Conditions

Condition	Condition Requirement	Where Addressed
1	The approval holder must not impact any listed threatened species and ecological communities outside the Development Application Area. Within the Development Application Area, the approval holder must not impact more than: a. 7.3 hectares of the Shale Sandstone Transition Forest in Sydney Basin Bioregion. b.0 individuals of Small-flower Grevillea; c. 0 individuals of Bargo Geebung; d. 0 individuals of Rufous Pomaderris e. 1.3 hectares of Koala habitat	This Biodiversity Management Plan outlines the proposed ecology monitoring program and management measures for the management of ecology (including threatened species and ecological communities) during mining of LW S1A-S6A.
2	The approval holder must comply with the State development consent conditions A9, B37, B38, B39, B40, B56, B58, B59, B60, C1, C2, C3, C4, C8, C9 and C10	Relevant conditions applicable to this Extraction Plan are discussed in Section 3.2.1.1 and Section 3.2.1.2 of the Extraction Plan Main Document. Condition A9 of SSD 8445 is not considered relevant to this Extraction Plan. Conditions B37, B38, B39, B40, B58 and B59 of SSD 8445 are covered by the generic Biodiversity Management Plan for the Tahmoor South Domain, which has been approved by DPE.

2.1.4 Extraction Plan Guideline

This management plan has been prepared in accordance with the DPIE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPIE, 2015), as detailed in **Table 6**.

Table 6 Extraction Plan Guideline Requirements for Key Component Plans

Extraction Plan Guideline Content Requirements for Key Component Plans	Where Addressed
An overview of all landscape features, heritage sites, environmental values, built features or other values to be managed under the component plan.	**Section 3**
Setting out all performance measures included in the development consent relevant to the features or values to be managed under the component plan.	**Section 2.1.1**, **Section 5.1** and **5.2**
Setting out clear objectives to ensure the delivery of the performance measures and all other relevant statutory requirements (including relevant safety legislation).	**Section 2**, **Section 5.1** and **5.2**, **Section 6**
Proposing performance indicators to establish compliance with these performance measures and statutory requirements.	**Section 5.1** and **5.2**, **Appendix A**

Extraction Plan Guideline Content Requirements for Key Component Plans	Where Addressed
Describe the landscape features, heritage sites and environmental values to be managed under the component plan, and their significance.	**Section 3**
Describe all currently predicted subsidence impacts and environmental consequences relevant to the features, sites and values to be managed under the component plan.	**Section 4**
Describe all measures planned to remediate these impacts and/or consequences, including any measures proposed to ensure that impacts and/or consequences comply with performance measures and/or the Applicant's commitments.	**Section 6**, **Appendix A**
Describe the existing baseline monitoring network and the current baseline monitoring results, including pre-subsidence photographic surveys of key landscape features and key heritage sites which may be subject to significant subsidence impacts (such as significant watercourses, swamps and Aboriginal heritage sites).	**Section 3**
Fully describing the proposed monitoring of subsidence impacts and environmental consequences.	**Section 5.3**
Describe the proposed monitoring of the success of remediation measures following implementation.	**Section 6.2**, **Section 6.3.6**, **Appendix A**
Describe adaptive management proposed to avoid repetition of unpredicted subsidence impacts and/or environmental consequences.	**Section 6.5**
Describe contingency plans proposed to prevent, mitigate or remediate subsidence impacts and/or environmental consequences which substantially exceed predictions, or which exceed performance measures.	**Section 6.3.6**, **Appendix A**
Listing responsibilities for implementation of the plan.	**Section 7**
An attached Trigger, Action, Response Plan (effectively a tabular summary of most of the above).	**Appendix A**

2.2 Relevant Legislation and Policies

The relevant acts and regulations protecting and managing terrestrial and aquatic biodiversity in New South Wales and Australia are detailed in the subsections below.

2.2.1 Federal *Environment Protection and Biodiversity Conservation Act 1999*

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), approval from the Commonwealth Minister for Department of Agriculture, Water and the Environment is required for any action that may have a significant impact on Matters of National Environmental Significance. These matters are:

- Listed threatened species and ecological communities;
- Migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- The Commonwealth marine environment;
- World Heritage properties;
- National Heritage place;
- Great Barrier Reef Marine Park;
- Nuclear actions; and
- A water resource, in relation to coal seam gas development and large coal mining development.

No significant impacts to threatened biodiversity listed under the EPBC Act are likely as a result of the extraction of LW S1A-S6A (Niche, 2018a; Niche, 2020a; Niche, 2020c; **Section 4.1**).

2.2.2 NSW *Environmental Planning and Assessment Act 1979*

The NSW *Environment Planning and Assessment Act 1979* (EP&A Act) provides an assessment framework in concert with the NSW *Biodiversity Conservation Act 2016* (BC Act) for the consideration of impacts to biodiversity including threatened biodiversity. For NSW State approval, the Project was approved as an SSD (8445) under Section 4.36 of the EP&A Act.

2.2.3 NSW *Biodiversity Conservation Act 2016*

The BC Act provides protection for threatened species native to NSW (excluding fish and marine vegetation). Species, populations and ecological communities listed under Schedule 1 (threatened species) and Schedule 2 (threatened ecological communities) are considered to be threatened in NSW.

Protection is provided by integrating the conservation of threatened entities into development control processes under the NSW EP&A Act.

No significant impacts to threatened biodiversity listed under the BC Act are likely as a result of the extraction of LW S1A-S6A (Niche, 2018a; Niche, 2020a; Niche, 2020c; **Section 4.1**).

2.2.4 NSW *Fisheries Management Act 1994*

The main objectives of the NSW *Fisheries Management Act 1994* (FM Act) are to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations, and in particular:

- To conserve fish stocks and key fish habitats;
- To conserve threatened species, populations and ecological communities of fish and marine vegetation;
- To promote ecologically sustainable development, including the conservation of biological diversity, and be consistent with these objectives;
- To promote quality recreational fishing opportunities;
- To appropriately share fisheries resources between the users of those resources;
- To provide social and economic benefits for the wider community of NSW; and
- To recognise the spiritual, social, and customary significance to Aboriginal persons of fisheries resources and to protect, and promote the continuation of, Aboriginal cultural fishing.

The Project (extraction of coal from LW S1A-S6A) is expected to impact key fish habitat in Teatree Hollow, see **Section 4.2**. Monitoring and management of impacts to fish habitat are discussed in **Section 6.3** and **Appendix A**. No threatened aquatic fauna species listed under the FM Act are likely to be impacted from the Project.

2.2.5 NSW *State Environmental Planning Policy (Koala Habitat Protection) 2021*

The *Koala Habitat Protection State Environmental Planning Policy (SEPP) 2021* came into force on 17 March 2021 to replace and repeal the *SEPP (Koala Habitat protection) 2020* (which replaced the *SEPP (Koala Habitat protection) 2019* on 30 November 2020, and was in force from November 2020 until March 2021) for specific areas of NSW, as follows:

- The 83 Local Government Areas (LGAs) on the Koala SEPP LGA list;
- In nine of the listed LGAs (Blue Mountains, Campbelltown, Hawkesbury, Ku-Ring-Gai, Liverpool, Northern Beaches, Hornsby, Wollondilly, Central Coast) Koala Habitat Protection SEPP 2021 applies to all zones; and
- In the remaining 74 LGAs the Koala Habitat Protection SEPP 2021 applies to all zones except to land zoned RU1 Primary Production, RU2 Rural Landscape or RU3 Forestry. Koala Habitat Protection SEPP 2020 continues to apply to these zones.

The application of the Koala Habitat Protection SEPP 2020 to all RU1, RU2 and RU3 zoned land outside of the Sydney Metropolitan Area and the Central Coast (within the listed LGAs) is an interim measure while new land management and private native forestry codes are developed.

Wollondilly LGA is listed as an LGA to which the Koala Habitat Protection SEPP 2021 applies to all zones. As this report is being assessed under Part 4 of the EP&A Act, the provisions of the Koala Habitat Protection SEPP 2021 apply in relation to the assessment of Koala habitat.

Predicted impacts to Koalas and Koala habitat associated with the extraction of LW S1A-S6A are addressed in **Section 4.1.6**. Management of direct impacts to Koala habitat are discussed in the Biodiversity Management Plan prepared in accordance with consent condition B38 (SSD 8445).

2.2.6 NSW *Biosecurity Act 2015*

The broad objectives of the NSW *Biosecurity Act 2015* are to manage biosecurity risks from animal and plant pests and diseases, weeds and contaminants by preventing their entry into NSW, quickly finding, containing and eradicating any new entries, and effectively minimising the impacts of those pests, diseases, weeds and contaminants that cannot be eradicated through robust management arrangements.

Under the *Biosecurity Act 2015*, priority weeds are any weed identified in a local strategic plan, for a region that includes that land or area, as a weed that is or should be prevented, managed, controlled or eradicated in the region. This includes the following categories of weeds:

- Weeds of National Significance;
- National Environmental Alert List Weeds;
- Water weeds; and
- Native plants considered weeds.

In NSW all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Management of weeds is discussed in the Biodiversity Management Plan prepared in accordance with consent condition B38 (SSD 8445).

2.3 Other Leases and Licences

All development consents, leases, licences, and other relevant approvals are stored in the Cority Compliance Management database, which is administered by both site and Liberty GFG Corporate. A summary of the relevant mining leases is provided in **Table 7.** A summary of other approvals and licences is provided in **Table 8.**

Table 7 Mining Lease

Lease	Title	Granted	Expires
CCL 716	Original Tahmoor Lease	15/06/1990	13/03/2021 (renewal documentation submitted and being assessed)
CCL 747	Bargo Mining Lease	23/05/1990	06/11/2025
ML 1376	Tahmoor North Lease	28/08/1995	28/08/2016 (renewal documentation submitted and being assessed)
ML 1308	Small Western Lease to west of CCL 716	2/3/1993	2/3/2035
ML 1539	Tahmoor North Extensions Lease	16/06/2003	16/06/2024

Lease	Title	Granted	Expires
ML 1642	Pit-top and REA surface Mining Lease	27/08/2010	27/08/2031

Table 8 Environmental Approvals and Licences

Approval Title / Description	Date Granted	Expiry Date
Environmental Protection Licence 1389	01/05/2012	No Expiry
WAL36442 and WAL25777	6/12/2013	No Expiry
WAL43572	7/5/2021	No Expiry
WAL43656	1/8/2022	No Expiry

2.4 Stakeholder Consultation

2.4.1 Consultation to Date

The following stakeholders were consulted during the preparation of this management plan:

- NSW Department of Planning and Environment – Environment, Energy and Science (EES) Group (formerly NSW Department of Planning, Industry and Environment);
- NSW Department of Planning, Industry and Environment – Crown Lands Division (Crown Lands) (formerly NSW Department of Planning, Industry and Environment); and
- Wollondilly Shire Council (WSC).

The feedback provided by stakeholders is summarised within **Table 9** below. This consultation table does not include consultation completed during the Extraction Plan review stage post submission to DPE.

A summary of all consultation undertaken for this extraction plan is provided in Section 2.1.2 of the Extraction Plan Main Document, and a copy of the incoming correspondence is also provided in Appendix C of the Extraction Plan Main Document.

Table 9 Consultation to Date

Consulted Stakeholder	Consultation Conducted	Outcomes of Consultation
EES	A letter introducing the Extraction Plan for LW S1A-S6A was sent on 22 December 2021. Tahmoor Coal provided a figure of the Extraction Plan Study Area, and an overview of the longwalls. A response was received on 3 February 2022.	Noted.
	It is recommended that consideration be given to subsidence impacts to Hornes Creek which currently has good water quality and feeds into the Bargo River near Picton Weir and re-opening of fractures in the Bargo River caused by extraction of longwalls 14 – 19. In both instances, this will require an appropriate water monitoring program and a clear commitment to undertake the necessary remediation actions, should impacts occur.	Information regarding the water monitoring program and proposed remediation actions (if required) are provided in the LW S1A-S6A Water Management Plan.

Consulted Stakeholder	Consultation Conducted	Outcomes of Consultation
	It is suggested that an update is provided on the progress of the remediation of Myrtle and Redbank Creek which outlines the outcomes of an inspection of Redbank Creek remediation works and data that demonstrates 'success' of this work.	A report on the remediation progress of Myrtle and Redbank Creek is provided in Appendix B of the LW S1A-S6A Water Management Plan. This includes results from seasonal aquatic ecology monitoring completed in both creeks.
Crown Lands	A letter introducing the Extraction Plan for LW S1A-S6A was sent on 22 December 2021. Tahmoor Coal provided a figure of the Extraction Plan Study Area, and an overview of the longwalls. A response was received on 2 February 2022.	Noted.
	Within the Longwall area, there is a substantial amount of Crown Land. This Crown Land includes Dedication 500432 managed by The National Trust of Australia for Conservation of Native Flora, Fauna (45.03 ha) including Lot 33 DP 751250, Lot 18 DP 751250, Lot 19 DP 751250, all on the eastern side of Remembrance Drive.	Land associated with the Australian Wildlife Sanctuary (managed by The National Trust of Australia) will be managed in accordance with the LW S1A-S6A Australian Wildlife Sanctuary Management Plan. This land includes the three land parcels noted in the comment from Crown Land. This management plan will be prepared in consultation with The National Trust, and will be finalised prior to the commencement of Longwall South 1A extraction.
	This reserve is adjoined by other Crown reserves e.g. R751250 (1784 ha), a Parish reserve for Bargo, Camden with purpose of future public requirements, environmental studies and training purposes.	Any waterways or dams contained within these reserve lots will be managed in accordance with the LW S1A-S6A Water Management Plan. The management of flora and fauna within the Study Area will be in accordance with this management plan.
	Within the 600 m Study Area for Natural Features, identified in the Extraction plan, the Wingecarribee Shire Council holds Licence No 625498 (a Section 2.20 licence – Short Term Licence Type 1a – Combined) with Crown lands for Environmental Protection, which includes Lot 7311 DP 11410250. The account area for this licence is 9397 ha of Crown Land, so extends well beyond the Study Areas identified.	Any waterways or dams contained within these reserve lots will be managed in accordance with the LW S1A-S6A Water Management Plan. The management of flora and fauna within the Study Area will be in accordance with this management plan.
	The Crown Land area between Bargo and Tahmoor is understood to support numerous Endangered Ecological Communities and Threatened Species of Flora and Fauna. The Extraction Plan will need to address mitigation of adverse impacts of the extraction operation on flora and fauna within the Study Areas.	**Section 3.1** confirms the presence of a Threatened Ecological Community (TEC), Shale Sandstone Transition Forest in the Sydney Basin Bioregion, and numerous threatened flora and fauna species in the Study Area.

Consulted Stakeholder	Consultation Conducted	Outcomes of Consultation
		The Biodiversity Management Plan confirms the presence of any Endangered Ecological Communities and Threatened Species (flora and fauna) in the Study Area, as well as **Section 5.3** and **Section 6.2** outline the proposed ecology monitoring program and management measures for the management of ecology during mining of LW S1A-S6A.
WSC	A letter introducing the Extraction Plan for LW S1A-S6A was sent on 22 December 2021. Tahmoor Coal provided a figure of the Extraction Plan Study Area, and an overview of the longwalls. A response from Council's Waste and Environmental Services Team was received on 14 February 2022.	Noted.
	A scientific based investigation over the establishment of Risk Management Zones for third order watercourses for the purposes of identifying and managing impacts associated with subsidence to the ecological health of waterways within a catchment context.	Potential impacts and management of third order watercourses is provided in the LW S1A-S6A Water Management Plan. The predicted impacts to ecology are discussed in Section 4 of this document, while **Section 5.3** and **Section 6.2** outline the proposed ecology monitoring program and management measures for ecology, respectively.
	Trigger Response Action Plans and related monitoring programs that are developed as part of the Extraction Plan and Water Plan are to be scientifically based, supported by commensurate data. They are requested in this regard to include appropriate ecological focussed indicators to monitor any impacts to the ecological health of waterways at a suitable timeframe that would restrict the need for Creek Management Action Plans.	The monitoring program and TARPs for ecological health are provided in **Section 5.3** and **Appendix A**, respectively.

3 Existing Environment

3.1 Terrestrial Ecology

3.1.1 Previous Assessments

The information from the following reports has been used to populate the sub sections of **Section 3.1**, and refined to contain only the details relevant to the 600 m buffer and LW1A – LW6A Study Area:

- Biodiversity Assessment Report (Niche, 2018a (Appendix K of the EIS)), and the first and second amendments to the report (Niche, 2020a; Niche, 2020c);
- Terrestrial Ecology Monitoring Report – Spring 2020-Autumn 2021 riparian vegetation and amphibian baseline monitoring (Niche, 2021a); and
- Terrestrial Ecology Monitoring Report – Spring 2021 riparian vegetation and amphibian baseline monitoring 2021 (Niche, 2022a).

These reports should be referred to for further detail regarding baseline conditions of terrestrial biodiversity within the broader Project Area covered by the EIS (Niche, 2018a, 2018b).

3.1.2 Baseline Monitoring Summary

The existing environment is characterised by baseline studies and on-going amphibian and riparian monitoring in and adjacent to the Study Area. The riparian monitoring program has been designed as a Before-After-Control-Impact (BACI) study, such that a sufficient amount of data is collected over time in order to be able to compare any changes towards ecology indicators as a result of subsidence. Riparian vegetation monitoring sites have been set up along Hornes Creek, Teatree Hollow Creek and Moore Creek which include three impact sites (Sites i01-i03) and three control sites (Sites c04-c06) as illustrated in **Figure 10.**

Baseline monitoring has taken place twice each year over two years, as detailed in **Table 10.**

Table 10 Riparian and Amphibian Monitoring Season Summary

Year	Season	Reference
2020	Spring	Niche (2021a)
2021	Autumn	Niche (2021a)
2021	Spring	Niche (2022a)
2022	Autumn	(Niche 2022b)

3.1.2.1 Riparian Vegetation Baseline Data

According to the Google Earth Engine Burnt Area Map (GEEBAM) mapping (DPIE, 2020), all Sites were burnt in the Black Summer bushfires, and were within a 'High' to 'Very High' burnt class where all stratum layers were severely burnt to canopy height. Many species and communities will take years to recover, particularly those not adapted to fire or impacted by prolonged drought or other threatening processes. Observations and the results of data analysis indicate natural succession and post-fire recruitment is occurring at all monitoring sites.

Flora species richness across Sites ranged from 45 to 55 species in Spring 2020, 39 to 57 species in Autumn 2021, 31 to 45 species in Spring 2021.

Dominant species in terms of percent cover for Spring 2020 and Autumn 2021 include, *Pteridium esculentum, Acacia decurrens* (particularly dominant in Autumn at impact Site 3), *Desmodium rhytidophyllum, Banksia spinulosa* and *Banksia serrata.*

Significant Weeds recorded for the Spring 2020 and Autumn 2021 surveys include *Senecio madagascariensis* (Weed of National Significance and Priority Weed), *Ehrharta erecta* (High Threat Weed (HTW)), *Cyperus eragrostis* (HTW), *Lonicera japonica* (HTW), *Ligustrum lucidum* (HTW), *Ageratina Adenophora* (HTW), *Ipomoea indica* (HTW), and *Persicaria spp.* (Potential Priority weed).

Natural seasonal variation is observed at each site; however diversity of native species has been found to be generally decreasing as a result of competition from *Acacia* spp., refer to **Figure 3** and **Figure 4**.

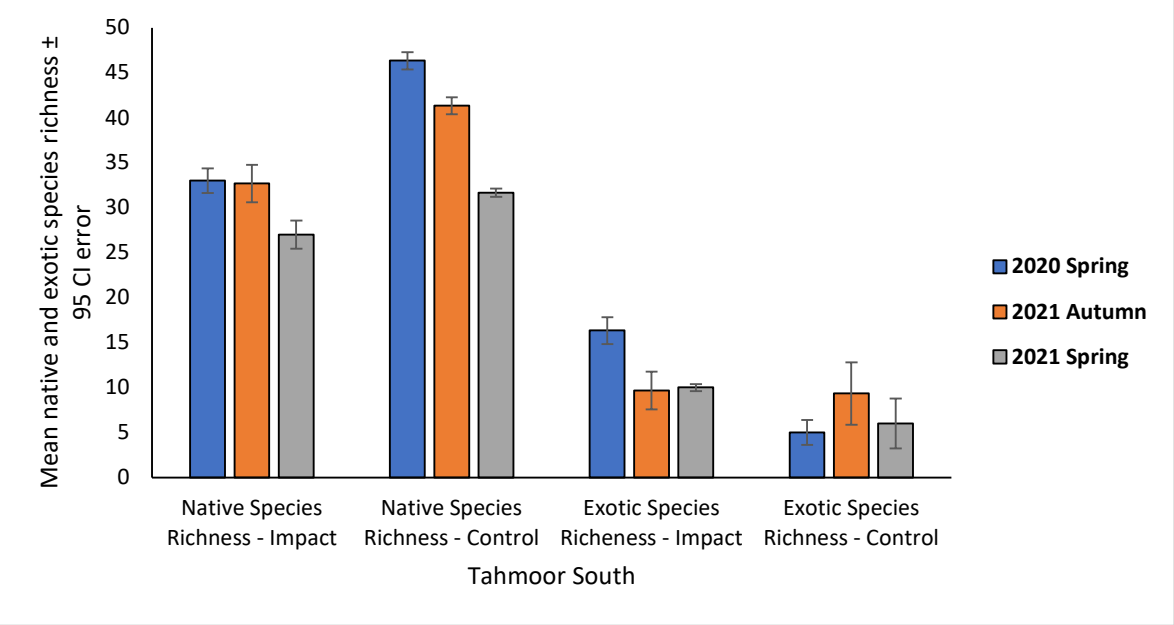

Figure 3 Mean native and exotic species richness at impact and control sites in Spring 2020, Autumn 2021 and Spring 2021

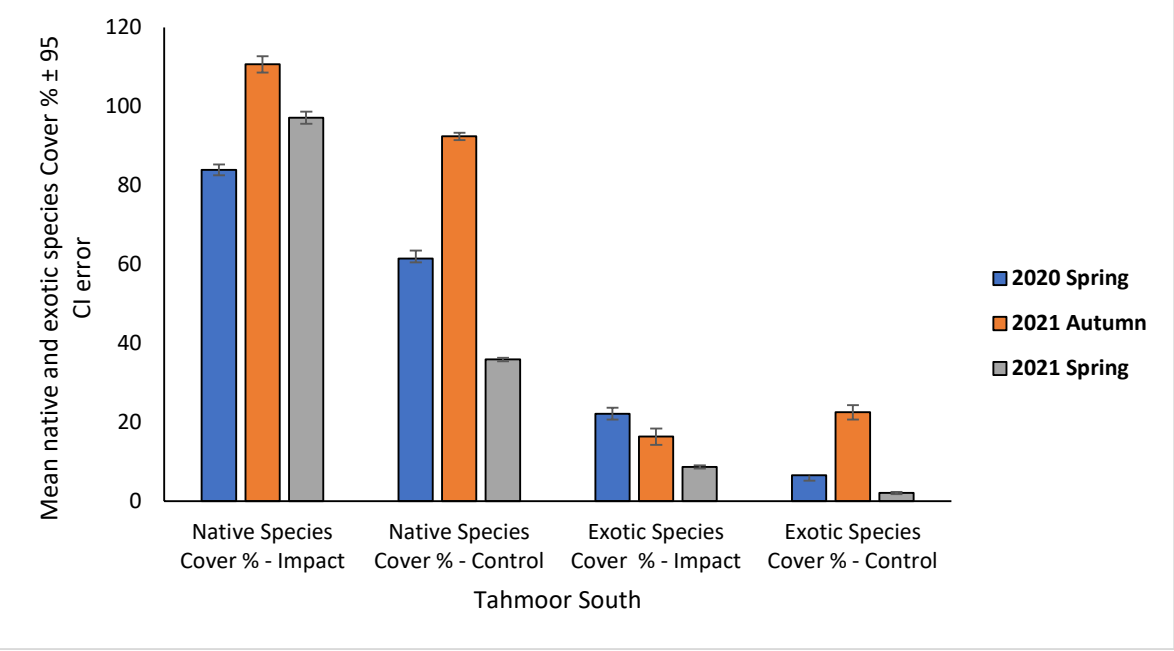

Figure 4 Mean native and exotic species cover percentage at impact and control sites in Spring 2020, Autumn 2021 and Spring 2021

3.1.2.2 Amphibian Baseline Data

Frog detection rates were variable between Spring and Autumn monitoring events, with frog species more abundant during Spring. Spring 2020 and Spring 2021 monitoring results were comparable. The two species driving this difference were Common Eastern Froglet and Peron's Tree Frog. At the time of Spring monitoring in 2020 and 2021, there were higher than average monthly rainfall totals and higher than average temperatures, creating favourable conditions for frog surveys.

Twelve common frog species were detected across the monitoring events, which represents an otherwise normal assemblage that may be expected to be present in the Study Area under the current climatic conditions. These species include:

- Common Eastern Froglet (*Crinia signifera*)
- Smooth toadlet (*Uperoleia laevigata*)
- Eastern Banjo Frog (*Limnodynastes dumerilii*)
- Striped Marsh Frog (*Limnodynastes peronii*)
- Eastern Dwarf Tree Frog (*Litoria fallax*)
- Broad-palmed Frog (*Litoria latopalmata*)
- Stony Creek Frog (*Litoria lesueuri*)
- Peron's Tree Frog (*Litoria peronii*)
- Green Stream Frog (*Litoria phyllochroa*)
- Tyler's Tree Frog (*Litoria tyleri*)
- Whistling Tree Frog (*Litoria verreauxii*)
- Blue Mountains Tree Frog (*Litoria citropa*).

No threatened amphibians were recorded during the surveys undertaken to inform the terrestrial ecology Biodiversity Assessment Report (Niche, 2018a), nor have any threatened amphibians been detected during the baseline monitoring (Niche, 2021a; Niche, 2022a). Despite the absence of detection, potential habitat exists for the Red-crowned Toadlet across the riparian areas within the Study Area.

During the baseline monitoring (Niche, 2021a; Niche, 2022a), no threatened amphibian species were detected either as frogs or tadpoles. The targeted threatened frog species, Red-crowned Toadlet *Pseudophryne australis* and Giant Burrowing Frog *Heleioporus australiacus*, appear not to be present in the Study Area. While the Study Area environment contains superficially suitable habitat, it is possible that these species would no longer be able to survive in the area due to number of factors such as:

- Absence of suitable non-breeding habitat for Giant Burrowing Frog at most monitoring sites as a result of groundcover removal from fire, heavy weed encroachment and erosion;
- Increased urban encroachment;
- Changes in hydrological flows, water quality and nutrient loads;
- Climatic variability; and
- Predation pressures from two introduced predators: Eastern Gambusia (*Gambusia holbrooki*) and the Yabby (*Cherax destructor*), both of which were detected at all monitoring sites.

3.1.3 Native Vegetation

Vegetation in the Study Area has been mapped by Office of Environment and Heritage (OEH 2013). Plant Community Types (PCTs) mapped in the Study Area are:

- PCT 1395: Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion;

- PCT 1081: Red Bloodwood – Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion; and
- PCT 1181: Smooth-barked Apple – Red Bloodwood – Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion.

3.1.3.1 Threatened Ecological Communities:

Of the listed PCT's above, PCT 1395 is assigned to a Threatened Ecological Community (TEC), *Shale Sandstone Transition Forest in the Sydney Basin Bioregion.* Niche (2018a, 2020a, 2020c) has confirmed the presence of PCT 1395 in the Direct Impact Area (**Figure 7**), as such the TEC is considered likely to occur within the remainder of the Study Area as is mapped by OEH (2013).

No TECs are present within the six monitoring Sites.

3.1.4 Threatened Flora

One threatened flora species was potentially recorded at impact Site 3 and Site 6 during the Spring 2021 monitoring surveys, *Pomaderris brunnea* (Brown Pomaderris). *Persoonia bargoensis* (Bargo Geebung) and *Grevillea Parviflora* subsp. *parviflora* (Small-leaved Grevillea) were recorded in the Study Area in 2018.

Records of the species listed in **Table 11** are located within the 600 m buffer area, as illustrated in **Figure 6**.

Table 11 Threatened Flora Species in the Study Area

Species	Niche records	BioNet (DPIE 2022) records
Grevillea parviflora subsp. *Parviflora*	711	10
Persoonia bargoensis	25	332
Pomaderris brunnea	441	8
Persoonia glaucescens	0	36
Persoonia hirsuta	0	3
Acacia bynoeana	0 records, identified as having a high likelihood of occurrence as it was recorded in the EIS Project Area	0
Leucopogon exolasius	0 records, identified for consideration by SEARs.	0

3.1.5 Threatened Fauna

Seventy-four threatened fauna species listed on the BC Act and/or EPBC Act have been recorded or predicted to occur within 10 km of the EIS Project Area based on database searches of BioNet (DPIE, 2022) and the EPBC Act Protected Matter Search tool (Department of Agriculture, Water and the Environment (DAWE), 2017). Of those, 34 threatened fauna species were identified as having a moderate or higher likelihood of occurrence in the EIS Project Area, which includes twelve threatened fauna species that were recorded within the EIS Project Area or immediately adjacent (Niche 2018a). Threatened fauna species recorded by Niche (2018a) include (**Figure 5**):

- Glossy Black Cockatoo *Calyptorhynchus lathami*;
- Little Eagle *Hieraaetus morphnoides*;
- Powerful Owl *Ninox strenua*;
- Scarlet Robin *Petroica boodang*;
- Sooty Owl *Tyto tenebricosa*;
- Varied Sittella *Daphoenositta chrysoptera*;

- Large Bent-wing Bat *Miniopterus orianae oceanensis*;
- Eastern Coastal Free-tailed Bat *Micronomus norfolkensis*;
- Large-fooacropusis *Myotis macropus*;
- Eastern Cave Bat *Vespadelus troughtoni*;
- Eastern False Pipistrelle *Falsistrellus tasmaniensis*; and
- Red-crowned Toadlet *Pseudophryne australis*.

Additionally, Red-crowned Toadlet and Giant Burrowing Frog, were recorded during the Tahmoor Amphibian Monitoring Program in 2013, outside the Study Area for LW S1A – LW S6A. Giant Burrowing Frog was recorded at Cow Creek and Red-crowned Toadlet was recorded at Hornes Creek (Niche, 2018a).

In addition to the species recorded by Niche, BioNet (**Figure 5;** DPIE, 2022) also holds records in the Study Area for Dusky Woodswallow *Artamus cyanopterus cyanopterus*, Gang-gang Cockatoo *Callocephalon fimbriatum*, Brown Treecreeper (eastern subspecies) *Climacteris picumnus victoriae*, Little Lorikeet *Glossopsitta pusilla*, Black-chinned Honeyeater (eastern subspecies) *Melithreptus gularis gularis*, Diamond Firetail *Stagonopleura guttata*, Large-eared Pied Bat *Chalinolobus dwyeri*, Greater Broad-nosed Bat *Scoteanax rueppellii* and Grey-headed Flying-fox *Pteropus poliocephalus.*

No threatened fauna species have been recorded within the Study Area during the ongoing biodiversity monitoring program which commenced in Spring 2019.

This information has been retracted
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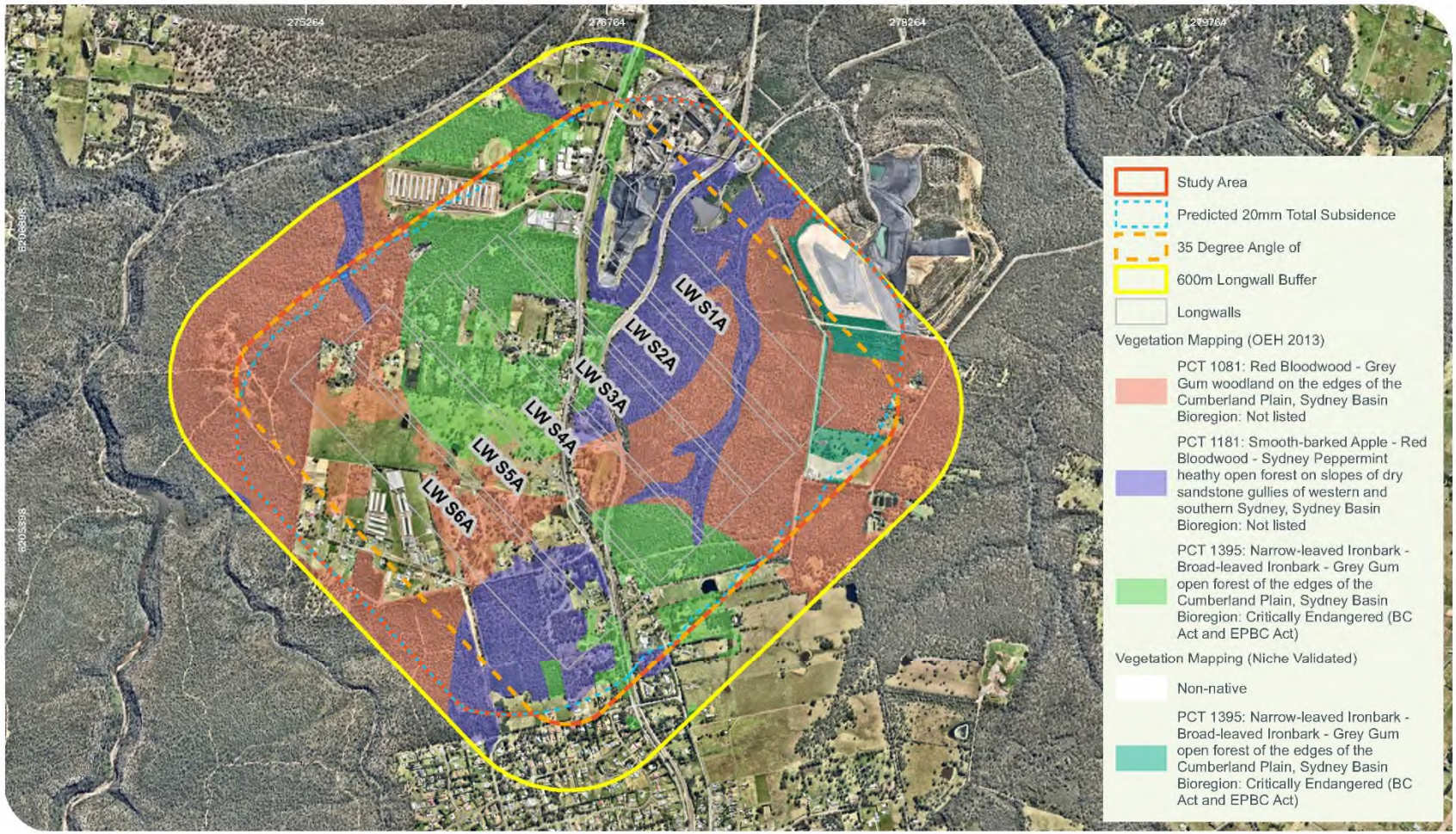

Figure 7 Plant Community Types and Threatened Ecological Communities

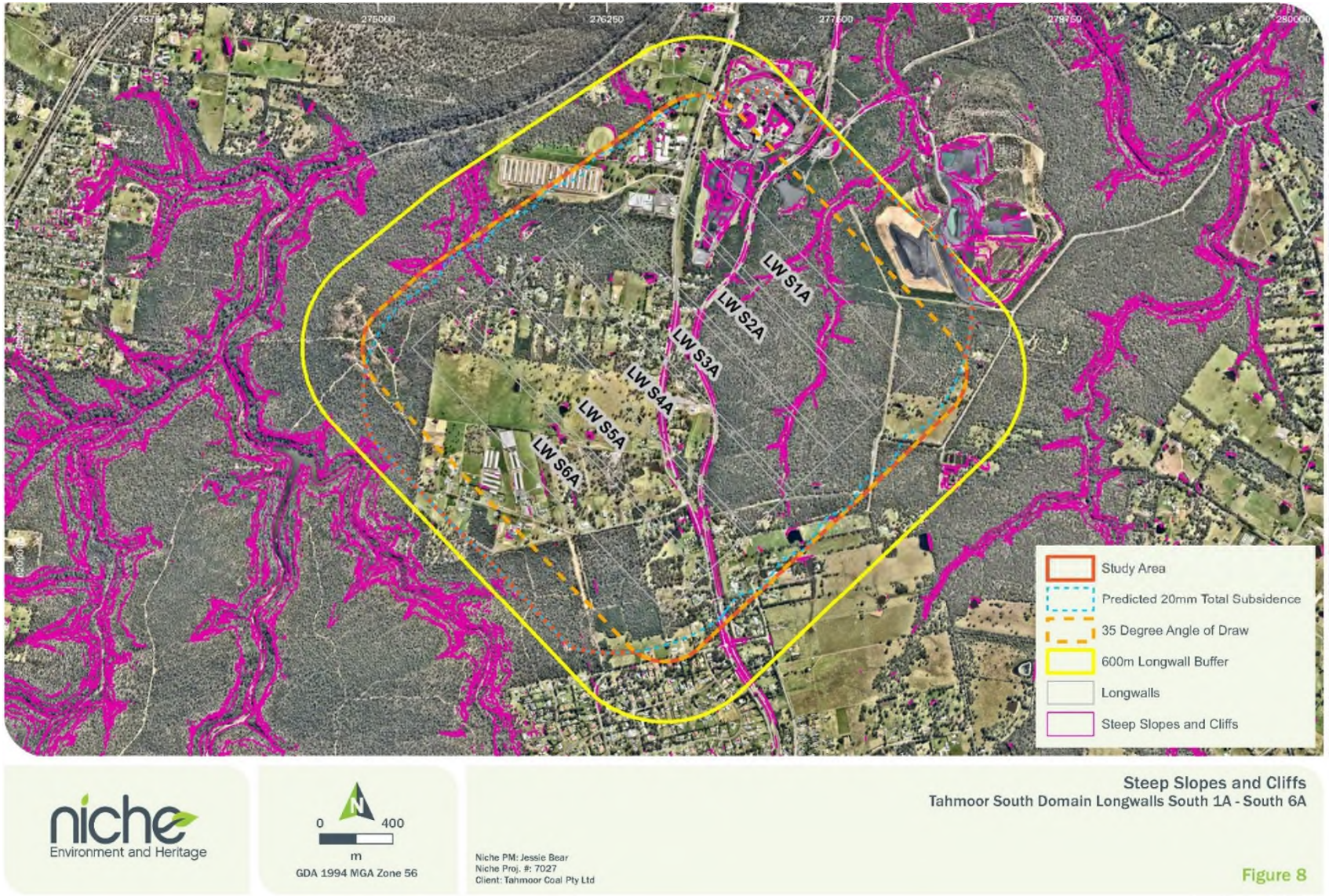

Figure 8 **Steep Slopes and Cliffs**

3.2 Aquatic Ecology

The following subsections have been sourced from previous aquatic ecological assessment in the Study Area (Niche, 2018b, 2020b; Niche, 2020c), the most recent Aquatic Monitoring Report from Spring 2019 to Spring 2021 (Niche, 2020e; Niche, 2021b; Niche, 2022b). These reports should be referred to for further detail regarding baseline conditions of aquatic biodiversity.

3.2.1 Baseline Monitoring Data Sources

Two and a half years of baseline monitoring (five seasons) have been completed to date from 2019 – 2021, with an additional two years of data collection, including at sites along Teatree Hollow, completed in 2012 – 2013 (four seasons). The aquatic monitoring undertaken within the Study Area to date is listed below in **Table 12**, with the findings of these surveys used to inform the description of existing environments and characterisation of baseline conditions.

Table 12 Aquatic Monitoring Season Summary and Reference Material

Year	Season	Reference
2012	Autumn	Niche (2018b)
2012	Spring	Niche (2018b)
2013	Autumn	Niche (2020b)
2013	Spring	Niche (2020b)
2019	Spring	Niche (2020e)
2020	Autumn	Niche (2020e)
2020	Spring	Niche (2021b)
2021	Autumn	Niche (2021b)
2021	Spring	Niche (2022a)
2022	Autumn	Niche (2022b)

Recent monitoring over the last two and a half years has provided up to date baseline data to characterise the prevailing aquatic ecological conditions within Teatree Hollow, which is anticipated to be impacted by extraction from Longwalls S1A to S6A, and suitable controls, as part of an ongoing BACI study design. The baseline monitoring program commenced in Spring 2019, with field surveys most recently undertaken in Spring 2021. The aquatic baseline monitoring includes water quality sampling and monitoring primarily based on the Australian River Assessment System (AUSRIVAS) and quantitative macroinvertebrate sampling biannually since Spring 2019 (Niche, 2021b).

Previous monitoring and assessment completed over four monitoring seasons in 2012 – 2013 (Niche, 2020b) and current baseline monitoring program (2019 – 2022) (Niche, 2020e; Niche, 2021b; Niche, 2022b) includes the methodologies in **Table 13** below.

Table 13 Aquatic Baseline Monitoring Program Methodologies

Year	Methodology
2012 2013	• AUSRIVAS stream health assessment (including visual assessments of aquatic habitat, macrophytes, in situ water quality conditions and the sampling of benthic macroinvertebrates), according to Turak et al. (2004). • Recording the presence/absence of macrophytes within a 100 m reach at each sample site. With all macrophytes observed at surveys sites identified to lowest taxonomic level. • Quantitative benthic macroinvertebrate assemblage sampling and assessment. • Physico-chemical water quality sampling. • Threatened species and key fish habitat assessment.

Year	Methodology
	• Fish survey.
2019	• AUSRIVAS stream health assessment (including visual assessments of aquatic habitat, macrophytes, in situ water quality conditions and the sampling of benthic macroinvertebrates), according to Turak et al. (2004). • Quantitative benthic macroinvertebrate assemblage sampling and assessment (Brook, 1994).
2020	
2021	
2022	

AUSRIVAS, macroinvertebrate samples are compared to modelled reference sites and is a rapid assessment approach based upon the presence/absence of macroinvertebrates. This provides baseline data for before and after impact monitoring of the sites through time, as well as comparisons of conditions at impact sites to control sites within seasons and over time. The assessment of site results against reference site data held within the AUSRIVAS predictive models provides an additional level of stream health assessment and comparison to that of modelled 'un-impacted' reaches.

The quantitative macroinvertebrate program compares potential impacts sites with upstream control sites and contains community assemblage data, which can be used to determine quantitative changes in fauna abundance, richness and structure that may otherwise be missed by a rapid assessment approach. This approach takes into account the natural variability of the stream through the comparison to upstream control sites through time.

Collected habitat and water quality data is used to aid the interpretation of macroinvertebrate monitoring; to determine the likely drivers behind any changes in stream health indicators. This suite of aquatic ecological assessment methods collectively forms the comprehensive monitoring approach of the current iteration of the Tahmoor South aquatic ecological monitoring program.

The monitoring locations for the current monitoring program are shown in **Figure 9**, and identified in bold below in **Table 14**. For reference, monitoring sites previously utilised as part of aquatic ecological monitoring in the Study Area and immediate surrounds are also presented.

Table 14 Monitoring Site Summary

Site	Easting	Northing	Watercourse	Sampling methods undertaken			Monitoring to date
				AUSRIVAS	Quantitative macro-invertebrate	Water quality	
Impact sites (potentially impacted by LW S1A – S6A)							
3	276964	6208797	Bargo River		X	X	Spring 2019 – Autumn 2021
4	277034	6208893	Bargo river	X	X	X	Spring 2019 – Autumn 2021
5	279490	6207467	Bargo River	X	X	X	Spring 2019 – Autumn 2021
6	279630	6207585	Bargo River	X	X	X	Spring 2019 – Autumn 2021
9	278286	6205050	Dogtrap Creek tributary	X	X	X	Autumn 2020
10	278879	6205973	Dogtrap Creek	X	X	X	Autumn 2020
11	279194	6206395	Dogtrap Creek	X	X	X	Autumn 2020
12	**277204**	**6205632**	**Teatree Hollow**	**X**	**X**	**X**	**Spring 2019-Spring 2021**
13	**277437**	**6206801**	**Teatree Hollow**	**X**	**X**	**X**	**Autumn 2020-Spring 2021**
16	**277432**	**6206040**	**Teatree Hollow**	**X**		**X**	**Spring 2021**
17	**277246**	**6206601**	**Teatree Hollow**	**X**		**X**	**Spring 2021**
Control sites							
1	274424	6206513	Bargo River		X	X	Spring 2019

Site	Easting	Northing	Watercourse	Sampling methods undertaken			Monitoring to date
				AUSRIVAS	Quantitative macro-invertebrate	Water quality	
2	274739	6207065	Bargo River		X	X	Spring 2019
14	**270959**	**6200225**	**Moore Creek**		**X**	**X**	**Autumn 2020-Autumn 2021**
15	**271328**	**6204392**	**Moore Creek**		**X**	**X**	**Autumn 2020-Autumn 2021**
7	**275705**	**6203691**	**Hornes Creek**	**X**	**X**	**X**	**Spring 2019-Spring 2021**
8	**275575**	**6204588**	**Hornes Creek**	**X**	**X**	**X**	**Spring 2019-Spring 2021**

Note: monitoring sites that are part of the current iteration of the program are highlighted in bold.

The following section describes the aquatic ecological features and monitoring program within the Study Area. The major results and conclusions from the baseline aquatic monitoring are provided in **Table 15**, and more detailed analysis of baseline results are provided in the most recent aquatic ecological monitoring report by Niche (2021b) and recent preliminary results by Niche (2022b).

3.2.2 Watercourses and Stream Morphology

The Study Area is located in the Hawkesbury-Nepean catchment with the natural waterway features comprising Bargo River, Hornes Creek, Moore Creek, and Teatree Hollow (**Figure 9**). Teatree Hollow catchment, which is located within the 600 m Environmental Feature Study Area, will primarily be impacted by the Project (extraction of coal from LW S1A-S6A). Hornes Creek is unlikely to be impacted by the Project (Niche, 2020b) and if no subsidence impacts are observed will be used as a control stream. Bargo River is outside of the potential 600 m Environmental Feature Study Area, however it does receive waters from Teatree Hollow. Moore Creek is a control stream located outside of the 600 m Environmental Feature Study Area.

Baseline data for water table depth is established in the Groundwater Management Plan.

3.2.2.1 Aquatic Monitoring Program (2019-2022)

Over the two and a half year monitoring period, a total of 17 sites have been sampled (**Figure 9**) comprising of potential impact sites and non-impacted (control sites) including Teatree Hollow, Bargo River, Dogtrap Creek, Hornes Creek and Moore Creek. It is to be noted that four impact sites (sites 9, 10, 11 and 13) and one control site (site 14) were found to be dry on more than one occasion. In addition, two sites (Site 1 and 2) were inaccessible in Autumn 2020 due to widespread bushfires in this period preventing safe access (Niche, 2020e). The monitoring program has been complicated by a variety of factors that Niche (2021b) recommended to be considered in the amended program design to improve the overall efficacy of ongoing monitoring. These are:

- Mine water discharge potentially confounding downstream results in Bargo River;
- The highly variable nature of water availability in Teatree Hollow;
- Existing poor stream health in Teatree Hollow;
- No upstream reference sites in Teatree Hollow; and
- Limited or no aquatic habitat in the western Teatree Hollow tributary.

To adapt the monitoring program, negate the influence of the above variables, address limitations to site access, changes to the mine plan, and to increase efficacy of the program, sampling locations have been both removed and added in the latest round of data collection in Spring 2021.

Initial monitoring included sites that were previously sampled for the EIS including Dogtrap Creek and the Bargo River which have since been removed from the current program. Dogtrap Creek will not be affected by the longwalls for this extraction plan and is not currently surveyed for stream health. Monitoring of this waterway will recommence two years prior to mining in this location. Bargo River was surveyed under the EIS and during the first two years of base line monitoring. Sampling sites on Bargo River have been removed due to the low likelihood of detecting any changes downstream of Teatree Hollow as any changes would be masked by the mine water discharge into Teatree Hollow.

Additionally, there is a comprehensive aquatic health program which monitors the Bargo River that started in Spring 2021 which could be analysed to assess downstream impacts if required. Additional sites have been added to the Teatree Hollow catchment to increase spatial representation in the area that is considered most likely to be impacted.

The current and previously utilised sampling locations are detailed in **Table 14** and shown on **Figure 9**.

Baseline pool water level and surface water quality data has been collected within and surrounding the Study Area by HEC (2018), which has been incorporated throughout the following sections.

3.2.2.2 Bargo River

The Bargo River is a north-easterly flowing stream approximately 32 kilometres long, stretching from Colo Vale to the Nepean River near Tahmoor. It is a 5th order stream that has carved through the sandstone tableland forming valleys and gorges. The stream morphology is variable and includes waterfalls, cascades and pools. The Bargo River is a consistently high flow stream totalling an average of 23.9 ML/day. Bargo River's upper reaches and tributaries provide high quality aquatic habitat and no artificial barriers to fish passage and are considered to be in 'near intact' condition, (OEH, 2015; DPE, 2019).

3.2.2.3 Hornes Creek

Hornes Creek occurs within the Bargo sub-catchment and drains an area of 19.5 km². It is a 4th order stream with flows primarily influenced by stormwater runoff from south Bargo and several headwater tributaries which rise on the south-western boundary of the Study Area (DPE, 2019).

3.2.2.4 Teatree Hollow

Teatree Hollow is a 3rd order stream within the Bargo sub-catchment draining an area of approximately 6.8 km². The flow comprises of headwaters at the northern end of the township through to the western part of the Study Area to the Bargo River. Teatree Hollow has a consistently moderate flow with a mean daily flow of 6.3 ML/day. Two main tributaries joining upstream of the Study Area and influenced by the release of water from Tahmoor Coal Mine in accordance with its EPL. In the absence of this discharge, the creek would be ephemeral flowing only after rainfall. The lower reaches of the creek have previously been affected by mining-induced subsidence associated with Tahmoor Coal Mine (DPE, 2019).

3.2.2.5 Moore Creek

Moore Creek is the control creek located outside the 600 m Environmental Feature Study Area, to the west of the railway line and within Bargo State Recreation Area. It flows into Little River which flows north into Lake Burragorang which merges with the Nepean River. Habitat attributes include pools with trailing bank vegetation and some rock bars and associated drops and a lot of snags (Niche, 2020b).

3.2.3 Aquatic Biodiversity

A summary of results for the sites which are relevant to the extraction plan are provided in **Table 15**. This includes Impact sites on Teatree Hollow and Control Sites in Moore Creek and Hornes Creek.

Table 15 Summary of Results and Conclusions of Baseline Studies

Parameter	Results	Conclusion
Stream condition/aquatic habitat		
Stream condition	Bargo River, Hornes Creek, Teatree Hollow and Moore Creek were found to be in mostly stable condition. Water quality had appeared to be mostly clear between Autumn and Spring surveys except for Hornes Creek Sites 7 and 8, and flow was low to moderate.	Streams are generally in moderate to good condition, however low flows place natural stress on the aquatic environment and the availability and quality of aquatic habitat. The drought in Spring 2019-Autumn 2020 likely put pressure on macrophyte growth and post-fire regeneration has been observed at burnt sites. Overall habitat quality across the sites is considered good, with the exception of highly disturbed sites 3 and 4 along the Bargo River.
Aquatic habitat	Habitat quality along Bargo River, Hornes Creek, Dogtrap Creek, Teatree Hollow and Moore Creek were generally good except for Sites 3 and 4 (Bargo River), which were highly disturbed. Weed presence varied between watercourses but were mostly low-mod or not present. Macrophyte presence was low, only found in Sites 1, 2 and 5. Previously burnt sites were showing signs of regeneration.	
Water quality		
Electrical conductivity	The water quality results showed salinity at relatively consistent levels within the guideline range except for Sites 5 and 6 downstream Bargo River. In Spring 2019 they reached around 880 µS/cm, Autumn 2020 they returned to guideline ranges and in Spring 2020 and Autumn 2021 reached around 500 µS/cm. Previously, high salinities in Teatree Hollow have been identified and attributed to mine water discharge from Licensed Discharge Point LDP1 (Niche 2020b). However, in the most recent sampling events (Niche 2021b, Niche 2022b), all Teatree Hollow sites have reported electrical conductivity levels within the guideline range.	Electrical conductivity is generally within ANZG (2018) guidelines which may indicate that the sites are overall unaffected by discharge from the Project Area, except for downstream at Sites 5 and 6 (Bargo River). Given the consistent high results at these sites, resident fauna are likely to be adapted to these relatively high concentrations.
Dissolved oxygen (DO)	From Spring 2019 to Autumn 2020, a majority of sites experience low DO levels, noting many sites were dry due to drought. As of Spring 2020 and Autumn 2021, DO improved across most sites, with only Sites 3 and 4 (Bargo River) being slightly over the guidelines.	Low dissolved oxygen is considered normal for stream pools exhibiting low- to no-flow conditions.
pH	The pH from Spring 2019 to Autumn 2021 was variable. In Spring 2019, most exceedances were below guideline ranges, however from 2020 onwards, sites that exceeded the guidelines were in the high range regardless of stream position. With the exception of Spring 2019, typically only a minor number of sites (one to three per season) record pH values outside of guideline levels, with the sites along Teatree Hollow only recording one.	Reduction in pH may be related to low rainfall, less surface water flow and increase in groundwater water influence. The increase in pH may be indicative of the increased rainfall throughout Spring 2020 and Autumn 2021.
Alkalinity	Alkalinity was generally greater than or equal to 20 mg $CaCO_3$/L and was found to vary according to site. Most sites typically recorded relatively low values in the 20 – 40 $CaCO_3$/L range, including those along Teatree Hollow.	Low alkalinity indicates a low buffering capacity against changes in pH.

Parameter	Results	Conclusion
Macroinvertebrates		
AUSRIVAS	Most sites on all sampling occasions were different to modelled reference sites scoring in Band B and Band C. However, Site 4 on Bargo River scored in Band A on one occasion. Teatree Hollow site 12 scored a D in 2021.	When taken together the steam health results indicate that Teatree Hollow has existing impaired stream health conditions when compared to reference site and control site data. The results show that Teatree Hollow is under environmental stress, which is potentially from a combination of natural stressors and anthropogenic disturbance from, agriculture and road crossings. This could potentially be exacerbated by the previous bushfire within its catchment and recent high rainfall preceding Autumn 2021 sampling. Low stream health scores and indices that were observed in the baseline study can be considered natural characteristics of drying intermittent/low flow streams, e.g. Teatree Hollow. Note that the current monitoring sites are not subject to any mine discharge or previous mining impacts.
SIGNAL2	Teatree Hollow sites recorded low SIGNAL2 scores (<4), with other sites typically recording scores between 4 and 5, also considered low. .	
EPT	EPT scores were generally low with Bargo River Sites tending to have higher EPT scores. EPT scores have tended to be slightly lower than those on the Bargo River and Hornes Creek sites.	
Assemblage data (quantitative analysis)	Analysis of the differences within the macroinvertebrate assemblage using PERMANOVA detected a significant difference for the interaction terms of 'Season x Site'. This indicates that differences between sites are dependent on 'Season' and differences between seasons are dependent on 'Site'.	The quantitative data showed great variability across the sites, with less dispersion observed of sites in Bargo River and Hornes Creek. Differences were driven by common taxa including worms (Oligochaeta), flies (Ceratopognidae) and Mayflies (Baetidae and Caenidae).
Fish		
Fish identification and counts	A total of nine fish species have been detected during fish and AUSRIVAS sampling (Niche, 2020b) across the Study Area and broader locality. The most commonly encountered species were the Yabby (*Cherax destructor*), Common Freshwater Shrimp, (*Paratya australiensis*), Eastern Gambusia (*Gambusia holbrooki*) and Australian Smelt (*Retropinna semoni*). The results indicate a simplistic fish community structure, dominated in terms of abundance and extent across the monitoring sites by the Eastern Gambusia, an introduced pest species. No threatened fish species were recorded during the surveys and based upon historic records and landforms, are considered unlikely to occur within the Study Area.	Given the limited catch data, lack of threatened aquatic species and inherent variability in fish survey data, fish are considered unlikely to be a good indicator of environmental impact in this program. As such, fish community data collection does not form part of the ongoing monitoring program.
Insects		
Sydney Hawk Dragonfly (*Austrocordulia 38acropus*)	Targeted survey for the Sydney Hawk Dragonfly, listed as endangered under the FM Act, has been previously carried out in identified aquatic habitats within the locality across a total of 29sites, including along Teatree Hollow (Niche, 2020b). The Sydney Hawk Dragonfly has a moderate likelihood of occurrence in areas identified outside of the Study Area only, as potential habitat may occur in the Bargo River or in the Nepean River.	Given that no individuals have previously been recorded during targeted surveys and the species is considered unlikely to occur within the Study Area, no ongoing targeted monitoring is to be completed for the species.

Parameter	Results	Conclusion
	However, these areas are unlikely to be impacted by subsidence associated with the extraction of LW S1A-S6A. Within the Study Area the species is considered a low likelihood of occurrence. As such, the species is considered unlikely to be impacted by the extraction of LW S1A-S6A.	

3.2.4 Threatened Aquatic Species

No threatened fish have been recorded despite targeted survey and ongoing monitoring (Niche, 2020b; Niche, 2021b). No aquatic threatened species are considered likely to occur in the Study Area (Niche, 2020b), and therefore aquatic threatened species are unlikely to be impacted by longwall mining as part of the extraction of LW S1A-S6A. No threatened aquatic species have been identified as part of the baseline monitoring. It is also understood that there would be no reduction in the quality of the water in Bargo River below Mermaid Falls, where there is potential Macquarie Perch habitat, as a result of the Project (extraction of LW S1A-S6A) (HEC, 2020a).

4 Predicted Surface Impacts and Environmental Consequences

4.1 Terrestrial Ecology

The information from the following reports has been used to populate the following sub sections of **Section 4.1**, and refined to contain only the details relevant to the 600 m Environmental Feature Study Area:

- Biodiversity Assessment Report (Niche, 2018a; Appendix K of the EIS), and the first and second amendments to the report;
- Terrestrial Ecology Monitoring Report Spring riparian vegetation and amphibian baseline monitoring 2020/2021 (Niche, 2021a); and
- Terrestrial Ecology Monitoring Report Spring riparian vegetation and amphibian baseline monitoring 2021/2022 (Niche 2022a).

These reports should be referred to for further detail regarding baseline conditions of terrestrial biodiversity within the broader Project Area covered by the EIS (SIMEC 2019).

Refer to **Section 5.1** for performance measures relating to predicted and measurable environmental consequences for terrestrial ecology.

4.1.1 Strata Gas Emissions and Vegetation Dieback

As predicted in the EIS, the release of gas emissions from fracturing of sandstone strata may occur as a result of subsidence. Gas may be released into rivers and streams as these areas form topographical low points in the landscape.

The extraction of LW S1A-S6A may result in enhanced strata gas emissions with some of these emissions visible as bubbling in more persistent pools in overlying watercourses (HEC, 2020a; MSEC, 2022). While not affecting water quality per se, the gas expression associated with release of strata gas has the potential to cause vegetation dieback in the vicinity of the gas release point.

As discussed by Niche (2018a) there is only one reported example of vegetation dieback as result of gas emissions at Tower Mine. The impacts were short term, and limited to small areas of vegetation, local to the points of emission, and when the gas emissions declined, the affected areas were successfully restored. No similar impacts have been reported during the mining of Tahmoor North or Tahmoor West.

PCT 1181 is the dominant PCT that occurs in riparian habitat in the Study Area (**Figure 7**). It is possible that some localised die back from gas emissions may occur in this PCT where plants immediately occur above or adjacent to the point of gas emission. MSEC (2018) has not predicted any significant gas emission releases along any of the water courses within the Study Area. Therefore, based on the previous known example of vegetation dieback as result of gas emissions, it is expected that any impacts to the PCT as a result of gas emissions from Tahmoor South would be temporary and limited in extent, and that the vegetation would regenerate once the gas emissions declined. As such, it is unlikely that gas emissions from subsidence would result in a decrease in the extent of the PCTs and habitat within the Study Area.

4.1.2 Changes to Riparian Floristic Composition due to Increased Levels of Ponding, Scouring or Desiccation

As predicted in the EIS, changes in the grade of a stream as a result of subsidence has the potential to lead to increased ponding, scouring and/or desiccation. MSEC (2022) states 'It is possible that there could be very localised areas along the streams which could experience small increases in the levels of ponding, where the predicted maximum tilts occur in the locations where the natural gradients are low. However, as the predicted changes in grade are typically less than 1%, any localised changes in ponding are expected to be minor and not result in adverse impacts on these streams.

Predicted maximum increases in grade are up to 1.0 %, which are relatively small compared to the natural gradients and, therefore, the potential for increased scouring is not expected to be substantial'.

Vegetation communities that are independent of groundwater and not closely associated with the water levels and hydrology of the creeks are unlikely to be impacted by subsidence due to underground mining. However, where groundwater – surface connectivity indicates a gaining stream there is potential for riparian vegetation to be supported by groundwater. Consequently, riparian vegetation in these situations could be a Groundwater Dependent Ecosystem (GDE). Riparian vegetation that could be GDE will be monitored through the riparian vegetation monitoring program as well as the groundwater monitoring program.The localised changes to ponding are predicated by MSEC (2022) to be relatively minor and not result in adverse impacts on the streams. It is similarly expected that any potential impacts to riparian vegetation that may affect the floristic composition of the community would be subtle, and highly localised to the area adjacent to the water source. In the Southern Coalfield, previous impacts to riparian vegetation as a result of subsidence have been minor in occurrence, and mostly attributed from gas release causing short-term damage to the vegetation, rather than changes to hydrological regimes (as mentioned above).

To date, no impacts to riparian vegetation have been observed at Tahmoor Mine. The creeks within the Study Area are all ephemeral in nature with many being consistently dry throughout the years of survey. It is highly likely that the vegetation along the watercourses is accustomed to periodically dry conditions. The vegetation along watercourses is not reliant upon groundwater for its survival and frequently experiences dry conditions. As such, should water diversion occur as a result of subsidence, it is unlikely to result in significant alterations to the composition of the community or vegetation die back.

Therefore, it is considered unlikely that subsidence would result in any extensive or significant impact to native riparian vegetation within the Study Area. Should any impact occur, it is likely to be highly localised with only some subtle changes to species composition likely depending on interaction of that species with the change in watercourse. It is highly unlikely that potential impacts as a result of a predicted change to stream hydrology, would decrease the area of PCTs or vegetative habitat that currently occurs along the watercourses in the Study Area.

4.1.3 Destruction of Vegetation/Tree Fall by Rock Falls and Earth Slippages

The steep slopes on the sides of valleys are predominantly found in Hawkesbury Sandstone and consist of a mixture of cliffs and rock outcrops, which are stable at vertical to overhanging, and screed slopes with rocky soils and loose rock fragments. Steep slopes have been previously mapped by MSEC (**Figure 8**) as occurring along all creeklines within the Study Area. The majority of the slopes are stabilised, to some extent, by natural vegetation (MSEC, 2022).

As predicted in the EIS, slippage of earth and rocks down steep slopes and rock falls have the potential to directly impact (destroy/smother) vegetation, flora and fauna habitat as well as directly injure or kill native fauna.

Subsidence may result in the downslope movement of soils, causing tension cracks to appear at the tops of the slopes, and compression ridges to form at the bottoms of the slopes. Untreated tension cracks have the potential to cause erosion (MSEC, 2022). However, as indicated by MSEC (2022), there is a low probability of large-scale slope slippage as a result of the extraction of LW S1A-S6A. The probability is assessed to be very low for slopes that will not be directly mined beneath by the longwalls.

MSEC (2022) further supports this prediction due to the following:

- Experience in the Southern Coalfield indicates that the probability of mining-induced large-scale slippages is extremely low due to significant depth of cover;
- There is extensive experience of mining beneath steep slopes in the Southern Coalfield. These include steep slopes along the Cataract, Nepean, Bargo and Georges Rivers and streams such as Myrtle Creek and Redbank Creek above Tahmoor Colliery Longwalls 22 to 27. No large-scale slope failures have been observed along these slopes, even where longwalls have been mined directly beneath them; and
- Minor rock falls along cliff lines or rock outcrops have been observed, for example, during the mining of Appin Longwalls 301 and 302 adjacent to the Cataract River. These have resulted in minor and localised rock collapses.

As such, it is considered likely that any impacts to vegetation as a result of earth and rock-face instability will be highly localised and relatively minor. Large-scale impacts to vegetation as a result of large-scale slope failures are highly unlikely based on the prediction of MSEC (2022). The potential impact to PCTs along creeklines are therefore likely to be so small and localised that they would be relatively insignificant.

4.1.4 Threatened Ecological Communities

As predicted in the EIS, subsidence as a result of the Project (extraction of LW S1A-S6A) may cause cracking of the soil within the SSTF TEC, however SSTF occurs within drier soils and is not solely dependent on groundwater interaction that may be impacted by surface cracking. Therefore, SSTF is not considered likely to be impacted by subsidence as a result of the Project.

4.1.5 Flora

As predicted in the EIS, subsidence impacts to threatened flora may occur as a result of the following:

- Die-back of threatened flora that occurs immediately adjacent to a strata gas emission/drainage event;
- Loss of threatened flora and its habitat as a result of a change hydrological regime; and
- Damage or loss of threatened flora from rock falls and/or slippage of earth and rocks down steep slopes.

These impacts are generally centred on habitat types along riparian areas, immediately above and below cliff lines and steep slopes. Vegetation and habitat that occurs on the flat terrain of the Study Area are located away from areas that may be prone to subsidence related impacts. Of the threatened flora recorded, only *Pomaderris brunnea* was recorded within the gully habitat of the Study Area. The remainder of the threatened flora were located away from the subsidence sensitive areas. Threatened flora records obtained from BioNet (DPIE, 2022) also indicate that most of the threatened flora occur away from these areas (**Figure 6**).

Three threatened flora species are known to occur within the Study Area, three are considered to have a moderate to high likelihood of occurring in the Study Area and one was nominated by the Department of Energy and Environment as being a candidate for potential impacts as a result of the extraction of LW S1A-S6A. **Table 16** summarises considerations of potential impacts as a result of subsidence discussed in the Biodiversity Assessment Report, which have been amended to reflect the predicted impacts of LW S1A-S6A.

Table 16 Predicted Impacts and Considerations for Threatened Flora Species

Species	Status (BC Act/EPBC Act)	Subsidence Considerations	Impact/ Consequences
Grevillea parviflora subsp. Parviflora (Small-flower Grevillea)	Vulnerable (BC Act)/ Vulnerable (EPBC Act)	*Grevillea parviflora* subsp. *Parviflora* is unlikely to be impacted by subsidence, as the species does not occur within areas that are sensitive to subsidence related impacts (e.g. bed of watercourses, ridgelines). The habitat within Dry Sclerophyll Forest vegetation may be exposed to subsidence cracking of the soil, however such an impact is unlikely to result in significant changes to floristics and composition that may impact upon *Grevillea parviflora* subsp. *Parviflora*. Threatened flora plots within the Tahmoor South EIS Project Area are established and will be monitored regularly on a six-monthly basis during and after LW S1A-S6A mining.	Unlikely
Persoonia bargoensis (Bargo Geebung)	Endangered (BC Act)/ Vulnerable (EPBC Act)	*Persoonia bargoensis* is unlikely to be impacted by subsidence, as the species does not occur along ridgelines or close to waterways. The woodland and forest environments that it inhabits are not water dependent, and therefore subsidence is unlikely to impact the species. Threatened flora plots within the Tahmoor South EIS Project Area are established and will be monitored regularly on a six-monthly basis during and after LW S1A-S6A mining.	Unlikely
Pomaderris brunnea (Rufous Pomaderris)	Endangered (BC Act)/ Vulnerable (EPBC Act)	As discussed in **Section 3.1.4**, the population of *Pomaderris brunnea* was recorded along Teatree Hollow Creek and near Hornes Creek. For the most part, the population typically occurred on the mid-bank to higher banks of the creek, away from the creek bed. The creek was dry for much of its traverse during the survey and monitoring years, with intermittent shallow pools occurring in the area where the majority of the population resided. As such, it could be reasonably assumed that there is a disconnection of *Pomaderris brunnea* to the water within the creek given the species persistence during periods where water in the creek was absent. The drying of pools or predicted changes to the hydrological regime as a result of subsidence is therefore unlikely to result in die back of the *Pomaderris brunnea* population. Similarly, as discussed in **Section 4.1.1** gas emissions as a result of subsidence are predicted to be rare. If gas emissions were to occur along the portion of Teatree Hollow Creek and Hornes Creek where *Pomaderris brunnea* resides, it may be reasonable to assume that given the plants position away from the lowest points in the topography, that die back would largely be avoided. Furthermore, the chances of a rock fall or steep slope collapse occurring directly above the population of *Pomaderris brunnea* resulting in the loss of individuals within the population is unlikely given such events are predicted by MSEC (2018) to be minor in occurrence, and no cliffs occur within this portion of Teatree Hollow Creek. Based on the above reasons, we have concluded that potential subsidence related impacts to threatened flora, in particular *Pomaderris brunnea* are highly unlikely. Threatened flora plots within the Tahmoor South EIS Project Area are established and will be monitored regularly on a six-monthly basis during and after LW S1A-S6A mining.	Unlikely

Species	Status (BC Act/EPBC Act)	Subsidence Considerations	Impact/ Consequences
Persoonia glaucescens (Mittagong Geebung)	Endangered (BC Act)/ Vulnerable (EPBC Act)	Subsidence is unlikely to impact on potential habitat for *Persoonia glaucescens*, as the species does not occur within habitat types that are sensitive to changes due to subsidence (e.g. creek beds, groundwater dependent ecosystems etc.).	Unlikely
Persoonia macropu (Hairy Geebung)	Endangered (BC Act)/ Endangered (EPBC Act)	Subsidence is unlikely to impact on potential habitat for *Persoonia 44acropu*, as the species does not occur within habitat types that are sensitive to changes due to subsidence (e.g. creek beds, groundwater dependent ecosystems etc.).	Unlikely
Acacia bynoeana (Bynoe's Wattle)	Endangered (BC Act)/ Vulnerable (EPBC Act)	It is unlikely that subsidence would result in the modification of habitat given the species is reliant upon dry sclerophyll forest habitats that are not solely reliant or groundwater. Furthermore, the species is not considered likely to be impacted by subsidence, as it is unlikely that cracking of soils within areas of potential habitat would lead to vegetation die back, or significant vegetation composition changes.	Unlikely
Leucopogon exolasius (Woronora Beard-heath)	Vulnerable (BC Act)/ Vulnerable (EPBC Act)	An Assessment of Significance (Niche, 2018) concluded that a significant impact was unlikely given the species is unlikely to have habitat with the area proposed for surface infrastructure, and subsidence is unlikely to result in a loss to any important population given the species occurs on the creek banks not within the riparian zone of creek. Thus, any hydrological change from subsidence is unlikely to impact upon *Leucopogon exolasius.* Furthermore, as discussed in **Section 4.1.1,** gas emissions as a result of subsidence are predicted to be rare, and given the species is known to occur on rock hill slopes, that die back from gas emission would largely be avoided.	Unlikely

4.1.6 Fauna

Thirty-four threatened and migratory fauna have been attributed a moderate or higher likelihood of occurrence within the EIS Project Area. The majority of these species are highly mobile species (such as threatened birds and microbats) that are likely to use the Study Area on an intermittent basis and would not be solely dependent upon the habitat features within the area to be disturbed by the surface infrastructure works.

Considerations of potential impacts to the following species that are considered to have a moderate to high likelihood of occurrence in the Study Area and are species credit species or may depend on the resources in the Study Area are summarised from Niche (2018a) in **Table 17** below:

- Koala *Phascolarctos cinereus*;
- Large-eared Pied Bat *Chalinolobus dwyeri;*
- Large-fooacropusis *Myotis macropus;*
- Large Bent-wing Bat *Miniopterus orianaes oceanensis*;
- Red-crowned Toadlet *Pseudophryne australis*;
- Grey-headed Flying-fox *Pteropus poliocephalus;*
- Eastern Cave Bat *Vespadelus troughtoni*;
- Broad-headed Snake *Hoplocephalus bungaroides*;
- Greater Glider *Petauroides Volans*;
- Grey-headed Flying-fox *Pteropus poliocephalus*; and

- Birds (grouped): Swift Parrot *Lathamus discolor*, Regent Honeyeater *Anthochaera macropu*, Cattle Egret *Bubulcus ibis*, Great Egret *Ardea alba*, Fork-tailed Swift *Apus pacificus*, Rainbow Bee-eater *Merops ornatus*, and Satin Flycatcher *Myiagra cyanoleuca*.

Additional species with moderate or higher likelihood of occurrence are ecosystem credits species and therefore do not require further consideration (Niche, 2018a).

Potential impact considerations for threatened fauna have been revised to reflect the predicted impacts associated with the extraction of LW S1A-S6A.

Table 17 Predicted Impacts and Considerations for Threatened Fauna Species with Moderate or Higher Likelihood of Occurrence

Species	Status (BC Act/EPBC Act)	Subsidence Considerations (Niche, 2018)	Impact/ Consequences
Chalinolobus dwyeri (Large-eared Pied Bat)	Vulnerable (BC Act and EPBC Act)	The Large-eared Pied Bat may utilise caves and rocky crevices for roosting and breeding habitat. According to MSEC (2022), a total of 2 cliffs are located within the 600 m Environmental Feature Study Area. One is located within a tributary to the Bargo River and is more than 500 metres from the proposed LW S4A. A small portion of another cliff is located along Hornes Creek and is located approximately 600 metres from the proposed LW S6A (MSEC, 2022). No caves were encountered within the Study Area during any of the surveys completed by Niche, nor have any caves been reported by MSEC (2022), although one rock shelter is located directly above LW S2A on a tributary to Teatree Hollow (MSEC, 2022). Cliff line environments which may indicate cave-like habitat, are generally limited to the Nepean River to the north of the Study Area with some scattered cliff lines within the valleys of the Bargo River, along Dogtrap Creek, and Hornes Creek. The rock shelter is not expected to suffer any adverse consequences from the maximum predicted mining induced tilt (4.5 mm/m or a change in grade of 1 in 222). As such, despite the Large-eared Pied Bat having a high likelihood of occurrence within the Study Area, it is unlikely that the species would be impacted by subsidence related impacts.	Unlikely
Heleioporus australiacus	Giant Burrowing Frog	Giant Burrowing Frog was recorded during the Tahmoor Amphibian Monitoring Program in 2013, outside the Study Area for LW S1A – LW S6A. Giant Burrowing Frog was recorded at Cow Creek (Niche, 2018a). Despite the presence of suitable habitat, Giant Burrowing Frog has not been recorded during the baseline Amphibian and Riparian monitoring program, which commenced in Spring 2019. Nonetheless, subsidence associated with the extraction of LW S1A-S6A has the potential to modify suitable habitat by: • potentially reducing the frequency of pools overflowing, lowering pool water levels and periodic loss of interconnection between pools during dry weather (HEC 2020a). • contamination of waterbodies via releases of aluminium, iron, manganese and zinc from subsidence related cracking of sandstone strata (HEC 2020a). It is likely these would be seen as transient spikes in the concentration of these and possibly other metals which would be relatively localised. Such impacts may affect the suitability of the pools as breeding habitat for the species. If recorded in the future during amphibian monitoring, the presence of threatened frog species would be reported, and further investigations	Unlikely

Species	Status (BC Act/EPBC Act)	Subsidence Considerations (Niche, 2018)	Impact/ Consequences
		will be initiated to determine ongoing presence of threatened species in the locality and assess whether updates to the BMP and TARP documentation are required.	
Hoplocephalus bungaroides (Broad-headed Snake)	Endangered (BC Act)/ Vulnerable (EPBC Act)	Based on mine subsidence prediction, it is likely that the extraction of LW S1A-S6A would result in minor, isolated rock falls and cracking, and thus any impact to habitat is likely to be relatively minor. Furthermore, rock falls and cracking may create habitat for the species.	Unlikely
Miniopterus orianaes oceanensis (Large Bent-wing Bat)	Vulnerable (BC Act)/ Not listed (EPBC Act)	Within the Study Area, no caves were encountered during surveys completed by Niche, nor have any caves been reported by MSEC (2018). Furthermore, cliff line environments which may indicate cave-like habitat, are generally limited to the Nepean River to the north of the Study Area with some scattered cliff lines along the Dogtrap Creek, and Hornes Creek. Given the specific cave requirements, the ability of the species to traverse over 300 kilometres from a breeding site, lack of known breeding colonies in the	

Species	Status (BC Act/EPBC Act)	Subsidence Considerations (Niche, 2018)	Impact/ Consequences
		area, it is unlikely that breeding habitat occurs within the Study Area. acropusy	
Myotis macropus (Large-footed Myotis)	Vulnerable (BC Act)/ Not listed (EPBC Act)	Given the cliffs are located outside the predicted limit of subsidence as a result of the extraction of LW S1A-S6A, the probability that roosting habitat would be impacted is very low. Furthermore, no hollow-bearing trees, bridges or culverts within the Study Area that provide roosting habitat for the Large-footed Myotis are likely to be substantially impacted by subsidence. As such, roosting habitat for the species is unlikely to be impacted by the extraction of LW S1A-S6A. Teatree Hollow and its tributary (Wirrimbirra Creek) provides suitable foraging habitat for the Large-footed Myotis. Subsidence has the potential to result in the loss or decrease in some potential foraging pools within the watercourses of the Study Area. HEC (2020a) has indicated that subsidence from the extraction of LW S1A-S6A may result in the reduced frequency of pools overflowing, lowering of pool water levels and periodic loss of interconnection between pools during dry weather. Streams or sections of streams located away from the proposed longwalls, are less likely to have fracturing and surface flow diversions, compared to stream sections located directly above the proposed longwalls. A total of 5 pools are mapped within Teatree Hollow and its tributary (Wirrimbirra Creek), which may experience fracturing could impact the holding capacity of the standing pools, particularly those located directly above the proposed longwalls (MSEC 2022). However, the potential for ponding as predicted by MSEC (2018) may increase the availability of foraging habitat for the Large-footed Myotis. As discussed in Niche (2018), increased ponding is likely to provide localised increase in available habitat for aquatic macroinvertebrates and if there is stream connectivity in the area of ponding, it may also provide additional habitat for fish and macrophytes. As such, the potential impacts to pools within the Study Area may not disrupt the life cycle of the species such that the population would decline.	Unlikely
Petauroides Volans (Greater Glider)	Not listed (BC Act)/ Vulnerable (EPBC Act)	Subsidence is unlikely to impact upon tree hollows which the species may utilise. Similarly, subsidence is unlikely to result in a decline in the availability of foraging habitat for the species, as no large-scale vegetation die back events are likely. As such, no significant impact to the Greater Glider is likely.	Unlikely
Phascolarctos cinereus (Koala)	Vulnerable (BC Act and EPBC Act)	Between 2019 and 2022 (baseline surveys), no Koala individuals have been encountered (indicating that their occurrence may be occasional to the study area). This finding is supported by the Tahmoor South LW S1A-S6A Terrestrial Monitoring Re–orts (Niche 2019 - 2022) and the LW S1A-S6A Terrestrial Biodiversity Assessment Report (Niche, 2020). Koala is considered highly mobile and unlikely to be directly impacted by mining-related subsidence. However, potential habitat for Koala within the Tahmoor South EIS Project Area includes Shale Sandstone Transition Forest TEC, and this community will be monitored regularly on a six-monthly basis during and after LW S1A-S6A mining.	Unlikely

Species	Status (BC Act/EPBC Act)	Subsidence Considerations (Niche, 2018)	Impact/ Consequences
Pseudophryne australis (Red-crowned Toadlet)	Vulnerable (BC Act)/ Not listed (EPBC Act)	A population of the Red-crowned Toadlet was recorded within the EIS Project Area at Hornes Creek during the Tahmoor South Project Terrestrial Ecology Monitoring Program (Niche 2018a). The Red-crowned Toadlet was not recorded within any other riparian areas within the Study Area and surrounds, including Dogtrap Creek, Teatree Hollow Creek, Bargo River and its tributaries, Eliza Creek, Cow Creek, Dry Creek and Carter Creek. Additionally, despite the presence of suitable habitat, the Red-Crowned Toadlet has not been recorded during the baseline Amphibian and Riparian monitoring program, which commenced in Spring 2019. Nonetheless, subsidence associated with the extraction of LW S1A-S6A has the potential to modify suitable habitat by: • potentially reducing the frequency of pools overflowing, lowering pool water levels and periodic loss of interconnection between pools during dry weather (HEC 2020a). • contamination of waterbodies via releases of aluminium, iron, manganese and zinc from subsidence related cracking of sandstone strata (HEC 2020a). It is likely these would be seen as transient spikes in the concentration of these and possibly other metals which would be relatively localised. Such impacts may affect the suitability of the pools as breeding habitat for the species. If recorded in the future during amphibian monitoring, the presence of threatened frog species would be reported, and further investigations will be initiated to determine ongoing presence of threatened species in the locality and assess whether updates to the BMP and TARP documentation are required.	Unlikely
Pteropus poliocephalus (Grey-headed Flying-fox)	Vulnerable (BC Act)/ Vulnerable (EPBC Act)	Given the species has not been detected during the current survey, and no populations are known in the area, it is unlikely that an important population exists within the Study Area. Furthermore, habitat features for the Grey-headed Flying-fox are unlikely to be impacted by subsidence.	Unlikely
Threatened and Migratory Birds (grouped)	Various	Subsidence is unlikely to affect any resources or habitat features on which these species depend such that it would result in any measurable changes to their breeding or foraging behaviour or habitat. Further, individuals have not been incidentally encountered during other baseline monitoring surveys (irregular occurrence in the study area). Therefore, in light of the above review of habitat availability for Threatened Fauna Species in the LW S1A-S6A Study Area and low likelihood of impact, monitoring of habitat for Threatened Fauna Species has not been included in the biodiversity monitoring program.	Unlikely
Vespadelus troughtoni (Eastern Cave Bat)	Vulnerable (BC Act)/ Not listed (EPBC Act)	The Eastern Cave Bat was recorded within the surface infrastructure development area during targeted surveys. The species is known to have breeding habitat identified by the presence of rocky areas containing caves, or overhangs or crevices or escarpments, old, tunnels or culverts. The likelihood of subsidence impacting upon a roosting site is very low. According to MSEC (2022), a total of 2 cliffs are located within the 600 m Environmental Feature Study Area. One is located within a tributary to the Bargo River and is more than 500 metres from the proposed LW S4A. A small portion of another cliff is located along Hornes Creek and is	Unlikely

Species	Status (BC Act/EPBC Act)	Subsidence Considerations (Niche, 2018)	Impact/ Consequences
		locate approximately 600 metres from the proposed LW S6A (MSEC, 2022). No caves were encountered within the Study Area during any of the surveys completed by Niche, nor have any caves been reported by MSEC (2022), although one rock shelter is located directly above LW S2A on a tributary to Teatree Hollow (MSEC, 2022). Cliff line environments which may indicate cave-like habitat, are generally limited to the Nepean River to the north of the Study Area with some scattered cliff lines within the valleys of the Bargo River, along Dogtrap Creek, and Hornes Creek. The rock shelter is not expected to suffer any adverse consequences from the maximum predicted mining induced tilt (4.5 mm/m or a change in grade of 1 in 222). As such, despite the Eastern Cave Bat having a high likelihood of occurrence within the Study Area, it is unlikely that the species would be impacted by subsidence related impacts.	

4.2 Aquatic Ecology

The following subsections have been sourced from the Tahmoor South Project – Aquatic Ecology Impact Assessment (Niche, 2018b) and Tahmoor South Project – Aquatic Ecology Impact Assessment of the Amended Project (Niche, 2020b), and these reports should be referred to for further detail regarding predicted surface impacts and environmental consequences to aquatic biodiversity.

Refer to **Section 5.2** for performance measures relating to predicted and measurable environmental consequences for aquatic ecology.

4.2.1 LW S1A-S6A Predicted Impacts to Aquatic Ecology

Table 18 summarises the potential environmental consequences to aquatic biodiversity in impact creeks, as identified in the EIS (SIMEC, 2019).

Table 18 Environmental Consequences to Aquatic Biodiversity

Aquatic value	Creek System	Environmental Consequence
Aquatic Habitat	Teatree Hollow	• Changes to the hydraulics characteristics and associated impacts to the physical stability of the watercourses. • Changes to surface water chemistry due to releases of iron and other minerals from the flushing of fractures. • Potential reduction in pool habitat near Longwalls S1A-S6A, and increase in iron floc smothering the benthos at Teatree Hollow.
Riparian Vegetation	Teatree Hollow	• Potential localised impacts from gas emissions.
Macrophytes	Teatree Hollow	• Potential localised reduction in available wetted habitat.
Macroinvertebrates	Teatree Hollow	• Potential localised reduction in available habitat and macroinvertebrate biomass. Reduction of sensitive macroinvertebrate species. Potential localised temporal change in community composition from episodic changes in water quality.
Fish	Teatree Hollow	• Potential localised temporal reduction in fish passage in low flows when there is naturally limited fish passage.
Threatened Species	Teatree Hollow	• No aquatic threatened species are considered likely to occur in the Study Area, direct and indirect Impacts to aquatic threatened species are considered unlikely. • Red-crowned Toadlet was recorded within the Study Area at Hornes Creek (**Section 4.1.6**).

5 Subsidence Monitoring Program

5.1 Terrestrial Ecology Performance Measures and Indicators

Performance measures for terrestrial ecology are provided in **Table 2**, extracted from Condition C1 of SSD 8445 and are summarised and addressed below in **Table 19**.

Table 19 Subsidence Performance Measures and Performance Indicators for Terrestrial Ecology

Feature	Subsidence Performance Measures	Subsidence Performance Indicators
Threatened species, threatened populations, or endangered ecological communities	• No greater subsidence impacts or environmental consequences than predicted in the EIS (**Section 4.1**) • Negligible impacts on threatened species, populations or communities due to remediation of subsidence cracking	This performance measure will be triggered if subsidence impacts cannot be remediated in a manner that restores habitat of threatened species, threatened populations, or endangered ecological communities. This performance measure and performance indicator have been incorporated into TARP BMP4 (threatened species, threatened populations and endangered ecological communities).
GDEs including Thirlmere Lakes	• Negligible impacts including: - Negligible change in groundwater levels; and - Negligible change in groundwater quality	The performance measure will be considered to be exceeded if the groundwater levels or groundwater quality decline below Level 3 (in the relevant groundwater TARP triggers for water level and water quality – TARP WMP8 or WMP11) following the commencement of extraction, and the investigation outcomes indicate a mining related impact based on monitoring data for riparian vegetation. This performance measure and performance indicator have been incorporated into TARP BMP3 (riparian vegetation).

Note: For the purpose of this management plan, 'negligible' is defined as being 'so small and insignificant as to not be worth considering'. A negligible impact is viewed with regards to a long-term context, causing little or no impact. If a short-term impact causes a greater than negligible impact, the impact can still be considered negligible if the impacts are of a limited duration and are considered negligible when considered over the long term.

Based on the predicted subsidence impacts provided by MSEC (2022), it is anticipated that the performance measures for aquatic and terrestrial ecology within the Study Area will be achieved during and after mining of LW S1A-S6A.

Given that the terrestrial monitoring Sites have been impacted by a natural disaster event (Black Summer Bushfires) our hypothesis is that there is unlikely to be any significant difference/trends between BACI Sites data for the first few years until substantial regeneration has occurred and the monitoring data replication becomes sufficient to interpret statistically. Monitoring will need to primarily focus on the changes in hydrological regimes overtime, rate of recovery (i.e., identify whether mining impacts are influencing this), and ensure the recording of any anomalous changes in the existing environment (particularly those that cannot be attributed to post-fire) in control and future impact Sites. The monitoring program is designed to assess whether these predictions are exceeded. It is expected that there will be isolated and localised impacts, as was predicted in the EIS, however these are not expected to change the function and overall ecology of Teatree Hollow.

Although amphibians are monitored under this management plan and have a dedicated TARP, no relevant performance measures were provided in Condition C1 of SSD 8445 and as such is omitted from the table.

Threatened amphibian habitat will be also assessed under the threatened species, threatened populations, or endangered ecological communities' performance measures.

5.2 Aquatic Performance Measures and Indicators

Performance measures for aquatic ecology are provided in **Table 2**, extracted from Condition C1 of SSD 8445 and are summarised and addressed below in **Table 20.**

Table 20 Subsidence Performance Measures and Performance Indicators for Aquatic Ecology

Feature	Subsidence Performance Measures	Subsidence Performance Indicators
Aquatic habitat	Negligible environmental consequences to aquatic and riparian ecosystems beyond those predicted in the EIS (summarised in **Table 18**).	This performance measure will be considered to be triggered if subsidence impacts cannot be remediated in a manner that restores aquatic habitat. This performance measure and performance indicator have been incorporated into TARP BMP3 (riparian vegetation) and TARP BMP1 (aquatic habitat and macroinvertebrate indicators).

Note: For the purpose of this management plan, 'negligible' is defined as being 'so small and insignificant as to not be worth considering'. A negligible impact is viewed with regards to a long-term context, causing little or no impact. If a short-term impact causes a greater than negligible impact, the impact can still be considered negligible if the impacts are of a limited duration and are considered negligible when considered over the long term.

Based on the predicted subsidence impacts (MSEC, 2022), it is considered that the performance measures for aquatic ecology within the Study Area will be achieved during and after mining of LW S1A-S6A.

The EIS predicted localised reduction in available habitat for aquatic flora and fauna and temporary responses to short term episodic water quality changes (**Table 18**). The monitoring program is designed to assess whether these predictions are exceeded. It is expected that there will be isolated and localised impacts however these are not expected to change the function and overall ecology of Teatree Hollow. An exceedance is thus considered long term changes to the aquatic environment in Teatree Hollow. An exceedance (Level 3) would trigger additional monitoring, studies and or remediation measures in accordance with the TARP (**Appendix A**). To account for natural fluctuations in ecology, the TARP for aquatic ecology is explicitly linked to surface water and visual monitoring. This is to provide additional supporting evidence that an impact has occurred and is likely to be related to subsidence.

5.3 Monitoring Program

A subsidence monitoring program for biodiversity will be implemented to monitor the impacts and consequences of subsidence during and after the extraction of LW S1A-S6A. The details of this monitoring program are provided in **Section 5.3.2**, **Section 5.3.3** and **Table 23**, and the locations of monitoring sites are illustrated in **Figure 9** and **Figure 10,** and **Appendix B** and **Appendix C**.

The aim of the monitoring program is to identify where there is a risk of impact to biodiversity as a result of extraction activities. The monitoring program provides for the opportunity to record the condition of the site during the following three phases:

- Prior to Mining – baseline survey of the condition of the site before the commencement of mining;
- During Mining – monitoring of the condition of the site during active subsidence to establish whether there has been any change to the site or if changes have occurred from the effects of subsidence; and

- Post Mining – monitoring of the condition of the site after mining to identify whether there has been any change to the site in the period since mining, and to determine if the ground surface conditions have stabilised.

If an impact is identified to have occurred or is likely to occur, the relevant TARP (**Appendix A**) will then be referred to for the identification of appropriate mitigation strategies.

Details of planned monitoring works and investigations that are in addition to the proposed monitoring program are provided in the following subsections.

5.3.1 Before-After-Control-Impact (BACI) framework

A Before-After-Control-Impact (BACI) framework has been implemented, where feasible, for aquatic and terrestrial ecology monitoring and has been incorporated in the design of the TARP triggers. The monitoring program aims to develop a baseline (before) dataset for a range of biodiversity features and to assess operational and post-mining (after) impacts through the monitoring of reference (control) and performance measure (impact) sites. The TARP triggers have been designed to enable identification of potential impacts based on the before and after monitoring at reference and performance measure sites.

5.3.2 Terrestrial Ecology Monitoring Methods

Amphibian and riparian monitoring will be carried out in accordance with the methods used for collection of baseline data. Riparian and amphibian monitoring will be conducted at six sites, including three impact Sites and three control Sites. Details of each impact and control Site is provided in **Table 21**, with locations shown in **Figure 10** and **Appendix C**.

Table 21 Riparian and amphibian monitoring locations

Treatment	Site Name	Watercourse	Existing Impacts and Features	Latitude	Longitude
Future Longwall Impact	i01	Tea-tree Hollow Creek within REA 80m upstream of LW 101A	REA for Tahmoor Coal, shallow stream with sandy soils	-34.25698921	150.5825481
	i02	Tea-tree Hollow Creek above LW103A	REA for Tahmoor Coal, shallow stream with sandy soils	-34.26742768	150.5802032
	i03	Tea-tree Hollow Creek within REA 300m upstream of LW 101A	Adjacent lands to the REA for Tahmoor Coal, rocky, shallow ephemeral stream with sandy soils	-34.25511535	150.5834553
Control	c04	Hornes Creek	Within Crown Lands, permanent pools, rocky outcrops, tallus slopes, exposed bed rock	-34.2755724	150.561401
	c05	Hornes Creek	Within Crown Lands, permanent pools, slow flowing riffles, rocky outcrops, exposed bed rock	-34.28203121	150.5629797
	c06	Moore Creek	Buxton within Bargo State Conservation Area, rocky, shallow ephemeral stream with some pooling habitat and sandy soils	-34.27644214	150.5159983

Tasks to be completed during riparian monitoring using the Biodiversity Assessment Methodology (BAM; OEH, 2016) are detailed below.

5.3.2.1 Permanent Vegetation Plots

One floristic plot (BAM plot) has been established for the baseline assessments within each of the six monitoring Sites. BAM plots will be monitored and data collected will consist of the following:

- One 50 x 20 metres (m) functional plot immediately adjacent to or spanning the water body
- One 10 x 40 m floristic plot following the creek line to accommodate the steep, narrow gullies.

The following attributes are to be collected within the BAM plots:

- Composition:
  - native species richness (10 x 40 m plot).
- Structure:
  - native flora cover (% of the 10 x 40 m plot) divided into the growth forms:
    - Tree;
    - Shrub;
    - Grass and grass like;
    - Forb;
    - Fern; and
    - Other.
  - exotic species cover; and
  - high threat weed vegetation cover.
- Function:
  - tree regeneration (size classes present);
  - number of trees with hollows (within 50 x 20 m plot);
  - total length of fallen logs (within 50 x 20 m plot);
  - number of large trees (within 50 x 20 m plot);
  - tree stem size class (within 50 x 20 m plot); and
  - litter cover (sampled in 5 x 1 m quadrats within the 50 x 20 m plot).

The BAM plot location will be marked for repeated survey using GPS coordinates, flagging tape and photo points.

5.3.2.2 Vegetation Condition Assessment

Within each of the BAM plots, the condition and structure of vegetation are assessed using key indicators to permit comparison of results throughout different monitoring periods. The BAM provides a standardised scoring system of key attributes.

5.3.2.3 Photo Point Monitoring

Photo monitoring from a permanent photo point was undertaken within each of the BAM plots, as the transect start photo of the plot.

5.3.2.4 Plant Taxonomy

Plant taxonomy used was consistent with the nomenclature accepted by the National Herbarium of NSW (as per their PlantNet website http://plantnet.rbgsyd.nsw.gov.au/). All floristic data will be entered into a suitable Flora Information System (FIS) to enable data manipulation and export for species lists and analysis.

5.3.3 Amphibian Monitoring Site Selection

All detected amphibian species were recorded during monitoring surveys. The amphibian data (abundance and species richness) were subject to statistical hypothesis testing.

Multivariate statistical analyses have been performed to test whether there is a difference between frog assemblages at future control and impact (using the baseline data available). The non-significant interaction (P-value of >/= 0.05) between Control/Impact sites indicates that established future Control and Impact sites are suitable for mining and post-mining monitoring purposes, as they support similar amphibian assemblages (taxa and numbers of individuals), and similar microhabitats.

5.3.4 Aquatic Ecology Monitoring Methods

Aquatic monitoring will be carried out in accordance with the methods used for collection of baseline data for the Spring 2021 season. Aquatic monitoring will be conducted at eight Sites, including four impact Sites and four control Sites. Details of each impact and control Site is provided in **Table 22**.

Table 22 Aquatic Monitoring Locations

	Site	Easting	Northing	Watercourse	Sampling Methods Undertaken		
					AUSRIVAS	Quantitative Macro-invertebrate	Water Quality
Future Longwall Impact	12	277204	6205632	Teatree Hollow	X	X	X
	13	277437	6206801	Teatree Hollow	X	X	X
	16	277432	6206040	Teatree Hollow	X		X
	17	277246	6206601	Teatree Hollow	X		X
Control	14	270959	6200225	Moore Creek		X	X
	15	271328	6204392	Moore Creek		X	X
	7	275705	6203691	Hornes Creek	X	X	X
	8	275575	6204588	Hornes Creek	X	X	X

5.3.4.1 AUSRIVAS

AUSRIVAS provides a rapid assessment based on presence/absence of invertebrates, where macroinvertebrate samples are compared to modelled reference sites. Samples collected using AUSRIVAS protocol were analysed using the predictive models for NSW pool edge habitats (Turak et al., 2004). The AUSRIVAS model predicts the aquatic macroinvertebrate fauna expected to occur at a site in the absence of environmental stress, such as pollution or habitat degradation. The AUSRIVAS NSW Autumn and Spring models were used for the data collected. Observed to expected ratio (OE50), SIGNAL (Stream Invertebrate Grade Number Average Level), Ephemeroptera, Plecoptera and Trichoptera (EPT) index, and number of taxa were the indices used to interpret stream health.

5.3.4.2 Quantitative Macro-invertebrate

The quantitative macroinvertebrate program compares potential impact sites with upstream control sites and contains community assemblage data through time. Samples are collected with a benthic suction sampler (Brooks, 1994). The quantitative data can be used to determine quantitative changes in fauna density, richness and structure that may otherwise be missed by a rapid assessment approach. Statistical methods such as Principle Coordinates Analysis (PcoA) and PERMANOVA will be employed to analyse the data.

5.3.4.3 Water Quality

Surface water quality will be measured in situ using a Yeokal 611 water quality probe at each site, data from which is used to inform analysis of the results from AUSRIVAS and Quantitative Macro-invertebrate data analysis. The following variables will be measured:

- Temperature (°C);
- Conductivity (µS/cm);
- pH;
- Alkalinity measured with a standard titration kit (mg CaCO3/L);
- Dissolved Oxygen (DO) (% saturation and mg/L); and
- Turbidity (NTU).

5.3.5 Additional Monitoring Items to be Installed

5.3.5.1 Aquatic Ecology

To increase efficacy of the program, sampling locations have been both removed and added in the latest round of data collection in Spring 2021.

Initial monitoring included sites that were previously sampled for the EIS (SIMEC 2019) including Dogtrap Creek and Bargo River which have since been removed from the current program. Dogtrap Creek will not be affected by the longwalls for this extraction plan and is not currently surveyed for stream health. Monitoring of this waterway will recommence two years prior to mining in this location. Bargo River was surveyed under the EIS and first two years of baseline monitoring. Bargo River has been removed as there is a low likelihood of detecting any changes downstream of Teatree Hollow. This is because mine water discharged from Teatree Hollow will mask any small changes in the Bargo River. Additionally, there is a comprehensive aquatic health program which monitors the Bargo River that commenced in Spring 2021 which could be analysed to assess downstream impacts if required. Additional sites (Sites 16 and 17) have been added to the Teatree Hollow catchment to increase spatial representation in the area that is considered most likely to be impacted.

5.3.5.2 Terrestrial Ecology

It is recommended that another year of baseline data is collected to capture the natural variation across sites. This will assist in the analysis of post-mining activity changes at the future impact Sites. The annual monitoring should continue in Spring and Autumn for riparian vegetation, threatened ecological communities and populations, and amphibian monitoring (or after rain and peak calling periods deemed suitable by the ecologist) to enable comparison between impact and control Sites.

5.4 Baseline Monitoring to Support Future Extraction Plans

To assist in the preparation of future Extraction Plans, aquatic and terrestrial ecology monitoring as outlined in **Table 23** and **Figure 10** would provide sufficient baseline data. Monitoring data collected during the mining of LW S1A-S6A would be used in the review of observed subsidence impacts to inform future Extraction Plans for the Tahmoor South Domain.

The monitoring program going forward should aim to be consistent with baseline monitoring conducted in 2019-2022. The program should also adapt to changing priorities, mine design and/or include improvements to overall design of the monitoring program. This may involve addition or removal of sites and/or indicators as necessary to streamline and detect meaningful ecological change.

Table 23 Monitoring Program for Aquatic and Terrestrial Ecology

Feature	Monitoring Component / Location	Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Water quality	Physico-chemical water quality sampling at all aquatic ecology monitoring sites	Bi-annually (Spring and Autumn) Completed as part of baseline monitoring.	Bi-annually (Spring and Autumn)	Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation management Plan and/or if required to monitor a corrective management action(s).
Aquatic habitat	Aquatic habitat observations at aquatic ecology monitoring sites 1-15.			
Macroinvertebrates	AUSRIVAS macroinvertebrate sampling at aquatic ecology monitoring sites 7, 8, 12, 13, 16, 17. Quantitative macroinvertebrate sampling at aquatic ecology monitoring sites 7, 8, 12, 13, 14, 15, 16, 17.			
Riparian vegetation	Permanent floristic plots, vegetation condition assessment, photo-point monitoring and plant taxonomy at all riparian vegetation monitoring sites (sites i01-i03 and c04-c06)	Bi-annually (Spring and Autumn) Completed as part of baseline monitoring program	Bi-annually (Spring and Autumn)	Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).
Amphibians	Amphibian monitoring and photo-point monitoring at all amphibian monitoring sites (sites i01-i03 and c04-c06)	Bi-annually (Spring and Autumn) Completed as part of baseline monitoring program	Bi -annually (Spring and Autumn)	Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation management Plan and/or if required to monitor a corrective management action(s).

Feature	Monitoring Component / Location	Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Threatened flora	Permanent 10 x 10 m threatened flora monitoring plots within portions of LW S1A-S6A Study Area, where Brown Pomaderris (*Pomaderris brunnea*), Bargo Geebung (*Persoonia bargoensis*) and Small-flower Grevillea (*Grevillea Parviflora* subsp. p*arviflora*) have been previously detected and species individual counts have been recorded.	Annually	Bi-annually (Spring and Autumn)	Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).
Threatened fauna	Further investigations will be initiated to determine ongoing presence of threatened fauna habitat in the locality.	Bi-annually (Spring and Autumn) Completed as part of baseline riparian and amphibian monitoring program	Bi-annually (Spring and Autumn)	Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A.
Threatened Ecological Communities	Permanent floristic plots, vegetation condition assessment, photo-point monitoring and plant taxonomy at all TEC monitoring sites within the LW S1A-S6A Study Area.	Annually	Bi-annually (Spring and Autumn)	Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).
Groundwater Dependant Ecosystems	Review of corresponding TARPs If, a Level 3 in the riparian monitoring TARP (BMP3) and/or a Level 3 (in the relevant groundwater TARP triggers for water level and water quality – TARP WMP8 or WMP11)	Annually	Bi-annually (Spring and Autumn)	Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).

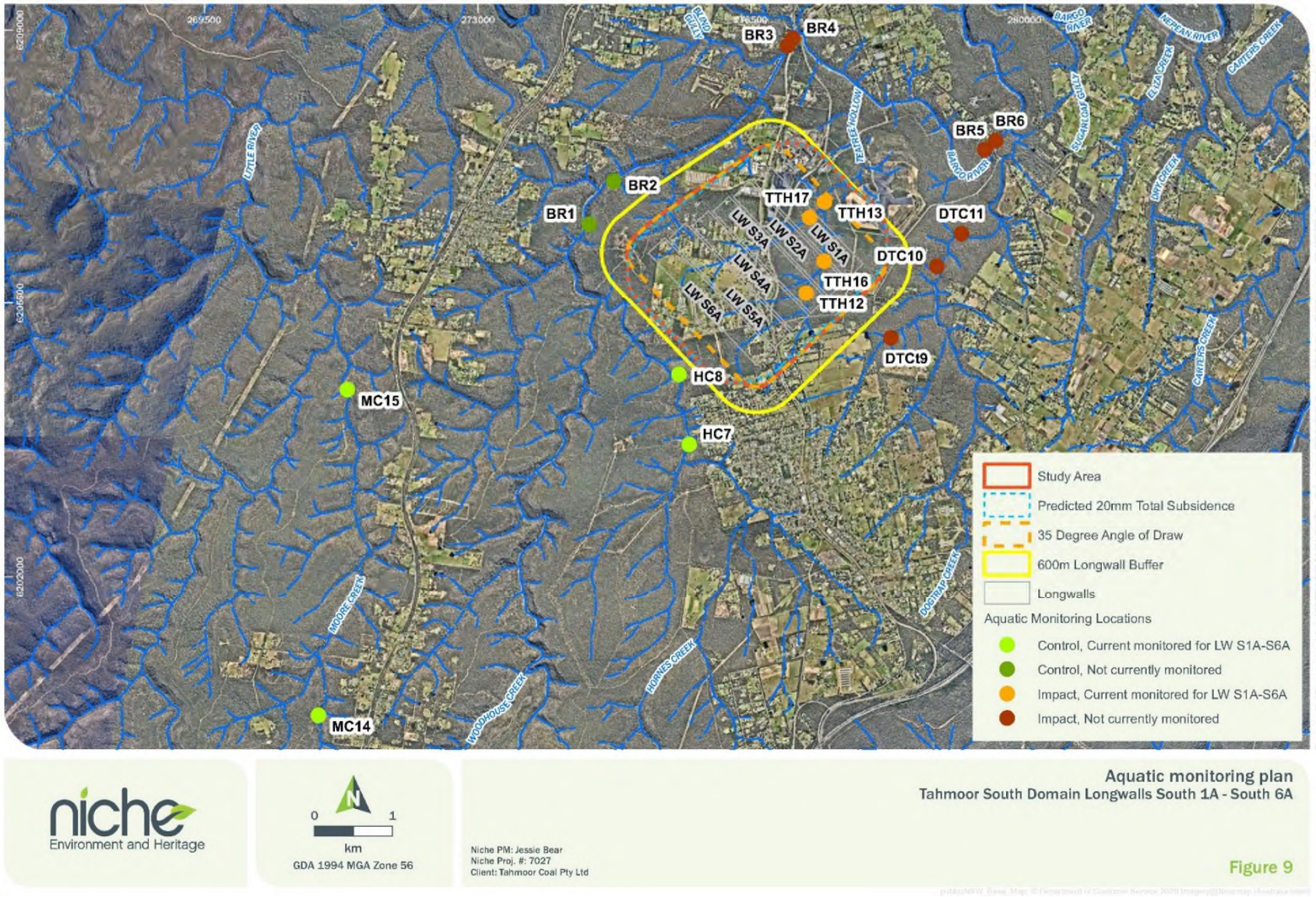

Figure 9 Aquatic Ecology Monitoring Plan

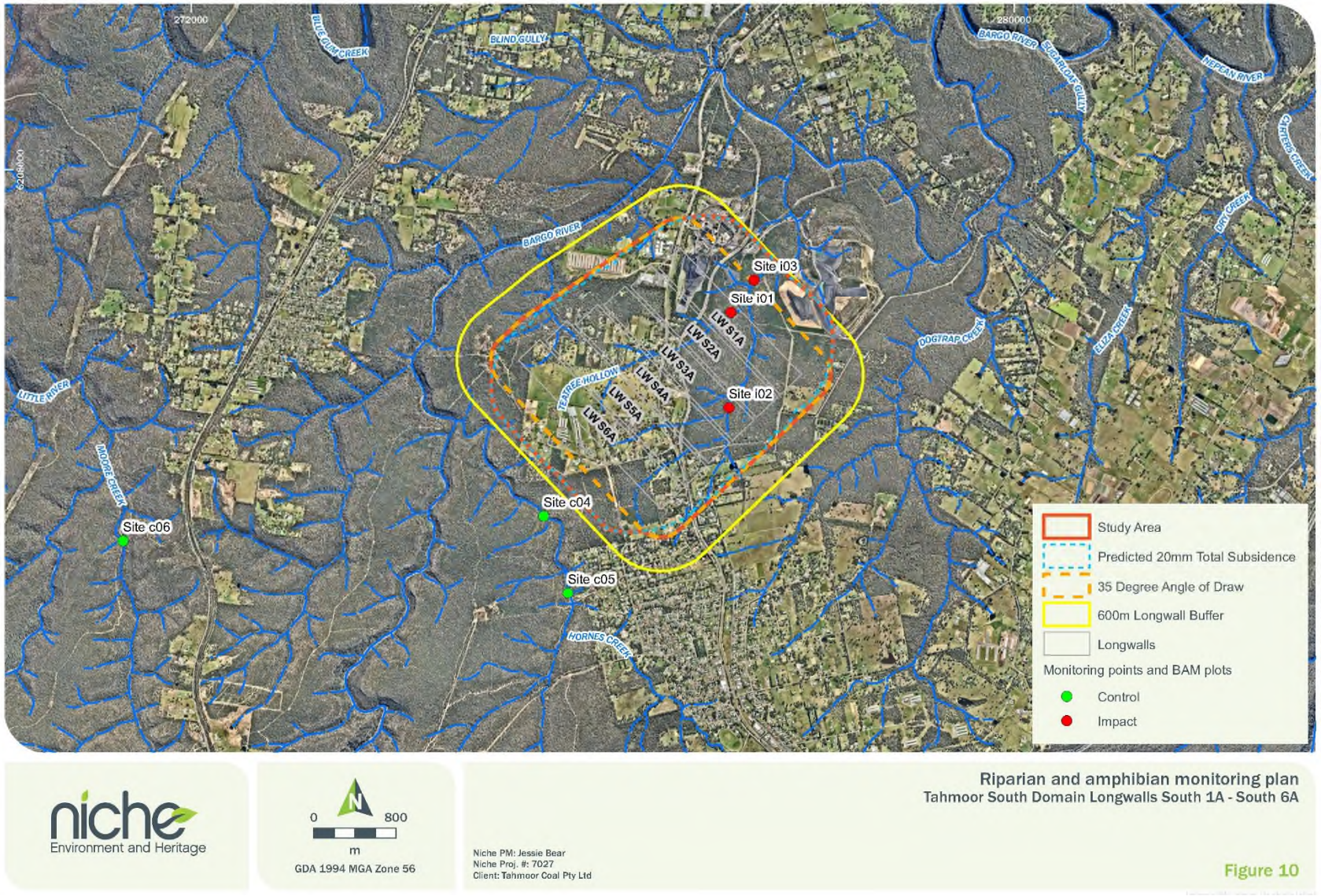

Figure 10 Riparian and Amphibian Monitoring Plan

6 Subsidence Management Strategies

6.1 Mine Design Considerations

The Tahmoor South Domain mine plan has undergone a series of amendments since the issue of the first EIS for the Tahmoor South Project in 2014. These mine plan revisions are summarised below:

- EIS Submission (2014): Original EIS submission, which was placed on hold and subsequently withdrawn in late 2015.
- EIS Submission (January 2019): Updated EIS submission based on revised Secretary's Environmental Assessment Requirements (SEARs) issued in June 2018.
- Project Amendment Report (February 2020): The mine design was modified to reduce potential environmental impacts of the Project through the reduction in the extent of longwall mining. This was achieved by the following modifications:
  - Removal of LW 109, which was located directly beneath Dogtrap Creek, resulting in elimination of direct impacts to Aboriginal heritage items;
  - Configuration of the longwall layout to comprise two series of shorter longwall panels;
  - Reduction in the proposed longwall width, from approximately 305 m to approximately 285 m; and
  - Reduction in the height of extraction within the longwall panels from up to 2.85 m to up to 2.6 m.
- Second Amendment Report (August 2020): The mine design was again modified to further reduce potential environmental impacts. This included the removal of two longwalls in the southern part of the mine near the township of Bargo (LW 107B and LW108B), which would result in a reduction in magnitude of subsidence impacts.

The numerous modifications of the Tahmoor South Domain mine plan have resulted in a reduction of the magnitude and extent of subsidence impacts, as well as avoidance of significant impact to sensitive surface features of the environment, including Aboriginal heritage items.

The current mine plan proposes to complete underground mining with access to the Tahmoor South Domain provided from the existing pit top facilities. This mine design consideration minimises surface impacts from mining through the avoidance of establishing new surface facilities.

6.2 Mitigation Measures / Corrective Management Actions

6.2.1 Management Measures

There are no management measures identified for terrestrial or aquatic biodiversity in relation to the extraction of LW S1A-S6A. All potential impacts to biodiversity that may arise would be from modification to stream flow. As such, the Water Management Plan will contain Management and remediation measures for rectifying impacts to stream flow.

6.2.2 Remediation Measures

There are no remediation measures identified for terrestrial or aquatic biodiversity in relation to the extraction of LW S1A-S6A. In the event of impact to flow refer to the Water Management Plan and any Corrective Management Action Plan that may be created in response to identified impacts.

6.2.3 Verification Methods

Niche recommend aquatic monitoring to be undertaken following any remediation measures implemented to rectify impacts to stream flow.

6.3 Trigger Action Response Plan

A series of TARPs have been developed to address various components of aquatic and terrestrial ecology using the performance indicators for implementation during LW S1A-S6A mining, in accordance with Condition C8(g)(viii) of the Consent (refer to **Appendix A**).

The primary actions of the TARP are to:

- Define appropriate trigger levels for aquatic and terrestrial ecology in proximity to waterbodies;
- Develop specific actions to respond to high risk of exceedance of any performance measure to ensure that the measure is not exceeded; and
- Present a plan in the event performance measures are exceeded or are likely to be exceeded and describe the management / corrective actions to be implemented (i.e., notifications to relevant agencies, groundwater, revision in any Corrective Action Management Plan and/or Six-monthly Subsidence Impact Reports and/or Annual Review).

The 'Normal Condition' section of each TARP indicates that the environment is performing within normal levels or natural variability. Deviation from baseline or expected condition triggers an increased level of risk to the environment (Level 1 or higher based on escalating corresponding risk).

The sections below summarise the impact assessment trigger criteria for aquatic and terrestrial ecology, which are used in the TARPs to determine the TARP trigger level that has occurred.

6.3.1 Implementation of Monitoring Program and TARP Requirements

Tahmoor Coal's standard approach for all monitoring, reporting, investigation and remediation is to commence all tasks as soon as practicable. The following sections provide more information on this standard approach to be adopted during the LW S1A-S6A pre-mining, mining and post-mining phases:

- All monitoring commitments will be tracked on a weekly basis so that tasks are completed as required, taking into consideration land access and environmental factors. Post-mining monitoring will typically be completed within one month of the completion of the relevant longwall and prior to the influence from the active subsidence zone on the feature from the next longwall.
- Following the receipt of monitoring data and laboratory results, specialist consultants will review the data against the relevant TARPs as soon as practicable. If any TARP trigger has occurred, specialist consultants will notify Tahmoor Coal as soon as practicable. Monitoring results and TARP triggers will also be discussed during the monthly Environmental Response Group meetings, and any relevant information from other disciplines will be shared within the group. It is noted that discussions amongst specialists from different disciplines will not be restricted to ERG meetings, and relevant specialists will be included at any time to discuss results and assist with the completion of required actions and responses, as required.
- In the event of a TARP trigger occurrence, Tahmoor Coal will initiate all requirements (actions and responses) in accordance with the relevant TARP (i.e. investigation, report, negotiation, CMA determination, or similar) as soon as practicable and endeavour to commence actions and responses within one month of the exceedance being recorded. This timeframe is noted to be subject to issues outside of Tahmoor Coal's control such as land access constraints, inclement weather, extended timeframes where further monitoring is required, and inability to communicate with a third party / landholder.
- Tahmoor Coal will complete the required actions and responses relating to the TARP trigger as soon as practicable and will endeavour to finalise these requirements, subject to issues outside of Tahmoor Coal's control, as follows:

- Level 1 and Level 2 TARP trigger actions and responses within three months of the exceedance being recorded;
- Level 3 and Level 4 TARP trigger actions and responses within six months of the exceedance being recorded; and
- Exceeds Performance Measures actions and responses in accordance with the timeframes provided in the relevant TARPs.

6.3.2 Macroinvertebrate Indicators

The macroinvertebrate criteria indicate the decline or negative changes in modelled stream health. This is triggered by when AUSRIVAS scores at one or more sites are Band D for two or more consecutive surveys. This data is supported by SIGNAL 2 and EPT index. Statistical analysis BACI of macroinvertebrate quantitative data is used to assess whether macroinvertebrate communities are within the range of baseline data and/or comparable to control sites.

6.3.3 Aquatic Habitat and Water Quality Indicators

The aquatic habitat and quality criteria indicate the reduction in aquatic habitat through loss of pools or associated reduction in water quality. This is triggered during visual monitoring when potential or significant change in aquatic habitat compared to baseline observations is recorded at one or more monitoring sites from two or more consecutive surveys.

6.3.4 Amphibian Populations Indicators

The amphibian population criteria indicates the decline in populations within watercourses of the Study Area. This is triggered during monitoring when population parameters are predominantly or significantly not within a reasonable range of baseline data as supported by statistical analysis.

6.3.5 Riparian Vegetation Indicators

The riparian vegetation criteria indicate the dieback of vegetation within watercourses of the Study Area. This is triggered during monitoring when vegetation parameters are predominantly or significantly not within a reasonable range of baseline data as supported by statistical analysis.

The vegetation monitoring indicates condition parameters that are outside of reasonable range (declining in condition faster than predicted natural attrition) of average baseline Vegetation Integrity (VI) scores (more than 10 % decline).

6.3.6 TEC Vegetation Indicators

The vegetation monitoring indicates STFF TEC signs of dieback, or condition parameters that are outside of reasonable range (declining in condition faster than predicted natural attrition) of average baseline data (Vegetation Integrity (VI) scores (more than a 10 % decline).

6.3.7 Threatened Flora Indicators

The 10 m x 10 m permanent threatened flora monitoring plots indicate target threatened flora species numbers are in decline. This is triggered during monitoring when population parameters are predominantly or significantly not within a reasonable range of baseline data as supported by statistical analysis.

6.3.8 Groundwater Dependant Ecosystems (GDE) Indicators

The GDE monitoring will consider signs of dieback of vegetation within watercourses of the Study Area during riparian vegetation monitoring (Level 3 Trigger of TARP BMP3) and reductions in groundwater levels or groundwater quality below Level 3 (in the relevant groundwater TARP triggers for water level and water quality – TARP WMP8 or WMP11) following the commencement of extraction. TARP BMP3 will be enacted via results from TARP WMP8 or WMP11 as well as via its own specific criteria, to support investigations providing a holistic review of groundwater and surface water in relation to GDEs.

6.4 Contingency Plan

In accordance with Conditions C8(g)(ix) and E5(f) of the Consent, in the event that performance measures (in the form of pre-defined triggers) are considered to have been exceeded or are likely to be exceeded, a response will be undertaken in accordance with these TARPs (refer to **Appendix A**). This response is a contingency plan that describes the corrective management actions which can be implemented where required to remedy the exceedance.

If a Corrective Action Management Plan is required in accordance with the TARP, this plan will be prepared in accordance with Section 3.6.3 of the Extraction Plan Main Document.

The success of remediation measures / corrective management actions that have been implemented for any TARP exceedance would be reviewed as part of any Corrective Action Management Plan, the Six-monthly Subsidence Impact Reports and the Annual Review.

6.5 Adaptive Management Strategies

6.5.1 Adaptive Management for Aquatic and Terrestrial Ecology

There are no adaptive management strategies currently proposed for the management of aquatic or terrestrial ecology in the Study Area.

6.5.2 Continuous Improvement

Tahmoor Coal have adopted the "Plan-Do-Check-Act" model as shown in **Figure 11**. This model will be applied to all aspects of Tahmoor Coal's environmental management and is utilised to embed the continuous improvement process in all system documents.

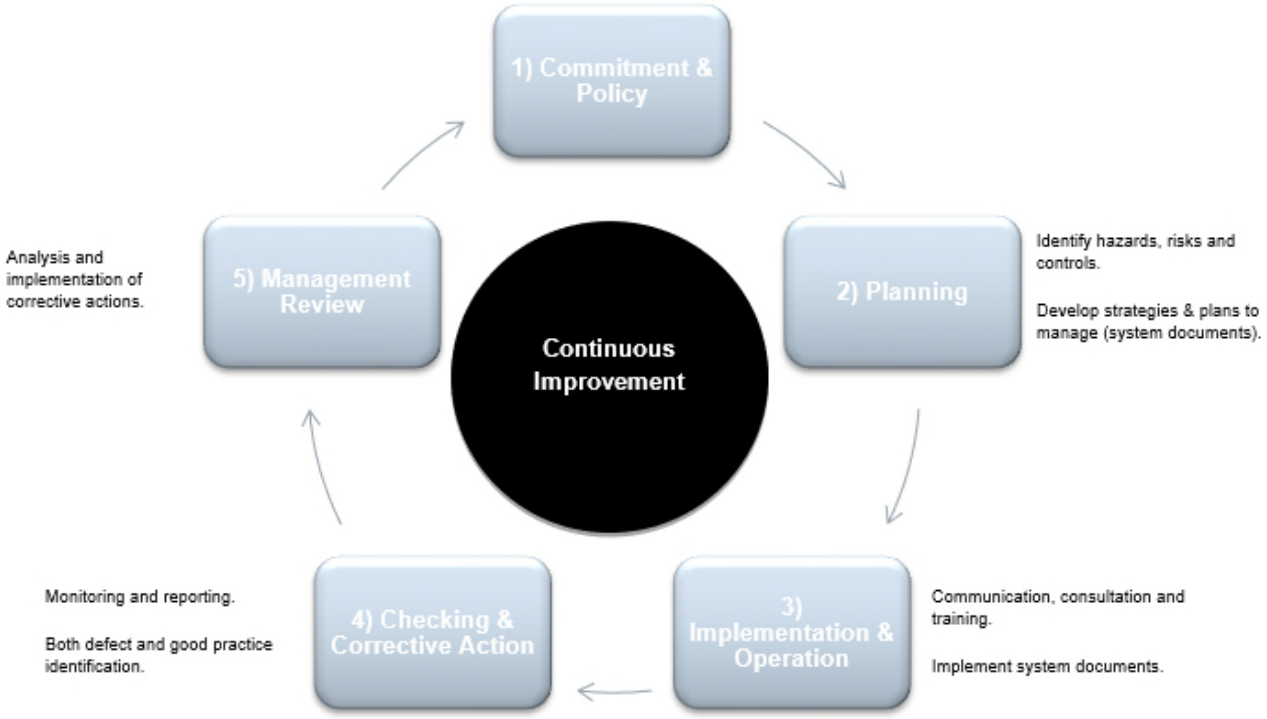

Figure 11 Continuous Improvement Model

6.5.3 Strategy for Continuous Improvement to the Aquatic Monitoring Program

The BACI designed aquatic monitoring program will be evaluated each season and adapted where required to account for prevailing environmental conditions. To date, the baseline aquatic monitoring program has been adapted to account for consistently dry creek beds at sampling locations and to avoid collecting data where other environmental variables would confound results. Monitoring reports will identify any limitations and improvements that could be made to the program including additional sites and analyses that could be incorporated.

6.5.4 Strategy for Continuous Improvement to the Riparian and Amphibian Monitoring Program

The BACI designed terrestrial monitoring program will be evaluated each season and adapted where required to account for prevailing environmental conditions. To date, the baseline amphibian monitoring program has been adapted to account for the potential decline in amphibian populations within watercourses of the Study Area. The program currently collects watercourse parameters associated with sensitive amphibian habitat areas and accounts for total frog species richness and abundance.

Riparian monitoring focuses on signs of riparian vegetation dieback. To date, the program obtains data on flora species richness, floristic cover, prevalence of exotic species, and other anecdotal information (e.g., visual shifts in vegetation assemblages, evidence of post-fire recovery, stochastic events [flooding], and above surface human disturbance). Monitoring reports will identify any limitations and improvements that could be made to the program including additional sites and analyses that could incorporated.

7 Implementation and Reporting

7.1 General Requirements

This section of the management plan describes the key elements of implementation and reporting specific to the management of terrestrial and aquatic biodiversity.

A description of requirements and procedures that are applicable to the extraction of LW S1A-S6A in general are provided in the Extraction Plan Main Document. This detail includes:

- Environmental Management System Framework;
- General reporting requirements, including details regarding the Six Monthly Subsidence Impact Report, Annual Review, and Annual Return;
- Incident management and reporting requirements;
- Non-compliance management and reporting requirements;
- Exceedances management and reporting requirements;
- Compliant and dispute management protocol;
- Audit and review requirements for general environmental performance, including internal audits and reviews, and independent environmental audits;
- General roles and responsibilities;
- Employee and contractor training requirements;
- Response groups to facilitate the review of monitoring data;
- Internal and External Stakeholder Communication Procedures;
- Access to information requirements, including Tahmoor Coal website and the Tahmoor Colliery Community Consultative Committee;
- Document control protocol; and
- Risk assessment for built and natural features and corresponding outcomes.

7.2 Reporting Requirements

7.2.1 Performance Measure Exceedance

In accordance with Condition E4 of the Consent, where any exceedance of the criteria or performance measures outlined within this document has occurred, Tahmoor Coal will:

- Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
- Consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures / corrective management actions or other course of action;
- Within 14 days of the exceedance occurring (or other timeframe agreed by the Planning Secretary), submit a report to the Planning Secretary describing these remediation options and any preferred remediation measures / corrective management actions or other course of action; and
- Implement reasonable remediation measures / corrective management actions as directed by the Planning Secretary.

7.2.2 Specific Reporting for Aquatic and Terrestrial Biodiversity

There are no reporting requirements, except within the above reporting requirement or response reporting discuss in the TARPs, specific to the management of terrestrial and aquatic biodiversity identified for the extraction of LW S1A-S6A.

7.3 Review and Auditing

7.3.1 Plan Audit

Audits of the ***Biodiversity Management Plan*** are to be conducted in consultation with the Plan owner and nominated individuals and shall focus on the content and implementation.

Audits on the content shall consist of a determination of understanding of the ***Biodiversity Management Plan*** by the individual's allocated responsibility under this plan.

Audits on the implementation shall consist of reviews of the safe working procedures and risk assessments developed to ensure safe operation of this ***Biodiversity Management Plan***, they may also involve discussions with personnel involved in the management plan to determine understanding and compliance.

Should an audit of this ***Biodiversity Management Plan*** determine that a deficiency is evident in the content or implementation, a corrective action must be developed and implemented. Actions will be assigned to a nominated individual and tracked in Cority.

Tahmoor Coal is responsible to verify that the nominated corrective action has been implemented by way of a follow up audit.

Any changes to the ***Biodiversity Management Plan*** are to be managed and communicated to all personnel in line with the Change Management Process.

7.3.2 Plan Review

This ***Biodiversity Management Plan*** will be reviewed:

Event based: in accordance with Condition E7 (a) of the Consent, a review will be required within 3 months of any incident, event or finding that identifies an inadequacy in the ***Biodiversity Management Plan*** risk assessment or associated documents to continue to effectively manage the identified hazard; a change to the workplace itself or any aspect of the work environment, a change to a system of work, a process or a procedure; or

Time based: in the absence of regular event-based reviews and in accordance with Condition E7 (b-e) of the Consent, this plan will be reviewed within three months of:

- the submission of an Annual Review under Condition E13;
- the submission of an Independent Environmental Audit under Condition E15;
- the approval of any modification of the conditions of this consent (unless the conditions require otherwise); or
- notification of a change in development phase under Condition A19.

If deemed appropriate, relevant stakeholders may be included in the review process. All reviews are to be documented. The process for review of this document will be in accordance with Tahmoor Coal's *Document and Record Control* (TAH-HSEC-00124).

Following changes (or as otherwise required above), a copy of the amended management plan will be forwarded to the Secretary of the DPE for approval.

7.4 Roles and Responsibilities

There are no roles and responsibilities specific to the implementation of terrestrial and aquatic biodiversity management identified for the extraction of LW S1A-S6A.

8 Document Information

8.1 Referenced Documents

Reference information, listed in **Table 24** below, is information that is directly related to the development of this document or referenced from within this document.

Table 24 Reference Information

Title
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. Available at www.waterquality.gov.au/anz-guidelines.
Brooks S., (1994). An efficient and quantitative aquatic benthos sampler for use in diverse habitats with variable flow regimes. Hydrobiolgia.
DAWE (2017). EPBC Act Protected Matter Search tool. Accessed October 2017. Available at Protected Matters Search Tool – DAWE
DPE (2019). Tahmoor South Coal Project – Preliminary Issues Report: State Significant Development (SSD 8445). Sydney, Australia. Available at: https://www.miningnewsfeed.com/reports/Tahmoor_Preliminary_Issues_Report_062019.pdf
DPIE (2015). Draft Guidelines for the Preparation of Extraction Plans V5.
DPIE (2020). Google Earth Engine Burnt Area Map (GEEBAM). Available at: Google Earth Engine Burnt Area Map (GEEBAM) | Anzlic Dataset | SEED (nsw.gov.au)
DPIE (2022). NSW BioNet threatened species sightings records. Accessed January 2022. Available at: NSW BioNet | NSW Environment, Energy and Science.
HEC (2018). Tahmoor South Project Surface Water Baseline Study. Prepared for Tahmoor Coal Pty Ltd. Dated November 2018.
HEC (2020a). Tahmoor South Amended Project Surface Water Baseline Assessment. Prepared for: Tahmoor Coal Pty Ltd. Dated February 2020.
HEC (2020b). Tahmoor South Project Amendment – Surface Water Impacts. Prepared for: Tahmoor Coal Pty Ltd. Dated July 2020.
MSEC (2018). Tahmoor South Project – Longwalls 101 to 109. Prepared for Tahmoor Coal Pty Ltd. Dated December 2018.
MSEC (2020a). Tahmoor South Project – Amendment Report for Longwalls 101A to 108B. Prepared for Tahmoor Coal Pty Ltd. Dated February 2020.
MSEC (2020b). Tahmoor South Project – Second Amendment Report for Longwalls 101A to 106B. Prepared for Tahmoor Coal Pty Ltd. Dated July 2020.
MSEC (2022). Tahmoor South Project – Extraction Plan for Longwalls S1A to S6A. Prepared for Tahmoor Coal Pty Ltd. Dated February 2022.
Niche (2018a). Tahmoor South Project – Biodiversity Assessment Report. Prepared for Tahmoor Coal Pty Ltd. Dated November 2018.
Niche (2018b). Tahmoor South Project – Aquatic Ecology Impact Assessment. Prepared for Tahmoor Coal Pty Ltd. Dated November 2018.
Niche (2020a). Tahmoor South Project – Biodiversity Assessment Report of the Amended Report. Prepared for Tahmoor Coal Pty Ltd. Dated 12 February 2020
Niche (2020b). Tahmoor South Project – Aquatic Ecology Impact Assessment of the Amended Project. Prepared for Tahmoor Coal Pty Ltd. Dated 28 July 2020.
Niche (2020c). Tahmoor South Project – Biodiversity Assessment Update. Prepared for Tahmoor Coal Pty Ltd. Dated 2 August 2020.

Title
Niche (2020d). Tahmoor South Project: Aquatic Ecology Impact Assessment of the Amended Project. Prepared for Tahmoor Coal Pty Ltd. Dated 28 July 2020.
Niche (2020e). Aquatic Monitoring Report – Spring 2019-Autumn 2020. Prepared for Tahmoor Coal. Dated 6 August 2020.
Niche (2021a). Terrestrial Ecology Monitoring Report – Spring 2020-Autumn 2021 riparian vegetation and amphibian baseline monitoring. Prepared for Tahmoor Coal Pty Ltd.
Niche (2021b). Aquatic Monitoring Report – Spring 2020 – Autumn 2021. Prepared for Tahmoor Coal. Dated 29/07/2021.
Niche (2022a). Terrestrial Ecology Monitoring Report – Spring 2021 riparian vegetation and amphibian baseline monitoring 2021. Dated 25/02/2022.
Niche (2022b). Southern domain AUSRIVAS report – Survey results. Prepared for Tahmoor Coal Pty Ltd. Dated 8/02/2022.
OEH (2015). Plan of Management Bargo River State Conservation Area. Sydney, Australia. Available at: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Parks-reserves-and-protected-areas/Parks-plans-of-management/bargo-river-state-conservation-area-plan-of-management-160131.pdf
Office of Environment and Heritage (2013). Remnant Vegetation of the western Cumberland subregion, 2013 Update. VIS_ID 4207. Available at: https://datasets.seed.nsw.gov.au/dataset/remnant-vegetation-of-the-western-cumberland-subregion-2013-update-vis_id-4207fd1f4
SIMEC (2019) Tahmoor South Project Environmental Impact Statement, Volumes 1 and 7, dated January 2019.
SIMEC (2020a) Tahmoor South Project Amendment Report, including Appendices A to R and response to submissions, dated February 2020.
SIMEC (2020b) Tahmoor South Project Second Amendment Report, Appendices A to O and response to submissions, dated August 2020.
SIMEC (2020c) Additional information responses dated 14 September 2020 (including Appendices A to L), 23 October 2020 and 4 November 2020.
Turak, E., Waddel, l N., and Johnstone, G. (2004). New South Wales Australian River Assessment System (AUSRIVAS): Sampling and Processing Manual, 2004. Natural Heritage Trust, Department of Environment and Conservation NSW.

8.2 Related Documents

Related documents, listed in **Table 25** below, are internal documents directly related to or referenced from this document.

Table 25 Related Documents

Number	Title
TAH-HSEC-00124	Document and Record Control
TAH-HSEC-00365	LW S1A-S6A Extraction Plan Main Document
TAH-HSEC-00361	LW S1A-S6A Water Management Plan
TAH-HSEC-00362	LW S1A-S6A Land Management Plan
TAH-HSEC-00364	LW S1A-S6A Heritage Management Plan
TAH-HSEC-00366	LW S1A-S6A Built Features Management Plan
TAH-HSEC-00365	LW S1A-S6A Public Safety Management Plan
TAH-HSEC-00367	LW S1A-S6A Subsidence Monitoring Plan

8.3 Glossary of Terms

Section 8.3 of the Extraction Plan Main Document provides a compiles Glossary of Terms.

8.4 Abbreviations

Abbreviations used in this document are provided below in **Table 26.**

Table 26 Abbreviations

Abbreviation	Definition
AUSRIVAS	Australian River Assessment System
BACI	Before After Control Impact
BC Act	NSW Biodiversity Conservation Act 2016
BMP	Biodiversity Management Plan
CEEC	Critically Endangered Ecological Communities
CTF	Cease to flow
DPE	NSW Department of Planning and Environment (formerly DPIE)
DPIE	NSW Department of Planning, Industry and Environment (now DPE)
EEC	Endangered Ecological Communities
EES	NSW Department of Planning and Environment – Environment, Energy and Science Group
EIS	Environmental Impact Statement
EIS Project Area	Project Area addressed by Niche (2018a, 2018b)
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
EPT	Ephemeroptera, Plecoptera, Trichoptera – a macroinvertebrate index of stream health.
GDE	Groundwater Dependent Ecosystem
HEC	Hydro Engineering & Consulting
km	Kilometre/s
LW	Longwall
LW S1A-S6A	Longwall South 1A – South 6A
m	Metre/s
mm	Millimetre/s
ML	Mining Lease
Macrophytes	Aquatic vegetation
MSEC	Mine Subsidence Engineering Consultants
NSW	New South Wales

Abbreviation	Definition
PCT	Plant Community Type
Project	Extraction of LW S1A-S6A
RCE	Riparian Channel and Environment Inventory
Resources Regulator	Department of Regional NSW – Resources Regulator
SIGNAL2	'Stream Invertebrate Grade Number – Average Level' is a simple biotic index for aquatic macroinvertebrates that uses the pollution tolerance levels of different macroinvertebrate types to create a site score and water quality rating for the river, creek or pond being studied.
Study Area	Study Area applicable to this management plan consists of a combination of the predicted 20 millimetre (mm) Total Subsidence Contour and the 35o Angle of Draw Line as shown in **Figure 2.**
Tahmoor Coal	Tahmoor Coal Pty Ltd
Tahmoor Mine	Tahmoor Coal Mine
TARP	Trigger Action Response Plan
TECs	Threatened Ecological Communities

8.5 Change Information

Full details of the document history are recorded below in **Table 27**.

Table 27 Document History

Version	Date Reviewed	Reviewed By	Change Summary
1.0	May 2022	April Hudson, Charlie Wheatley, Zina Ainsworth, Malcolm Waterfall, Peter Vale	New Document.
2.0	September 2022	April Hudson, Charlie Wheatley, Zina Ainsworth	Updated document following consultation with DPE, government agencies and the Independent Advisory Panel for Underground Mining.
3.0	January 2023	April Hudson, Zina Ainsworth	Review in accordance with Condition E7(e) following the commencement of first and second workings (18 October 2022) of the Consent SSD 8445.

Appendix A – Trigger Action Response Plans

BIODIVERSITY MANAGEMENT PLAN TARP – BMP1 AQUATIC HABITAT AND MACROINVERTEBRATE INDICATORS (STREAM HEALTH)

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature Aquatic habitat and stream health. **Performance Measure** Negligible environmental consequences to aquatic and riparian ecosystems beyond those predicted in the EIS[1]. **Performance Indicator** This performance measure will be considered to be triggered if subsidence impacts cannot be remediated in a manner that restores aquatic habitat. **TARP Objective** This TARP defines levels of deviation in aquatic habitat and associated stream health from normal conditions and the actions required to be implemented in response to each level of deviation. **Assessment Criteria** Reduction in aquatic habitat through loss of pools or associated reduction in stream health (AUSRIVAS assessment).	**Locations** • AUSRIVAS stream health sampling at aquatic ecology monitoring sites 7, 8, 12, 13, 16, 17. • Quantitative macroinvertebrate sampling at aquatic ecology monitoring sites 7, 8, 12, 13, 14, 15, 16, 17. Refer to Figure 9 of the Biodiversity Management Plan for the location of aquatic ecology monitoring sites. **Monitoring Frequency** **Pre-mining** Bi-annually (Spring and Autumn). **During Mining** Bi-annually (Spring and Autumn). **Post-mining** Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).	**Normal conditions**		
		• Visual monitoring indicates aquatic pool habitat parameters are similar to baseline observations at aquatic ecology monitoring sites. AND • AUSRIVAS score equal to or greater than Band C.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Visual monitoring indicates reduction in aquatic pool habitat compared to baseline observations at aquatic ecology monitoring sites for two consecutive sampling occasions. OR • AUSRIVAS score of Band D recorded for two consecutive sampling occasions at one or more aquatic ecology monitoring site(s).	• *Actions as required for Normal Condition.* • Undertake an investigation of BACI quantitative macroinvertebrate data to assess Level 1 observations and determine if mining related or the response to environmental conditions (e.g. drought) within the catchment. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results). • Consider and decide on reasonable and feasible options for remediation, where relevant (e.g. limestone cobble for pH management). • Following investigation, any declines detected that are not attributable to mining impacts (e.g. are a result of environmental conditions or stochastic events) are to be considered 'normal condition' and are continued to be included in the ongoing development of the ecological monitoring dataset.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. limestone cobbles for pH management). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review. • Continue monitoring to determine if a Level 2 TARP trigger will occur.
		Level 2		
		• Visual monitoring indicates reduction in aquatic pool habitat compared to baseline observations at aquatic ecology monitoring sites for three consecutive sampling occasions. OR • AUSRIVAS score of Band D recorded for three consecutive sampling occasions at one or more aquatic ecology monitoring site(s).	• *Actions as stated in Level 1.* • Consider increasing monitoring and review of data frequency where Level 2 has been reached and at other relevant sites, subject to land access. • Consider the inclusion of additional sites within impact area. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Biodiversity Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Biodiversity Management Plan. • Continue monitoring to determine if a Level 3 TARP trigger will occur.
		Level 3		
		• Visual monitoring indicates reduction in aquatic pool habitat compared to baseline observations at aquatic ecology monitoring sites for four consecutive sampling occasions. OR • AUSRIVAS score of Band D recorded for four consecutive sampling occasions at one or more aquatic ecology monitoring site(s).	• *Actions as stated in Level 2.* • Increase monitoring frequency for sites where Level 3 has been reached and at corresponding reference sites, subject to land access. • Add additional monitoring sites as required. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effects unrelated to mining or the prevailing climate). • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Responses as stated in Level 2.* If it is concluded that pools/aquatic habitat have been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days. • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access. • Continue monitoring to determine if an exceedance of the performance measure will occur.
		Exceeds Performance Measure		
		• Structural integrity of the bedrock base of permanent pools or controlling rockbars in third order and above reaches of Teatree Hollow and Teatree Hollow tributary and/or pool TT2 cannot be restored e.g. pool holding capacity is not reinstated to pre-mining conditions after WCAMP completion.	• *Actions as stated in Level 3.* • Investigate reasons for the performance measure exceedance. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation.	• *Responses as stated in Level 3.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE). • Implement reasonable remediation measures as directed by DPE, subject to land access.

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
				• Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).
Notes: [1] EIS predictions for aquatic habitat are summarised in Table 19 of the Biodiversity Management Plan.				

BIODIVERSITY MANAGEMENT PLAN TARP – BMP2 AMPHIBIAN POPULATIONS

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measures relevant. **TARP Objective** This TARP defines levels of deviation in amphibian populations and habitat from normal conditions and the actions required to be implemented in response to each level of deviation. **Assessment Criteria** • Decline in amphibian populations (species abundance and richness) attributed to mining effects. • The presence of a significant interaction (P-value <0.05) between Before/After and Control/Impact indicates an effect on amphibian assemblages[1,2].	**Locations** Amphibian monitoring and photo-point monitoring at all amphibian monitoring sites (sites i01-i03 and c04-c06). Refer to Figure 10 of the Biodiversity Management Plan for the location of amphibian monitoring sites. **Monitoring Frequency** **Pre-mining** Bi-annually (Spring and Autumn). **During Mining** Bi-annually (Spring and Autumn). **Post-mining** Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).	**Normal Condition**		
		• Monitoring indicates amphibian populations (richness and abundance) are stable[3] and habitat parameters are predominantly within a reasonable range of baseline data (supported by statistical analyses).	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Monitoring indicates amphibian populations (species abundance) have reduced significantly below baseline values[4].	• *Actions as required for Normal Condition.* • Undertake an investigation of quantitative/qualitative monitoring data to assess the cause and determine if differences are mining related or are in the response to environmental conditions (e.g. drought) within the catchment. Cross check biodiversity monitoring data against other related environmental data (e.g. aquatic monitoring results or subsidence monitoring results) upon identification of the potential trigger. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results). • Investigate whether any surface water TARP indicators have been triggered. • Consider and decide on reasonable and feasible options for remediation, where relevant. • Following investigation, any significant differences detected that are not attributable to mining impacts (e.g. are a result of environmental conditions or stochastic events) are to be considered 'normal condition' and are continued to be included in the ongoing development of the ecological monitoring dataset.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation. • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review. • Continue monitoring to determine if a Level 2 TARP trigger will occur.
		Level 2		
		• Monitoring indicates amphibian populations (species abundance and richness) have reduced significantly below baseline values[4] over two consecutive sampling seasons that, following investigation, is attributed to mining impacts[5].	• *Actions as stated in Level 1.* • Consider increasing monitoring and review of data frequency where Level 2 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Biodiversity Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Land Management Plan. • Continue monitoring to determine if a Level 3 TARP trigger will occur.
		Level 3		
		• Monitoring indicates amphibian populations (species abundance and richness) have reduced significantly below baseline values[4] over four consecutive sampling seasons that, following investigation, is attributed to mining impacts[5].	• *Actions as stated in Level 2.* • Increase monitoring and review of data frequency for sites where Level 3 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area, where relevant. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects.	• *Response as stated in Level 2.* If it is concluded that amphibian habitat have been damaged by subsidence impacts: • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access.
Notes:				

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
[1] Multivariate statistical analyses have been performed to test whether there is a difference between frog assemblages at future control and impact (using the baseline data). The non-significant interaction (P-value of >/= 0.05) between Control/Impact sites indicates that established future Control and Impact sites are suitable for mining and post-mining monitoring purposes, as they support similar amphibian assemblages (taxa and numbers of individuals), and similar microhabitats. [2] Baseline amphibian surveys did not identify the presence of Red-crowned Toadlet (*Pseudophryne australis*) (listed as Vulnerable under the BC Act) or Giant Burrowing Frog (*Heleioporus australiacus*) (listed as Vulnerable under the BC Act and EPBC Act) within the LW S1A-S6A Study Area. Red-crowned Toadlet and Giant Burrowing Frog were recorded during the Tahmoor Amphibian Monitoring Program in 2013, outside the Study Area for LW S1A–S6A. Giant Burrowing Frog was recorded at Cow Creek, and Red-crowned Toadlet was recorded at Hornes Creek (Niche, 2018a). If recorded in the future during amphibian monitoring, the presence of threatened frog species would be reported, and further investigations will be initiated to determine ongoing presence of threatened species in the locality and assess whether updates to the BMP and associated TARPs are required. [3] Stable is defined as no significant interaction between Before/After and Control/Impact indicating the mining activity has not affected amphibian assemblages (which comprises of all detected amphibian species recorded during monitoring surveys). [4] Determined by BACI interaction analyses. Significantly below baseline values is determined to be a P-value result of less than or equal to 0.05 for Before, After, either/or Control and Impact groups. The detection of a significant interaction between Before/After and Control/Impact indicates the mining activity has an effect on amphibian assemblages. All detected amphibian species are to be recorded during monitoring surveys. The amphibian data will be subject to statistical hypothesis testing. Species richness and abundance are population metrics used to assess amphibian populations in the locality. [5] Mining impacts results in a decline in water quantity or quality influencing habitats.				

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature 1. Aquatic habitat. 2. GDEs including Thirlmere Lakes[1]. **Performance Measure** 1. Negligible environmental consequences to aquatic and riparian ecosystems beyond those predicted in the EIS[2]. 2. Negligible impacts including: • Negligible change in groundwater levels; and • Negligible change in groundwater quality. **Performance Indicator** 1. This performance measure will be considered to be triggered if subsidence impacts cannot be remediated in a manner that restores habitat. 2. The performance measure will be considered to be exceeded if the groundwater levels or groundwater quality decline below Level 3 (in the relevant groundwater TARP triggers for water level and water quality – TARP WMP8 or WMP11) following the commencement of extraction, and the investigation outcomes indicate a mining related impact based on monitoring data for riparian vegetation. **TARP Objective** This TARP defines levels of deviation in riparian vegetation condition from normal conditions and the actions required to be implemented in response to each level of deviation. **Assessment Criteria** Dieback and reduced condition of riparian vegetation community within the Study Area.	**Locations** Permanent floristic plots, vegetation condition assessment, photo-point monitoring and plant taxonomy at all riparian vegetation monitoring sites (sites i01-i03 and c04-c06). Refer to Figure 10 of the Biodiversity Management Plan for the location of monitoring sites. **Monitoring Frequency** **Pre-mining** Bi-annually (Spring and Autumn). **During Mining** Bi-annually (Spring and Autumn). **Post-mining** Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).	**Normal Condition**		
		• Monitoring indicates riparian vegetation parameters are predominantly within a reasonable range of baseline data[3], specifically that Vegetation Integrity (VI) scores are within 10% of baseline. AND • Monitoring indicates native vegetation cover (percent cover) is within a reasonable range of baseline data[4].	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Monitoring indicates the VI score has reduced further than 10 % of average baseline score, over two consecutive sampling event (and cannot be attributed to climatic conditions or natural attrition). AND • Monitoring indicates native vegetation cover (percent cover) has reduced significantly below baseline values[4] over two consecutive sampling event.	• *Actions as required for Normal Condition.* • Undertake an investigation of quantitative/qualitative data to assess the cause and determine if mining related or the response to environmental conditions (e.g. drought) within the catchment. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results). • Consider and decide on reasonable and feasible options for remediation, where relevant. • Following investigation, any significant differences detected that are not attributable to mining impacts (e.g. are a result of environmental conditions or stochastic events) are to be considered 'normal condition' and are continued to be included in the ongoing development of the ecological monitoring dataset.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation. • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review. • Continue monitoring to determine if a Level 2 TARP trigger will occur.
		Level 2		
		• Monitoring indicates the VI score has reduced further than 10 % of baseline score, over four consecutive sampling event (and cannot be attributed to climatic conditions or natural attrition). AND • Monitoring indicates native vegetation cover (percent cover) has reduced significantly below baseline values[4].	• Actions as stated in Level 1. • Consider increasing monitoring and review of data frequency where Level 2 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Biodiversity Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Land Management Plan. • Continue monitoring to determine if a Level 3 TARP trigger will occur.
		Level 3		
		• Monitoring indicates the VI score has reduced further than 10 % of baseline score, over six consecutive sampling event (and cannot be attributed to climatic conditions or natural attrition). AND • Monitoring indicates native vegetation cover (percent cover) has reduced significantly below baseline values[4] over six consecutive sampling events.	• *Actions as stated in Level 2.* • Increase monitoring and review of data frequency for sites where Level 3 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area, where relevant. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Response as stated in Level 2.* If it is concluded that riparian habitat have been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access. • If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days. • Continue monitoring to determine if an exceedance of the performance measure will occur.
		Exceeds Performance Measure		

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
		• This performance measure will be triggered if subsidence impacts cannot be remediated in a manner that restores habitat. AND/OR • A mining related impact has occurred to riparian vegetation (Level 3 triggered of this TARP) and a Level 3 TARP trigger has occurred for groundwater levels or groundwater quality (Level 3 of TARP WMP8 or WMP11) in a corresponding location.	• *Actions as stated in Level 3.* • Investigate reasons for the performance measure exceedance. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation. • Consider modifying mine plan.	• *Responses as stated in Level 3.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE). • Implement reasonable remediation measures as directed by DPE, subject to land access. • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).

Notes:
[1] Where groundwater – surface water connectivity indicates a gaining stream, there is potential for riparian vegetation to be supported by groundwater. Consequently, riparian vegetation in these situations could be a Groundwater Dependent Ecosystem (GDE). Discussion of findings through the Tahmoor Coal Environmental Response Group will enable linkage of this TARP to WMP12 to consider groundwater – surface water relationships when pertinent.
[2] EIS predictions for riparian vegetation are summarised in Table 18 of the Biodiversity Management Plan.
[3] No significant interaction between Before/After and Control/Impact indicating the mining activity has not affected riparian assemblages.
[4] Determined by BACI interaction analyses. Significantly below baseline values is determined to be a P-value result of less than or equal to 0.05 for Before, After, either/or Control and Impact groups. The detection of a significant interaction between Before/After and Control/Impact indicates the mining activity has an effect on riparian assemblages.

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature Threatened species, threatened populations, or endangered ecological communities. **Performance Measures** No greater subsidence impacts or environmental consequences than predicted in the EIS[1]. Negligible impacts on threatened species, populations, or communities due to remediation of subsidence cracking. **Performance Indicator** This performance measure will be triggered if subsidence impacts cannot be remediated in a manner that restores habitat. **TARP Objective** This TARP defines levels of deviation in Shale Sandstone Transition Forest (STFF) TEC and threatened flora species from normal conditions and the actions required to be implemented in response to each level of deviation. **Assessment Criteria** Decline or significant negative change in condition class of the TEC and threatened flora species (e.g. *Pomaderris brunnea*, *Persoonia bargoensis* and *Grevillea parviflora* subsp. *parviflora*). This TARP excludes the monitoring of threatened fauna species and habitat[2,3].	**Locations** Permanent floristic plots within the 600 m buffer study area, subject to land access. Refer to Figure 10 of the Biodiversity Management Plan for the location of monitoring sites. **Monitoring Frequency** **Pre-mining** Annually **During Mining** Bi-annually (Spring and Autumn). **Post-mining** Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).	**Normal Condition**		
		• Monitoring indicates STFF TEC parameters are within a reasonable range of average baseline data (Vegetation Integrity (VI) scores are within reasonable range of baseline [within 10 %]). AND • Monitoring indicates target threatened flora species[4] numbers are stable (within reasonable range of baseline numbers).	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Monitoring indicates the VI score has reduced further than 10 % of average baseline score. AND/ OR • Monitoring indicates target threatened flora species[4] are in decline or signs dieback are evident.	• *Actions as required for Normal Condition.* • Undertake an investigation of quantitative/qualitative data to assess the cause and determine if mining related or the response to environmental conditions (e.g. drought) within the catchment. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results). • Consider and decide on reasonable and feasible options for remediation, where relevant.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation. • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review. • Continue monitoring to determine if a Level 2 TARP trigger will occur.
		Level 2		
		• Monitoring indicates the VI score has reduced further than 10 % of the average baseline VI score, over two consecutive sampling events. AND/ OR • Monitoring indicates target threatened flora species[4] are in decline or visual signs of dieback are continued, over two consecutive sampling seasons.	• *Actions stated in Level 1.* • Consider increasing monitoring and review of data frequency where Level 2 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Biodiversity Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Land Management Plan. • Continue monitoring to determine if a Level 3 TARP trigger will occur.
		Level 3		
		• Monitoring indicates the VI score has reduced further than 10 % of baseline score, over four consecutive sampling event. AND/ OR • Monitoring indicates target threatened flora species[4] are in decline or visual signs of dieback are continued, over four consecutive sampling seasons.	• *Actions as stated in Level 2.* • Increase monitoring and review of data frequency to fortnightly at sites where Level 3 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area, where relevant. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Response as stated in Level 2.* If it is concluded that threatened species, habitats or endangered ecological communities have been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access. • If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days. • Continue monitoring to determine if an exceedance of the performance measure will occur.
		Exceeds Performance Measure		
		• Subsidence impacts cannot be remediated in a manner that restores habitat for TECs, or threatened flora.	• *Actions as stated in Level 3.* • Investigate reasons for the performance measure exceedance. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation.	• *Responses as stated in Level 3.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE). • Implement reasonable remediation measures as directed by DPE, subject to land access. • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
Notes: [1] EIS predictions for threatened species, threatened populations and endangered ecological communities are summarised in Section 4.1 of the Biodiversity Management Plan. [2] Baseline amphibian surveys did not identify the presence of Red-crowned Toadlet (*Pseudophryne australis*) (listed as Vulnerable under the BC Act) or Giant Burrowing Frog (*Heleioporus australiacus*) (listed as Vulnerable under the BC Act and EPBC Act) within the LW S1A-S6A Study Area. Red-crowned Toadlet and Giant Burrowing Frog were recorded during the Tahmoor Amphibian Monitoring Program in 2013, outside the Study Area for LW S1A–S6A. Giant Burrowing Frog was recorded at Cow Creek, and Red-crowned Toadlet was recorded at Hornes Creek (Niche, 2018a). If recorded in the future during amphibian monitoring, the presence of threatened frog species would be reported, and further investigations will be initiated to determine ongoing presence of threatened species in the locality and assess whether updates to the BMP and associated TARPs are required. [3] During the 2020 biodiversity surveys, there were 11 threatened fauna species encountered within the LW S1A-S6A Study Area (Niche 2020). Potential habitat for these species within the Tahmoor South EIS Project Area, includes riparian hollow-bearing trees, potential overhangs (only two cliff lines are being monitored within the project area), and disused buildings. No caves were encountered during surveys completed by Niche, nor have any caves been reported by MSEC (2018). Furthermore, cliff line environments which may indicate cave-like habitat, are generally limited to the Nepean River to the north of the Study Area with some scattered cliff lines along the Dogtrap Creek, and Hornes Creek. Given the cliffs are located outside the predicted limit of subsidence as a result of the extraction of LW S1A-S6A, the probability that cave roosting habitat would be impacted is very low. Furthermore, no hollow-bearing trees, bridges or culverts within the Study Area that provide roosting habitat for threatened bats are likely to be substantially impacted by subsidence. As such, roosting habitat for threatened microbats is unlikely to be impacted by the extraction of LW S1A-S6A. Subsidence is unlikely to affect any resources or habitat features on which these species depend such that it would result in any measurable changes to their breeding or foraging behaviour or habitat. Further, individuals have not been incidentally encountered during other baseline monitoring surveys (irregular occurrence in the study area). Therefore, as these threatened fauna species are considered highly mobile (consisting of bats and birds) and the species (and habitat) is considered unlikely to be impacted by mining practices, they have not been addressed further in the biodiversity TARPs.[4] Threatened flora species monitored are *Pomaderris brunnea*, *Persoonia bargoensis* and *Grevillea parviflora* subsp. *Parviflora*.				

Appendix B – Detailed Aquatic Monitoring Maps

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Niche Proj. #: 7027
Client: Tahmoor Coal Pty Ltd

Aquatic monitoring plan

Tahmoor South Domain Longwalls South 1A - South 6A

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Niche Proj. #: 7027
Client: Tahmoor Coal Pty Ltd

Aquatic monitoring plan
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Aquatic monitoring plan
Tahmoor South Domain Longwalls South 1A - South 6A

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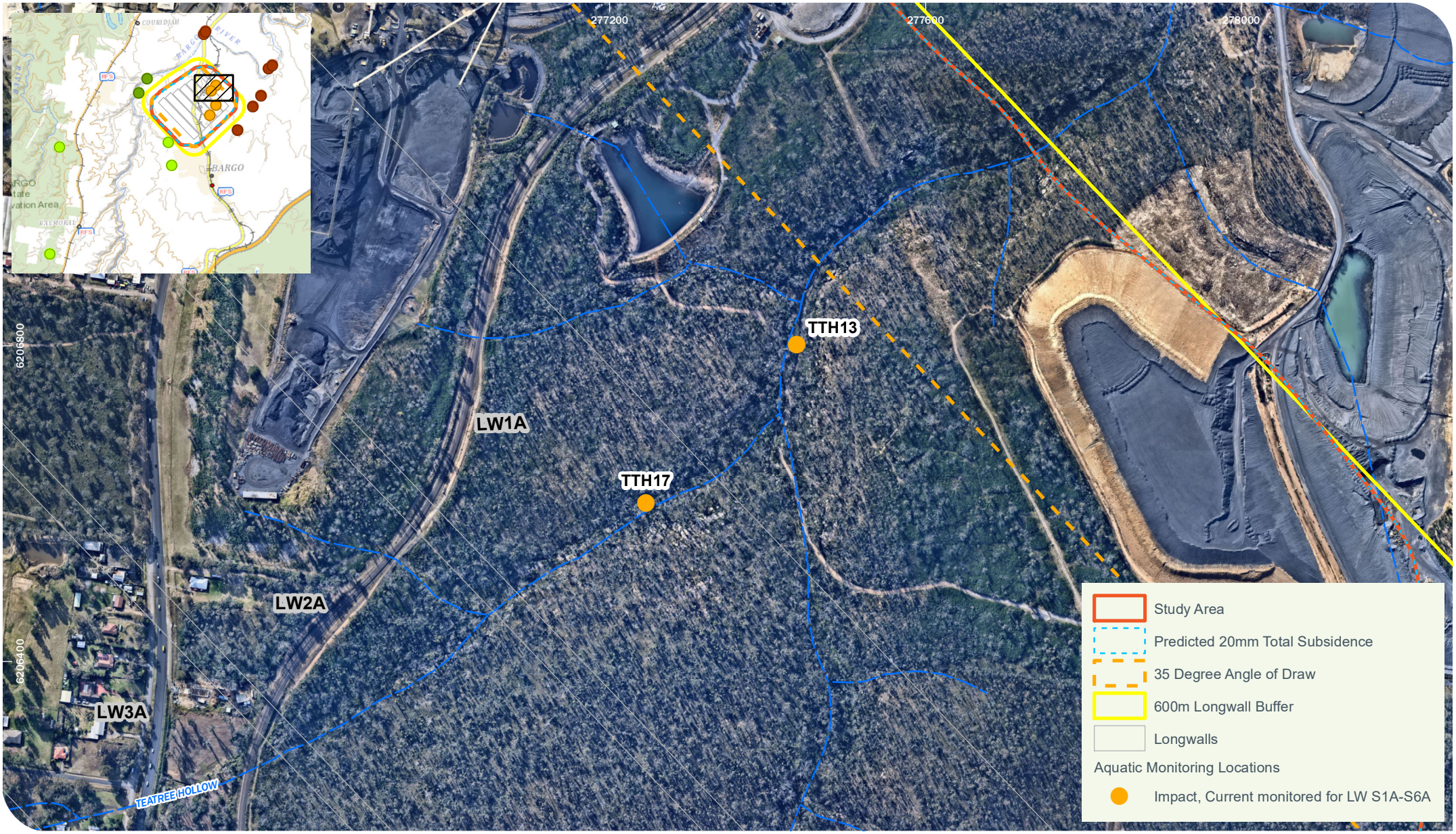

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Aquatic monitoring plan
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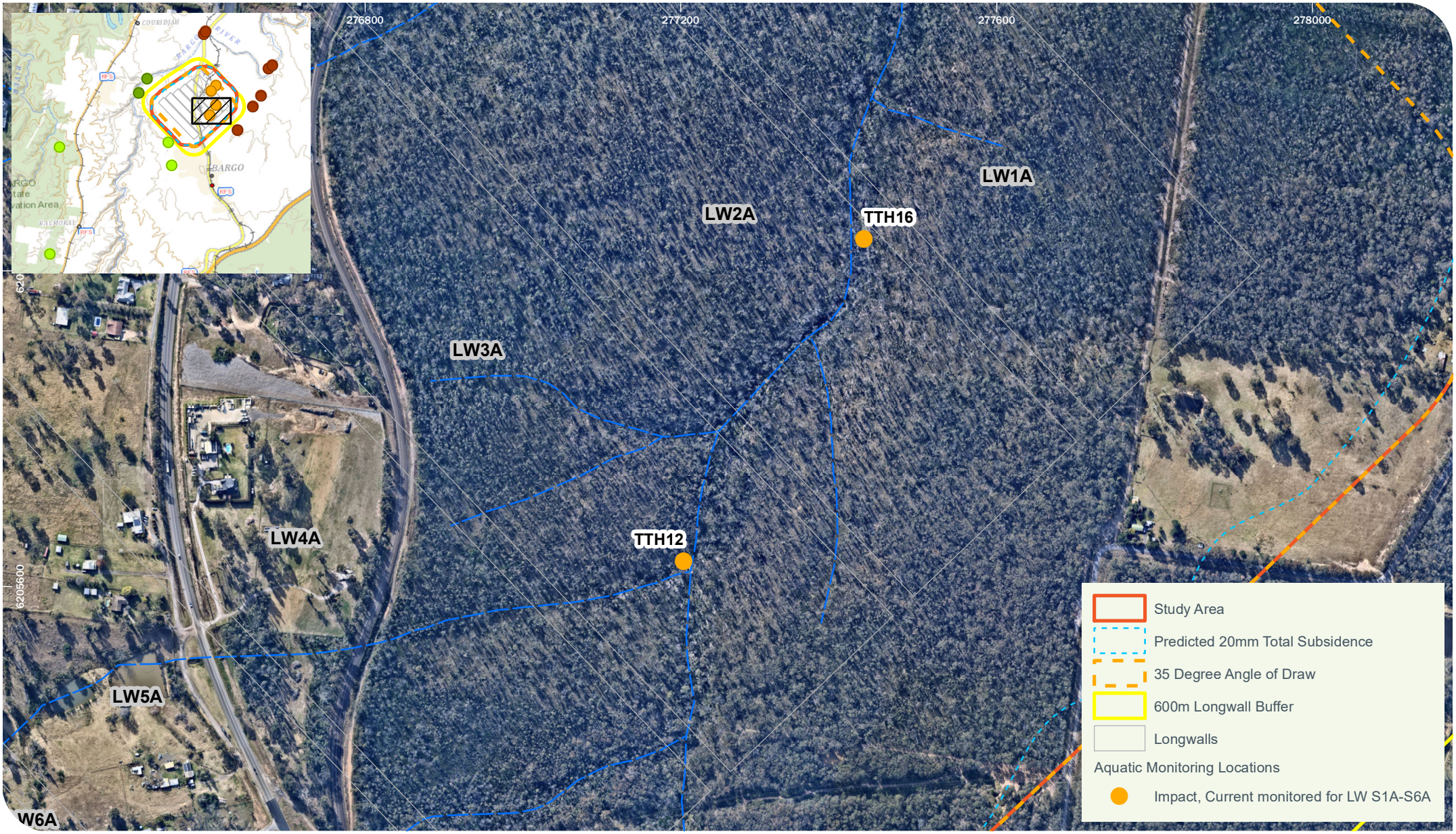

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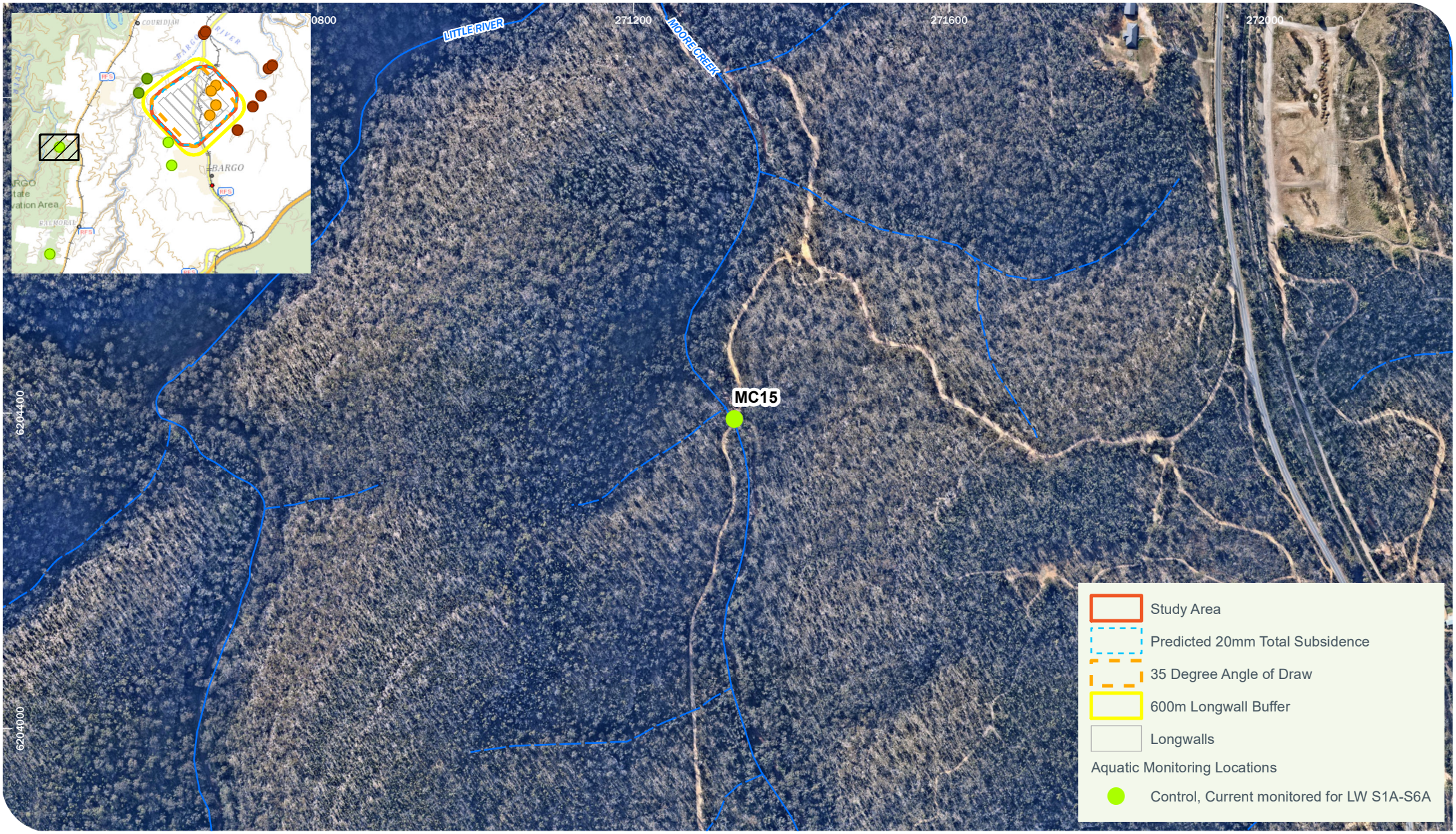

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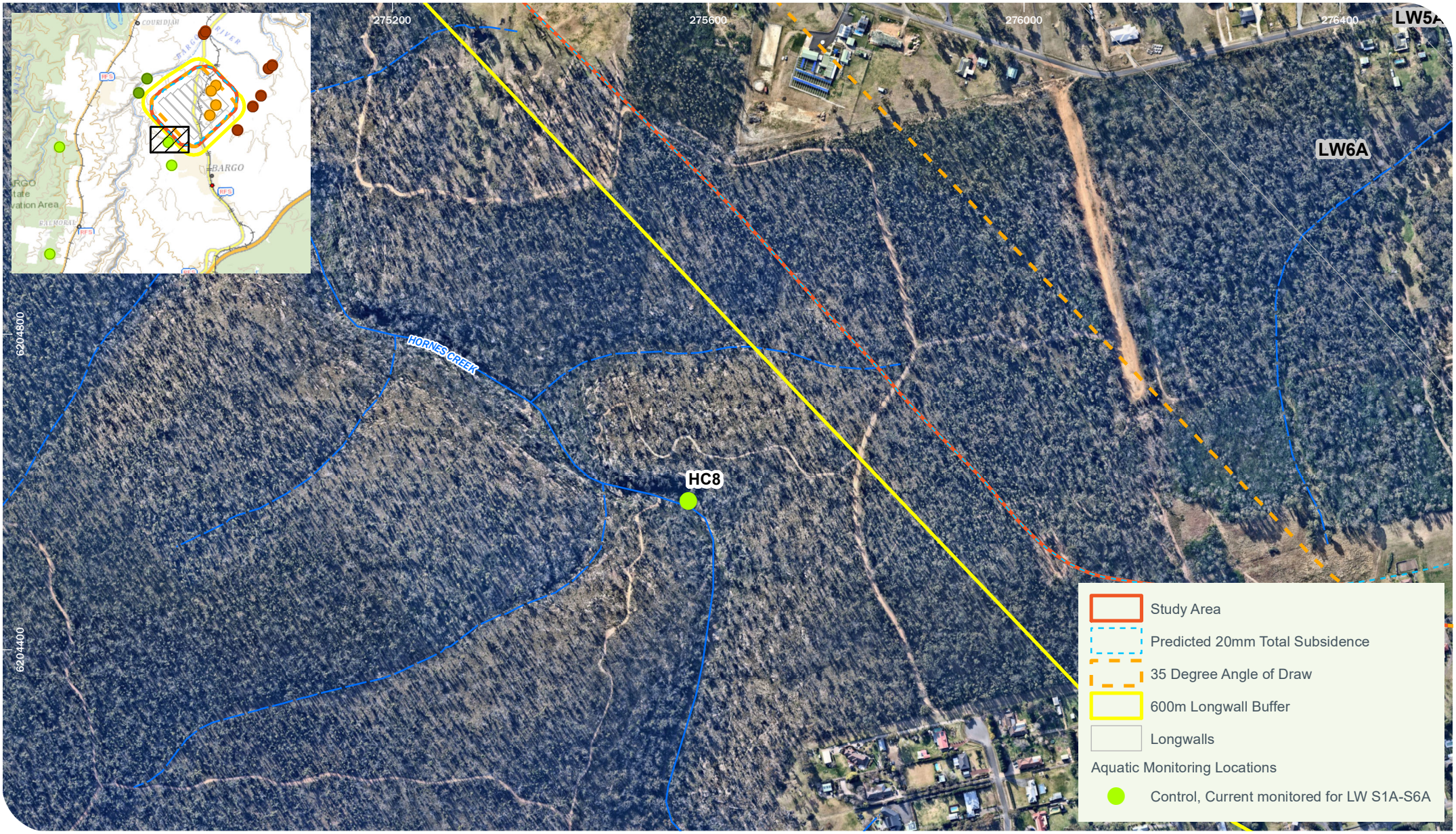

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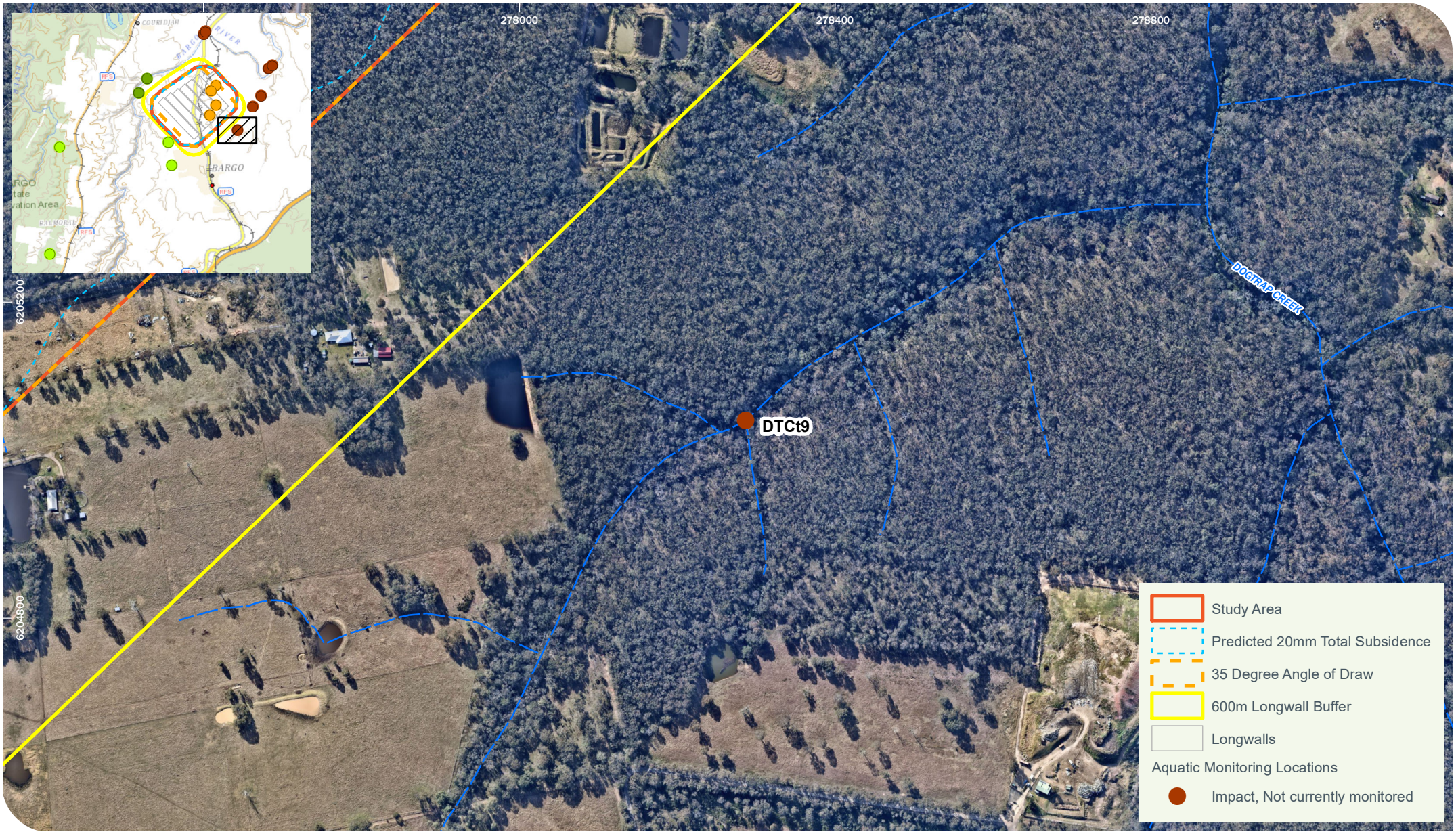

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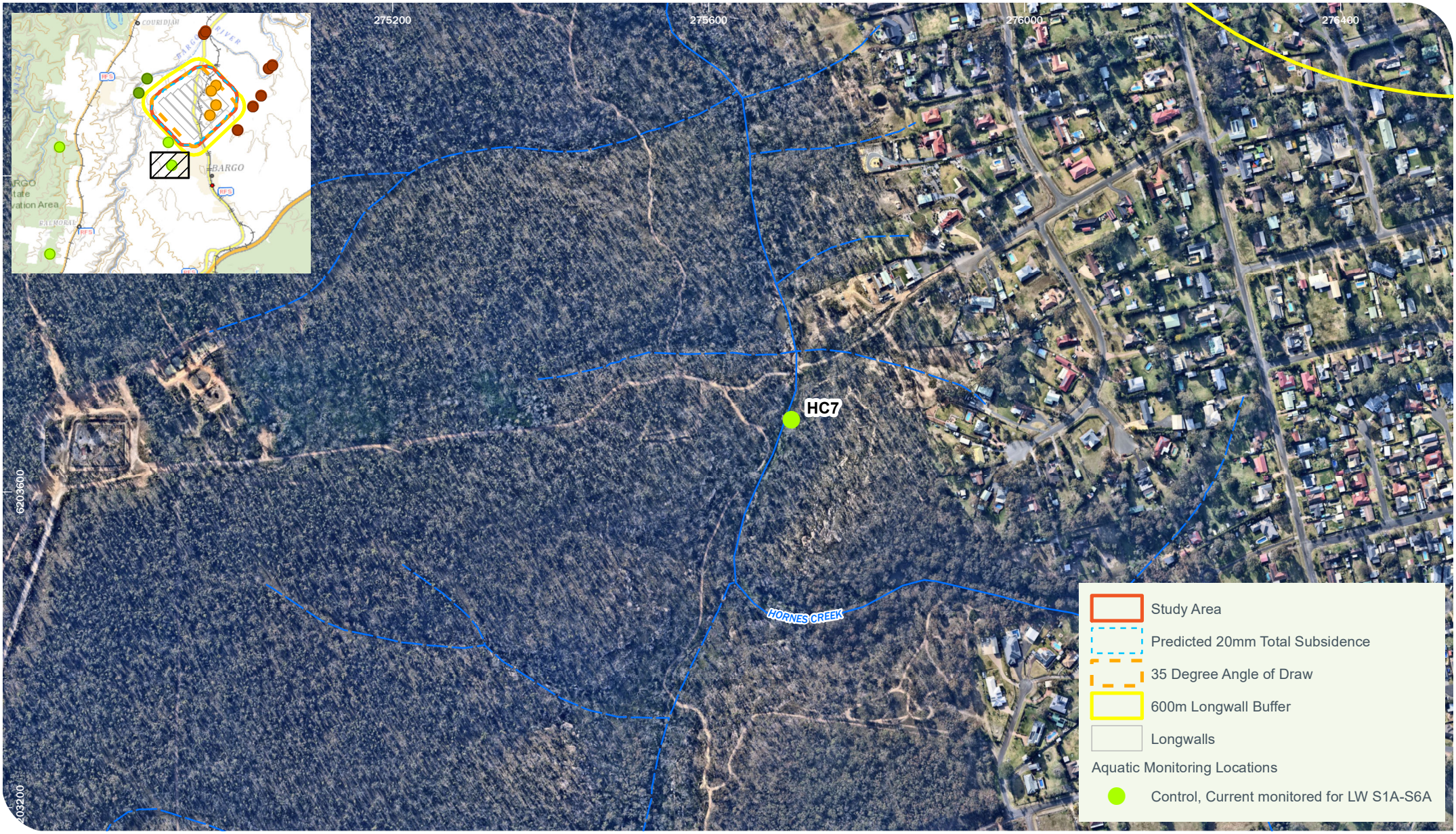

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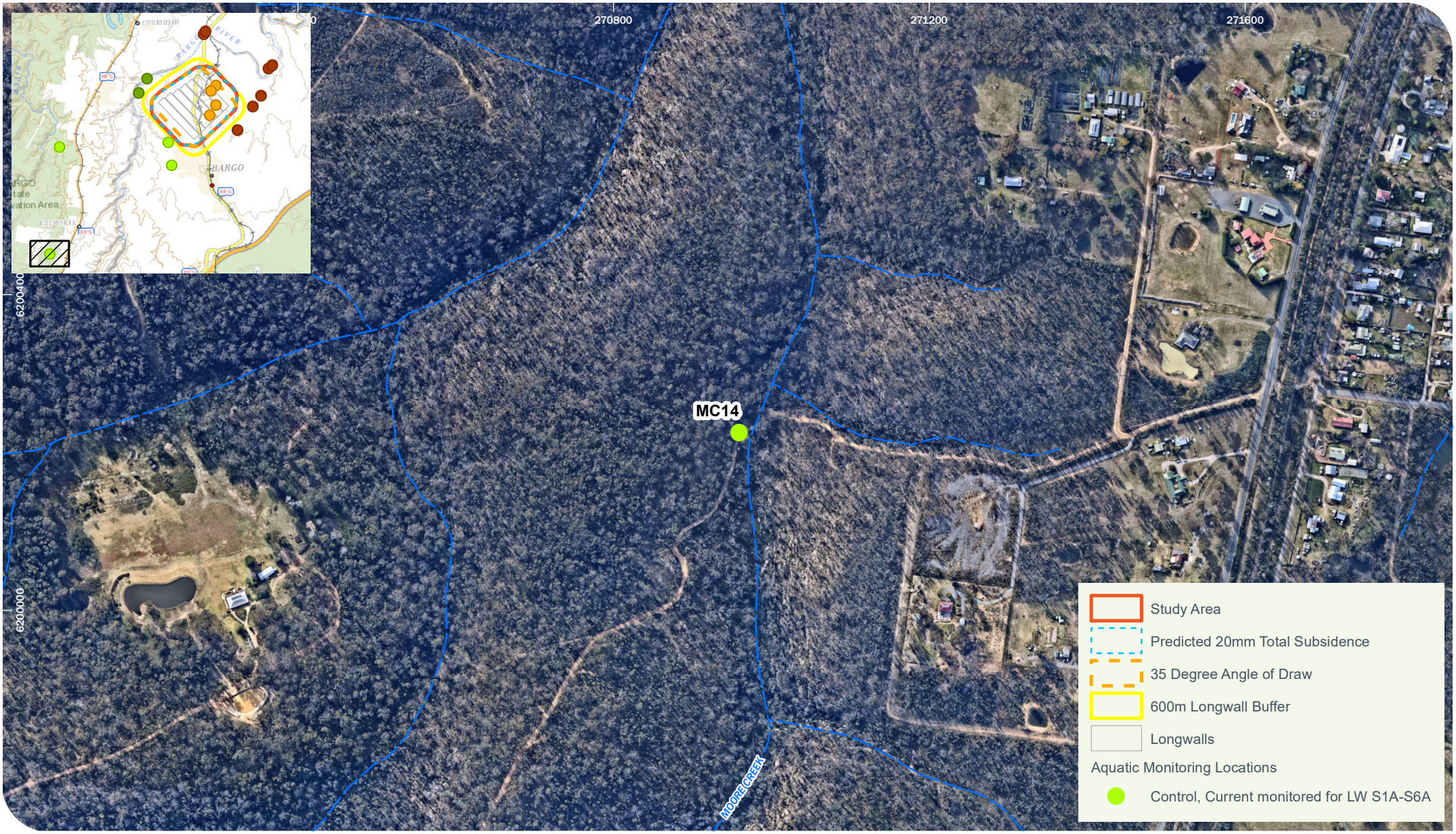

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Aquatic monitoring plan

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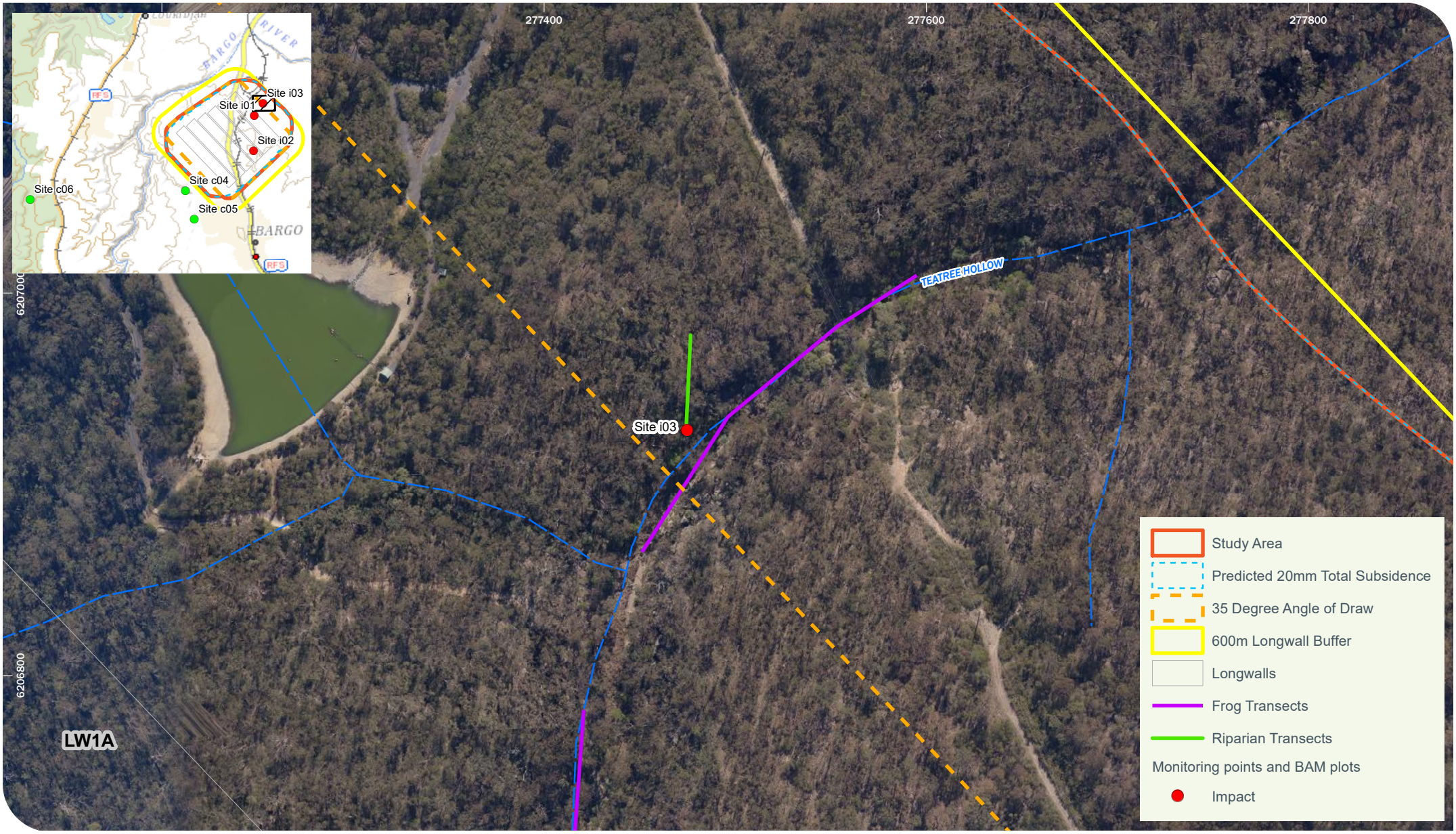
Appendix C – Detailed Riparian and Amphibian Monitoring Maps



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Riparian and amphibian monitoring plan
Tahmoor South Domain Longwalls South 1A - South 6A

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Niche Proj. #: 7027
Client: Tahmoor Coal Pty Ltd

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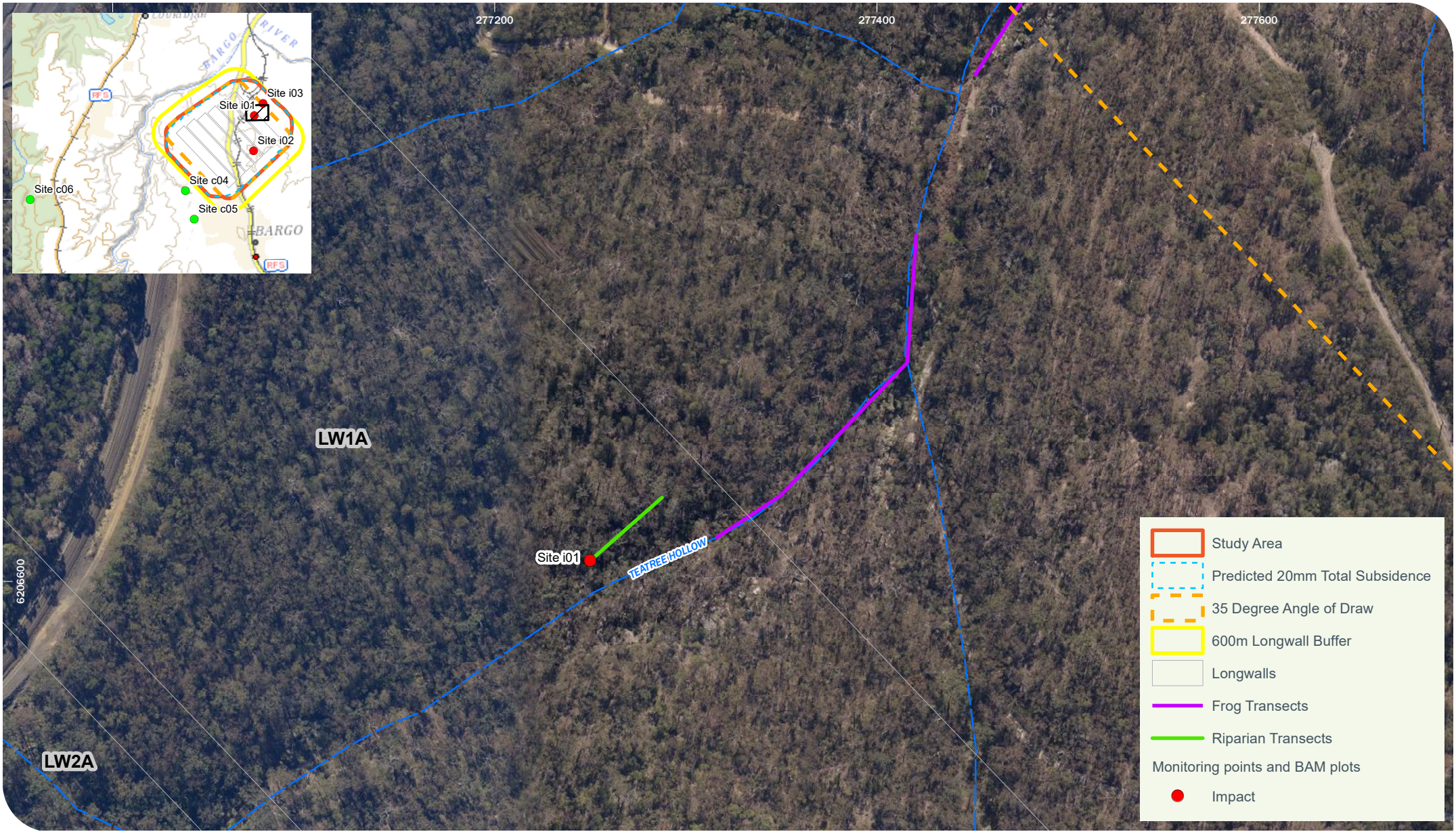

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Riparian and amphibian monitoring plan
Tahmoor South Domain Longwalls South 1A - South 6A

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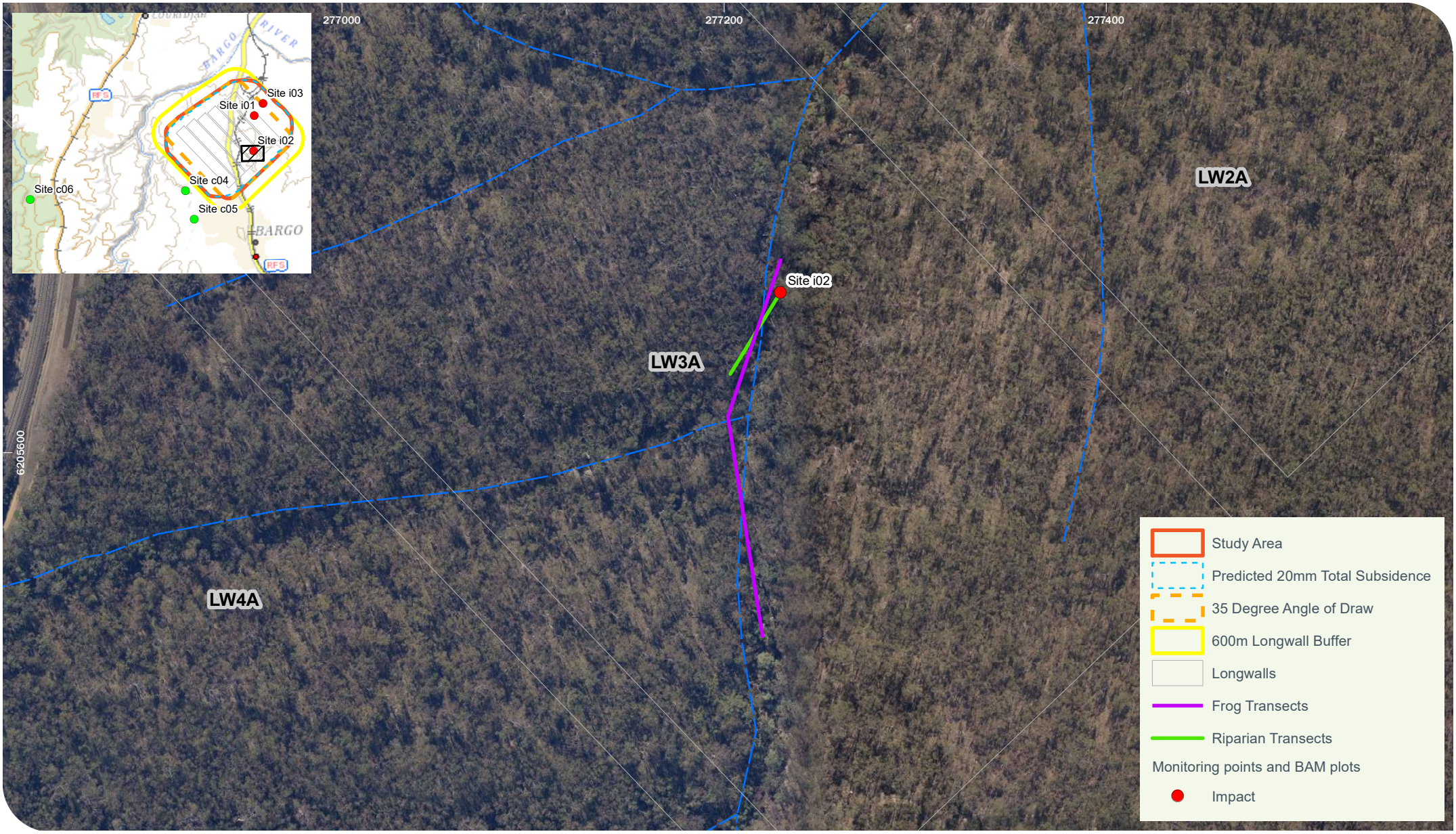

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Riparian and amphibian monitoring plan
Tahmoor South Domain Longwalls South 1A - South 6A

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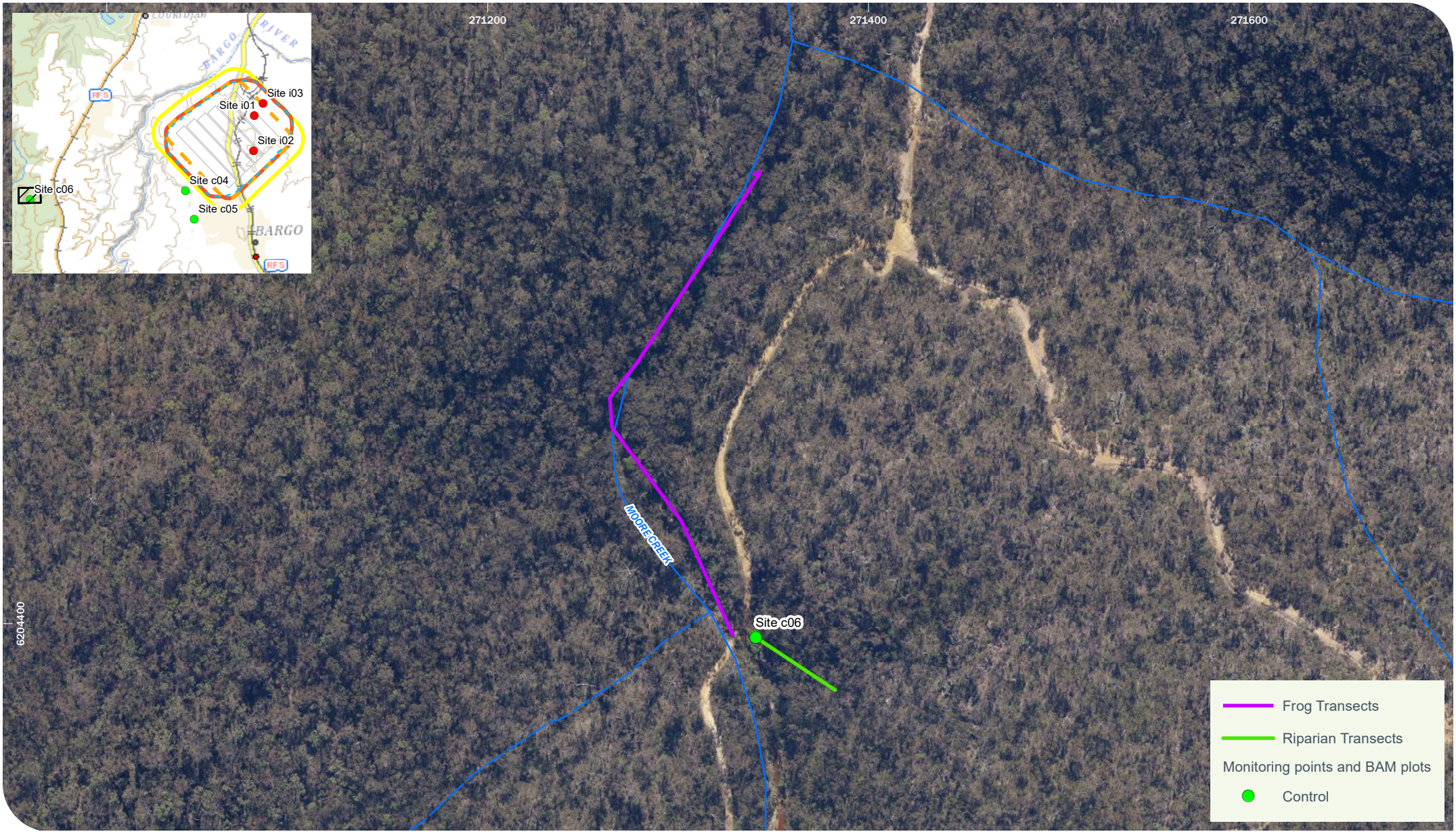

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Riparian and amphibian monitoring plan
Tahmoor South Domain Longwalls South 1A - South 6A

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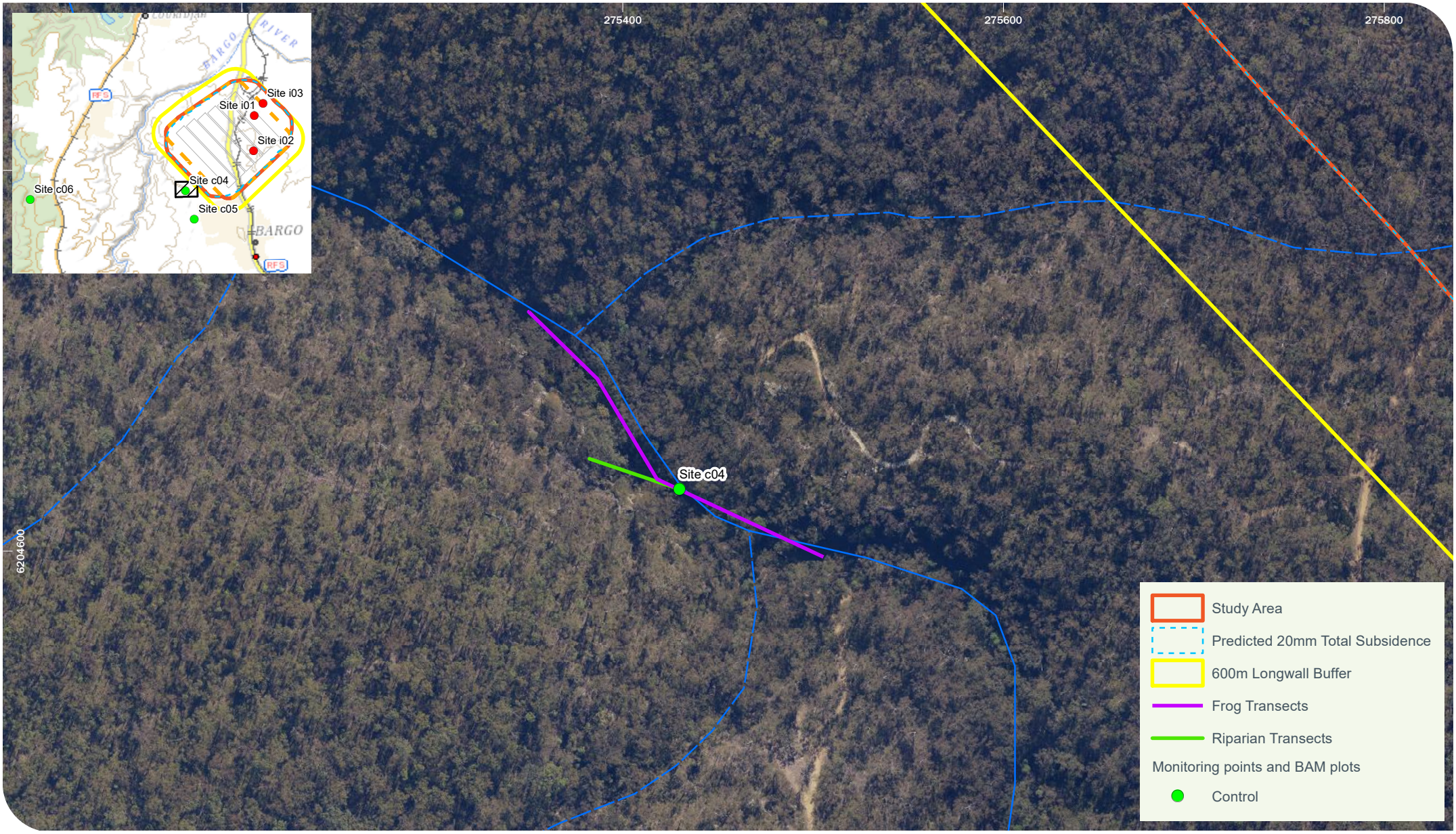

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Riparian and amphibian monitoring plan

Tahmoor South Domain Longwalls South 1A - South 6A

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Riparian and amphibian monitoring plan
Tahmoor South Domain Longwalls South 1A - South 6A

Niche PM: Jessie Bear
Niche Proj. #: 7027
Client: Tahmoor Coal Pty Ltd

Appendix C

Drawn by: Neil Berry Last updated: 9/12/2022 11:55:00 AM File: T:\spatial\projects\a7000\a7027_TahmoorSth_ExPlan_BMP\Maps\report\BMP7027_Appendix_C_RiparianMonitoring_LA4_page4.mxd