



GUJARAT NRE COKING COAL LIMITED
A.B.N. 28 111 244 896
NRE No 1 Colliery

NRE No.1 Colliery Wonga East – Longwalls 4 & 5 EP/SMP

LW5 BIODIVERSITYMANAGEMENT PLAN





Document Version	Revision				Revision Notes
	Date	Author	Checked	Release Date	
Rev 0	07/11/2012	NMG	MLC	09/11/2012	First Draft
Rev 1	20/11/2012	NMG	Dave Clarkson Kamlesh Prajapati	21/11/2012	Comments from NRE
Rev 2	21/12/2012	K.Prajapati	K.Prajapati	21/12/2012	Incorporated Minor Changes

TABLE OF CONTENTS

GLOSSARY OF TERMS AND ABBREVIATIONS.....	5
1 INTRODUCTION.....	6
1.1 Project Background.....	6
1.2 Purpose and Scope.....	7
1.3 Consultation.....	7
1.4 Distribution.....	10
1.5 Report Structure.....	10
2 STATUTORY REQUIREMENTS.....	13
2.1 Approval.....	13
2.2 Licences and Leases.....	16
2.3 Relevant Legislation and Guidelines.....	17
3 IMPACT ASSESSMENT.....	19
3.1 Baseline Data.....	19
3.2 Potential Impacts.....	29
4 PERFORMANCE MEASURES AND CRITERIA.....	36
5 MONITORING and REPORTING.....	38
5.1 Monitoring.....	38
5.2 Reporting.....	50
6 MITIGATION AND MANAGEMENT STRATEGIES.....	51
6.1 General.....	51
6.2 TARPS.....	52
6.3 Contingency Plan.....	53
7 INCIDENTS, COMPLAINTS AND NON-CONFORMANCES.....	54
7.1 Incidents and Ongoing Management Reporting.....	54
7.2 Complaints Handling.....	54
7.3 Non-Conformance Protocol.....	54
8 PLAN ADMINISTRATION.....	56
8.1 Roles and Responsibilities.....	56
8.2 Resources Required.....	56
8.3 Training.....	56
8.4 Record Keeping and Control.....	57
8.5 Plan Revision.....	57
9 References.....	59



LIST OF TABLES

Table 1.1 - Project Consultation.....	7
Table 1.2 - Initial Consultation Meeting with OEH, Issues Raised and Section of BMP Where These are Addressed.....	8
Table 2.1 - Biodiversity Management Plan Requirements.....	13
Table 3.1 - Upland Swamps located within the study area	22
Table 3.2 - Upland Swamps significance assessment (according to OEH 2012; sourced from Biosis 2012b).....	24
Table 3.3 - Threatened Flora with Potential Habitat in the Longwalls 4 & 5 study area	27
Table 3.4 - Threatened Flora with Potential Habitat within the Longwalls 4 &5 Study area	28
Table 3.5 - Threatened Species, Populations of Communities Considered at Risk from Subsidence Associated with Longwalls 4 & 5.....	30
Table 4.1 - Subsidence Impact Performance Measures for Biodiversity	36
Table 5.1 - Biodiversity Monitoring Program.....	41
Table 5.2 - SIGNAL 2 Scores and Stream Condition.....	49

LIST OF FIGURES

Figure 1 - Environmental Management Structure	12
Figure 2 - Vegetation Mapping of the Longwalls 4 & 5 Study Area	21
Figure 3 - Location of Upland Swamps in the Longwalls 4 & 5 Study Area.....	26
Figure 4 - Threatened Species Habitat in the Longwalls 4 & 5 Study Area	31
Figure 5 - Location of Upland Swamps within the Longwalls 4 & 5 Study Area in Relation to Predicted Vertical Movement	33
Figure 6 - Location of Upland Swamps within the Longwalls 4 & 5 Study Area in Relation to Predicted Tilt	34
Figure 7 - Location of Upland Swamps within the Longwalls 4 & 5 Study Area in Relation to Predicted Strain.....	35
Figure 8 - Management Process.....	37
Figure 9 - Terrestrial Monitoring Program Control Sites	44
Figure 10 - Terrestrial Monitoring Program Impact Sites	45
Figure 11 - Aquatic Monitoring Program Control and Impact Sites.....	47

APPENDICES

Appendix A – Trigger Action Response Plan Table	61
Appendix B – Terrestrial Monitoring Baseline Data	70
Appendix C – Aquatic Monitoring Baseline Data.....	82

GLOSSARY OF TERMS AND ABBREVIATIONS

Abbreviations	
BMP	Biodiversity Management Plan
DoP&I	Department of Planning & Infrastructure
DRE	NSW Department of Trade and Investment, Regional Infrastructure and Services, Division of Resources and Energy, Industry Co-ordination Unit
EEC	Endangered Ecological Community
EP	Extraction Plan
EPBC Act	Federal <i>Environmental Protection and Biodiversity Conservation Act, 1999</i>
Mtpa	Million tonnes per annum
NRE	Gujarat NRE Coking Coal Limited
OEH	Office of Environment and Heritage
ROM	Run of Mine
SCA	Sydney Catchment Authority
SMP	Subsidence Management Plan
Study Area	600m from the edge of secondary extraction (longwalls 4 and 5)
TSC Act	NSW <i>Threatened Species Conservation Act, 1995</i>

1 INTRODUCTION

1.1 Project Background

Gujarat NRE Coking Coal Ltd (NRE) operates the NRE No.1 Colliery in the Southern Coalfield of New South Wales (NSW). The mine is located at Russell Vale approximately 8 km north of Wollongong and 70 km south of Sydney, within the local government areas (LGAs) of Wollongong and Wollondilly in the Illawarra region of NSW.

On 13 October 2011, the Project Approval (MP 10_0046) for the No.1 Colliery Preliminary Works Project was granted by the Minister for Planning under Section 75(J) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This approval allows NRE to continue its operations at the mine including the extraction of coal up to 1 million tonnes per annum and upgrade of and improvements to surface facilities, in addition to first workings and transport of coal to the Port Kembla Coal Terminal for shipment as required.

NRE intends to expand its mining operations at No.1 Colliery and has submitted an application for a Underground Expansion Project (MP 09_0013) which is currently under assessment by the Department of Planning and Infrastructure (DoP&I). In order to ensure the ongoing viability of the mine while awaiting the necessary approvals, NRE lodged a concurrent Subsidence Management Plan (SMP) application for the extraction of Longwalls 4 and 5 to the Department of Trade and Investment, Division of Resources and Energy (referred to herein as DRE). The SMP approval for Longwall 4 was granted on 26 March 2012 by DRE, however, approval for Longwall 5 was not granted.

NRE lodged a section 75W (s75W) Modification Application to Project Approval (MP 10 0046), located within the approved Preliminary Works 'Application Area', to modify the Preliminary Works Approval (MP 10_0046) to include:

- Amending the reference to the use of maingates (MGs) 4 and 5 from exploratory driveages to operational gateroads;
- The extraction of coal using longwall mining techniques from Longwall (LW) 4 in accordance with the approved SMP;
- The extraction of coal using longwall mining techniques from Longwall (LW) 5; and
- Development of maingates (MGs) 6, 7 and 8.

The proposed longwalls are wholly contained within the Sydney Catchment Authority (SCA) controlled Metropolitan Catchment Area, which is used to provide drinking water to Sydney and Wollongong. The longwalls lie outside the Dam Safety Committee (DSC) Notification Area for Cataract reservoir, with the reservoir high water mark located approximately 600 m northwest of Longwall 5.

The proposed modification works underlie an area of largely undisturbed native bushland characteristic of the Woronora Plateau. The vegetation includes Warm Temperate Rainforest vegetation along Cataract Creek in the north, grading into Moist Blue Gum-Blackbutt Forest with Tall Open Blackbutt Forest and Exposed Sandstone Scribbly Gum Woodland dominating the area above

the longwall panels. A number of Upland Swamps are located within the study area. Cataract Creek forms a fourth order stream downstream of Mount Ousley Rd.

This Biodiversity Management Plan (BMP) has been prepared in support of an Extraction Plan, as required by **Condition 7/Schedule 3** of Project Approval (MP 10_0046). This BMP builds on the LW4 BMP prepared in support of the SMP application for extraction of LW4.

1.2 Purpose and Scope

Condition 7/ Schedule 3 of the Project Approval requires the preparation of a BMP as a component of an Extraction Plan for second workings. The purpose and scope of this BMP is to:

- Outline statutory requirements, including any performance measures to be achieved;
- Summarise environmental impact assessments undertaken to date and provide baseline data;
- Describe measures that will be implemented to ensure compliance with any statutory requirements or performance measures;
- Outline a biodiversity monitoring program to assess the environmental impacts of the project and assess effectiveness of any management measures;
- Develop specific performance indicators to ensure the project meets specific performance measures;
- Develop Contingency plans to manage any impacts that exceed performance measures; and
- Outline reporting structures.

1.3 Consultation

In accordance with **Condition 29/Schedule 3** of MP10_0046 this BMP has been prepared in consultation with the NSW Office of Environment and Heritage (OEH) and Department of Resources and Energy (DRE). Additional agencies, including the Sydney Catchment Authority (SCA) and Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), have been consulted. The details of consultation are provided below in **Table 1.1**.

Table 1.1 - Project Consultation

Agency	Consultation
Office of Environment and Heritage	Provision of LW4 BMP and receipt of comments, 6 April 2012 (via DRE) Meeting, 26 April 2012 Meeting, 12 September 2012 Meeting, 24 October 2012
Department of Resources and Energy	Provision of LW4 BMP and receipt of comments, 6 April 2012 (via DRE)
Sydney Catchment Authority	Provision of LW4 BMP and receipt of comments, 6 April 2012 (via DRE)
Department of Sustainability, Environment, Water,	Discussions on 16 March regarding status of



Population and Communities	Woronora swamps and inclusion in the Temperate Highland Peat Swamps on Sandstone listed community
----------------------------	---

A copy of the LW4 BMP, prepared in support of the LW4 SMP application, was provided to DRE, OEH and SCA for comment, and comments were received on 6 April 2012. This review provided feedback on the BMP and raised a number of matters that NRE were required to resolve. A response was provided to DRE on the 12 April 2012. A subsequent meeting was held with OEH on the 26 April 2012. At this meeting OEH raised a number of additional items that NRE were requested to address. Two additional meetings were held with OEH on the 12 September and 24 October 2012. The purpose of these meetings was to discuss potential changes to the monitoring programs and discuss the detailed upland swamp impact assessment methodology, respectively.

The items raised in the review and subsequent meetings, and NRE’s response to the item raised and / or the section of this BMP where these have been addressed, are outlined in **Table 1.2**.

Table 1.2 - Initial Consultation Meeting with OEH, Issues Raised and Section of BMP Where These are Addressed

Issue Raised	Response and / or Section of BMP
Potential for presence of Temperate Highland Peat Swamps on Sandstone (THPSS) within the SMP area. Need for referral to DSEWPaC.	Upland swamps within the study area are not representative of the THPSS community, as per advice from DSEWPaC and interpretation of the listing advice for the community. Not further addressed within the BMP.
The BMP does not provide a summary of baseline data collected to date.	Detailed baseline data was incorporated into the BMP. This data is provided in Appendix B .
Lack of baseline data available. Minimum requirements for two years baseline data not available.	Baseline data for one upland swamp (CRUS1) was collected for three seasons (1.5 years). Following discussions with OEH, the monitoring program was modified. Detailed quantitative, multi-variate monitoring was commenced at an additional four upland swamps (CCUS1, CCUS3/23, CCUS4 and CRUS3), and photopoint monitoring at an additional three upland swamps (CCUS2, CRUS2 and CRUS3) in Autumn 2012. Detailed mapping of potential breeding habitat for threatened frog species was undertaken in autumn 2012, with detailed monitoring of suitable breeding habitat commenced in winter 2012. Two years baseline data was not available due to changes in monitoring programs following discussions with OEH in April 2012. Monitoring programs have been set up to detect long term changes in vegetation structure and / or composition resulting from potential impacts, as well as impacts to suitable breeding habitat for threatened frog species. Impacts to the biodiversity values



	<p>present in upland swamps are likely to occur over long periods of time and be gradual in nature. Through the use of robust statistical techniques changes in structure and / or composition are likely to be detected through the current monitoring programs.</p> <p>The monitoring program is outlined in Section 5.1.1.</p>
<p>Changes to the monitoring programs were discussed, including:</p> <ul style="list-style-type: none"> • Monitoring of upland swamps located above longwalls to be extracted should be undertaken, particularly those of 'special significance' status; • Inclusion of visual monitoring and photographic recording; • Changes to the requirements for ridgeline monitoring; • Removal of flora monitoring along creeks; and, • Revision of monitoring of frogs, with increased focus on threatened species. 	<p>The monitoring programs have modified to incorporate comments from OEH.</p> <p>Detailed monitoring of CCUS1, CCUS3/23, CCUS4 and CRUS3 is now included in the monitoring program. Visual / photopoint monitoring of CCUS2, CRUS2 and CRUS3 is also now included. Monitoring of suitable breeding habitat for threatened frog species, including Littlejohn's Tree Frog, Giant Burrowing Frog and Stuttering Frog, is also undertaken.</p> <p>Monitoring of ridgelines has been modified following discussions with OEH. It was deemed that monitoring of ridgelines was unlikely to provide sufficient data to allow suitable pre- and post-mining comparisons to be made. Monitoring will now focus on detecting presence / absence of Red-crowned Toadlets near ridgelines.</p> <p>Due to lack of impacts to flora along creeks since the inception of monitoring it was deemed that monitoring of creeks should cease, with additional effort to be put into other areas of the monitoring programs, particularly upland swamps. Thus monitoring of creeks is not included in this BMP.</p> <p>Monitoring of frog populations in longwall mining domains has indicated that past monitoring, using 50 m transects in creeks, does not adequately assess impacts to frog populations. In consultation with OEH, the suggestion was made to alter the frog monitoring program to focus on suitable breeding habitat for threatened (and other) frog species. This alteration would allow the quantification of impacts to frog populations if impacts to breeding habitat, such as fracturing and draining of breeding pools, were to occur.</p> <p>The monitoring program is outlined in Section 5.1.1.</p>
<p>Remediation measures not suitably outlined. Difficulty with implementation of remediation measures for upland swamps.</p>	<p>Given the lack of success for implementation of remediation measures for upland swamps to date, it is considered that, if impacts to the biodiversity features present above LW 4 and 5 do occur, any impacts will</p>



	need to be offset. Mitigation and management measures are outlined in Section 6 and a Trigger Action Response Plan (TARP) is presented in Appendix A .
--	---

On 16 March 2012 advice was sought from DSEWPaC regarding the status of Woronora swamps in the study area as part of the Temperate Highland Peat Swamps on Sandstone threatened ecological community. DSEWPaC advised that there was a great degree of uncertainty regarding the swamps on the Woronora plateau west of Wollongong and that certain areas of the Wornora plateau had been missed during the original determination. DSEWPaC were looking to review the listing to align it with the recently determined Coastal Upland Swamp EEC determination under the TSC Act. We understand that this review is imminent.

Additional consultation will be undertaken as required.

1.4 Distribution

Copies of this BMP will be distributed to:

- Department of Planning and Infrastructure (DoP&I);
- Division of Resources and Energy (DRE);
- The Office of Environment and Heritage (OEH); and
- Sydney Catchment Authority (SCA).

NRE will make this Plan publicly available on the NRE website and will be responsible for its maintenance. A hard copy will also be kept at the NRE No.1 Colliery, Bellambi Lane, Russell Vale.

Any revisions undertaken will be the responsibility of NRE and any notifications sent to relevant consent authorities and stakeholders accordingly. NRE will not be responsible for maintaining uncontrolled copies beyond ensuring the most recent version is maintained on NRE's computer system, website, and hard copy at the NRE No.1 Colliery, Bellambi Lane, Russell Vale.

1.5 Report Structure

The remainder of this BMP is structured as follows:

Section 2: Outlines the statutory requirements applicable to the Plan.

Section 3: Outlines the baseline data and impact assessments undertaken which support this Plan.

Section 4: Details the performance measures and indicators that will be used to assess the Project.

Section 5: Describes the monitoring program.



Section 6: Describes the management, remediation and mitigation measures that will be implemented to reduce potential impacts as well as the Contingency Plan to manage any unpredicted impacts and their consequences.

Section 7: Describes the protocols for the handling of incidents, complaints and non-conformances.

Section 8: Details how the Plan will be implemented, managed, reviewed and updated and managed.

Figure 1 shows this Plan's position within the NRE Environmental Management Structure.

Environmental Management Structure

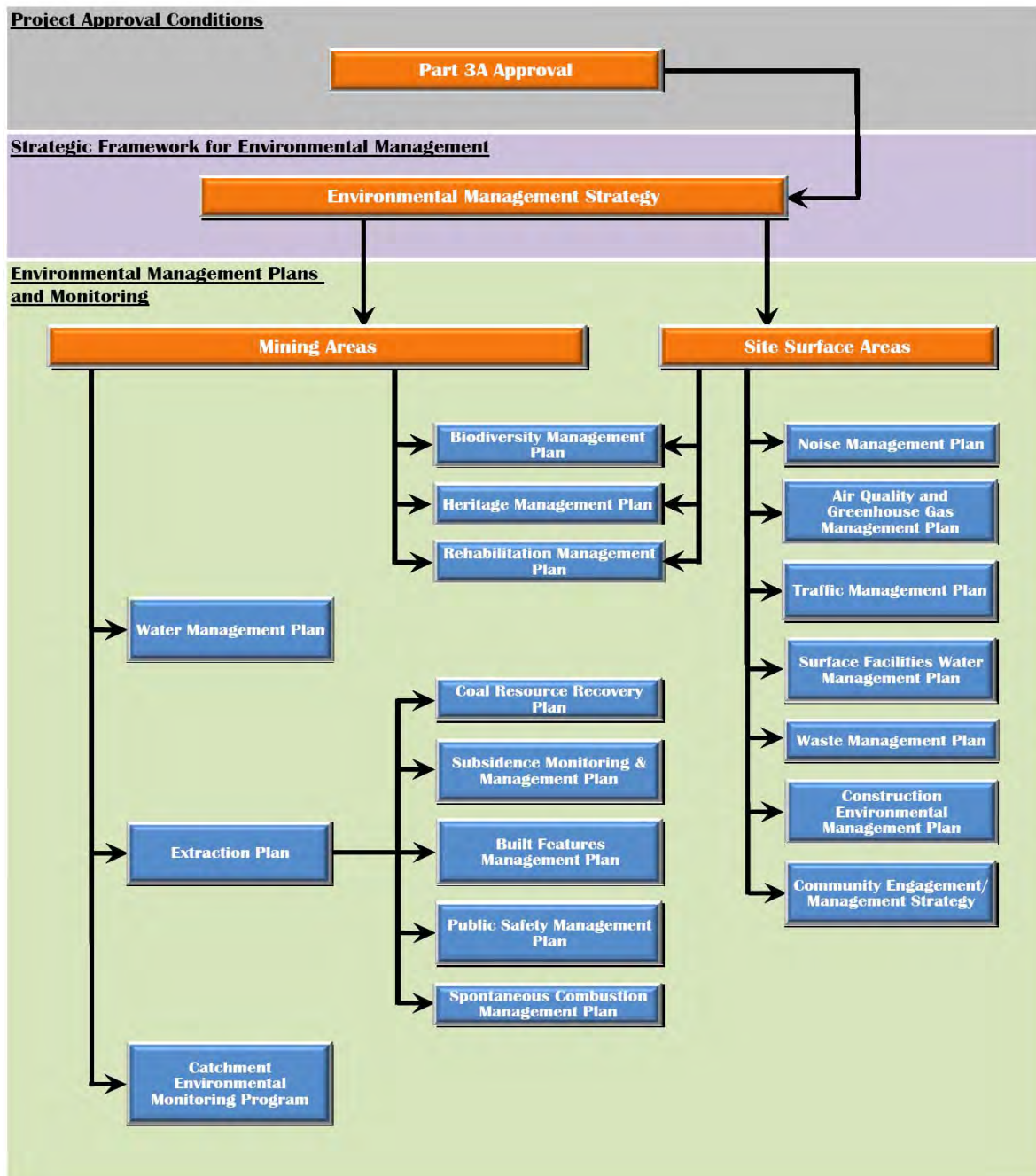


Figure 1 - Environmental Management Structure

2 STATUTORY REQUIREMENTS

2.1 Approval

Condition 7/ Schedule 3 of the Project Approval requires the preparation of a BMP as a component of an Extraction Plan for second workings. Approval condition 7(h1) states:

Extraction Plan

7. The Proponent shall prepare and implement an Extraction Plan for all second workings on site to the satisfaction of the Director-General. This plan must:

...

(h1) include appropriate references to:

- water resources, biodiversity values and heritage values managed under the Water Management, Biodiversity and Heritage Management Plans required under Conditions 29,35 and 38 of Schedule 3 and;
- programs, procedures, management measures and the like required under those plans;

Condition 29/ Schedule 3 of Project Approval outlines the requirements that are applicable to the preparation and performance of this BMP. **Table 2.1** indicates where each component of the condition is addressed within this Plan.

Table 2.1 - Biodiversity Management Plan Requirements

Project Approval Condition	Plan Section
<p>Condition 29/ Schedule 3 The Proponent shall prepare and implement a Biodiversity Management Plan for the project to the satisfaction of the Director-General. This Plan must:</p> <p>(a) be prepared by a suitably qualified expert in consultation with OEH;</p> <p>(b) be submitted for approval to the Director-General within 6 months of this approval;</p> <p>(c) include:</p> <ul style="list-style-type: none"> • management measures; • monitoring procedures; • performance indicators; and • reporting frameworks, <p>with particular reference to the Green and Golden Bell Frog, the Red-crowned Toadlet, Giant Burrowing Frog, Littlejohn’s Tree Frog and Giant Dragonfly; and</p> <p>(d) demonstrate achievement of the relevant performance measures in Table 1</p>	<p>Section 1.3 N/A</p> <p>Section 4,5,6 and 7</p> <p>Section 4</p>

In addition, **Condition 1/Schedule 3** and **Condition 2 to 4** and **6 to 9** of **/Schedule 5** of the Project Approval outlines the requirements that are applicable to the preparation and performance of this



Management Plan. **Table 2.2** indicates where each component of the condition is addressed within this Plan.

Table 2.2 - Management Plan Requirements

Project Approval Condition	Plan Section
<p>Condition 1/Schedule 3 The proponent shall ensure that the project does not cause any exceedance of the performance measures in Table 1, to the satisfaction of the Director General</p>	Section 4
<p>Condition 2/Schedule 5 The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:</p> <p>(a) detailed baseline data;</p> <p>(b) a description of:</p> <ul style="list-style-type: none"> • the relevant statutory requirements (including any relevant approval, licence or lease conditions); • any relevant limits or performance measures/criteria; • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures; <p>(c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;</p> <p>(d) a program to monitor and report on the:</p> <ul style="list-style-type: none"> • impacts and environmental performance of the project; • effectiveness of any management measures (see c above); <p>(e) 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;</p> <p>(f) a program to investigate and implement ways to improve the environmental performance of the project over time;</p> <p>(g) a protocol for managing and reporting any:</p> <ul style="list-style-type: none"> • incidents; • complaints; • non-compliances with statutory requirements; and • exceedances of the impact assessment criteria and/or performance criteria; and <p>(h) a protocol for periodic review of the plan.</p>	<p>Section 3</p> <p>Section 2</p> <p>Section 4</p> <p>Section 4</p> <p>Section 6</p> <p>Section 5</p> <p>Section 6.3</p> <p>Sections 8</p> <p>Section 7</p> <p>Section 8</p>
<p>Condition 3/Schedule 5 By the end of August 2012, and annually thereafter, the Proponent shall review the environmental performance of the project to the satisfaction of the Director-General. This review must:</p> <p>(a) describe the development (including any rehabilitation) that was</p>	Section 8.5.1



Project Approval Condition	Plan Section
<p>carried out in the past calendar year, and the development that is proposed to be carried out over the next year;</p> <p>(b) include a comprehensive review of the monitoring results and complaints records of the project over the past calendar year, which includes a comparison of these results against the:</p> <ul style="list-style-type: none"> • the relevant statutory requirements, limits or performance measures/criteria; • the monitoring results of the previous years; and, • the relevant predictions in the EA. <p>(c) Identify any non-compliance over the past year, and describe what actions were (or are being) taken to ensure compliance;</p> <p>(d) Identify any trends in the monitoring data over the life of the project;</p> <p>(e) Identify any discrepancies between the predicted and actual impacts of the project, and analyse the potential cause of any significant discrepancies; and,</p> <p>Describe what measures will be implemented over the next year to improve the environmental performance of the project.</p>	
<p>Condition 4/Schedule 5</p> <p>Within 3 months of:</p> <p>(a) The submission of an annual review under Condition 3 above;</p> <p>(b) The submission of an incident report under Condition 6 below;</p> <p>(c) The submission of an audit under Condition 8 below; and,</p> <p>Any modification to the conditions of this approval (unless the conditions require otherwise), the Proponent shall review, and if necessary revise, the strategies, plans, and programs required under this approval to the satisfaction of the Director-general.</p>	Section 8.5.3
<p>Condition 6/Schedule 5</p> <p>The proponent shall notify the director-General and any other relevant agencies of any incident that has caused, or has the potential to cause, significant risk of material harm to the environment, at the earliest opportunity. For any other incident associated with the project, the Proponent shall notify the director-General and any other relevant agencies as soon as practicable after the Proponent becomes aware of the incident. Within 7 days of the date of the incident, the Proponent shall provide the Director-general and any relevant agencies with a detailed report on the incident, and such further reports as may be requested.</p>	Section 7
<p>Condition 7/Schedule 5</p> <p>The Proponent shall provide regular reporting on the environmental performance of the project on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this approval, and to the satisfaction of the Director-General.</p>	Section 5.2
<p>Condition 8/Schedule 5</p> <p>Within 12 months of this approval, and every 3 years thereafter, unless the Director-General directs otherwise, the Proponent shall commission and pay the full cost of an Independent Environmental Audit of the</p>	Section 8.5.2

Project Approval Condition	Plan Section
<p>project. This audit must:</p> <ul style="list-style-type: none"> (a) Be conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Director-general; (b) Include consultation with the relevant agencies; (c) Assess the environmental performance of the project and assess whether it is complying with the requirements in this approval and any relevant EPL or Mining Lease (including any assessment, plan or program required under these approvals); (d) Review the adequacy of strategies, plans or programs required under the abovementioned approvals; and, <p>Recommend appropriate measures or actions to improve the environmental performance of the project, and/or any assessment, plan or program required under the abovementioned approvals.</p>	
<p>Condition 9/Schedule 5</p> <p>Within 6 weeks of the completion of this audit, or as otherwise agreed by the director-general, the proponent shall submit a copy of the audit report to the Director-General, together with its response to any recommendations contained in the Audit Report.</p>	Section 8.5.2

2.2 Licences and Leases

In addition to the requirements of the Project Approval, all activities at or in association with the NRE No.1 Colliery will be undertaken in accordance with the following licences, permits and leases which have been issued or are pending.

Table 2.3 - Licences, Permits and Leases

Licence/Approval	Document No.	Issue Date/Expiry Date
Consolidated Coal Lease Renewal	745	27/12/1990 – 30/12/2023
Mining Purposes Lease	271	09/05/1991 – 09/05/2033
Mining Lease	1575	22/3/2012 – 22/3/2029
Pillar Extraction Approval T&W Mains	C90/0146(G) C91/0146(H) C01/009	31/10/2001 23/01/2002 28/06/2001
Approval to mine P&O Panels (first workings)	10.123.081	7/01/2005
DC for Thin Seam Mining P/L	D1096/01	19/09/2001
EPA Licence	12040	Current
EPA Approval for Storm Water Control Dam	90/6041 (280.021C/21)	10/08/1992
DC for Storm Water Control Dam and Water Treatment	D91/551	17/06/1992

Dangerous Goods Licence	NDG021269	14/11/2012 - 01/11/2013
SPCC Approval for Stage 3	90/4711 (280021C/20)	04/09/1992
DC for Russell Vale Waste Emplacement	D89/839	11/04/1990
DC for Demolition of Washery	D2004/32	14/12/2004
Mining operations Plan (MOP)		01/01/2008 – 31/12/2017
Preliminary Works Major Project	MP10_0046	13/10/2011 – 13/10/2014
Complying Development Certificate – Bath House	1091/11	07/11/2011
SMP Approval – Longwall 4	11/3941	26/03/2012 – 31/03/2015
Water Extraction Licence	To be determined	Submitted to NoW in January 2009
EPBC Act approval	EPBC 2011/5891	12/01/2012

2.3 Relevant Legislation and Guidelines

NRE will conduct the Project consistent with the Project Approval conditions and any other legislation that is applicable. The following Acts may be applicable to the conduct of the Project:

- *Mining Act 1992*
- *Contaminated Land Management Act 1997*
- *Dangerous Goods Act 1975*
- *Mining Act 1992*
- *Noxious Weeds Act 1993*
- *Road and Rail Transport (Dangerous Goods) Act 1997*
- *Roads Act 1993*
- *Protection of the Environment Operations Act 1997*
- *Threatened Species Conservation Act 1995*
- *Sydney Water Catchment Management Act 1998*
- *Coal Mine Health and Safety Act 2002*
- *Crown Lands Act 1989*
- *Dams Safety Act 1978*
- *Energy and Utilities Administration Act 1987*
- *Fisheries Management Act 1994*
- *Water Act 1912*
- *Water Management Act 2000.*
- *Work Health and Safety Act 2011*
- *Environment Protection and Biodiversity Conservation Act 1999*



Relevant licences or approvals required under these Acts will be obtained as required.

3 IMPACT ASSESSMENT

3.1 Baseline Data

A number of environmental assessments have been undertaken of the Wonga East and West domains as a part of NRE's major expansion and Longwall 4 and 5 applications. A list of assessments used to inform this BMP are outlined below.

- ERM (2011a). *NRE No. 1 Colliery Terrestrial Flora and Fauna Assessment.*
- Cardno Ecology Lab (2010). *Aquatic Ecology Monitoring for Gujarat No. 1 Mine.*
- EcoLogical (2009). *Wonga East and Wonga West Threatened Fauna Habitat Assessment.*
- Biosis Research (2009). *NRE Gujarat Targeted Herpetological Surveys.*
- ERM (2012). *NRE No. 1 Colliery Proposed Wongawilli Seam Longwalls 4 & 5: Ecological Assessment.*
- Biosis (2012a). *Threatened Frog Habitat Mapping.*
- Biosis (2012b). *NRE No. 1 Colliery Major Expansion. Upland Swamp Assessment.*

A full and comprehensive assessment of the biodiversity values present in the study area can be found in these reports. Relevant information is summarised below.

3.1.1 Vegetation Mapping

Eleven native vegetation communities are mapped within the study area by NPWS (2003) shown in **Figure 2**.

These are:

- Escarpment Edge Silvertop Ash Forest;
- Tall Open Peppermint-Blue Gum Forest
- Exposed Sandstone Scribbly Gum Woodland;
- Coachwood Warm Temperate Rainforest;
- Moist Blue Gum – Blackbutt Forest;
- Tall Open Blackbutt Forest;
- Sandstone Gully Peppermint Forest;
- Rock Plate Heath-Mallee;
- Upland Swamps: Fringing Eucalypt Vegetation;
- Upland Swamps: Banksia Thicket; and
- Upland Swamps: Sedgeland-Heath Complex.

Three non-native vegetation communities (Regenerating Vegetation, Cleared and Weeds and Exotics) are mapped by NPWS (2003).

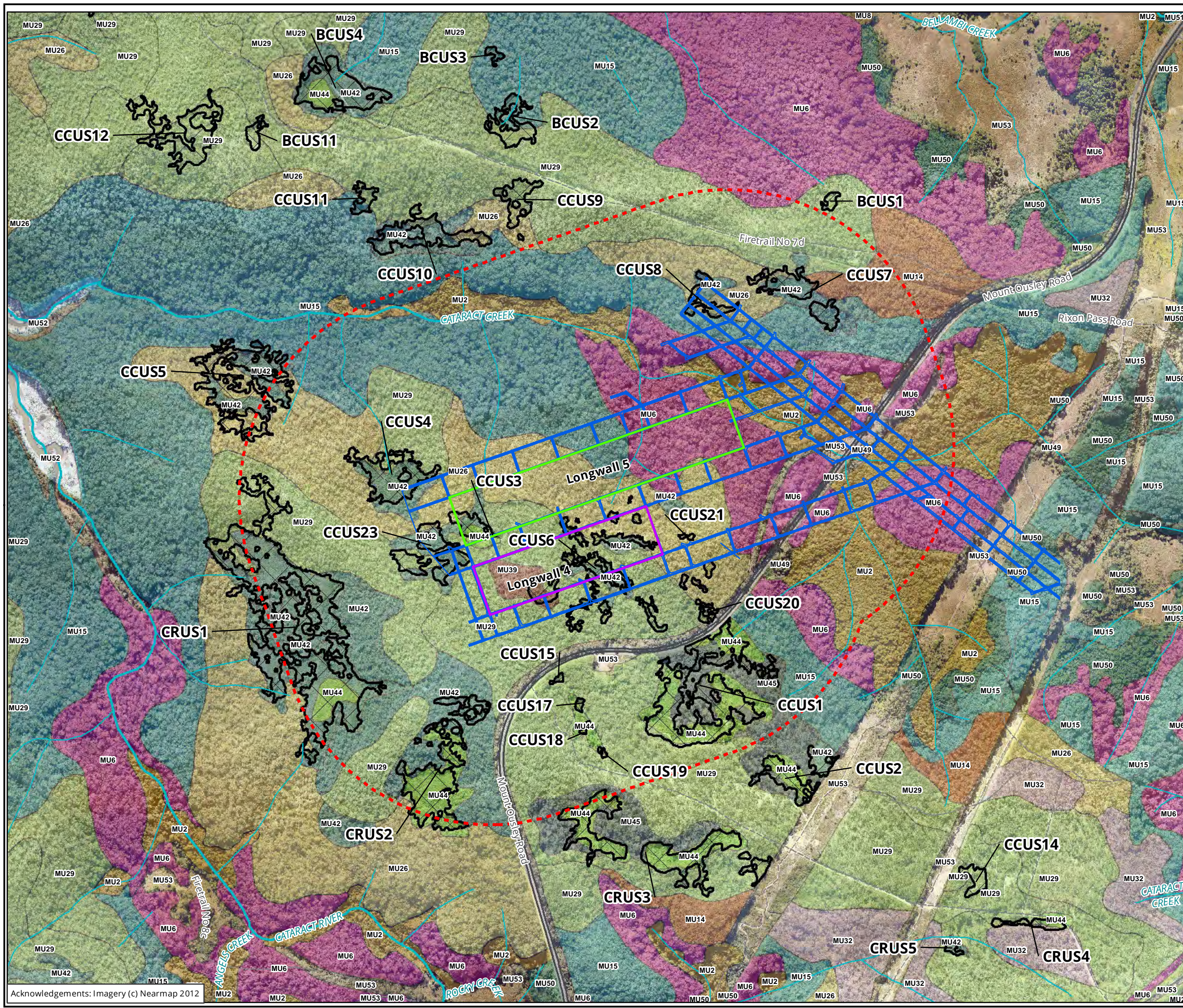


One additional native vegetation community (Upland Swamps: Tea-tree Thicket (MU43)) was mapped within the study area by ERM (2012) and Biosis (2012b).

3.1.2 Threatened Ecological Communities

Three of the vegetation communities mapped within the study area by NPWS (2003), ERM (2011a, b, 2012) and Biosis (2012b) form part of a threatened ecological community (TEC). Upland Swamps: Banksia Thicket (MU42), Upland Swamps: Tea-tree Thicket (MU43) and Upland Swamps: Sedgeland-Heath Complex (MU44) form part of the Coastal Upland Swamp in the Sydney Basin bioregion Endangered Ecological Community (EEC) which is listed under the TSC Act.

Detailed mapping by Biosis (2012b) maps 17 Upland Swamps within the Longwalls 4 & 5 study area. The location of these Upland Swamp communities in relation to Longwalls 4 & 5 is shown in **Figure 2** and **Figure 3**. Further detail is provided in **Section 3.1.3** below.



Legend

Vegetation Communities (NPWS 2003)

- MU2, Coachwood Warm Temperate Rainforest
- MU6, Moist Blue Gum-Blackbutt Forest
- MU8, Moist Gully Gum Forest
- MU14, Tall Open Peppermint-Blue Gum Forest
- MU15, Tall Open Blackbutt Forest
- MU23, Transitional Shale Stringybark Forest
- MU26, Sandstone Gully Peppermint Forest
- MU29, Exposed Sandstone Scribbly Gum Woodland
- MU32, Escarpment Edge Silvertop Ash Forest
- MU39, Rock Plate Heath-Mallee
- MU42, Upland Swamps: Banksia Thicket
- MU44, Upland Swamps: Sedgeland-Heath Complex
- MU45, Upland Swamps: Fringing Eucalypt Woodland
- MU50, Regenerating Vegetation
- Upland Swamps (Biosis 2012)

Survey Area

- Study Area
- Longwall 4
- Longwall 5
- Longwall Layout

Figure 1: Vegetation Mapping of the Longwalls 4 & 5 Study Area

0 100 200 300 400 500
Metres
Scale: 1:10,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Acknowledgements: Imagery (c) Nearmap 2012

Mapper: 15550
Date: 09 November 2012
Checked by: NMG, Drawn by: opritchard
Location: P:\15500s\15550\Mapping\Report Figures\15550.F1_Vegetation

3.1.3 Coastal Upland Swamp EEC

Seventeen Upland Swamps have been mapped by Biosis (2012b) within the study area. The location of Upland Swamps in relation to Longwalls 4 and 5 is shown in **Figure 3**.

Two Upland Swamps (CCUS3 and CCUS6) are located immediately above Longwalls 4 and 5. An additional 15 Upland Swamps (CCUS1, CCUS4, CCUS5, CCUS7, CCUS8, CCUS15, CCUS17, CCUS18, CCUS19, CCUS20, CCUS21, CCUS23, CRUS1, CRUS2 and CRUS3) are located within the study area (600 m from the edge of secondary extraction). These upland swamps are representative of the Coastal Upland Swamps in the Sydney Basin Bioregion Endangered Ecological Community (EEC), listed under the TSC Act.

The size, vegetation sub-communities, location in relation to Longwalls 4 and 5 and predicted subsidence (vertical movement, strains and tilts) for all Upland Swamps within the study is outlined in **Table 3.1**.

Table 3.1 - Upland Swamps located within the study area

Swamp	Size (ha)	Vegetation sub-communities	Located above longwall 4 or 5 (secondary extraction)	Predicted Subsidence (mm)	Strain (mm/m)	Tilt (mm/m)
CCUS1	4.81	Banksia Thicket (MU42) Tea-tree Thicket (MU43) Sedgeland-HeathComplex: Restioid Heath (MU44b) Sedgeland-Heath Complex: Cyperoid Heath (MU44c)	No 270 m southeast of Longwall 4	-	-	-
CCUS3	0.55	Banksia Thicket (MU42) Sedgeland-HeathComplex: Sedgeland (MU44a)	Yes Western end of Longwall 5	-75	-6 to 4	15
CCUS4	1.77	Banksia Thicket (MU42) Tea-tree Thicket (MU43) Sedgeland-Heath Complex: Cyperoid Heath (MU44c)	No 75 m northwest of Longwall 5, above pillar	-	-	-
CCUS5	3.45	Banksia Thicket (MU42) Tea-tree Thicket (MU43) Sedgeland-HeathComplex: Sedgeland (MU44a)	No 530 m northwest of Longwall 5	-	-	-
CCUS6	2.05	Banksia Thicket (MU42)	Yes Spanning Longwall 4	-100	-6 to 4	20
CCUS7	1.32	Banksia Thicket (MU42)	No 350 m northeast of Longwall 5	-	-	-

CCUS8	0.46	Banksia Thicket (MU42)	No 240 m north of Longwall 5, above Area 2 Mainroad	-	-	-
CCUS15	0.06	Tea-tree Thicket (MU43)	No 230 m south of Longwall 4	-	-	-
CCUS17	0.07	Banksia Thicket (MU42)	No 310 m south of Longwall 4	-	-	-
CCUS18	0.05	Banksia Thicket (MU42)	No 320 m south of Longwall 4	-	-	-
CCUS19	0.04	Banksia Thicket (MU42)	No 465 m south of Longwall 4	-	-	-
CCUS20	0.55	Banksia Thicket (MU42)	No 80 m south and southeast of Longwall 4	-	-	-
CCUS21	0.05	Banksia Thicket (MU42)	No 60 m east of Longwall 4	-	-	-
CCUS23	1.44	Banksia Thicket (MU42) Sedgeland-HeathComplex: Restioid Heath (MU44b)	No 20 m northwest of Longwall 4 and 15 m west of Longwall 5, above pillar	-	-	-
CRUS1	9.84	Banksia Thicket (MU42) Tea-tree Thicket (MU43)	No 370 m west of Longwalls 4 and 5	-	-	-
CRUS2	3.12	Banksia Thicket (MU42) Tea-tree Thicket (MU43) Sedgeland-Heath Complex: Cyperoid Heath (MU44c)	No 230 m southwest of Longwall 4	-	-	-
CRUS3	3.42	Banksia Thicket (MU42) Tea-tree Thicket (MU43) Sedgeland-HeathComplex: Sedgeland (MU44a) Sedgeland-HeathComplex: Restioid Heath (MU44b) Sedgeland-Heath Complex: Cyperoid Heath (MU44c)	No 570 m south of Longwall 4	-	-	-

As can be seen in **Table 3.1** only CCUS3 and CCUS6 are located within the predicted 20 mm subsidence zone for Longwall 4 or 5.

Significance Assessment (DECCW 2011)

OEH (2012) defines criteria for establishing whether Upland Swamps are of special significance. The significance assessment for all Upland Swamps in the Study Area was undertaken by Biosis (2012b) as a part of the detailed swamp impact assessment for Wonga East and West. The results of this assessment are presented in **Table 3.2**.

Table 3.2 - Upland Swamps significance assessment (according to OEH 2012; sourced from Biosis 2012b)

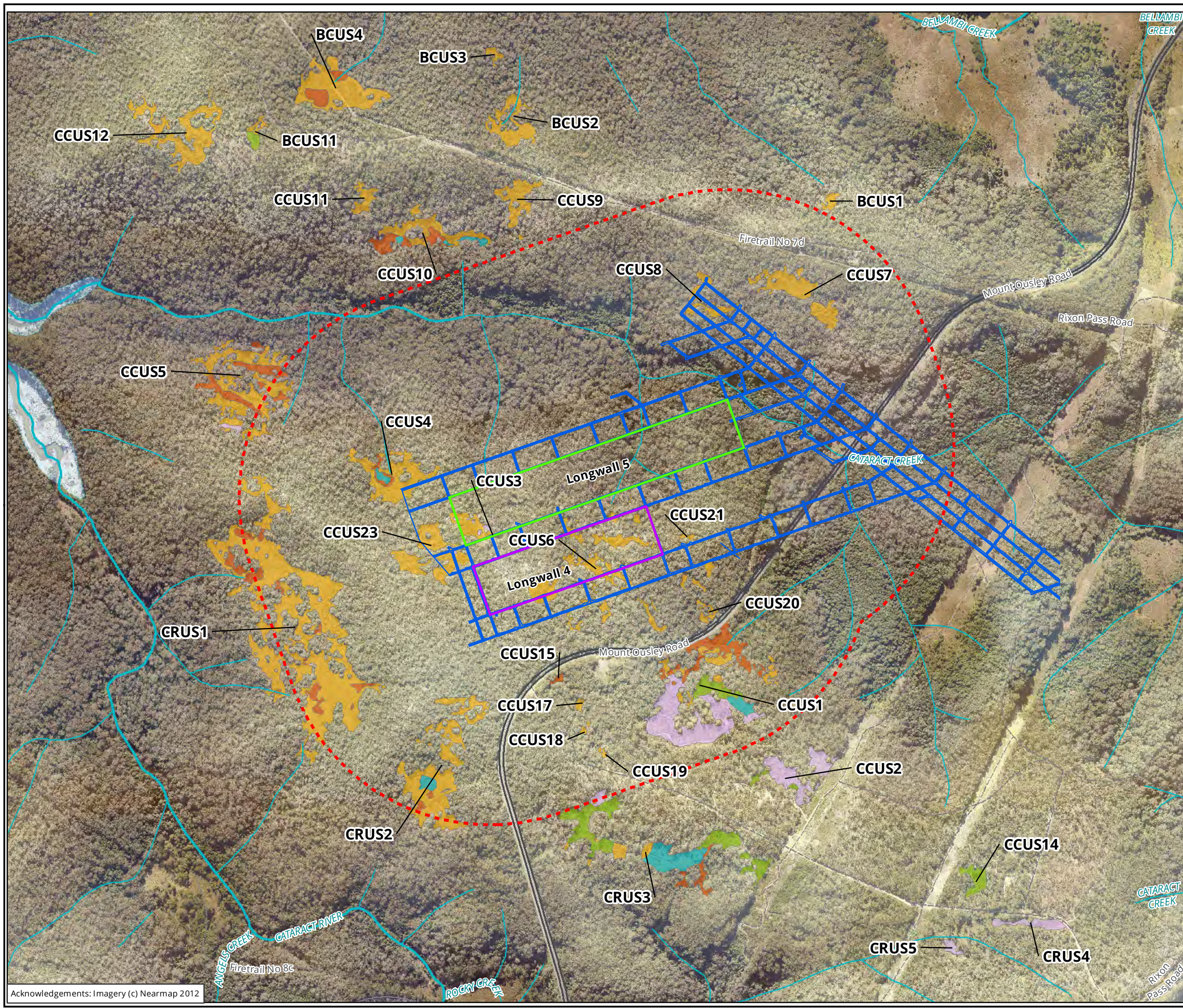
Swamp Name	Statutory	Size (ha)	Complexity	Cluster	Scientific	Special Significance
CCUS1	Coastal Upland Swamp EEC	4.81	MU42, MU43, MU44b, MU 44c	Wallandoola	No	Yes
CCUS3	Coastal Upland Swamp EEC	0.55	MU42, MU44a	Wallandoola	No	
CCUS4	Coastal Upland Swamp EEC	1.77	MU42, MU43, MU44c	Wallandoola	No	Yes
CCUS5	Coastal Upland Swamp EEC	3.45	MU42, MU43, MU44a	Wallandoola	No	Yes
CCUS6	Coastal Upland Swamp EEC	2.05	MU42	Wallandoola	No	
CCUS7	Coastal Upland Swamp EEC	1.32	MU42	Wallandoola	No	
CCUS8	Coastal Upland Swamp EEC	0.46	MU42	Wallandoola	No	
CCUS15	Coastal Upland Swamp EEC	0.06	MU43	Wallandoola	No	
CCUS17	Coastal Upland Swamp EEC	0.07	MU42	Wallandoola	No	
CCUS18	Coastal Upland Swamp EEC	0.05	MU42	Wallandoola	No	
CCUS19	Coastal Upland Swamp EEC	0.04	MU42	Wallandoola	No	
CCUS20	Coastal Upland Swamp EEC	0.55	MU42	Wallandoola	No	
CCUS21	Coastal Upland Swamp EEC	0.05	MU42	Wallandoola	No	
CCUS23	Coastal Upland Swamp EEC	1.44	MU42, MU44a	Wallandoola	No	
CRUS1	Coastal Upland Swamp EEC	9.84	MU42, MU43	Wallandoola	No	Yes



Swamp Name	Statutory	Size (ha)	Complexity	Cluster	Scientific	Special Significance
CRUS2	Coastal Upland Swamp EEC	3.12	MU42, MU43, MU44c	Wallandoola	No	Yes
CRUS3	Coastal Upland Swamp EEC	3.42	MU42, MU43, MU44a, MU44b, MU44c	Wallandoola	No	Yes

This assessment determined that of the 17 Upland Swamps within the study area, six of these (CCUS1, CCUS4, CCUS5, CRUS1, CRUS2 and CRUS3) are considered to be of 'special significance' according to criteria set out in OEH (2012). CCUS1, CCUS4, CCUS5, CRUS2 and CRUS3 are considered of 'special significance due to their complexity, while CRUS1 is deemed to be of 'special significance' due to it's size.

No upland swamps of special significance were deemed likely to be impacted as a result of the extraction of LWs 4 and 5 (Biosis 2012b).



Legend

Wonga East and West Swamp Boundaries

- MU42, Upland Swamps: Banksia Thicket
- MU43, Upland Swamps: Tea-Tree Thicket
- MU44, Upland Swamps: Sedgeland-Heath Complex
- MU44a, Upland Swamps: Sedgeland-Heath Complex (Sedgeland)
- MU44b, Upland Swamps: Sedgeland-Heath Complex (Restioid Heath)
- MU44c, Upland Swamps: Sedgeland-Heath Complex (Cyperoid Heath)

Survey Area

- Study Area
- Longwall 4
- Longwall 5
- Longwall Layout

Figure 2: Location of Upland Swamps in the Longwalls 4 & 5 Study Area

0 100 200 300 400 500
Metres

Scale: 1:10,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis
Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 15550
Date: 09 November 2012
Checked by: NMG, Drawn by: apritchard
Location: P:\15550s\15550\Mapping\Report Figures\15550_F2_UplandSwamps

Acknowledgements: Imagery (c) Nearmap 2012

3.1.4 Threatened Species

Flora

No threatened flora species listed under the TSC Act or EPBC Act were recorded within the Wonga East domain by ERM (2011a,b). One threatened flora species (*Pultenaea aristata*) has been recorded within CCUS3 and CRUS1 by ERM (2012) and Biosis during ecological monitoring (pers. obs.). One flora species (*Darwinia grandiflora*), listed on the Rare or Threatened Plants (RoTaP) list, is known to occur to the south of Longwalls 4 & 5.

There is potential habitat for an additional 10 threatened flora species, within the Longwalls 4 & 5 study area as shown in **Table 3.3**.

Table 3.3 - Threatened Flora with Potential Habitat in the Longwalls 4 & 5 study area

Scientific Name	Common Name	EPBC Act Status	TSC Act Status
<i>Acacia baueri</i> subsp. <i>aspera</i>		-	V
<i>Astrotricha crassifolia</i>	Thick-leaf Star-hair	V	V
<i>Persoonia bargoensis</i>	Bargo Geebung	E	V
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E
<i>Persoonia acerosa</i>	Needle Geebung	V	V
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V
<i>Leucopogon exolasius</i>	Woronora Beard-heath	V	V
<i>Pomaderris brunnea</i>	Brown Pomaderris	V	V
<i>Senna acclinis</i>	Rainforest Cassia	-	E

Fauna

Six threatened fauna species (Glossy Black-cockatoo *Calyptorhynchus lathami*, Eastern Freetail-bat *Mormopterus norfolkensis*, Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*, Eastern False Pipistrelle *Falsistrellus tasmaniensis* Giant Burrowing Frog *Heleioporus australiacus* and Macquarie Perch *Macquaria australasica*) have been recorded within the Wonga East domain (ERM 2011a, b, 2012, Biosis 2012a).

There is potential habitat for an additional 23 threatened fauna species within the Longwalls 4 & 5 study area as shown in **Table 3.4**.

Table 3.4 - Threatened Flora with Potential Habitat within the Longwalls 4 & 5 Study area

Scientific Name	Common Name	EPBC Act Status	TSC Act Status
<i>Climacteris picumnusvictoriae</i>	Brown Treecreeper	-	V
<i>Callocephalon fimbriatum</i>	Gang-Gang Cockatoo	-	V
<i>Lophoictinia isura</i>	Square-tailed Kite	-	V
<i>Podargus ocellatus</i>	Marbled Frogmouth	-	V
<i>Ninox strenua</i>	Powerful Owl	-	V
<i>Tyto tenebricosa</i>	Sooty Owl	-	V
<i>Petroica rodinogaster</i>	Pink Robin	-	V
<i>Pezoporus wallicuswallicus</i>	Eastern Ground Parrot	-	V
<i>Ptilinopus regina</i>	Rose-crowned Fruit Dove	-	V
<i>Ptilinops superbus</i>	Superb Fruit Dove	-	V
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	-	V
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll	V	V
<i>Isodon obesulus obesulus</i>	Southern brown Bandicoot	E	E
<i>Phascolarctos cinereus</i>	Koala	-	V
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	-	V
<i>Myotis macropus</i>	Large-footed Myotis	-	V
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V
<i>Pseudophryne australis</i>	Red-crowned Toadlet	-	V
<i>Mixophyes balbus</i>	Stuttering Frog	V	E
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	V	E
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	-	V
<i>Maccullochella peelii</i>	Murray Cod	V	-

Detailed mapping of frog habitat in the Wonga East domain by Biosis (2012a), shown in **Figure 4** threatened Species Habitat in the Longawalls 4&5 Study Area indicates that potential habitat for Littlejohn's Tree Frog, Giant Burrowing Frog and Stuttering Frog occurs in Wonga East. No suitable habitat is located immediately above Longwalls 4 or 5. Suitable habitat for the Stuttering Frog is located along Cataract Creek to the northeast of Longwalls 4 and 5. During subsequent monitoring of this habitat, tadpoles of the Giant Burrowing Frog were recorded in a creek downstream of CRUS2. No other species have been recorded.

3.1.5 Aquatic Ecology

Longwalls 4 & 5 are located below three first order and one second order tributaries of Cataract Creek. Cataract Creek to the east of Longwalls 4 and 5 is a fourth order stream. The Cataract River arm of Cataract Reservoir is located to the west of Longwalls 4 & 5. Previously, both Longwalls 4 and 5 were located within the Cataract River catchment; however as both longwalls have been shortened these longwalls are no longer located within the Cataract River Catchment.

A number of Macquarie Perch were captured during electrofishing surveys in Cataract Creek, approximately 1.2 km downstream of Longwalls 4 & 5 (Cardno Ecology Lab 2010). Juvenile freshwater cod were also captured during these surveys, and it is considered likely that these are Murray Cod *Maccullochella peelii peelii*. This species is listed as Vulnerable under the EPBC Act.

Macroinvertebrate sampling indicates that Cataract Creek sites have OE50 Taxa Scores of 0.61 (spring 2008) and 0.28 – 0.3 (autumn 2010), sit within BAND B (spring 2009) and C (autumn 2010) with SIGNAL2 scores of 4.5 to 4.9. Sites are currently below reference sites based on BAND data and are considered moderately degraded based on SIGNAL2 scores.

This data provides baseline against which ongoing monitoring can be compared.

3.2 Potential Impacts

The Southern Coalfield Inquiry (State of NSW 2008) and Bulli PAC report (PAC 2010) recommended that survey effort and impact assessment should be focussed on identifying natural features at risk from subsidence effects and thus impacts.

The majority of biodiversity values present in the Longwalls 4 & 5 study area are not reliant on surface water flows, ground water or rocky habitats, and are unlikely to be significantly impacted by subsidence associated with the extraction of coal from Longwalls 4 & 5. In addition, the conservation significance of species, populations and communities is considered when determining impacts to these biodiversity values and impact assessments should focus on threatened species, populations and communities.

The following species and ecological community (refer **Table 3.5**) are considered at risk of impact from subsidence effects associated with Longwalls 4 and 5 due to the presence of the species or community (or suitable habitat) within the study area, and their reliance on a narrow range of habitat features that are highly susceptible to impacts resulting from subsidence effects.

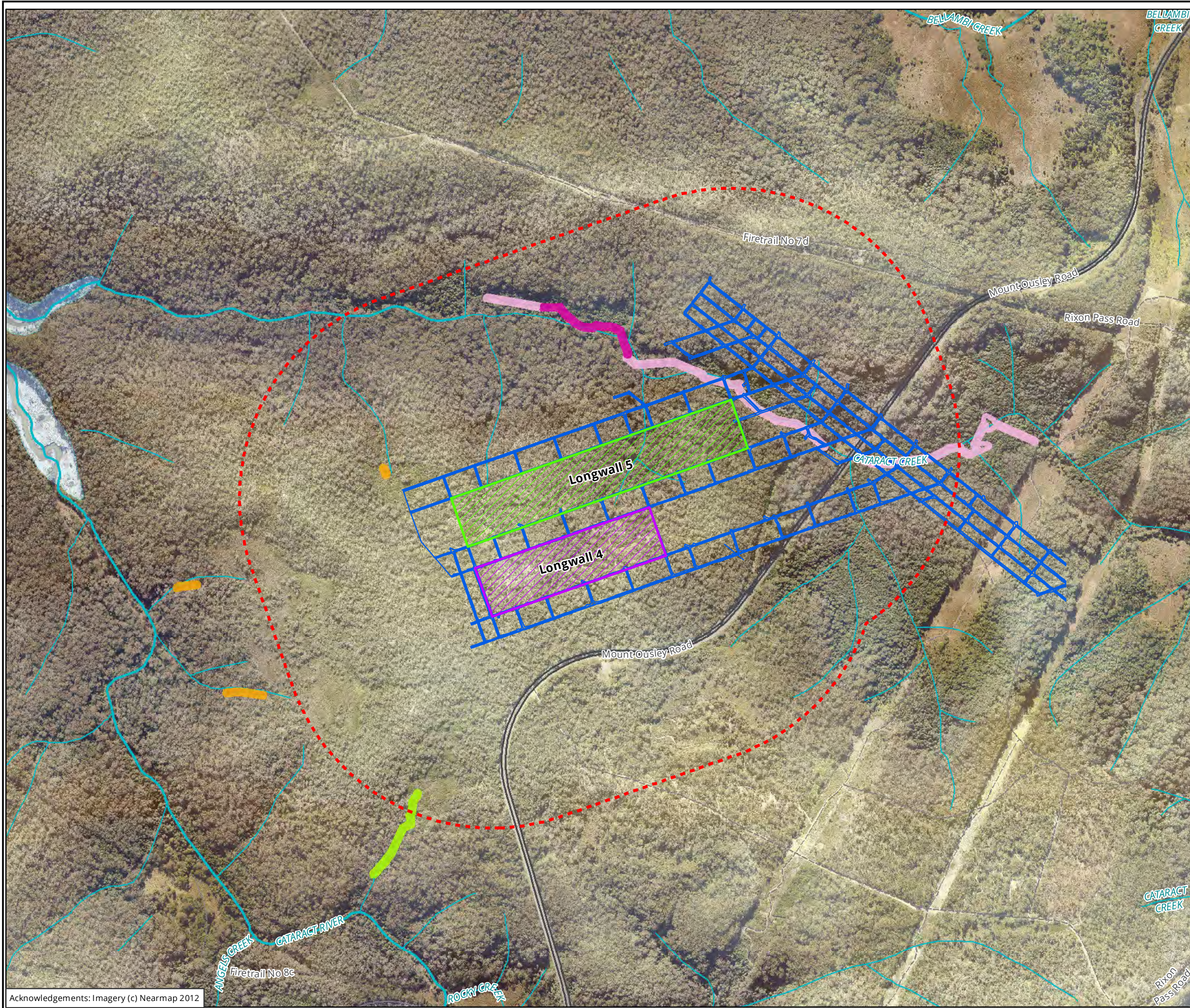
Table 3.5 - Threatened Species, Populations of Communities Considered at Risk from Subsidence Associated with Longwalls 4 & 5

Species/Community	EPBC Act Status	TSC Act Status
Coastal Upland Swamps EEC	-	E
Littlejohn's Tree Frog	V	V
Red-crowned Toadlet	-	V
Giant Burrowing Frog	V	V
Stuttering Frog	V	E
Broad-headed Snake	V	E

The location of Upland Swamps in relation to Longwalls 4 & 5 is shown in **Figure 3**. Potential habitat for the five fauna species listed in **Table 3.5** is shown in **Figure 4**.

Seedsman Geotechnics (2012) has prepared predictions of subsidence impacts (subsidence, tilt and strain) associated with the extraction of coal from Longwalls 4 & 5. These subsidence predictions have been updated following extraction of Longwall 4.

Based on these subsidence predictions and the proposed narrow longwalls and wide pillars it is concluded that the extraction of coal from Longwalls 4 & 5 does not pose a significant risk to Cataract Creek, is unlikely to result in changes to stream flow, pond drainage and/or water quality (ERM 2011b, GeoTerra 2012) and is unlikely to result in release of iron staining into Cataract Creek. For these reasons impacts to aquatic biota or their habitats, including the Stuttering Frog and Red-crowned Toadlet, are unlikely to occur as a result of the proposed extraction of Longwalls 4 & 5.



Legend

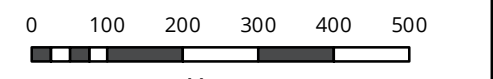
Threatened Frog Breeding Habitat

- Litoria littlejohni & Heleioporus australiacus - Good
- Litoria littlejohni & Heleioporus australiacus - Marginal
- Mixophyes balbus - Good
- Mixophyes balbus - Marginal

Survey Area

- Study Area
- Longwall 4
- Longwall 5
- Longwall Layout

Figure 3: Threatened Species Habitat in the Longwalls 4 & 5 Study Area



Scale: 1:10,000 @ A3
 Coordinate System: GDA 1994 MGA Zone 56



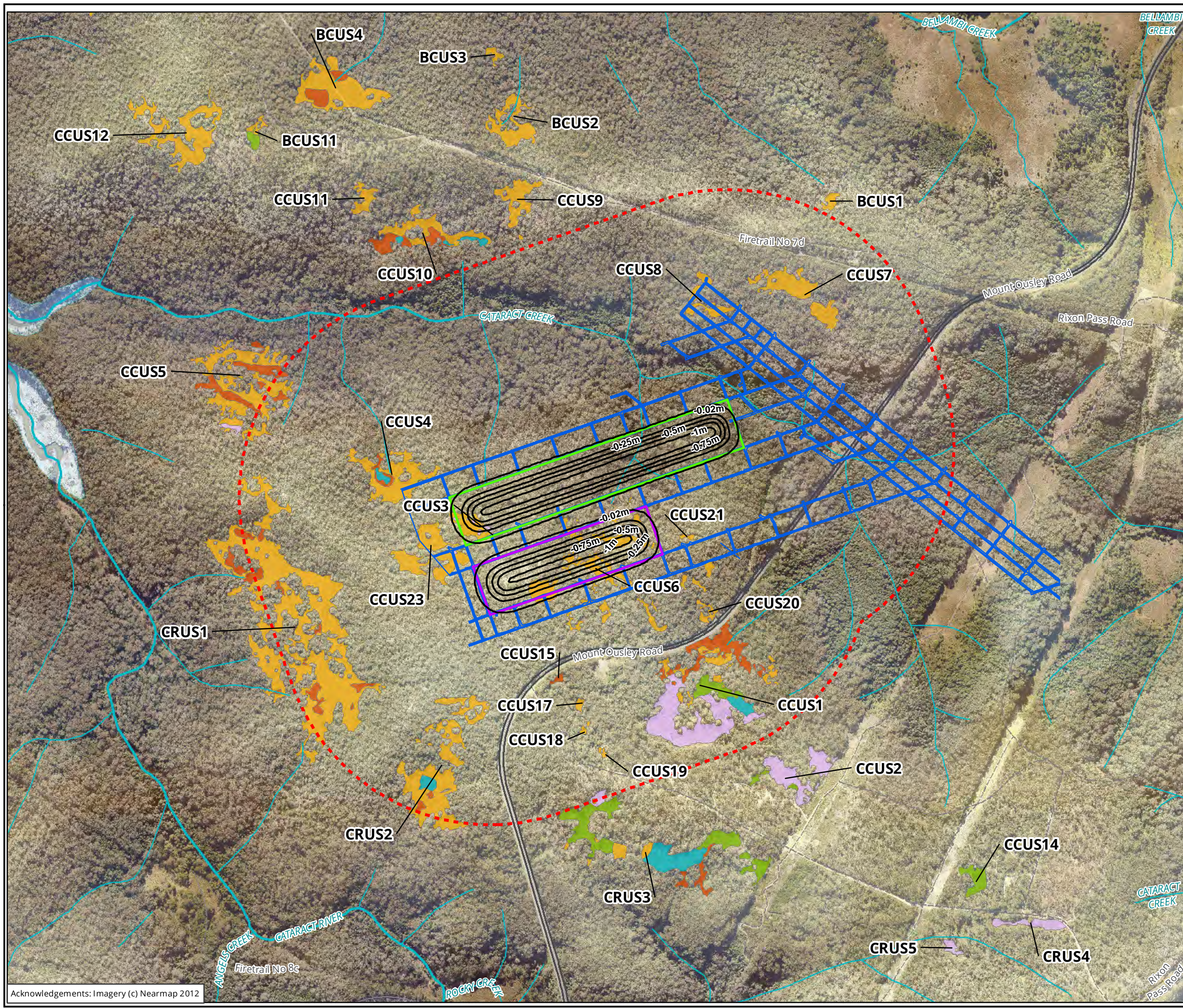
Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong



Impacts to rocky habitats, including rocky outcrops, ridgetops and cliffs, may include cracking, cliff falls and in the worst case scenario, collapse (ERM 2011a). Significant habitat features for species dependant on rocky habitat do not occur within the predicted 20 mm subsidence zone and are not predicted to be subject to significant tilt or strain. For these reasons impacts to threatened species dependant on rocky habitat, including the Broad-headed Snake, are unlikely to occur (ERM 2011b).

The location of Upland Swamps in relation to predicted subsidence, tilts and strains for Longwall 4 is shown in **Figure 5** to **Figure 7**. An Upland Swamp impact assessment was completed by Biosis (2012b). This impact assessment was completed for the Wonga East and West domains, and covered Upland Swamps within the Longwalls 4 and 5 study area. No Upland Swamps of 'special significance' occur above Longwalls 4 and 5 due to the shortening of both Longwalls.

As no negative environmental consequences are predicted to occur as a result of the extraction of Longwalls 4 and 5 NRE can proceed to mining, monitoring and adaptive management (OEH 2012).



Legend

- Vertical Movements

Wonga East and West Swamp Boundaries

- MU42, Upland Swamps: Banksia Thicket
- MU43, Upland Swamps: Tea-Tree Thicket
- MU44, Upland Swamps: Sedgeland-Heath Complex
- MU44a, Upland Swamps: Sedgeland-Heath Complex (Sedgeland)
- MU44b, Upland Swamps: Sedgeland-Heath Complex (Restioid Heath)
- MU44c, Upland Swamps: Sedgeland-Heath Complex (Cyperoid Heath)

Survey Area

- Study Area
- Longwall 4
- Longwall 5
- Longwall Layout

Figure 4: Location of Upland Swamps within the Longwalls 4 & 5 Study Area in Relation to Predicted Vertical Movement

0 100 200 300 400 500
Metres

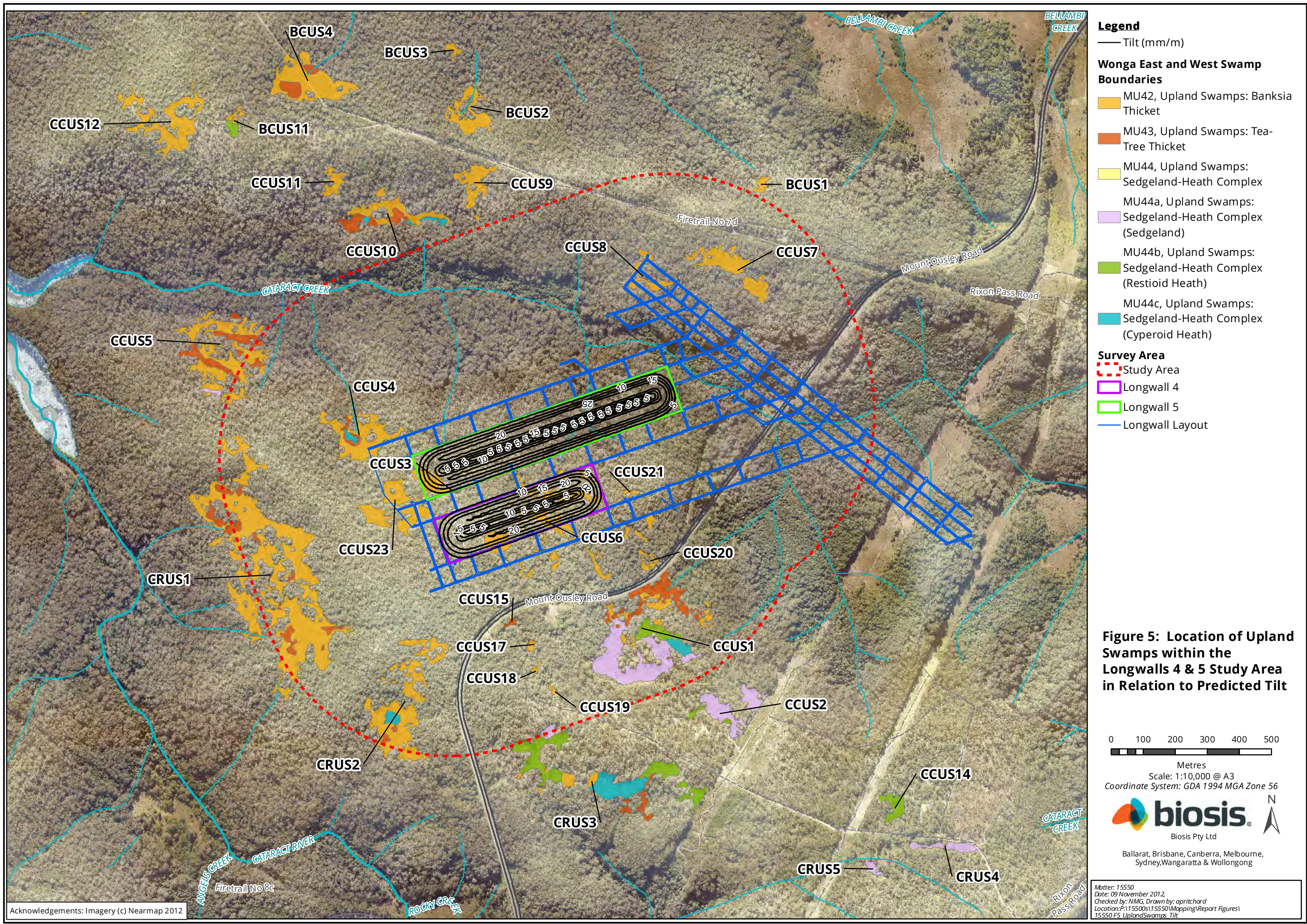
Scale: 1:10,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 15550
Date: 09 November 2012
Checked by: NMG, Drawn by: aprichard
Location: P:\15550s\15550\Mapping\Report Figures\15550_F4_UplandSwamps_Vert

Acknowledgements: Imagery (c) Nearmap 2012



Legend

- Tilt (mm/m)

Wonga East and West Swamp Boundaries

- MU42, Upland Swamps: Banksia Thicket
- MU43, Upland Swamps: Tea-Tree Thicket
- MU44, Upland Swamps: Sedgeland-Heath Complex
- MU44a, Upland Swamps: Sedgeland-Heath Complex (Sedgeland)
- MU44b, Upland Swamps: Sedgeland-Heath Complex (Restioid Heath)
- MU44c, Upland Swamps: Sedgeland-Heath Complex (Cyperoid Heath)

Survey Area

- Study Area
- Longwall 4
- Longwall 5
- Longwall Layout

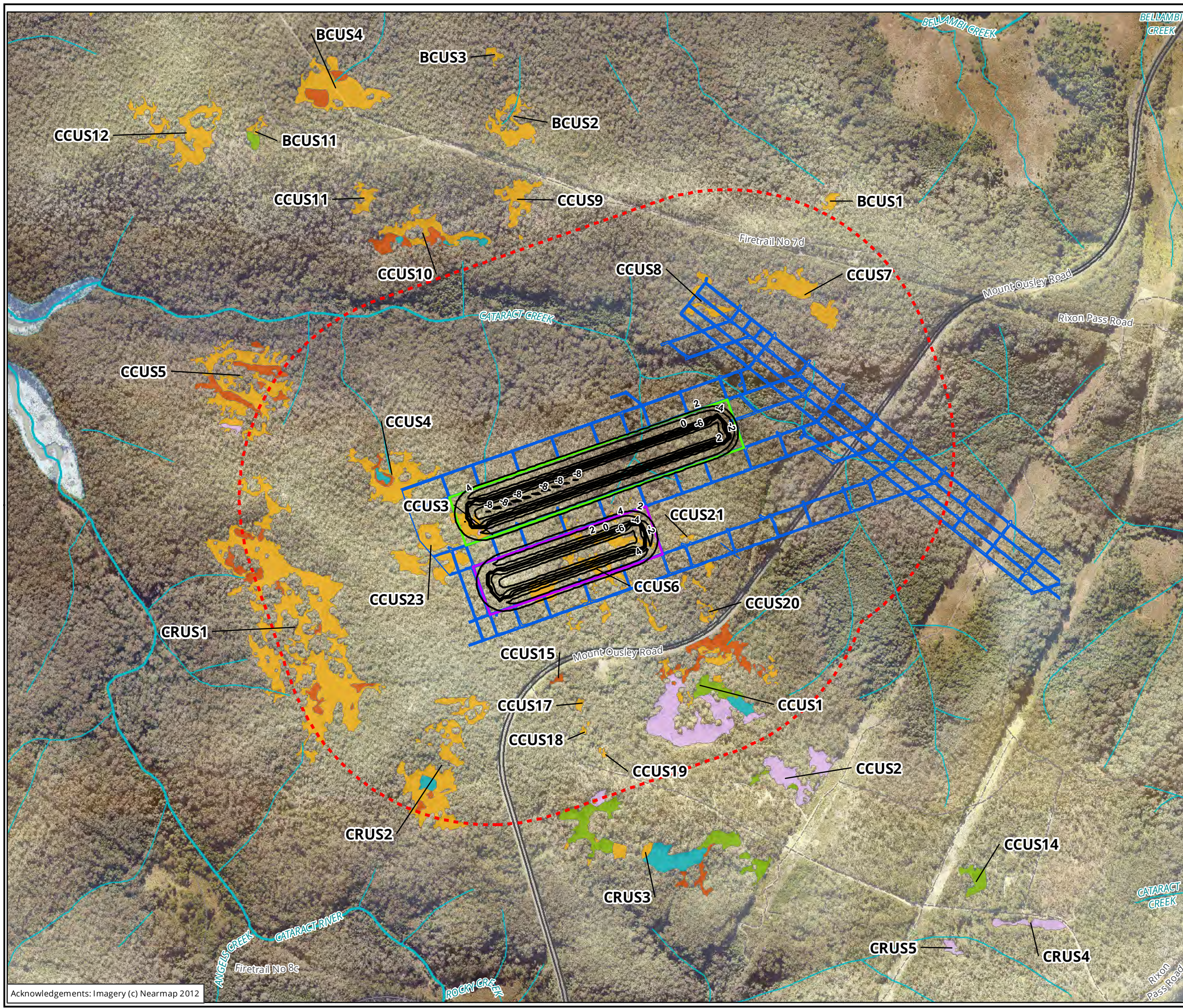
Figure 5: Location of Upland Swamps within the Longwalls 4 & 5 Study Area in Relation to Predicted Tilt

0 100 200 300 400 500
Metres
Scale: 1:10,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis
Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 15550
Date: 09 November 2012
Checked by: NMG, Drawn by: apritchard
Location: P:\15500s\15550\Mapping\Report Figures\15550_F5_UplandSwamps_Tilt

Acknowledgements: Imagery (c) Nearmap 2012



Legend

- Strain (mm/m)

Wonga East and West Swamp Boundaries

- MU42, Upland Swamps: Banksia Thicket
- MU43, Upland Swamps: Tea-Tree Thicket
- MU44, Upland Swamps: Sedgeland-Heath Complex
- MU44a, Upland Swamps: Sedgeland-Heath Complex (Sedgeland)
- MU44b, Upland Swamps: Sedgeland-Heath Complex (Restioid Heath)
- MU44c, Upland Swamps: Sedgeland-Heath Complex (Cyperoid Heath)

Survey Area

- Study Area
- Longwall 4
- Longwall 5
- Longwall Layout

Figure 6: Location of Upland Swamps within the Longwalls 4 & 5 Study Area in Relation to Predicted Strain

0 100 200 300 400 500
Metres

Scale: 1:10,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis
Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 15550
Date: 09 November 2012
Checked by: NMG, Drawn by: apritchard
Location: P:\15550s\15550\Mapping\Report Figures\15550_F6_UplandSwamps_Strain

Acknowledgements: Imagery (c) Nearmap 2012

4 PERFORMANCE MEASURES AND CRITERIA

Performance Measures for Longwall 4 and 5 in Project Approval are outlined in Table 1 of **Condition 1/ Schedule 3**. These Performance Measures relevant to the BMP are outlined in **Table 4.1** below.

Table 4.1 - Subsidence Impact Performance Measures for Biodiversity

Upland Swamps	
Upland swamps adjacent to Wallandoola and Cataract and Lizard Creeks (including valley fill swamp WCvfs1, Cataract Creek Upland Swamp 4 (CCUS4), and Cataract Reservoir Upland Swamp 1 (CRUS1))	Negligible environmental consequences including: <ul style="list-style-type: none"> • negligible change in the size of swamps; • negligible change in the functioning of swamps; • negligible change to the composition or distribution of species within swamps; and, • negligible drainage of water from swamps, or redistribution of water within swamps.
Cataract Creek Upland Swamp 3 (CCUS3)	No greater subsidence impact or environmental consequences than predicted in EA-Mod1
Biodiversity	
Threatened species, threatened populations, or endangered ecological communities	Negligible environmental consequences

Negligible is defined within the Project Approval as: *Small and unimportant, such as to be not worth considering.*

Environmental management will be undertaken in accordance with the process described in **Figure 8**.

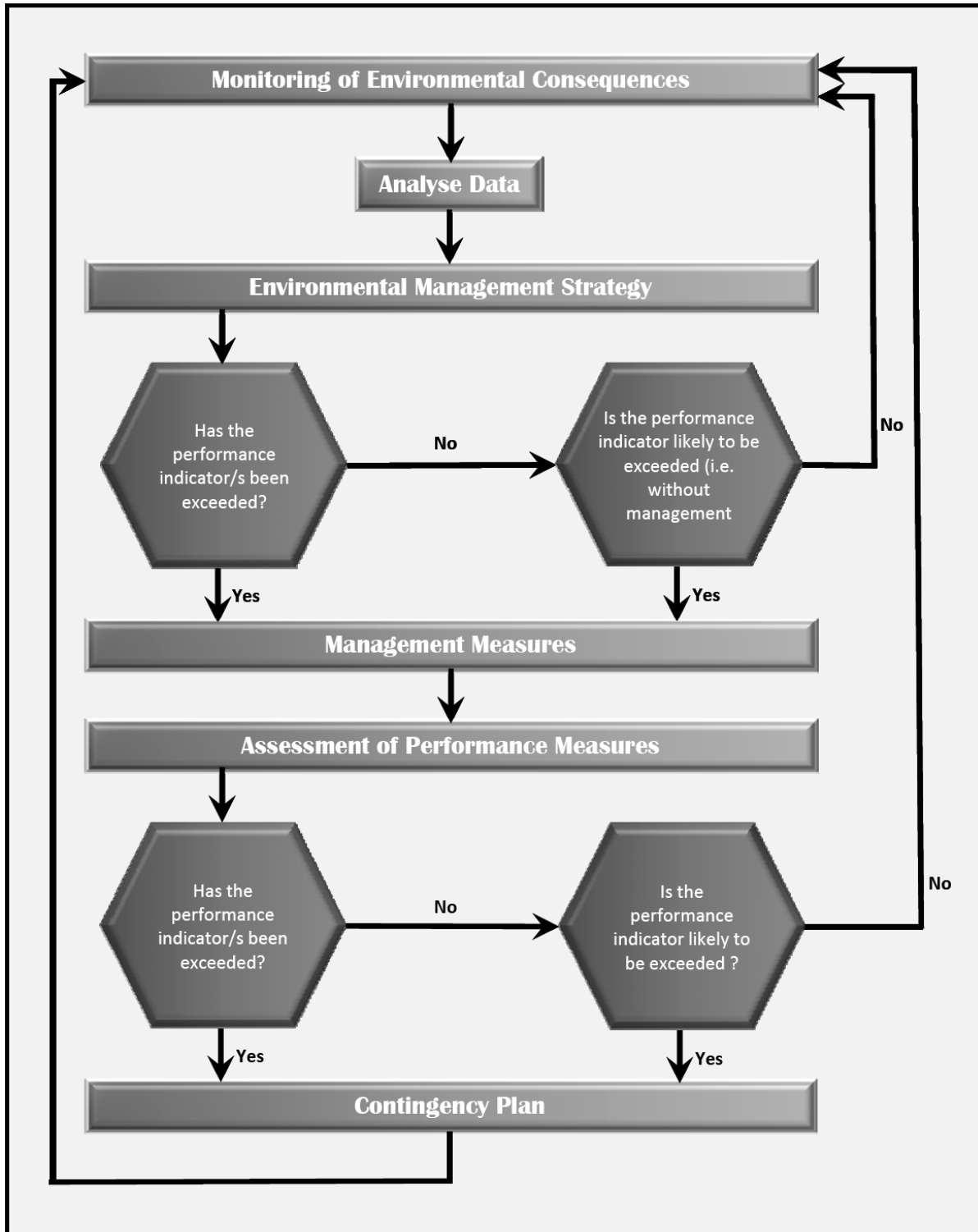


Figure 8 - Management Process

5 MONITORING AND REPORTING

5.1 Monitoring

The terrestrial and aquatic biodiversity monitoring programs are outlined below.

This monitoring program, and the Trigger Action Response Plan (TARP) outlined in **Section 6.2** and **Appendix A**, have been integrated with other management plans, particularly the Water Management Plan (GeoTerra 2012). This monitoring program builds on these plans, and triggers associated with the TARP rely on data obtained from monitoring undertaken as a part of the Water Management Plan (GeoTerra 2012).

In particular, data obtained from a network of groundwater monitoring piezometers (see **Figure 10**) and stream monitoring sites (see **Figure 10**), assessing pool depth and flow, will be used in conjunction with data obtained from monitoring of biodiversity to assess impacts.

This integration of management plans and monitoring will allow a more rapid response to potential impacts and a better approach to adaptive management. As changes observed as a part of other monitoring programs, such as hydrology and visual monitoring, are likely to be some of the first indicators of potential impacts to biodiversity monitoring data and triggers from other management plans and TARPs will be used to trigger additional actions as a part of this BMP.

5.1.1 Monitoring of Terrestrial Biodiversity

Monitoring of terrestrial biodiversity values present within the Wonga East domain has been underway since autumn 2011. This program was modified in mid-2012 following discussions with OEH. This modification to the monitoring programs was undertaken to ensure the monitoring program focused on threatened species, populations and communities at risk of impact due to subsidence effects, and ensure that those habitat features (such as breeding pools for frogs) were closely monitored.

The current terrestrial biodiversity monitoring program includes:

- Vegetation monitoring in five Upland Swamps biannually during spring and autumn;
- Photopoint monitoring of an additional two Upland Swamps; and
- Frog monitoring in breeding habitat at five locations and non-breeding habitat at seven locations.

Non-breeding habitat will be monitored for one year. If at the end of the first year of monitoring none of threatened species targeted have been located, it is recommended that monitoring be scaled back to only include those areas considered breeding habitat.

Additional monitoring for the Red-crowned Toadlet, in suitable habitat immediately adjacent to ridgelines, will be implemented. Monitoring will be undertaken using passive acoustic monitoring. The location of suitable monitoring sites is yet to be determined.

This revised monitoring program forms the basis of this BMP. The current monitoring program and methodology is outlined below. A summary of the biodiversity monitoring program is provided in **Table 5.1**. The location of all control sites are shown in **Figure 9** and the locations of the monitoring sites in **Figure 10**.

Giant Dragonfly (*Petalura gigantea*)

Biosis has undertaken numerous surveys of upland swamps within the Longwall 4 and 5 BMP study area between 2010 and 2012. Although targeted surveys for this species have not been undertaken but Biosis ecologists always record incidental observations of all species, particularly threatened species. In addition, the Giant Dragonfly prefers upland swamps with open vegetation, and on this basis only CRUS1 and CCUS4 would provide suitable habitat for this species. Given the extent of monitoring of upland swamps in the Wong East area and the lack of suitable habitat in the majority of upland swamps over Longwalls 4 and 5 Biosis consider there is a low likelihood of this species occurring, and, although the presence of the species cannot be discounted, targeted monitoring is not warranted.

BACI Approach

Monitoring is undertaken according to a modified Before-After Control-Impact (BACI) design where data is collected before (baseline) and after impact at control and impact sites. Data collected during baseline monitoring will be used for comparison to data collected during and after mining (the before-after component) and data collected at impact sites will be compared to data collected at control sites (the control-impact component).

Although two years baseline data collection is preferential to ensure adequate variance in biological systems is incorporated into the experimental design, iterative planning and changes to sampling methodology as suggested by government agencies has meant that the design of the monitoring program has changed. However impacts to flora and fauna values present are not likely to occur over short intervals and are likely to be preceded by changes to other variables such as surface and groundwater flows. Thus, although minimal baseline data has been collected at some sites, overall trending declines in various measures can still be used to achieve the goals of the monitoring program and determine whether subsidence associated with extraction of coal from Longwall 4 and 5 will result in impacts to biodiversity values.

Monitoring will continue for the duration of mining and for a suitable period post-mining. The duration of post-mining monitoring is determined based on results of annual analysis of data as well as observed impacts to surface features and other monitoring (e.g. groundwater) but will include a minimum of two years post-mining and up to five years post-mining monitoring. If data analysis indicates changes are occurring, impacts to surface features are observed, or changes to other monitoring programs indicate impacts may occur monitoring will continue for a suitable period, determined in conjunction with the SCA, OEH and DRE.

Data is collected at control (reference) sites in the same manner and for the same duration as impact sites. Control sites are sites that have not been mined beneath and will not be undermined during the monitoring period. These sites provide data against which impact sites can be analysed. The use of control sites allows us to distinguish between impacts associated with subsidence (observed only at



impact sites) and those associated with broader environmental and anthropomorphic variables (observed at both control and impact sites).

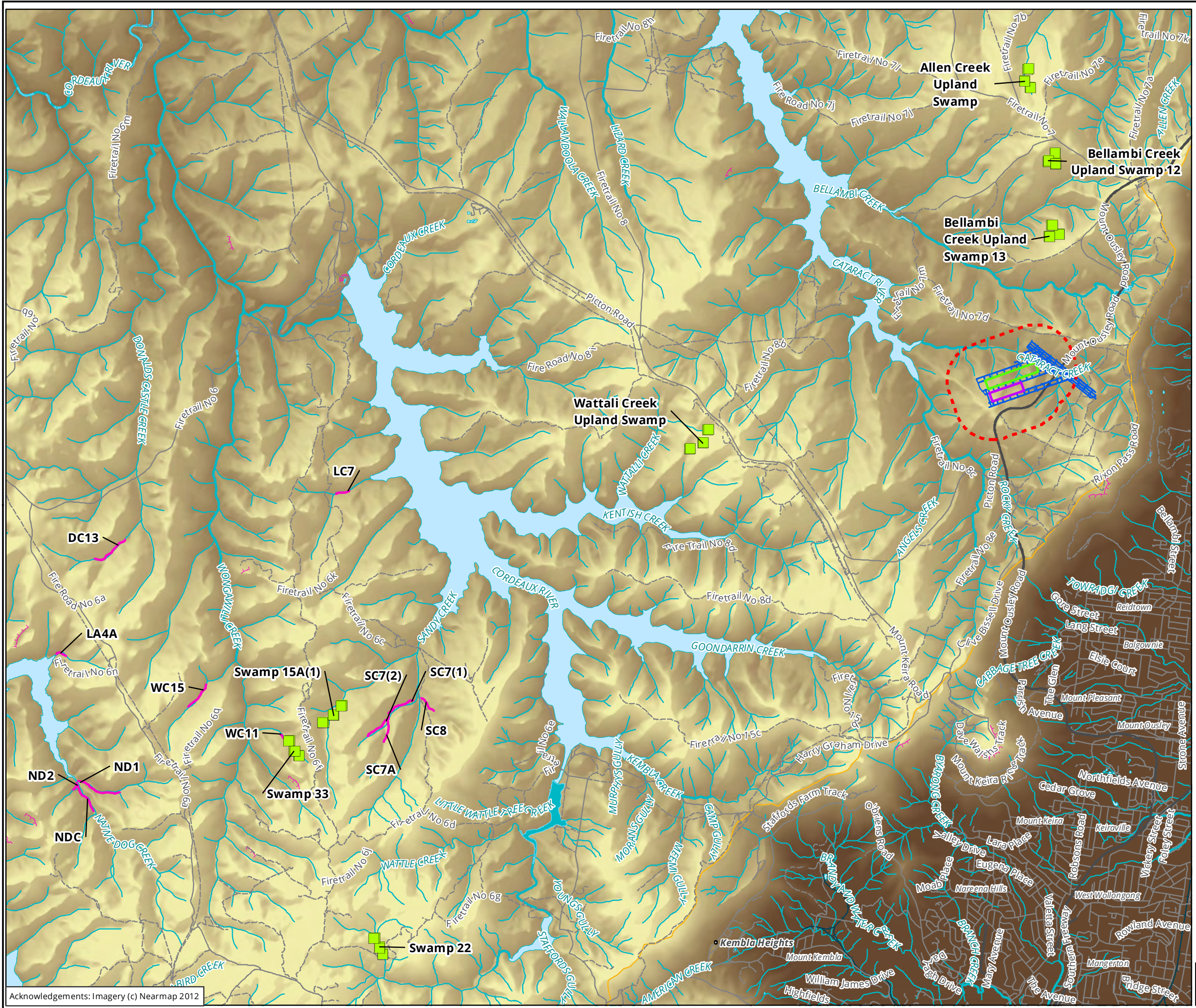
Table 5.1 - Biodiversity Monitoring Program

Monitoring	Sites (see Figure 10)	Season commenced	Methodology
Vegetation - Upland Swamps	CCUS1	Autumn 2011	Three 15 m transects have been established in each swamp (Figure 10). All flora species within 30 x 0.5 m x 0.5 m quadrats along the transect are recorded as presence only. A species can have a maximum score of 30 for any one transect, indicating it was present in all quadrats. Monitoring is undertaken once in spring and once in autumn each year.
	CCUS3	Autumn 2012	
	CCUS4	Autumn 2012	
	CRUS1	Autumn 2012	
	CRUS3	Autumn 2012	
Photopoint - Upland Swamps	All Upland Swamps listed above, plus , including CCUS2 and CRUS2	Autumn 2012	Three permanent photo monitoring points have been established in each swamp (Figure 10). Photos are taken at each fixed point to the north, east, south and west. Photos are taken once in spring and once in autumn each year.
Frogs - Breeding habitat (<i>Litoria littlejohni</i> and <i>Heleioporus australiacus</i>)	Cataract River trib below CRUS1	Winter 2012	Standardised transects have been established at each location, in areas mapped as suitable breeding habitat by Biosis (2012a; see Figure 9). Transects are surveyed by walking down the creekline and counting all frogs seen or heard. Tadpole counts are also undertaken. Monitoring of breeding habitat for these species is undertaken in winter (LJTF frogs and tadpoles, GBF tadpoles), summer (LJTF tadpoles, GBF frogs and tadpoles) and autumn (LJTF and GBF frogs and tadpoles) to detect the various life cycle stages for these species.
	Cataract River trib below CRUS1	Winter 2012	
	Cataract River trib below CRUS2	Winter 2012	
	Cattract Creek tributary below CCUS4	Winter 2012	

Monitoring	Sites (see Figure 10)	Season commenced	Methodology
Frogs - Breeding habitat (<i>Mixophyes balbus</i>)	Cataract Creek	Spring 2012	A single standardised transect has been established along Cataract Creek, in areas mapped as suitable breeding habitat by Biosis (2012a; see Figure 10). Transects are surveyed by walking down the creekline and counting all frogs seen or heard. Tadpole counts will also be undertaken. Monitoring of breeding habitat for this species is undertaken in spring and summer to detect the various life cycle stages for this species.
Frogs - Non-breeding habitat (<i>Litoria littlejohni</i> and <i>Heleioporus australiacus</i>)	CCUS1	Winter 2012	<p>Three 25 m x 25 m quadrats have been established in each swamp (Figure 10). At each quadrat a five minute (LJTF) to 30 minute (GBF) auditory survey will be undertaken at three fixed points throughout each swamp followed by 30 minutes of active searching within the quadrat. All frog species will be recorded.</p> <p>Non-standardised transect surveys will be undertaken when traversing between each quadrat location. These randomised transects will allow for the survey of greater area, increasing the probability of detecting the species' across habitat gradients. Call recognition surveys will be conducted simultaneously to detect those species that are hard to see.</p> <p>Monitoring of breeding habitat for these species is undertaken in winter (LJTF frogs and tadpoles, GBF tadpoles), summer (LJTF tadpoles, GBF frogs and tadpoles) and autumn (LJTF and GBF frogs and tadpoles) to detect the various life cycle stages for these species.</p>
	CCUS2	Winter 2012	
	CCUS3	Winter 2012	
	CCUS4	Winter 2012	
	CRUS1	Autumn 2011	
	CRUS2	Winter 2012	
	CRUS3	Winter 2012	



All flora and fauna will be identified to species/subspecies level where possible. Some flora species are grouped based on similar ecological and/or morphological characteristics to avoid confusion in identification and to reduce variability in the data



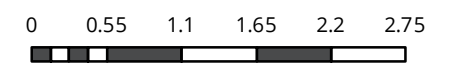
Legend

Flora Monitoring
■ Flora Swamp Control Site

Threatened Frog Monitoring
— Threatened Frog Control Site

Survey Area
 Study Area
 Longwall 4
 Longwall 5
 Longwall Layout

Figure 8: Terrestrial Monitoring Program Control Sites



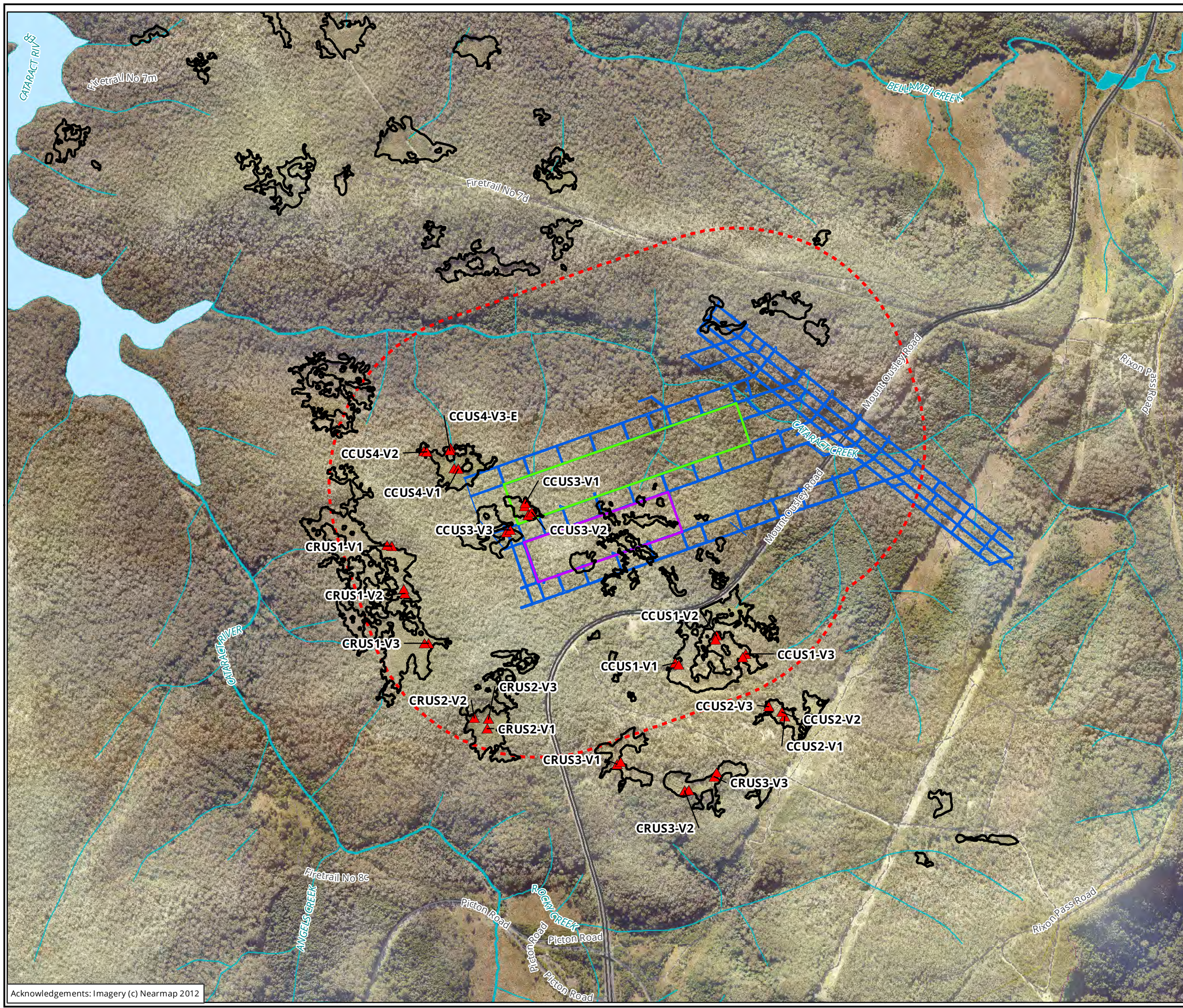
Scale: 1:55,578 @ A3
 Coordinate System: GDA 1994 MGA Zone 56



Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Mapper: 15550
 Date: 09 November 2012
 Checked by: NMG, Drawn by: opritchard
 Location: P:\15500s\15550\Mapping\Report Figures\15550_F8_MonControl

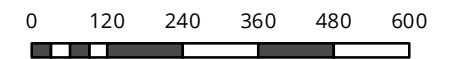
Acknowledgements: Imagery (c) Nearmap 2012



Legend

- Fauna Monitoring**
- ▲ Flora Swamp Impact Site
 - ▭ Upland Swamps (Biosis 2012)
- Survey Area**
- ▭ Study Area
 - ▭ Longwall 4
 - ▭ Longwall 5
 - Longwall Layout

Figure 9a: Terrestrial Monitoring program Impacts Sites - Flora

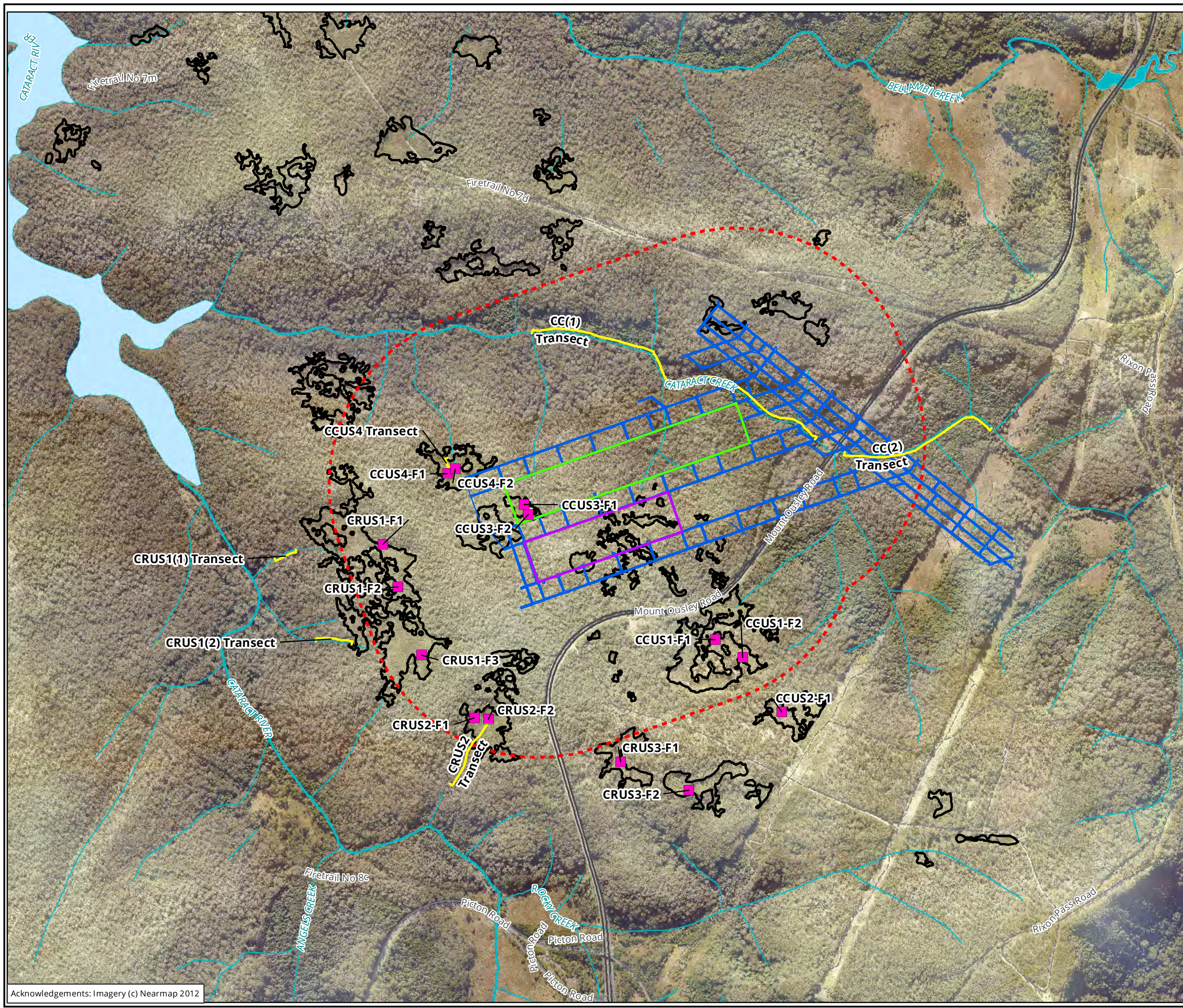


Meters
 Scale: 1:12,000 @ A3
 Coordinate System: GDA 1994 MGA Zone 56



Ballarat, Brisbane, Canberra, Melbourne,
 Sydney, Wangaratta & Wollongong

Matter: 15550
 Date: 09 November 2012
 Checked by: NMG, Drawn by: apritchard
 Location: P:\15500s\15550\Mapping\Report Figures\15550_F9a_MonImpact



Legend

- Threatened Frog Monitoring**
- Fauna Swamp Impact Site
 - Threatened Frog Impact Site
 - Upland Swamps (Biosis 2012)
- Survey Area**
- Study Area
 - Longwall 4
 - Longwall 5
 - Longwall Layout

Figure 9b: Terrestrial Monitoring program Impacts Sites - Fauna

0 120 240 360 480 600

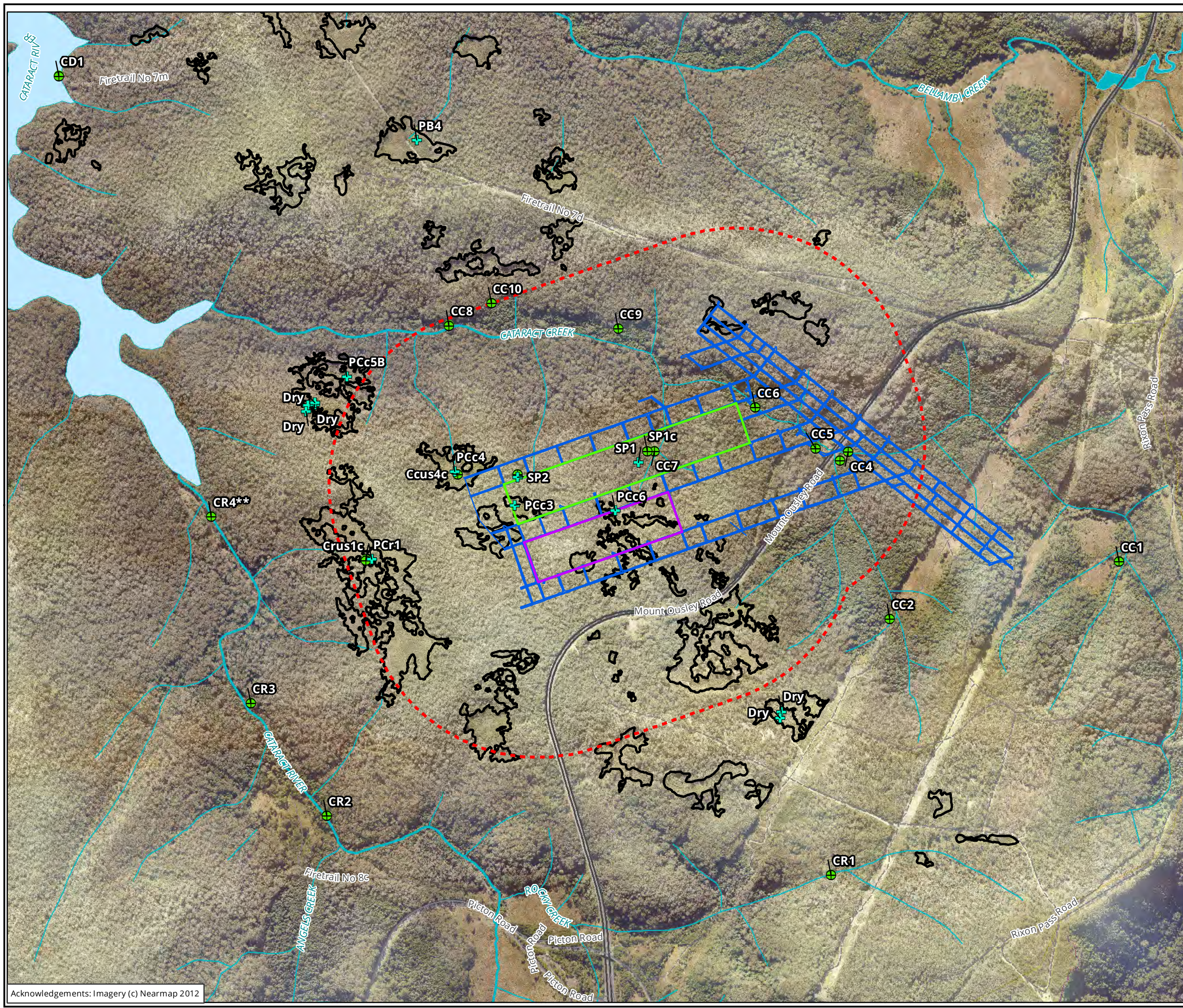
Meters
Scale: 1:12,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56



Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 15550
Date: 09 November 2012
Checked by: NMG, Drawn by: opritchard
Location: P:\15500s\15550\Mapping\Report Figures\15550_F9b_MonImpact

Acknowledgements: Imagery (c) Nearmap 2012



Legend

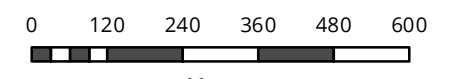
Groundwater and Surface Water Sites (GeoTerra Pty Ltd)

- + Peizo Locations
- ⊕ Stream Monitoring Locations
- Upland Swamps (Biosis 2012)

Survey Area

- Study Area
- Longwall 4
- Longwall 5
- Longwall Layout

Figure 9c: Groundwater and Stream Monitoring Locations



Meters
Scale: 1:12,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56



Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Acknowledgements: Imagery (c) Nearmap 2012

Matter: 15550
Date: 09 November 2012
Checked by: NMG, Drawn by: opritchard
Location: P:\15500s\15550\Mapping\Report Figures\15550_F9c_MonImpact

Statistical Analysis

Data is analysed using a hierarchical approach to data analysis. The first step is to look for global patterns and trends to determine if there are any observable discrepancies or trends in the data. The second step is to look for changes in diversity as indicators of community change. For this, species richness and species diversity are analysed at all sites across all years and changes in these indicators compared between control and impact sites.

Baseline variation between sites is established by clustering sites according to the Bray-Curtis similarities using Multi-Dimensional Scaling (MDS). To determine if impacts are occurring at impact sites a variety of statistical analyses are undertaken, including test of species richness and species diversity (Shannon diversity indices) as well as estimates of population size for frogs (where data allows). Where differences are detected, either between or within sites, additional analyses are undertaken to determine where and why differences are occurring.

Observational Monitoring

Observational Monitoring of upland swamps CRUS2 and CCUS2 will be undertaken. Observational monitoring will include visual surveys and collection of data on any subsidence effects observed within these swamps, including surface cracking, as well as data on vegetation condition. Photo points will be established within each swamp, with comparative photographs taken from north, east, south and west in autumn and spring. Areas of potential vegetation die back will be noted. Photos collected during baseline photo point monitoring will be used for comparison with post mining data.

Areas of suitable breeding habitat for frogs will also be monitored visually. Impacts to breeding habitat, such as fracturing of the base of creeks and breeding pools will be noted and photographs taken.

Results to Date

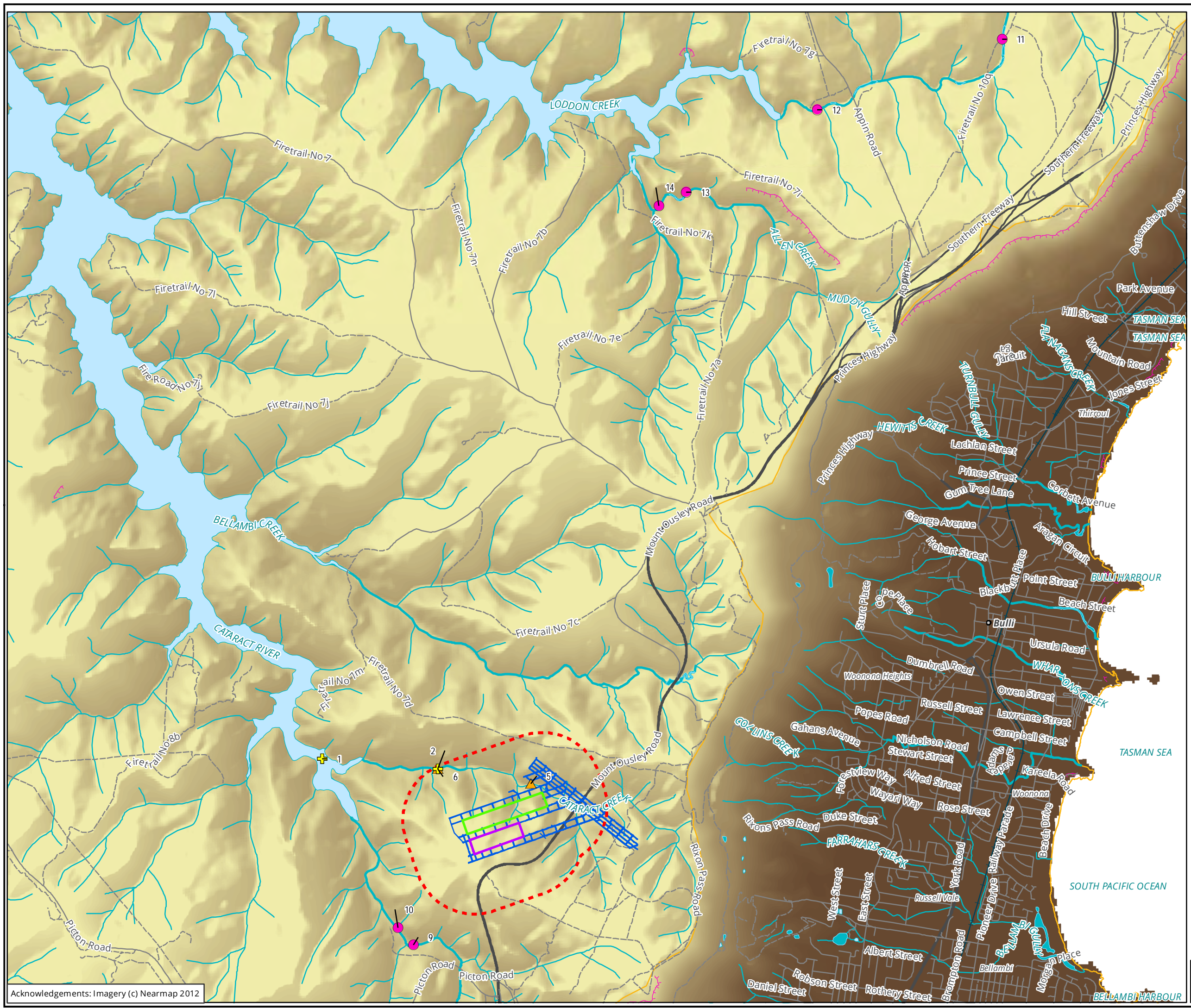
The results of terrestrial baseline monitoring as well as raw data are provided in **Appendix B**.

5.1.2 Monitoring of Aquatic Biodiversity

Monitoring of aquatic biodiversity is also undertaken using a BACI approach. Methodology is provided in Cardno Ecology Lab (2010).

Aquatic monitoring includes water quality monitoring and macroinvertebrate monitoring at two impact sites (sites 5 and 6 - **Figure 11**) and six control sites (sites 9-14 - **Figure 11**). Macquarie Perch monitoring is undertaken at two sites on Cataract Creek (sites Mac-1 and Mac-2 – **Figure 11**)

Full monitoring methodology is outlined below.



Legend

Aquatic Monitoring Locations

- Control
- ▲ Impact
- ✚ Macquarie Perch Survey - Cataract Ck

Survey Area

- ▭ Study Area
- ▭ Longwall 4
- ▭ Longwall 5
- Longwall Layout

Figure 10: Aquatic Monitoring Program Control and Impact Sites

0 350 700 1,050 1,400 1,750

Meters

Scale: 1:35,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 15550
 Date: 09 November 2012
 Checked by: NMG, Drawn by: opritchard
 Location: P:\15550s\15550\Mapping\Report Figures\15550_F10_Aquatic Monitoring

Acknowledgements: Imagery (c) Nearmap 2012

Water Quality Monitoring

Surface water quality will be measured *in situ* using a water quality monitor with two readings at each site. The following variables will be recorded:

- Temperature (C°);
- Conductivity ($\mu\text{S}/\text{cm}$);
- pH;
- Oxidation – Reduction Potential (ORP) (mV);
- Dissolved oxygen (% saturation); and
- Turbidity (ntu).

Data will be compared to ANZECC/AMARANZ (2000) guidelines. Data collected during 2011 and 2012 monitoring seasons will be used as a baseline for ongoing monitoring, with upper and lower limits used to establish triggers for ongoing monitoring.

Macroinvertebrate Monitoring

Macroinvertebrate samples are collected using two methods: AUSRIVAS sampling and aquatic macroinvertebrate collectors (Cardno Ecology Lab 2010).

Macroinvertebrate sampling using the AUSRIVAS method is undertaken according to the Rapid Assessment method (RAM) where pool edge habitats are sampled using a 250 μm mesh dip net, for a period of 3 to 5 minutes, along a 10 m length of the creekline. Each sample is then “picked” for a minimum of 40 minutes, followed by ten minute intervals, until no new specimens are found or for a maximum of one hour.

In addition eight artificial collectors are deployed at each site. These artificial collectors provide habitat structure for aquatic macroinvertebrates. Collectors are attached to vegetation and submerged in 30 to 60 cm of water. Collectors are retrieved approximately six weeks after deployment.

In accordance with the AUSRIVAS methodology RAM samples are sorted under a binocular microscope and identified to family level and up to ten animals of any one tax counted. Collector samples are also sampled using a binocular microscope, with macroinvertebrates identified to family (most taxa), sub-family (chironomids) or class (flatworms and leeches) and counted.

Surveys are undertaken twice annually in spring and autumn at two sites on Cataract Creek. Four reference sites are situated to the north on Allen and Loddon Creeks.

Fish Monitoring

Monitoring of Macquarie Perch is undertaken within Cataract Creek using a Smith-Root LR24 backpack electrofisher. Surveys are undertaken annually in summer from the confluence of Cataract Creek with the Cataract River (or the upstream extent of the current supply level within the Cataract Creek arm of Lake Cataract if this has inundated this confluence) to a rockbar identified as a likely barrier to fish movement (Cardno Ecology Lab 2010).

In addition to electrofishing dip netting is undertaken in conjunction with AUSRIVAS macroinvertebrate sampling (see above). Water quality monitoring data is also recorded.

Any Macquarie Perch captured are recorded and their location noted using a GPS. Caudal Fork Length, photographs and fin clip samples are taken.

Statistical Analysis

RAM samples are analysed using the AUSRIVAS predictive spring and autumn models for NSW pool edge habitats. The AUSRIVAS model generates the following indices:

- OE50Taxa Score – Ratio of macroinvertebrate families with a greater than 50% predicted probability of occurrence that were actually observed compared with those predicted to occur. Values range from 0 to 1 and provide a measure of impairment at each site, with values close to zero indicating impoverished assemblage and those close to one indicating condition is close to reference streams.
- Overall bands derived from OE50Taxa Scores which indicate the level of impairment of the assemblage. Bands are graded as follows:
 - Band X = Richer macroinvertebrate assemblage than reference condition
 - Band A = Equivalent to reference condition
 - Band B = Sites below reference condition
 - Band C = Well below reference condition
 - Band D = Impoverished.

The revised SIGNAL2 biotic index was also used to determine environmental quality of sites on the basis of presence or absence of macroinvertebrate families. The meaning of SIGNAL2 scores

Table 5.2 - SIGNAL 2 Scores and Stream Condition

SIGNAL2 Score	Stream Condition
>6	Clean
5-6	Mildly degraded
4-5	Moderately degraded
<4	Severely degraded

Differences in the types and relevant abundance of macroinvertebrates in each pair of replicate artificial collectors was analysed by examining the total numbers, total taxa and percent dominance of taxa at impact and control sites. SIGNAL2 scores were calculated.

Both OE50Taxa Scores and SIGNAL scores from baseline monitoring will be used to establish upper and lower limits for ongoing monitoring.

Results to Date

The results of aquatic baseline monitoring are provided in **Appendix C**.



5.2 Reporting

Progress against the requirements of this Plan will be reported regularly to the DoP&I and other relevant agencies as required by the Project Approval.

Reporting will be made available in accordance with the requirements of **Condition 7/Schedule 3** of the Project Approval.

.

6 MITIGATION AND MANAGEMENT STRATEGIES

6.1 General

General mitigation measures are outlined in Section 7.3 of ERM (2011a) and Section 16.6 of ERM (2011b). These measures include:

- If fracturing occurs remediate as soon as possible;
- Prioritise remediation to areas where fracturing has resulted in a loss of surface flows;
- Implement temporary fencing in areas where surface cracking occurs to prevent injury to fauna; and
- Seek advice from an ecologist prior to implementation of remediation works.

Additional measures to mitigate impacts to biodiversity resulting from subsidence effects include:

- Undertake monitoring as described in **Section 5**;
- Manage any impacts in accordance with the TARPS.
- If impacts are observed these must be reported as per the contingency plan outlined below;
- If impacts to significant biodiversity features result from subsidence effects immediate actions should be undertaken to remediate impacts; and
- If subsidence effects are observed in other areas increased monitoring of these areas should be undertaken. If impacts to significant biodiversity features are observed immediate actions should be undertaken to remediate impacts.

Rehabilitation and remediation measures to remedy subsidence impacts have been outlined in PAC (2010) and State of NSW (2008). In creeks or watercourses with naturally high sediment loads it is likely that fracture networks will fill naturally and require little if any intervention. However creeks, watercourses or swamps without naturally high sediment loads will require intervention.

GeoTerra (2012) list a number of mitigation measures for creeks. The major mitigation measure to protect Cataract Creek is to set longwalls back from the creek. This was done for Longwall 4, as a part of the mine planning, to reduce the likelihood of significant impacts to Cataract Creek. Measures to remediate impacts to creeks include:

- Sealing large cracks with:
 - hand mortaring;
 - injection grouting;
 - pattern grouting;
 - deep angled grouting; or
 - permeation grouting.
- Impermeable blankets or linings;
- Curtain grouting;

- Surface treatment; or
- Limestone to mitigate the effects of ferruginous springs;

Although impacts to upland swamps of 'special significance' are not predicted to occur, the Water Management Plan (GeoTerra 2012) outlines a number of remediation measures for Upland Swamps should impacts occur, including:

- Remediation of cracks in the base of streams associated with Upland Swamps using similar methods to remediation of creeks (see above);
- Use of coir log dams to prevent erosion of knick points; and
- Maintenance of swamp moisture in desiccated swamps using water spreading.

For further details see the Water Management Plan (GeoTerra 2012).

To date remediation measures have been attempted at a number of sites with mixed results, and it is likely that many of these would not be applicable to natural features present in the Longwall 4 and 5 study area. Grouting in the majority of creeks and swamps in the Longwall 4 and 5 study area would be impractical and slope stabilisation works and drainage and erosion control would likely cause substantial damage to these natural features. The impacts of any potential rehabilitation measures should be weighed up against any potential gains if the situation arises and expert input should be sought.

Implementation of any measures to remediate impacts to biodiversity features present in the Longwall 4 and 5 study area should be undertaken in conjunction with a suitable monitoring program to determine the success of these remediation measures.

If impacts to natural features do occur and rehabilitation measures cannot be reasonably implemented or prove unsuccessful offsets for losses of vegetation and/or fauna habitat will be sought either through protection of equivalent vegetation through the NSW BioBanking scheme (or similar) or via monetary offsets to fund rehabilitation works or research projects.

6.2 TARPS

The Trigger Action Response Plan (TARP) as presented in **Appendix A** has been designed specifically for this BMP to illustrate how the various predicted subsidence impacts, monitoring components, performance measures, and responsibilities are structured to achieve compliance with the relevant statutory requirements, and the framework for management and contingency actions.

The TARP system provides a simple, transparent and useable reference of the monitoring of environmental performance and the implementation of management and/or contingency measures.

The TARP is designed with consideration of baseline conditions and predicted subsidence impacts and comprises the following:

- Trigger levels from monitoring to assess performance; and,
- Triggers that flag implementation of contingency measures.

OEH (2012) outlines a method for undertaking monitoring to determine whether longwall mining is consistent with the performance measures outlined in **Section 4**. OEH (2012) defines negative environmental consequences in relation to only one of the four performance measures for Upland Swamps, namely a "*statistically significant decrease in water levels within the swamp that is directly attributable to subsidence*" (p. 12).

The TARP developed as a part of this BMP incorporates monitoring and triggers from the Water Management Plan (GeoTerra 2012).

6.3 Contingency Plan

In the event that the observed parameters or impacts exceed or are considered likely to exceed the performance measures detailed in **Section 4** of this Plan, NRE will implement the following Contingency Plan:

- The observation will be reported to the Environment and Community Manager within 24 hours.
- The observation will be recorded.
- NRE will report any exceedance of the performance measure to the DoP&I and other relevant stakeholder as soon as practicable after NRE becomes aware of the exceedance.
- NRE will assess the exceedances referred to in the TARP (outlined in **Section 6.2**) of this document) and where appropriate, implement safety measures in accordance with the appropriate Management Plan/s.
- The Environment and Community Manager will investigate any potential contributing factors and identify an appropriate action plan to manage the identified impact(s), in consultation with specialists and/or relevant agencies if necessary.
- NRE will identify an appropriate action plan to manage the identified impact(s), in consultation with other specialists and/or key stakeholders.
- NRE will submit the proposed course of action to DoP&I for approval.
- NRE will implement the approved course of action to the satisfaction of DoP&I.
- NRE will continue to monitor performance with the new action plan in place and, if successful will formalise these actions as part of the Management Plan.

Contingency measures will be developed in consideration of the specific circumstances of the issue and the assessment of consequences.

7 INCIDENTS, COMPLAINTS AND NON-CONFORMANCES

7.1 Incidents and Ongoing Management Reporting

The Project Approval defines an 'incident' to be *"a set of circumstances that causes or threatens to cause material harm to the environment, and/or breaches or exceeds the limits or performance measures/criteria in this Approval."*

Incidents will be managed through established NRE procedures in as detailed the Project Environmental Management Strategy (PEMS).

In accordance with **Condition 6/Schedule 5** NRE will notify the Director-General and any other relevant agencies of any incident:

- At the earliest opportunity if the incident has caused, or has the potential to cause significant risk of material harm to the environment.
- As soon as practicable in all other cases.

A detailed report of the incident shall be provided to DoP&I within 7 days of the incident occurring.

7.2 Complaints Handling

Complaints will be managed through established NRE procedures as detailed in the PEMS.

As required by **Condition 10/Schedule 5** of the Project Approval a copy of a complaints register (updated on a Monthly basis) will be kept on the NRE website. A summary of complaints will be available to regulatory authorities on request and provided in the Annual Environmental Management Reports (AEMRs).

7.3 Non-Conformance Protocol

NRE will manage and report non-compliances against statutory requirements in accordance with an established protocol developed as a component of the EMS.

Compliance with all approvals, plans and procedures will be the responsibility of all personnel (staff and contractors) employed on or in association with NRE No.1 Colliery, and will be promoted through direct consultation and direction of the mines' Operations Manager.

Regular inspections and/or internal audits will be undertaken as required by suitably qualified personnel under the direction of the E&C Manager, to identify any remediation/rectification work required, and areas of actual or potential non-compliance.

A Compliance Register **Compliance Register (EMS RV APP 003 & EMS WW APP 003)** will be established to monitor compliance against development consent criteria, mining leases and licenses. Non-compliances identified through the Compliance Register are to be reported, with corrective actions implemented.



A review of NRE's compliance with all conditions of the Project Approval, mining leases and all other approvals and licences will be undertaken prior to (and included within) each Annual Review. The Annual Review will be made publicly available on NRE's website.



8 PLAN ADMINISTRATION

8.1 Roles and Responsibilities

E&C management is regarded as part of the responsibilities of all Colliery personnel. The roles and function of the main personnel responsible for the implementation of environmental and community management including the plans, procedures and action plans contained in the PEMS are outlined in [NREG EMS PRO005 Environmental Roles and Responsibilities](#).

8.2 Resources Required

In accordance with the [NRE 001 NRE Environmental Policy](#), Management shall ensure that the appropriate resources are made available to achieve the implementation of this BMP.

It is the role of the Environment and Community Manager to ensure that these requirements are communicated to NRE Management.

8.3 Training

All training and inductions conducted are to be undertaken as per the [NRE 012 Training procedures](#).

8.3.1 Staff Training

Staff training will be undertaken as detailed in the PEMS. This consists of three levels of training applicable to different types of staff:

- Level 1 – High level training regarding environmental requirements – Management
- Level 2 – Operational level training – Project Managers, Supervisors, Surface Personnel
- Level 3 – Basic environmental awareness – Underground staff

8.3.2 Inductions

All contractors and associated subcontractors will be required to participate in site induction prior to the commencement of work. As a minimum, the induction is to include:

- An overview of the Cardinal Rules, Environment Policy and PEMS requirements.
- Environmental incident and community compliant reporting requirements.
- Environmental emergency contact details.

In the event that there are specific environmental management requirements relating to a contractor's work activities, details of these requirements are to be issued to the contractor in writing as a part of the induction.

Records, which detail the attendees, content of the induction/training as well as any additional information provided, will be maintained.

In addition to the induction program, training will be provided as deemed necessary to contractors to provide them with the knowledge, skills and awareness to minimise environmental impact. At a minimum this should include:

- Contractors whose activities are not directly supervised by Colliery personnel; and,
- Contractors whose activities are ongoing and have the potential to result in an environmental incident (e.g. stockpile contractors).

8.4 Record Keeping and Control

Environmental records are to be managed in accordance with the *NRE 010 Document and Data Control procedure*.

All records of the EMS will be stored so that they are readily retrievable and suitably protected from deterioration or loss. Archiving will be managed in accordance with the *NRE 010 Document and Data Control procedure*.

A master copy of each EMS document including all appendices and supporting information is to be held in the office of the E&C Department.

8.5 Plan Revision

8.5.1 Annual Review

In accordance with *Condition 3/Schedule 5* of the Project Approval, an Annual Review of the environmental performance of the Project will be undertaken and annually thereafter.

The Annual Review will:

- Describe the works carried out in the past year, and the works proposed to be carried out over the next year.
- Include a comprehensive review of the monitoring results and complaints records of the Project over the past year, including a comparison of these results against the:
 - relevant statutory requirements, limits or performance measures/criteria;
 - monitoring results of previous year/s; and
 - relevant predictions in the EA.
- Identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance.
- Identify any trends in the monitoring data over the life of the Project.
- Identify any discrepancies between the predicted and actual impacts of the Project, and analyse the potential cause of any significant discrepancies.
- Describe what measures will be implemented over the next year to improve the environmental performance of the Project.



8.5.2 Auditing

In accordance with **Condition 8/ Schedule 5** of the Project Approval an Independent Environmental Audit will be undertaken by a suitably qualified auditor and include experts in any field specified by the Director-General within 12 months of the approval and every three years after that.

This audit must:

- Be conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Director-General.
- Include consultation with the relevant agencies.
- Assess the environmental performance of the project and assess whether it is complying with the requirements in this approval and any relevant EPL or Mining Lease (including any assessment, plan or program required under these approvals).
- Review the adequacy of strategies, plans or programs required under the abovementioned approvals.
- Recommend measures or actions to improve the environmental performance of the project, and/or any strategy, plan or program required under these approvals.

8.5.3 Plan Revision

In accordance with **Condition 4/ Schedule 5** of Project Approval, this Plan will be reviewed within three months of the submission of:

- The submission of an annual review
- The submission of an incident report
- The submission of an audit
- Any modification to the conditions of approval (unless the conditions require otherwise)

The revision status of this plan is indicated on the title page of each copy. Revisions to any documents listed within this Plan will not necessarily constitute a revision of this document. The distribution of controlled copies is described in **Section 1.3**.

9 REFERENCES

- Biosis (2012a). *Threatened Frog Habitat Mapping*. Unpublished data provided to Gunarat NRE Coking Coal Ltd.
- Biosis (2012b). *NRE No. 1 Colliery Major Expansion. Upland Swamp Assessment*. Report for Gujarat NRE Coking Coal Ltd.
- Biosis Research (2009). *NRE Gujarat Targeted Herpetological Surveys*. Report for ERM Australia.
- Cardno Ecology Lab (2010). *Aquatic Ecology Monitoring for Gujarat No. 1 Mine*. Report for Gujarat NRE.
- EcoLogical (2009). *Wonga East and Wonga West Threatened Fauna Habitat Assessment*. Report for ERM Australia.
- ERM (2012). *NRE No. 1 Colliery Proposed Wongawilli Seam Longwalls 4 & 5: Ecological Assessment*. Report for Gujarat NRE Coking Coal Limited.
- ERM (2011a). *NRE No. 1 Colliery Terrestrial Flora and Fauna Assessment*. Report for Gujarat NRE Minerals.
- ERM (2011b). *NRE No. 1 Colliery Stage 2 Environmental Assessment*. Report for Gujarat NRE Coking Coal Limited.
- ERM (2012). *NRE No. 1 Colliery Proposed Wongawilli Seam Longwalls 4 and 5*. Report for Gujarat NRE Coking Coal Limited.
- GeoTerra (2012). *NRE No. 1 Colliery. Wonga East – Longwall 4 & 5 SMP / EP. Water Management Plan*. Report for Gujarat NRE Coking Coal Ltd.
- Keith, D., Rodoreda, S., Holman, L. and Lemmon, J. (2006). *Monitoring Change in Upland Swamps in Sydney's Water Catchment: The Roles of Fire and Rain*. NSW department of Conservation, Hurstville.
- NPWS (2003). *Native Vegetation of the Woronora, O'Hares and Sydney Metropolitan Catchments*. National Parks and Wildlife Service, Hurstville.
- NSW Scientific Committee (2011). *Coastal Upland Swamp in the Sydney Basin Bioregion - proposed endangered ecological community listing*. NSW Scientific Committee.
- OEH (2012). *Upland Swamp Environmental Assessment Guidelines: Guidance for the Underground Mining Industry Operating in the Southern Coalfield*. Office of Environment and Heritage, Hurstville.
- PAC (2010). *Bulli Seam Operations PAC Report*. NSW Planning Assessment Commission, Sydney.
- Seedsman Geotechnics (2012). *Longwalls 4 & 5 Revised Subsidence Predictions*. Letter to Gujarat NRE Coking Coal Limited.



State of NSW (2008). *Impacts of Underground Coal Mining on Natural features in the Southern Coalfield Strategic Review*. State of NSW through the NSW Department of Planning.



Appendix A - Trigger Action Response Plan Table

ASPECT	MONITORING				TRIGGER			
	SITES (see Figure 8 and 9)	PARAMETERS	FREQUENCY	PURPOSE	LEVEL	ACTION / REPORTING	RESPONSIBILITY	TIMING
Upland Swamps	Monitoring of groundwater using a network of piezometers in CCUS3 (PCc3), CCUS4 (PCc4), CCUS6 (PCc6) and CRUS1 (PCr1; see Water Management Plan for further detail). Vegetation monitoring in five Upland Swamps (CRUS1, CRUS3, CCUS1, CCUS3 and CCUS4). Observational monitoring, particularly photopoint monitoring seven upland swamps (CRUS1, CRUS2, CRUS3, CCUS1, CCUS2, CCUS3 and CCUS4). Photopoint monitoring has been set up in seven upland swamps. Any dieback will be noted.	Groundwater levels in piezometers. Collection of data on all species observed in 30 0.5m x 0.5m quadrats along three 15m transects per upland swamp. Analyses of data looks for changes in species richness and abundance using a hierarchical analysis. Initially, community composition is analysed looking for changes in species composition at each site. Following this changes in species richness and diversity are measured to determine if changes have occurred over time, or between control and impact sites. Observational monitoring will be undertaken across the Longwall 4 and 5 study area opportunistically during surveys.	Two years of baseline monitoring prior to mining. Monitoring during mining. A minimum of one year post-mining for piezometers, and two years of monitoring post-mining for vegetation. Groundwater piezometers are logged at a minimum of two hour frequency and downloaded on a weekly basis. See Water Management Plan for further detail). Vegetation monitoring is undertaken twice per year in autumn and spring.	To determine if subsidence effects resulting from longwall mining result in impacts to significant biodiversity features. Inform stakeholders of baseline assessment and monitoring Identify, investigate and report on impacts to upland swamps.	<p>Within prediction (Level 1):</p> <p>Negligible drainage of water from, or redistribution of water within a swamp, as illustrated by no observable mining induced change in groundwater levels.</p> <p>Negligible change to the composition or distribution of species, as illustrated by no statistically significant difference between control and impact sites or between before and after mining at impact sites.</p> <p>No change to vegetation recorded during observational monitoring.</p>	<ul style="list-style-type: none"> Continue monitoring. Report negligible impact in End of Panel reports. 	NRE No.1Colliery (Environmental Manager)	<ul style="list-style-type: none"> EoP Report within 6 months of Longwalls 4 and 5 completion.
		<p>Within prediction (Level 2):</p> <p>Negligible drainage of water from, or redistribution of water within a swamp, as illustrated by a short term water level reduction greater than variability observed in similar swamps and effect not persisting after a >2 year ARI rainfall event.</p> <p>Negligible change to the composition or distribution of species, as illustrated by a short term (one year duration – first year after mining commences) significant statistical difference between control and impact sites or between before and</p>	<ul style="list-style-type: none"> Continue monitoring. Review frequency and location of monitoring and determine if additional monitoring is required. Inform SCA, OEH & DRE of potential impact Report potential impacts in End of Panel reports 	NRE No.1Colliery (Environmental Manager)	<ul style="list-style-type: none"> SCA, OEH& DRE informed within 1 week of impact detection. Monitoring plan reviewed within one month of impact detection. EoP Report within 6 months of Longwalls 4 and 5 completion. 			

ASPECT	MONITORING				TRIGGER			
	SITES (see Figure 8 and 9)	PARAMETERS	FREQUENCY	PURPOSE	LEVEL	ACTION / REPORTING	RESPONSIBILITY	TIMING
					<p>after mining at the impact sites.</p> <p>Minimal dieback recorded during observational monitoring. Dieback restricted to single area.</p>			
					<p>Exceeding prediction:</p> <p>Peizometers become or stay dry where it has not done so before.</p> <p>Change to the composition or distribution of species, as illustrated by a long term (greater than one year) significant statistical difference between control and impact sites or between before and after mining at the impact sites.</p> <p>Significant dieback recorded during observational monitoring. Dieback not restricted to single area.</p>	<ul style="list-style-type: none"> Engage ecologist to investigate and report on the cause of trigger exceedences and advise of potential impacts. Inform SCA, OEH & DRE of investigation outcomes. Review monitoring program, including frequency and location, and modify if necessary. Develop and implement impact mitigation and remediation measures in consultation with SCA, OEH and DRE. Develop a monitoring plan to determine the success of mitigation / remediation measures. If mitigation / remediation measures are unsuccessful determine whether offsets will be required, and develop an offset strategy. Report in annual and End of Panel reports to inform relevant agencies of results of monitoring. 	NRE No.1 Colliery (Environmental Manager)	<ul style="list-style-type: none"> SCA, OEH and DRE informed within 1 week of impact detection. Investigation initiated within 1 week of impact detection. Results of investigation reported to SCA, OEH& DRE within 1 week of completion. Monitoring plan reviewed within one month of impact detection. Commence preparation of mitigation/action and monitoring plan within 1 week (if required). Monthly updates of investigation progress, if required by SCA / OEH. EoP Report within 6 months of Longwalls 4 and 5 completion.

ASPECT	MONITORING				TRIGGER			
	SITES (see Figure 8 and 9)	PARAMETERS	FREQUENCY	PURPOSE	LEVEL	ACTION / REPORTING	RESPONSIBILITY	TIMING
Threatened frog species	<p>Daily automated monitoring of selected pool water depths at CC1-10 see Water Management Plan for further detail).</p> <p>Photopoint monitoring in streams see Water Management Plan for further detail).</p> <p>Breeding habitat for</p>	<p>Pool water depths and stream flow.</p> <p>A comprehensive visual inspection and photographic record of each monitoring site will be collected each time a site is visited.</p> <p>In breeding habitat standardized transects, spanning the length of breeding habitat, have been established. All frogs and tadpoles encountered are recorded.</p> <p>In non-breeding habitat three 25 m x 25m quadrats have been</p>	<p>Two years of baseline monitoring prior to mining.</p> <p>Monitoring during mining.</p> <p>A minimum of two years of monitoring post-mining.</p> <p>Pool water depth and flow is monitored at two hour intervals and downloaded weekly during mining and monthly otherwise.</p> <p>Photopoint monitoring of creeks determined by proposed monitoring schedule for monitoring sites (see above).</p> <p>Surveys are undertaken in</p>	<p>To determine if subsidence effects resulting from longwall mining result in impacts to significant biodiversity features.</p> <p>Inform stakeholders of baseline assessment and monitoring Identify, investigate and report on impacts to threatened species, populations and communities or their habitat.</p>	<p>Within prediction (Level 1):</p> <p>Negligible changes in flow or natural drainage behaviour of pools, as illustrated by no observable mining induced change.</p> <p>Negligible environmental consequences for threatened frog species, as illustrated by no changes in parameters monitored and no impact to habitat for threatened species.</p>	<ul style="list-style-type: none"> • Continue monitoring. • Report negligible impact in End of Panel reports. 	NRE No.1 Colliery (Environmental Manager)	<ul style="list-style-type: none"> • EoP Report within 6 months of Longwalls 4 and 5 completion.

ASPECT	MONITORING				TRIGGER			
	SITES (see Figure 8 and 9)	PARAMETERS	FREQUENCY	PURPOSE	LEVEL	ACTION / REPORTING	RESPONSIBILITY	TIMING
	<p>Littlejohn's Tree Frog and Giant Burrowing Frog at four locations.</p> <p>Breeding habitat for Barred Stuttering Frog at one location.</p> <p>Non-breeding habitat for Littlejohn's Tree Frog and Giant Burrowing at seven locations.</p>	<p>established at each location. Aural surveys are following by active searching. All frogs observed or heard are recorded. Non-standardised transects are undertaken between quadrats.</p> <p>Analyses of data looks for changes in species richness and abundance using a hierarchical analysis. Analysis of population size will also be undertaken.</p> <p>Qualitative changes to species habitat will also be documented and reported as per this BMP.</p>	<p>winter, summer and autumn for Littlejohn's Tree Frog and Giant Burrowing Frog, and spring and summer for the Barred Stuttering Frog.</p>		<p>Within prediction (Level 2):</p> <p>Negligible changes in flow or natural drainage behaviour of pools, as illustrated by pool level / flow decline <20% during mining compared to baseline for > 2 months.</p> <p>Negligible impacts to changes in general condition of streams, as illustrated by no observable change in stream bed or bank erosion, turbidity, iron staining algal growth vegetation compared to pre-mining conditions.</p> <p>Negligible environmental consequences for threatened frog species, as illustrated by a short term (one year duration – first year after mining commences) significant statistical difference between control and impact sites or between before and after mining at the control sites.</p>	<ul style="list-style-type: none"> Continue monitoring. Review frequency and location of monitoring and determine if additional monitoring is required. Inform SCA, OEH & DRE of potential impact. Report potential impacts in End of Panel reports. 	NRE No.1 Colliery (Environmental Manager)	<ul style="list-style-type: none"> SCA, OEH & DRE informed within 1 week. Monitoring plan reviewed within one month of impact. EoP Report within 6 months of Longwalls 4 and 5 completion.

ASPECT	MONITORING				TRIGGER			
	SITES (see Figure 8 and 9)	PARAMETERS	FREQUENCY	PURPOSE	LEVEL	ACTION / REPORTING	RESPONSIBILITY	TIMING
					<p>Exceeding prediction:</p> <p>Re-direction of surface water flows and pool level / flow decline >20% during mining compared to baseline for > 2mths, considering rainfall / runoff variability.</p> <p>Observable increases stream bed or bank erosion, turbidity, iron staining algal growth vegetation compared to pre-mining conditions.</p> <p>Change to the composition or distribution of species, as illustrated by significant statistical difference between control and impact sites or between before and after mining at the control sites or a significant reduction in population numbers.</p> <p>Significant impacts to breeding habitat for threatened species at risk from subsidence effects (Giant Burrowing Frog, Littlejohn's Tree Frog, Stuttering Frog) spanning the annual lifecycle of these species.</p>	<ul style="list-style-type: none"> Engage ecologist to investigate and report on the cause of trigger exceedences and advise of potential impacts. Inform SCA, OEH & DRE of investigation outcomes. Review monitoring program, including frequency and location, and modify if necessary. This may include addition of flora monitoring along creeks where stream flow has reduced. <p>Develop and implement impact mitigation and remediation measures in consultation with SCA, OEH and DRE.</p> <ul style="list-style-type: none"> Develop a monitoring plan to determine the success of mitigation / remediation measures. If mitigation / remediation measures are unsuccessful determine whether offsets will be required, and develop an offset strategy. Report in annual and End of Panel reports to inform relevant agencies of results of monitoring. 	NRE No.1Colliery (Environmental Manager)	<ul style="list-style-type: none"> Investigation initiated within 1 week of impact detection. SCA, OEH and DRE informed within 1 week of impact detection. Results of investigation reported to SCA, OEH& DRE within 1 week of completion. Monitoring plan reviewed within one month of impact detection. Commence preparation of mitigation/action and monitoring plan within 1 week (if required). Monthly updates of investigation progress, if required by SCA / OEH. EoP Report within 6 months of Longwalls 4 and 5 completion.

ASPECT	MONITORING				TRIGGER			
	SITES (see Figure 10)	PARAMETERS	FREQUENCY	PURPOSE	LEVEL	ACTION / REPORTING	RESPONSIBILITY	TIMING
<i>Aquatic ecology</i>	Daily automated monitoring of selected pool water depths at CC1-10 see Water Management Plan for further detail). Photopoint monitoring in streams see Water Management Plan for further detail). Monitoring of water quality	Pool water depths and stream flow. A comprehensive visual inspection and photographic record of each monitoring site will be collected each time a site is visited. Physico-chemical water quality parameters, including temperature, conductivity, pH, Oxidation, dissolved oxygen and turbidity (see Water Management Plan as well). Physico-chemical properties of waterways are compared to ANZECC	Two years of baseline monitoring prior to mining. Monitoring during mining. A minimum of two years of monitoring post-mining. Pool water depth and flow is monitored at two hour intervals and downloaded weekly during mining and monthly otherwise. Photopoint monitoring of creeks determined by proposed monitoring schedule for monitoring sites (see above). Macroinvertebrate	To determine if subsidence effects resulting from longwall mining result in impacts to aquatic habitats or threatened species. Inform stakeholders of baseline assessment and monitoring. Identify, investigate and report on impacts to aquatic ecology.	Within prediction (Level 1): Negligible changes in flow or natural drainage behaviour of pools, as illustrated by no observable mining induced change. Negligible environmental consequences for creeks, as illustrated by no significant changes in water quality or data collected during macroinvertebrate sampling. Negligible environmental consequences for threatened fish species, as illustrated by no changes to habitat for or numbers of Macquarie Perch.	<ul style="list-style-type: none"> • Continue monitoring. • Report negligible impact in End of Panel reports 	NRE No.1 Colliery (Environmental Manager)	<ul style="list-style-type: none"> • EoP Report within 6 months of Longwalls 4 and 5 completion

ASPECT	MONITORING				TRIGGER			
	SITES (see Figure 10)	PARAMETERS	FREQUENCY	PURPOSE	LEVEL	ACTION / REPORTING	RESPONSIBILITY	TIMING
	<p>and aquatic macroinvertebrates at two impact sites in Cataract Creek.</p> <p>Monitoring of water quality and aquatic macroinvertebrates at six control sites.</p> <p>Monitoring of Macquarie Perch in Cataract Creek.</p>	<p>/AMRANZ (2000) guidelines. Baseline data (upper and lower limits) will be developed from data collected during baseline monitoring for comparison to data collected during mining.</p> <p>Condition of aquatic habitats based on AUSRIVAS method. Upper and lower limits of aquatic habitat will be established using OE50TaxaScores and SIGNAL scores.</p> <p>Quantitative data on Macquarie Perch in Cataract Creek.</p>	<p>monitoring is undertaken in spring and autumn.</p> <p>Monitoring of Macquarie Perch is undertaken in summer.</p>		<p>Within prediction (Level 2):</p> <p>Negligible changes in flow or natural drainage behaviour of pools, as illustrated by pool level / flow decline <20% during mining compared to baseline for > 2 months.</p> <p>Negligible impacts to changes in general condition of streams, as illustrated by no observable change in stream bed or bank erosion, turbidity, iron staining algal growth vegetation compared to pre-mining conditions.</p> <p>Negligible environmental consequences for creeks, as illustrated by a short term (1 year) reduction in aquatic habitat, as shown by:</p> <ul style="list-style-type: none"> • Water quality data exceeding upper or lower limits of baseline monitoring; • Change in OE50Taxa Score; or • Change in AUSRIVAS Band. 	<ul style="list-style-type: none"> • Continue monitoring. • Review frequency and location of monitoring and determine if additional monitoring is required. • Inform SCA, OEH, DPI & DRE of potential impact • Report potential impacts in End of Panel reports 	NRE No.1 Colliery (Environmental Manager)	<ul style="list-style-type: none"> • SCA, OEH, DPI & DRE informed within 1 week • Monitoring plan reviewed prior to next season • EoP Report within 6 months of Longwalls 4 and 5 completion

ASPECT	MONITORING				TRIGGER			
	SITES (see Figure 10)	PARAMETERS	FREQUENCY	PURPOSE	LEVEL	ACTION / REPORTING	RESPONSIBILITY	TIMING
					<p>Exceeding prediction:</p> <p>Re-direction of surface water flows and pool level / flow decline >20% during mining compared to baseline for > 2mths, considering rainfall / runoff variability.</p> <p>Observable increases stream bed or bank erosion, turbidity, iron staining algal growth vegetation compared to pre-mining conditions.</p> <p>Reduction in aquatic habitat at impact sites only for an extended timeframe (>2 years), as shown by:</p> <ul style="list-style-type: none"> • Water quality data exceeding upper or lower limits of baseline monitoring; Change in OE50Taxa Score; or • Change in AUSRIVAS Band 	<ul style="list-style-type: none"> • Engage ecologist to investigate and report on the cause of trigger exceedences and advise of potential impacts. • Inform SCA, OEH & DRE of investigation outcomes. • Review monitoring program, including frequency and location, and modify if necessary. This may include addition of flora monitoring along creeks where stream flow has reduced. Develop and implement impact mitigation and remediation measures in consultation with SCA, OEH and DRE. • Develop a monitoring plan to determine the success of mitigation / remediation measures. • If mitigation / remediation measures are unsuccessful determine whether offsets will be required, and develop an offset strategy. • Report in annual and End of Panel reports to inform relevant agencies of results of monitoring. 	NRE No.1Colliery (Environmental Manager)	<ul style="list-style-type: none"> • Investigation initiated within 1 week of impact detection. • SCA, OEH and DRE informed within 1 week of impact detection. Results of investigation reported to SCA, OEH& DRE within 1 week of completion. • Monitoring plan reviewed within one month of impact detection. • Commence preparation of mitigation/action and monitoring plan within 1 week (if required). • Monthly updates of investigation progress, if required by SCA / OEH. • EoP Report within 6 months of Longwalls 4 and 5 completion.

ASPECT	MONITORING				TRIGGER			
	SITES (see Figure 10)	PARAMETERS	FREQUENCY	PURPOSE	LEVEL	ACTION / REPORTING	RESPONSIBILITY	TIMING
					<p>Significant impacts (loss of habitat) to spawning habitat for Macquarie Perch</p>	<ul style="list-style-type: none"> Investigation of the potential cause of potential impact Inform SCA, OEH & DRE of investigation outcomes Implement impact mitigation measures in consultation with SCA, OEH and DRE Prepare and implement a site mitigation/action plan in consultation with SCA / OEH if appropriate Review monitoring program, including frequency and location, and modify if necessary Report in annual and End of Panel reports to inform relevant agencies of results of monitoring 	<p>NRE Wongawilli Colliery (Environmental Manager)</p>	<ul style="list-style-type: none"> Investigation initiated within 1 week of impact detection Results of investigation reported to SCA, OEH & DRE within 1 week of completion Commence preparation of mitigation/action plan within 1 week if required Monthly updates of investigation progress, if required by SCA / OEH EoP Report within 6 months of Longwalls 4 and 5 completion

Appendix B - Terrestrial Monitoring Baseline Data

Baseline Data – Upland Swamps

Treatment	Site	Autumn 2011			Spring 2011			Autumn 2012			Baseline Average		
		Shannon-Weiner DI	Species Richnes	Total Abundance	Shannon-Weiner DI	Species Richnes	Total Abundance	Shannon-Weiner DI	Species Richnes	Total Abundance	Shannon-Weiner DI	Species Richnes	Total Abundance
Upland Swamp	CRUS1-V1	2.88	30.00	230.00	2.92	20.00	258.00	2.85	27.00	210.00			
	CRUS1-V2	2.55	21.00	192.00	2.59	20.00	194.00	2.28	17.00	163.00			
	CRUS1-V3	2.33	20.00	156.00	2.25	15.00	142.00	2.31	16.00	196.00			
	CRUS1	2.58	23.67	192.67	2.59	18.33	198.00	2.48	20.00	189.67			
Upland Swamp	CRUS3-V1	-	-	-	-	-	-	2.83	23.00	251.00			
	CRUS3-V2	-	-	-	-	-	-	2.55	20.00	179.00			
	CRUS3-V3	-	-	-	-	-	-	2.98	28.00	269.00			
	CRUS3	-	-	-	-	-	-	2.79	23.67	233.00			
Upland Swamp	CCUS1-V1	-	-	-	-	-	-	2.08	14.00	146.00			
	CCUS1-V2	-	-	-	-	-	-	2.83	26.00	230.00			
	CCUS1-V3	-	-	-	-	-	-	2.04	11.00	129.00			
	CCUS1	-	-	-	-	-	-	2.32	17.00	168.33			
Upland Swamp	CCUS3-V1	-	-	-	-	-	-	2.48	22.00	145.00			
	CCUS3-V2	-	-	-	-	-	-	2.35	19.00	148.00			
	CCUS3-V3	-	-	-	-	-	-	2.66	22.00	182.00			
	CCUS3	-	-	-	-	-	-	2.50	21.00	158.33			
Upland Swamp	CCUS4-V1												
	CCUS4-V2												
	CCUS4-V3												
	CCUS4												

Raw Data

CRUS1 – Autumn 2011

	NRE No.1 Wonga East Aut 2011 2011	NRE No.1 Wonga East Aut 2011 2011	NRE No.1 Wonga East Aut 2011 2011
Area	Cataract River	Cataract River	Cataract River
Season	Headwater Swamp 1	Headwater Swamp 1	Headwater Swamp 1
Year	Impact Pre	Impact Pre	Impact Pre
Financial Year	CRUS1-V1	CRUS1-V2	CRUS1-V3
SiteCode			
Treatment			
Impact			
Site Code			
Acacia.terminalis	1	0	0
Actinotus.minor	0	2	0
Almaleea.paludosa	0	1	2
Baeckea.imbricata	0	29	0
Banksia.ericifolia.subsp..ericifolia	3	3	2
Banksia.robur	5	0	7
Bauera.sp.complex	3	0	0
Baumea.articulata	2	0	0
Baumea.sp.Chorizandra.sp.complex	26	0	0
Blandfordia.Burchardia.Caladenia.Haemodorum.Thelymitra.sp.complex	0	3	2
Boronia.parviflora	2	0	0
Callistemon.citrinus	1	0	0
Cassytha.glabella.f..glabella	9	4	1
Dampiera.stricta	4	0	0
Dillwynia.floribunda.retorta.complex	1	0	0
Empodisma.minus	23	11	28
Entolasia.sp.complex	0	4	0
Epacris.obtusifolia	7	0	0
Gonocarpus.tetragynus	1	0	0
Gymnoschoenus.sphaerocephalus	1	0	0
Hakea.teretifolia.subsp..teretifolia	4	2	0
Lepidosperma.limicola	0	0	30
Lepidosperma.neesii.Philothrix.deusta.complex	4	25	3
Leptocarpus.tenax	24	2	27
Leptospermum.juniperinum	12	0	3
Leptospermum.lanigerum	2	0	0
Leptospermum.squarrosum	5	17	4
Lepyrodia.sp. complex	25	30	2
Lindsaea.linearis	3	4	0
Panicum.simile	1	0	0
Ptilothrix.deusta	3	25	3
Schoenus.brevifolius	26	14	24
Schoenus.melanostachys	0	6	0
Selaginella.uliginosa	0	0	10
Sphaerolobium.Stackhousia.sp.complex	0	0	1
Sprengelia.incarnata	5	0	0
Stylidium.productum	0	3	0
Tetrarrhena.turfosa.Hemarthria.uncinata.complex	0	3	0
Thysanotus.juncifolius	26	2	0
Xanthorrhoea.sp.complex	0	0	5
Xanthosia.sp.complex	0	2	1
Xyris.species.complex	1	0	1

CRUS1 – Spring 2011

	NRE No.1 Wonga East Spr 2011 2011	NRE No.1 Wonga East Spr 2011 2011	NRE No.1 Wonga East Spr 2011 2011
Area	Cataract River	Cataract River	Cataract River
Season	Headwater Swamp 1	Headwater Swamp 1	Headwater Swamp 1
Year	Impact Pre	Impact Pre	Impact Pre
Financial Year	CRUS1-V1	CRUS1-V2	CRUS1-V3
SiteCode			
Treatment			
Impact			
Site Code			
Acacia.terminalis	3	0	0
Actinotus.minor	0	4	0
Baeckea.imbricata	1	22	0
Banksia.ericifolia.subsp..ericifolia	2	4	3
Banksia.robur	6	0	6
Bauera.sp.complex	3	0	0
Baumea.articulata	4	0	0
Baumea.sp.Chorizandra.sp.complex	29	0	0
Blandfordia.Burchardia.Caladenia.Haemodorum.Thelymitra.sp.complex	0	2	0
Boronia.parviflora	2	0	0
Callistemon.citrinus	1	0	0
Cassytha.glabella.f..glabella	8	4	0
Drosera.binata	5	0	0
Drosera.peltata	0	19	0
Drosera.spatulata	0	1	0
Empodisma.minus	25	0	26
Entolasia.sp.complex	0	9	0
Epacris.obtusifolia	8	0	0
Eurychorda.complanata	1	0	0
Gymnoschoenus.sphaerocephalus	1	0	0
Hakea.teretifolia.subsp..teretifolia	4	3	0
Lepidosperma.limicola	0	0	30
Lepidosperma.neesii.Philothrix.deusta.complex	19	23	4
Leptocarpus.tenax	18	1	24
Leptospermum.juniperinum	14	0	2
Leptospermum.lanigerum	3	0	0
Leptospermum.squarrosum	3	17	5
Lepyrodia.sp. Complex	8	28	2
Lindsaea.linearis	4	7	0
Mitrasacme.sp.	0	2	0
Ptilothrix.deusta	19	23	4
Schoenus.brevifolius	26	15	20
Selaginella.uliginosa	4	0	6
Sprengelia.incarnata	6	0	0
Stylidium.productum	0	4	0
Tetrarrhena.turfosa.Hemarthria.uncinata.complex	29	4	0
Xanthorrhoea.sp.complex	0	0	7
Xanthosia.sp.complex	0	2	2
Xyris.species.complex	2	0	1

CRUS1 – Autumn 2012

Area	NRE No.1 Wonga East	NRE No.1 Wonga East	NRE No.1 Wonga East
Season	Aut	Aut	Aut
Year	2012	2012	2012
Financial Year	2012	2012	2012
SiteCode	Cataract River	Cataract River	Cataract River
Treatment	Headwater Swamp 1	Headwater Swamp 1	Headwater Swamp 1
Impact	Impact Pre	Impact Pre	Impact Pre
Site Code	CRUS1-V1	CRUS1-V2	CRUS1-V3
Acacia.terminalis	4	0	0
Actinotus.minor	0	2	0
Baeckea.imbricata	1	30	0
Banksia.ericifolia.subsp..ericifolia	5	2	4
Banksia.robur	7	0	5
Bauera.sp.complex	1	0	0
Baumea.articulata	4	0	0
Baumea.sp.Chorizandra.sp.complex	28	0	1
Boronia.parviflora	1	0	0
Callistemon.citrinus	2	0	0
Cassytha.glabella.f..glabella	5	2	0
Dampiera.stricta	0	2	0
Dillwynia.floribunda.retorta.complex	1	0	0
Drosera.spatulata	0	1	0
Empodisma.minus	18	8	30
Entolasia.sp.complex	0	5	0
Epacris.obtusifolia	6	0	0
Gymnoschoenus.sphaerocephalus	2	0	0
Hakea.teretifolia.subsp..teretifolia	3	2	0
Lepidosperma.limicola	0	0	30
Lepidosperma.neesii.Philothrix.deusta.complex	11	0	0
Lepidosperma.sp.	0	4	0
Leptocarpus.tenax	21	0	28
Leptospermum.juniperinum	9	0	2
Leptospermum.lanigerum	3	0	0
Leptospermum.polygalifolium.trinervium.complex	0	2	0
Leptospermum.squarrosum	5	21	4
Lepyrodia.muelleri.scariosa.complex	6	28	2
Lindsaea.linearis	0	4	0
Ptilothrix.deusta	11	30	11
Schoenus.brevifolius	23	18	28
Selaginella.uliginosa	1	0	8
Sprengelia.incarnata	6	0	0
Stylidium.productum	0	2	0
Tetrarrhena.turfosa	25	0	28
Xanthorrhoea.sp.complex	0	0	13
Xanthosia.sp.complex	0	0	1
Xyris.species.complex	1	0	1

CRUS3 – Autumn 2012

Area	NRE No.1 Wonga East	NRE No.1 Wonga East	NRE No.1 Wonga East
Season	Aut	Aut	Aut
Year	2012	2012	2012
Financial Year	2012	2012	2012
SiteCode	Cataract River	Cataract River	Cataract River
Treatment	Headwater Swamp 3	Headwater Swamp 3	Headwater Swamp 3
Impact	Impact Pre	Impact Pre	Impact Pre
Site Code	CRUS3-V1	CRUS3-V2	CRUS3-V3
Actinotus.minor	0	0	22
Almaleea.paludosa	0	5	0
Baeckea.imbricata	0	0	22
Baloskion.gracile	5	0	0
Banksia.paludosa	4	0	0
Bauera.sp.complex	15	1	10
Blandfordia.Burchardia.Caladenia.Haemodorum.Thelymitra.sp.complex	0	0	1
Cassytha.glabella.f..glabella	14	0	20
Dampiera.stricta	5	8	15
Dillwynia.floribunda.retorta.complex	0	1	0
Drosera.spatulata	0	0	2
Empodisma.minus	20	16	18
Entolasia.sp.complex	5	0	10
Eurychorda.complanata	4	1	5
Gleichenia.sp.complex	0	19	4
Gonocarpus.micranthus.subsp..micranthus	0	0	3
Gymnoschoenus.sphaerocephalus	0	15	0
Hakea.teretifolia.subsp..teretifolia	0	5	0
Lepidosperma.limicola	13	26	2
Leptocarpus.tenax	28	24	23
Leptospermum.trinervium	0	0	3
Leptospermum.juniperinum	1	0	1
Lepyrodia.muelleri.scariosa.complex	4	2	23
Lindsaea.linearis	4	4	15
Lomandra..filiformis	0	0	2
Lomandra.sp.complex	0	0	14
Mirbelia.rubifolia	9	0	0
Panicum.simile	13	3	1
Patersonia.sericea	0	0	9
Persoonia.mollis.subsp..nectens	1	0	0
Platysace.linearifolia	6	0	5
Poa.sp.	5	0	0
Ptilothrix.deusta	24	12	15
Schoenus.brevifolius	24	0	9
Schoenus.turbinatus	0	1	0
Selaginella.uliginosa	18	4	13
Sphaerolobium.Stackhousia.sp.complex	0	1	0
Stylidium.lineare	0	0	1
Tetraria.capillaris	2	6	0
Tetrarrhena.turfosa	27	25	1

CCUS1 – Autumn 2012

Area	NRE No.1 Wonga East	NRE No.1 Wonga East	NRE No.1 Wonga East
Season	Aut	Aut	Aut
Year	2012	2012	2012
Financial Year	2012	2012	2012
	Cataract Creek	Cataract Creek	Cataract Creek
	Headwater Swamp 1	Headwater Swamp 1	Headwater Swamp 1
	Impact Pre	Impact Pre	Impact Pre
SiteCode	CCUS1-V1	CCUS1-V2	CCUS1-V3
Treatment			
Impact			
Site Code			
Anisopogon.avenaceus	8	8	0
Banksia.oblongifolia	0	6	0
Bauera.sp.complex	0	5	0
Baumea.sp.Chorizandra.sp.complex	0	3	7
Cassytha.glabella.f..glabella	15	22	0
Dampiera.stricta	0	6	0
Dillwynia.floribunda.retorta.complex	0	4	0
Empodisma.minus	30	17	26
Entolasia.sp.complex	16	5	0
Epacris.obtusifolia	0	1	0
Eurychorda.complanata	0	0	7
Gonocarpus.micranthus.subsp..micranthus	1	0	0
Gymnoschoenus.sphaerocephalus	0	1	28
Hibbertia.riparia.sp.complex	0	1	0
Lepidosperma.limicola	0	0	27
Lepidosperma.neesii.Philothrix.deusta.complex	0	2	0
Leptocarpus.tenax	0	19	13
Leptospermum.juniperinum	0	4	2
Lepyrodia.muelleri.scariosa.complex	0	13	8
Lindsaea.linearis	0	11	0
Microlaena.stipoides	2	2	0
Mitrasacme.sp.complex	0	2	0
Panicum.simile	3	2	0
Persoonia.mollis.subsp..nectens	1	0	0
Poa.sp.	1	0	0
Pteridium.esculentum	4	0	0
Ptilothrix.deusta	4	25	0
Schoenus.brevifolius	30	29	8
Selaginella.uliginosa	1	2	0
Tetraria.capillaris	0	2	0
Tetrarrhena.turfosa	30	22	0
Xanthorrhoea.sp.complex	0	16	2
Xyris.species.complex	0	0	1

CCUS3 – Autumn 2012

Area	NRE No.1 Wonga East	NRE No.1 Wonga East	NRE No.1 Wonga East
Season	Aut	Aut	Aut
Year	2012	2012	2012
Financial Year	2012	2012	2012
	Cataract Creek	Cataract Creek	Cataract Creek
	Headwater Swamp 3	Headwater Swamp 3	Headwater Swamp 3
	Impact Pre	Impact Pre	Impact Pre
SiteCode	CCUS3-V1	CCUS3-V2	CCUS3-V3
Actinotus.minor	2	0	0
Allocasuarina.littoralis	1	0	0
Baeckea.imbricata	1	0	4
Baloskion.gracile	0	0	5
Banksia.ericifolia.subsp..ericifolia	2	1	4
Banksia.oblongifolia	0	3	0
Banksia.robur	1	0	0
Bauera.sp.complex	0	0	2
Cassytha.glabella.f..glabella	4	3	5
Dampiera.stricta	4	0	0
Dillwynia.floribunda.retorta.complex	0	6	0
Empodisma.minus	12	23	20
Entolasia.sp.complex	1	8	10
Eucalyptus.racemosa	1	0	0
Goodenia.dimorpha.stelligera.complex	2	0	1
Grevillea.sp.complex	0	3	4
Hakea.teretifolia.subsp..teretifolia	0	0	1
Lepidosperma.limicola	16	20	8
Leptocarpus.tenax	8	5	21
Leptospermum.trinervium	0	3	0
Leptospermum.polygalifolium.trinervium.complex	1	0	0
Leptospermum.squarrosum	3	2	0
Lepyrodia.muelleri.scariosa.complex	0	0	7
Lindsaea.linearis	0	0	10
Lomandra.sp.complex	0	0	1
Mitrasacme.sp.complex	10	0	0
Monotaxis.linifolia	0	3	0
Opercularia.sp.	0	1	0
Panicum.simile	0	2	3
Parsonia.straminea	0	1	0
Patersonia.sericea	0	1	2
Persoonia.mollis.subsp..nectens	1	0	0
Pterostylis.sp.	1	0	0
Ptilothrix.deusta	26	4	27
Schoenus.brevifolius	30	30	30
Selaginella.uliginosa	4	0	9
Stylidium.graminifolium	0	0	1
Tetrarrhena.turfosa	14	29	7

CC – Autumn 2011

	NRE No.1 Wonga East Aut 2011 2011	NRE No.1 Wonga East Aut 2011 2011	NRE No.1 Wonga East Aut 2011 2011
Area			
Season			
Year			
Financial Year			
SiteCode	Cataract Creek	Cataract Creek	Cataract Creek
Treatment	Impact Pre	Impact Pre	Impact Pre
Impact			
Site Code	CC-V1	CC-V2	CC-V3
Acacia.binervata	2	0	1
Acacia.mearnsii	1	0	0
Acmena.smithii	0	0	2
Asplenium.flabellifolium	0	0	1
Blechnum.cartilagineum	1	2	0
Calochlaena.dubia	2	0	0
Ceratopetalum.apetalum	6	6	6
Cissus.hypoglauca	0	0	1
Clematis.aristata	0	0	2
Cryptocarya.glaucescens	0	0	4
Cyathea.australis	0	0	1
Cyathea.leichhardtiana	0	1	0
Dianella.caerulea.complex	2	0	0
Doryphora.sassafras	3	2	3
Eucalyptus.botryoides.x.saligna	0	0	4
Eucalyptus.elata	5	0	0
Eustrephus.latifolius	0	2	2
Gahnia.clarkei	2	0	0
Grammitis.billardierei	0	1	0
Livistona.australis	2	1	2
Lomandra.longifolia	1	0	0
Marsdenia.suaveolens	0	0	1
Microsorium.scandens	0	0	1
Morinda.jasminoides	0	2	3
Notelaea.species.complex	1	3	2
Pittosporum.pauciflorus	0	0	1
Pittosporum.revolutum	1	2	0
Pyrrhosia.rupestris	0	1	0
Schelhammera.undulata	0	1	0
Smilax.australis	0	0	2
Stenocarpus.salignus	0	2	0
Sticherus.flabellatus.var..flabellatus	0	2	0
Tasmania.insipida	1	3	3
Trochocarpa.laurina	2	3	0

CC – Spring 2011

	NRE No.1 Wonga East Spr 2011 2011	NRE No.1 Wonga East Spr 2011 2011	NRE No.1 Wonga East Spr 2011 2011
Area	Cataract	Cataract	Cataract
Season	Creek	Creek	Creek
Year	Impact	Impact	Impact
Financial Year	Pre	Pre	Pre
SiteCode	CC-V1	CC-V2	CC-V3
Treatment			
Impact			
Site Code			
Acacia.binervata	2	2	1
Acacia.mearnsii	1	0	0
Acmena.smithii	0	0	2
Asplenium.flabellifolium	0	0	1
Blechnum.cartilagineum	1	2	0
Calochlaena.dubia	2	0	0
Ceratopetalum.apetalum	6	6	6
Cissus.hypoglauca	0	0	1
Clematis.aristata	0	0	2
Cryptocarya.glaucescens	0	2	4
Cyathea.leichhardtiana	0	1	0
Doryphora.sassafras	3	2	3
Eucalyptus.botryoides.x.saligna	0	0	4
Eucalyptus.elata	5	0	0
Eustrephus.latifolius	0	2	0
Gahnia.clarkei	2	0	0
Grammitis.billardierei	0	1	0
Livistona.australis	2	1	2
Marsdenia.suaveolens	0	0	1
Microsorium.scandens	0	0	1
Morinda.jasminoides	0	2	3
Notelaea.species.complex	1	3	1
Parsonsia.straminea	0	1	0
Pittosporum.pauciflorus	0	0	1
Pittosporum.revolutum	1	0	0
Pyrrosia.rupestris	0	1	0
Schelhammera.undulata	0	1	0
Smilax.australis	0	0	2
Stenocarpus.salignus	0	2	0
Tasmania.insipida	1	3	3
Trochocarpa.laurina	2	3	1

CC – Autumn 2012

	NRE No.1 Wonga East Aut 2012 2012	NRE No.1 Wonga East Aut 2012 2012	NRE No.1 Wonga East Aut 2012 2012
Area			
Season			
Year			
Financial Year			
SiteCode	Cataract Creek	Cataract Creek	Cataract Creek
Treatment	Impact Pre	Impact Pre	Impact Pre
Impact			
Site Code	CC-V1	CC-V2	CC-V3
Acacia.binervata	4	0	1
Acacia.mearnsii	1	0	0
Acmena.smithii	0	0	5
Blechnum.cartilagineum	1	2	0
Calochlaena.dubia	1	0	0
Ceratopetalum.apetalum	6	6	6
Cissus.hypoglauca	0	0	2
Clematis.aristata	0	0	2
Cryptocarya.glaucescens	2	3	5
Cyathea.leichhardtiana	0	1	0
Dianella.caerulea.complex	2	0	0
Doryphora.sassafras	0	3	4
Eucalyptus.botryoides	0	0	4
Eucalyptus.elata	5	0	0
Eustrephus.latifolius	0	0	1
Gahnia.clarkei	3	0	0
Grammitis.billardierei	0	3	0
Livistona.australis	3	3	3
Marsdenia.suaveolens	0	0	1
Microsorium.scandens	0	0	2
Morinda.jasminoides	0	3	3
Notelaea.species.complex	1	3	0
Parsonsia.straminea	0	1	0
Pittosporum.multiflorum	0	1	0
Pyrrosia.rupestris	0	2	0
Schelhammera.undulata	0	2	0
Smilax.australis	0	0	2
Stenocarpus.salignus	0	2	0
Sticherus.flabellatus.var..flabellatus	0	2	0
Tasmania.insipida	2	3	3
Trochocarpa.laurina	3	3	1

Baseline Data – Frogs (Breeding)

Site	CRUS1(1)-T	CRUS1(1)-T	CRUS1(2)-T	CRUS2-T	CRUS2-T-S	CCUS4-T	CCUS4-T	CC(1)-T	CC(2)-T
Date	27/08/2012	29/08/2012	27/08/2012	28/08/2012	30/08/2012	28/08/2012	29/08/2012	24/10/2012	25/10/2012
Season	Winter	Winter	Winter	Winter	Winter	Winter	Winter		
Littlejohn's Tree Frog	Tadpoles	0	0	0	0	0	0	-	-
	Adults	0	0	0	0	0	0	-	-
Giant Burrowing Frog	Tadpoles	0	0	0	17	11	0	0	-
	Adults	0	0	0	0	0	0	0	-
Red-crowned Toadlet	Tadpoles	0	0	0	0	0	0	0	-
	Adults	0	0	0	0	0	0	0	-
Stuttering Frog	Tadpoles	-	-	-	-	-	-	-	0
	Adults	-	-	-	-	-	-	-	0
Incidental species	0	0	0	0	Limnodynastes spp.	0	C.signifera	C.signifera L.lesueuri L.phyllochroa L.phyllochroa/nudidigita	C.signifera L.phyllochroa L.phyllochroa/nudidigita
Breeding pools	0	0	0	3	3	1	1	Stream	Stream

Baseline Data – Frogs (Non-breeding)

	Site	CRUS1-F1	CRUS1-F1	CRUS1-F2	CRUS1-F2	CRUS1-F3	CRUS1-F3	CRUS2-F1	CRUS2-F1	CRUS2-F2	CRUS2-F2
	Date	27/08/2012	29/08/2012	27/08/2012	29/08/2012	27/08/2012	29/08/2012	28/08/2012	30/08/2012	28/08/2012	30/08/2012
	Season	Winter	Winter	Winter	Winter	Winter	Winter	Winter	Winter	Winter	Winter
Littlejohn's Tree Frog	Tadpoles	0	0	0	0	0	0	0	0	0	0
	Adults	0	0	0	0	0	0	0	0	0	0
Giant Burrowing Frog	Tadpoles	0	0	0	0	0	0	0	0	0	0
	Adults	0	0	0	0	0	0	0	0	0	0
Red-crowned Toadlet	Tadpoles	0	0	0	0	0	0	0	0	0	0
	Adults	0	0	0	0	0	0	0	0	0	0
Incidental species		0	0	0	C.signifera	C.signifera	C.signifera	C.signifera	C.signifera	C.signifera	C.signifera

	Site	CCUS3-F1	CCUS3-F1	CCUS3-F2	CCUS3-F2	CCUS4-F1	CCUS4-F1	CCUS4-F2	CCUS4-F2
	Date	28/08/2012	29/08/2012	28/08/2012	29/08/2012	28/08/2012	29/08/2012	28/08/2012	29/08/2012
	Season	Winter	Winter	Winter	Winter	Winter	Winter	Winter	Winter
Littlejohn's Tree Frog	Tadpoles	0	0	0	0	0	0	0	0
	Adults	0	0	0	0	0	0	0	0
Giant Burrowing Frog	Tadpoles	0	0	0	0	0	0	0	0
	Adults	0	0	0	0	0	0	0	0
Red-crowned Toadlet	Tadpoles	0	0	0	0	0	0	0	0
	Adults	0	0	0	0	0	0	0	0
Incidental species		0	C.signifera	0	C.signifera	0	C.signifera	0	C.signifera L.verreauxii

Appendix C - Aquatic Monitoring Baseline Data

Water Quality

	DTV	Spring 2008		Autumn 2009		Spring 2009		Autumn 2010		Spring 2010		Autumn 2011		Spring 2011		Autumn 2012		
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	
5	Temperature	-	13.4	0	17.8	0	14.4	0	17.9	0	9.4	0	14.9	0	13	0	9.8	0
	Conductivity (µS/cm)	30 - 350	138	0	4	4	112	0	214	0	108.5	10.5	114.5	2.5	146	1	119	2
	pH	6.5 - 8.0	7.3	0	6.9	0	6.8	0	6.7	0	6.5	0	6.5	0	6.5	0	6.2	0
	ORP (mV)	-	442.5	2.5	478.5	1.5	362	0	148	0	410	0	287.5	2.5	42.5	5.5	535	1
	Dissolved Oxygen (%)	90 - 110	80.9	0.7	77.6	0.6	101.4	4.7	74.1	0	74.7	4.3	101.1	0.5	85.1	0.3	87.6	0.9
	Turbidity (ntu)	2.0 - 25	7.9	0.1	2.2	0.1	20.9	0.6	19.2	0.3	3.4	0.1	27.3	0.5	1.4	0.2	11.3	0.2
6	Temperature	-	13.5	0	17.4	0	14.6	0	17.9	0	9.8	0	15	0	13	0	9.9	0
	Conductivity (µS/cm)	30 - 350	146.5	1.5	126	0	72.5	2.5	126.5	2.5	123	0	117	1	162.5	31.5	112	0
	pH	6.5 - 8.0	6.9	0	6.5	0	6.8	0	6.4	0	6.3	0	6.4	0	6.5	0	6.2	0.1
	ORP (mV)	-	378	9	437	0	352.5	0.5	474	0	420.5	0.5	266.5	2.5	10	2	533	3
	Dissolved Oxygen (%)	90 - 110	63.9	0.3	51.8	0.3	177.2	19	69.7	0.2	77.8	0.5	72.3	1.1	77.6	0.8	79.5	0.5
	Turbidity (ntu)	2.0 - 25	9.6	0.2	22.1	1	28.8	1.3	5.5	0.1	4.2	0.1	9.8	0.2	6.1	0.4	17.8	3.9
9	Temperature	-	14.4	0	17.3	0.1	14.9	0	17.4	0	11.7	0	14.8	0	12.9	0	9.3	0
	Conductivity (µS/cm)	30 - 350	161	0	131	5	96	2	188.5	5.5	112	0	122	0	215	2	116	2
	pH	6.5 - 8.0	7.1	0.1	6.8	0	6.6	0	6.2	0	6.6	0	6.8	0	6.5	0	6.2	0
	ORP (mV)	-	456	17	393	9	147	0	188	0	456.5	2.5	250.5	3.5	12.5	0.5	545	1
	Dissolved Oxygen (%)	90 - 110	67.5	1.8	56.1	10.4	68.1	0.1	82.4	0.8	75.9	2.3	89.7	0.6	67	0.7	83.1	1.3
	Turbidity (ntu)	2.0 - 25	18.1	0.1	5.9	1.2	0.6	0.1	51.8	4.7	7.2	0.4	4.1	0	5.7	0.4	11.2	1.2
10	Temperature	-	14.3	0	17.1	0	14.7	0	17.5	0	11.8	0	14.9	0	13.8	0	9.2	0.1
	Conductivity (µS/cm)	30 - 350	161	0	9	0	94	0	56	0	102.5	0.5	112	0	282	2	107	2
	pH	6.5 - 8.0	7.1	0.1	6.6	0	6.4	0.1	5.8	0	6.6	0	6.9	0	6.6	0	6.1	0
	ORP (mV)	-	494	5	429	1	142	2	483	3	472	2	229.5	2.5	57	0	548	1
	Dissolved Oxygen (%)	90 - 110	72.2	0.6	58.6	0.2	85.8	0.2	94.7	1.3	84	0.3	89.9	0.6	72.9	0.3	84.7	0.4
	Turbidity (ntu)	2.0 - 25	11.5	0.1	2.3	0.1	1.2	0.3	13.9	0.2	5.4	0.3	7.3	0.1	2.8	0.3	16.3	2.9
11	Temperature	-	14.8	0	22.3	0	18.5	0	21.4	0	13.6	0	17.5	0.2	14.5	0	8.7	0.1
	Conductivity (µS/cm)	30 - 350	136	8	8	0	86.5	0.5	104	0	89	0	73	23	97	1	74	0
	pH	6.5 - 8.0	5.9	0	6	0	5.6	0	5.7	0	5.6	0	5.9	0	5.6	0	5.8	0.1

	DTV	Spring 2008		Autumn 2009		Spring 2009		Autumn 2010		Spring 2010		Autumn 2011		Spring 2011		Autumn 2012		
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	
	-	509	0	495	1	227	1	463.5	0.5	439	1	326.5	2.5	196.5	2.5	568	0	
ORP (mV)	-	509	0	495	1	227	1	463.5	0.5	439	1	326.5	2.5	196.5	2.5	568	0	
Dissolved Oxygen (%)	90 - 110	80.3	0.5	80.2	0.1	90.2	0.9	81.7	0.1	123.5	0.6	88.4	0.5	67.2	0.3	83.2	0.6	
Turbidity (ntu)	2.0 - 25	7.1	0.3	FP		1.8	0.3	2.2	0	1.7	0.1	3	0.1	3.3	0.4	9.8	0.8	
12	Temperature	-	14.7	0	25.2	0.1	18.6	0	21.7	0	16.7	0	18.6	0	15.5	0	9.1	0.1
	Conductivity (µS/cm)	30 - 350	133.5	5.5	0	0	87	0	97	2	95	0.8	71.5	0.5	128	0	69	5
	pH	6.5 - 8.0	6.2	0	5.7	0	5.5	0	5.5	0	5.6	0	6.1	0	5.8	0	5.9	0.1
	ORP (mV)	-	489	0	532	3	240.5	0.5	460.5	2.5	448.5	0.5	297.5	3.5	225.5	0.5	568	2
	Dissolved Oxygen (%)	90 - 110	85.3	0.1	86.9	0.1	84.3	1.8	82	0.1	98.8	2.8	96.8	0.1	71.4	0.1	88.5	0.9
	Turbidity (ntu)	2.0 - 25	5.1	0.2	FP		1.8	0.5	0.5	0.1	1.4	0.1	1.3	0.1	6.7	0.2	6.1	0.7
13	Temperature	-	NS	NS	18.2	0	15.1	0	17.7	0	11.8	0	15.4	0	11	0	9.9	0
	Conductivity (µS/cm)	30 - 350	NS	NS	110.5	4.5	102	0	224.5	1.5	127	0	120	0	202.5	2.5	121	0
	pH	6.5 - 8.0	NS	NS	13.4	0	6.5	0	5.9	0	6.2	0	6.3	0.1	6.3	0	5.9	0
	ORP (mV)	-	NS	NS	563	0	184	1	206	1	416.5	0.5	348.5	8.5	133	1	556	11
	Dissolved Oxygen (%)	90 - 110	NS	NS	72.8	0.2	79.8	4.6	84	0.1	96.9	0.9	98.1	0.1	69.6	0.3	85.2	0.1
	Turbidity (ntu)	2.0 - 25	NS	NS	0.1	0	1.9	0.1	20.7	0.5	1.9	0.1	6	0.1	2.5	0.1	6.5	0.7
14	Temperature	-	NS	NS	18.3	0	15	0	17.8	0	11.9	0	15.4	0	11.4	0	9.7	0
	Conductivity (µS/cm)	30 - 350	NS	NS	115	9	64.5	4.5	73	0	104.5	2.5	98.5	2.5	194	0	122	0
	pH	6.5 - 8.0	NS	NS	13.4	0	6.8	0	5.9	0	6.4	0	6.6	0	6.3	0	6	0
	ORP (mV)	-	NS	NS	523	1	409.5	0.5	499.5	1.5	357	3	357.5	2.5	142.5	0.5	542	0
	Dissolved Oxygen (%)	90 - 110	NS	NS	77.8	0	119.5	1.8	499.5	0.6	72.2	1.3	106.3	1.1	67.7	0.2	86.7	0.8
	Turbidity (ntu)	2.0 - 25	NS	NS	0.7	0	31.4	0.9	10.4	0.2	2.5	0.1	8.6	0.3	2.3	0.2	6	0.7

Macroinvertebrate – AUSRIVAS

		Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Spring 2010	Autumn 2011	Spring 2011	Autumn 2012
5	Number of Taxa Sampled	23.0	20.0	14.0	13.0	15.0	16.0	13.0	10.0
	OE50 Taxa	0.8	0.7	0.6	0.3	0.8	0.7	0.7	0.6
	BAND Grade	A	B	B	C	A	B	B	B
	SIGNAL2	4.6	5.6	4.9	4.5		5.0	4.1	5.8
6	Number of Taxa Sampled	18.0	22.0	13.0	18.0	19.0	16.0	15.0	16.0
	OE50 Taxa	0.7	1.0	0.6	0.3	0.9	0.7	0.3	0.9
	BAND Grade	B	A	B	C	A	B	C	A
	SIGNAL2	4.8	4.9	4.6	4.8		4.9	4.9	5.1
9	Number of Taxa Sampled	26.0	33.0	24.0	20.0	25.0	28.0	19.0	13.0
	OE50 Taxa	0.8	1.1	1.1	0.5	0.8	0.6	0.4	0.7
	BAND Grade	B	A	A	B	B	B	C	B
	SIGNAL2	4.8	4.6	4.9	4.6		5.5	4.9	5.5
10	Number of Taxa Sampled	26.0	29.0	18.0	21.0	30.0	24.0	25.0	11.0
	OE50 Taxa	1.0	1.1	0.6	0.4	1.2	0.8	0.6	0.5
	BAND Grade	A	A	B	C	X	A	B	B
	SIGNAL2	4.5	4.9	5.7	4.5		4.9	5.3	6.0
11	Number of Taxa Sampled	20.0	28.0	16.0	20.0	13.0	22.0	30.0	15.0
	OE50 Taxa	0.8	0.9	0.7	0.4	0.6	0.9	0.6	0.7
	BAND Grade	B	A	B	C	B	A	B	B
	SIGNAL2	4.9	5.1	5.0	5.1		4.6	4.6	5.4
12	Number of Taxa Sampled	17.0	25.0	16.0	14.0	22.0	18.0	13.0	15.0
	OE50 Taxa	0.7	1.0	0.7	0.4	0.9	0.8	0.5	0.7
	BAND Grade	B	A	B	C	A	A	C	B
	SIGNAL2	4.7	4.9	5.3	5.6		5.4	5.2	5.1
13	Number of Taxa Sampled	-	29.0	23.0	17.0	23.0	21.0	22.0	17.0
	OE50 Taxa	-	1.1	0.8	0.5	1.2	1.0	0.5	0.9
	BAND Grade	-	A	B	B	A	A	B	A
	SIGNAL2	-	4.8	5.0	4.9		5.2	4.7	5.6
14	Number of Taxa Sampled	-	29.0	20.0	19.0	19.0	24.0	23.0	18.0
	OE50 Taxa	-	1.1	0.9	0.6	0.9	1.0	0.7	0.9
	BAND Grade	-	A	A	B	A	A	B	A
	SIGNAL2	-	4.7	5.2	5.2		5.0	4.7	5.6

Macquarie Perch

Common Name	Scientific Name	Summer 2009/2010				Summer 2010/2011				Summer 2011/2012			
		15/12/2009	8/01/2010	29/01/2010	25/02/2010	8/12/2010	7/01/2011	25/01/2011	21/02/2011	6/1/2012	19/1/2012	1/2/2012	21/2/2012
Macquarie perch	<i>Macquaria australasica</i>	3	6	6	15	11	14	37	28	7	2	5	4
Freshwater cod	<i>Maccullochella sp.</i>	5	2	5	53	5	8	18	22	1	1	2	2
Silver perch	<i>Bidyanus bidyanus</i>	0	0	0	9	0	0	5	4				
Goldfish	<i>Carrassius auratus</i>	93	27	11	8	1	0	0	12				
Eastern gambusia	<i>Gambusia holbrooki</i>	>1000	>1000	>1000	>1000	193	42	189	>500	>100	>100	>100	>100
Mountain galaxis	<i>Galaxias olidus</i>	49	19	4	56	249	34	82	57	>100	>100	>100	>100
Freshwater catfish	<i>Tandanus tandanus</i>										1		
Short-finned Eel	<i>Anguilla australis</i>					0	2	1	0				