



GUJARAT NRE Wonga Pty Ltd

WONGAWILLI COLLIERY LONGWALL 15 END OF PANEL REPORT



March 2013

DOCUMENT CONTROL

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Wongawilli Colliery – Longwall 15 End of Panel Report: Ecology and Cultural
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1 ABBREVIATIONS AND DEFINITIONS

DECCW - Formerly the NSW Department of Environment, Climate Change and Water now known as the NSW Office of Environment and Heritage (OEH). OEH has been used as the modern reference to this Department.

DRE - Divisions of Resources and Energy

EOP - End of Panel Report

ESSMP - Environment, Subsidence and Safety Management Plan

IIN - Formerly Industry and Investment NSW

Limit of Subsidence - Described as the Limit of Vertical Subsidence - the area extending beyond the 20mm/m subsidence contour line

ML - Mining Lease

MSEC - Mine Subsidence Engineering Consultants

SMP - Subsidence Management Plan

SMP Area - The area considered for the full SMP application for Longwalls 11,12,15,16 & 19 and 20

2 SUMMARY

This End of Panel (EOP) report has been prepared in accordance with Condition 17.1 (revised) of the NRE Wongawilli Colliery Longwalls 11, 12, 15, 16, 19 and 20 Subsidence Management Plan (SMP) Approval. This EOP relates to Longwall 15 only.

This EOP report outlines the measured and observed impacts following the extraction of NRE Wongawilli Colliery Longwall 15 and compares any observed impacts with the relevant impact predictions outlined in the SMP and its supporting expert reports and accompanying documentation.

Longwall 15 occurs within Mining Lease (ML) 1596 and was extracted using conventional longwall mining techniques and equipment. Extraction of coal from Longwall 15 commenced on 24 May 2012 and concluded on 6 November 2012.

Subsidence

There are no subsidence survey lines installed in the surface area above Longwall 15. As such, subsidence survey data is not available for Longwall 15.

No major surface cracking (>10mm) was observed in the Mining Area above Longwall 15 during longwall extraction.

Impacts on Man Made Features

Comparison between Predicted and Observed Impacts on Surface Infrastructure

The observed impacts on man made features resulting from the extraction of Longwall 15 were similar to, or less than, the impacts predicted in the SMP. Surface infrastructure located above or adjacent to LW15 and observed impacts are shown in **Table 5.1**.

No subsidence impacts to Indigenous heritage sites were observed.

During extraction of Longwall 15 there was also no increase to minor cracking and rock falls observed during the extraction of Longwall 11 along the Maldon-Dombarton Corridor.

Impacts on Natural Features

The observed impacts on natural features resulting from the extraction of Longwall 15 were all less than or in accordance with impacts predicted in the SMP.

There have been no observed impacts to cliffs, steep slopes or rock outcrops as a result of the extraction of Longwall 15.

There have been no observed impacts to terrestrial or aquatic ecological values or habitats as a result of the extraction of Longwall 15.

Monitoring of groundwater identified the groundwater level within the Hawkesbury Sandstone fell by 8.92m since June 2010 in open piezometer EGW3 (over Longwall 11) as a result of the extraction of Longwall 11. To date the EGW3 water level has not recovered and the other EGW water levels remained static to slightly rising during extraction of Longwalls 15, 19 and 20.

Trigger Action Response Plans (TARP's)

During extraction of Longwalls 15, no TARP triggers were exceeded.

The SCA and TransGrid, the owner and operator of the 330kv transmission line located to the east of the SMP Area, have not reported any environmental impacts related to Longwall 15.

Conclusion

The extraction of coal from NRE Wongawilli Colliery Longwall 15 has resulted in no unexpected impacts to natural or man made features. No remediation is currently considered to be required.

Currently there is no extraction occurring in the Mining Area, with Longwall 16 the only approved longwall remaining to be extracted in the area. Longwall 16 is scheduled to be mined prior to December 2017, following extraction of the N1-N6 longwalls in the approved Nebo Mining Area.

Monitoring of natural and man made features in accordance with the NRE Wongawilli Colliery Environment, Subsidence and Safety Management Plan (ESSMP) for the Mining Area will continue until the commencement of Longwall16.

3 INTRODUCTION

3.1 Background

This End of Panel (EOP) report has been prepared to define impacts observed from subsidence associated with the extraction of coal from Longwall 15 NRE Wongawilli Colliery. The EOP has been prepared in accordance with Condition 17(as revised) of the Subsidence Management Plan (SMP) approval.

Information in this EOP has been supplied by Gujarat NRE Wonga Pty Ltd (Gujarat NRE) and specialist consultants involved in monitoring the effects of mining within the limit of subsidence of Longwall 15.

Longwall 15 is located in Mining Lease (ML) 1596. The longwall was the fifth mined in a series of six longwalls (Longwalls 11,12,15,16,19 and 20). Longwalls 11, 12, 19 and 20 have already been extracted and were subject to previous EOP reports.

Coal from Longwall 15 was extracted using conventional longwall mining techniques between the following dates from 24 May 2012 to 6 November 2012

Longwall 15 is shown in **Figure 1**. Impact predictions associated with Longwall 15 as part of the larger application area are described in the following reports. Copies of these reports reside with the Division of Resources and Energy (DRE), formerly known as the Department of Industry and Investment.

- ❑ Gujarat NRE Minerals Limited 2008: Subsidence Management Plan for NRE Wongawilli Colliery (Longwall Panels 11, 12, 15, 16, & 19, and Pillar Extraction Area 1) – “Written Report”
- ❑ Mine Subsidence Engineering Consultants [MSEC] (2008) NRE Wongawilli Colliery; The Prediction of Subsidence Parameters and the Assessment of Subsidence Impacts on Natural Features and Surface Infrastructure due to Mining Longwalls 11, 12, 15, 16 & 19 & Pillar Extraction Area PE1 (MSEC 360).
- ❑ Wood, J (2008a) Indicative Hydrogeology NRE Wongawilli Colliery. Proposed Extraction of Longwalls 11, 12, 15, 16 & 19 and Pillar Extraction Area 1.
- ❑ Wood, J (2008b) Indicative Hydrology NRE Wongawilli Colliery. Proposed Extraction of Longwalls 11, 12, 15, 16 & 19 and Pillar Extraction Area 1.
- ❑ Biosis Research (2008a) Terrestrial Flora and Fauna Impact Assessment for Longwalls 11, 12, 15, 16, & 19 & Pillar Extraction Area 1; NRE Wongawilli Colliery.
- ❑ Biosis Research (2008b) Archaeological and Cultural Heritage Impact Assessment of Proposed Longwalls 11, 12, 15, 16, & 19 & Pillar Extraction Area 1; NRE Wongawilli Colliery.

- ❑ Biosis Research (2008c) Aquatic Ecology Impact Assessment for Proposed Longwalls 11, 12, 15, 16 & 19 & Pillar Extraction Area 1; NRE Wongawilli Colliery.
- ❑ Biosis Research (2009) Addendum to the Terrestrial Flora and Fauna Impact Assessment for Proposed Longwalls 11, 12, 15, 16, and 19 and Pillar Extraction Area 1 NRE Wongawilli Colliery.
- ❑ Biosis Research (2009) NRE Wongawilli Colliery Longwalls 11, 12, 15, 16 & 19, & Pillar Extraction Area 1 Cultural Heritage Management Plan and Baseline Recording & Monitoring Methodology.

3.2 Approval Conditions

Gujarat NRE Wonga Pty Ltd holds Mining Lease 1596 which includes the area to be mined at NRE Wongawilli Colliery (or in the case of Longwall 15, the area that has been mined). The lease was granted on 19 December 2007 and renewed on 3 February 2012. Condition 8 of the Lease provides for the extraction of coal from the lease area subject to the preparation and approval of a Subsidence Management Plan (SMP).

Approval of the SMP for Longwalls 11, 12, 15, 16, 19 and PEA 1 was granted for NRE Wongawilli Colliery on 16 July 2009. PEA 1 was later modified and removed for Longwall 20.

Conditions of the SMP approval pertinent to this EOP report include:

- Condition 12: Subsidence Monitoring
- Condition 13: Environmental Management
- Condition 17: End of Panel Report

3.3 Report Outline and Contributors

The following specialists and experts have contributed to this EOP through the assessments of subsidence impacts from Longwall 15 on their area of specialisation:

Biosis Pty Ltd	Aquatic & Terrestrial Ecology & Cultural Heritage	(Attachment A)
Gujarat NRE	Landscape Assessment; EOP Groundwater & Surface Water; and EOP Report	(this report)

Data and text from specialist reports have been incorporated into this EOP without further reference. Specialist reports are provided as attachments to this EOP.

This EOP is set out according to the following schedule:

Section 4 outlines the subsidence movements observed during mining and compares those results with the predicted subsidence parameters.

Section 5 outlines the impacts of mining associated with Longwall 15 on surface infrastructure.

Section 6 outlines the impacts of mining associated with Longwall 15 on natural features.

Sections 7 summarises the monitoring program and outlines the management and remediation of impacts associated with Longwall 15.

4 PREDICTED AND OBSERVED SUBSIDENCE

4.1 Monitoring Lines

No subsidence survey was undertaken after the completion of LW15 due to distance from survey lines. A full subsidence survey of the entire LW 11-20 area will be completed once LW16 has been extracted.

5 IMPACTS ON MAN MADE FEATURES

5.1 Surface Infrastructure within the Application Area

The surface infrastructure that is located above or adjacent to Longwall 15 is shown in **Figure 1**.

There is no significant infrastructure above or adjacent to Longwall 15 however the following items are considered in this EOP:

- ☐ Disused 33 kV power line
- ☐ 4WD access tracks.

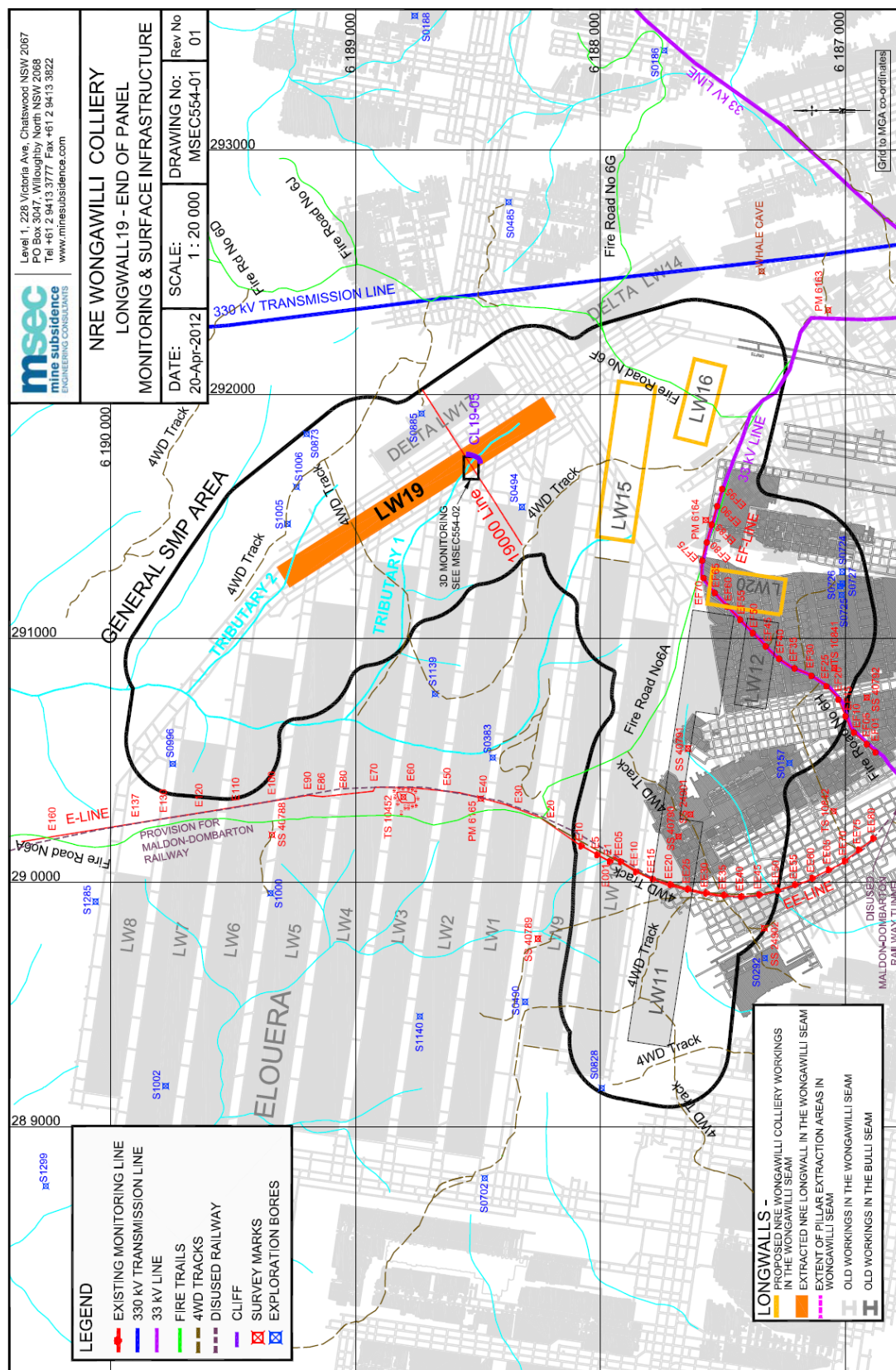
5.2 Comparison between Predicted and Observed Impacts on Surface Infrastructure

Comparisons between the observed and the predicted impacts on the man made surface infrastructure above or adjacent to Longwall 15 are summarised in **Table 5.1**. The predicted impacts were detailed in MSEC (2008). Man made infrastructure was inspected as part of the subsidence monitoring program (by foot and from a vehicle).

It can be seen from **Table 5.1** that there were no reported impacts on surface infrastructure resulting from the extraction of Longwall 15.

Table 5.1: Summary of Predicted and Observed Impacts from Longwall 15 on Surface Infrastructure

Surface Infrastructure	Predicted Impacts	Observed Impacts
Disused 33 kV Power Line	No predicted impacts	No observed impacts
4WD Access Tracks	Changes to surface drainage and some surface cracking of the unsealed road surfaces	No observed Impacts



5.3 Indigenous Heritage Sites

Biosis Pty. Ltd. (Biosis) prepared an End of Panel assessment on all Aboriginal heritage sites in the vicinity of Longwall 15 and the full report is provided in **Attachment A**.

Four previously recorded Aboriginal archaeological sites occur in the vicinity of Longwall 15. The archaeological sites considered in this EOP are:

- ☐ Browns Road Site 1;52-2-1616
- ☐ Browns Road Site 9;52-2-1624
- ☐ Browns Road Site 15;52-2-1630
- ☐ Browns Road site 16;52-2-1631

The risk of impact to these sites from subsidence related to extraction of Longwall 15 was considered to be low.

The sites and associated features were compared with photographs taken during the SMP application (Biosis Research 2008b). The condition of the sites as observed revealed no changes to either site or nearby joint and bedding planes.

No subsidence impacts to Indigenous heritage sites were observed and the monitoring program will continue in accordance with the requirements of the Environment, Subsidence and Safety Management Plan.

5.4 European Heritage Sites

There are no historic sites within the limit of subsidence of Longwall 15.

6 IMPACTS TO NATURAL FEATURES

Longwall 15 is located within the Metropolitan Special Areas Water Catchment. The catchment area is relatively undisturbed and therefore contains many important natural features relevant to Longwall 15.

6.1 Steep Slopes and Rock Outcrops

Areas of steep slopes and rock outcrops are identified in Figure MSEC 360-08 (MSEC 2008 – not reproduced in this report). There are two rock outcrops located above Longwall 15. Small areas of steep slopes appear above Longwall 15. There are no cliffs located above Longwall 15.

Predicted Impacts

Predicted impacts on the steep slopes that occur directly above longwalls and pillar extraction areas of NRE Wongawilli Colliery are defined in MSEC (2008) as:

- ☐ Minor slippage of soils down the steep slopes, resulting in the development of minor cracking in soils at the top of the slopes and minor compression ridges forming at the bottom of the slopes.
- ☐ Large scale slope failure was considered unlikely.
- ☐ Steep slopes which are not located directly above the longwall goaf were not predicted to experience any significant systematic subsidence movements.

Observed Impacts

Inspections of the areas of steep slopes and rock outcrops in the vicinity of Longwall 15 were undertaken during site inspections by Biosis Pty. Ltd. and personnel from Gujarat NRE.

There have been no observed impacts on steep slopes associated with the extraction of Longwall 15.

6.2 Surface Water and Groundwater Impacts

There are no major waterways within the limit of subsidence of Longwall 15.

One swamp piezometer (P46) is located within Swamp 46 that overlies Longwall 15.

Locations of surface and groundwater monitoring sites for Longwall 15 are shown in **Figure 2**.

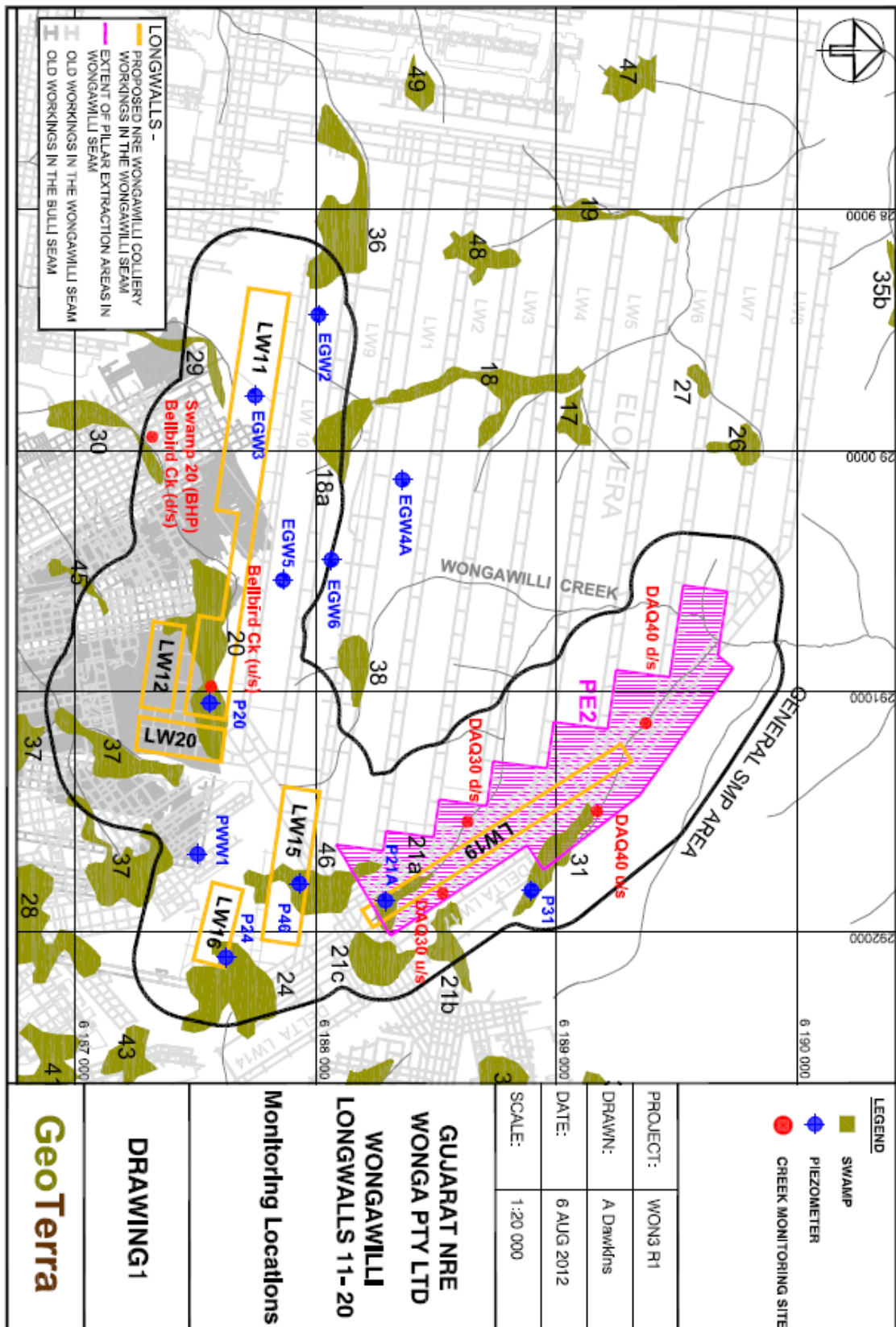


Figure 2: Monitoring Locations, Wongawilli Longwalls (Source – GeoTerra WON2-R1)

Predicted Impacts

An assessment of the surface and groundwater monitoring results was completed for this end of panel report for Longwall 15. Groundwater and Surface Water Impacts have been tabulated in **Table 6.1** below, which compares predicted impacts with actual observations or monitoring data analysis results.

Table 6.1: Summary of Groundwater and Surface Water Impacts

Predicted Impacts	Observed Impacts Due to Extraction of Longwall 15
Adverse interconnection of aquifers and aquitards is not anticipated within 20m of the surface	No adverse interconnection between aquifers and aquitards has been observed within 20m of the surface
Potential increased rate of recharge into the plateau	No increased rate of recharge has been observed
Temporary lowering of shallow Hawkesbury Sandstone piezometric surface by up to 10m which may stay at that level until maximum subsidence develops	Based on the available data, no above trigger lowering of the shallow Hawkesbury Sandstone piezometric surface has been observed in PWW1 in relation to extraction of Longwall 11, 12, 15, 19 and 20; however EGW3 over Longwall 11 fell by 8.92m but this was not related to LW15 extraction
Shallow Hawkesbury Sandstone groundwater levels should recover over a few months	Based on the available data, the EGW3 water level has not yet recovered from LW 11.
No permanent post mining reduction in the shallow Hawkesbury Sandstone water levels unless a new outflow path develops	Based on the available data, the EGW3 water level has not yet recovered from LW 11.
Strata dilation and subsequent re-filling of secondary voids may temporarily lower the shallow Hawkesbury Sandstone standing water levels	Based on the available data, the EGW3 water level has not yet recovered from LW 11.
No observable lowering of the Upland Swamp piezometric surface due to subsidence, although there is expected to be a direct relationship between the lack of rainfall recharge and reduced water levels	Lowering of the piezometric surface has been observed in association with low rainfall periods, although no observable adverse effect on Swamp 46 water levels has been caused by LW 11, 12, 15, 19 or 20
The shallow Hawkesbury Sandstone piezometers may experience increased iron / manganese hydroxide precipitation and / or lowering of pH	The water quality in the shallow Hawkesbury Sandstone piezometers have not been affected by subsidence related effects
Upland Swamp piezometers may experience increased iron / manganese hydroxide precipitation and / or lowering of pH	The Swamp 46 piezometer has not been adversely, or observably, affected by subsidence effects
Interface drainage, ferruginous, brackish seeps may be generated in streams	No interface drainage, ferruginous, brackish seeps have been generated in Bellbird Creek or the Wongawilli Creek tributaries
Ferruginous seeps may develop in the local creeks	No ferruginous seeps have developed in Bellbird Creek or the Wongawilli Creek tributaries
Increased basement groundwater seepage inflow into the workings should not occur	No increased rate of groundwater seepage into the workings has occurred
Strata gas discharge into piezometers may occur	No strata gas discharge has occurred
Stream flow in Bellbird Creek may be adversely affected by subsidence	Stream flow in Bellbird Creek and the Wongawilli Creek tributaries has not been adversely affected by subsidence related effects
Stream water quality in Bellbird Creek and Wongawilli Creek	Stream water quality in Bellbird Creek and the Wongawilli Creek tributaries has temporarily exceeded either the

may be adversely affected by subsidence	salinity and/or pH triggers, but has not been affected in the long term, with both pH and EC returning to its baseline, pre mining range.
Stream bed and bank stability in Bellbird Creek and Wongawilli Creek may be adversely affected by subsidence.	Stream bed and bank stability in Bellbird Creek and Wongawilli Creeks tributaries has not been adversely affected by subsidence related effects

Summary of Results

During extraction of Longwalls 15 there were no TARPs (Trigger Action Protocols) trigger levels exceeded for surface or groundwater impacts.

Refer **Table 7.1** for the relevant monitoring obligations and TARPs (Trigger Action Response Protocols).

Aquifer / Aquitard Interconnection

No adverse aquitard / aquifer interconnection or increased recharge has been observed in the vicinity of, or resulting from, extraction of Longwall 15.

Groundwater Quality

Table 6.2 contains water quality monitoring data for P46, being the only monitoring site directly impacted by the extraction of Longwall 15. No exceedance of water quality parameters was recorded during the extraction of Longwall 15 for P46.

Water quality monitoring data for the remaining suite of shallow groundwater monitoring sites showed no significant variation during extraction of Longwall 15.

Table 6.2: P46 Water Quality Results – Longwall 15 Extraction

Site: P46 Sample Period: 4/4/2012 - 6/11/2012 No. Samples: 7* * 2 laboratory samples required - 1 sample P46 dry 7 field samples required - 1 sample P46 dry									
Parameter	Unit of Measurement	4/4/12	20/6/12	25/7/12	02/08/12	04/09/12	04/10/12	06/11/12	Exceedance
pH	pH units	5.21	5.22	5.15	5.14	5.79	5.9	Dry - No sample	No
EC	µs	60	61.6	63.7	63.8	79.5	83.3	Dry - No sample	No
DOC	mg/L	5.00						Dry - No sample	No
TDS	mg/L	12.00						Dry - No sample	No
Na	mg/L	7.00						Dry - No sample	No
Ca	mg/L	1.00						Dry - No sample	No
K	mg/L	1.00						Dry - No sample	No
Mg	mg/L	1.00						Dry - No sample	No
Cl	mg/L	12.00						Dry - No sample	No
F	mg/L	0.10						Dry - No sample	No
SO4	mg/L	2.00						Dry - No sample	No
HCO3	mg/L	2.00						Dry - No sample	No
Total N	mg/L	2.00						Dry - No sample	No
Total P	mg/L	0.05						Dry - No sample	No
Fe	mg/L	3.79						Dry - No sample	No
Mn	mg/L	0.01						Dry - No sample	No
Fe Filtered	mg/L	0.54						Dry - No sample	No
Mn Filtered	mg/L	0.01						Dry - No sample	No
Cu Filtered	mg/L	0.02						Dry - No sample	No
Pb Filtered	mg/L	0.00						Dry - No sample	No
Zn Filtered	mg/L	0.15						Dry - No sample	No
Ni Filtered	mg/L	0.03						Dry - No sample	No
Al Filtered	mg/L	0.02						Dry - No sample	No
As Filtered	mg/L	0.00						Dry - No sample	No
Li Filtered	mg/L	0.00						Dry - No sample	No
Ba Filtered	mg/L	0.00						Dry - No sample	No
Sr Filtered	mg/L	0.00						Dry - No sample	No

Groundwater Levels

Figure 3 contains shallow piezometer water level for P46 for the life of the monitoring site. **Figure 4** contains the recorded rainfall data during the life of the P46 monitoring site. A reduction in shallow groundwater levels in Swamp 46 correlates with the extended dry period experienced during 2012.

Water level monitoring data from the remaining suite of shallow groundwater monitoring sites showed a gradual drop in level due to limited rainfall during 2012. No significant drop in level was recorded.

Figure 5 contains groundwater levels from the EGW series groundwater bores. The water level in EGW3, which lies directly above Longwall 11, dropped by 8.92 metres around June 2010 after it was undermined. No significant fall in the other EGW series piezometers has occurred.

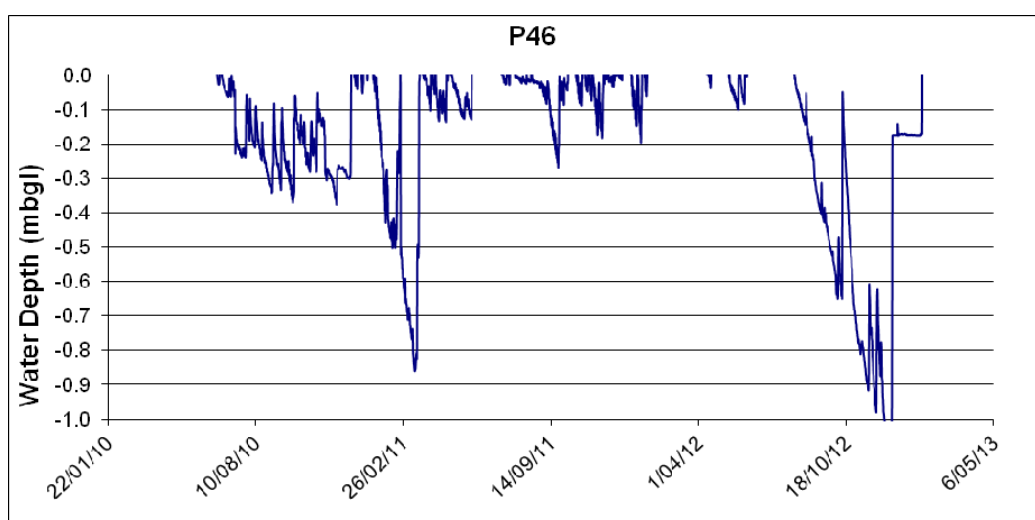


Figure 3: P46 Shallow Groundwater Level

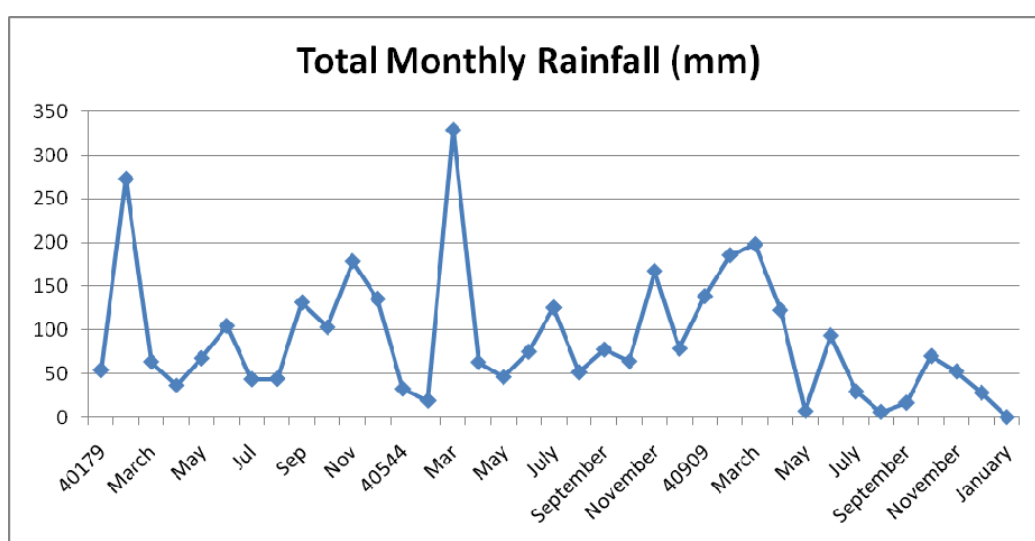


Figure 4: Rainfall Record

EGW holes: Water Level Monitoring

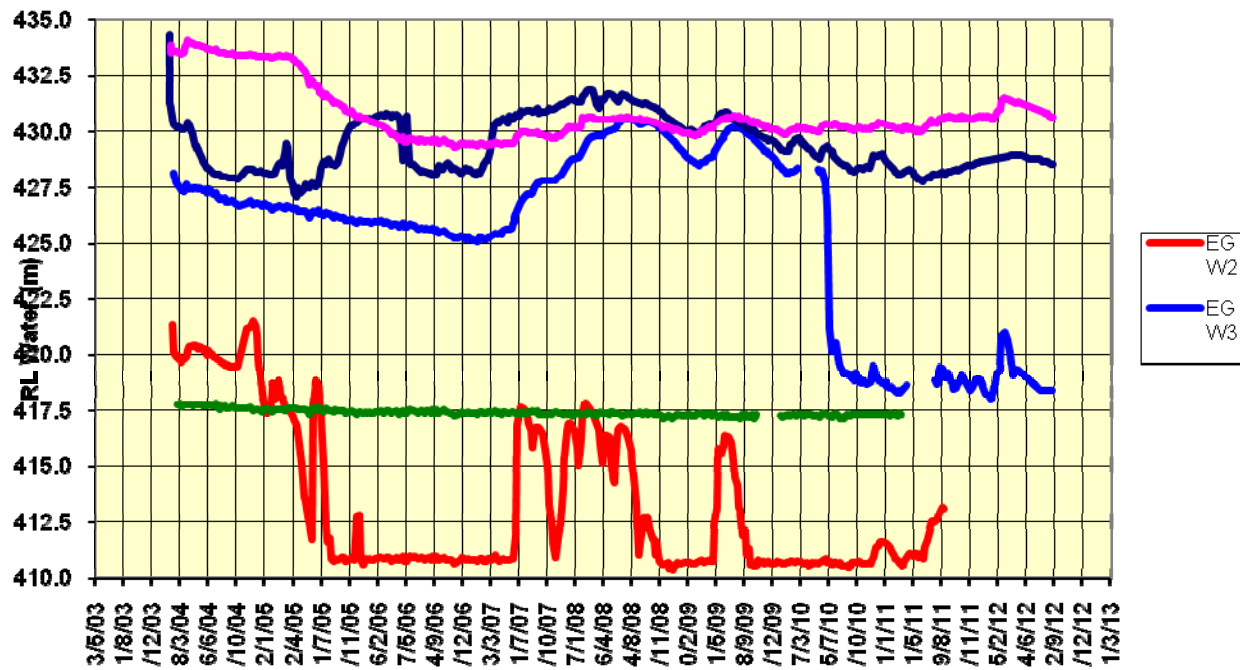


Figure 5: EGW Series Borehole Water Level

Inflow to mine Workings

In May 2011, a drop in mine water pump out rates occurred due to a limited supply of water for underground operations. This occurred due to the development for Longwall 19, where access to traditional water storages became restricted.

The underground operations now have a restricted water supply and during Longwall 15 extraction continued to use all available water. This situation will continue until adequate underground storages can be created.

During Longwall 15 extraction, there was no active mine pumpouts. No increase in inflow was recorded in the mine workings.

Creek Subsidence

There are no subsidence survey lines installed in the vicinity of Longwall 15. During Longwall 15 extraction, there were no observable subsidence impacts to drainage lines or tributary streams above Longwall 15.

Stream Flow

No observed adverse effect on the tributaries of Wongawilli Creek occurred as a result of Longwall 15 extraction.

Stream Water Quality

Monitoring of Wongawilli Creek during the extraction of Longwall 15 identified no significant variation from trigger level values due to extraction of Longwall 15. No creek, streams or tributaries were directly undermined by Longwall 15.

Stream Bed and Bank Stability

No observed adverse effect on the tributaries of Wongawilli Creek occurred as a result of Longwall 15 extraction.

Gas Emissions

No discharge of strata gas has been observed to be discharging at surface or in the open standpipe piezometers in the monitoring area following extraction of Longwall 15.

6.3 Aquatic Ecology

Biosis Pty. Ltd. (Biosis 2008c) assessed the aquatic habitat of the NRE Wongawilli SMP Area and potential for that habitat to provide suitable values for threatened aquatic species in August 2008. Aquatic habitats within the limits of subsidence of Longwall 15 were again inspected by Biosis Pty. Ltd. in autumn 2012. The results of the Biosis Pty. Ltd. End of Panel assessment for aquatic ecological values are provided in **Attachment A**.

6.3.1 Predicted Impacts on Aquatic Ecology

Aquatic habitats in the vicinity of Longwall 15 included Wongawilli Creek. There are also several small ephemeral drainage lines that are associated with Upland Swamps that are located above and adjacent to Longwall 15.

Habitat for three endangered aquatic species, Macquarie Perch (*Macquaria australasica*), Adam's Emerald Dragonfly (*Archaeophya adamsi*) and Sydney Hawk Dragonfly (*Austrocordulia leonardi*) was identified in the broad vicinity of the approved SMP Area (Biosis Research 2008c). Assessments of Significance concluded that the proposal was unlikely to have a significant impact on a local population of any of these species.

6.3.2 Observed Impacts on Aquatic Ecology

Field investigations have not observed any impacts to creeks or drainage lines as a result of the extraction of Longwall 15 (along with 11, 12, 19 and 20). There has been no observed impact on aquatic ecological values.

Refer to **Attachment A** for further details on monitoring methodology and site locations.

6.4 Terrestrial Ecology

Biosis Research (Biosis 2008a) assessed the terrestrial ecological values of the NRE Wongawilli SMP Area and potential for those values to provide suitable habitat for threatened aquatic species during several survey campaigns. Surveys were undertaken initially in the area in June 2006 as part of the assessment for Delta Colliery Longwalls. Further surveys have been undertaken in line with the ESSMP monitoring program.

Biosis have assessed the post-mining conditions with relation to aquatic and terrestrial ecology within the area potentially impacted by subsidence effects associated with mining of Longwall 15. The results of the Biosis End of Panel assessment for terrestrial ecological values are provided in **Attachment A**.

6.4.1 Predicted Impacts on Terrestrial Ecology

Predicted impacts are summarised in **Attachment A**.

6.4.2 Observed Impacts on Terrestrial Ecology

Ecological monitoring to date has not identified any impacts to flora and fauna as a result of subsidence associated with the extraction of Longwall 15 at the NRE Wongawilli Colliery. No other management actions have been triggered under the Trigger Action Response Plan.

6.4.3 Conclusion

Vegetation communities, fauna habitats, threatened species, populations and ecological communities are not considered to have been affected by subsidence related impacts associated with the extraction of Longwall 15 (along with 11, 12, 19 and 20).

Observational as well systematic ecological monitoring in this area will continue and any notable changes to the natural environment will be referred to specialist consultants for further consideration.

7 MANAGEMENT OF IMPACTS AND REMEDIATION

7.1 Trigger Action Response Plan

The monitoring and Trigger Action Response Plan (TARPs) for NRE Wongawilli Colliery Longwalls 11, 12, 15, 16, 19 and 20, are summarised in **Table 7.1**. Monitoring of man made and natural features within the SMP Area has identified no impacts as a result of the extraction of Longwall 15.

Table 7.1 sets out the agreed actions to be implemented once a trigger has been met or exceeded. The first step is usually informing the relevant agencies. All agencies were informed of the identified impacts as per **Table 7.1** where required.

The SCA and TransGrid, the owner and operator of the 330kv transmission line, located to the east of the SMP Area, have not reported any impacts related to Longwall 15.

Table 7.1: Monitoring and TARPs for NRE Wongawilli Colliery

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
330kv Transmission Line (Tower 37-6) (Visual inspections during mining and survey measurement post mining)	Observation of tower condition and survey measurement for later comparison (not required – tower well beyond limit of subsidence of LW 19 as advised by TransGrid)	None required	Monitoring will be undertaken prior to, during and after extraction of LW's 15, 16, 19 and 20. NB. TransGrid will undertake monitoring responsibilities as per App 2 of ESSMP	<input type="checkbox"/> No predicted impacts	<input type="checkbox"/> No observed or reported effects	<input type="checkbox"/> Observation of unsafe tower conditions as noted by Transgrid (the owner and operator of the transmission line(who are responsible for observational monitoring	<input type="checkbox"/> Report condition to TransGrid and Mine Subsidence Board <input type="checkbox"/> TransGrid to undertake remediation as necessary	<input type="checkbox"/> None required
Fire Roads and 4WD Tracks (Fortnightly visual inspection)	Observation of road condition once prior to mining and reported in SMP (completed)	Fortnightly observation of roads, tracks and area within 200m of roads/tracks (complete)	Monthly observation of roads, tracks and area within 200m of roads/tracks for 6 months post mining (ongoing)	<input type="checkbox"/> Potential for minor some surface cracking and compressive rippling of the unsealed road surfaces	<input type="checkbox"/> No observed or reported effects	<input type="checkbox"/> Minor cracking on roads and tracks (<10mm)	<input type="checkbox"/> Notification to SCA within 24 hrs, using photographic record	<input type="checkbox"/> None required
						<input type="checkbox"/> Major cracking (>10mm) or traffic impedance	<input type="checkbox"/> Notification to SCA immediately, then to DRE NSW and MSB <input type="checkbox"/> Make area safe as soon as practicable including warning	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
							signs <input type="checkbox"/> Proposal for rectification within 1 week upon approval from SCA <input type="checkbox"/> Completion of works following approval from SCA <input type="checkbox"/> Additional daily monitoring	
Indigenous Heritage Sites (Inspect once prior to, during and post mining)	Record significant heritage items once prior to mining (completed) Site nominated in CHMP are: - Browns Road Site 1 - Browns Road Site 2 - Upper Avon 2	Once for observed impacts such as: Cracking, opening of bedding planes, blockfalls, exfoliation, water seepage changes. For sites: - Browns Road Site 1 - Browns Road Site 9 - Upper Avon 2	<input type="checkbox"/> 3-6 months post mining <input type="checkbox"/> 2 years post mining For Sites: - Browns Road Site 1 - Browns Road Site 9 - Browns Road Site 15 - Browns Road Site 16	<input type="checkbox"/> Browns Road 1 - Moderate risk <input type="checkbox"/> Browns Road Site 9 – Low risk <input type="checkbox"/> Browns Road Site 15 - Very Low risk <input type="checkbox"/> Browns Road site 16 – Low risk	<input type="checkbox"/> No observed or reported effects.	<input type="checkbox"/> Observation of unstable conditions (in the case of overhangs) or damage	<input type="checkbox"/> Implement the Cultural Heritage Management Plan (CHMP) <input type="checkbox"/> Report impacts as required <input type="checkbox"/> Notify OEH, DRE NSW, SCA <input type="checkbox"/> Review and undertake remediation options as appropriate	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
Cliffs, Steep Slopes and Rock Outcrops (Monthly)	Observation and documentation of cliff and steep slope condition including CL 19-02, CL 19-03, CL 19-04 and CL 19-05 – (Once prior to mining)	Monthly observations during mining	Monthly observations for 6 Months	<input type="checkbox"/> Potential for minor rockfalls to occur at the rock outcrops which are located above the extracted goaf areas of the proposed longwalls <input type="checkbox"/> It is expected, however, that any rockfalls would be of a minor nature, as a majority of the predicted subsidence parameters are relatively small, and the rock outcrops are discontinuous and relatively low in height and, therefore, less susceptible to	<input type="checkbox"/> No observed or reported effects.	<input type="checkbox"/> Minor cracking on roads and tracks (<10mm)	<input type="checkbox"/> Notification to SCA and DRE NSW within 24 hrs, using photographic record <input type="checkbox"/> Warning sign/s erection <input type="checkbox"/> Reported in AEMR	<input type="checkbox"/> None required
						<input type="checkbox"/> Major cracking (>10mm) or traffic impedence	<input type="checkbox"/> Notification to SCA immediately then DRE NSW <input type="checkbox"/> Make area safe immediately including erection of warning sign/s and barrier fencing <input type="checkbox"/> Reported in AEMR <input type="checkbox"/> Review mining options	<input type="checkbox"/> None required
						<input type="checkbox"/> Major cliff collapse or steep slope movement	<input type="checkbox"/> Notification to SCA immediately then I&I NSW <input type="checkbox"/> Make area safe immediately	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
				impact.			including warning sign/s erection and barrier fencing <input type="checkbox"/> Proposal for rectification within 1 week <input type="checkbox"/> Completion of works following approval from SCA <input type="checkbox"/> Additional monitoring <input type="checkbox"/> Reported in AEMR	
Stream Water Quality and Flow	<input type="checkbox"/> Field Analysis (EC, pH, temp) <input type="checkbox"/> <u>Laboratory Analysis</u> TDS, Na, K, Ca, Mg, F, Cl, SO ₄ , HCO ₃ , NO ₃ , Total N, Total P, Cu, Pb, Zn, Ni, Fe, Mn, As, Se, Cd, Cr, Li, Ba, Cs, Rb,	<input type="checkbox"/> Weekly Field Analysis during active undermining of stream <input type="checkbox"/> Bi-monthly Lab analysis during active undermining of stream <input type="checkbox"/> Weekly observations during active undermining of stream	<input type="checkbox"/> Bi-monthly Field Analysis for one year after subsidence ceases <input type="checkbox"/> Lab analysis Every four months for one year until subsidence ceases <input type="checkbox"/> Bi-monthly observations	<input type="checkbox"/> Possible tensile cracking in the bed of Native Dog Creek and Wongawilli Creek <input type="checkbox"/> Possible buckling and fracturing of the bedrock along Native Dog Creek, Bellbird	<input type="checkbox"/> No observed or reported effects.	<input type="checkbox"/> Observable increase from baseline in iron hydroxide precipitation (e.g. orange staining in water or on banks/bed) from comparison with pre-mining monitoring and photographs <input type="checkbox"/> Based on the baseline monitoring	<input type="checkbox"/> Repeat water quality sampling and initiate laboratory water quality sampling on a monthly basis <input type="checkbox"/> Contract hydrologist investigate and report on changes identified <input type="checkbox"/> Inform SCA, OEH & DRE NSW of	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
	<p>Sr (filtered)</p> <p><input type="checkbox"/> Observable iron or salinity staining using Photo Points</p> <p><input type="checkbox"/> Monthly for at least two months prior to mining (for all parameters above)</p>	<p>using Photo points</p>	<p>for one year after subsidence ceases using Photo points</p>	<p>Creek, Wongawilli Creek and the Tributaries to Wongawilli Creek, above and adjacent to the proposed longwalls</p> <p><input type="checkbox"/> Gas emission could occur but significant emissions considered unlikely</p> <p><input type="checkbox"/> Iron staining not predicted to occur</p> <p><input type="checkbox"/> Water Quality: Lowering of pH in stream water due to iron staining (precipitate)</p>		<p>conducted since July 2005 the following triggers will be used:</p> <p><input type="checkbox"/> EC > 200uS/cm</p> <p><input type="checkbox"/> 4.2 > pH > 6.77</p> <p><input type="checkbox"/> Fe (Tot) > 6mg/L</p> <p><input type="checkbox"/> Mn (tot) > 0.1mg/L</p> <p><input type="checkbox"/> Al (tot) > 0.7mg/L</p> <p><input type="checkbox"/> Zn (filt) > 0.04mg/L</p> <p><input type="checkbox"/> SO4 (filt) > 8mg/L</p> <p><input type="checkbox"/> Dissolved oxygen / ORP / temperature</p>	<p>results of investigation</p> <p><input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with key agencies and in accordance with Section 54 of the Water Management Act</p> <p><input type="checkbox"/> Report in the End of Panel Report</p>	
Loss of Flow	<p><input type="checkbox"/> Monthly for at least two months prior to mining</p>	<p><input type="checkbox"/> Weekly during active undermining of stream</p>	<p><input type="checkbox"/> Bi-monthly for one year after subsidence ceases</p>	<p><input type="checkbox"/> Possible diversion of surface water into dilated strata and the draining of</p>	<p><input type="checkbox"/> No observed water quality impacts</p>	<p><input type="checkbox"/> Observation of loss of flow connectivity within a flowing ephemeral stream (related to</p>	<p><input type="checkbox"/> Repeat water quality sampling and initiate laboratory water quality sampling on a monthly</p>	<p><input type="checkbox"/> None required</p>

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
				pools		rainfall), compared to the flow regimes evident prior to the extraction of LW's 11-20	basis <input type="checkbox"/> Contract hydrologist investigate and report on changes identified <input type="checkbox"/> Inform SCA, OEH & DRE NSW of results of investigation <input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with key agencies and in accordance with Section 54 of the Water Management Act <input type="checkbox"/> Report in the End of Panel Report	
Areas of increased flooding	<input type="checkbox"/> Monthly for at least two months prior to mining	<input type="checkbox"/> Weekly during active undermining of stream	<input type="checkbox"/> Bi-monthly for one year after subsidence ceases	<input type="checkbox"/> Ponding, flooding and scouring considered unlikely to occur	<input type="checkbox"/> No observed increased flooding	<input type="checkbox"/> Observation of areas of flooded stream in excess of baseline conditions – identified by extended flooding within a	<input type="checkbox"/> Survey area to identify whether earthworks are required <input type="checkbox"/> Contract hydrologist investigate and	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
						terrestrial habitat and from comparison of pre-mining and post-mining photographs	report on changes identified <input type="checkbox"/> Inform SCA / OEH of results of investigation <input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with key agencies and in accordance with Section 54 of the Water Management Act if required <input type="checkbox"/> Report in the End of Panel Report	
Erosion of stream bed and banks	<input type="checkbox"/> Monthly for at least two months prior to mining	<input type="checkbox"/> Weekly during active undermining of stream	<input type="checkbox"/> Bi-monthly for one year after subsidence ceases	<input type="checkbox"/> Scouring considered unlikely to occur	<input type="checkbox"/> No observed erosion of stream bed and banks	<input type="checkbox"/> Observation of erosion of stream bed and banks in excess of baseline conditions identified from comparison of pre-mining and post-mining photographs	<input type="checkbox"/> Contract hydrologist investigate and report on changes identified <input type="checkbox"/> Inform SCA, OEH & DRE NSW of results of investigation <input type="checkbox"/> Prepare and	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
							implement a site mitigation/action plan in consultation with key agencies and in accordance with Section 54 of the Water Management Act <input type="checkbox"/> Report in the End of Panel Report	
Groundwater – Hawkesbury Sandstone (water quality and water levels) in four bores EGW2, EGW3,EGW5 ,WW1	<input type="checkbox"/> Field water quality (EC, pH, temp)– bi monthly <input type="checkbox"/> Laboratory analysis – every four months Lab Parameters- - TDS, Na, K, Ca, Mg, F, Cl, SO4, HCO3, NO3, Total N, Total P, Cu, Pb, Zn, Ni, Fe, Mn, As, Se, Cd, Cr, Li, Ba, Cs, Rb, Sr (filtered)	<input type="checkbox"/> Field water quality – monthly during extraction <input type="checkbox"/> Laboratory analysis – every two months	<input type="checkbox"/> Field water quality – bi monthly <input type="checkbox"/> Laboratory analysis – every four months	<input type="checkbox"/> Adverse interconnection of aquifers and aquitards is not anticipated within 20m of the surface <input type="checkbox"/> Potential increased rate of recharge into the plateau <input type="checkbox"/> Piezometers may experience increased iron / manganese hydroxide precipitation	<input type="checkbox"/> No observed or reported effects	<input type="checkbox"/> Ground Water Quality <input type="checkbox"/> 2 std deviation change, or distinctive diversion over at least 4 months from baseline levels for pH, EC, Fe, Mn, Al, Zn and SO4	<input type="checkbox"/> Investigation initiated within one week of trigger <input type="checkbox"/> Repeat water quality sampling of impacted and adjacent bores if triggers exceeded, as required <input type="checkbox"/> If trigger is exceeded for at least 4 months, engage hydrogeologist to investigate and report on any identified adverse changes to water	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
				and / or lowering of pH <input type="checkbox"/> Interface drainage, ferruginous, brackish seeps may be generated in streams <input type="checkbox"/> Shallow groundwater level within Swamp 46 will be dependent on rainfall recharge and will not be affected by mining <input type="checkbox"/> Strata gas discharge into piezometers may occur			level / water quality <input type="checkbox"/> Inform SCA, OEH & DRE NSW of investigation outcomes <input type="checkbox"/> Investigation of possible mitigation measures in consultation with SCA / OEH <input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with SCA / OEH if appropriate <input type="checkbox"/> Report in SMP / End of Panel reports to inform relevant agencies of results of monitoring	
Ground Water Levels (using pressure transducer and bores)	<input type="checkbox"/> Bi- monthly	<input type="checkbox"/> Monthly	<input type="checkbox"/> Bi -monthly	<input type="checkbox"/> Temporary lowering of piezometric surface by up to 10m which may stay at	<input type="checkbox"/> No or reported effects	<input type="checkbox"/> Continuous >5m ground water level reduction over a minimum 2 month period	<input type="checkbox"/> Instigate investigation within 1 week of trigger <input type="checkbox"/> Engage	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
				<p>that level until maximum subsidence develops</p> <p><input type="checkbox"/> Groundwater levels should recover over a few months</p> <p><input type="checkbox"/> No permanent post mining reduction in water levels in bores on the plateau unless a new outflow path develops</p> <p><input type="checkbox"/> Strata dilation and subsequent re-filling of secondary voids may temporarily lower standing water levels</p>			<p>hydrogeologist to investigate and report on the cause of trigger exceedances where the cause may not be directly related to lack of rainfall recharge</p> <p><input type="checkbox"/> Inform SCA, OEH & DRE of investigation outcomes</p> <p><input type="checkbox"/> Investigation of possible mitigation measures in consultation with SCA / OEH</p> <p><input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with SCA / OEH if necessary</p> <p><input type="checkbox"/> Report in End of Panel reports to inform relevant agencies of ongoing results of</p>	

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
monitoring								
Inflow into mine workings (during all active mining) (daily monitoring)	<input type="checkbox"/> Daily monitoring of mine discharge (completed) <input type="checkbox"/> Water quality sample of any measured inflow event (not required)	<input type="checkbox"/> Daily monitoring of mine discharge (completed) <input type="checkbox"/> Water quality sample of any measured inflow event (not required)	<input type="checkbox"/> Daily monitoring of mine discharge (ongoing) <input type="checkbox"/> Water quality sample of any measured inflow event (as required)	<input type="checkbox"/> Increased groundwater seepage inflow into the workings should not occur	<input type="checkbox"/> No increase in mine water discharge recorded	<input type="checkbox"/> Increase in water discharge of > 1ML/day for 7 successive days from active longwall or pillar extraction areas, which are suspected to be as a result of mine subsidence <input type="checkbox"/> Note: the typical discharge from U/G is 6ML/day	<input type="checkbox"/> Engage contract hydrogeologist to investigate and report on changes identified <input type="checkbox"/> Inform relevant agencies of results of investigation <input type="checkbox"/> Report in Subsidence Management Status Report <input type="checkbox"/> Report in End of Panel Report <input type="checkbox"/> Investigation initiated within one week of trigger <input type="checkbox"/> Monthly updates of investigation process	<input type="checkbox"/> None required
Potential Mine inflow events	<input type="checkbox"/> Daily monitoring of mine discharge (completed)	<input type="checkbox"/> Daily monitoring of mine discharge (completed)	<input type="checkbox"/> Daily monitoring of mine discharge (ongoing)	<input type="checkbox"/> Mine inflow events should not occur	<input type="checkbox"/> No increase in mine water discharge recorded	<input type="checkbox"/> Inflow event from mining area requiring notification to the mining	<input type="checkbox"/> Engage contract hydrogeologist to investigate and report on changes	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
	<input type="checkbox"/> Water quality sample of any measured inflow event (not required)	<input type="checkbox"/> Water quality sample of any measured inflow event (not required)	<input type="checkbox"/> Water quality sample of any measured inflow event (as required)			inspectorate	<input type="checkbox"/> identified <input type="checkbox"/> Inform SCA, OEH & DRE of investigation outcomes <input type="checkbox"/> Report in Subsidence Management Status Report <input type="checkbox"/> Report in End of Panel Report <input type="checkbox"/> Investigation initiated within one week of trigger <input type="checkbox"/> Monthly updates of investigation process	
Mine water connectivity to the surface	<input type="checkbox"/> Daily monitoring of mine discharge (completed) <input type="checkbox"/> Water quality sample of any measured inflow event (not required)	<input type="checkbox"/> Daily monitoring of mine discharge (completed) <input type="checkbox"/> Water quality sample of any measured inflow event (not required)	<input type="checkbox"/> Daily monitoring of mine discharge (ongoing) <input type="checkbox"/> Water quality sample of any measured inflow event (as required)	<input type="checkbox"/> Mine water connectivity to the surface should not occur	<input type="checkbox"/> No increase in mine water discharge recorded	<input type="checkbox"/> Water Chemistry or age indicates connectivity to the surface <input type="checkbox"/> NB: this trigger must be derived from a hydrogeologist's investigation report	<input type="checkbox"/> Inform SCA, OEH & DRE of this change <input type="checkbox"/> Commence preparation of mitigation/action plan within the timeframe agreed with relevant government agencies	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
							<input type="checkbox"/> Inform SCA, OEH & DRE within 24hrs <input type="checkbox"/> Commence preparation of mitigation/action plan within timeframe agreed with relevant agencies <input type="checkbox"/> Monthly updates of investigation progress <input type="checkbox"/> Report in Subsidence Management Status Report <input type="checkbox"/> Report in the End of Panel Report	
Aquatic Ecology (twice a year)	<input type="checkbox"/> Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime	<input type="checkbox"/> Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime	<input type="checkbox"/> Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime	<input type="checkbox"/> Unlikely that any threatened aquatic species would be significantly impacted by subsidence resulting from Longwall	<input type="checkbox"/> No impact to aquatic ecology or habitats observed	<input type="checkbox"/> None anticipated insofar as aquatic biota are concerned. Water flow and quality triggers would appropriate a response for aquatic biota	<input type="checkbox"/> None anticipated	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
	(completed) <input type="checkbox"/> Targeted surveys for threatened aquatic biota in major drainage lines (completed) <input type="checkbox"/> AUSRIVAS sampling of reference and impact sites in the broader ESSMP area (completed for LW 11,15,16,19 and 20 only)	(completed) <input type="checkbox"/> AUSRIVAS sampling of reference and impact sites in the broader ESSMP area (completed)	(ongoing) <input type="checkbox"/> AUSRIVAS sampling of reference and impact sites in the broader ESSMP area (ongoing)	mining <input type="checkbox"/> Unlikely to be impacts to aquatic ecology or loss of aquatic habitat				
Terrestrial Ecology (twice a year) General				<input type="checkbox"/> Potential for some minor surface cracking and compressive rippling	<input type="checkbox"/> No effects reported to date	<input type="checkbox"/> Observation of mining related impacts to surface	<input type="checkbox"/> Notification to SCA/NPWS within 24 hrs, using photographic record	<input type="checkbox"/> None required
Threatened species	<input type="checkbox"/> Observational monitoring of identified threatened species –	<input type="checkbox"/> Observational monitoring of identified threatened species –	<input type="checkbox"/> Observational monitoring of identified threatened species –	<input type="checkbox"/> Unlikely that any threatened flora would be significantly	<input type="checkbox"/> No effects reported to date	<input type="checkbox"/> Major impacts to threatened species to include:	<input type="checkbox"/> Notification to SCA/NPWS immediately <input type="checkbox"/> Proposal for	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
	once (completed)	twice annually during entire extraction (ongoing)	annually for one year (ongoing)	impacted by subsidence resulting from Longwall mining. <input type="checkbox"/> Impacts to threatened amphibian species as reported below.		<input type="checkbox"/> Their habitat; and/or a decline in numbers from baseline observed; and/or <input type="checkbox"/> Change in species composition	threatened species management within 1 week <input type="checkbox"/> Completion of management task following approval from SCA/NPWS <input type="checkbox"/> Additional monitoring as required by the relevant government agencies	
Amphibians	<input type="checkbox"/> Once prior to mining (completed)	<input type="checkbox"/> Twice annually during entire extraction period (ongoing)	<input type="checkbox"/> Annually for one year (ongoing)	<input type="checkbox"/> Threatened amphibian species (Littlejohn's Tree Frog, Red-crowned Toadlet and Giant Burrowing Frog) – potential alteration to breeding, sheltering and foraging habitat.	<input type="checkbox"/> None observed or reported.			
Swamp and riparian vegetation	Once prior to mining	Twice annually during entire extraction period	Annually for one year	<input type="checkbox"/> Minor impacts to Upland Swamp vegetation	<input type="checkbox"/> None observed or reported.			

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
	(completed)	(ongoing)	(ongoing)	through change in water levels, and the cracking of soils				
Ridge top vegetation	Once prior to mining (completed)	Twice annually during entire extraction period (ongoing)	Annually for one year (ongoing)	<input type="checkbox"/> Rock shelves, outcrops and overhang structures unlikely to be impacted.	<input type="checkbox"/> None observed or reported.			
General Upland Swamp observations (every second month during mining)	Twice per year (not required due to the relatively small size of the longwall)	Every second month (not required due to the relatively small size of the longwall)	Twice per year for one year post mining	<input type="checkbox"/> Minor impacts to Upland Swamp vegetation through change in water levels, and the cracking of soils.	<input type="checkbox"/> No effects noted in Upland Swamps to date	<input type="checkbox"/> Minor cracking (<10mm) <input type="checkbox"/> Major cracking (>10mm) <input type="checkbox"/> Water loss <input type="checkbox"/> Flora/Fauna changes <input type="checkbox"/> Increased erosion	<input type="checkbox"/> Report to SCA <input type="checkbox"/> Additional studies as required <input type="checkbox"/> Photographic record <input type="checkbox"/> Review of swamp piezometer data <input type="checkbox"/> Notification to SCA <input type="checkbox"/> Remediation options developed in consultation with SCA, which may include further mining limitations	<input type="checkbox"/> None required <input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15
							<input type="checkbox"/> Proposal for rectification within one month <input type="checkbox"/> Completion of works following approval from SCA <input type="checkbox"/> Additional monitoring as required	
Public Safety (fortnightly during extraction)	<input type="checkbox"/> Observation of Cliffs and steep slopes; Fire roads; 4WD tracks; Rocky outcrops and cuttings <input type="checkbox"/> Once prior to mining	<input type="checkbox"/> Fortnightly during extraction	<input type="checkbox"/> Monthly following mining for 6 months	<input type="checkbox"/> Potential for some minor surface cracking and compressive rippling of the unsealed road surfaces	<input type="checkbox"/> No effects observed	<input type="checkbox"/> Minor cracking (<10mm)	<input type="checkbox"/> Notification to SCA within 24 hrs, using photographic record	<input type="checkbox"/> None required
						<input type="checkbox"/> Major Cracking (>10mm), noticeable instability or traffic impedance	<input type="checkbox"/> Notification to SCA immediately <input type="checkbox"/> Make area safe as soon as practicable <input type="checkbox"/> Proposal for rectification within 1 week <input type="checkbox"/> Completion of works following approval from	<input type="checkbox"/> None required

Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 15

SCA

☐ Additional monitoring

ATTACHMENTS

ATTACHMENT A

Wongawilli Colliery – Longwall 15 End of Panel Report: Ecology and Cultural Heritage. Biosis Research Pty. Ltd. March 2013

26 March 2013

Chris Irving
Environment and Community Manager
Gujarat NRE Wonga Pty Ltd
PO Box 924
Dapto NSW 2530

Dear Chris,

**Re: Wongawilli Colliery – Longwall 15 End of Panel Report: Ecology and Cultural Heritage
Project no. 16171**

This report assesses the post-mining conditions with relation to aquatic ecology, terrestrial ecology and cultural heritage within the area potentially impacted by subsidence effects associated with mining of Longwall 15 at the Wongawilli Colliery (Figure 1). Coal was extracted from Longwall 15 between the 24th May 2012 and 28th October 2012.

This report includes:

- An outline of monitoring conducted to date;
- Any visual impacts to flora and fauna, aquatic environments and cultural heritage sites noted during monitoring; and,
- An updated Monitoring Actions and TARP table.

End of panel field inspections have not been conducted. Observations are based on monitoring undertaken to date and input from Gujarat NRE Wonga Pty Ltd (NRE) field teams.

Monitoring to Date

Biosis Pty Ltd was commissioned by NRE to undertake terrestrial and aquatic flora and fauna monitoring and monitoring of cultural heritage sites for the Wongawilli Colliery.

The terrestrial flora and fauna monitoring program commenced in September 2009 and has been completed for:

- Spring 2009;
- Autumn and spring 2010;
- Autumn and spring 2011; and
- Autumn and spring 2012.

The aquatic ecological monitoring commenced in March 2010 and has been completed for:

Biosis Pty Ltd
Wollongong Resource Group

8 Tate Street
Wollongong NSW 2500

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- Autumn and spring 2010;
- Autumn and spring 2011; and,
- Autumn and spring 2012.

Threatened frog surveys have been completed for 2009, 2010, 2011 and 2012.

The terrestrial and aquatic ecological monitoring programs employ a Before-After Control-Impact (BACI) design, comparing sites pre- and post-mining and comparing undermined sites (impact sites) with sites that have not been undermined (control sites).

Monitoring of cultural heritage values consists of baseline recording (conducted prior to mining), impact assessment recording (conducted within three months of the closest point of approach) and final assessment recording (at the completion of all subsidence movements likely to impact a site). Baseline recording was completed in January 2010. Impact assessment recording of cultural heritage sites potentially impacted by LW15 was completed on 18th September 2012.

Table 1 provides an outline of the terrestrial and aquatic ecological monitoring survey methodology.

Table 1: Summary of monitoring survey methodology – terrestrial and aquatic ecology

Survey	Creeklines		Upland Swamps	
	Sites	Methods	Sites	Methods
Vegetation	Three 20 m x 20 m quadrats ~150-200m apart per creekline	Species inventory and modified Braun Blanquette cover abundance score for each species	Three 15 m transects of thirty 0.5m x 0.5m quadrats within each swamp ~150-200m apart	presence of all plant species in each quadrat to indicate species abundance along transect
Amphibians	Three locations ~150-200m apart along each creekline conducted twice per season	50 m nocturnal stream searches and tadpole surveys for 30 person-minutes	Three locations ~150-200m apart within each swamp, preferentially sited along creeklines. Surveys are conducted twice per survey season	30 m x 30 m area surveys for 30 person-minutes
Threatened Amphibian Surveys	Suitable creeklines	Nocturnal stream searches and tadpole survey along length of creekline	N/A (except where suitable creeklines flow through upland swamp communities)	N/A
Aquatic ecology surveys	One edge sample per creekline. The survey reach for	Macroinvertebrate sampling as per AUSRIVAS methodology.	N/A	N/A

	each creekline ranged from 50 to 150 m depending on waterway width.	Surveys are conducted twice a year during spring and autumn.		
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Table 2 provides an outline of the cultural heritage monitoring survey methodology.

Table 2: Summary of monitoring survey methodology - cultural heritage

Survey	Sites	Methodology
Aboriginal heritage sites	Browns Road Site 1 (52-2-1616) Browns Road Site 9 (52-2-1624) Browns Road Site 15 (52-2-1630) Browns Road Site 16 (52-2-1631)	Visual observation

Ridgeline flora and fauna surveys, previously conducted as part of the monitoring program, have been excluded following consultation with the Office of Environment and Heritage (OEH) as these are unlikely to detect subsidence impacts. The most recent ridgeline surveys were conducted in Autumn 2012, prior to the commencement of extraction from Longwall 15.

Table 3 lists the terrestrial and aquatic ecology and cultural heritage sites included within the monitoring program. The location of monitoring sites included in Table 3 is shown in **Figure 2a-d**, **Figure 3a**, **3b** and **Figure 4**.

Table 3: Monitoring sites used in the program

Wongawilli Colliery Impact sites	Control Sites
Creek line impact sites (Figure 2a)	Creek line control sites (Figure 2d)
WC2 – Wongawilli Creek Tributary north	WC10 – Easement Creek
WC4 – Wongawilli Creek Tributary south	SC7 – Cascade Creek
BBC – Bellbird Creek	SC8 – Fern Tree Creek
Upland swamp impact sites (Figure 2b)	Upland swamp control sites (Figure 2d)
S46 – Swamp 46	S33 – Swamp 33
S20 – Swamp 20	S22 – Swamp 22
S24 – Swamp 24	S15a – Swamp 15a
S37A – Swamp 37A	
Threatened frog survey impact sites (Figure 2c)	Threatened frog survey control sites (Figure 2d)

WC2 Transect – Wongawilli Creek Tributary north	ND1 – Lower Native Dog Creek Tributary
WC4 Transect – Wongawilli Creek Tributary south	NDC – Native Dog Creek
BBC Transect - Bellbird Creek	ND2 - Native Dog Creek Western Tributary
	LA4A –
	WC10 – Wongawilli Creek Tributary 10
	WC11 – Wongawilli Creek Tributary 11
	WC15 – Wongawilli Creek Tributary 15
Aquatic Monitoring impact sites (Figure 3a)	Aquatic monitoring control sites (Figure 3b)
WWC-AQ1 - Wongawilli Creek	8IC-AQ1 – 8I Creek
WWC-AQ2 – Wongawilli Creek	EAC-AQ1 – Easement Creek
	DCT-AQ1 – Donald's Castle Tributary
Aboriginal cultural heritage impact sites (Figure 4)	
Browns Road Site 1 (AHIMS 52-2-1616)	
Browns Road Site 9 (AHIMS 52-2-1624)	
Browns Road Site 15 (AHIMS 52-2-1630)	
Browns Road Site 16 (AHIMS 52-2-1631)	

Creekline impact sites listed in Table 3 are not positioned to detect potential impacts from Longwall 15. The upper reaches of Wongawilli Creek are located at the western end of Longwall 15. Wongawilli creek was inspected, post mining, on the 19th March 2013 by NRE environmental field staff. The purpose of this inspection was to assess the creekline above and downstream of Longwall 15. Photos taken of the creek were assessed by Biosis ecology staff involved in the monitoring program.

Results of Monitoring

Visual observations undertaken during all monitoring listed in Table 3 have not detected any subsidence effects such as cracking, water loss in creeks or swamps or iron staining in creeks. Inspection of Wongawilli Creek by NRE environmental field staff recorded no observable impacts from subsidence. Photos of Wongawilli Creek showed no potential impacts.

Results from spring 2012 – autumn 2013 terrestrial ecology monitoring program are not currently available. Statistical analysis will be conducted following completion of autumn 2013 surveys, and results will be presented in the annual monitoring report.

With regard to aquatic ecology there were no observable differences in the macroinvertebrate communities sampled between control and impact sites over the survey period. Generally, the aquatic survey data collected indicates that there was no major divergence from the baseline data, which could be attributed to

a negative impact from longwall mining. Variations between impact and control sites as well as general spatial and temporal variation are most likely attributable to natural environmental changes related to seasonal and inter-annual conditions.

No subsidence impacts to Aboriginal cultural heritage sites were observed.

Monitoring will continue in accordance with the requirements of the *Environment, Subsidence and Safety Management Plan* (Gujarat NRE 2009). No management actions have been triggered under the Trigger Action Response Plan (TARP, see Table 4).

Conclusion

Monitoring to date has not identified any impacts to flora and fauna, aquatic ecology or cultural heritage sites as a result of subsidence associated with mining of Longwall 15 at the Wongawilli Colliery. No other management actions have been triggered under the Trigger Action Response Plan (Table 4).

Please contact me on 4229 5222 if you require further information.

Yours sincerely,

A handwritten signature in purple ink, appearing to read 'Ana Jakovljevic'.

Ana Jakovljevic

Archaeologist

Table 4: TARP and Monitoring Action Table.

Feature	ESSMP			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a result of Longwall 15
Aquatic ecology	Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime (completed) Surveys for habitat of threatened aquatic biota in major drainage lines (completed) AUSRIVAS sampling of control and impact sites in the broader ESSMP	Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime (ongoing) AUSRIVAS sampling of control and impact sites in the broader ESSMP Area (ongoing)	Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime (ongoing) AUSRIVAS sampling of control and impact sites in the broader ESSMP Area (ongoing)	Unlikely that any threatened aquatic species would be significantly impacted by subsidence resulting from Longwall mining. Unlikely to be impacts to aquatic ecology or loss of aquatic habitat.	No impact to aquatic ecology or habitats observed to date.	Major changes in flow and water quality as well as water loss would appropriate a response for aquatic biota.	Notification to SCA/NPWS within 24 hrs, using photographic record	None required

Feature	ESSMP			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a result of Longwall 15
	Area (completed for LW 11, 15, 16, 19 and LW 20 only)							
Terrestrial flora and fauna	<p>Observation of identified threatened species</p> <p>Amphibian monitoring</p> <p>Swamp and riparian vegetation monitoring</p> <p>Ridge tops surveyed once prior to mining</p> <p>Monitoring reported in SMP reports</p>	<p>Observation of identified threatened species</p> <p>Amphibian monitoring</p> <p>Swamp and riparian vegetation monitoring</p> <p>Ridge tops surveyed bi annually during entire extraction period</p> <p>Monitoring reported in AEMR</p>	<p>Observation of identified threatened species</p> <p>Amphibian monitoring</p> <p>Swamp and riparian vegetation monitoring</p> <p>Ridge tops surveyed i annually once within 12 months of extraction</p> <p>Monitoring</p>	<p>Pedicted impacts for threatened species, amphibians, swamps, riparian vegetation and ridgetops are given below.</p>	<p>No impacts observed to date</p>	<p>Observation of mining related impacts to surface</p> <p>Specific triggers and responses for threatened species, amphibians, swamps, riparian vegetation and ridgetops are given below</p>	<p>Notification to SCA/NPWS within 24 hrs, using photographic record</p> <p>Specific triggers and responses for threatened species, amphibians, swamps, riparian vegetation and ridgetops are given below</p>	<p>None required</p>

Feature	ESSMP			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a result of Longwall 15
			reported in AEMR					
Terrestrial flora and fauna (Threatened Species)	Observational monitoring of identified threatened species – once (completed)	Observational monitoring of identified threatened species – twice annually during entire extraction (ongoing)	Observational monitoring of identified threatened species – annually for one year (ongoing)	<p>Unlikely that any threatened flora would be significantly impacted by subsidence resulting from Longwall mining</p> <p>Threatened amphibian species (Littlejohn's Tree Frog, Red-crowned Toadlet and Giant Burrowing Frog) – potential alteration to breeding, sheltering and foraging habitat</p>	No impacts observed to date	<p>Major impacts to threatened species to include:</p> <p>Their habitat; and/or a decline in numbers from baseline observed; and/or</p> <p>Change in species diversity</p>	<p>Notification to SCA/NPWS immediately</p> <p>Proposal for threatened species management within 1 week</p> <p>Completion of management task following approval from SCA/NPWS</p> <p>Additional monitoring as required by the relevant government agencies</p>	None required

Feature	ESSMP			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a result of Longwall 15
Swamp and Riparian Vegetation	Once prior to mining (completed)	Twice annually during entire extraction period (ongoing)	Annually for one year (ongoing)	Minor impacts to Upland Swamp vegetation through change in water levels, and the cracking of soils.	No impacts observed to date	<p>During Mining: Minor cracking (<10mm)</p> <p>Major cracking (>10mm)</p> <p>Water loss</p> <p>Flora/fauna changes</p> <p>Increased erosion</p>	<p>Report to SCA</p> <p>Additional studies as required</p> <p>Photographic record</p> <p>Review of swamp peizo data</p> <p>Notification to SCA</p> <p>Remediation options developed in consultation with SCA, which may include further mining limitations</p> <p>Proposal for rectification within one month</p> <p>Completion of works following approval from SCA</p>	None required

Feature	ESSMP			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a result of Longwall 15
							Additional monitoring as required	
Aboriginal Cultural Heritage Sites	Record significant heritage items once prior to mining (completed) Sites nominated in CHMP: Browns Road Site 1 Browns Road Site 9 Browns Road Site 15 Browns Road Site 16	Once for observed impacts such as: Cracking, opening of bedding planes, blockfalls, exfoliation, water seepage changes. (completed) For sites: Browns Road Site 1 Browns Road Site 9 Browns Road Site 15 Browns Road Site 16	° 6 months post mining ° 2 years post mining For sites: Browns Road Site 1 Browns Road Site 9 Browns Road Site 15 Browns Road Site 16	° Browns Road Site 1 – Moderate risk ° Browns Road Site 9 – Low risk ° Browns Road Site 15 – Very low risk ° Browns Road Site 16 – Low risk	No impacts observed or reported	Observation of unstable condition (in the case of overhangs) or damage	Implement the Cultural Heritage management Plan (CHMP) Report impacts as required Notify OEH, DRE NSW, SCA Review and undertake remediation option as appropriate	None required

Figures

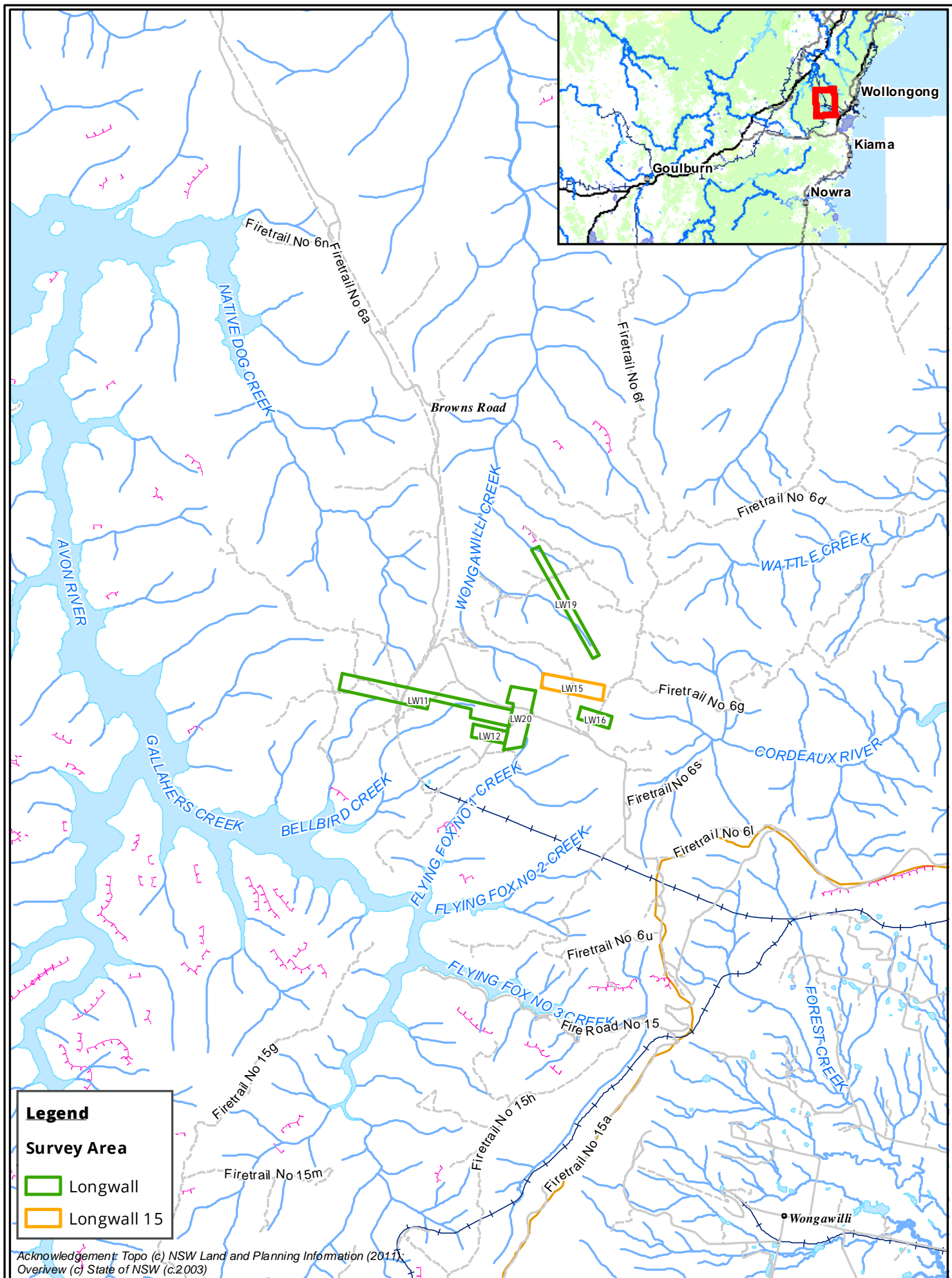
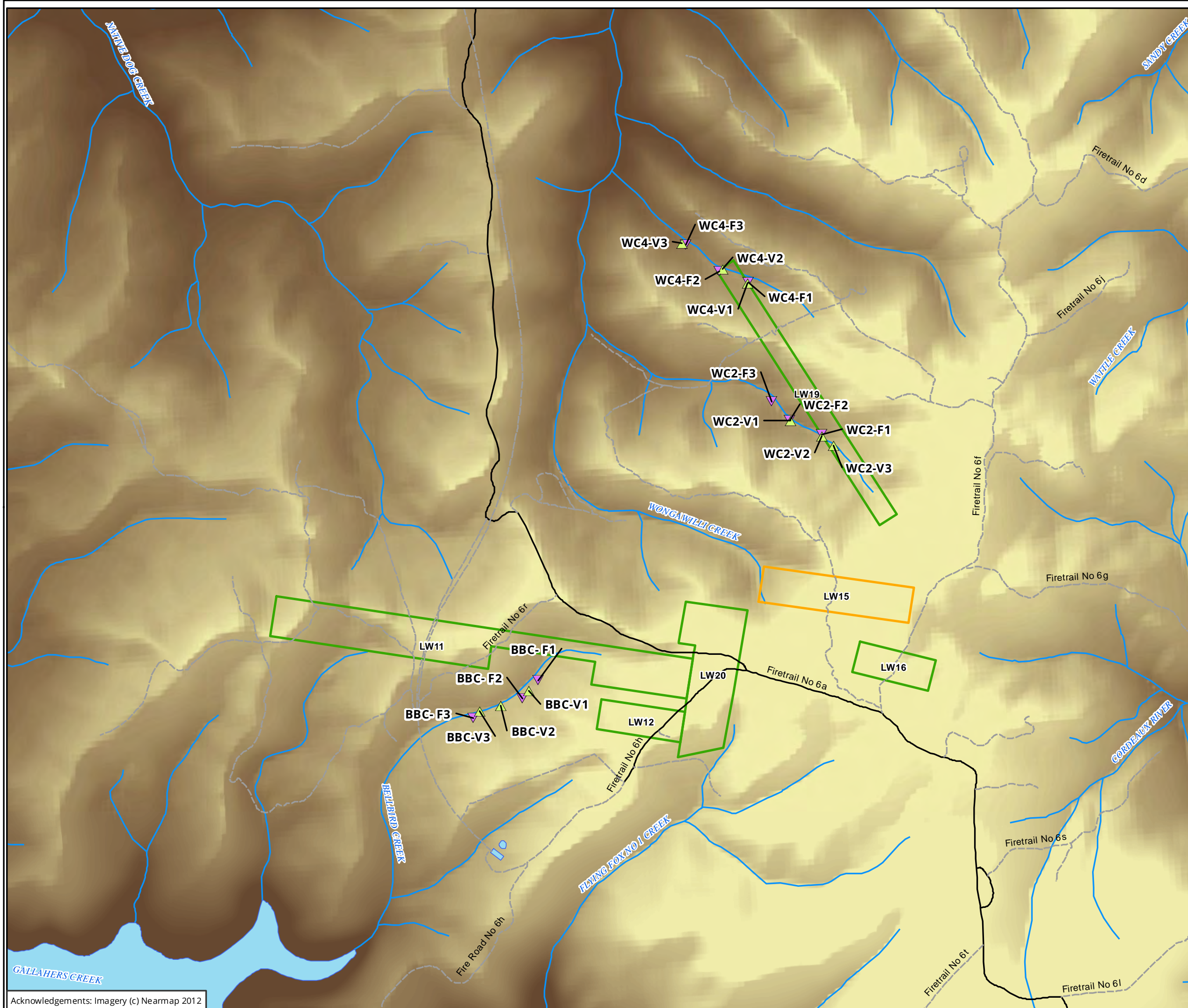




Figure 1: Location of the Study Area within the regional context



Legend

-  Vegetation Creekline Monitoring Site
-  Amphibian Creekline Monitoring Site

Survey Area


-  Longwall
-  Longwall 15

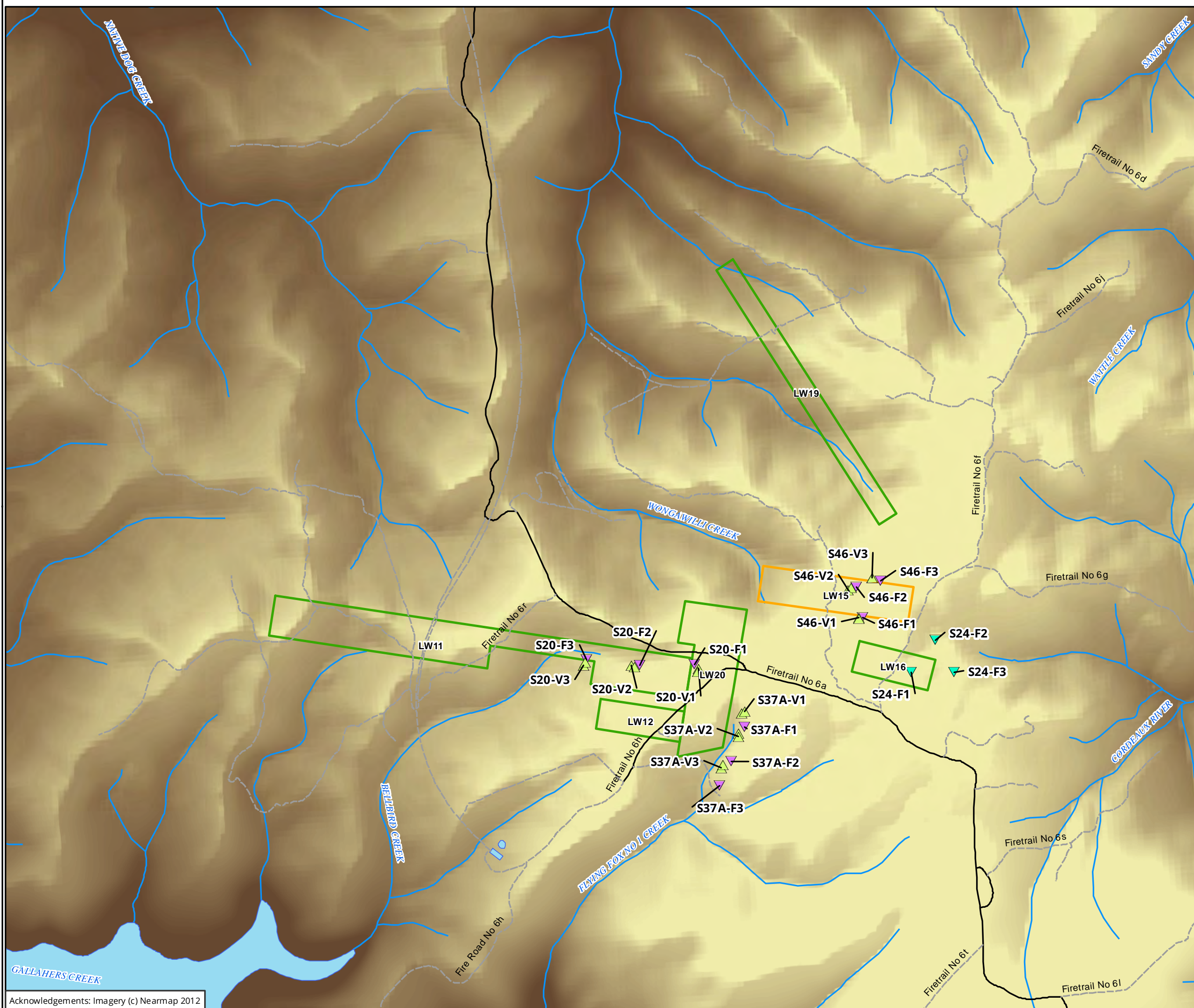
Figure 2a: Vegetation and Amphibian Creekline Monitoring Sites.

0 0.2 0.4 0.6 0.8
Kilometers

Scale: 1:15,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Matter: 16171
Date: 27 February 2013,
Checked by: AJ, Drawn by: ANP, Last edited by: aprichard
Location: P:\16100s\16171\Mapping\16171_F2a_Monitoring



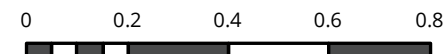
Legend

- ▲ Vegetation Upland Swamp Monitoring Site
- ▼ Amphibian and Vegetation Upland Swamp Monitoring Site
- ▼ Amphibian Upland Swamp Monitoring Site

Survey Area

- Longwall
- Longwall 15

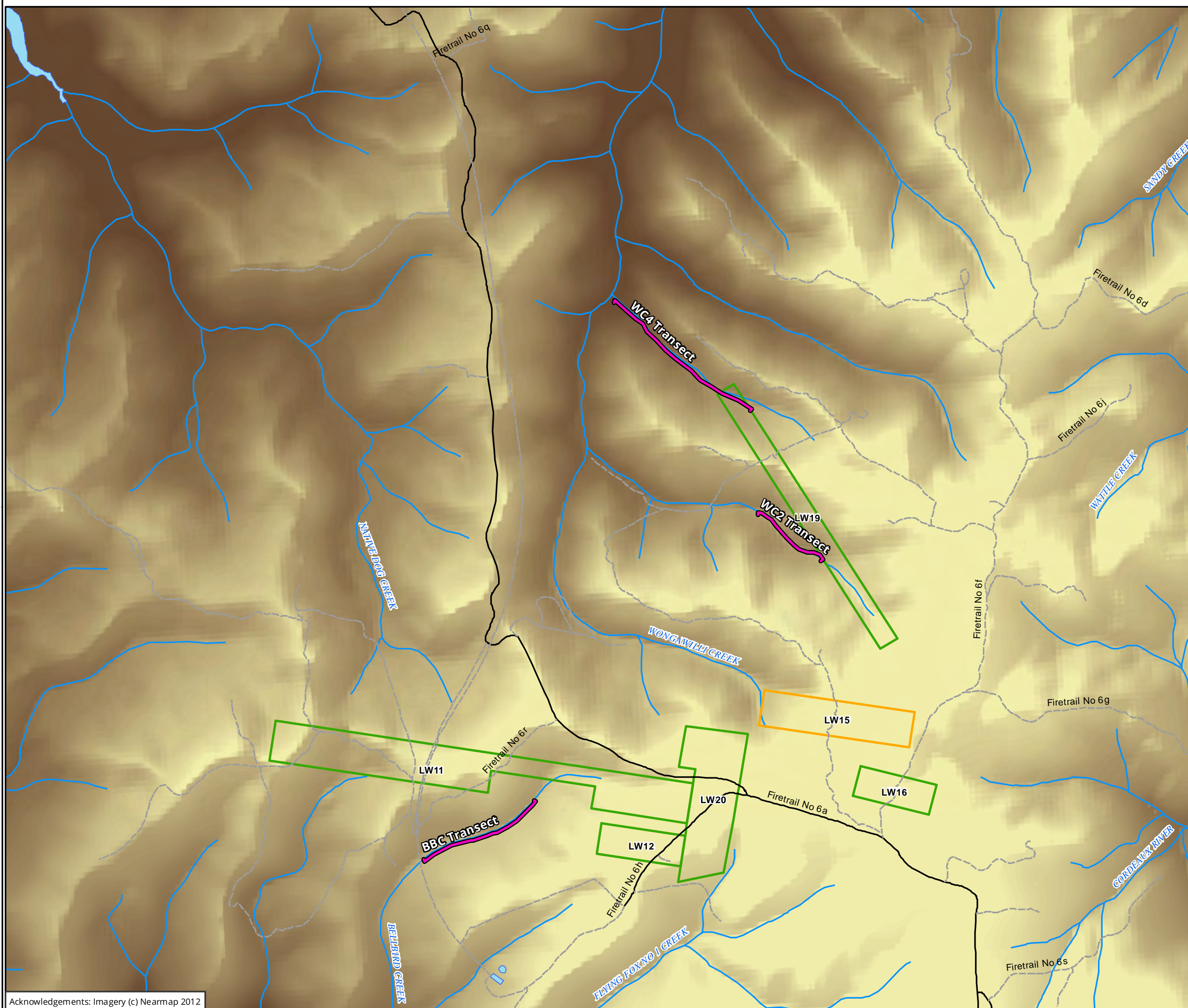
Figure 2b: Vegetation and Amphibian Upland Swamp Monitoring Sites



Scale: 1:15,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56



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Date: 27 February 2013.
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Location: P:\16100s\16171\Mapping\16171_F2b_Monitoring



Legend

Threatened Frog Transect - Impact

Survey Area

Longwall

Longwall 15

Figure 2c: Threatened Frog Monitoring Sites

0 0.2 0.4 0.6 0.8
Kilometers

Scale: 1:15,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Legend

- Vegetation Monitoring Control Site
- Amphibian and Reptile Monitoring Control Site
- Threatened Frog Transect - Control

Survey Area

- Longwall
- Longwall 15

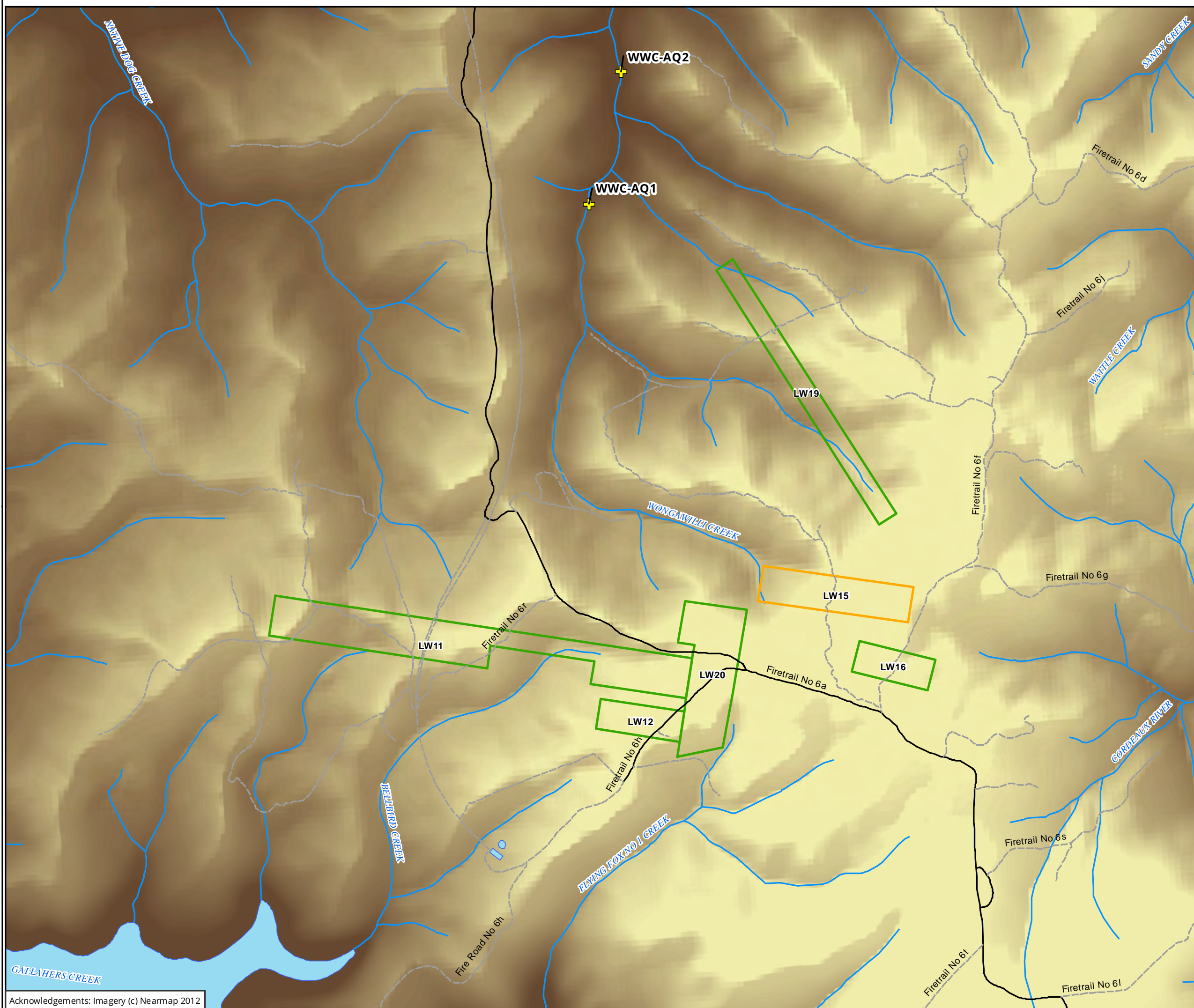
Figure 2d: Vegetation and Amphibian Monitoring Control Sites

0 0.3 0.6 0.9 1.2
Kilometers

Scale: 1:25,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Location: P:\16100s\16171\Mapping\16171_F2d_Monitoring



Legend

✚ Aquatic Monitoring Site - Impact

Survey Area

Longwall

Longwall 15

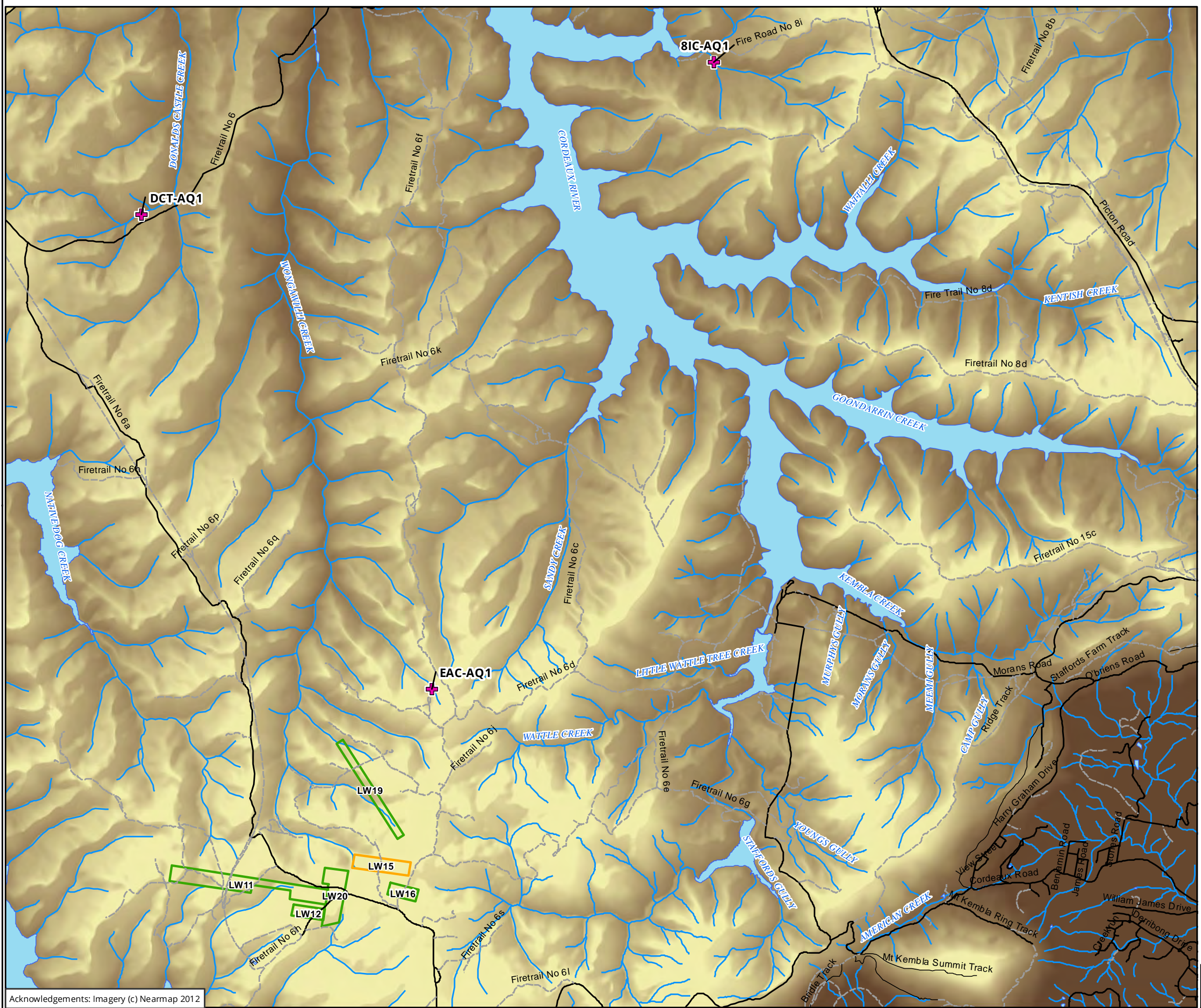
Figure 3a: Aquatic Monitoring Impact Sites

0 0.2 0.4 0.6 0.8
Kilometers

Scale: 1:15,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Location: P:\16100s\16171\Mapping\16171_F3a_Aquatic Monitoring



Legend

✚ Aquatic Monitoring Site - Control

Survey Area

Longwall
Longwall 15

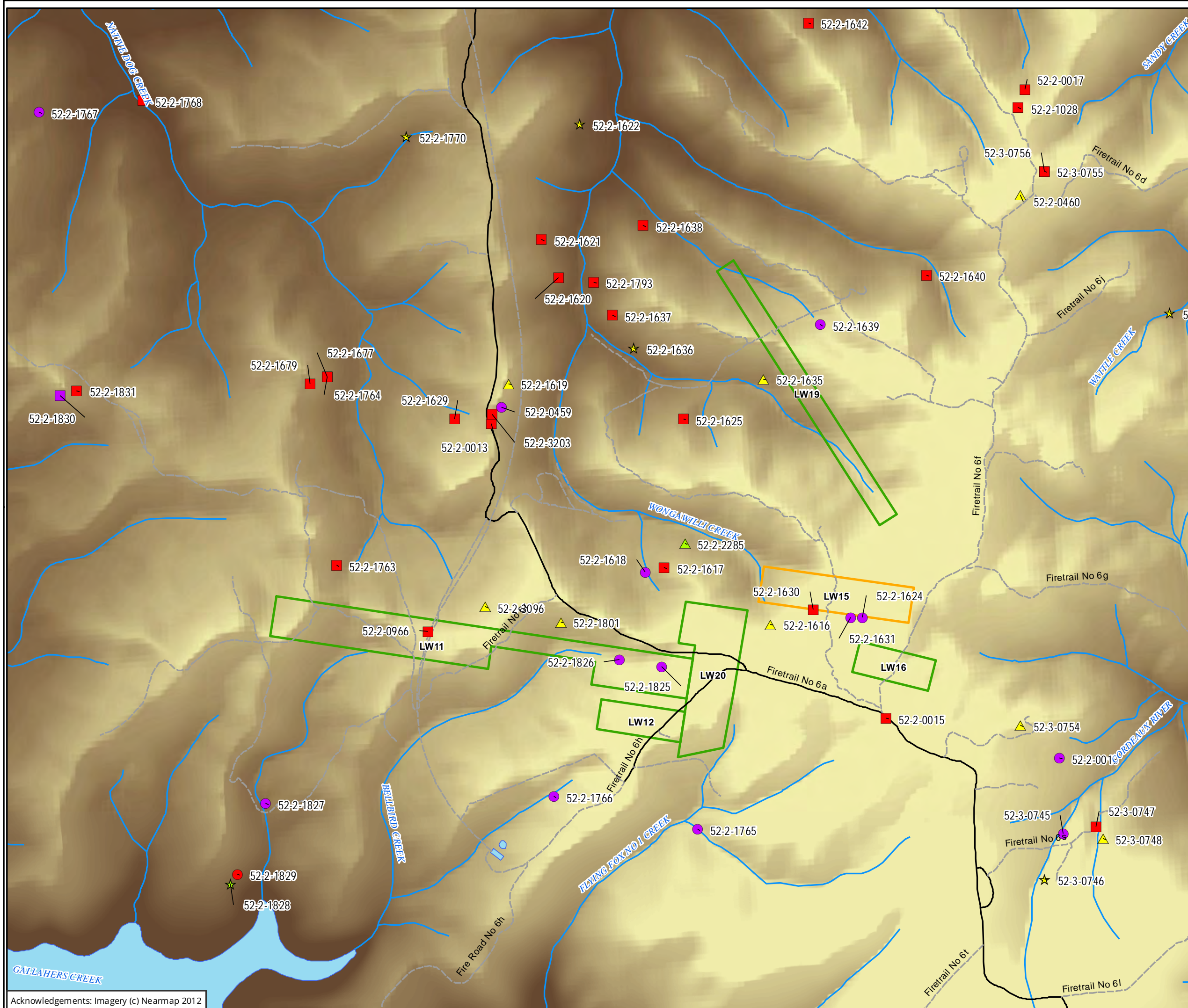
Figure 3b: Aquatic Monitoring Control Sites

0 0.55 1.1 1.65 2.2
Kilometers

Scale: 1:40,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Location: P:\16100s\16171\Mapping\16171_F3b_Aquatic Monitoring



Legend

- Axe Grinding Groove
- Open Camp Site
- ▲ Potential Archaeological Deposit
- ★ Shelter With Art, Shelter With Deposit
- Shelter With Deposit
- Shelter with Art
- ▲ Shelter with Art, Shelter with Deposit
- ★ Shelter with Deposit

Survey Area

- Longwall
- Longwall 15

Figure 4: Aboriginal Archaeological Sites

0 100 200 300 400 500
Metres

Scale: 1:15,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56



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