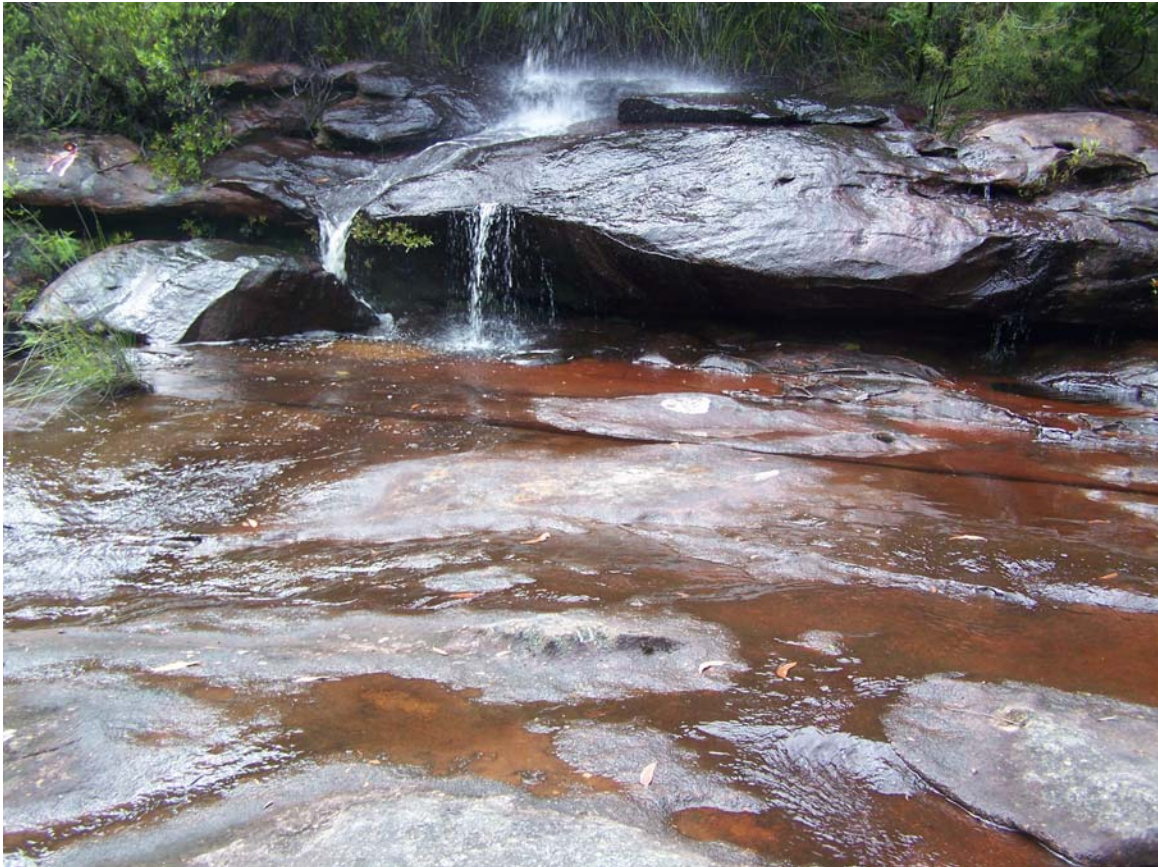




GUJARAT NRE FCGL Pty Ltd

WONGAWILLI COLLIERY LW19 END OF PANEL REPORT



MAY 2012

DOCUMENT CONTROL

DOCUMENT TITLE	NRE WONGAWILLI COLLIERY LW19 END OF PANEL REPORT
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NOTES	

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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 – also 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 only relates to Longwall 19.

This EOP report outlines the measured and observed impacts following the extraction of NRE Wongawilli Longwall 19 and compares any observed impacts with the relevant impact predictions outlined in the SMP and its supporting expert reports and accompanying documentation.

Longwall 19 occurs within Mining Lease (ML) 1596 and was extracted using conventional longwall mining techniques and equipment. Extraction of coal from Longwall 19 commenced on 26 June 2011 and concluded on 20 November 2011.

Subsidence

Subsidence movements resulting from the extraction of Longwall 19 were measured along the survey line known as 1900.

For the 19000 line, the maximum observed total subsidence due to the extraction of Longwall 19 was 28 mm at survey peg 19022, which is less than the maximum predicted total subsidence of 58 mm. Some increased subsidence has occurred away from the point of maximum subsidence, over the previously extracted Longwall 17. The increased subsidence in this area may be due to the reactivation of the Longwall 17 goaf.

The maximum observed total strain due to the extraction of Longwall 19 is a compressive strain of 0.6mm/m which occurs between survey pegs 19002 and 19003. The maximum observed total tilt due to extraction of Longwall 19 is an incremental tilt of 0.3mm/m and is less than the predicted maximum of 4.4mm/m. The observed tilts and strains are very low and generally within the level of survey accuracy.

The 19000 survey line crosses Tributary 1 (tributary of Wongawilli Creek, DAQ30) near the south western edge of Longwall 19. The observed closure of the Tributary 1 valley measured along the 19000 survey line is 25mm, less than the predicted closure of 30mm

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 19 were similar to, or less than, the impacts predicted in the SMP. A 4WD track is the only infrastructure located in the vicinity of Longwall 19 and no impacts were observed.

No subsidence impacts to Indigenous heritage sites were observed.

During extraction of LW19 there was also no increase to minor cracking and rock falls observed during the extraction of LW11 along the Maldon-Dombarton Corridor.

Impacts on Natural Features

The observed impacts on natural features resulting from the extraction of Longwall 19 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 19.

There have been no observed impacts to terrestrial or aquatic ecological values or habitats as a result of the extraction of Longwall 19.

Monitoring of groundwater has 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 have remained static to slightly rising during extraction of Longwalls 19 and 20.

Trigger Action Response Plans (TARP's)

During extraction of Longwalls 19, no TARP triggers were exceeded.

Neither the SCA, nor TransGrid the owner and operator of the 330kv transmission line, located to the east of the SMP Area, have reported any environmental impacts related to Longwall 19.

Conclusion

The extraction of coal from NRE Wongawilli Colliery Longwall 19 has not resulted in unexpected impacts to natural or man made features. No remediation is currently considered to be required.

NRE Wongawilli Colliery Longwall 20 has commenced extraction. Monitoring of natural and man made features in accordance with the NRE Wongawilli Colliery Environment, Subsidence and Safety Management Plan (ESSMP) in relation to Longwall 20 will continue and be documented in the next end of panel report.

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 19 of 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 FCGL Pty Ltd (Gujarat NRE) and specialist consultants involved in monitoring the effects of mining within the limit of subsidence of Longwall 19.

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

Coal from Longwall 19 was extracted using conventional longwall mining techniques between the following dates:

- ☐ Longwall commencement: 26 June 2011.
- ☐ Longwall completion: 20 November 2011.

Longwall 19 is shown in **Figure 1**. Impact predictions associated with Longwall 19 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 FCGL Pty Ltd holds Mining Lease 1596 which includes the area to be mined at NRE Wongawilli Colliery (or in the case of Longwall 19, the area that has been mined). The lease was granted on 19 December 2007. 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 Pillar Extraction Area 1 was granted for NRE Wongawilli Colliery on 16 July 2009.

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 19 on their area of specialisation:

Southern Cross Consulting Surveyors Survey

MSEC	Mine Subsidence	(Attachment A)
GeoTerra	Groundwater & Surface Water	(Attachment B)
Biosis Research	Aquatic & Terrestrial Ecology	(Attachment C)
	Cultural Heritage	(Attachment D)

Gujarat NRE FCGL Landscape Assessment and EOP (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 19 on surface infrastructure.

Section 6 outlines the impacts of mining associated with Longwall 19 on natural features.

Sections 7 summarises the monitoring program and outlines the management and remediation of impacts associated with Longwall 19.

4 PREDICTED AND OBSERVED SUBSIDENCE

4.1 Monitoring Lines

The subsidence movements resulting from the extraction of Longwall 19 were measured along the 2D survey line known as 19000. A set of 3D monitoring pegs were also surveyed in the base of Tributary 1 (Wongawilli Creek tributary) valley to monitor the movement of the valley floor and Cliff CL19-05. The locations of the longwalls at the Colliery and the monitoring lines are shown in **Figure 1**. A comparison of the observed and predicted movements resulting from the extraction of Longwall 19 has been prepared by MSEC and is provided in full in **Attachment A**.

The survey monitoring line was established on 29th June 2011, close to the commencement of extraction of Longwall 19. The previously extracted Elouera Colliery Longwalls 1-6, which are located to the west of Longwall 19, were completed prior to February 2000. The previously extracted Delta Colliery Longwall 17, which is located to the east of Longwall 19, was completed in April 2007. The survey monitoring results therefore include the influence of the previously extracted Elouera Colliery and Delta Colliery longwalls on Longwall 19 but do not include the surface movements that occurred when the Elouera Colliery Longwalls were extracted.

The predicted subsidence profiles for the 19000 Line were obtained using the standard Incremental Profile Method for the Southern Coalfield, which uses an empirical database based on monitoring data from the Bulli Seam. Comparison between predicted and observed subsidence movements along the 19000 Line is provided in the following section.

4.2 19000 Line

The 19000 Line was installed to monitor the subsidence movements due to the extraction of Longwalls 19. A maximum observed incremental subsidence of 28 mm was monitored along this line at survey peg 19022 and is less than the predicted subsidence of 58 mm. The incremental and total observed subsidence due to the extraction of Longwall 19 is presented in Fig. A.01 **Attachment A**. Some increased subsidence has occurred away from the point of maximum subsidence, over the previously extracted Longwall 17. This increased subsidence in this area may be due to some reactivation of the Longwall 17 goaf.

The maximum observed incremental total tilt due to the extraction of Longwall 19 is 0.3mm/m, which is less than the maximum predicted total tilt of 4.4 mm/m. The maximum observed incremental strain due to the extraction of LW19 is a tensile strain of 0.66mm/m which occurs between survey pegs 19002 and 19003. The observed tilts and strains are very low and generally within the level of survey accuracy.

4.3 Vector and Loci of Horizontal Movement

A set of 3D monitoring pegs were also surveyed in the base of the Tributary 1 valley to monitor movement of the valley floor and Cliff CL19-05. The locations of 3D monitoring pegs are shown in **Figure 2**.

A plot of the observed incremental horizontal movement vectors of the 3D monitoring pegs after the completion of Longwall 19 is shown in MSEC491-02 **Attachment A**. This drawing also shows the incremental loci of horizontal movement of the 3D monitoring pegs during the extraction of Longwall 19.

The vectors and loci indicate that a net movement in the approximate range of 10 mm to 20 mm toward the north and west occurred as the result of the extraction of Longwall 19. The net direction of these movements in flat terrain would normally be expected to result in movement towards the finishing end of the longwall. The net horizontal movements of these 3D monitoring pegs appear to have been influenced by downslope movements. The downslope direction of Tributary 1 is towards the northwest. The vectors in the steeper terrain near cliff CL19-05 trend more in the downslope direction. The change in direction of vectors between pegs E and P4 indicate that potential shear movement may have occurred in this area, however there were no observed impacts at the surface.

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 19 is shown in **Figure 1**.

There is no significant infrastructure above or adjacent to Longwall 19 however the following items are considered in this EOP:

- ☐ Survey control marks.
- ☐ 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 19 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 the only reported impacts on surface infrastructure resulting from the extraction of Longwall 19 were minor impacts on the survey control marks. Impacts were similar to, or less than predicted.

There are no exploration bores within the limit of subsidence for Longwall 19.

Table 5.1: Summary of Predicted and Observed Impacts from Longwall 19 on Surface Infrastructure

Surface Infrastructure	Predicted Impacts	Observed Impacts
Survey Control Marks	Horizontal movements requiring re-establishment	Horizontal movements require re-establishment
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 Research Pty. Ltd. (Biosis) prepared an End of Panel assessment on all Aboriginal heritage sites in the vicinity of Longwall 19 and the full report is provided in **Attachment D**.

Three previously recorded Aboriginal archaeological sites occur in the vicinity of Longwall 19. The archaeological sites considered in this EOP are:

- ☐ Browns Road Site 21; 52-2-1635
- ☐ Browns Road Site 25; 52-2-1639
- ☐ Wongawilli 1; 52-2-3669

The risk of impact to these sites from subsidence related to extraction of Longwall 19 was considered to be low.

These were reassessed and other local landscape features such as natural joint and bedding planes within the sandstone platforms on which the sites occur were also inspected for evidence of subsidence related impact.

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 19.

6 IMPACTS TO NATURAL FEATURES

Longwall 19 is located within the Metropolitan Special Areas Water Catchment. By definition the catchment area is relatively undisturbed and therefore contains many important natural features, as discussed below relevant for LW19.

6.1 Steep Slopes and Rock Outcrops

There are several areas identified in Figure MSEC 360-08 (MSEC 2008 – not reproduced in this report). CL19-04 and CL19-05 both occur above Longwall 19, along with several small areas of steep slope and rock outcrops.

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 in the vicinity of Longwall 19 were undertaken during site inspections by Biosis Research and personnel from Gujarat NRE.

There have been no observed impacts on steep slopes associated with Longwall 19.

6.2 Surface Water and Groundwater Impacts

There are no major waterways within the limit of subsidence of Longwall 19. Tributaries of Wongawilli Creek flow above LW19, with their headwaters located within upland swamps upstream of Longwall 19.

One swamp piezometer (P21A) is located over Longwall 19, with two piezometers located near Longwall 19 (P31 and P46) that are used to measure groundwater levels and water quality.

Locations of surface and groundwater monitoring sites for Longwall 19 are shown on **Figure 3**.

Predicted Impacts

GeoTerra (**Attachment B**) have assessed the surface and groundwater monitoring results and prepared a comprehensive end of panel report for Longwall 19. 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 19
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, 19 and 20; however EGW3 over Longwall 11 fell by 8.92m.
Shallow Hawkesbury Sandstone groundwater levels should recover over a few months	Based on the available data, the EGW3 water level has not yet recovered
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
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
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 20 or 21A water levels has been caused by LW 11, 12, 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 20 and 21A piezometers have 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 and Wongawilli Creek may be adversely affected by subsidence from Longwall 11, 12, 19 and 20	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 may be adversely affected by subsidence from Longwall 11, 12, 19 and 20	Stream water quality in Bellbird Creek and the Wongawilli Creek tributaries has not been adversely affected by subsidence related effects against TARP triggers.

Summary of Results

During extraction of Longwalls 19, there were no TARP trigger levels exceeded for surface or groundwater impacts.

Refer **Attachment D** for detailed results.

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

6.3 Aquatic Ecology

Biosis Research (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 LW 19 were again inspected by Biosis Research in spring 2011. The results of the Biosis Research End of Panel assessment for aquatic ecological values are provided in **Attachment C**.

6.3.1 Predicted Impacts on Aquatic Ecology

Aquatic habitats in the vicinity of Longwall 19 included an unnamed tributary of Wongawilli Creek. There are also several small ephemeral drainage lines that are associated with Upland Swamps that are located above and adjacent to Longwall 19.

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 19 (along with 11 and 12). There has been no observed impact on aquatic ecological values.

Refer to **Attachment C** 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 19. The results of the Biosis End of Panel assessment for terrestrial ecological values are provided in **Attachment C**.

6.4.1 Predicted Impacts on Terrestrial Ecology

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

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 mining of Longwall 19 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 mining of Longwall 19 (along with 11 and 12).

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 – 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 19.

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 have been informed of the identified impacts as per **Table 7.1**.

Neither the SCA, nor TransGrid the owner and operator of the 330kv transmission line, located to the east of the SMP Area, have reported any environmental impacts related to Longwall 19.

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 19
Subsidence lines E&EE, EF & 19000 (Pre and post mining)	2D Survey once prior to mining	During mining - only if regular inspections identify greater than predicted impacts (not required)	Post mining 2D survey of E&EE and EF lines of: -Total subsidence; - Incremental subsidence; - Variation in horizontal strain. • Survey measurement comparison with predictions • Reported in Survey Reports	<input type="checkbox"/> As per MSEC predicted subsidence contours.	<input type="checkbox"/> No observed or reported effects	<input type="checkbox"/> Major surface cracking (>10mm)	<input type="checkbox"/> Notify Principal Subsidence Engineer - DRE NSW; <input type="checkbox"/> Undertake subsidence survey and review against predictions; <input type="checkbox"/> Review mining options	<input type="checkbox"/> None required.
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 PE1. 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 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	<input type="checkbox"/> None required
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 21 - Wongawilli 1 - Browns Road Site 25	Once for observed impacts such as: Cracking, opening of bedding planes, blockfalls, exfoliation, water seepage changes.	<input type="checkbox"/> 3-6 months post mining <input type="checkbox"/> 2 years post mining	<input type="checkbox"/> Browns Road 21 - Moderate risk <input type="checkbox"/> Wongawilli 1 - Moderate risk <input type="checkbox"/> Browns Road 25 - Very 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 19
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 impact.	<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 impedance	<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 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	<input type="checkbox"/> None required
Stream Water Quality and Flow	<input type="checkbox"/> Field Analysis (EC, pH, temp) <input type="checkbox"/> Laboratory Analysis 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"/> Observable iron or salinity staining using Photo Points <input type="checkbox"/> Monthly for at least two months prior to mining (for all parameters above)	<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 using Photo points	<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 for one year after subsidence ceases using Photo points	<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 Creek, Wongawilli Creek and the Tributaries to Wongawilli Creek, above and adjacent to the proposed longwalls <input type="checkbox"/> Gas emission could occur but significant emissions considered unlikely <input type="checkbox"/> Iron staining not predicted to occur <input type="checkbox"/> Water Quality: Lowering of pH in stream water due to iron staining (precipitate)	<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 conducted since July 2005 the following triggers will be used: <input type="checkbox"/> EC > 200uS/cm <input type="checkbox"/> 4.2 > pH > 6.77 <input type="checkbox"/> Fe (Tot) > 6mg/L <input type="checkbox"/> Mn (tot) > 0.1mg/L <input type="checkbox"/> Al (tot) > 0.7mg/L <input type="checkbox"/> Zn (filt) > 0.04mg/L <input type="checkbox"/> SO4 (filt) > 8mg/L <input type="checkbox"/> Dissolved oxygen / ORP / temperature	<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 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	<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 19
Loss of Flow	<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"/> Possible diversion of surface water into dilated strata and the draining of pools	<input type="checkbox"/> No observed water quality impacts	<input type="checkbox"/> Observation of loss of flow connectivity within a flowing ephemeral stream (related to rainfall), compared to the flow regimes evident prior to the extraction of LW's 11-19	<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 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	<input type="checkbox"/> None required
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 terrestrial habitat and from comparison of pre-mining and post-mining photographs	<input type="checkbox"/> Survey area to identify whether earthworks are required <input type="checkbox"/> Contract hydrologist investigate and 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	<input type="checkbox"/> None required
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 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	<input type="checkbox"/> None required
Groundwater – Hawkesbury Sandstone (water quality and water levels) in four bores EGW2,	<input type="checkbox"/> Field water quality (EC, pH, temp)– bi monthly <input type="checkbox"/> Laboratory analysis – every four months	<input type="checkbox"/> Field water quality – monthly during extraction <input type="checkbox"/> Laboratory analysis –	<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"/> 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	<input type="checkbox"/> Investigation initiated within one week of trigger <input type="checkbox"/> Repeat water quality sampling of impacted and adjacent	<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 19
EGW3,EGW5 ,WW1	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)	every two months		<div><div><input type="checkbox"/> Potential increased rate of recharge into the plateau</div><div><input type="checkbox"/> Piezometers may experience increased iron / manganese hydroxide precipitation and / or lowering of pH</div><div><input type="checkbox"/> Interface drainage, ferruginous, brackish seeps may be generated in streams</div><div><input type="checkbox"/> Shallow groundwater level within Swamp 20 will be dependent on rainfall recharge and will not be affected by mining</div><div><input type="checkbox"/> Strata gas discharge into piezometers may occur</div><div><input type="checkbox"/> Stream flow in Bellbird Creek and Wongawilli Creek may be adversely affected by subsidence from Longwall 19</div><div><input type="checkbox"/> Stream water quality in Bellbird Creek and Wongawilli Creek may be adversely affected by subsidence from Longwall 19</div></div>		levels for pH, EC, Fe, Mn, Al, Zn and SO4	<div>bores if triggers exceeded, as required</div> <div><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 level / water quality</div> <div><input type="checkbox"/> Inform SCA, OEH & DRE NSW of investigation outcomes</div> <div><input type="checkbox"/> Investigation of possible mitigation measures in consultation with SCA / OEH</div> <div><input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with SCA / OEH if appropriate</div> <div><input type="checkbox"/> Report in SMP / End of Panel reports to inform relevant agencies of results of monitoring</div>	
Ground Water Levels (using pressure transducer and bores)	<input type="checkbox"/> Bi- monthly	<input type="checkbox"/> Monthly	<input type="checkbox"/> Bi -monthly	<div><div><input type="checkbox"/> Temporary lowering of piezometric surface by up to 10m which may stay at that level until maximum subsidence develops</div><div><input type="checkbox"/> Groundwater levels should recover over a few months</div><div><input type="checkbox"/> No permanent post mining reduction in water levels in bores on the plateau unless a new outflow path develops</div><div><input type="checkbox"/> Strata dilation and subsequent re-filling of secondary voids may temporarily lower standing water levels</div></div>	<input type="checkbox"/> No observed or reported effects	<input type="checkbox"/> Continuous >5m ground water level reduction over a minimum 2 month period	<div><input type="checkbox"/> Instigate investigation within 1 week of trigger</div> <div><input type="checkbox"/> Engage hydrogeologist to investigate and report on the cause of trigger exceedances where the cause may not be directly related to lack of rainfall recharge</div> <div><input type="checkbox"/> Inform SCA, OEH & DRE of investigation outcomes</div> <div><input type="checkbox"/> Investigation of possible mitigation measures in consultation with SCA / OEH</div> <div><input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with SCA / OEH if necessary</div> <div><input type="checkbox"/> Report in End of Panel reports to inform relevant agencies of ongoing results of monitoring</div>	<input type="checkbox"/> None required
Inflow into mine workings (during all active mining)	<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"/> Increased groundwater seepage inflow into the	<input type="checkbox"/> No increase in mine water discharge recorded	<input type="checkbox"/> Increase in water discharge of > 1ML/day for 7 successive	<input type="checkbox"/> Engage contract hydrogeologist to investigate	<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 19
(daily monitoring)	<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)	workings should not occur		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	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	
Potential Mine inflow events	<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 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 inspectorate	<input type="checkbox"/> Engage contract hydrogeologist to investigate and report on changes 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	<input type="checkbox"/> None required
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"/> 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	<input type="checkbox"/> None required
Aquatic Ecology	<input type="checkbox"/> Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime <input type="checkbox"/> Targeted surveys for	<input type="checkbox"/> Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime <input type="checkbox"/> AUSRIVAS sampling of	<input type="checkbox"/> Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime (ongoing) <input type="checkbox"/> AUSRIVAS sampling of	<input type="checkbox"/> Unlikely that any threatened aquatic species would be significantly impacted by subsidence resulting from Longwall mining <input type="checkbox"/> Unlikely to be impacts to	<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

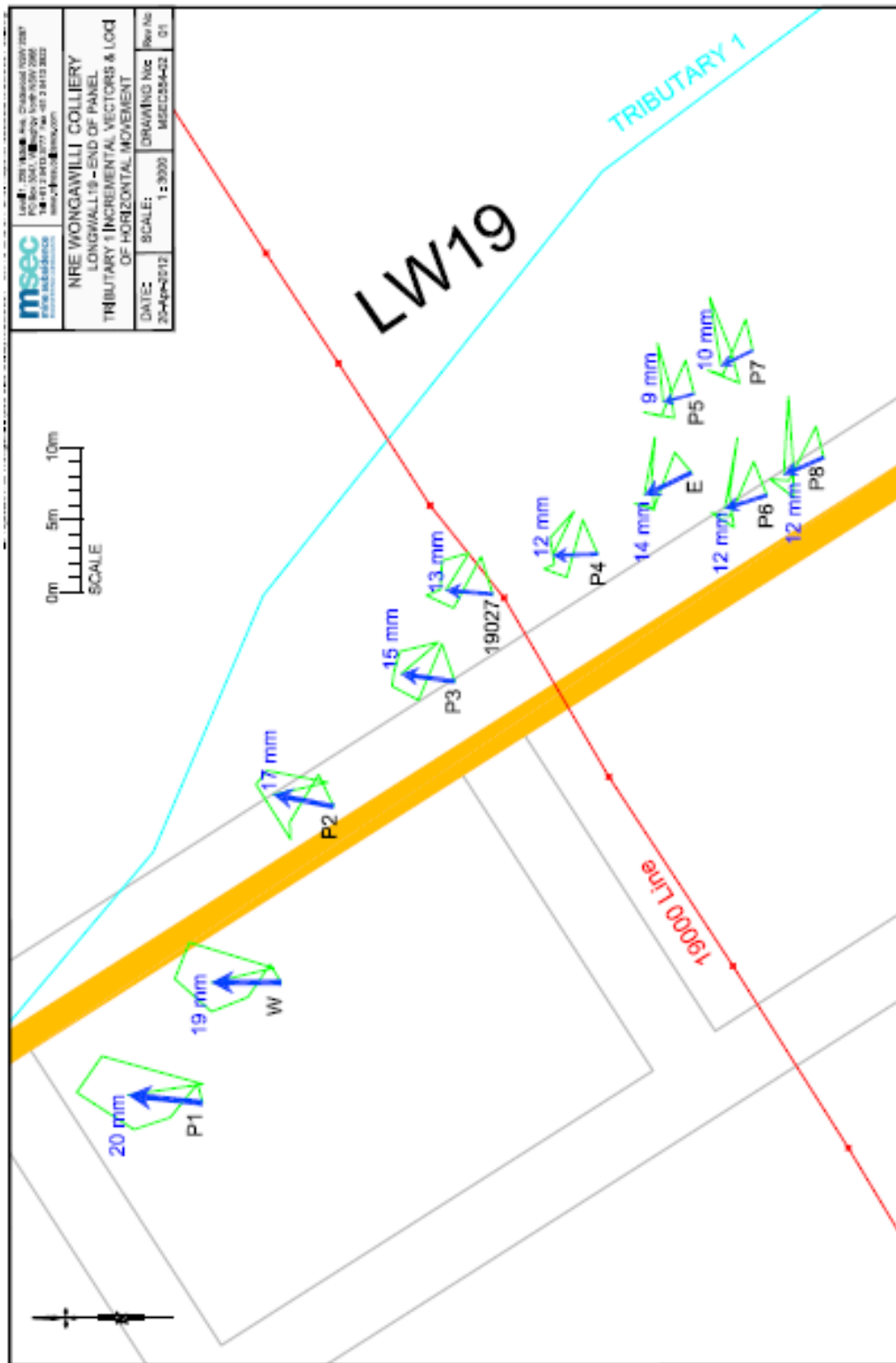
Feature	ESSMP Monitoring Commitments			Impact Assessment		TARPS		
	Prior to Mining	During Mining	Post Mining and Future Monitoring	Predicted Impacts	Observed Impacts	Trigger	Response	Action as a Result of Longwall 19
	threatened aquatic biota in major drainage lines <input type="checkbox"/> AUSRIVAS sampling of reference and impact sites in the broader ESSMP area	reference and impact sites in the broader ESSMP area	reference and impact sites in the broader ESSMP area	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 – once (completed)	<input type="checkbox"/> Observational monitoring of identified threatened species – twice annually during entire extraction (ongoing)	<input type="checkbox"/> Observational monitoring of identified threatened species – annually for one year (ongoing)	<input type="checkbox"/> Unlikely that any threatened flora would be significantly impacted by subsidence resulting from Longwall mining. <input type="checkbox"/> Impacts to threatened amphibian species as reported below.	<input type="checkbox"/> No effects reported to date	<input type="checkbox"/> Major impacts to threatened species to include: <input type="checkbox"/> Their habitat; and/or a decline in numbers from baseline observed; and/or <input type="checkbox"/> Change in species composition	<input type="checkbox"/> Notification to SCA/NPWS immediately <input type="checkbox"/> Proposal for threatened species management within 1 week <input type="checkbox"/> Completion of management task following approval from SCA/NPWS	<input type="checkbox"/> None required
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.		<input type="checkbox"/> Additional monitoring as required by the relevant government agencies	
Swamp and riparian vegetation	Once prior to mining (completed)	Twice annually during entire extraction period (ongoing)	Annually for one year (ongoing)	<input type="checkbox"/> Minor impacts to Upland Swamp vegetation through change in water levels, and the cracking of soils	<input type="checkbox"/> None observed or reported.			
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"/> 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"/> None required
						<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"/> Notification to SCA <input type="checkbox"/> Remediation options developed in consultation with SCA, which may include further mining limitations <input type="checkbox"/> Proposal for rectification within one month <input type="checkbox"/> Completion of works following	<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 19
Public Safety (fortnightly during extraction)	<div><input type="checkbox"/> Observation of Cliffs and steep slopes; Fire roads; 4WD tracks; Rocky outcrops and cuttings</div> <div><input type="checkbox"/> Once prior to mining</div>	<div><input type="checkbox"/> Fortnightly during extraction</div>	<div><input type="checkbox"/> Monthly following mining for 6 months</div>	<div><input type="checkbox"/> Potential for some minor surface cracking and compressive rippling of the unsealed road surfaces</div>	<div><input type="checkbox"/> No effects observed</div>	<div>approval from SCA</div> <div><input type="checkbox"/> Additional monitoring as required</div>	<div><input type="checkbox"/> Notification to SCA within 24 hrs, using photographic record</div> <div><input type="checkbox"/> None required</div>	<div><input type="checkbox"/> None required</div>
						<div><input type="checkbox"/> Major Cracking (>10mm), noticeable instability or traffic impedance</div>	<div><input type="checkbox"/> Notification to SCA immediately</div> <div><input type="checkbox"/> Make area safe as soon as practicable</div> <div><input type="checkbox"/> Proposal for rectification within 1 week</div> <div><input type="checkbox"/> Completion of works following approval from SCA</div> <div><input type="checkbox"/> Additional monitoring</div>	

FIGURES

[illegible]

Figure 2: Longwall 19, Tributary 1 Incremental Vectors & Loci of Horizontal Movement (Source – MSEC 554-02)



ATTACHMENTS

ATTACHMENT A

**Subsidence Report: End of Panel Monitoring Report for
Longwall 19 at Wongawilli Colliery. Mine Subsidence
Engineering Consultants (MSEC) Report # MSEC554 –
Revision A. April 2012**



GUJARAT NRE WONGA PTY LTD

NRE Wongawilli Colliery

End of Panel Monitoring Report For Longwall 19

DOCUMENT REGISTER

Revision	Description	Author	Checker	Date
01	End of Panel Report for Wongawilli Longwall 19 - Draft	PD	AAW	2 nd May 12
A	End of Panel Report for Wongawilli Longwall 19 - Final	PD	AAW	3 rd May 12

Report produced for:- Compliance with conditions attached to the SMP Approval set by The Department of Primary Industries.

Previous reports:- MSEC360 (September 2008) – 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 and due to Pillar Extraction Areas 1 & 2 (In Support of a SMP Application).

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LIST OF TABLES, FIGURES AND DRAWINGS

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Table 3.1	Summary of Predicted and Observed Impacts Resulting from the extraction of Longwall 19	7

Figures

The figures are provided in Appendix A at the end of this report.

<i>Figure</i>	<i>Description</i>
Fig. A.01	Observed and Predicted Profiles of Subsidence, Tilt and Strain along the 19000-Line resulting from the Extraction of Longwall 19

Drawings

The drawings are provided in Appendix A at the end of this report.

<i>Drawing No.</i>	<i>Description</i>
MSEC554-01	NRE Wongawilli Colliery, LW19 End of Panel, Monitoring & Surface Infrastructure
MSEC554-02	NRE Wongawilli Colliery, LW19 End of Panel, Tributary 1 Incremental Vectors & Loci of Horizontal Movement

1. BACKGROUND

1.1. Introduction

Gujarat NRE WONGA Pty Ltd (NRE) has completed the extraction of Longwall 19 at NRE Wongawilli Colliery in the Southern Coalfield of New South Wales. NRE Wongawilli Colliery was previously operated as Elouera Colliery and Delta Colliery. Longwall 19 is located between the previously extracted Elouera Colliery Longwalls 1 to 6 and Delta Colliery Longwall 7 and is shown in Drawing No. MSEC554-01 in Appendix A.

The extraction of Longwall 19 commenced on the 26th of June 2011 and was completed on the 5th of December 2011. Longwall 19 had an extracted width of approximately 84 metres and length of approximately 1280 metres. The depth of cover over the Longwall 19 footprint varied from approximately 320 metres to 350 metres.

In accordance with approval conditions detailed in the Environmental Subsidence and Safety Management Plan, (ESSMP), this report provides a comparison between the predicted and observed subsidence movements along the monitoring lines at Wongawilli Colliery resulting from the extraction of Longwall 19 and an analysis of these monitoring results.

This report also details the observed impacts on the manmade surface infrastructure within the Application Area resulting from the extraction of Longwall 12. Detailed descriptions of impacts on natural features within the Application Area are provided in the reports by other consultants, and the observations provided in this report should be read in conjunction with all other relevant reports.

2. COMPARISON BETWEEN PREDICTED AND OBSERVED SUBSIDENCE MOVEMENTS

2.1. Monitoring Lines

The subsidence movements resulting from the extraction of Longwall 19 were measured by the 19000 Line which is a 2D monitoring line across the longitudinal alignment of Longwall 19. A set of 3D monitoring pegs were also surveyed in the base of the Tributary 1 valley to monitor the movement of the valley floor and Cliff CL19-05. The locations of the longwalls at the Colliery and the monitoring lines are shown in Drawing No. MSEC554-01 in Appendix A.

The survey monitoring lines were established 29th June 2011, close to the commencement of extraction of Longwall 19. The previously extracted Elouera Colliery Longwalls 1 to 6, which are located to the west of Longwall 19, were completed prior to February 2000. The previously extracted Delta Colliery Longwall 17, which is located to the east of Longwall 19, was completed in April 2007. The survey monitoring results therefore include the influence of the previously extracted Elouera Colliery and Delta Colliery longwalls on Longwall 19 but do not include the surface movements that occurred when the Elouera Colliery and Delta Colliery Longwalls were extracted.

The predicted subsidence profiles for the 19000 Line were obtained using the predicted standard Incremental Profile Method for the Southern Coalfield, which uses an empirical database based on monitoring data from the Bulli Seam. Comparison between predicted and observed subsidence movements along the 19000 Line monitoring line are provided in the following section.

19000 Line

The 19000 Line was installed to monitor the subsidence movements due to the extraction of Longwall 19. A graph showing the observed and predicted subsidence movements due to the extraction of Longwall 19 is presented in Fig. A.01.

The maximum observed incremental subsidence due to the extraction of Longwall 19 was 28 mm located at survey peg 19022. The maximum observed subsidence resulting from the extraction of Longwall 19 is less than the maximum predicted subsidence of 58 mm. It can be seen from Fig. A.01 that the extent of the subsided surface generally matched the predicted profile. Some increased subsidence has occurred away from the point of maximum subsidence, over the previously extracted Longwall 17. This increased subsidence in this area may be due to some reactivation of the Longwall 17 goaf.

The maximum observed incremental tilt due to the extraction of LW19 is 0.3mm/m, which is less than the maximum predicted incremental tilt of 4.4 mm/m. The maximum observed incremental strain due to the extraction of LW19 is a tensile strain of 0.6mm/m which occurs between survey pegs 19002 and 19003. The observed tilts and strains are very low and generally within the level of survey accuracy.

The 19000 Line crosses Tributary 1 near the south western edge of Longwall 19. The observed closure of the Tributary 1 valley measured along the 19000 Line is 25 mm which is less than the predicted closure of 30 mm.

Vector and Loci of Horizontal Movement

A set of 3D monitoring pegs were also surveyed in the base of the Tributary 1 valley to monitor the movement of the valley floor and Cliff CL19-05. The locations of the 3D monitoring pegs are shown in Drawing No. MSEC554-02.

A plot of the observed incremental horizontal movement vectors of the 3D monitoring pegs after the completion of Longwall 19 is shown in Drawing No. MSEC491-02. This drawing also shows the incremental loci of horizontal movement of the 3D monitoring pegs during the extraction of Longwall 19.

The vectors and loci indicate that a net movement in the approximate range of 10 mm to 20 mm toward the north and north west occurred as the result of the extraction of Longwall 19. The net direction of these movements in flat terrain would normally be expected to result in movement towards the finishing end of the longwall. The net horizontal movements of these 3D monitoring pegs appear to have been influenced by downslope movements. The downslope direction of Tributary 1 is towards the northwest. The vectors in the steeper terrain near cliff CL19-05 trend more in the downslope direction. The change in direction of vectors between pegs E and P4 indicated that potential shear movement may have occurred in this area, however there were no observed impacts at the surface.

The pegs P5, P6, P7 and P8 are located at the top of cliff CL19-05. The distance between Pegs P5 and P6 is approximately 8.6 metres and the distance between Pegs P7 and P8 is approximately 7.3 metres. The observed strains between P5 to P6 and P7 to P8 were less than 0.1 mm/m indicating that no significant closure occurred across the top of cliff CL19-05. The loci plots of horizontal movement shown in Drawing No. MSEC491-02 indicate that these pegs moved bodily in the same direction with very little differential movement between pegs.

3. IMPACTS ON SURFACE INFRASTRUCTURE

Surface Infrastructure within the Application Area

The only items of surface infrastructure that are located above or adjacent to Longwall 19 are the 4WD tracks one of which passes directly above Longwall 19. The locations of the surface infrastructure are shown in Drawing No. MSEC554-01

Comparison between Predicted and Observed Impacts on Surface Infrastructure

A comparison between the observed and the predicted impacts on the manmade surface infrastructure above or adjacent to Longwall 19 is provided in Table 3.1. The predicted impacts were detailed in the report that was titled "*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 and due to Pillar Extraction Areas 1 & 2 (In Support of a SMP Application)*" and this report was issued in September 2008 as MSEC360.

Comparisons between predicted and observed impacts on the natural features above or adjacent to the Longwall 19 are provided in other consultant reports.

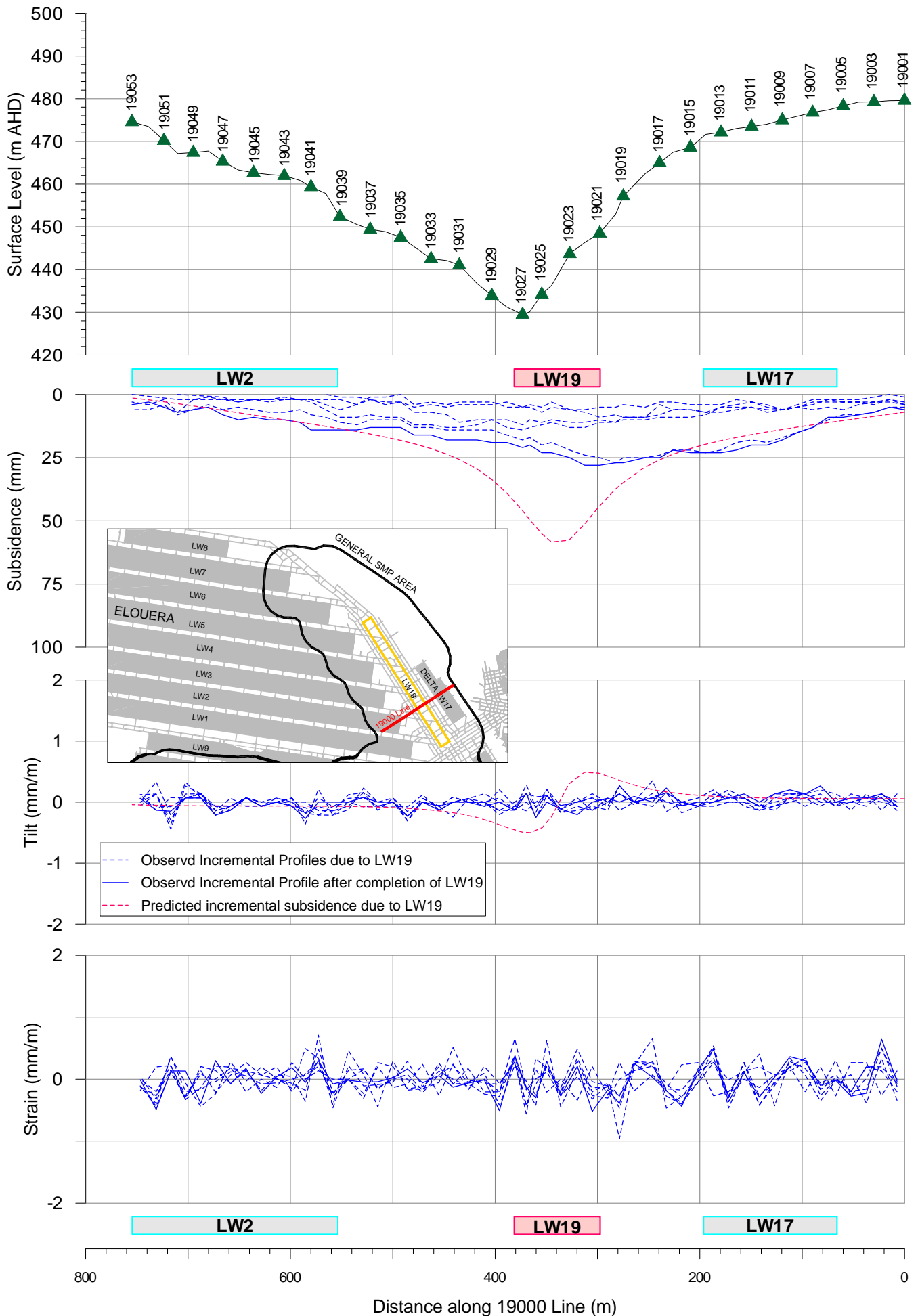
Table 3.1 Summary of Predicted and Observed Impacts Resulting from the extraction of Longwall 19

Surface Infrastructure	Predicted Impacts	Observed Impacts
Fire trails and 4WD tracks	Changes to surface drainage and some surface cracking of the unsealed road surfaces	No reported impacts

It can be seen from Table 3.1, that reported impacts were less than predicted.

APPENDIX A. FIGURES AND DRAWINGS

Observed and Predicted Profiles of Subsidence, Tilt and Strain along the 19000-Line resulting from LW19 Extraction



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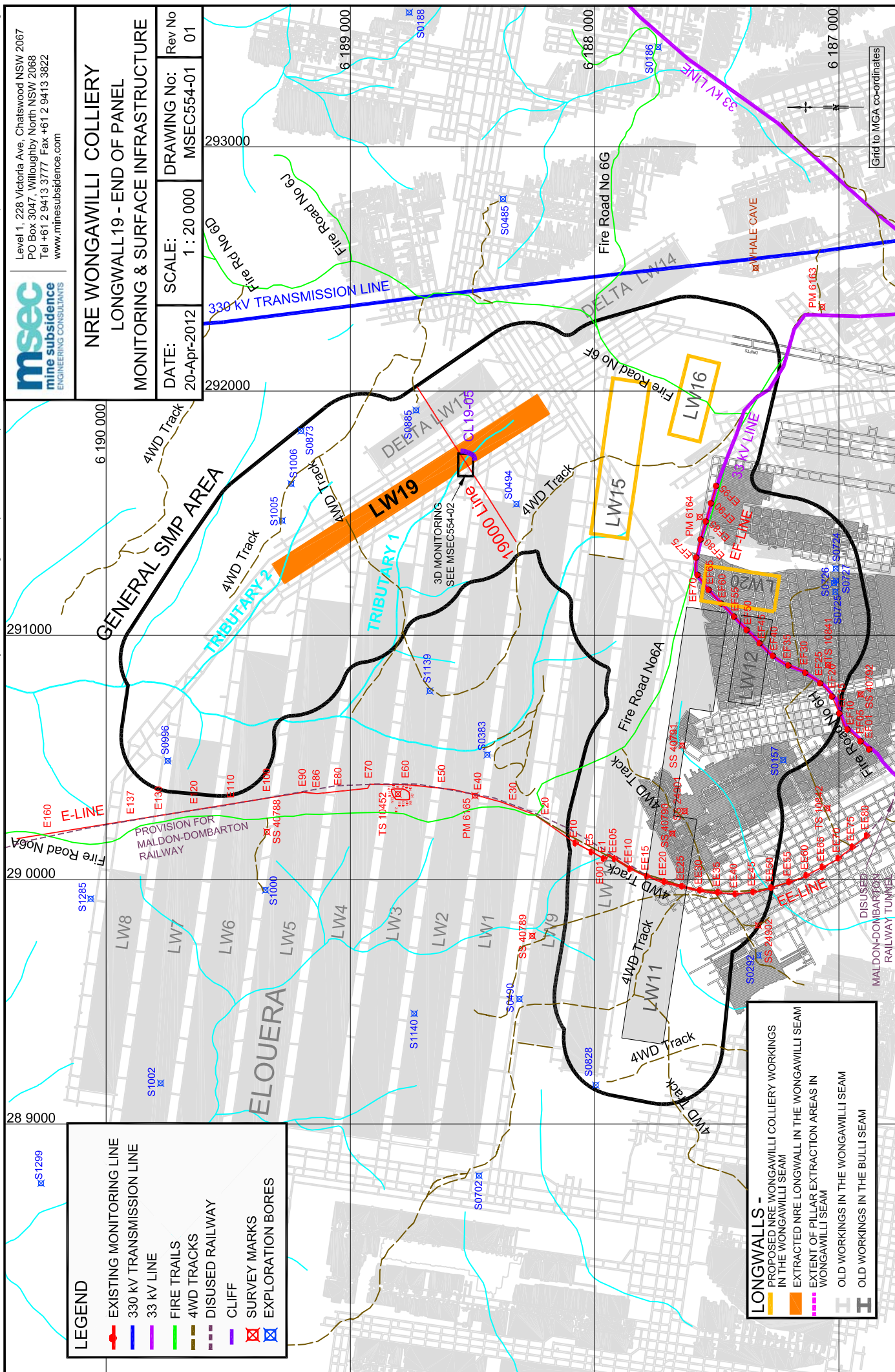


NRE WONGAWILLI COLLIERY

LONGWALL 19 - END OF PANEL

MONITORING & SURFACE INFRASTRUCTURE

DATE:	SCALE:	DRAWING No:	Rev No
20-Apr-2012	1 : 20 000	MSEC554-01	01



LEGEND

EXISTING MONITORING LINE

330 kV TRANSMISSION LINE

33 kV LINE

FIRE TRAILS

4WD TRACKS

DISUSED RAILWAY

CLIFF

SURVEY MARKS

EXPLORATION BORES

LONGWALLS -

PROPOSED NRE WONGAWILLI COLLIERY WORKINGS IN THE WONGAWILLI SEAM

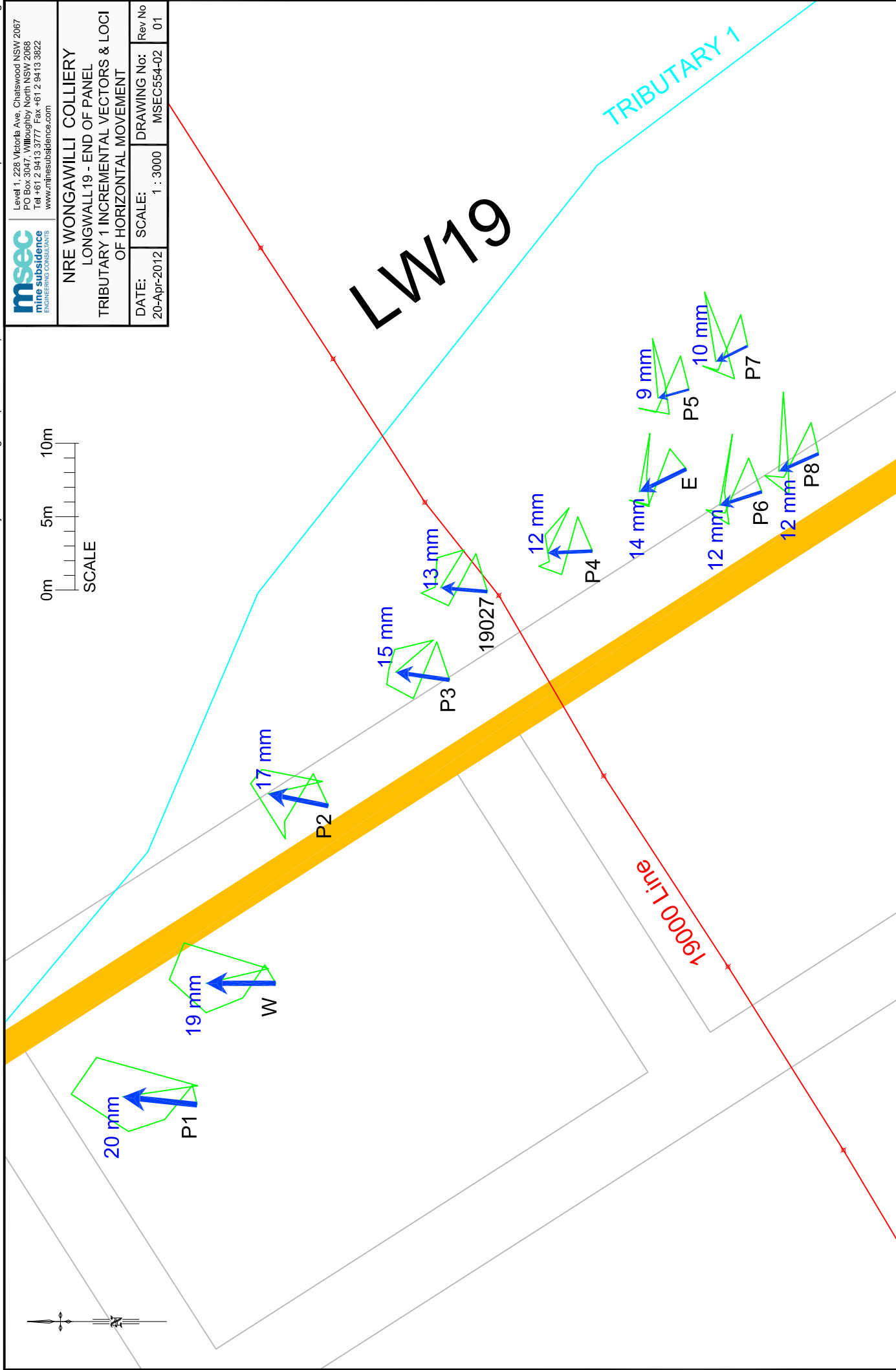
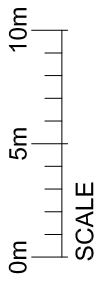
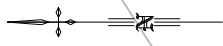
EXTRACTED NRE LONGWALL IN THE WONGAWILLI SEAM

EXTENT OF PILLAR EXTRACTION AREAS IN WONGAWILLI SEAM

OLD WORKINGS IN THE WONGAWILLI SEAM

OLD WORKINGS IN THE BULLI SEAM

Grid to MGA coordinates



ATTACHMENT B

**Groundwater and Surface Water: NRE Wongawilli Colliery End
of Longwall 19 Groundwater & Surface Water Report.
GeoTerra Report: WON2-R1, May 2012**



**GUJARAT NRE WONGA PTY LTD
WONGAWILLI COLLIERY
END OF LONGWALL 19
GROUNDWATER & SURFACE WATER
ASSESSMENT
Wollongong, NSW**

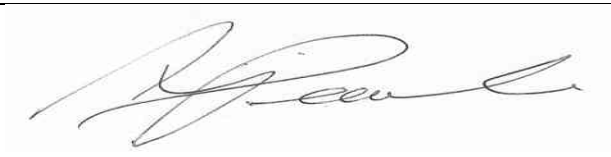
WON2-R1
3 MAY 2012

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Date	Rev	Comments
03.05.2012		Final

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1. INTRODUCTION

Extraction of the Wongawilli Seam in Longwalls 11 to 19, as well as the pillar extraction areas PE1 and PE2, by Gujarat NRE Wonga Pty Ltd (Gujarat) at Wongawilli Colliery was approved by the Department of Primary Industries (DPI) on 16th July 2009, with longwall mining conducted to date as shown in **Table 1**.

A modification to mine PE1 as a longwall (LW20) was approved in June 2010.

Longwall 20 is in its final stages of being extracted, with the panel anticipated to be finished later in May 2012.

Table 1 Wongawilli Panel Extraction Summary

Longwall	Start	Finish	Depth of Cover (mbgl)	Width (m)	Length (m)
Longwall 12	25/8/2009	26/11/2009	320 - 340	130	358
Longwall 11	29/1/2010	13/5/2011	310 - 360	171	1785
Longwall 19	26/6/2011	20/11/2011	320 - 350	84	1280
Longwall 20	29/12/2012	ongoing	330 - 340	190	670

The overlying Bulli Seam has previously been mined in the vicinity of Longwalls 11, 12 and 20 by bord and pillar extraction as shown in **Drawing 1**.

2. SCOPE OF WORK

Geoterra were commissioned by Gujarat NRE Wonga Pty Ltd (Gujarat) to report on any observed groundwater system or surface water changes resulting from extraction of Longwalls 19 and 20 in accordance with the SMP Approval Conditions for Longwalls 11, 12, 15, 16, 19 and PE1, as well as the Environmental Subsidence and Safety Management Plan (ESSMP).

This report follows on from a previous end of Panel 11 assessment (Geoterra, 2011).

3. WATER MONITORING DESCRIPTIONS

3.1 Surface Water

As shown in **Table 2**, Bellbird Creek (Swamp 20) field water pH and electrical conductivity was monitored by BHPBIC using hand held field meters between March 2005 and the present at a culvert underneath the decommissioned Dombarton railway line.

Monitoring by Gujarat at the re-named site Bellbird Ck (d/s) as well as Bellbird Creek (u/s) commenced in March 2010.

It should be noted that the BHP "Swamp 20" monitoring site is not actually within Swamp 20.

BHPBIC started monitoring sites DAQ30 and DAQ40, which are in the headwaters of Wongawilli Creek over Longwall 19, in March 2006.

Gujarat took over the monitoring of these two sites in February 2011.

Table 2 Longwalls 11 to 19 Surface Water Monitoring Sites

BELLBIRD Ck	E	N	Commenced	Location
Bellbird Ck up	292795	6187560	02.03.2010	In Swamp 20 d/s of P20
Bellbird Ck ds	289962	6187290	19.07.2005	culvert under railway
DAQ30	291855	6188500	01.03.2006	Wongawilli Ck headwater over LW19
DAQ40	291327	6189226	02.03.2006	Wongawilli Ck headwater upstm of LW19

3.2 Groundwater

In relation to Longwall 19, one swamp piezometer (P21A) is located over the subject panel, with two piezometers located near the panel (P31 and P46) that are used to measure groundwater levels and water quality.

Outside of the area specific to Longwall 19, although within the overall Longwall 11 to 19 mining area;

- a vibrating wire piezometer array (PWW1) was installed between Longwall 11 and Longwall 16 with intakes in the Hawkesbury Sandstone at 90m and 135m below surface, the Bald Hill Claystone at 150m and Bulgo Sandstone at 165m which measure water pressure heads. During drilling in November 2009, the first water make occurred at 23m below surface;
- five, 35.1 - 51.5m deep open standpipe Hawkesbury Sandstone piezometers (EGW2, 3, 4A, 5 and 6) were installed by BHPBIC in February 2004 over the old southern Eloura workings (as well as Gujarat's Longwall 11) as summarised in **Table 3** and shown in **Drawing 1**, which measure water levels, and;
- two piezometers (P20 over Longwall 11 and P24 over Longwall 16) were installed by Gujarat in Quaternary swamp colluvium / alluvium which are used to measure groundwater levels and water quality.

In addition, BHPIC conduct regular water level and water quality monitoring in Swamps 18 and 36, however as they are outside the subsidence influence of Longwall 11, they are not discussed in this report.

No NOW registered private bores are located within the SMP area as it is a restricted access water catchment area administered by the SCA.

Hawkesbury Sandstone and swamp piezometers not directly overlying, or within the subsidence depressurisation zone of Longwall 11 and 12 are not discussed further in this report.

Table 3 Longwalls 11 to 19 Piezometers

GW	E	N	Intake Depth (mbgl)	SWL (m)	Commenced	Lithology
MULTI	LEVEL	PIEZO				
PWW1	291677	6187507	90	See plot	19.11.09	Hawkes. Sandstone
	-	-	135	See plot	19.11.09	Hawkes. Sandstone
	-	-	150	See plot	19.11.09	Bald Hill Claystone
	-	-	165	See plot	19.11.09	Bulgo Sandstone
EGW2	289434	6188008	0 – 45.67	See plot	19.02.04	Hawkes. Sandstone
EGW3	289773	6187749	0 – 35.10	See plot	27.02.04	Hawkes. Sandstone
EGW4A	290122	6188359	0 – 48.45	See plot	09.03.04	Hawkes. Sandstone
EGW5	290538	6187861	0 – 51.51	See plot	09.02.04	Hawkes. Sandstone
EGW6	290453	6188065	0 – 39.55	See plot	16.02.04	Hawkes. Sandstone
SWAMP	PIEZO					
P20	291144	6187583	0.3 – 0.85	See plot	18.09.09	Swamp Alluvium
P21A	291860	6188293	0.3 – 1.72	See plot	01.07.11	Swamp Alluvium
P24	292076	6187585	0.3 – 0.81	See plot	11.06.10	Swamp Alluvium
P31	291867	6188897	0.3 – 0.87	See plot	09.06.11	Swamp Alluvium
P46	291875	6187988	0.3 – 1.14	See plot	15.06.10	Swamp Alluvium

4. PIEZOMETER INSTALLATION AND HYDRAULIC TESTING

The hydrogeology of the Longwall 11 to 19 and 20 mining area was investigated by water intersection observations during drilling, in addition to packer testing and piezometer installation in the PWW1 bore as well as during hand installation of the swamp piezometers in the Longwall 11 to 19 area.

Further details of the packer testing on PWW1 will be outlined in the Longwall 11 to 19 End of Panel(s) Report.

5. PREDICTED AND OBSERVED GROUNDWATER IMPACTS

A full discussion on the Gujarat VWP and the BHP (EGW series) open standpipe piezometers will be outlined in the Longwall 11 to 19 End of Extraction Report.

The following discussion only relates to the extraction of Longwalls 11, 12 and 19.

5.1 Piezometer Subsidence

Up to 140mm of subsidence was predicted along Subsidence Line EF, with a maximum of 321mm of subsidence being observed over Longwall 12 and 126mm over Longwall 11.

As measured on the 19000 Line, Longwall 19 was subsided by a maximum of 28mm, along with a tilt of 0.3mm/m and tensile strain of 0.6m/m as shown in **Table 4**.

No TARP trigger levels have been reached or exceeded and no ameliorative actions are required.

Table 4 Wongawilli Panel Subsidence Summary

Longwall	Maximum Subsidence (mm)	Maximum Strain (mm/m)	Maximum Tilt (mm/m)	Survey Line
Longwall 12	130	0.6	1.5	EF
Longwall 11	320	1.5	3.2	EF
Longwall 19	28	0.6	0.3	19000

5.2 Aquifer / Aquitard Interconnection

5.2.1 Potential Impacts

- no adverse interconnection of aquifers and aquitards was anticipated within 20m of the surface;
- a potential increase in the rate of groundwater recharge into the Hawkesbury Sandstone following rainfall due to the increased porosity and permeability of the fractured strata was possible.

5.2.2 Aquifer / Aquitard Interconnection Observations

No adverse aquitard / aquifer interconnection or increased recharge has been observed in the vicinity of, or resulting from, extraction of Longwalls 11, 12 and 19.

No TARP trigger levels have been reached or exceeded and no ameliorative actions are required.

5.3 Groundwater Levels

The piezometer monitoring has been used to determine the pre, during and post Longwalls 11, 12, 19 and 20 groundwater levels and head pressures.

In addition the data is used to indicate variations in the surface water and groundwater systems within the upland swamps, Hawkesbury Sandstone, Bald Hill Claystone and upper Bulgo Sandstone to a maximum depth of 165m below surface.

Groundwater levels are logged using vibrating wire piezometers in the EGW and PWW series piezometers, and by a pressure transducer in the swamp piezometers.

5.3.1 Potential Impacts

The following potential groundwater level impacts could potentially occur;

- temporary lowering of the deep piezometric surface over the subsidence area due to horizontal dilation of strata and resultant increase in secondary porosity;
- Hawkesbury Sandstone groundwater levels may reduce by up to 10m, and may stay at that reduced level until maximum subsidence develops at a specific location;
- no significant change in swamp piezometric levels due to subsidence outside of the effects of the current climatic variability;
- Hawkesbury Sandstone groundwater levels should recover over a few months as the newly developed secondary porosity is recharged by rainfall, and;
- no permanent post mining reduction in Hawkesbury Sandstone groundwater levels unless a new outflow path develops.

5.3.2 Basement Groundwater Level Observations

Standing water levels in the BHP piezometers range from 29.42m to 48.50m below surface. Note that the **Figure 1** plot shows groundwater depths as relative levels to the Australian Height datum (AHD), not depth below surface.

The EGW series water levels have varied by either being undermined by the old BHP Elouera Longwalls, or where they have not been undermined, or have previously been undermined, by seasonal and longer term climatic variations in rainfall recharge.

EGW3, which directly overlies Longwall 11, had an 8.92m drop in water level since mid June 2010 after it was undermined, whereas no significant fall in the other EGW series piezometers occurred.

To date the EGW3 water level has not recovered and the other EGW water levels have remained static to slightly rising during extraction of Longwalls 19 and 20.

A gradual depressurisation has been monitored in the Hawkesbury Sandstone (90m and 135m), Bald Hill Claystone (150m) and upper Bulgo Sandstone (165m) since the VWP array was installed in late November 2009 as shown in **Table 5**.

No TARP triggers were exceeded during extraction of Longwalls 19 or 20.

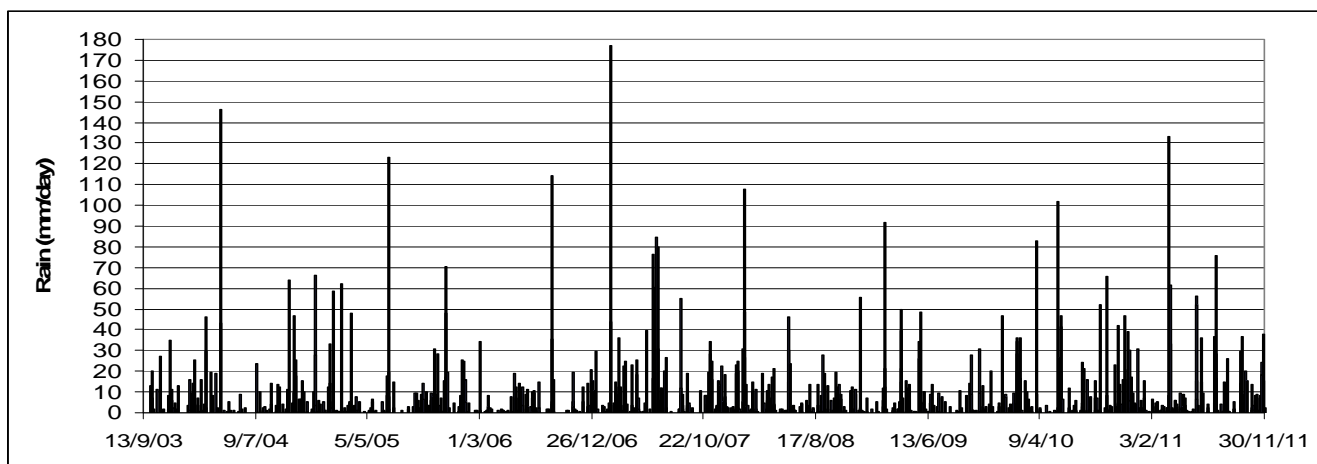
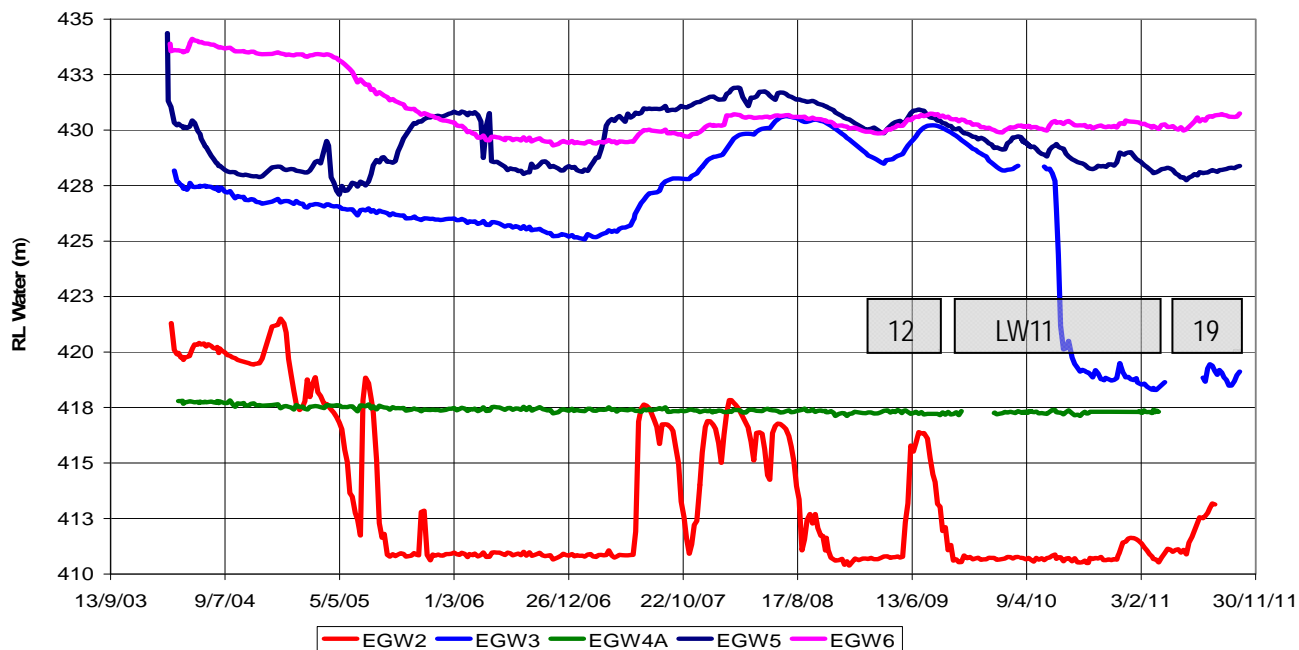


Figure 1 Hawkesbury Sandstone Water Levels and Rainfall

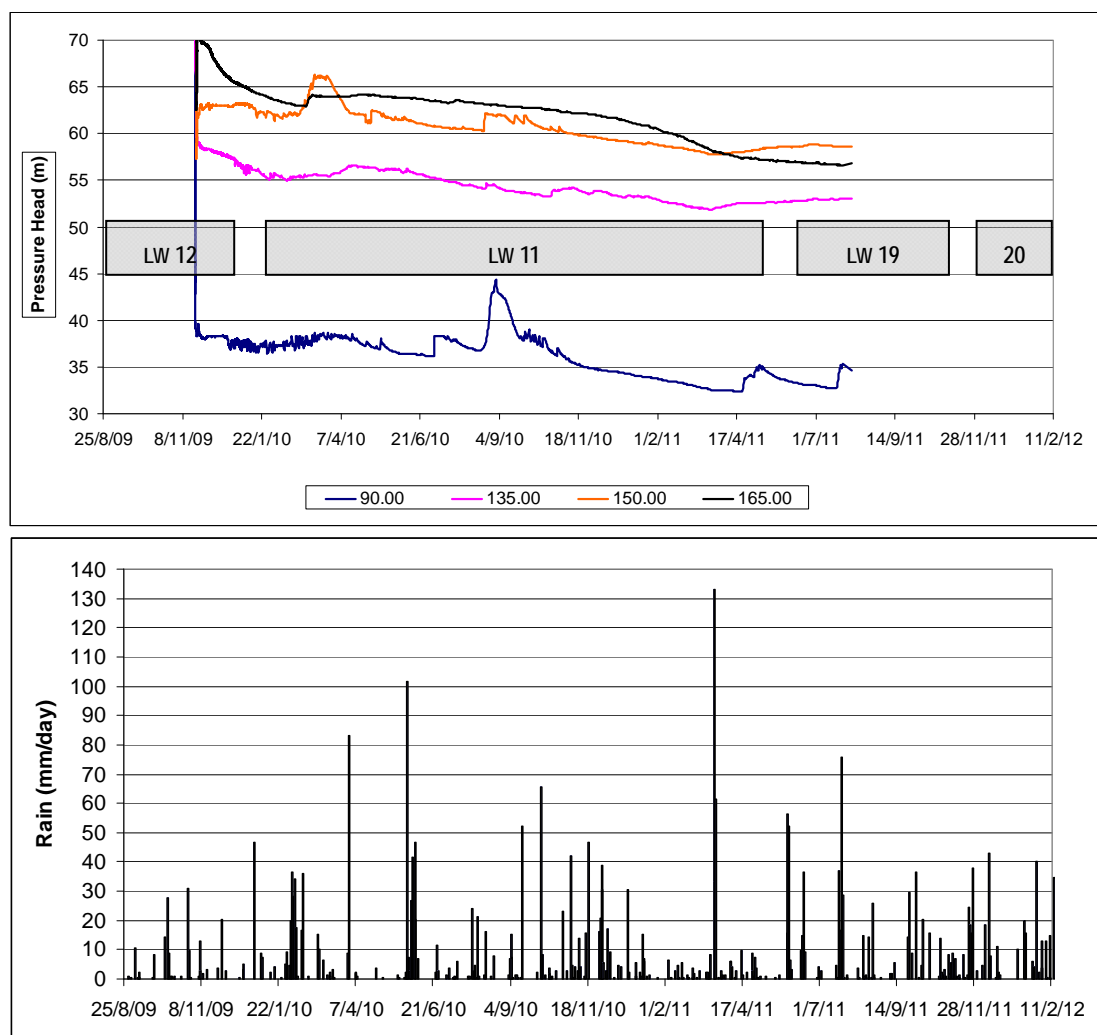


Figure 2 PWW1 Groundwater Levels and Rainfall

5.3.3 Swamps 20 and 21A Groundwater Level Observations

Groundwater levels in the Wongawilli swamps are shown in **Figures 3 and 4**.

Water levels in the perched Quaternary sedimentary aquifer in the swamps, including Swamp 20, are predominantly influenced by the frequency and quantum of rainfall that occurs during the monitoring period, where the water levels have a direct relationship with the amount of rainfall recharge infiltration.

No change in groundwater levels in Swamps 20 or 21A due to subsidence induced impacts from extraction of Longwalls 19 and 20 was observed.

No evidence of swamp desiccation due to mining subsidence in Swamp 20 or 21A was observed.

No TARP trigger levels were reached or exceeded and no ameliorative actions are required.

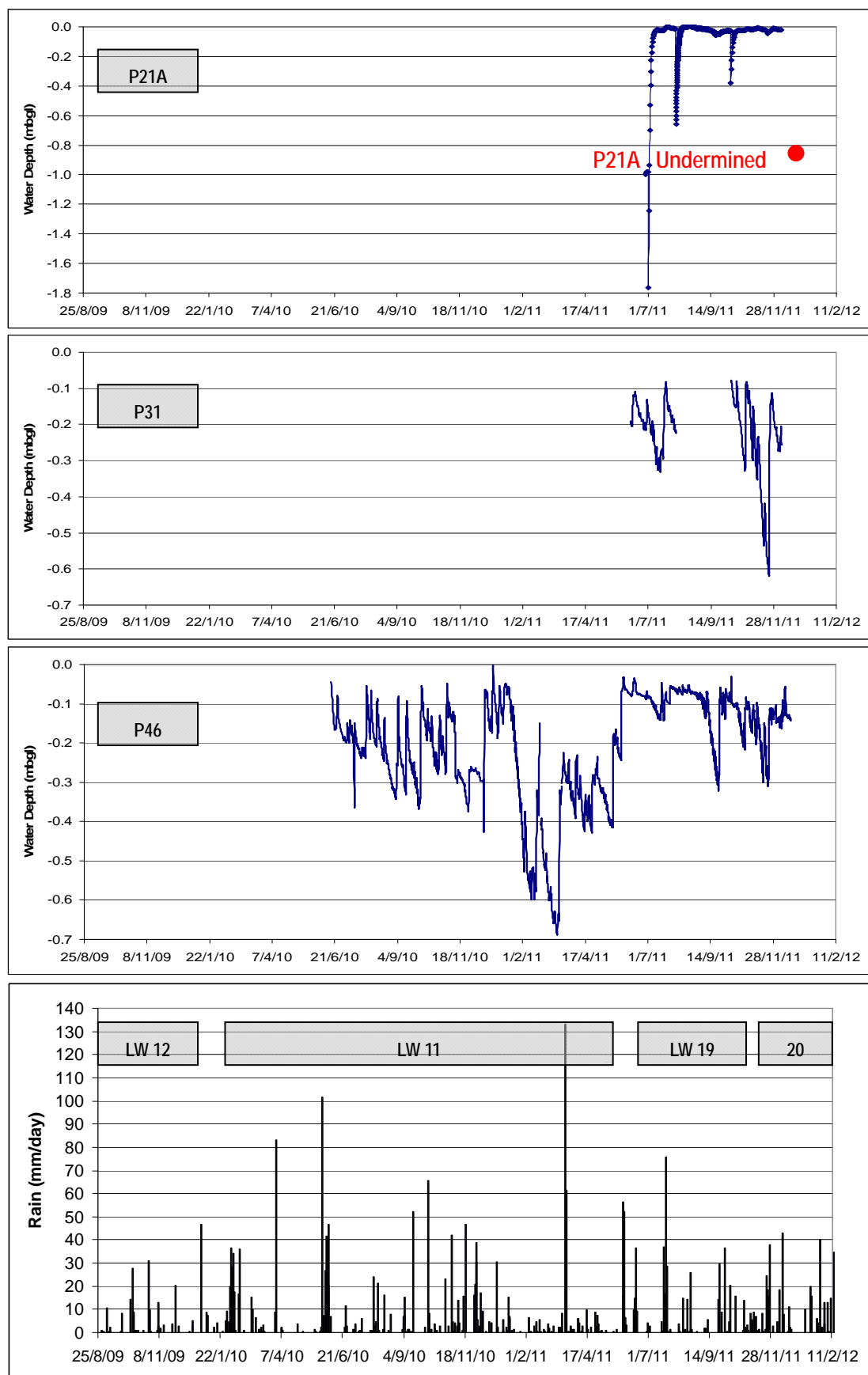


Figure 3 Longwall 19 Swamp Groundwater Levels and Rainfall

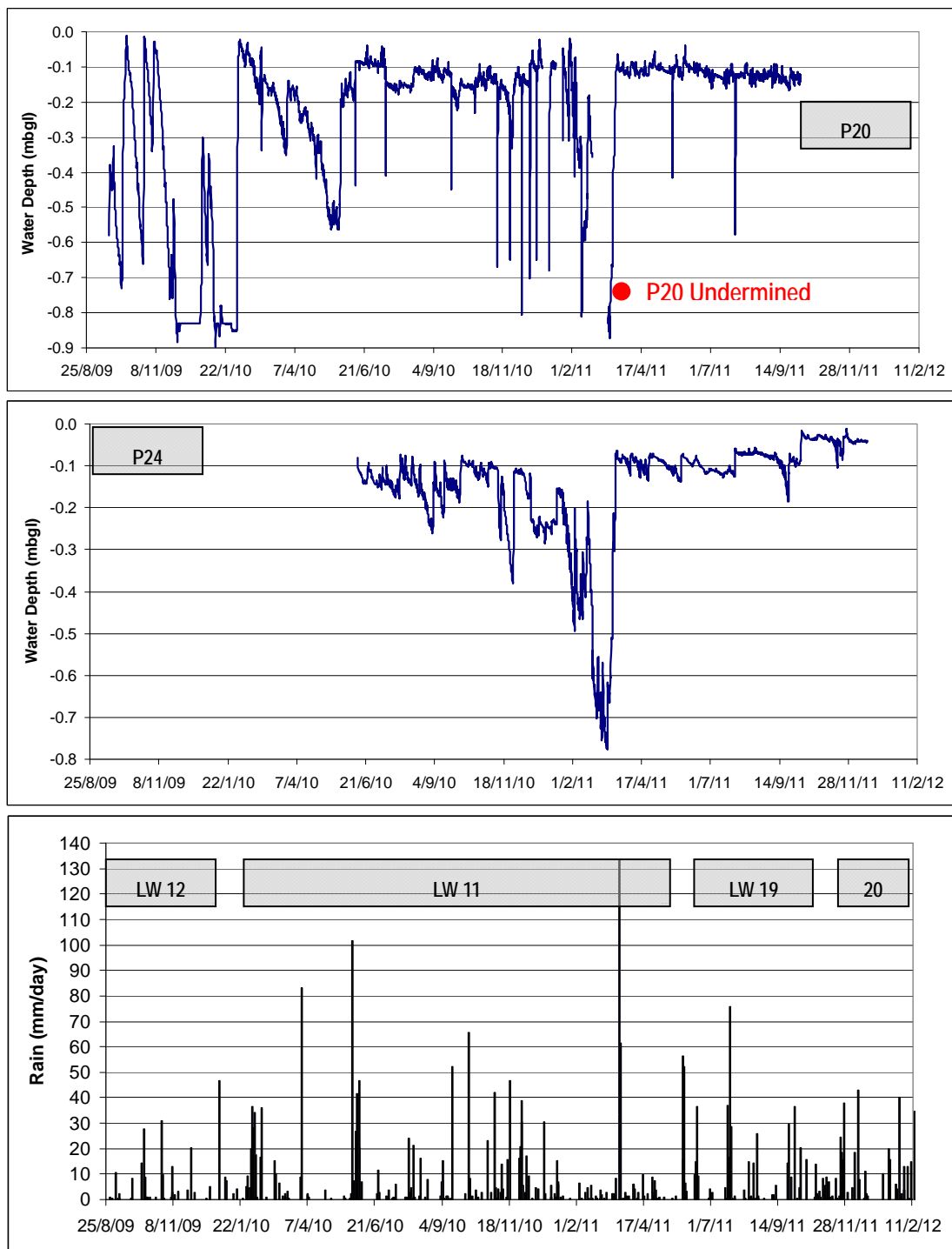


Figure 4 P20 and P24 Swamp Groundwater Levels and Rainfall

5.4 Groundwater Quality

5.4.1 Potential Impacts

- increased iron and manganese hydroxide precipitation in groundwater, and;
- lowering (acidification) of pH.

5.4.2 Swamp P20 Observations

During and after extraction of Longwalls 11, 12, 19 and 20, the field water quality in P20 has not changed markedly due to subsidence, although variations in response to the quantum and duration of rainfall recharge in the perched aquifer were observed.

The peak in electrical conductivity monitored between 23rd September to 12th November 2010, along with the acidification during 25th November 2010, was not due to subsidence, as the piezometer was not undermined during that period, and is interpreted to be a result of lower rainfall recharge to the swamp.

Field groundwater quality monitoring for Swamp 20 is shown in **Figure 5**.

Field monitoring and laboratory analyses indicate that its perched groundwater can exceed the ANZECC 2000 Upland Streams criteria for total nitrogen, total phosphorous, copper, lead, zinc, nickel and aluminium.

During the monitoring period, a 2 standard deviation change, or distinctive diversion over at least 4 months from baseline levels for pH, EC, Fe, Mn, Al, Zn and SO₄ has not occurred.

No adverse effects on groundwater quality in Swamp 20 due to subsidence effects from extraction of Longwalls 11, 12, 19 or 20 have been observed.

No TARP water quality trigger levels have been exceeded and no ameliorative actions are required.

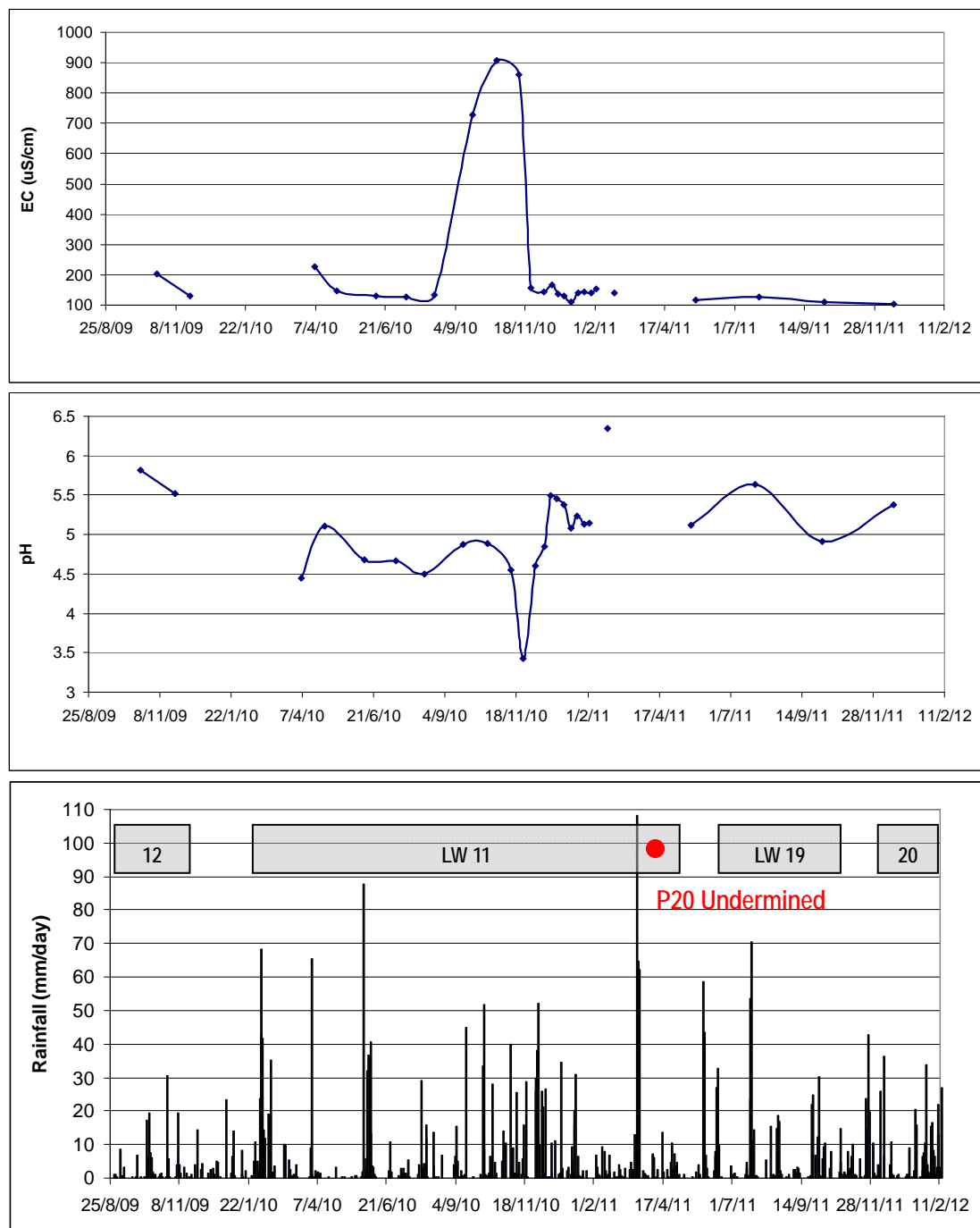


Figure 5 P20 EC, pH and Rainfall

5.4.3 Swamp P21A Observations

During and after extraction of Longwall 19, the field water quality in P21A has not changed markedly due to subsidence, although variations in response to the quantum and duration of rainfall recharge in the perched aquifer were observed.

A rise in electrical conductivity from 84 – 293 μ S/cm, although no distinctive change in pH, occurred between 7th October and 7th December 2011, which coincides with the period when the swamp piezometer was undermined.

Field groundwater quality monitoring for Swamp 21A is shown in **Figure 6**.

Field monitoring and laboratory analyses indicate that its perched groundwater can exceed the ANZECC 2000 Upland Streams criteria for total nitrogen, total phosphorous, copper, lead, zinc, nickel and aluminium.

During the monitoring period, a 2 standard deviation change, or distinctive diversion over at least 4 months from baseline levels for pH, EC, Fe, Mn, Al, Zn and SO₄ has not occurred.

No adverse effects on groundwater quality in Swamp 21A due to subsidence effects from extraction of Longwall 19 have been observed.

No TARP water quality trigger levels have been exceeded and no ameliorative actions are required.

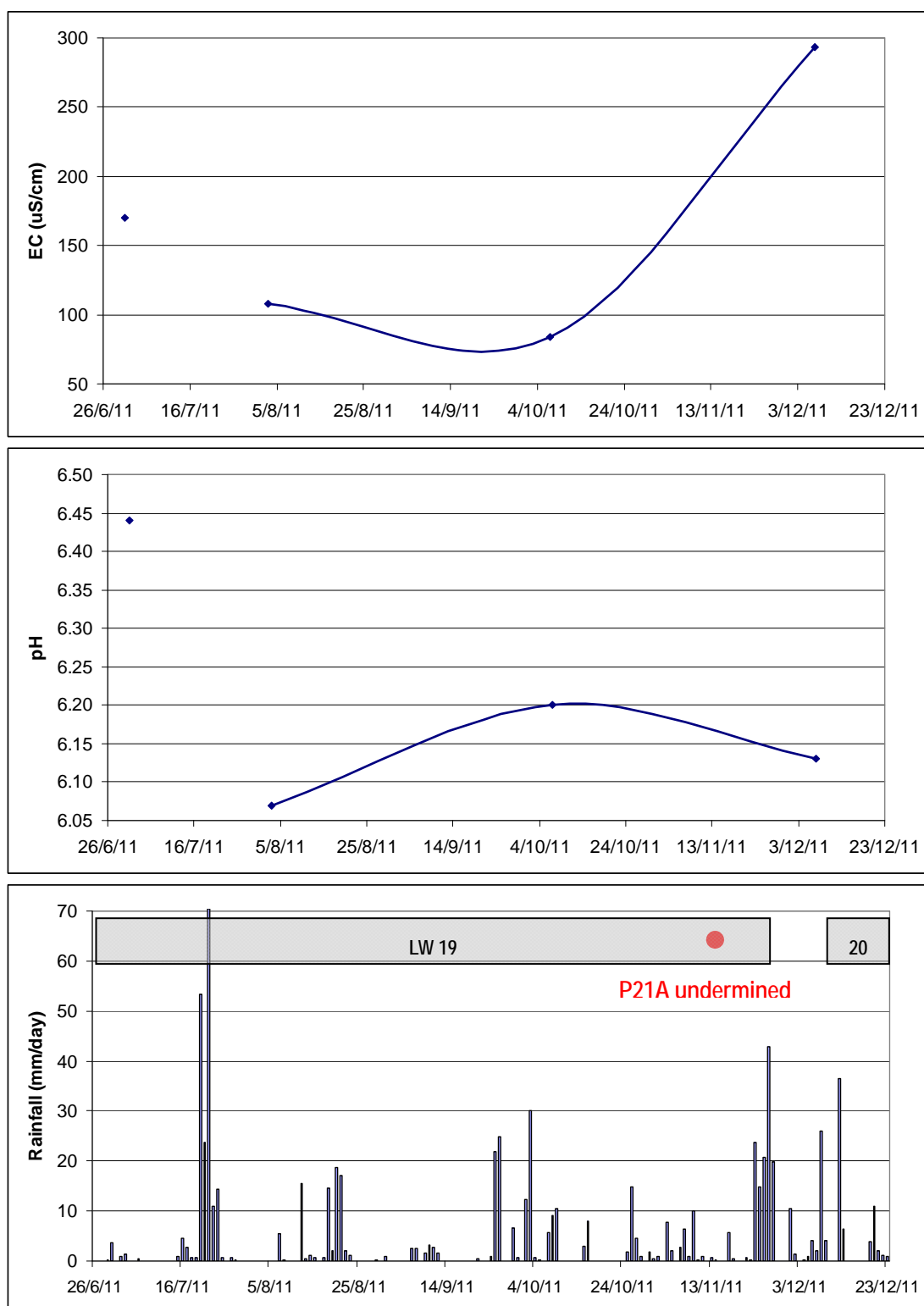


Figure 6 P21A pH, EC and Rainfall

5.4.4 Hawkesbury Sandstone

The water quality from the Hawkesbury Sandstone between 23m and 53m below surface is within ANZECC 2000 Freshwater Stream guidelines.

No ongoing water quality measurements are available in PWW1 as the bore has been sealed, with vibrating wire piezometers permanently installed in the bore and no groundwater quality data is available from the BHPB EGW series piezometers.

5.5 Inflow to Mine Workings

5.5.1 Predicted Impacts

- No observable increase in mine workings groundwater inflow.

5.5.2 Mine Inflow Observations

A plot of mine water discharges from the Wongawilli workings, which includes the decommissioned Eloura and associated workings, is shown in **Figure 7**.

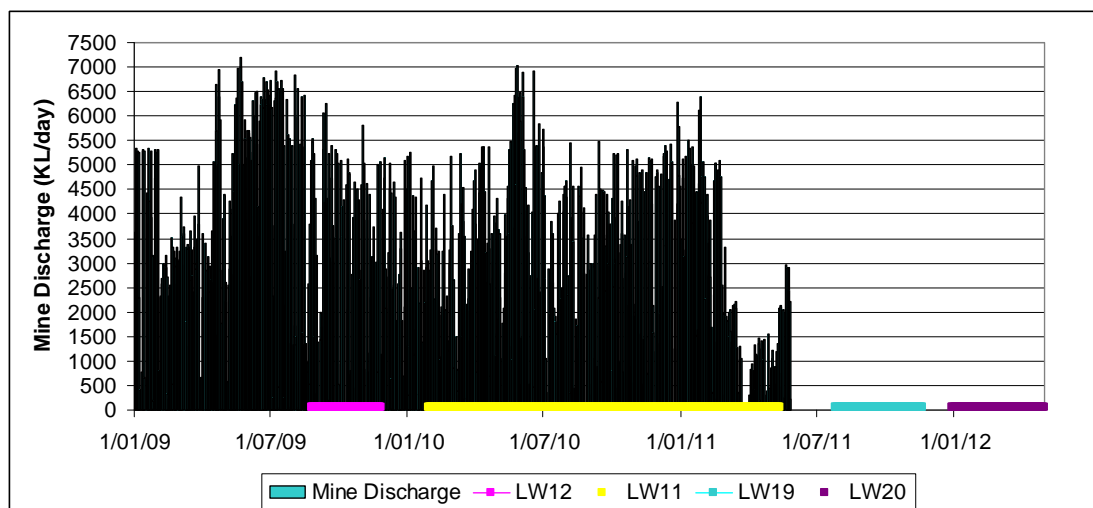


Figure 7 Wongawilli Workings Mine Water Extraction

The significant drop off in water pumped out in the last few months is due to access to underground water storages being blocked due to panel development for LW19 as well as a shortage of water in the underground during extraction of Longwalls 19 and 20..

The underground now has a limited water supply and needs to use all available water until new storages can be created underground.

Based on mine pump out data records, no observable increased inflow to the Wongawilli mine workings following extraction of Longwall 11, 12, 19 and 20 has occurred and no TARP trigger levels have been reached or exceeded.

6. PREDICTED AND OBSERVED SURFACE WATER IMPACTS

The observed impacts discuss general observations from the tributaries of Wongawilli Creek over Longwall 19 and Bellbird Creek over Longwall 11.

6.1 Creek Subsidence

6.1.1 Potential Impacts

Maximum subsidence of;

- <100mm along line EE, to the west of Bellbird Creek;
- 45mm along line 19000 under Wongawilli Tributary DAQ30

6.1.2 Creek Subsidence Observations

Maximum subsidence of;

- 673mm along Line EE, which does not intersect Bellbird Creek;
- 20mm along line 19000, under Wongawilli Creek Tributary DAQ30

It should be noted that no direct measurements have been conducted specifically along Bellbird Creek or the DAQ40 tributary of Wongawilli Creek over or near Longwalls 11, 12, 19 or 20.

6.2 Stream Flow

6.2.1 Potential Impacts

- No anticipated adverse effect on stream flow in Bellbird Creek or the tributaries of Wongawilli Creek.

6.2.2 Stream Flow Observations

No observed adverse effect on Bellbird Creek or the tributaries of Wongawilli Creek resulting from extraction of Longwalls 19 and 20.

No TARP trigger levels have been reached or exceeded and no ameliorative actions are required due to extraction of Longwalls 19 and 20.

6.3 Stream Water Quality

6.3.1 Potential Impacts

- increased iron hydroxide precipitation, and;
- lowering (acidification) of pH.

6.3.2 Bellbird Creek Observations

During and after extraction of Longwalls 19 and 20, the field water quality in Bellbird Creek did not observably change as it was not undermined by either Longwall, although minor variations in response to the quantum and duration of rainfall recharge in the catchment were observed as shown in **Figure 8**.

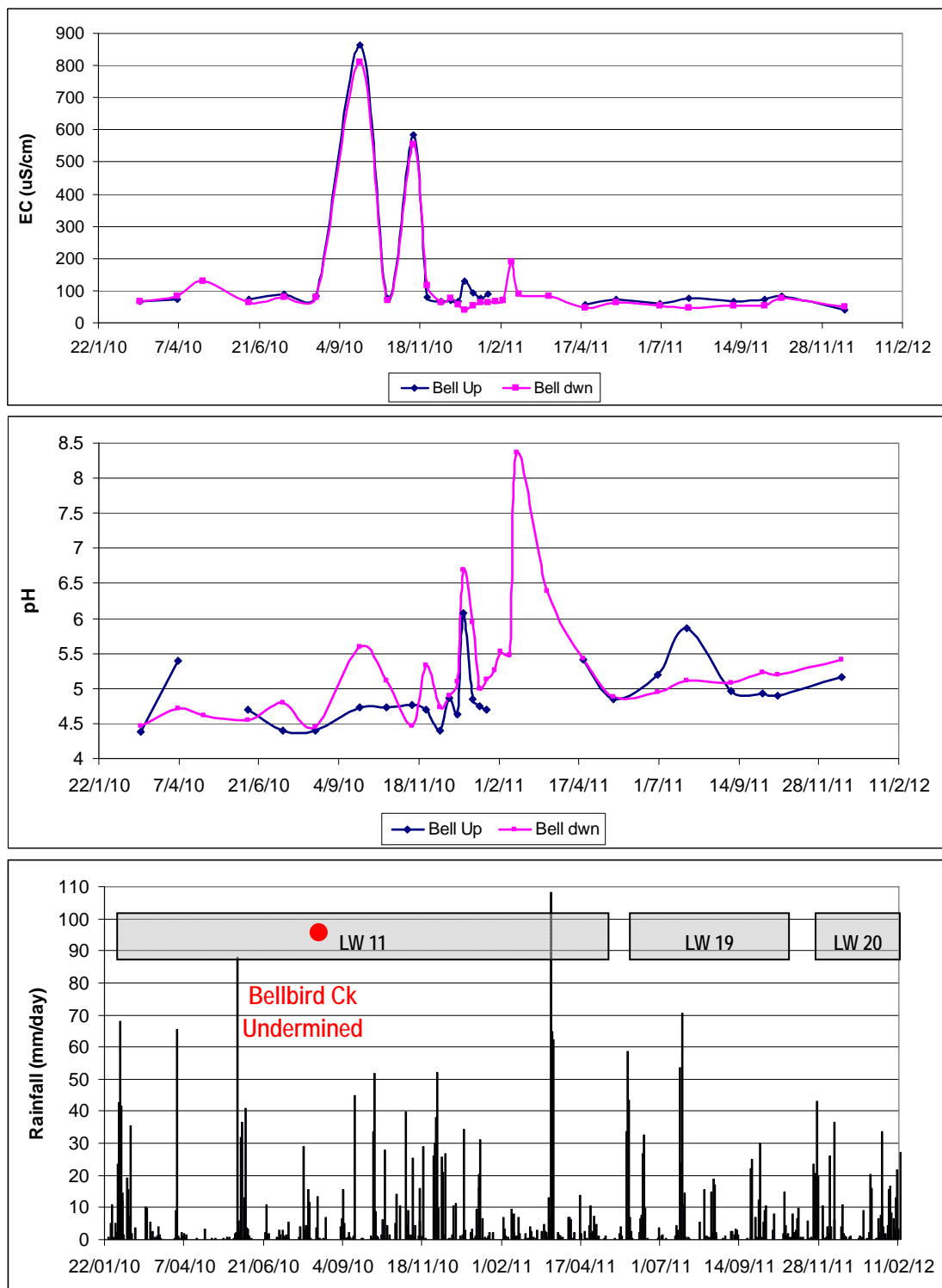


Figure 8 Bellbird Creek EC, pH and Rainfall

The stream water quality TARP trigger levels in Bellbird Creek were not exceeded during extraction of Longwalls 19 and 20.

6.3.3 Wongawilli Creek Tributary DAQ30 Observations

Plots of the Wongawilli Creek DAQ30 tributary pH and EC are shown in **Figure 9**.

During and after extraction of Longwall 19, the field water quality in the DAQ30 tributary was observed to change due to subsidence, along with minor variations in response to the quantum and duration of rainfall recharge in the catchment.

A moderate rise from 52 - 87 μ S/cm occurred between 14th September and 6th October 2011 in DAQ30 (d/s), which was undermined first, followed by a rise from 48 - 115 μ S/cm at DAQ30 (u/s) between 12th October and 1st November 2011.

Both salinity peaks reverted back to their original range within 1 week for DAQ30(d/s) and 6 weeks for DAQ30(u/s).

In the same period, the pH of DAQ30 (d/s) rose from 4.7 - 5.4, whilst DAQ30(u/s) rose from pH 5 - 5.82. After the peaks, both site's pH fell back to its original range within approximately 1 week.

Field monitoring from the DAQ30 tributary of Wongawilli Creek indicates that it can be outside the ANZECC 2000 Upland Streams criteria for pH.

No surface water quality TARP trigger levels were exceeded in the Wongawilli Creek tributary DAQ30 during the extraction of Longwall 19.

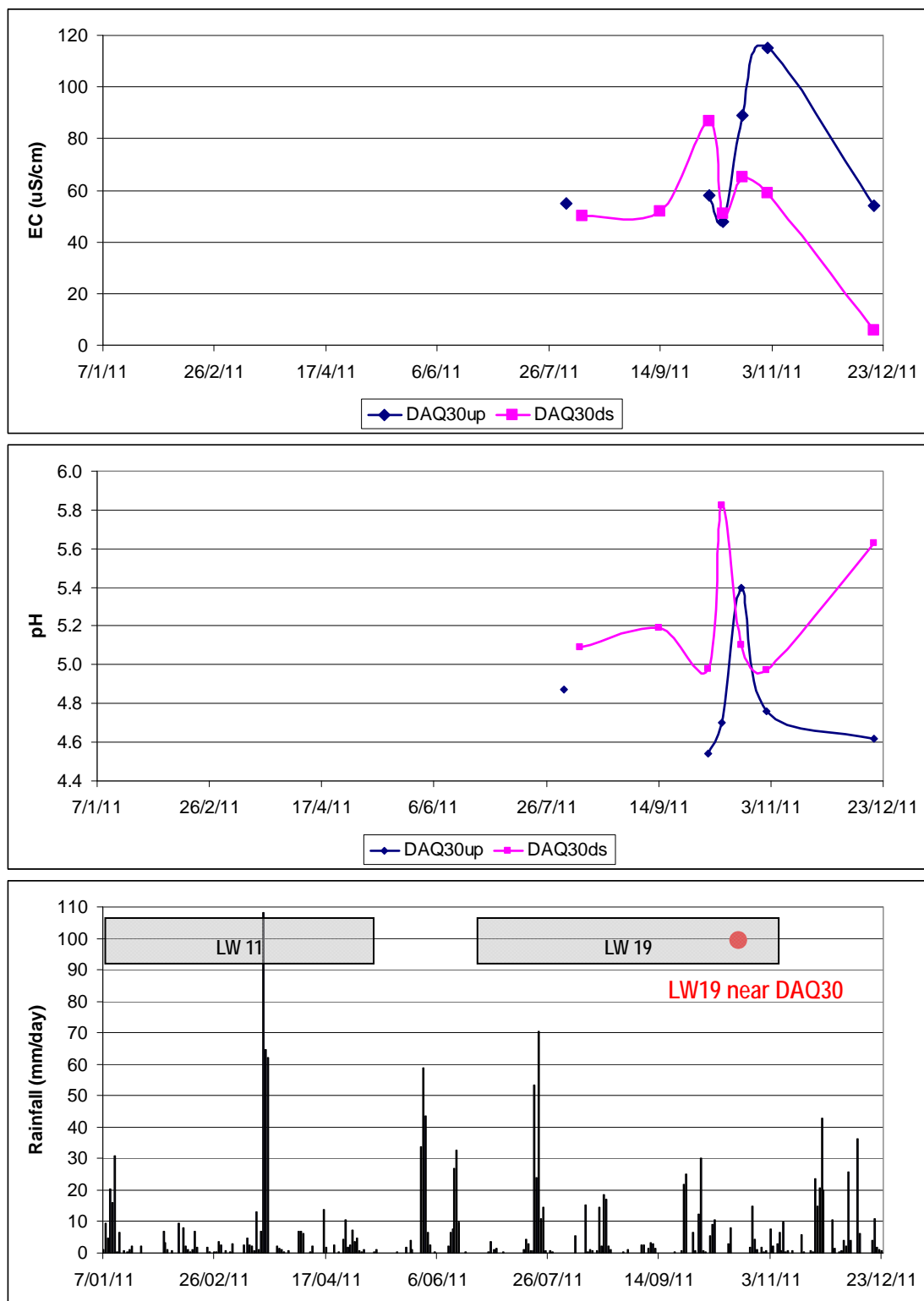


Figure 9 DAQ30 (Wongawilli Creek) EC, pH and Rainfall

6.3.4 Wongawilli Creek Tributary DAQ40 Observations

Plots of the Wongawilli Creek DAQ40 tributary pH and EC are shown in **Figure 10**.

During and after extraction of Longwall 19, the field water quality in the DAQ40 tributary was not observed to change markedly due to subsidence, although minor variations in response to the quantum and duration of rainfall recharge in the catchment occurred.

A moderate rise from 66 - 89 μ S/cm occurred between 15th July and 7th September 2011 in DAQ40 (u/s) and 63 - 81 μ S/cm at DAQ40 (d/s).

The DAQ40 (u/s) salinity peak then fell back to its baseline range, whilst DAQ40 (d/s) remained at that level, which is still within the pre Longwall 19 baseline range).

In the same period, the pH of both sites did not markedly change, although a minor rise of approximately 0.5pH units did occur in both sites.

Field monitoring and laboratory analyses from the DAQ40(u/s) tributary of Wongawilli Creek indicates that it can exceed the ANZECC 2000 Upland Streams criteria for total nitrogen, total phosphorous and aluminium, whilst the DAQ40 (d/s) site can exceed the criteria for Total nitrogen, Copper, zinc, nickel and aluminium.

During and after the extraction of Longwall 19, in the Wongawilli Creek tributaries, there has been no;

- observable increase in iron hydroxide precipitation
- Mn (tot) above 0.1mg/L
- Al (tot) above 0.7mg/L
- Zn (filt) above 0.04mg/L
- SO₄ (filt) above 8mg/L

No surface water quality TARP trigger levels were exceeded in the Wongawilli Creek tributary DAQ40 during the extraction of Longwall 19.

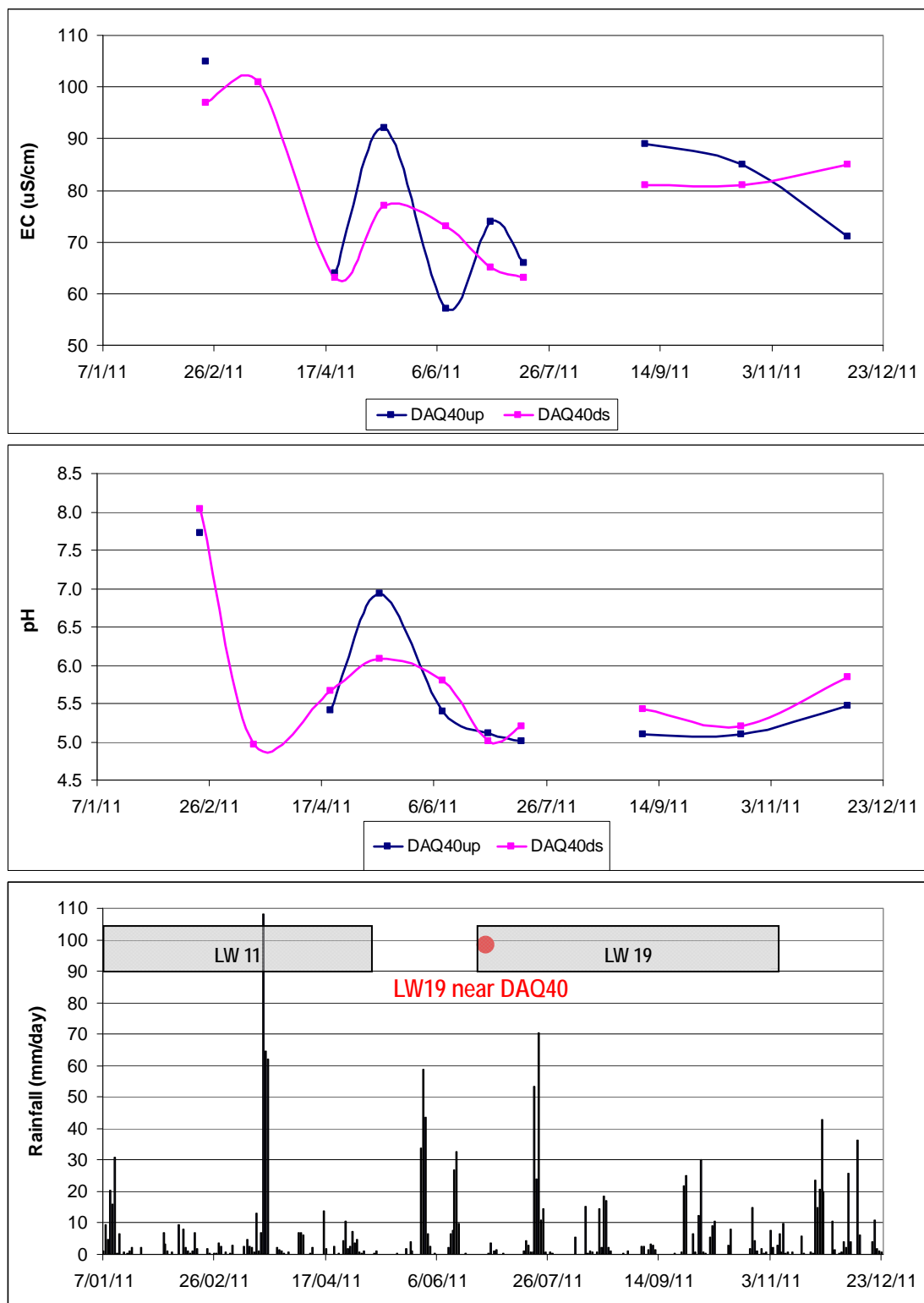


Figure 10 DAQ40 (Wongawilli Creek) EC, pH and Rainfall

No surface water quality TARP trigger levels were exceeded during the extraction of Longwall 19.

6.4 Stream Bed and Bank Stability

6.4.1 Potential Impacts

- increased stream bed or bank instability;
- cracking of exposed sandstone rock faces;
- no anticipated adverse effect on Bellbird Creek or the tributaries of Wongawilli Creek resulting from extraction of Longwalls 19 and 20.

6.4.2 Observed Impacts

No observed adverse effect has been observed on Bellbird Creek or the tributaries of Wongawilli Creek resulting from extraction of Longwalls 19 and 20.

No TARP trigger levels have been reached or exceeded and no ameliorative actions are required due to extraction of Longwalls 19 and 20.

6.5 Gas

6.5.1 Predicted Impacts

- Potential discharge of strata gas into private bores.

6.5.2 Observed Impacts

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 19 and 20.

No TARP trigger levels have been reached or exceeded due to extraction of Longwalls 19 and 20.

7. SUMMARY OF RESULTS

During extraction of Longwalls 19 and 20, no surface water or groundwater TARP triggers were exceeded.

Table 5 summarises the predicted and observed effects on the Longwall 11 to 19 SMP area surface water and groundwater system in relation to extraction of Longwalls 11, 12, 19 and 20.

Table 5 Summary of Groundwater and Surface Water Impacts

Predicted Impacts	Observed Impacts Due to Extraction of Longwall 12
<i>Adverse interconnection of aquifers and aquitards is not anticipated within 20m of the surface</i>	No adverse interconnection between aquifers and aquitards has been observed within 20m of the surface
<i>Potential increased rate of recharge into the plateau</i>	No increased rate of recharge has been observed
<i>Temporary lowering of shallow Hawkesbury Sandstone piezometric surface by up to 10m which may stay at that level until maximum subsidence develops</i>	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 Longwalls 11, 12, 19 and 20, however EGW3 over Longwall 11 fell by 8.92m during extraction of LW11.
<i>Shallow Hawkesbury Sandstone groundwater levels should recover over a few months</i>	Based on the available data, the EGW3 water level has not yet recovered
<i>No permanent post mining reduction in the shallow Hawkesbury Sandstone water levels unless a new outflow path develops</i>	Based on the available data, the EGW3 water level has not yet recovered
<i>Strata dilation and subsequent re-filling of secondary voids may temporarily lower the shallow Hawkesbury Sandstone standing water levels</i>	Based on the available data, the EGW3 water level has not yet recovered
<i>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</i>	Lowering of the piezometric surface has been observed in association with low rainfall periods, although no observable adverse effect on Swamp 20 or 21A water levels has been caused by LW11, 12, 19 or 20
<i>The shallow Hawkesbury Sandstone piezometers may experience increased iron / manganese hydroxide precipitation and / or lowering of pH</i>	The water quality in the shallow Hawkesbury Sandstone piezometers have not been affected by subsidence related effects
<i>Upland Swamp piezometers may experience increased iron / manganese hydroxide precipitation and / or lowering of pH</i>	The Swamp 20 and 21A piezometers have not been adversely, or observably, affected by subsidence effects
<i>Interface drainage, ferruginous, brackish seeps may be generated in streams</i>	No interface drainage, ferruginous, brackish seeps have been generated in Bellbird Creek of the Wongawilli Creek tributaries
<i>Ferruginous seeps may develop in the local creeks</i>	No ferruginous seeps have developed in Bellbird Creek or the Wongawilli Creek tributaries
<i>Increased basement groundwater seepage inflow into the workings should not occur</i>	No increased rate of groundwater seepage into the workings has occurred
<i>Strata gas discharge into piezometers may occur</i>	No strata gas discharge has occurred
<i>Stream flow in Bellbird Creek may be adversely affected by subsidence from Longwall 11</i>	Stream flow in Bellbird Creek and the Wongawilli Creek tributaries has not been adversely affected by subsidence related effects
<i>Stream water quality in Bellbird Creek may be adversely affected by subsidence from Longwall 11</i>	Stream water quality in Bellbird Creek and the Wongawilli Creek tributaries has temporarily exceeded either the 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
<i>Stream bed and bank stability in Bellbird Creek may be adversely affected by subsidence from Longwall 11</i>	Stream bed and bank stability in Bellbird Creek and the Wongawilli Creek tributaries has not been adversely affected by subsidence related effects

8. PROPOSED AND ONGOING MONITORING

Swamp and basement groundwater as well as swamp and stream based surface water monitoring proposed for the Longwall 11 to 19 SMP Area was detailed in the ESSMP.

Future monitoring will be in accordance with the ESSMP and its contained Trigger Action Response Plan (TARP) for each component of the plan.

The monitoring program has been clarified since the ESSMP was produced to include the components outlined in **Tables 6 and 7**.

Table 6 Current and Proposed Groundwater Monitoring

SMP Commitment	Monitoring To Date	Future Monitoring
Aspect: Piezometer Baseline Data		
Assess piezometer location, depth drilled, date drilled, aquifer depth, lithologies, yield and purpose for piezometers within LW11 to 19 SMP area	Piezometer database compilation completed	No additional baseline database compilation required
Aspect: Piezometer Water Quality		
Sample and monitor open standpipe piezometer water iron, field parameters and selected laboratory analytes for piezometers within LW11 to 19 SMP area	Longwalls 11, 12, 19 and 20 extraction period monitoring and laboratory analysis conducted	Sample and monitor open standpipe piezometer iron, field parameters and selected laboratory analytes prior to and after each piezometer is undermined, or extraction is in the vicinity of an active panel, on a panel by panel basis
Aspect: Piezometer Water Levels		
Monitor standing water levels in open standpipe and multi level vibrating wire piezometers within the LW11 to 19 SMP area	Water level monitoring in all swamp and basement piezometers initiated	Monitor pressure heads in VWP multi level piezometers and standing water levels in open standpipe piezometers prior to and after each piezometer is undermined on a panel by panel basis
Aspect: Strata Gas		
Monitor strata gas discharges (if any) in piezometers within the LW11 to 19 SMP area	Piezometers monitored at time of Longwall 12 extraction	Report any strata gas discharges (if any)

Table 7 Current and Proposed Surface Water Monitoring

SMP Commitment	Monitoring To Date	Future Monitoring
Aspect: Stream Flow and Swamp Water Levels		
Assess stream location within LW11 to 19 SMP area	Stream database completed	No additional data compilation required
Aspect: Stream and Swamp Water Quality		
Sample and monitor Bellbird Ck, Wongawilli Creek tributaries, as well as Swamps 20, 21A, 24, 31 and 46 iron, field parameters and selected laboratory analytes in the SMP area	Longwalls 11, 12, 19 and 20 sampling / monitoring completed.	Sample and monitor Bellbird Ck and Wongawilli Ck (headwaters) as well as Swamps 20, 21A, 24, 31 and 46 iron, field parameters and selected laboratory analytes
Aspect: Stream and Swamp Bed and Bank Stability		
Monitor Bellbird Ck, Wongawilli Creek tributaries, as well as Swamps 20, 21A, 24, 31 and 46 stream bed and bank stability and presence of cracking	Monitoring conducted in Swamps 20, 21A, 24, 31 and 46, Bellbird Ck and Wongawilli Creek tributaries	Monitor Bellbird Ck and Wongawilli Ck (headwaters) as well as Swamps 20, 21A, 24, 31 and 46 stream bed and bank stability and presence of cracking
Aspect: Strata Gas		
Monitor strata gas discharges (if any) within LW 11 to 19 SMP area	Strata gas discharges (if any) being monitored when stream and swamp samples collected	Continue to monitor strata gas discharges (if any) when stream and swamp samples collected

9. REFERENCES

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The findings contained in this report are the result of discrete / specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site / sites in question. Under no circumstances, however, can it be considered that these findings represent the actual state of the site / sites at all points. Should information become available regarding conditions at the site, Geoterra reserve the right to review the report in the context of the additional information.

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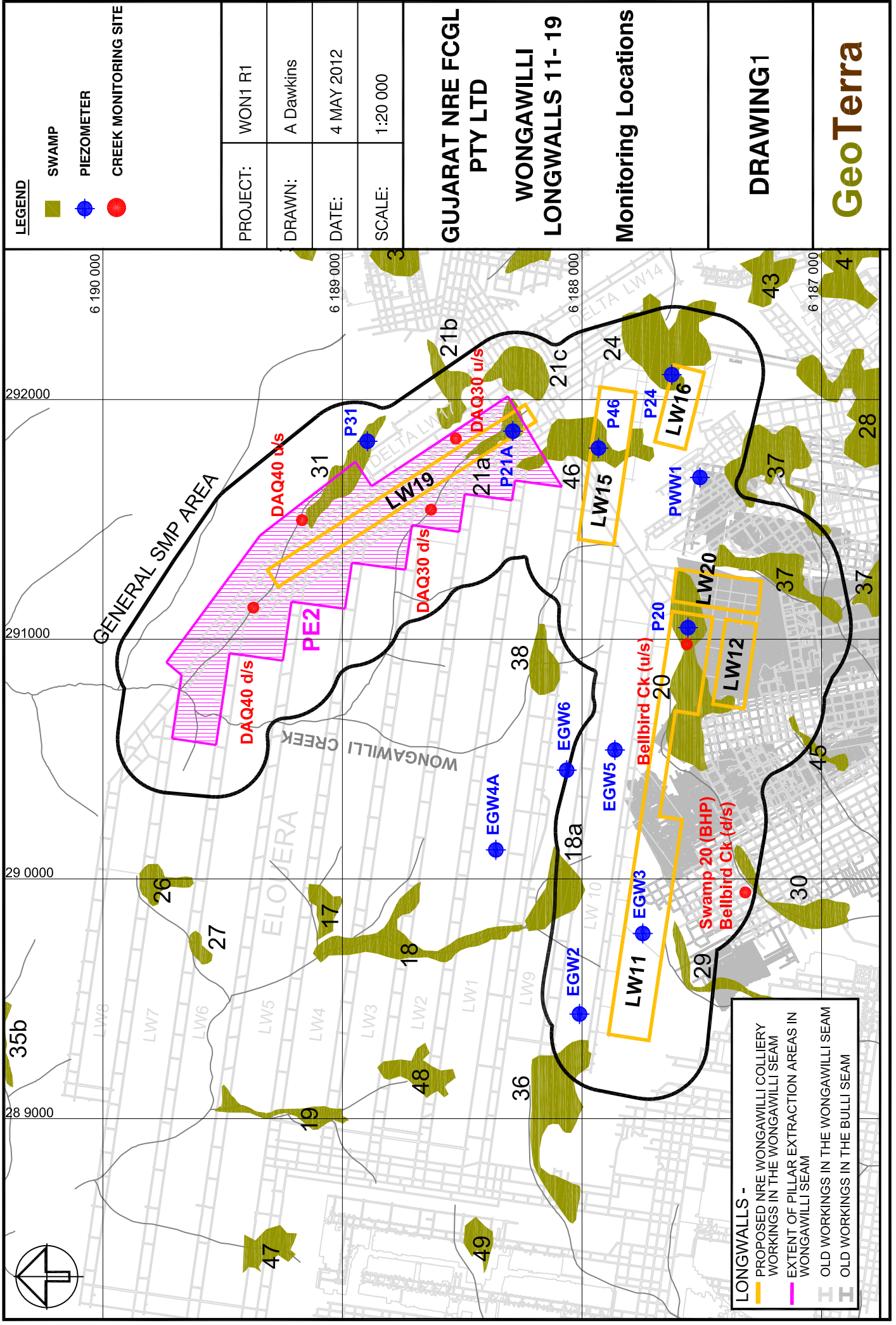
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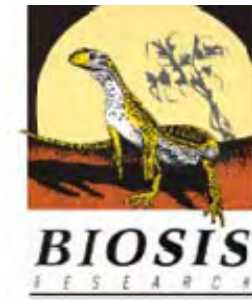
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ATTACHMENT C

**Terrestrial and Aquatic Ecology: Terrestrial and Aquatic Flora
and Fauna Assessment NRE Wongawilli Colliery: Longwall 19
End of Panel Report. Biosis Research Pty. Ltd., April 2012**



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

5 April 2012

Dear Chris,

NRE Wongawilli Colliery - Longwall 19 End of Panel Report

This report assesses the post-mining conditions with relation to aquatic and terrestrial ecology within the area potentially impacted by subsidence effects associated with mining of Longwall 19 at the Wongawilli Colliery (Figure 1). Coal was extracted from Longwall 19 from the 26th June to 5th December 2011.

This report includes;

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

Please note an end of panel field inspection has not been conducted. Observations are based on terrestrial ecological monitoring undertaken to date.

Monitoring to Date

Biosis Research Pty. Ltd. was commissioned by Gujarat NRE Wonga Pty. Ltd. to undertake terrestrial and aquatic flora and fauna monitoring for the Wongawilli Colliery. The terrestrial monitoring program commenced in September 2009 and has been completed for;

- spring 2009;
- autumn and spring 2010; and,
- autumn and spring 2011.

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

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- autumn and spring 2010; and,
- autumn and spring 2011.

Threatened frog surveys have been completed for 2010 and 2011.

Table 1 below provides an outline of the ecological monitoring survey methodology.

Table 1 Summary of the ecological monitoring survey methodology

Survey	Creeklines		Upland Swamps		Ridgelines	
	Sites	Methods	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	Record presence of all plant species in each quadrat to indicate species abundance along transect	Three 20 m x 20 m quadrats per ridgeline	Species inventory and modified Braun Blanquette cover abundance score for each species in autumn only
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	N/A	N/A
Winter 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	N/A	N/A
Targeted fauna habitat assessments (e.g. rocky outcrops)	N/A	N/A	N/A	N/A	Three 40 m x 40 m quadrats per ridgeline	Habitat assessments and rock turning and timed searches for 30 person-minutes
Aquatic ecology surveys	One sample per creekline. The survey reach for each creekline	Macroinvertebrate sampling as per AUSRIVAS methodology. Surveys are conducted twice a	N/A	N/A	N/A	N/A

Survey	Creeklines		Upland Swamps		Ridgelines	
	Sites	Methods	Sites	Methods	Sites	Methods
	ranges from 50-150 m depending on the breadth of the waterway.	year and are conducted once during spring and once during autumn.				

The 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 (reference sites). Table 2 lists the survey sites used. Monitoring sites are shown in Figures 2 and 3.

Table 2 Creek line, upland swamp, ridgeline and winter threatened frog monitoring sites used in the program

Vegetation, amphibian , reptile and aquatic monitoring	
Impact sites	Reference sites (Figure 2e)
Creek lines (Figure 2a)	
Bellbird Creek (BBC) upstream of and below LW 11	8I Creek
Wongawilli Creek Tributary North (WTN) above and downstream of LW 19	Easement Creek
Wongawilli Creek Tributary South (WTS) downstream of LW 19	Donald's Castle Tributary
Upland swamps (Figure 2b)	
Swamp 20 (S20) above LW 11 (and partially PEA1) and adjacent to LW 12	Donald's Castle Swamp B
Swamp 37A (S37A) adjacent to PEA1	Swamp 11
Swamp 24 (S24) (frog monitoring) above and adjacent to LW 16	Swamp 33
Swamp 46 (S46) (flora monitoring) above and adjacent to LW 15	Swamp 22
Ridgelines (Figure 2c)	
LW 11 ridge above LW 11	Kentish Trig
LW 15 ridge adjacent to LW 15 and LW 16	8I Ridge
LW 19 ridge adjacent to LW 19	Wattalli Trig A
Winter threatened frog surveys (Figure 2d)	
Bellbird Creek	Easement Creek
Wongawilli Creek Tributary South	Swamp 11 Creek
Wongawilli Creek Tributary North	Donald's Castle Swamp B Creek
Native Dog Creek	Wongawilli Creek Tributary – WC 21
Native Dog Creek Tributary West	Swamp 33 Creek
	Cordeaux River Tributary

Aquatic Monitoring	
Impact Sites (Figure 3a)	Reference Sites (Figure 3b)
Bellbird Creek (BBC-AQ1) downstream of LW 11, 12 and 20	8I Creek (8IC-AQ1)
Wongawilli Creek (WWC-AQ1) downstream of LW 20, 15, 16 and 19	Easement Creek (EAC-AQ1)
Wongawilli Creek (WWC-AQ2) downstream of LW 15, 16 and 19 (established during spring 2011)	Donald's Castle Tributary (DCT-AQ1)
Wongawilli Creek Tributary South (WTS-AQ1) downstream of LW 15, 16 and 19	
Flying Fox Creek (FFC-AQ1) downstream of LW12 and 20	

Monitoring at these sites includes flora monitoring, amphibian monitoring including winter threatened frog surveys and aquatic monitoring. Visual observations undertaken during monitoring have not detected any subsidence effects such as cracking, water loss in creeks or swamps or iron staining in creeks

The flora and fauna data collected during the autumn 2010, spring 2010 and autumn 2011 monitoring periods has been subject to statistical analysis. No changes in species richness or composition for flora or fauna have been detected during ecological monitoring. The report concludes that no impact to terrestrial flora or fauna has resulted from mining at the Wongawilli Colliery.

Currently there does not appear to be any observable differences in the macroinvertebrate communities sampled between control and impact sites over the survey period. The data collected indicates that a natural variability in stream condition occurs between autumn and spring and current results indicate that there does not appear to be any observable difference from the baseline established prior to mining commenced.

The monitoring commitments outlined in the ESSMP, impact assessments and Trigger Action Response Plan (TARP) commitments are outlined in Table 3, along with predicted and observed impacts and a conclusion as to whether TARPs have been triggered and whether any action is required.

Conclusion

Ecological monitoring to date has not identified any impacts to flora and fauna as a result of subsidence associated with mining of Longwall 19 at the Wongawilli Colliery. No other management actions have been triggered under the Trigger Action Response Plan (see Table 3).

If you have any questions please do not hesitate to contact me.

Kind regards,

A handwritten signature in black ink, reading "B Coddington". The signature is written in a cursive, flowing style.

Ben Coddington
Botanist, Biosis Research

Table 3 TARP and Monitoring Action Table

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 19
Aquatic Ecology (twice a year)	Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime	Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime	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 mining.	<input type="checkbox"/> No impact to aquatic ecology or habitats observed to date	<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
	(completed)	(completed)	(ongoing)	<input type="checkbox"/> Unlikely to be impacts to aquatic ecology or loss of aquatic habitat				
	Surveys for habitat of threatened aquatic biota in major drainage lines	AUSRIVAS sampling of reference and impact sites in the broader ESSMP Area	AUSRIVAS sampling of reference and impact sites in the broader ESSMP Area					
	(completed)	(ongoing)	(ongoing)					
	AUSRIVAS sampling of reference and impact sites in the broader ESSMP Area							
	(completed for LW 11, 15, 16, 19 and LW 20 only)							
Terrestrial Ecology (twice a year)				<input type="checkbox"/>	<input type="checkbox"/> No impacts observed 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	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)	<input type="checkbox"/> Unlikely that any threatened flora would be significantly impacted by subsidence resulting from Longwall mining. <input type="checkbox"/> Impacts to threatened amphibian species as reported below .	<input type="checkbox"/> No impacts observed to date	<input type="checkbox"/> Major impacts to threatened species to include: <input type="checkbox"/> Their habitat; and/or a decline in numbers from baseline observed; and/or <input type="checkbox"/> Change in species composition	<input type="checkbox"/> Notification to SCA/NPWS immediately <input type="checkbox"/> Proposal for threatened species management within 1 week <input type="checkbox"/> Completion of management task following approval from SCA/NPWS	<input type="checkbox"/> None required
Amphibians	Once prior to mining (completed)	Twice annually during entire extraction period (ongoing)	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"/> No impacts observed to date		<input type="checkbox"/> Additional monitoring as required by the relevant government agencies	
Swamp and riparian vegetation	Once prior to mining (completed)	Twice annually during entire extraction period (ongoing)	Annually for one year (ongoing)	<input type="checkbox"/> Minor impacts to Upland Swamp vegetation through change in water levels, and the cracking of soils.	<input type="checkbox"/> No impacts observed to date			

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 19	
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"/> No impacts observed to date				
General observations (every second month during mining)	Upland Swamp	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 impacts observed to date	<div><div><input type="checkbox"/> Minor cracking (<10mm)</div><div><input type="checkbox"/> Major cracking (>10mm)</div><div><input type="checkbox"/> Water loss</div><div><input type="checkbox"/> Flora/Fauna changes</div><div><input type="checkbox"/> Increased erosion</div></div>	<div><div><input type="checkbox"/> Report to SCA</div><div><input type="checkbox"/> Additional studies as required</div><div><input type="checkbox"/> Photographic record</div><div><input type="checkbox"/> Review of swamp piezometer data</div></div> <div><div><input type="checkbox"/> Notification to SCA</div><div><input type="checkbox"/> Remediation options developed in consultation with SCA, which may include further mining limitations</div><div><input type="checkbox"/> Proposal for rectification within one month</div><div><input type="checkbox"/> Completion of works following approval from SCA</div><div><input type="checkbox"/> Additional monitoring as required</div></div> <td><div><div><input type="checkbox"/> None required</div><div><input type="checkbox"/> None required</div></div></td>	<div><div><input type="checkbox"/> None required</div><div><input type="checkbox"/> None required</div></div>

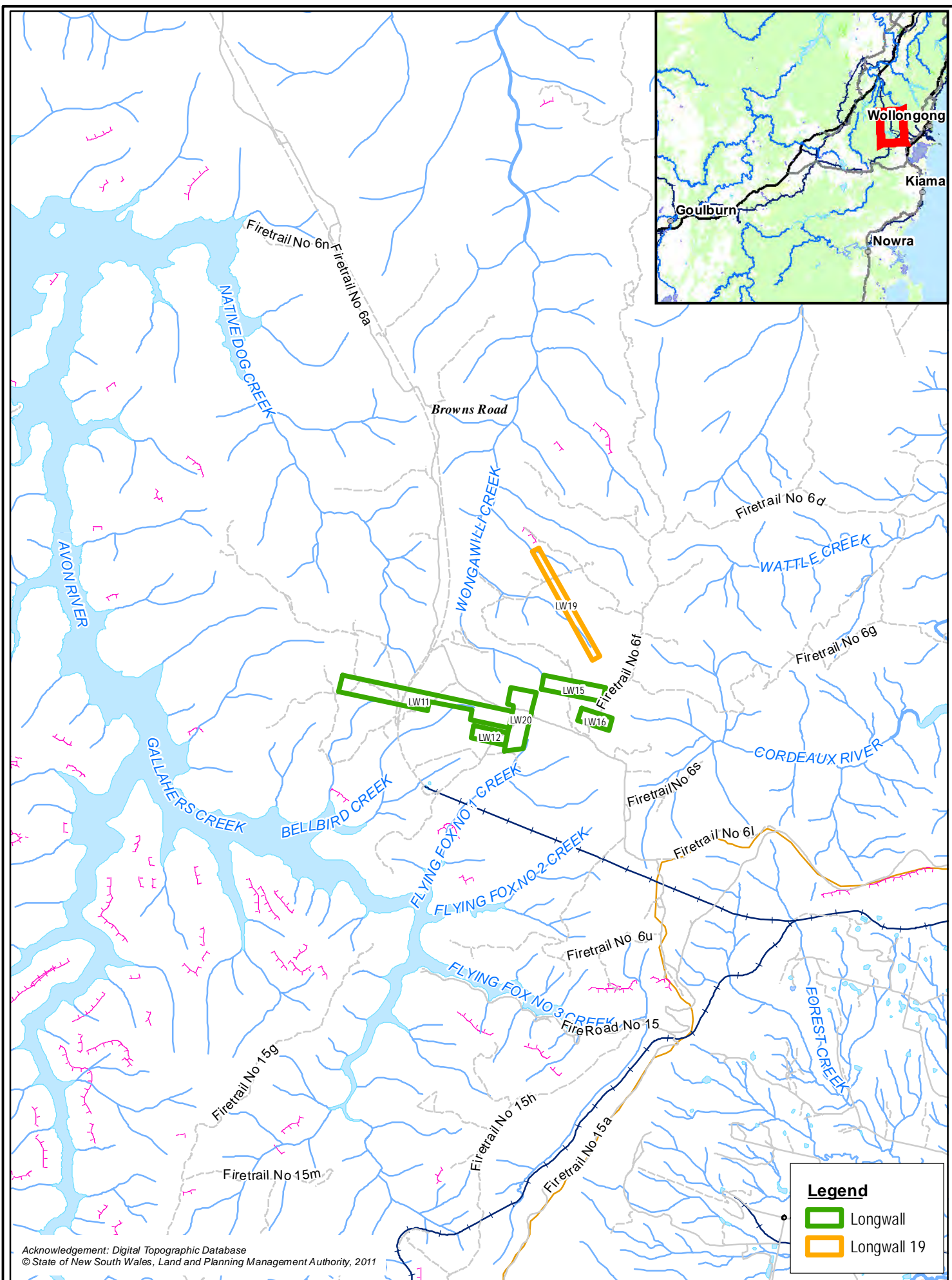
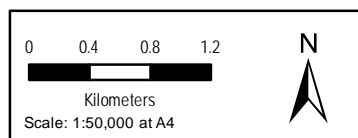


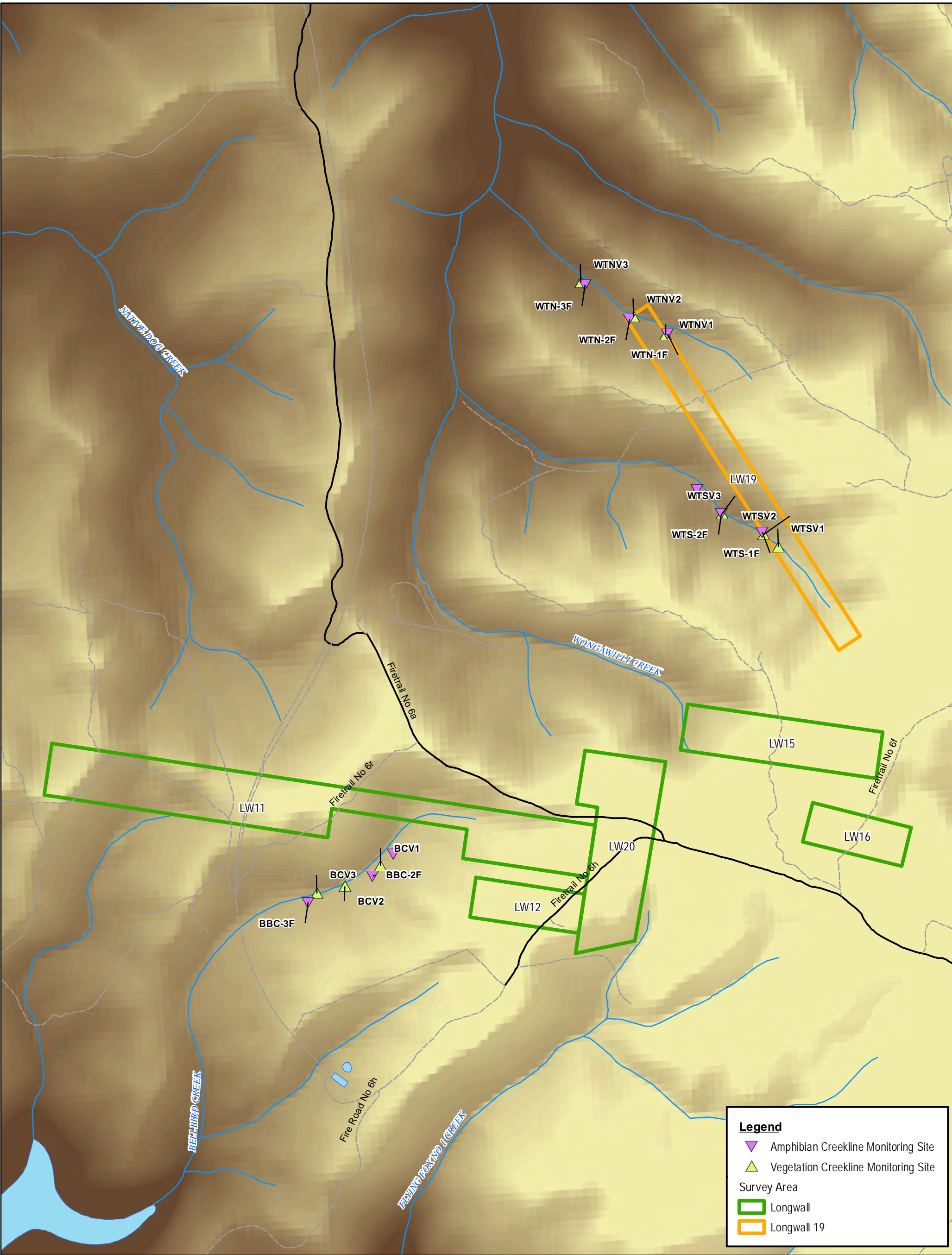
Figure 1: Location of the Study Area within a regional context

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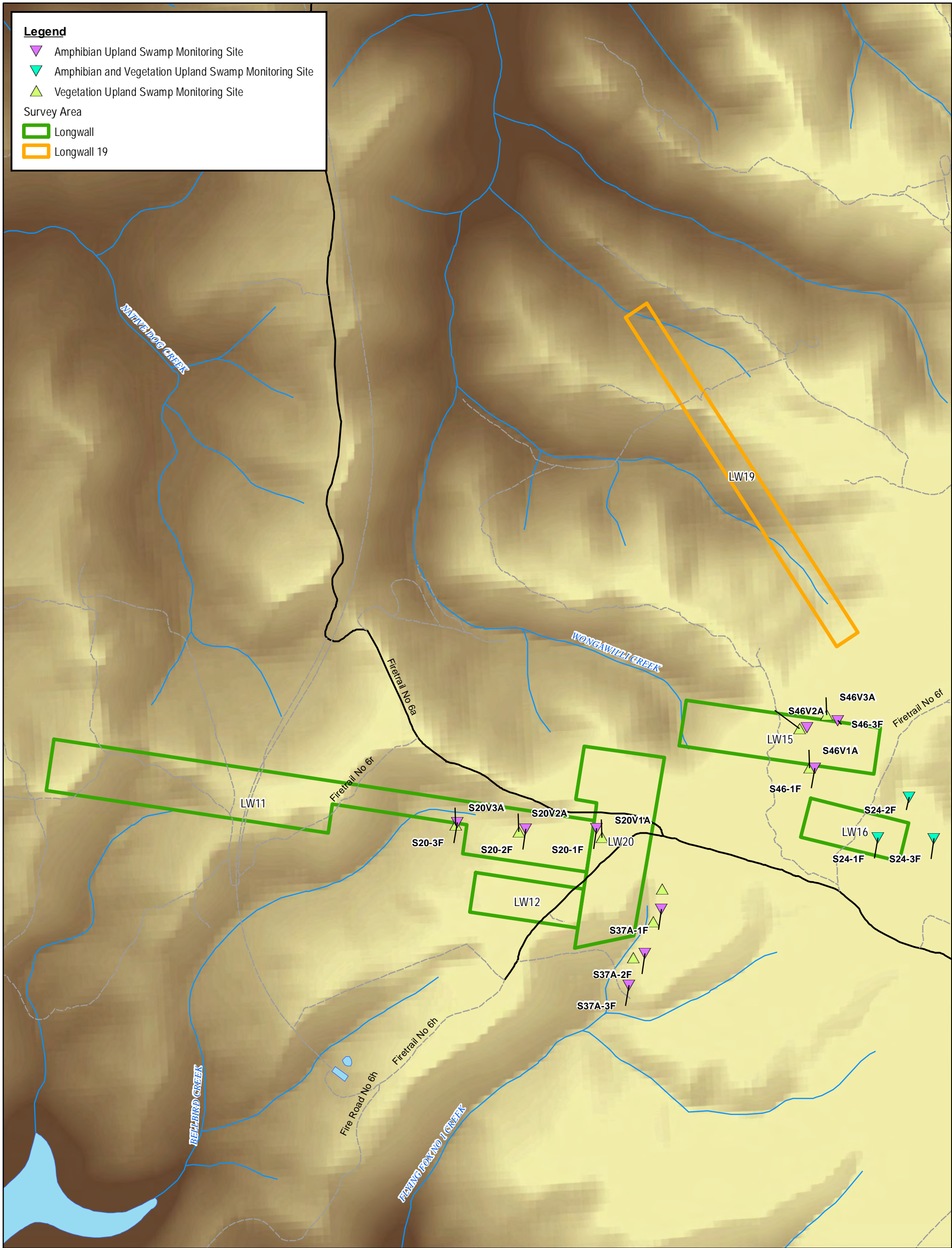
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Figure 2a: Vegetation and Amphibian Creekline Monitoring Sites.

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Figure 2a



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Figure 2b: Vegetation and Amphibian Upland Swamp Monitoring Sites.

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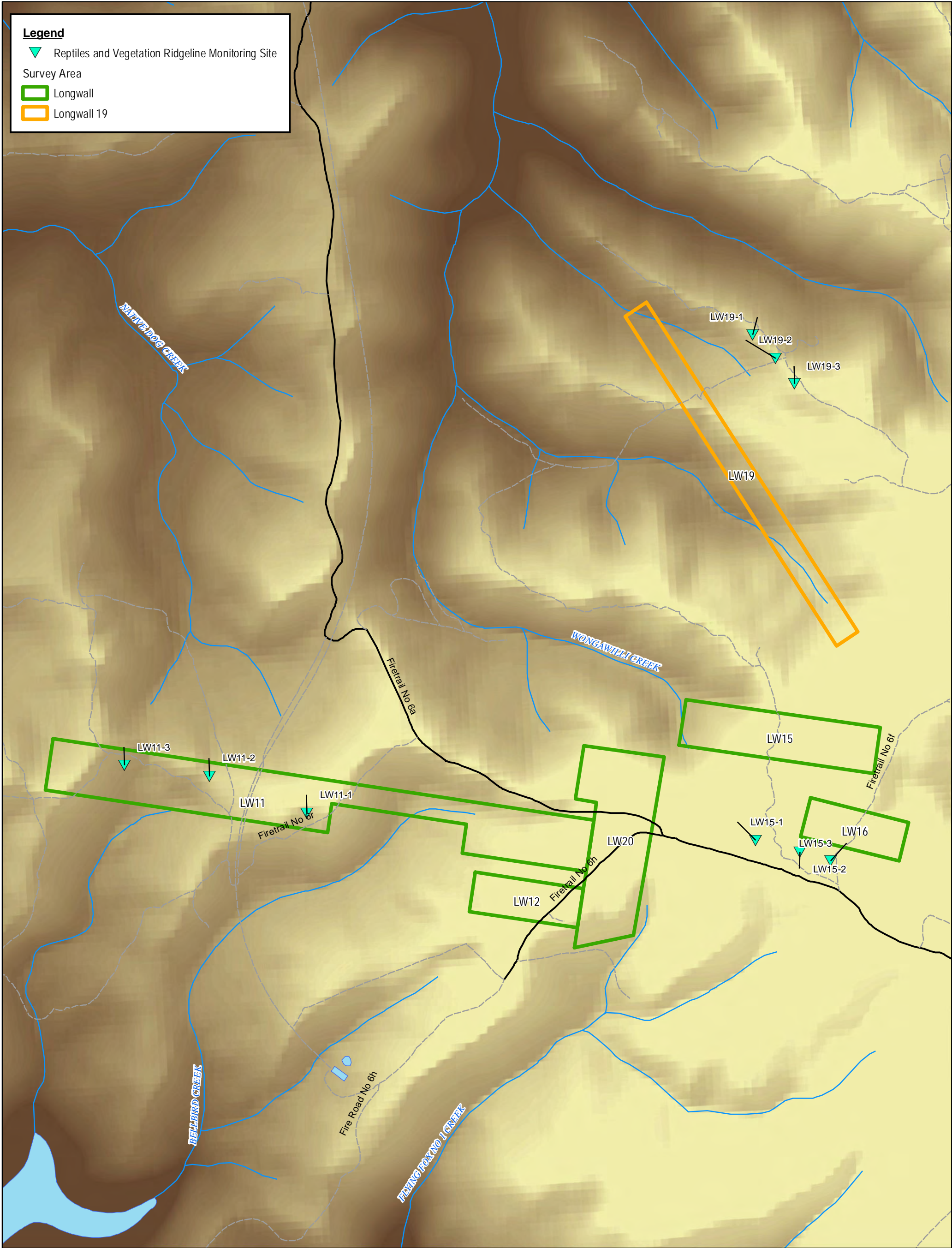
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Figure 2b



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Figure 2c: Vegetation and Reptile Ridgeline Monitoring Sites.

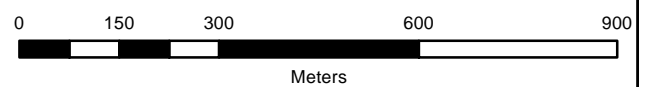
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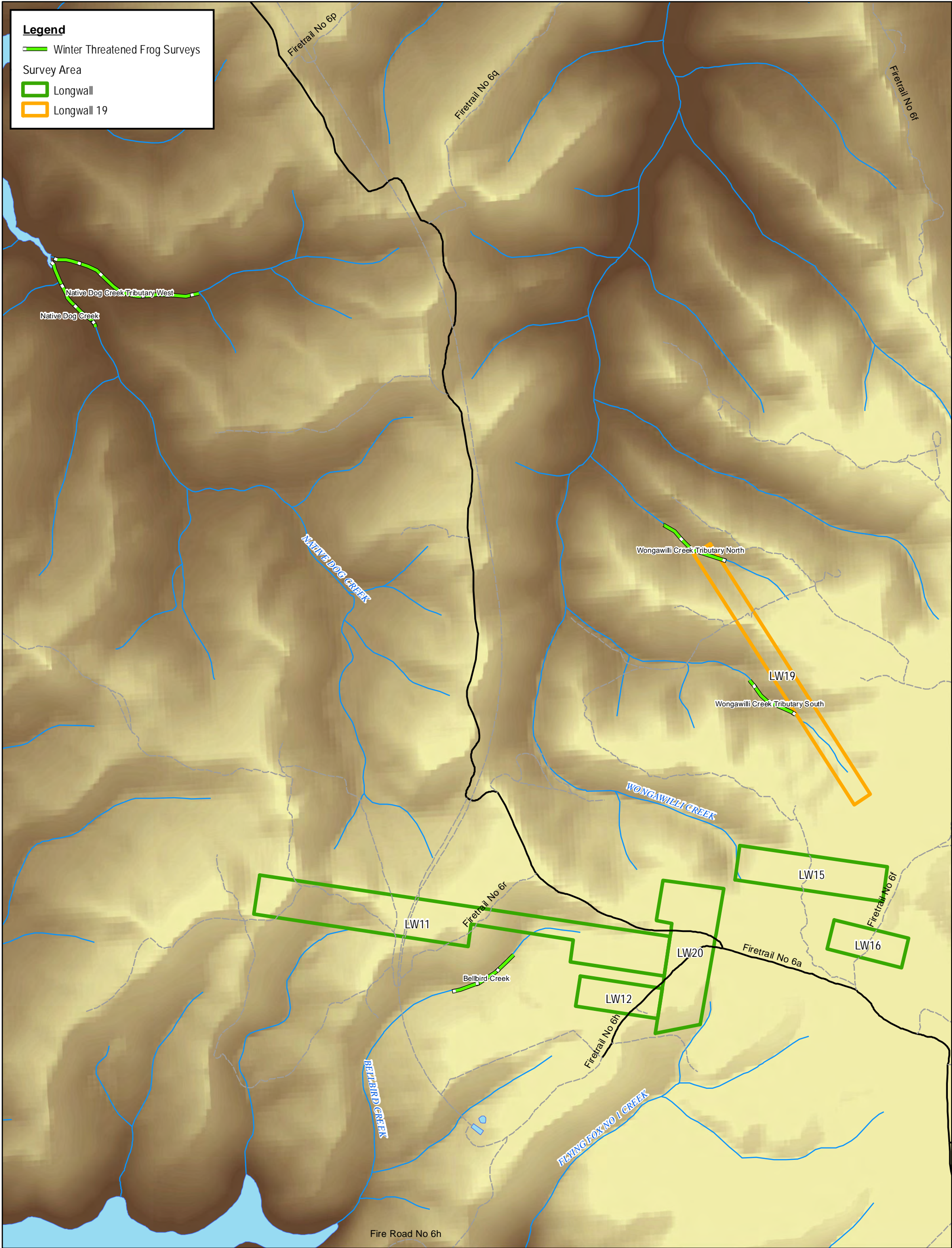
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Figure 2c



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Acknowledgements:
Background Image provided by NSW Land Planning Management Authority

Figure 2d: Vegetation and Amphibian Creekline Monitoring Sites.

Date: 23 March 2012

Drawn by: ANP/JMS

File number: 14582

Checked by: NMG

Location:P:\14500s\14582\Mapping\Report Figures\
14582 F2d_Monitoring.mxd

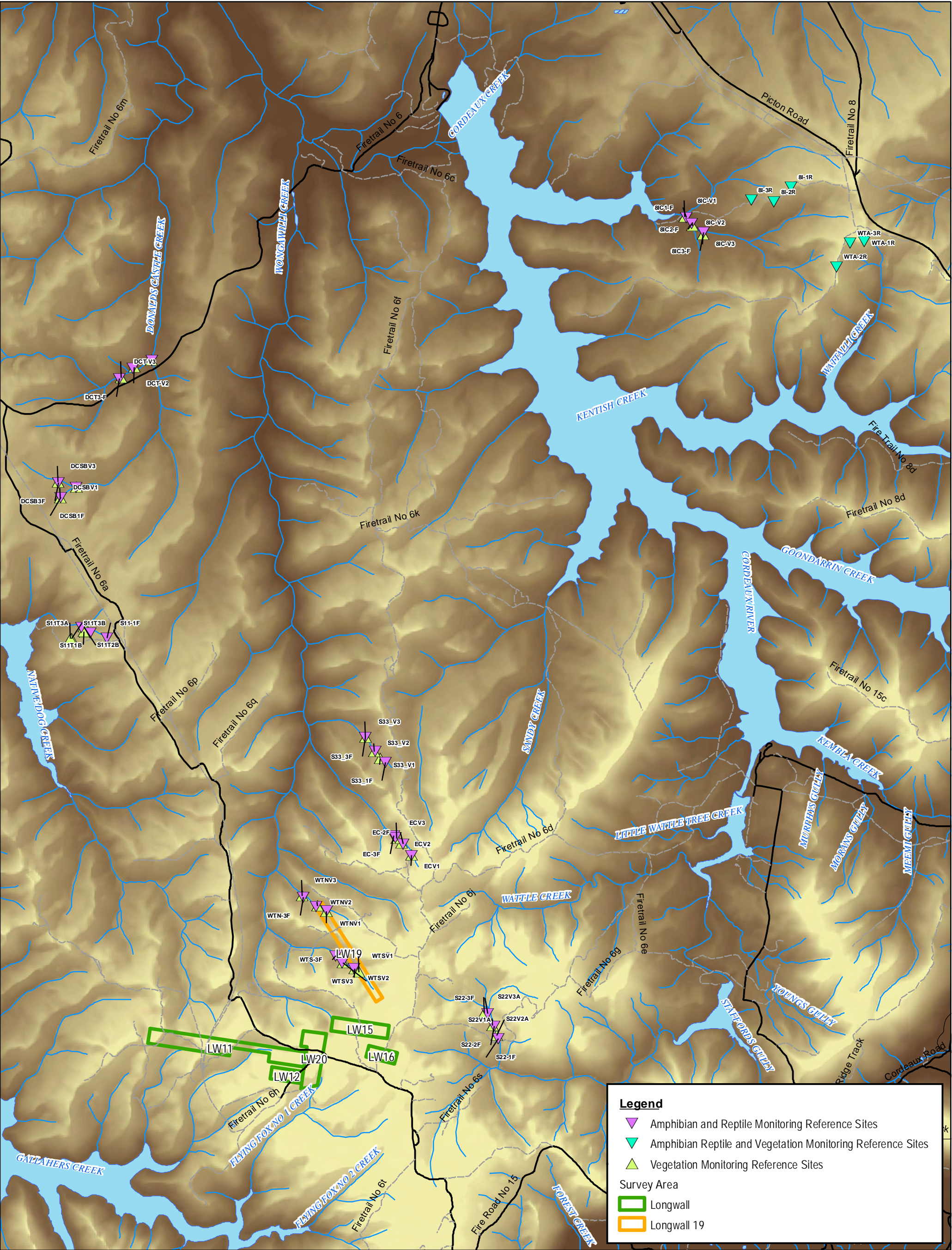
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Meters

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56



Figure 2d



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Figure 2e: Vegetation, amphibian and reptile monitoring reference sites.

Date: 23 March 2012	Drawn by: ANP/JMS
File number: 14582	Checked by: NMG
Location:P:\14500s\14582\Mapping\Report Figures\14582 F2e_Monitoring.mxd	

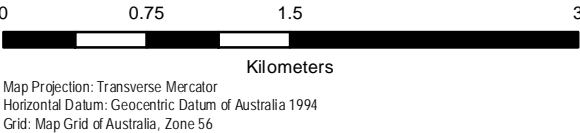
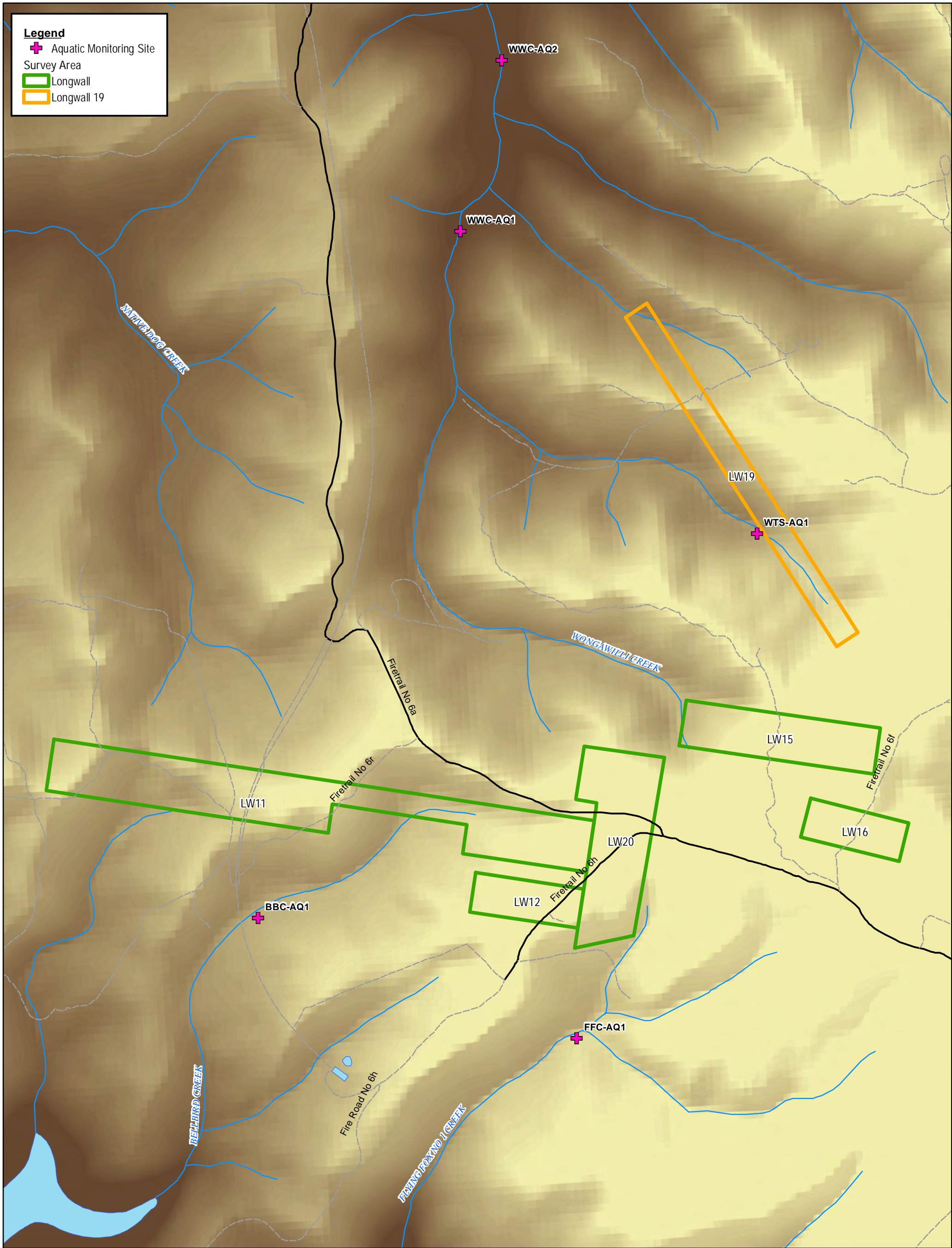


Figure 2e



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Figure 3a: Aquatic Monitoring Sites.

Date: 23 March 2012

Drawn by: JMS/ANP

File number: 14582

Checked by: NMG

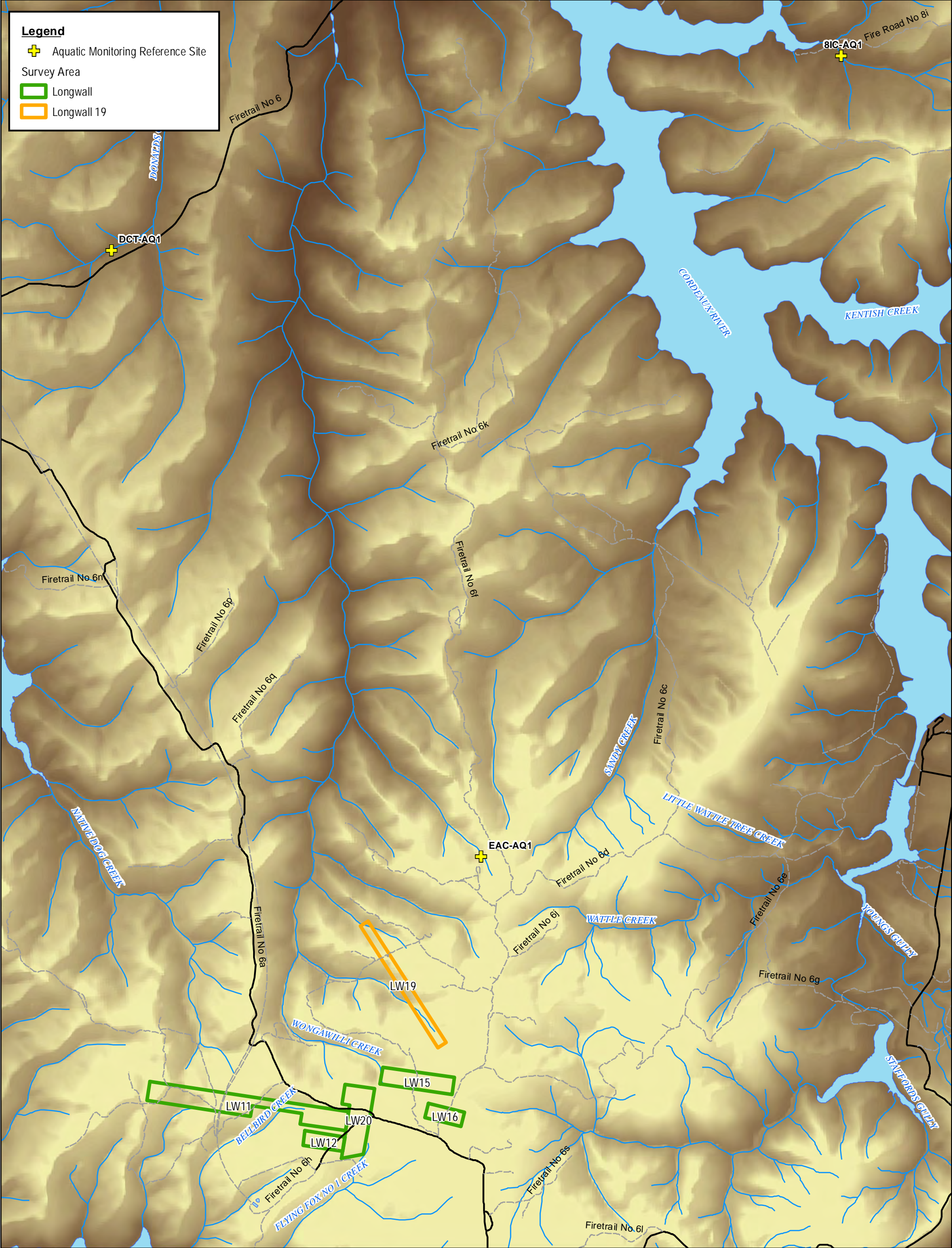
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14582 F3a_Aquatic Monitoring.mxd



Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56



Figure 3a



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Figure 3b: Aquatic Monitoring Reference Sites.

Date: 23 March 2012

Drawn by: JMS/ANP

File number: 14582

Checked by: NMG

Location: P:\14500s\14582\Mapping\Report Figures\14582 F3b_Aquatic Monitoring.mxd

0 0.38 0.76 1.52 2.28
Kilometers

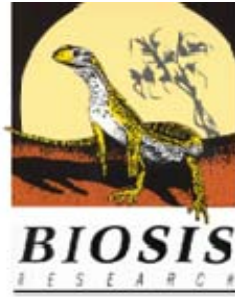
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Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56



Figure 3b

ATTACHMENT D

**Cultural Heritage: Longwall 19 – Aboriginal Archaeological Sites
Assessment End of Panel Report. Biosis Research Pty. Ltd., April
2012**



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

5 April 2012

Dear Chris,

NRE Wongawilli Colliery - Longwall 19 End of Panel Report

This report assesses the post mining conditions with relation to Indigenous heritage sites within the area potentially impacted by Longwall 19 of the Wongawilli Colliery. Coal was extracted from Longwall 19 from 26th June to 5th December 2011. Baseline recording and impact assessment monitoring has been undertaken for the following Indigenous Heritage sites:

- 52-2-1635 (Browns Road Site 21);
- 52-2-3669 (Wongawilli 1); and
- 52-2-1639 (Browns Road Site 25).

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. No other management actions have been triggered under the Trigger Action Response Plan (TARP, see Table 1). If there are any questions or queries with this report, please do not hesitate to contact me on the details below.

Kind Regards,

A handwritten signature in blue ink, which appears to read "Ana Jakovljevic".

Ana Jakovljevic
Archaeologist

Table 1: TARP Table

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 19
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 21 - Wongawilli 1 - Browns Road Site 25	Once for observed impacts such as: Cracking, opening of bedding planes, blockfalls, exfoliation, water seepage changes.	<input type="checkbox"/> 6 months post mining <input type="checkbox"/> 2 years post mining	<input type="checkbox"/> Browns Road Site 21- Moderate risk <input type="checkbox"/> Wongawilli 1-- Moderate risk <input type="checkbox"/> Browns road Site 25 – Vey low risk	<input type="checkbox"/> No impacts observed or reported.	<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 DECCW, DRE NSW, SCA <input type="checkbox"/> Review and undertake remediation options as appropriate	<input type="checkbox"/> None required