




**GUJARAT NRE FCGL Pty Ltd**

**NRE WONGAWILLI COLLIERY  
LONGWALL 11  
END OF PANEL REPORT**

**FOR THE NSW DIVISION OF RESOURCES AND ENERGY**

## DOCUMENT CONTROL

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**Cover Photo:** A rock cutting located above Longwall 11, along the Maldon-Dombarton rail corridor.  
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## LIST OF CONTENTS

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|                                                                                          |           |
|------------------------------------------------------------------------------------------|-----------|
| <b>1 Abbreviations and Definitions</b>                                                   | <b>6</b>  |
| <b>2 Summary</b>                                                                         | <b>7</b>  |
| <b>3 Introduction</b>                                                                    | <b>10</b> |
| 3.1 Background .....                                                                     | 10        |
| 3.2 Approval Conditions .....                                                            | 11        |
| 3.3 Report Outline and Contributors .....                                                | 13        |
| <b>4 Predicted and Observed Subsidence</b>                                               | <b>14</b> |
| 4.1 Monitoring Lines .....                                                               | 14        |
| 4.2 E&EE Monitoring Line .....                                                           | 14        |
| 4.3 EF Monitoring Line .....                                                             | 15        |
| <b>5 Impacts on Man Made Features</b>                                                    | <b>16</b> |
| 5.1 Surface Infrastructure Within the Application Area .....                             | 16        |
| 5.2 Comparison Between Predicted and Observed Impacts on Surface<br>Infrastructure ..... | 16        |
| 5.3 Indigenous Heritage Sites .....                                                      | 18        |
| 5.4 European Heritage Sites .....                                                        | 18        |
| <b>6 Impacts to Natural Features</b>                                                     | <b>19</b> |
| 6.1 Steep Slopes and Rock Outcrops .....                                                 | 19        |
| 6.2 Surface Water and Groundwater Impacts .....                                          | 20        |
| 6.3 Aquatic Ecology .....                                                                | 23        |
| 6.4 Terrestrial Ecology .....                                                            | 24        |
| <b>7 Management of Impacts and Remediation</b>                                           | <b>26</b> |
| 7.1 Trigger Action Response Plan .....                                                   | 26        |

## LIST OF TABLES

---

|                                                                                                          |    |
|----------------------------------------------------------------------------------------------------------|----|
| Table 5.1: Summary of Predicted and Observed Impacts from Longwall 11 on<br>Surface Infrastructure ..... | 17 |
| Table 6.1: Summary of Groundwater and Surface Water Impacts .....                                        | 22 |
| Table 7.1: Monitoring and TARPs for NRE Wongawilli Colliery .....                                        | 28 |

## LIST OF FIGURES

---

|                                                                                  |    |
|----------------------------------------------------------------------------------|----|
| Figure 1: Longwall 11, Monitoring and Surface Infrastructure (Source - MSEC 518) | 37 |
|----------------------------------------------------------------------------------|----|

## LIST OF ATTACHMENTS

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|                                                                                                                                                                                            |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Attachment A</b>                                                                                                                                                                        | <b>39</b> |
| Subsidence Report: End of Panel Monitoring Report for Longwall 11 at Wongawilli Colliery. Mine Subsidence Engineering Consultants (MSEC) Report # MSEC518 - Revision A. August 2011 .....  | 39        |
| <b>Attachment B</b>                                                                                                                                                                        | <b>40</b> |
| Groundwater and Surface Water: NRE Wongawilli Colliery End Of Longwall 11 Groundwater & Surface Water Report. GeoTerra Report: WON1-R1, August 2011 .....                                  | 40        |
| <b>Attachment C</b>                                                                                                                                                                        | <b>41</b> |
| Terrestrial and Aquatic Ecology: Terrestrial and Aquatic Flora and Fauna Assessment NRE Wongawilli Colliery: Longwall 11 End of Panel Report. Biosis Research Pty. Ltd., August 2011 ..... | 41        |
| <b>Attachment D</b>                                                                                                                                                                        | <b>42</b> |
| Cultural Heritage: Longwall 11 - Aboriginal Archaeological Sites Assessment End of Panel Report. Biosis Research Pty. Ltd., August 2011 .....                                              | 42        |



## 1 ABBREVIATIONS AND DEFINITIONS

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**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

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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 11.

This EOP report outlines the measured and observed impacts following the extraction of NRE Wongawilli Longwall 11 and compares any observed impacts with the relevant impact predictions outlined in the SMP and its supporting expert reports and accompanying documentation.

Longwall 11 occurs within Mining Lease (ML) 1596 and was extracted using conventional longwall mining techniques and equipment. Extraction of coal from Longwall 11 commenced on 29 January 2010 and concluded on 13 May 2011.

### ***Subsidence***

Subsidence movements resulting from the extraction of Longwall 11 were measured along two 2D seismic survey lines known as E&EE and EF.

For the E&EE line, the maximum observed total subsidence due to the extraction of Longwall 11 and Longwall 12 is 670 mm, which is greater than the maximum predicted total subsidence of 500 mm. The maximum observed total tilt due to the extraction of Longwall 11 and Longwall 12 is 8.9mm/m, which is greater than the maximum predicted total tilt of 5.4 mm/m.

The maximum observed total strain due to the extraction of Longwall 11 and Longwall 12 is a compressive strain of 1.2mm/m which occurs between survey pegs EE10 and EE11. Measured strains along the E&EE Line are generally less than 1.0mm/m for both compressive and tensile strain.

For the EF line, the maximum observed total subsidence due to the extraction of Longwall 11 and Longwall 12 is 320 mm, which is greater than the maximum predicted total subsidence of 270 mm. The maximum observed total tilt due to the extraction of Longwall 11 and Longwall 12 is 3.2 mm/m, which is greater than the maximum predicted total tilt of 1.2 mm/m.

The maximum observed total strain due to the extraction of Longwall 11 and Longwall 12 is a compressive strain of 1.5mm/m which occurs between survey pegs EF46 and EF47, which are located over Longwall 12. Measured strains along the EF Line are predominantly less than 0.5mm/m for both compressive and tensile strain.

### ***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 11 were similar to, or less than, the impacts predicted in the SMP. As tabulated below, no impacts were observed to transmission lines, Fire Roads or 4WD tracks. Minor cracking and very minor rock falls were observed in a rock cutting along the Maldon - Dombarton Railway Corridor.

| Surface Infrastructure               | Predicted Impacts                                                                   | Observed Impacts                              |
|--------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------|
| Fire Roads 6H* and 6A and 4WD Tracks | Changes to surface drainage and some surface cracking of the unsealed road surfaces | No reported or observed impacts               |
| Maldon - Dombarton Rail Corridor*    | Fracturing of rock cuttings                                                         | Minor cracking of rock cuttings               |
| Disused 33kV Powerline               | No predicted impacts                                                                | No reported or observed impacts               |
| Survey Control Marks                 | Horizontal movements requiring re-establishment                                     | Horizontal movements require re-establishment |

No subsidence impacts to Indigenous heritage sites were observed.

#### ***Impacts on Natural Features***

The observed impacts on natural features resulting from the extraction of Longwall 11 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 11.

There have been no observed impacts to terrestrial or aquatic ecological values or habitats as a result of the extraction of Longwall 11.

Monitoring of groundwater has identified the groundwater level within the Hawkesbury Sandstone fell by 8.92m in open piezometer EGW3 (over Longwall 11) as a result of the extraction of Longwall 11.

#### ***Trigger Action Response Plans (TARP's)***

During extraction of Longwalls 11, the TARP triggers exceeded were:

- ☐ Subsidence monitoring, Rock Outcrops and Public Safety Management trigger relating to minor cracking.
- ☐ Groundwater- >5m groundwater drawdown over a minimum 2 month period in EGW3.
- ☐ Water Quality- Bellbird Creek EC above 200µS/cm, (not known to be subsidence induced) and Bellbird Creek pH below 4.2 and above 6 (related to a calibration error with the monitoring equipment)

**Table 7.1** (Monitoring and TARPs Table) 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**.

In relation to the minor cracking and rock falls in a rock cuttings of the Maldon-Dombarton rail corridor, warning sign erection is not deemed to be required due to the minor nature of the two observed rock falls. No public safety risk is inferred. No further mining is to be undertaken in the area and there is no public access.

The >5m groundwater level drawdown over a minimum 2 month period TARP Trigger was exceeded in EGW3 (which is over Longwall 11). No ameliorative actions are currently recommended as this was a predicted impact. Monitoring will continue to assess the status of the impact. The groundwater level is predicted to recover over the next few months.

The surface water pH and EC TARP trigger levels were exceeded, however no ameliorative actions are required due to extraction of Longwalls 11 or 12, as the changes were not sustained.

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 11.

### ***Conclusion***

The extraction of coal from NRE Wongawilli Colliery Longwall 11 has not resulted in unexpected impacts to natural or man made features. No remediation is currently considered to be required.

NRE Wongawilli Colliery Longwall 19 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 19 will continue and be documented in the next end of panel report.

## 3 INTRODUCTION

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### 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 11 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 11.

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

Coal from Longwall 11 was extracted using conventional longwall mining techniques between the following dates:

- ❑ Longwall commencement: 29 January 2010.
- ❑ Longwall completion: 13 May 2011.

Longwall 11 is shown in **Figure 1**. Impact predictions associated with Longwall 11 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 11, 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:** *The leaseholder must submit to the Principle Subsidence Engineer for approval a subsidence monitoring program for the longwall panels which are subject to this approval. This program must include:*

- a. Inspection regimes*
- b. Layout and monitoring points*
- c. Parameters to be measured*
- d. Monitoring methods and accuracy*
- e. Timing and frequencies of surveys and inspections*
- f. Recording and reporting of monitoring results*

*The leaseholder must not commence longwall mining prior to the subsidence monitoring program being approved*

**Condition 13: Environmental Management:** In accordance with Condition 13 of the SMP approval, Gujarat NRE has prepared an *Environment, Subsidence and*

*Safety Management Plan (ESSMP).* The ESSMP itself required approval from the Director, Environmental Sustainability Unit of the NSW Department of Industry and Investment prior to the commencement of extraction from Longwall 12 (the 1<sup>st</sup> longwall extracted in this series) only as outlined in correspondence from the Director dated 24 August 2009. Approval of the full and final ESSMP was granted on 24 December 2009 for all Longwalls within the SMP application.

The following consent condition as outlined in the ESSMP approval correspondence from the Director dated 24 August 2009 and later updated on 24 December 2009 applies.

*End of Panel Reports, required by Condition 17 of the Subsidence Management Plan Approval Dated 16 July 2009, must be provided to the Sydney Catchment Authority (SCA) and the Department of Environment, Climate Change and Water (DECCW) at the same time as they are submitted to Industry and Investment NSW.*

This EOP will be supplied to all three departments/agencies simultaneously.

**Condition 17** was recently revised to allow for summary End of Panel reports. It is outline below as revised.

- 17.1 *Within 4 months of the completion of each longwall panel, an end of panel report must be prepared to the satisfaction of the Director General Sustainability {DRE }. The end of panel report must include a summary of the subsidence and environmental monitoring results for the applicable longwall panel.*
- 17.2 *Within 4 months of the completion of all longwall panels, No 11,12,13,14,15,16,19, & 20 an end of panel report must be prepared to the satisfaction of the Director General Sustainability {DRE }. The end of panel report must include all of the longwall panels and:*
  - a. *include a summary of the subsidence and environmental monitoring results for each longwall panel.*
  - b. *include an analysis of these monitoring results against the relevant:*
    - ☐ *Impact assessment criteria*
    - ☐ *Monitoring results from previous panels*
    - ☐ *Predictions in the SMP*
  - c. *identify any trends in the monitoring results over the life of the activity and*
  - d. *describe what actions were taken to ensure adequate management of any potential subsidence impacts due to the longwall mining*
- 17.3 *an end of panel report for a particular longwall is to be supplied to the Director General Sustainability {DRE } if:*

- a) *An action is required due to the activation of a trigger in the approved Environment Management Plan, Public Safety Management Plan or Subsidence Management Plan.*
- b) *Requested by Industry and Investment NSW (now DRE). The end of panel report must contain the information stipulated in 17.2 a) to d).*

### 3.3 Report Outline and Contributors

The following specialists and experts have contributed to this EOP through the assessments of subsidence impacts from Longwall 11 on their area of specialisation:

|                                            |                               |                                      |
|--------------------------------------------|-------------------------------|--------------------------------------|
| <b>Southern Cross Consulting Surveyors</b> | Survey                        |                                      |
| <b>MSEC</b>                                | Mine Subsidence               | (Attachment C)                       |
| <b>GeoTerra</b>                            | Groundwater & Surface Water   | (Attachment D)                       |
| <b>Biosis Research</b>                     | Aquatic & Terrestrial Ecology | (Error! Reference source not found.) |
|                                            | Cultural Heritage             | (Error! Reference source not found.) |

**Niche Environment and Heritage** 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 11 on surface infrastructure.

**Section 6** outlines the impacts of mining associated with Longwall 11 on natural features.

**Sections** Error! Reference source not found. summarises the monitoring program and outlines the management and remediation of impacts associated with Longwall 11.

## 4 PREDICTED AND OBSERVED SUBSIDENCE

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### 4.1 Monitoring Lines

The subsidence movements resulting from the extraction of Longwall 11 were measured along two monitoring lines, E&EE Line and EF Line, both of which are 2D monitoring lines. 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 11 has been prepared by MSEC and is provided in full in **Attachment C**.

Comparisons between predicted and observed subsidence movements along the monitoring lines are provided in the following sections.

The survey results for the E&EE lines and EF lines provide measured surface movements due to the extraction of Longwalls 12 and 11, with Longwall 12 having been extracted prior to the commencement of Longwall 11.

The survey monitoring lines were established 20th July 2009, prior to the extraction of Longwall 12. The previously extracted Elouera Colliery Longwall 10, which is located immediately to the north of Longwall 11, was completed in June 2005. The survey monitoring results therefore include the influence of the previously extracted Elouera Colliery longwalls on Longwalls 11 and 12 but do not include the surface movements that occurred when the Elouera Colliery Longwalls were extracted.

Previous extraction was carried out above parts of Longwall 11 and Longwall 12 in the Bulli seam. Old pillar extraction workings within the Wongawilli Seam were also extracted beneath the Bulli Seam directly adjacent to the southern edge of Longwall 11 and Longwall 12. The areas of extraction in the Bulli seam and the Wongawilli Seam are shown in Drawing No. MSEC518-01 in **Attachment C**.

The predicted subsidence profiles along the monitoring lines 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. The effects of multi-seam mining conditions were also taken into account in the prediction model as previous extraction was carried out above Longwall 11 in the Bulli seam.

### 4.2 E&EE Monitoring Line

The E&EE Monitoring Line was installed to monitor the subsidence movements due to the extraction of Longwalls 1 to 10 at Elouera Colliery. A maximum total subsidence of 1370 mm was monitored along this line, which occurred above Longwall 6 as shown in the attached Fig. A.01. The incremental and total observed



subsidence due to the extraction of Longwall 11 has been added to this survey data and presented in Fig. A.01 **Attachment C**.

The E&EE monitoring line is located along the Maldon Dombarton rail corridor and extends through the footprint of Longwall 11. The survey line was last monitored on 28th April 2011 at the completion of Longwall 11. Survey results of the total subsidence of E&EE pegs due to the extraction of Longwall 11 and Longwall 12 are presented in Fig. A.02 **Attachment C**.

The maximum observed total subsidence due to the extraction of Longwall 11 and Longwall 12 is 670 mm, which is greater than the maximum predicted total subsidence of 500 mm. The maximum observed total tilt due to the extraction of Longwall 11 and Longwall 12 is 8.9mm/m, which is greater than the maximum predicted total tilt of 5.4 mm/m.

The maximum observed total strain due to the extraction of Longwall 11 and Longwall 12 is a compressive strain of 1.2mm/m which occurs between survey pegs EE10 and EE11. Measured strains along the E&EE Line are generally less than 1.0mm/m for both compressive and tensile strain. A plot of the observed subsidence parameters for the E&EE Line is included in Fig. A.02 **Attachment C**. Note this area of higher strain is approximately coincident with the chain pillar separating Longwall 11 and 10.

### 4.3 EF Monitoring Line

The EF monitoring line is located diagonally at the eastern end of Longwall 11 as is shown in Drawing No. MSEC518-01 **Attachment C**. The route of the monitoring line follows Fire Road 6H and a disused 33kV power line.

The survey line was last monitored on 28th April 2011 at the completion of Longwall 11. Survey results of the incremental total subsidence, tilt and strain of the EF line resulting from the extraction of Longwall 11 and Longwall 12 are presented in Fig. A.03 **Attachment C**. The predicted profiles of total subsidence, tilt and strain along the EF Line due to the extraction of Longwall 11 are also shown in Fig. A.03 **Attachment C**.

The maximum observed total subsidence due to the extraction of Longwall 11 and Longwall 12 is 320 mm, which is greater than the maximum predicted total subsidence of 270 mm. The maximum observed total tilt due to the extraction of Longwall 11 and Longwall 12 is 3.2 mm/m, which is greater than the maximum predicted total tilt of 1.2 mm/m.

The maximum observed total strain due to the extraction of Longwall 11 and Longwall 12 is a compressive strain of 1.5mm/m which occurs between survey pegs EF46 and EF47, which are located over Longwall 12. Measured strains along the EF Line are predominantly less than 0.5mm/m for both compressive and tensile strain.

## 5 IMPACTS ON MAN MADE FEATURES

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### 5.1 Surface Infrastructure Within the Application Area

The surface infrastructure that is located above or adjacent to Longwall 11 is shown in **Figure 1**.

There is no significant infrastructure above or adjacent to Longwall 11 however the following items are considered in this EOP:

- ☐ Fire Road 6H, Fire Road 6A and minor sections of 4WD tracks passing directly above Longwall 11;
- ☐ Maldon - Dombarton rail corridor;
- ☐ Disused 33 kV power line passing over eastern perimeter above Longwall 11;
- ☐ Survey control marks.

### 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 11 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 11, was minor cracking and rock falls in rock cuttings of the Maldon-Dombarton rail corridor and impacts on the survey control marks. Impacts were similar to, or less than predicted.

Minor cracking was observed on the EE survey line between survey marks EE15 and EE30. This area is directly coincident with the LW 11 goaf. The highest levels of strain measured along the EE survey line was not in this area but was between survey marks EE10 and EE11 which is approximately coincident with the chain pillar separating Longwall 11 and Longwall 10 (see Drawing MSEC518-01 in **Attachment C**).

There are no exploration bores within the limit of subsidence for Longwall 11.

**Table 5.1: Summary of Predicted and Observed Impacts from Longwall 11 on Surface Infrastructure**

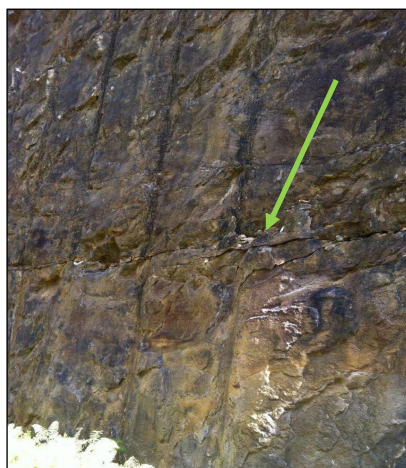
| Surface Infrastructure               | Predicted Impacts                                                                | Observed Impacts                              |
|--------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------|
| Fire Roads 6H* and 6A and 4WD Tracks | Changes to surface drainage. Some surface cracking of the unsealed road surfaces | No reported or observed impacts               |
| Maldon - Dombarton Rail Corridor*    | Fracturing of rock cuttings                                                      | Minor cracking- minor rock falls              |
| Disused 33kV Powerline               | No predicted impacts                                                             | No reported or observed impacts               |
| Survey Control Marks                 | Horizontal movements requiring re-establishment                                  | Horizontal movements require re-establishment |

\*Fire Road 6H and the Maldon - Dombarton rail corridor correspond to Survey Lines EF and EE&E respectively (see **Section 4.2** and **4.3**).

**Plate 1: Minor fresh Rock fall and corresponding rock fragment observed in Maldon - Dombarton rail corridor rock cutting-suspected to be subsidence induced.**



**Plate 2: Minor cracking observed in Maldon - Dombarton rail corridor rock cutting-suspected to be subsidence induced.**



### 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 11 and the full report is provided in Error! Reference source not found..

Five previously recorded Aboriginal archaeological sites occur in the vicinity of Longwall 11. The archaeological sites considered in this EOP are:

- ☐ Upper Avon 2 (52-2-1825) - axe grinding groove.
- ☐ Upper Avon 3 (52-2-1826) - axe grinding groove.
- ☐ Native Dog Creek Shelter (52-2-0966/3096) - Shelter with Art.
- ☐ Upper Avon 4 (52-2-1801) - Shelter with Art.
- ☐ Upper Avon 27 (52-2-1763) - Shelter with Art.

The risk of impact to these sites from subsidence related to extraction of Longwall 11 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 11.

## 6 IMPACTS TO NATURAL FEATURES

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Longwall 11 is located within the Metropolitan Special Areas Water Catchment. By definition the catchment area is relatively undisturbed and therefore contains many important natural features.

Natural features in the vicinity of Longwall 11 include:

- ☐ Cliffs, steep slopes and rock outcrops.
- ☐ Creeks and watercourses including the headwaters of Bellbird Creek.
- ☐ Lake Avon.
- ☐ Upland swamps (Swamp 20).
- ☐ Native vegetation and fauna habitat.

Each of these values are discussed below. Monitoring activities for natural features within the limit of subsidence for Longwall 11 include the following:

- ☐ Landscape assessment.
- ☐ Water flow and quality.
- ☐ Groundwater.
- ☐ Terrestrial flora and fauna.
- ☐ Aquatic ecology.

### 6.1 Steep Slopes and Rock Outcrops

There are several areas identified in Figure MSEC 360-08 (MSEC 2008 - not reproduced in this report). Several small areas of steep slope and rock outcrops occur in the vicinity of Longwall 11.

#### ***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.



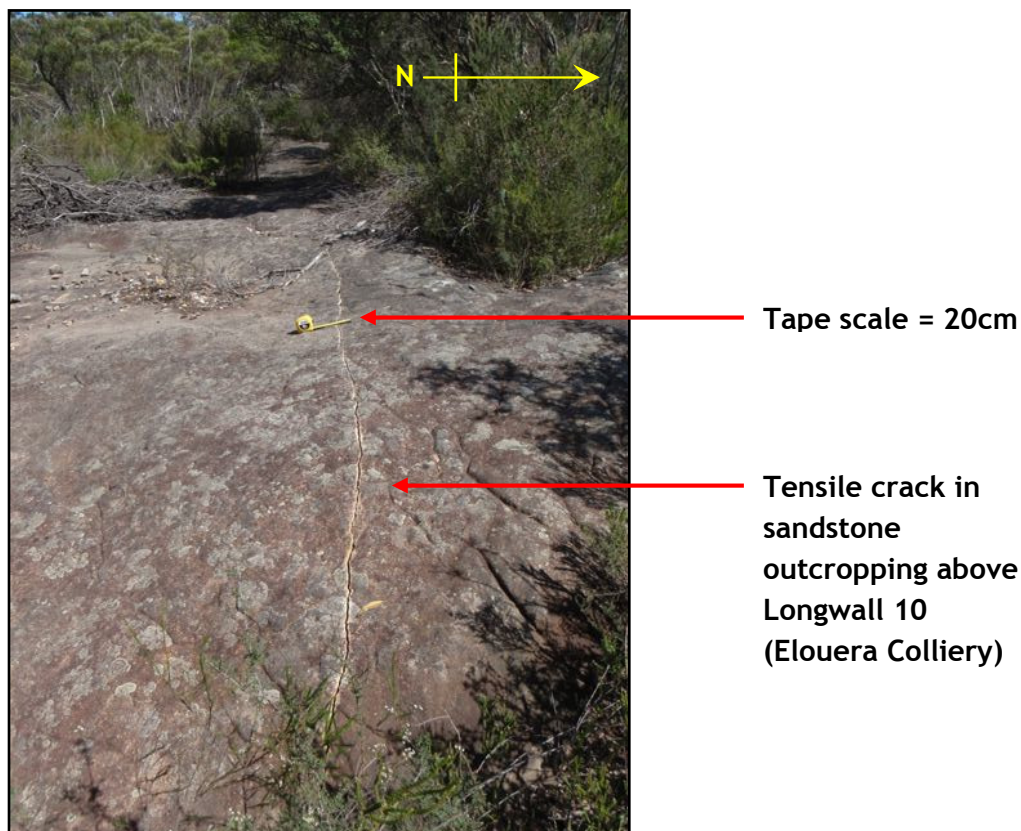
### ***Observed Impacts***

Inspections of the areas of steep slopes in the vicinity of Longwall 11 were undertaken during site inspections by Biosis Research, GeoTerra, Niche Environment and Heritage and personnel from Gujarat NRE.

There have been no observed impacts on steep slopes associated with Longwall 11.

The impacts that may be expected to occur at the top of a slope could include cracking in landscape features such as rock outcrops. **Plate 3** shows a tensile crack in a sandstone outcrop immediately above the edge of a longwall panel in the Southern Coal Field. Cracking like this was not observed in any sandstone outcrop inspected above or in the vicinity of Longwall 11 (see **Plate 3**).

**Plate 3: Cracking in sandstone outcrop above the southern edge of the goaf of Elouera Colliery - Longwall 10**



## **6.2 Surface Water and Groundwater Impacts**

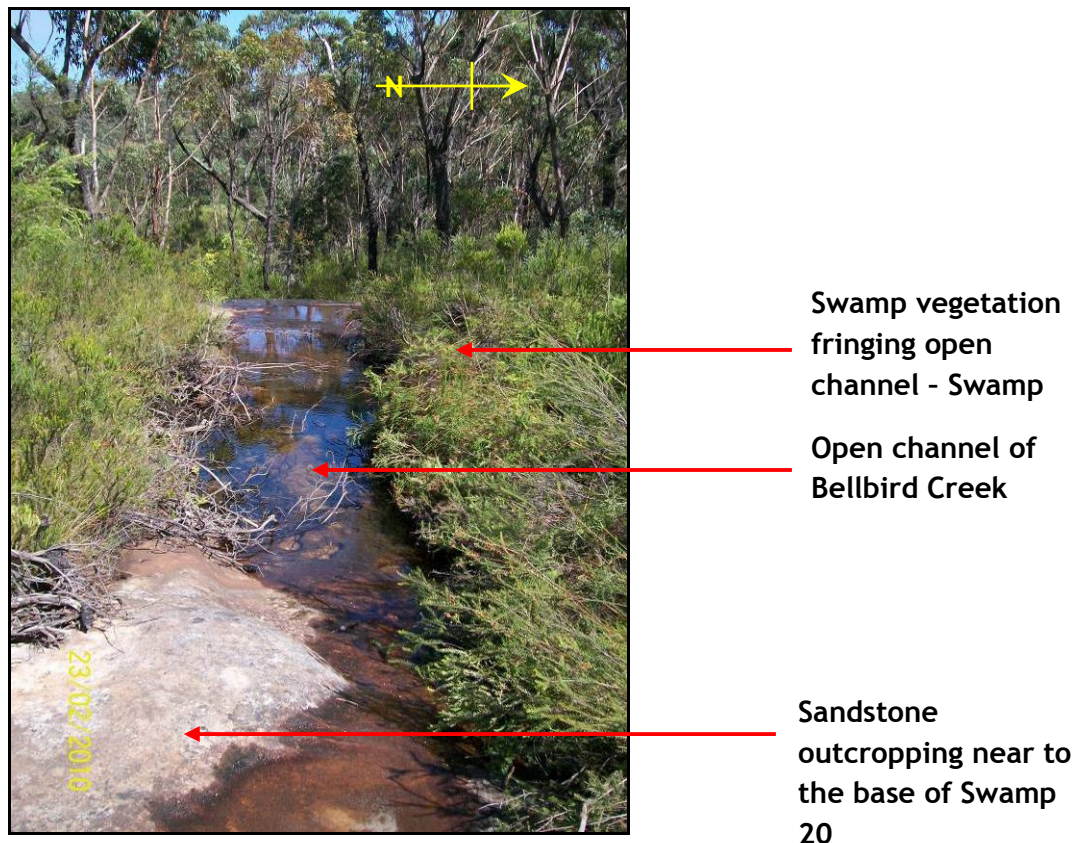
There are no major waterways within the limit of subsidence of Longwall 11. One creek, Bellbird Creek has its headwaters within an Upland Swamp (Swamp 20) while the headwaters of Native Dog Creek lie north of the western end of Longwall 11.



Within Swamp 20, Bellbird Creek is obscured for the most part by dense vegetation which only opens into an open channel over short distances where bedrock sandstone is close to the swamp base. In these locations, standing pools of water occur in deeper natural potholes in the sandstone with small volumes of water flowing in naturally eroded drainage depressions located along joint and bedding planes (see **Plate 4**). Longwall 11 mined directly beneath Bellbird Creek. A number of smaller, ephemeral drainage lines occur above Longwall 11 and were inspected for this EOP. No impacts to the ephemeral drainage lines were observed.

Lake Avon is located more than 1 km from any of the Longwalls associated with NRE Wongawilli Colliery (i.e. outside the Dam Safety Committee notification zone and has not been considered further in this EOP.

**Plate 4: The open channel of Bellbird Creek within Swamp 20**



### ***Predicted Impacts***

GeoTerra (**Attachment D**) have assessed the surface and groundwater monitoring results and prepared a comprehensive end of panel report for Longwall 11. 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 11                                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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, <b>however EGW3 over Longwall 11 fell by 8.92m.</b>                                                                |
| Shallow Hawkesbury Sandstone groundwater levels should recover over a few months                                                                                                                        | <b>Based on the available data, the EGW3 water level has not yet recovered</b>                                                                                                                                                                                                                        |
| No permanent post mining reduction in the shallow Hawkesbury Sandstone water levels unless a new outflow path develops                                                                                  | <b>Based on the available data, the EGW3 water level has not yet recovered</b>                                                                                                                                                                                                                        |
| Strata dilation and subsequent re-filling of secondary voids may temporarily lower the shallow Hawkesbury Sandstone standing water levels                                                               | <b>Based on the available data, the EGW3 water level has not yet recovered</b>                                                                                                                                                                                                                        |
| 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 water levels has been caused by LW 11                                                                                                               |
| 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 piezometer has not been adversely, or observably, affected by subsidence effects                                                                                                                                                                                                         |
| Interface drainage, ferruginous, brackish seeps may be generated in streams                                                                                                                             | No interface drainage, ferruginous, brackish seeps have been generated in Bellbird Creek                                                                                                                                                                                                              |
| Ferruginous seeps may develop in the local creeks                                                                                                                                                       | No ferruginous seeps have developed in Bellbird Creek                                                                                                                                                                                                                                                 |
| Increased basement groundwater seepage inflow into the workings should not occur                                                                                                                        | No increased rate of groundwater seepage into the workings has occurred                                                                                                                                                                                                                               |
| Strata gas discharge into piezometers may occur                                                                                                                                                         | No strata gas discharge has occurred                                                                                                                                                                                                                                                                  |
| Stream flow in Bellbird Creek may be adversely affected by subsidence from Longwall 11                                                                                                                  | Stream flow in Bellbird Creek has not been adversely affected by subsidence related effects                                                                                                                                                                                                           |
| Stream water quality in Bellbird Creek may be adversely affected by subsidence from Longwall 11                                                                                                         | <b>Stream water quality in Bellbird Creek has temporarily exceeded the salinity and pH triggers, but has not been affected in the long term, with both pH and EC returning to its baseline, pre mining range. This data represents a sampling anomaly which is related to instrument calibration.</b> |
| Stream bed and bank stability in Bellbird Creek may be adversely affected by subsidence from Longwall 11                                                                                                | Stream bed and bank stability in Bellbird Creek has not been adversely affected by subsidence related effects                                                                                                                                                                                         |

## Summary of Results

During extraction of Longwalls 11 and 12, the TARP triggers exceeded were:

- ☐ >5m drawdown over a minimum 2 month period in EGW3
- ☐ Bellbird Creek EC above 200µS/cm (not suspected to be subsidence induced)and
- ☐ Bellbird Creek pH below 4.2 and above 6.77(not suspected to be subsidence induced).

The >5m drawdown over a minimum 2 month period TARP Trigger was exceeded in EGW3 (which is over Longwall 11). Although a fall of 7.05m has been recorded in the Upper Bulgo Sandstone in PWW1 (165mbgl), it has not exceed the TARP trigger, as it occurred over a period of greater than 2 months. No ameliorative actions are currently recommended and monitoring will continue to assess the status of the impact. The groundwater level is predicted to recover over the next few months.

The pH and EC TARP trigger levels were exceeded, however no ameliorative actions are required due to extraction of Longwalls 11 or 12 as the changes were not sustained. These results were not suspected to be subsidence induced and are linked to a sampling anomaly which was induced by an instrument calibration error. The rapid return of the data to pre-mining ranges supports this finding.

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 11 were again inspected by Biosis Research in Autumn 2011. The results of the Biosis Research End of Panel assessment for aquatic ecological values are provided in Error! Reference source not found..

### 6.3.1 Predicted Impacts on Aquatic Ecology

Aquatic habitats in the vicinity of Longwall 11 included Flying Fox No. 1 Creek, Bellbird Creek and an unnamed tributary of Wongawilli Creek (to the north). There are also several small ephemeral drainage lines that are associated with Upland Swamps that are located above and adjacent to Longwall 11.

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

Refer to Error! Reference source not found. 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 11. The results of the Biosis End of Panel assessment for terrestrial ecological values are provided in Error! Reference source not found..

### **6.4.1 Predicted Impacts on Terrestrial Ecology**

Predicted impacts are summarised in Error! Reference source not found..

### **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 11 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 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

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### 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 the following impacts as a result of the extraction of Longwall 11.

- ☐ Minor cracking and rock falls in a rock cutting of the Maldon-Dombarton rail corridor.
- ☐ Hawkesbury Sandstone groundwater level fell by 8.92m in open piezometer EGW3 over Longwall 11.

During extraction of Longwalls 11, the TARP triggers exceeded were:

- ☐ Subsidence monitoring, Rock Outcrops and Public Safety Management trigger relating to minor cracking.
- ☐ >5m groundwater drawdown over a minimum 2 month period in EGW3.
- ☐ Water Quality- Bellbird Creek EC above 200 $\mu$ S/cm, (not known to be subsidence induced) and Bellbird Creek pH below 4.2 and above 6.77 (not known to be subsidence induced as it is linked to a sampling anomaly which was induced by an instrument calibration error).

**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**.

In relation to the minor cracking and rock falls in a rock cuttings of the Maldon-Dombarton rail corridor, warning sign erection is not deemed to be required due to the minor nature of the two observed rock falls. No public safety risk is inferred. No further mining is to be undertaken in the area and there is no public access.

The >5m groundwater level drawdown over a minimum 2 month period TARP Trigger was exceeded in EGW3 (which is over Longwall 11). No ameliorative actions are currently recommended as this was a predicted impact. Monitoring will continue to assess the status of the impact. The groundwater level is predicted to recover over the next few months.

The surface water pH and EC TARP trigger levels were exceeded, however no ameliorative actions are required due to extraction of Longwalls 11 or 12 as the changes were not sustained.



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 11.

**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 11                                                                |
| <b>Subsidence lines E&amp;EE and EF (Pre and post mining)</b>                                                     | 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:<br>- Total subsidence;<br>- Incremental subsidence;<br>- Variation in horizontal strain.<br><br>• Survey measurement comparison with predictions<br>• Reported in Survey Reports | <input type="checkbox"/> As per MSEC predicted subsidence contours.                                                                                                                                                                                                                            | <input type="checkbox"/> Minor cracking and rock falls observed in rock cutting<br><input type="checkbox"/> Subsidence data has slightly exceeded predictions. | <input type="checkbox"/> Major surface cracking (>10mm)                                                                                                                                  | <input type="checkbox"/> Notify Principal Subsidence Engineer - DRE NSW;<br><input type="checkbox"/> Undertake subsidence survey and review against predictions;<br><input type="checkbox"/> Review mining options                                                                                                                                                                                          | <input type="checkbox"/> SCA Notified.<br><input type="checkbox"/> DRE notified via this report. |
| <b>330kv Transmission Line (Tower 37-6) (Visual inspections during mining and survey measurement post mining)</b> | Observation of tower condition and survey measurement for later comparison (not required – tower well beyond limit of subsidence of LW 11 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<br><input type="checkbox"/> TransGrid to undertake remediation as necessary                                                                                                                                                                                                                                                | <input type="checkbox"/> None required                                                           |
| <b>Fire Roads and 4WD Tracks (Fortnightly visual inspection)</b>                                                  | 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 impedence                                                                                                                     | <input type="checkbox"/> Notification to SCA immediately, then to DRE NSW and MSB<br><input type="checkbox"/> Make area safe as soon as practicable including warning signs<br><input type="checkbox"/> Proposal for rectification within 1 week upon approval from SCA<br><input type="checkbox"/> Completion of works following approval from SCA<br><input type="checkbox"/> Additional daily monitoring | <input type="checkbox"/> None required                                                           |
| <b>Indigenous Heritage Sites (Inspect once prior to, during and post mining)</b>                                  | Record significant heritage items once prior to mining (completed)<br>Site nominated in CHMP are:<br>- Native Dog Creek Shelter<br>- Upper Avon 27<br>- Upper Avon 2<br>- Upper Avon 3<br>- Upper Avon 4 | Once for observed impacts such as:<br>Cracking, opening of bedding planes, blockfalls, exfoliation, water seepage changes. | <input type="checkbox"/> 3-6 months post mining<br><input type="checkbox"/> 2 years post mining                                                                                                                                 | <input type="checkbox"/> Native Dog Creek Shelter - Very Low risk<br><input type="checkbox"/> Upper Avon 27-- Very Low risk<br><input type="checkbox"/> Upper Avon 2- Very Low risk<br><input type="checkbox"/> Upper Avon 3- Low risk<br><input type="checkbox"/> Upper Avon 4- Very Low risk | <input type="checkbox"/> None 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)<br><input type="checkbox"/> Report impacts as required<br><input type="checkbox"/> Notify OEH, DRE NSW, SCA<br><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 11                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Cliffs, Steep Slopes and Rock Outcrops (Monthly)</b><br><br>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 )<br><br>Note: There are no cliffs over LW11 but several steep slopes. |                                                                                                                                                                                                               | 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<br><br><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"/> Minor cracking and rock falls observed in rock cutting                                                                                                                            | <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<br><input type="checkbox"/> Warning sign/s erection<br><input type="checkbox"/> Reported in AEMR                                                                                                                                                                                                                                 | <input type="checkbox"/> Notification to SCA and DRE NSW using photographic record<br><input type="checkbox"/> Warning sign/s erection not deemed to be required due to the minor nature of two observed rock falls and vertical nature of rock face. No public safety risk is inferred. No further mining to be undertaken in the area and there is no public access<br><input type="checkbox"/> Will be reported in AEMR |
|                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                               |                                                                                                                                                                                                                            |                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                            | <input type="checkbox"/> Major cracking (>10mm) or traffic impedence                                                                                                                                                                                    | <input type="checkbox"/> Notification to SCA immediately then DRE NSW<br><input type="checkbox"/> Make area safe immediately including erection of warning sign/s and barrier fencing<br><input type="checkbox"/> Reported in AEMR<br><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<br><input type="checkbox"/> Make area safe immediately including warning sign/s erection and barrier fencing<br><input type="checkbox"/> Proposal for rectification within 1 week<br><input type="checkbox"/> Completion of works following approval from SCA<br><input type="checkbox"/> Additional monitoring<br><input type="checkbox"/> Reported in AEMR | <input type="checkbox"/> None required                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Stream Water Quality and Flow</b>                                                                                                                                                                                                                                               | <input type="checkbox"/> Field Analysis (EC, pH, temp)<br><input type="checkbox"/> <u>Laboratory Analysis</u><br>TDS, Na, K, Ca, Mg, F, Cl, SO4, HCO3, NO3, Total N, Total P, Cu, Pb, Zn, Ni, Fe, Mn, As, Se, | <input type="checkbox"/> Weekly Field Analysis during active undermining of stream<br><input type="checkbox"/> Bi-monthly Lab analysis during active undermining of stream<br><input type="checkbox"/> Weekly observations | <input type="checkbox"/> Bi-monthly Field Analysis for one year after subsidence ceases<br><input type="checkbox"/> Lab analysis Every four months for one year until subsidence ceases<br><input type="checkbox"/> Bi-monthly observations | <input type="checkbox"/> Possible tensile cracking in the bed of Native Dog Creek and Wongawilli Creek<br><input type="checkbox"/> Possible buckling and fracturing of the bedrock along Native Dog Creek, Bellbird Creek,                                                                                                                                                                                                                                          | <input type="checkbox"/> EC above 200µS/cm,<br><input type="checkbox"/> pH below 4.2 and above 6.77. These changes were not sustained and the creek water quality returned to its baseline range after the | <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<br><input type="checkbox"/> Based on the baseline | <input type="checkbox"/> Repeat water quality sampling and initiate laboratory water quality sampling on a monthly basis<br><input type="checkbox"/> Contract hydrologist investigate and report on changes identified                                                                                                                                                                                                             | <input type="checkbox"/> Repeat water quality sampling and initiate laboratory water quality sampling on a monthly basis<br><input type="checkbox"/> The pH and EC TARP trigger levels were                                                                                                                                                                                                                                |

| 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 11                                                                                                                                                                                                                                                                                                |
|                                 | <p>Cd, Cr, Li, Ba, Cs, Rb, Sr (filtered)</p> <p><input type="checkbox"/> Observable iron or salinity staining using Photo Points</p> <p><input type="checkbox"/> Monthly for at least two months prior to mining (for all parameters above)</p> | <p>during active undermining of stream using Photo points</p>              | <p>for one year after subsidence ceases using Photo points</p>                  | <p>Wongawilli Creek and the Tributaries to Wongawilli Creek, above and adjacent to the proposed longwalls</p> <p><input type="checkbox"/> Gas emission could occur but significant emissions considered unlikely</p> <p><input type="checkbox"/> Iron staining not predicted to occur</p> <p><input type="checkbox"/> Water Quality: Lowering of pH in stream water due to iron staining (precipitate)</p> | <p>exceedance</p> <p><input type="checkbox"/> Note: and have been linked within a sampling anomaly which was induced by an instrument calibration error (Andrew Dawkins pers. Comm.). Further the rapid return of the data to pre-mining tolerance ranges supports this finding</p> | <p>monitoring conducted since July 2005 the following triggers will be used:</p> <p><input type="checkbox"/> EC &gt; 200uS/cm</p> <p><input type="checkbox"/> 4.2 &gt; pH &gt; 6.77</p> <p><input type="checkbox"/> Fe (Tot) &gt; 6mg/L</p> <p><input type="checkbox"/> Mn (tot) &gt; 0.1mg/L</p> <p><input type="checkbox"/> Al (tot) &gt; 0.7mg/L</p> <p><input type="checkbox"/> Zn (filt) &gt; 0.04mg/L</p> <p><input type="checkbox"/> SO4 (filt) &gt; 8mg/L</p> <p><input type="checkbox"/> Dissolved oxygen / ORP / temperature</p> | <p><input type="checkbox"/> Inform SCA, OEH &amp; DRE NSW of results of investigation</p> <p><input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with key agencies and in accordance with Section 54 of the Water Management Act</p> <p><input type="checkbox"/> Report in the End of Panel Report</p>                                                                                                                                                                                                                                   | <p>exceeded, however no ameliorative actions are required due to extraction of Longwalls 11 or 12 as the changes were not sustained and the data is linked to an instrument calibration error</p> <p><input type="checkbox"/> Report to agencies via EOP report</p> <p><input type="checkbox"/> Mitigation plan not required</p> |
| Loss of Flow                    | <p><input type="checkbox"/> Monthly for at least two months prior to mining</p>                                                                                                                                                                 | <p><input type="checkbox"/> Weekly during active undermining of stream</p> | <p><input type="checkbox"/> Bi-monthly for one year after subsidence ceases</p> | <p><input type="checkbox"/> Possible diversion of surface water into dilated strata and the draining of pools</p>                                                                                                                                                                                                                                                                                          | <p><input type="checkbox"/> No observed water quality impacts</p>                                                                                                                                                                                                                   | <p><input type="checkbox"/> Observation of loss of flow connectivity within a flowing ephemeral stream (related to rainfall), compared to the flow regimes evident prior to the extraction of LW's 11-19</p>                                                                                                                                                                                                                                                                                                                               | <p><input type="checkbox"/> Repeat water quality sampling and initiate laboratory water quality sampling on a monthly basis</p> <p><input type="checkbox"/> Contract hydrologist investigate and report on changes identified</p> <p><input type="checkbox"/> Inform SCA, OEH &amp; DRE NSW of results of investigation</p> <p><input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with key agencies and in accordance with Section 54 of the Water Management Act</p> <p><input type="checkbox"/> Report in the End of Panel Report</p> | <p><input type="checkbox"/> None required</p>                                                                                                                                                                                                                                                                                    |
| Areas of increased flooding     | <p><input type="checkbox"/> Monthly for at least two months prior to mining</p>                                                                                                                                                                 | <p><input type="checkbox"/> Weekly during active undermining of stream</p> | <p><input type="checkbox"/> Bi-monthly for one year after subsidence ceases</p> | <p><input type="checkbox"/> Ponding, flooding and scouring considered unlikely to occur</p>                                                                                                                                                                                                                                                                                                                | <p><input type="checkbox"/> No observed increased flooding</p>                                                                                                                                                                                                                      | <p><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</p>                                                                                                                                                                                                                                                                                                       | <p><input type="checkbox"/> Survey area to identify whether earthworks are required</p> <p><input type="checkbox"/> Contract hydrologist investigate and report on changes identified</p> <p><input type="checkbox"/> Inform SCA / OEH of results of investigation</p> <p><input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with key agencies and in accordance with Section 54 of the Water Management Act if required</p> <p><input type="checkbox"/> Report in the End of Panel Report</p>                                          | <p><input type="checkbox"/> None required</p>                                                                                                                                                                                                                                                                                    |
| Erosion of stream bed and banks | <p><input type="checkbox"/> Monthly for at least two</p>                                                                                                                                                                                        | <p><input type="checkbox"/> Weekly during active</p>                       | <p><input type="checkbox"/> Bi-monthly for one year</p>                         | <p><input type="checkbox"/> Scouring considered</p>                                                                                                                                                                                                                                                                                                                                                        | <p><input type="checkbox"/> No observed erosion of</p>                                                                                                                                                                                                                              | <p><input type="checkbox"/> Observation of erosion of</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><input type="checkbox"/> Contract hydrologist</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p><input type="checkbox"/> None required</p>                                                                                                                                                                                                                                                                                    |

| Feature                                                                                                       | ESSMP Monitoring Commitments                                                                                                                                                                                                                                                                       |                                                                                                                                             |                                                                                                                               | Impact Assessment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                         | TARPS                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                |
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|                                                                                                               | Prior to Mining                                                                                                                                                                                                                                                                                    | During Mining                                                                                                                               | Post Mining and Future Monitoring                                                                                             | Predicted Impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Observed Impacts                                                                                                        | Trigger                                                                                                                                                                                                          | Response                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Action as a Result of Longwall 11                                                                                                              |
|                                                                                                               | months prior to mining                                                                                                                                                                                                                                                                             | undermining of stream                                                                                                                       | after subsidence ceases                                                                                                       | unlikely to occur                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | stream bed and banks                                                                                                    | stream bed and banks in excess of baseline conditions identified from comparison of pre-mining and post-mining photographs                                                                                       | investigate and report on changes identified<br><input type="checkbox"/> Inform SCA, OEH & DRE NSW of results of investigation<br><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<br><input type="checkbox"/> Report in the End of Panel Report                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                |
| <b>Groundwater – Hawkesbury Sandstone (water quality and water levels)</b> in four bores EGW2, EGW3,EGW5 ,WW1 | <input type="checkbox"/> Field water quality (EC, pH, temp)– bi monthly<br><input type="checkbox"/> Laboratory analysis – every four months<br>Lab Parameters- -TDS, Na, K, Ca, Mg, F, Cl, SO4, HCO3, NO3, Total N, Total P, Cu, Pb, Zn, Ni, Fe, Mn, As, Se, Cd, Cr, Li, Ba, Cs, Rb, Sr (filtered) | <input type="checkbox"/> Field water quality – monthly during extraction<br><input type="checkbox"/> Laboratory analysis – every two months | <input type="checkbox"/> Field water quality – bi monthly<br><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<br><input type="checkbox"/> Potential increased rate of recharge into the plateau<br><input type="checkbox"/> Piezometers may experience increased iron / manganese hydroxide precipitation and / or lowering of pH<br><input type="checkbox"/> Interface drainage, ferruginous, brackish seeps may be generated in streams<br><input type="checkbox"/> Shallow groundwater level within Swamp 20 will be dependent on rainfall recharge and will not be affected by mining<br><input type="checkbox"/> Strata gas discharge into piezometers may occur<br><input type="checkbox"/> Stream flow in Bellbird Creek may be adversely affected by subsidence from Longwall 11<br><input type="checkbox"/> Stream water quality in Bellbird Creek may be adversely affected by subsidence from Longwall 11 | <input type="checkbox"/> Hawkesbury Sandstone groundwater level fell by 8.92m in open piezometer EGW3 over Longwall 11. | <input type="checkbox"/> <b>Ground Water Quality</b><br><input type="checkbox"/> 2 std deviation change, or distinctive diversion over at least 4 months from baseline levels for pH, EC, Fe, Mn, Al, Zn and SO4 | <input type="checkbox"/> Investigation initiated within one week of trigger<br><input type="checkbox"/> Repeat water quality sampling of impacted and adjacent bores if triggers exceeded, as required<br><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<br><input type="checkbox"/> Inform SCA, OEH & DRE NSW of investigation outcomes<br><input type="checkbox"/> Investigation of possible mitigation measures in consultation with SCA / OEH<br><input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with SCA / OEH if appropriate<br><input type="checkbox"/> Report in SMP / End of Panel reports to inform relevant agencies of results of monitoring | <input type="checkbox"/> None required                                                                                                         |
| <b>Ground Water Levels</b> (using pressure transducer and bores)                                              | <input type="checkbox"/> Bi- monthly                                                                                                                                                                                                                                                               | <input type="checkbox"/> Monthly                                                                                                            | <input type="checkbox"/> Bi -monthly                                                                                          | <input type="checkbox"/> Temporary lowering of piezometric surface by up to 10m which may stay at that level until maximum                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <input type="checkbox"/> Hawkesbury Sandstone groundwater level fell by 8.92m in open piezometer EGW3 over Longwall 11  | <input type="checkbox"/> Continuous >5m ground water level reduction over a minimum 2 month period                                                                                                               | <input type="checkbox"/> Instigate investigation within 1 week of trigger<br><input type="checkbox"/> Engage hydrogeologist to investigate and report on the                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <input type="checkbox"/> Agencies notified by NRE via this report<br><input type="checkbox"/> Monitoring will evaluate recovery of groundwater |

| 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 11                                                                                                           |
|                                                                                |                                                                                                                                                                      |                                                                                                                                                                      |                                                                                                                                                                   | subsidence develops<br><input type="checkbox"/> Groundwater levels should recover over a few months<br><input type="checkbox"/> No permanent post mining reduction in water levels in bores on the plateau unless a new outflow path develops<br><input type="checkbox"/> Strata dilation and subsequent re-filling of secondary voids may temporarily lower standing water levels | <input type="checkbox"/> A fall of 7.05m has been recorded in the Upper Bulgo Sandstone in PWW1 (165mbgl), it has not exceed the TARP trigger, as it occurred over a period of greater than 2 months. |                                                                                                                                                                                                                                                                               | cause of trigger exceedances where the cause may not be directly related to lack of rainfall recharge<br><input type="checkbox"/> Inform SCA, OEH & DRE of investigation outcomes<br><input type="checkbox"/> Investigation of possible mitigation measures in consultation with SCA / OEH<br><input type="checkbox"/> Prepare and implement a site mitigation/action plan in consultation with SCA / OEH if necessary<br><input type="checkbox"/> Report in End of Panel reports to inform relevant agencies of ongoing results of monitoring | levels and any impacts on groundwater quality<br><input type="checkbox"/> The next EOP report will update the data and report appropriately |
| <b>Inflow into mine workings (during all active mining) (daily monitoring)</b> | <input type="checkbox"/> Daily monitoring of mine discharge (completed)<br><input type="checkbox"/> Water quality sample of any measured inflow event (not required) | <input type="checkbox"/> Daily monitoring of mine discharge (completed)<br><input type="checkbox"/> Water quality sample of any measured inflow event (not required) | <input type="checkbox"/> Daily monitoring of mine discharge (ongoing)<br><input type="checkbox"/> Water quality sample of any measured inflow event (as required) | <input type="checkbox"/> Increased groundwater seepage inflow into the workings should not occur                                                                                                                                                                                                                                                                                   | <input type="checkbox"/> No increase in mine water discharge recorded                                                                                                                                 | <input type="checkbox"/> Increase in water discharge of > 1ML/day for 7 successive days from active longwall or pillar extraction areas, which are suspected to be as a result of mine subsidence<br><input type="checkbox"/> Note: the typical discharge from U/G is 6ML/day | <input type="checkbox"/> Engage contract hydrogeologist to investigate and report on changes identified<br><input type="checkbox"/> Inform relevant agencies of results of investigation<br><input type="checkbox"/> Report in Subsidence Management Status Report<br><input type="checkbox"/> Report in End of Panel Report<br><input type="checkbox"/> Investigation initiated within one week of trigger<br><input type="checkbox"/> Monthly updates of investigation process                                                               | <input type="checkbox"/> None required                                                                                                      |
| Potential Mine inflow events                                                   | <input type="checkbox"/> Daily monitoring of mine discharge (completed)<br><input type="checkbox"/> Water quality sample of any measured inflow event (not required) | <input type="checkbox"/> Daily monitoring of mine discharge (completed)<br><input type="checkbox"/> Water quality sample of any measured inflow event (not required) | <input type="checkbox"/> Daily monitoring of mine discharge (ongoing)<br><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<br><input type="checkbox"/> Inform SCA, OEH & DRE of investigation outcomes<br><input type="checkbox"/> Report in Subsidence Management Status Report<br><input type="checkbox"/> Report in End of Panel Report<br><input type="checkbox"/> Investigation initiated within one week of trigger<br><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)<br><input type="checkbox"/> Water quality sample of any measured inflow event (not required) | <input type="checkbox"/> Daily monitoring of mine discharge (completed)<br><input type="checkbox"/> Water quality sample of any measured inflow event (not required) | <input type="checkbox"/> Daily monitoring of mine discharge (ongoing)<br><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<br><input type="checkbox"/> NB: this trigger must be derived from a                                                                                                                     | <input type="checkbox"/> Inform SCA, OEH & DRE of this change<br><input type="checkbox"/> Commence preparation of mitigation/action plan within the timeframe agreed with                                                                                                                                                                                                                                                                                                                                                                      | <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 11      |
|                                                         |                                                                                                                                                                                                                                        |                                                                                                                                        |                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                 | hydrogeologist's investigation report                                                                                                                                                                                                    | relevant government agencies<br><input type="checkbox"/> Inform SCA, OEH & DRE within 24hrs<br><input type="checkbox"/> Commence preparation of mitigation/action plan within timeframe agreed with relevant agencies<br><input type="checkbox"/> Monthly updates of investigation progress<br><input type="checkbox"/> Report in Subsidence Management Status Report<br><input type="checkbox"/> Report in the End of Panel Report |                                        |
| <b>Aquatic Ecology</b>                                  | <input type="checkbox"/> Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime<br><br><input type="checkbox"/> Targeted surveys for threatened aquatic biota in major drainage lines | <input type="checkbox"/> Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime       | <input type="checkbox"/> Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime (ongoing)<br><br><input type="checkbox"/> AUSRIVAS sampling of reference and impact sites in the broader SMP Area | <input type="checkbox"/> Habitat for three Endangered aquatic species, Macquarie Perch, Adam's Emerald Dragonfly and Sydney Hawk Dragonfly was identified in the broad vicinity of the Study Area.<br><br><input type="checkbox"/> Macquarie Perch extremely unlikely to be present in vicinity of LW11 (Bellbird Creek)<br><br><input type="checkbox"/> Assessments of Significance concluded that the proposal was unlikely to have a significant impact on any threatened aquatic fauna with potential habitat in the Study Area. | <input type="checkbox"/> No impact to aquatic 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 |
| <b>Terrestrial Ecology</b><br>(twice a year)<br>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.<br><br><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 effects reported to date            | <input type="checkbox"/> Major impacts to threatened species to include:<br><input type="checkbox"/> Their habitat; and/or a decline in numbers from baseline observed; and/or<br><input type="checkbox"/> Change in species composition | <input type="checkbox"/> Notification to SCA/NPWS immediately<br><input type="checkbox"/> Proposal for threatened species management within 1 week<br><input type="checkbox"/> Completion of management task following approval from SCA/NPWS<br><input type="checkbox"/> Additional monitoring as required by the relevant government agencies                                                                                     | <input type="checkbox"/> None required |
| Amphibians                                              | <input type="checkbox"/> Once prior to mining                                                                                                                                                                                          | <input type="checkbox"/> Twice annually during                                                                                         | <input type="checkbox"/> Annually for one year                                                                                                                                                                                                     | <input type="checkbox"/> Threatened amphibian                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <input type="checkbox"/> None observed or                       |                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                        |

| 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 11                                                                                                                                                                                                                                                                                                                 |
|                                                                      | (completed)                                                                                                                                                           | entire extraction period (ongoing)                       | (ongoing)                                                      | species (Littlejohn's Tree Frog, Red-crowned Toadlet and Giant Burrowing Frog) – potential alteration to breeding, sheltering and foraging habitat.                                   | reported.                                                                       |                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                   |
| Swamp and riparian vegetation                                        | Once prior to mining (completed)                                                                                                                                      | Twice annually during entire extraction period (ongoing) | Annually for one year (ongoing)                                | <input type="checkbox"/> Unlikely subsidence impacts would have a significant impact on any plant community within the Study Area.                                                    | <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"/> Tension cracks or soil slumping on steep slopes possible, but unlikely to result in significant impact. Large scale slope failures were considered unlikely. | <input type="checkbox"/> None observed or reported.                             |                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                   |
| General Upland Swamp observations (every second month during mining) | Twice per year (completed)                                                                                                                                            | Every second month                                       | Twice per year for one year post mining (ongoing)              | <input type="checkbox"/> Potential 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 (Swamp 20) to date   | <input type="checkbox"/> Minor cracking (<10mm)                                                                                                                                      | <input type="checkbox"/> Report to SCA<br><input type="checkbox"/> Additional studies as required<br><input type="checkbox"/> Photographic record<br><input type="checkbox"/> Review of swamp piezometer data                                                                                                                                                                                   | <input type="checkbox"/> None required                                                                                                                                                                                                                                                                                                            |
|                                                                      |                                                                                                                                                                       |                                                          |                                                                |                                                                                                                                                                                       |                                                                                 | <input type="checkbox"/> Major cracking (>10mm)<br><input type="checkbox"/> Water loss<br><input type="checkbox"/> Flora/Fauna changes<br><input type="checkbox"/> Increased erosion | <input type="checkbox"/> Notification to SCA<br><input type="checkbox"/> Remediation options developed in consultation with SCA, which may include further mining limitations<br><input type="checkbox"/> Proposal for rectification within one month<br><input type="checkbox"/> Completion of works following approval from SCA<br><input type="checkbox"/> Additional monitoring as required | <input type="checkbox"/> None required                                                                                                                                                                                                                                                                                                            |
| <b>Public Safety (fortnightly during extraction)</b>                 | <input type="checkbox"/> Observation of Cliffs and steep slopes; Fire roads; 4WD tracks; Rocky outcrops and cuttings<br><input type="checkbox"/> Once prior to mining | <input type="checkbox"/> Fortnightly during extraction   | <input type="checkbox"/> Monthly following mining for 6 months | <input type="checkbox"/> Potential for some minor surface cracking and compressive rippling of the unsealed road surfaces                                                             | <input type="checkbox"/> Minor cracking and rock falls observed in rock cutting | <input type="checkbox"/> Minor cracking (<10mm)                                                                                                                                      | <input type="checkbox"/> Notification to SCA within 24 hrs, using photographic record                                                                                                                                                                                                                                                                                                           | <input type="checkbox"/> Notification to SCA has been actioned<br><input type="checkbox"/> Warning sign/s erection not deemed to be required due to the minor nature of two observed rock falls and vertical nature of rock face. No public safety risk is inferred. No further mining to be undertaken in the area and there is no public access |

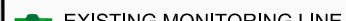
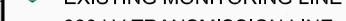

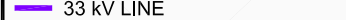



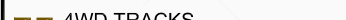
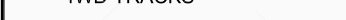
| Feature | ESSMP Monitoring Commitments |               |                                   | Impact Assessment |                  | TARPS                                                                                        |                                                                                                                                                                                                                                                                                                                               |                                        |
|---------|------------------------------|---------------|-----------------------------------|-------------------|------------------|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
|         | Prior to Mining              | During Mining | Post Mining and Future Monitoring | Predicted Impacts | Observed Impacts | Trigger                                                                                      | Response                                                                                                                                                                                                                                                                                                                      | Action as a Result of Longwall 11      |
|         |                              |               |                                   |                   |                  | <input type="checkbox"/> Major Cracking (>10mm), noticeable instability or traffic impedance | <input type="checkbox"/> Notification to SCA immediately<br><input type="checkbox"/> Make area safe as soon as practicable<br><input type="checkbox"/> Proposal for rectification within 1 week<br><input type="checkbox"/> Completion of works following approval from SCA<br><input type="checkbox"/> Additional monitoring | <input type="checkbox"/> None required |

# FIGURES






# NRE WONGAWILLI COLLIERY LONGWALL11 - END OF PANEL MONITORING & SURFACE INFRASTRUCTURE

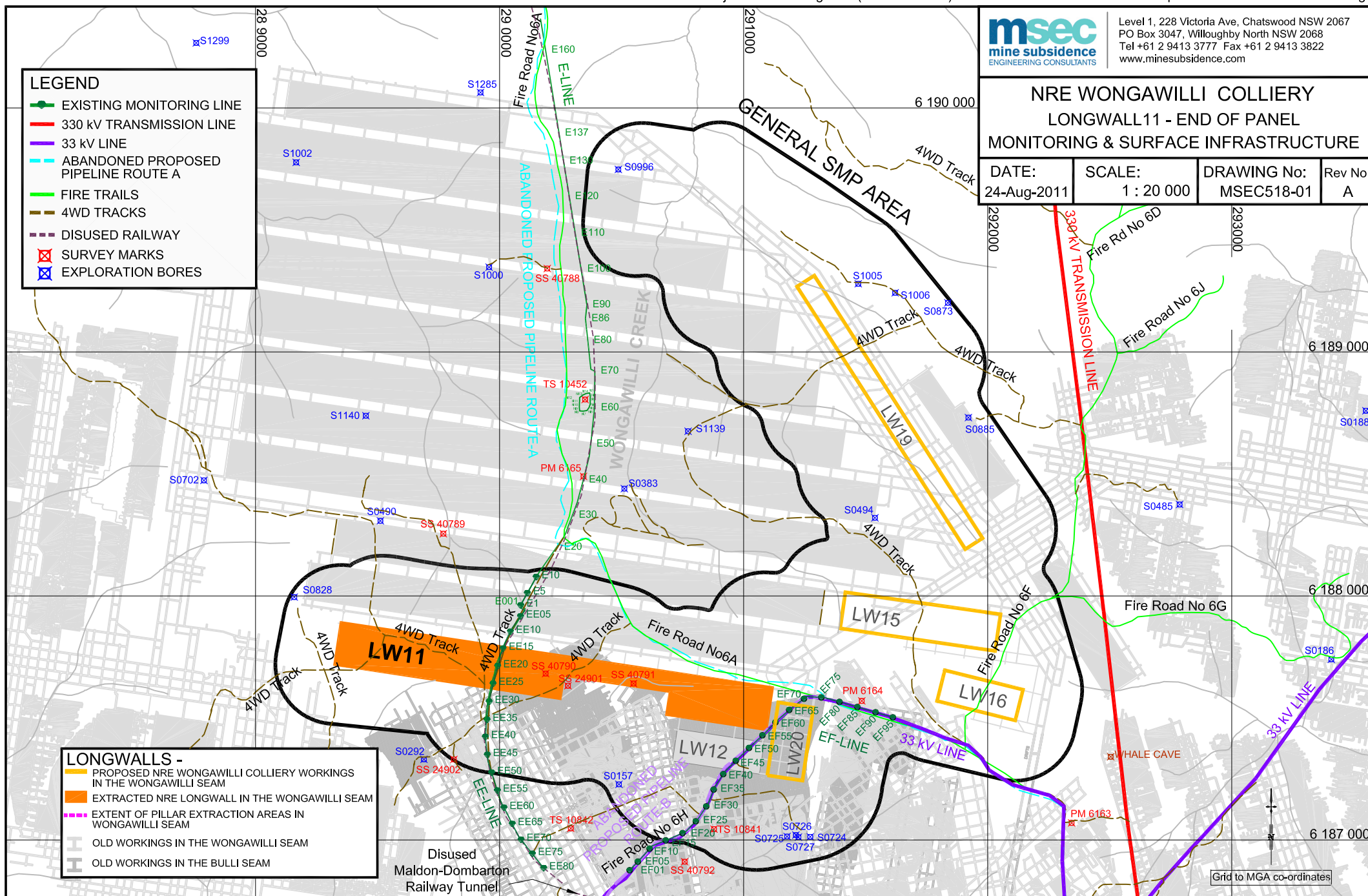
| DATE:       | SCALE:     | DRAWING No: | Rev No |
|-------------|------------|-------------|--------|
| 24-Aug-2011 | 1 : 20 000 | MSEC518-01  | A      |

## LEGEND

-  EXISTING MONITORING LINE
-  330 kV TRANSMISSION LINE
-  33 kV LINE
-  ABANDONED PROPOSED PIPELINE ROUTE A
-  FIRE TRAILS
-  4WD TRACKS
-  DISUSED RAILWAY
-  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



# ATTACHMENTS



## ATTACHMENT A

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Subsidence Report: End of Panel Monitoring Report for  
Longwall 11 at Wongawilli Colliery. Mine Subsidence  
Engineering Consultants (MSEC) Report # MSEC518 - Revision  
A. August 2011



GUJARAT NRE FCGL PTY LTD

**NRE Wongawilli Colliery**

End of Panel Monitoring Report For Longwall 11

## DOCUMENT REGISTER

| Revision | Description                                                   | Author | Checker | Date                    |
|----------|---------------------------------------------------------------|--------|---------|-------------------------|
| 01       | End of Panel Report for Wongawilli Longwall 11 - Draft        | PA     | PD      | 19 <sup>th</sup> Aug 11 |
| A        | End of Panel Report for Wongawilli Longwall 11 – Final Report | PA     | PD      | 24 <sup>th</sup> Aug 11 |
|          |                                                               |        |         |                         |
|          |                                                               |        |         |                         |

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).

## CONTENTS

|                                                                          |          |
|--------------------------------------------------------------------------|----------|
| <b>1. BACKGROUND</b>                                                     | <b>4</b> |
| 1.1. Introduction                                                        | 4        |
| <b>2. COMPARISON BETWEEN PREDICTED AND OBSERVED SUBSIDENCE MOVEMENTS</b> | <b>5</b> |
| 2.1. Monitoring Lines                                                    | 5        |
| <b>3. IMPACTS ON SURFACE INFRASTRUCTURE</b>                              | <b>6</b> |
| <b>APPENDIX A. FIGURES AND DRAWINGS</b>                                  | <b>7</b> |

## LIST OF TABLES, FIGURES AND DRAWINGS

### Tables

| <i>Table</i> | <i>Description</i>                                                   | <i>Page</i> |
|--------------|----------------------------------------------------------------------|-------------|
| Table 3.1    | Summary of Predicted and Observed Impacts Resulting from Longwall 11 | 6           |

### Figures

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

| <i>Figure</i> | <i>Description</i>                                                                                                |
|---------------|-------------------------------------------------------------------------------------------------------------------|
| Fig. A.01     | Elouera Colliery E & EE Line Subsidence Monitoring Results Longwalls 1 to 11                                      |
| Fig. A.02     | Observed and Predicted Profiles of Subsidence, Tilt and Strain along the E&EE Line resulting from LW11 Extraction |
| Fig. A.03     | Observed and Predicted Profiles of Subsidence, Tilt and Strain along the EF Line resulting from LW11 Extraction   |

### Drawings

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

| <i>Drawing No.</i> | <i>Description</i>                                                            |
|--------------------|-------------------------------------------------------------------------------|
| MSEC518-01         | Wongawilli Colliery, LW11 End of Panel, Monitoring and Surface Infrastructure |

## 1. BACKGROUND

### 1.1. Introduction

Gujarat NRE FCGL Pty Ltd (NRE) has completed the extraction of Longwall 11 at NRE Wongawilli Colliery in the Southern Coalfield of New South Wales. NRE Wongawilli Colliery was previously operated as Elouera Colliery and Delta Colliery. The location of Longwall 11 is shown in Drawing No. MSEC518-01 in Appendix A.

The extraction of Longwall 11 commenced on the 29th of January 2010 and was completed on the 13th of May 2011.

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 11 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 11. 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 11 were measured along two monitoring lines, E&EE Line and EF Line, both of which are 2D monitoring lines. The locations of the longwalls at the Colliery and the monitoring lines are shown in Drawing No. MSEC518-01 in Appendix A.

The survey results for the E&EE lines and EF lines provide measured surface movements due to the extraction of Longwalls 12 and 11, with Longwall 12 having been extracted prior to the commencement of Longwall 11. The survey monitoring lines were established 20<sup>th</sup> July 2009, prior to the extraction of Longwall 12. The previously extracted Elouera Colliery Longwall 10, which is located immediately to the north of Longwall 11, was completed in June 2005. The survey monitoring results therefore include the influence of the previously extracted Elouera Colliery longwalls on Longwalls 11 and 12 but do not include the surface movements that occurred when the Elouera Colliery Longwalls were extracted.

Previous extraction was carried out above parts of Longwall 11 and Longwall 12 in the Bulli seam. Old pillar extraction workings within the Wongawilli Seam were also extracted beneath the Bulli Seam directly adjacent to the southern edge of Longwall 11 and Longwall 12. The areas of extraction in the Bulli seam and the Wongawilli Seam are shown in Drawing No. MSEC518-01 in Appendix A.

The predicted subsidence profiles along the monitoring lines 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. The effects of multi-seam mining conditions were also taken into account in the prediction model as previous extraction was carried out above Longwall 11 in the Bulli seam. Comparisons between predicted and observed subsidence movements along the monitoring lines are provided in the following sections.

#### E&EE Monitoring Line

The E&EE Monitoring Line was installed to monitor the subsidence movements due to the extraction of LWs 1 to 10 at Elouera Colliery. A maximum total subsidence of 1370 mm was monitored along this line, which occurred above LW6 as shown in the attached Fig. A.01. The incremental and total observed subsidence due to the extraction of Longwall 11 has been added to this survey data and presented in Fig. A.01.

The E&EE monitoring line is located along the Maldon Dombarton rail corridor and extends through the footprint of Longwall 11. The survey line was last monitored on 28<sup>th</sup> April 2011 at the completion of Longwall 11. Survey results of the total subsidence of E&EE pegs due to the extraction of LW11 and LW12 are presented in Fig. A.02.

The maximum observed total subsidence due to the extraction of LW11 and LW12 is 670 mm, which is greater than the maximum predicted total subsidence of 500 mm. The maximum observed total tilt due to the extraction of LW11 and LW12 is 8.9mm/m, which is greater than the maximum predicted total tilt of 5.4 mm/m. The maximum observed total strain due to the extraction of LW11 and LW12 is a compressive strain of 1.2mm/m which occurs between survey pegs EE10 and EE11. Measured strains along the E&EE Line are generally less than 1.0mm/m for both compressive and tensile strain. A plot of the observed subsidence parameters for the E&EE Line is included in Fig. A.02 in Appendix A.

#### EF Monitoring Line

The EF monitoring line is located diagonally at the eastern end of Longwall 11 as is shown in Drawing No. MSEC518-01. The route of the monitoring line follows Fire Road 6H and a disused 33kV power line.

The survey line was last monitored on 28<sup>th</sup> April 2011 at the completion of Longwall 11. Survey results of the incremental total subsidence, tilt and strain of the EF line resulting from the extraction of LW11 and LW12 are presented in Fig. A.03. The predicted profiles of total subsidence, tilt and strain along the EF Line due to the extraction of Longwall 11 are also shown in Fig. A.03.

The maximum observed total subsidence due to the extraction of LW11 and LW12 is 320 mm, which is greater than the maximum predicted total subsidence of 270 mm. The maximum observed total tilt due to the extraction of LW11 and LW12 is 3.2 mm/m, which is greater than the maximum predicted total tilt of 1.2 mm/m. The maximum observed total strain due to the extraction of LW11 and LW12 is a compressive strain of 1.5mm/m which occurs between survey pegs EF46 and EF47, which are located over Longwall 12. Measured strains along the EF Line are predominantly less than 0.5mm/m for both compressive and tensile strain.

### 3. IMPACTS ON SURFACE INFRASTRUCTURE

#### Surface Infrastructure within the Application Area

The surface infrastructure that is located above or adjacent to Longwall 11 is shown in Drawing No. MSEC518-01 and are listed below:-

- Fire trails 6H and sections of 4WD tracks passing directly above Longwalls 11,
- Maldon-Dombarton rail corridor over Longwall 11,
- Disused 33 kV powerline passing adjacent to Longwall 11,
- Survey control marks.

#### 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 11 is summarised 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 12 are provided in other consultant reports.

**Table 3.1 Summary of Predicted and Observed Impacts Resulting from Longwall 11**

| 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                           |
| Maldon-Dombarton rail corridor | Fracturing of rock cuttings                                                         | Minor cracking of rock cuttings               |
| Disused 33 kV powerline        | No predicted impact                                                                 | No reported impact                            |
| Survey control marks           | Horizontal movements requiring re-establishment                                     | Horizontal movements require re-establishment |

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

## **APPENDIX A. FIGURES AND DRAWINGS**

# Elouera Colliery E&E Subsidence Monitoring Results Longwalls 1 to 11

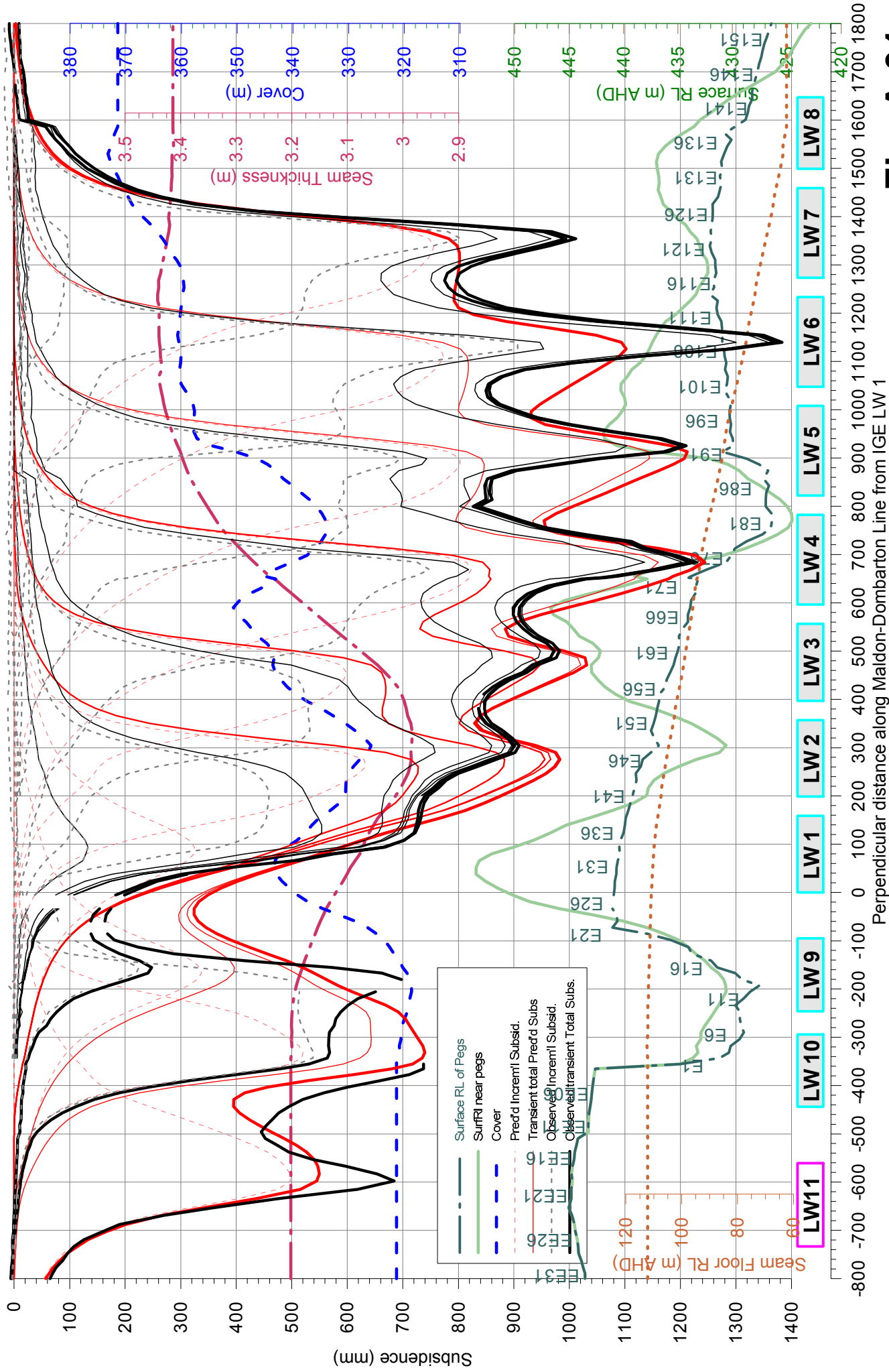
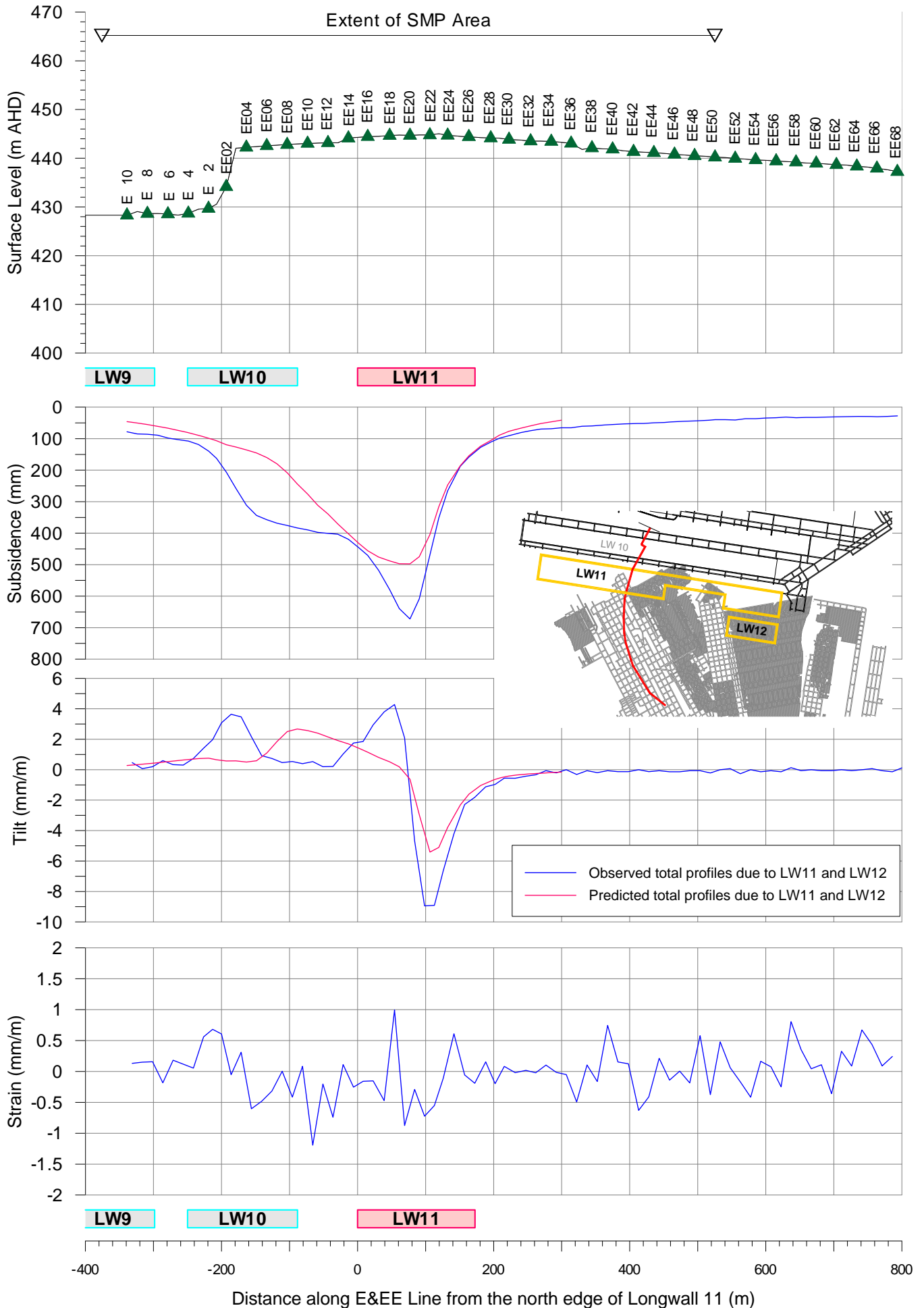
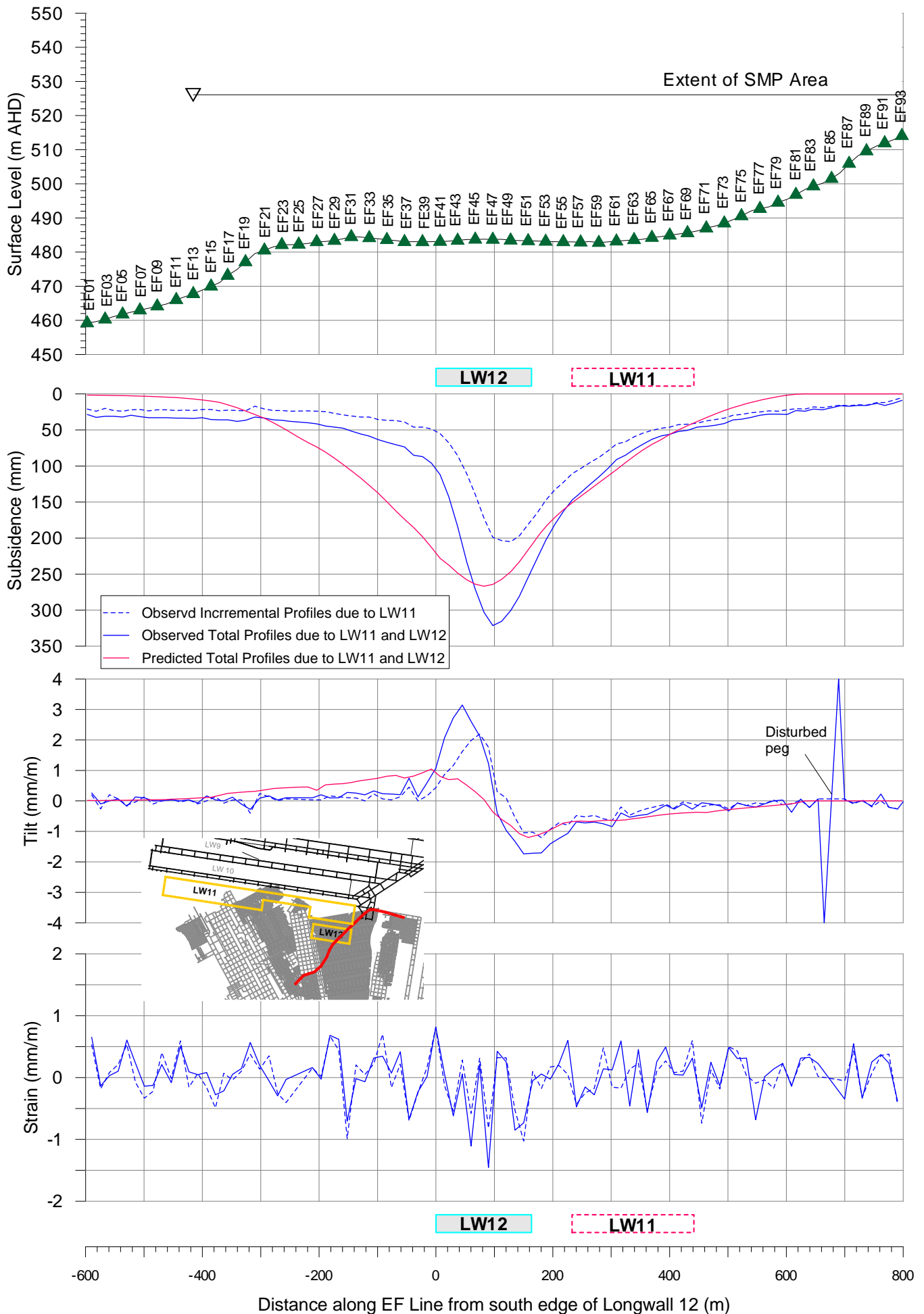


Fig. A.01

## Observed and Predicted Profiles of Subsidence, Tilt and Strain along the E&EE Line resulting from LW11 Extraction



## Observed and Predicted Profiles of Subsidence, Tilt and Strain along the EF-Line resulting from LW11 Extraction











# NRE WONGAWILLI COLLIERY LONGWALL11 - END OF PANEL MONITORING & SURFACE INFRASTRUCTURE

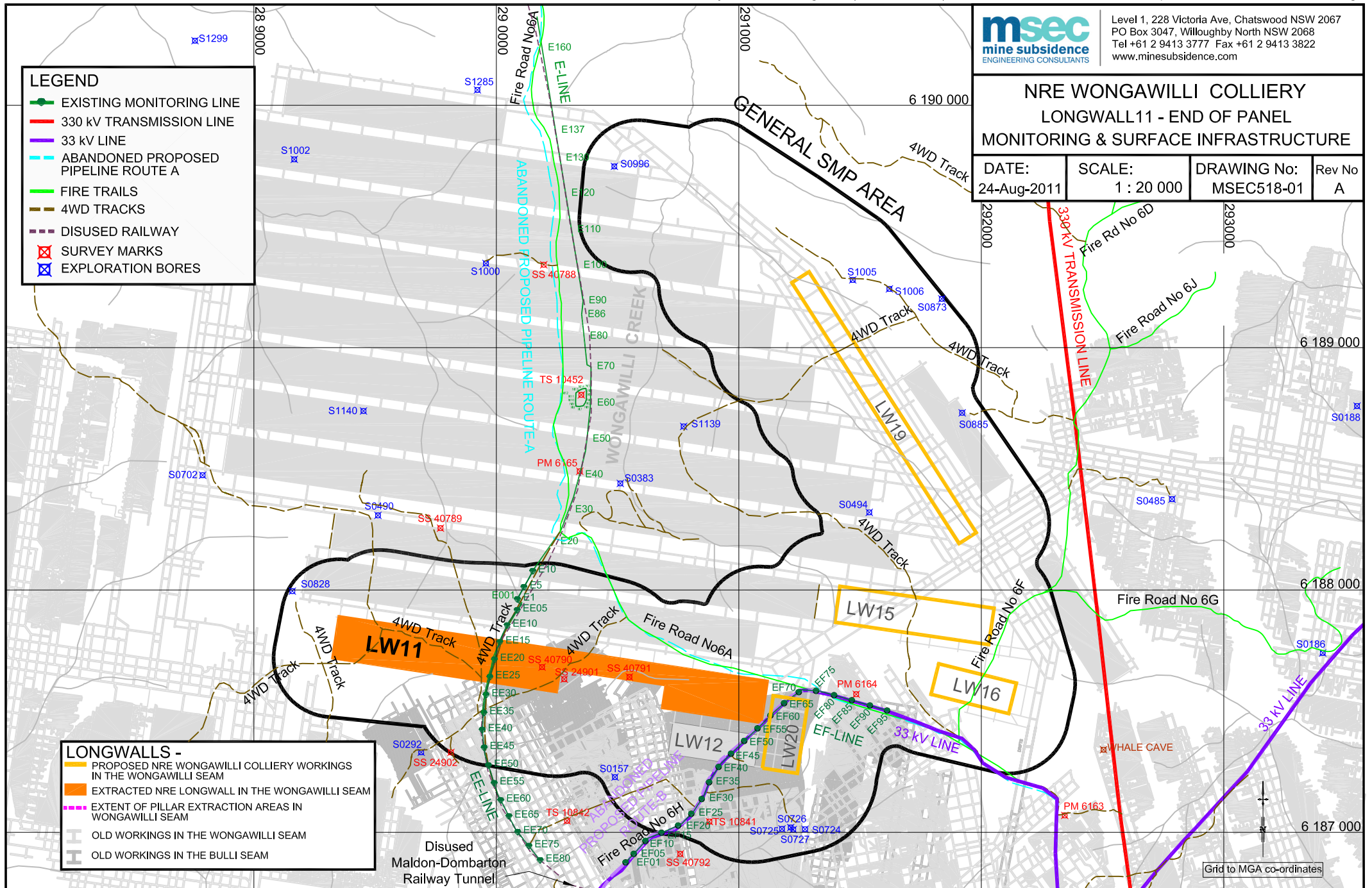
|                      |                      |                           |             |
|----------------------|----------------------|---------------------------|-------------|
| DATE:<br>24-Aug-2011 | SCALE:<br>1 : 20 000 | DRAWING No:<br>MSEC518-01 | Rev No<br>A |
|----------------------|----------------------|---------------------------|-------------|

## LEGEND

-  EXISTING MONITORING LINE
-  330 kV TRANSMISSION LINE
-  33 kV LINE
-  ABANDONED PROPOSED PIPELINE ROUTE A
-  FIRE TRAILS
-  4WD TRACKS
-  DISUSED RAILWAY
-  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



## ATTACHMENT B

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Groundwater and Surface Water: NRE Wongawilli Colliery End  
Of Longwall 11 Groundwater & Surface Water Report.  
GeoTerra Report: WON1-R1, August 2011



**GUJARAT NRE FCGL PTY LTD**  
**WONGAWILLI COLLIERY**  
**END OF LONGWALL 11**  
**GROUNDWATER & SURFACE WATER REPORT**  
Wollongong, NSW

WON1-R1A  
9 SEPTEMBER, 2011

**GeoTerra** PTY LTD ABN 82 117 674 941

77 Abergeldie Street Dulwich Hill NSW 2203

Phone: 02 9560 6583 Fax: 02 9560 6584 Mobile 0417 003 502 Email: [geoterra@iinet.net.au](mailto:geoterra@iinet.net.au)

WON1 - R1A (9 SEPTEMBER, 2011)

**GeoTerra**

Gujarat NRE FCGL Pty Ltd  
PO Box 924  
DAPTO NSW 2530

Attention: David Clarkson

David,

**RE: Wongawilli Colliery Longwall 11 End of Panel Groundwater &  
Surface Water Report**

Please find enclosed a copy of the above mentioned report.

Yours faithfully

**GeoTerra Pty Ltd**



**Andrew Dawkins** (AuSIMM CP-Env)


Managing Geoscientist

|               |                   |                                        |
|---------------|-------------------|----------------------------------------|
| Distribution: | Original          | GeoTerra Pty Ltd                       |
|               | 1 electronic copy | Gujarat NRE FCGL Coal Pty Ltd          |
|               | 1 electronic copy | Niche Environment and Heritage Pty Ltd |

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|-------------------------------------------|------------------------------------------------------------------------------------|
| <b>Name:</b>                              | Andrew Dawkins                                                                     |
| <b>Signature:</b>                         |  |
| <b>Position:</b>                          | Managing Geoscientist                                                              |

| Date       | Rev | Comments                       |
|------------|-----|--------------------------------|
| 22.08.2011 |     | Initial Draft                  |
| 9.09.2011  | A   | Incorporate reviewers comments |
|            |     |                                |

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**TABLE OF CONTENTS**

|                                                         |           |
|---------------------------------------------------------|-----------|
| <b>1. INTRODUCTION</b>                                  | <b>3</b>  |
| <b>2. SCOPE OF WORK</b>                                 | <b>3</b>  |
| <b>3. WATER MONITORING SITE DESCRIPTIONS</b>            | <b>3</b>  |
| <b>3.1 Groundwater Locations</b>                        | <b>3</b>  |
| <b>3.2 Surface Water Locations</b>                      | <b>5</b>  |
| <b>4. PIEZOMETER INSTALLATION AND HYDRAULIC TESTING</b> | <b>5</b>  |
| <b>5. PREDICTED AND OBSERVED GROUNDWATER IMPACTS</b>    | <b>5</b>  |
| <b>5.1 Piezometer Subsidence</b>                        | <b>5</b>  |
| 5.1.1 Potential and Observed Impacts                    | 5         |
| <b>5.2 Aquifer / Aquitard Interconnection</b>           | <b>6</b>  |
| 5.2.1 Potential Impacts                                 | 6         |
| 5.2.2 Observed Impacts                                  | 6         |
| <b>5.3 Groundwater Levels</b>                           | <b>6</b>  |
| 5.3.1 Potential Impacts                                 | 6         |
| 5.3.2 Basement Groundwater Levels                       | 7         |
| 5.3.3 Basement Groundwater Level Impacts                | 8         |
| 5.3.4 Swamp Groundwater Levels                          | 10        |
| 5.3.5 Swamp 20 Groundwater Level Impacts                | 10        |
| <b>5.4 Groundwater Quality</b>                          | <b>11</b> |
| 5.4.1 Potential Impacts                                 | 11        |
| 5.4.2 Swamp P20 Impacts                                 | 11        |
| 5.4.3 Hawkesbury Sandstone Impacts                      | 11        |
| <b>5.5 Potential Inflow to Mine Workings</b>            | <b>13</b> |
| 5.5.1 Predicted Impacts                                 | 13        |
| 5.5.2 Observed Impacts                                  | 13        |
| <b>5.6 Gas</b>                                          | <b>13</b> |
| 5.6.1 Predicted Impacts                                 | 13        |
| 5.6.2 Observed Impacts                                  | 13        |
| <b>6. PREDICTED AND OBSERVED SURFACE WATER IMPACTS</b>  | <b>14</b> |
| <b>6.1 Creek Subsidence</b>                             | <b>14</b> |
| 6.1.1 Potential Impacts                                 | 14        |
| 6.1.2 Observed Impacts                                  | 14        |
| <b>6.2 Stream Flow</b>                                  | <b>14</b> |
| 6.2.1 Potential Impacts                                 | 14        |

|            |                                        |           |
|------------|----------------------------------------|-----------|
| 6.2.2      | Observed Impacts                       | 14        |
| <b>6.3</b> | <b>Stream Water Quality</b>            | <b>14</b> |
| 6.3.1      | Potential Impacts                      | 14        |
| 6.3.2      | Observed Impacts                       | 15        |
| <b>6.4</b> | <b>Stream Bed and Bank Stability</b>   | <b>17</b> |
| 6.4.1      | Potential Impacts                      | 17        |
| 6.4.2      | Observed Impacts                       | 17        |
| <b>6.5</b> | <b>Summary of Results</b>              | <b>17</b> |
| <b>7.</b>  | <b>PROPOSED AND ONGOING MONITORING</b> | <b>19</b> |
| <b>8.</b>  | <b>REFERENCES</b>                      | <b>20</b> |

## FIGURES

|          |                                                                 |    |
|----------|-----------------------------------------------------------------|----|
| Figure 1 | EGW Hawkesbury Sandstone Water Levels & Cordeaux Rainfall ..... | 7  |
| Figure 2 | PWW1 Groundwater Levels and Rainfall .....                      | 8  |
| Figure 3 | P20 Swamp Groundwater Levels and Rainfall .....                 | 10 |
| Figure 4 | P20 pH, EC and Rainfall .....                                   | 12 |
| Figure 5 | Wongawilli Workings Pump Out Mine Water .....                   | 13 |
| Figure 6 | Bellbird Creek pH, EC and Rainfall.....                         | 16 |

## TABLES

|         |                                                        |    |
|---------|--------------------------------------------------------|----|
| Table 1 | Wongawilli Panel Extraction Summary .....              | 3  |
| Table 2 | Longwalls 11 to 19 ESSMP Area Piezometers.....         | 4  |
| Table 3 | Piezometer Distance to Longwall 11 .....               | 4  |
| Table 4 | Longwall 11 and 12 Surface Water Monitoring Sites..... | 5  |
| Table 5 | Longwall 11 and 12 Groundwater Level Change.....       | 9  |
| Table 6 | Summary of Groundwater and Surface Water Impacts ..... | 18 |
| Table 7 | Current and Proposed Groundwater Monitoring .....      | 19 |
| Table 8 | Current and Proposed Surface Water Monitoring .....    | 20 |

## DRAWINGS

|           |                                          |
|-----------|------------------------------------------|
| Drawing 1 | Piezometer and Stream Sampling Locations |
|-----------|------------------------------------------|

## APPENDIX A

|                             |
|-----------------------------|
| Laboratory Analyses Summary |
|-----------------------------|



## 1. INTRODUCTION

Extraction of the Wongawilli Seam in Longwalls 11 to 19 by Gujarat NRE FCGL Pty Ltd (Gujarat) at Wongawilli Colliery was approved by the Department of Primary Industries (DPI) on 16<sup>th</sup> July 2009, with longwall mining conducted to date as shown in **Table 1**.

**Table 1 Wongawilli Panel Extraction Summary**

| Longwall    | Start     | Finish     |
|-------------|-----------|------------|
| Longwall 12 | 25/8/2009 | 26/11/2009 |
| Longwall 11 | 29/1/2010 | 13/5/2011  |
| Longwall 19 | 26/6/2011 | ongoing    |

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

## 2. SCOPE OF WORK

Geoterra were commissioned by Gujarat NRE FCGL Pty Ltd (Gujarat) to report on any observed groundwater system or surface water changes resulting from extraction of Longwall 11 in accordance with the SMP Approval Conditions for Longwalls 11, 12, 15, 16, 19 and Pillar Extraction Area 1, as well as the Environmental Subsidence and Safety Management Plan (ESSMP).

This report follows on from a previous end of Panel 12 assessment (Geoterra, 2010).

## 3. WATER MONITORING SITE DESCRIPTIONS

### 3.1 Groundwater Locations

One Gujarat vibrating wire piezometer (PWW1) has been installed to the east, and one swamp piezometer (P20) is located over Longwall 11.

In addition, one open standpipe BHPB Hawkesbury Sandstone piezometer (EGW3) is located over Longwall 11 as summarised in **Table 2** and shown in **Drawing 1**.

PWW1 was installed by Gujarat with intakes in the Hawkesbury Sandstone at 90m and 135m below surface, the Bald Hill Claystone at 150m and Bulgo Sandstone at 165m. During drilling in November 2009, the first water make occurred at 23m below surface.

P20 was installed by Gujarat in Quaternary swamp colluvium / alluvium to 0.85m below surface during September 2009.

EGW3 was installed in February 2004.

Within the overall ESSMP area, Gujarat also monitor shallow colluvial upland swamp groundwater levels and water quality in swamps P21A, P24, P31 and P46.

BHP 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.

BHPB have been monitoring groundwater levels in the 35.1 - 51.5m deep open standpipe Hawkesbury Sandstone piezometers EGW2, 4A, 5 and 6 since February 2004 to the north of Longwall 11, over the old Eloura Colliery longwall panels as shown in **Table 2**, with the monitoring location shown in **Drawing 1**.

NSW Office of Water (NOW) Test Monitoring Bore Licences and Sydney Catchment Authority (SCA) approval for the piezometers was received prior to their installation.

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

**Table 2 Longwalls 11 to 19 ESSMP Area Piezometers**

| GW           | E            | N            | Intake Depth (mbgl) | SWL (m)  | Commenced | Lithology           | pH   | EC (uS/cm) |
|--------------|--------------|--------------|---------------------|----------|-----------|---------------------|------|------------|
| <b>MULTI</b> | <b>LEVEL</b> | <b>PIEZO</b> |                     |          |           |                     |      |            |
| <b>PWW1</b>  | 291677       | 6187507      | 90                  | See plot | 19.11.09  | Hawkes. Sandstone   | 6.17 | 102        |
|              | -            | -            | 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     | —    | —          |
| <b>EGW2</b>  | 289434       | 6188008      | 0 – 45.67           | See plot | 19.02.04  | Hawkes. Sandstone   | see  | plot       |
| <b>EGW3</b>  | 289773       | 6187749      | 0 – 35.10           | See plot | 27.02.04  | Hawkes. Sandstone   | see  | plot       |
| <b>EGW4A</b> | 290122       | 6188359      | 0 – 48.45           | See plot | 09.03.04  | Hawkes. Sandstone   | see  | plot       |
| <b>EGW5</b>  | 290538       | 6187861      | 0 – 51.51           | See plot | 09.02.04  | Hawkes. Sandstone   | see  | plot       |
| <b>EGW6</b>  | 290453       | 6188065      | 0 – 39.55           | See plot | 16.02.04  | Hawkes. Sandstone   | see  | plot       |
| <b>SWAMP</b> | <b>PIEZO</b> |              |                     |          |           |                     |      |            |
| <b>P20</b>   | 291144       | 6187583      | 0.3 – 0.85          | See plot | 18.09.09  | Swamp Alluvium      | see  | plot       |
| <b>P21A</b>  | 291860       | 6188293      | 0.3 – 1.72          | See plot | 01.07.11  | Swamp Alluvium      | see  | plot       |
| <b>P24</b>   | 292076       | 6187585      | 0.3 – 0.81          | See plot | 11.06.10  | Swamp Alluvium      | see  | plot       |
| <b>P31</b>   | 291867       | 6188897      | 0.3 – 0.87          | See plot | 09.06.11  | Swamp Alluvium      | see  | plot       |
| <b>P46</b>   | 291875       | 6187988      | 0.3 – 1.14          | See plot | 15.06.10  | Swamp Alluvium      | see  | plot       |

As shown in **Table 3**, the basement piezometers of the PWW and EGW series bores range from 155m to 1390m away from Longwall 11.

**Table 3 Piezometer Distance to Longwall 11**

| Piezometer   | Distance From Longwall 11 |
|--------------|---------------------------|
| <b>PWW1</b>  | 560m east                 |
| <b>EGW2</b>  | 130m north                |
| <b>EGW4A</b> | 580m north                |
| <b>EGW5</b>  | 150m north                |
| <b>EGW6</b>  | 335m north                |

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.

### 3.2 Surface Water Locations

Bellbird Creek (Swamp 20) field water pH and electrical conductivity has been monitored by BHPB 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 (ds) as well as Bellbird Creek (us) commenced in March 2010.

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

**Table 4 Longwall 11 and 12 Surface Water Monitoring Sites**

| BELLBIRD Ck    | E      | N       | Commenced | Location                          | pH  | EC (uS/cm) |
|----------------|--------|---------|-----------|-----------------------------------|-----|------------|
| Bellbird Ck up | 292795 | 6187560 | 02.03.10  | In Swamp 20 d/s of P20            | see | plot       |
| Bellbird Ck ds | 289962 | 6187290 | 19.07.05  | culvert under railway             | see | plot       |
| DAQ40 up       | 291327 | 6189226 | 02.03.06  | Wongawilli Ck headwater over LW19 | see | plot       |
| DAQ40 ds       | 291183 | 6189302 | 22.02.11  | Wongawilli Ck headwater over LW19 | see | plot       |

## 4. PIEZOMETER INSTALLATION AND HYDRAULIC TESTING

The hydrogeology of the Longwall 11 to 19 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 Panel(s) Report. The following discussion only relates to the extraction of Longwalls 11 and 12.

### 5.1 Piezometer Subsidence

#### 5.1.1 Potential and Observed Impacts

Up to 140mm of subsidence was predicted along Subsidence Line EF, with a maximum of 321mm being observed over Longwall 12, whilst on the same line (EF), which is the closest line to the P20 swamp piezometer, Longwall 11 had a maximum subsidence of 126mm.

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

## 5.2 Aquifer / Aquitard Interconnection

### 5.2.1 Potential Impacts

- No adverse interconnection of aquifers and aquitards anticipated within 20m of the surface.
- 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.

### 5.2.2 Observed Impacts

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

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

## 5.3 Groundwater Levels

The stream and piezometer monitoring has been used to determine the pre, during and post Longwall 11 and 12 groundwater level and quality. 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

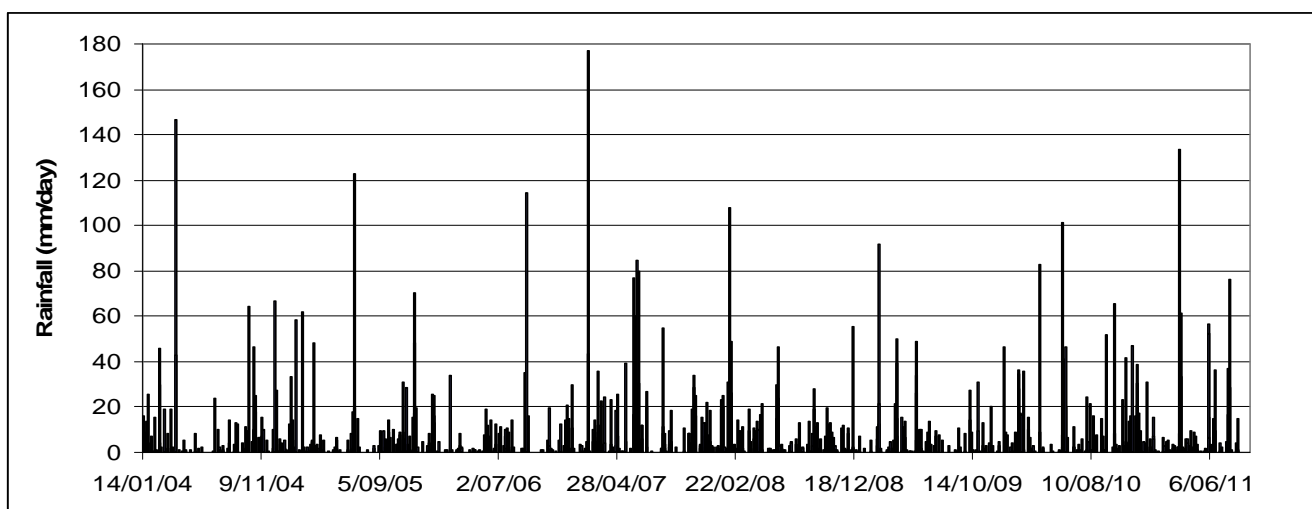
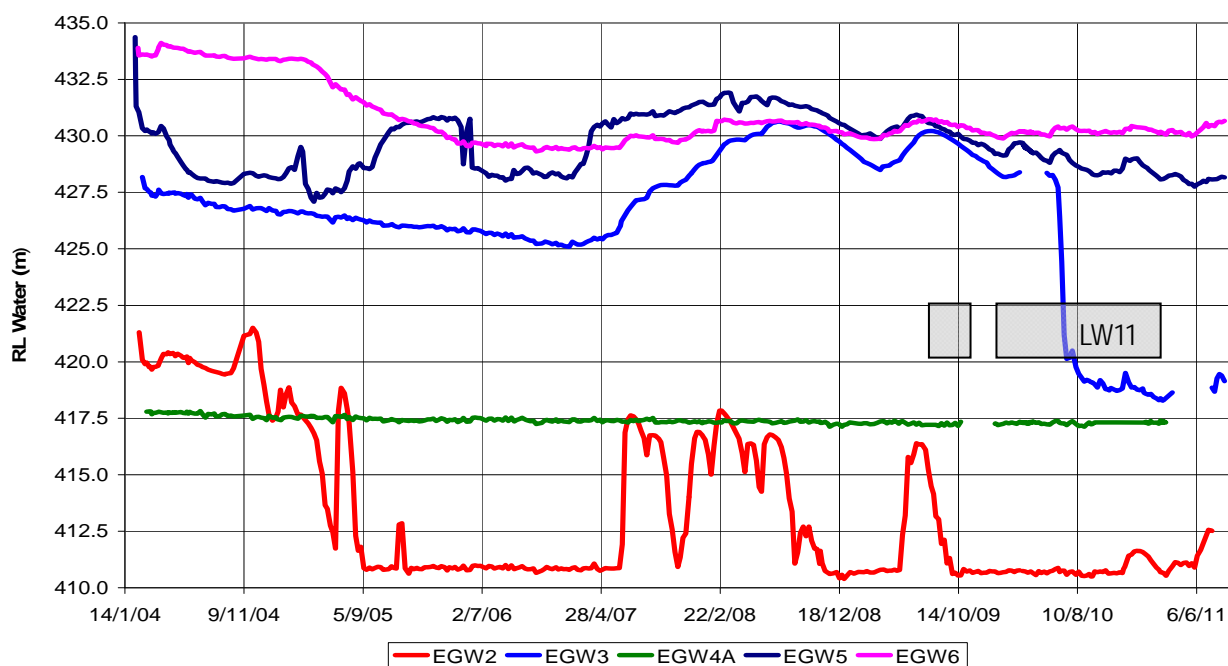
The following potential groundwater level impacts could occur;

- 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.
- No permanent post mining reduction in Hawkesbury Sandstone groundwater levels unless a new outflow path develops.

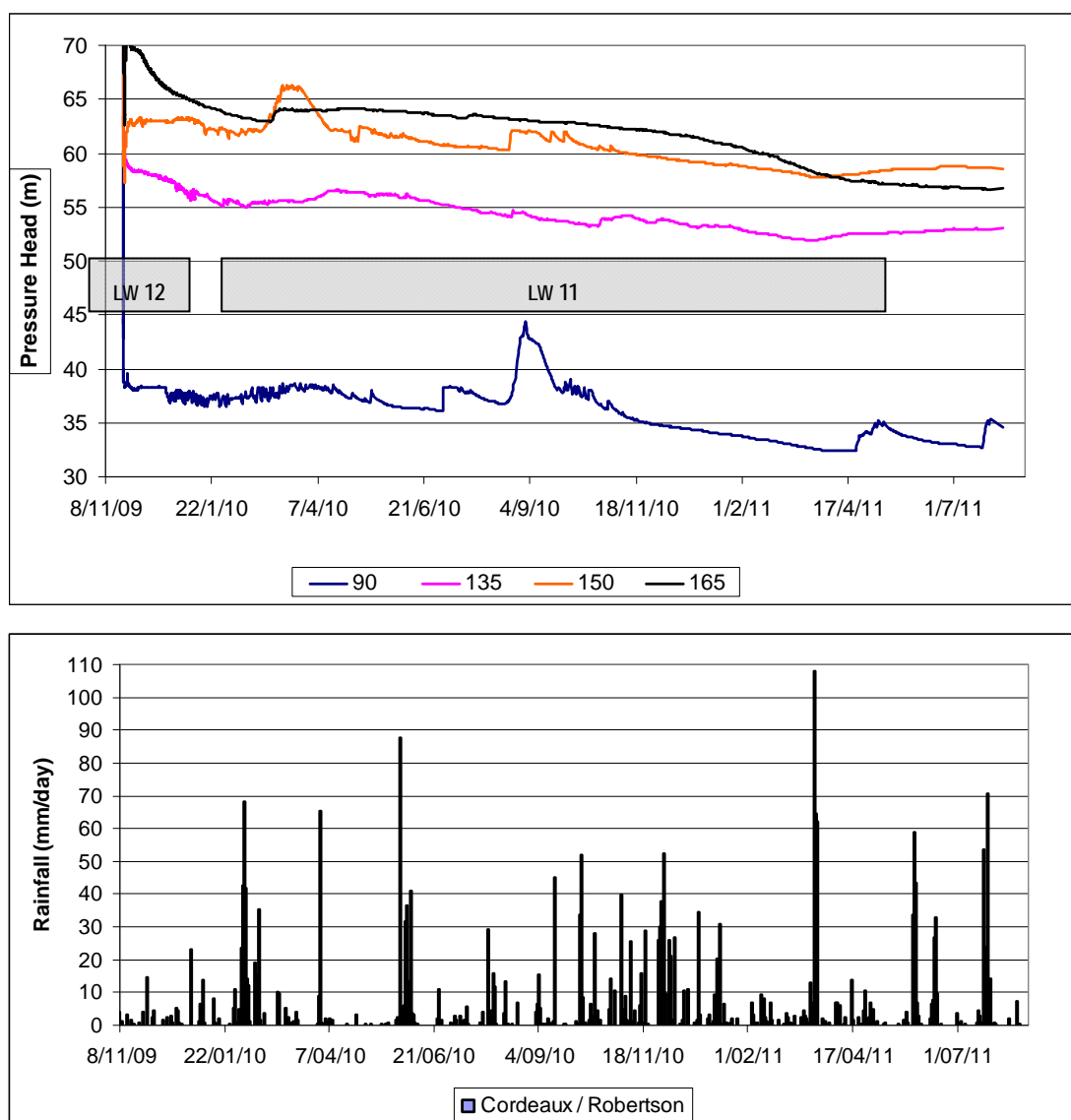
### 5.3.2 Basement Groundwater Levels

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 vary 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.



**Figure 1** EGW Hawkesbury Sandstone Water Levels & Cordeaux Rainfall



**Figure 2 PWW1 Groundwater Levels and Rainfall**

### 5.3.3 Basement Groundwater Level Impacts

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

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

**Table 5 Longwall 11 and 12 Groundwater Level Change**

| Piezo | Intake Lithology      | Intake Depth | Start    | End     | SWL Change  |
|-------|-----------------------|--------------|----------|---------|-------------|
| EGW3  | Hawkesbury Sandstone  | 0 – 35.1     | 18/03/04 | 15/8/11 | 8.35        |
| EGW3  | Hawkesbury Sandstone  | 0 – 35.1     | 15/6/10  | 15/8/11 | <b>8.92</b> |
| PWW1  | Hawkesbury Sandstone  | 90           | 29/1/10  | 15/8/11 | 2.69        |
| PWW1  | Hawkesbury Sandstone  | 135          | 29/1/10  | 15/8/11 | 2.05        |
| PWW1  | Bald Hill Claystone   | 150          | 29/1/10  | 15/8/11 | 3.71        |
| PWW1  | Upper Bulgo Sandstone | 165          | 29/1/10  | 15/8/11 | 7.05        |

**Note:** bolded / shaded figures indicates TARP exceedance

The >5m drawdown over a minimum 2 month period TARP Trigger was exceeded in EGW3 (which is over LW11).

Although a fall of 7.05m has been recorded in the Upper Bulgo Sandstone in PWW1 (165mbgl), it has not exceed the TARP trigger, as it occurred over a period of greater than 2 months.

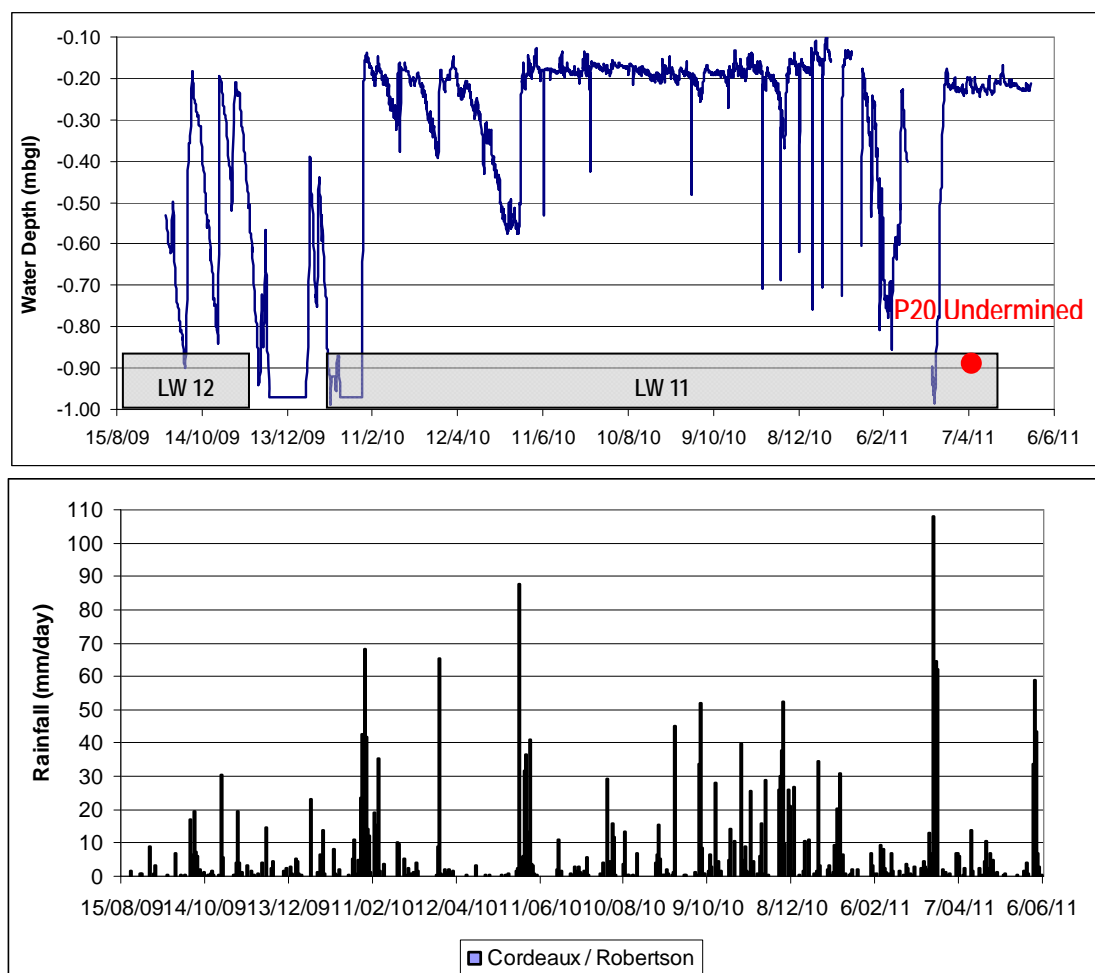
No ameliorative actions are recommended.



### 5.3.4 Swamp Groundwater Levels

Monitored groundwater levels in the Wongawilli swamps are shown in **Figure 2**.

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.



**Figure 3 P20 Swamp Groundwater Levels and Rainfall**

### 5.3.5 Swamp 20 Groundwater Level Impacts

Based on monitoring conducted by both Gujarat and BHPB, no change in groundwater levels in Swamp 20 due to subsidence induced impacts from extraction of Longwalls 11 and 12 have been observed.

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

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

## 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 Impacts

During and after extraction of Longwalls 11 and 12, 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 that was monitored between 23<sup>rd</sup> September to 12<sup>th</sup> November 2010, along with the acidification during 25<sup>th</sup> 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 3**.

Laboratory analyses for P20 shown in **Appendix A**.

Field monitoring and laboratory analyses from P20 indicates 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, in Swamp 20 there has not been an observed 2 standard deviation change, or distinctive diversion over at least 4 months, from baseline levels for pH, EC, Fe, Mn, Al, Zn and SO<sub>4</sub>.

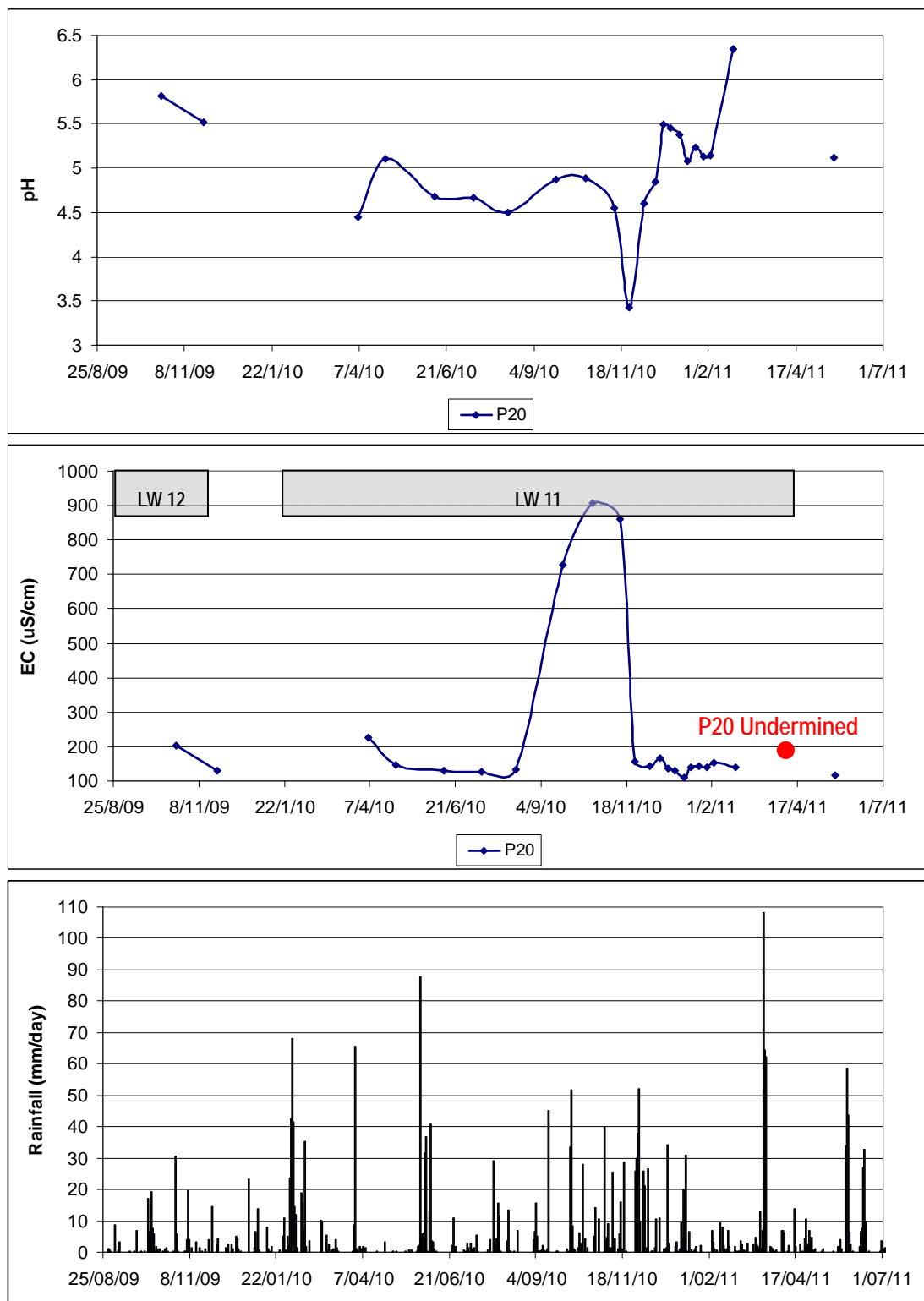
*No adverse effects on groundwater quality in Swamp 20 due to subsidence effects from extraction of Longwalls 11 and 12 have been monitored, no TARP water quality trigger levels have been exceeded and no ameliorative actions are required.*

### 5.4.3 Hawkesbury Sandstone Impacts

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.

No groundwater quality data is available from the BHPB EGW series piezometers.

**Figure 4** P20 pH, EC and Rainfall

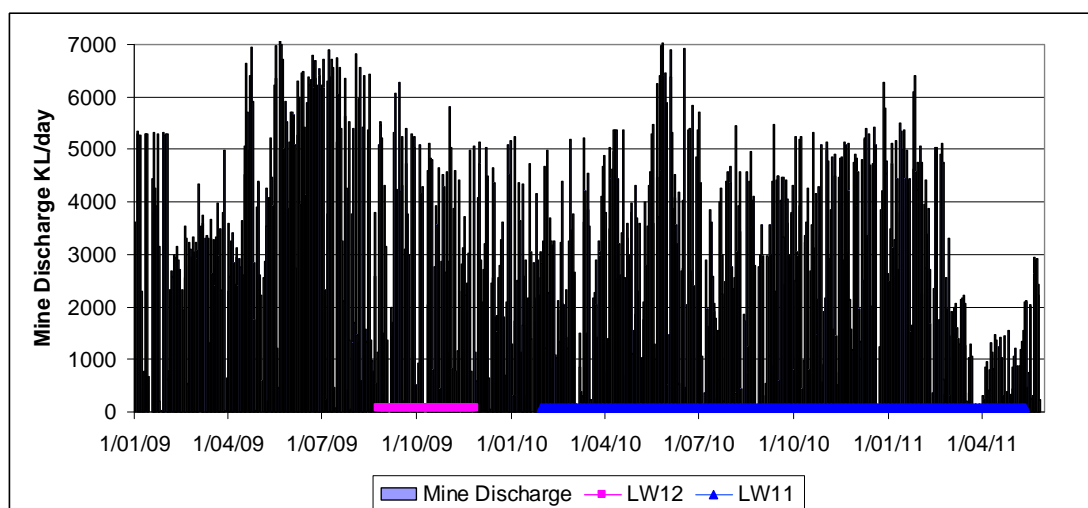
## 5.5 Potential Inflow to Mine Workings

### 5.5.1 Predicted Impacts

- No observable increase in mine workings groundwater inflow.

### 5.5.2 Observed Impacts

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



**Figure 5 Wongawilli Workings Pump Out Mine Water**

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. 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 or 12 has occurred and no TARP trigger levels have been reached or exceeded.

## 5.6 Gas

### 5.6.1 Predicted Impacts

- Potential discharge of strata gas into private bores.

### 5.6.2 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 12.

No TARP trigger levels have been reached or exceeded due to extraction of Longwall 12.

## 6. PREDICTED AND OBSERVED SURFACE WATER IMPACTS

The observed impacts discuss general observations from Bellbird Creek, which overlies Longwall 11.

It should be noted that Bellbird Creek lies approximately 170m to the north of Longwall 12.

It should also be noted that the predicted impacts are derived from the SMP which do not separate the potential surface water impacts of Longwalls 11 and 12 from the overall impacts of the entire mining program.

### 6.1 Creek Subsidence

#### 6.1.1 Potential Impacts

- Maximum subsidence of <100mm along the subsidence line EE, to the west of Bellbird Creek.

#### 6.1.2 Observed Impacts

- Maximum subsidence of 673mm along Subsidence Line EE, which does not intersect Bellbird Creek.

It should be noted that no direct measurements have been conducted along Bellbird Creek over Longwall 11.

No TARP trigger levels have been reached or exceeded and no ameliorative actions are required due to extraction of Longwalls 11 or 12.

### 6.2 Stream Flow

#### 6.2.1 Potential Impacts

- No anticipated adverse effect on stream flow in Bellbird Creek.

#### 6.2.2 Observed Impacts

No observed adverse effect on Bellbird Creek resulting from extraction of Longwalls 11 and 12.

No TARP trigger levels have been reached or exceeded and no ameliorative actions are required due to extraction of Longwalls 11 or 12.

### 6.3 Stream Water Quality

#### 6.3.1 Potential Impacts

- Increased iron hydroxide precipitation, and;
- Lowering (acidification) of pH.

### 6.3.2 Observed Impacts

Plots of the Bellbird Creek field pH and EC are shown in **Figure 6**.

During and after extraction of Longwalls 11 and 12, the field water quality in Bellbird Creek has not changed markedly due to subsidence, although variations in response to the quantum and duration of rainfall recharge in the catchment were observed.

The peak in electrical conductivity that was monitored between 23<sup>rd</sup> September to 12<sup>th</sup> November 2010 was not due to subsidence as the creek was not undermined during that period, and is interpreted to be a result of lower rainfall recharge to the catchment.

The increase in alkalinity in late December 2010 and mid February 2011 corresponds to a low rainfall period.

The channel of Bellbird Creek was undermined around the 11<sup>th</sup> August 2010.

Field monitoring and laboratory analyses from Bellbird Creek indicates that it can exceed the ANZECC 2000 Upland Streams criteria for total nitrogen, total phosphorous, copper, zinc, aluminium and arsenic.

Laboratory analyses for Bellbird Creek are contained in **Appendix A**.

No observed adverse effect on Bellbird Creek resulting due to extraction of Longwalls 11 and 12 has been observed.

During and after the extraction of Longwalls 11 and 12, in Bellbird Creek, 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
- SO<sub>4</sub> (filt) above 8mg/L

Although there has been;

- EC above 200µS/cm, and
- pH below 4.2 and above 6.77,

these changes were not sustained and the creek water quality returned to its baseline range after the exceedance.

The apparent change in salinity around the time Bellbird Creek was undermined was due to a malfunction in the Gujarat NRE FCGL field meter, and was not due to subsidence induced changes. This is supported by the lack of notable total dissolved solids change in the laboratory analyses around the same period as shown in **Appendix A**.

*The pH and EC TARP trigger levels were exceeded, however no ameliorative actions are required due to extraction of Longwalls 11 or 12 as the changes were not sustained.*

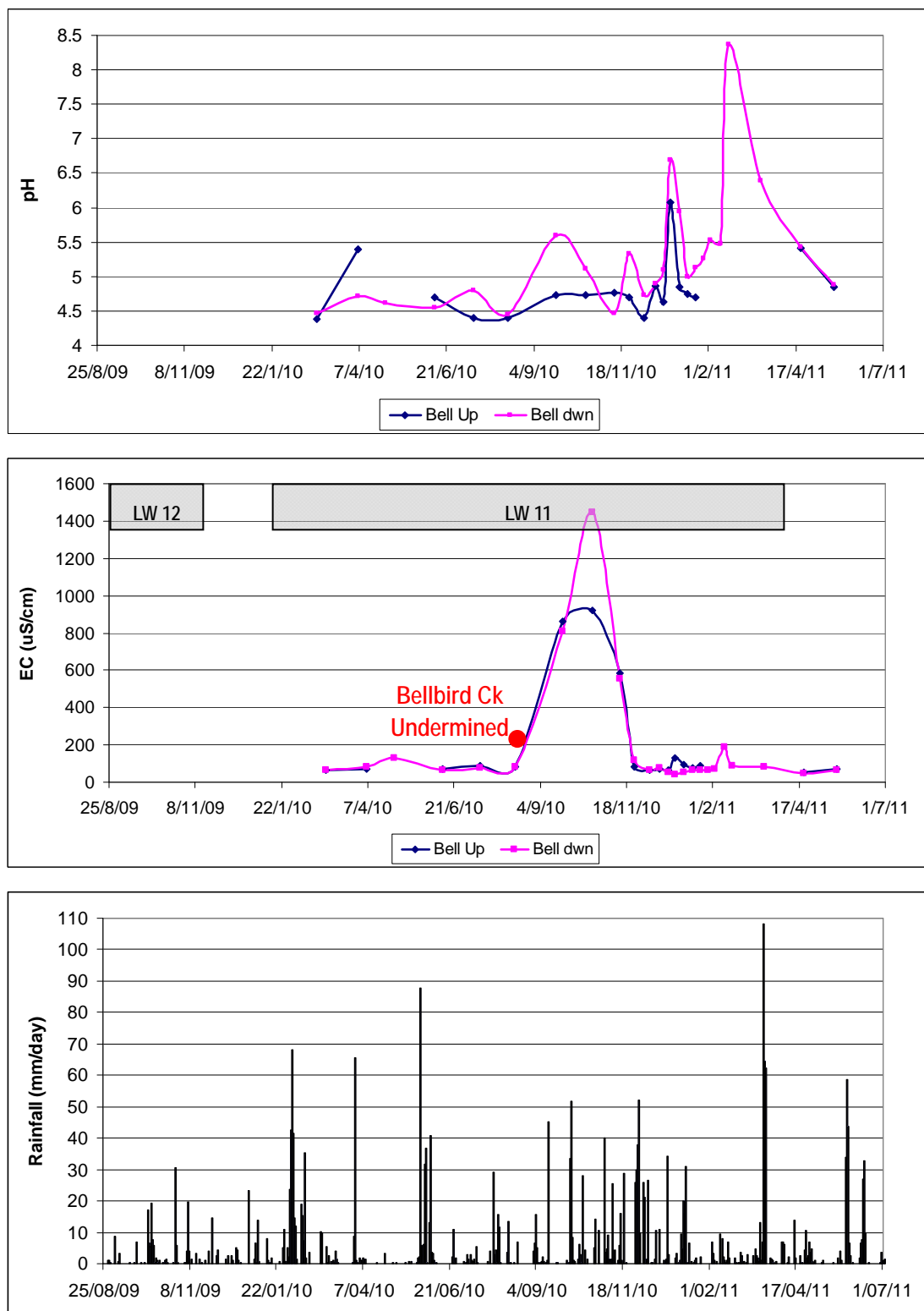


Figure 6 Bellbird Creek pH, EC and Rainfall



## 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 resulting from extraction of Longwall 11 or 12.

### 6.4.2 Observed Impacts

No observed adverse effect on Bellbird Creek resulting from extraction of Longwall 11 or 12.

No TARP trigger levels have been reached or exceeded and no ameliorative actions are required due to extraction of Longwalls 11 and 12.

## 6.5 Summary of Results

During extraction of Longwalls 11 and 12, the TARP triggers exceeded were;

- >5m drawdown over a minimum 2 month period in EGW3
- Bellbird Creek EC above 200 $\mu$ S/cm, and
- Bellbird Creek pH below 4.2 and above 6.77,

**Table 4** 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 and 12.

**Table 6 Summary of Groundwater and Surface Water Impacts**

| <b>Predicted Impacts</b>                                                                                                                                                                                       | <b>Observed Impacts Due to Extraction of Longwall 12</b>                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <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 Longwall 12, however EGW3 over Longwall 11 fell by 8.92m. |
| <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 water levels has been caused by LW 11                                         |
| <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 piezometer has 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                                                                                                                                        |
| <i>Ferruginous seeps may develop in the local creeks</i>                                                                                                                                                       | No ferruginous seeps have developed in Bellbird Creek                                                                                                                                                                           |
| <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 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 has temporarily exceeded the salinity and 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 has not been adversely affected by subsidence related effects                                                                                                                   |

## 7. 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 7 and 8**.

**Table 7 Current and Proposed Groundwater Monitoring**

| SMP Commitment                                                                                                                                        | Monitoring To Date                                                                 | Future Monitoring                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Aspect: Piezometer Baseline Data</b>                                                                                                               |                                                                                    |                                                                                                                                                                                                                                       |
| 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                                                                                                                                                                                  |
| <b>Aspect: Piezometer Water Quality</b>                                                                                                               |                                                                                    |                                                                                                                                                                                                                                       |
| Sample and monitor open standpipe piezometer water iron, field parameters and selected laboratory analytes for piezometers within LW11 to 19 SMP area | Longwalls 11 and 12 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 |
| <b>Aspect: Piezometer Water Levels</b>                                                                                                                |                                                                                    |                                                                                                                                                                                                                                       |
| 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                                              |
| <b>Aspect: Strata Gas</b>                                                                                                                             |                                                                                    |                                                                                                                                                                                                                                       |
| Monitor strata gas discharges (if any) in piezometers within the LW11 to 19 SMP area                                                                  | Piezometers monitored at time of t Longwall 12 extraction                          | Report any strata gas discharges (if any)                                                                                                                                                                                             |

**Table 8 Current and Proposed Surface Water Monitoring**

| <b>SMP Commitment</b>                                                                                                       | <b>Monitoring To Date</b>                                                              | <b>Future Monitoring</b>                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Aspect: Stream Flow and Swamp Water Levels</b>                                                                           |                                                                                        |                                                                                                                                                                |
| Assess stream location within LW11 to 19 SMP area                                                                           | Stream database completed                                                              | No additional data compilation required                                                                                                                        |
| <b>Aspect: Stream and Swamp Water Quality</b>                                                                               |                                                                                        |                                                                                                                                                                |
| Sample and monitor Bellbird Ck and Swamp 20 iron, field parameters and selected laboratory analytes in LW 11 to 19 SMP area | Longwall 11 and 12 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 |
| <b>Aspect: Stream and Swamp Bed and Bank Stability</b>                                                                      |                                                                                        |                                                                                                                                                                |
| Monitor Bellbird Ck and Swamp 20 stream bed and bank stability and presence of cracking                                     | Monitoring conducted in Swamp 20 and Bellbird Ck                                       | Monitor Bellbird Ck and Wongawilli Ck (headwaters) as well as Swamp 20, 21A, 24, 31 and 46 stream bed and bank stability and presence of cracking              |
| <b>Aspect: Strata Gas</b>                                                                                                   |                                                                                        |                                                                                                                                                                |
| 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                                                                     |

## 8. REFERENCES

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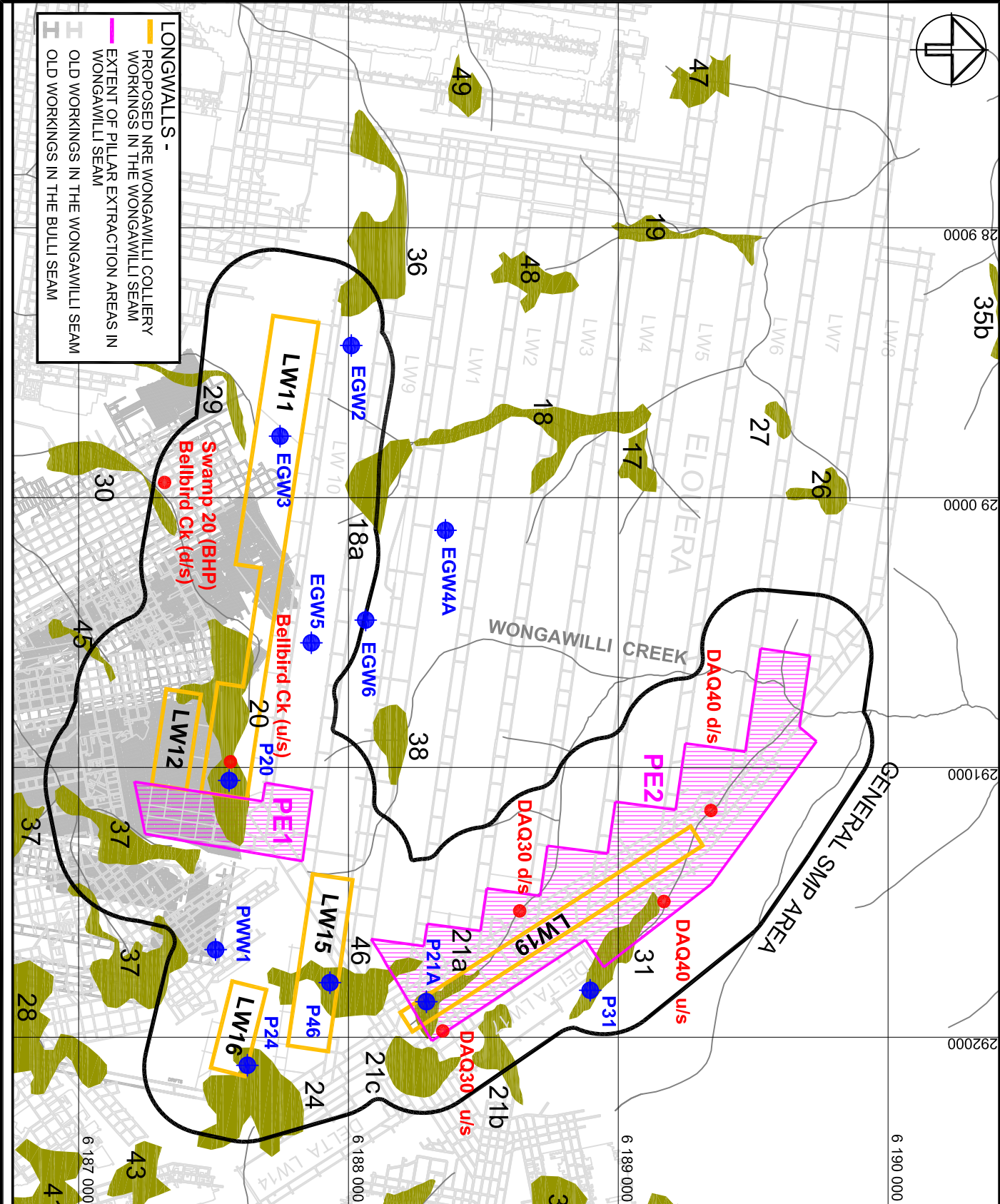
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| LEGEND   |                       |
|----------|-----------------------|
|          | SWAMP                 |
|          | PIEZOMETER            |
|          | CREEK MONITORING SITE |
| PROJECT: | WON1 R1               |
| DRAWN:   | A Dawkins             |
| DATE:    | 22 AUG 2011           |
| SCALE:   | 1:20 000              |

**GUJARAT NRE FCGL**  
**PTY LTD**

**WONGAWILLI**  
**LONGWALLS 11- 19**

**Monitoring Locations**

**DRAWING 1**

**GeoTerra**



# APPENDIX A

## Bellbird Creek (Upstream)

| ANZECC     |        |        |       |       |       |        |       |       |       | 0.25       | 0.02       |       |       | 1.9   | 1.9   | 0.0014 | 0.0034 | 0.008 | 0.011 | 0.055 | 0.024<br>(III) /<br>0.013(V) |       |       |       |       |
|------------|--------|--------|-------|-------|-------|--------|-------|-------|-------|------------|------------|-------|-------|-------|-------|--------|--------|-------|-------|-------|------------------------------|-------|-------|-------|-------|
| Date       | TDS    | Na     | Ca    | K     | Mg    | Cl     | F     | SO4   | HCO3  | Total<br>N | Total<br>P | Fe.T  | Fe.D  | Mn.T  | Mn.D  | Cu     | Pb     | Zn    | Ni    | Al    | As                           | Li    | Ba    | Sr    | DOC   |
| 6/04/2010  | 45     | 13     | 1.2   | 0.5   | 1.6   | 20     | 0.1   | 4     | 4     | 0.3        | 0.05       | 1.3   | 0.01  | 0.06  | 0.03  | 0.001  | 0.001  | 0.016 | 0.01  | 0.06  | 0.01                         | 0.001 | 0.001 | 0.007 | 7     |
| 11/06/2010 | 34     | 6.2    | 3.2   | <0.1  | 1.7   | 16     | 0.1   | 4     | 3     | 0.4        | 0.01       | 0.04  | 0.01  | 0.02  | 0.01  | 0.001  | 0.001  | 0.008 | 0.01  | 0.03  | 0.01                         | 0.012 | 0.003 | 0.003 | 6     |
| 14/07/2010 | 41     | 11     | 1.6   | 0.1   | 2.1   | 22     | 0.1   | 4     | 3     | 0.8        | 0.01       | 0.01  | 0.01  | 0.02  | 0.02  | 0.001  | 0.001  | 0.01  | 0.01  | 0.04  | 0.01                         | 0.002 | 0.007 | 0.02  | 4     |
| 23/09/2010 | 45     | 11     | 1     | 1     | 2     | 22     | 0.1   | 2     | 1     | 0.3        | 0.02       | 0.06  | 0.07  | 0.002 | 0.002 | 0.001  | 0.001  | 0.007 | 0.001 | 0.3   | 0.001                        | 0.001 | 0.002 | 0.006 | 4     |
| 12/11/2010 | 46     | 10     | 1     | 1     | 2     | 21     | 0.1   | 4     | 3     | 1          | 0.01       | 0.06  | 0.05  | 0.004 | 0.004 | 0.001  | 0.001  | 0.007 | 0.001 | 0.33  | 0.001                        | 0.001 | 0.003 | 0.004 | 4     |
| 17/12/2010 | 44     | 8      | 1     | 1     | 1     | 16     | 0.1   | 1     | 2     | 0.4        | 0.01       | 0.28  | 0.08  | 0.006 | 0.005 | 0.001  | 0.001  | 0.01  | 0.001 | 0.35  | 0.001                        | 0.001 | 0.002 | 0.003 | 7     |
| 30/12/2010 | 64     | 8      | 1     | 1     | 1     | 16     | 0.1   | 1     | 2     | 0.6        | 0.39       | 0.51  | 0.16  | 0.005 | 0.004 | 0.001  | 0.001  | 0.008 | 0.001 | 0.31  | 0.001                        | 0.001 | 0.002 | 0.003 | 6     |
| 7/01/2011  | 60     | 10     | 1     | 1     | 2     | 14     | 0.1   | 1     | 3     | 0.9        | 0.01       | 0.75  | 0.28  | 0.007 | 0.006 | 0.002  | 0.001  | 0.016 | 0.001 | 0.29  | 0.001                        | 0.001 | 0.002 | 0.003 | 5     |
| 14/01/2011 | 53     | 9      | 1     | 1     | 1     | 21     | 0.1   | 2     | 1     | 1.1        | 0.01       | 0.45  | 0.16  | 0.006 | 0.006 | 0.001  | 0.001  | 0.014 | 0.001 | 0.34  | 0.001                        | 0.001 | 0.002 | 0.004 | 5     |
| 21/01/2011 | 48     | 11     | 1     | 1     | 1     | 21     | 0.1   | 6     | 1     | 0.4        | 0.08       | 0.37  | 0.31  | 0.007 | 0.006 | 0.001  | 0.001  | 0.014 | 0.001 | 0.3   | 0.001                        | 0.001 | 0.002 | 0.003 | 6     |
| 28/01/2011 | dry    | dry    | dry   | dry   | dry   | dry    | dry   | dry   | dry   | dry        | dry        | dry   | dry   | dry   | dry   | dry    | dry    | dry   | dry   | dry   | dry                          | dry   | dry   | dry   | dry   |
| 3/02/2011  | dry    | dry    | dry   | dry   | dry   | dry    | dry   | dry   | dry   | dry        | dry        | dry   | dry   | dry   | dry   | dry    | dry    | dry   | dry   | dry   | dry                          | dry   | dry   | dry   | dry   |
| 11/02/2011 | dry    | dry    | dry   | dry   | dry   | dry    | dry   | dry   | dry   | dry        | dry        | dry   | dry   | dry   | dry   | dry    | dry    | dry   | dry   | dry   | dry                          | dry   | dry   | dry   | dry   |
| 18/03/2011 | dry    | dry    | dry   | dry   | dry   | dry    | dry   | dry   | dry   | dry        | dry        | dry   | dry   | dry   | dry   | dry    | dry    | dry   | dry   | dry   | dry                          | dry   | dry   | dry   | dry   |
|            |        |        |       |       |       |        |       |       |       |            |            |       |       |       |       |        |        |       |       |       |                              |       |       |       |       |
| STD DEV    | 8.869  | 1.962  | 0.694 | 0.324 | 0.488 | 3.035  | 0.000 | 1.729 | 1.059 | 0.305      | 0.118      | 0.404 | 0.110 | 0.017 | 0.009 | 0.000  | 0.000  | 0.004 | 0.004 | 0.134 | 0.004                        | 0.003 | 0.002 | 0.005 | 1.174 |
| Max        | 64.000 | 13.000 | 3.200 | 1.000 | 2.100 | 22.000 | 0.100 | 6.000 | 4.000 | 1.100      | 0.390      | 1.300 | 0.310 | 0.060 | 0.030 | 0.002  | 0.001  | 0.016 | 0.010 | 0.350 | 0.010                        | 0.012 | 0.007 | 0.020 | 7.000 |
| Min        | 34.000 | 6.200  | 1.000 | 0.100 | 1.000 | 14.000 | 0.100 | 1.000 | 1.000 | 0.300      | 0.010      | 0.010 | 0.010 | 0.002 | 0.002 | 0.001  | 0.001  | 0.007 | 0.001 | 0.030 | 0.001                        | 0.001 | 0.001 | 0.003 | 4.000 |
| Av         | 48.000 | 9.720  | 1.300 | 0.844 | 1.540 | 18.900 | 0.100 | 2.900 | 2.300 | 0.620      | 0.060      | 0.383 | 0.114 | 0.014 | 0.009 | 0.001  | 0.001  | 0.011 | 0.004 | 0.235 | 0.004                        | 0.002 | 0.003 | 0.006 | 5.400 |
| Median     | 45.500 | 10.000 | 1.000 | 1.000 | 1.650 | 20.500 | 0.100 | 3.000 | 2.500 | 0.500      | 0.010      | 0.325 | 0.075 | 0.007 | 0.006 | 0.001  | 0.001  | 0.010 | 0.001 | 0.300 | 0.001                        | 0.001 | 0.002 | 0.004 | 5.500 |

## Bellbird Creek (Downstream)

| ANZECC     |        |        |       |       |       |        |       |       |       | 0.25<br>Total<br>N | 0.02<br>Total<br>P |       |       | 1.9   | 1.9   | 0.0014 | 0.0034 | 0.008 | 0.011 | 0.055 | 0.024<br>(III) /<br>0.013(V) |       |       |       |       |
|------------|--------|--------|-------|-------|-------|--------|-------|-------|-------|--------------------|--------------------|-------|-------|-------|-------|--------|--------|-------|-------|-------|------------------------------|-------|-------|-------|-------|
|            | TDS    | Na     | Ca    | K     | Mg    | Cl     | F     | SO4   | HCO3  |                    |                    | Fe.T  | Fe.D  | Mn.T  | Mn.D  | Cu     | Pb     | Zn    | Ni    | Al    | As                           | Li    | Ba    | Sr    | DOC   |
| 6/04/2010  | 42     | 11     | 1.6   | 0.3   | 1.7   | 20     | 0.1   | 3     | 3     | 0.4                | 0.01               | 1.5   | 0.01  | 0.08  | 0.06  | 0.001  | 0.001  | 0.008 | 0.01  | 0.01  | 0.01                         | 0.001 | 0.001 | 0.005 | 3     |
| 5/05/2010  | 50     | 13     | 2     | 0.7   | 2.1   | 23     | 0.1   | 3     | 8     | 0.1                | 0.01               | 3.1   | 0.02  | 0.02  | 0.02  | 0.001  | 0.001  | 0.012 | 0.01  | 0.01  | 0.03                         | 0.001 | 0.007 | 0.027 | 2     |
| 11/06/2010 | 34     | 6.4    | 4.1   | 0.1   | 1.3   | 16     | 0.1   | 4     | 3     | 0.1                | 0.01               | 0.06  | 0.07  | 0.01  | 0.01  | 0.001  | 0.001  | 0.016 | 0.01  | 0.04  | 0.01                         | 0.017 | 0.004 | 0.003 | 3     |
| 14/07/2010 | 41     | 12     | 0.8   | 0.1   | 1.5   | 20     | 0.1   | 4     | 4     | 0.5                | 0.01               | 1.7   | 0.03  | 0.02  | 0.02  | 0.001  | 0.001  | 0.007 | 0.01  | 0.04  | 0.01                         | 0.002 | 0.005 | 0.009 | 2     |
| 23/09/2010 | 40     | 11     | 1     | 1     | 1     | 19     | 0.1   | 3     | 1     | 0.2                | 0.01               | 0.15  | 0.16  | 0.016 | 0.016 | 0.001  | 0.001  | 0.005 | 0.001 | 0.21  | 0.001                        | 0.001 | 0.002 | 0.005 | 2     |
| 12/11/2010 | 68     | 10     | 1     | 1     | 1     | 18     | 0.1   | 3     | 1     | 0.6                | 0.01               | 0.19  | 0.14  | 0.013 | 0.014 | 0.001  | 0.001  | 0.008 | 0.001 | 0.21  | 0.001                        | 0.001 | 0.003 | 0.004 | 2     |
| 17/12/2010 | 45     | 8      | 1     | 1     | 1     | 15     | 0.1   | 3     | 2     | 0.2                | 0.01               | 0.14  | 0.08  | 0.01  | 0.009 | 0.001  | 0.001  | 0.006 | 0.001 | 0.22  | 0.001                        | 0.001 | 0.002 | 0.003 | 3     |
| 30/12/2010 | 49     | 8      | 1     | 1     | 1     | 15     | 0.1   | 3     | 1     | 0.8                | 0.15               | 0.58  | 0.3   | 0.014 | 0.012 | 0.001  | 0.001  | 0.005 | 0.001 | 0.18  | 0.001                        | 0.001 | 0.002 | 0.003 | 3     |
| 7/01/2011  | 54     | 9      | 1     | 1     | 1     | 11     | 0.1   | 2     | 4     | 0.1                | 0.01               | 0.72  | 0.61  | 0.022 | 0.021 | 0.001  | 0.001  | 0.008 | 0.001 | 0.14  | 0.001                        | 0.001 | 0.002 | 0.004 | 2     |
| 14/01/2011 | 45     | 10     | 1     | 1     | 1     | 19     | 0.1   | 2     | 2     | 0.1                | 0.02               | 0.81  | 0.54  | 0.017 | 0.017 | 0.001  | 0.001  | 0.007 | 0.001 | 0.19  | 0.001                        | 0.001 | 0.002 | 0.004 | 3     |
| 21/01/2011 | 45     | 10     | 1     | 1     | 1     | 17     | 0.1   | 3     | 2     | 0.1                | 0.01               | 1.1   | 0.73  | 0.023 | 0.021 | 0.001  | 0.001  | 0.005 | 0.001 | 0.15  | 0.001                        | 0.001 | 0.002 | 0.004 | 3     |
| 28/01/2011 | 58     | 11     | 1     | 1     | 1     | 23     | 0.1   | 2     | 3     | 0.1                | 0.02               | 1.16  | 0.78  | 0.028 | 0.024 | 0.001  | 0.001  | 0.007 | 0.001 | 0.15  | 0.001                        | 0.001 | 0.002 | 0.004 | 3     |
| 3/02/2011  | 57     | 11     | 1     | 1     | 1     | 24     | 0.1   | 4     | 2     | 0.2                | 0.1                | 3.1   | 1.3   | 0.069 | 0.001 | 0.001  | 0.001  | 0.005 | 0.001 | 0.13  | 0.001                        | 0.048 | 0.002 | 0.002 | 4     |
| 11/02/2011 | 48     | 11     | 1     | 1     | 1     | 17     | 0.1   | 2     | 2     | 0.1                | 0.03               | 1.04  | 0.57  | 0.032 | 0.029 | 0.001  | 0.001  | 0.006 | 0.001 | 0.12  | 0.001                        | 0.001 | 0.003 | 0.004 | 3     |
| 18/03/2011 | 59     | 12     | 1     | 1     | 1     | 18     | 0.1   | 1     | 1     | 0.6                | 0.01               | 1.94  | 0.34  | 0.053 | 0.052 | 0.001  | 0.001  | 0.006 | 0.001 | 0.05  | 0.001                        | 0.001 | 0.003 | 0.005 | 1     |
|            |        |        |       |       |       |        |       |       |       |                    |                    |       |       |       |       |        |        |       |       |       |                              |       |       |       |       |
| STD DEV    | 8.864  | 1.756  | 0.831 | 0.346 | 0.337 | 3.457  | 0.000 | 0.862 | 1.805 | 0.237              | 0.041              | 0.979 | 0.372 | 0.022 | 0.016 | 0.000  | 0.000  | 0.003 | 0.004 | 0.075 | 0.008                        | 0.013 | 0.002 | 0.006 | 0.737 |
| Max        | 68.000 | 13.000 | 4.100 | 1.000 | 2.100 | 24.000 | 0.100 | 4.000 | 8.000 | 0.800              | 0.150              | 3.100 | 1.300 | 0.080 | 0.060 | 0.001  | 0.001  | 0.016 | 0.010 | 0.220 | 0.030                        | 0.048 | 0.007 | 0.027 | 4.000 |
| Min        | 34.000 | 6.400  | 0.800 | 0.100 | 1.000 | 11.000 | 0.100 | 1.000 | 1.000 | 0.100              | 0.010              | 0.060 | 0.010 | 0.010 | 0.001 | 0.001  | 0.001  | 0.001 | 0.010 | 0.001 | 0.001                        | 0.001 | 0.001 | 0.002 | 1.000 |
| Av         | 49.000 | 10.227 | 1.300 | 0.813 | 1.173 | 18.333 | 0.100 | 2.800 | 2.600 | 0.280              | 0.028              | 1.153 | 0.379 | 0.028 | 0.022 | 0.001  | 0.001  | 0.007 | 0.003 | 0.123 | 0.005                        | 0.005 | 0.003 | 0.006 | 2.600 |
| Median     | 48.000 | 11.000 | 1.000 | 1.000 | 1.000 | 18.000 | 0.100 | 3.000 | 2.000 | 0.200              | 0.010              | 1.040 | 0.300 | 0.020 | 0.020 | 0.001  | 0.001  | 0.007 | 0.001 | 0.140 | 0.001                        | 0.001 | 0.002 | 0.004 | 3.000 |

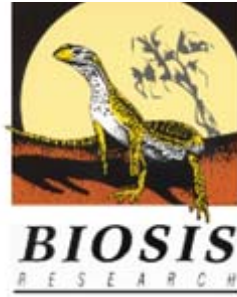
## Swamp P20 Piezometer

| ANZECC     |         |        |       |       |       |        |       |        |       | 0.25    | 0.02    |       |       | 1.9   | 1.9   | 0.0014 | 0.0034 | 0.008 | 0.011 | 0.055 | 0.024 (III)<br>/ 0.013(V) |       |       |       |        |
|------------|---------|--------|-------|-------|-------|--------|-------|--------|-------|---------|---------|-------|-------|-------|-------|--------|--------|-------|-------|-------|---------------------------|-------|-------|-------|--------|
|            | TDS     | Na+    | Ca++  | K+    | Mg++  | Cl-    | F-    | SO4--  | HCO3- | Total N | Total P | Fe.T  | Fe.D  | Mn.T  | Mn.D  | Cu     | Pb     | Zn    | Ni    | Al    | As                        | Li    | Ba    | Sr    | DOC    |
| 20/10/2009 | 92      | 23     | 5.1   | 1.4   | 3.9   | 46     | 0.1   | 7      | 7     | 10      | 0.9     | 2     | 0.05  | 0.11  | 0.09  | 0.004  |        | 0.51  | 0.02  | 0.03  | 0.01                      | 0.001 | 0.31  | 0.025 | 16     |
| 6/04/2010  | 83      | 17     | 6.7   | 1.7   | 3.6   | 43     | 0.1   | 5      | 4     | 0.5     | 0.01    | 2.3   | 0.01  | 0.09  | 0.08  | 0.001  | 0.001  | 0.13  | 0.01  | 0.02  | 0.01                      | 0.001 | 0.004 | 0.009 | 4      |
| 5/05/2010  | 50      | 19     | 2.6   | 0.4   | 2.9   | 39     | 0.1   | 3      | 5     | 0.3     | 0.04    | 1.8   | 0.01  | 0.03  | 0.03  | 0.004  | 0.001  | 1.4   | 0.34  | 0.01  | 0.01                      | 0.001 | 0.009 | 0.015 | 3      |
| 11/06/2010 | 62      | 16     | 6.0   | 0.2   | 2.7   | 40     | 0.1   | 2      | 4     | 0.9     | 0.05    | 1     | 0.04  | 0.03  | 0.01  | 0.084  | 0.021  | 1.3   | 0.14  | 0.04  | 0.01                      | 0.013 | 0.006 | 0.004 | 2      |
| 14/07/2010 | 58      | 18     | 1.6   | 0.1   | 2.8   | 36     | 0.1   | 2      | 5     | 0.5     | 0.04    | 0.61  | 0.01  | 0.06  | 0.05  | 0.1    | 0.003  | 2     | 0.12  | 0.05  | 0.01                      | 0.003 | 0.024 | 0.017 | 2      |
| 12/11/2010 | 55      | 15     | 1     | 1     | 2     | 32     | 0.1   | 2      | 3     | 1.5     | 0.1     | 2.41  | 1.04  | 0.018 | 0.014 | 0.062  | 0.025  | 0.855 | 0.077 | 0.35  | 0.001                     | 0.001 | 0.004 | 0.002 | 3      |
| 17/12/2010 | 240     | 23     | 1     | 1     | 1     | 33     | 0.1   | 2      | 8     | 31.5    | 3       | 5.25  | 3.07  | 0.04  | 0.035 | 0.055  | 0.055  | 0.234 | 0.036 | 4.69  | 0.002                     | 0.001 | 0.043 | 0.013 | 50     |
| 30/12/2010 | 176     | 17     | 2     | 1     | 2     | 32     | 0.1   | 2      | 3     | 3.4     | 0.15    | 6.24  | 2.51  | 0.052 | 0.039 | 0.01   | 0.002  | 0.172 | 0.019 | 0.24  | 0.001                     | 0.001 | 0.004 | 0.012 | 9      |
| 7/01/2011  | 240     | 21     | 2     | 1     | 3     | 29     | 0.1   | 34     | 1     | 7       | 0.03    | 7.7   | 4.53  | 0.051 | 0.042 | 0.016  | 0.013  | 0.22  | 0.028 | 2.57  | 0.001                     | 0.001 | 0.008 | 0.013 | 10     |
| 14/01/2011 | 96      | 17     | 2     | 1     | 2     | 38     | 0.1   | 1      | 4     | 1.6     | 0.02    | 5.4   | 4.6   | 0.033 | 0.032 | 0.006  | 0.003  | 0.22  | 0.024 | 0.38  | 0.001                     | 0.001 | 0.005 | 0.01  | 16     |
| 21/01/2011 | 110     | 21     | 1     | 2     | 2     | 36     | 0.1   | 15     | 1     | 2.8     | 0.03    | 6.43  | 4.1   | 0.034 | 0.027 | 0.004  | 0.002  | 0.16  | 0.021 | 0.29  | 0.001                     | 0.001 | 0.005 | 0.007 | 7      |
| 28/01/2011 | 100     | 19     | 1     | 1     | 2     | 41     | 0.1   | 1      | 7     | 5.3     | 0.05    | 6.12  | 4.01  | 0.032 | 0.023 | 0.009  | 0.002  | 0.238 | 0.025 | 0.28  | 0.001                     | 0.001 | 0.003 | 0.006 | 9      |
|            |         |        |       |       |       |        |       |        |       |         |         |       |       |       |       |        |        |       |       |       |                           |       |       |       |        |
| STD DEV    | 68.085  | 2.657  | 2.065 | 0.561 | 0.810 | 5.035  | 0.000 | 9.557  | 2.229 | 8.488   | 0.834   | 2.474 | 1.988 | 0.514 | 0.517 | 0.035  | 0.016  | 0.623 | 0.092 | 1.380 | 0.005                     | 0.003 | 0.087 | 0.006 | 13.263 |
| Max        | 240.000 | 23.000 | 6.700 | 2.000 | 3.900 | 46.000 | 0.100 | 34.000 | 8.000 | 31.500  | 3.000   | 7.700 | 4.600 | 1.900 | 1.900 | 0.100  | 0.055  | 2.000 | 0.340 | 4.690 | 0.010                     | 0.013 | 0.310 | 0.025 | 50.000 |
| Min        | 50.000  | 15.000 | 1.000 | 0.100 | 1.000 | 29.000 | 0.100 | 1.000  | 1.000 | 0.250   | 0.010   | 0.610 | 0.010 | 0.018 | 0.010 | 0.001  | 0.001  | 0.008 | 0.010 | 0.010 | 0.001                     | 0.001 | 0.003 | 0.002 | 2.000  |
| Av         | 113.500 | 18.833 | 2.667 | 0.983 | 2.492 | 37.083 | 0.100 | 6.333  | 4.333 | 5.042   | 0.342   | 3.938 | 1.998 | 0.191 | 0.182 | 0.027  | 0.011  | 0.573 | 0.067 | 0.693 | 0.005                     | 0.002 | 0.035 | 0.011 | 10.917 |
| Median     | 94.000  | 18.500 | 2.000 | 1.000 | 2.350 | 37.000 | 0.100 | 2.000  | 4.000 | 1.600   | 0.040   | 3.830 | 1.775 | 0.040 | 0.035 | 0.009  | 0.003  | 0.234 | 0.025 | 0.240 | 0.002                     | 0.001 | 0.006 | 0.011 | 8.000  |

## ATTACHMENT C

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**Terrestrial and Aquatic Ecology: Terrestrial and Aquatic Flora and Fauna Assessment NRE Wongawilli Colliery: Longwall 11 End of Panel Report. Biosis Research Pty. Ltd., August 2011**



David Clarkson  
Environment and Community Manager  
Gujarat NRE FCGL Pty. Ltd.  
PO Box 924  
Dapto NSW 2530

19 August 2011

Dear David,

### **NRE Wongawilli Colliery - Longwall 11 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 11 at the Wongawilli Colliery (Figure 1). Coal was extracted from Longwall 11 from the 29<sup>th</sup> of January to the 13<sup>th</sup> of May 2011.

This report includes;

- An outline of monitoring conducted to date;
- Any visual impacts to flora and fauna noted during monitoring;
- An updated table combining the previous Trigger Action Response Plan (TARP) and Monitoring Actions Tables.

Please note an end of panel field inspection has not been conducted. Observations are based on terrestrial ecological monitoring undertaken in April 2011 and aquatic monitoring undertaken in May 2011.

### **Monitoring to Date**

Biosis Research Pty. Ltd. was commissioned by Gujarat NRE FCGL 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 2010, spring 2010 and autumn 2011, while the aquatic ecological monitoring commenced in March 2010 and has been completed for autumn 2010, spring 2010 and autumn 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                                                                                               |
| <b>Vegetation</b>                                               | 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 |
| <b>Amphibians</b>                                               | 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                                                                                                   |
| <b>Winter Threatened Amphibian Surveys*</b>                     | 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                                                                                                   |
| <b>Targeted fauna habitat assessments (e.g. rocky outcrops)</b> | 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                         |
| <b>Aquatic ecology surveys</b>                                  | One sample per creekline. The survey reach for each creekline ranges from 50-150 m depending on the breadth of the waterway. | Macroinvertebrate sampling as per AUSRIVAS methodology. Surveys are conducted twice a year during spring and autumn. | N/A                                                                                                                                     | N/A                                                                                               | N/A                                      | N/A                                                                                                   |



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 and Reptile Monitoring                              |                                     |
|---------------------------------------------------------------------------|-------------------------------------|
| Impact sites                                                              | Reference sites (Figure 2e)         |
| <b>Creek lines (Figure 2a)</b>                                            |                                     |
| Bellbird Creek (BBC) downstream of 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           |
| <b>Upland swamps (Figure 2b)</b>                                          |                                     |
| 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                            |
| <b>Ridgelines (Figure 2c)</b>                                             |                                     |
| 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                     |
| <b>Winter threatened frog surveys (Figure 2d)</b>                         |                                     |
| 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            |
| <b>Aquatic Monitoring</b>                                                 |                                     |
| Impact Sites (Figure 3a)                                                  | Reference Sites (Figure 3b)         |
| Bellbird Creek (BBC-AQ1) downstream of LW 11 , 12 and PE1                 | 8I Creek (8IC-AQ1)                  |
| Wongawilli Creek (WWC-AQ1) downstream of PE1, LW15, 16 and 19             | Easement Creek (EAC-AQ1)            |
| Wongawilli Creek Tributary South (WTS-AQ1) downstream of LW 15, 16 and 19 | Donald's Castle Tributary (DCT-AQ1) |
| Flying Fox Creek (FFC-AQ1) downstream of LW12 and PE1                     |                                     |

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 11 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, appearing to read 'N Garvey', with a stylized flourish at the end.

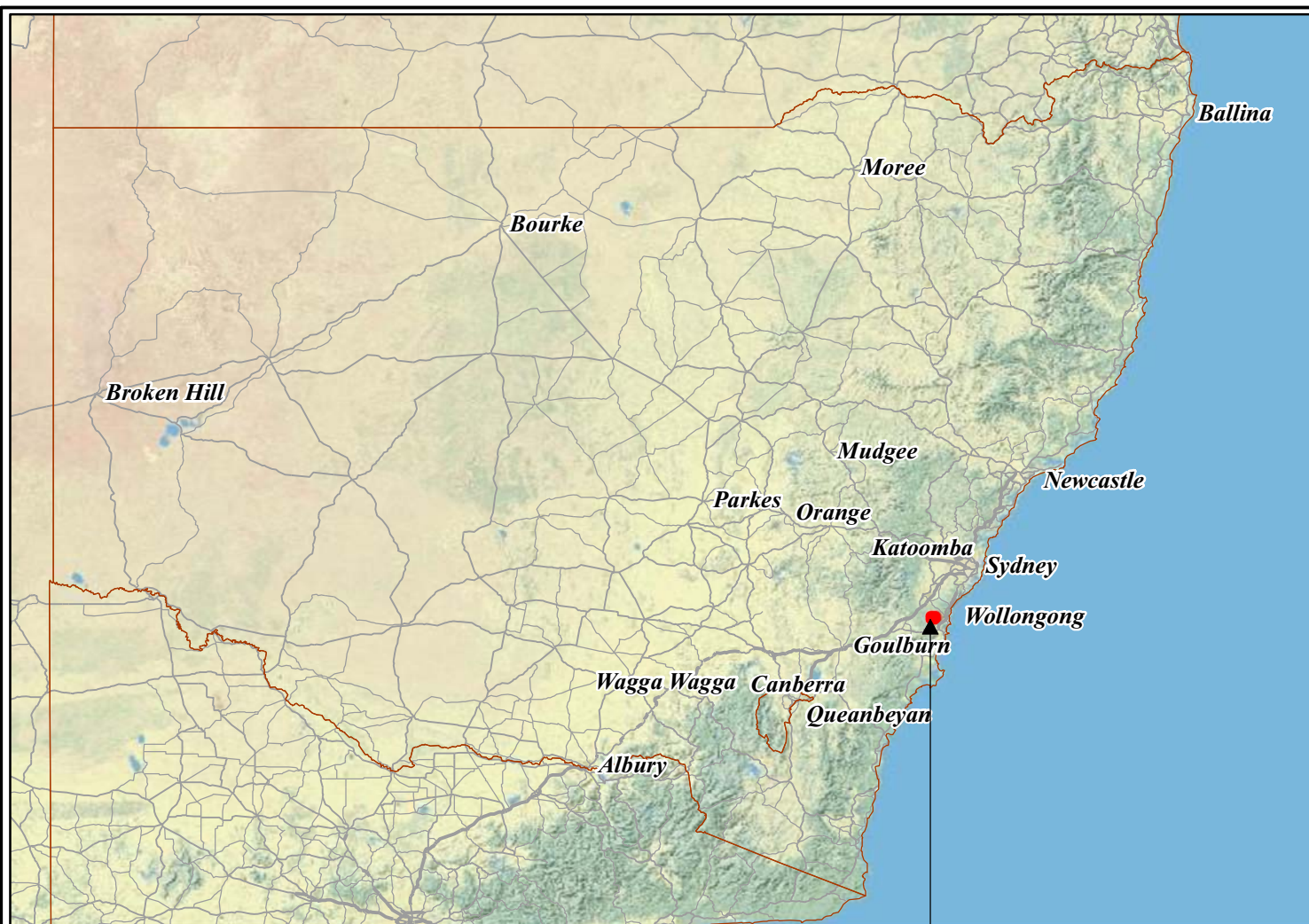
Nathan Garvey  
Wollongong Resource Group Manager

**Table 3 TARP and Monitoring Action Table**

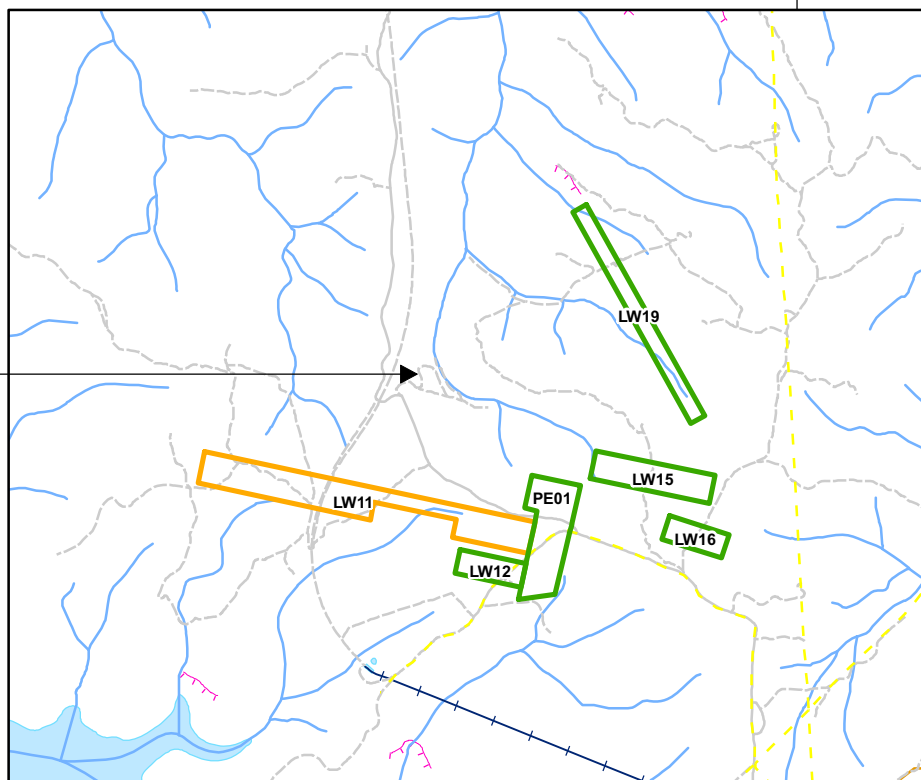
| Feature                                             | ESSMP Monitoring Commitments                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                   | 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 11             |
| <b>Aquatic Ecology</b><br><b>(twice a year)</b>     | <p>Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime</p> <p>(completed)</p> <p>Targeted surveys for threatened aquatic biota in major drainage lines</p> <p>(completed)</p> <p>AUSRIVAS sampling of reference and impact sites in the broader ESSMP Area</p> <p>(completed for LW 11, 15, 16, 19 and PE1 only)</p> | <p>Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime</p> <p>(completed)</p> <p>AUSRIVAS sampling of reference and impact sites in the broader ESSMP Area</p> <p>(ongoing)</p> | <p>Observational monitoring for presence/absence of aquatic habitat during water quality monitoring regime</p> <p>(ongoing)</p> <p>AUSRIVAS sampling of reference and impact sites in the broader ESSMP Area</p> <p>(ongoing)</p> | <p><input type="checkbox"/> Unlikely that any threatened aquatic species would be significantly impacted by subsidence resulting from Longwall mining.</p> <p><input type="checkbox"/> Unlikely to be impacts to aquatic ecology or loss of aquatic habitat</p> | <p><input type="checkbox"/> No impact to aquatic ecology or habitats observed to date</p> | <p><input type="checkbox"/> None anticipated insofar as aquatic biota are concerned. Water flow and quality triggers would appropriate a response for aquatic biota</p>                                                                                 | <p><input type="checkbox"/> None anticipated</p>                                                                                                                                                                                                             | <p><input type="checkbox"/> None required</p> |
| <b>Terrestrial Ecology</b><br><b>(twice a year)</b> |                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                   | <p><input type="checkbox"/></p>                                                                                                                                                                                                                                 | <p><input type="checkbox"/> No impacts observed to date</p>                               | <p><input type="checkbox"/> Observation of mining related impacts to surface</p>                                                                                                                                                                        | <p><input type="checkbox"/> Notification to SCA/NPWS within 24 hrs, using photographic record</p>                                                                                                                                                            | <p><input type="checkbox"/> None required</p> |
| Threatened species                                  | <p>Observational monitoring of identified threatened species – once</p> <p>(completed)</p>                                                                                                                                                                                                                                                                               | <p>Observational monitoring of identified threatened species – twice annually during entire extraction</p> <p>(ongoing)</p>                                                                                                         | <p>Observational monitoring of identified threatened species – annually for one year</p> <p>(ongoing)</p>                                                                                                                         | <p><input type="checkbox"/> Unlikely that any threatened flora would be significantly impacted by subsidence resulting from Longwall mining.</p> <p><input type="checkbox"/> Impacts to threatened amphibian species as reported below .</p>                    | <p><input type="checkbox"/> No impacts observed to date</p>                               | <p><input type="checkbox"/> Major impacts to threatened species to include:</p> <p><input type="checkbox"/> Their habitat; and/or a decline in numbers from baseline observed; and/or</p> <p><input type="checkbox"/> Change in species composition</p> | <p><input type="checkbox"/> Notification to SCA/NPWS immediately</p> <p><input type="checkbox"/> Proposal for threatened species management within 1 week</p> <p><input type="checkbox"/> Completion of management task following approval from SCA/NPWS</p> | <p><input type="checkbox"/> None required</p> |
| Amphibians                                          | <p>Once prior to mining</p> <p>(completed)</p>                                                                                                                                                                                                                                                                                                                           | <p>Twice annually during entire extraction period</p> <p>(ongoing)</p>                                                                                                                                                              | <p>Annually for one year</p> <p>(ongoing)</p>                                                                                                                                                                                     | <p><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.</p>                                                        | <p><input type="checkbox"/> No impacts observed to date</p>                               |                                                                                                                                                                                                                                                         | <p><input type="checkbox"/> Additional monitoring as required by the relevant government agencies</p>                                                                                                                                                        |                                               |
| Swamp and riparian vegetation                       | <p>Once prior to mining</p> <p>(completed)</p>                                                                                                                                                                                                                                                                                                                           | <p>Twice annually during entire extraction period</p> <p>(ongoing)</p>                                                                                                                                                              | <p>Annually for one year</p> <p>(ongoing)</p>                                                                                                                                                                                     | <p><input type="checkbox"/> Minor impacts to Upland Swamp vegetation through change in water levels, and the cracking of soils.</p>                                                                                                                             | <p><input type="checkbox"/> No impacts observed to date</p>                               |                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                              |                                               |

| Feature                                                    | ESSMP Monitoring Commitments                                                          |                                                                                           |                                         | Impact Assessment                                                                                                           |                                                      | TARPS                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                      |
|------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|                                                            | Prior to Mining                                                                       | During Mining                                                                             | Post Mining and Future Monitoring       | Predicted Impacts                                                                                                           | Observed Impacts                                     | Trigger                                                                                                                                                                                                                                     | Response                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Action as a Result of Longwall 11                                                    |
| Ridge top vegetation                                       | Once prior to mining<br>(completed)                                                   | Twice annually during entire extraction period<br>(ongoing)                               | Annually for one year<br>(ongoing)      | <input type="checkbox"/> Rock shelves, outcrops and overhang structures unlikely to be impacted                             | <input type="checkbox"/> No impacts observed to date |                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                      |
| General observations<br>(every second month during mining) | Twice per year<br><br>(Not required due to the relatively small size of the longwall) | Every second month<br><br>(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 | <input type="checkbox"/> Minor cracking (<10mm)<br><br><input type="checkbox"/> Major cracking (>10mm)<br><input type="checkbox"/> Water loss<br><input type="checkbox"/> Flora/Fauna changes<br><input type="checkbox"/> Increased erosion | <input type="checkbox"/> Report to SCA<br><input type="checkbox"/> Additional studies as required<br><input type="checkbox"/> Photographic record<br><input type="checkbox"/> Review of swamp piezometer data<br><br><input type="checkbox"/> Notification to SCA<br><input type="checkbox"/> Remediation options developed in consultation with SCA, which may include further mining limitations<br><input type="checkbox"/> Proposal for rectification within one month<br><input type="checkbox"/> Completion of works following approval from SCA<br><input type="checkbox"/> Additional monitoring as required | <input type="checkbox"/> None required<br><br><input type="checkbox"/> None required |

- Please note that the results of monitoring for 2011/12 are not currently available and have not been included within this report



Study Area



Acknowledgements: This product contains Data which is copyright to the Commonwealth of Australia (c.2003-)



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

Date: 06 September 2011

Drawn By: ANP

File ID: 13561

Checked By: NMG

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Metres





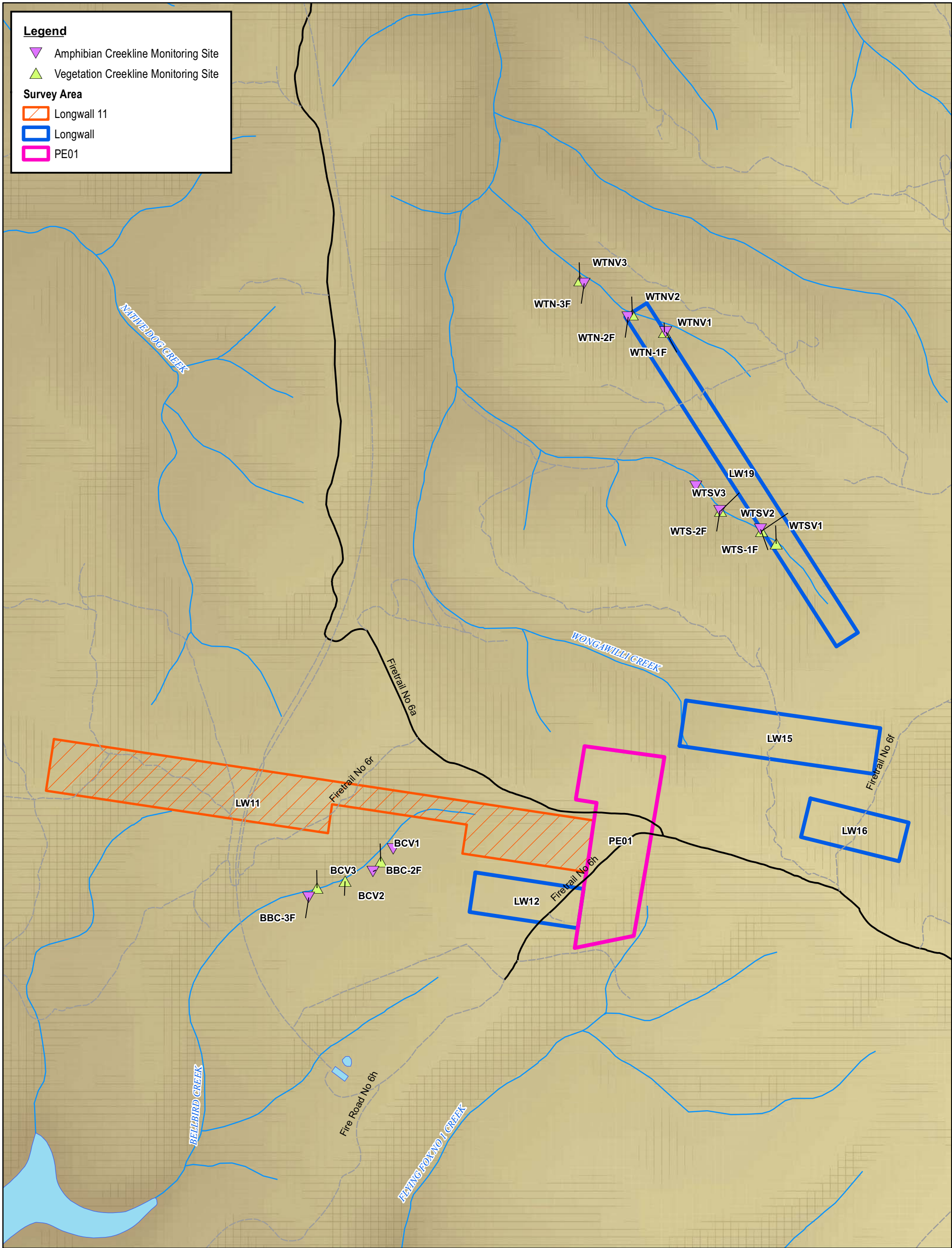


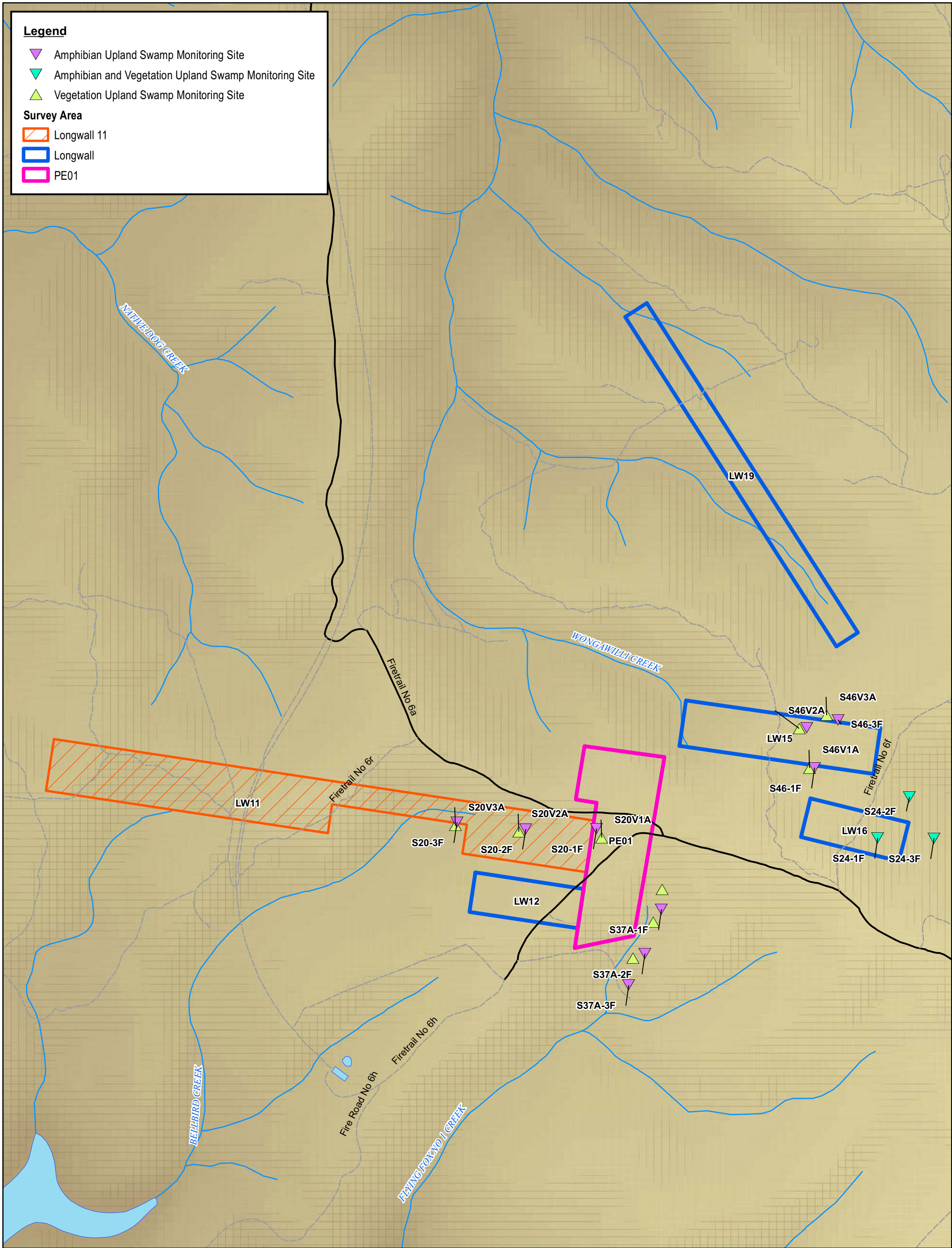
Figure 2a: Vegetation and Amphibian Creekline Monitoring Sites.

|                                                                          |                   |
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| File number: 11892                                                       | Checked by: NMG   |
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Meters

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



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Acknowledgements:  
Background Image provided by NSW Land Planning Management Authority

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

Date: 06 September 2011 Drawn by: ANP/JMS

File number: 11892 Checked by: NMG

Location:P:\13500s\13561\Mapping\Report Figures\  
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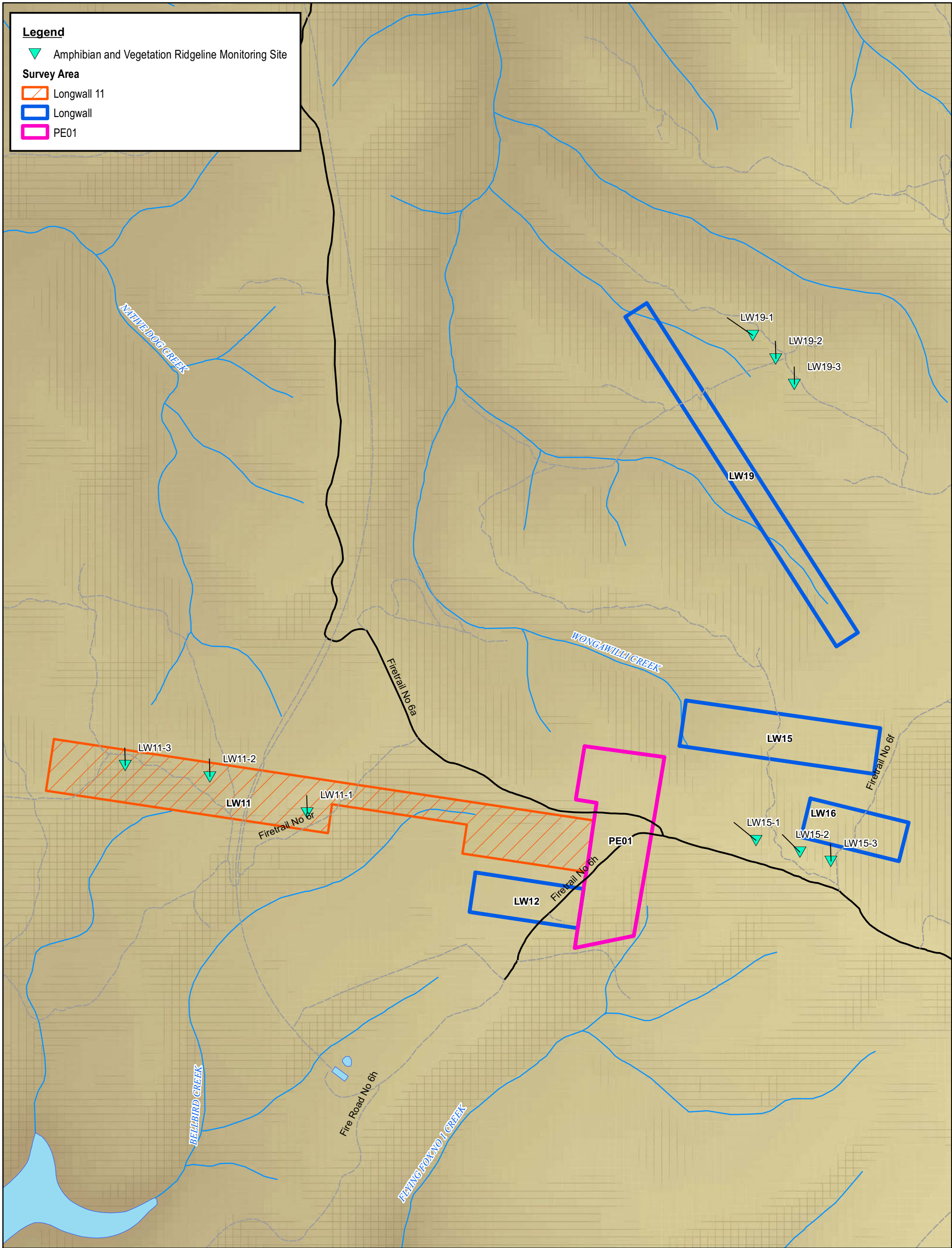
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Map Projection: Transverse Mercator  
Horizontal Datum: Geocentric Datum of Australia 1994  
Grid: Map Grid of Australia, Zone 56



Figure 2b





**Legend**

- Amphibian and Vegetation Ridgeline Monitoring Site

**Survey Area**

- Longwall 11
- Longwall
- PE01

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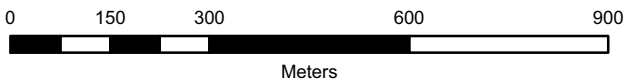
Acknowledgements:  
 Background Image provided by NSW Land Planning Management Authority

Figure 2c: Vegetation and Reptile Ridgeline Monitoring Sites.

Date: 06 September 2011    Drawn by: ANP/JMS

File number: 11892    Checked by: NMG

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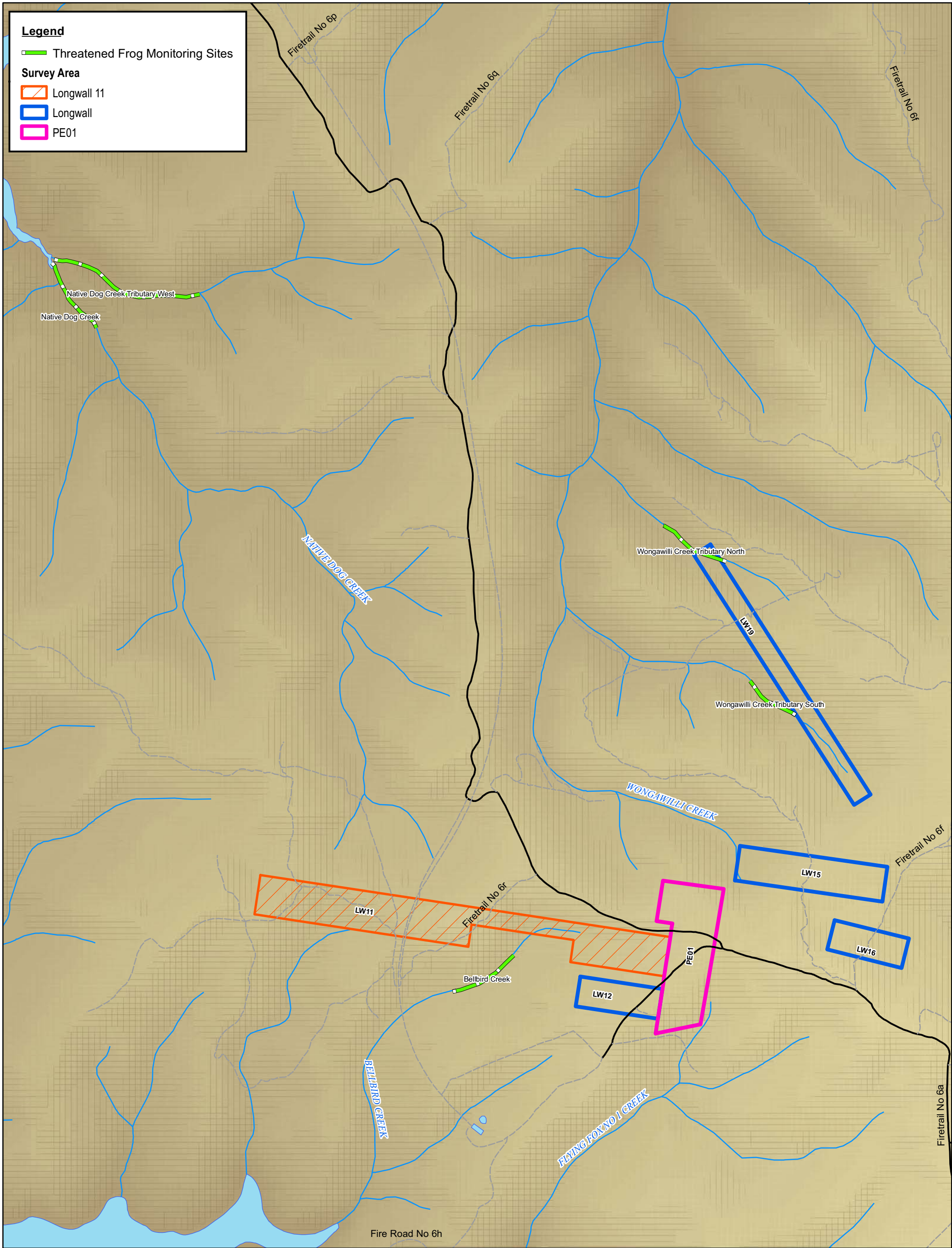


Map Projection: Transverse Mercator  
 Horizontal Datum: Geocentric Datum of Australia 1994  
 Grid: Map Grid of Australia, Zone 56



Figure 2c





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Figure 2d: Vegetation and Amphibian Creekline Monitoring Sites.

Date: 06 September 2011 Drawn by: ANP/JMS

File number: 11892 Checked by: NMG

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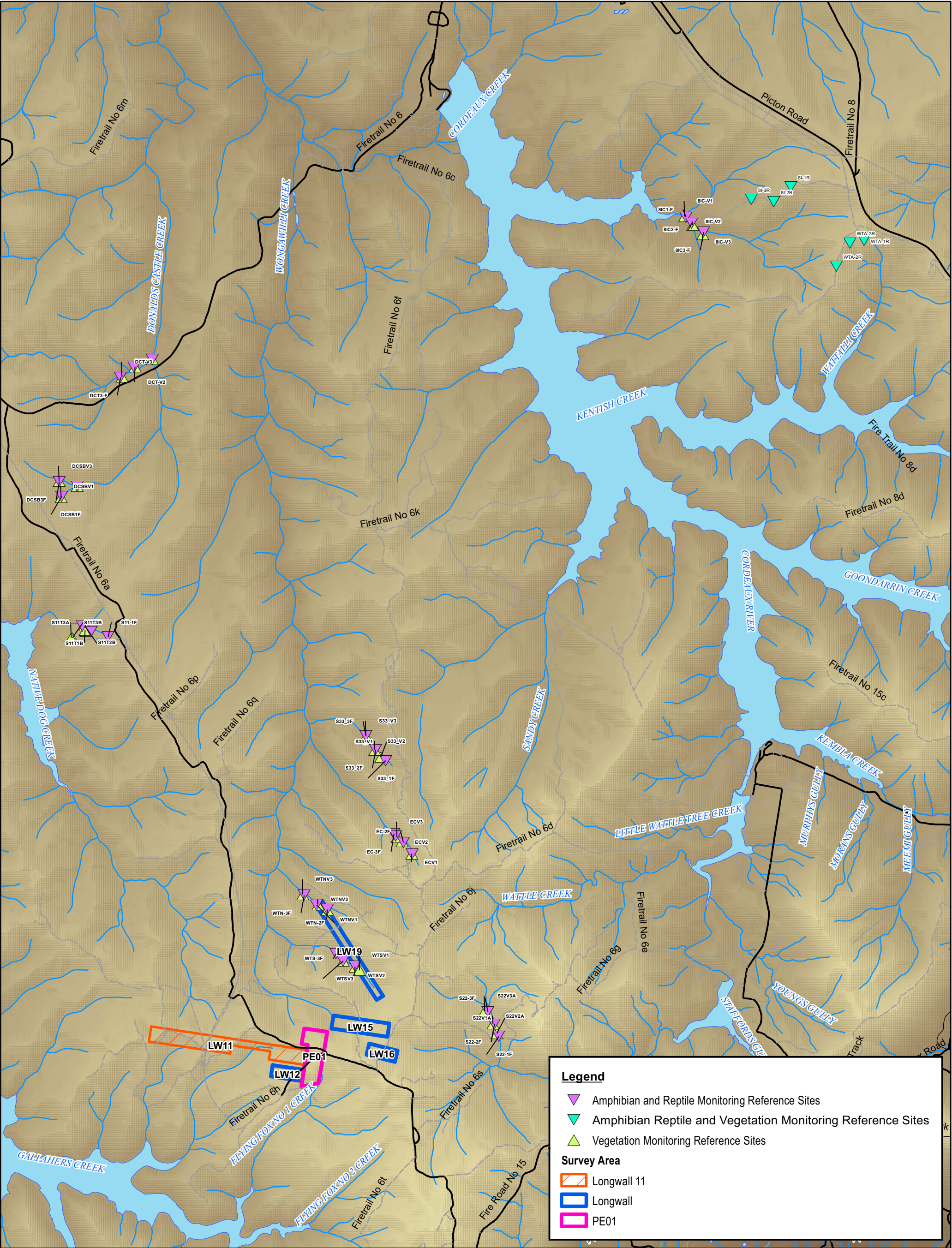
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Map Projection: Transverse Mercator  
Horizontal Datum: Geocentric Datum of Australia 1994  
Grid: Map Grid of Australia, Zone 56



Figure 2d





**Legend**

- Amphibian and Reptile Monitoring Reference Sites
- Amphibian Reptile and Vegetation Monitoring Reference Sites
- Vegetation Monitoring Reference Sites

**Survey Area**

- Longwall 11
- Longwall
- PE01




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

|                                                                          |                   |
|--------------------------------------------------------------------------|-------------------|
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| File number: 11892                                                       | Checked by: NMG   |
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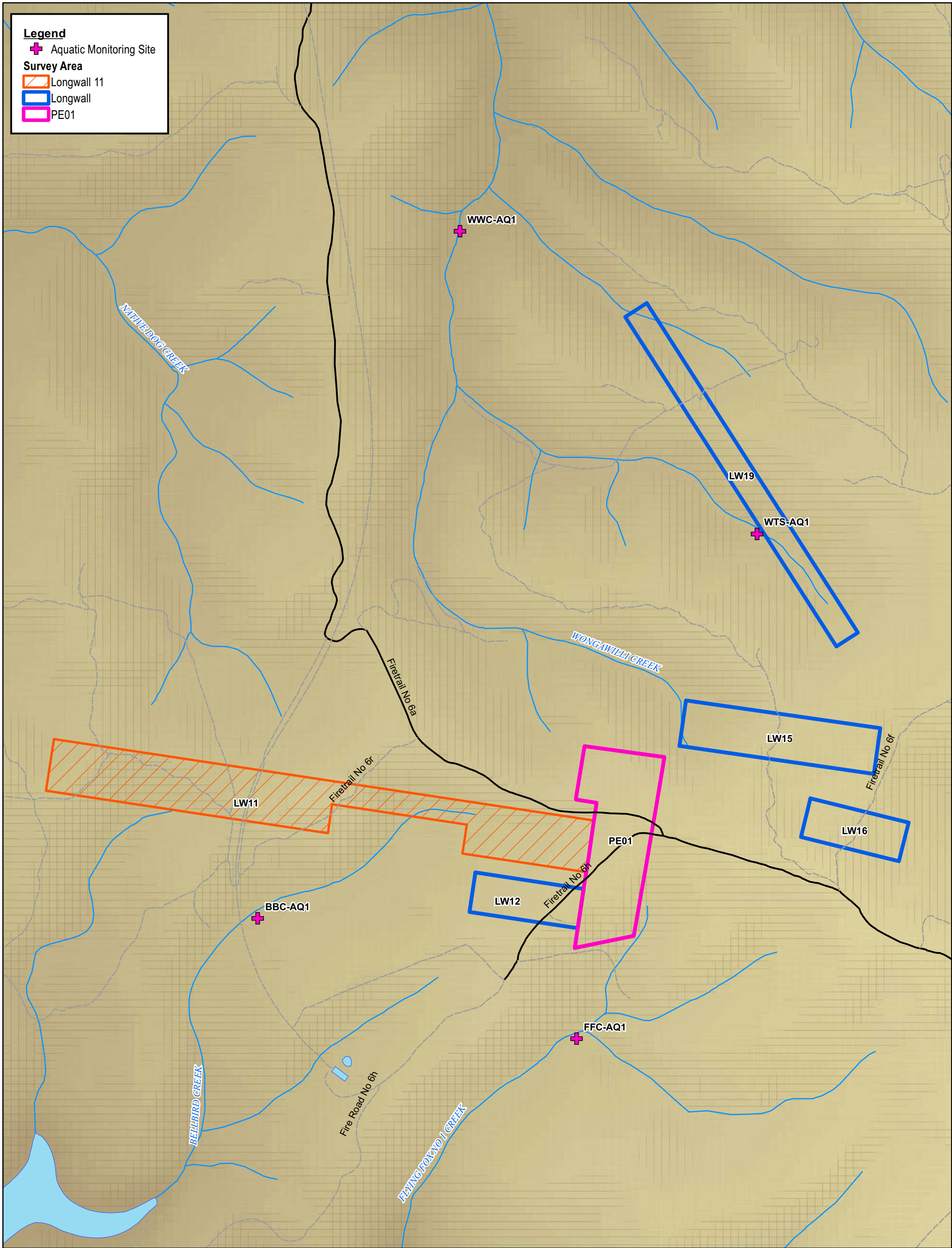
Meters

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



Figure 2e





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Figure 3a: Aquatic Monitoring Sites.

Date: 06 September 2011 Drawn by: JMS/ANP

File number: 11892 Checked by: NMG

Location: P:\13500s\13561\Mapping\Report Figures\  
13561 F3a\_Aquatic Monitoring.mxd

0 150 300 600 900  
Metres

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



Figure 3a



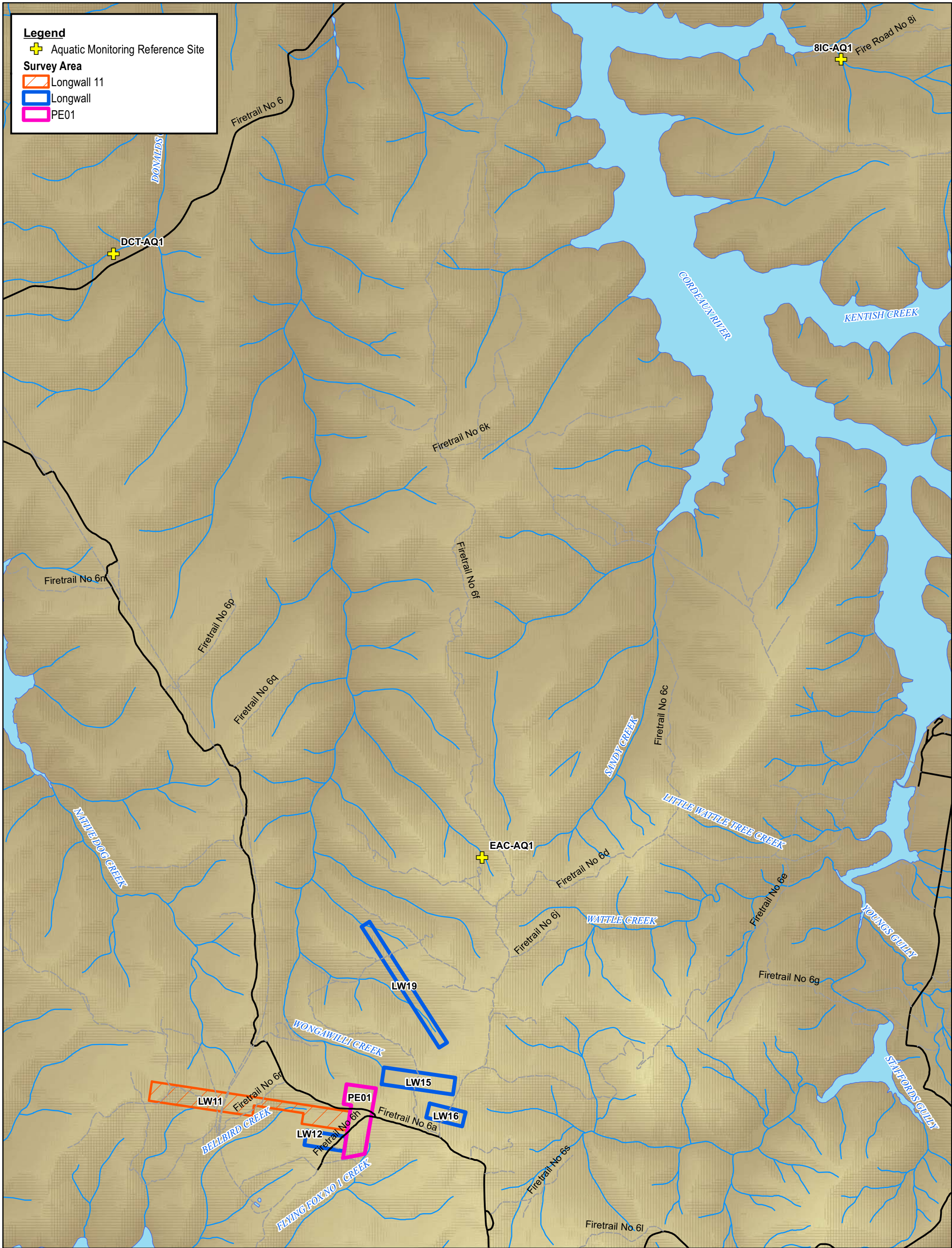


Figure 3b: Aquatic Monitoring Reference Sites.

Date: 06 September 2011 Drawn by: JMS/ANP

File number: 11892 Checked by: NMG

Location: P:\13500s\13561\Mapping\Report Figures\  
13561 F3b\_Aquatic Monitoring.mxd

0 0.38 0.76 1.52 2.28  
Kilometers

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



Figure 3b

## ATTACHMENT D

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Cultural Heritage: Longwall 11 - Aboriginal Archaeological Sites  
Assessment End of Panel Report. Biosis Research Pty. Ltd., August  
2011



David Clarkson  
Environment and Community Manager  
Gujarat NRE FCGL Pty. Ltd.  
PO Box 924  
Dapto NSW 2530

16 August 2011

Dear David,

**NRE Wongawilli Colliery - Longwall 11 End of Panel Report**

This report assesses the post mining conditions with relation to Indigenous heritage sites within the area potentially impacted by Longwall 11 of the Wongawilli Colliery. Coal was extracted from Longwall 11 from the 29<sup>th</sup> of January to the 13<sup>th</sup> of May 2011. Baseline recording and 3 to 6 month post-mining monitoring has been undertaken for the following Indigenous Heritage sites:

- 52-2-0966/3096 (Native Dog Creek Shelter);
- 52-2-1825 (Upper Avon 2);
- 52-2-1826 (Upper Avon 3);
- 52-2-1801 (Upper Avon 4); and,
- 52-2-1763 (Upper Avon 27).

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,

Asher Ford  
Consultant Archaeologist

*Biosis Research Pty. Ltd. A.B.N. 65 006 175 097 A.C.N. 006 175 097  
8 Tate Street Wollongong NSW 2500  
Phone: (02) 4229 5222 Fax (02) 4229 5500  
Email: wollongong@biosisresearch.com.au*



**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 11      |
| <b>Indigenous Heritage Sites</b><br><br><b>(Inspect once prior to, during and post mining)</b> | Record significant heritage items once prior to mining (completed)<br><br>Site nominated in CHMP are:<br>- Native Dog Creek Shelter<br>- Upper Avon 27<br>- Upper Avon 2<br>- Upper Avon 3<br>- Upper Avon 4 | Once for observed impacts such as:<br><br>Cracking, opening of bedding planes, blockfalls, exfoliation, water seepage changes. | <input type="checkbox"/> 3-6 months post mining<br><br><input type="checkbox"/> 2 years post mining | <input type="checkbox"/> Native Dog Creek Shelter - Very Low risk<br><br><input type="checkbox"/> Upper Avon 27-- Very Low risk<br><br><input type="checkbox"/> Upper Avon 2- Very Low risk<br><br><input type="checkbox"/> Upper Avon 3- Low risk<br><br><input type="checkbox"/> Upper Avon 4- Very 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)<br><br><input type="checkbox"/> Report impacts as required<br><br><input type="checkbox"/> Notify DECCW, DRE NSW, SCA<br><br><input type="checkbox"/> Review and undertake remediation options as appropriate | <input type="checkbox"/> None required |