UG1 LONGWALLS 101 TO 103
BUILT FEATURES
MANAGEMENT PLAN
TRANSGRID

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<th>Issue Date</th>
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<th>Description</th>
<th>Author(s)</th>
<th>Review Team</th>
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<td>Approved</td>
<td>MCO and MSEC</td>
<td>Environmental Department</td>
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Approved: S. Archinal  
Date: 21/9/2017

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<tr>
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<td>S. Archinal</td>
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Attachment 2  MSEC (2017b) Supplementary Report – Moolarben Coal Operations – Longwalls 101 to 103 – Subsidence Predictions and Impact Assessments for the TransGrid Infrastructure
Attachment 3  UG1 Longwalls 101 to 103 Built Features Management Plan – TransGrid Trigger Action Response Plan
Attachment 4  UG1 Longwalls 101 to 103 Built Features Management Plan – TransGrid Subsidence Impact Register
1.0 INTRODUCTION

The Moolarben Coal Complex is an open cut and underground coal mining operation located approximately 40 kilometres north of Mudgee in the Western Coalfield of New South Wales (NSW) (Figure 1).

Moolarben Coal Operations Pty Ltd (MCO) is the operator of the Moolarben Coal Complex on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Sojitz Moolarben Resources Pty Ltd and a consortium of Korean power companies). MCO and MCM are wholly owned subsidiaries of Yancoal Australia Limited.

The UG1 Underground Mine is a component of the approved Moolarben Coal Complex (Figure 2). The UG1 Underground Mine commenced first workings in April 2016 and is scheduled to commence secondary workings (longwall extraction) in October 2017 by longwall mining methods from the Ulan Seam within Mining Lease (ML) 1605, ML 1606, ML 1628, ML 1691 and ML 1715 (Figure 3).

Mining operations at the Moolarben Coal Complex are currently approved until 31 December 2038 and would continue to be carried out in accordance with Project Approval (05_0117) (Moolarben Coal Project Stage 1) as modified and Project Approval (08_0135) (Moolarben Coal Project Stage 2) as modified, granted under the NSW Environmental Planning and Assessment Act, 1979 (EP&A Act).

This UG1 Longwalls 101 to 103 Built Features Management Plan – TransGrid (LW101-103 BFMP-TRANSGRID) forms a part of the Extraction Plan being developed for Longwalls 101 to 103 (herein referred to as Longwalls 101-103) of the approved UG1 Underground Mine.

1.1 PURPOSE AND SCOPE

Purpose: This LW101-103 BFMP-TRANSGRID outlines the management of potential subsidence impacts of the proposed secondary workings described in the Extraction Plan on the existing 330 kilovolt (kV) electricity transmission line (ETL).

Scope: This LW101-103 BFMP-TRANSGRID covers the section of the 330 kV ETL in the vicinity of the Study Area1 (i.e. between Towers 102 and 111), which relates to the extent of subsidence effects resulting from the secondary extraction of Longwalls 101-103 (Figure 4). This LW101-103 BFMP-TRANSGRID will be reviewed and updated, prior to the secondary extraction of Longwalls 104 and 105.

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1 Longwalls 101-103 and the area of land within the furthest extent of the 26.5 degree (°) angle of draw and 20 millimetres (mm) predicted subsidence contour. The TransGrid assets are not located within the Study Area.
Figure 1

Source: NSW Land & Property Information (2015); NSW Department of Industry (2016); Office of Environment and Heritage NSW (2016)
Figure 2

LEGEND
- Exploration Licence Boundary
- Mining Lease Boundary
- Haul Road
- Approved Road Realignment (not yet constructed)
- Existing/Approved Development
- Open Cut Mining Area
- Out-of-pit Emplacement
- Surface Infrastructure Area
- Underground Longwall Layout
- Direction of Longwall Mining
- Longwalls 101 to 103 Study Area

Source: MCO (June 2016); NSW Dept of Industry (2016)
Figure 3

Source: MCO (June 2016); NSW Dept of Industry (2016)
1.2 SUITABLY QUALIFIED AND EXPERIENCED PERSONS

In accordance with Condition 5(a), Schedule 4 of Project Approval (08_0135), the suitably qualified and experienced persons that have prepared this LW101-103 BFMP-TRANSGRID, namely representatives from Mine Subsidence Engineering Consultants (MSEC) and MCO were endorsed by the Secretary of the Department of Planning and Environment (DP&E).

This LW101-103 BFMP-TRANSGRID has been prepared in consultation with TransGrid (Section 4.4).

A list of the key responsibilities of MCO personnel in relation to this LW101-103 BFMP-TRANSGRID, and a list of key contacts, is provided in Section 11.

1.3 STRUCTURE OF THE LONGWALLS 101-103 BFMP-TRANSGRID

The remainder of the LW101-103 BFMP-TRANSGRID is structured as follows:

Section 2: Describes the review and update of the LW101-103 BFMP-TRANSGRID.
Section 3: Outlines the statutory requirements applicable to the LW101-103 BFMP-TRANSGRID.
Section 4: Provides baseline data, extraction schedule, revised assessment of the potential subsidence impacts and environmental consequences for Longwalls 101-103, as well as the outcomes of the risk assessment.
Section 5: Details the performance measures relevant to TransGrid assets.
Section 6: Describes the monitoring program.
Section 7: Describes the management measures that will be implemented.
Section 8: Details the performance indicators that will be used to assess against the performance measures.
Section 9: Provides a contingency plan to manage any unpredicted impacts and their consequences.
Section 10: Describes the Trigger Action Response Plan (TARP) management tool.
Section 11: Describes the roles and responsibilities for MCO personnel and key contacts.
Section 12: Describes the program to collect sufficient baseline data for future Extraction Plans.
Section 13: Describes the Annual Review, audits, regular reporting and improvement of environmental performance.
Section 14: Outlines the management and reporting of incidents.
Section 15: Outlines the management and reporting of complaints.
Section 16: Outlines the management and reporting of non-compliances with statutory requirements.
Section 17: Lists the references cited in this LW101-103 BFMP-TRANSGRID.
2.0 LONGWALLS 101 TO 103 BFMP-TRANSGRID REVIEW AND UPDATE

In accordance with Condition 5, Schedule 6 of Project Approval (08_0135), this LW101-103 BFMP-TRANSGRID will be reviewed within three months of the submission of:

- an Annual Review under Condition 4, Schedule 6;
- an incident report under Condition 7, Schedule 6;
- an audit under Condition 9, Schedule 6; or
- any modification to the conditions of Project Approval (08_0135) or Project Approval (05_0117) (unless the conditions require otherwise); and

if necessary, revised to the satisfaction of the Secretary of the DP&E to ensure the plan is updated on a regular basis and to incorporate any recommended measures to improve environmental performance. Where this review leads to revisions to the LW101-103 BFMP-TRANSGRID, then within four weeks of the review, the revised LW101-103 BFMP-TRANSGRID will be submitted to the Secretary of the DP&E for approval.

2.1 ACCESS TO INFORMATION

In accordance with Condition 11, Schedule 6 ‘Access to Information’, MCO will make the approved LW101-103 BFMP-TRANSGRID publicly available on the MCO website.
3.0 STATUTORY REQUIREMENTS

MCO’s statutory obligations are contained in:

- the conditions of the NSW Project Approval (05_0117) (as modified) and NSW Project Approval (08_0135) (as modified);
- the conditions of Commonwealth Approvals (EPBC 2007/3297, EPBC 2013/6926 and EPBC 2008/4444);
- relevant licences and permits, including conditions attached to the Environment Protection Licence (EPL) No. 12932 and MLs (i.e. ML 1605, ML 1606, ML 1628, ML 1691 and ML 1715); and
- other relevant legislation.

Obligations relevant to this LW101-103 BFMP-TRANSGRID are described below.

3.1 EP&A ACT APPROVAL

Condition 5(g), Schedule 4 of Project Approval (08_0135) requires the preparation of a Built Features Management Plan as a component of the Extraction Plan. In addition, Conditions 3, 5(n), 5(p) and 6, Schedule 4 and Condition 3, Schedule 6 of Project Approval (08_0135) outline general management plan requirements that are applicable to the preparation of this LW101-103 BFMP-TRANSGRID.

Table 1 presents these requirements and indicates where they are addressed within this LW101-103 BFMP-TRANSGRID.
Table 1: Management Plan Requirements

<table>
<thead>
<tr>
<th>Condition 3, Schedule 4</th>
<th>Project Approval (08_0135) Condition</th>
<th>LW101-103 BFMP-TRANSGRID Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The Proponent will be required to define more detailed performance indicators for each of these performance measures in Built Features Management Plans or Public Safety Management Plan (see condition 5 below).</td>
<td>Section 8</td>
<td></td>
</tr>
<tr>
<td>• Measurement and/or monitoring of compliance with performance measures and performance indicators is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans. In the event of a dispute over the appropriateness of proposed methods, the Secretary will be the final arbiter.</td>
<td>Sections 5, 6 &amp; 8</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td>Section 9</td>
</tr>
<tr>
<td>• Requirements under this condition may be met by measures undertaken in accordance with the Mine Subsidence Compensation Act 1961.</td>
<td></td>
<td></td>
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<tr>
<td>...</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition 5(g), Schedule 4</th>
<th></th>
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<tbody>
<tr>
<td>(g) include a Built Features Management Plan, which has been prepared in consultation with DRE and the owners of affected public infrastructure, to manage the potential subsidence impacts and/or environmental consequences of the proposed second workings, and which:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• addresses in appropriate detail all items of key public infrastructure and other public infrastructure and all classes of other built features;</td>
<td>Section 4.1</td>
<td></td>
</tr>
<tr>
<td>• has been prepared following appropriate consultation with the owner/s of potentially affected feature/s;</td>
<td>Section 4.4</td>
<td></td>
</tr>
<tr>
<td>• recommends appropriate remedial measures and includes commitments to mitigate, repair, replace or compensate all predicted impacts on potentially affected built features in a timely manner; and</td>
<td>Sections 7 &amp; 9</td>
<td></td>
</tr>
<tr>
<td>• in the case of all key public infrastructure, and other public infrastructure except roads, trails and associated structures, reports external auditing for compliance with ISO 31000 (or alternative standard agreed with the infrastructure owner) and provides for annual auditing of compliance and effectiveness during extraction of longwalls which may impact the infrastructure;</td>
<td>Section 13.1</td>
<td></td>
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<table>
<thead>
<tr>
<th>Condition 5(n), Schedule 4</th>
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<tr>
<td>(n) include a contingency plan that expressly provides for adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Tables 18 and 19, or where any such exceedance appears likely; ...</td>
<td>Section 9</td>
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<table>
<thead>
<tr>
<th>Condition 5(p), Schedule 4</th>
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<td>(p) include a program to collect sufficient baseline data for future Extraction Plans.</td>
<td>Section 12</td>
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<tr>
<th>Condition 6, Schedule 4</th>
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<tr>
<td>6. The Proponent shall ensure that the management plans required under conditions 5(g)-(l) above include:</td>
<td></td>
<td></td>
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<tr>
<td>a) an assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval; and</td>
<td>Section 4 and 6.3</td>
<td></td>
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<tr>
<td>b) a detailed description of the measures that would be implemented to remediate predicted impacts.</td>
<td>Section 7</td>
<td></td>
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Document | Version | Issue | Effective | Review | Author | Approved
---|---------|-------|-----------|--------|--------|-------
MCO_BFMP_TRANSGRID | 1 | Sept 2017 | Sept 2017 | Sept 2018 | MCO | S. Archinal
Table 1 (Continued): Management Plan Requirements

<table>
<thead>
<tr>
<th>Condition 3, Schedule 6</th>
<th>Project Approval (08_0135) Condition</th>
<th>LW101-103 BFMP-TRANSGRID Section</th>
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<tr>
<td>3. The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) detailed baseline data;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) a description of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• the relevant statutory requirements (including any relevant approval, licence or lease conditions);</td>
<td>Sections 3 and 4.4</td>
<td></td>
</tr>
<tr>
<td>• the relevant limits or performance measures/criteria;</td>
<td></td>
<td>Section 3</td>
</tr>
<tr>
<td>• the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;</td>
<td></td>
<td>Section 5</td>
</tr>
<tr>
<td>c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;</td>
<td></td>
<td>Section 8</td>
</tr>
<tr>
<td>d) a program to monitor and report on the:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• impacts and environmental performance of the project;</td>
<td></td>
<td>Sections 6, 8 &amp; 13</td>
</tr>
<tr>
<td>• effectiveness of any management measures (see c above);</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) a contingency plan to manage any unpredicted impacts and their consequences;</td>
<td></td>
<td>Section 9</td>
</tr>
<tr>
<td>f) a program to investigate and implement ways to improve the environmental performance of the project over time;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>g) a protocol for managing and reporting any:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• incidents;</td>
<td></td>
<td>Section 14</td>
</tr>
<tr>
<td>• complaints;</td>
<td></td>
<td>Section 15</td>
</tr>
<tr>
<td>• non-compliances with statutory requirements; and</td>
<td></td>
<td>Section 16</td>
</tr>
<tr>
<td>• exceedances of the impact assessment criteria and/or performance criteria; and</td>
<td></td>
<td>Section 9</td>
</tr>
<tr>
<td>h) a protocol for periodic review of the plan.</td>
<td></td>
<td>Section 2</td>
</tr>
</tbody>
</table>

3.2 OTHER LEGISLATION

MCO will operate the Moolarben Coal Complex consistent with Project Approval (08_0135) and any other legislation that is applicable to an approved Part 3A Project under the EP&A Act.

The following Acts may be applicable to, but are not limited to, the conduct of the Moolarben Coal Complex:

- **Crown Lands Act, 1989;**
- **Fisheries Management Act, 1994;**
- **Heritage Act, 1977;**
- **Mine Subsidence Compensation Act, 1961;**
- Mining Act, 1992;
- National Parks and Wildlife Act, 1974;
- Biodiversity Conservation Act, 2016;
- Protection of the Environment Operations Act, 1997;
- Roads Act, 1993;
- Water Act, 1912;
- Water Management Act, 2000;
- Work Health and Safety Act, 2011; and

Relevant licences or approvals required under these Acts will be obtained as required.
4.0 TRANSGRID 330 KV ELECTRICITY TRANSMISSION LINE

4.1 BASELINE DATA

A 330 kV ETL (Wollar-Wellington 330 kV High Voltage Line) owned by TransGrid runs adjacent to Ulan-Wollar Road and the Sandy Hollow Gulgong Railway Line and is shown on Figure 4.

The 330 kV ETL and towers are located to the north and east of Longwalls 101-103 and the longwalls will not pass beneath these electrical services. The distances from the towers to the nearest longwalls are summarised in Table 2 below.

<table>
<thead>
<tr>
<th>Tower Number</th>
<th>Tower Type</th>
<th>Nearest Longwall</th>
<th>Approximate Distance of the Transmission Towers Centrelines from the Nearest Longwalls (m)</th>
<th>Distance Divided by Depth of Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td>Suspension</td>
<td>Longwall 103</td>
<td>960</td>
<td>8.7</td>
</tr>
<tr>
<td>103</td>
<td>Suspension</td>
<td>Longwall 103</td>
<td>690</td>
<td>6.3</td>
</tr>
<tr>
<td>104</td>
<td>Suspension</td>
<td>Longwall 103</td>
<td>650</td>
<td>5.9</td>
</tr>
<tr>
<td>105</td>
<td>Suspension</td>
<td>Longwall 102</td>
<td>635</td>
<td>5.3</td>
</tr>
<tr>
<td>106</td>
<td>Tension</td>
<td>Longwall 101</td>
<td>620</td>
<td>4.8</td>
</tr>
<tr>
<td>107</td>
<td>Suspension</td>
<td>Longwall 101</td>
<td>390</td>
<td>3.0</td>
</tr>
<tr>
<td>108</td>
<td>Suspension</td>
<td>Longwall 101</td>
<td>340</td>
<td>2.6</td>
</tr>
<tr>
<td>109</td>
<td>Suspension</td>
<td>Longwall 101</td>
<td>550</td>
<td>4.2</td>
</tr>
<tr>
<td>110</td>
<td>Tension</td>
<td>Longwall 101</td>
<td>765</td>
<td>5.9</td>
</tr>
<tr>
<td>111</td>
<td>Suspension</td>
<td>Longwall 101</td>
<td>910</td>
<td>7.0</td>
</tr>
</tbody>
</table>

m = metres

Photographs of the 330 kV suspension tower and tension tower types are shown in Plates 1 and 2. The nearest tension tower is located 620 m to the north-east of the northern corner of Longwall 101. The nearest suspension tower is located approximately 340 m to the north of the northern corner of Longwall 101.
4.2 LONGWALLS 101-103 EXTRACTION SCHEDULE

The 330 kV ETL is located to the north and east of the Study Area for Longwalls 101-103 (Figure 4) and will be subject to small far field subsidence effects.

Longwalls 101-103 and the area of land within the furthest extent of the 26.5° angle of draw and 20 mm predicted subsidence contour (i.e. the Longwalls 101-103 Study Area) are shown on Figures 3 and 4. Longwall extraction will occur from the west to the east. The longwall layout includes approximately 311 m panel widths (void) with 20 m pillars (solid).

The provisional extraction schedule for Longwalls 101-103 is provided in Table 3.

<table>
<thead>
<tr>
<th>Longwall</th>
<th>Estimated Start Date</th>
<th>Estimated Duration</th>
<th>Estimated Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>October 2017</td>
<td>10 months</td>
<td>August 2018</td>
</tr>
<tr>
<td>102 (A+B)</td>
<td>October 2018</td>
<td>12 months</td>
<td>October 2019</td>
</tr>
<tr>
<td>103</td>
<td>November 2019</td>
<td>10 months</td>
<td>September 2020</td>
</tr>
</tbody>
</table>
Following approval of the UG1 Optimisation Modification in April 2016, MCO has delineated a geological feature in Longwall 102 that prevents economic mining of this section, and has subsequently revised the longwall layout to incorporate a barrier pillar around this feature. The barrier pillar separating Longwalls 102A and 102B is approximately 140 m in length. In addition, following further detailed design, Longwalls 101-103 have been shortened by approximately 70 m to provide safe operational conveyor distance between the end of the longwalls and main headings. With the exception of these changes, the longwall geometry is the same as that for the approved UG1 Optimisation Modification, and MSEC (2017a) concludes that the overall impact assessments for the natural and built features are unchanged or reduced.

4.3 REVISED SUBSIDENCE AND IMPACT PREDICTIONS

Subsidence and impact predictions for Longwalls 101-105 in relation to the TransGrid assets was conducted by MSEC (2015) as part of the Moolarben Coal Complex UG1 Optimisation Modification Environmental Assessment (EA) and was summarised as follows:

As the 330kV transmission line is located well outside the UG1 Study Area, no systematic subsidence parameters are provided for the 330kV transmission line. However, some of the 330kV towers may experience small far field horizontal movements of up to 120 mm. These far-field horizontal movements tend to be bodily movements towards the extracted goaf area and are accompanied by very low levels of strain. Hence, the differential far field movements due to the proposed extraction of the UG1 longwalls between the legs of the towers are expected to be very small and are unlikely to adversely impact on the towers.

Revised subsidence and impact predictions specifically for the extraction of Longwalls 101-103 on TransGrid assets were conducted by MSEC and reported in MSEC (2016) (Attachment 1). Subsequent to the preparation of MSEC (2016), the longwall layout was revised to incorporate a reduced longwall length and shorter barrier pillar (Section 4.2). MSEC (2017a) includes updated subsidence predictions for the revised layout. As the asset is located further from Longwalls 101-103, a reduced impact is predicted by MSEC (2017a) compared to MSEC (2016).

In relation to subsidence predictions, MSEC (2016; 2017a) makes the following conclusions:

- Cables can be affected by changes in bay lengths (i.e. the distances between the towers at the level of the cables) which result from differential movements.
- The stability of the tower structures can be affected by mining induced tilts, curvatures and ground strains and by changes in the catenary profiles of the cables.
- Given the nearest tower of the 330 kV ETL is approximately 340 m or more from the finishing end of Longwalls 101-103, the towers will not be subjected to measurable conventional vertical mine subsidence ground movements (i.e. less than limits of survey accuracy [<20 mm]).
• As the towers will not be subjected to measurable conventional vertical subsidence, tilt, curvature or strain, it is unlikely that conventional movements would result in adverse impacts on the transmission line.

• The tower structures may, however, experience some far-field horizontal movements of up to 70 mm towards Longwalls 101-103.

• With the alignment of the towers around the northern corner of the longwalls at the nearest point, the predicted horizontal movements are expected to result in a net shortening of the distances between the towers, with a maximum predicted shortening between Towers 107 and 108 of 50 mm. The towers located the furthest distances from the longwalls may experience minor net opening.

• The existing open cut (OC1) will significantly reduce the potential for far-field movements.

• The presence of unconsolidated Tertiary sediments (in the north-east) should result in further reducing the potential for far-field movements to develop at the tower structures.

• Notwithstanding, even very low tilts and strains at the base of the 330 kV ETL tower structures may induce a greater arc of travel at the top of the towers, and thus monitoring and management measures have been developed (Sections 6 and 7, respectively).

It is expected that any potential impacts on the 330 kV ETL could be managed using typical mitigation and management techniques for such ETLs (Section 7). Following the risk assessment held on 24 March 2017, MSEC provided a supplementary report incorporating additional detailed predictions that were requested by TransGrid (Attachment 2). MSEC (2017b) makes the following conclusions:

• The 330 kV ETL is not expected to experience measurable conventional vertical subsidence, tilt and curvature resulting from the extraction of Longwalls 101 to 103.

• Predicted far-field horizontal movements at the towers based on a 95% confidence level range from less than 25 mm to 43 mm.

• The predicted total strains at the towers based on a 95% confidence level are 0.4 mm/m tensile and 0.3 mm/m compressive. It is noted that these predicted strains include a component of survey tolerance, which is in the order of 0.1 to 0.3 mm/m.

• Monitoring is recommended for potential far-field horizontal movements and non-conventional movements.

• It is expected that the potential impacts on the 330 kV ETL can be managed with the implementation of the necessary monitoring and management strategies.

It should be noted that as the TransGrid 330 kV ETL is located further from Longwalls 101-103 than was considered in MSEC (2017b), a reduced impact is predicted by MSEC (2017a).
4.4 RISK ASSESSMENT MEETING

In accordance with the Guidelines for the Preparation of Extraction Plans (DP&E and DRE, 2015), potential risks and potential risk control measures and procedures have been considered at a risk assessment for the TransGrid infrastructure in the vicinity of Longwalls 101-103, held on 24 March 2017. Attendees at the risk assessment meeting included representatives from MCO, TransGrid, MSEC, Resource Strategies and a risk assessment facilitator (AXYS Consulting Pty Ltd [AXYS]).

The investigation and analysis methods used during the risk assessment included (AXYS, 2017):

- Confirmation of relevant TransGrid assets.
- Review of the revised subsidence predictions and potential impacts on TransGrid assets (including consideration of past experience in the Western Coalfield).
- Consideration and discussion of the proposed monitoring program, management measures and contingency measures.

The following potential risks were identified during the risk assessment (AXYS, 2017):

- Longwall mining impacts the 330 kV ETL and MCO are required to compensate TransGrid to make repairs.
- Longwall mining impacts the 330 kV ETL and customers are affected.

A number of risk control measures and procedures were identified prior to and during the risk assessment and are summarised as follows:

**Baseline Data / Validation**

1. TransGrid to advise the most recent and proposed maintenance inspections dates and processes for the 330 kV ETL.
2. MCO to arrange for a baseline survey and dilapidation audit (if required) of the 330 kV ETL in the area that may be affected by the mining of Longwalls 101-103. A baseline survey and dilapidation audit would not be considered to be required if TransGrid has, or will, complete a routine inspection of the 330 kV ETL that would be representative of the state of the 330 kV ETL prior to the commencement of longwall mining.
3. Installation of the subsidence monitoring program.
Management / Monitoring / Response Measures

4. Establish a key contacts list between MCO and TransGrid to provide a regular update of status of mining activities, and for ongoing liaison.

5. Include in the LW101-103 BFMP-TRANSGRID a schedule of times/frequency of communication with TransGrid for the status of mining of Longwalls 101-103.

6. Develop a TARP and include triggers for conditions that may need to be actioned by MCO and/or TransGrid.

MCO considers all risk control measures and procedures to be feasible to manage all identified risks.

The proposed risk control measures and procedures have been incorporated where relevant in this LW101-103 BFMP-TRANSGRID and the program for implementation is summarised in Table 3.

Table 3: Program for Implementation of Proposed Risk Control Measures and Procedures

<table>
<thead>
<tr>
<th>Risk Control Measure / Procedure</th>
<th>LW101-103 BFMP-TRANSGRID Section</th>
<th>Proposed Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline Data / Validation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 TransGrid to advise the most recent and proposed maintenance inspection dates and processes for the 330 kV ETL.</td>
<td>Section 6.2</td>
<td>Prior to Longwall 101</td>
</tr>
<tr>
<td>2 MCO to arrange for a baseline survey and dilapidation audit (if required) of the 330 kV ETL in the area that may be affected by the mining of Longwalls 101-103.</td>
<td>Section 6.2</td>
<td>Prior to Longwall 101</td>
</tr>
<tr>
<td>3 Installation of the subsidence monitoring program.</td>
<td>Section 6.2</td>
<td>Prior to Longwall 101</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management / Monitoring / Response Measures</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Establish key contacts list in the LW101-103 BFMP-TRANSGRID.</td>
<td>Section 11.1</td>
<td>Complete</td>
</tr>
<tr>
<td>5 Include in the LW101-103 BFMP-TRANSGRID a schedule of times/frequency of communication with TransGrid for the status of mining of Longwalls 101-103.</td>
<td>Section 7 and Table 6</td>
<td>Complete</td>
</tr>
<tr>
<td>6 Develop a TARP and include triggers for conditions that may need to be actioned by MCO and/or TransGrid.</td>
<td>Section 10 and Attachment 3</td>
<td>Complete</td>
</tr>
</tbody>
</table>
5.0 PERFORMANCE MEASURES

The performance measures specified in Table 19, Schedule 4 of Project Approval (08_0135) relevant to the 330 kV ETL, as a built feature, are listed in Table 5.

Table 5: Built Features Subsidence Impact Performance Measures

<table>
<thead>
<tr>
<th>Feature</th>
<th>Subsidence Impact Performance Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key public infrastructure:</strong></td>
<td></td>
</tr>
<tr>
<td>Gulgong-Sandy Hollow Railway Line</td>
<td>Always safe and serviceable.</td>
</tr>
<tr>
<td>Ulan-Wollar Road</td>
<td>Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired.</td>
</tr>
<tr>
<td><strong>Other infrastructure:</strong></td>
<td></td>
</tr>
<tr>
<td>Murragamba Road</td>
<td>Always safe.</td>
</tr>
<tr>
<td>Low voltage electricity power line *</td>
<td>Serviceability should be maintained wherever practicable. Loss of serviceability must be fully compensated.</td>
</tr>
<tr>
<td></td>
<td>Damage must be fully repairable, and must be fully repaired or else fully replaced or fully compensated.</td>
</tr>
</tbody>
</table>

Source: Table 19 in Schedule 4 of Project Approval (08_0135).

* Essential Energy 66 kV/22 kV dual circuit powerline as per Project Approval (08_0135).

It is recognised that the 330 kV ETL is ‘key public infrastructure’ and therefore the same subsidence impact performance measures applicable to the Sandy Hollow Gulgong Railway Line and Ulan-Wollar Road will apply.

In accordance with Condition 3, Schedule 4 of Project Approval (08_0135), MCO must ensure that there is no exceedance of the performance measures listed in Table 19, Schedule 4, to the satisfaction of the Secretary of the DP&E.

Section 6 outlines the monitoring that will be undertaken to assess the impact of Longwalls 101-103 against the performance measures in relation to the 330 kV ETL. Management measures for the 330 kV ETL are outlined in Section 7 and performance indicators for the performance measures are summarised in Section 8.
6.0 MONITORING

A monitoring program will be developed in order to monitor the impacts of the extraction of Longwalls 101-103 on the 330 kV ETL to identify unsafe conditions or loss of serviceability during or after mining. Key components of the monitoring program are summarised in Table 6.

Table 6: 330 kV ETL Monitoring Program Overview

<table>
<thead>
<tr>
<th>Monitoring Component</th>
<th>Parameter</th>
<th>Timing/Frequency</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-mining</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>330 kV ETL – Visual inspection / baseline audit (between Towers 102 to 111).</td>
<td>Condition of existing 330 kV ETL (e.g. land clearance, vegetation clearance, road clearance, integrity and function of support clamps or other items). Photo points (including baseline photographic record).</td>
<td>Prior to commencement of Longwall 101 extraction. [Unless a suitable inspection has been or will be completed by TransGrid prior to commencement of Longwall 101 extraction]</td>
<td>Underground Technical Manager / TransGrid</td>
</tr>
<tr>
<td>UG1 subsidence monitoring lines, as described in the UG1 Longwalls 101 to 103 Subsidence Monitoring Program (LW101-103 SMP).</td>
<td>Ground survey based on FF monitoring line along the Ulan-Wollar Road easement.</td>
<td>Prior to commencement of Longwall 101 extraction.</td>
<td>Underground Technical Manager / Registered Mine Surveyor</td>
</tr>
<tr>
<td>330 kV ETL – Towers 102 to 111.</td>
<td>Tower survey – 4 x leg mounted prisms at each tower (measuring differential separation), target (bolt) locations on both earth peaks of each tower and ground survey marks at the base of each tower.</td>
<td>Prior to commencement of Longwall 101 extraction.</td>
<td>Underground Technical Manager / Registered Mine Surveyor</td>
</tr>
<tr>
<td><strong>During and After Mining</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| UG1 subsidence monitoring lines, as described in the LW101-103 SMP. | Ground survey based on FF monitoring line. Monitoring parameters include:  
- subsidence;  
- tilt;  
- tensile strain;  
- compressive strain; and  
At 100 m intervals determined by the longwall chainage marks while the active mining face is within 400 m of the longwall take-off point. \[Inspection sheets to be provided to TransGrid for Longwall 101 monitoring. This requirement is to be reviewed following completion of Longwall 101\]  
At any time in case of fault or emergency and where requested by TransGrid. | Underground Technical Manager / Registered Mine Surveyor |
Table 6 (Continued): 330 kV ETL Monitoring Program Overview

<table>
<thead>
<tr>
<th>Monitoring Component</th>
<th>Parameter</th>
<th>Timing/Frequency</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>During and After Mining (Continued)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>330 kV ETL – Towers 102 to 111.</td>
<td>Tower survey – 4 x leg mounted prisms at each tower (measuring differential separation), target (bolt) locations on both earth peaks of each tower and ground survey marks at the base of each tower. Calculation of differential leg movement.</td>
<td>When mining reaches the “A” Line for Longwall 101. At 100 m intervals determined by the longwall chainage marks while the active mining face is within 400 m of the longwall take-off point. [Inspection sheets to be provided to TransGrid for Longwall 101 monitoring. This requirement is to be reviewed following completion of Longwall 101] At any time in case of fault or emergency and where requested by TransGrid.</td>
<td>Underground Technical Manager / Registered Mine Surveyor</td>
</tr>
<tr>
<td>330 kV ETL – Routine Inspections of Towers 102 to 111.</td>
<td>Condition of existing 330 kV ETL (e.g. land clearance, vegetation clearance, road clearance, integrity and function of support clamps or other items).</td>
<td>Routinely as per TransGrid requirements.</td>
<td>TransGrid</td>
</tr>
<tr>
<td><strong>Post-Mining</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UG1 subsidence monitoring lines, as described in the LW101-103 SMP.</td>
<td>Ground survey based on FF monitoring line. Monitoring parameters include: • subsidence; • tilt; • tensile strain; • compressive strain; and • absolute horizontal translation.</td>
<td>Within two weeks following completion of longwall recovery from each of Longwalls 101, 102 and 103. Within three months following completion of longwall recovery from each of Longwalls 101, 102 and 103.</td>
<td>Underground Technical Manager / Registered Mine Surveyor</td>
</tr>
<tr>
<td>330 kV ETL – Towers 102 to 111.</td>
<td>Tower survey – 4 x leg mounted prisms at each tower (measuring differential separation), target (bolt) locations on both earth peaks of each tower and ground survey marks at the base of each tower. Calculation of differential leg movement.</td>
<td>Within two weeks following completion of longwall recovery from each of Longwalls 101, 102 and 103. Within three months following completion of longwall recovery from each of Longwalls 101, 102 and 103.</td>
<td>Underground Technical Manager / Registered Mine Surveyor</td>
</tr>
</tbody>
</table>
The frequency of monitoring will be reviewed either:

- in accordance with the Annual Review; or
- if triggered as a component of the Contingency Plan as outlined in Section 9 of this LW101-103 BFMP-TRANSGRID.

### 6.1 SUBSIDENCE PARAMETERS

Subsidence parameters (i.e. subsidence, tilt, tensile strain, compressive strain and absolute horizontal translation) associated with mining will be measured in accordance with the LW101-103 SMP.

In summary, surveys will be conducted to measure subsidence movements in three dimensions using a total station survey instrument. Subsidence movements (i.e. subsidence, tilt, tensile strain and compressive strain) will be measured along subsidence lines that have been positioned across the general landscape.

Monitoring of subsidence parameters specific to the TransGrid 330 kV ETL will be measured by a survey line (‘FF Line’) along the Ulan-Wollar Road, and by survey of tower structures (Towers 102 to 111).

Surveys of the FF Line and Towers 102 to 111 will be conducted prior to extraction of Longwall 101, when mining reaches the mid-point of Longwall 101, and at 100 m intervals based on longwall chainage marks when mining is within 400 m of the longwall take-off position (e.g. at a frequency of approximately one to two weeks based on expected longwall progression). Surveys will also be conducted following completion of longwall recovery (the first within two weeks and the second within three months). Additional opportunistic observations of subsidence impacts will be conducted during routine works by MCO and its contractors. Surveys of Towers 102 to 111 will include measurement of differential separation between tower legs, monitoring of both earth peaks and ground survey.

Inspection sheets detailing the outcomes of the subsidence impact monitoring program will be provided to TransGrid during mining of Longwall 101 (requirement to be reviewed following completion of Longwall 101).
6.2 SUBSIDENCE IMPACTS

A visual inspection / baseline audit of the 330 kV ETL will be conducted prior to commencement of Longwall 101 unless TransGrid has completed, or will complete, a suitable inspection prior to commencement of Longwall 101. Where relevant, inspections of subsidence impacts will include photographic record of the impacts from nominated photo points for comparison with baseline photographic records.

It is understood that TransGrid conducts routine inspections (including fault and emergency patrols) which would be used for monitoring of potential subsidence impacts if conducted during the course of mining Longwalls 101-103.

Information will be recorded in the LW101-103 BFMP-TRANSGRID Subsidence Impact Register (Attachment 4) and reported in accordance with Project Approval (08_0135) (Section 13).

6.3 ENVIRONMENTAL CONSEQUENCES

MCO and TransGrid will compare the results of the subsidence impact monitoring against the built features performance measure and indicators (Sections 5 and 8). In the event the observed subsidence impacts from the Moolarben Coal Complex exceed the performance measure or indicators, MCO and TransGrid will assess the consequences of the exceedance in accordance with the Contingency Plan described in Section 9.
7.0 MANAGEMENT MEASURES

A number of potential management measures in relation to the 330 kV ETL are considered to be applicable. These include:

- alteration of conductor tensions;
- installation of temporary structures;
- modification to attachment points such as placement of stringing sheaves to earth wires and/or phase conductors; and
- strengthening of tower structures through installation of cruciform footings.

The requirement for these management measures will be determined by TransGrid during the pre-mining inspection / baseline audit and if required, implemented prior to mining within 400 m of the relevant feature.

A summary of management measures will be reported in the Annual Review.

Key management actions and timing is summarised in Table 7.

<table>
<thead>
<tr>
<th>Table 7: 330 kV ETL Key Management Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Management Measure</strong></td>
</tr>
<tr>
<td><strong>Pre-mining</strong></td>
</tr>
<tr>
<td>Notification to TransGrid prior to commencement of secondary extraction.</td>
</tr>
<tr>
<td>Baseline audit and survey of 330 kV ETL towers to identify management measures potentially required pre-subsidence.</td>
</tr>
<tr>
<td><strong>During Mining</strong></td>
</tr>
<tr>
<td>Notification to TransGrid prior to subsidence effects on the 330 kV ETL.</td>
</tr>
<tr>
<td>Provision of inspection sheets detailing the outcome of the subsidence impact monitoring program to TransGrid.</td>
</tr>
<tr>
<td>Ensure safe access to 330 kV ETL is available such that routine inspections and maintenance and remediation works are able to be undertaken.</td>
</tr>
<tr>
<td>Implement TARP (Attachment 3).</td>
</tr>
<tr>
<td><strong>Post-mining</strong></td>
</tr>
<tr>
<td>Audit and survey of 330 kV ETL towers to identify any post-mining remediation works required.</td>
</tr>
</tbody>
</table>
8.0 ASSESSMENT OF PERFORMANCE INDICATORS AND MEASURES

In accordance with Condition 5(d), Schedule 4 of Project Approval (08_0135), performance indicators have been developed for the performance measures listed in Table 5 (Section 5).

The performance indicators proposed to ensure that the performance measures are achieved include:

- the structural integrity of the 330 kV ETL (towers and transmission lines) is maintained;
- the electrical clearance from land, vegetation and roads is maintained; and
- the serviceability of the access roads/tracks is maintained.

Monitoring conducted to inform the assessment of secondary extraction of Longwalls 101-103 against the performance indicators for the performance measures relevant to the 330 kV ETL as a built feature is outlined in Section 6.

If a performance measure is considered to have been exceeded, the Contingency Plan outlined in Section 9 of this LW101-103 BFMP-TRANSGRID will be implemented.
9.0 CONTINGENCY PLAN

In the event the performance measures relevant to the 330 kV ETL as a built feature, summarised in Table 5, are considered to have been exceeded or are likely to be exceeded, MCO will implement the following Contingency Plan:

- The observation will be reported to the Underground Technical Manager or the Environmental and Community Manager within 24 hours.
- The observation will be recorded in the Subsidence Impact Register (Attachment 4).
- The likely exceedance will be reported in an Incident Report (refer to the Extraction Plan).
- MCO will provide the Incident Report to relevant stakeholders (i.e. DP&E, DRE and TransGrid).
- MCO will conduct an investigation to identify and evaluate contributing factors to the exceedance, including re-survey of the relevant subsidence monitoring lines, analysis of predicted versus observed subsidence parameters and a review of the subsidence monitoring program with updates to the program where appropriate.
- An appropriate course of action will be developed in consultation with relevant stakeholders and government agencies including proposed contingency measures (Section 9.1), and a program to review the effectiveness of the contingency measures.
- The course of action will be approved by, and implemented to the satisfaction of, TransGrid and DRE.
- This LW101-103 BFMP-TRANSGRID and the performance indicators will be reviewed to adequately manage future potential impacts within the limits of Project Approval (08_0135).

MCO will comply with the NSW Mine Subsidence Compensation Act, 1961 in the event that property damages occur as a result of mining Longwalls 101-103.

9.1 CONTINGENCY MEASURES

Contingency measures will be developed in consideration of the specific circumstances of the feature (e.g. the location, nature and extent of the impact, and the assessment of environmental consequences).

TransGrid designs its network with full redundancy provision (i.e. n-1 capability). In the unlikely event that the 330 kV ETL became unserviceable due to a subsidence impact, TransGrid can potentially switch around the 330 kV ETL for a period of time to effect emergency works, continuing to provide power to its customers (unless there are planned outages/faults in other connected parts of the transmission network).
Potential contingency measures that could be considered in the event the performance measure for the 330 kV ETL is exceeded are summarised in Table 8.

### Table 8: Potential Contingency Measures

<table>
<thead>
<tr>
<th>Environmental Consequence</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact on:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Towers</td>
<td>Stabilisation techniques</td>
<td>Installation of tower supports such as cruciform elements.</td>
</tr>
<tr>
<td></td>
<td>Repair/replace</td>
<td>Repair/replace tower(s) or construct emergency structures. Emergency structures, such as temporary wooden poles, deployed to re-establish line operations within 72 hours (depending on the amount of towers requiring replacement).</td>
</tr>
<tr>
<td>Transmission Wires</td>
<td>Stabilisation techniques</td>
<td>Sheaving of conductors and/or earth wires.</td>
</tr>
<tr>
<td></td>
<td>Repair/replace</td>
<td>Repair/replace transmission lines.</td>
</tr>
</tbody>
</table>

In the event that contingency measures in Table 8 are still expected to exceed performance measures, adaptive management will be considered, including: reduction in extraction height; modification to longwall layout; or shortening (finishing) the longwall panel earlier than planned.
10.0 TRIGGER ACTION RESPONSE PLAN – MANAGEMENT TOOL

The framework for the various components of this LW101-103 BFMP-TRANSGRID are summarised in the TARP shown in Attachment 3. The TARP illustrates how the various predicted subsidence impacts, monitoring components, performance measures, and responsibilities are structured to achieve compliance with the relevant statutory requirements, and the framework for management and contingency actions.

The TARP comprises:

- baseline conditions;
- predicted subsidence impacts;
- trigger levels from monitoring to assess performance; and
- triggers that flag implementation of contingency measures.

The TARP system provides a simple and transparent snapshot of the monitoring of environmental performance and the implementation of management and/or contingency measures.
11.0 ROLES AND RESPONSIBILITIES

Key responsibilities of MCO personnel in relation to this LW101-103 BFMP-TRANSGRID are summarised in Table 9. Responsibilities may be delegated as required.

Table 9: Longwalls 101 to 103 Built Features Management Plan – TransGrid
Responsibility Summary

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Manager</td>
<td>• Ensure resources are available to MCO personnel to facilitate the completion of responsibilities under this LW101-103 BFMP-TRANSGRID.</td>
</tr>
<tr>
<td>Underground Technical Manager</td>
<td>• Ensure the LW101-103 SMP is implemented.</td>
</tr>
<tr>
<td></td>
<td>• Ensure monitoring required under this LW101-103 BFMP-TRANSGRID is carried out within specified timeframes, adequately checked and processed and prepared to the required standard.</td>
</tr>
<tr>
<td></td>
<td>• Undertake relevant monitoring and implementation of management measures summarised in Tables 6 and 7 respectively.</td>
</tr>
<tr>
<td>Environmental and Community Manager</td>
<td>• Ensure the LW101-103 BFMP-TRANSGRID is implemented.</td>
</tr>
<tr>
<td></td>
<td>• Liaise with relevant stakeholders regarding subsidence impact management and related environmental consequences.</td>
</tr>
<tr>
<td>Registered Mine Surveyor</td>
<td>• Undertake all subsidence monitoring to the required standard within the specified timeframes and ensure data are adequately checked, processed and recorded.</td>
</tr>
</tbody>
</table>

11.1 KEY CONTACTS

The details of key contacts and phone numbers in relation to this LW101-103 BFMP-TRANSGRID are summarised in Table 10.

Table 10: Longwalls 101 to 103 Built Features Management Plan – TransGrid
Key Personnel Contact Details

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Position</th>
<th>Contact Name</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCO</td>
<td>Underground Technical Manager</td>
<td>Mr Shane Pegg</td>
<td>02 6376 1656</td>
</tr>
<tr>
<td></td>
<td>Environmental and Community Manager</td>
<td>Mr Graham Chase</td>
<td>02 6376 1407</td>
</tr>
<tr>
<td></td>
<td>Moolarben Coal Hotline</td>
<td></td>
<td>1800 556 484</td>
</tr>
<tr>
<td>TransGrid</td>
<td>Development Assessment Officer</td>
<td>Kylie O’Brien Pratt</td>
<td>02 9284 3174</td>
</tr>
<tr>
<td></td>
<td>Senior Structural Engineer</td>
<td>Sanu Maharjan</td>
<td>02 9284 3446</td>
</tr>
</tbody>
</table>
12.0 FUTURE EXTRACTION PLANS

In accordance with Condition 5(p), Schedule 4 of Project Approval (08_0135), MCO will collect baseline data for the future Extraction Plan (e.g. Longwalls 104-105). However, for the 330 kV ETL, the baseline (and post-mining) data collected for Longwalls 101-103 will be used as baseline for Longwalls 104-105 as longwall mining progressively moves further south of the TransGrid assets.

In addition to the baseline data collection, consideration of the environmental performance and management measures, in accordance with the review(s) conducted as part of this LW101-103 BFMP-TRANSGRID, will inform the appropriate type and frequency of monitoring of the assets relevant to the next Extraction Plan.
13.0 ANNUAL REVIEW, REGULAR REPORTING AND IMPROVEMENT OF ENVIRONMENTAL PERFORMANCE

In accordance with Condition 4, Schedule 6 of Project Approval (08_0135), MCO will conduct an Annual Review of the environmental performance of the Project by the end of March each year, or as otherwise agreed by the Secretary of the DP&E.

The Annual Review will:

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

In accordance with Condition 11, Schedule 6 of Project Approval (08_0135), the Annual Review will be made available on the MCO website.

As described in Section 2, this LW101-103 BFMP-TRANSGRID will be reviewed within three months of the submission of an Annual Review, and revised where appropriate.

In accordance with Condition 8, Schedule 6 of Project Approval (08_0135), MCO will also provide regular reporting on the environmental performance of the Project on the MCO website.
13.1 AUDITS

In accordance with Condition 9, Schedule 6 of Project Approval (08_0135), an independent environmental audit was conducted by the end of December 2015, and will be undertaken every three years thereafter. A copy of the independent environmental audit will be provided to the Secretary of the DP&E and made available on the MCO website.

The independent environmental audit will be conducted by suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Secretary of the DP&E.

The independent environmental audit will assess the environmental performance of the Project and assess whether it is complying with the requirements of Project Approval (08_0135), and any other relevant approvals, and recommend measures or actions to improve the environmental performance of the Project.

Further to the above, external auditing for compliance with ISO 31000 – Risk Management (or alternative standard agreed with TransGrid) will be undertaken annually to report compliance and effectiveness of risk management practices during the extraction of Longwalls 101-103.
14.0 INCIDENTS

An incident is defined in Project Approval (08_0135) as a set of circumstances that:

- causes or threatens to cause material harm to the environment; and/or
- breaches or exceeds the limits or performance measures/criteria in Project Approval (08_0135).

In the event that an incident which causes, or threatens to cause, material harm to the environment occurs, the incident will be managed in accordance with the Pollution Incident Response Management Plan.

The reporting of incidents will be conducted in accordance with Condition 7, Schedule 6 of Project Approval (08_0135).

MCO will notify the Secretary of DP&E and any other relevant agencies of any incident associated with the UG1 Underground Mine immediately after MCO confirms that an incident has occurred. Within seven days of the date of the incident, MCO will provide the Secretary of DP&E and any relevant agencies with a detailed report on the incident. The report will:

- describe the date, time and nature of the exceedance/incident;
- identify the cause (or likely cause) of the exceedance/incident;
- describe what action has been taken to date; and
- describe the proposed measures to address the exceedance/incident.
15.0 COMPLAINTS

MCO maintains a Community Complaints Line (Phone Number: 1800 556 484) that is dedicated to the receipt of community complaints. The Community Complaints Line is publicly advertised and operates 24 hours per day, seven days a week, to receive any complaints from neighbouring residents or other stakeholders.

MCO has developed a Community Complaints Procedure which details the process to be followed when receiving, responding to and recording community complaints. The Community Complaints Procedure is supported by a Complaints Database.

The Community Complaints Procedure is a component of the MCO Environmental Management Strategy which requires the recording of relevant information including:

- the nature of complaint;
- method of the complaint;
- relevant monitoring results and meteorological data at the time of the complaint;
- site investigation outcomes;
- any necessary site activity and activity changes;
- any necessary actions assigned; and
- communication of the investigation outcome(s) to the complainant.

In accordance with Condition 11, Schedule 6 of Project Approval (08_0135), the complaints register will be updated monthly and made available on the MCO website.
16.0 NON-COMPLIANCES WITH STATUTORY REQUIREMENTS

A protocol for the managing and reporting of non-compliances with statutory requirements has been developed as a component of MCO’s Environmental Management Strategy and is described below.

Compliance with all approvals, plans and procedures will be the responsibility of all personnel (staff and contractors) employed on or in association with the Moolarben Coal Complex.

The Environmental and Community Manager (or delegate) will undertake regular inspections, internal audits and initiate directions identifying any remediation/rectification work required, and areas of actual or potential non-compliance.

As described in Section 14, MCO will notify the Secretary of the DP&E, and any other relevant agencies, of any incident associated with MCO immediately after MCO becomes aware of the incident. Within seven days of the date of the incident, MCO will provide the Secretary of the DP&E, and any relevant agencies, with a detailed report on the incident.

A review of MCO’s compliance with all conditions of Project Approval (08_0135), mining leases and all other approvals and licenses will be undertaken prior to (and included within) each Annual Review. The Annual Review will be made publicly available on the MCO website.

As described in Section 13.1, an independent environmental audit was conducted by the end of December 2015, and will be undertaken every three years thereafter. A copy of the audit report will be submitted to the Secretary of the DP&E and made publicly available on the MCO website.
17.0 REFERENCES


ATTACHMENT 1

MSEC (2016) MOOLARBEN COAL OPERATIONS – LONGWALLS 101 TO 103
- SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENTS
FOR THE TRANSGRID INFRASTRUCTURE
Dear Shane,

**RE: Moolarben Coal Operations – Longwalls 101 to 103 - Subsidence Predictions and Impact Assessments for the TransGrid Infrastructure**

Moolarben Coal Operations is preparing an Extraction Plan to support the commencement of longwall mining operations in the 4th quarter of 2017, and this letter has been prepared to detail potential subsidence impacts on infrastructure owned and operated by TransGrid.

This letter report summarises the predicted subsidence movements and the assessed subsidence impacts for the TransGrid 330 kV transmission line resulting from the extraction of Longwalls 101 to 103 at Moolarben Coal Complex. In doing so this letter considers potential subsidence induced mechanisms of impact and concludes with a summary of the impact assessment. The potential subsidence impacts are consistent with those previously assessed and approved for the Moolarben Coal Complex UG1 Optimisation Modification Environmental Assessment.

The locations of the 330 kV transmission line and towers, and Longwalls 101 to 103 are shown in the attached Drawing No. MSEC877-04. The transmission line is located to the north of Longwalls 101 to 103 and will not be directly undermined.

The transmission towers and reference numbers are also shown in Drawing No. MSEC877-04. There are ten towers that are located within 1 km of Longwalls 101 to 103. The distances of these towers from the nearest longwall, are summarised in Table 1, and some of the distances are shown in Drawing No. MSEC877-04. Pictures of the tension and suspension towers are shown in Figure 1. Depths of cover at the nearest longwalls vary from about 110 m to 140 m.
Table 1  Distances of the 330 kV Transmission Towers from Longwalls 101 to 103

<table>
<thead>
<tr>
<th>Tower Number</th>
<th>Nearest Longwall</th>
<th>Tower Type</th>
<th>Distance of the Transmission Towers Centrelines from the Nearest Longwall (m)</th>
<th>Distance divided by depth of cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td>103</td>
<td>Suspension</td>
<td>915</td>
<td>8.3</td>
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<td>111</td>
<td>101</td>
<td>Suspension</td>
<td>910</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Figure 1  Photograph of a 330 kV Suspension Tower (Left) and Tension Tower (Right)

The predictions and impact assessments for the 330 kV transmission line are provided in the following sections.

Conventional Subsidence Parameters

At distances of 325 m or more between the longwalls and the transmission line towers and based on depths of cover of 110 m to 130 m, the towers will not be subjected to measurable conventional mine subsidence ground movements (i.e. less than limits of survey accuracy); however, the towers may experience far-field horizontal movements which are discussed below.

Far-Field Movements

The measured horizontal movements at survey marks which are located beyond the longwall goaf edges and over solid unmined coal areas are often greater than the observed vertical movements at those marks. These movements are often referred to as far-field horizontal movements.
Far-field horizontal movements tend to be bodily movements towards the extracted goaf area and are accompanied by very low levels of strain. These movements generally do not result in impacts on natural or built features, except where they are experienced by large structures which are very sensitive to differential horizontal movements.

In some cases, higher levels of far-field horizontal movements have been observed where steep slopes or surface incisions exist nearby, as these features influence both the magnitude and the direction of ground movement patterns. Similarly, increased horizontal movements are often observed around sudden changes in geology or where blocks of coal are left between longwalls or near other previously extracted series of longwalls. In these cases, the levels of observed vertical subsidence and horizontal movements can be slightly higher than normally predicted, but these increased movements are generally accompanied by very low levels of tilt, curvature and strain.

An empirical database of observed incremental far-field horizontal movements has been compiled using available monitoring data from the NSW and Queensland Coalfields, but this database predominately comprises measurements from the Southern Coalfield. The far-field horizontal movements are generally observed to be orientated towards the extracted longwall. At very low levels of far-field horizontal movements, however, there is a higher scatter in the orientation of the observed movements.

The observed incremental far-field horizontal movements, resulting from the extraction of each longwall within a series, are shown in Figure 2. The observed directions of these far-field horizontal movements were generally observed to be orientated towards the extracted longwall.

This plot of far-field horizontal movements includes some multi-seam mining cases and some sites where it is known that the plotted movements include components from valley closure effects. The confidence levels, based on fitted Generalised Pareto Distributions (GPDs), have also been shown in this figure to illustrate the spread of the data. The magnitude of these movements decrease with distance from the mined edges however, there have been cases where the observed far-field horizontal movements beyond the edges of the mined panels have approached 400 mm. The highest observed far-field horizontal movements are multi seam cases that are located close to large valleys.

This data includes some of the available observed far-field horizontal movements that have been measured at Ulan Coal Mine and other observed data from other regions where the depths of cover are also relatively shallow compared to the Southern Coalfield of NSW. The available far-field incremental horizontal movement data has therefore been replotted, as shown in Figure 3, against the distances from the nearest edge of the incremental panel divided by the depth of cover.

**Figure 2** Observed Incremental Far-field Horizontal Movements (mm) from Many Regions in NSW Plotted Against the Distance to the Nearest Edge of the Mined Panel (m)
Figure 3 replots the available far-field horizontal movement data that is shown in Figure 2 to allow for varying depths of cover and this plot is more appropriate for use at the Moolarben Coal Complex. This plot still includes those many cases where higher movements occurred because of multi-seam mining and valley closure effects.

As successive longwalls within a series of longwall panels are mined, the magnitudes of the incremental far-field horizontal movements decrease. This is possibly due to the fact that once the in situ stresses in the strata within the collapsed zones above the first few extracted longwalls has been redistributed, the potential for further movement is reduced. The total far-field horizontal movement is not, therefore, the sum of the incremental far-field horizontal movements for the individual longwalls.

The shortest distance from the towers to the longwalls is 325 m, from tower 108. This equates to approximately 2.5 times the depth of cover from the longwalls. Figure 3 shows the upper limit of previously observed absolute far-field horizontal movements at Ulan Coal Mine for the sites located 2.5 times the depths of cover from longwalls, was less than 100 mm, (however this data includes the H-Line case and the F-Line case where high valley closure movements were observed). Ignoring sites with high valley closure movements and the multi seam cases, Figure 3 shows the upper limit of previously observed absolute far-field horizontal movements for sites located 2.5 times the depths of cover from longwalls, is less than 70 mm.

The transmission line, therefore, is predicted to experience incremental far-field horizontal movements in the order of 70 mm due to the extraction of each of Longwalls 101 to 103. These low level horizontal movements are not expected to be associated with measurable tilts, curvatures or strains.

**Influence of Unconsolidated Tertiary Sediments on Horizontal Far-field Movements**

There are unconsolidated Tertiary sediments, with a maximum thickness of 40-50 m, to the north and east of the Longwalls 101 to 103 as shown in Drawing No. MSEC877-04. These unconsolidated sediments are remnants of inactive river or stream channels that have been later filled in or buried by younger sediment that can be stronger or weaker than the original strata.

At the Moolarben Coal Complex the unconsolidated sediments to the north and east of Longwalls 101 to 103 were formed when Permian strata layers were replaced with infill sediments consisting of poorly-sorted semi-consolidated quartzose sands and gravels in a clayey matrix, i.e. including unsaturated alluvium and low permeability clays. The
presence of these materials can modify the subsidence ground movements beyond the end of the longwalls, 
(depending on the depth of the channels, and its location with respect to the panel edges).

Since these unconsolidated sediments are located away from the edges of the longwalls, then, their presence
should result in less subsidence within these areas and reduced far-field movements beyond these channels at the
transmission line.

**Influence of the Existing Open Cut (OC1) on Horizontal Far-field Movements**

An open cut mining area (OC1) currently in operation is located to the north west of the longwalls as shown in
Drawing No. MSEC877-04. Access to the longwalls will be via the OC1 pit. An open cut mining area is also located
to the south east (OC4) and will be extracted as part of future operations.

The open cut pits extract the overburden material and the target coal seam. i.e. down to the seam floor level of the
longwalls. The effect of the removal of this material is to relieve or redistribute much of the in situ stress in the
overburden strata adjacent to the pit. With the removal of the overburden material, the potential for far-field effects
to develop in the vicinity of the pit are significantly reduced.

With rehabilitated open cut mine areas, the overburden material has been replaced, typically with other stripped
material which is compacted by vehicle tracking during the emplacement process. Potential for far-field movements
where the open cut pit has been fully rehabilitated between the longwalls and the outer natural overburden is
expected to be significantly reduced, similar to the open cut pit, as the emplaced material is unlikely to support any
significant stress redistribution.

**Potential for Non-Conventional Movements**

It is believed that most non-conventional ground movements are the result of the reaction of near surface strata to
increased horizontal compressive stresses due to mining operations. Some of the geological conditions that are
believed to influence these irregular subsidence movements are the blocky nature of near surface sedimentary
strata layers and the possible presence of unknown faults, dykes or other geological structures, cross bedded
strata, thin and brittle near surface strata layers and pre-existing natural joints. The presence of these geological
features near the surface can result in a localised bump in an otherwise smooth subsidence profile and these
bumps are usually accompanied by locally increased tilts and strains.

Even though it may be possible to attribute a reason behind most observed non-conventional ground movements,
there remain some observed irregular ground movements that still cannot be explained with the available geological
information. The term “anomaly” is therefore reserved for those non-conventional ground movement cases that
were not expected to occur and cannot be explained by any of the above possible causes.

It is not possible to predict the locations and magnitudes of non-conventional anomalous movements. In some
cases, approximate predictions for the non-conventional ground movements can be made where the underlying
geological or topographic conditions are known in advance.

The likelihood of non-conventional anomalous movements reduces with increasing distance away from the longwall
panels.

The range of potential strains associated with non-conventional movements has been assessed using monitoring
data from previously extracted panels in the NSW Coalfields, for single-seam conditions, where the width-to-depth
ratios and extraction heights were similar to those of Longwalls 101 to 103. The data used in the analysis of
observed strains included those resulting from both conventional and non-conventional anomalous movements, but
did not include those resulting from valley related movements. The strains resulting from damaged or disturbed
survey marks have also been excluded. The survey database has been analysed to extract the maximum tensile
and compressive strains that have been measured at any time during mining for survey bays that were located
beyond the goaf edges of the mined panels and positioned on unmined areas of coal between 200 m and 600 m of
the nearest longwall goaf edge.

The 95 % confidence levels for the maximum total strains that the individual survey bays above solid coal
experienced at any time during mining were 1.6 mm/m tensile and 1.5 mm/m compressive. The 99 % confidence
levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during
mining were 2.9 mm/m tensile and 3.0 mm/m compressive. It is noted that these results comprise a component of
survey tolerance and have also been affected by disturbed survey marks and survey errors. It is noted that these
results comprise a component of survey tolerance and have also been affected by disturbed survey marks and survey errors.

**Impact Assessments for the 330 kV Transmission Line**

The cables along the 330 kV transmission line are not directly affected by ground strains, as they are supported by the towers above ground level. The cables can, however, be affected by the changes in bay lengths, i.e. the distances between the towers at the level of the cables, which result from mining induced differential subsidence, horizontal ground movements and lateral movements at the tops of the towers due to differential tilting of the towers. The stability of the transmission towers can be affected by the mining induced tilts, curvatures and ground strains at the tower locations and by changes in the catenary profiles of the cables.

The transmission towers are not expected to be subject to measurable conventional vertical subsidence, tilt, curvature or strain. It is unlikely, therefore, that the conventional movements would result in adverse impacts on the transmission line.

Far-field horizontal movements could result in small changes in the distances between the towers, particularly those located closest to the longwalls. With the alignment of the towers around the northern corner of the longwall layout, the predicted horizontal movements are expected to result in a net shortening of the distances between the towers. The towers located the furthest distances from the longwalls may experience minor net opening. The maximum predicted shortening is 65 mm, between towers 107 and 108. The predicted change in distance between the remaining towers due to far-field horizontal movements is less than 20 mm, which is the typical limit of survey accuracy. The predicted change in distance between the remaining towers is small since they are generally expected to move in the same direction towards the longwalls. It is also noted that the presence of unconsolidated sediments may result in reduced far-field movements and associated changes in distance between towers.

The existing open cut (OC1) would significantly reduce the potential for far-field movements to develop at features located beyond the open cut extent. The location of the transmission line outside OC1 is greater than nine times the depth of cover from the longwalls and far-field horizontal movements would not be expected, even without the presence of OC1.

The 95 % confidence levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining were 1.6 mm/m tensile and 1.5 mm/m compressive. The 99 % confidence levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining were 2.9 mm/m tensile and 3.0 mm/m compressive. It is recommended that TransGrid review the structural integrity of the towers based on changes in the tower leg spacings (i.e. k-point distances) resulting from the above strains. The potential for non-conventional movements in the locations of the towers is very low, due to their distances from the longwalls, however, the potential for these irregular movements cannot be discounted.

It is recommended that strategies are developed, in consultation with TransGrid, to manage the potential for non-conventional movements at the transmission tower locations.

The management strategies should include monitoring of the transmission towers during active subsidence to identify the potential development of non-conventional ground movements between tower legs and the absolute positions of the towers.

**Recommendations**

In order to manage the predicted impacts on TransGrid infrastructure, the following is recommended:

a) Implement a program of monitoring for potential far-field horizontal movements and non-conventional movement.

b) Develop and implement monitoring and management strategies for dealing with potential impacts on TransGrid infrastructure.
Summary

The 330 kV transmission line is not expected to experience measurable conventional vertical subsidence movements resulting from the extraction of Longwalls 101 to 103, and the predicted far-field horizontal movements are likely to be less than 70 mm.

If far-field horizontal movement towards the longwalls develops at the transmission towers, minor changes in the distances between the towers would develop. The maximum estimated change in distance is a 65 mm shortening between towers 107 and 108. The predicted change in distance between the remaining towers due to far-field horizontal movements is less than 20 mm, which is the typical limit of survey accuracy.

Monitoring is recommended for potential far-field horizontal movements and non-conventional movements.

It is expected that the potential impacts on the TransGrid 330kV transmission line can be managed with the implementation of the necessary monitoring and management strategies.

Yours sincerely

Peter DeBono
Mine Subsidence Engineering Consultants

Attachments:

Drawing No. MSEC877-04 – Longwalls 101 to 103 – TransGrid 330 kV Transmission Line
ATTACHMENT 2

MSEC (2017b) SUPPLEMENTARY REPORT – MOOLARBEN COAL OPERATIONS – LONGWALLS 101 TO 103 - SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENTS FOR THE TRANSGRID INFRASTRUCTURE
Supplementary Report
Moolarben Coal Operations – Longwalls 101 to 103 - Subsidence Predictions and Impact Assessments for the TransGrid Infrastructure

Moolarben Coal Operations is preparing an Extraction Plan to support the commencement of longwall mining operations in the fourth quarter of 2017. A meeting was held with TransGrid on Friday 24th March 2017 to conduct a risk assessment and to discuss the management plan for the 330 kV transmission line in the vicinity of Longwalls 101 to 103. During the meeting a request was made by TransGrid seeking further subsidence prediction information additional to the Report MSEC877-04 prepared by Mine Subsidence Engineering Consultants (MSEC). This supplementary letter has been prepared to provide the additional subsidence prediction information for TransGrid.

The locations of the 330 kV transmission line and towers and Longwalls 101 to 103 are shown in the attached Drawing No. MSEC877-04. The transmission line is located to the north of Longwalls 101 to 103 and will not be directly mined beneath.

The transmission towers and reference numbers are also shown in Drawing No. MSEC877-04. There are ten towers that are located within 1 km of Longwalls 101 to 103. The distances of these towers from the nearest longwall are summarised in Table 1 and some of the distances are shown in Drawing No. MSEC877-04. Pictures of the tension and suspension towers are shown in Figure 1. The depths of cover at the nearest longwalls vary from approximately 110 m to 140 m.
Table 1  Distances of the 330 kV Transmission Towers from Longwalls 101 to 103

<table>
<thead>
<tr>
<th>Tower Number</th>
<th>Nearest Longwall</th>
<th>Tower Type</th>
<th>Distance of the Transmission Tower Centreline from the Nearest Longwall (m)</th>
<th>Distance divided by depth of cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td>103</td>
<td>Suspension</td>
<td>915</td>
<td>8.3</td>
</tr>
<tr>
<td>103</td>
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<td>625</td>
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</tr>
</tbody>
</table>

Figure 1  Photographs of a 330 kV Suspension Tower (Left) and Tension Tower (Right)

Conventional Subsidence Parameters

Clarification was requested on the potential for tilt of the towers resulting from the extraction of Longwalls 101 to 103. It was noted in Report MSEC877-04 that “At distances of 325 m or more between the longwalls and the transmission line towers and based on depths of cover of 110 m to 130 m, the towers will not be subjected to measurable conventional mine subsidence ground movements (i.e. less than limits of survey accuracy); however, the towers may experience far-field horizontal movements which are discussed below.”

Conventional mine subsidence ground movements refer to the conventional (or systematic) subsidence, tilt and curvature. These parameters represent the mine subsidence movements when the ground subsides relatively uniformly without localised or elevated movements. A longitudinal prediction line through the finishing end of Longwall 103 was prepared to show the locations of the Study Area boundary and two towers (108 and 106) relative to the predicted profiles of conventional subsidence, tilt and curvature. The figure was tabled during the meeting and is presented in Figure 2 below.
The conventional vertical subsidence at the tower locations is predicted to be less than 20 mm. That is, the vertical movements are expected to be less than those that can naturally occur due to wetting and drying of the soils. The associated conventional tilts and curvatures at the tower locations are predicted to be very small and not measurable.

**Far-Field Movements**

Horizontal movements due to longwall mining extend outside the predicted limit of vertical subsidence, which are referred to as far-field horizontal movements. The available observed far-field incremental horizontal movement data was presented in Report MSEC877-04 against the distances from the nearest edge of the incremental panel divided by the depth of cover. The monitoring data has been taken from longwall mining in the NSW and
Queensland Coalfields. A 95% confidence level line has been fitted to the data presented in Figure 3 in Report MSEC877-04 and is reproduced in Figure 3 below.

The nearest towers to Longwalls 101 to 103 are located at distances equal to 2.5 times the depth of cover. The upper limit of previously observed absolute far-field horizontal movements for sites located 2.5 times the depth of cover from longwalls, excluding the multi-seam and valley closure cases presented in Report MSEC877-04, is 70 mm.

The predicted absolute far-field horizontal movements for the towers have been based on the 95 % confidence level shown in the above figure. A summary of the observed far-field horizontal movements based on the 95 % confidence level for selected towers, is presented in Table 2. The direction of the far-field horizontal movements should be assumed to be towards the extracted longwalls.

Figure 3  Observed Incremental Far-Field Horizontal Movements (mm) from Many Regions in NSW Versus the Distance to the Nearest edge of the Mined Panel Divided by the Depth of Cover (m/m)
Table 2  Distances of the 330 kV Transmission Towers from Longwalls 101 to 103

<table>
<thead>
<tr>
<th>Tower Number</th>
<th>Nearest Longwall</th>
<th>Tower Type</th>
<th>Distance of the Transmission Towers Centrelines from the Nearest Longwall (m)</th>
<th>Distance divided by depth of cover</th>
<th>Far-field horizontal movement based on 95% confidence level (mm)</th>
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<td>102</td>
<td>103</td>
<td>Suspension</td>
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<td>8.3</td>
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</tbody>
</table>

The commencement of monitoring for the infrastructure occurs when the longwall extraction face of Longwalls 101 to 103 is within a nominal distance of approximately 400 m from the infrastructure. This value was selected based on the distance at which measurable horizontal movements typically occur (i.e. the movements based on the 95% confidence level are greater than the survey tolerance for absolute position of 25 mm), and this represents a ratio of distance divided by depth of cover of 3.1 to 3.6 for Longwall 101 to 103. In many cases, such as for the transmission towers, monitoring is conservatively scheduled to commence when the longwall face is 400 m from completion, rather than 400 m from the item of surface infrastructure.

Predicted Strains

Predicted strains were presented in Report MSEC877-04 for potential non-conventional movements based on observed data from NSW coalfields where the width-to-depth ratios and extraction heights were similar to those for Longwalls 101 to 103. A plot of the strain data used in Report MSEC877-04 is shown in Figure 4. The observed strain data represents monitoring from the Gunnedah, Newcastle, Hunter and Western Coalfields. This data is affected by the survey tolerance due to the low magnitudes and the smaller survey bay lengths.

Further assessment of observed strain data was carried out following the meeting held on 24th March 2017 and includes observed strain data from the Southern Coalfield which is presented in Figure 5. The far-field horizontal movements in the Southern Coalfield extend considerably further than other areas with shallower depths of cover, such as in the Western Coalfield and, therefore, should provide some conservatism for the far-field strains (i.e. differential horizontal movements). The data from the Southern Coalfield is also influenced less by survey tolerance due to larger survey bay lengths and the larger dataset. The survey tolerance based on a 20 m survey bay is in the order of 0.1 to 0.3 mm/m.

The available data for observed total strain for all survey bay lengths are shown as grey points in both Figure 4 and Figure 5. The data based on survey bay lengths between 15 m and 25 m are shown as the red points in these figures.

It can be seen from Figure 5 that there is much less scatter in observed strain data for the Southern Coalfield when compared to data in Figure 4, which represents shallow cover longwall mining. There is also a greater number of observed data points for the Southern Coalfield, particularly with increasing distance from the mined longwalls. The reasons for the differences in scatter between the two data sets is that mining operations in the Southern Coalfield frequently extract beneath and in close proximity to surface infrastructure and, therefore, there is a greater emphasis on frequency and accuracy of monitoring. Subsidence effects also extend further with higher depths of cover, therefore monitoring in the Southern Coalfield typically extends further from the extracted longwalls. Also,
since the average strain is a function of the length of measurement, lower survey tolerance and greater scatter can be expected in observed strain measurements when measured over shorter length survey bays. A bay length of 10 m is typically used for shallow mining conditions, and 20 m is commonly used for deeper mining in the Southern Coalfield. However, with data assessed based on a spacing of 20 m ±5 m in both Figure 4 and Figure 5, there is still a significantly greater scatter in the data for shallow mining. The use of the range of bay lengths of 15 m to 25 m is to provide a reasonable average strain value based on a nominal bay length of 20 m ±5 m.

Figure 4 Observed Total Strain Versus the Distance to the Nearest Edge of the Mined Panel for Longwall Width-to-Depth ratio greater than 1.7

Figure 5 Observed Total Strain Versus the Distance to the Nearest Edge of the Mined Panel for the Southern Coalfield

A summary of the observed strains based on a 95 % confidence level for assessments of different coalfields and different bay lengths presented in Figure 4 and Figure 5 is provided in Table 3.
Table 3  Observed Strain with 95% Confidence Level for Survey Bays Located above Solid Coal and Greater than 325 m from the Nearest Longwall

<table>
<thead>
<tr>
<th></th>
<th>Hunter, Newcastle, Western, Gunnedah Coalfields</th>
<th>Hunter, Newcastle, Western, Gunnedah Coalfields</th>
<th>NSW Southern Coalfield</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>~10 m bay length (from MSEC877-04)</td>
<td>bay length 20m ±5m</td>
<td>bay length 20m ±5m</td>
</tr>
<tr>
<td>Tensile Strain (mm/m)</td>
<td>1.6</td>
<td>0.8</td>
<td>0.4</td>
</tr>
<tr>
<td>Compressive Strain (mm/m)</td>
<td>1.5</td>
<td>0.6</td>
<td>0.3</td>
</tr>
</tbody>
</table>

As noted previously, the data from the Southern Coalfield is influenced less by survey tolerance and, therefore, should provide a more accurate prediction of ground strains outside of Longwalls 101 to 103. Also, the far-field horizontal movements extend further from longwall mining in the Southern Coalfield when compared to that at shallower depths of cover. The observed strains from the Southern Coalfield should, therefore, provide a conservative prediction of the ground strains at the locations of the transmission towers. Whilst the observed strains in the Hunter, Newcastle, Western, and Gunnedah Coalfields presented in Table 3 are greater than those measured in the Southern Coalfield, this is considered to be due to the higher survey tolerance.

It is therefore recommended that the predicted strains for the transmission towers are based on monitoring data from the Southern Coalfield. The predicted strains at a distance of 325 m from longwall mining are 0.4 mm/m tensile and 0.3 mm/m compressive based on the 95 % confidence level.

Summary

A summary of the subsidence prediction information presented in this supplementary report is provided below.

The 330 kV transmission line is not expected to experience measurable conventional vertical subsidence, tilt and curvature resulting from the extraction of Longwalls 101 to 103.

Predicted far-field horizontal movements at the towers based on a 95 % confidence level range from <25 mm to 43 mm.

The predicted total strains at the towers based on a 95% confidence level are 0.4 mm/m tensile, and 0.3 mm/m compressive. It is noted that these predicted strains comprise a component of survey tolerance, which is in the order of 0.1 to 0.3 mm/m.

Monitoring is recommended for potential far-field horizontal movements and non-conventional movements.

It is expected that the potential impacts on the TransGrid 330 kV transmission line can be managed with the implementation of the necessary monitoring and management strategies.

Yours sincerely

Peter DeBono
Mine Subsidence Engineering Consultants

Attachments:

Drawing No. MSEC877-04 – Longwalls 101 to 103 – TransGrid 330 kV Transmission Line
ATTACHMENT 3

UG1 LONGWALLS 101 TO 103 BUILT FEATURES MANAGEMENT PLAN – TRANSGRID
TRIGGER ACTION RESPONSE PLAN
## Condition

<table>
<thead>
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<th>Trigger</th>
<th>Action</th>
<th>Frequency</th>
<th>Position of Decision Making</th>
</tr>
</thead>
</table>
| TransGrid 330 kilovolt (kV) electricity transmission line (ETL) is safe, serviceable and repairable (or as otherwise identified by pre-mining inspection). | Establish baseline data, including:  
- Baseline inspection/audit (including baseline photographic record).  
- Ground survey as per the UGI Longwalls 101 to 103 Subsidence Monitoring Program.  
- Survey of Towers 102 to 111 (monitoring of tower legs, both earth peaks and ground survey). | Prior to commencement of extraction of Longwall 101. The baseline inspection/audit will not be required in the event that a suitable inspection has been, or will be, conducted by TransGrid prior to commencement of extraction of Longwall 101. | Underground Technical Manager.  
- TransGrid.  
- Principal Subsidence Engineer (Division of Resources and Energy [DRE]). |

### Normal Phase: Phase 1

<table>
<thead>
<tr>
<th>Baseline Conditions</th>
<th>Predicted Impacts</th>
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| Small far field subsidence effects on the TransGrid 330 kV ETL. Impacts are considered to be within acceptable limits if monitoring identifies (limits as advised by TransGrid):  
- No observable surface deformations.  
- Less than 4 millimetres (mm) of differential separation between tower legs.  
- Less than 15 mm of horizontal movement at towers. | Monitoring identifies impacts that are greater than predicted, but the performance measure has not been exceeded and is not likely to be exceeded. Management measures are considered to be required if monitoring identifies (limits as advised by TransGrid):  
- Observable surface deformations.  
- Between 4 and 10 mm of differential separation between tower legs.  
- Between 15 and 30 mm of horizontal movement at towers. |

### Level 1 Phase: Implement Management Measures

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<th>Implement Management Measures</th>
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<td>In the event monitoring identifies greater than predicted allowable impacts, TransGrid and the Principal Subsidence Engineer (DRE) will be notified within 24 hours. Management measures will be implemented as described in Section 7 (with regard to the specific circumstances of the subsidence impact). Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.</td>
</tr>
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</table>

### Level 2 Phase: Restoration/Contingency Phase

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| In the event monitoring identifies greater than predicted/allowable impacts, TransGrid and the Principal Subsidence Engineer (DRE) will be notified within 24 hours. Contingency Plan implemented (with regard to the specific circumstances of the subsidence impact). In summary:  
- The observation will be recorded to the Underground Technical Manager and the Environmental and Community Manager within 24 hours.  
- The observation will be recorded in the Subsidence Impact Register.  
- The exceedance or likely exceedance will be reported in an incident report.  
- An investigation will be conducted to identify and evaluate contributing factors to the exceedance.  
- An appropriate course of action will be developed in consultation with TransGrid, relevant stakeholders and government agencies.  
- The course of action will be approved by, and implemented to the satisfaction of TransGrid, relevant stakeholders and government agencies.  
- The Built Features Management Plan – TransGrid and the performance indicators will be reviewed to adequately manage future potential impacts.  
- Additional surveys will be completed, with results compared against pre-mining monitoring data and predictions.  
- Adaptive management will be considered. |

### Ground and tower surveys:

- When mining reaches the “A” Line for Longwall 101.  
- At 100 m intervals determined by the longwall chainage marks while the active mining face is within 400 m of the longwall take-off point.  
- Within two weeks following completion of longwall recovery from each of Longwalls 101, 102 and 103.  
- Within three months following completion of longwall recovery from each of Longwalls 101, 102 and 103.  
- At any time in case of fault or emergency and where requested by TransGrid. |

To be implemented as required (i.e. if monitoring identifies impacts that are greater than predicted, but the performance measure has not been exceeded and is not likely to be exceeded). To be implemented following identification of an exceedance of the performance measure, or if the performance measure is likely to be exceeded (i.e. unsafe or loss of serviceability).
ATTACHMENT 4

UG1 LONGWALLS 101 TO 103 BUILT FEATURES MANAGEMENT PLAN – TRANSGRID
SUBSIDENCE IMPACT REGISTER
## UG1 Longwalls 101 to 103 Built Features Management Plan – TransGrid

### Subsidence Impact Register

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<tr>
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<th>Impact Description</th>
<th>Does Impact Exceed the Built Feature Performance Measure/Indicators? (Yes/No)</th>
<th>Management Measures Implemented</th>
<th>Were Management Measures Effective? (Yes/No)</th>
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**Document Details**

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