CENTENNIAL

Built Features Management Plan
Longwalls 30 and 31

Mandalong Mine

MEMS-EP-9000-BFMP-9050

June 2021

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1 BACKGROUND

1.1 Introduction

Mandalong Mine is an existing underground longwall coal mine located on the western side of Lake Macquarie near Morisset, approximately 35 km southwest of Newcastle. Centennial Mandalong Pty Ltd is the operator of the mine and is a wholly owned subsidiary of Centennial Coal Company Pty Limited.

Development Consent for Mandalong Mine (SSD-5144) was approved on 12 October 2015 and permits extraction of 6.5 million tonnes of run-of-mine (ROM) coal per calendar year until 31 December 2040.

An Extraction Plan is required to be developed and approved prior to undertaking secondary extraction. The Extraction Plan is prepared for longwall panels 30-31 (LW30-31), describes the applicable regulatory framework, mine planning, management and monitoring measures to be implemented to protect all surface/subsurface natural and built features in addition to administering public safety measures associated with secondary extraction.

This Built Features Management Plan (in support of LW30-31 Extraction Plan) has been developed in accordance with the current requirements of Condition 6, Schedule 4 of SSD-5144 for the extraction of LW30-31, and in accordance with Mining Leases (ML1722 and ML1744) requirements issued under the Mining Act 1992 to extract the longwall panels within the West Wallarah Seam. The Extraction Plan and Built Features Management Plan have been prepared generally in accordance with the Department of Planning & Environment, *Draft Guidelines for the Preparation of Extraction Plans V5* (2015) and the Department of Industry - Resources Regulator, *Managing Risks of Subsidence Guide: WHS (Mines and Petroleum Sites) Legislation* (2017).

The area applicable to this extraction plan is defined in detail in **Section 3.1**

1.2 Project Description

The Extraction Plan area comprises a surface area of approximately 209 hectares. Across the Extraction Plan area, the ground surface elevation ranges from 40 m to 240 m. Due to the elevated topography, alluvium is limited in this area. The depth of cover above the West Wallarah Seam in this area ranges from approximately 285 m to 500 m.

The existing surface environment of the Extraction Plan area includes watercourses, native bushland, steep slopes and archaeological heritage items.

There are nine private properties, one property owned by Central Coast Council, one owned by Centennial Coal and one Crown Land lot. A small area of Olney State Forest is located at the southern extent of the Extraction Plan Area. The privately owned properties and four affected dwellings are managed by individual Property Subsidence Management Plans (PSMP) as required by SSD-5144 Schedule 4 Condition 6 (h).

Local roads, power lines, telecommunication networks and other associated infrastructure are also included in the area of potential subsidence influence. This surface infrastructure is managed by the Built Features Management Plan and supporting individual infrastructure management plans developed for Public Roads (Crown), Telstra Communications and Ausgrid Powerlines.

2 Purpose

The purpose of the Built Features Management Plan is to provide the management strategies, controls and monitoring programs to be implemented for the management of potential subsidence impacts on built features affected by the secondary extraction of LW30-31.

3 Scope

3.1 Extraction Plan Area

The Built Features Management Plan applies to the management of risks relating to the development of subsidence from the extraction of LW30-31, located within Centennial Mandalong Mining Leases (ML1722 and ML1744) and the SDD-5144 approved mining area. The Extraction Plan Area is defined by a minimum 26.5^{o} angle of draw or 20mm limit of subsidence at the Upper 95% Confidence Limits from the extents of proposed extraction of LW30-31 (**Figure 1**).

Built features on private property are managed separately by individual Property Subsidence Management Plans (PSMP). Refer to the Extraction Plan LW30-31 document for a detailed summary of the PSMPs.

3.2 Built Features

The built features located within the Extraction Plan Area are managed by the Built Features Management Plan and supporting individual infrastructure management plans. Separate infrastructure management plans have been developed for Public Roads, Telstra Communications and Ausgrid Powerlines. Additionally, private dwellings are addressed by individual PSMPs. **Table 1** shows each built feature and the relevant assessment and management plans.

Table 1 – Built Feature within Extraction Plan Area and Relevant Management Plan

Feature	Identification and Assessment	Management and Monitoring
Public Roads **Crown Lands**	Subsidence Predictions and Impact Assessment for Proposed LW30 and 31 MAN-005/2 (Ditton Geotechnical Services, 2021)	**Public Roads Management Plan** Built Features Management Plan Public Safety Management Plan Subsidence Monitoring Program
Telstra Communication Network	Subsidence Predictions and Impact Assessment for Proposed LW30 and 31 MAN-005/2 (Ditton Geotechnical Services, 2021) Telstra Communications Assessment Report for Extraction Plan LW30-33 (Comms Network Solutions, 2020)	**Communication Management Plan** Built Features Management Plan Public Safety Management Plan Subsidence Monitoring Program
Ausgrid 11 kV Powerlines	Subsidence Predictions and Impact Assessment for Proposed LW30 and 31 MAN-005/2 (Ditton Geotechnical Services, 2021) Ausgrid assessment	**Powerline Management Plan** Public Safety Management Plan Built Features Management Plan Subsidence Monitoring Program

Feature	Identification and Assessment	Management and Monitoring
Private Dwellings	Subsidence Predictions and Impact Assessment for Proposed LW30 and 31 MAN-005/2 (Ditton Geotechnical Services, 2021) Flood Impact Assessment - Full Subsidence Over Longwalls 1 to 33 (Umwelt, 2020) Pre-mining Dwelling Structural Assessments – Leigh Appleyard Chartered Professional Engineer Centennial Mandalong Extraction Plan LW30-31 Land and Agricultural Resource Assessment (SLR, 2020)	**Property Subsidence Management Plans (PSMP)** Public Safety Management Plan Subsidence Monitoring Program
Unsealed tracks – steep slopes	Subsidence Predictions and Impact Assessment for Proposed LW30 and 31 MAN-005/2 (Ditton Geotechnical Services, 2021) Centennial Mandalong Extraction Plan LW30-31 Land and Agricultural Resource Assessment (SLR, 2020)	**Land Management Plan** Public Safety Management Plan Subsidence Monitoring Program
State Survey Marks	SCIMS Subsidence Predictions and Impact Assessment for Proposed LW30 and 31 MAN-005/2 (Ditton Geotechnical Services, 2021)	**Built Features Management Plan**

4 Consultation and Plan Development

Individual Infrastructure management plans have been prepared and developed in consultation with the relevant infrastructure owner for Public Roads (Crown Lands), Communications (Telstra), Powerlines (Ausgrid) and State Survey Control (Spatial Services – Department of Customers Service).

The Resource Regulator (RR) has been consulted in the preparation of the Extraction Plan, infrastructure management plans, Public Safety Management Plan and the Subsidence Monitoring Program.

Specific consultation has been documented in each of the infrastructure management plans as outlined in **Table 2**.

Table 2 – Location of Consultation in each Infrastructure Management Plan

Infrastructure Management Plan	Summary of Correspondence	Copy of Correspondence
Public Roads Management Plan	Section 4	Appendix 7
Communications Management Plan	Section 4	Appendix 4
Powerline Management Plan	Section 4	Appendix 4
Property Subsidence Management Plans	Section 3.2	

The process for consultation, communication and the provision of information pertaining to this management plan will be managed according to Centennial Mandalong's **HSMC-SC-Information and Communications Arrangements** and **HSMS-SE-6592-Consultation Arrangements**.

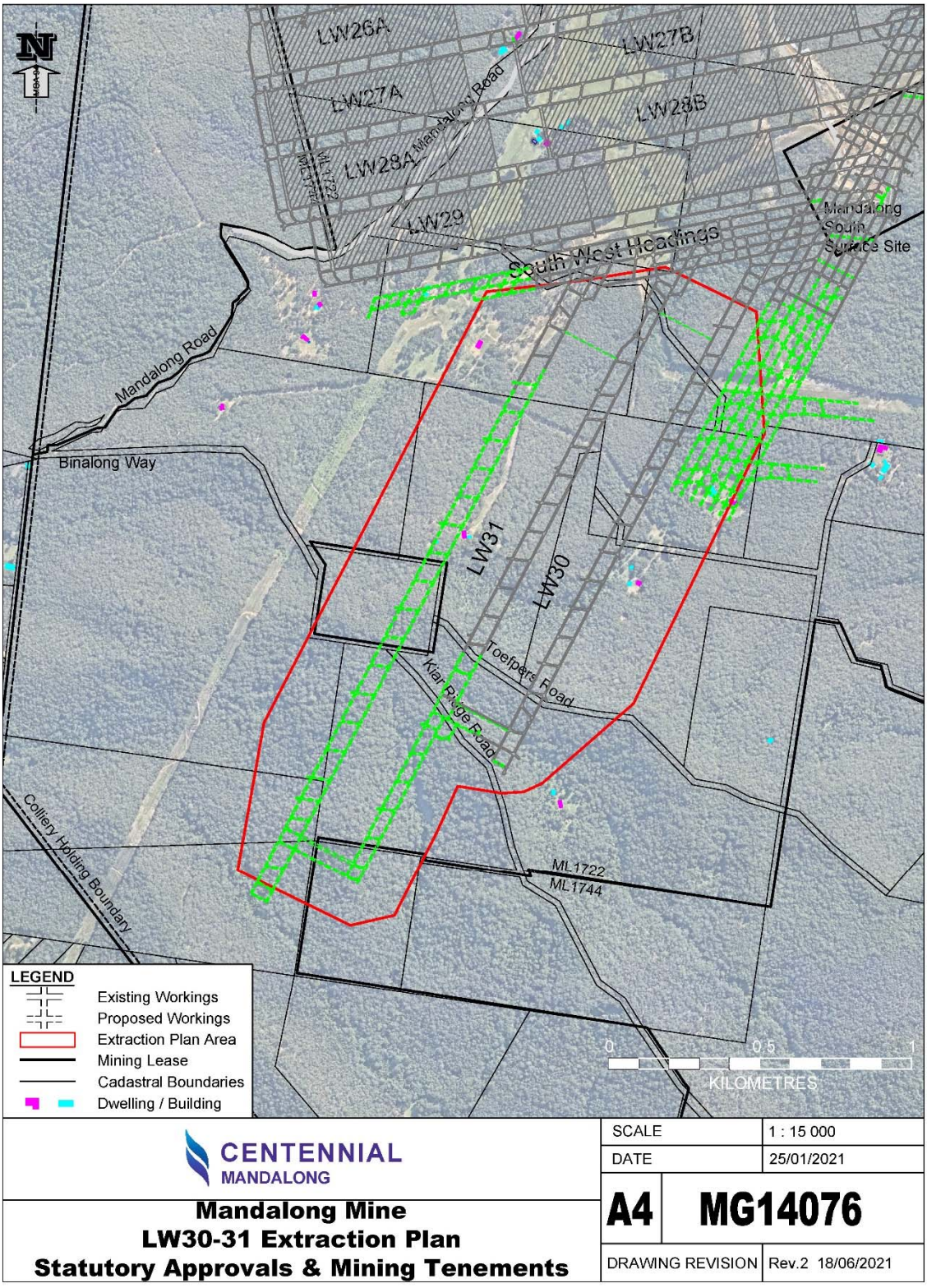

Figure 1 – Extraction Plan Area LW30-31

5 Regulatory Requirements

Centennial Mandalong operations are conducted in accordance with relevant legislation and requirements of statutory authorities. Legislative and regulatory requirements are generally recognised through the imposition of conditions on the development consent, licences, mining approvals and Work, Health and Safety legislation.

5.1 Development Consent

Development Consent SSD-5144 provides a number of conditions relating to the preparation of the Built Features Management Plan. These conditions are summarised in **Table 3** below, together with the notation of the section of this document in which each matter is addressed.

Table 3 - Development Consent Conditions SSD-5144

Condition	Development Consent Condition	Section Addressed
Schedule 4 Condition 4	**Performance Measures – Built Features** The Applicant must ensure that the development does not cause any exceedances of the performance measures in Table 7, to the satisfaction of the Secretary.	Section 6 and Table 7
Schedule 4 Condition 5	**Performance Measures** Any dispute between the Applicant and the owner of any built feature over the interpretation, application or implementation of the performance measures in Table 7 is to be settled by the Secretary, following consultation with RR. Any decision by the Secretary shall be final and not subject to further dispute resolution under this consent.	Section 6
Schedule 4 Condition 6 (g)	**Extraction Plan** (g) include a Built Features Management Plan, which has been prepared in consultation with DRE and the owners of affected built features, to manage the potential subsidence impacts and/or environmental consequences of the proposed second workings, and which: • addresses in appropriate detail all items of key public infrastructure (with particular consideration to tension/angle/suspension towers on transmission lines), and other public infrastructure; • has been prepared following appropriate consultation with the owner/s of potentially affected feature/s; • 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 • 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 which may impact the infrastructure;	Extraction Plan LW30-31 Built Features Management Plan LW30-31 Section 4 Section 7 Section 9

Condition	Development Consent Condition	Section Addressed
Schedule 4 Condition 6 (o)	(o) Trigger Action Response Plan addressing all features in Tables 6 and 7 which contain: • appropriate triggers to warn of the development of an increasing risk of exceedance of any performance measures; • specific actions to respond to high risk exceedance of any performance measure to ensure that the measure is not exceeded; and • an assessment of remediation measures that may be required if exceedances occur and the capacity to implement the measures;	Section 12 and Appendix 1
Schedule 4 Condition 6 (p)	(p) 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 6 and 7, or where any such exceedance appears likely; and an assessment of the remediation measures that may be required if exceedances occur and the capacity to implement the measures;	Section 12 and Appendix 1
Statement of Commitments EIS	**Subsidence Monitoring and Management** As part of the development of each Extraction Plan, Centennial Mandalong will update the Public Safety Management Plan and Built Features Management Plans in consultation with the relevant infrastructure owners.	This Plan Public Safety Management Plan

5.2 Mining Leases

The Extraction Plan Area for LW30-31 is associated with two mining leases held by Centennial Mandalong; ML1722 and ML1744. **Table 4** summaries the relevant conditions relating to the Extraction Plan and preparation of the Built Features Management Plan.

Table 4 – Summary of ML1722 and ML1744 conditions relating to Built Features

	Mining Lease No. 1722 and 1744	Section Addressed
ML1722 and ML1744 Condition 6	**Extraction Plan** (a) In this condition: (i) approved Extraction Plan means a plan, being: A. an extraction plan or subsidence management plan approved in accordance with the conditions of a relevant development consent and provided to the Secretary; or B. a subsidence management plan relating to the mining operations subject to this lease: I. submitted to the Secretary on or before 31 December 2014; and II. approved by the Secretary. (ii) relevant development consent means a development consent or project approval issued under the Environmental Planning & Assessment Act 1979 relating to the mining operations subject to this lease. (b) The lease holder must not undertake any underground mining operations that may cause subsidence except in accordance with an approved Extraction Plan. (a) The lease holder must ensure that the approved Extraction Plan provides for the effective management of risks associated with any subsidence resulting from mining operations carried out under this lease. (b) The lease holder must notify the Secretary within 48 hours of any: (i) incident caused by subsidence which has a potential to expose any person to health and safety risks; (ii) significant deviation from the predicted nature, magnitude, distribution, timing and duration of subsidence effects, and of the potential impacts and consequences of those deviations on built features and the health and safety of any person; or (iii) significant failure or malfunction of a monitoring device or risk control measure set out in the approved Extraction Plan addressing: A. built features; B. public safety; or C. subsidence monitoring.	Extraction Plan LW30-31 Built Features Management Plan LW30-31 Public Safety Management Plan LW30-31 Subsidence Monitoring Program LW30-31

5.3 Extraction Plan Guidelines

The Extraction Plan and Built Features Management Plan have been prepared generally in accordance with the Department of Planning & Environment, *Draft Guidelines for the Preparation of Extraction Plans V5* (2015). **Table 5** provides a summary of the guideline's requirements for key component plans together with the notation of the section of this document in which each matter is addressed.

Table 5 - Extraction Plan Guideline Requirements for Key Component Plans

Extraction Plan Guideline Requirement – Key Component Plans	Section Addressed
An overview of all landscape features, heritage sites, environmental values, built features or other values to be managed under the component plan	Section 1
Setting out all performance measures included in the development consent relevant to the features or values to be managed under the component plan	Section 6
Setting out clear objectives to ensure the delivery of the performance measures and all other relevant statutory requirements (including relevant safety legislation)	Section 6
Proposing performance indicators to establish compliance with these performance measures and statutory requirements;	Section 6
Describe the landscape features, heritage sites and environmental values to be managed under the component plan, and their significance. It should be noted that a full description of such features, sites and values would commonly have been provided and considered in a recent environmental impact assessment. Consequently, this section can be relatively brief, and focus on the presentation of appropriate figures and/or graphical plans;	Section 8
Describe all currently-predicted subsidence impacts and environmental consequences relevant to the features, sites and values to be managed under the component plan;	Section 8
Describe all measures planned to remediate these impacts and/or consequences, including any measures proposed to ensure that impacts and/or consequences comply with performance measures and/or the Applicant's commitments;	Section 10.2 and TARPS in Appendix 1
Describe the existing baseline monitoring network and the current baseline monitoring results, including pre-subsidence photographic surveys of key landscape features and key heritage sites which may be subject to significant subsidence impacts (such as significant watercourses, swamps and Aboriginal heritage sites);	Section 10.1
Fully describing the proposed monitoring of subsidence impacts and environmental consequences;	Section 10.2
Describe the proposed monitoring of the success of remediation measures following implementation;	Section 9
Describe adaptive management proposed to avoid repetition of unpredicted subsidence impacts and/or environmental consequences;	Section 11 and TARPS in Appendix 1
Describe contingency plans proposed to prevent, mitigate or remediate subsidence impacts and/or environmental consequences which substantially exceed predictions or which exceed performance measures;	Section 11 and TARPS in Appendix 1
Listing responsibilities for implementation of the plan; and	Section 13
An attached Trigger, Action, Response Plan (effectively a tabular summary of most of the above).	TARPS in Appendix 1.

5.4 Work, Health and Safety Legislation

Mandalong Mine has developed a Safety Management System framework (MS-1001) that integrates plans, policies and procedures that enables a systematic approach to establishing and maintaining effective systems to manage health and safety consistent with WHS legislation and AS/NZS 4804:2001.

The following Work, Health and Safety (WHS) requirements have been considered for the Extraction Plan principally within the context of subsidence related risks to public safety, including to private property and public infrastructure and in reference to *Managing Risks of Subsidence Guide: WHS (Mines and Petroleum Sites) Legislation* (NSW Department of Industry - Resources Regulator, 2017).

Work Health and Safety legislation relating to the management of risk to health and safety from mine subsidence is addressed in (**Table 6**).

Table 6 – Summary of WHS Legislation Relating to Mine Subsidence

Work Health and Safety Legislation Clause	Requirement	Section Addressed
WHS Regulation 2017 Clause 34	**Duty to identify hazards** A duty holder, in managing risks to health and safety, must identify reasonably foreseeable hazards that could give rise to risks to health and safety.	Section 7 Section 8 Extraction Plan Appendix 4 -Risk Assessments
WHS Regulation 2017 Clause 35	**Managing risks to health and safety** A duty holder, in managing risks to health and safety, must: (a) eliminate risks to health and safety so far as is reasonably practicable, and (b) if it is not reasonably practicable to eliminate risks to health and safety, minimise those risks so far as is reasonably practicable.	Section 6.1 Section 7 Section 9 Section 11
WHS Regulation 2017 Clause 36	**Hierarchy of control measures** (1) This clause applies if it is not reasonably practicable for a duty holder to eliminate risks to health and safety. (2) A duty holder, in minimising risks to health and safety, must implement risk control measures in accordance with this clause. (3) The duty holder must minimise risks, so far as is reasonably practicable, by doing 1 or more of the following: (a) substituting (wholly or partly) the hazard giving rise to the risk with something that gives rise to a lesser risk, (b) isolating the hazard from any person exposed to it, (c) implementing engineering controls. (4) If a risk then remains, the duty holder must minimise the remaining risk, so far as is reasonably practicable, by implementing administrative controls. (5) If a risk then remains, the duty holder must minimise the remaining risk, so far as is reasonably practicable, by ensuring the provision and use of suitable personal protective equipment. **Note.** A combination of the controls set out in this clause may be used to minimise risks, so far as is reasonably practicable, if a single control is not sufficient for the purpose.	Section 6.1 Section 7 Section 9 MS-1001
WHS Regulation 2017 Clause 37	**Maintenance of control measures** A duty holder who implements a control measure to eliminate or minimise risks to health and safety must ensure that the control measure is, and is maintained so that it remains, effective, including by ensuring that the control measure is and remains: (a) fit for purpose, and (b) suitable for the nature and duration of the work, and	Section 9 Section 10 Volume 3 of LW30-31 EP

Work Health and Safety Legislation Clause	Requirement	Section Addressed
	(c) installed, set up and used correctly.	
WHS Regulation 2017 Clause 38	**Review of control measures** (1) A duty holder must review and as necessary revise control measures implemented under this Regulation so as to maintain, so far as is reasonably practicable, a work environment that is without risks to health or safety. (2) Without limiting subclause (1), the duty holder must review and as necessary revise a control measure in the following circumstances: (a) the control measure does not control the risk it was implemented to control so far as is reasonably practicable, (b) before a change at the workplace that is likely to give rise to a new or different risk to health or safety that the measure may not effectively control, (c) a new relevant hazard or risk is identified, (d) the results of consultation by the duty holder under the Act or this Regulation indicate that a review is necessary, (e) a health and safety representative requests a review under subclause (4). (3) Without limiting subclause (2) (b), a change at the workplace includes: (a) a change to the workplace itself or any aspect of the work environment, or (b) a change to a system of work, a process or a procedure. (4) A health and safety representative for workers at a workplace may request a review of a control measure if the representative reasonably believes that: (a) a circumstance referred to in subclause (2) (a), (b), (c) or (d) affects or may affect the health and safety of a member of the work group represented by the health and safety representative, and (b) the duty holder has not adequately reviewed the control measure in response to the circumstance.	Section 11 Section 15 Extraction Plan Appendix 4 -Risk Assessments
WHS Regulation (Mines and Petroleum Sites) 2014 Clause 9	**Management of risks to health and safety** (cl 617 model WHS Regs) (1) A person conducting a business or undertaking at a mine must manage risks to health and safety associated with mining operations at the mine in accordance with Part 3.1 of the WHS Regulations. (2) A person conducting a business or undertaking at a mine must ensure that a risk assessment is conducted in accordance with this clause by a person who is competent to conduct the particular risk assessment having regard to the nature of the hazard. (3) In conducting a risk assessment, the person must have regard to: (a) the nature of the hazard, and (b) the likelihood of the hazard affecting the health or safety of a person, and (c) the severity of the potential health and safety consequences. (4) Nothing in subclause (3) limits the operation of any other requirement to conduct a risk assessment under this Regulation. (5) A person conducting a business or undertaking at a mine (who is the mine operator of the mine or who is a contractor) must keep a record of the following: (a) each risk assessment conducted under this clause and the name and competency of the person who conducted the risk assessment, (b) the control measures implemented to eliminate or minimise any risk that was identified through any such risk assessment. (6) A person conducting a business or undertaking at a mine is not required to keep a record of a risk assessment if: (a) the risk assessment is one that an individual worker is required to carry out before commencing a particular task, and (b) the person keeps a record of risk assessments that addresses the overall activity being undertaken (of which the task forms a part) such as risk assessments carried out in relation to the development of the safety management system for the mine or for a principal mining hazard management plan. (7) The record kept under subclause (5): (a) if kept by a mine operator—forms part of the safety management system of the mine and the records of the mine, or (b) if kept by a contractor who has prepared a contractor health and safety	Section 7 MS-1001

Work Health and Safety Legislation Clause	Requirement	Section Addressed
	management plan—forms part of the plan.	
WHS Regulation (Mines and Petroleum Sites) 2014 Clause 10	**Review of control measures** (cl 618 model WHS Regs) (1) A person conducting a business or undertaking at a mine must review and as necessary revise control measures implemented under clause 9 in the following circumstances: (a) an audit of the effectiveness of the safety management system for the mine indicates a deficiency in a control measure, (b) a worker is moved from a hazard or assigned to different work in response to a recommendation contained in a health monitoring report provided under Part 3, (c) an incident referred to in clause 128 occurs, (d) any other incident occurs that is required to be notified to the regulator under the WHS laws. (2) The mine operator of a mine must ensure that a control measure that is the subject of a request by a health and safety representative under clause 38 (4) of the WHS Regulations is reviewed and as necessary revised, whether the request is made to the mine operator or notified to the mine operator under subclause (3) by another person conducting a business or undertaking at the mine. (3) A person conducting a business or undertaking at the mine who is not the mine operator of the mine must immediately notify the mine operator of a request made to the person under clause 38 (4) of the WHS Regulations. (4) A health and safety representative for workers at the mine may request a review of a control measure under clause 38 (4) of the WHS Regulations as if the circumstances referred to in subclause (1) were included as a circumstance in clause 38 (4) (a) of the WHS Regulations.	Section 11 Section 14 Section 15 MS-1001
WHS Regulation (Mines and Petroleum Sites) 2014 Clause 23 Identification of principal mining hazard management plan	(1) The mine operator of a mine must identify all principal mining hazards associated with mining operations at the mine. (2) The mine operator must conduct, in relation to each principal mining hazard identified, a risk assessment that involves a comprehensive and systematic investigation and analysis of all aspects of risk to health and safety associated with the principal mining hazard. (3) The mine operator, in conducting a risk assessment under subclause (2), must: (a) use investigation and analysis methods that are appropriate to the principal mining hazard being considered, and (b) consider the principal mining hazard individually and also cumulatively with other hazards at the mine.	Centennial Risk Management System – consistent with AS/NZS ISO 31000:2009 Risk Assessments in Appendix 4 Extraction Plan Subsidence WHS No. 1001025001 Built Features LW30-31 No. 1001284061 PSMPs LW30-31 No. 1001285007 Environment LW30-31 No. 1001284063
WHS Regulation (Mines and Petroleum Sites) 2014 Clause 24 Preparation of principal mining	(1) The mine operator of a mine must consider the following when preparing a principal mining hazard management plan for a principal mining hazard at the mine in accordance with this clause and Schedule 1. (2) A principal mining hazard management plan must: (a) provide for the management of all aspects of risk control in relation to the principal mining hazard, and (b) so far as is reasonably practicable, be set out and expressed in a way that is readily understandable by persons who use it..	Extraction Plan LW30-31 and Public Safety Management Plan

Work Health and Safety Legislation Clause	Requirement	Section Addressed
hazard management plan	(3) A principal mining hazard management plan must: (a) describe the nature of the principal mining hazard to which the plan relates, and (b) describe how the principal mining hazard relates to other hazards associated with mining operations at the mine, and (c) describe the analysis methods used in identifying the principal mining hazard to which the plan relates, and (d) include a record of the most recent risk assessment conducted in relation to the principal mining hazard, and (e) describe the investigation and analysis methods used in determining the control measures to be implemented, and (f) describe all control measures to be implemented to manage risks to health and safety associated with the principal mining hazard, and (g) describe the arrangements in place for providing the information, training and instruction required by clause 39 of the WHS Regulations in relation to the principal mining hazard, and (h) refer to any design principles, engineering standards and technical standards relied on for control measures for the principal mining hazard, and (i) set out the reasons for adopting or rejecting each control measure considered. (4) The mine operator of a mine must consider the following when preparing a principal mining hazard management plan for a principal mining hazard at the mine: (a) the matters set out in Schedule 1 in respect of the principal mining hazard, and (b) any other matter relevant to managing the risks associated with the principal mining hazard at the mine.	
WHS Regulation (Mines and Petroleum Sites) 2014 Clause 67 Subsidence	(1) In complying with clause 9, the mine operator of an underground coal mine must manage risks to health and safety associated with subsidence at the mine. (2) Without limiting subclause (1), the mine operator must ensure that: (a) so far as is reasonably practicable, the rate, method, layout, schedule and sequence of mining operations do not put the health and safety of any person at risk from subsidence, and (b) monitoring of subsidence is conducted, including monitoring of its effects on relevant surface and subsurface features, and (c) any investigation of subsidence and any interpretation of subsidence information is carried out only by a competent person, and (d) all subsidence monitoring data is provided to the regulator in the form and at the times required by the regulator, and (e) so far as is reasonably practicable, procedures are implemented for the effective consultation, co-operation and co-ordination of action with respect to subsidence between the mine operator and relevant persons conducting any business or undertaking that is, or is likely to be, affected by subsidence	Section 6.1 Section 9 Section 10 Section 13 Section 14 TARPs Extraction Plan Appendix 4 - Risk Assessments
WHS Regulation (Mines and Petroleum Sites) 2014 Clause 128 Duty to notify regulator of certain incidents	(1) The operator of a mine or petroleum site must take all reasonable steps to ensure that the regulator is notified in accordance with this clause after becoming aware of an incident (other than a notifiable incident) arising out of the carrying out of mining operations or petroleum operations at the mine or petroleum site, but only if the incident: (a) results in illness or injury that requires medical treatment within the meaning of clause 13 of Schedule 9, or (b) is a high potential incident. (5) In this clause: *high potential incident* means any of the following: (m) any indication from monitoring data of the development of subsidence which may result in any incident referred to in clause 179 (a) (xvi) - a failure of ground, or of slope stability control measures, or	Appendix 1 TARPs Public Safety Management Plan

Work Health and Safety Legislation Clause	Requirement	Section Addressed
	179 (a) (xvii) - rock falls, instability of cliffs, steep slopes or natural dams, occurrence of sinkholes, development of surface cracking or deformations or release of gas at the surface, due to subsidence.	
WHS Regulation (Mines and Petroleum Sites) 2014 Schedule 1 Subsidence Clause 3C Principal hazard management plans – additional matters to be considered	**Subsidence** The following matters must be considered in developing the control measures to manage the risks of subsidence: (a) the characteristics of all relevant surface and subsurface features, (b) the characteristics of all relevant geological, hydrogeological, hydrological, geotechnical, topographic and climatic conditions, including any conditions that may cause elevated or abnormal subsidence or the formation of sinkholes, (c) the characteristics of any previously excavated or abandoned workings that may interact with any proposed or existing mine workings, (d) the existence, distribution, geometry and stability of significant voids, standing pillars or remnants within any old pillar workings that may interact with any proposed or existing mine workings, (e) the predicted and actual nature, magnitude, distribution, timing and duration of subsidence, (f) the rate, method, layout, schedule and sequence of mining operations.	Extraction Plan - Appendix 1 (Ditton Geotechnical Services, 2021) Extraction Plan and Volume 3 (Component Plans)
WHS Regulation (Mines and Petroleum Sites) Schedule 3 Clause 16 High Risk Activities	**Secondary extraction or pillar extraction, splitting or reduction** (1) The following are identified as high risk activities: (a) secondary extraction by longwall mining, shortwall mining or miniwall mining, (b) pillar extraction, (c) pillar splitting, (d) pillar reduction. (2) The waiting period for any such activity is 3 months. (3) The information and documents that must be provided in relation to any such activity are as follows: (a) details of the authoritative sources used in determining that the proposed method of work can be done safely, (b) engineering plans showing the manner and sequence of extraction, endorsed by the individual nominated to exercise the statutory function of mining engineering manager at the mine, (c) information about the land above or in the vicinity of the proposed activity including land use and details of who owns or occupies any land that may be affected by subsidence, (d) in the case of a pillar extraction, details of the procedures for the recovery of buried and immobile mining plant in or around a goaf, (e) details of how the risks to the health and safety of workers and other persons from subsidence caused by the activity will be managed.	Extraction Plan LW30-31 and High Risk Activity Notification for LW30-31

6 Performance Measures and Indicators

6.1 Mine Design

Mandalong Mine is designed to provide reduced levels of subsidence by using sub-critical longwall panels (180m to 200m) combined with 43m to 53m wide chain pillars that utilise the bridging effect of the overlying massive conglomerate and sandstone strata. This design is proven and provides subsidence impacts below safe, serviceable and repairable (SSR) criteria for dwellings and also minimises the impacts to the flood plain, natural features and the built features managed by this plan.

6.2 Subsidence Prediction

Subsidence predictions and potential impacts from the extraction of LW30-31 on surface and subsurface features present within the Extraction Plan Area has been prepared by Ditton Geotechnical Services (Ditton Geotechnical Services, 2021) based on the following methodology:

(i) The development of a geotechnical model of the overburden and immediate roof-pillar-floor system using available borehole log and testing data.

(ii) Prediction of maximum subsidence effect parameters for the proposed longwalls.

(iii) Review of Mandalong Mine's subsidence data and impacts associated with LW1-27.

(iv) Prediction of first and final subsidence effect profiles and final contours and assessment of the potential impacts to existing and proposed features or developments.

(v) Prediction of post-mining surface levels.

(vi) Potential surface cracking widths and their general location.

(vii) Prediction of sub-surface heights of continuous and discontinuous fracturing above the proposed longwall panels.

(viii) Potential ponding depth locations.

(ix) Potential surface gradient changes and erosion / slope stability impacts.

(x) Valley Closure and Uplift potential along watercourses.

(xi) Far-field horizontal displacements and strains.

(xii) Predicted impacts and management strategies required for the environment, developments and Aboriginal and European Heritage sites.

Two empirically based prediction models (**ACARP, 2003** and **SDPS®**) have been used to generate subsidence profiles and contours above the proposed longwall panels after mining is complete. **Surfer 8®** software has then been used to generate subsidence, tilt, horizontal displacement, and strain contours above the panels from the **SDPS®** output files.

The subsidence predictions models used in this study are summarised below:

- **ACARP, 2003** - An empirical model that was originally developed for predicting maximum single and multiple longwall panel subsidence, tilt, curvature and strain in the Newcastle Coalfield. The model database included measured subsidence parameters and overburden geology data, which have been back analysed to predict the subsidence reduction potential (SRP) of massive lithology in terms of 'Low', 'Moderate' and 'High' SRP categories.

The model database also includes chain pillar subsidence, inflexion point distance, goaf edge subsidence and angle of draw prediction models, which allow subsidence profiles to be generated for any number of panels and a range of appropriate confidence limits. The Upper 95% Confidence Limit (U95%CL) has been adopted in this study for predictions of the Credible Worst-Case values.

The model has been updated by Ditton Geotechnical Services (DgS) since 2007 to allow the original **ACARP, 2003** model to be applied to other Australian Coalfields and improve its robustness over a greater range of mining geometries and geologies.

- **SDPS®, 2007** - A US developed (Virginia Polytechnical Institute) influence function model for subsidence predictions above longwalls or pillar extraction panels. The model requires calibration to measured subsidence profiles to reliably predict the subsidence and differential subsidence profiles required to assess impacts on surface features.

  The model also includes a database of percentage of hard rock (i.e. massive sandstone / conglomerate) that effectively reduces subsidence above super-critical and sub-critical panels due to either bridging or bulking of collapsed material. This is consistent with the **ACARP, 2003** models prediction methodology.

Pre-feasibility studies of appropriate panel widths and set-back distances required to minimise or limit surface impacts to manageable levels have been undertaken by Centennial Mandalong and DgS prior to the preparation of the predictions. The outcomes of the preliminary analysis have resulted in the mining geometry and layout adopted.

Based on regression analysis techniques, curves of 'best fit' have been used to estimate Mean and Credible Worst-Case (Upper 95% Confidence Limits) for the subsidence effects due to the proposed longwalls. The curves are based on measured subsidence data in the NSW Coalfields and key mining geometry parameters (refer **ACARP, 2003**). The Mandalong mining experience to-date has also been reviewed against the database (LW1-27).

The prediction method allows specialist consultants to assess the potential range of impacts to a given feature in a probabilistic manner. Impact Management Plans and strategies can then be developed that allows appropriate Trigger Action Responses and mine planning adjustments or mitigation measures necessary to deliver satisfactory outcomes to stakeholders.

6.3 Performance Measures

As outlined in **Section 6.1**, the primary objective of the mine design is to prevent any significant mine induced risk to built features by providing low levels of subsidence, that allow built features including private dwellings to remain safe, serviceable and repairable.

The Built Features Management Plan aims to ensure the performance measures in SSD-5144 Schedule 4 Condition 4 Table 7 are not exceeded. The performance measures are shown in **Table 7**.

Table 7 - Subsidence Impact Performance Measures

Key Public Infrastructure	
M1 Motorway	Always safe and serviceable.
Main Northern Railway	
330 kV power supply infrastructure	Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired.
Other Built Infrastructure	
Power lines and power poles	Always safe.
Telecommunications infrastructure	Serviceability should be maintained wherever practicable.
Privately-owned residences	
Local Roads	Loss of serviceability must be fully compensated.
Other built features and improvements, (including access roads, farm dams, swimming pools, tracks and fences)	Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.
Public Safety	
Public Safety	Negligible additional risk.

Notes:

- *Key public infrastructure is shown in Figure 2 of Appendix 2 and in Figure 1 of Appendix 5*
- *Other built infrastructure is shown in Figure 1 of Appendix 5.*
- *The Applicant will be required to define more detailed performance indicators for each of these performance measures in the Built Features Management Plan, Property Subsidence Management Plans and Public Safety Management Plan (see condition 6 below).*
- *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.*
- *Requirements regarding safety or serviceability do not preclude preventative or mitigatory actions being taken prior to or during mining in order to achieve or maintain these outcomes.*
- *Requirements under this condition may be met by measures undertaken in accordance with the Mine Subsidence Compensation Act 1961.*

6.4 Performance Indicators

To establish compliance with the performance measured outlined in **Section 6.3**, Centennial Mandalong has established a subsidence and environmental monitoring program developed in consultation with the built feature owners and RR. Trigger Action Response Plans (TARPs) have also been established and provided in **Appendix 1**. These documents establish the appropriate subsidence monitoring, parameters and associated trigger levels to demonstrate that subsidence performance satisfies the Subsidence Performance Measures set in **Table 7** and infrastructure requirements.

The Performance Indicators have been established for each built feature. The TARPS provide the trigger values as outlined in **Table 8**.

Table 8 – Performance Indicators

Performance Indicator	Tigger	Action / Response
Level 1 Low	Operations within prediction and approved impact.	Continued operations and monitoring as normal.
Level 2 Medium	Operations within approved impacts but exceed or potentially exceed predictions.	Review and investigation processes are engaged, with adaptive management as required.
Level 3 High	Operations exceed approved impact.	Adaptive Management fully engaged

7 Risk Management

Centennial Mandalong has adopted the Stature Risk Assessment Program which was developed to ensure consistency in all risk assessments across the Centennial Coal operations. The Stature Risk Assessment Program sets out a consequences table and risk ranking matrix for managing identified risks consistent with AS/NZS ISO 31000:2009.

All operational processes undertaken at the Centennial Mandalong operations are subject to the risk assessment process prior to implementation. The process for risk and change management is undertaken according to the methodology and tools contained within **HSMS-SE-1024-Risk Management Arrangements** and **HSMS-SE-1082- Change Management System**.

Centennial Mandalong completed a WRAC Risk Assessments for Built Features (No. 1001284061) and PSMPs (1001285007) affected by subsidence from the secondary extraction of LW30-31. The built features assessed include:

- Public Roads – Crown roads: Toefpers Road and Kiar Ridged Rd;
- Telstra Communications (aerial cables);
- Ausgrid 11kV powerlines;
- State Survey Control; and
- Dwellings and structures.

A full copy of the risk assessments are included within Appendix 4 of the Extraction Plan LW30-31.

7.1 Identified Risks

Mandalong Mine has well established Infrastructure Management Plans, which have been developed and refined since the commencement of longwall mining in 2005. The risks to built features from the development of mine subsidence within the Extraction Plan area are detailed for each infrastructure item. Subsidence predictions and assessment was provided by Ditton Geotechnical Services (2021).

The risk assessment team also considered the tolerance of landscape features to subsidence impact. Two case studies were modelled:

1. Maximum Subsidence Prediction (mean); and
2. Credible Worst-Case Subsidence (Upper 95% Confidence Limits).

This enabled a form of sensitivity analysis of the subsidence predictions to be made as outlined in **Table 9**.

Table 9 – Subsidence Sensitivities

Prediction	Cause
Maximum Predicted Subsidence (Mean)	Expected geotechnical conditions
Maximum Predicted Subsidence (Credible Worst-Case, U95% CL)	Geotechnical conditions worse than anticipated

The maximum predicted subsidence values for LW30-31 are:

- Final maximum panel subsidence ranges from 0.98 m (mean) to 1.33 m (U95% CL).
- Final maximum chain pillar subsidence ranges from 0.62 m (mean) to 1.12 m (U95% CL).
- Maximum panel tilt ranges from 6 to 15 mm/m (mean) and 9 to 22 mm/m (U95% CL).
- Maximum panel compressive strains range from 3 to 6 mm/m (mean) and from 5 to 9 mm/m (U95% CL).
- Maximum panel tensile strains range from 3 to 5 mm/m (mean) and from 4 to 7 mm/m (U95% CL).

Potential hazards to public safety and the built features from the impact of mine subsidence can include:

7.1.1 Public Roads

Potential hazards to public roads and public safety from the impact of mine subsidence can include:

- Potential for surface cracking - edges of extraction void and travelling abutments particularly in rock outcrop areas;
- Potential for surface humps (compression) - near centre of extracted panels and travelling abutment;
- Potential for step change in road - associated with cracking;
- Potential reduced serviceability of drainage channels; and
- Potential for flooding hazards for roads and access tracks.

7.1.2 Ausgrid 11kV Power Lines

Potential hazards to the Ausgrid power supply network and public safety from the impact of mine subsidence on powerlines can include:

- Potential damage to poles, cross arms, insulators and conductors;
- Potential for tilting poles, increased/decreased conductor tension;
- Potential for reduced conductor ground clearance; and
- Potential interruption of power supply to customers.

7.1.3 Telstra Communication Network

Potential hazards to the Telstra communications network and public safety from the impact of mine subsidence on phone lines can include:

- Potential damage to direct buried copper cables and potential loss of service to customers;
- Potential damage to aerial copper cables and potential loss of service to customers; and
- Potential damage to conduit and pit network supporting communications cables.

7.1.4 Private Properties and Dwellings

Potential hazards to private property, dwellings and public safety from the impact of mine subsidence can include:

- Potential damage to the dwellings and buildings, resulting in structural damage, being beyond safe, service and repairable.
- Potential increased flooding to land;
- Potential to reduce dwelling freeboard below 100 year flood level;
- Potential increased flood hazard at dwellings; and
- Potential increased flood hazard on property access routes.

7.1.5 State Survey Marks

Subsidence from longwall mining will affect both vertical and horizontal the accuracy of state survey marks.

7.2 Risk Assessment Outcome

A risk ranking (low, moderate, significant, high or extreme) was assigned to each risk/hazard. The risk ranking for all features was assessed as **Low** to **Significant** at the maximum predicted subsidence.

The risk assessments undertaken for the extraction plan and subsequently identified control measures to ensure the potential for these risks to occur is appropriately controlled to ensure infrastructure and built features are maintained as Safe, Serviceable and Repairable as a minimum and in many cases no significant impact at all was predicted. Refer to **Sections 8** and **Section 9** for details.

The Risk Assessments are included in the Extraction Plan LW30-31 - Appendix 4.

8 Built Features and Predicted Impacts

8.1 Public Roads

The existing **Public Roads Management Plan (MEMS-EP-9000-PRMP-9051)** has been reviewed for LW30-31 and developed in consultation with LMCC and Crown Lands. There are two unsealed Crown roads (Toepfers Road and Kiar Ridge Road) and two private access roads (mainly unsealed) contained within the Extraction Plan area. The location of public roads and the Extraction Plan Area are shown in **Figure 2**.

8.1.1 Predicted Impacts

Mandalong Mine has been mining beneath sections of both sealed and unsealed public roads since the commencement of longwall mining in 2005. Where actual subsidence has been within prediction and below SSR criteria for dwellings, the road pavement has not been affected. Where compressive strains have been recorded greater than 5mm/m, a number of compression humps have developed in the pavement located over the centre of the longwall panel. In these few cases Centennial, LMCC and the SA NSW have repaired the pavement.

The impacts due to the predicted subsidence effects for proposed LW30 to 31 may include:

- Tensile crack widths of between 20 mm & 50 mm.
- Compressive shearing or heaving between 20 mm & 40 mm.
- Increase of super-elevation in the road of 1.0% to 1.3%.
- Cracking of culverts and fill embankments due to curvatures of +/- 0.3 to 0.5 km-1 (radius of curvature from 3.3 km to 2 km).
- Erosion and slope instability of fill embankments.

The subsidence impacts predicted for the proposed mining layout for LW30 to 31 are consistent with observed impacts for the given tilt and strain at Mandalong to-date and are similar to the values approved under SSD-5144 MOD 9.

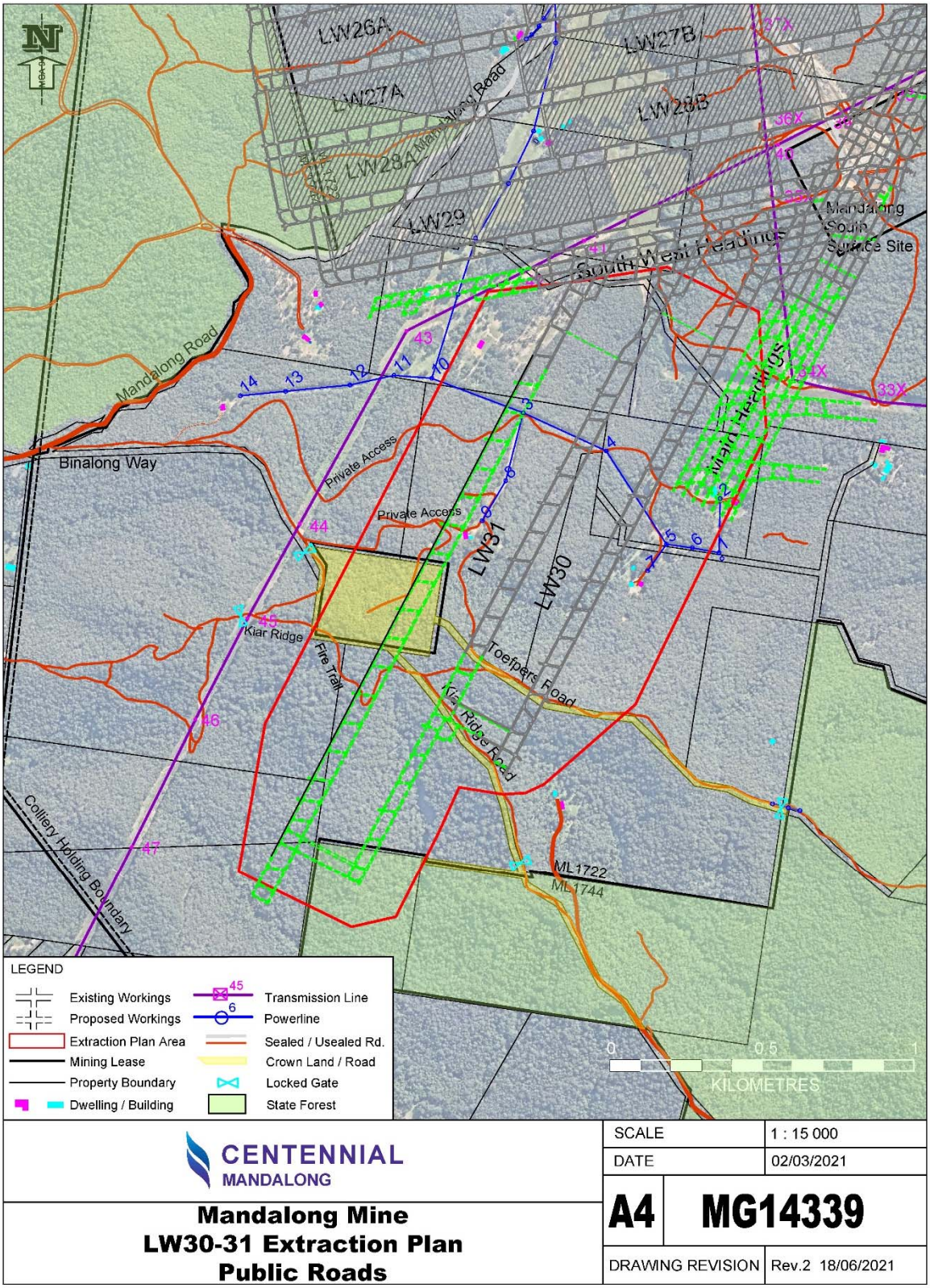

Figure 2 – Public Roads and Extraction Plan Area LW30-31

8.2 Telstra Communications

Telstra Network Integrity Services and their approved contractor Comms Network Solutions have been consulted on the development of the **Communications Management Plan for LW30-31** (MEMS-EP-9000-CMP-9052). Within the Extraction Plan Area for LW30-31, the Telstra communications network is generally located from Binalong Way and extending along a private access road and powerline easements to private properties. The network consists of the following two main components:

- The Aerial CAN copper cable extending from Binalong Way is fed from Dooralong Exchange Area by an aerial 100Pr cable feeding east along Mandalong Road via the Durren Durren area. The aerial cable then extends along a private access road and Ausgrid powerline easement over LW30-31; and
- Associated pits conduits and elevated joints support the above cable network.

8.2.1 Predicted Impacts

Centennial Mandalong has a proven history of mining beneath the Telstra communications network. Communications Management Plans have been developed in consultation with Telstra for each of the previous nine SMP / Extraction Plan areas. Similarly, a **Communications Management Plan** (MEMS-9000-CMP-9052) has been developed in consultation with Telstra for the Extraction Plan LW30-31, based on the Ditton Geotechnical Services (2021) subsidence predictions as detailed in the Telstra Communications Assessment Report for Extraction Plan LW30-33 (Comms Network Solutions, 2020).

There has been no recorded impact to the Telstra copper cable network during the development of subsidence over Longwalls 1 to 28 in the past 16 years.

The expected subsidence impact over the LW30-31 extraction plan area is **Low** to aerial copper cables and the associated pits, joints and conduits. Serviceability of the network is not expected to be affected, therefore no additional risk to the health and safety of the public.

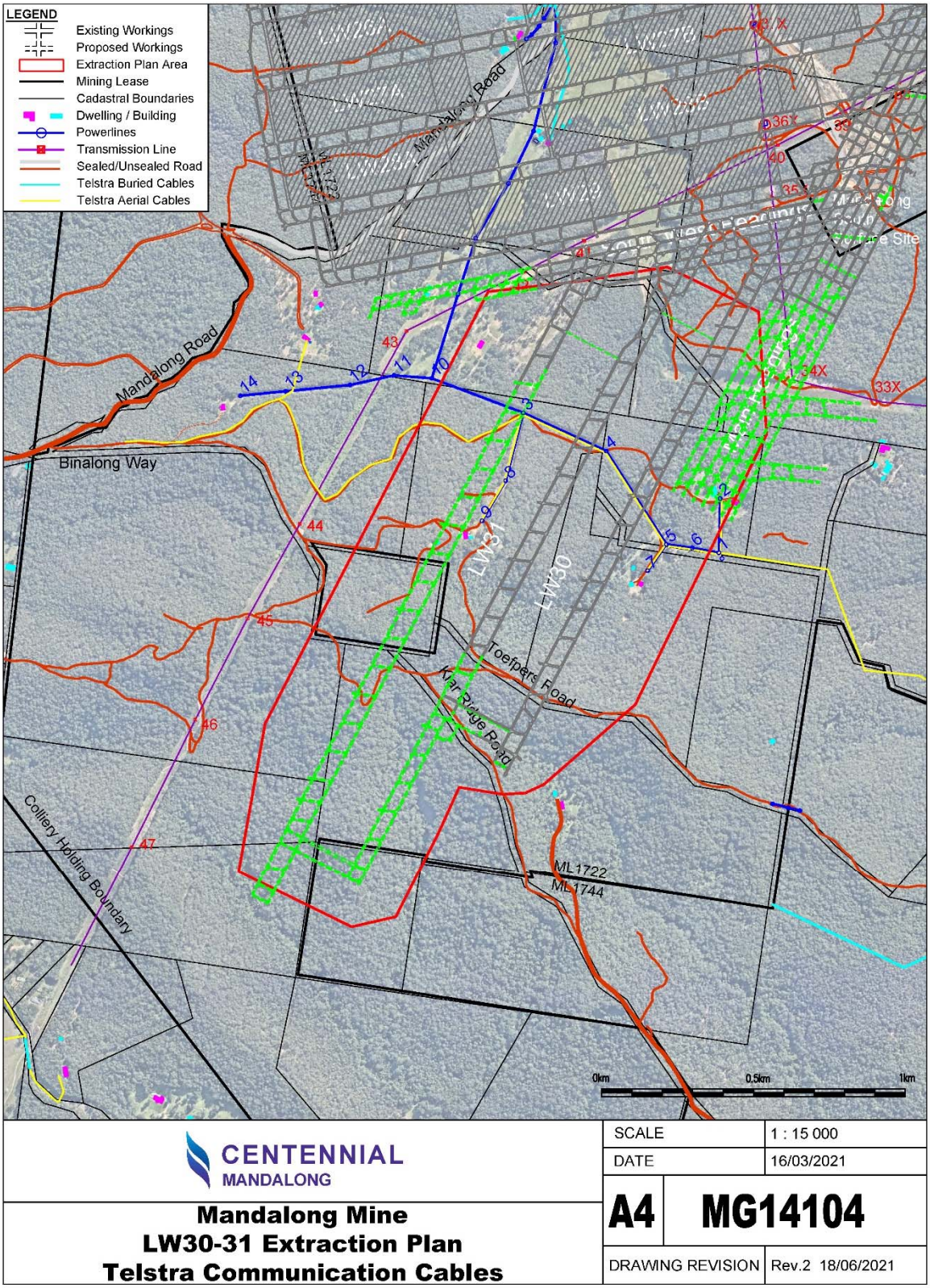

Figure 3 – Telstra Network and LW30-31

8.3 Ausgrid Powerlines

Ausgrid is responsible for the care and maintenance of the 11kV power supply network within Mandalong. Mandalong Mine has been mining beneath Ausgrid powerlines since the commencement of longwall mining in 2005 and during the extraction of the 29 previous longwall panels. The Powerline Management Plan has been developed and reviewed for each of the previous nine Extraction Plan areas. Similarly, this **Powerline Management Plan (MEMS-EP-9000-PLMP-9054)** has been reviewed for LW30-31 Extraction Plan and developed in consultation with Ausgrid, based on the Ditton Geotechnical Services (2021) subsidence predictions which are consistent with previous mining.

8.3.1 Predicted Impact

There has been no interruption or loss of serviceability from subsidence on any powerline infrastructure during the extraction of the previous 29 longwall panels due to the low levels of vertical subsidence, tilt and strain.

The predicted Final U95%CL subsidence for the poles range between 0.0 m and 1.20 m with tilts ranging from 0 mm/m to 11 mm/m and strains from -5.5 mm/m (compressive) and 3.1 mm/m (tensile). Horizontal displacement of the pole bases is estimated to range from 5 mm to 226 mm after mining is complete.

Slightly lower subsidence effects were assessed at some pole locations in the Mod 9 Report and is due to the difference in the number of longwalls and chain pillar compression effects. The conductors between the poles may experience lengthening and/or shortening due to the pole tilts which may result in conductor clearance losses. It is considered very unlikely that the poles will be impacted by surface strains due to the absence of cracking observed to-date.

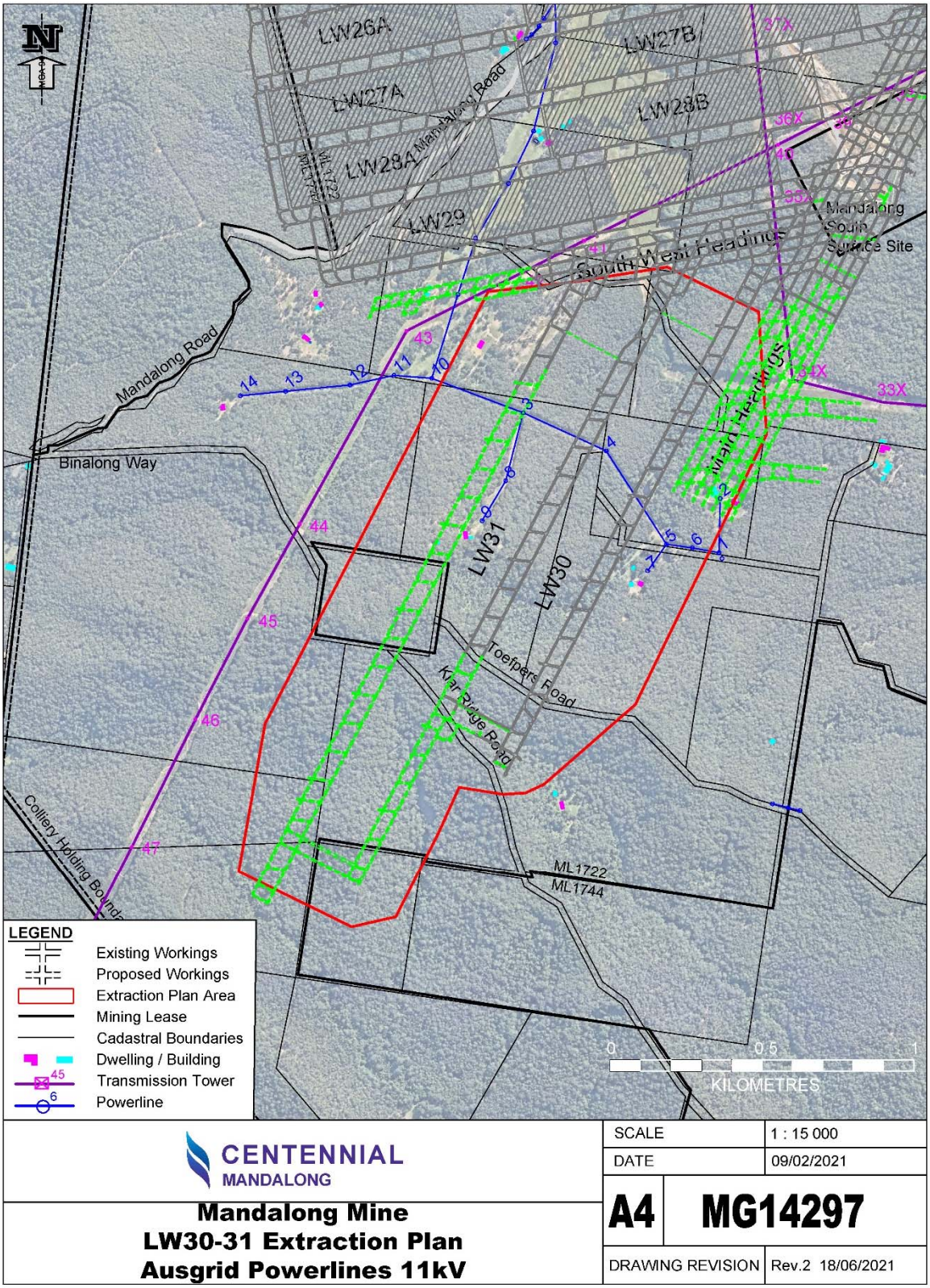

Figure 4 –Ausgrid Powerline Network within Extraction Plan Area

8.4 State Survey Marks

One Survey Mark and Yambo Trigonometrical Station (located on crown land Lot 175 DP 755271) are positioned within the Extraction Plan area. The location and details of the permanent survey marks were obtained from the NSW Spatial Service Portal – SCIMS Online and detailed in **Table 10**.

Table 10 – Permanent Marks within Extraction Plan Area LW30-31

Mark	Status	Height	Vertical Class / Order	MGA Easting	MGA Northing	Zone	Horizontal Class / Order
TS 4890 Yambo Trig. Station	Found intact	264.28	LC, L3	350950.853	6328177.144	56	2A, 0
SS18256	Found intact	44.865	LB, L2	351936	6328969	56	U, U

8.4.1 Predicted Impact

The permanent survey marks will be affected by vertical subsidence in the order of 0.05m at Yambo Trig Station and up to 1.2m at the State Survey Mark. This level of movement will require the survey marks to be resurveyed following the completion of subsidence. The SCIMS online status for the two survey marks has been noted as affected by mine subsidence and will remain until a resurvey of the marks is provided to NSW Spatial Services.

9 Management Measures

The primary management strategy being implemented is impact avoidance through the sub-critical longwall design and bridging overburden to provide reduced levels of subsidence. Monitoring will be undertaken to confirm that mine design measures to prevent impact are adequate and will provide data for trend analysis to enable adaptive management if required. Mitigation measures have been required to ensure the serviceability of key infrastructure across the Extraction Plan area.

9.1 Public Roads

Access to the two crown roads, Toefpers Road and Kiar Ridge Road are limited by:

- Locked gates at private property and Olney State Forest;
- 4 wheel drive access; and
- Located within private property boundaries.

Subsidence warning signs will be installed at road access points and mining notifications will be provided to landowners and agencies including Crown Lands, Landowners and the NSW Rural Fire Service. The management strategy is to monitor subsidence and conduct weekly visual inspections of the affected sections of the public and private access roads.

Any repairs, temporary or otherwise, to the Kiar Ridge fire trail will be undertaken in consultation with Crown Lands and the NSW Rural Fire Service to ensure that the road is repaired to the appropriate fire trail standard.

9.2 Telstra Communications

The management strategy is to monitor subsidence and conduct visual inspections of the affected section of the Telstra communications network. Subsidence effects monitoring will be consistent with the Property Subsidence Management Plans and Communications Management Plan due to the location of the infrastructure positioned along private access roads and Ausgrid powerlines.

9.3 Powerlines

Ausgrid have identified the following mitigation work is required on a number of poles prior to the powerlines being impacted by subsidence from LW30-31.

The management measures are:

- Ausgrid has completed modelling of subsidence effects on the powerline network;
- Ausgrid has identified mitigation works are required to be completed prior to power poles being impacted by subsidence;
- Ausgrid will conduct the mitigation works prior to subsidence affecting the powerline network (typical works include installing rollers, replacing cross-arms, replacing poles and removing stays);
- Centennial to monitor subsidence line Crossline 24 and Crossline 25 and conduct visual inspections of the affected section of the powerline; and
- Centennial to conduct weekly inspections powerlines when the infrastructure is within the Active Longwall Subsidence Zone.

9.4 State Survey Marks

Notification and restoration of permanent survey marks is conducted in accordance with the *Surveyor-General's Direction No. 11 - Preservation of Survey Infrastructure* (Spacial Services - Department of Customer Service, 2020).

In accordance with Surveyor-General's Direction No. 11, Centennial Mandalong has consulted with Spatial Services to notify and manage the resurvey of permanent survey marks affected by subsidence.

Following the completion of subsidence in the current mining area, Centennial Mandalong will consult with Spatial Services to arrange the resurvey of the affected state survey marks. The Mine Surveyor will be assigned an action in the Centennial Compliance Database to arrange the resurvey of the permanent survey marks and provision to Spatial Services.

10 Monitoring Program

The Mandalong Mine Subsidence Monitoring Program consists of conventional surveys, visual inspections and aerial LIDAR surveys, developed in order to:

- Demonstrate mine development and extraction is undertaken as per approved designs;
- Provide information to demonstrate statutory compliance and obligations are satisfied;
- Targeted monitoring of sensitive surface and built features;
- Meet stakeholder monitoring requirements to minimise impact to infrastructure;
- Provide data to manage the risks associated with both conventional and non-conventional subsidence;
- Provide appropriate and timely subsidence information to assess against triggers established in the TARPs; and
- To provide data for future monitoring systems for ongoing mining within Mandalong mining leases.

The approved Subsidence Monitoring Program is scheduled in the Centennial Compliance Database. The compliance database allows for surveys, inspections and notifications to be scheduled on either time or productions schedule (longwall face chainage). The required actions are assigned to the relevant role to ensure the subsidence monitoring program is achieved.

10.1 Baseline Monitoring

10.1.1 Detail Aerial Mapping

An aerial LIDAR survey was undertaken in April 2020, providing the pre-mining landform for the Extraction Plan Area and post mining landform for Longwalls 1 to 25. The LIDAR surveys provide surface mapping with a vertical accuracy of 0.15m. Aerial LIDAR surveys of the whole mining area are conducted approximately every three years and allow the post mining landform included in the flood model and to be used to analyse against subsidence predictions.

10.1.2 Conventional Survey Monitoring

Conventional subsidence monitoring lines typically consist of buried star pickets with cast iron covers, nominally spaced at 10m intervals that are measured for vertical subsidence, tilt and strain. Within the Extraction Plan area, three crosslines are established:

- Crossline 23 Centennial property over LW28-30;
- Crossline 24 Located along Toepfers Road and Kiar Ridge Fire Trail over LW30-33; and
- Crossline 25 Located along a private access road over LW31.

The monitoring point spacing, survey methods and scheduled visual inspections allow for the detection of both conventional and non-conventional subsidence movements due to any potential changes in geological conditions and mining within steep slope areas within the Extraction Plan Area.

10.1.3 Telstra Phone Lines

Comms Network Solutions recommends visual inspections of the aerial cable route prior to and during the development of subsidence in the location of the Telstra Network.

Crosslines 24 and 25 will provide the baseline subsidence monitoring for within the extraction plan area.

10.1.4 Ausgrid Powerlines

Centennial will record the pre and post condition of Ausgrid power poles using both conventional monitoring and laser scanning.

10.2 Subsidence Monitoring

10.2.1 Subsidence Monitoring Zones

Mandalong Mine has developed three subsidence monitoring zones to accommodate the development of subsidence from the narrow longwall panels and the bridging effect of the overlying massive strata that provides the reduced levels of subsidence. Unique to Mandalong Mine and as a result of the bridging massive strata, subsidence develops later than in typical longwall operations, with the majority of subsidence realised after the longwall face has retreated approximately 500m.

Additional subsidence also develops over the longwall panel following the extraction of the next adjacent longwall panel. This is due to the compression of the intervening chain pillar and strata. The additional subsidence contributed is typically in the order of 0.30m and is dependent on the geotechnical conditions and the depth of cover. Tilts and strains typically remain unchanged and may be reduced as a result of the decreased vertical subsidence differential between the maingate chain pillar and the centre of the longwall panel. In areas with higher depth of cover over 300m some additional minor settlement may occur following the extraction of the adjacent two to three longwall panels.

Accordingly, with 24 longwall panels now completed, Mandalong has developed three subsidence monitoring zones which define required monitoring activities in actively subsiding and stable areas of the mine as follows below. Full details of proposed monitoring activities within each zone are described within the Subsidence Monitoring Program for each Extraction Plan progressively approved by the mine.

10.2.1.1 Active Subsidence Zone for Visual Monitoring

The “Active Subsidence Zone” for visual monitoring inspections is defined as:

- 100m in advance of the current longwall face position; and
- the following 500m of longwall extraction (i.e. 500m behind the face position).

10.2.1.2 Active Longwall Zone for Crossline Monitoring

The “Active Longwall Subsidence Zone” includes the nominated crosslines for the current longwall panel and the three previous longwall panels.

10.2.1.3 Stable Longwall Subsidence Zone for Crossline Monitoring

The “Stable Longwall Subsidence Zone” represents the stable non-subsiding areas beyond the three previous longwall panels, defined as being from the start of the nominated crosslines up to the Active Longwall Subsidence Zone.

10.2.2 Public Roads

Subsidence monitoring will be conducted post mining for each longwall panel. Weekly visual inspections will be conducted when Crown and private access roads are located within the active

subsidence zone of each longwall. Monthly visual inspections along the roads will continue for the following six months or when the next longwall mines beneath the public road. The results of the visual inspections will be recorded on the subsidence inspection checklist sheet and filed.

10.2.3 Telstra Communications

Subsidence is not expected to impact the serviceability of aerial copper cables, pits, conduits and elevated Joints. The management strategy for the Telstra communication network is to monitor subsidence similar to the monitoring for Public Roads as outlined above in **Section 10.2.2**. Any damage to the network will be rectified in accordance with the **Communications Management Plan**.

The monitoring program is summarised in and detailed in **Table 11,** the **Communications Management Plan** and **Subsidence Monitoring Program**.

10.2.4 Ausgrid Power Lines

The Ausgrid 11kV powerlines suppling properties within the Extraction Plan Area are timber poles that are generally located near the access roads to private property. The management strategy as outlined in the **Powerline Management Plan** is to monitor subsidence using conventional and laser scanning techniques and conduct visual inspections of the affected section of the powerline. Visual will be consistent with Public Roads and Telstra Communications as detailed in **Section 10.2.2**. Weekly visual inspections will record the condition of the powerline infrastructure.

10.2.5 State Survey Marks

A resurvey of the survey marks will be undertaken following the completed of subsidence over the extraction plan area for LW30-31. Spatial Services will be consulted prior to the reestablishment of the survey control marks in accordance with the *Surveyor-Generals Direction No. 11 - Preservation of Survey Infrastructure* (Spacial Services - Department of Customer Service, 2020).

10.2.6 Property and Dwellings

The proposed management measures for each property are documented in each of the landowner's PSMP. Copies of the nine PSMPs are included in the Extraction Plan LW30-31 (Volume 3).

The management measures for properties affected by LW30-31 typically consist of monitoring subsidence on the dwellings, dams, surface improvements and drainage channels. A pre-mining inspection will also be conducted by SA NSW to record the pre-mining condition of the dwellings and improvements. Any necessary remediation works will be undertaken when required or following the completion of subsidence and in consultation with the landowner and SA NSW. The monitoring for private dwellings is summarised in **Table 11**, **PSMPs** and the **Subsidence Monitoring Program.**

Table 11 –BFMP Subsidence Monitoring Program Summary

Feature	Location	Monitoring Method	Parameter	Monitoring Frequency and Duration
Crown Roads Public Roads Management Plan **Private Access Roads** PSMP **Telstra Communications Network** Communications Management Plan **Ausgrid Powerlines** Powerline Management Plan	**Crown Roads** Toefpers Rd Kiar Ridge Rd **Private Access Roads** Private properties **Powerline easements** 11kV powerline	**Crossline 23** Star posts on Centennial property at 10m spacing **Crossline 24 and Crossline 25** Star posts adjacent to road at 10m spacing	Vertical subsidence, tilt and strain.	<u>Baseline</u> Prior to mining LW30 and LW31. <u>Post Mining</u> 2 months after mining LW30 and LW31. <u>Stable Zone</u> 2 yearly.
		Visual Inspection	Presence of mine-induced damage: • surface tensile cracking in pavement • surface compressive shearing in pavement • surface cracking in fill embankments • erosion of local slope stability for fill embankment if cracking occurs • cracking to culverts and under-road pipes • road drainage Risk to public safety Powerline –tilting pole, damage cross arms, insulators; change in conductor sag/tension; ground clearance. Communications - aerial cable, tilting pole; change in conductor sag/tension; ground clearance; damage to connections.	<u>Active Zone</u> Weekly visual inspection while road and adjacent powerlines and communications are within the active subsidence zone. <u>Post Mining</u> Monthly visual inspection for the following six months or until the commencement of weekly inspections for the next longwall panel.
		Telstra Visual inspection of infrastructure conducted by Comms Network Solutions.	Inspection of aerial cables, poles, pits, cables, joints and conduits.	<u>Baseline</u> Prior to mining LW30-31 <u>Post Mining</u> 2 months after mining LW30-31

Feature	Location	Monitoring Method	Parameter	Monitoring Frequency and Duration
		Powerlines - 3D Scanning Trimble SX10 Scanning Total Station of each pole affected by subsidence.	3D scan of power pole, High resolution photograph of pole, Vertical subsidence at pole Tilt of pole, Change in distance between poles.	Baseline Prior to mining impacting poles from the extraction of LW30 and 31. Post Mining 2 months after mining LW30 and LW31.
		Ausgrid	Overhead powerline modelling using LIDAR data.	Baseline Prior to mining LW30 and 31 2015 LIDAR information. Post mining After the completion of mining LW30-31.
Steep Slopes Land Management Plan	Private properties Centennial Olney State Forest	Visual Inspection	Presence of mine-induced damage – surface cracking and rock falls, damage to tracks and drainage	Active Zone Weekly visual inspection of steep slopes from public and private access roads. Post Mining Visual inspection following completion of each LW panel.
Private Dwellings PSMP LW30-31	Centennial Ref. MS0025 MS0107 MS0137 MS0139	Monitoring points installed as agreed in consultation with each landowner: • Four points in ground surrounding dwelling • Pins installed at dwelling corners • Points on dams and other structures • As agreed in PSMP	Vertical subsidence, tilt and strain	Baseline Prior to being affected by mining LW30-31 Post Mining 2 months after mining LW30-31

Feature	Location	Monitoring Method	Parameter	Monitoring Frequency and Duration
		Visual Inspection	Pre-mining Structural Assessment by civil/structural engineer Pre-mining Inspection SA NSW Centennial Mandalong Inspection	Baseline Prior to being affected by mining LW30-31
			Post-mining SA NSW Inspection (where claim is lodged for subsidence damage) Centennial Mandalong	Post Mining Following completion of subsidence or request by landowner

11 Adaptive Management

In addition to the conservative sub-critical longwall panel design specifically designed to provide reduced levels of subsidence and impact, Centennial Mandalong developed an adaptive management approach designed to avoid repetition of any unpredicted subsidence and or environmental consequences. This system involves the monitoring and evaluation of impacts to built features against the performance indicators defined in **Section 6.4** and contingency plan (TARP) in the event that a performance indicator is exceeded.

12 Contingency Plans

Trigger Action Response Plans (TARP) have been developed using performance indicators for built features. In the event that subsidence monitoring and or visual inspections identify that a performance indicator has been exceeded, Centennial Mandalong will implement the contingency measures as detailed in the TARP for the specific built features (refer **Appendix 1**).

13 Roles and Responsibilities

The responsibility for implementation, monitoring and review of the Built Features Management Plan lies with the Mining Approvals Coordinator. The roles and responsibilities for the Built Features Management Plan are outline in **Table 12**.

Table 12 – BFMP Roles and Responsibilities

Position	Responsibility
Mine Manager	• Authorisation of the Built Features Management Plan • Ensuring that sufficient resources are available to implement this plan.
Mining Approvals Coordinator	Implementation, monitoring and review of this plan, including: • Ensure that the Subsidence Monitoring Program, required inspections, mining notifications are scheduled into the Centennial Compliance Database prior to the commencement of each longwall panel. • Ensuring subsidence monitoring and inspections are conducted at the required schedule and persons conducting monitoring/inspections are trained in the requirements of this plan. • Consulting with the landowners, infrastructure owners and relevant government departments including Ausgrid, Telstra, Local Councils, SA NSW, DPIE and RR. • Review and assess the subsidence monitoring results against the performance measures. • Notification of any exceedance of performance indicators in accordance with the TARPs and management plan. • Coordinating any remedial work as required. • Preparation and submission of formal reporting requirements outlined in this plan. • Review and audit of the Built Features Management Plan.
Subsidence Surveyor	• Establishment of subsidence monitoring in accordance with the Subsidence Monitoring Program. • Ensure all subsidence surveys are conducted in accordance with the approved Subsidence Monitoring Program. • Review and assess subsidence monitoring results. • Notify the Mining Approvals Coordinator of any identified public safety issues. • Provide the monitoring results to the Mining Approvals Coordinator, RR, Ditton Geotechnical Services, Ausgrid, Telstra and SA NSW.
Survey Department	• When required, conduct inspections within the applicable subsidence zone to the standard required, using the subsidence inspection checklist. • Promptly notify the Mining Approvals Coordinator of any issue identified during a subsidence inspection.

14 Reporting

Reporting will be completed in accordance with the Guidelines for the Preparation of Extraction Plans (NSW Department of Planning & Environment, 2015) and WHS (Mines and Petroleum Sites) Regulation requirements, as summarised in **Table 13**.

Table 13 - Reporting Requirements

Report	Trigger	Requirements	Stakeholders
Incident Reporting	Any occasion or incident in accordance with consent condition, WHS Regulations or TARP.	In accordance with requirements of: • Development Consent Schedule 6 Condition 10; or • WHS Regulation (Mines and Petroleum Sites) Clause 128; or • TARP.	RR DPIE Local Councils Telstra Ausgrid Ditton Geotechnical Services SA NSW CCC
Bi-Monthly Subsidence Impact Reporting	If a new impact is identified, compile after monthly subsidence.	Distinguish impact: • within predictions; • those which exceed predictions but remain within performance measures and/or performance indicators; and • those which exceed performance measures and/or performance indicators. Report to include: • full description; • location identification using aerial photos with longwall layout superimposed; • photos of the impact; and • preliminary characterisation of the impact in accordance with the relevant TARP(s).	
Annual Review	Annual Report required under development consent SSD-5144.	Report to include: • six-monthly reports of impacts and environmental monitoring results; • monitoring results; and • summary of subsidence impacts.	DPIE RR CCC Local Councils
Community Consultative Committee (CCC)	CCC meetings are typically held three times per year.	Subsidence and environmental performance is included as an agenda item at each meeting.	CCC

Report	Trigger	Requirements	Stakeholders
Mining Notifications	One month prior to mining beneath property or built feature.	Scheduled date that the property or built feature will be affected by subsidence and within the Active Subsidence Zone.	Local Councils Telstra Comms Network Solutions Ausgrid Private Landowners

15 Audit and Review

Audit and review procedures are outlined in Centennial Mandalong's Safety Management System that comply with the NSW Work Health and Safety (Mines and Petroleum Sites) Regulations. These procedures are utilised to mange audit and review functions of the Built Features Management Plan. Refer Document **HSMS-SE-1028- System Evaluation**.

15.1 Audit

The requirements of the Built Features Management Plan are to be audited annually for compliance and effectiveness during the extraction of LW30-31.

Any non-conformances or deficiencies found during the audit are to be brought to the attention of the System Coordinator so that corrective actions can be outlined. These corrective actions are to be allocated and carried out accordance with **HSMS-SE-1029 - Corrective Action Procedure**.

15.2 Review

The Built Features Management Plan will be reviewed every three years or in the event that one of the following occurs:

- Stakeholders raise issues that necessitates a review;
- Where unpredicted impacts or consequences have required implementation of contingency actions under this plan;
- Monitoring, incident or audit processes demonstrate a review is required;
- Where triggered by a TARP;
- Where triggered by circumstances in either Clause 10 or Clause 128 of WHS (Mines and Petroleum Sites) Regulation or Clause 38 WHS Regulation;
- Each new Extraction Plan; or
- Change in mine design or layout.

16 Document Control

An integrated Document Control Procedure is incorporated into Centennial Mandalong's Safety Management System. Documents, data and records pertaining to this plan will be managed according to **HSMS-SE-1025-Information Control**.

17 BIBLIOGRAPHY

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APPENDIX 1 – Trigger Action Response Plans

Monitoring and Controls	Trigger	Action
Built Feature – Telstra Communications Network **CAN Local Aerial copper cable 10/0.64**		
• **Centennial** established subsidence monitoring / inspection sites for private access roads and adjacent communications lines • **Centennial** to mark the centreline and edges of current longwall panel on road pavement one month prior to private access roads and communications being affected by subsidence. • **Centennial** to notify Telstra one month prior to communications being affected by subsidence from each longwall panel. • **Centennial** to conduct weekly visual inspections of private roads and communications located along road and powerline easement when influenced by subsidence within the Active Subsidence Zone. Record results on the Subsidence Inspection Checklist. • **Centennial** to conduct monthly visual inspections for the following six months or until next longwall, and record results on the Subsidence Inspection Checklist. • **Comms Network Solutions** to inspect cable after completion of longwall panel. • **Centennial** to conduct post-mining surveys following the development of subsidence (majority of subsidence developed after 2 months) when LW is completed. • **Centennial** to provide pre and post mining subsidence monitoring results to Telstra, RR and SA NSW.	**LEVEL 1 – LOW** **Operations within predicted subsidence and impact.** • Development of subsidence and impact as expected. • Subsidence prediction – tilt and strains within Upper 95% Confidence Limits • No interruption of service. • Continue operations and monitoring program • Unlikely remedial work will be required.	• **Centennial** to conduct post mining inspection and provide subsidence monitoring results to **Telstra, RR and SA NSW.**
	LEVEL 2 – MEDIUM **Operations within approved impacts but exceed or potentially exceed predictions** • Development of subsidence exceeding or potentially exceeding subsidence prediction (Upper 95% Confidence Limits). • Tensile and compressive strains may increase 2 to 3 times predicted values due to crack development. • No or minor impact to communication network. • No interruption of service. • Continue operations and monitoring program	• **Centennia**l to notify **Telstra Integrity Services** and **Comms Network Solutions** that subsidence predictions have exceeded or potentially exceeded predictions. • **Comms Network Solutions** to inspect Telstra network for any damage and provide report to **Centennial** and **Telstra**. • **Centennial** to conduct post mining inspection and provide subsidence monitoring results to **Telstra, RR** and **SA NSW.**
	LEVEL 3 – HIGH **Operations exceed approved impact** • Development of subsidence and impact greater than expected (Upper 95% Confidence Limits). • Damage to aerial copper cable phone line causing interruption to Telstra communications service.	• **Centennial** to notify **Telstra Integrity Services** and **Comms Network Solutions** that subsidence predictions have exceeded. • **Centennial** to provide notification to **RR** and **SA NSW** • **Centennial** to arrange a Review Meeting to review survey results, cable inspections and proposed action to remediate damage to communication network. • **Centennial** to notify external stakeholders including relevant government agencies in accordance with **Incident Reporting** S6 Condition 10 and WHS Regulations. • **Centennial** to conduct review and predictions as per adaptive management process as detailed in the Extraction Plan LW25-31.

Monitoring and Controls	Trigger	Action / Response
Powerlines – LW30-31		
• **Centennial** to establish subsidence monitoring and inspection sites for public / private roads and adjacent powerlines prior to mining. • **Centennial** to conduct pre and post mining 3D scanning and survey of power poles. • **Ausgrid** to model and install mitigation works on affected section of the powerline. • **Centennial** to mark the centreline and edges of current longwall panel on public/private road pavement one month prior to public road and powerlines being affected by subsidence. • **Centennial** to notify Ausgrid one month prior to powerline being affected by subsidence from each longwall panel. • **Centennial** to conduct weekly visual inspections of public/private roads and powerlines located along road easement when influenced by subsidence within the Active Longwall Subsidence Zone. Record results on the Subsidence Inspection Checklist. • **Centennial** to conduct monthly visual inspections for the following six months and record results on the Subsidence Inspection Checklist. • **Centennial** to be in regular contact with private property owner during the development of subsidence. • **Centennial** to conduct post-mining surveys following the development of subsidence (majority of subsidence developed when LW is completed or LW face is 800m past feature). • **Centennial** to provide pre and post mining subsidence monitoring results to Ausgrid, RR and SANSW.	**LEVEL 1 – LOW** **Operations within prediction and approved impact** • Development of subsidence and impact as expected. • Subsidence within predicted range (Upper 95% CL). • No noticeable impact to the surface or powerline network. • Damage powerlines unlikely.	• **Centennial** to conduct post mining inspection and subsidence monitoring and provide results to the Ausgrid, RR and SA NSW**.**
	LEVEL 2 – MEDIUM **Operations within approved impact but exceed or potentially exceed predictions** • Development of subsidence exceeding or potentially exceeding prediction (greater than Upper 95% CL). • Minor impact to powerline network • No immediate mitigation / remediation works on poles, insulators and conductors is considered necessary.	• **Centennial** to inspect powerlines. • **Centennial** to notify **Ausgrid** and **RR** of increased subsidence and any observed impact to powerline network. • **Ausgrid** to conduct inspection and investigate the impact of increased subsidence on powerline network. • **Ausgrid** to conduct repairs if considered necessary. • **Centennial** to advise **SA NSW** of potential repairs. • **Centennial** to review results and predictions as per Extraction Plan LW30-31.
	LEVEL 3 – HIGH **Operations exceed approved impact** • Development of subsidence and impact greater than expected. • Damage to powerline network that causes loss or potential loss of service.	• **Centennial** to immediately advise **Ausgrid** of observed damage to the powerline network. • **Ausgrid Emergency Service -** 1800 627 005 • **Ausgrid** to inspect any damage to powerline network and arrange repairs. • **Centennial** to promptly notify **RR** and **SA NSW** of increased subsidence and observed impact to powerlines. • **Centennial** to conduct post mining inspection and subsidence monitoring and provide results to **Ausgrid, RR** and the **SANSW.** • **Centennial** to review results and predictions as per Extraction Plan LW30-31. • **Centennial** to notify external stakeholders and government agencies in accordance with **Incident Reporting** requirements DC S6 Condition 10 and WHS Regulations.

Monitoring and Controls	Trigger	Action
Public Roads – LW30 -31		
• **Centennial** to establish subsidence monitoring / inspection sites for public roads prior to mining. • **Centennial** to mark the centreline and edges of current longwall panel one month prior to public road being affected by subsidence. • **Centennial** to notify Crown Lands one month prior to public road affected by subsidence from each longwall panel. • **Centennial** to conduct weekly visual inspections of public roads when located within Active Subsidence Zone. Record results on the Subsidence Inspection Checklist. • **Centennial** to conduct post-mining surveys following the development of subsidence (majority of subsidence developed when LW is completed or LW face is 800m past feature). • **Centennial** to provide pre and post mining subsidence monitoring results to stakeholders. **CONTROLS** Flood Modelling and Assessment LW30-31 (Umwelt 2020) determined that there was no predicted increase in flood hazard category on the access road at both the 1 year and 100 year ARI Storm Events.	**LEVEL 1 – LOW** **Operations within prediction and approved impact** • Development of subsidence and impact as expected. • Subsidence within predicted range (U95% CL). • Negligible visible impact on gravel access roads. • Possible minor tensile and compressive cracking to pavement not requiring immediate repairs.	• **Centennial** to conduct post mining inspection and subsidence monitoring and provide results to the **Landowner, RR** and **Crown Lands.**
	LEVEL 2 – MEDIUM **Operations within approved impact but exceed or potentially exceed predictions** • Development of subsidence exceeding or potentially exceeding prediction (Upper 95% Confidence Limits). • Tensile and compressive strains may increase 2 times predicted values due to crack development. • Vertical subsidence greater than predicted. • Typically minor impact to gravel access roads. • Cracking may be visible on roads – development of minor compression hump near centre of longwall and minor tensile cracking to pavement at edges. • Repairs to pavement may be required to reseal pavement.	• **Centennial** to advise **Landowner** and **Crown Lands** of observed damage to the public road. • **Centennial** to erect warning signs near affected area of road if necessary. • **Centennial** to conduct post mining inspection and subsidence monitoring and provide results to the **Landowner, RR** and **Crown Lands.** • **Centennial** to conduct repairs to damaged pavement.
	LEVEL 3 – HIGH **Operations exceed approved impact** • Development of subsidence and impact greater than expected (Upper 95% Confidence Limits). • Cracking to road pavement requiring immediate repairs to ensure public safety. • Repairs required, reshaping road, restoring drainage and resealing pavement.	• **Centennial** to immediately advise **Landowner** and **Crown Lands** of observed damage to the public road. • **Centennial** to erect warning signs near affected area of road. • **Centennial** to conduct post mining inspection and subsidence monitoring and provide results to **Landowner, RR** and **Crown Lands.** • **Centennial** to conduct repairs to damaged pavement. • **Centennial** to review results and predictions as per Extraction Plan. • **Centennial** to notify external stakeholders including relevant government agencies in accordance with **Incident Reporting** S6 Condition 10 and WHS Regulations.

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