

Our ref: 125.89220

29 September 2022

Attention: Cody Brady, Principal Mining Approvals
cc: Richard Walsh, Superintendent Infrastructure Protection

South32, Illawarra Metallurgical Coal
Cordeaux Colliery, Picton Road
Mt Kiera West, NSW, 2526
PO Box 514, UNANDERRA, NSW, 2526

Dear Cody,

**Appin Area 7 and Area 9, Extraction Plan
Appin Longwalls 709-711 and Longwall 905
GHD response to Approval Conditions**

Introduction

Illawarra Metallurgical Coal (IMC) have advised that the Appin Extraction Plan has been approved by DPE. The approval includes conditions recommended by the Independent Advisory Panel for Underground Mining (IAPUM).

Two of the conditions of approval require IMC to undertake some further work regard to landslide risk assessment in the Extraction Plan area, in response to issues raised by the IAPUM in their review. GHD have been advised that the conditions of interest are:

- 2. The last three objectives included in the Extraction Plan's Landslide Risk Assessment (GHD, 2021) for LW905 must be completed within three months of this approval and thereafter on a longwall-by-longwall basis, to the satisfaction of the Planning Secretary.*
- 3. Prior to extraction of LW711, IMC must prepare and submit to the Department a report examining the potential expected range of effects associated with mine-induced modification of groundwater on slope instability. The report must be supported by the outcomes of monitoring of subsidence effects, impacts and environmental consequences required by the development consent and this approval. This report must also include discussions on reasonable and feasible measures for mitigating potential mine-induced impacts on slope instability.*

IMC have requested that GHD address these Conditions. In particular, Condition 2 is to be addressed in a short timeframe relating to the properties around Longwall 905.

GHD has been advised that Condition 3 is a more significant body of work but has a more relaxed timeframe, and so will not be provided with a response at this time. Nevertheless, GHD has been advised that IMC have undertaken the installation of downhole sets of vibrating wire piezometers at a site situated over the footprint of LW711, thereby initiating the collection of background groundwater pressure monitoring data.

This letter responds to Condition 2.

Background information provided – IAPUM review

In their report, the IAPUM advised that on 4 March 2022, the NSW Department of Planning and Environment (NSW DPE) requested advice be provided in relation to the Appin Area 7 and Area 9 Extraction Plan (EP).

Specifically, it is reported that NSW DPE requested advice on:

- *the reliability of the damage predictions outlined in MSEC’s Subsidence Assessment for houses on top of the Razorback Range and within 25 m of steep slopes in the EP Study Area;*
- *the adequacy of GHD’s Landslide Risk Assessment to assess the landslide risks, site susceptibility and potential impact of mine subsidence with no supporting field-based geotechnical assessments at the potentially impacted houses; and*
- *the appropriateness of IMC’s proposed monitoring for the management of mine subsidence and slope instability for houses and its additional commitment to undertake geotechnical assessments at potentially impacted residences prior to the extraction of the first influencing longwall.*

NSW DPE (2022) provided conditional approval of the Extraction Plan and noted in Section 5 “Evaluation and Conclusions” *inter alia* that:

“Potential mine-induced slope instability and impacts on residential properties and the adequacy of groundwater impacts were identified as key matters of concern.

In response to the (IAPUM) Panel’s recommendations on slope instability under Razorback Range and potential impacts to houses above it, IMC committed to undertaking extensive assessments using geotechnical, structural and remote sensing techniques for the monitoring and management of mine-induced impacts.

The Department is satisfied that with the implementation of these controls in combination with the trigger action response plans any residual risks associated with slope instability would be mitigated or adequately managed.”

IAPUM and NSW DPE recommendations

IAPUM appraised subsidence effects and impacts, and subsidence impacts for slope instability. Their conclusions (as copied from within the Executive Summary of their report) are reproduced in **Appendix A**. The conclusions led to recommendations which were identified in their Executive Summary, and that became Conditions in Table 1 of NSW DPE (2022). Of those conditions, GHD refer to:

Condition 2

- complete the last three objectives of its Landslide Risk Assessment (LRA) as set out in Section 2.3 of its report.

Condition 3

- provides advice on the expected range of effects associated with modification of groundwater due to mining-induced subsidence and how these effects can be mitigated.

Under Condition 3, NSW DPE requires advice to be provided before extraction of LW711, recognising the work involved with the task. This task will be addressed by way of a GHD report supplemental to the original LRM to address this condition, in the timeframe nominated.

In regard to Condition 2, the last three objectives were identified in the Extraction Plan’s Landslide Risk Assessment (GHD, 2021) as:

- Outline a monitoring program (including identification of monitoring points) with appropriate trigger levels for corrective management actions for areas at most risk of landslide instability by considering the likelihood and consequences of instability;
- Provide descriptors of the corrective management actions proposed; and
- Assess potential cumulative effects.

In regard to bullet points one and two (above): these conditions have been satisfied by the “Management Plan for Potential Impacts to Building Structures” developed for LW905 by MSEC, specifically Section 6. Appendix 2 contains an extract from Management Plan, being Section 6, Risk Control Procedures. The monitoring measures are outlined in detail therein. GHD contributed to the development of Section 6.

In regard to bullet point three (above): the landslide risk assessment conducted by GHD was based on appraisal of the cumulative effects from the natural hazards identified across the study area, and existing man-made (anthropomorphic) features, combined with the potential contribution from mine subsidence in appraisal of landslide scenarios, the likelihood of instability and the consequences in the event of instability. Further appraisal of these issues would be conducted as part of the individual Property Subsidence Management Plans (PSMP) that are to be developed progressively, longwall-by-longwall. The PSMPs would include landslide risk assessments in recognition of the natural and man-made hazards in accordance with the concepts and guidelines provided within AGS (2007), together with appraisal of the cumulative effects from mining subsidence.

Indicative residential structure landslide hazard scenarios

In support of the Extraction Plan for LW905, eight properties were identified in MSEC (2022) for inclusion in a site-specific structure inspection plan – refer to Drawing MSEC1268-03 in the Attachment which illustrates the locations of the properties. Pre-mining structural and geotechnical inspections are proposed in MSEC (2022) for these properties. The hazard setting for five of the eight structures has been appraised in the context of the likely range of cumulative hazards from the natural slopes, man-made modifications, and mine subsidence impacts - see Table 1.

Table 1 *Indicative structure hazard ratings*

Structure Identification	Indicative Cumulative Hazard Rating	Context of Rating
N13 and N12 [refer Figure 01]	High	Structures are situated upon steep slopes below crest of ridgeline, are immediately adjacent to or over the footprint of LW905, the landform has been significantly modified to develop the building platforms. Nature and form of structure foundation system to be determined. Nature and quality of earthworks to be determined.
N16 and N15 [refer Figure 02]	Low	Structures are situated upon the crests of relatively level rounded ridgelines with expectation of shallow depth to shale bedrock. Dwellings are situated about half a panel-width outside the footprint of LW905 and over footprint of previously mined LW904.
N18 [refer Figure 03]	Low	Structure situated upon lower slopes well away from the Razorback Escarpment cliff-lines and outside extent of previous debris flows associated with natural slope forming processes endemic to the study area. Dwelling is situated approximately one panel-width outside the footprint of LW905 at the starting end, and situated over previously mined LW904.

Table 1 illustrates the likely range of cumulative hazards that should be acknowledged in the assessments contained within the individual PSMPs.

GHD understands that IMC intends to provide copies of the High and Low hazard settings by way of illustration of the landslide issues and their assessed risk levels.

Yours sincerely,

Andrew Leventhal
Senior Technical Director - Geotechnics
(02) 9462 4839
andrew.leventhal@ghd.com

Jon Thompson
Technical Director - Geotechnics
(02) 4222 2328
jon.thompson@ghd.com

References:

AGS (2007) AGS (2007) – a generic term that covers the suite of 5 papers developed by the Australian Geomechanics Society, Landslide Taskforce, *Australian Geomechanics*, V42 N1, March 2007 – copy downloadable from: www.australiangeomechanics.org

GHD (2021) “Appin Area 7 and 9 proposed longwalls, landslide risk assessment relating to mine subsidence influences”, report prepared for South32, Illawarra Metallurgical Coal, doc ref: 125.367-30_LRM issues Desktop study, Rev 1, 06 July 2021.

IAPUM, Independent Advisory Panel for Underground Mining (2022) “Advice re: Appin Colliery, Longwalls 709-711 & 905, Extraction Plan”, June 2022 (without document reference)

Mine Subsidence Engineering Consultants (MSEC) (2022) “Illawarra Metallurgical Coal, Appin - Area 9 - Longwall 905, Management Plan for Potential Impacts to Building Structures”, report doc ref: MSEC1268, Rev 02, June 2022.

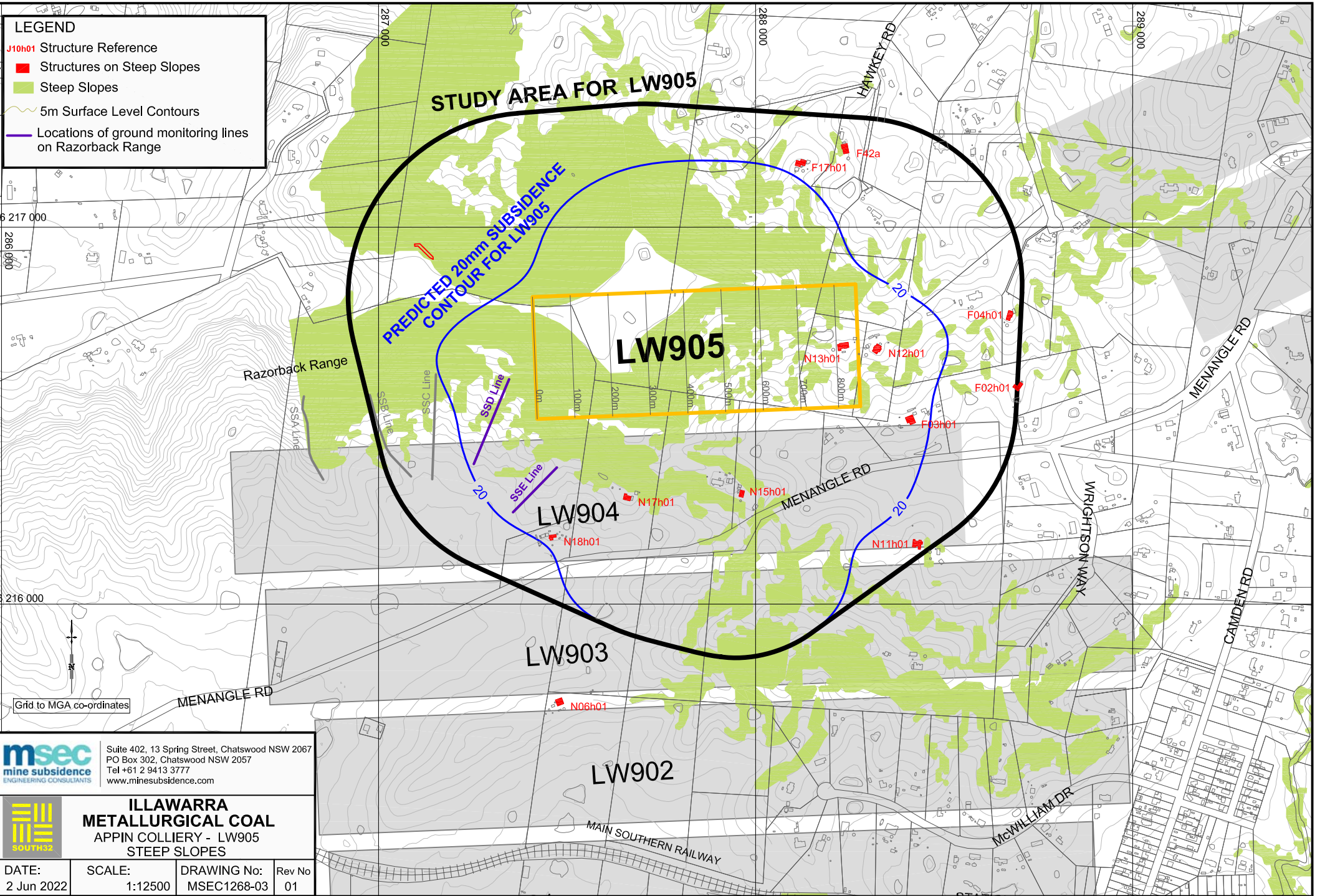
NSW Department of Planning and Environment (2022) “Appin Mine Extraction Plan: Longwalls 709-711 & 905 for Bulli Seam Operations Project (Condition 5, Schedule 3 of consent MP 08_0150), doc ref: MP08_0150-PA-46, 29 July 2022.

Figures

Drawing MSEC1268-03 – “LW905 Steep Slopes” (with structures identified)
MSEC1268 Figure 6.1 & Figure 6.2 – extracts from MSEC (2022)
Figures 01, 02 & 03 illustrating settings of structures

LEGEND

- J10h01 Structure Reference
- Structures on Steep Slopes
- Steep Slopes
- 5m Surface Level Contours
- Locations of ground monitoring lines on Razorback Range



msec
mine subsidence
ENGINEERING CONSULTANTS

Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

ILLAWARRA METALLURGICAL COAL
APPIN COLLIERY - LW905
STEEP SLOPES

DATE: 2 Jun 2022	SCALE: 1:12500	DRAWING No: MSEC1268-03	Rev No 01
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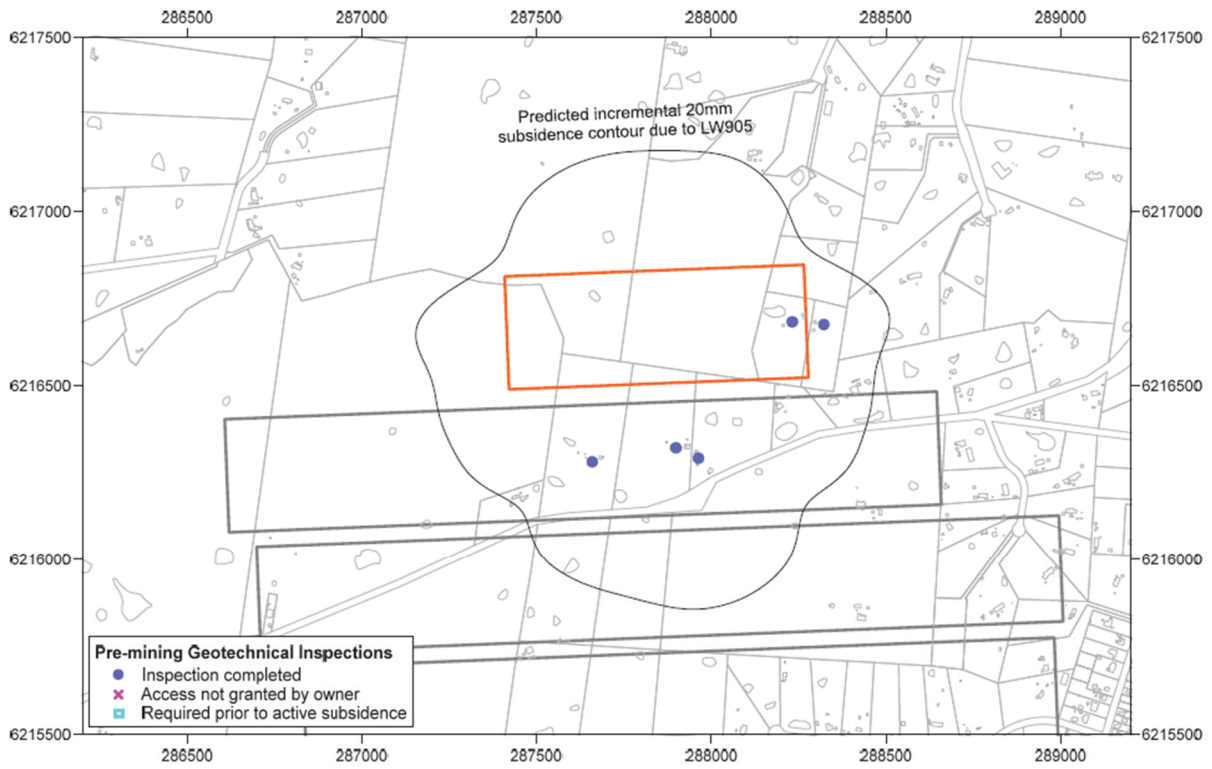


Fig. 6.1 Pre-mining geotechnical inspections

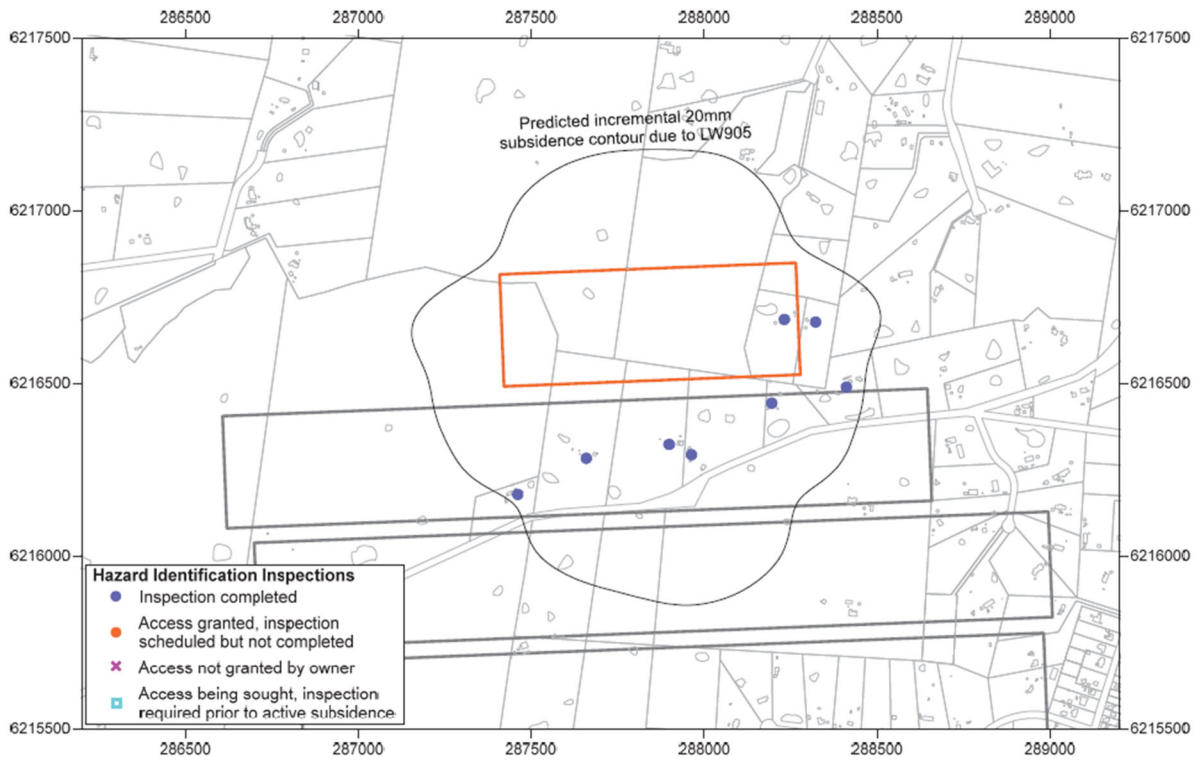


Fig. 6.2 Pre-mining hazard identification inspections



Figure 01: Property setting for Structure References N13 and N12 (ref: SIX Maps)



Figure 02: Property setting for Structure References N16 and N15 (ref: SIX Maps)



Figure 03: Property setting for Structure References N18 (ref: SIX Maps)

Appendix A

**COPY OF IAPUM EXECUTIVE
SUMMARY**

EXECUTIVE SUMMARY

Appin Mine is an underground coal mine located approximately 25 kilometres (km) northwest of Wollongong. Appin Mine and the adjoining West Cliff are part of a mining complex, operating as the Bulli Seam Operations Project (BSO Project) under a State significant development consent (MP 08_0150). The consent requires the preparation of an Extraction Plan (EP) prior to the commencement of second workings.

Illawarra Metallurgical Coal Holdings Pty Ltd (IMC), (the Applicant) submitted the EP for Longwalls (LWs) 709-711 and LW 905 within Area 7 and Area 9 in October 2021. Mining is currently underway in both Area 7 and Area 9, with extraction of LW 709 and LW 904 in the two respective domains occurring concurrently.

The EP has identified potentially impacted built features including residential properties located on and above the steep slopes along Razorback Range. To assess these potential impacts, the EP included a Subsidence Predictions and Impacts Assessment report, prepared by Mine Subsidence Engineering Consultants (MSEC), and a Landslide Risk Assessment (LRA) prepared by GHD.

On 4 March 2022, the NSW Department of Planning and Environment (the Department) requested the Independent Advisory Panel for Underground Mining (the Panel) to provide advice in relation to the EP.

Specifically, the Department requested advice on the following:

- the reliability of the damage predictions outlined in MSEC's Subsidence Assessment for houses on top of the Razorback Range and within 25 m of steep slopes in the EP Study Area;
- the adequacy of GHD's Landslide Risk Assessment to assess the landslide risks, site susceptibility and potential impact of mine subsidence with no supporting field-based geotechnical assessments at the potentially impacted houses; and
- the appropriateness of IMC's proposed monitoring for the management of mine subsidence and slope instability for houses and its additional commitment to undertake geotechnical assessments at potentially impacted residences prior to the extraction of the first influencing longwall.

The Panel reviewed a range of documents in preparing its advice, met on multiple occasions via videoconference and requested supplementary information from the Applicant. The Panel concludes and recommends the following.

SUBSIDENCE EFFECTS AND IMPACTS

The Panel concludes:

- There is not an adequate database to support the pre-mining prediction of the likelihood of varying levels of damage to the each of the eight houses located at the top of Razorback Range that are of particular concern to Subsidence Advisory NSW.
- The approach proposed by IMC in this circumstance of implementing, on a longwall panel-by-longwall panel basis, adaptive management that is underpinned by a Property Subsidence Management Plan (PSMP) for each potentially affected property, is an appropriate means for managing risk to achieve conformance with consent conditions, provided that the PSMP and supporting management process (including IMC's Structural Review Group) reflect at least the degree of technical detail and management due diligence evidenced and committed to in the EP, the additional information provided to the Department by IMC dated 8 June 2022, and due consideration to the Panel's recommendations in relation to land stability (included below).

SUBSIDENCE CONSEQUENCES FOR SLOPE STABILITY

The Panel concludes:

- The EP would benefit from a number of refinements (listed under Recommendations).
- Mining-induced changes in the slope (i.e. local gradients) of hillsides are very unlikely to change the risk profile for land instability.
- Mining-induced rockfalls from the escarpment are very unlikely to present a risk to structures. This should be confirmed for each structure prior to mining of the relevant panel(s).
- A very low (but finite) likelihood of irreversible damage to structures cannot be excluded. On this basis, the costs of responding to such damage should be specifically addressed in the Landscape Management Plan (LMP).
- Traditional monitoring may not provide forewarning of damage to structures as points monitored are not likely to coincide with locations of damage (both being quite local). It is usual for the structures themselves to provide the best leading indicator of consequential damage. On this basis, the Panel considers that detailed dilapidation surveys are essential for detecting early warning indicators such that the LMP Trigger Action Response Plan (TARP) responds in a timely manner, including keeping inhabitants informed.

The Panel recommends:

- GHD
 - complete the last three objectives of its Landslide Risk Assessment (LRA) as set out in Section 2.3 of its report.
 - provides advice on the expected range of effects associated with modification of groundwater due to mining-induced subsidence and how these effects can be mitigated.
- The EP be refined to include the following:
 - Reconciliation of the number of potentially affected properties.
 - Provision in management plans, if need be, for any new significant matters arising out of the completion by GHD of the last three objectives of its LRA and arising out of its advice on the expected range of effects associated with modification of groundwater due to mining-induced subsidence and how these effects may be mitigated.
 - A statement clearly identifying the limitations of the GHD LRA being a desktop, first pass and/or preliminary assessment and, therefore, the degree of reliance that can be placed upon it.
 - Provision for undertaking site inspections (ground truthing) prior to the commencement of mining in the subject area of at least some of the Category E and Category F structures possibly affected by longwall mining in the EP. This is for the purpose of providing a level of confidence in GHD's preliminary assessments and the appropriateness of the associated advice provided on the likelihood and magnitude of damage, especially irreversible damage, and proposed triggers and corrective actions.
 - Identification by GHD of "the techniques and management tools available and previously employed in similar geotechnical circumstances" referred to in its LRA, where each has been adopted, why it was adopted and how successful it was.
 - A commitment to the installation of any piezometers or inclinometers, including documented past usage and effectiveness and clear triggers for when and where these would be installed.
 - Revision of the LMP TARP to clearly reference structures with quantitative triggers and commitments to defined corrective actions.

- Clarification in the LMP on accountability for the costs of responding to structural damage.

APPROPRIATENESS OF MONITORING AND MANAGEMENT OF MINE SUBSIDENCE AND SLOPE INSTABILITY

The Panel concludes:

- It is reasonable to expect that the EP will satisfactorily address the monitoring of the management of mine subsidence and slope instability provided that:
 - associated PSMPs are developed in a timely manner to at the least the standard evidenced in the documentation provided to the Panel under covering letter of 8 June 2020;
 - due consideration is given to the Panel's recommendations in relation to the EP; and
 - the IMC Structural Review Group, established as part of the Built Structures Management Plan, meets regularly to review all results of subsidence monitoring.

The Panel recommends:

- Any endorsement of the EP for LW 709-711 and LW 905 include a condition to the effect that PSMPs are developed in a timely manner to at the least the standard evidenced and committed to in the documentation provided by IMC to the Department under covering letter of 8 June 2022.

[end of copy of IAPUM Executive Summary]

Appendix B

MSEC Structures Management Plan for Appin LW905

Extract from MSEC (2022) being Section 6, Risk Control Procedures



South32

Illawarra Metallurgical Coal

ILLAWARRA METALLURGICAL COAL:

Appin – Area 9 – Longwall 905

Management Plan for Potential Impacts to Building Structures

AUTHORISATION OF MANAGEMENT PLAN

Authorised on behalf of South32 Illawarra Metallurgical Coal:

Name: Richard Walsh

Signature:

Position: Superintendent Infrastructure Protection

Date:

DOCUMENT REGISTER

Date	Report No.	Rev	Comments
May 2022	MSEC1268	01	Draft version
June 2022	MSEC1268	02	Final version

References: AS/NZS ISO 31000:2009 – Risk Management – Principles and Guidelines
MSEC (2021). Subsidence Predictions and Impact Assessments for the Natural and Built Features due to the Extraction of the Proposed Longwalls 709, 710A, 710B, 711 and 905 at Appin Colliery. Mine Subsidence Engineering Consultants, Report No. MSEC1117, Revision B, issued on 18 May 2021.

CONTENTS

1.0 STRUCTURES	1
1.1. Introduction	1
1.2. Objectives	2
1.3. Scope	2
1.4. Limitations	2
1.5. Definition of the Study Area	3
1.6. Descriptions of the structures	3
1.7. Proposed mining schedule	4
1.8. Definition of the active subsidence zone	4
2.0 PREDICTIONS OF SUBSIDENCE EFFECTS	5
2.1. Maximum predicted conventional subsidence effects	5
2.2. Measured subsidence effects due to the mining of LW901 to LW904	5
2.3. Predicted strains	7
3.0 METHOD OF ASSESSMENT OF POTENTIAL MINE SUBSIDENCE IMPACTS	10
3.1. NSW Work Health and Safety Legislation	10
3.2. General	10
3.2.1. Consequence	11
3.2.2. Likelihood	11
3.2.3. Hazard	11
3.2.4. Method of assessment of potential mine subsidence impacts	11
4.0 SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENTS	12
4.1. Predicted subsidence effects for the structures	12
4.2. Recorded impacts for houses due to LW702 to LW708B	12
4.3. Assessed impacts for the houses due to the mining of LW905	13
5.0 RISK ASSESSMENT	15
5.1. Experience of mining beneath structures in the Southern Coalfield	15
5.2. Managing public safety	15
5.2.1. Subsidence impact management process	16
5.3. Residential structures	19
5.3.1. Structures on steep slopes	19
5.3.2. Structures of heritage significance	22
5.3.3. Structures above hidden creeks	22
5.3.4. Houses prone to flooding or inundation	23
5.3.5. Houses located outside the declared Mine Subsidence Districts	23
5.3.6. Older houses	23
5.3.7. Future house construction	23
5.4. Flats or Units	23
5.5. Rural structures	23
5.6. Pools	24
5.6.1. Pool structures	24
5.6.2. Pool gates	24

5.7.	Septic tanks	24
5.8.	General services	25
5.9.	Access and mobility	25
5.10.	Private roads and walking trails near steep slopes	25
5.11.	Commercial and business establishments	25
5.12.	Public amenities	25
5.13.	Risks associated with existing structural condition	25
5.14.	Farm dams	26
5.15.	Summary of potential impacts	27
5.16.	Identification of subsidence hazards that could give rise to risks to health and safety	28
	6.0 RISK CONTROL PROCEDURES	29
6.1.	Structures Response Group	29
6.2.	Community consultation, cooperation and coordination	29
6.3.	Development and selection of risk control measures	30
6.4.	Avoidance and mitigation measures	30
6.5.	Site-specific structure inspection plan	32
	6.5.1. Identification of building structures	32
	6.5.2. Pre-mining geotechnical inspections of steep slopes	32
	6.5.3. Pre-mining hazard identification inspections	32
	6.5.4. Visual kerbside inspections during mining	33
	6.5.5. Visual inspections of structures during mining	33
	6.5.6. Visual inspections by the residents	34
6.6.	Ground and structure monitoring plan	34
	6.6.1. Ground surveys	34
	6.6.2. Specific structure surveys	35
	6.6.3. Monitoring of Razorback Range	35
6.7.	Schedule of inspections and surveys	37
6.8.	Inspection and survey register	37
6.9.	Triggers and responses	37
6.10.	Risk control procedures for LW905	38
	7.0 SRG REVIEW MEETINGS	44
	8.0 AUDIT AND REVIEW	44
	9.0 RECORD KEEPING	44
	10.0 CONTACT LIST	45
	APPENDIX A.	46

6.1. Structures Response Group

The Structures Response Group (SRG) is responsible for taking the necessary actions required to manage the risks that are identified from monitoring of structures. The SRG's key members are:

- IMC;
- Mine Subsidence Engineering Consultants;
- Inglis Engineering;
- SLR Consulting; and
- GHD Geotechnics.

SA NSW may also participate as observers at the SRG meetings, when available. The SRG may also invite other specialist consultants, from time to time.

6.2. Community consultation, cooperation and coordination

The extensive experience of longwall mining in the Southern Coalfield has found that the most effective method of managing potential impacts on the safety and serviceability of structures is by way of community consultation. Residents living within the active subsidence zone have often provided early feedback about impacts developing at their houses or along their local roads. Contact is made well before impacts develop to a level of severity sufficient to become a safety hazard.

The initial community consultation commenced during the preparation of the Bulli Seam Operations Part 3A Application, the LW901 to LW904 Extraction Plan Application and the LW709 to LW711 and LW905 Extraction Plan Application. IMC has continued dialogue with the residents through the IMC Community Consultation Committee (CCC) and the community newsletter.

The approaches adopted by IMC are listed below:

- *Undertake conservative predictions and impact assessments*
IMC and MSEC have adopted a conservative approach to predicting subsidence and assessing impacts. This reduces the likelihood of understating the assessed impacts. For example, predictions for each structure have been made by predicting the maximum subsidence, tilt, curvature and strain within a 20 m radius around each structure;
- *Undertake detailed predictions and impact assessments*
By undertaking detailed subsidence predictions, IMC is able to provide residents with site-specific predictions for their own structures. Individual assessments provide some comfort to concerned residents. This is particularly helpful for residents that live beyond the extent of mining and are expected to experience only small movements;
- *IMC Community Consultative Committee*
This committee meets at regular (two-monthly) intervals. It allows IMC to present information to the committee and receive feedback. The committee is committed to ensuring that the concerns of the community are well understood by IMC. Many of the members have been part of the committee for several years, and this allows for informed discussion to take place;
- *Letters to residents*
IMC sends many letters to community advising of imminent longwall mining in their area. By continuing to engage with residents at each stage of mining, IMC is able to find new residents who might not have been aware that mining was taking place. The letters include:
 - Notification of preparation of the Extraction Plan Applications for LW901 to LW904 and for LW709 to LW711 and LW905. The notification letter includes a Built Features Management Plan Pack, which included information on longwall mining and mine subsidence, claims process with SA NSW, recommendation to undertake pre-mining hazard identification inspection by IMC, a list of emergency contact numbers and point of contact at IMC;
 - Notification of imminent commencement of each longwall, the issue of quarterly update letters and completion letters. The letters are sent to all landowners whose properties are located within the predicted limit of vertical subsidence. The letter encourages the landowners to undertake pre-mining hazard identification inspections;

- For properties where pre-mining hazard identification inspections or checks have been or will be undertaken in accordance with this Management Plan, IMC has or will make direct contact to arrange access with the landowner by mail, letterbox drop and phone;
- *Individual meetings with residents*
Many members of the community prefer to meet with Colliery representatives face to face. IMC has held many individual meetings with concerned residents to explain how mine subsidence develops and what the impacts might be. This is a time consuming but rewarding process for residents and IMC;
- *Quarterly reporting*
IMC provides regular updates on the progress of mining in the area. This is conducted mainly by community newsletter by mail, email, website and noticeboards for any member of the community who wishes to be regularly informed. The updates advise the current position of the longwall and what impacts have been observed during the past few months;
- *Prompt response to reported impacts*
IMC responds quickly to impacts that are reported by the community. If a severe impact is reported, IMC checks neighbouring properties to see whether the incident is localised or part of a larger potential issue;
- *Ongoing monitoring if impacts occur*
Where impacts have been reported, IMC offers to continue monitoring the property for further impacts, if required.

6.3. Development and selection of risk control measures

IMC has developed and selected risk control measures in consultation, co-ordination and co-operation with the landowner in accordance with WHS legislation. In accordance with Clauses 35 and 36 in Part 3.1 of the Work Health and Safety regulation (2017) and the guidelines (MSO, 2017), a hierarchy of control measures has been considered and selected where reasonably practicable, using the following process:

1. eliminate risks to health and safety so far as is reasonably practicable, and
2. if it is not reasonably practicable to eliminate risks to health and safety – minimise those risks so far as is reasonably practicable, by doing one 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.
3. if a risk then remains, minimise the remaining risk, so far as is reasonably practicable, by implementing administrative controls.
4. 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.

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.

There are primarily two different methods to control the risks of subsidence, namely:

Method A – Selection of risk control measures to be implemented before the development of subsidence, (Items 1 and 2 above), and

Method B – Selection of risk control measures to be implemented during the development of subsidence (Items 3 and 4 above).

Method A risk control measures are described in Section 6.4.

Method B risk control measures are described in Sections 6.5 to 6.10. Before selecting Method B risk control measures, IMC has investigated and confirmed that the measures are feasible and effective for the site-specific conditions during the mining of LW905.

6.4. Avoidance and mitigation measures

Based on its own assessments, and the assessments by the structural engineer, IMC considered Method A risk control measures, in accordance with the process described in Section 6.3.

Elimination

In this instance, no reasonably practicable controls could be identified that would eliminate the identified risks.

Substitution

In this instance, no reasonably practicable controls could be identified that will change the environment so the hazards could be substituted for hazards with a lesser risk.

Isolation

In this instance, no reasonably practicable controls could be identified to isolate a hazard from any person exposed to it.

Engineering controls

The hazard identification inspections by the structural engineer will identify elements that are in poor existing condition or elements that could be susceptible to mine subsidence movements. The structural engineer will recommend engineering controls and monitoring to minimise risk.

A summary of the inspections, engineering controls and monitoring that have been recommended by the structure engineer, to date, are provided in Table A.02, in Appendix A. The engineering controls will be implemented before the structure experiencing active subsidence from LW904, i.e. before the longwall face approaches to within 150 m of travel of mining beneath the structure, or before the first 200 m of longwall extraction.

The hazards identified from the inspections will be risk assessed and they will be summarised in the structural inspection reports. Preventive measures will be recommended or management strategies implemented so that the risks are considered to be *Moderate* or lower. The assessed levels of risk for the building structures including the implementation of the engineering controls are summarised in Table 5.3.

Additional engineering controls will be developed as further hazard identification inspections are completed by the structural engineer. The properties that are pending or still require hazard identification inspections before active subsidence are illustrated in Fig. 6.2. The hazard identification inspections will be undertaken before the longwall face approaches to within 300 m of travel of mining beneath each property.

Administrative controls

The following Administrative Controls were identified and selected that will put in place procedures on site to minimise the potential of impacts on health and safety:

- implementation of a Monitoring Plan and Trigger Action Response Plan (TARP). As described in Table 6.1 and Table 6.2, the SRG has developed and implemented a management strategy of detecting early the development of potential adverse subsidence movements, so that contingency response measures can be implemented before impacts on the safety and serviceability develop. The TARP includes the following:
 - ground monitoring and visual inspections along the streets in the active subsidence zone;
 - visual inspections of the structures that are considered to be at higher risk in the active subsidence zone, including those located on steep slopes, that are in poor existing condition, that have had previous mining impacts and the pool gates;
 - additional surveys and inspections, if required, such as regular recording of widths of new cracks that might appear;
 - repair of impacts that create a serious public safety hazard;
 - repair of impacts that impair essential services;
 - repair of impacts that impair access and mobility to the property, even if further impacts are anticipated; and
 - in the worst case, as a last resort, advise the landowner to restrict entry to part of the property or emergency evacuate the premises.

With the implementation of the above management strategies, IMC will ensure that the health and safety of people on the properties will not be put at risk due to differential mine subsidence movements due to the mining of LW905.

6.5. Site-specific structure inspection plan

6.5.1. Identification of building structures

At the time of preparing Report No. MSEC1117 (MSEC, 2021), in support of the Extraction Plan Application, structures were identified from aerial photographs, with structure types identified from kerbside inspections. Further structures have been identified from the latest aerial photograph and from kerbside inspections as part of the preparation of this Management Plan.

Front of house inspections will be carried out by a structural engineer for the properties located directly LW905, where they were visible from the street. The purpose of these inspections is to identify structures that are in poor existing condition or elements that could be sensitive to mine subsidence movements, where access was not granted by the owner for the hazard identification inspections.

6.5.2. Pre-mining geotechnical inspections of steep slopes

A qualified geotechnical engineer will inspect the properties within the Study Area that are located on or near steep slopes. The purpose of these inspections is to identify the potential for slope instability before, during or after mining. The properties that require pre-mining geotechnical inspections are detailed in Section 5.3.1.

A summary of the pre-mining geotechnical inspections for the properties within the Study Area is provided in Fig. 6.1.

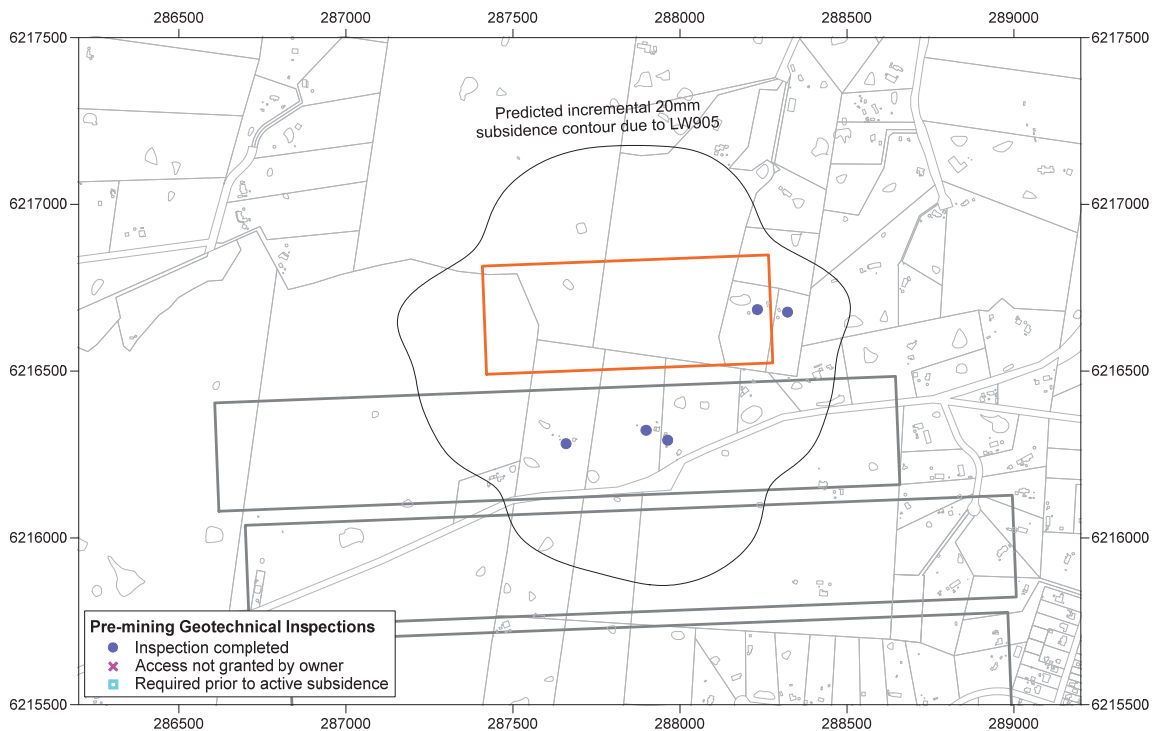


Fig. 6.1 Pre-mining geotechnical inspections

The pre-mining geotechnical inspections have been completed for five properties located within the Study Area (refer to Table 5.2). None have been declined or are pending. Geotechnical inspections are not required for the remaining properties within the Study Area because they are either not located on or near steep slopes or they are predicted to experience less than 150 mm total vertical subsidence after the mining of LW905.

6.5.3. Pre-mining hazard identification inspections

Hazard identification inspections will be carried out by a structural engineer for the residential structures that are located within the predicted 20 mm subsidence contour due to the mining of LW905. There are no commercial or business establishments and no public amenities located within the Study Area.

A summary of the hazard identification inspections for the properties within the Study Area is provided in Fig. 6.2.

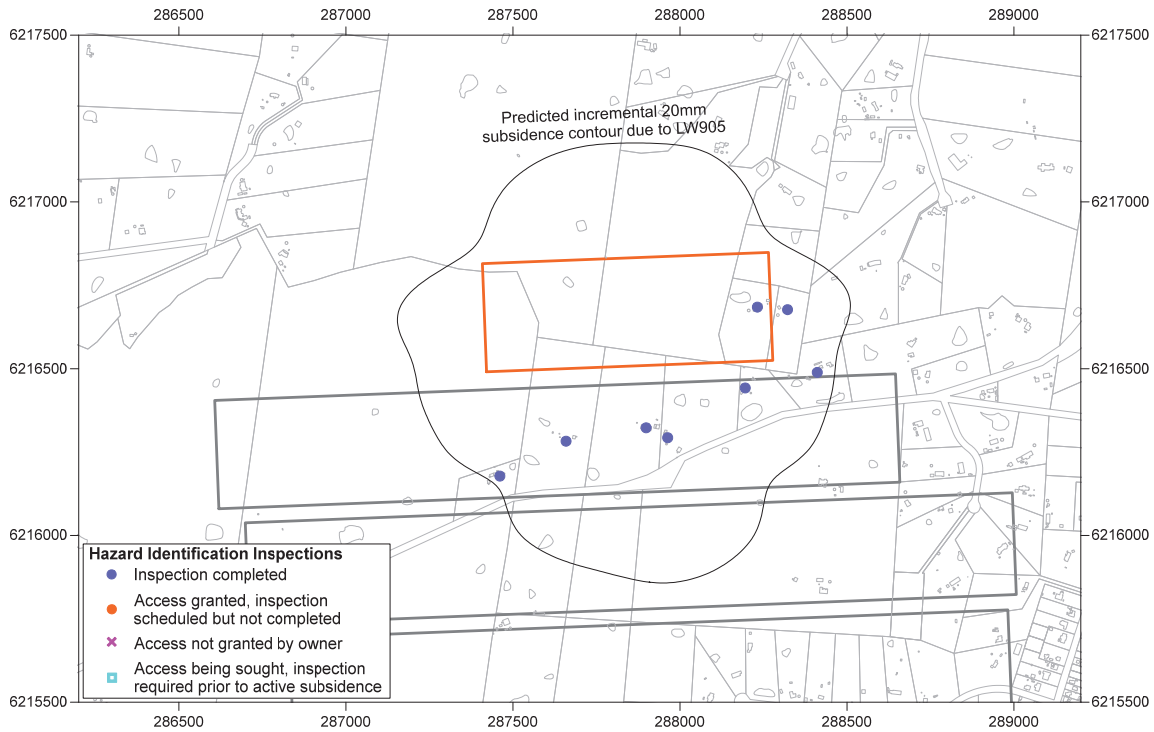


Fig. 6.2 Pre-mining hazard identification inspections

The hazard identification inspections have been completed for eight properties within the Study Area. None have been declined or are pending. Hazard identification inspections are not required for the remaining properties within the Study Area since they are predicted to experience less than 20 mm incremental vertical subsidence due to LW905.

6.5.4. Visual kerbside inspections during mining

Detailed visual inspections will be undertaken along streets on a weekly basis within the active subsidence zone during the mining of LW905, commencing after 200 m of extraction. The frequency of these inspections can be increased, if required, based on actual observations.

6.5.5. Visual inspections of structures during mining

Weekly visual inspections will be conducted for the following structures, when they are located within the active subsidence zone, where access is provided by the landowner:

- residential structures that are either: located on or above steep slopes, are in poor existing condition (based on the hazard identification inspections by the structural engineer, refer to Table A.02 in Appendix A for further details);
- residential structures that have experienced impacts as a result of mining previous longwalls, or where recommended by the SRG;
- pool fences and gates; and
- commercial and business establishments and public amenities (none identified within Study Area).

The inspections during active subsidence for the houses and public amenities are illustrated in Fig. 6.3. The active subsidence zone is described in Section 1.8, with the weekly inspections of the houses carried out from when they are 150 m in front of the longwall face to 450 m behind the longwall face.

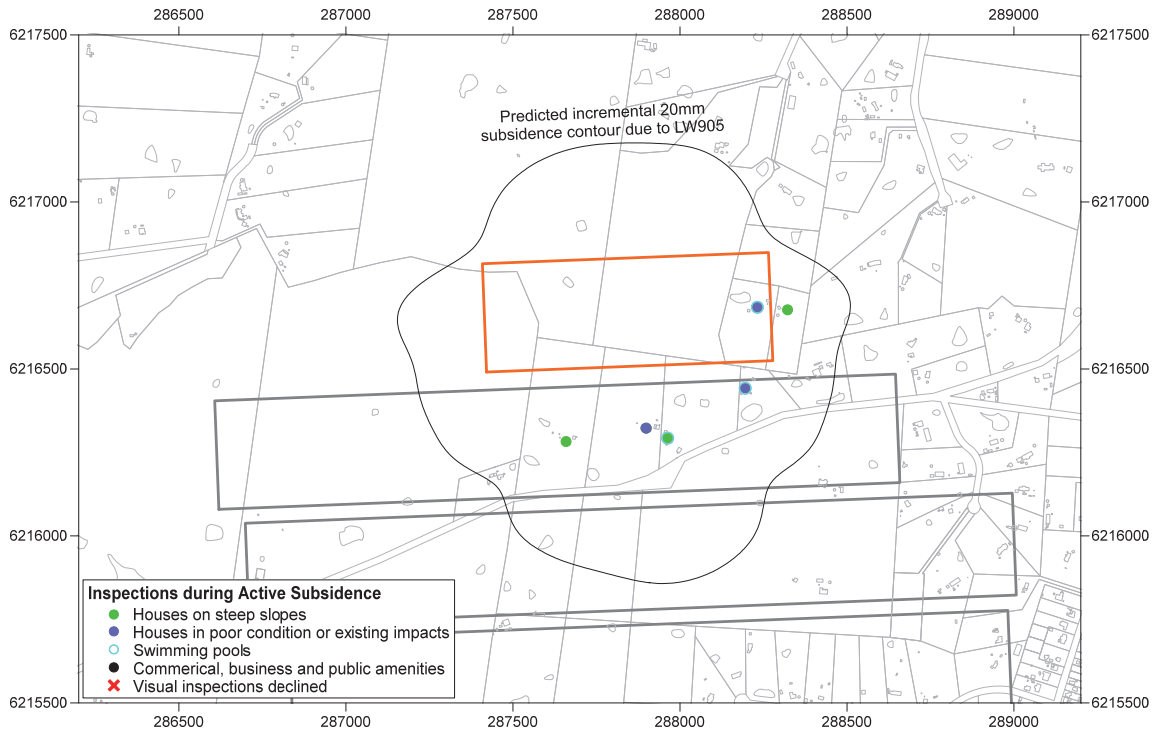


Fig. 6.3 Inspections during active subsidence

The weekly inspections of the structures located near the longwall commencing end will start after the first 200 m of longwall extraction. The inspections for the residential structures located beyond the longwall finishing end will be carried out for the last 300 m of extraction.

The residents will visually monitor their structures, pool gates and driveways where IMC has not been provided access by the landowner. Refer to Section 6.5.6.

6.5.6. Visual inspections by the residents

Some residents have not provided IMC with access to inspect their properties. These residents will visually monitor their structures, pool gates and driveways and will notify IMC if adverse impacts are observed. IMC will then inspect the properties, upon request by the landowners, and rectify adverse impacts that could result in adverse impacts to public safety.

6.6. Ground and structure monitoring plan

6.6.1. Ground surveys

Ground monitoring lines have been installed along Menangle Road, the Main Southern Railway, a private extension of Hawkey Road and on the steep slopes at the base or Razorback Range. Far-field 3D monitoring points have also been installed above and adjacent to the mining area and at the top of Razorback Range.

The locations of these existing monitoring lines and monitoring points are shown in Drawing No. MSEC1268-01. The monitoring lines and points will be initially surveyed to provide a baseline reference for LW905. The monitoring frequencies during the mining of LW905 are described in Table 6.1. The frequency of monitoring and inspections will be increased based on the triggers outlined in and below Table 6.2 or by the recommendations of the SRG.

6.6.2. Specific structure surveys

IMC will undertake building surveys where recommended by the geotechnical engineer or structural engineer.

Ground surveys around structures are used as a baseline monitoring tool. Surveys are undertaken following completion of each longwall unless adverse impacts or high tilts are observed. IMC will place permanent ground survey marks around each subject building. IMC will endeavour to place the marks at each external and internal corner of the building, and one mark at the centre of each external side of reasonable length (this will depend on the overall size of the building but is approximately 10 m).

IMC will record the reduced levels of each survey mark, as well as the horizontal distance between each mark around the perimeter of the building. The survey information will provide subsidence, tilt, curvature and strain information on the ground around the building. This general surveying scheme is illustrated in Fig. 6.4. It is recognised that in some cases, it will not be possible to gain access and suitable lines of sight to the entire perimeter of the building, and in some cases, the number of survey pegs may be reduced. However, as a minimum, survey marks will be placed at every corner of the building.

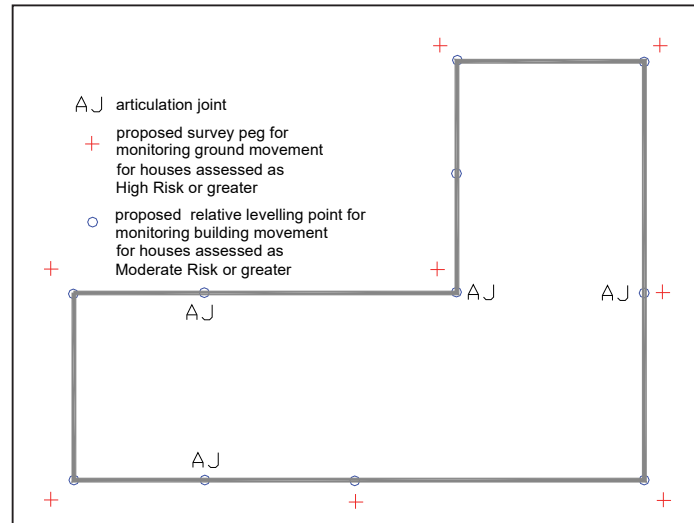


Fig. 6.4 Schematic layout for ground movement and building level surveys around a typical building

6.6.3. Monitoring of Razorback Range

IMC will undertake monitoring of Razorback Range to identify movements associated with the steep slopes and to manage potential impacts to the houses located at the top or base of the range. The monitoring includes ground monitoring lines and monitoring points, GNSS and visual inspections.

Ground monitoring

The locations of the existing monitoring lines and monitoring points are shown in Drawing No. MSEC1268-01. The lines and points shown in red will be monitored during the mining of LW905 and include:

- Ground monitoring line along Menangle Road;
- Ground monitoring line along the southern end of Hawkey Road;
- Steep slopes monitoring lines (SSD Line and SSE Line) on the steep slopes near the base of Razorback Range;
- Far-field 3D monitoring points (A9FF03, A9FF06, A9FF07, A9FF08, A9FF10, A9FF11, GD, GD01, GD02, GD03, PM61513 and WRIG01) above and around the mining area;

Ground monitoring points have also been established around three houses located at the top of Razorback Range located west of the Study Area (Refs. O17h01, O18h01 and O18h02). These monitoring points will only be measured during the mining of LW905 if recommended by the SRG.

The monitoring frequencies during the mining of LW905 are described in Table 6.1. The frequency of monitoring and inspections will be increased based on the triggers outlined in and below Table 6.2 or by the recommendations of the SRG.

Global Navigation Satellite System (GNSS)

The locations of the existing GNSS units are shown in Drawing No. MSEC1268-01 and comprise:

- six units along the Main Southern Railway (GNSS 76.0 km, GNSS 75.58 km, GNSS 75.26 km, GNSS 74.82 km, GNSS 74.12 km and GNSS 73.8 km);
- two unit above LW902 (GNSS 902_500 and GNSS 902_mid), two units above LW903 (GNSS 903_500 and GNSS 903_1000) and four units above LW904 (GNSS 904_500, GNSS 904_900, Site 05 and Site 06);
- four units above LW905 (SSGNSS09 to SSGNSS12); and
- nine units on the side and at the top of Razorback Range (SSGNSS01 to SSGNSS08 and Site 4).

The GNSS unit installations generally include a solar panel, rechargeable battery, data logger and telemetry hardware. A photograph of a typical GNSS installation is provided in Fig. 6.5.



Source: Michael Nicholson Consulting

Fig. 6.5 Nominal GNSS unit installation set-up

The GNSS units measure the absolute vertical and horizontal movements in real time before the commencement and during the mining of LW905. The nominal accuracy is ± 10 mm for absolute position and ± 10 mm for absolute level. The movements will be recorded at regular intervals (nominally 10 seconds) and will be recorded in a database that can be accessed using an online website.

The four-hour running averages for the GNSS units will be used as a trigger for the commencement of ground surveys and as a monitoring review point for the SRG to assess the effectiveness of the monitoring and management strategies. Further details on the monitoring and triggers are provided in Table 6.1 and in and below Table 6.2.

Visual inspections

A structural engineer will carry out visual inspections of the properties that are located within the active subsidence zone, subject to the approval of the property owners. The inspection frequencies during the mining of LW905 are described in Table 6.1 and in and below Table 6.2.

A geotechnical engineer will carry out visual inspections of the steep slopes associated with Razorback Range on Property Refs. F17 and N19 and if required N21. The locations of these properties are shown in Drawing No. MSEC1268-02. The inspection frequencies during the mining of LW905 are described in Table 6.1 and in and below Table 6.2. The GHD Geotechnical Visual Observation Protocol is attached to the Management Plan.

Rainfall

Rainfall is monitored locally at the IMC Ventilation Shaft 6 Site. In addition, data is available from two additional sites associated with the Main Southern Railway. The rainfall data is local and available in real time. Actual rainfall data and forecast rainfall are reviewed in the SRG and reported. Rainfall forecasts increase the level of awareness of significant rainfall events and assist in planning additional inspections. During rainfall events, daily updates of rainfall data is reviewed and distributed by GHD.

6.7. Schedule of inspections and surveys

A schedule of inspections and surveys is maintained by IMC.

6.8. Inspection and survey register

A register is kept by IMC, recording when inspections and surveys are conducted. IMC can, at any time, provide a copy of the register to Mine Safety Operations (MSO).

6.9. Triggers and responses

Trigger levels have been developed by IMC based on observed ground movements or impacts. Trigger levels for each monitoring parameter are described in the risk control procedures in Table 6.1 and Table 6.2. Structural inspections will be undertaken for structures where ground tilt is observed to exceed 7 mm/m or curvature is observed to exceed 0.2 km^{-1} at nearby monitoring lines or points.

The GNSS units at the top of Razorback Range (SSGNSS01 to SSGNSS06) will be alarmed and the SRG will be notified if the absolute movements (vertical or horizontal) exceed 20 mm and for every additional 20 mm of movement. The monitoring and actions are discussed further in Table 6.1 and in and below Table 6.2.

IMC will coordinate and ensure that building contractors are on standby for immediate call out and service in the event of impacts occurring. Temporary alternative accommodation will also be arranged by IMC in the unlikely event that a residence becomes unsafe as a result of mine subsidence impacts.

Immediate responses will be undertaken by IMC for the following impacts:

- impacts that create a serious public safety hazard;
- impacts to all entry and exit doors, and all other doors that must remain operational for security and fire egress reasons, even if further impacts are anticipated;
- impacts that impair essential services;
- impacts to sensitive equipment, even if further impacts are anticipated; and
- in the worst case, restriction on entry to part of the property and the provision of alternative accommodation for the resident.

The risk control measures described in this Management Plan have been developed to ensure that the health and safety of people who may be present at the property are not put at risk due to mine subsidence. It is also an objective to avoid disruption and inconvenience to owners, or if unavoidable, keep disruption and inconvenience to minimal levels.

No potential hazards have been identified that could reasonably give rise to the need for an emergency response for the building structures located within the Study Area. It is possible that irregular ground movements could cause a severe impact to a building structure. Historically these impacts have developed gradually; however, this management plan has considered the potential for more rapid development of subsidence due to the mining beneath the steep slopes associated with Razorback Range.

Detailed monitoring and management measures have been established to identify the development of potentially adverse differential subsidence movements early, consider whether additional management measures are required, and repair or adjust affected surface features, in close consultation with landowners.

IMC and the SRG will review and assess monitoring reports and consider whether additional management measures are required on a weekly basis. If irregular movements or adverse impacts are detected, it is anticipated that a focussed inspection will be undertaken for the affected property, and a decision will likely be made to increase the frequency of surveys and/or inspections. Additional management measures may also be implemented. It is therefore expected that, as a potential adverse situation escalates, IMC will be present on site on a more frequent basis to survey or inspect the property, and that the landowner will be consulted on a more frequent basis.

Notwithstanding the above, if a hazard has been identified that involves potential serious injury or illness to a person or persons at the property, and it cannot be controlled, the immediate response is to remove people from the hazard. If such a situation is observed or is forecast to occur by either IMC or by people at the property, IMC and the landowner will immediately meet and implement emergency procedures.

The implementation of emergency procedures may include a combination of the following:

- restriction of access to the hazardous area; and/or
- in the worst case, the relocation of the residents to alternative accommodation until the hazard is rectified.

6.10. Risk control procedures for LW905

The general risk control procedures for the management of potential impacts to residential properties are provided in Table 6.1. The specific triggers and actions for the three private properties located at the top of Razorback Range (Refs. O02, O17 and O18) are provided in and below Table 6.2.

Table 6.1 Risk control procedures for residential structures for LW905

Infrastructure	Hazard or impact	Risk	Trigger	Control procedure/s	Timing and frequency	By whom?
Residential structures that will experience mine subsidence effects due to the mining of LW905	Impacts occur	Low to Moderate	Before active subsidence for LW905	Contact residents to inform them of the commencement of mine subsidence. Request owners for information on potential issues with existing structures	Completed	IMC
				Conduct pre-mining geotechnical assessment of the steep slopes associated with Razorback Range to confirm whether there is potential for slope instability before, during or after mining	Completed	IMC (GHD)
				Conduct pre-mining geotechnical assessment of steep slopes in the vicinity of the structures within the Study Area to confirm whether there is potential for slope instability before, during or after mining	Completed	IMC (SLR)
				Conduct pre-mining hazard identification inspection and assessment of: <ul style="list-style-type: none"> residential structures located within the predicted 20 mm subsidence contour due to the mining of LW905 commercial structures located within the predicted 20 mm subsidence contour due to the mining of LW905 (none identified, the structures associated with the Axicom Razorback Compound are covered in a separate management plan) 	Before longwall face approaching within 300 m of each property (or before the first 200 m of extraction for properties near the longwall commencing end)	IMC (Inglis Engineering)
				Installation of additional monitoring measures or mitigation/strengthening measures as recommended by the structural engineer or SRG	Before longwall face approaching within 100 m of each property (or before the first 200 m of extraction for properties near the longwall commencing end)	IMC
				Install ground monitoring lines along Menangle Road, southern end of Hawkey Road, steep slopes lines on Razorback Range (SSD Line and SSE Line) and far-field 3D marks (as shown in Drawing No. MSEC1268-01) and survey the initial levels and strain distances	Completed	IMC
				Install GNSS units above and around the mining area and on the side and top of Razorback Range (as shown in Drawing No. MSEC1268-01)	Completed	IMC
				Install survey marks around each of the houses at the top of Razorback Range (Refs. O02h01, O17h01, O18h01 and O18h02), subject to the approval of the property owners	Completed for properties Refs. O17 and O18. Installation on property Ref. O02 pending property owner approval	IMC
				Install survey marks and a siphon at the dam of Property N13, subject to the approval of the property owner	Before the longwall face approaching within 100 m of the property	IMC
				Discovery of potential structural issues before mining of LW905	Conduct pre-mining structural inspection and assessment and consider: <ul style="list-style-type: none"> mitigation / strengthening measures to improve the existing structural condition management measures that should be undertaken before or during mining monitoring and inspection measures, triggers and responses during mining 	Within two weeks of discovery
	During the mining of LW905			Advise property owner, SA NSW and MSO of findings of structural engineer	Within two weeks of inspection	IMC
				Undertake mitigation / strengthening measures if decided by the SRG	Before the structure experiencing active subsidence	IMC
				Monitoring of the GNSS units	Continuous monitoring (four-hour running average) during the mining of LW905, unless recommended otherwise by the SRG. The GNSS units at the top of Razorback Range (SSGNSS01 to SSGNSS06) will be alarmed and the SRG will be notified if the absolute movements (vertical or horizontal) exceed 20 mm and for every additional 20 mm of movement. The GNSS units will remain alarmed until the completion of LW905 and then the SRG will review the ongoing requirements	IMC
				Survey the Steep Slopes monitoring lines (SSD Line to SSE Line)	Weekly 2D surveys and monthly 3D surveys will commence after 200 m of longwall extraction. Surveys will continue until the completion of LW905, unless recommended otherwise by the SRG	IMC
				Survey the Menangle Road monitoring line	Weekly surveys will commence after 200 m of longwall extraction. Surveys will continue for the section of road located within the active subsidence zone until the completion of LW905, unless recommended otherwise by the SRG	IMC
				Survey the Hawkey Road extension monitoring line	Monthly surveys will commence after 500 m of longwall extraction. Surveys will continue until the completion of LW905, unless recommended otherwise by the SRG	IMC
				Survey the far-field 3D marks	Weekly surveys will commence after 200 m of longwall extraction. Surveys will continue until the completion of LW905, unless recommended otherwise by the SRG	Survey the far-field 3D marks
	Survey the marks on the dam on Property N13	Monthly surveys during active subsidence, unless recommended otherwise by the SRG	IMC			

Table 6.1 Risk control procedures for residential structures for LW905 (continued)

Infrastructure	Hazard or impact	Risk	Trigger	Control procedure/s	Timing and frequency	By whom?		
Residential structures that will experience mine subsidence effects due to the mining of LW905	Impacts occur	Low to Moderate		Survey the ground monitoring points around the houses at the top of Razorback Range (Refs. O17h01, O18h01 and O18h02), subject to the approval of the property owners	Completion of mining of LW905, unless recommended otherwise by the SRG	IMC		
				Visual inspections of houses and associated structures at the top of Razorback Range (Refs. O17h01, O18h01 and O18h02), subject to the approval of the property owners. Geotechnical inspections in accordance with the GHD Visual Observation Protocol attached to the Management Plan	Completion of mining of LW905, unless recommended otherwise by the SRG	IMC (Inglis Engineering, GHD)		
				Visual inspection of the steep slopes on Razorback Range on properties Refs. F17 and N19 and if required N21. Geotechnical inspections in accordance with the GHD Visual Observation Protocol attached to the Management Plan	Monthly visual inspections by a geotechnical engineer after 200 m of longwall extraction. Inspections will continue until the completion of LW905, unless recommended otherwise by the SRG	IMC (GHD)		
				Visual inspection of dam on Property N13	Weekly during active subsidence, unless recommended otherwise by SRG	IMC (SLR)		
				Conduct kerbside visual inspections of the streets and structures	Once per week within the active subsidence zone	IMC (Inglis Engineering)		
				Review and assess the ground monitoring data and provide subsidence monitoring reports when monitoring lines are located within the active subsidence zone	Weekly when monitoring lines are located within the active subsidence zone, unless recommended otherwise by the SRG	IMC (MSEC)		
				Confirm arrangements for building contractors to remain on standby for immediate call out and service in the event of impacts affecting safety or serviceability	Before the structure experiencing active subsidence	IMC		
				Conduct inspections during mining for following structures: a) Commercial and business establishments (none identified) b) Structures that have previously experienced mine subsidence impacts, where recommended by the SRG c) Pool gates d) Other structures recommended for regular inspections and/or structure surveys by geotechnical engineer or structural engineer due to their proximity to steep slopes or pre-existing condition	Regular inspections during active subsidence, frequency as recommended by the geotechnical engineer, structural engineer and/or SRG, subject to the approval of access from the property owner	IMC		
				GNSS units at the top of Razorback Range (SSGNSS01 to SSGNSS06)	Measured absolute (vertical and horizontal) movements greater than triggers	Refer to Table 6.2	IMC and SRG	
				Razorback Range 3D	Measured horizontal distances greater than triggers	Refer to Table 6.2	IMC and SRG	
				Steep slopes monitoring lines	Measured strains greater than triggers	Refer to Table 6.2	IMC and SRG	
				Rainfall	Measured rainfall greater than triggers	Refer to Table 6.2	IMC and SRG	
				Measured tilts are greater than 7 mm/m or measured curvatures are greater than 0.2 km ⁻¹ near the structure	Notify SRG	Within 24 hours	IMC	
					Conduct inspection of building and provide photographic survey and impact report, subject to the approval of the property owner	As soon as possible subject to landowner access	IMC	
					Consider structural inspection/additional monitoring and/or mitigation/strengthening measures	Commence immediately during inspection and report to SRG within 24 hours of inspection	IMC (Inglis Engineering)	
					Significant non-conventional movement occurs; or impacts observed to surface infrastructure (not just structures); or slope slippage observed	Consider whether additional management measures are required in light of the observations, including additional geotechnical or structural inspections, increase frequency of surveys and inspections, additional community consultation	As required by the SRG	IMC and SRG
						Notify landowner, SA NSW and MSO	Within 48 hours	IMC
						As information can come from many possible sources: If not already done, notify landowner, IMC and SA NSW	Within 48 hours	IMC
						Inspect impact of subsidence on building	Within 48 hours	IMC
						Inspect condition of building, where recommended by the SRG based on feedback from SA NSW or IMC	As recommended by the SRG within the active subsidence zone or as agreed with owner	IMC
						Rectify adverse impacts that impair upon the: • safety, access and mobility, security or fire egress; • essential services; or • sensitive equipment used for commercial and business establishments	Within 48 hours	IMC
						Repair damage to structure	When subsidence impacts cease	IMC
						Observed impacts are greater than predicted impacts	Investigate cause(s) for greater impacts, including possibility of non-conventional or anomalous movements, type of structure. Investigate spatial trends in data to identify patterns.	Commence immediately and report within 48 hours of observation

Table 6.1 Risk control procedures for residential structures for LW905 (continued)

Infrastructure	Hazard or impact	Risk	Trigger	Control procedure/s	Timing and frequency	By whom?			
Residential structures that will experience mine subsidence effects due to the mining of LW905	Impacts occur	Low to Moderate	Observed impact is AS2870 Category 3 or greater	Notify landowner, IMC, SA NSW and MSO	Within 48 hours of identifying impact	IMC			
				Ongoing inspections by structural engineer	As recommended by the SRG	IMC			
				Re-assess final level of damage based upon likelihood of further damage and structural condition	Within 48 hours after structural re-inspection, as recommended by the SRG	IMC and SRG			
				Consider additional monitoring and/or mitigation/strengthening measures	Within 48 hours after structural re-inspection, as recommended by the SRG	IMC and SRG			
			A hazard has been identified that involves potential serious injury or illness to a person or persons at the property, and cannot be controlled	Notify landowner, IMC, SA NSW and MSO	Within 24 hours of identifying impact	IMC			
				Coordinate with SA NSW and provide temporary accommodation for the residents	Within 24 hours of identifying impact	IMC			
				Restrict access to the property until the hazard has been rectified	Within 24 hours of identifying impact	IMC			
			Property owner does not accept acquisition	Temporarily relocate residents until building is repaired	Within 48 hours	IMC			
			New houses	Impacts to new houses	Low to Moderate	Before mining	Contact residents to inform them of commencement of mine subsidence	Before active subsidence	IMC
						Owner notifies of the new house	Conduct hazard identification survey of structures (where access is provided) and PMI (if requested by owner)	Before active subsidence	IMC
Conduct impact assessment and risk analysis, if requested	Before active subsidence	IMC (MSEC)							
New house has maximum plan dimension greater than 30 m	Conduct subsidence predictions and impact assessment	Before active subsidence				IMC (MSEC)			
Swimming pools and pool gates	Damage to pool	Low	None	Notify owner of potential impacts to pool	Before active subsidence	IMC			
				Notify owner of potential impact to pool gate and fence	Before active subsidence	IMC			
	Pool gate will not close	High	None	Visually inspect pool gate to check that it is operating properly	Weekly when each pool is within active subsidence zone and at the completion of LW905, subject to the approval of access from the property owner	IMC			
				Pool gate will not close	Repair gate	Within 24 hours	IMC		
Farm dams	Loss of water storage due to leakage of dam	Low	Loss of water supply due to leakage of dam wall or floor	Supply water to landowner	As required	IMC			

Table 6.2 Trigger Action Response Plan for private properties at top of Razorback Range (Refs. O02, O17 and O18)

Monitoring method	Frequency (minimum frequency unless increased by SRG based on a trigger, refer to Table 6.1 for minimum monitoring period)	Measurement	Status		
			Level 1	Level 2	Level 3
GNSS on private properties (SSGNSS01 to SSGNSS06) GNSS units are alarmed (SMS and e-mail sent to the SRG)	Continuous	Absolute movement (vertical or horizontal)	Less than 20 mm	Greater than 20 mm and for every additional 20 mm of movement thereafter	-
		Change in absolute movement (vertical or horizontal) within 72 hours	Less than 20 mm	20 mm to 50 mm	Greater than 50 mm
		Change in absolute movement (vertical or horizontal) within 24 hours	Less than 50 mm	50 mm to 100 mm	Greater than 100 mm
Razorback Range 3D (GD01 to SSGNSS01, GD02 to SSGNSS05 and GD03 to SSGNSS06)	Monthly	Change in horizontal distance (extension)	Less than 50 mm	Greater than 50 mm and for every additional 50 mm of movement	-
		Change in horizontal distance (extension) between surveys	Less than 50 mm	50 mm to 100 mm	Greater than 100 mm
Steep slopes monitoring lines (SSD Line and SSE Line)	Weekly	Strain (tensile or compressive) north of LW905 maingate (measured over standard survey bay length)	Less than 2 mm/m	2 mm/m to 4 mm/m	Greater than 4 mm/m
Survey marks on private properties (Refs. O17 and O18)	Start and end of longwall	Strain (tensile or compressive)	Less than 2 mm/m	2 mm/m to 4 mm/m	Greater than 4 mm/m
Structural or geotechnical inspection of private properties (Refs. O17 and O18) and geotechnical inspection of steep slopes (Refs. N19 and N20)	Start and end of longwall	Hazard identification	No mining-related impacts or hazards identified	Minor mining-related impacts identified not considered to affect public safety	Mining-related impacts that could potentially affect public safety
Rainfall (Vent Shaft 6)	Continuous	Cumulative rainfall	Less than 20 mm within 24 hours	20 mm to 100 mm within 24 hours	Greater than 100 mm within 24 hours

The following actions will be carried out based on the triggers outlined in the above table:

Level 1 status:

- SRG to meet fortnightly and review the monitoring data and assess for ongoing trends;
- if ongoing trends identified (and less than Level 2 trigger), the SRG to consider whether to:
 - increase frequency of ground surveys including the steep slopes monitoring lines and the far-field monitoring points along Top Ridge Road;
 - increase frequency of visual inspections by structural engineer and surveys of the monitoring points on the three properties at the top of Razorback Range (Refs. O02, O17 and O18);
 - increase frequency of geotechnical inspections of the three properties at the top of Razorback Range (Refs. O02, O17 and O18) and of the steep slopes along the range (Refs. N19 and N21);
 - increase frequency of monitoring data reviews and SRG meetings; and
 - carry out any other additional management measures as required.
- if ongoing trends identified and predicted/expected to exceed Level 2 trigger within the next week, the SRG to carry out actions associated with Level 2 status;

Level 2 status:

- SRG respond to GNSS alarm and attend teleconference within 1 hour to review available data;
- IMC engineer to inspect the base of the steep slopes (Refs. N19 and N20) within 24 hours. If inspection identifies potential mining-related impacts to steep slopes then:
 - IMC to inspect private properties within 24 hours;
 - geotechnical and structural engineers to inspect steep slopes and private properties within 48 hours;
 - if the inspections identify a potential hazard to public safety, SRG to meet within 24 hours and carry out actions associated with Level 3 status;
- SRG to meet and review outcomes of the inspections and monitoring data and assess for ongoing trends;
- if ongoing trends identified (and less than Level 3 trigger), then within a further 48 hours:
 - carry out an additional survey of steep slopes monitoring lines and far-field monitoring points along Top Ridge Road;
 - carry out an additional geotechnical inspection of the base of the steep slopes (Refs. N19 and N20);
 - carry out an additional geotechnical and structure inspection of the private properties (Refs. O02, O17 and O18) pending property owner approval;
 - SRG to consider whether any other additional surveys to be carried out;
 - SRG to review the additional surveys and inspections and assess for ongoing trends;
 - SRG to review the frequency of meetings and data reviews;
- if ongoing trends identified and predicted/expected to exceed Level 3 trigger within the next week, the SRG to carry out actions associated with Level 3 status.

Level 3 status:

- SRG respond to GNSS alarm and attend teleconference within 1 hour to review available data;
- geotechnical engineer to inspect the base of the steep slopes (Refs. N19 and N20) and structural engineer and geotechnical engineer to inspect private properties (Refs. O02, O17 and O18) within 24 hours pending property owner approval;
- if the geotechnical or structural engineer identified a hazard that could affect public safety then:
 - IMC to notify landowner, SRG and Resource Regulator within 24 hours;
 - IMC to carry out recommendations from the geotechnical and structural engineers within 24 hours;
 - IMC to consider relocating the residents, if recommended by the geotechnical or structural engineers, or if the hazard cannot be managed;
- SRG to meet and review outcomes of the inspections and monitoring data and assess for ongoing trends;
- increase the frequency of monitoring and inspections to twice-weekly or as recommended by the SRG for:
 - geotechnical inspection of the base of the steep slopes (Refs. N19 and N20);
 - geotechnical and structure inspection of the private properties (Refs. O02, O17 and O18) pending property owner approval;
 - steep slopes monitoring lines and far-field monitoring points along Top Ridge Road;
- SRG to consider increasing the frequency of other monitoring including:
 - survey marks around the private properties (Refs. O02, O17 and O18);
 - any other additional surveys and inspections recommended by the SRG;
- SRG to meet twice-weekly, or as determined by SRG, and review the continuous GNSS monitoring data, additional surveys and inspections until the SRG agree that there is no ongoing hazards or trends;