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SIMEC

SIMEC Mining:

# Tahmoor South Longwalls S1A to S7A

Management Plan for potential impacts to Sydney Water Potable Water Infrastructure

Sydney WATER

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## AUTHORISATION OF MANAGEMENT PLAN

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| Aug-25 | MSEC1193-04 | C | Draft for LW S1A to S7A |
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References:-


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**Drawings**

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## 1.1. Background

Tahmoor Coal Pty Ltd (Tahmoor Coal), owns and operates Tahmoor Mine, an existing underground coal mine located approximately 80 km southwest of Sydney in the Southern Coalfields of New South Wales (NSW). Tahmoor Coal is a wholly owned entity within the SIMEC Mining division of the GFG Alliance group. Tahmoor Coal has extracted 39 longwalls and completed extraction of LW S3A.

Tahmoor Coal received development consent in April 2021 for the Tahmoor South Project, which is an extension of the current Tahmoor Mine underground coal mining within the Bulli seam towards the south of the existing Tahmoor Mine.

Tahmoor Coal has received approval for an Extraction Plan for Longwalls S1A to S6A (LW S1A-S6A), which are the first longwall panels to be extracted in the Tahmoor South domain. The proposed longwalls are located between Tahmoor's surface facilities to the north and the township of Bargo to the south. Infrastructure owned by Sydney Water is located within this area.

In December 2022, Sydney Water and Tahmoor Coal developed an agreed Revision B of the Management Plan for the mining of LWs S1A to S6A beneath Sydney Water's infrastructure.

Tahmoor Coal subsequently received approval to shorten the commencing (i.e. southern) ends of LWs S3A and S4A by 104 metres from the positions that were approved in the Extraction Plan.

In December 2024, Amendment No. 2 of the Management Plan described both the shortening of LW S4A and additional measures to manage mine subsidence risks to Sydney Water infrastructure at creek crossings, which were developed by Tahmoor Coal and Sydney Water. This Management Plan incorporates measures described in Amendment No. 2.

In May 2025, Tahmoor Coal received approval for a Modification to the development consent to extract LW S7A to the side of LW S6A. The proposed LW S7A will extract directly beneath Sydney Water potable infrastructure along Yarran Road and will result in additional subsidence effects.

A summary of the dimensions of LW S1A-S7A are provided in Table 1.1.

**Table 1.1 Longwall dimensions**

| Longwall | Overall void length including the installation heading (m) | Overall void width including the first workings (m) | Overall tailgate chain pillar width (m) |
|---|---|---|---|
| LW S1A | 1,711 | 283 | - |
| LW S2A | 1,768 | 285 | 38 |
| LW S3A | 1,704 | 285 | 36 |
| LW S4A | 1,755 | 285 | 36 |
| LW S5A | 1,949 | 285 | 36 |
| LW S6A | 1,999 | 285 | 36 |
| LW S7A | 1,918 | 285 | 36 |

This Management Plan provides detailed information about how the risks associated with mining beneath Sydney Water's potable water infrastructure will be managed by Tahmoor Coal and Sydney Water.

The Management Plan is a live document that can be amended at any stage of mining, to meet the changing needs of Tahmoor Coal and Sydney Water.

## 1.2. Sydney Water's Potable Water assets potentially affected by LW S1A-S7A

The locations of Sydney Water's potable water infrastructure in relation to LW S1A-S7A are shown in Drawing No. MSEC1193-04-01.

The potable water infrastructure includes a Cast Iron Cement Lined (CICL) 450 mm diameter watermain which follows the alignment of Remembrance Drive, before crossing beneath the Main Southern Railway and following Great Southern Road. The water main supplies potable water to the greater Picton area, including the townships of Tahmoor, Thirlmere, Picton and The Oaks.

A 100 mm diameter CICL pipe runs along Caloola Road and a 200 mm diameter CICL and 100 mm diameter Ductile Iron Cement Lined (DICL) water pipelines are located along Yarran Road. A 100 mm diameter DICL water pipeline runs along Remembrance Drive to the south of Yarran Road.

## 1.3. Consultation

### 1.3.1. Consultation with Sydney Water

Tahmoor Coal regularly consults with Sydney Water in relation to mine subsidence effects. This includes consultation during the development of Subsidence Management Plans for previous Longwalls 22 to 32, and LW W1-W4, and regular reporting of subsidence movements and impacts.

Details regarding consultation and engagement are outlined below:

- Risk assessment with Nad Balgunan and Trop Cooper (Sydney Water), Amanda Bateman, Amanda Fitzgerald, Diana Harris (Tahmoor Coal) and Daryl Kay (MSEC);
- Provision of the draft Subsidence Management Plan for LW S1A-S6A to Troy Cooper (Sydney Water) in November 2022.
- Letter advising planned shortening of LW S3A in March 2024;
- Risk assessment Sydney Water, Tahmoor Coal, Burnett Engineering, Newcastle Geotech, MSEC, Sweeting Consulting and facilitator Shane Chiddy (Axys Consulting) on 11 June 2024.
- Review of risk assessment on 13 December 2024 following adoption of Option 2 for the Creek 3 and Main Southern Railway crossing.
- Letter advising planned shortening of LW S4A and measures to manage risks at creek crossings in December 2024;
- Ongoing reporting of monitoring results during the mining of LWs S1A to S3A.

Tahmoor Coal will continue to consult regularly with Sydney Water during the extraction of LW S1A-S7A in relation to mine subsidence effects.

### 1.3.2. Consultation with Government Agencies & Key Infrastructure Stakeholders

Government agencies including the NSW Department of Planning & Environment, Resources Regulator, Mine Safety Operations, Subsidence Advisory NSW and key infrastructure stakeholders including Wollondilly Shire Council, Endeavour Energy, Telstra and Jemena have also been consulted as part of the Extraction Plan approval process.

## 1.4. Limitations

This Management Plan is based on the predictions of the effects of mining on surface infrastructure as provided in Report No. MSEC1192 for LWs S1A to S6A by Mine Subsidence Engineering Consultants (MSEC, 2022) and Report No. MSEC1348 for LW S7A by Mine Subsidence Engineering Consultants (MSEC, 2024). Predictions are based on the planned configuration of LW S1A-S7A at Tahmoor South (as shown in Drawing No. MSEC1193-04-01), along with available geological information and data from numerous subsidence studies for longwalls previously mined in the area.

Infrastructure considered in this Plan has been identified from site visits and aerial photographs and from discussions between Tahmoor Coal and Sydney Water representatives.

The impacts of mining on surface and sub-surface features have been assessed in detail. However, it is recognised that the prediction and assessment of subsidence can be relied upon only to a certain extent. The limitations of the prediction and assessment of mine subsidence are discussed in report MSEC1192 by Mine Subsidence Engineering Consultants.

As discussed in the report, there is a low probability that ground movements and their impacts could exceed the predictions and assessments. However, if these potentially higher impacts are considered prior to mining, they can be managed. This Management Plan will not necessarily prevent impacts from longwall mining, but will limit the impacts by establishing appropriate procedures that can be followed should evidence of increased impacts emerge.

## 1.5. Objectives

The objectives of this Management Plan are to establish procedures to measure, control, mitigate and repair potential impacts that might occur to potable water pipelines.

The objectives of the Management Plan have been developed to:

- Ensure the safe and serviceable operation of all surface infrastructure. Public and workplace safety is paramount. Ensure that the health and safety of people who may be present on public property are not put at risk due to mine subsidence;
- Avoid disruption and inconvenience, or, if unavoidable, keep to minimal levels;
- Monitor ground movements and the condition of infrastructure during mining;
- Initiate action to mitigate or remedy potential significant impacts that are expected to occur on the surface;
- Provide a plan of action in the event that the impacts of mine subsidence are greater than those that are predicted;
- Establish a clearly defined decision-making process to ensure timely implementation of risk control measures for high consequence but low likelihood mine subsidence induced hazards that involve potential serious injury or illness to a person or persons that may require emergency evacuation, entry or access restriction or suspension of work activities;
- Provide a forum to report, discuss and record impacts to the surface. This will involve Tahmoor Coal, Sydney Water, relevant government agencies as required, and consultants as required; and
- Establish lines of communication and emergency contacts.

## 1.6. Scope

The Management Plan is to be used to protect and monitor the condition of the Sydney Water infrastructure identified to be at risk due to mine subsidence and to ensure that the health and safety of people who may be present on public property or Sydney Water property are not put at risk due to mine subsidence.

The major items at risk are:

- Water pipelines

The pipelines are shown in Drawing No. MSEC1193-04-01.

The Management Plan only covers the potable water infrastructure that is located within the limit of subsidence, which defines the extent of land that may be affected by mine subsidence as a result of mining LW S1A-S7A only. The management plan does not include other potable water infrastructure owned by Sydney Water which lies outside the extent of this area.

Tahmoor Coal is also managing potential impacts on features that may be sensitive to mining-induced differential far field movements, such as the Main Southern Railway Viaduct over the Bargo River and the Bargo River Road Bridge over a tributary to the Bargo River. Sydney Water potable water pipelines are buried in the creek bed near these bridges and this Management Plan includes measures to manage the pipeline crossings that are located near these bridges.

This Management Plan does not include Sydney Water sewer infrastructure, which is included in a separate management plan.

## 1.7. Proposed mining schedule

It is planned that LW S1A-S7A will extract coal working north from the southern end. This Management Plan covers longwall mining until completion of mining in LW S7A and for sufficient time thereafter to allow for completion of subsidence effects. The current schedule of mining is shown in Table 1.2. LW S1A-S3A have been extracted.

**Table 1.2 Schedule of mining**

| Longwall | Start Date | Completion Date |
|---|---|---|
| LW S1A | October 2022 | July2023 |
| LW S2A | August 2023 | April 2024 |
| LW S3A | May 2024 | December 2024 |
| LW S4A | January 2026 | August 2026 |
| LW S5A | September 2026 | April 2027 |
| LW S6A | May 2027 | December 2027 |
| LW S7A | January 2028 | August 2028 |

Please note the above schedule is subject to change due to unforeseen impacts on mining progress. Tahmoor Coal will keep Sydney Water informed of changes.

## 1.8. Definition of Active Subsidence Zone

As a longwall progresses, subsidence begins to develop at a point in front of the longwall face and continues to develop after the longwall passes. The majority of subsidence movement typically occurs within an area 150 metres in front of the longwall face to an area 450 metres behind the longwall face.

This is termed the "active subsidence zone" for the purposes of this Management Plan, where surface monitoring is generally conducted. The active subsidence zone for each longwall is defined by the area bounded by the predicted 20 mm subsidence contour for the active longwall and a distance of 150 metres in front and 450 metres behind the active longwall face, as shown by Fig. 1.1.

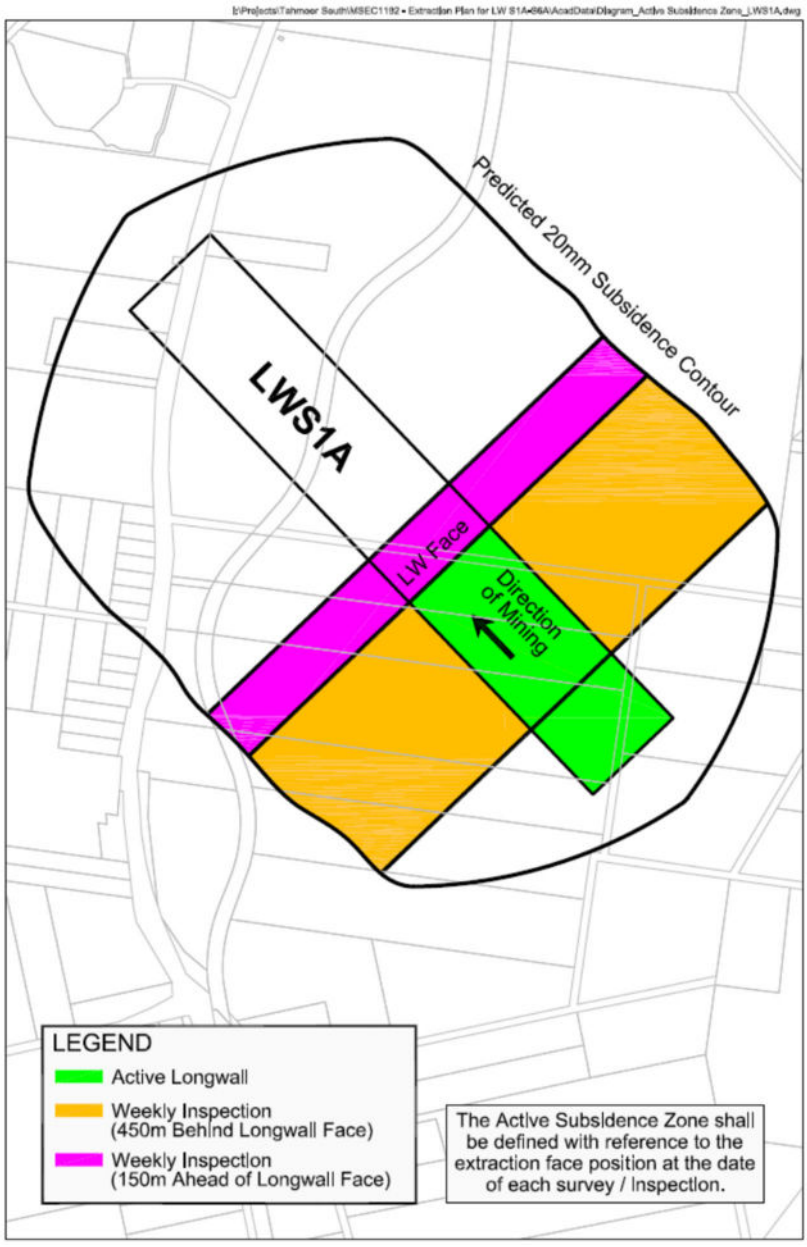



**Fig. 1.1 Diagrammatic Representation of Active Subsidence Zone**

## 1.9. Compensation

The *Coal Mine Subsidence Compensation Act 2017* (MSC Act) is administered by Subsidence Advisory NSW (Mine Subsidence Board).

Currently, under the *Coal Mine Subsidence Compensation Act 2017*, any claim for mine subsidence damage needs to be lodged with Subsidence Advisory NSW. Subsidence Advisory NSW staff will arrange for the damage to be assessed by an independent specialist assessor. If the damage is attributable to mine subsidence, a scope will be prepared and compensation will be determined. For further details please refer to *the Approved Procedure – Claiming in active mining areas at* [www.nsw.gov.au/departments-and-agencies/subsidence-advisory/claiming-for-mine-subsidence-damage/active-mining-claims](www.nsw.gov.au/departments-and-agencies/subsidence-advisory/claiming-for-mine-subsidence-damage/active-mining-claims).

## 2.1. NSW Work Health & Safety Legislation

All persons conducting a business or undertaking (PCBUs), including mine operators and contractors, have a primary duty of care to ensure the health and safety of workers they engage, or whose work activities they influence or direct. The responsibilities are legislated in *Work Health and Safety Act 2011* and the *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and associated Regulations (collectively referred to as the 'WHS laws').

The *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014* commenced on 1 February 2015 and contains specific regulations in relation to mine subsidence.

As outlined in the Guide by the NSW Department of Trade & Investment Mine Safety:

*"a PCBU must manage risks to health and safety associated with mining operations at the mine by:*

- *complying with any specific requirements under the WHS laws*
- *identifying reasonably foreseeable hazards that could give rise to health and safety risks*
- *ensuring that a competent person assesses the risk*
- *eliminating risks to health and safety so far as is reasonably practicable*
- *minimising risks so far as is reasonably practicable by applying the hierarchy of control measures, any risks that it is are not reasonably practical to eliminate*
- *maintaining control measures*
- *reviewing control measures.*

*The mine operator's responsibilities include developing and implementing a safety management system that is used as the primary means of ensuring, so far as is reasonably practicable:*

- *the health and safety of workers at the mine, and*
- *that the health and safety of other people is not put at risk from the mine or work carried out as part of mining operations."*

Detailed guidelines have also been released by the NSW Department of Planning & Environment, Resources Regulator, Mine Safety Operations (MSO, 2017).

The risk management process has been carried out in accordance with guidelines published by the NSW Department of Planning & Environment, Resources Regulator, Mine Safety Operations (MSO, 2017). The following main steps of subsidence risk management have been and will be undertaken, in accordance with the guidelines:

1. identification and understanding of subsidence hazard;
2. assessment of risks of subsidence;
3. development and selection of risk control measures;
4. implementation and maintenance of risk control measures, and
5. continual improvement and change management.

Each of the above steps have been or will be conducted together with the following processes.

1. consultation, co-operation and co-ordination, and
2. monitoring and review.

This Management Plan documents the risk control measures that are planned to manage risks to health and safety associated with the mining of LW S1A-S7A in accordance with the WHS laws.

## 2.2. General

The method of assessing potential mine subsidence impacts in the Management Plan is consistent with the Australian/New Zealand Standard for Risk Management (AS/NZS ISO 31000:2009). The Standard defines the terms used in the risk management process, which includes the identification, analysis, assessment, treatment and monitoring of potential mine subsidence impacts. In this context:-

### 2.2.1. Consequence

'The outcome of an event expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain. There may be a range of possible outcomes associated with an event.' The consequences of a hazard are rated from negligible to catastrophic.

### 2.2.2. Likelihood

'Used as a qualitative description of probability or frequency.' The likelihood can range from rare to almost certain.

### 2.2.3. Hazard

'A source of potential harm or a situation with a potential to cause loss.'

### 2.2.4. Method of assessment of potential mine subsidence impacts

The method of assessing potential mine subsidence impacts combines the likelihood of an impact occurring with the consequence of the impact occurring. In this Management Plan, the likelihood and consequence are combined via the SIMEC Risk Matrix to determine an estimated level of risk for particular events or situations (Tahmoor Coal, 2021 for LWs S1A to S6A and Tahmoor Coal, 2025 for LW S7A). A copy of the Risk Matrix is included in the Appendix of this Management Plan.

Tahmoor Coal and Sydney Water also conducted a detailed risk assessment for creek crossings on 11 June 2024. The risk assessment was facilitated by Axys Consulting (2024) and was attended by representatives from Tahmoor Coal, Sydney Water, Sydney Water's appointed civil engineer Burnett Engineering and Tahmoor Coal's appointed geotechnical engineer Newcastle Geotech, mine subsidence engineer MSEC and monitoring engineer Sweeting Consulting.

On 6 December 2024, Tahmoor Coal and Sydney Water met via teleconference to review Revision A of this Amendment No. 2 (dated 28 November 2024). While the Amendment No. 2 was agreed in principle, it was agreed to formally reassess the risk assessment that was conducted in June 2024.

The risk assessment was revised on 13 December 2024 following the adoption of Option 2 for the Creek 3 and Main Southern Railway crossing (Axys, 2024).

As there is no material difference between the risks to Sydney Water potable infrastructure associated with the extraction of LW S7A compared to the risks associated with the extraction of LWs S1A to S6A, the same risk ratings have been adopted in the risk assessment for LW S7A (Tahmoor Coal, 2025).

## 3.1. Maximum predicted conventional subsidence parameters

Predicted mining-induced conventional subsidence movements were provided in Report No. MSEC1192, which was prepared in support of Tahmoor Coal's Extraction Plan for LW S1A-S6A. Tahmoor Coal has revised its forecast extraction heights since the previous predictions were provided in Report No. MSEC1192. The changes are generally minor, in the range of 50 to 100 mm greater subsidence than previously forecast.

Revised predicted mining-induced conventional subsidence movements were provided in Report No. MSEC1348, which was prepared in support of Tahmoor Coal's application to extract LW S7A. The predictions do not materially change the assessment of potential impacts on Sydney Water potable water infrastructure (MSEC1348). This Management Plan provides subsidence predictions based on the revised predictions that were provided in Report No. MSEC1348.

A summary of the maximum predicted values of incremental conventional subsidence, tilt and curvature, due to the extraction of LW S1A-S7A, is provided in Table 3.1. The predicted ground strains are discussed in Section 3.3. The predicted tilts provided in this table are the maxima after the completion of each of the proposed longwalls. The predicted curvatures are the maxima at any time during or after the extraction of each of the proposed longwalls.

**Table 3.1 Maximum predicted incremental conventional subsidence, tilt and curvature resulting from the extraction of each of the proposed longwalls**

| Longwall | Maximum predicted incremental conventional subsidence (mm) | Maximum predicted incremental conventional tilt (mm/m) | Maximum predicted incremental conventional hogging curvature ($km^{-1}$) | Maximum predicted incremental conventional sagging curvature ($km^{-1}$) |
|---|---|---|---|---|
| LW S1A | 825 | 7.0 | 0.08 | 0.23 |
| LW S2A | 950 | 8.0 | 0.09 | 0.22 |
| LW S3A | 950 | 8.0 | 0.09 | 0.22 |
| LW S4A | 975 | 8.0 | 0.09 | 0.22 |
| LW S5A | 975 | 8.0 | 0.10 | 0.22 |
| LW S6A | 975 | 8.3 | 0.09 | 0.23 |
| LW S7A | 1,050 | 8.9 | 0.10 | 0.24 |

A summary of the maximum predicted values of total conventional subsidence, tilt and curvature, after the extraction of LW S1A-S7A, is provided in Table 3.2.

**Table 3.2 Maximum predicted total conventional subsidence, tilt and curvature resulting from the extraction of each of the proposed longwalls**

| Longwalls | Maximum predicted total conventional subsidence (mm) | Maximum predicted total conventional tilt (mm/m) | Maximum predicted total conventional hogging curvature ($km^{-1}$) | Maximum predicted total conventional sagging curvature ($km^{-1}$) |
|---|---|---|---|---|
| LW S1A | 825 | 7.0 | 0.08 | 0.23 |
| LW S2A | 1,050 | 8.1 | 0.10 | 0.23 |
| LW S3A | 1,250 | 8.3 | 0.11 | 0.23 |
| LW S4A | 1,300 | 8.7 | 0.13 | 0.22 |
| LW S5A | 1,350 | 9.2 | 0.14 | 0.23 |
| LW S6A | 1,400 | 9.7 | 0.14 | 0.23 |
| LW S7A | 1,400 | 10.0 | 0.14 | 0.25 |

The maximum predicted total subsidence, after the completion of LW S7A, is1,400 mm. The maximum predicted total conventional tilt is10 mm/m (i.e.1.0 %), which represents a change in grade of 1 in100. The maximum predicted total conventional curvatures are 0.14 $km^{-1}$ hogging and0.25 $km^{-1}$ sagging, which represent minimum radii of curvature of 7 kilometres and 4 kilometres, respectively.

The values provided in the above table are the maximum predicted conventional subsidence parameters which occur above LW S1A to S7A. The locations of the maximum predicted conventional subsidence parameters do not necessarily coincide with potable water infrastructure. Specific predictions along potable water infrastructure are provided later in this Management Plan.

## 3.2. Comparison between Observed and Predicted Subsidence during the mining of Longwalls S1A to S3A

Extensive monitoring has been undertaken by Tahmoor Coal during the mining of LW S1A to S3A. Observed incremental subsidence due to the extraction of LW S1A has correlated reasonably well with predictions, as shown in Fig. 3.1 to Fig. 3.6.

Subsidence was observed to vary in magnitude along the centreline of LW S1A. Maximum subsidence was measured at Peg V51 on the V-Line, which is located between Teatree Hollow and the Tributary to Teatree Hollow. Observed subsidence was reduced in magnitude over the northern half of the longwall panel at the Main Southern Railway and Tahmoor Mine Site (Pier 2).

As shown in Fig. 3.1, observed subsidence at Peg V51 was slightly greater than predicted but within the accuracy of the prediction model of ± 15% (Reports Nos. MSEC1123 and MSEC1192). Observed total subsidence at Peg V51 after the mining of LW S3A is less than predicted, as shown in Fig. 3.4. Observed subsidence values at other locations above LW S1A were less than predicted.

Monitoring during the mining of LW S2A measured subsidence movements within predictions, as shown in Fig. 3.2. Whilst observed subsidence along Remembrance Drive has been less than predicted, increased compressive strains have been observed at two locations, as shown in Fig. 3.6. Sydney Water and Tahmoor Coal have managed potential impacts at these two locations in accordance with this Management Plan, and the previously agreed Revision B a of this Management Plan.

Monitoring during the mining of LW S3A measured subsidence movements within predictions, as shown in Fig. 3.3. Maximum subsidence was measured at Peg MS99500 which is located along the Main Southern Railway and above the centreline of LW S3A. Whilst observed subsidence along the Main Southern Railway has been less than predicted, a bump was observed in the subsidence profile along with a corresponding increased compressive strain at one location, as shown in Fig. 3.5.

As recommended in Report Nos. MSEC1192 and MSEC1348, Tahmoor Coal is monitoring during mining to compare observations with predictions. Tahmoor Coal has extensive experience in successfully managing potential subsidence impacts on surface features, even when actual subsidence is substantially greater than the magnitudes that have been predicted above LW S1A-S7A. Subsidence management plans have been developed to manage potential impacts that could occur if greater than predicted subsidence occurs.

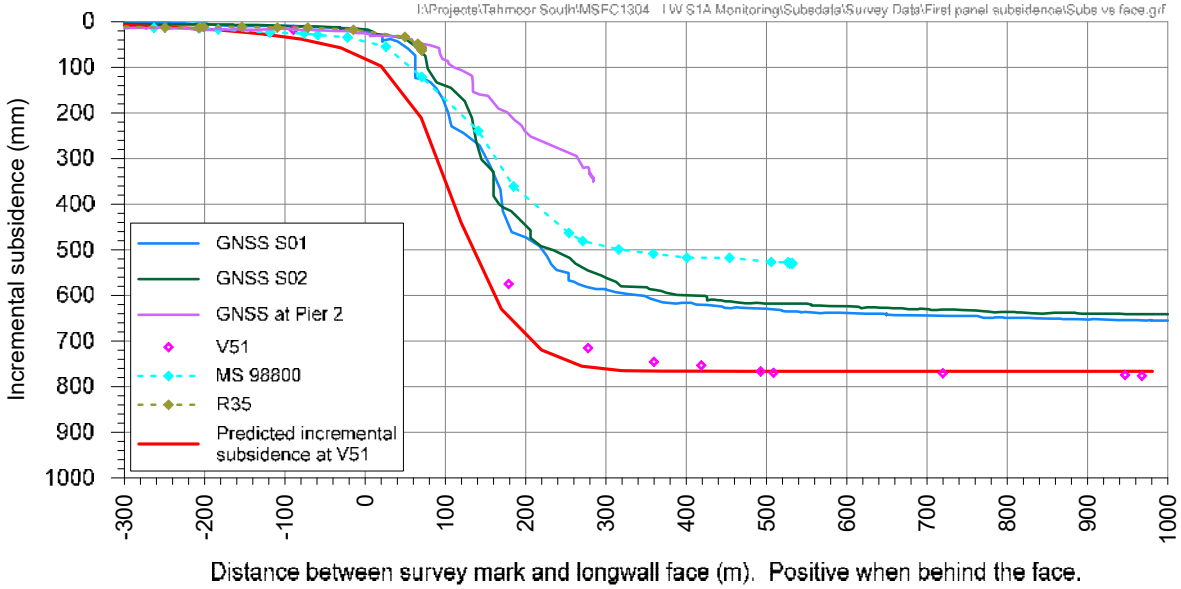



**Fig. 3.1 Comparison between predicted and observed subsidence above centreline of LW S1A**

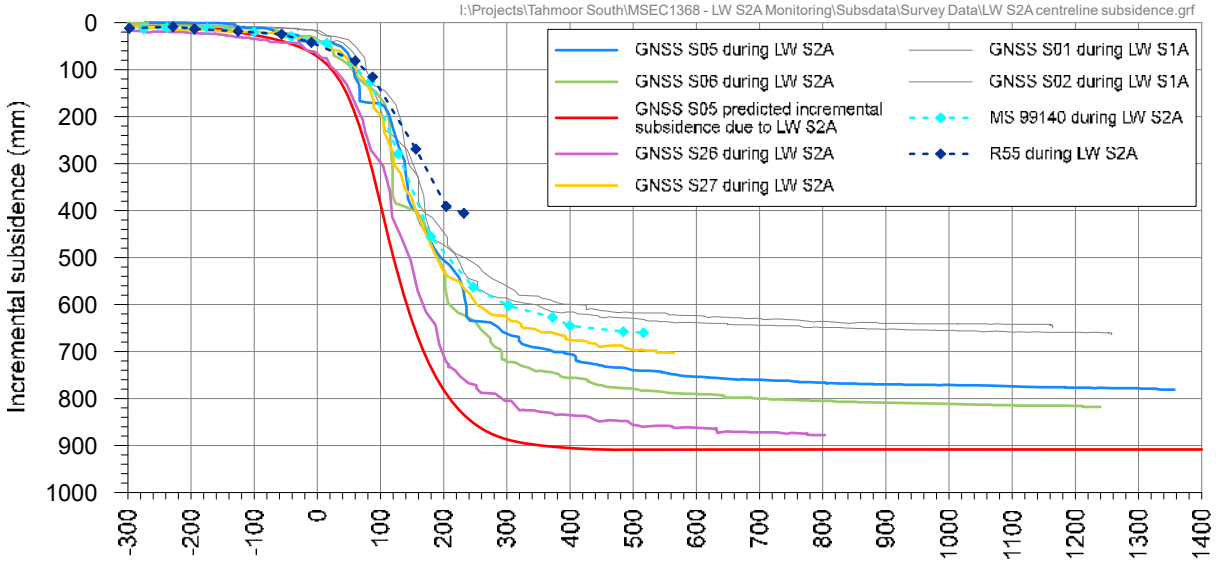



**Fig. 3.2 Comparison between predicted and observed subsidence above centreline of LW S2A**

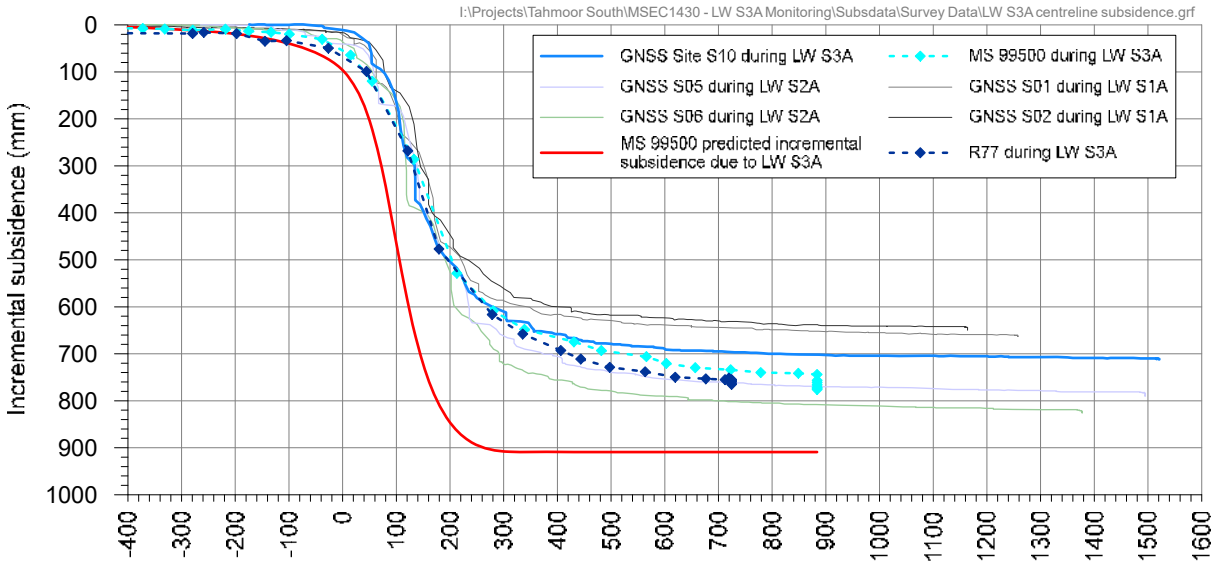



**Fig. 3.3 Comparison between predicted and observed subsidence above centreline of LW S3A**

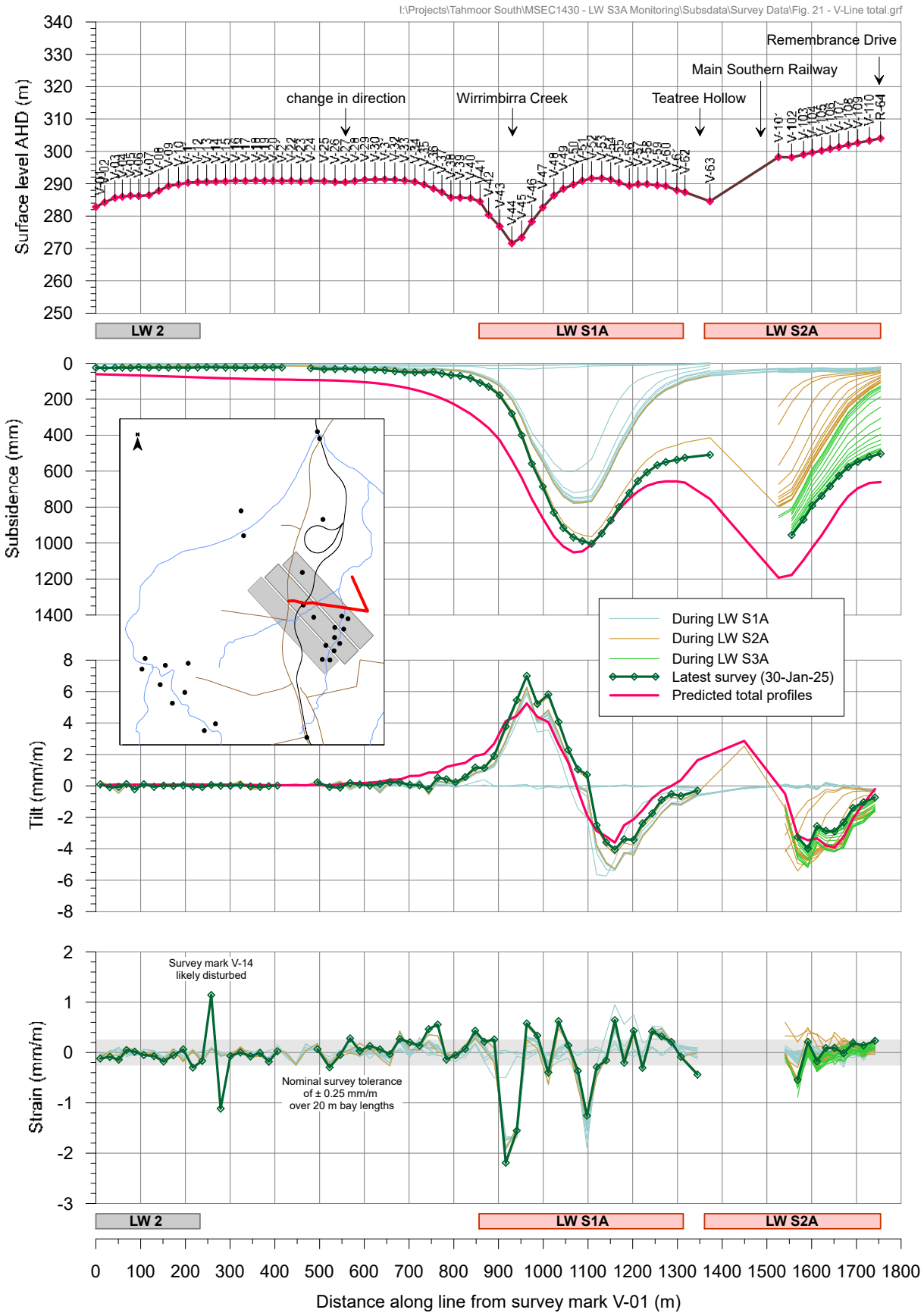



**Fig. 3.4 Observed subsidence along V Line during the mining of LW S1A-S3A**

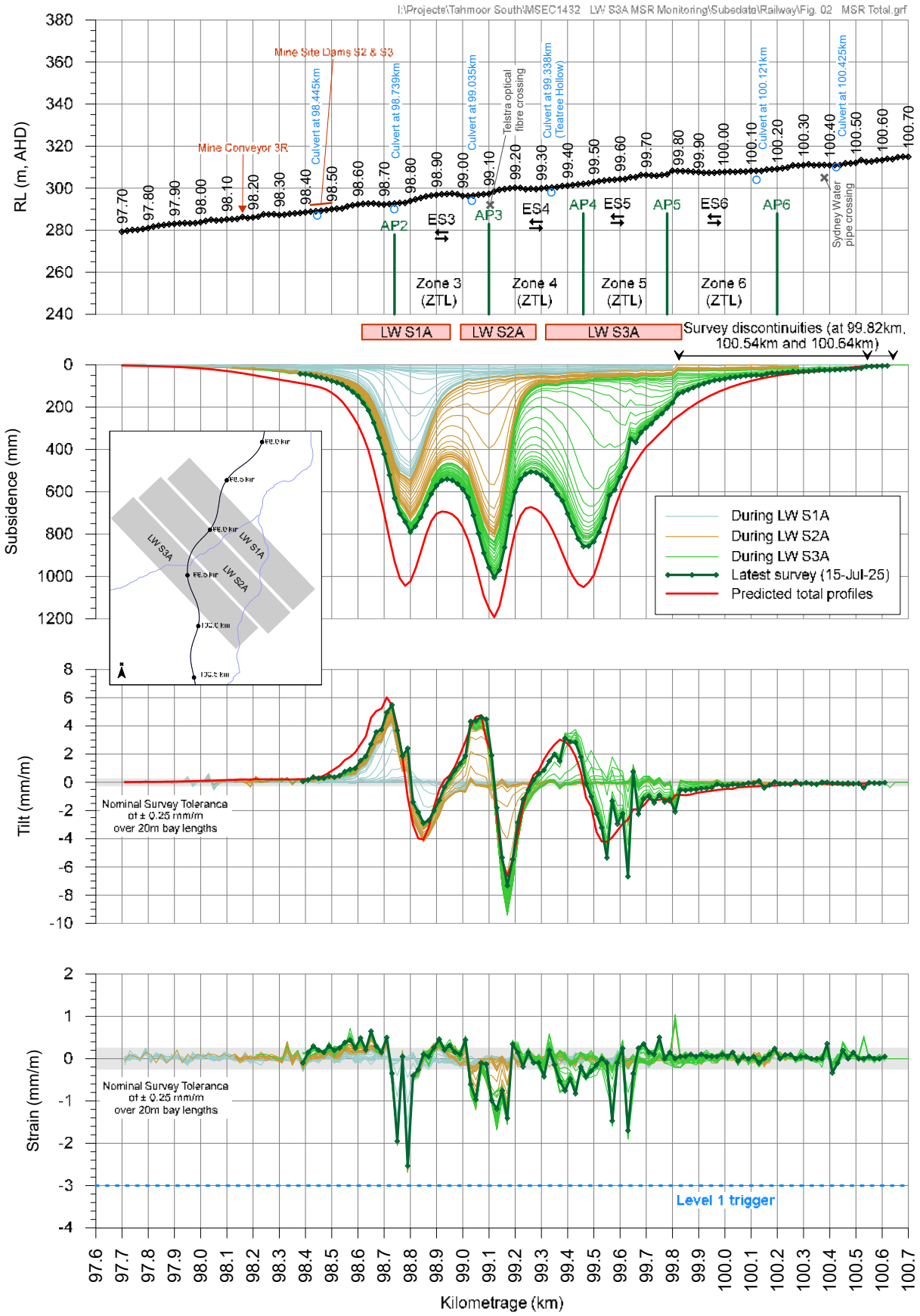



**Fig. 3.5 Observed subsidence along Main Southern Railway during the mining of LW S1A-S3A**

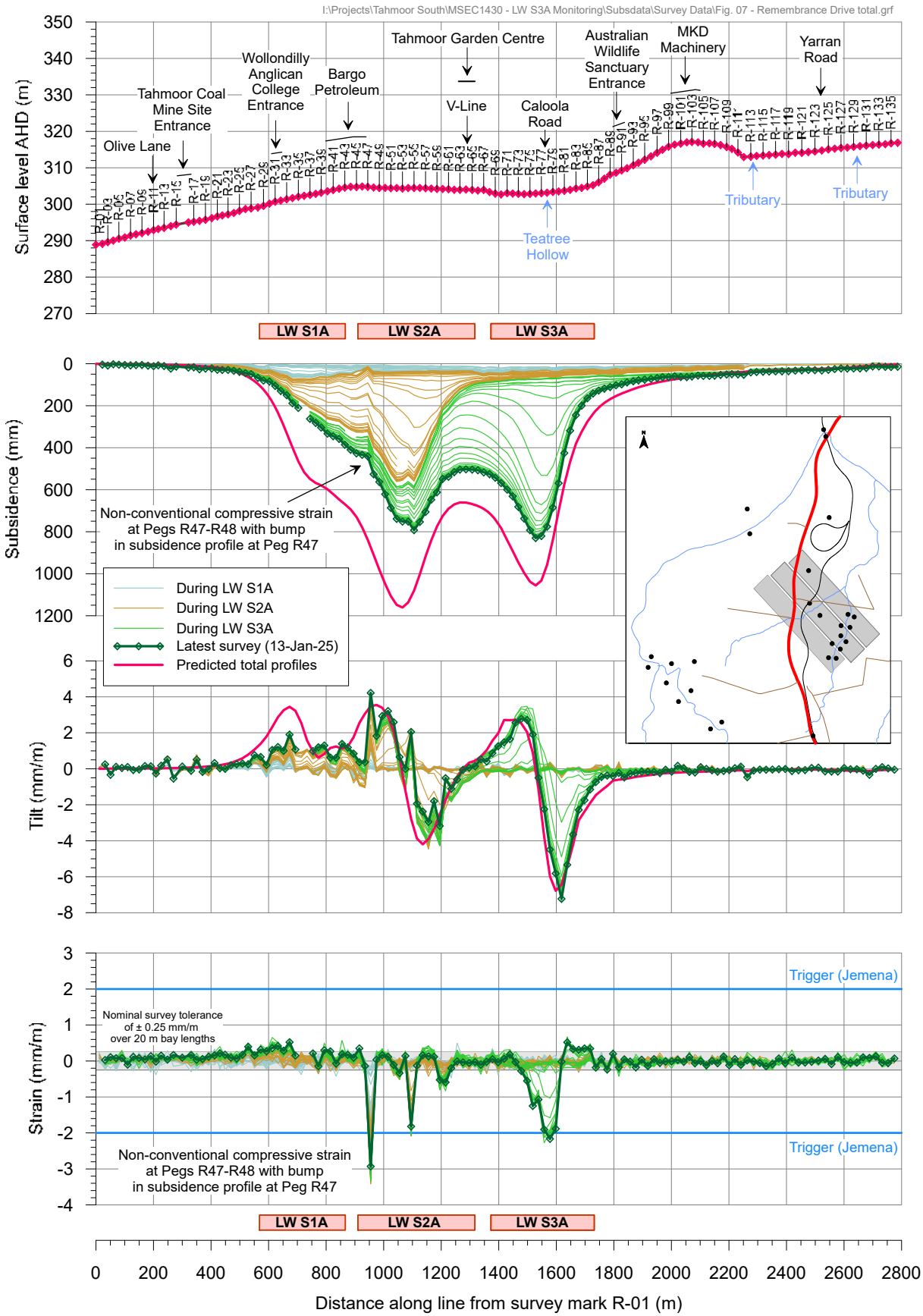



**Fig. 3.6 Observed subsidence along Remembrance Drive during the mining of LW S1A-S3A**

## 3.3. Predicted strain

The prediction of strain is more difficult than the predictions of subsidence, tilt and curvature. The reason for this is that strain is affected by many factors, including ground curvature and horizontal movement, as well as local variations in the near surface geology, the locations of pre-existing natural joints at bedrock, and the depth of bedrock. Survey tolerance can also represent a substantial portion of the measured strain, in cases where the strains are of a low order of magnitude. The profiles of observed strain, therefore, can be irregular even when the profiles of observed subsidence, tilt and curvature are relatively smooth.

In previous MSEC subsidence reports, predictions of conventional strain were provided based on the best estimate of the average relationship between curvature and strain. Similar relationships have been proposed by other authors. The reliability of the strain predictions was highlighted in these reports, where it was stated that measured strains can vary considerably from the predicted conventional values.

Adopting a linear relationship between curvature and strain provides a reasonable prediction for the conventional tensile and compressive strains. The locations that are predicted to experience hogging or convex curvature are expected to be net tensile strain zones and locations that are predicted to experience sagging or concave curvature are expected to be net compressive strain zones. In the Southern Coalfield, it has been found that a factor of 15 provides a reasonable relationship between the predicted maximum curvatures and the predicted maximum conventional strains.

At a point, however, there can be considerable variation from the linear relationship, resulting from non-conventional movements or from the normal scatters which are observed in strain profiles. When expressed as a percentage, observed strains can be many times greater than the predicted conventional strain for low magnitudes of curvature. In this report, therefore, we have provided a statistical approach to account for the variability, rather than providing a single predicted conventional strain.

The data used in the analysis of observed strains included those resulting from both conventional and non-conventional anomalous movements, but did not include those resulting from valley-related effects. The strains resulting from damaged or disturbed survey marks have also been excluded.

### 3.3.1. Analysis of strains measured in survey bays

For features that are in discrete locations, such as building structures, farm dams and archaeological sites, it is appropriate to assess the frequency of the observed maximum strains for individual survey bays.

*Predictions of strain above goaf*

A database of survey data has been analysed to extract the maximum tensile and compressive strains that have been measured at any time during the extraction of the previous longwalls at Tahmoor, Appin and West Cliff Collieries, for survey bays that were located directly above goaf or the chain pillars that are located between the extracted longwalls, which has been referred to as "*above goaf*".

A histogram of the maximum observed total tensile and compressive strains measured in survey bays above goaf, for monitoring lines at Tahmoor, Appin and West Cliff Collieries is provided in Fig. 3.7. Probability distribution functions, based on fitted *Generalised Pareto Distributions (*GPDs), have also been shown in this figure.

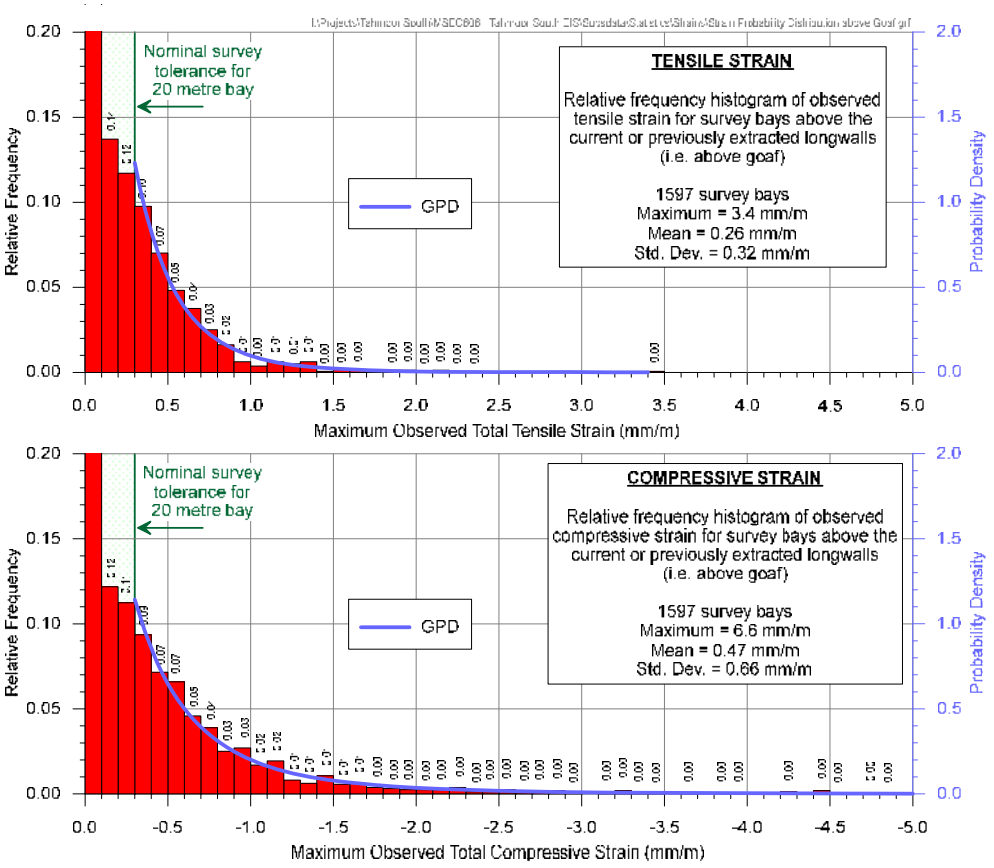



**Fig. 3.7 Distributions of the maximum measured tensile and compressive strains for survey bays located above goaf at Tahmoor, Appin and West Cliff Collieries**

The 95 % confidence levels for the maximum total strains that the individual survey bays *above goaf* experienced at any time during mining at Tahmoor, Appin and West Cliff Collieries were 0.9 mm/m tensile and 1.6 mm/m compressive. The strains for the proposed longwalls are predicted to be 20 % to 40 % greater than those previously observed at these collieries and, therefore, it is expected that 95 % of the strains measured *above goaf* would be less than 1.3 mm/m tensile and 2.2 mm/m compressive.

The 99 % confidence levels for the maximum total strains that the individual survey bays *above goaf* experienced at any time during mining at Tahmoor, Appin and West Cliff Collieries were 1.4 mm/m tensile and 3.1 mm/m compressive. Similarly, it is expected that 99 % of the strains measured *above goaf* for the proposed longwalls would be less than 2.0 mm/m tensile and 4.3 mm/m compressive.

*Predictions of strain above solid coal*

The survey database has also been analysed to extract the maximum tensile and compressive strains that have been measured at any time during the extraction of the previous longwalls at Tahmoor, Appin and West Cliff Collieries, for survey bays that were located beyond the goaf edges of the mined panels and positioned on unmined areas of coal, i.e. outside panels but within 200 metres of the nearest longwall goaf edge, which has been referred to as "*above solid coal*".

A histogram of the maximum observed tensile and compressive strains measured in survey bays above solid coal, for monitoring lines at Tahmoor, Appin and West Cliff Collieries is provided in Fig. 3.8. The probability distribution functions, based on the fitted GPDs, have also been shown in this figure.

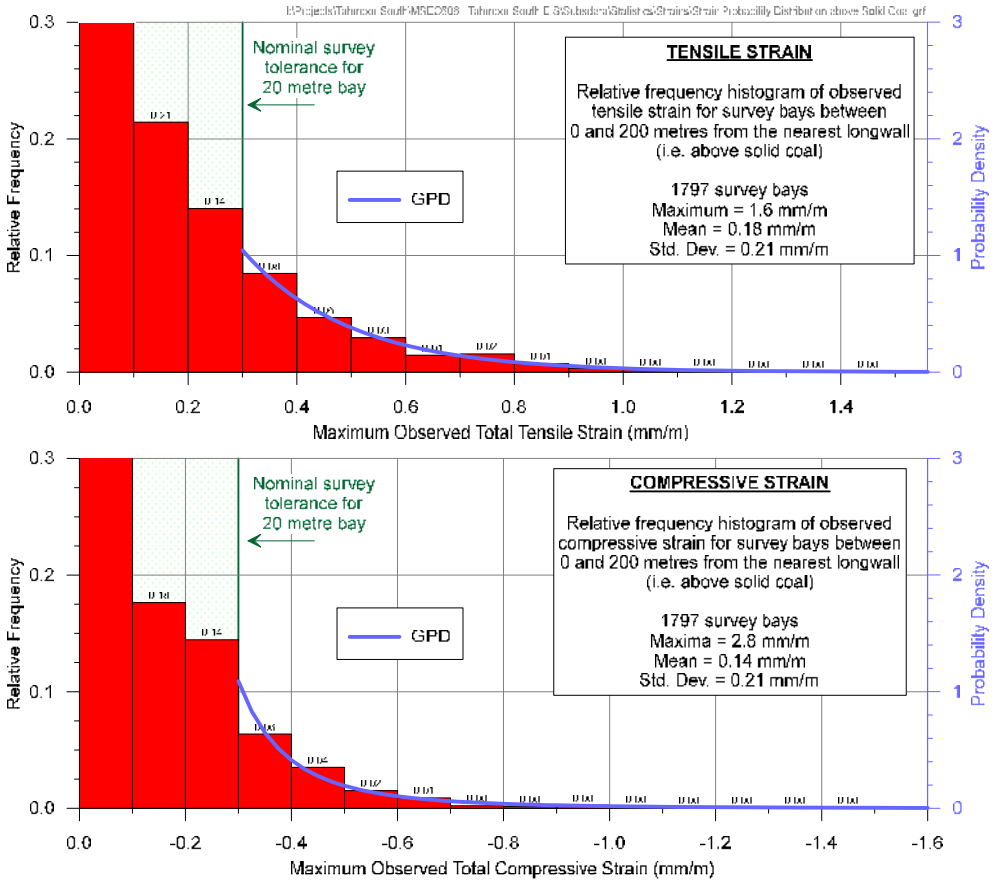



**Fig. 3.8 Distributions of the maximum measured tensile and compressive strains for survey bays located above solid coal at Tahmoor, Appin and West Cliff Collieries**

The 95 % confidence levels for the maximum total strains that the individual survey bays *above solid coal* experienced at any time during mining at Tahmoor, Appin and West Cliff Collieries were 0.6 mm/m tensile and 0.5 mm/m compressive. The strains for the proposed longwalls are predicted to be 20 % to 40 % greater than those previously observed at these collieries and, therefore, it is expected that 95 % of the strains measured *above solid coal* would be less than 1.0 mm/m tensile and compressive.

The 99 % confidence levels for the maximum total strains that the individual survey bays *above solid coal* experienced at any time during mining at Tahmoor, Appin and West Cliff Collieries were 0.9 mm/m tensile and compressive. Similarly, it is expected that 99 % of the strains measured *above solid coal* adjacent to the proposed longwalls would be less than 1.5 mm/m tensile and compressive.

### 3.3.2. Analysis of strains measured along whole monitoring lines

For linear features such as roads, cables and pipelines, it is more appropriate to assess the frequency of the maximum strains measured along whole monitoring lines, rather than for individual survey bays. That is, an analysis of the maximum strains measured anywhere along the monitoring lines, regardless of where the strain occurs.

A histogram of maximum observed total tensile and compressive strains measured anywhere along the monitoring lines, at any time during or after the extraction of the previous longwalls Tahmoor, Appin and West Cliff Collieries, is provided in Fig. 3.9.

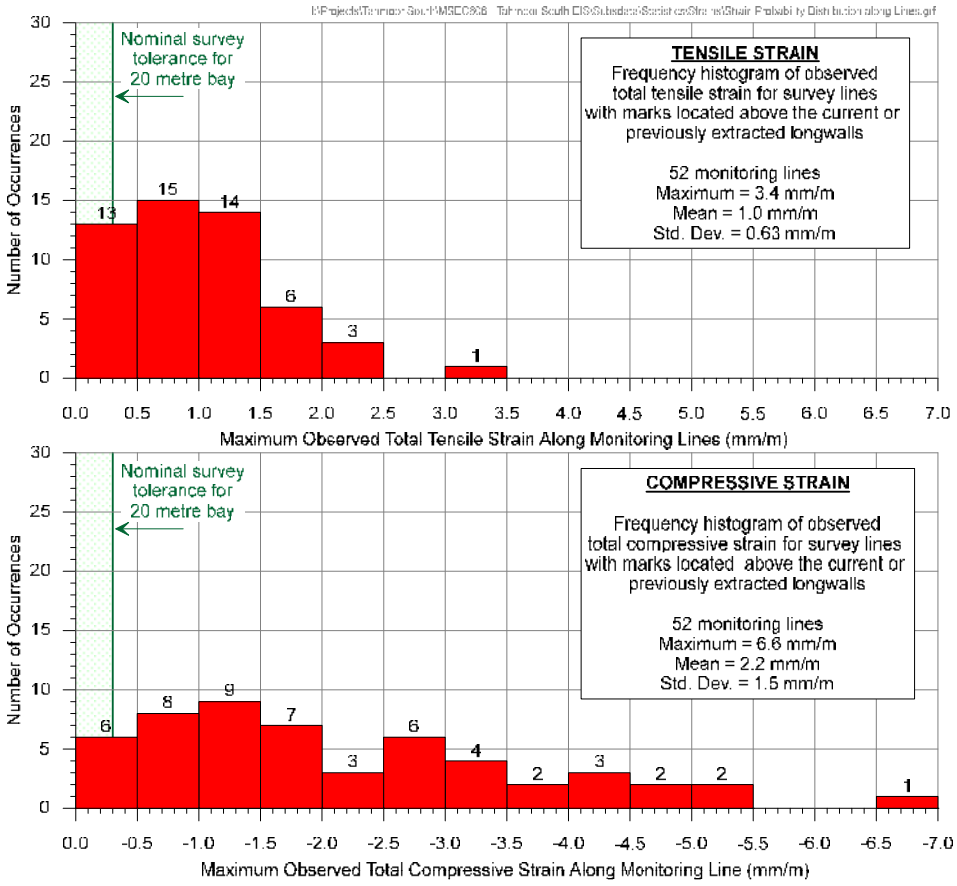



**Fig. 3.9 Distributions of maximum measured tensile and compressive strains anywhere along monitoring lines at Tahmoor, Appin and West Cliff Collieries**

It can be seen from the above figure, that 42 of the 52 monitoring lines (i.e. 92 % of the total) at Tahmoor, Appin and West Cliff Collieries had recorded maximum total tensile strains of 2.0 mm/m, or less. The strains for the proposed longwalls are predicted to be 20 % to 40 % greater than those previously observed at these collieries and, therefore, it is expected that 92 % of the monitoring lines above the proposed longwalls would experience maximum tensile strains of 3.0 mm/m, or less.

It can also be seen, that 45 of the 52 monitoring lines (i.e. 87 % of the total) at Tahmoor, Appin and West Cliff Collieries had recorded maximum total compressive strains of 4.0 mm/m, or less. The strains for the proposed longwalls are predicted to be 20 % to 40 % greater than those previously observed at these collieries and, therefore, it is expected that 87 % of the monitoring lines above the proposed longwalls would experience maximum compressive strains of 5.5 mm/m, or less.

## 3.4. Managing public safety

The primary risk associated with mining beneath potable water infrastructure is public safety. Tahmoor Coal has previously directly mined beneath or adjacent to more than 2000 houses and civil structures, commercial and retail properties, the Main Southern Railway and local roads and bridges. It has implemented extensive measures prior to, during and after mining to ensure that the health and safety of people have not been put at risk due to mine subsidence. People have not been exposed to immediate and sudden safety hazards as a result of impacts that have occurred due to mine subsidence movements.

Emphasis is placed on the words “immediate and sudden” as in rare cases, some structures have experienced severe impacts, but the impacts did not present an immediate risk to public safety as they developed gradually with ample time to repair the structure.

In the case of this Subsidence Management Plan, the potential for impacts on public safety has been assessed on a case by case basis.

### 3.4.1. Subsidence Impact Management Process for Infrastructure

Tahmoor Coal has developed and acted in accordance with agreed subsidence management plans to manage potential impacts during the mining of LWs 22 to 32 and LW W1-W4 at Tahmoor North and LWs S1A to S3A. The management strategy has been reviewed and updated based on experiences gained during the mining of these longwalls, and the strategy for LW S1A-S7A at Tahmoor South includes the following process:

1. Regular consultation with Sydney Water before, during and after mining;
2. Site-specific investigations; and
3. Surveys and inspections during mining within the active subsidence area:
   - Detailed visual inspections and vehicle-based inspections along the streets;
   - Ground surveys along streets; and
   - Specific ground surveys and visual inspections, where recommended by an engineer based on the inspections and assessments.

A flowchart illustrating the subsidence impact management process prior to, during and after Sydney Water infrastructure experiences mine subsidence movements is shown in Fig. 3.10.

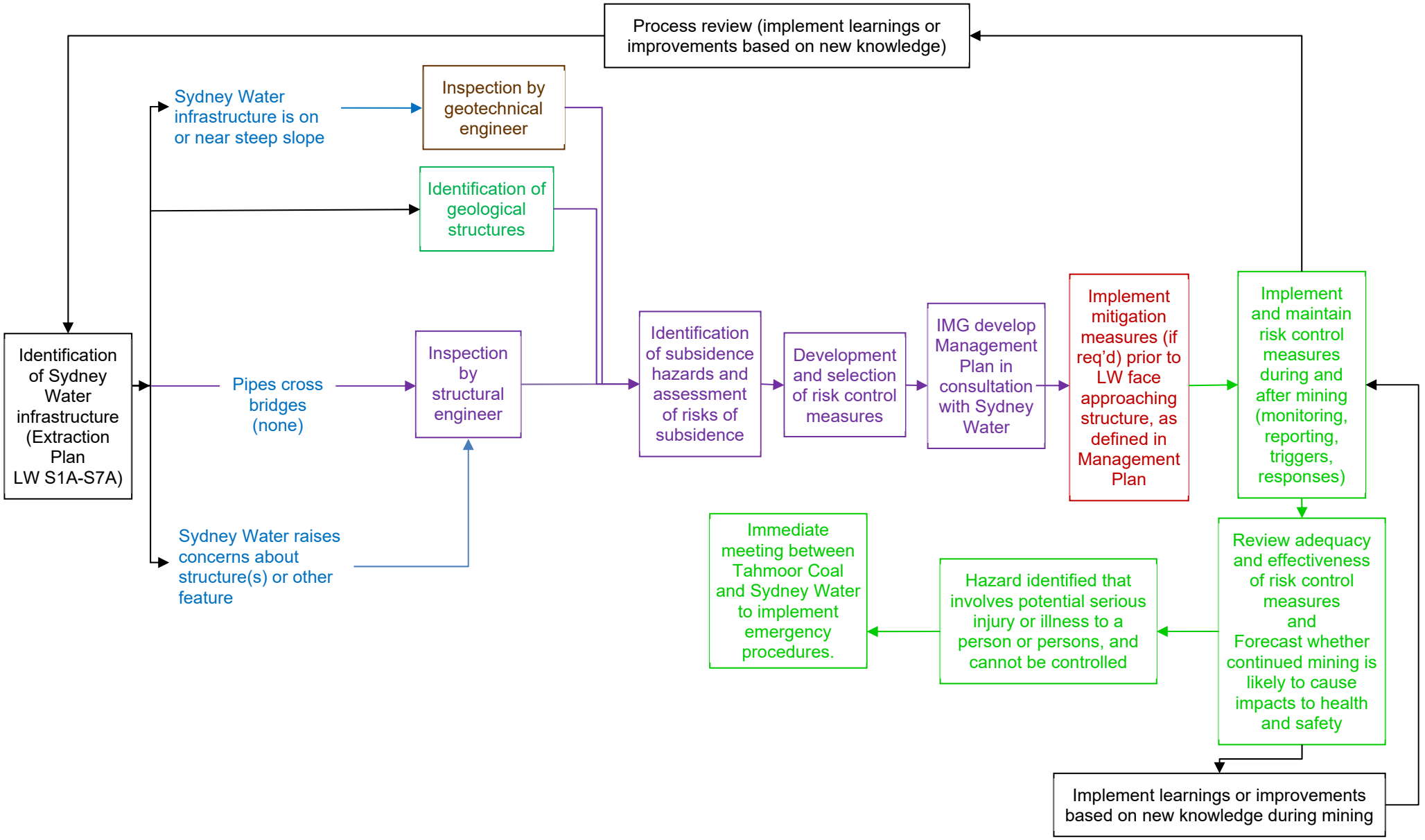



**Fig. 3.10 Flowchart for Subsidence Impact Management Process**

## 3.5. Summary of potential impacts

A summary of potential impacts on Sydney Water's Potable Water infrastructure for LW S1A-S7A is provided in Table 3.3. The summary is consistent with the risk assessment undertaken by Sydney Water and Tahmoor Coal (2022). The results of the risk assessment are included in the Appendix.

**Table 3.3 Summary of Potential Mine Subsidence Impacts in 2022**

| Risk | Likelihood | Consequence | Level of Potential Impact |
|---|---|---|---|
| Leakage of local services within Study Area such as along Caloola Road and Yarran Road (i.e. not the 450mm dia water main) | UNLIKELY | MINOR | LOW |
| Leakage of 450 mm dia CICL water main within Study Area (in general) | UNLIKELY | MODERATE | MEDIUM |
| Leakage of 450 mm dia CICL water main at creek crossings within Study Area | LIKELY | MODERATE | HIGH* |
| Leakage of 450 mm dia CICL water main at crossings under Remembrance Drive and Main Southern Railway within Study Area | UNLIKELY | SEVERE | MEDIUM* |
| Leakage of buried 450 mm dia CICL water main beneath Bargo River bed near Railway Viaduct and buried water mains beneath tributary to Bargo River | RARE | SEVERE | MEDIUM |

In the case of the two risks marked with an asterisk (*), it was agreed in 2022 that the controls can be managed effectively within the implementation of additional, feasible measures. It was also agreed that additional investigations would be required before the appropriate controls are assessed and selected.

In the case of the buried 450 mm water main beneath the Bargo River near the Railway Viaduct, the level of potential impact was assessed as Medium due to the length of time required to repair the leakage. It was agreed that the planned controls to manage the risk were effective and appropriate.

The additional controls for the creek, Remembrance Drive and Main Southern Railway crossings were developed following a risk assessment that was conducted on 11 June 2024. The risk assessment was facilitated by Axys Consulting (2024) and was attended by representatives from Tahmoor Coal, Sydney Water, Sydney Water's appointed civil engineer Burnett Engineering and Tahmoor Coal's appointed geotechnical engineer Newcastle Geotech, mine subsidence engineer MSEC and monitoring engineer Sweeting Consulting.

On 6 December 2024, Tahmoor Coal and Sydney Water met via teleconference to review Revision A of this Amendment No. 2 (dated 28 November 2024). While the Amendment No. 2 was agreed in principle, it was agreed to formally reassess the risk assessment that was conducted in June 2024.

The risk assessment was revised on 13 December 2024 following the adoption of Option 2 for the Creek 3 and Main Southern Railway crossing (Axys, 2024).

As there is no material difference between the risks to Sydney Water potable infrastructure associated with the extraction of LW S7A compared to the risks associated with the extraction of LWs S1A to S6A, the same risk ratings have been adopted in the risk assessment for LW S7A (Tahmoor Coal, 2025).

A summary of potential impacts on Sydney Water's Potable Water infrastructure for LW S3A-S6A is provided in Table 3.4. The results of the risk assessment are included in the Appendix.

**Table 3.4 Summary of Potential Mine Subsidence Impacts in 2024**

| Risk | Likelihood | Consequence | Level of Potential Impact |
|---|---|---|---|
| Leakage of local services within Study Area such as along Caloola Road and Yarran Road (i.e. not the 450mm dia water main) | UNLIKELY | NEGLIGIBLE | LOW |
| Leakage of 450 mm dia CICL water main within Study Area (in general) | UNLIKELY | MINOR | LOW |
| Leakage of 450 mm dia CICL water main at creek crossing at Caloola Road | UNLIKELY | MINOR | LOW |
| Leakage of 450 mm dia CICL water main at creek crossing (North of Yarran Road) | POSSIBLE | MINOR | MEDIUM |
| Leakage of 450 mm dia CICL water main at creek crossing (South of Yarran Road) | RARE | MAJOR | MEDIUM |
| Leakage of 450 mm dia CICL water main at crossings under Remembrance Drive | RARE | MINOR | LOW |
| Leakage of 450 mm dia CICL water main at crossings under Main Southern Railway | RARE | MAJOR | MEDIUM |
| Leakage of buried 450 mm dia CICL water main beneath Bargo River bed near Railway Viaduct and buried water mains beneath tributary to Bargo River | RARE | MINOR | LOW |

Additional information on each potential impact is provided below.

## 3.6. Identification of subsidence hazards that could give rise to risks to health and safety

Clause 34 of the Work Health and Safety Regulation (2017) requires that the duty holder (in this case Tahmoor Coal), in managing risks to health and safety, must identify reasonably foreseeable hazards that could give rise to risks to health and safety.

This section of the Management Plan summarises hazards that have been identified in Chapter 3, which could give rise to risks to health and safety of people in the vicinity of potable water infrastructure.

Using the processes described in Section 3.4 of this Management Plan, mine subsidence hazards have been identified, investigated and analysed in a systematic manner by examining each aspect of the infrastructure, as described in Section 3.7 of this Management Plan. Each of the aspects below could potentially experience mine subsidence movements that give rise to risks to the health and safety of people:

- Water pipelines at creek crossings; and
- Water pipelines at crossings of Remembrance Drive and the Main Southern Railway.

The following mine subsidence hazards were identified that could give rise to risks to health and safety due to the extraction of LW S1A-S7A:

- Water main break.

The identification and risk assessment process took into account the location of infrastructure relative to LW S1A-S7A and the associated timing and duration of the subsidence event, as described in Section 1.8 of this Management Plan.

Whilst mine subsidence predictions and extensive past experiences from previous mining at Tahmoor were taken into account, the identification and risk assessment process recognised that there are uncertainties in relation to predicting subsidence movements, and uncertainties in how mine subsidence movements may adversely impact Sydney Water infrastructure, as discussed in Section 1.4 and Chapter 3 of this Management Plan. In this case, hidden creeks have been mapped that intersect water pipelines.

Tahmoor Coal has considered the outcomes of the hazard identification and risk assessment process when developing measures to manage potential impacts on the health and safety of people, and potential impacts on Sydney Water property in general. These are described in Chapter 4 of this Management Plan.

## 3.7. Potable water pipelines

There are a number of potable water pipelines that are located above and adjacent to LW S1A-S7A, as shown in Drawing No. MSEC1193-04-01:

- 450 mm diameter trunk mains

  Sydney Water's supply trunk main runs directly above and adjacent to LW S1A-S5A. The watermain follows the alignment of Remembrance Drive, before crossing beneath the Main Southern Railway and following Great Southern Road. The trunk feeds Sydney Water Reservoirs at Picton, Thirlmere, Buxton and Oakdale, all of which are located outside the Study Area. As shown in Drawing No. MSEC1193-04-01, the trunk main is generally constructed as CICL, with a short section of Steel Cement Lined (SCL) pipe beneath the creek crossing at Teatree Hollow, at the corner of Remembrance Drive and Caloola Road.

- 100 mm diameter CICL water mains

  As shown in Drawing No. MSEC1193-04-01, 100 mm diameter CICL water mains are located directly above and adjacent to LW S3A-S5A. The water mains follow the alignment of Caloola Road and the northern section of Great Southern Road.

- 100 mm diameter DICL water mains

  As shown in Drawing No. MSEC1193-04-01, 100 mm diameter DICL water mains are located directly above and adjacent to LW S5A-S7A. The water mains follow the alignment of Yarran Road and Remembrance Drive, south of the Yarran Road intersection.

- 200 mm diameter CICL water mains

  As shown in Drawing No. MSEC1193-04-01, a 200 mm diameter CICL water main is located directly above LW S7A. The water main follows the alignment of Yarran Road. The water main is old and thought to have been constructed originally with the purpose of connecting to the Bargo Weir. The connection was not completed due to the construction of the Nepean Dam and its associated water supply network.

- 150 mm diameter CICL water mains

  As shown in Drawing No. MSEC1193-04-01, 150 mm diameter CICL water mains are located to the southeast of LW S5A. The water mains connect to a property on Great Southern Road.

- 200 mm diameter DICL water mains

  As shown in Drawing No. MSEC1193-04-01, 200 mm diameter DICL water mains are located to the south of LW S6A-S7A. The water mains follow the alignment of Wellers Road.

A number of valves, hydrants and other fittings are located within the Study Area. The locations of stop valves are shown in Drawing No. MSEC1193-04-01, which can be used by Sydney Water to control water flows in the event that section of pipeline requires repair. Some of the valves have smaller bypass valves to allow the larger valves to be opened and closed more easily. One is located approximately 320 metres south of Olive Lane near the finishing end of LW S1A.

Sydney Water advises that there have been no major watermain breaks along the section of 450 mm CICL above and adjacent to LW S1A-S7A in the last 25 years. There have been a few smaller leaks but these may have been related to service connections.

### 3.7.1. As-built survey of 450 mm diameter CICL water main

Tahmoor Coal has conducted an as-built survey of the 450 mm diameter CICL water main to confirm the actual position of the pipeline. The purpose of the survey was to provide information for contingency plans in the event that non-conventional movement develop within the road corridor.

The surveys were conducted on publicly accessible land and confirmed that Sydney Water's spatial mapping of the water main is reasonably accurate, including where the pipeline crosses under Remembrance Drive and the Main Southern Railway. A summary plan showing the surveyed locations of the watermain relative to Sydney Water's GIS shapefiles is shown in Fig. 3.11.

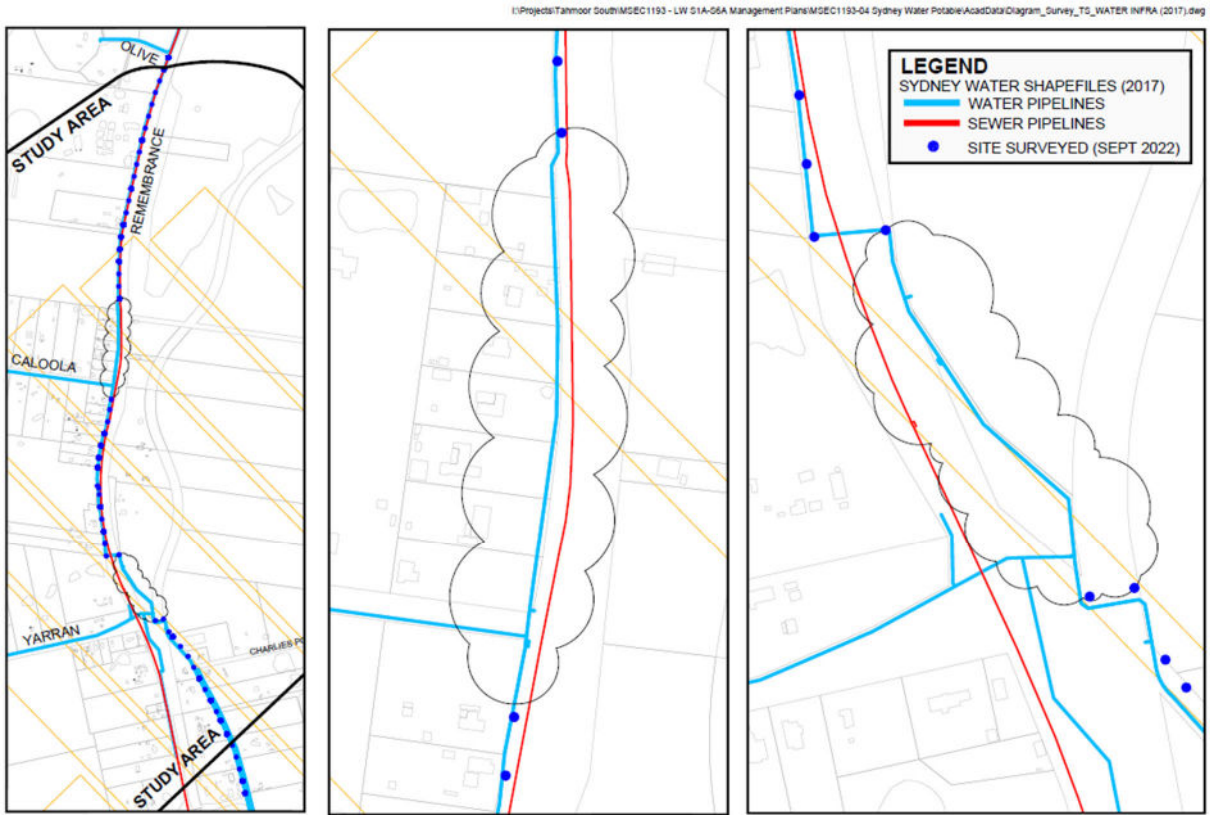



**Fig. 3.11 Surveyed location of 450 mm diameter CICL water main relative to Sydney Water GIS shapefile**

Based on the results of the as-built survey, drawings provided in this Management Plan are based on Sydney Water's GIS shapefiles.

### 3.7.2. Predicted subsidence movements

The potable water infrastructure includes a Cast Iron Cement Lined (CICL) 450 mm diameter watermain which follows the alignment of Remembrance Drive, before crossing beneath the Main Southern Railway and following Great Southern Road. 100 mm, 200 mm and 250 mm diameter CICL and DICL water pipelines are located along Caloola Road, Yarran Road and along a short section Remembrance Drive to the south of Yarran Road.

The predicted profiles of conventional subsidence and tilt for the 450 mm diameter watermain along the alignment of Remembrance Drive, due to the extraction of LW S1A-S7A, are shown in Fig. 3.12.

A summary of the maximum predicted total conventional subsidence parameters for the 450 mm diameter watermain along Remembrance Drive, after the extraction of each of the proposed longwalls, is provided in Table 3.5.

The predicted tilts are the maxima along the alignment of the 450 mm diameter watermain after the completion of each of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

**Table 3.5 Maximum predicted total conventional subsidence parameters for Remembrance Drive due to the extraction of LWs S1A to S7A**

| Longwall | Maximum predicted subsidence (mm) | Maximum predicted tilt along alignment (mm/m) | Maximum predicted tilt across alignment (mm/m) | Maximum predicted hogging curvature in any direction ($km^{-1}$) | Maximum predicted sagging curvature in any direction ($km^{-1}$) |
|---|---|---|---|---|---|
| LW S1A | 325 | 2.5 | 5.0 | 0.06 | 0.06 |
| LW S2A | 1000 | 5.0 | 5.5 | 0.08 | 0.20 |
| LW S3A | 1200 | 6.5 | 5.5 | 0.10 | 0.21 |
| LW S4A | 1300 | 6.0 | 6.0 | 0.12 | 0.21 |
| LW S5A | 1350 | 6.5 | 5.5 | 0.12 | 0.21 |
| LW S6A | 1375 | 7.5 | 5.5 | 0.12 | 0.21 |
| LW S7A | 1400 | 7.5 | 5.0 | 0.12 | 0.21 |

The maximum predicted conventional strains for the watermain after the extraction of LW S7A, based on applying a factor of 15 to the maximum predicted conventional curvatures, are1.9 mm/m tensile and 3.2 mm/m compressive. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The pipeline is a linear feature and, therefore, the most relevant distribution of strain is the maximum strains measured along whole monitoring lines above previous longwall mining. The analysis of strains along whole monitoring lines during the mining of previous longwalls in the Southern Coalfield is discussed in Section 3.3.2 and the results are provided in Fig. 3.9.

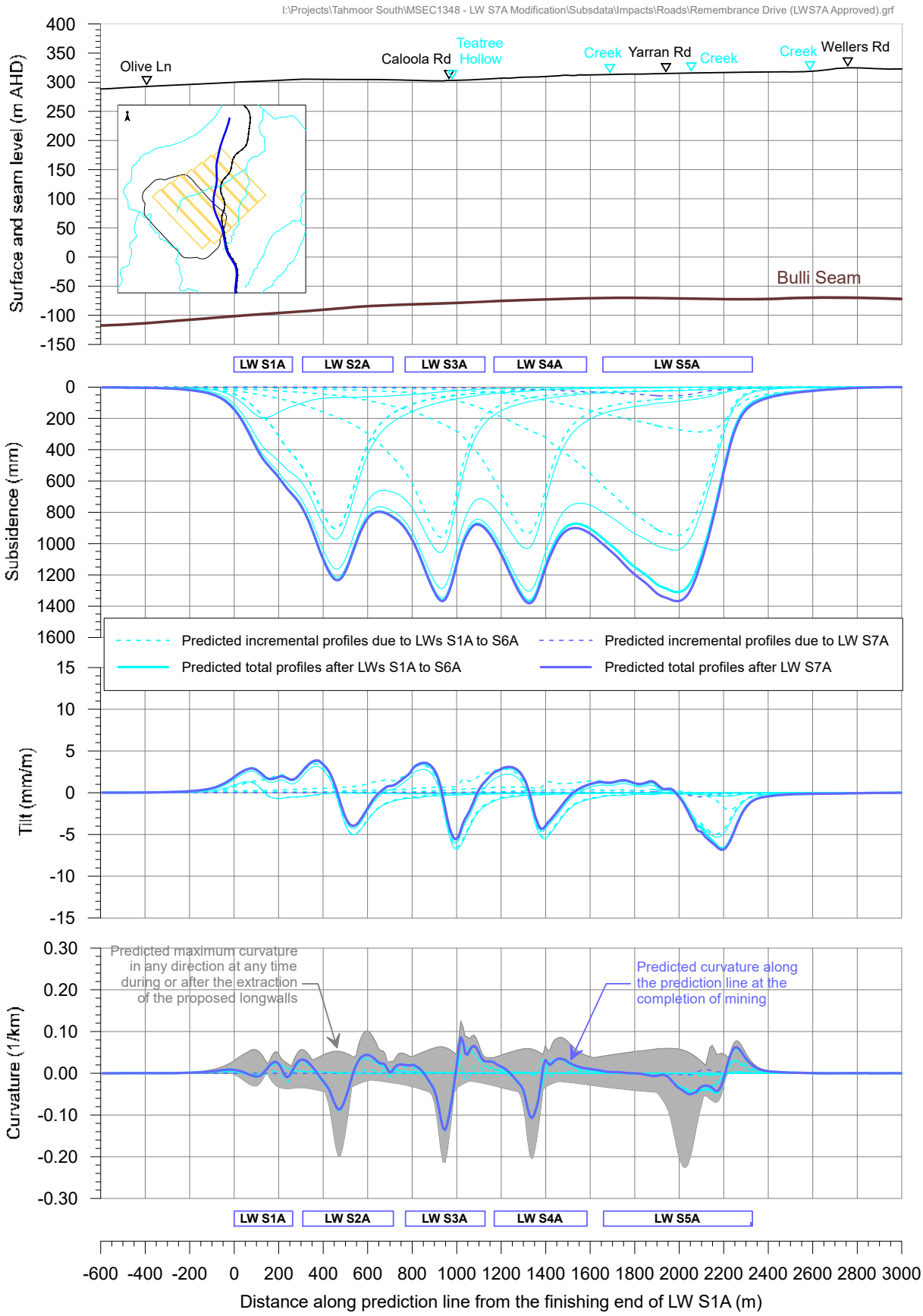



**Fig. 3.12 Predicted profiles of total subsidence, tilt and curvature for the 450 mm dia water main along Remembrance Driveway after the mining of LW S1A-S7A**

Caloola Road is located directly above LW S3A-S5A and, therefore, could experience the full range of predicted subsidence movements. The predicted profiles of conventional subsidence and tilt along the alignment of Caloola Road, resulting from the extraction of the proposed longwalls, is shown in Fig. 3.13.

A summary of the maximum predicted total conventional subsidence parameters for Caloola Road, after the extraction of each of the proposed longwalls, is provided in Table 3.6.

The predicted tilts are the maxima along the alignment of the road after the completion of each of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

**Table 3.6 Maximum predicted total conventional subsidence parameters for Caloola Road due to the extraction of LWs S1A to S7A**

| Longwall | Maximum predicted subsidence (mm) | Maximum predicted tilt along alignment (mm/m) | Maximum predicted tilt across alignment (mm/m) | Maximum predicted hogging curvature in any direction ($km^{-1}$) | Maximum predicted sagging curvature in any direction ($km^{-1}$) |
|---|---|---|---|---|---|
| LW S1A | 20 | < 0.5 | 5.0 | < 0.01 | < 0..01 |
| LW S2A | 80 | < 0.5 | 5.5 | < 0.01 | < 0..01 |
| LW S3A | 875 | 5.5 | 5.5 | 0.09 | 0.09 |
| LW S4A | 1150 | 5.0 | 6.5 | 0.11 | 0.20 |
| LW S5A | 1300 | 6.0 | 5.5 | 0.11 | 0.20 |
| LW S6A | 1350 | 6.5 | 5.5 | 0.12 | 0.20 |
| LW S7A | 1400 | 6.5 | 6.5 | 0.12 | 0.20 |

Yarran Road is located directly above LW S5A-S7A and, therefore, could experience the full range of predicted subsidence movements. The predicted profiles of conventional subsidence and tilt along the alignment of Yarran Road, resulting from the extraction of the proposed longwalls, is shown in Fig. 3.14.

A summary of the maximum predicted total conventional subsidence parameters for Yarran Road, after the extraction of each of the proposed longwalls, is provided in Table 3.7.

The predicted tilts are the maxima along the alignment of the road after the completion of each of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

**Table 3.7 Maximum predicted total conventional subsidence parameters for Yarran Road due to the extraction of LWs S1A to S7A**

| Longwall | Maximum predicted subsidence (mm) | Maximum predicted tilt along alignment (mm/m) | Maximum predicted tilt across alignment (mm/m) | Maximum predicted hogging curvature in any direction ($km^{-1}$) | Maximum predicted sagging curvature in any direction ($km^{-1}$) |
|---|---|---|---|---|---|
| LW S1A | < 20 | < 0.5 | < 0.5 | < 0.01 | < 0.01 |
| LW S2A | < 20 | < 0.5 | < 0.5 | < 0.01 | < 0.01 |
| LW S3A | 20 | < 0.5 | < 0.5 | < 0.01 | < 0.01 |
| LW S4A | 100 | < 0.5 | < 0.5 | < 0.01 | < 0.01 |
| LW S5A | 1050 | 8.0 | 2.0 | 0.09 | 0.20 |
| LW S6A | 1300 | 7.0 | 4.0 | 0.09 | 0.20 |
| LW S7A | 1350 | 6.5 | 7.5 | 0.10 | 0.20 |

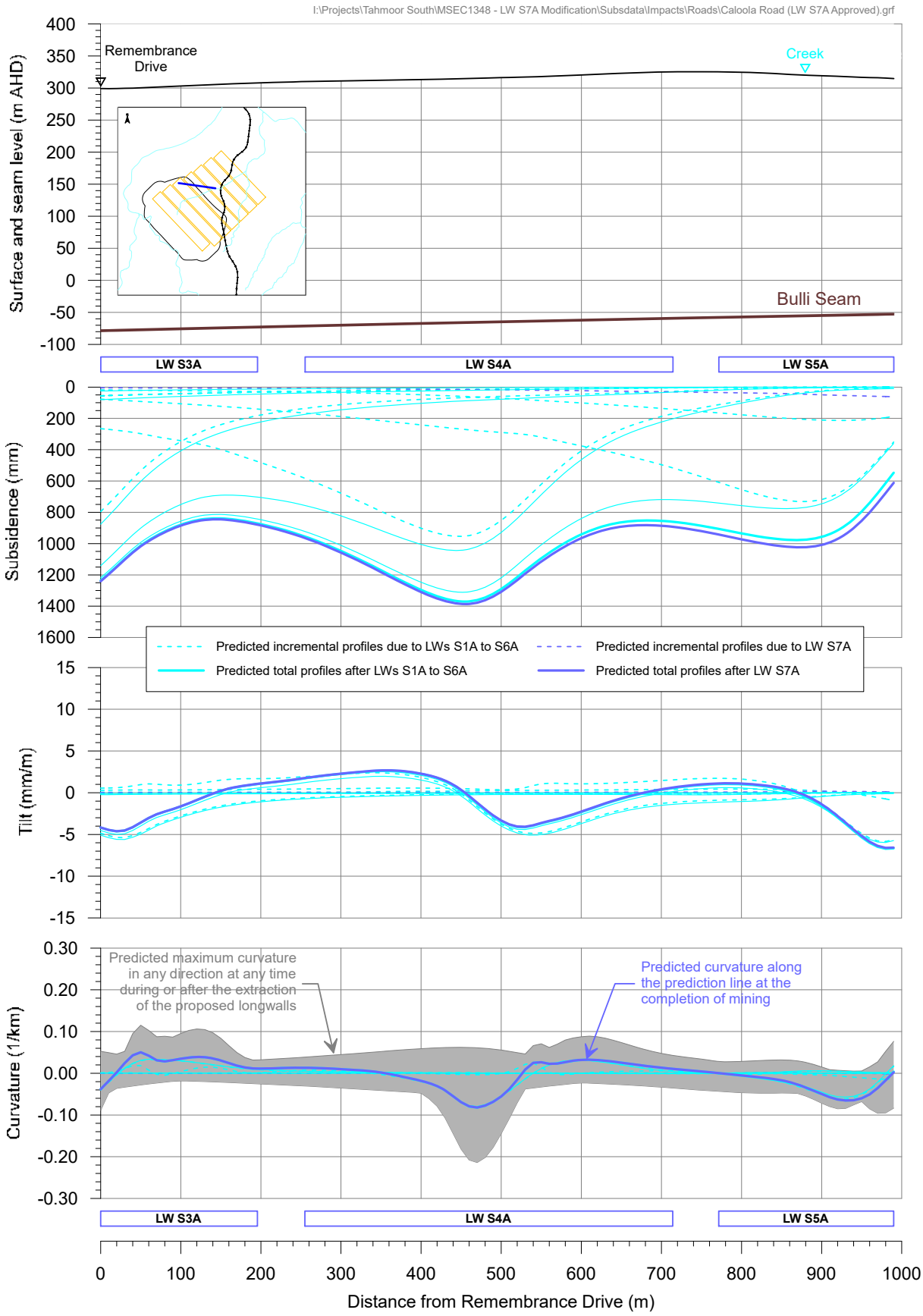



**Fig. 3.13 Predicted profiles of total subsidence, tilt and curvature along Caloola Road after the mining of LW S1A-S7A**

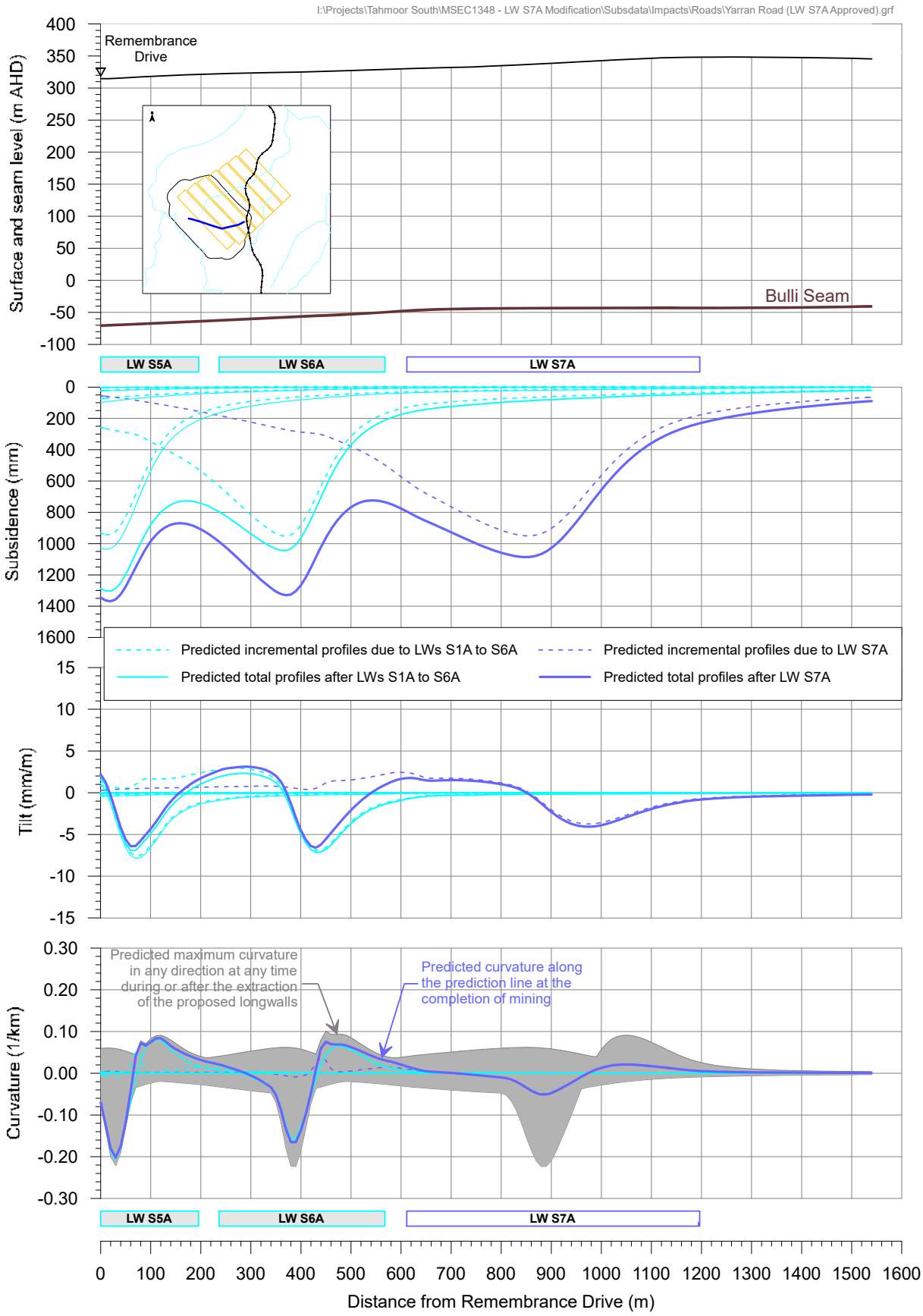



**Fig. 3.14 Predicted profiles of total subsidence, tilt and curvature along Yarran Road after the mining of LW S1A-S7A**

The 450mm diameter water main crosses Teatree Hollow and a number of its tributaries within the Study Area, as shown in Drawing No. MSEC1193-04-01. Valley-related movements could be experienced in these locations. A summary of the maximum predicted conventional subsidence and valley related movements for the crossing at Teatree Hollow is provided in Table 3.8.

Maps showing the location of the 450 mm water main relative to Remembrance Drive and the Main Southern Railway are shown in Drawings Nos. MSEC1193-03-07 to MSEC1193-03-09.

**Table 3.8 Predicted Conventional Subsidence and Valley-Related Movements for the creek crossings along Remembrance Drive and water main within the Study Area**

| Location | Maximum Predicted Total Subsidence (mm) | Maximum Predicted Total Hogging Curvature (1/km) | Maximum Predicted Total Sagging Curvature (1/km) | Maximum Predicted Total Upsidence (mm) | Maximum Predicted Total Closure (mm) |
|---|---|---|---|---|---|
| Opposite Tahmoor Mine above LW S2A | 1250 | 0.05 | -0.18 | 100 | 50 |
| Teatree Hollow (Caloola Road) (upstream Remembrance Drive) | 1300 | 0.06 | -0.18 | 250 | 150 |
| Tributary to Teatree Hollow (downstream Remembrance Drive) | 1100 | 0.05 | -0.04 | 125 | 100 |
| Tributary to Teatree Hollow (downstream Main Southern Railway at 100.425 km) | 1275 | 0.05 | -0.12 | 150 | 75 |
| Tributary to Teatree Hollow (Great Southern Road) | 30 | < 0.01 | < 0.01 | 50 | 30 |

### 3.7.3. Potential subsidence impacts on water pipelines

Longwalls 22 to 32 at Tahmoor Mine have directly mined beneath approximately 5.5 kilometres of DICL pipe and 19.5 kilometres of CICL pipe, with only minor impacts recorded to the older CICL pipes. Water leaks were repaired by Sydney Water using normal response procedures.

The predicted systematic curvatures and strains for the water pipelines within the *Subsidence Study Area* are of a similar order of magnitude to those observed and predicted along the pipelines that have been mined directly beneath by previously extracted longwalls in the Southern Coalfield. The overall levels of impacts on the water pipelines in the *Subsidence Study Area*, therefore, are expected to be similar to those observed during the previously extracted longwalls in the Southern Coalfield. Longwalls in the Southern Coalfield have been mined directly beneath water pipelines in the past, and some of these cases are provided in Table 3.9.

**Table 3.9 Examples of previous experience of mining beneath water pipelines in the Southern Coalfield**

| Colliery and Longwalls | Pipelines | Observed movements | Observed impacts |
|---|---|---|---|
| Appin LW301 and LW302 | 0.6 km of 150 dia. DICL<br>0.6 km of 300 dia. CICL<br>0.6 km of 1200 dia. SCL | 650 mm Subsidence<br>4.5 mm/m Tilt<br>1 mm/m Tensile Strain<br>3 mm/m Comp. Strain<br>(Measured M & N-Lines) | Leakage of the 150 mm and 300 mm CICL pipelines at a creek crossing, elsewhere no other reported impacts |
| Tahmoor Mine<br>LW22 to LW32 | 5.5 km DICL pipes<br>19.5 km CICL pipes | 1200 mm Subsidence<br>6 to 10 mm/m Tilt<br>1.5 mm Tensile Strain<br>2 mm (typ.) and up to<br>5 mm/m Comp. Strain<br>(Extensive street monitoring) | Impacts occurred to the distribution network at 8 locations and a very small number of minor leaks in the consumer connection pipes |
| West Cliff<br>LW5A3, LW5A4<br>& LW29 to LW34 | 2.8 km of 100 dia. CICL pipe directly mined beneath | 1100 mm Subsidence<br>10 mm/m Tilt<br>1 mm/m Tensile Strain<br>5.5 mm/m Comp. Strain<br>(Measured B-Line) | No reported impacts |

Based on this experience, it is expected that some minor leakages of the water pipelines could occur at isolated locations, as a result of the extraction of the longwalls, however, the incidence of impacts is expected to be low. Impacts are more likely to occur in the locations of non-systematic movements, and at creek crossings, due to valley related movements.

Tahmoor Coal has previously developed and selected risk control measures in consultation, co-ordination and co-operation with Sydney Water in accordance with WHS legislation. The controls have been implemented during the mining of LWs 22 to 32 and LW W1-W4 at Tahmoor North and LWs S1A to S3A.

Potential impact sites are identified by weekly ground surveys and visual inspections. The frequency of inspections are typically increased if non-conventional subsidence movements are identified. Any impacts to the pipelines along the local streets (e.g. Caloola Road and Yarran Road) are expected to be of a minor nature which could be easily repaired.

Sydney Water and Tahmoor Coal also have extensive experience in successfully managing potential impacts on the trunk water main along Remembrance Drive at Tahmoor and Argyle Street at Picton during the mining of previous Longwalls 22 to 32 and LW W4 at Tahmoor North. A water leak was immediately repaired by Sydney Water, for example, when mining-induced impacts were observed when LW 32 mined directly beneath the water main adjacent to the vehicle entrance to Sydney Water's Picton Water Recycling Plant.

Sydney Water advises that the 450 mm diameter CICL water main within the Study Area currently has a reasonable history of performance. Sydney Water currently reduces the potential consequences of water main break by remotely monitoring water pressure at pressure reducing valves stationed along the pipeline. Sydney Water are notified when water pressures build up, and a maintenance crew is sent to site to reduce pressure. This standard procedure will continue to be followed during the mining of LWs S1A-S7A.

Sydney Water has emergency plans in place to respond and repair leaks to the 450 mm diameter water main along Remembrance Drive within 24 hours to maintain supply to the downstream reservoirs, particularly during times of peak demand during the summer period.

In the event that the 450 mm diameter water main requires repair within the Study Area, the majority of the network will remain on mains supply as stop valves can be used to shut down and isolated the affected section of the pipeline. Prior to the influence of each longwall, Sydney Water will mark out the stop valves within the predicted extent of incremental subsidence to minimise the response time.

Customers will continue to receive potable water via the reservoirs at Picton, Thirlmere, Buxton and Oakdale. The storage capacities in the reservoirs are sufficient to supply water for at least 24 hours. Sydney Water will, therefore, ensure that reservoir levels are kept above 90 % whilst the water main is experiencing active subsidence movements to maximise the period of time available to repair a water main.

In the event of a leak, customers within the affected section of pipework will temporarily lose mains supply. Sydney Water has procedures and appropriate resources to notify the community and provide an alternative supply of potable water to consumers whilst the water main is shut down to complete the repairs. Tahmoor Coal can also contact affected customers and offer assistance. Water supply can be provided to all residential and commercial consumers, including the Wollondilly Anglican College during an outage, with the only exception being Tahmoor Mine itself.

The most likely locations for severe ground deformations and impacts on the pipelines would be where they cross streams within the Study Area. The potable water pipelines are buried in the ground at the creek crossings. Additional risk control measures have been selected and implemented at creek crossings, which are discussed in more detail in following sections.

### 3.7.4. Hidden creeks

As shown in Drawing No. MSEC1193-04-01, the 450 mm diameter CICL water main along Remembrance Drive does not cross creek crossings directly above LWs S1A and S2A. Two hidden creeks are located above LWs S1A and S2A but historical aerial photographs indicate that they did not extend to Remembrance Drive. Non-conventional valley closure and upsidence movements were observed to develop where the hidden creeks are projected to intersect the pipeline and a conservative prediction were provided in Table 3.8 where the hidden creek is projected to cross beneath above LW S2A. Potential impacts at these locations by regular ground surveys and visual inspections, with responses triggered by actual observations. Gibault joints were installed with displacement sensors at the first site, which was located opposite Pegs R47 and R48. Whilst the pipe joints have closed in response to compressive ground strains, no damage or leakage has been observed at the two sites during the mining of LWs S1A to S3A.

### 3.7.5. Teatree Hollow at Caloola Road (Creek 1)

LW S3A extracted directly beneath the water main where it crosses Teatree Hollow at the intersection of Remembrance Drive and Caloola Road, with no damage or leakage observed. A Steel Cement Lined (SCL) pipe is buried directly under the creek bed, which is connected to the CICL pipework on both sides.

The pipeline runs within private properties, except where it crosses the creek and Caloola Road, as shown in Drawing No. MSEC1193-03-07. A Google Streetview image of the intersection is shown in Fig. 3.15 and a photograph of the Sydney Water pit is shown in Fig. 3.16.

It can be seen that the water main is located upstream of the road embankment but approximately 10 metres away from the toe of the embankment. In the event of a water leak, water will drain through the twin culverts under the embankment and is extremely unlikely to erode the embankment.



**Fig. 3.15 Google Streetview image at intersection of Remembrance Drive and Caloola Road**



**Fig. 3.16 Sydney Water pit for potable water main at intersection of Remembrance Drive and Caloola Road**

Whilst the predictions of valley closure and upsidence are based on a conservative, upper-bound model, it is considered likely that the pipeline will experience an increase in compressive strains and increased changes in vertical and/or lateral alignment at or near the creek crossing. It is likely, therefore, that the capacity of some existing SCL-CICL or CICL-CICL joints will fully close in response to valley closure and rotations caused by vertical and/or lateral alignment could result in rotation of the joints and possible leaks to the pipe.

If actual valley closure and upsidence approach the upper-bound predictions, leaks could develop on multiple occasions at the creek crossing site.

In light of the assessment, Tahmoor Coal and Sydney Water conducted further investigations and considered, selected and implemented additional reasonably practicable risk controls at the creek crossing site, prior to the influence of LW S2A.

- Installation of Gibault expansion joints on both sides of Creek 1; and
- Displacement sensors have been installed on the joints.

The Gibault joints and displacement monitoring were installed at the creek crossing prior to the influence of LW S2A.

The pipeline experienced valley closure at the creek crossing during the mining of LW S3A, with no damage or leakage observed. Tahmoor Coal will continue to manage potential impacts on the pipeline during the mining of LWs S4A to S7A in accordance with the Management Plan.

### 3.7.6. Tributary to Teatree Hollow north of Yarran Road (Creek 2)

The water main crosses tributaries to Teatree Hollow on the downstream side of embankments along Remembrance Drive and the Main Southern Railway, as shown in Drawings Nos. MSEC1193-03-08 and MSEC1193-03-09 and a site location diagram is shown in Fig. 3.17. In the event of a water leak, water will drain away from the embankments.

Tahmoor Coal and Sydney Water have considered, select options and implemented additional reasonably practicable risk controls at the creek crossing site, prior to the commencement of LW S4A.

- Installation of Gibault expansion joints on both sides of Creek 2; and
- Displacement sensors have been installed on the joints.

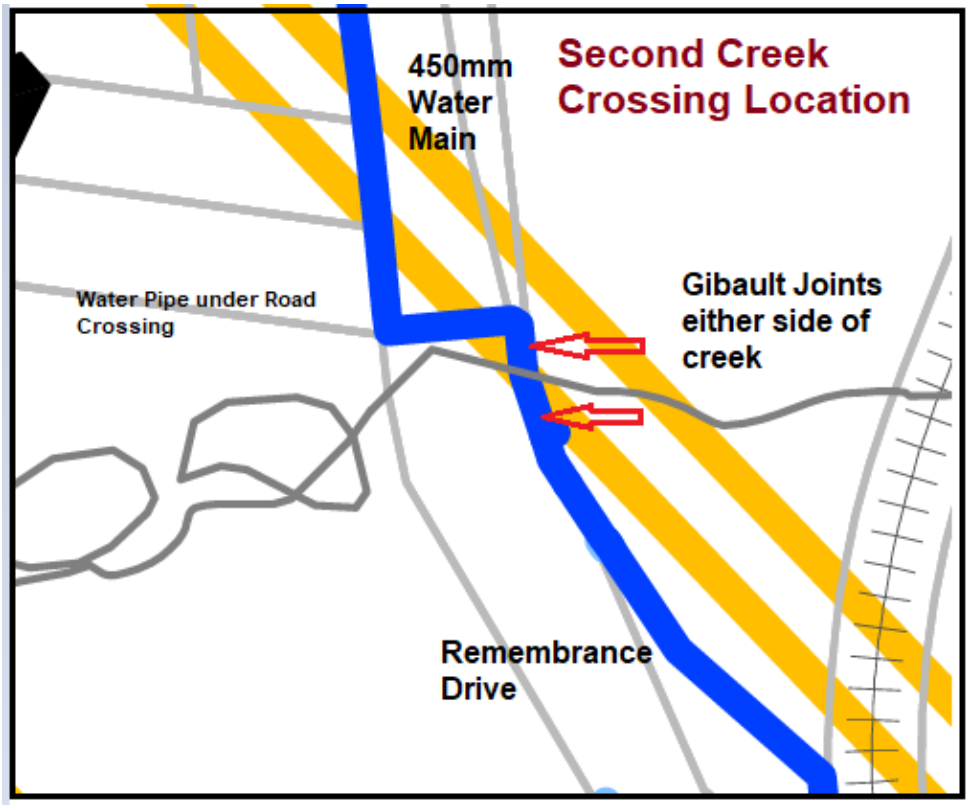



**Fig. 3.17 Location of Gibault joints on both sides of Creek 2**



**Fig. 3.18 View of Creek 2 excavation site to install joints**

Photographs of the Gibault joints and displacement sensors are shown in Fig. 3.19.



*Photographs courtesy Sweeting Consulting*

**Fig. 3.19 Gibault joints and sensors at Creek 2**

### 3.7.7. Remembrance Drive crossing north of Creek 2

The 450 mm diameter CICL water main crosses beneath Remembrance Drive between Caloola and Yarran Roads, directly above the chain pillar between LW S4A and S5A, as shown in Drawing No. MSEC1193-04-01 and Fig. 3.17. The crossing consists of direct buried CICL pipe sections with two right angle bends at a cut-fill interface along Remembrance Drive.

Sydney Water's GIS shapefiles indicate the pipes are direct buried CICL pipe sections that are not concrete encased. There is good access at both ends of each crossing, as shown in Fig. 3.20.



**Fig. 3.20 Google Streetview image of crossing beneath Remembrance Drive**

The likelihood of mining-induced impacts at the Remembrance Drive crossing north of Creek 2 is similar to those along the majority of the water main. There is, however, a chance of impacts to pipe joints that are located at the right angle bends because the bends could act as anchor points in the ground as the pipe sections slide relative to them.

Tahmoor Coal and Sydney Water implemented the following reasonably practicable risk controls at the road crossing site, which are in addition to the risk controls for the majority of the water main:

- Installation of Gibault joint north of Creek 2, which has reduced the potential for impacts on the right angle bend at the southbound (eastern) side of the crossing; and
- Installation of additional survey marks in local 3D around the crossing.

In the event that increased ground strains are observed at the road crossing, access is available to excavate and install additional Gibault joints at the crossing if required, particularly between the extraction of LWs S4A and S5A.

Stop valves are also present at Creek 2, immediately upstream of the road crossing and at Caloola Road, downstream of the road crossing, which limits the number of affected Sydney Water customers that would be affected if repairs must be conducted. Traffic management would be required to safely access the damaged pipeline.

### 3.7.8. Tributary to Teatree Hollow adjacent to Main Southern Railway at 100.425 km (Creek 3)

Sydney Water and Tahmoor Coal have conducted site investigations and considered additional risk control options for the creek crossing adjacent to the Main Southern Railway at 100.425 km. The site has been named Creek 3 for ease of reference.

The shortening of LW S4A has slightly reduced the predicted closure that may occur at the crossing due to the extraction of LW S4A.

Valley-related movements could be experienced in these locations. A summary comparison of maximum predicted conventional subsidence and valley-related movements for Creek 3 is provided in Table 3.10.

**Table 3.10 Predicted Conventional Subsidence and Valley Related Movements for the railway creek crossing at 100.425 km (Creek 3, with changes since Management Plan in blue)**

| Longwall | Maximum Predicted Total Subsidence (mm) | Maximum Predicted Total Hogging Curvature (1/km) | Maximum Predicted Total Sagging Curvature (1/km) | Maximum Predicted Total Upsidence (mm) | Maximum Predicted Total Closure (mm) |
|---|---|---|---|---|---|
| LW S1A | <20 | < 0.01 | < 0.01 | <20 | <20 |
| LW S2A | <20 | < 0.01 | < 0.01 | <20 | <20 |
| LW S3A | 2030 | < 0.01 | < 0.01 | <20 | <20 |
| LW S4A | 90110 | < 0.01 | < 0.01 | 2530 | 2030 |
| LW S5A | 1000 | 0.040.05 | -0.13-0.12 | 90100 | 4550 |
| LW S6A | 1275 | 0.040.05 | -0.14-0.12 | 125150 | 6075 |
| LW S7A | 1325 | 0.04 | -0.14 | 150 | 75 |

It can be seen from Table 3.10 that predicted subsidence, closure and upsidence movements due to the extraction of LW S4A at the crossing at Creek 3 have slightly reduced.

For future LWs S5A and S6A, there were no changes in predicted total subsidence as the changes were within MSEC's rounding conventions. It can also be seen that the maximum predicted sagging curvature due to the extraction of LWs S5A and S6A are slightly greater than originally predicted as the planned extraction heights have been slightly increased.

In light of the shortening of LW S4A, Tahmoor Coal and Sydney Water have agreed to implement the following reasonably practicable risk controls at the creek crossing site due to the mining of LWs S4A to S6A, which are in addition to the risk controls for the majority of the water main, as described in the Management Plan.

- Installation of Gibault joints on both sides of the crossing at Creek 3, prior to the influence of LW S5A (subject to confirmation of the LW S5A mine plan).
- Displacement sensors will also be installed on the joints.

*Management of potential impacts during the mining of LW S4A*

It is considered that the existing joints in the potable water pipework will be adequate to manage the potential valley closure movements during the mining of LW S4A, even if greater than predicted closure occurs. This has been demonstrated from experience at other locations along the water main that have accommodated increased compressive strains without Gibault joints during the mining of LWs S1A to S3A as shown in Table 3.11.

**Table 3.11 Observed increased closure and compressive strains along Sydney Water 450 mm CICL potable water main along Remembrance Drive during mining of LWs S1A to S3A where Gibault joints have not been installed**

| Location | Maximum closure over long bay lengths (mm) | Average compressive strain over long bay lengths (mm/m) | Maximum closure over 20m bay length (mm) | Compressive strain over 20m bay length (mm/m) | Comments |
|---|---|---|---|---|---|
| Bump 1<br>Pegs R47 to R48 | 38 mm over 20m | 1.9 mm/m | 38 mm | 1.9 mm/m | Due to LW S1A prior to installation of Gibault joints in late October 2023 |
| Bump 2<br>Pegs R54 to R55 | 42 mm over 20m | 2.1 mm/m | 42 mm | 2.1 mm/m | Mainly due to LW S2A Gibault joints not installed |
| Bump 3<br>Pegs R59 to R61 | 26 mm over 40m | 0.6 mm/m | 17 mm | 0.8 mm/m | Mainly due to LW S2A Gibault joints not installed |
| Caloola South<br>Pegs R78C to R81C | 82 mm over 60m | 1.4 mm/m | 50 mm | 2.6 mm/m | Mainly due to LW S3A Gibault joints not installed south of intersection at Caloola Road |

In the event that increased ground strains are observed at the creek crossing, access is available to excavate and install additional Gibault joints at the crossing if required, particularly between the extraction of LWs S4A and S5A. Access is also available to repair the pipework, if required.

Stop valves are also present upstream and downstream of the creek crossing, which limits the number of affected Sydney Water customers that would be affected if emergency repairs must be conducted.

*Management of potential impacts during the mining of LW S5A*

Tahmoor Coal and Sydney Water identified two risk control options:

1. Replace existing CICL pipework with new pipework that crosses beneath the crossing at Creek 3 and the Main Southern Railway at 100.380 km via a directional horizontal bore. The bore would consist of a PVC sleeve bore that would be grouted to the host rockmass, with a polyethylene (PE) water pipeline sleeved inside it.
2. Install Gibault joints on both sides of the crossing at Creek 3 and manage potential impacts at the rail crossing at 100.380 km.

Option 1 was initially selected as it could reduce the potential for impacts at both the creek crossing and rail crossing. The work, however, required timely design and implementation by Sydney Water's appointed contractor for the Western Region. The project has experienced significant delays to the point that the project is unlikely to be completed before the commencement of LW S5A.

Option 2 was, therefore, selected and implemented as the preferred risk control option as it can be implemented in a timely manner and has proven to be effective during the mining of LWs S1A to S3A.

The two Gibault joints have a combined capacity of accommodating 100 mm of closure in addition to the existing capacity of the spigot and socket CICL joints to accommodate ground closure. The total combined capacity is estimated to be more than twice the capacity of the predicted total closure at the crossing. The Gibault joints can also be re-cut and reset in the event that increased closure develops at the site.

A description of risk controls for the railway crossing is provided in the following section.

### 3.7.9. Main Southern Railway crossing

The 450 mm diameter CICL water main crosses beneath Main Southern Railway, directly above LW S5A, as shown in Drawing No. MSEC1193-04-01. The crossing consists of direct buried CICL pipe sections with two right angle bends at a cut-fill interface along the Railway near Kilometrage 100.380 km.

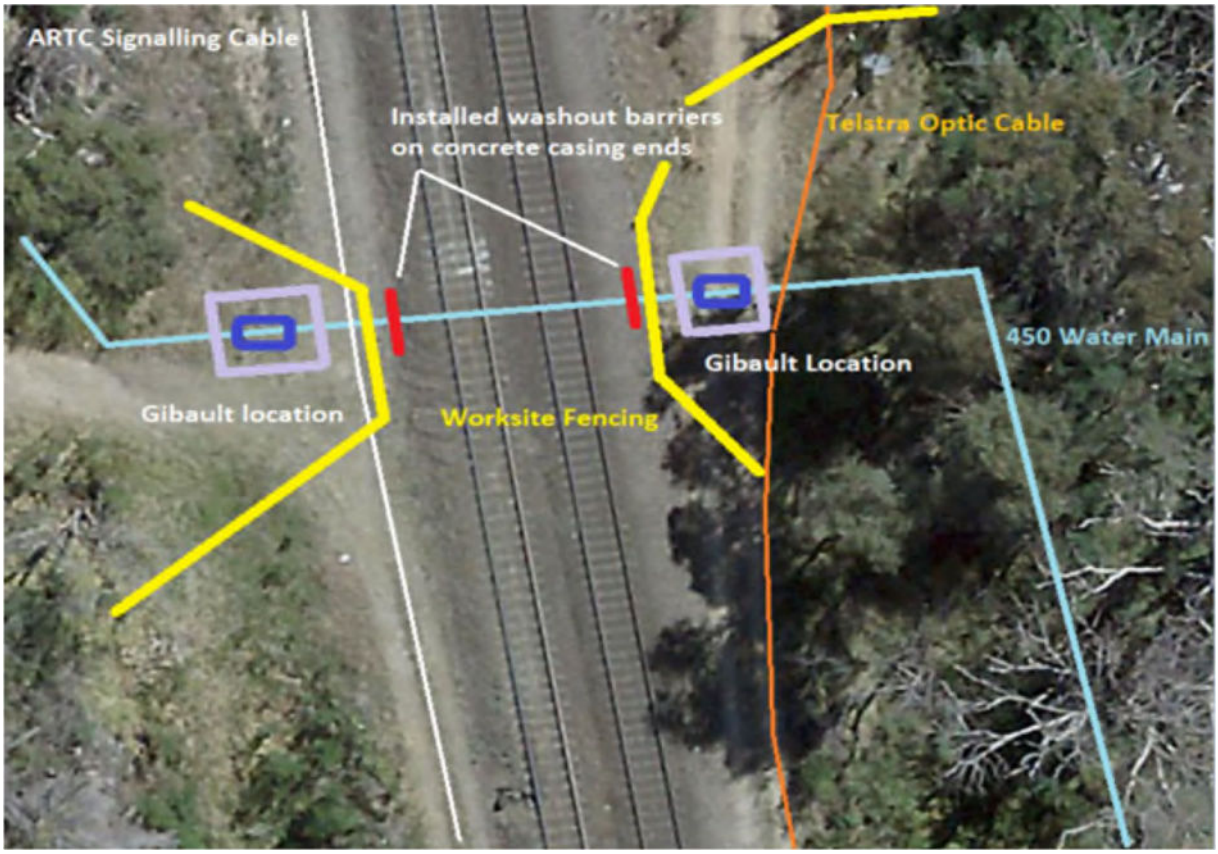
The likelihood of mining-induced impacts at the crossings are similar to those along the majority of the water main. There is, however, a chance of impacts to pipe joints that are located at the right angle bends because the bends could act as anchor points in the ground as the pipe sections slide relative to them.

A concern for Sydney Water is that a leak could occur directly beneath Remembrance Drive or the Main Southern Railway, where it could take longer than 24 hours to be repaired, potentially resulting in a loss of water supply to customers in the region. Traffic management would be required in both instances to safely access the damaged pipeline.

Tahmoor Coal, with supervision from Sydney Water, conducted a site investigation of the rail crossing on 14 and 15 September 2024. The aim of the investigation was to:

- Locate the extent of concrete encasement of the water main beneath the track;
- Install a concrete barrier to divert water away from the track, to reduce the potential for washouts in the unlikely event that non-conventional subsidence movement impacts the asset;
- Investigate site conditions and local geology;
- Positively locate all services that cross the pipe crossing in this area using non-destructive techniques; and
- Determine potential locations to fit Gibault expansion joints.

A site map is provided in Fig. 3.21 below.




*Map courtesy Tahmoor Coal*

**Fig. 3.21 Site plan of Railway water main crossing at 100.380 km**

The following observations were made:

- The pipe was originally laid in an excavated rock trench;
- Formwork was used to encase the pipe in concrete within the trench;
- The length of encasement supports the railway track with its ends located approximately directly beneath the base of ballast formation – 3.0 m from the Up Main Up Rail (westernmost rail) and 2.8 m from the Down Main Down Rail (easternmost rail);
- Approximately 100 mm of clearance exists between the rock and pipe;
- Locations have been identified on both sides of the crossing that are free of services and concrete encasements, where it would be possible to install Gibault joints in the unlikely event that they are required due to mining-induced ground strains. The excavated trench would need to be widened to install the joints;
- The pipe is 1.2 metres below the surface so shoring is not required to access the pipe;
- The trench has been backfilled with bedding sand.

Photographs of the exposed CICL pipework beyond the ends of the concrete encasement are provided in Fig. 3.22 and Fig. 3.23.



*Photographs courtesy Tahmoor Coal*

**Fig. 3.22 Exposed CICL water main on western side of Railway crossing (Up side)**




*Photographs courtesy Tahmoor Coal*

**Fig. 3.23 Exposed CICL water main on eastern side of Railway crossing (Down side)**

On 14 and 15 September 2024, Tahmoor Coal in consultation with railway operator ARTC, constructed concrete washout barriers within the ballast formation directly above the ends of the concrete encased pipework. The washout barriers provide protection to the track from washout in the unlikely event of leakage of the water main.

Photographs of the buried concrete washout barriers are provided in Fig. 3.24 and Fig. 3.25



*Photograph courtesy Tahmoor Coal*

**Fig. 3.24 Concrete bearers placed on concrete bags above pipework and backfilled**



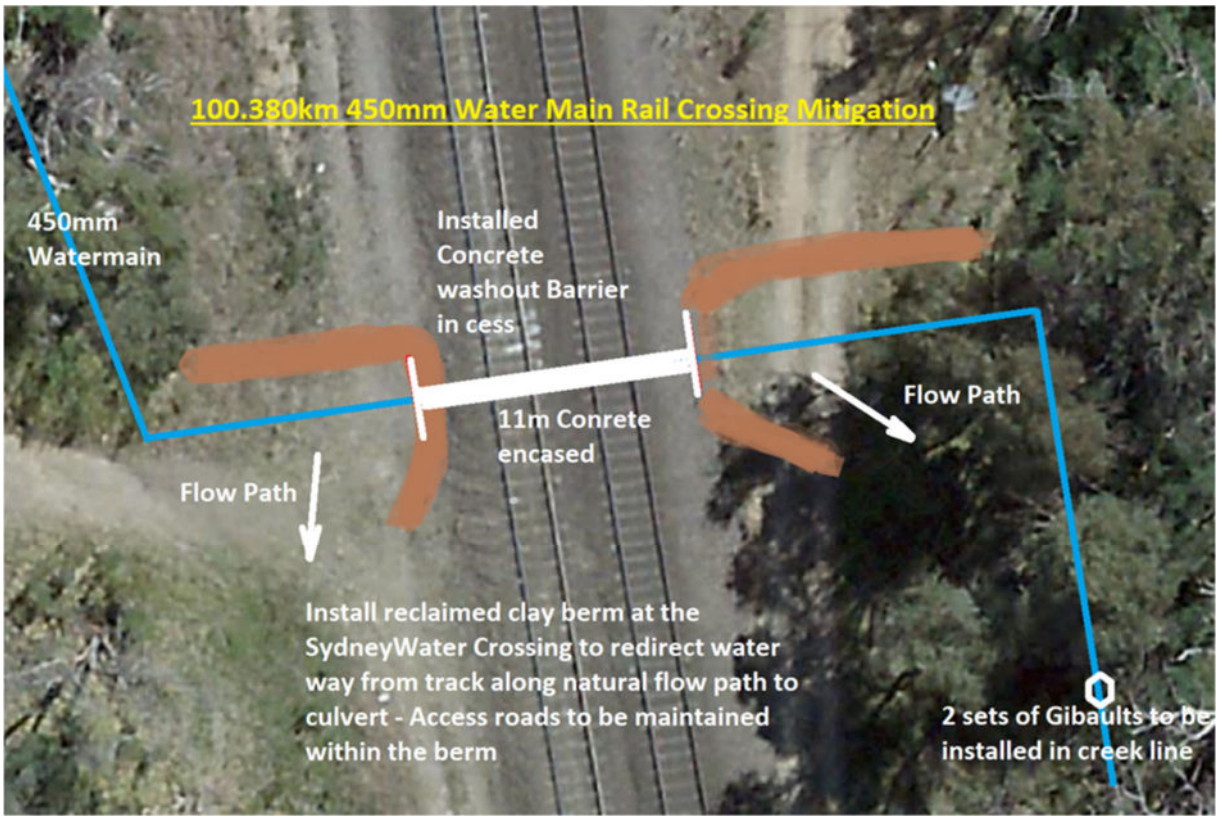
*Photograph courtesy Tahmoor Coal*

**Fig. 3.25 Finished concrete washout barriers in track ballast shoulder**

As discussed previously, the likelihood of mining-induced impacts at the railway crossing is similar to those along the majority of the water main. There is, however, a chance of impacts to pipe joints that are located at the right angle bends because the bends could act as anchor points in the ground as the pipe sections slide relative to them.

Tahmoor Coal and Sydney Water have agreed to implement the following reasonably practicable risk controls at the railway crossing site due to the mining of LW S4A to S6A, which are in addition to the risk controls for the majority of the water main, as described in the Management Plan.

- Site investigations to confirm as-built construction of the railway crossing (complete);
- Identification of potential location for installing Gibault joints and placement of sand bedding above pipework, if required in future based on actual observations (complete);
- Installation of concrete washout barrier above railway crossing (complete);
- Construction of earth berms to direct water away from railway track, as shown in Fig. 3.26;
- Installation of Gibault joint on north of creek crossing at Creek 3, prior to the influence of LW S5A (subject to confirmation of the LW S5A mine plan). The Gibault joint will reduce the potential for impacts on the right angle bend at the eastern (Down) side of the railway crossing;
- Installation of additional survey marks in local 3D around the crossing; and
- Daily visual inspections of the pipeline crossing by Tahmoor Coal's Rail Maintenance Contractor during periods of active subsidence during the mining of LWs S4A to S7A.




*Plan courtesy Tahmoor Coal*

**Fig. 3.26 Plan of Railway water main crossing at 100.380 km**

***Management of potential impacts to potable water infrastructure***

Tahmoor Coal has previously developed and selected risk control measures in consultation, co-ordination and co-operation with Sydney Water in accordance with WHS legislation. The controls were implemented during the mining of LWs 22 to 32 and LW W1-W4 at Tahmoor North.

In this instance, reasonably practicable controls have been identified that could eliminate, substitute or isolate the identified risks and engineering controls have been identified that could put in place a structure or item that prevents or minimises risks.

- Mark out locations of stop valves prior to the influence of each longwalls;
- Arrange for reservoirs within the network to be more than 90% capacity during periods of active subsidence;
- Install Gibault joints at Creeks 1, 2 and 3;
- Installation of concrete washout barriers above the railway crossing; and
- Construction of earth berms to direct water away from railway track at the railway crossing.

Tahmoor Coal has identified controls that will manage potential issues associated with damage to pipelines resulting in damage to potable water pipelines during the extraction of LW S1A-S7A by implementing the following measures:

- Regular ground surveys along streets located within the active subsidence zone;
- Absolute 3D survey of subsidence along Remembrance Drive;
- Regular visual inspections along streets located within the active subsidence zone;
- Regular consultation with the community to report potential impacts;
- Additional surveys and/or inspections, if triggered by monitoring results;
- If triggered by monitoring results, excavate and expose the pipeline to relieve it from ground deformations; and
- In the worst case, repair of damaged pipeline.

### 3.7.10. Tributary to Teatree Hollow at Great Southern Road

The water main crosses the Tributary to Teatree Hollow at Great Southern Road beyond the commencing end of LW S5A, as shown in Drawing No. MSEC1193-04-01. The valley is not particularly incised at this location.

It is possible, but not certain that non-conventional valley closure and upsidence movements could develop where at the creek crossing and a conservative prediction has been provided in Table 3.8. It is planned to manage potential impacts at this location by regular ground surveys and visual inspections, with responses triggered by actual observations.

## 3.8. Sydney Water potable water mains near bridges

There are no bridges along local roads within the vicinity of LW S1A-S7A., though some bridges may experience far field movements during the mining of LW S1A-S7A. Sydney Water's potable water mains are located alongside two bridges.

Sydney Water potable water pipelines are buried in the creek bed near these bridges and this Management Plan includes measures to manage the pipeline crossings that are located near these bridges. A photograph of the buried crossing beneath the Bargo River adjacent to the Main Southern Railway Viaduct is shown in Fig. 3.27.

A summary of the closest distances of LW S1A to S7A to the bridges are provided in Table 3.12.

**Table 3.12 Bridges near Sydney Water potable water mains that may be potentially affected by far field movements**

| Bridge | Closest distance (m) | Closest LW | Closest LW end |
|---|---|---|---|
| Main Southern Railway over the Bargo River | 1,755 m | LW S1A | Finishing end (North-western end) |
| Bargo River Road Bridge over a tributary to Bargo River | 1,790 m | LW S1A | Finishing end (North-western end) |

Tahmoor Coal has managed potential impacts on the bridges in consultation with Wollondilly Shire Council and the Australian Rail Track Corporation. The management plans include monitoring of absolute and differential movements at the bridges and visual inspections.



**Fig. 3.27 Photograph of buried crossing of 450 mm CICL water main beneath the Bargo River adjacent to the Main Southern Railway Viaduct**

The potential for impacts on the pipeline crossings do not result from absolute far-field horizontal movements, but rather from differential horizontal movements. It can be seen from Fig. 3.28 that infrastructure located well away from active longwalls are likely to experience relatively small differential horizontal movements, particularly given that a large proportion of the measured variations are within survey tolerance. Statistical analyses were not conducted for offset distances greater than 1800 metres as there are insufficient measurements beyond the nominal survey tolerance of 3 mm.

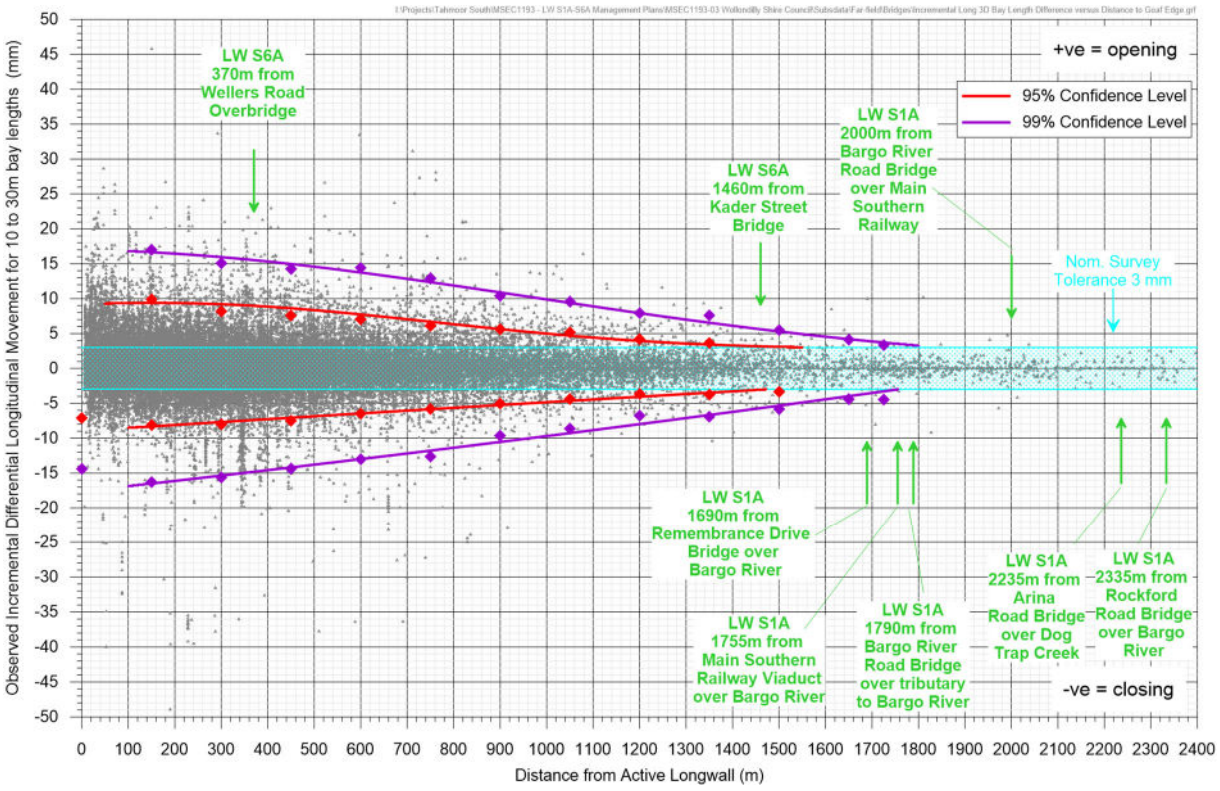



**Fig. 3.28 Observed incremental differential longitudinal horizontal movements versus distance from active longwall for marks spaced between 10 and 30 metres**

The buried water mains are located approximately 1,700 metres from LWs S1A to S7A. It can be seen from Fig. 3.28 that only 1% of previously observed differential horizontal movements have exceeded 5 mm over a bay length of 20 metres. Differential movements of this magnitude are likely to be accommodated at the pipe joints, even if they concentrate at one joint.

A concern for Sydney Water was that if actual differential mining-induced were greater than expected, a leak could occur directly beneath the river bed, where depending on water flows, it could take longer than 24 hours to be repaired, potentially resulting in a loss of water supply to customers in the region.

No impacts have been recorded to the bridges or the Sydney Water potable infrastructure adjacent to them during the extraction of LWs S1A to S3A. Observed changes in distances between the Bridge abutments were within survey tolerances and less than trigger levels. Whilst GNSS monitoring will continue, monitoring at the bridges have ceased, in accordance with risk control procedures for LWs S1A to S3A of this Management Plan.

Information on the methods that were implemented to manage potential impacts on Sydney Water sewer infrastructure at the bridges can be found in Revision B of this Management Plan

## 4.1. Infrastructure Management Group (IMG)

The Infrastructure Management Group (IMG) is responsible for taking the necessary actions required to manage the risks that are identified from monitoring the infrastructure and to ensure that the health and safety of people who may be present on public property or Sydney Water property are not put at risk due to mine subsidence. The IMG develops and reviews this management plan, collects and analyses monitoring results, determines potential impacts and provides advice regarding appropriate actions. The members of the IMG are highlighted in Chapter 8.

## 4.2. Development and selection of risk control measures

Tahmoor Coal has developed and selected risk control measures in consultation, co-ordination and co-operation with the infrastructure owner 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 prior to 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 and B risk control measures are described in Section 4.3 to Section 4.6. Prior to selecting Method B risk control measures, Tahmoor Coal has investigated and confirmed that the measures are feasible and effective for the site-specific conditions during the extraction of LW S1A-S7A.

## 4.3. Selection of risk controls for potable water infrastructure

Based on the above assessments, Tahmoor Coal considered Method A and Method B risk control measures, in accordance with the process described in Section 4.2.

*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*

Tahmoor Coal and Sydney Water have identified the following reasonably practicable engineering controls to put in place a structure or item that prevents or minimises risks.

- Installation of Gibault joints at Creeks 1, 2 and 3;
- Installation of concrete washout barriers above railway crossing; and
- Construction of earth berms to direct water away from railway track.

*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 the health and safety of people in relation to mining-induced damage to potable water infrastructure:

- Implementation of a Monitoring Plan and Trigger Action Response Plan (TARP)
  As described in the Management Plan, Tahmoor Coal and Sydney Water has developed and implemented a management strategy of detecting early the development of potential adverse subsidence movements in the ground, so that contingency response measures can be implemented before impacts on the safety and serviceability develop. The TARP includes the following:
    - Continuous GNSS monitoring along the centrelines of LWs S1A to S3A, and at each end of the Main Southern Railway Viaduct over the Bargo River (installed and operating). A GNSS unit has also been installed where the rail corridor is located directly above the centreline of LW S5A at approximate rail kilometrage of 100.52 km;
    - Mark out locations of stop valves prior to the influence of each longwalls;
    - Arrange for reservoirs within the network to be more than 90% capacity during periods of active subsidence of the 450 mm diameter CICL water main;
    - Follow Sydney Water procedures to monitor and respond to high water pressure levels at water reducing valves;
    - Local 2D surveys along local roads as shown in Drawing No. MSEC1193-01-01. These include streets along which potable water pipelines are located, including Remembrance Drive, Caloola Road, Yarran Road and Great Southern Road;
    - Absolute 3D survey of subsidence along Remembrance Drive and the Main Southern Railway;
    - Continuous monitoring of displacement sensors on Gibault joints;
    - Monitoring along the Main Southern Railway in accordance with the Railway Subsidence Management Plan, including ground surveys, rail stress monitoring, track geometry surveys, and visual inspections;
    - Local 3D / Absolute 3D of structure and ground marks on the Remembrance Drive Bridge over the Bargo River, as shown in Drawing No. MSEC1193-03-02;
    - Local 3D / Absolute 3D of structure and ground marks on the Bargo River Road Bridges, as shown in Drawing No. MSEC1193-03-03;
    - Visual inspections along the streets within the active subsidence zone;
    - Additional surveys and/or inspections, if triggered by monitoring results;
    - Regular consultation with the community to report potential impacts;
    - If triggered by monitoring results, excavate and expose the pipeline to relieve it from ground deformations;
    - In the event of damage to the water mains, implement Sydney Water's emergency procedures; and
    - In the worst case, repair of damaged pipeline and supply water to affected customers by alternative methods.

## 4.4. Monitoring measures

A number of monitoring measures will be undertaken during mining.

### 4.4.1. Continuous GNSS monitoring

Global Navigation Satellite System (GNSS) units are fixed survey stations that continuously measure their absolute horizontal and vertical positions in real time.

The locations of GNSS units are shown in Drawings No. MSEC1193-01-01 and the GNSS units that are relevant to managing Sydney Water infrastructure are summarised below:

- Centrelines of LWs S1A to S3A - The GNSS units are located in bushland within the Australian Wildlife Sanctuary. The units are proposed to track the development of subsidence and horizontal movements above the commencing ends of the longwalls. The monitoring data will provide the first subsidence results for each panel to compare against subsidence predictions. Conventional survey lines are not possible in this area due to thick vegetation, preventing lines of sight;
- Main Southern Railway above centreline of LW S5A – GNSS 28 has been installed where the rail corridor is located directly above the centreline of LW S5A at approximate rail kilometrage of 100.52 km. The purpose of the GNSS unit is to detect the initial development of subsidence and trigger the commencement of regular ground surveys; and
- Railway Viaduct across Bargo River - Two GNSS units have been installed within the Main Southern Railway corridor to measure far field movements, if any, between the abutments of the Viaduct. The two GNSS units will also allow valley closure, if any, to be detected. The results will be cross-checked by manual surveys across the Remembrance Drive over the Bargo River

### 4.4.2. Early warning survey lines

*LW S1A Tahmoor Mine Boundary*

A survey line has been installed along the southern boundary of Tahmoor Mine's property, as shown in Drawing No. MSEC1192-01-01. The survey line has been installed with pegs spaced nominally 20 metres apart. The survey line commences at the south-eastern end at the end of an unsealed road that is accessed from Charlies Point Road. The line terminates at the top of Teatree Hollow due to thick vegetation.

The purpose of the survey line is to measure the subsidence profile across the width of LW S1A prior to experiencing significant subsidence along the Main Southern Railway and Remembrance Drive. It is planned to survey the line once a month during the period of active subsidence of LW S1A. Additional surveys can be conducted, if required.

*Main Southern Railway*

LWs S1A to S5A will extract directly beneath the Main Southern Railway prior to mining directly beneath Sydney Water infrastructure along Remembrance Drive and Caloola Road.

A survey has been installed along the Main Southern Railway, as shown in Drawing No. MSEC1192-01-01. The survey line has been installed with pegs spaced nominally 20 metres apart.

Surveys along the Railway will provide an early warning of the magnitude of subsidence that is likely to develop. The surveys will also detect the development of non-conventional subsidence movements along the Railway and provide an opportunity to project locations where potential non-conventional subsidence movements may occur along Remembrance Drive. The IMG can assess the monitoring results and assess whether any additional monitoring and management measures may be required to manage potential impacts along Remembrance Drive and Caloola Road.

It is planned to survey the line weekly during periods of active subsidence. Additional surveys can be conducted, if required.

### 4.4.3. Ground Surveys along streets

Survey lines have been installed along Remembrance Drive, Caloola Road, Yarran Road, Charlies Point Road and Great Southern Road, as shown in Drawing No. MSEC1193-01-01.

The survey lines consist of pegs spaced nominally every 20 metres. 2D surveys will measure levels and horizontal distances between adjacent pegs. Survey pegs along Remembrance Drive will be surveyed in 2D and 3D (level, eastings and northings).

### 4.4.4. Visual inspections

Visual inspections will be undertaken during the period of active subsidence by an experienced inspector appointed by Tahmoor Coal who is familiar with mine subsidence impacts. The inspector will undertake the following:

- Visual inspections along streets within the active subsidence zone;
- Visual inspections at pipeline crossings under creeks; and
- Visual inspections of culverts, embankments, cuttings and bridges.

### 4.4.5. Changes to monitoring frequencies

Monitoring frequencies will continue while Sydney Water infrastructure is experiencing active subsidence due to the extraction of LW S1A-S7A. As a general guide, monitoring is likely to continue until the longwall has moved away from the property by a distance of approximately 450 metres. Monitoring, however, may continue if ongoing adverse impacts are observed.

## 4.5. Triggers and responses

Trigger levels have been developed by Tahmoor Coal based on engineering assessments and consultation with Sydney Water.

Trigger levels for each monitoring parameter are described in the risk control procedures in Table 4.1.

Immediate responses, if triggered by monitoring results, may include:

- Increase in survey and inspection frequencies if required by the IMG;
- Additional surveys and inspections;
- Exposing pipeline to relieve it of stress;
- Repair of impacts that create a serious public safety hazard; and
- In the worst case, restriction on entry, or access to, Sydney Water infrastructure.

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

With respect to the extraction of LW S1A-S7A, no potential hazards have been identified that could reasonably give rise to the need for an emergency response. Of the potential hazards identified in Section 3.6, only a water main break beneath the crossings under Remembrance Drive and Main Southern Railway could possibly give rise to the need for an emergency response. In light of the assessment, Tahmoor Coal and Sydney Water have agreed to conduct further investigations for the purposes of assessing and selecting options and implementing additional risk controls at the road and rail crossing sites, prior to the commencement of LW S4A. With additional controls implemented, the likelihood is considered extremely remote and would require substantial differential subsidence movements to develop before such an event occurs.

As discussed in Section 3.1, mine subsidence movements will develop gradually and there will be ample time to identify the development of potentially adverse differential subsidence movements early, consider whether any additional management measures are required, and repair or adjust affected surface features, in close consultation with Sydney Water.

As documented in Section 4.6, Tahmoor Coal and the IMG will review and assess monitoring reports and consider whether any additional management measures are required on a weekly basis. If potentially adverse differential subsidence movements are detected, it is anticipated that a focussed inspection will be undertaken in the affected area, 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, Tahmoor Coal will be present on site on a more frequent basis to survey or inspect the affected site, and that Sydney Water 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 on public property or in the vicinity of potable water infrastructure, and 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 Tahmoor Coal or by people on public property, Tahmoor Coal and Sydney Water will immediately meet and implement emergency procedures.

## 4.6. Subsidence Impact Management Procedures

The procedures for the management of potential impacts to Sydney Water infrastructure are provided in Table 4.1.

**Table 4.1 Risk Control Procedures during the extraction of Tahmoor LW S1A-S7A**

| INFRASTRUCTURE | HAZARD / IMPACT | RISK | TRIGGER | CONTROL PROCEDURE/S | FREQUENCY | BY WHOM? |
|---|---|---|---|---|---|---|
| Potable water infrastructure | Impacts to Sydney Water potable water infrastructure | Low to High | None | Follow Sydney Water procedures to monitor and respond to high water pressure levels at water reducing valves | Ongoing | Sydney Water |
| | | | | Mark out locations of stop valves on site prior to the influence of each longwalls | Prior to active LW face approaching within 150 metres of each water main within predicted limit of incremental subsidence of each active LW. | Sydney Water |
| | | | | Arrange for reservoirs within the network to be more than 90% capacity during periods of active subsidence of the 450 mm diameter CICL water main | LW S1A: start after 1300m extraction<br>LW S2A: start after 900m extraction<br>LW S3A: start after 500m extraction<br>LW S4A: start after 200m extraction<br>LW S5A: start after 200m extraction<br>LW S6A: start after 200m extraction<br>LW S7A: start after 200m extraction | Sydney Water |
| | | | | Consider and select options and implement additional risk controls at the creek crossing site for the 450 mm diameter CICL water main (most likely to be installation of expansion joints, subject to ongoing investigations)<br>Selected risk controls<br>- Gibault expansion joints installed at Teatree Hollow crossing at intersection of Remembrance Drive and Caloola Road (Creek 1)<br>- Gibault expansion joints installed at Tributary to Teatree Hollow crossing north of intersection of Remembrance Drive and Yarran Road (Creek 2)<br>- Install Gibault expansion joints at Tributary to Teatree Hollow crossing adjacent to Main Southern Railway at 100.425 km (Creek 3) | Teatree Hollow crossing at intersection of Remembrance Drive and Caloola Road and Tributary to Teatree Hollow crossings north of intersection of Remembrance Drive and Yarran Road (Creek 2) complete<br>Install Gibault joints at Tributary to Teatree Hollow crossing at Main Southern Railway at 100.425 km (Creek 3) prior to start of LW S5A | Tahmoor Coal and Sydney Water |
| | | | | Consider and select options and implement additional risk controls at the crossing beneath Remembrance Drive and beneath the Main Southern Railway at 100.380 km (most likely to be installation of valve tees and connection points across the rail crossing, subject to ongoing investigations)<br>Selected risk controls at Remembrance Drive road crossing<br>- Gibault expansion joints installed north of Creek 2, which has reduced the potential for impacts on the right angle bend at the southbound (eastern) side of the crossing<br>Selected risk controls at Main Southern Railway crossing<br>- As-built construction investigated, potential Gibault locations identified, sand bedding placed<br>- Installed concrete washout barrier<br>- Construct earth berm<br>- Install Gibault expansion joint north of creek crossing adjacent to Main Southern Railway at 100.425 km (Creek 3) | Remembrance Drive crossing completed<br>Main Southern Railway crossing completed except for planned installation of Gibault joint north of Creek 3, which will be completed prior to start of LW S5A | Tahmoor Coal and Sydney Water |
| | | | | Continuous monitoring of displacements at Gibault joints | Hourly | Tahmoor Coal (SweetingConsulting) |
| | | | | Continuous GNSS monitoring as shown in Drawing No. MSEC1193-01-01 | GNSS units installed<br>Continuous readings, with data averaged over 24 hours and recorded once per day until end of LW S7A. | Tahmoor Coal (Unit Zero) |
| | | | | 2D survey line along Tahmoor Mine property boundary | Pegs installed. Baseline survey complete<br>Monthly survey during LW S1A between 200m and 1300m extraction, and continue if ongoing adverse movements are observed.<br>End of LW S1A (complete). | Tahmoor Coal (SMEC) |
| | | | | Conduct 2D / Absolute 3D surveys along Main Southern Railway in accordance with Railway Management Plan | Monthly 3D / Weekly 2D surveys for pegs within active subsidence zone during LWs S1A to S7A | Tahmoor Coal (SRS) |
| | | | | Conduct 2D / Absolute 3D surveys along Remembrance Drive | Pegs installed from northern boundary of Tahmoor Mine site to Caloola Road. Baseline survey prior to 900m extraction of LW S1A.<br>Extend line and baseline survey pegs within predicted limit of incremental subsidence of each active LW, prior to active LW face approaching within 600 metres of survey line.<br>Monthly 3D / Weekly 2D surveys for pegs within active subsidence zone commencing as per below:<br>LW S1A: start after 1300m extraction<br>LW S2A: start after 900m extraction<br>LW S3A: start after 500m extraction<br>LW S4A: start after 200m extraction<br>LW S5A: start after GNSS 28 subsides more than 20 mm due to LW S5A or 200m extraction, whichever occurs first<br>LW S6A: start after GNSS 28 subsides more than 20 mm due to LW S6A or 200m extraction, whichever occurs first<br>LW S7A: start after 200m extraction<br>Continue surveys until outside active subsidence zone or one month after end of LW and continue further if ongoing adverse movements are observed.<br>End of LW S1A-S7A. | Tahmoor Coal (SMEC) |

| INFRASTRUCTURE | HAZARD / IMPACT | RISK | TRIGGER | CONTROL PROCEDURE/S | FREQUENCY | BY WHOM? |
|---|---|---|---|---|---|---|
| Potable water infrastructure | Impacts to Sydney Water potable water infrastructure | Low to High | None | Conduct Local 3D / Absolute 3D survey of Remembrance Drive Embankment over Tributary to Teatree Hollow north of Yarran Road (Creek 2) including water main crossing over Remembrance Drive | Install and baseline survey prior to LW S3A (complete).<br>3D Survey at end of LW S3A (complete).<br>Monthly 3D / Weekly 2D surveys within active subsidence zone commencing as per below:<br>LW S4A: start after 300m extraction<br>LW S5A: start after 400m extraction<br>LW S6A: start after 400m extraction<br>Continue if ongoing adverse movements are observed.<br>End of LW S4A-S7A. | Tahmoor Coal (SMEC) |
| | | | | Conduct Local 3D / Absolute 3D survey of Main Southern Railway Embankment over Tributary to Teatree Hollow adjacent to 100.425 km, including water main crossing over Railway | Install and baseline survey prior to LW S3A (complete).<br>3D Survey at end of LW S3A.<br>Monthly 3D / Weekly 2D surveys within active subsidence zone commencing as per below:<br>LW S4A: start after 200m extraction<br>LW S5A: start after 400m extraction<br>LW S6A: start after 400m extraction<br>Continue if ongoing adverse movements are observed.<br>End of LW S4A-S7A. | Tahmoor Coal (SMEC) |
| | | | | Conduct 2D surveys along Caloola Road | Pegs installed. Baseline survey prior to 900m extraction of LW S1A..<br>Survey at end of LW S1A.<br>Weekly 2D surveys for pegs within active subsidence zone commencing as per below:<br>LW S2A: start after 900m extraction<br>LW S3A: start after 800m extraction<br>LW S4A: start after 800m extraction<br>LW S5A: start after 900m extraction<br>LW S6A: start after 900m extraction<br>Continue surveys until outside active subsidence zone or one month after end of LW and continue further if ongoing adverse movements are observed.<br>End of LW S2A-S7A. | Tahmoor Coal (SMEC) |
| | | | | Conduct 2D surveys along Yarran Road | Install and baseline prior to start of LW S3A.<br>Survey at end of LW S3A.<br>Weekly 2D surveys for pegs within active subsidence zone commencing as per below:<br>LW S4A: start after 200m extraction<br>LW S5A: start after 200m extraction<br>LW S6A: start after 200m extraction<br>LW S7A: start after 200m extraction<br>Continue if ongoing adverse movements are observed.<br>End of LW S4A-S7A. | Tahmoor Coal (SMEC) |
| | | | | Conduct 2D surveys along Great Southern Road | Install and baseline complete.<br>Survey at end of LW S3A.<br>Weekly 2D surveys for pegs within active subsidence zone commencing as per below:<br>LW S4A: start after 200m extraction<br>LW S5A: start after 200m extraction<br>LW S6A: start after 200m extraction<br>Continue if ongoing adverse movements are observed.<br>End of LW S4A-S7A. | Tahmoor Coal (SMEC) |
| | | | | Conduct Local 3D survey of structure and ground marks on the Main Southern Railway Viaduct over the Bargo River as per Drawing No. MSEC1193-03-02, with one mark on the Viaduct to be surveyed in Absolute 3D. | Install and baseline survey complete.<br>Monthly surveys between 1000m and one month after end of extraction of LWs S1A to S3A and continue if ongoing adverse movements are observed.<br>End of LW S1A-S3A (complete). | Tahmoor Coal (SRS) |
| | | | | Visual inspections by Track Certifier along Main Southern Railway, including Tributary to Teatree Hollow crossing adjacent to Main Southern Railway at 100.425 km (Creek 3) and Main Southern Railway crossing at 100.380 km | Daily within the active subsidence zone during LWs S4A to S6A and continue if ongoing adverse movements or impacts are observed. | Tahmoor Coal |

| INFRASTRUCTURE | HAZARD / IMPACT | RISK | TRIGGER | CONTROL PROCEDURE/S | FREQUENCY | BY WHOM? |
|---|---|---|---|---|---|---|
| Potable water infrastructure | Impacts to Sydney Water potable water infrastructure | Low to High | None | Visual inspection of Main Southern Railway Viaduct over the Bargo River | Baseline inspection complete<br>Monthly inspections between 1000m and one month after end of extraction of LWs S1A to S3A and continue if ongoing adverse movements are observed.<br>End of LW S1A to S3A (complete) | Tahmoor Coal |
| | | | | Conduct Local 3D survey of structure and ground marks on the Bargo River Road Bridge over tributary to Bargo River and Bargo River Road Bridge over Main Southern Railway as per Drawing No. MSEC1193-03-03, with one mark on each Bridge to be surveyed in Absolute 3D | Install and baseline complete.<br>Monthly surveys between 1000m and one month after end of extraction of LWs S1A to S3A and continue if ongoing adverse movements are observed.<br>End of LW S1A-S3A (complete). | Tahmoor Coal (SRS) |
| | | | | Visual inspection of Bargo River Road Bridges | Baseline inspection complete<br>Monthly inspections between 1000m and one month after end of extraction of LWs S1A to S3A and continue if ongoing adverse movements are observed.<br>End of LW S1A to S3A (complete) | Tahmoor Coal |
| | | | | Detailed visual inspections of local roads, culverts, embankments and cuttings along the routes of the water mains | Weekly for areas within the active subsidence zone during LWs S1A to S7A and continue if ongoing adverse movements or impacts are observed until one month after the extraction of each LW. | Tahmoor Coal (BIS) |
| | | | | Inform Sydney Water Call Centre of mining in area and possible issues. | Completed | Sydney Water |
| | | | | Notify residents of potential mine subsidence impacts and contact numbers. | Completed | Tahmoor Coal |
| | | | | Analyse and report results to IMG, including information on the position of the longwall face. | Weekly during LW S1A-S7A after the length of the extraction exceeds 200 metres. | Tahmoor Coal |
| | | | Non-conventional ground movement detected | Notify Sydney Water | Within 24 hours | Tahmoor Coal |
| | | | | Infrastructure Management Group (IMG) meets to consider whether any additional management measures should be undertaken, including:<br>- increasing the frequency of surveys and visual inspections in vicinity of the non-conventional movement;<br>- investigating for potential of damage occurring to Sydney Water infrastructure; and/or<br>- relieving stresses on the pipes by locally excavating and exposing the pipes in the affected area. | As agreed between Tahmoor Coal and Sydney Water | IMG |
| | | | Leakage of water observed | Notify all stakeholders, including Sydney Water, Tahmoor Coal, Subsidence Advisory NSW and Resources Regulator | Within 24 hours | Tahmoor Coal |
| | | | | Repair leak. | As per Sydney Water procedures<br>(target within 24 hours for 450 mm dia water main) | Sydney Water |
| | | | | Provide alternative water supply to customers | As required | Tahmoor Coal |
| | | | | Consider increasing the frequency of surveys and visual inspections in vicinity of water leak, if appropriate. | As agreed between Tahmoor Coal and Sydney Water | Tahmoor Coal |
| | | | A hazard has been identified that involves potential serious injury or illness to a person or persons on public property or, or in vicinity of potable water infrastructure and cannot be controlled | IMG, Tahmoor Coal and Sydney Water meet to decide whether any additional management measures are required, including:<br>- emergency evacuation of hazardous area<br>- demarcation to prevent people entering hazardous area | Immediately | Tahmoor Coal and Sydney Water |
| | | | | Notify SRG of trigger exceedance and any management decisions undertaken (incl Subsidence Advisory NSW, Resources Regulator) | Within 24 hours of decision | Tahmoor Coal |

| INFRASTRUCTURE | HAZARD / IMPACT | RISK | TRIGGER | CONTROL PROCEDURE/S | FREQUENCY | BY WHOM? |
|---|---|---|---|---|---|---|
| Potable water infrastructure | Impacts to Sydney Water potable water infrastructure | Low to High | Closure between abutments on Main Southern Rail Viaduct over Bargo River exceeds 7 mm<br>or<br>Closure between GNSS units at ends of Main Southern Rail Viaduct over Bargo River exceeds 7 mm<br>or<br>Closure between abutments Bargo River Road Bridge exceeds 5 mm | Notify Sydney Water | Within one week | MSEC |
| | | | | Sydney Water and IMG meet and consider whether any additional management measures are required, which may include:<br>- increase monitoring frequency and reporting procedures<br>- install temporary bypass pipeline over creek crossing at Bargo River (Viaduct) or tributary to Bargo River (Bargo River Road Bridge) | Within one week | IMG |
| | | | | Report trigger exceedance and actions taken to IMG, Sydney Water, SA NSW & MSO in Status Report | Within one week | Tahmoor Coal |

## 5.1. Consultation, co-operation and co-ordination

Substantial consultation, co-operation and co-ordination has taken place between Tahmoor Coal and Sydney Water prior to the development of this Management Plan, as detailed in Section 1.3.1.

The following procedures will be implemented during and after active subsidence of the property to ensure the continued effective consultation, co-operation and co-ordination of action with respect to subsidence between Tahmoor Coal and Sydney Water:

- Reporting of observed impacts to Tahmoor Coal either during the weekly visual inspection or at any time directly to Tahmoor Coal;
- Distribution of monitoring reports, which will provide the following information on a weekly basis during active subsidence:
    - Position of longwall;
    - Summary of management actions since last report;
    - Summary of consultation with Sydney Water since last report;
    - Summary of observed or reported impacts, incidents, service difficulties, complaints;
    - Summary of subsidence development;
    - Summary of adequacy, quality and effectiveness of management process;
    - Any additional and/or outstanding management actions; and
    - Forecast whether there will be any subsidence impacts to the health and safety of people due to the continued extraction of LW S1A-S7A.
- Convening of meetings between Tahmoor Coal and Sydney Water at any time as required, as discussed in Section 5.2;
- Arrangements to facilitate timely repairs, if required; and
- Immediate contact between Tahmoor Coal and Sydney Water if a mine subsidence induced hazard has been identified that involves potential serious injury or illness to a person or persons on public property or Sydney Water property and may require emergency evacuation, entry restriction or suspension of work activities.

## 5.2. IMG meetings

The IMG undertakes reviews and, as necessary, revises and improves the risk control measures to manage risks to health and safety, and potential impacts to infrastructure.

The reviews are undertaken weekly during the period of active subsidence based on the results of the weekly surveys and visual inspections and summarised in the monitoring reports, as described in Section 5.1.

The purpose of the reviews is to:

- Detect changes, including the early detection of potential impacts on health and safety and impacts to Sydney Water infrastructure;
- Verify the risk assessments previously conducted;
- Ensure the effectiveness and reliability of risk control measures; and
- Support continual improvement and change management.

IMG meetings may be held between Tahmoor Coal and Sydney Water for discussion and resolution of issues raised in the operation of the Management Plan. The frequency of IMG Meetings will be as agreed between Tahmoor Coal and Sydney Water.

IMG Meetings will discuss any incidents reported in relation to the relevant infrastructure, the progress of mining, the degree of mine subsidence that has occurred, and comparisons between observed and predicted ground movements.

It will be the responsibility of the meeting representatives to determine whether the incidents reported are due to the impacts of mine subsidence, and what action will be taken in response.

In the event that a significant mine subsidence impact is observed, any party may call an emergency IMG Meeting, with one day's notice, to discuss proposed actions and to keep other parties informed of developments in the monitoring of the infrastructure.

## 6.0 AUDIT AND REVIEW

This Management Plan has been agreed between parties and can be reviewed and updated to continually improve the risk management systems based on audit, review and learnings from the development of subsidence during mining and manage changes in the nature, likelihood and consequence of subsidence hazards.

The review process will be conducted to achieve the following outcomes:

- Gain an improved understanding of subsidence hazards based on ongoing subsidence monitoring and reviews, additional investigations and assessments as necessary, ongoing verification of risk assessments previously conducted, ongoing verification of assumptions used during the subsidence hazard identification and risk assessment process, ongoing understanding of subsidence movements and identified geological structures at the mine;
- Revise risk control measures in response to an improved understanding of subsidence hazards;
- Gain feedback from stakeholders in relation to managing risks, including regular input from business or property owners;
- Ensure on-going detection of early warnings of changes from the results of risk assessments to facilitate corrective or proactive management actions or the commencement of emergency procedures in a timely manner; and
- Ensure timely implementation of a contingency plan in the event that the implemented risk control measures are not effective.

Some examples where review may be applied include:

- Observation of greater impacts on surface features due to mine subsidence than was previously expected;
- Observation of fewer impacts or no impacts on surface features due to mine subsidence than was previously expected; and
- Observation of significant variation between observed and predicted subsidence.

Should an audit of the Management Plan be required during that period, an auditor shall be appointed by Tahmoor Coal to review the operation of the Management Plan and report at the next scheduled Plan Review Meeting. The Management Plan shall be audited for compliance with ISO 31000, or alternative standard agreed with Sydney Water.

## 7.0 RECORD KEEPING

Tahmoor Coal will keep and distribute minutes of any IMG Meeting.

## 8.0 CONTACT LIST

| Organisation | Contact | Phone | Email |
|---|---|---|---|
| NSW Department of Planning and Environment – Resources Regulator | Ray Ramage | (02) 4063 6485<br>0442 551 293 | ray.ramage@regional.nsw.gov.au |
| | Alan Blakeney | 0473 461 118 | alan.blakeney@regional.nsw.gov.au |
| Subsidence Advisory NSW | - | (02) 4908 4300 | subsidenceadvisory@customerservice.nsw.gov.au |
| Mine Subsidence Engineering Consultants (MSEC) | Daryl Kay* | (02) 9413 3777<br>0416 191 304 | daryl@minesubsidence.com |
| SIMEC Mining Tahmoor Coal<br>Project Manager | Ross Barber* | (02) 4640 0028<br>Mob: 0419 466 143 | ross.barber@simecgfg.com |
| SIMEC Mining Tahmoor Coal<br>Environment and Community Officer | Amanda Fitzgerald* | (02) 4640 0057<br>0414 848 213 | amanda.fitzgerald@simecgfg.com |
| SIMEC Mining Tahmoor Coal<br>Community Liaison Specialist | Amanda Bateman | (02) 4640 0025<br>0429 442 811 | amanda.bateman@simecgfg.com |
| Sydney Water | Emergency Line | 13 20 90 | |
| Sydney Water – Lead Operations Engineer<br>Networks West | Richard Nguyen* | 0438 127 522 | richard.nguyen@sydneywater.com.au |

* denotes member of Infrastructure Management Group

# APPENDIX A. Drawings and Supporting Documentation

The following supporting documentation is provided in Appendix A.

**Drawings**

| *Drawing No.* | *Description* | *Revision* |
|---|---|---|
| MSEC1193-01-01 | Monitoring plan | D |
| MSEC1193-04-01 | Water Infrastructure | D |
| MSEC1193-03-02 | MSR Rail Viaduct & Remembrance Drive Bridge over Bargo River | B |
| MSEC1193-03-03 | Bargo River Road Bridges | B |
| MSEC1193-03-07 | Remembrance Drive Embankment over Teatree Hollow over LW S3A (RE4) | B |
| MSEC1193-03-08 | Remembrance Drive Cutting and Embankment north of Yarran Road over LWs S4A and S5A (RE3) | B |
| MSEC1193-03-09 | Remembrance Drive Embankment south of Yarran Road over LW S5A (RE2) | B |
| MSEC1193-03-10 | Remembrance Drive Embankment at Wellers Road intersection beyond LW S6A (RE1) | B |
| MSEC1193-03-11 | Remembrance Drive Cutting north of Yarran Road over LW S4A and S5A (RC1) | B |

**Supporting Documentation**

| | |
|---|---|
| Tahmoor Coal (2022) | *Risk Assessment Report – Infrastructure. Tahmoor Underground – Sydney Water – Sewer and Potable Water*. Tahmoor Coal, October 2022. |
| Tahmoor Coal (2025) | *Risk Assessment Report – Infrastructure*. Tahmoor South – Extraction Plan, Longwall South 7A, July 2025. |
| Axys (2024) | *SIMEC Mining – Tahmoor Mine – Sydney Water – Water Pipeline – Risk Assessment Report*, Axys Consulting, Report No. AR3883, Revision 2, 13 December 2024. |

I:\Projects\Tahmoor South\MSEC1193 - LW S1A-S6A Management Plans\MSEC1193-01 General\AcadData\MSEC1193-01-01 Subsidence Monitoring.dwg

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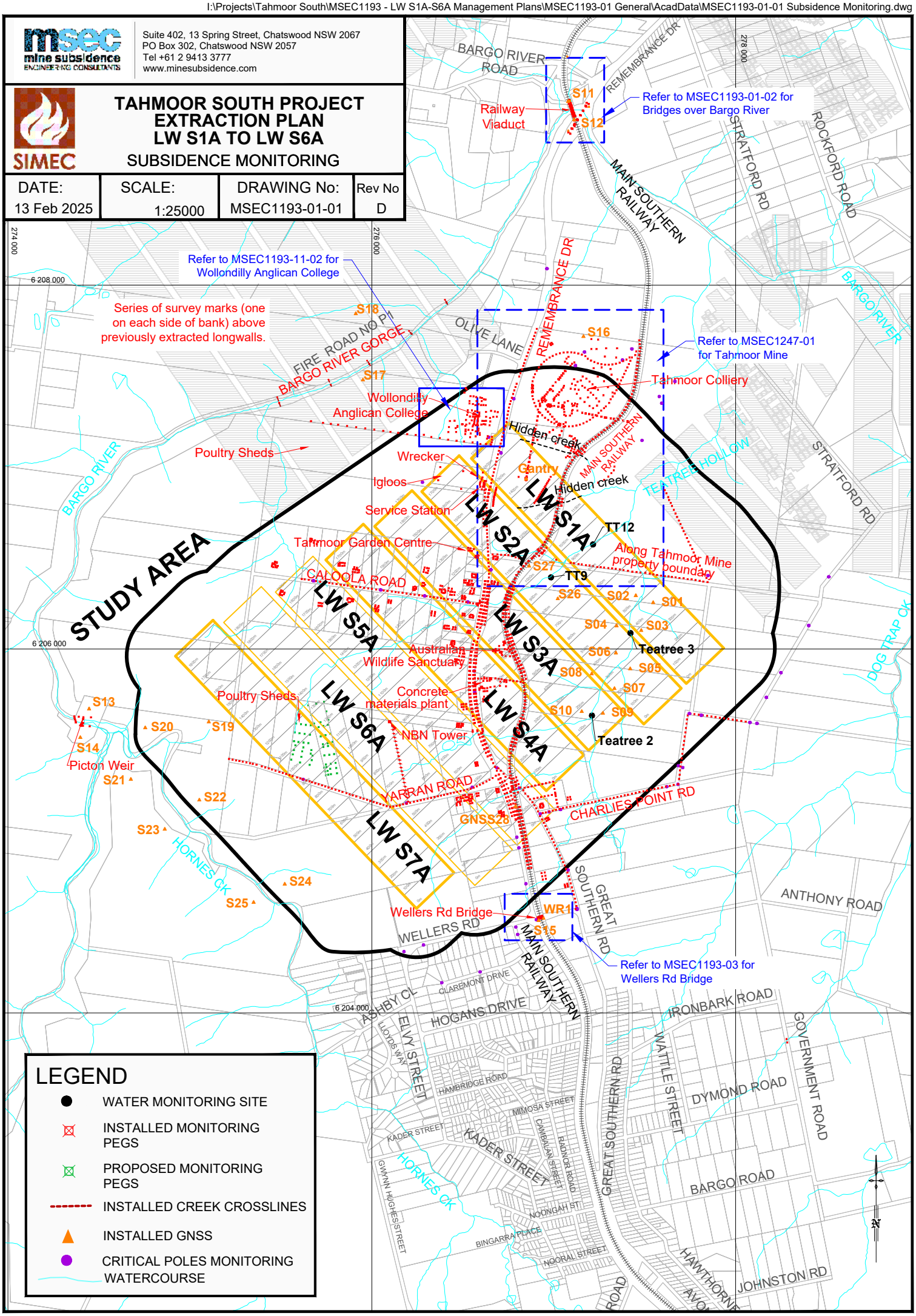
# TAHMOOR SOUTH PROJECT EXTRACTION PLAN LW S1A TO LW S6A

## SUBSIDENCE MONITORING

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 13 Feb 2025 | 1:25000 | MSEC1193-01-01 | D |



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# TAHMOOR SOUTH PROJECT MANAGEMENT PLAN LW S1A TO LW S6A

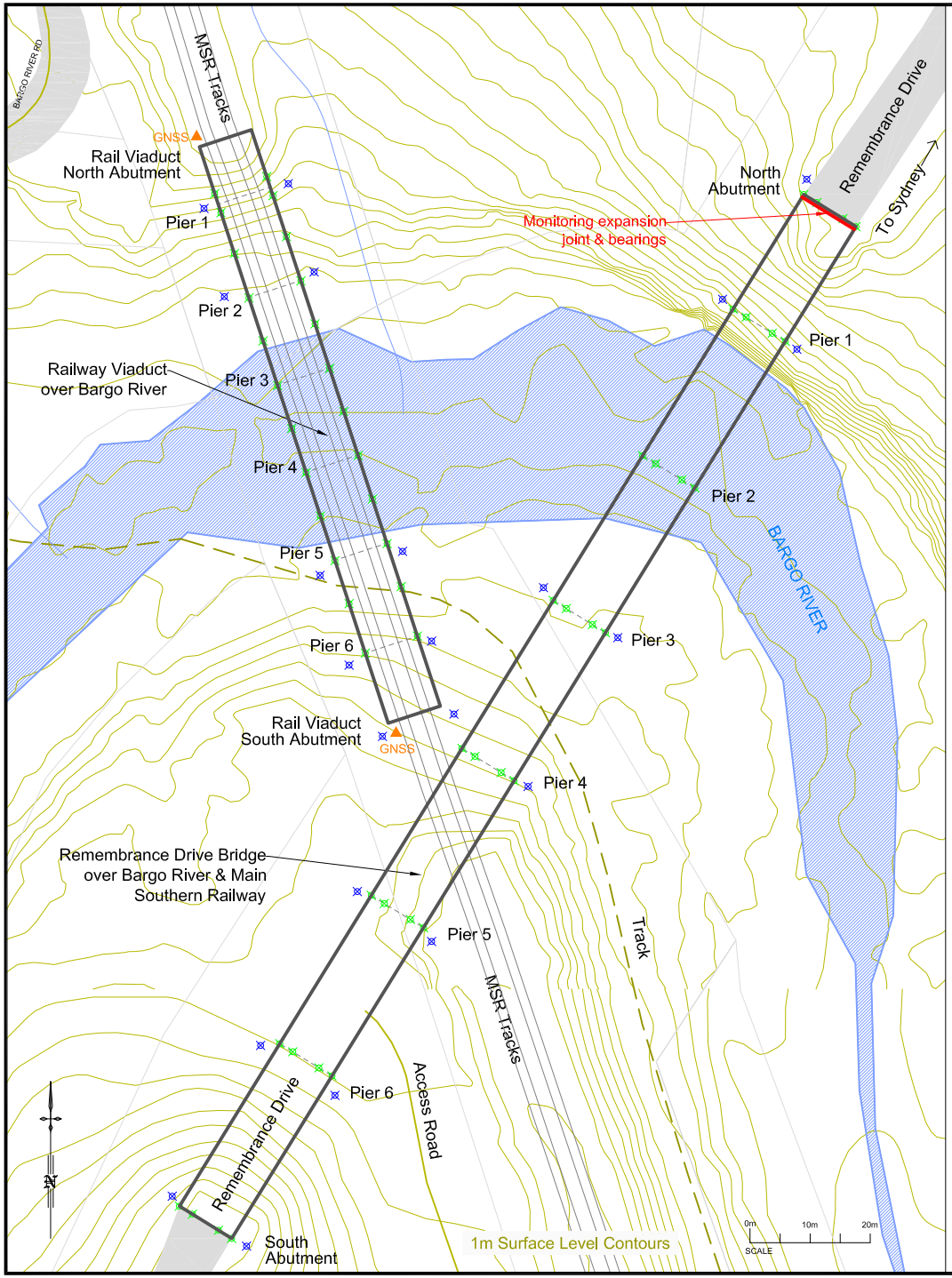
SYDNEY WATER
POTABLE WATER INFRASTRUCTURE

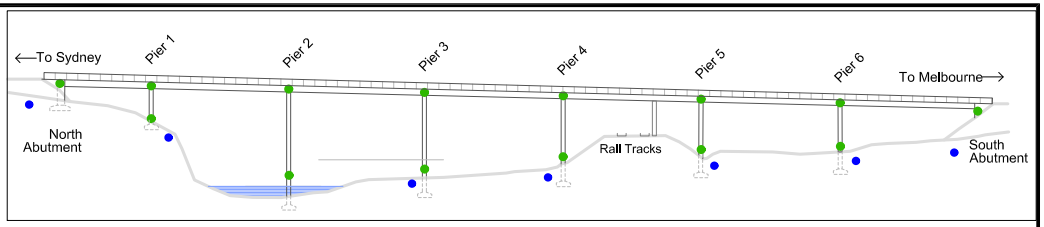
| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 23 Oct 2024 | 1:25000 | MSEC1193-04-01 | D |

PIPE SIZE
- 100 mm Ø
- 150 mm Ø
- 200 mm Ø
- 250 mm Ø
- 300 mm Ø
- 375 mm Ø
- 450 mm Ø
- 500 mm Ø
- 600 mm Ø
- Stop Valves

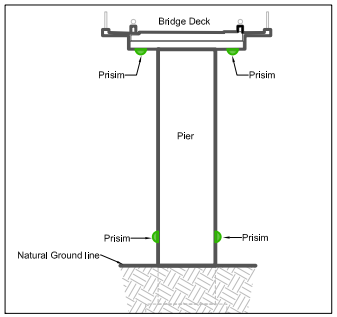
STUDY AREA
LW S1A
LW S2A
LW S3A
LW S4A
LW S5A
LW S6A
LW S7A
Hidden Creek
TEATREE HOLLOW
TRIBUTARY OF TEATREE HOLLOW
BARGO RIVER
Bargo River Rd over Railway
Railway Viaduct
Bargo River Rd over tributary
Remembrance Drive Bridge
Wellers Rd Bridge (WR-BR1)
Kader St bridge (KS-BR1)
TANK
PICTON DAM WALL
TRIBUTARY 2 OF DOG TRAP CREEK
TRIBUTARY 1 OF DOG TRAP CREEK
DOGTRAP CK
(D-section) Type: DICL Size: 375mmØ Size: 100mmØ
Type: CICL Size: 450mmØ
(T-section) Type: SCL Size: 450mmØ
Type: CICL Size: 100mmØ
Type: CICL Size: 200mmØ
Type: DICL Size: 100mmØ
Type: CICL Size: 100mmØ
Type: DICL Size: 100mmØ
(T-section) Type: CICL Size: 150mmØ
Type: DICL Size: 200mmØ
Grid to MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1193 - LW S1A-S6A Management Plans\MSEC1193 Bridges\AcadData\MSEC1193- Monit Bridges Rail Viaduct & Remebrance Dr.dwg

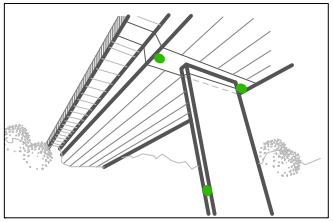



**ELEVATION - REMEMBRANCE DRIVE BRIDGE OVER BARGO RIVER**

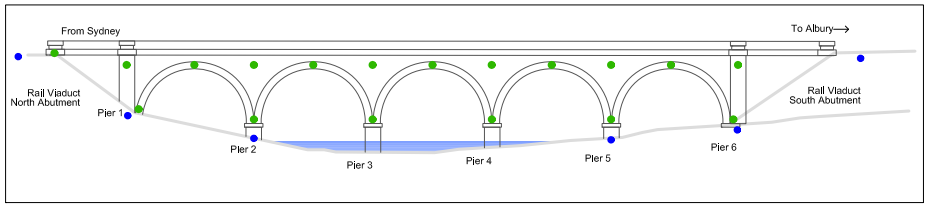



**TYPICAL PIER** (nts)



**DIAGRAM**

- PROPOSED STRUCTURE PRISMS
- PROPOSED GROUND PEGS




**ELEVATION - RAIL VIADUCT OVER BARGO RIVER**

**LEGEND**

- PROPOSED STRUCTURE PRISMS
- PROPOSED GROUND PEGS
- PROPOSED GNSS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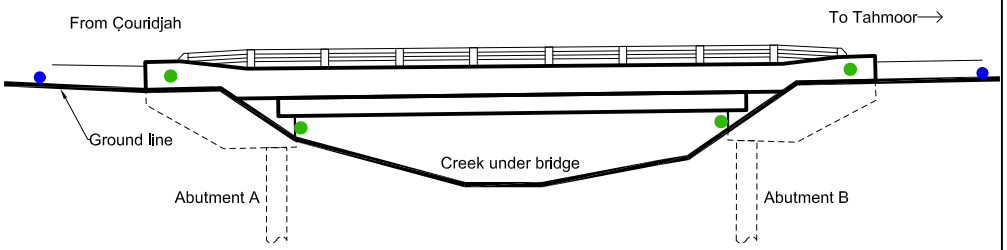
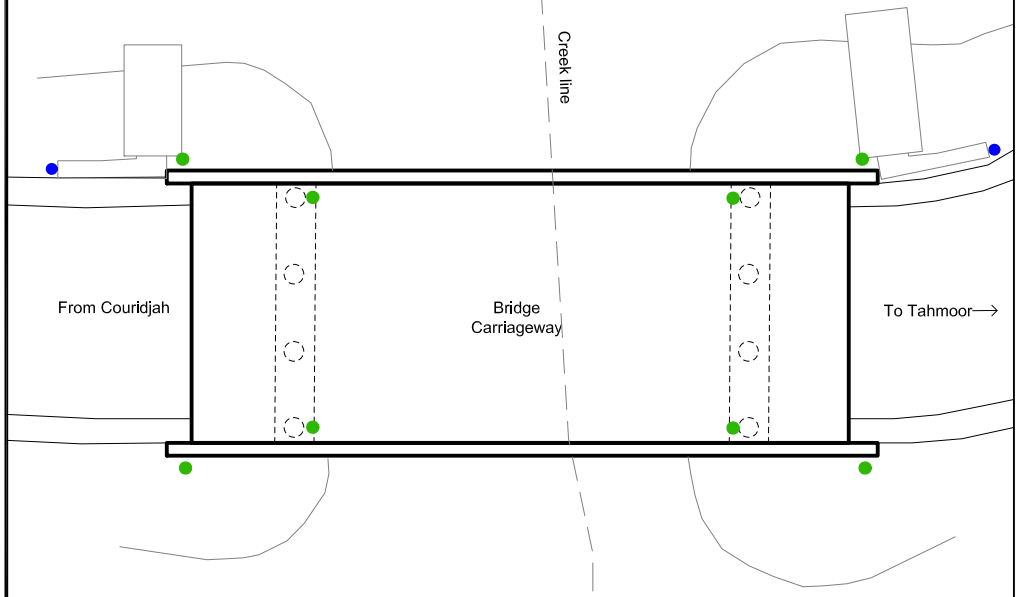
# TAHMOOR SOUTH PROJECT
## LWS1A TO LWS6A
## MSR RAIL VIADUCT & REMEMBRANCE DRIVE BRIDGE OVER BARGO RIVER

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 19 Oct 2022 | as shown | MSEC1193-03-02 | B |

I:\Projects\Tahmoor South\MSEC1193 - LW S1A-S6A Management Plans\MSEC1193 Bridges\AcadData\MSEC1193- Monit_Bargo River Bridge.dwg

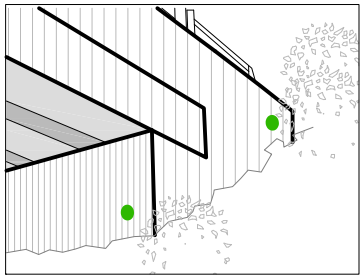



**ELEVATION BRIDGE OVER CREEK**

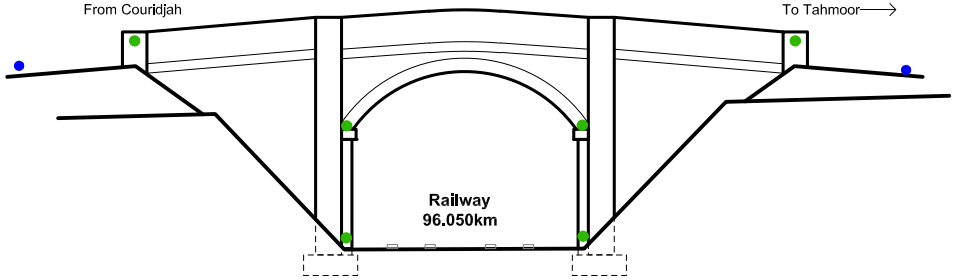



**PLAN VIEW BRIDGE OVER CREEK**

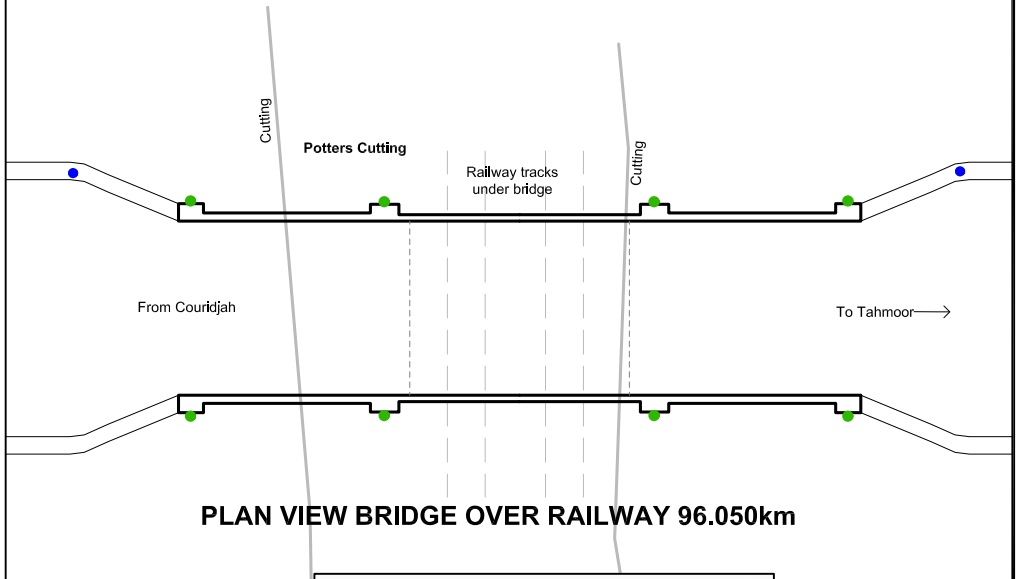
**BARGO RIVER ROAD BRIDGE OVER TRIBUARY OF BARGO RIVER**



**TYPICAL**




**ELEVATION BRIDGE OVER RAILWAY**




**PLAN VIEW BRIDGE OVER RAILWAY 96.050km**

**BARGO RIVER ROAD BRIDGE OVER MAIN SOUTHERN RAILWAY**

**LEGEND**

- PROPOSED STRUCTURE PRISMS
- PROPOSED GROUND PEGS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**TAHMOOR SOUTH PROJECT**
**LWS1A TO LWS6A**

BARGO RIVER ROAD BRIDGES

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 19 Oct 2022 | nts | MSEC1193-03-03 | B |

I:\Projects\Tahmoor South\MSEC1193 - LW S1A-S6A Management Plans\MSEC1193-03 Wollondilly Shire Council\AcadData\MSEC1193-03-07 Remembrance Dr Embkmt_Teatree Hollow_LWS3A (RE4).dwg

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# TAHMOOR SOUTH PROJECT
## LWS1A TO LWS6B

REMEMBRANCE DRIVE EMBANKMENT OVER
TEATREE HOLLOW OVER LW S3A (RE4)

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 19 Oct 2022 | as shown | MSEC1193-03-07 | B |

LEGEND
- 11kV POWERLINES
- GAS PIPELINE
- WATER PIPELINE
- SEWER PIPELINE
- OPTICAL FIBRE CABLES

LEGEND
- ANCHOR POINTS
- STRAIN GAUGES
- SWITCHES
- MONITORING PEGS
- EMBANKMENT MONITORING PEGS
- EMBANKMENT MONITORING LINES
- BOREHOLES
- CULVERTS
- 1m SURFACE LEVEL CONTOURS

0m 25m 50m
SCALE

N

853038

798853

LW S3A

LW S2A

ES4

SEWER PIPELINE

GAS PIPELINE

11kV POWERLINES

WATER PIPELINE

REMEMBRANCE DRIVE

OPTICAL FIBRE CABLES

bus shelter

CALOOLA RD

Culvert 99.338

Teatree Hollow

AP4

99.460

99.340

99.400

99.4 km

99.500

99.5 km

99.580

Main Southern Railway

EMBANKMENT 99.338 km

I:\Projects\Tahmoor South\MSEC1193 - LW S1A-S6A Management Plans\MSEC1193-03 Wollondilly Shire Council\AcadData\MSEC1193-03-08 Embkmt_Remembrance Dv_Yarran Road_LW S5A (RE3).dwg

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# TAHMOOR SOUTH PROJECT LWS1A TO LWS6B

REMEMBRANCE DRIVE EMBANKMENT NORTH OF YARRAN RD OVER LW S4A & LW S5A (RE3)

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 19 Oct 2022 | as shown | MSEC1193-03-08 | B |

**LEGEND**
- ANCHOR POINTS
- STRAIN GAUGES
- SWITCHES
- MONITORING PEGS
- EMBANKMENT MONITORING PEGS
- EMBANKMENT MONITORING LINES
- BOREHOLES
- CULVERTS
- 1m SURFACE LEVEL CONTOURS

LEGEND
- 11kV POWERLINES
- GAS PIPELINE
- WATER PIPELINE
- SEWER PIPELINE
- OPTICAL FIBRE CABLES

0m 25m 50m
SCALE

CUTTING

LW S4A

LW S5A

11kV POWERLINES

GAS PIPELINE

EMBANKMENT
100.121 km

Culvert 100.121

AP6

EMBANKMENT

WATER PIPELINE

SEWER PIPELINE

REMEMBRANCE DRIVE

OPTICAL FIBRE CABLES

Main Southern Railway

100 km

100.1 km

100.2 km

100.3 km

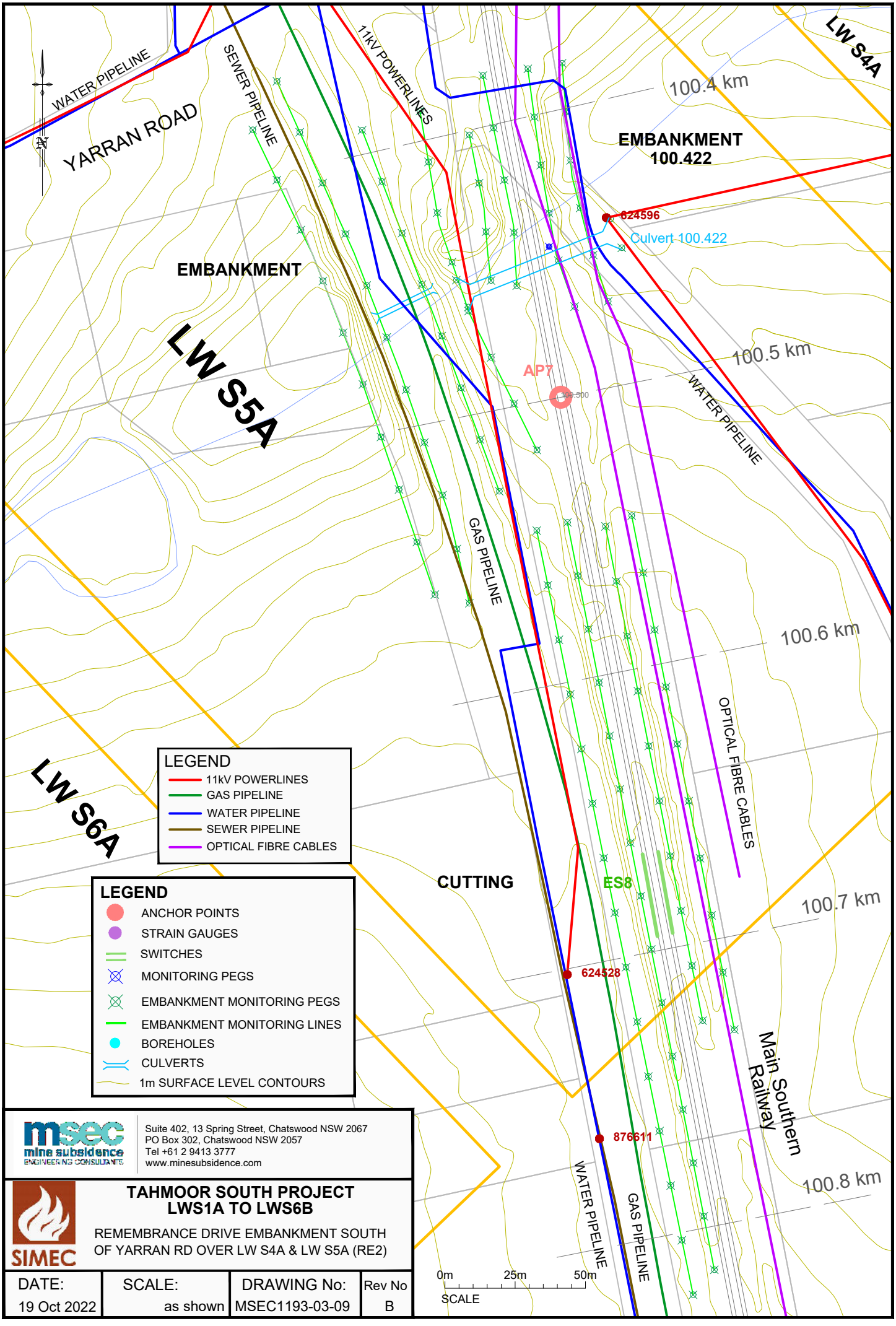
772375

ES7

To Yarran Rd

N

I:\Projects\Tahmoor South\MSEC1193 - LW S1A-S6A Management Plans\MSEC1193-03 Wollondilly Shire Council\AcadData\MSEC1193-03-09 Embkmt_Remembrance Dv_Yarran Road_LW S5A (RE2).dwg




LEGEND
- 11kV POWERLINES
- GAS PIPELINE
- WATER PIPELINE
- SEWER PIPELINE
- OPTICAL FIBRE CABLES

**LEGEND**
- ANCHOR POINTS
- STRAIN GAUGES
- SWITCHES
- MONITORING PEGS
- EMBANKMENT MONITORING PEGS
- EMBANKMENT MONITORING LINES
- BOREHOLES
- CULVERTS
- 1m SURFACE LEVEL CONTOURS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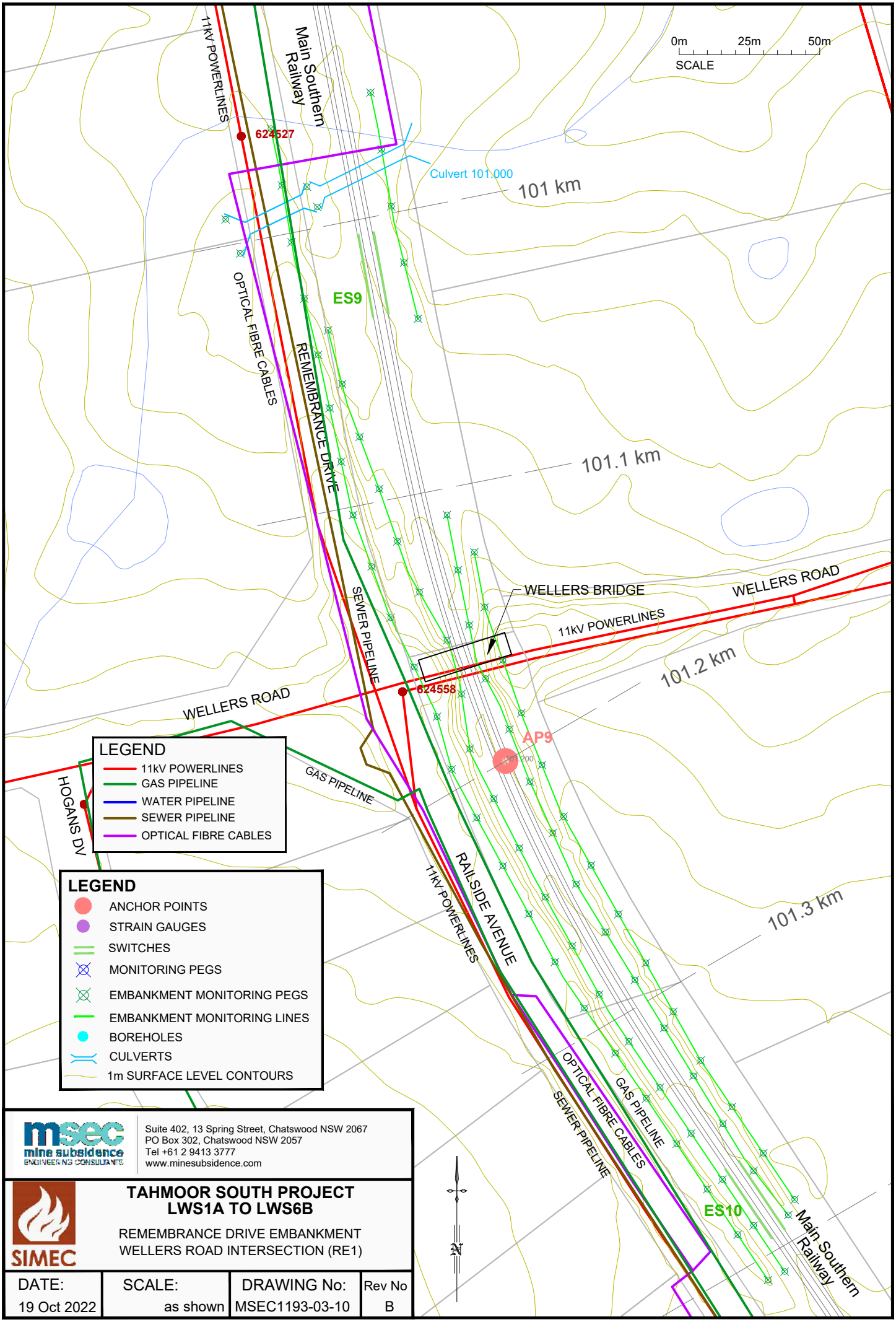
**TAHMOOR SOUTH PROJECT**
**LWS1A TO LWS6B**

REMEMBRANCE DRIVE EMBANKMENT SOUTH OF YARRAN RD OVER LW S4A & LW S5A (RE2)

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 19 Oct 2022 | as shown | MSEC1193-03-09 | B |

I:\Projects\Tahmoor South\MSEC1193 - LW S1A-S6A Management Plans\MSEC1193-03 Wollondilly Shire Council\AcadData\MSEC1193-03-10 Embkmt_Remembrance Dv_Wellers Rd_LWS6A.dwg





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# TAHMOOR SOUTH PROJECT LWS1A TO LWS6B

REMEMBRANCE DRIVE EMBANKMENT
WELLERS ROAD INTERSECTION (RE1)

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 19 Oct 2022 | as shown | MSEC1193-03-10 | B |

I:\Projects\Tahmoor South\MSEC1193 - LW S1A-S6A Management Plans\MSEC1193-03 Wollondilly Shire Council\AcadData\MSEC1193-03-11 Remembrance Dv Cutting_LW S4A.dwg

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# TAHMOOR SOUTH PROJECT
## LWS1A TO LWS6B

REMEMBRANCE DRIVE CUTTING NORTH OF YARRAN RD OVER LW S4A & LW S5A (RC1)

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 19 Oct 2022 | as shown | MSEC1193-03-11 | B |

LEGEND
- 11kV POWERLINES
- GAS PIPELINE
- WATER PIPELINE
- SEWER PIPELINE
- OPTICAL FIBRE CABLES

LEGEND
- ANCHOR POINTS
- STRAIN GAUGES
- SWITCHES
- MONITORING PEGS
- EMBANKMENT MONITORING PEGS
- EMBANKMENT MONITORING LINES
- BOREHOLES
- CULVERTS
- 1m SURFACE LEVEL CONTOURS

SCALE 0m 25m 50m

LW S3A
LW S4A
LW S5A
CUTTING
CUTTING
EMBANKMENT
100.121 km
GAS PIPELINE
SEWER PIPELINE
11KV POWERLINES
WATER PIPELINE
REMEMBRANCE DRIVE
OPTICAL FIBRE CABLES
Main Southern Railway
ES5
ES6
AP5
AP6
857627
396228
99.6 km
99.7 km
99.8 km
99.9 km
100 km
100.1 km
Culvert 100.121
To Yarran Rd
N

# Equipment Risk Assessment: Tahmoor Underground - Sydney Water - Sewer and Potable Water

| | Step 2: Assess Type; Key Elements-These change depending on TYPE of Risk Assessment | | | Step 3: Identify the risks, causes and potential consequences | | | Step 4: Identify the existing controls to manage the identified risks | Step 5: Determine RCE | Steps 6, 7 & 8: Determine the Expected Consequence / Likelihood applicable to the Expected Consequence / Current level of risk | | | Step 10: PMC | | Step 11: Treat the Risks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appendix B | Type of Risk Assessment | Key Element (CURA Context/Category) | Sub Key Element (If applicable) | Risk Description - Something happens…… | Consequence - resulting in: | Causes - Caused by | Existing Control Description | Risk Control Effectiveness | Expected Consequence Category | Expected Risk Consequence | Risk Likelihood | Current Risk Rating | Potential Maximum Consequence | Potential Maximum Category | Treatment plans/tasks (Description) | Task Owner | Due Date | Comments |
| Tahmoor Underground | Equipment | Sydney Water Sewer Main | Within Tahmoor South Study Zone and far field service crossings | Sydney Water Sewer PE180mm Pipe running along Remembrance Drive effected by Subsidence | Potential interruption / blocking of sewer service | 1 Mining Induced Ground Movement<br>2 Potential Valley Closure<br>3 Leakage from cracked or blocked pipe | Inherent Control:<br>1. Public Notification of service issues direct to Sydney Water<br>2. Designed PE Pipe for Main Supply - designed to handle subsidence impacts.<br>3. All domestic residence within subsidence zone are on contain Septic systems (council).<br><br>Monitoring Controls as per Tahmoor Coal Sydney Water SEWER Management Plan:<br>4. Survey Monitoring plan<br>5. Visual Inspections and reporting<br>6. Geotechnical inspections and reporting during active mining subsidence of embankments and cuttings.<br>7. Review, Report and Technical meetings to review and assess trending data.<br><br>Trigger Response Action Plan:<br>Trigger Response Action Plan:<br>8. Contained within the Management is a staged Trigger response to potential high strain locations including excavating / uncoupling pipe to relieve pressure. | 2 | Health & Safety | 3 | E | 6 | 3 | Health & Safety | Seek advice on the potential installation of a pressure monitoring device on the pipe line to monitor pressure drops to pick up any ruptures/leaks etc. Post LW S1A. | Ross Barber | | Tahmoor Coal has developed and implemented measures to successfully manage potential impacts on pipe services |
| Tahmoor Underground | Equipment | | | | | | | | | | | | | | Confirm locations of valves / cross connections within the mining area and consider additional management measures. | Ross Barber | | |
| Tahmoor Underground | Equipment | | | Sydney Water Sewer PE180mm Pipe running along Remembrance Drive effected by Subsidence | Environmental Impact | Rupture escape of sewer | Inherent Control:<br>1. Public Notification of service issues direct to Sydney Water<br>2. Designed PE Pipe for Main Supply - designed to handle subsidence impacts.<br>3. All domestic residence within subsidence zone are on contain Septic systems (council).<br><br>Monitoring Controls as per Tahmoor Coal Sydney Water SEWER Management Plan:<br>4. Survey Monitoring plan<br>5. Visual Inspections and reporting<br>6. Geotechnical inspections and reporting during active mining subsidence of embankments and cuttings.<br>7. Review, Report and Technical meetings to review and assess trending data.<br><br>Trigger Response Action Plan:<br>8. Contained within the Management is a staged Trigger response to potential high strain locations including excavating / uncoupling pipe to relieve pressure. | 2 | Environment | 3 | E | 6 | 3 | Environment | Confirm location of pipe along the road corridor to determine high risk locations to assist with contingency planning. | Ross Barber | | Tahmoor Coal has developed and implemented measures to successfully manage potential impacts on pipe services |
| Tahmoor Underground | Equipment | | | Sydney Water Sewer 150mm (DICL) Pipe running on far field bridges effected by Subsidence | Environmental Impact | Rupture escape of sewer | Inherent Control:<br>1. Public Notification of service issues direct to Sydney Water<br>2. Designed Expansions / Bellows in Pipe for Main Supply - designed to handle subsidence impacts.<br>3. All domestic residence within subsidence zone are on contain Septic systems (council).<br><br>Monitoring Controls as per Tahmoor Coal Sydney Water SEWER Management Plan:<br>4. Survey Monitoring plan<br>5. Visual Inspections and reporting<br>6. Geotechnical inspections and reporting during active mining subsidence of embankments and cuttings.<br>7. Review, Report and Technical meetings to review and assess trending data.<br><br>Trigger Response Action Plan:<br>8. Contained within the Management is a staged Trigger response to potential high strain locations including excavating / uncoupling pipe to relieve pressure. | 2 | Environment | 3 | E | 6 | 3 | Environment | Investigate with Sydney Water the sensor on the Remembrance drive bridge supply is monitoring | | | |
| Tahmoor Underground | Equipment | Sydney Water Domestic road supply Services (not 450mm) (CICL) and (DICL) | Yarran Road 100mm & 200mm<br>Coloola 100mm<br>Remembrance Drive 100m | Sydney Water Potable 100 - 200mm Water Pipe running along streets to a series of houses effected by Subsidence | Potential interruption or damage to water supply to local residences | 1 Mining Induced Ground Movement<br>2 Potential Valley Closure<br>3 Leakage from cracked or blocked pipe | Inherent Control:<br>1. Public Notification of service issues direct to Sydney Water<br>2. Inherent controls with spigot and socket joints<br><br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan:<br>3. Survey Monitoring plan<br>4. Visual Inspections and reporting<br>5. Review, Report and Technical meetings to review and assess trending data.<br><br>Trigger Response Action Plan:<br>6. Contained within the Management is a staged Trigger response to potential high strain | 2 | Health & Safety | 2 | D | 5 | 2 | Health & Safety | Confirm locations of valves within the mining area and consider additional management measures. | Ross Barber | | Tahmoor Coal has developed and implemented measures to successfully manage potential impacts on pipe services |
| Tahmoor Underground | Equipment | Sydney Water Domestic road supply Services | 450mm (CICL) Water supply pipe running along Remembrance drive - under the MSR - along Great South Rd (Excluding Creek Crossings and Under MSR and Under Remembrance Drive) | Sydney Water 450mm Pipe running along Remembrance Drive effected by Subsidence | Potential interruption or damage to water supply to local residences Resulting in<br>- Loss of water to Picton, Thirlmere, Buxton and Oakdale Reservoir's, supply issue<br>- Damage to road reserve infrastructure form pipe failure | 1. Mining Induced Ground Movement<br>2. Potential Valley Closure<br>3. Leakage from cracked or blocked pipe | Inherent Control:<br>1. Public Notification of service issues direct to Sydney Water<br>2. Inherent controls with spigot and socket joints<br>3. Sydney Water to maintain reservoirs above 90% during active subsidence to provide 24 / 48 hour repair time.<br><br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan:<br>3. Survey Monitoring plan<br>4. Visual Inspections and reporting<br>5. Review, Report and Technical meetings to review and assess trending data.<br><br>Trigger Response Action Plan:<br>6. Contained within the Management is a staged Trigger response to potential high strain locations | 2 | Health & Safety | 3 | D | 9 | 3 | Health & Safety | Confirm locations of valves within the mining area and consider additional management measures. | Ross Barber | | Tahmoor Coal has developed and implemented measures to successfully manage potential impacts on pipe services |
| Tahmoor Underground | Equipment | | 450mm (CICL) Water supply pipe running along Creek Crossings | Sydney Water 450mm Pipe running along Creek Crossings effected by Subsidence | Potential interruption or damage to water supply to local residences Resulting in<br>- Loss of water to Picton, Thirlmere, Buxton and Oakdale Reservoir's, supply issue<br>- Damage to road reserve infrastructure form pipe failure | 1. Mining Induced Ground Movement<br>2. Potential Valley Closure<br>3. Leakage from cracked or blocked pipe | Inherent Control:<br>1. Public Notification of service issues direct to Sydney Water<br>2. Inherent controls with spigot and socket joints<br>3. Sydney Water to maintain reservoirs above 90% during active subsidence to provide 24 / 48 hour repair time.<br><br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan:<br>3. Survey Monitoring plan<br>4. Visual Inspections and reporting<br>5. Review, Report and Technical meetings to review and assess trending data.<br><br>Trigger Response Action Plan:<br>6. Contained within the Management is a staged Trigger response to potential high strain | 2 | Community / Reputation | 3 | B | 17 | 3 | Community / Reputation | Investigate options for creek crossing mitigation (Teatree hollow and tributary's) prior to S3A to determine mitigation controls. | Ross Barber | | |
| Tahmoor Underground | Equipment | | 450mm (CICL) Water supply pipe running along Remembrance drive - under the MSR - along Great South Rd | Sydney Water 450mm Pipe running Remembrance Drive Road Crossing and Rail Service Crossings effected by Subsidence | Potential interruption or damage to water supply to local residences Resulting in<br>- Loss of water to Picton, Thirlmere, Buxton and Oakdale Reservoir's, supply issue<br>- Damage to road reserve infrastructure form pipe failure | 1. Mining Induced Ground Movement<br>2. Potential Valley Closure<br>3. Leakage from cracked or blocked pipe | Inherent Control:<br>1. Public Notification of service issues direct to Sydney Water<br>2. Inherent controls with spigot and socket joints<br><br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan:<br>3. Survey Monitoring plan<br>4. Visual Inspections and reporting<br>5. Review, Report and Technical meetings to review and assess trending data.<br><br>Trigger Response Action Plan:<br>6. Contained within the Management is a staged Trigger response to potential high strain | 2 | Community / Reputation | 4 | D | 14 | 4 | Community / Reputation | Investigate options for mitigating impacts at crossings including temporary bypass lines and additional joints / flexible joints prior to mining LWS4A. | Ross Barber | | |
| Tahmoor Underground | Equipment | | 450mm (CICL) Water supply pipe running along Bargo Riverbed | Sydney Water 450mm Pipe running across Bargo Riverbed | Potential interruption or damage to water supply to local residences Resulting in<br>- Loss of water to Picton, Thirlmere, Buxton and Oakdale Reservoir's, supply issue<br>- Damage to road reserve infrastructure form pipe failure | 1. Mining Induced Ground Movement<br>2. Potential Valley Closure<br>3. Leakage from cracked or blocked pipe | Inherent Control:<br>1. Public Notification of service issues direct to Sydney Water<br>2. Inherent controls with spigot and socket joints<br><br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan:<br>3. Survey Monitoring plan<br>4. Visual Inspections and reporting<br>5. Review, Report and Technical meetings to review and assess trending data.<br><br>Trigger Response Action Plan:<br>6. Contained within the Management is a staged Trigger response to potential high strain | 3 | Community / Reputation | 4 | E | 10 | 4 | Community / Reputation | | | | |

# Major Project Risk Assessment: Tahmoor Underground - Extraction Plan Update to include Longwall South 7A

| Step 2: Assess Type; Key Elements-These change depending on TYPE of Risk Assessment | Step 3: Identify the risks, causes and potential consequences | Step 4: Identify the existing controls to manage the identified risks | Step 5: Determine RCE | Steps 6, 7 & 8: Determine the Expected Consequence / Likelihood applicable to the Expected Consequence / Current level of risk | Step 10: PMC | Step 11: Treat the Risks |
|---|---|---|---|---|---|---|

☑ Appendix B

| Key Element (CURA Context/Category) | Sub Key Element (If applicable) | Risk Description - Something happens…… | Consequence - resulting in: | Causes - Caused by | Existing Control Description | Risk Control Effectiveness | Expected Consequence Category | Expected Risk Consequence | Risk Likelihood | Current Risk Rating | Potential Maximum Consequence | Potential Maximum Category | Treatment plans/tasks (Description) | Task Owner | Due Date | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Built Infrastructure | Sydney Water Potable Water Infrastructure | Leakage of the joints | Reduced water supply requiring emergency repair or replacement of pipework | Subsidence | * Management Plans prepared for previous longwalls<br>* Previous ground survey and visual inspection as part of LW 22-W4 management and LW S1A to S3A management<br>* Previous consultation, coordination and cooperation with Sydney Water | 2 | Property Damage | 2 | D | 5 | 2 | Property Damage | Review and update Sydney Water Potable Water Management Plan including TARP and susbisdence effect on 200mm CICL pipe | Ross Barber | 01-Mar-27 | |

# SIMEC Mining - Tahmoor Mine

## Sydney Water - Water Pipelines

Risk Assessment Report

AR3883

Revision 2

13 December 2024

Assessment and report completed by;
AXYS Consulting Pty Ltd
PO Box 1011, Wilton, 2571
NSW, Australia
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## 1. Revisions

| Rev No | Date | Description |
|---|---|---|
| 1 | 11 June 2024 | Initial Release |
| 2 | 13 December 2024 | Review of risk assessment hazard 1E1 following notice that underbore of rail crossing will not be delivered in time |

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## 2. Participants

| Name | Position | Relevant Years' Experience |
|---|---|---|
| Revision 1 - 11-6-2024 | | |
| Paul Sweeting | Sweeting Consulting<br>Monitoring Engineer | 26 Years |
| Mark Delaney | Newcastle Geotech<br>Geotechnical Engineer | 35 Years |
| Brendan O'Connor | Sydney Water<br>Project Manager | |
| Richard Nguyan | Sydney Water<br>Operations Lead | 7 Years |
| David Talbert | SIMEC - Tahmoor Coal Pty Ltd<br>Project Manager | 30 Years |
| Ross Barber | SIMEC - Tahmoor Coal Pty Ltd<br>Project Manager Subsidence | 15 Years |
| Daryl Kay | MSEC<br>Ming Subsidence Engineer | 20 Years |
| Grant Mason | Burnett Engineering<br>Engineer | |
| Amanda Fitzgerald | SIMEC - Tahmoor Coal Pty Ltd<br>Environment and Community Officer | 6 Years |
| | | |
| Revision 2 - 13-12-2024 | | |
| Amanda Fitzgerald | SIMEC - Tahmoor Coal Pty Ltd<br>Environment and Community Officer | 6 Years |
| David Talbert | SIMEC - Tahmoor Coal Pty Ltd<br>Project Manager | 30 Years |
| Ross Barber | SIMEC - Tahmoor Coal Pty Ltd<br>Project Manager Subsidence | 15 Years |
| Daryl Kay | MSEC<br>Ming Subsidence Engineer | 20 Years |
| David Ho | Advisian Worley<br>Principal Consultant | 20 Years |
| Mark Delaney | Newcastle Geotech<br>Geotechnical Engineer | 35 Years |
| Richard Nguyan | Sydney Water<br>Operations Lead | 7 Years |

## 3. Introduction

This risk assessment was undertaken for Tahmoor Coking Coal Operations (Tahmoor), on potential subsidence impacts of Tahmoor's South Project longwalls LWS3A through to LWS7A on the Sydney Water pipelines. The pipeline supplies potable water to the townships of Tahmoor and Picton in the Macarthur Region of New South Wales.

Tahmoor has mined coal by longwall methods from the Southern Coalfields since 1987 and in that time has maintained a harmonious co-existence with the communities of; Tahmoor to the south-east, Thirlmere to the west and Picton to the north. Subsidence from longwall mining has impacted private dwellings, community and other infrastructure, including; the Main Southern Railway Line and associated bridges, culvert, embankments and cuttings.

All subsidence is monitored commensurate with the criticality of impact and a range of mitigation measures has been devised to provide every means of ensuring that only tolerable and sustainable impacts occur. Mitigation measures include; rail expansion joints and relevelling on the Main Southern Railway Line and uncovering of the gas pipelines to uncouple them from the ground during subsidence.

This report is for the risk assessment of the impacts on the Sydney Water pipelines from LWS3A through to LWS7A only.

The overriding objective of this risk assessment was to engage with the asset owner (Sydney Water) and subject specialists (subsidence and structural engineers) to identify and assess the risks and to develop mitigation strategies, where necessary, to prevent So Far As Is Reasonably Practicable (SFAIRP) unacceptable or unsustainable subsidence impacts to the Sydney Water Pipelines and associated consequential outcomes, e.g., to public safety.

There were no non-consensus items identified during the risk assessment.

This assessment was reviewed in December 2024 to review hazard 1E1 following notice that underbore of rail crossing will not be delivered in time.

## 4. System Description

Tahmoor is located approximately 80 kilometres south-west of Sydney in the Southern Coalfields of New South Wales, within the Wollondilly Shire Council. Tahmoor has mined in this area employing longwall methods since 1987 and in that time has maintained a harmonious co-existence with the communities of; Tahmoor to the south-east, Thirlmere to the west and Picton to the north.

Tahmoor extracts up to 4Mtpa of Run of Mine (ROM), with up to 33Mt of ROM coal proposed over the remaining Life of the Project. This will produce approximately 2.5Mtpa of Hard Coking Coal for steel production.

The next years of production will focus on the Tahmoor South (Bargo) Area, which contains a further 4 longwall blocks, divided into the A-Series (northern blocks LWA3A – LWS6A) and the B-Series (southern blocks LW1B – LW6B). Tahmoor received Development Consent for both A and B Series blocks in early April 2022. Tahmoor Coal is also seeking approval for Longwall S7A that planned to be extracted after LW S6A.

Tahmoor South undermines private dwellings, businesses and private and government-owned infrastructure, e.g., roads, the Main Southern Railway Line, power, water, sewer, optical fibre communications cables, gas supply pipelines and Picton Weir.

During the mining of Longwalls LWA3A – LWS7A subsidence will have an affect on the Sydney Water 450mm Sydney Water Trunk Main Pipeline supplying potable water for the Picton Region and the 100mm and 200mm Reticulation Supply Pipelines or the local area.

Tahmoor Mine has a proven track record for carrying out detailed monitoring, subsidence modelling and prediction and for assessing and mitigating impacts on all public utilities and identified structures.

Subsidence modelling and predictions have been carried out by Mine Subsidence Engineering Consultants (MSEC) and have been provided in reports and includes consideration of the Sydney Water pipelines. The contents of these reports were presented during the risk assessment and the reader should consult these reports to specific details.

## 5. Context Summary

### *5.1 Strategic Context*

SIMEC Mining, Tahmoor Colliery, is committed to ensuring safety and environmental compliance within its operation. When new equipment or processes are implemented, SIMEC insist that risk assessment techniques are used to reduce the risks to people, equipment, environment and operations.

### *5.2 Corporate Context*

As SIMEC is committed to safety and environmental compliance, when a change to systems or new equipment or systems are introduced into the operation, management insist that risk assessment techniques are used to identify and minimising exposure to its people and the operations. SIMEC is also committed to implementing risk assessment techniques to identify risk when required by external sources.

### *5.3 Risk Management Context*

The primary objective of this risk assessment is to identify hazards and existing controls associated with the safety and serviceability of the Sydney Water Pipelines from the mining of Longwalls S3A through to S7A, and to make recommendations for further controls where appropriate.

The main consideration is for personal safety however equipment damage, operational loss and environmental issues will be considered where relevant.

## 6. Objectives and Scope

The objective of the risk assessment was to facilitate a structured process to enable critical and objective challenge of the subject area to assist Tahmoor fulfil its obligations, namely:

- Public safety by direct or consequential impacts from subsidence on the Sydney Water pipelines,

- Obligations imposed by NSW Work Health and Safety legislation, including;
    - Work Health & Safety Regulation 2017, with particular focus on:
        - Part 3.1 Managing risks to health and safety,
    - Work Health & Safety (Mines & Petroleum Sites) Regulation 2014, with particular focus on:
        - Clause 9 Management of risks to health and safety - 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.
        - Clause 23 Identification of principal hazards and conduct of risk assessments,
        - Clause 33 Notification of high risk activities,
        - Clause 67 Subsidence,
        - Clause 128 Duty to notify regulator of certain incidents, (5) High Potential Incidents (m) any indication from monitoring data of the development of subsidence which may result in damage to any plant or structure or a failure of ground
        - Schedule 1 Principal hazard management plans—additional matters to be considered, 3C Subsidence
        - Schedule 3 High risk activities, 16 Secondary extraction

- Risk assessment process in accordance with AS/NZ ISO 31000:2018 – Risk Management and MDG 1010 - Risk Management Handbook for the Mining Industry, with risk rating in accordance with the Tahmoor Risk Assessment Matrix

- Participation of the asset owner, subsidence and specialist engineers and Tahmoor,

- Compliance with Planning Approval - Key Performance Measures:
    - The project does not cause any exceedances of the performance measures to the satisfaction of the stakeholders,
    - The Sydney Water Pipelines as key infrastructure serving the public is always safe and serviceable,
    - Damage that effects safety or serviceability must be fully repaired at the completion of the mining,
    - Arrangements are in place to maintain the serviceability of the asset

## 7. Assumptions and Constraints

The following assumptions were made during the risk assessment:

- Existing monitoring and control systems will be maintained throughout the project unless otherwise stated.
- Subsidence movements will normally occur gradually over a period of months.
- Stage 1 (Early Subsidence) refers to small movements and limited impacts as longwall extraction approaches the pipelines.
- Stage 2 (Active Subsidence) refers to the period of significant movement and potential impacts as extraction occurs beneath the pipelines.
- Stage 3 (Post Active Subsidence) refers to the limited impacts and movements, reducing to zero over time, experienced as the longwall extraction continues to retreat away from the pipelines.

## 8. Risk Treatment

An audit system needs to be in place to ensure all recommendations from this assessment are implemented.

The group were introduced to the Risk Assessment Process at the commencement of the session by the facilitator. The various steps were explained and the group reviewed the Likelihood, Consequence and Risk Ranking matrix.

The risk ranking was done with consideration to existing controls being in place.

Controls were developed using the following forms.

1. Avoidance – avoid the risk by deciding not to proceed with the activity likely to generate the risk (where this is practicable).
2. Reduction – reduce the likelihood of the event.
3. Reduction – reduce the consequences of the event.
4. Accept – accept the risk within the organisation and establish an appropriate plan to manage the consequences of these risk if they are to occur.

The above risk control options were applied by reference to the following control methodologies in a hierarchical sequence.

1. Design – to the extent reasonable and practicable ensure that hazards are designed out when new materials, equipment or work systems are being planned for the workplace.
2. Remove the hazard or substitute less hazardous materials, equipment or substances.
3. Adopt a safer process – alter tool, equipment or work practices to make them safer.
4. Enclose or isolate the hazard – provide guards or remote operation and handling techniques.
5. Provide effective ventilation – install local or general exhaust ventilation systems.
6. Establish appropriate administrative procedures. Set up, document and implement new procedures that provide for:
   - Scheduling of the job so that fewer workers are exposed;
   - Routine maintenance and housekeeping procedures;
   - Training on hazards and correct work procedures.
7. Personal Protective Equipment – provide suitable and properly maintained personal protective equipment and training in its use.

## 9. Facilitator Qualifications and Experience

Shane Chiddy holds an Associate Diploma in Engineering (Electrical), is an Officer of the Institution of Engineers (Australia) and is a member of the Asset Management Council of Australia (AMC) and the Mining Electrical and Mining Mechanical Engineering Society (MEMMES). He has also completed Contract Law through Macquarie University, Carry out the Risk Management Process (G2) and Establish the Risk Management Systems (Mine 7033 - G3) through Queensland University and is certified as a Functional Safety Engineer by TÜV Rheinland for both Safety Instrumented Systems (#7652/13) and Machine Safety (#9315/14).

Prior to commencing his consulting career, Shane Chiddy qualified as an electrician and worked underground for 9 years. He then occupied a number of engineering roles within Rio Tinto, including such roles as electrical supervisor, Development Engineer and Senior Production Engineer. This latest role was responsible for the Longwall, underground diesel equipment and conveyors.

Additionally Shane Chiddy has been trained and accredited by John Moubray in the UK as a certified RCM II practitioner and has conducted a number of extensive Reliability-centred Maintenance II analyses including underground and surface equipment such as Longwalls, Continuous Miners and conveying systems. He has facilitated RCM II analysis and delivered training in the mining, defence, power distribution and telecommunications industries.

His consulting experience includes the application of Reliability-centred Maintenance II and extensive Risk Management and Project Management assignments.

## 10. Sub-Systems Considered in the Assessment

| Sub-System | | STEP IN PROCESS | |
|---|---|---|---|
| 1 | 450mm Sydney Water Trunk Main Pipeline | A | General Pipeline |
| | | B | Remembrance Road Crossing |
| | | C | Teatree Hollow Creek Tributories (North of Yarran Road) near Remembrance Drive |
| | | D | Teatree Hollow Creek Tributories (South of Yarran Road) |
| | | E | Rail Crossing at 100.395km |
| | | F | Far Field Effects |
| | | G | Caloola Road Crossing |
| 2 | 100mm and 200mm Reticulation Supply Pipelines | A | General Pipeline |

## 11. Risk Assessment Methodology

### *11.1 Qualitative Risk Analysis*

This Risk Assessment has been performed using Qualitative Risk Analysis techniques and has been performed to align with the principles of the Australian Standard AS31000 - Risk Management Principles and Guidelines and the Department of Mineral Resource Guideline MDG1010.

The Risk Assessment has followed the WRAC (Workplace Risk Assessment and Control) principles as outlined in the guideline.

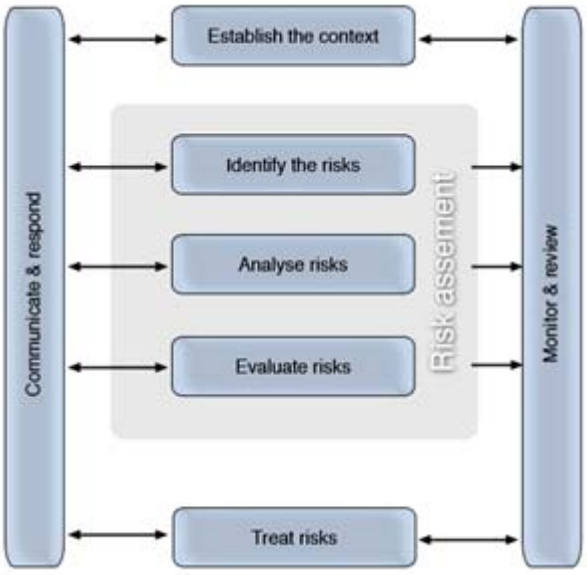
The qualitative approach succeeds by using local expert knowledge and relevant historical data.

This system of analysis uses a participative approach which is very powerful for identifying potential hazard scenarios.

The following steps outline the systematic identification of hazards, ranking of risks, and identification of new and/or improved controls that were used in the Risk Assessment session:

1. Introduce team to the Risk Assessment process and the context of the Risk Assessment. This includes the scope and method of the Risk Assessment.
2. Identify discrete components, or elements, of the Project.
3. Identify and add potential deviation steps.
4. Review each sub-system and identify loss scenarios - (Potential Incidents and Accidents).
5. For those hazards evaluate the risk using the risk rank method by determining the probability, consequence, and risk rank of each loss scenario.
6. Identify existing controls for each hazard.
7. Specify additional controls required to control the hazard(s).
8. Close the Risk Assessment.
9. Document and distribute to the team for proof reading.
10. Undertake verification of the assessment by a nominated person.

The available Standards on Risk Management (including MDG1010) define the Risk Management process as that shown below.



### *11.2 Establish the Context*

This risk analysis has been performed using Qualitative Risk Analysis techniques and is performed in compliance with the Department of Mineral Resources (now the Resources Regulator) Guideline MDG1010.

### *11.3 Identify Hazards*

This step involves identification of all the hazards to be managed. To correctly apply this step a well-structured systematic process must be used, because controls may not be able to be implemented to reduce or eliminate any hazards missed at this point in the analysis.

For each hazard, the team identifies:

1. What Can Happen; and
2. How and Why it Can Happen.

Checklists, Flowcharts and Brainstorming are used to identify hazards.

### *11.4 Analyse Risks*

The main objectives of an analysis is to separate minor risks from major risks and to provide data to assist in the evaluation and treatment of hazards.

Risk Analysis involves considering the following:

1. Likelihood of the Hazard occurring (identified as 'L' within the worksheets).
2. Consequences if the Hazard does occur (identified as 'C' in the worksheets).
3. Determining any existing controls.

The combination of the Likelihood and the Consequence determines the level of the risk involved. The likelihood and consequence categories used are outlined in Section 13.

During the assessment the consequences are categorised as either hazards to personnel, the environment or to the site operations. Additional categories such as reputation and community may also be considered where deemed appropriate.

The consequence category is identified on the Analysis Worksheets in the Column labelled 'T' for Type.

### *11.5 Evaluate Risks*

Evaluation involves comparing the level of risk found during the analysis with previously established risk criteria.

The output of this part of the process is a list of prioritised hazards for further action.

If the resulting hazards fall into the low or tolerable risk categories, they may be accepted with minimal further treatment. Although, low and tolerable hazards should be monitored and periodically reviewed to ensure that they remain tolerable.

If hazards do not fall into the low or tolerable risk category, then they should be treated using other options.

### *11.6 Treat Risks*

Risk treatment involves identifying the range of options for treating risks, assessing the options and preparing risk treatment plans and implementing them.

Risk treatment may be in one of the following forms:

1. Risk Avoidance. Decide not to proceed with the activity.
2. Reduce Likelihood. Reduce the chance of the risk occurring.
3. Reduce the Risk Consequences. Reduce the consequence if the risk occurs.
4. Retain (or accept) the Risk. Plans should be put in place to mitigate the consequences of these risks in the event that they occur.

Risk treatment options should be assessed on the extent of any additional benefits or opportunities created. A number of options may be considered and applied either individually or in a combination.

Risk treatment plans should be developed to identify responsibilities, schedules, budgets and performance measures and the review process that is to be established. If no other actions are identified, as needing to be implemented, the group believed the risk was As Low As Reasonably Practicable (ALARP).

### *11.7 Monitor and Review*

It is essential to monitor the effectiveness of the risk management system and the risk treatment implementation.

Risks and the effectiveness of control measures need to be monitored to ensure that the changing environments do not alter risk priorities. Few risks remain static.

Factors affecting Likelihood and/or Consequence change as do factors regarding suitability of controls.

### *11.8 Communications and Consultations*

Communication and consultation are important during the entire risk management process. It is important to develop a communication plan for both internal and external stakeholders.

This should be a two-way consultation not a one-way flow of information.

Effectiveness of internal and external communications is important to ensure that those responsible for implementing risk management understand the basis on which all decisions have been made, and why particular actions are required.

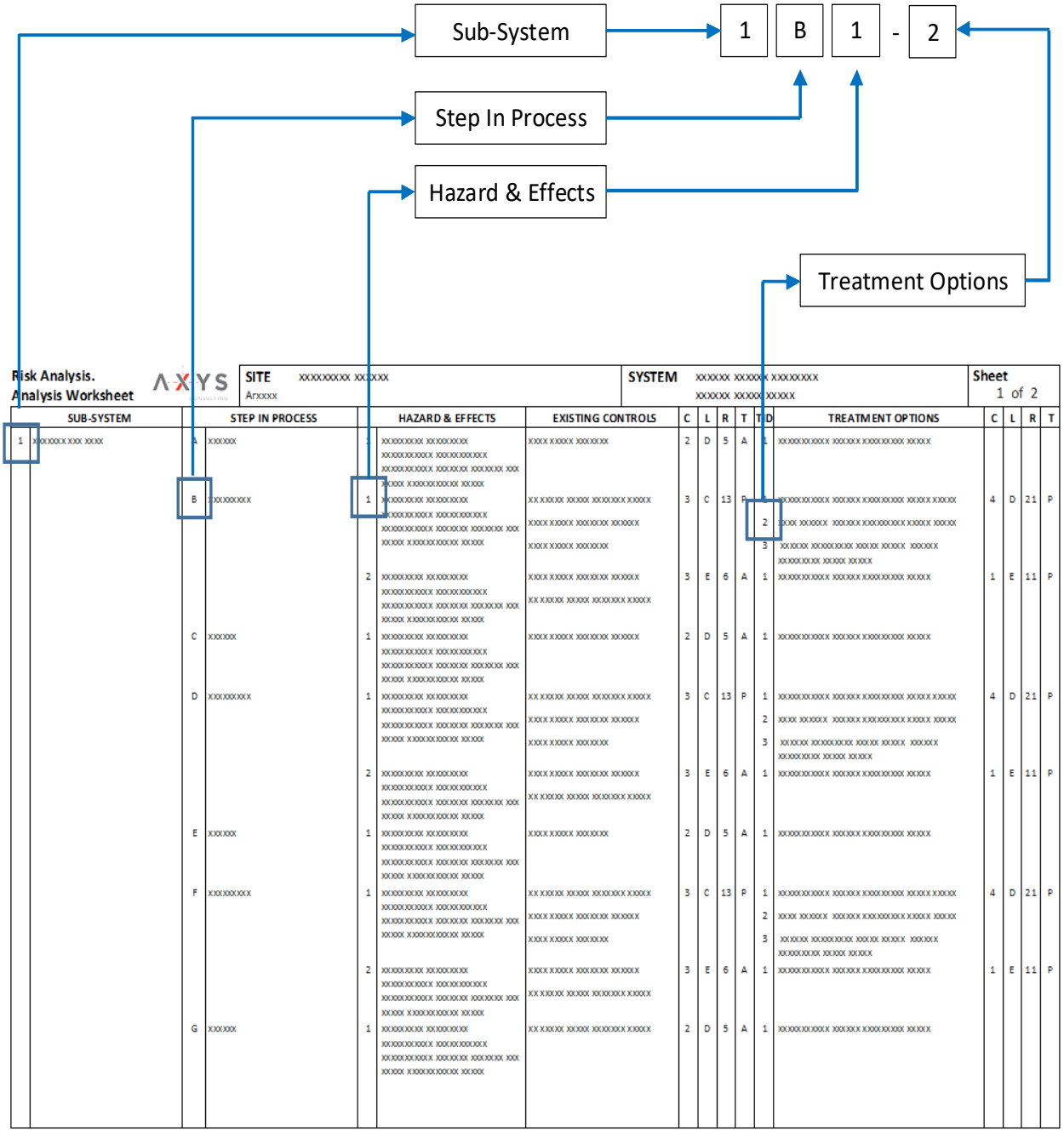
## 12. Risk Assessment Numbering

The assessment uses an alphanumeric numbering system to differentiate each component, the step in the process, the hazard and the treatment options.

The sub system number is found in the first column of the worksheets, the step is identified as a letter and is found in the third column, the hazard number in the fifth column and the treatment options in the TID (Treatment ID) column.

Using this method each hazard and treatment option throughout the analysis has a distinct identifier. This identifier then flows through all of the worksheets and can be referenced back to the Analysis Worksheets.

The example below shows the distinct identifier for the hazard is 1B1, the treatment option identified below would be identified as 1B1-2.



## 13. Risk Rank Method

For each event, the Likelihood (a letter A to E) and Consequence (a number 1 to 5) is selected. If an event effects more than one area of consequence (e.g. effects people and operations), the highest rank number is always selected.

| Risk Matrix | | | | | | |
|---|---|---|---|---|---|---|
| **Likelihood** | | **Consequence** | | | | |
| | | Negligible | Minor | Moderate | Major | Catastophic |
| **A (Almost Certain)** | May occur several times per year OR Expected to occur OR Has occurred several times within Glencore | **11 (M)** | **16 (H)** | **20 (H)** | **23 (H)** | **25 (H)** |
| **B (Likely)** | May occur about once per year OR More likely to occur than not occur OR Has occurred at least once within Glencore | **7 (M)** | **12 (M)** | **17 (H)** | **21 (H)** | **24 (H)** |
| **C (Possible)** | Could occur more than once during a lifetime OR As likely to occur as not to occur OR Has occurred at least once in the mining / commodities trading industries | **4 (L)** | **8 (M)** | **13 (M)** | **18 (H)** | **22 (E)** |
| **D (Unlikely)** | Could occur about once during a lifetime OR More likely NOT to occur than to occur OR Has occurred at least once in broader worldwide industry | **2 (L)** | **5 (L)** | **9 (M)** | **14(M)** | **19 (M)** |
| **E (Rare)** | Unlikely to occur during a lifetime OR Very unlikely to occur OR No known occurrences in broader worldwide industry | **1 (L)** | **3 (L)** | **6 (L)** | **10 (M)** | **15 (M)** |
| **Area of Effect** | | **Estimated Level of Consequence** | | | | |
| | | **1** | **2** | **3** | **4** | **5** |
| **(P) Health and Safety** | | First Aid Injury (FAI) illness (not considered disease or disorder) | Restricted Work Injury (RWI) / Disease (RWD) or Medical Treatment Injury (MTI) / Disease (MTD) | Lost Time Injury (LTI) / Disease (LTD) - Single incident resulting in multiple RWIs or MTIs | Fatalities (<5) due to a single incident or health cause<br>Permanent disability or disease cases (<5) due to a single incident or health cause (mental or physical) | Multiple fatalities (5+) due to a single incident or health cause<br>Multiple permanent disability or disease cases (5+) due to a single incident or health cause (mental or physical) |
| **(E) Environment** | | Negligible, and reversible, environmental impact to ecosystems, habitat or species<br>(<1 week to remediate) | Limited, but reversible, environmental impact to ecosystems, habitat or species (<3 months to remediate) | Limited, but reversible, environmental impact to ecosystems, habitat or species (<2 years to remediate) | Widespread, but reversible, environmental impact to ecosystems, habitat or species (2 to 10 years to remediate) | Widespread environmental impact to ecosystems, habitat or species (irreversible, or >10 years to remediate) |
| **(F) Financial Impact** | | <$1M operating profit<br><$300k property damage<br><$1M asset devaluation | $1M to 5M operating profit<br>$300k to $1M property damage<br>$1M to $5M asset devaluation | $5M to $50M operating profit<br>$1M to $5Mproperty damage<br>$5M to $25M asset devaluation | $50M to $100M operating profit<br>$5M to $50M property damage<br>$25M to $250M asset devaluation | >$100M operating profit<br>>$50M property damage<br>>$250M asset devaluation |

| Area of Effect | Estimated Level of Consequence | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| **(R)**<br>**Image and Reputation** | Negligible interest from media and no local, national or international pick-up<br><br>Low-level social media pick-up, posts are neutral and isolated<br><br>Negligible interest from local, regional or national government<br><br>Negligible interest from NGOs and pressure groups<br><br>Negligible interest from customers and/or suppliers<br><br>Negligible interest from investors and/or analysts | Limited but negative media coverage at local / regional level that subsides after 24 hours<br><br>Negative social media pick-up, but limited to local stakeholders that subsides after 24 hours<br><br>Queries but no public statements from local, regional or national government<br><br>Queries but no public statements from NGOs and pressure groups<br><br>Queries from one or more customers and/or suppliers<br><br>Queries from one or more investors and/or analysts | Negative media coverage at local / regional and national level for more than 24 hours, limited pick-up internationally<br><br>Negative social media pick-up, from a mix of local and national stakeholders, limited pick-up internationally<br><br>Public statements from local and/or regional but not national government<br><br>Public statements from a limited number of NGOs and pressure groups<br><br>Queries from multiple customers and/or suppliers<br><br>Queries from multiple investors and/or analysts | Negative media coverage at local / regional, national and international levels over several days<br><br>Negative social media internationally with a hostile tone<br><br>Strongly negative public statements from local, regional and national government, and separately from multiple NGOs and pressure groups<br><br>Threat of losing business from customers and/or suppliers<br><br>Strong concerns from multiple investors and/or analysts | Sustained negative international media coverage<br><br>ICondemnation from heads of state, governments, religious leaders and supranational bodies, e.g. the U.N.<br><br>Negative social media campaigning reaches into mainstream public awareness<br><br>Consistent and sustained negative public statements from high-profile NGOs and pressure groups<br><br>Loss of customers and suppliers<br><br>Investors consider divestment and analysts publish notes condemning the company and change their ratings |
| **(L)**<br>**Legal and Compliance** | Civil investigation which might result in a non-penal remedy or with potential negligible financial consequences<br><br>Any litigation or arbitration, license or permit non-compliance, or cancellation of a contract with potential negligible financial consequences | Civil investigation of any member of the Group with potential penalty of minor financial consequences<br><br>Any litigation or arbitration, license or permit non-compliance, or cancellation of a contract with potential minor financial consequences | Civil investigation of any member of the Group with potential penalty of moderate financial consequences or short-term stop work order<br><br>Any litigation or arbitration, loss of license or permit, or cancellation of a contract with potential moderate financial consequences | Criminal investigation of a Group company (but not for the Group) or directors or officers of a Group company<br><br>Civil investigation at Group level or for any Group entity with potential penalty of major financial consequences or extended work stoppage<br><br>Any litigation or arbitration, loss of license or permit, or cancellation of a contract with potential major financial consequences | Criminal investigation at Glencore Group level or in respect of the Board or senior management<br><br>Any litigation or arbitration, loss of license or permit, or cancellation of a contract with potential catastrophic financial consequences<br><br>Default under Group funding arrangements |

| PMC Category | Consequence Type | Ownership / Action |
|---|---|---|
| Cat 5 | **Catastrophic Hazard / Threat** | **Ownership -** Department/Functional/Operational/Asset Leadership.<br>**Action -** Detailed assessment is required to confirm achievement of ALARP ('As Low As Reasonably Practicable'). Critical Control Management is required. |
| Cat 4<br>(Health & Safety consequence) | **Fatal Control** | **Ownership** - Department/Functional/Operational/Asset Leadership<br>**Action** - GCAA Fatal Hazard Protocol implementation is required. |

| Risk Rank | Risk Rating | Ownership / Action |
|---|---|---|
| 23 – 25 | **Very High Risk** | **Ownership -** Department/Functional/Operational/Asset Leadership<br>**Escalation and Communication -** COO/CEO |
| 17 – 22 | **High Risk** | **Ownership -** Department/Functional/Operational/Asset Leadership.<br>**Escalation and Communication -** Director/COO |
| 7-16 | **Medium Risk** | **Ownership -** Operation / Asset / Function /Department.<br>**Escalation and Communication -** Operation / Asset / Function / Department |
| 1 - 6 | **Low Risk** | **Ownership -** Operation / Asset / Function /Department.<br>**Escalation and Communication -** Operation / Asset / Function / Department |

# Attachment 1

Analysis Worksheets

| SUB-SYSTEM | | STEP IN PROCESS | | HAZARD & EFFECTS | | EXISTING CONTROLS | RCE | PMC | C | L | R | T | TID | TREATMENT OPTIONS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 450mm Sydney Water Trunk Main Pipeline | A | General Pipeline | 1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | Sydney Water remote monitoring via pressure gauges and flow meters, reporting to Systems Operations Centre (SOC) Team can identify major faults<br>High Risk pipeline locations have been identified and risk assessed separately<br>Location of pipeline confirmed by survey<br>Public Notification of service issues direct to Sydney Water from customers<br>Sydney Water Emergency Response Plan<br>Contained within the subsidence management is a staged Trigger Response to potential high strain locations including mitigation and/or increasing monitoring frequencies<br>Sydney Water have conducted valve audits, location of valves and their operations<br>Sydney Water maintains reservoirs above 90% during active subsidence to provide 24 / 48 hour repair time.<br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan: including<br>1. Survey Monitoring plan<br>2. Visual Inspections and reporting<br>3. Review, Report and Technical meetings to review and assess trending data<br>Current pipe design, Spigoted and Socketed pipe connections allows for minimal pipe movements, backfilled. | Satisfactory | 3 | 2 | D | 5 | R | 1 | None Identified |

| SUB-SYSTEM | | STEP IN PROCESS | | HAZARD & EFFECTS | | EXISTING CONTROLS | RCE | PMC | C | L | R | T | TID | TREATMENT OPTIONS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 450mm Sydney Water Trunk Main Pipeline | B | Remembrance Road Crossing | 1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | Sydney Water remote monitoring via pressure gauges and flow meters, reporting to Systems Operations Centre (SOC) Team can identify major faults<br>Location of pipeline confirmed by survey<br>Public Notification of service issues direct to Sydney Water from customers<br>Sydney Water Emergency Response Plan<br>Sydney Water have conducted valve audits, location of valves and their operations<br>Sydney Water maintains reservoirs above 90% during active subsidence to provide 24 / 48 hour repair time.<br>Contained within the subsidence management is a staged Trigger Response to potential high strain locations including mitigation and/or increasing monitoring frequencies<br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan: including<br>1. Survey Monitoring plan<br>2. Visual Inspections and reporting<br>3. Review, Report and Technical meetings to review and assess trending data<br>Current pipe design, Spigoted and Socketed pipe connections allows for minimal pipe movements, backfilled and concrete encased under road easement for short distance (20-30 metres). | Improvement | 3 | 2 | E | 3 | R | 1<br>2 | Provided additional survey monitoring points in the area of the Remembrance Road Crossing pipeline<br>Secure copy of Work as Constructed (WAC) and confirm for concrete encased design under Remembrance Drive, and identify mitigating measures as required e.g. Gibault Joints, Sanitube type. |

| SUB-SYSTEM | | STEP IN PROCESS | | HAZARD & EFFECTS | | EXISTING CONTROLS | RCE | PMC | C | L | R | T | TID | TREATMENT OPTIONS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 450mm Sydney Water Trunk Main Pipeline | C | Teatree Hollow Creek Tributories (North of Yarran Road) near Remembrance Drive | 1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | Sydney Water remote monitoring via pressure gauges and flow meters, reporting to Systems Operations Centre (SOC) Team can identify major faults<br>Location of pipeline confirmed by survey<br>Public Notification of service issues direct to Sydney Water from customers<br>Sydney Water Emergency Response Plan<br>Sydney Water have conducted valve audits, location of valves and their operations<br>Sydney Water maintains reservoirs above 90% during active subsidence to provide 24 / 48 hour repair time.<br>Contained within the subsidence management is a staged Trigger Response to potential high strain locations including mitigation and/or increasing monitoring frequencies<br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan: including<br>1. Survey Monitoring plan<br>2. Visual Inspections and reporting<br>3. Review, Report and Technical meetings to review and assess trending data<br>Current pipe design, Spigoted and Socketed pipe connections allows for minimal pipe movements, backfilled. | Improvement | 3 | 2 | C | 8 | R | 1<br>2 | Install Gibault Joints to the pipeline at Teatree Hollow Creek Tributaries (North of Yarran Road) near Remembrance Drive<br>Secure copy of Work as Constructed (WAC) and confirm for concrete encased design under the Teatree Hollow Creek Tributaries (North of Yarran Road) near Remembrance Drive |

| SUB-SYSTEM | | STEP IN PROCESS | | HAZARD & EFFECTS | | EXISTING CONTROLS | RCE | PMC | C | L | R | T | TID | TREATMENT OPTIONS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 450mm Sydney Water Trunk Main Pipeline | D | Teatree Hollow Creek Tributories (South of Yarran Road) | 1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences or disruption to rail services. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | Additional survey monitoring points in the area of the Creek Crossing pipeline<br>Rail Management Plan includes remote monitoring, rail strain gauges, daily visual inspection of track and corridor in addition to a weekly geotechnical inspection.<br>Sydney Water remote monitoring via pressure gauges and flow meters, reporting to Systems Operations Centre (SOC) Team can identify major faults<br>Location of pipeline confirmed by survey<br>Public Notification of service issues direct to Sydney Water from customers<br>Sydney Water Emergency Response Plan<br>Sydney Water have conducted valve audits, location of valves and their operations<br>Sydney Water maintains reservoirs above 90% during active subsidence to provide 24 / 48 hour repair time.<br>Contained within the subsidence management is a staged Trigger Response to potential high strain locations including mitigation and/or increasing monitoring frequencies<br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan: including<br>1. Survey Monitoring plan<br>2. Visual Inspections and reporting<br>3. Review, Report and Technical meetings to review and assess trending data<br>Current pipe design, Spigoted and Socketed pipe connections allows for minimal pipe movements, backfilled | Improvement | 4 | 4 | E | 10 | F | 1<br>2 | Sydney Water to provide and deliver a new PE Underbore service to replace the Rail Crossing at 100.395km and Teatree Hollow Creek Tributaries (South of Yarran Road) creek crossing<br>Alternative action, if unable to underbore the creek, is to install Gibault Joints to the pipeline at Teatree Hollow Creek Tributaries (South of Yarran Road) near Remembrance Drive |

| SUB-SYSTEM | | STEP IN PROCESS | | HAZARD & EFFECTS | | EXISTING CONTROLS | RCE | PMC | C | L | R | T | TID | TREATMENT OPTIONS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 450mm Sydney Water Trunk Main Pipeline | E | Rail Crossing at 100.395km | 1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences or disruption to rail services. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | Additional survey monitoring points in the area of the Rail Crossing pipeline<br>Rail Management Plan includes remote monitoring, rail strain gauges, daily visual inspection of track and corridor in addition to a weekly geotechnical inspection.<br>Sydney Water remote monitoring via pressure gauges and flow meters, reporting to Systems Operations Centre (SOC) Team can identify major faults<br>Location of pipeline confirmed by survey<br>Public Notification of service issues direct to Sydney Water from customers<br>Sydney Water Emergency Response Plan<br>Sydney Water have conducted valve audits, location of valves and their operations<br>Sydney Water maintains reservoirs above 90% during active subsidence to provide 24 / 48 hour repair time.<br>Contained within the subsidence management is a staged Trigger Response to potential high strain locations including mitigation and/or increasing monitoring frequencies<br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan: including<br>1. Survey Monitoring plan<br>2. Visual Inspections and reporting<br>3. Review, Report and Technical meetings to review and assess trending data | Improvement | 4 | 4 | E | 10 | F | 1 | Sydney Water to provide and deliver a new PE Underbore service to replace the Rail Crossing at 100.395km |
| | | | | | | | | | | | | | 2 | Undertake potholing to identify extend of concrete encasement and pipe layout |
| | | | | | | | | | | | | | 3 | Install potential rail washout Barrier and Berm (Partially installed) to redirect water flow |
| | | | | | | | | | | | | | 4 | Develop a TARP trigger response to non-conventional ground movements to install Gibault joints at the located first socket and spigot joint (to add to the MP next amendment) |
| | | | | | | | | | | | | | 5 | Install remote monitoring on joints (if Gibault joints are installed) |
| | | | | | | | | | | | | | 6 | Install ground survey matrix over the Rail pipe crossing |
| | | | | | | | | | | | | | 7 | Complete visual inspection during active subsidence S4a and S5a from the rail maintenance contractor |
| | | | | | | | | | | | | | 8 | Post Mining, complete a permanent repair solution of these 2 sets of Gibault's (if installed) within the rail corridor. (managed by Tahmoor Coal in consultation with Sydney Water) |

| SUB-SYSTEM | STEP IN PROCESS | HAZARD & EFFECTS | EXISTING CONTROLS | RCE | PMC | C | L | R | T | TID | TREATMENT OPTIONS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Current pipe design, Spigoted and Socketed pipe connections allows for minimal pipe movements, backfilled and concrete encased under rail corridor for short distance (10-15 metres). | | | | | | | | |

| SUB-SYSTEM | | STEP IN PROCESS | | HAZARD & EFFECTS | | EXISTING CONTROLS | RCE | PMC | C | L | R | T | TID | TREATMENT OPTIONS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 450mm Sydney Water Trunk Main Pipeline | F | Far Field Effects | 1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | Note: Longwalls S1A and S2A have been mined and no adverse changes observed<br>Sydney Water remote monitoring via pressure gauges and flow meters, reporting to Systems Operations Centre (SOC) Team can identify major faults<br>High Risk pipeline locations have been identified and risk assessed separately<br>Location of pipeline confirmed by survey<br>Public Notification of service issues direct to Sydney Water from customers<br>Sydney Water Emergency Response Plan<br>Sydney Water have conducted valve audits, location of valves and their operations<br>Sydney Water maintains reservoirs above 90% during active subsidence to provide 24 / 48 hour repair time.<br>Contained within the subsidence management is a staged Trigger Response to potential high strain locations including mitigation and/or increasing monitoring frequencies<br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan: including<br>1. Survey Monitoring plan<br>2. Visual Inspections and reporting<br>3. Review, Report and Technical meetings to review and assess trending data<br>4. GNSS and Bridge structure monitoring<br>Current pipe design, Spigoted and Socketed pipe connections allows for minimal pipe movements, backfilled. | Satisfactory | 3 | 2 | E | 3 | R | 1 | None Identified |

| SUB-SYSTEM | | STEP IN PROCESS | | HAZARD & EFFECTS | | EXISTING CONTROLS | RCE | PMC | C | L | R | T | TID | TREATMENT OPTIONS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 450mm Sydney Water Trunk Main Pipeline | G | Caloola Road Crossing | 1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | Gibault Joints installed to the pipeline at Caloola Road intersection crossing<br>Sydney Water remote monitoring via pressure gauges and flow meters, reporting to Systems Operations Centre (SOC) Team can identify major faults<br>Location of pipeline confirmed by survey<br>Public Notification of service issues direct to Sydney Water from customers<br>Sydney Water Emergency Response Plan<br>Sydney Water have conducted valve audits, location of valves and their operations<br>Sydney Water maintains reservoirs above 90% during active subsidence to provide 24 / 48 hour repair time.<br>Contained within the subsidence management is a staged Trigger Response to potential high strain locations including mitigation and/or increasing monitoring frequencies<br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan: including<br>1. Survey Monitoring plan<br>2. Visual Inspections and reporting<br>3. Review, Report and Technical meetings to review and assess trending data<br>Current pipe design, Spigoted and Socketed pipe connections allows for minimal pipe movements, backfilled. | Improvement | 3 | 2 | D | 5 | R | 1 | Implement monitoring to the Southern side of Caloola Road to identify any adverse movemen |

| SUB-SYSTEM | | STEP IN PROCESS | | HAZARD & EFFECTS | | EXISTING CONTROLS | RCE | PMC | C | L | R | T | TID | TREATMENT OPTIONS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 100mm and 200mm Reticulation Supply Pipelines | A | General Pipeline | 1 | Sydney Water 100mm and 200mm Reticulation Supply Pipelines effected by subsidence, leading to a potential interruption or damage to water supply to local residences. | Sydney Water have conducted valve audits, location of valves and their operations<br>Sydney Water remote monitoring via pressure gauges and flow meters, reporting to Systems Operations Centre (SOC) Team can identify major faults<br>Public Notification of service issues direct to Sydney Water from customers<br>Sydney Water Emergency Response Plan<br>Contained within the subsidence management is a staged Trigger Response to potential high strain locations including mitigation and/or increasing monitoring frequencies<br>Monitoring Controls as per Tahmoor Coal Sydney Water, Potable Management Plan: including<br>1. Survey Monitoring plan<br>2. Visual Inspections and reporting<br>3. Review, Report and Technical meetings to review and assess trending data<br>Current pipe design, Spigoted and Socketed pipe connections allows for minimal pipe movements, backfilled. | Satisfactory | 2 | 1 | D | 2 | R | 1 | None Identified |

# Attachment 2

Assessment Worksheets
(Risk Rank Order)

| REF | Risk | HAZARD | TID | TREATMENT OPTIONS |
|---|---|---|---|---|
| 1D1 | 10 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences or disruption to rail services. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Sydney Water to provide and deliver a new PE Underbore service to replace the Rail Crossing at 100.395km and Teatree Hollow Creek Tributaries (South of Yarran Road) creek crossing |
| | | | 2 | Alternative action, if unable to underbore the creek, is to install Gibault Joints to the pipeline at Teatree Hollow Creek Tributaries (South of Yarran Road) near Remembrance Drive |
| 1E1 | 10 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences or disruption to rail services. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Sydney Water to provide and deliver a new PE Underbore service to replace the Rail Crossing at 100.395km |
| | | | 2 | Undertake potholing to identify extend of concrete encasement and pipe layout |
| | | | 3 | Install potential rail washout Barrier and Berm (Partially installed) to redirect water flow |
| | | | 4 | Develop a TARP trigger response to non-conventional ground movements to install Gibault joints at the located first socket and spigot joint (to add to the MP next amendment) |
| | | | 5 | Install remote monitoring on joints (if Gibault joints are installed) |
| | | | 6 | Install ground survey matrix over the Rail pipe crossing |
| | | | 7 | Complete visual inspection during active subsidence S4a and S5a from the rail maintenance contractor |
| | | | 8 | Post Mining, complete a permanent repair solution of these 2 sets of Gibault's (if installed) within the rail corridor. (managed by Tahmoor Coal in consultation with Sydney Water) |
| 1C1 | 8 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Install Gibault Joints to the pipeline at Teatree Hollow Creek Tributaries (North of Yarran Road) near Remembrance Drive |
| | | | 2 | Secure copy of Work as Constructed (WAC) and confirm for concrete encased design under the Teatree Hollow Creek Tributaries (North of Yarran Road) near Remembrance Drive |
| 1A1 | 5 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | None Identified |
| 1G1 | 5 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Implement monitoring to the Southern side of Caloola Road to identify any adverse movement |
| 1B1 | 3 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Provided additional survey monitoring points in the area of the Remembrance Road Crossing pipeline |
| | | | 2 | Secure copy of Work as Constructed (WAC) and confirm for concrete encased design under Remembrance Drive, and identify mitigating measures as required e.g. Gibault Joints, Sanitube type. |
| 1F1 | 3 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | None Identified |
| 2A1 | 2 | Sydney Water 100mm and 200mm Reticulation Supply Pipelines effected by subsidence, leading to a potential interruption or damage to water supply to local residences. | 1 | None Identified |

# Attachment 3

Assessment Worksheets
(Consequence Order)

| REF | Cons | HAZARD | TID | TREATMENT OPTIONS |
|---|---|---|---|---|
| 1D1 | 4 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences or disruption to rail services. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Sydney Water to provide and deliver a new PE Underbore service to replace the Rail Crossing at 100.395km and Teatree Hollow Creek Tributaries (South of Yarran Road) creek crossing |
| | | | 2 | Alternative action, if unable to underbore the creek, is to install Gibault Joints to the pipeline at Teatree Hollow Creek Tributaries (South of Yarran Road) near Remembrance Drive |
| 1E1 | 4 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences or disruption to rail services. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Sydney Water to provide and deliver a new PE Underbore service to replace the Rail Crossing at 100.395km |
| | | | 2 | Undertake potholing to identify extend of concrete encasement and pipe layout |
| | | | 3 | Install potential rail washout Barrier and Berm (Partially installed) to redirect water flow |
| | | | 4 | Develop a TARP trigger response to non-conventional ground movements to install Gibault joints at the located first socket and spigot joint (to add to the MP next amendment) |
| | | | 5 | Install remote monitoring on joints (if Gibault joints are installed) |
| | | | 6 | Install ground survey matrix over the Rail pipe crossing |
| | | | 7 | Complete visual inspection during active subsidence S4a and S5a from the rail maintenance contractor |
| | | | 8 | Post Mining, complete a permanent repair solution of these 2 sets of Gibault's (if installed) within the rail corridor. (managed by Tahmoor Coal in consultation with Sydney Water) |
| 1A1 | 2 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | None Identified |
| 1B1 | 2 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Provided additional survey monitoring points in the area of the Remembrance Road Crossing pipeline |
| | | | 2 | Secure copy of Work as Constructed (WAC) and confirm for concrete encased design under Remembrance Drive, and identify mitigating measures as required e.g. Gibault Joints, Sanitube type. |
| 1C1 | 2 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Install Gibault Joints to the pipeline at Teatree Hollow Creek Tributaries (North of Yarran Road) near Remembrance Drive |
| | | | 2 | Secure copy of Work as Constructed (WAC) and confirm for concrete encased design under the Teatree Hollow Creek Tributaries (North of Yarran Road) near Remembrance Drive |
| 1F1 | 2 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | None Identified |
| 1G1 | 2 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Implement monitoring to the Southern side of Caloola Road to identify any adverse movement |
| 2A1 | 1 | Sydney Water 100mm and 200mm Reticulation Supply Pipelines effected by subsidence, leading to a potential interruption or damage to water supply to local residences. | 1 | None Identified |

# Attachment 4

Risk Treatment Schedule Action Plan

| ID | HAZARD | TID | TREATMENT OPTIONS | RESPONSIBILITY | IMPLEMENTATION | COMMENTS | COMPLETED (Sign Off) |
|---|---|---|---|---|---|---|---|
| 1A1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | None Identified | | | | |
| 1B1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Provided additional survey monitoring points in the area of the Remembrance Road Crossing pipeline | SIMEC - Subsidence Project Manager | Friday, 30 August 2024 | | |
| | | 2 | Secure copy of Work as Constructed (WAC) and confirm for concrete encased design under Remembrance Drive, and identify mitigating measures as required e.g. Gibault Joints, Sanitube type. | SIMEC - Subsidence Project Manager | Friday, 30 August 2024 | | |
| 1C1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Install Gibault Joints to the pipeline at Teatree Hollow Creek Tributaries (North of Yarran Road) near Remembrance Drive | SIMEC - Subsidence Project Manager | Friday, 30 August 2024 | | |
| | | 2 | Secure copy of Work as Constructed (WAC) and confirm for concrete encased design under the Teatree Hollow Creek Tributaries (North of Yarran Road) near Remembrance Drive | SIMEC - Subsidence Project Manager | Friday, 30 August 2024 | | |
| 1D1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences or disruption to rail services. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Sydney Water to provide and deliver a new PE Underbore service to replace the Rail Crossing at 100.395km and Teatree Hollow Creek Tributaries (South of Yarran Road) creek crossing | SIMEC - Subsidence Project Manager | Friday, 30 August 2024 | | |
| | | 2 | Alternative action, if unable to underbore the creek, is to install Gibault Joints to the pipeline at Teatree Hollow Creek Tributaries (South of Yarran Road) near Remembrance Drive | SIMEC - Subsidence Project Manager | Friday, 30 August 2024 | | |

| ID | HAZARD | TID | TREATMENT OPTIONS | RESPONSIBILITY | IMPLEMENTATION | COMMENTS | COMPLETED (Sign Off) |
|---|---|---|---|---|---|---|---|
| 1E1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences or disruption to rail services. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Sydney Water to provide and deliver a new PE Underbore service to replace the Rail Crossing at 100.395km | SIMEC - Subsidence Project Manager | Friday, 30 August 2024 | | |
| | | 2 | Undertake potholing to identify extend of concrete encasement and pipe layout | SIMEC - Subsidence Project Manager | Friday, 27 September 2024 | | |
| | | 3 | Install potential rail washout Barrier and Berm (Partially installed) to redirect water flow | SIMEC - Subsidence Project Manager | Friday, 31 January 2025 | | |
| | | 4 | Develop a TARP trigger response to non-conventional ground movements to install Gibault joints at the located first socket and spigot joint (to add to the MP next amendment) | SIMEC - Subsidence Project Manager | Friday, 31 January 2025 | | |
| | | 5 | Install remote monitoring on joints (if Gibault joints are installed) | SIMEC - Subsidence Project Manager | Friday, 31 January 2025 | | |
| | | 6 | Install ground survey matrix over the Rail pipe crossing | SIMEC - Subsidence Project Manager | Friday, 27 September 2024 | | |
| | | 7 | Complete visual inspection during active subsidence S4a and S5a from the rail maintenance contractor | SIMEC - Subsidence Project Manager | Friday, 31 January 2025 | | |
| | | 8 | Post Mining, complete a permanent repair solution of these 2 sets of Gibault's (if installed) within the rail corridor. (managed by Tahmoor Coal in consultation with Sydney Water) | SIMEC - Subsidence Project Manager | Friday, 31 January 2025 | | |
| 1F1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | None Identified | | | | |
| 1G1 | Sydney Water 450mm pipe effected by subsidence, leading to a potential interruption or damage to water supply to local residences. Loss of water to Picton, Thirlmere, Buxton, Greenhills and Oakdale Reservoir's, supply issue from pipe failure. | 1 | Implement monitoring to the Southern side of Caloola Road to identify any adverse movement | SIMEC - Subsidence Project Manager | Friday, 30 August 2024 | | |
| 2A1 | Sydney Water 100mm and 200mm Reticulation Supply Pipelines effected by subsidence, leading to a potential interruption or damage to water supply to local residences. | 1 | None Identified | | | | |