



Tahmoor Colliery Longwalls 25 to 26

PUBLIC, COMMERCIAL AND RESIDENTIAL STRUCTURES

SURFACE SAFETY AND SERVICEABILITY MANAGEMENT PLAN

REVISION D



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GENERAL

REVIEW

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May-08	C	Amended to include additional management measures for LW24A
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CHAPTER 1. STRUCTURES

1.1. Introduction

Tahmoor Colliery is located approximately 80 kilometres south west of Sydney in the township of Tahmoor NSW. It is managed and operated by Xstrata Coal. Tahmoor Colliery has previously mined 24 longwalls to the north and west of the mine's current location.

Longwalls 25 to 26 are a continuation of a series of longwalls that extend into the Tahmoor North Lease area, which began with Longwall 22. The longwall panels are located between the Bargo River in the south-east, the township of Thirlmere in the west and Picton in the north. A portion of each longwall is located beneath the urban area of Tahmoor.

It is noted that a total of 901 houses, public amenities and commercial and business establishments have experienced subsidence movements during the mining of Longwalls 22, 23A, 23B, 24B and 24A. While impacts have been observed to some structures, mine subsidence has not directly exposed residents to any immediate or sudden safety hazards.

This Management Plan provides detailed information about how the risks associated with the mining beneath structures will be managed by Tahmoor Colliery in coordination with the Mine Subsidence Board.

This Management Plan (Revision D) is an update of previous management plans, taking into account experiences gained during the mining of Longwalls 22 to 24A. The risk control procedures include additional measures to manage the potential for increased impacts from increased subsidence that has been observed above the commencing end of Longwall 25.

This Management Plan represents a merger of four previously separate management plans:

- Public Amenities
- Commercial and Business Establishments
- Residential Establishments
- Structures that do not comply with Australian Standards or are Unstable

Separate management plans have been developed for the following structures:

- Structures owned by Inghams Enterprises
- Tahmoor Town Centre
- Structures owned by owners of services infrastructure, such as bridges, culverts, railway stations and sewage pumping stations.
- Heritage structures

The Management Plan is a live document that can be amended at any stage of mining.

1.2. Predicted Subsidence Movements

A summary of the predicted maximum incremental parameters over the whole subsided area, due to the extraction of each longwall, is shown in Table 1.1.

Table 1.1 Maximum Predicted Incremental Subsidence Parameters

Subsidence Parameter	LW 22	LW 23	LW 24	LW 25	LW 26
Vertical Subsidence (mm)	503	613	596	631	636
Transverse Tilt (mm/m)	3.5	4.9	4.7	5.0	5.1
Longitudinal Tilt (mm/m)	3.0	3.8	3.5	3.7	3.7
Transverse Tensile Strain (mm/m)	0.4	0.7	0.7	0.8	0.8
Longitudinal Tensile Strain (mm/m)	0.6	0.7	0.8	0.8	0.8
Transverse Compressive Strain (mm/m)	0.9	1.6	1.5	1.7	1.7
Longitudinal Compressive Strain (mm/m)	0.6	0.8	0.6	0.6	0.8
Transverse Hogging Curvature (km ⁻¹)	0.03	0.05	0.05	0.05	0.05
Longitudinal Hogging Curvature (km ⁻¹)	0.04	0.05	0.05	0.05	0.05
Transverse Sagging Curvature (km ⁻¹)	0.06	0.11	0.10	0.11	0.11
Longitudinal Sagging Curvature (km ⁻¹)	0.04	0.05	0.04	0.04	0.05

The maximum predicted cumulative subsidence parameters, after the extraction of each longwall, are shown in Table 1.2.

Table 1.2 Maximum Predicted Cumulative Subsidence Parameters

Subsidence Parameter	LW 22	LW 23	LW 24	LW 25	LW 26
Vertical Subsidence (mm)	503	756	850	892	934
Transverse Tilt (mm/m)	3.5	5.0	4.8	5.2	5.2
Longitudinal Tilt (mm/m)	3.0	4.4	4.9	5.1	5.2
Transverse Tensile Strain (mm/m)	0.4	0.7	0.7	1.0	1.3
Longitudinal Tensile Strain (mm/m)	0.6	0.7	0.8	0.9	0.9
Transverse Compressive Strain (mm/m)	0.9	1.6	1.7	1.7	1.8
Longitudinal Compressive Strain (mm/m)	0.6	0.8	0.8	0.8	0.8
Transverse Hogging Curvature (km ⁻¹)	0.03	0.05	0.05	0.07	0.09
Longitudinal Hogging Curvature (km ⁻¹)	0.04	0.05	0.05	0.06	0.06
Transverse Sagging Curvature (km ⁻¹)	0.06	0.11	0.11	0.11	0.12
Longitudinal Sagging Curvature (km ⁻¹)	0.04	0.05	0.05	0.05	0.05

1.3. Objectives

The objectives of this Surface Safety and Serviceability Management Plan (SSSMP) are to establish procedures to measure, control, mitigate and repair potential impacts that might occur to structures.

The objectives of the SSSMP have been developed to:-

- Ensure the safety and serviceability of all structures. Public safety is paramount. Disruption and inconvenience should be kept to minimal levels.
- Monitor ground movements and the condition of structures during mining.
- Initiate or coordinate action with the Mine Subsidence Board to mitigate or remedy potential significant impacts that are expected to occur to structures.
- Provide a plan of action in the event that the impacts of mine subsidence are greater than those that are predicted.
- Provide a forum to report, discuss and record impacts to the surface. This will involve Tahmoor Colliery, Mine Subsidence Board, Department of Primary Industries, and consultants as required.
- Establish lines of communication and emergency contacts.

1.4. Scope

The Management Plan is to be used to protect and monitor the condition of the items of infrastructure identified to be at risk due to mine subsidence. The major items at risk are:-

- Residential Establishments
- Public Amenities
- Commercial and Business Establishments

The Management Plan only covers infrastructure that is located within the general application area, which defines the extent of land that may be affected by mine subsidence as a result of mining Longwalls 24 to 26. The management plan does not include other property which lies outside the extent of the general application area.

Separate management plans have been developed for the following structures:

- Structures owned by Inghams Enterprises
- Tahmoor Town Centre
- Structures owned by owners of services infrastructure, such as bridges, culverts, railway stations and sewage pumping stations.
- Heritage structures

1.5. Proposed Mining Schedule

It is planned that each longwall will extract coal working northwest from the southeastern ends. This Management Plan covers longwall mining until completion of mining in Longwall 26 and for sufficient time thereafter to allow for completion of subsidence effects.

The current schedule of mining is shown in Table 1.3.

Table 1.3 Schedule of Mining

Longwall	Start Date	Completion Date
Longwall 25	August 2008	August 2009
Longwall 26	October 2009	October 2010

1.6. 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.

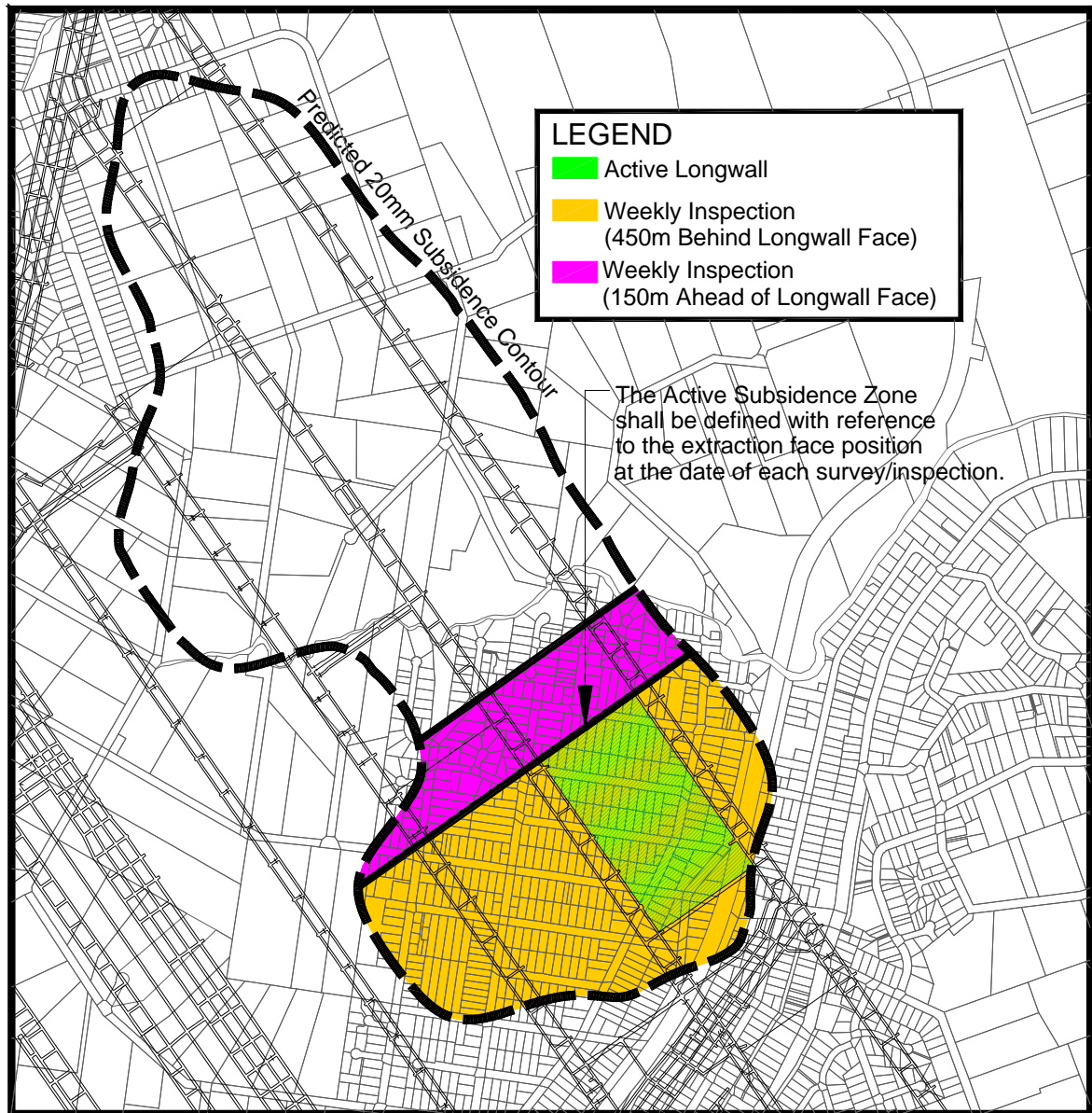


Fig. 1.1 Diagrammatic Representation of Active Subsidence Zone

CHAPTER 2. RISK ASSESSMENT

2.1. Public, Commercial and Main Residential Structures

2.1.1. Experience of mining Tahmoor Longwalls 22 to 24

A total of 901 houses, public amenities and commercial and business establishments have experienced subsidence movements during the mining of Longwalls 22, 23A, 23B, 24B and 24A. The following observations are made:

- Mine subsidence has not directly exposed residents to any immediate or sudden safety hazards.
- The MSB has received a total of 166 claims from individual properties (not including refused claims) of which 146 claims include impacts to main structures. The remaining 20 claims from properties relate solely to claims of damage to small improvements such as swimming pools, sheds and pavements.
- This represents an overall claim rate of 146 out of 901 main structures, or 16%. Conversely, no impacts have been reported for 84% of main structures.
- The rate of impact is understandably greater for structures located directly above extracted mining domains. A total of 672 houses, public amenities and commercial and business establishments are located directly above the extracted longwalls (or pillars between them). A total of 130 claims have been made from this subset, which represents a claim rate of 19% for structures above goaf.
- The claim rate for structures within the predicted limit of subsidence but not located directly above extracted coal (or 'solid coal') is 16 claims out of a total of 229 structures, or 7%.
- The majority of impacts are considered very slight to slight and consist of sticky doors and minor impacts to internal walls, ceilings or floor finishes. However, 1.2% of impacts are considered to be moderate or greater. In three of these cases (i.e. 0.3 % of all building structures), the impacts were substantial and the costs to repair these structures were deemed to be greater than the costs to rebuild.

2.1.2. Increased Subsidence observed during the mining of Longwall 24A

While there has been a reasonable correlation between observed and predicted subsidence above Longwalls 22 to 24B, increased subsidence has been observed above Longwall 24A. Observed subsidence was greatest above the southern half of Longwall 24A, and gradually reducing in magnitude towards the northern half of the longwall, which was directly beneath the urban area of Tahmoor. These observations are shown graphically in Fig. 2.1, which shows observed subsidence at survey pegs located along the centreline of Longwall 24A.

It can be seen from Fig. 2.1 that while observed subsidence was substantially greater than predicted above the commencing end of the longwalls, observed subsidence compared reasonably well with predictions towards the finishing end of Longwall 24A. It is noted that the extent of the urban area of Tahmoor above Longwall 25 is located between Ralfe Street (Peg RF19) and Remembrance Drive (Peg R15).

A total of 13 houses have reported impacts out of a total of 102 houses within the predicted 20 mm subsidence of Longwall 24A (as at the end of August 2008). This represents a claim rate of approximately 13%, which is similar to the claim rate for houses near Longwalls 22 to 24B, which is 16% (as at the end of August 2008). However, the previously observed claim rate for the single panel Longwall 22 was 5%, where 21 houses reported impacts out of a total of 426 houses (as at September 2005). Longwall 24A is also a single panel and based on this comparison, the claim rate for Longwall 24A is approximately 2.6 times greater than the observed claim rate for the mining Longwall 22.

It is important to note that there have been no mine subsidence impacts to residential establishments above Longwall 24A that have directly exposed residents to immediate and sudden safety hazards. While one house has experienced cracks with widths classified as Category 4, the house is presently considered safe and serviceable.

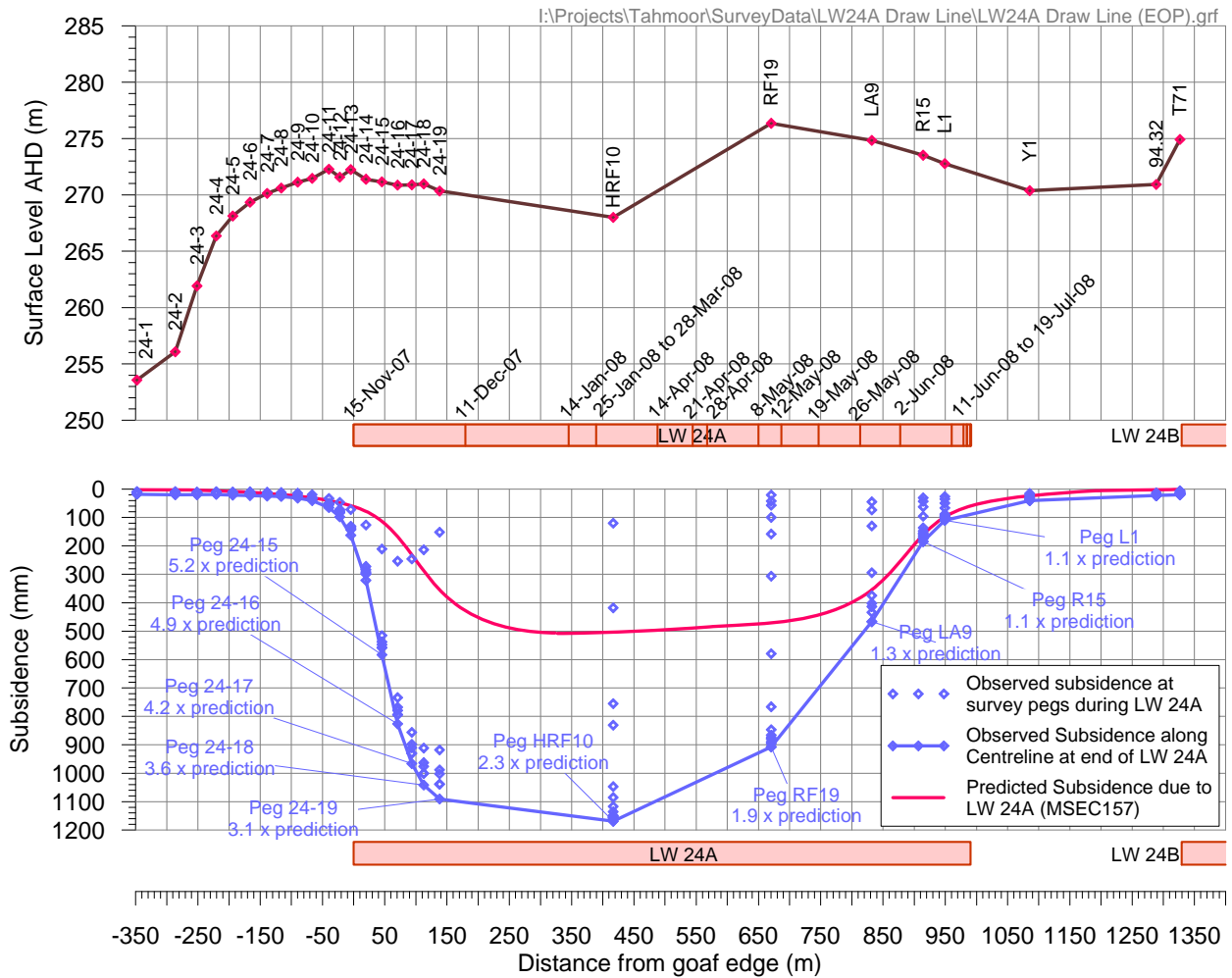


Fig. 2.1 Observed Subsidence along Centreline of Longwall 24A

2.1.3. Potential Increased Subsidence during the mining of Longwall 25

Recent subsidence monitoring after 200 metres of extraction has confirmed that increased subsidence is developing above the commencing end of Longwall 25. This is best illustrated by Fig. 2.2, which compares maximum observed subsidence during the mining of Longwalls 24B, 24A and 25, as well as maximum predicted subsidence during the mining of Longwall 25.

It can be seen from Fig. 2.2 that the observed subsidence behaviour during the mining of Longwall 25 is similar to but slightly less than the behaviour observed during the mining of Longwall 24A. This is substantially more subsidence compared to observations during the mining of Longwall 24B, which closely matches the subsidence predictions.

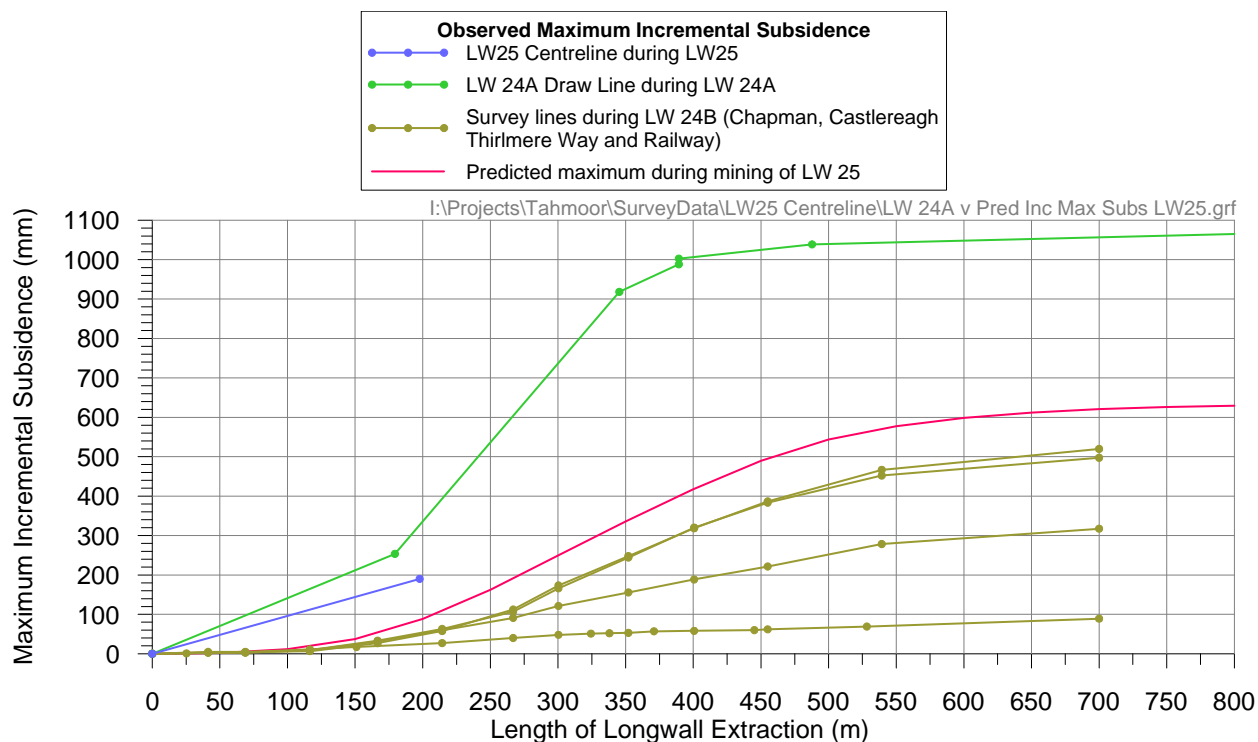


Fig. 2.2 Observed Maximum Incremental Subsidence during the mining of LWs 24B, 24A and 25

In light of the above data, it is considered likely that increased subsidence will be observed along the southern-most streets of Tahmoor, such as Courtland Avenue, Tanya Place, Pandora Place and Progress Street. It is possible that increased subsidence may also be observed further north-west of these streets within the urban area of Tahmoor. However, the probability is considered low because subsidence movements were observed to gradually return to normal levels towards the finishing (northern) end of Longwall 24A.

However, given the observation of increased subsidence, additional risk control procedures will be undertaken to manage the potential development of increased impacts within the urban areas above Longwall 25. The management measures are the same as those that were implemented during the mining of Longwall 24A. The Mine Subsidence Board has demonstrated its capacity to quickly respond to any claims for damage where they affect the safety or serviceability of structures. Building inspectors and structural engineers are available to inspect any affected structures within 24 hours on behalf of Tahmoor Colliery. If an impact occurs to a structure that represents a risk to public safety, the Mine Subsidence Board and Tahmoor Colliery are able to temporarily relocate residents at short notice.

It is important to recognise that while any potential risks to public safety must be responsibly managed, the likelihood of a severe public safety hazard occurring at a structure is extremely low, even if the structure experiences increased subsidence, tilts and curvatures. This was observed during the mining of Longwall 24A and is consistent with experiences gained during a long history of mining beneath structures in the Southern Coalfield. This experience shows that residents have not been exposed to immediate and sudden safety hazards as a result of impacts that occur due to mine subsidence movements. 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 relocate residents.

2.2. Residential Structures

2.2.1. Structures above ‘Hidden’ Creeks

A total of 47 houses are located above ‘hidden’ creeks within the SMP Area, and these are identified in Report No. MSEC157. Hidden creeks are defined as natural watercourses that appear to have been covered during development of a property or road. Hidden creeks have been identified from surface contours and historical aerial photographs. Predictions of upsidence, closure and compressive strain due to valley closure have been made at each house on the assumption that the maximum movements occur at the

house. Impact assessments have been made based upon the predicted compressive strains due to closure. A summary of impact assessments is provided in Table 2.1.

Table 2.1 Summary of Impact Assessments for Houses above ‘Hidden’ Creeks

Strain Impact Category	No. of Houses
Category 0	25
Category 1	18
Category 2	4
Total	47

The four houses that are assessed to experience Category 2 Strain Impacts are J07a, J19a, Y53a, and Y92a. In all cases, the strain impact assessments are greater than the impacts assessments that were based upon predicted systematic subsidence movements.

It can be seen from the above table that the potential impact of upsidence and closure on houses is generally assessed to be negligible to slight. The impact assessments are considered to be conservative and it is possible that many of the identified houses may not experience any upsidence and closure movements. This is because the valleys in which the houses are located are very small and may not be sufficiently incised to generate upsidence and closure. If any movements do occur, it is also possible that they may not be completely transferred from the bedrock to the house through the constructed fill, depending on the design of the building foundations.

It is noted that Structures J07a and J19a are located near Longwall 23A and have not reported any impacts. Structures Y53a and Y92a are located above a possible hidden creek directly above Longwall 25. Additional visual inspections will be undertaken for these structures during mining.

2.2.2. Structures on Steep Slopes

There are 20 structures and dams (including 9 houses) located on steep slopes, which are conservatively defined as a slope greater than 1 in 3. There are no structures located near cliffs. It is possible, though unlikely, that tension cracks may form at the top of the slope and these may coincide with some houses and cause additional impacts to them. It is considered extremely unlikely that the houses would be severely damaged due to large-scale slope failure. No impacts have been observed to steep slopes during the mining of Longwalls 22 to 24B, including steep slopes on the banks of Myrtle Creek.

A qualified geotechnical engineer (GHD Geotechnics) has inspected all steep slopes on which structures are located to determine whether there is any potential for slope instability prior to, during or after mining. Structural inspections by John Matheson & Associates (JMA) have also been undertaken where recommended by the geotechnical engineer.

The risks for most structures have been assessed by GHD Geotechnics as VERY LOW to MODERATE. Both GHD and JMA have recommended monitoring of some properties with assessed moderate risks:

- **Property Ref. K09:** Weekly visual inspections, wall tilt monitoring and baseline ground survey were recommended for the house during periods of active subsidence. Monitoring was undertaken during the mining of Longwall 24B and no impacts were observed. Maximum observed ground strains were 1.7 mm/m. Further monitoring will be undertaken during the mining of Longwall 25.
- **Property Ref. X60:** Weekly visual inspections, wall tilt monitoring and baseline ground survey were recommended for the house during periods of active subsidence. The property is located near the chain pillar between Longwalls 24B and 25. Monitoring was undertaken during the mining of Longwall 24B and no impacts were observed. Maximum observed ground strains were 0.6 mm/m. Further monitoring will be undertaken during the mining of Longwalls 25 and 26.
- **Property Ref. X61:** Additional monitoring was recommended for the house and retaining wall as per Property X60. Monitoring was undertaken during the mining of Longwall 24B and no impacts were observed. Maximum observed ground strains were 0.7 mm/m. Further monitoring will be undertaken during the mining of Longwalls 25 and 26.

- **Property Ref. W42:** Weekly visual inspections and baseline ground survey were recommended for a pool, which is located above Longwall 27. Monitoring will be undertaken during the mining of Longwalls 26 and 27.

The risks for four structures have been assessed by GHD Geotechnics as HIGH or VERY HIGH. The assessment was based on their existing conditions and it was considered that mining does not change the assessments.

- **Property Ref. Y62 (VERY HIGH):** A poorly constructed retaining wall has been identified at the rear property boundary backing onto Myrtle Creek. GHD recommends that Tahmoor Colliery encourage the owner to demolish the wall or conduct regular inspections and a baseline ground survey. GHD advises that there is no mechanism for landslide of the house. The property is located directly above Longwall 26 and beyond the predicted limit of subsidence for Longwall 25. Tahmoor Colliery will encourage the owner to demolish the wall. If the owner refuses, Tahmoor Colliery will encourage the owner to keep away from the wall and will undertake weekly visual inspections during the mining of Longwalls 26 and 27 and install baseline survey marks along the wall. It is noted that there are no walking tracks beneath the wall. However, Tahmoor Colliery will conduct further investigations into whether it would be prudent to erect warning signs at the base of the wall.
- **Property Ref. Y65 (VERY HIGH):** A poorly constructed retaining wall has been identified at the rear property boundary backing onto Myrtle Creek. GHD recommends that Tahmoor Colliery encourage the owner to demolish the wall. The property is located directly above Longwall 26 and beyond the predicted limit of subsidence for Longwall 25. Tahmoor Colliery will adopt the same management strategy as for Y62.
- **Property Ref. Y64 (VERY HIGH):** A small brick BBQ is located on the crest of the steep slope into Myrtle Creek. Given the nature of the structure, GHD recommends that the owner be made aware of the risk. The dwelling is considered a very low to low landslide risk. However, existing cracking is observed and GHD recommends a structural inspection and baseline survey. The property is located directly above Longwall 26 and beyond the predicted limit of subsidence for Longwall 25. Tahmoor Colliery will inspect the property on a weekly basis during periods of active subsidence due to the mining of Longwalls 26 and 27 and conduct a baseline survey around the house. A pre-mining building and structural inspection will also be undertaken.
- **Property Ref. Y67 (HIGH):** A timber deck is located on the crest of the steep slope into Myrtle Creek. There were no foundation details available to GHD at the time of inspection and GHD advises that the risk assessment can be reduced if it is found that the deck is founded on deep footings. GHD has assessed the risk for the adjoining house to be low. A structural inspection of the deck and installation of baseline survey marks was recommended. The property is located directly above Longwall 26 and just beyond the predicted limit of subsidence for Longwall 25. Tahmoor Colliery has engaged JMA to inspect the deck. A pre-mining inspection will also be undertaken. Tahmoor Colliery will undertake weekly visual inspections during the mining of Longwall 26 and 27 and install baseline survey marks around the deck and house.

2.2.3. Houses Prone to Flooding or Inundation

Potential flood prone areas have been identified within the SMP Area along Myrtle and Redbank Creeks.

A flood study has been undertaken by Hughes Trueman which concluded that the proposed mining is not likely to result in any habitable floor levels subsiding below the 100 year ARI flood level, based on the predictions of subsidence provided.

The ground level at most houses are currently above the 100 year ARI flood level, with the exception of houses K09a, K10a, X80a. The floor levels of all houses are currently above the 100 year ARI flood level and this is predicted to remain the case after mining Longwall 26. There was, however, one house (Ref. X80a) where the estimated freeboard is predicted to reduce from 200 mm to approximately 100 mm above the 100 year ARI flood level. The prediction of 100 mm is less than the stated accuracy of the flood level estimation.

This study has recently been updated as a result of the clearance of sediment from Myrtle Creek culvert increasing the cross sectional area. The study findings are essentially the same while structural steel ribs are in place to manage potential subsidence risks to the Myrtle Creek Culvert, that is, the steel ribs offset the increase in waterway opening created by the sediment clearance. However, once the culvert strengthening works are removed, House X80a would have a freeboard of approximately 2.0 metres above the 100 year ARI flood level, assuming that the culvert is kept clear of sediment (Reference: *Myrtle Creek Railway Culvert Flood Study*. Hughes Trueman, Job No. 07s659, July 2008)

The likelihood of any habitable floor levels subsiding below the 100 year ARI flood level is therefore considered **UNLIKELY**.

The houses near flood prone areas are located along the banks of Myrtle and Redbank Creeks, and are generally constructed on piers to accommodate the sloping surface. If it is found that a habitable floor level subsides below the 100 year ARI flood level, it may be possible to raise the height of the floor by jacking the foundations. The consequence of this impact is therefore considered **MODERATE**.

The risk is therefore assessed as **UNLIKELY / MODERATE → MODERATE**.

2.2.4. Houses outside any Mine Subsidence District

There are 122 houses within the SMP Area that are not located within any Mine Subsidence District. The houses are located near the township of Thirlmere, north of Redbank Creek. A small number of houses will experience subsidence movements during the mining of Longwall 25 and the majority will experience movements during the mining of Longwall 26. The hazard associated with these houses is that these houses may be less tolerant to mine subsidence movements as their designs have not been checked and approved by the Mine Subsidence Board. As discussed in Report No. MSEC157, the majority of the houses are single-storey buildings that are less than 30 metres long and less than 30 years old.

The tilt and impact assessments and risk analyses for these structures are the same as those provided for houses whose designs have been approved by the Mine Subsidence Board. This is considered appropriate as the assessments are conservative and empirically based upon houses that were not approved by the Mine Subsidence Board. Nevertheless, the risk associated with these houses could be slightly greater than houses whose designs have been approved by the Mine Subsidence Board as the houses have not been inspected by anyone experienced with mine subsidence issues.

Tahmoor Colliery proposes to control this potential additional risk by conducting a pre-mining check on all houses located outside the Mine Subsidence District that are predicted to experience more than 150 mm of subsidence.

2.2.5. Older houses

There are 403 houses within the SMP Area that are estimated to have been constructed prior to the proclamation of the Bargo Mine Subsidence District in 1975 (Report No. MSEC157). The hazard associated with these houses is that these houses may be less tolerant to mine subsidence movements as their designs have not been checked and approved by the Mine Subsidence Board. Some old houses may also be in poor condition. As shown in Report No. MSEC157, the majority of the houses are single-storey buildings that are less than 30 metres long. Many of the houses, particularly houses over 39 years old, are constructed with timber frames and weatherboard panels or fibro sheets.

The tilt and impact assessments and risk analyses for these structures are the same as those provided for houses whose designs have been approved by the Mine Subsidence Board. This is considered appropriate as the assessments are conservative and empirically based upon houses that were not approved by the Mine Subsidence Board. Nevertheless, the risk associated with these houses could be slightly greater than houses whose designs have been approved by the Mine Subsidence Board as the houses have not been inspected by anyone experienced with mine subsidence issues, and the condition of the houses may have deteriorated over time.

Tahmoor Colliery proposes to control this potential additional risk by conducting a pre-mining check on all houses that were constructed prior to 1975 that are predicted to experience more than 150 mm of subsidence.

2.2.6. Future House Construction

As discussed in Report No. MSEC157, an analysis on the rate of growth of Tahmoor suggests that approximately 27 additional houses are being constructed every year, which equates to approximately 2 to 3 new houses per month.

The hazard associated with these houses is considered to be generally low for the following reasons.

- The design for new houses will be approved by the Mine Subsidence Board (unless they are located outside any Mine Subsidence District),
- The condition of the houses will generally be high as they are newly constructed.

Given that no houses have been assessed to have a high level of risk, it is unlikely that any new houses would be assessed to have a high level of risk.

Tahmoor Colliery proposes to notify all residents immediately prior to the commencement of subsidence movements. If it is discovered during this period that a new house has been constructed, Tahmoor Colliery will offer a pre-mining inspection by the MSB and offer to conduct and provide an impact assessment and risk analysis to the landowner upon request. If the new house is observed to have a maximum plan dimension greater than 30 metres, an impact assessment and risk analysis will be conducted.

In the event that a new house is assessed to have a moderate level of risk or greater, the results of the risk analysis will be provided to the Department of Primary Industries and the Mine Subsidence Board. Standard risk control procedures will then be applied to these houses, which are provided in this Management Plan.

2.3. Flats or Units

A total of 28 flats or units have been identified within the SMP Area. Flats or units have been defined in this report as any properties that contain at least one structure and which contain at least three strata units.

This definition is necessary because there are many single-dwelling or semi-detached houses within the SMP Area that are called "units". These structures have been classified as houses for the purposes of this SMP. However, housing estates that contain a number of multi-dwelling structures have been classified as units, even if some of the structures only contain two strata units.

The hazard associated with units is that they may be damaged due to mine subsidence impacts, and potentially damaged to the extent that they are rendered unserviceable or unsafe. This is the same hazard as for other structures, and the likelihood and consequence of this risk are considered to be the same those outlined for other structures.

2.4. Pools

2.4.1. Pool Damage

A total of 12 swimming pools have experienced mine subsidence impacts during the mining of Longwalls 22 to 24A. Eight pools have noticeable tilt. Four in-ground pools have cracked and one could not retain water.

Predictions and impacts assessments were provided for the SMP Report, using the same method that has been used for residential structures. It was recognised at the time of writing the SMP Report that the overall predicted level of impact is generally quite low. While predicted tilts were not expected to cause a loss in capacity, tilts are more readily noticeable in pools as the height of the freeboard will vary along the length of the pool. While predicted strains impacts were low, many of the pools are in-ground pools, which are more susceptible to impacts than above-ground pools.

It is considered that a separate method for assessing impacts to pools should be developed. A review is currently being conducted as part of the ACARP Research Project to develop a method for assessing impacts to pools.

2.4.2. Pool Gates

The hazard to pool gates is that they may not close due to mine subsidence impacts, even if they are spring-loaded.

A number of pool gates have been impacted by mine subsidence during the mining of Longwall 22 to 24A. While the gates can be easily repaired, the consequence of breaching pool fence integrity is considered to be severe.

Tahmoor Colliery will inspect pool fences on a weekly basis during the active subsidence period. Any damage to pool fences and gates caused by mine subsidence will be repaired by the Mine Subsidence Board.

2.5. Septic Tanks

The risk to septic tanks is that they could be damaged and/or rendered unserviceable from mine subsidence impacts. There are two types of potential damage to septic tanks.

- Compressive ground strains could cause cracking and leaking of tanks.
- Shearing could also occur at the joint connecting the sewer pipes to the septic tank, as sewer pipes are generally able to slide as the ground moves horizontally beneath them, while the septic tanks are fixed and unable to slide relative to the sewer pipes.

Given that tanks are quite small (usually less than three (3) metres in diameter), constructed of reinforced concrete, and are usually bedded in sand and backfilled, the likelihood of cracking to septic tanks is assessed as very rare. It is noted that no impacts to septic tanks have been reported during the mining of Longwalls 22 to 24A, with the exception of a claim for minor cracking to a large industrial septic tank near Longwall 24A.

Pipe joints are usually flexible and consist of relatively short lengths, due to the proximity of the septic tank to the house. However, given that both the house and septic tank are effective ground anchors, it is possible that pipe joints can pull out or shear as a result of subsidence. The MSB reports that this has been observed in a small number of cases during the mining of Longwalls 22 to 24A. This impact is relatively easy to repair.

The MSB also report that on two occasions during the mining of Longwalls 22 to 24A, the grade of the sewer pipe to the septic tank has been reversed. The impacts are considered to have been partially due to very low pre-mining grades. In both cases, the repairs have been straight-forward, where the pipes were re-laid at an improved fall, entering the septic tank at a slightly lower level.

2.6. Sheds and Other Domestic Structures

The risk to sheds and other domestic structures is that they could be damaged and/or rendered unserviceable from mine subsidence impacts.

There are 1632 structures identified as “Other Domestic Structures” (Type D). These include garages, sheds, carport, tanks, greenhouses, hothouses, playhouses and shade structures.

These structures are able to withstand greater subsidence impacts than houses as they are generally lighter, more flexible in construction, and smaller in size. The risk of damage to sheds and other domestic structures is therefore considerably less when compared to houses.

A small number of sheds and other domestic structures have reported impacts during the mining of Longwalls 22 to 24A, all of which are considered to be relatively minor and easy to repair.

Any damage to sheds and other domestic structures will be repaired by the Mine Subsidence Board.

2.7. Private Roads and Walking Trails in close proximity of steep slopes

There are a small number of private driveways that are located on steep slopes. These driveways are found on properties along the banks of Myrtle Creek, and at the end of Tickle Drive on a spur of the Redbank Range.

It is possible that tension cracks may form at the tops of the slopes, and compression ridges may form at the bottoms of the slopes, and that these may coincide with private driveways. If the tension cracks are left untreated, these may cause erosion to occur, which may further damage driveways. It is unlikely that large-scale slope failure will occur. No impacts of this type have been observed during the mining of Longwalls 22 to 24A.

2.8. Public Amenities

There are a number of public amenities identified within the SMP area.

The hazard associated with public amenities is that they may be damaged due to mine subsidence impacts, and potentially damaged to the extent that they are rendered unserviceable or unsafe. This is the same hazard as for other structures, and the likelihood and consequence of this risk are considered to be the same those outlined for other structures. However, there are a number of additional issues associated with public amenities, which may affect the way these hazards are managed.

- Public amenities are used and enjoyed by many members of the community.
- In the case of hospitals, schools, shopping centres and public utility buildings, it is not economically or socially feasible to temporarily or permanently close the amenities.
- While it is possible to temporarily close some public amenities and relocate any activities, it is extremely inconvenient to the public.
- Public amenities must maintain access and mobility standards throughout the mining period.

Predictions and impact assessments have been made for all public amenities in Report No. MSEC157. The public amenities that have been assessed as moderate risk are listed below:

- Tahmoor Town Centre main buildings (Ref. Y02a and Y02b)
- Presbyterian Church and Child Care Centre (Ref. AA01a)
- Wollondilly Health Centre (Ref. Z57a)

The assessment of moderate risk is primarily based upon the length of the structures.

The assessment of risk for the Tahmoor Town Centre structures is based upon structural analysis and consultation with Tahmoor Town Centre. A separate management plan has been developed and agreed between Tahmoor Colliery and Tahmoor Town Centre.

The Presbyterian Church and Child Care Centre have been inspected by structural engineer John Matheson & Associates. The structures appear to be in a sound condition. However, a small brick retaining wall was observed to have a high pre-mining tilt. Given that increased subsidence has been observed above Longwall 25, Tahmoor Colliery will undertake daily inspections once the longwall approaches to within 50 metres of the structures. Weekly ground monitoring will also be undertaken along Progress and Abelia Streets.

The Wollondilly Health Centre is located to the west of Longwall 24A and experienced no impacts during the mining of this longwall. The centre will experience only very small additional movements during the mining of Longwalls 25 and 26.

2.9. Commercial and Business Establishments

2.9.1. Tahmoor Town Centre

Please refer to the Subsidence Management Plan for Tahmoor Town Centre.

2.9.2. Inghams Enterprises

Please refer to the Subsidence Management Plan for Inghams Enterprises.

2.9.3. Pepes Ducks

Please refer to the Subsidence Management Plan for Pepes Ducks, which will be prepared prior to the commencement of Longwall 26.

2.9.4. Other Commercial and Business Establishments

The business and commercial establishments within the SMP Area have been identified and are described in Report No. MSEC157. A total of 105 structures have been identified, including those owned by Inghams Enterprises and the Tahmoor Town Centre.

The hazard associated with public amenities is that they may be damaged due to mine subsidence impacts, and potentially damaged to the extent that they are rendered unserviceable or unsafe. This is the same hazard as for other structures, and the likelihood and consequence of this risk are considered to be the same those outlined for other structures. However, there are a number of additional issues associated with commercial and business establishments, which may affect the way these hazards are managed.

- Commercial and business establishments are used and enjoyed by many members of the community. Many of the establishments are also described as public amenities.
- While it is possible to temporarily close commercial and business establishments and relocate any activities, it is extremely inconvenient to the owner of the establishment, its employees and its customers. There are many additional consequences associated with temporarily relocating commercial and business establishments.
- Retail establishments must maintain access and mobility standards throughout the mining period.

The predicted subsidence parameters and impact assessments for each establishment, after the completion of each longwall, are provided in Report No. MSEC157. The establishments that have been assessed as moderate risk are listed below:

- Tahmoor Town Centre main buildings (Ref. Y02a and Y02b)
- Presbyterian Church Child Care Centre (Ref. AA01a)

At the request of the Department of Primary Industries, structural inspections have been undertaken of all commercial structures within the Tahmoor CBD district that are directly located above the longwalls. These inspections have been undertaken and in some cases, the structural engineer has recommended some mitigation works. These works were undertaken prior to the influence of Longwall 24A.

2.9.5. Shopfronts along Remembrance Drive

JMA has recommended trigger levels based on cross-tilts along the shopfronts along Remembrance Drive. Shopfronts differ from most other structures as their ability to accommodate lateral tilts is reduced due to the large wall openings. The cross-tilt trigger level is generally 3 mm/m, though the recommended trigger for some shops is less due to existing structural condition or design.

Tahmoor Colliery will conduct weekly surveys for tilts along the Remembrance Drive monitoring line as a preliminary trigger for the shops. Survey marks have been installed directly outside the shopfront and a baseline survey has been undertaken. The “shopfront line” was initially installed during the mining of Longwall 24A and has since been extended to cover shops located closer to Longwall 25. The shopfront line will be monitored during mining if tilts appear to be reaching trigger levels.

Observed tilts along the shopfront line are shown in Fig. 2.3. This figure also shows predicted total tilts if subsidence due to Longwall 25 along Remembrance Drive is normal, or if increased subsidence occurs. Based on the current predictions, it appears that the shopfront tilts will not exceed the defined triggers.

Given the uncertainty in predictions due to the unique subsidence behaviour above Longwalls 24A and 25, the progressively acquired observed subsidence results during the mining of Longwall 25 will be used to reassess the predicted profiles along Remembrance Drive. If it appears that the tilts across the shopfronts are likely to exceed the defined trigger levels, Tahmoor Colliery will consider implementing response measures as recommended by JMA.

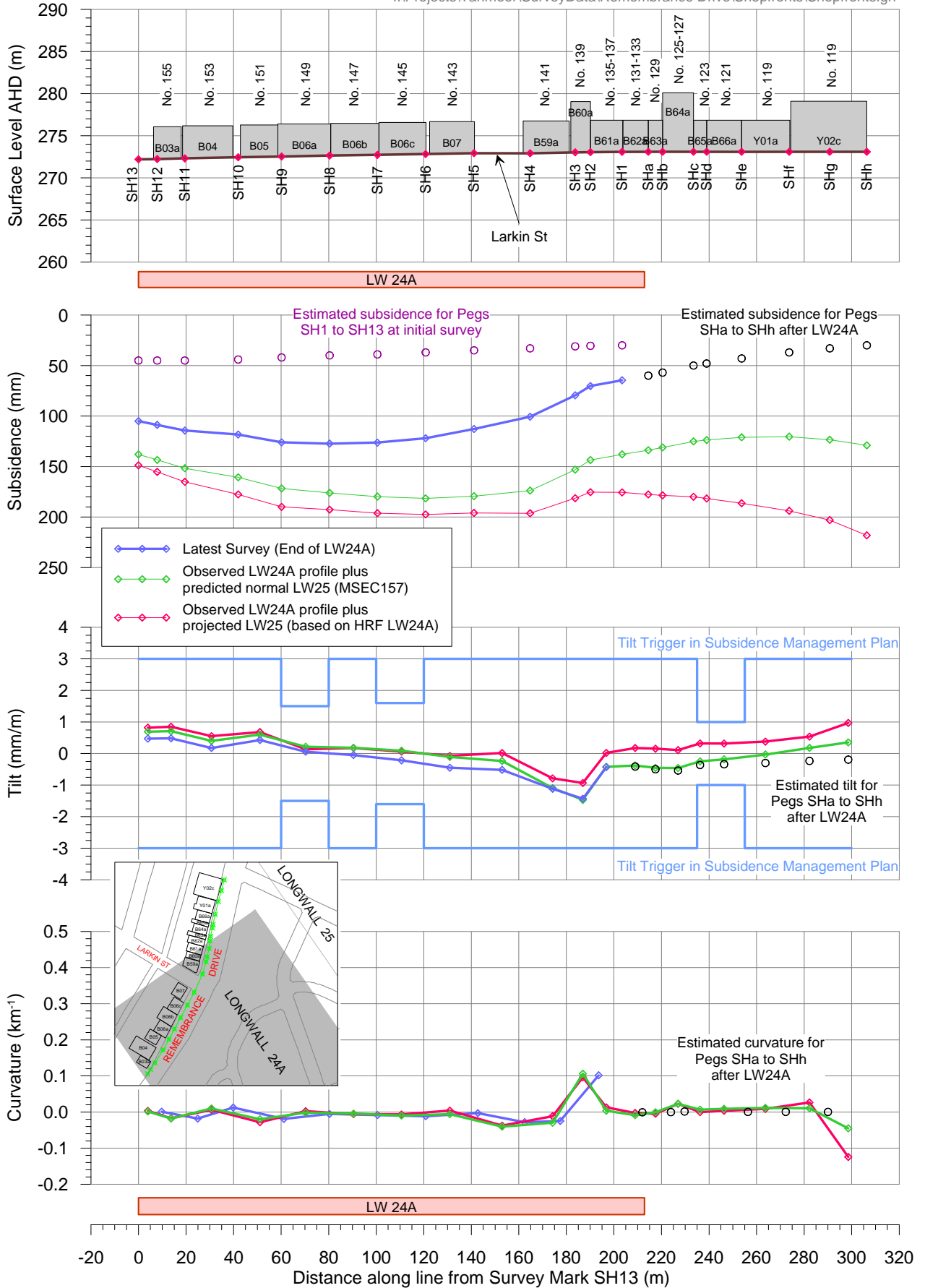


Fig. 2.3 Observed and Predicted Subsidence along the Shopfront Line

2.10. Risks associated with Existing Structural Condition

The existing structural condition of structures varies above Longwalls 25 and 26. This is a function of age, structural design, construction workmanship and maintenance. Pre-mining inspections undertaken by Tahmoor Colliery have identified elements of structures that did appear to comply fully with Australian Standards, in regard to design and construction. In a small number of cases, the existing structural condition has been considered unsafe and Tahmoor Colliery has undertaken measures to repair the defect.

There is a remote possibility that the comparatively small additional contribution of mine subsidence movements could be sufficient to result in failure of structures that do not meet Australian Standards or are unsafe. While the warnings appear dire, it should be noted that the likelihood of structural failure is still considered to be remote as no structures have collapsed as a result of mine subsidence movements in the Southern Coalfield.

The experience from the mining of 901 structures affected by Longwalls 22 to 24A shows that residents have not been exposed to immediate and sudden safety hazards as a result of impacts that occur due to mine subsidence movements. 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 relocate residents.

Tahmoor Colliery has undertaken the following strategy to identify potentially 'unstable structures':

- Initial building identification – kerbside survey
- Pre-mining geotechnical inspections of structures located on steep slopes
- Pre-mining structural inspections of the following structures:
 - All public amenities and commercial and business establishments that are located directly above Longwall 25.
 - Structures that have been recommended for structural inspection by the geotechnical engineer.
- Pre-mining building inspections of the following structures:
 - Houses and units assessed as Moderate risk or greater based on systematic subsidence predictions and length of structures.
 - Public amenities and commercial and business establishments with a maximum plan dimension of 15 metres or greater.
 - Houses and units located above hidden creeks for which an impact assessment is Strain Category 2 or greater.
 - Houses and units located on steep slopes, if recommended by the geotechnical engineer. In some cases structural inspections are conducted.
- Pre-mining building checks of the following structures:
 - Houses and units located outside any Mine Subsidence District that are predicted to experience more than 150 mm of subsidence.
 - Houses estimated to have been constructed prior to the declaration of the Mine Subsidence District (1975), and which are predicted to experience more than 150 mm of subsidence, and which have not already been directly mined beneath by Longwalls 22 and 23.
 - Houses in areas where increased subsidence is expected. Pre-mining checks were conducted on all houses located directly above Longwall 24A. In light of the observation of increased subsidence at the commencing of Longwall 25, pre-mining checks will be undertaken for all houses located directly above the first 700 metres of extraction. This will be extended if increased subsidence is projected to extend beyond this area.
- Pre-mining inspections conducted by the Mine Subsidence Board
- Letters to all residents of structures that will soon be affected by subsidence. The letters invite the residents to contact Tahmoor Colliery should have any concerns with their structure, or alternatively contact the Mine Subsidence Board for a pre-mining inspection.

- Inspections during mining, where any potentially unstable structures may be identified by their response to subsidence movements:
 - Kerbside visual inspections twice a week, which is increased to daily when increased subsidence is observed.
 - Building inspections of public amenities and commercial and business establishments
 - Building inspections of structures that have already reported impacts
 - Structures and driveways located on steep slopes

A total of 659 pre-mining inspections and 94 pre-mining checks have been undertaken by the Mine Subsidence Board and Tahmoor Colliery to date. Tahmoor Colliery undertook a total of 2,551 visual inspections of structures during the mining of Longwall 24B. A similar volume of inspections is inspected to be undertaken during the mining of Longwall 25.

Tahmoor Colliery will undertake a structural inspection of any structures that have been identified as being potentially unstable. Further management measures may be implemented following the findings of the inspection.

CHAPTER 3. RISK CONTROL PROCEDURES

3.1. Structures Response Group (SMG)

The SMG is responsible for taking the necessary actions required to manage the risks that are identified from monitoring of structures. The SMG's key members are:

- Tahmoor Colliery
- John Matheson and Associates
- Mine Subsidence Engineering Consultants
- Mine Subsidence Board
- Sunrise Building and Property Services

The SMG may invite other specialist consultants from time to time, including GHD Geotechnics where issues related to slope stability.

3.2. Mitigation Measures

Mitigation measures have been undertaken to strengthen a small number of structures prior to the influence of mine subsidence movements. The measures have been undertaken in response to building or structural inspections, where the existing condition of the structure could be improved to better accommodate mine subsidence movements, particularly above Longwalls 24A and 25 where increased subsidence was projected to occur.

The following outstanding mitigation measures are required to be undertaken prior to the influence of subsidence from Longwall 25:

- **Property Ref. B06b:** This shopfront experienced a Category 3 crack during the mining of Longwall 24A following the installation of a structural steel support frame, which was installed as a mitigation measure prior to the influence of Longwall 24A. The crack will be treated prior to the influence of subsidence from Longwall 25, as recommended by John Matheson & Associates.
- **Property Ref. Y41:** This house contains a number of large cracks in its external masonry walls, prior to the influence of subsidence. Some large cracks will be treated prior to the influence of subsidence from Longwall 25, as recommended by John Matheson & Associates.

The mitigation measures will be completed prior to Longwall 25 approaching to within 200 metres of each structure.

3.3. Structure Inspection Plan

3.3.1. Geotechnical Inspections of Steep Slopes

A qualified geotechnical engineer (GHD Geotechnics) has inspected all steep slopes on which structures are located to determine whether there is any potential for slope instability prior to, during or after mining. The inspection findings are detailed in Section 2.2.2.

3.3.2. Structural Inspections

A qualified structural engineer (John Matheson & Associates) has inspected and provided engineering assessments for the following structures:

- All public amenities and commercial and business establishments that are located directly above Longwall 25.
- Structures that have been recommended for structural inspection by the geotechnical engineer.
- Structures that have been identified as being potentially unstable. This includes two structures above Longwall 25, where large pre-mining cracks were identified.

3.3.3. Pre-mining Building Inspections

Pre-mining building inspections will be conducted for the following structures, as shown in Fig. 3.1:

- All houses and units assessed as Moderate risk or greater.
- All houses and units located above hidden creeks for which an impact assessment is Strain Category 2 or greater.
- All houses and units located on steep slopes, if recommended by the geotechnical engineer.

The building inspection includes the following actions:

- **A pre-mining inspection for Mine Subsidence Board purposes**
As part of the building inspection, inspections will be undertaken on behalf of the Mine Subsidence Board (MSB). Inspections will record the incidence and locations of defects in hard or finished surfaces (internal or external), including cracking and any pre-existing misalignments or bows in walls and floors. The inspection is conducted by a licensed builder with experience in mine subsidence. Pre-mining inspection reports will be forwarded to the MSB.
- **A pre-mining check for potential stability issues**
A check for any potential stability issues on the property.
- **A relative level survey (Zip level survey)**
Relative level surveys (Zip level survey) measures vertical heights relative to a base mark. Levels will be measured using the Technidea ZipLevel Pro-2000, which is an electronic elevation measurement system with a stated accuracy of approximately ± 3 mm. The levelling tool adopts the principles of water pressure to measure changes in elevation, which is ideal for level surveys around and inside buildings as measurements can be taken without requiring a line of sight. The ZipLevel has also been chosen by the MSB for its future surveys.
As shown in Fig. 3.3, levels will be measured at all external and internal corners of the building and at the centre of each external side of reasonable length (this will depend on the overall size of the building, but is approximately 10 metres), any construction joints and articulation joints within the building and at a point within the building at a hard surface if the shortest axis of the building is a reasonable length (approximately 10 metres). Full descriptions of each survey point will be recorded, as permanent marks will not be left on residential structures.
Due to the variability in access available to conduct level surveys, it is anticipated that there will be some cases where the above principles cannot be followed.
Where possible, levels will be taken at roughly the same elevation around the building. For example, in the case of brick buildings on reasonably level ground, levels will be taken along the same brick course. By following this procedure, it should be possible to develop an understanding of any pre-existing tilts within the external walls, as well as providing a uniform point of reference for analysis and future surveys. Levels will be taken at approximately one metre above ground level for ease and safety of surveying.
- **Measurement of Horizontal Distances**
Horizontal distances will also be measured for all external walls of reasonable length with reasonable access. As a minimum, horizontal distances will be measured for two walls that are perpendicular to each other. Where possible, distances will be recorded at the same height as the building levels. However, this procedure may be difficult to follow where there are numerous obstructions around the perimeter of the building, for example downpipes, water heaters, switchboards, fences and vegetation.
Horizontal distances will be measured using a Leica DISTO distancemeter, which is an electronic laser distancemeter with a stated accuracy of approximately ± 3 mm. This tool is considered more appropriate for measuring buildings as it can avoid the many obstructions typically found around building perimeters. However, a steel tape will be used to measure horizontal distances where appropriate.
- **Vertical tilts of Walls**
A spirit level will be used to estimate vertical tilt on walls at external corners.
- **Written Report**

As a general guide, pre-mining inspections will be undertaken prior to each structure experiencing subsidence greater than 20 mm.

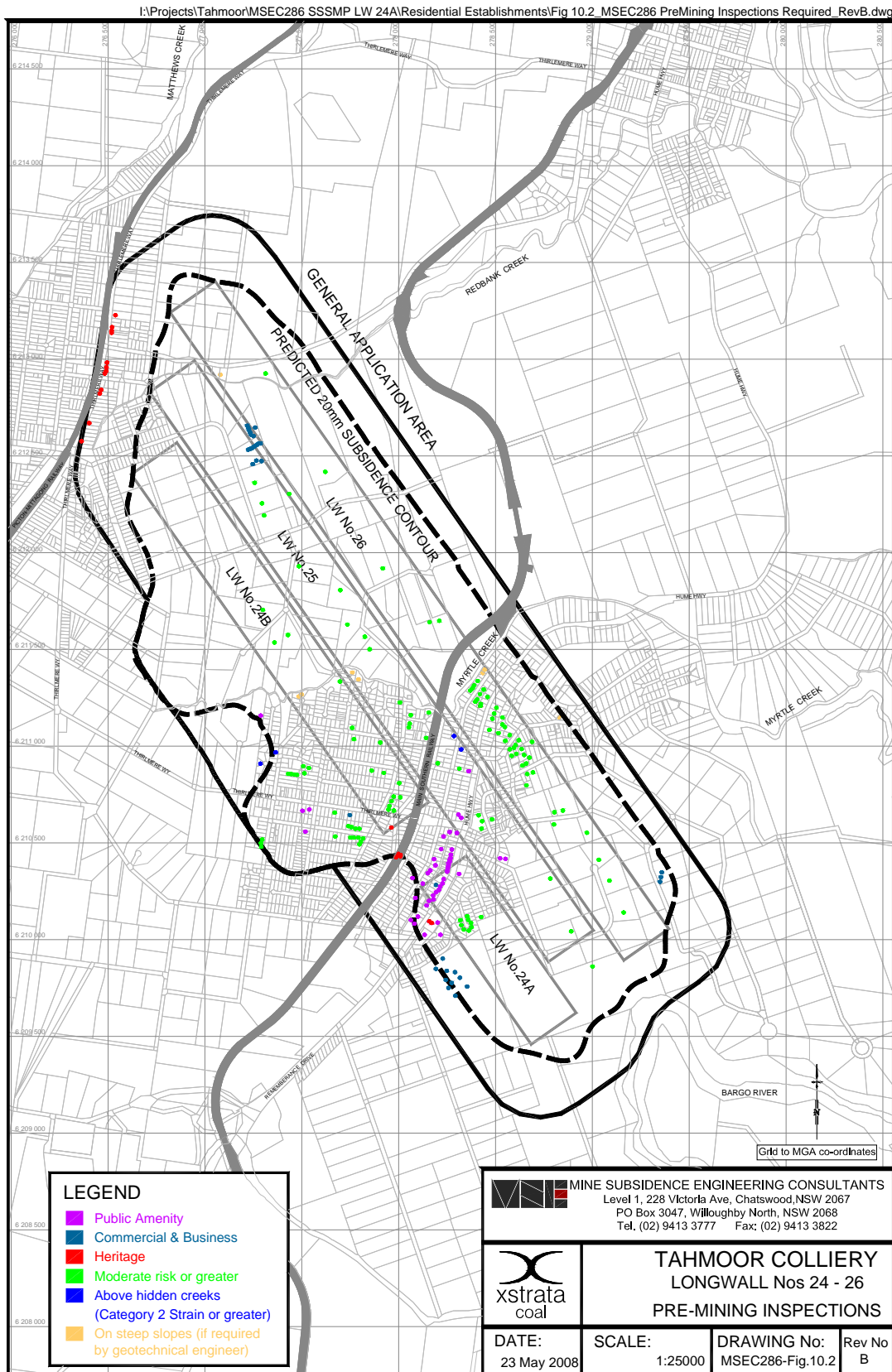


Fig. 3.1 Location of all Structures selected for Pre-Mining Inspections

3.3.4. Pre-mining Building Checks

Pre-mining building checks will be conducted for the following structures, as shown in Fig. 3.2:

- All houses and units located outside any Mine Subsidence District that are predicted to experience more than 150 mm of subsidence.
- All houses estimated to have been constructed prior to the declaration of the Mine Subsidence District (1975), and which are predicted to experience more than 150 mm of subsidence.
- All structures where increased subsidence is projected to occur. This was conducted for all structures within the urban area directly above Longwall 24A. In light of the observed increased subsidence above the commencing end of Longwall 25, a pre-mining check will be conducted for all structures that are located above the first 700 metres of extraction above Longwall 25. This covers the spatial extent of increased subsidence above Longwall 24A and will be extended if increased subsidence is projected to extend beyond the first 700 metres, as determined by the monitoring results.

This type of inspection checks for any potential stability issues on the property. A short written report is provided that includes details of the property inspected, the date of inspection and whether any potential stability issues were observed. The inspection is conducted by a licensed builder with experience in mine subsidence.

As a general guide, pre-mining checks will be undertaken prior to each structure experiencing subsidence greater than 20 mm.

3.3.5. Pre-Mining Inspections by the Mine Subsidence Board

The Mine Subsidence Board (MSB) has already undertaken a number of pre-mining inspections above Longwalls 24 to 26. Further inspections will be conducted by the MSB in the future. Where a landowner has already undertaken a pre-mining inspection by the MSB, or has requested a pre-mining inspection to be conducted by the MSB, Tahmoor Colliery will not conduct its own pre-mining inspection.

3.3.6. Visual kerbside inspections

Kerbside street inspections will be conducted on a daily basis during the mining of Longwall 25. These inspections include the Tahmoor CBD area. This frequency may be reduced to standard twice weekly intervals, as were conducted for Longwalls 22, 23A, 23B and 24B once it is established that normal subsidence behaviour is occurring.

3.3.7. Visual Inspections of Structures during mining

Single inspections during mining will be conducted for the following structures:

- Houses and units assessed as Moderate risk or greater.
- Structures identified as not complying with Australian Standards, where each structure is predicted to experience more than 20 mm of subsidence. In some cases, weekly inspections will be conducted where recommended by a geotechnical or structural engineer.

Single inspections will be conducted when the longwall face has passed each structure by approximately 200 metres, and the structure is predicted to experience more than 20 mm of subsidence as a result of mining the active longwall.

Weekly inspections will be conducted for the following structures or slopes when they are located within the active subsidence zone, as defined in CHAPTER 1:

- Houses and units assessed as High risk or greater (there are none)
- Houses and driveways located on steep slopes, if recommended by a geotechnical engineer.
- Houses and units that have experienced impacts as a result of mining previous longwalls.
- Pool gates, where the pool is predicted to experience more than 20 mm of subsidence.
- Public amenities and commercial and business establishments. Daily inspections will be undertaken within the Tahmoor CBD area.
- Structures recommended for weekly monitoring by a geotechnical or structural engineer.

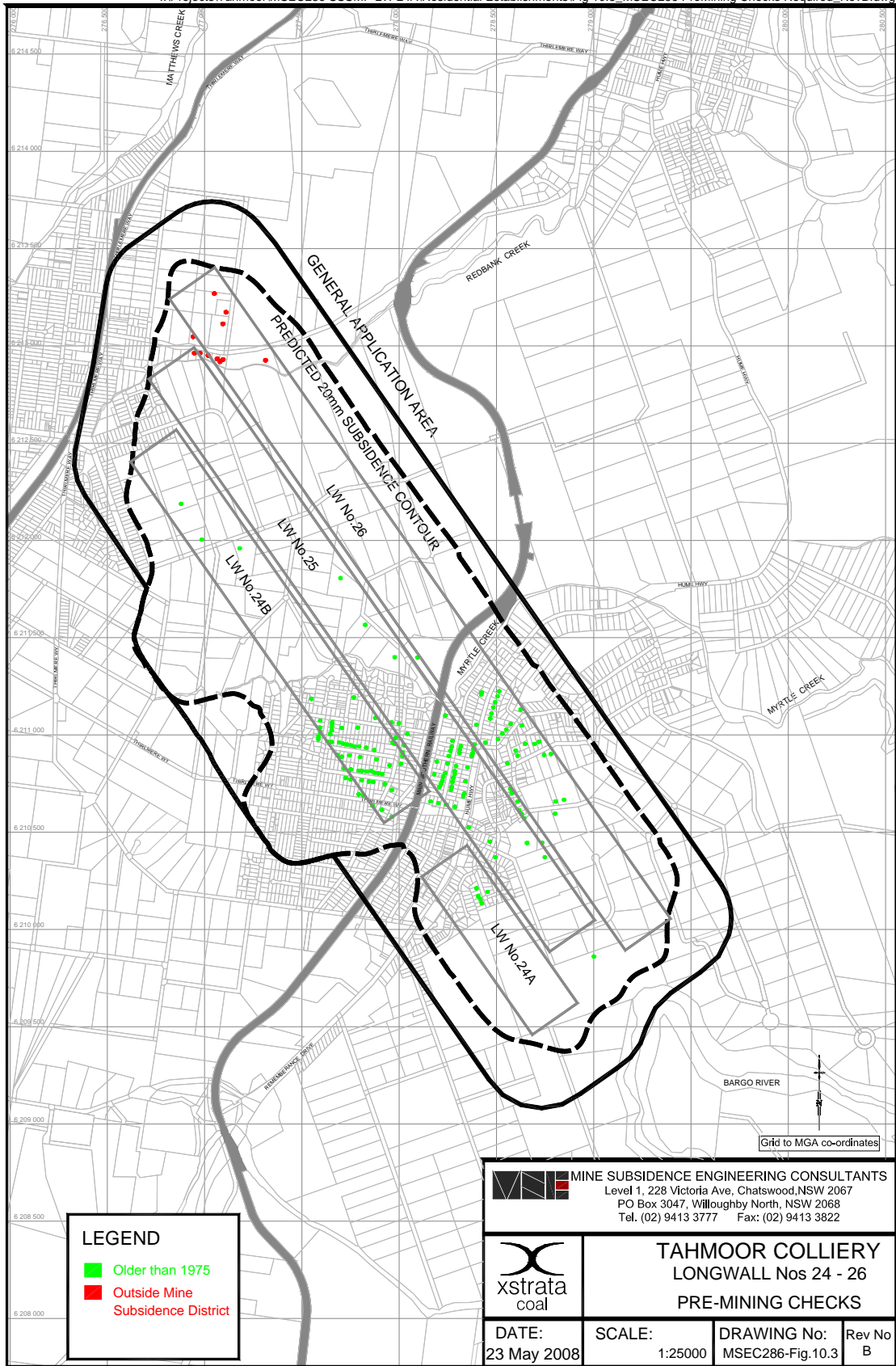


Fig. 3.2 Location of all Structures selected for Pre-Mining Checks

3.3.8. Visual Inspections of Structures after mining

End of Longwall inspections will be conducted for the following structures where they are predicted to experience more than 20 mm of subsidence as a result of mining the active longwall:

- All houses and units assessed as Moderate risk or greater.
- All structures identified as being potentially unsafe, where the structure is predicted to experience more than 20 mm of subsidence.
- All pool gates, where the pool is predicted to experience more than 20 mm of subsidence.

3.4. Ground and Structure Monitoring Plan

Monitoring lines have been installed along all streets within the urban area above Longwalls 25 and 26, as shown in Fig. 3.4. The monitoring lines have been initially surveyed to provide a baseline reference.

In light of the observed increased subsidence above the commencing end of Longwall 25, level surveys will be undertaken for all survey marks when each mark is within 50 metres of the longwall face and levels will be surveyed weekly. Baseline strain distances have also been measured and strain distances will be surveyed in the event of an impact to any surface feature or where non-systematic movement is suspected to have occurred.

The weekly survey frequency will be maintained until it is apparent that subsidence behaviour has returned to normal levels. Based on observations during the mining of Longwall 24A, maximum subsidence along monitoring lines located near the finishing end compared well with predictions. Changes to survey frequency will be considered by the SMG in light of monitoring results, subject to approval from the Department of Primary Industries. The lines were previously surveyed every 200 metres of extraction within the active subsidence area during the mining of Longwalls 22, 23A and 24B.

It is noted, however, that higher frequency monitoring of some monitoring lines will be conducted as part of subsidence management procedures for other surface features. This includes Remembrance Drive, Thirlmere Way and York Street.

3.4.1. Specific Structure Surveys

Tahmoor Colliery will undertake building surveys where recommended by a geotechnical or structural engineer. Table 3.1 lists which building surveys. Table 3.1 lists where specific structure surveys will be undertaken or baseline monitoring installed during the mining of Longwall 25:

Table 3.1 Building Surveys scheduled during the mining of Longwall 25

Structure Ref.	Structure Type	Weekly LW25 crack monitoring	Weekly LW25 tilt monitoring	Baseline ground monitoring	Reason
AA01	Public	×	✓	Streets only	Structural inspection identified pre-mining tilt in small retaining wall
B06b	Shop	×	✓	Installed along shopfront	Tilt of post supporting a wall opening used as trigger for installation of flybrace
K09	House	×	✓	Installed	House on slope, monitoring as recommended by structural engineer
X60	House	×	✓	Installed	House on slope, monitoring as recommended by structural engineer
X61	House	×	✓	Installed	House on slope, monitoring as recommended by structural engineer
Y07	Public	×	✓	Street only	Recommended by structural engineer
Y19	House	✓	✓	Street only	Recommended by structural engineer due to existing condition of house
Y41	House	✓	✓	Street only	Recommended by structural engineer due to existing condition of house
Y62	Retaining wall	×	× Likely during LW26	200m prior to LW25 in line with wall	Existing condition on steep slope, wall outside predicted limit of subsidence for LW25
Y64	House	× Likely during LW26	× Likely during LW26	200m prior to LW25 in line with house	Recommended by geotechnical engineer due to existing condition of house (not due to slope stability). House outside predicted limit of subsidence for LW25.
Y65	Retaining wall	×	× Likely during LW26	200m prior to LW25 in line with wall	Existing condition on steep slope, wall outside predicted limit of subsidence for LW25
Y67	House	× Likely during LW26	× Likely during LW26	200m prior to LW25 in line with house	Recommended by geotechnical engineer due to proximity of deck to slope. House outside predicted limit of subsidence for LW25.
W42	Pool	×	×	200m prior to LW26 in line with wall	Recommended by geotechnical engineer due to proximity of pool to slope.

Crack monitoring is undertaken using sliding rules fixed to either side of the crack. Tilt monitoring is undertaken using a spirit level. These inspections will be undertaken on a weekly basis when each structure is located within the active subsidence zone.

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

The Colliery will record the reduced levels of each peg, as well as the horizontal distance between each peg around the perimeter of the building. The survey information will provide subsidence, tilt, curvature and strain information on the ground around the building. This general surveying scheme is illustrated in Fig. 3.3. It is recognised that in some cases, it will not be possible to gain access and suitable lines of sight to the entire perimeter of the building, and in some cases, the number of survey pegs may be reduced. However, as a minimum, survey marks will be placed at every corner of the building.

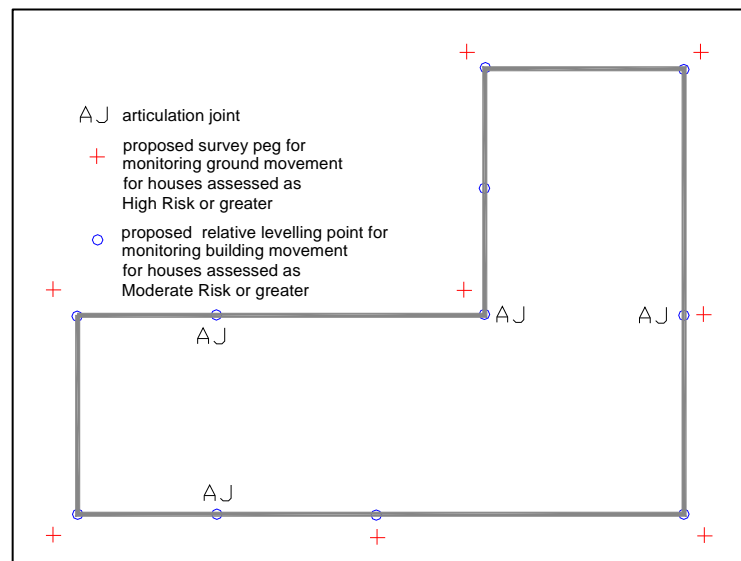


Fig. 3.3 Schematic layout for ground movement and building level surveys around a typical building

3.5. Schedule of Inspections and Surveys

A schedule of inspections and surveys is maintained using an electronic database. Weekly job sheets are issued by Tahmoor Colliery to all inspection and survey contractors. Tahmoor Colliery can, at any time, provide a copy of the schedule of inspections to the Department of Primary Industries.

3.6. Inspection and Survey register

A register will be kept by Tahmoor Colliery, recording when inspections and surveys were conducted. Tahmoor Colliery can, at any time, provide a copy of the register to the Department of Primary Industries.

3.7. Triggers and Responses

Trigger levels have been developed by Tahmoor Colliery based on observed ground movements or impacts. In a small number of cases, the structural engineer has recommended responses triggered by observed tilts across shopfronts. Trigger levels for each monitoring parameter are described in the risk control procedures in Table 3.2.

Structural inspections will be undertaken for any structure where ground tilts is observed to exceed 7 mm/m or curvature is observed to exceed 0.2 km^{-1} or where observed impact is Category 3 for strain impacts or greater.

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

Immediate responses will be undertaken by Tahmoor Colliery or the Mine Subsidence Board for the following impacts:

- Impacts that create a serious public safety hazard
- Impacts to all entry and exit doors, and all other doors that must remain operational for security and fire egress reasons, even if further impacts are anticipated. This includes access gates for child care centres.
- Impacts that impair any essential services.
- Impacts that impair access and mobility to public amenities and commercial and business establishments, even if further impacts are anticipated.
- Impacts to the aesthetic appearance of commercial and business establishments, even if further impacts are anticipated.
- Impacts to food preparation areas that result in a potential breach of health regulations, even if further impacts are anticipated.
- Impacts to sensitive equipment, even if further impacts are anticipated.

3.8. Risk Control Procedures for Longwall 25

The risk control procedures for the management of potential impacts to residential, public amenities and commercial or business establishments are provided in Table 3.2.

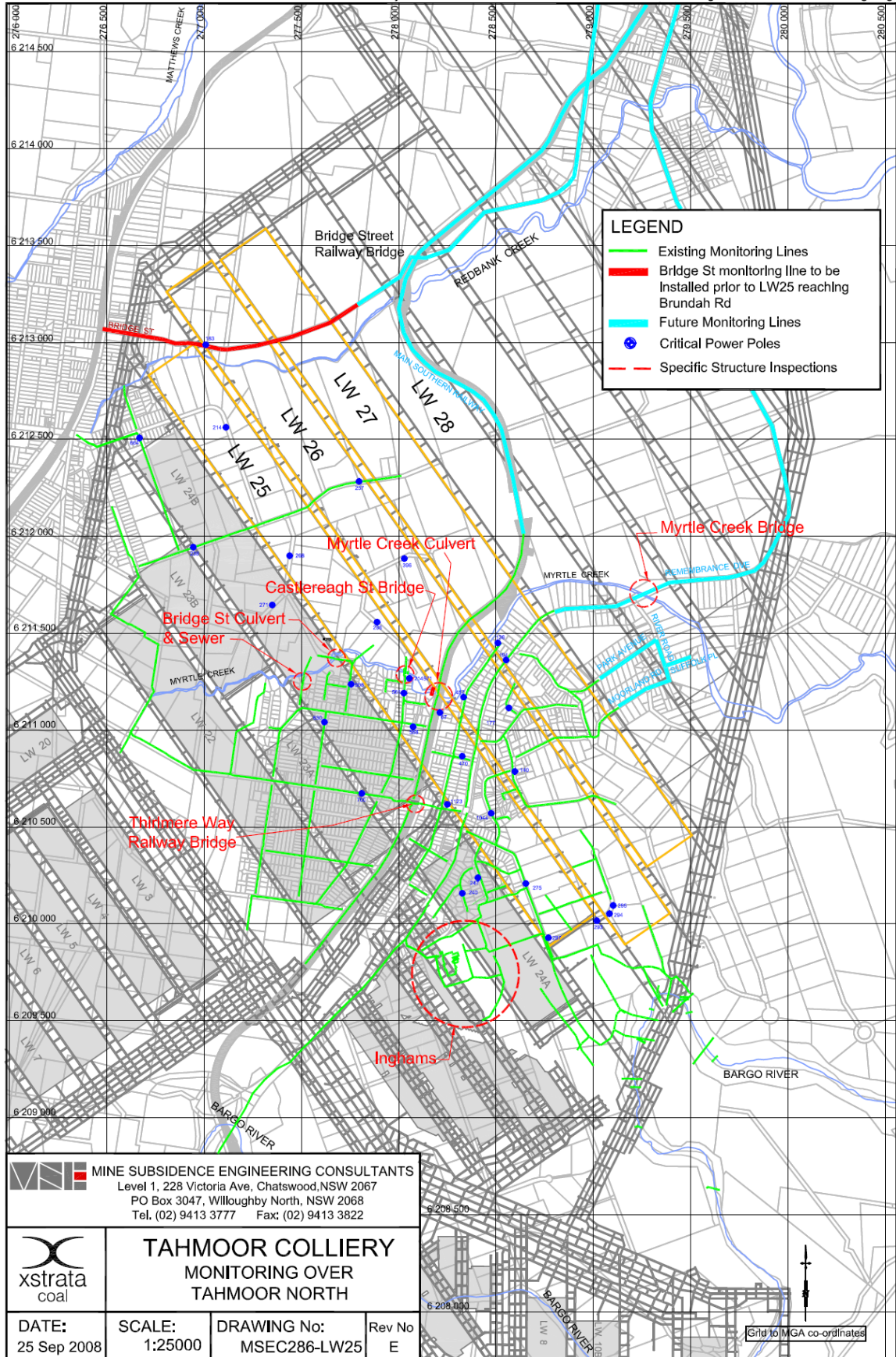


Fig. 3.4 Monitoring Lines above Longwall 25

Table 3.2 Risk Control Procedures for Residential Establishments, Public Amenities and Business and Commercial Establishments for Longwall 25

Infrastructure	Hazard / Impact	Risk	Trigger	Control Procedure/s	Timing and Frequency	By Whom?
Houses, Units, Public Amenities, Business and Commercial Establishments that will experience mine subsidence movements due to the mining of Longwall 25	Impacts occur	Low to High	Baseline monitoring for SMP	Kerbside inspection to identify any potentially unstable structures	Complete	Tahmoor Colliery (MSEC)
			Prior to mining	Contact residents to inform them of commencement of mine subsidence. Request owners for information on any potential issues with existing structures	Prior to subsidence occurring	Tahmoor Colliery
				Conduct geotechnical assessment of steep slopes in vicinity of structure to check whether there is any potential for slope instability prior to, during or after mining.	Complete for LWs 24 to 26	Tahmoor Colliery (GHD)
				Conduct pre-mining structural inspection and assessment of: <ul style="list-style-type: none"> Public amenities and commercial and business establishments located directly above LW 25. Assessments are based upon projected increased subsidence movements based on observed monitoring results. Structures that have been recommended for structural inspection by the geotechnical engineer Structures that have been identified as being potentially unstable 	Prior to subsidence occurring (complete for LWs 24 to 25)	Tahmoor Colliery (JMA)
				Conduct pre-mining building inspection of the following structures: <ul style="list-style-type: none"> Public amenities and commercial and business establishments with maximum plan dimension of 15 metres or greater Houses assessed with moderate risk or greater Houses above potential hidden creeks where impact assessment is Category 2 or greater Houses on steep slopes if recommended by geotechnical engineer 	Prior to subsidence occurring	Tahmoor Colliery (SBPS)
				Conduct pre-mining check of all houses for any potential issues that fall into one of the following descriptions. <ul style="list-style-type: none"> Houses built outside Mine Subsidence District which are predicted to experience more than 150 mm of subsidence Houses built prior to declaration of the Mine Subsidence District (1975) and predicted to experience more than 150 mm of subsidence Structures located directly above first 700 metres of LW 25. This may be extended if increased subsidence extends beyond this area. 	Prior to subsidence occurring	Tahmoor Colliery (SBPS)
				Installation of additional monitoring measures or mitigation/strengthening measures as recommended by structural engineer	Complete for all except Structure B06b and Y41, which will be complete prior to LW 25 approaching within 200 metres of structure	Tahmoor Colliery
				Install survey lines on all streets above Longwalls 25 & 26 and survey initial levels and strain distances (as shown in Fig. 3.4).	Complete, except for Bridge Street, Thirlmere, which will be completed prior to LW25 directly mining under Brundah Road	Tahmoor Colliery (L&H)
				Discovery of potential structural issue prior to mining	Conduct structural pre-mining inspection and assessment and consider: <ul style="list-style-type: none"> - any measures to improve the existing structural condition - any management measures that should be undertaken prior to or during mining - any monitoring and inspection measures, triggers and responses during mining 	Prior to subsidence occurring
			Advise property owner, MSB and DPI of findings of structural engineer	Prior to subsidence occurring	Tahmoor Colliery	
Consider installation of additional monitoring measures or mitigation/strengthening measures as recommended by structural engineer. Consideration is made on a case by case basis, based on risk to public safety	Prior to subsidence occurring	Tahmoor Colliery				

Infrastructure	Hazard / Impact	Risk	Trigger	Control Procedure/s	Timing and Frequency	By Whom?	
Houses, Units, Public Amenities, Business and Commercial Establishments that will experience mine subsidence movements due to the mining of Longwall 24A	Impacts occur	Low to High	During mining of Longwall 25 (monitoring already established that increased subsidence has developed above commencing end of Longwall 25)	Survey levels on all street survey lines within active subsidence area	Weekly for all pegs behind active LW face and all pegs within 50 m in front of LW face	Tahmoor Colliery (L&H)	
				Conduct visual inspection of streets and structures, including Tahmoor CBD area	Daily for all streets directly above LW 25 once LW face is directly beneath each street.	Tahmoor Colliery (SBPS)	
				Assess subsidence results and project likely ground movements for all structures directly affected by Longwall 25. Provide subsidence monitoring report and commentary.	Weekly after 200 m of extraction of LW25	Tahmoor Colliery (MSEC)	
				Confirm arrangements through MSB for building contractors to remain on standby for immediate call out and service in the event of impacts affecting safety or serviceability.	Prior to subsidence occurring	Tahmoor Colliery	
				Conduct inspections during mining for following structures: a) Houses and driveways located on steep slopes and steep slopes generally b) Structures that have experienced mine subsidence impacts (weekly) c) Pool gates (weekly) d) Public amenities and commercial business establishments (weekly) e) Tahmoor CBD area (daily) f) Houses assessed with moderate risk or greater g) Any other structures recommended for regular inspections and/or structure surveys by geotechnical or structural engineer	Conduct inspections during mining for following structures: a) Weekly within active subsidence zone b) Weekly within active subsidence zone c) Weekly within active subsidence zone and end of longwall d) Weekly within active subsidence zone e) Daily within active subsidence zone f) Once when LW has passed structure by approximately 200 metres, and end of longwall g) Generally weekly, please refer Section 3.4.1	Tahmoor Colliery (SBPS)	
				Conduct weekly meeting or teleconference of SMG to assess survey results and observed impacts and consider: - whether any additional pre-mining checks should be conducted for structures that will experience movements as LW 25 progresses - whether any additional management measures are required to reduce risk of impacts to any structures. - whether monitoring and survey frequencies can be reduced should subsidence behaviour return to normal levels	Weekly after 400 m of extraction of LW25 (when LW is directly beneath urban area)	SMG	
				Tilt across shopfront of Structure B06a exceeds 1.5 mm/m, or Tilt across shopfront of Structure B06c exceeds 1.6 mm/m, or Tilt across shopfront of Structures B65a and B66a exceeds 1.0 mm/m and wall cracking is evident in the front façade wall panels, or Tilt across any other shopfront exceeds 3mm/m, or Total pre-mining and mining tilt exceed 10 mm/m for external walls of Structures Y19 or Y41	Inspect structural condition of building	Within two days and then as recommended by structural engineer	Tahmoor Colliery (JMA)
					Consider additional monitoring and/or mitigation/strengthening measures	Immediately after structural re-inspection.	Tahmoor Colliery (JMA)
				Observed tilts are greater than 7 mm/m or observed curvatures are greater than 0.2 km ⁻¹ near structure	Conduct inspection of building and provide photographic survey and impact report	Within two days	Tahmoor Colliery (SBPS)
					Consider structural inspection/additional monitoring and/or mitigation/strengthening measures	Immediately after building inspection.	Tahmoor Colliery (JMA)

Infrastructure	Hazard / Impact	Risk	Trigger	Control Procedure/s	Timing and Frequency	By Whom?
Houses, Units, Public Amenities, Business and Commercial Establishments that will experience mine subsidence movements due to the mining of Longwall 24A	Impacts occur	Low to High	Significant non-systematic movement occurs or Impacts observed to any surface infrastructure (not just structures) or Slope slippage observed	Notify landowner, Tahmoor Colliery, Mine Subsidence Board, DPI – Minerals	Within 24 hours	Tahmoor Colliery
				Conduct strain distance surveys along monitoring line as required	As required	Tahmoor Colliery (L&H)
				SMG consider whether any additional management measures are required in light of observations, including geotechnical or structural inspections	Within one week	SMG
			Any impact occurs to structure	Notify landowner, Tahmoor Colliery, Mine Subsidence Board, DPI – Minerals	Within 24 hours	Tahmoor Colliery
				Inspect impact of subsidence on building	As soon as possible	MSB
				Inspect condition of building	Once a week with active subsidence area or as agreed with owner	Tahmoor Colliery (SBPS)
				Rectify any adverse impacts that impair upon: - the safety, access and mobility, security or fire egress - any essential services - aesthetic appearance of commercial and business establishments - food preparation areas that result in a potential breach of health regulations - sensitive equipment used for commercial and business establishments	As soon as possible at any stage during mining	Tahmoor Colliery and/or MSB
				Repair damage to structure	When subsidence impacts cease	MSB
			Observed impacts are greater than predicted impacts	Investigate cause(s) for greater impacts, including possibility of non-systematic or anomalous movements, type of structure. Investigate spatial trends in data to identify any pattern.	Within one week of inspection	Tahmoor Colliery (MSEC)
			Observed impact is Category 3 or greater	Notify landowner, Tahmoor Colliery, Mine Subsidence Board, DPI – Minerals	Within 24 hours	Tahmoor Colliery
				Inspect structural condition of building.	Within two days and then as recommended by structural engineer	Tahmoor Colliery (MSEC)
				Reassess final level of damage based upon likelihood of further damage and structural condition.	Immediately after structural re-inspection.	Tahmoor Colliery
				Consider additional monitoring and/or mitigation/strengthening measures	Immediately after structural re-inspection.	Tahmoor Colliery
			Property is likely to be safe during and after mining	Monitor impacts on building (e.g. extent of cracking, level of tilt)	As advised by subsidence engineer and structural engineer	Tahmoor Colliery (MSEC)
				Re-inspect condition of building	Weekly within active subsidence area	Tahmoor (SBPS)
			Property is likely to be unsafe during or after mining	Coordinate with MSB and provide temporary accommodation for residents.	Immediately	MSB & Tahmoor Colliery
Utilise acquisition and compensation procedure from DA67/98-1999 Development Consent Conditions 18-26 and MSB procedures	Immediately	MSB & Tahmoor Colliery				
Property owner does not accept acquisition	Temporarily relocate residents until building is repaired	Immediately	MSB & Tahmoor Colliery			

Infrastructure	Hazard / Impact	Risk	Trigger	Control Procedure/s	Timing & Frequency	By Whom?
Houses	House subsides below 100 year ARI flood level	Moderate	Prior to Mining	Assess potential for houses to subside below 100 year ARI flood level, including transverse ground surveys of Myrtle and Redbank Creeks.	Complete	Tahmoor Colliery (Hughes Trueman)
			Completion of Mining	Conduct transverse ground surveys of Myrtle and Redbank Creeks	Completion of LW26 or future longwalls until subsidence movements along Myrtle and Redbank Creeks cease	Tahmoor (L&H)
				Assess whether any houses has subsided below 100 year ARI flood level	Completion of LW26 or future longwalls until subsidence movements along Myrtle and Redbank Creeks cease	Tahmoor Colliery (Hughes Trueman)
			House(s) subside below 100 year ARI flood level	Raise house so that floor level is above 100 year ARI flood level	As required	Tahmoor Colliery
Houses	Impacts to future houses	Low to Moderate	Prior to mining	Contact residents to inform them of commencement of mine subsidence. Request owners for information on whether any new houses have been constructed since mid-2005.	Prior to subsidence occurring	Tahmoor Colliery
			Owner notifies of new house	Conduct pre-mining inspection by MSB, if requested	Prior to subsidence occurring	MSB
				Conduct impact assessment and risk analysis, if requested	Prior to subsidence occurring	Tahmoor Colliery (MSEC)
			New house has maximum plan dimension greater than 30 m	Conduct subsidence predictions, impact assessment and risk analysis	Prior to subsidence occurring	Tahmoor Colliery (MSEC)
				Follow risk control procedures, as for other houses	Immediately	Tahmoor Colliery
			New houses are assessed to have a moderate level of risk or greater	Advise results of the risk analysis to landowner, DPI-Minerals and Mine Subsidence Board	Prior to subsidence occurring	Tahmoor Colliery (MSEC)
Follow risk control procedures, as for other houses	Immediately	Tahmoor Colliery				
Swimming pools and pool gates	Damage to pool	Low	None	Notify owner of potential impacts to pool	Before mine subsidence impacts occur	Tahmoor Colliery
	Pool gate – won't shut	High	None	Notify owner of potential impact to pool gate and fence	Before mine subsidence impacts occur	Tahmoor Colliery
				Visually inspect pool gate to check that it is operating properly	Weekly when each pool is within active subsidence zone, and at completion of each longwall	Tahmoor Colliery (SBPS)
			Pool gate won't close	Contact MSB to repair gate	Immediately	Tahmoor Colliery
Repair gate	As soon as possible	MSB				

CHAPTER 4. SMG REVIEW MEETINGS

SMG meetings will be held between Tahmoor Colliery, the Mine Subsidence Board and / or the Department of Primary Industries for discussion and resolution of issues raised in the operation of the Management Plan. The frequency of the SMG meetings will be monthly unless agreed otherwise between representatives of each Plan Review Meeting.

SMG meetings will discuss any incidents reported in relation to the relevant surface feature, 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 risk is identified for a particular surface feature, any member of the SMG may call an emergency SMG Meeting, with one day's notice, to discuss proposed actions and to keep other parties informed of developments in the monitoring of the surface feature.

CHAPTER 5. AUDIT AND REVIEW

All Management Plans within this document have been agreed between parties. The Management Plan will be reviewed following extraction of each longwall.

Should an audit of the Management Plan be required during that period, an auditor shall be appointed by the Tahmoor Colliery to review the operation of the Management Plan and report at the next scheduled Plan Review Meeting.

Other factors that may require a review of the Management Plan are:-

- 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.
- Observation of significant variation between observed and predicted subsidence.

CHAPTER 6. RECORD KEEPING

Tahmoor Colliery will keep and distribute minutes of any SMG Meeting.

CHAPTER 7. CONTACT LIST

Organisation	Contact (* SMG Member)	Phone	Email / Mail	Fax
Department Primary Industries (Mineral Resources Division)	Phil Steuart	(02) 4931 6648	phil.steuart@dpi.nsw.gov.au	(02) 4931 6790
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Department Primary Industries (Mineral Resources Division)	Ray Ramage	(02) 4931 6645 0402 477 620	ray.ramage@dpi.nsw.gov.au	(02) 4931 6790
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Sunrise Building and Property Services (SBPS)	John Schwarz*	(02) 4883 9030 0400 390058	sunbuilding@bigpond.com.au	(02) 4883 9738
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Xstrata Coal Tahmoor Colliery – Community and SMP Coordinator	David Clarkson*	(02) 4640 0133 0428 114 614	dclarkson@xstratacoal.com.au	(02) 4640 0140