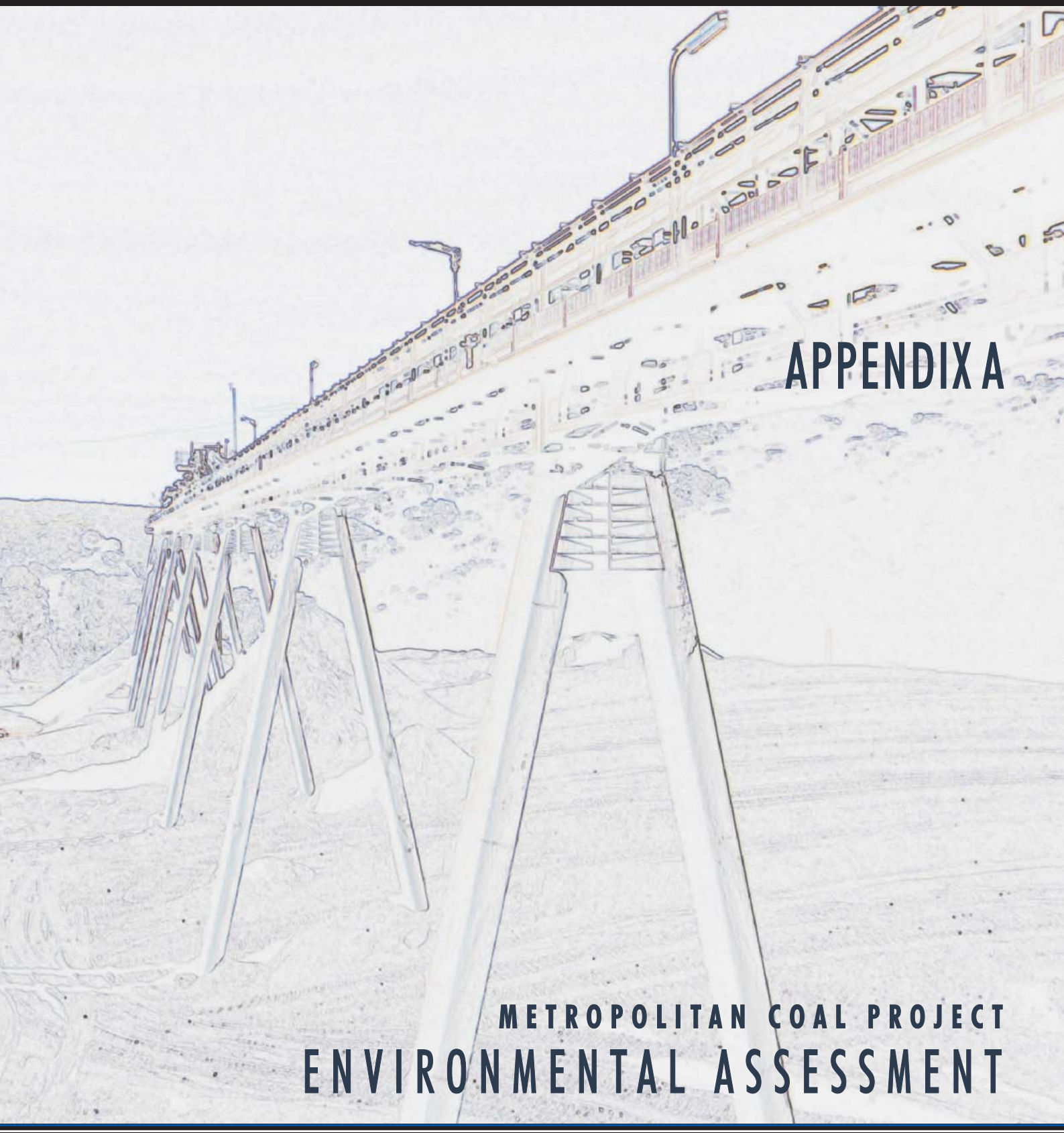

APPENDIX A

METROPOLITAN COAL PROJECT

ENVIRONMENTAL ASSESSMENT

Helensburgh Coal Pty Ltd

Metropolitan Colliery
Longwalls 20 to 44

Subsidence Assessment

REPORT

on

THE PREDICTION OF SUBSIDENCE PARAMETERS AND THE ASSESSMENT OF MINE SUBSIDENCE IMPACTS ON NATURAL FEATURES AND SURFACE INFRASTRUCTURE RESULTING FROM THE PROPOSED EXTRACTION OF LONGWALLS 20 TO 44 AT METROPOLITAN COLLIERY IN SUPPORT OF A PART 3A APPLICATION

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Revision	Description	Author	Checker	Date
A	DRAFT Subsidence Predictions and Impact Assessment for Proposed Metropolitan Longwalls 20 to 44 in Support of the Part 3A Application	PLD	JB/DRK	14/4/08
B	Review by Resource Strategies and Updates	PLD	DRK	18/7/08
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Report produced for:- Helensburgh Coal Pty Ltd to support a Part 3A Application

EXECUTIVE SUMMARY

Helensburgh Coal Pty Ltd (HCPL) proposes to continue its underground coal mining operations within the Bulli Seam at Metropolitan Colliery, which is located in the Southern Coalfield of New South Wales (NSW). HCPL proposes to extract 25 new longwall panels, Longwalls 20 to 44. The proposed Longwalls 20 to 44 are located to the north of Longwalls 1 to 19A. HCPL has approval to extract up to Longwall 19A at the mine, and has recently completed coal extraction within Longwall 15.

The overall layout of the longwalls at Metropolitan Colliery is shown in Drawing No. MSEC285-01, which together with all other drawings is included in Appendix E.

Mine Subsidence Engineering Consultants Pty Ltd (MSEC) was commissioned by HCPL in June 2007, to study the mining proposals, to prepare subsidence predictions for the proposed Longwalls 20 to 44 at Metropolitan Colliery, and to identify and prepare detailed subsidence impact assessments for all major natural features and items of surface infrastructure above the longwalls, in support of a Part 3A application.

The proposed Longwalls 20 to 44 pass below the Waratah Rivulet which flows into the Woronora Reservoir. The southern limit of the Full Supply Level of the Woronora Reservoir is located over the proposed Longwall 28. The nearest longwall to the Woronora Dam is Longwall 44, and this longwall is approximately 4000 metres to the south of the dam wall structure.

The proposed Longwalls 20 to 44 have a general void width of 163 metres but Longwalls 25 to 44 have been narrowed to 133 metres width where they pass near to or below the stored water area of the Woronora Reservoir. The proposed chain pillar widths between the panels are generally 40 metres wide, rib to rib, however, under parts of the Waratah Rivulet the pillar widths increase to 70 metres.

The standard Incremental Profile Method as used for the Southern Coalfield was calibrated to local data using observed monitoring data above the previously extracted longwalls at the colliery. Data used for calibration of the model was obtained from the monitoring lines that were located over the previous underground mining area (i.e. east of Longwall 1) and the monitoring data along the D-Line, which is located over Longwalls 1 to 15.

The maximum predicted systematic subsidence parameters have been obtained using the Incremental Profile Method and have been compared to those obtained using other methods. The predicted profiles obtained using the calibrated model showed good correlation to the observed profiles.

A number of natural features and items of surface infrastructure have been identified in the vicinity of the proposed longwalls, which are described in Section 2 of this report. The natural features and items of surface infrastructure that are located over the proposed longwalls include the Waratah Rivulet and other streams, Woronora Reservoir, Endangered Ecological Communities (EECs), upland swamps, cliffs and overhangs, archaeological sites, Garrawarra Complex, Sydney Water pipelines, optical fibre and copper telecommunications cables, survey marks and several fire roads. Most of the other surface infrastructure, which includes the Southern Freeway, 330 kilovolt (kV) and 132 kV transmission lines, and the Illawarra Railway, are located to the east of the proposed longwalls.

Potential subsidence impacts to the Waratah Rivulet and other streams within the Study Area include cracking in the bedrock along the valleys and fracturing and dilation of the underlying strata above and immediately adjacent to the proposed longwalls. Longwalls 11 and 12 at Metropolitan Colliery were extracted under the Waratah Rivulet between June 2004 and December 2005 with panel void widths of 163 metres and chain pillar widths of 35 metres. The panel void widths of the proposed Longwalls 20 to 44 are similar to or much less than the widths of Longwalls 11 and 12 and the proposed widths of longwall pillars are all wider than the pillar widths of Longwalls 11 and 12. Accordingly the predicted levels of subsidence and valley upsidence and closure ground movements over longwalls 20 to 44 are less than the predicted subsidence and valley upsidence and closure ground movements over Longwalls 11 and 12.

Based on the predicted systematic subsidence and valley upsidence and closure ground movements at the time impacts were observed at the rockbars along the Waratah Rivulet, over the previously extracted longwalls, the proposed mining would result in leakage of several but not all rockbars. Cracking would result in the diversion of a portion of surface flow into underlying bedrock. Studies undertaken by Dr Noel Merrick (Heritage Computing, 2008) and Gilbert & Associates (2008), that can be found as Appendices B and C in the Metropolitan Coal Project Environmental Assessment, have demonstrated that the portion of stream that is diverted re-emerges downstream of the mined area with no loss of flow from the catchment.

The predicted height of the fractured zone below the Woronora Reservoir and above the narrow 133 metre wide longwalls is about 155 metres. This predicted fracture zone height is approximately 265 metres below the existing ground surface level in the base of the Waratah Rivulet and about 100 metres below the estimated level of the Bald Hill claystone. Consequently, the proposed mining is not expected to result in a loss of surface water into the mine.

No cliff falls (i.e. freshly exposed surfaces dissimilar to natural weathering processes) have been observed by HCPL above or near the extracted longwalls at Metropolitan Colliery. The lengths of potential cliff instabilities along the cliffs and overhangs resulting from the extraction of Longwalls 20 to 44 are expected to be less than 3 % of the lengths of these cliffs and overhangs. The conditions of the cliffs should be monitored throughout the mining period and until such time that the mine subsidence movements have effectively ceased. As there is a small possibility of rock falls, it is recommended that appropriate management strategies are put in place to ensure the safety of people that may be within the vicinity of the cliffs during the mining period.

The size and extent of future surface cracking at the steep slopes over the proposed Longwalls 20 to 44 is expected to be minor and similar to that observed during the extraction of previous longwalls at the Colliery. It is considered unlikely that mine subsidence would result in any large-scale slope failure. Such failures have not been observed as a result of longwall mining in the Southern Coalfield.

Generally, the upland swamps that are located over the longwalls would be more susceptible to potential subsidence impacts than swamps that are located beyond the edges of the longwall panels. The potential fracturing of the bedrock below the upland swamps is expected to be isolated and of a minor nature, due to the relatively low magnitudes of the predicted strains and due to the relatively high depth of cover.

The Illawarra Railway is located more than 900 metres from the nearest edge of the proposed longwalls at Cawleys Creek, the predicted subsidence, upsidence and closure ground movements are negligible and much lower than if the railway were to be undermined. The predicted combined effects of upsidence and closure and differential far field movements at this railway crossing are insignificant and would be difficult to measure accurately and, hence, these movements are unlikely to adversely impact on the railway line at Cawleys Creek.

No part of the existing Southern Freeway is located over the proposed longwalls. The nearest point of the Southern Freeway to the proposed longwalls is approximately 165 metres from the end of the proposed Longwall 29.

As the magnitudes of the maximum predicted strains along the Southern Freeway are relatively low, potential impacts are likely to be infrequent occurrences and of a minor nature. A design review should be undertaken to check the adequacy of the embankment, culvert and pavement at the Cawleys Creek crossing, the adequacy of several freeway bridges, which are predicted to experience differential far field and small upsidence and closure movements, and the stability of various embankments and cuttings along the Southern Freeway. However, it is expected that with a suitable monitoring and response plan in place, that the freeway can be maintained in a safe and serviceable condition throughout the mining period. It is unlikely that the traffic signs and other road infrastructure would suffer potential impact due to mine subsidence associated with the proposed longwalls.

There are four road bridges and two culverts along the Southern Freeway on the eastern side of the proposed mining area. The predicted systematic subsidence movements at the Southern Freeway bridges, due to the proposed extraction of Longwalls 20 to 44, are small and less than survey tolerance and, hence these movements are not expected to have significant impact on the bridges. It is possible that minor potential impacts could result from the predicted small far-field horizontal movements and upsidence and closure movements at the bridges along the Southern Freeway, particularly those bridges that are located within 1 kilometre of the proposed longwalls. A preliminary structural assessment of three of the bridges (Underpass No.1, Underpass No. 2, and Cawley Bridge) has been carried out by Cardno (2008). The assessment indicated that the Underpass No. 2 and Cawley Bridge have a capacity to tolerate only low magnitudes of ground movement. It is expected, however, that potential impacts from far field movements can be managed through the establishment of a suitable management plan.

The Princes Highway crosses over the north east corner of the proposed mining area and would be affected by the mining of Longwalls 32 to 44. The Princes Highway was constructed as a flexible pavement with a bitumen seal and is likely to tolerate strains resulting from extraction of the proposed longwalls without significant impact. It is possible that minor cracking could occur in some places along the road, due to localised concentrations of tensile strains, and that minor rippling of the road surface could occur in other places, due to localised concentrations of compressive strains. As the magnitudes of the maximum predicted strains are relatively low, potential impacts are likely to be infrequent occurrences and of a minor nature. It is recommended that potential impacts are remedied in consultation with the Wollongong City Council. Using normal road maintenance techniques, it is expected that the road can be maintained in a safe and serviceable condition throughout the mining period.

It is possible that the tracks and fire roads could experience surface tension cracking during the mining period, particularly where the tracks and roads are located near the tops of existing slopes. To date, the only surface tension crack reported at Metropolitan Colliery is adjacent to the Fire Road 9H which is near the top of a steep slope. It is recommended that the tracks and roads be monitored during mining. Potential cracks should be repaired in a timely manner to avoid erosion and further crack widening.

The maximum predicted systematic strains at the transmission towers could result in increased stresses within the tower structural members. It is recommended that the predicted movements at the transmission towers are provided to TransGrid and Integral Energy so that a detailed structural analysis of the towers can be undertaken. If required, necessary mitigative measures should be established, so that the transmission lines can be maintained in a safe and serviceable condition throughout the mining period. With the implementation of these management strategies, it is unlikely that there would be a significant impact on the transmission lines resulting from the extraction of the proposed longwalls.

The 330 kV transmission line and 132 kV power line pass over some drainage lines along the eastern side of the Study Area and as such may experience small valley related subsidence movements. The most significant drainage line passing below the transmission and power lines is Cawleys Creek, which is adjacent to the proposed Longwall 44. The predictions of upsidence and closure movements are both 45 mm. The maximum predicted upsidence and compressive strain due to valley closure movements would occur in the base of the drainage line, away from the locations of the towers and are unlikely, therefore, to have potentially impact on the electrical services. The predicted closure is insignificant across this valley and is not expected to potentially impact on the power lines.

It is possible that the extraction of the proposed Longwalls 20 to 44 could result in some minor potential impacts, such as leaking joints, along the Sydney Water pipelines. Based on the experiences at Appin and Tahmoor Collieries, potential impacts are expected to be infrequent and of a relatively minor nature. With the implementation of necessary remediation measures, the pipelines can be maintained in a serviceable condition throughout the mining period.

Based on previous experience of mining beneath optical fibre cables, it has been found that optical fibre cables can typically tolerate tensile strains of up to 4 mm/m without significant impact. It is expected, therefore, that the optical fibre cable could tolerate the predicted systematic tensile strains resulting from the extraction of the proposed longwalls.

It is unlikely that the copper telecommunication cables would be potentially impacted by the predicted systematic strains resulting from the extraction of the proposed longwalls. It is possible, however, that the cables could experience locally elevated tensile strains where they are anchored to the ground by associated infrastructure, or by tree roots. It is unlikely, however, given the relatively low magnitudes of the predicted systematic strains, that there would be a significant impact on the copper telecommunication cables at any anchor points.

There are a total of 85 building structures located within the Garrawarra Complex, comprising 57 residential or hospital buildings and 28 structures that have been labelled as sheds. Only very limited access to the Garrawarra Complex was available and, therefore most structural details were determined from aerial photographs, cadastral information and historical images of the complex. There are also 7 tanks located within the Garrawarra Complex. The Garrawarra Complex is listed with the Heritage Office of the NSW Department of Planning as a heritage conservation area with a number of items of heritage significance.

There are no buildings in the Garrawarra Complex that are assessed to experience a tilt impact greater than Category A or B, as all the predicted tilts are less than 6 mm/m. A total of nine buildings were assessed to experience a strain impact greater than Category 0 or 1. Provided the buildings are in reasonable condition, they are expected to remain in a safe and serviceable condition throughout the mining period, based on the current mine plan. However, in order to reduce the assessed potential impact to a level that is considered to be more acceptable, some mitigative measures may need to be undertaken, subject to the necessary approval of the heritage requirements.

The assessed impacts on the residential and hospital buildings in the Garrawarra Complex resulting from the predicted systematic subsidence parameters can be managed if suitable management strategies are implemented. A more detailed structural assessment of the buildings would be required in order to develop appropriate management strategies.

There are several houses near the Study Area, but there are only two houses located within the Study Area. A third house, which is located outside the Study Area, has been included in the study as it is listed in Wollongong Council LEP as having heritage significance. Potential impacts, if any, on the houses resulting from the extraction of Longwalls 20 to 44 are generally expected to be of a minor nature, which could be easily remedied using well established building techniques. With these remedial measures in place, it is unlikely that there would be significant impact on the houses resulting from the extraction of the proposed longwalls.

There is one privately owned swimming pool (Structure Type P – ID E03p01) that has been identified within the Study Area. The pool would not be directly mined beneath and is about 300 metres from the nearest longwall. The pool is unlikely, therefore, to be impacted as a result of the extraction of Longwalls 20 to 44.

There are 32 rural building structures (Structure Type R) that have been identified within the Study Area, which include farm sheds, garages and other non-residential structures. There are no rural building structures which are assessed to experience a Category D tilt impact or a Category 4 strain impact during the extraction of Longwalls 20 to 44. Provided that the rural building structures are in a sound condition, they are expected to remain in a safe and serviceable condition throughout the mining period. Preventive measures are not therefore considered necessary for the rural building structures prior to the extraction of Longwalls 20 to 44.

There are seven tanks (Structure Type T) that have been identified within the Study Area that are likely to be impacted. It is possible, however, that buried water pipelines associated with the tanks within the Study Area could be impacted by the predicted systematic strains if they are anchored by the tanks, or by other structures in the ground. Potential impacts are expected to be of a minor nature, including leaking pipe joints, and could be easily repaired. With these remedial measures available, it would be unlikely that there would be significant impacts on the pipelines associated with the tanks.

There is one farm dam (Structure Type D) that has been identified within the Study Area. The farm dam is located over the chain pillar between the proposed Longwalls 43 and 44. Farm dams are typically constructed of cohesive soils with reasonably high clay content. The walls of the dams should be capable of withstanding tensile strains of up to 3 mm/m without impact, because of their inherent elasticity. It is unlikely, therefore, that the maximum predicted systematic strains would result in significant impacts on the farm dams.

There are 188[1] archaeological sites located within the Study Area and surrounds, the locations of which are shown in Drawing No. MSEC285-15. It is possible that the maximum predicted systematic and valley related movements, resulting from the extraction of the proposed longwalls, could result in some fracturing of the exposed sandstone at the open archaeological sites. Some open sites are located in or close to drainage lines, and therefore have a higher risk of fracturing at the site. Potential fracturing of the exposed sandstone is expected to be isolated and of a minor nature, due to the relatively low magnitudes of the predicted strains and the relatively high depth of cover. The potential for fracturing to occur at the grinding grooves would be considered low. Previous studies of archaeological sites with overhangs at the Metropolitan Colliery suggest that the likelihood of potential subsidence impacts on the overhang sites, due to mining the proposed longwalls is low.

There are twenty two survey control marks located within the Study Area. It would be necessary on the completion of the proposed longwalls, when the ground has stabilised, to re-establish these marks. Consultation between HCPL and the Department of Lands would be required throughout the mining period to ensure that these survey marks are reinstated at an appropriate time, as required.

Monitoring of ground movements is recommended, as subsidence occurs, so that the observed ground movements can be compared with those predicted, and to periodically review the predictions and impact assessments in the light of measured data. The condition of natural features should be compared to baseline records as subsidence occurs to validate the nature of subsidence effects, impacts and consequences as predicted, or to implement appropriate additional management measures if necessary. This process would be detailed in the Subsidence Management Plan (SMP) and/or relevant environmental management plan.

The assessments in this report indicate that potential subsidence effects and/or impacts on the natural features and items of surface infrastructure can be managed by the preparation and implementation of management strategies. It should be noted, however, that more detailed assessments of some natural features and items of surface infrastructure have been undertaken by other consultants, and the findings in this report should be read in conjunction with the findings in all other relevant reports.

[1] This number is sourced from Appendix H of the Metropolitan Coal Project Environmental Assessment and includes sites located within the Longwalls 18-19A area outside of the Study Area.

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CHAPTER 1. BACKGROUND

1.1. Introduction

Helensburgh Coal Pty Ltd (HCPL) proposes to continue its underground coal mining operations within the Bulli Seam at Metropolitan Colliery, which is located in the Southern Coalfield of New South Wales (NSW). HCPL proposes to extract 25 new longwall panels, Longwalls 20 to 44. The proposed Longwalls 20 to 44 are located to the north of Longwalls 1 to 19A. HCPL has approval to extract up to Longwall 19A at the mine, and has recently completed coal extraction within Longwall 15.

The overall layout of the longwalls at Metropolitan Colliery is shown in Drawing No. MSEC285-01, which together with all other drawings is included in Appendix E.

Mine Subsidence Engineering Consultants Pty Ltd (MSEC) was commissioned by HCPL in June 2007, to study the mining proposals, prepare subsidence predictions for the proposed Longwalls 20 to 44 at Metropolitan Colliery, and to identify and prepare detailed subsidence impact assessments for all major natural features and items of surface infrastructure above the longwalls, in support of a Part 3A application.

The proposed Longwalls 20 to 44 pass below the Waratah Rivulet which flows into the Woronora Reservoir. The limit of the Full Supply Level of the reservoir is located over the proposed Longwall 28. The nearest longwall to the Woronora Dam is Longwall 44, which is approximately 4,000 metres to the south of the dam.

A number of natural features and items of surface infrastructure have been identified in the vicinity of the proposed longwalls, which are described in Chapter 2 of this report. The proposed longwalls and the Study Area, which is defined in Section 2.1, have been overlaid on an orthophoto and topographic map of the area, which are shown in Fig. 1.1 and Fig. 1.2 respectively. The major natural features and items of surface infrastructure within the Study Area can be seen in these figures.

Chapter 3 includes a brief overview of longwall mining, the development of mine subsidence and the method that has been used to predict the mine subsidence movements resulting from the extraction of the proposed longwalls.

Chapter 4 provides a general overview of the maximum predicted systematic subsidence parameters resulting from the extraction of the proposed longwalls.

Chapter 5 provides the site-specific predicted subsidence parameters for each natural feature and item of surface infrastructure described in Chapter 2. The impact assessments and recommendations for each of these features have been made based on the predicted subsidence parameters.

This report has been provided to assist in the preparation of the Metropolitan Coal Project Environmental Assessment.

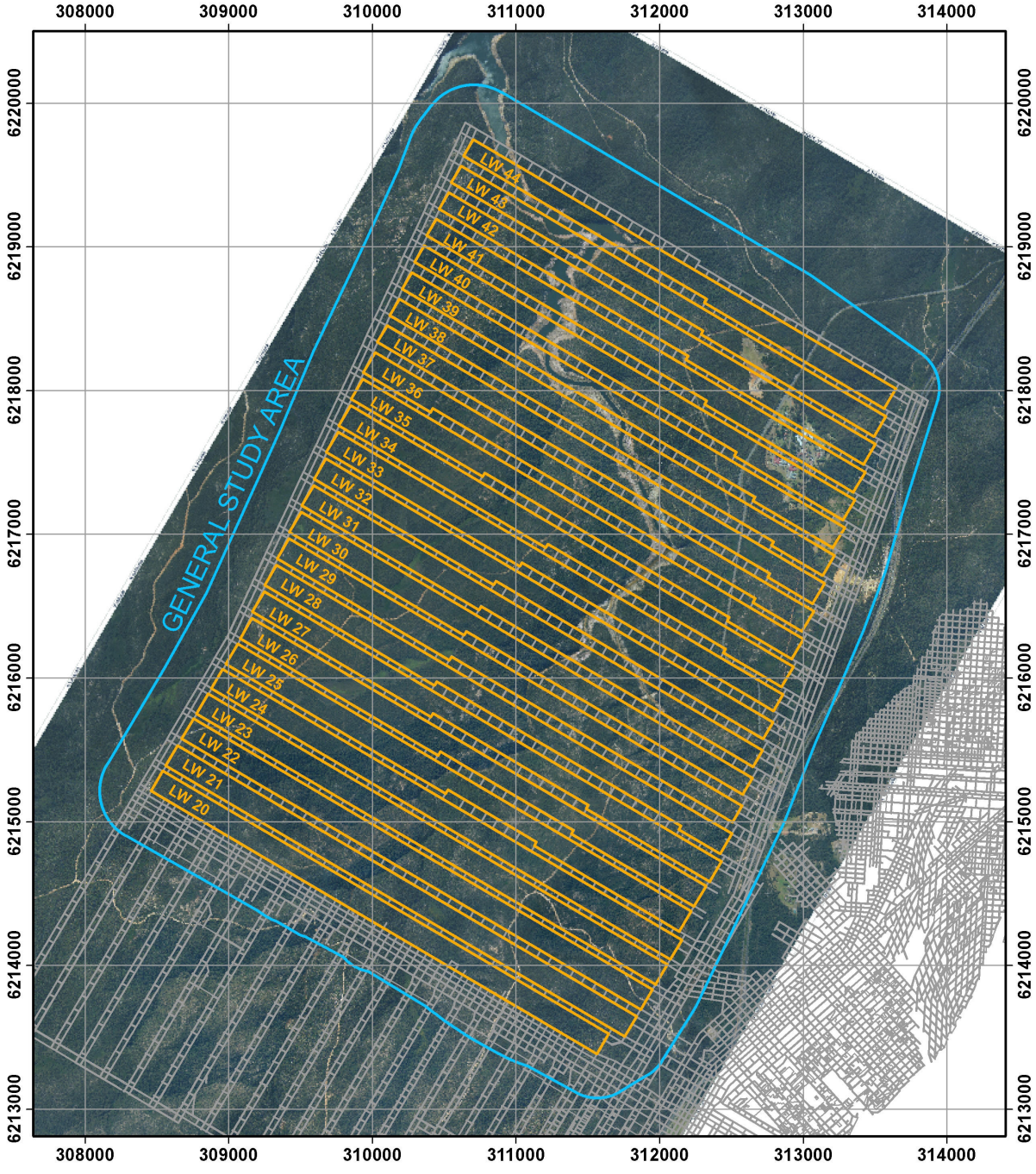

Fig. 1.1 Aerial Photograph Showing Proposed Longwalls 20 to 44 and the Study Area

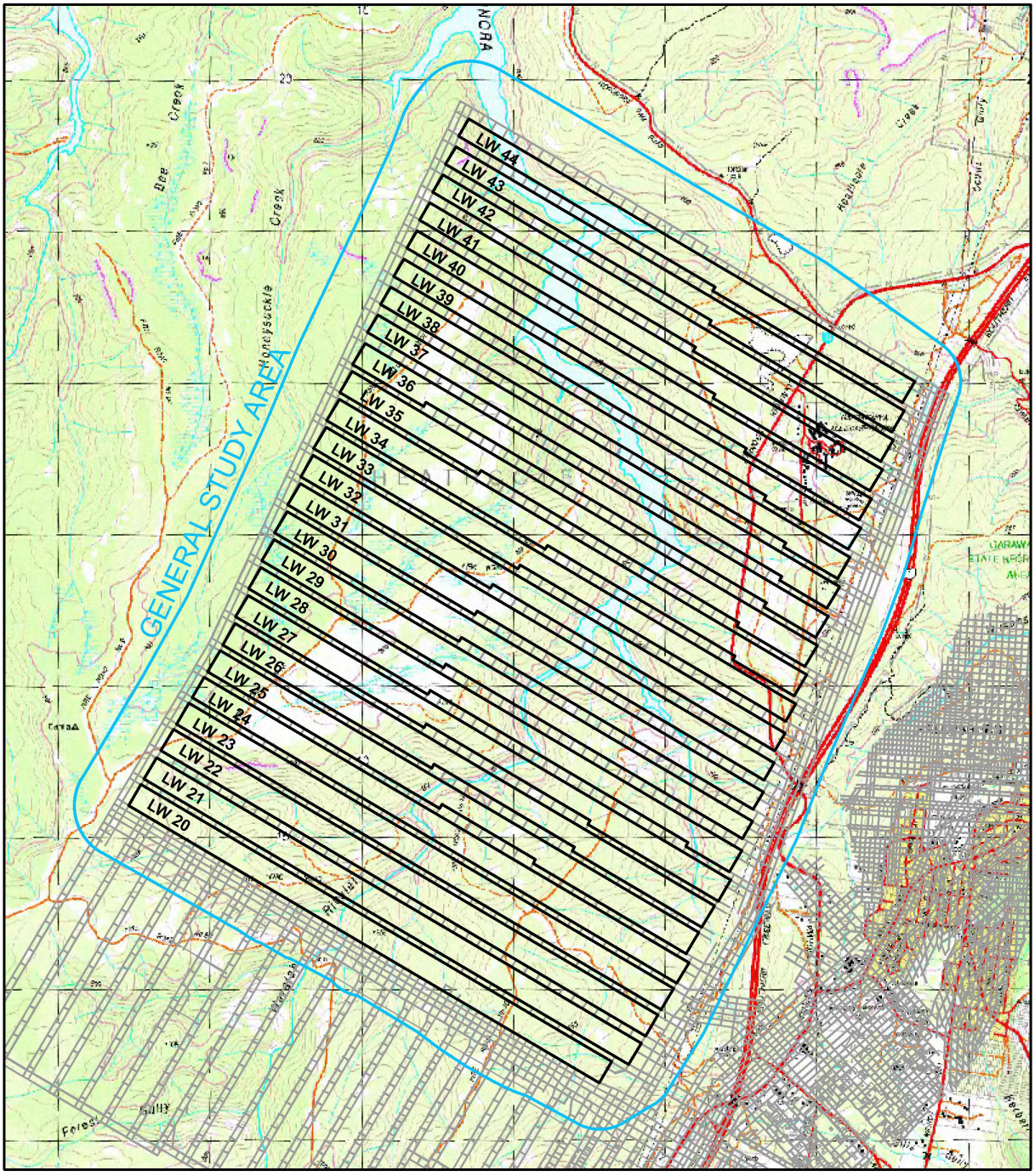

Fig. 1.2 Topographic Map Showing Proposed Longwalls 20 to 44 and the Study Area

1.2. Mining Geometry

The proposed layout of Longwalls 20 to 44 is shown in Drawing No. MSEC285-01. The proposed Longwalls 20 to 44 have a general void width of 163 metres, but Longwalls 25 to 44 have been narrowed where the longwalls pass beneath the stored water area of the Woronora Reservoir. These longwalls are narrowed to a void width of 133 metres and the length of the narrowed section of the longwalls was determined based on an area that has been defined as the stored water zone. This zone was determined by a 35 degree angle of draw plus 0.5 times the depth of cover from the edge of the Full Supply Level.

These changes were undertaken to comply with the general recommendations of panel widths being less than one third of the depth of cover and the pillars being greater than one fifth of the depth of cover, which have been generally adopted by the Dams Safety Committee (DSC) following the Reynolds Inquiry into Mining Under Stored Waters. The general pillar width for Longwalls 20 to 44 is 40 metres with the exception of the pillar between Longwall 21 and 22, which is 55 metres. Where the longwalls have been narrowed below the stored water area, the pillars have been widened from 40 metres to 70 metres. A summary of the proposed longwall dimensions is provided in Table 1.1.

Table 1.1 Proposed Longwall Dimensions within the Study Area

Longwall Number	Total Void Width (m)	Width of Pillar Preceding Longwall Maingate (m)	Overall Longwall Length (m)	Void Width of Narrowed Section of Longwall (m)	Width of Pillar Preceding Longwall Tailgate for Narrowed Section of Longwall (m)	Length of Narrowed Section of Longwall (m)
LW20	163	-*	3603	-	-	-
LW21	163	40	3171	-	-	-
LW22	163	55	3711	-	-	-
LW23	163	40	3711	-	-	-
LW24	163	40	3711	-	-	-
LW25	163	40	3665	133	70	715
LW26	163	40	3670	133	70	1075
LW27	163	40	3696	133	70	1255
LW28	163	40	3680	133	70	1975
LW29	163	40	3663	133	70	2270
LW30	163	40	3646	133	70	2233
LW31	163	40	3629	133	70	2196
LW32	163	40	3613	133	70	2159
LW33	163	40	3596	133	70	2033
LW34	163	40	3579	133	70	1435
LW35	163	40	3563	133	70	1975
LW36	163	40	3546	133	70	2605
LW37	163	40	3535	133	70	3172
LW38	163	40	3516	133	70	3102
LW39	163	40	3499	133	70	2853
LW40	163	40	3482	133	70	2603
LW41	163	40	3465	133	70	2263
LW42	163	40	3449	133	70	2013
LW43	163	40	3432	133	70	2033
LW44	163	40	3445	133	70	1964

* The distance between the proposed Longwall 20 and Longwalls 1 to 19A is approximately 290 metres and the barrier includes several development headings.

The depth of cover to the Bulli Seam above the proposed longwalls varies between a minimum of approximately 400 metres over the proposed Longwalls 30 and 31, and a maximum of 560 metres over the proposed Longwalls 42 and 43. The seam floor generally dips from the south-west to the north-east along the western side of the proposed mining area, and generally dips from the south east to the north west along the eastern side of the proposed mining area.

The seam thickness within the goaf areas of the proposed longwalls varies from a minimum of 2.5 metres over Longwalls 29 to 32, to a maximum of 3.8 metres near the centre of Longwall 20. The maximum thickness of extraction of the Bulli Seam is 3.4 metres, which has been used as the maximum extraction thickness to determine the subsidence parameters. The surface level contours, seam floor contours, seam thickness contours, and depth of cover contours are shown in Drawings Nos. MSEC285-02, MSEC285-03, MSEC285-04 and MSEC285-05, respectively.

1.3. Geological Details

The geology mainly comprises sedimentary sandstones, shales and claystones of the Permian and Triassic Periods, which have in some places been intruded by igneous sills. The major geological features in the area of the proposed longwall are shown in Drawing No. MSEC285-06.

The sedimentary stratigraphic sections at two borehole locations within the Study Area, which were provided by HCPL, are shown in Fig. 1.3. The locations of the boreholes are shown in Drawing No. MSEC285-15.

The sandstone and shale units vary in thickness from a few metres to over 160 metres. The major sandstone units are interbedded with other rocks and, though shales and claystones are quite extensive in places, the sandstone predominates.

An analysis of the variation in Wombarra and Stanwell Shale thicknesses is discussed in Section 3.5.

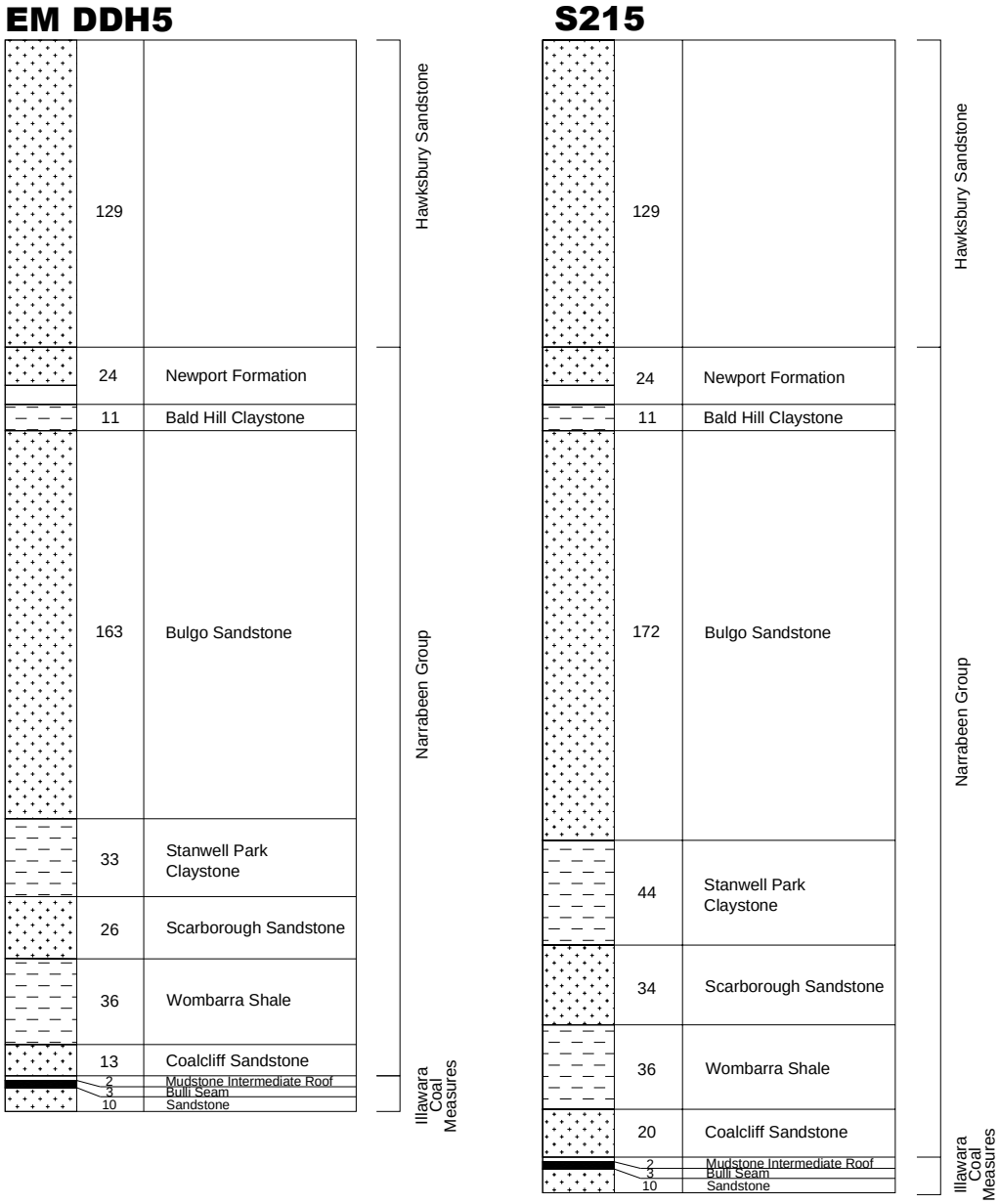

Fig. 1.3 Stratigraphic Columns

1.3.1. Lithology

The major sedimentary units in the Metropolitan area are, from the top down:-

- Hawkesbury Sandstone; and
- the Narrabeen Group.

The Narrabeen Group contains the Newport Formation (sometimes referred to as the Gosford Formation), the Bald Hill Claystone (also referred to as Chocolate Shale), the Bulgo Sandstone, the Stanwell Park Claystone/Shale, the Scarborough Sandstone, the Wombarra Shale and the Coal Cliff Sandstone.

The geology varies throughout the Study Area and this variability would have some effect on the potential subsidence impacts that may occur from place to place. The available exploration boreholes within the proposed mining area have been studied, together with some surface mapping of outcrops undertaken by HCPL, and this information has enabled the variations in the geology to be more closely defined.

The rocks of the Hawkesbury Sandstone and the Narrabeen Group are of relatively low permeability and therefore limit the vertical movement of water. This capacity is further reduced by the relatively high level of in situ horizontal stress that is a feature of the Southern Coalfield.

As mining occurs, the subsidence of the strata above the goaf areas can lead to some fracturing of the strata, which in turn can increase vertical permeability. This increased permeability is referred to as the fracture permeability.

The vertical permeability is reduced by the claystone layers, which, on exposure to water, tend to swell and seal fractures (if any) preventing passage of water. Such layers are referred to as aquicludes. If the claystone layers are in the collapsed or fractured zones above the proposed longwalls, however, the fractures could be too large to be sealed by this process. The height of the fractured zone over the proposed longwalls is discussed in Section 5.29.

The Bald Hill Claystone/Chocolate Shale is generally considered to be the most impervious aquiclude and potential cracking that might occur in the strata above this layer would generally have little impact on the potential for vertical migration of water through this layer. The Stanwell Park Claystone/Shale is located over the full area of the proposed longwalls and would also tend to reduce the vertical permeability between the surface and the seam. The Wombarra Shale lies within the collapsed zone above the longwalls and would not be effective in reducing vertical permeability.

Normally, in the Southern Coalfield, where the depth to the seam is substantial and where the seam thickness varies up to 4 metres, the fracturing of the strata does not form continuous paths from the surface to the seam, and potential cracks that might form tend to be blocked by the aquicludes. Where the depth of cover is shallow, say less than 120 metres however, the collapsed or major fractured zones are closer to the surface resulting in greater impacts and consequences on the bedrock and stream flows. At Metropolitan Colliery, the thickness of extraction varies from 2.5 to 3.4 metres and the depth of cover ranges from 400 metres to 560 metres. Therefore, there is a very low likelihood of continuous cracking from the ground surface to the extracted seam. Appendix B (groundwater assessment) of the Metropolitan Coal Project Environmental Assessment presents a detailed hydrogeological assessment of the Project.

CHAPTER 2. IDENTIFICATION OF SURFACE FEATURES

2.1. The Study Area

The Study Area is defined as the surface area that is likely to be affected by the proposed mining of Longwalls 20 to 44 in the Bulli Seam at Metropolitan Colliery. The extent of the Study Area has been calculated by combining the areas bounded by the following limits:-

- The 35 degree angle of draw line,
- The predicted vertical limit of subsidence, taken as the 20 mm subsidence contour, and
- Features sensitive to far-field movements.

The 35 degree angle of draw line is described as the "surface area defined by the cover depths, angle of draw of 35 degrees and the limit of the proposed extraction area in mining leases of the Southern Coalfield", as stated in Section 6.2 of the Department of Primary Industries (DPI) Subsidence Management Plan (SMP) Guideline 2003. Given that the depth of cover above the proposed longwall varies between 400 and 560 metres, the 35 degree angle of draw line has been conservatively determined by drawing a line that is a horizontal distance, varying between 280 and 390 metres around the limit of the proposed extraction area.

The predicted limit of vertical subsidence, taken as the predicted incremental 20 millimetre (mm) subsidence contour, has been determined using the Incremental Profile Method, which is described in further detail in Section 3.4. A detailed discussion of the Incremental Profile method can also be found at http://www.minesubsidence.com in Background Reports in the report titled 'General Discussion of Mine Subsidence Ground Movements'.

The predicted incremental 20 mm subsidence contour resulting from the extraction of the proposed Longwalls 20 to 44 was found to be located mostly within the area bounded by the 35 degree angle of draw line. The main area where the 20 mm subsidence contour line lies outside the 35 degree angle of draw line is over previously mined panels, which occurs over some of the previously approved or previously mined Longwalls 1 to 19A. A thick black line has been drawn, therefore, defining the general Study Area, and it was based upon the combined 35 degree angle of draw line and the 20 mm subsidence contour line, whichever was furthest from the proposed longwalls, and this line is shown in Drawing No. MSEC285-01.

There are additional areas that lie outside the general Study Area that are expected to experience either far-field movements, or valley related upsidence and closure movements. The surface features which may be sensitive to such movements have been identified in this report and, hence, these features, which are listed below, have been included as part of the Study Area.

- The Waratah Rivulet where the predicted total upsidence exceeds 20 mm,
- Tributaries where the predicted total upsidence exceeds 20 mm,
- Woronora Dam,
- Southern Freeway bridges at Princes Highway crossings and Cawleys Road,
- Illawarra Railway,
- One residential building with heritage significance,
- Metropolitan Colliery Ventilation Shaft,
- Monitoring bores, and
- Survey Control Marks.

2.2. General Description of the Natural Features and Items of Surface Infrastructure

The major natural features and items of surface infrastructure within the Study Area can be seen in the 1:25,000 Topographic Map of the area, published by the Central Mapping Authority (CMA), numbered APPIN 9029-1S, a copy of which is included above as Fig. 1.2. The following sections in this chapter identify and describe the major natural features and items of surface infrastructure that lie within the Study Area. The natural features and items of surface infrastructure, which are further defined in specific studies, are illustrated in Drawings Nos. MSEC285-07 to MSEC285-15.

Table 2.1 lists the types of natural features and surface improvements that have been identified within the Study Area and indicates the sections of this report that provide further descriptions and details of these features. This list follows the format of the list included in Appendix B of the DPI SMP Guideline 2003. Further details of areas of environmental sensitivity, are provided in subsequent sections of this report.

Table 2.1 Natural Features and Surface Improvements

Item	Within Study Area	Environmentally Sensitive Area	Section Number Reference
NATURAL FEATURES			
Catchment Areas or Declared Special Areas	✓	✓	2.3.1
Watercourses	✓	✓	2.3.3
Aquifers or Known Groundwater Resources	✓		2.3.4
Springs	✓		2.3.5
Sea or Lakes			
Shorelines			
Natural Dams			
Cliffs or Pagodas	✓	✓	2.3.9
Steep Slopes	✓		2.3.10
Escarpments			2.3.11
Land Prone to Flooding or Inundation	✓		2.3.12
Swamps, Wetlands or Water Related Ecosystems	✓	✓	2.3.13
Threatened, Protected Species or Critical Habitats	✓		2.3.14
National Parks or Wilderness Areas	✓	✓	2.3.15
State Recreational or Conservation Areas	✓	✓	2.3.16
State Forests			2.3.17
Natural Vegetation	✓		2.3.18
Areas of Significant Geological Interest			2.3.19
Any Other Natural Feature Considered Significant			2.3.20
PUBLIC UTILITIES			
Railways	✓		2.4.1
Roads (All Types)	✓		2.4.2
Bridges	✓		2.4.3
Tunnels			0
Culverts			2.4.5
Water, Gas or Sewerage Pipelines	✓		2.4.6
Liquid Fuel Pipelines			
Electricity Transmission Lines or Associated Plants	✓		2.4.7
Telecommunication Lines or Associated Plants	✓		2.4.8
Water Tanks, Water or Sewage Treatment Works			
Dams, Reservoirs or Associated Works	✓		2.4.9
Air Strips			
Any Other Public Utilities			2.4.10
PUBLIC AMENITIES			2.5
Hospitals			
Places of Worship			
Schools			
Shopping Centres			
Community Centres			
Office Buildings			
Swimming Pools			
Bowling Greens			
Ovals or Cricket Grounds			
Race Courses			
Golf Courses			
Tennis Courts			
Any Other Public Amenities			

Item	Within Study Area	Environmentally Sensitive Area	Section Number Reference
FARM LAND AND FACILITIES			
Agricultural Utilisation, Agricultural Improvements or Agricultural Suitability of Farm Land			
Farm Buildings or Sheds			
Gas or Fuel Storages			
Poultry Sheds			
Glass Houses or Green Houses			
Hydroponic Systems			
Irrigation Systems			
Fences			
Farm Dams	✓		2.6.4
Wells or Bores	✓		2.6.5
Any Other Farm Features			
INDUSTRIAL, COMMERCIAL AND BUSINESS ESTABLISHMENTS			
Factories			
Workshops			
Business or Commercial Establishments or Improvements			
Gas or Fuel Storages or Associated Plants			
Waste Storages and Associated Plants			
Buildings, Equipment or Operations that are Sensitive to Surface Movements			
Surface Mining (Open Cut) Voids and Rehabilitated Areas	✓		2.7.2
Mine Infrastructure Including Tailings Dams or Emplacement Areas	✓		2.7.1
Any Other Industrial, Commercial or Business Features			
AREAS OF ARCHAEOLOGICAL OR HERITAGE SIGNIFICANCE	✓		2.9
ITEMS OF ARCHITECTURAL SIGNIFICANCE			2.11
PERMANENT SURVEY CONTROL MARKS	✓		2.12
RESIDENTIAL ESTABLISHMENTS			
Houses	✓		2.13.1
Flats or Units			
Caravan Parks			
Retirement or Aged Care Villages	✓		2.13.3
Associated Structures such as Workshops, Garages, On-Site Waste Water Systems, Water or Gas Tanks, Swimming Pools or Tennis Courts	✓		2.13.2
Any Other Residential Features			
ANY OTHER ITEM OF SIGNIFICANCE			

2.3. Natural Features

2.3.1. Catchment Areas or Declared Special Areas

The Study Area lies within the Woronora Special Area, which is controlled by the Sydney Catchment Authority (SCA). Some sections of the proposed mining area also lie within the DSC Notification Area for the Woronora Reservoir, which is also known as Lake Woronora. The Woronora Special Area provides the main water supply for the Sutherland region, via the Woronora Reservoir.

2.3.2. Rivers

There are no rivers within the Study Area. The Woronora River is located more than than 1.5 kilometres west of the proposed longwalls.

2.3.3. Watercourses

The largest watercourse within the Study Area is the Waratah Rivulet which is oriented in an approximate north south direction and flows over the middle of Longwalls 20 to 28, where it enters the limit of the Full Supply Level of Woronora Reservoir.

The Bulk Water Storage & Supply Report for 7th February 2008 advised that the available storage in the Reservoir was 42,720 megalitres (ML) which represents 59.5% of the Full Operating Storage with a reservoir water level at -9.4 metres from the full supply level, or an RL of 159.5 metres based on a full supply level of RL 168.88 metres. At this date and based on surface contour information, the reservoir surface water level of 159.5 metres was approximately 2,180 metres downstream of the full supply level.

The Bulk Water Storage & Supply Report for 19th June 2008 advised that the available storage in the Reservoir was 46,800 ML which represents 65.2% of the Full Operating Storage with a reservoir water level at -7.8 metres from the Full Supply Level, or an RL of 161.1 metres based on a Full Supply Level of RL 168.88 metres. The Reservoir inundation area is considered further in Section 2.3.12.

The natural gradient of Waratah Rivulet within the Study Area varies between a minimum of less than 1 mm/m and a maximum of approximately 80 mm/m, with an average natural gradient of approximately 20 mm/m. Photos of Waratah Rivulet are shown in Fig. 2.1 and Fig. 2.2.

Fig. 2.1 Waratah Rivulet over Proposed Longwalls

Fig. 2.2 Waratah Rivulet over Proposed Longwalls

Natural ponds in the streams have developed at the rockbars, the locations of which are shown in Drawing No. MSEC285-08. The beds of the streams are formed within the Hawkesbury Sandstone.

Flows during and following the frequent rainfall events typical of the area are characteristically chaotic, high energy and of high velocity which prevents the build up of loose sediment or vegetation in the stream bed. During dry periods, flow is characterised by shallow, wide sections of slow moving (non turbulent) flow in the flatter sections and pools interspersed by narrow, shallow fast moving flows over the steeper inter-connecting cascades and rock bars (Gilbert & Associates, 2008).

There are also extensive reaches where the bed is covered in large boulders which appear to be the weathered remnants of former rock bars or collapsed overhangs where the stream undercuts the banks and cantilevers fail along rock joints. The flow in these sections is frequently not visible and dominated by specific pathways through the boulder maze (Gilbert & Associates, 2008).

A number of other drainage lines have also been identified within the Study Area (as shown on NSW Department of Lands, 2003 1:25,000 topographic map), which are shown in Drawing No. MSEC285-07.

2.3.4. Aquifers and Known Ground Water Resources

The aquifers and groundwater resources within the vicinity of the proposed longwalls have been investigated and are described in the report by Dr Noel Merrick (Heritage Computing) (2008).

2.3.5. Springs

Groundwater resources within the Study Area are described in the report by Dr Noel Merrick (Heritage Computing) (2008) including springs/seeps associated with the perched and shallow groundwater systems.

2.3.6. Seas or Lakes

There are no natural seas or lakes within the study area. Details of the Woronora Reservoir are provided in Section 2.4.9.

2.3.7. Shorelines

There are no shorelines within the Study Area.

2.3.8. Natural Dams

There are no natural dams within the Study Area. Natural ponds in the streams, which have developed at the rockbars along Waratah Rivulet are described in Section 2.3.3.

2.3.9. Cliffs and Natural Rock Formations

For the purposes of this report, a cliff has been defined as a continuous rockface having a minimum height of 10 metres and a minimum slope of 2 to 1, ie: having a minimum angle to the horizontal of 63°. The locations of the cliffs were determined from site inspections and from the 1 metre surface contours of the area.

The cliffs and overhangs within the Study Area have been typically identified along the alignment of the Waratah Rivulet, and the locations of these which are shown in Drawing No. MSEC285-09. The cliffs and overhangs have formed from Hawkesbury Sandstone. Details of the cliffs and overhangs are provided in Table 2.2. Some of the cliffs and overhangs listed in Table 2.2 are less than 10 metres in height but have been included in the assessment due to the sensitivity of some overhangs to potential movements resulting from mine subsidence.

Table 2.2 Details of the Cliffs and Overhangs identified within the Study Area

ID	Approximate Overall Length (m)	Approximate Maximum Height (m)	Approximate Maximum Overhang (m)
COH1	50	14	2 to 3
COH2	20	7	4 to 5
COH3	30	5 to 7	4
COH4	30	5 to 7	4
COH5	35	4.5	2
COH6	35	8	1
COH7	50	6	2
COH8	40	5	5
COH9	30	6	4
COH10	50	10	5
COH11	35	22	0
COH12	40	17	2
COH13	50	22	2
COH14	35	10 to 12	3
COH15	20	10	2
COH16	30	5	3

Photographs of some of the cliffs identified within the Study Area are provided in Fig. 2.3 to Fig. 2.6. Away from Waratah Rivulet, the potential for significant cliffs and overhangs reduces with distance as the higher points in the topography are approached. However, the potential for rock features still exists. Where relevant, such features have been noted in other specialist studies being prepared in support of the Metropolitan Coal Project Environmental Assessment.

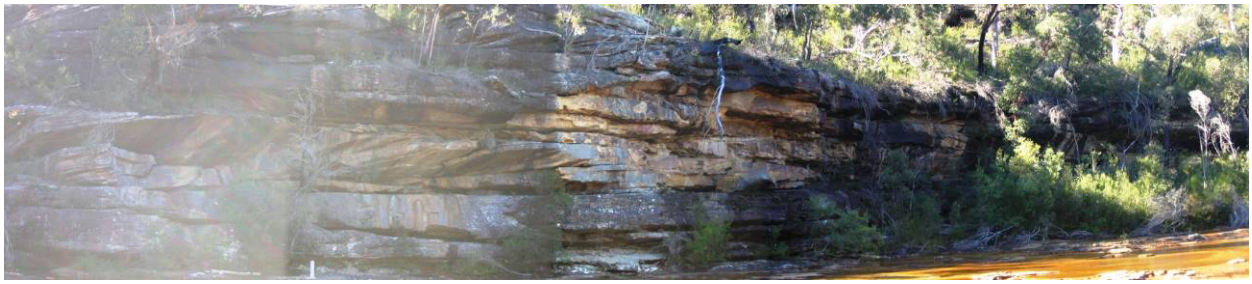

Fig. 2.3 Photograph of COH1

Fig. 2.4 Photograph of COH2

Fig. 2.5 Photograph of COH8

Fig. 2.6 Photograph of COH14

The cliffs and overhangs have been defined as an area of environmental sensitivity for the purposes of the Part 3A approval process.

There are also a number of smaller cliffs, which have been called rock ledges in this report, which are located across the Study Area, generally within the valleys of the drainage lines.

2.3.10. Steep Slopes

A number of steep slopes have been identified within the Study Area. The reason for identifying the steep slopes is to highlight areas where existing ground slopes may be marginally stable. For the purposes of this report, a steep slope has been defined as an area of land having a natural gradient between 1 in 3 (ie: a grade of 33 %, or an angle to the horizontal of 18°) and 2 in 1 (ie: a grade of 200 %, or an angle to the horizontal of 63°).

The maximum slope of 2 to 1 represents the threshold adopted for defining a cliff. The minimum slope of 1 to 3 represents a slope that would generally be considered stable for slopes consisting of rocky soils or loose rock fragments. Clearly the stability of natural slopes varies depending on their soil or rock types, and in many cases, natural slopes are stable at much higher gradients than 1 to 3, for example talus slopes in Hawkesbury Sandstone, which are often stable at 45 degrees or a slope of 1 to 1.

The surface soils above the proposed longwalls generally consist of soils derived from Hawkesbury Sandstone, in varying stages of weathering and fracturing. The majority of the slopes are stabilised, to some extent, by trees and other natural vegetation.

The steep slopes were identified from the surface level contours which were generated from the one metre surface contours of the area, and the locations have been shown in Drawing No. MSEC285-09

The steepest slopes within the Study Area, not including the identified cliffs and rock outcrops, were identified within the valley of Waratah Rivulet and have natural grades of up to 1 in 2, or a maximum angle to the horizontal of 27°. The steep slopes located directly above the proposed longwalls within the Study Area typically have natural grades of up to 1 in 3 to 1 in 2, or a maximum angle to the horizontal of 18° to 27° respectively.

2.3.11. Escarpments

There are no escarpments within the Study Area.

2.3.12. Land Prone to Flooding or Inundation

For the purposes of this assessment, the area between the Woronora Reservoir surface water level, as described in Section 2.3.3, and the Full Supply Level is considered as land prone to inundation. Photographs of the inundation area are shown in Fig. 2.7.

Fig. 2.7 Inundation Area over Proposed Longwalls

The watercourses above the proposed longwalls drain freely into the Woronora Reservoir. There are no major natural flood prone areas identified within the Study Area.

2.3.13. Wetlands and Swamps

A number of upland swamps are situated within the Study Area as shown on Drawing No. MSEC285-07 (based on vegetation mapping by Bangalay Botanical Surveys [2008]). The vegetation of the upland swamps has been mapped as Map Unit 3a: Upland Swamp - Banksia Thicket, Map Unit 3b: Upland Swamp - Tea Tree Thicket, Map Unit 3c: Upland Swamp – Sedgeland-Heath Complex, or Map Unit 3d: Upland Swamp – Fringing Eucalypt Woodland (Bangalay Botanical Surveys, 2008).

There are two basic types of upland swamps located over the Study Area:-

1. “Headwater” upland swamps; and
2. “In-Valley” upland swamps.

A full definition of the two upland swamp types is provided in Appendix G (flora and fauna impact assessment) of the Environment Assessment.

Most of the swamps situated near to Longwalls 20 to 44 are headwater upland swamps. One in-valley upland swamp (Swamp S21 on Drawing No. MSEC285-07) is situated on a tributary (a third order watercourse) of Waratah Rivulet to the south of Longwall 20. This swamp is situated close to Longwalls 20 to 44 (i.e. outside the proposed future mining area, but within the potential extent of mine subsidence effects [i.e. angle of draw]). This swamp overlies completed Longwalls 7 and 8 and consequently has already experienced mine subsidence from Metropolitan Colliery’s previous operations.

2.3.14. Endangered Ecological Communities

Two vegetation communities mapped within the Study Area and surrounds by Bangalay Botanical Surveys (2008) are listed as Endangered Ecological Communities (EECs) in Schedule 1 of the *Threatened Species and Conservation Act, 1995*, being the *Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion* (Map Unit 5a) and *O'Hares Creek Shale Forest* (Map Units 5b and 5r). A discussion on these Vegetation Communities is included in reports by Bangalay Botanical Surveys (2008) and FloraSearch et. al.(2008).

The locations of these vegetation communities are shown in Drawing No. MSEC285-07.

2.3.15. National Parks or Wilderness Areas

The longwall panel layout is not within the boundary of a National Park. A small portion of the Heathcote National Park is however located in the north of the Study Area as shown in Drawing No. MSEC285-01.

There is no land identified as wilderness under the *Wilderness Act 1987* within the Study Area.

2.3.16. State Recreation Areas and State Conservation Areas

The longwall panel layout is not within the boundaries of any State Recreation Area or State Conservation Area. A very small portion of the Garawarra State Conservation Area is however located in the north east and east of the Study Area as shown in Drawing No. MSEC285-01.

2.3.17. State Forests

There are no State Forests within the Study Area.

2.3.18. Natural Vegetation

The vegetation within the Study Area generally consists of undisturbed native bush. A detailed survey of the natural vegetation has been undertaken and is described in Bangalay Botanical Surveys (2008).

2.3.19. Areas of Significant Geological Interest

There are no areas of significant geological interest within the Study Area. A brief description of the geology within the Study Area is provided in Section 1.3. A detailed study of geological features in the Study Area is provided in the report by Geosensing Solutions (2008).

2.3.20. Any Other Natural Feature Considered Significant

There are no other significant natural features within the Study Area.

2.4. Public Utilities

2.4.1. Railways

There are no railways within the Study Area. The Illawarra Railway is located to the east of the Study Area. The nearest point from the proposed Longwalls 20 to 44 to the Railway (which links Sydney and Wollongong) is located near Cawleys Creek and is approximately 900 metres from the nearest edge of Longwall 44. At this location the rail track would not be subjected to measurable systematic mine subsidence induced ground movements, however it could experience small far field horizontal movements and small upsidence and closure movements and it has therefore been included in the assessment.

2.4.2. Roads

The locations of the roads, fire trails and four wheel drive tracks within and adjacent to the Study Area are shown in Drawing No. MSEC285-10.

There are two main public roads that pass through the Study Area. The Princes Highway passes over the north east part of the Study Area over the proposed Longwalls 32 to 44. The Southern Freeway passes in a north south direction on the eastern side of the Study Area. Most of the Southern Freeway is outside the Study Area but it enters the Study Area near the proposed Longwalls 28 to 30 and the proposed Longwalls 42 to 44. The Southern Freeway does not pass directly over the proposed longwalls.

Specific details of the construction of the Princes Highway and Southern Freeway pavements are not known, however it is understood that the Princes Highway has a relatively flexible asphalt pavement and that the Southern Freeway has a more rigid pavement construction of limestone/sandstone/ blast furnace slag and asphalt.

The internal roads within the Garrawarra Complex are asphaltic concrete pavements and are located over the proposed Longwalls 40 to 42. The access road from the Princes Highway to Woronora Dam is of concrete construction and is located immediately north of the proposed Longwall 44. All other roads within the Study Area are unsealed fire trails or access roads which are used by the SCA and other groups for fire fighting and other activities. Darkes Forest Road is an unsealed road that passes through the south western corner of the Study Area, but does not cross over the proposed longwalls.

2.4.3. Bridges

There are four road bridges and two culverts along the Southern Freeway on the eastern side of the proposed mine area. Most of the bridges lie outside the Study Area, however due to the sensitivity of bridges to movements, and in particular horizontal movements, they have been included in this assessment. The locations of the bridges are shown in Drawing No. MSEC285-10. A summary of the bridges is outlined in Table 2.3.

Table 2.3 Summary of Bridge Details along the Southern Freeway

Bridge Name	RTA Name	RTA Chainage from Sydney	Number of Spans	Nearest proposed Longwall	Approximate Distance to nearest proposed longwall
Princes Highway Underpass 1	Twin Bridges over Princes Hwy	31 Miles 3,091Feet (50 kilometres 831.1metres)	3	21	715m
Princess Highway Underpass 2	Twin Bridges over Princes Hwy	30 Miles 1,326Feet (48 kilometres 684.5 metres)	3	31	200m
Cawleys Road Overpass	Overbridge at Cawley Road	28 Miles 1,350Feet (45 kilometres 473.1metres)	2	44	435m
Cawleys Creek Culvert	Not known	Not known	Na	44	195m
Road Culvert	Not known	Not known	Na	44	1,820m
Princess Highway Overpass	Overbridge at 27M.1120FT.	27 Miles 1,120Feet (43 kilometres 793.7 metres)	2	44	2,050m

2.4.4. Tunnels

There are no tunnels within the Study Area.

2.4.5. Drainage Culverts

No drainage culverts were identified within the Study Area. There are likely to be small drainage culverts associated with drainage lines along the Southern Freeway, particularly at Cawleys Creek.

2.4.6. Water, Gas or Sewerage Pipelines

There are no pipelines located over the proposed Longwalls 20 to 31. Most of the existing pipelines are located in the north east corner of the Study Area.

The Sydney Water pipelines over the proposed mining area include 100 mm to 300 mm (most are 200 mm and 300 mm) diameter Cast Iron Cement Lined (CICL) watermains that extend from the Woronora Dam to Helensburgh, and a 150 mm diameter PVC pressure main sewer which extends northward from the Garrawarra Complex and connects to a 450 mm diameter pressure main outside the Study Area.

The locations of the service lines are shown in Drawings Nos. MSEC285-11 to MSEC285-14. The watermain pipeline shown following Woronora Dam road and Princes Highway is yet to be constructed. This pipeline would be designed and constructed to allow for possible mine subsidence movements.

2.4.7. Electrical Services

There are above ground electrical services within the Study Area, the locations of which are shown in Drawings Nos. MSEC285-11 to MSEC285-14. There are no electrical services located directly over the proposed Longwalls 20 to 31. A 330 kV Transmission Line, which is owned by Transgrid, and a 132 kV power line, which is owned by Integral Energy, are located to the east of proposed Longwalls 20 to 44. A photograph showing the typical designs of the transmission towers is provided in Fig. 2.8.

Fig. 2.8 Typical Transmission Towers (looking South)
132kV is on the left and 330kV is on the right

A number of low voltage lines on power poles are located in the north east part of the Study Area, most of which are associated with the Garrawarra Complex.

2.4.8. Telecommunications Services

There are underground telecommunication lines within the Study Area consisting of both optical fibre and copper cables, the locations of which are shown in Drawing Nos. MSEC285-11 to MSEC285-14. The main optical fibre cables are located to the east of the proposed longwalls, following an approximately north south alignment, and are owned by Optus, Nextgen and Telstra. The copper telecommunications cables service mainly the Garrawarra Complex and other residences, and are owned by Telstra.

2.4.9. Dams, Reservoirs and Associated Works

There are no dams located within the general Study Area. The closest dam is the Woronora Dam which is approximately 4,000 metres from the nearest point of the proposed Longwall 44.

2.4.10. Any Other Public Utilities

There are no other public utilities within the Study Area.

2.5. Public Amenities

There are no public amenities within the Study Area. The Sutherland Shire Sports Flying Association uses a former quarry site, as described in Section 2.7.2. A structure located at the site is used as a club house (Structure number D01a on Drawing No. MSEC285-12). The site is kept locked and signposted for the exclusive use of the Sutherland Sports Flying Association. As a result, the club house was included in the Rural Building Structures described in Section 2.6.2.

2.6. Farm Land or Facilities

2.6.1. On-Site Waste Water Systems

The three residences on the two properties within the Study Area are likely to have on-site waste water systems.

2.6.2. Rural Building Strucutres

There are 32 rural building structures (Structure Type R) that have been identified within the Study Area, which include farm sheds, garages and other non-residential structures, most of which are located within the Garrawara Complex.

The locations of the rural building structures are shown in Drawings Nos. MSEC285-11 to MSEC285-14.

2.6.3. Tanks

There are seven tanks (Structure Type T) that have been identified within the Study Area. The locations of the tanks are shown in Drawings Nos. MSEC285-11 to MSEC285-14.

2.6.4. Farm Dams

There is one dam (Structure Type D) that has been identified within the Study Area. The dam is located over the chain pillar between proposed Longwalls 43 and 44 and the location of the dam is shown in Drawing No. MSEC285-12.

2.6.5. Wells or Bores

A search of the Natural Resources Atlas (http://test.nratlas.nsw.gov.au) by Dr Noel Merrick (Heritage Computing) (2008) identified seven registered bores within or in proximity to the Study Area. Only one registered monitoring bore (GW107489) is within the Study Area and is licensed to HCPL.

2.7. Industrial, Commercial or Business Establishments

There are no industrial, commercial or business establishments within the general Study Area.

2.7.1. Mine Infrastructure

There is no mine infrastructure with the Study Area. However the Metropolitan Colliery Ventilation Shaft is located 525 metres from the nearest edge of Longwall 22. This Ventilation Shaft could be subjected to small far-field horizontal movements and valley related movements and since this structure may be sensitive to these movements, it has been included in the assessment provided in this report.

2.7.2. Surface Mining (Open Cut) Voids and Rehabilitated Areas

There are two former quarries, located over Longwalls 42 and 43 and over Longwall 44. The locations of the quarries are shown in Drawings Nos. MSEC285-11 and 12.

The former quarry located over Longwall 44 is mostly revegetated. The former quarry over Longwalls 42 and 43 is partly revegetated and is in use by the Sutherland Shire Sports Flying Association.

2.8. Known Proposed Developments

There are no known proposed developments within the Study Area.

2.9. Items of Archaeological Significance

There are 188[2] archaeological sites that have been identified within the Study Area and surrounds, of which 46 are open sites, and 142 contain overhangs. The locations of the archaeological sites within the Study Area are shown in Drawing No. MSEC285-15. Detailed descriptions of the archaeological sites are provided in the report by Kayandel Archaeological Surveys (2008) included in Appendix H of the Metropolitan Coal Project Environmental Assessment.

2.10. Items of Historical or Heritage Significance

The Garrawarra Complex is listed with the Heritage Office of the NSW Department of Planning as a heritage conservation area with a number of items of heritage significance.

The location and layout of the buildings in the Garrawarra Complex are shown in Drawings Nos. MSEC285-11 to MSEC285-13. Further details of the Garrawarra Complex are provided in Section 2.13.3.

The Wollongong council LEP 1990 lists two houses at Lots 713 and 911, DP 752033 (43 Princes Highway), as items of heritage significance. These houses are not listed in the NSW Heritage Council online database. The two houses are identified by structure numbers E01a and E02a as shown in Drawing No. MSEC285-14. Although Structure E02a is outside the Study Area, the house was included in this assessment because of the Heritage value of the house.

There is also a cemetery located approximately 900 metres to the south of the Garrawarra Complex and over the eastern finishing end of proposed Longwall 37. The Wollongong Council LEP 1990 identifies the cemetery as an item of heritage significance.

A detailed description of Items of Historical or Heritage Significance is provided in the report by Heritage Management Consultants (2008), which is included in Appendix I of the Metropolitan Coal Project Environmental Assessment.

2.11. Items of Architectural Significance

There are no items of architectural significance within the Study Area.

2.12. Permanent Survey Control Marks

The locations of survey control marks are shown in Drawing No. MSEC285-15. The survey control marks adjacent to the Study Area may be subjected to small amounts of subsidence or far-field horizontal movements and have, therefore, also been included in the assessments provided in this report. There are twenty two survey control marks included in the Study Area.

2.13. Residential Establishments

2.13.1. Houses

There are three houses that have been included in the study. Two houses (structure numbers E01a and E03a) are located within the Study Area. The third house (structure number E02a) lies outside the Study Area, but was included in the Study Area because of the heritage significance of the house as detailed in Section 2.10.

All of the above houses are located to the east of the proposed Longwalls 20 to 44. The nearest house to the proposed longwalls is E01a, which is about 250 metres east of Longwall 29.

2.13.2. Swimming Pools

There is one privately owned swimming pool (Structure Type P – ID E03p01) which has been identified within the Study Area, the location of which is shown in Drawing No. MSEC285-14.

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[2] This number is sourced from Appendix H of the Metropolitan Coal Project Environmental Assessment and includes sites located within the Longwalls 18-19A area outside of the Study Area.

2.13.3. Retirement or Aged Care Villages

There are a total of 85 buildings located within the Garrawarra Complex, comprising 57 residential and hospital buildings and 28 structures that have been labelled sheds. Only very limited access to the Garrawarra Complex was available, therefore most structural details were determined from aerial photographs, cadastral information and historical images of the complex. There are also 7 tanks that were identified within the Garrawarra Complex.

The location and layout of the buildings in the Garrawarra Complex are shown in Drawings Nos. MSEC285-11 to MSEC285-13.

CHAPTER 3. OVERVIEW OF LONGWALL MINING, THE DEVELOPMENT OF SUBSIDENCE AND THE METHOD USED TO PREDICT THE MINE SUBSIDENCE PARAMETERS FOR THE PROPOSED LONGWALLS

3.1. Introduction

This chapter provides a brief overview of longwall mining, the development of mine subsidence and the method that has been used to predict the mine subsidence movements resulting from the extraction of the proposed longwalls. More detailed descriptions of longwall mining and the development of subsidence are provided in a document titled "Introduction to Longwall Mining and Subsidence" which can be downloaded from the MSEC website at http://www.minesubsidence.com. Detailed descriptions of methods used to predict mine subsidence movements are provided in a document titled "General Discussion of Mine Subsidence Ground Movements" which can also be downloaded from the website.

3.2. Overview of Longwall Mining

The coal within the proposed project would be extracted using longwall mining techniques. A cross-section along the length of a typical longwall at the coal face is shown in Fig. 3.1.

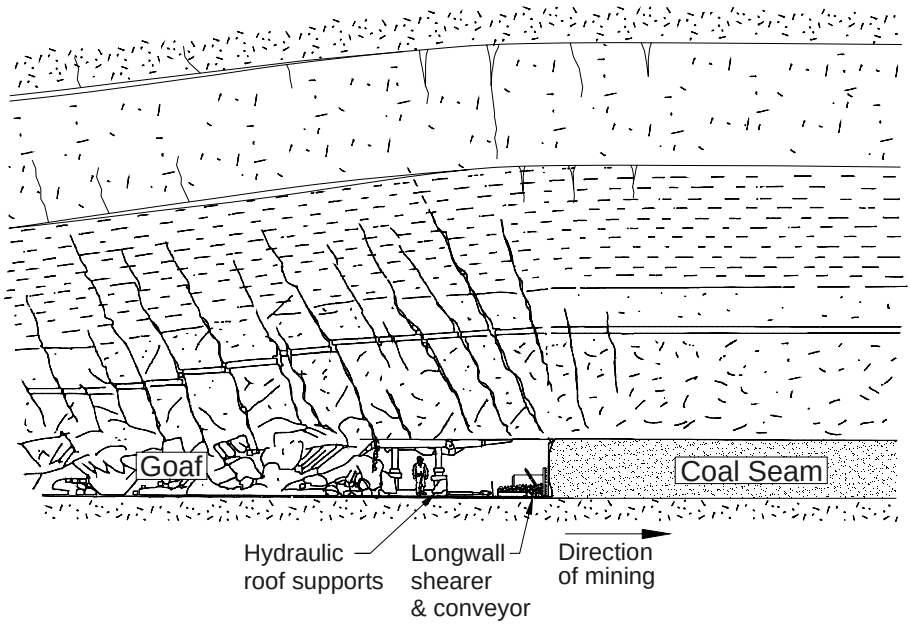


Fig. 3.1 Cross-section along the Length of a Typical Longwall at the Coal Face

The coal is removed by a shearer that cuts the coal from the coal face on each pass as it traverses the width of the longwall. The roof at the coal face is supported by a series of hydraulic roof supports, which temporarily hold up the roof strata, and provide a working space at the coal face. The coal is then transported by an armoured chain conveyor which is located behind the shearer. As the coal is removed from each section of the coal face, the hydraulic supports are stepped forward, and the coal face progresses (retreats) along the length of the longwall.

The strata directly behind the hydraulic supports and immediately above the extracted coal seam, is allowed to collapse into the void that is left as the coal face retreats. The collapsed zone comprises loose blocks and can contain large voids. Immediately above the collapsed zone, the strata remains relatively intact and bends into the void, resulting in new vertical factures, opening up of existing vertical fractures, and bed separation. The amount of strata sagging, fracturing, and bed separation reduces towards the surface.

At the surface, the ground subsides vertically as well as moving horizontally towards the centre of the mined goaf area. The maximum subsidence at the surface varies, depending on a number of factors including longwall geometry, depth of cover, extracted seam thickness, and geology. Based on observed data it is generally accepted that the maximum achievable subsidence in the Southern Coalfield is 65 % of the extracted seam thickness.

3.3. Overview of Systematic Subsidence Movements

The normal ground movements resulting from the extraction of longwalls are referred to as systematic subsidence movements. These movements are described by the following parameters:-

- **Subsidence** usually refers to vertical movement of a point, but subsidence of the ground actually includes both vertical and horizontal movements. The horizontal movements in some cases, where the subsidence is small, can be greater than the vertical subsidence. Subsidence is usually expressed in units of *millimetres (mm)*.
- **Tilt** is the change in the slope of the ground as a result of differential subsidence, and is calculated as the change in subsidence between two points divided by the distance between those points. Tilt is, therefore, the first derivative of the subsidence profile. Tilt is usually expressed in units of *millimetres per metre (mm/m)*. A tilt of 1 mm/m is equivalent to a change in grade of 0.1 %.
- **Curvature** is the second derivative of subsidence, or the rate of change of tilt, and is calculated as the change in tilt between two adjacent sections of the tilt profile divided by the average length of those sections. Curvature is usually expressed as the inverse of the **Radius of Curvature** with the units of *1/kilometres (1/km)*, but the value of curvature can be inverted, if required, to obtain the radius of curvature, which is usually expressed in *kilometres*.
- **Strain** is calculated as the change in horizontal distance between two points on the ground, divided by the original horizontal distance between them. Strain is typically expressed in units of *millimetres per metre (mm/m)*. **Tensile Strains** occur where the distance between two points increases and **Compressive Strains** occur where the distance between two points decreases. So that ground strains can be compared between different locations, they are typically measured over bay lengths that are equal to the depth of cover between the surface and seam divided by 20.

A cross-section through a typical single longwall showing typical profiles of systematic subsidence, tilt, curvature and strain is provided in Fig. 3.2.

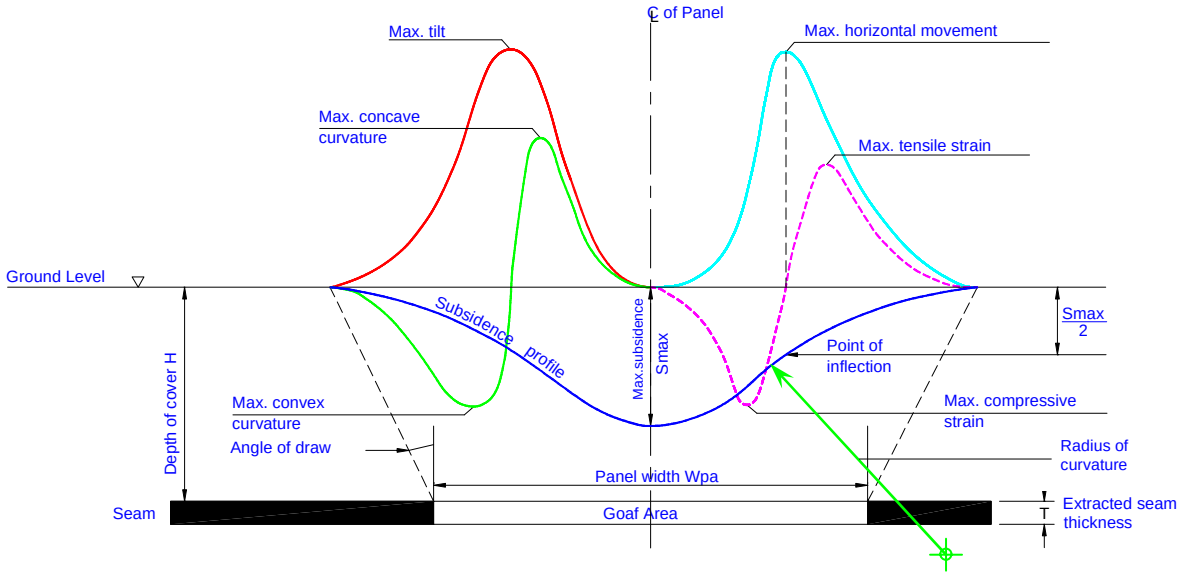


Fig. 3.2 Typical Profiles of Systematic Subsidence Parameters for a Single Longwall

The definitions of incremental, cumulative, total and travelling subsidence parameters are as follows:-

- **Incremental** parameters provided in this report, are the additional subsidence, tilts, curvatures and strains which occur as a result of the extraction of an individual longwall. Observed incremental subsidence profiles are determined by subtracting the observed subsidence profiles before from the observed subsidence profiles after the extraction of each longwall.
- **Cumulative** parameters provided in this report, are the accumulated subsidence, tilts, curvatures and strains which occur as a result of the extraction of the proposed Longwalls 20 to 44, and do not include the parameters resulting from the previously extracted longwalls at the Colliery. The cumulative parameters do, however, include the influence of the previously extracted longwalls at the Colliery on the predicted parameters resulting from the extraction of the proposed longwalls.
- **Total** subsidence parameters provided in this report, are the accumulated subsidence, tilts, curvatures and strains which occur as a result of the previously extracted longwalls at the Colliery, plus the proposed Longwalls 20 to 44. The total parameters also include the influence of the previously extracted longwalls at the Colliery on the predicted parameters resulting from the extraction of the proposed longwalls.
- **Travelling** subsidence parameters provided in this report, are the transient tilts, curvatures and strains which occur as the proposed longwall extraction faces mine directly beneath a point. The maximum travelling tilts, curvatures and strains are typically aligned along the longitudinal axes of the longwalls, with the maximum values typically occurring along a line through the points of maximum incremental subsidence for each longwall.

3.4. The Incremental Profile Method

The predicted systematic subsidence parameters for the proposed longwalls were made using the Incremental Profile Method, which was developed by MSEC, formally trading as Waddington Kay and Associates. The method is an empirical model based on a large database of observed monitoring data from previous mining within the Southern, Newcastle, Hunter and Western Coalfields of NSW.

The database consists of detailed subsidence monitoring data from collieries including: Angus Place, Appin, Baal Bone, Bellambi, Beltana, Bulli, Chain Valley, Clarence, Coal Cliff, Cooranbong, Cordeaux, Corrimal, Cumnock, Dartbrook, Delta, Dendrobium, Eastern Main, Ellalong, Fernbrook, Glennies Creek, Gretley, Invincible, John Darling, Kemira, Lambton, Liddell, Metropolitan, Mt. Kembla, Munmorah, Nardell, Newpac, Newstan, Newvale, Newvale 2, South Bulga, South Bulli, Stockton Borehole, Teralba, Tahmoor, Tower, Wambo, Wallarah, Western Main, Ulan, West Cliff, West Wallsend, and Wyee.

The database consists of the observed incremental subsidence profiles, which are the additional subsidence profiles resulting from the extraction of each longwall within a series of longwalls. It can be seen from the normalised incremental subsidence profiles within the database, that the observed shapes and magnitudes are reasonably consistent where the mining geometry and local geology are similar.

Subsidence predictions made using the Incremental Profile Method use the database of observed incremental subsidence profiles, the proposed longwall geometries, local surface and seam information, and geology. The method has a tendency to over-predict the systematic subsidence parameters (ie: is slightly conservative) where the proposed mining geometry and geology are within the range of the empirical database.

The model uses the surface level contours, seam floor contours and seam thickness contours to make predictions. The surface level, seam floor and seam thickness contours were provided by HCPL and are shown in Drawings Nos. MSEC285-02, MSEC285-03 and MSEC285-04, respectively. The identified geological structures at seam level are shown in Drawing No. MSEC285-06.

The predicted systematic subsidence parameters for the proposed longwalls were determined using the standard Incremental Profile Model for the Southern Coalfield based on monitoring data from the Bulli Seam, calibrated to local data. Modifications to the standard Incremental Profile Method have not been made for the presence of any thick massive strata units. A detailed description of the standard Incremental Profile Method is provided in the background reports that can be found on the website at http://www.minesubsidence.com.

Predictions have been made at points on regular grids orientated north-south and east-west across the Study Area. A grid spacing of 10 metres in each direction was adopted, which provides sufficient resolution for the generation of subsidence, tilt and strain contours.

An overview of the maximum predicted systematic subsidence parameters resulting from the extraction of the proposed longwalls is provided in Chapter 4. The predicted site-specific subsidence parameters at the natural features and items of surface infrastructure are provided in Chapter 5 and form the basis of the impact assessments.

The model was calibrated using the observed monitoring data over the previously extracted longwalls at the colliery, which is described in the following section.

3.5. Calibration of the Incremental Profile Method

The standard Incremental Profile Method as used for the Southern Coalfield was calibrated to local data using observed monitoring data above the previously extracted longwalls at the colliery.

Data used for calibration of the model was analysed from the monitoring lines over the SW series panels, located to the east of Longwalls 1 to 19A and to the east of the Southern Freeway, and the monitoring data from the D-Line that is located over Longwalls 1 to 15.

3.5.1. Comparison with Monitoring Line Data for SW Panels

The initial comparison was made using monitoring line data for the SW panels, SW1 to SW10, that were mined using bord and pillar mining methods from 1980 to 1992. Due to the variable panel dimensions, lack of chain pillars, presence of remnant coal stooks and the continuous nature of bord and pillar mining, subsidence profiles are more difficult to predict than over longwall panels. Nonetheless, a comparison between observed and predicted subsidence profiles, using the Incremental Profile Method, for the SW panels was useful in determining the suitability of our existing model for the Metropolitan Colliery.

Five monitoring lines were installed over the SW panels. The locations of these monitoring lines, named the A-Line, B-Line, C-Line, D-Line and H-Line are shown in Fig. 3.3. A portion of the previous Coal Cliff mine workings to the south of Metropolitan Colliery is also shown in Fig. 3.3. Data for the monitoring lines was provided by Metropolitan Colliery.

For each monitoring line, plots of predicted and observed incremental and total subsidence, and incremental and total strain were produced. The values of predicted subsidence and strain were determined using the standard Incremental Profile Method model for the southern coalfield.

The plots of observed and predicted subsidence and strain for one of these monitoring lines, the D Line, are presented as examples in Fig. 3.4 and Fig. 3.5.

The D Line monitored over the SW panels extended towards LW1. However, a new D Line was installed over LW1 and across all the previously mined longwalls with an offset of about 200 metres towards the south and west from the original D-Line so that this new line was further away from the finishing ends of these longwalls. Peg numbers for both lines are preceded by the letter D so care should be taken when reviewing the D Line monitoring data to ensure that they are read in the context of the correct mining area.

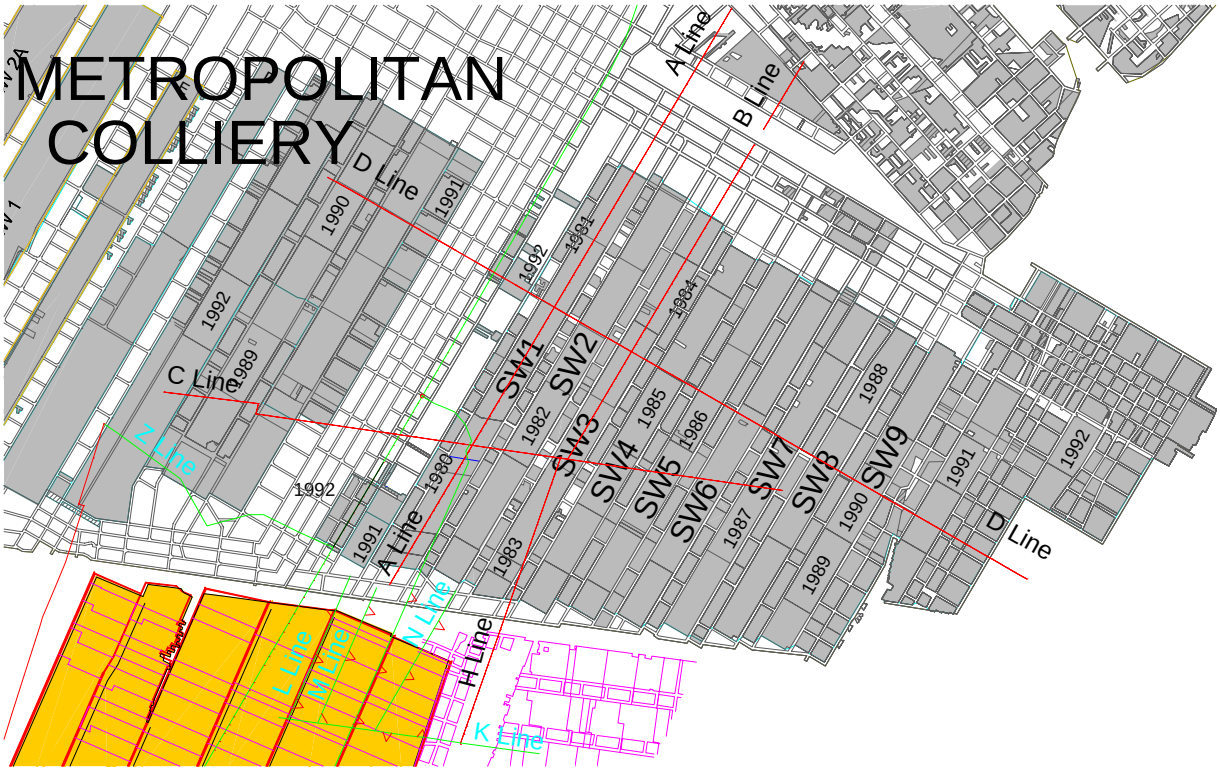


Fig. 3.3 Monitoring Lines over SW Panels

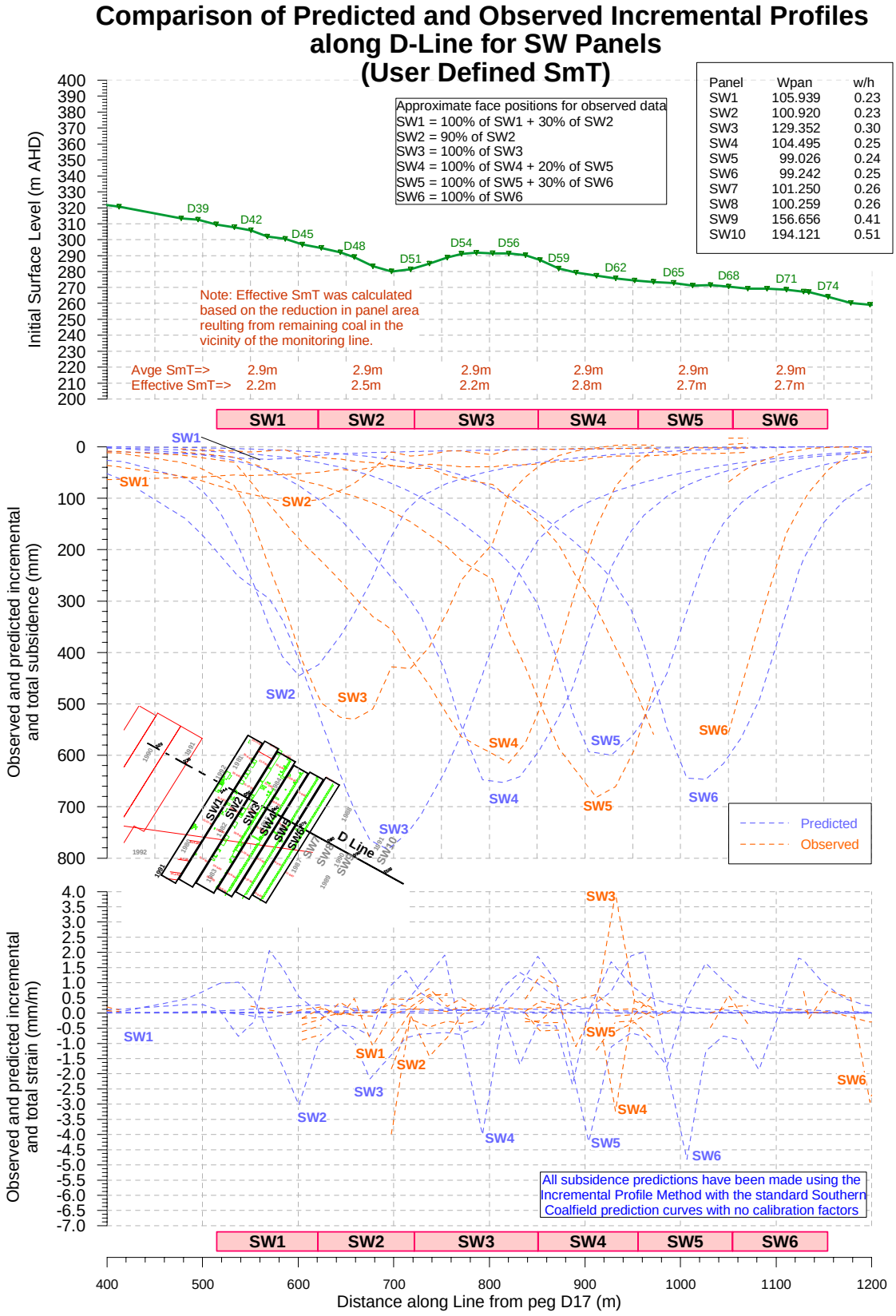


Fig. 3.4 Comparison of Predicted and Observed Incremental Subsidence and Strain along D-Line over SW Panels

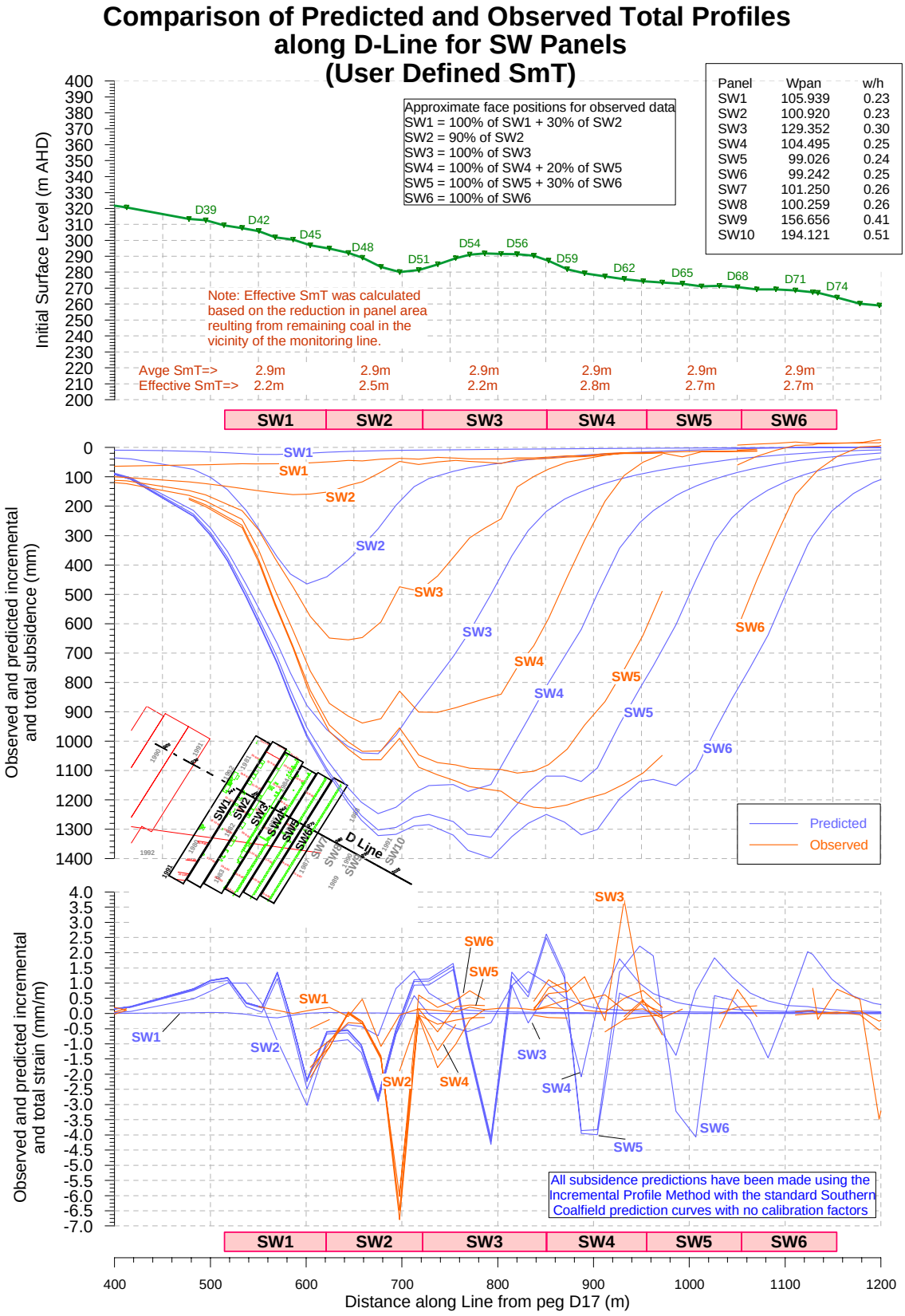


Fig. 3.5 Comparison of Predicted and Observed Total Subsidence and Strain along D-Line over SW Panels

It can be noted from these figures that the Incremental Profile Method provides a reasonable and conservative prediction for these panels, despite the difficulties associated with remnant stooks, no chain pillars and variable panel dimensions. Valley upsidence and closure ground movements were observed in the tributary of Kellys Creek which is located over SW2. The depth of the valley at this location was 20 metres. The observed upsidence increased from 30 mm to 60 mm to 100mm and then 110 mm after mining SW2 to SW5 and an observed maximum closure strain of 6.7 mm/m was observed after mining SW2. This strain did not increase after the extraction of the following panels. These observed values are all less than the predicted upsidence and closure values using the ACARP upsidence and closure prediction method that is discussed in Section 3.6.3.

A comparison was made between the predicted and observed maximum incremental and maximum total subsidence for each monitored SW panel. The results are presented in Fig. 3.6.

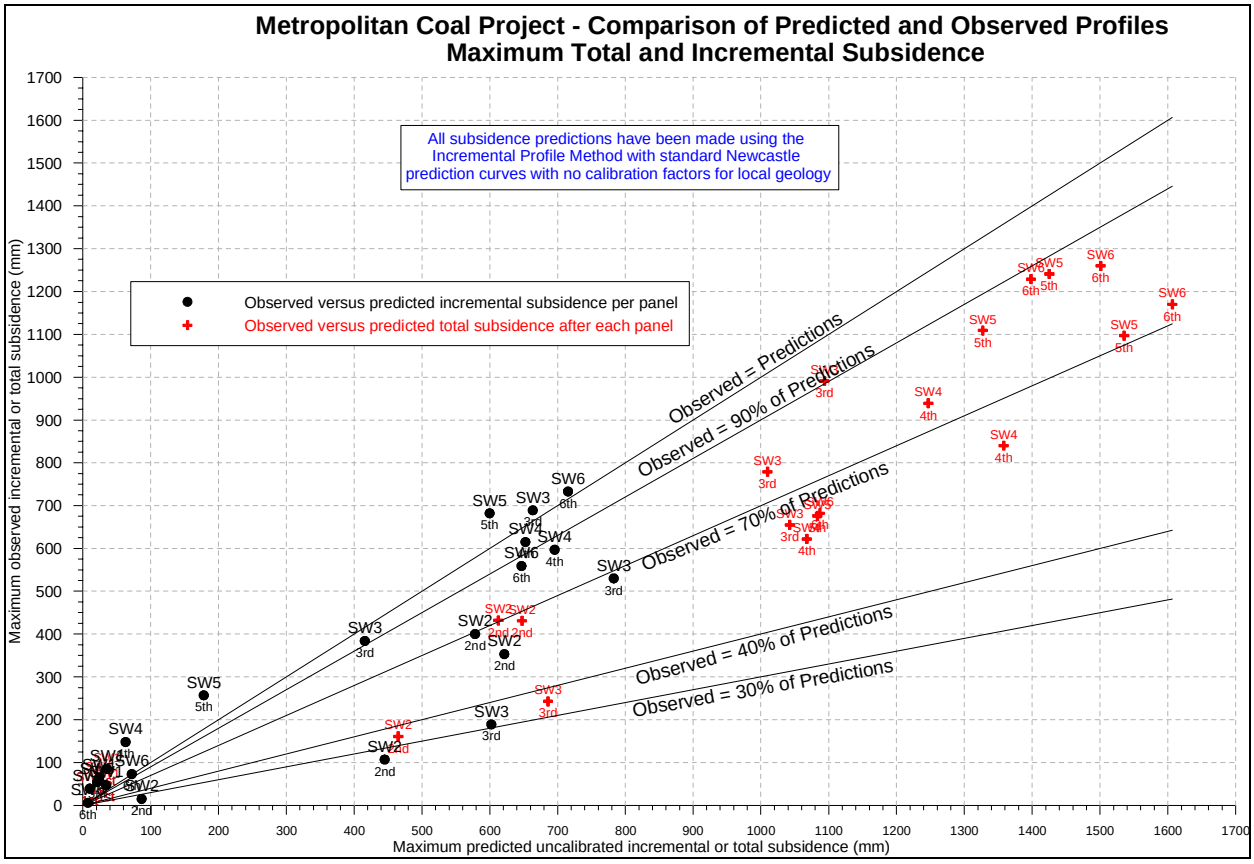


Fig. 3.6 Comparison of Predicted and Observed Incremental and Total Subsidence for the SW Panels

The comparison plot presented in Fig. 3.6 shows a reasonable result, with most of the predicted subsidence results higher than the observed subsidence. Most total observed subsidence values are in the range of about 70% to 90% of predicted total subsidence and there is more scatter of incremental subsidence values ranging from about 30% of predicted to slightly higher than predicted.

While the above comparison presented a reasonable result, given the unusual mining conditions, the comparison on the SW panels indicated there was no reason to adjust the standard Southern Coalfield Incremental Profile Method for the Metropolitan geological conditions. It was recognised however that this comparison should not be used directly as a guide for predictions over the future longwall mining panels.

3.5.2. Comparison with Monitoring Line Data over the Current Longwalls

Monitoring data for the D Line over Longwalls 1 to 14 was used to calibrate the Incremental Profile Method for future longwall predictions.

The D Line extends over all the currently mined longwalls and it is oriented approximately 90 degrees to the longitudinal orientation of the longwalls. The location of the D Line is presented in Figure MSEC285-17 in Appendix E.

Although the initial pegs commence over Longwall 1, the first available monitoring data along this D-Line was measured after Longwall 3 was extracted. At least one survey is available during the extraction of each of the later longwalls.

The longwall panel and pillar widths have been increased since commencement of mining as follows:

- Longwalls 3 to 7 panels are 125 metres wide (void) with 35 metre wide pillars
- Longwalls 8 to 10 panels are 140 metres wide (void) with 35 metre wide pillars
- Longwalls 11 to 14 panels are 163 metres wide (void) with 35 metre wide pillars.

Prior to comparing the D Line data with predicted subsidence parameters, some adjustments were needed to the raw survey data to account for small movements of bench marks and the end of line pegs as the line was extended. It is apparent from the monitoring data that several survey reference marks had subsided by small amounts and simple adjustment is required to correct these small movements. A plot of the raw monitoring data is shown in Fig. 3.7.

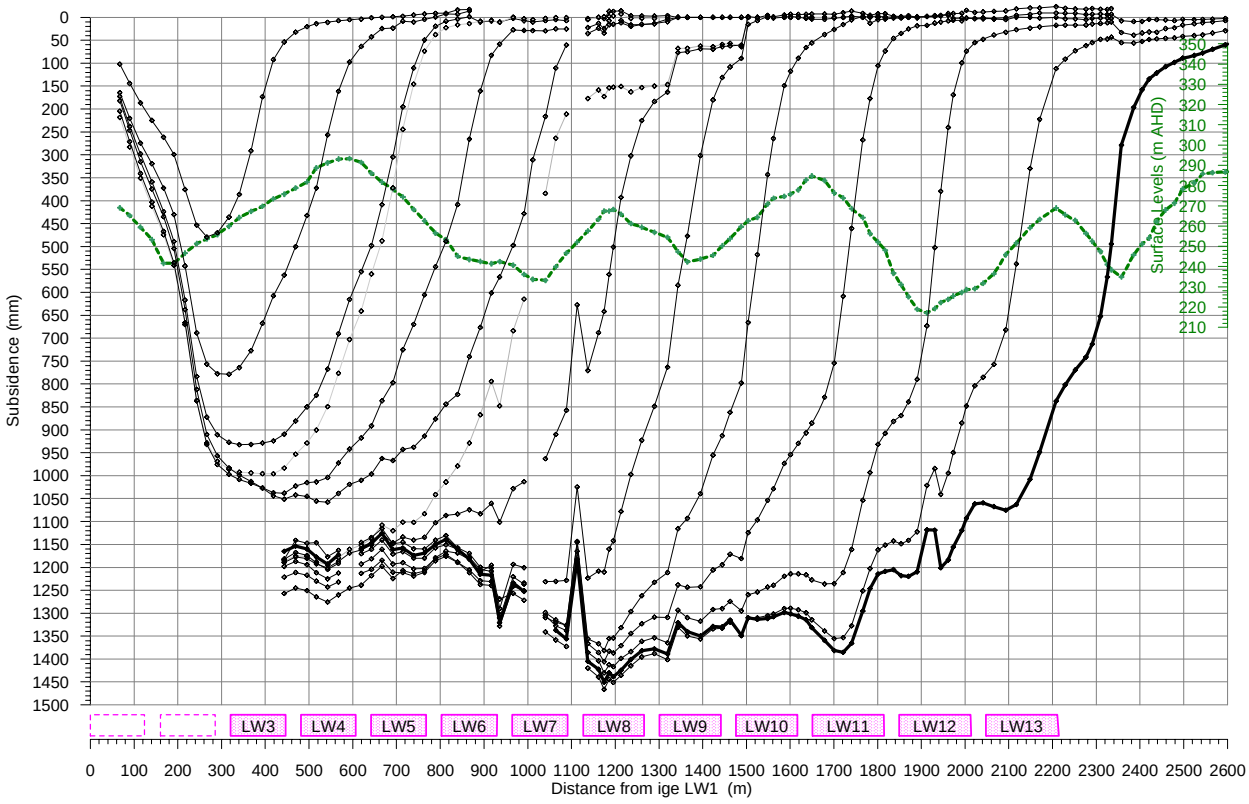


Fig. 3.7 D Line Observed Subsidence – No Adjustment

The survey data was adjusted to take into account the apparent steps in the total subsidence profile and to match the expected progression of total subsidence from Longwall 7. A plot of the adjusted subsidence profiles is presented in Fig. 3.8. A similar adjustment to the survey data was carried out by Ken Mills of SCT Operations Pty Ltd (SCT) and the adjustments were confirmed with HCPL.

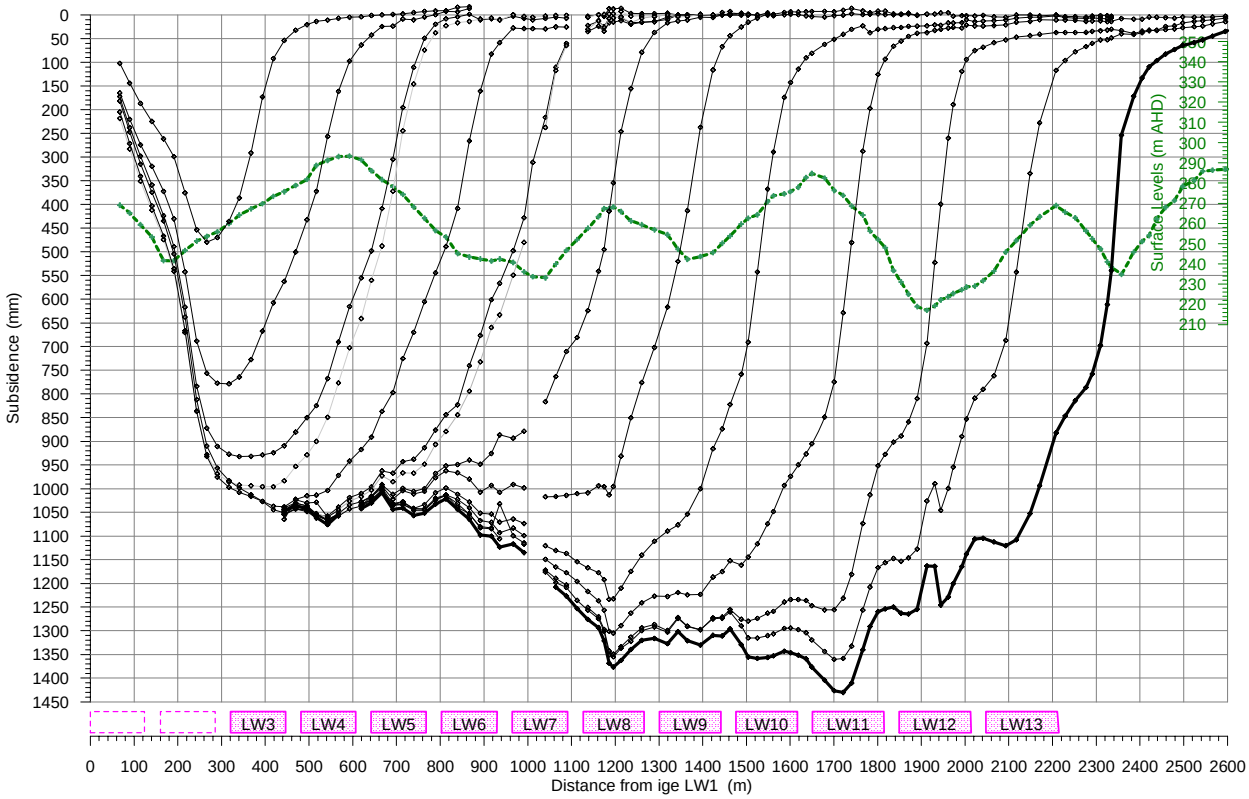


Fig. 3.8 D Line Observed Subsidence – Adjusted

A subsidence prediction has been undertaken for Longwalls 1 to 14 using the Incremental Profile Method and a slice has been taken through the predicted subsidence bowl along the alignment of the D-Line.

A plot of the predicted uncalibrated incremental subsidence profiles and observed incremental subsidence profiles is shown in Fig. 3.9. This comparison of the observed and predicted total and incremental subsidence profiles using the standard Southern Coalfield model indicated that the observed subsidence exceeded the predicted values, while the shapes of the predicted subsidence profiles closely matched the observed profiles.

A comparison of the maximum predicted and observed incremental and total subsidence from each of these longwalls is shown in Fig. 3.10. This plot shows that most of the maximum observed incremental subsidence values were between approximately 100% and 150% higher than the uncalibrated predicted subsidence.

The greatest difference was noted between the maximum observed incremental subsidence for Longwall 10 and the maximum predicted incremental subsidence for Longwall 10. It was also noted that the observed incremental subsidence for Longwall 10 was considerably greater than the maximum incremental subsidence for Longwalls 8 and 9 even though these longwalls have similar panel and pillar widths to Longwall 10.

It is believed that the main reason for this variation in observed subsidence for similar mining conditions is due to differences in geology in the immediate roof strata and the strata layers within say 150 metres of the seam roof. HCPL has provided extensive borehole stratigraphy data around the mine and the typical stratigraphy is shown in Fig. 1.3.

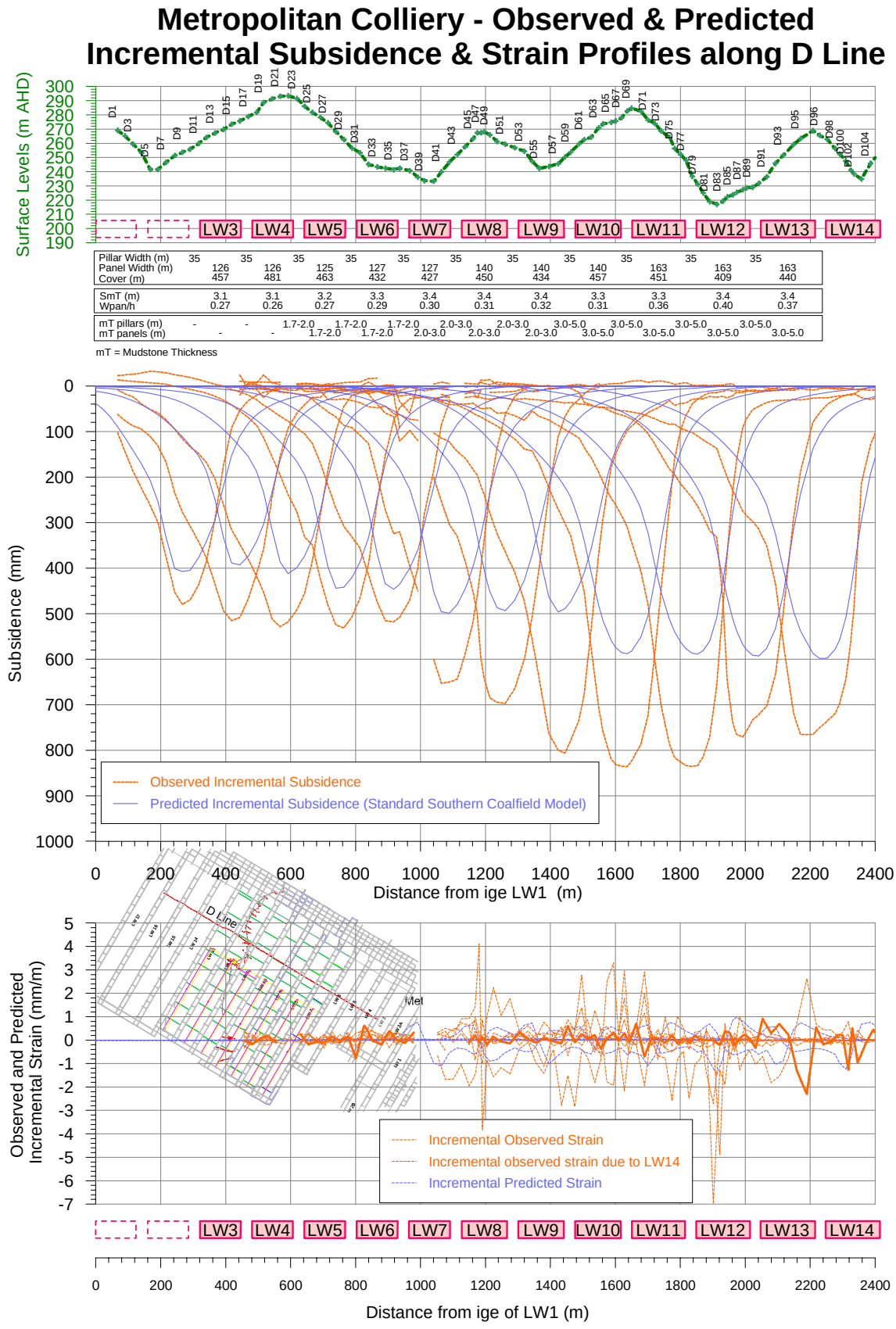


Fig. 3.9 D Line Observed and Uncalibrated Predicted Incremental Subsidence

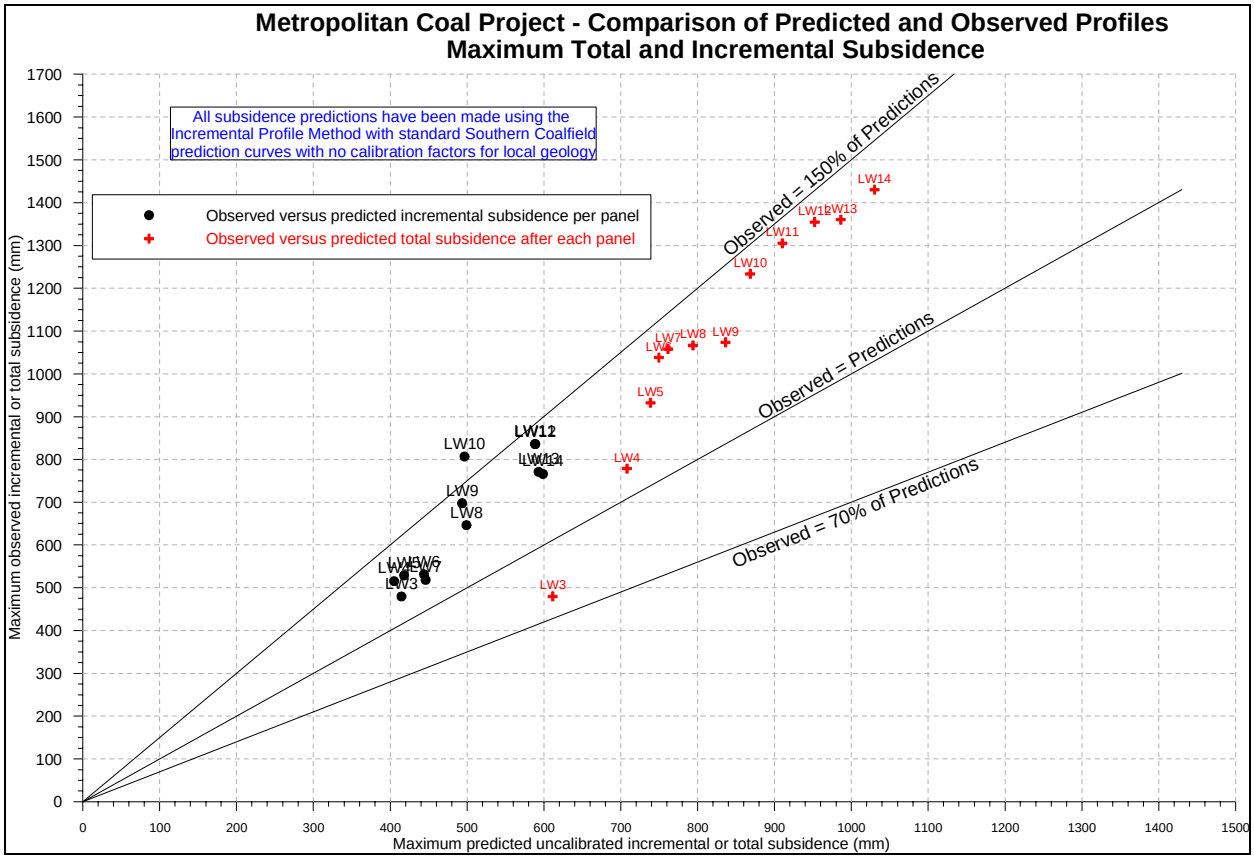
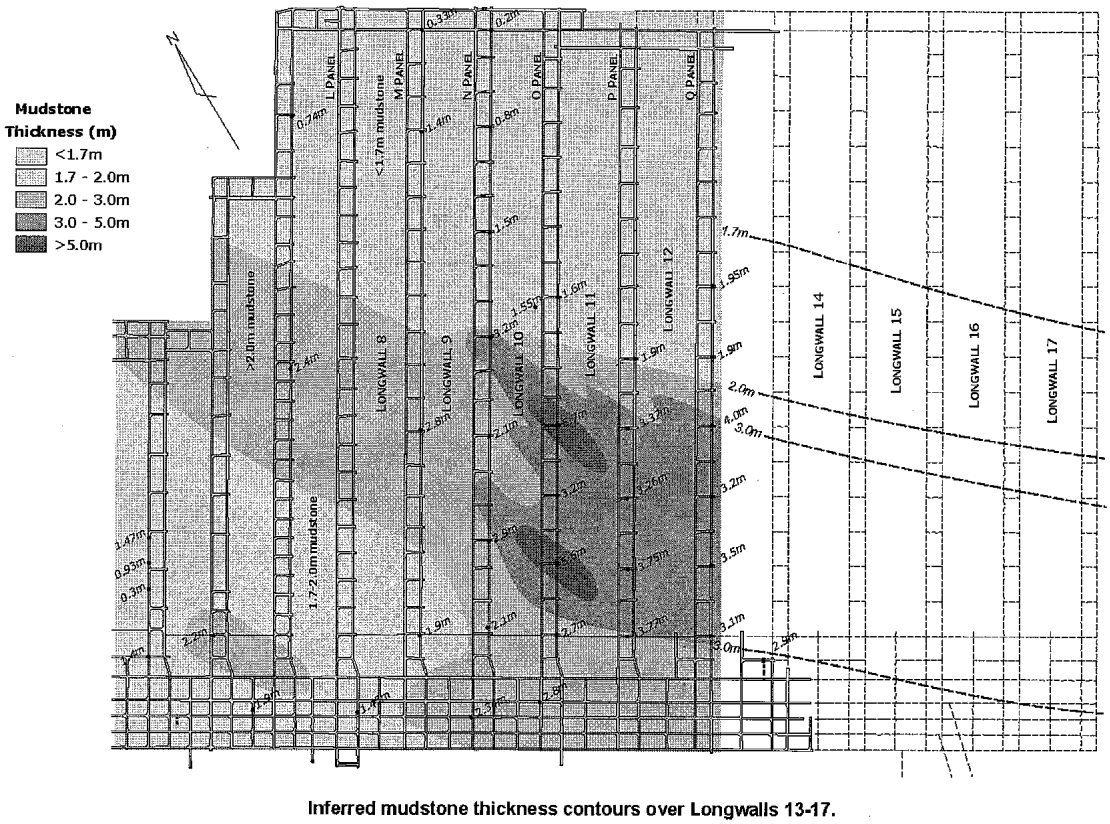


Fig. 3.10 Comparison of Predicted and Observed Incremental and Total Subsidence

It has been noted that the proportion of shale to sandstone layers within 150 metres of the coal seam and the thickness of the shale layers within 150 metres of the coal seam (ie: the Wombarra Shale and Stanwell Park Shale) at Metropolitan Colliery is greater than at the mines further to the south of Metropolitan Colliery. Shale layers are less strong than the more massive sandstone layers. The shale layers tend to fracture more readily and be compressed with lower bulking factors or smaller volumes than sandstone layers. As a result increased subsidence levels are observed where increased proportions of shale exist.

As the Incremental Profile Method was predominantly based on empirical data that was monitored over the mines to the south of Metropolitan Colliery, where the proportion of shale within 150 metres of the seam roof was far less than has been noted at Metropolitan Colliery, the predicted subsidence levels have been calibrated to reflect the extra subsidence that has been observed over some longwalls at Metropolitan Colliery to date.

Additionally, it has been noted that, after Longwall 9, the thickness of a mudstone layer in the immediate seam roof increased and the presence of this thicker mudstone roof was found to coincide with a change in the subsidence profiles. A contour plot showing the thickness of this mudstone layer was prepared by SCT and it is shown in Fig. 3.11 and in Drawing MSEC285-06. It can be noted that the D Line passes into a region of thicker mudstone from Longwall 10 to Longwall 12 and this is where the difference between the observed and predicted incremental subsidence profiles was greatest, see Fig. 3.9. The presence of this mudstone layer immediately above the seam therefore appears to be an additional factor resulting in the observed subsidence profiles beyond Longwall 9 being greater than the profiles predicted using the standard Southern Coalfield model.



Inferred mudstone thickness contours over Longwalls 13-17.

Fig. 3.11 Mudstone Thickness Contours above Longwalls from SCT report MET2787 "SMP Longwall 14-17" dated 1 May 2006

A calibration of the Incremental Profile Method model was therefore carried out to produce predicted subsidence results that were a closer and slightly conservative match when compared to the observed subsidence. Two methods were tested to calibrate the prediction method to the observed data. The first adjustment method was to apply a fixed proportional factor to the predicted incremental subsidence profiles and the second adjustment was to apply a fixed proportional factor to simulate weaker or narrower chain pillars. The results showed that the second method, i.e. adjusting the strength of the chain pillars, provided more consistent results for incremental and total subsidence profiles.

The resulting adjustment factor is a pillar proportion factor of 0.65, which is applied to all pillars in the model. A comparison of observed incremental and total subsidence profiles and predicted incremental and total subsidence profiles using this pillar proportion factor of 0.65 are shown in Fig. 3.12 and Fig. 3.13.

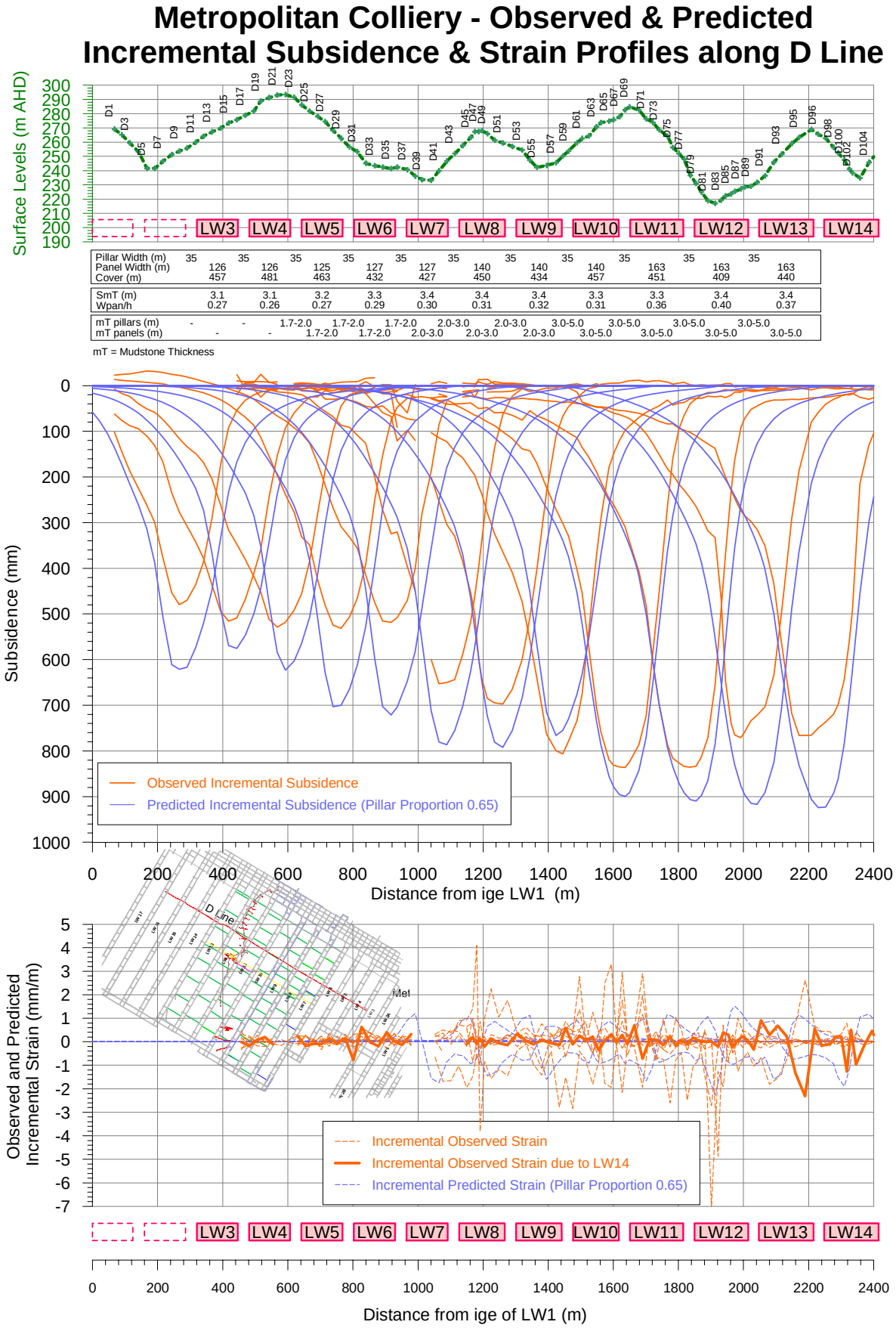


Fig. 3.12 Comparison of Predicted and Observed Incremental Subsidence along the D Line

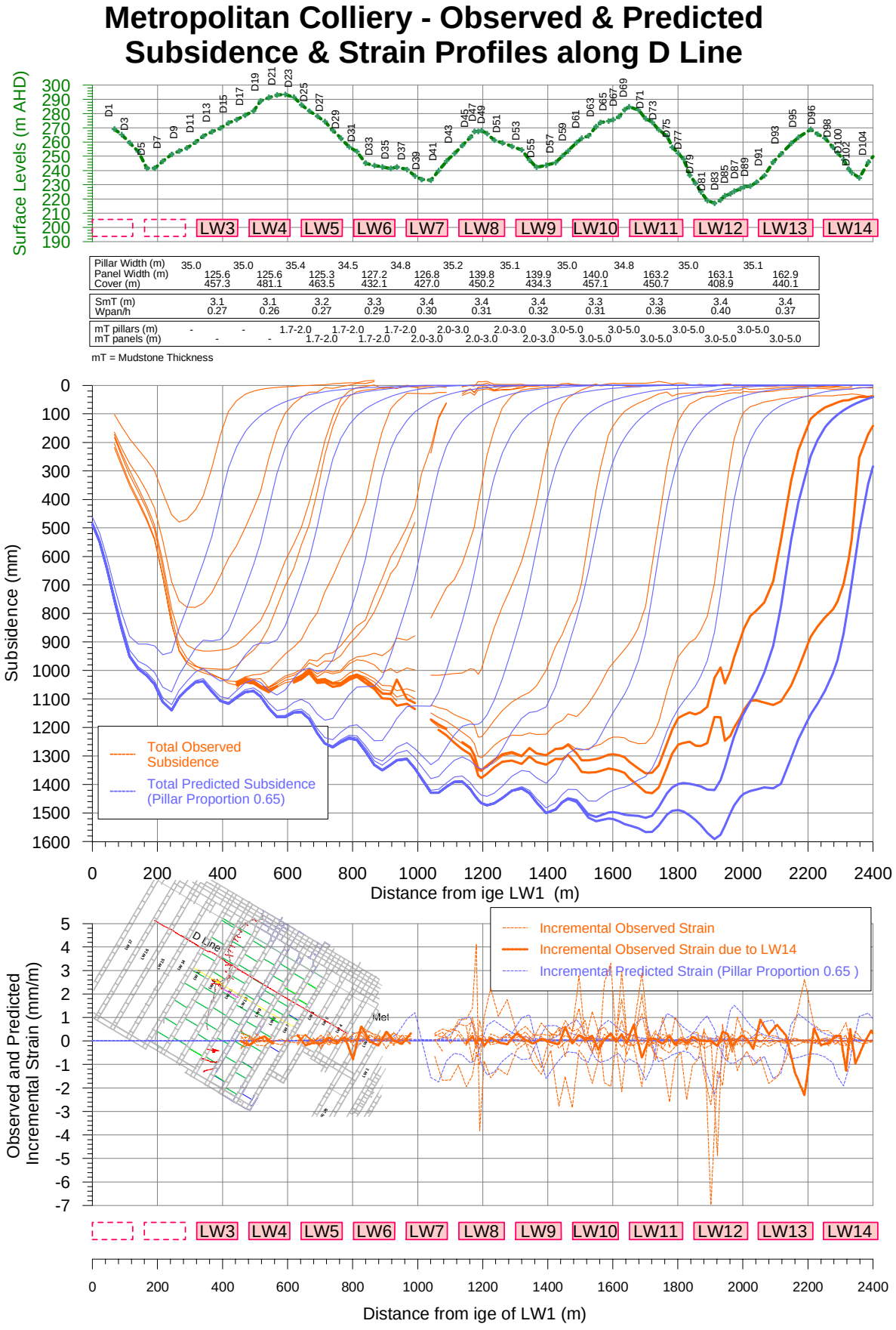


Fig. 3.13 Comparison of Predicted and Observed Total Subsidence along the D Line

The predicted subsidence profiles obtained using the calibrated model result in a good correlation with the observed D Line subsidence results.

From the available borehole stratigraphic logs, the proportion of shale above the seam over the proposed longwalls appears to be similar to the proportion of shale seen over Longwalls 1 to 14, and, although a smaller calibration could be applied since the thickness of the mudstone in the roof over the future proposed longwalls is thinner, the same calibration model has been conservatively applied to Longwalls 20 to 44.

3.6. Overview of Non-Systematic Subsidence Movements

Non-systematic subsidence movements include far-field horizontal movements, irregular subsidence movements, and valley related movements. These movements are briefly described below, and more detailed descriptions are provided in the MSEC document "General Discussion of Mine Subsidence Ground Movements" which can be viewed and/or downloaded from the MSEC website http://www.minesubsidence.com.

3.6.1. Far-field Movements

In addition to the systematic horizontal movements, which occur above and adjacent to extracted longwalls, far-field horizontal movements have been observed at considerable distances from extracted longwalls. Such movements are predictable and occur whenever significant excavations occur from the surface or underground.

Far-field horizontal movements tend to be bodily movements towards the extracted goaf area and are accompanied by low levels of strain. These movements generally do not result in impacts, except where they occur at long structures, which are sensitive to differential horizontal movements.

Detailed descriptions of far-field horizontal movements, and the method used to predict such movements, is provided in Section 5.28 of this report and Section 1.7 of the online document "General Discussion of Mine Subsidence Ground Movements", mentioned previously.

3.6.2. Irregular Subsidence Movements

Irregular subsidence movements can result from near surface geological structures, including faults, dykes, and abrupt changes in geology. The presence of these features near the surface can result in a bump in the subsidence profile, which is accompanied by locally higher tilts and strains.

Irregular subsidence movements can also occur at shallow depths of cover, where the collapsed zone above the extracted longwalls extends near to the surface. In this situation, the resulting subsidence profiles become erratic, and are accompanied by higher tilts and strains.

The non-systematic tilts and strains resulting from irregular subsidence movements can be much greater than those resulting from the normal systematic subsidence movements. Irregular subsidence movements, and the potential impacts resulting from such movements are described in Sections 5.30 of this report and Section 1.7 of the online document "General Discussion of Mine Subsidence Ground Movements", mentioned previously.

3.6.3. Valley Related Movements

The watercourses within the Study Area are likely to be subjected to valley related movements, which are commonly observed along river and creek alignments in the Southern Coalfield. Valley related movements are a natural phenomenon, resulting from the formation and ongoing development of the valley, as illustrated in Fig. 3.14.

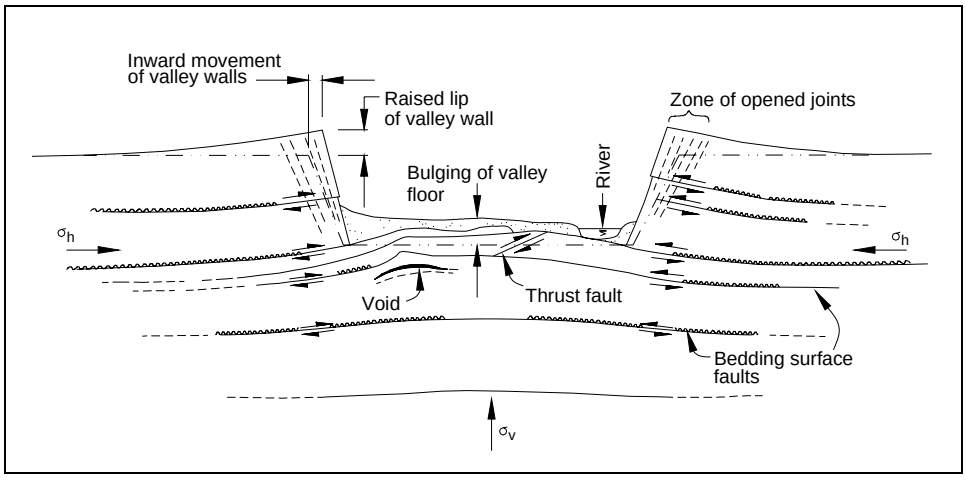


Fig. 3.14 Natural Valley Formation in Flat-Lying Sedimentary Rocks (after Patton and Hendron, 1972)

These naturally occurring valley related movements can be accelerated by mine subsidence and are described using the following parameters:-

- **Upsidence** is the reduced subsidence, bulging, or net uplift movement within the base of a valley. It is typically expressed in units of *millimetres (mm)*. Upsidence predominantly results from the buckling of near surface strata in the base of the valley, where there are lower vertical confining stresses and increased horizontal stresses caused by a redistribution of in-situ horizontal stresses around the collapsed zones above the extracted longwalls. It follows that, whilst some strong bedrock layers are capable of accommodating an increase in horizontal stress, other valley floors, which may be weaker with thinner strata layers or with pre-existing natural joints, will fail and experience increased levels of upsidence. Upsidence can be measured by a comparison between the monitored survey data and an interpolated "flat terrain profile". It is often easier to detect the magnitude and extent of the upsidence profile across a valley from the incremental subsidence profiles than from the total subsidence profiles.

  It is difficult to assess the full extent of upsidence from short monitoring lines located solely in the base of valleys as these short lines do not include the full upward thrust that extends beyond the cliff lines, as shown in the diagram above. Often incomplete assessments of upsidence are quoted because of short monitoring lines.

- **Closure** is the reduction in the horizontal distance between the valley sides, and is expressed in units of *millimetres (mm)*. Closure predominantly results from the above redistribution of and increase in the horizontal stresses around the collapsed zones above extracted longwalls coupled with failure of the rocks in the base of the valley. Additional closure can result from additional localised stress relaxation and slippage between bedding planes above the floor of the valley.

  The maximum measured closure along monitoring lines usually includes those survey bays across the bottom of the valley and it should be remembered that these observed movements often include a component of the mining induced systematic ground movements.

- **Compressive Strains** occur within the valley as a result of valley closure movements and are calculated as the decrease in horizontal distance over a standard bay length, divided by the original bay length. **Tensile Strains** also occur adjacent to the valley as a result of valley closure movements, and are calculated as the increase in horizontal distance over a standard bay length, divided by the original bay length. So that ground strains can be compared on an equal basis between different locations within the Southern Coalfield, they are typically measured over bay lengths that are equal to the depth of cover between the surface and seam divided by 20. Compressive and tensile strains due to valley closure movements are typically expressed in units of *millimetres per metre (mm/m).*

There are a number of factors which affect valley related movements (Kay, Barbato and Mills, 2007). These include:

- Longwall geometry, such as panel width, panel length and pillar width,
- Depth of cover, seam extraction height and direction of mining,
- Position of a longwall within a series of longwalls and previous adjacent mining,
- Magnitude of subsidence resulting from mining,
- Distance of the valley from mining, orientation of the valley to mining and whether the valley is directly mined beneath,
- Height, width and shape of the valleys, as well as the type of topography in the vicinity of the valleys,
- Geology in the overburden and in the base of the valley, including the type of strata, bedding, jointing and geomechanical properties, and
- Composition of the valley sides, whether comprising clifflines, large talus slopes or colluvium.

The predicted valley related movements resulting from the extraction of the proposed longwalls at the colliery were made using the empirical method outlined in ACARP Research Project No. C9067 (Waddington Kay & Associates, 2004) which assumes a stress related mechanism for valley related movements (Kay, Barbato and Mills, 2007). A detailed description of valley related movements and the method used to predict such movements, are provided in Section 1.7 of the online document "General Discussion of Mine Subsidence Ground Movements", mentioned previously.

The profile of equivalent valley height used to determine the predicted valley related upsidence and closure movements at the Waratah Rivulet is shown in Fig. C.04. The equivalent valley height is calculated by multiplying the measured overall valley depth by a factor which reflects the shape of the valley. The overall valley height is measured after examining the terrain across the valley within a radius of half the depth of cover. The factor varies from 1.0, for steeply sided valleys in flat terrain, to less than 0.5, for valleys of flatter profile in undulating terrain. An equivalent valley height factor of 1.0 was conservatively adopted for the Waratah Rivulet.

Predicted upsidence and closure values were determined for several monitoring lines that cross the Waratah Rivulet. The predicted values of upsidence and closure were plotted against observed values of upsidence and closure, along with observations from several other collieries, and the results are presented in Fig. 3.15 and Fig. 3.16. The results show that observed upsidence and closure movements are generally less than predicted values of upsidence and closure.

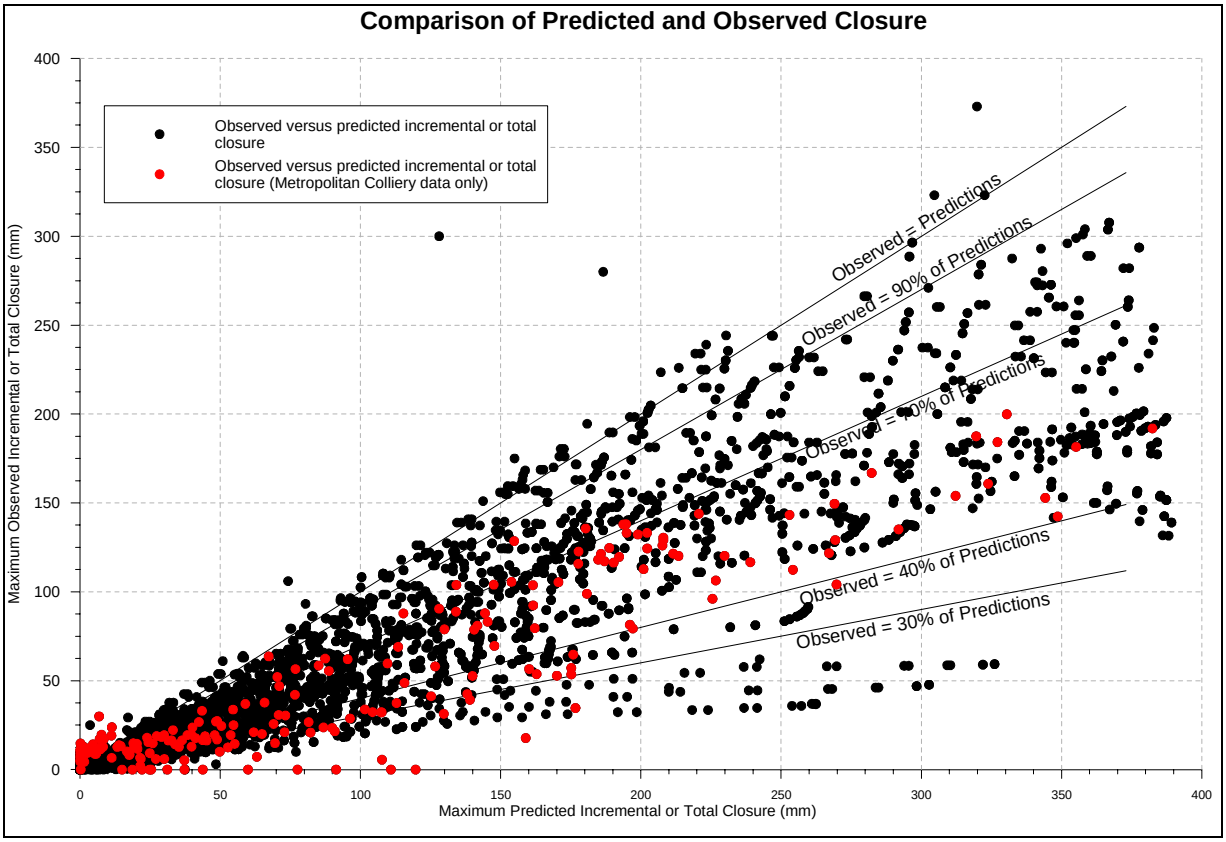


Fig. 3.15 Plot of Predicted versus Observed Closure

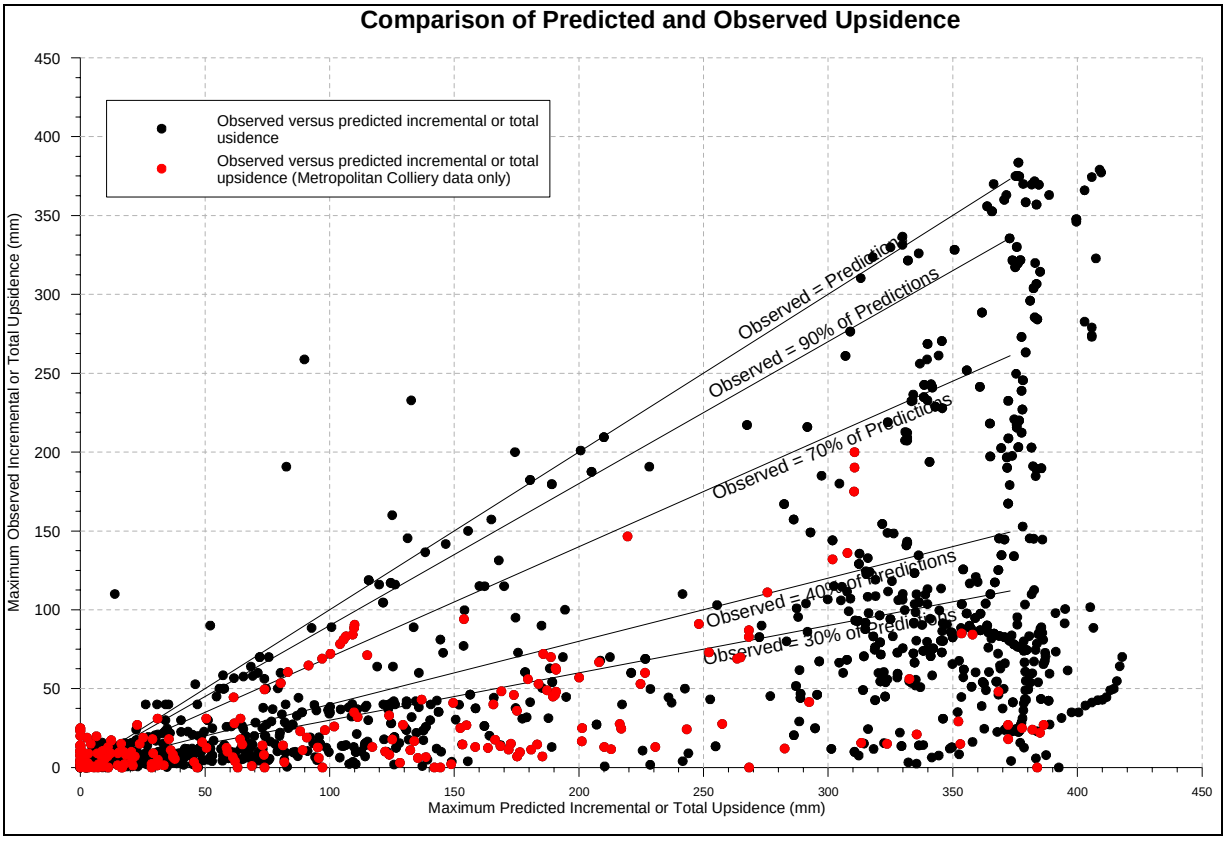


Fig. 3.16 Plot of Predicted versus Observed Upsidence

3.7. Comparison of Predicted Subsidence Parameters Obtained using the Holla Series and Department's Handbook Methods

The maximum predicted systematic subsidence parameters along Prediction Line 1, obtained using the Incremental Profile Method, were compared with the maximum subsidence parameters obtained using the Holla Series Method (Holla, 1988) and the Department's Handbook Method (Holla, 1985).

The Holla Series and the Department's Handbook Methods only allow the prediction of the maximum values of subsidence, tilt, curvature and strain, and do not precisely indicate where these maxima will occur. The comparisons were, therefore, limited to the maximum predicted values of each parameter over the proposed longwalls.

The overall void widths of the proposed longwalls and the widths of the chain pillars vary across the proposed mining area. The proposed Longwalls 20 to 44 have void widths of either 163 metres or 133 metres and the proposed widths of the solid chain pillars between the longwalls are either 40 metres or 70 metres. One exception is the proposed chain pillar between Longwalls 21 and 22 which is 55 metres wide.

The maximum predicted subsidence obtained using the Holla Series Method is determined from Figure 4 of a published paper which has been reproduced in Fig. 3.17. This figure provides the maximum predicted subsidence, as a ratio of the extracted seam thickness, for varying panel width-to-depth ratios and varying pillar width-to-depth ratios, based on critical extraction conditions. It should be noted that the maximum predicted total subsidence obtained using the Holla Series Method is based on achieving critical extraction conditions.

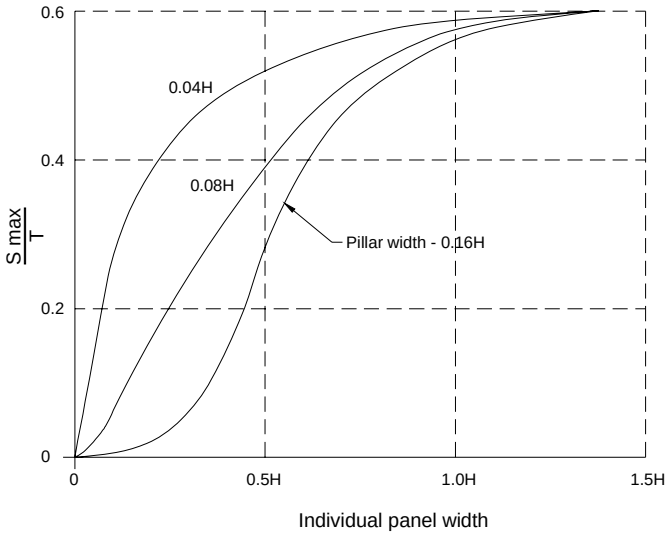


Fig. 3.17 Graph for the Prediction of Maximum Subsidence over a Series of Panels for Critical Extraction Conditions (after Holla, 1988)

The maximum predicted systematic tilts and strains can be predicted using the Department's Handbook Method and are obtained by multiplying various factors by the maximum predicted subsidence in millimetres and dividing the result by the depth of cover in metres. The factors for tensile strain, compressive strain and tilt are given in Figures 14, 15 and 17, respectively, of the handbook. The curvatures are determined from the strains using Figure 18 of the handbook.

In the Department's Handbook Method, the tilt and strain factors are only applicable to single panels, but, based upon the definition of width, W, in the new handbook, it appears that the factors can be used to determine the tilts and strains over a series of longwall panels, using the overall width of the series to determine the width-to-depth ratio.

The maximum predicted values of subsidence, tilt, curvature and strain obtained using the Incremental Profile Method are compared to those obtained using the Holla Series and Department's Handbook Methods in Table 3.1.

Table 3.1 Comparison of Maximum Predicted Parameters Obtained using Alternative Methods

Predicted Parameter	Incremental Profile Method Results		Holla Series and the Departments Handbook Methods	
	Prediction Line 1 (wide panels)	Prediction Line 1 (narrow panels)	Prediction Line 1 (wide panels)	Prediction Line 1 (narrow panels)
Vertical Subsidence (mm)	1170	400	900	269
Tilt (mm/m)	4.9	3.7	6.1	1.6
Hogging Curvature (1/km)	0.087	0.040	0.070	0.031
Sagging Curvature (1/km)	0.107	0.060	0.139	0.047
Tensile Strain (mm/m)	1.3	1.0	0.8	0.2
Compressive Strain (mm/m)	1.6	0.9	1.8	0.5

It can be seen from Table 3.1, that the maximum predicted systematic subsidence values obtained using the Incremental Profile Method are greater than those obtained using the Holla Series and Department's Handbook Methods. It can also be seen that the maximum predicted systematic tilt and systematic tensile and compressive strain obtained using the Incremental Profile Method are generally similar to those obtained using the Department's methods for the wide panels below Prediction Line 1. The maximum predicted systematic compressive strain obtained using the Incremental Profile Method is slightly lower than that obtained using the Department's methods for Prediction Line 1 for the wide panels. The maximum predicted systematic subsidence, tilt and strain obtained using the Incremental Profile Method are generally greater than those obtained using the Holla Series and Department's Handbook Methods.

3.8. Testing of the Incremental Profile Method against Monitoring Data at the Colliery

Subsidence has been measured along the main D monitoring line at the colliery. Other monitoring lines have been established along the Waratah Rivulet mainly for the purpose of observing upsidence movements at rock bars. The existing observed data along the D Line was used to calibrate the Incremental Profile Method. The calibration of the Incremental Profile is outlined in detail in Section 3.5, which includes comparisons of the calibrated model with observed D Line data. Previous predictions of subsidence at Metropolitan Colliery were carried out by SCT.

3.9. Testing of the Incremental Profile Method against Appin and Tower Colliery Surveys

Using the Incremental Profile Method, subsidence predictions were made along Survey Line A, which crosses transversely over the previously mined Longwalls 21B to 28 at Appin Colliery. The measured and predicted incremental and total subsidence profiles along Line A are plotted in Fig. 3.18. It can be seen that a good correlation between the final predicted and final measured subsidence profiles was achieved.

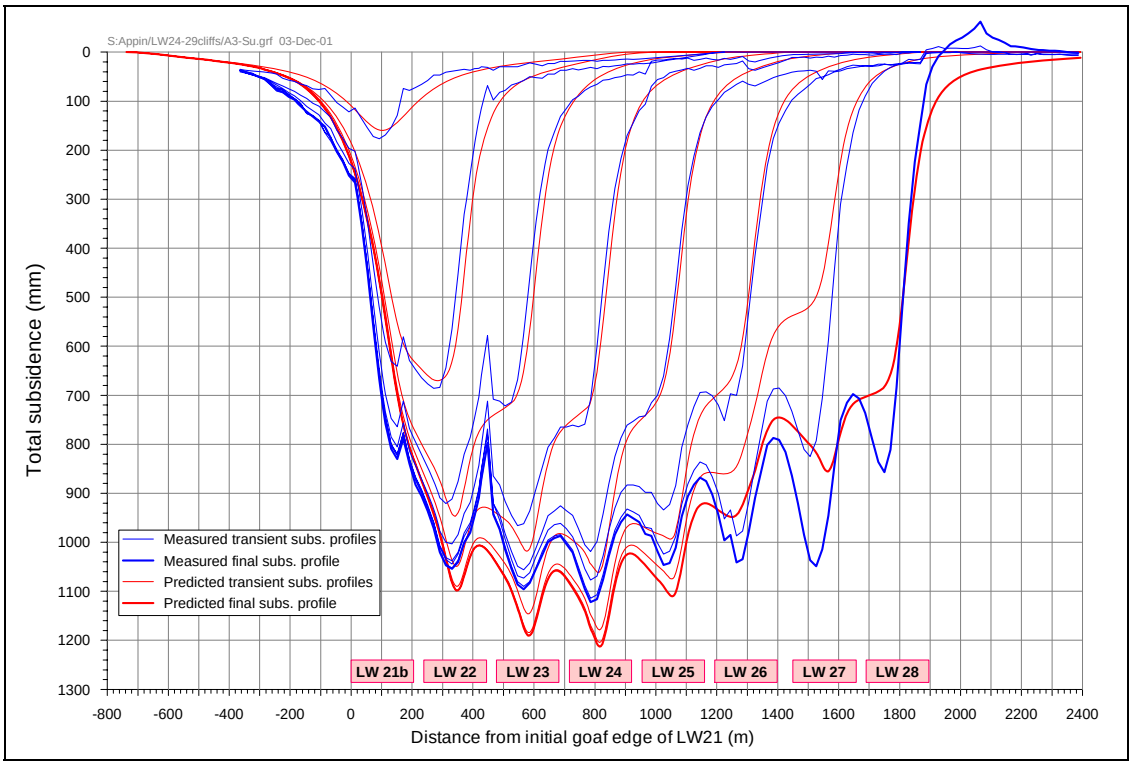


Fig. 3.18 Appin Colliery – A Line – Measured & Predicted Profiles

It is noticeable that the measured incremental subsidence over Longwall 28 was much greater than over previous longwalls in the series and higher than predicted. This increase in subsidence is apparently due to the presence of significant faulting in the strata above this longwall. The upsidence in the final subsidence profile over the advancing edge of Longwall 28 is due to the presence of a local creek, which runs alongside the survey line, at right angles to the longwall centreline.

Subsidence predictions were also made along the line of the Cataract Tunnel, which crosses diagonally over Longwalls 401 to 408 at Appin Colliery and the predicted and observed results are plotted in Fig. 3.19

Subsidence predictions were also made along the irregular TG Line at Tower Colliery. The measured and predicted subsidence profiles after mining Longwall 16 at Tower Colliery are plotted in Fig. 3.20. In both cases, the predicted and observed subsidence and tilt profiles were in reasonably close agreement, though the predicted and observed curvatures showed greater divergence due to scatter in the measured data, which was caused by buckling of near-surface strata.

It can be seen that the Incremental Profile Method compares reasonably well with observed subsidence profiles at Appin and Tower Collieries, and it is anticipated that it would also provide reasonable results for the proposed longwalls.

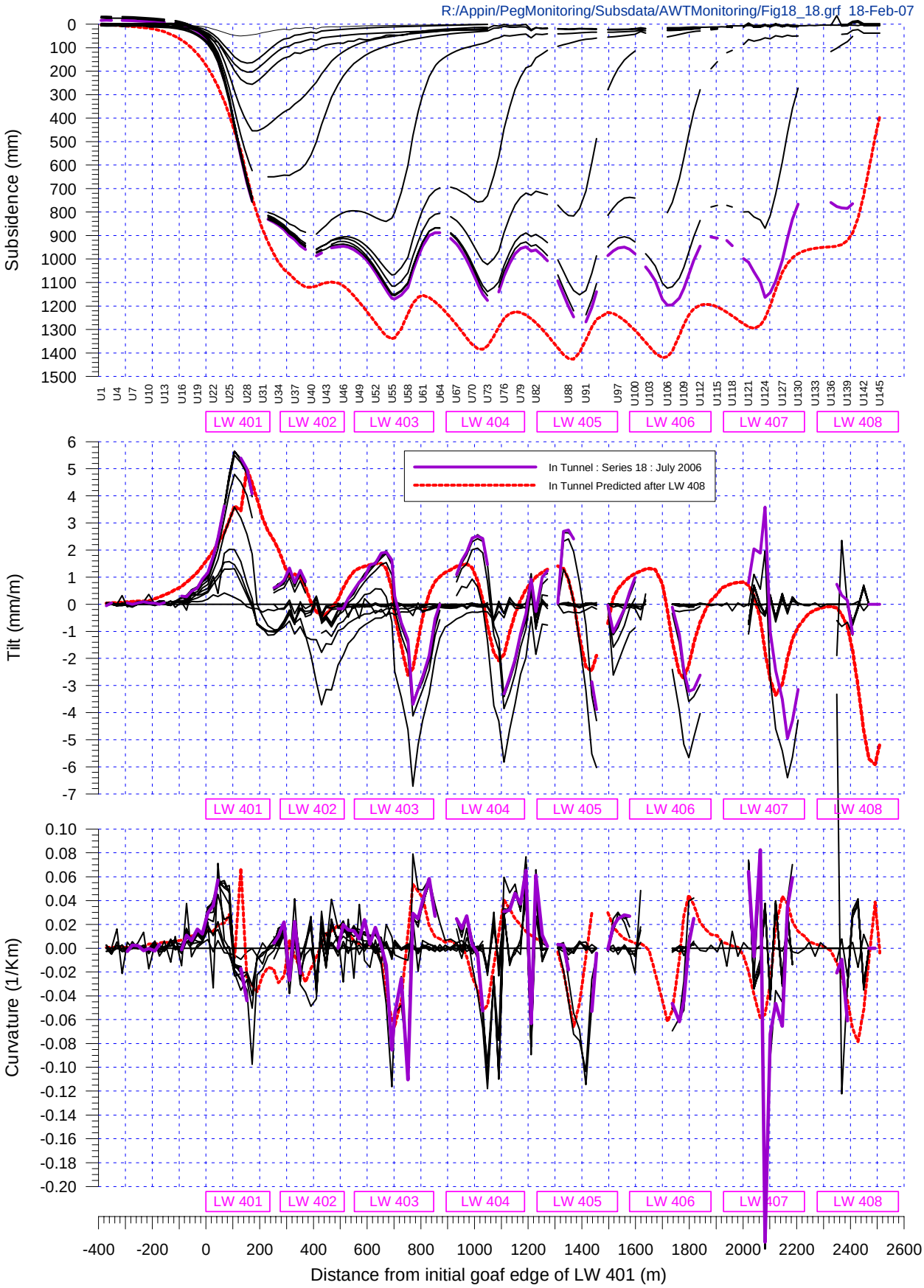


Fig. 3.19 Appin Colliery – Cataract Tunnel – Predicted & Observed Profiles

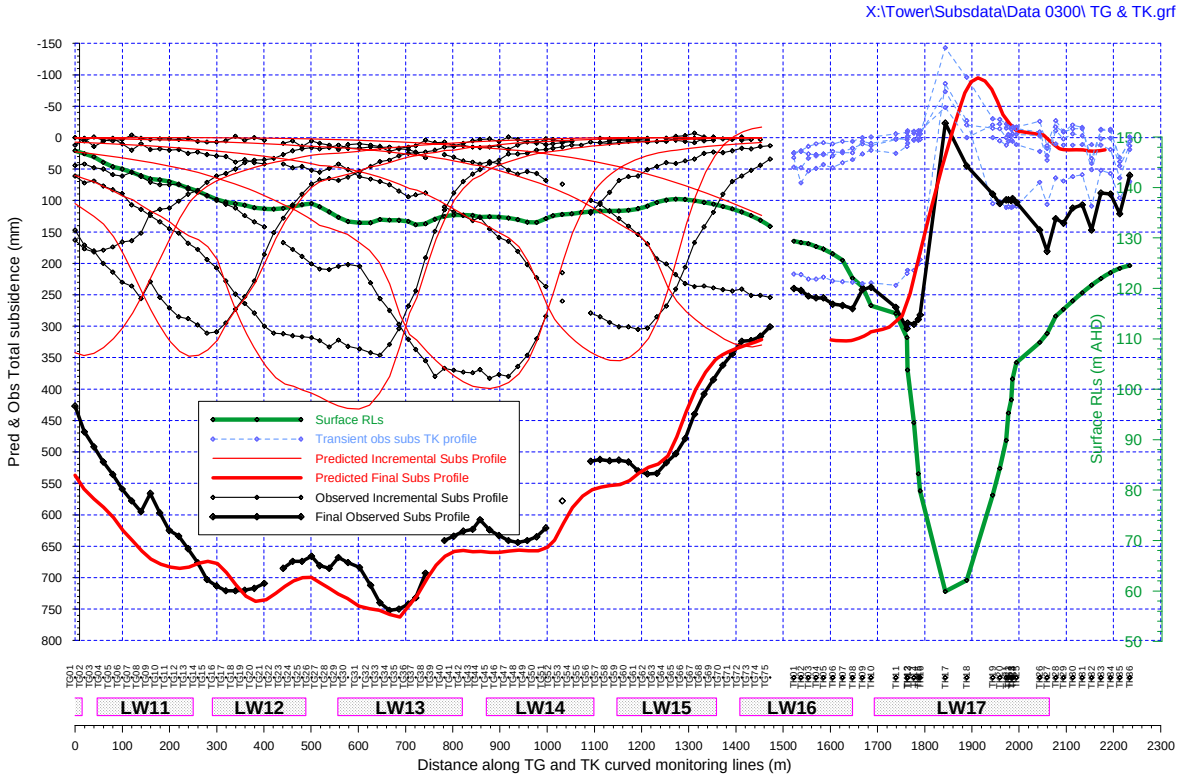


Fig. 3.20 Tower Colliery TG Curved Line – Predicted & Observed Profiles

3.10. Estimation of the Reliability of the Subsidence Predictions

The Incremental Profile Method is based upon a large database of observed subsidence movements in the Southern Coalfield and has been found to give good, if rather conservative results in most cases.

As indicated in Sections 3.7 to 3.9, the predicted subsidence movements obtained using the Incremental Profile Method for the previous longwalls at the Colliery, and for the nearby longwalls at Appin and Tower Collieries, have shown a reasonable correlation with the measured movements over those longwalls. It should also be noted, as discussed in Section 3.7, that the maximum predicted subsidence parameters obtained using the Incremental Profile Method are generally greater than those obtained using the Holla Series and Department's Handbook Methods.

The Incremental Profile Method should, therefore, provide realistic, and possibly conservative predictions of subsidence, tilt, curvature and strain over the proposed longwalls. The predicted profiles obtained using this method also reflect the way in which each parameter varies over the mined area and indicate the movements that are likely to occur at any point on the surface.

It is possible, however, that the predicted systematic tilts, curvatures and strains could be exceeded at the creek alignments, as described in Section 1.7 of the online document "General Discussion of Mine Subsidence Ground Movements". The predicted net vertical movements, due to the addition of subsidence plus upsidence, and the compressive strains due to valley closure movements along the alignments of the streams are provided and discussed in Section 5.2.

It is possible that localised irregularities could occur elsewhere in the subsidence profiles, and the likelihood of these is discussed in Section 5.30 and in Section 1.7 of the online document "General Discussion of Mine Subsidence Ground Movements". Elsewhere, it is reasonable to assume that any significant irregularities or anomalies in the subsidence profiles would be relatively infrequent occurrences.

Empirical methods of subsidence prediction are generally accepted as providing predictions of maximum subsidence to an accuracy of ±10 % to ±15 %. It was indicated by Dr Lax Holla (1991), in his paper entitled, "Reliability of Subsidence Prediction Methods for use in Mining Decisions in New South Wales", that the accuracy of predictions of maximum subsidence, made using the Department's Empirical Method, generally ranged from +8 % to -11 %. Of the 14 examples, referred to in the paper, from longwalls at seven different collieries in the Southern and Newcastle Coalfields, the predicted maximum subsidence was less than the measured maximum subsidence in only four cases. Where empirical models have been calibrated to local data, even greater accuracies have been found to be possible in predicting the maximum values of the subsidence parameters.

The prediction of systematic subsidence parameters at a specific point is more difficult, but, based upon a large number of comparative analyses, it has been concluded that the vertical subsidence predictions for single seam extractions, obtained using the Incremental Profile Method, should generally be conservative where the geology is consistent and the model has been calibrated to local data. Where subsidence is predicted at points beyond the goaf edge, which are likely to experience low values of subsidence, the predictions should generally be accurate to within 50 mm of subsidence.

In this case, the model has been calibrated to local data and, therefore, there is greater confidence in the subsidence predictions made using the Incremental Profile Method.

The systematic tilts can be predicted to the same level of accuracy as subsidence, but the measured curvatures and strains can vary considerably from the predicted systematic values for the following reasons:-

- Variations in local geology can affect the way in which the near surface rocks are displaced as subsidence occurs. In the compression zone, the surface strata can buckle upwards or can fail by shearing and sliding over their neighbours. If localised cross bedding exists, this shearing can occur at relatively low values of stress. This can result in fluctuations in the local strains, which can range from tensile to compressive. In the tensile zone, existing joints can be opened up and new fractures can be formed at random, leading to localised concentrations of tensile strain.
- Where a thick surface layer of soil, clay or rock exists, the underlying movements in the bedrock are often transferred to the surface at reduced levels and the measured strains are, therefore, more evenly distributed and hence more systematic in nature than they would be if they were measured at rockhead.
- Strain measurements can sometimes give a false impression of the state of stress in the ground. For example:
    - buckling of the near-surface strata can result in localised cracking and apparent tensile strain in areas where overall, the ground is in fact being compressed, because the actual values of the measured strains are dependent on the locations of the survey pegs.
    - where joints open up or cracks develop in the tensile phase and fail to close in the compressive phase, as they sometimes do if they are subsequently filled, the ground can appear to be in tension when it is actually in compression.
- Sometimes, survey errors can also affect the measured strain values and these can result from movement in the benchmarks, inaccurate instrument readings, or disturbed survey pegs. In these circumstances it is not surprising that the predicted systematic strain at a point does not match the measured strain.
- In sandstone dominated environments, much of the earlier ground movements can be concentrated at the existing natural joints, which have been found to be at an average spacing of 7 to 15 metres.

It is also recognised that the ground movements above a longwall panel can be affected by the gradient of the coal seam, the direction of mining and the presence of faults and dykes within the panel, which can cause a lateral shift in the subsidence profile. The assessments at isolated features have, therefore, been based upon the highest values of subsidence, tilt, curvature and strain within a radius of 20 metres of each feature, rather than the values at the point.

A comparative analysis along the line of the Cataract Tunnel over Longwalls 401 to 403 at Appin Colliery revealed that the predicted strains at points along the surface over a length of 1.1 kilometres were exceeded in only eight locations. At six of these locations, the measured strain in a particular bay was immediately preceded or followed by a strain of equal amplitude, but of opposite sign, in the adjoining bay.

The two highest values of measured strain were 1.9 mm/m, tensile, and 2.1 mm/m, compressive, and all other strains were within the range 1.2 mm/m, tensile, to 1.4 mm/m, compressive. In five out of the eight locations, the measured strains exceeded the maximum predicted values. In many locations, the measured strains at particular points were less than predicted.

The prediction of strain at a point must be considered within an appropriate confidence interval, but the Incremental Profile Method approach does allow a more realistic assessment of the subsidence impacts to be made. An assessment based upon applying the maximum predicted strains at every point would be overly conservative and would yield an excessively overstated assessment of the potential subsidence impacts.

3.11. Estimation of the Reliability of Upsidence and Closure Predictions

It should be noted that the development of the predictive methods for upsidence and closure are the result of recent research and the methods do not, at this stage, have the same confidence level as systematic subsidence prediction techniques. As further case histories are studied, the method will be improved, but it can be used in the meantime, so long as suitable factors of safety are applied. This is particularly important where the predicted levels of movement are small, and the potential errors, expressed as percentages, can be higher.

Whilst the major factors that determine the levels of movement have been identified, there are some factors that are difficult to isolate. One factor that is thought to influence the upsidence and closure movements is the level of in-situ horizontal stress that exists within the strata.

In-situ stresses are difficult to obtain and not regularly measured and the limited availability of data makes it difficult to be definitive about the influence of the in-situ stress on the upsidence and closure values. The methods are, however, based predominantly upon the measured data from Tower Colliery, where the in-situ stresses are high. The methods will, therefore, tend to over-predict the movements in areas of lower stress.

It should be noted, that the method used to predict upsidence and closure was not adjusted for local changes in the geology within the stream beds. The database for upsidence and closure is mainly based on creeks and rivers which predominantly have sandstone beds. It has been observed where creeks or rivers are founded on thinly bedded shales, the observed closure is higher and the observed upsidence is smaller than what would be predicted using the upsidence and closure model. However, the streams within the Study Area predominantly have sandstone beds and are, therefore, expected to behave in a similar way to those within the database.

A review has been undertaken of all the available observed upsidence and closure movements at locations within the Georges River, Cataract River, Nepean River and the Bargo River against the predictions using the revised upsidence and closure prediction curves. Fig. 3.21 to Fig. 3.24 show the raw observed data and adjusted upsidence and closure data for these rivers.

It can be noted that the adjusted data predominantly falls below both the old and the revised prediction curves except for some data, where the observed movements were less than 5 mm, which are less than survey tolerances. Accordingly, it is believed that the prediction curves provide conservative upper bound results.

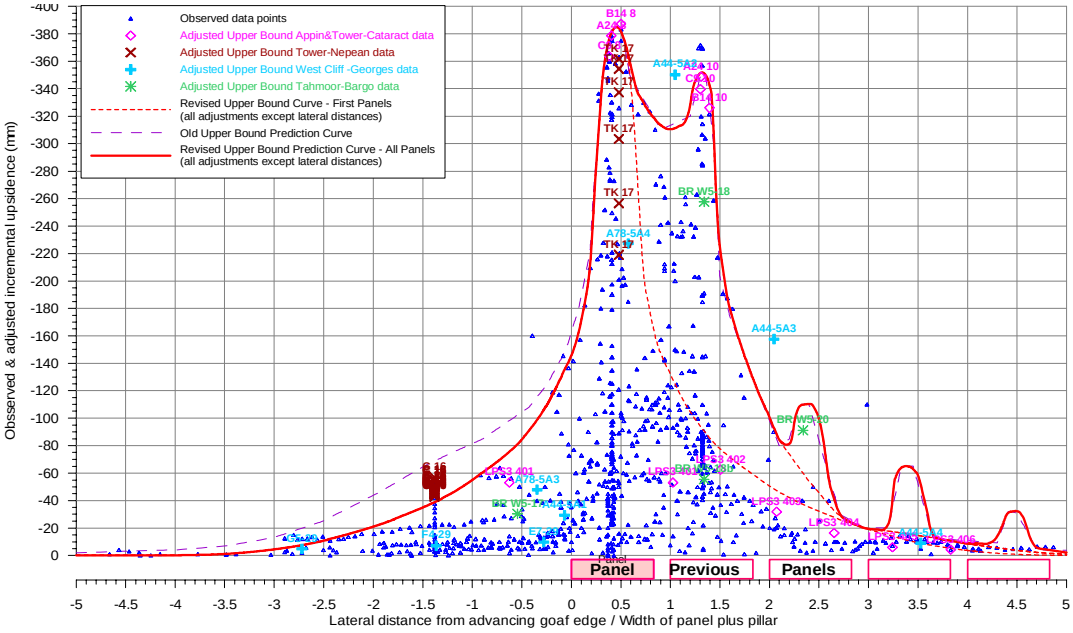


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Fig. 3.21 Comparison of Observed and Predicted Upsidence Data versus Lateral Distance

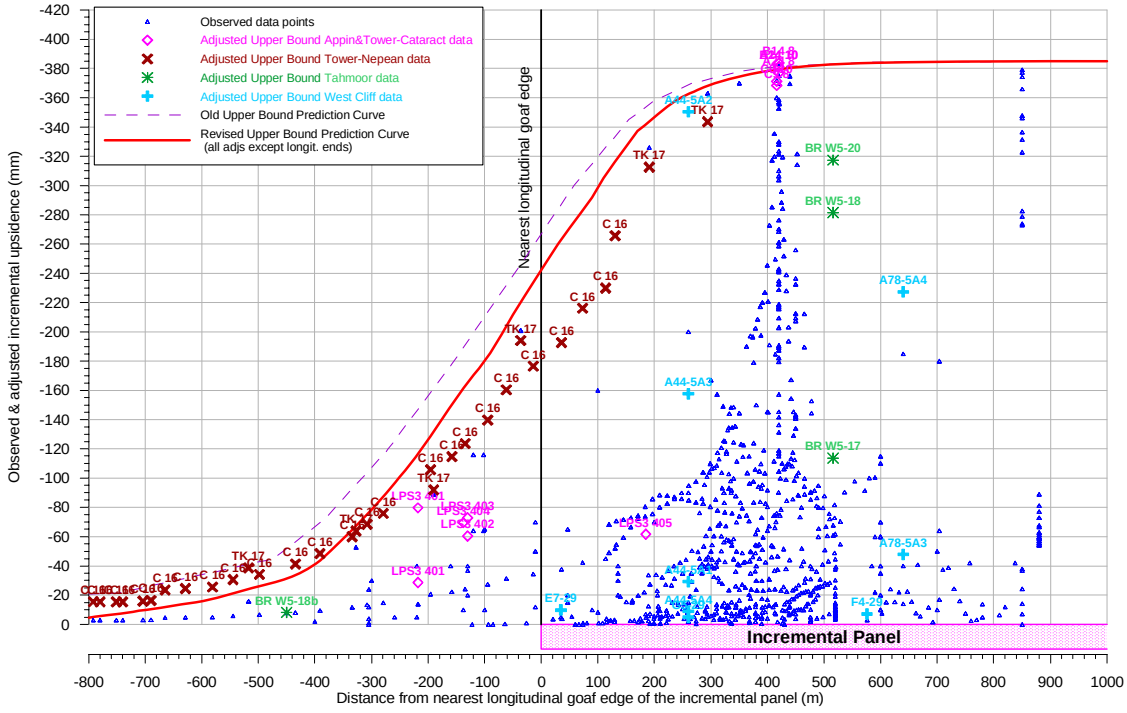

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Fig. 3.22 Comparison of Observed and Predicted Upsidence Data versus Longitudinal Distance

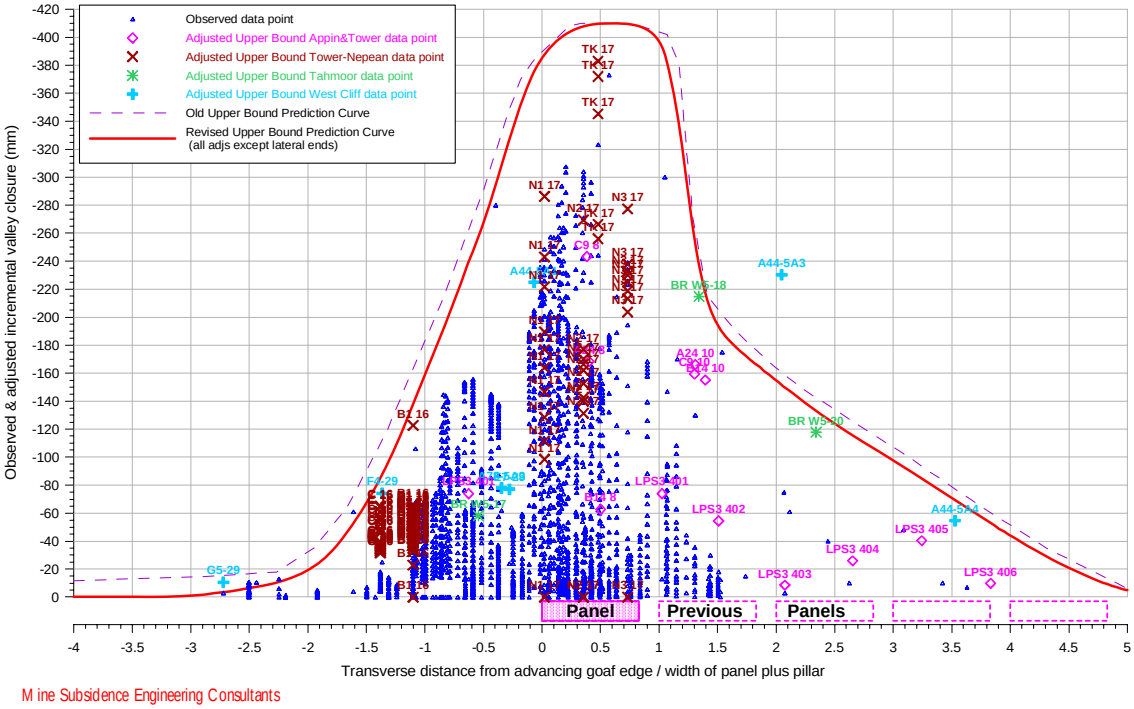

Fig. 3.23 Comparison of Observed and Predicted Closure Data versus Lateral Distance

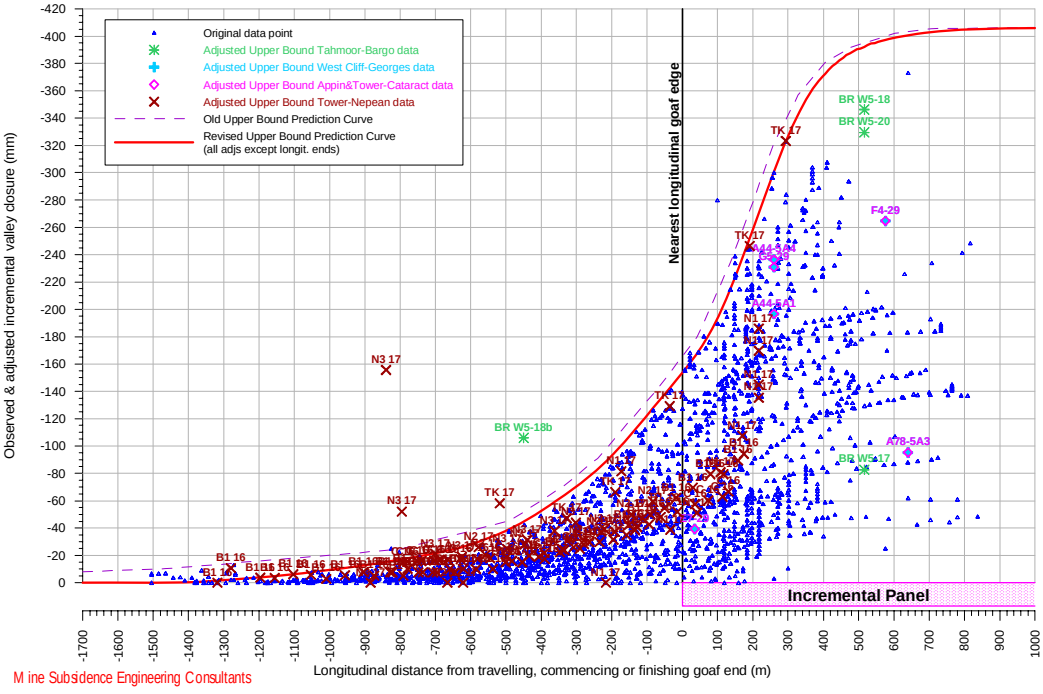

Fig. 3.24 Comparison of Observed and Predicted Closure Data versus Longitudinal Distance

Fig. 3.25 shows a comparison between the observed and the predicted closure movements as Longwall 5A4 at West Cliff Colliery approached a rock bar at Marhnyes Hole. The figure shows that prior to the construction of the 150 mm wide slot, the timing of predicted closure movements compared well with the observed movements. After the construction of the 150 mm wide slot, which permitted additional movements to occur, the observed closure movements were approximately 80 to 90 mm greater than the predicted closure movements.

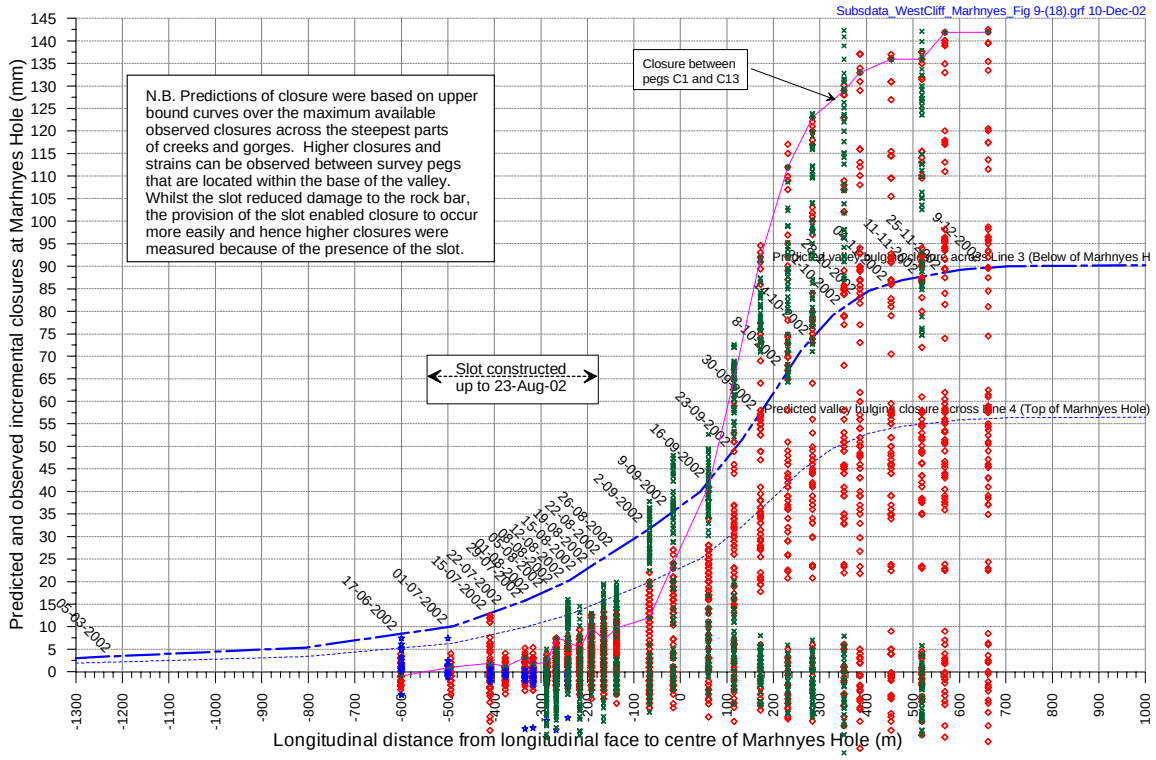

Fig. 3.25 Comparison of Observed and Predicted Closure Data versus Longitudinal Distance at Marhnyes Hole

The reliability of upsidence and closure predictions in creeks located on plateau areas above the base of river valleys has been tested primarily at Appin Colliery Area 4 and at West Cliff Colliery Area 5, as longwalls approached and passed beneath gas and water pipelines. Fig. 3.26 shows a comparison between the observed and the predicted closure movements across Unnamed Creek (Creek 1) along the pipeline easement, due to the extraction of Longwall 29 at West Cliff Colliery. It can be seen from this figure that there was a good correlation both in magnitude and timing between observed and predicted movements as the longwall approached and passed beneath the pipelines, where the predictions were generally conservative.

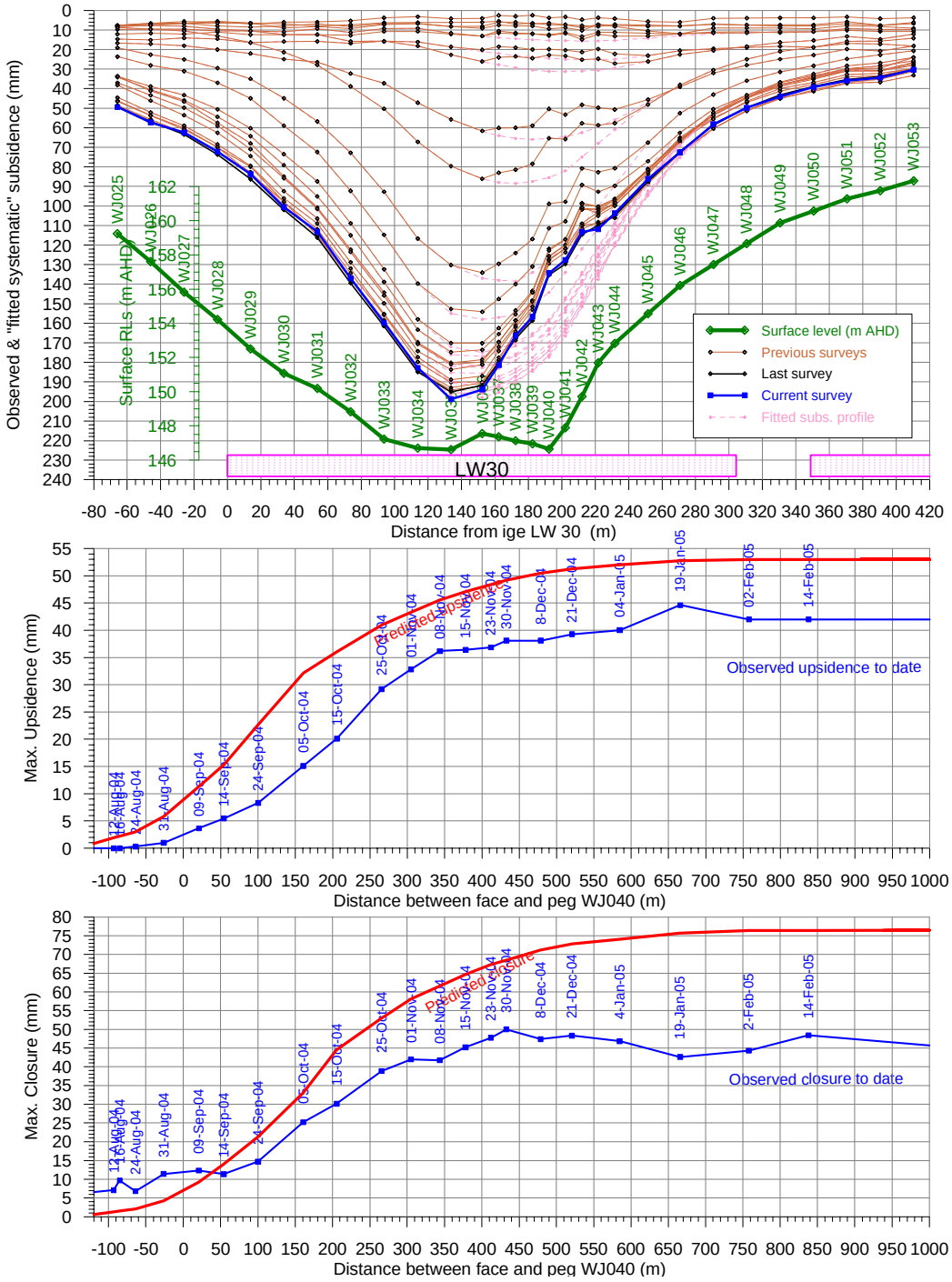

Fig. 3.26 Comparison of Observed and Predicted Closure Data versus Longitudinal Distances at Unnamed Creek (Creek 1)

Fig. 3.27 and Fig. 3.28 show a comparison between the observed and the predicted upsidence and closure movements along the gas pipeline monitoring line and across Rocky Ponds Creek, Creek 2A and Simpsons Creek due to the extraction of Longwalls 403 to 407 at Appin Colliery.

It can be seen from Fig. 3.27 that there is a reasonable correlation in the magnitude and timing between observed and predicted upsidence movements. However, the comparison shows that upsidence predictions can be conservative, by up to 50%. The comparison also indicates that, in some cases such as Simpsons Creek, the upsidence movements may not develop as predicted, and that the majority of the movement only develops after mining has occurred directly beneath the creek.

It can be seen from Fig. 3.27 and 3.28 that there is a reasonable correlation in magnitude and timing between observed and predicted valley closure and systematic movements, with the exception of Rocky Ponds Creek, following the extraction of Longwall 405. Limited site investigations indicate that the rock bed strata at the base of this creek consisted of thinly bedded shale layers.

Similar comparisons of predicted and observed upsidence and closure for the monitoring lines along the Waratah Rivulet are presented in Figs. C.16 to C.25.

The comparisons between observed and predicted movements suggest that there is generally a reasonable correlation between observed and predicted closure and upsidence movements. In most cases, the predictions have been found to be conservative, which is understandable given the adoption of an upper bound predictive model. However, there has been at least one instance where the movements were under-predicted. It is therefore recommended that appropriate measures are put in place during the development of preventive and mitigatory measures, in order to protect sensitive surface infrastructure. These measures should include consideration of potential impacts based on increased predictions, as well as monitoring, identification and response to potential cases in which observed movements might exceed predicted movements.

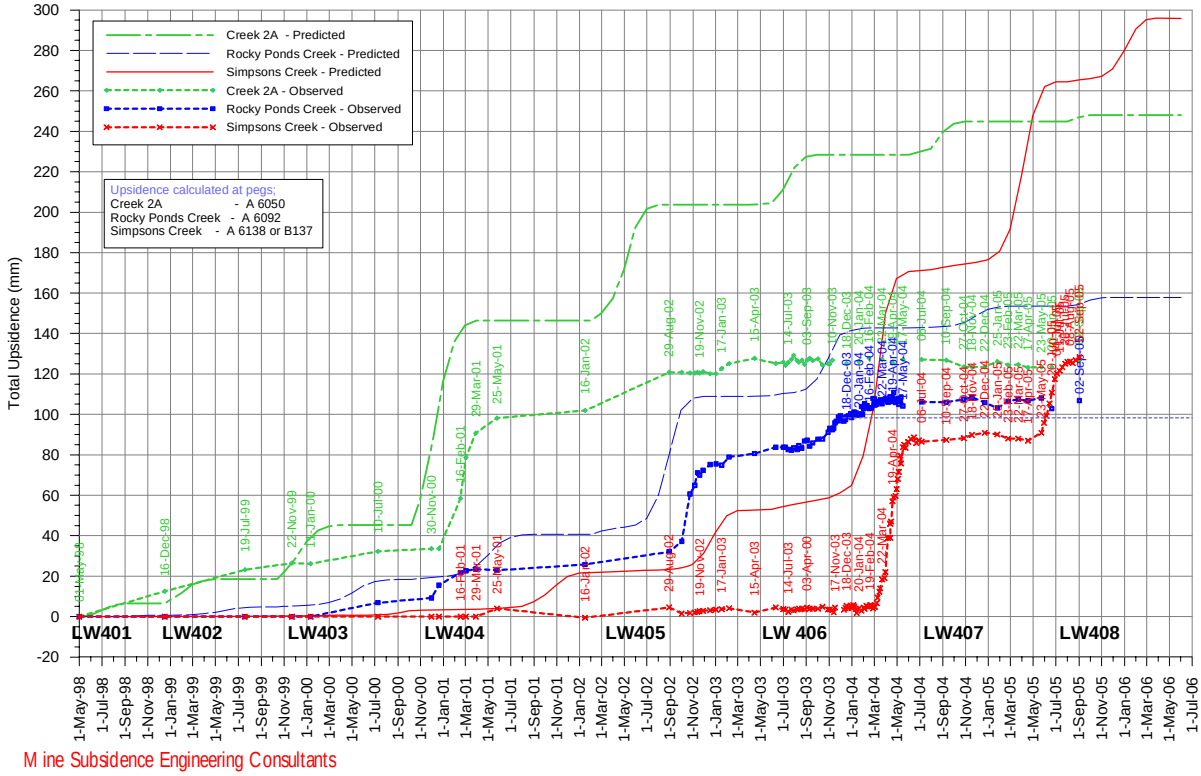

Fig. 3.27 Comparison of Observed and Predicted Upsidence Profiles over Longwalls 403 to 407 at Appin Colliery

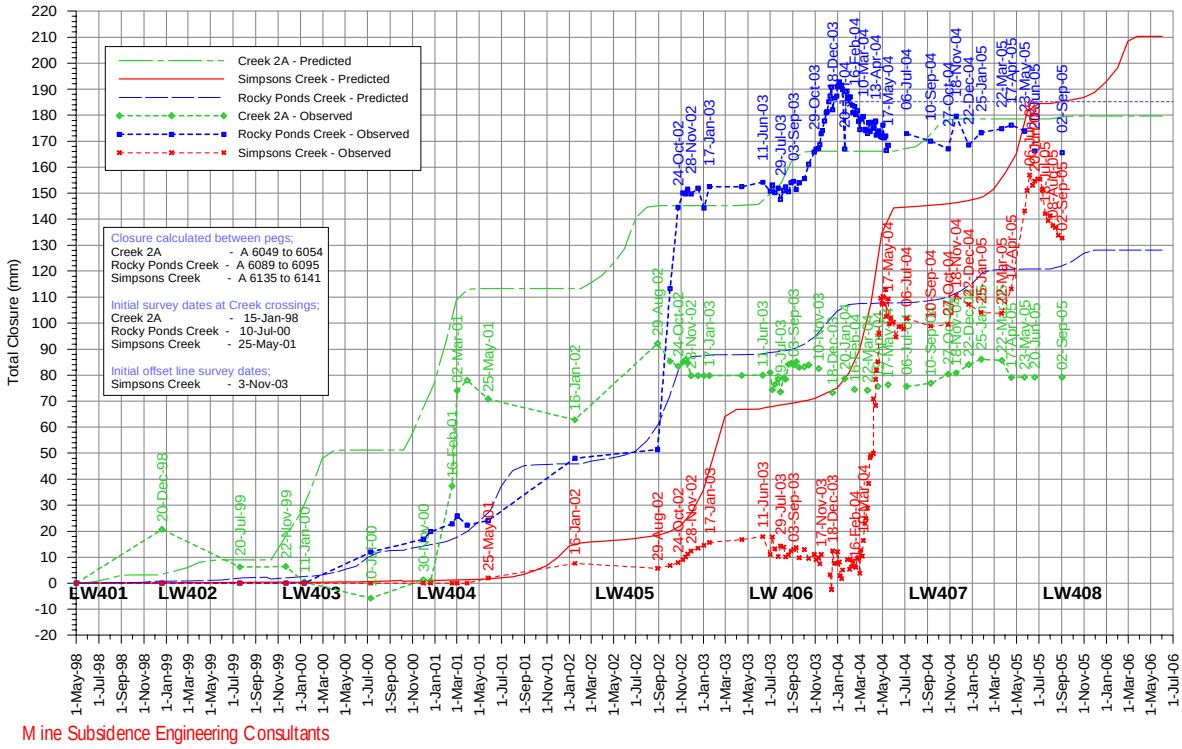

Fig. 3.28 Comparison of Observed and Predicted Closure Profiles over Longwalls 403 to 407 at Appin Colliery

CHAPTER 4. MAXIMUM PREDICTED SYSTEMATIC SUBSIDENCE PARAMETERS FOR THE PROPOSED LONGWALLS

4.1. Introduction

The following sections in this Chapter provide the maximum predicted systematic subsidence parameters resulting from the proposed extraction of Longwalls 20 to 44 at Metropolitan Colliery, using the calibrated Incremental Profile Method, which was described in Chapter 3. The predicted subsidence parameters and the impact assessments for each of the natural features and items of surface infrastructure that have been identified within the Study Area, and detailed in Chapter 2, are provided in Chapter 5.

4.2. Maximum Predicted Systematic Subsidence Parameters for the Proposed Longwalls

The predicted subsidence parameters, which are detailed in this Chapter and in Chapter 5, are referred to as systematic ground movements and do not include the valley related upsidence and closure movements, or the effects of faults and other geological structures, or other non-systematic ground movements, which are discussed in Section 3.6. Such effects have been addressed separately in Chapter 5.

The predicted systematic subsidence parameters are presented as:

- Incremental Subsidence Parameters, which are the predicted subsidence parameters due to the extraction of a single Longwall;
- Cumulative Subsidence Parameters, which include the predicted subsidence parameters resulting from the proposed extraction of Longwalls 20 to 44 only; and
- Total Subsidence Parameters, which include the predicted subsidence parameters resulting from the extraction of Longwalls 20 to 44 and will include the predicted total subsidence parameters from previously extracted longwalls, including Longwalls 1 to 19A.

The total subsidence parameters allow for the influence of previous longwalls, and include the predicted total subsidence resulting from previous longwalls. The predicted incremental and cumulative subsidence parameters allow for the influence of the previously extracted longwalls, but do not include the predicted subsidence resulting from the previously extracted longwalls.

Typical examples of the predicted shapes of the systematic subsidence profiles have been prepared along a prediction line called Prediction Line 1, the location of which is shown in Drawing No. MSEC285-16, which can be found in Appendix E. The predicted incremental and total systematic subsidence, tilt and strain profiles along Prediction Line 1 is shown in Fig. C.01 which can be found in Appendix C.

A summary of the maximum predicted incremental systematic subsidence parameters, i.e. subsidence, tilt and tensile and compressive strain ground movements, within the Study Area, due to the extraction of each of the proposed longwalls, is provided in Table 4.1.

Table 4.1 Maximum Predicted Incremental Systematic Subsidence Parameters due to the Extraction of Longwalls 20 to 44

Longwall	Maximum Predicted Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt (mm/m)	Maximum Predicted Incremental Tensile Strain (mm/m)	Maximum Predicted Incremental Compressive Strain (mm/m)
Due to LW20	200	2.5	0.6	1.1
Due to LW21	830	7.4	1.9	1.8
Due to LW22	575	5.1	1.0	1.3
Due to LW23	765	6.8	1.3	1.9
Due to LW24	715	5.9	1.1	1.9
Due to LW25	690	5.7	1.1	1.6
Due to LW26	705	6.3	1.3	1.9
Due to LW27	700	6.5	1.3	2.0
Due to LW28	625	3.9	0.7	1.5
Due to LW29	595	3.7	0.7	1.5
Due to LW30	585	3.7	0.7	1.5
Due to LW31	585	3.7	0.7	1.4
Due to LW32	585	3.7	0.7	1.5
Due to LW33	600	3.8	0.7	1.5
Due to LW34	670	3.8	0.7	1.5
Due to LW35	670	4.0	0.7	1.4
Due to LW36	600	3.5	0.6	1.3
Due to LW37	575	3.0	0.4	0.5
Due to LW38	605	3.0	0.4	0.9
Due to LW39	665	4.2	0.8	1.6
Due to LW40	670	4.2	0.8	1.7
Due to LW41	680	4.3	0.8	1.7
Due to LW42	685	4.2	0.7	1.6
Due to LW43	695	4.4	0.7	1.6
Due to LW44	700	4.9	0.8	1.6

The greatest maximum incremental subsidence of 830 mm has been predicted for Longwall 21, and the smallest maximum incremental subsidence of 200 mm has been predicted for Longwall 20.

The maximum predicted incremental subsidence of 830 mm for Longwall 21 represents 24 % of the proposed extracted seam thickness at this location (3.40 metres). The depth of cover at this location near Tributary A is 420 metres. The panel width to depth ratio at this location is therefore 163/420, i.e. 0.39, and the pillar width to depth ratio is 40/420, i.e. 0.095. These predictions all compare well against the available monitoring data over Longwalls 1 to 15.

The maximum predicted incremental subsidence movements for Longwall 20 are much less than those for the longwalls that are currently being extracted at Metropolitan Colliery because Longwall 20 would be the first longwall in a new series of longwalls and there is a large barrier of 285 metres of unmined coal between Longwall 20 and the nearest previously mined goaf edge. Longwall 20 is therefore the only longwall that would not be preceded directly by an adjacent panel.

As can be seen from the typical example at Appin Colliery in Fig. 4.1, less subsidence is observed over the first panel in a new series than over the subsequent longwall panels. In this figure it can be seen that the observed subsidence over the first panels, i.e. LW14 and LW21B, were less than 200 mm, whilst the incremental subsidence, i.e. the blue dashed line, over the following panels averaged around 600 mm. This figure also provides an illustration of the effects of upsidence, in valley floors, and minor faulting on typical observed subsidence profiles.

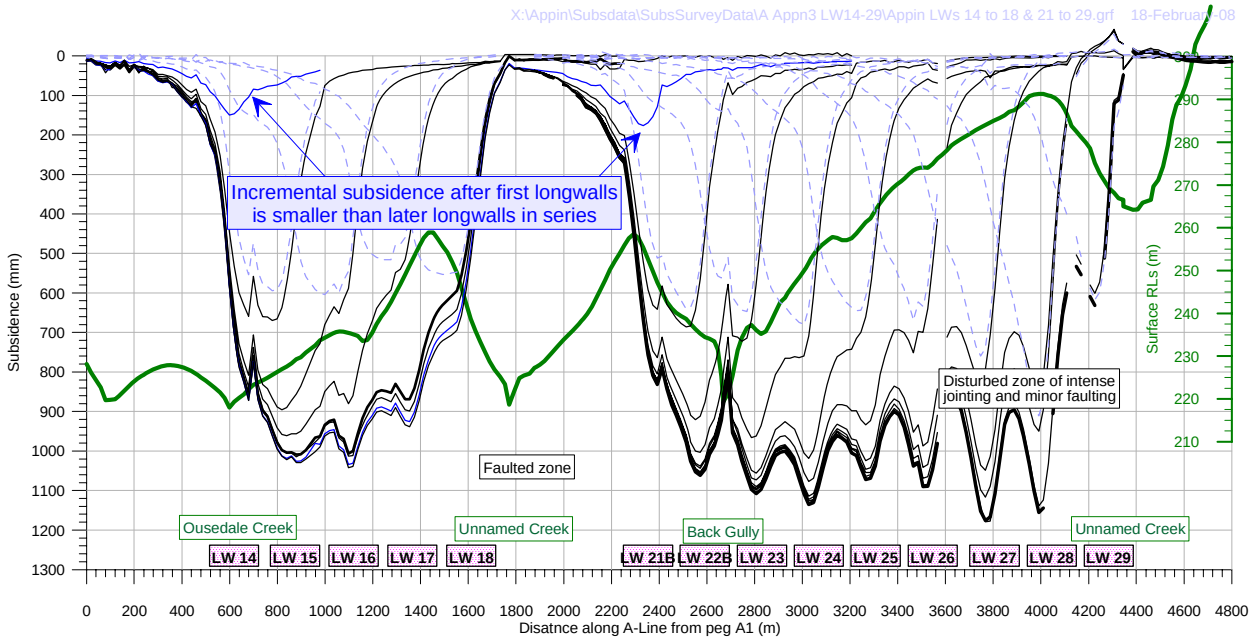

Fig. 4.1 Observed Incremental & Total Subsidence over Two Series of Longwalls separated by a Wide Chain Pillar

Whilst the magnitude of the observed incremental subsidence over the first panel in a series of panels is much smaller than the other longwalls, greater variation in this magnitude is observed because this observed subsidence is dependent on the exact geomechanical properties of the various overburden strata units and their ability to span over the goaf (e.g. the positioning of the natural joints with respect to the panel edges, the presence of strong strata beams or jointing, which can all affect the actual subsidence). Therefore, the level of confidence in the accuracy of the prediction of subsidence parameters for Longwall 20 is not as high as the level of confidence in predicting subsidence parameters for subsequent longwalls in the series, not only because of the difficulty in predicting the subsidence of a single panel, but also because of the uncertainty with respect to the influence of the multiple pillars between Longwall 20 and the previously extracted longwalls. Further discussions on predicting subsidence over a series of longwalls can be found in Chapter 3.

A summary of the maximum predicted cumulative systematic subsidence parameters within the Study Area, resulting from the extraction of the proposed Longwalls 20 to 44, is provided in Table 4.2. The values provided in this table include the influence of previously extracted longwalls in this series on the predicted ground movements but do not include the subsidence resulting from the previously extracted longwalls at the Colliery. The predicted cumulative systematic subsidence contours, after the extraction of the proposed Longwalls 30 and 44, are shown in Drawings Nos. MSEC285-18 and MSEC285-19 in Appendix E.

Table 4.2 Maximum Predicted Cumulative Systematic Subsidence Parameters within the Study Area Resulting from the Extraction of Longwalls 20 to 44 Only

Longwall	Maximum Predicted Cumulative Subsidence (mm)	Maximum Predicted Cumulative Tilt (mm/m)	Maximum Predicted Cumulative Tensile Strain (mm/m)	Maximum Predicted Cumulative Compressive Strain (mm/m)
Due to LW20	200	2.5	0.6	1.1
Due to LW20 to LW21	845	7.4	1.6	1.8
Due to LW20 to LW22	1045	5.4	1.7	1.7
Due to LW20 to LW23	1155	7.1	1.7	1.8
Due to LW20 to LW24	1180	6.4	1.7	1.9
Due to LW20 to LW25	1245	6.1	1.7	1.7
Due to LW20 to LW26	1280	6.6	1.7	1.8
Due to LW20 to LW27	1280	6.8	1.7	1.9
Due to LW20 to LW28	1280	6.6	1.7	1.7
Due to LW20 to LW29	1280	6.6	1.7	1.6
Due to LW20 to LW44	1280	6.6	1.7	1.6

The maximum predicted cumulative subsidence parameters are unchanged due to mining Longwall 29 through to Longwall 44 and these identical results have been excluded from this table.

The maximum predicted cumulative systematic subsidence over Longwalls 20 to 44 is 1280 mm, at a point over Longwall 23 where the depth of cover is 440 metres and the proposed extracted seam thickness is 3.1 metres. This predicted cumulative subsidence of 1280 mm represents 41% of the extracted seam thickness.

The maximum predicted cumulative systematic tilt over Longwalls 20 to 44 of 7.4 mm/m (ie: 0.7 %), or a change in grade of 1 in 135, occurs near the centre of Longwall 21.

The maximum predicted cumulative systematic tensile strain over Longwalls 20 to 44 of 1.7 mm/m, occurs above Longwall 20. The maximum predicted cumulative systematic compressive strain over Longwalls 20 to 44 of 1.9 mm/m occurs above Longwalls 24 and 27. The minimum radii of curvature associated with the maximum predicted cumulative systematic tensile and compressive strains are 9 kilometres and 8 kilometres, respectively.

A summary of the maximum predicted total systematic subsidence parameters within the Study Area, after the extraction of the proposed Longwall 44, is provided in Table 4.3. The values provided in this table include subsidence resulting from the previously extracted longwalls at the Colliery and the influence of these longwalls on the proposed longwalls and hence the following values for Longwall 20 are slightly higher than the subsidence parameters given in Table 4.2. The predicted total systematic subsidence contours, after the extraction of Longwall 44, are shown in Drawing No. MSEC285-20 in Appendix E.

Table 4.3 Maximum Predicted Total Systematic Subsidence Parameters within the Study Area after the Extraction of Longwall 44 (i.e. including Longwalls 1 to 19A)

Longwall	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt (mm/m)	Maximum Predicted Total Tensile Strain (mm/m)	Maximum Predicted Total Compressive Strain (mm/m)
After LW20	550	7.5	1.5	0.9
After LW21	845	7.5	1.6	1.8
After LW22	1045	7.5	1.6	1.7
After LW23	1155	7.5	1.7	1.8
After LW24	1180	7.5	1.7	1.9
After LW25	1245	7.5	1.7	1.7
After LW26	1280	7.5	1.7	1.8
After LW27	1280	7.5	1.7	1.9
After LW28	1280	7.5	1.7	1.7
After LW29	1280	7.5	1.7	1.6
After LW44	1280	7.5	1.7	1.6

The maximum predicted total subsidence parameters are unchanged due to mining Longwall 29 through to Longwall 44 and these identical results have been excluded from this table. The maximum predicted total systematic subsidence due to Longwalls 1 to 44 and within the Study Area is 1280 mm which occurs above Longwall 23 after the extraction of Longwall 26, which is the same as the maximum predicted cumulative subsidence.

The maximum predicted total systematic tilt due to mining Longwalls 1 to 44, and within the Study Area, is 7.5 mm/m (ie: 0.8 %), or a change in grade of 1 in 135, occurs at the finishing ends of Longwalls 11 to 13 after the extraction of Longwall 19A.

The maximum predicted total systematic tensile strain due to mining Longwalls 1 to 44, and within the Study Area, of 1.7 mm/m occurs over Longwall 20 after the extraction of Longwall 23. The maximum predicted total systematic compressive strain due to mining Longwalls 1 to 44, and within the Study Area, is 1.9 mm/m, which occurs above Longwalls 24 and 27. The minimum radii of curvature associated with the maximum predicted total systematic tensile and compressive strains are 9 kilometres and 8 kilometres, respectively.

As discussed above, these predictions of systematic subsidence parameters do not include the valley related upsidence and closure movements, or the effects of faults and other geological structures. Such effects have been addressed separately in Chapter 5.

A summary of the maximum predicted travelling tilts and strains within the Study Area, during the extraction of each of the proposed longwalls, is provided in Table 4.4.

Table 4.4 Maximum Predicted Travelling Subsidence Parameters during the Extraction of Longwalls 20 to 44

Longwall	Maximum Predicted Travelling Tilt (mm/m)	Maximum Predicted Travelling Tensile Strain (mm/m)	Maximum Predicted Travelling Compressive Strain (mm/m)
During LW20	0.8	0.1	0.1
During LW21	3.3	0.5	0.4
During LW22	2.3	0.4	0.3
During LW23	3.0	0.5	0.4
During LW24	2.8	0.5	0.3
During LW25	2.6	0.4	0.3
During LW26	2.7	0.5	0.3
During LW27	2.8	0.5	0.4
During LW28	2.8	0.5	0.4
During LW29	2.9	0.5	0.4
During LW30	2.9	0.5	0.4
During LW31	2.9	0.5	0.4
During LW32	2.7	0.5	0.3
During LW33	2.6	0.4	0.3
During LW34	2.6	0.4	0.3
During LW35	2.6	0.4	0.3
During LW36	2.6	0.4	0.3
During LW37	2.5	0.4	0.3
During LW38	2.5	0.4	0.3
During LW39	2.4	0.4	0.3
During LW40	2.3	0.4	0.3
During LW41	2.3	0.4	0.3
During LW42	2.3	0.3	0.3
During LW43	2.4	0.3	0.3
During LW44	2.5	0.4	0.3

The directions of these maximum predicted travelling tilts and strains are aligned along the longitudinal axes of the proposed longwalls, with the maximum values occurring along a line passing through the points of maximum subsidence.

CHAPTER 5. PREDICTED SUBSIDENCE PARAMETERS AND IMPACT ASSESSMENTS FOR THE NATURAL FEATURES AND ITEMS OF SURFACE INFRASTRUCTURE WITHIN THE STUDY AREA

5.1. Introduction

This Chapter provides site specific predicted subsidence parameters and impact assessments for each of the natural features and items of surface infrastructure that are located within the Study Area, due to the proposed extraction of Longwalls 20 to 44 at Metropolitan Colliery. Additionally, natural features and items of surface infrastructure that are located outside the Study Area, which may be subjected to far-field movements and may be sensitive to the predicted subsidence parameters, have also been included as part of these assessments. In particular, the following sections of this Chapter address:-

- Waratah Rivulet (Section 5.2);
- Other Tributaries (Section 5.3);
- Woronora Reservoir and Woronora Dam (Section 5.4);
- Heathcote National Park and Garawarra State Conservation Area (Section 5.5)
- Cliffs and Rock Overhangs (Section 5.6);
- Steep Slopes (Section 5.7);
- Upland Swamps (Section 5.8);
- Endangered Ecological Communities (Section 5.9)
- Illawarra Railway (Section 5.10);
- Southern Freeway (Section 5.11);
- Princes Highway (Section 5.12);
- Fire Trails and Four Wheel Drive Tracks (Section 5.13);
- Bridges (Section 5.14);
- Electrical Services (Section 5.15);
- Sydney Water Infrastructure (Section 5.16);
- Optical Fibre Cables (Section 5.17);
- Copper Telecommunications Cables (Section 5.18);
- Garrawarra Complex (Section 5.19);
- Other Structures (Sections 5.20 to 5.23);
- Archaeological Sites (Section 5.24); and
- Survey Control Marks (Section 5.25).

The predicted subsidence parameters for each of the natural features and items of surface infrastructure were determined using the calibrated Incremental Profile Method, which is described in Chapter 3. The Incremental Profile Method is generally conservative (ie: it provides predicted subsidence values that are generally higher than those actually measured after mining). Similarly, the predictions of valley upsidence and closure movements using the ACARP method for predicting upsidence and closure are generally higher than those actually measured after mining.

Accordingly the observed parameters at a specific site are more likely to be less than predicted, particularly when comparing the maximum predicted values with the maximum observed values. However, when comparing site specific predictions, the actual subsidence parameters often vary from those predicted, depending on many factors including differences in local geology, and the exact position of each feature or item within the subsidence trough. Therefore, to provide additional conservatism for these site specific predictions, the maximum predicted values of subsidence, tilt, curvature and strain within 20 metres of the perimeter of each natural feature or item of infrastructure has been determined rather than the value at the centre of the natural feature or item of infrastructure. This methodology has therefore increased the site specific predictions quite significantly, especially where the predicted values are small.

5.2. Waratah Rivulet

The location of the Waratah Rivulet is shown in Drawing No. MSEC285-07. As discussed in Chapter 2, the Waratah Rivulet flows into the Woronora Reservoir. The Woronora Reservoir collects water from the catchment areas of the Woronora River and its tributaries and the water that is released from the Woronora Dam flows down the Woronora River to Botany Bay. The Woronora Reservoir supplies water to residents within the Sutherland Shire in Sydney's south.

The predicted subsidence parameters and the impact assessments for the Waratah Rivulet are provided in this Section, whilst Section 5.3 provides the predictions and impact assessments for other tributaries that are located within the Study Area.

Section 5.4 provides a preliminary assessment of the possible impacts from the predicted ground movements for the inundation area downstream of the Waratah Rivulet that is within the Full Supply Level of the Woronora Reservoir, to address the concerns of the NSW Dams Safety Committee (DSC). The DSC is a statutory body which is responsible for ensuring the safety of all prescribed dams in NSW. The DSC has defined Notification Areas around all prescribed dams and storages which it considers may be affected by mining. Prior to the commencement of mining within a Notification Area, mining companies must receive the consent of the Minister administering the *Mining Act, 1992*. The DSC advises the Minister on the extent and type of mining to be permitted, and on special conditions which should apply.

Drawing No. MSEC285-07 shows the Notification Area around the Woronora Reservoir in the vicinity of the Study Area and it shows the extent of the Full Supply Level, (168.88 metres), of this reservoir. The SCA publishes weekly bulk water storage and supply reports that provide information on how much rainfall has been recorded within the Reservoir catchment and how full the dams are. The Bulk Water Storage & Supply Report for 19th June 2008 advised that the available storage in the Reservoir was 46,800 ML, which represents 65.2% of the Full Operating Storage, and that the reservoir water level was then at -7.82 metres from the Full Supply Level. For comparison, one year earlier the Bulk Water Storage & Supply Report for 8 February 2007 advised that the available storage in the Reservoir was 20,650 ML, which represented 28.8% of the Full Operating Storage, and the reservoir water level at that time was at -20.55 metres from the Full Supply Level.

The panel void widths for Longwalls 20 to 24 are 163 metres and the solid chain pillar widths between the panels would be at least 40 metres. Chain pillar widths of 35 metres have been adopted for Longwalls 11 to 19A. This increase in chain pillar width would have two effects on the predicted subsidence parameters. The wider pillar reduces the magnitude of each of the incremental subsidence profiles and, since the adjacent incremental subsidence profiles are now slightly further apart, there is less overlapping of each profile and the cumulative subsidence would be further reduced.

Drawing No. MSEC285-07 shows that the pillar widths have been further increased from 40 metres to 70 metres and the panel widths have been reduced from 163 metres to 133 metres within a “stored water” zone under and downstream of the Waratah Rivulet that has been determined by a 35 degree line plus 0.5 times the depth of cover from the edge of the Full Supply Level. These changes have been undertaken to comply with the general recommendations of panel widths less than one third the depth of cover, and pillar widths greater than one fifth the depth of cover, that have been used by the DSC following the Reynolds Inquiry into Mining Under Stored Waters. This “stored water” zone applies under the Waratah Rivulet from Longwall 25 to Longwall 28 and under the inundation area and Woronora Reservoir up to Longwall 44. These wider pillars and narrower panels have a significant effect on reducing the subsidence movements. The potential impacts of these changes are discussed generally in this Section and in greater detail in Section 5.4.

5.2.1. Subsidence Parameter Predictions for the Waratah Rivulet

The predicted profiles of incremental and total subsidence, upsidence, net vertical movement and closure along the Waratah Rivulet, after the extraction of each longwall are shown in Fig. C.02 in Appendix C. This figure also shows the surface levels down the Waratah Rivulet, the Full Supply Level of Woronora Reservoir and the equivalent valley heights.

A summary of the predicted maximum systematic incremental subsidence parameters along the Waratah Rivulet, resulting from the extraction of the proposed Longwalls 20 to 28, is provided in Table 5.1.

Table 5.1 Maximum Predicted Incremental Systematic Subsidence Parameters along the Waratah Rivulet Resulting from the Extraction of Longwalls 20 to 28

Longwall	Maximum Predicted Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt along the Waratah Rivulet (mm/m)	Maximum Predicted Incremental Tensile Strain along the Waratah Rivulet (mm/m)	Maximum Predicted Incremental Compressive Strain along the Waratah Rivulet (mm/m)
Due to LW20	200	2.4	0.6	1.0
Due to LW21	800	5.7	1.3	1.1
Due to LW22	560	4.4	0.8	1.0
Due to LW23	760	6.6	1.3	1.8
Due to LW24	705	5.1	1.0	0.8
Due to LW25	640	4.5	0.7	1.1
Due to LW26	290	1.8	0.2	0.5
Due to LW27	260	1.8	0.3	0.7
Due to LW28	255	1.3	0.2	0.3

A summary of the maximum predicted cumulative systematic subsidence parameters within the Study Area along the Waratah Rivulet and Woronora Reservoir, resulting from the extraction of the proposed Longwalls 20 to 44, is provided in Table 5.2. The values provided in this table were determined after allowing for the influence of the previously extracted longwalls at the Colliery but these values do not include the subsidence resulting from the previously extracted longwalls.

Table 5.2 Maximum Predicted Cumulative Systematic Subsidence Parameters along the Waratah Rivulet and Woronora Reservoir resulting from the Extraction of Longwalls 20 to 44

Longwall	Maximum Predicted Cumulative Systematic Subsidence (mm)	Maximum Predicted Cumulative Tilt along the Waratah Rivulet (mm/m)	Maximum Predicted Cumulative Tensile Strain along the Waratah Rivulet (mm/m)	Maximum Predicted Cumulative Compressive Strain along the Waratah Rivulet (mm/m)
Due to LW20	200	2.4	0.6	1.0
Due to LW20 to LW21	815	5.8	1.1	1.7
Due to LW20 to LW22	1010	4.7	0.9	1.6
Due to LW20 to LW23	1115	6.9	1.3	1.7
Due to LW20 to LW24	1150	5.5	1.0	1.6
Due to LW20 to LW25	1170	5.0	0.9	1.6
Due to LW20 to LW26	1175	5.0	0.9	1.6
Due to LW20 to LW44	1175	5.0	0.9	1.6

The maximum predicted cumulative subsidence parameters along the Waratah Rivulet resulting from the extraction of Longwall 20 through to Longwall 44 occur within the first few extracted longwalls. As a result, the maximum predicted cumulative subsidence parameters are not increased by mining Longwall 26 through to Longwall 44 and the identical results have been excluded from Table 5.2.

The maximum predicted cumulative systematic subsidence of 1175 mm along the Waratah Rivulet occurs above Longwall 23, after the extraction of Longwall 26. The maximum predicted cumulative systematic tilt of 6.9 mm/m (ie: 0.7 %), or a change in grade of 1 in 145, occurs over Longwall 23.

The maximum predicted cumulative systematic tensile strain of 1.3 mm/m occurs over Longwall 23. The maximum predicted cumulative systematic compressive strain of 1.7 mm/m occurs over Longwalls 20 and 23. The minimum radii of curvature associated with the maximum predicted cumulative systematic tensile and compressive strains are 12 kilometres and 9 kilometres, respectively.

A summary of the maximum predicted total systematic subsidence parameters along the Waratah Rivulet, and within the Study Area, after the extraction of the proposed Longwalls 20 to 44, is provided in Table 5.3.

Table 5.3 Maximum Predicted Total Systematic Subsidence Parameters along the Waratah Rivulet and Woronora Reservoir after the Extraction of Longwall 44 (i.e. including Longwalls 1 to 19A)

Longwall	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt (mm/m)	Maximum Predicted Total Tensile Strain (mm/m)	Maximum Predicted Total Compressive Strain (mm/m)
After LW20	500	7.0	1.2	1.0
After LW21	815	6.9	1.2	1.7
After LW22	1010	6.9	1.3	1.6
After LW23	1115	6.9	1.3	1.7
After LW24	1150	6.9	1.3	1.6
After LW25	1170	6.9	1.3	1.6
After LW26	1175	6.9	1.3	1.6
After LW44	1175	6.9	1.3	1.6

The maximum predicted total subsidence parameters along the Waratah Rivulet resulting from the extraction of Longwall 20 through to Longwall 44 occur within the first few extracted longwalls. As a result, the maximum predicted cumulative subsidence parameters are not increased due to mining Longwall 26 through to Longwall 44 and the identical results have been excluded from Table 5.3.

The maximum predicted total systematic subsidence within the Study Area along the Waratah Rivulet of 1175 mm occurs above Longwall 23 after the extraction of Longwall 26. The maximum predicted total systematic tilt along the Waratah Rivulet of 7.0 mm/m (ie: 0.7%), or a change in grade of 1 in 145, occurs at the finishing end of Longwall 12 after the extraction of Longwall 14 (i.e. the maximum predicted or back-predicted total systematic tilt occurs over already extracted longwalls). The maximum predicted total systematic tilt along the Waratah Rivulet over Longwalls 20 to 44 is 6.9 mm/m (ie: 0.7 %), or a change in grade of 1 in 145, and this occurs over Longwall 23 after the extraction of Longwall 23.

The maximum predicted total systematic tensile strain of 1.3 mm/m occurs near the finishing end of Longwall 12 after the completion of Longwall 22. The maximum predicted total systematic tensile strain over Longwalls 20 to 44 is 1.1 mm/m and occurs over Longwall 21 after the completion of Longwall 21. The maximum predicted total systematic compressive strain of 1.7 mm/m occurs over Longwalls 20 and 23 after the extraction of Longwalls 21 and 23, respectively.

The minimum radii of curvature associated with the maximum predicted total systematic tensile and compressive strains are 12 kilometres and 10 kilometres, respectively.

It should be noted that the above predictions of systematic subsidence parameters do not include the valley related upsidence and closure movements, or the effects of faults and other geological structures. Such effects have been addressed separately below and in Section 3.6.

A summary of the maximum predicted incremental values of upsidence and closure at the Waratah Rivulet, resulting from the extraction of the proposed Longwalls 20 to 28, is provided in Table 5.4. These values have been determined using the predictive methods that are detailed in Chapter 3 and in ACARP Research Project No. C9067 (Waddington Kay & Associates, 2004).

Table 5.4 Maximum Predicted Incremental Upsidence and Closure at the Waratah Rivulet Resulting from the Extraction of Longwalls 20 to 28

Longwall Extraction	Maximum Predicted Incremental Upsidence (mm)	Maximum Predicted Incremental Closure (mm)
Due to LW20	210	255
Due to LW21	327	376
Due to LW22	266	249
Due to LW23	261	243
Due to LW24	317	346
Due to LW25	354	378
Due to LW26	289	332
Due to LW27	297	342
Due to LW28	307	344

A summary of the maximum predicted cumulative values of upsidence, closure and compressive strain due to closure at the Waratah Rivulet, resulting from the extraction of the proposed Longwalls 20 to 44, is provided in Table 5.5. These values have been determined using the predictive methods that are detailed in Chapter 3 and in ACARP Research Project No. C9067 (Waddington and Kay, 2004).

Table 5.5 Maximum Predicted Cumulative Upsidence and Closure at the Waratah Rivulet Resulting from the Extraction of Longwalls 20 to 44

Longwall Extraction	Maximum Predicted Cumulative Upsidence (mm)	Maximum Predicted Cumulative Closure (mm)	Maximum Predicted Cumulative Strain due to Closure (mm/m)
Due to LW20	210	255	11.3
Due to LW20 to LW21	430	610	15.3
Due to LW20 to LW22	615	725	16.2
Due to LW20 to LW23	695	800	16.6
Due to LW20 to LW24	745	830	16.8
Due to LW20 to LW25	770	835	16.8
Due to LW20 to LW26	770	910	17.2
Due to LW20 to LW27	770	945	17.4
Due to LW20 to LW28	790	960	17.4
Due to LW20 to LW44	790	960	17.4

The maximum predicted cumulative upsidence and closure parameters along the Waratah Rivulet resulting from the extraction of Longwall 20 through to Longwall 44 occur after the extraction of Longwall 28. As a result, the maximum predicted cumulative upsidence and closure parameters are unchanged by mining Longwall 28 through to Longwall 44 and the identical results have been excluded from Table 5.5.

The maximum predicted cumulative upsidence along the Waratah Rivulet of 790 mm occurs over Longwall 24 after the extraction of Longwall 28. The maximum predicted cumulative closure along the Waratah Rivulet, of 960 mm, occurs over Longwall 24 after the extraction of Longwall 28. The maximum predicted cumulative strain due to closure, of 17.4 mm/m, occurs over Longwall 24 after the extraction of the Longwall 27. These maximum values have been predicted at these locations rather than downstream principally because the valley heights are slightly greater at this location and the panel widths are reduced. Also, the pillar widths are increased down the Waratah Rivulet from Longwalls 24 to 44 (see C.02 in Appendix C).

A summary of the maximum predicted total values of upsidence, closure and compressive strain due to closure at the Waratah Rivulet, resulting from the extraction of the proposed Longwalls 20 to 44, is provided in Table 5.6.

Table 5.6 Maximum Predicted Total Upsidence and Closure at the Waratah Rivulet Resulting from the Extraction of Longwalls 20 to 44

Longwall Extraction	Maximum Predicted Total Upsidence (mm)	Maximum Predicted Total Closure (mm)	Maximum Predicted Total Strain due to Closure (mm/m)
After LW20	460	470	14.0
After LW21	485	720	16.1
After LW22	640	835	16.8
After LW23	720	910	17.3
After LW24	770	940	17.4
After LW25	795	945	17.4
After LW26	795	945	17.4
After LW27	795	965	17.5
After LW44	795	965	17.5

The maximum predicted total upsidence and closure parameters along the Waratah Rivulet resulting from the extraction of Longwall 20 through to Longwall 44 occur after the extraction of the first few longwalls. As a result, the maximum predicted total upsidence and closure parameters are unchanged due to mining Longwall 27 through to Longwall 44 and the identical results have been excluded from Table 5.6.

The maximum predicted total upsidence of 795 mm at the Waratah Rivulet occurs above Longwall 21 after the extraction of Longwall 25. The maximum predicted total closure of 965 mm occurs above Longwall 24 after the extraction of Longwall 27.

The maximum predicted total closure strain of 17.5 mm/m at the Waratah Rivulet occurs above Longwall 24 after the extraction of Longwall 28.

The predicted changes in surface level along the Waratah Rivulet are illustrated in Fig. C.02 by the predicted net vertical movement profiles, which have been determined by the addition of the subsidence and upsidence movements. Where net vertical movements are negative the predicted upsidence is greater than predicted subsidence and uplift would occur. As discussed above, both subsidence and upsidence predictions are upper bound conservative predictions, but, greater deviations from the predicted values have been recorded in the observed upsidence values than in the observed subsidence values.

As discussed in Chapter 3, comparisons between predicted and observed upsidence along monitoring lines above Longwalls 12 and 13 indicate that observed incremental upsidence has typically been less than 50% of the predicted upsidence. If the observed subsidence is close to the predicted subsidence values and the observed upsidence is much less than the predicted upsidence values, then the predicted net vertical movement may be greater than is currently predicted. In other words some of the predicted uplift areas that are shown in Fig. C.02 may not eventuate and small amounts of subsidence may be observed instead.

A summary of the maximum predicted cumulative net vertical movements, and the subsequent changes in grade along the alignment of the Waratah Rivulet, after the extraction of the proposed Longwalls 20 to 44, is provided in Table 5.7.

Table 5.7 Maximum Predicted Cumulative Net Vertical Movements and Tilts along the Waratah Rivulet Resulting from the Extraction of Longwalls 20 to 44

Location	Maximum Predicted Cumulative Subsidence plus Upsidence (mm)		Maximum Predicted Cumulative Tilt due to Systematic Subsidence (mm/m)	
	Net Subsidence (+ve)	Net Uplift (-ve)	Increase in Gradient (+ve)	Decrease in Gradient (-ve)
Due to LW20	90	45	1.1	2.4
Due to LW20 to LW21	535	<20	4.1	5.8
Due to LW20 to LW22	615	25	4.7	4.7
Due to LW20 to LW23	700	40	4.9	6.9
Due to LW20 to LW24	750	55	5.0	5.5
Due to LW20 to LW25	775	90	5.0	4.9
Due to LW20 to LW26	775	220	5.0	3.3
Due to LW20 to LW27	770	315	5.0	3.1
Due to LW20 to LW28	770	330	5.0	3.0
Due to LW20 to LW29	770	365	5.0	3.0
Due to LW20 to LW30	770	385	5.0	3.0
Due to LW20 to LW31	770	410	5.0	3.0
Due to LW20 to LW32	770	430	5.0	3.0
Due to LW20 to LW44	770	430	5.0	3.0

The maximum predicted net vertical movements and tilts along the Waratah Rivulet resulting from the extraction of Longwall 20 through to Longwall 44 occur within the extraction of the first twelve longwalls (i.e. to Longwall 32). As a result, the maximum predicted cumulative net vertical movements and tilts are unchanged due to mining Longwall 32 through to Longwall 44 and the identical results have been excluded from Table 5.7.

The maximum predicted cumulative net vertical uplift along the Waratah Rivulet and within the Study Area due to the extraction of Longwall 20 to 44, is 430 mm, which occurs over Longwall 28 after the extraction of Longwall 32.

A summary of the maximum predicted total net vertical movements, and the subsequent changes in grade along the alignment of the Waratah Rivulet, after the extraction of the proposed Longwalls 20 to 44, is provided in Table 5.8.

Table 5.8 Maximum Predicted Total Net Vertical Movements and Tilts along the Waratah Rivulet Resulting from the Extraction of Longwalls 20 to 44

Location	Maximum Predicted Total Subsidence plus Upsidence (mm)		Maximum Predicted Total Tilt due to Systematic Subsidence (mm/m)	
	Net Subsidence (+ve)	Net Uplift (-ve)	Increase in Gradient (+ve)	Decrease in Gradient (-ve)
After LW20	100	240	0.8	7.0
After LW21	500	225	4.0	6.9
After LW22	580	220	4.6	6.9
After LW23	665	215	4.8	6.9
After LW24	750	215	4.9	6.9
After LW25	775	215	4.9	6.9
After LW26	775	220	4.9	6.9
After LW27	770	315	4.9	6.9
After LW28	770	330	4.9	6.9
After LW29	770	365	4.9	6.9
After LW30	770	385	4.9	6.9
After LW31	770	410	4.9	6.9
After LW32	770	430	4.9	6.9
After LW44	770	430	4.9	6.9

The maximum predicted total net vertical movements and tilts along the Waratah Rivulet resulting from the extraction of Longwall 20 through to Longwall 44 occur within the extraction of the first twelve longwalls (i.e. to Longwall 32). As a result, the maximum predicted total upsidence and closure parameters are unchanged due to mining Longwall 32 through to Longwall 44 and the identical results have been excluded from Table 5.8.

The maximum predicted total net vertical uplift along the Waratah Rivulet and within the Study Area after the extraction of Longwall 20 to 44, is 430 mm, which occurs above Longwall 28 after the extraction of Longwall 32.

5.2.1.1. Predictions of Upsidence and Closure at Rock Bars

A number of rock bars have been identified along the Waratah Rivulet, within the Study Area upstream of the high water level of the Woronora Reservoir, both from site observations and aerial photographs. The approximate locations of the rock bars are shown in Drawing No. MSEC285-08 and a surveyed long section of the Waratah Rivulet is shown in Fig. C.02.

The maximum predicted cumulative upsidence and closure at each of these rock bars due to the proposed extraction of Longwall 20 to Longwall 44 and the total closure and upsidence at each of the rock bars after the extraction of Longwalls 1 to 19A is summarised in Table 5.9. Whilst the results are presented for the extraction of all proposed longwalls, there is no predicted contribution to upsidence and closure at the rockbars due to the extraction of the proposed Longwalls 33 to 44.

Table 5.9 shows that the maximum predicted cumulative closure at the rock bars due to the proposed extraction of Longwalls 20 to 44 ranges from 15 mm to 910 mm.

Table 5.9 Maximum Predicted Upsidence and Closure at the Rock bars in the Waratah Rivulet within the Study Area and after the Extraction of Longwalls 20 to 44

Rock bar Number	Maximum Predicted Total Closure due to Longwalls 1 to 19A (mm)	Maximum Predicted Cumulative Closure due to Longwalls 20 to 44 (mm)	Maximum Predicted Total Closure after Longwalls 1 to 44 (mm)	Maximum Predicted Total Upsidence due to Longwalls 1 to 19A (mm)	Maximum Predicted Cumulative Upsidence due to Longwalls 20 to 44 (mm)	Maximum Predicted Total Upsidence after Longwalls 1 to 44 (mm)
RB-F	545	15	560	520	15	535
RB-G	420	55	475	410	30	440
RB-G1	330	135	465	375	50	425
RB-H	240	255	495	225	85	310
RB-I	195	405	600	110	145	255
RB-J	145	635	780	70	485	555
RB-K	125	725	850	45	455	500
RB-L	110	835	945	35	405	440
RB-M	70	800	870	30	595	625
RB-N	35	700	735	5	400	405
RB-P	0	895	895	0	565	565
RB-Q	0	910	910	0	455	455
RB-R	0	875	875	0	630	630
RB-S	0	875	875	0	425	425
RB-T	0	820	820	0	715	715
RB-V	0	800	800	0	365	365
RB-W	0	810	810	0	615	615

5.2.2. Impact Assessments for the Waratah Rivulet

The impact assessments for the Waratah Rivulet, based on the predicted systematic and valley related movements, are provided in the following sections. The findings in the following sections should be read in conjunction with the other relevant technical reports appended to the Metropolitan Coal Project Environmental Assessment including (but not necessarily limited to) the following:

- Groundwater Assessment (Appendix B);
- Surface Water Assessment (Appendix C);
- Aquatic Ecology Assessment (Appendix D); and
- Terrestrial Flora and Fauna Impact Assessment (Appendix G).

5.2.2.1. Potential for Changes to Pool Levels due to Changes in Bed Gradients

Waratah Rivulet generally has small flows, except for increased flows for periods after each significant rain event. The limit of the high water mark or Full Supply Level of the Woronora Reservoir, (168.88 metres) is located over Longwall 28 and, measured along the Waratah Rivulet, this point is approximately 2310 metres from the initial goaf edge of Longwall 20.

Upstream of the Full Supply Level, natural ponds have developed above rock bars along the Waratah Rivulet, at the locations shown in Drawing No. MSEC285-08. During times of lower water levels in the Woronora Reservoir, additional ponds form downstream of the Waratah Rivulet within the Inundation Area below the high water mark down to the water surface level of Lake Woronora. The potential impacts within the Inundation Area, downstream of the Waratah Rivulet, are assessed in Section 5.4.

New ponds or an increased level of ponding and some minor flooding of the adjacent riparian areas can occur at locations where the maximum predicted tilts, due to the net vertical movements, oppose and are greater than the natural stream gradients that existed before mining. From Table 5.8, the maximum predicted increase in total tilt along the Waratah Rivulet and within the Study Area, due to net vertical movements, is 4.9 mm/m (ie: 0.5 %), or a change in grade of 1 in 205. The maximum predicted decrease in total tilt along the Waratah Rivulet, due to net vertical movements, is 6.9 mm/m (ie: 0.7 %), or a change in grade of 1 in 145.

The natural gradient of Waratah Rivulet within the Study Area and upstream of the full supply level of the Woronora Reservoir varies between a minimum of less than 1 mm/m and a maximum of more than 110 mm/m, with an average natural gradient of approximately 20 mm/m.

It is therefore assessed that changes in grade will occur within the Study Area in some locations, but the changes would be small relative to the existing grades. Potential changes to pool levels would be small relative to the natural changes to pool levels which occur in response to variations in water flow. Consideration of the potential changes in grades and pool levels as a result of subsidence are provided in the Surface Water Assessment (Appendix C of the Metropolitan Coal Project Environmental Assessment).

5.2.2.2. Potential for Scouring

An increased potential for scouring of the stream banks can occur at locations where the predicted tilts considerably increase the natural pre-mining stream gradients and the potential for scouring is greatest in stream sections with alluvial deposits. Since the stream bed of the Waratah Rivulet in the Study Area is predominantly Hawkesbury Sandstone the potential for scouring is expected to be very low.

5.2.2.3. Potential for Changes to Stream Alignment

Changes to stream alignment may occur in flat terrain, however the maximum observed changes in gradient across the Waratah Rivulet for monitoring lines above Longwalls 12 and 13, range from about 0.5 mm/m to 9 mm/m, whilst the existing gradients across the Waratah Rivulet range from 12 mm/m to more than 100 mm/m. Hence, in all cases, the existing gradients across the Waratah Rivulet are more than twice the predicted changes in gradients due to mining, and are mostly more than five times the predicted changes in gradients across the Waratah Rivulet. Therefore the potential for mining induced changes in stream alignments is low.

Changes to the stream alignment may occur where there are alluvial deposits. However alluvial deposits are relatively scarce along Waratah Rivulet within the Study Area and since the stream bed consists predominantly of Hawkesbury Sandstone, the potential for changes to the alignment of the Waratah Rivulet is low.

The potential impact of changes to stream alignments along the Waratah Rivulet as a result of mining are likely to be minor compared to the changes in stream depth and width that occur during times of high flows in Waratah Rivulet. Consideration of the potential changes to stream alignments as a result of subsidence is provided in the surface water assessment (Appendix C of the Metropolitan Coal Project Environmental Assessment).

5.2.2.4. Potential for Fracturing of the Waratah Rivulet Bedrock

Fresh fractures and joints in the surface bedrock and rock bars occur naturally from erosion and weathering processes and from natural valley bulging movements. Almost all streams flow over naturally cracked rock strata.

The nature, origin and significance of natural joints have attracted the attention of geologists and engineers. Natural joints have been defined as breaks of geological origin in the continuity of a body of rock, occurring either singularly or more frequently in a set or system, but not attended by observable displacement along the joint. Joints are ubiquitous structural features that are present in all rocks, whether igneous, sedimentary or metamorphic in origin.

Some joints in sedimentary sequences were formed by shrinkage during the drying out and dewatering of sediments whilst others resulted from folding, faulting and igneous intrusions. All of these natural joints have been formed by stress, usually tensional or shearing stresses; however, sometimes differential compressive stresses result in jointing. Later alteration, emplacement and decomposition can occur along joint surfaces which in some instances may bond the joint.

The frequency and continuity, both vertically and horizontally of natural joints in the Southern Coalfield have been studied and are related to the lithology and the depositional fabric of sediments in each layer. Even within the Hawkesbury Sandstone unit natural joint spacing varies widely from 3 to 40 metres and these joints can be curved, discontinuous and cross bedded. Fresh tensional joints may be formed, particularly in valley walls and floors and within the weathered zone due to stress release in response to erosional processes such as valley down cutting or valley bulging. Sometimes this natural valley bulging process results in an anticline forming within the valley sides with the sides dipping away from the valley centre.

The presence of natural joints in stream beds provides natural flow paths for surface water to flow into groundwater and vice versa. It is important to recognise that all streams flow over many existing natural joints. It is also important to recognise that the presence of natural joints and natural valley bulging movements, have in some cases, resulted in pre-existing natural flow paths through or under many rock bars along the Waratah Rivulet. Further description of pre-existing flow conditions along Waratah Rivulet is provided in the surface water assessment (Appendix C of the Metropolitan Coal Project Environmental Assessment).

Where underground longwall mining occurs in the vicinity of creek and river valleys, mine subsidence movements and mine subsidence induced valley closure movements can result in additional fracturing and/or reactivation of the existing natural joints. This can in turn result in a faster rate of drainage of these pools. The precise causes of these mining-induced fractures are difficult to determine as the mechanisms are complex, although the main mining-related mechanisms are systematic mine subsidence and valley related upsidence and closure movements. The sizes and frequency of these mining induced fractures would vary along the stream, with observed impacts above the extracted longwalls increasing with thinly bedded and highly jointed rock strata in the stream bed and at wide and high rock bars. Fewer fractures have been noticed where the stream bedrock consists of thick strong strata units.

With so many natural joints along the stream bed it is often difficult to identify all the new mining induced fractures. Generally the new fractures can be recognised since they have a white or yellow appearance against the otherwise darker brown coloured bedrock. The experiences gained from previous longwall mining in the Southern Coalfield indicate that the majority of the mining-induced fracturing in bedrock and rock bars are found in sections of creeks and rivers that are located directly above extracted longwalls with few fractures being observed beyond the panel edges.

Observations made at the Waratah Rivulet north of Flat Rock Crossing identified minor fracturing in the bedrock up to approximately 110 metres from the finishing end of Longwall 12. Visible movement of the rock bar labelled WRS3, which is shown in Fig. C.15, was reported in the End of Block report for Longwall 10 (June 2004), and at this time the nearest edge of the Longwall was about 295 metres from the centre of the Waratah Rivulet at WRS3.

The maximum predicted systematic incremental tensile strain along the alignment of the Waratah Rivulet resulting from the extraction of Longwalls 20 to 44 is 1.3 mm/m and the maximum predicted systematic incremental compressive strain is 1.8 mm/m as detailed in Table 5.1. The fracturing of sandstone has generally not been observed in the Southern Coalfield where the predicted systematic incremental tensile and compressive strains are less than 0.5 mm/m and 2 mm/m, respectively and hence fracturing of bedrock is not expected from systematic incremental compressive strains. Fracturing of sandstone creek beds has however been observed in the Southern Coalfield where the predicted incremental compressive strains due to valley closure are greater than 2 mm/m.

The maximum predicted incremental compressive strain due to valley closure, which would act across the alignment of the Waratah Rivulet, is 17.4 mm/m.

Therefore, fracturing of bedrock is likely to occur as a result of the predicted incremental upsidence and closure movements and the systematic incremental tensile strains along the Waratah Rivulet, particularly at points directly above the mined longwall panels. Potential impacts are more likely to be located directly above extracted longwalls, however, minor fractures may occur beyond the edges of the panels. This assessment correlates with past predictions and observations of fracturing of bedrock in the Waratah Rivulet and other streams affected by mining in the Southern Coalfield. The locations where the additional fractures are most likely to occur would be where the predicted movements are the greatest, where the valleys are the deepest, where the valleys are wider, where there are local geological features, such as heavily jointed zones or thinly bedded strata beds or cross bedded strata layers, or where there are large rock bars. The locations of the rock bars are shown in Drawing MSEC285-08 and Fig. C.15. The expected potential impact on these rock bars resulting from valley related movements is discussed in more detail in the following Sections.

5.2.2.5. Potential for Surface Water Flow Diversion

The surface water assessment (Appendix C of the Metropolitan Coal Project Environmental Assessment) concluded that:

- Analysis of streamflow data at Waratah Rivulet inflow with Woronora River (control catchment) and O'Hares Creek shows no loss of stream yield from the Waratah Rivulet catchment.
- Process model based analysis of recorded hydrographs at Waratah Rivulet inflow confirms there is no loss occurring.
- The quantity of inflows to Woronora Reservoir 1977 to 2008 are consistent with model predicted inflows over the entire period indicating reservoir yields are unaffected by mining.

The above conclusions are consistent with those of the groundwater assessment (Appendix B of the Metropolitan Coal Project Environmental Assessment), which relevantly concluded that:

- There is no mechanism for loss of groundwater contribution to the Woronora Reservoir.
- There is a hydraulic disconnect between the deep and shallow groundwater systems. This separation is driven by the very low permeability of
    - the Upper Bulgo sequence;
    - Hawkesbury Sandstones; and
    - the Bald Hill Claystone.

Based on the above, mine subsidence related potential impacts on surface water at the Metropolitan Colliery are typically concerned with localised diversion of a portion of the surface flow through the following mechanisms:

- **Diversion into subterranean flows**, where water travels via new mining induced fractures and opened natural joints in the bedrock into near-surface dilated strata beneath the bedrock. This water resurfaces further downstream.
- **Leakage through rock bars**, where the rate of leakage from pools through rock bars to the downstream reaches of the stream is accelerated by new mining induced fractures.

Diversions of surface water into subsurface groundwater systems occur naturally due to erosion and weathering processes and natural valley bulging movements, i.e. new fractures and bed separation in response to erosion and stress concentrations in the floors of valleys. Many natural flow diversions into subterranean flows exist within the Study Area and along the Waratah Rivulet.

Further description of the hydrological and hydrogeological conditions of Waratah Rivulet pre and post mine subsidence are provided in Appendix B (groundwater assessment) and Appendix C (surface water assessment) of the Metropolitan Coal Project Environmental Assessment.

Where these mining induced flow diversions from the pools into the groundwater occur, the water reappears on the surface downstream of the mined and fractured zone as the water is only redirected below the stream bed for a certain distance where the upsidence and closure has provided the subterranean flow paths. This has been documented for those reaches along the Waratah Rivulet that were affected by the mining of Longwalls 10 to 17 during the drought conditions of 2002 to 2007.

Although predicted values of upsidence and closure along the Waratah Rivulet and within the Study Area are generally smaller than the predicted values of upsidence and closure experienced along these upper reaches of the Waratah Rivulet, the proposed mining does have the potential to result in flow diversions into subterranean flows and rock bar leakages, particularly during drought conditions.

Mining-induced surface flow diversions due to rock bar leakage occur in a similar manner to the above mechanism, except that the rock bar is elevated above the rest of the stream bed and the general water table. The rate of leakage is dependent, among other things, on the extent of horizontal fracturing within the depth of the rock bar and the water level difference. Clearly the rock bar leaks at a higher rate when the pool is full as there is access to all drainage paths and this is when the water pressure is at its highest. However, as the pool level falls the drainage rate would understandably reduce as the head reduces and access is restricted to drainage paths near the base of the rock bar. This type of flow diversion has been observed previously in the Waratah Rivulet.

The types of flow diversion mentioned above are illustrated in Fig. 5.1 and Fig. 5.2.

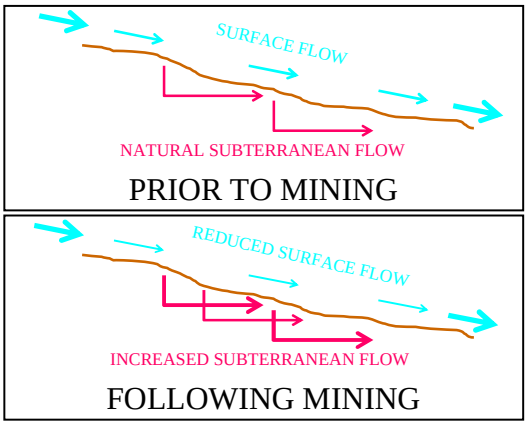

Fig. 5.1 Diagrammatic Representation of Subterranean Flows

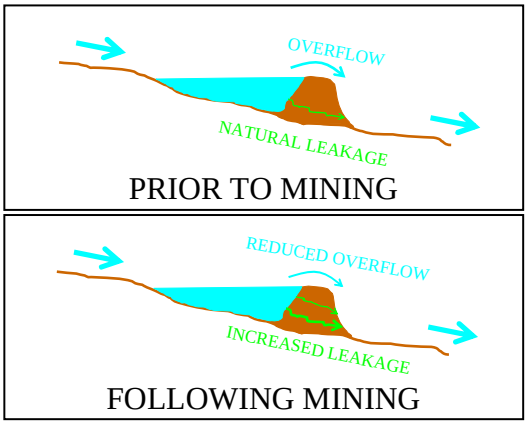

Fig. 5.2 Diagrammatic Representation of Rock bar Leakage

It is important to note that the natural or mining induced diversions of surface flows into subterranean flows and the leakage through rock bars do not result in loss of water from the overall surface water system (see Appendix B and Appendix C of the Metropolitan Coal Project Environmental Assessment). Additionally it should be noted that, with time, as is discussed later in this report, these subterranean flow channels and fractures in the rock bars may become blocked with debris and sediment which would reduce the rates of flow diversions.

A recent study of dilation of the near-surface strata due to upsidence and closure was reported by SCT in March 2007 (SCT, 2007). Extensometer readings were taken at four locations along the Waratah Rivulet at rock bar WRS3, which is located over LW12, over various depths to a maximum depth of about 20 metres. The extensometer readings indicated that dilation of the bedrock had occurred vertically to depths of no more than about 14 metres below the ground surface. The early extensometer records, when mining had not yet passed under the rock bar, showed shallower effects but as mining continued with additional longwalls, the depth to which dilation or bed separation occurred was noted to increase with each longwall to the current maximum depth of about 14 metres.

Given that flow diversions have occurred previously as a result of mining directly beneath the Waratah Rivulet, it is assessed that flow diversions would occur along some sections of the Waratah Rivulet within the Study Area as a result of mining Longwalls 20 to 44. These flow diversions can be reduced or remediated and trials have already been undertaken by Metropolitan Colliery that indicate this can be completed successfully, HCPL (June 2008).

5.2.2.6. Potential for Impacts at Rock Bars

Table 5.9 details the maximum predicted upsidence and closure at the rock bars in the Waratah Rivulet within the Study Area after the extraction of Longwalls 1 to 19A and 20 to 44. A comparison of observed and predicted upsidence and closure, along with recorded pool levels for previously monitored pools and rockbars, is presented in Fig C.16 to Fig C.25.

It can be noted that many of these rock bars would have experienced high upsidence and closure ground movements as a result of the extraction of previous longwalls and the proposed extraction of Longwalls 20 to 44 is predicted to cause further small additional upsidence and closure ground movements.

Based on the total predicted movements and previous experience at the Waratah Rivulet, which is discussed in the preceeding Sections, it is possible that subsidence induced cracking would occur and result in increased leakage through the rock bars after the mining of the proposed Longwalls 20 to 44, in the absence of remediation works.

However these observations and back-predictions have also shown that some rock bars (C and E) have not leaked significantly until back-predicted total closures have exceeded 650 mm and subsidence induced leakage was not observed at WRS1 even when the back-predicted total closures exceeded 1,000 mm. It is therefore unlikely that all rock bars within the Study Area would experience subsidence induced leakage as a result of mining Longwalls 20 to 44. The probability of such effects would be higher for those rock bars with:

a) greater predicted subsidence and valley upsidence and closure movements;

b) greater incidence of weathering and jointing, especially where the surface strata layers are thinly bedded, highly jointed and/or cross bedded;

c) greater widths across the stream;

d) greater hydraulic gradients between the upstream and downstream pools; and

e) where the systematic mining induced movements act in addition to the valley related closure movements.

5.2.2.7. Potential for Loss of Surface Water to Mine Workings

As mining occurs, the subsidence of the strata above the goaf areas can lead to some fracturing of the strata, which in turn can increase vertical permeability. However, the depth of cover under the Waratah Rivulet ranges from approximately 400 metres to 420 metres and the loss of surface water into the mine workings is considered to be very unlikely in the Southern Coalfield and within this Study Area where the depth of cover is greater than 400 metres and where various fine grained strata units, such as the Upper Bulgo Sequence, Hawkesbury Sandstone, and Bald Hill Claystone, are present. The permeability of the strata is discussed in more detail in the groundwater assessment (Appendix B of the Metropolitan Coal Project Environmental Assessment).

A piezometric investigation was conducted in April 2007 over the previously mined Longwall 10 at Metropolitan Colliery and the results are presented in the groundwater assessment (Appendix B of the Metropolitan Coal Project Environmental Assessment). The investigation analysed possible groundwater movements over the previously mined Longwall 10 during the mining of Longwall 14. The investigation hole was drilled to approximately 130 metres above the coal seam.

The draft report concluded that the fractured zone above the longwall goaf did not extend beyond the height of 130 metres above the longwall as the hydrostatic pressure heads in the formations above this level were all positive. It can be noted that:

- this height is less than the void width of Longwall 10 which was 140 metres;
- this height represents 40 times the extracted seam thickness of 3.3 metres; and
- the Bald Hill Claystone was located about 170 metres above the bottom of this hole.

The panel width of 140 metres was less than one third of the depth of cover at this location, which was 460 metres. A detailed assessment of the experience gained from this borehole and the groundwater system at Metropolitan Colliery is provided in the groundwater assessment (Appendix B of the Metropolitan Coal Project Environmental Assessment).

The height of the fractured and collapsed zone over the proposed longwalls is discussed further in Section 5.29.

There is no evidence to suggest that surface water was lost into the mine workings as a result of mining the previous Longwalls 9, 10, 11 and 12 at Metropolitan Colliery directly under the Waratah Rivulet. This is supported by the findings of the surface water assessment (Appendix C of the Metropolitan Coal Project Environmental Assessment) and the fact that the Metropolitan Colliery is essentially a dry mine.

The above findings and observations are similar to the results reported by officers of the Water Conservation and Irrigation Commission during the Stored Waters Inquiry when Mr Justice Reynolds was commissioned to advise on whether coal mining should be permitted beneath or in the vicinity of the stored waters of the Nepean, Avon, Cordeaux, Cataract and Woronora Reservoirs.

The Senior Hydrogeologist of the Commission reported that the mines themselves provided a large scale laboratory because at that time 166 hectares of mine workings lay directly beneath the stored waters. The depths of cover of these workings ranged from 64 to 300 metres. In all instances except two, at Huntley and Wongawilli Collieries, there was no evidence of substantial or continuous leakage or percolation. The depths of cover at these two locations were 64 metres and 76 metres, respectively, which were the shallowest areas of coal that were mined beneath the water storages. There was no major unabated inflow of water encountered at any fault and dyke even though many were mined through. Furthermore, apart from undermining the storages the mines on the South Coast underlie groundwater systems, some of which obviously have as a recharge source the leakage from the reservoirs. There had been much total extraction under these groundwater systems however, the mines were comprehensively described as dry mines.

Normally, in the Southern Coalfield, where the depth of cover to the seam is reasonably high and where the seam thickness varies up to 4 metres, the fracturing of the strata does not form continuous paths from the surface to the seam, and potential cracks that might form tend to be blocked by the aquicludes.

In summary, based on extensive previous mining in the area and since the depth of cover over the Study Area ranges between 400 metres and 590 metres, the potential for loss of surface water into the mine is considered to be very unlikely.

5.2.2.8. The Potential Impacts on Water Quality

Mine subsidence can potentially impact on the quality of water in streams. An assessment of the potential impacts of mine subsidence on water quality in the streams within the Study Area is presented in the surface water assessment (Appendix C of the Metropolitan Coal Project Environmental Assessment).

5.2.2.9. The Potential Impacts on Flora and Fauna

Mine subsidence can potentially impact on flora, terrestrial fauna and aquatic ecology. The potential impacts of mine subsidence on flora, terrestrial fauna and aquatic ecology are addressed in the relevant assessments by other consultants in Appendices D and G of the Metropolitan Coal Project Environmental Assessment.

5.2.2.10. Gas Emissions

Refer to Section 5.31.2 for detailed discussion of gas emissions. While no gas emissions have previously been observed during mining beneath the Waratah Rivulet, gas emissions could potentially occur at the surface as a result of mine subsidence.

5.2.3. Impact Assessment on the Waratah Rivulet Based on Increased Predictions

If the predicted tilts along the Waratah Rivulet were increased by factors of up to 2 times, the maximum predicted changes in grade along the streams would still be relatively small at less than 2 %. It is possible that there could be small changes in the levels of ponding and flooding where the maximum predicted tilts coincide with existing pools, steps, or cascades along the streams, however, potential impacts to the levels of ponding and flooding would be expected to be minor and not significant.

If the predicted strains along the alignments of the Waratah Rivulet, due to the net vertical movements, were increased by factors of up to 2 times, fracturing of the sandstone bedrock and flow diversion would be expected to increase accordingly.

If the predicted valley related upsidence and closure movements were increased by factors of up to 2 times, it is likely that fracturing and dilation of the sandstone bedrock would increase accordingly. It should be noted, however, that the method used to predict the valley related movements is based upon conservative upper-bound prediction curves and it is unlikely, therefore, that these movements would be exceeded by any more than 15 %.

5.2.4. Consideration of Avoidance/Minimisation of Impacts on the Waratah Rivulet

The proposed longwall widths for Longwalls 20 to 44 have been selected to be much narrower than the typical longwall widths that are currently being extracted at other collieries in the Southern Coalfield. These narrower longwall widths were selected in order to limit surface subsidence movements, impacts and consequences to manageable levels that are significantly less than the predicted impacts that would have occurred if the much wider longwall widths had been adopted that are typical of the current practice. These manageable levels of impacts and consequences were selected after consideration was given to avoidance and minimisation of subsidence impacts on the Waratah Rivulet from alternative longwall layouts.

In order to achieve certainty of avoidance of any environmental impacts on the Waratah Rivulet, a large area of coal would have to be left unmined or sterilised under the Waratah Rivulet. Based on this analysis, HCPL considered that a mine design such that certainty of avoidance of impacts on the Waratah Rivulet is achieved would not leave an economic mine plan.

Subsidence predictions were prepared by MSEC to assess possible changes to the mine layout that would minimise the potential impacts to the Waratah Rivulet.

A criteria to assess the potential for increased rockbar leakage (ie. in excess of normal natural leakage) was determined for this minimisation assessment. A target criteria of 200 mm maximum total closure was developed based on reviews of previously observed impacts along the Waratah Rivulet due to the previously mined Longwalls 1 to 14 and experience from other mines in the Southern Coalfield. The criteria or relationships that were established were based on the levels of predicted closure at the time of the onset of observed impacts at each rockbar along the Waratah Rivulet.

A notched mine plan concept was suggested based on using wider longwalls outside the Waratah Rivulet zone and narrower panels with wider pillars immediately over the Waratah Rivulet and within a particular distance from the Waratah Rivulet. Resultant 'notching' of longwalls, is illustrated in Fig. 5.3. X represents that total longwall width extracted outside of any area of pillar widening (or 'notching'); Y represents the extracted width in areas of notching; and Z represents the setback distance from the edge of Waratah Rivulet.

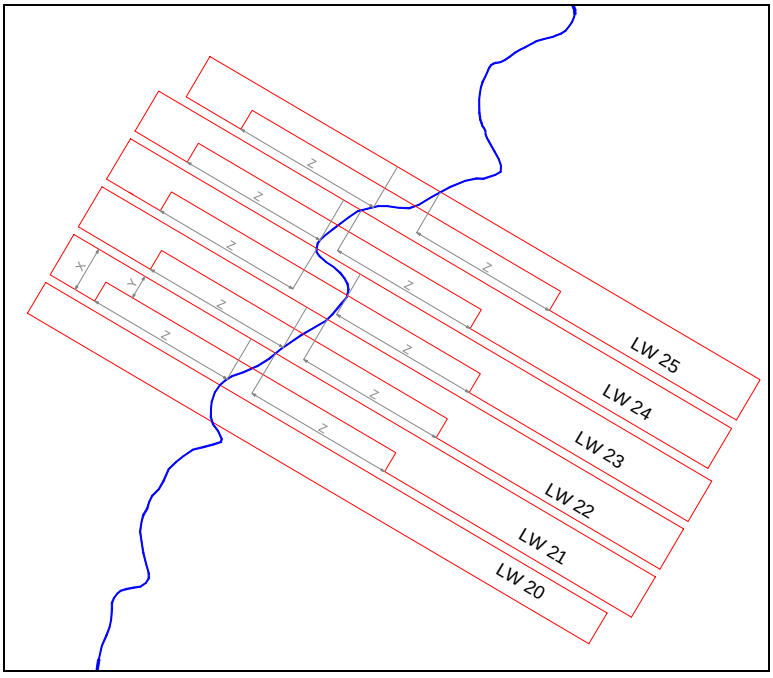

Fig. 5.3 Proposed Longwall Layout with Transition Setback

A study of required setback distances to minimise impacts at the rockbars was conducted to establish suitable stand-off distances from the Waratah Rivulet based on the proposed mine layout. In this analysis no panels were proposed to be extracted beneath the Rivulet as illustrated on Fig 5.4. The stand-off distances were assessed in 50 metre increments as illustrated in Fig. 5.4 (i.e. the Z dimension was increased in 50 m increments, with Y = 0 m for each increment).

Table 5.10 presents a summary of the upsidence and closure predictions for longwall setbacks from Waratah Rivulet.

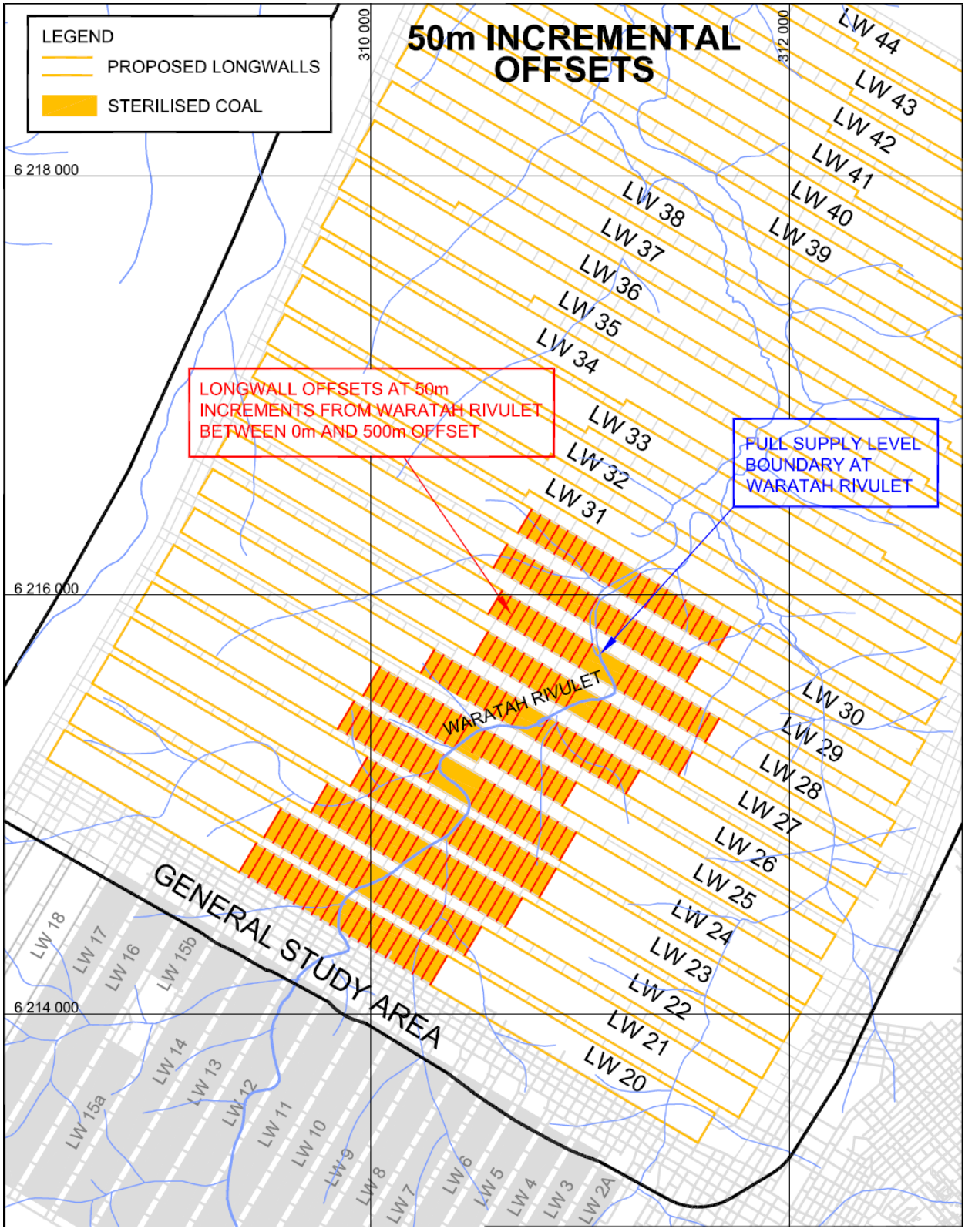

Fig. 5.4 Proposed Offset Distances from Waratah Rivulet

Table 5.10 Summary of Predicted Maximum Upsidence & Closure and Sterilised Coal

Case	Maximum Cumulative Upsidence (mm)	Maximum Cumulative Closure[1] (mm)	Maximum Total Closure[2] (mm)	Estimated Volume of Coal Sterilised (million m^3)	Estimated In Situ Tonnage of Coal Sterilised (million Tonnes)
0 metre offset from Waratah Rivulet	495	519	589	0.6	0.9
50 metre offset from Waratah Rivulet	435	458	533	1.1	1.8
100 metre offset from Waratah Rivulet	374	407	482	1.6	2.6
150 metre offset from Waratah Rivulet	316	365	450	2.1	3.4
200 metre offset from Waratah Rivulet	265	326	448	2.7	4.3
250 metre offset from Waratah Rivulet	221	292	446	3.2	5.2
300 metre offset from Waratah Rivulet	182	261	444	3.8	6.0
350 metre offset from Waratah Rivulet	156	233	442	4.3	6.9
400 metre offset from Waratah Rivulet	139	209	441	4.8	7.7
450 metre offset from Waratah Rivulet	124	188	440	5.4	8.6
500 metre offset from Waratah Rivulet	110	171	439	5.9	9.4

Note: Offset refers to the distance either side of the rivulet from the end of the longwall to the nearest point on the rivulet. The estimated volume and tonnage of sterilised coal are based on offset distances applied to each of the Longwalls 20 to 30.

[1] Maximum cumulative closure due to extraction of Longwalls 20 to 44 only.

[2] Total closure due to extraction of Longwalls 20 to 44 plus Longwalls 1 to 19A.

It should be noted that Longwalls 29 and 30 are located downstream of the Waratah Rivulet and inside the FSL of the Woronora Reservoir. Because of the influence from extracting Longwalls 29 and 30 on the predicted upsidence and closure levels over Longwall 28 at the Waratah Rivulet, it was necessary to apply offsets to Longwalls 29 and 30 as well as those for Longwalls 20 to 28 (Fig. 5.4).

Based on these predictions, a longwall setback of greater than 500 metres would be required to minimise rockbar leakage along the Waratah Rivulet. However, since the Longwalls 1 to 15 have already been extracted, the subsidence effects from these longwalls on the Waratah Rivulet have already occurred. Predicted closures from Longwalls 1 to 19A are 170 mm over LW20 and up to 430 mm near LW12 at a point. Consequently, the predicted maximum total closure in Waratah Rivulet over Longwalls 20 and 21 exceeds 200 mm even with a constant 500 m offset across Longwalls 20 to 30.

To account for the above, analysis was then undertaken by setting Longwalls 20 and 21 back a larger distance (i.e. approximately 800 to 1,000 m) and reducing the setback over Longwalls 23 to 30 (Figure 5.4[i]), so as to achieve the 200 mm maximum total closure downstream of Longwall 20. The results of this scenario indicate a maximum predicted total closure downstream of Longwall 20 of 206 mm and an estimated in situ tonnage of sterilised coal along the Waratah Rivulet of 9.56 million tonnes.

Further analysis was then undertaken with specific focus on the four rock bars (WRS5 to WRS8) by limiting the maximum predicted total closure at the rock bars to 200 mm rather than the entire length of the Waratah Rivulet (Fig 5.4 [ii] & [iii]). The results of this scenario indicate an estimated in situ tonnage of sterilised coal along the Waratah Rivulet of 5.44 million tonnes.

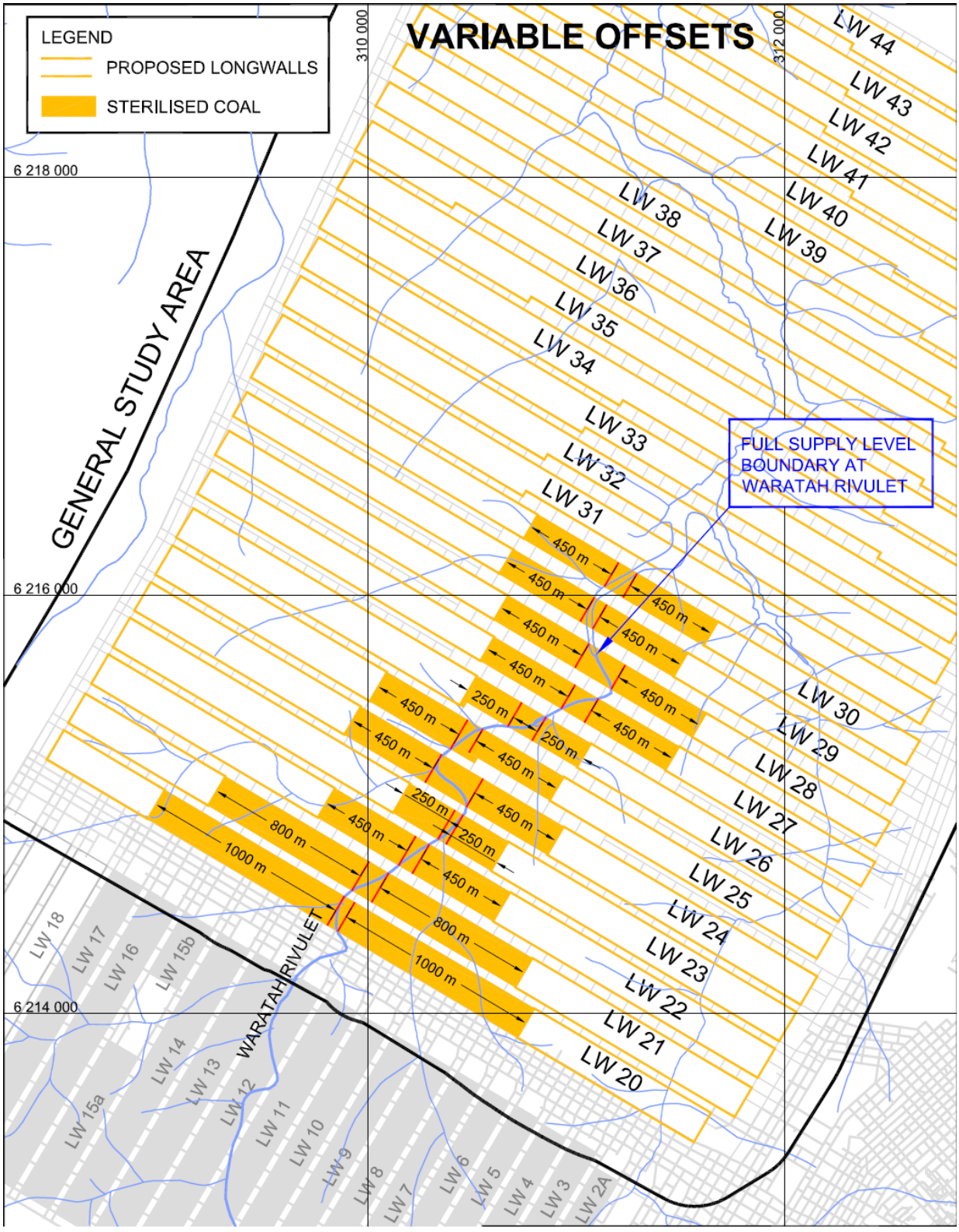

Fig 5.4 [i] Proposed Offset Distances from Waratah Rivulet - Variable

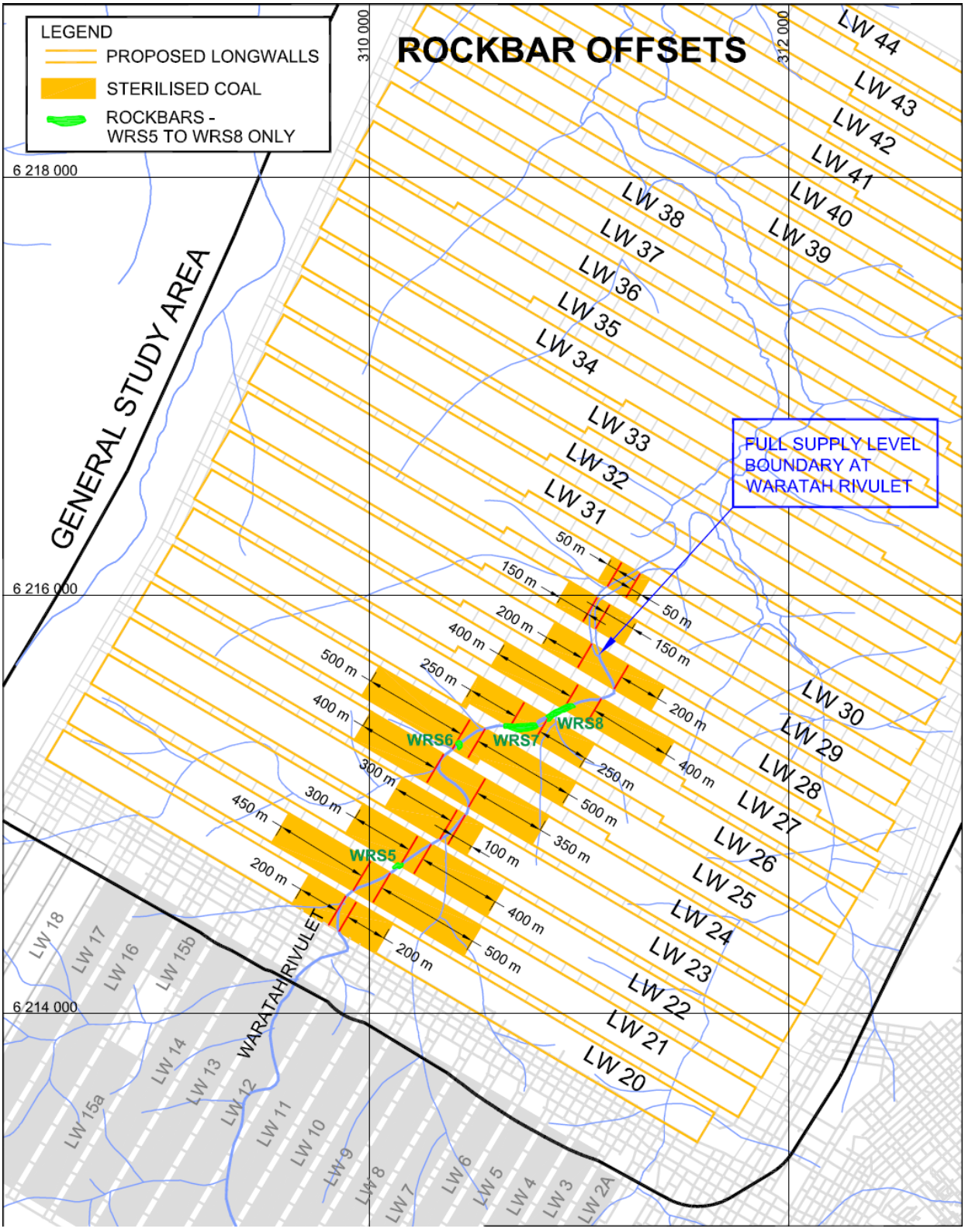

Fig 5.4 [ii] Proposed Offset Distances from Waratah Rivulet – Rock Bars WRS5-8

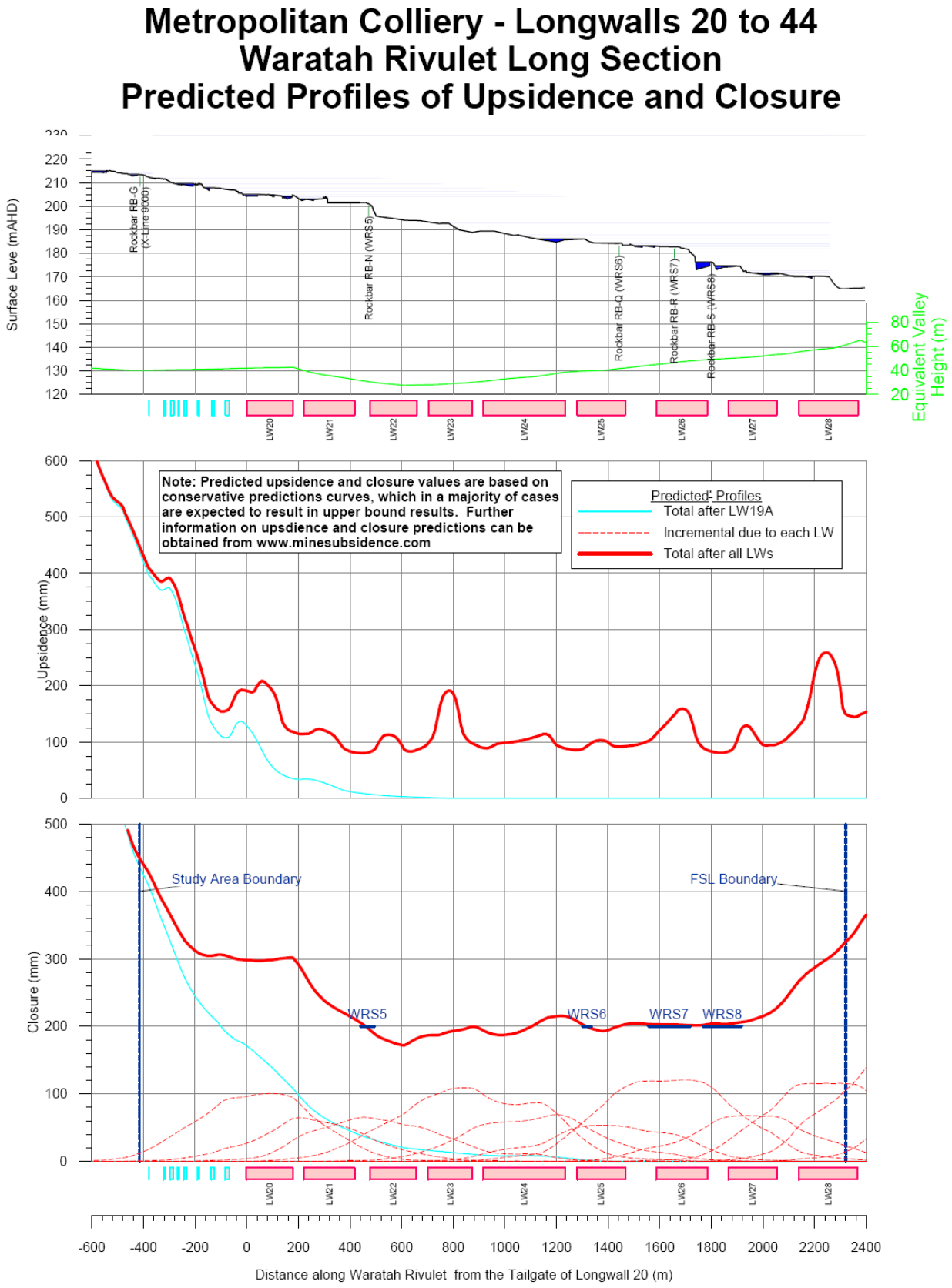

Fig 5.4 [iii] Proposed Offset Distances from Waratah Rivulet – Rock Bars WRS5-8

5.2.5. Recommendations for the Waratah Rivulet

Baseline studies of the surface and groundwater flow conditions along the Waratah Rivulet, in particular at pools and rock bars, should continue so as to allow ongoing characterisation of conditions that exist prior to the mining of Longwalls 20 to 44.

It is recommended that the surface and groundwater flow conditions of the Waratah Rivulet are monitored before, during and after the extraction of the proposed Longwalls 20 to 44, as described in the groundwater and surface water assessments (Appendices B and C of the Metropolitan Coal Project Environmental Assessment). It is also recommended that the adaptive management approach and restoration commitments proposed by HCPL for Waratah Rivulet (as described in Section 5 of the Environmental Assessment) be employed. Discussions on these management strategies are provided in the Metropolitan Coal Project Environmental Assessment.

5.3. Other Tributaries

The Waratah Rivulet is the principal stream within the Study Area. However, there are a number of other unnamed tributaries or drainage lines within the Study Area, as shown in Drawing No. MSEC285-07. All of these unnamed tributaries or drainage lines flow into the Waratah Rivulet or to the Woronora Reservoir. The predictions and impact assessments for these tributaries within the Study Area are provided in the following sections.

5.3.1. Predictions for the Tributaries

The tributaries are located across the Study Area and are likely, therefore, to be subjected to the full range of predicted systematic subsidence and valley related movements. The predicted movements have been determined for four of these tributaries, which have been called Tributaries A, B, C and E, and these unnamed tributaries are shown in Drawing No. MSEC285-07.

The predicted profiles of incremental and total subsidence, upsidence and closure along these tributaries are shown in Figs. C.03, C.04, C.05 and C.06 in Appendix C. These figures also show the profile of the equivalent valley heights along these tributaries that were used to determine the predicted valley related upsidence and closure movements along the streams. An equivalent valley height factor of 0.5 was used for Tributary A and Tributary E and an equivalent valley height factor of 0.7 was adopted for Tributaries B and C. Further information on valley height factors is provided in Section 3.6.3.

A summary of the maximum predicted values of cumulative subsidence, upsidence and closure within the Study Area along the selected tributaries, resulting from the extraction of the proposed longwalls, is provided in Table 5.11. A summary of the maximum predicted values of cumulative subsidence plus upsidence and tilt within the Study Area at the selected tributaries, resulting from the extraction of the proposed longwalls, is provided in Table 5.12. The values provided in this table were predicted knowing the influence of the previously extracted longwalls but these values do not include the parameters resulting from the previously extracted longwalls at the Colliery.

Table 5.11 Maximum Predicted Cumulative Subsidence, Upsidence and Closure at Tributaries A, B, C and E Resulting from the Extraction of Longwalls 20 to 44

Location	Maximum Predicted Cumulative Subsidence (mm)	Maximum Predicted Cumulative Upsidence (mm)	Maximum Predicted Cumulative Closure (mm)	Maximum Predicted Cumulative Strain due to Closure (mm/m)
Tributary A	1250	400	360	11.8
Tributary B	1285	860	1010	15.6
Tributary C	1215	400	275	11.1
Tributary E	380	390	305	11.9

Table 5.12 Maximum Predicted Cumulative Subsidence plus Upsidence and Tilt at Tributaries A, B, C and E Resulting from the Extraction of Longwalls 20 to 44

Location	Maximum Predicted Cumulative Subsidence plus Upsidence (mm)		Maximum Predicted Cumulative Tilt due to Systematic Subsidence (mm/m)	
	Net Subsidence (+ve)	Net Uplift (-ve)	Increase in Gradient (+ve)	Decrease in Gradient (-ve)
Tributary A	1000	<20	2.4	4.7
Tributary B	805	<20	4.9	2.0
Tributary C	975	<20	4.2	2.0
Tributary E	225	50	0.9	0.5

A summary of the maximum predicted values of total subsidence, upsidence and closure at the selected drainage lines within the Study Area, after the extraction of the proposed longwalls, is provided in Table 5.13. A summary of the maximum predicted values of total subsidence plus upsidence and tilt at the selected drainage lines within the Study Area, after the extraction of the proposed longwalls, is provided in Table 5.14. The values provided in these tables include the parameters resulting from the previously extracted longwalls at the Colliery and the influence of these longwalls on the proposed longwalls.

Table 5.13 Maximum Predicted Total Subsidence, Upsidence and Closure at Tributaries A, B, C and E after the Extraction of Longwall 44

Location	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Upsidence (mm)	Maximum Predicted Total Closure (mm)	Maximum Predicted Total Strain due to Closure (mm/m)
Tributary A	1250	400	370	12.8
Tributary B	1285	860	1030	17.8
Tributary C	1215	410	290	11.7
Tributary E	380	390	305	12.0

Table 5.14 Maximum Predicted Total Subsidence plus Upsidence and Tilt at Tributaries A, B, C and E Resulting from the Extraction of Longwall 44

Location	Maximum Predicted Total Subsidence plus Upsidence (mm)		Maximum Predicted Total Tilt due to Systematic Subsidence (mm/m)	
	Net Subsidence (+ve)	Net Uplift (-ve)	Increase in Gradient (+ve)	Decrease in Gradient (-ve)
Tributary A	990	<20	3.4	4.6
Tributary B	820	<20	4.9	2.0
Tributary C	975	35	4.2	2.0
Tributary E	225	50	0.9	0.5

5.3.2. Impact Assessments for the Tributaries

The maximum predicted total tilts along Tributaries A, B, C and E within the Study Area are 4.6 mm/m (ie: 0.5 %), 4.9 mm/m (ie: 0.5 %), 4.2 mm/m (ie: 0.4 %), and 0.9 mm/m (ie: 0.1 %) respectively, or changes in grade of 1 in 220, 1 in 205, 1 in 240, and 1 in 1110, respectively. The natural grade of Tributary A varies between less than 5 mm/m and 180 mm/m, with an average natural grade of 40 mm/m. The natural grade of Tributary B varies between less than 5 mm/m and 160 mm/m, with an average natural grade of 55 mm/m. The natural grade of Tributary C varies between less than 5 mm/m and 85 mm/m, with an average natural grade of 16 mm/m. The natural grade of Tributary E varies between less than 5 mm/m and 150 mm/m, with an average natural grade of 70 mm/m. The predicted total tilts are therefore much lower than the typical natural grades in the tributaries.

The magnitudes of the predicted systematic and valley related movements are likely to result in cracking in the bedrock along these valleys and fracturing and dilation of the underlying strata above and immediately adjacent to the proposed longwalls. This fracturing and bed separation may lead to leakage from pools or the streams in these tributaries, as discussed in Section 5.2.2 above.

Where streams have a thick layer of alluvial sediments above the bedrock strata, it is unlikely that fracturing in the strata would continue up to the surface. In the event that cracking does occur at the surface within the alignments of the streams with alluvial beds, the cracks are likely to be filled and sealed at the next major flow event. As noted previously, the stream beds in the Study Area are predominantly Hawkesbury Sandstone and there is expected to be only a few locations with alluvial sediments.

As described in Section 5.2.2, mine subsidence related potential impacts on surface water at the Metropolitan Colliery are typically concerned with localised diversion or loss of water. Based on findings of the surface water and groundwater assessments (Appendices B and C of the Metropolitan Coal Project Environmental Assessment), observations and data from extensive previous mining in the area, and since the depth of cover over the Study Area ranges between 400 metres and 590 metres, the potential for loss of surface water into the mine or out of the catchment is considered to be very unlikely.

5.3.3. Impact Assessments for the Tributaries Based on Increased Predictions

If the predicted tilts along the tributaries were increased by factors of up to 2 times, the level of ponding, flooding and scouring above and adjacent to the longwall chain pillars and goaf edges would increase accordingly, where the existing natural grades are small. Typically, however, the predicted changes in grade are expected to be much lower than the natural grades in the tributaries. An increased level of ponding, flooding or scouring would also be likely to occur where the maximum predicted tilts coincide with existing pools, steps or cascades along the streams.

If the predicted strains along the alignments of the streams were increased by factors of up to 2 times, the likelihood and extent of cracking in the alluvial beds and the likelihood and extent of fracturing and dilation in the bedrock would increase accordingly directly above the proposed longwalls. Fracturing of the surface rocks could allow low flow of surface water in the streams to be redirected into the dilated strata in some locations. Pools in some sections of the tributaries could experience a higher rate of leakage due to the occurrence of the surface fractures at these locations. However in times of heavy rainfall, the majority of the runoff would flow over the beds and rock bars.

5.4. Woronora Reservoir and Woronora Dam

As discussed in Section 5.2, the northern part of the Study Area is within the DSC Notification Area for Woronora Dam. The limit of the Full Supply Level of the Woronora Reservoir (168.88 metres) is located over proposed Longwalls 28 to 44. The inundation area downstream of Waratah Rivulet starts at a distance of approximately 2320 metres from the tailgate of Longwall 20.

All longwall panels have been reduced and all pillar widths have been increased within the inundation area, that has been referred to as the stored water zone. The limits of this zone were determined by a 35 degree angle of draw plus 0.5 times the depth of cover from the edge of the Full Supply Level. These changes have been made to comply with the general recommendations of panel widths being less than one third of the depth of cover and the pillars being greater than one fifth of the depth of cover that have been used by the DSC following the Reynolds Inquiry into Mining Under Stored Waters. Drawing No. MSEC285-07 shows that the panel and pillar widths have been reduced below the inundation area and within this stored water zone for Longwalls 28 to 44. The void widths of the longwall panels under the inundation area and within this stored water zone have been reduced from 163 metres to 133 metres and the solid pillar widths have been increased from 40 metres to 70 metres.

The predictions and impact assessments for the inundation area within the Full Supply Level of the Woronora Reservoir (ie: for the section above the proposed Longwalls 28 to 44) are provided in the following sections.

5.4.1. Predictions for the Inundation Area and Stored Water Area

The predicted profiles of incremental and total subsidence, upsidence, net vertical movement and closure within the inundation area, after the extraction of each longwall are shown in Fig. C.02 in Appendix C. This figure also shows the surface levels within the inundation area downstream of the Waratah Rivulet, the Full Supply Level of Woronora Reservoir and the equivalent valley heights within the inundation area downstream of the Waratah Rivulet.

A summary of the predicted maximum systematic incremental subsidence parameters along the inundation area and the Woronora Reservoir, resulting from the extraction of Longwalls 28 to 44, is provided in Table 5.15.

Table 5.15 Maximum Predicted Incremental Systematic Subsidence Parameters along the Waratah Rivulet and Woronora Reservoir Resulting from the Extraction of Longwalls 28 to 44

Longwall	Maximum Predicted Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt along the Inundation Area and Woronora Reservoir (mm/m)	Maximum Predicted Incremental Tensile Strain along the Inundation Area and Woronora Reservoir (mm/m)	Maximum Predicted Incremental Compressive Strain along the Inundation Area and Woronora Reservoir (mm/m)
Due to LW29	245	1.6	0.3	0.3
Due to LW30	240	1.8	0.4	0.6
Due to LW31	240	1.6	0.3	0.4
Due to LW32	245	1.8	0.3	0.5
Due to LW33	245	1.8	0.4	0.3
Due to LW34	250	1.8	0.4	0.5
Due to LW35	250	1.7	0.3	0.5
Due to LW36	255	1.8	0.4	0.6
Due to LW37	250	1.5	0.2	0.2
Due to LW38	250	1.4	0.3	0.3
Due to LW39	250	1.5	0.3	0.4
Due to LW40	245	1.6	0.3	0.5
Due to LW41	245	1.8	0.3	0.9
Due to LW42	250	1.9	0.4	0.8
Due to LW43	255	1.9	0.4	0.8
Due to LW44	260	1.9	0.4	0.9

The maximum predicted incremental systematic subsidence along the inundation area and stored water area from Longwall 28 to Longwall 44 is 260 mm, which occurs after the extraction of Longwall 44.

The predicted incremental systematic tensile strain along the inundation area and stored water area varies from 0.2 mm/m to 0.4 mm/m. The maximum predicted incremental systematic compressive strain along the inundation area and stored water area is 0.9 mm/m, which occurs due to Longwall 41.

A summary of the maximum predicted total systematic subsidence parameters within the Study Area along the Waratah Rivulet, resulting from the extraction of the proposed Longwalls 20 to 44, is provided in Table 5.3. The values provided in this table were determined after allowing for the influence of or the presence of the previously extracted adjacent longwalls.

The maximum predicted cumulative systematic subsidence along the inundation area and stored water area of 381 mm occurs above Longwall 35, after the extraction of Longwall 39. The maximum predicted cumulative systematic tilt of 1.9 mm (ie: 0.2 %), or a change in grade of 1 in 525, occurs over Longwall 41.

The maximum predicted total systematic tensile strain of 0.6 mm/m occurs over Longwall 41. The maximum predicted cumulative systematic compressive strain of 0.7 mm/m occurs over Longwall 40. The minimum radii of curvature associated with the maximum predicted total systematic tensile and compressive strains are 25 kilometres and 21 kilometres, respectively.

The above predictions of systematic subsidence parameters do not include the valley related upsidence and closure movements, or the effects of faults and other geological structures.

A summary of the maximum predicted total values of upsidence, closure and compressive strain due to closure at the Waratah Rivulet, resulting from the extraction of the proposed Longwalls 20 to 44, is provided in Table 5.6. A summary of the maximum predicted incremental values of upsidence and closure at the inundation area and Woronora Reservoir, resulting from the extraction of the proposed Longwalls 20 to 44, is provided in Table 5.16.

Table 5.16 Maximum Predicted Incremental Upsidence and Closure at the Waratah Rivulet Resulting from the Extraction of Longwalls 20 to 44

Longwall Extraction	Maximum Predicted Incremental Upsidence (mm)	Maximum Predicted Incremental Closure (mm)
Due to LW29	309	345
Due to LW30	260	308
Due to LW31	214	226
Due to LW32	222	247
Due to LW33	237	267
Due to LW34	244	275
Due to LW35	244	273
Due to LW36	242	271
Due to LW37	265	314
Due to LW38	293	333
Due to LW39	275	317
Due to LW40	229	209
Due to LW41	179	170
Due to LW42	177	176
Due to LW43	225	303
Due to LW44	307	312

The maximum predicted total upsidence and closure in the inundation area and stored water area are 745 mm and 855 mm respectively, and these values are predicted to occur over Longwalls 28 and 29 after the extraction of Longwall 33. The maximum predicted total strain due to closure of 16.9 mm/m occurs over Longwall 28 after the extraction of the Longwall 32.

The predicted changes in surface level along the Waratah Rivulet, inundation area and stored water area are illustrated in Fig. C.02 by the predicted net vertical movement profiles, which have been determined by the addition of the subsidence and upsidence movements. Where net vertical movements are negative the predicted upsidence is greater than predicted subsidence and uplift would occur. It should be noted that predicted upsidence is typically conservative in that observed upsidence is often lower than predicted and hence less areas are likely to experience uplift than have been predicted.

A summary of the maximum predicted total net vertical movements, and the subsequent changes in grade along the alignment of the Waratah Rivulet, after the extraction of the proposed Longwalls 20 to 44, is provided in Table 5.8.

The maximum predicted total net vertical uplift within the Study Area and along the inundation area and stored water area of 425 mm is predicted to occur over Longwall 29 after the extraction of Longwall 33.

5.4.2. Impact Assessments for the Inundation Area and Stored Water Area

The Bulk Water Storage & Supply Report for 7th February 2008 advised that the available storage in the Reservoir was 42,720 ML which represents 59.5% of the Full Operating Storage with a reservoir water level at -9.4 metres from the full supply level, or an RL of 159.5 metres based on a full supply level of RL 168.88 metres. At this date and based on surface contour information, the reservoir surface water level of 159.5 metres is approximately 2,180 metres downstream of the full supply level.

The Bulk Water Storage & Supply Report for 19th June 2008 advised that the available storage in the Reservoir was 46,800 ML which represents 65.2% of the Full Operating Storage with a reservoir water level at -7.8 metres from the Full Supply Level, or an RL of 161.1 metres based on a Full Supply Level of RL 168.88 metres.

When the water level is below the Full Supply Level, portions of the inundation area would form temporary pools above exposed rock bars that would normally be covered at the Full Supply Level. Specific predictions for the temporary pools and rock bars that may be exposed within the inundation area and stored water area are not presented in this report. For an indication of the potential impacts to these temporary pools and exposed rock bars due to extraction of the proposed Longwalls 28 to 44 reference can be made to Section 5.2 of this report. The predicted impacts to pools and exposed rock bars that may be exposed within the inundation area and stored water area would however be less than predicted impacts upstream of the Full Supply Level (along Waratah Rivulet) since the proposed panel widths would be narrower and the proposed pillars would be wider.

The maximum predicted systematic incremental tensile strain along the alignment of the inundation area and stored water area resulting from the extraction of Longwalls 20 to 44 is 0.4 mm/m and the maximum predicted systematic incremental compressive strain is 0.9 mm/m as detailed in Section 5.4.1. The maximum predicted incremental compressive strain due to valley closure, which would act across the inundation area and stored water area, is 16.9 mm/m.

The fracturing of sandstone has generally not been observed in the Southern Coalfield where the predicted systematic incremental tensile and compressive strains are less than 0.5 mm/m and 2 mm/m, respectively and hence only minor fracturing of bedrock is expected due to the systematic incremental strains. However, fracturing of sandstone creek beds has been observed in the Southern Coalfield where the predicted incremental compressive strains due to valley closure are greater than 2 mm/m. Therefore, fracturing of bedrock is likely to occur as a result of the predicted incremental upsidence and closure movements within the inundation area and stored water area. This assessment correlates with past predictions and observations of fracturing of bedrock in the Waratah Rivulet and other streams in the Southern Coalfields.

The locations where the additional fractures are most likely to occur would be where the predicted movements are the greatest or where rock bars are present.

Sections 5.2.2.5 and 5.2.2.7 provide comments on potential surface water flow diversion and potential loss of water to the mine workings.

Diversion of surface water flows into subterranean flows and leakage through rock bars will be of little significance within the stored water area when the water level is at Full Supply Level since the valley would be drowned and hence surface bedrock cracking and bed separation caused by the systematic and valley closure movements would not provide a leakage path. However, within the inundation area when the reservoir level is lower than the Full Supply Level, diversion of a portion of surface water flow is likely to occur as described in Section 5.2.2.5.

Subsurface profiles below the inundation area and stored water area are similar to those encountered in the previously mined areas over Longwalls 1 to 14, as described in a report prepared by Geosensing Solutions (2008).

The predicted height of the fractured zone above the narrow 133 metre wide longwalls is about 155 metres as detailed in Section 5.29. This predicted fracture zone height is approximately 265 metres below the existing ground surface level in the base of the inundation area and stored water area and about 100 metres below the estimated level of the Bald Hill claystone as detailed by Geosensing Solutions (2008).

5.4.3. Far-field Horizontal Movements at Woronora Dam

The nearest point of the Woronora Dam is approximately 4,000 metres from the closest longwall (ie: Longwall 44). At this large distance no systematic or valley closure movements are anticipated.

It is possible, however, that small far-field horizontal movements could be observed at the Woronora Dam. Based on previous case studies of observed far-field horizontal movements at various sites, the far-field horizontal movements at the Woronora Dam resulting from the extraction of the proposed longwalls are likely to be insignificant and could only be detected by precise surveys. Such movements tend to be bodily movements towards the extracted goaf area, and are accompanied by low levels of strain.

The potential impacts of far-field horizontal movements on the Woronora Dam are expected to be insignificant.

Further discussion on predicted far-field horizontal movements is provided in Section 5.28.

5.4.4. Recommendations for the Woronora Reservoir and Woronora Dam

As part of detailed mine design studies, SMP preparations and application to enter the DSC Notification Area, a review of potential far-field horizontal movements should be carried out for the Woronora dam. It is envisaged that this would also include additional geological investigations.

5.5. Heathcote National Park and Garawarra State Conservation Area

The longwall panel layout is not within the boundary of any National Park or State Conservation Area. A small portion of the Heathcote National Park and the Garawarra State Conservation Area is however located in the north and north east of the General Study Area respectively as shown in Drawing No. MSEC285-01.

The nearest part of the Heathcote National Park to the proposed longwalls is close to the intersection of the Princes Highway and Woronora Dam Road, approximately 90 metres from the nearest edge of Longwall 44. At this location, the predicted total systematic subsidence is less than 100 mm, predicted total systematic tilt is approximately 0.6 mm/m and predicted systematic strain is less than 0.1 mm/m. These predicted values reduce with the distance to the north, away from Longwall 44. At these low levels of predicted subsidence parameters, negligible impact is expected at the National Park.

The Garawarra State Conservation Area is located on the eastern side of the Southern Freeway and is marginally inside the General Study Area at locations opposite Longwalls 43 and 44 and Longwalls 30 to 32. The nearest part of the Garawarra State Conservation Area to the proposed longwalls is on the eastern side of the southern freeway opposite Longwalls 43 and 44, and is approximately 270 metres from the nearest edge of Longwall 43. At these locations, the predicted total systematic subsidence is less than 15 mm, predicted total systematic tilt is less than 0.2 mm/m and predicted systematic strain is less than 0.1 mm/m. These predicted values reduce with increasing distance to the east. At these low levels of predicted subsidence parameters, negligible impact is expected at the Conservation Area.

5.6. The Cliffs and Overhangs

The cliffs and overhangs within the Study Area are generally located along the alignment of the Waratah Rivulet. The locations of the cliffs and overhangs within the Study Area are shown in Drawing No. MSEC285-09. The predictions and impact assessments for the cliffs are provided below.

5.6.1. Predictions for the Cliffs and Overhangs

A summary of the maximum predicted total values of systematic subsidence, tilt and strain at the cliffs and overhangs within the Study Area, at any time during or after the extraction of the proposed longwalls, is provided in Table 5.17. The predicted values are the maximum values which occur anytime during or after the extraction of the proposed Longwalls 20 to 44. They also include the small movements that resulted from the extraction of the earlier Longwalls 1 to 17, but they do not include valley closure movements. The values provided below are the maximum predicted parameters which occur within a distance of 20 metres from the identified extents of the cliffs.

Table 5.17 Maximum Predicted Total Systematic Subsidence, Tilt and Strain at the Cliffs and Overhangs within the Study Area Resulting from the Extraction of Longwalls 20 to 44

Cliff	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total or Travelling Tilt (mm/m)	Maximum Predicted Total or Travelling Tensile Strain (mm/m)	Maximum Predicted Total or Travelling Compressive Strain (mm/m)
COH1	495	2.1	0.4	-0.3
COH2	750	5.3	1.3	-0.9
COH3	1080	3.6	0.4	-1.5
COH4	1050	3.8	1.0	-1.4
COH5	400	1.0	1.1	-0.3
COH6	400	1.2	1.2	-0.3
COH7	395	0.9	0.5	-1.1
COH8	370	1.9	1.0	-1.7
COH9	365	1.7	1.1	-0.3
COH10	370	0.9	0.5	-1.2
COH11	345	1.6	0.7	-1.7
COH12	340	1.8	1.3	-1.0
COH13	370	1.1	0.4	-1.8
COH14	1205	2.2	0.5	-0.9
COH15	440	1.0	0.4	-1.1
COH16	380	1.1	0.5	-1.3

5.6.2. Impact Assessments for the Cliffs and Overhangs

Most of the mining induced cliff falls have been observed where the depth of cover to mining was shallow, as in the Western Coalfield, and few cliff falls or rock falls have been observed where the depth of cover is more than 400 metres, as is generally the case in the Southern Coalfield. Prior to the extraction of Longwall 301 at Appin Colliery all of the rock falls that were observed near mined areas in the Southern Coalfield were located immediately above the extracted longwall. However, some minor rock instabilities were observed beyond the goaf edges of Longwall 301.

Whilst the observed cliff falls at shallow depths of cover occur off fresh mining induced cracks, the minor rock falls at Appin Colliery occurred off pre-existing natural joints, which is typical of those observed where the depth of cover is more than 400 metres.

Similar minor rock falls have been observed to occur naturally at other locations where there has been no mining and this is a reminder that cliffs and rock overhangs are landforms that are part of a naturally occurring erosion/weathering cycle and they are often only marginally stable. This highlights that caution is required when inspecting the surface near these natural features and when proposing any surface management plans near or around cliffs and overhangs during and immediately after mining.

Extensive databases have been established which include the topography, geometries and the magnitudes of the observed and predicted subsidence induced ground movements at cliff sites at the time of known rock falls and these provide a guide as to the likelihood or frequency of rock falls and rock instabilities.

The maximum predicted total systematic tilt at the identified cliffs or overhangs, resulting from the extraction of the proposed longwalls, is 5.3 mm/m (ie: 0.5 %), or a change in grade of 1 in 190.

Tilt does not directly induce differential movements along cliffs, which is the main cause of cliff instabilities. Tilt, however, can increase the overturning moments in steep or overhanging cliffs which, if it is of sufficient magnitude, could result in toppling type failures. A review of the occurrence and location of observed cliff falls with respect to panel edges and increasing or decreasing the steepness of the slopes of the cliff faces at known cliff falls indicates that this mechanism does not result in many of the observed cliff falls. The predicted tilts at the cliffs and overhangs are small in comparison to the existing slopes of the cliff faces and are unlikely, therefore, to result in topping type failures in these cases. It is more likely, since the depth of cover is greater than 400 metres, that where the mining induced strains are of sufficient magnitude, sections of rock faces could fracture along existing bedding planes or existing joints and become unstable, resulting in sliding or toppling type failures along the cliffs and overhangs.

The maximum predicted systematic total tensile strain resulting from the extraction of Longwalls 20 to 44, of 1.3 mm/m, is predicted to occur at cliffs COH2 and COH12, and the associated minimum radius of curvature is 12 kilometres. The maximum predicted systematic total compressive strain, resulting from the extraction of Longwalls 20 to 44 of 1.8 mm/m is predicted to occur at cliff COH13 and the associated minimum radius of curvature is 8 kilometres.

Fracturing of sandstone has generally been observed in the Southern Coalfield where the systematic tensile and compressive strains have exceeded 0.5 mm/m and 2 mm/m, respectively. It is likely, therefore, that the predicted maximum systematic tensile strains at some of the cliffs and overhangs would be of sufficient magnitude to result in the fracturing of sandstone.

The maximum systematic total tensile and compressive strains are however much lower than the compressive strains resulting from valley related upsidence and closure movements. The maximum predicted compressive strain resulting from valley closure is 17.5 mm/m. The predicted compressive strains from valley closure along the Waratah Rivulet act perpendicular to the alignment of the rivulet and are, therefore, perpendicular to many of the cliffs and overhangs identified within the Study Area. It is possible, however, that at sharp bends or where drainage lines enter the Waratah Rivulet, stress concentrations could occur, resulting in high strains from the valley related closure movements. If cliffs or overhangs are present in these areas, there may be a higher risk of fractures occurring as a result of valley related closure movements.

No cliff falls (i.e. freshly exposed surfaces dissimilar to natural weathering processes) have been observed by HCPL above or near the extracted longwalls at Metropolitan Colliery. Cliff instabilities have been observed, however, at other Southern Coalfield Collieries along cliff lines which have been located above extracted longwalls. It is possible, therefore, that cliff instabilities could occur at some cliffs within the Study Area as a result of the extraction of the proposed longwalls.

It is difficult to assess the likelihood of cliff instabilities based upon predicted ground movements. The likelihood of a cliff becoming unstable, without the effects of mining induced ground movements, is dependent on many factors which are difficult to fully quantify, including the existing vertical and horizontal jointing, inclusions or weaknesses within the rock mass, the height, extent of undercutting, the length and orientation of the particular cliff with respect to the valley and the water pressure and seepage flow behind the rock face. Even if these factors could be determined, it is even more difficult to assess an individual cliff's stability after being exposed to mine subsidence movements which are influenced by the magnitude of the mining-induced subsidence parameters, the location of the cliff with respect to the longwall panels, and the orientation of the cliff with respect to the panels and the valley.

When assessing the effect of mining at shallow depths of cover under high and long cliff lines it has been found to be difficult to predict which particular cliff would experience a fall, however the proportion of that cliff line that was damaged was more easily assessed. Statistics have been gathered on the effects of the various factors that influence the proportion or extent of the cliff falls per length of cliff line.

Therefore, rather than trying to quantify the likelihood of falls at a particular cliff, it has been found to be more meaningful to quantify the likely proportion of a cliff line that could be affected by mining. This proportion is increased with increasing mining induced movements, higher and longer cliffs, and shallower depths of cover.

To assist in this assessment of the effects of the proposed mining on the identified cliffs within the Study Area a comparison has been provided with three recent case studies where cliff lines have been undermined in the Southern Coalfield, due to the extraction of Longwalls 11 to 15 at Metropolitan Colliery, Longwalls 301 and 302 at Appin Colliery and Longwalls 1 and 2 at the Dendrobium Mine. These case studies are described below:-

Metropolitan Colliery Longwalls 1 to 15

Longwalls 1 to 8 were extracted beneath various clifflines and Longwalls 9 to 15 were extracted under the Waratah Rivulet and under the cliff lines facing this valley. The proposed Longwalls 20 to 44 have the same general panel width but wider pillars than the extracted Longwalls 11 to 15. The proposed longwalls below the Woronora Reservoir have been further narrowed and the pillars widened, as detailed in Section 1.2.

No cliff falls (i.e. freshly exposed surfaces dissimilar to natural weathering processes) have been observed by HCPL at Metropolitan Colliery.

Appin Colliery Longwalls 301 and 302

Appin Longwalls 301 and 302 mined adjacent to a number of cliff lines located along the Cataract River Gorge. The overall depth of the Cataract Gorge ranged from 50 to 65 metres. A total of 68 cliffs were identified within the application area having continuous lengths ranging between 5 and 230 metres and overall heights ranging between 10 and 37 metres. The cliffs were formed in the Hawkesbury Sandstone.

Appin Longwalls 301 and 302 have void widths of 260 metres and solid chain pillar widths of 40 metres and were extracted from the Bulli Seam at a depth of cover of 500 metres. The maximum predicted systematic tensile and compressive strains, resulting from the extraction of these longwalls, were 1.1 mm/m and 2.2 mm/m, respectively.

The longwalls were extracted within 50 metres of the identified locations of the cliffs. The maximum predicted systematic tensile and compressive strains at the cliffs were 0.2 mm/m and 0.1 mm/m, respectively.

There were no cliff instabilities observed as a result of the extraction of Appin Longwalls 301 and 302. There were, however, five minor rockfalls or disturbances which occurred during the mining period, of which, four were considered likely to have occurred due to natural causes, as they occurred following heavy rainfall.

Tower Colliery Longwalls 1 to 17

Tower Colliery Longwalls 1 to 17 mined directly beneath a number of cliff lines located along the Cataract River and Nepean River. The void widths of Longwalls 1 to 17 varied from 110 metres to 208 metres, with chain pillar widths of 34 metres to 40 metres and a depth of cover of the order of 500 metres. The cliffs were formed in the Hawkesbury Sandstone. The longwalls mined directly beneath the cliff lines and, therefore, the cliffs were subjected to the full range of predicted systematic subsidence movements.

There were eight cliff instabilities observed during the extraction of Tower Longwalls 1 to 15 along the Cataract River, having a total length of disturbance of approximately 160 metres. The total plan length of cliff line located directly above the longwalls was approximately 3700 metres. The length of cliff line disturbed along the Cataract River as a result of the extraction of Tower Longwalls 1 to 16 is, therefore, estimated to be less than 5 % (4.3%) of the total plan length of cliff line located directly above the longwalls.

There were two cliff instabilities observed during the extraction of Tower Longwalls 16 and 17 along the Nepean River, having a total length of disturbance of approximately 40 metres. The total plan length of cliff line located directly above the longwalls was approximately 1,875 metres. The length of cliff line disturbed along the Nepean River as a result of the extraction of Tower Longwalls 16 and 17 is, therefore, estimated to be approximately 2% of the total plan length of cliff line located directly above the longwalls.

Dendrobium Mine Longwalls 1 and 2

Dendrobium Longwalls 1 and 2 mined directly beneath a ridgeline which consists of a number of discontinuous cliffs having overall heights of up to 30 metres. The cliffs were formed in the Hawkesbury Sandstone.

Dendrobium Longwalls 1 and 2 have void widths of 245 metres and a solid chain pillar width of 50 metres and were extracted from the Wongawilli Seam at a depth of cover ranging between 170 metres and 320 metres. The maximum predicted systematic tensile and compressive strains, resulting from the extraction of these longwalls, were 5 mm/m and 11 mm/m, respectively.

The longwalls mined directly beneath the ridgeline and, therefore, the cliffs were subjected to the full range of predicted systematic subsidence movements, whilst the travelling wave passed underneath the clifflines. There were eight cliff instabilities observed during the extraction of Dendrobium Longwalls 1 and 2, having a total length of disturbance of approximately 135 to 175 metres. The total plan length of ridgeline located directly above the longwalls is approximately 1,800 to 2,000 metres. The length of ridgeline disturbed as a result of the extraction of Dendrobium Longwalls 1 and 2 is, therefore, estimated to be between 7 % and 10 % of the total plan length of ridgeline located directly above the longwalls.

It can be noted that there were two levels of cliff lines in some locations and, therefore, the total length of cliffline that was undermined could be assessed to be greater than the total plan length of the ridgeline and hence the level of observed cliff line impact could be estimated at 4 % to 7% of the undermined cliff line.

The observed level of impact is less than the predicted level of impact of 10 % of the undermined cliff line that was provided in the Dendrobium EIS documentation.

Summary

No cliff falls or instabilities (i.e. freshly exposed surfaces or cracks dissimilar to natural weathering processes) have been reported by HCPL over Metropolitan Colliery.

Fig. C02 provides predictions of the systematic and valley closure movements along the Waratah Rivulet. It can be noted that the cliffs over Longwalls 20 to 28 are predicted to be subjected to higher systematic ground movements than those over Longwalls 28 to 44 and both of these areas are predicted to experience less systematic and valley closure movements than was experienced over Longwalls 11 to 15. Accordingly the mining induced ground movements would be less than or similar to those experienced over the previously extracted longwalls. As the identified cliffs over Longwalls 20 to 44 are slightly higher than those identified over Longwalls 11 to 15, it is possible that some small rock falls could occur and care should be taken when conducting site inspections around these cliff sites.

The extent of potential instabilities at the cliffs and overhangs at Metropolitan Colliery over Longwalls 20 to 44 are expected to be similar to, or greater than those observed as a result of Appin Longwalls 301 and 302, but significantly less than that observed as a result of Dendrobium Longwalls 1 and 2 and Tower Longwalls 1 to 16.

The reasons for this are:-

- The cliffs at Appin Colliery were not undermined, which significantly reduced the magnitude of predicted ground movements and hence the likelihood of those cliffs falling. The maximum predicted systematic tensile and compressive strains at the cliffs and overhangs at Metropolitan Colliery over Longwalls 20 to 44 of 1.3 mm/m to 1.8 mm/m, respectively, though greater than those predicted for the cliffs adjacent to Appin Longwalls 301 and 302 of 0.2 mm/m and 0.1 mm/m, respectively, are significantly less than those predicted for the cliffs above Dendrobium Longwalls 1 and 2 of 5 mm/m and 11 mm/m, respectively.
- The depth of cover in the vicinity of the identified cliffs and overhangs at Metropolitan Colliery over Longwalls 20 to 44 mostly varies from approximately 400 metres to 440 metres (approximately 500 metres below cliff COH14), which is less than the 500 metres depth of cover above the Appin and Tower longwalls, and greater than the 170 to 320 metres depth of cover over the Dendrobium Longwalls 1 and 2.
- The proposed extracted widths of the longwalls of 163 metres and 133 metres are much less than the 260 metre width for the Appin Longwalls 301 and 302 and the 245 metre width for the Dendrobium Longwalls 1 and 2. The proposed longwall widths of 163 metres and 133 metres are wider than the Tower Longwalls 1 to 5 but generally narrower than the Tower Longwalls 6 to 17.
- The heights of the cliffs at both Dendrobium, Appin, and Tower were significantly higher than the cliffs at Metropolitan Colliery over Longwalls 20 to 44.
- The lengths of the cliffs at both Dendrobium, Appin and Tower were significantly longer than the cliffs at Metropolitan Colliery over Longwalls 20 to 44.

Based on these comparisons the lengths of potential cliff instabilities along the cliffs and overhangs, resulting from the extraction of the Longwalls 20 to 44 are, therefore, expected to be less than 3 % of the lengths of these cliffs and overhangs.

One of the most significant consequences associated with cliff instabilities is the potential to cause injury to people or death. All of the cliffs and overhangs are located within the Woronora Special Area that is owned and administered by the Sydney Catchment Authority (SCA) and, whilst the area is generally not available for public access, it is possible that the area could be visited during the mining period. It is recommended, therefore, that persons who enter the area in the vicinity of the cliffs and overhangs are made aware of the potential for rockfalls resulting from the extraction of the proposed longwalls by appropriate signs and temporary fencing that should be prepared in consultation with the SCA. The conditions of the cliffs should be monitored throughout the mining period and until such time that the mine subsidence movements have ceased.

The aesthetics of the landscape could be temporarily altered by isolated rock falls and whilst these would typically occur off pre-existing natural joints, they could result in the exposure of a fresh face of rock and debris scattered around the base of the cliff. As with naturally occurring instabilities, the exposed fresh rockface weathers and erodes over time to a point where it blends in with the remainder of the cliff face and in time the vegetation below the cliff regenerates. If a cliff or overhang instability were to occur, however, the appearance of the landscape could be restored, if necessary, by revegetation below the cliff or overhang.

5.6.3. Rock Ledges

As discussed in Chapter 2, there are many rock ledges, i.e. small cliffs, distributed over the Study Area which are likely to be subjected to the full range of predicted systematic subsidence movements as presented in Chapter 4. Many of these smaller rock ledges are located near the base of the Waratah Rivulet valley and just above the pool water levels.

As discussed in the previous Sections, these rock ledges would be subjected to relatively small mining induced systematic ground movements and larger valley closure related ground movements, as detailed below.

The maximum predicted total tilt within the Study Area, after the extraction of the proposed Longwalls 1 to 44, is 7.5 mm/m (ie: 0.8 %), or a change in grade of 1 in 135. The maximum predicted total systematic tensile and compressive strains within the Study Area, after the extraction of the proposed Longwalls 1 to 44, are 1.7 mm/m and 1.9 mm/m, respectively. The minimum radii of curvature associated with the maximum predicted tensile and compressive strains are 9 kilometres and 8 kilometres, respectively. The maximum predicted valley closure movements along the Waratah Rivulet are 965 mm of closure and 795 mm of upsidence. Valley closure strains of 17.5 mm have been predicted along the Waratah Rivulet.

Fracturing of sandstone has been observed in the Southern Coalfield in the past where the systematic tensile and compressive strains have been greater than 0.5 mm/m and 2 mm/m, respectively. It is likely, therefore, that the maximum predicted systematic strains are of sufficient magnitude to result in the fracturing of sandstone and, hence, the potential for rockfalls, particularly where the rocks ledges are marginally stable. Such occurrences, however, would be expected to be rare. One impact to a rock ledge was recorded in the end of panel report for Longwall 12 for a small section of rock ledge on the western side of WRS1 which fell away in June 2005.

As there is a small possibility of rock falls from these rock ledges, it is recommended that appropriate management strategies are put in place to ensure the safety of people that may be within the vicinity of these rock ledges during the mining period.

It is recommended that visual inspections, of the exposed rock ledges within the Study Area that are easily inspected, should be undertaken during the mining period. Should any rock ledge appear to become unstable, management strategies should be put in place to prevent access and appropriate signs should be provided to warn of the possibility of rock falls.

5.6.4. Impact Assessments for the Cliffs and Overhangs Based on Increased Predictions

If the predicted systematic tilts were increased by factors of up to 2 times, the likelihood and extent of cliff instabilities would not significantly increase, as the changes in grade would still be small when compared to the existing slopes of the cliff faces.

If the predicted systematic strains were increased by factors of up to 2 times, the potential for cliff instabilities would increase accordingly. It would be expected, however, that the proportion of cliff line affected by cliff instabilities would still be significantly less than that observed as a result of the extraction of Dendrobium Longwalls 1 and 2.

5.6.5. Consideration of Avoidance/Minimisation of Impacts on Cliffs and Overhangs

Most of the cliffs identified within the Study Area are located along the alignment of the Waratah Rivulet as shown in Drawing No. MSEC285-09.

Given that most of the cliffs are located along the alignment of the Waratah Rivulet, the set back or stand-off distances required to completely avoid subsidence impacts on cliffs and overhangs would be similar to the set back distances required to avoid or minimise all impacts along the Waratah Rivulet, which is discussed in Section 5.2.4.

With the exception of cliffs and overhangs that are located further away from the Waratah Rivulet, it is, however, expected that the stand-off distance would be governed largely by the Waratah Rivulet rock bar assessments, which was based on predicted valley closure movements (Section 5.2.4). For example, the stand-off distance from the cliffs and overhangs for minimisation of subsidence impacts would be expected to be approximately half of the depth of cover, which would be in the order of 250 metres. This is much less than the stand-off necessary for the rock bars, which would be in the order of 500 metres for the Waratah Rivulet.

5.6.6. Recommendations for the Cliffs and Overhangs

As there is a small possibility of rock falls, it is recommended that appropriate management strategies are put in place to ensure the safety of people that may be within the vicinity of the cliffs during the mining period. With these measures in place, it is unlikely that there would be a significant impact associated with the cliffs resulting from the extraction of the proposed longwalls.

It is recommended that the cliffs should be visually monitored during the mining period from a remote and safe location. It is also recommended that the existing condition of cliffs within the Study Area should be documented and photographed prior to mining.

5.7. Steep Slopes

The locations of the steep slopes within the Study Area are shown in Drawing No. MSEC285-09. The predictions and impact assessments for the steep slopes are provided in the following sections.

5.7.1. Predictions for the Steep Slopes

The steep slopes are located across the Study Area and are likely, therefore, to be subjected to the full range of predicted systematic subsidence movements, as presented in Chapter 4.

5.7.2. Impact Assessments for the Steep Slopes

The maximum predicted total tilt within the Study Area, after the extraction of the proposed Longwalls 1 to 44, is 7.5 mm/m (ie: 0.8 %), or a change in grade of 1 in 135. The steep slopes are more likely to be impacted by the systematic strains, rather than tilt, as the maximum predicted tilt is small when compared to the existing surface gradients of the steep slopes.

The maximum predicted total systematic tensile and compressive strains within the Study Area, after the extraction of the proposed Longwalls 1 to 44, are 1.7 mm/m and 1.9 mm/m, respectively. The minimum radii of curvature associated with the maximum predicted tensile and compressive strains are 9 kilometres and 8 kilometres, respectively. The maximum predicted total systematic tensile strains at the steep slopes are likely to be of sufficient magnitude to result in surface cracking.

It has been observed that down slope movements occur on slopes that are located over or near extracted longwalls. Sometimes these movements are observed to be directed down the hill slope rather than towards the extracted goaf area.

A portion of the survey results of the observed incremental horizontal peg movements due to the extraction of Longwall 10 for the D-Line at Metropolitan Colliery are shown below in Fig. 5.5. The pegs D40 to D70 all moved towards the centre of the incremental subsidence bowl and towards a first order stream that flows into Tributary A (ie: these observed directions match the expected systematic horizontal ground movements). The observed incremental horizontal peg movements, as illustrated in the top left of this figure, show that the pegs to the west of Peg D70 moved away from the Longwall 10 goaf and towards the Waratah Rivulet at a time when, if the terrain had been flat, they would have been expected to move towards the extracted panel.

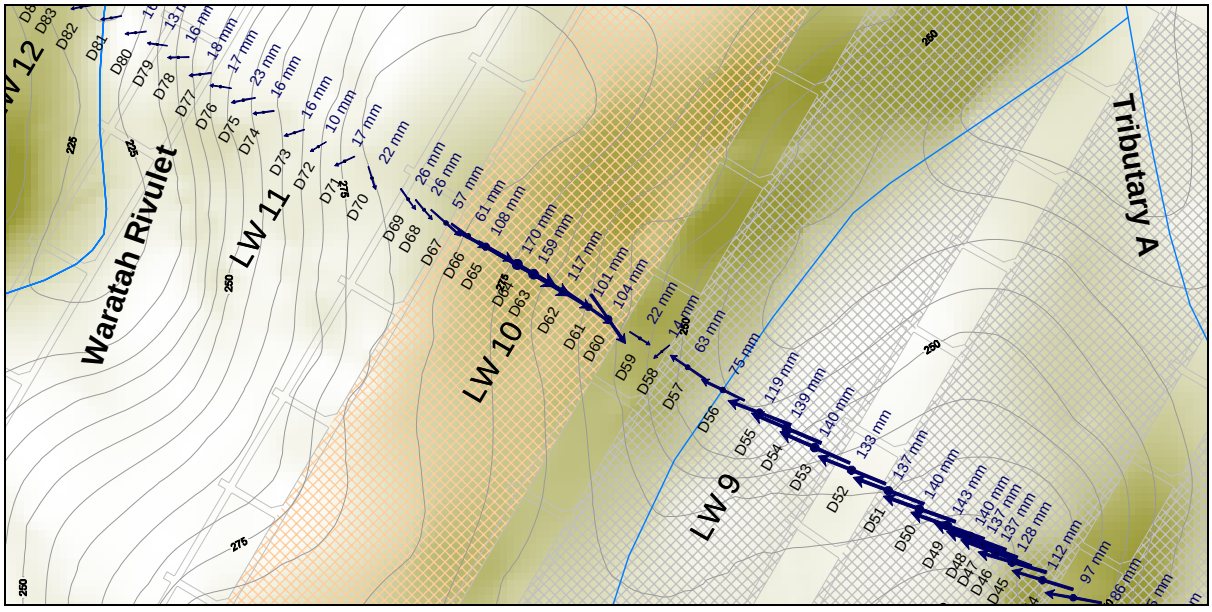

Fig. 5.5 Observed Incremental Horizontal Peg Movements along D-Line due to Longwall 10

Fig. 5.6 shows the total observed horizontal movements at this location after the extraction of Longwall 13. The total movement vectors and values are shown for every second peg for greater clarity. The peg movements show a large closure movement towards the Waratah Rivulet, particularly on the slope to the east of Waratah Rivulet. It should be noted that Pegs D16 to D81 were installed when Longwall 8 had been partly extracted, therefore these pegs would not show any horizontal movements that may have occurred prior to Longwall 8. The D-Line Pegs D82 to D102 were installed at the completion of Longwall 10 extraction and would not, therefore, show any horizontal movements that may have resulted from the extraction of Longwall 9 or previous longwalls.

The maximum observed horizontal movement at peg D72 of 483 mm occurs near the top of the steep slope to the east of Waratah Rivulet. The maximum observed horizontal movement on the western side of the Waratah Rivulet is 211 mm at peg D94. The maximum measured closure across the Waratah Rivulet after the extraction of Longwall 13 is 690 mm, which is close to the sum of the two maximum horizontal movement vectors either side of the rivulet. These observed horizontal movements are a combination of systematic, valley closure, slippage along horizontal bedding planes and downhill slumping mechanisms as discussed in Section 3.6.

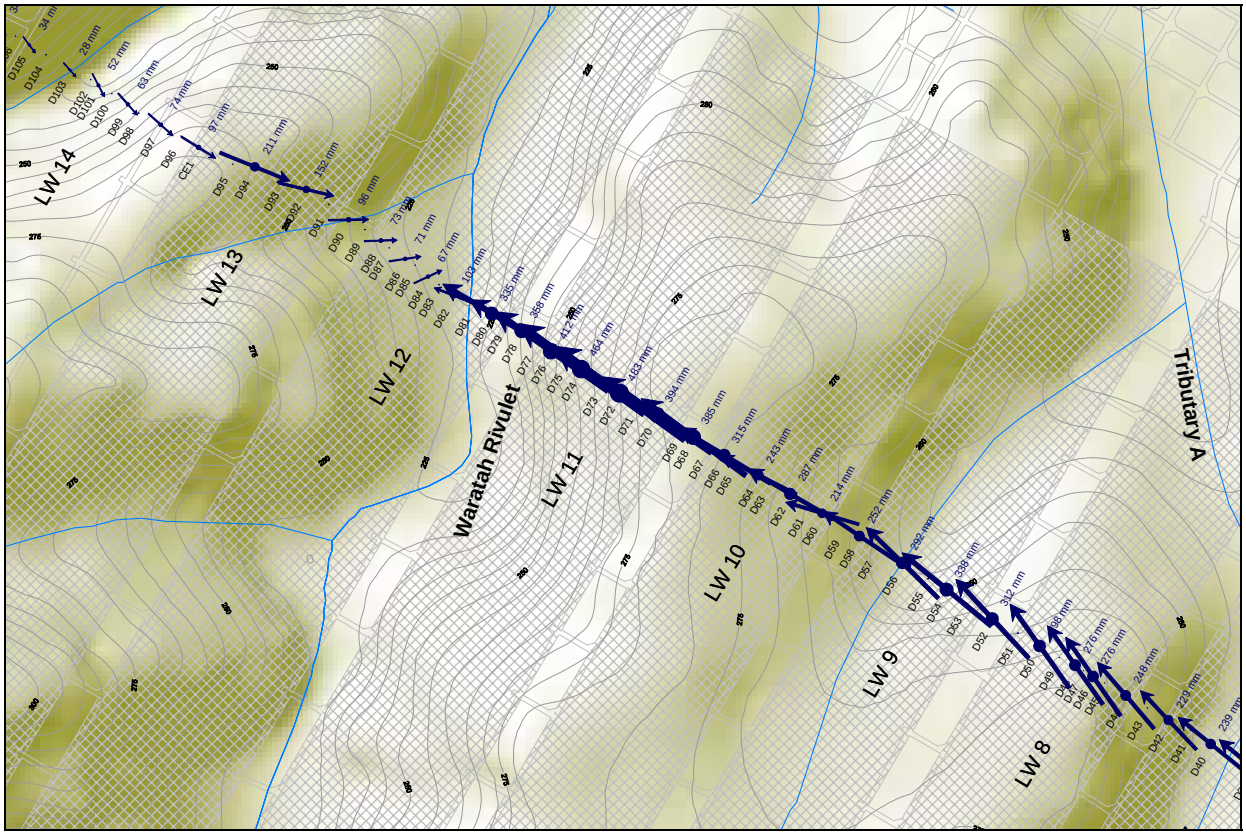

Fig. 5.6 Observed Total Horizontal Peg Movements along D-Line after Longwall 13

Where such movements occur on steep slopes, there is a higher likelihood that surface tension cracking can occur near the tops of the slopes. A surface crack measuring approximately 25 metres long and 0.1 metres wide was reported in the end of panel report for Longwall 12 at Metropolitan Colliery. During a site visit conducted in February 2007, the crack was observed at the top of a slope to the east of WRS1. The size and extent of future surface cracking at the steep slopes over the proposed Longwalls 20 to 44 is expected to be similar to that observed during the extraction of previous longwalls at the Colliery. It is unlikely that mine subsidence would result in any significant slope failure, since such failures have not been observed as the result of longwall mining in the Southern Coalfield.

5.7.3. Impact Assessments for the Steep Slopes Based on Increased Predictions

If the predicted systematic tilts were increased by factors of up to 2 times, the potential impacts on the steep slopes would not significantly increase, as the predicted tilts would still be much less than the natural surface gradients of the steep slopes.

If the predicted systematic strains were increased by factors of up to 2 times, the extent of potential surface cracking and soil slippage would increase accordingly at the steep slopes located directly above the proposed longwalls. It is expected, however, that the surface cracking could be remediated by infilling with soil or other suitable materials, or by locally regrading and compacting the surface. The relevant approvals for such works would be obtained prior to undertaking any remediation works. With these remediation measures in place, it is unlikely that there would be any significant impact on the environment.

5.7.4. Consideration of Avoidance/Minimisation of Impacts on Steep Slopes

The steep slopes identified in Drawing No. MSEC285-09 are scattered over much of the Study Area, with the exception of approximately the western half of Longwalls 26 to 33. There is also a greater concentration of steep slopes located along the alignment of the Waratah Rivulet and the Woronora Reservoir.

Given that most of the steep slopes are located along the alignment of the Waratah Rivulet, the stand-off distances required to completely avoid subsidence impacts on steep slopes would be similar to the set back distances required to avoid or to minimise all impacts along the Waratah Rivulet. As discussed in Section 5.2.4, large stand-off distances would be required in order to achieve avoidance of subsidence impacts to rock bars along the Waratah Rivulet.

It is considered reasonable to adopt a preliminary minimum stand-off distance of no less than half of the depth of cover for minimising subsidence impacts at the steep slopes. Assuming a stand-off distance of half of the depth of from the steep slopes, much of the coal within the Study Area would need to be sterilised. A layout indicating the approximate area of sterilised coal based on a stand-off distance of half of the depth of cover is shown in Drawing MSEC285-22.

It should be noted, however, that this stand-off distance of half of the depth of cover is being applied to only the steep slopes. Should the same distance also be applied to other features such as streams, cliffs and overhangs, upland swamps and archaeological sites, the whole of the proposed Study Area would be sterlilised.

5.8. Upland Swamps

A number of upland swamps are located within the Study Area as shown in Drawing No. MSEC285-07 (based on vegetation mapping by Bangalay Botanical Surveys [2008]). The predictions and impact assessments for the headwater upland swamps and in-valley upland swamps are provided in the following sections.

5.8.1. Predictions for the Upland Swamps

A summary of the maximum predicted values of systematic subsidence, tilt and strain at the upland swamps within the Study Area, for the extraction of the proposed Longwalls 1 to 44, at any time during or after the extraction of the longwalls, is provided in Table D.03 in Appendix D.

The values provided in Table D.03 are the maximum predicted parameters within a 20 metre radius of the perimeter of each swamp. The predicted tilts and strains are the greater of the maximum values which occur during and after extraction of the proposed longwall.

As described in Section 2.3.13, most of the swamps situated close to Longwalls 20 to 44 are headwater upland swamps (Appendix B of the Metropolitan Coal Project Environmental Assessment). One in-valley upland swamp (Swamp S21 on Drawing No. MSEC285-07) is situated on a tributary (a third order watercourse) of Waratah Rivulet to the south of Longwall 20 (Appendix G of the Metropolitan Coal Project Environmental Assessment). This swamp is situated near to Longwalls 20 to 44 (i.e. outside of the proposed future mining area, but within the potential extent of mine subsidence effects [i.e. angle of draw]). This swamp partially overlies the completed Longwalls 7 and 8 and consequently has already experienced mine subsidence from Metropolitan Colliery's previous operations. In both types of swamps, significant quantities of sediment are found above the bedrock which is naturally fractured and weathered.

Headwater Upland Swamps

The maximum predicted total systematic subsidence in headwater upland swamps situated close to Longwalls 20 to 44 ranges from 10 mm (Swamp S125) to 1205 mm (Swamp S25). The swamp locations are shown on Drawing No. MSEC285-07.

At Metropolitan Colliery, tensile strains greater than 0.5 mm/m may have the potential to result in cracking in the bedrock. Compressive strains greater than 2 mm/m may have the potential to result in cracking, buckling and/or dilating the strata beneath the bedrock. The maximum predicted total systematic tensile and compressive strains in the headwater swamps near to Longwalls 20 to 44, are 1.4 mm/m and 1.7 mm/m respectively. The maximum predicted systematic total tensile strain and total compressive strain occur at Swamp S20. Cracking, buckling and/or dilating of the strata as a result of systematic compressive strains is not predicted to occur as a result of the subsidence from the extraction of Longwalls 1 to 44 (i.e. compressive strains less than 2 mm/m are predicted).

Upsidence and closure movements also have the potential to result in cracking, buckling and/or dilating of the strata beneath the bedrock. However, as headwater upland swamps are generally located higher in the catchment topography in areas with relatively shallow relief (Appendix B of the Metropolitan Coal Project Environmental Assessment), headwater swamps would generally be subject to minimal valley related upsidence and closure movements. Predictions of valley related upsidence and closure movements were made for a number of headwater swamps located in those drainage lines with the steepest valley profiles. A maximum total closure strain of 8.9 mm/m is predicted, which occurs at Swamp S20.

The soils in the swamps comprise mainly unconsolidated alluvial sediments and in most cases, the cracking that might occur at the rock surface may not appear at the surface of the swamps. Most of the swamps are also located in relatively level areas and not on steep slopes so the type of cracking resulting from downslope movements would not be expected to occur in the swamps. The most likely locations where cracking of surface soils may occur would be where the swamps are located over the edges of the mining area. However, given the depth of cover which is generally more than 420 metres, even on the edges of the mining area we would not expect much cracking in the surface soils. As indicated above, the headwater swamps would generally be subject to minimal valley related upsidence and closure movements.

A maximum total systematic tensile strain at headwater swamps of 1.4 mm/m is conservatively predicted to occur and therefore there is some potential for minor cracking. Any cracking, however, of the bedrock is expected to be isolated and of a minor nature, due to the relatively low magnitudes of the predicted strains and due to the relatively high depths of cover. Further, the minor cracking within the swamp areas would generally not be expected to propagate through swamp soil profiles. Such cracking is more generally expected to be observed along the higher ridge top rock outcrops, based on monitoring over the previous longwalls at the Metropolitan Colliery.

Maximum ground tilts are developed above longwalls and adjacent to the edges of the area of extraction. The maximum predicted total systematic tilt in any of the headwater swamps within the proposed future mining area (Longwalls 20 – 44) and within the potential extent of systematic mine subsidence effects is 7.2 mm/m. Thirty seven headwater swamps close to Longwalls 20 to 44 are predicted to have maximum total systematic tilts of 2 mm/m or less, forty three swamps are predicted to have maximum total systematic tilts in the range 2.1 to 4 mm/m, thirty eight swamps in the range 4.1 to 6 mm/m and three swamps in the range 6.1 to 7.2 mm/m. The predicted tilts are comparable to what has been experienced by other headwater swamps in the Southern Coalfield and that are predicted to be experienced by swamps situated in the Longwalls 18-19A area at the Metropolitan Colliery (maximum predicted total systematic tilts up to 8.2 mm/m).

Swamp grades vary naturally and the predicted maximum mining-induced tilts are generally orders of magnitude lower than the existing natural grades within the swamps (e.g. estimated natural grades of approximately 30 mm/m to 100 mm/m). Significant changes in grade within the swamps as a result of mining-induced tilt are not anticipated. It should also be noted that the maximum predicted values of tilt are at one location within the relevant swamp and do not apply to the entire area of the swamp.

In-Valley Upland Swamps

It is estimated that longwall mining to date has resulted in a maximum predicted total systematic subsidence at the in-valley swamp (Swamp S21) of 1432 mm. There is no additional predicted subsidence at this swamp due to the extraction of the proposed Longwalls 20 to 44.

At Metropolitan Colliery, tensile strains greater than 0.5 mm/m may have the potential to result in cracking in the bedrock. Compressive strains greater than 2 mm/m may have the potential to result in cracking, buckling and/or dilating of the strata beneath the bedrock.

The maximum predicted systematic total tensile and compressive strains at the in-valley swamp overlying the earlier Longwalls 7 and 8, after the extraction of Longwalls 1 to 44, are 1.4 mm/m and 1.0 mm/m, respectively. This means that cracking, buckling and/or dilationng as a result of systematic compressive strains is not predicted to occur as a result of the cumulative subsidence from the extraction of Longwalls 1 to 44 (i.e. systematic compressive strains less than 2 mm/m are predicted).

Upsidence and closure movements also have the potential to result in cracking, buckling and/or dilation. It is predicted that longwall mining to date has already resulted in a maximum total closure strain of 10.6 mm/m at swamp S21 and closure strain would not be increased as a result of the extraction of Longwalls 20 to 44.

The predicted maximum total systematic tensile strain of 1.4 mm/m is predicted to occur at Swamp S21, however, it is estimated that longwall mining to date has resulted in maximum predicted total systematic tensile and compressive strains of 1.3 mm/m and 1.0 mm/m, respectively, at Swamp S21. The extraction of Longwalls 20 to 44 is expected to result in only a negligible change in the predicted existing systematic tensile strains (i.e. less than 1 mm/m). Any cracking of the bedrock is expected to be isolated and of a minor nature, due to the relatively low magnitudes of the predicted strains and due to the relatively high depth of cover. Further, the minor cracking within the swamp areas would generally not be expected to propagate through swamp soil profiles. Such cracking is more generally expected to be observed along the higher ridge top rock outcrops based on monitoring over the previous longwalls at the Metropolitan Colliery.

Maximum ground tilts are developed above longwalls and adjacent to the edges of the area of extraction. The maximum predicted total systematic tilt at Swamp S21, after the extraction of Longwalls 1 to 44, is predicted to be 8.0 mm/m. However, it is estimated that longwall mining to date at this in-valley swamp has resulted in a maximum predicted total systematic tilt of 8.1 mm/m. As a result, the extraction of Longwalls 20 to 44 is expected to result in a negligible change in the predicted existing tilts (i.e. less than 1 mm/m). Swamp grades vary naturally and the predicted maximum mining-induced tilts are generally orders of magnitude lower than the existing natural grades within the swamps. Significant changes in grade within the swamps as a result of mining-induced tilt are not anticipated. It should also be noted that the maximum predicted values of tilt occur only at one location within the relevant swamp and do not apply to the entire area of the swamp.

5.8.2. Impact Assessments for the Upland Swamps Based on Increased Predictions

If the predicted systematic subsidence at the swamps was increased by a factor of up to 2 times, the differential subsidence and, hence, the potential for impacts to the swamps, would increase accordingly. The increased maximum predicted systematic tilt at the swamps would generally remain much lower than the natural average grades within the swamps.

If the predicted systematic strains or the predicted upsidence and closure movements at the swamps were increased by factors of 2 times, the likelihood and extent of fracturing, buckling, and dilation in the topmost bedrock would increase accordingly.

5.8.3. Consideration of Avoidance/Minimisation of Impacts on Upland Swamps

The upland swamps identified on Drawing No. MSEC285-07 are scattered over much of the Study Area, with the exception of steeper terrain, mainly along the Waratah Rivulet, Woronora Reservoir and drainage lines.

As discussed in Section 5.2.4, very large stand-off distances would be required in order to achieve complete certainty of avoidance of subsidence effects on the natural features, including upland swamps. Given the scatter of the upland swamps within the Study Area, avoidance of subsidence effects on the upland swamps would only likely be achievable by not mining the proposed longwalls.

A preliminary minimum stand-off distance of half of the depth of cover from the upland swamps can be used for minimising subsidence impacts at the upland swamps. Assuming a stand-off distance of half of the depth of cover, more than half of the coal within the Study Area would need to be sterilised. A layout indicating the approximate area of sterilised coal, based on a stand-off distance of half of the depth of cover is shown in Drawing MSEC285-23.

It should be noted, however, that this stand-off distance of half of the depth of cover is applied only to the upland swamps. Should the same distance also be applied to other features such as streams, cliffs and overhangs, steep slopes and archaeological sites, the whole of the proposed Study Area would be sterlilised.

5.9. Endangered Ecological Communities

Two vegetation communities mapped within the Study Area and surrounds by Bangalay Botanical Surveys (2008) are listed as EECs on Schedule 1 of the *Threatened Species and Conservation Act, 1995*, being the *Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion* (Map Unit 5a) and *O'Hares Creek Shale Forest* (Map Units 5b and 5r). A discussion on these Vegetation Communities is included in reports by Bangalay Botanical Surveys (2008) and FloraSearch et. al (2008).

The locations of these vegetation communities are shown in Drawing No. MSEC285-07. The predictions and impact assessments for the Endangered Ecological Communities that are within the Study Area are provided in the following sections.

5.9.1. Predictions for the Endangered Ecological Communities

A summary of the maximum predicted values of total systematic subsidence, tilt and strain at the EEC's EEC01 to EEC07, resulting from the extraction of the proposed Longwalls 1 to 44, is provided in Table 5.18.

Table 5.18 Maximum Predicted Total Systematic Subsidence, Tilt and Strain at the Endangered Ecological Communities Resulting from the Extraction of Longwalls 1 to 44

Endangered Ecological Community ID	Vegetation Map Unit[1]	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total or Travelling Tilt (mm/m)	Maximum Predicted Total or Travelling Tensile Strain (mm/m)	Maximum Predicted Total or Travelling Compressive Strain (mm/m)
EEC01	5b	1250	6.3	0.7	0.6
EEC02	5b and 5r	90	0.7	0.1	0.0
EEC03	5b	40	0.2	0.1	0.0
EEC04	5a	1325	6.7	0.8	0.7
EEC05	5a	600	5.6	0.8	0.2
EEC06	5a	955	5.6	0.7	0.6
EEC07	5a	11	0.1	0.0	0.0

[1]Vegetation map unit based on mapping by Bangalay Botanical Surveys (2008)

The values provided in the above table are the maximum predicted systematic subsidence parameters within a 20 metre radius of the perimeter of each EEC and do not include valley related upsidence & closure movements. Valley related upsidence & closure movements are considered below.

The predicted tilts and strains provided in the above table are the maximum values which occur at any time during, or after the extraction of each proposed longwall, whichever is the greater. The predicted subsidence, tilts and strains also include the predicted movements resulting from the extraction of Longwalls 1 to 19A.

5.9.2. Impact Assessments for the Endangered Ecological Communities

The extraction of Longwalls 20 to 44 would not result in any additional subsidence movements, over and above those predicted to occur as a result of Longwalls 1 to 19A, to EEC01, EEC02, EEC03, EEC04, EEC05 or EEC07, situated in the vicinity of Longwalls 18 to 19A (Drawing No. MSEC285-07).

Subsidence movements at EEC08 to EEC14 situated to the east of the Study Area (Drawing No. MSEC285-07), as a result of Longwalls 20 to 44, would be negligible.

The maximum predicted systematic tensile and compressive strains at EEC06 are 0.7 mm/m and 0.6 mm/m, respectively. Fracturing, buckling and/or dilating as a result of systematic compressive strains is therefore not predicted to occur as a result of the extraction of Longwalls 20 to 44. There is potential for cracking to occur due to closure strain, however it is expected to be isolated to the drainage lines that occur in the north and south of EEC06. Away from these drainage lines, EEC06 is not expected to be impacted by valley related movements.

Tensile strains greater than 0.5 mm/m could be of sufficient magnitude to result in the fracturing of the bedrock, which could result in minor surface cracking where the bedrock is thinly bedded. EEC06 is located in an area where the depth of cover varies from approximately 450 metres to 500 metres. Surface cracking as the result of systematic subsidence movements in this location is expected to be isolated and of a minor nature due to the relatively low magnitudes of the predicted strains and due to the relatively high depths of cover.

The maximum predicted total systematic tilt at EEC06 is 5.6 mm/m. The maximum predicted systematic tilt at EEC06 is small when compared to the existing natural surface gradients. The maximum predicted total systematic tilt is comparable to those that would be experienced by the EECs situated in the vicinity of Longwalls 18 to 19A at the Metropolitan Colliery (maximum predicted total systematic tilts up to 6.7 mm/m).

5.9.3. Impact Assessments for the Endangered Ecological Communities Based on Increased Predictions

If the predicted systematic tilts were increased by factors of up to 2 times, the maximum predicted change in grade would still be small when compared to the existing natural gradients.

If the predicted systematic strains were increased by factors of up to 2 times, the likelihood and extent of surface cracking would increase accordingly. As the depth of cover at EEC06 ranges from 450 metres to 500 metres, potential surface cracking would still be expected to be minor.

5.9.4. Consideration of Avoidance/Minimisation of Impacts on Endangered Ecological Communities

There is one EEC (EEC06) identified on Drawing No. MSEC285-07, at the north east corner of the Study Area.

As discussed in Section 5.2.4, very large stand-off distances would be required in order to achieve complete certainty of avoidance of subsidence effects on natural features, including EECs. In addition to EEC06, there are other EECs outside the Study Area to the south west and to the south east of the Study Area. Avoidance of subsidence effects on these EECs would only likely be achievable by not mining the proposed longwalls.

A preliminary minimum stand-off distance of half of the depth of cover from the EECs can be used for minimising subsidence impacts at the EECs. Assuming a stand-off distance of half of the depth of cover from the EECs, a significant quantity of the coal within the Study Area would need to be sterilised. A layout indicating the approximate area of sterilised coal based on a stand-off distance of half of the depth of cover is shown in Drawing MSEC285-24. It should be noted, however, that this drawing shows the stand-off distance applied to only the EECs. Should the same distance also be applied to other features such as streams, cliffs and overhangs, steep slopes, upland swamps and archaeological sites, the whole of the proposed Study Area would be sterlilised.

5.10. Illawarra Railway

There are no railways within the Study Area. The nearest point from the proposed Longwalls 20 to 44 to the Illawarra Railway that links Sydney and Wollongong is located near Cawleys Creek and is approximately 900 metres from the nearest edge of Longwall 44. At this location the rail track would not be subjected to measurable systematic mine subsidence ground movements; however, it would experience small far-field horizontal movements and negligible upsidence and closure movements.

5.10.1. Predictions for the Illawarra Railway

Since the predicted subsidence is negligible we have not prepared profiles of total systematic subsidence, tilt and strain along the alignment of the Illawarra Railway.

The upper limit of observed absolute far-field horizontal movements at this location is approximately 55 mm. A discussion of far-field horizontal movements is presented in Section 5.28 of this report. Far-field horizontal movements tend to be bodily movements towards the extracted goaf area and are accompanied by low levels of strain. These movements generally do not result in impact, except where they occur at long structures which are sensitive to differential horizontal movements.

Valley related upsidence and closure movements could also occur along the railway where the infrastructure crosses valley shaped terrain such as at Cawleys Creek.

As the railway is located more than 900 metres from the nearest edge of the proposed longwalls at Cawleys Creek, the predicted subsidence, upsidence and closure ground movements are much lower than if the railway was to be undermined. However, because the Cawleys Creek crossing is a deep valley, the predicted upsidence and closure movements may be measureable. If the valley related ground movements are calculated based on the valley depths within half the depth of cover on the full valley depth around Cawleys Creek, then, upsidence and closure values of less than 5 mm are predicted.

No mining induced movements are expected at Cawleys Creek from the first fifteen longwalls. By that time the Colliery would have obtained monitoring data in nearby valleys to assist in the detailed predictions of movements within the Cawleys Creek valley.

As the longwalls are extracted near the rail track at Cawleys Creek, monitoring can be undertaken at the end of each longwall to confirm that the observed movements are as small as are being predicted.

5.10.2. Impact Assessments for the Illawarra Railway

The combined effects of upsidence and closure and differential far field movements are small and are unlikely to adversely impact on the railway line at Cawleys Creek.

5.10.3. Recommendations for the Illawarra Railway

As part of a SMP (post Project Approval determination), a monitoring, management and response plan should be established for the railway to the satisfaction of Railcorp, which would include monitoring of the railway as the proposed longwalls are mined near Cawleys Creek, to confirm that the observed ground movements match the predictions. In this way, the railway can be maintained in a safe and serviceable condition throughout the mining period. As part of detailed mine design studies and SMP preparation, a design review should be undertaken including a review of predicted far-field horizontal movements for the Illawarra Railway near the Cawleys Creek crossing.

5.11. Southern Freeway

The Southern Freeway is located to the east of the proposed Longwalls 20 to 44 and the proposed longwalls do not extend below the road pavement. The location of the Southern Freeway is shown in Drawing No. MSEC285-10. The predictions and impact assessments for the Southern Freeway are provided in the following sections. A detailed discussion is provided in Section 5.14 on the predictions and impact assessments for the Southern Freeway bridges.

5.11.1. Predictions for the Southern Freeway

The predicted profiles of incremental, cumulative and total systematic subsidence, tilt and strain along the alignment of the Southern Freeway, resulting from the extraction of the proposed longwalls, are shown in Fig. C.11 in Appendix C. The profiles were predicted along the north bound carriageway which is closer to the proposed longwalls than the south bound carriageway.

A summary of the maximum predicted values of total systematic subsidence, tilt and strain along the alignment of the road, after the extraction of each of the proposed longwalls, is provided in Table 5.19.

Table 5.19 Maximum Predicted Total Systematic Subsidence, Tilt and Strain along the Alignment of the Southern Freeway Resulting from the Extraction of Longwalls 1 to 44

Longwall	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt (mm/m)	Maximum Predicted Total Tensile Strain (mm/m)	Maximum Predicted Total Compressive Strain (mm/m)
After LW25	0	0.0	0.0	0.0
After LW26	2	0.0	0.0	0.0
After LW27	7	0.0	0.0	0.0
After LW28	15	0.1	0.0	0.0
After LW29	20	0.1	0.0	0.0
After LW41	20	0.1	0.0	0.0
After LW42	20	0.1	0.0	0.0
After LW43	25	0.1	0.0	0.0
After LW44	30	0.1	0.0	0.0

As shown in this table, the Southern Freeway would only be subjected to negligible systematic ground movements, principally because the nearest edge of the proposed longwalls is more than 170 metres from the Southern Freeway.

The Southern Freeway would also be subjected to travelling tilts and strains as the extraction faces approach it. For the existing longwall layout, all predicted values of travelling tilts and strains for the Southern Freeway were zero, with the exception of travelling tilts due to Longwalls 43 and 44 which were both 0.1 mm/m.

The Southern Freeway would also be subjected to differential far-field movements and these differential movements could potentially cause minor impacts on the cuttings, embankments, culverts, bridges and the pavement of the Southern Freeway. Section 5.28 provides further discussion on far-field movements.

Valley related upsidence and closure movements could also occur along the Southern Freeway where the infrastructure crosses undulating terrain. The most significant creek crossing along the Southern Freeway and near the proposed Longwalls 20 to 44 is at Cawleys Creek which is adjacent to the proposed Longwall 44.

As the Southern Freeway is located more than 170 metres from the nearest edge of the proposed longwalls at Cawleys Creek, the predicted subsidence, upsidence and closure movements are much lower than if the freeway was undermined. However, because the Cawleys Creek crossing is a deep valley, the predicted upsidence and closure movements should still be considered. If the valley related ground movements are calculated based on the valley depths within half the depth of cover around Cawleys Creek, then, upsidence and closure values of 65 mm and 110 mm respectively are predicted. If the valley related ground movements are calculated based on the full valley depths across this large valley, which is 1 to 2 kilometres wide, then upsidence and closure values of 95 mm and 145 mm respectively are predicted.

Since the combined effects of systematic subsidence, upsidence and closure and differential far-field movements could potentially impact on the freeway embankment and culvert and pavement stability at Cawleys Creek, as part of detailed mine design studies and SMP preparation (post Project Approval determination), a detailed review should be undertaken to the satisfaction of the Roads and Traffic Authority (RTA). No mining induced movements are expected at Cawleys Creek from the first fifteen longwalls. By that time the Colliery would have obtained monitoring data in nearby valleys to assist in the detailed predictions of movements at Cawleys Creek valley.

There are also several deep cuttings along the Southern Freeway. One cutting which is opposite Longwalls 36 to 41 has rock faces that are approximately 22 metres high and more than 1 kilometre long. This cutting is more than 350 metres from the nearest edge of the longwalls and hence it should not be subjected to measurable systematic subsidence movements. However, it is possible that this and the other cuttings could experience differential far-field movements and upsidence and closure movements within the cutting following the release of in-situ stress.

Since the combined effects of upsidence and closure and differential far-field movements could potentially impact on the rock face of the deeper cutting and the pavement stability along the cutting, as observed at some other collieries, as part of detailed mine design studies and SMP preparation (post Project Approval determination), a detailed review of the potential impacts should be undertaken to the satisfaction of the RTA. No mining induced movements are expected at the cuttings from the first ten longwalls. By that time the Colliery would have obtained monitoring data over previously affected smaller cuttings to assist in the detailed predictions of movements at this deeper and longer cutting.

Further discussion on possible impacts to the Southern Freeway from valley related movements is provided below.

5.11.2. Impact Assessments for the Southern Freeway

The maximum predicted systematic tilt at the Southern Freeway within the Study Area, at any time during or after the extraction of the proposed longwalls, is 0.1 mm/m (ie: 0.01 %), or a change in grade of 1 in 10,000. The existing gradients along the alignment of the Southern Freeway within the Study Area vary up to about 60 mm/m (ie: 6 %).

It is unlikely, therefore, that the predicted systematic tilts at the Southern Freeway would result in significant changes in surface water drainage, as the maximum predicted change in grade is less than 1 % and is much less than the typical existing gradients along the alignment of the Southern Freeway within the Study Area.

The maximum predicted systematic tensile and compressive strains at the Southern Freeway within the Study Area, at any time during or after the extraction of the proposed longwalls, are all less than 0.1 mm/m. The minimum radii of curvature associated with the maximum predicted systematic tensile and compressive strains are much greater than 150 kilometres.

Previously Observed Impacts on Roads and Freeways near Metropolitan Colliery

Impacts have occurred at the Southern Freeway during earlier mining at Coal Cliff Colliery and some earlier mining at Metropolitan Colliery, at the locations shown in Drawing No. MSEC285-22. A study of this previous mining (both adjacent to and below the Southern Freeway) was conducted by MSEC to collect a history of impacts on the Southern Freeway pavements due to mining. This study was undertaken with assistance from RTA officers and access to RTA survey data. A summary of the observed data and impacts is as follows:

- The Southern Freeway experienced up to 1.7 metres of subsidence, tilts of up to 10 mm/m and strains up to 1.2 mm/m tensile and 3.0 mm/m compressive.
- Non-systematic movements were observed in a number of locations such as at valley crossings and across geological faults. Peak compressive strains and occasional upsidence were observed in these locations.

- Ground strains were observed to develop gradually, based on monthly surveys. Ground strains have been consistently observed to develop gradually where regular monitoring is undertaken in the Southern Coalfield.
- Impacts were observed along the Southern Freeway during mining. Impacts included cracking to the pavement, damage to drainage structures, kerbs and gutters, and rock cuttings.
- Most of the impacts were located where subsidence was greater than 20 mm. Most of the observed impacts occurred directly above the mined panels. Approximately 60% of the Southern Freeway directly above the mined panels experienced impacts to the pavement, drainage structures, kerb and gutter and other impacts.
- Two step failures and one hump in the pavement were observed.
- Most impacts were reported between 1977 and 1981, during mining at Coal Cliff Colliery. A small number of impacts were reported in 1984 and 1985.
- A review of observed subsidence and strain measurements after the step occurred in the pavement, during mining at Coal Cliff Colliery, indicates that ground strains were probably 1 mm/m, in combination with some upsidence in the subsidence profile.

Southern Freeway traffic was maintained throughout the mining operations and damage was repaired. Two key points from the study are that the majority of impacts to the pavement only occurred where the pavement was located directly above the mined panels, and there was not a suitable monitoring programme in place at the time that would have identified potential impacts prior to occurrence. Current subsidence management practices have much more advanced monitoring and notification systems designed to identify and respond to potential subsidence related impacts.

Summary

No part of the existing Southern Freeway is located over the proposed longwalls. The nearest point of the Southern Freeway to the proposed longwalls is approximately 165 metres from the end of the proposed Longwall 29.

As the magnitudes of the maximum predicted strains are relatively low, potential impacts are likely to be infrequent occurrences and of a minor nature. As part of detailed mine design studies and SMP preparation (post Project Approval determination), a design review should be undertaken to determine specific management measures required to maintain the adequacy of the embankment, culvert and pavement at the Cawleys Creek crossing and the stability of various embankments and cuttings along the Southern Freeway. This detailed design process should result in the preparation of a monitoring, management and response plan to the satisfaction of the RTA. Bridges which would experience differential far field and small upsidence and closure movements are discussed in Section 5.14.

With a suitable monitoring, management and response plan in place, it is expected that the Southern Freeway can be maintained in a safe and serviceable condition throughout the mining period. It is unlikely that the traffic signs and other road infrastructure would suffer potential impacts due to mine subsidence.

5.11.3. Impact Assessments for the Southern Freeway Based on Increased Predictions

If the predicted systematic tilts were increased by factors of up to 2 times, the maximum predicted tilt at the Southern Freeway within the Study Area would be 0.2 mm/m (ie: 0.02 %), or a change in grade of 1 in 5000. It would still be unlikely that the predicted tilts would result in significant changes in surface water drainage, as the maximum predicted change in gradient would still be less than the typical existing gradients along the alignment of the Southern Freeway within the Study Area.

If the maximum predicted systematic strains were increased by factors of up to 2 times, the maximum predicted tensile and compressive strains would still be less than 0.1 mm/m, but the likelihood and extent of cracking in the road surface would not be expected to increase by an appreciable amount. As the magnitudes of the maximum predicted strains are relatively low, it would still be likely that potential impacts could be easily repaired using normal road maintenance techniques.

5.11.4. Recommendations for the Southern Freeway

As part of detailed mine design studies and SMP preparation (post Project Approval determination), a design review should be undertaken to determine specific management measures required. This detailed design process should result in the preparation of a monitoring, management and response plan for the Southern Freeway for the extraction of Longwalls 20 to 44 to the satisfaction of the RTA, in order to monitor subsidence movements and maintain the pavement in a safe and serviceable condition throughout the mining period.

5.12. Princes Highway

The Princes Highway crosses over the north east corner of the proposed mining area and would be affected by the mining of Longwalls 32 to 44. The location of the Princes Highway in relation to the proposed and previously extracted workings is shown in Drawing No. MSEC285-10.

The Princes Highway lies above the previously mined panels at Metropolitan Colliery near Kelly's Creek to the south of the proposed Longwall 20, and development headings to the east of Longwalls 20 to 28. Impacts observed along the Princes Highway due to this past mining were less than those observed along the Southern Freeway principally because of the differences in the road pavement construction. It appears that the more flexible pavement construction along the Princes Highway can accommodate greater ground movements than the more rigid limestone/sandstone/blast furnace slag and asphalt pavement construction of the Southern Freeway.

The predictions and impact assessments for the Princes Highway are provided in the following sections.

5.12.1. Predictions for the Princes Highway

The predicted profiles of incremental and total systematic subsidence, tilt and strain along the alignment of the Princes Highway, resulting from the extraction of the proposed longwalls, are shown in Fig. C.10 in Appendix C. The profiles were predicted along the known centreline of the road. A summary of the maximum predicted values of incremental systematic subsidence, tilt and strain along the alignment of the road, after the extraction of each of the proposed longwalls, is provided in Table 5.20.

Table 5.20 Maximum Predicted Incremental Systematic Subsidence, Tilt and Strain along the Alignment of the Princes Highway Resulting from the Extraction of Longwalls 20 to 44

Longwall	Maximum Predicted Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt (mm/m)	Maximum Predicted Incremental Tensile Strain (mm/m)	Maximum Predicted Incremental Compressive Strain (mm/m)
Due To LW28	1	0.0	0.0	0.0
Due To LW29	3	0.0	0.0	0.0
Due To LW30	3	0.0	0.0	0.0
Due To LW31	15	0.1	0.0	0.0
Due To LW32	75	0.5	0.1	0.1
Due To LW33	170	1.1	0.2	0.3
Due To LW34	285	3.3	0.4	0.6
Due To LW35	285	3.0	0.4	0.7
Due To LW36	285	2.0	0.4	0.9
Due To LW37	285	2.0	0.4	0.9
Due To LW38	285	2.0	0.4	0.9
Due To LW39	285	2.3	0.4	0.5
Due To LW40	285	3.2	0.5	1.2
Due To LW41	650	4.1	0.7	1.6
Due To LW42	655	4.1	0.7	1.6
Due To LW43	660	4.1	0.7	1.6
Due To LW44	665	4.1	0.7	1.5

The maximum predicted incremental systematic subsidence parameters along the Princes Highway due to the extraction of Longwalls 20 to 27 are all zero since these longwalls are a significant distance from the Princes Highway. The results for Longwalls 20 to 27 have therefore been excluded from this table.

A summary of the maximum predicted values of total systematic subsidence, tilt and strain along the alignment of the road, after the extraction of each of the proposed longwalls, is provided in Table 5.21.

Table 5.21 Maximum Predicted Total Systematic Subsidence, Tilt and Strain along the Alignment of the Princes Highway Resulting from the Extraction of Longwalls 1 to 44

Longwall	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt (mm/m)	Maximum Predicted Total Tensile Strain (mm/m)	Maximum Predicted Total Compressive Strain (mm/m)
After LW27	1	0.0	0.0	0.0
After LW28	2	0.0	0.0	0.0
After LW29	4	0.0	0.0	0.0
After LW30	7	0.0	0.0	0.0
After LW31	16	0.1	0.0	0.0
After LW32	90	0.5	0.1	0.0
After LW33	198	1.2	0.2	0.2
After LW34	360	2.6	0.4	0.6
After LW35	428	3.1	0.4	0.6
After LW36	441	3.1	0.6	0.7
After LW37	443	3.1	0.6	0.7
After LW38	443	3.1	0.6	0.7
After LW39	443	3.1	0.6	0.7
After LW40	443	3.6	0.6	0.9
After LW41	785	4.2	0.6	1.1
After LW42	968	4.3	0.6	1.0
After LW43	1102	4.4	0.7	1.0
After LW44	1155	4.5	0.7	1.0

The maximum predicted incremental systematic subsidence parameters along the Princes Highway due to the extraction of Longwalls 20 to 26 are all zero since these longwalls are a significant distance from the Princes Highway. The results for Longwalls 20 to 26 have therefore been excluded from this table.

The Princes Highway would also be subjected to travelling tilts and strains as the extraction faces of the proposed longwalls pass beneath it. A summary of the maximum predicted travelling tilts and strains at the Princes Highway, during the extraction of each of the proposed longwalls, is provided in Table 5.22.

Table 5.22 Maximum Predicted Travelling Tilts and Strains at Princes Highway during the Extraction of Longwalls 20 to 44

Longwall	Maximum Predicted Travelling Tilt (mm/m)	Maximum Predicted Travelling Tensile Strain (mm/m)	Maximum Predicted Travelling Compressive Strain (mm/m)
During LW32	0.3	0.0	0.0
During LW33	0.6	0.1	0.1
During LW34	2.1	0.3	0.2
During LW35	1.7	0.2	0.2
During LW36	0.9	0.1	0.1
During LW37	0.9	0.1	0.1
During LW38	0.9	0.1	0.1
During LW39	1.2	0.2	0.1
During LW40	1.7	0.2	0.2
During LW41	1.9	0.2	0.2
During LW42	2.0	0.2	0.2
During LW43	2.0	0.3	0.2
During LW44	2.0	0.3	0.2

Longwalls 20 to 31 do not pass below the Princes Highway and this results in negligible predicted travelling systematic subsidence parameters along the Princes Highway. The results for Longwalls 20 to 31 have therefore been excluded from this table.

The Princes Highway does not cross any significant drainage lines. It is unlikely, therefore, that the road would be subjected to any significant valley related upsidence or closure movements resulting from the extraction of the proposed longwalls.

5.12.2. Impact Assessments for the Princes Highway

The maximum predicted systematic tilt at the road within the Study Area, at any time during or after the extraction of the proposed longwalls, is 4.5 mm/m (ie: 0.5 %), or a change in grade of 1 in 220. The existing gradients along the alignment of the road within the Study Area vary up to a maximum of about 65 mm/m (ie: 7 %).

It is unlikely, therefore, that the predicted systematic tilts at the road would result in significant changes in surface water drainage, as the maximum predicted change in grade is less than 1 % and is much less than the typical existing gradients along the alignment of the road within the Study Area.

The maximum predicted total systematic tensile and compressive strains at the road within the Study Area, at any time during or after the extraction of the proposed longwalls, are 0.7 mm/m and 1.1mm/m respectively. The minimum radii of curvature associated with the maximum predicted systematic tensile and compressive strains are 21 kilometres and 9 kilometres respectively.

The road is of flexible construction with a bitumen seal and is likely to tolerate strains of these magnitudes without significant impact. It is possible that minor cracking could occur in some places along the road, due to localised concentrations of tensile strains, and that minor rippling of the road surface could occur in other places, due to localised concentrations of compressive strains. As the magnitudes of the maximum predicted strains are relatively low, potential impacts are likely to be infrequent occurrences and of a minor nature.

As part of the SMP process (post Project Approval determination), a monitoring, management and response plan should be established for the Princes Highway to the satisfaction of the RTA and Wollongong City Council, which should include measures to remediate potential impacts using normal road maintenance techniques. With these remediation measures in place, it is expected that the road can be maintained in a safe and serviceable condition throughout the mining period.

5.12.3. Impact Assessments for the Princes Highway Based on Increased Predictions

If the predicted systematic tilts were increased by factors of up to 2 times, the maximum predicted tilt at the Princes Highway within the Study Area would be 9 mm/m (ie: 0.9 %), or a change in grade of 1 in 110. It would still be unlikely that the predicted tilts would result in significant changes in surface water drainage, as the maximum predicted change in gradient is still less than the typical existing gradients along the alignment of the road within the Study Area.

If the maximum predicted systematic strains were increased by factors of up to 2 times, the likelihood and extent of potential cracking in the road surface would increase accordingly. As the magnitudes of the maximum predicted strains are relatively low, however, it would still be expected that potential impacts could be easily repaired using normal road maintenance techniques. With these remediation measures in place, it is expected that the road can be maintained in a safe and serviceable condition throughout the mining period.

5.12.4. Recommendations for the Princes Highway

As part of the SMP process (post Project Approval determination), a monitoring, management and response plan should be established for the Princes Highway to the satisfaction of the RTA and Wollongong City Council, which should include monitoring of the Princes Highway as the proposed longwalls are mined beneath it, so that potential impacts can be identified and remediated accordingly.

In this way, the road can be maintained in a safe and serviceable condition throughout the mining period. It is unlikely that the traffic signs and other road infrastructure would suffer potential impacts due to mine subsidence.

5.13. Fire Trails and Four Wheel Drive Tracks

The locations of the four wheel drive tracks and fire roads within and adjacent to the Study Area are shown in Drawing No. MSEC285-10. Many of these tracks and road sections are located directly above the proposed longwalls. The tracks and roads would therefore experience the full range of subsidence movements during the extraction of the proposed longwalls, which are provided in Chapter 4.

Predicted profiles of incremental, and total systematic subsidence, tilt and strain along the alignment of three fire roads, 9E, 9G and 9J, resulting from the extraction of the proposed longwalls, are shown in Fig. C.07, C.08, and C.09 in Appendix C.

It is possible that the tracks and roads could experience surface tension cracking during the mining period, particularly where the tracks and roads are located near the tops of existing slopes. To date, the only surface tension crack reported at Metropolitan Colliery is adjacent to the Fire Road 9H which is near the top of a steep slope. The size and extent of surface tension cracking on slopes is expected to be minor and similar to that observed during the extraction of previous longwalls at the Metropolitan Colliery. It is recommended that the tracks and roads be monitored during mining.

Woronora Dam road is a concrete road that extends from the Princes Highway to Woronora Dam. The nearest point of the road to the proposed longwalls is at the intersection of the road with the Princes Highway and is approximately 45 metres from Longwall 44. Approximately 920 metres of the road from the Princes Highway is within the Study Area. It is possible that the concrete road could experience minor cracking during the mining of proposed Longwall 44. It is recommended that the tracks and roads be monitored during mining.

5.14. Bridges

There are four road bridges and two road culverts along the Southern Freeway on the eastern side of the proposed mining area. Most of the bridges lie outside of the Study Area, however due to the sensitivity of bridges to movements, and in particular horizontal movements, they have been included in this assessment. The locations of the bridges are shown in Drawing No. MSEC285-10. A summary of the bridge details is provided in Table 5.23.

Table 5.23 Summary of Bridge Details along the Southern Freeway

Bridge Name	RTA Name	RTA Chainage from Sydney	Nearest proposed Longwall	Approximate Distance to nearest proposed longwall (metres)
Princes Highway Underpass 1	Twin Bridges over Princes Hwy	31 Miles 3,091Feet (50 kilometres 831.1metres)	21	715
Princess Highway Underpass 2	Twin Bridges over Princes Hwy	30 Miles 1,326Feet (48 kilometres 684.5metres)	31	200
Cawleys Road Overpass	Overbridge at Cawley Road	28 Miles 1,350Feet (45 kilometres 473.1metres)	44	435
Cawleys Creek Culvert	Not known	Not known	44	195
Road Culvert	Not known	Not known	44	1,820
Princess Highway Overpass	Overbridge at 27M.1120FT.	27 Miles 1,120Feet (43 kilometres 793.7metres)	44	2,050

5.14.1. Predictions for the Bridges

One bridge and one culvert are located within the Study Area, namely the Princes Highway Underpass 2 and Cawleys Creek Culvert, which are approximately 200 metres and 195 metres respectively to the nearest of the proposed longwalls. All other bridges and the road culverts are located outside the Study Area and are not expected to be subjected to any significant systematic subsidence movements (i.e. less than 20 mm of subsidence).

The values of predicted systematic Subsidence, Tilt and Strain for each of the bridges and the road culverts are also summarised on Fig. C.11 in Appendix C. The predicted Maximum Total Systematic Subsidence at the Princes Highway Underpass 2 is 12 mm and predicted Maximum Total Systematic Tilt is 0.01 mm/m. The location of the bridge at Princes Highway Underpass 2 is shown on the plot of predicted systematic subsidence parameters for the Southern Freeway, which is presented in Fig. C.11.

The bridges and the road culvert located outside the Study Area are not expected to be subjected to any significant subsidence movements, however they may experience small far field horizontal movements towards the proposed longwalls and small valley related upsidence and closure movements. The bridge at Princes Highway Underpass 2 may also experience far field horizontal movements towards the proposed longwalls.

While absolute incremental vertical and horizontal movements are important to understand, mine subsidence impacts to surface features, and to bridges in particular, occur due to the influence of differential movements. If the bridges and their abutments all move in a uniform manner in magnitude and direction, there would be no impact. However, if the ground moves differentially across the bridge and its abutments, impacts might be experienced.

A discussion of far-field horizontal movements is provided in Section 5.28 of this report and in Section 1.7 of the online document "General Discussion of Mine Subsidence Ground Movements" which can be downloaded from www.minesubsidence.com. The online document includes a plot of observed incremental horizontal movements for survey pegs that are located over solid coal.

It can be seen from this plot that, at a distance of approximately 200 metres from the nearest goaf edge, the potential absolute far-field horizontal movements resulting from the extraction of the proposed Longwalls 20 to 44 could vary from approximately 150 mm to less than 20 mm, depending on the distance from the extracted longwall.

As part of detailed mine design and SMP preparation (post Project Approval determination), a detailed study of the absolute and relative horizontal movements should be undertaken for each bridge location near to the longwalls to be extracted. The study should also include a review of the possible upsidence and closure movements at the bridge due to the changes in valley levels around the bridge and the distribution of systematic subsidence movements.

The Southern Freeway overpass/underpass bridges are generally located in saddles along the tops of ridges. There is a large database of monitored valley upsidence and closure movements of pegs in the base of valleys. Based on the few cases from locations in saddles along the tops of ridges that are available, and the change in surface levels along these saddles, we would expect that the upsidence and closure at these bridges would be lower than the predicted values shown in Fig. C.11.

5.14.2. Impact Assessments for the Bridges

On 9 September 1985, the DMR reported surface cracking across the pavement of the bridge at Princes Highway Underpass 1, see Drawing No. MSEC285-10, along the line of what appeared to be expansion joints. Separation between the wing wall and earth fill at the bridges were also reported. The nearest active mining at the time of reporting was approximately 480 metres south of the bridges, at Metropolitan Colliery.

The bridge at Princes Highway Underpass 1 was monitored for subsidence movements during mining. Ground survey records in this area suggested that vertical subsidence was less than 20 mm and ground strains were small although they were less than survey tolerance. Far-field horizontal movements were not measured.

The predicted systematic subsidence movements and relative horizontal movements from the proposed Longwalls 20 to 44 at the Southern Freeway bridges are small, less than survey tolerance and are not expected to have any significant impact on the bridges.

Potential minor impacts could result from the predicted small far-field horizontal movements and upsidence and closure movements at the bridges along the Southern Freeway, particularly those bridges that are located within 1 kilometre of the proposed longwalls. A preliminary structural assessment of three of the bridges (Underpass No.1, Underpass No. 2, and Cawley Bridge) has been carried out by Cardno (2008). The assessment indicated that the Underpass No. 2 and Cawley Bridge had a capacity to tolerate only low magnitudes of ground movement.

It is expected, however, that potential impacts from far field movements can be managed through the establishment of a suitable management plan as part of detailed mine design studies and SMP preparation (post Project Approval determination).

5.14.3. Recommendations for the Bridges

As part of detailed mine design studies and SMP preparation (post Project Approval determination), it is recommended that a detailed study of the bridges along the Southern Freeway be undertaken to review the potential impacts of far-field horizontal movements and review the absolute and relative horizontal movements for each bridge. This study should also include a detailed review of possible upsidence and closure movements that could occur at these bridges which are generally located in saddles along the tops of ridges. The review of the Princes Highway Underpass 2 should also include consideration of the distribution of systematic subsidence movements.

The detailed ground movement predictions should be then used to review the potential impacts to the bridges and to input into the design of specific management measures required.

A monitoring, management and response plan should be established for the bridges to the satisfaction of the RTA, in order to both monitor subsidence movements and to maintain the bridges in a safe and serviceable condition throughout the mining period.

Consideration of the potential impacts on the Southern Freeway, including potential impacts to the road pavement and cuttings, are outlined in Section 5.11.

5.15. Electrical Services

The locations of the 330 kV transmission line and towers and the 132 kV power line are shown in Drawings Nos. MSEC285-11 to MSEC285-14. The predictions and impact assessments for these electrical services are provided in the following sections.

5.15.1. Predictions for the Electrical Services

The 330 kV transmission line and the 132 kV power line and towers are all located along the eastern side of the proposed Longwalls 20 to 44 and based on the existing longwall layout, the longwalls would not pass beneath these electrical services.

The predicted profiles of incremental, and total systematic subsidence, tilt along and tilt across the alignment of the 330 kV transmission line, resulting from the extraction of the proposed Longwalls 20 to 44, are shown in Fig. C.13 in Appendix C.

A summary of the maximum predicted values of incremental systematic subsidence, tilt along the alignment, tilt across the alignment and ground strain, after the extraction of each of the proposed longwalls, is provided in Table 5.24.

Table 5.24 Maximum Predicted Incremental Systematic Subsidence, Tilt Along, Tilt Across and Strain at the 330 kV Transmission Line Resulting from the Extraction of Longwalls 20 to 44

Longwall	Maximum Predicted Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt Along Alignment (mm/m)	Maximum Predicted Incremental Tilt Across Alignment (mm/m)	Maximum Predicted Incremental Tensile Strain (mm/m)	Maximum Predicted Incremental Compressive Strain (mm/m)
Due To LW20	0	0.0	0.0	0.0	0.0
Due To LW21	6	0.0	0.1	0.0	0.0
Due To LW22	7	0.0	0.1	0.0	0.0
Due To LW23	15	0.1	0.2	0.0	0.0
Due To LW24	19	0.1	0.2	0.0	0.0
Due To LW25	16	0.1	0.2	0.0	0.0
Due To LW26	24	0.2	0.3	0.0	0.1
Due To LW27	36	0.3	0.4	0.0	0.1
Due To LW28	39	0.3	0.4	0.0	0.1
Due To LW29	15	0.1	0.1	0.0	0.0
Due To LW30	15	0.1	0.1	0.0	0.0
Due To LW31	15	0.1	0.1	0.0	0.0
Due To LW32	16	0.1	0.1	0.0	0.0
Due To LW33	17	0.1	0.1	0.0	0.0
Due To LW34	43	0.2	0.4	0.0	0.0
Due To LW35	43	0.2	0.3	0.0	0.0
Due To LW36	44	0.2	0.3	0.0	0.0
Due To LW37	46	0.2	0.4	0.0	0.0
Due To LW38	46	0.2	0.4	0.0	0.0
Due To LW39	46	0.2	0.4	0.0	0.0
Due To LW40	47	0.2	0.4	0.0	0.0
Due To LW41	48	0.2	0.4	0.0	0.0
Due To LW42	50	0.3	0.4	0.0	0.0
Due To LW43	50	0.3	0.4	0.0	0.1
Due To LW44	50	0.3	0.5	0.0	0.1

The transmission line would also be subjected to travelling tilts and strains as the extraction faces of the proposed longwalls approach the transmission line. The maximum predicted travelling tilts and strains at the 330 kV transmission line, resulting from the extraction of the proposed Longwalls 20 to 44, are less than 0.2 mm/m and less than 0.1 mm/m respectively.

A summary of the maximum predicted values of total systematic subsidence, tilt along the alignment, tilt across the alignment and ground strain at the towers within the Study Area, after the extraction of the proposed Longwalls 1 to 44, is provided in Table 5.25.

Table 5.25 Maximum Predicted Total Systematic Subsidence, Tilt Along, Tilt Across and Strain at the Towers within the Study Area Resulting from the Extraction of Longwalls 1 to 44

Location	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt Along Alignment (mm/m)	Maximum Predicted Total Tilt Across Alignment (mm/m)	Maximum Predicted Total Tensile Strain (mm/m)	Maximum Predicted Total Compressive Strain (mm/m)
After LW20	0	0.0	0.0	0.0	0.0
After LW21	6	0.0	0.1	0.0	0.0
After LW22	11	0.0	0.1	0.0	0.0
After LW23	19	0.1	0.2	0.0	0.0
After LW24	29	0.1	0.3	0.0	0.0
After LW25	31	0.1	0.3	0.0	0.0
After LW26	34	0.2	0.4	0.0	0.0
After LW27	49	0.3	0.5	0.0	0.1
After LW28	63	0.3	0.6	0.0	0.1
After LW29	65	0.2	0.7	0.0	0.1
After LW30	65	0.2	0.7	0.0	0.1
After LW31	65	0.2	0.7	0.0	0.1
After LW32	65	0.2	0.7	0.0	0.1
After LW33	65	0.2	0.7	0.0	0.1
After LW34	65	0.2	0.7	0.0	0.1
After LW35	75	0.2	0.7	0.0	0.1
After LW36	84	0.3	0.7	0.0	0.1
After LW37	91	0.3	0.7	0.0	0.1
After LW38	98	0.3	0.8	0.0	0.1
After LW39	102	0.3	0.8	0.0	0.1
After LW40	105	0.3	0.8	0.0	0.1
After LW41	106	0.3	0.8	0.0	0.1
After LW42	106	0.3	0.8	0.0	0.1
After LW43	106	0.3	0.9	0.0	0.1
After LW44	106	0.4	0.9	0.0	0.1

5.15.2. Impact Assessments for the Electrical Services

The cables along the transmission lines are not directly affected by ground strains, as they are supported by the towers above ground level. The cables can, however, be affected by the changes in bay lengths, ie: the distances between the towers at the level of the cables, which result from mining induced differential subsidence, horizontal ground movements and lateral movements at the tops of the towers due to tilting of the towers. The stabilities of the towers can also be affected by the mining induced tilts and ground strains at the location of each tower and by changes in the catenary profiles of the cables.

The maximum predicted systematic tilt at the transmission line anywhere within the Study Area is 0.9 mm/m (ie: 0.09 %), or a change in gradient of 1 in 1110. The associated predicted systematic horizontal movement at the base of a tower with a tilt of 0.9 mm/m is 14 mm. Based on a tower height of 50 metres, the maximum predicted systematic tilt and maximum predicted systematic horizontal movement at the base of the tower results in a maximum predicted horizontal movement of 60 mm at the top of the tower, which is orientated across the alignment of the transmission line.

The predicted horizontal movements at the tops of the towers are expected to result in small changes in the catenary profiles of the aerial cables, which in turn could result in differential horizontal loads on the towers.

The maximum predicted systematic tensile and compressive strains at the transmission line anywhere within the Study Area are <0.1 mm/m and 0.1 mm/m, respectively. The minimum radii of curvature associated with a strain of 0.1 mm/m is 150 kilometres. The maximum predicted systematic strains could result in increased stresses within the tower structural members.

As part of detailed mine design and SMP preparation (post Project Approval determination), it is recommended that the predicted movements at the transmission towers and transmission line are provided to TransGrid and Integral Energy for assessment to aid in preparation of specific management measures required for the towers. A monitoring, management and response plan should be established to the satisfaction of TransGrid and Integral Energy so that the transmission lines can be maintained in a safe and serviceable condition throughout the mining period. With the implementation of these management strategies, it is unlikely that there would be a significant impact on the transmission lines resulting from the extraction of the proposed longwalls.

Other powerlines are located in the Study Area, as shown in Drawings Nos. MSEC285-11 to MSEC285-14. The powerlines are located mainly along the line of the roads and in the Garrawarra Complex, on conventional powerpoles. These powerpoles would be subjected to the full range of systematic subsidence movements detailed in Section 4. Powerpoles are designed as flexible structures which can tolerate substantial movements. It is therefore expected that the maximum predicted subsidence parameters would not have a significant impact on the powerpoles. As part of detailed mine design and SMP preparation (post Project Approval determination), it is recommended that the predicted movements over the Study Area, resulting from the extraction of the proposed Longwalls 20 to 44, be provided to TransGrid and Integral Energy to check whether the predicted subsidence movements can be accommodated.

The 330 kV transmission line and 132 kV power line pass over some drainage lines along the eastern side of the Study Area and as such may experience small valley related subsidence movements. The most significant drainage line passing below the transmission and power lines is Cawleys Creek which is adjacent to the proposed Longwall 44. The predictions of upsidence and closure movements are both 45 mm. The maximum predicted upsidence and compressive strain due to valley closure movements would occur in the base of the drainage line, away from the locations of the towers and are unlikely, therefore, to have any significant impact on the electrical services. The predicted closure is small across this valley and is not expected to significantly impact on the power lines.

5.15.3. Impact Assessments for the Electrical Services Based on Increased Predictions

If the predicted systematic tilts were increased by a factor of 2 times, the maximum predicted systematic tilt at the transmission line would be 1.8 mm/m and the resulting maximum predicted horizontal movement at the top of the tower would be 120 mm.

If the predicted systematic strains were increased by a factor of 2 times, the maximum predicted systematic tensile and compressive strains at the transmission lines would be <0.1 mm/m and 0.2 mm/m, respectively.

As part of detailed mine design and SMP preparation (post Project Approval determination), it is recommended that a detailed structural review of the transmission line be undertaken by TransGrid and Integral Energy, which would include appropriate factors of safety applied in the design of specific management measures required for the towers.

5.15.4. Recommendations for the Electrical Services

As part of detailed mine design and SMP preparation (post Project Approval determination), it is recommended that the predicted movements at the 330 kV transmission line and 132 kV power line are provided to TransGrid and Integral Energy respectively so that a detailed design review can be undertaken for the transmission towers.

5.16. Sydney Water Infrastructure

The Sydney Water pipelines over the proposed mining area include 100 mm to 300 mm (most are 200 mm and 300 mm) diameter CICL watermains that extend from the Woronora Dam to Helensburgh, and a 150 mm diameter PVC pressure main sewer which extends northward from the Garrawarra Complex and connects to a 450 mm diameter pressure main outside the Study Area. The locations of the service lines are shown in Drawings Nos. MSEC285-11 to MSEC285-14. The watermain pipeline shown following Woronora Dam road and the Princes Highway is yet to be constructed. This pipeline would be designed and constructed to allow for possible mine subsidence movements.

Predictions were carried out for one of the watermains, which is labelled Watermains in Drawing No. MSEC285-11, as this watermain is the largest in pressure and length, and traverses the Study Area including over one drainage line. Potential subsidence impacts on the other watermains within the Study Area would be less than those predicted below. The predictions and impact assessments for the pipeline are provided in the following sections.

5.16.1. Predictions for the Sydney Water Pipelines

The predicted profiles of systematic subsidence, tilt and strain along the alignment of the Sydney Water Watermains Pipeline are shown in Fig. C.12 in Appendix C. A summary of the maximum predicted values of total systematic subsidence, tilt and strain along the alignment of the pipeline, after the extraction of each of the proposed longwalls, is provided in Table 5.26.

Table 5.26 Maximum Predicted Total Systematic Subsidence Parameters along the Sydney Water Pipeline Resulting from the Extraction of Longwalls 1 to 44

Longwall	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt (mm/m)	Maximum Predicted Total Tensile Strain (mm/m)	Maximum Predicted Total Compressive Strain (mm/m)
After LW36	7	0.0	0.0	0.0
After LW37	32	0.0	0.0	0.0
After LW38	94	0.0	0.1	0.0
After LW39	684	0.0	0.3	-0.3
After LW40	976	0.3	0.2	-0.5
After LW41	1112	0.8	0.2	-0.5
After LW42	1166	1.0	0.2	-0.5
After LW43	1182	1.0	0.2	-0.5
After LW44	1186	1.1	0.2	-0.5

The maximum predicted total systematic subsidence parameters along the Sydney Water pipeline after the extraction of Longwall 20 through to Longwall 35 are all zero since these longwalls are a significant distance from the pipeline. The results for Longwall 20 to Longwall 35 have therefore been excluded from this table.

The pipeline would also be subjected to travelling tilts and strains as the extraction faces of the proposed longwalls pass beneath it. A summary of the maximum predicted travelling tilts and strains at the pipeline, during the extraction of each of the proposed longwalls, is provided in Table 5.27.

Table 5.27 Maximum Predicted Travelling Tilts and Strains along the Sydney Water Pipeline during the Extraction of Longwalls 20 to 44

Longwall	Maximum Predicted Travelling Tilt (mm/m)	Maximum Predicted Travelling Tensile Strain (mm/m)	Maximum Predicted Travelling Compressive Strain (mm/m)
During LW32	0.1	0.0	0.0
During LW33	0.1	0.0	0.0
During LW34	0.4	0.1	0.0
During LW35	0.7	0.1	-0.1
During LW36	1.0	0.1	-0.1
During LW37	1.3	0.2	-0.1
During LW38	1.7	0.2	-0.2
During LW39	2.0	0.3	-0.2
During LW40	2.0	0.2	-0.2
During LW41	1.9	0.2	-0.2
During LW42	1.9	0.2	-0.2
During LW43	1.9	0.2	-0.2
During LW44	2.1	0.3	-0.2

The maximum predicted travelling systematic subsidence parameters along the Sydney Water pipeline due to the extraction of Longwall 20 to Longwall 31 are all zero since these longwalls are a significant distance from the pipeline. The results for Longwall 20 to Longwall 31 have therefore been excluded from this table.

Most of the pipelines are laid along existing ridgelines and do not cross any major drainage lines and, hence, are unlikely to be subjected to any valley related upsidence or closure movements. One section of the pipeline, however, does cross a confluence where a tributary joins the Waratah Rivulet, which is above the maingate of Longwall 44. It is possible, therefore, that this section of the pipeline could be subjected to valley related upsidence or closure movements resulting from the extraction of the proposed longwalls. The predicted valley related upsidence and closure movements at this location resulting from the extraction of Longwalls 20 to 44 are 90 mm and 165 mm respectively. The predicted maximum closure strain associated with the maximum predicted closure, resulting from the extraction of the proposed Longwalls 1 to 44, is 9.9 mm/m.

5.16.2. Impact Assessments for the Sydney Water Pipelines

Since the pipelines over the mining area comprise rising and pressure mains they are unlikely to be affected to any great extent by changes in gradient due to subsidence or tilt.

The maximum predicted systematic tensile and compressive strains at the pipeline are 0.3 mm/m and 0.5 mm/m, respectively, and the associated minimum radii of curvature are 75 kilometres and 30 kilometres, respectively. These predicted strains have the potential to impact on the pipelines and as part of the SMP process (post Project Approval determination), a review of potential impacts on other undermined pipelines is recommended.

Previous mining below several kilometres of monitored pipelines has been completed at the Appin and Tahmoor Collieries with minimal impacts on the pipelines. A summary of the observed impacts are outlined below.

Appin Longwalls 301 and 302 mined beneath a 150 mm diameter and a 300 mm diameter CICL pipeline. The maximum predicted systematic tensile and compressive strains along these pipelines were 0.7 mm/m and 1.2 mm/m, respectively, which are greater than those predicted for the Sydney Water watermains pipeline above the Metropolitan colliery.

To date, two impacts on the CICL pipelines have been reported as a result of the extraction of Appin Longwalls 301 and 302, both being leaking joints, one at a creek crossing and the other at a location of maximum predicted systematic strain. Appin Longwalls 301 and 302 mined beneath a length of 580 metres of each of these pipelines, that is, a total length of 1,160 metres of CICL pipeline.

Tahmoor Longwalls 22, 23A, 23B and 24B have mined beneath a total length of 14,000 metres of CICL pipeline, having diameters ranging between 100 and 375 mm. The predicted systematic strains along the pipelines at Tahmoor Colliery varied, but reached a maximum of 1.3 mm/m in tension and 1.8 mm/m in compression. To date, there has been only one reported impact on these pipelines, being a leaking joint, which resulted from a non-systematic movement due to a near surface geological feature.

It is possible, therefore, that the extraction of the proposed Longwalls 20 to 44 could result in some minor potential impacts, such as leaking joints, along the Sydney Water pipelines. Based on the experiences at Appin and Tahmoor Collieries, potential impacts are expected to be infrequent and of a relatively minor nature. A monitoring, management and response plan should be established for the watermains to the satisfaction of Sydney Water in order to both monitor subsidence movements and to maintain the pipelines in a serviceable condition throughout the mining period.

5.16.3. Impact Assessments for the Sydney Water Pipelines Based on Increased Predictions

If the predicted systematic subsidence or tilts along the Sydney Water pipeline were increased by factors of up to 2 times, it would be unlikely to result in a significant impact on the pipelines, as the pipelines are rising mains.

If the predicted systematic tensile and compressive strains along the Sydney Water pipeline were increased by factors of up to 2 times, the values would still be lower than those predicted for Appin colliery. Based on the experiences at Appin and Tahmoor Collieries, it would be expected that potential impacts on the pipe joints would be relatively isolated, of a minor nature and easily repairable. With the implementation of necessary remediation measures, the pipeline can be maintained in a serviceable condition throughout the mining period.

5.16.4. Recommendations for the Sydney Water Pipelines

As part of detailed mine design and SMP preparation (post Project Approval determination), it is recommended that the predicted movements along the Sydney Water pipelines, resulting from the extraction of Longwalls 20 to 44, are reviewed by Sydney Water, to aid in the preparation of specific management measures required for the proposed longwalls. With the implementation of these management measures, the pipeline can be maintained in a serviceable condition during and after the extraction of the proposed Longwalls 20 to 44.

5.17. Optical Fibre Cable

The main optical fibre cables generally follow the alignment of the transmission line easement and include Telstra, Optus, and Nextgen. There are other Telstra owned optical fibre cables that extend from the Woronora Dam, and pass through the Garrawarra Complex. The location of the optical fibre cables are shown in Drawings Nos. MSEC285-11 to MSEC285-14. The predictions and impact assessments for the optical fibre cables are provided in the following sections.

5.17.1. Predictions for the Optical Fibre Cable

The predicted profiles of incremental, and total systematic subsidence, tilt and strain along the alignment of the main optical fibre cables (ie: along the line of the transmission easement) are shown in Fig. C.14 in Appendix C. A summary of the maximum predicted values of total systematic subsidence, tilt and strain along the alignment of the main optical fibre cables after the extraction of each of the proposed longwalls, is provided in Table 5.28.

Table 5.28 Maximum Predicted Total Systematic Subsidence, Tilt and Strain along the main Optical Fibre Cables Resulting from the Extraction of Longwalls 1 to 44

Longwall	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt (mm/m)	Maximum Predicted Total Tensile Strain (mm/m)	Maximum Predicted Total Compressive Strain (mm/m)
After LW20	0	0.0	0.0	0.0
After LW21	3	0.0	0.0	0.0
After LW22	9	0.0	0.0	0.0
After LW23	22	0.1	0.0	0.0
After LW24	27	0.2	0.0	0.0
After LW25	28	0.2	0.0	0.0
After LW31	28	0.2	0.0	0.0
After LW32	38	0.2	0.0	0.0
After LW33	45	0.3	0.1	0.0
After LW34	67	0.3	0.1	-0.1
After LW35	76	0.3	0.1	0.0
After LW36	78	0.3	0.1	0.0
After LW44	78	0.3	0.1	0.0

The maximum predicted total subsidence parameters along the optical fibre cable are identical from Longwall 25 through to Longwall 31 and from Longwall 36 through to Longwall 44 and the intermediate identical results have been excluded from Table 5.28.

The main optical fibre cables would also be subjected to travelling tilts and strains as the extraction faces of the proposed longwalls approach them. The maximum predicted tilt and strain values are less than 0.3 mm/m and 0.1 mm/m respectively.

Most of the optical fibre cables do not cross any significant drainage lines and would, therefore, not be subjected to any significant valley related upsidence and closure movements. At one location in the north east of the Study Area, however, the optical fibre cable crosses Cawleys Creek. It is possible at this location, that the cable could be subjected to valley related upsidence or closure movements resulting from the extraction of the proposed longwalls. The valley related upsidence and closure at this location, resulting from the extraction of the proposed Longwalls 1 to 44, are 95 mm and 155 mm respectively. The maximum predicted compressive strain due to closure at Cawleys Creek, resulting from the extraction of the proposed Longwalls 1 to 44, is 9.7 mm/m.

5.17.2. Impact Assessments for the Optical Fibre Cable

The optical fibre cables within the Study Area are unlikely to be affected by the tilts resulting from the extraction of the proposed longwalls. The cables, however, are likely to experience the ground strains resulting from the extraction of the proposed longwalls.

The maximum predicted systematic tensile and compressive strains along the main optical fibre cable, at any time during or after the extraction of the proposed longwalls, are both equal to or less than 0.1 mm/m. The minimum radii of curvature associated with the maximum predicted systematic tensile and compressive strains are greater than 150 kilometres.

The optical fibre cables at other locations within the Study Area are generally encompassed by the locations of the transmission lines, the Princes Highway, Garrawarra Complex and the Sydney Water pipelines. Based on predicted systematic tensile and compressive strains for the transmission lines, the Princes Highway, Garrawarra Complex and the Sydney Water Pipelines, the maximum tensile and compressive strains at the optical fibre cables at any time during or after the extraction of the proposed longwalls is expected to be no greater than 0.7 mm/m and 1.6 mm/m respectively.

Based on previous experience of mining beneath optical fibre cables, it has been found that optical fibre cables can typically tolerate tensile strains of up to 4 mm/m without significant impact. It is expected, therefore, that the optical fibre cable could tolerate the predicted systematic tensile strains resulting from the extraction of the proposed longwalls.

The tensile strains in the optical fibre cables can be higher, however, where the cables connect to the support structures, which may act as anchor points, preventing any differential movements that may have been allowed to occur within the ground. Tree roots have also been known to anchor cables to the ground. The extent to which the anchor points affect the ability of the cable to tolerate the mine subsidence movements depends on the cable size, type, age, installation method and ground conditions.

In addition to this, optical fibre cables contain additional fibre lengths over the sheath length, where the individual fibres are loosely contained within tubes. Compression of the sheath can transfer to the loose tubes and fibres and result in "micro-bending" of the fibres constrained within the tubes, leading to higher attenuation of the transmitted signal. If the maximum predicted systematic compressive strains were to be fully transferred into the optical fibre cables, the strains could be of sufficient magnitude to result in a reduction in the capacity of the cables or transmission loss.

An optical fibre cable was mined beneath at Appin colliery by two longwalls and there were no reported impacts. The maximum predicted systematic tensile and compressive strains along this cable were 0.7 mm/m and 0.8 mm/m, respectively, which are much lower than the predicted strains for the main cable that runs along the eastern side of the proposed Study Area, but less than those predicted for the cables over the proposed longwalls.

5.17.3. Impact Assessments for the Optical Fibre Cables based on Increased Predictions

If the predicted systematic movements along the optical fibre cables were to be increased by factors of up to 2 times, the predicted systematic tensile strain along the cables would still be less than 4 mm/m and unlikely, therefore, to result in a significant impact on the cables. It would be possible, however, that elevated strains could occur at any anchor points along the cables during the extraction of the proposed longwalls. It is expected, however, that the cables can be maintained in a serviceable condition by monitoring and the implementation of suitable mitigation measures if elevated strains were detected.

5.17.4. Recommendations for the Optical Fibre Cables

It is recommended that the optical fibre cables are monitored during the extraction of the proposed longwalls using optical fibre sensing techniques, such as Optical Time Domain Reflector (OTDR) monitoring. Management measures can be undertaken, such as excavating and exposing the cables, if a strain concentration is detected during mining. With the required management measures in place, the optical fibre cables can be maintained in a serviceable condition throughout the mining period.

A monitoring, management and response plan should be established for the optical fibre cables prior to mining the proposed Longwalls 20 to 44, to the satisfaction of the owners of the optical fibre cables.

5.18. Copper Telecommunications Cables

The locations of the copper telecommunications cables within the Study Area are shown in Drawings Nos. MSEC285-11 to MSEC285-14. The predictions and impact assessments for the copper telecommunications cables are provided in the following sections.

5.18.1. Predictions for the Copper Telecommunications Cables

The copper telecommunications cables are located over the north east and eastern parts of the Study Area and are generally encompassed by the locations of the transmission lines, the Princes Highway, Garrawarra Complex, and the Sydney Water pipelines. Based on predicted systematic tensile and compressive strains for the transmission lines, the Princes Highway, Garrawarra Complex and the Sydney Water Pipelines, the maximum tensile and compressive strains at the copper cables any time during or after the extraction of the proposed longwalls is expected to be no greater than 0.7 mm/m and 1.6 mm/m respectively.

The minimum radii of curvature associated with the maximum predicted systematic tensile and compressive strains are 21 kilometres and 9.5 kilometres, respectively.

5.18.2. Impact Assessments for the Copper Telecommunications Cables

The copper telecommunication cables are direct buried and are unlikely, therefore, to be impacted by tilt. The cables, however, are likely to experience the ground strains resulting from the extraction of the proposed longwalls.

The age of the copper telecommunication cables is uncertain at present, however, it is expected that older cables, which are typically air filled lead sheathed cable would be able to tolerate some tensile strains without impact. More modern copper telecommunication cables can, in some cases, tolerate tensile strains of up to 20 mm/m without impact.

It is unlikely, therefore, that the copper telecommunication cables would be potentially impacted by the predicted systematic strains resulting from the extraction of the proposed longwalls. It is possible, however, that the cables could experience locally elevated tensile strains where they are anchored to the ground by associated infrastructure, or by tree roots. It is unlikely, however, given the relatively low magnitudes of the predicted systematic strains that there would be a significant impact on the copper telecommunication cables at any anchor points.

5.18.3. Impact Assessments for the Copper Telecommunications Cables Based on Increased Predictions

If the predicted systematic movements along the copper telecommunications cables were increased by factors of up to 2 times, the predicted systematic tensile strains along the cables would still be less than 4 mm/m and unlikely, therefore, to result in a significant impact on the cables. It would be possible, for elevated strains to occur at any anchor points along the cables during the extraction of the proposed longwalls. It is unlikely, however, given the relatively low magnitudes of the predicted systematic strains that there would be a significant impact on the copper telecommunication cables at any anchor points, even if the predictions were exceeded by a factor of 2 times.

5.18.4. Recommendations for the Copper Telecommunications Cables

A monitoring, management, and response plan should be established for the copper telecommunications cables, prior to mining the proposed Longwalls 20 to 44, to the satisfaction of Telstra.

5.19. Garrawarra Complex

The Garrawarra Complex is listed with the Heritage Office of the NSW Department of Planning as a heritage conservation area with a number of items of heritage significance. There are a total of 85 building structures located within the Garrawarra Complex, comprising 57 residential or hospital buildings and 28 structures that have been labelled as sheds. There are also 7 tanks located within the Garrawarra Complex. Structural details for the buildings and structures were determined from:

- aerial photographs;
- cadastral information;
- historical images of the complex;
- review of the Conservation Plan for Garrawarra Centre for Aged Care (Howard Tanner & Associates, 1993); and
- limited access to the Garrawarra Complex.

A detailed description of Garrawarra Complex is provided in the report by Heritage Management Consultants (2008) included in Appendix I of the Metropolitan Coal Project Environmental Assessment.

The locations of the buildings and structures within the Garrawarra Complex area are shown in Drawing Nos. MSEC285-11 to MSEC285-13 and details are provided in Table D.02 in Appendix D. The impact assessments for the residential or hospital buildings are provided in the following sections.

The impact assessments for other structures are provided in Sections 5.20 and 5.21. Since the Longwalls 1 to 19A are a long distance from the Garrawarra Complex, they would not impact on the Garrawarra Complex, and as a result, the predicted cumulative and total subsidence parameters are the same.

5.19.1. Predictions for the Buildings

Predictions of systematic subsidence, tilt and strain have been made at the centroid and at the vertices of each building within the Garrawarra Complex, as well as eight equally spaced points placed radially around the centroid and vertices at a distance of 20 metres. In the case of a rectangular shaped building, therefore, predictions have been made at a minimum of 45 points within and around the structure.

The assessed impacts on the buildings were determined using the method outlined in the background report entitled *Mine Subsidence Damage to Building Structures (Revision A)* which can be obtained from *www.minesubsidence.com*. The systematic subsidence parameters were categorised according to Table 5.29 and Table 5.30 below.

Table 5.29 Classification of Tilt Impacts to Buildings

Impact Category	Mining Induced Ground Tilt (mm/m)*	Description
A	< 5	Unlikely that remedial work will be required.
B	5 to 7	Adjustment to roof drainage and wet area floors might be required.
C	7 to 10	Minor structural work might be required to rectify tilt. Adjustments to roof drainage and wet area floors will probably be required and remedial work to surface water drainage and sewerage systems might be necessary.
D	> 10	Considerable structural work might be required to rectify tilt. Jacking to level or rebuilding could be necessary in the worst cases. Remedial work to surface water drainage and sewerage systems might be necessary.

* mm/m: millimetres per metre

Table 5.30 Classification of Strain Impacts to Buildings

Impact Category	Description of typical impact to walls and required repair	Approximate crack width limit
0	Hairline cracks.	< 0.1 mm
1	Fine cracks which do not need repair.	0.1 mm to 1.0 mm
2	Cracks noticeable but easily filled. Doors and windows stick slightly.	1 mm to 5 mm
3	Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weather-tightness often impaired.	5 mm to 15 mm, or a number of cracks 3 mm to 5 mm in one group
4	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window or door frames distort. Walls lean or bulge noticeably. Some loss of bearing in beams. Service pipes disrupted.	15 mm to 25 mm but also depends on number of cracks
5	As above but worse, and requiring partial or complete rebuilding. Roof and floor beams lose bearing and need shoring up. Windows broken with distortion. If compressive damage, severe buckling and bulging of the roof and walls.	> 25 mm

Systematic subsidence predictions were made for all the buildings within the Garrawarra Complex on an iterative basis, calculating the predicted potential impacts and corresponding impact categories (as defined in Table 5.29 and Table 5.30 above) for a range of longwall layouts. A summary of this assessment is provided in Section 5.19.2 below.

5.19.2. Impact Assessments for the Buildings

Preventive measures are generally not recommended for buildings unless the impact assessments exceed Category C for tilt or Category 3 for strain, or greater. However, given the heritage value associated with buildings in the Garrawarra Complex, we have assumed that in the Garrawarra Complex, impacts should not exceed Category A or B for tilt and Category 0 or 1 for strain. A heritage specialist was consulted and has assessed the potential impacts to the heritage items within the Garrawarra Complex (Appendix I of the Metropolitan Coal Project Environmental Assessment), based on up to Category B tilt impacts and Category 1 strain impacts.

Using the existing empirical model for assessing impacts resulting from strain, we have assessed the level of strain that would be required to result in negligible impacts to the large buildings, similar to those associated with a Category 0 or 1 strain impact. It was assessed that the maximum tensile or compressive strain at the large buildings resulting from the extraction of Longwalls 20 to 44, should not exceed 0.3 mm/m.

Potential subsidence impacts at the Garrawarra Complex are not predicted to occur until Longwall 38 is mined. As part of detailed mine design studies and SMP preparation (post Project Approval determination), a structural analysis of the buildings and a design review would be required to determine a preferred longwall layout that would maintain tilt impacts of no more than Category A or B and strain impacts of no more than Category 0 or 1 at the heritage buildings within the Garrawarra Complex. The design review should take into consideration monitoring results from previous longwalls at the Metropolitan Colliery.

5.19.3. Impact Assessments for Buildings Based on the Potential for Non-Systematic Movements

It is possible that some residential and hospital buildings may experience adverse potential impacts from non-systematic subsidence movements. The potential reasons for the non-systematic movements include the influence of geological structures and, where the buildings are located close to drainage lines, the influence of valley related movements. In some cases, the reason for an observed irregular movement cannot be explained and these are termed “anomalies”.

The locations of non-systematic or anomalous movements cannot be predicted prior to mining. Based on a study of the residential buildings that were impacted by mining at Tahmoor Colliery the probability of a residential building above the proposed Longwalls 20 to 44 having moderate or greater damage as a result of a non-systematic or anomalous movement is less than 1%.

A discussion on the potential for non-systematic movements is provided the background report entitled *General Discussion of Mine Subsidence Ground Movements* which can be obtained from *www.minesubsidence.com*.

5.19.4. Consideration of Avoidance/Minimisation of Impacts on the Garrawarra Complex

Consideration was given to avoiding and minimising subsidence impacts at the Garrawarra Complex.

In order to achieve complete certainty of avoidance of impacts, then no longwall mining should occur within a zone around the Garrawarra Complex and no subsidence movements should be measured at the Garrawarra Complex. In order to achieve minimal subsidence impacts then small movements would be acceptable and normally a distance of half the depth of cover would be applicable.

The difficulty in determining a suitable distance for complete certainty lies with the level of accuracy of data at large distances from mined longwalls. This difficulty is also compounded by the fact that, at large distances from goaf edges, the expected small movements caused by longwall extraction are below the typical accuracy of current survey methods.

A preliminary study was undertaken by MSEC for HCPL in February 2008 to assess the minimisation of impacts on the Garrawarra Complex. The preliminary study looked at minimising the impacts from subsidence effects by limiting the assessed impact categories for the buildings to a tilt impact category of no greater than Category A or B and a strain impact category of no greater than Category 0 or 1. A discussion of predictions and impact assessments for the Garrawarra Complex is provided above in Sections 5.19.1 and 5.19.2. Since the assessed tilt impacts were already no greater than Category A or B, it was assessed that in order to achieve a strain impact of no greater than Category 0 or 1, the maximum predicted tensile or compressive strain at the large buildings resulting from the extraction of Longwalls 20 to 44 should not exceed 0.3 mm/m. In order to limit the maximum predicted tensile or compressive strain at the large buildings to no greater than 0.3 mm/m, Longwalls 40, 41 and 42 would need to be reduced in length by at least 700 metres, 610 metres and 580 metres respectively. If the final mine design is constrained so as to achieve the above categories, then expected impacts to the buildings resulting from systematic subsidence movements would be negligible.

It should be noted that these assessments should be reviewed with data made available during the mining of Longwalls 20 to 39 to determine suitable stand-off distances for the Garrawarra Complex, should they be required.

5.19.5. Impact Assessments for the Buildings Based on Increased Predictions

If the predicted systematic subsidence parameters were to be increased by factors of 1.25 to 5 times, the potential impacts on the buildings would increase accordingly. As discussed above, as part of detailed mine design studies and SMP preparation (post Project Approval determination), a design review would be required to determine a preferred longwall layout that would maintain tilt impacts of no more than Category A or B and strain impacts of no more than Category 0 or 1, based on increased predictions, at the heritage buildings within the Garrawarra Complex.

5.19.6. Recommendations for the Residential and Hospital Buildings

The assessed potential impacts on the residential and hospital buildings in the Garrawarra Complex resulting from the predicted systematic subsidence parameters can be managed if suitable management strategies are implemented. As part of detailed mine design studies and SMP preparation (post Project Approval determination), a detailed design review would be required to determine appropriate management strategies. A management and response plan, developed to the satisfaction of the Department of Health, should include the requirement for all residential and hospital buildings located above the proposed longwalls to be inspected, prior mining, to assess the existing condition and to undertake a design review to determine whether any specific management measures may be required. It is also recommended that the residential and hospital buildings are visually monitored during the extraction of the proposed longwalls.

5.19.7. Non-Residential Building Structures

The predictions and impact assessments for the sheds and tanks are provided in Sections 5.21 and 5.22, respectively.

5.19.8. Internal Roads

The internal roads within the Garrawarra Complex are of ashphaltic concrete construction. The internal roads would be subjected to similar predicted subsidence movements as the transmission lines, the Princes Highway, Garrawarra Complex, and the Sydney Water pipelines. Based on predicted systematic tensile and compressive strains for the transmission lines, the Princes Highway, Garrawarra Complex and the Sydney Water Pipelines, the maximum tensile and compressive strains at any time during or after the extraction of the proposed longwalls is expected to be no greater than 0.7 mm/m and 1.6 mm/m respectively. The minimum radii of curvature associated with the maximum predicted systematic tensile and compressive strains are 21 kilometres and 9.5 kilometres, respectively.

The internal roads are considered to be of flexible construction with a bitumen seal and are likely to tolerate strains of these magnitudes without significant impact. It is possible that minor cracking could occur in some places along the roads, due to localised concentrations of tensile strains, and that minor rippling of the road surface could occur in other places, due to localised concentrations of compressive strains.

As the magnitudes of the maximum predicted strains are relatively low, potential impacts are likely to be infrequent occurrences and of a minor nature. It is recommended that the internal roads be monitored during mining. Potential cracks should be repaired to the satisfaction of the SESIHS.

5.19.9. Cemetery

There is a cemetery located approximately 900 metres to the south of the Garrawarra Complex, over the eastern end of the proposed Longwall 37, as shown in Drawings Nos. MSEC285-11 and MSEC285-12. The Wollongong Council LEP 1990 identifies the cemetery as an item of heritage significance. The Conservation Plan for the Garrawarra Centre for Aged Care (Howard Tanner & Associates, 1993) provides the following information on the cemetery:

- The cemetery was closed when the Sanatorium closed (i.e. now the Garrawarra Complex), which was in 1957;
- No maintenance has been carried out since it closed;
- The cemetery has been recolonised by neighbouring bushland;
- The cemetery is described as "*Mounds in ground, some broken pieces of marble. Overgrown with Eucalyptus haemastoma,…. and other indigenous vegetation*";
- The condition is described as "*poor – little remains to identify this area as the Cemetery*"

The cemetery is located in an area of relatively flat topography and is close to the upland swamps that have been identified as S43 to S45, as shown in Drawing No. MSEC285-07.

The maximum predicted total systematic subsidence at the cemetery, after the extraction of the proposed Longwall 44 is 690 mm. The maximum predicted total systematic tilt at the cemetery, after the extraction of the proposed Longwall 44 is 5.3 mm/m. The maximum predicted total tensile and compressive strains at the cemetery, during or after the extraction of the proposed Longwall 44 are 0.6 mm/m and 0.3 mm/m respectively. These site specific predictions are the maximum predicted values of subsidence, tilt, curvature and strain within 20 metres of the perimeter of the cemetery.

The description of the cemetery indicates that it is mostly overgrown with vegetation and little remains of any headstones or fencing. It is unlikely that existing headstones or fencing, if any, would be affected by the predicted maximum tilt of 5.3 mm/m.

It is possible that some minor cracking of the surface soils in the cemetery could occur as a result of the extraction of the proposed Longwalls 20 to 44, but it is unlikely that surface cracks in the soil would exceed 20 mm in width. Further details on the potential for surface cracking are provided in Section 5.31.1. If these cracks eventuate they can be identified by regular survey inspections and surface cracking can be readily overcome by infilling with soil or other suitable materials, or by locally regrading and compacting the surface.

5.20. Houses

The locations of houses within or near the Study Area are shown in Drawings Nos. MSEC285-11 to MSEC285-14. There are several houses near the Study Area, but, there are only two houses located within the Study Area, which are structure numbers E01a and E03a, as shown in Drawing No. MSEC285-14.

The Wollongong council LEP 1990 lists two houses at Lots 713 and 911, DP 752033 (43 Princes Highway) as items of heritage significance. These houses are not listed in the NSW Heritage Council online database. The two houses are identified by structure numbers E01a and E02a as shown in Drawing No. MSEC285-14. Although Structure E02a is outside the Study Area, predicted subsidence parameters and assessed impact categories were provided for this structure because of its heritage value.

All of the above three houses are located to the east of the proposed Longwalls 20 to 44. The nearest house to the proposed longwalls is E01a, which is about 250 metres to the east of Longwall 29.

The predicted subsidence parameters and assessed impact categories for each of these three houses, E01a, E02a, and E03a are provided in Table D.02 in Appendix D. This table also provides predictions at each of the identified structures within the Study Area and the structures are listed alphabetically.

5.20.1. Predictions for the Houses

Predictions of systematic subsidence, tilt and strain have been made at the centroid, at the vertices of each structure, and at eight equally spaced points placed radially around the centroid and vertices at a distance of 20 metres. In the case of a rectangular shaped structure, therefore, predictions have been made at a minimum of 45 points within and around the structure.

The maximum of these predicted values of systematic subsidence, tilt and strain have been determined, during and after the extraction of each proposed longwall, for each structure within the Study Area in order to provide further conservatism in the predicted subsidence parameters. An additional strain of 0.2 mm/m has been added to the magnitude of the predicted strains, when the predicted subsidence is greater than 20 mm, to account for the scatter in observed strain profiles.

The assessed potential impacts on the structures were determined using the method outlined in the background report entitled *Mine Subsidence Damage to Building Structures (Revision A)* which can be obtained from *www.minesubsidence.com*.

The maximum predicted subsidence and the impact assessments for tilt and strain for each house within the Study Area are provided in Tables D.02. The maximum predicted subsidence, tilt and strain for these houses listed in Table D02 are <20 mm, 0.1 mm/m and 0.1 mm/m respectively. The maximum predicted radius of curvature associated with the maximum strain is 150 kilometres.

5.20.2. Impact Assessments for the Houses

The assessed tilt impact for all three houses, resulting from the extraction of each longwall, was Category A. The assessed strain impact for all three houses, resulting from the extraction of each longwall, was Category 0. No houses are therefore assessed to experience a tilt impact greater than Category A or strain impact greater than Category 0. Based on these categories, any effects to these houses as a result of subsidence would be of a minor nature. Any effects could be easily remedied using well established building repair techniques.

Preventive measures are generally not recommended for houses unless the impact assessments exceed Category C for tilt or Category 3 for strain. There are no houses within the Study Area that have been assessed to experience a Category C tilt impact or a Category 3 strain impact, or greater, at any stage of the mining period. Provided that houses are in a sound condition, they are expected to remain in a safe and serviceable condition throughout the mining period.

No preventive measures are recommended for the houses prior to the extraction of Longwalls 20 to 44. A heritage specialist has assessed the potential impacts to the heritage values of the houses at 43 Princes Highway. Given the small predicted values of ground movement, it is unlikely that preventive measures would be required.

5.20.3. Impact Assessments for Houses Based on the Potential for Non-Systematic Movements

It is possible that some houses may experience adverse potential impacts from non-systematic subsidence movements. The potential reasons for the non-systematic movements include the influence of geological structures and, where the structures are located close to drainage lines, the influence of valley related movements. In some cases, the reason for an observed irregular movement cannot be explained and these are termed “anomalies”.

The locations of non-systematic or anomalous movements cannot be predicted prior to mining. Based on a study of the residential buildings that were impacted by mining at Tahmoor Colliery the probability of a residential building above the proposed Longwalls 20 to 44 having moderate or greater damage as a result of a non-systematic or anomalous movement is less than 1%. The study at Tahmoor Colliery included mining directly beneath or adjacent to approximately 800 houses, rural building structures and public amenities.

A discussion on the potential for non-systematic movements is provided the background report entitled *General Discussion of Mine Subsidence Ground Movements* which can be obtained from *www.minesubsidence.com*.

5.20.4. Impact Assessments for the Houses Based on Increased Predictions

If the predicted systematic subsidence parameters were to be increased by factors of 1.25 to 5 times, the potential impacts on the houses would increase accordingly. The impact assessments for tilt and strain for the houses based on increased predictions do not change from the Categories given above (ie: tilt impact Category A and strain impact Category 0).

Remedial measures may be required for these structures, after the extraction of the proposed longwalls, if the predictions were exceeded by a factor of up to 1.5 times. With remedial measures in place, it is unlikely that there would be any significant impact on the houses resulting from the extraction of the proposed longwalls.

5.20.5. Recommendations for the Houses

It is recommended that all houses be inspected, prior to extraction of nearby longwalls, to assess the existing condition and whether any management measures may be required. It is also recommended that the houses are visually monitored during the extraction of the proposed longwalls.

5.20.6. Non-Residential Building Structures

The predictions and impact assessments for the sheds and tanks are provided in Sections 5.21 and 5.22, respectively.

5.20.6.1. Swimming Pools

There is one privately owned swimming pool (Structure Type P – ID E03p01) that has been identified within the Study Area, the location of which is shown in Drawing No. MSEC285-14.

Predictions of systematic subsidence, tilt and strain have been made at the centroid and at the corners of each pool, as well as eight equally spaced points placed radially around the centroid and corners at a distance of 20 metres.

The pool is located to the east of the proposed longwalls and is about 300 metres from the end of Longwall 28. The maximum predicted systematic tilt at the pool, at any time during or after the extraction of the proposed longwalls is 0.1 mm/m (ie: 0.01 %) or a change in grade of 1 in 10000. The maximum predicted change in gradient at the pool is much less than 1 % and is unlikely, therefore, to result in any significant impacts on the serviceability of the pool. While the predicted systematic tilts are not expected to result in a loss of capacity for the pool, it is noted that tilts are more readily noticeable to property owners, particularly if the walls of the pool are tiled, as the height of the freeboard would vary along the length of the pool.

The maximum predicted systematic tensile and compressive strains at the pool are both less than 0.1 mm/m. The minimum radii of curvature associated with the maximum predicted tensile and compressive strains are greater than 150 kilometres, respectively.

The pool would not be directly mined beneath and is about 300 metres from the nearest longwall. The pool is unlikely, therefore, to be impacted as a result of the extraction of Longwalls 20 to 44.

5.20.6.2. On-Site Waste Water Systems

The residences on the properties within the Study Area are likely to have on-site waste water systems. The predicted systematic subsidence parameters at the on-site waste water systems are similar to those at the houses which they serve, which are summarised in Tables D.02 in Appendix D, as these are the maximum values which occur within 20 metres of the houses.

Apart from the Garrawarra Complex, which is serviced by a sewer main, the residences on the rural properties within the Study Area are all located to the east of the proposed longwalls. The maximum predicted systematic subsidence at the on-site waste water systems is <20 mm.

The maximum predicted systematic tilt at the on-site waste water systems is 0.2 mm/m (ie: 0.02 %), or a change in grade of 1 in 500, which represents a change in grade of less than 1 % and is unlikely, therefore, to have any significant impact on the systems. The maximum predicted tilt could be of sufficient magnitude to affect the serviceability of buried pipes between the houses and the on-site waste water systems, if the existing grades of these pipes were small, say less than 1 %. Potential impacts that occurred on the buried pipes in the location of maximum predicted tilt would be expected to be minor and easily repaired.

The maximum predicted systematic tensile and compressive strains at the on-site waste water systems are both <0.1 mm/m, and the associated minimum radii of curvature are greater than 150 kilometres. On-site waste water system tanks are generally small, typically less than 3 metres in diameter, and are constructed from reinforced concrete, and are usually bedded in sand and backfilled. It is unlikely, therefore, that the maximum predicted systematic strains would result in any significant impacts on the tank structures themselves.

It is possible, however, that the buried pipelines associated with the on-site waste water tanks could be potentially impacted by the predicted systematic strains if they are anchored by the tanks or other structures in the ground. Potential impacts are expected to be of a minor nature, including leaking pipe joints, and could be easily repaired. With these remediation measures in place, it would be unlikely that there would be any long term impact on the pipelines associated with the on-site waste water systems.

If the predicted systematic subsidence parameters at the on-site waste water systems were to be increased by factors of 1.25 to 2 times, it would still be unlikely to result in any significant impact on the tank structures themselves. The likelihood of potential impact on the buried pipelines would, however, increase accordingly.

5.21. Rural Building Structures

There are 32 rural building structures (Structure Type R) that have been identified within the Study Area, which include farm sheds, garages and other non-residential structures.

The locations of the rural building structures are shown in Drawings Nos. MSEC285-11 to MSEC285-14 and details are provided in Table D.02 in Appendix D. The impact assessments for the rural building structures within the Study Area are provided in the following sections.

5.21.1. Predictions for the Rural Building Structures

Predictions of systematic subsidence, tilt and strain have been made at the centroid and at the vertices of each rural building structure, as well as eight equally spaced points placed radially around the centroid and vertices at a distance of 20 metres. In the case of a rectangular shaped structure, predictions have been made at a minimum of 45 points within and around the structure.

At these points, the maximum predicted values of systematic subsidence, tilt and strain have been determined during and after the extraction of each proposed longwall, for each rural building structure. An additional strain of 0.2 mm/m has been added to the magnitude of the predicted strains, where the predicted subsidence is greater than 20 mm, to account for the scatter which is generally observed in strain profiles.

The assessed impacts on the rural building structures were determined using the method outline in the background report entitled *Mine Subsidence Damage to Building Structures (Revision A)* which can be obtained from *www.minesubsidence.com.*

The maximum predicted subsidence and the impact assessments for tilt and strain for each rural building structure within the Study Area are provided in Table D.02. A summary of the tilt and strain impact assessments for the rural building structures within the Study Area, after the extraction of each of the proposed longwalls from Longwall 34 onwards, is provided in Table 5.31.

Table 5.31 Summary of Impact Assessments for Tilt and Strain for the Rural Building Structures within the Study Area after the Extraction of Each Proposed Longwall

Longwall	Tilt Impact Categories				Strain Impact Categories					
	Cat A	Cat B	Cat C	Cat D	Cat 0	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5
After LW34	32	0	0	0	0	32	0	0	0	0
After LW35	32	0	0	0	0	32	0	0	0	0
After LW36	32	0	0	0	0	32	0	0	0	0
After LW37	32	0	0	0	0	32	0	0	0	0
After LW38	32	0	0	0	0	32	0	0	0	0
After LW39	32	0	0	0	0	32	0	0	0	0
After LW40	31	1	0	0	0	32	0	0	0	0
After LW41	31	1	0	0	0	32	0	0	0	0
After LW42	31	1	0	0	0	32	0	0	0	0
After LW43	31	1	0	0	0	32	0	0	0	0
After LW44	31	1	0	0	0	32	0	0	0	0

It can be seen from the above table, that no rural building structures are assessed to experience a tilt impact greater than Category B, and only one rural building structure is assessed to experience a tilt impact greater than Category A. It can also be seen from the above table that that no rural building structures are assessed to experience a strain impact greater than Category 1.

5.21.2. Impact Assessments for the Rural Building Structures

Preventive measures are generally not recommended for rural building structures unless the impact assessments exceed Category D for tilt or Category 4 for strain. This is due to the relatively flexible types of construction of these structures.

It should be noted that the structure types within the Garrawarra Complex were determined from available documentation and from aerial photographs. Therefore, there may be some structures within the complex that were assessed as rural building structures but may have some heritage significance associated with them.

There are no rural building structures which are assessed to experience a Category D tilt impact or a Category 4 strain impact at any stage of mining. Provided that the rural building structures are in a sound condition, they are expected to remain in a safe and serviceable condition throughout the mining period. Preventive measures are not therefore recommended for the rural building structures prior to the extraction of Longwalls 20 to 44.

5.21.3. Impact Assessments for the Rural Building Structures Based on Increased Predictions

If the predicted systematic subsidence parameters were to be increased by factors of 1.25 to 5 times, the potential impacts on the rural structures would increase accordingly. The impact assessments for tilt and strain for the rural building structures based on increased predictions are provided in Table D.02 and are summarised in Table 5.32.

Table 5.32 Summary of the Tilt and Strain Impact Assessments for the Rural Building Structures within the Study Area Based on Increased Predictions

Increased Prediction	Number of Rural Structures with Tilt Impact Assessment for Increased Predictions				Number of Rural Structures with Strain Impact Assessment for Increased Predictions					
	Cat A	Cat B	Cat C	Cat D	Cat 0	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5
x 1.25	30	2	0	0	30	2	0	0	0	0
x 1.50	30	1	1	0	29	3	0	0	0	0
x 1.75	30	0	2	0	29	3	0	0	0	0
x 2.00	30	0	1	1	26	6	0	0	0	0
x 5.00	12	18	0	2	6	19	7	0	0	0

If the predictions were to be increased by a factor of up to 1.5 times, the maximum assessed tilt and strain impacts on the rural building structures would be Category C and Category 1, respectively. It would be expected, therefore, that no significant remedial measures would be required for the rural building structures, even if the predictions were to be exceeded by a factor of up to 1.5 times.

If the predictions were to be increased by a factor of up to 2 times, there would be 1 rural building structure assessed as a Category D impact and 6 rural building structures assessed as Category 1 strain impacts. It would be expected, therefore, that some of these structures may require remedial measures for tilt, if the predictions were to be exceeded by a factor of up to 2 times. It would be expected, however, that all rural building structures would remain in a safe and serviceable condition throughout the mining period, even if the predictions were exceeded by a factor of up to 2 times.

5.21.4. Recommendations for the Rural Building Structures

The assessed impacts on the rural buildings structures resulting from the predicted systematic subsidence parameters can be managed with the implementation of suitable management strategies.

It is recommended that the rural building above the proposed longwalls should be inspected, prior to mining, to assess the existing condition and whether preventive measures may be required. It is also recommended that the rural building structures are visually monitored during the extraction of the proposed longwalls.

Structures within the Garrawarra Complex that were labelled as rural structures have been assessed by a heritage specialist (Heritage Management Consultants, 2008).

5.22. Tanks

There are seven tanks (Structure Type T) that have been identified within the Study Area. The locations of the tanks are shown in Drawings Nos. MSEC285-11 to MSEC285-14. The impact assessments for the tanks within the Study Area are provided in the following sections.

5.22.1. Predictions for the Tanks

Predictions of systematic subsidence, tilt and strain have been made at the centroid and at points located around the perimeter of each tank, as well as at points located at a distance of 20 metres from the perimeter of each tank. Most of the tanks are located in the Garrawarra Complex, near existing structures and are, therefore, subjected to predicted systematic subsidence movements similar to the structures within the Garrawarra Complex.

The maximum predicted systematic tilt at the tanks, after the completion of any of the proposed longwalls, is 4.5 mm/m (ie: 0.5 %), or a change in grade of 1 in 220. The maximum predicted systematic tensile and compressive strains at the tanks, at any time during or after the extraction of the proposed longwalls, are 0.9 mm/m and 1.0 mm/m, respectively, and the associated minimum radii of curvature 17 kilometres and 15 kilometres, respectively.

5.22.2. Impact Assessments for the Tanks

Tilt can affect the serviceability of tanks by altering the water levels in the tanks, which can in turn affect the minimum level of water which can be released from the taps. The maximum predicted systematic tilt at the tanks within the Study Area of 4.5 mm/m represents a change in grade of less than 1 % and is unlikely, therefore, to have any significant impact on the serviceability of the tanks.

The maximum predicted systematic tensile and compressive strains at the tanks are 0.9 mm/m and 1.0 mm/m, respectively. The ground strains are unlikely to be transferred into the tanks where the tanks are founded on a ground slab or on natural ground. In these cases, it is unlikely that the tanks would be potentially impacted by the predicted systematic strains.

It is possible, however, that buried water pipelines associated with the tanks within the Study Area could be potentially impacted by the predicted systematic strains if they are anchored by the tanks, or by other structures in the ground. Potential impacts are expected to be of a minor nature, including leaking pipe joints, and could be easily repaired. With remedial measures readily available, it would be unlikely that there would be any significant impacts on the pipelines associated with the tanks.

5.22.3. Impact Assessments for the Tanks Based on Increased Predictions

If the predicted systematic subsidence parameters at the tanks were to be increased by factors of 1.25 to 2 times, the maximum predicted tilt at the tanks would be 9 mm/m, which is in the order of 1 % and unlikely, therefore, to result in any significant impact on the serviceability of the tanks.

It would be unlikely that the ground strains would be transferred into the tanks themselves, even if the predicted systematic strains were increased by factors of 1.25 to 2 times. The likelihood of potential impacts on the associated buried water pipelines would increase accordingly, however, at these magnitudes of strain it would be expected that potential impacts would still be of a minor nature and could be easily repaired. With remedial measures readily available, it would be unlikely that there would be any significant impacts on the pipelines associated with the tanks.

5.22.4. Recommendations for the Tanks

The assessed impacts on the tanks and associated infrastructure resulting from the predicted systematic subsidence parameters can be managed with the implementation of suitable management strategies. It is recommended that the tanks are visually monitored during the mining period.

5.23. Farm Dams

There is one dam (Structure Type D) that has been identified within the Study Area. The dam is located over the chain pillar between the proposed Longwalls 43 and 44 and the location of the dam is shown in Drawing No. MSEC285-12. The predictions and impact assessments for the dam are provided in the following sections.

5.23.1. Impact Assessments for the Farm Dams

Predictions of systematic subsidence, tilt and strain have been made at the centroid and at points located around the perimeter the dam, as well as at points located at a distance of 20 metres from the perimeter of the dam.

The maximum predicted systematic tilt at the farm dam, at any time during or after the extraction of the proposed longwalls, is 2.7 mm/m (ie: 0.3 %), or a change in grade in 1 in 370. Mining induced tilts can affect the water levels around the perimeters of farm dams, with the freeboard increasing on one side and decreasing on the other.

The maximum predicted changes in freeboard at the dam within the Study Area was conservatively determined by applying the maximum predicted systematic tilts along the longest sides of the dam. The maximum predicted change in freeboard at the farm dam is only 70mm which is unlikely to have a significant impact on the stability of the dam wall or the capacity of the dam.

The maximum predicted systematic tensile and compressive strains at the dam, at any time during or after the extraction of the proposed longwalls, are 0.5 mm/m and 0.2 mm/m, respectively. The minimum radii of curvature associated with the maximum predicted systematic tensile and compressive strains at the farm dam are 30 kilometres and 75 kilometres, respectively.
Farm dams are typically constructed of cohesive soils with reasonably high clay content. The walls of the dams should be capable of withstanding tensile strains of up to 3 mm/m without impact, because of their inherent elasticity. It is unlikely, therefore, that the maximum predicted systematic strains would result in any significant impacts on the farm dam.

It is possible, however, that some minor cracking or leakage of water may occur in the farm dam walls which are subjected to the higher strains, though potential minor cracking or leakages can be easily identified and repaired as required. It is not expected that any significant loss of water would occur from the farm dams, and any loss would flow into the tributary in which the dam was formed.

There is a possibility that high concentrations of strain could occur at faults, fissures and other geological features, or points of weaknesses in the strata, and such occurrences could be coupled with localised stepping in the surface. If this type of phenomenon coincided with a dam wall then there is a possibility that a potential impact on the dam could occur, but the likelihood of this occurring is small.

5.23.2. Impact Assessments for the Farm Dams Based on Increased Predictions

If the predicted systematic tilts at the farm dam were increased by factors of 1.25 to 2 times, the maximum change in freeboard would be 140 mm which is still relatively small and unlikely to affect the stability of the dam walls.

If the predicted systematic strains at the farm dam were increased by factors of 1.25 to 2 times, the maximum predicted tensile strain would still be much less than 3 mm/m and unlikely, therefore, to result in any significant impact on the dam. It is possible that some minor impacts could occur at the dam subjected to the larger strains, such as minor cracking or leakages, which are expected to be easily identified and repaired as required. With remediation measures in place, it is unlikely that any significant impact on the farm dam would occur as a result of the extraction of the proposed longwalls.

5.23.3. Recommendations for the Farm Dams

The assessed impacts on the farm dam resulting from the predicted systematic subsidence parameters can be managed with the implementation of suitable management strategies. It is recommended that all water retaining structures be visually monitored during the extraction of the proposed longwalls, to ensure that they remain in a safe and serviceable condition.

If in the unlikely event of a loss of water from the farm dam caused by mining, HCPL should provide a temporary alternative supply of water while the dam was repaired.

5.24. Archaeological Sites

There are 188[3] archaeological sites located within the Study Area and previously approved Longwalls 18 to 19A, the locations of which are shown in Drawing No. MSEC285-15. The predictions and impact assessments for the archaeological sites located within the Study Area are provided in the following sections.

5.24.1. Predictions for the Archaeological Sites

The maximum predicted incremental and total systematic subsidence parameters at the archaeological sites within the Study Area, resulting from the extraction of the proposed longwalls, are shown in Table D.01 in Appendix D.

A summary of the maximum predicted values of cumulative systematic subsidence, tilt and strain at these sites, resulting from the extraction of the proposed Longwalls 20 to 44, is provided in Table 5.33. The values provided in this table do not include subsidence parameters resulting from the previously extracted longwalls at the Colliery, but these values were predicted knowing the influence of these longwalls on the proposed longwalls.

Table 5.33 Maximum Predicted Cumulative Systematic Subsidence, Tilt and Strain at the Archaeological Sites within the Study Area Resulting from the Extraction of Longwalls 20 to 44

Type	Maximum Predicted Cumulative Subsidence (mm)	Maximum Predicted Cumulative or Travelling Tilt (mm/m)	Maximum Predicted Cumulative or Travelling Tensile Strain (mm/m)	Maximum Predicted Cumulative or Travelling Compressive Strain (mm/m)
Open Sites	1210	7.1	1.0	2.0
Overhang Sites	1260	7.4	1.6	2.0

A summary of the maximum predicted values of total systematic subsidence, tilt and strain at the archaeological sites, after the extraction of the proposed longwalls, is provided in Table 5.34. The values provided in this table include the parameters resulting from the previously extracted longwalls at the Colliery and the influence of these longwalls on the proposed longwalls.

Table 5.34 Maximum Predicted Total Systematic Subsidence, Tilt and Strain at the Archaeological Sites within the Study Area after the Extraction of Longwalls 20 to 44

Type	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total or Travelling Tilt (mm/m)	Maximum Predicted Total or Travelling Tensile Strain (mm/m)	Maximum Predicted Total or Travelling Compressive Strain (mm/m)
Open Sites	1210	7.1	1.0	2.0
Overhang Sites	1260	7.4	1.6	2.0

The values provided in the above tables are the maximum predicted parameters within a 20 metre radius of each site. The predicted tilts and strains are the maximum values which occur during, or after the extraction of each proposed longwall, whichever is the greater.

[3] This number is sourced from Appendix H of the Metropolitan Coal Project Environmental Assessment and includes sites located above the Longwalls 18-19A area outside of the Study Area.

5.24.2. Impact Assessments for the Archaeological Sites

Grinding Grooves

Many of the open archaeological sites contain grinding grooves, which can potentially be impacted by the fracturing of sandstone resulting from mine subsidence. The fracturing of sandstone can be caused by two mechanisms, resulting in tensile or compressive strains, due to systematic movements, and compressive strains due to valley closure movements.

The maximum predicted total systematic tensile and compressive strains at the open sites, resulting from the extraction of the proposed longwalls, are 1.0 mm/m and 2.0 mm/m, respectively. The minimum radii of curvature associated with the maximum predicted systematic tensile and compressive strains are 15 kilometres and 8 kilometres, respectively. As described in Sections 5.2 and 5.3, the valley closure movements are likely to result in compressive strains greater than 2 mm/m in the bases of the tributaries located directly above the proposed longwalls.

Tensile strains greater than 0.5 mm/m may be of sufficient magnitude to result in the fracturing of sandstone. Compressive strains greater than 2 mm/m may be of sufficient magnitude to result in buckling of the underlying strata, which can result in the fracturing of sandstone. It is possible, therefore, that the maximum predicted systematic and valley related movements, resulting from the extraction of the proposed longwalls, could result in some fracturing of the exposed sandstone at these open archaeological sites. Some open sites are located in or close to drainage lines, and therefore have a higher risk of fracturing at the site.

Potential fracturing of the exposed sandstone is expected to be isolated and of a minor nature, due to the relatively low magnitudes of the predicted strains and the relatively high depth of cover. The potential for fracturing to occur at the grinding grooves would, therefore, be considered low.

Overhang Sites

Overhang sites can potentially be impacted by the fracturing of sandstone and rock falls. The artwork at some overhang sites can be affected by water seepage through joints. Overhang sites located over goaf areas are more susceptible to potential impact than those over solid coal. There are 142[4] overhang sites located directly above the proposed and previously approved longwalls. The main mechanisms which can potentially result in these types of impacts are the systematic strains and curvatures.

The maximum predicted total systematic tensile and compressive strains at the overhang sites, resulting from the extraction of the proposed longwalls, are 1.6 mm/m and 2.0 mm/m, respectively. The minimum radii of curvature associated with the maximum predicted systematic tensile and compressive strains are 9 kilometres and 8 kilometres, respectively.

As described above, tensile strains greater than 0.5 mm/m may be of sufficient magnitude to result in the fracturing of sandstone. It is possible, therefore, that the maximum predicted systematic tensile strain, resulting from the extraction of the proposed longwalls, could result in fracturing of sandstone. Where fracturing is coincident with an overhang, it is possible that there could be an isolated rock fall as the result of mining, or in extreme cases, collapse. Where the overhangs are located in valleys, they would also be subjected to valley related upsidence and closure movements. Further information on the likelihood of rock falls is provided in Section 5.6.2.

[4] This number is sourced from Appendix H of the Metropolitan Coal Project Environmental Assessment and includes sites located within the Longwalls 18-19A area outside of the Study Area.

Monitoring of approximately 41 Aboriginal heritage sites (subject to longwall mine subsidence) has been undertaken between 1995 and 2008 at the Metropolitan Colliery. Of the 41 sites monitored, 21 had maximum predicted tensile or compressive strains greater than 0.5 mm/m and/or 2.0 mm/m respectively. The majority of sites monitored had no observable change following mine subsidence, with observable change identified in six Aboriginal heritage sites. Changes noted during monitoring include: potential natural weathering; cracks noted in sandstone platforms away from engravings/grinding grooves; cracking along existing bedding planes; and rear wall blockfall (Kayandel Archaeological Services, 2008).

Previous risk assessments of the potential impact on Aboriginal heritage sites from longwall mining have indicated that the risk to Aboriginal heritage sites varies depending on the nature and location of the site. Monitoring of Aboriginal heritage sites over previously mined areas in the Illawarra region has shown that larger overhangs are at greater risk, particularly where water seepage is present (C. E. Sefton Pty Ltd, 1996 and 2004). The extent to which Aboriginal heritage sites may be affected is influenced by several factors such as overhang shape and size, seepage through bedding planes, the location of the Aboriginal heritage site in the landscape and its location with respect to the longwall and direction of mining (ibid). Whilst not part of a specific monitoring program, Caryll Sefton reports that she has observed the collapse of two wet overhangs (with one being an Aboriginal heritage site [FRC 149] with artefacts and archaeological deposit although no artwork) located in drainage lines above previous longwalls at Metropolitan Colliery (C. E. Sefton Pty Ltd, 2004).

As detailed above, impacts that have been recorded at the Metropolitan Colliery primarily relate to damage of the rear wall (e.g. cracking), however, this has not always resulted in impacts to associated features (e.g. Aboriginal artwork) (C. E. Sefton Pty Ltd, 2004, 2006; and Kayandel Archaeological Services, unpublished).

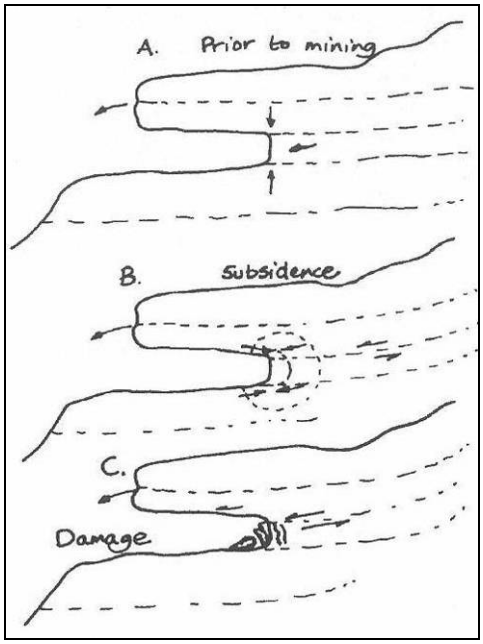

Fig. 5.7 Conceptual Model to Explain Back Wall Spall at Overhanging Rock Shelters (Shepherd and Sefton 2001)

Theses studies suggest that the likelihood of any significant impacts on the overhang sites, due to mining the proposed longwalls, is low.

Potential rock falls could occur near sites that are located close to existing cliffs, overhangs or ledges. Reference should be made to Section 5.6 for information relating to rock falls.

The findings of the Strategic Inquiry into Underground Coal Mining in the Southern Coalfield have recently been published (Department of Planning, 2008). This report recommends that environmental assessments for projects lodged under Part 3A include identification and assessment of natural features located within 600 metres of the edge of proposed longwalls (ibid). To this end, an additional 61 Aboriginal heritage sites have been identified between the Study Area boundary and within 600 metres of the edge of proposed Longwalls.

These additional sites are located outside the Study Area and as such the potential for subsidence induced impacts at these sites is considered to be very low to negligible.

Further assessments on the significance of potential impacts to archaeological sites are provided in the Aboriginal Cultural Heritage Assessment (Kayandel, 2007) (Appendix H of the Metropolitan Coal Project Environmental Assessment).

5.24.3. Impact Assessments for Archaeological Sites Based on Increased Predictions

If the predicted systematic strains were increased by factors of up to 2 times, the likelihood and extent of surface cracking and fracturing of sandstone would increase accordingly. Potential fracturing would still be expected to be isolated and of a minor nature, due to the relatively low magnitudes of the predicted strains and due to the relatively high depth of cover. The incidence of fracturing at the open sites and the likelihood of rock falls at the overhang sites would, therefore, still be considered low.

It should be noted that the Incremental Profile Method generally provides conservative predictions, and that additional conservatism has been provided by taking the maximum subsidence parameters within a 20 metre radius of each archaeological site. The observed levels of strain at the archaeological sites are not expected to exceed those predicted by any more than 15 %.

5.24.4. Consideration of Avoidance/Minimisation of Impacts on Archaeological Sites

Consideration has been given to avoiding and minimising subsidence impacts on the archaeological sites.

The archaeological sites identified on Drawing No. MSEC285-15 are scattered over much of the Study Area, with the exception of the western end of Longwalls 25 to 34.

As discussed in Section 5.2.4, very large stand-off distances would be required in order to achieve complete certainty of avoidance of subsidence impacts on the archaeological sites. Given the scatter of the archaeological site locations within the Study Area, avoidance of subsidence impacts on the archaeological sites would only likely be achievable by not mining the proposed longwalls.

A preliminary study was undertaken by MSEC for HCPL in June 2008 to assess the minimisation of effects on the archaeological sites. The study considered three cases as follows:

- Case 1 assessed minimisation of subsidence impacts on archaeological sites of high archaeological significance within the Study Area;
- Case 2 assessed minimisation of subsidence impacts on archaeological sites of moderate and high archaeological significance within the Study Area; and
- Case 3 assessed minimisation of subsidence impacts on all archaeological sites within the Study Area.

For the assessment, it was considered reasonable to adopt a preliminary minimum stand-off distance of no less than approximately half of the depth of cover from the archaeological sites for minimisation of subsidence effects. Assuming a stand-off distance of half of the depth from the archaeological sites, the resulting areas of sterilised coal as they apply to Longwalls 20 to 44 are shown for each case on the Drawings MSEC285-25, MSEC285-26 and MSEC285-27.

It should be noted, however, that these stand-off distances of half of the depth of cover are applied to only the archaeological sites. Should the same distance also be applied to other features such as streams, cliffs and overhangs, steep slopes and swamps, a majority to all of the proposed Study Area would be sterlilised for each case.

5.25. Survey Control Marks

The locations of survey control marks are shown in Drawing No. MSEC285-15. There are twenty two survey control marks located within the Study Area.

There are a number of other survey control marks that are located in the vicinity of the Study Area that are likely to experience either small amounts of subsidence or small far-field horizontal movements as the proposed longwalls are mined. It is possible that other marks outside the immediate area could also be affected by far-field horizontal movements, up to 3 kilometres outside the Study Area.

It would be necessary on the completion of the proposed longwalls, when the ground has stabilised, to re-establish these marks. Consultation between HCPL and the Department of Lands would be required throughout the mining period to ensure that these survey marks are reinstated at an appropriate time, as required.

5.25.1. Recommendations for the Survey Control Marks

It is recommended that management strategies are developed, in consultation with the Department of Lands, such that the survey control marks can be re-established, as required, at the appropriate time.

5.26. Ventilation Shaft

The Metropolitan Colliery Ventilation Shaft is located 525 metres from the nearest edge of Longwall 22. At this location the ventilation shaft would not be subjected to measurable systematic mine subsidence ground movements, however, it would experience small far-field horizontal movements. The shaft is not located in a valley and is therefore not expected to be impacted by any valley related upsidence and closure movements.

5.26.1. Predictions for the Ventilation Shaft

Since the predicted subsidence at the ventilation shaft is negligible we have not prepared profiles of total systematic subsidence, tilt and strain at the ventilation shaft.

The upper limit of observed absolute far-field horizontal movements at this location is approximately 80 mm. A discussion of far field horizontal movements is presented in Section 5.28 of this report. Far-field horizontal movements tend to be bodily movements towards the extracted goaf area and are accompanied by low levels of ground strain. Differential far-field movements at the surface around the shaft should be negligible.

It is possible however, that minor differential horizontal movements may occur between different strata layers down the shaft. These differential horizontal movements are expected to be small and generally are not expected to result in major impacts though some spalling is possible in the shaft wall.

5.26.2. Recommendations for the Ventilation Shaft

The ventilation shaft should be inspected on a regular basis as the proposed Longwall 20 and subsequent longwalls are mined, to confirm that the observed ground movements match the predictions. In this way, the shaft can be maintained in a safe and serviceable condition throughout the mining period.

5.27. Predicted Horizontal Movements

Predicted horizontal movements over the proposed longwalls are calculated by applying a factor to the predicted tilt values. In the Southern Coalfield a normal factor of 15 has been adopted, being the same factor as that used to determine strains from curvatures, and this has been found to give a reasonable correlation with measured data. The application of this factor would provide a conservative prediction of horizontal movement at the location of maximum tilt. The maximum predicted cumulative tilt within the Study Area, resulting from the extraction of the proposed longwalls is 6.9 mm/m, which occurs over Longwall 21. This area would experience the greatest horizontal movement. The maximum predicted horizontal movement is, therefore, approximately 100 mm.

Horizontal movements do not directly impact on natural features or items of surface infrastructure, rather impacts occur as the result of differential horizontal movements. Systematic strain is the rate of change of horizontal movement. The potential impacts of systematic strain on the natural features and items of infrastructure are addressed in the impact assessments for each feature in Sections 5.2 to 5.26.

5.28. Predicted Far-Field Horizontal Movements

In addition to the systematic movements that have been predicted above and adjacent to the proposed longwalls, and the predicted valley related movements along the streams, it is also likely that some far-field horizontal movements would also be experienced during the extraction of the proposed longwalls.

Far-field horizontal movements result from the redistribution of horizontal in-situ stress in the strata around the collapsed and fractured zones above longwall extractions. Such movements are, to some extent, predictable and occur whenever significant excavations occur at the surface or underground.

An empirical database of observed incremental far-field horizontal movements has been compiled using monitoring data primarily from the Southern Coalfield, from Collieries including Appin, Bellambi, Dendrobium, Douglas, Newstan, Tower and West Cliff. The far-field horizontal movements resulting from longwall mining were generally observed to be orientated towards the extracted longwalls. At low levels of far-field horizontal movements, however, there was a high scatter in the orientation of the observed movements.

The observed incremental far-field horizontal movements, resulting from the extraction of a single longwall, for all monitoring points within the database, is provided in Section 1.7 of the online document "General Discussion of Mine Subsidence Ground Movements" which can be downloaded from www.minesubsidence.com. The document also presents a plot of data points within the database only where there was solid coal between the longwalls and monitoring points.

It can be seen from these figures, that incremental far-field horizontal movements of up to 20 mm have been observed at distances of 2000 metres from extracted longwalls. It should be noted, however, that at the larger distances from the longwall extractions, the measured movements contain larger proportions of survey error, in addition to valley related closure movements, and movements along geological anomalies.

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

The predicted far-field horizontal movements resulting from the extraction of the proposed longwalls are small and could only be detected by precise surveys. Such movements tend to be bodily movements towards the extracted goaf area, and are accompanied by low levels of strain, which are generally less than 0.1 mm/m.

5.29. Likely Height of the Fractured Zone above the Proposed Longwalls

The background to sub-surface strata movements has been discussed in Section 1.7 of the online document "General Discussion of Mine Subsidence Ground Movements" which can be downloaded from www.minesubsidence.com. The following conclusions should be read in the context of the online document.

The terminology used by different authors to describe the strata displacement zones above extracted longwalls varies. Forster (1995) noted that most studies had recognised four separate zones, as shown in Fig. 5.8 with some variations in the definitions of each zone.

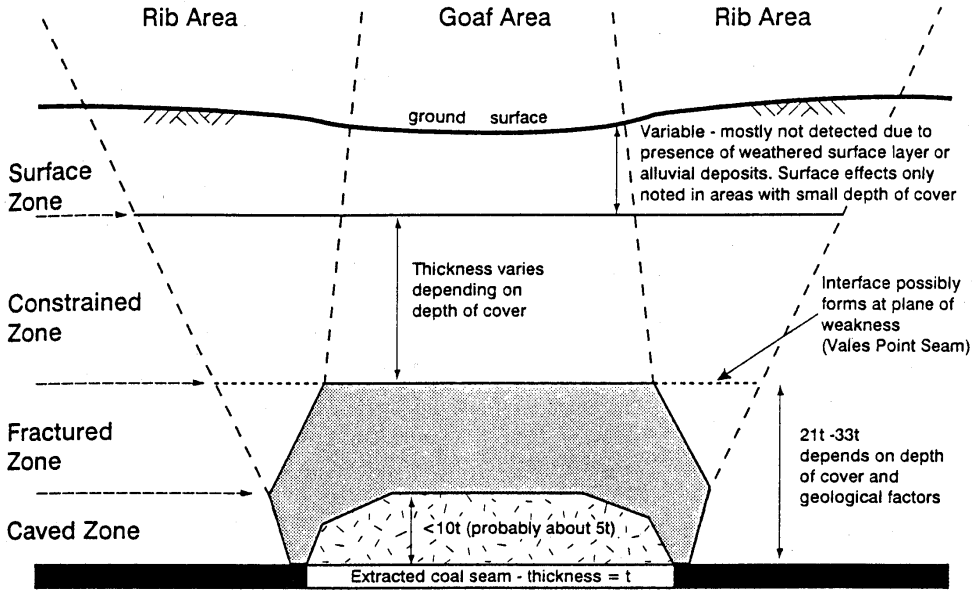

Fig. 5.8 Relationship between Vertical Dilation Heights and Seam Thickness (Forster 1995)

Peng and Chiang (1984) recognised only three zones as reproduced in Fig. 5.9.

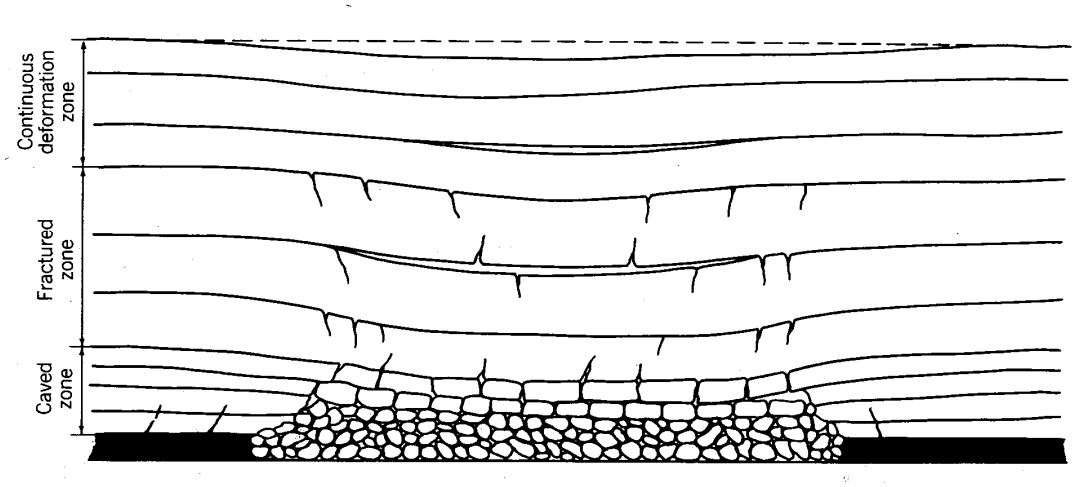

Fig. 5.9 Zones in the Overburden According to Peng and Chiang (1984)

McNally et al (1996) also recognised three zones, which they referred to as the caved zone, the fractured zone and the elastic zone. Kratzsch (1983) identified four zones, but he named them the immediate roof, the main roof, the intermediate zone and the surface zone.

For the purpose of this study, the following zones, as described by Singh and Kendorski (1981) and proposed by Forster (1995), as shown in Fig. 5.8 and described below, have been adopted:-

- *Caved or Collapsed Zone* comprises loose blocks of rock detached from the roof and occupying the cavity formed by mining. This zone can contain large voids. It should be noted, that some authors note primary and secondary caving zones.
- *Disturbed or Fractured Zone* comprises in-situ material lying immediately above the caved zone which have sagged downwards and consequently suffered significant bending, fracturing, joint opening and bed separation. It should be noted, that some authors include the secondary caving zone.
- *Constrained or Aquiclude Zone* comprises confined rock strata above the disturbed zone which have sagged slightly but, because they are constrained, have absorbed most of the strain energy without suffering significant fracturing or alteration to the original physical properties. Some bed separation or slippage can be present as well as discontinuous vertical cracks, usually on the underside of thick strong beds, but not of a degree or nature which would result in significant increases in vertical permeability. Some increases in horizontal permeability can be found. Weak or soft beds in this zone may suffer plastic deformation.
- *Surface Zone* comprises unconfined strata at the ground surface in which mining induced tensile and compressive strains may result in the formation of surface cracking or ground heaving.

As the terminology differs between authors, the means of determining the extents of each of these zones also varies. Some of the difficulties in establishing the heights of the various zones of disturbance above extracted longwalls stem from the imprecise definitions of the fractured and constrained zones, the differing zone names, the use of different groundwater testing methods, and differing interpretation of extensometer readings.

Some authors interpret the collapsed and fractured zones to be the zone from which groundwater or water in boreholes could be lost into the mine and, hence, look for the existence of aquiclude layers above this height to confirm whether surface water would or would not be lost.

The effects of mining geometry on the heights of the collapsed and fractured zones are not well documented and theory would suggest that the factors affecting the height of the collapsed zone are the:-

- width of extraction,
- height of extraction,
- depth of cover,
- type of previous workings, if any, above the current extraction,
- interburden to previous workings,
- presence of pre-existing natural joints within each strata layer,
- thickness of each strata layer,
- angle of break of each strata layer,
- spanning capacity of each strata layer, particularly those layers immediately above the collapsed and fractured zones,
- bulking ratios of each of strata layer within the collapsed zone, and the
- presence of aquiclude zones.

Where the panel width-to-depth ratio is high and the depth of cover is shallow, it is clear that the fractured zone would extend from the seam to the surface. This is clearly indicated in the extensometer readings from boreholes above shallow areas of extraction, where the vertical strains close to the surface are as high as those close to seam level. Where the panel width-to-depth ratio is low, as is the case for the proposed longwalls at Metropolitan Colliery, and where the depth of cover is high, it is clear that the height of the fractured zone would represent a high proportion of the depth of cover.

Some authors have suggested simple equations to estimate the heights of the collapsed and fractured zones based solely on the extracted seam height, others have suggested equations based solely on the width of extraction, whilst others have suggested equations based on the width-to-depth ratio of the extraction. As this is a complex issue, we understand that no simple equation can properly estimate the heights of the collapsed and fractured zones and a more thorough analysis is required.

A simplified analysis is presented to show the possible height of the fractured zone is dependent upon the angle of break (a), the width of the panel (W) and the spanning capacity of a competent stratum at the top of the fractured zone, span (w). These are illustrated in Fig. 5.10. From the mining geometry it can be shown that the height of the fractured zone equals the panel width (W) minus the span (w) divided by twice the tangent of the angle of break.

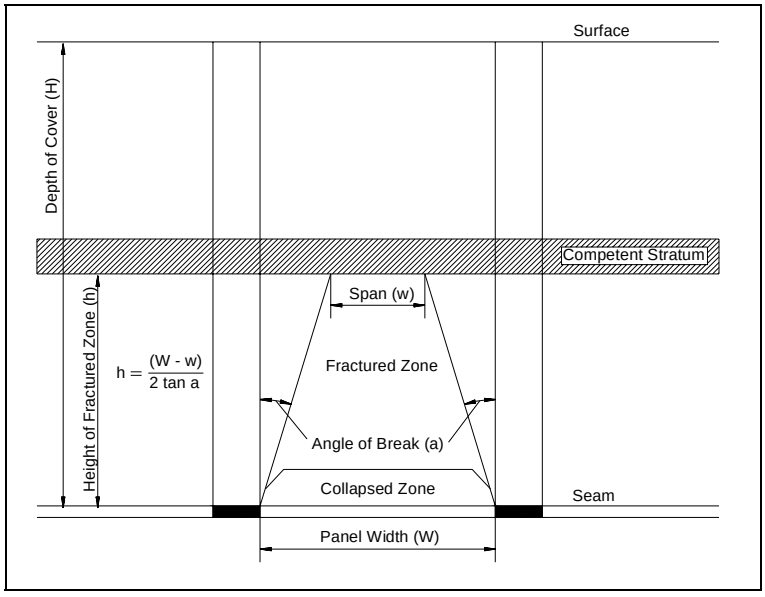

Fig. 5.10 Theoretical Model Illustrating the Development and Limit of the Fractured Zone

Using this relationship, the theoretical height of the fractured zone, as a proportion of the width of the extracted panel, has been determined for a range of panel width-to-depth ratios. These values have been plotted in the graph shown in Fig. 5.11, together with the values that have been reported in literature. The red data points are those which have been reported in literature whilst the theoretical values are shown in green, magenta and blue for angles of break of 17°, 20° and 23°, respectively.

A piezometric investigation was conducted in April 2007 over the previously mined Longwall 10 at Metropolitan Colliery and the analysis is presented in the groundwater assessment (Appendix B of the Metropolitan Coal Project Environmental Assessment). From the investigation, it was concluded that the fracture zone did not extend any higher than 130 metres above the goaf. On this basis, the result is plotted in Fig. 5.11 using a fracture height of 130 metres, panel width of 140 metres and depth of cover of 460 metres.

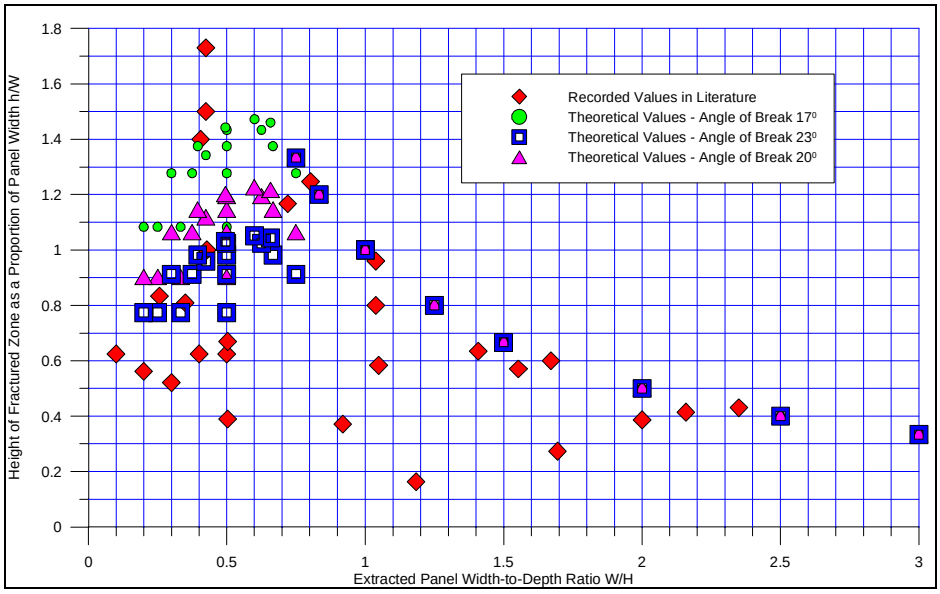

Fig. 5.11 Graph showing Height of Fractured Zone as a Proportion of Panel Width for different Width-to-Depth Ratios

It can be seen that the height of the fractured zone in the database is reasonably represented by the theoretical model using an angle of break of 20°. Only three red data points appear above the magenta data points and these are the heights of the fractured zone over Longwall 2 at Ellalong Colliery and over Longwall 3 at Tahmoor Colliery, which were given by Holla and Armstrong (1986) and Holla and Buizen (1991).

In both of these cases, the apparent heights of the fractured zone were determined from extensometer readings which could have included horizontal shear as well as vertical dilation. The stated heights of the fractured zone at Tahmoor, which are the highest data points in the graph, are not supported by the measured vertical strains, which averaged only 0.6 mm/m in the top 160 metres of the overburden. A more realistic assessment is that the fractured zone extended only to the Bald Hill Claystone.

In some cases, it is likely that the upwards progression of the fractured zone was limited by the levels of vertical strain that could be developed, which is dependent upon the extracted seam thickness, the surface subsidence and the depth of cover.

The proposed Longwalls have width-to-depth ratios varying from 0.2 to 0.4, which is well represented by the theoretical model using an angle of break of 23°.

The upper limit of the fractured zone would be reached when the strata above that zone are sufficiently strong to span the goaf area without significant bending or shear strains being developed. In the Southern Coalfield, the upper layers of the overburden strata could be relatively strong units in the Bulgo or the Hawkesbury Sandstone.

There are two different proposed panel widths (ie: 163 metres and 133 metres) for the proposed Longwalls 20 to 44, with the narrower longwalls located in the DSC Notification Area. Based on an average angle of break of 23°, the predicted height of the fracture zone would be approximately 190 metres for the 163 metre wide panels and 155 metres for the 133 metre wide panels. This is a conservative estimate as it assumes that there is no spanning of competent strata at the top of the fractured zone. From exploration borehole logs over the proposed mining area, the estimated heights of the fracture zone of 190 metres and 155 metres would be in the Bulgo Sandstone formation so there is likely to be some spanning of strata within the Bulgo Sandstone. A spanning width of around 30 metres is considered feasible within the Bulgo Sandstone.

If we assume a span of 30 metres for competent strata at the top of the fractured zone, the recalculated height of the fracture zone would be approximately 155 metres for the 163 metre wide panels and approximately 120 metres for the 133 metre wide panels.

The depth of cover contours above the proposed longwall are shown in Drawing No. MSEC285-05. A summary of the minimum, maximum and average depths of cover above the proposed longwalls is provided in Table 5.35.

Table 5.35 Depth of Cover above Proposed Longwalls 20 to 44

Longwall	Minimum Depth of Cover Above Longwall (metres)	Maximum Depth of Cover Above Longwall (metres)	Average Depth of Cover Above Longwall (metres)
20	405	515	450
21	405	505	450
22	405	515	455
23	410	530	465
24	410	535	475
25	415	540	480
26	405	550	485
27	405	535	490
28	400	550	490
29	400	550	490
30	405	550	480
31	400	550	480
32	400	545	485
33	410	535	500
34	410	545	505
35	415	540	505
36	415	540	500
37	425	535	500
38	430	510	495
39	435	555	500
40	445	560	510
41	445	560	515
42	460	565	520
43	465	565	510
44	470	560	500

Several exploration boreholes have been drilled over the lease area. A summary of the heights of the Bald Hill Claystone above the coal seam is provided in Table 5.36.

Table 5.36 Height of Bald Hill Claystone above Bulli Coal Seam

Borehole Number	Vertical Distance from top of Bulli Coal Seam to base of Bald Hill Claystone (metres)
S290	307
S872	288
EMDDH5	271
I0014	254
S8	300
S213	288
S214	301
S215	305
S227	297

Based on the data presented in Table 5.36 and the predicted height of the fractured zone of 155 metres to 190 metres for the 163 metre wide panels and 120 metres to 155 metres for the 133 metre wide panels, the top of the fractured zone is expected to occur well below the level of the Bald Hill Claystone.

Where the depths of cover are greater than the predicted height of the fractured zone, it is expected that a *Constrained Zone*, also call a *Continuous Deformation Zone*, would occur between the fractured zone and the surface, which is illustrated in Section 1.8 of the online document "General Discussion of Mine Subsidence Ground Movements" mentioned previously.

The constrained zone comprises confined rock strata which have sagged slightly but, because they are constrained, have absorbed most of the strain energy without suffering significant fracturing or alteration to the original physical properties. Some bed separation or slippage can be present, as well as discontinuous vertical cracks, usually on the underside of thick strong beds. Weak or soft beds in this zone may suffer plastic deformation.

5.30. The Likelihood of Irregular Profiles

Wherever faults, dykes and abrupt changes in geology are present at the surface, it is possible that irregularities in the subsidence profiles could occur. Similarly, where surface rocks are thinly bedded, and where cross-bedded strata exist close to the surface, it is possible for surface buckling to occur, leading to irregular movements. By far the greatest number of irregularities in subsidence profiles, however, can be explained by the presence of surface incisions such as gorges, river valleys and creeks.

Several geological structures have been identified in the vicinity of the proposed longwalls, which are shown in Drawing No. MSEC285-06. Most of the geological features identified occur at seam level and include faults, joints and dykes. Most features identified at seam level are unlikely to result in an irregular subsidence profile at the surface. A study of geological features in the Study Area is provided in the report by Geosensing Solutions (2008). The report recommends that further geological investigations be conducted progressively ahead of mining operations.

It is possible that anomalous movements could occur as a result of the extraction of the proposed longwalls. These have occurred in the past in the Southern Coalfield, as discussed in Section 1.7 of the online document "General Discussion of Mine Subsidence Ground Movements" mentioned previously. Given the relatively low density of surface features within the Study Area, the probability of an anomalous movement coinciding with a surface feature is assessed as low.

Irregularities also occur in shallow mining situations, where the collapsed zone, above the extracted seam, extends all the way to the surface. This type of irregularity is generally only seen where the depth of cover is less than 100 metres, which does not apply to the proposed longwalls.

5.31. Other Potential Impacts

5.31.1. The Likelihood of Surface Cracking in Soils and Fracturing of Bedrock

As subsidence occurs, surface cracks would generally appear in the tensile zone (ie: within 0.1 to 0.4 times the depth of cover from the longwall perimeter). Most of the cracks would occur within a radius of approximately 0.1 times the depth of cover from the longwall perimeter. The cracks would generally be parallel to the longitudinal edges of the longwall and to the ends of the longwall.

It is also possible that cracks could occur above and parallel to the moving extraction face (ie: at right angles to the longitudinal edges of the longwall) as the subsidence trough develops. This cracking is, however likely to be transient, since the tensile phase, which causes the cracks to open up, is generally followed by a compressive phase, which partially re-closes them.

Surface tensile fracturing in near surface or exposed sandstone is likely to occur coincident with the maximum tensile strains, but open fractures could also occur due to buckling of surface beds that are subject to compressive strains. Fracture widths tend to increase as the depth of cover reduces, and only minor fracturing would normally be expected where the depth of cover is greater than 200 metres above the proposed longwalls.

It is likely, however, that larger surface cracking would occur as a result of downhill movements adjacent to cliffs and along the steep slopes.

The incidence of cracks on the surface due to mine subsidence is dependent on the thickness and inherent plasticity of the soils that overlie the bedrock. Surface soils above the proposed longwalls are generally weathered to some degree. The widths and frequencies of the cracks are also dependent upon the pre-existing jointing patterns in the bedrock. Large joint spacing can lead to concentrations of strain and possibly the development of fissures at rockhead, which are not necessarily coincident with the joints.

A joint spacing of ten metres is not unusual for Hawkesbury and Bulgo Sandstones, which are the predominant strata above the proposed longwalls. The maximum predicted total tensile strain resulting from the extraction of the proposed longwalls is 1.7 mm/m and, therefore, the fractures at the joints could be as wide as 17 mm. If a reasonable thickness of surface soil exists, it is more likely that the surface soil would exhibit a number of cracks of lesser width rather than one large crack.

From Section 1.6 of the online document "General Discussion of Mine Subsidence Ground Movements" mentioned previously, it is unlikely that surface cracks in the soil would exceed 20 mm, where the depth of cover is greater than 400 metres, away from the cliffs and steep slopes. Larger cracks are expected to occur adjacent to the cliffs and along the steep slopes.

Cracking is also often found in the beds of creek and river valleys due to the strains associated with upsidence and valley closure. As discussed in Section 5.2, the predicted closure across the valleys would result in an elevated level of compressive strain across the valleys. This could lead to localised fracturing and buckling of the bedrock in the base of the streams and tensile cracks at the tops of the valley sides.

5.31.2. The Likelihood of Gas Emissions at the Surface

It is known that the mining of coal causes fracturing of the strata above the coal seam and this may result in the liberation of methane and other gases. Methane, being a lighter gas, would tend to move upwards to fill the voids in the rock mass and diffuse towards the surface through any continuous cracks or fissures.

The seam gas composition at the Metropolitan Colliery is greater than 90% CO_2 (HCPL, 2008). A large proportion of the methane present is pre-drained in the underground mine to allow a safe working environment.

Discussion of the low permeability of the overburden strata is provided in the groundwater assessment (Appendix B of the Metropolitan Coal Project Environmental Assessment).

If the strata were to be fractured by subsidence it is possible that some gas and/or water could move upwards/downwards through the cracks. As described in Section 5.28, there is separation of the fractured zone above the proposed longwalls and the near surface superficial cracks. Therefore, the likelihood of methane and other gases being liberated to the surface from the deep coal seam is low.

Gas bubbles at the surface can originate from a number of sources including mechanical action (e.g. riffles), biological activity, decay of organic matter, and dislodgement of air from cavities as a result of changes in stream water levels.

Gas emissions at the surface as a result of longwall mining in the Southern Coalfield have typically occurred within deep river valleys such as the Nepean, Cataract and Georges Rivers, although some gas emissions have also been observed in smaller creeks and in water bores. Analyses of gas compositions indicate that the coal seam is not the direct and major source of the gas and that the most likely source is the Hawkesbury Sandstone (APCRC, 1997).

The emission of gases at the surface generally tends to be short-lived temporary events and the consequences are generally minor and readily managed.

Gas released from the stream beds would be released directly to the atmosphere and would not have time to dissolve in any surface water which is present.

It is possible that substantial gas emissions at the surface could result in localised vegetation die back. This occurred at Tower Colliery along the Cataract River over small areas in the base of the Cataract Gorge, as a result of near-surface gas emissions directly above Longwalls 10 and 14. These impacts were however limited to small areas of vegetation, local to the points of emission where composting occurred. There have been no reported cases of significant gas releases in the Southern Coalfield that have resulted in the death of vegetation.

While no gas emissions or odours have previously been observed by HCPL during mining beneath the Waratah Rivulet at the Metropolitan Colliery, gas emissions could potentially occur at the surface as a result of mine subsidence.

5.31.3. The Potential Impacts of Ground Vibration on Structures due to Mining

The settlement of the ground resulting from systematic subsidence is generally a gradual and progressive movement, the effect of which is not apparent to an observer at the surface. The major breakage and collapse of strata into the voids left by extraction of the seam occur in the layer immediately above the seam. Above that level, the breakage and collapse of the strata reduces to become a bending and sagging of the upper layers of rock with less sudden and much smaller movements occurring. In some instances, the movements can be concentrated at faults or other points of weakness in the strata with minor stepping at the surface.

A potential major collapse below ground would result in some vibration in the layers of rock above it, which might be felt as a minor effect at the surface. This effect is generally only noticeable where the depth of cover is less than 100 metres, which does not apply to the proposed longwalls.

It is possible, therefore, as the longwalls are mined and the strata subsides, for some vibrations to be felt at the surface, though these are more likely to occur directly above or close to the longwalls. The levels of vibration would, however, generally be low and would not be of sufficient amplitude to result in any significant impact on the surface features or items of infrastructure. The potential impact due to vibration resulting from the extraction of the proposed longwalls is predicted to be insignificant.

5.31.4. The Potential for Noise at the Surface due to Mining

The potential noise impacts associated with the Project are discussed in noise impact assessment (Appendix J of the Metropolitan Coal Project Environmental Assessment).

Generally the systematic subsidence movements are gradual and cannot be detected by an observer at the surface. These movements are also generally shielded by the more plastic surface soils which tend to distribute the strains more evenly and insulate against potential sounds from below.

In some cases, the stresses in the rock can build up to the point that the rock suddenly shears to form a new fracture and if the rock is exposed or has only a thin covering of surface soil, the noise resulting from the fracturing can be heard at the surface. Normally the background level of noise in the countryside is high enough to ensure that the sound is not noticed, although in the stillness of night, it might occasionally be noticed when it occurs in close proximity. The potential impact due to noise at the surface resulting from the extraction of the proposed longwalls is predicted to be insignificant.

APPENDIX A - GLOSSARY OF TERMS AND DEFINITIONS

Glossary of Terms and Definitions

Some of the more common mining terms used in the report are defined below:

Angle of draw	The angle of inclination from the vertical of the line connecting the goaf edge of the workings and the limit of subsidence (which is usually taken as 20 mm of subsidence).
Chain pillar	A block of coal left unmined between the longwall extraction panels.
Consequence	Outcome or impact of an event, which may be multiple, may be positive or negative, can be expressed qualitatively or quantitatively, and are considered in relation to the achievement of objectives. Source: NSW Department of Planning (2008).
Cover depth (H)	The depth from the surface to the top of the seam. Cover depth is normally provided as an average over the area of the panel.
Critical area	The area of extraction at which the maximum possible subsidence of one point on the surface occurs.
Curvature	The change in tilt between two adjacent sections of the tilt profile divided by the average horizontal length of those sections.
Extracted seam	The thickness of coal that is extracted. The extracted seam thickness is thickness normally given as an average over the area of the panel.
Effective extracted seam thickness (T)	The extracted seam thickness modified to account for the percentage of coal left as pillars within the panel.
Face length	The width of the coalface measured across the longwall panel.
Flow diversion (mining-induced surface flow diversion)	The diversion of surface water through contiguous flow paths that mining-induced fractures in bedrock or rockbars.
Goaf	The void created by the extraction of the coal into which the immediate roof layers collapse.
Goaf end factor	A factor applied to reduce the predicted incremental subsidence at points lying close to the commencing or finishing ribs of a panel.
Horizontal displacement	The horizontal movement of a point on the surface of the ground as it settles above an extracted panel.
Inflection point	The point on the subsidence profile where the profile changes from a convex curvature to a concave curvature. At this point the strain changes sign and subsidence is approximately one half of S max.
Incremental subsidence	The difference between the subsidence at a point before and after a panel is mined. It is therefore the additional subsidence at a point resulting from the excavation of a panel.
Overlap adjustment factor	A factor that defines the ratio between the maximum incremental subsidence of a panel and the maximum incremental subsidence of that panel if it were the first panel in a series.
Panel	The plan area of coal extraction.
Panel length (L)	The longitudinal distance along a panel measured in the direction of mining from the commencing rib to the finishing rib.

Panel width (Wv)	The transverse distance across a panel, usually equal to the face length plus the widths of the roadways on each side.
Panel centre line	An imaginary line drawn down the middle of the panel.
Pillar	A block of coal left unmined.
Pillar width (Wpi)	The shortest dimension of a pillar measured from the vertical edges of the coal pillar, i.e. from rib to rib.
Strain	The change in the horizontal distance between two points divided by the original horizontal distance between the points.
Sub-critical area	An area of panel smaller than the critical area.
Subsidence	The vertical movement of a point on the surface of the ground as it settles above an extracted panel.
Subsidence or subsidence effects	The deformation of the ground mass surrounding a mine due to the mining activity. The term is a broad one, and includes all mining-induced ground movements, including both vertical and horizontal displacement, tilt, strain and curvature. Source: NSW Department of Planning (2008).
Subsidence impacts	The physical changes to the ground and its surface caused by subsidence effects. These impacts are principally tensile and shear cracking of the rock mass and localised buckling of strata caused by valley closure and upsidence but also include subsidence depressions or troughs. Source: NSW Department of Planning DoP (2008).
Super-critical area	An area of panel greater than the critical area.
Tilt	The difference in subsidence between two points divided by the horizontal distance between the points.
Uplift	An increase in the level of a point relative to its original position.
Upsidence	A reduction in the expected subsidence at a point, being the difference between the predicted subsidence and the subsidence actually measured.

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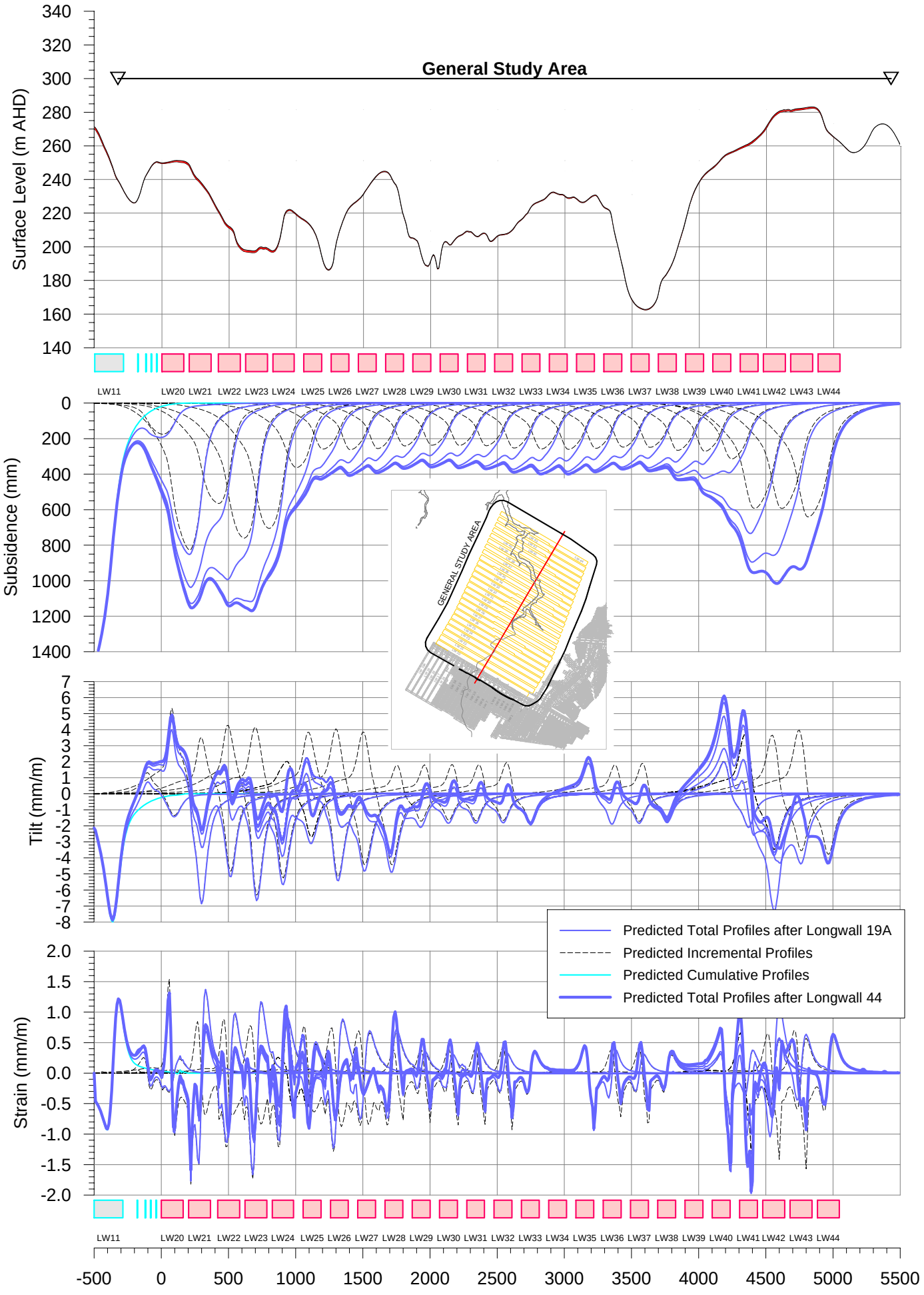
APPENDIX C - FIGURES

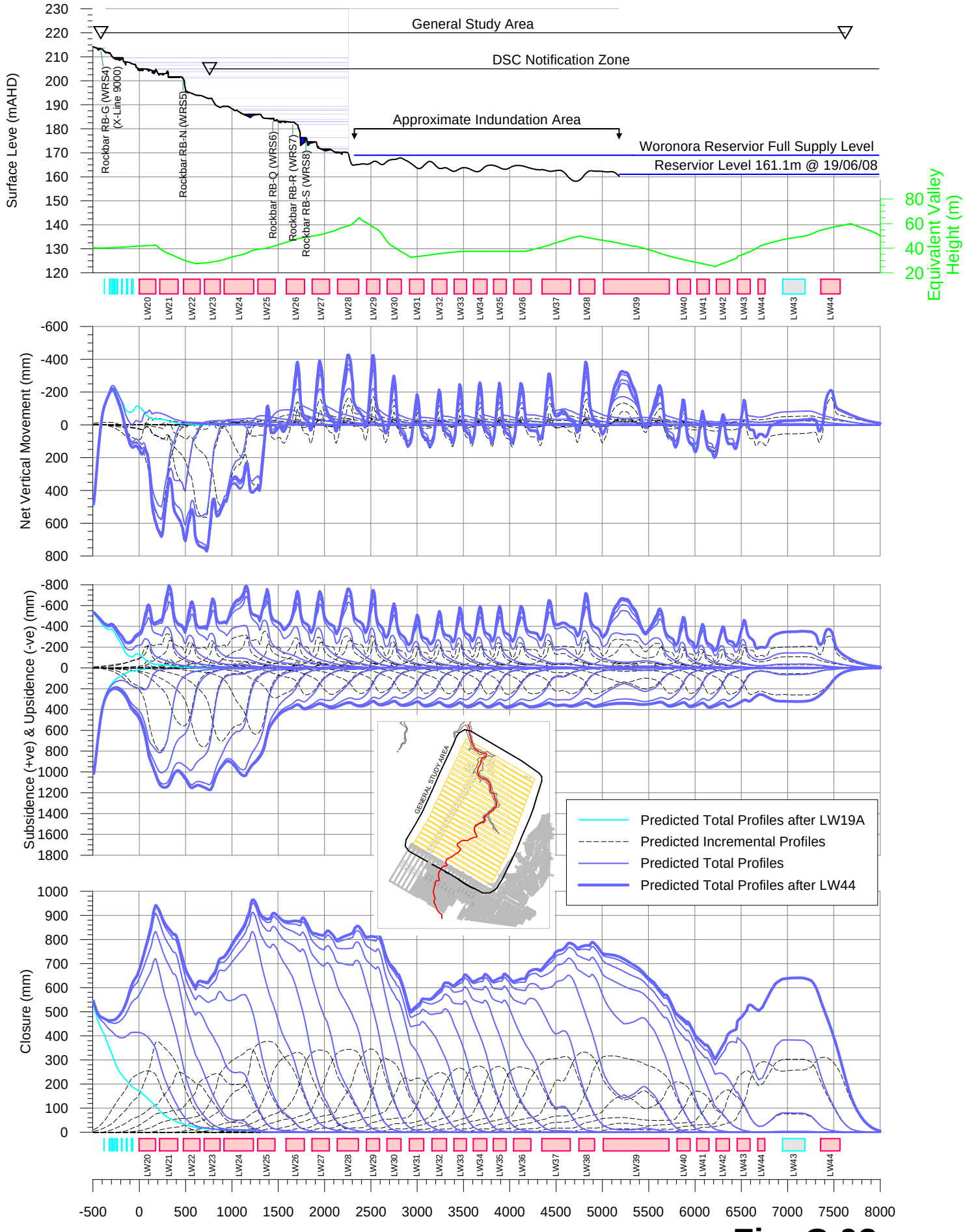
Predicted Profiles of Systematic Subsidence, Tilt and Strain along Prediction Line 1 Resulting from the Extraction of Longwalls 20 to 44



Mine Subsidence Engineering Consultants

Fig. C.01

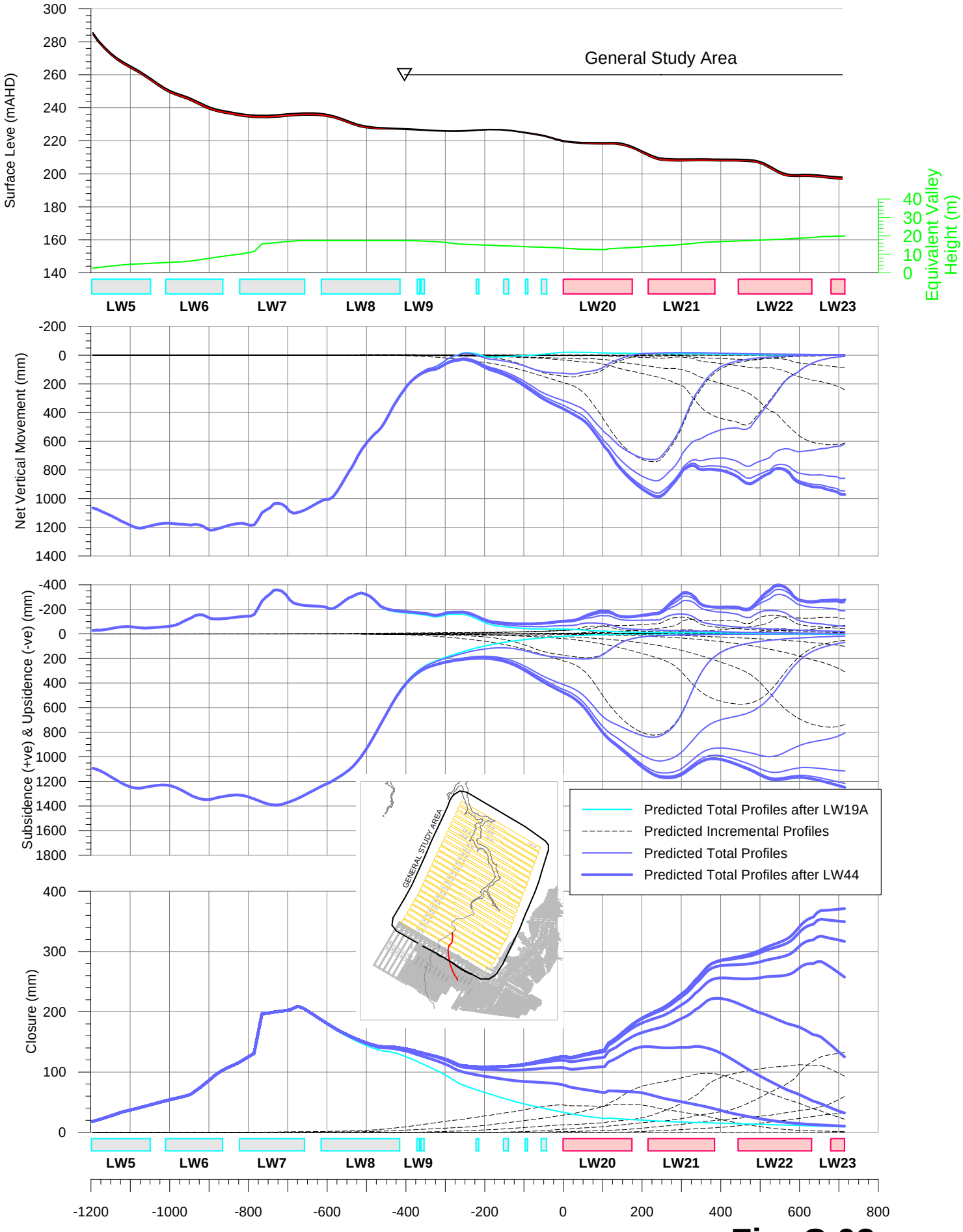
Metropolitan Colliery - Longwalls 20 to 44
Waratah Rivulet Long Section
Predicted Profiles of Subsidence, Upsidence and Closure



Mine Subsidence Engineering Consultants

Fig. C.02

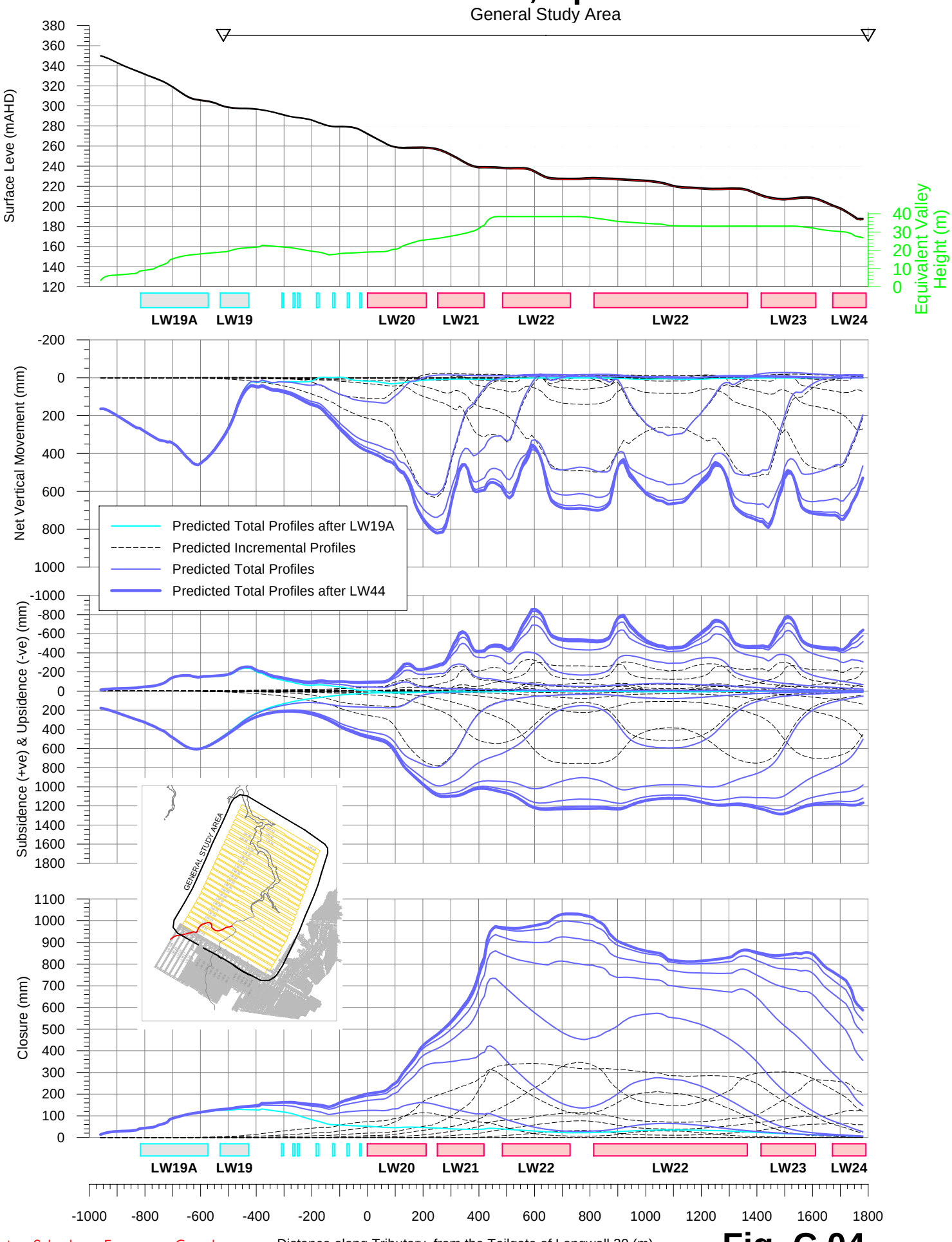
Metropolitan Colliery - Longwalls 20 to 44
Tributary A Long Section
Predicted Profiles of Subsidence, Upsidence and Closure



Mine Subsidence Engineering Consultants

Fig. C.03

Metropolitan Colliery - Longwalls 20 to 44
Tributary B Long Section
Predicted Profiles of Subsidence, Upsidence and Closure



Mine Subsidence Engineering Consultants

Fig. C.04

Metropolitan Colliery - Longwalls 20 to 44
Tributary C Long Section
Predicted Profiles of Subsidence, Upsidence and Closure

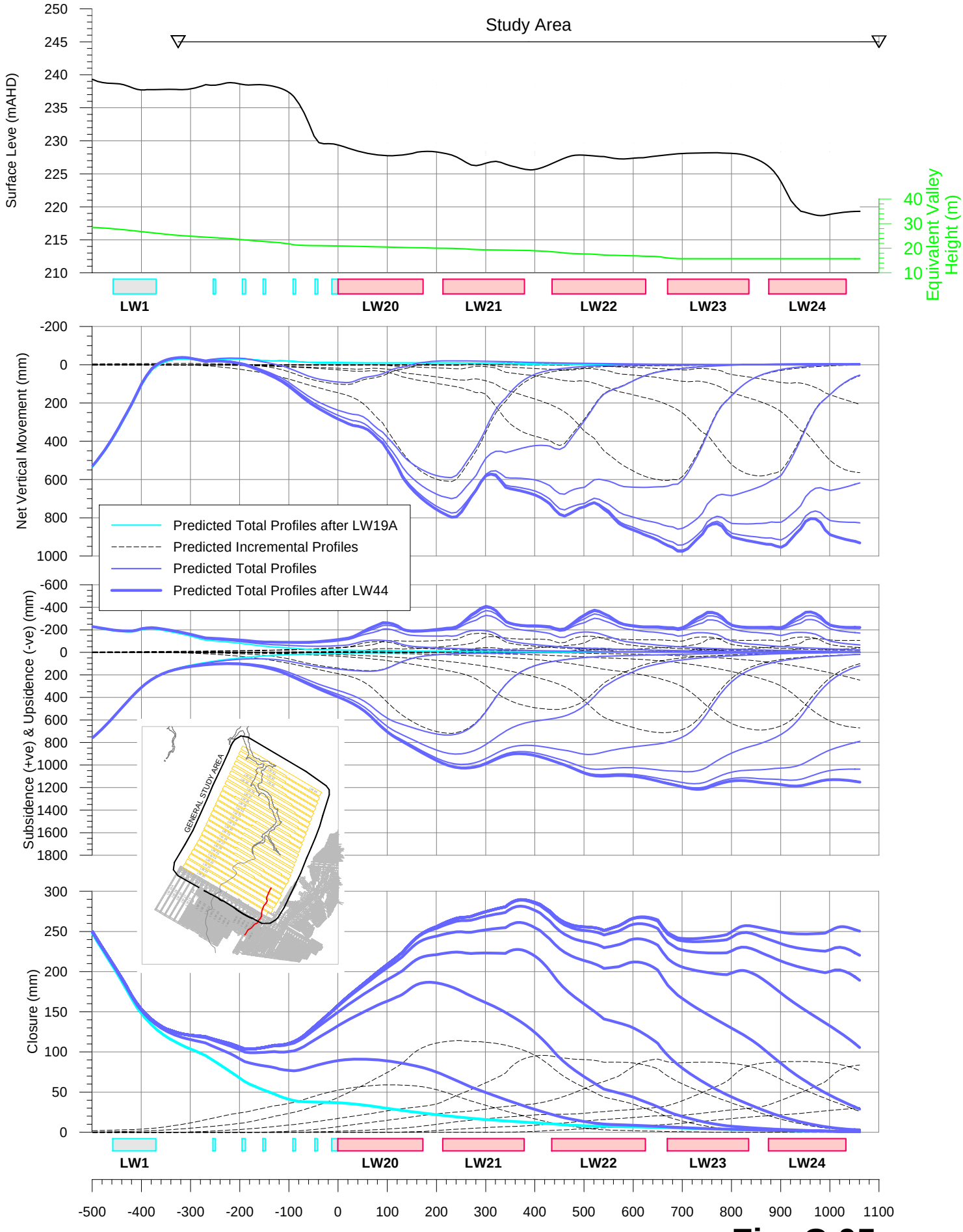


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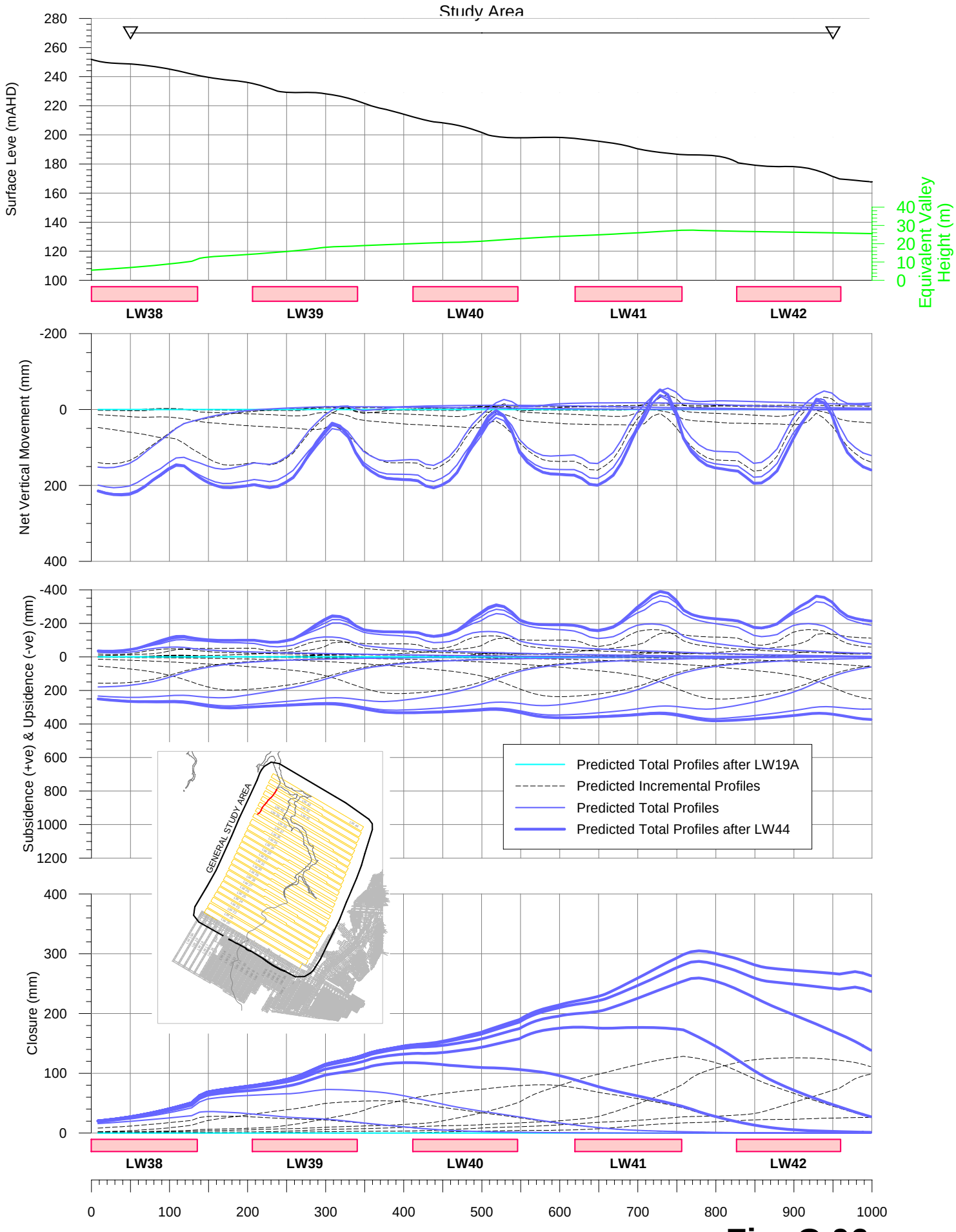
Fig. C.05

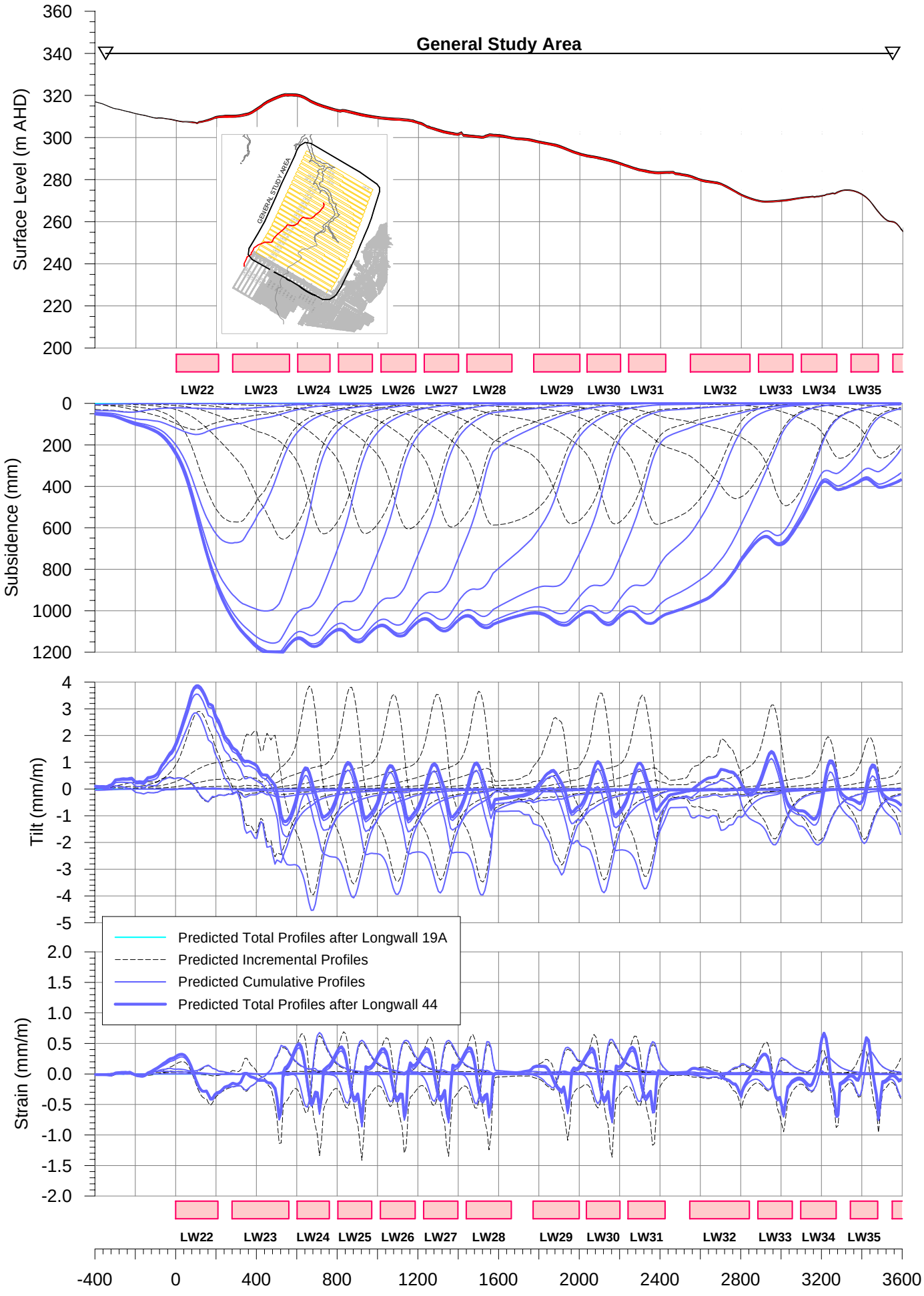
Metropolitan Colliery - Longwalls 20 to 44
Tributary E Long Section
Predicted Profiles of Subsidence, Upsidence and Closure



Mine Subsidence Engineering Consultants

Fig. C.06

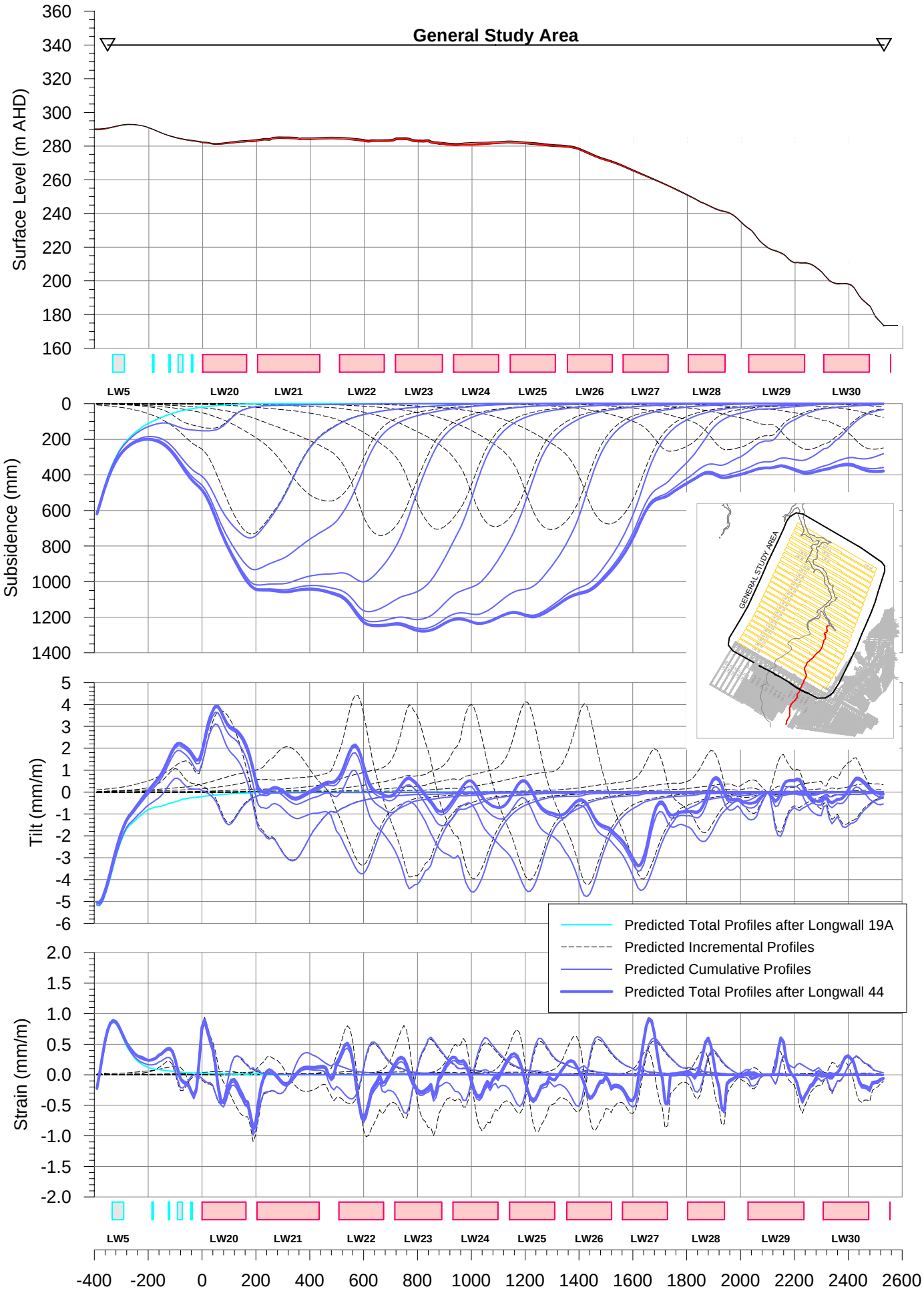
Predicted Profiles of Systematic Subsidence, Tilt and Strain along Fire Road 9E Resulting from the Extraction of Longwalls 20 to 44



Mine Subsidence Engineering Consultants

Fig. C.07

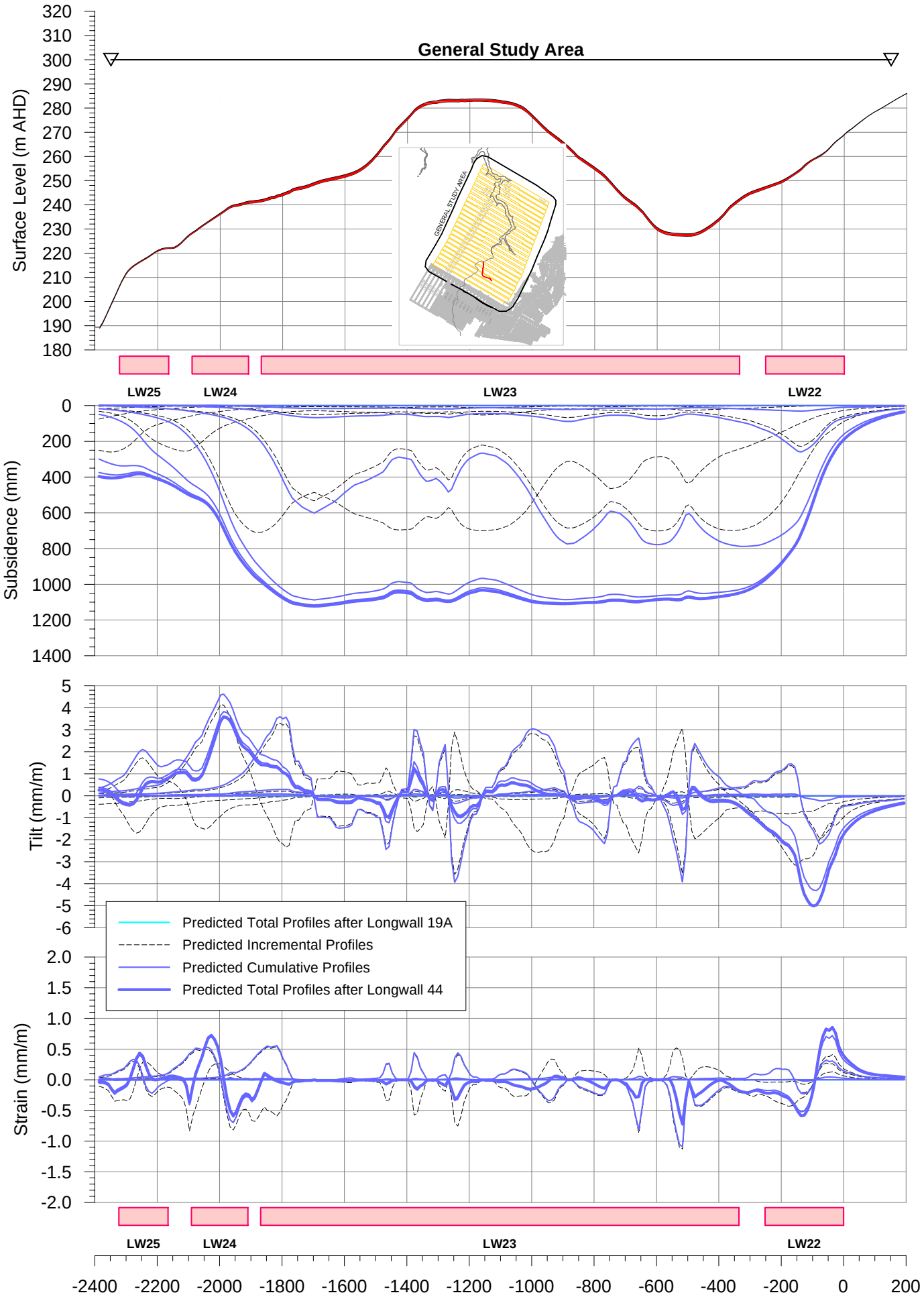
Predicted Profiles of Systematic Subsidence, Tilt and Strain along Fire Road 9G Resulting from the Extraction of Longwalls 20 to 44



Mine Subsidence Engineering Consultants

Fig. C.08

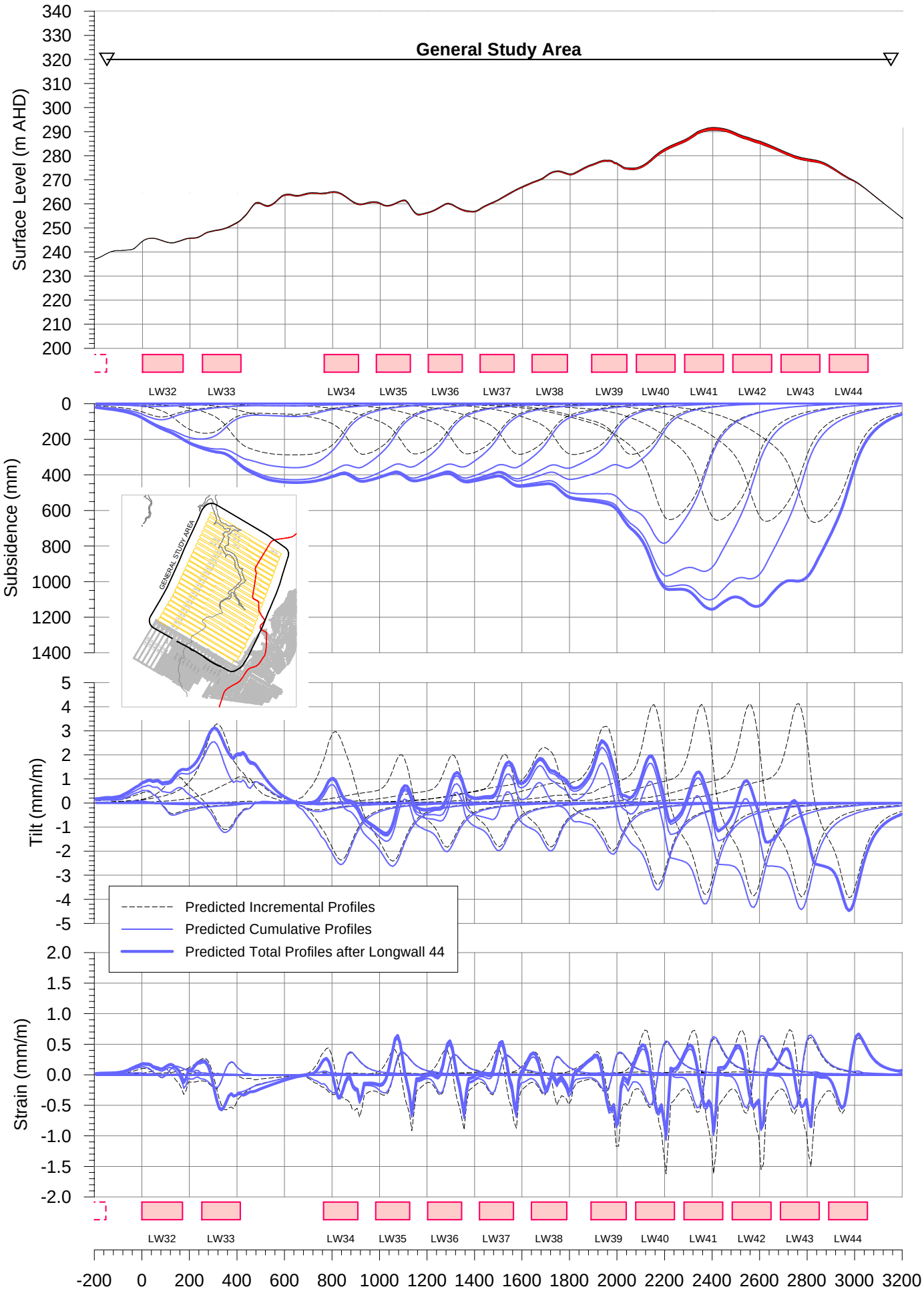
Predicted Profiles of Systematic Subsidence, Tilt and Strain along Fire Road 9J Resulting from the Extraction of Longwalls 20 to 44



Mine Subsidence Engineering Consultants

Fig. C.09

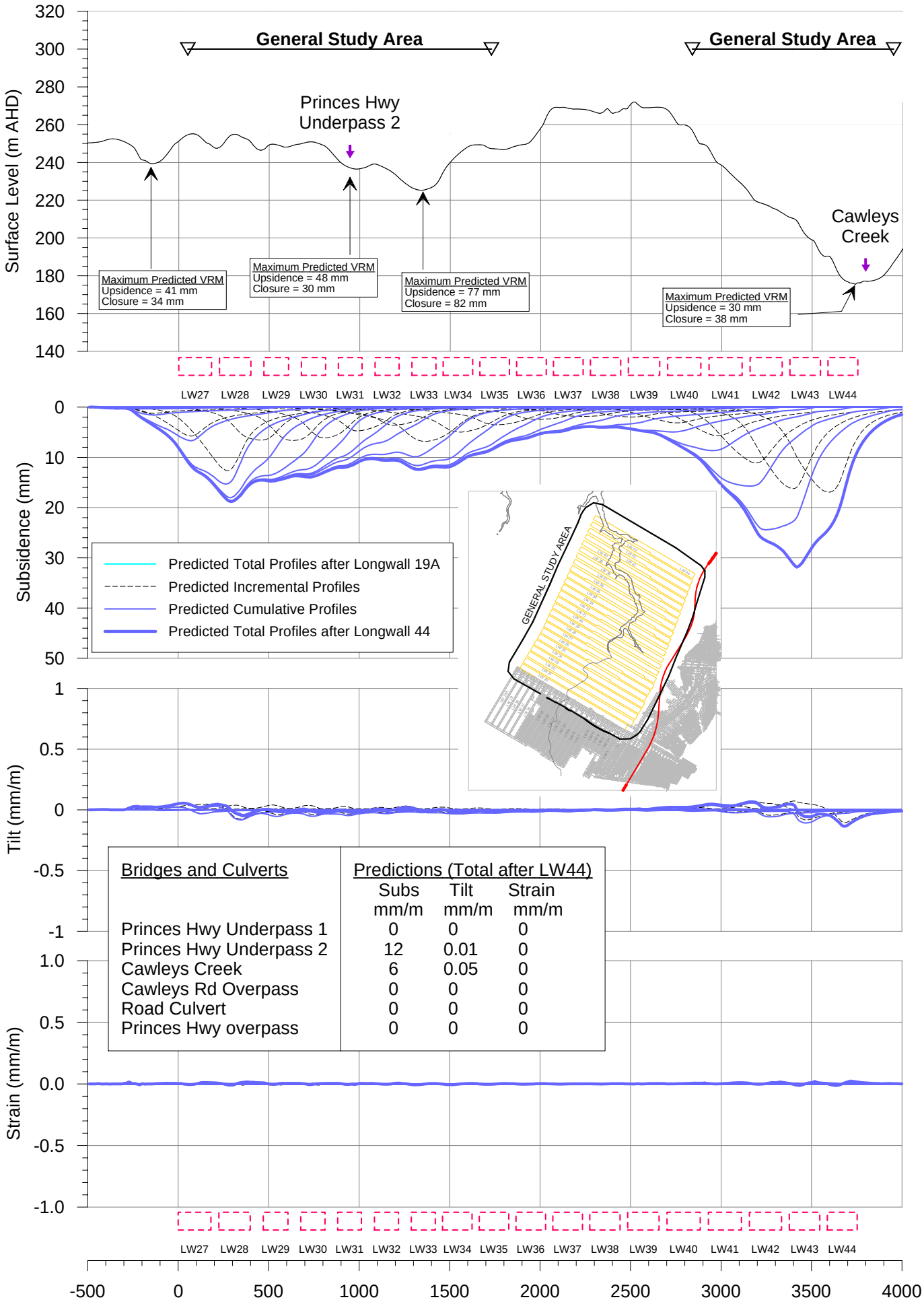
Predicted Profiles of Systematic Subsidence, Tilt and Strain along the Princes Hwy Resulting from the Extraction of Longwalls 20 to 44



Mine Subsidence Engineering Consultants

Fig. C.10

Predicted Profiles of Systematic Subsidence, Tilt and Strain along Southern Freeway Resulting from the Extraction of Longwalls 20 to 44

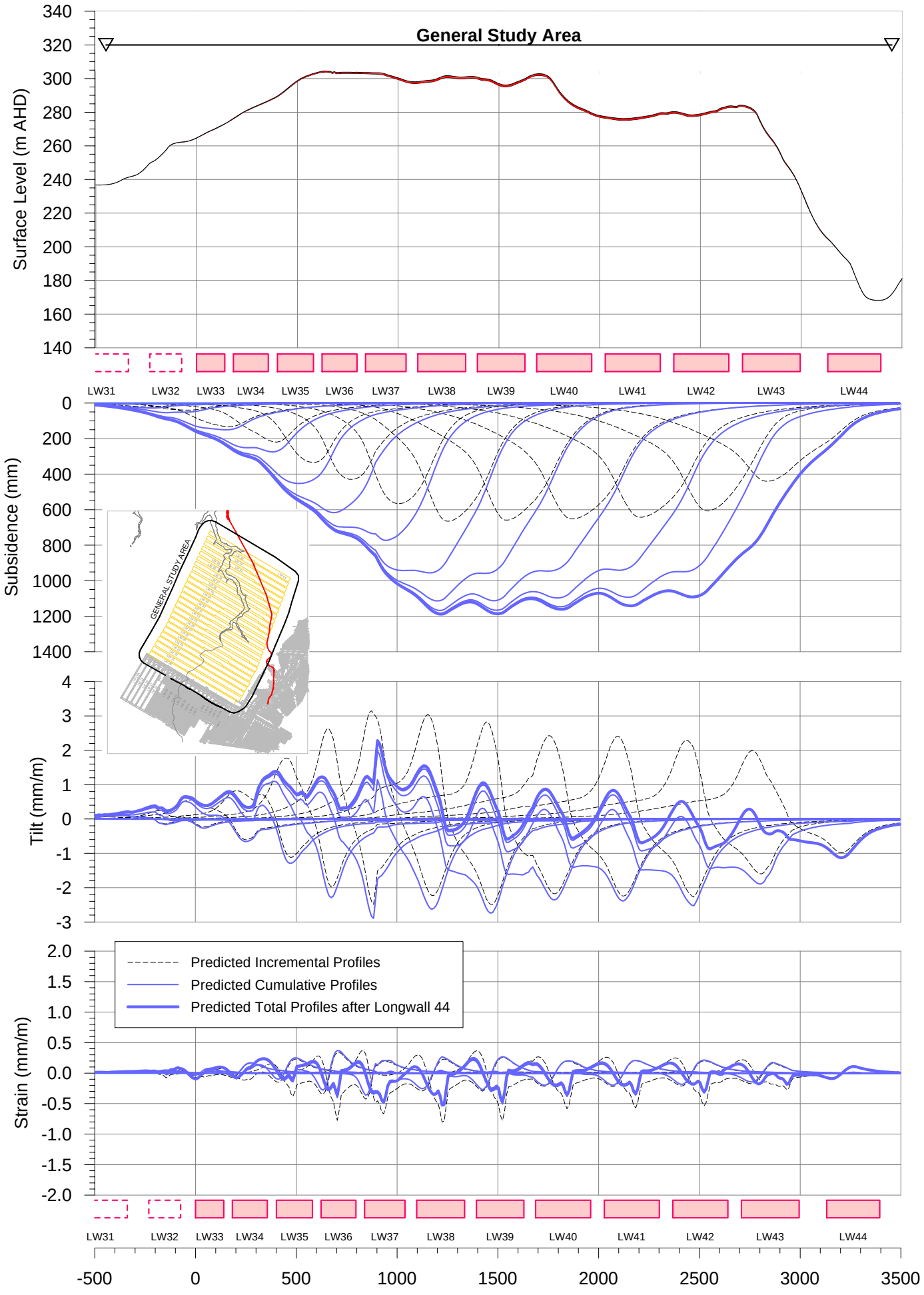


Bridges and Culverts	Predictions (Total after LW44)		
	Subs mm/m	Tilt mm/m	Strain mm/m
Princes Hwy Underpass 1	0	0	0
Princes Hwy Underpass 2	12	0.01	0
Cawleys Creek	6	0.05	0
Cawleys Rd Overpass	0	0	0
Road Culvert	0	0	0
Princes Hwy overpass	0	0	0

Mine Subsidence Engineering Consultants

Fig. C.11

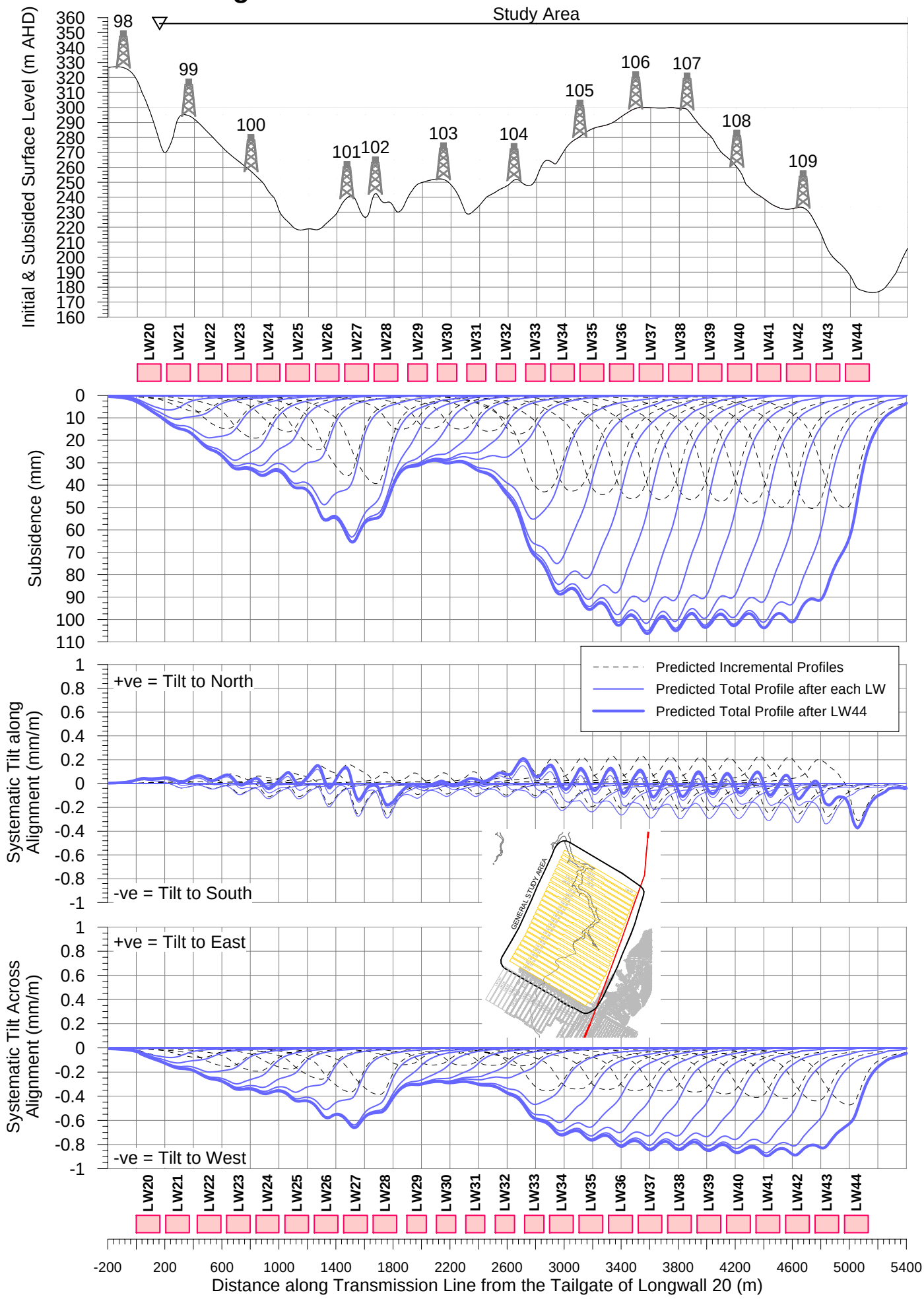
Predicted Profiles of Systematic Subsidence, Tilt and Strain along Watermain Resulting from the Extraction of Longwalls 20 to 44



Mine Subsidence Engineering Consultants

Fig. C.12

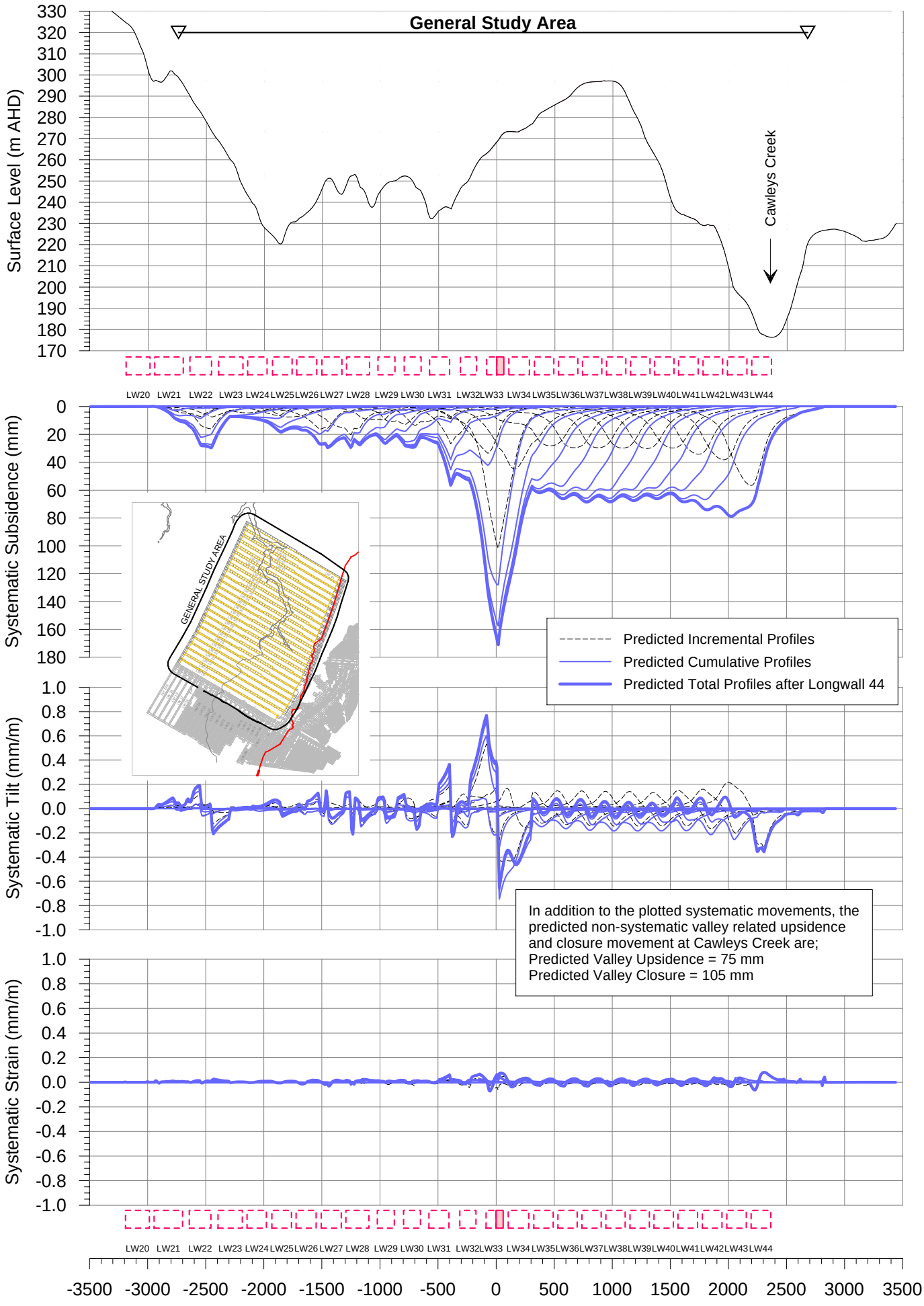
Predicted Profiles of Systematic Subsidence, Tilt Along and Tilt Across the Alignment of the 330 kV Transmission Line



Mine Subsidence Engineering Consultants

Fig. C.13

Predicted Profiles of Systematic Subsidence, Tilt and Strain along the Optus Cable Resulting from the Extraction of Longwalls 20 to 44



Mine Subsidence Engineering Consultants

Fig. C.14

I:\Projects\Metropolitan\Waratah Rivulet Monitoring\South\rawdata\Profile\Fig. C.15 - Waratah Rivulet profile.grf.....24-Jun-08

Metropolitan Colliery - Waratah Rivulet Long Section

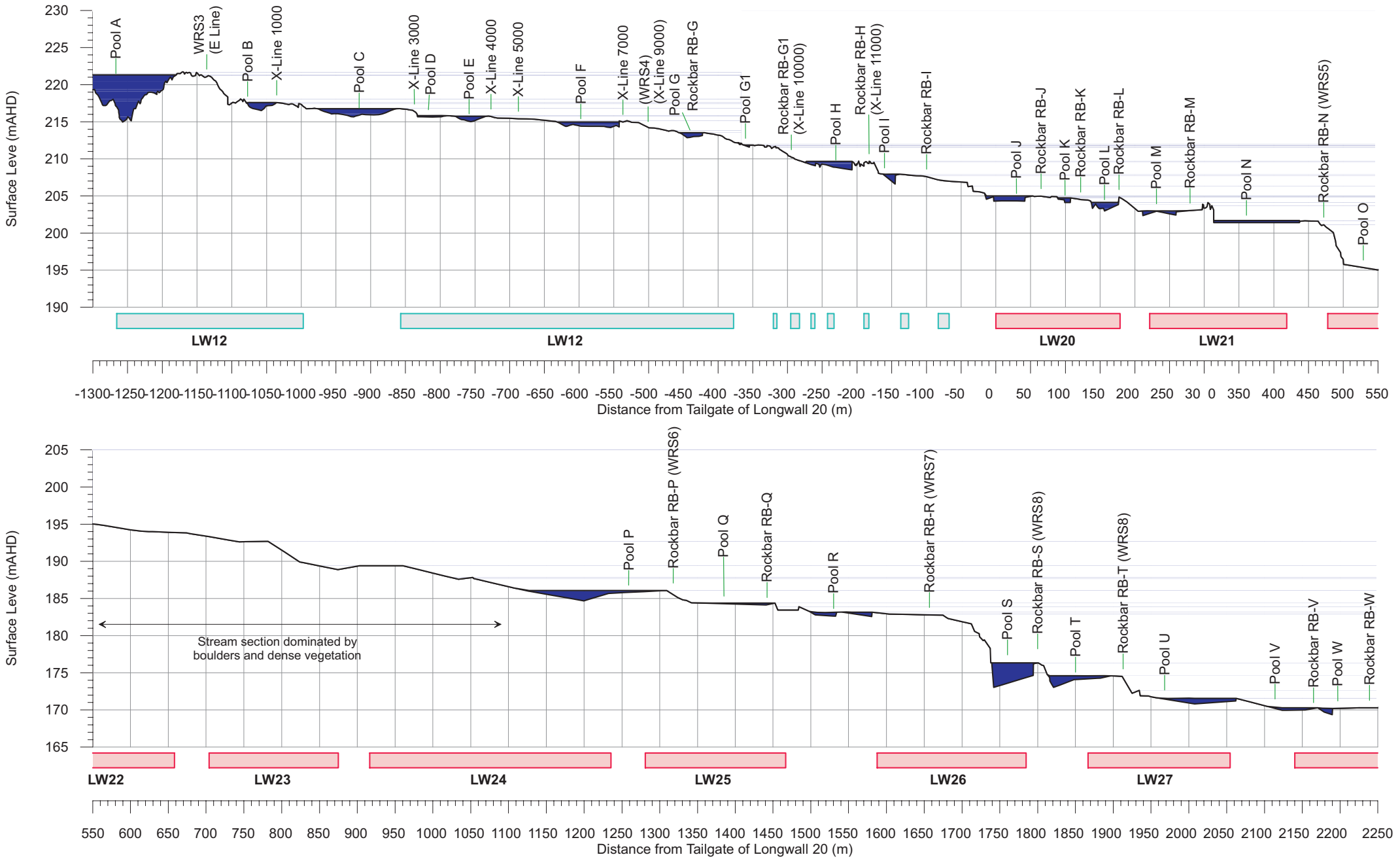
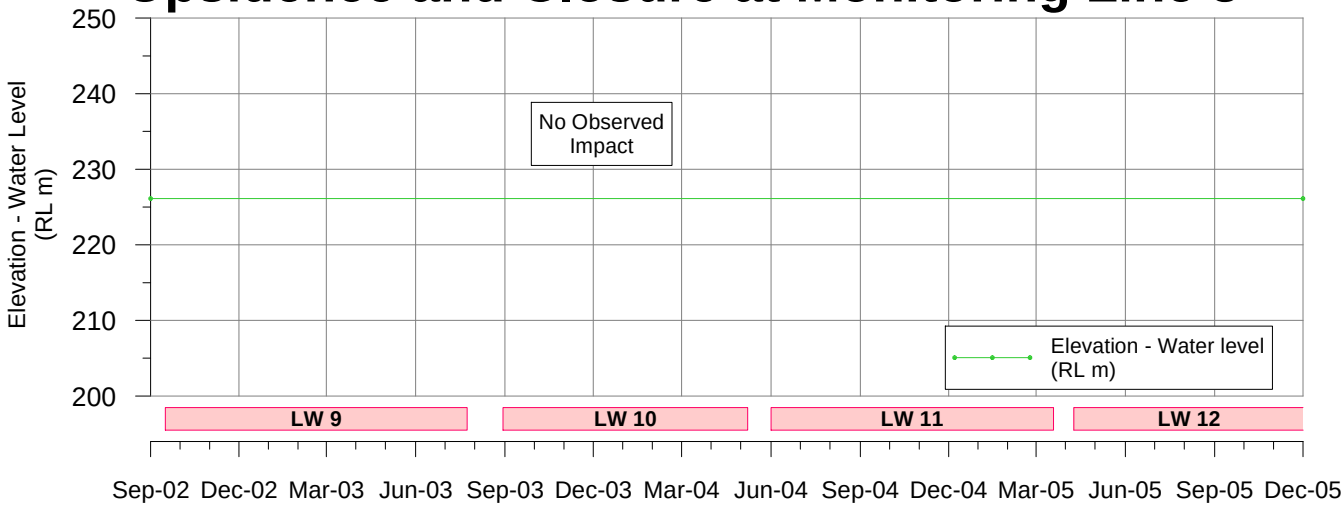
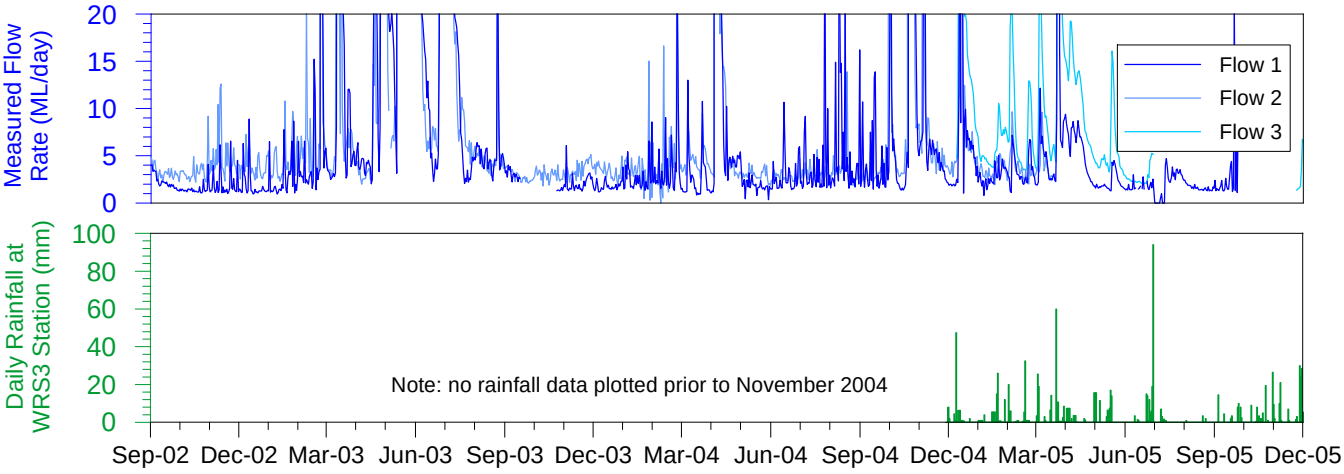


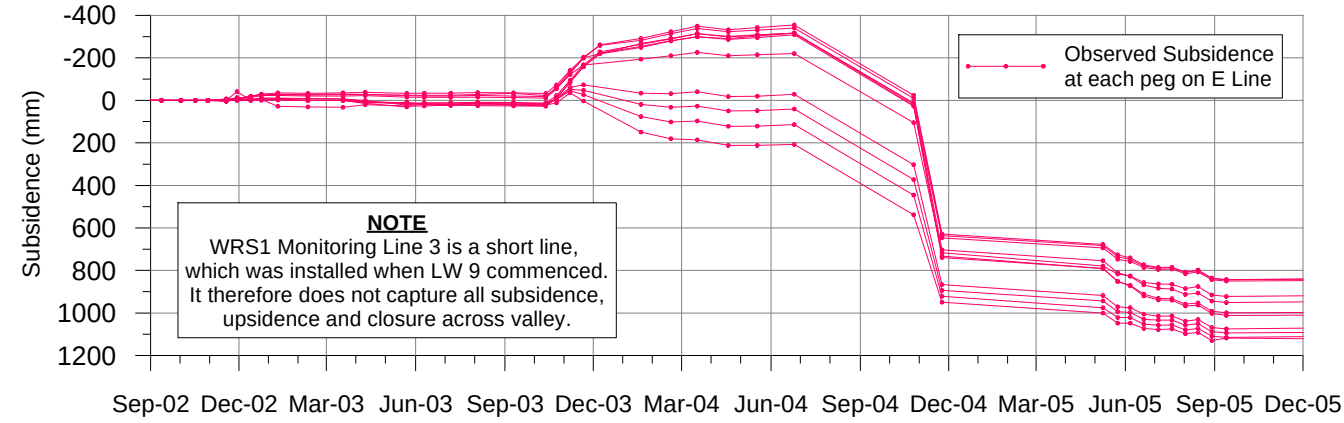
Fig. C.15

I:\Projects\Metropolitan\Waratah Rivulet Monitoring\South\WRS1 - with flow.grf

Waratah Rivulet - Pool Upstream of WRS1, Rainfall, Flow Rate, and Subsidence, Upsidence and Closure at Monitoring Line 3







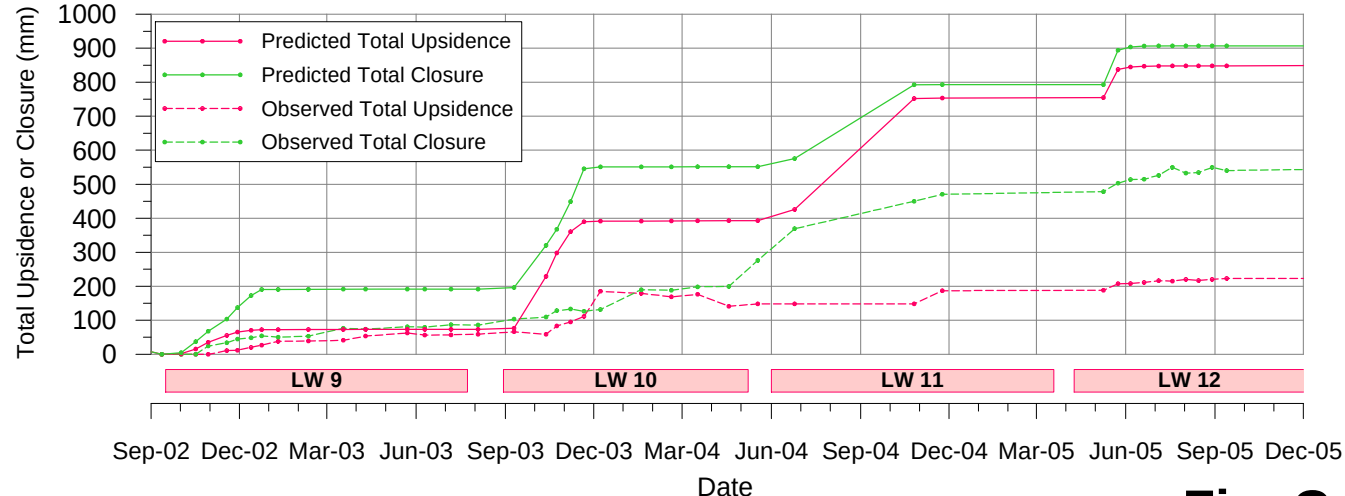
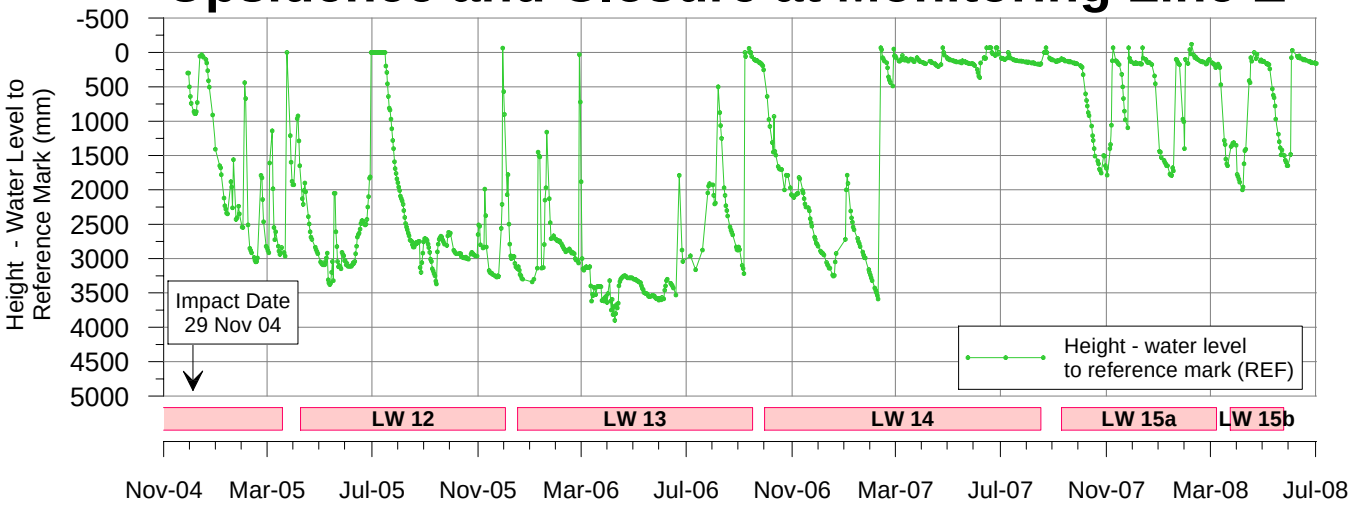
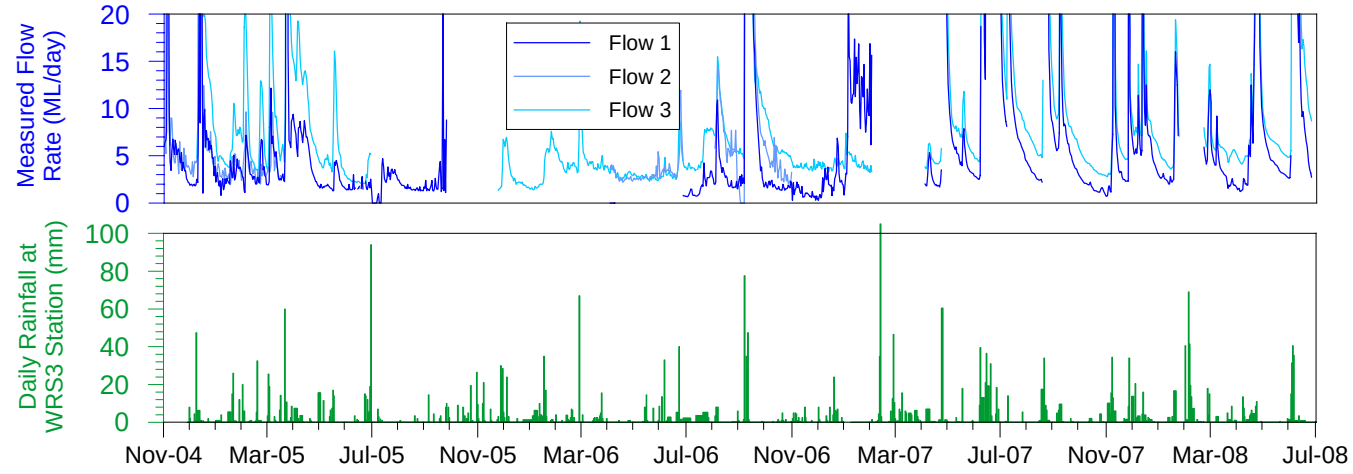


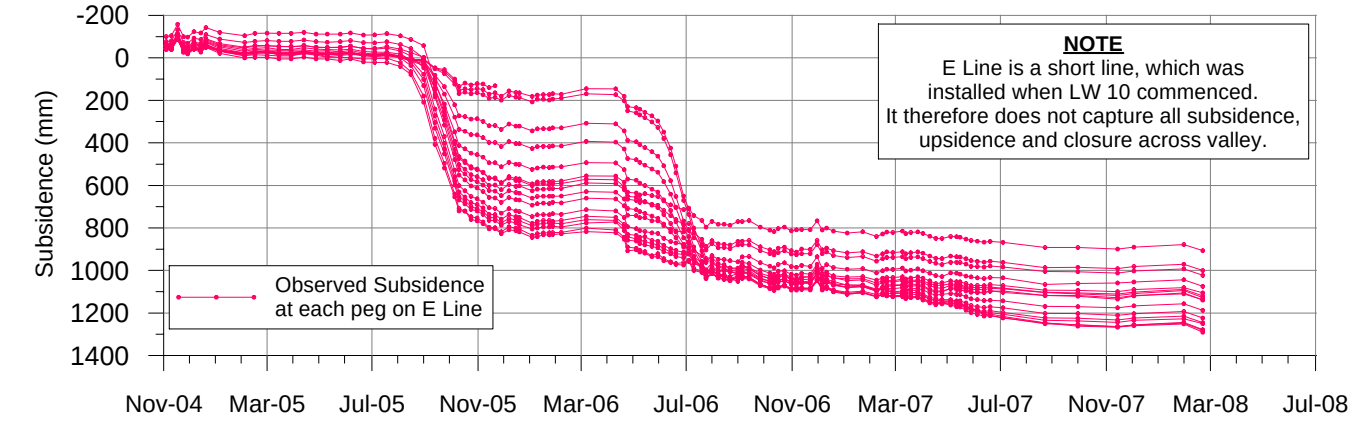
Fig. C.16

I:\Projects\Metropolitan\Waratah Rivulet Monitoring\South\Pool A Levels - with flow.grf

Waratah Rivulet - Pool A Water Level, Rainfall, Flow Rate, and Subsidence, Upsidence and Closure at Monitoring Line E







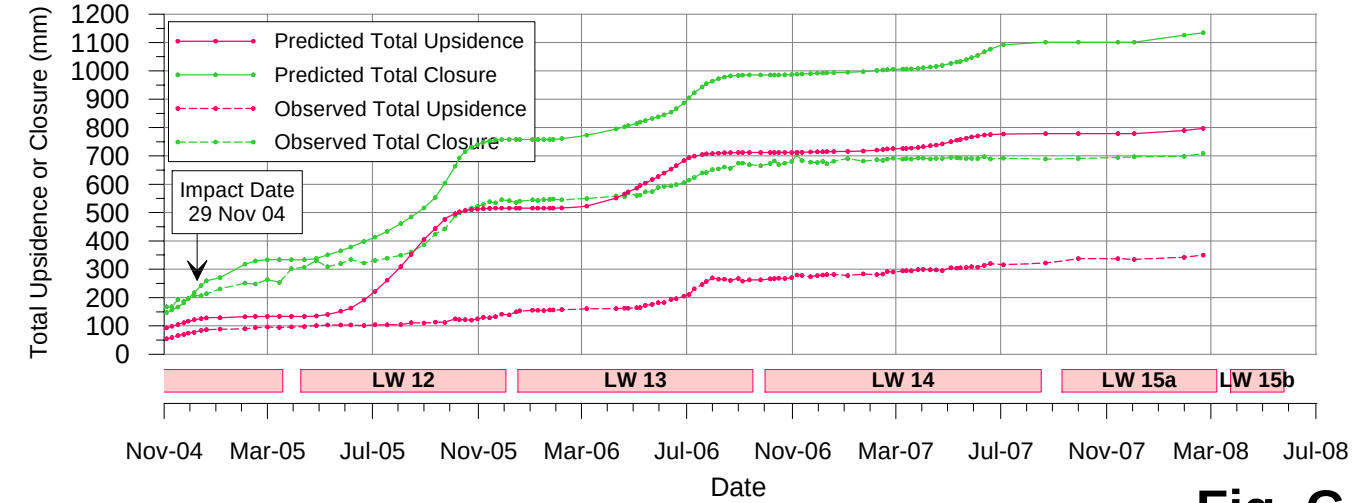


Fig. C.17

Waratah Rivulet - Pool B Water Level, Rainfall, Flow Rate, and Subsidence, Upsidence and Closure at Monitoring Line 1001

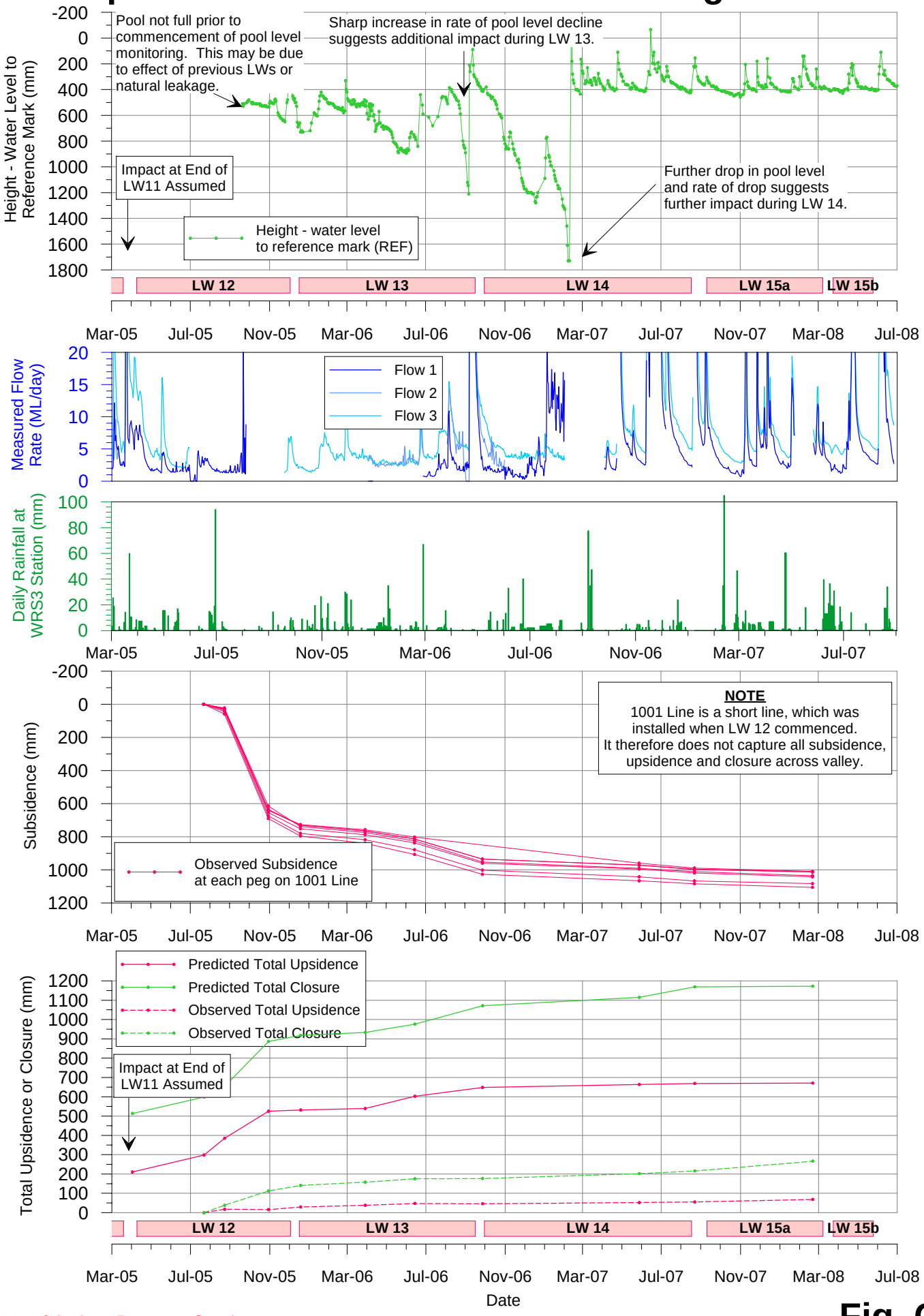
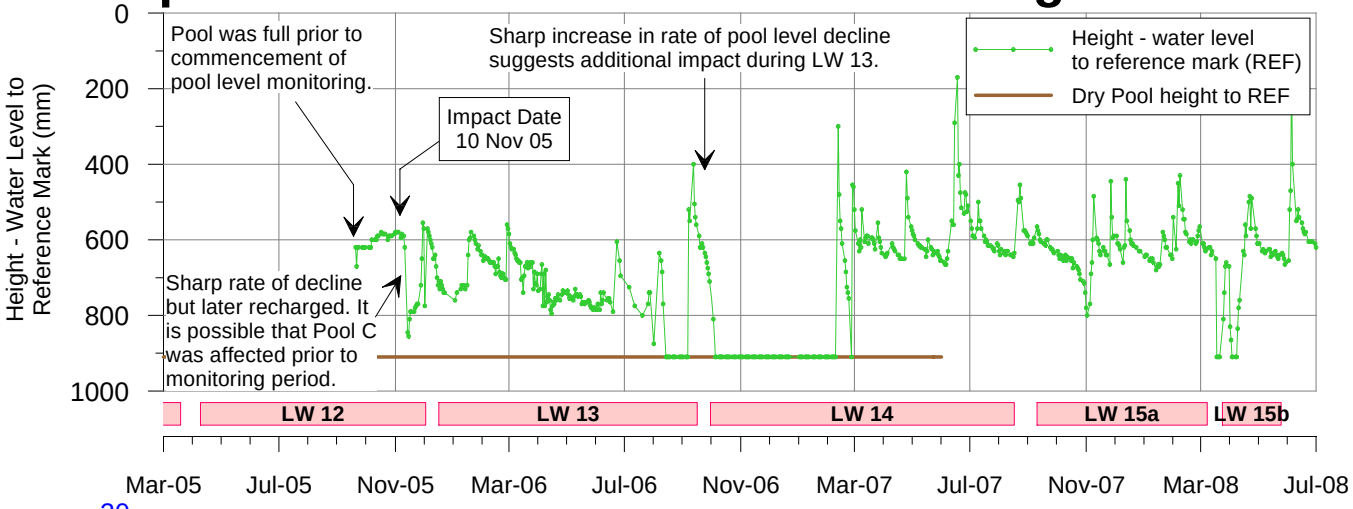
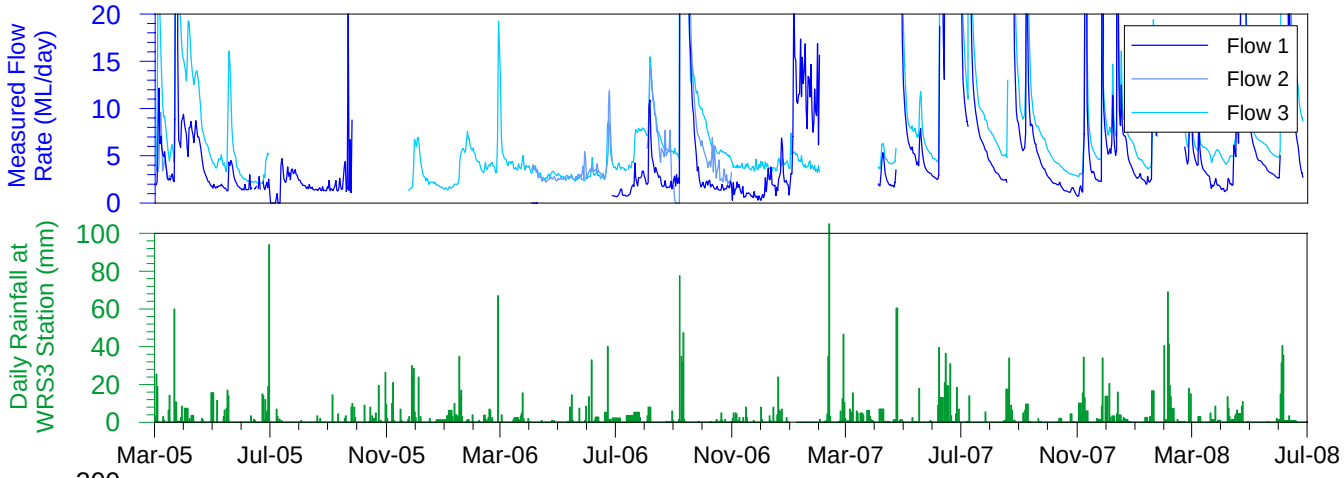
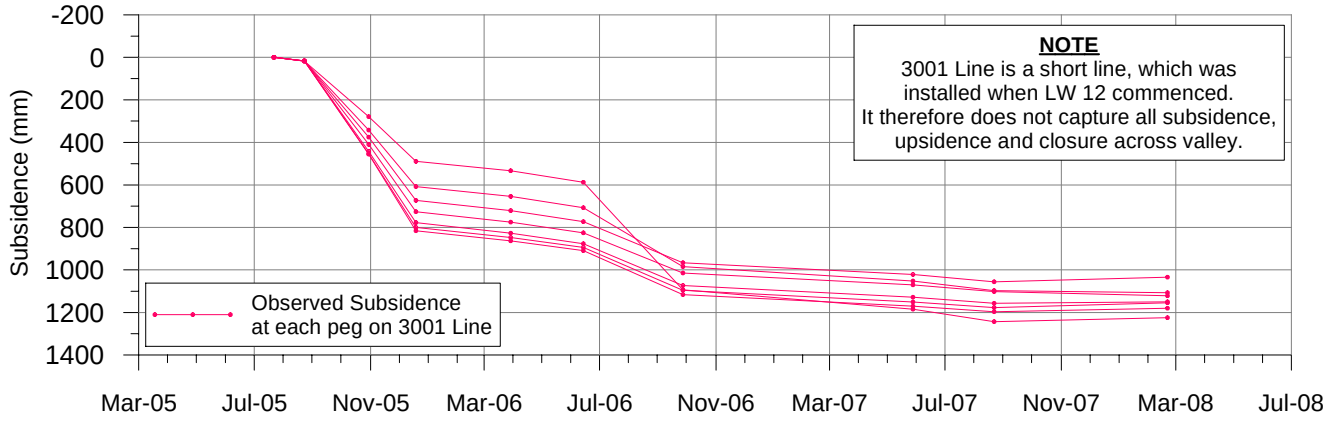


Fig. C.18

Waratah Rivulet - Pool C Water Level, Rainfall, Flow Rate, and Subsidence, Upsidence and Closure at Monitoring Line 3001







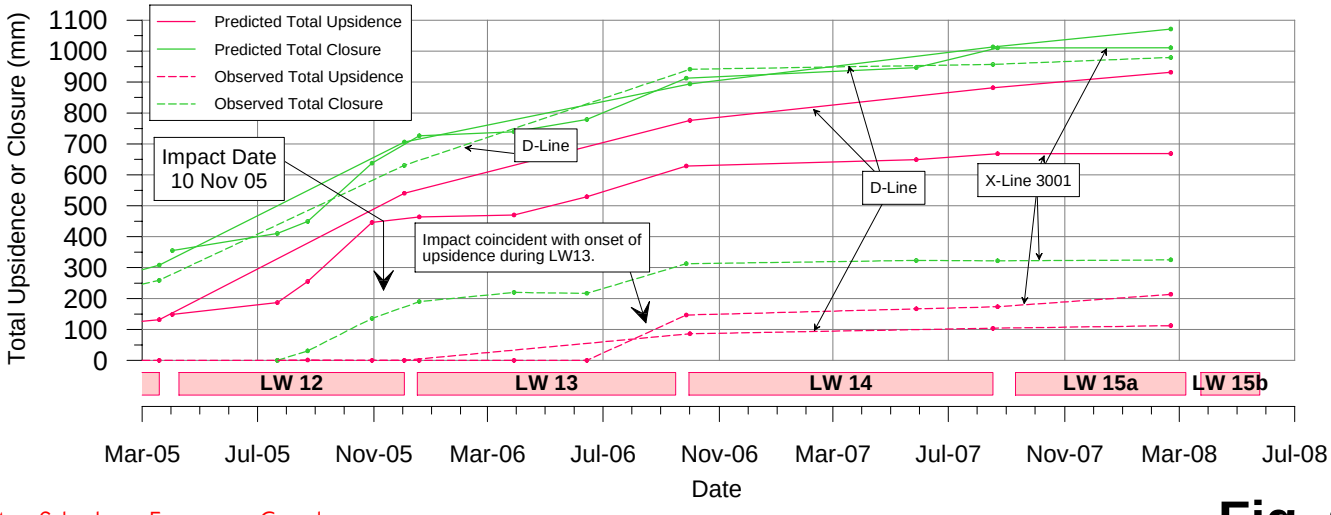


Fig. C.19

Waratah Rivulet - Pool E, Water Level, Rainfall, Flow Rate, and Subsidence, Upsidence and Closure at Monitoring Line 4001

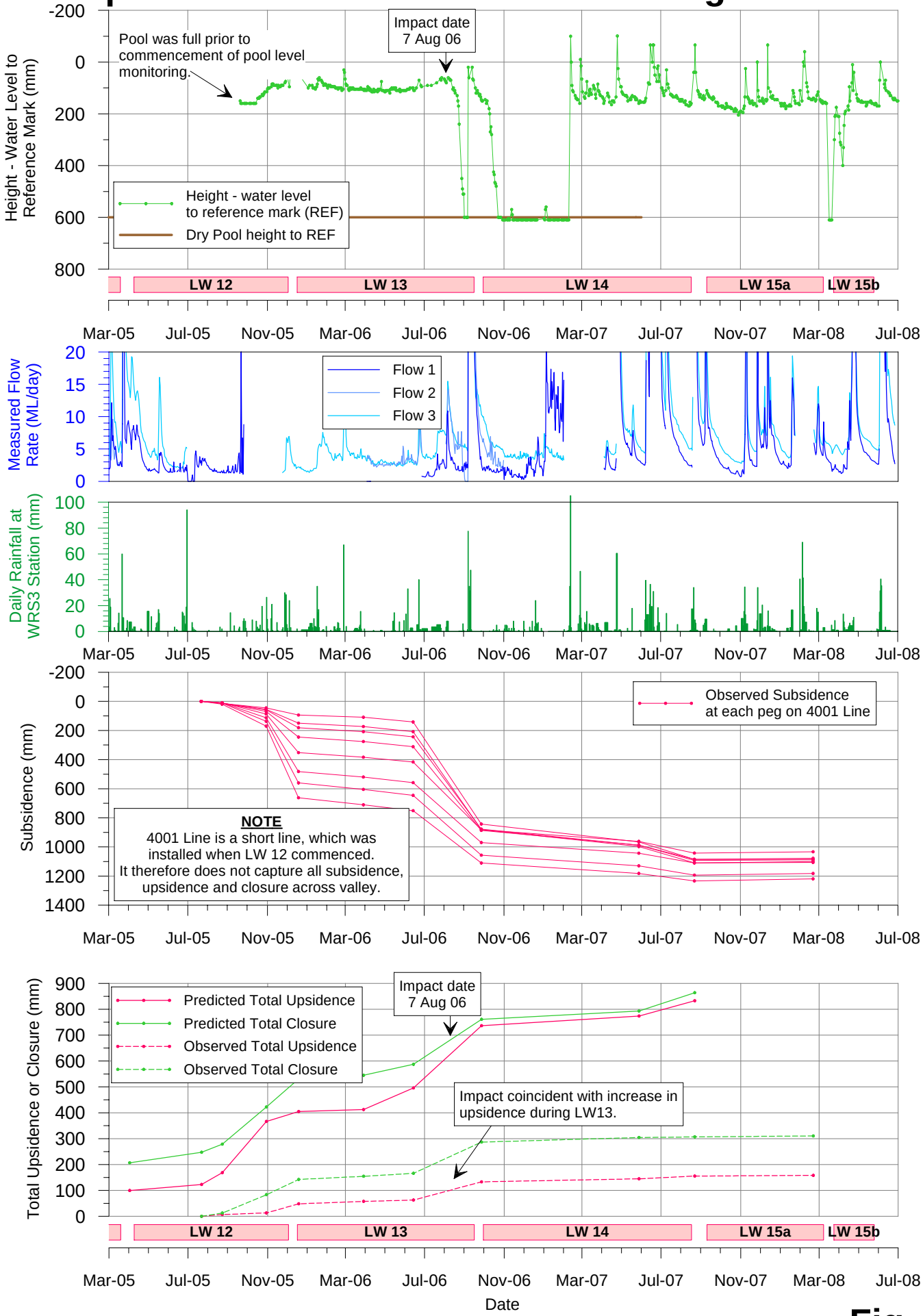


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Fig. C.20

Waratah Rivulet - Pool F Water Level, Rainfall, Flow Rate, and Subsidence, Upsidence and Closure at Monitoring Line 7001

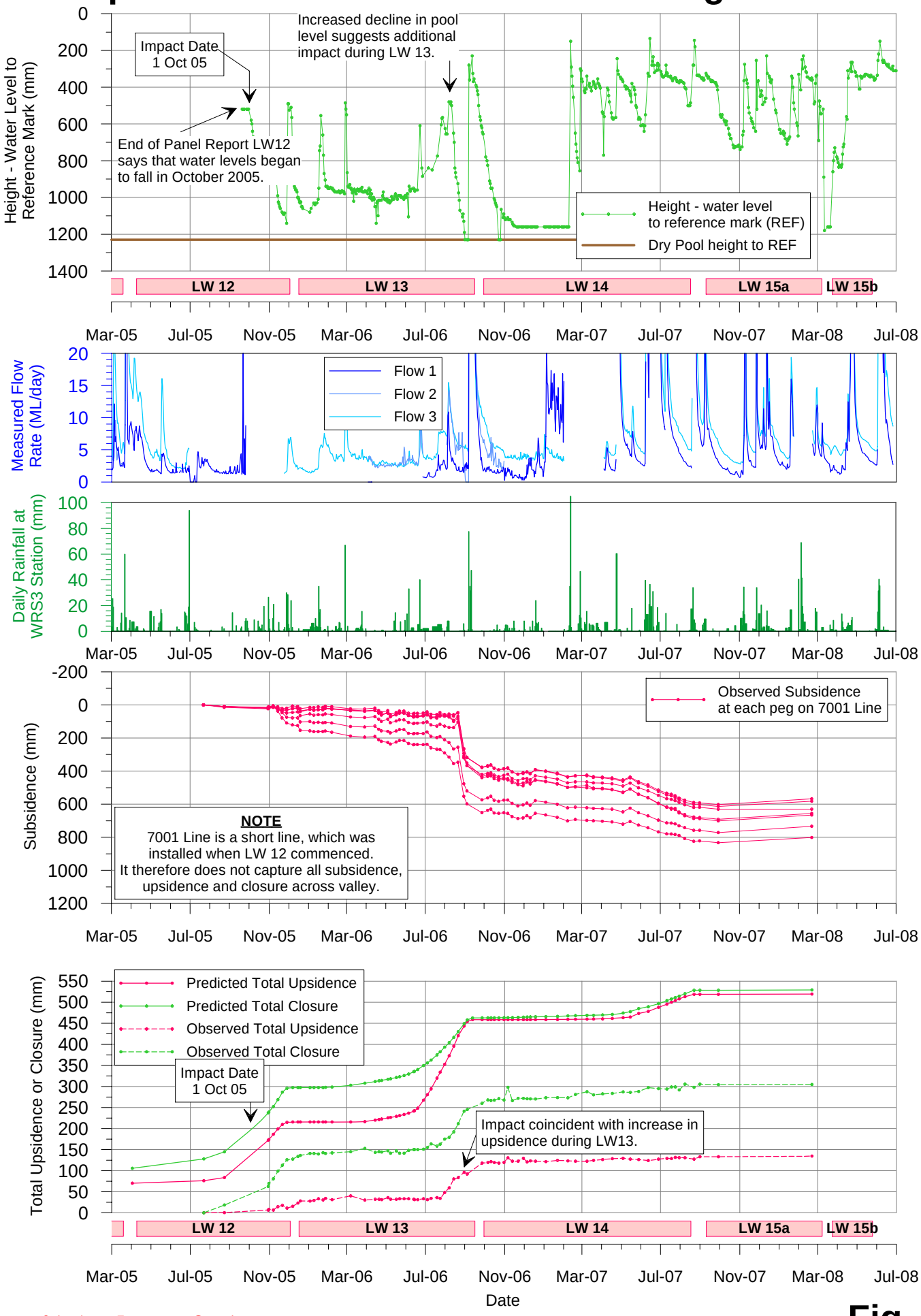

Fig. C.21

Waratah Rivulet - Pool G Water Level, Rainfall, Flow Rate, and Subsidence, Upsidence and Closure at Monitoring Line 9001

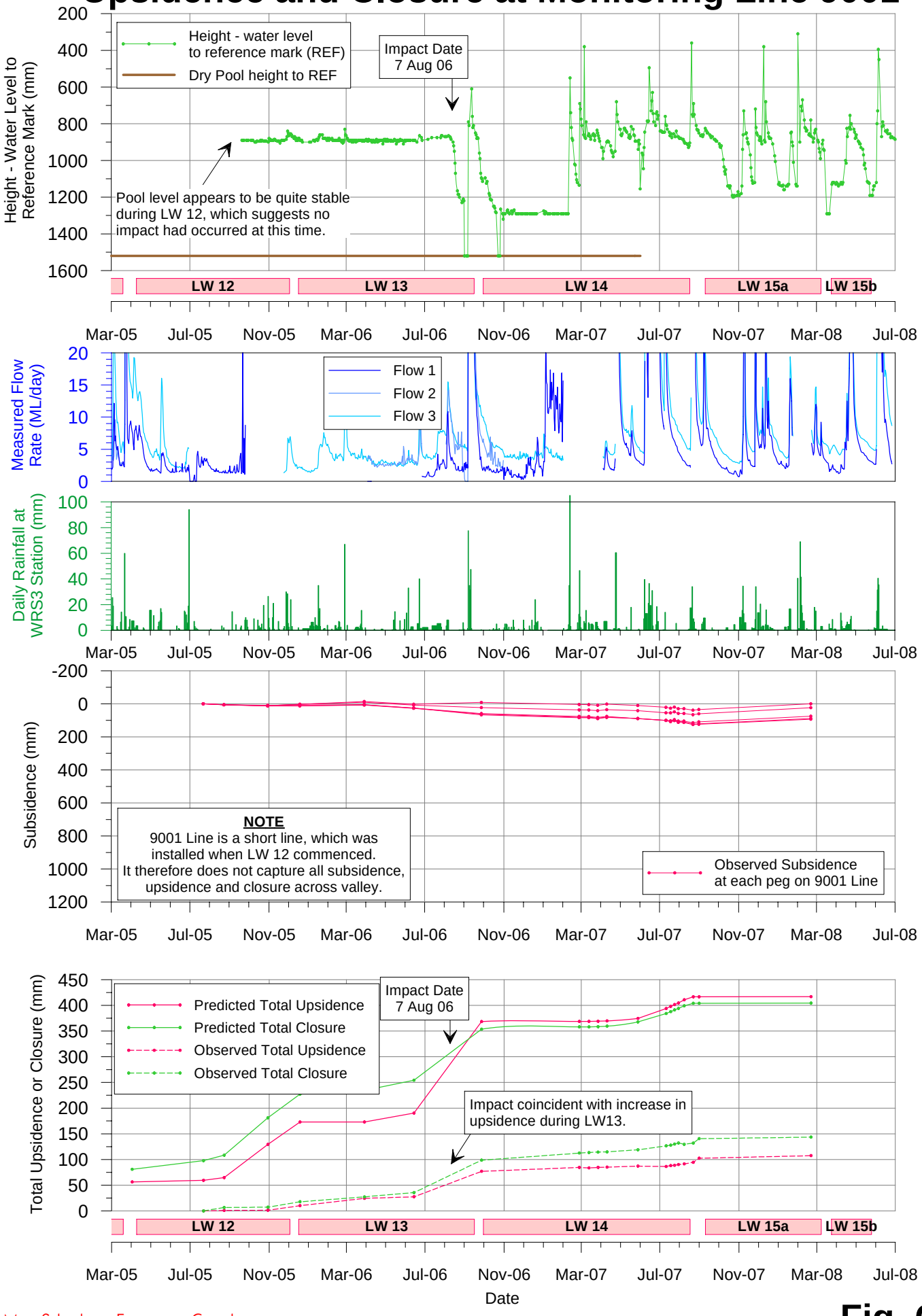

Fig. C.22

Waratah Rivulet - Pool G1 Water Level, Rainfall, Flow Rate, and Subsidence, Upsidence and Closure at Monitoring Line 10000

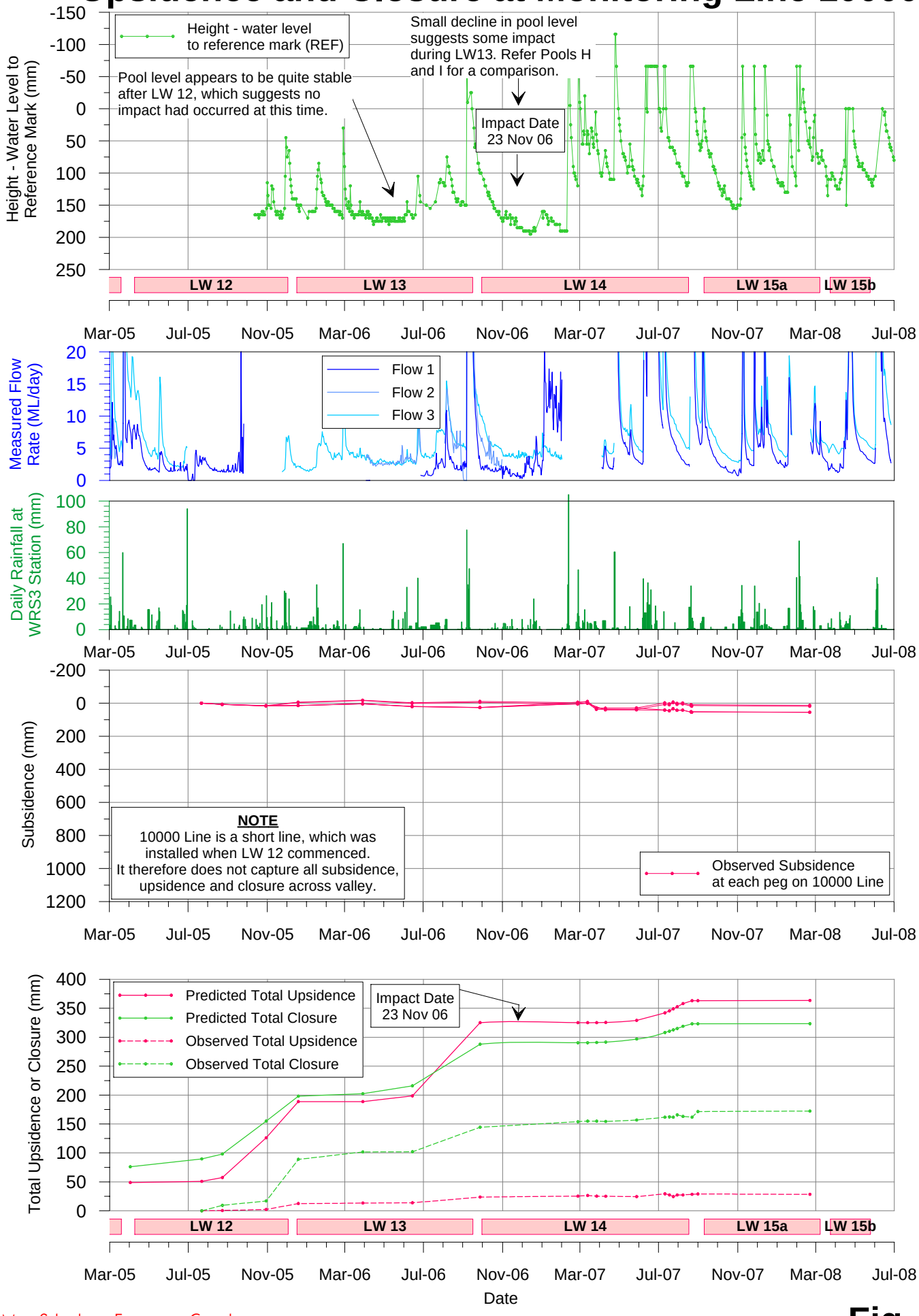

Fig. C.23

Waratah Rivulet - Pool H Water Level, Rainfall, Flow Rate, and Subsidence, Upsidence and Closure at Monitoring Line 11000

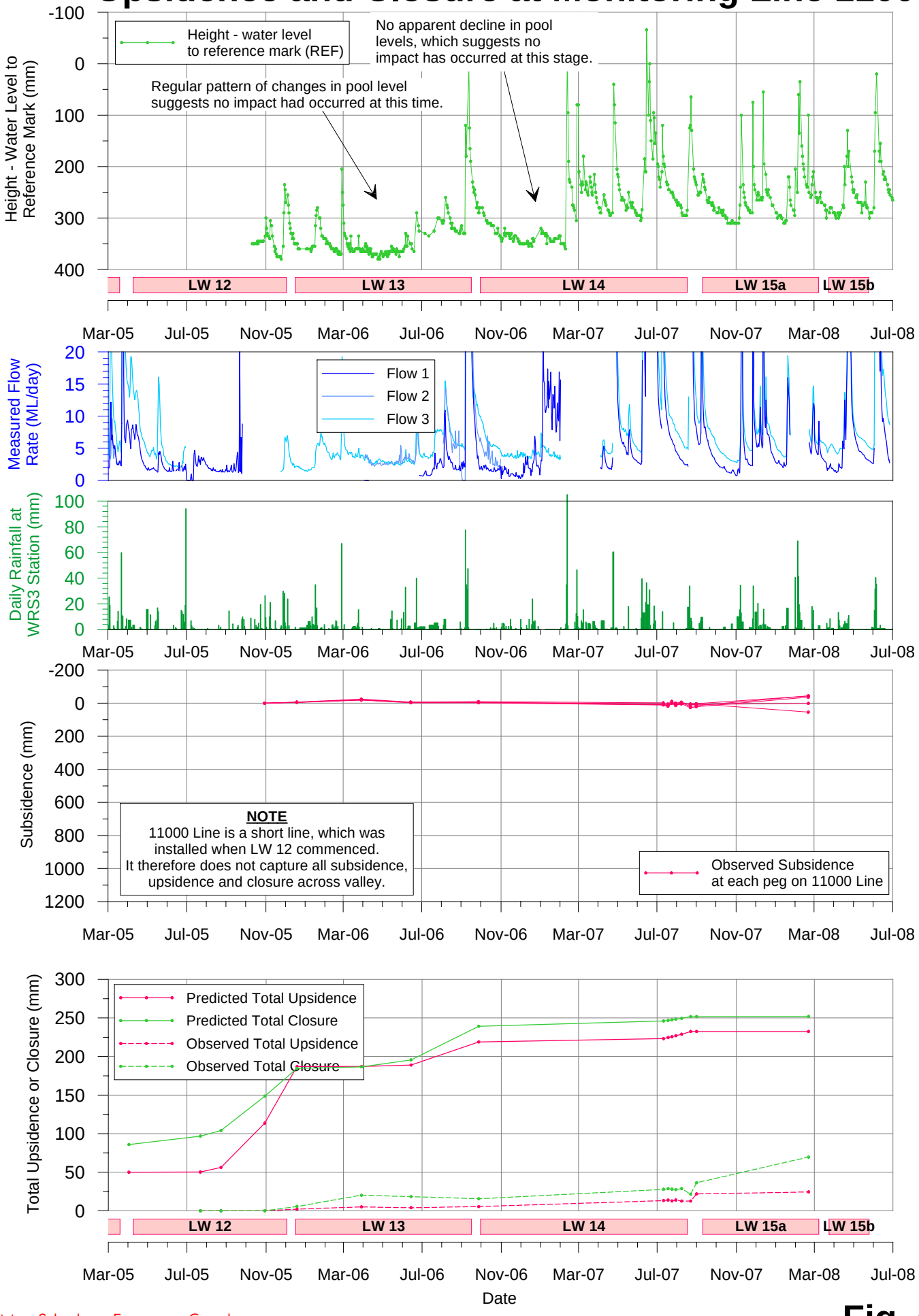

Fig. C.24

Waratah Rivulet - Pool I Water Level, Rainfall, Flow Rate, and Subsidence, Upsidence and Closure at Monitoring Line 11000

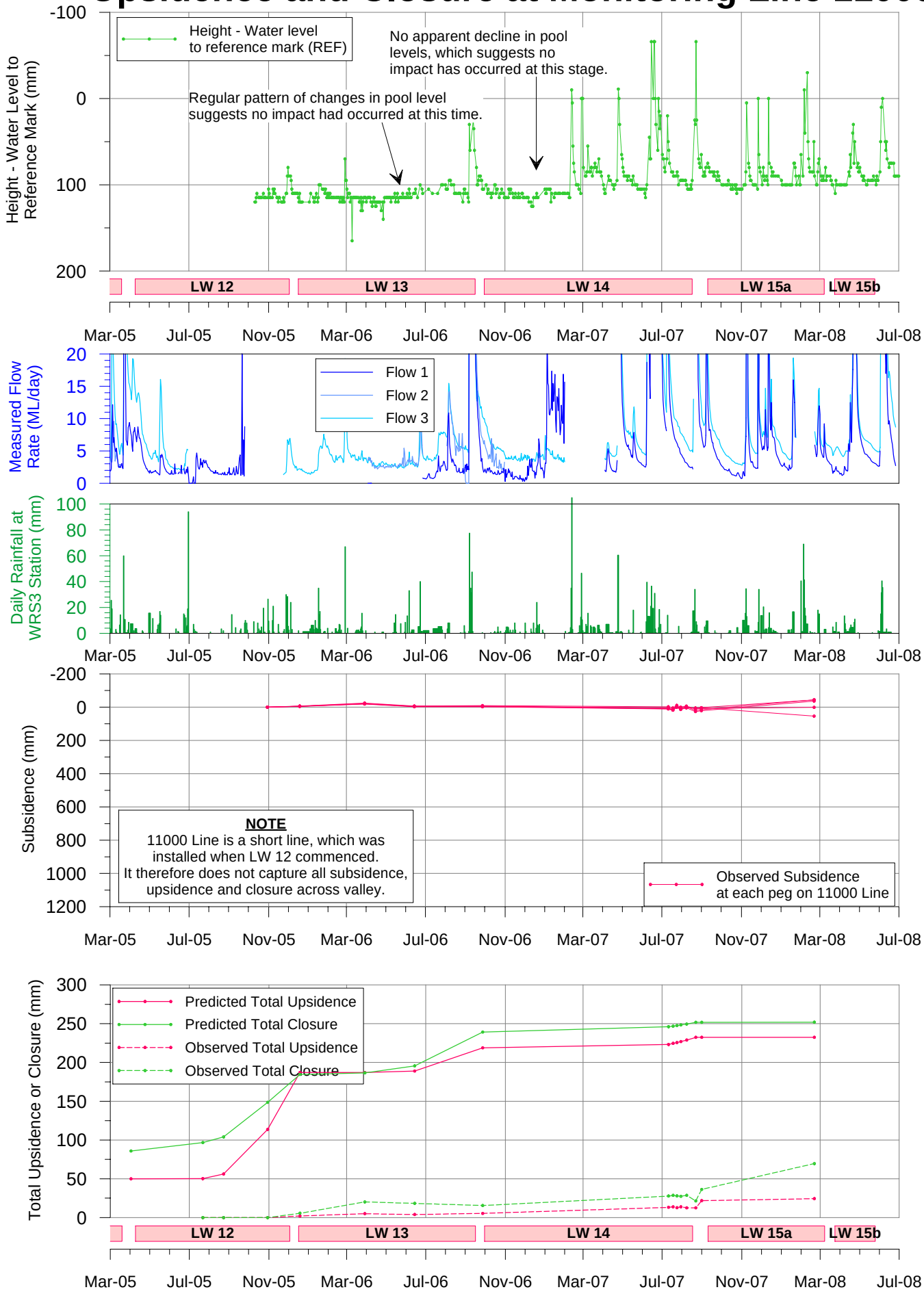

Fig. C.25

APPENDIX D - TABLES

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Subs after LW19A	Total Subs after LW20	Total Subs after LW21	Total Subs after LW22	Total Subs after LW23	Total Subs after LW24	Total Subs after LW25	Total Subs after LW26	Total Subs after LW27	Total Subs after LW28	Total Subs after LW29	Total Subs after LW30	Total Subs after LW31	Total Subs after LW32	Total Subs after LW33	Total Subs after LW34	Total Subs after LW35	Total Subs after LW36	Total Subs after LW37	Total Subs after LW38	Total Subs after LW39	Total Subs after LW40
2-0346	52-2-0346		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	14	87	636	983
FRC 101	52-2-0875	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	21	144
FRC 105	52-2-0340		1	14	161	500	568	602	606	606	606	606	606	606	606	606	606	606	606	606	606	606	606	606	606
FRC 113	52-2-0365		1	0	0	0	0	11	58	566	907	1013	1037	1038	1038	1038	1038	1038	1038	1038	1038	1038	1038	1038	1038
FRC 114	52-2-0725	1		0	0	0	0	1	3	14	27	32	34	34	34	34	34	34	34	34	34	34	34	34	34
FRC 115	52-2-0726		1	0	0	0	0	3	10	52	89	103	107	107	107	107	107	107	107	107	107	107	107	107	107
FRC 117	52-2-0739		1	0	0	0	0	0	0	0	0	0	0	9	83	322	382	393	404	408	408	408	408	408	408
FRC 119	52-2-0196		1	0	0	24	188	488	578	598	605	606	606	606	606	606	606	606	606	606	606	606	606	606	606
FRC 124	52-2-0162		1	0	31	793	989	1084	1108	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112
FRC 125	52-2-0310		1	0	4	133	651	910	1005	1029	1035	1037	1037	1037	1037	1037	1037	1037	1037	1037	1037	1037	1037	1037	1037
FRC 127	52-2-0203		1	0	0	0	0	0	0	0	4	21	55	314	390	405	406	406	406	406	406	406	406	406	406
FRC 13	52-2-0125		1	268	274	291	293	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294
FRC 14	52-2-0138		1	29	183	417	461	483	484	484	484	484	484	484	484	484	484	484	484	484	484	484	484	484	484
FRC 15	52-2-0396		1	0	9	672	965	1092	1124	1126	1126	1126	1126	1126	1126	1126	1126	1126	1126	1126	1126	1126	1126	1126	1126
FRC 16.1	52-2-0120		1	39	166	353	385	401	402	402	402	402	402	402	402	402	402	402	402	402	402	402	402	402	402
FRC 16.2	52-2-120		1	52	150	305	331	344	344	344	344	344	344	344	344	344	344	344	344	344	344	344	344	344	344
FRC 160	52-2-0823		1	0	23	626	750	810	828	833	833	833	833	833	833	833	833	833	833	833	833	833	833	833	833
FRC 164	52-2-0171	1		0	0	0	0	0	0	1	11	34	226	344	372	377	378	378	378	378	378	378	378	378	378	378
FRC 168	52-2-0541	1		60	133	289	317	329	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331
FRC 169	52-2-0747	1		0	0	0	0	0	7	31	417	740	810	812	813	813	813	813	813	813	813	813	813	813	813	813
FRC 17	52-2-0121		1	55	149	297	320	335	335	335	335	335	335	335	335	335	335	335	335	335	335	335	335	335	335
FRC 171	52-2-0734		1	0	0	0	0	0	0	5	35	283	362	377	381	381	381	381	381	381	381	381	381	381	381
FRC 172	52-2-0735		1	0	0	0	0	0	3	9	52	312	377	390	394	395	395	395	395	395	395	395	395	395	395
FRC 176	52-2-0826		1	0	2	52	326	977	1150	1203	1219	1223	1223	1223	1223	1223	1223	1223	1223	1223	1223	1223	1223	1223	1223
FRC 180	52-2-0828		1	0	0	0	0	0	0	0	0	1	9	62	315	376	387	389	389	389	389	389	389	389	389
FRC 184	52-2-0222		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	33	266	343	357
FRC 185	52-2-0223		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	12	113	303	353	361
FRC 186	52-2-0224		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	36	272	348	361	363
FRC 187	52-2-0225		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	51	298	360	370	372
FRC 189	52-2-0180		1	0	0	0	0	0	0	0	0	0	2	17	171	293	331	339	340	340	340	340	340	340	340
FRC 191	52-2-0183		1	0	0	0	0	0	0	0	0	0	0	2	16	133	300	347	357	359	360	360	360	360	360
FRC 193	52-2-0144	1		0	0	0	0	0	2	17	72	426	820	929	960	968	970	970	970	970	970	970	970	970	970
FRC 194	52-2-0263		1	0	0	0	0	0	0	0	3	18	124	298	345	354	356	356	356	356	356	356	356	356	356
FRC 195	52-2-0264		1	0	0	0	0	0	0	0	4	27	231	325	349	353	353	353	353	353	353	353	353	353	353
FRC 198	52-2-0268		1	0	0	0	0	0	0	0	0	0	0	8	63	294	351	361	363	363	363	363	363	363	363
FRC 199	52-2-0265		1	0	0	0	0	0	0	0	2	14	88	301	356	367	370	370	370	370	370	370	370	370	370
FRC 20	52-2-0107		1	27	196	465	521	552	553	553	553	553	553	553	553	553	553	553	553	553	553	553	553	553	553
FRC 201	52-2-0267		1	339	341	346	348	349	349	349	349	349	349	349	349	349	349	349	349	349	349	349	349	349	349
FRC 21	52-2-0105		1	13	179	647	729	763	767	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768
FRC 22	52-2-0145		1	0	0	28	158	885	1102	1141	1143	1143	1143	1143	1143	1143	1143	1143	1143	1143	1143	1143	1143	1143	1143
FRC 23	52-2-0161		1	0	24	793	990	1088	1112	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116
FRC 24.1	52-2-159		1	0	0	14	64	701	1105	1133	1139	1139	1139	1139	1139	1139	1139	1139	1139	1139	1139	1139	1139	1139	1139
FRC 24.2	52-2-0160		1	0	0	9	44	408	1024	1065	1073	1074	1074	1074	1074	1074	1074	1074	1074	1074	1074	1074	1074	1074	1074
FRC 25	52-2-0129		1	0	2	57	477	1032	1179	1225	1237	1240	1240	1240	1240	1240	1240	1240	1240	1240	1240	1240	1240	1240	1240

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Subs after LW19A	Total Subs after LW20	Total Subs after LW21	Total Subs after LW22	Total Subs after LW23	Total Subs after LW24	Total Subs after LW25	Total Subs after LW26	Total Subs after LW27	Total Subs after LW28	Total Subs after LW29	Total Subs after LW30	Total Subs after LW31	Total Subs after LW32	Total Subs after LW33	Total Subs after LW34	Total Subs after LW35	Total Subs after LW36	Total Subs after LW37	Total Subs after LW38	Total Subs after LW39	Total Subs after LW40
FRC 253	52-2-0738	1		0	0	0	0	0	0	0	0	13	32	232	342	368	372	372	372	372	372	372	372	372	372
FRC 254	52-2-0829		1	0	0	0	0	0	0	0	0	0	0	3	18	183	305	333	341	342	342	342	342	342	342
FRC 26	52-2-0135		1	0	0	2	11	64	580	1023	1136	1144	1145	1145	1145	1145	1145	1145	1145	1145	1145	1145	1145	1145	1145
FRC 266	N/A		1	81	126	223	241	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257
FRC 272	52-2-3074		1	0	9	572	917	1057	1083	1092	1094	1094	1094	1094	1094	1094	1094	1094	1094	1094	1094	1094	1094	1094	1094
FRC 273	52-2-3075	1		0	10	639	940	1067	1090	1098	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
FRC 274	N/A		1	0	0	20	90	688	1028	1162	1201	1211	1213	1213	1213	1213	1213	1213	1213	1213	1213	1213	1213	1213	1213
FRC 275	N/A		1	0	1	52	369	992	1150	1204	1218	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221
FRC 276	52-2-3078		1	0	0	3	15	81	687	1044	1147	1155	1156	1156	1156	1156	1156	1156	1156	1156	1156	1156	1156	1156	1156
FRC 277	52-2-3079		1	0	0	0	5	43	287	932	1119	1161	1168	1169	1169	1169	1169	1169	1169	1169	1169	1169	1169	1169	1169
FRC 278	52-2-3080	1		60	144	314	341	355	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357
FRC 279	52-2-3081		1	5	99	766	920	985	999	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002
FRC 28	52-2-0154		1	0	0	0	0	0	0	0	1	16	44	293	378	397	399	399	399	399	399	399	399	399	399
FRC 280	52-2-3082	1		0	5	309	802	1003	1056	1059	1059	1059	1059	1059	1059	1059	1059	1059	1059	1059	1059	1059	1059	1059	1059
FRC 281	52-2-3083		1	0	4	187	726	956	1037	1041	1041	1041	1041	1041	1041	1041	1041	1041	1041	1041	1041	1041	1041	1041	1041
FRC 283	52-2-3085		1	0	0	27	177	905	1112	1169	1172	1172	1172	1172	1172	1172	1172	1172	1172	1172	1172	1172	1172	1172	1172
FRC 284	52-2-3086		1	0	1	76	617	964	1089	1117	1118	1118	1118	1118	1118	1118	1118	1118	1118	1118	1118	1118	1118	1118	1118
FRC 285	52-2-3097		1	0	3	102	633	981	1109	1119	1120	1120	1120	1120	1120	1120	1120	1120	1120	1120	1120	1120	1120	1120	1120
FRC 29	52-2-0155		1	0	0	0	0	0	0	0	5	25	67	331	398	411	412	412	412	412	412	412	412	412	412
FRC 30	52-2-0200		1	0	0	0	0	0	0	0	8	35	104	344	405	417	418	418	418	418	418	418	418	418	418
FRC 301	N/A	1		0	0	0	1	14	74	656	956	1055	1079	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080
FRC 302	N/A		1	0	1	10	12	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
FRC 304	N/A	1		178	187	218	223	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225
FRC 305	N/A		1	0	0	0	0	2	17	84	744	1006	1083	1086	1086	1086	1086	1086	1086	1086	1086	1086	1086	1086	1086
FRC 306	N/A		1	0	0	0	0	6	35	270	849	1011	1054	1056	1056	1056	1056	1056	1056	1056	1056	1056	1056	1056	1056
FRC 307	N/A	1		0	0	0	0	0	0	0	0	10	30	239	348	374	378	378	378	378	378	378	378	378	378
FRC 308	N/A		1	0	0	0	0	0	0	0	0	0	8	26	212	316	339	343	347	347	347	347	347	347	347
FRC 309	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	24	226	337	363	371	379
FRC 31	52-2-0722		1	0	0	0	0	0	0	0	4	23	60	320	394	408	409	409	409	409	409	409	409	409	409
FRC 310	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	22	175	343	413
FRC 311	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	33	266	347	364
FRC 312	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	22	213
FRC 313	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	16	108
FRC 314	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	65
FRC 315	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	77
FRC 316	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	16	107	346
FRC 317	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	18
FRC 319	N/A		1	0	0	0	0	0	2	23	157	848	954	966	968	968	968	968	968	968	968	968	968	968	968
FRC 32	52-2-0194	1		0	0	0	0	0	0	0	6	27	71	331	398	412	413	413	413	413	413	413	413	413	413
FRC 320	N/A		1	0	0	0	0	0	0	0	0	6	15	82	323	384	394	396	396	396	396	396	396	396	396
FRC 321	N/A		1	0	0	0	0	0	0	0	0	2	7	39	292	371	385	387	388	389	389	389	389	389	389
FRC 322	N/A	1		0	0	0	0	0	0	8	29	155	410	469	484	486	486	486	486	486	486	486	486	486	486
FRC 323	N/A		1	0	0	0	0	0	0	0	2	15	162	302	348	358	360	360	360	360	360	360	360	360	360
FRC 324	N/A		1	0	0	0	0	0	0	0	3	22	222	325	354	360	361	361	361	361	361	361	361	361	361
FRC 325	N/A		1	0	0	0	0	0	0	0	0	0	0	1	13	141	323	375	386	388	388	388	388	388	388

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Subs after LW19A	Total Subs after LW20	Total Subs after LW21	Total Subs after LW22	Total Subs after LW23	Total Subs after LW24	Total Subs after LW25	Total Subs after LW26	Total Subs after LW27	Total Subs after LW28	Total Subs after LW29	Total Subs after LW30	Total Subs after LW31	Total Subs after LW32	Total Subs after LW33	Total Subs after LW34	Total Subs after LW35	Total Subs after LW36	Total Subs after LW37	Total Subs after LW38	Total Subs after LW39	Total Subs after LW40
FRC 33	52-2-0188	1		0	0	0	0	0	0	0	9	42	171	346	398	409	409	409	409	409	409	409	409	409	409
FRC 34	52-2-0195		1	0	0	0	0	0	0	0	0	11	28	199	326	356	360	360	361	361	361	361	361	361	361
FRC 340	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	71	308	361	369
FRC 342	N/A	1		0	0	0	12	77	505	1007	1150	1193	1204	1206	1206	1206	1206	1206	1206	1206	1206	1206	1206	1206	1206	1206
FRC 343	N/A		1	70	126	265	285	295	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296
FRC 344	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	1	8	49	314	387	405	410	410	410	410
FRC 345	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11	75	333	393	410	411	411	411
FRC 40	52-2-0333		1	0	0	11	42	333	998	1184	1241	1254	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257
FRC 44	52-2-0103		1	0	0	15	66	485	1013	1171	1220	1233	1236	1236	1236	1236	1236	1236	1236	1236	1236	1236	1236	1236	1236
FRC 45	52-2-0102		1	0	0	29	139	810	1057	1142	1164	1169	1169	1169	1169	1169	1169	1169	1169	1169	1169	1169	1169	1169	1169
FRC 46	52-2-0408		1	1	18	782	985	1071	1092	1099	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
FRC 52	52-2-0257		1	0	0	0	2	28	175	836	1068	1108	1114	1115	1115	1115	1115	1115	1115	1115	1115	1115	1115	1115	1115
FRC 57	2-258, 52-2-3	1		593	596	604	604	605	605	605	605	605	605	605	605	605	605	605	605	605	605	605	605	605	605
FRC 60	52-2-0177		1	0	0	5	20	89	682	784	810	814	814	814	814	814	814	814	814	814	814	814	814	814	814
FRC 61	52-2-0152		1	0	0	0	0	0	1	13	63	330	573	643	660	664	664	664	664	664	664	664	664	664	664
FRC 62	52-2-0168		1	0	0	0	0	0	0	11	56	249	399	441	451	452	452	452	452	452	452	452	452	452	452
FRC 67	52-2-0185		1	0	0	0	0	0	0	0	0	0	1	9	66	310	367	379	382	382	382	382	382	382	382
FRC 68	52-2-0186		1	0	0	0	0	0	0	0	0	0	0	7	47	300	366	379	382	382	382	382	382	382	382
FRC 70	52-2-0192		1	0	0	0	0	0	0	0	0	0	0	0	0	4	39	285	361	379	381	381	381	381	381
FRC 71	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	7	70	321	381	395	396	396	396	396	396
FRC 72	52-2-0199		1	0	0	0	0	0	0	0	8	48	461	573	603	607	608	608	608	608	608	608	608	608	608
FRC 76	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	18	161	373	432	446	456	458
FRC 77	52-2-0330		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	61	337	404	434	452
FRC 78	52-2-0885		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	62	337	403	431	449
FRC 85	52-2-0883		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	11	56	342	551
FRC 86	52-2-0207		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	45	310	449	561
FRC 87	52-2-0899		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	26	227	345	379
FRC 90	52-2-0869		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	20	147	408	577
FRC 91	52-2-0870		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	30	256	646
FRC 93	52-2-0198		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	26	239	338	362
FRC 94	52-2-0873		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	84	322	380
FRC 95	52-2-0347	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	13	71
FRC 97	52-2-0220		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	18	159	304	344	351	352
MET 1	-		1	1	29	783	975	1064	1085	1091	1091	1091	1091	1091	1091	1091	1091	1091	1091	1091	1091	1091	1091	1091	1091
NEW 1	N/A	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	14
NEW 10	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9	52
NEW 15	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEW 16	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEW 17	-		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEW 18	N/A	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEW 19	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEW 2	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
NEW 20	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEW 22	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEW 9	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Subs after LW19A	Total Subs after LW20	Total Subs after LW21	Total Subs after LW22	Total Subs after LW23	Total Subs after LW24	Total Subs after LW25	Total Subs after LW26	Total Subs after LW27	Total Subs after LW28	Total Subs after LW29	Total Subs after LW30	Total Subs after LW31	Total Subs after LW32	Total Subs after LW33	Total Subs after LW34	Total Subs after LW35	Total Subs after LW36	Total Subs after LW37	Total Subs after LW38	Total Subs after LW39	Total Subs after LW40
NT 11	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	16	45	248	356	385	391	391
NT 19	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NT 3	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	17	137
NT 33	52-2-0641		1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	18	88	323	410	431	435	436	436
NT 34	52-2-0642		1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	13	64	261	373	400	407	407	407
NT 35	52-2-0643		1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	13	64	264	370	397	402	403	403
NT 46	52-2-0755	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	51	309	552	603	613	615	615
NT 6	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	15	49	258	364	390	396
NT 7	N/A	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	12	60	248	373	406	412	413
NT 78	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	20	201	314	341
NT 79	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	83	304	358
NT 8	N/A	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	17	44	268	363	384	388
NT 80	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	93	320
NT 81	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	15
NT 9	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	22	125	320	372	383
PAD 2	N/A		1	17	177	558	628	656	660	661	661	661	661	661	661	661	661	661	661	661	661	661	661	661	661
NT 4	52-2-619		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	34	258	337
NT 5	52-2-620		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11	95	289
NT 10	52-2-625		1	0	0	0	0	0	0	0	0	0	0	0	0	2	7	38	170	235	263	264	264	264	264
NT 12	52-2-753	1		0	0	0	0	0	0	0	0	0	0	0	0	2	7	41	165	221	245	246	246	246	246
NT 17	52-2-629	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	14	85	277	328
NT 18	52-2-751		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	28
NT 21	52-2-630	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11	102
NT 22	52-2-758		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	7
NT 23	52-2-631		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	5
NT 29	52-2-637	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	17	167	263
NT 52	52-2-652	1		0	0	0	0	0	0	1	3	16	29	34	37	38	38	38	38	38	38	38	38	38	38
NT 53	52-2-371	1		0	0	0	0	0	0	0	0	1	2	10	29	38	43	44	45	45	45	45	45	45	45
NT 54	52-2-374		1	0	0	0	0	0	0	0	0	0	0	0	1	5	25	43	51	54	55	55	55	55	55
NT 74	52-2-658		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
NT 75	52-2-659		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
NT 76	52-2-660		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NT 85	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NT 86	N/A		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Subs after LW41	Total Subs after LW42	Total Subs after LW43	Total Subs after LW44	Cumulative Subs due to LW18 to LW44	Total Tilt after LW19A	Total Tilt after LW20	Total Tilt after LW21	Total Tilt after LW22	Total Tilt after LW23	Total Tilt after LW24	Total Tilt after LW25	Total Tilt after LW26	Total Tilt after LW27	Total Tilt after LW28	Total Tilt after LW29	Total Tilt after LW30	Total Tilt after LW31	Total Tilt after LW32	Total Tilt after LW33	Total Tilt after LW34
2-0346	52-2-0346		1	1120	1160	1176	1176	1176	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 101	52-2-0875	1		514	685	734	749	749	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 105	52-2-0340		1	606	606	606	606	592	0.2	0.2	3.5	3.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
FRC 113	52-2-0365		1	1038	1038	1038	1038	1038	0.0	0.0	0.0	0.0	0.1	0.5	5.8	3.2	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2
FRC 114	52-2-0725	1		34	34	34	34	34	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 115	52-2-0726		1	107	107	107	107	107	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.9	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1
FRC 117	52-2-0739		1	408	408	408	408	408	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	3.0	1.5	0.5	1.0	1.1
FRC 119	52-2-0196		1	606	606	606	606	606	0.0	0.0	0.3	2.8	4.8	5.6	5.9	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
FRC 124	52-2-0162		1	1112	1112	1112	1112	1111	0.0	0.5	1.7	1.5	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
FRC 125	52-2-0310		1	1037	1037	1037	1037	1037	0.0	0.0	1.3	1.8	0.4	1.0	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
FRC 127	52-2-0203		1	406	406	406	406	406	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.1	3.0	0.6	0.4	0.5	0.6	0.6
FRC 13	52-2-0125		1	294	294	294	294	26	3.1	3.0	2.8	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
FRC 14	52-2-0138		1	484	484	484	484	455	0.3	0.4	1.7	2.1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
FRC 15	52-2-0396		1	1126	1126	1126	1126	1126	0.0	0.1	7.4	3.8	2.9	2.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
FRC 16.1	52-2-0120		1	402	402	402	402	363	0.4	0.9	2.0	2.2	2.3	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
FRC 16.2	52-2-120		1	344	344	344	344	292	0.5	1.0	2.0	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
FRC 160	52-2-0823		1	833	833	833	833	833	0.0	0.6	2.4	3.0	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
FRC 164	52-2-0171	1		378	378	378	378	378	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	4.2	1.5	0.7	0.4	0.4	0.5	0.5
FRC 168	52-2-0541	1		331	331	331	331	271	0.6	0.7	1.9	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
FRC 169	52-2-0747	1		813	813	813	813	813	0.0	0.0	0.0	0.0	0.0	0.1	0.3	5.5	5.7	6.3	6.5	6.5	6.5	6.5	6.5	6.5
FRC 17	52-2-0121		1	335	335	335	335	280	0.6	1.0	2.0	2.2	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
FRC 171	52-2-0734		1	381	381	381	381	381	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8	3.6	0.5	0.7	0.8	0.9	0.9	0.9	0.9
FRC 172	52-2-0735		1	395	395	395	395	395	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.4	2.2	0.3	0.8	1.0	1.0	1.1	1.1	1.1
FRC 176	52-2-0826		1	1223	1223	1223	1223	1223	0.0	0.0	0.3	3.7	1.5	0.5	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
FRC 180	52-2-0828		1	389	389	389	389	389	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.7	2.4	0.9	0.5	0.3	0.2
FRC 184	52-2-0222		1	359	360	360	361	361	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 185	52-2-0223		1	362	363	363	363	363	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 186	52-2-0224		1	363	364	364	364	364	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 187	52-2-0225		1	372	372	372	372	372	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
FRC 189	52-2-0180		1	340	340	340	340	340	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.5	4.9	1.8	1.0	0.6	0.5
FRC 191	52-2-0183		1	360	360	360	360	360	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	4.3	1.9	1.0	0.7
FRC 193	52-2-0144	1		970	970	970	970	970	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.6	4.2	1.8	1.0	0.7	0.6	0.6	0.6	0.6
FRC 194	52-2-0263		1	356	356	356	356	356	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	4.2	1.9	1.1	0.9	0.7	0.7	0.7
FRC 195	52-2-0264		1	353	353	353	353	353	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	6.0	2.4	1.7	1.5	1.4	1.4	1.4
FRC 198	52-2-0268		1	363	363	363	363	363	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.9	1.2	0.3	0.7	0.9
FRC 199	52-2-0265		1	370	370	370	370	370	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	3.0	1.4	0.5	0.6	0.7	0.7	0.7
FRC 20	52-2-0107		1	553	553	553	553	526	0.3	0.3	1.9	2.2	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
FRC 201	52-2-0267		1	349	349	349	349	332	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
FRC 21	52-2-0105		1	768	768	768	768	755	0.2	1.0	4.2	4.7	4.9	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
FRC 22	52-2-0145		1	1143	1143	1143	1143	1143	0.0	0.0	0.2	2.2	0.8	0.5	0.9	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
FRC 23	52-2-0161		1	1116	1116	1116	1116	1116	0.0	0.4	2.4	1.0	1.5	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
FRC 24.1	52-2-159		1	1139	1139	1139	1139	1139	0.0	0.0	0.1	0.5	6.0	1.9	1.1	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
FRC 24.2	52-2-0160		1	1074	1074	1074	1074	1074	0.0	0.0	0.1	0.3	5.3	2.2	1.3	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
FRC 25	52-2-0129		1	1240	1240	1240	1240	1240	0.0	0.0	0.4	4.5	1.6	1.5	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Subs after LW41	Total Subs after LW42	Total Subs after LW43	Total Subs after LW44	Cumulative Subs due to LW18 to LW44	Total Tilt after LW19A	Total Tilt after LW20	Total Tilt after LW21	Total Tilt after LW22	Total Tilt after LW23	Total Tilt after LW24	Total Tilt after LW25	Total Tilt after LW26	Total Tilt after LW27	Total Tilt after LW28	Total Tilt after LW29	Total Tilt after LW30	Total Tilt after LW31	Total Tilt after LW32	Total Tilt after LW33	Total Tilt after LW34
FRC 253	52-2-0738	1		372	372	372	372	372	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	5.9	2.2	1.4	1.1	1.0	1.0
FRC 254	52-2-0829		1	342	342	342	342	342	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.5	5.9	2.5	1.7	1.5
FRC 26	52-2-0135		1	1145	1145	1145	1145	1145	0.0	0.0	0.1	0.1	0.6	5.7	2.2	1.3	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9
FRC 266	N/A		1	257	257	257	257	176	0.8	0.5	1.5	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
FRC 272	52-2-3074		1	1094	1094	1094	1094	1094	0.0	0.1	6.2	3.0	1.9	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
FRC 273	52-2-3075	1		1100	1100	1100	1100	1100	0.0	0.1	5.8	2.8	1.8	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
FRC 274	N/A		1	1213	1213	1213	1213	1213	0.0	0.0	0.1	0.7	4.5	0.6	0.7	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1
FRC 275	N/A		1	1221	1221	1221	1221	1221	0.0	0.0	0.4	3.8	1.7	0.9	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
FRC 276	52-2-3078		1	1156	1156	1156	1156	1156	0.0	0.0	0.1	0.2	0.8	5.4	1.7	0.8	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 277	52-2-3079		1	1169	1169	1169	1169	1169	0.0	0.0	0.0	0.1	0.3	3.2	2.4	1.3	0.9	0.7	0.7	0.7	0.7	0.7	0.7	0.7
FRC 278	52-2-3080	1		357	357	357	357	297	0.6	0.8	2.2	2.4	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
FRC 279	52-2-3081		1	1002	1002	1002	1002	998	0.1	1.8	1.7	2.6	3.0	3.0	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
FRC 28	52-2-0154		1	399	399	399	399	399	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.9	4.9	1.2	0.6	0.7	0.8	0.8
FRC 280	52-2-3082	1		1059	1059	1059	1059	1059	0.0	0.0	4.4	2.2	1.2	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
FRC 281	52-2-3083		1	1041	1041	1041	1041	1041	0.0	0.0	2.6	1.5	0.4	0.9	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
FRC 283	52-2-3085		1	1172	1172	1172	1172	1172	0.0	0.0	0.2	2.5	1.1	0.3	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
FRC 284	52-2-3086		1	1118	1118	1118	1118	1118	0.0	0.0	0.7	3.2	0.8	1.5	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
FRC 285	52-2-3097		1	1120	1120	1120	1120	1120	0.0	0.0	0.9	3.2	0.9	1.7	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
FRC 29	52-2-0155		1	412	412	412	412	412	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.4	1.8	0.4	0.8	1.0	1.0	1.0
FRC 30	52-2-0200		1	418	418	418	418	418	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	2.6	1.1	0.2	0.6	0.8	0.8	0.8
FRC 301	N/A	1		1080	1080	1080	1080	1080	0.0	0.0	0.0	0.0	0.1	0.7	5.3	2.3	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5
FRC 302	N/A		1	15	15	15	15	15	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
FRC 304	N/A	1		225	225	225	225	47	1.7	1.6	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
FRC 305	N/A		1	1086	1086	1086	1086	1086	0.0	0.0	0.0	0.0	0.1	0.2	0.9	2.5	1.9	2.2	2.4	2.4	2.4	2.4	2.4	2.4
FRC 306	N/A		1	1056	1056	1056	1056	1056	0.0	0.0	0.0	0.0	0.1	0.3	4.3	2.1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
FRC 307	N/A	1		378	378	378	378	378	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	7.1	3.3	2.4	2.2	2.1	2.1
FRC 308	N/A		1	347	347	347	347	347	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	6.3	3.7	3.7	3.8	3.8
FRC 309	N/A		1	381	381	381	381	381	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
FRC 31	52-2-0722		1	409	409	409	409	409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.2	2.7	0.6	0.3	0.5	0.5	0.5
FRC 310	N/A		1	457	469	471	471	471	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 311	N/A		1	369	375	376	376	376	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 312	N/A		1	329	363	369	372	372	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 313	N/A		1	353	478	515	532	532	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 314	N/A		1	325	383	397	400	400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 315	N/A		1	329	386	400	403	403	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 316	N/A		1	427	479	492	497	497	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 317	N/A		1	121	338	401	414	414	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 319	N/A		1	968	968	968	968	968	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.9	2.0	0.5	0.4	0.6	0.6	0.6	0.6	0.6
FRC 32	52-2-0194	1		413	413	413	413	413	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.4	2.5	0.7	0.3	0.2	0.2	0.2
FRC 320	N/A		1	396	396	396	396	396	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	2.5	1.2	0.1	0.6	0.7	0.7
FRC 321	N/A		1	389	389	389	389	389	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.0	3.6	0.8	0.3	0.4	0.5
FRC 322	N/A	1		486	486	486	486	486	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	2.2	2.4	1.1	0.7	0.5	0.5	0.5	0.5
FRC 323	N/A		1	360	360	360	360	360	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	6.0	2.5	1.7	1.5	1.4	1.4	1.4
FRC 324	N/A		1	361	361	361	361	361	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	5.7	2.1	1.3	1.0	1.0	0.9	0.9
FRC 325	N/A		1	388	388	388	388	388	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	6.0	3.1	2.1	1.8

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Subs after LW41	Total Subs after LW42	Total Subs after LW43	Total Subs after LW44	Cumulative Subs due to LW18 to LW44	Total Tilt after LW19A	Total Tilt after LW20	Total Tilt after LW21	Total Tilt after LW22	Total Tilt after LW23	Total Tilt after LW24	Total Tilt after LW25	Total Tilt after LW26	Total Tilt after LW27	Total Tilt after LW28	Total Tilt after LW29	Total Tilt after LW30	Total Tilt after LW31	Total Tilt after LW32	Total Tilt after LW33	Total Tilt after LW34
FRC 33	52-2-0188	1		409	409	409	409	409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	4.2	1.5	0.6	0.4	0.3	0.3	0.3
FRC 34	52-2-0195		1	361	361	361	361	361	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	5.9	2.2	1.4	1.2	1.1	1.1
FRC 340	N/A		1	370	371	371	371	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 342	N/A	1		1206	1206	1206	1206	1206	0.0	0.0	0.0	0.1	0.6	4.6	1.7	0.8	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 343	N/A		1	296	296	296	296	294	0.6	0.6	1.8	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
FRC 344	N/A		1	410	410	410	410	410	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.2	3.3
FRC 345	N/A		1	411	411	411	411	411	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.8
FRC 40	52-2-0333		1	1257	1257	1257	1257	1257	0.0	0.0	0.1	0.3	3.7	3.0	2.1	1.7	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5
FRC 44	52-2-0103		1	1236	1236	1236	1236	1236	0.0	0.0	0.1	0.4	4.5	1.9	1.0	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
FRC 45	52-2-0102		1	1169	1169	1169	1169	1169	0.0	0.0	0.2	1.2	3.0	1.3	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 46	52-2-0408		1	1100	1100	1100	1100	1100	0.1	0.3	2.7	1.0	1.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
FRC 52	52-2-0257		1	1115	1115	1115	1115	1115	0.0	0.0	0.0	0.0	0.2	1.8	2.8	1.1	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 57	2-258, 52-2-3	1		605	605	605	605	12	6.3	6.3	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
FRC 60	52-2-0177		1	814	814	814	814	814	0.0	0.0	0.1	0.2	0.8	5.5	1.7	0.9	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 61	52-2-0152		1	664	664	664	664	664	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	4.0	2.3	1.4	1.1	1.0	1.0	1.0	1.0
FRC 62	52-2-0168		1	452	452	452	452	452	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	4.1	2.0	1.2	0.9	0.8	0.8	0.8	0.8
FRC 67	52-2-0185		1	382	382	382	382	382	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	2.1	1.4	0.2	0.7	0.8
FRC 68	52-2-0186		1	382	382	382	382	382	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.3	2.2	0.4	0.5	0.7
FRC 70	52-2-0192		1	381	381	381	381	381	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	3.4	0.5
FRC 71	N/A		1	396	396	396	396	396	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	2.2	2.2	0.8
FRC 72	52-2-0199		1	608	608	608	608	608	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	6.8	3.1	2.4	2.2	2.1	2.1	2.1
FRC 76	N/A		1	459	459	459	459	459	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.4
FRC 77	52-2-0330		1	458	459	459	459	459	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
FRC 78	52-2-0885		1	454	455	455	455	455	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
FRC 85	52-2-0883		1	638	665	673	674	674	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 86	52-2-0207		1	598	607	610	610	610	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 87	52-2-0899		1	419	429	432	432	432	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 90	52-2-0869		1	629	644	647	648	648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 91	52-2-0870		1	795	842	856	859	859	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 93	52-2-0198		1	384	393	395	395	395	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 94	52-2-0873		1	391	398	400	401	401	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 95	52-2-0347	1		371	573	637	659	659	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 97	52-2-0220		1	352	352	352	352	352	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
MET 1	-		1	1091	1091	1091	1091	1090	0.0	0.5	1.8	1.3	1.8	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
NEW 1	N/A	1		76	341	402	418	418	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 10	N/A		1	321	479	528	559	559	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 15	N/A		1	0	0	0	9	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 16	N/A		1	0	0	0	12	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 17	-		1	0	1	9	70	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 18	N/A	1		0	0	1	16	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 19	N/A		1	0	1	15	165	165	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 2	N/A		1	20	149	330	385	385	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 20	N/A		1	0	0	1	15	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 22	N/A		1	0	16	73	558	558	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 9	N/A		1	0	0	0	12	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Subs after LW41	Total Subs after LW42	Total Subs after LW43	Total Subs after LW44	Cumulative Subs due to LW18 to LW44	Total Tilt after LW19A	Total Tilt after LW20	Total Tilt after LW21	Total Tilt after LW22	Total Tilt after LW23	Total Tilt after LW24	Total Tilt after LW25	Total Tilt after LW26	Total Tilt after LW27	Total Tilt after LW28	Total Tilt after LW29	Total Tilt after LW30	Total Tilt after LW31	Total Tilt after LW32	Total Tilt after LW33	Total Tilt after LW34
NT 11	N/A		1	391	391	391	391	391	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
NT 19	N/A		1	4	27	243	344	344	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 3	N/A		1	326	377	390	391	391	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 33	52-2-0641		1	436	436	436	436	436	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8
NT 34	52-2-0642		1	407	407	407	407	407	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5
NT 35	52-2-0643		1	403	403	403	403	403	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5
NT 46	52-2-0755	1		615	615	615	615	615	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4
NT 6	N/A		1	397	397	397	397	397	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 7	N/A	1		413	413	413	413	413	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
NT 78	N/A		1	345	346	346	346	346	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 79	N/A		1	369	370	371	371	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 8	N/A	1		389	389	389	389	389	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 80	N/A		1	376	388	390	390	390	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 81	N/A		1	133	316	370	379	379	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 9	N/A		1	385	385	385	385	385	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAD 2	N/A		1	661	661	661	661	644	0.2	0.3	3.9	4.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
NT 4	52-2-619		1	356	360	361	361	361	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 5	52-2-620		1	338	349	351	351	351	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 10	52-2-625		1	264	264	264	264	264	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.9
NT 12	52-2-753	1		246	246	246	246	246	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.7
NT 17	52-2-629	1		338	340	340	340	340	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 18	52-2-751		1	249	341	364	368	368	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 21	52-2-630	1		281	329	339	341	341	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 22	52-2-758		1	8	8	8	8	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 23	52-2-631		1	5	6	6	6	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 29	52-2-637	1		290	296	297	297	297	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 52	52-2-652	1		38	38	38	38	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3
NT 53	52-2-371	1		45	45	45	45	45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.4	0.4	0.4
NT 54	52-2-374		1	55	55	55	55	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	0.4
NT 74	52-2-658		1	11	87	301	361	361	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 75	52-2-659		1	10	79	304	364	364	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 76	52-2-660		1	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 85	N/A		1	6	42	280	355	355	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 86	N/A		1	0	2	12	16	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Tilt after LW35	Total Tilt after LW36	Total Tilt after LW37	Total Tilt after LW38	Total Tilt after LW39	Total Tilt after LW40	Total Tilt after LW41	Total Tilt after LW42	Total Tilt after LW43	Total Tilt after LW44	Cumulative Tilt due to LW18 to LW44	Maximum Predicted Tensile Strain during or after LW19A	Maximum Predicted Tensile Strain during or after LW20	Maximum Predicted Tensile Strain during or after LW21	Maximum Predicted Tensile Strain during or after LW22	Maximum Predicted Tensile Strain during or after LW23
2-0346	52-2-0346		1	0.0	0.1	0.2	0.9	4.3	0.7	1.1	1.3	1.4	1.4	1.4	0.0	0.0	0.0	0.0	0.0
FRC 101	52-2-0875	1		0.0	0.0	0.0	0.1	0.4	3.3	2.6	1.6	1.2	1.8	1.8	0.0	0.0	0.0	0.0	0.0
FRC 105	52-2-0340		1	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.1	0.0	0.1	1.3	1.3	1.3
FRC 113	52-2-0365		1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	0.0	0.0	0.0	0.0	0.0
FRC 114	52-2-0725	1		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0
FRC 115	52-2-0726		1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0
FRC 117	52-2-0739		1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0	0.0	0.0	0.0
FRC 119	52-2-0196		1	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	0.0	0.0	0.0	0.3	0.6
FRC 124	52-2-0162		1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	0.1	0.2	0.4	0.4	0.4
FRC 125	52-2-0310		1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0	0.3	0.3	0.3
FRC 127	52-2-0203		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0
FRC 13	52-2-0125		1	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	-0.4	0.8	0.8	0.8	0.8	0.8
FRC 14	52-2-0138		1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	1.9	0.0	0.1	0.2	0.2	0.2
FRC 15	52-2-0396		1	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.0	0.0	1.2	1.2	1.2
FRC 16.1	52-2-0120		1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.9	0.1	0.1	0.1	0.1	0.1
FRC 16.2	52-2-120		1	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.8	0.1	0.3	0.4	0.4	0.4
FRC 160	52-2-0823		1	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	0.0	0.2	0.4	0.4	0.4
FRC 164	52-2-0171	1		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
FRC 168	52-2-0541	1		2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.7	0.1	0.3	0.4	0.4	0.4
FRC 169	52-2-0747	1		6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	0.0	0.0	0.0	0.0	0.0
FRC 17	52-2-0121		1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.8	0.1	0.3	0.4	0.4	0.4
FRC 171	52-2-0734		1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0	0.0	0.0	0.0
FRC 172	52-2-0735		1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0
FRC 176	52-2-0826		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.6	0.6
FRC 180	52-2-0828		1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0
FRC 184	52-2-0222		1	0.1	0.2	0.9	4.1	0.5	0.7	0.9	0.9	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
FRC 185	52-2-0223		1	0.1	0.3	3.8	1.6	0.7	0.4	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0
FRC 186	52-2-0224		1	0.2	0.9	3.8	0.5	0.4	0.6	0.6	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0
FRC 187	52-2-0225		1	0.2	1.4	2.3	0.6	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0
FRC 189	52-2-0180		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
FRC 191	52-2-0183		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0
FRC 193	52-2-0144	1		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	2.0	2.0	0.0	0.0	0.0	0.0	0.0
FRC 194	52-2-0263		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0
FRC 195	52-2-0264		1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0	0.0	0.0	0.0
FRC 198	52-2-0268		1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0	0.0	0.0	0.0
FRC 199	52-2-0265		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0
FRC 20	52-2-0107		1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.1	0.0	0.1	0.1	0.1	0.1
FRC 201	52-2-0267		1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	0.0	0.6	0.6	0.6	0.6	0.6
FRC 21	52-2-0105		1	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.8	0.0	0.1	1.5	1.5	1.6
FRC 22	52-2-0145		1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.7	0.7
FRC 23	52-2-0161		1	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.6	0.0	0.2	0.4	0.4	0.4
FRC 24.1	52-2-159		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.1	0.4
FRC 24.2	52-2-0160		1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0	0.0	0.0	0.9
FRC 25	52-2-0129		1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	0.0	0.0	0.1	0.6	0.6

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Tilt after LW35	Total Tilt after LW36	Total Tilt after LW37	Total Tilt after LW38	Total Tilt after LW39	Total Tilt after LW40	Total Tilt after LW41	Total Tilt after LW42	Total Tilt after LW43	Total Tilt after LW44	Cumulative Tilt due to LW18 to LW44	Maximum Predicted Tensile Strain during or after LW19A	Maximum Predicted Tensile Strain during or after LW20	Maximum Predicted Tensile Strain during or after LW21	Maximum Predicted Tensile Strain during or after LW22	Maximum Predicted Tensile Strain during or after LW23
FRC 253	52-2-0738	1		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
FRC 254	52-2-0829		1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0	0.0	0.0	0.0
FRC 26	52-2-0135		1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0	0.0	0.0	0.1
FRC 266	N/A		1	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	0.9	0.1	0.3	0.4	0.4	0.4
FRC 272	52-2-3074		1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.0	0.0	1.1	1.1	1.1
FRC 273	52-2-3075	1		1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0	0.4	0.4	0.4
FRC 274	N/A		1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.1	0.3
FRC 275	N/A		1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.0	0.0	0.0	0.6	0.6
FRC 276	52-2-3078		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.1
FRC 277	52-2-3079		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0
FRC 278	52-2-3080	1		2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.0	0.1	0.3	0.5	0.5	0.5
FRC 279	52-2-3081		1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.0	0.0	0.4	0.4	0.4	0.4
FRC 28	52-2-0154		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0
FRC 280	52-2-3082	1		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0	1.0	1.0	1.0
FRC 281	52-2-3083		1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0	0.8	0.8	0.8
FRC 283	52-2-3085		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.7	0.7
FRC 284	52-2-3086		1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	0.0	0.0	0.1	0.3	0.4
FRC 285	52-2-3097		1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.2	0.3	0.4
FRC 29	52-2-0155		1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
FRC 30	52-2-0200		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0
FRC 301	N/A	1		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.0	0.0	0.0	0.0	0.0
FRC 302	N/A		1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0
FRC 304	N/A	1		1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	-0.5	0.3	0.4	0.4	0.4	0.4
FRC 305	N/A		1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0.0	0.0	0.0	0.0	0.1
FRC 306	N/A		1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.0	0.0	0.0	0.0	0.0
FRC 307	N/A	1		2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	0.0	0.0	0.0	0.0	0.0
FRC 308	N/A		1	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	0.0	0.0	0.0	0.0	0.0
FRC 309	N/A		1	0.5	5.5	2.1	1.2	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0
FRC 31	52-2-0722		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
FRC 310	N/A		1	0.0	0.1	0.4	4.1	2.1	1.1	0.7	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0
FRC 311	N/A		1	0.1	0.2	0.9	4.1	0.2	0.8	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
FRC 312	N/A		1	0.0	0.0	0.0	0.1	0.4	4.2	1.2	0.7	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
FRC 313	N/A		1	0.0	0.0	0.0	0.1	0.3	2.6	2.7	1.6	1.2	1.8	1.8	0.0	0.0	0.0	0.0	0.0
FRC 314	N/A		1	0.0	0.0	0.0	0.1	0.3	1.8	2.6	1.3	0.8	0.6	0.6	0.0	0.0	0.0	0.0	0.0
FRC 315	N/A		1	0.0	0.0	0.0	0.1	0.3	2.1	2.5	1.3	0.8	0.7	0.7	0.0	0.0	0.0	0.0	0.0
FRC 316	N/A		1	0.0	0.0	0.1	0.3	2.6	2.6	1.5	1.1	1.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0
FRC 317	N/A		1	0.0	0.0	0.0	0.0	0.1	0.3	2.9	2.5	1.4	1.0	1.0	0.0	0.0	0.0	0.0	0.0
FRC 319	N/A		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0
FRC 32	52-2-0194	1		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0
FRC 320	N/A		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0
FRC 321	N/A		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
FRC 322	N/A	1		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
FRC 323	N/A		1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0	0.0	0.0	0.0
FRC 324	N/A		1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0	0.0	0.0	0.0
FRC 325	N/A		1	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Tilt after LW35	Total Tilt after LW36	Total Tilt after LW37	Total Tilt after LW38	Total Tilt after LW39	Total Tilt after LW40	Total Tilt after LW41	Total Tilt after LW42	Total Tilt after LW43	Total Tilt after LW44	Cumulative Tilt due to LW18 to LW44	Maximum Predicted Tensile Strain during or after LW19A	Maximum Predicted Tensile Strain during or after LW20	Maximum Predicted Tensile Strain during or after LW21	Maximum Predicted Tensile Strain during or after LW22	Maximum Predicted Tensile Strain during or after LW23
FRC 33	52-2-0188	1		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0
FRC 34	52-2-0195		1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0
FRC 340	N/A		1	0.1	0.3	2.1	1.8	0.6	0.2	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0
FRC 342	N/A	1		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.1
FRC 343	N/A		1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	1.5	0.1	0.3	0.4	0.4	0.4
FRC 344	N/A		1	1.1	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0
FRC 345	N/A		1	2.6	1.3	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0
FRC 40	52-2-0333		1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0	0.0	0.0	0.6
FRC 44	52-2-0103		1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0	0.0	0.0	0.6
FRC 45	52-2-0102		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.2	0.3
FRC 46	52-2-0408		1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	0.1	0.1	0.4	0.4	0.4
FRC 52	52-2-0257		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
FRC 57	-2-258, 52-2-3	1		6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	-0.2	1.0	1.0	1.0	1.0	1.0
FRC 60	52-2-0177		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.1
FRC 61	52-2-0152		1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
FRC 62	52-2-0168		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	2.0	2.0	0.0	0.0	0.0	0.0	0.0
FRC 67	52-2-0185		1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0	0.0	0.0	0.0
FRC 68	52-2-0186		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0
FRC 70	52-2-0192		1	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0
FRC 71	N/A		1	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
FRC 72	52-2-0199		1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	3.2	3.2	0.0	0.0	0.0	0.0	0.0
FRC 76	N/A		1	4.0	2.3	1.2	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0
FRC 77	52-2-0330		1	0.3	1.7	3.0	1.2	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
FRC 78	52-2-0885		1	0.3	1.7	3.0	1.1	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0
FRC 85	52-2-0883		1	0.0	0.1	0.2	1.3	3.3	1.2	0.6	0.7	0.7	2.1	2.1	0.0	0.0	0.0	0.0	0.0
FRC 86	52-2-0207		1	0.1	0.3	1.1	3.9	0.9	0.9	1.1	1.2	1.2	2.1	2.1	0.0	0.0	0.0	0.0	0.0
FRC 87	52-2-0899		1	0.0	0.1	0.5	4.6	1.6	0.7	0.7	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0
FRC 90	52-2-0869		1	0.0	0.1	0.4	3.4	2.7	1.7	1.3	1.2	1.1	2.1	2.1	0.0	0.0	0.0	0.0	0.0
FRC 91	52-2-0870		1	0.0	0.0	0.1	0.6	4.3	1.2	0.8	1.1	1.1	2.1	2.1	0.0	0.0	0.0	0.0	0.0
FRC 93	52-2-0198		1	0.0	0.1	0.5	4.8	1.1	0.7	0.9	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
FRC 94	52-2-0873		1	0.0	0.1	0.3	2.8	2.1	1.0	0.6	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
FRC 95	52-2-0347	1		0.0	0.0	0.0	0.0	0.2	1.6	2.7	1.5	1.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0
FRC 97	52-2-0220		1	0.4	4.7	1.9	1.0	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0
MET 1	-		1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	0.1	0.2	0.4	0.4	0.4
NEW 1	N/A	1		0.0	0.0	0.0	0.0	0.1	0.3	1.8	2.6	1.4	0.9	0.9	0.0	0.0	0.0	0.0	0.0
NEW 10	N/A		1	0.0	0.0	0.0	0.0	0.2	1.2	3.2	1.1	0.6	1.8	1.8	0.0	0.0	0.0	0.0	0.0
NEW 15	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.0	0.0	0.0	0.0
NEW 16	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.0	0.0	0.0	0.0
NEW 17	-		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.8	1.8	0.0	0.0	0.0	0.0	0.0
NEW 18	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.0	0.0	0.0	0.0	0.0
NEW 19	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	3.9	3.9	0.0	0.0	0.0	0.0	0.0
NEW 2	N/A		1	0.0	0.0	0.0	0.0	0.0	0.1	0.4	3.6	1.9	0.9	0.9	0.0	0.0	0.0	0.0	0.0
NEW 20	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.4	0.0	0.0	0.0	0.0	0.0
NEW 22	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	4.5	4.5	0.0	0.0	0.0	0.0	0.0
NEW 9	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Total Tilt after LW35	Total Tilt after LW36	Total Tilt after LW37	Total Tilt after LW38	Total Tilt after LW39	Total Tilt after LW40	Total Tilt after LW41	Total Tilt after LW42	Total Tilt after LW43	Total Tilt after LW44	Cumulative Tilt due to LW18 to LW44	Maximum Predicted Tensile Strain during or after LW19A	Maximum Predicted Tensile Strain during or after LW20	Maximum Predicted Tensile Strain during or after LW21	Maximum Predicted Tensile Strain during or after LW22	Maximum Predicted Tensile Strain during or after LW23
NT 11	N/A		1	0.6	4.1	1.0	0.5	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0
NT 19	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	4.6	1.0	1.0	0.0	0.0	0.0	0.0	0.0
NT 3	N/A		1	0.0	0.0	0.0	0.1	0.4	3.4	2.1	1.2	0.8	0.7	0.7	0.0	0.0	0.0	0.0	0.0
NT 33	52-2-0641		1	4.2	0.5	0.4	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0
NT 34	52-2-0642		1	4.2	1.3	0.5	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0
NT 35	52-2-0643		1	4.4	1.3	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
NT 46	52-2-0755	1		3.5	2.2	1.3	0.9	0.8	0.7	0.7	0.7	0.7	1.5	1.5	0.0	0.0	0.0	0.0	0.0
NT 6	N/A		1	0.1	0.6	4.0	1.0	0.7	0.9	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
NT 7	N/A	1		0.5	4.0	1.4	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0
NT 78	N/A		1	0.0	0.1	0.5	4.8	1.6	0.8	0.5	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0
NT 79	N/A		1	0.0	0.1	0.3	2.6	1.5	0.5	0.2	0.2	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0
NT 8	N/A	1		0.1	0.7	4.2	0.9	0.4	0.6	0.7	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0
NT 80	N/A		1	0.0	0.0	0.1	0.3	2.6	2.1	1.0	0.6	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0
NT 81	N/A		1	0.0	0.0	0.0	0.0	0.1	0.4	3.4	1.9	0.9	0.5	0.5	0.0	0.0	0.0	0.0	0.0
NT 9	N/A		1	0.1	0.3	3.1	1.7	0.8	0.4	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0
PAD 2	N/A		1	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.5	0.0	0.1	1.5	1.6	1.6
NT 4	52-2-619		1	0.0	0.0	0.2	0.8	3.6	1.5	1.7	1.8	1.8	1.8	1.8	0.0	0.0	0.0	0.0	0.0
NT 5	52-2-620		1	0.0	0.0	0.1	0.3	2.5	2.2	2.1	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
NT 10	52-2-625		1	2.5	2.8	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	0.0	0.0	0.0	0.0	0.0
NT 12	52-2-753	1		2.3	2.6	2.6	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	0.0	0.0	0.0	0.0	0.0
NT 17	52-2-629	1		0.0	0.1	0.3	2.1	2.7	2.8	2.8	2.8	2.9	2.9	2.9	0.0	0.0	0.0	0.0	0.0
NT 18	52-2-751		1	0.0	0.0	0.0	0.0	0.1	0.7	4.2	0.7	0.6	0.7	0.7	0.0	0.0	0.0	0.0	0.0
NT 21	52-2-630	1		0.0	0.0	0.0	0.1	0.3	2.8	2.3	2.2	2.2	2.2	2.2	0.0	0.0	0.0	0.0	0.0
NT 22	52-2-758		1	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0
NT 23	52-2-631		1	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0
NT 29	52-2-637	1		0.0	0.0	0.1	0.4	3.4	2.8	3.1	3.2	3.3	3.3	3.3	0.0	0.0	0.0	0.0	0.0
NT 52	52-2-652	1		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0
NT 53	52-2-371	1		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0
NT 54	52-2-374		1	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
NT 74	52-2-658		1	0.0	0.0	0.0	0.0	0.0	0.1	0.3	2.4	2.2	1.5	1.5	0.0	0.0	0.0	0.0	0.0
NT 75	52-2-659		1	0.0	0.0	0.0	0.0	0.0	0.1	0.2	2.2	2.2	1.2	1.2	0.0	0.0	0.0	0.0	0.0
NT 76	52-2-660		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 85	N/A		1	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.1	3.2	1.1	1.1	0.0	0.0	0.0	0.0	0.0
NT 86	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.3	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Tensile Strain during or after LW24	Maximum Predicted Tensile Strain during or after LW25	Maximum Predicted Tensile Strain during or after LW26	Maximum Predicted Tensile Strain during or after LW27	Maximum Predicted Tensile Strain during or after LW28	Maximum Predicted Tensile Strain during or after LW29	Maximum Predicted Tensile Strain during or after LW30	Maximum Predicted Tensile Strain during or after LW31	Maximum Predicted Tensile Strain during or after LW32	Maximum Predicted Tensile Strain during or after LW33	Maximum Predicted Tensile Strain during or after LW34	Maximum Predicted Tensile Strain during or after LW35
2-0346	52-2-0346		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 101	52-2-0875	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 105	52-2-0340		1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
FRC 113	52-2-0365		1	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 114	52-2-0725	1		0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
FRC 115	52-2-0726		1	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
FRC 117	52-2-0739		1	0.0	0.0	0.0	0.0	0.1	0.1	0.9	0.9	0.9	0.9	0.9	0.9
FRC 119	52-2-0196		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
FRC 124	52-2-0162		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 125	52-2-0310		1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
FRC 127	52-2-0203		1	0.0	0.0	0.1	0.1	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 13	52-2-0125		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
FRC 14	52-2-0138		1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
FRC 15	52-2-0396		1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
FRC 16.1	52-2-0120		1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
FRC 16.2	52-2-120		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 160	52-2-0823		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 164	52-2-0171	1		0.0	0.0	0.0	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 168	52-2-0541	1		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 169	52-2-0747	1		0.0	0.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
FRC 17	52-2-0121		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 171	52-2-0734		1	0.0	0.0	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 172	52-2-0735		1	0.1	0.1	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 176	52-2-0826		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 180	52-2-0828		1	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 184	52-2-0222		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 185	52-2-0223		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 186	52-2-0224		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 187	52-2-0225		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 189	52-2-0180		1	0.0	0.0	0.0	0.0	0.1	0.1	0.7	0.7	0.7	0.7	0.7	0.7
FRC 191	52-2-0183		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8	0.8	0.8
FRC 193	52-2-0144	1		0.0	0.1	0.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 194	52-2-0263		1	0.0	0.0	0.0	0.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
FRC 195	52-2-0264		1	0.0	0.0	0.0	0.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 198	52-2-0268		1	0.0	0.0	0.0	0.0	0.1	0.1	0.6	0.6	0.6	0.6	0.6	0.6
FRC 199	52-2-0265		1	0.0	0.0	0.0	0.1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
FRC 20	52-2-0107		1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
FRC 201	52-2-0267		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 21	52-2-0105		1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
FRC 22	52-2-0145		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
FRC 23	52-2-0161		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 24.1	52-2-159		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 24.2	52-2-0160		1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
FRC 25	52-2-0129		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Tensile Strain during or after LW24	Maximum Predicted Tensile Strain during or after LW25	Maximum Predicted Tensile Strain during or after LW26	Maximum Predicted Tensile Strain during or after LW27	Maximum Predicted Tensile Strain during or after LW28	Maximum Predicted Tensile Strain during or after LW29	Maximum Predicted Tensile Strain during or after LW30	Maximum Predicted Tensile Strain during or after LW31	Maximum Predicted Tensile Strain during or after LW32	Maximum Predicted Tensile Strain during or after LW33	Maximum Predicted Tensile Strain during or after LW34	Maximum Predicted Tensile Strain during or after LW35
FRC 253	52-2-0738	1		0.0	0.0	0.0	0.0	0.1	0.8	0.8	0.8	0.8	0.8	0.8	0.8
FRC 254	52-2-0829		1	0.0	0.0	0.0	0.0	0.1	0.1	0.2	1.0	1.0	1.0	1.0	1.0
FRC 26	52-2-0135		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
FRC 266	N/A		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 272	52-2-3074		1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
FRC 273	52-2-3075	1		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 274	N/A		1	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 275	N/A		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 276	52-2-3078		1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
FRC 277	52-2-3079		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 278	52-2-3080	1		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 279	52-2-3081		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 28	52-2-0154		1	0.0	0.0	0.1	0.1	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 280	52-2-3082	1		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FRC 281	52-2-3083		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
FRC 283	52-2-3085		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
FRC 284	52-2-3086		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 285	52-2-3097		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 29	52-2-0155		1	0.0	0.0	0.0	0.0	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 30	52-2-0200		1	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 301	N/A	1		0.1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 302	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 304	N/A	1		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 305	N/A		1	0.1	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 306	N/A		1	0.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
FRC 307	N/A	1		0.0	0.0	0.0	0.0	0.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FRC 308	N/A		1	0.0	0.0	0.0	0.0	0.0	0.1	1.0	1.0	1.0	1.0	1.0	1.0
FRC 309	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
FRC 31	52-2-0722		1	0.0	0.0	0.0	0.0	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 310	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 311	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 312	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 313	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 314	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 315	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 316	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 317	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 319	N/A		1	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 32	52-2-0194	1		0.0	0.0	0.0	0.0	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 320	N/A		1	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 321	N/A		1	0.0	0.0	0.0	0.1	0.1	0.2	0.4	0.4	0.4	0.4	0.4	0.4
FRC 322	N/A	1		0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 323	N/A		1	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
FRC 324	N/A		1	0.0	0.0	0.0	0.1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
FRC 325	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3	1.3	1.3	1.3

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Tensile Strain during or after LW24	Maximum Predicted Tensile Strain during or after LW25	Maximum Predicted Tensile Strain during or after LW26	Maximum Predicted Tensile Strain during or after LW27	Maximum Predicted Tensile Strain during or after LW28	Maximum Predicted Tensile Strain during or after LW29	Maximum Predicted Tensile Strain during or after LW30	Maximum Predicted Tensile Strain during or after LW31	Maximum Predicted Tensile Strain during or after LW32	Maximum Predicted Tensile Strain during or after LW33	Maximum Predicted Tensile Strain during or after LW34	Maximum Predicted Tensile Strain during or after LW35
FRC 33	52-2-0188	1		0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
FRC 34	52-2-0195		1	0.0	0.0	0.0	0.0	0.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FRC 340	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 342	N/A	1		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 343	N/A		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 344	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3
FRC 345	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3
FRC 40	52-2-0333		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 44	52-2-0103		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 45	52-2-0102		1	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 46	52-2-0408		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 52	52-2-0257		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FRC 57	2-258, 52-2-3	1		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FRC 60	52-2-0177		1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
FRC 61	52-2-0152		1	0.0	0.0	0.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FRC 62	52-2-0168		1	0.0	0.0	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FRC 67	52-2-0185		1	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5
FRC 68	52-2-0186		1	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.4	0.4	0.4	0.4	0.4
FRC 70	52-2-0192		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.4	0.4
FRC 71	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.6	0.6	0.6	0.6
FRC 72	52-2-0199		1	0.0	0.0	0.0	0.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
FRC 76	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.7
FRC 77	52-2-0330		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 78	52-2-0885		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 85	52-2-0883		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 86	52-2-0207		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
FRC 87	52-2-0899		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 90	52-2-0869		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 91	52-2-0870		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 93	52-2-0198		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 94	52-2-0873		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 95	52-2-0347	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 97	52-2-0220		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
MET 1	-		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
NEW 1	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 10	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 15	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 16	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 17	-		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 18	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 19	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 2	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 20	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 22	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 9	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Tensile Strain during or after LW24	Maximum Predicted Tensile Strain during or after LW25	Maximum Predicted Tensile Strain during or after LW26	Maximum Predicted Tensile Strain during or after LW27	Maximum Predicted Tensile Strain during or after LW28	Maximum Predicted Tensile Strain during or after LW29	Maximum Predicted Tensile Strain during or after LW30	Maximum Predicted Tensile Strain during or after LW31	Maximum Predicted Tensile Strain during or after LW32	Maximum Predicted Tensile Strain during or after LW33	Maximum Predicted Tensile Strain during or after LW34	Maximum Predicted Tensile Strain during or after LW35
NT 11	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
NT 19	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 3	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 33	52-2-0641		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
NT 34	52-2-0642		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5
NT 35	52-2-0643		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5
NT 46	52-2-0755	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6
NT 6	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 7	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
NT 78	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 79	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 8	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 80	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 81	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 9	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAD 2	N/A		1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
NT 4	52-2-619		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 5	52-2-620		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 10	52-2-625		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.5
NT 12	52-2-753	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.5
NT 17	52-2-629	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 18	52-2-751		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 21	52-2-630	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 22	52-2-758		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 23	52-2-631		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 29	52-2-637	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 52	52-2-652	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 53	52-2-371	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 54	52-2-374		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 74	52-2-658		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 75	52-2-659		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 76	52-2-660		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 85	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 86	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Tensile Strain during or after LW36	Maximum Predicted Tensile Strain during or after LW37	Maximum Predicted Tensile Strain during or after LW38	Maximum Predicted Tensile Strain during or after LW39	Maximum Predicted Tensile Strain during or after LW40	Maximum Predicted Tensile Strain during or after LW41	Maximum Predicted Tensile Strain during or after LW42	Maximum Predicted Tensile Strain during or after LW43	Maximum Predicted Tensile Strain during or after LW44	Maximum Cumulative Tensile Strain due to LW18 to LW44	Maximum Predicted Comp. Strain during or after LW19A	Maximum Predicted Comp. Strain during or after LW20
2-0346	52-2-0346		1	0.0	0.0	0.1	0.2	0.4	0.4	0.5	0.5	0.5	0.5	0.0	0.0
FRC 101	52-2-0875	1		0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 105	52-2-0340		1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.0	-0.3
FRC 113	52-2-0365		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 114	52-2-0725	1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
FRC 115	52-2-0726		1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0
FRC 117	52-2-0739		1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0
FRC 119	52-2-0196		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0
FRC 124	52-2-0162		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.0	0.0
FRC 125	52-2-0310		1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
FRC 127	52-2-0203		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 13	52-2-0125		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.1	0.0	0.0
FRC 14	52-2-0138		1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.0	-0.2
FRC 15	52-2-0396		1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0
FRC 16.1	52-2-0120		1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-0.3
FRC 16.2	52-2-120		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	-0.3
FRC 160	52-2-0823		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 164	52-2-0171	1		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 168	52-2-0541	1		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	-0.2
FRC 169	52-2-0747	1		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0
FRC 17	52-2-0121		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	-0.2
FRC 171	52-2-0734		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 172	52-2-0735		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 176	52-2-0826		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 180	52-2-0828		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 184	52-2-0222		1	0.0	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 185	52-2-0223		1	0.1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0
FRC 186	52-2-0224		1	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 187	52-2-0225		1	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 189	52-2-0180		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
FRC 191	52-2-0183		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0
FRC 193	52-2-0144	1		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 194	52-2-0263		1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0
FRC 195	52-2-0264		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 198	52-2-0268		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 199	52-2-0265		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0
FRC 20	52-2-0107		1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-0.1
FRC 201	52-2-0267		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	-0.2	-0.2
FRC 21	52-2-0105		1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.5	0.0	-0.7
FRC 22	52-2-0145		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
FRC 23	52-2-0161		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 24.1	52-2-159		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 24.2	52-2-0160		1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0
FRC 25	52-2-0129		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Tensile Strain during or after LW36	Maximum Predicted Tensile Strain during or after LW37	Maximum Predicted Tensile Strain during or after LW38	Maximum Predicted Tensile Strain during or after LW39	Maximum Predicted Tensile Strain during or after LW40	Maximum Predicted Tensile Strain during or after LW41	Maximum Predicted Tensile Strain during or after LW42	Maximum Predicted Tensile Strain during or after LW43	Maximum Predicted Tensile Strain during or after LW44	Maximum Cumulative Tensile Strain due to LW18 to LW44	Maximum Predicted Comp. Strain during or after LW19A	Maximum Predicted Comp. Strain during or after LW20
FRC 253	52-2-0738	1		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0
FRC 254	52-2-0829		1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0
FRC 26	52-2-0135		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0
FRC 266	N/A		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.0	0.0
FRC 272	52-2-3074		1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
FRC 273	52-2-3075	1		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 274	N/A		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 275	N/A		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 276	52-2-3078		1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
FRC 277	52-2-3079		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 278	52-2-3080	1		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	-0.1	-0.2
FRC 279	52-2-3081		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 28	52-2-0154		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 280	52-2-3082	1		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0
FRC 281	52-2-3083		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0
FRC 283	52-2-3085		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
FRC 284	52-2-3086		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 285	52-2-3097		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 29	52-2-0155		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 30	52-2-0200		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 301	N/A	1		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 302	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 304	N/A	1		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.1	-0.1	-0.1
FRC 305	N/A		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 306	N/A		1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
FRC 307	N/A	1		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0
FRC 308	N/A		1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0
FRC 309	N/A		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
FRC 31	52-2-0722		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 310	N/A		1	0.0	0.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 311	N/A		1	0.0	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 312	N/A		1	0.0	0.0	0.0	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 313	N/A		1	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 314	N/A		1	0.0	0.0	0.1	0.1	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 315	N/A		1	0.0	0.0	0.1	0.1	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 316	N/A		1	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 317	N/A		1	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 319	N/A		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 32	52-2-0194	1		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 320	N/A		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 321	N/A		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 322	N/A	1		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 323	N/A		1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
FRC 324	N/A		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
FRC 325	N/A		1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Tensile Strain during or after LW36	Maximum Predicted Tensile Strain during or after LW37	Maximum Predicted Tensile Strain during or after LW38	Maximum Predicted Tensile Strain during or after LW39	Maximum Predicted Tensile Strain during or after LW40	Maximum Predicted Tensile Strain during or after LW41	Maximum Predicted Tensile Strain during or after LW42	Maximum Predicted Tensile Strain during or after LW43	Maximum Predicted Tensile Strain during or after LW44	Maximum Cumulative Tensile Strain due to LW18 to LW44	Maximum Predicted Comp. Strain during or after LW19A	Maximum Predicted Comp. Strain during or after LW20
FRC 33	52-2-0188	1		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
FRC 34	52-2-0195		1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0
FRC 340	N/A		1	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 342	N/A	1		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 343	N/A		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	-0.1
FRC 344	N/A		1	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 345	N/A		1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
FRC 40	52-2-0333		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 44	52-2-0103		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 45	52-2-0102		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 46	52-2-0408		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 52	52-2-0257		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 57	2-258, 52-2-3	1		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	-0.6	-0.6
FRC 60	52-2-0177		1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
FRC 61	52-2-0152		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 62	52-2-0168		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 67	52-2-0185		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 68	52-2-0186		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 70	52-2-0192		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 71	N/A		1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 72	52-2-0199		1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0
FRC 76	N/A		1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
FRC 77	52-2-0330		1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
FRC 78	52-2-0885		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
FRC 85	52-2-0883		1	0.0	0.0	0.2	0.3	0.4	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 86	52-2-0207		1	0.2	0.3	0.3	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 87	52-2-0899		1	0.0	0.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
FRC 90	52-2-0869		1	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 91	52-2-0870		1	0.0	0.0	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
FRC 93	52-2-0198		1	0.0	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
FRC 94	52-2-0873		1	0.1	0.1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
FRC 95	52-2-0347	1		0.0	0.0	0.0	0.0	0.3	0.3	0.4	0.4	0.4	0.4	0.0	0.0
FRC 97	52-2-0220		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0
MET 1	-		1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.0	0.0
NEW 1	N/A	1		0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.0	0.0
NEW 10	N/A		1	0.0	0.0	0.0	0.0	0.2	0.2	0.5	0.5	0.5	0.5	0.0	0.0
NEW 15	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
NEW 16	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 17	-		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0
NEW 18	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 19	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0
NEW 2	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.0	0.0
NEW 20	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
NEW 22	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.0
NEW 9	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Tensile Strain during or after LW36	Maximum Predicted Tensile Strain during or after LW37	Maximum Predicted Tensile Strain during or after LW38	Maximum Predicted Tensile Strain during or after LW39	Maximum Predicted Tensile Strain during or after LW40	Maximum Predicted Tensile Strain during or after LW41	Maximum Predicted Tensile Strain during or after LW42	Maximum Predicted Tensile Strain during or after LW43	Maximum Predicted Tensile Strain during or after LW44	Maximum Cumulative Tensile Strain due to LW18 to LW44	Maximum Predicted Comp. Strain during or after LW19A	Maximum Predicted Comp. Strain during or after LW20
NT 11	N/A		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
NT 19	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.3	0.0	0.0
NT 3	N/A		1	0.0	0.0	0.0	0.1	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
NT 33	52-2-0641		1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
NT 34	52-2-0642		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
NT 35	52-2-0643		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
NT 46	52-2-0755	1		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
NT 6	N/A		1	0.1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
NT 7	N/A	1		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
NT 78	N/A		1	0.0	0.1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
NT 79	N/A		1	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
NT 8	N/A	1		0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
NT 80	N/A		1	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
NT 81	N/A		1	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.0	0.0
NT 9	N/A		1	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
PAD 2	N/A		1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.0	-0.3
NT 4	52-2-619		1	0.0	0.0	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
NT 5	52-2-620		1	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
NT 10	52-2-625		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
NT 12	52-2-753	1		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
NT 17	52-2-629	1		0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
NT 18	52-2-751		1	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.0	0.0
NT 21	52-2-630	1		0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
NT 22	52-2-758		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 23	52-2-631		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 29	52-2-637	1		0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0
NT 52	52-2-652	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 53	52-2-371	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 54	52-2-374		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 74	52-2-658		1	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.0	0.0
NT 75	52-2-659		1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0
NT 76	52-2-660		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 85	N/A		1	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.3	0.3	0.0	0.0
NT 86	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Comp. Strain during or after LW21	Maximum Predicted Comp. Strain during or after LW22	Maximum Predicted Comp. Strain during or after LW23	Maximum Predicted Comp. Strain during or after LW24	Maximum Predicted Comp. Strain during or after LW25	Maximum Predicted Comp. Strain during or after LW26	Maximum Predicted Comp. Strain during or after LW27	Maximum Predicted Comp. Strain during or after LW28	Maximum Predicted Comp. Strain during or after LW29	Maximum Predicted Comp. Strain during or after LW30	Maximum Predicted Comp. Strain during or after LW31	Maximum Predicted Comp. Strain during or after LW32	Maximum Predicted Comp. Strain during or after LW33
2-0346	52-2-0346		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 101	52-2-0875	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 105	52-2-0340		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 113	52-2-0365		1	0.0	0.0	0.0	0.0	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4
FRC 114	52-2-0725	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 115	52-2-0726		1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
FRC 117	52-2-0739		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.4	-0.4	-0.4
FRC 119	52-2-0196		1	0.0	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 124	52-2-0162		1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
FRC 125	52-2-0310		1	0.0	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
FRC 127	52-2-0203		1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-1.2	-1.2	-1.2	-1.2	-1.2
FRC 13	52-2-0125		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 14	52-2-0138		1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 15	52-2-0396		1	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7
FRC 16.1	52-2-0120		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 16.2	52-2-120		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 160	52-2-0823		1	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 164	52-2-0171	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 168	52-2-0541	1		-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 169	52-2-0747	1		0.0	0.0	0.0	0.0	0.0	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3
FRC 17	52-2-0121		1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 171	52-2-0734		1	0.0	0.0	0.0	0.0	0.0	0.0	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6
FRC 172	52-2-0735		1	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
FRC 176	52-2-0826		1	0.0	-0.1	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
FRC 180	52-2-0828		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.5	-0.5	-0.5	-0.5
FRC 184	52-2-0222		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 185	52-2-0223		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 186	52-2-0224		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 187	52-2-0225		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 189	52-2-0180		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.4	-0.4	-0.4
FRC 191	52-2-0183		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3
FRC 193	52-2-0144	1		0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
FRC 194	52-2-0263		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 195	52-2-0264		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4
FRC 198	52-2-0268		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	-0.4	-0.4
FRC 199	52-2-0265		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 20	52-2-0107		1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
FRC 201	52-2-0267		1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 21	52-2-0105		1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
FRC 22	52-2-0145		1	0.0	-0.1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 23	52-2-0161		1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
FRC 24.1	52-2-159		1	0.0	0.0	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
FRC 24.2	52-2-0160		1	0.0	0.0	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 25	52-2-0129		1	0.0	-0.7	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Comp. Strain during or after LW21	Maximum Predicted Comp. Strain during or after LW22	Maximum Predicted Comp. Strain during or after LW23	Maximum Predicted Comp. Strain during or after LW24	Maximum Predicted Comp. Strain during or after LW25	Maximum Predicted Comp. Strain during or after LW26	Maximum Predicted Comp. Strain during or after LW27	Maximum Predicted Comp. Strain during or after LW28	Maximum Predicted Comp. Strain during or after LW29	Maximum Predicted Comp. Strain during or after LW30	Maximum Predicted Comp. Strain during or after LW31	Maximum Predicted Comp. Strain during or after LW32	Maximum Predicted Comp. Strain during or after LW33
FRC 253	52-2-0738	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-0.9	-0.9	-0.9	-0.9
FRC 254	52-2-0829		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.5	-0.5
FRC 26	52-2-0135		1	0.0	0.0	0.0	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
FRC 266	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 272	52-2-3074		1	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
FRC 273	52-2-3075	1		-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
FRC 274	N/A		1	0.0	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 275	N/A		1	0.0	-0.1	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
FRC 276	52-2-3078		1	0.0	0.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
FRC 277	52-2-3079		1	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 278	52-2-3080	1		-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 279	52-2-3081		1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 28	52-2-0154		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0
FRC 280	52-2-3082	1		-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 281	52-2-3083		1	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 283	52-2-3085		1	0.0	-0.1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 284	52-2-3086		1	0.0	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
FRC 285	52-2-3097		1	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 29	52-2-0155		1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 30	52-2-0200		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 301	N/A	1		0.0	0.0	0.0	0.0	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4
FRC 302	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 304	N/A	1		-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
FRC 305	N/A		1	0.0	0.0	0.0	0.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
FRC 306	N/A		1	0.0	0.0	0.0	0.0	-0.1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 307	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0
FRC 308	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	-1.3	-1.3	-1.3
FRC 309	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 31	52-2-0722		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-0.9	-0.9	-0.9	-0.9
FRC 310	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 311	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 312	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 313	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 314	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 315	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 316	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 317	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 319	N/A		1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 32	52-2-0194	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 320	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3
FRC 321	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-1.4	-1.4	-1.4
FRC 322	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 323	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 324	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
FRC 325	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3	-0.3

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Comp. Strain during or after LW21	Maximum Predicted Comp. Strain during or after LW22	Maximum Predicted Comp. Strain during or after LW23	Maximum Predicted Comp. Strain during or after LW24	Maximum Predicted Comp. Strain during or after LW25	Maximum Predicted Comp. Strain during or after LW26	Maximum Predicted Comp. Strain during or after LW27	Maximum Predicted Comp. Strain during or after LW28	Maximum Predicted Comp. Strain during or after LW29	Maximum Predicted Comp. Strain during or after LW30	Maximum Predicted Comp. Strain during or after LW31	Maximum Predicted Comp. Strain during or after LW32	Maximum Predicted Comp. Strain during or after LW33
FRC 33	52-2-0188	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 34	52-2-0195		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3	-0.3	-0.3	-0.3
FRC 340	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 342	N/A	1		0.0	0.0	0.0	-0.1	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
FRC 343	N/A		1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
FRC 344	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 345	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 40	52-2-0333		1	0.0	0.0	-0.1	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
FRC 44	52-2-0103		1	0.0	0.0	-0.1	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
FRC 45	52-2-0102		1	0.0	0.0	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 46	52-2-0408		1	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3
FRC 52	52-2-0257		1	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 57	2-258, 52-2-3	1		-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
FRC 60	52-2-0177		1	0.0	0.0	0.0	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
FRC 61	52-2-0152		1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
FRC 62	52-2-0168		1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
FRC 67	52-2-0185		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.5	-0.5	-0.5
FRC 68	52-2-0186		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.5	-0.5
FRC 70	52-2-0192		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1
FRC 71	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.5
FRC 72	52-2-0199		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5
FRC 76	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 77	52-2-0330		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 78	52-2-0885		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 85	52-2-0883		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 86	52-2-0207		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 87	52-2-0899		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 90	52-2-0869		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 91	52-2-0870		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 93	52-2-0198		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 94	52-2-0873		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 95	52-2-0347	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 97	52-2-0220		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MET 1	-		1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
NEW 1	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 10	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 15	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 16	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 17	-		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 18	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 19	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 2	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 20	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 22	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 9	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Comp. Strain during or after LW21	Maximum Predicted Comp. Strain during or after LW22	Maximum Predicted Comp. Strain during or after LW23	Maximum Predicted Comp. Strain during or after LW24	Maximum Predicted Comp. Strain during or after LW25	Maximum Predicted Comp. Strain during or after LW26	Maximum Predicted Comp. Strain during or after LW27	Maximum Predicted Comp. Strain during or after LW28	Maximum Predicted Comp. Strain during or after LW29	Maximum Predicted Comp. Strain during or after LW30	Maximum Predicted Comp. Strain during or after LW31	Maximum Predicted Comp. Strain during or after LW32	Maximum Predicted Comp. Strain during or after LW33
NT 11	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 19	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 3	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 33	52-2-0641		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 34	52-2-0642		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 35	52-2-0643		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 46	52-2-0755	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 6	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 7	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 78	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 79	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 8	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 80	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 81	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 9	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAD 2	N/A		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
NT 4	52-2-619		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 5	52-2-620		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 10	52-2-625		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 12	52-2-753	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 17	52-2-629	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 18	52-2-751		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 21	52-2-630	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 22	52-2-758		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 23	52-2-631		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 29	52-2-637	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 52	52-2-652	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 53	52-2-371	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 54	52-2-374		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 74	52-2-658		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 75	52-2-659		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 76	52-2-660		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 85	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 86	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Comp. Strain during or after LW34	Maximum Predicted Comp. Strain during or after LW35	Maximum Predicted Comp. Strain during or after LW36	Maximum Predicted Comp. Strain during or after LW37	Maximum Predicted Comp. Strain during or after LW38	Maximum Predicted Comp. Strain during or after LW39	Maximum Predicted Comp. Strain during or after LW40	Maximum Predicted Comp. Strain during or after LW41	Maximum Predicted Comp. Strain during or after LW42	Maximum Predicted Comp. Strain during or after LW43	Maximum Predicted Comp. Strain during or after LW44	Maximum Cumulative Compressive Strain due to LW18 to LW44
2-0346	52-2-0346		1	0.0	0.0	0.0	0.0	0.0	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
FRC 101	52-2-0875	1		0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.9	-0.9	-0.9	-0.9	-0.9
FRC 105	52-2-0340		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 113	52-2-0365		1	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4
FRC 114	52-2-0725	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 115	52-2-0726		1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
FRC 117	52-2-0739		1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 119	52-2-0196		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 124	52-2-0162		1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
FRC 125	52-2-0310		1	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
FRC 127	52-2-0203		1	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
FRC 13	52-2-0125		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 14	52-2-0138		1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 15	52-2-0396		1	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7
FRC 16.1	52-2-0120		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 16.2	52-2-120		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 160	52-2-0823		1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 164	52-2-0171	1		-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 168	52-2-0541	1		-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1
FRC 169	52-2-0747	1		-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3
FRC 17	52-2-0121		1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 171	52-2-0734		1	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6
FRC 172	52-2-0735		1	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
FRC 176	52-2-0826		1	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
FRC 180	52-2-0828		1	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 184	52-2-0222		1	0.0	0.0	0.0	0.0	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
FRC 185	52-2-0223		1	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 186	52-2-0224		1	0.0	0.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
FRC 187	52-2-0225		1	0.0	0.0	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 189	52-2-0180		1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 191	52-2-0183		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 193	52-2-0144	1		-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
FRC 194	52-2-0263		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 195	52-2-0264		1	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4
FRC 198	52-2-0268		1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 199	52-2-0265		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 20	52-2-0107		1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
FRC 201	52-2-0267		1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	0.0
FRC 21	52-2-0105		1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
FRC 22	52-2-0145		1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 23	52-2-0161		1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
FRC 24.1	52-2-159		1	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
FRC 24.2	52-2-0160		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 25	52-2-0129		1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Comp. Strain during or after LW34	Maximum Predicted Comp. Strain during or after LW35	Maximum Predicted Comp. Strain during or after LW36	Maximum Predicted Comp. Strain during or after LW37	Maximum Predicted Comp. Strain during or after LW38	Maximum Predicted Comp. Strain during or after LW39	Maximum Predicted Comp. Strain during or after LW40	Maximum Predicted Comp. Strain during or after LW41	Maximum Predicted Comp. Strain during or after LW42	Maximum Predicted Comp. Strain during or after LW43	Maximum Predicted Comp. Strain during or after LW44	Maximum Cumulative Compressive Strain due to LW18 to LW44
FRC 253	52-2-0738	1		-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
FRC 254	52-2-0829		1	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 26	52-2-0135		1	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
FRC 266	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 272	52-2-3074		1	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
FRC 273	52-2-3075	1		-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
FRC 274	N/A		1	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 275	N/A		1	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
FRC 276	52-2-3078		1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
FRC 277	52-2-3079		1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 278	52-2-3080	1		-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 279	52-2-3081		1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 28	52-2-0154		1	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
FRC 280	52-2-3082	1		-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 281	52-2-3083		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 283	52-2-3085		1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 284	52-2-3086		1	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
FRC 285	52-2-3097		1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 29	52-2-0155		1	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 30	52-2-0200		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 301	N/A	1		-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4
FRC 302	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRC 304	N/A	1		-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0
FRC 305	N/A		1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
FRC 306	N/A		1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 307	N/A	1		-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
FRC 308	N/A		1	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3
FRC 309	N/A		1	0.0	0.0	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
FRC 31	52-2-0722		1	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
FRC 310	N/A		1	0.0	0.0	0.0	0.0	-0.1	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 311	N/A		1	0.0	0.0	0.0	0.0	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
FRC 312	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.6	-0.6	-0.6	-0.6	-0.6
FRC 313	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 314	N/A		1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 315	N/A		1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 316	N/A		1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 317	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.8	-0.8	-0.8	-0.8
FRC 319	N/A		1	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 32	52-2-0194	1		-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 320	N/A		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 321	N/A		1	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4
FRC 322	N/A	1		-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 323	N/A		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 324	N/A		1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
FRC 325	N/A		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Comp. Strain during or after LW34	Maximum Predicted Comp. Strain during or after LW35	Maximum Predicted Comp. Strain during or after LW36	Maximum Predicted Comp. Strain during or after LW37	Maximum Predicted Comp. Strain during or after LW38	Maximum Predicted Comp. Strain during or after LW39	Maximum Predicted Comp. Strain during or after LW40	Maximum Predicted Comp. Strain during or after LW41	Maximum Predicted Comp. Strain during or after LW42	Maximum Predicted Comp. Strain during or after LW43	Maximum Predicted Comp. Strain during or after LW44	Maximum Cumulative Compressive Strain due to LW18 to LW44
FRC 33	52-2-0188	1		-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 34	52-2-0195		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 340	N/A		1	0.0	0.0	0.0	-0.1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 342	N/A	1		-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
FRC 343	N/A		1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
FRC 344	N/A		1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 345	N/A		1	0.0	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 40	52-2-0333		1	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
FRC 44	52-2-0103		1	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
FRC 45	52-2-0102		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 46	52-2-0408		1	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3
FRC 52	52-2-0257		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 57	-2-258, 52-2-3	1		-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	0.0
FRC 60	52-2-0177		1	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
FRC 61	52-2-0152		1	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
FRC 62	52-2-0168		1	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
FRC 67	52-2-0185		1	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 68	52-2-0186		1	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 70	52-2-0192		1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
FRC 71	N/A		1	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 72	52-2-0199		1	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5
FRC 76	N/A		1	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 77	52-2-0330		1	-0.1	-0.1	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 78	52-2-0885		1	-0.1	-0.1	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 85	52-2-0883		1	0.0	0.0	0.0	0.0	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 86	52-2-0207		1	0.0	0.0	0.0	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
FRC 87	52-2-0899		1	0.0	0.0	0.0	0.0	-0.3	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 90	52-2-0869		1	0.0	0.0	0.0	0.0	-0.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
FRC 91	52-2-0870		1	0.0	0.0	0.0	0.0	0.0	-0.3	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
FRC 93	52-2-0198		1	0.0	0.0	0.0	0.0	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
FRC 94	52-2-0873		1	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FRC 95	52-2-0347	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2	-0.2	-0.2	-0.2
FRC 97	52-2-0220		1	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
MET 1	-		1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
NEW 1	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2	-0.2	-0.2
NEW 10	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.4	-0.4	-0.4	-0.4
NEW 15	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 16	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 17	-		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
NEW 18	N/A	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 19	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
NEW 2	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.2
NEW 20	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEW 22	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.6
NEW 9	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.01 - Metropolitan Colliery - Longwalls 20 to 44
Details and Predicted Systematic Subsidence Parameters for the Archaeological Sites

Label	AHIMS Site No.	Open Sites	Over-hang Sites	Maximum Predicted Comp. Strain during or after LW34	Maximum Predicted Comp. Strain during or after LW35	Maximum Predicted Comp. Strain during or after LW36	Maximum Predicted Comp. Strain during or after LW37	Maximum Predicted Comp. Strain during or after LW38	Maximum Predicted Comp. Strain during or after LW39	Maximum Predicted Comp. Strain during or after LW40	Maximum Predicted Comp. Strain during or after LW41	Maximum Predicted Comp. Strain during or after LW42	Maximum Predicted Comp. Strain during or after LW43	Maximum Predicted Comp. Strain during or after LW44	Maximum Cumulative Compressive Strain due to LW18 to LW44
NT 11	N/A		1	0.0	0.0	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
NT 19	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.6	-0.6
NT 3	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3
NT 33	52-2-0641		1	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
NT 34	52-2-0642		1	0.0	-0.1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
NT 35	52-2-0643		1	0.0	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
NT 46	52-2-0755	1		0.0	-0.1	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
NT 6	N/A		1	0.0	0.0	0.0	-0.4	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
NT 7	N/A	1		0.0	0.0	-0.1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
NT 78	N/A		1	0.0	0.0	0.0	0.0	-0.2	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
NT 79	N/A		1	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
NT 8	N/A	1		0.0	0.0	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
NT 80	N/A		1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
NT 81	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3
NT 9	N/A		1	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
PAD 2	N/A		1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
NT 4	52-2-619		1	0.0	0.0	0.0	0.0	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
NT 5	52-2-620		1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
NT 10	52-2-625		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 12	52-2-753	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 17	52-2-629	1		0.0	0.0	0.0	0.0	-0.1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
NT 18	52-2-751		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.5	-0.5	-0.5	-0.5
NT 21	52-2-630	1		0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3
NT 22	52-2-758		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 23	52-2-631		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 29	52-2-637	1		0.0	0.0	0.0	0.0	0.0	-0.2	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
NT 52	52-2-652	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 53	52-2-371	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 54	52-2-374		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 74	52-2-658		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3
NT 75	52-2-659		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3
NT 76	52-2-660		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NT 85	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.5	-0.5
NT 86	N/A		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Structure Centroid MGA Easting (m)	Structure Centroid MGA Northing (m)	Maximum Structure Plan Dimension (m)	Structure Height (m)	Maximum Predicted Subsidence due to LW1 to LW34 (mm)	Maximum Predicted Subsidence due to LW1 to LW35 (mm)	Maximum Predicted Subsidence due to LW1 to LW36 (mm)	Maximum Predicted Subsidence due to LW1 to LW37 (mm)	Maximum Predicted Subsidence due to LW1 to LW38 (mm)	Maximum Predicted Subsidence due to LW1 to LW39 (mm)	Maximum Predicted Subsidence due to LW1 to LW40 (mm)	Maximum Predicted Subsidence due to LW1 to LW41 (mm)	Maximum Predicted Subsidence due to LW1 to LW42 (mm)	Maximum Predicted Subsidence due to LW1 to LW43 (mm)	Maximum Predicted Subsidence due to LW1 to LW44 (mm)
A01a	H4	313005	6217680	101.0	6.75	< 20	< 20	< 20	< 20	< 20	20	80	485	1015	1170	1225
A01b	H3	313021	6217647	17.0	6.75	< 20	< 20	< 20	< 20	< 20	< 20	60	335	980	1165	1225
A01c	H3	313038	6217633	5.0	6.75	< 20	< 20	< 20	< 20	< 20	< 20	60	320	975	1160	1225
A01d	H3	313048	6217638	5.0	6.75	< 20	< 20	< 20	< 20	< 20	< 20	55	290	955	1155	1220
A01e	H4	313059	6217732	34.0	6.75	< 20	< 20	< 20	< 20	< 20	< 20	30	135	765	1050	1165
A01f	H1	312980	6217707	5.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	45	220	895	1110	1190
A01g	H1	313022	6217756	5.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	30	125	730	1030	1155
A01h	H1	313009	6217750	7.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	30	140	760	1040	1150
A01i	H1	313002	6217761	5.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	30	130	740	1030	1150
A01j	H1	312997	6217772	5.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	30	125	720	1025	1155
A01k	H1	312990	6217782	5.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	30	120	705	1020	1160
A01l	R	312919	6217644	4.0	2.50	< 20	< 20	< 20	< 20	< 20	25	90	535	1015	1165	1220
A01m	H1	312934	6217847	18.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	25	105	635	1005	1165
A02a	H1	312880	6217843	18.5	3.75	< 20	< 20	< 20	< 20	< 20	< 20	30	135	725	1015	1150
A02b	R	312855	6217831	6.0	2.50	< 20	< 20	< 20	< 20	< 20	< 20	35	155	770	1030	1125
A03a	H1	312882	6217807	17.2	3.75	< 20	< 20	< 20	< 20	< 20	< 20	40	170	805	1055	1140
A03b	R	312864	6217791	10.0	2.50	< 20	< 20	< 20	< 20	< 20	< 20	45	200	850	1080	1155
A03c	R	312854	6217797	5.0	2.50	< 20	< 20	< 20	< 20	< 20	< 20	45	200	845	1075	1155
A03d	R	312852	6217790	2.0	2.50	< 20	< 20	< 20	< 20	< 20	< 20	45	210	860	1085	1160
A04a	H1	312884	6217771	16.9	3.75	< 20	< 20	< 20	< 20	< 20	< 20	50	230	885	1100	1175
A05a	H1	312884	6217743	12.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	60	285	945	1140	1200
A06a	H1	312882	6217722	15.1	3.75	< 20	< 20	< 20	< 20	< 20	< 20	65	350	975	1155	1215
A06b	R	312866	6217713	4.0	2.50	< 20	< 20	< 20	< 20	< 20	< 20	70	395	990	1155	1215
A07a	H1	312873	6217697	25.7	3.75	< 20	< 20	< 20	< 20	< 20	25	85	490	1005	1160	1215
A08a	H1	312876	6217663	17.0	3.75	< 20	< 20	< 20	< 20	< 20	25	100	590	1010	1165	1215
A08b	R	312863	6217673	13.0	2.50	< 20	< 20	< 20	< 20	< 20	25	95	570	1005	1160	1215
A08c	R	312866	6217649	6.5	2.50	< 20	< 20	< 20	< 20	< 20	30	105	620	1010	1160	1210
A08d	R	312862	6217656	3.0	2.50	< 20	< 20	< 20	< 20	< 20	25	100	605	1010	1160	1210
A08e	R	312836	6217670	3.9	2.50	< 20	< 20	< 20	< 20	< 20	30	105	610	1005	1155	1205
A08f	R	312803	6217632	3.6	2.50	< 20	< 20	< 20	< 20	< 20	40	150	755	1025	1120	1155
A09a	H1	312832	6217577	20.3	3.75	< 20	< 20	< 20	< 20	< 20	50	215	870	1090	1165	1185
A09b	R	312805	6217564	10.0	2.50	< 20	< 20	< 20	< 20	< 20	55	260	915	1120	1185	1205
B01a	H2	312818	6217519	51.4	3.75	< 20	< 20	< 20	< 20	20	80	460	1000	1165	1215	1235
B01b	H2	312866	6217516	51.4	3.75	< 20	< 20	< 20	< 20	< 20	70	365	985	1165	1220	1235
B01c	H2	312923	6217460	51.4	3.75	< 20	< 20	< 20	< 20	20	80	480	1010	1170	1230	1245
B01d	H2	312925	6217411	51.4	3.75	< 20	< 20	< 20	< 20	25	105	610	1015	1175	1230	1250
B01e	H2	312935	6217521	42.5	3.75	< 20	< 20	< 20	< 20	< 20	50	225	890	1110	1185	1210
B01f	H1	312898	6217489	11.0	3.75	< 20	< 20	< 20	< 20	< 20	65	320	970	1160	1220	1240
B01g	H1	312923	6217498	22.2	3.75	< 20	< 20	< 20	< 20	< 20	60	285	950	1150	1210	1230
B01h	H1	312885	6217492	19.2	3.75	< 20	< 20	< 20	< 20	< 20	65	320	965	1155	1215	1235
B01i	H1	312901	6217478	11.7	3.75	< 20	< 20	< 20	< 20	< 20	65	340	980	1165	1225	1240
B01j	H1	312840	6217504	11.6	3.75	< 20	< 20	< 20	< 20	< 20	70	380	990	1160	1215	1235
B01k	R	312907	6217496	3.0	2.50	< 20	< 20	< 20	< 20	< 20	55	270	935	1140	1205	1225
B01l	R	312913	6217498	5.0	2.50	< 20	< 20	< 20	< 20	< 20	55	255	925	1130	1200	1220
B01m	R	312958	6217505	3.0	2.50	< 20	< 20	< 20	< 20	< 20	45	190	845	1085	1170	1195
B01n	R	312944	6217466	7.0	2.50	< 20	< 20	< 20	< 20	< 20	60	290	955	1155	1220	1240
B01o	R	312955	6217469	5.0	2.50	< 20	< 20	< 20	< 20	< 20	55	265	935	1145	1210	1230
B01p	R	312947	6217408	7.0	2.50	< 20	< 20	< 20	< 20	20	85	495	1010	1175	1230	1250
B01q	R	312958	6217411	5.0	2.50	< 20	< 20	< 20	< 20	< 20	80	450	1010	1175	1230	1250
B02a	H4	313011	6217569	59.3	6.75	< 20	< 20	< 20	< 20	< 20	30	120	690	1025	1175	1230
B02b	H3	312976	6217559	28.1	6.75	< 20	< 20	< 20	< 20	< 20	35	135	730	1030	1170	1220
B02c	H4	313054	6217473	83.0	6.75	< 20	< 20	< 20	< 20	< 20	45	220	895	1115	1195	1220
B02d	H3	313028	6217481	29.9	6.75	< 20	< 20	< 20	< 20	< 20	40	185	845	1090	1175	1200

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Structure Centroid MGA Easting (m)	Structure Centroid MGA Northing (m)	Maximum Structure Plan Dimension (m)	Structure Height (m)	Maximum Predicted Subsidence due to LW1 to LW34 (mm)	Maximum Predicted Subsidence due to LW1 to LW35 (mm)	Maximum Predicted Subsidence due to LW1 to LW36 (mm)	Maximum Predicted Subsidence due to LW1 to LW37 (mm)	Maximum Predicted Subsidence due to LW1 to LW38 (mm)	Maximum Predicted Subsidence due to LW1 to LW39 (mm)	Maximum Predicted Subsidence due to LW1 to LW40 (mm)	Maximum Predicted Subsidence due to LW1 to LW41 (mm)	Maximum Predicted Subsidence due to LW1 to LW42 (mm)	Maximum Predicted Subsidence due to LW1 to LW43 (mm)	Maximum Predicted Subsidence due to LW1 to LW44 (mm)
B02e	H1	313043	6217531	23.0	3.75	< 20	< 20	< 20	< 20	< 20	30	120	700	1030	1175	1225
B02f	H1	313062	6217527	22.3	3.75	< 20	< 20	< 20	< 20	< 20	30	110	670	1025	1175	1225
B02g	H1	313051	6217519	9.0	3.75	< 20	< 20	< 20	< 20	< 20	30	120	700	1025	1170	1215
B02h	H1	313049	6217532	8.0	3.75	< 20	< 20	< 20	< 20	< 20	25	110	665	1025	1175	1225
B02i	R	313080	6217495	5.0	2.50	< 20	< 20	< 20	< 20	< 20	30	120	710	1025	1160	1205
B02j	R	313080	6217477	5.0	2.50	< 20	< 20	< 20	< 20	< 20	35	140	760	1040	1145	1185
B03a	H2	313108	6217552	42.7	3.75	< 20	< 20	< 20	< 20	< 20	20	90	570	1015	1170	1225
B03b	H1	313082	6217558	25.3	3.75	< 20	< 20	< 20	< 20	< 20	20	85	555	1020	1175	1230
B03c	H1	313089	6217549	8.0	3.75	< 20	< 20	< 20	< 20	< 20	20	85	535	1015	1175	1230
B03d	H1	313100	6217511	23.0	3.75	< 20	< 20	< 20	< 20	< 20	25	105	655	1015	1170	1220
B03e	H1	313101	6217586	25.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	65	380	995	1170	1230
B03f	H1	313114	6217603	28.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	55	295	960	1160	1220
B03g	H1	313116	6217616	8.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	50	245	930	1140	1215
B03h	H1	313139	6217616	28.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	45	230	915	1130	1205
B03i	H1	313131	6217614	5.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	45	230	915	1135	1205
B03j	H1	313186	6217564	14.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	50	285	925	1115	1180
B03k	H1	313160	6217553	15.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	60	370	965	1145	1200
B03l	H1	313126	6217533	11.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	80	515	1000	1165	1220
B04a	H1	312922	6217358	14.0	3.75	< 20	< 20	< 20	< 20	30	130	705	1020	1165	1215	1225
B05a	H1	312923	6217334	12.9	3.75	< 20	< 20	< 20	< 20	35	150	760	1040	1150	1195	1205
B06a	H1	312922	6217309	14.0	3.75	< 20	< 20	< 20	< 20	40	180	820	1070	1160	1185	1195
B06b	R	312954	6217299	5.0	2.50	< 20	< 20	< 20	< 20	40	160	790	1055	1150	1180	1190
B07a	H1	312920	6217286	11.8	3.75	< 20	< 20	< 20	< 20	45	215	875	1100	1180	1205	1210
B08a	H1	312918	6217261	14.1	3.75	< 20	< 20	< 20	< 20	55	275	945	1145	1215	1235	1240
B09a	H3	312918	6217240	14.0	6.75	< 20	< 20	< 20	< 20	60	325	980	1165	1230	1250	1250
B10a	R	312868	6217231	6.0	2.50	< 20	< 20	< 20	< 20	75	450	1010	1175	1230	1250	1250
B10b	R	312860	6217225	3.0	2.50	< 20	< 20	< 20	< 20	80	485	1015	1175	1230	1250	1250
B11a	R	312882	6217164	7.0	2.50	< 20	< 20	< 20	25	115	655	1025	1175	1225	1245	1245
B11b	R	312838	6217160	5.0	2.50	< 20	< 20	< 20	30	135	725	1025	1155	1200	1215	1215
B11c	R	312877	6217183	3.0	2.50	< 20	< 20	< 20	25	100	600	1025	1180	1230	1250	1250
B12a	H1	312893	6217065	14.0	3.75	< 20	< 20	< 20	45	220	885	1105	1180	1200	1210	1210
B13a	R	313074	6216914	5.0	2.50	< 20	< 20	< 20	50	230	680	795	825	835	835	835
C01a	R	311989	6217233	6.0	2.50	< 20	< 20	25	240	335	355	360	360	360	360	360
D01a	R	312667	6218309	12.0	2.50	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	65	375	990
E01a	H1	312786	6214956	19.0	3.75	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
E01b	R	312798	6214947	7.0	2.50	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
E01c	R	312837	6214970	12.0	2.50	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
E02a	H1	313011	6214959	20.4	3.75	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
E03a	H1	312742	6214745	26.4	3.75	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Maximum Predicted Tilt due to LW1 to LW34 (mm/m)	Maximum Predicted Tilt due to LW1 to LW35 (mm/m)	Maximum Predicted Tilt due to LW1 to LW36 (mm/m)	Maximum Predicted Tilt due to LW1 to LW37 (mm/m)	Maximum Predicted Tilt due to LW1 to LW38 (mm/m)	Maximum Predicted Tilt due to LW1 to LW39 (mm/m)	Maximum Predicted Tilt due to LW1 to LW40 (mm/m)	Maximum Predicted Tilt due to LW1 to LW41 (mm/m)	Maximum Predicted Tilt due to LW1 to LW42 (mm/m)	Maximum Predicted Tilt due to LW1 to LW43 (mm/m)	Maximum Predicted Tilt due to LW1 to LW44 (mm/m)	Maximum Predicted Travelling or Cumuatlive Tilt during LW18 to LW44 (mm/m)
A01a	H4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.6	4.6	3.5	1.7	1.3	3.4
A01b	H3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.5	3.9	2.5	1.4	1.0	3.4
A01c	H3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.5	3.7	2.4	1.4	0.9	3.4
A01d	H3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	3.3	2.5	1.4	0.9	3.3
A01e	H4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.1	4.3	1.1	0.7	2.9
A01f	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	2.3	2.7	1.6	1.1	3.2
A01g	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.0	4.0	0.9	0.8	2.8
A01h	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.2	3.6	1.1	0.7	2.7
A01i	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.1	3.7	1.0	0.8	2.7
A01j	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.0	3.9	0.8	0.8	2.7
A01k	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.0	4.1	0.6	0.9	2.8
A01l	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.6	4.5	1.3	0.8	1.1	3.3
A01m	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.8	4.5	1.0	0.9	3.2
A02a	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.1	4.1	0.9	0.9	2.7
A02b	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.3	3.1	1.3	0.7	2.7
A03a	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.3	1.6	3.1	1.5	0.9	2.8
A03b	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	2.0	2.7	1.6	1.1	3.0
A03c	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	1.9	2.7	1.6	1.1	3.0
A03d	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	2.1	2.7	1.6	1.2	3.1
A04a	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	2.3	2.7	1.7	1.2	3.2
A05a	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	3.1	2.7	1.7	1.3	3.4
A06a	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.5	3.9	2.7	1.7	1.3	3.4
A06b	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.5	4.3	2.7	1.7	1.3	3.4
A07a	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.6	4.5	2.7	1.7	1.3	3.4
A08a	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.7	4.5	1.4	0.9	1.1	3.2
A08b	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.7	4.5	1.4	0.9	1.1	3.2
A08c	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.8	4.5	0.6	0.9	1.1	3.1
A08d	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.7	4.5	0.7	0.9	1.1	3.1
A08e	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.7	4.4	0.6	0.9	1.2	3.0
A08f	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.2	3.2	1.1	0.7	0.9	2.6
A09a	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.3	2.1	2.8	1.6	1.2	1.0	3.1
A09b	R	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	2.7	2.7	1.8	1.4	1.2	3.3
B01a	H2	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.6	4.4	2.7	1.8	1.4	1.2	3.4
B01b	H2	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.5	4.0	2.7	1.8	1.3	1.2	3.4
B01c	H2	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.6	4.5	2.7	1.7	1.3	1.2	3.4
B01d	H2	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.7	4.5	2.6	1.7	1.3	1.2	3.4
B01e	H2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.3	2.2	3.0	1.6	1.2	1.0	3.1
B01f	H1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.5	3.6	2.7	1.7	1.3	1.2	3.4
B01g	H1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.5	3.1	2.7	1.8	1.3	1.2	3.4
B01h	H1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.5	3.5	2.7	1.8	1.3	1.2	3.4
B01i	H1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.5	3.8	2.7	1.7	1.3	1.2	3.4
B01j	H1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.5	4.1	2.7	1.8	1.3	1.2	3.4
B01k	R	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	2.9	2.7	1.7	1.3	1.2	3.4
B01l	R	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	2.7	2.7	1.7	1.3	1.2	3.4
B01m	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.3	1.7	2.8	1.5	1.0	0.9	2.9
B01n	R	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	3.2	2.7	1.7	1.3	1.2	3.4
B01o	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.4	2.8	2.7	1.7	1.3	1.1	3.4
B01p	R	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.6	4.5	2.0	1.1	0.8	0.9	3.3
B01q	R	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.6	4.5	2.4	1.5	1.1	0.9	3.4
B02a	H4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.9	4.7	1.7	0.8	1.1	3.4
B02b	H3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.1	4.6	0.9	0.8	1.1	3.0
B02c	H4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.3	2.2	4.5	1.6	1.2	1.1	3.2
B02d	H3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.3	1.7	3.3	1.5	1.0	0.9	2.9

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Maximum Predicted Tilt due to LW1 to LW34 (mm/m)	Maximum Predicted Tilt due to LW1 to LW35 (mm/m)	Maximum Predicted Tilt due to LW1 to LW36 (mm/m)	Maximum Predicted Tilt due to LW1 to LW37 (mm/m)	Maximum Predicted Tilt due to LW1 to LW38 (mm/m)	Maximum Predicted Tilt due to LW1 to LW39 (mm/m)	Maximum Predicted Tilt due to LW1 to LW40 (mm/m)	Maximum Predicted Tilt due to LW1 to LW41 (mm/m)	Maximum Predicted Tilt due to LW1 to LW42 (mm/m)	Maximum Predicted Tilt due to LW1 to LW43 (mm/m)	Maximum Predicted Tilt due to LW1 to LW44 (mm/m)	Maximum Predicted Travelling or Cumuatlive Tilt during LW18 to LW44 (mm/m)
B02e	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.9	4.7	0.8	0.7	1.0	3.2
B02f	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.8	4.7	0.8	0.7	1.0	3.2
B02g	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.9	4.5	0.6	0.7	1.0	2.9
B02h	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.8	4.6	0.6	0.7	1.0	3.1
B02i	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.0	4.3	0.8	0.8	0.9	2.8
B02j	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.1	3.7	1.2	0.8	0.9	2.7
B03a	H2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.7	4.7	2.1	1.3	1.0	3.4
B03b	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.7	4.7	1.7	0.9	0.9	3.4
B03c	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.6	4.7	1.5	0.7	0.8	3.4
B03d	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.8	4.6	1.0	1.0	1.1	3.3
B03e	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.5	4.3	2.4	1.4	1.0	3.4
B03f	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	3.4	2.6	1.5	1.1	3.3
B03g	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	2.7	2.6	1.4	1.0	3.2
B03h	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.4	2.5	2.8	1.6	1.3	3.2
B03i	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.4	2.4	2.7	1.5	1.2	3.2
B03j	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.4	3.2	2.7	2.2	2.2	3.3
B03k	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.5	4.1	2.5	1.8	1.7	3.3
B03l	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.6	4.6	1.7	1.1	1.2	3.4
B04a	H1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.0	4.4	0.7	0.8	1.1	1.2	2.8
B05a	H1	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.2	3.7	1.1	0.8	1.1	1.1	2.7
B06a	H1	< 0.1	< 0.1	< 0.1	< 0.1	0.3	1.5	3.0	1.5	1.0	0.8	0.7	2.9
B06b	R	< 0.1	< 0.1	< 0.1	< 0.1	0.2	1.3	3.1	1.3	0.8	0.7	0.8	2.8
B07a	H1	< 0.1	< 0.1	< 0.1	< 0.1	0.3	2.0	2.8	1.6	1.2	1.0	1.0	3.1
B08a	H1	< 0.1	< 0.1	< 0.1	< 0.1	0.4	2.9	2.7	1.8	1.3	1.2	1.2	3.4
B09a	H3	< 0.1	< 0.1	< 0.1	0.1	0.4	3.6	2.7	1.8	1.4	1.2	1.2	3.4
B10a	R	< 0.1	< 0.1	< 0.1	0.2	0.6	4.5	2.6	1.7	1.3	1.2	1.1	3.4
B10b	R	< 0.1	< 0.1	< 0.1	0.2	0.6	4.5	2.1	1.1	0.8	0.9	0.9	3.4
B11a	R	< 0.1	< 0.1	< 0.1	0.2	0.8	4.5	0.5	0.9	1.2	1.3	1.3	3.0
B11b	R	< 0.1	< 0.1	< 0.1	0.2	1.1	3.8	0.8	0.9	1.2	1.3	1.3	2.7
B11c	R	< 0.1	< 0.1	< 0.1	0.2	0.7	4.5	1.0	0.9	1.2	1.3	1.3	3.2
B12a	H1	< 0.1	< 0.1	< 0.1	0.3	2.1	2.8	1.7	1.3	1.2	1.1	1.1	3.1
B13a	R	< 0.1	< 0.1	0.1	0.4	2.7	4.3	5.1	5.3	5.4	5.4	5.4	5.4
C01a	R	< 0.1	< 0.1	0.2	1.9	0.7	0.5	0.4	0.4	0.4	0.4	0.4	1.3
D01a	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.5	4.1	2.7	3.3
E01a	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
E01b	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
E01c	R	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
E02a	H1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
E03a	H1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Tilt Impact Assessment at the Completion of Longwall 34	Tilt Impact Assessment at the Completion of Longwall 35	Tilt Impact Assessment at the Completion of Longwall 36	Tilt Impact Assessment at the Completion of Longwall 37	Tilt Impact Assessment at the Completion of Longwall 38	Tilt Impact Assessment at the Completion of Longwall 39	Tilt Impact Assessment at the Completion of Longwall 40	Tilt Impact Assessment at the Completion of Longwall 41	Tilt Impact Assessment at the Completion of Longwall 42	Tilt Impact Assessment at the Completion of Longwall 43	Tilt Impact Assessment at the Completion of Longwall 44
A01a	H4	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01b	H3	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01c	H3	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01d	H3	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01e	H4	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01f	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01g	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01h	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01i	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01j	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01k	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01l	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A01m	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A02a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A02b	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A03a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A03b	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A03c	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A03d	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A04a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A05a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A06a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A06b	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A07a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A08a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A08b	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A08c	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A08d	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A08e	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A08f	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A09a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
A09b	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01a	H2	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01b	H2	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01c	H2	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01d	H2	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01e	H2	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01f	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01g	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01h	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01i	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01j	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01k	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01l	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01m	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01n	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01o	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01p	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B01q	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B02a	H4	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B02b	H3	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B02c	H4	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B02d	H3	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Tilt Impact Assessment at the Completion of Longwall 34	Tilt Impact Assessment at the Completion of Longwall 35	Tilt Impact Assessment at the Completion of Longwall 36	Tilt Impact Assessment at the Completion of Longwall 37	Tilt Impact Assessment at the Completion of Longwall 38	Tilt Impact Assessment at the Completion of Longwall 39	Tilt Impact Assessment at the Completion of Longwall 40	Tilt Impact Assessment at the Completion of Longwall 41	Tilt Impact Assessment at the Completion of Longwall 42	Tilt Impact Assessment at the Completion of Longwall 43	Tilt Impact Assessment at the Completion of Longwall 44
B02e	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B02f	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B02g	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B02h	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B02i	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B02j	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03a	H2	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03b	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03c	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03d	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03e	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03f	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03g	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03h	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03i	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03j	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03k	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B03l	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B04a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B05a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B06a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B06b	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B07a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B08a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B09a	H3	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B10a	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B10b	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B11a	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B11b	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B11c	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B12a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
B13a	R	Category A	Category A	Category A	Category A	Category A	Category A	Category B	Category B	Category B	Category B	Category B
C01a	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
D01a	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
E01a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
E01b	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
E01c	R	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
E02a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A
E03a	H1	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Impact Assessment Strain due to LW1 to LW34 (mm/m)	Strain Impact Assessment due to LW1 to LW34	Impact Assessment Strain due to LW1 to LW35 (mm/m)	Strain Impact Assessment due to LW1 to LW35	Impact Assessment Strain due to LW1 to LW36 (mm/m)	Strain Impact Assessment due to LW1 to LW36	Impact Assessment Strain due to LW1 to LW37 (mm/m)	Strain Impact Assessment due to LW1 to LW37	Impact Assessment Strain due to LW1 to LW38 (mm/m)	Strain Impact Assessment due to LW1 to LW38
A01a	H4	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A01b	H3	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A01c	H3	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A01d	H3	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A01e	H4	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	-0.1	Category 0
A01f	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A01g	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A01h	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	-0.1	Category 0
A01i	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A01j	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A01k	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A01l	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	-0.1	Category 0
A01m	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	-0.1	Category 0
A02a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A02b	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A03a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A03b	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A03c	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A03d	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A04a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A05a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A06a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A06b	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	-0.1	Category 0
A07a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	-0.1	Category 0
A08a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A08b	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A08c	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A08d	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A08e	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A08f	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A09a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
A09b	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01a	H2	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.3	Category 1
B01b	H2	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01c	H2	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.3	Category 1
B01d	H2	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.3	Category 1
B01e	H2	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01f	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01g	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01h	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01i	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.2	Category 0
B01j	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01k	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01l	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01m	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01n	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01o	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B01p	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.3	Category 0
B01q	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B02a	H4	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	-0.1	Category 0
B02b	H3	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B02c	H4	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B02d	H3	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Impact Assessment Strain due to LW1 to LW34 (mm/m)	Strain Impact Assessment due to LW1 to LW34	Impact Assessment Strain due to LW1 to LW35 (mm/m)	Strain Impact Assessment due to LW1 to LW35	Impact Assessment Strain due to LW1 to LW36 (mm/m)	Strain Impact Assessment due to LW1 to LW36	Impact Assessment Strain due to LW1 to LW37 (mm/m)	Strain Impact Assessment due to LW1 to LW37	Impact Assessment Strain due to LW1 to LW38 (mm/m)	Strain Impact Assessment due to LW1 to LW38
B02e	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B02f	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B02g	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B02h	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B02i	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B02j	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B03a	H2	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B03b	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B03c	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	-0.1	Category 0
B03d	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B03e	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B03f	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B03g	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B03h	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B03i	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B03j	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B03k	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B03l	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
B04a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	-0.1	Category 0	0.2	Category 0
B05a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.2	Category 0
B06a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.2	Category 0
B06b	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.2	Category 0
B07a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.2	Category 0
B08a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.2	Category 0
B09a	H3	0.1	Category 0	0.1	Category 0	0.2	Category 0	0.2	Category 0	0.4	Category 0
B10a	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.3	Category 0
B10b	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.3	Category 0
B11a	R	0.1	Category 0	0.1	Category 0	-0.1	Category 0	-0.2	Category 0	0.3	Category 0
B11b	R	0.1	Category 0	0.1	Category 0	-0.1	Category 0	0.2	Category 0	0.4	Category 0
B11c	R	0.1	Category 0	0.1	Category 0	-0.1	Category 0	-0.2	Category 0	0.3	Category 0
B12a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.2	Category 0	0.7	Category 0
B13a	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.3	Category 0	0.8	Category 0
C01a	R	0.1	Category 0	0.1	Category 0	0.2	Category 0	-0.5	Category 0	0.6	Category 0
D01a	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
E01a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
E01b	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
E01c	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
E02a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
E03a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Impact Assessment Strain due to LW1 to LW39 (mm/m)	Strain Impact Assessment due to LW1 to LW39	Impact Assessment Strain due to LW1 to LW40 (mm/m)	Strain Impact Assessment due to LW1 to LW40	Impact Assessment Strain due to LW1 to LW41 (mm/m)	Strain Impact Assessment due to LW1 to LW41	Impact Assessment Strain due to LW1 to LW42 (mm/m)	Strain Impact Assessment due to LW1 to LW42	Impact Assessment Strain due to LW1 to LW43 (mm/m)	Strain Impact Assessment due to LW1 to LW43	Impact Assessment Strain due to LW1 to LW44 (mm/m)	Strain Impact Assessment due to LW1 to LW44
A01a	H4	0.3	Category 1	0.3	Category 2	1.2	Category 3	1.2	Category 3	1.2	Category 3	1.2	Category 3
A01b	H3	0.1	Category 0	0.3	Category 0	1.2	Category 1	1.2	Category 1	1.2	Category 1	1.2	Category 1
A01c	H3	0.1	Category 0	0.3	Category 0	1.2	Category 0	1.2	Category 0	1.2	Category 0	1.2	Category 0
A01d	H3	0.1	Category 0	0.3	Category 0	1.2	Category 0	1.2	Category 0	1.2	Category 0	1.2	Category 0
A01e	H4	0.1	Category 0	0.2	Category 0	0.5	Category 1	-0.6	Category 1	0.7	Category 1	0.8	Category 1
A01f	H1	0.1	Category 0	0.3	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0
A01g	H1	0.1	Category 0	0.2	Category 0	0.4	Category 0	-0.7	Category 0	0.7	Category 0	0.8	Category 0
A01h	H1	0.1	Category 0	0.2	Category 0	0.4	Category 0	-0.7	Category 0	0.7	Category 0	0.8	Category 0
A01i	H1	0.1	Category 0	0.2	Category 0	0.4	Category 0	-0.7	Category 0	0.7	Category 0	0.8	Category 0
A01j	H1	0.1	Category 0	0.2	Category 0	0.4	Category 0	-0.7	Category 0	0.7	Category 0	0.8	Category 0
A01k	H1	0.1	Category 0	0.2	Category 0	0.4	Category 0	-0.7	Category 0	0.7	Category 0	0.8	Category 0
A01l	R	0.2	Category 0	0.3	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0
A01m	H1	0.1	Category 0	0.2	Category 0	0.3	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0
A02a	H1	0.1	Category 0	0.2	Category 0	0.4	Category 0	-0.7	Category 0	0.8	Category 1	0.8	Category 1
A02b	R	0.1	Category 0	0.2	Category 0	0.5	Category 0	-0.5	Category 0	0.7	Category 0	0.8	Category 0
A03a	H1	0.1	Category 0	0.3	Category 0	0.6	Category 0	0.6	Category 0	0.8	Category 0	0.8	Category 1
A03b	R	0.1	Category 0	0.3	Category 0	0.7	Category 0	0.7	Category 0	0.7	Category 0	0.7	Category 0
A03c	R	0.1	Category 0	0.3	Category 0	0.7	Category 0	0.7	Category 0	0.7	Category 0	0.7	Category 0
A03d	R	0.1	Category 0	0.3	Category 0	0.7	Category 0	0.7	Category 0	0.7	Category 0	0.7	Category 0
A04a	H1	0.1	Category 0	0.3	Category 0	0.8	Category 1	0.8	Category 1	0.8	Category 1	0.8	Category 1
A05a	H1	0.1	Category 0	0.3	Category 0	1.0	Category 0	-1.0	Category 0	-1.0	Category 0	-1.0	Category 0
A06a	H1	0.1	Category 0	0.3	Category 0	1.0	Category 1	-1.1	Category 1	-1.1	Category 1	-1.1	Category 1
A06b	R	-0.1	Category 0	0.3	Category 0	1.0	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0
A07a	H1	-0.2	Category 0	0.3	Category 0	1.0	Category 1	-1.1	Category 1	-1.1	Category 1	-1.1	Category 1
A08a	H1	0.2	Category 0	0.3	Category 0	1.0	Category 1	1.0	Category 1	1.0	Category 1	1.0	Category 1
A08b	R	0.2	Category 0	0.3	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0
A08c	R	0.2	Category 0	0.3	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0
A08d	R	0.2	Category 0	0.3	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0
A08e	R	0.2	Category 0	0.3	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0
A08f	R	0.2	Category 0	0.4	Category 0	-0.6	Category 0	0.7	Category 0	0.8	Category 0	0.8	Category 0
A09a	H1	0.3	Category 0	0.8	Category 1	0.8	Category 1	0.8	Category 1	0.8	Category 1	0.8	Category 1
A09b	R	0.3	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0
B01a	H2	0.3	Category 1	1.0	Category 2	-1.1	Category 2	-1.1	Category 2	-1.1	Category 2	-1.1	Category 2
B01b	H2	0.3	Category 1	1.0	Category 2	-1.1	Category 2	-1.1	Category 2	-1.1	Category 2	-1.1	Category 2
B01c	H2	0.3	Category 1	1.1	Category 2	-1.1	Category 2	-1.1	Category 2	-1.1	Category 2	-1.1	Category 2
B01d	H2	0.3	Category 1	1.1	Category 2	1.1	Category 2	1.1	Category 2	1.1	Category 2	1.1	Category 2
B01e	H2	0.2	Category 0	0.8	Category 2	0.8	Category 2	0.8	Category 2	0.8	Category 2	0.8	Category 2
B01f	H1	0.3	Category 0	1.1	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0
B01g	H1	0.3	Category 0	1.0	Category 1	1.0	Category 1	1.0	Category 1	1.0	Category 1	1.0	Category 1
B01h	H1	0.3	Category 0	1.0	Category 1	-1.1	Category 1	-1.1	Category 1	-1.1	Category 1	-1.1	Category 1
B01i	H1	0.3	Category 0	1.1	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0
B01j	H1	0.3	Category 0	1.0	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0
B01k	R	0.3	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0
B01l	R	0.3	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0
B01m	R	0.2	Category 0	0.6	Category 0	0.6	Category 0	0.7	Category 0	0.7	Category 0	0.7	Category 0
B01n	R	0.3	Category 0	1.0	Category 0	-1.0	Category 0	-1.0	Category 0	-1.0	Category 0	-1.0	Category 0
B01o	R	0.3	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0
B01p	R	0.3	Category 0	1.0	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0
B01q	R	0.3	Category 0	1.0	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0
B02a	H4	0.2	Category 1	0.4	Category 1	1.2	Category 3	1.2	Category 3	1.2	Category 3	1.2	Category 3
B02b	H3	0.2	Category 0	0.4	Category 0	-0.7	Category 1	0.8	Category 1	0.9	Category 1	0.9	Category 1
B02c	H4	0.3	Category 1	0.9	Category 3	0.9	Category 3	0.9	Category 3	0.9	Category 3	0.9	Category 3
B02d	H3	0.2	Category 0	0.7	Category 1	0.7	Category 1	0.8	Category 1	0.9	Category 1	0.9	Category 1

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Impact Assessment Strain due to LW1 to LW39 (mm/m)	Strain Impact Assessment due to LW1 to LW39	Impact Assessment Strain due to LW1 to LW40 (mm/m)	Strain Impact Assessment due to LW1 to LW40	Impact Assessment Strain due to LW1 to LW41 (mm/m)	Strain Impact Assessment due to LW1 to LW41	Impact Assessment Strain due to LW1 to LW42 (mm/m)	Strain Impact Assessment due to LW1 to LW42	Impact Assessment Strain due to LW1 to LW43 (mm/m)	Strain Impact Assessment due to LW1 to LW43	Impact Assessment Strain due to LW1 to LW44 (mm/m)	Strain Impact Assessment due to LW1 to LW44
B02e	H1	0.2	Category 0	0.4	Category 0	-0.7	Category 1	-0.7	Category 1	0.8	Category 1	0.8	Category 1
B02f	H1	0.2	Category 0	0.3	Category 0	-0.7	Category 1	-0.7	Category 1	-0.7	Category 1	-0.7	Category 1
B02g	H1	0.2	Category 0	0.4	Category 0	-0.7	Category 0	-0.7	Category 0	0.7	Category 0	0.8	Category 0
B02h	H1	0.2	Category 0	0.3	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0
B02i	R	0.2	Category 0	0.4	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0
B02j	R	0.2	Category 0	0.4	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	0.7	Category 0
B03a	H2	0.2	Category 0	0.3	Category 0	1.0	Category 2	1.0	Category 2	1.0	Category 2	1.0	Category 2
B03b	H1	0.2	Category 0	0.3	Category 0	1.1	Category 1	1.1	Category 1	1.1	Category 1	1.1	Category 1
B03c	H1	0.2	Category 0	0.3	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0
B03d	H1	0.2	Category 0	0.3	Category 0	-0.7	Category 1	-0.7	Category 1	-0.7	Category 1	-0.7	Category 1
B03e	H1	0.1	Category 0	0.3	Category 0	1.1	Category 1	1.1	Category 1	1.1	Category 1	1.1	Category 1
B03f	H1	0.1	Category 0	0.3	Category 0	1.0	Category 1	1.0	Category 1	1.0	Category 1	1.0	Category 1
B03g	H1	0.1	Category 0	0.3	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0
B03h	H1	0.1	Category 0	0.3	Category 0	0.9	Category 1	0.9	Category 1	0.9	Category 1	0.9	Category 1
B03i	H1	0.1	Category 0	0.3	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0	0.9	Category 0
B03j	H1	0.1	Category 0	0.3	Category 0	1.0	Category 1	1.0	Category 1	1.0	Category 1	1.0	Category 1
B03k	H1	0.1	Category 0	0.3	Category 0	1.0	Category 1	1.0	Category 1	1.0	Category 1	1.0	Category 1
B03l	H1	0.1	Category 0	0.3	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0	1.0	Category 0
B04a	H1	0.4	Category 0	-0.7	Category 0	0.7	Category 0	0.8	Category 0	0.8	Category 0	0.8	Category 0
B05a	H1	0.4	Category 0	-0.7	Category 0	0.7	Category 0	0.8	Category 0	0.8	Category 0	0.8	Category 0
B06a	H1	0.6	Category 0	0.6	Category 0	0.7	Category 0	0.8	Category 0	0.8	Category 0	0.8	Category 0
B06b	R	0.5	Category 0	-0.5	Category 0	0.7	Category 0	0.8	Category 0	0.8	Category 0	0.8	Category 0
B07a	H1	0.7	Category 0	0.7	Category 0	0.7	Category 0	0.7	Category 0	0.7	Category 0	0.8	Category 0
B08a	H1	1.0	Category 1	1.0	Category 1	1.0	Category 1	1.0	Category 1	1.0	Category 1	1.0	Category 1
B09a	H3	1.2	Category 1	1.2	Category 1	1.2	Category 1	1.2	Category 1	1.2	Category 1	1.2	Category 1
B10a	R	1.0	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0
B10b	R	1.0	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0	-1.1	Category 0
B11a	R	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0
B11b	R	-0.7	Category 0	0.7	Category 0	0.8	Category 0	0.8	Category 0	0.8	Category 0	0.8	Category 0
B11c	R	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0	-0.7	Category 0
B12a	H1	0.7	Category 0	0.7	Category 0	0.8	Category 0	0.8	Category 0	0.8	Category 0	0.8	Category 0
B13a	R	0.8	Category 0	0.8	Category 0	0.8	Category 0	0.8	Category 0	0.8	Category 0	0.8	Category 0
C01a	R	0.6	Category 0	0.6	Category 0	0.6	Category 0	0.6	Category 0	0.6	Category 0	0.6	Category 0
D01a	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.3	Category 0	0.9	Category 0	-1.2	Category 1
E01a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
E01b	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
E01c	R	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
E02a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
E03a	H1	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0	0.1	Category 0
													-

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Tilt Impact Assessment at the Completion of LW1 to LW44 with an Increased Prediction x1.25	Tilt Impact Assessment at the Completion of LW1 to LW44 with an Increased Prediction x1.5	Tilt Impact Assessment at the Completion of LW1 to LW44 with an Increased Prediction x1.75	Tilt Impact Assessment at the Completion of LW1 to LW44 with an Increased Prediction x2.0	Tilt Impact Assessment at the Completion of LW1 to LW44 with an Increased Prediction x5.0	Strain Impact Assessment due to the Extraction of LW1 to LW44 with an Increased Prediction x1.25	Strain Impact Assessment due to the Extraction of LW1 to LW44 with an Increased Prediction x1.5	Strain Impact Assessment due to the Extraction of LW1 to LW44 with an Increased Prediction x1.75	Strain Impact Assessment due to the Extraction of LW1 to LW44 with an Increased Prediction x2.0	Strain Impact Assessment due to the Extraction of LW1 to LW44 with an Increased Prediction x5.0
A01a	H4	Category A	Category A	Category A	Category A	Category B	Category 4	Category 4	Category 5	Category 5	Category 5
A01b	H3	Category A	Category A	Category A	Category A	Category A	Category 1	Category 2	Category 2	Category 2	Category 3
A01c	H3	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
A01d	H3	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
A01e	H4	Category A	Category A	Category A	Category A	Category A	Category 2	Category 2	Category 2	Category 2	Category 4
A01f	H1	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
A01g	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
A01h	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
A01i	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
A01j	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
A01k	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
A01l	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
A01m	H1	Category A	Category A	Category A	Category A	Category A	Category 1	Category 1	Category 1	Category 1	Category 3
A02a	H1	Category A	Category A	Category A	Category A	Category A	Category 1	Category 1	Category 1	Category 2	Category 3
A02b	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
A03a	H1	Category A	Category A	Category A	Category A	Category A	Category 1	Category 1	Category 1	Category 1	Category 3
A03b	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 1	Category 2
A03c	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
A03d	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 0
A04a	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 1	Category 3
A05a	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 1	Category 2
A06a	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 2	Category 3
A06b	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
A07a	H1	Category A	Category A	Category A	Category A	Category B	Category 2	Category 2	Category 2	Category 2	Category 4
A08a	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 2	Category 3
A08b	R	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 1	Category 2
A08c	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
A08d	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 0
A08e	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
A08f	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
A09a	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 2	Category 3
A09b	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 1	Category 1	Category 1	Category 2
B01a	H2	Category A	Category A	Category A	Category A	Category B	Category 3	Category 3	Category 3	Category 3	Category 5
B01b	H2	Category A	Category A	Category A	Category A	Category B	Category 3	Category 3	Category 3	Category 3	Category 5
B01c	H2	Category A	Category A	Category A	Category A	Category B	Category 3	Category 3	Category 3	Category 3	Category 5
B01d	H2	Category A	Category A	Category A	Category A	Category B	Category 3	Category 3	Category 3	Category 3	Category 5
B01e	H2	Category A	Category A	Category A	Category A	Category B	Category 2	Category 2	Category 3	Category 3	Category 4
B01f	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 1	Category 3
B01g	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 2	Category 2	Category 2	Category 3
B01h	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 2	Category 2	Category 2	Category 3
B01i	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 1	Category 3
B01j	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 1	Category 3
B01k	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
B01l	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
B01m	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 0
B01n	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 1	Category 2
B01o	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
B01p	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 1	Category 1	Category 2
B01q	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
B02a	H4	Category A	Category A	Category A	Category A	Category B	Category 3	Category 3	Category 4	Category 4	Category 5
B02b	H3	Category A	Category A	Category A	Category A	Category B	Category 2	Category 2	Category 2	Category 2	Category 4
B02c	H4	Category A	Category A	Category A	Category A	Category B	Category 3	Category 3	Category 4	Category 4	Category 5
B02d	H3	Category A	Category A	Category A	Category A	Category A	Category 2	Category 2	Category 2	Category 2	Category 4

Table D.02 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Building Structures within the Study Area

Structure Name	Structure Type	Tilt Impact Assessment at the Completion of LW1 to LW44 with an Increased Prediction x1.25	Tilt Impact Assessment at the Completion of LW1 to LW44 with an Increased Prediction x1.5	Tilt Impact Assessment at the Completion of LW1 to LW44 with an Increased Prediction x1.75	Tilt Impact Assessment at the Completion of LW1 to LW44 with an Increased Prediction x2.0	Tilt Impact Assessment at the Completion of LW1 to LW44 with an Increased Prediction x5.0	Strain Impact Assessment due to the Extraction of LW1 to LW44 with an Increased Prediction x1.25	Strain Impact Assessment due to the Extraction of LW1 to LW44 with an Increased Prediction x1.5	Strain Impact Assessment due to the Extraction of LW1 to LW44 with an Increased Prediction x1.75	Strain Impact Assessment due to the Extraction of LW1 to LW44 with an Increased Prediction x2.0	Strain Impact Assessment due to the Extraction of LW1 to LW44 with an Increased Prediction x5.0
B02e	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 2	Category 2	Category 3
B02f	H1	Category A	Category A	Category A	Category A	Category A	Category 1	Category 1	Category 1	Category 2	Category 3
B02g	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 1	Category 2
B02h	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
B02i	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
B02j	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
B03a	H2	Category A	Category A	Category A	Category A	Category B	Category 2	Category 3	Category 3	Category 3	Category 5
B03b	H1	Category A	Category A	Category A	Category A	Category A	Category 2	Category 2	Category 2	Category 2	Category 4
B03c	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 1	Category 1	Category 2
B03d	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 2	Category 3
B03e	H1	Category A	Category A	Category A	Category A	Category B	Category 2	Category 2	Category 2	Category 2	Category 4
B03f	H1	Category A	Category A	Category A	Category A	Category B	Category 2	Category 2	Category 2	Category 2	Category 4
B03g	H1	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 1	Category 1	Category 2
B03h	H1	Category A	Category A	Category A	Category A	Category B	Category 2	Category 2	Category 2	Category 2	Category 4
B03i	H1	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
B03j	H1	Category A	Category A	Category A	Category A	Category D	Category 1	Category 1	Category 1	Category 1	Category 3
B03k	H1	Category A	Category A	Category A	Category A	Category C	Category 1	Category 1	Category 1	Category 2	Category 3
B03l	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 1	Category 2
B04a	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 1	Category 2
B05a	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 1	Category 2
B06a	H1	Category A	Category A	Category A	Category A	Category A	Category 1	Category 1	Category 1	Category 1	Category 2
B06b	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
B07a	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 1	Category 1	Category 1	Category 2
B08a	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 1	Category 3
B09a	H3	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 2	Category 2	Category 3
B10a	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 2
B10b	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
B11a	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
B11b	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 1
B11c	R	Category A	Category A	Category A	Category A	Category B	Category 0	Category 0	Category 0	Category 0	Category 0
B12a	H1	Category A	Category A	Category A	Category A	Category B	Category 1	Category 1	Category 1	Category 1	Category 2
B13a	R	Category B	Category C	Category C	Category D	Category D	Category 0	Category 0	Category 0	Category 0	Category 1
C01a	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 1
D01a	R	Category A	Category A	Category A	Category B	Category D	Category 1	Category 1	Category 1	Category 1	Category 3
E01a	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 0
E01b	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 0
E01c	R	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 0
E02a	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 0
E03a	H1	Category A	Category A	Category A	Category A	Category A	Category 0	Category 0	Category 0	Category 0	Category 0

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Subsidence after LW20	Total Predicted Subsidence after LW21	Total Predicted Subsidence after LW22	Total Predicted Subsidence after LW23	Total Predicted Subsidence after LW24	Total Predicted Subsidence after LW25	Total Predicted Subsidence after LW26	Total Predicted Subsidence after LW27	Total Predicted Subsidence after LW28	Total Predicted Subsidence after LW29	Total Predicted Subsidence after LW30
S01	1	7	12	14	15	15	15	15	15	15	15	15
S04	4	458	460	460	460	460	460	460	460	460	460	460
S14	14	1	11	44	123	151	162	166	167	168	168	168
S16	15	10	665	953	1077	1105	1111	1112	1112	1112	1112	1112
S17	16	8	435	856	1018	1056	1064	1066	1066	1066	1066	1066
S18	17	7	330	792	970	1027	1047	1052	1052	1052	1052	1052
S20	18	15	839	1045	1152	1180	1181	1181	1181	1181	1181	1181
S21	19	1432	1432	1432	1432	1432	1432	1432	1432	1432	1432	1432
S22	20	371	380	382	382	382	382	382	382	382	382	382
S95	21	0	0	1	7	16	17	18	19	19	19	19
S27	22	0	2	7	39	161	213	236	244	246	246	246
S23	23	0	21	109	803	1041	1151	1189	1202	1202	1202	1202
S24	24	4	152	648	911	1026	1057	1065	1067	1067	1067	1067
S25	25	8	485	815	995	1146	1191	1202	1205	1205	1205	1205
S26	26	0	31	142	890	1144	1174	1177	1177	1177	1177	1177
S19	27	0	11	44	342	998	1042	1051	1053	1053	1053	1053
S28	28	0	4	18	78	591	728	757	762	762	762	762
S29	29	0	0	7	35	213	478	534	545	546	546	546
S30	30	0	0	0	2	22	63	326	402	418	421	422
S31	31	0	0	2	17	77	513	660	698	711	713	714
S32	32	0	0	9	48	286	916	1006	1030	1031	1032	1032
S33	33	0	0	5	37	242	908	1114	1179	1181	1181	1181
S34	34	0	0	0	0	13	57	290	453	503	516	519
S35	35	0	0	0	0	11	48	239	606	666	680	683
S36	36	0	0	0	0	0	7	22	113	371	430	444
S37	37	0	0	0	0	0	0	0	4	19	48	58
S38	38	0	0	0	0	0	0	0	0	0	1	7
S39	39	0	0	0	0	0	0	0	0	0	0	0
S40	40	0	0	0	0	0	0	0	0	0	0	3
S41	41	0	0	0	0	0	0	0	0	0	0	0
S42	42	0	0	0	0	0	0	0	0	0	0	0
S43	43	0	0	0	0	0	0	0	0	0	0	0
S44	44	0	0	0	0	0	0	0	0	0	0	0
S45	45	0	0	0	0	0	0	0	0	0	0	0
S46	46	0	0	0	0	0	0	0	0	0	0	0
S47	47	0	0	0	0	0	0	0	0	0	0	0
S48	48	0	0	0	0	0	0	0	0	0	0	0
S49	49	0	0	0	0	0	0	0	0	0	0	0
S50	50	0	0	0	0	0	0	0	0	0	0	0
S51	51	0	0	0	0	0	0	0	0	0	0	0
S52	52	0	0	0	0	0	0	0	0	0	0	0
S53	53	0	0	0	0	0	0	0	0	0	0	0
S54	54	0	0	0	0	0	0	0	0	0	0	0
S55	55	0	0	0	0	0	0	0	0	0	0	0
S56	56	0	0	0	0	0	0	0	0	0	0	0
S57	57	0	0	0	0	0	0	0	0	0	0	0
S58	58	0	0	0	0	0	0	0	0	0	0	0

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Subsidence after LW20	Total Predicted Subsidence after LW21	Total Predicted Subsidence after LW22	Total Predicted Subsidence after LW23	Total Predicted Subsidence after LW24	Total Predicted Subsidence after LW25	Total Predicted Subsidence after LW26	Total Predicted Subsidence after LW27	Total Predicted Subsidence after LW28	Total Predicted Subsidence after LW29	Total Predicted Subsidence after LW30
S59	59	0	0	0	0	0	0	0	0	0	0	0
S60	60	0	0	0	0	0	0	0	0	0	0	0
S61	61	0	0	0	0	0	0	0	0	0	0	0
S62	62	0	0	0	0	0	0	0	0	0	0	0
S63	63	0	0	0	0	0	0	0	0	0	0	0
S64	64	0	0	0	0	0	0	0	0	0	0	0
S65	65	0	0	0	0	0	0	0	0	0	0	0
S66	66	0	0	0	0	0	0	0	0	0	0	0
S67	67	0	0	0	0	0	0	0	0	0	0	0
S68	68	0	0	0	0	0	0	0	0	0	0	0
S69	69	0	0	0	0	0	0	0	0	0	0	0
S70	70	0	0	0	0	0	0	0	0	0	0	0
S71	71	0	0	0	0	0	0	0	0	0	0	0
S72	72	0	0	0	0	0	0	0	0	0	0	0
S73	73	0	0	0	0	0	0	0	0	0	0	0
S74	74	0	0	0	0	0	0	0	0	0	0	0
S75	75	0	0	0	0	0	0	0	0	0	0	0
S76	76	0	0	0	0	0	0	0	0	3	24	107
S77	77	0	0	0	0	0	0	5	30	138	688	914
S78	78	0	0	0	0	0	0	0	0	0	3	20
S79	79	0	0	0	0	0	0	0	0	2	15	70
S80	80	0	0	0	0	0	0	0	0	0	3	20
S81	81	0	0	0	0	0	0	0	0	0	1	11
S82	82	0	0	0	0	0	0	0	0	0	0	5
S83	83	0	0	0	0	0	0	0	0	0	0	0
S84	84	0	0	0	0	0	0	0	0	0	0	0
S85	85	0	0	0	0	0	0	0	0	0	0	5
S86	86	0	0	0	0	0	0	0	0	0	3	21
S87	87	0	0	0	0	0	0	0	0	0	3	18
S88	88	0	0	0	0	0	0	3	12	58	306	368
S89	89	0	0	0	0	0	0	1	4	18	141	316
S90	90	0	0	0	0	0	0	0	2	14	66	435
S91	91	0	0	0	0	0	0	7	39	192	771	962
S92	92	0	0	2	19	68	364	948	1103	1148	1160	1163
S93	93	0	0	14	65	329	936	1105	1154	1166	1168	1168
S94	94	0	0	9	60	354	970	1141	1190	1202	1204	1204
S96	96	1	14	49	337	520	580	597	603	604	604	604
S97	97	0	15	55	389	784	914	952	963	966	966	966
S98	98	0	21	76	546	916	1050	1095	1108	1111	1111	1111
S99	99	0	6	25	124	541	701	756	773	777	778	778
S100	100	0	0	0	1	6	14	18	19	20	21	21
S101	101	0	0	0	0	1	3	14	27	38	43	45
S102	102	0	0	3	20	74	452	929	1076	1119	1130	1132
S103	103	0	0	0	4	15	68	387	594	669	691	697
S104	104	0	0	0	1	4	16	93	281	352	378	386
S105	105	0	0	0	0	3	21	100	554	781	881	910
S106	106	0	0	0	0	8	45	258	857	1032	1084	1097

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Subsidence after LW20	Total Predicted Subsidence after LW21	Total Predicted Subsidence after LW22	Total Predicted Subsidence after LW23	Total Predicted Subsidence after LW24	Total Predicted Subsidence after LW25	Total Predicted Subsidence after LW26	Total Predicted Subsidence after LW27	Total Predicted Subsidence after LW28	Total Predicted Subsidence after LW29	Total Predicted Subsidence after LW30
S107	107	0	0	0	0	1	16	79	514	913	1047	1088
S108	108	0	0	0	0	0	9	49	263	854	1023	1073
S109	109	0	0	0	0	0	0	1	5	26	82	107
S110	110	0	0	0	0	0	0	0	0	2	9	13
S111	111	0	0	0	0	0	0	0	0	1	6	13
S112	112	0	0	0	0	0	0	0	1	3	13	22
S113	113	0	0	0	0	0	0	0	9	48	285	851
S114	114	0	0	0	0	0	0	0	11	58	356	877
S115	115	0	0	0	0	0	0	0	2	18	84	537
S116	116	0	0	0	0	0	0	0	0	2	11	64
S117	117	0	0	0	0	0	0	0	0	4	21	122
S118	118	0	0	0	0	0	0	0	0	0	3	12
S119	119	0	0	0	0	0	0	0	0	0	4	22
S120	120	0	0	0	0	0	0	0	0	0	0	0
S121	121	0	0	0	0	0	0	0	0	0	0	0
S122	122	0	0	0	0	0	0	0	0	0	0	0
S123	123	0	0	0	0	0	0	0	0	0	0	0
S124	124	0	0	0	0	0	0	0	0	0	0	0
S125	125	0	0	0	0	0	0	0	0	0	0	0
S126	126	0	0	0	0	0	0	0	0	0	0	0
S127	127	0	0	0	0	0	0	0	0	0	0	0
S128	128	0	0	0	0	0	0	0	0	0	0	0
S129	129	0	0	0	0	0	0	0	0	0	0	0
S130	130	0	0	0	0	0	0	0	0	0	0	0
S131	131	0	0	0	0	0	0	0	0	0	0	0
S132	132	0	0	0	0	0	0	0	0	0	0	0
S133	133	0	0	0	0	0	0	0	0	0	0	0
S134	134	0	0	0	0	0	0	0	0	0	0	0

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Subsidence after LW31	Total Predicted Subsidence after LW32	Total Predicted Subsidence after LW33	Total Predicted Subsidence after LW34	Total Predicted Subsidence after LW35	Total Predicted Subsidence after LW36	Total Predicted Subsidence after LW37	Total Predicted Subsidence after LW38	Total Predicted Subsidence after LW39	Total Predicted Subsidence after LW40	Total Predicted Subsidence after LW41	Total Predicted Subsidence after LW42	Total Predicted Subsidence after LW43	Total Predicted Subsidence after LW44
S01	1	15	15	15	15	15	15	15	15	15	15	15	15	15	15
S04	4	460	460	460	460	460	460	460	460	460	460	460	460	460	460
S14	14	168	168	168	168	168	168	168	168	168	168	168	168	168	168
S16	15	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112
S17	16	1066	1066	1066	1066	1066	1066	1066	1066	1066	1066	1066	1066	1066	1066
S18	17	1052	1052	1052	1052	1052	1052	1052	1052	1052	1052	1052	1052	1052	1052
S20	18	1181	1181	1181	1181	1181	1181	1181	1181	1181	1181	1181	1181	1181	1181
S21	19	1432	1432	1432	1432	1432	1432	1432	1432	1432	1432	1432	1432	1432	1432
S22	20	382	382	382	382	382	382	382	382	382	382	382	382	382	382
S95	21	19	19	19	19	19	19	19	19	19	19	19	19	19	19
S27	22	246	246	246	246	246	246	246	246	246	246	246	246	246	246
S23	23	1202	1202	1202	1202	1202	1202	1202	1202	1202	1202	1202	1202	1202	1202
S24	24	1067	1067	1067	1067	1067	1067	1067	1067	1067	1067	1067	1067	1067	1067
S25	25	1205	1205	1205	1205	1205	1205	1205	1205	1205	1205	1205	1205	1205	1205
S26	26	1177	1177	1177	1177	1177	1177	1177	1177	1177	1177	1177	1177	1177	1177
S19	27	1053	1053	1053	1053	1053	1053	1053	1053	1053	1053	1053	1053	1053	1053
S28	28	762	762	762	762	762	762	762	762	762	762	762	762	762	762
S29	29	546	546	546	546	546	546	546	546	546	546	546	546	546	546
S30	30	422	422	422	422	422	422	422	422	422	422	422	422	422	422
S31	31	714	714	714	714	714	714	714	714	714	714	714	714	714	714
S32	32	1032	1032	1032	1032	1032	1032	1032	1032	1032	1032	1032	1032	1032	1032
S33	33	1181	1181	1181	1181	1181	1181	1181	1181	1181	1181	1181	1181	1181	1181
S34	34	519	519	519	519	519	519	519	519	519	519	519	519	519	519
S35	35	683	683	683	683	683	683	683	683	683	683	683	683	683	683
S36	36	446	446	446	446	446	446	446	446	446	446	446	446	446	446
S37	37	60	61	61	61	61	61	61	61	61	61	61	61	61	61
S38	38	44	134	149	165	169	170	170	170	170	170	170	170	170	170
S39	39	0	0	2	15	32	37	39	39	40	40	40	40	40	40
S40	40	17	141	352	527	575	586	592	593	593	593	593	593	593	593
S41	41	0	8	49	645	911	1003	1028	1034	1035	1035	1035	1035	1035	1035
S42	42	0	0	0	1	4	12	27	32	33	33	33	33	33	33
S43	43	0	0	2	23	101	390	486	512	520	522	523	523	523	523
S44	44	0	0	0	10	40	159	530	625	651	658	660	661	661	661
S45	45	0	0	2	23	104	415	638	709	728	733	734	735	735	735
S46	46	0	4	22	250	853	986	1021	1032	1035	1035	1035	1035	1035	1035
S47	47	0	1	9	51	380	471	494	503	513	516	517	517	517	517
S48	48	0	9	50	310	388	405	407	407	408	408	408	408	408	408
S49	49	0	3	13	81	347	409	424	437	443	446	446	446	446	446
S50	50	0	0	0	0	9	60	344	424	504	550	564	568	569	569
S51	51	0	0	0	1	14	81	373	454	517	560	575	581	582	582
S52	52	0	0	0	1	11	68	358	433	502	553	569	574	575	575
S53	53	0	0	0	1	12	46	315	731	887	940	955	959	960	960
S54	54	0	0	0	0	0	0	2	5	15	36	42	44	44	44
S55	55	0	0	0	0	0	0	1	2	5	14	19	21	21	21
S56	56	0	0	0	0	0	0	1	2	6	21	36	40	42	42
S57	57	0	0	0	0	0	0	5	34	453	936	1091	1148	1165	1169
S58	58	0	0	0	0	0	0	5	31	371	830	985	1040	1056	1060

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Subsidence after LW31	Total Predicted Subsidence after LW32	Total Predicted Subsidence after LW33	Total Predicted Subsidence after LW34	Total Predicted Subsidence after LW35	Total Predicted Subsidence after LW36	Total Predicted Subsidence after LW37	Total Predicted Subsidence after LW38	Total Predicted Subsidence after LW39	Total Predicted Subsidence after LW40	Total Predicted Subsidence after LW41	Total Predicted Subsidence after LW42	Total Predicted Subsidence after LW43	Total Predicted Subsidence after LW44
S59	59	0	0	0	0	0	0	0	0	0	1	13	60	371	1014
S60	60	0	0	0	0	0	0	0	0	0	0	6	36	170	820
S61	61	0	0	0	0	0	0	0	0	0	1	6	34	276	422
S62	62	0	0	0	0	0	0	0	0	2	15	87	356	419	442
S63	63	0	0	0	0	0	0	0	0	1	6	35	388	640	773
S64	64	0	0	0	0	0	0	0	0	3	18	142	719	883	942
S65	65	0	0	0	0	0	0	0	0	1	6	51	549	904	1055
S66	66	0	0	0	0	0	0	0	0	0	5	48	510	915	1067
S67	67	0	0	0	0	0	0	0	0	0	5	66	513	957	1111
S68	68	0	0	0	0	0	0	0	0	1	9	96	653	951	1099
S69	69	0	0	0	0	0	0	0	1	12	120	749	986	1082	1131
S70	70	0	0	0	0	0	0	0	0	6	70	564	968	1120	1172
S71	71	0	0	0	0	0	0	1	7	40	292	496	645	693	707
S72	72	0	0	0	0	0	0	0	5	28	227	388	526	569	582
S73	73	0	0	0	0	0	0	0	5	26	213	362	484	521	535
S74	74	0	0	2	12	53	369	453	498	508	510	510	510	510	510
S75	75	0	0	6	29	135	665	728	754	766	769	769	769	769	769
S76	76	612	885	1016	1060	1072	1078	1080	1082	1082	1084	1084	1084	1084	1084
S77	77	1014	1055	1066	1069	1074	1078	1081	1081	1081	1081	1081	1081	1081	1081
S78	78	87	553	897	1038	1062	1065	1068	1068	1068	1068	1068	1068	1068	1068
S79	79	456	803	939	988	992	992	992	992	992	992	992	992	992	992
S80	80	93	551	807	934	937	938	938	938	938	938	938	938	938	938
S81	81	68	351	459	519	526	529	530	530	530	530	530	530	530	530
S82	82	28	242	348	402	415	419	420	420	420	420	420	420	420	420
S83	83	1	10	62	475	582	627	640	643	643	643	643	643	643	643
S84	84	0	0	7	42	285	362	380	382	382	382	382	382	382	382
S85	85	30	243	333	362	373	376	376	376	376	376	376	376	376	376
S86	86	191	305	360	374	376	377	377	377	377	377	377	377	377	377
S87	87	176	297	344	354	356	356	356	356	356	356	356	356	356	356
S88	88	379	382	382	382	382	382	382	382	382	382	382	382	382	382
S89	89	371	384	389	392	393	393	393	393	393	393	393	393	393	393
S90	90	727	834	878	890	890	890	890	890	890	890	890	890	890	890
S91	91	1023	1039	1042	1042	1042	1042	1042	1042	1042	1042	1042	1042	1042	1042
S92	92	1163	1163	1163	1163	1163	1163	1163	1163	1163	1163	1163	1163	1163	1163
S93	93	1168	1168	1168	1168	1168	1168	1168	1168	1168	1168	1168	1168	1168	1168
S94	94	1204	1204	1204	1204	1204	1204	1204	1204	1204	1204	1204	1204	1204	1204
S96	96	604	604	604	604	604	604	604	604	604	604	604	604	604	604
S97	97	966	966	966	966	966	966	966	966	966	966	966	966	966	966
S98	98	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111
S99	99	778	778	778	778	778	778	778	778	778	778	778	778	778	778
S100	100	21	21	21	21	21	21	21	21	21	21	21	21	21	21
S101	101	46	47	47	47	47	47	47	47	47	47	47	47	47	47
S102	102	1132	1132	1132	1132	1132	1132	1132	1132	1132	1132	1132	1132	1132	1132
S103	103	698	698	698	698	698	698	698	698	698	698	698	698	698	698
S104	104	387	387	387	387	387	387	387	387	387	387	387	387	387	387
S105	105	917	918	918	918	918	918	918	918	918	918	918	918	918	918
S106	106	1099	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Subsidence after LW31	Total Predicted Subsidence after LW32	Total Predicted Subsidence after LW33	Total Predicted Subsidence after LW34	Total Predicted Subsidence after LW35	Total Predicted Subsidence after LW36	Total Predicted Subsidence after LW37	Total Predicted Subsidence after LW38	Total Predicted Subsidence after LW39	Total Predicted Subsidence after LW40	Total Predicted Subsidence after LW41	Total Predicted Subsidence after LW42	Total Predicted Subsidence after LW43	Total Predicted Subsidence after LW44
S107	107	1099	1101	1101	1101	1101	1101	1101	1101	1101	1101	1101	1101	1101	1101
S108	108	1086	1089	1089	1089	1089	1089	1089	1089	1089	1089	1089	1089	1089	1089
S109	109	119	123	124	124	124	124	124	124	124	124	124	124	124	124
S110	110	15	16	16	16	16	16	16	16	16	16	16	16	16	16
S111	111	16	17	18	18	18	18	18	18	18	18	18	18	18	18
S112	112	26	28	29	29	29	29	29	29	29	29	29	29	29	29
S113	113	1012	1060	1073	1075	1075	1075	1075	1075	1075	1075	1075	1075	1075	1075
S114	114	1021	1064	1075	1078	1078	1078	1078	1078	1078	1078	1078	1078	1078	1078
S115	115	884	1017	1060	1071	1074	1074	1074	1074	1074	1074	1074	1074	1074	1074
S116	116	311	417	455	466	469	469	469	469	469	469	469	469	469	469
S117	117	571	749	826	855	863	865	865	865	865	865	865	865	865	865
S118	118	80	314	405	435	444	447	447	447	447	447	447	447	447	447
S119	119	142	569	872	1007	1047	1057	1057	1057	1057	1057	1057	1057	1057	1057
S120	120	1	3	13	60	93	108	109	110	110	110	110	110	110	110
S121	121	1	4	16	96	183	219	224	225	225	225	225	225	225	225
S122	122	0	0	1	3	14	33	36	37	37	37	37	37	37	37
S123	123	0	0	0	1	7	22	25	25	26	26	26	26	26	26
S124	124	0	0	0	1	2	10	11	12	13	13	13	13	13	13
S125	125	0	0	0	0	0	0	1	4	8	9	10	10	10	10
S126	126	0	0	0	0	0	0	0	2	7	10	12	12	12	12
S127	127	0	0	0	0	0	1	2	11	24	29	31	32	32	32
S128	128	0	0	0	0	1	9	23	174	292	348	361	363	363	363
S129	129	0	0	0	0	1	4	8	45	74	86	88	89	89	89
S130	130	0	0	0	0	5	29	78	324	386	402	405	406	406	406
S131	131	0	0	0	0	0	0	0	2	8	36	51	56	57	58
S132	132	0	0	0	0	0	0	0	1	6	66	155	185	191	193
S133	133	0	0	0	0	0	0	0	0	0	0	0	0	1	21
S134	134	0	0	0	0	0	0	0	0	0	0	0	4	22	114

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Tilt after LW20	Total Predicted Tilt after LW21	Total Predicted Tilt after LW22	Total Predicted Tilt after LW23	Total Predicted Tilt after LW24	Total Predicted Tilt after LW25	Total Predicted Tilt after LW26	Total Predicted Tilt after LW27	Total Predicted Tilt after LW28	Total Predicted Tilt after LW29	Total Predicted Tilt after LW30
S01	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S04	4	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
S14	14	0.0	0.1	0.5	1.1	1.3	1.4	1.4	1.4	1.5	1.5	1.5
S16	15	0.1	6.3	3.1	2.1	1.8	1.8	1.7	1.7	1.7	1.7	1.7
S17	16	0.0	6.0	3.0	2.0	1.8	1.7	1.7	1.7	1.7	1.7	1.7
S18	17	0.0	4.9	2.6	1.5	1.2	1.3	1.4	1.4	1.4	1.4	1.4
S20	18	0.2	7.2	3.7	2.7	2.4	2.4	2.4	2.4	2.4	2.4	2.4
S21	19	8.0	8.0	8.0	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
S22	20	4.6	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
S95	21	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
S27	22	0.0	0.0	0.1	0.6	2.3	2.8	3.0	3.1	3.1	3.1	3.1
S23	23	0.0	0.1	1.2	6.0	3.2	3.7	3.9	3.9	3.9	3.9	3.9
S24	24	0.0	1.7	2.5	1.0	1.7	1.9	2.0	2.0	2.0	2.0	2.0
S25	25	0.0	5.1	3.8	1.4	1.9	2.2	2.2	2.2	2.2	2.2	2.2
S26	26	0.0	0.2	1.3	5.4	2.2	1.7	1.6	1.6	1.5	1.5	1.5
S19	27	0.0	0.1	0.3	4.4	2.7	2.3	2.1	2.1	2.1	2.1	2.1
S28	28	0.0	0.1	0.2	0.7	5.3	4.1	3.9	3.8	3.8	3.8	3.8
S29	29	0.0	0.0	0.1	0.3	2.5	2.5	1.4	1.3	1.3	1.3	1.3
S30	30	0.0	0.0	0.0	0.1	0.3	0.7	2.2	0.9	0.9	0.9	1.0
S31	31	0.0	0.0	0.0	0.1	0.7	4.4	2.9	2.5	2.5	2.5	2.5
S32	32	0.0	0.0	0.1	0.4	3.2	4.5	2.7	2.5	2.5	2.4	2.4
S33	33	0.0	0.0	0.1	0.3	2.9	5.5	2.0	1.1	1.1	1.1	1.1
S34	34	0.0	0.0	0.0	0.0	0.1	0.5	2.8	1.3	1.1	1.2	1.2
S35	35	0.0	0.0	0.0	0.0	0.1	0.4	2.9	3.3	2.0	2.0	2.0
S36	36	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.3	2.2	1.3	1.0
S37	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.6	0.6
S38	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
S39	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S40	40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S41	41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S42	42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S43	43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S44	44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S45	45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S46	46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S47	47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S48	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S49	49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S50	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S51	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S52	52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S53	53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S54	54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S55	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S56	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S57	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S58	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Tilt after LW20	Total Predicted Tilt after LW21	Total Predicted Tilt after LW22	Total Predicted Tilt after LW23	Total Predicted Tilt after LW24	Total Predicted Tilt after LW25	Total Predicted Tilt after LW26	Total Predicted Tilt after LW27	Total Predicted Tilt after LW28	Total Predicted Tilt after LW29	Total Predicted Tilt after LW30
S59	59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S60	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S61	61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S62	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S63	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S64	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S65	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S66	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S67	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S68	68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S69	69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S70	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S71	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S72	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S73	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S74	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S75	75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S76	76	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9
S77	77	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.2	4.0	3.9
S78	78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
S79	79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5
S80	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
S81	81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
S82	82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S83	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S84	84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S85	85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S86	86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
S87	87	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
S88	88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	2.0	0.8
S89	89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.9	2.0
S90	90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.5	3.4
S91	91	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.9	3.0	1.5
S92	92	0.0	0.0	0.0	0.1	0.5	3.9	4.3	4.2	4.0	3.9	2.4
S93	93	0.0	0.0	0.1	0.4	3.7	4.2	1.7	1.3	1.2	1.2	1.2
S94	94	0.0	0.0	0.1	0.4	3.9	4.3	4.3	1.6	1.3	1.2	1.1
S96	96	0.0	0.2	0.6	3.6	4.8	5.4	5.6	5.6	5.6	5.6	5.6
S97	97	0.0	0.1	0.4	3.7	4.4	5.1	5.3	5.3	5.4	5.4	5.4
S98	98	0.0	0.1	0.5	4.2	3.2	3.2	3.3	3.3	3.3	3.3	3.3
S99	99	0.0	0.1	0.2	1.5	4.2	5.1	5.4	5.5	5.5	5.5	5.5
S100	100	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2
S101	101	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.4
S102	102	0.0	0.0	0.0	0.1	0.5	4.1	3.0	3.0	3.0	3.0	3.0
S103	103	0.0	0.0	0.0	0.0	0.2	0.9	3.6	4.5	4.9	5.0	5.1
S104	104	0.0	0.0	0.0	0.0	0.1	0.2	1.4	3.2	4.0	4.2	4.2
S105	105	0.0	0.0	0.0	0.0	0.0	0.2	1.0	3.5	4.3	4.6	4.8
S106	106	0.0	0.0	0.0	0.0	0.1	0.3	2.9	4.1	4.1	4.8	4.9

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Tilt after LW20	Total Predicted Tilt after LW21	Total Predicted Tilt after LW22	Total Predicted Tilt after LW23	Total Predicted Tilt after LW24	Total Predicted Tilt after LW25	Total Predicted Tilt after LW26	Total Predicted Tilt after LW27	Total Predicted Tilt after LW28	Total Predicted Tilt after LW29	Total Predicted Tilt after LW30
S107	107	0.0	0.0	0.0	0.0	0.0	0.1	0.6	4.1	3.8	1.6	1.2
S108	108	0.0	0.0	0.0	0.0	0.0	0.1	0.3	2.9	2.5	1.6	1.2
S109	109	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.7	0.9
S110	110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
S111	111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
S112	112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
S113	113	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	3.2	3.2
S114	114	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	3.8	2.4
S115	115	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.7	3.9
S116	116	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0
S117	117	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.4
S118	118	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
S119	119	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
S120	120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S121	121	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S122	122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S123	123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S124	124	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S125	125	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S126	126	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S127	127	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S128	128	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S129	129	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S130	130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S131	131	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S132	132	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S133	133	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S134	134	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Tilt after LW31	Total Predicted Tilt after LW32	Total Predicted Tilt after LW33	Total Predicted Tilt after LW34	Total Predicted Tilt after LW35	Total Predicted Tilt after LW36	Total Predicted Tilt after LW37	Total Predicted Tilt after LW38	Total Predicted Tilt after LW39	Total Predicted Tilt after LW40	Total Predicted Tilt after LW41	Total Predicted Tilt after LW42	Total Predicted Tilt after LW43	Total Predicted Tilt after LW44
S01	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S04	4	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
S14	14	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
S16	15	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
S17	16	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
S18	17	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
S20	18	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
S21	19	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
S22	20	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
S95	21	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
S27	22	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
S23	23	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
S24	24	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
S25	25	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
S26	26	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
S19	27	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
S28	28	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
S29	29	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
S30	30	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S31	31	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
S32	32	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
S33	33	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
S34	34	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
S35	35	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
S36	36	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S37	37	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
S38	38	0.7	1.6	1.8	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
S39	39	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
S40	40	0.1	1.8	2.1	1.2	1.8	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1
S41	41	0.0	0.1	0.5	3.6	4.1	4.6	4.7	4.8	4.8	4.8	4.8	4.8	4.8	4.8
S42	42	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
S43	43	0.0	0.0	0.0	0.1	1.1	3.7	4.5	4.8	4.8	4.8	4.8	4.8	4.8	4.8
S44	44	0.0	0.0	0.0	0.1	0.3	1.7	4.2	4.9	5.1	5.1	5.2	5.2	5.2	5.2
S45	45	0.0	0.0	0.0	0.1	1.1	3.7	4.5	5.0	5.2	5.2	5.2	5.2	5.2	5.2
S46	46	0.0	0.0	0.2	2.9	3.6	1.9	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5
S47	47	0.0	0.0	0.1	0.5	2.5	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.3
S48	48	0.0	0.1	0.5	2.1	0.8	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S49	49	0.0	0.0	0.1	1.0	2.2	1.3	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1
S50	50	0.0	0.0	0.0	0.0	0.1	0.6	2.2	1.1	-0.1	-0.5	-0.6	-0.5	-0.5	-0.5
S51	51	0.0	0.0	0.0	0.0	0.1	0.9	2.3	1.1	-0.1	-0.5	-0.6	-0.6	-0.6	-0.6
S52	52	0.0	0.0	0.0	0.0	0.1	0.7	2.2	1.1	0.1	-0.3	-0.4	-0.4	-0.4	-0.4
S53	53	0.0	0.0	0.0	0.0	0.1	0.4	3.0	2.1	0.6	0.6	0.6	0.6	0.6	0.6
S54	54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.4	0.4	0.4	0.4
S55	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2
S56	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.4	0.4
S57	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.9	2.8	1.2	0.8	0.6	0.6
S58	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.1	1.4	0.4	0.0	-0.1	-0.1

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Tilt after LW31	Total Predicted Tilt after LW32	Total Predicted Tilt after LW33	Total Predicted Tilt after LW34	Total Predicted Tilt after LW35	Total Predicted Tilt after LW36	Total Predicted Tilt after LW37	Total Predicted Tilt after LW38	Total Predicted Tilt after LW39	Total Predicted Tilt after LW40	Total Predicted Tilt after LW41	Total Predicted Tilt after LW42	Total Predicted Tilt after LW43	Total Predicted Tilt after LW44
S59	59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	4.2	4.8
S60	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.5	4.5
S61	61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	2.3	0.8
S62	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	2.2	0.9	0.7
S63	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	3.0	1.5	0.7
S64	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.9	1.4	0.5	0.2
S65	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	3.9	1.4	0.6
S66	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	3.9	1.4	0.7
S67	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	4.1	2.5	1.6
S68	68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8	4.1	0.7	0.8
S69	69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.2	3.9	2.3	1.3	0.9
S70	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	4.2	2.6	1.6	1.2
S71	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	2.2	2.2	0.6	-0.3	-0.7
S72	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.1	1.1	-0.1	-0.4	-0.5
S73	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.1	1.0	0.2	0.0	-0.2
S74	74	0.0	0.0	0.0	0.1	0.5	3.2	3.3	3.3	3.4	3.4	3.4	3.4	3.4	3.4
S75	75	0.0	0.0	0.0	0.2	1.2	3.9	4.0	3.1	3.2	3.2	3.2	3.2	3.2	3.2
S76	76	3.9	3.9	4.0	4.0	4.1	4.0	3.6	3.0	3.0	3.0	3.0	3.0	3.0	3.0
S77	77	3.9	3.9	4.0	3.2	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
S78	78	0.7	4.0	4.0	4.2	3.3	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.2
S79	79	3.7	3.2	1.2	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
S80	80	0.8	3.5	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
S81	81	0.7	2.2	0.8	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
S82	82	0.2	2.0	1.1	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
S83	83	0.0	0.1	0.5	3.9	2.6	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
S84	84	0.0	0.0	0.1	0.4	2.1	0.9	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S85	85	0.3	1.9	0.6	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S86	86	1.9	1.0	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
S87	87	1.8	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
S88	88	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S89	89	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S90	90	1.9	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S91	91	1.1	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
S92	92	1.5	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
S93	93	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
S94	94	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
S96	96	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
S97	97	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
S98	98	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
S99	99	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
S100	100	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
S101	101	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
S102	102	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
S103	103	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
S104	104	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
S105	105	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
S106	106	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Total Predicted Tilt after LW31	Total Predicted Tilt after LW32	Total Predicted Tilt after LW33	Total Predicted Tilt after LW34	Total Predicted Tilt after LW35	Total Predicted Tilt after LW36	Total Predicted Tilt after LW37	Total Predicted Tilt after LW38	Total Predicted Tilt after LW39	Total Predicted Tilt after LW40	Total Predicted Tilt after LW41	Total Predicted Tilt after LW42	Total Predicted Tilt after LW43	Total Predicted Tilt after LW44
S107	107	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
S108	108	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
S109	109	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S110	110	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
S111	111	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
S112	112	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
S113	113	2.1	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
S114	114	1.5	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
S115	115	2.4	1.5	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
S116	116	3.5	4.3	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
S117	117	3.4	4.1	4.7	4.8	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
S118	118	1.2	3.5	4.3	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
S119	119	1.8	3.8	4.4	4.7	4.8	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
S120	120	0.0	0.0	0.1	0.5	0.7	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
S121	121	0.0	0.0	0.2	1.0	1.8	2.2	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3
S122	122	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
S123	123	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
S124	124	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S125	125	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
S126	126	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
S127	127	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2
S128	128	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.8	1.5	1.8	1.8	1.8	1.8	1.8
S129	129	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.8	0.9	0.9	0.9	0.9	0.9
S130	130	0.0	0.0	0.0	0.0	0.0	0.2	0.8	1.4	0.9	0.8	0.8	0.8	0.8	0.8
S131	131	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.4	0.5	0.5	0.5
S132	132	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	1.4	1.7	1.7	1.8
S133	133	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
S134	134	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Tensile Strain during or after LW20	Maximum Predicted Tensile Strain during or after LW21	Maximum Predicted Tensile Strain during or after LW22	Maximum Predicted Tensile Strain during or after LW23	Maximum Predicted Tensile Strain during or after LW24	Maximum Predicted Tensile Strain during or after LW25	Maximum Predicted Tensile Strain during or after LW26	Maximum Predicted Tensile Strain during or after LW27	Maximum Predicted Tensile Strain during or after LW28	Maximum Predicted Tensile Strain during or after LW29	Maximum Predicted Tensile Strain during or after LW30
S01	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S04	4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S14	14	0.0	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3
S16	15	0.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
S17	16	0.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
S18	17	0.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
S20	18	0.0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
S21	19	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
S22	20	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
S95	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S27	22	0.0	0.0	0.0	0.1	0.5	0.7	0.7	0.7	0.8	0.8	0.8
S23	23	0.0	0.0	0.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S24	24	0.0	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S25	25	0.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
S26	26	0.0	0.0	0.3	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
S19	27	0.0	0.0	0.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
S28	28	0.0	0.0	0.0	0.1	0.8	1.0	1.1	1.1	1.1	1.1	1.1
S29	29	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.7	0.7	0.7	0.7
S30	30	0.0	0.0	0.0	0.1	0.1	0.2	0.4	0.6	0.6	0.6	0.6
S31	31	0.0	0.0	0.0	0.0	0.1	0.6	0.7	0.8	0.8	0.8	0.8
S32	32	0.0	0.0	0.0	0.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S33	33	0.0	0.0	0.0	0.0	0.6	0.9	0.9	0.9	0.9	0.9	0.9
S34	34	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.6	0.6	0.6	0.6
S35	35	0.0	0.0	0.0	0.0	0.1	0.1	0.5	0.6	0.6	0.7	0.7
S36	36	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.3	0.3	0.3
S37	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
S38	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S39	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S40	40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S41	41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S42	42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S43	43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S44	44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S45	45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S46	46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S47	47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S48	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S49	49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S50	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S51	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S52	52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S53	53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S54	54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S55	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S56	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S57	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S58	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Tensile Strain during or after LW20	Maximum Predicted Tensile Strain during or after LW21	Maximum Predicted Tensile Strain during or after LW22	Maximum Predicted Tensile Strain during or after LW23	Maximum Predicted Tensile Strain during or after LW24	Maximum Predicted Tensile Strain during or after LW25	Maximum Predicted Tensile Strain during or after LW26	Maximum Predicted Tensile Strain during or after LW27	Maximum Predicted Tensile Strain during or after LW28	Maximum Predicted Tensile Strain during or after LW29	Maximum Predicted Tensile Strain during or after LW30
S59	59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S60	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S61	61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S62	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S63	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S64	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S65	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S66	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S67	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S68	68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S69	69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S70	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S71	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S72	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S73	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S74	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S75	75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S76	76	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
S77	77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.6
S78	78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S79	79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
S80	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
S81	81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S82	82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S83	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S84	84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S85	85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S86	86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
S87	87	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S88	88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3
S89	89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5
S90	90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5
S91	91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4
S92	92	0.0	0.0	0.0	0.0	0.1	0.6	0.6	0.6	0.6	0.6	0.6
S93	93	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.7	0.7	0.7	0.7
S94	94	0.0	0.0	0.0	0.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S96	96	0.0	0.0	0.1	0.5	0.7	0.8	0.8	0.8	0.8	0.8	0.8
S97	97	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
S98	98	0.0	0.0	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S99	99	0.0	0.0	0.0	0.2	0.5	0.7	0.8	0.8	0.8	0.8	0.8
S100	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S101	101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S102	102	0.0	0.0	0.0	0.0	0.1	0.6	0.6	0.6	0.6	0.6	0.6
S103	103	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.5	0.6	0.6	0.6
S104	104	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.6	0.7	0.7
S105	105	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.4
S106	106	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Tensile Strain during or after LW20	Maximum Predicted Tensile Strain during or after LW21	Maximum Predicted Tensile Strain during or after LW22	Maximum Predicted Tensile Strain during or after LW23	Maximum Predicted Tensile Strain during or after LW24	Maximum Predicted Tensile Strain during or after LW25	Maximum Predicted Tensile Strain during or after LW26	Maximum Predicted Tensile Strain during or after LW27	Maximum Predicted Tensile Strain during or after LW28	Maximum Predicted Tensile Strain during or after LW29	Maximum Predicted Tensile Strain during or after LW30
S107	107	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.6	0.6	0.6
S108	108	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6
S109	109	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
S110	110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S111	111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S112	112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S113	113	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6
S114	114	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.6
S115	115	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6
S116	116	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
S117	117	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
S118	118	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S119	119	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S120	120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S121	121	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S122	122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S123	123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S124	124	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S125	125	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S126	126	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S127	127	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S128	128	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S129	129	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S130	130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S131	131	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S132	132	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S133	133	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S134	134	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Tensile Strain during or after LW31	Maximum Predicted Tensile Strain during or after LW32	Maximum Predicted Tensile Strain during or after LW33	Maximum Predicted Tensile Strain during or after LW34	Maximum Predicted Tensile Strain during or after LW35	Maximum Predicted Tensile Strain during or after LW36	Maximum Predicted Tensile Strain during or after LW37	Maximum Predicted Tensile Strain during or after LW38	Maximum Predicted Tensile Strain during or after LW39	Maximum Predicted Tensile Strain during or after LW40	Maximum Predicted Tensile Strain during or after LW41	Maximum Predicted Tensile Strain during or after LW42	Maximum Predicted Tensile Strain during or after LW43	Maximum Predicted Tensile Strain during or after LW44
S01	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S04	4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S14	14	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
S16	15	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
S17	16	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
S18	17	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
S20	18	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
S21	19	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
S22	20	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
S95	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S27	22	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
S23	23	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S24	24	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S25	25	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
S26	26	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
S19	27	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
S28	28	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
S29	29	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
S30	30	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S31	31	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
S32	32	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S33	33	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
S34	34	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S35	35	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
S36	36	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
S37	37	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S38	38	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
S39	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S40	40	0.0	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
S41	41	0.0	0.0	0.1	0.4	0.4	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S42	42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S43	43	0.0	0.0	0.0	0.0	0.1	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6
S44	44	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6
S45	45	0.0	0.0	0.0	0.0	0.1	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6
S46	46	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S47	47	0.0	0.0	0.0	0.1	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S48	48	0.0	0.0	0.1	0.1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
S49	49	0.0	0.0	0.0	0.3	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S50	50	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S51	51	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.5	0.6	0.6	0.6	0.6	0.6	0.6
S52	52	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.6	0.6	0.7	0.7	0.7	0.7	0.7
S53	53	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6
S54	54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S55	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S56	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S57	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6
S58	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Tensile Strain during or after LW31	Maximum Predicted Tensile Strain during or after LW32	Maximum Predicted Tensile Strain during or after LW33	Maximum Predicted Tensile Strain during or after LW34	Maximum Predicted Tensile Strain during or after LW35	Maximum Predicted Tensile Strain during or after LW36	Maximum Predicted Tensile Strain during or after LW37	Maximum Predicted Tensile Strain during or after LW38	Maximum Predicted Tensile Strain during or after LW39	Maximum Predicted Tensile Strain during or after LW40	Maximum Predicted Tensile Strain during or after LW41	Maximum Predicted Tensile Strain during or after LW42	Maximum Predicted Tensile Strain during or after LW43	Maximum Predicted Tensile Strain during or after LW44
S59	59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	0.7
S60	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7
S61	61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5
S62	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.5	0.5
S63	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5
S64	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4
S65	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.6	0.6
S66	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.6	0.6
S67	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.6	0.6
S68	68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.4	0.5
S69	69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.6	0.6	0.6
S70	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.6	0.6	0.6
S71	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.5	0.5	0.5	0.5
S72	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.9	0.9	0.9
S73	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.8	0.8	0.8
S74	74	0.0	0.0	0.0	0.0	0.1	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S75	75	0.0	0.0	0.0	0.0	0.2	0.6	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
S76	76	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S77	77	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S78	78	0.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S79	79	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S80	80	0.1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
S81	81	0.2	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S82	82	0.0	0.4	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S83	83	0.0	0.0	0.1	0.6	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
S84	84	0.0	0.0	0.0	0.1	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S85	85	0.0	0.3	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S86	86	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S87	87	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S88	88	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
S89	89	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S90	90	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S91	91	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
S92	92	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S93	93	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
S94	94	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S96	96	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
S97	97	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
S98	98	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S99	99	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
S100	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S101	101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S102	102	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S103	103	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S104	104	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
S105	105	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
S106	106	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Tensile Strain during or after LW31	Maximum Predicted Tensile Strain during or after LW32	Maximum Predicted Tensile Strain during or after LW33	Maximum Predicted Tensile Strain during or after LW34	Maximum Predicted Tensile Strain during or after LW35	Maximum Predicted Tensile Strain during or after LW36	Maximum Predicted Tensile Strain during or after LW37	Maximum Predicted Tensile Strain during or after LW38	Maximum Predicted Tensile Strain during or after LW39	Maximum Predicted Tensile Strain during or after LW40	Maximum Predicted Tensile Strain during or after LW41	Maximum Predicted Tensile Strain during or after LW42	Maximum Predicted Tensile Strain during or after LW43	Maximum Predicted Tensile Strain during or after LW44
S107	107	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S108	108	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S109	109	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S110	110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S111	111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S112	112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S113	113	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S114	114	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S115	115	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S116	116	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S117	117	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S118	118	0.2	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S119	119	0.3	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
S120	120	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S121	121	0.0	0.0	0.0	0.2	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
S122	122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S123	123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S124	124	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S125	125	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S126	126	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S127	127	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S128	128	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.5	0.5	0.5	0.5	0.5
S129	129	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2
S130	130	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
S131	131	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
S132	132	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.3	0.3
S133	133	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S134	134	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Comp. Strain during or after LW20	Maximum Predicted Comp. Strain during or after LW21	Maximum Predicted Comp. Strain during or after LW22	Maximum Predicted Comp. Strain during or after LW23	Maximum Predicted Comp. Strain during or after LW24	Maximum Predicted Comp. Strain during or after LW25	Maximum Predicted Comp. Strain during or after LW26	Maximum Predicted Comp. Strain during or after LW27	Maximum Predicted Comp. Strain during or after LW28	Maximum Predicted Comp. Strain during or after LW29	Maximum Predicted Comp. Strain during or after LW30	Maximum Predicted Comp. Strain during or after LW31
S01	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S04	4	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
S14	14	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
S16	15	0.0	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
S17	16	0.0	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
S18	17	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
S20	18	0.0	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7
S21	19	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
S22	20	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
S95	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S27	22	0.0	0.0	0.0	0.0	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
S23	23	0.0	0.0	0.0	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4
S24	24	0.0	-0.1	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
S25	25	0.0	-0.6	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
S26	26	0.0	0.0	0.0	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
S19	27	0.0	0.0	0.0	-0.1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
S28	28	0.0	0.0	0.0	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
S29	29	0.0	0.0	0.0	0.0	-0.1	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
S30	30	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
S31	31	0.0	0.0	0.0	0.0	0.0	-0.5	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
S32	32	0.0	0.0	0.0	0.0	-0.1	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
S33	33	0.0	0.0	0.0	0.0	-0.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
S34	34	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.8	-0.8	-0.8	-0.8	-0.8
S35	35	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.7	-0.7	-0.7	-0.7	-0.7
S36	36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-0.8	-0.8	-0.8
S37	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S38	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S39	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S40	40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S41	41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S42	42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S43	43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S44	44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S45	45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S46	46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S47	47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S48	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S49	49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S50	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S51	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S52	52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S53	53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S54	54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S55	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S56	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S57	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S58	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Comp. Strain during or after LW20	Maximum Predicted Comp. Strain during or after LW21	Maximum Predicted Comp. Strain during or after LW22	Maximum Predicted Comp. Strain during or after LW23	Maximum Predicted Comp. Strain during or after LW24	Maximum Predicted Comp. Strain during or after LW25	Maximum Predicted Comp. Strain during or after LW26	Maximum Predicted Comp. Strain during or after LW27	Maximum Predicted Comp. Strain during or after LW28	Maximum Predicted Comp. Strain during or after LW29	Maximum Predicted Comp. Strain during or after LW30	Maximum Predicted Comp. Strain during or after LW31
S59	59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S60	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S61	61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S62	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S63	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S64	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S65	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S66	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S67	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S68	68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S69	69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S70	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S71	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S72	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S73	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S74	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S75	75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S76	76	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5
S77	77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.9	-0.9
S78	78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S79	79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5
S80	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S81	81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S82	82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S83	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S84	84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S85	85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S86	86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3
S87	87	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
S88	88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.3	-0.3
S89	89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.8
S90	90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.8
S91	91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.4	-0.4
S92	92	0.0	0.0	0.0	0.0	0.0	-0.1	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
S93	93	0.0	0.0	0.0	0.0	-0.1	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
S94	94	0.0	0.0	0.0	-0.1	-0.1	-0.6	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
S96	96	0.0	0.0	0.0	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
S97	97	0.0	0.0	0.0	-0.3	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
S98	98	0.0	0.0	0.0	-0.4	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
S99	99	0.0	0.0	0.0	-0.1	-0.4	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
S100	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S101	101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S102	102	0.0	0.0	0.0	0.0	0.0	-0.2	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
S103	103	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4
S104	104	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2	-0.2	-0.2	-0.2
S105	105	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	-0.4	-0.4	-0.5	-0.5
S106	106	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.7	-0.9	-0.9	-0.9	-0.9

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Comp. Strain during or after LW20	Maximum Predicted Comp. Strain during or after LW21	Maximum Predicted Comp. Strain during or after LW22	Maximum Predicted Comp. Strain during or after LW23	Maximum Predicted Comp. Strain during or after LW24	Maximum Predicted Comp. Strain during or after LW25	Maximum Predicted Comp. Strain during or after LW26	Maximum Predicted Comp. Strain during or after LW27	Maximum Predicted Comp. Strain during or after LW28	Maximum Predicted Comp. Strain during or after LW29	Maximum Predicted Comp. Strain during or after LW30	Maximum Predicted Comp. Strain during or after LW31
S107	107	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.9	-0.9	-0.9	-0.9
S108	108	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.8	-0.8	-0.8	-0.8
S109	109	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S110	110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S111	111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S112	112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S113	113	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.9	-0.9
S114	114	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.9	-0.9
S115	115	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.9
S116	116	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
S117	117	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3
S118	118	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S119	119	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
S120	120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S121	121	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S122	122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S123	123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S124	124	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S125	125	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S126	126	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S127	127	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S128	128	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S129	129	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S130	130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S131	131	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S132	132	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S133	133	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S134	134	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Comp. Strain during or after LW32	Maximum Predicted Comp. Strain during or after LW33	Maximum Predicted Comp. Strain during or after LW34	Maximum Predicted Comp. Strain during or after LW35	Maximum Predicted Comp. Strain during or after LW36	Maximum Predicted Comp. Strain during or after LW37	Maximum Predicted Comp. Strain during or after LW38	Maximum Predicted Comp. Strain during or after LW39	Maximum Predicted Comp. Strain during or after LW40	Maximum Predicted Comp. Strain during or after LW41	Maximum Predicted Comp. Strain during or after LW42	Maximum Predicted Comp. Strain during or after LW43	Maximum Predicted Comp. Strain during or after LW44	Maximum Differential Subsidence across swamp(mm)	Maximum Average Tilt Across Swamp (mm/m)
S01	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	0.1
S04	4	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	339	2.1
S14	14	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	166	0.4
S16	15	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	92	0.8
S17	16	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	48	0.9
S18	17	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	58	0.6
S20	18	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	143	1.0
S21	19	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	1238	2.1
S22	20	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	211	1.5
S95	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12	0.1
S27	22	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	203	0.8
S23	23	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	307	1.8
S24	24	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	115	1.1
S25	25	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	247	0.8
S26	26	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	87	1.1
S19	27	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	139	1.6
S28	28	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	235	1.9
S29	29	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	145	0.9
S30	30	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	56	0.5
S31	31	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	182	1.7
S32	32	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	373	2.0
S33	33	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	74	0.5
S34	34	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	145	1.5
S35	35	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	382	2.1
S36	36	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	61	0.6
S37	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33	0.4
S38	38	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	118	0.9
S39	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29	0.2
S40	40	-0.1	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	466	1.8
S41	41	0.0	0.0	-0.4	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	673	3.4
S42	42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27	0.2
S43	43	0.0	0.0	0.0	0.0	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	317	1.6
S44	44	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	445	3.6
S45	45	0.0	0.0	0.0	0.0	-0.2	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	487	3.8
S46	46	0.0	0.0	-0.1	-0.5	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	239	1.2
S47	47	0.0	0.0	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	166	1.6
S48	48	0.0	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	47	0.4
S49	49	0.0	0.0	0.0	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	111	0.6
S50	50	0.0	0.0	0.0	0.0	0.0	-0.4	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	232	1.3
S51	51	0.0	0.0	0.0	0.0	0.0	-0.8	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	177	1.0
S52	52	0.0	0.0	0.0	0.0	0.0	-0.4	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	323	2.1
S53	53	0.0	0.0	0.0	0.0	0.0	-0.2	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	172	1.1
S54	54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31	0.2
S55	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	0.1
S56	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27	0.2
S57	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.0	-1.0	-1.0	-1.0	-1.0	99	0.6
S58	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.0	-1.0	-1.0	-1.0	-1.0	94	0.6

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Comp. Strain during or after LW32	Maximum Predicted Comp. Strain during or after LW33	Maximum Predicted Comp. Strain during or after LW34	Maximum Predicted Comp. Strain during or after LW35	Maximum Predicted Comp. Strain during or after LW36	Maximum Predicted Comp. Strain during or after LW37	Maximum Predicted Comp. Strain during or after LW38	Maximum Predicted Comp. Strain during or after LW39	Maximum Predicted Comp. Strain during or after LW40	Maximum Predicted Comp. Strain during or after LW41	Maximum Predicted Comp. Strain during or after LW42	Maximum Predicted Comp. Strain during or after LW43	Maximum Predicted Comp. Strain during or after LW44	Maximum Differential Subsidence across swamp(mm)	Maximum Average Tilt Across Swamp (mm/m)
S59	59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.9	785	3.2
S60	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	508	3.4
S61	61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.7	95	0.9
S62	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-0.8	68	0.7
S63	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.6	-0.6	301	1.9
S64	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-1.0	-1.0	100	0.8
S65	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.9	-0.9	52	1.1
S66	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.9	-0.9	37	1.0
S67	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-1.0	-1.0	66	0.6
S68	68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.6	-0.6	67	0.8
S69	69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-1.0	-1.0	-1.0	101	1.0
S70	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-1.0	-1.0	-1.0	55	0.9
S71	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.9	-0.9	-0.9	-0.9	380	1.4
S72	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.8	-0.8	-0.8	-0.8	260	1.9
S73	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.8	-0.8	-0.8	-0.8	195	1.4
S74	74	0.0	0.0	0.0	0.0	-0.3	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	381	1.9
S75	75	0.0	0.0	0.0	-0.1	-0.5	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	382	1.2
S76	76	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	678	0.7
S77	77	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	359	0.8
S78	78	-0.5	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	591	1.1
S79	79	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	149	0.5
S80	80	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	317	2.0
S81	81	-0.3	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	327	1.9
S82	82	-0.3	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	269	1.2
S83	83	0.0	0.0	-0.4	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	122	1.6
S84	84	0.0	0.0	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	39	0.4
S85	85	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	40	0.6
S86	86	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	48	0.4
S87	87	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	30	0.5
S88	88	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	48	0.4
S89	89	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	180	0.9
S90	90	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	480	2.0
S91	91	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	34	0.5
S92	92	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	650	0.6
S93	93	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	79	0.8
S94	94	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	145	0.4
S96	96	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	345	3.9
S97	97	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	257	4.1
S98	98	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	181	2.5
S99	99	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	643	2.3
S100	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18	0.1
S101	101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42	0.2
S102	102	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	230	1.5
S103	103	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	299	4.4
S104	104	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	249	2.1
S105	105	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	363	3.5
S106	106	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	1079	1.1

Table D.03 - Metropolitan Colliery - Longwalls 20 to 44
Predictions and Impact Assessments for the Swamps within the Study Area

Location	ID	Maximum Predicted Comp. Strain during or after LW32	Maximum Predicted Comp. Strain during or after LW33	Maximum Predicted Comp. Strain during or after LW34	Maximum Predicted Comp. Strain during or after LW35	Maximum Predicted Comp. Strain during or after LW36	Maximum Predicted Comp. Strain during or after LW37	Maximum Predicted Comp. Strain during or after LW38	Maximum Predicted Comp. Strain during or after LW39	Maximum Predicted Comp. Strain during or after LW40	Maximum Predicted Comp. Strain during or after LW41	Maximum Predicted Comp. Strain during or after LW42	Maximum Predicted Comp. Strain during or after LW43	Maximum Predicted Comp. Strain during or after LW44	Maximum Differential Subsidence across swamp(mm)	Maximum Average Tilt Across Swamp (mm/m)
S107	107	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	77	0.5
S108	108	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	66	0.7
S109	109	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	79	0.6
S110	110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8	0.1
S111	111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12	0.1
S112	112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14	0.2
S113	113	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	195	1.0
S114	114	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	66	0.7
S115	115	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	52	0.6
S116	116	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	239	3.4
S117	117	-0.4	-0.4	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	605	3.7
S118	118	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	237	3.1
S119	119	-0.5	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	787	2.8
S120	120	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	74	0.4
S121	121	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	179	0.8
S122	122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17	0.2
S123	123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17	0.1
S124	124	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8	0.1
S125	125	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	0.0
S126	126	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8	0.1
S127	127	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26	0.1
S128	128	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	338	0.8
S129	129	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	67	0.3
S130	130	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	43	0.5
S131	131	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38	0.2
S132	132	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.2	116	1.1
S133	133	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14	0.1
S134	134	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66	0.5

APPENDIX E - DRAWINGS

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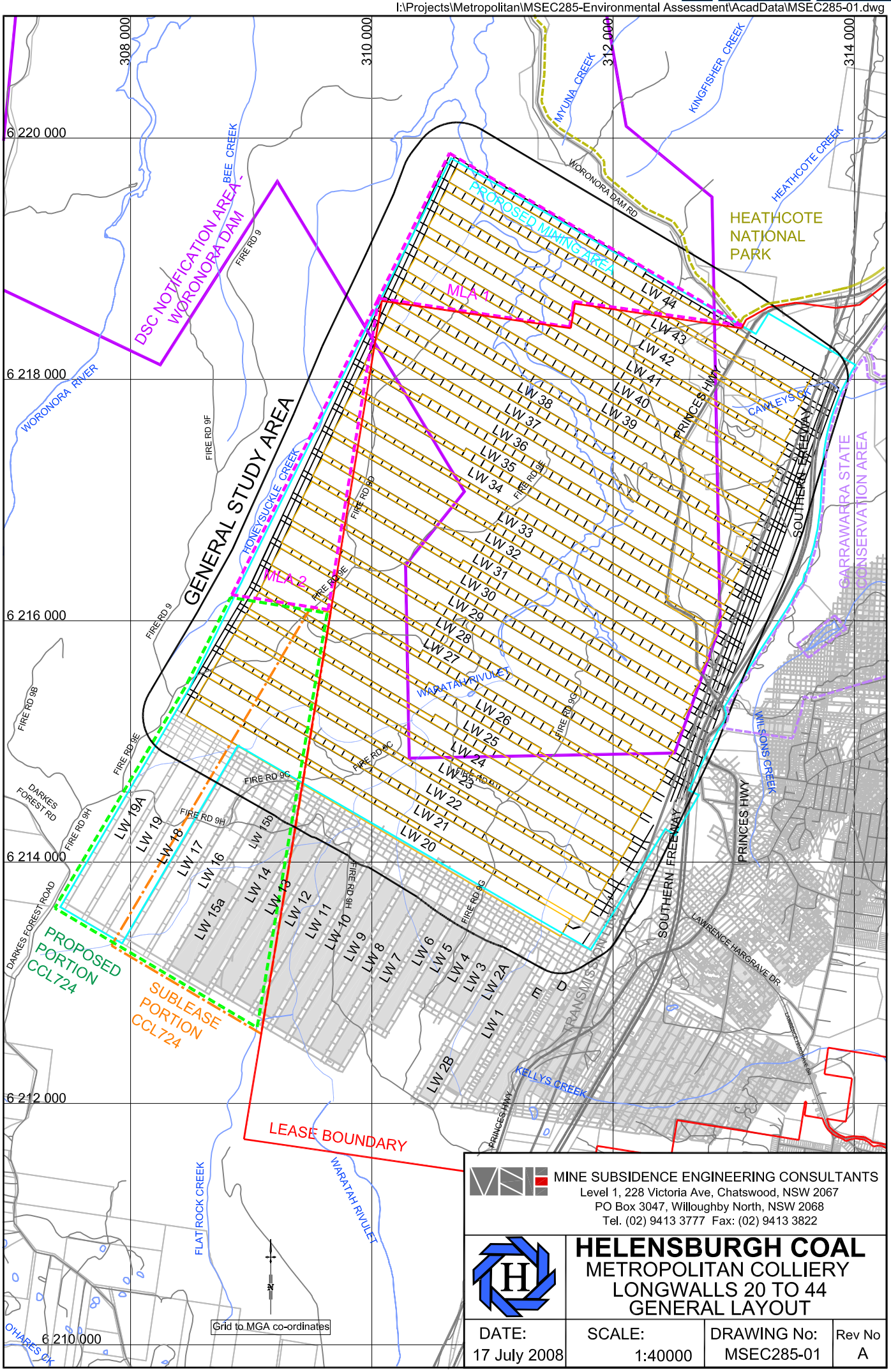

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HELENSBURGH COAL

METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
GENERAL LAYOUT

DATE:	SCALE:	DRAWING No:	Rev No
17 July 2008	1:40000	MSEC285-01	A

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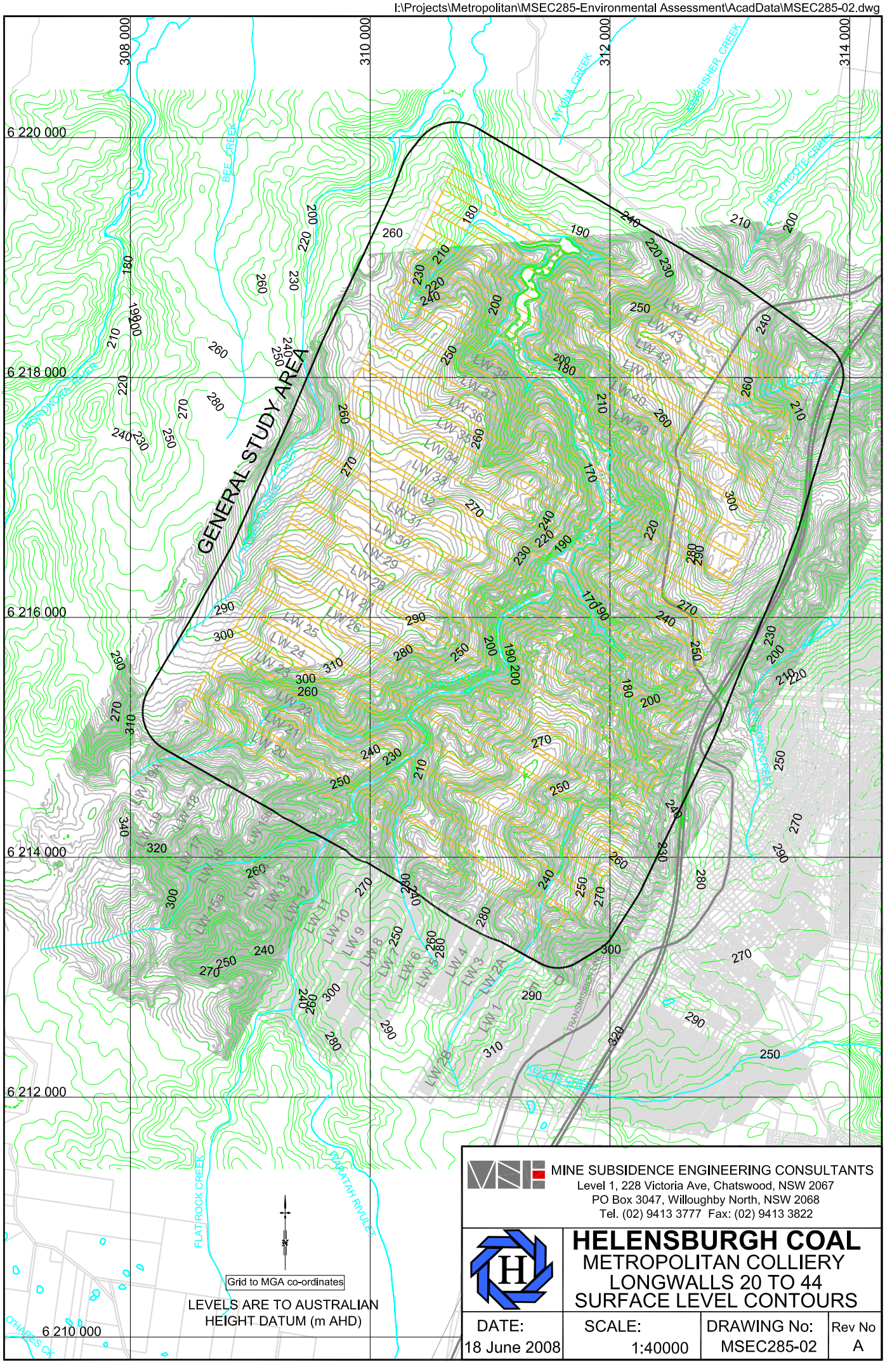

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HELENSBURGH COAL
METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
SURFACE LEVEL CONTOURS

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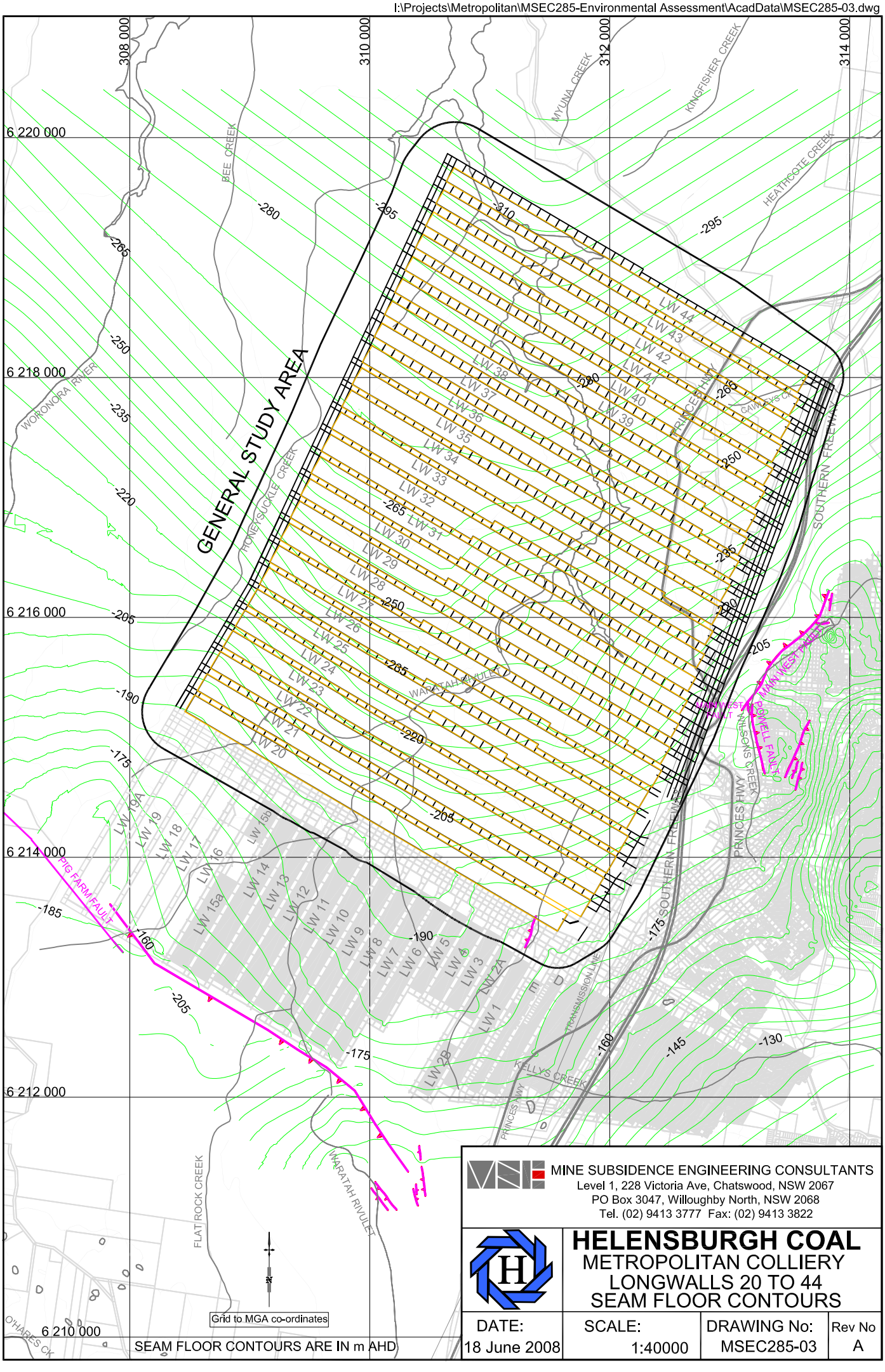

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METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
SEAM FLOOR CONTOURS

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18 June 2008	1:40000	MSEC285-03	A

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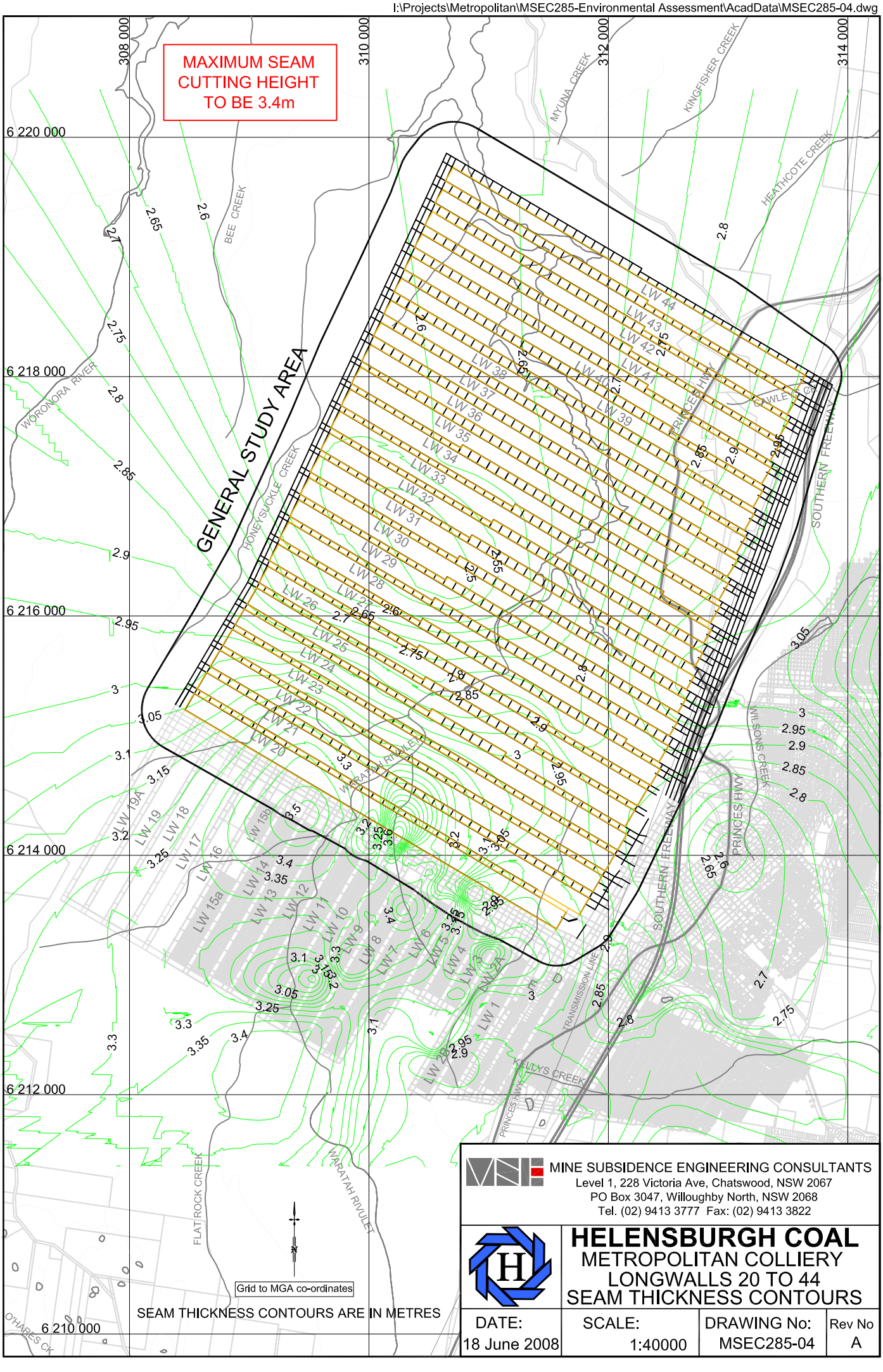

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HELENSBURGH COAL

METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
SEAM THICKNESS CONTOURS

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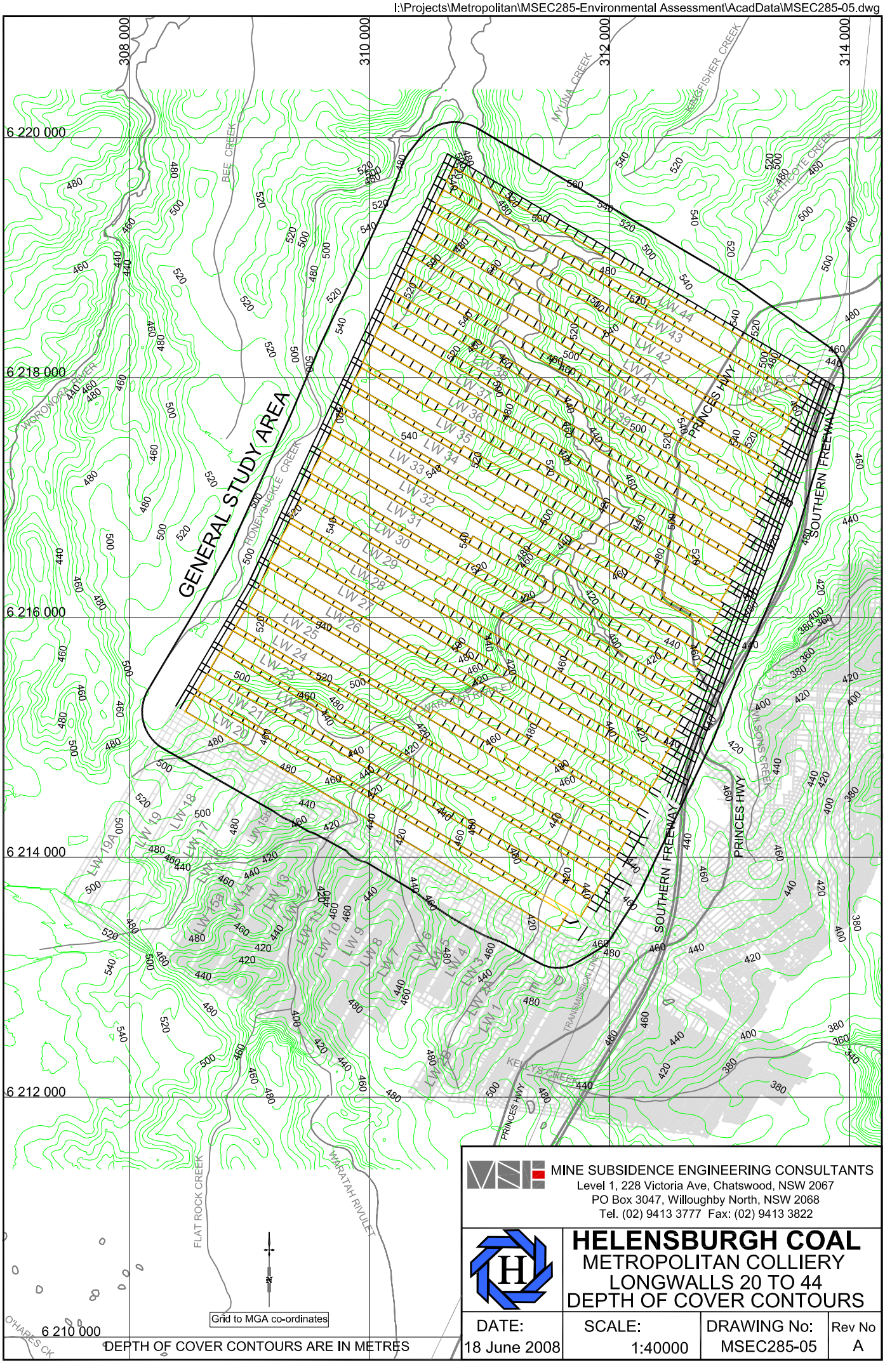

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METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
DEPTH OF COVER CONTOURS

DATE:	SCALE:	DRAWING No:	Rev No
18 June 2008	1:40000	MSEC285-05	A

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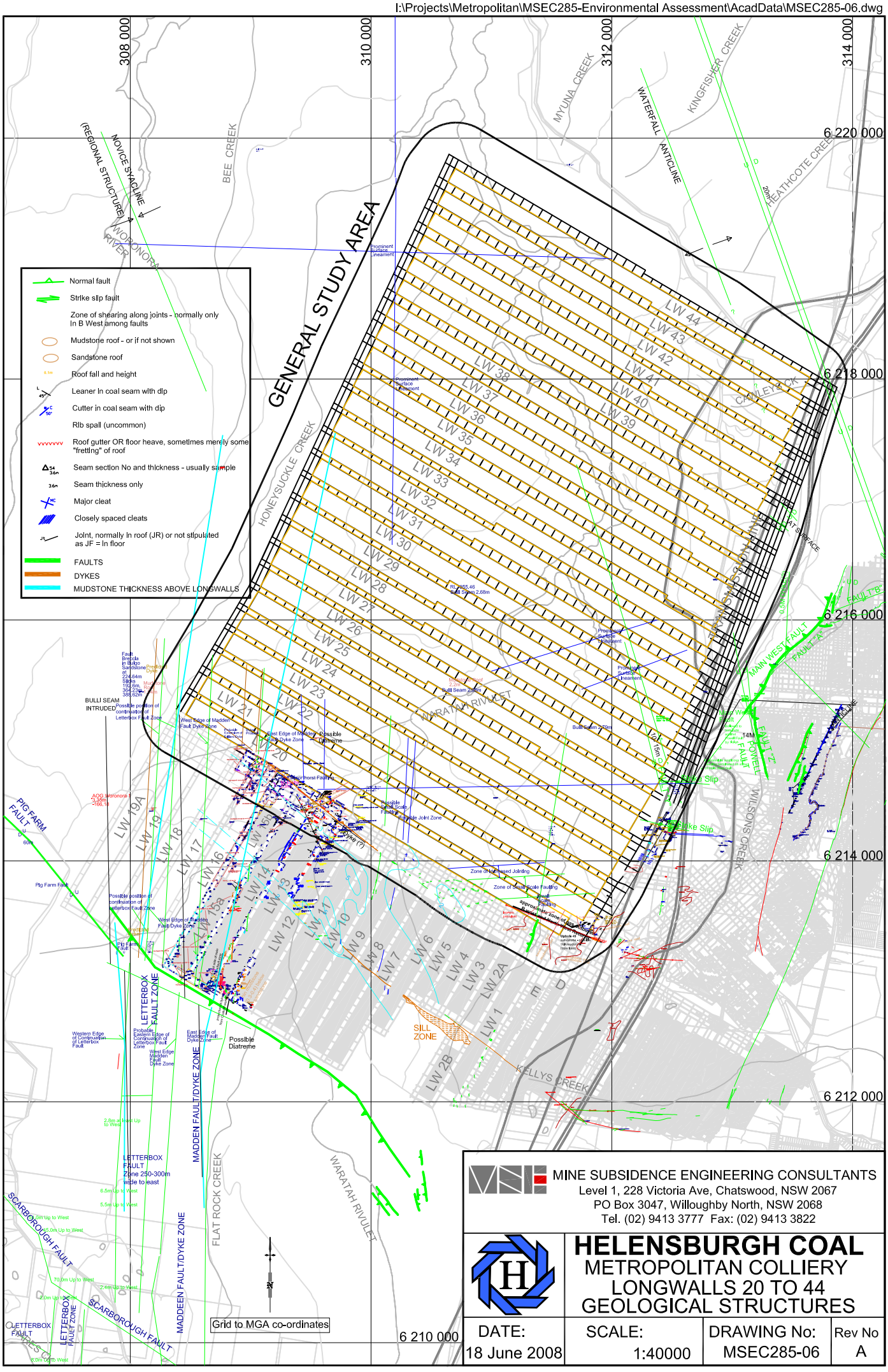

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LONGWALLS 20 TO 44
GEOLOGICAL STRUCTURES

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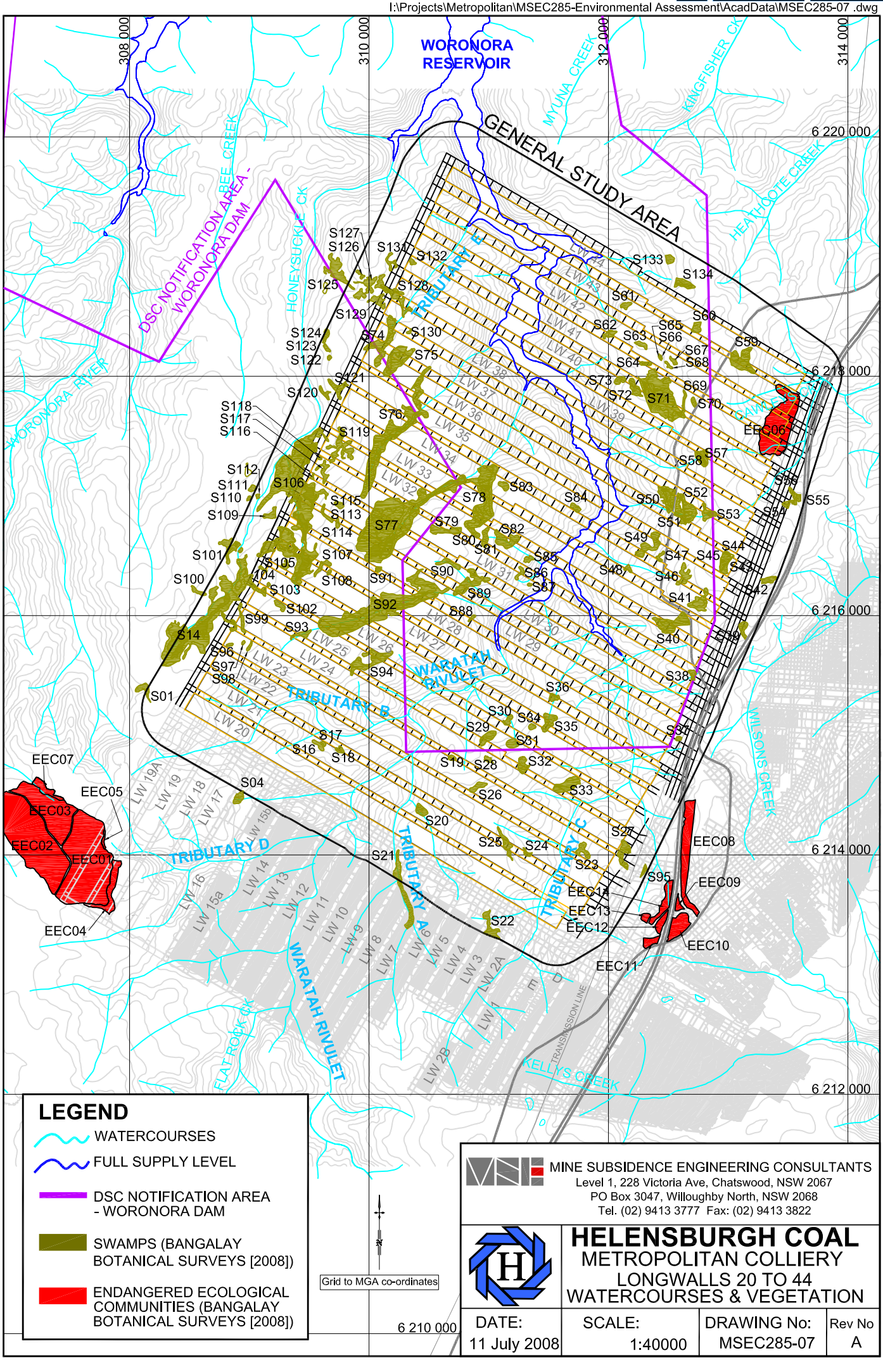

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METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
WATERCOURSES & VEGETATION

DATE:	SCALE:	DRAWING No:	Rev No
11 July 2008	1:40000	MSEC285-07	A

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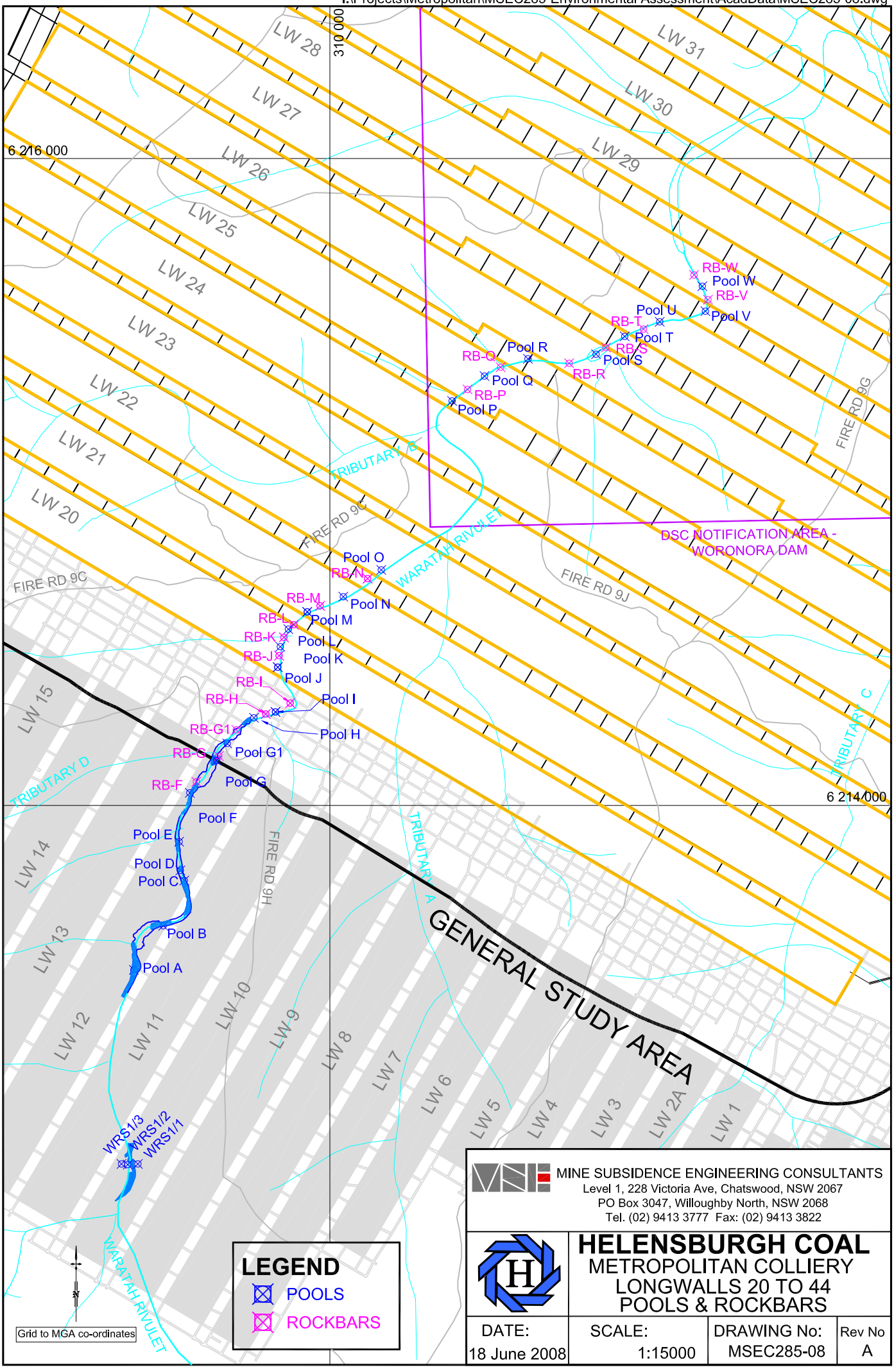

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METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
POOLS & ROCKBARS

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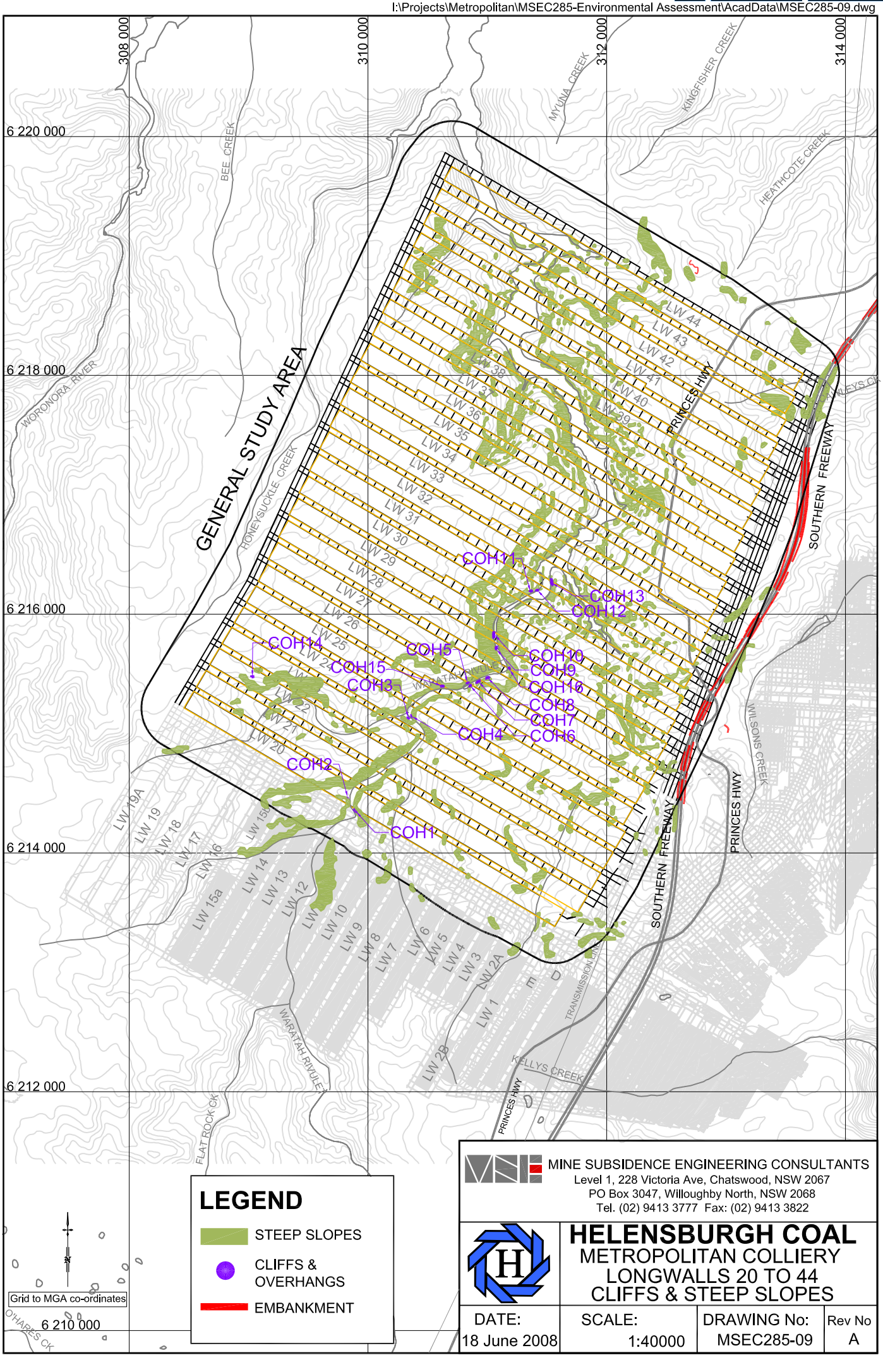

LEGEND

- STEEP SLOPES
- CLIFFS & OVERHANGS
- EMBANKMENT

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HELENSBURGH COAL

METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
CLIFFS & STEEP SLOPES

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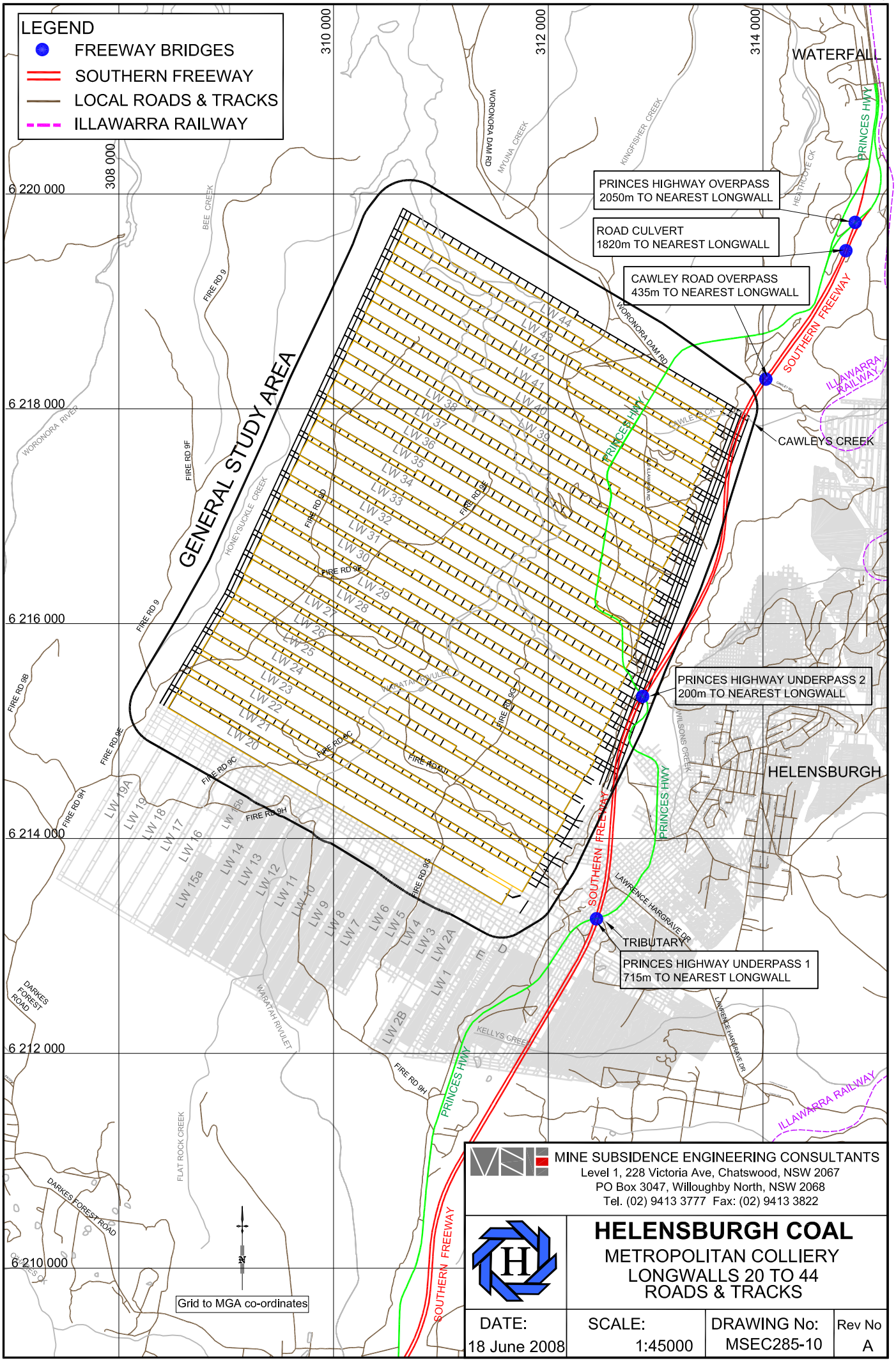

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METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
ROADS & TRACKS

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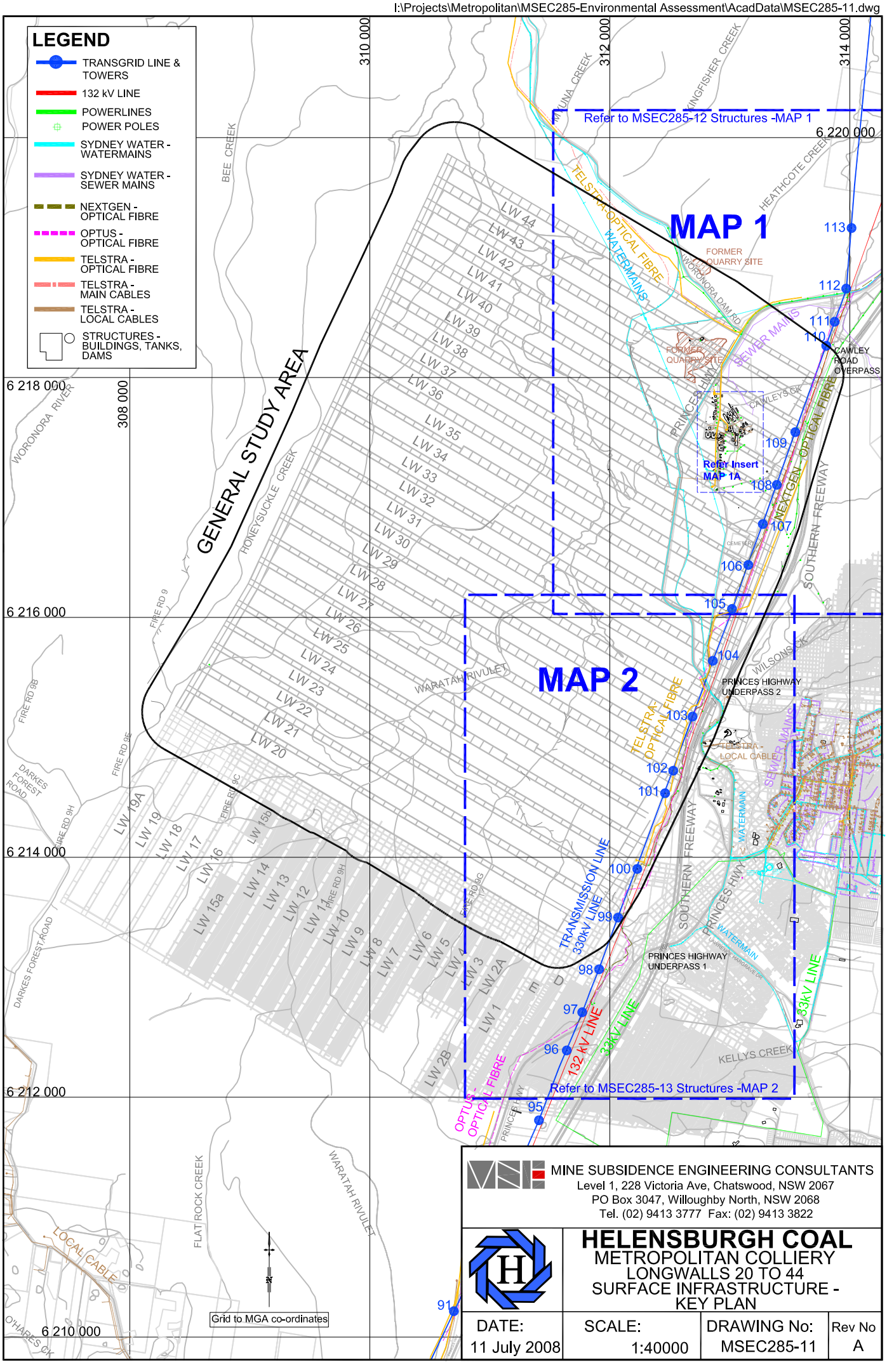

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METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
SURFACE INFRASTRUCTURE - KEY PLAN

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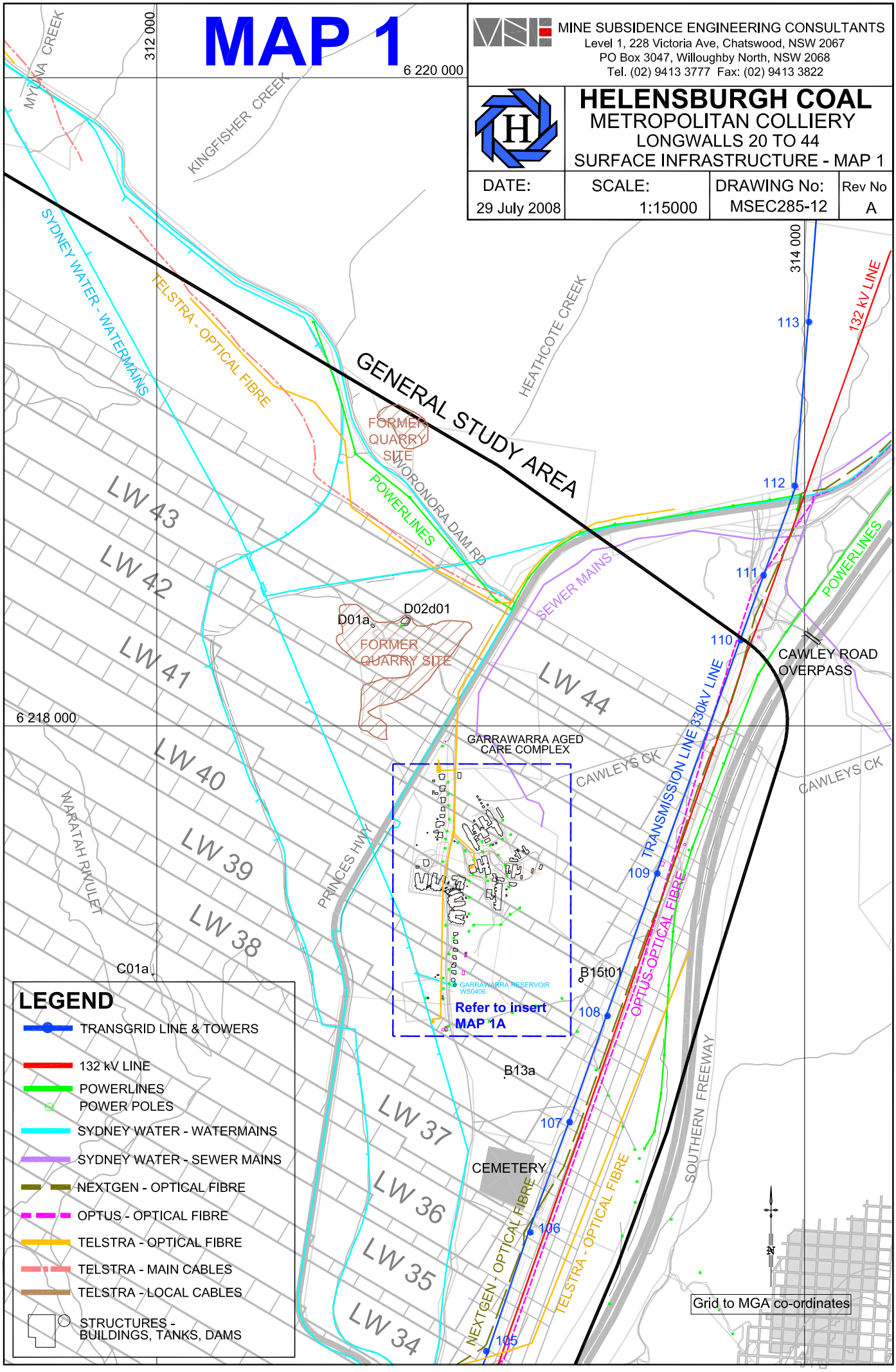

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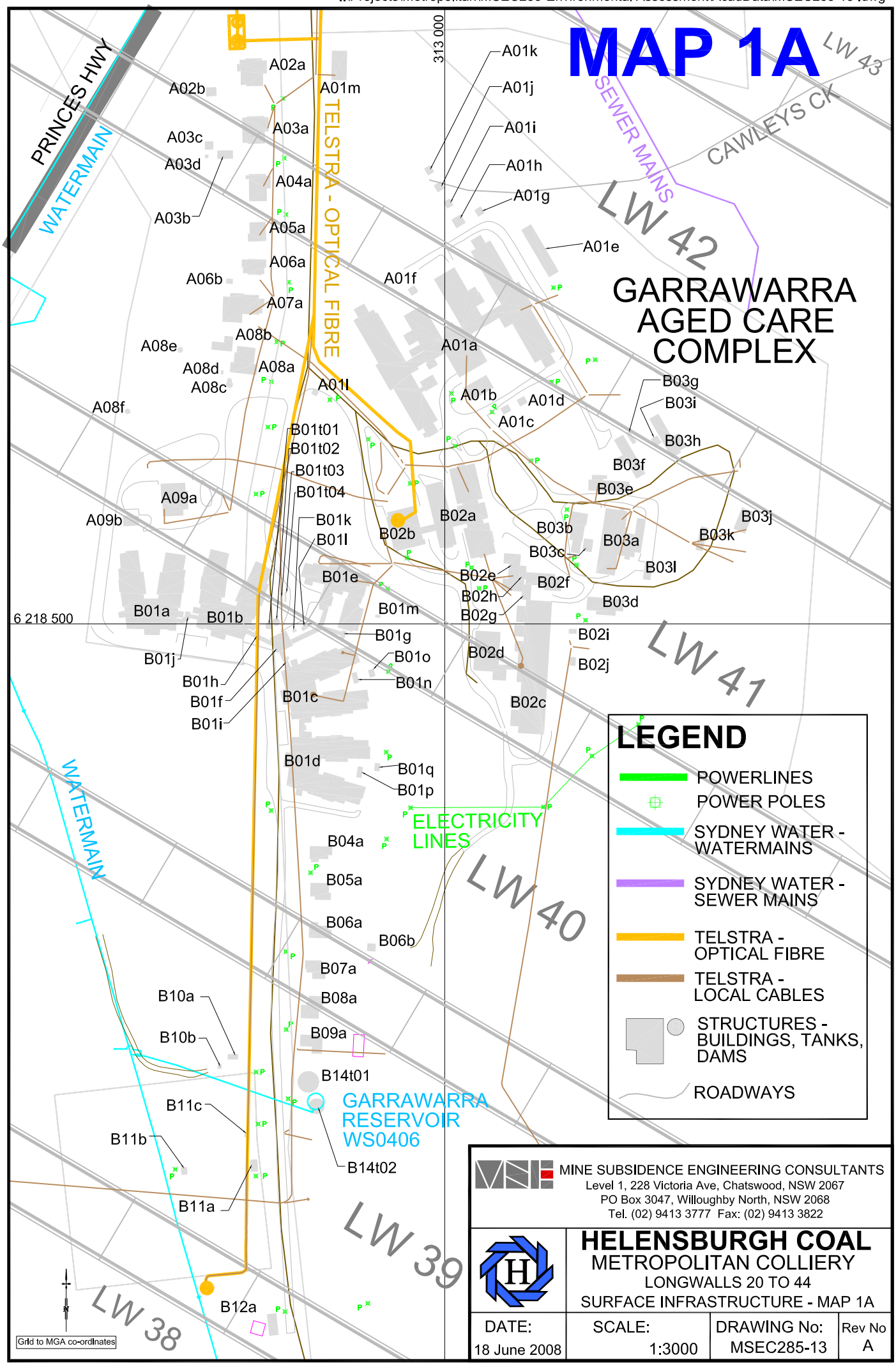

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HELENSBURGH COAL
METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
SURFACE INFRASTRUCTURE - MAP 1A

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METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
SURFACE INFRASTRUCTURE - MAP2

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LEGEND

- TRANSGRID LINE & TOWERS
- 132 kV LINE
- POWERLINES
- POWER POLES
- SYDNEY WATER - WATERMAINS
- SYDNEY WATER - SEWER MAINS
- NEXTGEN - OPTICAL FIBRE
- OPTUS - OPTICAL FIBRE
- TELSTRA - OPTICAL FIBRE
- TELSTRA - MAIN CABLES
- TELSTRA - LOCAL CABLES
- STRUCTURES - BUILDINGS, TANKS, DAMS

6 216 000
6 214 000
6 212 000
312 000

LW 34
LW 33
LW 32
LW 31
LW 30
LW 29
LW 28
LW 27
LW 26
LW 25
LW 24
LW 23
LW 22
LW 21
LW 20
LW 3
LW 2A
LW 1
D
E

105
104
103
102
101
100
99
98
97
96

WATERMAIN
OPTUS - OPTICAL FIBRE
132 kV LINE
PRINCES HIGHWAY UNDERPASS 2
TELSTRA - OPTICAL FIBRE
E01a
E01c
E01b
E02a
E03a
E03p01
WILSONS CREEK
SEWER MAINS
SAWAN ST
ALMA RD
TELSTRA - LOCAL CABLES
WATERMAIN
TRANSMISSION LINE
330kV LINE
SOUTHERN FREEWAY
PARKES ST
HELENSBURGH RESERVOIR WS0048
33kV LINE
PRINCES HWY
NEXTGEN - OPTICAL FIBRE
METROPOLITAN COLLIERY VENTILATION SHAFT
GENERAL STUDY AREA
FIRE RD 9G
PRINCES HIGHWAY UNDERPASS 1
LAWRENCE HARGRAVE DR
WATERMAIN
OPTUS - OPTICAL FIBRE
PRINCES HWY
KELLYS CREEK

MAP 2

Grid to MGA co-ordinates

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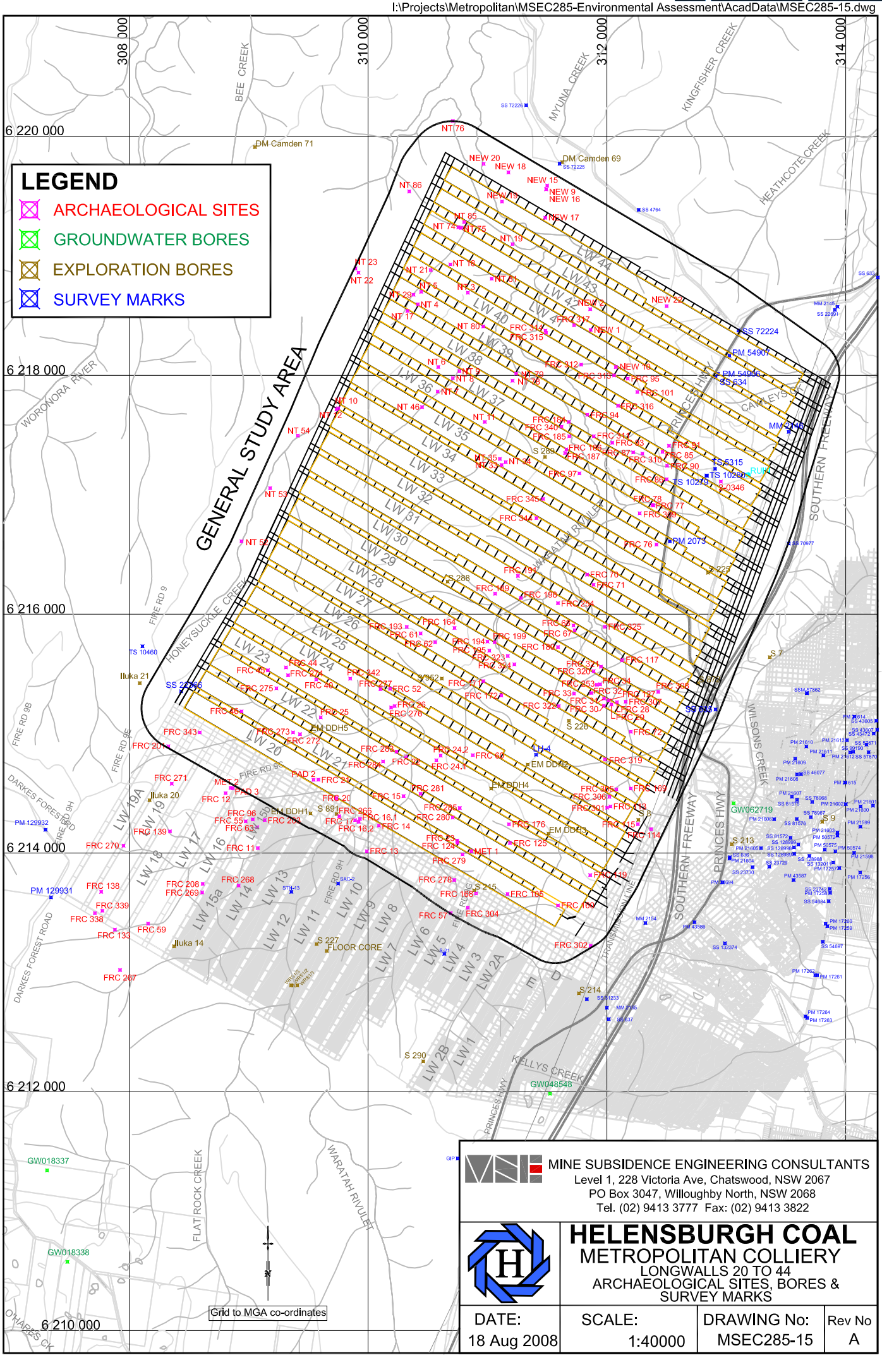

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HELENSBURGH COAL
METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
ARCHAEOLOGICAL SITES, BORES & SURVEY MARKS

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18 Aug 2008	1:40000	MSEC285-15	A

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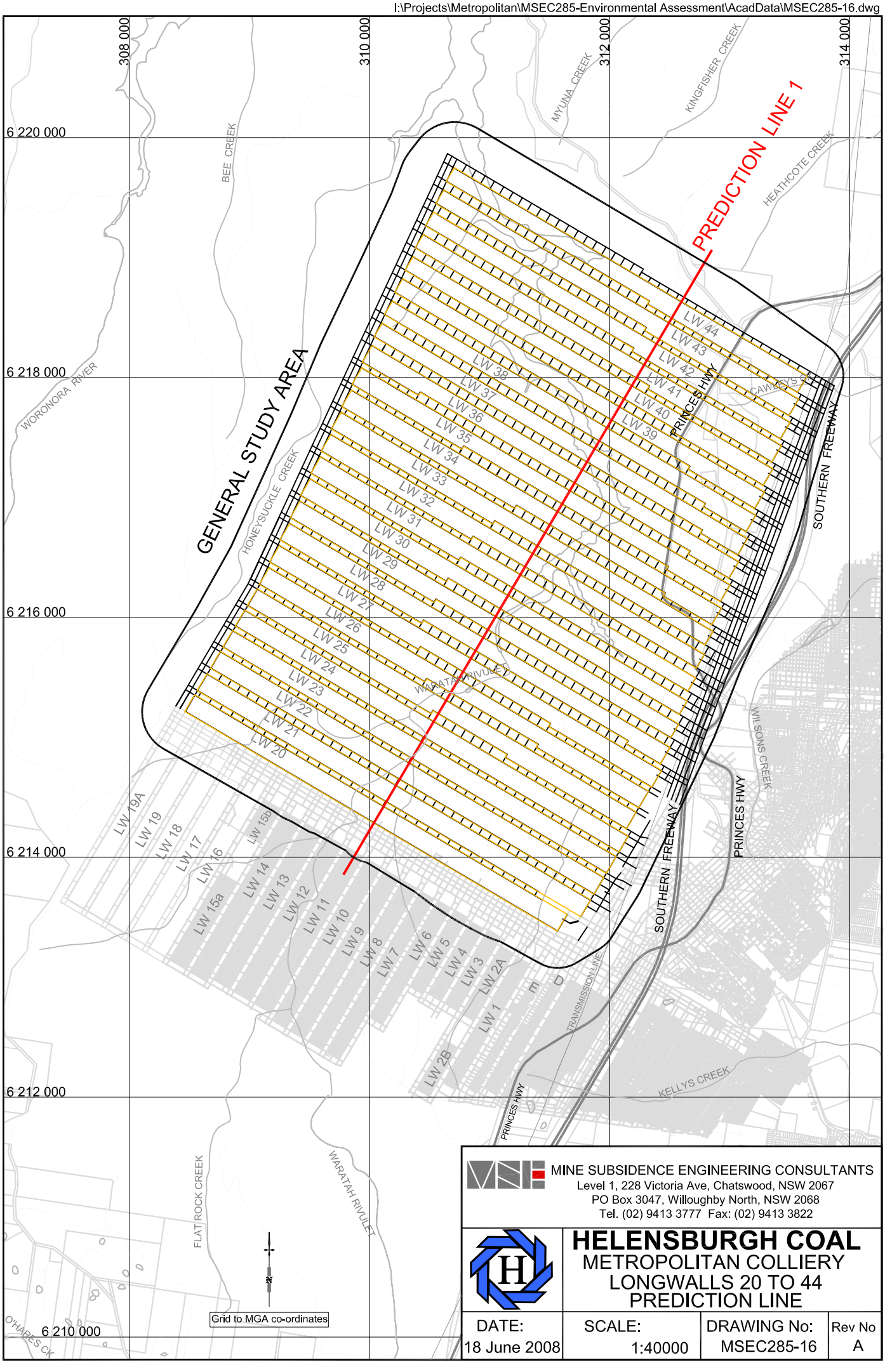

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HELENSBURGH COAL
METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
PREDICTION LINE

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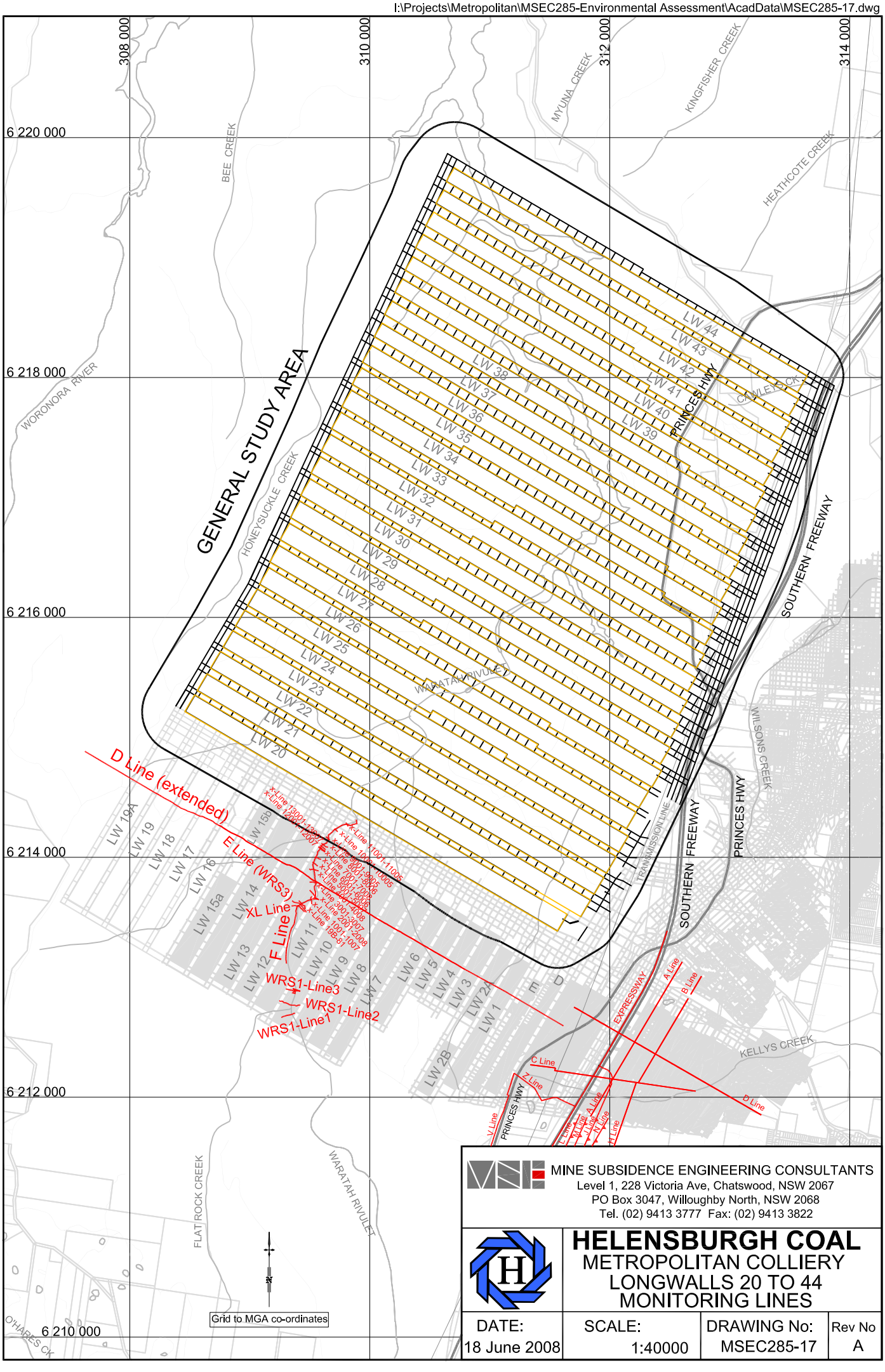

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HELENSBURGH COAL
METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
MONITORING LINES

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LONGWALLS 20 TO 44
PREDICTED CUMULATIVE SUBSIDENCE CONTOURS AFTER LONGWALL 30

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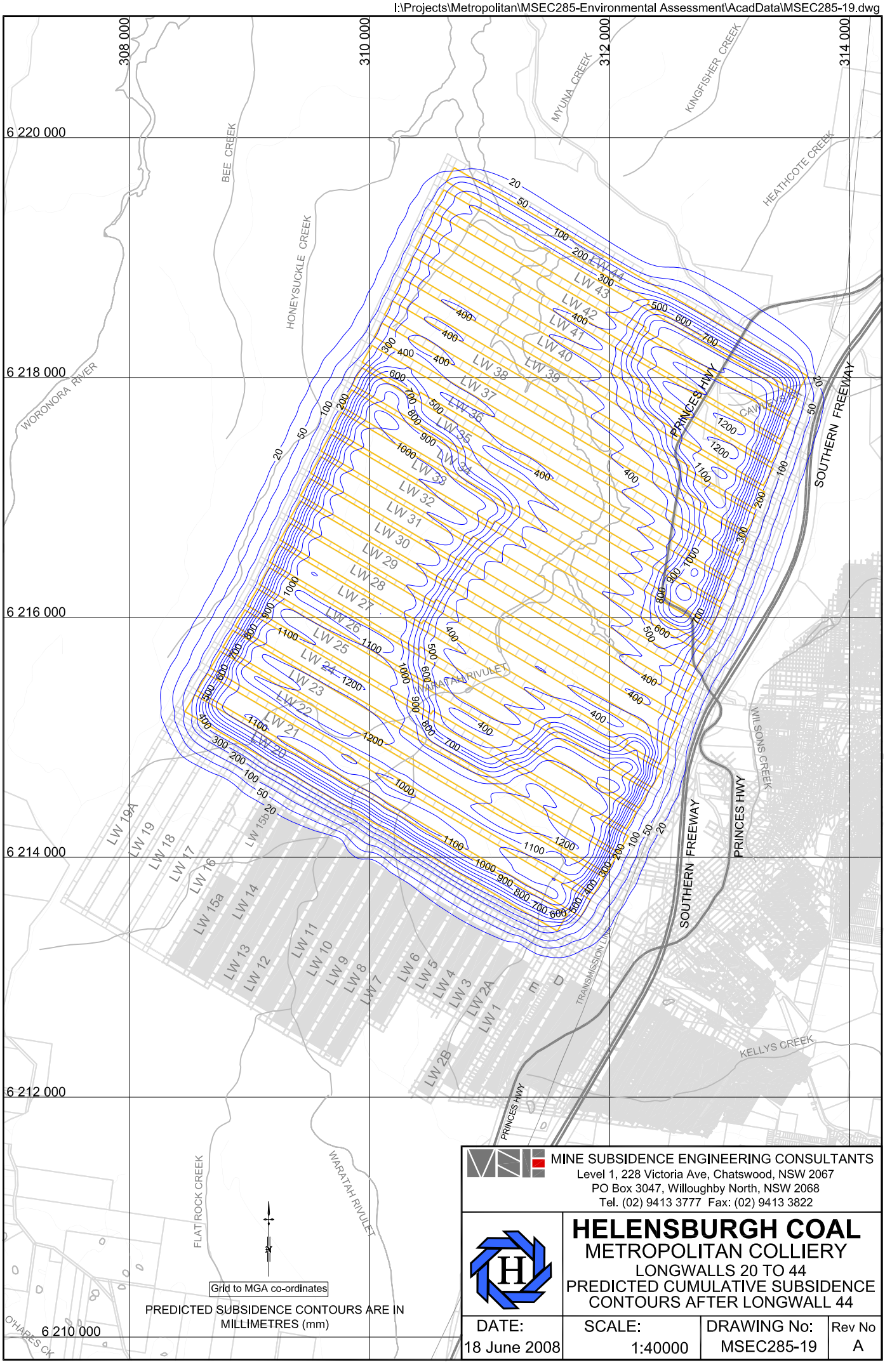

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LONGWALLS 20 TO 44
PREDICTED CUMULATIVE SUBSIDENCE CONTOURS AFTER LONGWALL 44

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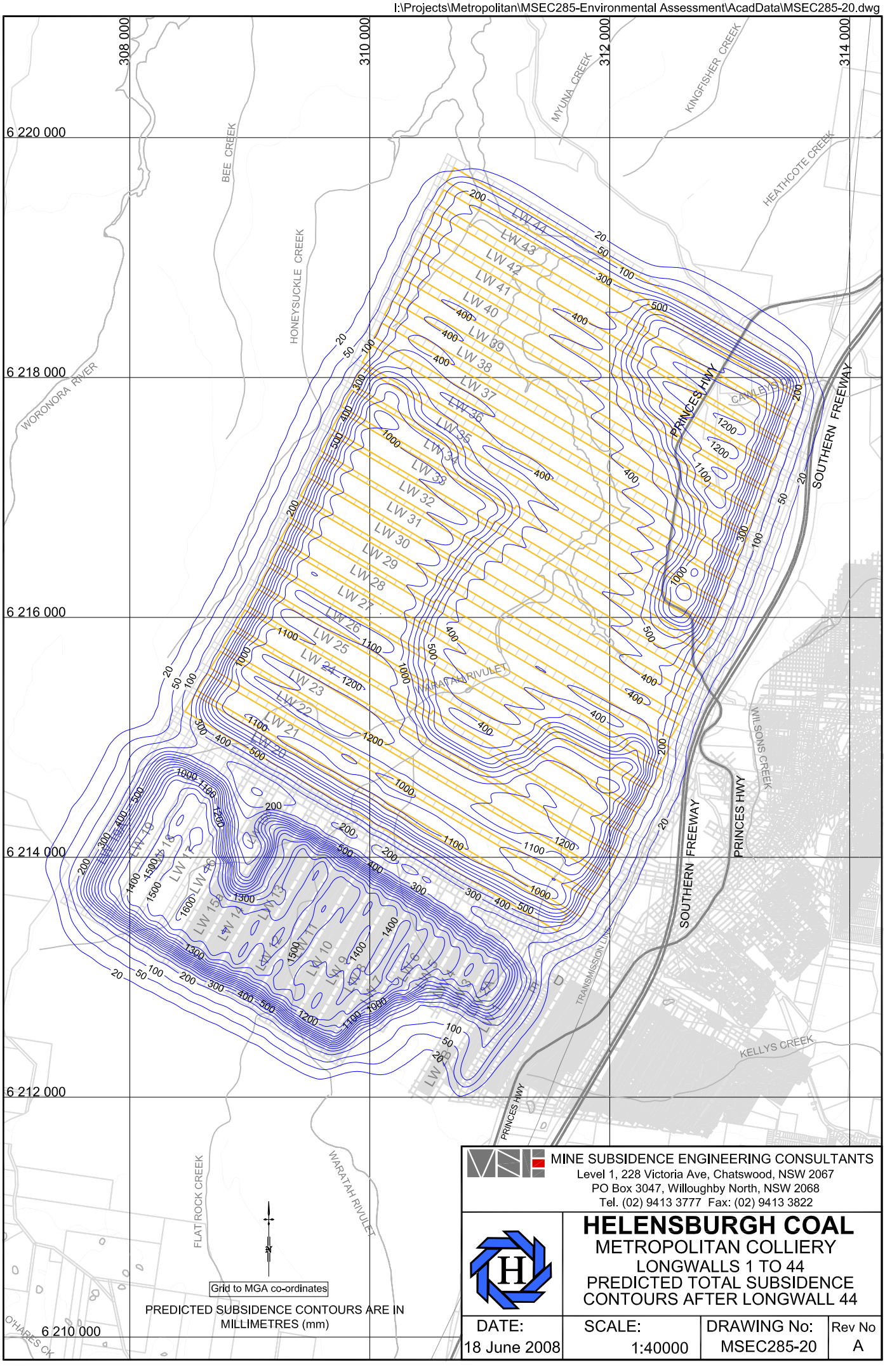

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HELENSBURGH COAL

METROPOLITAN COLLIERY

LONGWALLS 1 TO 44
PREDICTED TOTAL SUBSIDENCE CONTOURS AFTER LONGWALL 44

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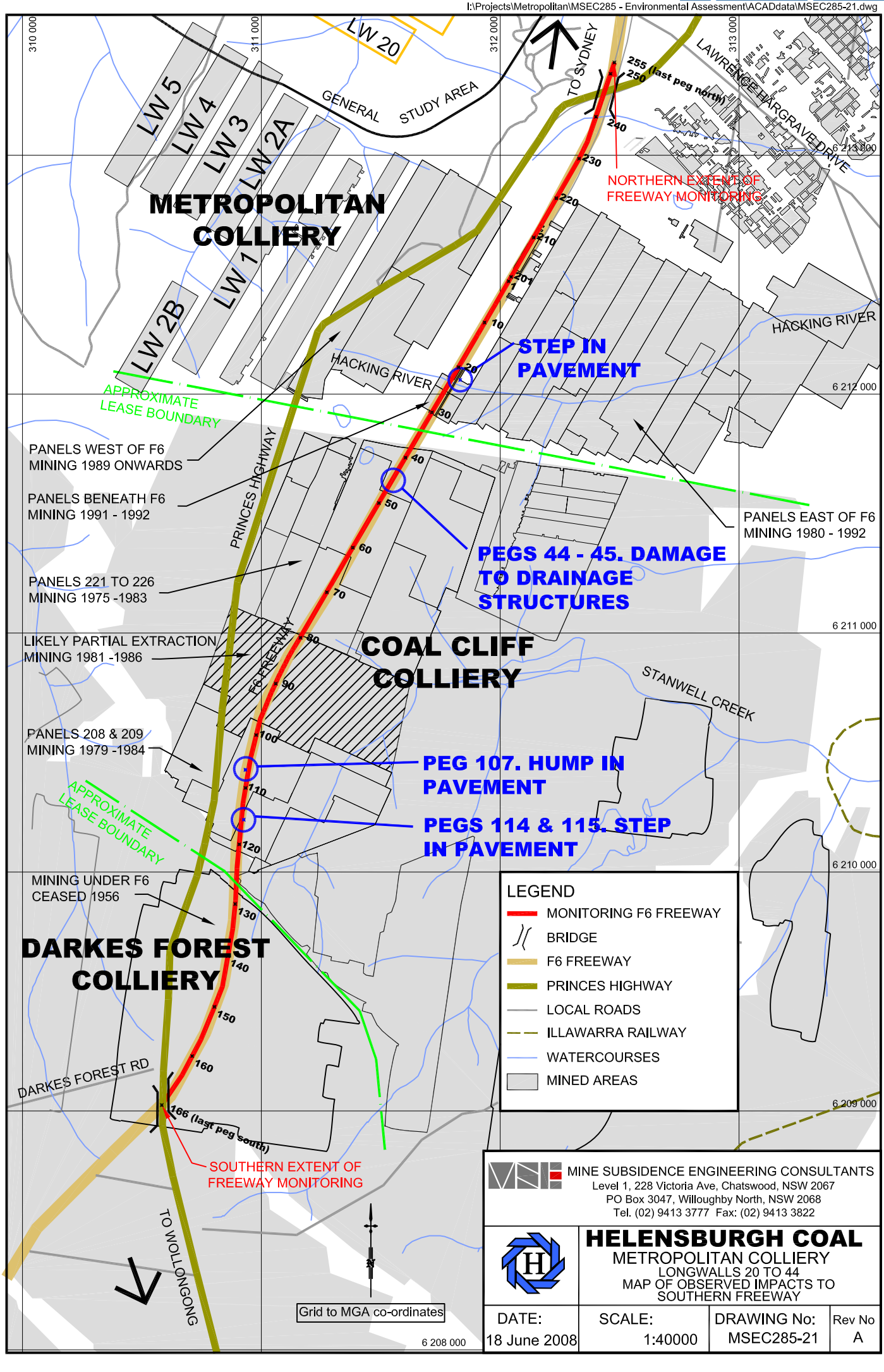

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HELENSBURGH COAL

METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
MAP OF OBSERVED IMPACTS TO SOUTHERN FREEWAY

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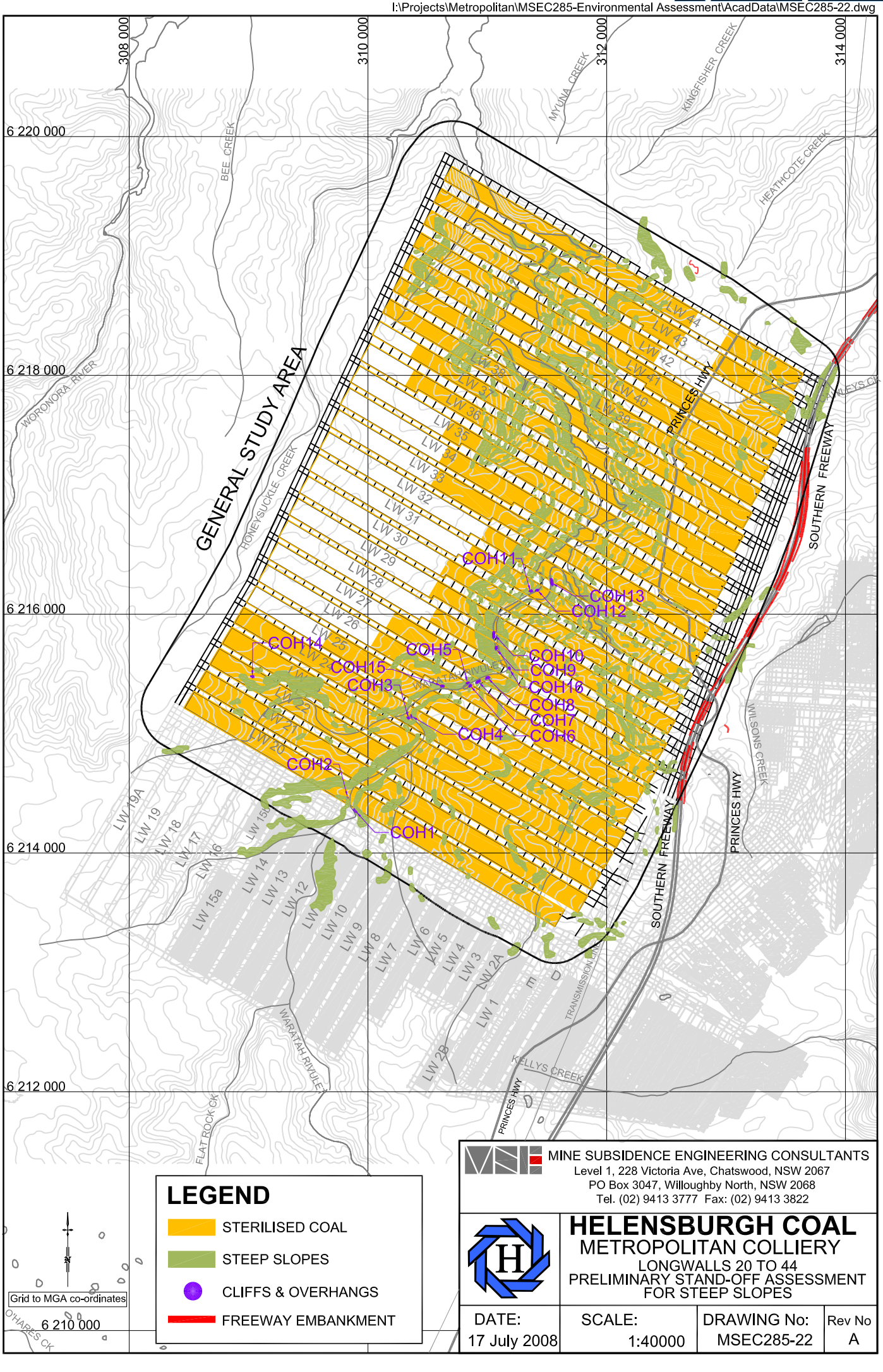

LEGEND

- STERILISED COAL
- STEEP SLOPES
- CLIFFS & OVERHANGS
- FREEWAY EMBANKMENT

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HELENSBURGH COAL
METROPOLITAN COLLIERY
LONGWALLS 20 TO 44
PRELIMINARY STAND-OFF ASSESSMENT FOR STEEP SLOPES

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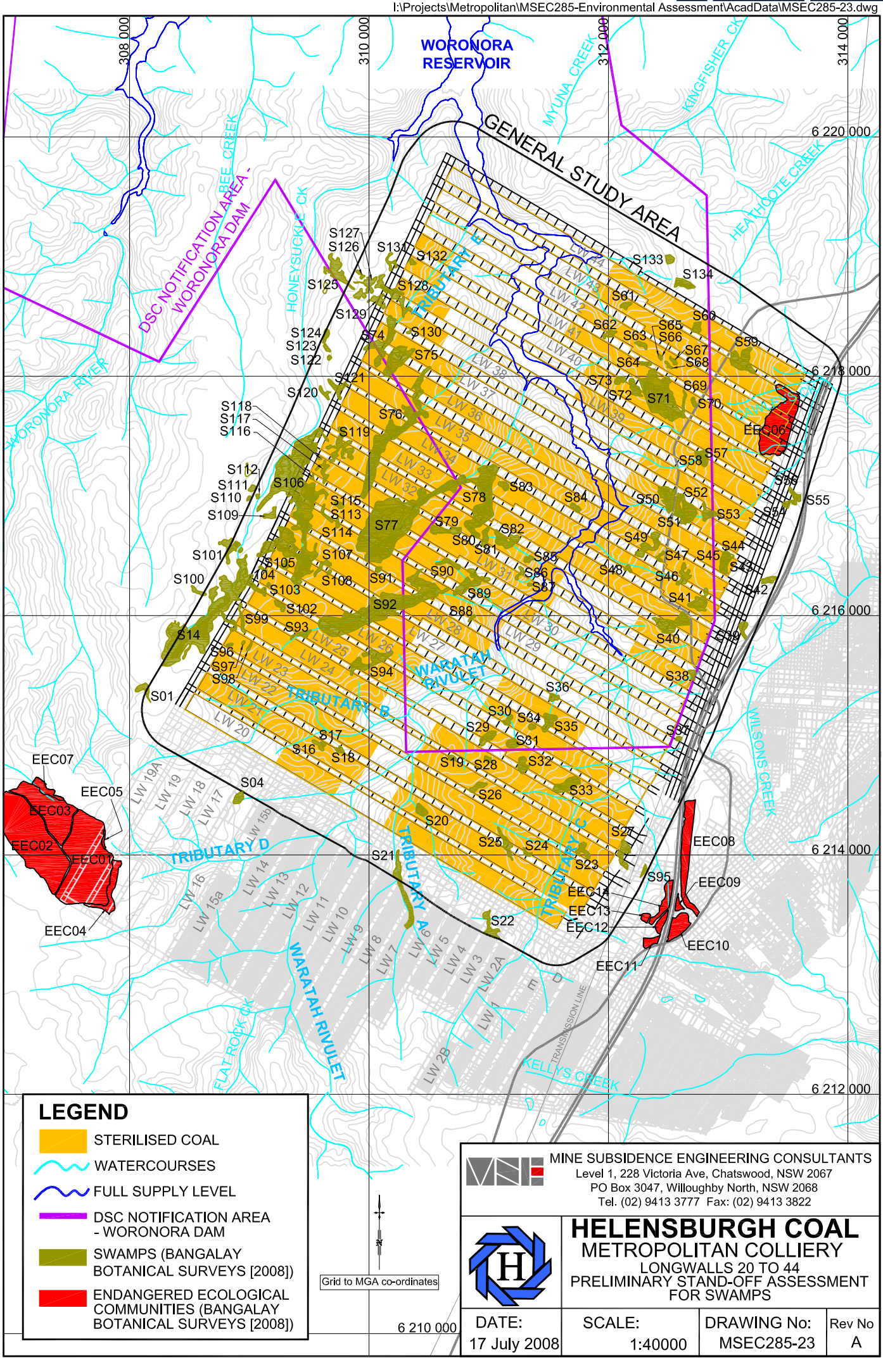

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LONGWALLS 20 TO 44
PRELIMINARY STAND-OFF ASSESSMENT FOR SWAMPS

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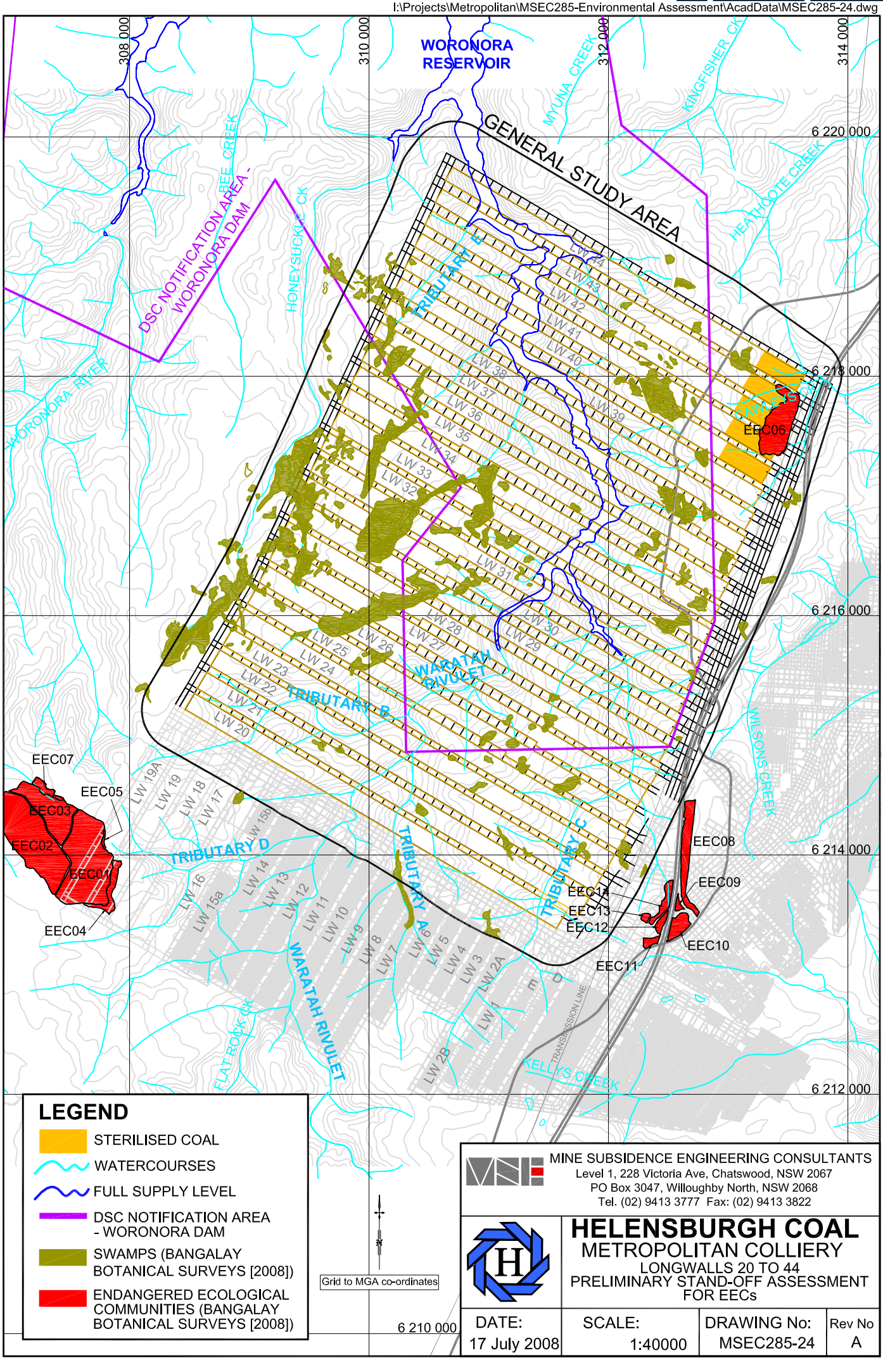

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LONGWALLS 20 TO 44
PRELIMINARY STAND-OFF ASSESSMENT FOR EECs

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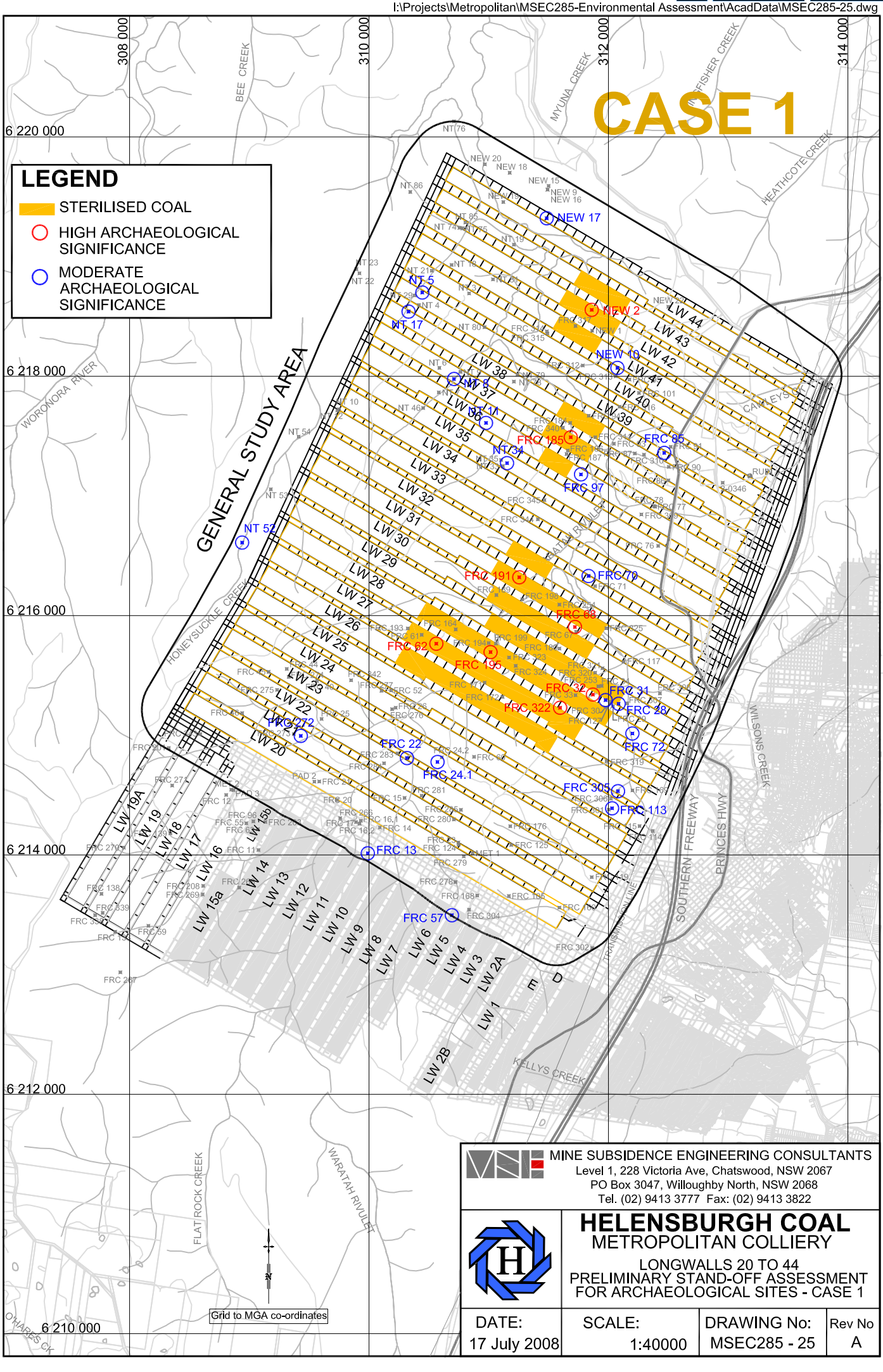

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METROPOLITAN COLLIERY

LONGWALLS 20 TO 44
PRELIMINARY STAND-OFF ASSESSMENT
FOR ARCHAEOLOGICAL SITES - CASE 1

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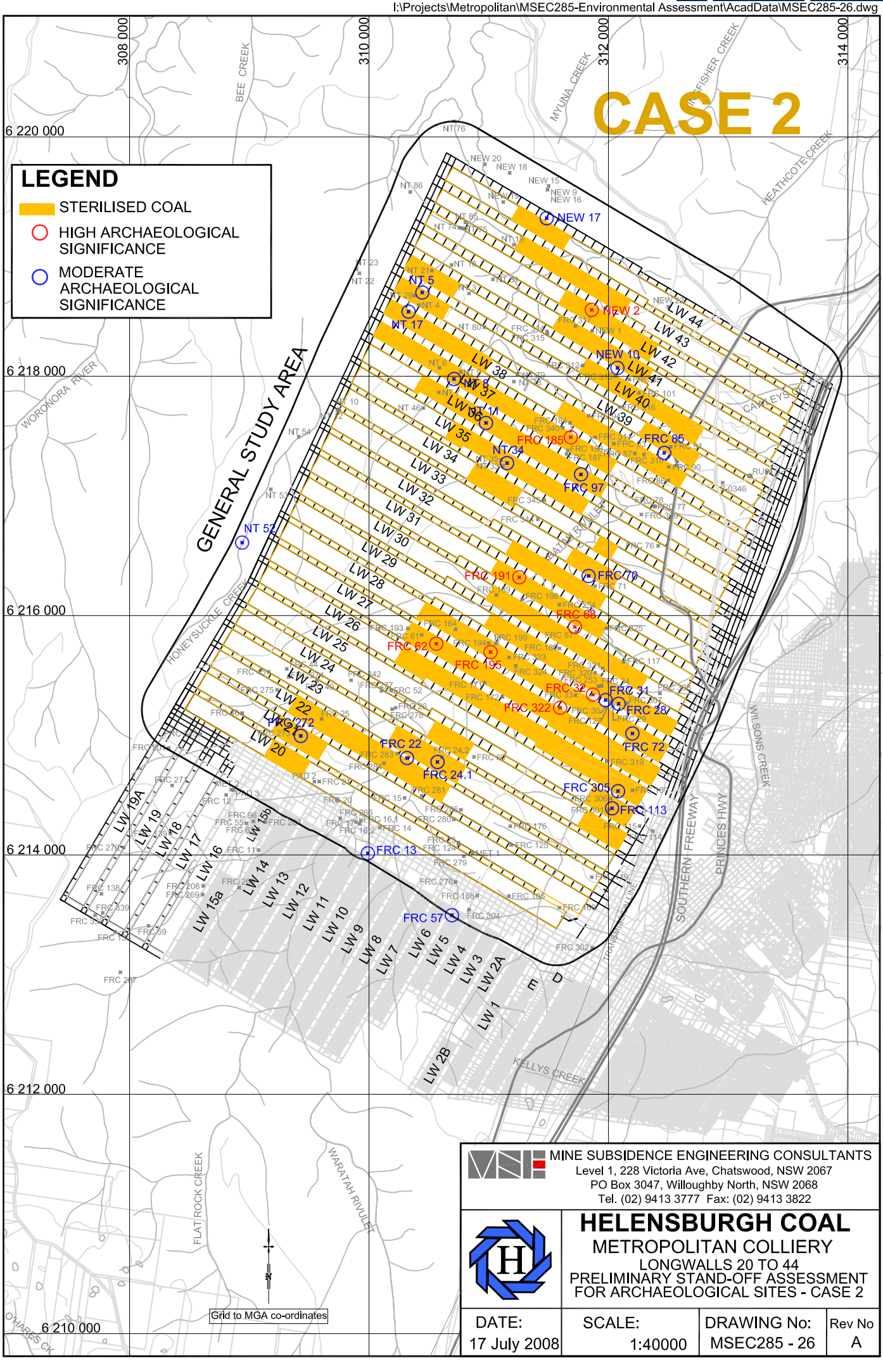

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HELENSBURGH COAL

METROPOLITAN COLLIERY

LONGWALLS 20 TO 44
PRELIMINARY STAND-OFF ASSESSMENT
FOR ARCHAEOLOGICAL SITES - CASE 2

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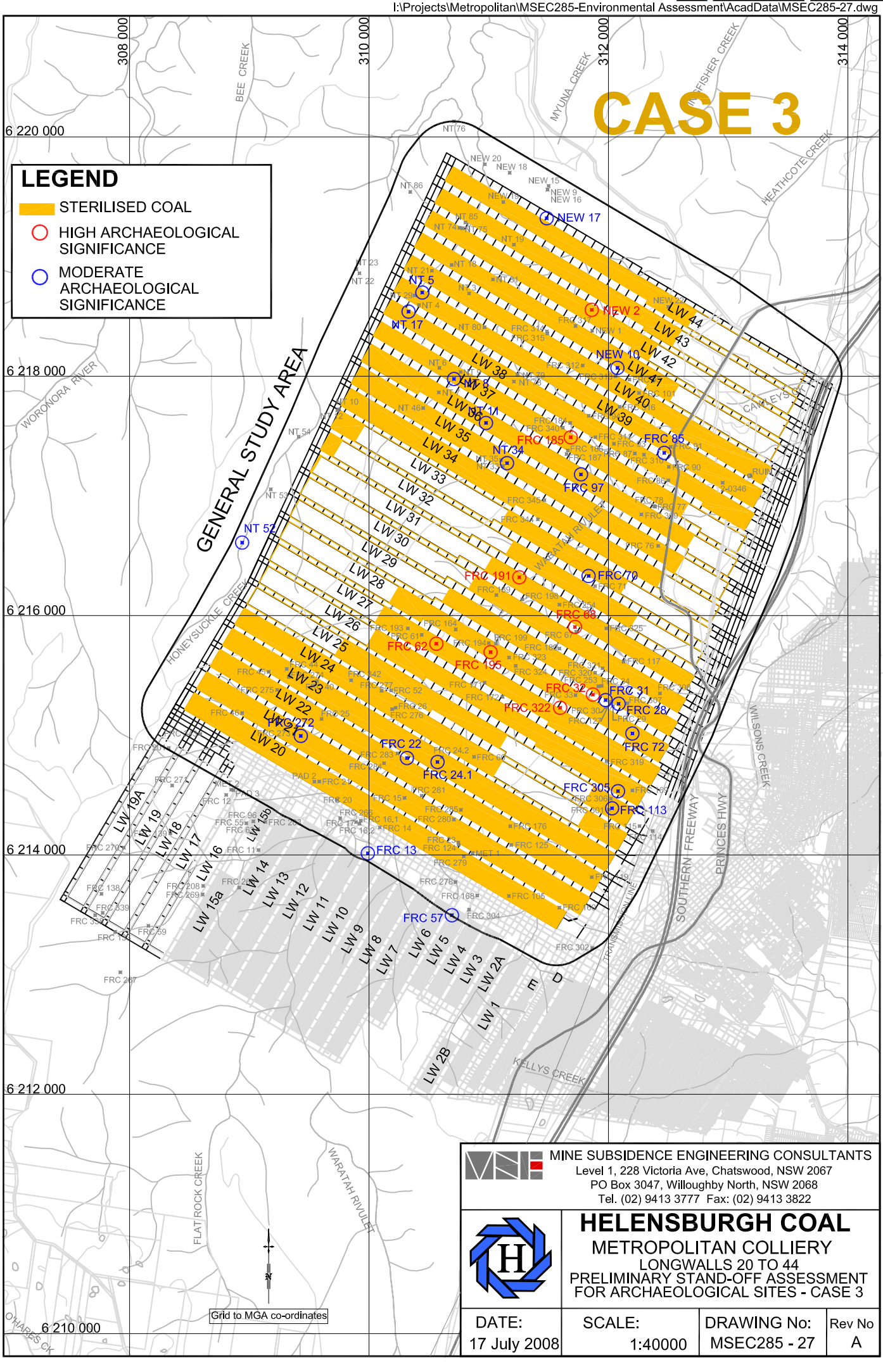

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HELENSBURGH COAL

METROPOLITAN COLLIERY

LONGWALLS 20 TO 44
PRELIMINARY STAND-OFF ASSESSMENT
FOR ARCHAEOLOGICAL SITES - CASE 3

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