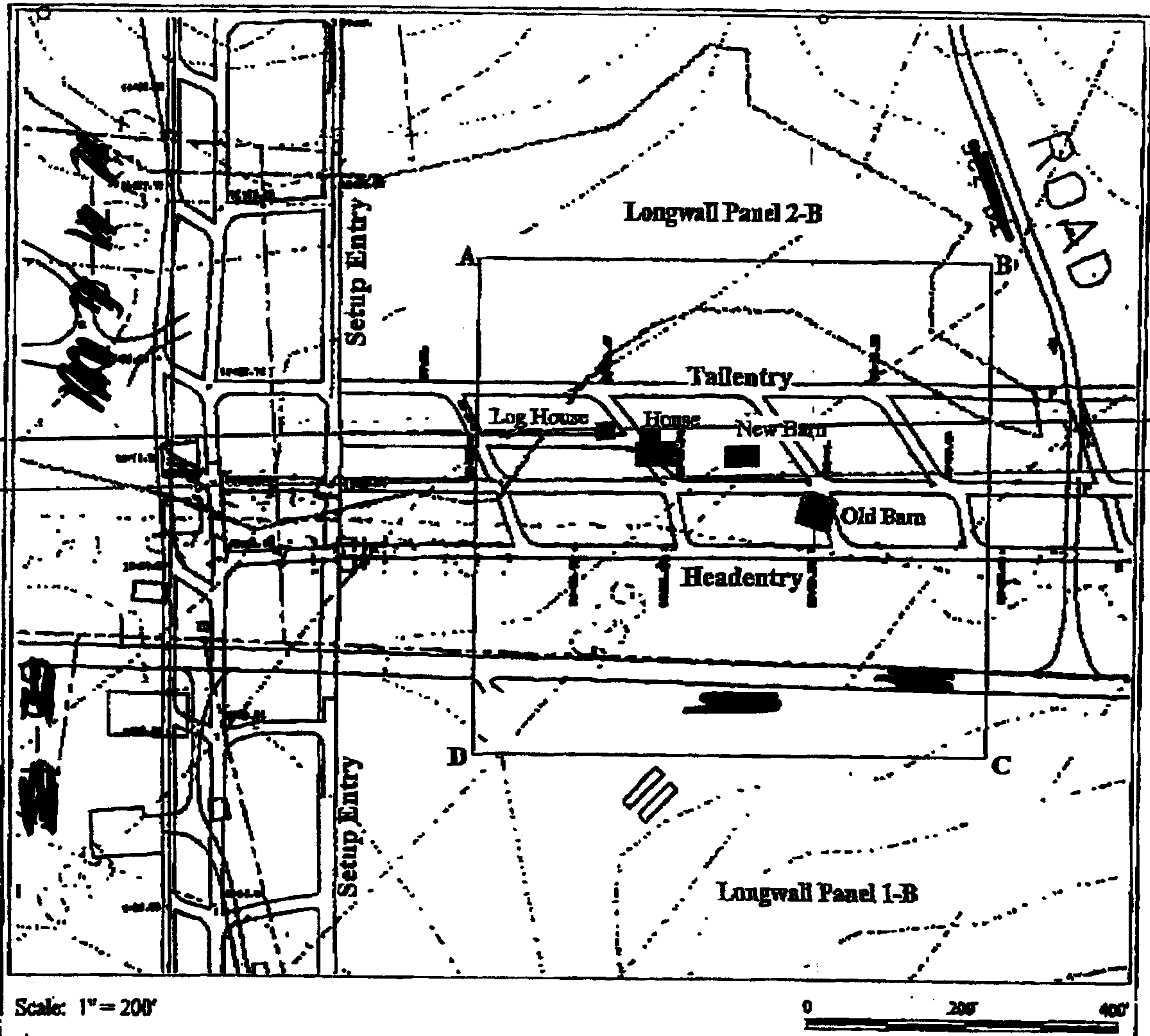


Scale: 1" = 200'

Fig. 1 Overview of the Study Site

The Structures

There are four residential and farm structures, including a brick house, a long house, a new steel sided wood pole barn and an old wood barn, located in this property.

The house is an old two-story brick structure as shown in Figs. 2 and 3. The main part of the house is a T-shaped structure. Three additional parts were attached to the main part of the house (Fig. 3). The front side of the house is about 46 ft wide and the depth of the entire structure is about 38 ft. A cover porch is located along the front side of the house. The basement walls were built with fieldstones.

The log house is shown in Fig. 4. Its dimension is 20 ft long and 18 ft wide. A brick chimney is attached to one of its end. The new barn (Fig. 5) has a dimension of 60 ft long and 24 ft wide. The old barn is a two-story wood frame structure (Fig. 6). It is about 40 ft long and 31 ft wide. This barn has experienced some structural problem before mining as shown in Fig. 6.

SUBSIDENCE PREDICTION

In order to assess the possible influences of the ground subsidence process on the house, the final surface movements (i.e., subsidence and horizontal displacement) and deformations (i.e., slope, strain and curvature) in a rectangular area around the structures (i.e., ABCD in Fig. 1) have been predicted. Since the area of this study is located over the chain pillar system between two longwall panels, it could be affected by the subsidence processes associated with the mining in both panels. Therefore, final subsidence predictions have been conducted at the following two stages: (1) mining in longwall panel 1-B is done, and (2) mining in panel 2-B is done. The mining height of 6.5 ft is used in these predictions.

The special edition of the subsidence prediction program package CISPM version 2.0 developed for Eighty-Four Mine has been used. A large amount of subsidence data collected in and around Eighty-Four Mine been used in the development of the program.

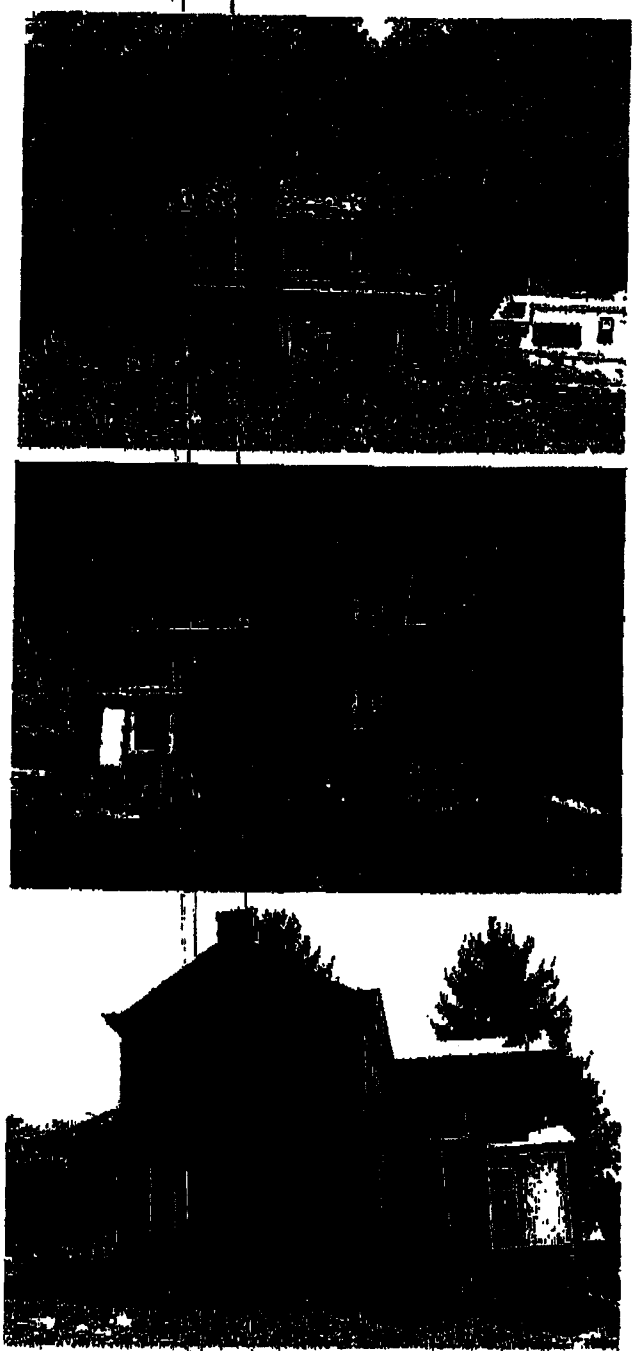
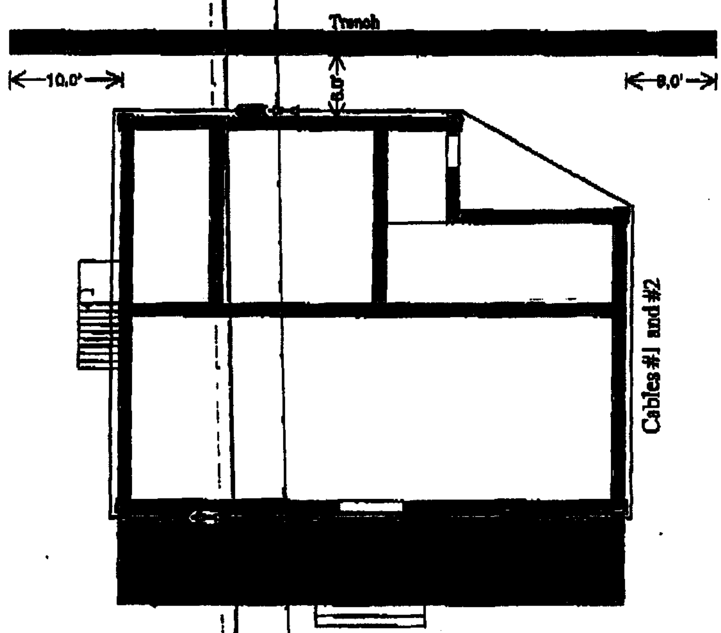


Fig. 2 The Front Right (Upper), Rear (Middle) and Right (Bottom) Views of the House



(a) Plan View

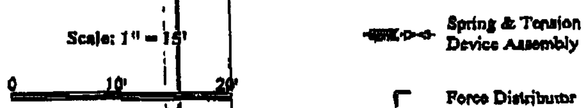
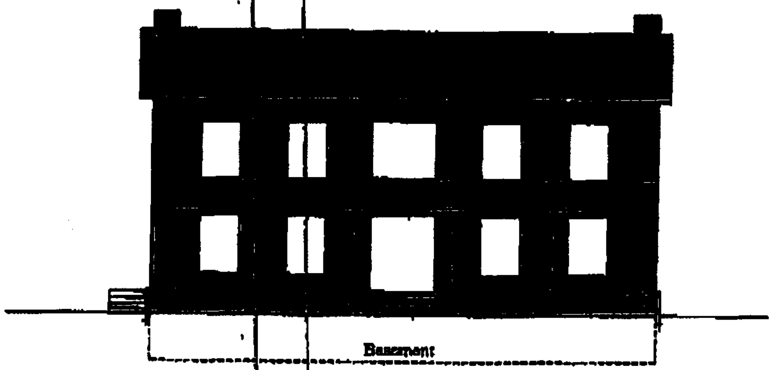
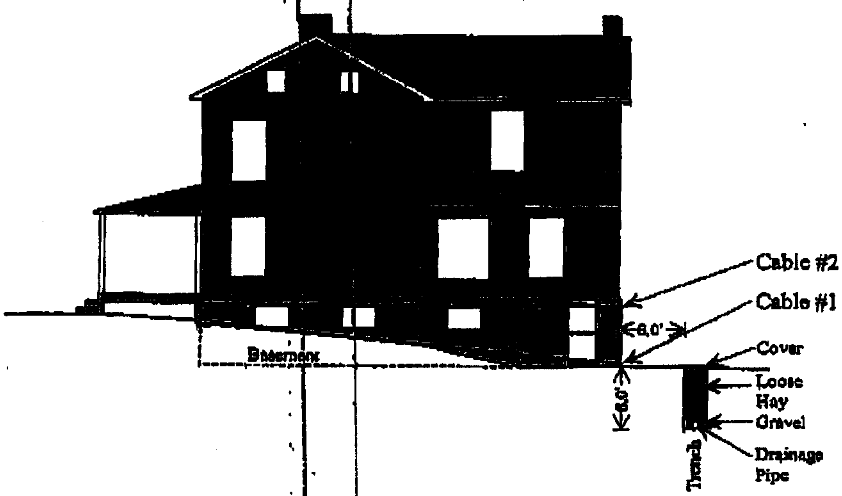


Fig. 3 Recommended Mitigation Measures for the House



(b) Front Side View



(c) Right Side View

Scale: 1" = 15'   0   10'   20'

Fig. 3 Recommended Mitigation Measures for the House (Continued)

Fig. 4 [redacted]

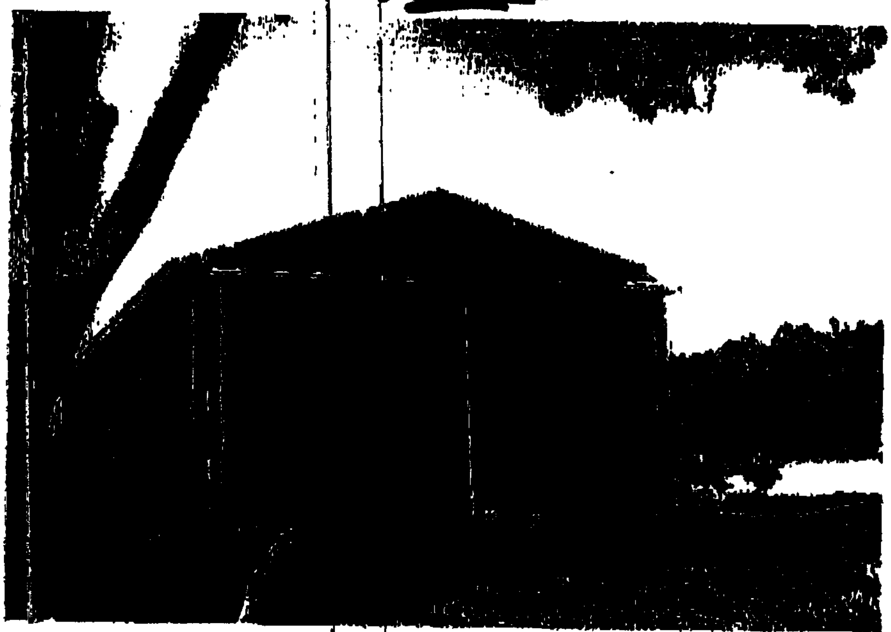


Fig. 5 [redacted]

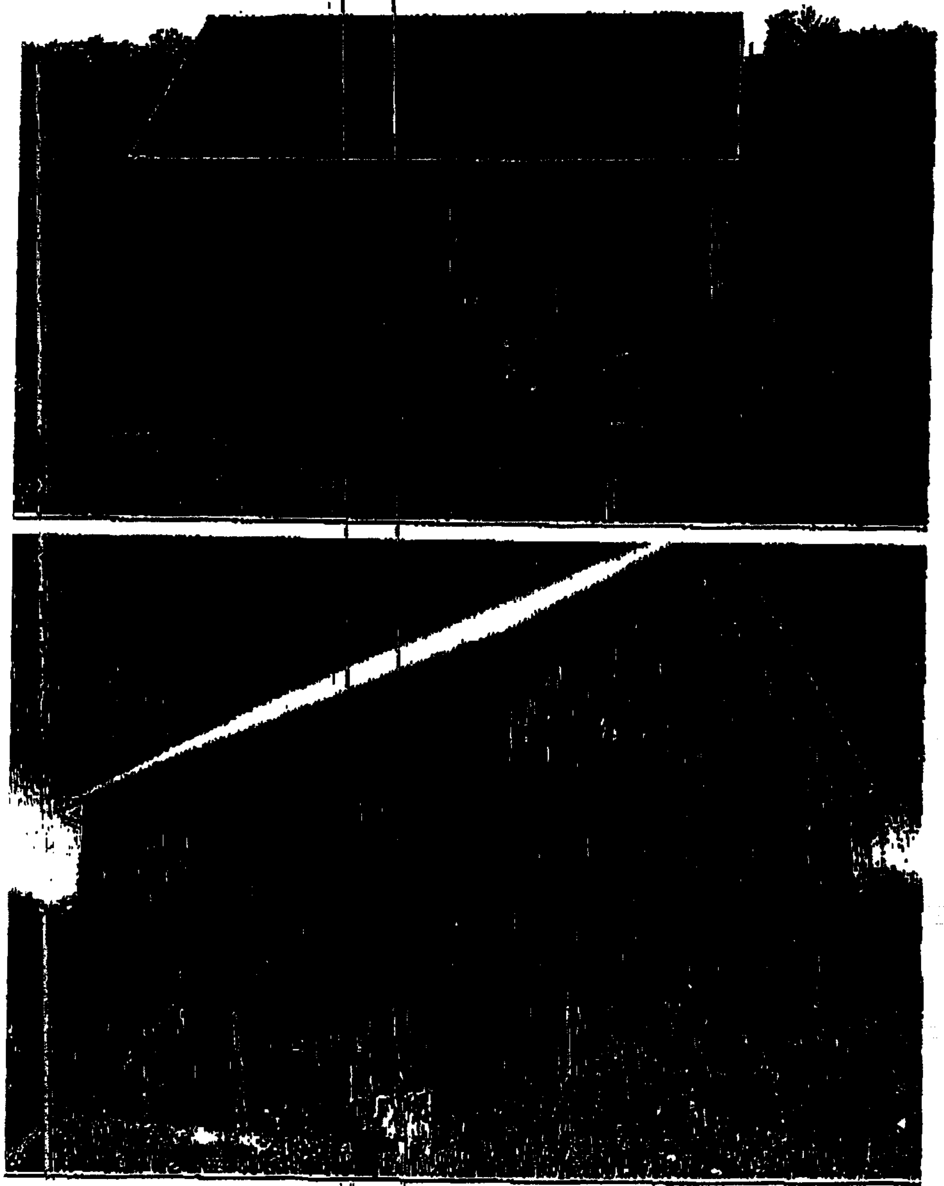


Fig. 6 Front (Top) and Rear Left (Bottom) Views of the [redacted]

Final Subsidence Prediction for Mining in Panel 1-B (1st Stage)

A final subsidence basin will be formed after mining in longwall panel 1-B (the first mining stage). The predicted final surface movements (i.e., subsidence and horizontal displacement) and deformations (i.e., slope, strain and curvature) in the specified rectangular area are presented in this section. It is anticipated that the final subsidence in the study area at this first stage of mining will be reached after the longwall face in panel 1-B has advanced a distance of 2,00 ft away from the panel setup entry.

Final Surface Movements at the First Mining Stage

The predicted final surface subsidence at this stage in the specified rectangular area is plotted in Fig. 7. It shows that all the structures are located beyond the edge of the final subsidence basin to be formed over panel 1-B at this stage. The old barn is closest the edge of this final subsidence basin.

The predicted final horizontal displacement (component along the panel transverse direction) around the structures at the first stage of mining is shown in Fig. 8. The negative values in the figure indicate that the surface movement is in the direction from the headentry to tailentry of panel 1-B. It also shows that the final horizontal displacement at the locations of the structures is very insignificant, if not zero.

Final Surface Deformations at the First Mining Stage

The surface deformations include the following three items: *slope* indicating the subsidence-induced surface tilting, *strain* indicating whether the ground surface is stretched or compressed, and *curvature* indicating the bending condition of the ground surface. The surface deformations plotted in this section are their respective components along the transverse direction of the panel. Their respective components along the panel longitudinal direction are very insignificant when they are compared to the transverse components.

Figure 9 shows the component of the predicted final surface slope along the panel transverse direction at the first mining stage. It shows that the maximum final slope to be experienced at the old barn is only about 0.15% - very insignificant. The other structures will not experience any subsidence-induced slope at the first mining stage.

Figure 10 shows the component of the predicted final surface strain along the panel transverse direction at the first mining stage. A positive value is for tensile strain otherwise for compressive strain. It shows that the maximum tensile strain to be experienced by the old barn is about 2.8×10^{-3} ft/ft at its front right corner. The surface strain induced by mining in panel 1-B is not to spread to the locations of the other structures. However, it should be noted that the maximum tensile zone of the final subsidence basin is located nearly half way between the old barn and route 40. The maximum final tensile strain there is about 1.15×10^{-2} ft/ft.

The component of the predicted final surface curvature along the panel transverse direction around the structures is plotted in Fig. 11. A positive value indicates a convex bending condition while a negative one for concave bending. Figure 11 shows that the front right corner of the old barn is to experience a final surface convex curvature 5×10^{-5} 1/ft. The other structures are located in the bending-free area.

Final Subsidence Prediction for Mining in Panel 2-B (2nd Stage)

Because the structures are located over the chain pillar system between two longwall panels, mining in panel 2-B will induce additional subsidence in the area of the structures. This section presents the predicted final surface movements and deformations in the specified rectangular area after panel 2-B is mined (the second mining stage).

Final Surface Subsidence at the Second Mining Stage

The predicted final surface subsidence in the specified rectangular area around the structures at the second mining stage is plotted in Fig. 12. In order to show the distribution of the final subsidence more clearly, the final subsidence profile along the cross-section of E-E' (Fig. 12) is plotted in Fig. 13. It shows that the final subsidence in the area of the structures after mining of panel 2-B is about 0.61 ft. The house is not to experience any significant differential subsidence after the mining is done.

Scale: 1" = 100'

0 50' 100'

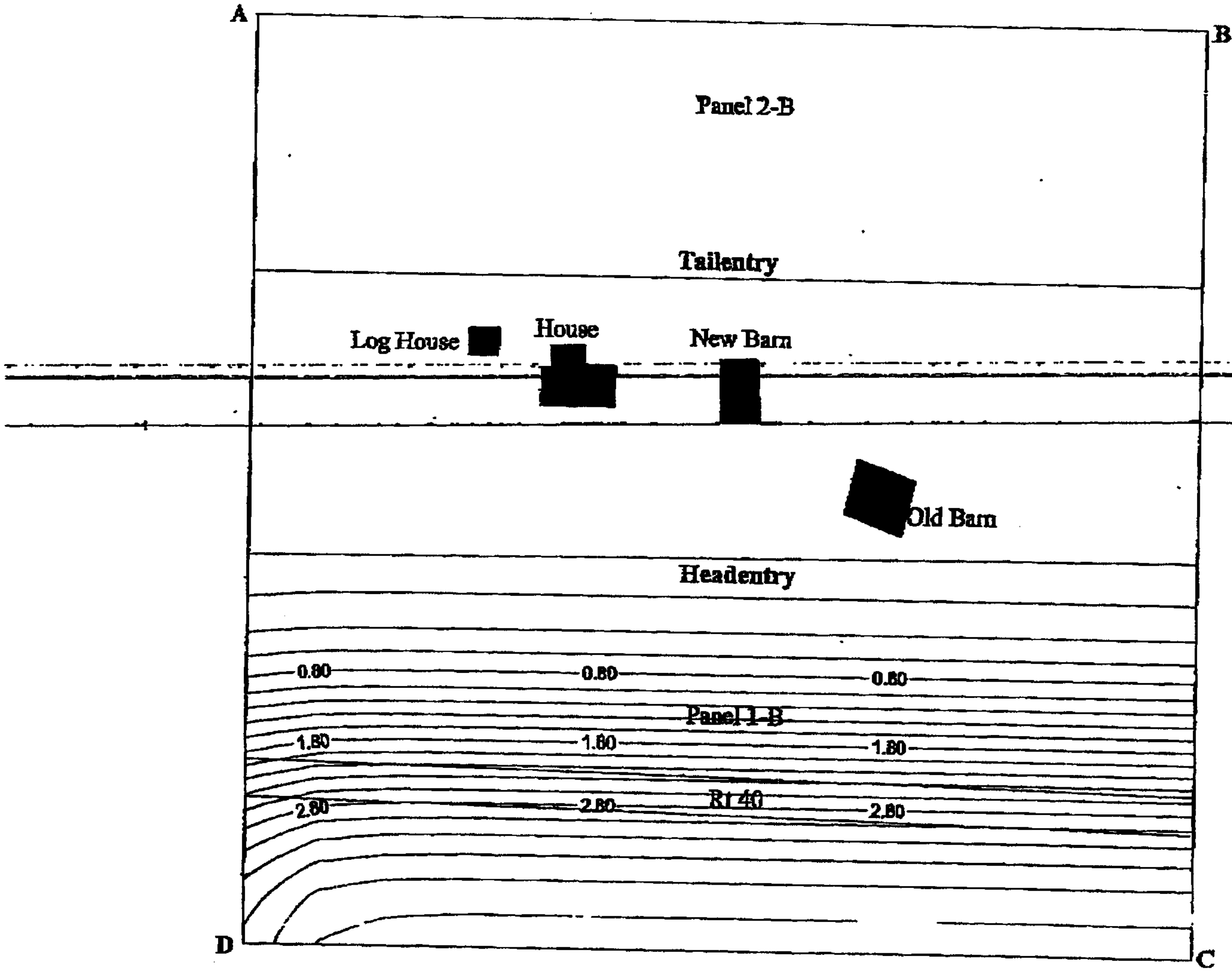


Fig. 7 Predicted Final Surface Subsidence Around the Structures After Panel 1-B Mined

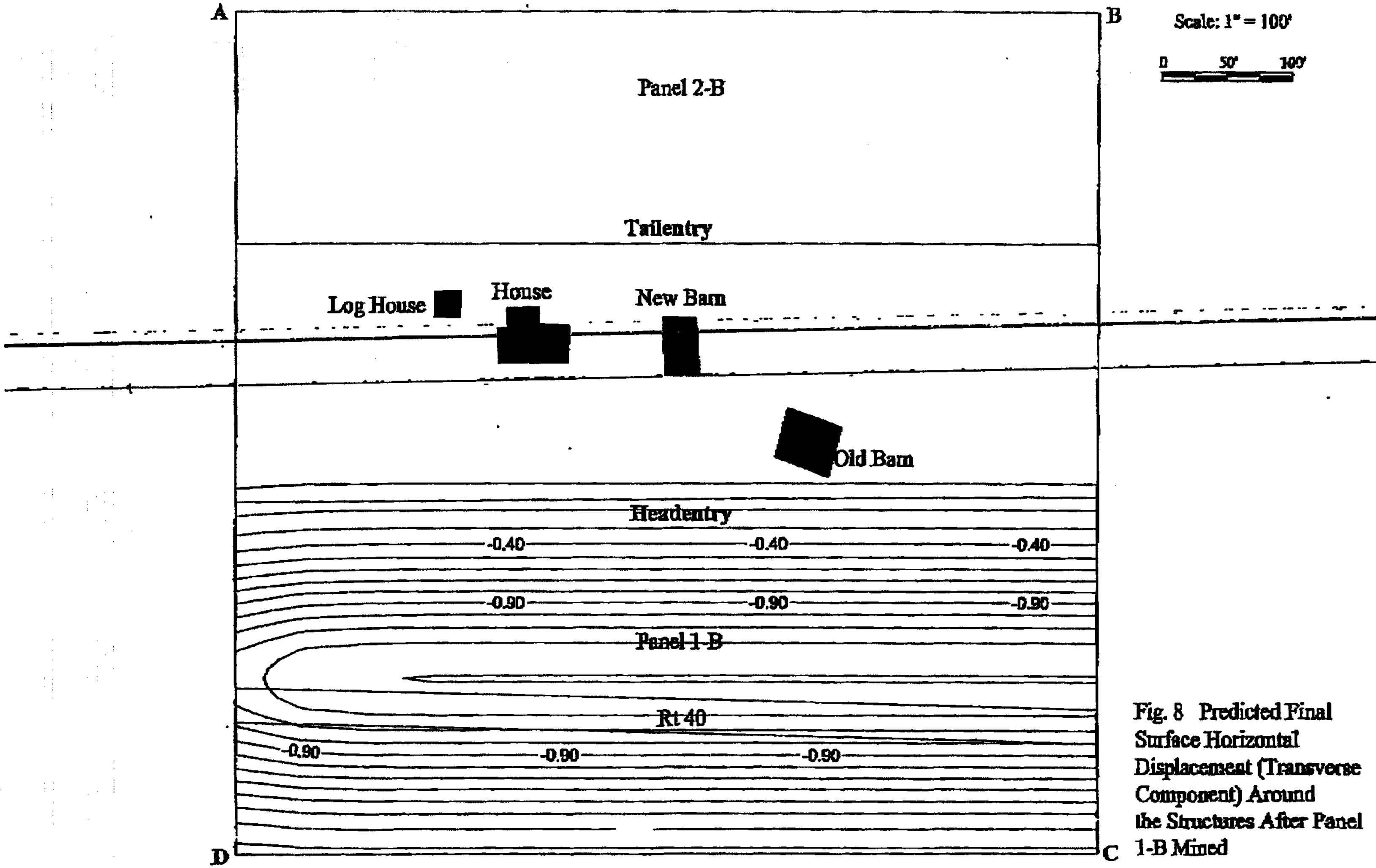
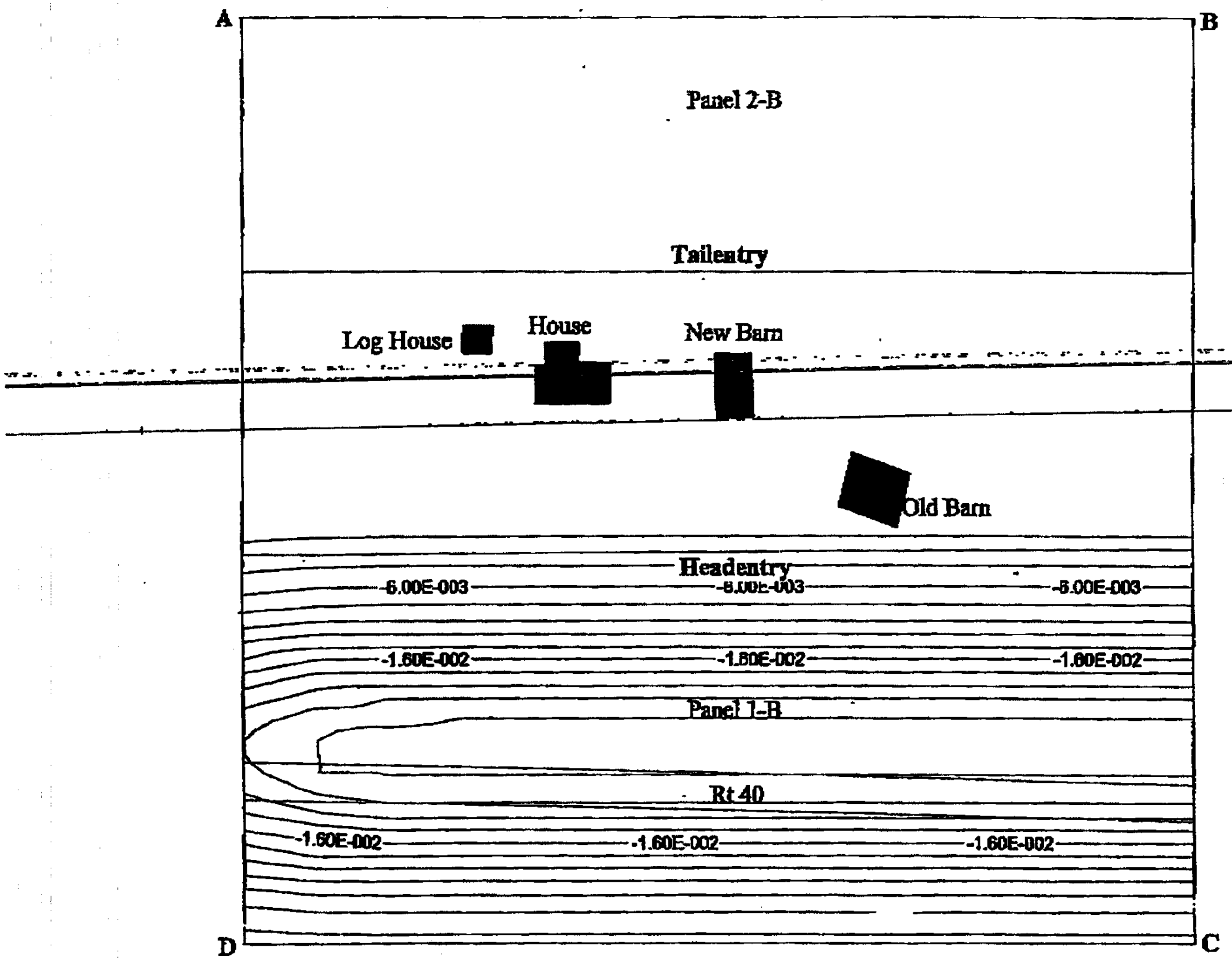


Fig. 8 Predicted Final Surface Horizontal Displacement (Transverse Component) Around the Structures After Panel 1-B Mined



Scale: 1" = 100'

0 50' 100'

Fig. 9 Predicted Final Surface Slope (Transverse Component) Around the Structures After Panel 1-B Mined

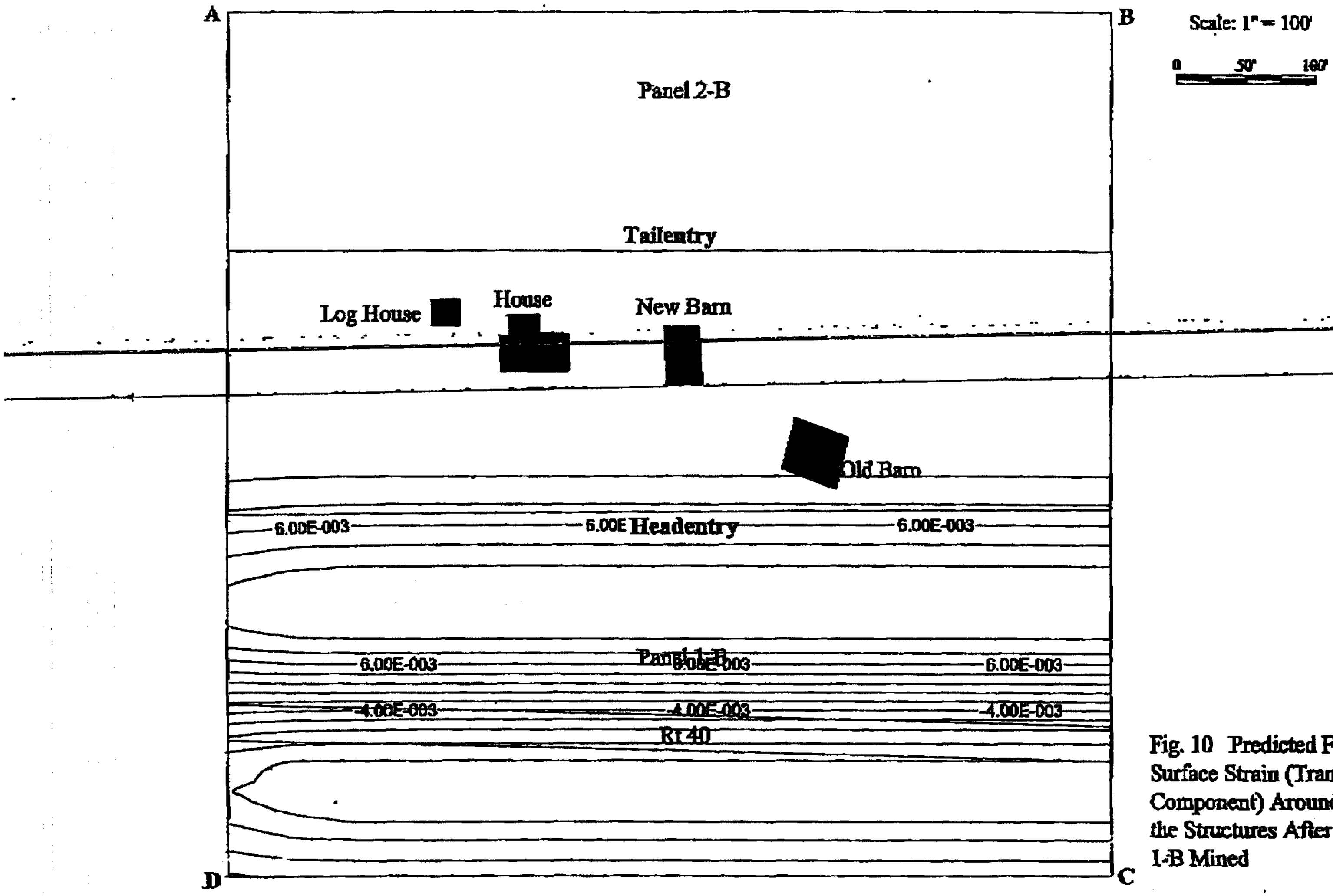


Fig. 10 Predicted Final Surface Strain (Transverse Component) Around the Structures After Panel 1-B Mined

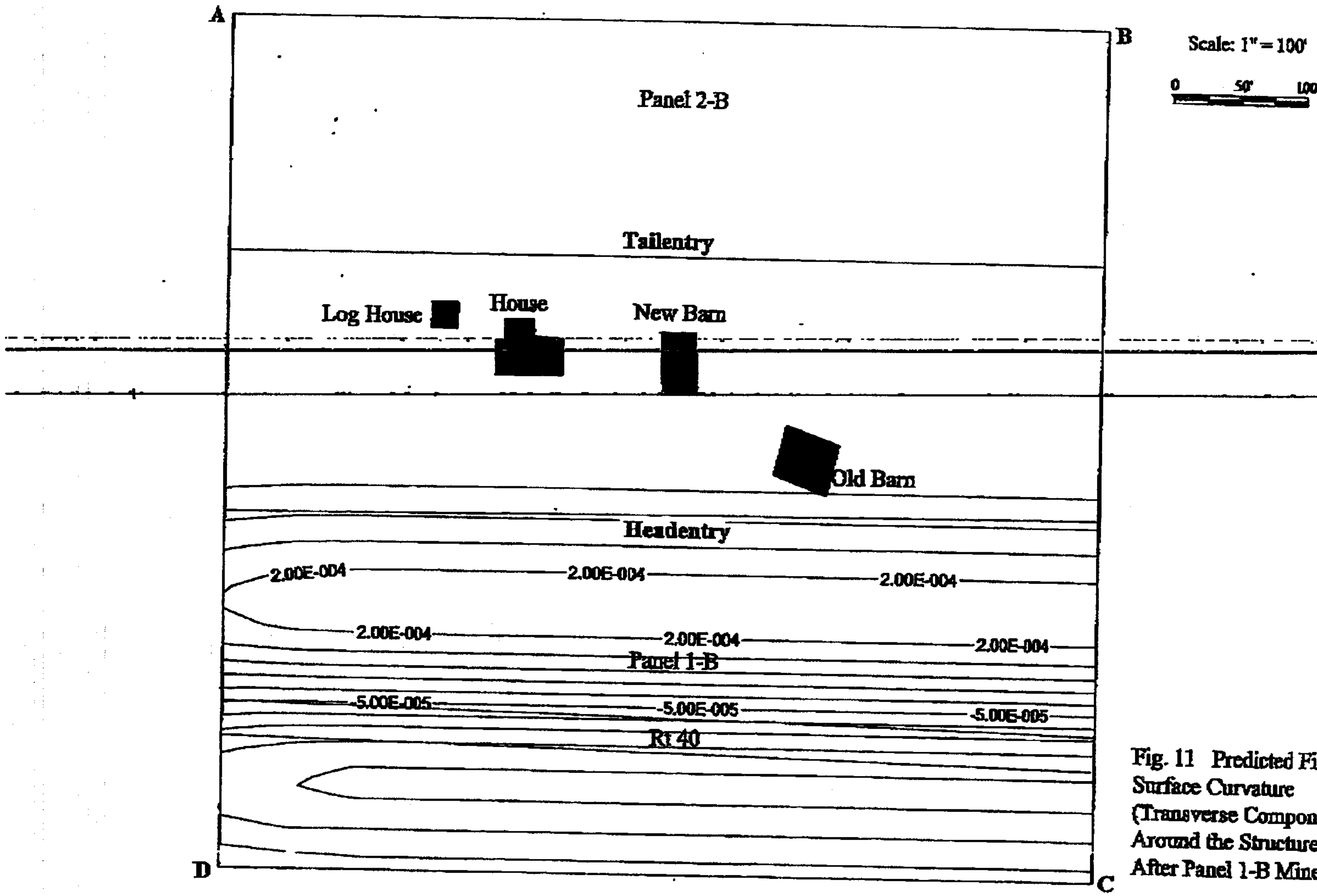
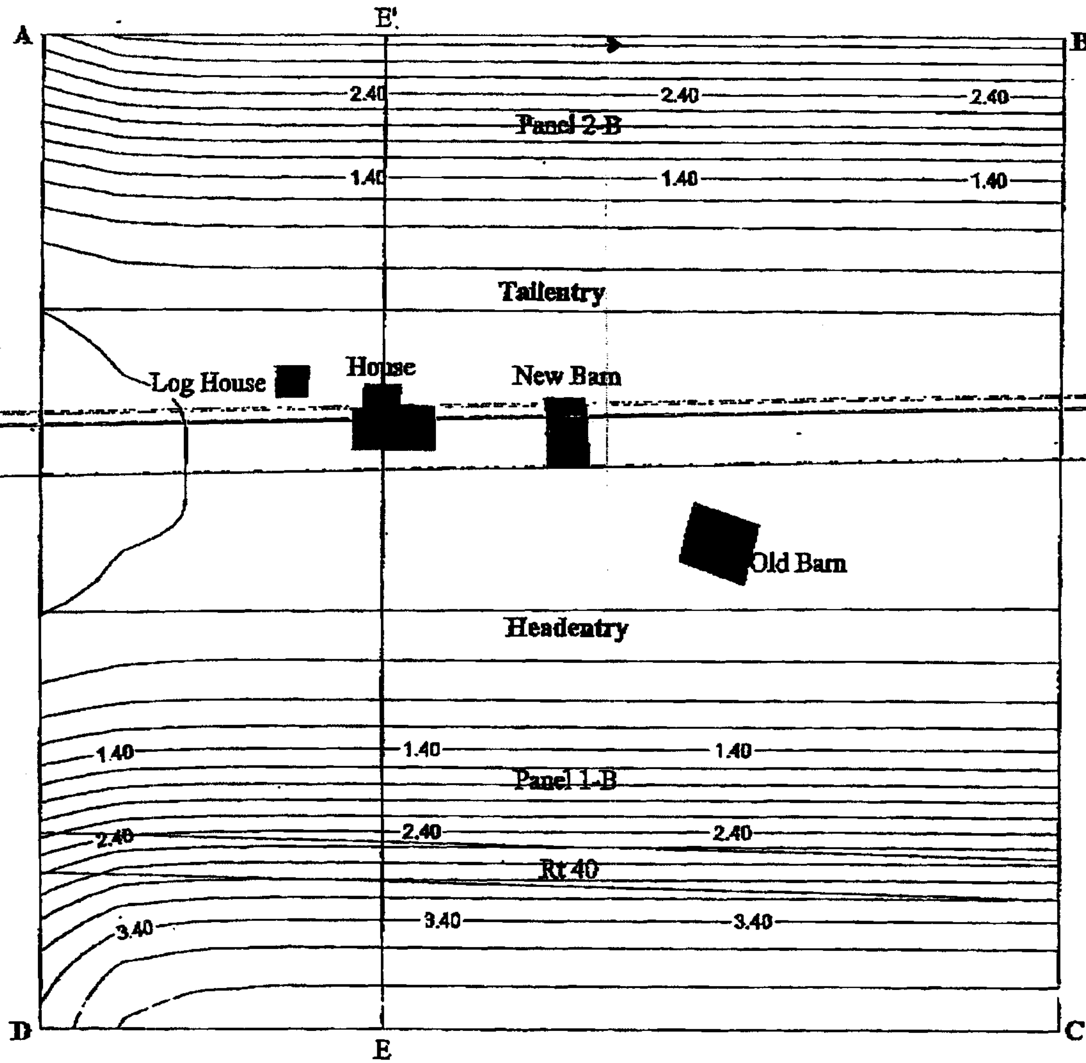


Fig. 11 Predicted Final Surface Curvature (Transverse Component) Around the Structures After Panel 1-B Mined



Scale: 1" = 100'

0 50' 100'

Fig. 12 Predicted Final Surface Subsidence Around the Structures After Panel 2-B Mined

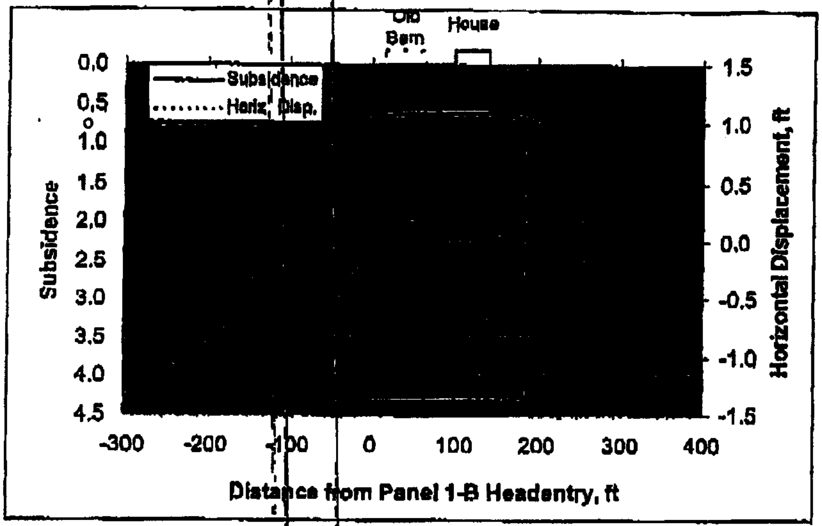


Fig. 13 Distribution of Final Subsidence and Horizontal Displacement Along Cross-Section E-E' After Panel 2-B is Mined

The final horizontal displacement (component along panel transverse direction) in the area of the structures at the second mining stage is plotted in Figs. 13 and 14. It shows that horizontal displacements to be experienced by the structures are very insignificant.

Final Surface Deformations at the Second Mining Stage

The component of the predicted final surface slope along the panel transverse direction in the area of the structures at the second mining stage is plotted in Fig. 15. The surface slope at the location of the house is about 0.05% - very insignificant.

Figure 16 shows the predicted final surface strain (transverse component) in the specified area after panel 2-B is mined. The maximum final surface tensile strain to be experienced by the house is about 0.8x10^{-3} ft/ft along its rear wall.

Figure 17 shows the predicted final surface curvature (transverse component) in the specified area after panel 2-B is mined. The maximum surface curvature at the location of the house at this stage is about 1x10^{-5} 1/ft in convex bending form.

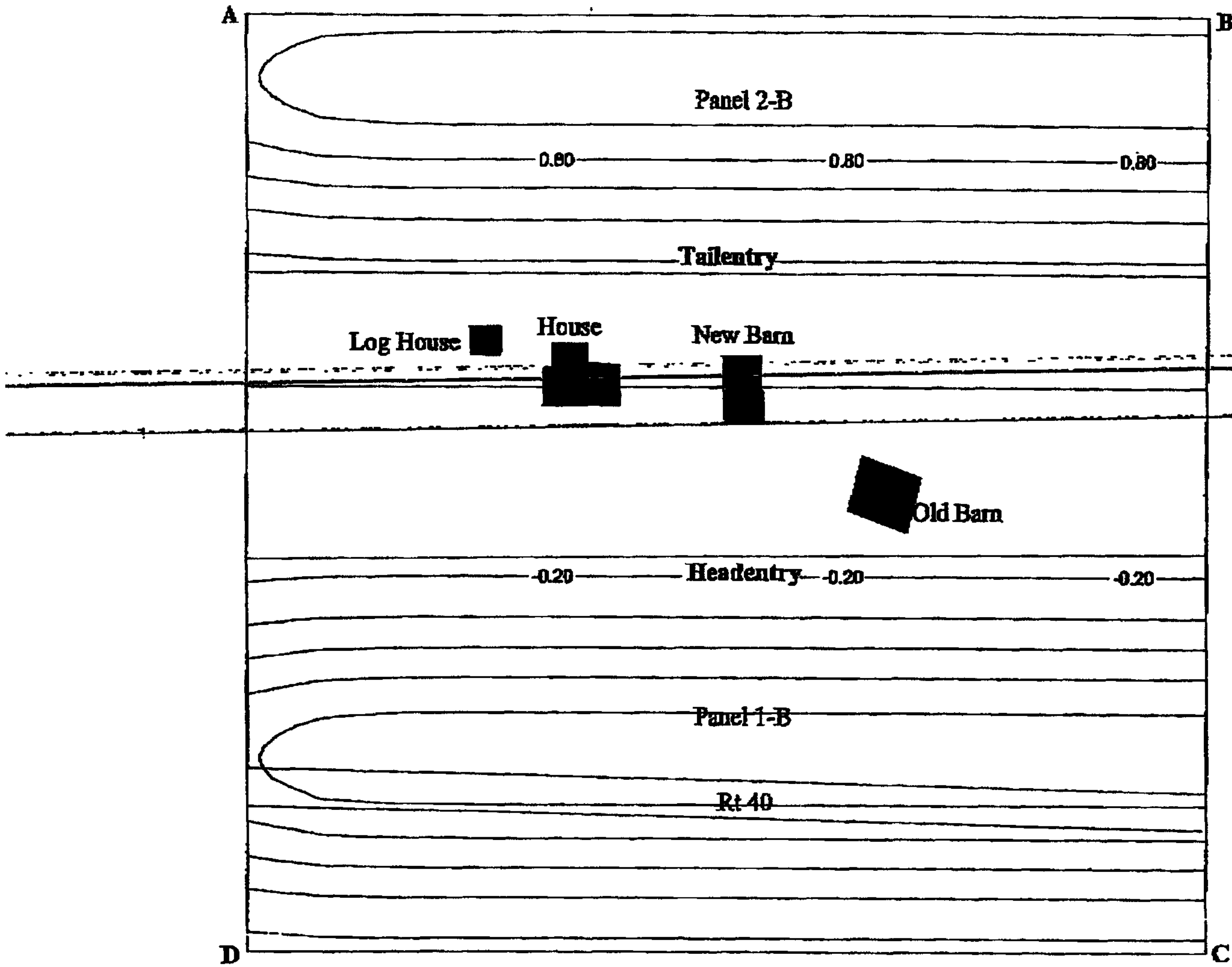
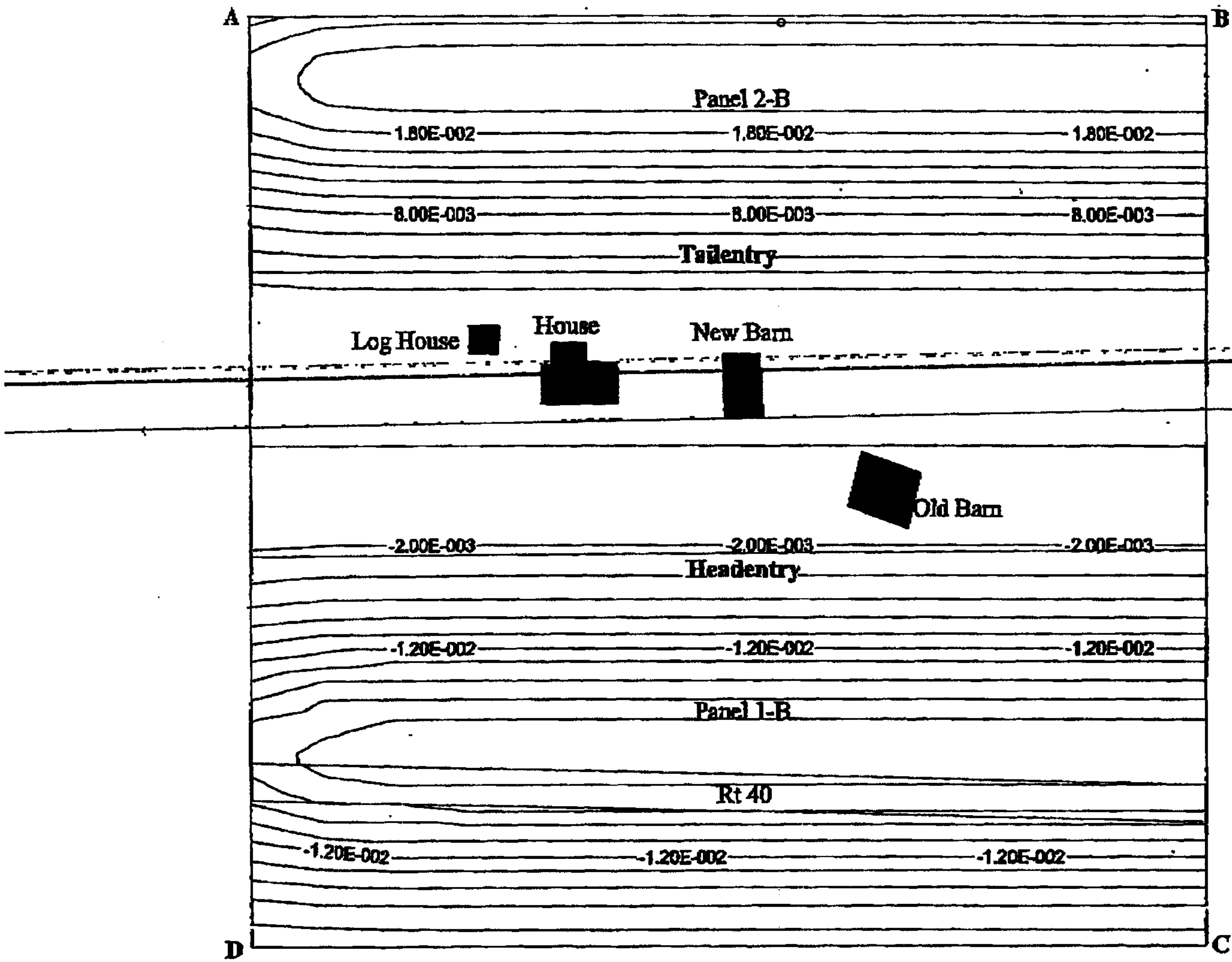


Fig. 14 Predicted Final Surface Horizontal Displacement (Transverse Component) Around the Structures After Panel 2-B Mined



Scale: 1" = 100'

0 50' 100'

Fig. 15 Predicted Final Surface Slope (Transverse Component) Around the Structures After Panel 2-B Mined

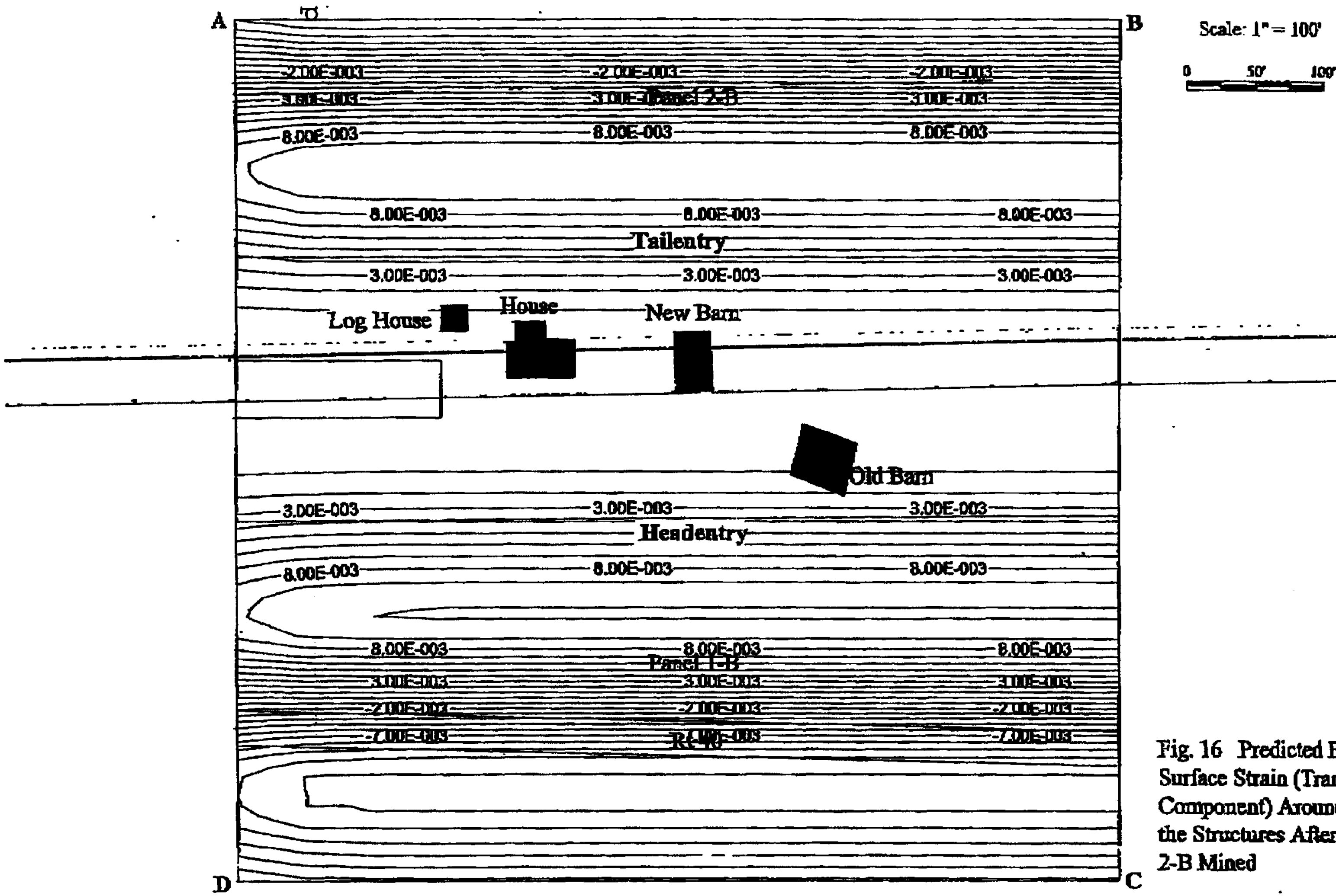


Fig. 16 Predicted Final Surface Strain (Transverse Component) Around the Structures After Panel 2-B Mined

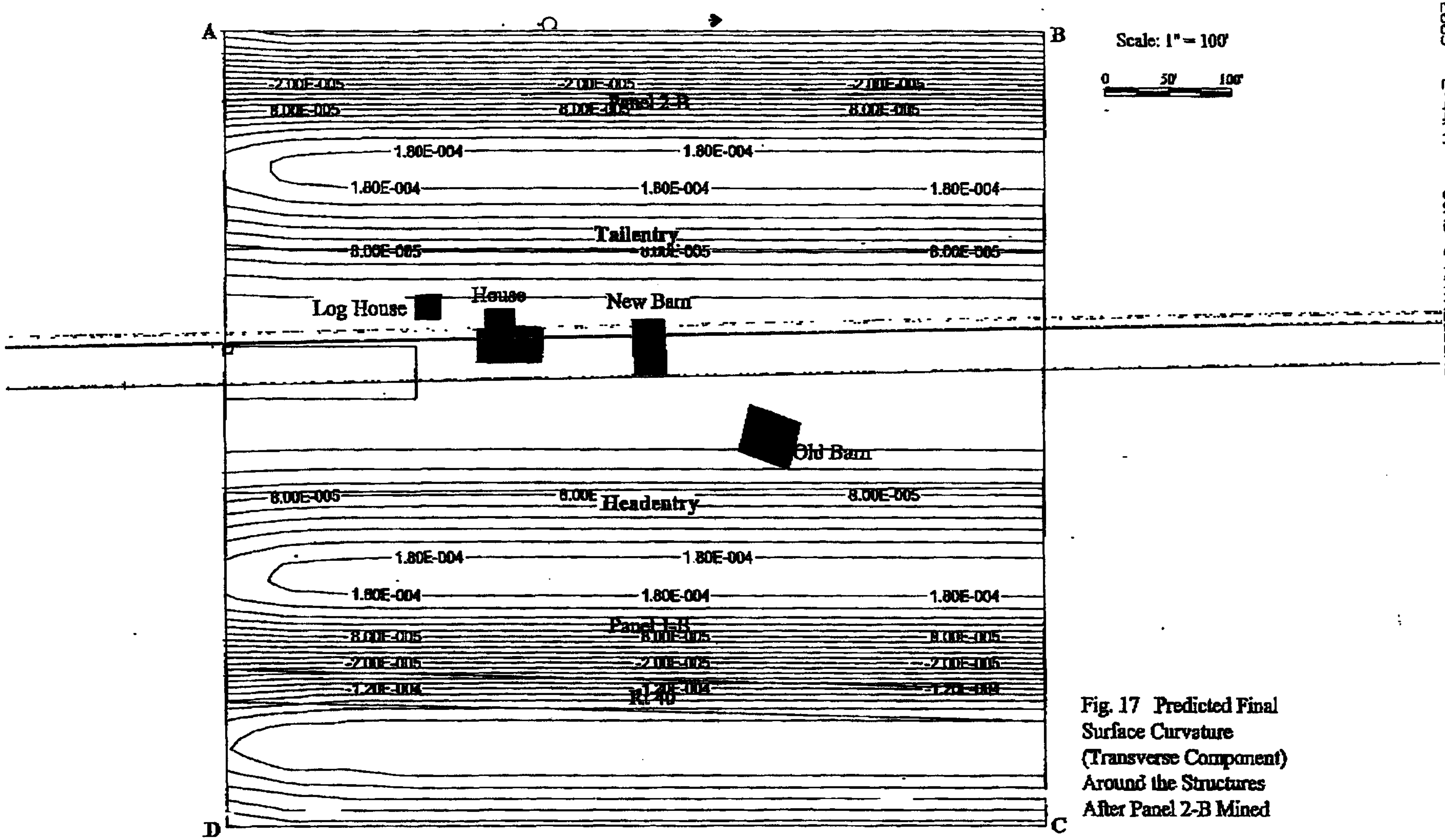


Fig. 17 Predicted Final Surface Curvature (Transverse Component) Around the Structures After Panel 2-B Mined

Dynamic Subsidence Process

The dynamic subsidence prediction describes the development process of surface movements and deformations at a surface point of interest before the final subsidence at this point is reached. Among the four structures, it is expected that the house will be more severely affected by the dynamic subsidence process than the other structures. Therefore, dynamic subsidence surface movements and deformations are predicted along the house rear wall where the dynamic subsidence process is more active than the other part of this structure. An advance rate of 60 ft/day is used in the dynamic subsidence prediction. The predicted development curves of dynamic subsidence and horizontal displacement are plotted in Fig. 18. It shows that the dynamic subsidence process starts when the longwall face in panel 2-B is right beside the house. The dynamic subsidence process is most active with one half of the final subsidence being reached when the face has passed the point of interest a distance of 170 ft. The surface point regain stable condition when the face is outby the point a distance of 500 ft.

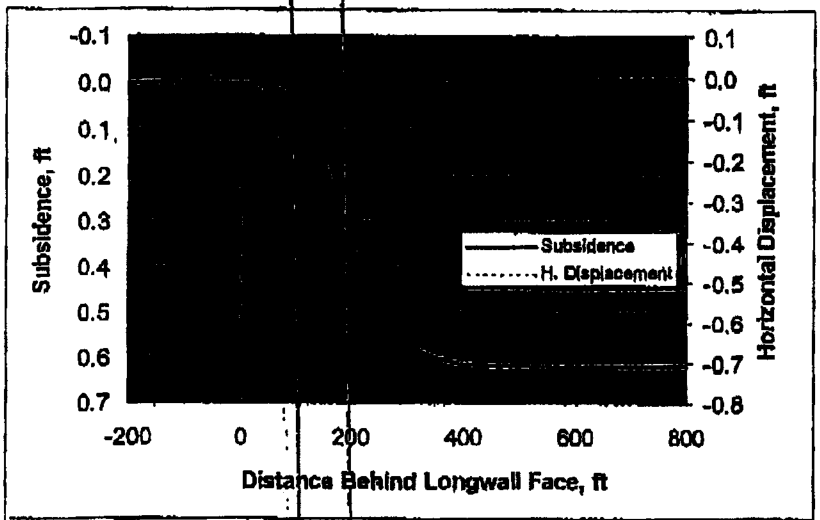


Fig. 18 Development Curves of Dynamic Subsidence and Horizontal Displacement along the Rear House Wall

Figure 19 shows the development curves of dynamic slope and strain (their respective components along the panel longitudinal direction) along the house rear wall. It shows that the dynamic slope at the house reaches its maximum of 1.3% when the face is about 170 ft outby the surface point of interest. The time period for the dynamic slope to exceed 1% is when the face location is between 130 ft and 210 ft passed the point of interest.

The dynamic strain profile indicates that the ground surface along the panel longitudinal direction begins to experience tensile strain when the longwall face is right beside the point. The maximum dynamic tensile strain, 7.4×10^{-3} ft/ft, is reached when the longwall face is 105 ft past the point of interest. The dynamic tension process ends when the face has passed the point a distance of 170 ft. The dynamic compression state follows and reaches its maximum of -6.6×10^{-3} ft/ft when the face is 230 ft outby the surface point. The ground surface point returns to strain free condition along the panel longitudinal direction when the face is about 600 ft passed.

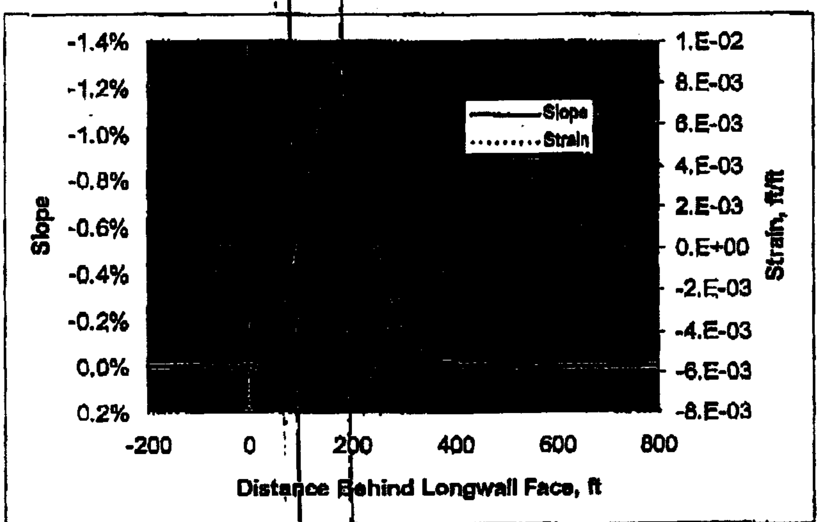


Fig. 19 Development Curves of Dynamic Slope and Strain Along House Rear Wall

ASSESSMENT OF SUBSIDENCE INFLUENCES

In the assessment of the possible subsidence influences on the structures, the predicted final and dynamic surface deformations are compared to the following critical deformation indices. The size, materia[l] and construction of the structures are also considered in the assessments. These critical deformation values have been deducted from and validated by numerous subsidence studies.

Critical slope:	1.00%
Critical strain for stone foundation walls:	3×10^{-3} ft/ft
Critical strain for initiating cracks earth ground:	1.2x10-2 ft/ft
Critical curvature for house super-structure:	6×10^{-5} 1/ft

Among the four structures, the two barns are flexible in materials and construction while the log house is very small. Therefore, it is very unlikely for these three structures to be affected to any significant degree by the surface deformations predicted at their respective locations in the previous section.

At the location of the house, only the dynamic surface slope and tensile strain among the predicted final and dynamic surface deformations are capable of causing problems to the house. The dynamic slope, with the maximum being 1.3%, could make living in the house slightly uncomfortable. However, the period for the dynamic surface slope at the location of the house to exceed the 1.0% limit will only last for about three days.

The dynamic tensile strain, with the maximum being 7.4×10^{-3} ft/ft, is capable of inducing cracks on the basement walls and the lower portion of the brick walls as well as the basement floor pavement. The most possible locations for the cracks are on the basement walls parallel or near parallel to the panel longitudinal direction. If not properly protected, the total width of the cracks on either the front or rear basement wall could be about 2.5 inches. The worst time for the house will be when the longwall face in panel 2-B is about 100 ft passed the center of the house.

RECOMMENDED MITIGATION MEASURE

Although the mining would not affect the two barns and the log house to any significant degree as indicated in the previous section, the poor existing conditions along the lower portion of the rear wall of the old barn (Fig. 6) warrants some precautionary actions being taken to protect the old barn. The most efficient way is to install a number wood post to increase the loading capacity to the super-structure.

The previous section also indicates that the dynamic tensile strain caused by the longwall mining operation in panel 2-B is the only surface deformations that could cause any significant structural problems to the house. It should also be noted that the high tension zone of the final subsidence basin to be formed over panel 2-B is just a short distance behind the house as shown in Fig. 16. In order to reduce the severity of the anticipated problems to the house, two mitigation measures, compensation trench and tension cable methods, are recommended for the house.

Compensation Trench Method

As a cautionary measure, it is recommended to dig one straight compensation trench on the back of the house as shown in Fig. 3 to reduce the final tensile strain to be experienced by the house basement from panel 2-B. A compensation trench creates a weak plane between the structure and the strain-generating ground so that a reduction of the transmission of the surface strain from the strain-generating ground to the structure can be realized. Through such a reduction of strain transmission, the problems that will potentially develop on the structural foundation on the structural parts can be reduced.

This trench should be located about 6 ft away from the rear house wall and extend 10 ft beyond the left and right house walls as shown in Fig. 3. It should be two (2) ft wide and 6 ft deeper than the basement floor. The trench should be kept well drained by burying a perforated pipe at the bottom with gravel and its remaining space filled with loose hay. When necessary, pumps should be used to pump the accumulated water in the trench. The trench should be properly covered with wood boards and fenced during its service.

Tension Cable Method

Two steel cables should be used to wrap the basement walls of the house as shown in Fig. 3. The tension cable method is reducing the severity of the structural problems that is to be caused by the dynamic strain through the following three ways.

(1) Initiating a compressive stress field in the basement walls so that it can compensate for some of the tensile stress caused by the tensile strains,

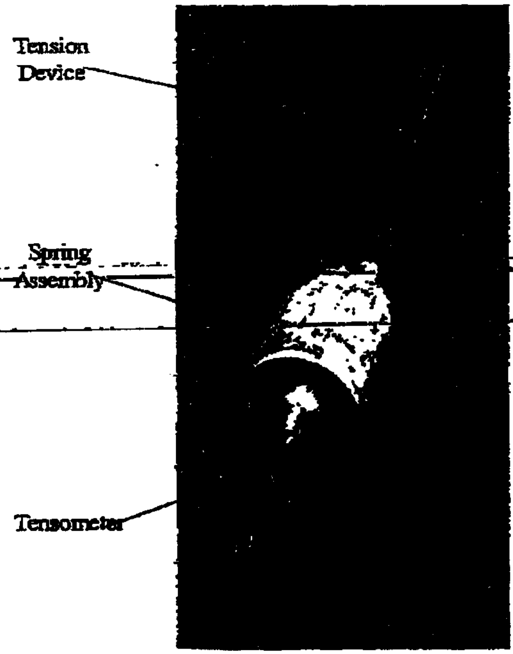
(2) Increasing the rigidity of house so that they can tolerate more tensile strain transmitted to it, and

(3) Applying counter-moment to compensate for the moment on the house superstructure induced by the convex curvature.

The placement of the two tension cables around the house is shown in Fig. 3. Tension cable No. 1 should wrap the basement walls and be placed as close to the ground surface around the house as possible. The tension on this cable should be maintained at 3.5 tons (7,000 lbs). Cable No. 2 should be placed about 6 inches below the top of the basement walls. The tension on this cable should be maintained at 3.0 tons (6,000 lbs).

Two tension devices should be used at the shown locations for each cable to maintain its tension at the specified level. Springs should be inserted on the cables to keep the tension relatively uniform around the house. An example of the assembly of tension device, spring and tensometer is shown in Fig. 20. Wood boards (12-inch wide and 2-inch thick) should be inserted between the cables and the house walls at the house corners to distribute the cable force more evenly to the walls. The tension cables in the areas of frequent traffic should be properly covered during their service. In order to strengthen the structures, the basement doors should be braced at the levels of the tension cables using wood boards as shown in Fig. 3.

The construction of the compensation trench and the installation of the tension cables around the house should be finished before the longwall face in panel 2-B is 100 ft inby the house. They will be kept in place until the face has reached a distance of 2,000 ft away from the panel setup entry.



Spring Assembly in Use

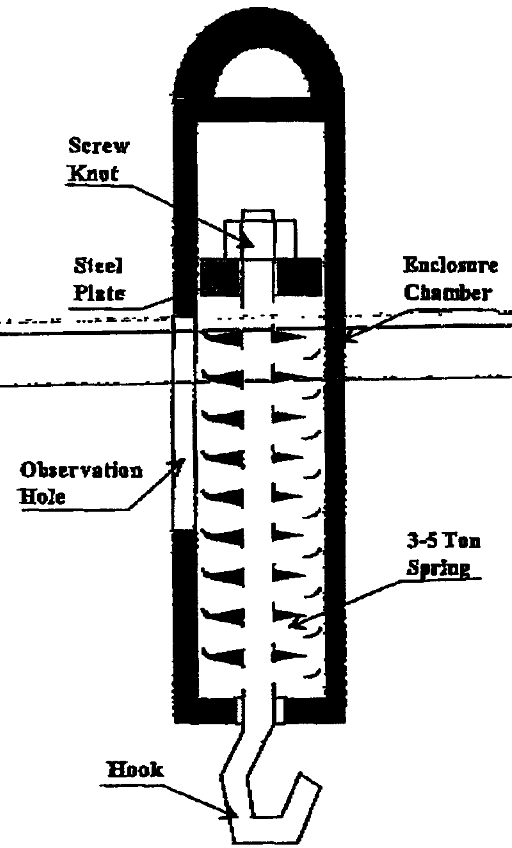


Fig. 20 Construction of the Spring Assembly

CONCLUSIONS AND RECOMMENDATIONS

The possible subsidence influences on two structures in the [redacted] property have been studied and presented in this report. Based on the study, the following conclusions and recommendation can be made:

- Since the two structures are located over the chain pillar system between two longwall panels, they will experience two subsidence processes. However, the subsidence process induced by mining of panel 1-B (the first mining stage) is unlikely to cause any significant problems to the structures. Mining of panel 2-B (the second mining stage) will induce some problems to the house mainly by the dynamic tensile strain.
- Compensation trench and tension cable method are recommended for the house to reduce the severity of the anticipated subsidence problems to the house basement. As a precautionary measure, wood posts should be installed in the lower part of the old barn to reduce the effects of mining in panel 1-B.

INTRODUCTION

Mining in a longwall panel in RAG Emerald Mine will be conducted under a house and a garage belonging to [redacted] family. It is anticipated that the ground subsidence processes associated with longwall mining operation in the panel could influence these structures to some degree. RAG has conducted an evaluation and assessment of the potential subsidence influences associated with longwall mining on the house and the garage.

This report presents the predicted final and dynamic surface movements and deformations in the area around the structures based on the application of CISPM, a subsidence prediction program, conducted by the Department of Mining Engineering, College of Engineering and Mineral Resources, West Virginia University. Based on RAG's analysis of the subsidence prediction and field experience, the possible subsidence effects on the structures have been assessed. Recommendations to reduce the severities of the anticipated problems on the structures have been developed by RAG's engineers.

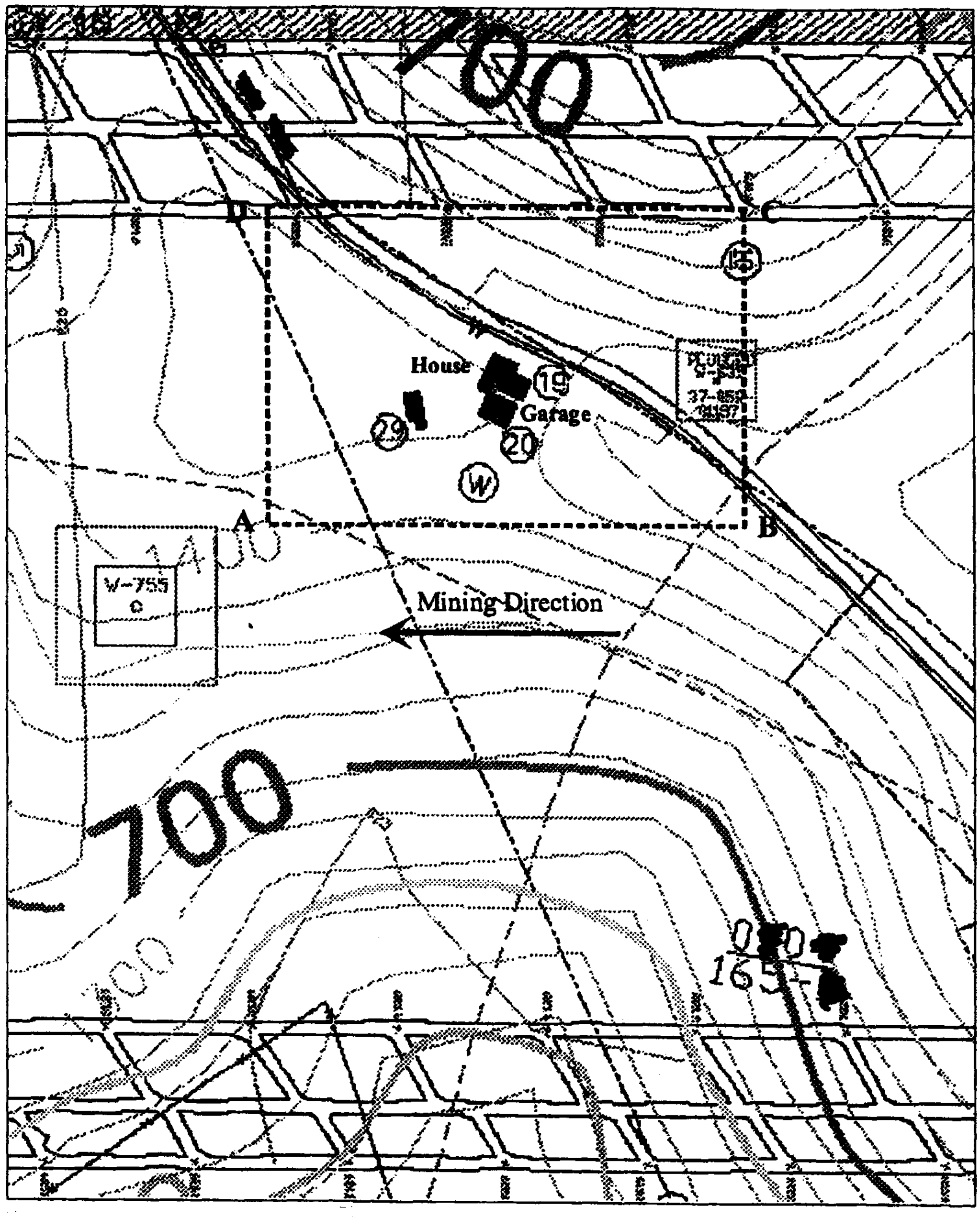
LONGWALL PANEL AND STRUCTURES

The Longwall Panel

Figure 1 shows the longwall panel located under the house and the garage. The rib-to-rib width of the longwall panel is about 1,038 ft wide and the thickness of the Pittsburgh coal seam is about 6.5 ft. The surface topography is also shown in Fig. 1. The house is located in a flat area of a ridge top with its front side being about 314 ft from the chain pillar tailentry. The garage is about 10 ft behind the house. The total width of the chain pillar system is about 184 ft. The average overburden depth at the house is about 790 ft.

The Structures

The house (Fig. 2) is a one-story wood structure with a full basement. It occupies an area of about 42 ft long and 34 ft wide as shown in Fig. 3.



Scale: 1" = 200' 0 200' 400'

Fig. 1 Overview of the Subsidence Study Site

One covered wood porch is attached to the front side of the house while a small room is attached to the rear side of the house as shown in Fig. 3. The basement has concrete block walls and its top is about 2 ft above the ground level. A concrete stairway on the rear side of the house leads to the basement. There is one wood beam runs under the superstructure along the longitudinal center line. Concrete paved walkways are located on both the front and rear sides of the house. There is one chimney located on the right side of the house. Two septic tanks are buried under the surface on the left side of the house.

The garage has concrete block walls and concrete pavement floor as shown in Fig. 4. The concrete pavement is said to be 8 inches thick. Two tanks (heating oil?) are buried underneath the garage floor with a pipeline leading to the house. The garage is located at the edge between the flat area top and a relatively steep slope surface on its left. Concrete step foundation is built to negotiate with the original uneven ground surface.

SUBSIDENCE PREDICTION

In order to evaluate the possible influences of the ground subsidence process on the two residential structures, final surface movements and deformations have been predicted in a rectangular area around the house (ABCD in Fig. 1) using the subsidence prediction program CISPM version 2.01 developed by the WVU Department of Mining Engineering. A mining height of 6.5 ft was used in these subsidence predictions.

The development of the prediction package is based on the influence function method that is widely adopted in the major mining countries including US coal mining industry and a large amount of collected subsidence data, with most of them being collected over longwall panels mining in the Pittsburgh coal seam. Among the collected subsidence cases from the Pittsburgh Seam, the majority of them was located within a 15-mile radius from this study site. This subsidence prediction program package has been successfully applied in various subsidence projects in the Pittsburgh coal seam and proven to be accurate.

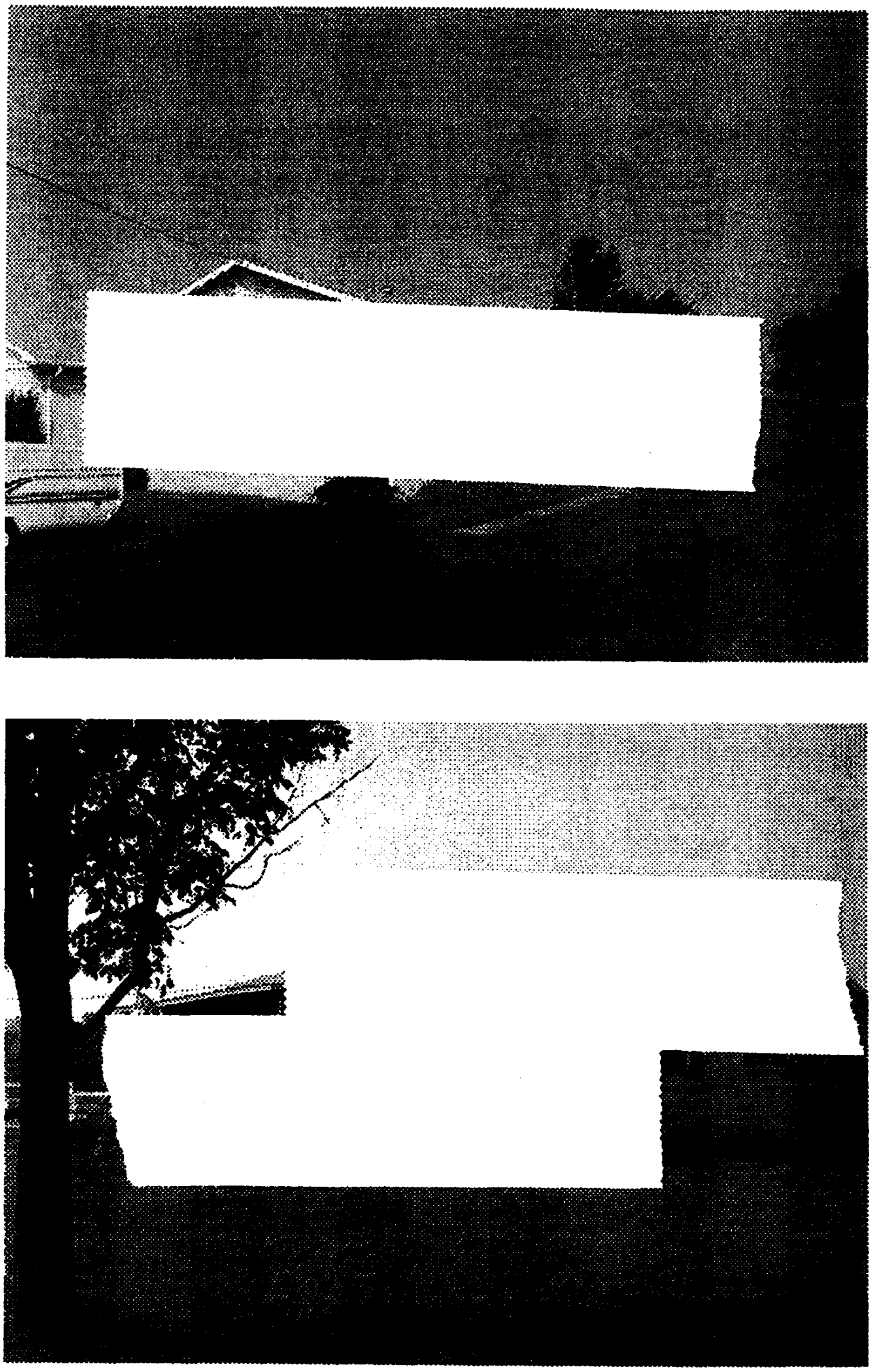


Fig. 2 The Front Left (Top) and Front Right (Bottom) Views of the House

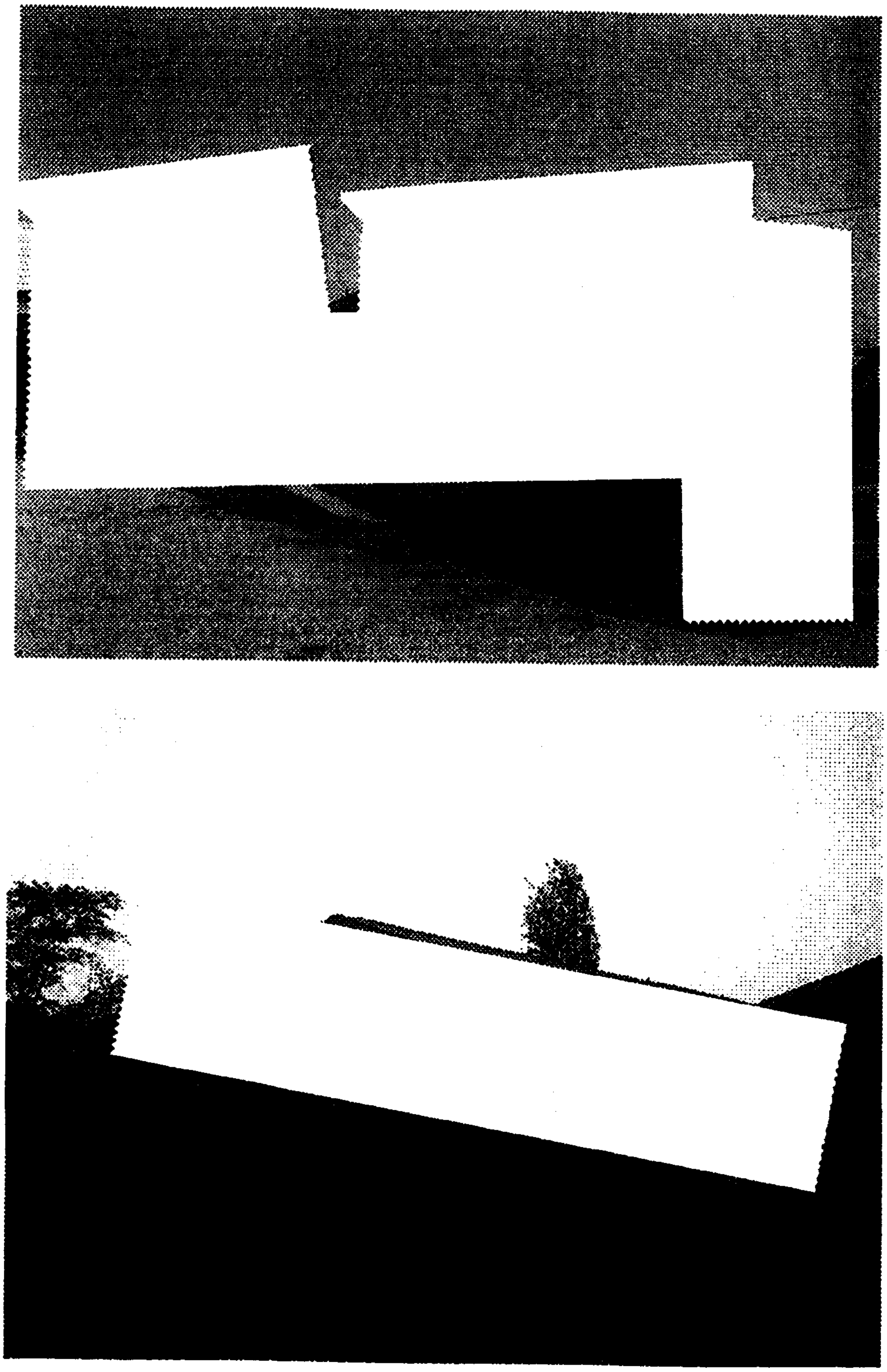
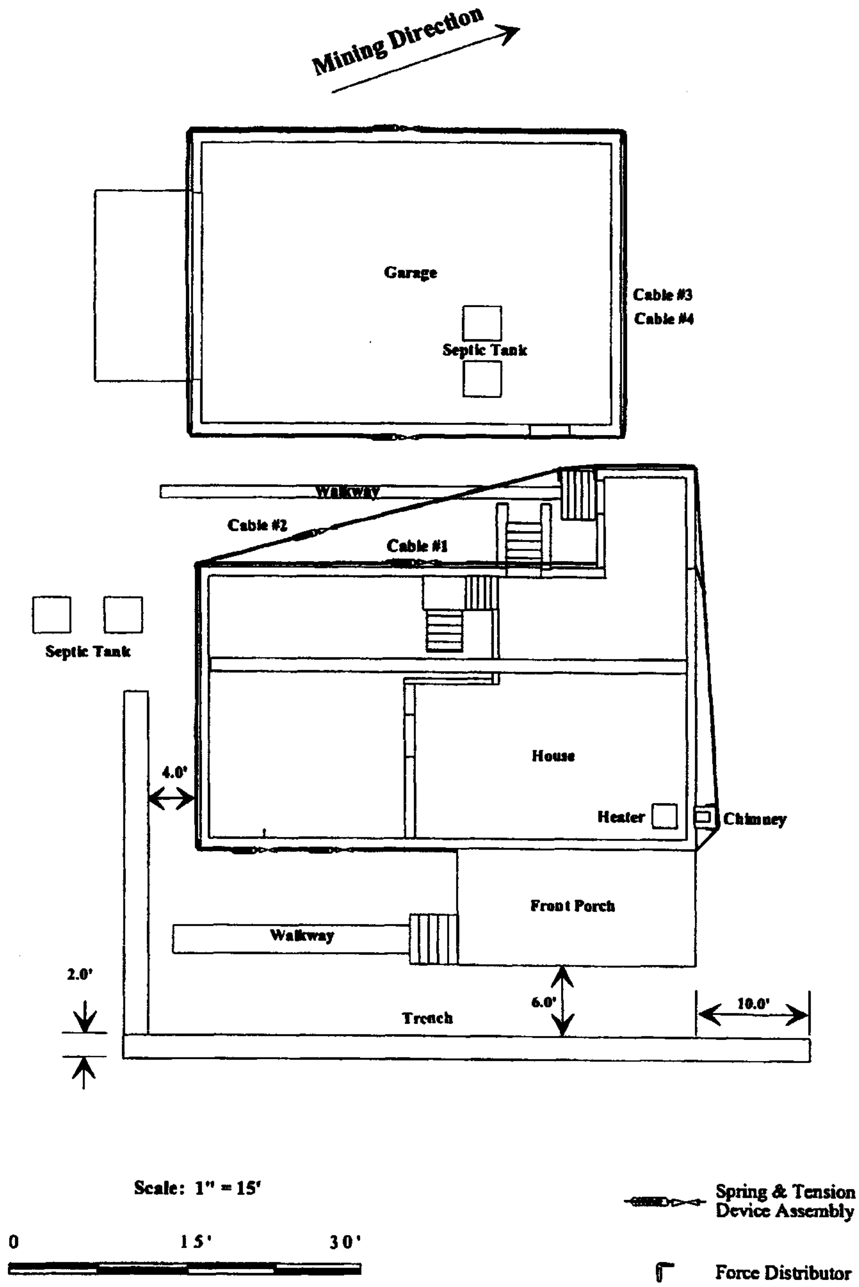
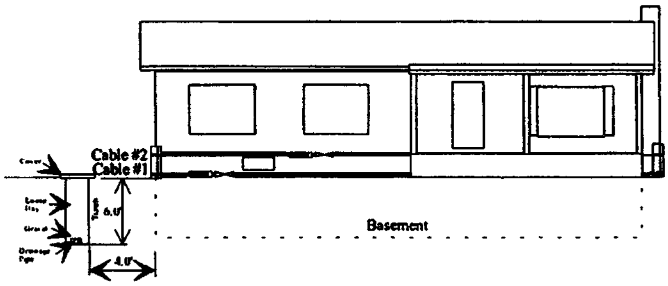


Fig. 2 (Continued) Rear Left (Top) and Rear Right (Bottom) Views of the House



(a) Plan View

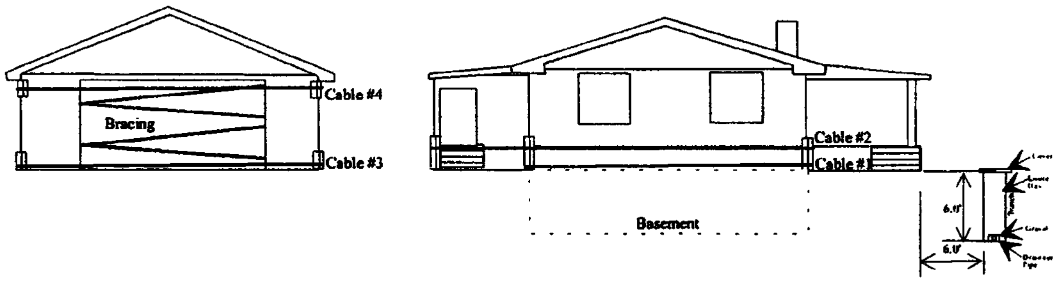
Fig. 3 Recommended Mitigation Measures for the House



(a) Front Side View

Scale: 1" = 15'

0 15' 30'



(b) Left Side View

Fig. 3 Recommended Mitigation Measures for the House (Continued)

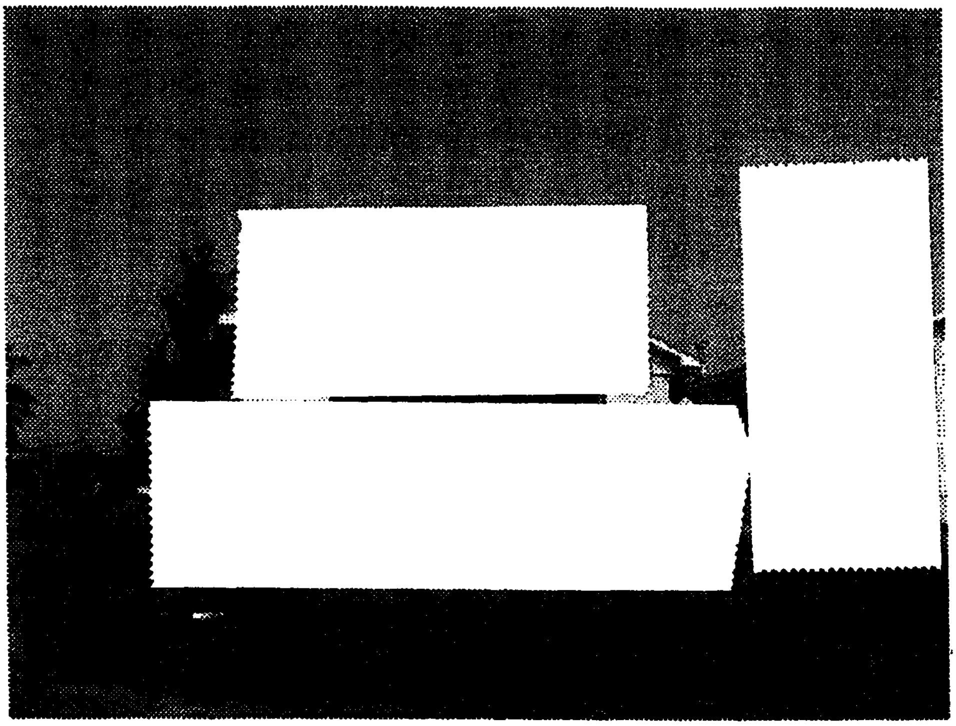


Fig. 4 The Garage

Predicted Final Surface Movements

The predicted final surface subsidence in the specified rectangular area is plotted in Fig. 5. It shows that both the structures are located in the major influence zone of the final subsidence basin to be formed over the longwall panel. The final subsidence to be experienced by the house is between 2.15 ft at the front right corner and 2.95 ft at the rear left corner with a 0.80 ft maximum differential subsidence across it. The garage is located right behind the house. The garage will experience about 3.00 ft final subsidence with 0.45 ft maximum differential subsidence.

The predicted final surface horizontal displacement (the component along panel transverse direction) in the specified rectangular area is shown in Fig. 6. The negative values indicate that the movement is toward the headentry side of the longwall panel (lower side of the figure). It shows that the house will experience final surface horizontal displacement between 1.20 ft at the front right corner and 0.93 ft at the rear left corner. The final horizontal displacement across the garage will be between 1.00 ft at the front right corner and 0.79 ft at the rear left corner.

Predicted Final Surface Deformations

The predicted surface deformations include three items: *slope* indicating the surface tilting after subsidence, *strain* indicating whether the ground surface is stretched or compressed, and *curvature* indicating the bending condition of the ground surface.

The final surface slope (component along the panel transverse direction) is plotted in Fig. 7. The final surface slope is 1.30% at the front right corner and 1.05% at the rear left corner of the house with an average slope of 1.2%. The predicted final surface slope at the garage is about 0.95%.

The predicted final surface strain (transverse component) is shown in Fig. 8. A negative value indicates that the ground is to experience compressive strain. Both the house and the garage are in the compression zone of the final subsidence basin. The average final surface strains to be experienced by the house and the garage are about 6.0×10^{-3} ft/ft and 7.0×10^{-3} ft/ft, respectively.

The predicted final surface curvature (transverse component) is shown in Fig. 9. A negative value indicates concave bending. The distribution of the final surface curvature in the specified area is very similar to that of final strain (Fig. 8). The final surface curvature across the house will be about -7.0×10^{-5} 1/ft while that across the garage will be about -8.0×10^{-5} 1/ft.

Predicted Dynamic Surface Movements

The dynamic subsidence prediction describes the development process of movements and deformations at a surface point before the final state at this point is reached. A surface point at the rear left corner of the house, which is 344 ft from the tailentry of the longwall panel, is used for dynamic subsidence prediction because this surface point will experience the most active dynamic subsidence process across the house. The predicted dynamic horizontal displacement, slope, strain and curvature are their respective components along the panel longitudinal direction. Four face advance rates of 70, 80, 90 and 100 ft/day, achievable at the Emerald Mine, have been used in the dynamic subsidence predictions.

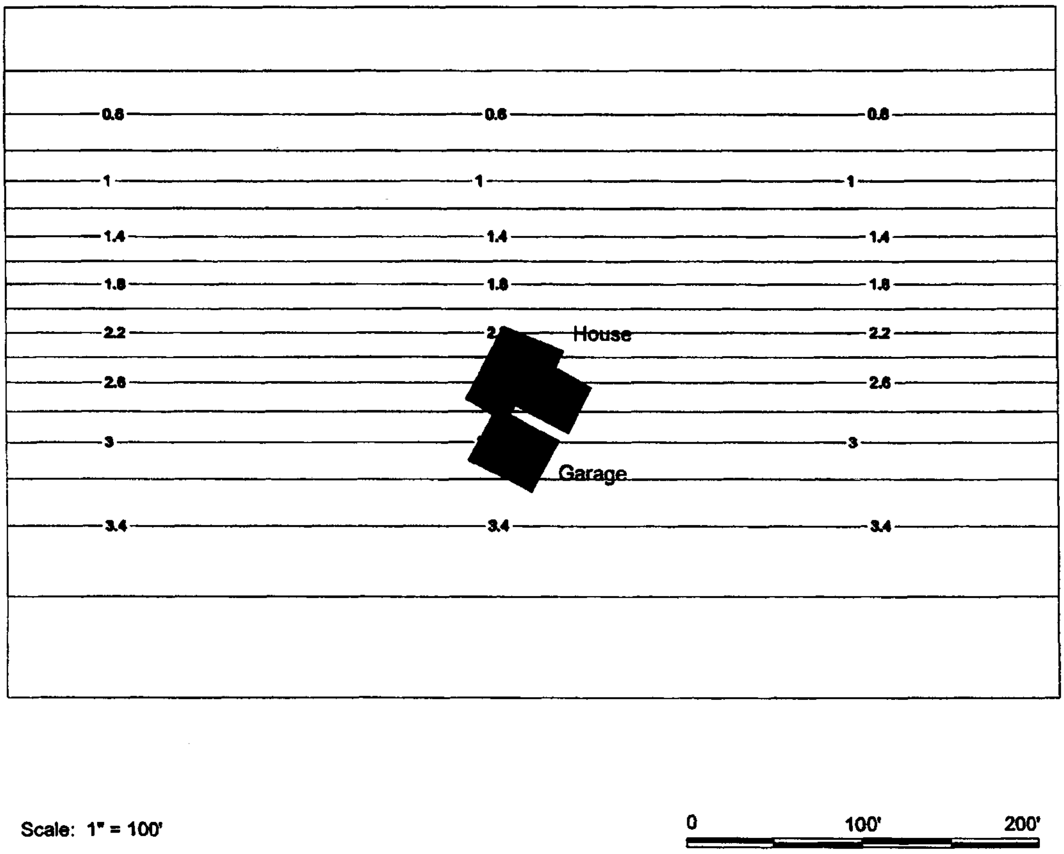
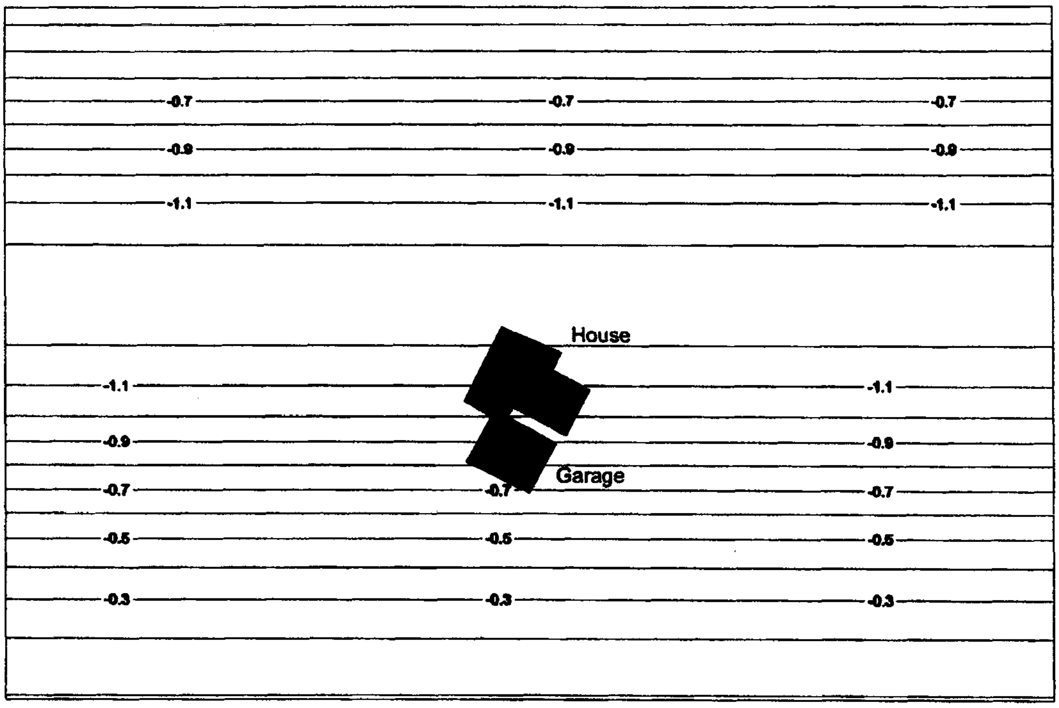


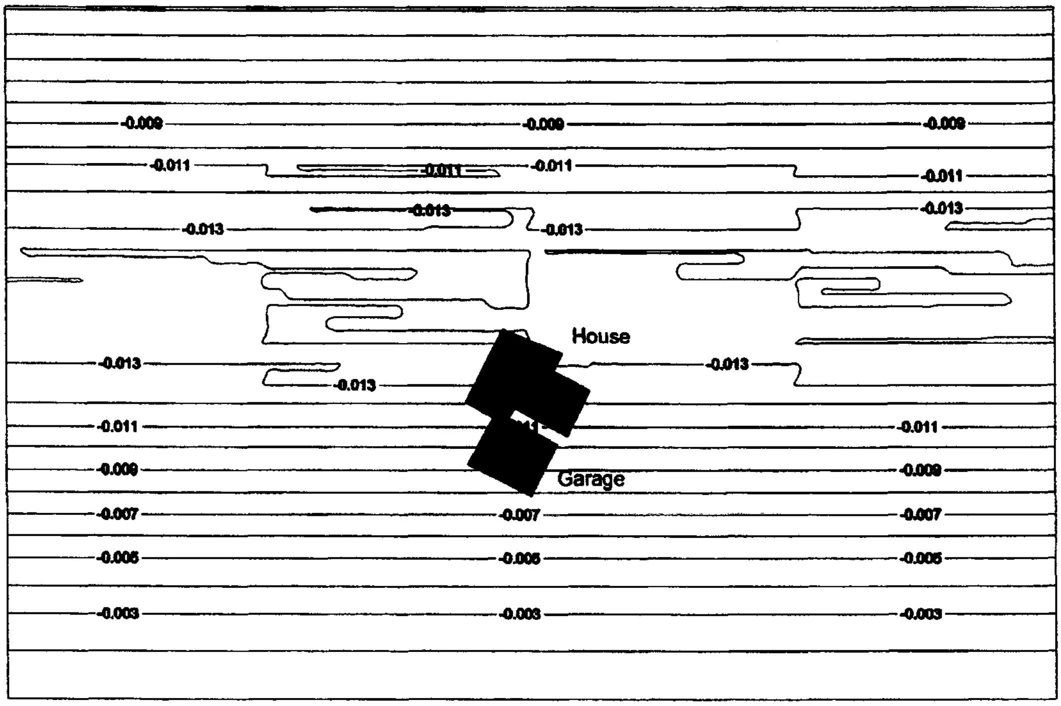
Fig. 5 Predicted Final Surface Subsidence Around the House



Scale: 1" = 100'

0 100' 200'

Fig. 6 Predicted Final Surface Displacement (Transverse Component) Around the House



Scale: 1" = 100'

0 100' 200'

Fig. 7 Predicted Final Surface Slope (Transverse Component)
Around the House

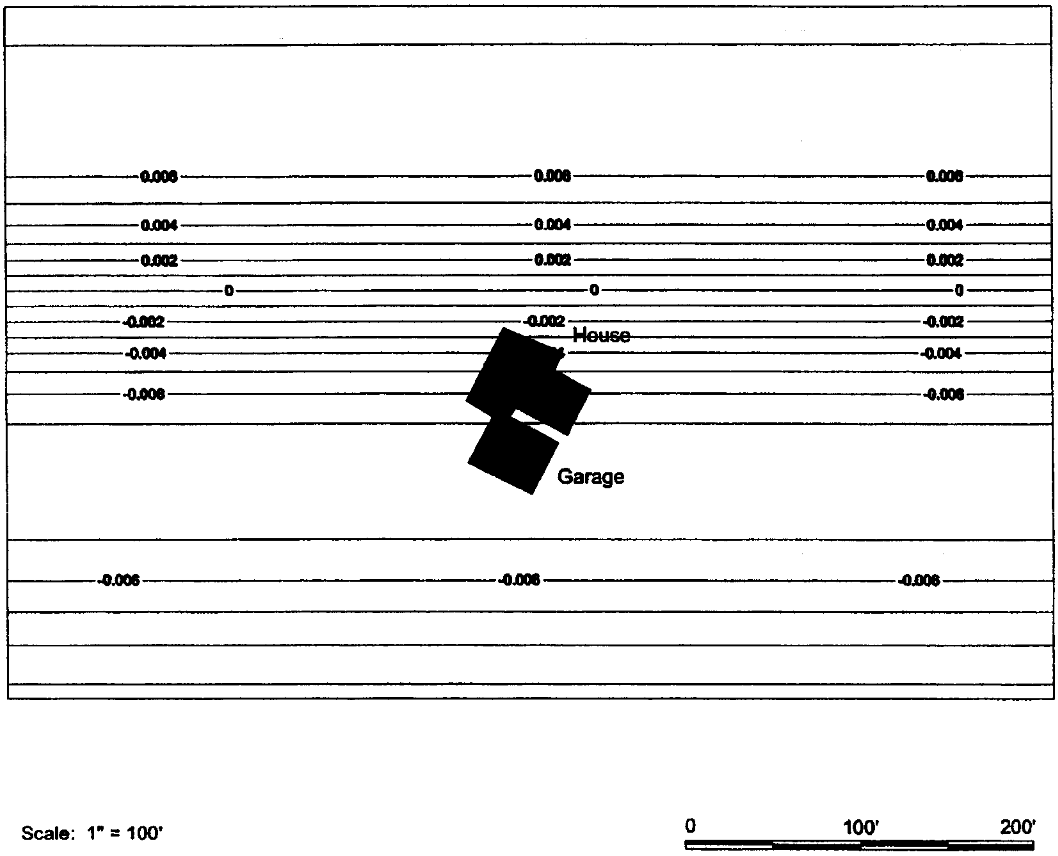
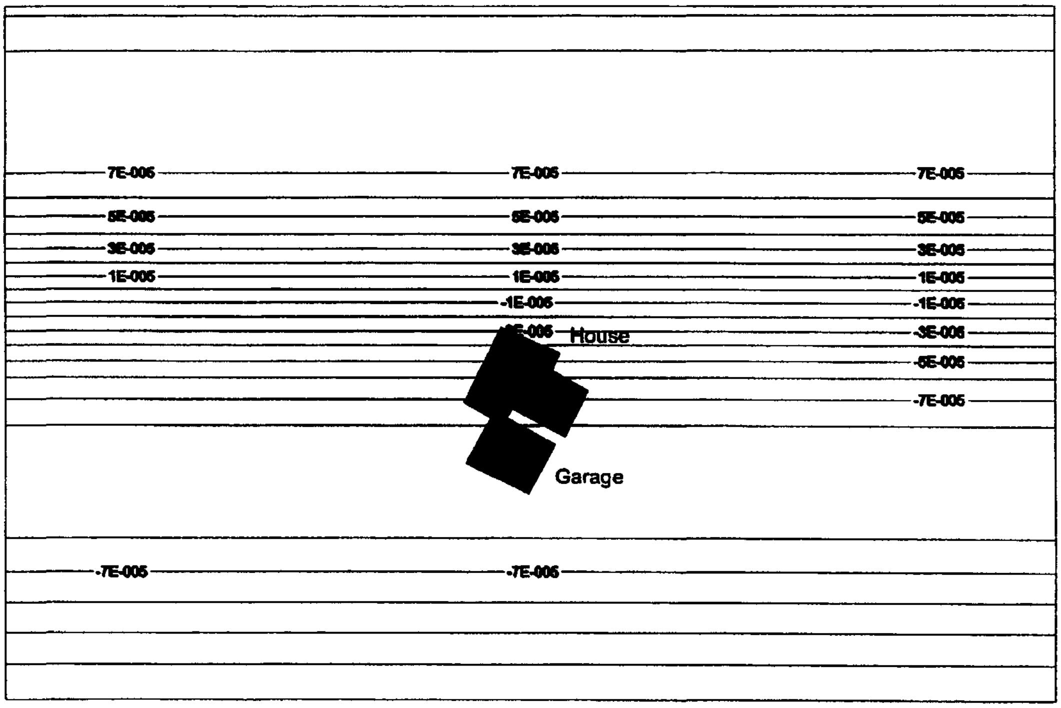


Fig. 8 Predicted Final Surface Strain (Transverse Component) Around the House



Scale: 1" = 100'

0 100' 200'

Fig. 9 Predicted Final Surface Curvature (Transverse Component) Around the House

The predicted dynamic subsidence development curves are plotted in Fig. 10. There is a very small amount of subsidence when the longwall face is directly under the point of interest. Then the subsidence process will accelerate and reaches about one half of its final amount when the face is about 340 ft passed the point of interest. At the same time, the subsidence process will be most active. A deceleration process is followed. The ground surface re-establishes the stable condition in vertical direction when the face has passed the house a distance about 800 ft.

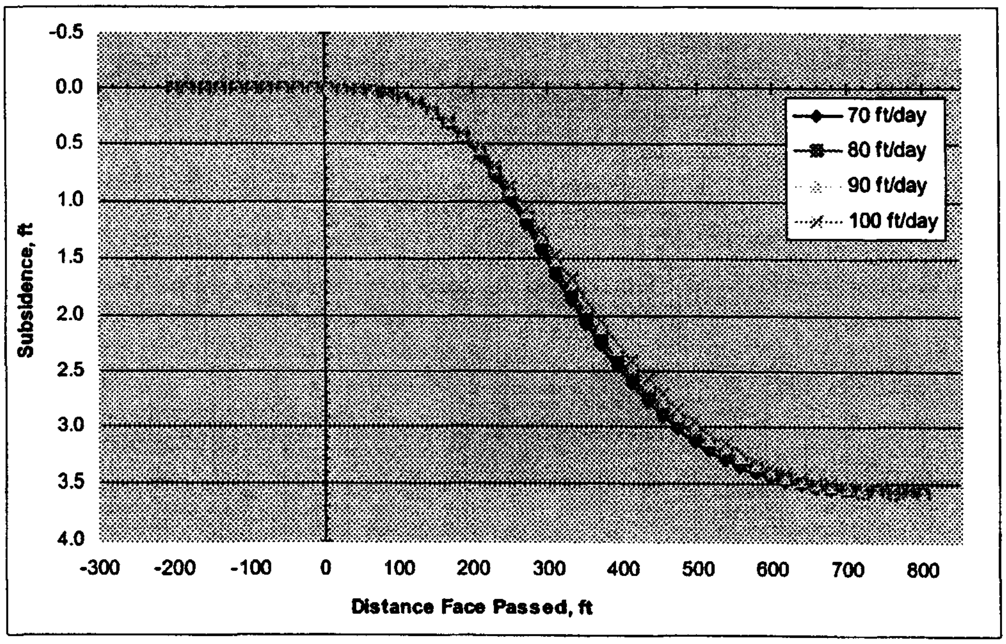


Fig. 10 Predicted Dynamic Subsidence Development Curves

Figure 11 shows the development curves of surface dynamic horizontal displacement (the component along the panel longitudinal direction). The negative values in the figure indicate that the movement is opposite to the mining direction. The maximum dynamic horizontal displacement, ranging from 0.66 ft to 0.72 ft, will occur a distance of between 250 and 290 ft behind the longwall face. The point regains its stable condition in horizontal direction when the face is about 800 ft outby the point of interest.

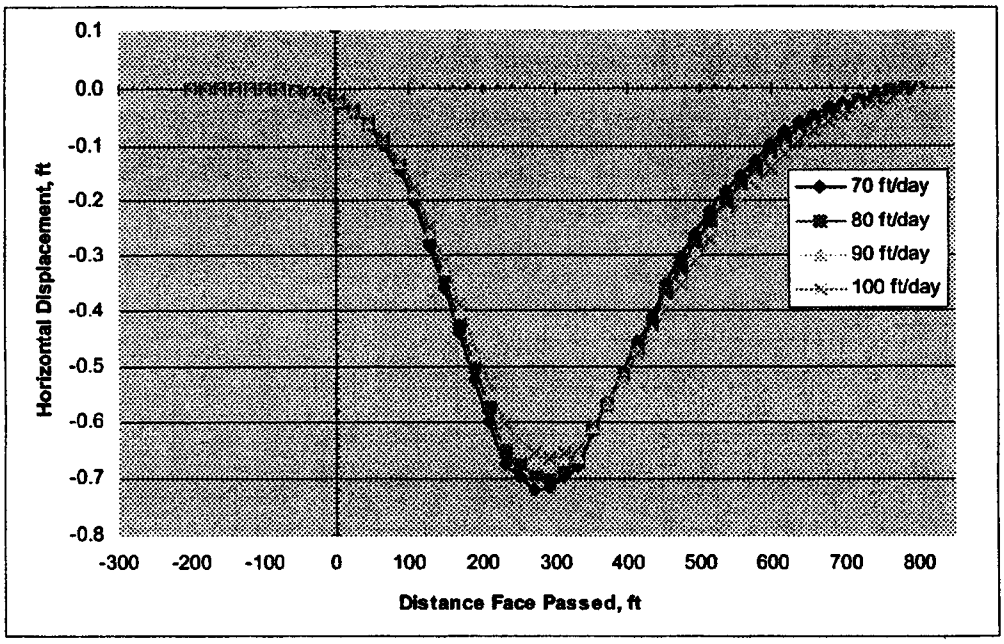


Fig. 11 Predicted Dynamic Horizontal Displacement Development Curves

Predicted Dynamic Surface Deformations

Figure 12 shows the development curves of dynamic surface slope (longitudinal component) at the structure. These curves have the similar distribution patterns as the dynamic horizontal displacement. The maximum dynamic slope ranges from 1.01% to 1.11%.

The development curves of dynamic strain (longitudinal component) are plotted in Fig. 13. The ground point begins to experience some minor tension when the longwall face is still 110 ft inby the surface point. The tensile strain increases as the face advances. The maximum dynamic tensile strain, ranging from 3.5×10^{-3} to 3.9×10^{-3} ft/ft, is reached when the face is about 110 ft passed the point of interest. The tensile strain decreases as face advances and reaches zero strain when the face is about 220 ft outby the surface point of interest. Then the surface enters the dynamic compression stage. The maximum dynamic compressive strain, ranging from -2.1×10^{-3} to -2.6×10^{-3} ft/ft, will occur when the face is between 340 ft and 400 ft passed the point of interest.

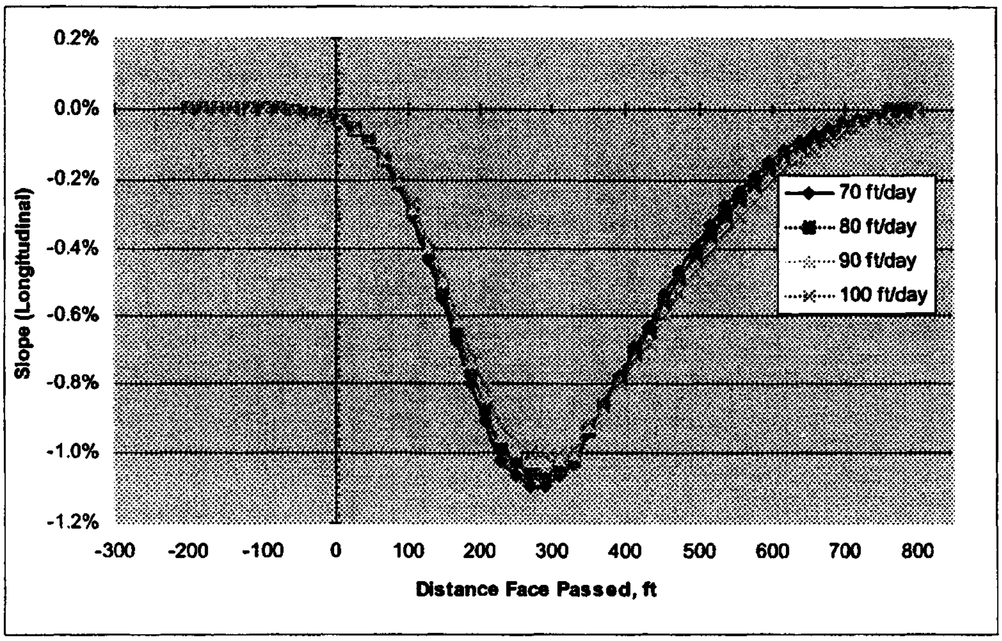


Fig. 12 Predicted Dynamic Slope Development Curves

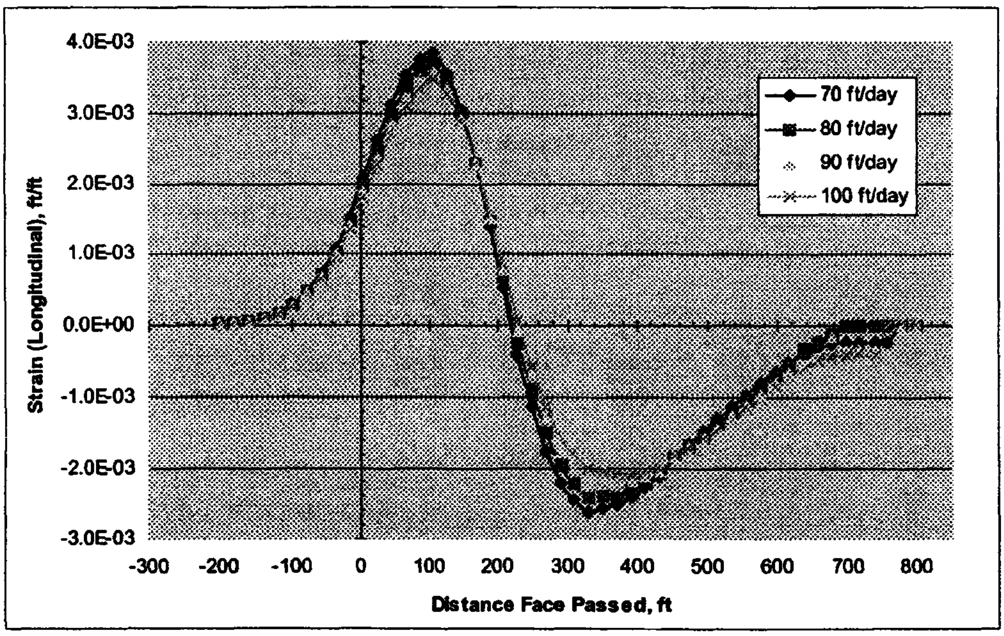


Fig. 13 Predicted Dynamic Strain Development Curves

The predicted development curves of dynamic curvature (component along the mining direction) are shown in Fig. 14. Their distributions are very similar to those of dynamic strain. The maximum dynamic convex curvature ranges from 5.2×10^{-5} to 5.9×10^{-5} 1/ft occurring at a distance of about 110 ft passing the house, while the maximum concave curvature is between -3.3×10^{-5} and -4.0×10^{-5} 1/ft occurring when the face has passed the house a distance between 340 ft and 400 ft.

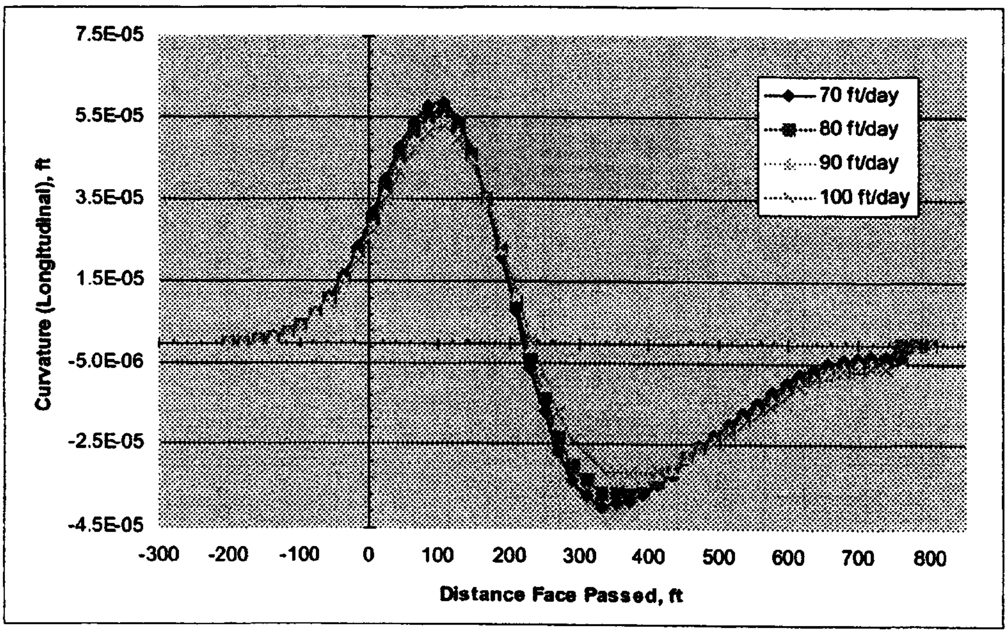


Fig. 14 Predicted Dynamic Curvature Development Curves

ASSESSMENT OF POSSIBLE SUBSIDENCE INFLUENCES

Based on the predicted dynamic and final surface movements and deformations at the locations of the structures, RAG assessed the possible influences of the ground subsidence process on the residential structures. In the assessment, the critical deformation values deduced from the subsidence monitoring programs performed on various residential structures affected by longwall subsidence are used. To assess the subsidence influences on structures, the size, shape, complexity, materials, construction method and existing condition of the structures are also considered in the assessment. Based on the published literature and consultation with WVU, the critical deformation values applicable to the structures in this property are as follows.

Critical slope for comfortable living:	1.00%
Critical tensile strain for brick or block walls:	2.0×10^{-3} ft/ft
Critical curvature for house super-structure:	6.0×10^{-5} 1/ft

It should be noted that the anticipated possible subsidence effects on the structures mentioned in this section are those without any proper mitigation measures being implemented on.

Influence of Final Surface Movements and Deformations

Final subsidence prediction shows that the house and the garage are located in the major influence zone of the final subsidence basin to be formed over the longwall panel. The final subsidence prediction shows that the front side of the house will subside less than its rear side. The final differential subsidence across the house, about 0.80 ft, would cause the house to tilt towards the backwards with the average surface slope of 1.2% along the panel transverse direction. Since the final surface slope across the house is larger than the critical value (1.00%), a slight discomfort of living at the house will be felt after the subsidence process is over.

The final compressive strain, with an average of 6.0×10^{-3} ft/ft, could cause problems to the house basement walls. The possible problems could be bow-in damages developed on the front basement wall. The final surface curvature, with an average of -7.0×10^{-5} 1/ft also could cause some minor problems to the house superstructure such as sticky windows or doors.

The predicted final surface compressive strain and concave curvature at the location of the garage could also cause minor problems to this structure.

Influence of Dynamic Subsidence Process

The predicted maximum dynamic surface slope at the house is able to create a slight discomfort for the residential living for a short time. Since the maximum dynamic tensile strain at the house is larger than the critical value, 2.0×10^{-3}, the dynamic strain is able to induce tensile cracks on the concrete block basement walls and the concrete floor pavement in the basement. The likely locations for such problems are front and rear basement walls and along the joint lines and pre-existing cracks on the floor pavement.

Since the garage is very close to the house, the dynamic tensile strain could also be large enough to cause cracks to the concrete block walls and concrete floor pavement of the garage.

RECOMMENDED MITIGATION MEASURES

The assessment of subsidence influence on the structures performed in the previous section indicates that the house and the garage would be affected by final surface slope, final compressive strain and curvature. The dynamic slope and strain would also affect the structures.

In order to reduce the severities of the anticipated subsidence influences on the house and the garage, a number of mitigation measures are recommended. These mitigation measures are based on the following principles:

a. Reducing the transmission of subsidence-induced surface deformations, particularly surface strain, from the surrounding ground to the structures;
b. Compensating the subsidence-induced deformations to further lower the deformations to be experienced by the structures;
c. Reinforcing the structures so that they are more tolerable to deformations to be experienced.

These mitigation measures and their working principles are detailed in the following sections.

Compensation Trench Method

In order to reduce the problems to the floor and walls of the house caused by final compressive strain, it is recommended to dig two compensation trenches on the front and left sides of the house as shown in Fig. 3. The compensation method is working on principles No. 1 as previously stated. A compensation trench creates a weak plane between the structure and the strain-generating ground so that a reduction of the transmission of the surface strain from the strain-generating ground to the structure can be realized. Through such a reduction of strain transmission, the problems that will potentially develop on the structural foundation on the structural parts can be reduced.

The front trench should be located about 6 ft from the front porch and the left trench 4 ft from the left wall of the house. They should be 2 ft wide and 6 ft deeper than the ground surface. The front trench should be extended 10 ft beyond the house at right side. The trenches should be kept well drained by burying a perforated pipe at the bottom with gravel and its remaining space filled with loose hay. When necessary, pumps should be used to pump the accumulated water in the trenches. The trenches should be properly covered with wood boards and fenced during its service.

Tension Cable Method

It is recommended to use tension cable method on the house and the garage. In this method, the structures to be protected are wrapped with pre-tensioned steel wire cables. The tension cable method can serve the following two purposes: (1) the tension force applied by the cables places the structure into a compression state so that it is able to compensate some of the subsidence-induced dynamic tensile stress and (2) the rigidity of those structural parts is increased so that they can tolerate more deformations transmitted to it. The tension cable method can also indirectly reduce the severity of the anticipated problems on the super-structures caused by dynamic and final surface curvature if the deformation on the structural part under the super-structure can be controlled effectively. This method is used for protecting those structure parts that have higher compressive strength than the tensile one, such as stone, block and brick structures. Steel wire cables of ¾" diameter in good working condition should be used as the tension cable. This type of wire cables has a breaking load of 41,400 lbs.

It is recommended to use four steel tension cables on the house and the garage as shown in Fig. 3. Tension cables #1 should be wrapped on the basement walls of the house. The cable should be placed as close to the ground as possible. The cable should go beneath the front porch and the small attachment at the rear right corner. Holes should be drilled on the retention walls of the stairway leading to the basement so that the cable can be placed low. A tension of 3.5 tons (7,000 lbs) should be applied and maintained on this cable during the active subsidence period.

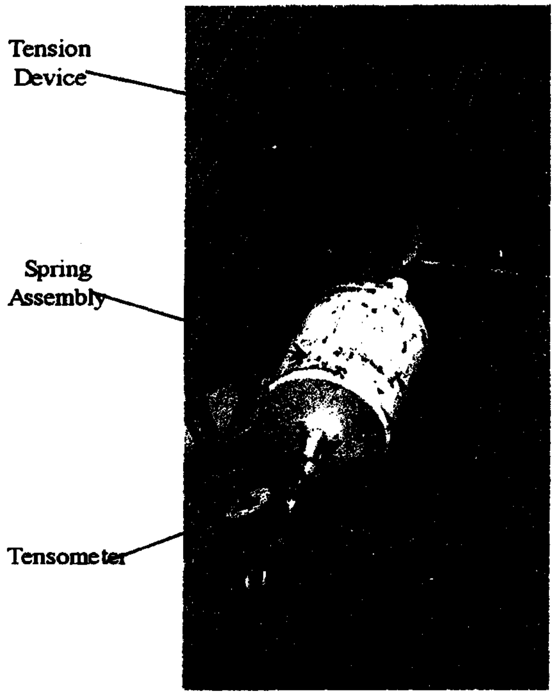
Tension cable #2 should be wrapped around the house 4 inches below the top of the basement walls. The cable #2 should enclose the attached room at the rear side but go beneath the front porch. A tension of 2.0 tons (4,000 lbs) should be applied and maintained on this cable during the active subsidence period.

Tension cable #3 should be wrapped around the garage at the ground level. The cable #3 should be placed as close to the ground surface as possible. A tension of 3.0 tons (6,000 lbs) should be applied and maintained on the cable during the active subsidence period.

Tension cable #4 should be wrapped around the garage near the ceiling level. The cable #4 should be placed on the concrete block walls, and bracing should be used at the garage door. A tension of 2.0 tons (4,000 lbs) should be applied and maintained on this cable during the active subsidence period.

Force distributors built with wood board (1" thick and 12" wide) should be inserted between the tension cables and the house or garage corners so that the force applied by tension cables can be more evenly distributed over a large area. Two tension/spring devices (An example of its construction is shown in Fig. 15) should be inserted on each of the cables at the locations shown in Fig. 3. The cable tensions should be periodically monitored during the active subsidence period and adjusted if necessary. The cables and the tension/spring devices should be properly covered in traffic areas.

The construction and installation of the recommended mitigation measures for the house should be completed before the longwall face reaches a distance of 300 ft toward the structure. Performance of the implemented mitigation measures should be checked



Spring Assembly in Use

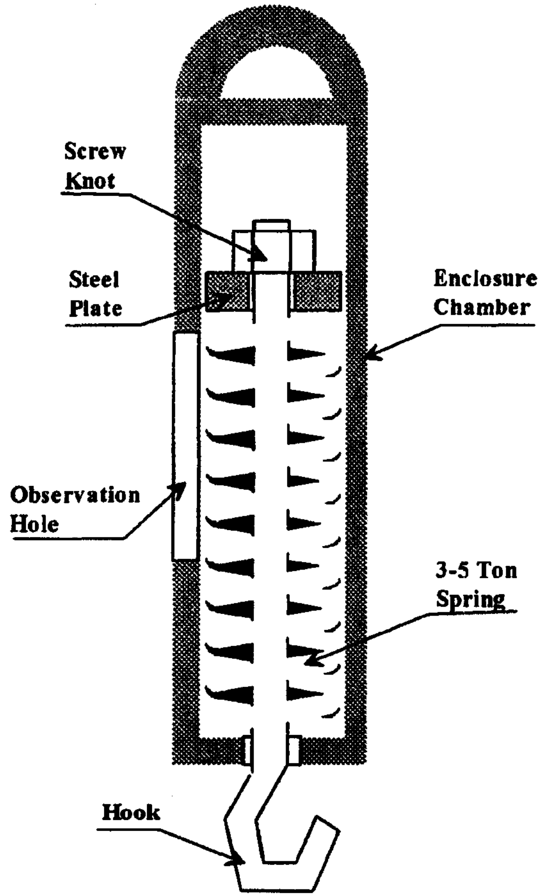


Fig. 15 Construction of the Spring Assembly

periodically during the active subsidence period. The trenches can be refilled and the cables can be removed when the face has passed the house a distance of 900 ft.

CONCLUSIONS

Based on RAG's field experience and evaluation of the predictions based on the application of WVU's CISPM model, the possible subsidence influences on the [redacted] house and garage caused by longwall mining have been predicted and assessed by RAG. Base on the study, the following conclusions and recommendations can be made:

- The house and garage will be located in the major influence zone of the final subsidence basin to be formed over the longwall panel. The final compressive strain could cause problems to the house basement wall and the final surface curvature might cause some minor problems to the house super-structure. The final slope could slightly affect the comfort level of the living. The garage will be impacted by the final compressive strain.
- The dynamic subsidence process could cause problems to the house and the garage. Dynamic tensile strain could induce cracks on the basement walls and floor pavement of the house basement and garage.
- Compensation trench method and tension cable method have been recommended for the house and the garage to reduce the severity of the anticipated problems.

INTRODUCTION

Mining in a longwall panel of RAG Cumberland Resources Corp. will be under a number of residential and farm structures (including a house, two barns, a garage, a storage building and a shed) in the [redacted] property. It is expected that the ground subsidence process associated with longwall mining in the panel could impact the some of the structures. In this report, the dynamic and final surface movements and deformations in the area around the structures have been predicted. Based on the predictions, the possible subsidence effects on the structures have been assessed and necessary mitigation measures for reducing the potential subsidence impacts have been recommended.

LONGWALL PANEL AND THE STRUCTURES

Longwall panel

The layout of the longwall panel under the residential and farm structures is shown in Fig. 1. The longwall panel is about 987 ft wide. The mining height in the Pittsburgh coal seam is about 6.5 ft. Most of the structures are located in the toe area of a gentle valley and also over the central portion of the longwall panel. The slope of the hell surface on the right side of the house is about 24% (13.6°). The average overburden depth at the house is about 586 ft. As shown in Fig. 1, barn No. 1 is closest to the panel tailentry (402 ft) while barn No. 2 is closest to the panel headentry (231 ft). The shortest distances between the house and the panel headentry and tailentry are 383 and 547 ft, respectively.

The Structures

There are six residential and farm structures in the property. The house is a two-story wood frame structure as shown in Fig. 2. The foundation of the house was built with block stones and a crawl space between one and three ft high was left beneath the house superstructure. The main portion of the house has a dimension of 32 ft wide and 30 ft deep as shown in Fig. 3. A covered porch is located on the front side of the house. The left half of the front porch is enclosed and has block stone foundation while the right portion is open sitting on stone columns. Two attachments were built on the right side of the house. A covered porch is located on the rear side of the house. Four chimneys are placed at four different locations.

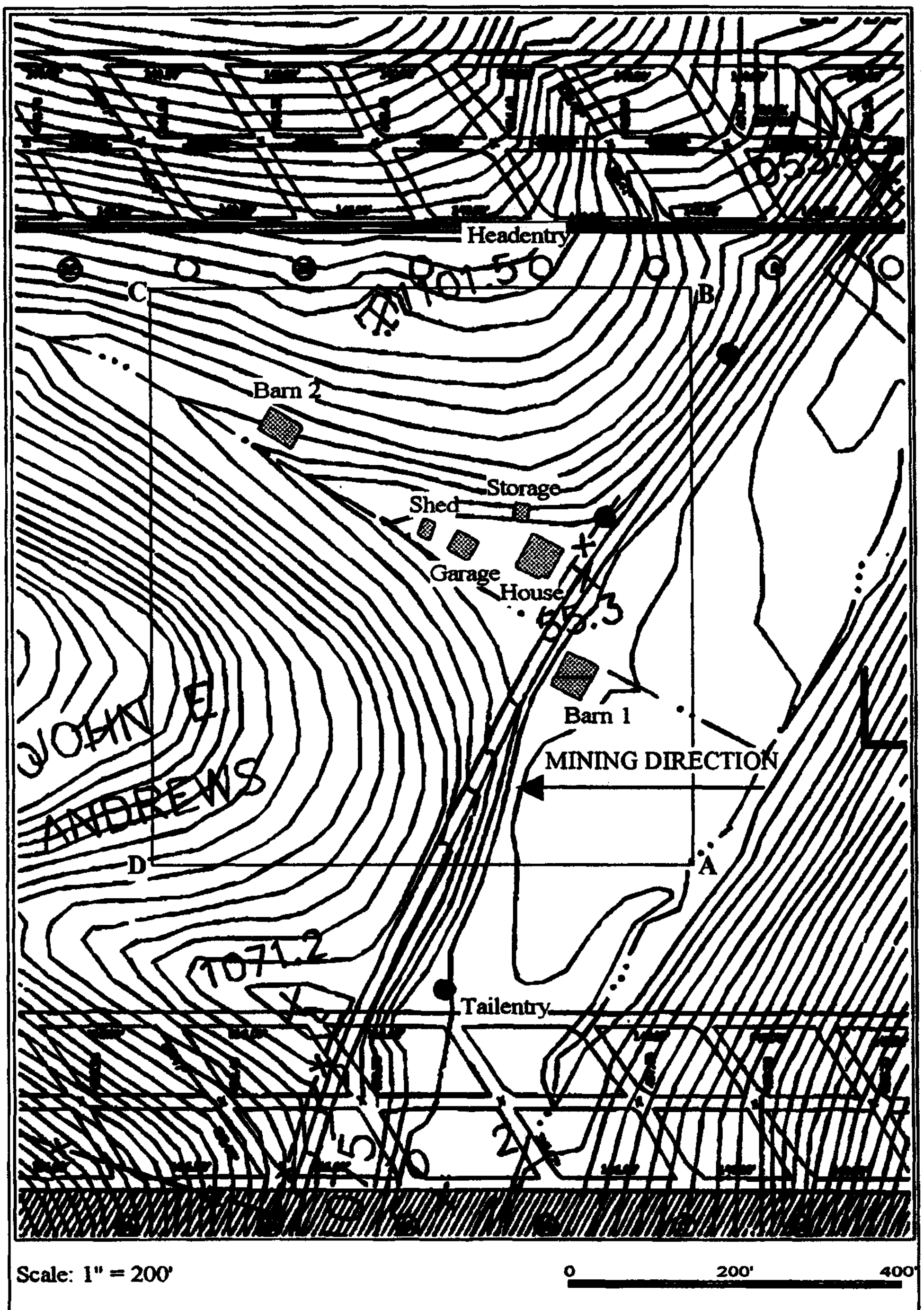


Fig. 1 Overview of the Study Site

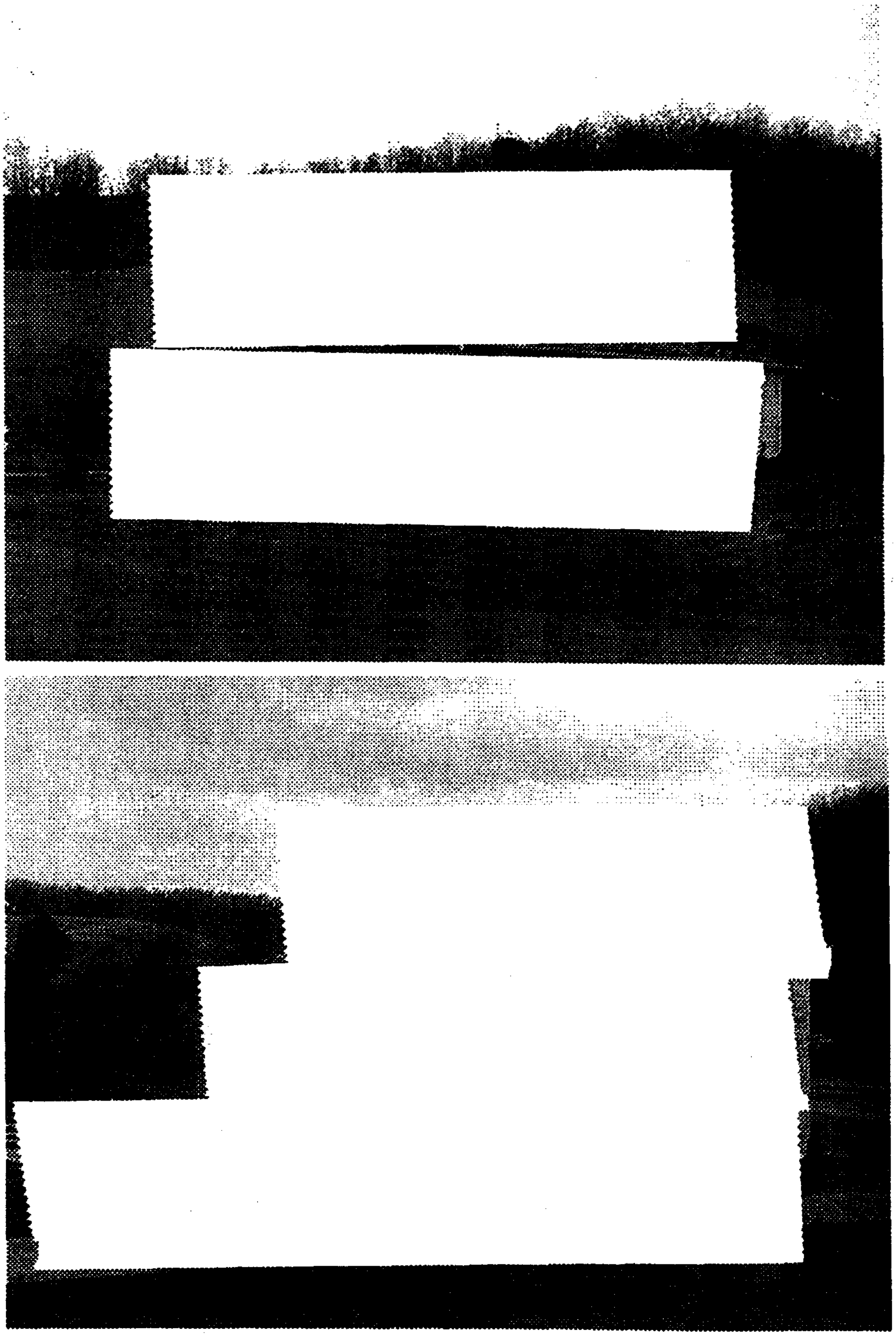
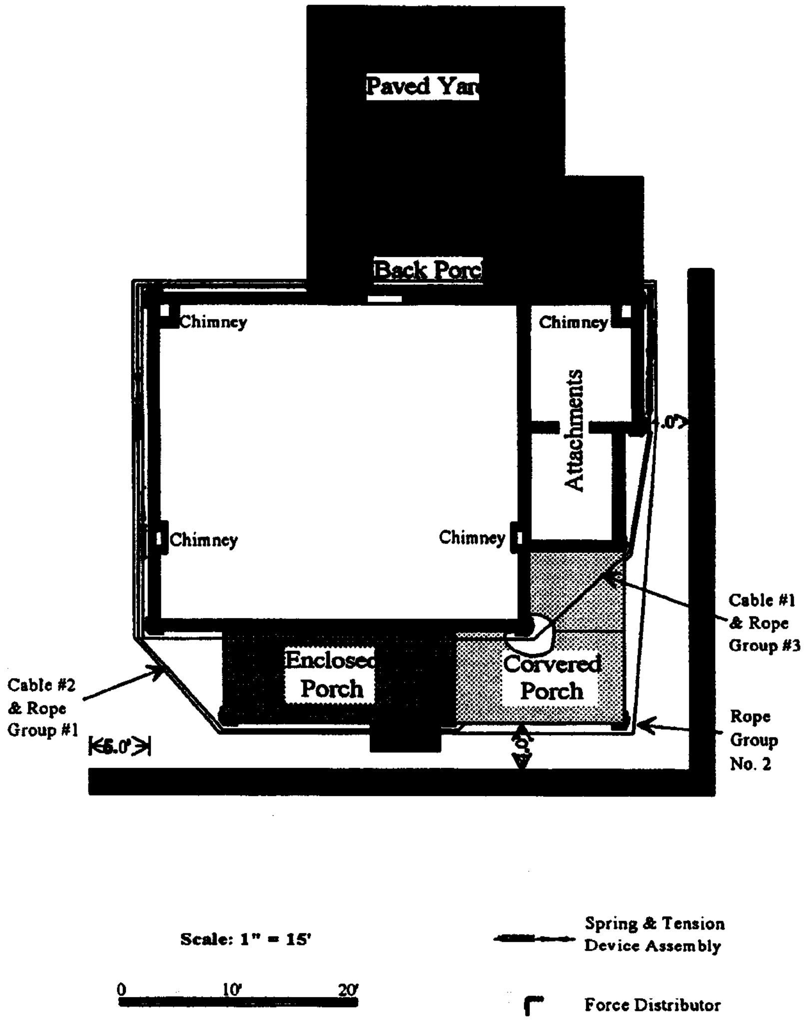
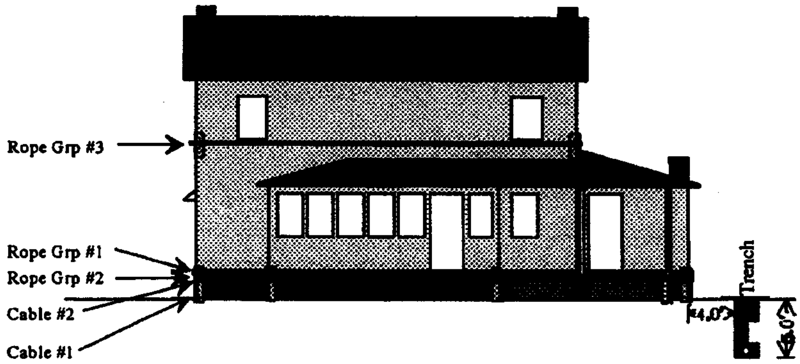


Fig. 2 Front Right (Top) and Rear Left (Bottom) Views of the House

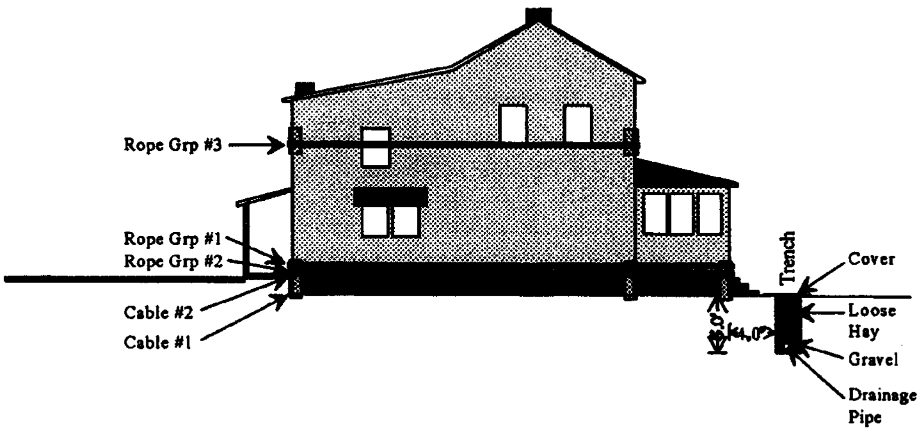


(a) Plane View

Fig. 3 Recommended Mitigation Measures for the House



(b) Front Side View



(c) Left Side View

Scale: 1" = 15'   0   10'   20'

Fig. 3 Recommended Mitigation Measures for the House (Continued)

There are two barns in the property. Barn No. 1 (Fig. 4), a typical wood frame structure, is located in the flat valley area and over the central portion of the longwall panel. The plane dimension of this barn is 48 ft long and 42 ft wide. Barn No. 2 (Fig. 5) is located on a slope area in the valley. It is about 24 ft wide and 45 ft long. The garage (Fig. 6) is a barn-type wood frame structure with a dimension of 28 ft long and 18 ft wide. The storage building is a small wood frame structure with stone foundation walls (Fig. 7). The shed is also very small and sits on a number of wood posts as shown in Fig. 8. The structures of the two barns and the garage appeared to be flexible in both materials and construction while the storage building and the shed are small in size.

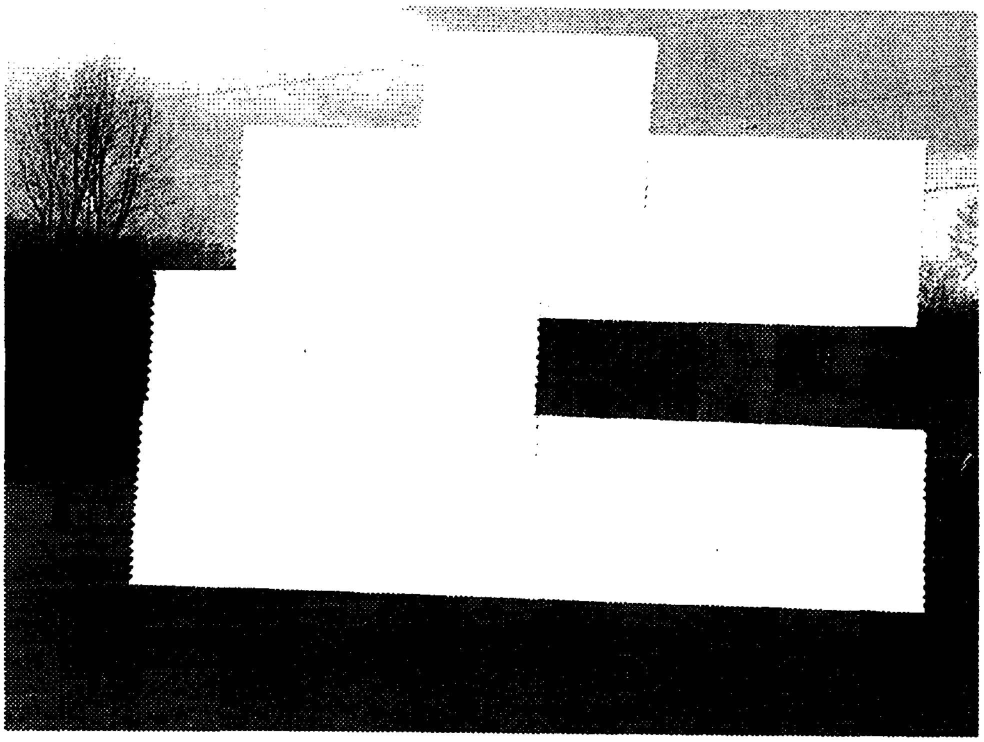


Fig. 4 Barn No. 1

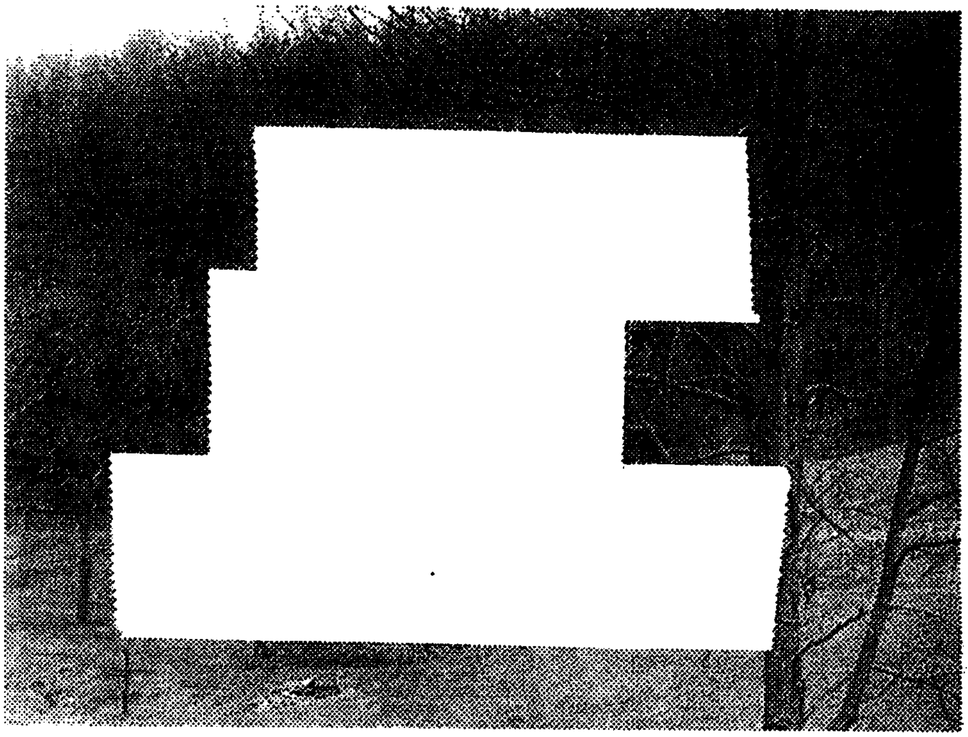


Fig. 5 Barn No. 2

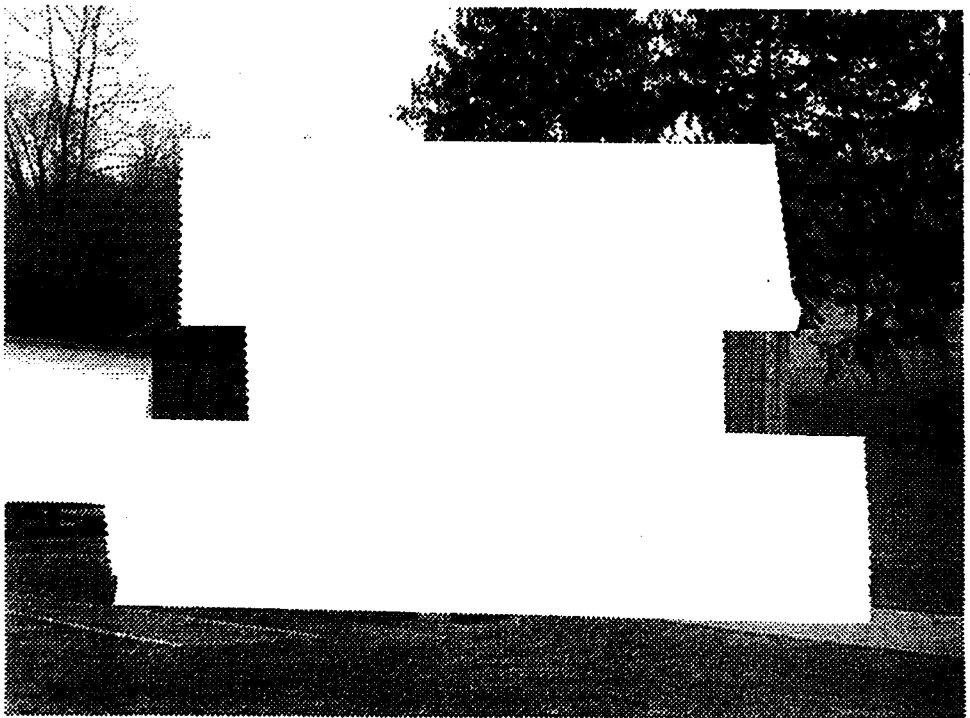


Fig. 6 Garage

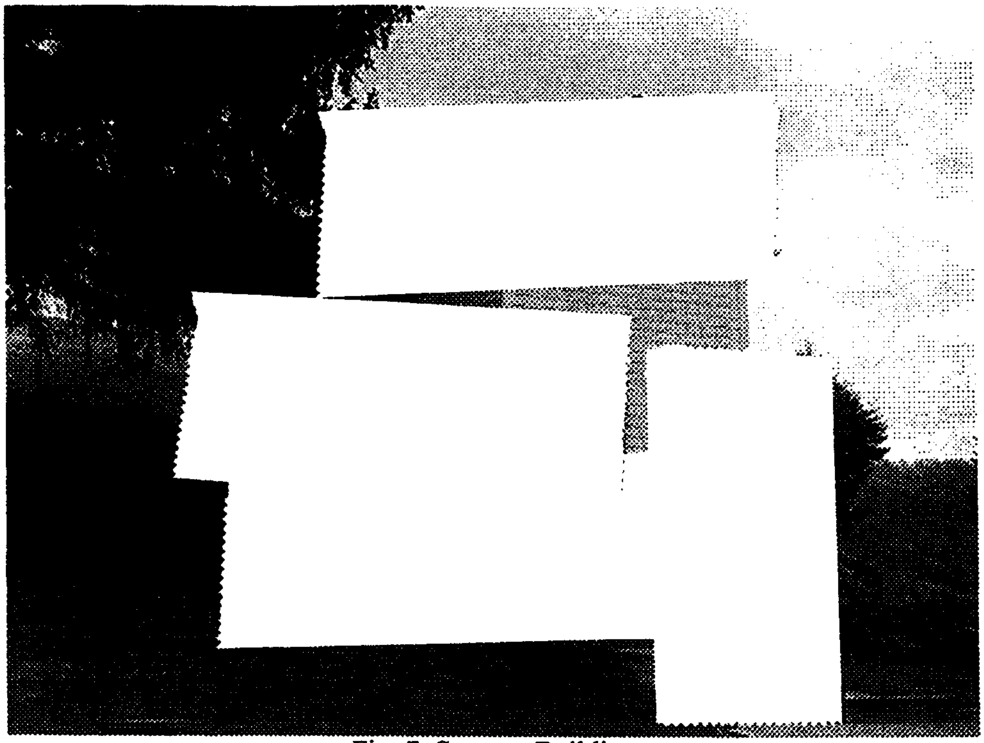


Fig. 7 Storage Building

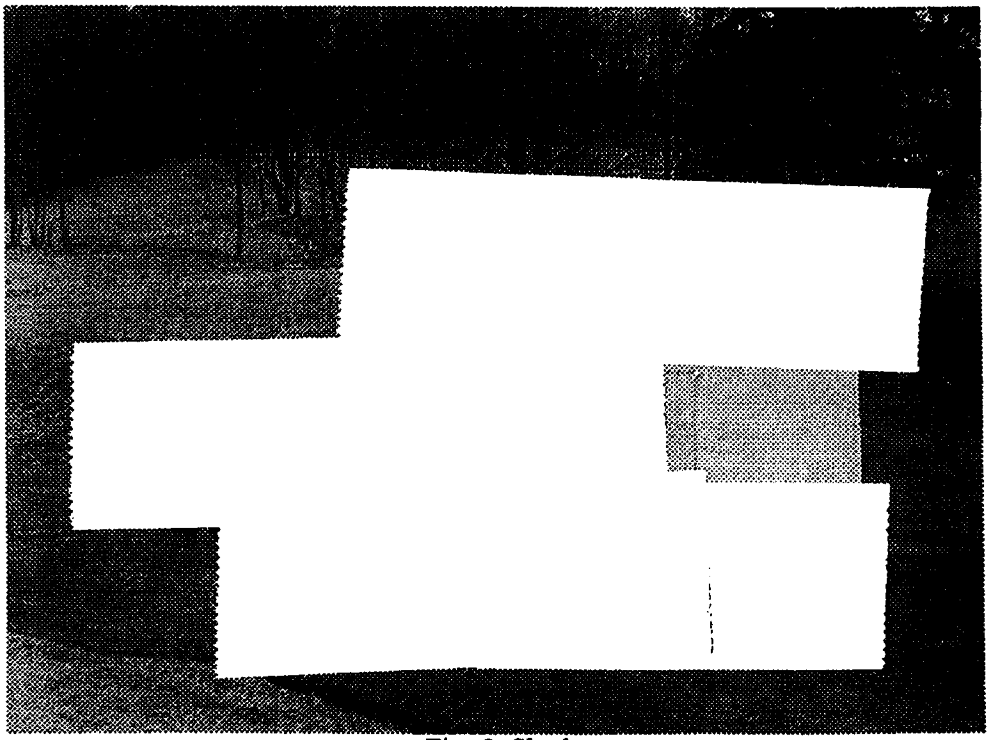


Fig. 8 Shed

SUBSIDENCE PREDICTION

In order to evaluate the possible influences of the ground subsidence process on the residential and farm structures, the final surface movements and deformations have been predicted in a rectangular area around the structures (ABCD in Fig. 1) using the subsidence prediction program CISPM version 2.01 developed by the WVU Department of Mining Engineering. Dynamic surface movements and deformations are also predicted at the house for the time period when the house is to experience the active subsidence process. A mining height of 6.5 ft was used in these subsidence predictions.

The development of the subsidence prediction package is based on the influence function method that is widely adopted in the major mining countries including US coal mining industry and a large amount of collected subsidence data, with most of them being collected over longwall panels mining in the Pittsburgh coal seam. Among the collected subsidence data cases from the Pittsburgh Seam, the majority of the sites were located within a 15-mile radius from this study site. This subsidence prediction program package has been successfully applied in various subsidence projects in the past few years and proven accurate.

Final Surface Movements

The predicted final surface subsidence in the specified rectangular area is plotted in Fig. 9. It shows that the house, barn No. 1, garage, storage building and shed are located in the flat bottom portion of the final subsidence basin to be formed over the longwall panel. The final subsidence to be experienced by these five structures is about 4.1 ft with very little differential subsidence across each of them The final subsidence across barn No. 1 is between 3.6 ft at the rear right corner and 4.0 at the front left corner. Therefore, the maximum differential final subsidence across this structure is 0.4 ft. The maximum, minimum and maximum differential final subsidence across each of the six structures are listed in Table 1.

The component of the predicted final surface horizontal displacement along the panel transverse direction around the structures is shown in Fig. 10. The negative values shown around the structures indicate that the movement is toward the tailentry side of the panel. It shows the final horizontal displacements around the house vary from zero across the major part of the house to an insignificant -0.03 ft at the house rear right corner.

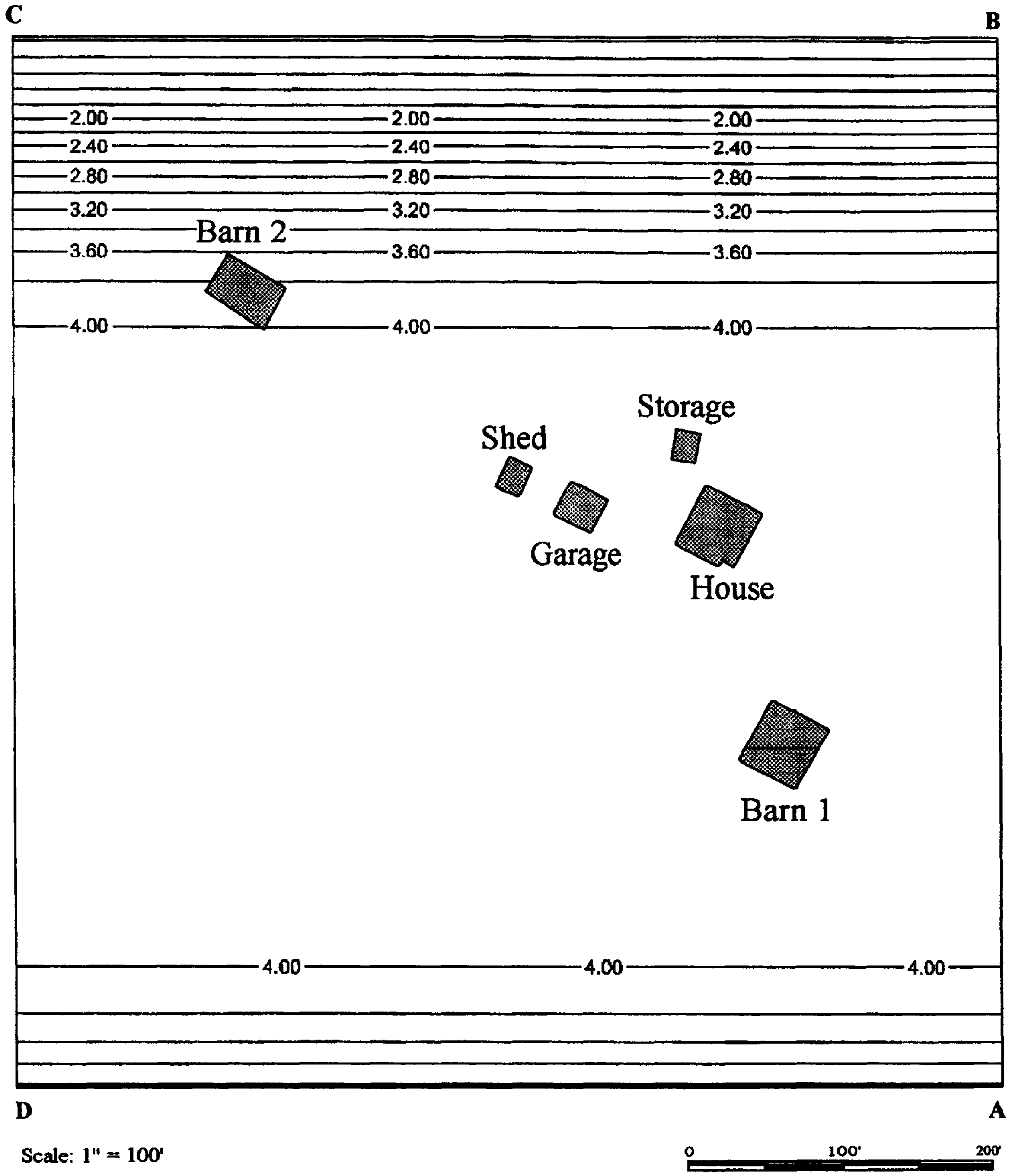


Fig. 9 Predicted Final Surface Subsidence in the Area of the Structures

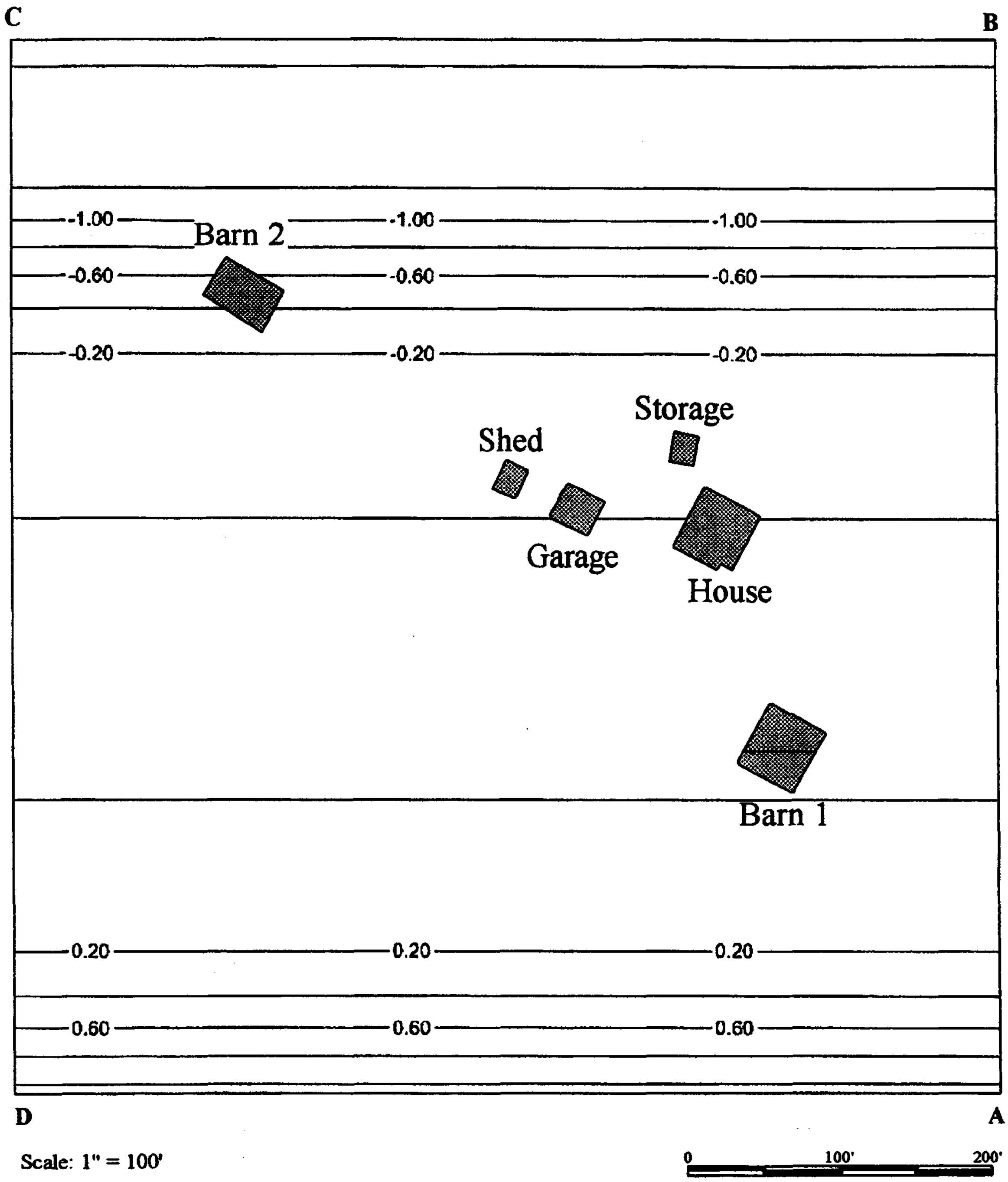


Fig.10 Predicted Final Surface Horizontal Displacement (Transverse Component) in the Area of the Structures

Table 1 Predicted Final Surface Movements and Deformations
Around the Structures

Item		Unit	House	Barn No. 1	Barn No. 2	Garage	Storage Building	Shed
Subsidence		*ft*						
	Maximum		4.10	4.10	4.00	4.10	4.10	4.10
	Minimum		4.10	4.10	3.60	4.10	4.10	4.10
	Max. Difference		0.00	0.00	0.40	0.00	0.00	0.00
Horizontal Displacement		*ft*						
	Maximum		-0.03	0.00	-0.70	-0.03	-0.10	-0.05
	Minimum		0.00	0.00	-0.30	0.00	-0.05	-0.02
	Max. Difference		-0.03	0.00	-0.40	-0.03	-0.05	-0.03
Slope								
	Maximum		-0.03%	0.00%	-1.10%	-0.03%	-0.10%	-0.05%
	Minimum		0.00%	0.00%	-0.45%	0.00%	-0.05%	-0.02%
	Average		-0.01%	0.00%	-0.78%	-0.01%	-0.07%	-0.03%
Strain		*ft/ft*						
	Maximum		-8.00E-04	0.00E+00	-1.10E-02	-1.00E-03	-2.20E-03	-1.50E-03
	Minimum		0.00E+00	0.00E+00	-7.20E-03	0.00E+00	-1.40E-03	-5.00E-04
	Average		-2.00E-04	0.00E+00	-9.30E-03	-2.00E-04	-1.80E-03	-1.00E-03
Curvature		*1/ft*						
	Maximum		-1.50E-05	-7.00E-06	-1.65E-04	-1.70E-05	-3.50E-05	-2.50E-05
	Minimum		0.00E+00	0.00E+00	-1.07E-04	-3.00E-06	-2.20E-05	-1.00E-05
	Average		-4.00E-06	-2.00E-06	-1.45E-04	-1.00E-05	-3.00E-05	-1.80E-05

The predicted final horizontal displacements around barn No. 1, garage, storage building and shed range from zero to value less than –0.1 ft as shown in Table 1. Barn No. 2 is to experience final horizontal displacement ranging from –0.3 ft at its front left corner to –0.7 ft at the rear right corner. The maximum differential final horizontal displacement across this structure, 0.4 ft, is to place it into compression.

Final Surface Deformations

The surface deformations include the following three items: *slope* indicating the subsidence-induced surface tilting, *strain* indicating whether the ground surface is stretched or compressed, and *curvature* indicating the bending condition of the ground surface. The presented final surface deformations in this report are their respective components along the panel transverse direction and they should be their respective maximum values at any surface point of interest. Their respective components along the panel longitudinal direction are very insignificant, if any.

Figure 11 shows the predicted final surface slope in the specified rectangular area around the four structures. The maximum slopes at the house, barns No. 1 and 2, garage, storage building and shed are -0.03%, 0.00%, -1.10%, -0.03%, -0.10% and -0.05%, respectively. The mentioned maximum slope values except that at barn No. 2 are very insignificant.

Figure 12 shows the predicted final surface strain around the structures. The negative values indicate that the ground surface will be in compression after the subsidence process is over. The surface strain across the house is between zero at the front left corner and -8.0×10^{-4} ft/ft – a very insignificant value. Barn No. 2 is located near the zone of maximum compression of the final subsidence basin with the maximum compressive strain at the rear right corner being -1.1×10^{-2} ft/ft. The other structures are to experience some insignificant final compressive surface strains.

The predicted final surface curvature (component along the panel transverse direction) around the structures is plotted in Fig. 13. The negative values are for concave bending. The maximum final surface curvature across the house is only -1.5×10^{-5} 1/ft – a very insignificant bending condition. The maximum final surface curvatures at barns No. 1 and No. 2, garage, storage building and shed are -7.00×10^{-6}, -1.65×10^{-4}, -1.70×10^{-5}, -3.50×10^{-5}, -2.50×10^{-5}, respectively. Again barn No. 2 is located near the maximum concave bending zone of the final subsidence basin to be formed over the panel.

Predicted Dynamic Surface Movements

The dynamic subsidence prediction describes the development process of movements and deformations at a surface point before the final state at this point is reached. Since all the structures except barn No. 2 will experience the maximum possible final subsidence, about 4.1 ft, in the subsidence basin, the presented development curves of dynamic surface movements and movements in this section are applicable to all structures but barn No. 2. The predicted dynamic horizontal displacement, slope, strain and curvature are their respective components along the panel longitudinal direction. Three face advance rates of 60, 80 and 100 ft/day, achievable at RAG Cumberland Mine, have been used in the dynamic subsidence predictions.

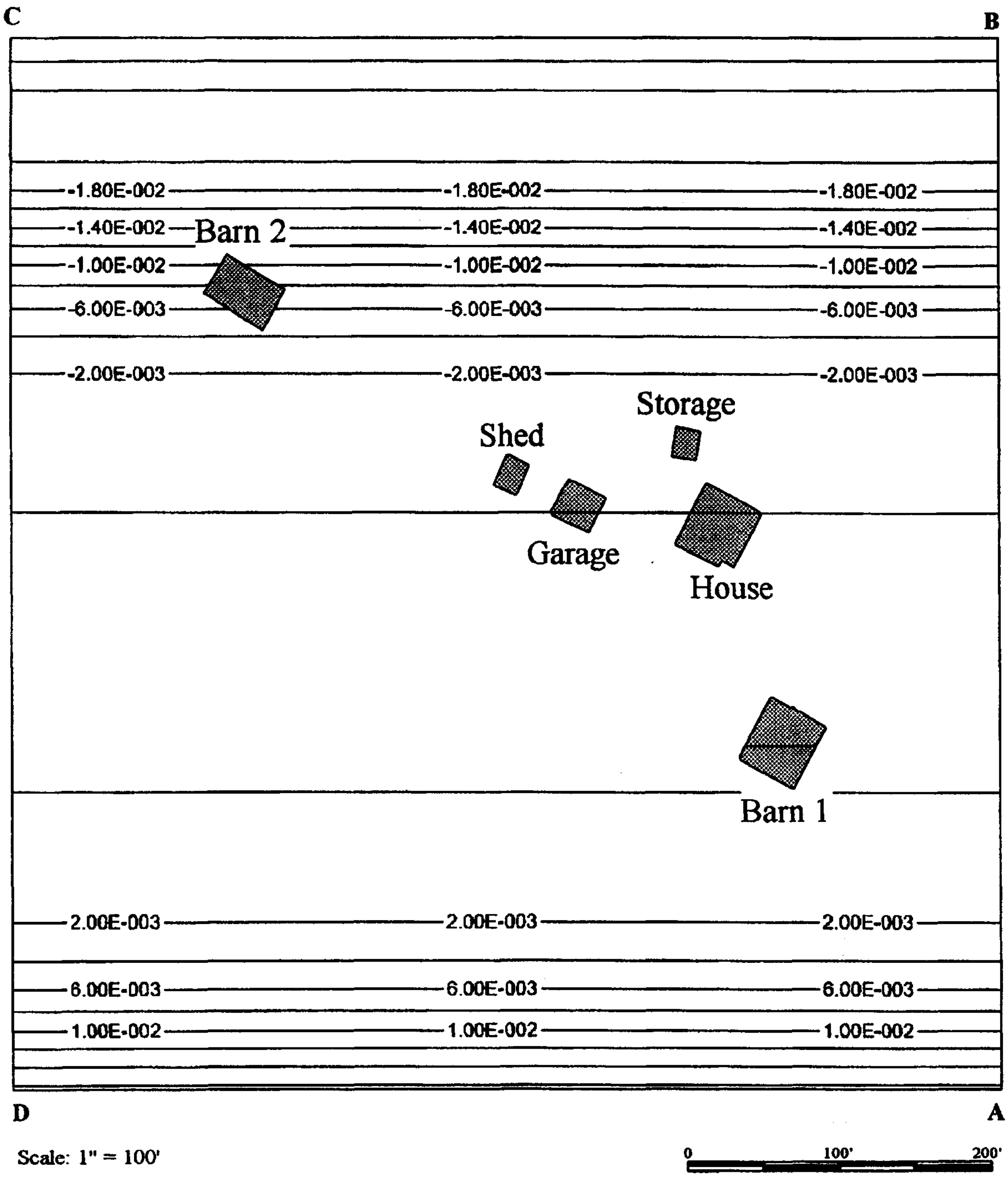


Fig. 11 Predicted Final Surface Slope (Transverse Component) in the Area of the Structures

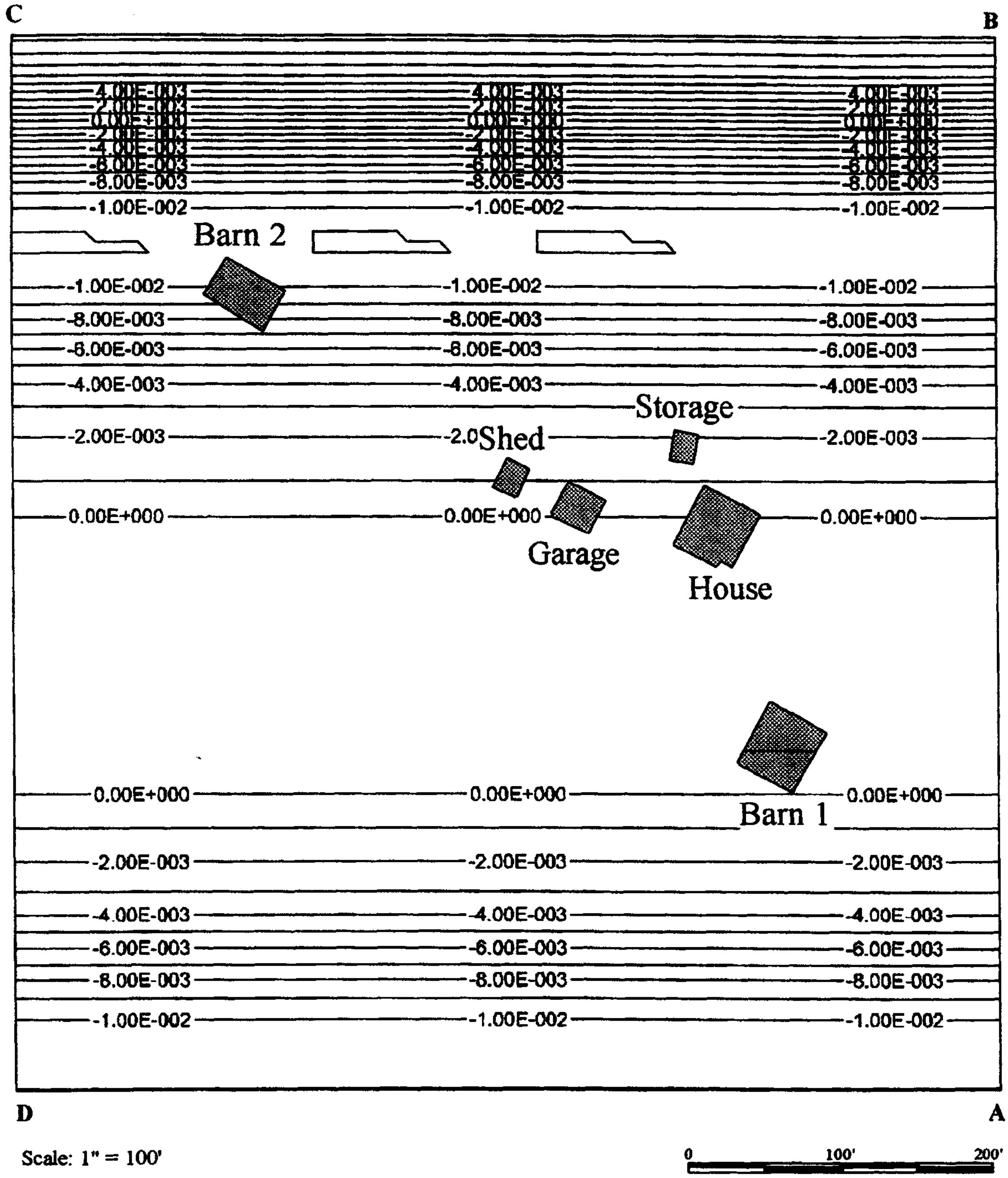


Fig. 12 Predicted Final Surface Strain (Transverse Component) in the Area of the Structures

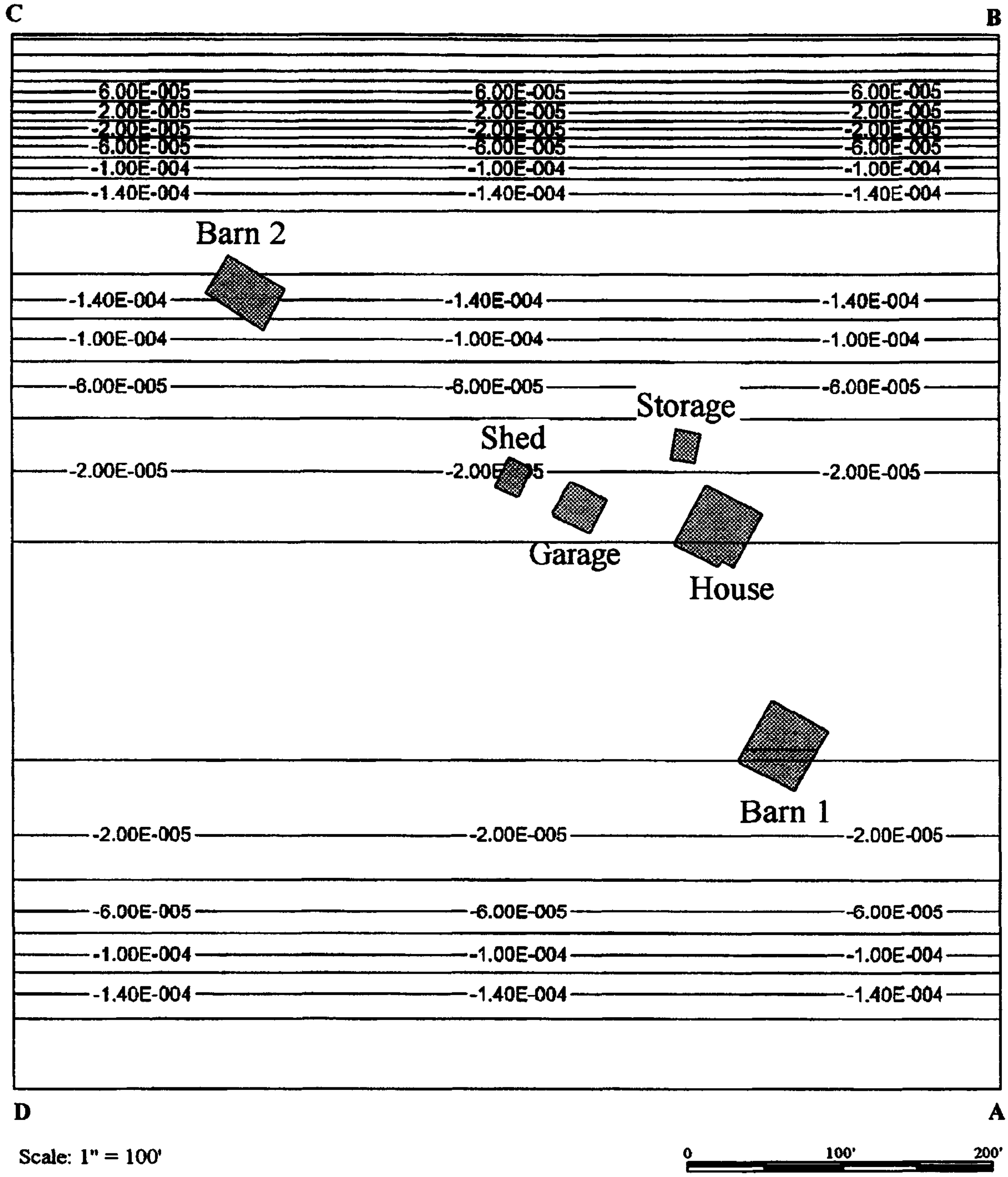


Fig. 13 Predicted Final Surface Curvature (Transverse Component)
in the Area of the Structures

The predicted dynamic subsidence development curves are plotted in Fig. 14. There is a very small amount of subsidence when the longwall face is directly under the point of interest. Then the subsidence process will accelerate and reaches about one half of its final amount when the face is about 250 ft passed the point if interest. At the same time, the subsidence process will be most active. A deceleration process is followed. The ground surface re-establishes its stable condition in vertical direction when the face has passed the point of interest a distance about 650 ft. Figure 14 also shows that a slower advance rate induces a steeper subsidence development curve. However, the differences between the subsidence development curves are not very significant for the range of high face advance rates used in the dynamic subsidence predictions.

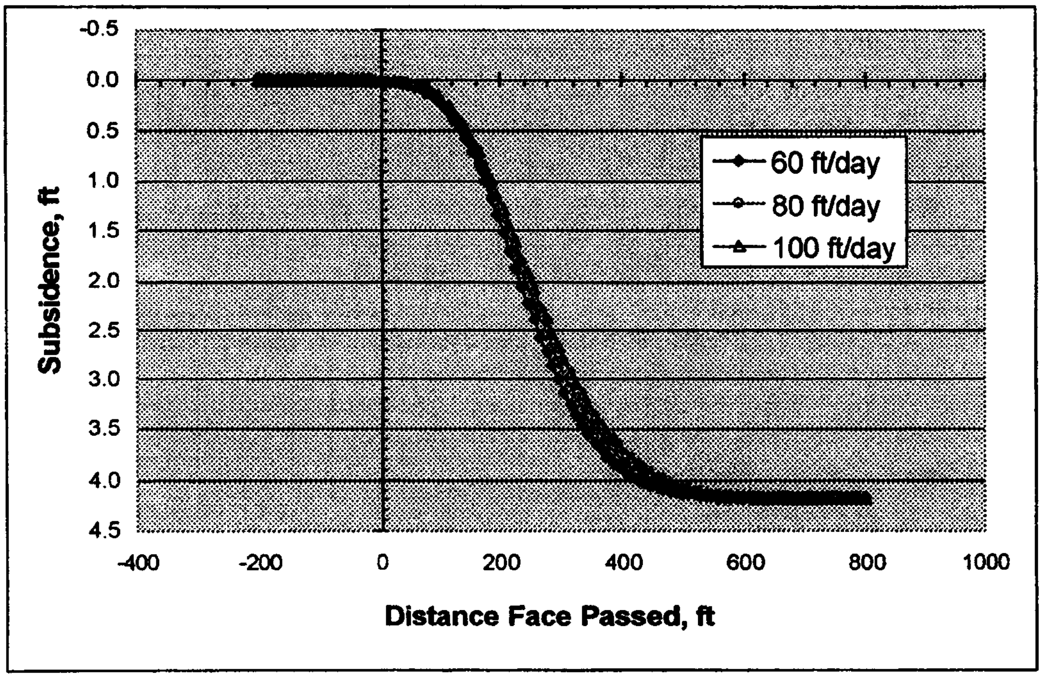


Fig. 14 Predicted Dynamic Subsidence Development Curves

Figure 15 shows the development curves of surface dynamic horizontal displacement (the component along the panel longitudinal direction). The negative values in the figure indicate that the movement is against the mining direction. The maximum dynamic horizontal displacement, ranging from 0.65 ft to 0.78 ft, will occur a distance between 210 and 235 ft behind the longwall face. The higher the advance rate is, the smaller will be the maximum dynamic horizontal displacement. The ground regains its stable condition in horizontal direction when the longwall face is about 700 ft outby the point of interest.

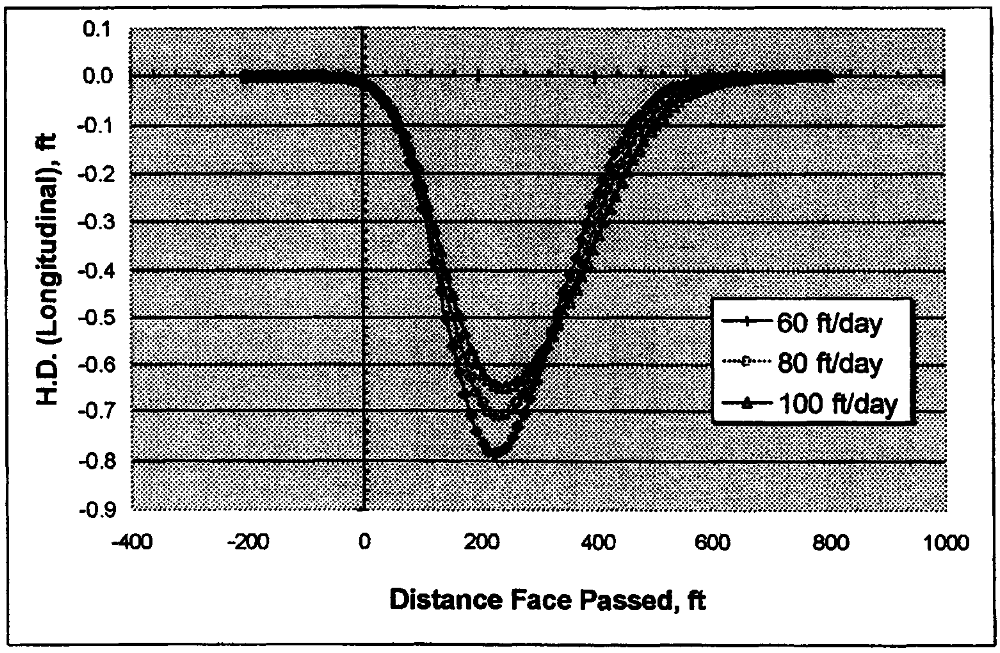


Fig. 15 Predicted Dynamic Horizontal Displacement Development Curves

Predicted Dynamic Surface Deformations

Figure 16 shows the development curves of dynamic surface slope (longitudinal component). These curves have the similar distribution patterns as the dynamic horizontal displacement. The maximum dynamic surface slope ranges from 1.0% to 1.25%. The dynamic surface slope is larger than 1.0% during the time period when the advance rate is 60 ft/day and the longwall face is between 170 and 300 ft passed the point of interest.

The development curves of dynamic strain (longitudinal component) are plotted in Fig. 17. The ground point begins to experience some minor tension when the longwall face is still 70 inby the surface point. The tensile strain increases as the face advances. The maximum tensile strain, ranging from 4.6×10^{-3} to 6.0×10^{-3} ft/ft, is reached when the face is about 120 ft passed the point of interest. The tensile strain decreases as face advances and reaches zero strain when the face is about 230 ft outby the surface point of interest. Then the surface enters the dynamic compression stage. The maximum dynamic compressive strain, ranging from -2.8×10^{-3} to –

$3.8x10^{-3}$ ft/ft, will occur when the face is between 320 and 400 ft passed the point of interest. Figure 17 also shows that a higher advance rate induces smaller maximum dynamic tensile and compressive strains, beneficial to the structures.

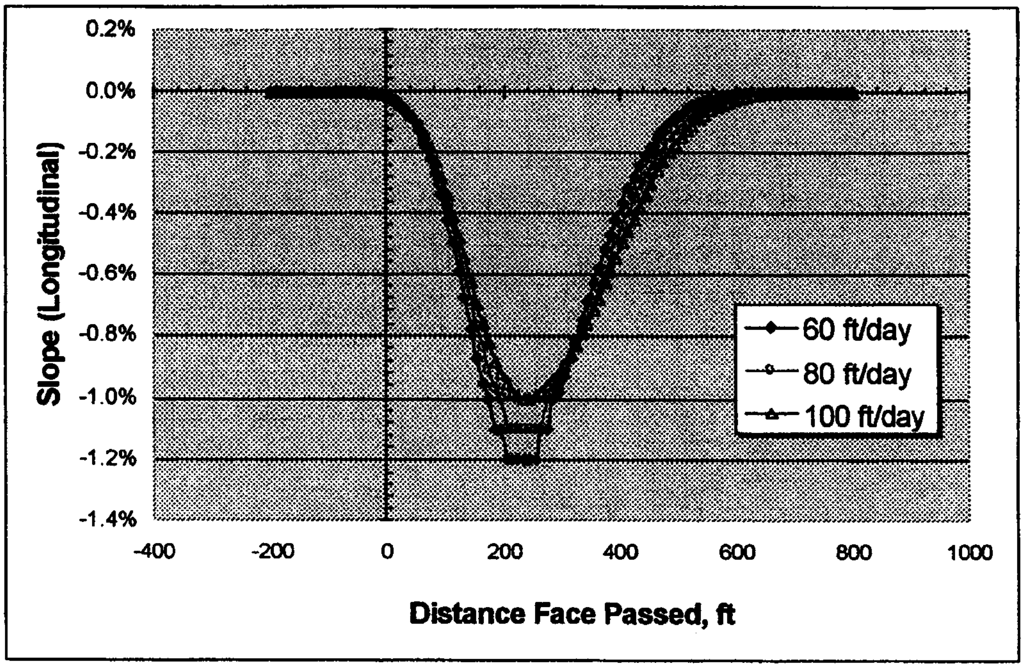


Fig. 16 Predicted Dynamic Slope Development Curves

The predicted development curves of dynamic curvature (component along the mining direction) are shown in Fig. 18. Their distributions are very similar to those of dynamic strain. The maximum dynamic convex curvature ranges from $7.2x10^{-5}$ to $9.2x10^{-5}$ 1/ft while the maximum concave curvature is between $-4.4x10^{-5}$ and $-5.9x10^{-5}$ 1/ft.

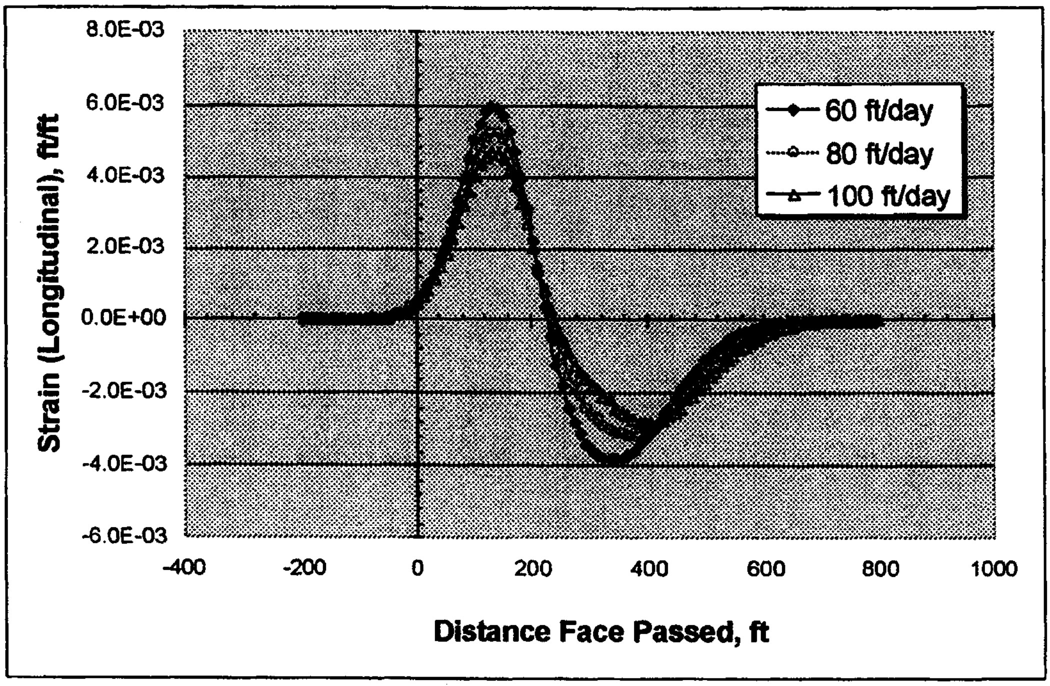


Fig. 17 Predicted Dynamic Strain Development Curves

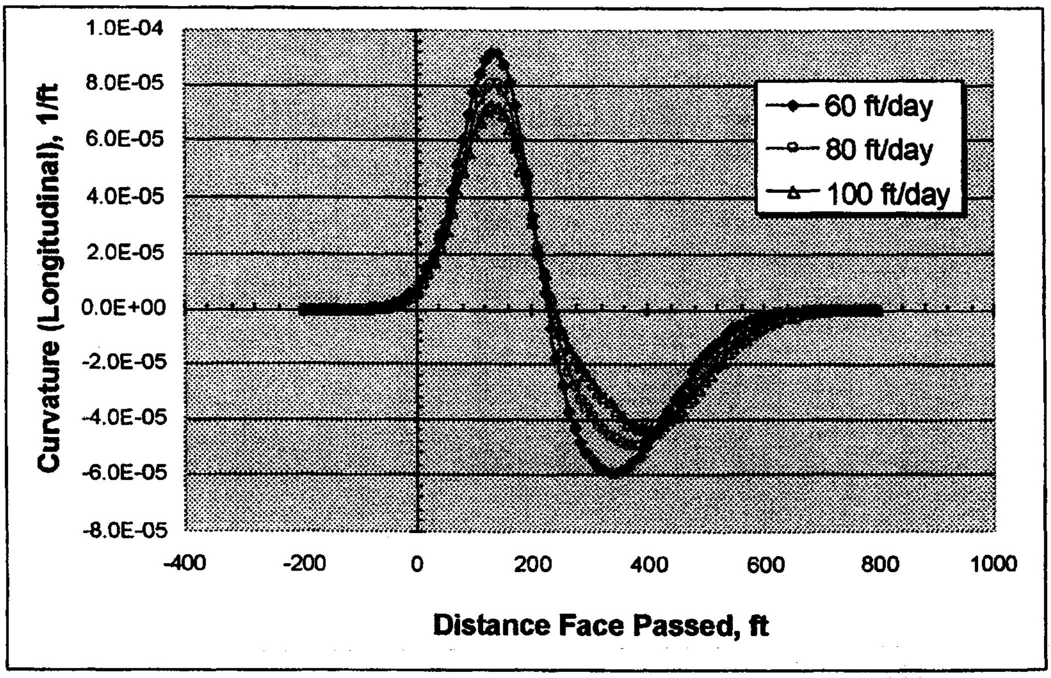


Fig. 18 Predicted Dynamic Curvature Development Curves

ASSESSMENT OF SUBSIDENCE INFLUENCES

Based on the predicted dynamic and final surface movements and deformations at the locations of the structures, RAG assessed the possible influences of the ground subsidence process on the farm and residential structures. In the assessment, the critical deformation values deduced from the subsidence monitoring programs performed on various residential house affected by longwall subsidence are used. To assess the subsidence influences on house, the size, shape, complexity, materials, construction method and existing condition of the house are also considered in the assessment. Based on the published literature and consultation with WVU, the critical deformation values applicable to the house in this property are as follows.

Critical slope:	1.00%
Critical strain for stone foundation walls:	$3x10^{-3}$ ft/ft
Critical curvature for house super-structure:	$6x10^{-5}$ 1/ft

Influences of Final Subsidence

As indicated in Figs. 9 to 13, all the structures except barn No. 2 will be located in the flat bottom portion of the final subsidence basin to be formed over the longwall panel. After the subsidence process is over, the only change on these structures is the lowered elevation by about 4.1 ft. The permanent surface deformations to be experienced by the structures are all very insignificant as shown in Table 1. Therefore, these final surface deformations would have no permanent effect on the house, barn No. 1, garage, storage building and the shed after the subsidence process is over.

Figure 12 shows that the rear right corner of barn No. 2 is located near the maximum compression zone of the final subsidence basin. The maximum compressive strain there is about $-9.30x10^{-3}$ ft/ft. The compressive strain at such magnitude is capable of causing push-in failure to the fieldstone foundation wall of this structure. The final surface curvature to be experienced by this barn seems to be high also. However, due to its flexible materials and construction, it is very unlikely for the final surface curvature to cause any noticeable problem to barn No. 2.

Influences of Dynamic Subsidence

As stated before, a surface point will experience a time-dependent movement and deformation process before it reaches its final state. The predicted dynamic deformations, shown in Figs. 16, 17 and 18, are capable of causing certain problems to the structures. Since the barns, garage and shed are flexible in materials and constructions and the storage building is small, the impacts caused by the dynamic subsidence process on these structures would be much less severe than those anticipated on the house. However, the influences of dynamic subsidence on the structures will only last for a relatively short time, typically less than two weeks.

During the dynamic subsidence process, the component of dynamic surface slope along panel longitudinal direction up to 1.25% when the face advances at 60 ft/day, is slightly over the house's limit for comfortable living. However, the time length for the dynamic slope to exceed the limit for comfortable living is short (between two and three days) under normal condition of longwall mining operation.

The dynamic tensile strain, ranging from $4.6\text{x}10^{-3}$ to $6.0\text{x}10^{-3}$ ft/ft, is capable of inducing cracks on the house foundation walls. . On the house foundation walls, the likely locations for the cracks are the weak spots along the left and right walls. If not properly mitigated, the total width of these cracks along either the left or right foundation wall could be up to two inches when the house is to experience the peak dynamic tensile strain. The maximum dynamic compressive strain, ranging from $-2.8\text{x}10^{-3}$ to $-3.8\text{x}10^{-3}$ ft/ft would do more help for the structures to close up the cracks created in the tension stage than creating further problems to the structures. The dynamic tensile and compressive strains are also capable to cause problems to the concrete pavements in the back yard and the paved driveways.

The dynamic convex curvature, ranging from $7.2\text{x}10^{-5}$ to $9.2\text{x}10^{-5}$ 1/ft, is enough to cause some problems to the house super-structures if no mitigation actions are taken. The problems include small step cracks at the corners of windows and doors, sticky windows and doors. The dynamic concave curvature, between $-4.4\text{x}10^{-5}$ and $-5.9\text{x}10^{-5}$ 1/ft, should not have significant impacts on the house.

Effects of Slope Surface

It should be noted that the house, barn No. 2 and the storage building are either located on the slope or very close to the toe of the slope. Since the longwall face is also mining "into" the slope as shown in Fig. 1, the effects of surface topography, though mild in this case, could intensify the predicted dynamic compressive strain to some degree. The structural parts that could be affected by such slope effects include the foundation walls of the house at its rear right corner, the foundation of the storage building and the right foundation walls of barn No. 2. Such problems could be further intensified if the active subsidence process at this site is coincident with a rainy season.

RECOMMENDED MITIGATION MEASURES

As indicated in the previous section, the dynamic subsidence process and the slope effects have the potential to cause problems to the structural integrity and functionality of the house. Therefore, RAG has proposed a number of mitigation measures to reduce the severity of the anticipated structural problems. These mitigation measures are working on the following four objectives of disturbance reduction:

1. Reducing the maximum dynamic surface deformations by maintaining a fast and steady face advance rate when the house is experiencing the active dynamic subsidence process. By maintaining a fast and steady face advance rate, the maximum dynamic tensile strain, the most contributing disturbance to the house, will be reduced and so will the disturbance potential.
2. Reducing the transmission of subsidence-induced surface strain from the surrounding ground to the house components;
3. Compensating the subsidence-induced deformations to further lower the deformations to be experienced by the house;
4. Reinforcing the house so that they are more tolerable to deformations to be experienced;

Compensation Trench

In order to reduce the problems to the house foundation walls caused by dynamic tensile strain and the slope effect, it is recommended to dig an L-shaped compensation trench along the front and right sides of the house as shown in Fig. 3. A compensation trench creates a weak plane between the house and the surrounding ground so that a reduction of the transmission of the surface strain from the surrounding ground to the house can be realized. By such a reduction of strain transmission, the house foundation walls will be subjected to smaller strains than those predicted. Therefore, the severity of problems that will potentially be developed on the house foundation walls can be reduced.

The trench should be located four (4) ft away from the front and right walls of the house as shown in Fig. 3. It should be two (2) ft wide and five (5) ft deep. The trench on the front side is to compensate for the dynamic tensile strain while that on the right side is to reduce the effects of surface slope topography. The trench should be kept properly drained by burying a perforated pipe at the trench bottom with gravel and filled the remaining depth with loose hay. A pump may be needed to drain the water collected at the trenches. The trenches should be securely covered by wood boards and properly fenced during its service.

Tension Cable Method

In order to further reduce the possible problems on the foundation walls of the house to be created by the dynamic tensile strain, it is also recommended to wrap the foundation walls with two 3/4-inch pre-tensioned steel wire cables at the locations shown in Fig. 3. The following two main purposes are served by wrapping pre-tensioned steel wire cables around the house:

- The force applied by the cables places the foundation walls into a compression state so that it is able to compensate some of the tensile stress induced by the dynamic subsidence process, and
- The rigidity of the foundational walls is increased so that they can tolerate more deformations transmitted to them.

The tension cable method can also indirectly reduce the severity of the anticipated problems on the super-structures caused by dynamic surface curvature if the deformation on the structural part under the super-structure can be controlled effectively. Steel wire cables of ¾ inch diameter in good working condition should be used as the tension cable. This type of wire cable has a breaking load of 41,400 lbs, far higher than the tensions to be specified on the cables in protecting the house.

As shown in Fig. 3, the two cables should wrap around the stone foundation walls. Tension cable #1 should be placed around the main part of the house and the two attachments on the right and as close to ground surface on all sides as possible. Small holes should be drilled on the foundation walls under the enclosed porch in the front for the placement of the cable. This cable should be tensioned to 3.5 tons (7,000 lbs). Tension cable #2 should be placed about six inches below the top of the foundation walls. It should also enclose the foundation walls under the enclosed porch in the front. The tension on cable #2 should be maintained at 3.0 tons (6,000 lbs).

Two tension devices should be used at the shown locations for each cable to maintain its tension at the required level. Springs should be inserted on the cables to keep the tension relatively uniform around the house. An example of the assembly of tension device, spring and tensometer is shown in Fig. 19. Force distributors built with wood board (1" thick and 12" wide) should be inserted between the tension cables and the house corners so that the force applied by the tension cables can be more evenly distributed over a large area.

Tension Rope Method

Tension rope method is recommended for the reduction of problems caused by dynamic surface curvature on the house super-structure. The working principles of the tension rope method are the same as the tension cable method but are more suitable for wood frame structures. Three groups of 3/4-inch polypropylene or nylon ropes (four courses per group) should be used around the house as shown in Fig. 3. Two groups of tension ropes should be used at the first floor level with the third group close to the second floor level. Group No. 1 should only enclose the main part of the house, the enclosed porch and the two attachments. Group No. 2 should also enclose the open porch in the front. Their placements should be as close to the first and second floor levels as possible so that the wood frame structures can have the maximum lateral resistance to the compression force applied by the ropes. Each of the ropes should be tensioned to about 600 lbs.

In order to reduce the possible impacts on the storage building and barn No. 2 caused by the effects of slope surface mentioned before, it is recommended to keep ground around these two structures well drained.

The installation of the tension cables around the house and the construction of the trench should be finished before the longwall face reaches a distance of about 200 ft inby the house.

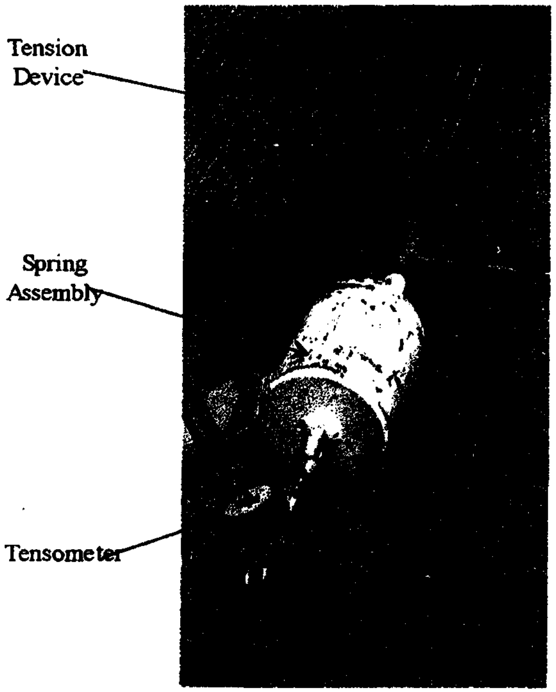
The tensions on the cables and ropes should be periodically monitored during the active subsidence and adjusted if necessary. During the early dynamic tension stage, the tensions on the cables and ropes are expected to rise. These tensions should not be reduced unless they are more than 15% higher than the installed tensions. The cables and ropes should be covered or fenced in traffic areas. These devices can be removed and the trench be filled after the longwall face has passed the house a distance of 1,000 ft.

CONCLUSIONS AND RECOMMENDATIONS

The possible subsidence influences on the [redacted]' house have been studied and presented in this report. Based on the study, the following conclusions and recommendations can be made:

- All the structures except barn No. 2 will be located on the flat bottom part of the final subsidence basin to be formed over the longwall panel. Therefore, the permanent deformations to be experienced by these structures are very insignificant after the subsidence process is over. Barn No. 2 is located near the maximum compression zone of the final subsidence. Its right foundation wall could be affected by the final compressive strain to some extent.
- The dynamic subsidence process has the potential to cause problems to the house. The influences on other structures would be insignificant because either of their flexible materials and constructions or small sizes. Among the dynamic deformations, dynamic tensile strain could cause most of the problems to the house foundation while the dynamic curvature could cause problem to the house super-structure. The dynamic slope will affect the comfort level of the living condition of the house for a short period of time. The effects of surface topography would also increase the dynamic strain to be experienced by the structures located either on the slope surface or near the toe of the slope.

Mitigation measures, compensation trench, tension cable and tension rope methods, have been recommended for the house to reduce the severity of the anticipated problems.



Spring Assembly in Use

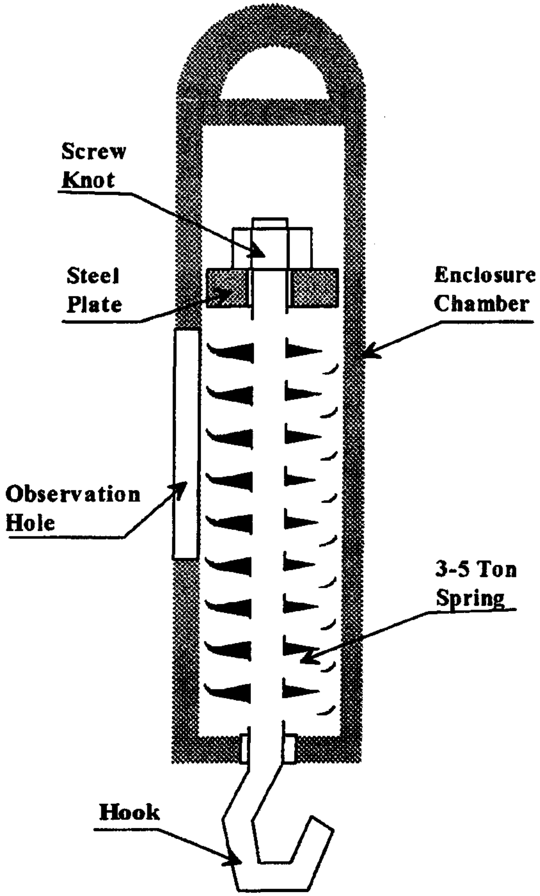


Fig. 19 Construction of the Spring Assembly

, Original: 2358

RECEIVED
2003 NOV -5 AM 7:45
REVIEW COMMISSION

Comments

on

Proposed Rulemaking

issued September 13, 2003

by

The Environmental Quality Board

on

Bituminous Mine Subsidence Control

from CAWLM

Concern About Water Loss due to Mining

written by Peggy Clark, Chair
7311 Rt 422 West
Indiana, PA 15701
Phone 724 354-2120

CAWLM submits the following comments on proposed Annex A chapter 89 as published in the PA Bulletin on September 13, 2003 p.4554.

CAWLM - Concern About Water Loss due to Mining, has been in existence since 1983, and since that time has continuously monitored and participated in public processes in development of laws and rules pertaining to damages and water supply loss caused by underground mining.

I attended three briefing sessions which DEP and OSM, jointly held in regard to the proposed changes.

Although OSM's original document which was published December 27, 2001, outlined discrepancies in PA rules fairly accurately, there have been numerous changes since then, which compromise or diminish OSM's original positions.

This process should not have been one of compromise. It is not a procedure to make new federal laws nor have federal rules changed but rather is a procedure to bring conformity of PA laws and rules to federal standards already established.

RULE CHANGES WE SUPPORT

CAWLM supports changes which eliminate two year statutes of limitations (89.143a(c) and encourage more prompt resolutions to problems, (89.145a(d)(3) and 89.145a(b), and covers ALL increases in costs when replacing water supplies to homes 89.145a (5). Also for a requirement to prevent damage to homes mined under by room and pillar techniques. (89.142a(d)((1)(ii)

(We are painfully aware that damage prevention requirement is limited to a very vague "minimize as much as is .... feasible" in cases where planned subsidence is deployed. This has meant very little to homeowners who continue to suffer severe damage.)

We approve the changes to 89.143a, which, minus a premining survey but in the presence of a "preponderance of evidence" the operator shall repair or pay full costs.(89.144a(b))

Landowners should certainly be encouraged to report damages early and cooperate on premining surveys. However, there may be circumstances where this has not happened and it should not preclude the replacement of water supplies or repair of damages where there is evidence the damage was caused by mining. This is not a large number of people but there may be some who are unable to meet deadlines for legitimate reasons and it meets OSM requirement for repair or replacement in all cases where mining caused damage..

We strongly support OSM and DEP's decision to eliminate the choice of the coal operator to either buy the property or pay cash for a settlement INSTEAD of replacing the water supply where it is possible to do so. We urge improved techniques and more careful permitting to make such incidences of impossibility to replace truly rare or non existent.

RULE Changes WE OPPOSE

Time of Premining Water Survey

We are concerned about the change on the time of premining water survey which are now taken prior to 1000 feet from mining activity to an uncertain distance, decided case by case, on when water supplies are susceptible to mining effects. 89.145a(a).

Yes, we agree 1000 feet is not always a sufficient distance, but this change is frought with potential for complications, miscalculations and misuse.

The change OSM allowed was reportedly based on a letter from then OSM Director Karpan to Gregory Conrad, Director of the Interstate Mining Compact Commission on March 9, 1999. Appendix A attached.

Ms. Karpan acknowledged it would be permissible to change the date of water survey for individual properties at time of mine application to a later time closer to the time of mining. The letter indicates it was her intent that a new point could be established where all applicants would take samples but must be well ahead of a time the water supply might have been affected by mining.

I quote from her letter "the state must demonstrate, THROUGH THE REGULATORY PROGRAM AMENDMENT PROCESS (our emphasis), that the analysis WOULD BE SUFFICIENTLY IN ADVANCE OF MINING (her emphasis) to avoid any adverse effect to the water supply.

And this was to be done through a REGULATORY CHANGE TO BE APPROVED BY OSM. Would DEP take each mine permit through the federal regulatory program amendment process to show it lives up to Ms. Karpan's rule?

This system of individual decisions for each mine permit would put an intolerable burden on DEP's California office, and open them up to time consuming challenges.

We believe an unquestionably safe UNIFORM distance should be decided on with the same standard for all. We suggest 2500 feet ahead of the mining area, which would have some certainty and convenience for DEP, the land owner AND the operator. It would also have some advantage to landowners who become alerted to the oncoming mining, their water supply condition and provide time to take their own surveys, if desired.

Quantity of Water Supply Replacement

In proposed 89.145a(b) OSM has accepted a standard for water supply replacement as one which "adequately serves the premining uses and reasonably forseeable uses of the premining supply". This is PA's present rule.

However, it seems to be a far cry from OSM's definition of a Replacement Water Supply in the Federal Code 30.701.5 which specifies replacements by operators to be "equivalent to premining quantity and quality".

OSM justifies this acceptance of PA's rule by claiming the OSM standard is for equivalent USE of the water supply and they promise to monitor PA's ADEQUACY of the supply to meet reasonably forseeable uses.

The present water supply replacements in PA sometimes appears to be based on what the operator can or is willing to provide at a particular spot. DEP has been known to approve supplies as low as 2 or 3 gpm for a supply which may have been 5 or 6 gpm before mining. (See Appendix B)

It is necessary to keep in mind, operators are never required to replace more water than was present before mining. Former OSM Director Karpan"s March 1999 letter (Appendix A) decided that water supplies higher than 10 gpm would not need to be replaced at higher than 10 gpm unless a future use were establishedd. But WATER SUPPLIES WHICH HAD UP TO 10 GPM MUST BE REPLACED AT PREMINING LEVELS. AppendixA We believe that should be DEP's standard.

If the final rules retain the present requirement, adequate for present and reasonably forseeable future use, as determined by DEP regardless of our appeal of the rule, we strongly protest DEP or an operator determining what a forseeable use would be.

Only the homeowner can best foresee what uses will be needed and could be reasonable as families grow, hobbies develop, aging parents move in, illness occurrs, additions of swimming pools, more bathrooms or additions might be needed. If the water supply which was present before mining would have made these needs feasible those needs should be covered in replacing the water supply. This is the ONLY way the value of the property which includes the water supply, could be maintained.

DEP's brief promise to replace based mostly on the number of bedrooms in a home is not reassuring. Certainly those future uses should be controlled by the owner, not DEP or the operator. The owner of the land should be satisfied that he can continue present use and has available uses which can reasonably occur over the years as he had before mining.

In the turmoil of passage of Act 54. we heard a lot about the coal industry's promise to make landowners "WHOLE". That means providing what was there before mining. (With the exception for HUGE quantities over 1o gpm)

This, with OSM's regulatory definition of replacement of water supply as equivalent, would appear to provide the same quantity, or, at the very least, the amount that the property owner best decides is required for future uses.

Always keep in mind, there is no requirement to replace MORE water than was there before mining. This might frequently be considerably less than 10 gpm, especially in areas of repeated mining.

However, Industry's argument that many people get along on 2 or 3 gpm and so that amount is appropriate for any home in the area should not be given credence. That would be like saying some people have incomes at the poverty level and so that is enough for everyone in the area.

Payment of Costs For Water Supply Replacement

In proposed 89.145(f)(5)(i), costs for EPACT water supplies which exceed premining costs must be paid by operator. It is at OSM's direction that costs higher than premining costs shall be paid by the operator (even so called de minimis costs)

However, in FED 30.701.5 definition if the operator is paying for future costs in one time payment the operator and property owner shall come to agreement on the time to be covered. (This OSM requirement does not make sense because it can easily allow less than the excessive costs to be paid.)

Even if this is a federal rule in 30.701.5 this is a lower standard than PA now has because PA now requires permanent payment for all increased costs (in perpetuity as DEP's Program Guidance describes.)

When state rules are higher than federal rules, they are not required to be changed to federal standards. A careful reading of the December '01 OSM Directives is silent on this issue. DEP gives no reason for the change to this part of the rule. Since PA present rules provide that increased costs be paid, there must be a rationale for making such a change and an explanation before it is proposed.

CAWLM believes that ALL increases in costs are inherant in truly replacing the original water supply.

We also object to the change because many so called "agreements" between landowners and numerous coal operators leave room for unfair, unchallenged settlements. How do YOU think an agreement between a landowner out of water, often unaware of all legalities, hard pressed for funds for legal guidance, inexperienced in legal procedures, fares in negotiations with a powerful company's well paid lawyer??

We challenge the agencies to show us an agreement which puts the OPERATOR at a disadvantage. It is the PROPERTY OWNER who is more often at a disadvantage with total costs and other limitations.

PA now requires full payment for permanent costs. 89.145(c) They give no explanation for lowering the standard to an "agreement" between operator and property owner. And OSM does not specifically require it.

No Water Supply Replacement Three Years After Mining Activity

We believe the agencies erred in not requiring a change in 89.152(a)(2) of present PA rules. This allows water supplies to go unreplaced, even though loss was caused by mining, if they occur more than 3 years after mining activity ceased.

They reason that this would rarely happen, as it would be after all mining and reclamation work is complete, usually at least ten years. We beleive there CAN be water losses in room and pillar mines in later years and they should be covered. If is is "not much of a problem" or just doesn't happen it would not put anyone at much disadvantage to require replacement.

Agreements Made between April 27. 1966 and Aug 21 1994

OSM has requested information regarding agreements made within the above timeframe. OSM's original December 27, 2001 document requested that sections 5.3(c) and 5.6(c) be removed as such agreements could interfere with measures now required by federal rules to repair subsidence damage and replace water supplies.

The sections of PA law relate to the use of deed clauses, leases and "agreements" between operators and surface owners.

Section 5.3(c) refers to water supply replacements. DEP assures OSM that this provision will not interfere with a person's rights under BMSLCA while seeking remedies under other laws. We don't understand that this cannot eliminate that mining right, if, under BMSCLA the operator rights continue to be present in the BMSCLA law, saying these deeds or agreements allow operators to mine without interference.

We are not lawyers - and even if we are wrong, so long as the law seems to suggest those operator rights continue, it is a disservice to homeowners.

What purpose does it play to keep it in? There has been no legally contested challenge to it which would prove DEP right, that we are aware of. If EPACT does not permit deeds, laws and "agreements to interfere with water supply replacement, why should it not be removed?

OSM also directed removal of 5.6c) in state law because that section provides for agreements entered into between April 27, 1966 and the date of passage of Act 54 which for valid considerations would release the operator from obligations to repair mine subsided homes from present or future mining. In this case, DEP argues, not that these agreements would not be valid, but that it is highly unlikely there ARE such agreements. They reason, since post '66 homes were not covered for repair by law there would be no reason to have an agreement. And, since pre'66 homes were fully protected they would not have agreements lapsing into this time period.

Wrong on both counts!

Neither industry nor affected homeowners could truthfully deny that such agreements exist. Don't the agencies remember the so called "good neighbor policies" which operators touted as a reason we don't need a LAW requiring repair for damages?

Although not universal, the policy of several large companies was to provide for some repair or compensation, often based on the "cooperation" of the landowner. The compensation was frequently, if not always accompanied by a required agreement,

Prior to about 1987, then DER allowed longwall mining under pre'66 homes UNTIL damage occurred in the vicinity. This occured in Cambria and Greene counties. There were pre66 homes mined in that period, also, which gave permission to be mined under. You can be sure settlements were accompanied by agreements

In Cambria County, between about 1985 and 1993, publicity and uproar brought SOME help from operators to subsided home owners on a voluntary basis. You can be sure that did not take place without a signature of the homeowner on a so called agreement. affecting how damage might be repaired.

We do not know the terms signed onto because they were most often required to be confidential - at legal risk if they were not.

CAWLM was told some terms preclude signors participation in citizens groups involving coal rights. Some reinforced the operator's continuing rights to mine and cause damage.

Some of these limitations on homeowners would still appear to be in effect today, if an oprator approached them to mine other seams on their property.

Property owners are much more conscious of these conditions in their agreements than they are of PA and federal laws and rules. The room for such restrictive clauses, in the period defined OR in present agreements can still put the homeowner at risk, either legally or hypothetically and misunderstood.

We ask that OSM and DEP rethink section 5.6(c) as well as 5.3(c) and supercede or set them aside in this process.

PA's Compliance Assistance Plan

Although not an actual part of legislative or regulatory requirements in this process. PA points out the assistance given surface owners in its Notice of Proposed Rulemaking under the topic PA's Compliance Plan, which presumably would make the rule changes work. It is stated that surface subsidence agents are available to help affected landowners and assist them in obtaining remedies provided by law and rules.

These agents have not been active in counties outside of Washington and Greene counties. It has been publicly stated, at an informal conference on a mine permit that such help is NOT available in Indiana County.

Although this measure is not required by federal rules, it is a disservice to claim it as an advantage in making DEP's program work.

Resolving water supply complaints is a HUGE problem. Establishing fair settlements, particularly for permanent payments required for public water establishment. Homeowners on Snyder Lane in Indiana County can attest to long drawn out unfair, unequal settlements for homes in similar situations accompanied by threats of bankruptcy and uneven payments. In Armstrong County, people wait for a public line to be put in while local governments struggle with funds. Isn"t the coal company required to get that line in?

Subsidence damage is a more rare problem in these counties but equally difficult to resolve in the absence of a DEP presence who may enter the picture too late.

CAWLM asks you to review our comments and these issues carefully and make decisions which will truly fulfill the federal laws and rules.

Citizens affected by mining have striven, over the years, for fair treatment from federal as well as state regulators through hard fought battles. Please do not take us backward in this process.

Thank you for your attention and consideration. We look forward to hearing the outcome of these rules.

Appendix A

United States Department of the Interior

OFFICE OF SURFACE MINING
RECLAMATION AND ENFORCEMENT
Washington, D.C. 20240

MAR 9 1999

Mr. Gregory E. Conrad
Executive Director
Interstate Mining Compact Commission
459-B Carlisle Drive
Herndon, Virginia 20170-8655

Dear Mr. Conrad:

Thank you for your letter of September 30, 1998, following up on the annual meeting of the Interstate Mining Compact Commission (IMCC).

I appreciate the IMCC summary of our discussions regarding implementation of the 1995 Energy Policy Act (EPAct) subsidence rules. Generally, I believe that you have accurately characterized the discussions in Asheville. However, I would like to fully express OSM's position on these issues.

Water Replacement: With regard to the water delivery ~~system, we interpret~~ our rules to require that the operator replace ~~the~~ homeowner's water supply, including the delivery system, to its pre-~~mining capability. For example~~, if the homeowner's actual pre-mining usage was 5 gallons per minute, but the water supply, including the delivery ~~system, was capable of~~ producing 10 gallons per minute, the operator must provide a post-mining water supply, including a delivery system, capable of producing 10 gallons per minute, of a quality suitable for all current ~~and reasonably foreseeable~~ uses.

If the source of the water supply was a flooded underground mine subsequently dewatered by the current operation, the operator need not reflood the mine or replace the mine pool. However, the operator must identify and provide an alternative water supply capable of producing the same quantity as the pre-mining delivery system and of a quality suitable for all current and reasonably foreseeable uses.

Subsidence Damage Determinations: There is no requirement that the regulatory authority make an independent determination as to the cause of damage to a protected structure. The regulations require the regulatory authority to evaluate the record, including technical information and any other available information, and determine whether it rebuts the presumption that subsidence from the underground mine operation was the cause of the damage. The ultimate burden of proof remains on the regulatory authority. The availability to the public of the regulatory authority's records are addressed in OSM's regulations at 30 CFR 840.14.

Compensation for Damaged Structures: The enforcement action in the New Warwick (Yost) case is currently before an Administrative Law Judge (ALJ) within the Department of the Interior's Office of Hearings and Appeals. In a letter dated October, 1998, the ALJ indicated that he anticipated issuing a decision in the case in the near future. While I had indicated that I might review the position taken in that case, I have decided not to intervene in this administrative review process.

Water Supply Information in Pre-Subsidence Surveys: With regard to baseline water supply information, the Energy Policy Act (EPAct) and its implementing regulations protect domestic water supplies from wells and springs in existence at the time of permit application. By necessary inference, then, EPAct protects the quantity and quality of those supplies as of the time of permit application. Under 30 CFR 817.41(j), the baseline hydrologic and geologic information collected under 30 CFR 784.14 and 784.22 will form the basis for determining the impact of underground mining on a protected water supply.

In addition as required by 30 CFR 784.14(b)(1) the permit application must include sufficient baseline data for each protected water supply to determine both the quantity and quality of the water supply at the time of permit application. This will allow the regulatory authority to determine the standard to which the damaged supply must be replaced.

The baseline data collected at the time of permit application must be sufficient to develop the PHC and the Cumulative Hydrologic Impact Assessment (CHIA). States may use the regulatory program amendment process to identify what additional information required under 30 CFR 784.20(a)(3) must be submitted at the time of permit application and which, if any, could be collected at a time closer to when mining would actually occur.

Within the constraints mentioned above, OSM will give serious consideration to approving a state program amendment which identifies what water supply information required under 30 CFR 784.20(a) must be submitted at the time of permit application and which, if any, could be collected at a time closer to when mining actually occurs. The state must demonstrate, through the regulatory program amendment process, that those analyses would be completed sufficiently in advance of mining to avoid any adverse effect to the water supply.

Public Access to Pre-Subsidence Surveys: We appreciate your concerns about protecting the privacy of citizens. OSM will also give serious consideration to approving a state program amendment that meets the requirements of 30 CFR 840.14, while protecting the privacy concerns of homeowners about information collected pursuant to 30 CFR 784.20(a)(3). For example, consistent with 30 CFR 840.14(b), OSM could approve reasonable restrictions on access to videos of structural condition surveys of home interiors, to the extent necessary under state laws which are analogous to Federal laws such as FOIA and the Privacy Act, in protecting individuals' privacy interests in the information.

Termination of Jurisdiction: You referred to Judge Bryant's decision on the EPAct regulations with regard to the applicability of the termination of jurisdiction rule to underground mining activities where future damage may occur to protected water supplies and structures. The court ruled that EPAct imposes a separate obligation with respect to water supplies and protected structures and that, in connection with this obligation, the statute of limitations begins to run from the time the damage actually occurs. The court's decision means that final bond release does not terminate jurisdiction with respect to 30 CFR 817.41(j) and 817.121(c)(2) only. The decision does not affect the applicability of the rule to all other aspects of underground mining operations.

OSM will continue to work with the individual States on the development and approval of State program amendments related to these regulations. We look forward to seeing the States fully implement the requirements of the 1995 regulations. Through our joint efforts, the mandate of EPAct will be realized.

If you have any questions do not hesitate to contact me at (202) 208-4006 or Margy White, OSM's Chief of Staff at (202) 208-2755. You may also contact Mary Josie Blanchard, Assistant Director, Program Support at (202) 208-4264, to discuss specific issues related to subsidence. Once again, thank you for your continued work with us on these issues.

Respectfully yours,

Kathy Karpan
Director

Appendix B

Pennsylvania Department of Environmental Protection

3913 Washington Road
McMurray, PA 15317
September 9, 2002

2003 NOV -5 AM 7:45
REVIEW COMMISSION

McMurray District Office 724-941-7100

The CAWLM Committee
Ms. Peggy Clark
RD 5, Box 195
Indiana, PA 15701

Dear Ms. Clark:

Thank you for expressing your concerns about water supply replacement. The following information will clarify the Department's position regarding the adequacy of a replacement water supply:

The coal mine operator must provide a restored or replaced water supply that adequately serves the pre-mining uses of the water supply and reasonably foreseeable needs. A restored or replaced water supply will be deemed adequate in quantity if it meets one of the following:

1. It delivers the amount of water necessary to satisfy the water user's needs and the demands of any reasonably foreseeable uses.
2. It is established through a connection to a public water supply system which is capable of delivering the amount of water necessary to satisfy the water user's needs and the demands of any reasonably foreseeable uses.
3. For agricultural supplies, reasonably foreseeable uses include the reasonable expansion of use where the water supply available prior to mining exceeded the farmer's actual use.

If a person uses approximately 75 gallons of water per day and a well produces a rate of two gallon per minute, then this well would supply enough water for residential uses. Water must meet the quality standards in DEP's safe drinking water regulations, unless the original supply did not meet those standards. If the supply did not meet the standards then the replacement supply must be at least similar to the original water quality.

If you have any other questions, feel free to contact me at the McMurray District Mining Office at the above telephone number.

Sincerely,

Wm. S. Plassio

William S. Plassio
District Mining Manager
District Mining Operations