WY DEQ HEARING –

Exhibit 11

SUBSIDENCE ENGINEERING INVESTIGATION OF THE PROPOSED BROOK MINE

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MEA
MARINO ENGINEERING ASSOCIATES, INC.

OUTLINE

- MINING METHOD
- MINE STABILITY PRINCIPLES
- GEOLOGICAL CONDITIONS
- MINE SUBSIDENCE POTENTIAL
- CONCLUSIONS

MINING METHOD

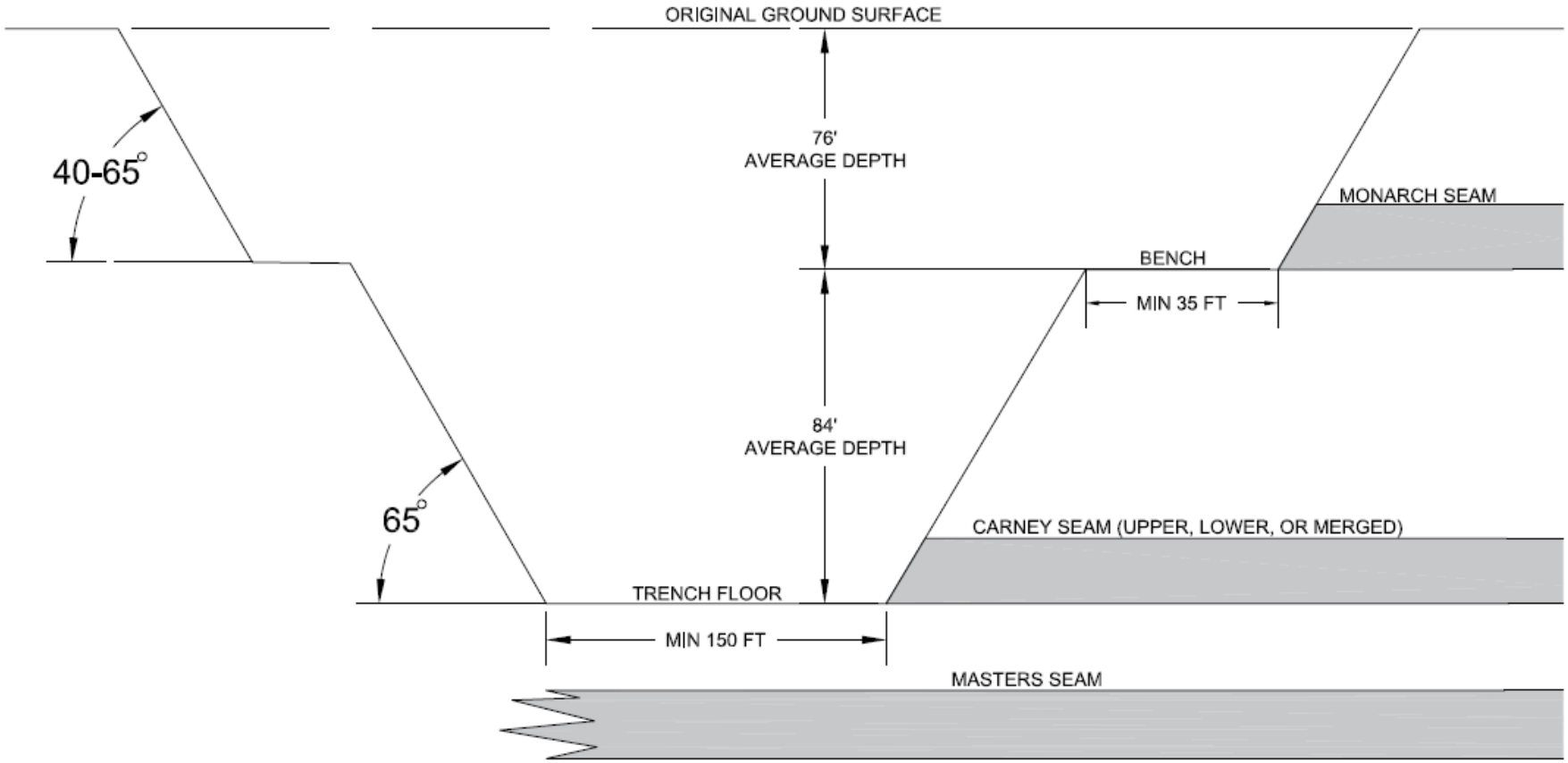
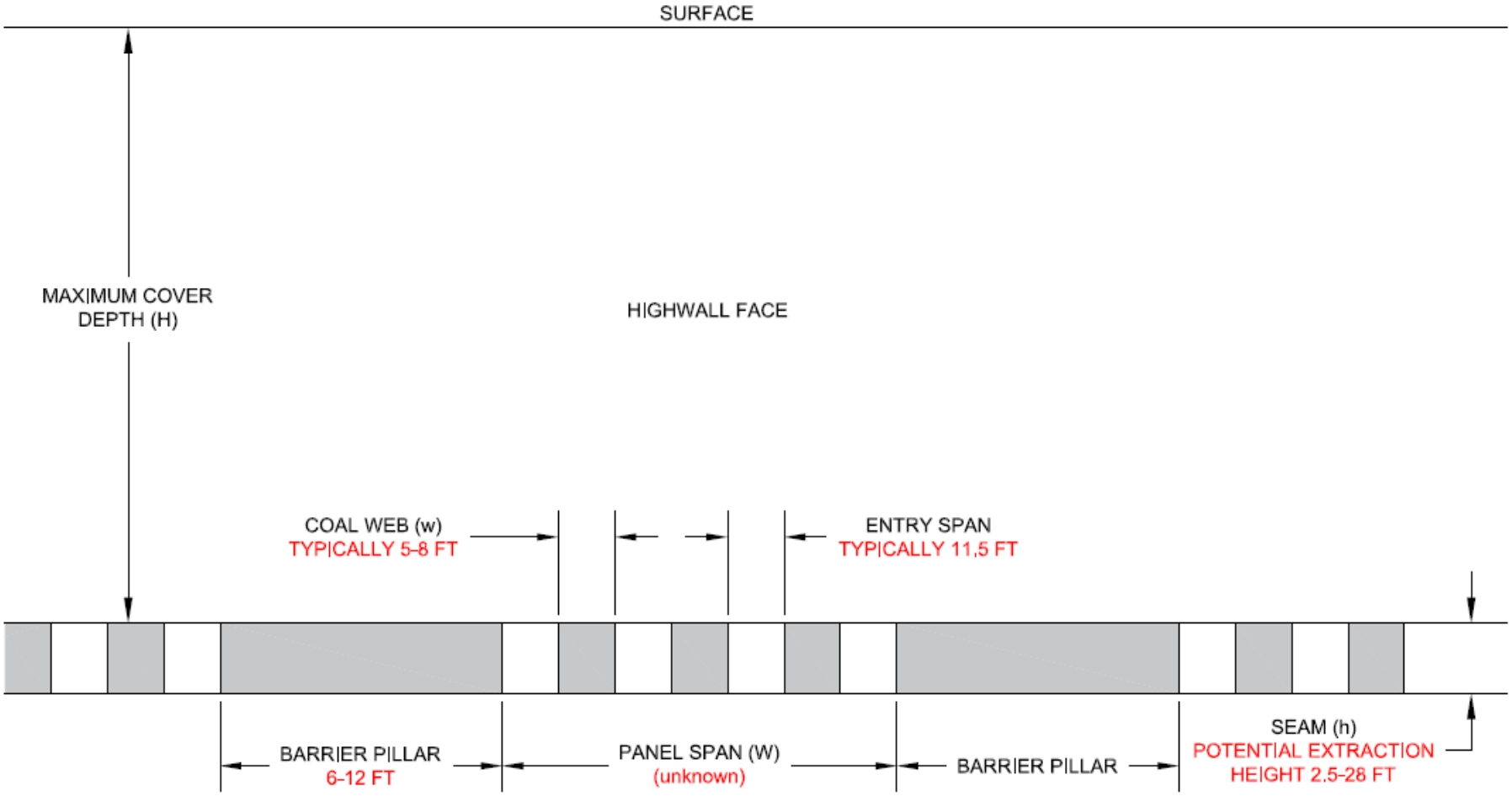


ILLUSTRATION OF PROPOSED HIGHWALL MINING OF COAL VIA STRIP-MINED TRENCH EXCAVATIONS (SEE P. MP-F2)


Photo courtesy of Friends of Coal

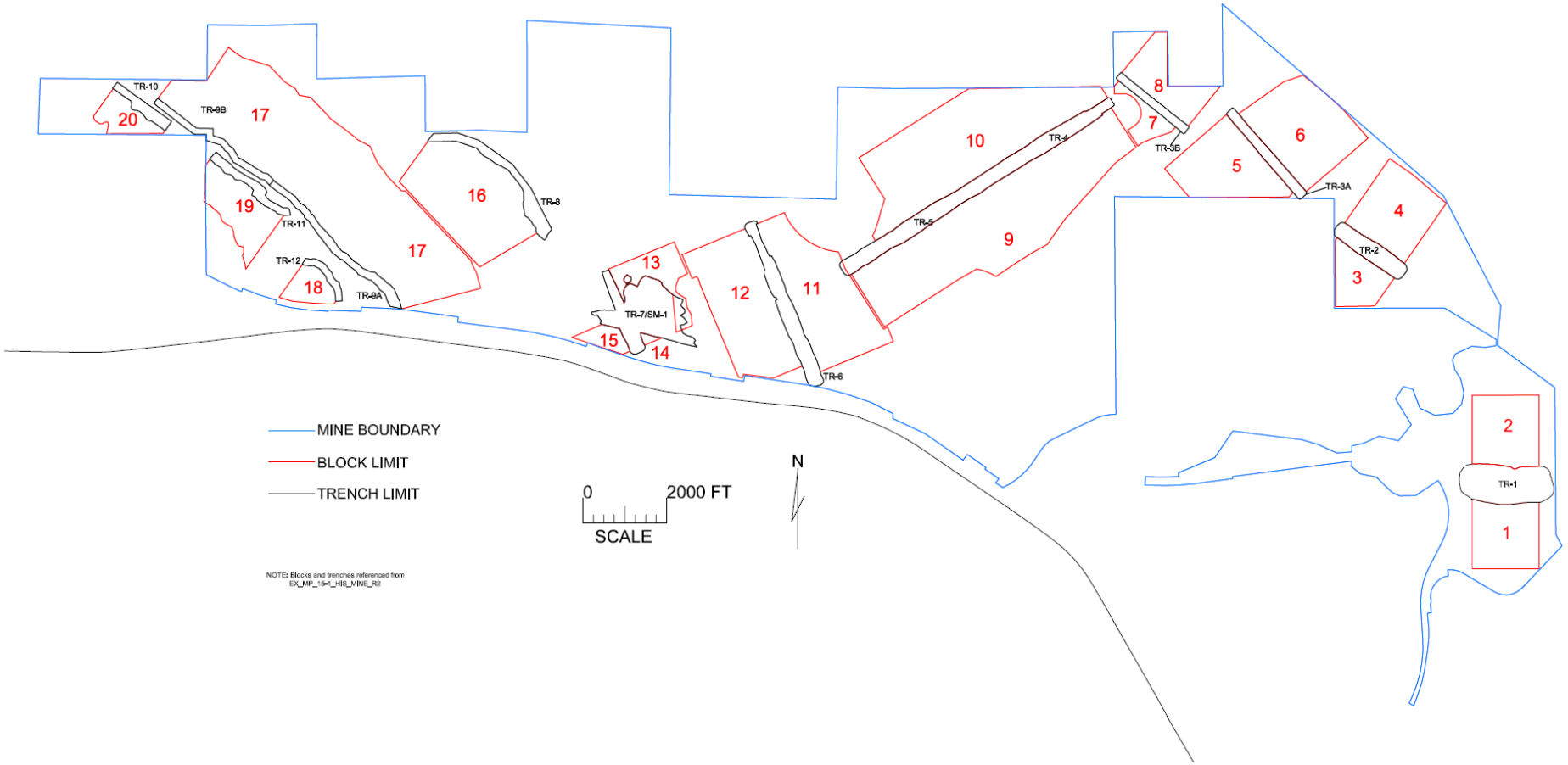

ARMPS-HWM 1.3



NOMENCLATURE FOR GUIDELINES - HIGHWALL MINING

NOT TO SCALE

PROPOSED HIGHWALL MINING AND PILLAR CONFIGURATION (SEE P. MP-F3)



PLANNED TRENCH AND COAL BLOCK AREAS

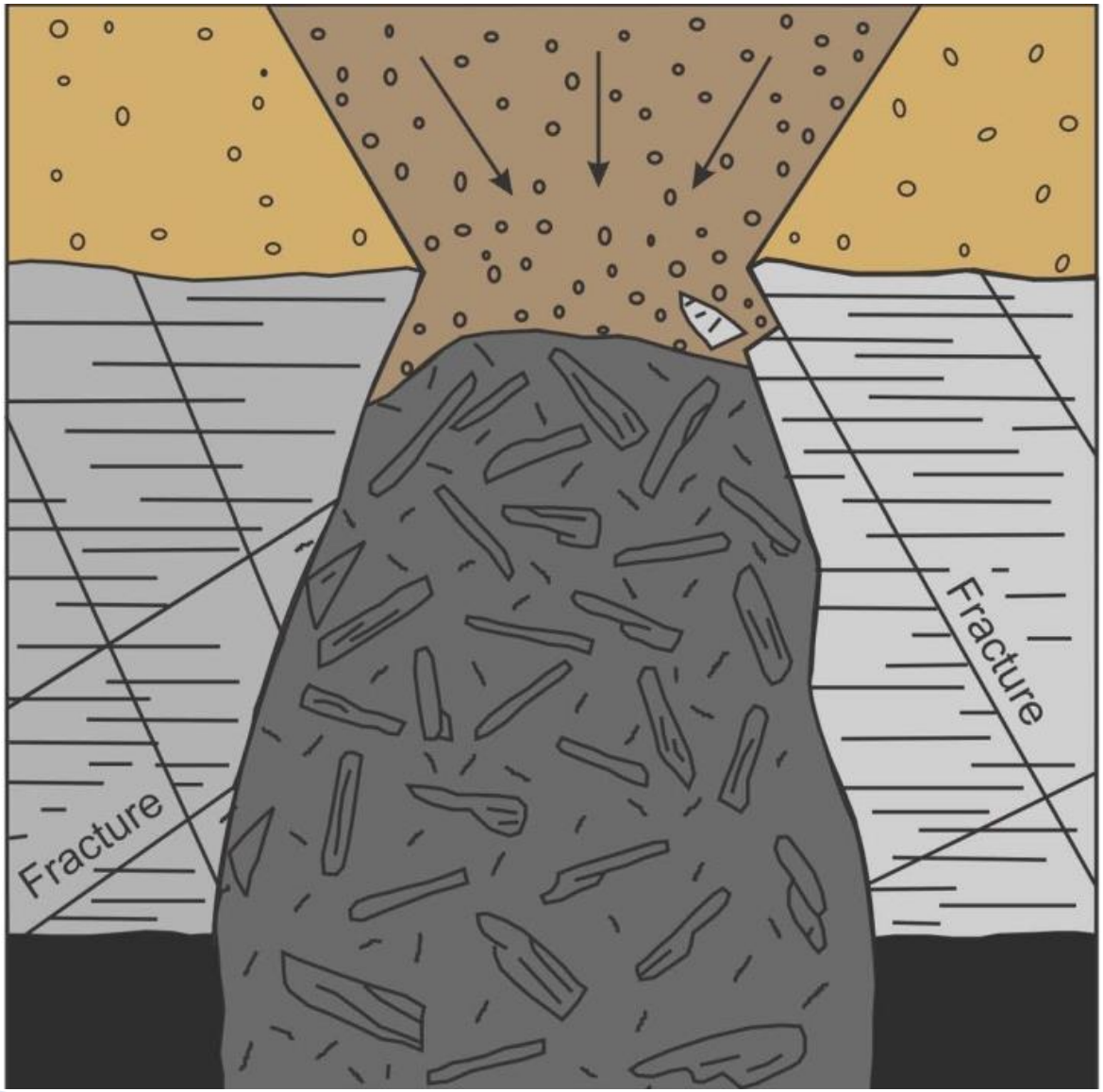
MINE STABILITY PRINCIPLES

MINE STABILITY PRINCIPLES

- MINE FAILURE MODES:
  - Roof (Room Caving) Failure
  - Pillar (Crushing) Failure
  - Roof/Floor (Bearing) Failure

MINE STABILITY PRINCIPLES

ROOF FAILURE

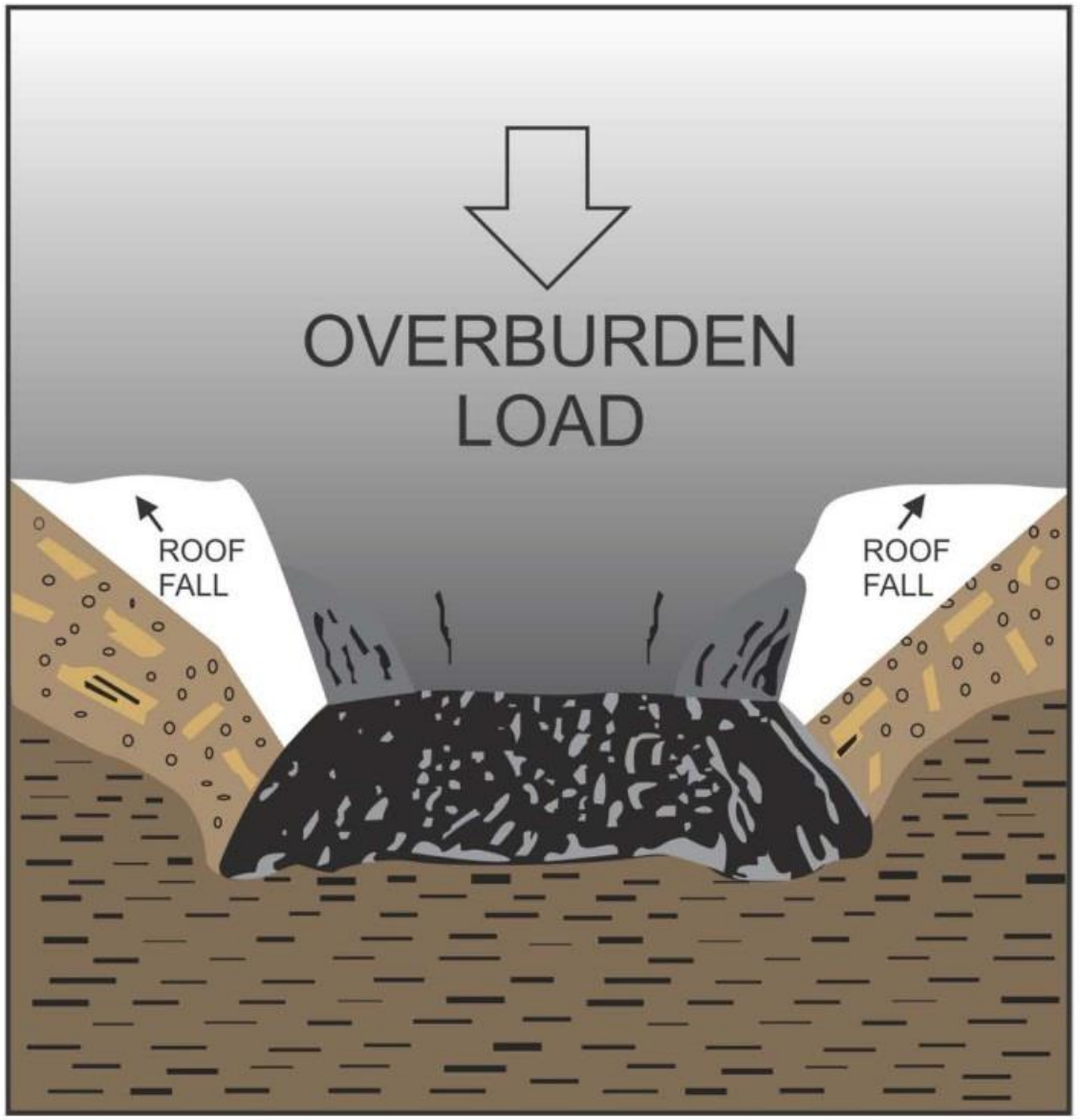


MINE STABILITY PRINCIPLES

- ROOM SPAN CAPACITY FACTORS:
  - Durability of bed(s)
  - Thickness of bed(s)
  - Strength of bed(s)
  - Rock Structure

MINE STABILITY PRINCIPLES

PILLAR FAILURE

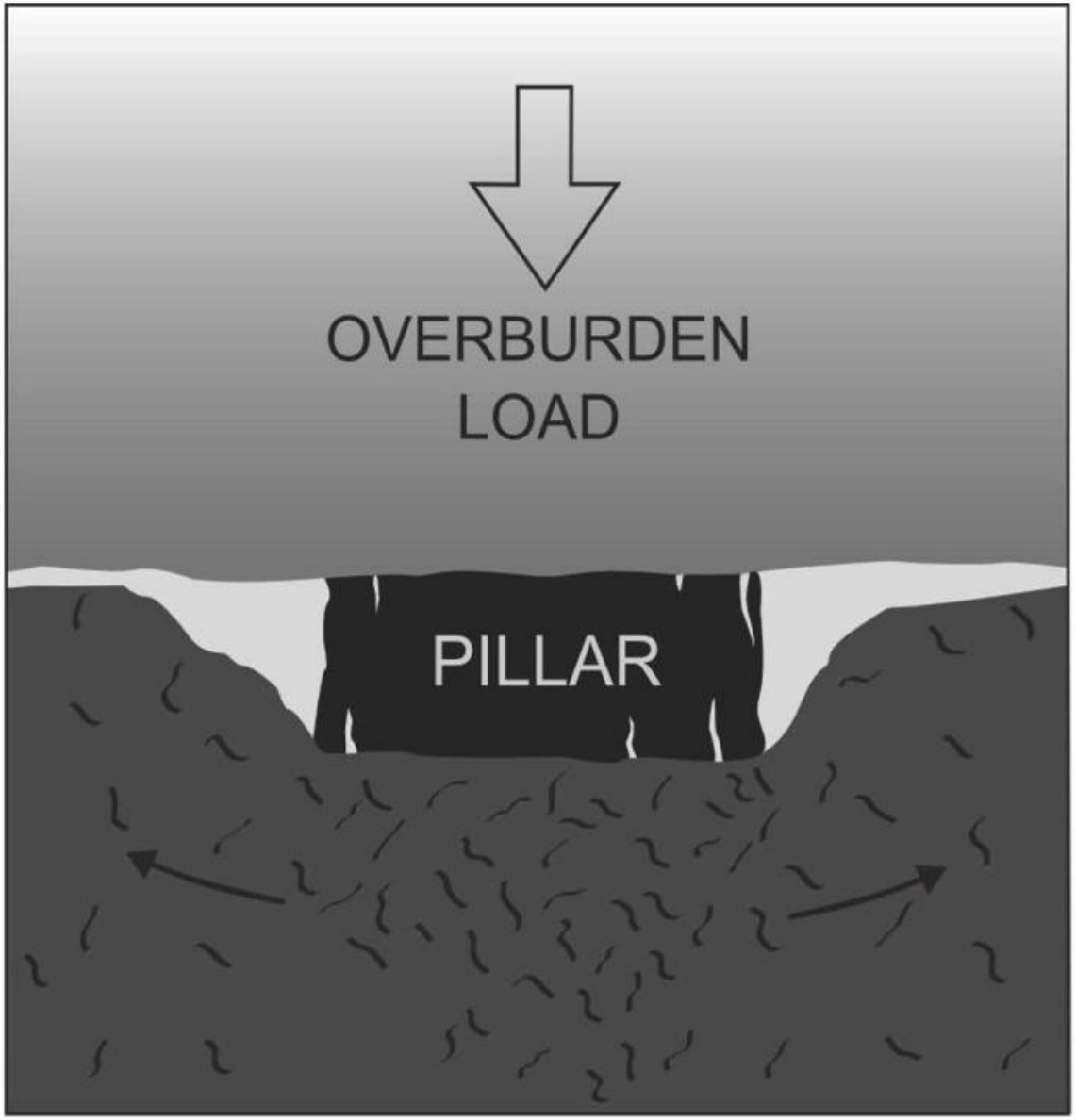


MINE STABILITY PRINCIPLES

- PILLAR STRENGTH:
  - Coal Strength
  - Pillar Height
  - Pillar Width and Length

MINE STABILITY PRINCIPLES

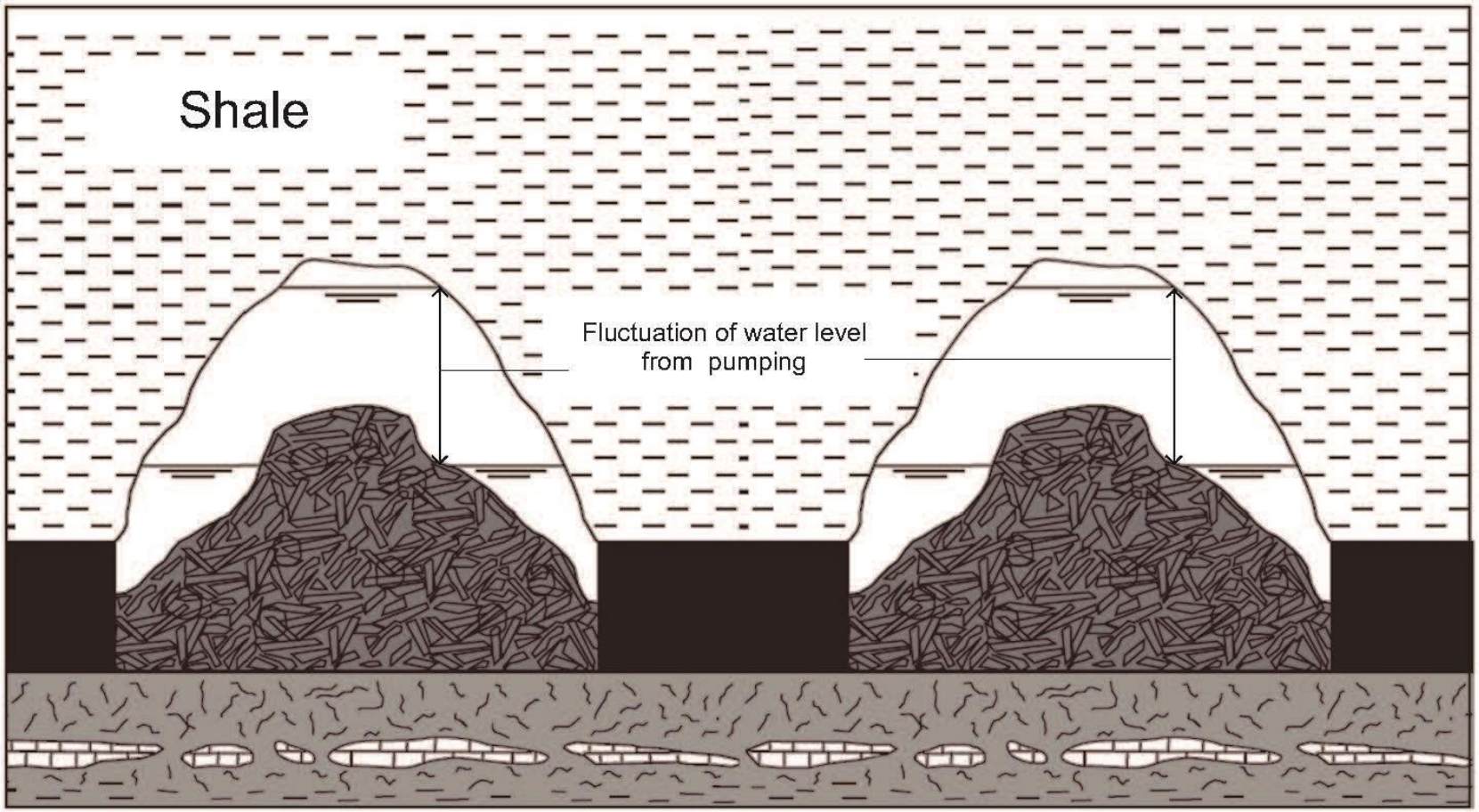
BEARING FAILURE



MINE STABILITY PRINCIPLES

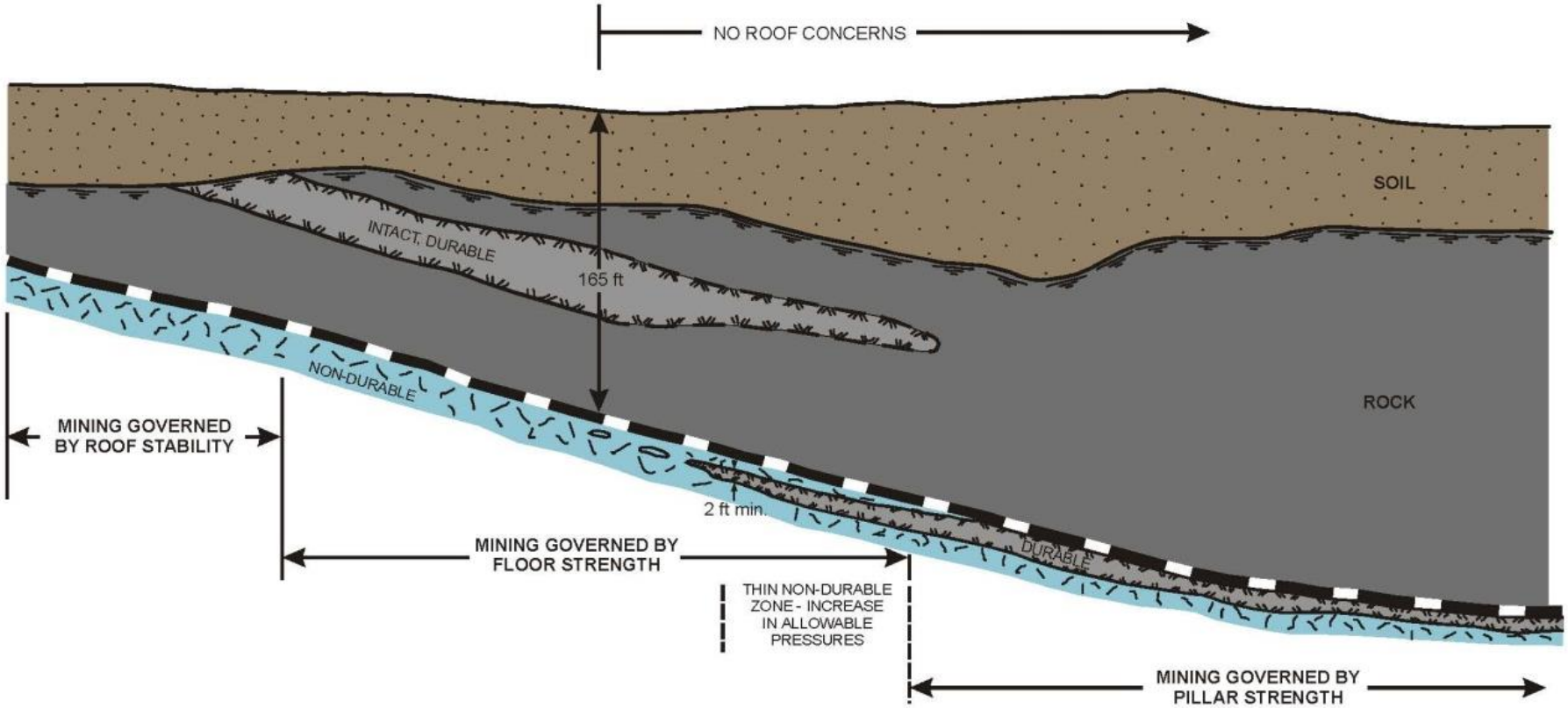
- FLOOR (ROOF) CAPACITY
  - Strength and Thickness of Non-Durable Zone
  - Structure
  - Strength and Thickness of Resistant Zone
  - Pillar Width

MINE STABILITY PRINCIPLES



OSCILLATING GROUNDWATER LEVEL WITHIN MINE VOID INTERVAL

GEOLOGIC EFFECTS ON STABILITY AND SURFACE SUBSIDENCE



MINE STABILITY PRINCIPLES

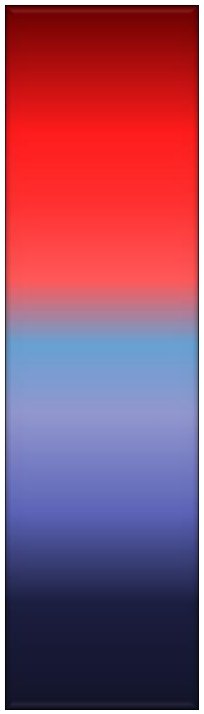
- SAFETY FACTOR

$$\frac{\text{AVAILABLE CAPACITY}}{\text{OVERBURDEN LOAD}} = \text{RISK}$$

MINE STABILITY PRINCIPLES

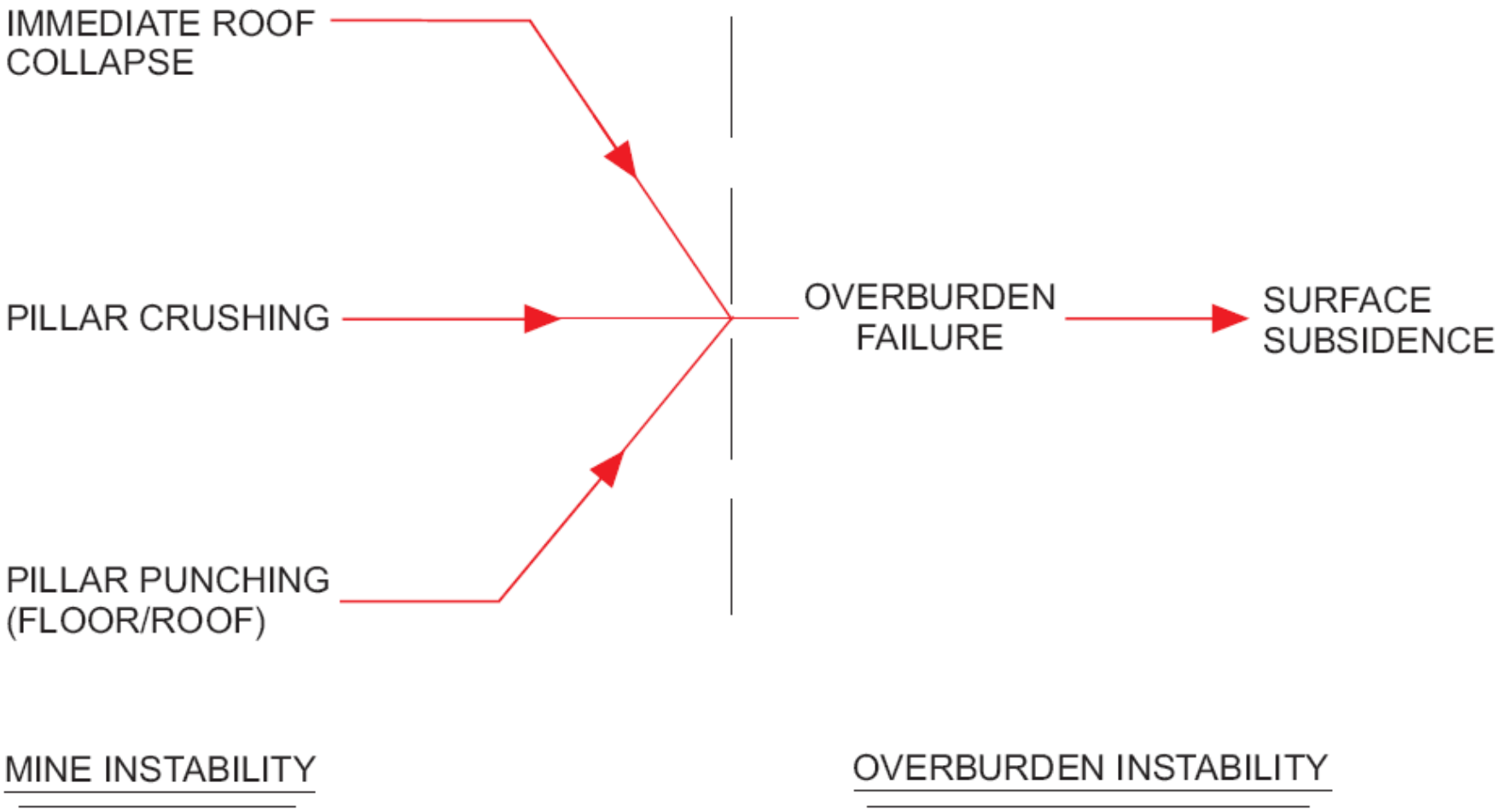
- QUALITY OF RISK ASSESSMENT

MINE STABILITY PRINCIPLES

STABILITY		SUBSIDENCE RISK
V. LOW SF		HIGH
V. HIGH SF		NEGLIGIBLE

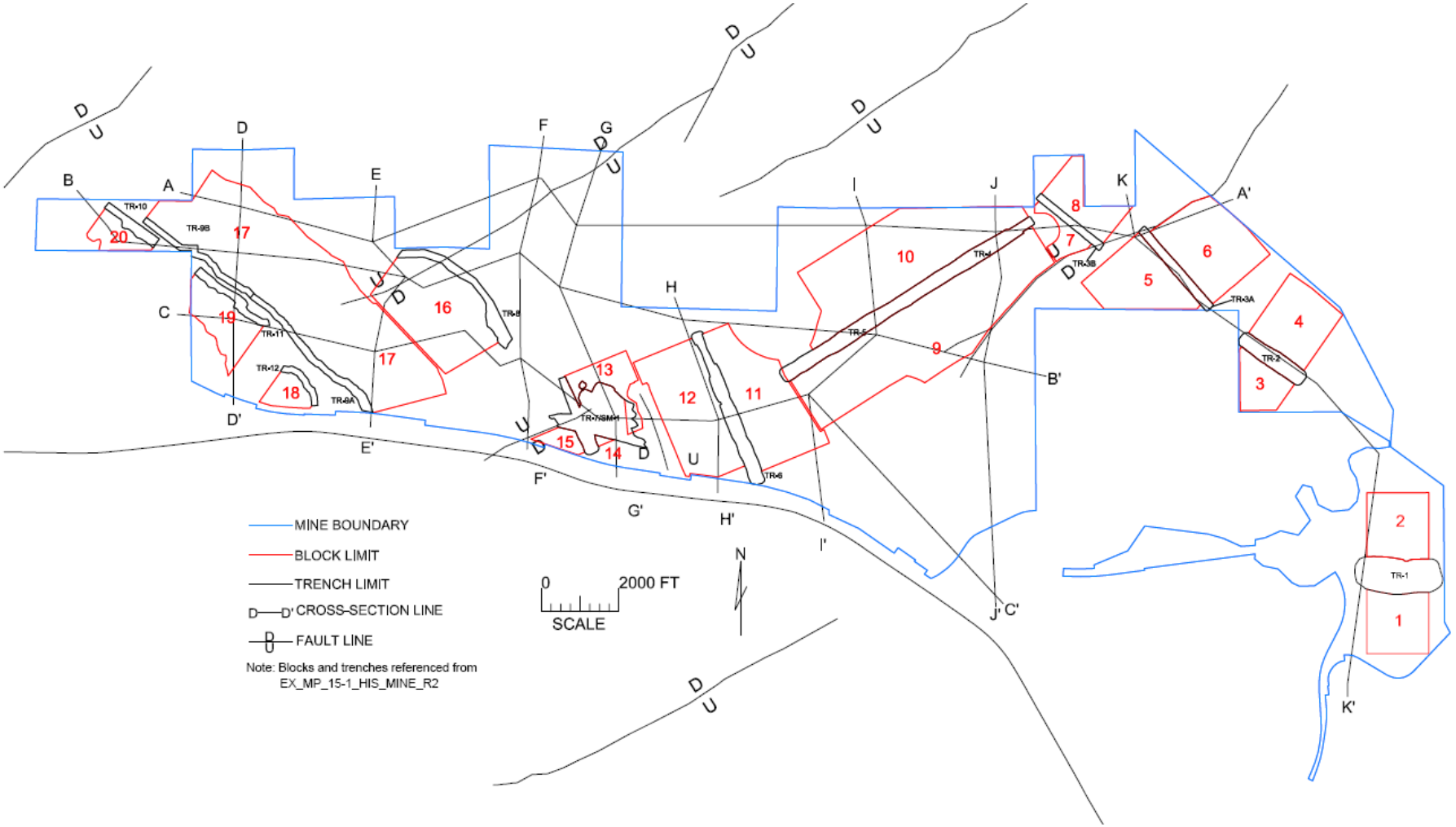
QUALITY OF RISK ASSESSMENT IS FUNCTION OF KNOWLEDGE AND EXPERIENCE

MINE STABILITY PRINCIPLES



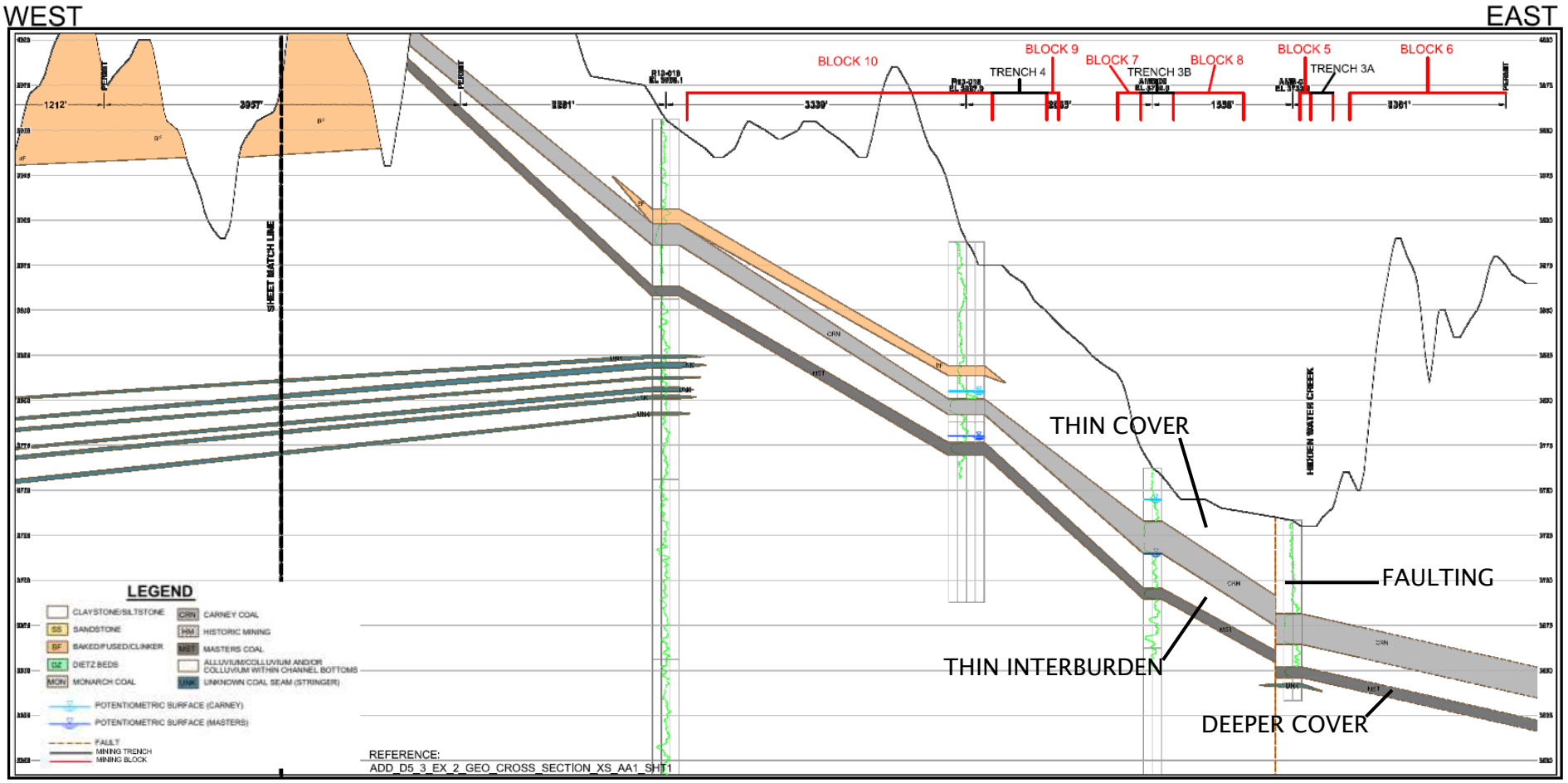
GEOLOGICAL CONDITIONS

GEOLOGICAL CONDITIONS



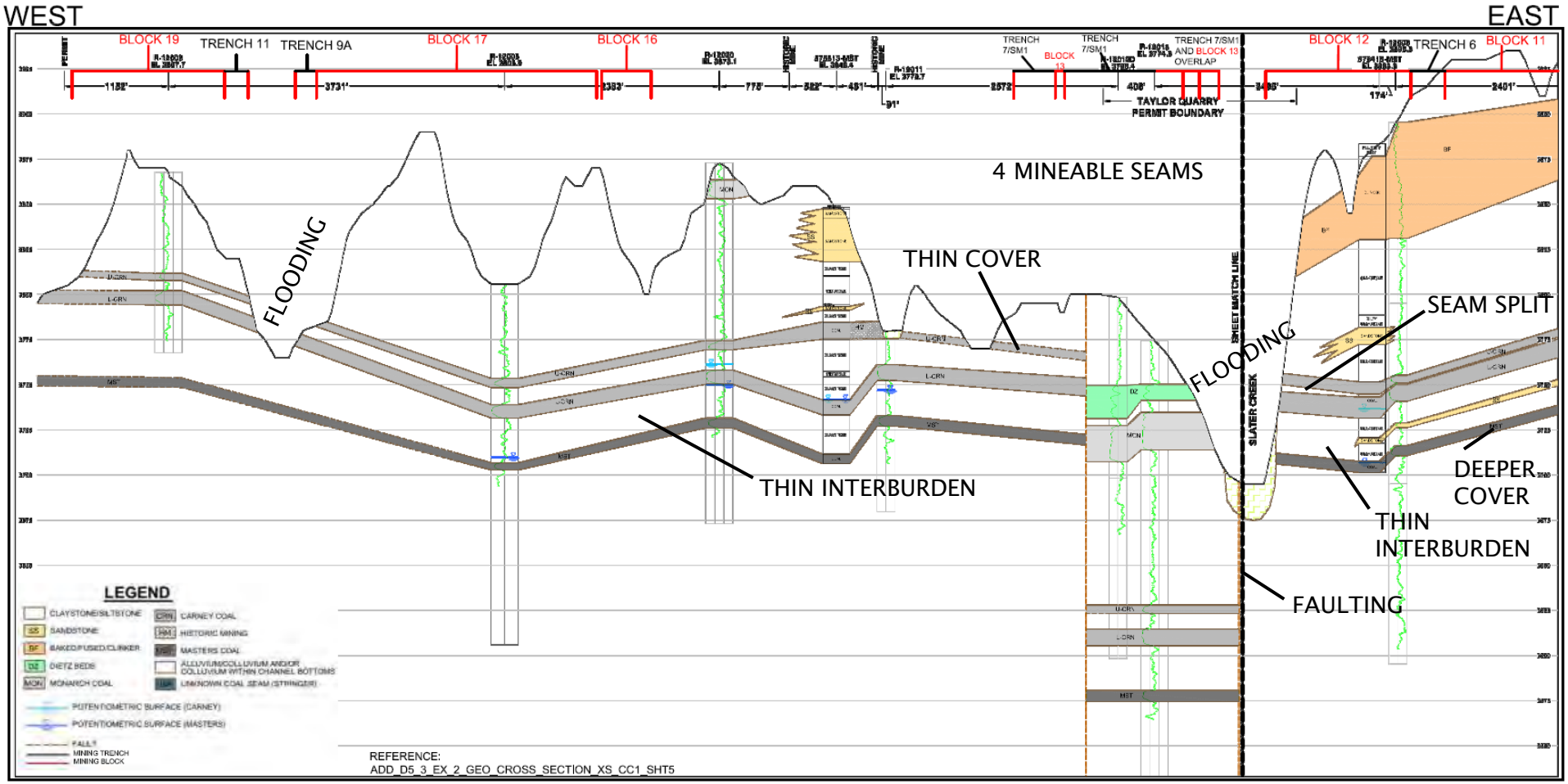
PLANNED TRENCH AND COAL BLOCK AREAS WITH FAULTS AND CROSS SECTION LINES

GEOLOGICAL CONDITIONS



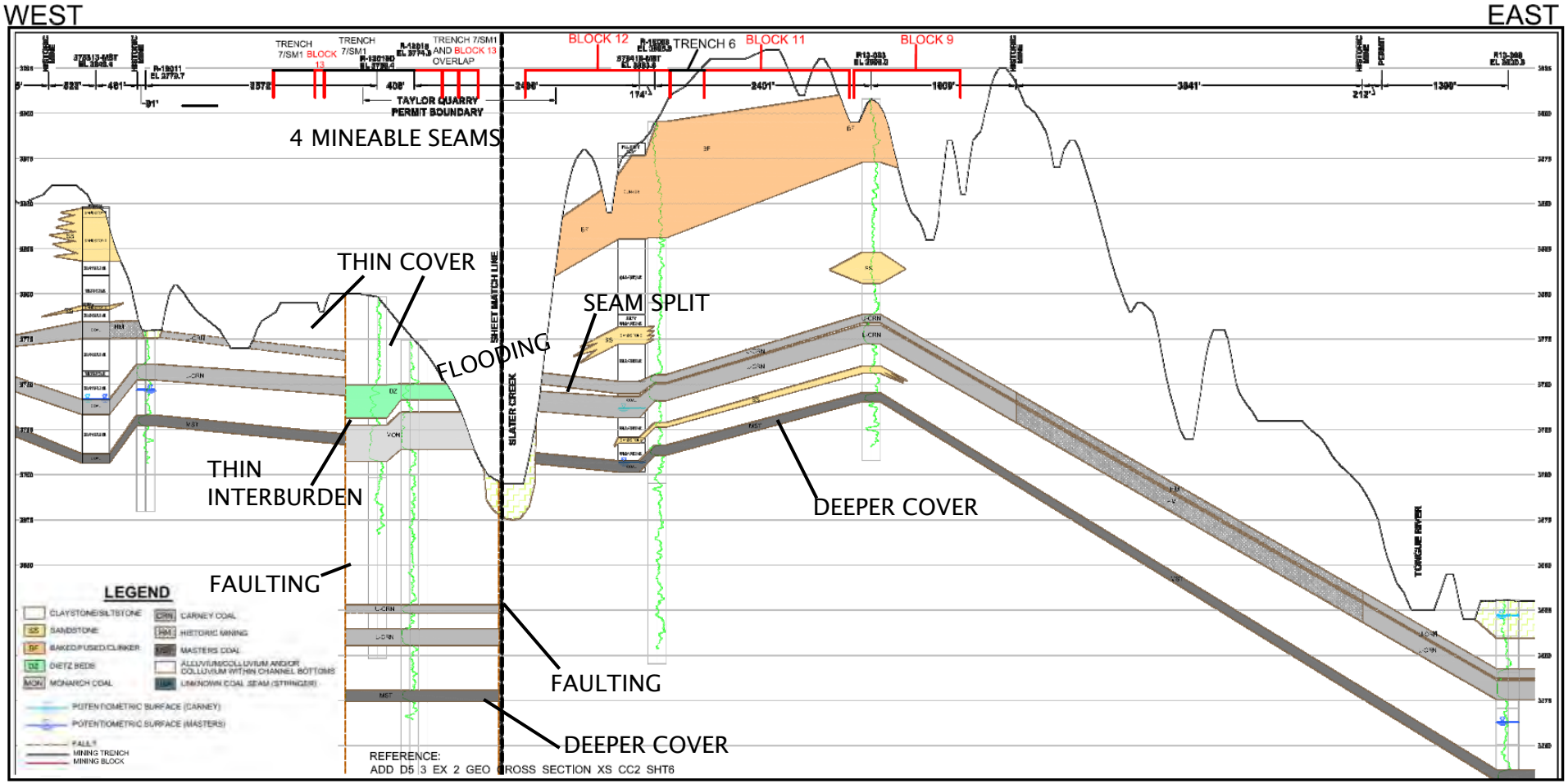
EAST SECTION OF CROSS-SECTION A-A' SHOWING MINING BLOCK AND TRENCH EXTENTS OF THE PROPOSED BROOK MINE

GEOLOGICAL CONDITIONS



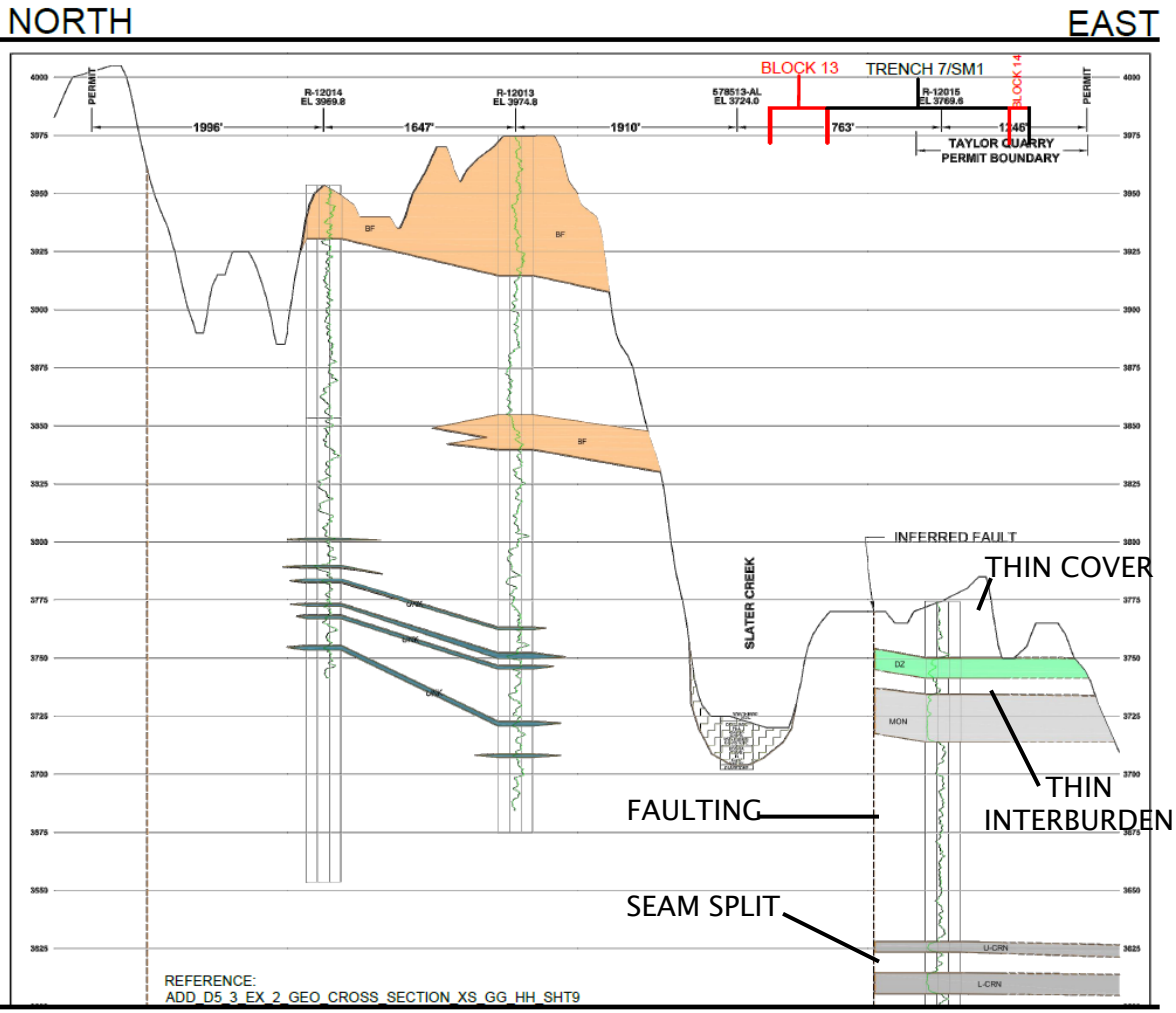
WEST SECTION OF CROSS-SECTION C-C' SHOWING MINING BLOCK AND TRENCH EXTENTS OF THE PROPOSED BROOK MINE

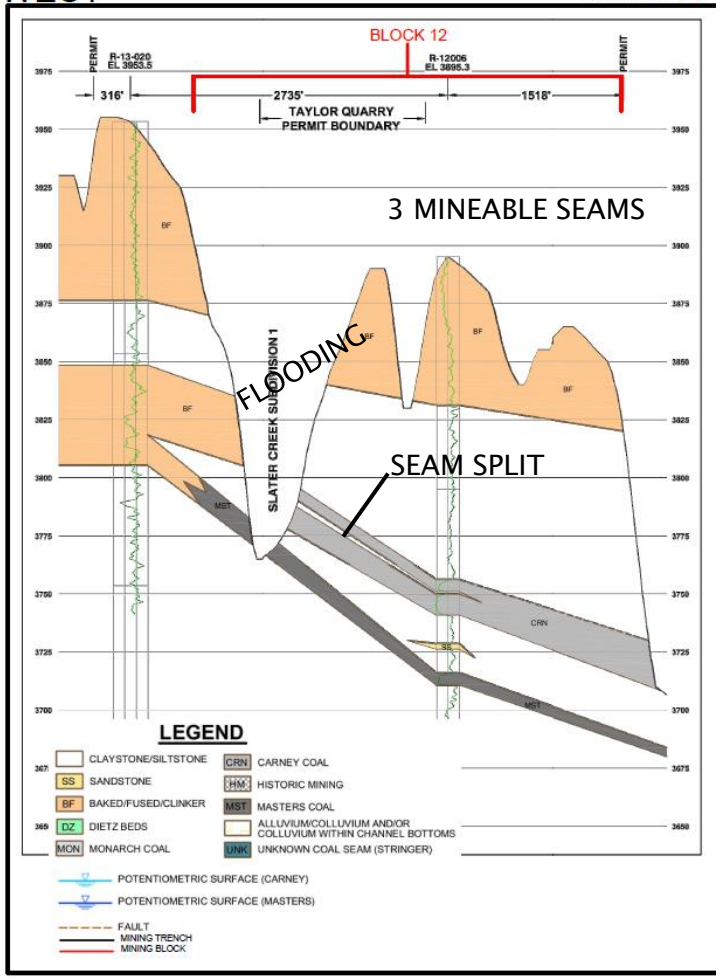
GEOLOGICAL CONDITIONS



EAST SECTION OF CROSS-SECTION C-C' SHOWING MINING BLOCK AND TRENCH EXTENTS OF THE PROPOSED BROOK MINE

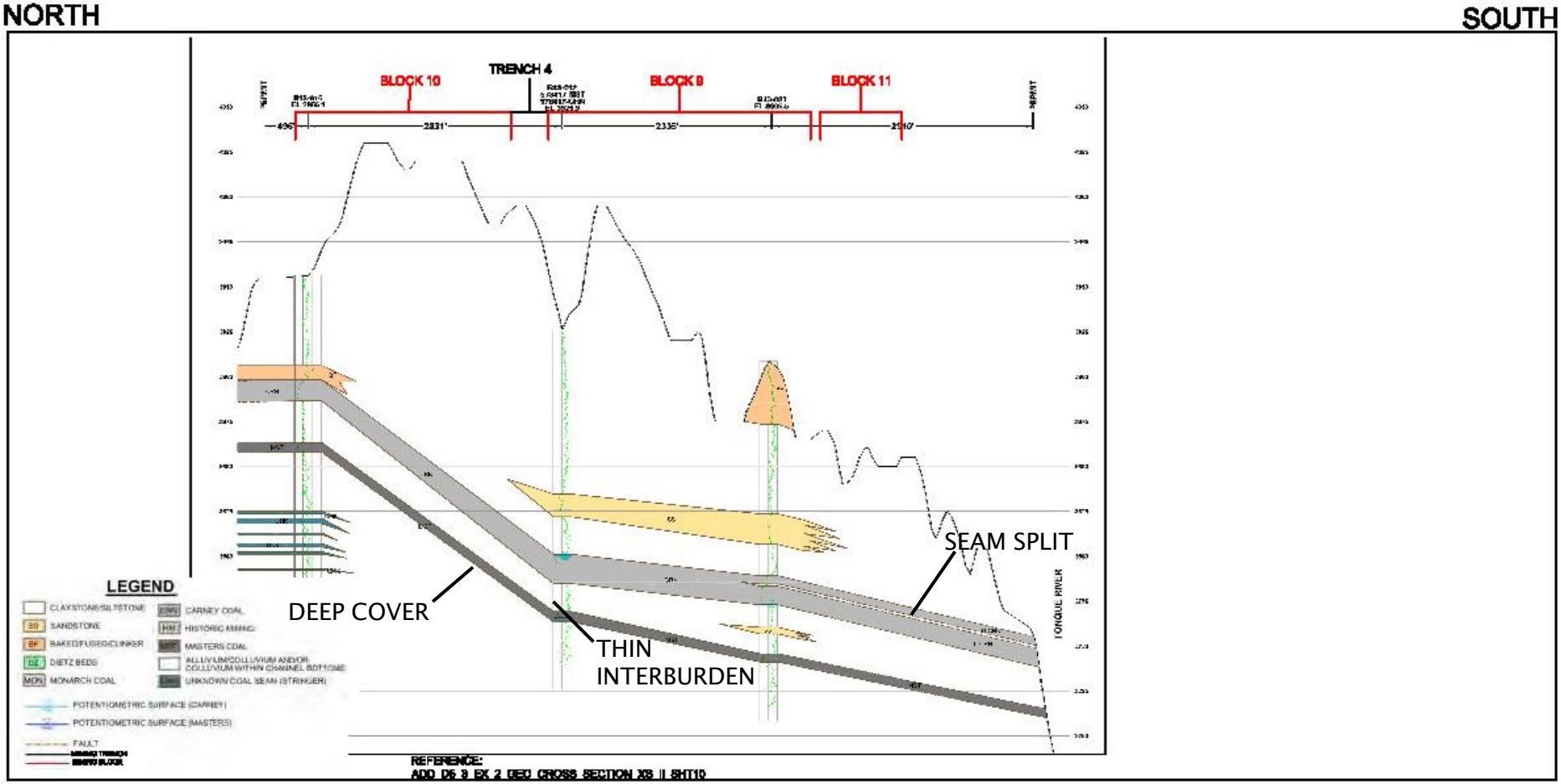
GEOLOGICAL CONDITIONS





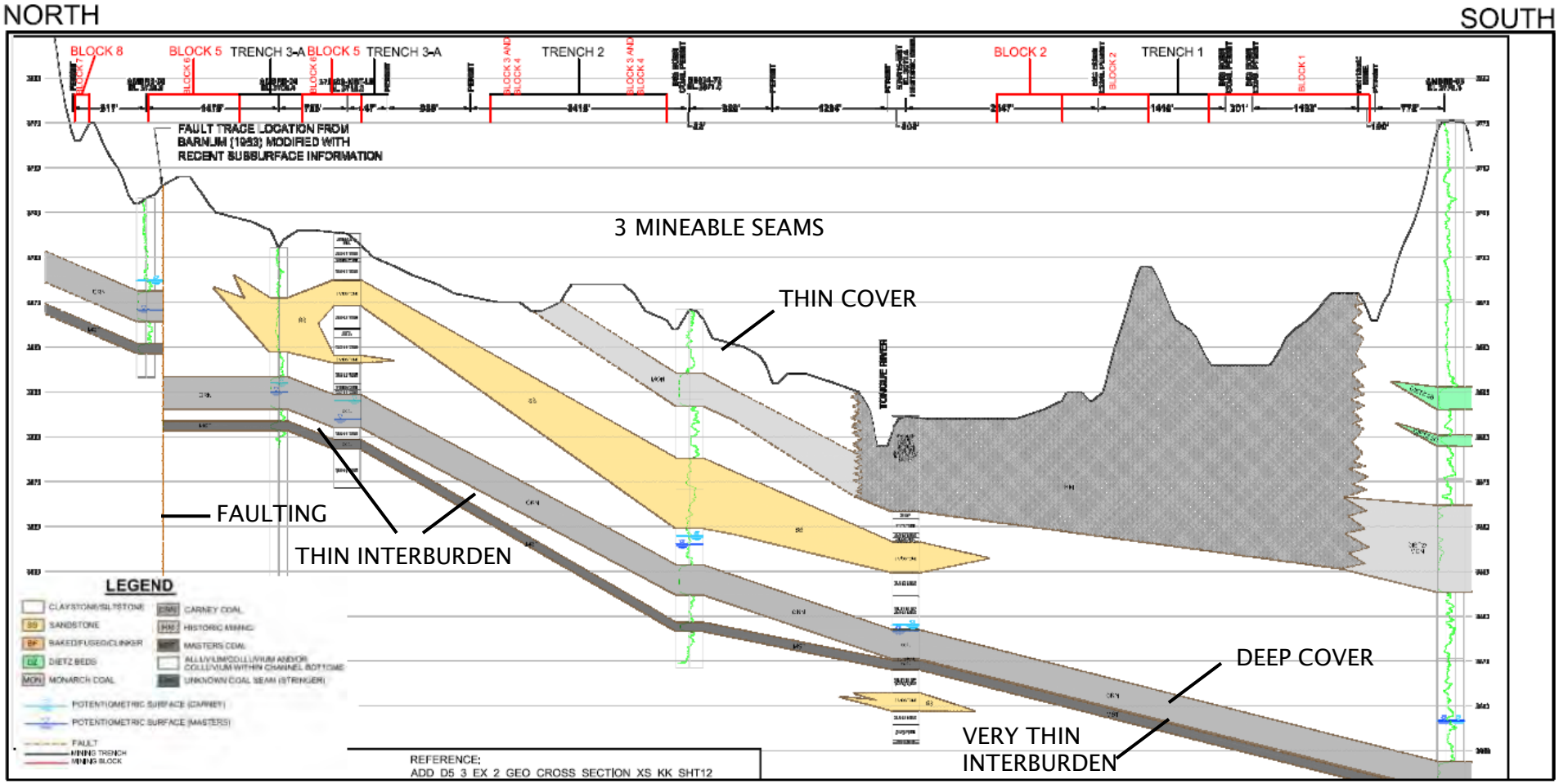
CROSS-SECTIONS G-G' AND H-H' SHOWING MINING BLOCK AND TRENCH EXTENTS FOR THE PROPOSED BROOK MINE

GEOLOGICAL CONDITIONS



CROSS-SECTION I-I' SHOWING MINING BLOCK AND TRENCH EXTENTS FOR THE PROPOSED BROOK MINE

GEOLOGICAL CONDITIONS



CROSS-SECTION K-K' SHOWING MINING BLOCK AND TRENCH EXTENTS FOR THE PROPOSED BROOK MINE

DIETZ, MONARCH, CARNEY, AND MASTERS RELATED CONDITIONS PER BLOCK

MINE BLOCK	COAL SEAM	HEIGHT OF SEAM (FT.)	DEPTH OF SEAM TOP (FT.)	ROOF		FLOOR	
				HEIGHT (FT.)	THICKNESS (FT.)	DEPTH (FT.)	THICKNESS (FT.)
1	DIETZ/ MONARCH	0-41	100-115				
1	CARNEY	14	220-390				
1	MASTERS	5	235-405				
2	MONARCH	MINED OUT	MINED OUT				
2	CARNEY	15-16	120-185				
2	MASTERS	5	145-210				
3	MONARCH	13-15	0-30			29-32	20-32
3	CARNEY	16	80-130	20-35	20-32		
3	MASTERS	5	106-176				
4	MONARCH	13-15	0-30			29-32	20-32
4	CARNEY	16-17	130-370	20-35	20-32		
4	MASTERS	5	156-417				
5	CARNEY	16-17	70-260	3-50WP	0-36		
5	MASTERS	5	93-289				
6	CARNEY	17-18+	70-345	3-50WP	0-36		
6	MASTERS	5	97-373				
7	CARNEY	8 -15	40-105				
7	MASTERS	5	58-160				
8	CARNEY	13-16+	30-225				
8	MASTERS	5	53-256				
9 EAST	CARNEY	6-16	100-220	12-13WP	0-12	7.5-9WP	0-3.5
9 EAST	MASTERS	6	126-256	6.5-7WP	0-3.5		
9 WEST	U CARNEY	4-8	80-220	17.5-18	16.5		
9 WEST	L CARNEY	5-8	85-231			12.5	2.5-4
9 WEST	MASTERS	6	100-259	10-11	2.5-4		
10 EAST	CARNEY	4 - 16	60-240	20WP	0-1.5		
10 EAST	MASTERS	6	74-286				
10 WEST	U CARNEY	4-8	120-200				
10 WEST	L CARNEY	4	125-211				
10 WEST	MASTERS	6	139-245				

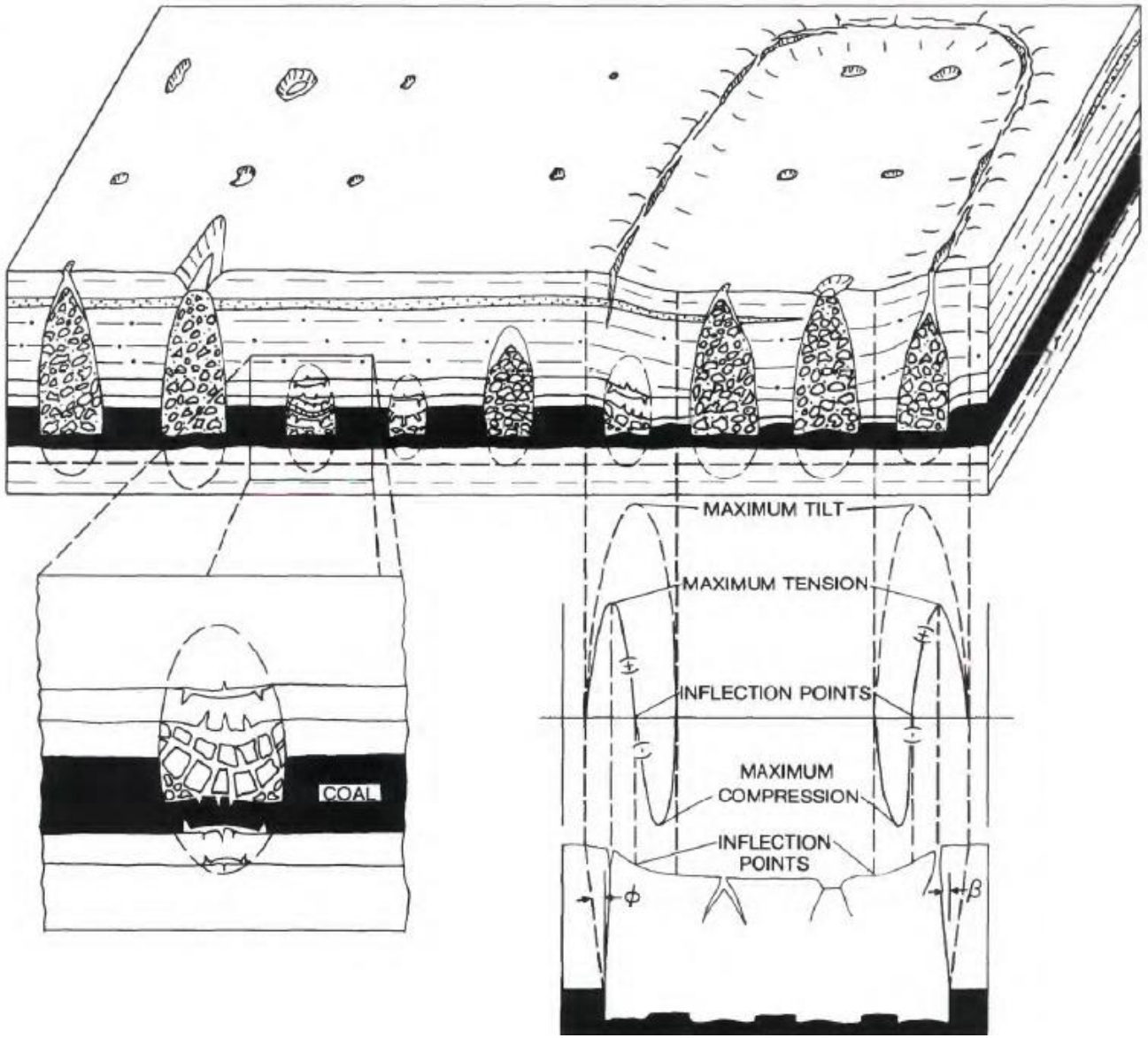
DIETZ, MONARCH, CARNEY, AND MASTERS RELATED CONDITIONS PER BLOCK (CONTINUED)

11	U CARNEY	3-6	20-160	22-30 WP	0-10		
11	L CARNEY	4-8+	25-172			12	2.5-3.5
11	MASTERS	6	49-210	10-11	2.5-3.5		
12	U CARNEY	4	20-200	8-21WP	0-9		
12	L CARNEY	8-10	25-208			0-16WP	0-3
12	MASTERS	>6-12+	53-248	7.5-10WP	0-3		
13	DIETZ	0-8.5	0-25				
13	MONARCH	0-20	0-40				
13	U CARNEY	4	15-80				
13	L CARNEY	9	21-114				
13	MASTERS	6-14+	50-143				
14	DIETZ	8	0-6				
14	MONARCH	20	16-22				
14	U CARNEY	4	120-150				
14	L CARNEY	9	146-180				
14	MASTERS	5	175-209				
15	U CARNEY	4	100-180				
15	L CARNEY	9	128-214				
15	MASTERS	4	147-253				
16	MONARCH	0-15	0-3				
16	U CARNEY	4-6	40-100				
16	L CARNEY	8-9	47-136				
16	MASTERS	6	65-185				
17	MONARCH	0-17	0-89	30-39WP	0-5.5		
17	U CARNEY	2-5	20-160				
17	L CARNEY	8-9	31-193				
17	MASTERS	4-6	64-237				
18	U CARNEY	0-4	15-45				
18	L CARNEY	2-6	15-61				
18	MASTERS	5	37-97				
19	U CARNEY	4-6	20-60				
19	L CARNEY	2-8	24-76				
19	MASTERS	5	56-124				
20	MONARCH	0-7	0-32				
20	U CARNEY	2-5	20-60				
20	L CARNEY	2-7	22-74				
20	MASTERS	5	54-111				

SUMMARY OF MINING AND GEOLOGICAL CONDITIONS

- VARIABLE CONDITIONS
  - COAL COVER DEPTH: 0-420 FT. (ALL SEAMS)
  - COAL EXTRACTION HEIGHT: 2.5-20 FT. (ALL SEAMS)
  - PANEL EXTRACTION : 60-70%
  - MIN. PILLAR WIDTH TO HEIGHT RATIO: 1
  - ROOF AND FLOOR: MAINLY CLAYSTONE

MINE SUBSIDENCE POTENTIAL



From Dunrud, C. Richard., and Frank W. Osterwald, 1980. Effects of Coal Mine Subsidence in the Sheridan, Wyoming Area. Washington: U.S. Govt. Print. Off.

PIT SUBSIDENCE POTENTIAL – Complete Roof Failure

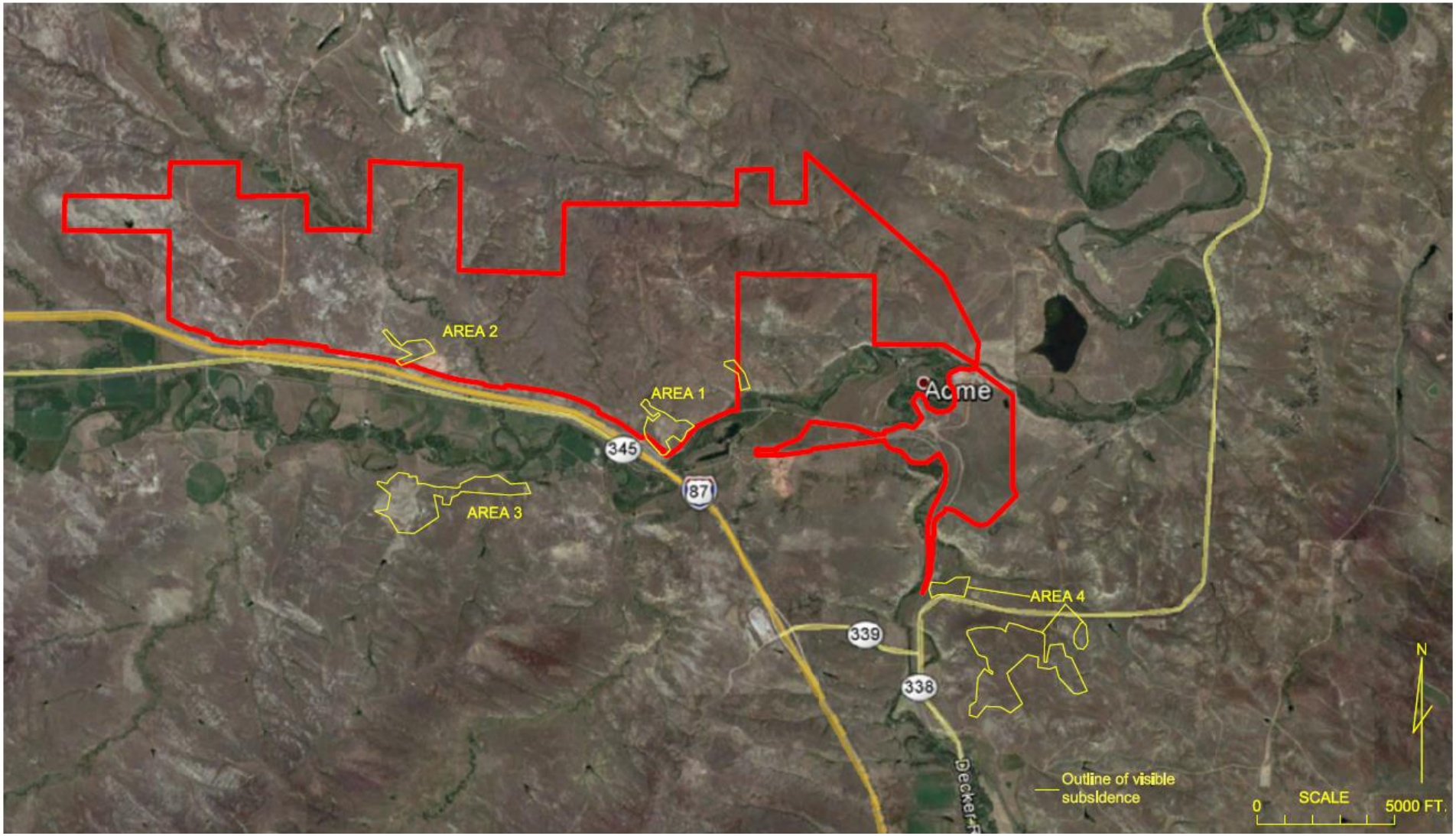
Consider Extraction Height: 14 ft.

Room Width: 11-11.5 ft.

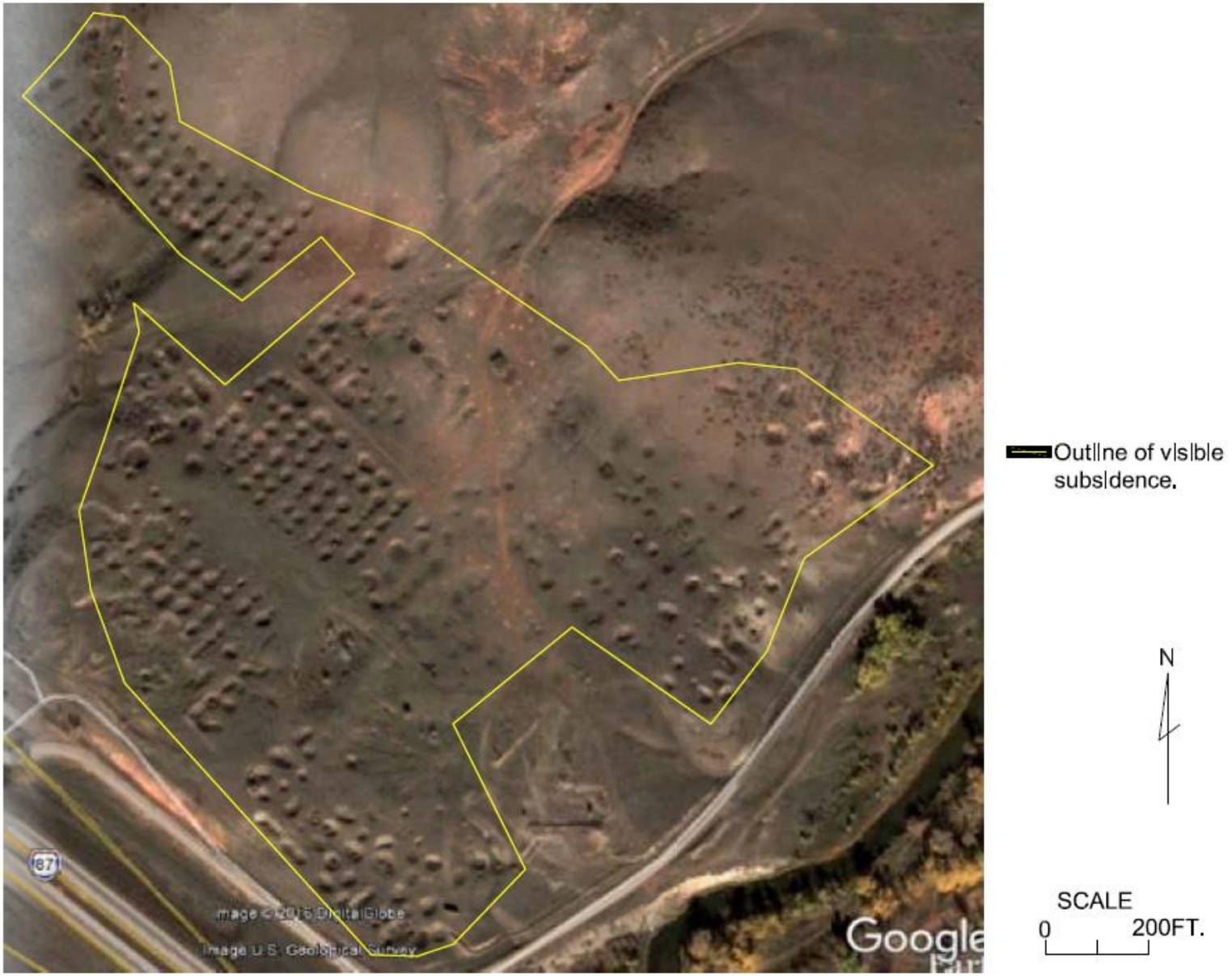
Claystone Roof

Chimney Subsidence Height → 220 ft.

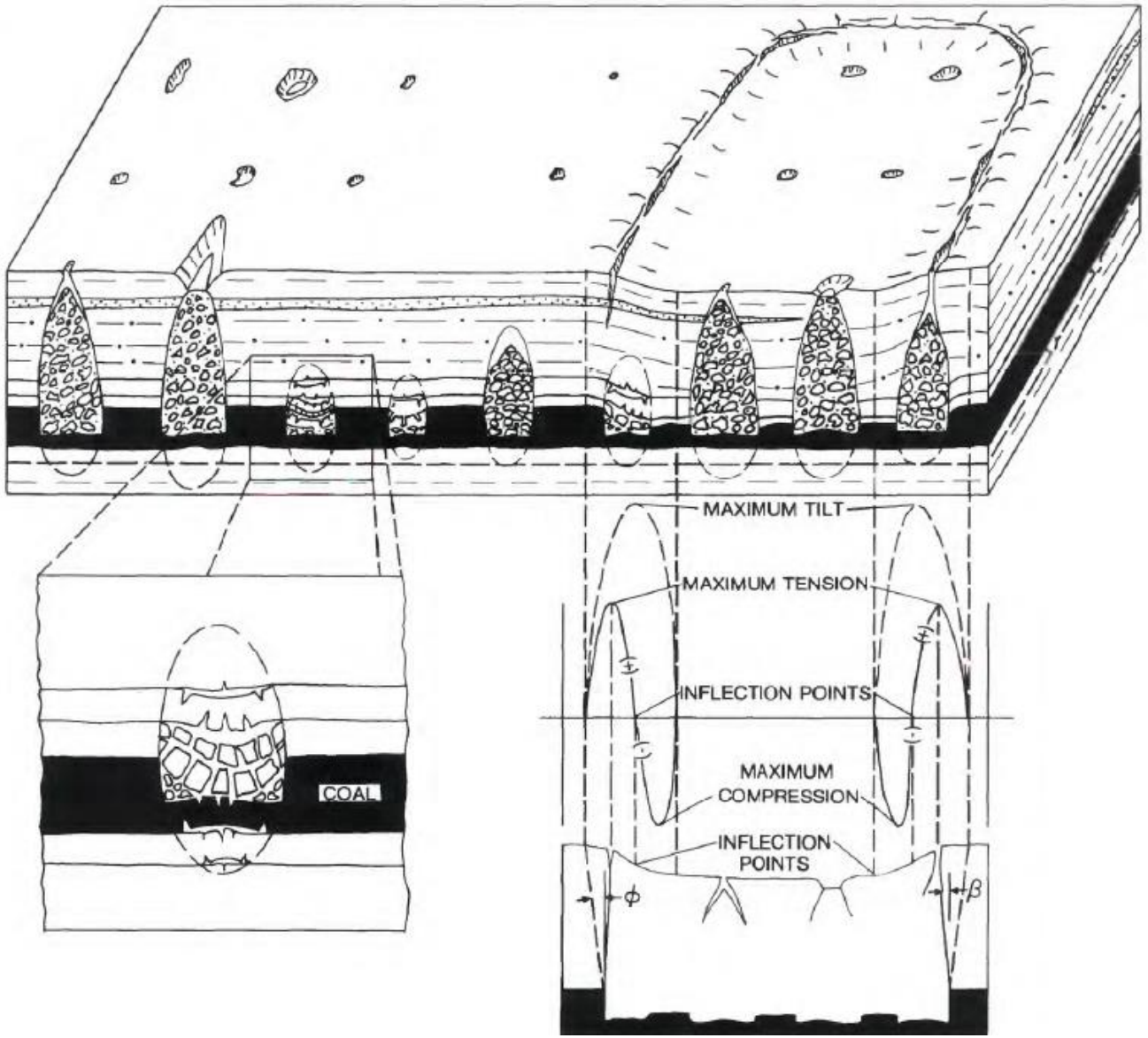
NOTE: Does not include multiple mined seams with stack pillars



MINE APPLICATION BOUNDARY AND OUTLINE OF VISIBLE MINE SUBSIDENCE OVER EXISTING UNDERGROUND WORKINGS



AREA 1 MINE SUBSIDENCE FROM UNDERGROUND MINING OF THE CARNEY NO.44 MINE. MINE DEPTH IN NOTED SUBSIDENCE AREA RANGED FROM 50 TO 160 FT. (ADD_D5-4_EX_1_OVB_ISO_R1)



From Dunrud, C. Richard., and Frank W. Osterwald, 1980. Effects of Coal Mine Subsidence in the Sheridan, Wyoming Area. Washington: U.S. Govt. Print. Off.

SAG SUBSIDENCE POTENTIAL – Pillar Failure

Pillar Pressure: up to about 1,300 psi

Safety Factor → less than one in places

Notes: 1. No significant clay seam is assumed
2. Assumed bituminous coal strength
3. Assumed truly parallel entries
4. Acceptable safety factors based on coal heights of 7 ft. or less.

SAG SUBSIDENCE POTENTIAL – Roof/Floor Bearing Failure

Pillar Pressure: up to about 1,300 psi

Safety Factor → less than one in places

Notes: 1. Claystone roof/floor ultimate capacity can be as low as 300 psi even with much larger pillars

2. Yielding of the roof or floor can result in pillar collapse

CONCLUSIONS

1. Dearth of engineering, geologic, and geotechnical information related to the mine interval.

2. Subsidence Control Plan exhibits a lack of geomechanical understanding of the short and long term stability on the proposed multi-seam mining.

3. With insufficient information and very limited analyses, the subsidence potential cannot be reasonably determined.

4. The submitted Subsidence Control Plan does not meet industry standards.

5. Given the reported information and based on my knowledge and experience, the proposed highwall mining has serious subsidence risk.