## IV. GEOLOGIC-SETTING (GS) CLASSIFICATION SYSTEM

Pertinent 30CFR[1] Sections:

- Geology description
- Cross sections, maps, and plans

The geologic-setting (GS) classification system is an outgrowth of the National Research Council (1981) "representative geologic settings" and categorizes into a numeric code the geologic factors, such as structure, lithology, and thickness of sedimentary bedrock units, that contain coal to be mined into eight types. This system applies only to sedimentary rocks and is designed to describe (1) the hydraulic character of the bedrock units above and below the coal bed(s) in terms of their permeability and (2) the structural features within the bedrock units of the general area, including folding and faulting. This system considers these bedrock units either as aquifers, such as sandstone, or as confining beds, such as shale, and is compatible with the hydrologic setting classification system (described in chapter VI). Each category indicates the nature of the setting and the potential for any ground-water problems related to the coal -mining operations.

The type of geologic setting category assigned to a permit area will depend upon the acreage and the geology of the area. More than one geologic setting may apply to a permit area. For example, the area depicted in figure III-2(b), which would require a large-acreage permit, contains deep coal beds under a stream valley that are locally flat lying and that vary from a synclinal setting to an anticlinal setting. Each of these settings can have different ground-water considerations in relation to mining.

The geologic-setting classification system is outlined in table IV-1. The settings are illustrated and described in figures TV-1 through IV-8.

[1] CFR = Code of Federal Regulations

Table 3V-1. Classification for geologic settings (GS) of coal beds (Examples are depicted in figures IV-1 through IV-8.)

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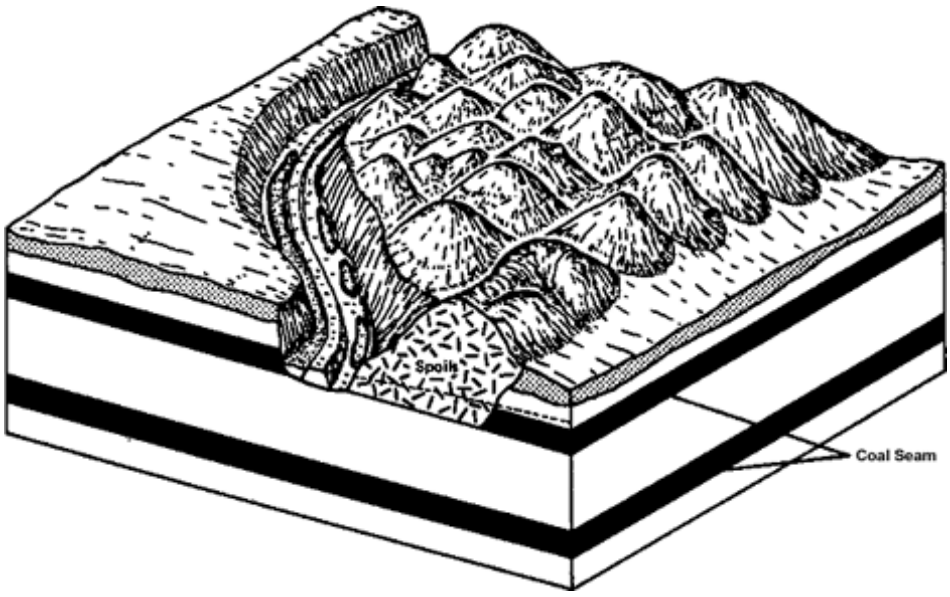
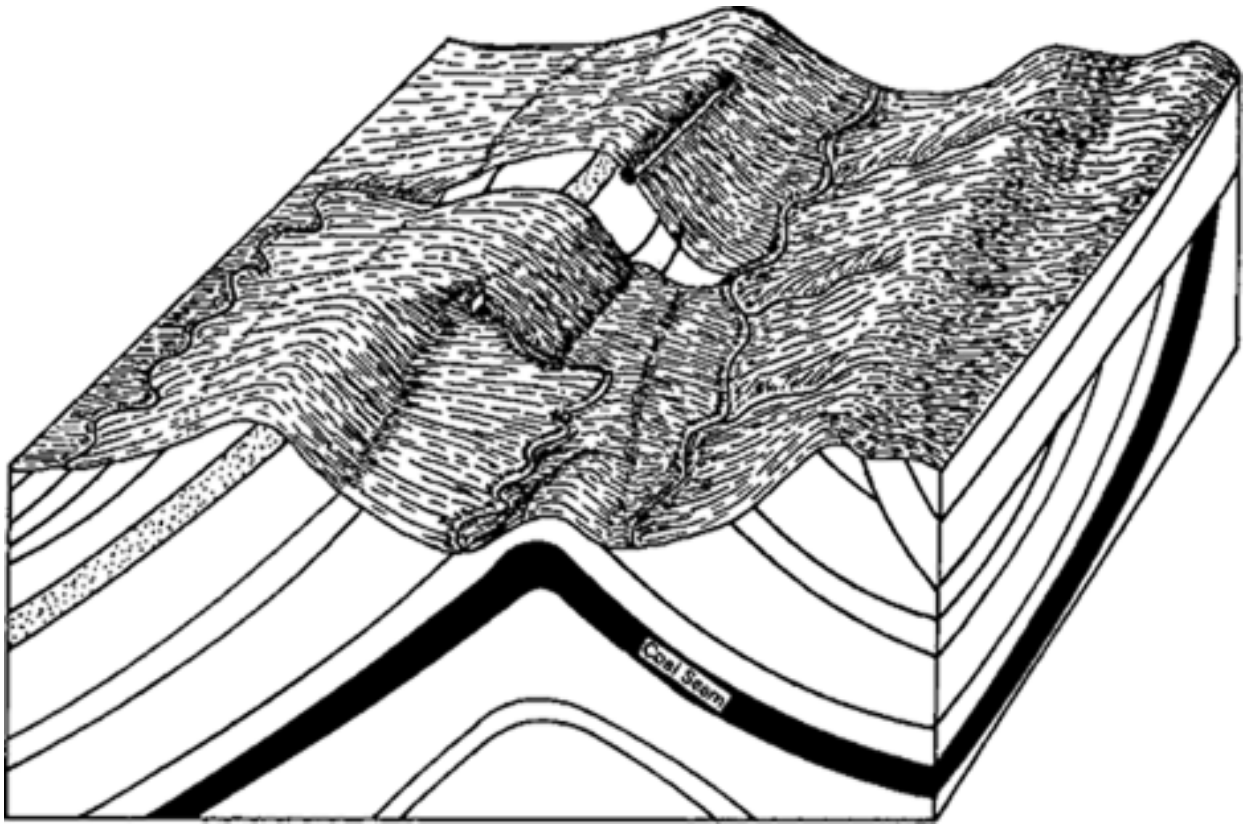
| GS-1. Flat lying coal beds of less than 5 degrees. |
| GS-2. Anticlinal structural setting. |
| GS-3. Synclinal structural setting. |
| GS-4. Low-angle coal beds dipping more than 5 degrees. |
| GS-5. "Alluvial valley floor" as defined by regulations for areas west of 100! meridian (See chapter XVIII). |
| GS-6. Coal bed under stream valley (east of the 100° meridian) and coal bed under stream valley (west of the 100° meridian) but not qualifying as an "Alluvial valley floor" (GS-5). |
| GS-7. Coal beds and fault structures (thrust faults, normal faults, fracture traces, and lineaments). |
| GS-8. Fractured bedrock caused by mine subsidence. |




Flat-lying coal beds of (less than 5° dip)

– If permit area is above the local drainage level (streambed elevation), mining requires only minor consideration for dewatering.
– If the permit area is below the local drainage level or if the coal bed is in contact with other aquifers, dewatering will be a major consideration.
– Joints associated with bedrock fracturing could be a major problem if the pore spaces contain ground water or if faulting has occurred in the surrounding area.

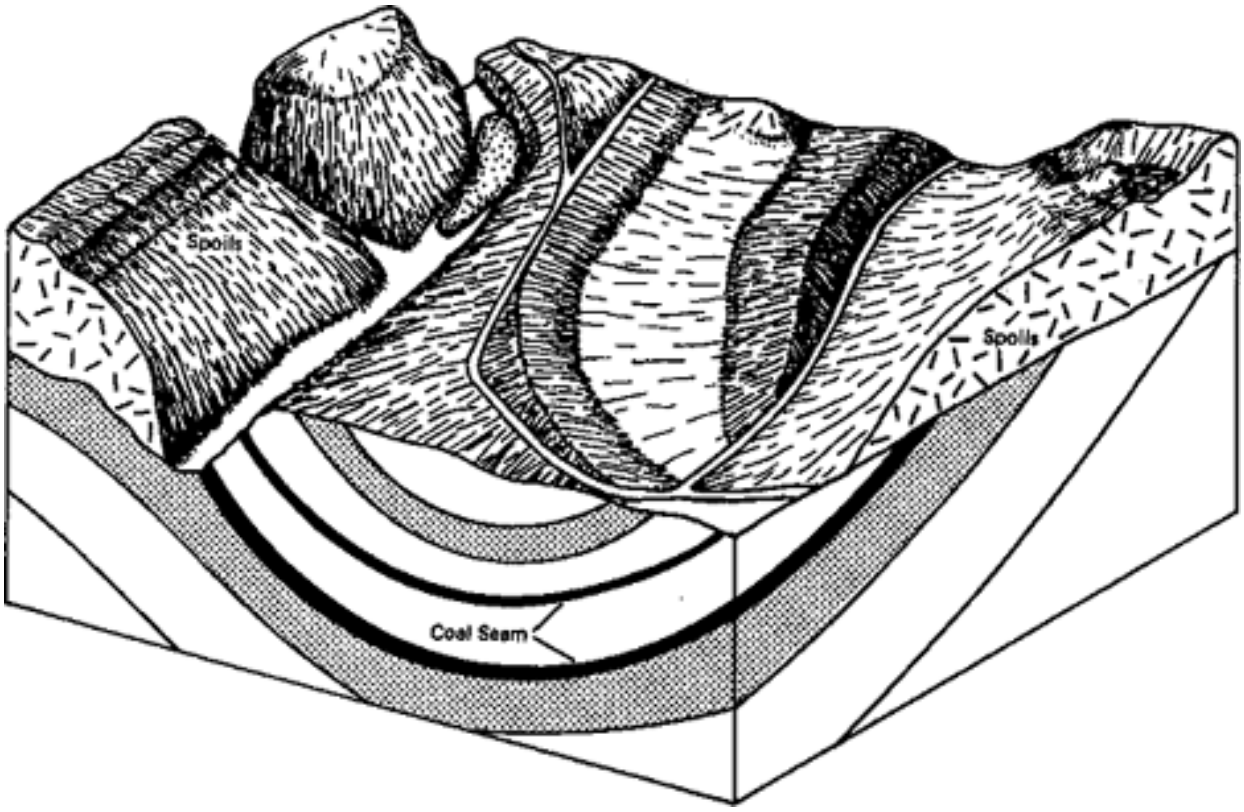
Figure IV-1.— Geologic setting and ground-water factors for flat-lying coal bed (GS 1). (Modified from Hounslow and Fitzpatrickf 1978, fig. 54)




Anticlinal structural setting

– Mining downdip on an anticlinal limb will require constant pumping if the coalbed is an aquifer or is in contact with other aquifers.
– Mining updip on an anticlinal limb will be self draining.
– Bedrock fracturing will be significant owing to the bending of the bedrock units; jointing will normally be greatest at the crest of the anticline.

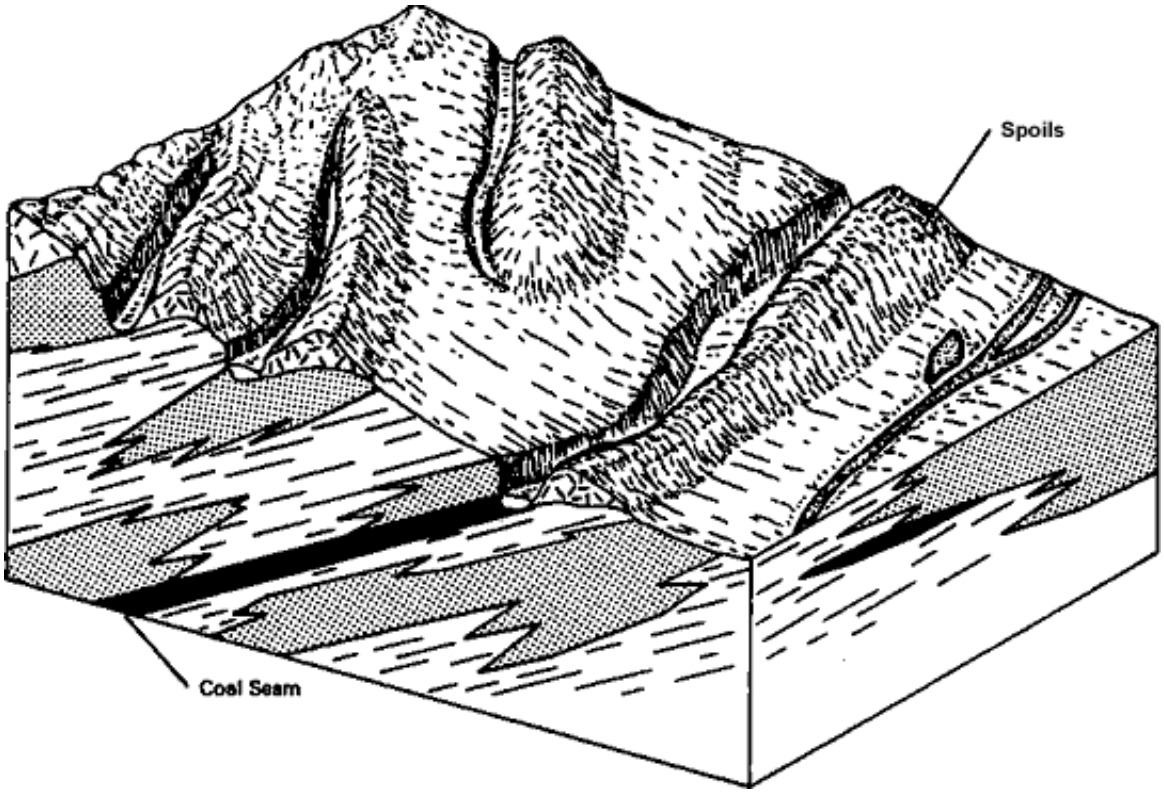
Figure IV-2.— Geologic setting and ground-water factors for anticlinal structure (GS 2).




Synclinal structural setting

– Mining downdip on a synclinal limb will require constant pumping if the coal is an aquifer or is in contact with other aquifers.
– Bedrock fracturing will be significant owing to the bending of the bedrock units; the occurrence of joints will normally be greatest at the trough of the syncline.

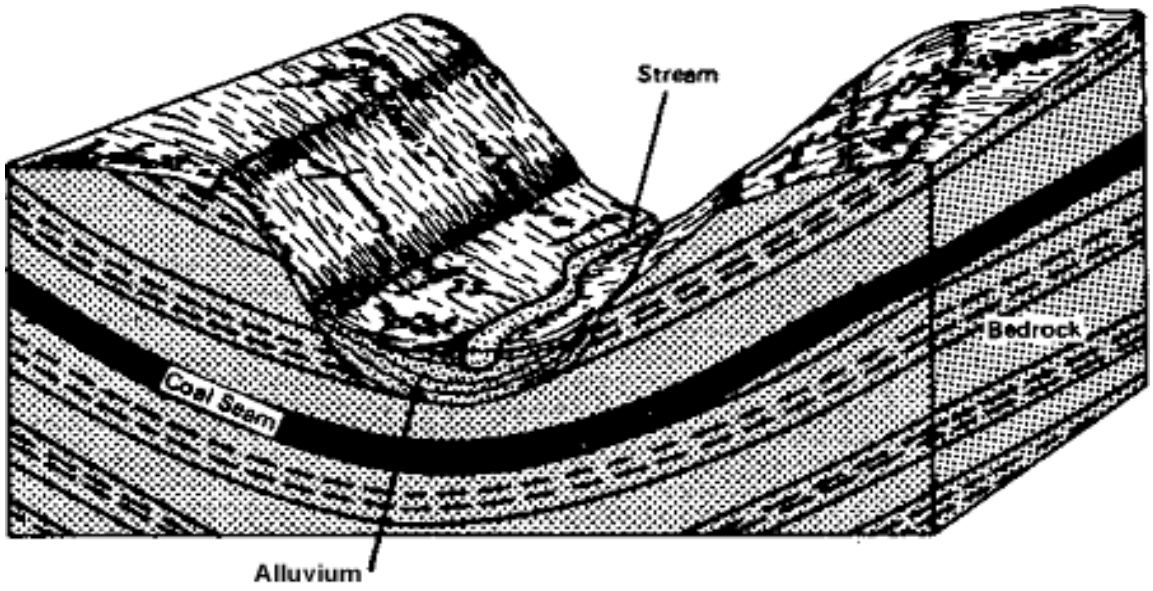
Figure IV-3.— Geologic setting and ground-water factors for synclinal structure (GS 3). (Modified from Hounslow and Fitzpatrick, 1978, fig. 40).




Low-angle dipping coal bed (greater than 5° dip)

- This occurs on the limb of a regional anticline or regional syncline, where the permit area is significantly smaller than the geologic structure.
- The density of bedrock fracturing will be dependent upon the distance between the permit area and the anticlinal crest or the synclinal trough or any linear fault structure.
- Under wet conditions, dewatering pumps have a greater head to pump against as mining progresses deeper.

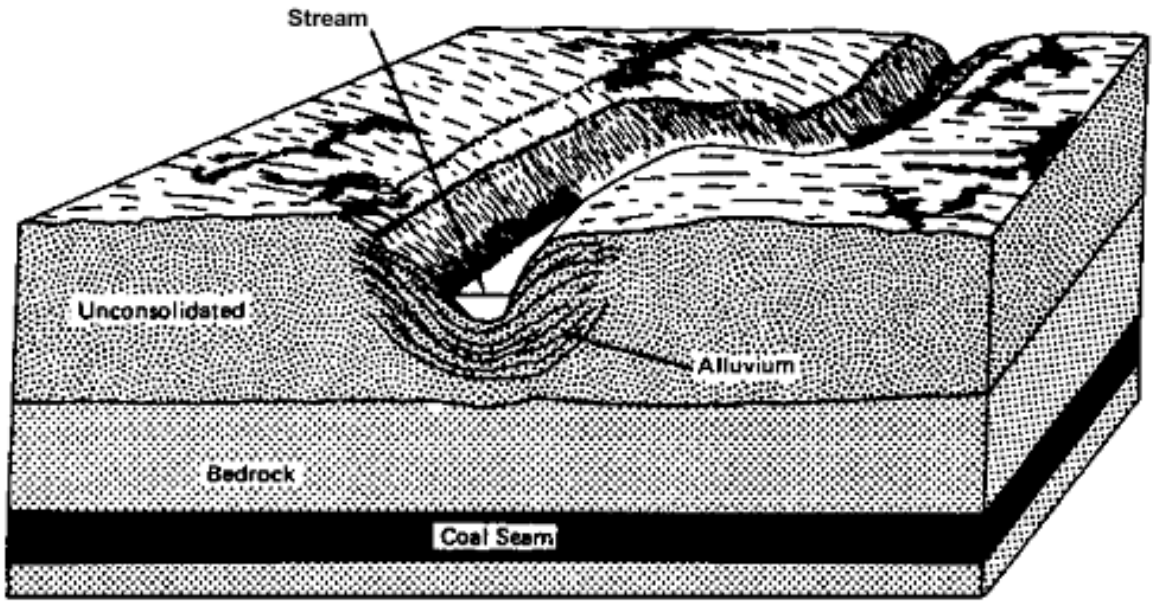
Figure IV-4.— Geologic setting and ground-water factors for low-angle dipping coal bed (GS 4). (Modified from Hounslow and Fitzpatrick, 1978, fig. 44)




"Alluvial Valley Floor" (west of the 100° meridian)

– Considerations for permit areas in this setting are:
  (1) the occurrence and effectiveness of confining beds separating the coal bed from the alluvial channel deposits, and
  (2) the presence of fracture zones between the coal bed and the alluvial channel deposits.

Figure IV-5.— Geologic setting for "Alluvial Valley Floor" (GS 5),
(From National Research Council, 1981, fig. 4.5c)

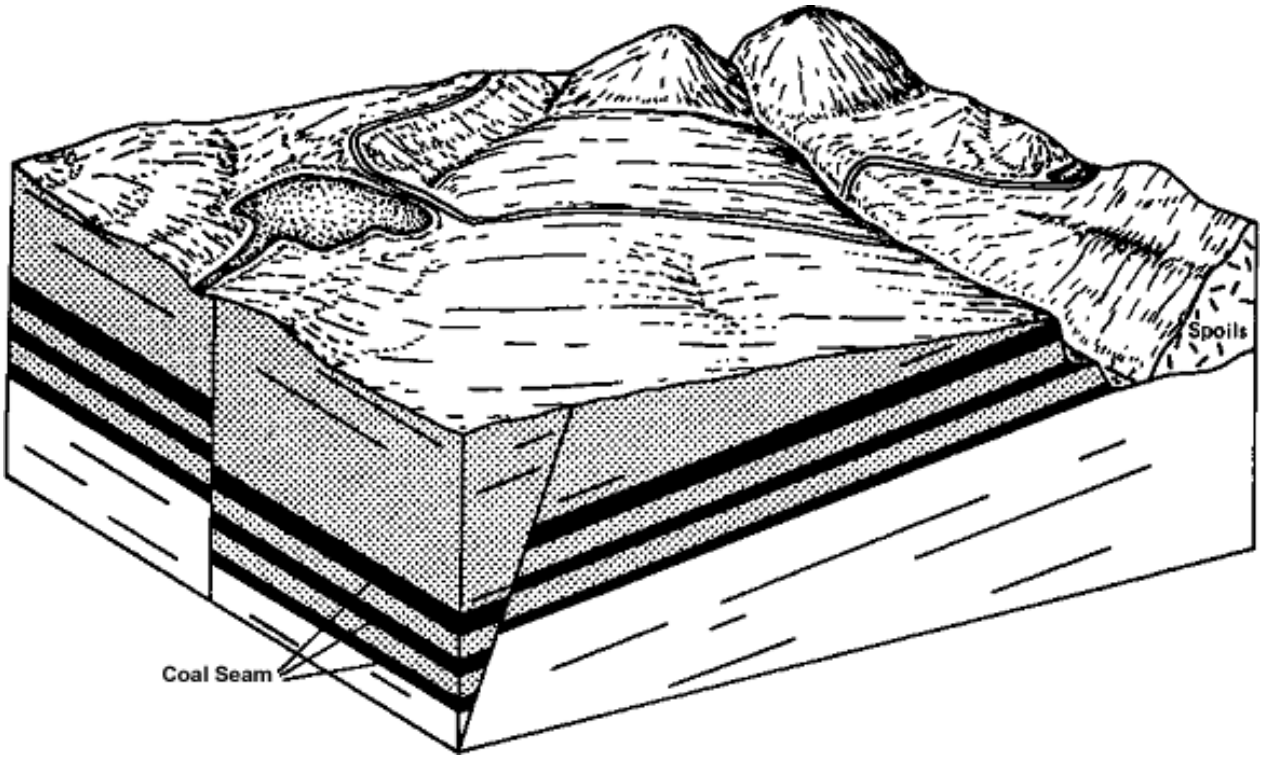



Coal bed under stream valley

(same as GS-5 but for permit areas east of 100° meridian and permit areas west of the 100° meridian that do not qualify as "Alluvial Valley Floor" settings)

– Significant ground-water inflow to proposed permit area can be dangerous to mining operations if:
  (1) no impermeable barrier separates the saturated alluvial deposits from the underlying coal bed to be mined, and
  (2) the stream valley is a surficial expression of a fracture trace, a lineament, or a fault structure. (Fractured, permeable rock would allow ground water to flow from the stream and alluvial deposits into the proposed excavation site.)

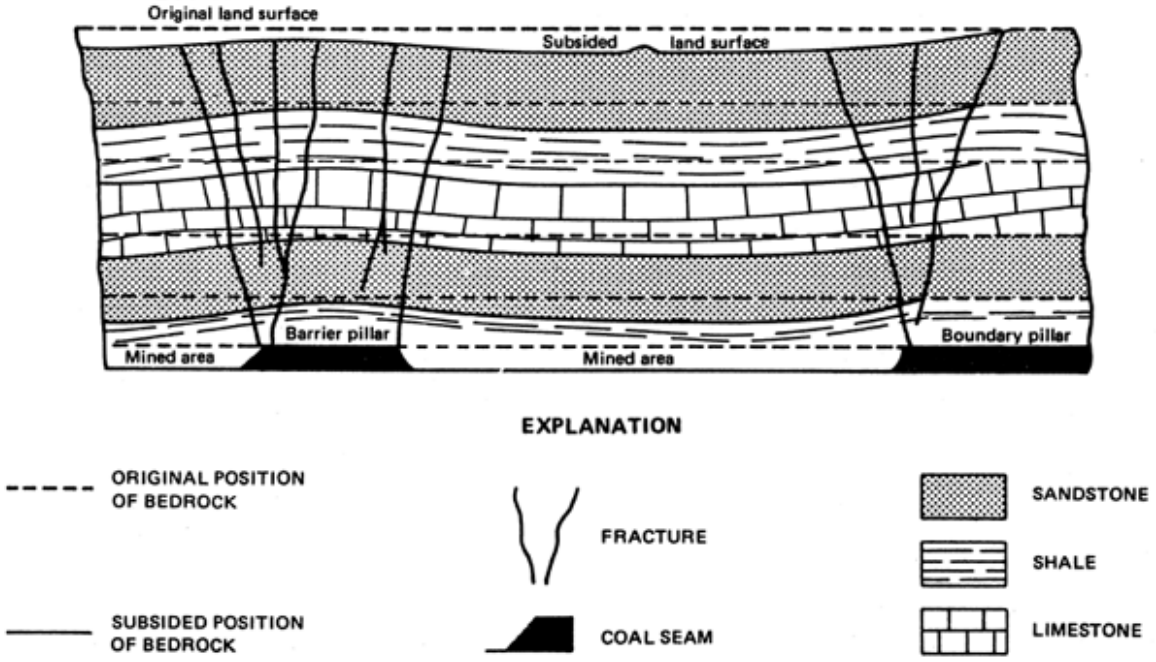
Figure IV-6.— Geologic setting and ground-water factors for coal bed under stream valley (GS 6). (From National Research Council, 1981, fig. 4.5b)




Coal beds and fault structures
(thrust, faults, normal faults, fracture traces, and lineaments)

- If the permit area includes a fault structure, significant quantities of ground water would initially discharge into the mine excavation; after a short time, however, depending upon the recharge source, the ground-water discharge may diminish to a controllable quantity.
- One of the greatest hazards in underground mining is the unexpected intersection of a water-bearing fracture zone with a heading, or to have the fracture zone intersect a major surface-water feature such as a perennial stream, river, or lake.

Figure IV-7.— Geologic setting and ground-water factors for coal beds and fault structure (GS 7).
(Modified from Hounslow and Fitzpatrick, 1978, fig. 30)




Physical setting of fractured bedrock caused by mine subsidence.

- This setting applies to previously mined areas; and the effects of subsidence are superimposed upon the previously discussed settings.
- If permit area is within, beneath, or adjacent to an area that has experienced mine subsidence, significant and prolonged ground-water infiltration into the proposed mine may result.
- Ground water from flooded "rooms" of an adjacent room and pillar operation may enter along faults and fractures resulting from:
  (1) roof sag and collapse,
  (2) roof sag and pillar squeeze,
  (3) pillar collapse or pillar removal, and
  (4) doming-type roof fall.

Figure IV-8.— Physical setting for fractured bedrock caused by mine subsidence (GS 8). (Modified from Dunrud, 1976, fig. 4, and Lines and others, 1984, fig. 3.3-1)