VIII. WELL DRILLING, COMPLETION, AND DEVELOPMENT; DRILLER'S LOGS

Pertinent 30CFR[1] sections:

Description of geology.
Ground-water information.
Cross sections, maps, and plans.

The geologic and hydrologic settings of the permit and adjacent areas, and the feasibility of mining them, are determined from the exploratory program (described in chapter XVI). The principal products from this program are geologic cross sections and potentiometric maps (described in chapter IX) based on data from drill holes and core borings. The maps and cross sections define:

(1) occurrence and areal extent of the coal reserves,
(2) aquifers above and below the coal seams,
(3) confining beds between the aquifers and the coal seams, and
(4) lithologic description of the overburden material to determine the acid-generating potential of the waste spoils by the acid-base accounting method.

During the drilling of the exploratory holes, the cores and cuttings are examined, recorded, and compiled on driller's logs, which are used to develop the cross section. Whenever practical, the water levels are measured during the drilling-rig "down time". Depending on the type of drilling method used, caution must be used in measuring water levels during this "down time". For example, if drilling mud is used, as in the rotary method, water-level measurements in mud-filled holes are not reliable. In cable-tool drilling, air rotary, and other methods that do not use drilling mud, measurements of water levels during rig "down time", may be more reliable. However, the length of "down time" should be considered, especially in materials of low permeability. The disturbance caused by removal of earth material and water during drilling, may require many hours for the water to return to levels that are representative of the aquifer.

Cross sections.—The most important features of the cross section (See example in fig. VIII-1) are the locations of the logs, the land-surface elevations of the: logs, the depth of the drill holes, the lithologic descriptions in the logs, and the depth to the final water level. Interpretation of the cross section indicates the geologic structure and the associated areal extent, variation of dip, and thickness of the coal seams. A planimetric or topographic map should accompany the cross section to show the location of the drill holes and core borings, the line of the cross section, the location of surface-water features, and the permit and adjacent areas.

Potentiometric maps.—If the water levels are representative of an aquifer, a potentiometric map should be drawn. If the water levels are indicative of a multiple-^aqiiifer system, additional water-level information may be needed before potentiometric maps can be drawn. The information from the map and cross sections aids in the definition of the occurrence, flow, and quality of ground water. Geohydrologic data may be compiled into a colunnar section such as the example in figure VIII-2, which is representative of the geohydrologic conditions of the permit area.

[1]CFR= Code of Federal Regulations

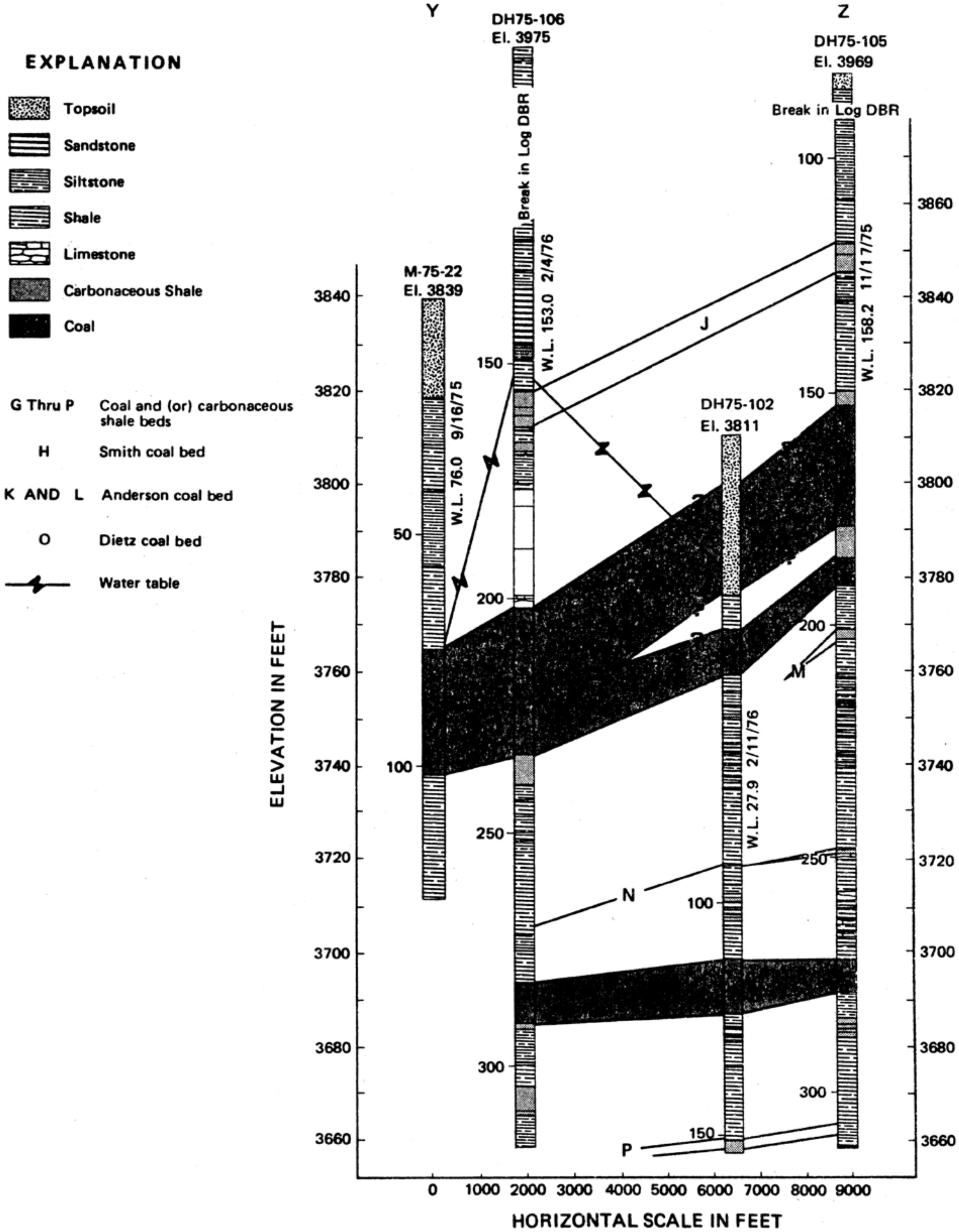

Figure VIII-1.— Example of geologic section derived from driller's logs. (Modified from U.S. Department of Interior, 1977b, p. 26)

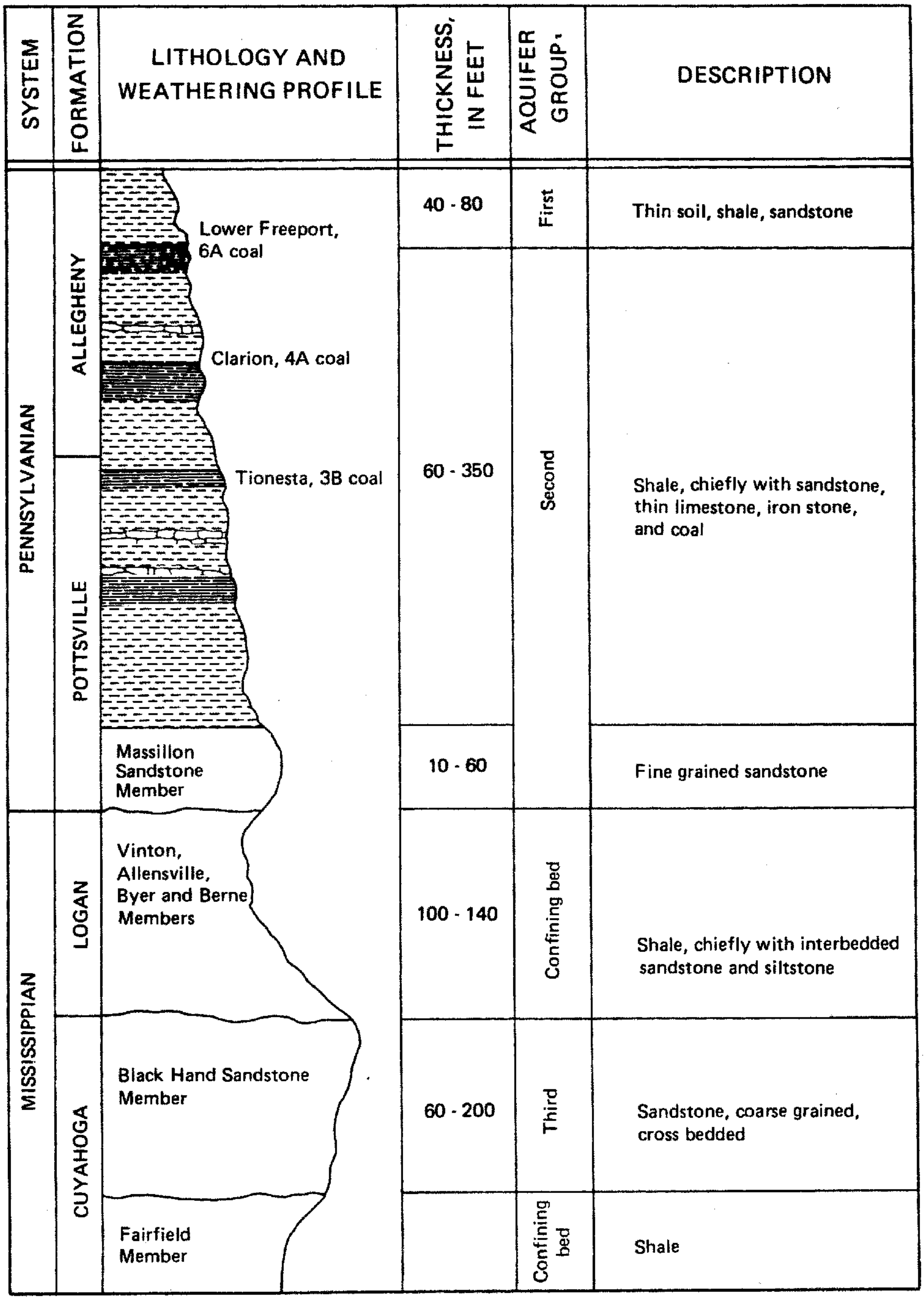

Figure VIII-2.— Example of columnar section of consolidated rocks showing arbitrary divisions into aquifer groups.
(Members follow the usage of the Ohio Geological Survey.)
(Modified from Norris, 1981, p. 28)

After the coal setting has been defined, the drilled or cored holes can be converted into wells, provided aquifers were penetrated. These wells could be used for water supply, water-level and water-quality monitoring, and aquifer testing to determine aquifer characteristics (as described in chapter X). Water-level montitoring and aquifer test information are necessary in the prediction and detection of potential hydrologic impacts due to mining (See chapter XIII).

The basis for selection of holes to be converted into wells includes ground-water availability, ease of access to well site for routine measuring, and site location relative to neighboring ground-water users, including adjacent active mining operations. The conversion of these exploratory holes to observation wells involves entails determination of the aquifer(s) to be monitored, well completion, including construction and development.

Well completion, construction, and development are important in aquifer testing and ground-water monitoring (See chapter XIV). If the wells are not in contact with the aquifer(s) and are not capable of responding to the variations in ground-water flow, the measured data will be of little value.

Well completion includes all activities after the drilling or coring of the hole, including construction and development. Well completion also includes the setting of perforated casing, or screening, at the center of the saturated thickness, and sealing off, by cement or clay grout, the space between the non-perforated casing and the drill-hole surface and the other aquifer groups not tested and monitored.

Well construction involves the selection of casing type (steel, plastic, or fiberglass); length of casing, both perforated and nonperforated; depths for setting the perforated casing; and casing diameter (2-, 4-, or 6-inch). The larger the casing diameter, the better the accessibility for testing and monitoring of water levels and quality.

Typical well construction designs are shown in figure VIII-3. In unconsolidated deposits, well completion within the top half of the saturated thickness is sufficient for monitoring purposes. However, the depth of monitoring wells is flexible, depending upon the proximity of the well to the mining operation. If the exploratory hole is to be converted to a large capacity water supply well, the full thickness of water-bearing material should be screened off. In bedrock aquifers, the well-completion screens are at the same depth as the water-bearing zones. If the bedrock is capable of maintaining an open hole, and if one aquifer is to be monitored, only surface casing needs to be cemented off.

Well development includes any and all operations necessary to remove the mud cake lining the drilled hole, and the mud and fines forced into the fractures and joints of the bedrock units. The mud and fines retard the ground-water flow into the drilled/cored hole. If the drill rig is used over the hole, the water can be overpumped to cause maximum water pressure on the mud and fines. Water can also be made to surge back and forth through the screen, gravel pack, and aquifer by means of surge blocks. Other development schemes include compressed air, hydraulic jetting, shooting of dynamite, and use of acids and polyphos-phates. Additional information on well completion, construction, and development can be found in references - Johnson Division, Inc., 1975, and U.S. Department of Interior, 1981a.

Well development is completed when the pumped water is clear and when successive periodic pH and specific conductance measurements (chapter XII) give identical results.

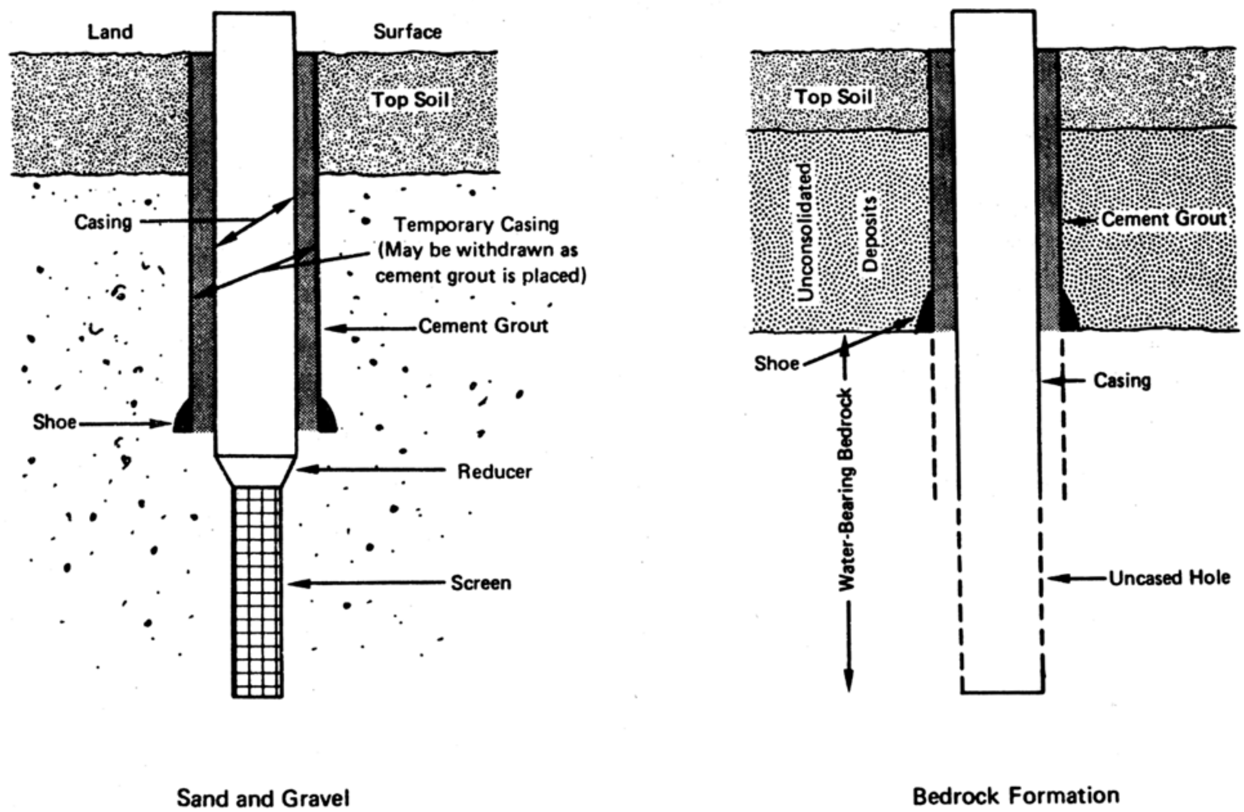

Figure VIII-3.— Typical well-construction designs.
(Modified from U.S. Department of Interior, 1981a, chapt. XI)