CHAPTER II

BACKGROUND DATA SEARCH AND PLANNING

Before any drilling or geologic sampling is performed, a background data search should be conducted to determine what information already exists in the area. A properly conducted data search may reveal that adequate geologic or other "equivalent" information already exists in the area and that further drilling and sampling are unwarranted. As a result, the data search could save thousands of dollars in sampling and analysis costs. Although more time would be consumed initially, the time expended would be minimal compared with time required to conduct unnecessary drilling, sampling, and laboratory analysis. Available information may also provide valuable data needed to write an accurate description of the regional geology of the permit area. However, if additional geologic information is needed, the background data search should reveal what data gaps exist and allow the operator to plan the drilling, sampling, and analytical program, accordingly.

If the background data search shows that gaps do exist, it is highly recommended that a determination be made of the "objectives" for data collection prior to actual drilling and sampling. If the objectives are clearly defined, the probability of unnecessary drilling and sampling is minimized. Likewise, the possibility of collecting data, which does not provide the information necessary to support a particular decision, is reduced. Geologic information utilized in determining the engineering and economic feasibility of mining may be inadequate for satisfying environmental and permitting requirements. Therefore, the overall needs of the mining operation should be considered during the drilling and sampling phase rather than addressing only individual issues. This is the process of establishing Data Quality Objectives (DQO). Additional sources of information on DQO and approaches may be found in the EPA's "Guidance for the Data Quality Objectives Process (EPA, 2000) and the Texas Mine Land Reclamation Monitoring Program Issues report (Askenasy, et al., 1998). The following sections briefly describe sources of primary and "equivalent" information that may be used for permit development and pre-permit planning. It also briefly discusses some methods and considerations in planning any additional geologic data collection.

A. EQUIVALENT INFORMATION

If the background data search reveals the existence of adequate geologic and/or hydrologic data to characterize the proposed permit area and develop an environmentally sound mining plan, no additional site-specific geologic sampling may be required. Thus, this "Equivalent Information" can be used to satisfy the regulatory requirements for site-specific chemical, physical, and engineering properties of geologic strata. An example of equivalent information might be water-quality data from adjacent mine sites, which demonstrate the lack of acid-forming material in the area. The types and amounts of data that may be considered "equivalent" will vary from site to site based on the type of mining and the history of the area. However, the use of equivalent information does not preclude the regulatory requirements for a site-specific geologic description nor does it exempt site-specific geologic maps and cross sections.

B. SOURCES OF INFORMATION

Geologic information can be collected from many sources, including private industry and both State and Federal agencies. Often the biggest problem is actually identifying these sources. Tables II-1 through II-3 list sources that may provide useful geologic information or technical publications on geology-related procedures and designs. Some sources have catalogs that provide a list of materials and associated costs. Others, such as the Department of Highways, often have copious amounts of geologic or hydrologic data collected during road construction or planning projects. However, such agencies are not often contacted about this type data and determining the actual types of information available for a specific area may be difficult. The list is intended as a guide to major sources of geologic-related information and should not be considered as the only sources available.

C. PRE-PERMIT PLANNING

Once a review of the existing information is completed, a more thorough understanding of the relevant issues and data needs should become more evident. For instance, a review of the existing information may reveal that significant water quality information exists from previously permitted mining operations on the same coal seams in the area of a proposed operation. In areas where historical water quality has demonstrated that the potential for acid or toxic mine drainage is minimal, a waiver of specific geologic information may be justifiable based on this “equivalent information.” However, in areas where acid and toxic mine drainage is common or where no “equivalent information” exists, a more thorough geologic sampling and analysis program will have to be developed. The following sections briefly discuss considerations in pre-permit planning that should be considered prior to actual geologic sampling.

1. Mining Method

Each mining method or activity will generally have its own issues, which should be considered during data collection. Surface mining operations generally result in changes to runoff, drainage patterns, flooding, slope stability, and changes in ground water storage and infiltration. Where excess spoil disposal is an issue, rock mechanics of the fill material as well as suitability of the disposal sites become important. In addition to these considerations, the potential for surface and ground water contamination from metals and dissolved and settleable solid increases should be determined. Underground mining evaluations must consider the potential for dewatering of streams and aquifer systems, subsidence effects, potential for gravity discharge, potential for mine pool formation, and subsequent outcrop barrier leakage or artesian effect, and contamination of surface and ground water systems from metals and increased concentrations of dissolved solids. Geologic information should be directed toward addressing the needs of the mining operation based on the method and site- specific character of the proposed mine plan. This would include planning to recover whole rock cores during drilling where rock durability or other mechanical tests may be needed.

WEST VIRGINIA STATE GOVERNMENT

Sources	Types of Information Available
West Virginia Department of Environmental Protection	
Division of Mining and Reclamation	Handbooks; geologic maps; underground mine projections; geology and hydrology data from adjacent coal mine permits; location and extent of adjacent mine operations; assistance with regulatory or technical problems; nearby drill hole data; coal NPDES issues;
Office of Abandoned Mine Lands	Locations of adjacent surface and underground mines; underground mine maps; mine water-quality information; AMD treatment and abatement data;
Division of Water and Waste Management	Watershed assessments; surface and ground water quality; non-coal NPDES forms and guidance documents; water quality standards; impacted streams listings;
Office of Oil and Gas	Locations of oil and gas wells; well logs; well permit numbers;
West Virginia Division of Miners Health, Safety and Training	Underground mine maps;
West Virginia Geological and Economic Survey	Geologic maps; geologic publications; well logs; coal quality information; coal reserve information; geologic and hydrologic characteristics of aquifers;
West Virginia Division of Highways	Shallow well logs; geologic reports; geochemical analyses of rock associated with road cuts;

Table II-1.–West Virginia State Government Sources of Geologic and Related Information

FEDERAL GOVERNMENT

Sources	Types of Information Available
Mine Safety and Health Administration	Underground mine maps; mine location information;
U.S. Army Corps of Engineers	Surface-water hydrology information; well logs; geologic reports; environmental assessments; Aquatic Resource Alteration Permit (ARAP) information;
U.S. Department of Energy	Coal seam quality analyses (both ultimate and proximate); coal production and utilization information;
U.S. Environmental Protection Agency	Technical research documents on AMD, wetland designs, mine waste disposal; watershed and geochemical modeling software; surface and ground water data; water quality standards and guidelines;
U.S. Forest Service	Geologic maps; well logs; surface- and ground-water data; geologic descriptions and environmental impact studies; revegetation and soils research; toxic material handling research; acid mine drainage research;
U.S. Geological Survey	Geologic maps; well logs; coal quality information; coal reserve information; technical manuals for well drilling, logging, sampling, etc.; ground and surface water quality and quantity information; mine water quality information; geologic and hydrologic characteristics of aquifers; aerial photographs; lineament mapping; geophysical survey maps; various geologic and hydrologic bulletins, reports, and models;
U.S. Office of Surface Mining	Subsidence control information; underground mine maps; geologic and hydrologic sampling methods; guidance documents for conducting cumulative hydrologic impact assessments and determinations for probable hydrologic consequences; regulatory standards and guidelines; AMD prevention and abatement; remining information and guidelines;
U.S. Natural Resources Conservation Service	Soils maps; land use information; aerial photography; wetland inventories; hydrologic and watershed models;

Table II-2.--Federal Government Sources of Geologic and Related Information

OTHER SOURCES

Sources	Types of Information Available
West Virginia Surface Mine Drainage Task Force	Acid mine drainage research; toxic material handling plan design;
Colleges and Universities	Various geologic and acid mine drainage research;
WVU National Mined Lands Reclamation Center	Soils and revegetation research; topsoil substitute identification and analysis; acid mine drainage research; toxic material handling plan design;
WVU Energy and Water Research Center	Acid mine drainage research; toxic material handling plan design;
West Virginia Mining and Reclamation Association	Acid mine drainage research; toxic material handling plan design;

Table II-3.--Nongovemmental Sources of Geologic and Related Information

2. Site Sensitivity

The environmental sensitivity of an area will likewise affect the overall data needs and requirements for a particular mine site. Documentation of ground water users and surface water intakes; documentation of sensitive or endangered aquatic organisms in receiving streams; and documentation of the existence of any environmentally sensitive, fragile, renewable resource, or developed lands (i.e. parks, transportation routes, man-made structures, regional aquifer systems) within the area of influence from a proposed mining operation will all assist in determining data needs.

3. Geologic Controls

Although somewhat difficult to distinguish under average field conditions, it has been established by Caruccio (Caruccio, 1970), Caruccio et al. (1977), Ferm (1974), and numerous others, that depositional environments can be used as a tool to assist in predicting postmining water quality. The presence or absence of calcareous minerals and pyrite is based primarily on depositional environment and the paleoclimate during deposition. If such information can be determined, or is available for the strata associated with a proposed mine site, then the overburden sampling and testing program could theoretically be adjusted to consider environments conducive to high or low concentrations of pyrite and/or calcareous material. A paper by Brady, Hornberger, and Fleeger (1998), which is entitled "Influence of Geology on Postmining Water Quality: Northern Appalachian Basin", provides significant detail and reference on this concept.

It is stated, "For example, wet climates typically yielded less pyrite than dry climates and dry climates favored deposition of freshwater limestone. Rocks deposited in marine environments often have high sulfur and high neutralization potential. Brackish environments generally produce high sulfur with no calcareous minerals, although siderite can be present. High Sulfur occurs in marine and brackish environments because of abundant sulfate ions in marine waters. This sulfate served as the source of pyritic sulfur. Marginally brackish environments are generally lower in sulfur and have little neutralization potential. Freshwater (terrestrial) deposits are often calcareous and frequently contain limestones."

These two groups of minerals, the acid-forming sulfides and acid-neutralizing carbonates, are of primary importance in determining whether geologic materials will weather to generate acid or alkaline water. Table II-4 provides general information to assist in recognizing depositional environments of geologic strata. However, as stated above, the paleoclimatology, which existed at the time of deposition, may also have an affect on the availability of sulfates, which is necessary for pyrite formation. The Brady, Hornberger, and Fleeger (1998) paper showed that freshwater rocks associated with the coals of the Monongahela and Dunkard Groups generally had thicker sequences of high-sulfur strata than the Allegheny overburden. Since there seems to be no evidence of marine influence within this section, it is suggested that the higher pyrite concentrations could possibly be accounted for by arid conditions, which would have resulted in higher total dissolved solids (including sulfates) in the surface and ground water.

Despite the use of these methods to assist in pre-permit planning and data collection, it must be remembered that overall reclamation success and field water quality data may be more of an indicator than trying to determine paleoenvironments and paleoclimatology. Brady, Hornberger, and Fleeger (1998) state that "using conventional wisdom, and early research in the northern Appalachians, coal and rocks associated with marine environments should be high in sulfur. However, marine sediments in the southern Appalachian rocks are very common. If depositional environment was controlling sulfur content in the southern Appalachian coals and rocks, the sulfur should be high, but it is not. Also, acid mine drainage typically is less of a problem in the southern Appalachians than in the northern Appalachians." Cecil et al. (1985) interpretation of this discrepancy by suggesting that the paleoclimate created an ever-wet setting where the swamp water was generally fed by rainwater, which resulted in low dissolved solids and a low pH (<4); not conducive to pyrite formation or accumulations of solids (ash).

Depositional Environments					
Criteria for Recognition	Fluvial and Upper Delta Plain	Transitional Lower Delta Plain	Lower Delta Plain	Back-Barrier	Barrier
I. Coarsening upward					
A. Shale and Siltstone sequences	C - R	C	A	C - A	R - C
1. Greater than 50 feet	N	R - N	C - A	C - A	R - C
2. 5 to 25 feet	C - R	C - A	C - A	C - A	R - C
B. Sandstone sequences	R - N	R - C	C - A	C	C - A
1. Greater than 50 feet	N	N	C - A	R	C - A
2. 5 to 25 feet	R	R - C	C - A	C	C
II. Channel Deposits					
A. Fine grained abandoned fill	R	C - R	A - C	C	R - C
1. Clay and silt	R	C - R	A - C	C	R - C
2. Organic debris	R	C - R	A - C	C - R	R
B. Active sandstone fill	A	C	C - R	C - R	C
1. Fine grained	C	C	C - R	C - R	C
2. Medium and coarse grained	A	C - R	R	R	C - R
3. Pebble lags	A	A	C	C - R	R - C
4. Coal spar	A	A	C	C - R	R - C
III. Contacts					
A. Abrupt (scour)	A	A	C	C	C - A
B. Gradational	C - R	C	C - A	C	C
IV. Bedding					
A. Cross beds	A	A	A	A - C	A - C
1. Ripples	C	C - A	A	A	A
2. Ripple drift	C-A	C	C - R	R - C	R - C
3. Festoon cross beds	A	A - C	C - A	C	C - A
4. Graded beds	R	R	C - A	R - C	R - C
5. Point bar accretion	A	C	R - N	R - N	R - N
6. Irregular bedding	A	C	R - C	R - C	R - C
V. Levee Deposits	A	A - C	R - C	R	N
VI. Mineralogy of sandstones					
A. Lithic greywacke	A	A	A - C	R	R
B. Orthoquartzites	N	N	N - R	A - C	A
VII. Fossils					
A. Marine	N	R - C	C - A	A - C	A - C
B. Brackish	R	C	C	C - R	C - R
C. Fresh	C - R	R - C	R - N	N	N
D. Burrow structures	R	C	A	A	A
Key: A = abundant; C = common; R = rare; N = not present					

Table II-4.–Criteria for recognizing depositional environments (after Caruccio et al.,1977)