

PENNSYLVANIA'S APPROACH TO CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT
OF COAL MINING ACTIVITIES¹

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Abstract.--Pennsylvania's regulations require that an assessment be made of probable cumulative hydrologic impacts of all anticipated coal mining in the general area of a proposed mining operation and that the proposed operation be designed to prevent damage to the hydrologic balance. The cumulative hydrologic impact assessment (CHIA) process, therefore, consists of two steps: (1) definition of potential damage to the hydrologic balance, and (2) prevention of such damage. Damage to the hydrologic balance is referenced to quality, quantity, and present uses of surface and ground water systems. The Pennsylvania Department of Environmental Resources' (DER's) approach is to describe existing hydrologic conditions and potential adverse effects from mining in two-phase reports on watersheds of 20 to 50 mi². The Phase I CHIA Report is a brief description of the watershed and a synopsis of surface and ground water uses and present and potential impacts from mining. The Phase II CHIA Report is a more detailed discussion of geology, hydrology, and mining history in the watershed. DER has found that insufficient data exist to adequately define existing hydrologic conditions. The phase approach allows available core information to be disseminated on a large number of watersheds while hydrologic data collection for more detailed assessment progresses. Prevention of damage to the hydrologic balance is accomplished primarily through evaluation of individual proposed mine sites. Because Pennsylvania's cumulative impact assessment program is based on existing permit review mechanisms, a permit reviewer can perform a mine site assessment even when a Phase I or II CHIA for the appropriate watershed has not yet been written. The major challenge which Pennsylvania faces in implementing its CHIA program is in assuring the equitableness of effluent restrictions within individual watersheds.

INTRODUCTION

In order to obtain primacy in regulating its coal mining industry, Pennsyl-

vania was required to make numerous changes in its existing regulations. One change was the addition of a requirement that the regulatory agency (in this case, the Pennsylvania Department of Environmental Resources) evaluate each mining permit application in light of all existing and proposed mining operations in the general area and make an assessment of the probable cumulative hydrologic impacts. Proposed mining activities must be designed to prevent damage to the hydrologic balance within and outside the proposed permit area (25 Pa. Code Section 86.37(a)(4), which is based on 30 CFR Section 773.15(c)(5)). This Pennsylvania regulation went into effect in 1982.

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The cumulative hydrologic impact assessment, or CHIA, process consists of two steps: (1) definition of damage to the hydrologic balance, and (2) prevention of such damage. Under Pennsylvania regulations, damage to the hydrologic balance is referenced to quality and quantity of surface and ground water systems and to the present uses of the surface and ground water. Because these conditions vary from area to area, the definition of damage to the hydrologic balance does also. Accordingly, the first step of the CHIA process is to delineate the cumulative impact area and describe the current physical and hydrologic conditions of that area. Existing and proposed surface and ground water uses are defined, and the susceptibility of those uses to potential adverse effects from mining activities is evaluated. Prevention of damage to the hydrologic balance (the second step of the CHIA process) involves a prediction of potential impacts from mining activities and efforts needed to prevent adverse impacts.

In developing a CHIA program, DER has expanded on its own existing mechanisms for accomplishing both steps of the cumulative hydrologic impact assessment process. The CHIA has become a set of written documents wherein damage to the hydrologic balance is defined primarily in two-phase reports on watershed areas and efforts to prevent hydrologic damage are addressed primarily in written assessments for individual mine sites.

BACKGROUND

Pennsylvania's environmental regulations require cumulative hydrologic impact analyses for six types of mining activities: surface and underground mining of bituminous coal, surface and underground mining of anthracite coal, disposal of coal refuse, and operation of coal preparation plants. The Pennsylvania Department of Environmental Resources (DER) is the regulatory agency responsible for reviewing permit applications and, consequently, for making impact analyses. Because DER receives more permit applications for bituminous surface mines than for other types of coal activities, the agency has been orienting its initial efforts in development and implementation of the CHIA program toward bituminous surface mining, which will be the main thrust of this paper.

Although Pennsylvania's formal program for cumulative hydrologic impact analysis is in the first stages of implementation, elements of CHIA have existed in the permit review program for a number of years. These elements include: (1) statewide designation of "Special Protection" watersheds, where waste discharges of any nature are restricted; (2) mining management plans for sensitive watersheds; and (3) review of each proposed mine site for hydrologic interactions with adjacent mines.

Pennsylvania designates streams having excellent quality water and high public resource value as Special Protection streams, specifically "Exceptional Value Waters" and "High Quality Waters". Regulations prohibit degradation of ambient stream water quality in Exceptional Value Waters, which virtually eliminates further mining in those watersheds. High Quality Waters may be degraded from ambient quality if the discharge is a result of a project having public value and if downstream water uses will be protected. Mining operations proposed for High Quality watersheds have been required to meet more stringent permit requirements and have often been restricted in extent and nature. For several years, DER has required discharges from mining operations on High Quality watersheds to meet volume restrictions as well as effluent quality standards in order to provide additional protection to the instream water quality.

In the early 1980's, DER developed mining management plans for watersheds where adverse cumulative impacts from mining were identified. Most of these watersheds were public water supply sources. Typically, the mining management plans required stricter erosion and sedimentation control measures, a limit on disturbed acreage on each mine site, mandatory overburden analysis, and prohibition from mining coal seams which were known to produce acid mine drainage in the watershed. Many of these management plans are still being implemented.

CHIA elements have long been part of the individual mining permit review process. Permit reviewers consider the interaction of the proposed mining activities with adjacent active and abandoned mine sites. Typical analyses done by reviewers include determining probable impacts on the quality and quantity of discharges from underlying underground mines, impacts on surface flow and ground water recharge on adjacent surface mines, and cumulative impacts of several sites on ground water recharge to private water supplies or to wetlands. In recent years, DER has used effluent volume restrictions to address cumulative impacts on stream quality in some non-High Quality watersheds.

The formalized CHIA process incorporates and expands on the existing permit review elements. A standard format for impact analysis was developed to improve consistency of permit review among the various District Offices and help ensure that no aspect of cumulative impact assessment is overlooked. The resulting written format for analysis of impact assessments will also facilitate oversight by the federal Office of Surface Mining Reclamation and Enforcement. Formalization of the CHIA process has ensured a systematic examination of hydrologic impacts by watershed and has revealed a need for an expanded hydrologic data base.

CHIA REPORT ELEMENTS

Phase I CHIA Report

Phase I provides a brief introduction to a cumulative impact area, highlighting areas of concern. For this part of the CHIA process, DER has chosen to use watersheds of 20 to 50 mi² as cumulative impact areas. Each Phase I report is a short description of a watershed and a synopsis of surface and ground water uses, coal seams being mined, and previous and potential hydrologic impacts of mining. For permit reviewers, it can increase familiarity with the area and encourage a watershed-scale perspective. It alerts coal operators and consultants to potential impacts they might be expected to address in mine permit applications.

Phase I includes the following sub-topics: (1) Hydrologic Unit, (2) Drainage Characteristics, (3) Physiography/Topography, and (4) Special Considerations. The Hydrologic Unit section defines the limits and location of the watershed and delineates it on a map. Drainage Characteristics include basin and subbasin drainage areas, maximum relief, stream lengths, and stream classifications. Physiography/Topography is a brief, general discussion of the physical characteristics of the watershed. These three sections set the stage for the core of the Phase I report, Special Considerations.

Special Considerations include a wide variety of hydrologic concerns. The presence of a public water supply in the watershed is often a major concern. Phase I describes the supply's location, source, and service area and any previous mining-related problems. Private water supplies (usually wells or springs) are common in the rural areas where bituminous surface mining takes place. Because their specific locations and sources are identified in permit applications, little emphasis is placed on reiterating this information in Phase I. Phase I does, however, note any previous adverse impacts on private water supplies in the area, such as diminution or degradation.

As part of the Special Considerations, Phase I identifies water-based recreational uses which could be adversely affected by mining in the watershed. The most common instance is trout fishing in streams stocked by the Pennsylvania Fish Commission. The use of wetlands, streams, and lakes by threatened or endangered species is also noted in this section.

A brief summary of mining history and resultant hydrologic impacts in the cumulative impact area completes the Phase I report. This section identifies the coal seams which have been mined in the watershed and whether they have produced acid mine drainage. A summary of the presence of toxic strata, calcareous strata, channel sandstones, and other strata of interest is

made from overburden analyses performed in the area. Existing mining management plans are outlined. The report identifies previous impacts which mining has had on watershed resources and potential future hydrologic impacts from mining.

The Phase I CHIA is based on information from a number of sources. Reports by State and Federal agencies on regional coal hydrology and water resources are helpful for a broad overview, but they generally deal with much larger basin areas than the CHIA reports. For information which is more specific to the cumulative impact area, interviews with mining permit review and inspection staff personnel and review of DER data bases, biological stream surveys, and water quality reports for abandoned mine reclamation projects are useful.

Phase II CHIA Report

In addition to describing vegetation, land uses, and soil types in the cumulative impact area, Phase II discusses watershed geology, hydrology, and mining history in much more detail than Phase I.

Pennsylvania's initial attempt to write a Phase II CHIA revealed that existing water quality and quantity data at key stream points are insufficient to adequately define watershed hydrology. Most existing data fall into two categories: (1) data from stream points with drainage areas larger than CHIA units (such as Pennsylvania Water Quality Network stations or USGS gauge stations); or (2) data from coal operators' water monitoring reports, which include stream points located immediately upstream and downstream of mine sites, but not necessarily at the receiving stream's mouth. In the 20 to 50 mi² watersheds which make up Pennsylvania's CHIA units, water quality and quantity data from major tributary confluences and critical points along the main stem (often including the main stem mouth) are minimal or absent.

DER is currently using two approaches to develop the needed data on watershed hydrology -- data collection by DER personnel and data collection by the United States Geological Survey (USGS). Bureau of Mining and Reclamation staff members are collecting quarterly water quality and quantity data from key points (main stem mouth, major tributary confluences, and other points) in two watersheds. Limited staff time prevents the use of this approach for additional watersheds. Therefore, DER is planning to initiate a joint project with the USGS to collect hydrologic data from additional watersheds. The project will be patterned after data collection by USGS on three prototype watershed projects in Pennsylvania which are being funded by the Office of Surface Mining Reclamation and Enforcement. Data collection on these projects includes (1) continuous monitoring of the main stem mouth for stream discharge, pH, specific conductance, and temperature; (2) monthly water quality sampling of the

main stem mouth for additional parameters; and (3) four sets of water quality samples and flow measurements from key watershed points taken during baseflow and high flow periods.

DER is also taking steps to increase the amount and availability of site-specific hydrologic data. Since November 1986 the Department has required surface mine operators to measure, rather than estimate, the flows of all stream and discharge points they monitor, thus increasing the amount of reliable water quantity data available. In addition, the Department has completed compilation of existing quality and quantity data on acid mine drainage discharges from surface mines and is entering the results into a computer data base. This data base, categorized by drainage basin, will provide information on the severity and hydrologic impact of each mine drainage discharge, identification of the coal seams mined on the associated site, and a mechanism for prioritization of watersheds for further evaluation.

The hydrology, mining history, and geology sections are expected to be the most useful for permit reviewers and others interested in the CHIA. These sections will serve to document current "baseline" watershed conditions for comparison with future conditions, detail the impacts previous mining has had on the hydrologic balance, and relate those conditions and impacts to the geology of the area. The vegetation, land use, and soils sections will increase in importance if DER finds computer modeling of impacts to be valuable and practical.

If current mining management practices are found to be inadequate to prevent cumulative damage to the hydrologic balance, the Phase II report will also develop recommendations for future management strategies.

Mine Site Assessment

The Mine Site Assessment is a written appraisal of the probable impacts of a specific site on the hydrologic balance, in conjunction with existing and anticipated mine sites in the general area. The Mine Site Assessment describes the proposed mining activities and how they have been planned to prevent damage to the hydrologic balance.

In evaluating potential damage to existing uses of surface and ground water, the permit reviewer relies on hydrologic data and resource information from several sources, primarily the permit application and the Phase I and II CHIA Reports. Because of the information available in the permit application, the inspector's field review report, and reports submitted by other agencies, a permit reviewer can perform a Mine Site Assessment even if the Phase I and II CHIA Reports for that watershed have not yet been written.

Potential cumulative hydrologic impacts are as varied as the hydrologic conditions on potential mine sites. One factor common to all sites, however, is the potential for impact on the quality of the receiving stream immediately downstream of the site.

Under Pennsylvania's environmental regulations, every stream in the state is protected for certain minimum uses (potable water supply, fishing, esthetics, etc.) and also for specific additional uses, according to its classification. Therefore, even though a stream is not currently being used for a specific purpose (like those identified in the Phase I CHIA Report), instream water quality may not be degraded beyond certain criteria. As previously discussed, the Department has been using discharge volume restrictions as a tool for preventing violations of the instream criteria in High Quality watersheds and has been expanding their use to non-High Quality watersheds.

At present, the volume restriction calculations are based on the acreage disturbed by the mine site and the total drainage area upstream of the discharge point. The incorporation of factors such as slope, soils, and vegetation through computer modeling is being explored by DER in a joint project with the U.S. Geological Survey. Implementation of computer modeling in the CHIA program will be dependent on the amount of data collection required for accurate calibration of the model and on the transferability of the calibrated model from one watershed to another.

CHALLENGES IN IMPLEMENTATION

The major challenge which Pennsylvania faces in implementing its CHIA program is in the area of assigning effluent quality and quantity limits. DER strives to be equitable in the restrictions it places on operations within a single watershed. Three approaches exist to accomplish this: (1) base effluent limits on the maximum acreage predicted to be disturbed in the watershed at one time; (2) impose new, stricter limits on existing operations when additional discharges are approved; or (3) establish an upper limit of disturbed acreage for each watershed, and require new operations to wait until older ones are completed.

For the first approach, it is virtually impossible to predict the maximum acreage which will be disturbed at one time in any given watershed. An estimate of remaining mineable coal reserves could be substituted, representing the absolute maximum possible, but this tactic would require significant amounts of information not readily available to the Department. In addition, it could result in measures overly restrictive for protection of the water resources.

The second approach, imposing more restrictive effluent limits on existing operations, may require substantial physical modifications on those sites which might not be technologically or economically feasible.

The third approach, establishing a ceiling on the amount of disturbed acreage, involves considerable administrative effort and may impose economic hardships and planning difficulties on individual mine operators.

CONCLUSIONS

The Pennsylvania Department of Environmental Resources has attempted to develop a practical approach to cumulative hydrologic impact assessment. Existing information on surface and ground water uses and on past and potential hydrologic impacts from mining is made readily available to permit reviewers through Phase I CHIA Reports. Additional key water quality and quantity data are being collected and will be made available, along with detailed geology and mining history discussions, in the Phase II CHIA Reports. The two-phase report allows basic, core information to be disseminated on a large number of watersheds, facilitating permit review, while more detailed data collection progresses. Reviewers of mine permit applications use all available information to make assessments of cumulative hydrologic impacts and to ensure that individual mining operations are designed to prevent damage to the hydrologic balance.

