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CHAPTER I

I. INTRODUCTION

1.1 The Purpose

The need for control of sediment eroded from areas disturbed by coal mining operations has been well documented. Presently, several erosion and sedimentation control measures are available to the operator. Of these various methods, sedimentation ponds have been the most widely used and are required by federal regulations. Sedimentation ponds are typically the last treatment measure applied before runoff leaves the permit area. Therefore, it is paramount that sedimentation ponds be designed, constructed, and maintained to provide sediment removal to meet regulatory effluent limitations and maintain the hydrologic balance.

Previously, federal and state regulations have required design of sedimentation ponds for two general criteria: (1) to provide a specific storage capacity based on the amount of disturbed area and (2) provide a required storage capacity to retain the runoff from a design precipitation event for a specified period of time. Recent studies have shown that the sedimentation ponds designed to meet the above criteria do not necessarily meet applicable effluent limitations. This inconsistency is addressed by the regulations currently published by the Office of Surface Mining (OSM), whereby sedimentation ponds are required to meet effluent limitations and the selection of sedimentation pond design criteria such as storage volume, pond geometry, and detention time is left to the design engineer. Thus, the design of sedimentation ponds should be based on the pond's ability to achieve specific effluent limitations.

1.2 Application of Sedimentation Ponds

As stated previously, sedimentation ponds are the last treatment measure applied before the runoff leaves the permit area. However, it should be understood that sedimentation ponds are not the only means of sediment and erosion control, but simply an integral part of an overall plan. The need for a complete sediment and erosion control plan before, during, and after mining operations based on sound engineering knowledge is necessary to minimize potential environmental damage from surface mining activities. Further, it is essential that the designer realize that the drainage basin in the permit area is only one part of a larger, more complex drainage system. The drainage

network in the permit area interacts with other parts of the larger drainage system in a complex fashion. Over time this complicated system has established a state of balance or quasi-equilibrium. The mining operation, or any other large-scale disturbance, will affect this balance or equilibrium and can result in dynamic responses through the system. The designer must recognize this situation in order to restore the disturbed topography and drainage to a condition where it will again properly function as part of the larger system.

Sedimentation ponds as referred to in this manual are used for the removal of sediment due to erosion from disturbed areas during the active mining phase and during the reclamation phase until adequate revegetation has been established. Sedimentation ponds are used in all OSM regions, with all types of mining methods, on natural drainageways and in conjunction with diversions. The major controlling factor in the application of sedimentation ponds is topography of the specific site. Although mining in steep sloped terrain is normally associated with eastern mines in the Appalachian Mountain range, limited mining is conducted on steep sloped terrain in the Rocky Mountain states. There are also rolling and flat terrain areas in southeastern parts of the United States. Therefore, techniques for application and design of sedimentation ponds cannot be specified by region, but are very dependent on the topography of the site being analyzed.

1.3 Scope

The procedures presented in this manual are based on a comprehensive literature review and assessment of the best technology currently available. Selection criteria for inclusion in the design manual for the range of design methodologies available included consideration of the physical environment of surface mine operations, current design procedures employed, the problems with existing sedimentation ponds, and the level of effort required to provide compliance with effluent limitations. Modeling methods for design of sedimentation ponds are considered state-of-the-art procedures. However, based on the capabilities and present procedures used by most operators, modeling is not included in the manual. In contrast, many of the simplified procedures, including some methods in common use, are presented in this manual.

This manual addresses all aspects of the pond that affect the removal of suspended solids including, but not limited to, type of mining, topography, location soil types, pond geometry, inlet and outlet control, and maintanence. No attempt is made to present information on structural design.

To help meet the needs of designers and operators, contacts were made with appropriate agencies in states where significant active mining operations occur. Further, contacts were made with operators to develop a background of their capabilities, problems in sedimentation pond performance, innovative techniques, and present design procedures. This information provided insight for development of a useable design manual.

1.4 Design Manual Use

The methodologies and considerations in design of sedimentation ponds have been presented to provide the designer or operator with an understanding of the processes involved to remove suspended solids and what effects these processes have. In Chapter II, preliminary considerations of watershed characteristics and sources of sediment are discussed. In Chapter III, computational methods for water routing and removal efficiency are presented along with a discussion on the characteristics of sediment removal to meet effluent limitations. This chapter contains the data requirements and the methodologies that are used to design a sedimentation pond. An important discussion in this chapter is that pertaining to sediment data, specifically the particle size distribution. The design of ponds to meet effluent limitations is greatly dependent on the particle size distribution. Therefore, great care should be taken to develop an accurate representative size distribution. Chapter IV presents modifications that can be made to improve the performance of the sedimentation pond. Chapter V deals with maintenance and sediment removal. Maintenance of sedimentation ponds cannot be emphasized enough. Lack of pond maintenance is one of the major problems in the performance of existing sedimentation ponds and the development of a maintenance program is a significant part of pond design. Chapter VI presents how these sections are interrelated in the design process.

To bring the information and methodology together, the final chapter presents the procedural steps for design along with a comprehensive design

example. Users of the design manual are encouraged to carefully review the example presented in Chapter VI to better understand the design methodology. With a little practice, the complete design process will become familiar and straightforward.