Chapter 14
Post Mining Development

Introduction

As the last chapter in the Environmental Compliance Manual one might reasonably believe the post mine development plan to be the last activity of a mining operation to be addressed. Therefore, a plan may be postponed until the end of the operational life of the facility. However, this can be very costly.

Any aggregate operation that waits until it finishes mining to develop its post-mining plan will have severely limited its financial potential. The mine operator should understand the basic fundamentals of good post mine planning. ***Post Mine Development and Planning should start at the same time as Pre-Mine Development and Planning.***

As one starts to develop the mine plan with the geologist, the mining engineer and the mine operator one should also start, simultaneously, to develop the reclamation plan and the post mine land use plan.

The purpose of the concepts presented here is to show the operator how to create and add value to a parcel of land that no longer holds any mineable aggregate reserves. The fundamentals presented here are intended only as a guide to the planning process. The concepts are limited only by the ideas, ingenuity and resources of the mine operator.

Integration of the reclamation plan, the plan for post mine land use, and the daily operational mine plan is paramount to the success and profitability of any post mine land use development.

Starting the Process

The first step in the process requires forming a team of people with some expertise in the various areas needed to formulate a good reclamation plan.

The initial member of the team should be your geologist. This professional can provide information to the team about the deposit and its characteristics. This will be very important in the reclamation process since the same person will have input on the mine development plan, and the two plans must be coordinated. The second person that needs to be included in your planning is the plant manager or person responsible for implementing the reclamation work. The manner in which the daily mining operations are conducted have a direct bearing on whether the objectives of the post mine plan can be met through the most efficient means available while still incurring minimum costs. Additional members of the company team may come from the accounting, sales or engineering departments in order to assist in the long range planning. Outside input should be considered from other professionals in the areas of wildlife management, hydrology, local governmental planning agencies, real estate development and marketing specialists.

The primary goals of the plan should always be to coordinate and sequence the daily mining operation of the deposit, and to maximize return not only from the mining operation but also from the post mine land development. For the aggregate industry in Ohio this process centers around two types of aggregate operations: sand and gravel, or stone quarries.

The difference in these two types of aggregate leads to two general differences in development of the post mine development plan. Sand and gravel operations generally can adopt the principle of sequencing their reclamation work immediately after the mining operations are completed in one portion of the pit while continuing operations in other portions of the pit. Sequential reclamation becomes more difficult in stone quarries because of the general method of mining in benches. This prevents doing a great deal of concurrent reclamation since the benches most often must remain until successive benches and final operations to exploit the full depth of the deposit are completed. This does not, however, prevent operations, such as placing overburden for future shorelines, topsoil placement, or shaping of benches from proceeding when feasible.

The second step involves developing and defining objectives for the project. This may begin as a very basic short list and later evolve with the project into a more comprehensive and detailed list.

The short list should include such fundamentals as maximizing the extraction of the reserves, minimizing earth moving costs and coordinating and sequencing operations to maximize opportunities while reducing costs. The team should look for any unique features of the deposit, which can be exploited to enhance the land forming operations. This can add value to the post mine property that one may not be able to achieve at a later date.

At this point in the process, one simply wants to collect as much information as possible about the deposit and what the post deposit conditions may be.

In the third step the team should analyze the information it collects for any relationships that may affect or can have an impact on the post mining landform. The purpose here is not to develop a fixed finite plan but to develop a well-reasoned plan. This plan is developed, but is still subject to revisions as information about the mining process, time frames, market, and new data becomes available in the coming years.

Because of the long life of most mining operations, changes to the plan will become inevitable over time. The preliminary plan developed by the team should be reviewed periodically. At the operation’s mid-life the plan should be reviewed and modified based on changes in the mining process, deposits, and surrounding land use. At a point approaching the last five years before termination of the operations the plan should be review and modified in order to meet the final completion date.

Basic Elements of the Plan

Because the Post Mine Plan should be initiated at the same time one starts to develop the Mine Plan, much of the same initial data collected can be used to develop both plans. If the mine

facility has already been in operation for a number of years without a plan, an attempt should be made to develop a Post Mine Plan as soon as possible.

At a minimum, this inventory list should consist of the following:

A. Local land use plans, zoning ordinances, comprehensive development plans, growth projections, aggregate market information, transportation and a road network around the facility, environmental concerns, and other local policy issues which may impact the operation.
B. The geographical features and the topographical nature of the property, contours that affect the surface drainage, flood plain or retarding basin areas, streams or creeks, soil and drainage conditions and vegetation or wetland issues.
C. The geological conditions of the site, including static water table elevations, the amount of reserves above water verses the amounts below water, deposit parameters, overburden volumes as both topsoil and subsoil, projections of waste materials that can be used for fill, and aggregate quality. The depth and thickness of the formation and its quality can be very important in determining if the material should be recovered as part of the aggregate reserve or if it holds a greater value when used to create something like the final landform.
D. The mineral processing operation itself will have a significant impact on the final landform. Location of the processing plant, type of equipment, either portable or fixed, storage areas, access roads, and associated operations, such as ready mix and asphalt producers often determine much of the remaining landform. Review of the final landform objectives should be considered before determining the site location for these operations.

Steps in Development of the Plan

1. Determine what potential or prospective end uses are feasible. The way mining operations are conducted and the sequence has significant influence on the ability to create landforms and hence value. Therefore, one should ask some of the following questions:
    1. Will there be potential land for building sites?
    2. Will the property have reasonable road and utility access?
    3. Will the property be suitable for residential building or commercial development?
    4. Will it have bodies of water?

5. Will the water areas be suitable for recreational use or wildlife habitat? (The case study at the end of the chapter will highlight why sequencing is so important to the Post Mine Plan)

2. Write the plan as a formal document. Far too often good concepts and objectives in long range plans get sidetracked over the years with changes in personnel, technology, or as a result of lacking a more formalized objective. To avoid this and to stay on track with the idea of creating value in the property when the mining operation is completed, review the plan and update it periodically over the years.
3. Determine the location of the processing facilities on site. Never site facilities over reserves. If this is not possible then place the facilities over the lowest quality or most shallow area of the deposit. This will permit the higher quality and deeper reserves to be fully exploited.
4. Start your reclamation program early. This serves several purposes. First you get years for growth of trees, plant vegetation, and screening and erosion control with results that cannot be duplicated in a short time frame near the end of an operation. Secondly these programs go a long way towards creating a positive public relations image, community acceptance, and meeting reclamation regulatory requirements. This is accomplished at a lower rate of investment than waiting until the end of the mining operation.

5. Maximize how you can create landforms. Mining is earth movement. Consider how you will sequence earth-moving operations to gain the maximum amount of landform at the lowest cost. Consider also that lakefront property holds the potential for greater value than non-shoreline property. Review how you can increase shoreline with the same amount of earth movement.
6. Plan stripping and waste disposal of overburden. Excavation of aggregate involves both the removal and placement of waste materials. The proper sequencing of these operations can save expensive and costly placement and grade work at the end of the operation. Remember that the termination of the mining operations also brings the end to normal cash flow. You want to have the majority of your reclamation and earth moving done before this point and not be faced with large expenditures for land form to meet your development objectives.
7. Ensure that the mining and reclamation plans are integral to the Post Mine Plan. None of the plans should stand-alone but should be integrated and complementary to maximize the mining phase, concurrent reclamation, and the post mine development of the property into one master plan.

Case Study Example

The following example shows how the proper sequencing can create value at the end of the mining operation and what relative values can result with only minor changes when a Post Mine Plan is developed.

The property represented in Fig. 1 below contains 47 acres of sand and gravel reserves.

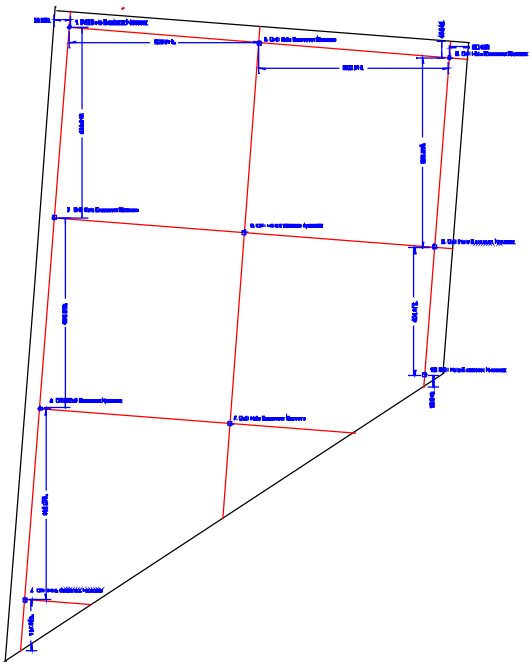

Fig. 1

The parcel pictured was drilled on a 600-foot grid pattern consisting of ten drill holes, with the following information being derived about the deposit:

1. It contained 260,800 cubic yards of topsoil.
2. Overburden or strippings were 99,000 cubic yards.
3. Sand and gravel amounted to 2,400,000 cubic yards.
4. There is fine sand layer underlying the S&G of 895,000 cubic yards.
5. Clay materials amounted to 455,800 cubic yards.

No processing or stockpiling would be taking place on site, so there was no reduction in reserve for that reason. However, the perimeter amounted to about 6,000 feet and with a set back of 50 feet approximately 6.8 acres were going to be lost. The water table was only 6.3 feet below surface elevation; hence the reclamation plan would result in a lake of about 40 acres. The object was to exploit the maximum amount of reserves from the property.

The access road to the property was from the west and presented several possible scenarios. The starting point of the mining cuts could begin from the north side and move

south, start on the south side and move north, or start at the central entry point and move outward. In all scenarios, the objective was to maximize cycle times, minimize mine cuts, and reduce operating costs.

Due to these results there would be no land capable of development to build on and a grass slope around the lake would exist only 50 feet wide, upon completion. Farmland in the immediate area averaged $4,800 per acre. Acreage price for water surface area held the lowest tax base in the county and sold for far less than land itself. Therefore the maximum price for the property expected after mining would be something less than $225,600 with no property on which to build.

The National Association of Realtors median lot size data indicated the following lot sizes for single family homes in 1999. contractor-built homes averaged 32,670 sq. ft. lots while owner-built homes used 45,759 sq. ft. lots. Looking at lot prices within developed areas in the county it was found that one-acre lots averaged $34,290. Shoreline property on a close relatively large public recreational lake was going for $115,800 per acre. Lots within small plat developments with ponds or other water features, such as streams ranged in price from $45,800 to $78,500. Thus, a reasonable average for a residential home site on the lake was $62,150.

If value was to be added at the end of the mining operation some land or developable property needed to be created. The question was how. In looking at the drill records, the deposit depth mean average was 38 feet. If a progressive stripping and mining pattern were followed across the full property to extract all the sand and gravel then all the overburden, strippings and clay would be backfilled into the lake as the deposit was exploited to its max depth of 81 ft. Thus, using all the fill would not result in creating any land form.

The key solution lay with drill data presented by the geologist on the team concerning the three holes in the SW corner of the property. The deposit is very shallow in this area, averaging a depth of 19 feet. The deposit trends deeper to the north of these three holes. If the mine plan called for starting the excavation in the SW corner and moves north, strippings could be placed in the SW portion, which would result in a land form being created. Allowing for underwater slope and filling to grade as excavation to the north continues could create up to 18 acres.

If we contour the land form we can then position up to six residential home sites of one acre each along the lake shore. Laying out a curved street to provide access and a cul-de-sac we can create an additional six non-lake front properties. Each property would be a minimum of one acre or slightly greater depending on lot positioning.

Value created would be six residential shoreline lots at $62,150 or $372,900 and six non-lake shore lots at $34,290 or $205,740. We would still have 29 acres of lake and non-buildable land. As part of the total development we have figured the price at $3,000 per

acre, which is less than the $4,800 average price per acre in the area for a total of $87,000.

The Post Mine Plan has created a value of $665,640 or almost three times the expected post mine value. The same amount of gravel is mined in all three starting point scenarios. However, only one starting point provided the return and value created at the end of mining operations.

A well thought out Post Mine Development Plan starts at the same time as Pre-Mine Development and Planning.