

Major Challenges in Landscape Planning: Simulated Field Trips

Surface Mining¹

Robert Leopold, Bruce Rowland and Reed Stalder ^{2/}

Abstract: The surface mining process consists of four phases: (1) exploration; (2) development; (3) production; and (4) reclamation. A variety of surface mining methods has been developed, including strip mining, auger, area strip, open pit, dredging, and hydraulic. Sound planning and design techniques are essential to implement alternatives to meet the myriad of laws, regulations, and mining and visual resource objectives.

INTRODUCTION

Our brief slide introduction of various mining activities should reinforce your conviction(s) that management of the visual resource in conjunction with surface mining is a feasible and necessary undertaking. We have far too long stressed the negative; the time is now to stress the positive.

The purpose of this simulated visual field trip is to increase the audience's (1) understanding of the surface mining process; (2) sensitivity to surface mining-related visual impacts; and (3) awareness of visual impact mitigation and design practices and planning techniques.

OVERVIEW OF SURFACE MINING

Stated in the simplest terms, surface mining consists of removing the topsoil, rock, and other strata called overburden that lie above mineral or fuel deposits to recover them.

When compared to underground methods, surface mining offers several advantages: it (1) allows recovery of deposits which cannot be deep-mined; (2) it usually results in a more complete recovery of the deposit; and (3) generally, lower cost per unit of production.

The surface mining process generally consists of four phases: (1) exploration; (2) development; (3) production; and (4) reclamation.

The purpose of exploration or "prospec-ting" is to discover, delineate, and prove the ore body. Exploration techniques vary with the commodity and its geographic location. These include remote sensing or on-site mapping, core drilling to intersect deeper-lying ore bodies, or excavating shallow trenches or pits to expose the ore. For example, uranium exploration in the West combines aerial geo-physical mapping and core drilling.

During the development phase, detailed mining and reclamation plans are developed, access and haul roads are constructed, and support facilities and structures are built.

Production is a four-step process, including: (1) site preparation to remove vegetation and other obstructions, and to prepare sites for spoil or waste disposal; (2) blasting and removing overburden; (3) excavating and

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^{2/} Chief, Division of Planning and Environmental Coordination Colorado State Office Bureau of Land Management, Denver, Colo.; Landscape Architect, Tennessee Valley Authority, Division of Natural Resources Services, Norris, Tenn.; State Landscape Architect, Utah State Office, Bureau of Land Management, Salt Lake City, Utah.

loading ore; and (4) transporting the ore to a processing plant, storage area, or to market.

Reclamation involves restoring the land to productive use and controlling on-site and off-site impacts. Reclamation problems and techniques vary with the type of mineral, mining method, regional climatic differences, and regulations.

For example, regulations which resulted from enactment of the Surface Mining Control and Reclamation Act of 1977 require surface coal mines to be reclaimed back-to-approximate original contour. Successful reclamation depends in large part on accurate identification of the physical and chemical characteristics of the overburden and effective segregation of material which will support re-establishment of vegetation.

A variety of surface mining methods has been developed to handle effectively the diversity of geologic, topographic, and climatic conditions inherent in the location of various minerals. These include:

- (1) contour strip mining; (2) auger mining;
- (3) area strip mining; (4) open pit mining;
- (5) dredging; and (6) hydraulic mining.

(1) Contour strip mining is used in hilly or mountainous terrain where the mineral lies in beds or seams. The overburden is removed beginning where the mineral outcrops on the surface and proceeds into the mountain until the cost of removing the overburden exceeds the value of the deposit to be recovered. In the past, this unconsolidated material was cast down the outslope as spoil. Once exposed, the deposit is loosened and removed. This creates a bench on the mountainside with an associated highwall, sometimes exceeding 100 feet in height, which marks the lateral extent of overburden removal. This process is continued generally on contour around the mountainside. Coal in Appalachia and phosphate in the West are mined using this method.

(2) Auger mining is often performed in conjunction with contour strip mining. When the economics of mining stop the stripping, the operator sometimes chooses to extract more of the deposit by boring horizontally into the seam where it is exposed at the base of the highwall, like a carpenter bores a hole in wood. However, it is an extremely wasteful technique. For example, augering coal may recover only 40 per cent of the seam, leaving the remaining 60 per cent in a condition that makes it unrecoverable by existing mining techniques.

(3) Area strip mining is used in flat or rolling terrain where the deposits are extensive and lie relatively near the surface. A trench is made through the overburden, exposing the deposit which is then removed. As each succeeding parallel cut is made, the spoil is deposited in the previous cut. The final cut leaves an open trench and a highwall. Prior to reclamation, the area from the air appears to have been subjected to a giant plow with furrows reaching a depth of 100 feet or more. Eastern phosphate, western coal, and some clays and iron ore are mined using this method.

In recent years, a combination of area and contour strip mining methods called mountaintop removal has been employed to recover coal in southern Appalachia. This method is often used when the coal lies close to the ridge of the mountain, thus allowing economical removal of the overburden above the entire seam.

(4) Open pit mining, also called quarrying, is similar to area strip mining, but it is generally conducted in a localized area resulting in large vertical pits. Unlike area strip mining, the amount of overburden removed is proportionately small compared with the quantity of ore recovered. In many cases, large quantities of ore are obtained within a relatively small surface area because of the thickness of the deposits. In addition, open pit mines are generally in operation over much longer periods of time, often decades. Limestone, sandstone, marble, granite, sand and gravel, iron ore, copper, uranium, mica, sulfur, and some phosphate are mined using this method.

(5) Dredging is a water-oriented mining operation that uses a suction apparatus or various mechanical devices such as buckets, clamshells, and draglines mounted on floating barges to recover the deposits. Tailing piles left at mine sites resemble spoil piles created during area strip mining for coal. This technique is often used to mine gold and sand and gravel.

(6) In hydraulic mining, a powerful jet of water is used to erode a bank of earth or gravel which is either the overburden or contains the desired mineral. Ore-bearing material is fed into slurries or other concentrating devices where the desired product is separated from the tailings (waste). Although extensively used in the past to mine gold, it is a practice that has been virtually eliminated today.

To date, an estimated 6.5 million acres of land, approximately 10,000 square miles

or roughly the size of Maryland, have been disturbed in the United States by surface mining activities and associated access facilities. As of 1971, 90 per cent of this acreage was attributed to seven commodities: coal, sand and gravel, stone, copper, clay, phosphate, and iron ore. The current estimated rate of disturbance, which is 225,000 acres annually, will increase in future years.

Over 50 types of minerals and commodities are recovered by surface mining methods. Their nature, extent, and geographic distribution vary widely. For example, coal in different forms is found scattered throughout the eastern, midwestern and western portions of the United States in 34 states.

As our society becomes more complex in its industrial and technological development and needs increased energy sources and independence, the pressure to recover our natural resources will intensify. This inevitably means that surface mining will greatly increase, not decrease in significance in the coming decades. For example, coal strip mining in Appalachia, recently thought to be near an end, is only just beginning, considering development in mining technology and revived national coal production goals. The challenge is to increase production efficiently while maintaining or enhancing environmental and visual quality.

VISUAL IMPACT AND SURFACE MINING

The visual resource, like other earth resources, must be properly managed to maintain acceptable standards of quality. Whether existing quality is enhanced or degraded is a function of the nature and extent of change to the landscape. Surface mining extensively changes the landscape through removal and/or relocation of vegetation and large quantities of earth. Changes in the land's natural form, line, color, and texture that create contrast between the mine and its surroundings constitute the major visual impacts of surface mining.

Examples of these changes include:

(1) form - notches or sombreros; (2) line - haul roads; (3) color - bare soil against green vegetation; and (4) texture - excavated overburden.

Surface mining's visual impacts result from basic mining activities and other associated environmental impacts both on-site and off-site.

In the past, improper placement of overburden and topsoil, exposure of toxic materials, and inadequate drainage and revegetation have resulted in many environmental impacts, including landslides, erosion, stream siltation, and acid mine drainage.

In the exploration phase, visual impacts are generally slight, due to the limited disturbance caused by drilling, trench excavating, and access road development.

The visual impact of the mining process becomes more intense in the development and production phases due to the large amount of land disturbance.

Although one of the goals of reclamation is to reduce visual impacts, the visual contrast between reclaimed areas and surrounding undisturbed areas often remains for many years.

Changes over time in the mining process due to advances in technology (equipment) and mining methods, and the influence of regulatory laws and their enforcement have affected the nature, extent, and duration of associated surface mining visual impacts. Until the mid-1960's, surface mining was largely uncontrolled with little concern for the environment. Between the mid-1960's and the mid-1970's, surface mining states made enormous efforts to regulate mining and reclamation activities by law. These laws concentrated on reducing environmental impacts, which indirectly lessened the severity of visual impacts. The back to contour provisions of the Surface Mining Control and Reclamation Act of 1977 are the strongest attempt to date to control visual impacts of surface mining, although they apply only to coal.

VISUAL IMPACT MITIGATION

Sound planning and design techniques are essential to implement creative alternatives to meet mining objectives. These techniques must be viewed as principles or objectives and not rigid standards with limited flexibility. Two specific components are generally recognized. They are: (1) regional analysis, which establishes broad visual quality guidelines for implementation of basic land-use planning; and (2) site-specific analysis, which establishes specific visual resource objectives for the site, which may be as large as several thousand acres. Generally, the site-specific analysis of the four categories of stages of mining, as previously discussed, are evaluated, and design changes are proposed if required. Simulation and

computer-graphics are a key to complete understanding by all. Let's look at a case study for illustration.

Case Study 1

This case study involves a large limestone deposit in California. At the time of this proposal, there was no specific mining plan, but the proposal indicated these visual impacts were possibilities:

1. Large open-pit mine;
2. Slurry line to deep water port;
3. Power and telephone, water lines, material and housing center.

The visual analysis process included the following computer-generated overlays for analysis of impacts on the visual resource:

1. Seen areas from 36 observation points;
2. Seen area during exploration;
3. Slope map and aspect maps and vegetation;
4. Visual Resource Management class maps;
5. Overlay to indicate degree of visual absorption capability of proposed action.

With these base overlays, the agency now can evaluate a definite mining proposal, including supporting facilities. Quality standards to lessen the visual impacts now can be implemented by management. Specific design alternatives are now identified and implemented.

One federal agency utilizes a design process called a "visual contrast rating process" to insure that all design alternatives are carefully and analytically considered to meet the visual objectives for the site. It has been found to be a valuable tool for planning and design implementation for mining plans, etc. Examples of these various "nuts and bolts technology" are discussed in the subsection on Surface Mining and Reclamation.

SURFACE MINING CONTROL AND RECLAMATION ACT OF 1977

Public concern over the environmental, cultural, visual, and economic impacts of surface coal mining culminated with the enactment of the Surface Mining Control and Reclamation Act of 1977. In the law, Congress recognized that recovery of coal through surface mining methods must continue in order to meet future national energy needs, and they established standards to insure that it would be conducted in a sound manner.

In various sections, the Act requires consideration of the visual environment through explicit language and general legislative intent. In addition, environmental standards set by the law do much to alleviate the visual impacts associated with surface coal mining. Beyond these standards, the final regulations, which translated the law into detailed procedures for implementation, only minimally express visual criteria.

Visual considerations are included in the final regulations in two categories: (1) regulation of present mining practices; and (2) reclamation of previously disturbed mine lands.

Many people believe that in large part the back-to-contour reclamation provision for new mining was adopted in response to public concern for the visual impacts of surface coal mining. As such, additional visual criteria are not required in order to grant mining permits on private lands unless the land has been designated unsuitable for surface mining, nor will they be used to determine variances for post mining land uses. Each state has the discretion to include or omit visual criteria as part of the designation criteria within their Lands Unsuitable for Surface Mining Program (LUSM) and to determine reclamation priorities within their Abandoned Mine Land Reclamation Program (AMLR).

Visual criteria will be considered for permitting surface mining on federal lands and to determine priorities within the USDA Soil Conservation Service's Rural Abandoned Mine Program (RAMP). It's uncertain whether visual considerations will have a role in setting priorities for distribution of research funds.

SUMMARY

With the increasing knowledge acquired by study, practice, and experimentation, surface mining is being developed into an art and science which is increasingly attracting trained professionals of all disciplines. As a result, their impacts are being more effectively utilized in both private corporations and public policy. This trend will increase.

The individuals will have a significant role in the enactment and enforcement (monitoring) of existing and future surface mining laws and regulations. This will be especially true for local situations.

Interdisciplinary team involvement, representing the physical/natural, social/economic, and environmental design arts is the key to the full enactment of surface mining in this country.

Technology will allow the designer to show more clearly planning and design alternatives to all constituents through computer-graphic systems and simulation techniques.

New equipment advances and other technological advances will allow us to accomplish in the future what today we think is unattainable.

The key is a spirit, a belief, a commitment, that we must relate man to earth--for ourselves and for future generations. We have the creativity, the drive, and almost the technology. We need communications among all, and time to enact these beliefs.

The future role of visual resource management in the eyes of the public will significantly increase. This concept will be fostered by all, in recognition that professional planning and design for surface mining is essential for economic, social, and environmental survival and enhancement for the lands of our country.