THE LAND USE PLANNING PROCESS AS APPLIED TO A MOUNTAINTOP REMOVAL COAL MINE SITE IN EASTERN KY[1]

by

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Abstract -- Pro-active planning is a classic case of "form following function" as it encompasses the spectrum of land uses and land forms. The planning model being developed for mountaintop removal coal mining sites is designed to transform inaccessible, unusable, mined land into land suitable for industrial, residential, recreational and a multitude of other uses. The mine site in question is unique in that the land area is contiguous, it is owned fee-simple by one company, and all of the coal is removed. Unlike many surface mines, the site will never be remined. Thus any reclamation and subsequent development can be considered permanent. It is the intent of this project to provide a model for economic and social development through planned utilization of "developable" land resulting from mining and reclamation.

Introduction

Comprehensive land use planning, when approached from the physical resource perspective, typically responds to existing physiographic characteristics. Factors such as slope, aspect, soil, and vegetation influence many existing land use decisions and present conditions. However, in the case of mountaintop removal mining sites, all existing physiographic characteristics are obliterated, thus leaving the planner with no existing topographical factors on which to apply developmental considerations. Land forms and site conditions can be developed as a result of land use decisions made prior to the mining and reclamation process.

One concern is the "carrying capacity" of the possible land forms, including topped mountains and filled valleys. Developmental experiences on mined lands have led to the conclusion that "all made land consisting of valley fill in surface mine areas of the Southern Appalachians should be considered as potentially unstable ground, subject to subsidence, even where normal engineering precautions for good stabilization have been taken in the placement of the fill" (Krebs 1987).

Subsidence or creep and collapse settlements are current topics in geotechnical research. Creep settlement refers to the routine settlement of loose earth materials over time as the materials consolidate under forces imposed by their own weight. The rate of creep settlement varies directly with the fill depth, decreases exponentially with time, and varies greatly with the degree of compaction during placement. In contrast, collapse settlement, which is dependent upon water and expected in most fills over 20 feet, may be both substantial and rapid. This hydroconsolidation is accelerated as the water softens the point-to-point rock contacts (Krebs and Zipper 1989). Additionally, "angular distortion from vertical movement should be expected closer to the side than to the centerline" of valley fills (Krebs 1987). These shifts in the earth are often exacerbated by water percolation from leaky pipes or runoff from paved areas.

Additional physical concerns include problems associated and compounded by standard developments. They include sewage disposal, an adequate water supply, and access. However, planning and innovative techniques can contribute to a successful development. Constructed wetlands sewage systems (Goldstein 1989) have been effective as well as economical to build and maintain in rural settings. Similarly, a computer program, IWR-MAIN, a water use forecasting system (U.S. Army Corps of Engineers 1988), may be used to realistically assess the needs and estimate future water demand of an area. Community sectors are disaggregated into individual categories such as metered and sewered residences, commercial establishments, and three-digit SIC manufacturing categories. Using this tool, a planner can predict long-term impacts of water demand management or water conservation practices. Regional access has been greatly improved due to the efforts of the Appalachian Regional Commission.

However, to be successful, planning also needs to be approached from the sociocultural perspective. Historically, in eastern Kentucky, the local economy

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has been dependent upon fluctuations in the international energy markets; therefore, the coal industry has not generated the kind of income stability that would provide for public and individual investments in the future. Local politics, land ownership patterns, an inadequate tax base and until recently, poor access have limited public efforts to search for alternative economic development. When confronted with low and uncertain incomes, individuals and families have had little incentive or means to invest in their own futures through educational and other improvements. With all of these various needs and concerns identified, the integration of the issues will permit a planning model and suitable development to take place.

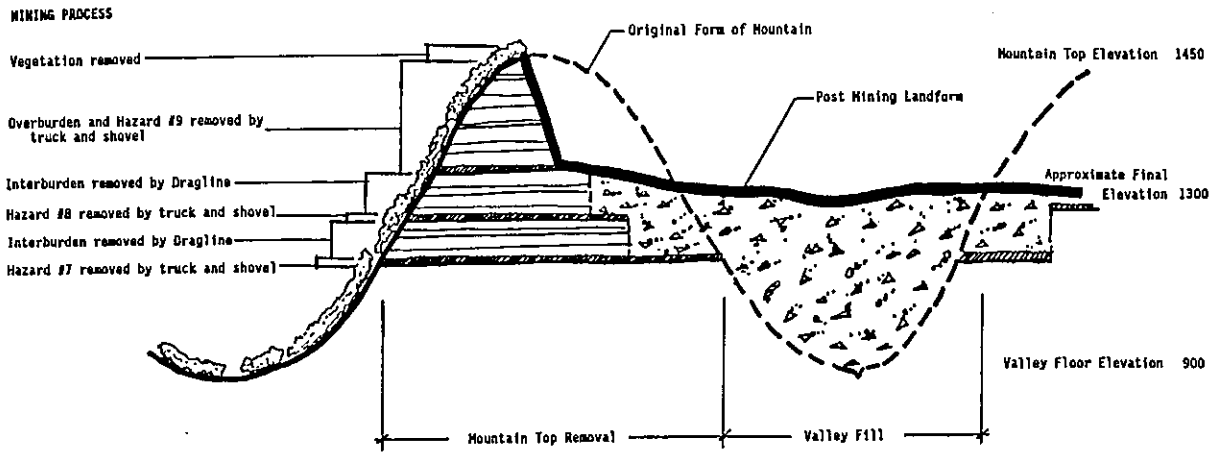
Site Description

The Cyprus Minerals Corporation is the sole owner of the mineral and surface rights of Star Fire, a 17,000 acre site in eastern Kentucky. In response to their concern for an ecologically sound post-mined land use, they have supported efforts to develop a comprehensive plan to demonstrate a commitment to stewardship of the land. The mountaintop removal/valley fill mining process (Figure 1) includes the excavation of the entire top of a coal-bearing mountain while the coal is removed seam by seam. At Star Fire all of the overburden above the Hazard #9 seam is removed by the standard truck and shovel technique, with the overburden being placed in an adjacent valley. After the 9th seam of coal is removed, the interburden between the Hazard #9 and #8 seams is "moved over" by "cast blasting" and a 65 yard capacity Marion drag line. Similarly, the interburden between the Hazard #8 and #7 seam is "moved over;" however, it remains on the mined out area of the mountain. The result is a newly created landscape devoid of vegetation. The mountain per se is dramatically changed, all of the coal has been removed, and the site will never be remined. What were once valleys may now be the highest areas of the site.

At the present rate of mining, approximately 4 million tons per year, by the year 2010 over 5000 acres of reformed "land" will have been created. Currently the mining process and the reclamation program at Star Fire is focused on the creation of flat land that meets the reclamation standards. A Canada goose lake and wildlife refuge, which was a short-term goal, has been realized. While the normal reclamation process with regard to grading side slopes, smoothing out spoil cones and hydroseeding the area was taking place, a 35 acre lake was created in 1988 and 1989 on 250 feet of unconsolidated spoil. This newly created ecological niche on a "mountain-topped" site is being monitored to aid in the understanding of the dynamics and problems associated with building on massive fill areas.

Methods

While short-term goals such as the Canada goose lake are being achieved, a planning process is evolving that will define long-term objectives and establish the models needed to accomplish these objectives. Investigation is centering on the intersection of the realm of the mining process and the resulting potential land forms, the economic feasibility of future development including the criteria critical for land uses, and the social acceptability of future plans (Figure 2). The model and the intersection of the elements will continue to change as more information is integrated into the system. The process is dynamic, and since there is little historical reference to use as a basis, much of the investigation evolves around the dynamics of the process rather than pre-established planning and development criteria.



MOUNTAIN TOP REMOVAL / VALLEY FILL MINING PROCESS

Figure 1

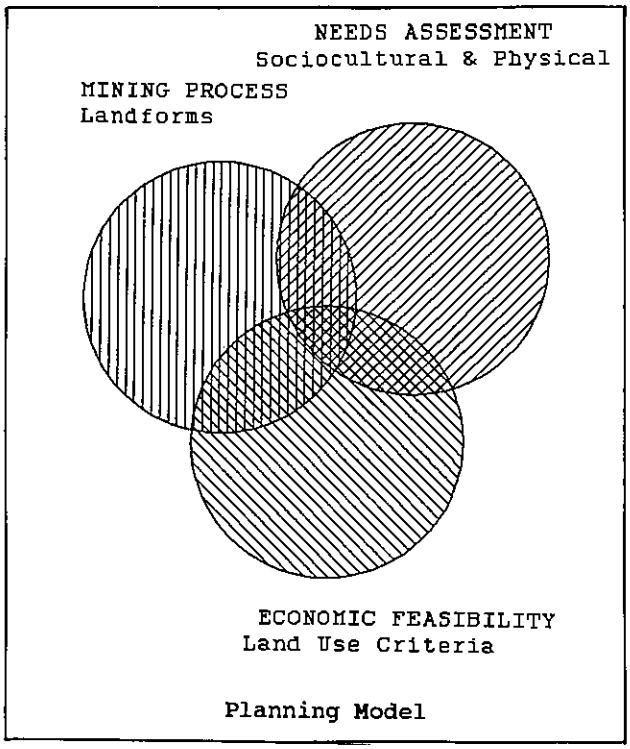


Figure 2

Land Forms

Three proposed land forms and their relationship to the original land form are illustrated (Figure 3). In each sketch, the fill on the original mountain is very gently rolling or flat; however, in (A) the fill on the valley is at an elevation that is less than the elevation of the fill on the mountain and it can be shaped to capture maximum solar radiation (Olgyay 1973); in (B) the fill is gently rolling at the same elevation as the fill on the mountain; and in (C) the fill is significantly higher than the fill on the mountain, which again can be shaped to capture and maximize solar radiation. The ridge lines should be parallel to the original valley; however, they can be moved to create long gentle slopes with the desired orientation. Land forms as well as vegetation can be used to channel the strong north west winter winds and buffer pedestrian activities. These hypothetical land forms are presented to emphasize the choices that are available when making final land form determinations.

Sociocultural

The existing social factors of the region, such as eastern Kentucky's historical dependence on the coal industry for the majority of its income, its land ownership patterns, and its low educational attainments and high unemployment levels, comprise a third area of this study. The scarcity of developable land in eastern Kentucky is related as much to these sociocultural factors as it is to the physiographic conditions of the region.

Existing law (federal - Public Law 95-87 1977 and state - 405 KAR 1978) and regional land use plans (KRADD 1978) were reviewed to ascertain which reclamation efforts would be consistent with established social perceptions. In addition, existing land forms and land use patterns were analyzed in order to understand their cultural implications for future development. The intent of a new comprehensive master plan is to satisfy the long term goals, to enhance what already exists and to integrate new ideas.

Economic Feasibility

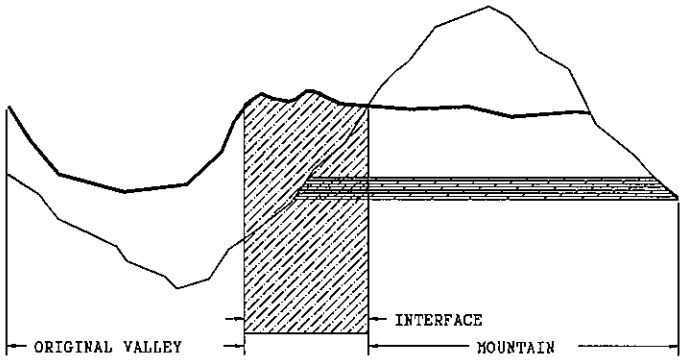
Heavy industry, light industry, public services, residential, agriculture, impoundments of water and wildlife, alone or in combination, are the land uses categorized by 405 KAR. Their potential for development on Star Fire is the second realm examined from the perspective of use intensity and carrying capacity in order to establish influencing criteria (Nieman et al. 1989). These criteria will then be used to develop scenarios depicting the range of each land use intensity and to serve as an aid to communicate potential design concepts and various alternatives. The number of physical site related factors which appear to be influencing development decisions are surprisingly few but very complex. They include macroclimate (wind, solar orientation and rainfall), drainage, soils, slope, and infrastructure such as access and utilities. Once influencing physical factors are established, acceptable parameters can be proposed that will determine which criteria can be satisfied within the realm of economic feasibility.

Results and Discussion

Using the integration of the mining process, the economic feasibility and the sociocultural studies, it was decided to examine the original topography of the Star Fire site: the 1200 foot contour was traced, since this is the approximate elevation of the seventh seam (where it exists) (Figure 4). The line delineating the opaque (original mountain) and the light (valley fill) areas is the interface zone. This is the area in which there is the greatest likelihood for maximum differential movement and maximum angular distortion. For this reason, the area along the interface is not an optimum building site and should be left as a buffer between land forms and/or land uses. It could be a transition zone accommodating recreational land uses, such as golf courses or wildlife refuges. These areas or "cone zones" would require minimal grading efforts and would act as a delineator of land forms in the landscape.

Each of the three areas of the model is being investigated independently. The results are being integrated, and potential scenarios are being developed and illustrated. The first scenario is a residential neighborhood conjoined with industry (Figure 5). The residences are situated on a slope which has a southeast orientation and is supported by all valley fill. The industry is sited on the spoils overlaid on the original mountain, with the interface zone left as a buffer. This buffer could be planted for aesthetics and as a wind break for

A.



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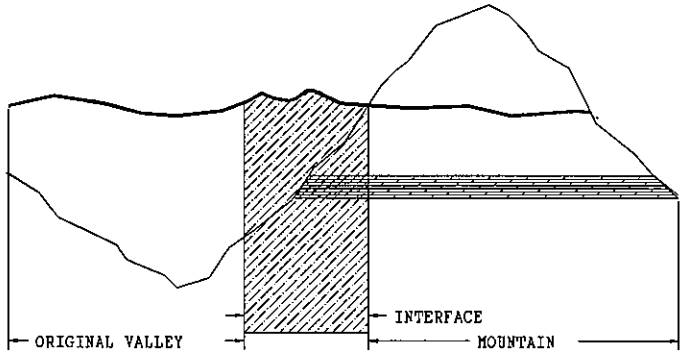

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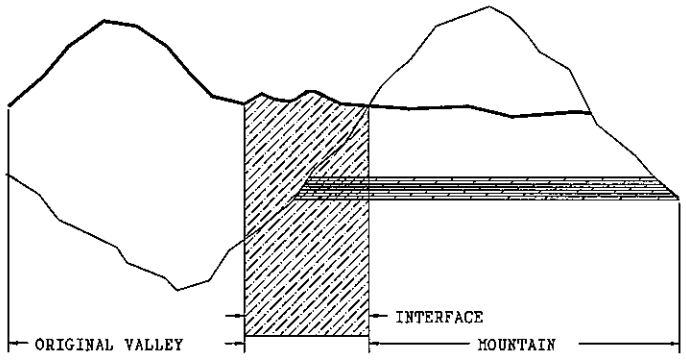

HAZARD #7 -- 1200 FT

PROPOSED FINAL GRADE -- 1300 FT

ORIGINAL CONTOUR -- 900 TO 1400 FT

Figure 3

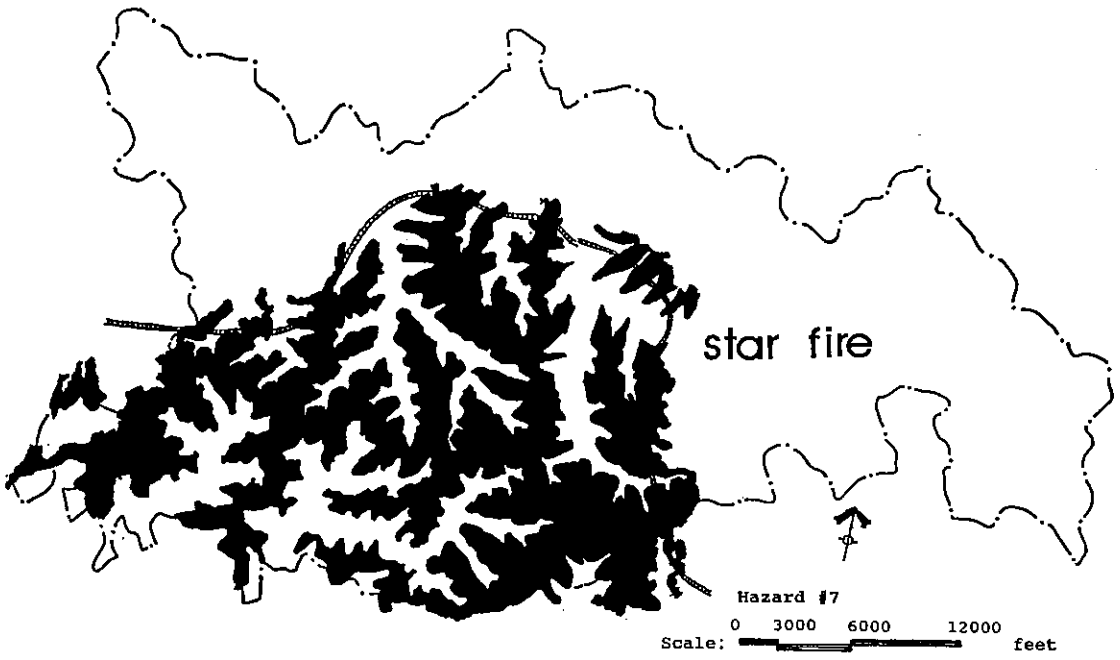

Figure 4

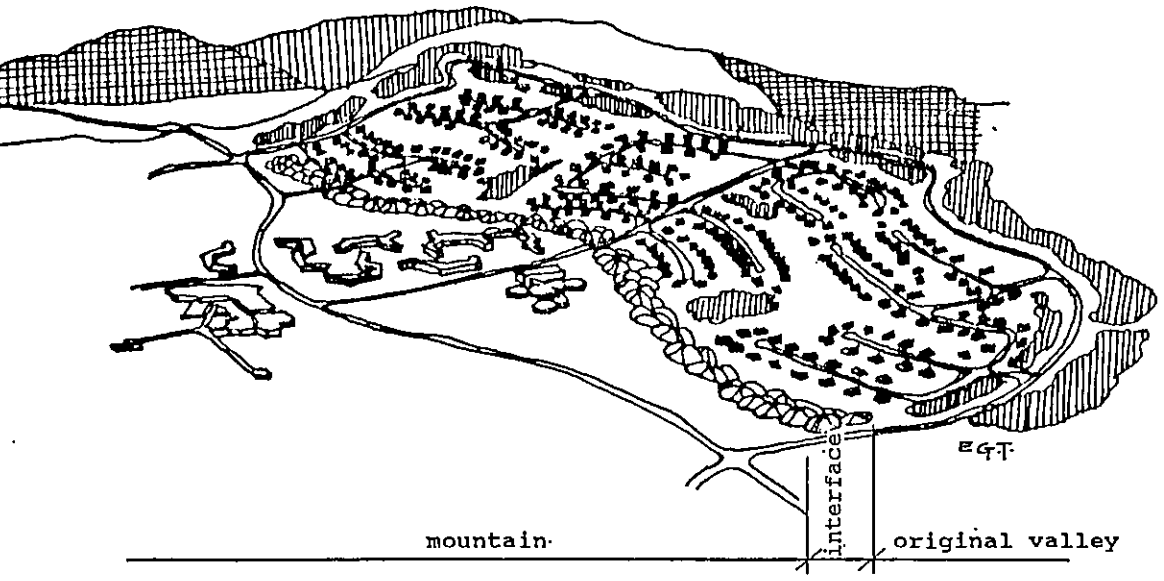

Figure 5: Industry conjoined with residential landuse. The industry is sited on the original mountain and the residences on valley fill. Each benefits from the use of the interface zone as a buffer.

industry. In this scenario the valley has been filled to an elevation higher than the fill on the original mountain in order to capitalize on the macroclimate. In addition, the residences are also oriented parallel to the valley centerline, which should minimize foundation adjustments. Both the solar orientation of the structures and the buffered northwest winter wind will provide efficient and comfortable dwellings and employment sites. Other scenarios including agriculture, public services, recreation, and wildlife development are being investigated and considered in various combinations and intensities.

Conclusion

Star Fire has proven to be a very large, dynamic, and challenging laboratory that integrates the broad realm of physical, social, and economic decision making. Its uniqueness relative to location, process and support establishes Star Fire as a potential demonstrative model that can impact the changing pattern of development in eastern Kentucky far into the future. This is a unique situation, where past planning experience provides little help in making land form determinations or development decisions. All of the existing physiographic characteristics have been altered as a result of the mining process. Thus physiographic elements are being newly created rather than acting as influencing determinants. The culture of the region, which traditionally has been an enigma, may become the most critical aspect of the planning process. The land form that is being constructed is deceiving -- it neither reflects the cultural character of the area nor does it reveal the underlying substructure of the previous mountain/valley configurations. The plains evoke a false sense of stability, which conveys a mixed message. To an observer who is familiar with the shortage of developable land in the area, Star Fire must look like a gold mine. To a professional who is familiar with the previous land configuration it presents a challenge. If people truly prefer to live in an environment that is similar to the one in which they were reared, it is incumbent upon the planning process to sift out and provide the physical elements that are determined to be salient in providing an environment that will be acceptable to the people in question. Time and commitment on the part of the coal company, the various levels of government, and those involved in the planning process will make the difference.

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