

**MOUNTAIN TOP REMOVAL MINING: AN ENVIRONMENTAL IMPACT  
ASSESSMENT (EIA) SCOPING EXERCISE AND IMPACT ASSESSMENT OF  
MINING ACTIVITIES ON AQUATIC RESOURCES**

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## **ABSTRACT**

### **MOUNTAINTOP REMOVAL MINING: AN ENVIRONMENTAL IMPACT ASSESSMENT (EIA) SCOPING EXERCISE AND ASSESSMENT OF MINING ACTIVITIES ON AQUATIC RESOURCES**

**By Jeff Lee Hansbarger**

Mountaintop Removal Mining (MTR) is a controversial topic in West Virginia. This controversy includes the people of the areas mined, local politicians, and many aspects of the mining itself. This thesis included two main objectives. The first objective was to analyze MTR, Environmental Impact Assessment (EIA), and the specific impacts arising from MTR. The second objective was to develop impact matrices using information from the first objective. Included within the analysis is a critical investigation of past EIAs used to assess mining activities. Special attention has been directed towards aquatic resource impacts and their documentation and validity. Methods included a literature review of technical reports, newspaper articles, books, and current journal articles, as well as the creation of impact matrices. Findings drawn from the project include a lack of adequate assessment and monitoring of MTR in West Virginia using current federal EIA techniques. Aquatic impacts are extremely lacking in representation and validity in current EIAs. The constructed matrices offer a novel approach for a scoping step in a formal EIA on MTR, as well as demonstrating the usefulness of this technique for EIA in general.

Keywords: Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS), Mountaintop Removal Mining (MTR), scoping, aquatic resource.

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## INTRODUCTION

Mountaintop removal mining (MTR) has become a major controversial topic in West Virginia, and indeed elsewhere in the nation. Supporters cite jobs and economic benefit to the state; others view it as a horrible environmental practice that should be stopped. MTR is a type of surface mining activity in which large amounts of soil and rock are removed from mountaintops in order to obtain underlying coal seams, once deemed too deep and costly for removal (Ripley, et. al., 1996). Once the coal is removed from an MTR site, the previous mountains are left flattened, and the surrounding valleys are filled with the spoil from the mining activity. Due to this type of spoil disposal method, this mining practice has also been termed 'Valley Fill Mining' (EPA Report, 1979).

The amount of material removed from the mines, along with the methods used, present new problems and impacts on the environment due to the large scale of operation. This impact is profound on aquatic resources located within the watersheds of MTR areas (Starnes, et. al., 1995). The primary problem results from the physical alteration of the aquatic resource, or even its complete removal. Removal consists of total upper valley fill, with replacement being in the form of a culvert or series of culverts. These culverts then drain into what was the stream channel farther down the valley.

The amount of land covered by the spoil material is dependent upon the size of the mine and its operational longevity. To date, an estimated 470 miles of headwater streams of an estimated 32,000 total miles of stream have already been lost in southern West Virginia alone due to this practice (Governor's Task Force Report, 1998). The quality of water draining from these areas during and after alteration creates another

potential problem for aquatic resources (Starnes, et. al, 1995). Many argue the creation of jobs and some economic growth is not commensurable, in comparison to the loss of headwater streams forever.

## II. Research Tasks and Research Design

**Research Task One** is to undertake a literature review on MTR processes and related environmental consequences. This is based on previous studies including the Governor's Task force Report on MTR in W.Va., a literature review of professional journals, newspapers, professional reports, and previous EIA studies. Environmental Impact Assessment (EIA) is also reviewed. EIA by definition is a systematic process that examines the environmental consequences of development actions, in advance of the development occurring (Glasson, et. al., 1994; EPA Interagency Report 1979; 1981; 1984). The goals of EIA, its techniques, methods, and socio-political setting concerning MTR in W.Va. is covered. EIA was chosen for the focus of this project for a number of reasons. First, it is an accepted federal, state, and private sector process. Because of its use in many MTR cases, it is at the center of the MTR debate. The effectiveness and validity of current EIA techniques used to assess current MTR practices has also become a major issue (Ward, 1999).

The final topic to be reviewed under **research task one** is to investigate the general impacts of MTR, with an emphasis on aquatic resource impacts in West Virginia. A resource, is wealth, an asset, or something that lies ready for use or can be drawn upon for aid (Webster, 1994). Aquatic ecosystems are ecosystems associated with water, or aquatic environments, and include all organisms, plants, and energy transfer within a given aquatic environment. Freshwater aquatic ecosystems affected by mountaintop

removal include lakes, streams, and other aquatic environments, such as bogs, swamps, and springs. Aquatic resource therefore is a term used to describe an aquatic ecosystem by professional biologists, etc. that implies its general wealth to the public or particular parties interested. The value of an 'aquatic resource' should be its level of functionality and historic preservation. Within the debate of MTR there is very little understanding and agreement between the different parties involved over the impacts of MTR to aquatic resources, and to what level or magnitude they are effected (Ward, 1999). This project seeks to identify these gray areas, and to serve as a guide for future research that could improve our knowledge in dealing with MTR.

**Research Task Two** is to undertake a limited scoping exercise as a prelude to an EIA. This will be accomplished by undertaking:

- 1.) A scoping exercise on possible general impacts of MTR in West Virginia.
- 2.) A scoping exercise on aquatic resources in particular.

This task will follow the guidelines for EIA, as stipulated by Glasson, et. al., (1994), Rau, et. al., (1980), Roberts, et. al., (1984), and Shopley, et. al., (1984). The scoping exercise will involve the creation of matrices which list activities and impacts associated with valley fill mining, and generate a checklist of resources or entities that are impacted (Rau, et. al., 1980; and Roberts, et. al., 1984). Scoping by definition, is an introductory or beginning step in a formal EIA. It is used to organize all key impacts, issues, and alternatives to be considered before the actual development take place (Morris, et. al., 1995). This step gives direction to a formal EIA. The creation of a series of matrices in an actual EIA is a prelude to greater in-depth scientific analysis. This project/thesis will stop short of this step due to the required length, and nature of the project option.

Other matrices are constructed to investigate impacts on aquatic resources. This focus was chosen to illustrate the generation of specific scoping matrices derived from the general impact matrix. It also draws upon my own specialty and demonstrates how specialists can be brought into an EIA to bring their expertise to bear on a specific impact area. The scoping exercise is expanded to incorporate more detailed information on the effect of valley fill mining in West Virginia, such as higher order effects (e.g. 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> order effects). Specific types of matrices used will be determined upon further investigation of the literature.

The first goal is linked in many ways to the second goal. An understanding of the EIA process and MTR is needed before a scoping exercise can be undertaken correctly. This ensures an accurate and relevant piece of work that will draw on past, present, and ongoing research on this topic. In addition, information populating the matrices must stand up to scrutiny and peer review. To accomplish this goal, a literature review, documentation, and an understanding of all relevant information is a must.

## CHAPTER ONE

### MOUNTAINTOP REMOVAL MINING (MTR)

#### I. Definition

There are a variety of mining practices used in the world today depending on whether the mine is located underground, or on the surface (Chadwick, et. al., 1987). Historically, the mining type and practice has largely been dependent on the location of the coal seam or seams, and how best to extract the coal in the cheapest way possible. Underground mining can be further broken down into two categories, (1) long wall mining, and (2) room and pillar mining. Room and pillar mining is the most prevalent type of underground mining in the United States. Long wall mining is the prominent type in Europe and in the countries formerly comprising the USSR (Chadwick, et. al., 1987). Surface mining methods comprise open pit (quarry, open cast), surface (area, contour, mountaintop removal), auger, dredging, or hydraulic (Johnson, et. al., 1996).

Surface mining, is practiced to extract a large, relatively flat seam or seams of coal located at or near the surface. Spoil material is removed or ‘shaved’ back from the earth to extract the underlying coal seams (Chadwick, et. al., 1987). Large earth moving equipment and massive amounts of high explosive are used to remove overburden and gain access to the coal. Dump trucks, endloaders, and bulldozers are the most prominent types of equipment found on strip mine jobs today. MTR is surface mining on a grand scale (Starnes, et. al., 1995; Charleston Gazette, 1998, 1999). Coal extracted from surface mines is generally higher in value and energy content (Pack, pers. comm.; Governor’s Task Force Report, 1998).

The southern part of West Virginia where most MTR sites are located, has high relief, and occur in very steep, and mountainous country with deep valleys, and gorges (Figure 1). They are also very remote in terms of location from population centers and or major highways. (Charleston Gazette, 1998). These conditions associated with MTR sites have enabled coal companies to dispose of the spoil material from mines in the valleys and hollows adjacent to the mine sites, thereby keeping costs low (Charleston Gazette, 1996). Due to this, MTR is sometimes referred to as ‘valley fill mining’, or head of hollow mining’ (EPA Report, 1974; 1979; 1981; Charleston Gazette, 1998). As cited from the Governor’s Task Force Report on MTR in W.Va. (1998), “MTR involves the removal of a mountain, ridge, or hill, with overburden removal following the coal seam elevation from one outcrop to another”.

The operation of MTR can be broken down into (but not limited to) three stages; exploration, extraction, and reclamation (Starnes, et. al., 1995). Physical exploration techniques generally consist of drilling boreholes, excavating shallow trenches or pits, sinking shafts or adits, or a combination of the three techniques (Starnes, et. al., 1995). Exploration activities vary in size and impact on surrounding areas, with the construction of support roads and camps constituting the major surface disturbances for surface mining. The exploration phase affects far more terrain than other phases, but for a shorter time period and with less severity. The primary goal in this phase is to minimize the area that will be cleared or stripped, to minimize the disturbance to native vegetation and soils when disturbance cannot be avoided, and to reduce or prevent erosion by means of physical manipulation of the soil and or the seeding of adapted plants (Chadwick, et. al., 1996).

Many factors influence the exploration and mining phase of an MTR project (Starnes, et. al., 1995). Topography of the site surface; depth of the coal seam; size of the deposit; grade of the site; geological and hydrological characteristics of the site; shape and slope of the coal (or ore); presence, nature, and the location of acid potent materials all play a part in the planning phase of a MTR site. Therefore, special and unique impacts are often associated with each type of mineral recovery technique and reclamation process. An example of unique MTR impact would be the filling in of streams in the spoil removal phase as mentioned earlier. Before proceeding, this unique characteristic warrants further explanation.

Recently in a court ruling on MTR, Federal Judge Hayden in Charleston West Virginia ruled in favor of halting MTR (Charleston Gazette, 1999). The main deciding point Hayden cited in the case was that under present federal law, perennial, and intermittent streams may not be filled in with spoil material (Charleston Gazette, 1999). Perennial streams flow all year, with intermittent streams being defined as streams flowing 80% of the year (Class Notes, WMAN 245; Charleston Gazette, 1999). Ephemeral streams which flow only during storm events may be filled under federal law, and are routinely filled as a result of activities such as highway construction (Charleston Gazette, 1999).

What makes MTR unique is that federal law has been allowed to be broken for so long due to the way the permitting has been allowed to be carried out by the West Virginia Department of Environmental Protection (WVDEP), and ultimately by the Federal Environmental Protection Agency, or EPA. Presently, this case is still pending due to an injunction granted by Judge Hayden after Governor Underwood, the United

Mine Workers Union, and The Rail Union filed with a higher court in Richmond Virginia. As a result of this appeal, mining will presently go on until the higher court rules in the decision. In addition, Senator Byrd (D-West Virginia) is trying to get a bill passed allowing continued MTR, which he is trying to tack onto other pieces of legislature. It was extracted once already to allow for further discussion (Charleston Gazette, 1999). The continued filling of perennial and intermittent streams is in fact a defining illegal feature of MTR. No mining activities are to take place within a 100-meter buffer of all perennial and intermittent streams by law. One of the outcomes from this cornerstone debate might be a change in the laws to actually allow this activity to occur.

Most MTR operations in W.Va. are privately operated on owned, or leased property (Starnes, et. al., 1995; Charleston Gazette, 1998). At the center of the extraction process is a modern piece of machinery called a dragline. This is a huge piece of equipment over 20 stories tall, weighing up to 4000 tons, which can remove 75 cubic feet or more of earth in one load. The cost of one dragline can be upwards of \$25 million, and they are very expensive to operate (Charleston Gazette, 1999). Coal companies usually run draglines day and night, and all week on a job until the coal seams are exhausted due to the great costs associated with the entire operation (Charleston Gazette, 1998).

A large area of land is thus needed as well to operate the dragline and its accompanying fleet of trucks and other equipment. In 1980, 85 ton capacity dump trucks were used for the removal and transportation of materials associated with MTR. Currently, trucks with 240 ton capacity have replaced the older 85 ton trucks. As a result,

mines in the 1980s created valley fills usually no larger than 250,000 cubic yards of rock and spoil material. Today using 240 ton dump trucks and modern draglines, some valley fills have exceeded 100,000,000 cubic yards of spoil material (Charleston Gazette, 1998). Larger equipment demands larger operating areas, and to be economically feasible, permits are constantly sought for larger scale mining operations. This explains the increasing size of MTR sites (Charleston Daily Mail, 1999).

Associated with this practice are a number of potential environmental impacts. Areas must be first leveled to allow a dragline to be constructed on site. A process known as pre-stripping is carried out to provide a flat area from which to begin operation (Charleston Gazette, 1998). Subsequently the dragline, and explosives are used to level the surrounding terrain, while a fleet of trucks follow the dragline operation. As coal is exposed, it is hauled by dump trucks to a coal processing plant. The spoil material (rocks and dirt) is trucked away, usually to the edge of the newly created flat area, where it is then dumped into the valley, or 'hollow'.

One of the biggest environmental concerns actually arises from the pre-stripping phase, because the dragline operates on a lag-phase behind the stripping machinery, and must have a flat area to operate. Thus there are times when large expanses of land are left bare or exposed and this can facilitate erosion, dust, and other impacts. It has been recommended by agencies such as the EPA, that impacts should be minimized by reducing the lag phase upon which the dragline operates behind the pre-stripping equipment (Charleston Gazette, 1997). This could potentially minimize disturbances during this phase of operation, and has been termed 'contemporaneous reclamation'

(Charleston Gazette, 1998). This reclamation technique would also limit costs incurred by federal and state agencies if a mining operation were to potentially go bankrupt.

Preferred reclamation practices vary for each type of mine. For example 'fish and wildlife use' has been the preferred use of post-mined land created by MTR (Charleston Gazette, 1993; Samuel et. al., 1976; Gregg, 1997; Pack, pers. comm., 1999). In the past coal companies have sometimes escaped reclamation costs by claiming fish and game use as their post mine land reclamation, which in many cases means not doing too much to the land other than letting nature take its course. Literature suggests this is not an acceptable practice due to the sheer magnitude of the disturbances derived from MTR that requires proactive remediation (Starnes, et. al., 1995; Governor's Task Force Report, 1998; EPA Region 3 Website, 1999). It is suggested that commercial forestry should be the preferred post land use at MTR sites, as opposed to fish and game use or enhancement (Governor's Task Force Report, 1998).

Reclamation is the last step in the process, but one that could potentially extend over long period of time. Reclamation on MTR sites is now a rule, and encompasses long term monitoring and environmental assessment (Skully and Low, 1984; EPA Region 3 Website, 1999). This is due to long term impacts and higher order impacts associated with MTR that require prolonged attention (Chadwick, et. al., 1987). An example would be checking water quality or slope stability over time. Impacts due to MTR will be discussed further in Chapter 4.

By law, during the reclamation phase of strip mining, coal companies are required to construct 'an original contour' of the mine site (Governor's Task Force Report, 1998). This is not an exact art, and usually leaves a terrace-like effect on sloped areas (EPA

Region 3 Website, 1999). Recently, coal companies involved in MTR in W.Va. have offered a different solution. They have begun to claim that post mine sites in some areas should be left flat for the purpose of future economic development. This proposal has helped coal companies strengthen their argument for continued MTR in W.Va. by identifying economic development as one of the beneficial options arising from the operation (Charleston Gazette, 1999). This idea has been highly disputed due to the inadequate roads and infrastructure found on the mine sites for development, their inaccessibility, and potentially negative environmental legacy (Charleston Gazette, 1999).

## II. History

The first surface mine in the United States was located in Danville, Illinois, and began operation in 1866 (Starnes, et. al., 1995). Large-scale surface mining did not become commonplace until after W.W. II. Industrial development following World War II spurred other industrial ventures such as mining. Market demand, new technology and machinery, and a more complete understanding of the science of mining were all responsible for the growth of mining in the United States, and in particularly coal rich areas in the Appalachian mountains such as West Virginia, Kentucky and Virginia. These are now the states mainly impacted by MTR. For the purpose of this study I will concentrate on the growth of MTR in West Virginia, but it is appropriate to understand that MTR is an issue on a national, if not international scale as well (Chadwick, et. al., 1987).

Strip mining began in West Virginia during the early 1950s. (Pack, pers. comm.). The first documented case of MTR in West Virginia can be traced to Montgomery, West

Virginia in 1967. Cannelton Coal, working with an independent contractor, removed coal seams from a series of outcroppings creating a plateau in the final step of operation (Governor's Task Force Report, 1998). The area was known as Bullpush Ridge, and was later reclaimed as grazing land for cattle (Pack, pers. comm.). From the time of the first strip mine operation in West Virginia during the 1950s, the equipment and set up has remained the same but has grown in scale and magnitude of operation, and materials removed and disturbed.

Along with the development of MTR, and its associated practices, there has been an evolution of legislative issues, laws, and acts. At the time of the first strip mining in West Virginia, there was no legislation requiring permitting or reclamation. The first law in the United States requiring reclamation of land surface-mined for coal was actually enacted in West Virginia in 1939 (Starnes, et. al., 1995). As society changed its concept as to what constitutes an acceptable level of impact and increased its awareness of the potential effects of mining, laws regulating surface mining have become more stringent. In 1977, the U.S. Congress passed the Surface Mining Control and Reclamation Act (SMCRA), Public Law 95-87, which imposed national standards regulating coal mining and exploration activities. Their jurisdiction, in addition to surface mining, also covers regulating surface impacts arising from underground mining as well as the enforce land reclamation, and water quality standards on water draining from mine sites (Starnes, et. al., 1995; Johnson et. al., 1996).

The SCMRA sought to ensure prompt and adequate reclamation of coal mined lands and to provide a means of prohibiting surface mining where it would, "in the opinion of experts", cause irreparable damage to the environment. This point has become

a source of scrutiny and debate for both sides of the mining debate. The definition of 'expert' has been highly argued, and each side to the debate often has their own 'expert'. SCMRA also instituted the Office of Surface Mining (OSM) to administer and enforce provisions of the act; however, OSM, contrary to the law, continued to allow mining in areas where irreparable damage would occur from mining practices. An example would be environmental problems arising from ore mining in the western United States. Long-term environmental problems of tailing ponds and hydrological impacts are incurred during mineral extraction (Starnes, et. al., 1995; Ripley, et. al., 1996). Mining is allowed in these situations if the companies agree to treat stream and rivers effected by mining operations. This has resulted in a growing liability, with large river systems now depending on "uninterrupted perpetual treatment (Starnes, et. al., 1995).

Due to topographical, climatic and other regional differences among major coal deposits, each state may acquire primacy and administer its own program, which must be no less stringent in environmental protection than the federal program. This is a path taken by West Virginia and takes some of the regulatory burden off the federal EPA and allows states to treat the cases in a more site specific manner (Charleston Gazette, 1998). All mining in the eastern United States is regulated by state and federal laws. In the western half of the U.S, most regulation is administered through federal agencies, due to the large amount of federal land involved (Chadwick, et. al., 1987). Federal, state, and sometimes local regulations are imposed on surface mining companies, and the level of stringency varies with location, mineral type, historical perspective, and controversy generated by proposed or existing projects. MTR in West Virginia obviously has generated its own controversy, with parties playing economic development against

potential long-term environmental damage. Within this is also a debate over the validity and accuracy of scientific studies on MTR.

The West Virginia Department of Environmental Protection Agency (WVDEP), the National Environmental Protection Agency (NEPA), U.S. Fish and Wildlife Service (USFW), the Army Corps of Engineers (COE), and the OSM all have overlapping interests in the debate of MTR as stated in the permitting process. Legally, the WVDEP issues permits to the mine applicants while upholding federal EPA guidelines. Agencies included in the permitting process include but are not limited to the USFWS, COE, and the WVDEP and EPA. The COE for instance is concerned with waterway issues, and navigable waterways. The USFWS is concerned with any degradation to natural resources, particularly fish and wildlife resources. Together they review permits and recommend permits or not based on their expertise, and overlapping interests.

On paper, federal law is very blunt concerning what is an accepted practice and what is not, in surface mining. Each agency has their own agenda and guidelines for MTR in addition to a comprehensive plan including all regulating agencies. The plan or action taken to issue permits has been criticized as well for not being sufficiently current for the scale of mining occurring today. One of the main goals regardless of the outcome of the legal battles over MTR, is a more thorough and current permitting process (Governor's Task Force Report, 1998).

In the case of West Virginia, the level of stringency has varied in terms of expectations from the legislation, and what actually occurs. An excellent example of this is the contradictory effects of MTR and OSM's mission statement concerning 'no irreparable damage' as determined by experts. Losing headwater streams forever due to

MTR practices falls under the category of ‘irreparable damage’, as determined by many experts today (Charleston Gazette, 1998, 99; EPA Region 3 Website, 1999; Sierra Club, 1999; WVDNR Interagency letter, 1999; Highlands Conservancy, 1998). But, due to the socio-political setting in West Virginia, it has been an accepted loss associated with living in these areas.

### III. Socio-Political Setting of MTR in West Virginia

MTR in W.Va. is based mainly in the southern coalfields (Figure 1). Historically, and indeed today, these areas have been and are sustained economically by natural resource extraction, comprising either timbering or coal mining. At the root of the controversy over MTR is the previously stated conflict between economic benefits, and irreparable environmental damage (Governor’s Task Force Report, 1998). The land in southern W.Va. is steep and difficult to traverse, and is still heavily forested. Little economic development otherwise has taken place in most of these areas. Environmental concerns over MTR have invariably come up against one of the most emotional and driven opposition groups – the well being of society and the way people choose to make a living and support their families. Employment, or rather unemployment, is a major problem for many southern West Virginia communities.

In addition, legislation at the state level has demonstrated the West Virginia state government’s acceptance of MTR as a ‘necessary evil’ for the state’s welfare. A bill introduced in the state senate four years ago titled No. 145 increased the acreage of mining operations requiring reclamation by law from 250 acres to 480 acres (Charleston Gazette, 1995). This bill can be interpreted in many ways, depending on what side of the debate one is on. One interpretation is that it relaxes reclamation standards imposed upon

coal companies, which could in the long run make MTR more profitable for coal companies. Companies often operate a number of smaller mines and circumvent the bill by slightly downsizing current operations, and sidestep the reclamation process, which increases costs to their operations. This highly controversial bill encompasses much of the debate over economic needs, and environmental harmful impacts.

An example of MTR and its related issues and conflicts is in the case of a mine owned by Arch Coal, called the Spruce Mine No. 1, in Logan County, W.Va. In July of 1997, Arch Mineral Company acquired Ashland Coal Company, creating the largest coal producer in W.Va (Charleston Gazette, 1998). The company is based in St. Louis Missouri, and also includes Hobet Mining Company as a subsidiary. If opened, Spruce No. 1 will be the largest MTR site in history at 3,100 acres in size. Its opening has been blocked by law makers and opposed by many opposition groups for a number of reasons. The people in the area of the mine want the mine very badly for jobs, and economic support. In return for a permit to mine the land, Arch Coal claims it will create sites for further economic development during the reclamation process. According to Arch Coal representatives, all that is needed is an extended road off State Route 119 running from Madison W.Va., to Logan (Pack, pers. comm.). This stance has been challenged by opposition groups that cite lack of access to these reclaimed areas, and lack of actual need for a 'flattened area' for economic development (Charleston Gazette, 1998). Examples of beneficial MTR post-mine site development include the Welch Consolidated High School recently built on land donated to the state by Cannelton Coal (Pack, pers. comm.). Another example is the regional jail in Montgomery that was built on land donated again by Cannelton Coal after MTR operations ceased (Pack, pers. comm.).

Arch Coal Company is based in St. Louis, and many opposed to MTR feel that this is a repetitive cycle of degradation thrust upon the state by 'outsiders'. Other than pay given directly to the workers of the mines, many MTR opposition groups feel that the companies move in with little regard to anything other than their own profits and well being. In the middle of this situation are the people who live in and around the MTR sites who seek to make a living. Historically their work has been coal mining. So cases like this are very much a part of their lives. The case is still before the federal supreme court in Richmond Virginia after Hayden granted an injunction on his own ruling banning MTR (Charleston Gazette, 1999; Pack, pers. comm.). This was done after heavy pressure by Governor Underwood of West Virginia and associated pro-MTR interest groups was applied. The next step is to await the federal ruling or make a change in the laws, which is what Senator Byrd is pushing for in Washington as stated earlier.

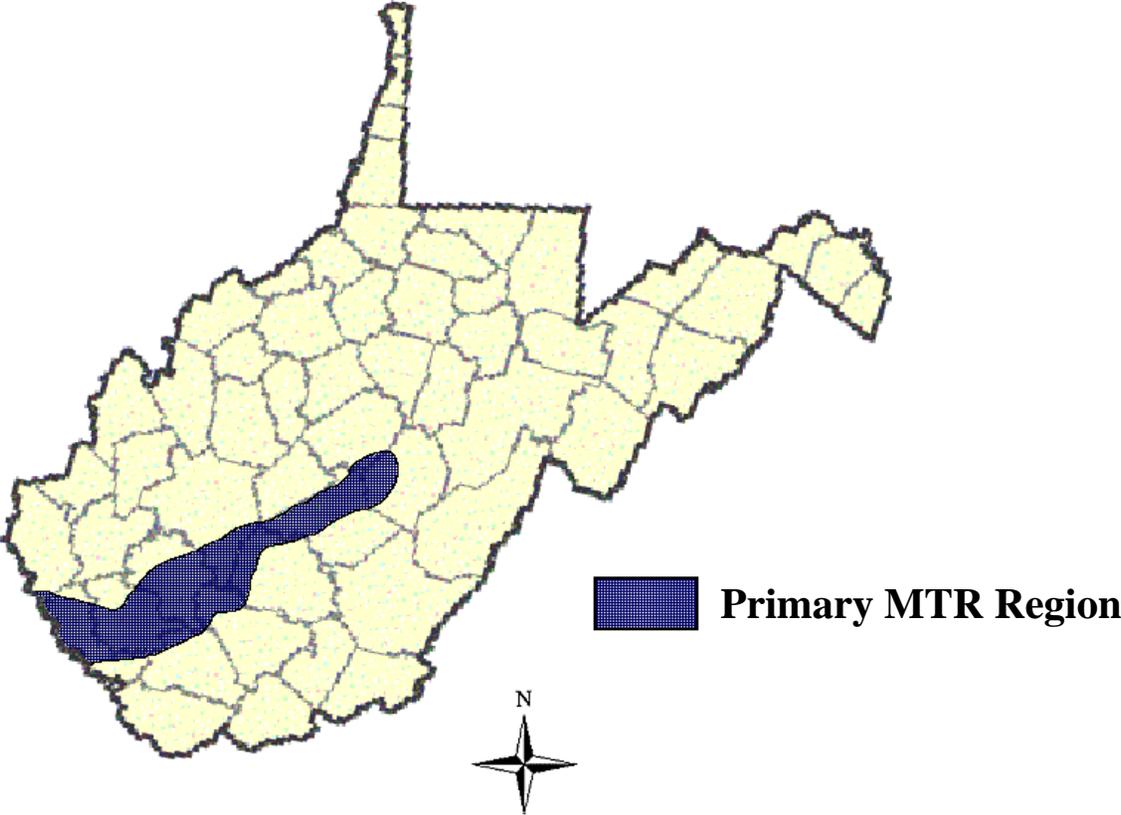
Arch Coal stands to lose a lot of money if it is not allowed to mine this area. For comparison purposes another one of Arch Coal's smaller mines operating in Cabin Creek, West Virginia, extracted 5 million tons of coal in 1998 alone (Charleston Gazette, 1998). Value is dependent on fluctuating coal costs, but this is obviously a large, and valuable site. Arch Coal Company claims they have to operate large scale mines in order to compete with mines from overseas and the western U.S., particularly Wyoming (Charleston Gazette, 1998). This situation is a good example of the current dynamics surrounding MTR in West Virginia, and the competing interests of jobs, economic development, environmental impacts, and people.

In addition to these issues, there are many other questions such as those of impact severity, how accurate and indisputable are current EIA findings, and how to close legislation loopholes concerning MTR (EPA Region 3 Website, 1999). An example of a current legislative problem was given with bill no. 145, and the issue of covering definable streams. The issue of indisputable and accurate EIA findings is heavily documented in literature regarding MTR, especially with regard to aquatic resource impacts (Charleston Gazette, 1999; EPA Region 3 Website, 1999; Governor's Task Force Report, 1998; Starnes, et. al., 1995). These topics will be developed more in chapter three (EIA), and chapter four (MTR impacts).

In response to the growing conflicts of MTR in West Virginia, Governor Cecil Underwood in June of 1998 created a task force on MTR to engage in 'wide ranging discussions and fact finding missions' in West Virginia (Governor's Task Force Report, 1998). The report was formally entitled the "Governor's Task Force on MTR and Related Practices" (Governor's Task Force Report, 1998). People were appointed to the task force by the governor and his advisory board on MTR. Task force members were chosen to ensure that both the economic development side of MTR, and the environmentalist point of view were equally represented. Their job task was to outline all concerns, and impacts, and to create guidelines for future research into MTR. Chapters were divided into MTR impacts to the people, economy, and environment. The report was finished in the fall of 1998 following many public forums organized by the Governor's Task Force. This document will be referred to throughout this work due to its considerable significance.

All organizations listed previously (NEPA, OSM, etc.) are involved currently in creating a comprehensive EIS (Environmental Impact Statement) with the goal of accurately assessing the current status and impacts arising from MTR in the state of West Virginia. A formal draft should be released sometime in May of 2000. The Region 3 office of the NEPA, in Philadelphia is heading up this task. A draft was requested from the EPA for reference purposes for this project, but was refused (Hoffman, pers. comm.). Referral was given to their website for region 3, which lists all current public information from the EPA on MTR in West Virginia. It can be speculated that due to the highly volatile nature of the subject and its importance in the state, the EPA did not want to pre-release this document until it was completed.

**Figure 1: Map Showing Present and Projected Major MTR Activity in West Virginia**



**West Virginia Geological and  
Economic Survey -- October, 1998**

## CHAPTER TWO

### ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

#### I. Introduction to EIA

Environmental Impact Assessment (EIA) is a process that examines the environmental consequences of development actions, in advance of those actions taking place (Glasson, et. al., 1994). The emphasis of this approach is prevention, with the identification of suitable alternatives to the developmental action to minimize impacts from such developments. As defined by Canter (1977), EIA seeks to evaluate the consequences of a proposal action on each of the descriptors in a given environmental inventory. By definition ‘environmental inventory’ is a complete description of the natural and man-made environment as it exists in an area where a particular proposed action is being considered (Canter, 1977). It is usually compiled from a checklist of descriptors for the physical, biological, and cultural environment of a given area.

Documentation of relevant information and the estimates of impacts derived from the various steps in the EIA process when federal lands are included, is termed an Environmental Impact Statement, or EIS. An EIS is comprised of many parts, and can be defined as a non-technical summary (Table 1). Due to the complex nature of EIA, the non-technical summary is invaluable in communicating the findings of the EIA to all parties involved. A methods statement is given first. This helps clarify information (such as who was the developer, who has produced the EIS, who has been consulted and how, what methods have been used, what difficulties have been encountered and what are the limitations of the EIA) (Glasson, et. al., 1994).

A summary statement follows in a formal EIS and also facilitates communication of the findings of the EIA. A monitoring program would possibly be addressed here or at the end of the document. The background of the proposed development follows the summary. It communicates to the reader a clear description of the project, the early steps in the EIA process, and baseline conditions (including relevant planning policies and plans) (Glasson, et. al., 1994). Topic areas are given next that were analyzed for possible impacts from the development in question. Within each topic area of the EIS there would normally be a discussion of existing conditions, predicted impacts, scope for mitigation and residual impacts.

An example of the use of EIS and EIA in development decision-making is Corridor H, a highway that starts in Elkins West Virginia, and when completed, will link West Virginia with Virginia. The highway is currently under construction. Corridor H was a vision of lawmakers in the state to improve the infrastructure of the state through improved transportation (Charleston Gazette, 1990). Many routes were analyzed for placement of the highway with the impacts noted (Corridor H EIA, EIS, 1992). Many collaborating agencies came up with a comprehensive plan to minimize all impacts, principally organized by the West Virginia Department of Highways. Public meetings were held to allow for public input.

The decision had been made by lawmakers to proceed, but they needed to know what was the best route to choose for Corridor H. The 'no build' option did nothing to satisfy the transportation needs of the project area (Corridor H EIA, 1992). All route options included identified impacts. The EIA and following EIS helped determine the

best route for the corridor, while minimizing impacts. This was a highly contested issue in the state, and demonstrates a contemporary use of EIA in West Virginia.

EIA can also be thought of as a ‘planning tool’ (Vanclay, et. al., 1996). Assessments are done to forecast and evaluate the impacts of a proposed project and its alternatives (Vanclay, et. al., 1996). This perspective of EIA as a planning tool has been referred to as the ‘technocratic paradigm’ since it is a view widely held by engineers and scientists who conduct EIAs (Vanclay, et. al., 1996). This has also caused EIA to be criticized by some because it ignores politics and real life issues which should be considered (Canter, 1977). As a planning tool, EIA serves to inform interested parties of the likely environmental impacts of a proposed project and its alternatives. It illuminates environmental issues which should be considered in making decisions. Generating and circulating information on impacts has salutary effects in that it forces a ‘hard look’ at the environmental effects of projects, and facilitates coordination among those effected by the proposed project.

A more realistic conception of decision making embraces political realities and recognizes that “the ultimate purpose of EIA is not just to assess impacts; it is to improve the quality of decisions” (Vanclay, et. al., 1996). EIA in this scenario can influence the attitudes of top officials, the strategies of project opponents, and the standard operating procedures of organizations proposing projects. In addition, this approach fosters a sustainable development ethic, or one that focuses on development without destruction of the earth (Glasson, et. al., 1994). Using this broader conception of EIA, the focus is not just on scientific studies or EISs, it is on improving decisions, for the long term. This is

accomplished by a sustainable development ethic, and long term monitoring of impacts, beyond the actual scope of the development.

## II. History of EIA

The establishment of the EIA process in the United States (and indeed the EPA) has its genesis within the National Environmental Policy Act (NEPA) of 1969. The impetus for this law was the widespread recognition in the late 1960s that some significant environmental problems in the U.S. had resulted from actions taken by the U.S. government itself (Vanclay, et. al., 1996). The thirst of large infrastructure agencies in charge of water resources projects, highways, energy facilities, and private business, appeared to be unquenchable. The mission statements of these agencies and organizations did not force them to account for the adverse environmental impacts arising from their actions. Congress changed this with the NEPA, which required all federal agencies to consider the environmental effects of their actions before development or action could occur.

The most well known provisions to this law is in section 102(2)(C), which states that, “all agencies of the federal government shall include in every recommendation or report on proposals for legislation and other major federal actions significantly effecting the quality of the human environment, a detailed statement by the responsible official on the environmental impacts of the proposed action and its alternatives” (Vanclay, et. al., 1996; Canter, 1977; Glasson, et. al., 1994). This detailed statement became known as an ‘environmental impact statement’, or EIS, and is the product of a formal EIA required by law when federal jurisdiction is involved. This document contains the findings of the EIA and recommendations towards mitigation, and alternatives to developmental action.

The process of carrying out a formal EIA and producing an EIS has become embedded in the 'NEPA process' (Vanclay, et. al., 1996).

The process of EIA which was formalized by regulation (U.S. Council on Environmental Quality 1986), includes preliminary assessments to determine if an EIA is necessary, a 'scoping process' to identify the main environmental issues to be examined, provisions for the public and agencies to comment on a draft EIS, and opportunities for citizens to sue federal agencies that fail to meet their responsibilities under NEPA (Vanclay, et. al., 1996). The public forums and scoping exercises for preparation of the comprehensive EIS being prepared by the region 3 EPA office concerning MTR were held in fall 1998 and spring 1999. Meetings were held in Charleston, Summersville, and Logan (Hoffman, pers. comm.).

NEPA has significantly influenced both federal projects and federal agencies. For example many states have their own programs calling for EIAs, in addition to what is mandated by NEPA itself. This makes it practically impossible to implement a major private development project (like MTR) without some discretionary action by the local or federal government due to agency jurisdiction overlap (Canter, 1977). In a way this is good, because it means actions will be reviewed before action is taken. On the other hand there is much overlap and apparent duplication of regulations making it a difficult and tedious process to undertake.

An example of this issue is the fact that there are so many agencies involved in the EPA's formal EIS on MTR in West Virginia, due out next May 2000 (EPA Region 3 Website, 1999). Each agency has its own mission statement and concerns, with MTR in W.Va. occupying a top spot on many of these agencies priority list. This is as much a

reflection of the magnitude of the debate generated by MTR and its potential impacts or benefits to the state of West Virginia. Within West Virginia, the EPA and CEQ have federal jurisdiction, with a smaller state version entitled the WVDEP carrying out regulations set forth under NEPA (Charleston Gazette, 1997).

### III. Formal process of EIA

At this point it would be advantageous to explain the steps of a formal EIA further. A formal EIA as defined by Glasson, et. al., 1994, is made up of, but not limited to the following steps:

- 1) Project screening
- 2) Scoping exercises
- 3) Consideration of alternatives
- 4) Description of the project/development action
- 5) Baseline data
- 6) Identification of key impacts
- 7) Prediction of impacts
- 8) Evaluation and assessment of significance
- 9) Mitigation
- 10) Public consultation and participation
- 11) EIA presentation
- 12) Review
- 13) Decision Making
- 14) Post Decision Monitoring
- 15) Auditing

Some steps in this process may be combined, left out, and some new ones added dependent on the specific case. A review of similar EIAs carried out in areas of W.Va., Kentucky, and Virginia on MTR, have shown this to be an accepted set of guidelines for a formal EIA (Skelly and Low, 1984; EPA Region 3 Website, 1999; Chadwick, 1984). Project screening identifies projects or developments that require an EIA. Screening can be due to federal regulations concerning development at that time, which mandates an EIA. For example, any development on federal land requires an EIA by law (NEPA of 1969). Another example would be if any impacts were expected on waterways and streams of a given area. All waterways fall under the jurisdiction of the Army Corps of Engineers, therefore an EIA must be undertaken if there is potential impacts to rivers and streams. (Cantor, 1977). Public outcry can also cause an EIA to be undertaken or in some cases, re-evaluated. This has been the case with MTR in West Virginia.

Scoping (step two) seeks to identify at an early stage, all of a project's possible impacts and the alternatives that could be addressed (Chadwick, et. al., 1994). Chapter four of this project is comprised of a scoping exercise on MTR in West Virginia, focusing on general environmental impacts, and aquatic resource impacts in particular. Within a formal EIA, such as the one undertaken by the Region 3 office of the EPA, all steps would be completed in sequential order. The goal of this project is to complete the process only for the scoping stage of the EIA.

Once the scoping stage has been accomplished, and all key impacts have been identified, alternatives are considered in step three. This step ensures that all alternative site locations, processes, layouts, operating conditions, and "no action or build" options have been addressed (Glasson, et. al., 1994). No build or action options are suggested

when the development in question is deemed too costly (in impacts) for its completion. Step four, the description of the project or development includes a rationale for the project, and a description. Baseline studies of the area chosen for development are done next. Environmental baseline studies ensure accuracy in determining levels of impact or environmental change potentially caused by the development.

Step six involves the identification of key impacts. Impact identification brings together project characteristics and baseline environmental characteristics with the aim of ensuring that all potentially significant environmental impacts (favorable and adverse) are identified and taken into account in the EIA process (Glasson, et. al., 1994). Impacts need to be identified and distinguished from one another for the purpose of allowing them to be represented, addressed, and /or mitigated correctly. Impacts identified in an EIA can be distinguished as positive, negative, large, small, long-term, short-term, reversible, irreversible, significant, insignificant, secondary, indirect, cumulative, and direct (Glasson, et. al., 1994). Impacts are measured and designated based on current literature and practice in the scientific community. Determination of the specific types of impacts will be addressed further in Chapter IV. One of the strengths of EIA in theory, is its ability to identify all impacts (Glasson, et. al., 1994).

Prediction of the magnitude of these impacts follows (step seven) with the goal of identifying the extent and other dimensions of change in the environment brought about by a project, in comparison with the situation without that project or development (Glasson, et. al., 1994). This is what has been historically lacking in past MTR EIAs (Hoffman, pers. comm.; Tibbott, pers. comm.; Skully and Low, 1984). Future EIAs concerning aquatic resource impacts, will include baseline data for areas before impacts,

during, and after (Tibbott, pers. comm.) In addition this will be coupled with a replicate system that does not have any proposed development. This replicate will allow for any change to be better classified as natural, or stemming from the development in question.

Evaluation and assessment of significance seeks to assess the relative significance of the predicted impacts to allow a focus on key adverse impacts (Glasson, et. al., 1994). This is perhaps the most difficult step in the process (Vanclay, et. al., 1996). Attempts have been made to develop algorithms that combine predictions and the subjective values of affected parties to create an overall index to rate individual projects (Vanclay, et. al., 1996). This has been criticized in the literature as a method of evaluation of EIAs as well, and can be identified as a current topic under scrutiny and research in EIA (Vanclay, et. al., 1996; Tu, 1993; Dee, et. al., 1972).

Regardless of whether an evaluation of impacts is attempted, the amount of information presented in EIA documents for evaluation can sometimes overwhelm even the most persistent reader. This has prompted the search for clearer formats to display EIA results to allow for a better evaluation of the process (Vanclay et. al., 1996). Some formats display a qualitative description of impacts or ordinally scaled ratings while others show results as quantitative, weighted impact scores (Smit et. al., 1995, Jain et. al., 1993). Matrices encompassing a plan to assess MTR impacts will be developed in chapter four.

Mitigation can be defined as the act of making something less severe, and in the case of EIA involves measures to avoid, reduce, remedy, and or compensate for any significant adverse effects (Webster's, 1993). Within the realm of MTR, one mitigating factor used by some coal companies, has been to reward people living in MTR areas,

with land in other locations (Charleston Gazette, 1998). This potentially lessens the effect of blasting, dust, and other impacts on people living in the area, while compensating homeowners for their loss of land, and its value.

Step ten includes public consultation and participation. This step in EIA attempts to assure the quality, comprehensiveness and effectiveness of the EIA. The goal is to ensure that the public's views are taken into consideration during the overall decision making process. Presentation of the EIS follows (step eleven), and is a critical step. This must be done correctly to ensure that the important aspects of the EIA are well communicated. If this step is carried out incorrectly, it could potentially compromise all the work done on an EIA up to this point, by inadequately communicating its findings. This could be devastating to the defined purpose of an EIA. A review step (step twelve) follows the presentation of the EIS. It is a systematic review of the EIS used to judge the effectiveness of the EIS in decision-making scenarios.

Step thirteen is the decision-making process, and involves a consideration by the relevant authority of the EIS (including consultation responses) together with other material considerations. If in conjunction with other material the development is determined to be acceptable and within guidelines, the state will issue a permit to the company (Charleston Gazette, 1996). If the EIS documents extreme environmental damage or degradation, the permit could be rejected. In this case, either party could proceed to a higher judicial authority. For example, if a coal company in W.Va. wants to start and operate an MTR site, they must submit an EIA to the WVDEP along with their request for a permit to carry out the operation. Usually the coal companies hire an independent consulting firm to do this. In addition, agencies such as the U.S. Fish and

Wildlife Service (USFWS), Army Corps of Engineers (COE), and EPA carry out their own EIAs on the proposed site or critically analyze the coal companies EIS. If at any point one of these agencies is not satisfied with the project proposed by the coal company, they can reject the development plan on the basis of too much damage to the environment, after reviewing all relevant EISs. This is classified as the 'no build option' (Glasson, et. al., 1994).

If the 'no build option' is chosen, the coal company can take its case to the state supreme court. The Spruce Mine case mentioned in chapter one is at this stage. Arch Coal Company wants to open the mine, but due to public outcry, and recommendations by the USFWS and the West Virginia Highlands Conservancy they have not been allowed to start the mine. In the past, permitting was done to create jobs and bring economic relief to areas of southern West Virginia. Recently, permitting has become a bigger problem for coal companies associated with MTR. This has been due to public outcry, interest groups, and recognition by many resource agencies (i.e.-USFWS, EPA) that impacts from MTR are substantial, and warrant close attention, monitoring, and in certain cases, exclusion (EPA Region 3 Website, 1999).

Sometimes decisions are made to proceed with a development even though there is a public outcry against it, or there are known significant environmental impacts. This has been the case with many MTR sites, even though EIAs have identified potentially 'irreparable damage' to the environment, that violate SMCRA mentioned in chapter one, not to mention federal law excluding the filling of perennial and ephemeral streams. This has caused EIA to be criticized by some because it ignores politics and is a process somewhat removed from everyday processes (Canter, 1977). As noted by Cullhane in

1973 and 1974, “the critical literature on EIS has consistently documented the failure of EISs written in both the U.S. and abroad, to meet basic tests of the rational-scientific model”. The rational scientific model is a model for decision making process adopted by the federal government for industrial, commercial, and private sector business disputes. The history of MTR in West Virginia to this point has been no different.

Decisions on significant public or private development projects are not, in fact, made following the logic of the rational model. Instead, decisions are influenced by non-scientific factors such as agency and corporate power, and interest group politics (Vanclay, et. al., 1996). Decisions sometimes are made like this because jobs and people’s well being are included in the equation, and sometimes concessions have to be made. In a situation like this, the case is taken to a higher court. In this situation one has to ask if there is a chance of winning in a higher court, even though the case was previously ruled against in a lower court. Coal companies are in a better position financially to do this until the court rules in its favor. Therefore coal companies have had the upper hand in dealing with MTR issues in the state of West Virginia to this point. Recently federal and state agencies have begun to bring to bear their considerable resources as well in the debate of MTR.

Another fact worth mentioning is that the W.Va. government advocated this practice as economic development, until recently (Charleston Gazette, 1997). As stated some development has occurred on MTR sites (Welch Consolidated High School, etc.) (Pack, pers. comm.). But, Governor Cecil Underwood realized the extent of the issues surrounding MTR and organized a task force this past year. The governor’s goal was to try to ultimately balance the needs and issues with minimal environmental impacts. MTR

does represent a large economic force in the state. There are many separate industries that are located in the state due to MTR directly, and indirectly.

Post decision monitoring follows in step fourteen, and involves the recording of development impacts once the decision has been made to proceed. This can contribute to effective project management. For example, as construction or development proceeds, impacts can vary from what is expected. This step allows for documentation, and the incorporation of this new knowledge into the development plan. This will ensure the development is done within the law, and carried out to mitigate all harmful impacts. As new knowledge about impacts is acquired, development plans can be adjusted to incorporate this information and use it effectively.

Auditing is the final step (fifteen) in a formal EIA. This step involves comparing actual outcomes with predicted outcomes, and can be used to assess the quality of the predictions and the effectiveness of mitigation measures in the process. Even though EIA can be broken down into a number of steps, it must be stressed that this seemingly linear process contains feedback loops throughout (Figure 2). Information derived along the way can be added later to influence future decisions, as well as to modify a past step.

#### IV. Current EIA Advantages and Disadvantages

There are a number of areas upon which future EIAs could be improved in assessing MTR projects. Glasson, et. al., (1994), suggests seven main topics for areas of improvement in current EIAs. These seven topics serve as an excellent backdrop by which to investigate current shortcomings in the literature in reference to MTR. They are the following:

- 1) Coverage of project assessment

- 2) Nature of methods of assessment
- 3) The quality of assessment
- 4) Relative roles of participants in the process
- 5) The quality of assessment
- 6) Beyond the Decision
- 7) Beyond project assessment

These seven topics exist as a feedback loop to the EIA process. Each topic is tied to the others in many ways, and each benefits or hinders the other sectors depending on their overall strengths and weaknesses. Progress in one or more areas will help improve the process of EIA as a whole.

‘Coverage of project assessment’ concerns how broad the assessment is itself. Upon review of historical MTR EIA data, they appear to be in need of expansion to include a larger ‘scope’ of issues, and be more beneficial as a decision making tool and guide for sustainable development (Skelly and Low, 1984; Governor’s Task Force Report, 1998; Vanclay, et. al., 1996; EPA Report on MTR, 1979; 1981; and 1984). This problem has become less severe recently with the development of new concepts such as ‘watershed management’ and ‘ecosystem management’. At the center of these concepts is the fact that processes and relationships occur on a holistic scale, and therefore warrant study suited to this scale (AFS Symposium Reprint, 1992). These concepts foster an understanding of the interrelationships of ecosystems; their possible impacts (i.e.- cumulative, second order, third order, and short and long term); and have begun to invade the process of EIA and their evaluation (Hoffman, pers. comm.). Much of the formal

EIA being developed by the EPA Region 3 office on MTR have these concept grounded in their formal structure and methods of analysis (EPA Region 3 Website, 1999).

Many past EIAs have lacked certain formal steps, or have problems with the methods used. The establishment of baseline data is one of the most prominent steps lacking in MTR studies. There is a general lack of undisputed information on the impacts arising from MTR on aquatic systems and resources in particular (Gov's Task Force Report, 1998; Charleston Gazette, 1998). Much of this stems from a lack of baseline studies (Charleston Gazette 1997; Hartman, pers. comm., 1998). Documenting natural and man-made change is missing. In addition, studies have under represented investigations encompassing the temporal aspect of impacts before, during, and after MTR has occurred in an area (Skelly and Low, 1984; EPA Region 3 Website, 1999). This has resulted in an abundance of knowledge on impacts after MTR has taken place, with no baseline data to go by. Monitoring and research would be undertaken during the exploration phase, mining phase, and reclamation phase to better determine man-made change and natural change. This would follow a more scientific approach and would potentially stand up better to peer review and scrutiny in the future.

The lack of data, the tendency to focus on the quantitative and often on single indicators, are other problems associated with MTR EIAs to this point. For example, information concerning aquatic resource impacts caused by MTR is sparse, and anecdotal at best (Tibbott, pers. comm.). Therefore documenting long-term, cumulative, and other more extended impacts (either temporally or spatially) is almost non-existent. Past aquatic resource impact analyses has focused on a few key species as indicators, and therefore lack the holistic view of analysis favored today in watershed based studies

(Starnes, et. al., 1993). Nevertheless, innovative methods are being developed to predict impacts, ranging from simple checklists and matrices to complex mathematical models (Glasson, et. al., 1994).

‘Roles of participation’ within the process of EIA can always be improved. By improving knowledge transfer, people living in the areas of concern have the opportunity of becoming active rather than passive participants in the process (Vanclay, et. al., 1996). A key issue concerns the stages in the EIA process in which the public should have access. Government roles in the EIA process may be conditioned by limited experience and expertise in this new and rapidly developing area, and by resource considerations. For federal government this may be evident in limited guidance on best practices, and inconsistency in decisions. For local government, this may be revealed in difficulties in handling the scope and content complexities of EISs when they are submitted for particular proposals (Glasson, et. al., 1994). This has been the case with MTR in W.Va. historically. It is only now due to massive public outcry and concern that resources and expertise have been directed towards understanding this major issue.

The quality of assessment is a major problem with EIAs associated with MTR (Governor’s Task Force Report, 1998; EPA Region 3 Website, 1999). New standards have been set by federal agencies which seek to ensure better quality control in future EIA. The lack of quality baseline data has compromised the effectiveness of current and historical EIAs (Charleston Gazette, 1997; 1998; Skully and Low, 1984; EPA Report, 1979; 1984; EPA Region 3 Website, 1999). In many cases the ‘scope’ of the project was not extensive enough, and therefore devoid of a long-term temporal aspect. Quality has also suffered because long term and cumulative effects have been neglected (Glasson, et.

al., 1994). This is being addressed in current comprehensive EISs like the EPA's Region 3 EIS on MTR, which includes long term monitoring projects on MTR sites ( Tibbott, pers. comm.).

The two topics identified by Glasson (1994), 'Beyond project decision-making' and 'project assessment' can be discussed together. Many EISs are for one project, and therefore lack quality auditing to report the quality of the assessment for the next possible project. EIA which extends no further than the project decision is a very partial linear process, and provides little opportunity for a cyclic learning process (Glasson, et. al., 1994). Due to the interest in MTR impacts, this cycle has begun to be reversed due to the need for better decision-making processes and the accumulation of similar studies. An example would be the current EPA EIS due out in May of 2000, which draws on all past work in an attempt to set a new guideline for MTR EIAs (EPA Region 3 Website, 1999).

'Beyond project assessment' encompasses the formation of a Strategic Environmental Assessment (SEA). SEA of policies, plans, and programs represents a logical extension of project assessment. SEA is better able to deal with cumulative impacts, alternatives, and mitigation measures than EIA, due to its broader scale of focus and longer temporal span (Glasson, et. al., 1994). This is due to the fact that SEAs incorporate long term monitoring, and address overriding trends and focus points which could be incorporated into future EIAs. This type of plan is just starting with MTR in W.Va. Even though MTR has been developing since 1969 in West Virginia, there has been no SEA to accompany it. This has begun to change as researchers have begun to investigate, and realize the implications of MTR in West Virginia (Governor's Task Force Report, 1998; EPA Region 3 Website, 1999). This change is also related to the

concepts introduced earlier with watershed management and sustainable development.

Both require that EIA focus on a larger scale in terms of both space and time.

When used correctly and comprehensively, EIS has significantly altered projects (Vanclay, et. al., 1996). A list of positive influences can be given for EIA:

- 1) withdrawal of unsound projects
- 2) legitimization of sound projects
- 3) Selection of improved project location
- 4) Reformulation of plans
- 5) Redefinition of goals and responsibilities

The process of EIA continues to evolve and become more efficient, as new and modern techniques are introduced (Glasson, et. al., 1994).

The EIS review process emphatically affects people. It affects investment decisions, unemployment, health, recreation, the cost of living, housing, and virtually every other aspect of people's lives. Costs and benefits must be weighed by the people themselves, with the function of EIS being to evaluate and present alternatives so that the ultimate decision may be determined through sociopolitical processes by an informed public and its representatives (Roberts, et. al., 1984). The system is by no means perfect. At the very least the process of EIA has served to raise the environmental consciousness of the American public.

## **Table 1: Breakdown of an Environmental Impact Statement (EIS)**

### Non-technical summary

#### Part 1: Methods and Key issues

1. Method statement
2. Summary of key issues; monitoring program statement

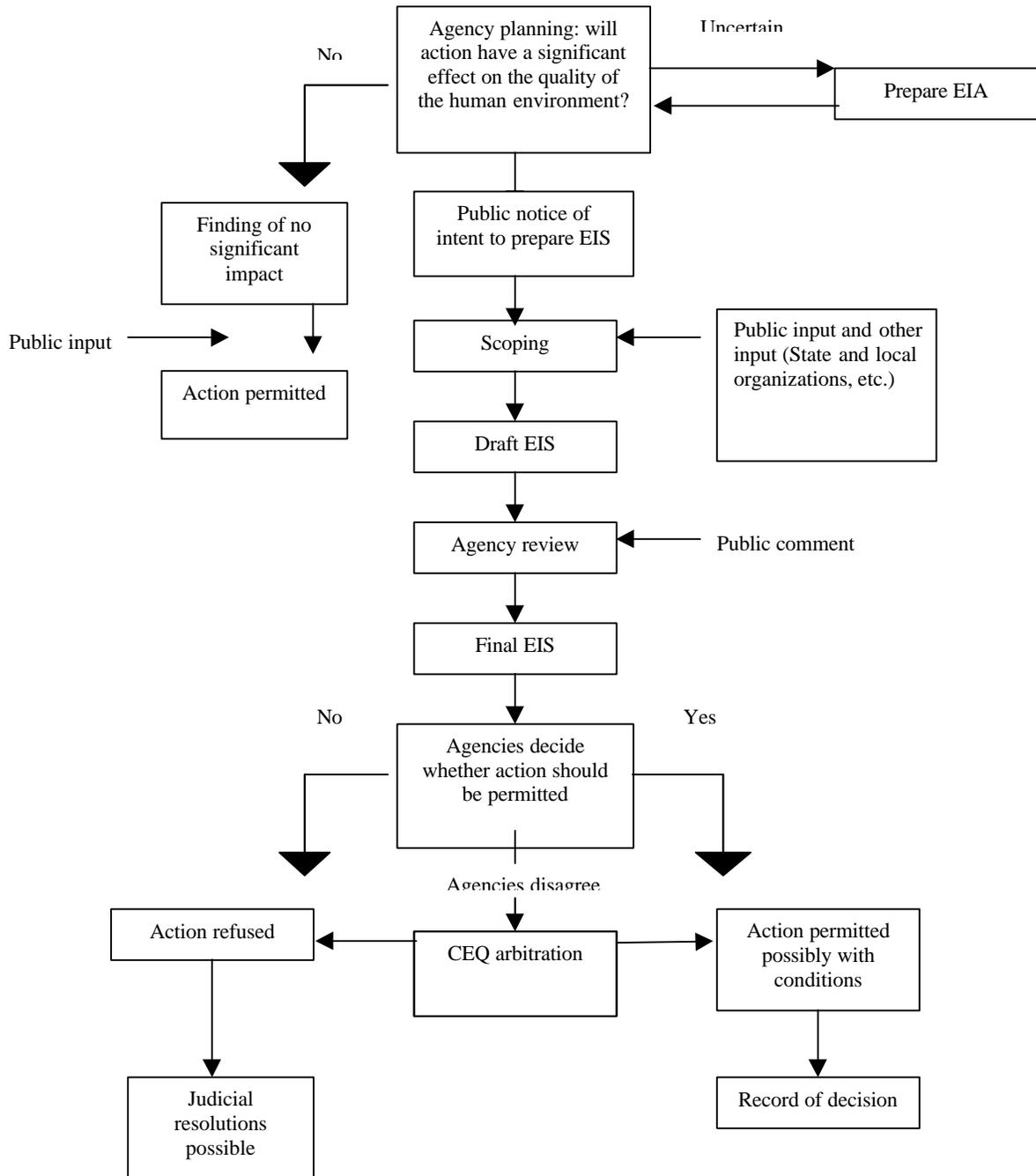
#### Part 2: Background to the proposed development

3. Preliminary studies: need, planning, alternatives, site selection
4. Site description / baseline conditions
5. Description of proposed development
6. Construction activities and program

#### Part 3: Environmental Impact Statement

7. Land use, landscape and visual quality
8. Geology, topography and soils
9. Hydrology and water quality
10. Air quality and climate
11. Ecology : terrestrial and aquatic
12. Noise
13. Transport
14. Socio-economic
15. Interrelationships between effects

**Figure 2: Process of an Environmental Impact Assessment (EIA) under NEPA**



## **CHAPTER THREE**

### **IMPACTS FROM MTR**

#### **I. Introduction**

An 'Impact' can be defined as a shocking effect, or the force of impression of one thing on another: a significant or major effect (Webster, 1993). Impacts of varying magnitude are experienced in three main areas associated with MTR in West Virginia. These three impact areas are in the field of economics, the community or personal arena, and finally the environmental field (Governor's Task Force Report, 1998; Skully and Low, 1984; E.P.A. Region 3 Website, 1999). Economic impact and community impact will be reviewed briefly, followed by a thorough evaluation and description of environmental impacts caused by MTR in West Virginia. A more intensive evaluation on aquatic resource impacts caused by MTR in West Virginia will follow.

The economic impact arising from MTR is, for the most part 'positive', and consists of job creation, improved tax base, and secondary and indirect jobs (Charleston Gazette, 1998; E.P.A. Region 3 Website, 1998). Examples of secondary jobs would be the sale and repair of equipment, such as dump truck tires and engines for trucks and bulldozers (E.P.A. Region 3 Website, 1998; Skully and Low, 1984). Economic impact has always been touted by the supporters of MTR as one of the main reasons for suffering the impacts of MTR in West Virginia. Along with silviculture, mining has had a long history in the state, and has supplied many people in West Virginia with jobs. This is obviously a positive impact to the communities close to MTR sites, but there are also potentially negative impacts.

Negative economic impacts arising from mining in West Virginia comes from too great a dependence on MTR by a community. Coal companies are in a position to demand infrastructure and other 'perks' due to their economic influence input on the dependent communities that are located near the mine. When communities do not meet these conditions, coal companies have left, and in certain cases have refused to allow the rights to the coal to be bought out by other parties (Charleston Gazette, 1998). This essentially leaves the community without an economic base if they do not fulfill the demands of the coal company (Charleston Gazette, 1998; EPA Region 3 Website, 1999). This situation is reminiscent of the mining wars in the 1920s and 1930s, when communities were in many cases today held hostage by these coal companies due to their pull economically in the area, and state (Charleston Gazette, 1998; Johnson, et. al., 1996). Many argue that this unhealthy dependence continues to exist.

Community or personal impacts derived from MTR consist of a range of issues. Many of these could be discussed further under environmental impacts, but a few need to be addressed here due to their importance and significance. Dust from blasting, noise from construction, alteration of structures due to blasting, and the actual fragmentation of communities are some of the main points community impacts that arise due to MTR in West Virginia (EPA Region 3 Website, 1999; Governor's Task Force Report, 1998). Communities are disrupted mainly by the alteration of their land and indirectly through effects of the mining process, and the removal of homeowners by coal companies through buy-outs. Indirect effects from mining have caused people to leave their homes because of blasting noise, alteration of their housing due to blasting, and in some cases, flying debris (Governor's Task Force Report, 1998; EPA Region 3 Website, 1999; Charleston

Gazette, 1998). At times these impacts have become so great, and mitigating action on the part of the coal companies so minimal, that the impacts listed have literally driven people out of their homes, and therefore fragmented communities in southern West Virginia (EPA Region 3 Website, 1999; Charleston Gazette, 1997, 1998).

Environmental impacts are obviously one of the main MTR concerns, and the focus of this project. An excellent definition of an environmental impact is, “a net change, either positive or negative, in man’s health and well-being and in the stability of the ecosystem on which man’s survival depends” (Goudie, et. al., 1994). Rau et. al., (1980), defines ‘environmental impact’ as, “any alteration of environmental conditions or creation of a new set of environmental conditions, adverse or beneficial, caused or induced by the action or set of actions under consideration”. These changes may result from an accidental or planned action and can effect the change in natural balance either directly, or indirectly.

Direct impacts either planned or premeditated, are generally experienced during or after environmental modification (Goudie, et. al., 1994). These effects are usually long term, but normally reversible and include alterations such as land use change arising from constructional and excavational activities (Gouldie, et. al., 1994; Rau, et. al., 1984). In the case of MTR in West Virginia, an area of further research identified at the EPA’s public scoping meetings recently held on MTR, were the possible effects of MTR on local microclimate cycles (EPA Region 3 Website, 1999).

Indirect environmental impacts are generally unplanned and are often socially, if not economically, undesirable. The nature of these impacts are often not known until well after the original impact and depend upon the sensitivity of the system to change, the

existence of threshold conditions, and interaction between different side-effects of the initial impact. Many impacts are long-term, cumulative and irreversible, difficult to identify, and almost impossible to predict (Gouldie, et. al., 1994). In the case of MTR in West Virginia, it is in the area of indirect and higher order effects that historical and current EIA have most often failed to accurately document (Tibbott, pers. comm.; Hartman, pers. comm.; EPA Region 3 Website, 1999; Governor's Task Force Report, 1998).

Environmental impact is the final stage of a basic resource process whereby resources are extracted from the environment, used in some fashion, and then returned to the environment. These actions, whether they be legislative proposals, policies, programs, or operational procedures may well set into motion or accelerate environmental impacts. These could include erosion, and displacement of people, unless some form of preventative measure is put in place. If management at this stage is ineffectual an environmental impact will probably occur, and any subsequent management action may be too late, too expensive, or too palliative (Gouldie, et. al., 1994). Management in this scenario would be the act of managing impacts, or mitigation. The party responsible for this in this scenario would ultimately be the WVDEP.

Unfortunately most knowledge to date on MTR is still concerned with what is still put into the system rather than with how the environment responds to it. It is this response that defines the nature and magnitude of the environmental impact (Gouldie, et. al., 1994). It is possible that at a later stage, the original homeostasis or equilibrium of the system effected will attempt to be reached, and the cycle will come full circle. But, it

is rare for the new equilibrium ever to approach the original equilibrium in terms of productivity, etc. (Gouldie, et. al., 1994). This also highlights the issue raised earlier in Chapter 3 concerning the lack of and need for baseline data in MTR studies. In addition baseline data allows one to document how resilient a system in fact is.

## II. Overview of Impacts from MTR

In the exploration phase of MTR, boreholes are drilled to check for the size and extent of the coal seam. These holes are drilled mechanically or explosives are used. The boreholes have the potential to contaminate surface and groundwater (Chadwick, et. al., 1996). Trenches and pits are dug also to investigate the geology of the site (Chadwick, et. al., 1996). Additionally exploration grids used to delineate the mine site can potentially disturb wildlife and lead to considerable erosion (Chadwick, et. al., 1996; Donalson, et. al., 1980). By far the greatest impact from exploration is the creation of transportation routes to the remote MTR sites in southern West Virginia, and their maintenance (Chadwick, et. al., 1996; Charleston Gazette, 1998). It is documented that United Forest Service (USFS) road networks, for instance, contribute to up to 70% of the erosion and sediment loads in streams and rivers on national forest land (Class Notes, WMAN 245).

The environmental effects of the extraction stage tend to be mainly local, associated with surface disturbance, the production of large amounts of solid waste material, and the spread of chemically reactive particulate matter to the atmosphere and hydrosphere (Chadwick, et. al., 1996; Cushman, et. al., 1980). Surface disturbance, water movement and air quality impacts are the major impacts caused by the extraction phase. The removal of MTR spoil material is one of the biggest problems, and has traditionally

been disposed of in the valleys adjacent to the mine sites (Charleston Gazette, 1998; EPA Region 3 Website, 1999).

The pollution of streams and rivers with acidic and /or reactive chemicals is also an issue due to the chemical composition of coal, and its accompanying rock and soil formations which are disturbed and exposed by the act of mining (Starnes, et. al., 1995; EPA Region 3 Website, 1999). Backfilled, reclaimed surface mine sites, for example, constitute man-made porous “geological recharge areas”, where infiltrating water percolates through the fill to emerge as a seep or a spring (Starnes, et. al., 1995). Often these seeps or springs are very acidic and will flow even during drought conditions (Starnes, et. al., 1995).

Impacts arising from the reclamation phase can also contribute to negative environmental outcomes. If reclamation has not been carried out properly, these impacts can continue, and leave a legacy of damage for future generations. Erosion and destabilization of mined lands are two of the most important impacts that arise in the reclamation process (Chadwick, et. al., 1996; EPA region 3 Website, 1998; Skully and Low, 1984). Destabilization has also become exaggerated in many areas due to the increase in recreational use of these lands (EPA Region 3 Website, 1999). On the other hand, many mine sites are remote and on coal company owned lands, and access can only be obtained through trespassing.

Another aspect to consider is whenever dealing with extreme headwater areas where the slope is great, as with most MTR sites, the potential for problems arising from water issues increases. Extreme headwater refers to the uppermost part of a drainage system, close to the ridge that defines its watershed. In all locations, but especially

extreme headwaters, water must be dealt with in small quantities and at low velocity, or else it serves as an excellent vehicle for erosion (Class notes, WMAN 245, 1998). In the past, coal companies have been negligent in dealing with this issue, and other post mining land use laws (Skully and Low, 1984; EPA Region 3 Website, 1999). One of the main reasons for this is the recurring theme that the laws and standards put into place by the OSM, EPA, and WVDEP regulating surface mining activities are outdated compared to the scale of disturbances now carried out on MTR sites.

Other impacts present include visual, noise, and air quality impacts. Noise impacts arise from the blasting and extraction phase. Visual impacts could be labeled subjective by some, but if one is going by the definition of impact given earlier, removal of mountaintops and alteration of the original terrain constitutes a large visual, if not physical impact. This is a good point to interject the fact that many, if not all of these decisions in impact mitigation, are subjective and usually based on personal or community value systems. John McFerrin past president of the West Virginia Highlands Conservancy, and board member of the Governor's Task Force on MTR (1998), has postulated that without some action, 50% of the 'mountainscape' in southern West Virginia would be altered in 5-10 years at current mining rates (West Virginia Highlands Conservancy Newsletter Website, 1999).

Air quality impacts arise mainly from blasting dust (EPA Region 3 Website, 1999). This is also a highly disputed impact. People in MTR areas cite this as a major problem, while many government officials claim it is a minimal problem, or negligible due to its short duration of effect. Noise from blasting also has an impact on communities. It has been suggested that automated telephone calls be placed to all

residents in an area prior to blasting, to allow for some form of 'readiness' on the part of the residents for the actual blasting (EPA Region 3 Website, 1999). This has not been possible due to the fact that not all people in these areas have phones, or access to one. Blasting, and the dust it creates, has led many residents to leave and relocate in other areas or states. This then becomes an indirect effect of MTR on the community and people.

### III. Specific Geological Impacts from MTR

There are two major categories of geological disturbances: pedological and hydrological (Law, 1984). Pedological impacts apply to the soils in the area of MTR. They may consist of compaction, acidification, erosion, and /or pollution. Hydrological impacts effect surface and groundwater. MTRs major pedological impact is erosion. This is mainly due to all of the cumulative disturbances that occur at MTR sites. Soil particles become sediment when they are detached and moved from their initial resting place. If sediment washes into neighboring watercourses, it becomes a resource out-of-place and a pollutant by definition (Law, 1984; EPA Region 3 Website, 1999). This can then lead to indirect biological impacts by altering aquatic habitat, invertebrates, and native fish assemblages (Starnes, et. al. 1995; Governor's Task Force Report, 1998). MTR permanently and drastically alters soil and subsurface geologic structure and disrupts surface and subsurface hydrologic regimes.

Specific hydrological impacts caused by the practice of MTR are mainly pollution, mineralization, sedimentation, and acidification (Starnes, et. al., 1995; Cushman, et. al., 1980). Surface hydrology disturbances have the potential to indirectly impact the ground-water hydrology as well, due to their inter-connectiveness (Cushman,

et. al., 1980). Surface waters may also disappear if their flow is intercepted by induced fractures or subsidence (Cushman, et. al., 1980; Starnes, et. al., 1995). The dewatering of wetlands is another possible effect, either indirectly or through overall disturbances in the hydrological regime. The covering of headwater perennial and intermittent streams on a large scale with spoil material is the major hydrological impact, and very characteristic of MTR. This is not a case of alteration, but of removal in function and form.

The hydrological impacts are poorly understood, and yet are at the cornerstone of the debate over MTR in West Virginia. Federal Judge Hayden's ruling in West Virginia on November 2, 1999 to stop all MTR was based on the fact that it is against the law presently to bury perennial, and intermittent streams. Ephemeral streams flow only during times of high precipitation, or have water in them less than 20% of the time. These streams are allowed to be filled under current law (Charleston Gazette, 1999; EPA Region 3 Website, 1999). Presently this decision is being challenged by the Governor of West Virginia, the coal industry, and the rail industry (EPA Region 3 Website, 1999; Charleston Gazette, 1999).

#### IV. Specific Biological Impacts From MTR

Onsite and downstream areas of valley fills can be negatively impacted by sediment, mineralization, and acidification (Starnes, et. al., 1995). The alteration of water quality can limit biodiversity, alter natural aquatic assemblages (i.e.-invertebrates, fish, amphibians, and mammals), and possibly cause certain species to become extinct (Starnes, et. al., 1995; Hartman, pers. comm.; Tibbott, pers. comm.). Many receiving streams (streams that receive wastewater, or valley fill streams) have naturally little alkalinity (<10mg/l), and require either great volumes of water or extensive lengths of

stream to neutralize even small mine flow that may carry 1,000mg/l or 2,000mg/l of acid load (Starnes, et. al., 1995). Many small streams even though low in alkalinity, are valuable trout streams, or contain unique aquatic ecosystems. This is particularly true in Appalachia, and in particular southern West Virginia. Aquatic resource impacts are in dire need of research, and documentation. All information to date on aquatic impacts from MTR is anecdotal at best (Starnes, et. al., 1995; Tibbott, pers. comm.).

The impacts to aquatic resources also affect the net energy flow in these ecosystems (EPA Region 3 Website, 1999). As sediment is added into a stream, productivity falls off due to a drop in photosynthesis caused by turbidity in the water column. Productivity can be defined as the nutrients and organisms produced by a stream through photosynthesis and required to sustain the lowest levels of life. Natural flow regimes and dynamics are effected too (EPA Region 3 Website, 1999; Starnes, et. al., 1995). This change will alter the natural fauna. Conductivity and element ratios levels in the water on site also change during MTR, creating changes to the chemical make-up of the water downstream (Starnes, et. al., 1995). Examples of element or ionic changes would be aluminum (Al) concentrations, and iron (Fe). Therefore the streams impacted are potentially not as productive, and lack the ability to carry the natural fauna, or do so at a reduced rate (Keeton, et. al., 1987). This reduced rate of K, or the carrying capacity in numbers or biomass, will limit higher order organisms dependent on aquatic organisms for food or other purposes.

An example of this indirect aquatic effect would be a reduction in the numbers of brook trout (*Salvelinus fontinalis*) in cold-water streams due to a lack of adequate numbers of prey species. Prey species numbers could be depressed due to the reduction

of spawning habitat, lethal levels of chemicals or acidity, and /or actual alteration of habitat (Starnes, et. al., 1995; Nielson, et. al., 1991). A further higher order impact might be the potential loss of a valuable recreational fishery, and a negative impact to a community. All of these changes have been documented as outcomes of MTR (EPA region 3 Website, 1999; Hartman, pers. comm.). The mechanisms are known, but to what degree and what level this change occurs is not known. Aquatic resource impacts will be represented further in Chapter 4, by developing an impact matrix for aquatic resources, in addition to a general impact matrix for MTR.

Biological impacts from MTR have also been documented on plants and animals. It has been documented that the original location where wild boar (*Sus scrofa*) were originally introduced into the state, has been decimated by MTR (Dotson, pers. comm.). This is a non-native species, but it had been determined by the WVDNR that it was a good choice for these parts of West Virginia as a big-game animal. Tracking studies have shown that wild boar can adapt rather well, but overall they and other wildlife are losing habitat in southern West Virginia, as well as having traditional migration routes, travel corridors, and food sources disturbed by MTR (Dotson, pers. comm.).

Literature suggests birds are impacted by mining too, but it has not been quantified to what degree with the larger mines of today (Samuel, 1976; Gregg, 1997). Some species such as quail and grouse benefit from the open grass fields and edge effect left behind from historic MTR (Brown, et. al., 1990). Once an area is mined, it is not as productive as the land was in its previous state, nor is the natural flora as abundant. Trees and shrubs that birds depend on are reduced or removed. Raptors and birds of prey suffer also due to the lack of prey species (Robinson, et. al., 1984). Wildlife move out into

other areas during MTR operations because of disruption, and may or may not move back in and use the reclaimed land. This is a field of current research, using tracking and radiotelemetry studies to monitor responses and movements of wildlife to disturbances.

Plant life is either removed or the natural flora is altered as a result of MTR (West Virginia Highlands Conservancy Newsletter, 1999; EPA Region 3 Website, 1999). In the past a common practice in the reclamation phase was to plant grasses on the remaining plateau (Governor's Task Force Report, 1999; E.P.A. Region 3 Website; Pack, pers. comm.). The grasses used are usually not native to the area. This new species along with the new topographical features created by the MTR process, serve as a very inhospitable and foreign environment for the flora and fauna which originally occurred there (Tibbott, pers. comm., 1999; Samuel, 1986; EPA Region 3 Website, 1999). This does not mesh well with current accepted watershed management principles based on native functioning ecosystems (Wesche, et. al., 1999)

Carnivores and higher order animals depend on herbivores, and their fitness, for their own success. As their success is altered by MTR, the effect is felt farther up the ecosystem with larger higher order fauna (Dotson, et. al., 1999). One top-level predator at risk from MTR is the black bear (*Ursus americanus*). This big-game animal has been displaced like the boar from its native ranges in MTR areas. Their whole life cycle and habits have been altered to adapt and survive in these areas (Governor's Task Force Report, 1998; West Virginia Highlands Conservancy Newsletter, 1999; WVDNR inter-agency memo, 1998). Displacement of the bear has led to their raiding garbage cans, houses, and ultimately to their death due to the potential danger associated with this contact with humans (Dotson, pers. comm.). To what degree wildlife will respond

negatively or positively to MTR and the reclamation process has been determined quantitatively, but only with mine sites of much smaller size (Brown, et. al., 1976; Gregg, 1997). Current research is lacking in identifying and quantifying disturbances caused by the more modern large-scale mines found today.

The lack of directed research and associated problems has resulted in a lack of cumulative and higher order biological impacts on MTR being documented in the current EIAs. The purpose of EIA is to record and document environmental impacts at all scales and magnitude, but historically this has not been carried out adequately with MTR. The number of parties involved, beurocratic red tape, lack of direction and adequate focus have all led to the current poor state of knowledge on the impact of MTR, and on higher order impacts in particular (EPA Region 3 Website, 1999; West Virginia Highlands Conservancy, 1999; Hartman, pers. comm.).

## CHAPTER FOUR

### MTR IMPACT MATRICES

A regulation taken from the NEPA of 1969 states ‘the EIA process begins as close as possible to the time the agency is developing or is presented with a proposal...the statement shall be prepared early enough so that it can serve practically as an important contribution to the decision-making process and will not be used to rationalize or justify decisions made.’ (Glasson et. al., 1994). In the case of MTR, coal companies applying for permits would have formal EIAs carried out on their proposed mining activities by the WVDEP. This ‘lead’ agency is designated to co-ordinate the EIA process, with other federal and state agencies such as the USFWS, COE, and EPA. (Roberts, et. al., 1984; EPA Region 3 Website, 1999).

The lead agency (WVDEP), first determines whether the proposal requires the preparation of a full EIS, or no EIS at all, or a more concise “environmental assessment” (Glasson, et. al., 1994). This in turn would allow the WVDEP to determine whether an EIS is needed or whether the preparation of a “finding of no significant impact” (FONSI) is appropriate (Glasson, et. al., 1994). If a FONSI is prepared, then a permit would usually be granted following public discussion. This has traditionally been the case in the past with MTR in southern West Virginia. If a full EIS is found to be needed, the lead agency (in this case the WVDEP, and the EPA) publishes a ‘Notice of Intent’, and the process of scoping begins. The aim of the scoping exercise is to determine the issues to be addressed in the EIA, to eliminate insignificant issues, focus on the issues that are significant, and identify alternatives to be addressed (Glasson, et. al., 1994; Roberts, et. al., 1984).

Scoping is an important step in EIA because it enables the limited resources of the team preparing the EIA to be allocated to the best effect. This prevents misunderstanding between the parties concerned about the information required in an EIS. Scoping begins with the identification of individuals, communities, local authorities and statutory consultees before preparing the EIS (Glasson, et. al., 1994). According to Roberts (1984), an excellent subsequent step would be to bring the parties together in a working group and /or meeting with the developer, or coal company representative in the case of MTR. To handle the information generated from such meetings, five techniques are proposed by Glasson (1994); checklists, matrices, quantitative methods, networks, and overlay maps. Matrices will be used for this work on MTR, and will be explained later in the chapter. The end result of this process of information collection and negotiation (the scoping process), should be the identification of key issues and impacts. In addition, an explanation of why other issues are not considered significant is included, and, for each key impact, a defined temporal and spatial boundary within which the impact will be measured and given (Glasson, et. al., 1994).

As a case example, consider the current EPA's EIA process on MTR. The Region 3 office in Philadelphia Pennsylvania is currently heading up the publication of a formal EIS due in May 2000, mentioned earlier in this work (EPA Region 3 Website, 1999). The scoping exercises carried out by the EPA consisted of public hearings held around the state last year, and into this year, 1999. Public discussion held within a round table discussion format was used by the EPA and other agencies to capture the concerns and interests of citizens. This was then meshed with their most current scientific findings and used in their formal scoping exercise to identify alternatives and areas of further research

and analysis for MTR in West Virginia. As stated in Chapter 3, exploration of the actual documents from this process before the formal EIS is to be released in May 2000, was not possible due to the sensitivity of the subject (Hoffman, pers. comm.). General findings from these public meetings were released on the EPA's website for Region 3. This information was incorporated into the matrices constructed later in this chapter, in addition to other relevant information found during the literature review on MTR impacts.

Matrices are a type of method or technique used in the scoping process. They are the most commonly used method of impact identification (Glasson, et. al., 1994). Matrices are usually two dimensional charts showing environmental components on one axis, and developmental actions on the other. The cells are then populated with appropriate numbers, symbols, or other 'scores' which demonstrate the impact of the specified action on the environmental component. Matrices are essentially checklists that acknowledge the different components of a development project and their different impacts (Roberts, et. al., 1984). The best-known type of quantified matrix is the Leopold matrix, developed for the U.S. Geological Survey by Leopold, et. al., (1971). The Leopold matrix is easily understood and can be applied to a wide variety of developments, and is reasonably comprehensive for first-order, direct impacts (Glasson, et. al., 1994).

There are some disadvantages to this approach. Because the matrix can be applied to so many developmental actions, matrices can be unwieldy in certain instances (Glasson, et. al., 1994; Rau, et. al., 1980). Like checklists, matrices do not relate environmental components to one another, and therefore simplify the complex

interactions between ecosystem components leading to indirect impacts (Glasson, et. al., 1994; Shopley, et. al., 1984). The inclusion of magnitude/significance scores has additional drawbacks in not giving any indication of where the data came from, or if it is qualitative or quantitative in nature. Additionally Leopold matrices do not specify the probability of an impact occurring, and excludes details of the techniques used to predict impacts. People also sometimes attempt to sum the numerical values within matrices to produce a composite value for the development's impacts and to compare this to other developments. This urge should be guarded against because the Leopold matrix does not assign weightings to different impacts to reflect their relative importance (Glasson, et. al., 1994; Rau, et. al., 1980). This practice would lead to erroneous results due to the fact that individual impacts are recorded on an ordinal or interval scale, and therefore aggregations are invalid (Roberts, et. al., 1980).

Regardless of their shortcomings, matrices do make handling information involved in a formal EIS easier and more understandable when used correctly. They force a generalized but well-defined approach, forcing a comprehensive consideration of environmental components and primary impacts. Matrices also have low resource requirements and, in extended forms, methods can include information about many impact attributes and clarify the assumptions supporting the assessment. Most advantageous is that it is a relatively simple and easy process, which aids specification of the overall character of a project early in the design phase.

Other types of matrices have been developed in addition to the Leopold (1971). Magnitude matrices, for example, go beyond the mere identification of impacts by describing the impacts according to their magnitude, importance, and/or time frame (i.e.

short, medium, long-term) (Glasson, et. al., 1994). Weighted matrices were developed in an attempt to respond to some of the above mentioned problems with Leopold matrices. Importance weightings are assigned to environmental components, and sometimes to project components (Glasson, et. al., 1994). The impact of the project (component) on the environmental component is then assessed and multiplied by the appropriate weighting(s), to obtain an overall total for the project (Rau, et. al., 1980).

For this project, three Leopold matrices were constructed using the three phases of MTR on the X-axis, and characteristics or elements of the environment potentially effected by MTR on the Y-axis. Matrix 1 (Figure 4) was constructed to incorporate all general environmental impacts arising from MTR. Matrix 2 (Figure 5) is an extension of this format, and identifies general socio-economic impacts, and aesthetic impacts. Matrix 3 (Figure 6) was constructed to identify possible aquatic resources impacts, and is an expansion of the matrix cell labeled “aquatic resources” found within Matrix 1 (Figure 4). Cells located within Matrix 3 (Figure 6) represent aquatic resource impacts arising during the three phases of MTR in West Virginia. In all three matrices, large black circles denote major negative impacts, small black circles denote minor negative impacts, dark positive signs denote major positive impacts, and thin positive signs denote minor positive impacts (Figure 3).

It must be noted that due to the scope of this project, the data used to populate the matrices is very subjective in form. The matrices have been used mainly for enhanced learning of EIA techniques, and demonstration purposes. Scrutiny over information populating the matrices would best be left to other agencies actually responsible for this with MTR, such as the WVDEP, or EPA. The choice of symbols denoting impacts were

arrived at objectively after undertaking this project, and analyzing all the information that was reviewed for this project. It is ironic to note that as described earlier, this type of scoping exercise has yet to be documented by agencies involved in MTR studies, so this approach is somewhat novel in its attempt to represent MTR, and identify areas of further research and focus.

Matrix 1 and 2 (Figures 4, 5) as stated, identify general impacts associated with MTR in West Virginia. Cells with no symbol either have no impact, or no information relating to the possible impact has been documented to date. It is apparent that the extraction phase of MTR is the most environmentally degrading phase of MTR, as one would expect. Environmental impacts present also in the exploration phase are magnified during the extraction phase due to the longevity of operation.

Matrix 2 (Figure 5) includes a combination of impacts. Cultural preservation is the most heavily effected element. To coordinate excavation takes time, effort, and money. Many times these mining operations proceed so fast after permitting, that whatever cultural or historical value the lands once had is usually lost forever. Once completed (reclamation and post-reclamation), one can see that the impacts of MTR become more and more positive due to the ability to now develop the land by the community or the coal companies. Sometimes this is never realized though because of either lack of roads to the site, remoteness, or lack of need at that potential location. So in a contemporary situation, this section would warrant definite further explanation for the reasoning behind the choice of symbols.

The 'aesthetic and other' sections of Matrix 2 (Figure 5) represent elements that are discussed in the Governor's Task force Report and usually scrutinized by all sides of

the MTR debate. The visual quality of a landscape is difficult to measure. Many people opposed to MTR, claim that it is removing the one feature by which the state is identifiable, mountains. People have chosen to move to this state, and live here for generations due to the aesthetics of the landscape. Another interesting impact is the potential for MTR to alter microclimates. This topic is listed under the EPA's webpage (EPA Region 3 Website, 1999), and within the Governor's Task Force Report (1998). To what extent this actually occurs is under investigation.

Matrix 3 (Figure 6) focuses on aquatic resource impacts. It is an expansion of the row entitled 'aquatic resources' from matrix 2. This matrix seeks to demonstrate the manner in which individual cells may be expanded for further in-depth investigation. The importance of this environmental resource in any review of MTR is warranted due to the presence of many large black circles, denoting major negative impacts. Many minor impacts found in the exploration phase, are magnified in the extraction phase. This is again due to the extent, duration, and magnitude of alterations arising from the extraction phase. The act of filling in streams has a devastating effect on aquatic resources as noted. Either habitat is totally lost, or severely impacted. By removing this part of the ecosystem in West Virginia, many interrelationships to terrestrial systems have been potentially severed or lost.

The reclamation phase of MTR help to rectify some of the impacts from the extraction phase on aquatic resources (Figure 6). Commercial forestry has been one aspect which has had mixed reviews. This option stabilizes the land quicker, but if done with non-native species this process could potentially have further negative impacts to the systems. Pines are acidic in nature, and have the ability to change the soil chemistry, and

therefore potentially alter native tree assemblages. This could also effect forest animals by limiting mast production. Native tree operations have been identified as a more viable alternative, and are more consistent with the principles of watershed management.

Matrix 3 (Figure 6) identifies the action of MTR as a major negative impact to basically all listed environmental themes at some point in the complete operation of MTR. The reasoning behind this is the distinct possibility of habitat removal or alteration. The choice for these symbols could (and should be) be mitigated in a real life situation. In a contemporary situation, these elements would still sustain impact more than likely, but impact would be minimized, compared to construction or mining without the process of EIA.

Under 'fish' and 'invertebrates' the terms abundance, diversity, and habitat are listed. All three are interrelated, and affect one another. Sedimentation for example from road construction and land clearing can alter habitat, and more specifically the spawning habitat of fishes. Species more tolerant of the altered conditions would begin to dominate. Abundance and diversity of native species would be impacted. Issues such as this and changes in the natural flora and fauna become even more significant when dealing with rare, threatened, or endangered species. Organisms are usually listed this way due to their lack of habitat, or alteration of their habitat by people. One can see that if an endangered species is present in areas of land and aquatic alteration, the chances are greater for that species to become extinct through further loss of habitat. One of the recent arguments used by anti-mining groups recently concerning the Spruce Mine (Arch Coal), was the presence of a rare and endangered bat species located on the coal company

land. The anti-mining groups claim further alteration would possibly cause the bats to become extinct in parts of West Virginia.

Higher order impacts were not specifically evaluated, but a few examples are included due to their significance. One of the best known approaches for investigating higher order impacts using matrices is the Sorenson Matrix (Shopley, et. al., 1984). To properly use this technique, one must include and have a network for the impacts being evaluated. Networks are directional diagrams that identify linkages, and are used to display, in an easily understood format, the intermediary links between a project and its ultimate impacts (Shopley, et. al., 1984). The network is correctly described as a “framework” in the title of Sorenson’s paper (1971) (Shopley, et.al., 1984). The form and content of the diagram has to be predetermined for a particular EIA analysis. Sorenson (1971) postulated that his matrices would lead to the identification of remedial measures and monitoring schemes (Shopley, et. al., 1984).

This approach also has a few disadvantages and advantages. A disadvantage of this approach is that it does not establish the magnitude of inter-relationships between components or the extent of change (Roberts, et. al., 1984). It also requires considerable knowledge of the environment under consideration to construct the network. Use of the network is therefore limited to environments and development alternatives for which adequate data are available, and for which reference networks exist. The main advantage to this approach is its ease with which the ramification of proposed development can be demonstrated. Therefore its main value is as an aid to presenting information on a proposed developmental action.

An example of a section of a Sorenson matrix is given in Figure 8. Even though MTR does not satisfy the guidelines for a Sorenson matrix by having little understanding of the linkages, common effects such as erosion, and sedimentation are documented in literature as having specific effects on aquatic systems. These effects will be extrapolated to the matrix where needed in an attempt to demonstrate potential higher order impacts of MTR on aquatic resources. A network has not been given for this matrix, it is merely an example of the matrix itself. The issues of soil compaction, deforestation, road building, and surface extraction have been followed to third order effects, and their corrective measures given. This matrix is a very powerful representation of environmental linkages.

An additional figure is included showing how one individual cell in a matrix may be extracted and expanded upon to show higher order, or more in depth representation of impacts arising from MTR (Figure 8). The impact of road construction during all phases of MTR is expanded upon to show potential higher order impacts on fish spawning habitat. This is the same process applied in creating matrix 3 from matrix 1, and demonstrates the effectiveness of using matrices for preliminary identification of potential impact areas for further research. Deposition and erosion are two primary impacts arising from road construction under MTR. Deposition in this example, is comprised of both leaf litter and soil sedimentation, and potential acidic deposition.

Second order impacts arising from deposition are the alteration of stream morphology and function. This impact would effect the habitat structure, and complexity. For example, the filling in of spawning runs and other habitat could potentially limit these sites and their availability to invertebrates and fishes. This would be termed an unnatural change in habitat suitability (i.e.-spawning, foraging, etc.),

potentially leading to competition between species and serving as a limiting factor on larval fish recruitment. Recruitment is defined as the numbers or relative levels of fish that pass a certain designated life stage. Fourth order impacts would be the alteration or loss of native aquatic assemblages on a watershed, or larger geographic scale.

Biodiversity ultimately would suffer and is considered another higher impact under this example. This is in violation of the current principles of watershed and ecosystem management, centered on the restoration of historic function and form to watersheds.

Mitigation of aquatic resource impacts is obviously a priority if MTR is to continue in the future.

**Figure 3: Symbol Key for Impact Matrices**

**+** - Major Positive Impact

**+** - Minor Positive Impact

**●** - Major Negative Impact

**●** - Minor Negative Impact

**Figure 4: General Impact Matrix for MTR in West Virginia**

	Boreholes	Road Construction	Heavy Machinery	Trenches	Blasting/Drilling	Soil Compaction	Deforestation	Jobs	Heavy Machinery	Blasting/Explosives	Surface Excavation	Deforestation	Road Construction	Compaction	Valley Fills	Heavy Land Use	Coal Spills	Oil, Gas Spills	Jobs	App. Original Contour	Re seeding	Commercial Forestry	Economic Development	Limited Jobs	
Elements	Exploration Phase of MTR								Extraction Phase of MTR										Reclamation						
Land																									
Ground Cover	•	•		•			●				●	●	•	•	●	●		•			•	+	+		
Deposition		•	•	•		•	•		•		●	●	●	•	●	●					•	+	+		
Stability		•			•		•			•	●	●	•		•	•						+	+		
Floods		•					•				●	•	•				●	●				+			
Waste Mngmt.																	●	●							
O. Contour										●	●	●			●									•	
Wildlife				•	•	•	•			•	●	●	•	•	●	•						+		•	
Water																									
Chemistry		•				•	•				●	●	•	•	•		•	●					•		
Drainage		•		•		•	•			•	●	●	•	•	●	•					•	+		•	
Ground Water	•				•					●	•	●	●	●	●		●	●			•	+	+	•	
Surface Water	•	•	•	•	•	•	•		•	●	●	●	●	●	●	●	●	●	●		●	+	+	●	
A. Resources	•	•				•			•		•	●	•	•	●	•		●	●			+			
F., Wildlife				•	•	•	•		•		•	●			●	•		●				+			
Flow Regime	•	•	•		•	•	•		•		•	●	•	•	●	•					•	+	+		
Air Quality																									
Large P. Matter										●															
Chemicals										•															
Odors										•															
Dust				•						●	•														
W. Patterns																									

**Figure 5: General Impact Matrix for MTR in West Virginia (continued)**

	Boreholes	Road Construction	Heavy Machinery	Trenches	Blasting/ Drilling	Soil Compaction	Deforestation	Jobs	Heavy Machinery	Blasting/ Explosives	Surface Excavation	Deforestation	Road Construction	Compaction	Valley Fills	Heavy Land Use	Coal Spills	Oil, Gas Spills	Contour Jobs	App. Original	Reseeding	Commercial Forestry	Economic Development	Limited Jobs	
Elements	Exploration Phase of MTR								Extraction Phase of MTR										Reclamation						
S.-Economic																									
Open Space							+					+			+									+	
Industry							+					+	+											+	
Jobs		+	+				+	+	+		+	+	+							+				+	+
Community					●			+	+	●										+				+	●
C. Viability		+							+	●										+				+	●
Access/ Roads		+											+											+	
Housing Quality					●					●															
Aesthetics																									
Noise/ Vibration	●	●	●		●				●	●		●	●		●	●						●			
Scenery/ View		●					●			●	●	●			●		●	●			●				
Dust		●			●				●	●					●	●									
Cultural Pres.			●		●				●	●	●	●	●	●	●	●	●	●	●		●			●	

**Figure 6: Aquatic Resource Impact Matrix for MTR in West Virginia**

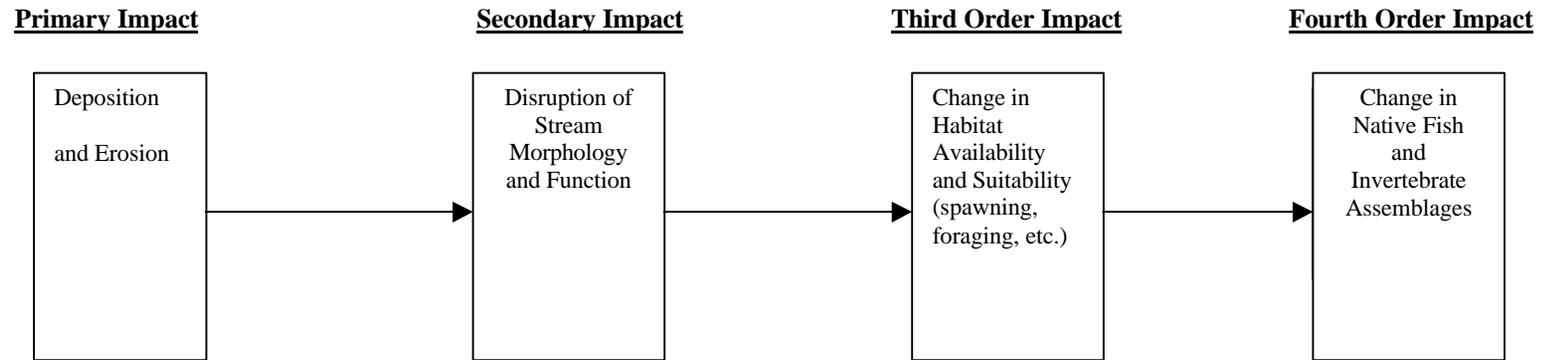
	Boreholes	Road Construction	Heavy Machinery	Trenches	Blasting/ Drilling	Soil Compaction	Deforestation	Jobs	Heavy Machinery	Blasting/ Explosives	Surface Excavation	Deforestation	Road Construction	Compaction	Valley Fills	Heavy Land Use	Coal Spills	Oil, Gas Spills	Jobs	App. Original Contour	Reseeding	Commercial Forestry	Economic Development	Limited Jobs
Elements	Exploration Phase of MTR								Extraction Phase of MTR								Reclamation							
<b>A. Resources</b>																								
Ground Water	•				•	•				•	•	•	•	•	•		•			•	+	+	•	
Surface Water	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•		•	+	+	•	
Turbidity		•	•	•		•	•		•		•	•	•	•	•	•	•	•			+	+	•	
Chemistry		•									•	•	•	•	•		•	•				+	•	
Deposition		•	•	•		•	•		•		•	•	•	•	•	•	•				+		•	
C. Cycling						•					•	•	•	•	•								•	
Geomorphology											•	•	•	•	•					•			•	
Temperature							•				•	•			•								•	
Habitat			•								•	•	•	•	•		•	•			+	+	•	
Flow regime							•				•	•			•						+		•	
<b>Fish</b>																								
Behavior											•	•	•		•		•	•			+		•	
S. Habitat		•					•				•	•	•	•	•	•	•	•		•	+		•	
Migration		•									•	•	•		•		•	•		•	+		•	
Survivorship		•									•	•	•		•		•	•		•	+		•	
Diversity		•					•				•	•	•	•	•	•	•	•		•	+	•	•	
Abundance		•					•				•	•	•	•	•	•	•	•		•	+		•	
<b>Invertebrates</b>																								
Abundance		•					•				•	•	•	•	•		•	•		•	+		•	
Diversity		•					•				•	•	•	•	•		•	•		•	+	•	•	
Migration		•									•	•	•		•		•	•		•	+		•	
Habitat		•					•				•	•	•	•	•		•	•		•	+	•	•	
<b>Others</b>																								
Mammals										•	•	•	•	•	•		•	•			+		•	
Birds				•						•	•	•	•	•	•		•	•			+	+	•	
Amphibians		•					•			•	•	•	•	•	•		•	•			+		•	
Reptiles				•						•	•	•	•	•	•		•	•			+		•	

**Figure 7: Example of a Sorenson Matrix for West Virginia**

<b>Initial Conditions</b>	<b>Consequent Action</b>	<b>Third Order Effect</b>	<b>Corrective Actions</b>	<b>Control Mechanisms</b>
Deforestation	Inc. Surface Run-off	Erosion	Reseeding	Forestry BMPs
Soil Compaction	Increased Run-off	Flooding	Resurfacing, time, reseeding	WVDEP, OSM
Road Building	Increased Run-off	Sedimentation	Reseeding	Forestry BMPs
Surface Excavation	Compaction, Erosion, Inc. Run-off.	Flooding	Reseeding, AOC	WVDEP, OSM

**Figure 8: Example Diagram of MTR Higher Order Impacts on Fish Spawning Habitat**

**(Expansion of Road Construction/ Fish Spawning Habitat Cell from Figure 6)**



## CHAPTER FIVE

### CONCLUSION AND SUMMARY

In this thesis / project I have sought to accomplish two main research tasks. The first task was to review MTR, EIA, and all impacts arising from MTR. MTR is an activity heavily embedded within the state of West Virginia, and its economic input is paramount to many communities. EIA was not found to provide the necessary science and rational framework with which to identify and evaluate the impacts arising from MTR. Current EIA techniques and standards used for evaluating mines are not in accordance with the size of mines operating today, and findings are suspect. MTR is a practice with many long-term environmental impacts that are presently poorly understood and documented. A step forward must be taken by all involved agencies towards improving the process of EIA, and understanding of MTR impacts.

Aquatic resource impacts and research are the most underrepresented and outdated in the current literature. Too many unconnected researchers with no central focus persist as the main problem. Monitoring of mining activities before, during and after development for aquatic impacts along with control areas are lacking in current MTR EIAs. This baseline data is crucial for arriving at any conclusion about impact origins and extent.

Research task two was to undertake a limited scoping exercise on MTR. This was accomplished with five different matrices. Findings suggest an ease of use, and application for the matrix techniques. Despite being basic in design, without them, this information would not have the same impact to the reader. Therefore matrices are valuable tools for representation, as well as for preliminary evaluation of impacts.

As people have become more informed about MTR, and impacts mount, what is accepted and what is not, has changed. Currently it has been shown that lawmakers and politicians such

as Senator Byrd (D-West Virginia) will continue to champion the cause of MTR citing economic benefit and jobs. When jobs and people's welfare are at stake, decisions are usually made favoring communities and people's welfare, not on the environment's well being. Mitigation tends to favor the developer or development to proceed. This is ironic because in the long-term our health depends on the health of our environment. The decision to proceed or not with MTR will probably not be a biologically based decision, even though we know that the impacts from MTR are profound, and long-term (Cincotta, pers. comm.). Many other forces such as political concerns and societal needs must be balanced into the equation along with the environmental concerns. This will more than likely be the future scenario regarding MTR in West Virginia. Hopefully if this practice is to continue, we can learn from past mistakes in the process and mitigate impacts better and more effectively.

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