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EXTENSIVE OVERBURDEN POTENTIALS FOR SOIL AND WATER QUALITY

by

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FOREWORD

When energy and material resources are extracted, processed, and used, these operations usually pollute our environment. The resultant air, land, solid waste and other pollutants may adversely impact our aesthetic and physical well-being. Protection of our environment requires that we recognize and understand the complex environmental impacts of these operations and that corrective approaches by applied.

The Industrial Environmental Research Laboratory - Cincinnati assesses the environmental, social and economic impacts of industrial and energy-related activities and indentifies, evaluates, develops and demonstrates alternatives for the protection of the environment.

This report provides extensive observations and data about rocks and soils involved in surface mining of coal. The conclusions are that controlled placement and proper treatment, based on pre-mining planning, can prevent contamination and make beneficial use of needed plant nutrients exposed by mining operations.

Results of this work will be especially interesting to State and Federal agencies and mining firms who require detailed information from overburden sampling and analysis. This data aids in planning surface mining operations including reclamation and projected land use.

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ABSTRACT

Chemical, physical and mineralogical measurements and interpretations developed during previous studies in West Virginia have been improved and applied to coal overburden columns in 12 widely spaced Neighborhoods and 2 Adjunct locations in 10 states, from Pennsylvania on the Northeast to Alabama on the Southeast and Oklahoma on the West.

Field studies in each Neighborhood and Adjunct location involved logging and sampling soil and rock horizons from surface to coal, testing and improving field clues, determining properties of minesoils and water resulting from mining operations, and checking reclamation. Results in different coal basins have broadened our perspectives and strengthened our conclusions. Refinements have been made in field observations, laboratory methods and interpretations related to kinds of mine soils and anticipated uses of mined lands.

Consistent overburden property relationships within basins and over particular named coals provide opportunities for generalizations and extrapolation between sampled sites.

It appears feasible to use detailed information from overburden sampling and analysis as an aid to pre-mining planning of surface mining operations including reclamation and projected land use.

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In consideration of the reader, who may have need to confer with the authors of individual major topics, the following list is provided:

- Materials and Methods (Freeman and Sobek)
- Geologic Considerations (Arkle and Lotz)
- Pedologic Considerations (Sencindiver and Smith)
- Eastern Coal Province; Central Appalachian Region (Smith and Sobek)
- Eastern Coal Province; Southern Appalachian Region (Cole, Smith and Sobek)
- Interior Coal Province; Eastern Region (Freeman, Sencindiver and Smith)
- Interior Coal Province; Western Region (Sencindiver and Smith)
- Toxic or Potentially Toxic Materials (Singh and Sobek)

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SECTION I

CONCLUSIONS

1. Studies of coal overburden at 12 regular Neighborhoods and 2 Adjunct locations involving 10 Appalachian and Midwestern States support previous conclusions that in humid United States and above permanent water tables pyritic minerals capable of forming sulfuric acid have been oxidized and largely destroyed to depths approximating 6 meters (m), (19.7 feet, ft), or deeper in rocks that have been fractured by geologic processes. Munsell color chroma greater than 2 is an excellent clue to weathered material with pyrite destroyed. Insignificant exceptions involve pockets of pyrite encased in a ground mass of tough, cemented sandstone, hard mudrock or limestone.

2. Studies in Central Appalachia, Southern Appalachia, the Eastern Interior Basin, and the Western Interior Basin support the idea that the Acid-Base Accounting method has wide applications as a means of assuring against acid-toxic or potentially toxic minesoils.

3. The definition of acid-toxic or potentially toxic overburden or minesoils by the following measurements and interpretations has proven generally applicable: (1) determine pH of the pulverized rock paste in distilled water, toxicity is indicated by readings below 4.0; (2) determine total pyritic sulphur and convert to maximum tons (t) calcium carbonate equivalent per 1000 t of material by multiplication of percent sulphur by 31.24; (3) determine neutralization potential of the pulverized rock against standard hydrochloric acid. Then, if the maximum acid calculation from percent sulphur is more than 5 t calcium carbonate equivalent per 1000 t of material in excess of the neutralization potential, the rock is considered potentially acid-toxic regardless of its pH.

4. As a generalization, the parting between coal horizons tends to have a high sulphur concentration, even when the parting (or interval) is as thick as 6.1 m (20 ft). Probably one reason for this is that the parting includes both the roof of the lower coal

(the dying swamp) and the root rock of the upper coal, both of which concentrate sulphur. When the interval is no more than 6.1 m (20 ft), these two zones of concentrations essentially occupy the interval. Concentrations of calcium carbonate, as the limestone and mudstone between coals at River Queen (Western Kentucky) and at Burning Star #2 (Illinois), often overwhelm acidity in spite of pyritic minerals.

5. In our extensive studies it is evident that pyritic sulphur percentage and neutralizing equivalents sometimes tend to correlate positively in overburden rocks that are not necessarily rich in organic matter or coal. The incidence of marine fossils may also correlate positively with pyrite and carbonates. Locally, it may be valid to set neutralization potential levels that are safe from acid dominance regardless of pyritic sulfur content, but on an extensive basis we must continue to use the Acid-Base Accounting method.

6. Some geologic sections in the Southern Appalachians are so low in total pyritic sulphur that non-toxic minesoils are assured even though the neutralization potentials range downward from 5 t calcium carbonate equivalent per 1000 t of materials. An example is Northeastern Alabama, Neighborhood #4 in this study. Previously studied sections giving similar results were overburdens of Sewell coal in Northern Greenbrier County, West Virginia. Since correlation charts place Sewell Coal of West Virginia and Underwood Coal of Alabama at corresponding positions in the geologic sections, it is interesting that overburden composition in this case are so similar for sections separated by a distance of about 643.6 kilometers (km) (400 miles, mi).

7. Rock type studies and analyses from the Eastern Interior Basin and the Western Interior Basin have confirmed that black rocks in general, and black roof shales in particular are not good indicators of overburdens that may develop acid toxicities. Light colored and low chroma sandstones and mudrocks (including claystones, mudstones, siltstones and intercalates) are some of the most acid-toxic materials encountered when their neutralization potentials are low. Some black shales (carboliths and non-carboliths), on the other hand, are low in pyritic sulphur, and others are so charged with neutralizers that their acid potentials are overwhelmed and they make productive mine soils (Spolents) in our humid climate.

8. Sodium bicarbonate extraction of available phosphorus continues to be a promising method for use with overburdens and minesoils,

primarily because a high percentage of samples contain active neutralizers (mostly carbonates) that react with acid extractants and often release ferrous ions from siderite, resulting in green colors that invalidate the colorimetric test for phosphorus in acid extractants. Extensive data obtained by the bicarbonate extraction method now suggests that two zones in the overburden often contain highest available phosphours: (1) the weathering front, at or near the depth boundary between the high chroma (highly weathered iron colors) and low chroma rocks; and (2) carbon rich rocks (carboliths) where phosphorus may have accumulated from plant residues.

9. The rather massive bulk of overburden data now accumulated indicates that we should place more emphasis on the blending of materials to form better minesoils, rather than thinking so much about burial of selected materials that are potentially toxic. Desirable blending can be planned intelligently when sufficient overburden analyses have been completed in advance. Advantages that may be gained from blending include reduced operation costs in some cases, as well as superior minesoils because blends combine desirable properties from different kinds of materials. Often, neutralizers are abundant enough in certain mudrocks or weak sandstones to prevent any possible toxicity from associated carboliths, whereas available phosphorus and minor elements in the carbon rich rock are important nutrient sources. A blend should be superior to either material alone or buried.

10. It is increasingly evident that coarse rock fragments can be desirable in minesoils rather than harmful. Stable, angular rocks form the best basal contact with bedrock or old soil. A broad mixture of particle sizes including at least 50 percent coarse fragments constitutes physically stable deposits in deep minesoil horizons. Subsoil suitability for plant roots, aeration, and available water retention are likely to be improved rather than harmed by some coarse fragments. Surface layers that are to be plowed must be relatively free from rock fragments coarser than 150 millimeters (mm) (6 inches, in) diameter. On the other hand, surface coarse fragments as large as 75 mm (3 in) diameter are not necessarily harmful and may prevent serious erosion. Simple slaking tests in water (mild treatment) and prolonged gentle shaking in Calgon solution (drastic treatment) are methods that help to predict rock fragment stabilities and best uses.

11. If the term "topsoil" is used it should mean material suitable for placement on the surface to improve the soil for anticipated uses.

12. A widespread, serious problem contributing to minesoil erosion and water pollution is excessive compaction in the plant root zone. Extensive minesoil profile observations and descriptions fully support early research (Chapman 1967) that grading and other machine operations tend to pack minesoils, thus restricting plant roots and preventing vigorous top growth.

SECTION II

RECOMMENDATIONS

1. Surface mining should be planned in advance, and the total plan should include reclamation designed for intended land use with no water pollution.

2. Essential information for developing a surface mining plan should include detailed knowledge of soil and overburden properties that will influence the suitability of these earth materials for prevention of water pollution and formation of desirable minesoils.

3. A standard Soil Survey should be made for each operation as an aid to soil sampling and for deciding whether the original soil has properties that justify its special handling and placement.

4. Detailed geologic overburden sampling of rock columns down to the coal should be required arbitrarily, at intervals of 1 km (0.6 mi) or less, depending on the rate of lateral change of rock strata. The need for more frequent sampling must be determined locally to satisfy the demands of soil and water quality.

5. Routine sequential sampling of overburden columns with depth should require at least one sample representing each 0.3 m (1 ft) of overburden from the land surface to the top of each coal to be mined. If samples for analysis are taken by a named, qualified Geologist or Pedologist (Soil Scientist as defined by the U.S. Civil Service), each vertical sample may represent as much as 1.5 m (5 ft) of depth if the Geologist or Pedologist states in writing that each sample represents soil or rock which he believes to be reasonably uniform in physical and chemical properties that are to be determined.

6. Each overburden column sampled should be analyzed as necessary to obtain a detailed Acid-Base Account with depth. This Account should provide the basis for decision whether or not the operation is feasible without acid pollution, and if approved as feasible, the Account dictates the placement of materials that will assure prevention of acid pollution.

7. Within the limitations set by the Acid-Base Account, other overburden properties will determine placement of materials that will provide massive physical stability of the deposit and minimum erosion hazards from surface runoff.

8. Within limitations set by demands of physical stability and erosion resistance, choices of materials for placement should consider water-holding characteristics and available plant nutrient levels favorable for intended uses of the land.

9. Lime and fertilizer, mechanical manipulation, and erosion control practices required for quick reclamation suited to the intended use of new minesoils, should be anticipated from physical and chemical studies of the overburden and should therefore be stated as a part of the advance plan for the total operation.

SECTION III

INTRODUCTION

The purpose of this investigation was to enable strip mine operators to eliminate water pollution from mine spoils and to assure minesoil characteristics needed for anticipated uses of the land. This was accomplished by determining overburden characteristics from test core, rotary drill, hand and grab samples obtained in advance of surface mining in 12 Neighborhoods and 2 Adjuncts (Figure 1) in nine states other than West Virginia. These samples were correlated with named coals and identified strata in rock and soil sections, and keyed to field observations and clues that aided consistent recognition of particular rock types and properties which were revealed by laboratory study.

Field and laboratory determinations make use of technology and standardization of methods established during the past 5 years of study of coal overburdens in West Virginia. Properties which were determined with depth from the land surface and distance above the coal, included acid-base potential balances derived from present acidity (or alkalinity), potential maximum pyritic acidity and neutralization potentials (from exchangeable bases, alkaline carbonates, and other weatherable materials). Other determinations included plant available phosphorus, potassium, calcium and magnesium and other nutrients that may be severely seperate deficient and toxic elements where concentrations are likely to inhibit plant covers. The application of these results to neighborhoods not studied in detail was guided by stratigraphic rock and soil correlations including areal trends that were demonstrated or inferred. Also, further progress in the precision of classification and morphological description of minesoils in all areas studied was made.

The following specific objectives were fulfilled in order to fill the information void found regarding overburden characteristics and pre-planning of the resultant minesoils before strip mining had occurred: (1) determination of acid-base potentials and other essential properties with depth for coal overburdens at 12 selected Neighborhoods in nine states within the Eastern and Interior Coal Provinces, (Figure 1) and interpretation of these properties into recommendations for sequential placement and treatment options to accomplish planned reclamation and land use with minimum water pollution; (2) provide a basis for predicting the extent to which overburden data may apply to neighborhoods and regions not samples; (3) indicate, generally, the nature of supporting practices and timing that may be necessary to assure success of planned reclamation; (4) indicate available geologic and soils information, including certain observable or easily measurable field clues that may aid recognition of soil or rock properties needed for planned overburden uses; (5) develop new procedures or adapt established procedures when necessary to achieve essential characterization of overburden materials.

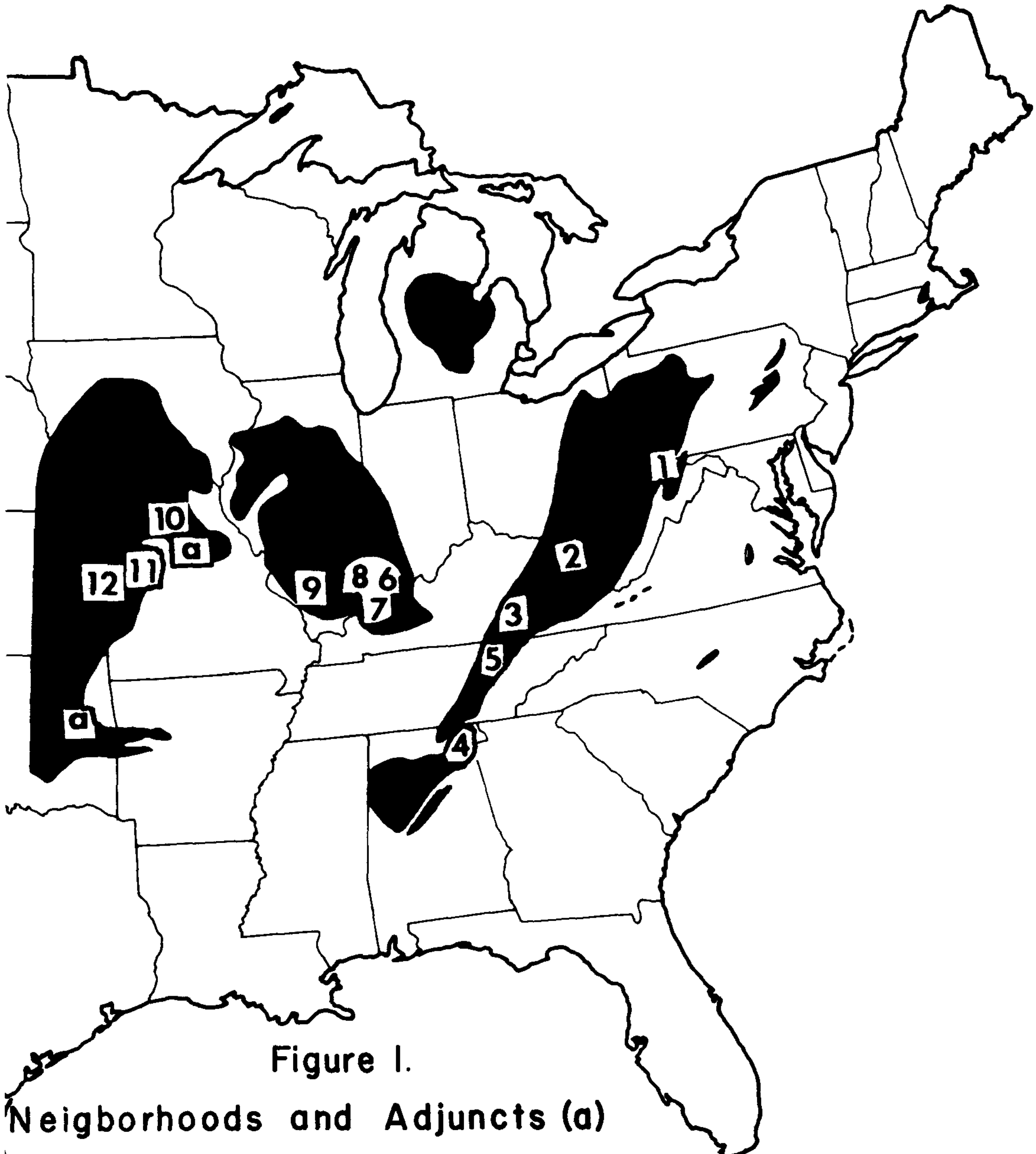


Figure I.
Neigborhoods and Adjuncts (a) investigated

Key to Figure 1

Neighborhood 1:	Somerset County, Pennsylvania and Garrett County, Maryland
Neighborhood 2:	Mingo County, West Virginia and Pike County, Kentucky
Neighborhood 3:	Hazard Area, Kentucky
Neighborhood 4:	Fabius Mine, Jackson County, Alabama
Neighborhood 5:	Scott and Campbell Counties, Tennessee
Neighborhood 6:	Lynnville Mine, Warrick County, Indiana
Neighborhood 7:	River Queen Mine, Mullenberg County, Kentucky
Neighborhood 8:	Will Scarlet and Eagle Mines, Saline and Gallatin Counties, Illinois
Neighborhood 9:	Burning Star #2 Mine, Perry County, Illinois
Neighborhood 10:	Bee Veer and Prairie Hill Mines, Macon and Randolph Counties, Missouri
Adjunct (a) to Neighborhood 10:	Mark Twain Mine, Boone County, Missouri
Neighborhood 11:	Power and Tebo Mines, Henry County, Missouri
Neighborhood 12:	Midway Mine, Bates County, Missouri and Linn County, Kansas
Adjunct (a) to Neighborhood 12:	Sierra Mine, Muskogee County, Oklahoma

SECTION IV

MATERIALS AND METHODS

SAMPLING

The sampling of overburden materials from the undisturbed soil surface to the coal being sought for mining was accomplished by test cores, rotary drill, hand and some grab samples in advance of surface mining.

Test cores were available for some sites studied, but the majority of sites were sampled by collecting rock chips and hand sampling. Rock chips were collected as they were expelled by compressed air from a rotary drill at regular intervals, usually 30 centimeters (cm) (1 ft) of depth during the drilling of blast holes above the highwall. The vertical column of material from the drill bench up to the surface of the undisturbed soil was sampled by hand. When an appropriate rotary drill was lacking, overburden samples were taken by hand sampling the highwall at regular intervals from the coal to the land surface by working along access roads, by using extension ladders, and by cliff-climbing technique on a rope. In addition, grab samples were taken of unique or interesting materials whenever they appeared.

All core, or section logging, sample preparation, subsampling, and grinding of overburden samples were done according to previously published procedures (Smith, *et al*. 1974).

ACID-BASE ACCOUNTS AND COROLLARY INFORMATION

The Acid-Base Account Table includes four measurements: color, fiz, total sulfur and neutralization potential. Soil color was determined on all samples ground to pass a 60 mesh sieve, using the standard Munsell soil color charts which have color subdivided into *hue*, *value*, and *chroma* (Munsell 1971). *Value* was used to distinguish highly carbonaceous materials from materials that appear black to the casual observer. When such materials are powdered (ground to less than 60 mesh or rubbed on a porcelain plate), the highly carbonaceous materials will have a value of 3 or less on any Munsell hue.

Chroma is one of the most easily recognized color attributes and can be used to recognize many soil and rock features. It is now well established that minesoils developing in overburden from the intensely weathered zone below the original land surface is safe from pyritic sulfur (pyrite, marcasite, chalcopyrite, etc.) and extreme acidity. This zone commonly is 6.1 m (20 ft) deep or deeper in West Virginia, depending on lithology, degree of structural fracturing of the rock, and position of the water table. Brown and yellow rock colors (Chroma of 3 or higher on Munsell Soil Color Charts) as typified by materials from the weathered zone, provide useful clues to safe materials regardless of whether their position in the stratigraphic section is known. However, absence of high chromas in near-surface soils and rocks can result from intense leaching of iron oxides or (in soils) from impeded drainage which causes iron reduction. The low chroma imparted to the surface of highly leached materials in soils and near-surface rocks can be distinguished readily from pyritic low chroma rocks below the depth of weathering. One difference is that lowest chromas (gray colors) caused by leaching or impeded soil drainage occur on rock or soil ped exteriors, whereas lowest chromas typify interiors of unweathered (may be pyritic) sandstones or shales. Color chroma has proven reliable as a field clue particularly with many sandstones. Freshly broken rock surfaces with chromas of 3 or higher (hand specimen of pulverized sample) indicate negligible percentages of pyritic sulfur. Chromas of 2 or less often correspond with sufficient pyrite to cause pH below 4.0 and biotoxic reactions.

Geologists and soil scientists commonly test rocks and soils for the presence of carbonates by applying a few drops of dilute (1:3 or 10%) hydrochloric acid to the sample. If noticeable reaction, evidenced by effervesence, or bubbling, or even an audible "fiz" occurs, our results indicate that at least the equivalent of 10 t calcium carbonate equivalent per 1000 t of material is present. Some rocks may not show immediate reaction, but if a powder is scraped from the rock with a knife or other tool and tested with acid, an otherwise unnoticed limerock may be detected.

The LECO Induction Furnace with Automatic Sulfur Titrator was used to determine total sulfur following the procedure of Caruccio for the analysis of coal which was modified for the analysis of overburden materials (West Virginia University 1971).

The Neutralization Potential procedure measures the total amount of bases in rock materials following a modification (Smith, et al. 1974) of a procedure used to measure the neutralizing equivalence of agricultural limestone (Jackson 1958).

CHEMICAL CHARACTERIZATIONS

The pH was determined on < 60 mesh samples by two methods: (1) 1:1 (solid:water) ratio on a weight basis; and (2) the paste or slurry method (2:1 ratio of solid to water). The 2:1 ratio results in the filling of porosity with water and is preferable because it assures close contact between solid and the electrode with essentially no supernatant liquid.

The overburden material was extracted with an acid solution, 0.05N hydrochloric acid + 0.025N Sulfuric acid (Nelson et al. 1953) and extractable potassium, calcium, magnesium, and phosphorus were measured utilizing a colorimeter for phosphorus and an atomic absorption spectrophotometer for potassium, calcium, and magnesium. Phosphorus was also determined by the bicarbonate extraction method (Olson and Dean 1954) which was modified to be used with overburden materials. Lime Requirement was done using the Woodruff buffer method (Woodruff 1948). The analyses for total macro- and micro-elements were accomplished using standard soil procedures (Jackson 1958) and modified as noted in Section X.

The nutrient levels were evaluated using the information in Table 1. It should be NOTED that any acid-extracted phosphorus values which have a G or M following it in the tables should be disregarded. The G and M represent green and milky which are the colors that develop due to an interfering ion, possibly ferrous, being present. All data are presented to show the higher reliability of the bicarbonate-extracted phosphorus values as compared to the acid-extracted.

Table 1. AGRONOMIC LEVELS OF PLANT NUTRIENTS USED TO RATE THE NUTRIENT STATUS OF SOILS AND OVERBURDEN MATERIALS AT WEST VIRGINIA UNIVERSITY FOR BOTH ACID AND BICARBONATE EXTRACTS, EXPRESSED AS POUNDS PER THOUSAND TONS OF MATERIAL OR MILLIGRAMS PER TWO KILOGRAMS.

	Acid Extracted				Bicarbonate Extracted
Rating	P	K	Ca	Mg	P
Very low	0-24	0-39	0-399	0-49	-
Low	25-49	40-78	400-799	50-99	0-10
Medium	50-99	79-156	800-1999	100-249	10-20
High	100-174	157-234	2000-3999	250-499	20+
Very high	175+	235+	4000+	500+	-

PHYSICAL CHARACTERIZATIONS

Rock types were identified according to the definitions found in Section XIII and in accordance with the procedures used previously (Smith, et al. 1974).

Water slaking was developed as a mild, weathering procedure to be used in the field or the laboratory. It indicates if the rock will disintegrate easily when exposed to atmospheric conditions. The procedure for the water slaking test is as follows:

Apparatus

1. 250 milliliters (ml) beakers
2. 6.35 mm (1/4 in) mesh, hardware cloth
3. Distilled water
4. Paper clips

Procedures For Core, Hand And Grab Samples

1. Select one or more representative fragments, weighing approximately 15 grams (g).
2. The hardware cloth is cut to fit into the beaker and is suspended in the beaker by large paper clips hooked over the rim of the beaker.
3. Fill the beaker with enough distilled water (tap water can be used) to cover the screen and the fragment which is to be tested.
4. Drop fragment on screen and let the sample stand undisturbed for 30 minutes (min).
5. Visually estimate the percentage of material which has fallen through the screen, using a scale of 0 through 10 to represent 0 to 100 percent.

Procedure For Rock Chip Samples

1. Sieve the sample through a 6.35 mm (1/4 in) sieve and collect all the material caught by the sieve.

1A. Select a representative subsample weighing approximately 15 g (4 or 5 large chips) then follow above procedure starting with step 2.

SECTION V

GENERAL CONSIDERATIONS

GEOLOGIC

This section reviews and discusses geologic considerations in an interdisciplinary geologic-pedologic study of spoil material. In addition to more efficient controlled placement of spoil materials during reclamation, a joint study of this type tests the broad geologic assumptions and refines knowledge of the potential soil making properties. Further, analysis of spoil material by the pedologist may be another tool in establishing co-relationships between the strata and other geologic featurs and the delineation of environments of deposition represented in regional facies changes, i.e., the encroachment of alluvial (deltaic) deposits on swamp (organic) and lacustrine-marine (chemical) deposits.

All natural material between parent rock or bedrock and the atmosphere is included in the pedologic discussion following in this section. The great diversity of natural soils and surficial (alluvial, colluvial, glacial) deposits of varying thicknesses associated above the coal-bearing strata of the eastern United States, however, preempts these materials from the scope of the geologic discussion.

The geologist assumes that the gross physical and chemical characteristics of similar thick bodies of coal bearing rocks reflect similar environments of deposition although not necessarily contemporaneity. The stratigraphy reflects the sedimentary history and structural activity and determines the subsequent development of the physiography of the surface of the region. Since only remnants of widely separated coal basins are extant for study, it becomes difficult to establish whether thick series of shale and mudstone and fine- to coarse-grained sandstones, locally conglomeratic, arranged in repetitious sequences with thinner coals, clays, lacustrine and marine limestone, chert and ironstones are co-relational or coincidental to the several geologic features available for study.

Nevertheless, geologic considerations center on the development of a geologic frame of reference to aid the pedologist in efficient selection of sites for sampling of overburden materials. The limited time for traveling great distances to sampling sites and consumed in sampling restricts the density of the number of samples for analysis and the time for detailed study of the geology in such a large area.

West Virginia becomes the type section and geologic frame of reference for the study of spoil material in the bituminous coal basins of the eastern United States for two reasons: (1) Study of pedogenic processes of spoil material was initiated in West Virginia in 1940 in material stripped during removal of iron mineral (ore) concentrations prior to and following the Civil War. This work continued with the advent of coal stripping during World War II but at greatly increased tempo under grants from the Environmental Protection Agency since 1969; (2) West Virginia has the most complete and continuous Pennsylvanian and Permian (West Virginian) stratigraphic section extending without appreciable interruption from a younger basin of deposition on a stable cratonic platform of the Continental Interior during Pennsylvanian time to an older less stable basin farther to the southeast. The younger mining district includes the youngest Paleozoic rocks of the Appalachians (Surface Mining Province 3) and older related subadjacent Pennsylvanian rocks (Surface Mining Province 2) in northern West Virginia and the older mining district includes the wedge of basal Pennsylvanian beds (Surface Mining Province 1) thickening to the southeast in southern West Virginia (Arkle 1974; West Virginia University 1971).

Within such a broad geologic frame of reference, some note of the local irregularities so typical of all coal-bearing rocks in the eastern United States is necessary, *i.e.*, the broad generalizations are further complicated within the several coal basins by the diverse local nature of the more terrigenous continental environments of deposition encroaching on lake-swamp-marine environments of deposition. Tributaries and distributaries of the shifting drainage system debouched sand and mud (deltaic) below and on irregular surfaces above the more regular and thinner swamp (organic) and lacustrine-marine (chemical) deposits. In the former case, differential compaction of the irregular fine and coarse clastics formed irregularities on the floor of the swamp lake and sea resulting in local wants in coal and limestone deposits and penecontemporaneous slumping of beds. In the latter case, erosion of the surface by shifting drainage systems cut out the underlying sediments and organic and chemical deposits. The channels and other irregularities were filled with clastics. Channel filling with sand often coalesce with sand bank or channel deposits below to form sandstone sections over 30.5 m (100 ft) thick. Both instances, separately or combined, alter the physical and chemical characteristics of potential spoil materials and interrupt the continuity of coal and limestone deposits, locally as well as regionally. These disruptions are often responsible for local problems in the reclamation of surface mines.

Water quality and other reclamation problems generally exist in Surface Mining Province 2 (Allegheny Formation and lowermost part of the Conemaugh Group in West Virginia). Varieties of association of overburden materials and attendant problems of an area can be anticipated in advance by construction of generalized and somewhat diagrammatic cross sections similar to the northeast cross section E-E' of the Georges Creek Basin of Garrett County, Maryland and Preston, Tucker, Grant and Mineral Counties, West Virginia (Figures 2, 3a and 3b) for purposes of advanced planning. More detailed cross sections should be constructed from measured sections, core records and sections penetrated in overburden blast hole drilling during preparations for surface mining operations. Preparation of isopachous maps of thickness and of net acid-making potential of lithologic units of prospective spoil material would be more useful than cross sections in areas where closely spaced overburden sections and analytical data are available.

The depositional history of the Pennsylvanian rocks of the younger mining district of northern West Virginia, western Maryland (Figure 2, 3a and 3b), southwestern Pennsylvania, and eastern Ohio of the bituminous coal field of central Appalachians have a comparable depositional history to the rocks of the Eastern (western Kentucky, Indiana and Illinois) and Western (Missouri) Interior Coal Province of the central United States, i.e., in both instances, the coal swamps and associated sediments were deposited in shelving rather stable basins on the craton of the continental interior during Pennsylvanian time.

The layer cake concept of deposition reflected the nature of the rhythmically repetitive marine and terrestrial sediments in the midcontinent and the northern part of the central Appalachians. The Pennsylvanian subcommittee of the National Research Council, Committee on Stratigraphy attempted to establish contemporaneity of beds between the respective coal basins (Committee on Stratigraphy of the Pennsylvanian 1944, p. 666-704, Chart No. 6) based on the cyclothemic theory of coal deposition which conceived closely spaced repetitive transgressive and regressive couplets resulting from wide-spread inundations of the shallow seas upon a broad low-lying swampy coastal plain.

Cumulative maximum thicknesses of the thickest Pennsylvanian units in the younger mining district of the central Appalachians is 594.4 m (1950 ft) (Arkle 1974) as compared with 762 m (2500 ft) in Illinois (Smith 1958) and about 609.6 m (2000 ft) in Missouri in the Interior

Coal Province (Howe and Koeng 1961). In addition, there are about 365.8 m (1200 ft) of similar beds of Permian (?) age with generally thin locally developed coals above the Pennsylvanian in West Virginia and southwestern Pennsylvania in the central Appalachians.

Perceptible changes take place in the coals and associated rocks between the eastern edge of the younger mining district of the central Appalachians and the Interior Coal Province. High volatile and generally high sulphur (> 2 percent) coals occur on the eastern edge of the central Appalachians. Lower volatile and local areas of lower sulfur (< 2.0 percent) coals in several seams occur in the Allegheny Mountain Section on the northern and eastern fringe of the Appalachian Plateau. Coals increase in sulfur (> 3 percent) and moisture contents with a commensurate decrease in fixed carbon and calorific value to the west although coals approach the high quality of lower grade Appalachian coals in the Southern part of Illinois. Sandstones are present in all the coal basins of this report; however, a larger quantity of coarser sediments from sources to the south and northeast of the eastern perimeter of the younger mining district of the central Appalachians were deposited to form medium grained sandstones and some pebbly coarse grained sandstones (Surface Mining Province 2). The percentage of sandstone decreases in ascending the section to the youngest beds of the Paleozoic System in the Appalachians (Surface Mining Province 3) (Figure 3b). From here, there is a progressive decrease in the percentage of sandstone in sections and size of grains from the east into the western Interior Coal Basin. The amount of pyrite and alkaline earths in sandstone is small in the east. These constituents increase in sandstone to the west. Concentrations of pyritic carbonaceous shales are common in several coal basins. Pyrite is an ubiquitous mineral in shale, mudstone and limestone of the younger mining district of the central Appalachians and the eastern and western Interior Coal Province. The pyritic content of these beds increase from east to west; however, the alkaline earths increase in the section from east to west with the intercalation of more numerous and thicker lacustrine and marine limestones and an increased carbonate content in more numerous shale and mudstone units. These argillaceous units contain numerous carbonate (calcic and sideritic) pellets, knots and nodules. Concentrations of gypsum and of phosphates are known to occur in the eastern and western Interior Province.

Changes in the lithologic or rock section of some coal basins signal extensive regional and long standing changes in environments of deposition, e.g., the regional facies changes of southwestern and central West Virginia, northeastern Kentucky and southeastern and central eastern Ohio of the Appalachian Basin (Arkle 1974). Regional changes in extensive environments of deposition in other coal basins, e.g., the eastern and western Interior Coal Basins are not as evident; however, a large part of the latter basins are blanketed with thick glaciofluvial deposits. It is, however, the subtleties of local changes in the physical and chemical characteristics of the coal and associated rocks from the more usual and normal condition that plagues the reclaimers of surface mined lands. Recognition of often hidden subtle changes in overburden material prior to placement of spoil material and during reclamation may eliminate the need for costly remedial treatment of the surface of reclaimed lands. Cross sections or isopachous maps where sufficient data are available illustrate graphically the lithic and pedogenic characteristics of the rock associations above coal. Examples of changes in rock associations or prospective spoil materials from the usual suitable situation are evident in both the eastern and western Interior Coal Basins.

In Perry County, Illinois, the normal overburden above the high sulphur (3 to 5 percent) No. 6 (Herrin) coal is dark gray shale, mudstone (argillaceous beds include varying amounts of siltstone, limestone and fossiliferous shale) having generally an excess of $CaCO_3$ as indicated in Neighborhood 9 (Tables 111-120). Lower sulphur (1 to 3 percent) No. 6 metallurgical coal occurs in pod-like bodies associated with an oval narrow channel sandstone-complex extending from Shelby County in south central Illinois to the northwestern corner of St. Clair County and thence on south across the eastern edge of Perry into Williamson County (Gluskoter and Simon 1968). Overburden above the lower sulphur No. 6 coal consists of gray shale and associated sandstone in ascending the section.

A detailed acid-base account of samples of shale and sandstone in ascending the section above the lower sulphur No. 6 coal at Desota, Jackson County indicates a slight excess of carbonate with the exception of variable gray shale (partly carbolith) distributed in the section 6.1 m (20 ft) above the top of the coal. The top 18 m (59 ft) of the core shows only a slight excess of carbonates. Experience indicates that overburden material of this type should be used carefully in reclamation because slight concentration of pyrite laterally could result in a toxic spoil material.

Great local variations and irregularities in the distribution of coal, shale, mudstone (argillaceous beds include varying amounts of siltstone), irregular limestone and occasional fine grained channel sandstones were analyzed and observed in the surface mining of the high-sulphur Wheeler-Bevier and Mulky coals of the Western Interior coal basin. Variability of beds accounts for the great lateral changes in the acid-base accounts of samples from Henry County (Neighborhood 11, Tables 146-151), Boone County (Adjunct to Neighborhood 10, Tables 134 to 136), and Macon and Randolph counties (Neighborhood 10, Tables 122-133).

The beds of the Pocahontas (219 m:720 ft), New River (314 m:1030 ft) and Kanawha (640 m:2100 ft) Formations and the Charleston (122 m:400 ft) Group in ascending the section represent the earlier of the two coal basins of Pennsylvanian age in West Virginia (Surface Mining Province 1) and contiguous areas of western Virginia and eastern Kentucky of the central Appalachians which is related depositionally to the beds of Pennsylvanian age of Tennessee and Alabama of the southern Appalachians. The basin subsided intermittently and deepened to the southeast. The sediments, essentially a wedge of fine to coarse clastics, were derived from older rocks of the Appalachian region to the south. The coal bearing facies, the base of which is the southeastern exposure of Pennsylvanian rocks in southern West Virginia and western Virginia, thin rapidly from the thickest section to the northwest into massive marine (early) and deltaic (late) sandstones and finally disappear in the subsurface of western West Virginia.

The thickness of the beds of the older mining district are perhaps 1370 m (4250 ft) thick in West Virginia, somewhat thinner in Tennessee and the basal Pocahontas-New River equivalents are a maximum of 3200 m (10,000 ft) in Alabama of the southern Appalachians.

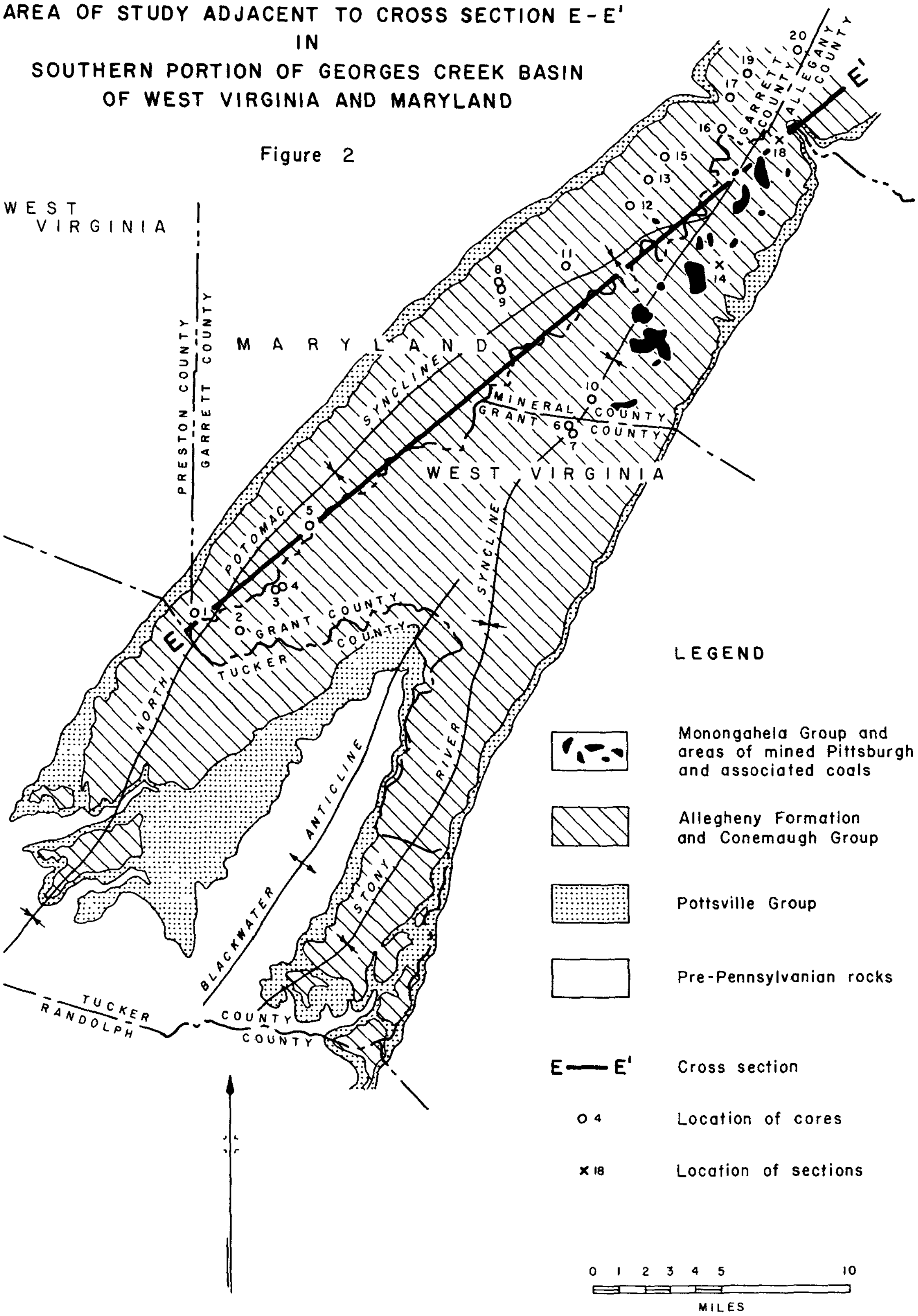
The beds of the coal facies (1:1 sandstone-shale ratio) of the Pocahontas-New River Formations in West Virginia and equivalents in Alabama and the Cumberland Plateau of Tennessee of the southern Appalachians are subgraywacke and some quartzose sandstone and generally medium gray shale intercalated with low to medium volatile coal beds of very high calorific value and generally low sulfur (< 1.0 percent). The entire rock section is generally low in pyrite as well as alkaline earth minerals.

The beds of the coal facies (1:1 sandstone-shale ratio) of the Kanawha Formation in southern West Virginia and eastern Kentucky of the Central Appalachians and equivalent beds in central Tennessee of the southern Appalachians are subgraywackes and light to medium gray shale or mudstones intercalated with high volatile coals of high calorific value and generally low sulfur (< 1.50 percent) coal. The carbonates are occasionally either thin lacustrine limestone beds or small to medium size limestone concretionary bodies and generally thin lenticular or concretionary marine limestone beds occurring in thicker marine shales. Chert of small areal extent is present toward the top of the Kanawha and in the overlying Charleston Group. Siderite ($FeCO_3$) occurs as cementing material in sandstone and siltstone and as numerous small to large, up to 1.2 m (4 ft) impure lenses, nodules and stringers in shale, siltstone and sandstone.

Pyrite is not a ubiquitous mineral in the Kanawha Formation and equivalents; however, coal and associated rocks locally contain concentrations of pyrite, as noted in Neighborhood 3 (Hazard, Kentucky).

AREA OF STUDY ADJACENT TO CROSS SECTION E-E'
IN
SOUTHERN PORTION OF GEORGES CREEK BASIN
OF WEST VIRGINIA AND MARYLAND

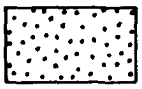
Figure 2



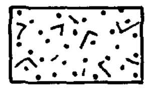
LEGEND

GEOLOGIC CROSS SECTION E-E'
Figure 3 a

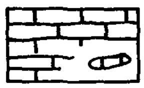
Lithologies adapted to the
American Comprehensive System
of Soil Classification



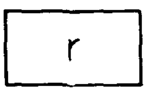
Sandstone



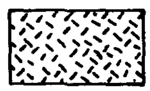
Quartzose sandstone



Limestone (includes beds and carbonate knots, nodules, concretions and pellets)



Red shale and mudstone and variegated or mottled red and green and gray shale, mudstone and claystone



Mudstone (includes claystone and flint and plastic clay)

Shale and siltstone

Coal and partings

Thickness of coal section

Marine fossil

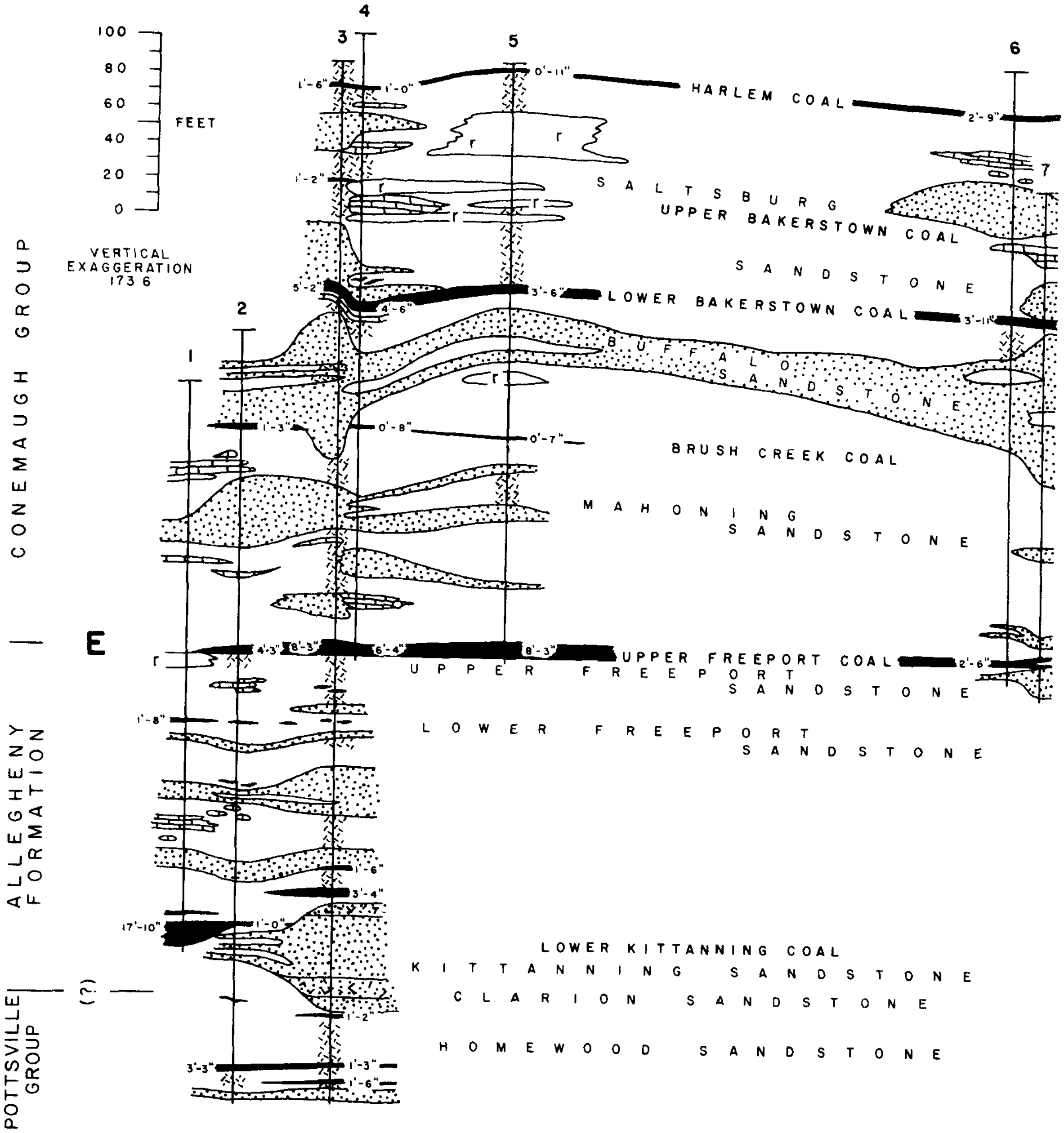
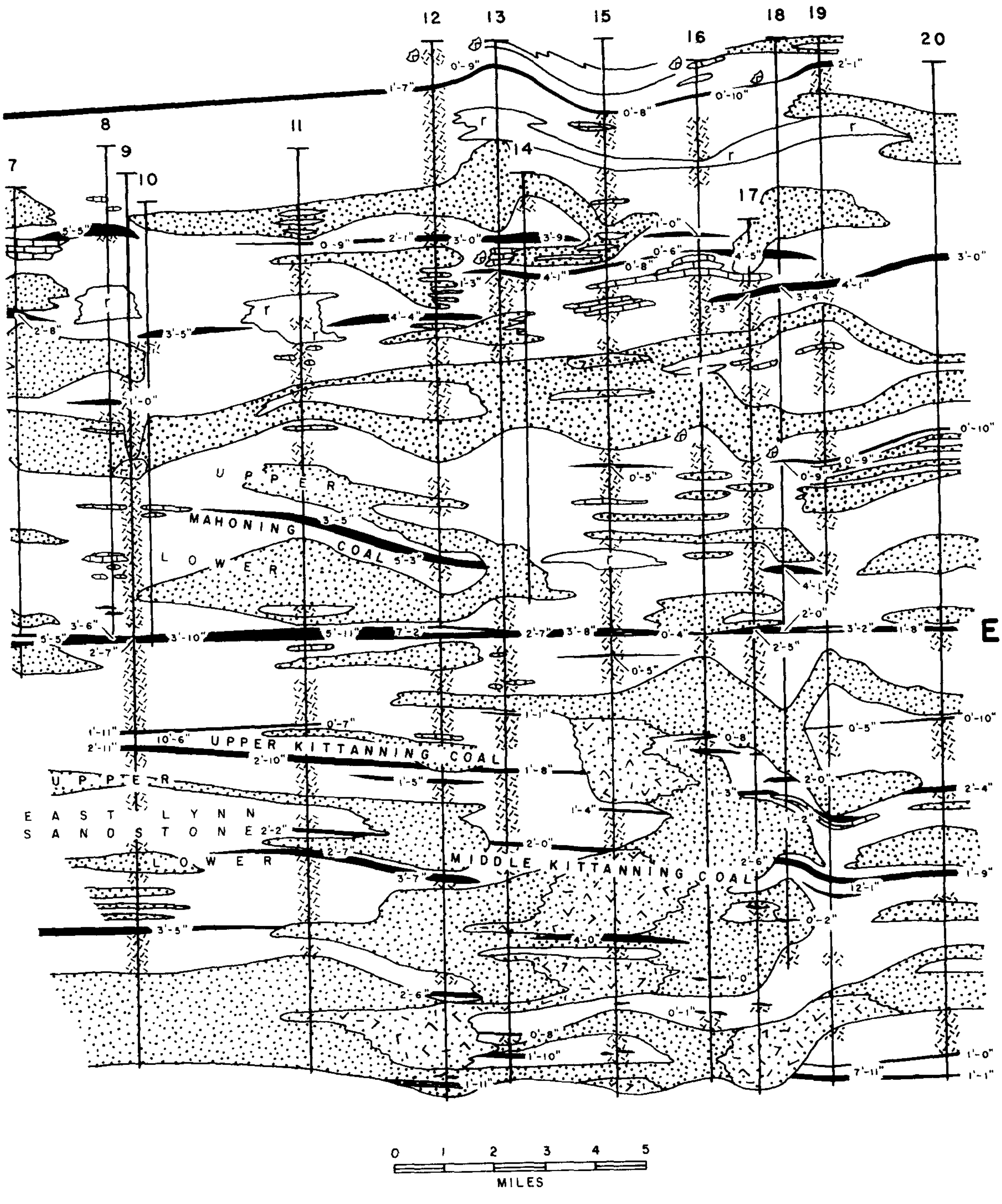


Figure 3b

GEOLOGIC CROSS SECTION E-E'



E'
UPPER MAHONING COAL LOWER
UPPER KITTANNING COAL
UPPER EAST LYNN SANDSTONE LOWER
MIDDLE KITTANNING COAL
0 1 2 3 4 5
MILES

KEY TO
SECTIONS AND CORES
ON
CROSS SECTION E-E, FIGURES 2 AND 3

Number

1. Wilson Bore Hole No. 3 (WVGS No. 104), Garrett County, Maryland Hennen, R. W. and Reger, D. B., 1914, Preston County, West Virginia: West Virginia Geol. Survey, p. 259-260.

2. Davis Coal and Coke Company No. 51 (WVGS No. 44) Coal Test Boring, Garrett County, Maryland (Reger, D. B., 1923, Tucker County, West Virginia: West Virginia Geol. Survey, p. 339-340).

3. Henry Section, Union District and Davis Coal and Coke Company No. 73 (WVGS No. 74) Coal Test Boring (Reger, D. B., 1924, Mineral and Grant counties, West Virginia: West Virginia Geol. Survey, p. 184-187.

4. Davis Coal and Coke Company No. 75 (WVGS No. 75) Coal Test Boring, Union District, Grant County, West Virginia, (Reger, D. B., 1924, Mineral and Grant counties, West Virginia: West Virginia Geol. Survey, p. 493, 494).

5. Davis Coal and Coke Company No. 88 (WVGS No. 58) Coal Test Boring, Garrett County, Maryland (Reger, D. B., 1924, Mineral and Grant counties, West Virginia: West Virginia Geol. Survey, p. 484).

6. Davis Coal and Coke Company No. 113 (WVGS No. 19) Coal Test Boring, Union District, Grant County, West Virginia, (Reger, D. B., 1924, Mineral and Grant counties, West Virginia: West Virginia Geol. Survey, p. 482).

7. Davis Coal and Coke Company No. 114 (WVGS No. 18) Coal Test Boring, Union District, Grant County, West Virginia (Reger, D. B., 1924, Mineral and Grant counties, West Virginia: West Virginia Geol. Survey, p. 481).

8. No. TB-1, Deer Park Daylighting Project, Garrett County, Maryland A. C. Ackenheil and Associates, Project No. 71642/72332.

9. Log, hole 24-CG, Garrett County, Maryland (Toenges, A. L., Turnbull, L. A., Williams, Lloyd, Smith, H. L., O'Donnell, H. J., Cooper, H. M., Abernathy, R. F., and Waage, Karl, 1949, Investigation of lower coal beds in Georges Creek and north part of Upper Potomac Basins, Allegany and Garrett counties, Maryland: United States Bureau of Mines Technical Paper 725, p. 91, 92).

10. Davis Coal and Coke Company No. 115 (WVGS No. 16) Coal Test Boring, Elk District, Mineral County, West Virginia (Reger, D. B., 1924, Mineral and Grant counties, West Virginia: West Virginia Geol. Survey, p. 480, 481).

11. Log, hole 22-GC, Garrett County, Maryland (Toenges, A. L., Turnbull, L. A., Williams, Lloyd, Smith, H. L, O'Donnell, H. J., Cooper, H. M., Abernathy, R. F. and Waage, Karl, 1949, Investigation of lower coal beds in Georges Creek and north part of Upper Potomac Basins, Allegany and Garrett counties, Maryland: United States Bureau of Mines Technical Paper 725, p. 85-87).

12. Log, hole 23-GC, Garrett County, Maryland (Toenges, A. L., Turnbull, L. A., Williams, Lloyd, Smith, H. L., O'Donnell, H. J., Cooper, H. M., Abernathy, R. F., and Waage, Karl, 1949, Investigation of lower coal beds in Georges Creek and north part of Upper Potomac Basins, Allegany and Garrett counties, Maryland: United States Bureau of Mines Technical Paper 725, p. 89, 90).

13. Log, hole 18-GC, Garrett County, Maryland (Toenges, A. L., Turnbull, L. A., Williams, Lloyd, Smith, H. L., O'Donnell, H. J., Cooper, H. M., Abernathy, R. F., and Waage, Karl, 1949, Investigation of lower coal beds in Georges Creek and north part of Upper Potomac Basins, Allegany and Garrett counties, Maryland: United States Bureau of Mines Technical Paper 725, p. 70-72).

14. Section at Head of Howell Run, one mile northwest of Pinnacle Rock, Elk District, Mineral County, West Virginia.

15. Log, hole 17-GC, Garrett County, Maryland (Toenges, A. L., Turnbull, L. A., Williams, Lloyd, Smith, H. L., O'Donnell, H. J., Cooper, H. M., Abernathy, R. F., and Waage, Karl, 1949, Investigation of lower coal beds in Georges Creek and north part of Upper Potomac Basins, Allegany and Garrett counties, Maryland: United States Bureau of Mines Technical Paper 725, p. 69, 70).

16. Log, hole 13-GC, Garrett County, Maryland (Toenges, A. L., Turnbull, L. A., Williams, Lloyd, Smith, H. L., O'Donnell, H. J., Cooper, H. M., Abernathy, R. F., and Waage, Karl, 1949, Investigation of lower coal beds in Georges Creek and north part of Upper Potomac Basins, Allegany and Garrett counties, Maryland: United States Bureau of Mines Technical Paper 725, p. 57, 58).

17. Log, hole 12-GC, Garrett County, Maryland (Toenges, A. L., Turnbull, L. A., Williams, Lloyd, Smith, H. L, O'Donnell, H. J., Cooper, H. M., Abernathy, R. F., and Waage, Karl, 1949, Investigation of lower coal beds in Georges Creek and north part of Upper Potomac Basins, Allegany and Garrett counties, Maryland: United States Bureau of Mines Technical Paper 725, p. 56, 57).

18. Luke Section, Allegany County, Maryland (Reger, D. B., 1924, Mineral and Grant counties, West Virginia: West Virginia Geol. Survey, p. 158, 159).

19. Log, hole 9-GC, Garrett County, Maryland (Toenges, A. L., Turnbull, L. A., Williams, Lloyd, Smith, H. L., O'Donnell, H. J., Cooper, H. M., Abernathy, R. F., and Waage, Karl, 1949, Investigation of lower coal beds in Georges Creek and north part of Upper Potomac Basins, Allegany and Garrett counties, Maryland: United States Bureau of Mines Technical Paper 725, p. 47, 49, 50).

20. Log, hole 1-GC, Garrett County, Maryland (Toenges, A. L., Turnbull, L. A., Williams, Lloyd, Smith, H. L., O'Donnell, H. J., Cooper, H. M., Abernathy, R. F., and Waage, Karl, 1949, Investigation of lower coal beds in Georges Creek and north part of Upper Potomac Basins, Allegany and Garrett counties, Maryland: United States Bureau of Mines Technical Paper 725, p. 29-31).

PEDOLOGIC

The soil at any position on the landscape is a composite of physical, chemical and biological properties. Each property is a net result of processes that have added to and those that have subtracted from the particular property being considered, starting when original material was first exposed to conditions in the zone of contact between the earth and atmosphere. This is true regardless of how the original material happened to be placed at the point in question. And regardless of how it got there, properties of the original material may be good or bad for the intended use or for interaction with surface processes.

Following placement, natural processes begin to add to or subtract from each property that may be considered. An outstanding case of "adding to" is organic matter, which is likely to be insignificant in many original rock materials. An equally obvious case of "subtracting from" is the process of leaching, which removes soluble and exchangeable elements in downward moving waters.

Many properties can be identified and related to processes in the soil forming environment. The important point is to recognize that we are interested in adding to those soil properties that are favorable to future land use and in subtracting from those properties that are unfavorable. When we learn this simple objective and begin to observe and measure rock and soil properties exposed by surface mining activities, we have taken a major step forward, toward the realistic goal of assuring better soils for the future than we had in the past. Overburden rock disturbance and controlled placement is an automatic improvement in some cases.

Minesoil Classification

A minesoil classification scheme that can be incorporated into the USDA comprehensive system of soil classification has previously been proposed (West Virginia University 1971 and Smith et al. 1974). Spolents, the proposed suborder for minesoils, include young soils in recently deposited earth materials resulting from surface mining or other earth moving operations. Additions and changes to the definition of Spolents and to the classification scheme have been made as the knowledge of disturbed soils has been expanded.

Properties of Spolents -

1. If coarse fragments constitute at least 10% of the volume of the control section, they are disordered such that more than 50% will have their long axis at an angle of at least 10% relative to any plane in

the profile. The test for disorder should exclude fragments with longest diameter less than 2 cm (3/5 in) or greater than 25 cm (10 in) and should be based on numbers of coarse fragments rather than volume.

2. Color mottling without regard to depth or spacing in the profile. The mottling involves color differences of at least two color chips in the standard Munsell soil color charts (Munsell, 1971). This mottling occurs among fines as well as within coarse fragments or between fines and coarse fragments.

3. If coarse fragments are fissile, the edges are frayed or splintery rather than smooth.

4. Coarse fragments bridging across voids as a result of placement of materials leaving discontinuous, irregular pores larger than texture porosity. Such voids are present consistently but vary in frequency, prominence, and size in some cases.

5. A thin surface horizon or horizon immediately below a surface pavement of coarse fragments, which contains a higher percentage of fines (less than 2 mm) than any other horizon in the profile to the bottom of the control section. This horizon ranges from 2.5 to 10 cm (1 to 4 in) thick in most minesoils, but it may be thicker in minesoils that have been "topsoiled".

6. Local pockets of materials, excluding single coarse fragments that range from 7.6 cm (3 in) to 100 cm (40 in) in horizontal diameter. These pockets have no lateral continuity and are the result of the original placement of materials and not of postdepositional processes. They may differ from the surrounding material in color (2 or more Munsell color chips), soil textural or particle-size class, or dominant rock type constituting the coarse fragments.

7. Presence of artifacts within the profile. This includes plastics, glass, paper, metal, tires, logs, etc.

8. Presence of disordered carbolithic coarse fragments. These coarse fragments, which are usually associated with the coal, are found in the profile because of moving and mixing of overburden materials during regrading.

9. Irregular distribution of oxidizable carbon with depth in the profile. This irregular distribution is due to the mixing of overburden materials when placed during regrading.

To be classified as a Spolent a soil need not show all of these properties, but it must have at least three. In many cases pedons will exhibit more than three and in some cases all nine of the properties can be identified. In addition to these properties Spolents also include properties 1, 2 and 4 of Orthents (Soil Survey Staff, In Press).

Minesoil Families -

Simple location names have been given to each scientific family for the purpose of expediency and simplicity. These family names will allow the soil surveyor to use short names rather than the long scientific names for the mapping units. An up-to-date list of suggested minesoil family names with a profile description for each appears later in this report. These names are provisional, non-correlated, and subject to change. It should be noted that the families listed are the ones that are considered to occur in mappable expanse. Other families have been found in small, localized areas. These additional families will be inclusions in mapping units or variants of other named families.

Minesoils of the Killarm and Valley Point families are found in Neighborhood 7 (Figures 1 and 6). Minesoils of the Shawneetown family are found in Neighborhoods 8 and 9 (Figures 1 and 6). The Bevier family is found in Neighborhood 10 (Figures 1 and 7) and the Postoak family is found in Neighborhoods 6 and 11 (Figure 1). The remaining families are found in neighborhoods not covered in the scope of this project but covered in previous projects (West Virginia University 1971 and Smith et al. 1974).

The fact that these other families were not listed in numbered neighborhoods does not mean that they do not occur there; it simply indicates that because of limited research time in these areas, other families were not studied and located. For the same reason, families already located only in certain neighborhoods might also be found in other areas.

Minesoil Criteria for Suitability Classes

Regarding criteria for new soils, based on overburden study and analysis, we would suggest that the Acid-Base Accounting Method be applied regardless of anticipated land use. In general, the entire profile to 100 cm (40 in) depth should qualify as Not Toxic or Potentially Toxic with respect to acidity. In other regions, a comparable approach could assure against excess or toxic alkalinity.

We now have extensive data showing that the Acid-Base Accounting Method does not set unreasonable or unachievable standards for coal overburdens. On the other hand, in our experience, conforming to the standard has prevented near-surface acid-induced toxicity. Basic or well-buffered neutralizers are so much more abundant than extreme acid-formers in the earth's superficial crust that it is a matter of locating and placing local materials where the acid-formers, if present, will be overwhelmed by the neutralizers. In rare cases, only, would acid-formers predominate throughout the overburden and require extraordinary measures.

Having agreed that avoiding toxicity deserves top priority, we can begin to set standards for minesoil suitability classes: (1) suitable for multiple uses; (2) suitable for rural, urban or industrial building sites and grounds; (3) suitable for extensive recreation: hiking, camping, hunting, etc.; (4) suitable for production of forest products; (5) suitable for pasture, hay, or other crops not requiring plowing; (6) suitable for intensive agriculture including plowing.

General Discussion of Criteria for Suitability Classes

Suitability Class 1 -

The implication here is that few limitations of any kind exist. Weather-resistant rock fragments (tough sandstone, limestone and ironstone) would anchor the base into old soil or bedrock. The overlying layer would be a broad mix of particle sizes including enough coarse rock fragments to interlock with basal fragments. Subsoil for permeation by plant roots should be medium textured, near neutral in reaction, and high in plant nutrients. The best surface layer would probably be a near-neutral, highly fertile sandy loam with no coarse fragments larger than 75 mm (3 in) diameter. Significant soil organic matter would be desirable throughout the plant root zone (surface and subsoil to a depth of about one meter). Weatherable coarse fragments would be desirable throughout the subsoil.

Suitability Class 2 -

If primary interest focused on building sites and grounds, the emphasis would be placed on physical strength and stability throughout. A broad mixture of particle sizes (including coarse fragments) would be favorable, with emphasis on packing to high density, and provision for quick controlled surface drainage. The base should be well-anchored with resistant rock fragments.

Suitability Class 3 -

Extensive recreation areas would need to emphasize physical stability and drainage, much as for Suitability Class 2, but with more interest in leaving the top layer loose enough for good growth of wildlife food and cover crops of trees, shrubs and ground cover. Plant nutrient and pH requirements would be satisfied by the non-toxic rule.

Suitability Class 4 -

Production land for Forest Products would be favored most by leaving deep, medium-textured materials relatively unpacked, but shaped for efficient future harvesting. Reaction and plant nutrients would be relatively unimportant for adapted species.

Suitability Class 5 -

Suitability for forages and other crops not requiring plowing, would emphasize available phosphorus, potash and other nutrients as well as a deep-rooting zone. Minimum compaction consistent with physical stability would be desirable. High base status would be favorable for most crops. Most coarse fragments in the surface should be smaller than 75 mm (3 in) diameter and preferably soft enough to be cut with a disk. A relatively high percentage of coarse fragments in subsoils would be tolerable and might be desirable, especially if they are readily weatherable.

Suitability Class 6 -

Suitability for crops requiring plowing would emphasize relatively few coarse fragments in the plow layer with none coarser than 150 mm (6 in) diameter. In addition, soil organic matter as a source of nitrogen and to favor soil granulation might be important in the plow layer. A sandy loam surface layer might substitute for a finer textured layer with granular structure, especially if the subsoil contained soil organic matter and the profile was fertile.

As outlined, all suitability standards assume proper burial, blending or special treatments to prevent toxic or potentially toxic acidity from occurring. In addition, the standards assume that adequate measures will be taken to control erosion. Quick establishment of effective ground cover on all critical slopes is the basis for erosion control. However, properly designed diversion terraces, stable, loose-rock or other terrace outlets, mulching, and lime plus fertilization according to chemical tests, are standard aids to ground cover establishments that should not be neglected.

These suggestions for creating Spolents according to plan are feasible only when overburden samples are studied and analyzed in advance. This appears to be the approach favored by many modern operators, regulatory agents, service technicians, research scientists and legislators.

Suggested Minesoil Families -

1. Brandonville Family - Fissile Udispolents; loamy-skeletal, mixed, acid, mesic.
Date: June, 1971
Location: Appalachian Coal Company. East of Brandonville, Preston County, West Virginia. Brandonville Quadrangle.
Vegetation: Birdsfoot trefoil, timothy, alsike clover, oxeye daisy.
Described and sampled by: Sencindiver and Sturm.

Horizons:

1. 0-2.5 cm (0-1 in) Yellowish brown (10YR 5/4) loam; weak granular structure; friable; 55% coarse fragments; many roots; neutral (pH 7.0); abrupt wavy boundary.

2. 2.5-17.8 cm (1-7 in) Yellowish brown (10YR 5/4) clay loam; massive to weak granular structure with some platy structure; friable to firm; common distinct brownish yellow (10YR 6/8) mottles; 55% coarse fragments of black and brown shales; many roots; strongly acid (pH 5.0-5.5); abrupt irregular boundary.

3. 17.8-61 cm (7-24 in) Yellowish brown (10YR 5/4) loam; massive; friable to firm; common distinct brownish yellow (10YR 6/8) mottles; 75% coarse fragments of black and brown shale with 25% greater than 7.6 cm (3 in); some discontinuous layers of shale; common rocks; very strongly acid (pH 4.5); clear wavy boundary.

4. 61-88.9 cm (24-35 in) Brown (10YR 4/3) and dark yellowish brown (10YR 4/4) loam; massive and shale controlled structure; friable to firm; common distinct brownish yellow (10YR 6/8) mottles; 80% coarse fragments of black and brown shale; few roots; abrupt smooth boundary.

5. 88.9-94+ cm (25-37+ in) Brownish yellow (10YR 6/8) loam; massive; friable to firm; common distinct brown (10YR 4/3) mottles; 85% dark gray (N 3/0) shale coarse fragments; very strongly acid (pH 4.5).

Notes: The digging was easier from 61 cm (24 in) to the bottom of the pit than it was in the top 61 cm. Shale seemed to be somewhat layered in 3rd horizon but discontinuous. However, with increased depth the shales were more disordered.

Parent Material: Shale
Drainage: Well drained (field estimates)
Permeability: Moderate (field estimates)
Erosion: None - slight
Elevation: 548.6 m (1800 ft)
Slope: 3-5%
Aspect: North
Relief: Gently undulating
Coal Horizon Mined: Lower Kittaning
Age: 4-5 years

2. Beechrun Family - Fissile Udispolents; loamy-skeletal, mixed, neutral, mesic.
Date: July 24, 1971
Location: Preston County, West Virginia. 0.8 km (0.5 mi) south and 0.2 km (0.12 mi) east of Beech Run Church. Valley Point Quadrangle; 39.5297°N., 79.6586°W.
Vegetation: Black locust, poverty grass, coltsfoot, wild strawberry, deertongue grass.
Described and sampled by: Sencindiver

Horizons:

1. 0-12.7 cm (0-5 in) Very dark grayish brown (10YR 3/2) loam; weak fine granular structure; friable; few mottles; 40% shale coarse fragments; few black coatings; many roots; very strongly acid (pH 4.5); clear boundary.

2. 12.7-25.4 cm (5-10 in) Very pale brown (10YR 7/4) and yellow (10YR 7/6) clay loam; massive; firm; many prominent high chroma mottles; 40% shale coarse fragments; few gray (10YR 6/1) coatings; many roots; clear boundary.

3. 25.4-94 cm (10-37 in) Brown (10YR 4/3) clay loam; massive; firm; 50% disordered shale coarse fragments of various colors - dusky red (2.5YR 3/2), black (10YR 2/1), olive (5Y 5/3), yellow (10YR 7/6); common roots; medium acid (pH 6.0); clear wavy boundary.

4. 94-144.8+ cm (37-57+ in) Yellowish brown (10YR 5/6), light brownish gray (10YR 6/2), and strong brown (7.5YR 5/8) clay loam; massive; firm; 2-5% coarse fragments; black concretions present; very few roots.

Parent Material: Shale
Drainage: Well drained
Permeability: Moderate
Erosion: None - slight
Elevation: 563.9 m (1850 ft)
Slope: 3-8%
Aspect: East
Relief: Undulating
Coal Horizon Mined: Bakerstown
Age: 20-25 years

3. Fort Martin Family - Fissile Udispolents; clayey-skeletal, mixed, neutral, mesic.
Date: September 22, 1972
Location: Monongalia County, West Virginia. 0.8 km (0.5 mi) west of Fort Martin School. Morgantown North Quadrangle; 39.7067°N., 79.9618°W.
Vegetation: Wheat, pilewort, foxtail, ragweed
Described and sampled by: Sencindiver, Sturm, Akers.

Horizons:

1. 0-5.1 cm (0-2 in) Yellowish brown (10YR 5/4) and brown (10YR 5/3) silty clay loam; weak granular structure with some massive pockets; very friable to friable; 40-45% yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) shale fragments and 5% sandstone fragments; many fine roots; mildly alkaline (pH 7.7); clear wavy boundary.

2. 5.1-28.9 cm (2-11 in) Yellowish brown (10YR 5/4) and brown (10YR 5/3) silty clay loam; massive; firm; common distinct yellowish brown (10YR 5/8) and brownish yellow (10YR 6/8) mottles and few faint light brownish gray (2.5Y 6/2) mottles; 50% very dark gray (N 3/0), gray (N 5/0) and olive yellow (2.5Y 6/6) shale fragments; 5% sandstone fragments; common fine roots; neutral (pH 7.3); clear wavy boundary.

3. 28.9-66 cm (11-26 in) 50% brownish yellow (10YR 6/8) and yellowish red (5YR 4/6) clay and 50% brownish yellow (10YR 6/6) silty clay loam; massive; firm; common distinct yellowish brown (10YR 5/4) and strong brown (7.5YR 5/8) mottles and few faint gray (5Y 6/1) mottles; 50% gray (N 5/0) and very dark gray (N 3/0) shale fragments with 5% > 7.6 cm (3 in) diameter; < 5% sandstone and < 5% limestone fragments; few fine roots; slightly acid to neutral (pH 6.2-6.9); gradual irregular boundary.

4. 66-91.4+ cm (26-36+ in) Light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/4) silty clay loam; with pockets of clay; massive; firm; many prominent yellowish brown (10YR 5/8), light yellowish brown (2.5Y 6/2) and strong brown (7.5YR 5/6) mottles; 50% very dark gray (N 3/0) and dark gray (N 4/0) shales with 5-10% > 7.6 cm (3 in) diameter; < 5% sandstone and < 5% limestone fragments; few fine roots; neutral (pH 7.0).

Notes: Localized spots of free carbonates on the surface. 35-50% coarse fragments showing on surface with 15-20% of these sandstone and 1-2% limestone. Coarse fragments disordered throughout profile. Pockets of original A_1 material found at about 76.2 cm (30 in). Several limestone fragments found throughout profile. Greenish gray (5GY 5/1) and pale olive (5Y 6/4) shales found on the surface.

Parent Material: Shale
Drainage: Moderately well
Permeability: Moderately slow
Erosion: None - slight
Elevation: 335.3 m (1100 ft)
Slope: 19%
Aspect: North-east
Relief: Hilly
Coal Horizon Mined: Sewickley
Age: 2-3 years

4. Fieldcrest Family - Typic Udispolents; loamy-skeletal, mixed, acid, mesic.
Date: June 12, 1974
Location: West Virginia University Agronomy Farm; Morgantown North Quadrangle; 0.5 km (0.3 mi) north of Route 73 and 1.2 km (0.75 mi) east of Route 119; area is located on the west side of the road entering the farm. 39.6569°N., 79.9021°W.
Vegetation: Aspen, black birch, iron weed, poison ivy, blackberry.
Described and sampled by: Sencindiver and D. Hall.

Horizons:

1. 0-5.1 cm (0-2 in) Dark brown (10YR 4/3) loam; weak medium platy structure breaking to weak fine granular structure; very friable; 20% coarse fragments < 2.5 cm (1 in) in diameter; many roots; extremely acid (pH 4.4); abrupt wavy boundary.

2. 5.1-12.7 cm (2-5 in) Brown (10YR 5/3) loam; weak medium subangular blocky structure; friable; few distinct brownish yellow (10YR 6/8) mottles; 45% sandstone coarse fragments 7.6-15.2 cm (3-6 in) in diameter; many roots; extremely acid (pH 4.3); abrupt wavy boundary.

3. 12.7-81.3 cm (5-3 in") Mixed yellow (10YR 7/6), yellowish brown (10YR 5/6), strong brown (7.5YR 5/6), very dark gray (N 3/0), black (N 2.5/0), brown (10YR 5/3) and gray (10YR 6/1) loam; massive; firm; 40% disordered coarse fragments 7.6-15.2 cm (3-6 in) in diameter (50% sandstone, 25% carbolith, 25% mudstone); few small bridging voids; common roots; extremely acid (pH 4.2); abrupt irregular boundary.

4. 81.6-96.5 cm (32-38 in) Yellowish brown (10YR 5/8) clay loam; massive; firm; common prominent strong brown (7.5YR 5/6), black (N 2.5/0), yellowish brown (10YR 5/4), and gray (5YR 5/1) mottles; 25% disordered sandstone coarse fragments; few roots; extremely acid (pH 4.3); abrupt irregular boundary.

5. 96.5-114.3+ cm(38-45+ in) Black (N 2.5/0) sandy loam; coarse fragment controlled structure; very friable; common prominent yellowish brown (10YR 5/8) mottles; 75% disordered carbolithic coarse fragments 2.5-7.6 cm (1-3 in) in diameter; common small bridging voids; extremely acid (pH 4.0).

Parent Material: Sandstone, mudstone, carbolith
Drainage: Moderately well drained
Permeability: Moderate to slow
Erosion: None - slight
Elevation: 359.7 m (1180 ft)
Slope: 8-15%
Aspect: East
Relief: Rolling
Coal Horizon Mined: Pittsburgh
Age: 35 years
pH at 25.4 cm (10 in): 4.4

5. Killarm Family - Typic Udispolents; loamy-skeletal, mixed, neutral, mesic.
Date: August 1, 1973
Location: Near Smithers, West Virginia. Fayette and Kanawha County line. Perry and Hilton and Cannelton Coal Companies. 8

km (5 mi) north of Route 60. Montgomery Quadrangle; 38.2190°N., 81.2742°W.

Vegetation: Tall fescue and ladino clover

Sampled and described by: Sencindiver, McKinney and Teets

Horizons:

1. 0-12.7 cm (0-5 in) Mixed yellowish brown (10YR 5/8 and 10YR 5/4), light yellowish brown (2.5Y 6/4), and yellowish red (5YR 5/8) silty clay loam with pockets of clay loam; weak medium blocky structure parting to moderate medium granular structure; friable to firm; 10% coarse fragments; common roots; abrupt smooth boundary.

2. 12.7-25.4 cm (5-10 in) Very dark gray (N 3/0) with few pockets of yellowish brown (10YR 5/8) and light gray (10YR 7/1) silty clay loam; massive; firm with some friable pockets; common roots; 45% coarse fragments; gradual wavy boundary.

3. 25.4-88.9+ cm (10-35+ in) Mixed dark gray (5Y 4/1), yellowish brown (10YR 5/4 and 10YR 5/8), light gray (10YR 7/1) and strong brown (7.5YR 5/6) clay loam with pockets of silty clay loam; massive; 65-70% coarse fragments that are dominantly > 5 cm (2 in) in diameter; very few roots.

Parent Material: Shale, mudstone, sandstone and carbolith
Drainage: Moderately well
Permeability: Moderately slow
Erosion: None - slight
Elevation: 518.2 m (1700 ft)
Slope: 8-15%
Aspect: North-east
Relief: Rolling
Coal Horizon Mined: #5 and #6 Block
Age: 3-4 years
pH at 25.4 cm (10 in): 7.0

6. Overfield Family - Typic Udispolents; loamy-skeletal, mixed, extremely acid, mesic.
Date: June 5, 1974
Location: In northeast Barbour County, West Virginia near the head-waters of the West Branch of Simpson Creek. Go approximately 2 km (1.25 mi) south of Brownton on Route 16/2 and then travel west approximately 1.2 km (0.75 mi).

Description was taken in a road cut. Brownton Quadrangle; 39.20°N., 80.17°W.

Vegetation: Wild strawberry, sour grass, virginia creeper, poison ivy, broomsedge, blackberry, sycamore, black locust.

Described by: Sencindiver, Grube, Freeman

Horizons:

1. 0-2.54 cm (0-1 in) Dark brown (10YR 4/3) loam; weak medium granular structure; very fraible; few faint high chroma mottles; 25% coarse fragments dominantly < 2.54 cm (1 in) in diameter; many roots; extremely acid (pH 3.5); abrupt wavy boundary.

2. 2.54-30.5 cm (1-12 in) Narrow bands of yellowish brown (10YR 5/6), black (N 2.5/0), very dark gray (N 3/0) and brown (10YR 5/3), loam and silty clay loam; moderate fine subangular blocky and weak medium subangular blocky structure; friable and firm; 30% disordered coarse fragments (25% sandstone, 25% carbolith, 25% fissile, 25% schlickig) dominantly < 7.6 cm (3 in) in diameter; common roots; extremely acid (pH 3.6); abrupt wavy boundary.

3. 30.5-76.2 cm (12-30 in) Mixed yellowish brown (10YR 5/6), black (N 2.5/0), dark gray (10YR 4/1), dark grayish brown (10YR 4/2), yellowish red (5YR 5/6), and dark reddish brown (5YR 3/2) silty clay loam; massive friable; 60% disordered coarse fragments (50% schlickig, 25% fissile, 25% fine sandstone) dominantly 7.6-15.2 cm (3-6 in) in diameter; common bridging voids 2-20 mm (0.08-0.8 in) in diameter; few roots; extremely acid (pH 3.6); abrupt wavy boundary.

4. 76.2-132 cm (30-52 in) Yellowish brown (10YR 5/8) silty clay; massive; firm; common distinct gray (N 6/0) mottles; 10% coarse fragments < 2.5 cm (1 in) in diameter; large pockets of gray (N 6/0) material; extremely acid (pH 4.3); clear irregular boundary.

5. 132-165+ cm (52-65+ in) Yellowish brown (10YR 5/4) clay loam; coarse fragments controlled structure; friable; many prominent black (N 2.5/0), yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) mottles; 65% disordered coarse fragments (40% siltstone, 40% mudstone, 20% fissile) dominantly < 2.5 cm (1 in) in diameter; many voids < 5 mm (0.2 in) in diameter; extremely acid (pH 3.8).

Surface stoniness: 5%
Parent Material: Mudstone, shale and sandstone
Drainage: Moderately well-drained
Permeability: Moderately - slow
Erosion: Moderate
Elevation: 304.8 m (1000 ft)
Slope: 3%
Aspect: South
Relief: Pit Site: Nearly level
Area: Rolling - hilly
Coal Horizon Mined: Redstone
Age: 10-15 years

7. Hinton Family - Typic Udispolents; fine loamy, mixed, neutral, mesic.
Date: May 10, 1972
Location: Mark Twain Mine in Columbia, Missouri. Peabody Coal Company.
Vegetation: Aspen, scotch pine, sweet clover, downy brome, golden rod, broomsedge and various other weedy species, tulip poplar, cotton wood, black alder.
Described and sampled by: Sencindiver and Ammons.

Horizons:

1. 0-7.6 cm (0-3 in) Brown (10YR 4/3) and yellowish brown (10YR 5/4) sandy loam to loam; weak granular structure; friable; few faint light gray (10YR 7/1) mottles; < 1% coal fragments; many roots; neutral (pH 7.0); abrupt wavy boundary.

2. 7.6-25.4 cm (3-10 in) Pinkish gray (7.5YR 6/2) clay loam; weak medium subangular blocky structure; many prominent strong brown (7.5YR 5/6) and dark brown (7.5YR 4/2) mottles; pockets of yellowish brown (10YR 5/6) loam; 25% coarse fragments mainly mudstone and siltstone with a few sandstone and chert fragments; gypsum crystals present; common roots; strongly acid (pH 5.5); abrupt wavy boundary.

3. 25.4-50.8 cm (10-20 in) Mixed strong brown (7.5YR 5/8), pinkish gray (7.5YR 6/2) brown (10YR 5/3) and yellowish brown (10YR 5/4) clay loam with few pockets of clay; massive; 25% coarse fragments; few coal fragments; common roots; strongly acid (pH 5.5); clear wavy boundary.

4. 50.8-101.6+ cm(20-40+ in) Mixed strong brown (7.5YR 5/6), pinkish gray (7.5YR 6/2) and yellowish brown (10YR 5/4) clay

loam with yellowish brown (10YR 5/6) sand pockets; massive; 15% coarse fragments of siltstone and mudstone; few roots; slightly acid (pH 6.5).

Notes: Coal, chert, sandstone and mudstone was found throughout the pit. Few fine roots were found at the bottom of the pit. Siltstone and mudstone predominantly dark gray (N 4/0) and very dark gray (N 3/0) and some of these had coatings of reddish brown (5YR 4/4). Sandstone predominantly red (2.5YR 4/6).

Parent Material: Mudstone, siltstone, sandstone
Drainage: Moderately well-drained
Permeability: Moderately slow
Erosion: None - slight
Elevation: 228.6 m (750 ft)
Slope: 8-15%
Relief: Rolling
Coal Horizon Mined: Bevier
Age: 10 years

8. Birdcreek Family - Plattic Udispolents; loamy-skeletal, siliceous, acid, mesic.
Date: June 25, 1973
Location: Preston County, West Virginia. 3.2 km (2 mi) south and 1.6 km (1 mi) east of State Route 92 and Birds Creek Road intersection. Newburg Quadrangle; 39.4038°N., 79.7955°W.
Vegetation: Seeded birdsfoot trefoil and K-31 tall fescue. Also deertongue, poverty grass, blackberry, beggar ticks.
Sampled and described by: Sencindiver and Ammons.

Horizons:

1. 0-5.1 cm (0-2 in) Dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) loam; weak fine granular structure; very friable; 15-20% sandstone coarse fragments; many roots; very strongly acid (pH 4.7) clear wavy boundary.

2. 5.1-24.5 cm (2-10 in) Dark yellowish brown (10YR 4/4) loam; weak coarse subangular blocky structure; friable; few faint yellowish brown (10YR 5/6 & 5/4) brownish yellow (10YR 6/6) and strong brown (7.5YR 5/8) mottles; 60% coarse fragments of sandstone with 40-50% of these > 7.6 cm (3 in); common roots; very strongly acid (pH 4.7); clear wavy boundary.

3. 25.4-76.2+ cm (10-30+ in) Dark yellowish brown (10YR 4/4) clay loam; weak coarse subangular blocky structure; friable to firm; few faint yellowish brown (10YR 5/6 & 10YR 5/4), brownish yellow (10YR 6/6) and strong brown (7.5YR 5/8) mottles; 60-70% coarse fragments with 40% > 7.6 cm (3 in); few roots; extremely acid (pH 4.4)

Notes: Coarse fragments all disordered. Voids and bridging seen. Several large voids were discovered while digging pit.

Surface Stoniness: 50%
Parent Material: Sandstone
Drainage: Well-drained
Permeability: Moderately rapid
Erosion: None - slight
Elevation: 548.6 m (1800 ft)
Slope: 3%
Aspect: East
Relief: Nearly level
Coal Horizon Mined: Upper Freeport
Age: 1 year
pH at 25.4 cm (10 in): 4.7

9. Cuzzart Family - Regolithic Plattic Udispolents; loamy-skeletal, siliceous, acid, mesic.
Date: July 30, 1973
Location: 1.6 km (1 mi) west of Odd, West Virginia in Raleigh County. Pit located on lower bench; 37.5970°N., 81.2098°W.
Vegetation: Sericea lespedeza, yarrow, autumn olive, and other weedy species.
Sampled and described by: McKinney and Sencindiver.

Horizons:

1. 0-5.1 cm (0-2 in) Dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure breaking to moderate fine granular structure; very friable; 20-25% sandstone coarse fragments; common fine roots; clear wavy boundary.

2. 5.1-24.5 cm (2-10 in) Yellowish brown (10YR 5/4) sandy loam; weak medium subangular blocky structure; friable; 50% sandstone coarse fragments; few fine roots; clear wavy boundary.

3. 24.5-55.9 cm (10-22 in) Yellowish brown (10YR 5/4) sandy loam; weak medium subangular blocky structure; friable;

50% sandstone coarse fragments; occasional roots; clear wavy boundary.

4. 55.9-88.9+ cm (22-35+ in) Yellowish brown (10YR 5/4 and 5/6) sandy loam; very weak medium subangular blocky structure; very friable; 40% sandstone coarse fragments.

Parent Material: Sandstone
Drainage: Well-drained
Permeability: Moderately rapid
Erosion: None - slight
Elevation: 804.7 m (2640 ft)
Slope: 3-8%
Relief: Gently undulating
Coal Horizon Mined: Beckley
Age: 5-10 years
pH at 25.4 cm (10 in): 4.9

10. Valley Point Family - Plattic Udispolents; loamy-skeletal, siliceous, extremely acid, mesic.
Date: May 17, 1974
Location: 1.9 km (1.2 mi) south of Valley Point, Preston County, West Virginia; area is west of Route 26; Valley Point Quadrangle; 39.5751°N., 79.6493°W.
Vegetation: Birdsfoot trefoil, tall fescue.
Described and sampled by: Sencindiver and D. Hall

Horizons:

1. 0-5.1 cm (0-2 in) Brown (10YR 5/3) loamy sand; very fine granular structure and single grained; loose; few faint high chroma mottles; 30% sandstone coarse fragments < 2.5 cm (1 in) in diameter; many matted roots; strongly acid (pH 5.2); abrupt wavy boundary.

2. 5.1-25.4 cm (2-10 in) Yellowish brown (10YR 5/4) sandy loam to loamy sand; structureless; very friable; common distinct yellowish brown (10YR 5/8) and brownish yellow (10YR 6/6) mottles; 60% disordered sandstone coarse fragments 15.2-25.4 cm (6-10 in) in diameter; many bridging voids; many roots; extremely acid (pH 4.2); gradual irregular boundary.

3. 25.4-50.8 cm (10-20 in) Yellowish brown (10YR 5/4) sandy loam; structureless; friable; common distinct brownish yellow (10YR 6/8) mottles; 70% disordered coarse fragments 7.6-38.1 cm (6-15 in) in diameter (5% mud-

rock, 95% sandstone); many bridging voids; common roots; extremely acid (pH 3.1); clear irregular boundary.

4. 50.8-101.6+ cm(20-40+ in) Yellowish brown (10YR 5/4) sandy loam to loamy sand; structureless; friable; common distinct brownish yellow (10YR 6/8) and yellowish red (5YR 4/6) mottles; 80% disordered coarse fragments 25.4-38.1 cm (10-15 in) in diameter (5% carbolith, 95% sandstone); many bridging voids; extremely acid (pH 2.9).

Notes: Sandstones are 50% high chroma and 50% low chroma. Vegetation is growing very well. Roots are densely matted in top 25.4 cm (10 in).

Surface Stoniness: 10-15%
Parent Material: Sandstone
Drainage: Well-drained
Permeability: Moderately rapid
Erosion: None - slight
Elevation: 589.1 m (1900 ft)
Slope: 20%
Aspect: South-east
Relief: Hilly
Coal Horizon Mined: Upper Freeport
Age: 3 years

11. Shawneetown Family - Matric Udispolents; fine-loamy, mixed, neutral, mesic.
Date: June 21, 1974
Location: Eagle Mine; Peabody Coal Company; near Shawneetown, Gallatin County, Illinois; Saline Mines Quadrangle; 0.8 km (0.5 mi) east of Route 1, 1.6 km (1 mi) west of Saline River; T10S, R9E, S28; 37.6166°N., 88.2172°W.
Vegetation: None
Described and sampled by Sencindiver, Freeman, D. Hall

Horizons:

1. 0-5.1 cm (0-2 in) Brown (7.5YR 4/4) silty clay loam; weak fine granular structure; very friable; 5% coarse fragments, 2.5-5.0 cm (1-2 in) in diameter; neutral (pH 7.2); abrupt smooth boundary.

2. 5.1-30.5 cm (2-12 in) Brown (7.5YR 4/4) silty clay loam; weak thin platy structure; firm; common distinct yellowish brown (10YR 5/8), light yellowish brown (10YR 6/4),

and very dark gray (N 3/0) mottles; 5% coarse fragments of sandstone, mudstone, and carbolith, < 2.5 cm (1 in) in diameter; neutral (pH 7.2); gradual wavy boundary.

3. 30.5-86.4 cm (12-34 in) Brown (7.5YR 4/4) silty clay loam; massive; firm; common distinct yellowish brown (10YR 5/8), light yellowish brown (10YR 6/4), very dark gray (N 3/0), and light gray (5Y 6/1) mottles; 15% disordered coarse fragments of mudstone and sandstone, 7.6-15.2 cm (3-6 in) in diameter; mildly alkaline (pH 7.5); clear wavy boundary.

4. 86.4-101.6+ cm (34-40+ in) Brown (7.5YR 4/4) silty clay loam; massive; friable; common distinct yellowish brown (10YR 5/8), light gray (5Y 6/1), and dark yellowish brown (10YR 4/4); 5% mudstone coarse fragments < 5.0 cm (2 in) in diameter; mildly alkaline (pH 7.6).

Note: Surface 5.1 cm (2 in) was dryer than the remainder of the profile. The top 86.4 cm (34 in) of the profile was very compact.

Parent Material: Loess
Drainage: Moderately well-drained
Permeability: Moderately slow
Erosion: None - slight
Elevation: 121.9 m (400 ft)
Slope: 10%
Aspect: Northeast
Relief: Gently rolling
Coal Horizon Mined: Davis and Dekoven
Age: 1-2 months
pH at 25.4 cm (10 in): 7.3

12. Bevier Family - Schlickig Udispolents; fine loamy, mixed, neutral, mesic.
Date: June 29, 1974
Location: Bee Veer Mine; Peabody Coal Company; 1.6 km (1 mi) south of College Mound, Missouri, on County Road T. College Mound Quadrangle; 39.6247°N., 92.5566°W.
Vegetation: Tall fescue, sweet clover, white clover, alfalfa, Korean lespedeza.
Described and sampled by: D. Hall and R. M. Smith

Horizons:

1. 0-5.1 cm (0-2 in) Dark yellowish brown (10YR 4/4) silty clay loam; moderate thin platy structure; firm; < 5%

mudstone coarse fragments; many roots; mildly alkaline (pH 7.5); abrupt smooth boundary,

2. 5.1-17.8 cm (2-7 in) Yellowish brown (10YR 5/4) clay loam; massive; firm; many distinct yellowish brown (10YR 5/6), yellow (10YR 7/6), light gray (10YR 7/2), and light gray (N 7/0) mottles; < 5% mudstone coarse fragments; many roots; mildly alkaline (pH 7.8); clear wavy boundary.

3. 17.8-40.7 cm (7-16 in) Yellowish brown (10YR 5/4) clay loam; moderate prismatic structure breaking to strong angular blocky structure; firm; many distinct yellowish brown (10YR 5/8), pale brown (10YR 6/3), gray (10YR 5/1), and yellow (10YR 7/8) mottles; < 5% mudstone coarse fragments; many roots; moderately alkaline (pH 8.0); abrupt wavy boundary.

4. 40.7-48.3 cm (16-19 in) Mixed yellowish brown (10YR 5/4 and 10YR 5/8), gray (10YR 6/1) and very pale brown (10YR 7/4) clay loam; massive; 50% disordered mudstone coarse fragments dominantly 2.5-10.2 cm (1-4 in) in diameter; many roots; mildly alkaline (pH 7.5); abrupt wavy boundary.

5. 48.3-61.0 cm (19-24 in) Yellowish brown (10YR 5/6) clay loam; strong angular blocky structure; firm; many distinct yellowish brown (10YR 5/4) and light brownish gray mottles; < 5% mudstone coarse fragments; many roots; mildly alkaline (pH 7.6); clear wavy boundary.

6. 61.0-101.6+ cm(24-40+ in) Yellowish brown (10YR 5/4) clay loam; massive; firm; common distinct brownish yellow (10YR 6/6), yellowish brown (10YR 5/8) and light brownish gray (10YR 6/2) mottles; 10-15% mudstone and limestone coarse fragments dominantly 7.6-15.2 cm (3-6 in) in diameter; several pockets of gray (N 6/0) material with diameter of 7.6 cm (3 in); common roots; mildly alkaline (pH 7.7).

Notes: This profile is predominantly glacial till with residual mudstone appearing in horizons 4 and 6. Gypsum is found throughout the profile. The fine material effervesces with 1:3 HCl throughout the profile. This area was recon. mapped and inclusions of extremely acid material were found which consisted of sandstone and mudstone.

Parent Materials: Glacial till and mudstone
Drainage: Well-drained
Permeability: Moderately slow
Erosion: Slight - moderate
Elevation: 213.4 m (700 ft)
Slope: 3-8%
Aspect: North
Relief: Undulating
Coal Horizon Mined: Bevier
Age: 5-10 years

13. Postoak Family - Schlickig Udispolents; loamy-skeletal, mixed, neutral, mesic.
Date: July 2, 1974
Location: Tebo Mine; Peabody Coal Company; 4-4.8 km (2 1/2-3 mi) N.NE. of Clinton, Missouri; T42N, R25W, S24, NE 1/4 of NW 1/4; 38.4199°N, 93.6379°W.
Vegetation: Alfalfa, wheat
Described and sampled by: D. Hall and R. M. Smith

Horizons:

1. 0-10.2 cm (0-4 in) Dark gray (10YR 4/1) silty clay loam; weak medium granular structure; firm; common distinct grayish brown (10YR 5/2), very pale brown (10YR 7/4) and very dark gray (N 3/0) mottles; 50% disordered coarse fragments dominantly < 2.5 cm (1 in) in diameter (98% mudstone, 2% carbolith); few vesicular pores; common roots; very strongly acid (pH 4.6); clear wavy boundary.

2. 10.2-40.7 cm (4-16 in) Mixed gray (10YR 5/1), dark gray (10YR 4/1), yellow (10YR 7/6), strong brown (7.5YR 5/6), dark gray (N 4/0) and very dark gray (N 3/0) silty clay loam; massive; firm; 65% disordered coarse fragments dominantly 2.5-7.6 cm (1-3 in) in diameter (50% mudstone, 30% carbolith, 20% sandstone); common roots; slightly acid (pH 6.5); clear wavy boundary.

3. 40.7-63.5 cm (16-25 in) Mixed dark gray (10YR 4/1), very dark grayish brown (10YR 3/2), very dark gray (N 3/0), grayish brown (10YR 5/2), and light brownish gray (2.5Y 6/2) silty clay loam; massive; firm; 70% disordered coarse fragments dominantly 2.5-7.6 cm (1-3 in) in diameter (90% mudstone, 5% sandstone, 5% carbolith); few roots; medium acid (pH 5.9); clear wavy boundary.

4. 63.5-76.2 cm (25-30 in) Mixed dark grayish brown (2.5Y 4/2), very dark gray (N 3/0), dark gray (N 4/0), gray (N 5/0), brownish yellow (10YR 6/6), and reddish brown (5YR 4/4) silty clay loam; massive; friable; 70% disordered coarse fragments, 2.5-7.6 cm (1-3 in) in diameter (95% mudstone, 5% carbolith); few roots; medium acid (pH 6.0); clear wavy boundary.

5. 76.2-101.6+ cm(30-40+ in) Very dark grayish brown (2.5Y 3/2) silty clay loam; massive; friable; many prominent light yellowish brown (2.5Y 6/4), yellowish brown (10YR 5/8), very dark gray (N 3/0), gray (5Y 5/1) mottles; 70% disordered mudstone coarse fragments, 2.5-7.6 cm (1-3 in) in diameter; few roots; very strongly acid (pH 4.5)

Notes: Several spots of fine material from each horizon effervesces with 1:3 HCl.

Surface Stoniness: 5-10%
Parent Material: Mudstone
Drainage: Well-drained
Permeability: Moderate
Erosion: Slight - moderate
Elevation: 243.8 m (800 ft)
Slope: 12%
Aspect: West
Relief: Rolling
Coal Horizon Mined: Tebo
Age: 3 years

14. Widen Family - Carbolithic Udispolents; loamy-skeletal, mixed, acid, mesic.
Date: August, 1974
Location: Clay County, Widen, West Virginia; site is located 1.6 km (1 mi) southeast of Widen, West Virginia up Buffalo Creek.
Vegetation: Broomsedge, moss, ironweed and various other small weeds.
Sampled and described by: C. H. Delp.

Horizons:

1. Few coarse fragments of bone coal and sandstone on surface; coarse fragments dominantly less than 7.6 cm (3 in).

2. 0-10.2 cm (0-4 in) Mixed black (N 2.5/0) and dark gray (10YR 4/1) sandy loam; weak fine granular structure; very friable; 20% coarse fragments of bone coal and sandstone; coarse fragments less than 1.3 cm (1/2 in) in diameter; many fine roots; moderately alkaline; abrupt wavy boundary.

3. 10.2-20.4 cm (4-8 in) Black (N 2.5/0) sandy loam; massive; friable to firm; common fine and medium distinct gray (10YR 5/1) and yellow (10YR 7/6) mottles; 40% coarse fragments of bone coal and sandstone; coarse fragments dominantly less than 10.2 cm (4 in) in diameter; few fine roots; strongly acid; abrupt wavy boundary.

4. 20.4-101.6+ cm(8-40+ in) Black (N 2.5/0) sandy loam; massive and coarse fragment controlled structure; firm with few loose pockets; common fine and medium distinct gray (10YR 5/1) and yellow (10YR 4/4) mottles; 80% coarse fragments of bone coal and sandstone; coarse fragments in various sizes up to 20.3 cm (8 in) in diameter; common bridging voids; very strongly acid.

Parent Material: Waste from coal mines and preparation plants
Drainage: Well-drained
Permeability: Moderately rapid
Erosion: Severe (taken in gully)
Elevation: 466.3 m (1530 ft)
Slope: 3%
Aspect: South
Relief: Nearly level
Age: 30-40 years

15. Pursglove Family - Carbolithic Udispolents; loamy-skeletal, mixed, extremely acid, mesic.
Date: May 24, 1974
Location: Bureau of Mines experimental plot in Monongalia County, West Virginia. Approximately 1.6 km (1 mi) west of Jere on Route 7; 39.6698°N., 80.0555°W.
Vegetation: Sparse weedy species
Sampled and described by: Delp, Sencindiver, Hall

Horizon:

1. Surface pavement of gravel.

2. 0-5.1 cm (0-2 in) Black (N 2.5/0) loam; weak medium and thick

platy breaking to weak fine granular structure; very friable; 40% coarse fragments dominantly less than 2.5 cm (1 in) in diameter; few roots; very strongly acid (pH 4.5); abrupt smooth boundary.

3. 5.1-17.8 cm (2-7 in) Black (N 2.5/0) loam; weak medium and coarse subangular blocky structure breaking to weak fine granular structure; friable in place and very friable in hand sample; few distinct reddish yellow (7.5YR 6/8) mottles; 40% coarse fragments dominantly < 2.5 cm (1 in) in diameter; few vesicular pores; few bridging voids < 5 mm (0.2 in) in diameter; extremely acid (pH 3.8); clear wavy boundary.

4. 17.8-30.5 cm (7-12 in) Black (N 2.5/0) sandy loam; coarse fragments controlled structure; firm in place and friable in hand sample; common prominent reddish yellow (7.5YR 6/8), yellowish brown (10YR 5/6) and red (10YR 4/8) mottles; 70% coarse fragments dominantly less than 7.6 cm (3 in) in diameter; few bridging voids < 5 mm (0.2 in) in diameter; extremely acid (pH 3.6); abrupt wavy boundary.

5. 30.5-96.5 cm (12-38 in) Mixed black (N 2.5/0), reddish yellow (7.5YR 6/8), dark grayish brown (10YR 4/2), gray (10YR 5/1) and reddish brown (2.5YR 4/4); coarse fragments controlled texture and structure; firm to very firm in place and loose to very friable in hand sample; 80% coarse fragments, dominantly < 7.6 cm (3 in) in diameter; gypsum crystals throughout the horizon; pockets of silty clay loam material; pockets of massive, extremely firm carbolithic material; many bridging voids < 5 mm (0.2 in) in diameter; containing several artifacts of bottles, cans, and copper wire; extremely acid (pH 3.6); gradual irregular boundary.

6. 96.5-127+ cm (38-50+ in) Mixed black (N 2.5/0), dark gray (10YR 4/1) yellowish red (5YR 5/8) and reddish brown (2.5YR 4/4); coarse fragment controlled texture and structure; friable to firm in place and loose to very friable in hand sample; 90% disordered coarse fragments; many bridging voids < 5 mm (0.2 in) in diameter; containing several artifacts of bottles, cans and copper wire; extremely acid (pH 3.3).

Parent Material: Waste from coal mines
Drainage: Well-drained

Permeability: Moderate
Erosion: Severe (Profile described in a gully)
Elevation: 335.3 m (1100 ft)
Slope: 5%
Aspect: South
Relief: Nearly level to gently undulating
Age: 15-20 years

EROSION CONTROL AND RECLAMATION

Some principles of erosion control and reclamation are applicable to all Neighborhoods studied and are stated here rather than being repeated in each subsequent chapter. Related details have been developed by the Environmental Protection Agency (Grim and Hill, 1974).

Since highly disturbed soils are likely to be low in total and available nitrogen it is a good rule to plan to use approximately 22.7 kilograms (kg) (50 pounds, lb) of nitrogen per acre on all seedings designed to give quick cover and erosion control. As much as 45.4 kg (100 lb) may be used in connection with straw or equivalent mulch on critical slopes.

Heavy seedings of adapted, inoculated legumes together with grasses should be made promptly after grading, preferably on a prepared (roughened) seedbed. Repeated grading and smoothing should be avoided to prevent excessive compaction.

Prevention of erosion on long, smooth slopes can be accomplished by quick establishment of thick stands of adapted grasses and legumes, such as lespedeza sericea, birdfoot trefoil, alfalfa, tall fescue, redtop, and smooth bromegrass, with or without light seedings of small grains. Diversion terraces are helpful on unprotected slopes longer than 30.5 m (100 ft). Liming in addition to nitrogen, when indicated by adapted soil tests, should help assure quick ground cover. On slopes steeper than 5%, hay or straw mulch or equivalent at 4480 kg per hectare (2 t per acre) would provide assurance of quick cover to prevent erosion.

Although terraces and mulching are good insurance on all erodible slopes, excellent quick cover can often be established without such measures by proper soil treatment, good seedbeds, proper timing, and favorable weather. On steep slopes, hydroseeding methods are effective. Properly designed sediment ponds may be needed, to prevent downstream sedimentation when terraces and (or) mulches are not feasible.

In all cases surface erosion will be less severe if surface layers contain significant percentages of coarse fragments. Unless intensive cultivation is planned, as much as 75% of the top layer and subsoil (by weight) may consist of coarse fragments without seriously reducing productivity. Such soil is only slightly erodible as compared to stone-free silt loams or loams. Coarse fragments consisting of mudrocks or weak sandstones disintegrate rather quickly at the soil surface to provide more fines. For this reason it may be desirable to include more coarse fragments on the surface than is commonly favored.

SECTION VI

EASTERN COAL PROVINCE: CENTRAL APPALACHIAN REGION

SUMMARY

Both the Garrett County, Maryland and the Somerset County, Pennsylvania sites (Table 2) in this Neighborhood revealed only minor toxic or potentially toxic zones. These sites (Neighborhood 1, Figure 4) are within previously defined Surface Mining Province #2 which includes some unfavorable acid sites in Preston County, West Virginia (West Virginia University 1971). However, depositional history favored relatively fine-grained sediments where samples were taken in Neighborhood 1, rather than medium textured, massive Mahoning sandstone as represented at the least favorable locations in Preston County. Results, therefore, support the idea originally developed in West Virginia, that the most unfavorable overburdens and minesoils in Surface Mining Province #2 were derived from acid-forming sandstones over the Freeport and Kittanning coals. Where shales and mudstones were dominant, problems of reclamation were not severe. Pyrite percentages in shales and mudstones may be at least as high as in the sandstones, but the finer-textured sediments, sometimes including carbonates, provide higher buffering and neutralizing capacities than the sandstones. In addition, available plant nutrients tend to be higher. The composite result is better minesoils.

As illustrated in Cross Section E-E' (Figures 2, 3a and 3b) sandstones of variable thickness occur in distributary systems in much of Surface Mining Province 2. Our samples in Neighborhood 1 accidentally missed all thick sandstone bodies. At sites where the sandstones are prominent it is to be expected that acid problems will occur, unless the sandstones contain at least one percent of calcium or other carbonates.

The most distinctive case of unweathered, acid or potentially-acid sandstone discovered in present studies was that represented in southern Illinois at the Will Scarlett Mine, Neighborhood 8. At this location as well as at problem sites in Preston and other West Virginia counties, the practical solution involved surface placement and fertilization of high chroma, weathered material from the top 6.1 m (20 ft) of the overburden. This is now standard practice at Will Scarlett and in Preston County.

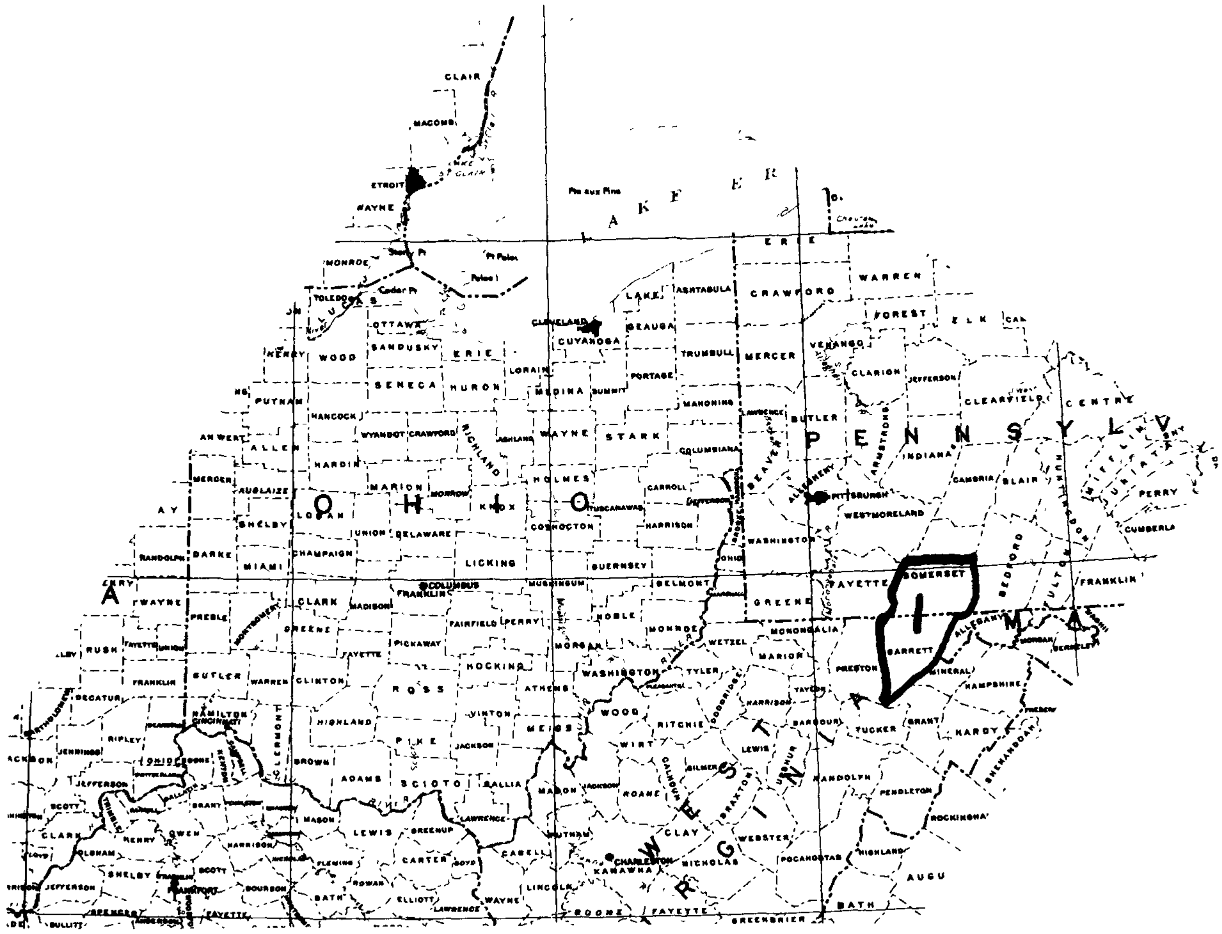


Figure 4. Neighborhood in Central Appalachian Region, Eastern Coal Province.

NEIGHBORHOOD 1: SOMERSET COUNTY, PENNSYLVANIA AND GARRETT COUNTY, MARYLAND

Somerset County: P.B.S. Coal Company -

The coals being mined at this location are designated as the Upper Freeport (E), Lower Freeport (D), Upper Kittanning (C') and the Middle Kittanning (C). Only the Upper and Lower Freeport coals were available and accessable at the time of sampling; therefore, the Freeport coals are the only ones that will be discussed.

The Upper and Lower Freeport coals are in the Allegheny Group of Pennsylvanian rocks. The Allegheny Group in southern Somerset County extends upward from the base of the Brookville coal to the top of the Upper Freeport coal, an average of 85.3 m (280 ft). The Clarion, Kittanning, and Freeport Formation are, in ascending order, further subdivisions of the Allegheny Group. The Freeport Formation extends from the top of the bottom member of the Upper Kittanning coal group to the top of the Upper Freeport Coal and averages 29.5 m (96.9 ft) (Flint 1965).

The mine is located approximately 8.0 km (5 mi) east of Somerset, immediately south of Route 31, just east of the Negro Mountain anticline axis and in the Allegheny Mountain Section of the Appalachian Plateau Province. This is in the main bituminous coal field near the eastern edge of the depositional basin. Nearly all of the coal-bearing rocks, except for this area and on the Centerville dome southwest of Somerset, are found in synclines (Flint 1965).

The Lower Freeport coal group in southern Somerset county consists of two seams. The bottom or "D" seam is minable and a rider coal of variable thickness, when present, occurs approximately 3.0 m (10 ft) above. The "D" coal correlates with the Lower Freeport in Preston County, West Virginia. The Upper Freeport coal (E) correlates with the Upper Freeport coal of West Virginia and is one of the four most economically important coals of the Allegheny Group (Allegheny Formation of West Virginia) in southern Somerset County.

The overburden above the Upper Freeport coal consists primarily of a shale-mudstone sequence with little sandstone. The usual thick Mahoning Sandstone so prevalent in West Virginia is not present at the P.B.S. Mine. This is not an uncommon occurrence as indicated in Arkle and Lotz's cross section E-E' (Figure 3b) and cross section B-B' in Preston County, West Virginia (Smith, et al. 1974). The section of rock between the Upper and Lower Freeport coals is a shale-mudrock sequence with a 73 cm (2.4 ft) section of carbolith above the 36.6 cm (1.2) ft of rider coal. Again this is indicated in cross section E-E'

(Figure 3b) and B-B' in West Virginia. The Upper Freeport sandstone pinches out in some areas and is replaced by shales and mudrocks.

The data (Tables 3-8) indicate two zones of potentially toxic materials in the overburden. One zone only appears in the second column (Tables 6-8) under the Upper Freeport coal and is due to the lack of neutralizers in the sample as the total sulfur percentage is not exceedingly high. At this site, the Upper Freeport limestone is not present. This potentially toxic zone was not sampled in the first column as indicated by the data in Tables 3-5. The second zone of potentially toxic material appears in both overburden columns at the same position and is the rider coal of the Lower Freeport coal group. The rider coal is only 30 cm (1 ft) thick while the other potentially toxic zone is only 91 cm (3 ft) thick, including the unsampled portion. This is a very small proportion of the total overburden which has a net excess of neutralizers.

The natural soil above the highwall was formed in residual parent material. The soil supported a good stand of mixed hardwood trees which were harvested before mining operations began. A 10 cm (4 in) layer of leaf litter in various stages of decomposition was on the surface of the soil. The soil was strongly acid, low in inherent fertility (Table 4), and had coarse fragments prominent throughout the profile. The A_2 and B_1 horizons had sandy loam textures while the lower part of the B and the C horizons had silty clay loam textures. Low chroma mottling was found in the lower part of the B and in the C horizons indicating somewhat impeded drainage.

The overburden columns studied at this site indicate that there is a weathered zone penetrating downward 6.1 m (20 ft) from the surface. Total sulphur, pH and extractable nutrient levels are low, while carbonates are absent in this zone. The remainder of the rocks over the Upper Freeport coal are higher in both nutrients and carbonates, but the most favorable strata, chemically, are between the Upper and Lower Freeport coal with the exception of the thin toxic zones previously discussed. Rock materials are suitable for blending or selective placement to provide properties needed for planned future use of the minesoil. However, reclamation will require phosphorus fertilization, as the rock strata are consistently low in this nutrient (Tables 4 and 7).

Water coming out of the highwall at the position of the "D" coal and the rider coal above it had a pH of 3.0, but as it flowed down the face of the highwall the pH was raised to average between 6.5 and 8.2 except when there was a hard rain it decreased to about 5.5.
Three sediment ponds in sequence served the stripmine but no erosion was evident. All water was caught and treated in these three ponds before being released to a small creek behind the mine area.

Earlier reclamation of an adjacent area showed a very good stand of clover, perennial ryegrass and timothy. The company had previously used trees for revegetation, but found that the testing of minesoils for lime and fertilizer recommendations and using a grass-legume mixture vastly improved the resultant erosion control and reclamation.

Garrett County: Mary Ruth Coal Company -

The coal mined at the Mary Ruth Coal Company's mine in Garrett County, Maryland, is the Upper Freeport seam (Amsden, 1953). It correlates with the Upper Freeport in both Preston County, West Virginia and Somerset County, Pennsylvania (Flint, 1965). The mine is located on the west flank of the axis of the North Potomac syncline, approximately 3.2 km (2 mi) southeast of core 8 (Figure 2, on Cross Section E-E') in the Georges Creek Basin of Maryland (Figures 2, 3a, and 3b). The Upper Freeport coal is the top-most unit in the Allegheny Formation of Pennsylvania Age; therefore, the overburden materials of the Upper Freeport coal are predominately mudstones or shales (Figure 3b).

The land surface increases in elevation and the coal dips to the southeast of Laurel Run at this mine, thus accounting for the large increase in overburden thickness between column one and column four (Tables 9 and 18). Column one (Tables 9-11) was taken at the northern-most part of the sampling area and column two (Tables 12-14) and three (Tables 15-17) were taken at 3 m (10 ft) intervals in a line directly south of column one while column four (Tables 18-20) was taken at the southern-most extent of the mine approximately 91 m (300 ft) from column three.

The overburden materials in column one through three have a weathered zone of 5.5 m (18 ft) from the surface while column four has a weathered zone of 8.2 m (27 ft) as evidenced by the high chromas of the samples (Tables 9, 12, 15, and 18). In the weathered zone of column four, there are four samples at the 1.8-2.7 m (6-9 ft) depth which are believed to belong to the Mahoning coal zone (Figure 3b) This coal is known to occur intermittently throughout the Georges Creek Basin. Sample #5 (Table 20) is the only toxic material in the upper part of column four, but the zone on top of the coal (19.8-21.6 m; 65-71 ft) called the Uffington shale is high in pyrite and toxic. This toxic zone (Uffington Shale) is only 30 cm (1 ft) thick in columns one through three and does not present much hazard to reclamation unless it is left concentrated at some point on the surface of the resultant minesoil.

The natural undisturbed soil of this area has silt loam textures with coarse fragments proliferated throughout the profile. The soil has an argillic horizon with low chroma mottling indicating drainage problems. Also the lower part of the B horizon has definite fragipan tendencies with many prominant low chroma mottles. The soil is acid and low in inherent fertility. It is not recommended for placement on the surface of the minesoil. With the exception of the first 3.0 m (10 ft) of overburden in column four, the data (Tables 18-20) indicate an excess of neutralizers and favorable inherent fertility until the Uffington shale is reached. This material could be put on the surface of the minesoil or all the material above the Uffington shale could be blended to insure good minesoil parent material and successful reclamation.

There was no evidence that erosion would be a severe problem at this site as water was diverted away from the pit area. Water that came from the pit had a pH of 7.2-7.5 which can be attributed to the mining method employed and the neutralizers in the rock strata. The Box-Cut method (Greene and Raney 1974) of mining was employed; therefore, the first section of the new minesoil had been seeded with a mixture of birdsfoot trefoil, clover, and oats. The company had good success reclaiming their first strip mine in this area with the above practices. Details of mining method and reclamation appear consistent with recent E.P.A. suggestions (Grim and Hill, 1974).

Table 2. LOCATIONS OF FIELD STUDY SITES IN NEIGHBORHOOD ONE, CENTRAL APPALACHIAN REGION.

Site	Latitude Longitude Surf. Elev.	Coal Seam	Detail of Site Locations
PBS Coal Company	39.9908°N 78.9835°W 2550 ft	Upper Freeport (E) Lower Freeport (D)	3.2 km (2 mi) northwest of Berlin, Somerset Co., PA
Mary Ruth Coal Company	39.3689°N 79.3164°W 2840-2860 ft	Upper Freeport	2.0 km (1.25 mi) northwest of Taskers Corners, Garrett Co., MD

Table 3. PHYSICAL CHARACTERIZATIONS OF THE UPPER FREEPORT (E) AND LOWER FREEPORT (D) COAL OVERBURDENS AT THE P. B. S. COAL COMPANY'S MINE, NEIGHBORHOOD ONE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A_1	0.0-0.6	Soil	10YR 6/4	2
B_1	0.6-0.9	Soil	2.5Y 7/4	7
B_{21t}	0.9-1.4	Soil	10YR 7/4	6
B_{22t}	1.4-1.9	Soil	10YR 7/3	7
C	1.9-4.0	Soil	2.5Y 7/4	6
1	4.0-5.0	MS	10YR 7/6	7
2	5.0-6.0	MS	10YR 7/6	7
3	6.0-7.0	SS	10YR 7/4	5
4	7.0-8.0	MS	10YR 7/4	6
5	8.0-9.0	MS	10YR 8/4	7
6	9.0-10.0	MR	10YR 7/3	2
7	10.0-11.0	MR	2.5Y 8/2	1
8	11.0-12.0	MR	2.5Y 7/4	1
9	12.0-13.0	SS	10YR 7/4	0
10	13.0-14.0	MR	2.5Y 7/2	0
11	14.0-15.0	MS	7.5YR 6/8	5
12	15.0-16.0	MR	10YR 7/4	1
13	16.0-17.0	MR	10YR 7/3	4
14	17.0-18.0	MR	7.5YR 7/6	4
15	18.0-19.0	MS	7.5YR 7/6	5
16	19.0-20.0	MR	10YR 6/1	4
17	20.0-21.2	MS	2.5Y 7/4	10
18	21.2-22.4	MS	2.5Y 7/2	10
19	22.4-23.6	MS	5Y 7/2	8
20	23.6-24.8	SH	5Y 7/1	5
21	24.8-26.0	SH	5Y 7/1	4
22	26.0-27.2	SH	5Y 7/1	4
23	27.2-28.4	SH	5Y 7/1	4
24	28.4-29.6	SH	5Y 7/1	4
25	29.6-30.8	SH	5Y 7/1	3
26	30.8-32.0	MR	5Y 7/1	3
27	32.0-33.2	SS	5Y 7/1	2
28	33.2-34.4	MR	10YR 6/1	3
29	34.4-35.6	MR	5Y 7/1	2
30	35.6-36.8	MS	10YR 5/1	7
31	36.8-38.0	SH	10YR 4/1	3
32	38.0-39.2	SH	10YR 4/1	2
	39.2-42.6	UPPER FREEPORT COAL		

Table 3. continued

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	42.6-45.6	NOT SAMPLED		
33	45.6-46.8	MS	5Y 7/2	6
34	46.8-48.0	MR	5Y 8/1	2
35	48.0-49.2	MR	5Y 7/1	1
36	49.2-50.4	MR	5Y 7/1	1
37	50.4-51.6	MR	5Y 7/1	2
38	51.6-52.8	SH	5Y 7/1	1
39	52.8-54.0	MR	5Y 7/1	1
40	54.0-55.2	SH	5Y 7/1	2
41	55.2-56.4	SH	5Y 7/1	1
42	56.4-57.6	SH	5Y 7/1	2
43	57.6-58.8	MR	5Y 7/1	2
44	58.8-60.0	MR	5Y 7/1	2
45	60.0-61.2	SH	5Y 7/1	1
46	61.2-62.4	MR	2.5Y 6/2	2
47	62.4-63.6	MR	2.5Y 5/2	2
48	63.6-64.8	MR	5Y 7/1	1
49	64.8-66.0	MR	10YR 7/1	1
50	66.0-67.2	MR	5Y 7/1	1
51	67.2-68.4	MR	5Y 7/1	1
52	68.4-69.6	MR	5Y 7/1	1
53	69.6-70.2	Carb	10YR 3/1	1
54	70.2-70.8	Carb	5YR 2/1	1
55	70.8-71.4	Carb	10YR 3/1	1
56	71.4-72.0	Carb	5YR 3/1	1
57	72.0-73.2	SH	10YR 4/1	1
58	73.2-74.4	SH	10YR 4/1	1
59	74.4-75.6	Coal	5YR 2/1	1
60	75.6-76.8	SH	10YR 4/1	1
61	76.8-78.0	SH	2.5Y 5/2	1
62	78.0-79.2	SH	2.5Y 5/2	1
63	79.2-80.4	SH	2.5Y 5/2	1
LOWER FREEPORT COAL (D)				

Table 4. CHEMICAL CHARACTERIZATIONS OF THE UPPER FREEPORT (E) AND LOWER FREEPORT (D) COAL OVERBURDENS AT THE P. B. S. COAL COMPANY'S MINE, NEIGHBORHOOD ONE

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A_1	4.3	4.5	2.0	92	80	6	88	13.2
B_1	4.1	4.4	2.0	92	40	12	85	8.9
B_{21t}	4.0	4.2	6.5	100	40	12	20	2.2
B_{22t}	4.0	4.1	6.0	95	40	12	20	2.2
C	3.9	4.2	7.0	109	80	18	19	2.2
1	3.9	4.1	7.5	131	40	6	25	2.2
2	4.2	4.4	6.5	150	80	30	47	2.2
3	4.2	4.5	3.0	92	80	30	43	4.5
4	4.3	4.5	8.0	139	240	156	43	6.8
5	4.3	4.6	5.5	167	40	72	27	2.2
6	4.2	4.5	4.5	187	40	84	25	2.2
7	4.4	4.6	4.0	210	120	120	35	2.2
8	4.5	4.7	3.5	202	240	180	50	6.8
9	5.9	5.1	2.0	191	720	576	48	15.9
10	5.1	5.3	1.0	191	840	588	45	6.8
11	4.9	5.1	1.5	131	680	516	58	4.5
12	5.1	5.1	1.5	198	760	528	48	2.2
13	4.5	4.7	5.0	160	280	192	37	2.2
14	4.5	4.6	6.0	153	160	144	38	2.2
15	4.4	4.6	6.5	147	80	72	31	2.2
16	5.0	5.2	1.0	289	800	660	62	9.1
17	5.8	5.7	1.5	171	880	600	111	12.0
18	5.0	4.8	2.0	222	680	564	103	7.2
19	5.6	5.2	1.0	270	840	672	142	4.8
20	6.2	6.1	0.5	343	800	600	94	2.4
21	5.4	5.3	1.0	317	760	432	200	2.4
22	5.2	5.2	1.0	322	800	444	200	2.4
23	6.8	6.4	1.0	307	1920	480	342	2.4
24	5.6	5.4	1.0	307	1000	420	246	2.4
25	6.1	5.8	0.5	298	800	396	216	7.2
26	7.2	7.0	0	243	3120	744	294G	2.4
27	7.6	7.3	0	218	2720	528	360G	4.8
28	7.5	7.6	0	275	6640	516	360G	9.2
29	7.0	7.0	0	289	2080	432	342	4.8
30	6.5	6.4	1.0	307	3920	456	385	4.8
31	4.5	4.7	1.0	280	3760	492	385	4.8

Table 4. continued

Sample No.	pH (paste)	pH (1:1)	Lime Requirement (tons)	Acid Extracted K (lbs.)	Acid Extracted Ca (lbs.)	Acid Extracted Mg (lbs.)	Acid Extracted P (lbs.)	Bicarbonate Extracted P (lbs.)
			Per Thousand Tons of Material					
32	7.3	6.9	0	100	1760	468	360	2.4
UPPER FREEPORT COAL (E)								
33	7.0	7.1	0	280	2160	516	183	4.8
34	8.0	7.8	0	312	7360	804	94	2.4
35	8.1	8.1	0	359	7520	780	111	0.5
36	8.0	8.1	0	327	4560	492	128	0.5
37	8.0	8.0	0	405	2560	504	183	0.5
38	8.0	7.8	0	437	3920	612	216	2.4
39	8.0	7.9	0	432	3920	528	200	2.4
40	7.9	7.9	0	421	3040	504	294	2.4
41	8.0	8.0	0	410	3760	696	256	2.4
42	8.1	8.0	0	432	3520	636	192	2.4
43	8.1	8.0	0	380	7760	708	128	1.2
44	8.1	8.0	0	427	4720	888	174	0.5
45	8.1	8.1	0	302	9440	588	200	4.8
46	7.6	7.7	0	256	8800	768	167	4.8
47	7.7	7.7	0	280	4640	468	360	4.8
48	8.0	8.0	0	353	2240	396	192	2.4
49	8.1	8.0	0	421	2480	468	294	2.4
50	8.0	7.8	0	405	3120	468	360	2.4
51	8.0	7.9	0	332	5760	660	372G	4.8
52	8.1	8.0	0	312	4400	480	372G	4.8
53	7.8	7.7	0	338	2880	444	308	2.4
54	7.5	7.4	0	280	2320	336	342	2.4
55	7.7	7.6	0	312	5680	456	385	4.8
56	7.5	7.4	0	302	2240	468	246	2.4
57	7.9	7.7	0	400	3680	912	256	2.4
58	8.0	7.8	0	410	3600	888	216	4.5
59	3.9	3.6	0.5	145	960	192	115	4.5
60	7.6	7.3	0	353	1840	378	200	2.2
61	7.9	7.6	0	380	2000	504	238	2.2
62	8.0	7.7	0	416	2160	528	246	4.5
63	7.9	7.7	0	395	1840	372	256	2.2
LOWER FREEPORT COAL (D)								

Table 5. ACID-BASE ACCOUNT OF THE UPPER FREEPORT (E) AND LOWER FREEPORT (D) COAL OVERBURDENS AT THE P. B. S. COAL COMPANY'S MINE, NEIGHBORHOOD ONE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
A_1	6/4	0	.010	.31	- 0.74	1.05	
B_1	7/4	1	.010	.31	- 0.50	.81	
B_{21t}	7/4	0	.010	.31	- 2.23	2.54	
B_{22t}	7/3	0	.015	.47	- 2.45	2.92	
C	7/4	0	.015	.47	- 2.95	3.42	
1	7/6	0	.025	.78	- 2.23	3.01	
2	7/6	0	.020	.63	- 2.23	2.86	
3	7/4	0	.010	.31	.25	.06	
4	7/4	0	.015	.47	- 1.49	1.96	
5	8/4	0	.005	.16	- 1.49	1.65	
6	7/3	0	.005	.16	- 1.24	1.40	
7	8/2	0	.005	.16	0	.16	
8	7/4	0	.010	.31	1.24		.93
9	7/4	0	.005	.16	.99		.83
10	7/2	0	.005	.16	1.73		1.57
11	6/8	0	.025	.78	- 1.98	2.76	
12	7/4	0	.005	.16	.50		.34
13	7/3	0	.010	.31	- 1.49	1.80	
14	7/6	0	.005	.16	- 1.49	1.65	
15	7/6	0	.010	.31	- .74	1.05	
16	6/1	0	.180	5.63	3.19	2.44	
17	7/4	0	.040	1.25	4.68		3.43
18	7/2	0	.015	.47	.50		.03
19	7/2	0	.020	.62	4.18		3.56
20	7/1	0	.035	1.09	14.03		12.94
21	7/1	0	.050	1.56	6.41		4.85
22	7/1	1	.115	3.59	6.41		2.82
23	7/1	0	.050	1.56	12.55		10.99
24	7/1	0	.070	2.19	6.16		3.97
25	7/1	0	.070	2.19	10.10		7.91
26	7/1	1	.060	1.87	12.80		10.93
27	7/1	1	.070	2.19	15.52		13.33
28	6/1	1	.100	3.12	19.95		16.83
29	7/1	1	.060	1.87	11.09		9.22
30	5/1	0	.225	7.03	18.71		11.68
31	4/1	0	.325	10.16	13.29		3.13

Table 5. continued

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
32	4/1	0	.125	3.91	17.00		13.09
UPPER FREEPORT COAL (E)							
33	7/2	1	.140	4.38	15.77		11.39
34	8/1	1	.050	1.56	21.93		20.37
35	7/1	1	.040	1.25	22.92		21.67
36	7/1	1	.035	1.09	17.75		16.66
37	7/1	1	.020	.63	6.16		5.53
38	7/1	1	.020	.63	- .74	1.37	
39	7/1	1	.030	.94	7.15		6.21
40	7/1	1	.020	.63	3.94		3.31
41	7/1	0	.015	.47	9.11		8.64
42	7/1	0	.010	.31	7.65		7.34
43	7/1	1	.015	.47	15.77		15.30
44	7/1	1	.015	.47	15.02		14.55
45	7/1	1	.025	.78	27.82		27.04
46	6/2	1	.125	3.91	36.77		32.86
47	5/2	1	.110	3.44	13.04		9.60
48	7/1	0	.020	.63	4.18		3.55
49	7/1	1	.040	1.25	4.68		3.43
50	7/1	1	.030	.94	7.87		6.93
51	7/1	1	.040	1.25	15.27		14.02
52	7/1	1	.060	1.88	12.33		10.45
53	3/1	0	.030	.94	6.16		5.22
54	2/1	0	.150	4.69	4.18	.51	
55	3/1	0	.100	3.13	14.53		11.40
56	3/1	0	.400	12.50	12.82		.32
57	4/1	0	.100	3.13	17.00		13.87
58	4/1	0	.125	3.91	19.70		15.79
59	2/1	0	.625	19.53	.74	18.79	
60	4/1	0	.125	3.91	3.44	.47	
61	5/2	0	.100	3.13	11.83		8.70
62	5/2	0	.040	1.25	9.11		7.86
63	5/2	0	.030	.94	7.65		6.71
LOWER FREEPORT COAL (D)							

Table 6. PHYSICAL CHARACTERIZATIONS OF THE UPPER FREEPORT (E) AND LOWER FREEPORT (D) COAL OVERBURDENS AT THE P. B. S. COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-22.4	NOT SAMPLED		
1	22.4-23.6	MR	2.5Y 7/2	4
2	23.6-24.8	MR	5Y 7/1	4
3	24.8-26.0	MR	N 8/0	1
4	26.0-27.2	MR	5Y 7/1	3
5	27.2-28.4	MR	N 7/0	3
6	28.4-29.6	MR	5Y 7/1	2
7	29.6-30.8	MR	5Y 7/1	1
8	30.8-32.0	SS	5Y 6/1	1
9	32.0-33.2	SS	5Y 6/1	4
10	33.2-34.4	MR	5Y 7/1	3
11	34.4-35.6	MR	5Y 7/1	3
12	35.6-36.8	MR	10YR 4/1	2
13	36.8-38.0	MR	10YR 4/1	3
14	38.0-39.2	MR	10YR 5/1	3
	39.2-42.6	UPPER FREEPORT COAL (E)		
	42.6-44.4	NOT SAMPLED		
15	44.4-45.6	MS	10YR 5/1	6
16	45.6-46.8	MS	5Y 7/1	6
17	46.8-48.0	MS	5Y 7/1	5
18	48.0-49.2	MR	5Y 7/1	3
19	49.2-50.4	MR	5Y 7/1	2
20	50.4-51.6	MR	5Y 7/1	3
21	51.6-52.8	MR	5Y 7/1	2
22	52.8-54.0	MR	5Y 7/1	2
23	54.0-55.2	MR	2.5Y 7/2	3
24	55.2-56.4	MR	5Y 7/2	3
25	56.4-57.6	MR	5Y 7/1	2
26	57.6-58.8	MR	5Y 7/1	3
27	58.8-60.0	MR	5Y 7/1	2
28	60.0-61.2	MR	5Y 7/1	2
29	61.2-62.4	MR	10YR 4/1	2
30	62.4-63.6	MR	5Y 7/1	2
31	63.6-64.8	MR	5Y 7/1	2
32	64.8-66.0	MR	5Y 7/1	2
33	66.0-67.2	MR	5Y 7/1	2
34	67.2-68.4	MS	10YR 6/1	-

Table 6. continued

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
35	68.4-69.6	MS	5Y 7/1	-
36	69.6-70.8	Carb	10YR 2/1	-
37	70.8-72.0	Carb	10YR 3/1	-
38	72.0-73.2	MS	10YR 4/1	-
39	73.2-74.4	MS	5YR 4/1	-
40	74.4-75.6	Coal	N 2/0	-
41	75.6-76.8	Carb	10YR 3/1	-
	76.8-80.4	NOT SAMPLED		
LOWER FREEPORT COAL (D)				

Table 7. CHEMICAL CHARACTERIZATIONS OF THE UPPER FREEPORT (E) AND LOWER FREEPORT (D) COAL OVERBURDENS AT THE P. B. S. COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	5.5	5.4	1.0	234	1680	900	246	24.3
2	5.6	5.5	1.0	302	1120	780	103	4.5
3	5.5	5.5	0.5	437	880	540	123	6.7
4	6.5	6.4	0.5	348	1520	480	216	4.5
5	6.2	6.1	0.5	312	2800	504	308	6.7
6	7.3	7.1	0	302	2720	552	342	4.5
7	7.0	6.9	0	266	1600	564	294	6.7
8	7.8	7.6	0	183	6080	1656	77G	4.5
9	7.1	7.6	0	270	4720	600	385G	6.7
10	6.9	6.8	0	327	2800	504	342G	6.7
11	6.7	6.5	0	317	4320	492	372	8.9
12	5.5	5.4	0.5	284	1680	516	294	6.7
13	6.4	6.2	0.5	332	2080	480	342	6.7
14	7.0	6.8	0	343	1920	528	308	6.7
UPPER FREEPORT COAL (E)								
15	3.4	3.4	2.5	230	1680	552	97	4.5
16	6.6	6.1	0.5	289	1840	492	246	4.5
17	7.9	7.7	0	283	9760	660	67	4.5
18	8.2	8.2	0	293	9760	708	35	4.5
19	8.1	8.1	0	327	8800	612	82	4.5
20	8.1	8.1	0	275	11360	480	43	4.5
21	8.1	8.1	0	353	7120	852	128	4.5
22	8.1	8.0	0	369	3680	732	246	2.2
23	8.2	8.0	0	289	7120	948	77	4.5
24	8.1	8.1	0	307	7760	672	67	4.5
25	8.1	8.1	0	327	8800	696	94	4.5
26	8.1	8.1	0	312	8960	504	82	4.5
27	8.1	8.1	0	338	8800	672	123	6.7
28	8.0	8.0	0	317	7920	576	142	4.5
29	7.8	7.9	0	343	4080	564	320	4.5
30	7.9	7.9	0	421	2800	564	183	4.5
31	8.1	8.1	0	437	2800	576	200	4.5
32	8.1	8.2	0	390	3760	636	200	4.5

Table 7. continued

Sample No.	pH (paste)	pH (1:1)	Lime Requirement (tons)	Per Thousand Tons of Material — Acid Extracted K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	Bicarbonate Extracted P (lbs.)
33	8.1	8.1	0	459	4460	576	320G	6.7
34	8.1	8.2	0	400	7920	468	115	4.5
35	8.2	8.2	0	380	4720	720	246G	4.5
36	7.6	7.8	0	374	2320	408	300	4.5
37	7.6	7.8	0	374	4560	624	385G	4.5
38	7.8	7.8	0	459	2720	636	294	4.5
39	7.9	8.0	0	464	4160	1188	142G	2.4
40	5.4	5.6	0.5	270	1600	336	200	0.5
41	7.8	7.8	0	490	2400	528	238	0.5
LOWER FREEPORT COAL (D)								

Table 8. ACID-BASE ACCOUNT OF THE UPPER FREEPORT (E) AND LOWER FREEPORT (D) COAL OVERBURDENS AT THE P. B. S. COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	7/2	0	.035	1.09	2.70		1.61
2	7/1	0	.050	1.56	5.17		3.61
3	8/0	1	.060	1.88	7.40		5.52
4	7/1	0	.040	1.25	15.02		13.77
5	7/0	1	.050	1.56	8.39		6.83
6	7/1	0	.080	2.50	10.35		7.85
7	7/1	1	.060	1.88	8.86		6.98
8	6/1	0	.050	1.56	19.45		17.89
9	6/1	0	.080	2.50	12.08		9.58
10	7/1	0	.030	.94	14.53		13.59
11	7/1	0	.180	5.63	11.09		5.46
12	4/1	0	.160	5.00	31.04		26.04
13	4/1	0	.300	9.38	11.09		1.71
14	5/1	0	.150	4.69	14.03		9.34
UPPER FREEPORT COAL (E)							
15	5/1	0	.560	17.50	- 1.98	19.48	
16	7/1	0	.130	4.06	4.21		.15
17	7/1	2	.090	2.81	35.96		33.15
18	7/1	3	.020	.63	86.45		85.82
19	7/1	2	.030	.94	33.02		32.08
20	7/1	4	.020	.63	74.10		73.47
21	7/1	1	.040	1.25	16.02		14.77
22	7/1	0	.010	.31	5.92		5.61
23	7/2	1	.030	.94	27.60		26.66
24	7/2	2	.030	.94	39.40		38.46
25	7/1	2	.030	.94	33.98		33.04
26	7/1	3	.030	.94	48.15		47.21
27	7/1	0	.040	1.25	27.32		26.07
28	7/1	1	.040	1.25	24.38		23.13
29	4/1	0	.080	2.50	9.85		7.35
30	7/1	0	.030	.94	4.18		3.24
31	7/1	0	.020	.63	7.62		6.99
32	7/1	0	.020	.63	13.79		13.16
33	7/1	0	.030	.94	13.79		12.85
34	6/1	1	.030	.94	21.21		20.27
35	7/1	1	.030	.94	14.52		13.58
36	2/1	0	.100	3.13	3.19		.06

Table 8. continued

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
37	3/1	0	.175	5.47	9.36		3.89
38	4/1	0	.100	3.13	8.12		4.99
39	4/1	0	.200	6.25	19.21		12.96
40	2/0	0	.600	18.75	3.94	14.81	
41	3/1	0	.200	6.25	3.94	2.31	
LOWER FREEPORT COAL (D)							

Table 9. PHYSICAL CHARACTERIZATIONS OF THE UPPER FREEPORT COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
1	0.0-1.0	Soil	2.5Y 6/4	-
2	1.0-3.0	Soil	10YR 6/6	8
3	3.0-4.0	MS	7.5YR 6/6	8
4	4.0-5.0	MS	2.5Y 7/4	7
5	5.0-6.0	MS	7.5YR 6/6	9
6	6.0-7.0	MS	10YR 6/6	5
7	7.0-8.0	MS	7.5YR 5/6	7
8	8.0-9.0	MS	10YR 5/8	4
9	9.0-10.0	MS	7.5YR 6/6	3
10	10.0-11.0	MS	2.5Y 7/4	3
11	11.0-12.0	MR	10YR 6/4	4
12	12.0-13.0	MR	2.5Y 7/4	3
13	13.0-14.0	MR	2.5Y 7/4	3
14	14.0-15.0	MR	2.5Y 7/4	2
15	15.0-16.0	MR	2.5Y 7/4	3
16	16.0-17.0	MR	10YR 7/4	3
17	17.0-18.0	SS	2.5Y 7/4	2
18	18.0-19.0	SS	2.5Y 7/2	3
19	19.0-20.0	MR	2.5Y 7/4	3
20	20.0-21.0	MS	2.5Y 6/2	4
21	21.0-22.0	Carb	2.5Y 3/2	2
22	22.0-23.0	UPPER FREEPORT COAL		

Table 10. CHEMICAL CHARACTERIZATIONS OF THE UPPER FREEPORT COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	4.5	4.0	4.5	374	1360	192	34	20.4
2	4.6	4.2	4.5	120	240	96	31	2.2
3	4.6	4.3	3.0	145	200	96	65	2.2
4	4.6	4.2	2.5	128	160	84	31	2.2
5	4.6	4.2	4.0	128	160	78	45	9.1
6	4.6	4.2	3.5	128	160	84	32	4.5
7	4.6	4.2	4.5	122	160	84	67	63.8
8	4.8	4.3	3.5	142	160	84	52	6.8
9	4.6	4.1	3.0	131	160	84	38	6.8
10	4.6	4.2	5.0	131	160	84	47	18.2
11	4.4	4.2	3.5	142	160	60	45	6.8
12	4.6	4.2	3.0	134	160	60	40	4.5
13	5.1	4.7	1.5	147	880	348	48	9.1
14	5.2	4.9	1.0	145	880	348	56	15.9
15	5.5	5.1	1.0	134	720	264	58	11.4
16	5.7	5.3	1.0	111	800	252	75	13.6
17	5.9	5.4	1.0	106	880	264	72	6.8
18	6.0	5.6	0.5	103	560	216	72	2.2
19	6.1	5.8	1.0	120	1840	624	100	13.6
20	5.9	5.7	1.0	136	1600	624	67	6.7
21	3.7	3.5	1.0	171	1440	396	32	4.5
22	UPPER FREEPORT COAL							

Table 11. ACID-BASE ACCOUNT OF THE UPPER FREEPORT COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	6/4	0	.040	1.25	1.24	.01	
2	6/6	0	.005	.16	- .49	.65	
3	6/6	0	.005	.16	- .49	.65	
4	7/4	0	.005	.16	.75		.59
5	6/6	1	.005	.16	.50		.34
6	6/6	1	.005	.16	.50		.34
7	5/6	1	.005	.16	- .98	1.14	
8	5/8	1	.005	.16	.25		.09
9	6/6	0	.005	.16	.50		.34
10	7/4	0	.005	.16	1.24		1.08
11	6/4	1	.010	.31	- .25	.56	
12	7/4	1	.010	.31	- .02	.33	
13	7/4	1	.005	.16	1.81		1.65
14	7/4	1	.005	.16	1.35		1.19
15	7/4	1	.005	.16	.88		.72
16	7/4	1	.005	.16	1.59		1.43
17	7/4	1	.005	.16	2.50		2.34
18	7/2	1	.050	1.56	2.50		.94
19	7/4	1	.005	.16	4.34		4.18
20	6/2	1	.055	1.72	2.28		.56
21	3/2	0	.700	21.87	- .71	22.58	
22	UPPER FREEPORT COAL						

Table 12. PHYSICAL CHARACTERIZATIONS OF THE UPPER FREEPORT COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
1	0.0-1.0	Soil	10YR 6/6	-
2	1.0-3.0	Soil	7.5YR 5/6	8
3	3.0-4.0	MS	7.5YR 5/6	9
4	4.0-5.0	MS	7.5YR 6/6	7
5	5.0-6.0	MS	10YR 6/6	7
6	6.0-7.0	MS	7.5YR 5/6	4
7	7.0-8.0	MS	2.5Y 7/4	2
8	8.0-9.0	MS	10YR 6/6	3
9	9.0-10.0	MS	2.5Y 7/4	4
10	10.0-11.0	MR	10YR 7/6	4
11	11.0-12.0	MR	2.5Y 7/6	4
12	12.0-13.0	MR	2.5Y 7/4	3
13	13.0-14.0	MR	2.5Y 7/4	2
14	14.0-15.0	MR	2.5Y 7/4	3
15	15.0-16.0	MR	10YR 6/3	3
16	16.0-17.0	SS	2.5Y 7/4	3
17	17.0-18.0	MR	2.5Y 6/4	2
18	18.0-19.0	MR	2.5Y 5/2	1
19	19.0-20.0	Carb	2.5Y 3/2	1
20	20.0-22.0+	UPPER FREEPORT COAL		

Table 13. CHEMICAL CHARACTERIZATIONS OF THE UPPER FREEPORT COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	4.4	3.9	4.5	117	240	48	31	4.5
2	4.6	4.2	4.0	136	240	96	38	4.5
3	4.6	4.1	3.0	125	240	96	50	2.2
4	4.6	4.2	4.0	114	160	78	32	4.5
5	4.6	4.1	3.0	134	240	84	37	4.5
6	4.6	4.2	3.0	131	240	78	38	9.1
7	4.6	4.1	3.5	136	200	90	29	4.5
8	4.6	4.2	3.5	142	200	84	31	6.8
9	4.5	4.2	3.5	147	200	96	40	9.1
10	4.5	4.2	5.5	145	160	84	50	9.1
11	4.4	4.2	4.5	134	160	72	47	11.4
12	4.5	4.3	4.0	150	160	96	48	11.4
13	4.6	4.4	2.0	139	320	180	48	9.1
14	5.1	4.9	1.0	131	800	348	52	13.6
15	5.8	5.4	1.0	114	1200	384	75	20.5
16	6.1	5.9	1.0	106	640	180	65	11.4
17	6.4	6.1	1.0	125	2240	768	111	9.1
18	4.4	4.3	1.5	150	2000	672	58	2.2
19	3.2	3.2	2.5	191	1680	444	31	4.5
20	UPPER FREEPORT COAL							

Table 14. ACID-BASE ACCOUNT OF THE UPPER FREEPORT COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	6/6	1	.030	.94	- .49	1.43	
2	4/5	0	.005	.16	- .49	.65	
3	5/6	1	.005	.16	.75		.59
4	6/6	1	.005	.16	- .74	.90	
5	6/6	0	.005	.16	- .24	.40	
6	5/6	1	.005	.16	.00	.16	
7	7/4	1	.005	.16	- .49	.65	
8	6/6	1	.005	.16	.50		.34
9	7/4	1	.005	.16	-2.72	2.88	
10	7/6	1	.005	.16	- .25	.41	
11	7/6	1	.005	.16	2.28		2.12
12	7/4	1	.005	.16	.20		.04
13	7/4	1	.005	.16	.20		.04
14	7/4	1	.005	.16	3.19		3.03
15	6/3	1	.005	.16	2.03		1.87
16	7/4	1	.005	.16	.88		.72
17	6/4	1	.040	1.25	6.17		4.92
18	5/2	0	.135	4.22	2.50	1.72	
19	3/2	0	.725	22.66	- .93	23.59	
20	UPPER FREEPORT COAL						

Table 15. PHYSICAL CHARACTERIZATIONS OF THE UPPER FREEPORT COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN THREE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
1	0.0- 1.0	Soil	10YR 6/6	
2	1.0- 3.0	Soil	10YR 5/6	9
3	3.0- 4.0	MS	10YR 6/8	9
4	4.0- 5.0	MS	7.5YR 6/8	4
5	5.0- 6.0	MS	10YR 6/6	8
6	6.0- 7.0	MS	10YR 7/6	5
7	7.0- 8.0	MS	10YR 8/6	4
8	8.0- 8.5	MS	7.5YR 7/8	8
9	8.5- 9.0	MS	2.5Y 7/4	2
10	9.0-10.0	MS	10YR 7/4	2
11	10.0-11.0	MR	2.5Y 7/4	3
12	11.0-12.0	MR	2.5Y 7/4	5
13	12.0-13.0	MR	10YR 6/6	5
14	13.0-14.0	MR	2.5Y 6/6	3
15	14.0-15.0	MR	2.5Y 6/4	5
16	15.0-16.0	MR	2.5Y 7/4	3
17	16.0-17.0	MR	2.5Y 7/4	2
18	17.0-18.0	MR	10YR 6/6	3
19	18.0-19.0	SS	10YR 7/3	2
20	19.0-20.0	SS	2.5Y 7/2	0
21	20.0-21.0	SS	5Y 8/1	1
22	21.0-22.0	MR	2.5Y 7/4	2
23	22.0-23.0	MR	10YR 4/1	2
UPPER FREEPORT COAL				

Table 16. CHEMICAL CHARACTERIZATIONS OF THE UPPER FREEPORT COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN THREE

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	4.6	4.1	4.5	95	480	108	35	4.5
2	4.7	4.2	2.0	142	240	120	47	4.5
3	4.5	4.2	5.5	125	240	108	47	4.5
4	4.6	4.2	2.5	125	160	90	40	4.5
5	4.6	4.2	3.0	125	240	96	31	4.5
6	4.6	4.2	3.0	125	160	84	42	13.2
7	4.6	4.3	4.0	136	160	90	31	4.5
8	4.7	4.3	4.5	142	160	96	45	4.5
9	4.6	4.1	4.0	134	160	96	35	8.9
10	4.6	4.1	4.5	145	160	96	31	6.7
11	4.2	3.9	3.5	139	160	72	38	6.7
12	4.5	4.1	3.5	150	160	108	42	4.5
13	4.6	4.2	4.0	160	240	180	56	17.6
14	4.8	4.4	2.0	167	640	456	50	20.0
15	5.1	4.7	1.5	164	1600	552	256	37.7
16	6.1	5.7	0.5	142	2080	504	294	17.6
17	6.3	6.0	0.5	111	1040	252	142	8.9
18	6.3	5.8	1.0	125	1200	300	132	24.3
19	6.7	6.3	0.5	145	1280	360	119	8.9
20	6.9	6.8	0	128	4560	1164	65G	4.5
21	7.2	6.8	0	125	1360	360	91G	2.2
22	6.6	6.5	0	179	2000	480	153	13.6
23	3.2	3.3	2.5	218	1760	516	34	2.2

UPPER FREEPORT COAL

Table 17. *ACID-BASE ACCOUNT OF THE UPPER FREEPORT* COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN THREE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	6/6	0	.005	.16	- 1.48	1.64	
2	5/6	1	.005	.16	- .49	.65	
3	6/8	0	.005	.16	- 1.73	1.89	
4	6/8	0	.005	.16	.00	.16	
5	6/6	0	.005	.16	- .98	1.14	
6	7/6	1	.005	.16	.75		.59
7	8/6	0	.005	.16	.00	.16	
8	7/8	1	.005	.16	- .74	.90	
9	7/4	1	.005	.16	- 2.22	2.38	
10	7/4	0	.005	.16	- .24	.40	
11	7/4	1	.005	.16	- .47	.63	
12	7/4	1	.005	.16	- .22	.38	
13	6/6	1	.010	.31	- .22	.53	
14	6/6	1	.010	.31	2.25		1.94
15	6/4	2	.005	.16	3.63		3.47
16	7/4	1	.005	.16	4.09		3.93
17	7/4	1	.010	.31	3.63		3.32
18	6/6	1	.005	.16	2.50		2.34
19	7/3	2	.030	.94	7.25		6.31
20	7/2	1	.040	1.25	20.19		18.94
21	8/1	1	.050	1.56	15.88		14.32
22	7/4	0	.185	5.78	8.16		2.38
23	4/1	0	1.000	31.25	2.94	28.31	
UPPER FREEPORT COAL							

Table 18. PHYSICAL CHARACTERIZATIONS OF THE UPPER FREEPORT COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN FOUR

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
Ap	0.0- 0.5	Soil	10YR 5/3	1
B1	0.5- 1.0	Soil	10YR 7/4	7
B21	1.0- 1.3	Soil	10YR 7/4	7
B22t	1.3- 1.8	Soil	10YR 7/4	7
C	1.8- 4.0	Soil	2.5Y 7/4	8
1	4.0- 5.0	MR	2.5Y 6/4	2
2	5.0- 6.0	MS	2.5Y 7/4	5
3	6.0- 7.0	MR	10YR 4/1	2
4	7.0- 7.7	MR	10YR 4/1	2
5	7.7- 8.0	Carb.	5YR 2/1	1
6	8.0- 9.0	MR	2.5Y 6/2	3
7	9.0- 9.7	MR	10YR 6/3	4
8	9.7-10.0	MR	10YR 6/2	2
9	10.0-11.0	MR	10YR 6/6	2
10	11.0-12.0	MR	2.5Y 7/4	3
11	12.0-13.0	MR	2.5Y 7/4	2
12	13.0-14.0	MR	2.5Y 7/2	1
13	14.0-15.0	MR	2.5Y 7/4	1
14	15.0-16.0	MR	2.5Y 7/2	1
15	16.0-17.0	MR	2.5Y 6/4	2
16	17.0-18.0	MR	5Y 7/2	1
17	18.0-19.0	MR	5Y 7/3	1
18	19.0-20.0	MR	2.5Y 7/4	4
19	20.0-21.0	MR	2.5Y 7/4	3
20	21.0-22.0	MR	10YR 5/6	4
21	22.0-23.0	MR	10YR 5/8	5
22	23.0-24.0	NOT SAMPLED		
23	24.0-25.0	MR	2.5Y 7/4	
24	25.0-26.0	MR	10YR 6/6	1
25	26.0-27.0	MR	2.5Y 6/4	2
26	27.0-28.0	MR	2.5Y 7/2	1
27	28.0-29.0	MR	2.5Y 7/2	1
28	29.0-30.0	SH	2.5Y 7/2	0
29	30.0-31.0	SH	2.5Y 7/4	0
30	31.0-32.0	SH	2.5Y 7/4	0

Table 18. continued

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
31	32.0-33.0	SH	N 8/0	0
32	33.0-34.0	SH	2.5Y 7/4	1
33	34.0-35.0	SH	N 8/0	0
34	35.0-36.0	SH	N 8/0	0
35	36.0-37.0	SH	N 8/0	0
36	37.0-38.0	SH	N 8/0	0
37	38.0-39.0	SH	N 7/0	0
38	39.0-40.0	SH	N 8/0	1
39	40.0-41.0	SH	5Y 7/1	1
40	41.0-42.0	SH	5Y 7/1	0
41	42.0-43.0	SH	N 7/0	0
42	43.0-44.0	SH	5Y 7/1	1
43	44.0-45.0	SH	5Y 7/1	0
44	45.0-46.0	SH	5Y 7/1	0
45	46.0-47.0	SH	5Y 7/1	1
46	47.0-48.0	SH	5Y 7/3	1
47	48.0-49.0	SH	5Y 7/1	0
48	49.0-50.0	SH	5Y 7/1	0
49	50.0-51.0	SH	5Y 7/1	1
50	51.0-52.0	SH	5Y 7/1	0
51	52.0-53.0	SH	5Y 7/1	1
52	53.0-54.0	SH	5Y 7/1	0
53	54.0-55.0	SH	5Y 7/1	0
54	55.0-56.0	SH	5Y 7/1	0
55	56.0-57.0	SH	5Y 7/1	1
56	57.0-58.0	SH	5Y 7/1	1
57	58.0-59.0	SH	5Y 7/1	1
58	59.0-60.0	SH	5Y 7/1	1
59	60.0-61.0	SH	5Y 7/1	0
60	61.0-62.0	SH	5Y 7/1	1
61	62.0-63.0	SH	5Y 7/1	0
62	63.0-64.0			
63	64.0-65.0	SH	5Y 7/1	1
64	65.0-66.0	SH	10YR 5/1	1
65	66.0-67.0	SH	10YR 4/1	1
66	67.0-68.0	Carb.	10YR 3/1	1
67	68.0-69.0	Carb.	5YR 2/1	1
68	69.0-70.0	Carb.	N 2/0	1
69	70.0-71.0	Carb.	N 2/0	1
UPPER FREEPORT COAL				

Table 19. CHEMICAL CHARACTERIZATIONS OF THE UPPER FREEPORT COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN FOUR

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A_p	4.5	4.3	4.0	98	880	132	23	6.7
B_1	4.6	4.4	2.5	69	640	144	35	2.2
B_{21}	4.4	4.2	3.5	114	400	156	38	2.2
B_{22t}	4.4	4.2	4.0	114	320	156	34	2.2
C	4.5	4.2	4.0	122	320	192	45	4.5
1	4.6	4.4	3.0	191	520	156	52	4.5
2	4.5	4.3	5.0	142	640	156	38	4.5
3	4.5	4.3	4.0	198	640	168	54	6.7
4	4.4	4.2	4.5	218	440	144	56	6.7
5	4.4	4.2	4.5	92	280	42	22	11.0
6	4.4	4.2	4.5	167	320	144	72	24.3
7	4.3	3.9	4.5	206	560	300	52	4.5
8	4.8	4.5	3.5	275	640	480	91	48.6
9	4.9	4.6	2.5	167	640	408	52	4.5
10	4.9	4.6	2.0	175	720	456	48	6.8
11	4.7	4.4	2.5	160	400	300	29	2.2
12	4.8	4.4	2.0	210	440	324	38	4.5
13	4.8	4.6	2.5	210	400	300	47	6.8
14	4.9	4.6	2.5	252	400	336	47	6.8
15	4.8	4.6	2.5	218	480	330	52	15.9
16	4.9	4.6	2.0	243	560	420	45	2.2
17	4.9	4.6	2.0	230	640	468	40	2.2
18	4.7	4.6	3.0	175	880	468	52	6.7
19	4.9	4.6	4.0	206	880	540	56	4.5
20	4.8	4.6	3.0	175	640	420	69	4.5
21	5.0	4.8	1.5	153	560	360	111	15.4
22		NOT SAMPLED						
23	5.5	5.4	1.5	198	1120	720	85	13.2
24	5.8	5.6	1.0	171	800	600	82	11.0
25	5.9	5.8	1.0	191	1920	552	360	11.0
26	6.8	6.7	0	218	3440	492	372	8.9
27	6.6	6.7	0	191	2240	432	372	11.0
28	6.2	6.1	1.0	210	1120	456	147	6.7

Table 19. continued

Sample No.	pH (paste)	pH (1:1)	Lime Requirement (tons)	Acid Extracted K (lbs.)	Acid Extracted Ca (lbs.)	Acid Extracted Mg (lbs.)	Acid Extracted P (lbs.)	Bicarbonate Extracted P (lbs.)
			Per Thousand Tons of Material					
29	6.4	6.4	1.0	214	1200	504	111	8.9
30	6.6	6.6	0	261	1600	516	294	11.0
31	7.2	7.1	0	252	2000	372	360	4.5
32	7.3	7.2	0	230	2880	444	360	6.7
33	7.2	7.1	0	261	1760	360	294	6.7
34	7.4	7.2	0	312	2080	360	360	4.5
35	7.5	7.3	0	275	1520	324	294	2.2
36	7.5	7.3	0	252	1680	300	294	2.2
37	7.8	7.6	0	270	3280	384	300G	4.5
38	7.6	7.3	0	256	2880	324	360G	6.7
39	7.5	7.2	0	275	1840	300	300	2.2
40	7.5	7.1	0	280	1920	312	300	4.5
41	7.8	7.6	0	261	1920	312	137	2.2
42	7.6	7.3	0	312	2800	324	360G	4.5
43	7.5	7.3	0	238	1600	252	216	4.5
44	7.6	7.5	0	266	1600	288	192	4.5
45	7.7	7.4	0	247	2000	312	294	4.5
46	7.2	7.1	0	238	2560	432	294	6.8
47	7.7	7.5	0	247	2000	312	300	4.5
48	7.9	7.8	0	247	3520	420	192G	4.5
49	8.0	7.8	0	243	4320	444	132G	4.5
50	7.9	7.7	0	317	2160	360	294	4.5
51	7.9	7.9	0	275	4240	408	200G	4.5
52	7.9	7.8	0	298	2320	360	246G	4.5
53	7.8	7.7	0	298	2240	408	183	4.5
54	7.9	7.6	0	289	2960	360	246G	4.5
55	7.7	7.3	0	280	1280	204	238	4.5
56	7.8	7.6	0	270	3680	348	360G	4.5
57	7.9	7.6	0	252	3040	408	308G	4.5
58	7.5	7.6	0	256	2560	336	308G	4.5
59	7.7	7.4	0	266	2560	300	342G	4.5
60	7.5	7.2	0	252	1760	252	300	4.5
61	7.7	7.4	0	210	4160	984	97G	4.5
62	NOT SAMPLED							
63	7.3	7.0	0	289	2000	456	128	4.5
64	3.1	3.1	2.0	256	2000	564	37	2.2

Table 19. continued

Sample No.	pH (paste)	pH (1:1)	Per Thousand Tons of Material: Lime Requirement (tons)	Acid Extracted: K (lbs.)	Acid Extracted: Ca (lbs.)	Acid Extracted: Mg (lbs.)	Acid Extracted: P (lbs.)	Bicarbonate Extracted P (lbs.)
65	3.0	3.1	2.0	252	2080	600	31	2.2
66	2.8	2.8	2.5	198	1840	336	183G	2.2
67	2.8	3.0	2.0	202	1440	324	72G	2.2
68	3.0	3.1	1.0	114	1520	120	294G	4.5
69	3.1	3.3	1.0	78	640	96	32G	2.2
UPPER FREEPORT COAL								

Table 20. ACID-BASE ACCOUNT OF THE UPPER FREEPORT COAL OVERBURDEN AT THE MARY RUTH COAL COMPANY'S MINE, NEIGHBORHOOD ONE, COLUMN FOUR

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material			
				Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
Ap	5/3	1	.030	.94	1.62		.68
B_1	7/4	1	.015	.47	- .22	.69	
B_{21}	7/4	0	.015	.47	- 1.35	1.82	
B_{22t}	7/4	1	.010	.31	- 1.13	1.44	
C	7/4	1	.015	.47	.25	.22	
1	6/4	1	.010	.31	0	.31	
2	7/4	1	.015	.47	- 1.13	1.60	
3	4/1	0	.025	.78	- .20	.98	
4	4/1	0	.015	.47	0	.47	
5	2/1	0	.275	8.59	- 1.13	9.72	
6	6/2	1	.015	.47	- .22	.69	
7	6/3	1	.020	.62	- .44	1.06	
8	6/2	0	.005	.16	.69		.53
9	6/6	1	.010	.31	1.62		1.31
10	7/4	1	.010	.31	1.84		1.53
11	7/4	1	.005	.16	.93		.77
12	7/2	1	.005	.16	.93		.77
13	7/4	1	.005	.16	1.62		1.46
14	7/2	1	.010	.31	1.62		1.31
15	6/4	1	.005	.16	1.15		.99
16	7/2	1	.005	.16	1.62		1.46
17	7/3	1	.005	.16	1.37		1.21
18	7/4	0	.035	1.09	1.89		.80
19	7/4	0	.005	.16	2.13		1.97
20	5/6	0	.005	.16	.71		.55
21	5/8	0	.015	.47	2.62		2.15
22		NOT SAMPLED					
23	7/4	0	.005	.16	4.75		4.59
24	6/6	1	.055	1.72	2.84		1.12
25	6/4	1	.025	.78	4.51		3.73
26	7/2	1	.035	1.09	11.86		10.77
27	7/2	1	.025	.78	9.75		8.97
28	7/2	0	.075	2.34	6.66		4.32
29	7/4	1	.020	.62	6.88		6.26
30	7/4	1	.020	.62	11.17		10.55
31	8/0	1	.015	.47	11.88		11.41
32	7/4	1	.020	.62	12.84		12.22
33	8/0	1	.025	.78	8.33		7.55

Table 20. continued

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
34	8/0	1	.015	.47	14.04		13.57
35	8/0	1	.005	.16	14.97		14.81
36	8/0	1	.015	.47	14.26		13.79
37	7/0	1	.020	.62	16.64		16.02
38	8/0	1	.045	1.41	10.71		9.30
39	7/1	1	.060	1.87	8.09		6.22
40	7/1	1	.030	.94	8.55		7.61
41	7/0	0	.005	.16	14.75		14.59
42	7/1	0	.020	.62	10.00		9.38
43	7/1	0	.005	.16	10.71		10.55
44	7/1	1	.020	.62	9.26		8.64
45	7/1	1	.015	.47	10.93		10.46
46	7/3	1	.015	.47	15.21		14.74
47	7/1	1	.015	.47	16.64		16.17
48	7/1	1	.020	.62	11.17		10.55
49	7/1	1	.010	.31	16.17		15.86
50	7/1	1	.010	.31	9.51		9.20
51	7/1	1	.015	.47	15.21		14.74
52	7/1	1	.050	1.56	14.04		12.48
53	7/1	1	.015	.47	10.93		10.46
54	7/1	1	.010	.31	9.51		9.20
55	7/1	1	.010	.31	7.13		6.82
56	7/1	1	.015	.47	10.46		9.99
57	7/1	1	.005	.16	10.00		9.84
58	7/1	1	.015	.47	12.13		11.66
59	7/1	1	.010	.31	8.09		7.78
60	7/1	1	.045	1.41	8.09		6.68
61	7/1	1	.040	1.25	12.37		11.12
62		NOT SAMPLED					
63	7/1	1	.375	11.72	8.82	2.90	
64	5/1	1	1.200	37.50	3.55	33.95	
65	4/1	0	1.150	35.94	5.00	30.94	
66	3/1	0	1.875	58.59	3.80	54.79	
67	2/1	0	1.550	48.44	4.51	43.93	
68	2/0	0	1.775	55.47	.22	55.25	
69	2/0	0	1.575	49.22	.96	48.26	
UPPER FREEPORT COAL							

SECTION VII

EASTERN COAL PROVINCE: SOUTHERN APPALACHIAN REGION

SUMMARY

This Region (Figure 5) encompasses Surface Mining Province #1 as originally defined for West Virginia by Arkle (West Virginia University 1971). Extension to northeastern Alabama on the south and to central Kentucky on the west has not added noticeably to the heterogeneity of overburden properties influencing soil and water quality. From limited data it appears that pyritic sulphur contents may be uniformly low in overburdens of the New River Formation, but more variable at selected sites in the Kanawha Formation, probably near the edge or shelf of the basin.

High pyritic sulphur contents found in Neighborhood 3 (Table 21) were associated with marine fossils. Since this zone contains carbonates, questions of potential acid-toxicity depend upon which is dominant, neutralizers or acid formers, as measured by Acid-Base Accounting. In some cases, siderite ($Fe\ CO_3$) and ankerite (dolomite containing intrinsic Fe replacing part of the Mg) may constitute a significant proportion of the neutralizers, resulting in ferrous iron and high available magnesium in acid soiltest extractions.

In this Region, more detailed attention should be given to overburden properties that influence physical stability on steep slopes. Advance knowledge of rock types and their physical stability or tendency toward slippage could aid planned placement of materials to assure stability. Only limited attention to this aspect of planning is evident. A little more effort in this direction could help eliminate land slippage problems to the same degree that chemical analysis is being used to eliminate acid-toxicity.

NEIGHBORHOOD 2: MINGO COUNTY, WEST VIRGINIA AND PIKE COUNTY, KENTUCKY

The geologic sequence from the Williamson coal overburden to the Alma coal was studied in Strafford district of Mingo County, West Virginia. The interval lies in the Kanawha formation of the

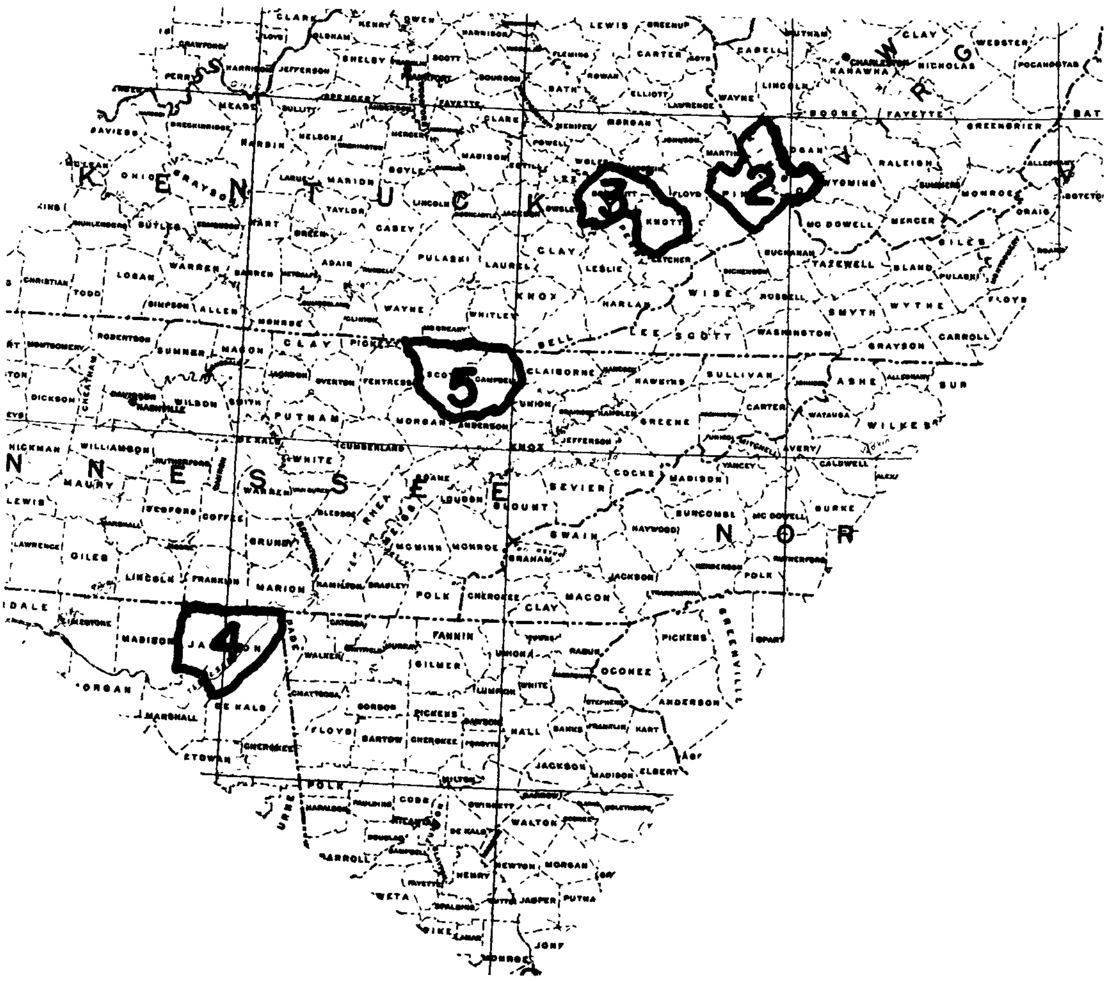


Figure 5. Neighborhoods in Southern Appalachian Region, Eastern Coal Province.

Pennsylvania geologic period (White, et al. 1914). The sequence includes many recognizable horizons including the Dingess limestone zone (Kendrick shale member) above the Williamson coal. The massive sandstone of the Cedar Grove coal beds is a dominant member of the sequence. The coals in the sequence are known for their properties, especially the many partings of the Alma coal (White et al. 1914).

The most widely observed member of the sequence is the Dingess limestone zone. This is a thin marine fossiliferous zone located in dark-gray shaly mudrock with siderite nodules. The member correlates with the Kendrick shale member of the eastern Kentucky coal reserve area. The Kendrick shale member is underlain by the Amburgy coal, a highly productive bed, in Kentucky and correlates with the Williamson in West Virginia (Huddle, et al. 1963). This sequence is only found on the highly elevated hills in the studied area.

The Cedar Grove sandstone occurs between the Williamson and Alma coals of southern West Virginia. This is a sandstone that has zones where carbonates act as cementing media for the quartz grains. The sandstone is continuous but thins and thickens within the sequence. The sandstone is broken by two coal beds, various mudrocks, and high carbon shales. The high quality Upper Cedar Grove coal correlates with the Upper Elkhorn No. 3 coal of Kentucky. The Lower Cedar Grove coal is split into two beds and correlates with the Upper Elkhorn No. 2 coal of Kentucky (Huddle, et al. 1963).

The Alma is a good quality coal with a uniformly dependable occurrence in southern West Virginia. The coal bed tends to thin towards the west and correlates with the Upper Elkhorn No. 1 coal of Kentucky (Huddle, et al. 1963). The coal splits into a multi-bedded coal of two or three coal horizons with partings of high carbolithic shale and mudrock (Tables 28-30). The fine textured parting material of the Alma changes in potential acidity like other areas change in rock type.

The properties of undisturbed soils of this area are obviously dependent on topography, land use, and parent material. The area is composed of high hills approximately 305 m (1000 ft) above stream level with very steep slopes (approximately 70%) and narrow valleys. The deepest natural upland soils are located on the ridges and footslopes of these hills. The hill slopes may reach 80% in travelling from the ridge toward the footslopes and narrow valleys. The sloping hillsides are highly eroded with sandstone frequently appearing at the surface. Logging and burning have contributed to severe erosion.

The vegetation of the area is of a perennial forest type with the best quality trees usually found on the lower north-facing footslopes. The vegetation is dependent on soil depth, moisture regime and nutrient supply. At the PW-5 site (Tables 22-24), highly leached Dystrochrepts soils of low plant nutrients and low water-holding capacity overlie the massive Cedar Grove sandstone. The PW-6 site (Tables 25-27) has moderately-deep Hapludalfs soils that have a higher water-holding capacity and plant nutrient supply. The lush growth of hercules' club (Aralia spinosa), red maple, and black locust at the PW-6 site contrasts with the sparce growth of huckleberry, greenbrier, and sassafras at the PW-5 site.

The major problems of the natural soil are depth, acidity, and available plant nutrients. These problems may be partially solved in future minesoils if parent materials are properly placed.

The material placed near the surface should consist of degradable parent material for a desirable soil, plant growing medium. The majority of the overburden material has an excess of neutralizers. The soil material should have a texture in the loam range.

The major zones of high neutralization potential are located in the massive Cedar Grove sandstone. Wherever this carbonate-cemented sandstone is weak enough to disintegrate, it will serve as a source of carbonates and coarse-textured separates for the new soil. Also, carbonate accumulation occurs above each major coal horizon as indicated by the excess calcium carbonate equivalents and fizz of the samples.

Ideally, a portion of the soil should consist of fine textured material with an adequate supply of plant nutrients. This kind of soil material is limited in this geologic sequence. Most of the shales, mudrocks, and mudstones associated with the coals are satisfactory; however, some of this fine-textured material is toxic or potentially-toxic as noted by its Acid-Base Account, and should be blended with materials having a dominance of neutralizers. Strongly cemented sandstone fragments should be available to provide mass stability at the contact between original slopes and the overburden fills resulting from mining.

The overburden rock strata should be blended so a favorable surface texture is obtained. The new soil should be supplemented with fertilizer when mulching and seeding are performed, to aid in rapid plant cover and soil stability. The outslopes should include a high proportion of coarse fragments to slow erosion.

Earlier reclamation of adjacent minesoils was satisfactory in all cases where the pH was near neutral. The areas of lower pH, near 5, had less plant growth. The root penetration was much better in the disturbed soils than the natural soils. Some of the outslopes had good growth of

Kentucky fescue and black locust among the large sandstone rocks, while others were nearly bare with poor plant growth. The outslope vegetation is dependent on pH and plant nutrients, steepness, and erosion, unless controlled by large coarse fragments.

In neighboring Pikeville, Kentucky, a few overburden samples from the Winifrede or Haddix coal (Tables 31-33) were studied for potential acidity and plant nutrient status. This coal correlates with the Winifrede or Quakertown of the Kanawha group of West Virginia (Pocahontas Land Corporation, 1971). All the overburden samples appear low in acid potential except for the carbolith parting under the mined coal horizon. The overburden is sufficient in and all plant nutrients needed for good reclamation except phosphorus if the carbolithic material is buried. The minesoil should be supplemented with phosphorus and nitrogen at the time of seeding.

NEIGHBORHOOD 3: HAZARD AREA, KENTUCKY

Sampling in this Neighborhood involved the Falcon Coal Co. (Tables 34-45) located in Breathitt County and the Combs Coal Co. (Tables 46-54) near Hindman in Knotts County.

The coals represented are Hazard #5A, #7, #8, and #9, correlated with West Virginia coals: Winifrede, Little Coalburg, Coalburg, and Stockton - Lewiston (Pocahontas Land Corp., 1971). These coals occur in the upper part of the Kanawha Group of Pennsylvanian rocks. The Hazard #9 is approximately 30.5 m (100 ft) below the well-known No. 5 Block coal.

Sampling near Hazard was aimed especially at clarification of the acid difficulties that have been attributed to some part of the overburden of the Hazard #9, possibly at or near an associated coal horizon.

The hilltop-removal operation (Greene and Raney 1974) sampled in cooperation with Falcon Coal Co. involved the Hazard #9 only on a point near the ridge top. As shown in Tables 43-45, two samples of shale and two of carbolith associated with this coal were all acid toxic or potentially toxic. Sample #2 contained significant neutralizing capacity, but had an acid pH when powdered and enough sulphur to indicate potential toxicity. Also, the one mudrock grab sample from minesoil on Flint Ridge derived from mining the Hazard #9 proved to be potentially toxic.

Three columns of samples over the Hazard #9 at the Combs Coal Co. (Tables 46-54) operation revealed acid-toxic or potentially toxic overburden material immediately above the coal, and again 6.7 to 7.6 m (22 to 25 ft) higher in the column, immediately below a thick-bedded sandstone. The toxicity occurs partly in the marine zone (indicated by abundant marine shells) in the mudrock (partly fissile and partly non-fissile), approximately 3 m (10 ft) thick over the Hazard #9. The entire 7.6 m (25 ft) of mudrock over the coal, where sampled, was relatively high in pyritic sulphur (0.5 to 4.5%), but associated with the pyritic sulfur was a concentration of neutralizers from a trace to 17% calcium carbonate equivalent, resulting in excess neutralization capacity throughout the central 4.6 m (15 ft) of soft mudrock between the coal and the caprock sandstone (Tables 49, 51 and 54). If the carbonate equivalents had been much lower the acid from sulphur could have been severe.

Since persistent reports indicate that some sites are extremely acid, there is reason to believe that these are situations where the pyritic levels persist but the neutralizing levels are low or absent. A comparable situation would be Neighborhood 11 (Figure 7) where sulfur percentages above the Bevier coal (Tebo Mine) are about the same as those over the Hazard #9 and neutralizing capacities are low or absent. At other locations over the Bevier coal, (Neighborhood 10, Figure 7), neutralization capacity is abundant for preventing toxic acidity. With the Bevier, also, as with the Hazard #9, marine fossils occur over the coal at some locations but not throughout the region.

In cases involving marine fossils, which apparently occur in the Eastern Interior Basin also, marine environments may contribute to the relatively high sulfur concentrations as well as to generally high but variable concentrations of carbonate neutralizers. The net Acid-Base Account can swing from one side of neutrality to the other in relatively short distances with no striking change in appearance of the mudrock. The presence of a strong fizz reaction to dilute hydrochloric acid, indicating at least 20 t of calcium carbonate equivalent per 1000 t of rock or soil, indicates no immediate danger of extreme acidity, but with high percentages of pyritic sulfur present, such materials may become acid unless neutralizers are abundant enough to neutralize all possible sulfuric acid that can form by oxidation.

The generally high level of neutralizers noted in Neighborhood 3 is not typical throughout the Kanawha Group of the Southern Appalachians. At Neighborhood 2, Mingo County, West Virginia, for example, neutralizing capacity and pyritic sulphur both are relatively low.

From Tables 34 and 37 it is apparent from rock types, ease of slaking (increasing positive ratings) and chemical tests for plant nutrients that difference in physical properties as well as fertility deserve serious consideration. Sandstones that don't slake (0 to 1 ratings) should be used to anchor the toe of outslopes and to build loose rock flume outlets. Other choices of overburden for special placement should depend upon suitability for particular planned land use, for which guidelines have been suggested in Section V, under Criteria for New Soils.

Undisturbed soils in Neighborhood 3 are acid, medium-textured and variable in depth from shallow (less than 50.8 cm, 20 in, to bedrock) to moderately deep. Shallow, sandy loam, woodland soil at Coombs was stony and underlain at less than 50.8 cm (20 in) by thick-bedded sandstone. The upland soil at Falcon was light brown, somewhat stony loam, deeper than at Coombs and underlain by weathered mudstone (Table 40). Previous mining near the Falcon site involved high concentrations of flint (and chert) on the well-known Flint Ridge where rocks for arrows and tools were obtained by native Indians and early European settlers.

The best material for near-surface placement or blending would be the mudstones with excess neutralizing capacities and water slaking ratings higher than one. A blend of such materials with non-stony sandy loam would result in favorable minesoils. Any potentially acid-toxic materials can be neutralized by blending with carbonate-rich, soft mudstones, which are abundant.

Phosphorus is the most deficient plant nutrient needed in addition to nitrogen for quick establishment of ground covers to prevent erosion, even though the minesoils may be intended for reforestation (Bengtson et al. 1969).

Acid-extracted phosphorus values marked with a "G" are likely false values, probably because of interference from ferrous iron, dissolved by the acid extractant from carbonate minerals, siderite and ankerite. High levels of magnesium, which are common, probably derive from ankerite.

NEIGHBORHOOD 4: FLATROCK, ALABAMA

The overburden here is so low in total sulphur that there is no likelihood of acid toxicity developing. The geologic section, which has been correlated with the New River Group of West Virginia, corresponds well with analyses of overburden above the Sewell coal from Pocahontas County, West Virginia (Smith et al. p. 123-127). Observations on other surface mining operations involving Sewell coal in Greenbrier, Randolph, Raleigh and Wyoming counties, West Virginia, provide additional evidence that pyritic sulphur and acid toxicity are not common problems on much of the Sewell Coal.

Although the mudrock, sandstone and intercalate (interlayered mudstone and sandstone) of the section studied (Tables 55-60) in Alabama are low in acid potential, they are generally low also, in basic materials and some plant nutrients, especially phosphorus. In addition there is a great differential in resistance of the rocks to physical weathering. Some of the sandstone in the upper 7.6 m (25 ft) of the section crumbles readily into loose sand whereas other sandstone, both upper and lower, is extremely tough, with grains cemented by silica. This rock is difficult to drill or shatter. The mudrocks vary in texture and stratification. Near the coal these rocks tend to be fissile, whereas throughout most of the section they split only into thicker fragments or blocks, many of which contain thin layers of fine sand separated by thicker layers of silt and clay. From the standpoint of soil texture, the grain size of these rocks would be excellent whenever they disintegrate, and the intercalate layering favors disintegration breakdown.

In considering how to create desirable minesoils at the Fabius Neighborhood, it is apparent that many boulders and other tough sandstone fragments should be used to anchor the spoil into the underlying rocks and soil. Outslope erosion control could be aided by coarse fragments, also, whereas gentle slopes would profit for most uses from a high proportion of medium (loam) textures, unless use for cultivated crops is anticipated, in which case a sandy loam surface layer would be most desirable.

The original soil was relatively thin, acid and infertile. Its sandy loam to sandy clay loam texture would be satisfactory for placement on the surface, as would the texture of weathered weak sandstone deeper in the section. However, unweathered mudrock with fine sand lenses or thin sandstone layers deeper in the overburden would provide more fertility as well as fines of desirable texture. This interstratified mudrock and sandstone cuts readily with a farm type disc harrow, and it tends to disintegrate because of layering.

Prevention of erosion on long slopes requires quick establishment of close-growing grasses and legumes even though the long range land use is production of woodland products: Fertilization with phosphorus and nitrogen is needed (Zargar _et al_. 1969a), together with diversion terraces, stable terrace outlets and mulches of straw or its equivalent.

NEIGHBORHOOD 5: SCOTT AND CAMPBELL COUNTIES, TENNESSEE

The coal measures of Tennessee are all found in the Cumberland Plateau area. These coals belong in the Pottsville Series of Pennsylvanian rocks which have a thickness of 1,219 m (4000 ft), but due to erosion, the thickness is quite variable. The greatest thickness is believed to be in the Cumberland Mountains and the thinnest sections near the edge of the plateau (Luther 1959).

The Poplar Creek Coal (locally called the Glen Mary) is the lowest in the Pottsville Series that was studied. This coal is the top unit of the Crooked Fork Group of the lower Pottsville Series and is the most important seam in Scott County where it was sampled (Johnson and Luther

1972). The usual overburden is an unnamed shale interval which varies from 9 to 73 m (30 to 240 ft) in thickness; however, pyritic sandstone lenses of varying sizes have been observed in highwall exposures.

The Coal Creek coal is the lowest of the three commercially important coals in the Slatestone Formation and the most important in Campbell County. It is found above the Stephens sandstone and its overburden generally is a shale sequence of varying thickness. Locally, a thin, discontinuous sandstone may be present above the coal. The Coal Creek coal overburden was sampled on the Cumberland Block, where most of the Campbell County reserves are located (Luther 1959).

The Big Mary (Dean) coal is the second most important coal in Scott County. It is the lowest mineable coal in the Redoak Mountain Formation, located an average of 12 m (40 ft) above the Windrock coal, top unit of the Graves Gap Formation. The overburden of the Big Mary seam generally contains a dark, organic shale with marine fossils and some limestone nodules. This shale is one of the more persistant marine zones found in this area. A thin sandstone may also be present above the fossile zone (Luther 1959).

The Rock Spring coal is in the Vowell Mountain Formation under the Frozen Head sandstone, the top unit of the formation; however, the Grassy Spring coal, being mined with the Rock Spring seam, is the lowest coal in the Cross Mountain Formation. These two coals are only preserved on the higher mountaintops. In Campbell County near Caryville the Frozen Head sandstone may not be present at all, leaving the overburden of the Rock Spring coal to be predominately shales and mudrocks. The overburden of the Grassy Spring coal is mainly an unnamed shale sequence (Luther 1959).

All the coals are associated with beds which were correlated with the Kanawha Formation of the Pottsville Group in southern West Virginia (Pocahontas Land Corporation 1971). The coals, in descending order in the section, correlate as follows:

Tennessee	West Virginia
Grassy Spring	Coalburg
Rock Spring	Below Coalburg
Big Mary	Chilton "A"
Coal Creek	Matewan
Poplar Creek	Glen Alum Tunnel

The data (Tables 61-66) from Helenwood Excavating mine indicate a weathered zone of approximately 4.9 m (16 ft) in the overburden comprised, dominantly, of mudrocks and shales. Total sulfur, pH, neutralizers and fertility are low in this zone. The toxic and potentially toxic materials occur in samples #7-9, #16, and #24 (Table 63). The first two zones are thick enough to cause reclamation problems if concentrations of this material were left on the surface of the minesoil; whereas, sample #24 is at top of the coal and would be removed with the coal or left in the bottom of the pit. The remainder of the overburden has substantial neutralizers to provide a neutral pH for the new minesoil if properly placed during grading of the spoil.

The natural soil in the area is acid, low in inherent fertility and contains many coarse fragments throughout the profile. The C horizon was heavy textured mudstone and mudrock with an argillic horizon overlying it in the B horizon. Because of these properties, it would be best to blend the surface soil with the non-toxic, nutrient-rich rock lower in the column (Table 61-63).

The nutrient status of the unweathered, non-toxic zones is medium to high for all nutrients except phosphorus, which is generally low. There is a 2.4 m (8 ft) layer of rock in the weathered zone, samples #2-5 (Table 62) which contains medium to high levels of bicarbonate extractable phosphorus. This strengthens the recommendation for selective blending of overburden to achieve successful reclamation.

The overburden of the Big Mary coal contains no toxic zones in column one (Tables 67-69), although there is an increase in total sulfur in the last three samples (Table 69). Column two (Tables 70-72) extends down to the top of the coal, 1.2 m (4 ft) deeper than column one, and this zone is highly toxic (Table 72). This zone found associated with the coal would pose serious problems to reclamation if left concentrated at the surface.

There is a 5.5 m (18 ft) zone starting at a depth of 9.7 m (32 ft) from the surface, which contains marine fossils. The total sulfur increases slightly but the carbonates increase greatly to give a large excess of neutralizers in this zone. There is a very high level of nutrients, except for phosphorus, in the overburden beneath the weathered zone, which is indicated by the high chromas (Table 68). Phosphorus levels are low except for the 5 m (16.5 ft) starting at the 3.3 m (11 ft) depth. In this layer of rock, bicarbonate extractable phosphorus levels are medium to very high. Consideration should be given to blending the high-phosphorus material with the carbonate-rich rock and placing the mixture on the surface of the resultant minesoil.

The natural soil of this area was acid, low in fertility and had drainage problems as evidenced by the low chroma mottling in the lower part of the argillic horizon. This material should only be considered for replacement on the surface if it is to be blended with the lower nutrient-rich rock.

The McCall Enterprises' mine is situated on one of the highest knobs on Cross Mountain and although contour stripmining was being done, future plans called for mountaintop removal (Day-Lighting)(Greene and Raney 1974) (Grim and Hill 1974) to be accomplished. The overburden of the coals being mined was dominated by mudrocks and mudstones with some sandstone and shale. The data (Tables 73-75) indicate that the majority of the overburden is deficient in neutralizers and the only toxic zones are associated with the two coals. The parting layer in the Grassy Spring coal is extremely toxic mainly due to the complete lack of neutralizers, while the toxic zone associated with the Rock Spring coal is due mainly to the high total sulfur. There is an increase in total sulfur as the coals are approached (descending the column from the surface).

There is a 6.1 m (20 ft) zone of low sulfur, base-rich materials starting at the 9.2 m (30.3 ft) depth, and a 5.6 m (18.6 ft) zone starting at the 26 m (85.4 ft) depth. These zones could be mixed with the first 9.2 m (30.3 ft) of the overburden and placed back on the surface of the spoil.

The natural soil of the area has silt loam textures, but is acid, low in fertility and contains coarse fragments. It would be unsuitable to be placed on the surface of the spoil without blending it with the base-rich zones. Phosphorus fertilization would be essential because the highest amounts of this nutrient are associated with the toxic zone above the Rock Spring coal while the rest of the overburden is phosphorus deficient.

The Coal Creek coal overburden was not all exposed at the site sampled; therefore, the first and last 2.4 m (8 ft) were unavailable for analysis. The data (Tables 76-78) from the column sampled indicate no toxic zones, but the resultant minesoil's surface was covered with carbon-rich shale (carboliths). Therefore, it is assumed that the last 2.4 m (8 ft) of overburden was toxic high-carbon shale (Tables 79-81). There is an excess of neutralizers in the overburden and nutrient levels are medium to high except for phosphorus. Only samples #11, #19, #20, #21 have high phosphorus levels.

The minesoil at the Ollis Creek site was sampled in such a way as to cover the entire expanse of the highwall. The minesoil surface was left with much carbon-rich shale exposed which influenced its properties. The data (Tables 79-81) indicate that except for two samples, all surface samples were toxic while only five of the twelve lower depth samples were toxic. The pH and fertility of the minesoil were low. Only bicarbonate extractable phosphorus was present at high levels.

The carbon-rich rock on the surface, high phosphorus levels, low pHs and generally low nutrient status all indicate that most of the materials immediately above the coal (Tables 77-79) which was not sampled was left concentrated at the surface of the minesoil. The more favorable material was evidently buried beneath this toxic surface. At this site reclamation efforts (Zarger et al. 1969b) had failed and modification of the minesoil was to be undertaken before the planting of pines for pulpwood.

Table 21. LOCATIONS OF FIELD STUDY SITES IN NEIGHBORHOODS TWO THRU FIVE, SOUTHERN APPALACHIAN REGION

Site	Latitude Longitude Surf. Elev.	Coal Seam	Detail of Site Location
Peter White Coal Co.	37.5601°N 81.9022°W 2088 ft	Williamson Cedar Grove Alma	3.6 km (2.25 mi) north of Hardy Union School, Mingo Co., WV
Peter White Coal Co.	37.5697°N 81.8977°W 1970 ft	Cedar Grove Alma	0.8 km (0.5 mi) southwest of Cleni School, Mingo Co., WV
Peter White Coal Co.	37.5689°N 81.9081°W 1840 ft	Alma	1.6 km (1 mi) south of Gilbert Creek PO, Mingo Co., WV
Case Coal Co.	37.61°N 82.47°W 1600 ft	Winifrede	4.8 km (3 mi) northwest of Meta, Pike Co., KY
Falcon Coal Co.	37.4744°N 83.1770°W 1400-1440 ft	Hazard #5A	3.5 km (2.2 mi) east of Fugate Fork School, Breathitt Co., KY
Falcon Coal Co.	37.4824°N 83.1926°W 1360 ft	Hazard #7	2.6 km (1.6 mi) northeast of Fugate Fork School, Breathitt Co., KY
Falcon Coal Co.	37.4873°N 83.2204°W 1500-1550 ft	Hazard #9	1.93 km (1.2 mi) north of Fugate Fork School, Breathitt Co., KY

Table 21. continued

Site	Latitude Longitude Surf. Elev.	Coal Seam	Detail of Site Location
Coombs Coal Co.	37.3633°N 82.9958°W 1550 ft	Hazard #9	3.2 km (2 mi) north northwest of Hindman, Knotts Co., KY
Coombs Coal Co.	37.3627°N 82.9937°W 1600 ft	Hazard #9	3.2 km (2 mi) north northwest of Hindman, Knotts Co., KY
Arch Coal Co. Fabious Mine	34.7874°N 85.7870°W 1420 ft	Underwood	6.0 km (3.75 mi) southeast of Stevenson, Jackson Co., AL
Helenwood Excavating Inc.	36.4522°N 84.5536°W 1560 ft	Poplar Creek	6.0 km (3.75 mi) southwest of Oneda, TX
W.B. Spradling Coal Co.	36.3096°N 84.3845°W 2500 ft	Big Mary	2.4 km (1.5 mi) north of Smoky Junction, Scotts Co., TN
McCall Enterprises Inc.	36.2617°N 84.2343°W 3000 ft	Grassy Springs Rock Springs	4.0 km (2.5 mi) south southwest of Caryville, Campbell Co., TN
Ollis Creek	36.3626°N 84.2239°W 1800 ft	Coal Creek	4.8 km (3 mi) northwest of Jacksonboro, Campbell Co., TN

Table 22. PHYSICAL CHARACTERIZATIONS OF THE CEDAR GROVE AND ALMA COAL OVERBURDENS AT THE PETER WHITE COAL COMPANY'S MINE, NEIGHBORHOOD TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A	0.0-0.5	Soil	2.5Y 6/4	4
B	0.5-2.5	Soil	10YR 8/4	7
C	2.5-4.5	Soil	2.5Y 8/6	3
C	4.5-5.5	Soil	2.5Y 7/4	9
1	5.5-6.5	MS	2.5Y 8/4	4
2	6.5-10.0	MS	7.5YR 5/4	5
3	10.0-	SS	2.5Y 7/2	0
4		SS	2.5Y 7/4	1
5		SS	2.5Y 7/2	0
6	-26.0	SS	2.5Y 7/4	0
7	26.0-27.0	SS	2.5Y 7/4	0
8	27.0-32.0	SS	2.5Y 8/4	0
9	32.0-37.0	SS	5Y 7/1	0
10	37.0-39.5	SS	10YR 7/4	0
11	39.5-43.5	SS	10YR 8/3	0
12	43.5-44.5	SS	2.5Y 8/0	0
13	44.5-46.5	SS	10YR 8/3	0
14	46.5-48.0	SS	10YR 8/3	0
15	48.0-53.0	SS	10YR 7/4	0
16	53.0-58.0	SS	2.5Y 7/4	0
17	58.0-63.0	SS	2.5Y 8/4	0
18	63.0-69.0	SS	2.5Y 8/4	0
19	69.0-76.0	SS	2.5Y 8/6	0
20	76.0-80.5	SS	N 8/0	0
21	80.5-81.5	SH	N 4/0	0
22	81.5-85.0	UPPER CEDAR GROVE COAL		
23	85.0-86.0	NO SAMPLE		
24	86.0-89.0	MS	5Y 6/3	0
25	89.0-93.0	SS	5Y 6/1	0
26	93.0-98.0	SS	2.5Y 8/4	0
27	98.0-103.0	SS	2.5Y 8/2	0
28	103.0-108.0	SS	2.5Y 8/2	0
29	108.0-112.0	SS	2.5Y 8/2	0
30	112.0-117.0	SS	2.5Y 8/2	0
31	117.0-122.0	SS	2.5Y 7/2	0
32	122.0-127.0	SS	2.5Y 7/2	0
33	127.0-136.0	SS	2.5Y 7/2	0
34	136.0-137.0	SS	2.5Y 7/4	0
35	137.0-140.0	SS-I	N 5/0	0

Table 22. (continued)

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
36	140.0-144.0	SS	2.5Y 8/4	0
37	144.0-151.5	SS	5Y 7/3	0
38	151.5-152.5	LS	2.5Y 8/4	0
39	152.5-155.0	SS	5Y 7/1	0
40	155.0-157.0	SS	N 8/0	0
41	157.0-162.0	SS	N 8/0	0
42	162.0-162.5	MR	N 6/0	0
43	162.5-164.0	MR	5Y 6/1	0
44	164.0-166.0	SS	5Y 6/1	0
45	166.0-169.0	MS	N 6/0	0
46	169.0-172.0	MS	N 8/0	0
47	172.0-177.0	MS	5Y 7/1	0
48	177.0-180.0	LOWER CEDAR GROVE COAL		
49	180.0-181.0	Carb	5Y 3/1	0
50	181.0-182.0	SH	5Y 6/1	0
51	182.0-185.0	SH	5Y 6/1	0
52	185.0-186.0	LOWER CEDAR GROVE COAL		
53	186.0-188.0	SS	N 8/0	0
54	188.0-191.0	SS	N 8/0	0
55	191.0-196.0	SS	N 8/0	0
56	196.0-198.0	SS	N 8/0	0
57	198.0-200.0	SS	N 8/0	0
58	200.0-202.0	SS	N 8/0	0
59	202.0-204.0	SS	N 8/0	-
60	204.0-206.0	SS-I	N 8/0	0
61	206.0-208.0	SS	N 8/0	0
62	208.0-210.0	SS	N 8/0	0
63	210.0-212.0	SS	5Y 7/1	0
64	212.0-214.0	SS	5Y 7/1	0
65	214.0-218.0	SS	5Y 7/1	
66	218.0-219.0	SS	5Y 8/1	0
67	219.0-221.0	SS	5Y 8/1	0
68	221.0-223.0	SS	5Y 8/1	0
69	223.0-225.0	SS	N 8/0	0
70	225.0-227.0	SS	N 8/0	0
71	227.0-229.0	SS	N 8/0	0
72	229.0-231.0	SS	N 8/0	0
73	231.0-233.0	SS	N 8/0	0
74	233.0-234.0	SS-I	N 4/0	0
75	234.0-236.0	MS	N 7/0	0

Table 22. (continued)

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
76	236.0-238.0	MS	5Y 7/1	0
77	238.0-241.0	UPPER ALMA COAL		
78	241.0+	MS	5Y 7/1	0
MIDDLE ALMA COAL				

Table 23. CHEMICAL CHARACTERIZATIONS OF THE CEDAR GROVE AND ALMA COAL OVERBURDENS AT THE PETER WHITE COAL COMPANY'S MINE, NEIGHBORHOOD TWO

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A	4.0	4.3	4.0	156	200	84	56	7.4
B	4.7	4.9	2.0	214	40	186	38	6.4
C	4.7	4.8	2.0	171	40	300	47	4.3
C	4.3	4.6	4.5	183	40	702	40	3.2
1	5.2	4.5	4.0	183	40	984	45	3.2
2	4.6	4.6	6.0	167	40	888	40	5.4
3	5.1	5.7	1.0	111	440	330	142	21.6
4	5.2	5.3	1.5	109	800	642	183	21.6
5	5.1	5.2	1.5	187	1160	720	238	23.8
6	5.0	5.2	1.0	142	1080	792	216	17.2
7	5.7	6.6	0	150	960	960	159	10.8
8	5.5	6.8	0	117	800	696	159	4.3
9	5.4	6.7	0	150	880	372	238	4.3
10	5.7	7.0	0	103	920	516	192	5.4
11	5.9	7.0	0	111	960	372	192	3.2
12	6.6	7.6	0	122	10240	174	34	4.3
13	6.7	7.7	0	73	12000	216	20	4.3
14	7.7	8.2	0	69	1200	204	21	4.3
15	6.7	7.7	0	125	1280	228	192	3.2
16	6.5	7.3	0	114	1200	240	238	4.3
17	6.5	7.2	0	106	1160	240	174	4.3
18	6.1	6.8	0	98	1280	258	246	8.6
19	6.0	6.7	0	95	960	162	256	6.4
20	5.0	5.6	2.0	142	800	120	300	3.2
21	4.1	4.0	0.5	198	560	618	94	9.3
22	UPPER CEDAR GROVE COAL							
23	NO SAMPLE							
24	6.6	7.2	0	179	1360	480	294	1.1
25	7.1	7.7	0	230	960	300	294	1.1
26	6.4	7.2	0	134	1120	408	200	1.1
27	6.3	7.9	0	142	1120	342	246	1.1
28	6.1	6.7	0	117	1280	354	200	1.1
29	6.1	6.7	0	125	920	258	246	1.1
30	6.6	7.2	0	106	720	138	200	1.1
31	6.7	7.3	0	103	1720	348	167	2.2

Table 23. (continued)

Sample No.	pH (paste)	pH (1:1)	Per Thousand Tons of Material: Lime Requirement (tons)	Acid Extracted: K (lbs.)	Acid Extracted: Ca (lbs.)	Acid Extracted: Mg (lbs.)	Acid Extracted: P (lbs.)	Bicarbonate Extracted P (lbs.)
32	6.5	7.0	0	100	1600	288	246	6.8
33	6.1	6.7	0	134	2640	480	216	1.1
34	6.6	7.1	0	106	1040	180	159	1.1
35	7.3	7.3	0	164	880	168	246	1.1
36	6.7	6.8	0	167	1520	336	128	1.1
37	6.8	6.7	0	145	2120	456	256	2.2
38	7.2	7.9	0	81	10560	192	23	2.2
39	7.4	7.7	0	164	2240	234	294	1.1
40	7.9	7.8	0	131	7440	810	56	1.1
41	7.8	7.8	0	156	3200	714	97	2.2
42	7.2	7.5	0	284	1600	276	360	1.1
43	7.5	7.5	0	256	3600	1320	183	2.2
44	7.4	7.6	0	343	3880	1416	183	2.2
45	7.5	7.7	0	332	5280	1968	159	2.2
46	7.7	7.8	0	293	4280	1824	183	2.2
47	7.3	7.5	0	348	4480	1920	238	1.1
48	LOWER CEDAR GROVE COAL							
49	7.0	7.1	0	327	1040	498	94	2.2
50	7.2	7.2	0	322	1520	444	308	1.1
51	7.4	7.4	0	307	1840	432	342	2.2
52	LOWER CEDAR GROVE COAL							
53	6.6	7.0	0	187	800	180	294	2.2
54	6.9	7.0	0	195	760	162	246	2.2
55	7.1	6.9	0	210	840	168	246	2.2
56	7.4	7.1	0	179	1880	432	137	2.2
57	7.5	7.5	0	198	1000	222	200	2.2
58	7.5	7.8	0	175	1600	252	147	2.2
59	7.6	7.8	0	160	3160	234	142	3.2
60	7.5	7.9	0	210	3040	240	294	2.2
61	7.7	7.9	0	156	9920	210	31	3.2
62	7.7	8.1	0	187	7200	1296	56	2.2
63	7.4	7.9	0	230	3880	1056	119	3.2
64	7.4	8.0	0	160	9760	480	25	3.2
65	7.9	8.1	0	134	10880	138	19	3.2
66	7.6	7.7	0	147	8320	900	42	3.2
67	7.6	7.8	0	160	5760	1536	80	3.2
68	7.6	7.8	0	198	5680	1632	77	2.2

Table 23. (continued)

				Per Thousand Tons of Material				
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
69	7.7	7.8	0	183	6480	720	85	3.2
70	8.1	8.0	0	175	3760	882	111	3.2
71	7.7	7.9	0	187	1960	564	103	3.2
72	8.0	8.0	0	171	4320	750	94	4.3
73	7.8	8.0	0	218	2240	594	111	3.2
74	6.8	7.5	0	171	2960	581	111	4.3
75	7.6	8.0	0	448	3920	1440	216	3.2
76	7.4	7.5	0	359	3280	1092	216	3.2
77	UPPER ALMA COAL							
78	7.2	7.5	0	298	1840	330	342	2.2
MIDDLE ALMA COAL								

Table 24. ACID-BASE ACCOUNT OF THE CEDAR GROVE AND ALMA COAL OVERBURDENS AT THE PETER WHITE COAL COMPANY'S MINE, NEIGHBORHOOD TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum (Needed pH 7)	Excess $CaCO_3$
A	6/4	0	.010	.31	- .97	1.28	
B	8/4	0	.015	.47	- .74	1.21	
C	8/6	0	.010	.31	- .23	.54	
C	7/4	0	.005	.16	- .74	.90	
1	8/4	0	.005	.16	.56		.40
2	5/4	0	.010	.31	-1.99	2.30	
3	7/2	0	.015	.47	2.52		2.05
4	7/4	0	.005	.16	3.26		3.10
5	7/2	0	.005	.16	2.78		2.62
6	7/4	0	.005	.16	3.77		3.61
7	7/4	0	.005	.16	5.76		5.60
8	8/4	0	.005	.16	4.77		4.61
9	7/1	0	.020	.63	4.51		3.88
10	7/4	0	.005	.16	4.03		3.87
11	8/3	0	.005	.16	4.03		3.87
12	8/0	4	.005	.16	228.20		228.04
13	8/3	5	.005	.16	294.25		294.09
14	8/3	4	.005	.16	289.22		289.06
15	7/4	0	.005	.16	2.52		2.36
16	7/4	0	.005	.16	3.52		3.36
17	8/4	0	.005	.16	3.01		2.85
18	8/4	0	.005	.16	4.03		3.87
19	8/6	0	.005	.16	3.77		3.61
20	8/0	0	.095	2.97	3.01		.04
21	4/0	0	.180	5.63	.76	4.87	
22	UPPER CEDAR GROVE COAL						
23	NO SAMPLE						
24	6/3	0	.005	.16	7.01		6.85
25	6/1	0	.005	.16	4.26		4.10
26	8/4	0	.010	.31	4.26		3.95
27	8/2	0	.005	.16	3.26		3.10
28	8/2	0	.005	.16	4.26		4.10
29	8/2	0	.005	.16	4.26		4.10
30	8/2	0	.005	.16	4.26		4.10
31	7/2	0	.005	.16	4.77		4.61
32	7/2	0	.005	.16	4.77		4.61
33	7/2	0			7.27		

Table 24. (continued)

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material			
				Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
34	7/4	0	.005	.16	4.03		3.87
35	5/0	0	.025	.78	6.53		5.75
36	8/4	0	.005	.16	4.03		3.87
37	7/3	0	.005	.16	6.02		5.86
38	8/4	4	.005	.16	228.20		228.04
39	7/1	0	.010	.31	5.02		4.71
40	8/0	1	.005	.16	25.76		25.60
41	8/0	1	.005	.16	18.0		17.84
42	6/0	0	.085	2.66	6.27		3.61
43	6/1	1	.040	1.25	25.02		23.77
44	6/1	1	.050	1.56	26.01		24.45
45	6/0	1	.050	1.56	30.01		28.45
46	8/0	1	.030	.94	31.52		30.58
47	7/1	1	.055	1.72	23.77		22.05
48	LOWER CEDAR GROVE COAL						
49	3/1	0	.080	2.50	3.77		1.27
50	6/1	0	.035	1.09	4.77		3.68
51	6/1	0	.030	.94	10.51		9.57
52	LOWER CEDAR GROVE COAL						
53	8/0	0	.010	.31	3.77		3.46
54	8/0	0	.010	.31	3.52		3.21
55	8/0	0	.010	.31	3.26		2.95
56	8/0	0	.010	.31	9.03		8.72
57	8/0	0	.010	.31	7.52		7.21
58	8/0	0	.005	.16	4.03		3.87
59	8/0	1	.005	.16	16.27		16.11
60	8/0	1	.010	.31	17.26		16.95
61	8/0	2	.020	.63	35.78		35.15
62	8/0	1	.005	.16	33.76		33.60
63	7/1	0	.030	.94	25.76		24.82
64	7/1	3	.010	.31	86.04		85.73
65	7/1	4	.010	.31	372.68		372.37
66	8/1	1	.005	.16	39.50		39.34
67	8/1	1	.010	.31	26.26		25.95
68	8/1	1	.010	.31	27.77		27.46
69	8/0	1	.010	.31	21.27		20.96
70	8/0	1	.005	.16	14.25		14.09
71	8/0	0	.005	.16	23.51		23.35

Table 24. (continued)

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
72	8/0	1	.010	.31	20.27		19.96
73	8/0	1	.010	.31	20.27		19.96
74	4/0	0	.115	3.59	17.52		13.93
75	7/0	0	.055	1.72	20.22		18.50
76	7/1	0	.045	1.41	14.76		13.35
77	UPPER ALMA COAL						
78	7/1	0	.025	.78	5.76		4.98
MIDDLE ALMA COAL							

Table 25. PHYSICAL CHARACTERIZATIONS OF THE WILLIAMSON, CEDAR GROVE, AND ALMA COAL OVERBURDEN AT THE PETER WHITE COAL COMPANY'S MINE, NEIGHBORHOOD TWO, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A	0.0- 0.7	Soil	10YR 5/4	0
B_1	0.7- 1.0	Soil	10YR 6/4	3
B_{2t}	1.0- 1.5	Soil	2.5Y 7/4	5
B_3	1.5- 2.0	Soil	2.5Y 7/4	4
1	2.0- 5.0	SS	10YR 5/6	0
2	5.0- 8.0	SS	10YR 5/6	0
3	8.0-11.0	SS	10YR 6/4	0
4	11.0-14.0	SS	10YR 6/4	0
5	14.0-17.0	MS	10YR 6/6	3
6	17.0-19.0	SS	2.5Y 6/4	0
7	19.0-21.0	SS	2.5Y 7/4	0
8	21.0-23.0	SS	2.5Y 6/4	0
9	23.0-26.0	SS	2.5Y 7/4	0
10	26.0-28.0	SS	2.5Y 6/4	0
11	28.0-30.0	SS	2.5Y 5/6	0
12	30.0-32.0	MR	10YR 6/1	1
13	32.0-34.0	MR	2.5Y 5/4	0
14	33.0	MR	2.5Y 6/2	0
15	34.0-36.0	MR	2.5Y 6/2	1
16	36.0-38.0	MR	10YR 4/1	0
17	38.0-40.0	MR	10YR 5/1	0
18	40.0-42.0	MR	10YR 5/1	0
19	42.0-44.0	MR	10YR 5/1	0
20	44.0-47.0	MR	10YR 5/1	0
21	47.0-49.0	MR	2.5Y 6/4	1
22	49.0-51.0	MR	2.5Y 6/4	0
23	51.0-53.0	MR	2.5Y 6/4	0
24	53.0-55.0	MR	10YR 6/1	0
25	55.0-57.0	MR	10YR 5/1	0
26	57.0-59.0	MR	10YR 6/1	0
27	59.0-61.0	MR	10YR 5/1	0
28	61.0-64.0	MR	10YR 6/1	0
29	64.0-66.2	MR	2.5Y 6/6	0
30	66.2-67.8	MR	2.5Y 6/2	0
31	67.8-68.9	MR	5Y 7/1	0
32	68.9-72.0	MR	10YR 5/4	0

Table 25. continued

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
33	72.0- 74.0	SS	2.5Y 6/4	0
34	74.0- 76.0	SS	10YR 7/4	0
35	76.0- 78.0	SS	N 8/0	0
36	78.0- 81.0	SS	10YR 7/4	0
37	81.0- 84.0	SS	10YR 7/4	0
38	84.0- 87.0	SS	10YR 7/4	0
39	87.0- 90.0	SS	10YR 7/4	0
40	90.0- 92.0	NO SAMPLE		
41	92.0- 93.3	SS	N 7/0	0
42	93.3- 95.0	SH	2.5Y 7/4	0
43	95.0- 97.0	SS	2.5YR 7/2	0
44	97.0-100.0	SS	2.5YR 7/2	0
45	100.0-103.0	SS	2.5YR 8/2	0
46	103.0-105.6	SS	2.5YR 8/2	0
47	105.6-108.0	SH	10YR 6/1	0
48	108.0-110.0	SH	10YR 6/1	0
49	110.0-110.5	WILLIAMSON COAL		
50	110.5-111.5	MR	N 6/0	1
51	111.5-113.5	MR	5Y 7/1	0
52	113.5-115.5	MR	10YR 6/1	0
53	115.5-117.5	SH	N 7/0	0
54	117.5-119.5	SH	N 7/0	0
55	119.5-123.0	SH	5Y 7/1	0
56	123.0-126.0	SH	5Y 6/1	0
57	126.0-128.0	SH	5Y 7/1	0
58	128.0-129.0	MR	5Y 6/1	3
59	129.0-129.5	WILLIAMSON COAL		
60	129.5-131.8	Carb.	5Y 3/1	0
61	131.8-134.7	MR	5Y 7/1	0
62	134.7-135.9	MR	5Y 6/3	0
63	135.9-138.0	SS	5Y 8/1	0
64	138.0-141.0	SS	5Y 7/1	0
65	141.0-143.0	SS	5Y 7/1	0
66	143.0-145.0	SS	5Y 7/1	0
67	145.0-146.6	SS	5Y 7/2	0
68	146.6-148.0	SS	2.5Y 7/2	0
69	148.0-150.0	SS	N 8/0	0
70	150.0-152.0	SS	2.5Y 7/4	0
71	152.0-153.0	SS	N 8/0	0
72	153.0-156.0	SS	N 8/0	0

Table 25. continued

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
73	156.0-159.2	SS	N 8/0	0
74	159.2-161.0	SS	N 8/0	0
75	161.0-163.0	SS	N 8/0	0
76	163.0-166.0	SS	N 8/0	0
77	166.0-169.0	SS	10YR 6/1	0
78	169.0-172.0	SS	N 8/0	0
79	172.0-175.0	SS	N 8/0	0
80	175.0-178.0	SS	N 7/0	0
81	178.0-181.0	SS	N 8/0	0
82	181.0-183.0	SS	N 8/0	0
83	183.0-185.0	SS-I	N 7/0	0
84	185.0-187.0	SS-I	5Y 6/1	0
85	187.0-189.0	SS-I	N 8/0	0
86	189.0-191.0	SS-I	5Y 6/1	0
87	191.0-193.0	SS-I	N 6/0	0
88	193.0-195.0	SH	5Y 5/1	0
89	195.0-197.0	MR	5Y 7/1	0
90	197.0-199.1	MR	N 7/0	0
91	199.1-201.0	MR	5Y 7/1	0
92	201.0-203.0	MR	N 8/0	0
93	203.0-204.5	MR	5Y 7/1	0
94	204.5-205.8	NO SAMPLE		
95	205.8-208.0	UPPER CEDAR GROVE COAL		
96	208.0-210.5	NO SAMPLE		
97	210.5-212.0	SH	N 7/0	0
98	212.0-214.0	SS	5Y 8/1	0
99	214.0-216.0	SS	5Y 7/1	0
100	216.0-218.0	SS	5Y 7/1	0
101	218.0-220.0	SS	5Y 7/1	0
102	220.0-220.4	MR	5Y 6/1	0
103	220.4-222.4	SS	N 8/0	0
104	222.4-225.0	SS	N 8/0	0
105	225.0-227.0	SS	N 8/0	0
106	227.0-229.4	SS	N 7/0	0
107	229.4-232.0	SS	N 8/0	0
108	232.0-234.0	SS	N 8/0	0
109	234.0-237.0	SS	N 8/0	0
110	237.0-239.0	SS	N 8/0	0
111	239.0-241.0	SS	2.5Y 7/2	1
112	241.0-244.2	SS	10YR 7/3	0

Table 25. continued

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
113	244.2-245.0	SS	N 7/0	0
114	245.0-248.0	SS	N 8/0	0
115	248.0-251.0	SS	N 8/0	0
116	251.0-254.0	SS	N 8/0	0
117	254.0-257.0	SS	N 8/0	0
118	257.0-260.0	SS	N 8/0	0
119	260.0-263.0	SS	N 8/0	0
120	263.0-265.3	SS	5Y 8/1	0
121	265.3-267.0	MR	5Y 5/1	0
122	271.0-273.0	MR	5Y 6/1	0
123	273.0-275.0	MR	5Y 7/1	0
124	275.0-277.0	SH	N 6/0	0
125	277.0-279.0	SH	N 6/0	0
126	279.0-281.0	SH	5Y 5/1	0
127	281.0-283.8	SH	N 3/0	0
128	283.8-285.5	LOWER CEDAR GROVE COAL		
129	285.5-288.0	SS	N 8/0	0
130	288.0-291.0	SS	N 8/0	0
131	291.0-294.0	SS	N 8/0	0
132	294.0-295.4	SS	N 8/0	0
133	295.4-296.7	MR	N 5/0	0
134	296.7-299.0	MR	N 7/0	0
135	299.0-301.7	SS	5Y 7/1	0
136	301.7-303.0	SS	N 8/0	0
137	303.0-305.0	SS	5Y 8/1	0
138	305.0-307.0	SS	N 8/0	0
139	307.0-308.4	SS	N 8/0	0
140	308.4-311.9	SS	5Y 6/1	0
141	311.9-314.9	MR	5Y 7/1	0
142	314.9-320.0	ALMA COAL		
143	320.0-322.0	MR	5Y 7/1	0
144	322.0-323.3	MR	5Y 7/1	0
145	326.2-328.0	MR	5Y 7/1	0
146	326.2-328.0	MR	5Y 6/1	0
147	328.0-331.0	MR	5Y 6/1	0
148	331.0-334.0	MR	5Y 7/1	0
149	334.0-336.8	MR	5Y 6/1	0
150	336.8-337.8	MR	5Y 6/1	0
151	337.8-343.0	LOWER ALMA COAL		

Table 25. continued

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
152	343.0-344.5	MR	N 7/0	0
153	344.5-347.0	SH	5Y 5/1	0
154	347.0-350.0	SH	5Y 7/1	0
155	350.0-353.0	SH	5Y 6/1	0
156	353.0-358.0	SS	N 8/0	0
157	358.0-362.0	SS	N 8/0	0
158	362.0-366.0	SS	N 8/0	0
159	366.0-370.0	SS	N 8/0	0
160	370.0-373.0	SS	N 8/0	0
161	373.0-376.0	SH	5Y 7/1	0
162	376.0-379.0	SH	5Y 6/1	0
163	379.0-382.0	SH	5Y 5/1	0
164	382.0-385.0	SH	5Y 7/1	0
165	385.0-388.0	SH	5Y 5/1	0
166	388.0-391.0	SH	5Y 6/1	0
167	391.0-392.5	SH	5Y 6/1	0

Table 26. CHEMICAL CHARACTERIZATIONS OF THE WILLIAMSON, CEDAR GROVE, AND ALMA COAL OVERBURDENS AT THE PETER WHITE COAL COMPANY'S MINE, NEIGHBORHOOD TWO, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A	5.9	5.9	2.0	380	5600	732	294	21.2
B_1	5.8	5.6	2.5	322	3360	720	23	16.7
B_{2t}	5.6	5.7	1.5	252	2400	660	35	17.6
B_3	5.8	5.8	1.5	214	2400	900	88	15.4
1	5.0	4.9	2.0	421	400	204	119	56.2
2	5.1	5.0	2.0	327	560	264	80	22.6
3	4.8	4.8	2.5	317	800	348	216	25.9
4	4.6	4.6	5.5	289	120	216	100	30.3
5	4.7	4.8	3.5	374	200	480	85	12.9
6	6.6	5.5	1.0	164	880	432	238	13.0
7	6.4	5.3	1.5	150	880	396	308	17.6
8	6.7	5.6	1.0	109	880	348	256	15.4
9	6.5	5.4	1.5	153	400	180	300	11.8
10	6.7	5.6	1.0	139	2480	960	294	13.0
11	6.6	5.7	1.5	175	2480	924	200G	19.5
12	7.2	6.7	0.0	293	2640	456	360	4.8
13	8.0	7.4	0.0	100	11200	516	48	3.6
14	7.2	6.3	0.5	160	4000	648	342	9.2
15	6.9	6.1	0.5	198	6800	696	372G	1.2
16	7.3	6.7	0.0	410	7440	1632	372G	2.4
17	7.5	7.1	0.0	327	6640	1560	300G	2.4
18	7.4	7.1	0.0	338	6080	1632	342G	2.4
19	7.2	6.5	0.0	374	5280	1080	372	2.4
20	7.2	6.5	0.0	167	5040	972	372	4.8
21	6.7	6.6	0.0	153	4320	948	360	8.4
22	7.5	6.6	0.0	131	4320	780	360	4.8
23	6.8	6.6	0.0	147	4320	924	360G	4.8
24	7.5	6.9	0.0	364	3440	540	360G	1.2
25	7.3	7.1	0.0	364	960	156	342G	1.2
26	7.6	7.5	0.0	390	3120	588	246G	1.2
27	7.3	6.8	0.0	327	2960	528	342	1.2
28	6.6	5.9	0.5	353	2080	468	360	1.2
29	7.5	6.7	0.0	147	3280	636	360	7.2
30	7.2	6.4	0.5	214	2960	708	342G	2.4
31	7.8	7.1	0.0	238	2480	216	360	2.4
32	7.7	6.7	0.0	156	640	96	372	4.8

Table 26. continued

Sample No.	pH (paste)	pH (1:1)	Lime Requirement (tons)	Acid Extracted K (lbs.)	Acid Extracted Ca (lbs.)	Acid Extracted Mg (lbs.)	Acid Extracted P (lbs.)	Bicarbonate Extracted P (lbs.)
			Per Thousand Tons of Material					
33	7.2	6.8	0.0	125	1040	192	300	2.4
34	7.8	7.1	0.0	150	2160	408	320	2.4
35	7.5	7.1	0.0	156	1680	372	238	1.2
36	7.7	7.0	0.0	139	1680	264	320	2.4
37	7.0	6.7	0.0	114	960	156	300	1.2
38	7.6	6.8	0.0	117	1280	180	308	2.4
39	7.0	6.8	0.0	122	1440	204	300	2.4
40		NO SAMPLE						
41	7.7	7.4	0.0	416	160	36	153G	3.6
42	7.6	6.8	0.0	131	680	180	88	1.2
43	7.2	6.8	0.0	92	360	48	142	1.2
44	7.3	6.8	0.0	117	1120	216	216	1.2
45	6.9	6.6	0.0	95	1120	216	200	1.2
46	7.3	6.6	0.0	103	1760	324	238	1.2
47	7.8	7.3	0.0	353	2080	372	360	1.2
48	7.6	7.2	0.0	322	2080	360	342G	2.4
49		WILLIAMSON COAL						
50	7.3	6.7	0.0	243	1600	336	342	3.6
51	7.2	6.9	0.0	142	960	180	342	1.2
52	7.5	6.9	0.0	238	1600	252	360G	2.4
53	7.5	7.3	0.0	275	2320	576	200G	1.2
54	7.8	7.4	0.0	348	3280	1116	308G	2.4
55	8.2	7.6	0.0	364	2400	624	300G	1.1
56	7.5	7.4	0.0	261	2560	840	300G	1.1
57	7.0	7.5	0.0	327	2000	444	360G	1.1
58	7.6	7.4	0.0	312	2080	636	342G	1.1
59		WILLIAMSON COAL						
60	7.6	7.2	0.0	416	1520	672	294	1.1
61	7.5	7.8	0.0	353	800	372	107	1.1
62	7.2	6.9	0.0	247	1680	888	115	0.5
63	7.7	6.9	0.0	164	1200	300	159	0.5
64	7.3	7.5	0.0	164	1120	300	200	1.1
65	7.8	7.5	0.0	171	1440	360	147	0.5
66	8.0	7.1	0.0	238	1040	264	256	2.2
67	7.8	7.4	0.0	179	1120	204	216	2.2
68	8.0	7.7	0.0	111	6400	276	82	4.5
69	8.2	7.8	0.0	147	10400	156	19	2.2
70	8.2	7.7	0.0	117	3600	204	100	0.5

Table 26. continued

Sample No.	pH (paste)	pH (1:1)	Per Thousand Tons of Material: Lime Requirement (tons)	Acid Extracted K (lbs.)	Acid Extracted Ca (lbs.)	Acid Extracted Mg (lbs.)	Acid Extracted P (lbs.)	Bicarbonate Extracted P (lbs.)
71	7.3	7.8	0.0	226	3600	888	128G	1.1
72	7.9	7.4	0.0	160	1280	312	159	0.5
73	8.0	7.2	0.0	145	1600	324	159G	2.2
74	8.0	7.5	0.0	175	1760	408	111G	2.2
75	7.7	7.6	0.0	210	1200	300	132G	2.2
76	8.2	7.7	0.0	206	3680	888	119G	1.1
77	7.4	7.8	0.0	226	1120	240	238	1.1
78	8.1	7.7	0.0	164	4400	1092	72G	0.5
79	7.6	7.8	0.0	206	4480	1140	80G	3.2
80	7.8	7.2	0.0	139	8480	504	50G	3.2
81	7.8	6.6	0.0	175	2400	600	111G	3.2
82	8.0	7.2	0.0	202	3920	948	103G	3.2
83	7.8	7.3	0.0	307	2480	660	294G	3.2
84	8.0	7.5	0.0	312	2400	672	183G	2.2
85	7.9	7.2	0.0	284	2240	600	174G	3.2
86	8.1	7.3	0.0	312	2080	588	256G	3.2
87	7.9	7.5	0.0	302	2240	624	294G	3.2
88	7.8	7.4	0.0	405	2640	708	246G	3.2
89	7.2	7.2	0.0	298	2000	576	200G	3.2
90	8.0	7.6	0.0	275	2640	756	216G	3.2
91	7.9	7.5	0.0	432	2080	708	320G	3.2
92	8.1	6.9	0.0	395	1360	348	342	3.2
93	7.5	6.6	0.0	416	1280	276	360	3.2
94		NO SAMPLE						
95		UPPER CEDAR GROVE COAL						
96		NO SAMPLE						
97	7.9	7.0	0.0	343	1440	312	360G	3.2
98	7.7	6.8	0.0	293	1280	228	342G	4.3
99	8.0	7.2	0.0	343	2080	696	342G	3.2
100	8.2	7.4	0.0	369	2720	996	320G	3.2
101	8.2	7.6	0.0	410	2400	912	294G	3.2
102	8.0	7.5	0.0	432	2880	1224	300G	3.2
103	8.0	7.7	0.0	261	5120	1392	91G	4.3
104	8.1	7.7	0.0	247	2960	780	159G	3.2
105	8.0	7.6	0.0	202	2160	444	137G	4.3
106	8.1	7.2	0.0	302	720	348	216	1.1

Table 26. continued

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
107	7.8	7.2	0.0	284	720	312	200	2.2
108	8.0	7.3	0.0	261	1280	372	200	4.5
109	8.0	7.3	0.0	206	1280	372	159	2.2
110	8.0	7.4	0.0	238	1600	480	159	2.2
111	7.6	7.0	0.0	125	1440	420	119	1.1
112	7.1	6.8	0.0	131	1120	372	183	1.1
113	7.7	7.3	0.0	343	2960	1116	308G	2.2
114	7.9	7.2	0.0	243	800	300	246	1.1
115	8.2	7.7	0.0	202	5680	1464	91M	2.2
116	8.0	7.6	0.0	222	4320	1200	88G	4.5
117	8.4	8.0	0.0	153	9120	660	22	2.2
118	8.2	7.7	0.0	252	3280	1092	100G	2.2
119	8.3	7.1	0.0	210	5360	1608	100M	2.2
120	7.8	7.4	0.0	353	960	324	128	2.2
121	7.8	7.6	0.0	348	1920	396	360	2.2
122	8.1	7.4	0.0	307	2000	408	342G	2.2
123	8.0	7.9	0.0	364	4160	852	238G	2.2
124	8.2	7.9	0.0	369	3280	960	256G	4.5
125	8.1	7.9	0.0	343	2800	876	183G	2.2
126	8.1	7.8	0.0	353	2080	504	256G	3.3
127	8.0	7.0	0.0	24	240	12	15	2.2
128		LOWER CEDAR GROVE COAL						
129	7.3	7.3	0.0	198	1440	252	256	2.2
130	7.8	7.8	0.0	198	1680	324	294	1.1
131	7.8	7.9	0.0	153	5520	1296	88M	1.1
132	8.2	7.4	0.0	164	6000	1440	58	1.1
133	7.9	7.1	0.0	405	3560	480	308	2.2
134	8.1	7.5	0.0	395	2240	696	308G	1.1
135	7.9	7.6	0.0	353	2320	816	167G	1.1
136	8.2	7.9	0.0	275	360	1032	132G	1.1
137	8.2	7.9	0.0	160	4800	1068	82G	1.1
138	8.2	7.8	0.0	171	4320	1092	88G	1.1
139	8.2	8.0	0.0	214	4000	996	85G	1.1
140	8.2	7.7	0.0	410	3320	1044	246G	1.1
141	7.7	7.2	0.0	416	2400	576	320G	1.1
142		ALMA COAL						

Table 26. continued

Sample No.	pH (paste)	pH (1:1)	Lime Requirement (tons)	Acid Extracted K (lbs.)	Acid Extracted Ca (lbs.)	Acid Extracted Mg (lbs.)	Acid Extracted P (lbs.)	Bicarbonate Extracted P (lbs.)
			Per Thousand Tons of Material					
143	7.9	7.6	0.0	359	2350	480	320	2.2
144	8.0	7.8	0.0	298	5240	1752	85G	2.2
145	8.4	8.0	0.0	298	5520	1632	119G	2.2
146	7.9	7.8	0.0	405	3200	1200	167G	2.2
147	8.2	7.9	0.0	427	4720	1992	159G	2.2
148	8.2	8.0	0.0	437	1840	576	320	2.2
149	8.1	7.6	0.0	432	2880	828	342G	2.2
150	7.9	7.7	0.0	496	1440	624	147	1.1
151		LOWER ALMA COAL						
152	7.9	7.7	0.0	524	1550	288	308G	2.2
153	7.9	7.6	0.0	453	1760	300	342G	2.2
154	8.4	8.2	0.0	252	5440	1536	82G	2.2
155	8.3	8.0	0.0	427	2640	936	147G	2.2
156	8.3	8.1	0.0	222	3280	852	100G	2.2
157	8.3	8.2	0.0	191	5120	972	82G	2.2
158	8.3	8.2	0.0	214	4960	888	97G	3.4
159	8.1	7.8	0.0	198	3280	804	147G	2.2
160	8.2	8.0	0.0	195	6120	1488	85G	2.2
161	8.3	8.1	0.0	591	2480	798	216G	3.4
162	8.1	7.9	0.0	563	2640	720	174G	4.5
163	8.1	7.8	0.0	427	2480	660	137G	4.5
164	8.1	7.9	0.0	507	3120	888	238G	2.2
165	8.2	7.9	0.0	416	2400	576	192G	3.4
166	8.1	7.9	0.0	480	2400	660	238G	4.5
167	8.1	7.9	0.0	474	3200	948	216G	4.5

Table 27. ACID-BASE ACCOUNT OF THE WILLIAMSON, CEDAR GROVE, AND ALMA COAL OVERBURDEN AT THE PETER WHITE COAL COMPANY'S MINE, NEIGHBORHOOD TWO, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
A	5/4	0	.015	.47	3.26		2.79
B_1	6/4	0	.015	.47	.28	.19	
B_{2t}	7/4	0	.010	.31	.76		.45
B_3	7/4	0	.010	.31	.28	.03	
1	5/6	0	0	0	1.62		1.62
2	5/6	0	.005	.16	2.75		2.59
3	6/4	0	.005	.16	3.72		2.56
4	6/4	0	.005	.16	1.50		1.34
5	6/6	0	.005	.16	1.25		1.09
6	6/4	0	.005	.16	7.92		7.76
7	7/4	0	.005	.16	6.45		6.29
8	6/4	0	.005	.16	5.70		5.54
9	7/4	0	.005	.16	6.92		6.76
10	6/4	0	.005	.16	6.70		6.54
11	5/6	0	.005	.16	5.45		5.29
12	6/1	0	.080	2.50	5.95		3.45
13	5/4	2	.015	.47	61.88		61.41
14	6/2	0	.010	.31	9.68		9.37
15	6/2	0	.350	10.94	10.65	.29	
16	4/1	0	.870	27.19	18.33	8.86	
17	5/1	1	.560	17.50	20.30		2.80
18	5/1	0	.400	12.50	21.05		8.55
19	5/1	0	.530	16.56	13.38	3.18	
20	5/1	0	.030	.94	10.65		9.71
21	6/4	0	.005	.16	9.90		9.74
22	6/4	0	.005	.16	9.90		9.74
23	6/4	0	.005	.16	8.68		8.52
24	6/1	0	.185	5.78	7.18		1.40
25	5/1	0	.130	4.06	10.40		6.34
26	6/1	0	.070	2.19	13.88		11.69
27	5/1	0	.265	8.28	5.45	2.83	
28	6/1	0	.690	21.56	4.70	16.86	
29	6/6	0	.005	.16	9.40		9.24
30	6/2	0	.150	4.69	3.72	.97	
31	7/1	0	.005	.16	14.35		14.19
32	5/4	0	.005	.16	8.68		8.52
33	6/4	0	.005	.16	5.70		5.54
34	7/4	0	.005	.16	6.20		6.04
35	8/0	0	.005	.16	9.90		9.74

Table 27. continued

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
36	7/4	0	.005	.16	5.45		5.29
37	7/4	0	.010	.31	4.70		4.39
38	7/4	0	.005	.16	4.95		4.79
39	7/4	0	.005	.16	4.20		4.04
40		NO SAMPLE					
41	7/0	0	.025	.78	6.45		5.67
42	7/4	0	.005	.16	1.98		1.82
43	7/2	0	.005	.16	2.48		2.32
44	7/2	0	.005	.16	4.70		4.54
45	8/2	0	.005	.16	4.20		4.04
46	8/2	0	.005	.16	4.70		4.54
47	6/1	0	.025	.78	4.45		3.67
48	6/1	0	.060	1.87	8.18		6.31
49		WILLIAMSON COAL					
50	6/0	0	.010	.31	3.98		3.67
51	7/1	0	.030	.94	5.95		5.01
52	6/1	0	.060	1.87	7.68		5.81
53	7/0	0	.035	1.09	20.80		19.71
54	7/0	0	.050	1.56	17.58		16.02
55	7/1	0	.020	.62	11.15		10.53
56	6/1	0	.080	2.50	14.10		11.60
57	7/1	0	.045	1.41	10.15		8.74
58	6/1	0	.210	6.56	8.93		2.37
59		WILLIAMSON COAL					
60	3/1	0	.150	4.69	5.45		.76
61	7/1	0	.075	2.34	2.98		.64
62	6/3	0	.010	.31	5.70		5.39
63	8/1	0	.010	.31	6.20		5.89
64	7/1	0	.015	.47	4.20		3.73
65	7/1	0	.010	.31	5.45		5.14
66	7/1	0	.005	.16	4.20		4.04
67	7/2	0	.025	.78	4.95		4.17
68	7/2	2	.020	.62	15.85		15.23
69	8/0	4	.015	.47	285.48		285.01
70	7/4	1	.005	.16	9.65		9.49
71	8/0	1	.010	.31	12.62		12.31
72	8/0	1	.005	.16	10.65		10.49
73	8/0	0	.015	.47	3.98		3.51
74	8/0	1	.010	.31	11.88		11.57
75	8/0	1	.005	.16	13.13		12.97

Table 27. continued

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
76	8/0	1	.010	.31	14.60		14.29
77	6/1	0	.050	1.56	3.95		2.39
78	8/0	1	.015	.47	25.25		24.78
79	8/0	1	.025	.78	28.72		27.94
80	7/0	1	.260	8.12	22.78		14.66
81	8/0	1	.040	1.25	15.10		13.85
82	8/0	1	.060	1.87	14.85		12.98
83	7/0	0	.040	1.25	12.12		10.87
84	6/1	0	.060	1.87	15.60		13.73
85	8/0	0	.050	1.56	15.10		13.54
86	6/1	0	.060	1.87	13.88		12.01
87	6/0	0	.070	2.19	15.10		12.91
88	5/1	0	.060	1.87	12.12		10.25
89	7/1	0	.050	1.56	13.88		12.32
90	7/0	0	.035	1.09	16.60		15.51
91	7/1	0	.080	2.50	14.35		11.85
92	8/0	0	.020	.62	5.95		5.33
93	7/1	0	.090	2.81	5.95		3.14
94		NO SAMPLE					
95		UPPER CEDAR GROVE COAL					
96		NO SAMPLE					
97	7/0	0	.020	.62	7.92		7.30
98	8/1	0	.010	.31	9.40		9.09
99	7/1	0	.040	1.25	16.82		15.57
100	7/1	0	.040	1.25	17.08		15.83
101	7/1	0	.035	1.09	17.08		15.99
102	6/1	0	.040	1.25	18.82		17.57
103	8/0	1	.015	.47	29.45		28.98
104	8/0	1	.010	.31	12.12		11.81
105	8/0	0	.010	.31	4.70		4.39
106	7/0	0	.010	.31	5.95		5.64
107	8/0	0	.005	.16	4.95		4.99
108	8/0	0	.005	.16	4.95		4.79
109	8/0	0	.005	.16	5.70		5.54
110	8/0	0	.005	.16	5.95		5.79
111	7/2	0	.005	.16	2.47		2.31
112	7/3	0	.010	.31	3.48		3.17
113	7/0	0	.060	1.87	12.12		10.25
114	8/0	0	.025	.78	8.42		7.64
115	8/0	1	.005	.16	22.02		21.86

Table 27. continued

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
116	8/0	1	.005	.16	17.82		17.66
117	8/0	2	.050	1.56	56.70		55.14
118	8/0	1	.005	.16	19.30		19.14
119	8/0	1	.010	.31	22.62		22.31
120	8/1	0	.030	.94	3.72		2.78
121	5/1	0	.050	1.56	2.98		1.42
122	6/1	0	.020	.62	4.20		3.58
123	7/1	0	.040	1.25	6.92		5.67
124	6/0	0	.030	.94	11.42		10.48
125	6/0	0	.030	.94	12.38		11.44
126	5/1	0	.015	.47	16.60		16.13
127	3/0	0	.050	1.56	12.88		11.32
128		LOWER CEDAR GROVE COAL					
129	8/0	0	.010	.31	3.22		2.91
130	8/0	0	.010	.31	2.27		1.96
131	8/0	0	.010	.31	5.76		5.45
132	8/0	1	.005	.16	23.00		22.84
133	5/0	0	.360	11.25	3.52	7.73	
134	7/0	0	.020	.62	10.28		9.66
135	7/1	0	.025	.78	14.51		13.73
136	8/0	1	.010	.31	17.26		16.95
137	8/1	1	.010	.31	21.27		20.96
138	8/0	1	.010	.31	21.01		20.70
139	8/0	1	.010	.31	19.51		19.20
140	6/1	0	.060	1.87	12.27		10.40
141	7/1	0	.050	1.56	5.76		4.20
142		ALMA COAL					
143	7/1	0	.050	1.56	2.01		.45
144	7/1	1	.030	.94	19.76		18.82
145	7/1	1	.040	1.25	18.26		17.01
146	6/1	1	.040	1.25	14.02		12.77
147	6/1	1	.025	.78	25.27		24.49
148	7/1	0	.030	.94	2.27		1.33
149	6/1	0	.040	1.25	4.26		3.01
150	6/1	0	.040	1.25	2.01		.76
151		LOWER ALMA COAL					
152	7/0	0	.020	.62	6.27		5.65

Table 27. continued

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
153	5/1	0	.130	4.06	5.28		1.22
154	7/1	1	.020	.62	22.01		21.39
155	6/1	1	.070	2.19	17.77		15.58
156	8/0	1	.020	.62	19.02		18.40
157	8/0	1	.010	.31	21.01		20.70
158	8/0	1	.010	.31	16.52		16.21
159	8/0	0	.010	.31	9.26		8.95
160	8/0	1	.020	.62	23.00		22.38
161	7/1	0	.010	.31	14.76		14.45
162	6/1	0	.745	23.28	6.53	16.75	
163	5/1	0	.380	11.87	10.28	1.59	
164	7/1	0	.175	5.47	13.77		8.30
165	5/1	0	.340	10.62	14.25		3.63
166	6/1	0	.260	8.12	11.27		3.15
167	6/1	0	.360	11.25	14.03		2.78

Table 28. PHYSICAL CHARACTERIZATIONS OF THE ALMA COAL OVERBURDEN AT THE PETER WHITE COAL COMPANY'S MINE, NEIGHBORHOOD TWO, COLUMN THREE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-3.0	NOT SAMPLED		
1	3.0-4.0	MS	2.5Y 7/2	1
2	4.0-11.0	SS	2.5Y 7/4	0
3	11.0-11.5	Carb	2.5Y 3/2	0
4	11.5-12.0	SH	5Y 6/1	0
5	12.0-13.0	SH	5Y 5/1	0
6	13.0-14.0	SH	5Y 6/1	0
7	14.0-15.0	SH	5Y 6/1	1
8	15.0-16.0	SH	5Y 4/1	0
	16.0-18.0	UPPER ALMA COAL		
9	18.0-18.5	MS	5Y 6/1	1
	18.5-20.5	MIDDLE ALMA COAL		
10	20.5-21.5	MS	5Y 5/1	0
11	21.5-22.5	MS	5Y 6/1	0
12	22.5-23.5	MR	5Y 6/1	0
	23.5-25.5	LOWER ALMA COAL		

Table 29. CHEMICAL CHARACTERIZATIONS OF THE ALMA COAL OVERBURDEN AT THE PETER WHITE COAL COMPANY'S MINE, NEIGHBORHOOD TWO, COLUMN THREE

			Per Thousand Tons of Material					
			Lime Require-	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	ment (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	4.6	4.5	2.5	214	640	618	308	30.8
2	4.7	5.0	0.5	125	160	312	47	8.9
3	3.7	3.6	6.5	179	400	1176	18	6.7
4	4.7	4.2	1.5	218	160	660	47	30.8
5	4.1	3.8	1.5	608	160	660	17	4.5
6	5.0	5.8	0.5	87	1200	1272	360	8.9
7	4.0	4.5	1.0	437	2320	1176	300	15.4
8	4.4	4.6	1.5	87	480	660	35	4.5
UPPER ALMA COAL								
9	3.3	3.6	3.5	238	160	312	34	4.5
MIDDLE ALMA COAL								
10	3.3	3.6	6.0	117	1040	1416	142	17.6
11	3.8	4.2	2.0	198	400	2400	54	4.5
12	3.9	4.3	1.5	142	400	1116	167	8.9
LOWER ALMA COAL								

Table 30. ACID-BASE ACCOUNT OF THE ALMA COAL OVERBURDEN AT THE PETER WHITE COAL COMPANY'S MINE, NEIGHBORHOOD TWO, COLUMN THREE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	7/2	0	.005	.16	3.52		3.36
2	7/4	0	.005	.16	2.01		1.85
3	3/2	0	.375	11.72	- 2.22	13.94	
4	6/1	0	.100	3.12	0.51	2.61	
5	5/1	0	.125	3.91	0.03	3.88	
6	6/1	0	.045	1.41	4.03		2.62
7	6/1	0	.275	8.59	1.76	6.83	
8	4/1	0	.150	4.69	0.51	4.18	
UPPER ALMA COAL							
9	6/1	0	.100	3.12	- 4.49	7.61	
MIDDLE ALMA COAL							
10	5/1	0	.425	13.28	2.22	11.06	
11	6/1	0	.200	6.25	0.05	6.20	
12	6/1	0	.100	3.12	2.01	1.11	
LOWER ALMA COAL							
AFTER LEACHING THE SAMPLES TO REMOVE SULFATES							
1	7/2	0	.005	.16	3.52		3.36
2	7/4	0	.005	.16	2.01		1.85
3	3/2	0	.300	9.38	0.74	8.64	
4	6/1	0	.075	2.34	-0.74	3.08	
5	5/1	0	.125	3.91	0.03	3.88	
6	6/1	0	.045	1.41	4.03		2.62
7	6/1	0	.100	3.13	0	3.13	
8	4/1	0	.150	4.69	0.51	4.18	
UPPER ALMA COAL							
9	6/1	0	.100	3.12	-4.49	7.61	
MIDDLE ALMA COAL							
10	5/1	0	.250	7.81	-3.99	8.80	
11	6/1	0	.050	1.56	-3.00	4.56	
12	6/1	0	.075	2.34	0.74	1.60	
LOWER ALMA COAL							

Table 31. PHYSICAL CHARACTERIZATIONS OF THE WINIFREDE COAL OVERBURDEN AT CASE COAL COMPANY'S MINE, NEIGHBORHOOD TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-35.0	NOT SAMPLED		
1	35.0-35.5	SS-I	5Y 6/1	0
2	35.5-36.0	SS	5Y 6/1	0
3	36.0-37.0	MR	2.5Y 5/2	1
4	37.0-38.0	SS	5Y 7/1	0
5	38.0-39.0	MR	10YR 5/1	0
6	39.0-39.3	COAL	N 2/0	1
7	39.3-40.3	MS	10YR 5/1	2
8	40.3-44.3	WINIFREDE COAL		
9	44.3-45.0	Carb	5YR 2/1	0
10	45.0-47.0	COAL	N 2/0	0

Table 32. CHEMICAL CHARACTERIZATIONS OF THE WINIFREDE COAL OVERBURDEN AT CASE COAL COMPANY'S MINE, NEIGHBORHOOD TWO

			Per Thousand Tons of Material					
			Lime Require-	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	ment (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	7.3	7.6	0	380	3200	1104	153G	2.2
2	7.2	7.5	0	364	2640	852	137G	4.5
3	7.1	7.3	0	247	2320	504	216	4.5
4	6.5	6.6	0	187	3120	840	128G	2.2
5	7.2	7.4	0	400	2000	564	216	2.2
6	6.4	6.7	0	114	960	264	19	2.2
7	4.3	5.6	0.5	122	2240	384	37	2.2
8	WINIFREDE COAL							
9	1.8	2.2	10.0	179	640	288	38	2.2
10	6.1	6.7	0	67	800	72	18	2.2

Table 33. ACID-BASE ACCOUNT OF THE WINIFREDE COAL OVERBURDEN AT CASE COAL COMPANY'S MINE, NEIGHBORHOOD TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	6/1	1	.060	1.87	25.48		23.61
2	6/1	1	.050	1.56	25.48		23.92
3	5/2	1	.065	2.03	11.29		9.26
4	7/1	1	.020	.62	9.87		9.25
5	5/1	1	.050	1.56	2.67		1.11
6	2/0	0	.800	25.00	- 4.78	29.78	
7	5/1	1	.050	1.56	2.18		.62
8	WINIFREDE COAL						
9	2/1	0	14.625	457.03	- 8.87	465.90	
10	2/0	0	.575	17.97	- 2.13	20.10	

Table 34. PHYSICAL CHARACTERIZATIONS OF THE HAZARD #5A COAL OVERBURDEN AT FALCON COAL COMPANY'S RUSSELL FORK MINE, NEIGHBORHOOD THREE.

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
Hazard #7 Coal				
1	0.0- 1.0	MS	2.5Y 6/2	4
2	1.0- 2.0	MS	2.5Y 8/2	8
3	2.0- 3.0	MS	2.5Y 7/2	9
4	3.0- 4.0	MS	2.5Y 7/2	10
5	4.0- 5.0	MS	2.5Y 7/4	10
6	5.0- 6.0	MS	2.5Y 7/4	10
7	6.0- 7.0	MS	2.5Y 6/4	10
8	7.0- 8.0	MS	2.5Y 7/4	10
9	8.0- 9.0	MS	2.5Y 6/4	10
10	9.0-10.0	MS	2.5Y 5/4	8
11	10.0-11.0	MS	2.5Y 6/2	7
12	11.0-12.0	MR	5Y 6/1	7
13	12.0-13.0	MR	5Y 6/1	7
14	13.0-14.0	MR	5Y 6/1	3
15	14.0-15.0	MS	2.5Y 6/2	3
16	15.0-16.0	MS	2.5Y 6/2	3
17	16.0-17.0	MS	2.5Y 6/2	4
18	17.0-18.0	MS	2.5Y 6/4	3
19	18.0-19.0	MS	2.5Y 5/4	3
20	19.0-20.0	MS	2.5Y 6/4	3
21	20.0-21.0	MS	2.5Y 6/4	3
22	21.0-22.0	MS	2.5Y 6/2	3
23	22.0-23.0	MS	2.5Y 6/2	3
24	23.0-24.0	MR	5Y 6/1	2
25	24.0-25.0	MR	5Y 6/1	2
26	25.0-25.2	Hazard #5A Coal		

Table 35. CHEMICAL CHARACTERIZATIONS OF THE HAZARD #5A COAL OVERBURDEN AT FALCON COAL COMPANY'S RUSSELL FORK MINE, NEIGHBORHOOD THREE.

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
HAZARD #7 Coal								
1	4.5	4.5	5.5	156	300	396	43	4.5
2	4.4	4.4	4.0	156	80	300	20	2.2
3	4.4	4.5	4.0	175	80	348	21	4.5
4	4.4	4.5	3.0	150	120	312	45	17.6
5	4.5	4.5	3.0	139	80	300	32	15.4
6	4.6	4.6	3.0	202	160	588	35	13.2
7	4.9	4.9	1.5	187	480	684	50	13.2
8	5.1	5.0	2.0	195	560	660	85	11.0
9	5.6	5.3	1.5	171	1360	888	192	11.0
10	6.4	6.6	0	195	2000	960	294	6.7
11	7.2	7.0	0	226	2000	924	183	6.7
12	7.6	7.4	0	252	2080	912	147G	2.2
13	7.7	7.5	0	256	2480	1188	132G	2.2
14	7.6	7.5	0	243	2400	1104	137G	3.4
15	7.5	7.4	0	198	2560	1092	142	4.5
16	7.4	7.3	0	206	2400	1044	159	4.5
17	6.9	7.0	0	187	2720	1164	159	6.7
18	6.3	6.5	0	164	2160	984	167	6.7
19	6.1	6.1	1.0	153	2080	948	183	6.7
20	5.9	6.1	1.5	145	2000	912	192	7.8
21	5.9	5.9	1.0	150	2080	912	200	8.9
22	6.2	6.5	0	180	2080	840	200	7.8
23	7.0	7.1	0	210	2080	828	183	4.5
24	7.1	7.2	0	284	2000	768	167G	4.5
25	7.1	7.1	0	284	2000	732	294	4.5
26	HAZARD #5A Coal							

Table 36. ACID-BASE ACCOUNT OF THE HAZARD #5A COAL OVERBURDEN AT FALCON COAL COMPANY'S RUSSELL FORK MINE, NEIGHBORHOOD THREE.

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
HAZARD #7 Coal							
1	6/2	0	.035	1.09	-1.26	2.35	
2	8/2	0	.010	.31	- .76	1.07	
3	7/2	0	.010	.31	-1.26	1.57	
4	7/2	0	.005	.16	- .76	.92	
5	7/4	0	.005	.16	- .25	.41	
6	7/4	0	.020	.62	0	.62	
7	6/4	0	.020	.62	1.26		.64
8	7/4	0	.010	.31	- .25	.56	
9	6/4	0	.005	.16	2.75		2.59
10	5/4	0	.010	.31	5.78		5.47
11	6/2	0	.020	.62	12.57		11.95
12	6/1	1	.040	1.25	22.85		21.60
13	6/1	0	.035	1.09	17.60		16.51
14	6/1	0	.035	1.09	19.85		18.76
15	6/2	0	.025	.78	14.06		13.28
16	6/2	1	.030	.94	20.35		19.41
17	6/2	0	.020	.62	6.79		6.17
18	6/4	0	.010	.31	5.53		5.22
19	5/4	0	.005	.16	6.29		6.13
20	6/4	0	.005	.16	3.76		3.60
21	6/4	0	.005	.16	4.27		4.11
22	6/2	0	.015	.47	5.02		4.55
23	6/2	0	.025	.78	14.57		13.79
24	6/1	1	.075	2.34	20.10		17.76
25	6/1	0	.075	2.34	11.56		9.22
26	HAZARD #5A Coal						

Table 37. PHYSICAL CHARACTERIZATIONS OF THE HAZARD #5A COAL OVERBURDEN AT FALCON COAL COMPANY'S RUSSELL FORK MINE, NEIGHBORHOOD THREE, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	HAZARD #7 COAL			
1	0.0-1.0	MS	5Y 6/1	8
2	1.0-2.0	MS	5Y 6/1	7
3	2.0-3.0	MR	5Y 6/1	5
4	3.0-4.0	MR	5Y 6/1	5
5	4.0-5.0	MS	5Y 6/1	4
6	5.0-6.0	MS	5Y 6/1	4
7	6.0-7.0	MR	5Y 6/1	4
8	7.0-8.0	MR	5Y 6/1	4
9	8.0-9.0	MR	5Y 6/1	4
10	9.0-10.0	MR	5Y 6/1	1
11	10.0-11.0	MR	5Y 6/1	
	11.0-14.0	NOT SAMPLED		
12	14.0-15.0	MR	5Y 6/1	3
13	15.0-16.0	MR	5Y 6/1	4
14	16.0-17.0	MR	5Y 6/1	4
15	17.0-18.0	MR	5Y 6/1	3
	18.0-19.0	NOT SAMPLED		
16	19.0-20.0	MR	5Y 6/1	4
17	20.0-21.0	MR	5Y 6/1	3
18	21.0-22.0	MR	5Y 5/0	3
	HAZARD #5A COAL			

Table 38. CHEMICAL CHARACTERIZATIONS OF THE HAZARD #5A COAL OVERBURDEN AT FALCON COAL COMPANY'S RUSSELL FORK MINE, NEIGHBORHOOD THREE, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Require- ment	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
HAZARD #7 COAL								
1	6.1	6.2	0.5	261	1360	624	132	2.2
2	6.8	6.8	0	252	1280	516	238	2.2
3	7.3	7.5	0	234	1200	456	238G	2.2
4	7.3	7.3	0	289	1680	588	256G	2.2
5	7.5	7.5	0	307	1920	684	200G	2.2
6	7.6	7.6	0	280	1840	624	153G	2.2
7	7.7	7.7	0	293	1920	648	192G	2.2
8	7.7	7.7	0	298	2080	660	192G	2.2
9	7.7	7.7	0	289	2560	924	183G	2.2
10	7.7	7.7	0	284	2560	948	192G	2.2
11	7.5	7.5	0	243	3040	1056	308	2.2
12	7.8	7.8	0	322	3280	1212	147G	2.2
13	7.8	7.7	0	307	3200	1176	174G	2.2
14	7.8	7.8	0	327	3520	1392	159G	2.2
15	7.8	7.8	0	317	3360	1344	167G	2.2
16	7.8	7.8	0	317	3200	1320	174G	2.2
17	7.7	7.6	0	322	2320	840	216G	2.2
18	6.6	6.8	0	293	2080	672	256	2.2
HAZARD #5A COAL								

Table 39. ACID-BASE ACCOUNT OF THE HAZARD #5A COAL OVERBURDEN AT FALCON COAL COMPANY'S RUSSELL FORK MINE, NEIGHBORHOOD THREE, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
HAZARD	#7 COAL						
1	6/1	0	.040	1.25	4.77		3.52
2	6/1	0	.035	1.09	5.78		4.69
3	6/1	1	.025	.78	25.63		24.85
4	6/1	0	.035	1.09	18.08		16.99
5	6/1	1	.035	1.09	20.60		19.51
6	6/1	1	.040	1.25	24.62		23.37
7	6/1	1	.040	1.25	22.62		21.37
8	6/1	1	.040	1.25	30.40		29.15
9	6/1	1	.040	1.25	26.64		25.39
10	6/1	1	.030	.94	28.13		27.19
11	6/1	1	.035	1.09	24.37		23.28
12	6/1	1	.040	1.25	24.37		23.12
13	6/1	0	.040	1.25	19.09		17.84
14	6/1	0	.040	1.25	16.84		15.59
15	6/1	0	.040	1.25	19.59		18.34
16	6/1	0	.040	1.25	19.34		18.09
17	6/1	0	.040	1.25	14.06		12.81
18	5/1	0	.250	7.81	11.31		3.50
HAZARD	#5A COAL						

Table 40. PHYSICAL CHARACTERIZATIONS OF THE HAZARD #7 COAL OVERBURDEN AT FALCON COAL COMPANY'S RUSSELL FORK MINE, NEIGHBORHOOD THREE.

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
1	0.0-0.9	Soil	2.5Y 6/2	10
2	0.9-2.0	Soil	2.5Y 7/4	10
	2.0-6.0	NOT SAMPLED		
3	6.0-7.0	HAZARD #8 COAL		
4	7.0-9.0	MS	10YR 8/1	7
	9.0-13.0	NOT SAMPLED		
5	13.0-15.0	MS	10YR 8/3	5
6	15.0-17.0	MS	2.5Y 7/2	9
	17.0-19.0	NOT SAMPLED		
7	19.0-20.5	MR	10YR 7/1	2
8	20.5-22.0	SS	2.5Y 7/2	1
9	22.0-27.0	SS	2.5Y 5/2	0
10	27.0-30.0	SS	5Y 7/1	0
11	30.0-34.0	SS	5Y 8/1	0
12	34.0-38.0	SS	5Y 8/1	1
13	38.0-42.0	SS	5Y 8/1	1
14	42.0-44.0	SH	5Y 6/1	2
15	44.0+	HAZARD #7 COAL		

Table 41. CHEMICAL CHARACTERIZATIONS OF THE HAZARD #7 COAL OVERBURDEN AT FALCON COAL COMPANY'S RUSSELL FORK MINE, NEIGHBORHOOD THREE.

			Per Thousand Tons of Material					
			Lime Require- ment	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	6.8	7.0	0	226	4240	144	91	4.5
2	8.0	8.3	0	106	1040	144	100	2.2
3	HAZARD	#8 COAL						
4	4.2	4.1	4.5	114	80	228	12	2.2
5	4.4	4.3	4.0	128	160	576	24	1.1
6	4.4	4.3	4.0	103	240	492	25	2.2
7	4.6	4.7	2.0	183	240	408	24	2.2
8	4.9	4.8	1.0	125	440	300	137	17.2
9	7.0	6.6	0	128	720	780	82G	3.2
10	7.5	7.1	0	117	640	480	123G	2.2
11	8.0	7.7	0	73	4240	1296	38G	3.2
12	8.2	8.0	0	87	6080	1680	82M	2.2
13	7.9	7.9	0	226	1200	1044	153G	2.2
14	7.2	7.5	0	353	1760	480	320	4.3
15	HAZARD	#7 COAL						

Table 42. ACID-BASE ACCOUNT OF THE HAZARD #7 COAL OVERBURDEN AT FALCON COAL COMPANY'S RUSSELL FORK MINE, NEIGHBORHOOD THREE.

				Tons $CaCO_3$ Equivalent/Thousand Tons Material			
Sample No.	Value and Chroma	Fiz	%S	Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	6/2	0	.005	.16	5.28		5.12
2	7/4	0	.005	.16	1.01		.85
3	HAZARD #8 COAL						
4	8/1	0	.035	1.09	- .76	1.85	
5	8/3	0	.005	.16	- 1.26	1.42	
6	7/2	0	.015	.47	- 1.26	1.73	
7	7/1	0	.005	.16	0.00	.16	
8	7/2	0	.005	.16	1.26		1.10
9	5/2	0	.170	5.31	32.42		27.11
10	7/1	0	.015	.47	21.36		20.89
11	8/1	1	.010	.31	30.40		30.09
12	8/1	1	.005	.16	41.97		41.81
13	8/1	1	.175	5.47	8.79		3.32
14	6/1	0	.050	1.56	3.76		2.20
15	HAZARD #7 COAL						

Table 43. PHYSICAL CHARACTERIZATIONS OF THE HAZARD #9 COAL ZONE AND RESULTANT MINESOIL SAMPLES AT FALCON COAL COMPANY'S MINE ON FLINT RIDGE, NEIGHBORHOOD THREE

Sample No.	Location	Rock Type	Color	Water Slaking
1	Above coal	SH	10YR 4/1	2
2	Above coal	Carb.	N 2/0	1
HAZARD #9 COAL				
3	Parting	SH	10YR 5/1	1
HAZARD #9 COAL				
4	Parting	Carb.	10YR 3/1	1
		MINESOIL SAMPLES		
1	Surface	Chert.	5Y 6/1	0
2	Surface	Flint	5Y 8/1	0
3	Surface	Flint	5Y 6/1	0
4	Surface	SS	5Y 7/1	1
5	Surface	MR	5Y 5/1	0

Table 44. CHEMICAL CHARACTERIZATIONS OF THE HAZARD #9 COAL ZONE AND RESULTANT MINESOIL SAMPLES AT FALCON COAL COMPANY'S MINE ON FLINT RIDGE, NEIGHBORHOOD THREE

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	3.1	2.9	7.0	114	160	48	19	4.3
2	4.4	4.5	9.5	122	8960	444	12	2.2
HAZARD	#9 COAL							
3	3.1	3.2	6.5	147	400	84	48	8.6
HAZARD	#9 COAL							
4	3.1	3.1	6.0	218	240	72	24	4.3
			MINESOIL SAMPLES					
1	7.9	8.0	0.0	156	11200	348	20	6.7
2	7.5	7.4	0.0	167	640	156	47	3.4
3	7.9	8.1	0.0	120	11520	180	21	7.8
4	6.3	7.0	0.0	117	1360	180	246	80.0
5	4.7	4.7	1.0	385	3600	276	216	28.8

Table 45. ACID-BASE ACCOUNT FOR THE HAZARD #9 COAL ZONE AND RESULTANT MINESOIL SAMPLES AT FALCON COAL COMPANY'S MINE ON FLINT RIDGE, NEIGHBORHOOD THREE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	4/1	0	.375	11.72	- 3.76	15.48	
2	2/0	0	.900	28.12	15.58	12.54	
HAZARD	#9 COAL						
3	5/1	0	.175	5.47	- 3.00	8.47	
HAZARD	#9 COAL						
4	3/1	0	.125	3.91	- 2.27	6.18	
				MINESOIL SAMPLES			
1	6/1	5	.250	7.81	549.15		541.34
2	8/1	0	.040	1.25	.76	.49	
3	6/1	5	.150	4.69	456.79		452.10
4	7/1	0	.075	2.34	1.01	1.33	
5	5/1	0	.575	17.97	5.28	12.69	

Table 46. PHYSICAL CHARACTERIZATIONS OF THE HAZARD #9 COAL OVERBURDEN AT THE COOMBS COAL COMPANY'S MINE, NEIGHBORHOOD THREE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-10.0	NOT SAMPLED		
1	10.0-13.0	SS-I	2.5Y 5/2	1
1A	10.0-13.0	SS	10YR 6/6	2
2	13.0-16.0	SS	10YR 6/4	1
2A	13.0-16.0	SS	10YR 6/6	2
3	16.0-18.0	SS	10YR 6/6	1
4	18.0-20.0	MR	10YR 5/1	1
5	20.0-22.0	SS	10YR 6/6	1
6	22.0-24.0	SS	2.5Y 7/2	0
7	24.0-25.0	SS	5Y 7/1	1
8	25.0-27.0	SS	N 8/0	0
9	27.0-29.0	SS	5Y 7/1	1
10	29.0-31.0	SS	5Y 7/1	1
11	31.0-32.1	MR	5Y 5/1	5
12	32.1-33.2	MR	5Y 5/1	6
13	33.2-34.3	MR	5Y 5/1	6
14	34.3-35.4	MR	5Y 5/1	5
15	35.4-36.6	MR	5Y 5/1	5
16	36.6-37.7	MR	5Y 5/1	5
17	37.7-38.8	MR	5Y 5/1	5
18	38.8-39.9	MR	5Y 5/1	5
19	39.9-41.0	MR	5Y 5/1	4
20	41.0-42.2	MR	5Y 5/1	5
21	42.2-43.3	MR	5Y 5/1	5
22	43.3-44.4	MR	5Y 5/1	5
23	44.4-45.5	MR	5Y 5/1	5
24	45.5-46.6	MR	5Y 5/1	4
25	46.6-47.8	MR	5Y 5/1	4
26	47.8-48.9	MR	5Y 5/1	5
27	48.9-50.0	MR	5Y 5/1	4
28	50.0-51.1	MR	5Y 5/1	5
29	51.1-52.2	MR	5Y 5/1	5
30	52.2-53.4	MR	5Y 6/1	3
31	53.4-54.5	MR	5Y 6/1	2
32	54.5-55.6	MR	5Y 6/1	3
33	55.6-56.7	MR	5Y 5/1	4
HAZARD #9 COAL				

Table 47. CHEMICAL CHARACTERIZATIONS OF THE HAZARD #9 COAL OVERBURDEN AT THE COOMBS COAL COMPANY'S MINE, NEIGHBORHOOD THREE

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	4.8	4.8	4.0	120	1360	528	37	20.0
1A	5.6	5.5	1.0	106	400	120	48	4.5
2	6.2	5.9	1.0	81	320	120	62G	11.0
2A	6.0	5.8	1.0	103	240	108	60G	5.5
3	6.1	6.1	1.0	120	320	96	65G	6.7
4	3.4	3.3	3.0	238	1200	672	123	18.8
5	4.9	4.8	1.0	78	320	144	47G	12.4
6	5.9	5.6	0.5	92	240	144	43G	5.5
7	6.3	5.9	0.5	134	560	192	88G	2.2
8	5.8	5.6	0.5	92	320	48	80G	2.2
9	6.0	5.6	0.5	92	480	48	94G	3.4
10	5.2	5.1	0.5	89	2160	108	308G	6.8
11	6.1	6.1	0.5	364	3920	564	372	5.5
12	3.3	3.7	1.5	322	3520	588	372	5.5
13	4.6	6.4	0.5	380	3440	612	372G	4.5
14	6.5	6.5	0	364	5520	1464	385G	3.4
15	7.1	7.0	0	416	6000	1632	385	4.5
16	7.3	7.3	0	364	9280	1044	119	3.4
17	7.4	7.3	0	364	10080	828	52	4.5
18	7.4	7.3	0	359	10560	708	32	3.4
19	7.4	7.4	0	385	10720	720	35	3.4
20	7.5	7.4	0	364	10720	648	26	2.2
21	7.4	7.4	0	359	10720	696	26	2.2
22	7.4	7.4	0	348	11040	672	23	2.2
23	7.3	7.3	0	343	10720	624	21	3.4
24	7.3	7.4	0	332	10880	600	21	4.5
25	7.4	7.4	0	353	10880	648	22	3.4
26	7.3	7.4	0	348	10880	612	23	3.4
27	7.4	7.5	0	338	10720	588	22	3.4
28	7.3	7.4	0	343	10880	576	22	2.2
29	7.3	7.3	0	343	10720	564	22	3.4
30	7.2	7.3	0	327	9600	780	65	4.5
31	6.8	6.8	0	280	10080	1248	360	7.8
32	5.4	5.7	1.0	284	6880	1080	385	11.0
33	3.1	3.2	5.5	117	5920	912	300G	24.3
HAZARD	#9 COAL							

Table 48. ACID-BASE ACCOUNT OF THE HAZARD #9 COAL OVERBURDEN AT THE COOMBS COAL COMPANY'S MINE, NEIGHBORHOOD THREE

Sample No.	Value and Chroma	Fix	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	5/2	0	.055	1.72	2.27		.55
1A	6/6	0	.005	.16	.50		.34
2	6/4	0	.010	.31	.50		.19
2A	6/6	0	.005	.16	.25		.09
3	6/6	0	.010	.31	.25	.06	
4	5/1	0	.280	8.75	.25	8.50	
5	6/6	0	.010	.31	.25	.06	
6	7/2	0	.005	.16	.76		.60
7	7/1	0	.030	.94	12.83		11.89
8	8/0	0	.010	.31	.25	.06	
9	7/1	0	.020	.62	.76		.14
10	7/1	0	.080	2.50	7.55		5.05
11	5/1	0	.825	25.78	12.57	13.21	
12	5/1	0	1.150	35.94	8.53	27.41	
13	5/1	0	1.225	38.28	9.04	29.24	
14	5/1	0	1.225	38.28	16.84	21.44	
15	5/1	0	.775	24.22	21.87	2.35	
16	5/1	1	.500	15.62	28.63		13.01
17	5/1	1	.700	21.87	32.67		10.80
18	5/1	1	.675	21.09	38.18		17.09
19	5/1	1	.675	21.09	41.46		20.37
20	5/1	1	.475	14.84	68.83		53.99
21	5/1	2	.425	13.28	67.09		53.81
22	5/1	2	.450	14.06	68.58		54.52
23	5/1	2	.550	17.19	65.57		48.38
24	5/1	2	.475	14.84	69.34		54.50
25	5/1	2	.450	14.06	64.06		50.00
26	5/1	2	.475	14.84	73.86		59.02
27	5/1	3	.400	12.50	119.45		106.95
28	5/1	3	.470	14.69	117.00		102.31
29	5/1	2	.970	30.31	115.71		85.40
30	6/1	1	1.450	45.31	31.41	13.90	
31	6/1	1	2.400	75.00	19.09	55.91	
32	6/1	0	2.600	81.25	8.53	72.72	
33	5/1	0	3.400	106.25	1.01	105.24	
HAZARD	#9 COAL						

Table 49. PHYSICAL CHARACTERIZATIONS OF THE HAZARD #9 COAL OVERBURDEN AT THE COOMBS COAL COMPANY'S MINE, NEIGHBORHOOD THREE, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-31.0	NOT SAMPLED		
1	31.0-32.1	MS	10YR 5/1	7
2	32.1-33.2	MS	10YR 6/1	8
3	33.2-34.3	MR	10YR 6/1	9
4	34.3-35.4	MR	10YR 6/1	7
5	35.4-36.6	MR	10YR 6/1	7
6	36.6-37.7	MR	10YR 6/1	7
7	37.7-38.8	MR	10YR 6/1	7
8	38.8-39.9	MR	10YR 6/1	5
9	39.9-41.0	MR	10YR 6/1	6
10	41.0-42.2	MR	10YR 6/1	5
11	42.2-43.3	MR	10YR 6/1	6
12	43.3-44.4	MR	10YR 6/1	6
13	44.4-45.5	MR	10YR 6/1	6
14	45.5-46.6	MR	10YR 6/1	6
15	46.6-47.8	MR	10YR 6/1	7
16	47.8-48.9	MR	10YR 6/1	6
17	48.9-50.0	MR	10YR 6/1	6
18	50.0-51.1	MR	10YR 6/1	5
19	51.1-52.2	MR	10YR 6/1	5
20	52.2-53.4	MR	10YR 6/1	5
21	53.4-54.5	MR	10YR 6/1	4
22	54.5-55.6	SH	N 5/0	4
HAZARD #9 COAL				

Table 50. CHEMICAL CHARACTERIZATIONS OF THE HAZARD #9 COAL OVERBURDEN AT THE COOMBS COAL COMPANY'S MINE, NEIGHBORHOOD THREE, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Require-ment	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	5.2	5.1	1.0	343	3200	672	372	2.2
2	3.1	3.0	3.5	179	3360	828	372G	7.9
3	4.0	3.9	1.5	380	3600	744	372	3.2
4	6.0	6.2	1.0	380	4240	1272	385G	1.1
5	7.1	7.2	0	369	8960	1200	238	1.1
6	7.2	7.4	0	364	9920	804	52	1.1
7	7.2	7.3	0	343	9760	672	32	2.2
8	7.3	7.4	0	332	10240	648	24	2.2
9	7.4	7.5	0	343	10880	648	25	2.2
10	7.3	7.4	0	327	11040	636	21	0.5
11	7.4	7.4	0	327	10560	648	24	1.1
12	7.3	7.4	0	312	10400	600	21	0.5
13	7.4	7.4	0	312	10400	612	21	1.1
14	7.3	7.3	0	343	10400	648	24	2.2
15	7.2	7.3	0	322	9920	636	45	2.2
16	7.0	7.0	0	343	6560	780	385G	4.5
17	6.5	6.8	0	390	6640	696	385G	3.2
18	6.8	7.0	0	312	10720	576	52	1.1
19	6.9	7.0	0	298	10560	612	52	3.2
20	6.8	6.1	1.0	338	7360	912	385	9.1
21	5.4	6.3	1.0	307	4720	732	372	4.5
22	2.8	2.8	6.0	120	4480	672	300G	20.4
HAZARD	#9 COAL							

Table 51. ACID-BASE ACCOUNT OF THE HAZARD #9 COAL OVERBURDEN AT THE COOMBS COAL COMPANY'S MINE, NEIGHBORHOOD THREE, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	5/1	0	1.130	35.31	20.07	15.24	
2	6/1	0	1.660	51.87	10.07	41.80	
3	6/1	0	1.760	55.00	9.54	45.46	
4	6/1	0	.680	21.25	24.37		3.12
5	6/1	1	.430	13.44	31.16		17.72
6	6/1	1	1.100	34.37	34.67		.30
7	6/1	1	.930	29.06	38.68		9.62
8	6/1	2	.590	18.44	67.85		49.41
9	6/1	2	.730	22.81	71.61		48.80
10	6/1	2	.760	23.75	71.86		48.11
11	6/1	2	.650	20.31	74.11		53.80
12	6/1	2	.560	17.50	73.38		55.88
13	6/1	2	.580	18.12	73.86		55.74
14	6/1	2	.640	20.00	67.59		47.59
15	6/1	1	.620	19.37	29.47		10.10
16	6/1	0	.690	21.56	16.59	4.97	
17	6/1	0	.950	29.69	12.07	17.62	
18	6/1	2	1.240	38.75	52.52		13.77
19	6/1	2	1.610	50.31	41.46	8.85	
20	6/1	0	2.170	67.81	11.56	56.25	
21	6/1	0	1.500	46.87	5.78	41.09	
22	5/0	0	4.500	140.62	.50	140.12	
HAZARD #9 COAL							

Table 52. PHYSICAL CHARACTERIZATIONS OF THE HAZARD #9 COAL OVERBURDEN AT THE COOMBS COAL COMPANY'S MINE, NEIGHBORHOOD THREE, COLUMN THREE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-48.0	NOT SAMPLED		
1	48.0-48.5	MR	10YR 7/6	4
2	48.5-49.0	SH	10YR 6/3	3
3	49.0-51.0	MR	10YR 6/3	2
4	51.0-53.0	MR	10YR 6/1	2
5	53.0-55.0	MR	N 6/0	1
6	55.0-56.0	MR	10YR 6/1	1
7	56.0-57.7	MR	N 5/0	2
8	57.7-58.0	MR	N 4/0	5
9	58.0+	HAZARD #9 COAL		

Table 53. CHEMICAL CHARACTERIZATION OF THE HAZARD #9 COAL OVERBURDEN AT THE COOMBS COAL COMPANY'S MINE NEIGHBORHOOD THREE, COLUMN THREE

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	5.9	5.3	2.5	206	1760	468	75	13.6
2	5.4	5.5	2.0	226	2400	468	88	20.5
3	6.7	6.8	0	214	4560	516	360	11.4
4	7.1	7.1	0	280	11360	420	25	4.5
5	7.1	7.1	0	289	11200	420	40	4.5
6	5.7	5.6	1.0	385	3280	324	385	4.5
7	3.5	3.5	6.0	78	7280	732	183G	28.4
8	1.6	2.0	12.5	353	4080	2208	238G	17.0
9	HAZARD	#9 COAL						

Table 54. ACID-BASE ACCOUNT OF THE HAZARD #9 COAL OVERBURDEN AT THE COOMBS COAL COMPANY'S MINE, NEIGHBORHOOD THREE, COLUMN THREE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	7/6	0	.010	.31	1.26		.95
2	6/3	0	.015	.47	3.03		2.56
3	6/3	0	.070	2.19	8.28		6.09
4	6/1	3	1.470	45.94	167.31		121.37
5	6/0	3	.480	15.00	172.34		157.34
6	6/1	0	.330	10.31	5.28	5.03	
7	5/0	0	3.825	119.53	3.03	116.50	
8	4/0	0	22.000	687.50	- 40.76	728.26	
9	HAZARD #9 COAL						

Table 55. PHYSICAL CHARACTERIZATIONS OF THE UNDERWOOD COAL OVERBURDEN AT ARCH COAL COMPANY'S FABIUS MINE, NEIGHBORHOOD FOUR.

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A	- 0.7	Soil	2.5Y 5/2	0
B_{21}	0.7- 1.7	Soil	2.5Y 7/4	1
B_{22}	1.7- 2.0	Soil	10YR 6/6	3
C	2.0- 2.5	Soil	7.5YR 6/6	5
1	2.5- 3.3	SS	10YR 8/2	10
2	3.3- 4.0	MR	10YR 7/4	7
3	4.0- 6.0	MS	7.5YR 8/2	5
4	6.0- 8.0	SS	2.5Y 8/4	1
5	8.0-10.0	SS	5Y 7/1	1
6	10.0-12.0	SS	N 8/0	2
7	12.0-14.0	SS	5Y 7/1	2
8	14.0-16.0	SS	10YR 7/3	1
9	16.0-20.0	SS	5YR 7/1	1
10	20.0-22.0	SS	10YR 7/3	2
11	22.0-24.0	MR-I	10YR 8/2	10
12	24.0-26.0	MR-I	10YR 7/2	10
13	26.0-28.0	MR-I	2.5Y 7/2	1
14	28.0-30.0	MS-I	2.5Y 6/2	4
15	30.0-32.0	MS-I	5Y 6/1	4
16	32.0-34.0	SS-I	5Y 6/1	1
17	34.0-36.0	SS-I	2.5Y 7/4	1
18	36.0-38.0	SS	5Y 6/1	1
19	38.0-40.0	SS-I	5Y 5/1	1
20	40.0-42.0	SS-I	5Y 6/1	1
21	42.0-44.0	SS-I	5Y 6/1	0
22	44.0-46.0	SS	5Y 7/1	1
23	46.0-48.0	SS	10YR 7/1	1
24	48.0-50.0	SS	5Y 7/1	0
25	50.0-50.5	SS	2.5Y 6/4	2
26	50.5-52.5	SS	10YR 7/1	1
27	52.5-54.5	SS	5Y 7/1	0
28	54.5-56.5	SS	5Y 7/1	1
29	56.5-58.5	SS	5Y 7/1	0
30	58.5-60.0	MR	2.5Y 5/2	1
31	60.0-61.0	MR	10YR 5/1	1
32	61.0-62.5	MR	10YR 5/1	1
33	62.5-64.6	UNDERWOOD COAL		
34	64.6-	MR	10YR 4/1	2

Table 56. CHEMICAL CHARACTERIZATIONS OF THE UNDERWOOD COAL OVERBURDEN AT ARCH COAL COMPANY'S FABIUS MINE, NEIGHBORHOOD FOUR.

			Per Thousand Tons of Material					
			Lime	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	Requirement (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A	4.3	4.2	4.5	100	480	48	22	9.1
B_{21}	4.5	4.4	2.0	73	160	24	32	6.8
B_{22}	4.4	4.2	3.5	95	240	72	45	4.5
C	4.4	4.3	5.5	64	80	96	58	4.5
1	4.7	4.7	1.5	75	80	24	19	2.2
2	4.1	4.1	7.0	69	40	36	35	2.2
3	4.3	4.1	6.0	103	80	48	20	2.2
4	4.6	4.4	2.0	111	160	60	17	4.5
5	7.2	6.7	0	89	280	36	56	4.5
6	6.7	6.0	1.0	64	120	12	38	4.5
7	6.5	5.8	1.0	81	240	24	40	2.2
8	5.0	4.8	2.0	92	80	12	19	2.2
9	7.7	7.3	0	73	960	24	40	4.5
10	5.8	4.7	1.5	29	440	24	17	4.5
11	4.4	4.2	4.5	89	40	18	15	4.5
12	4.6	4.5	3.0	111	80	48	15	4.5
13	4.8	4.5	2.0	106	80	60	12	4.5
14	5.0	4.6	2.0	147	80	348	22	2.2
15	5.0	4.6	2.0	131	80	300	19	2.2
16	6.1	5.6	0.5	160	480	276	132	2.2
17	5.4	5.1	1.0	122	400	228	88	2.2
18	7.7	7.4	0	145	720	204	115	2.2
19	5.9	5.6	1.5	252	800	384	216	4.5
20	6.4	6.1	1.0	171	600	264	153	2.2
21	6.6	6.3	0.5	156	560	252	153	2.2
22	5.4	5.1	1.0	73	240	84	48G	2.2
23	5.2	5.1	1.0	67	160	36	43G	2.2
24	5.9	5.4	1.0	73	160	48	40G	2.2
25	6.6	6.1	1.0	46	160	24	37	2.2
26	5.7	5.7	1.0	69	320	36	43G	2.2
27	5.2	5.2	1.0	64	320	48	77	2.2
28	5.3	5.2	1.0	87	240	36	56G	2.2
29	5.9	5.8	1.0	103	640	48	56G	2.2
30	6.5	6.9	0	284	1240	384	159	6.8
31	6.4	6.7	0	280	1760	348	174	9.1
32	4.8	4.9	1.5	289	720	264	132	6.8
33	UNDERWOOD COAL							
34	3.7	3.5	2.5	266	360	192	34	6.8

Table 57. ACID-BASE ACCOUNT OF THE UNDERWOOD COAL OVERBURDEN AT ARCH COAL COMPANY'S FABIUS MINE, NEIGHBORHOOD FOUR.

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
A	5/2	0	.005	.16	0	.16	
B_{21}	7/4	0	.005	.16	- .25	.41	
B_{22}	6/6	0	.005	.16	- 1.77	1.93	
C	6/6	0	.020	.62	- 1.26	1.88	
1	8/2	0	.005	.16	- .50	.66	
2	7/4	0	.010	.31	- 3.77	4.08	
3	8/2	0	.005	.16	- 3.00	3.16	
4	8/4	0	.010	.31	- .50	.81	
5	7/1	0	.025	.78	.76	.02	
6	8/0	0	.005	.16	0	.16	
7	7/1	0	.005	.16	0	.16	
8	7/3	0	.005	.16	- .50	.66	
9	7/1	0	.005	.16	.76		.60
10	7/3	0	.010	.31	.25	.06	
11	8/2	0	.005	.16	0	.16	
12	7/2	0	.005	.16	- 1.26	1.42	
13	7/2	0	.005	.16	- .25	.41	
14	6/2	0	.005	.16	- .50	.66	
15	6/1	0	.010	.31	- .78	1.09	
16	6/1	0	.035	1.09	7.30		6.21
17	7/4	0	.050	1.56	3.51		1.95
18	6/1	0	.030	.94	9.54		8.60
19	5/1	0	.035	1.09	4.27		3.18
20	6/1	0	.040	1.25	11.06		9.81
21	6/1	0	.045	1.41	14.57		13.16
22	7/1	0	.045	1.41	1.26	.15	
23	7/1	0	.040	1.25	1.01	.24	
24	7/1	0	.015	.47	1.52		1.05
25	6/4	0	.015	.47	4.77		4.30
26	7/1	0	.060	1.87	2.78		.91
27	7/1	0	.025	.78	1.26		.48
28	7/1	0	.070	2.19	1.01	1.18	
29	7/1	0	.020	.62	1.26		.64
30	5/2	0	.130	4.06	9.04		4.98
31	5/1	0	.030	.94	4.27		3.33
32	5/1	0	.035	1.09	3.26		2.17
33	UNDERWOOD COAL						
34	4/1	0	.125	5.91	1.26	2.65	

Table 58. PHYSICAL CHARACTERIZATIONS OF THE UNDERWOOD COAL OVERBURDEN AT ARCH COAL COMPANY'S FABIUS MINE, NEIGHBORHOOD FOUR, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	-50.0	NOT SAMPLED		
1	50.0-51.0	SS	5Y 7/1	3
2	51.0-52.0	SS	5Y 7/1	3
3	52.0-53.0	SS	5Y 7/2	9
4	53.0-54.0	SS	10YR 6/1	2
5	54.0-55.0	SS	5Y 7/1	4
6	55.0-56.0	SS	10YR 6/2	5
7	56.0-57.0	SS	5Y 7/2	2
8	57.0-58.0	MR	10YR 5/1	2
9	58.0-59.0	MR	10YR 5/1	2
10	59.0-60.0	MR	2.5YR 5/2	2
11	60.0-61.0	MR	5Y 4/1	2
12	61.0-62.0	UNDERWOOD COAL		

Table 59. CHEMICAL CHARACTERIZATIONS OF THE UNDERWOOD COAL OVERBURDEN AT ARCH COAL COMPANY'S FABIUS MINE, NEIGHBORHOOD FOUR, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	4.7	4.4	1.0	84	160	66	52	4.5
2	4.8	4.7	1.0	84	160	66	54	4.5
3	4.7	4.6	1.0	128	240	108	75	4.5
4	4.8	4.7	1.0	128	240	102	67	4.5
5	4.8	4.6	1.0	111	200	90	54	4.5
6	5.1	4.8	1.0	134	240	96	67	4.5
7	4.8	4.7	1.0	120	200	96	50	4.5
8	5.3	5.1	1.0	256	960	270	238	13.6
9	5.2	5.0	1.5	252	1040	312	216	11.4
10	5.6	5.3	1.5	289	1040	336	174	13.6
11	4.6	4.5	1.5	280	880	300	159	11.4
12	UNDERWOOD COAL							

Table 60. ACID-BASE ACCOUNT OF THE UNDERWOOD COAL OVERBURDEN AT ARCH COAL COMPANY'S FABIUS MINE, NEIGHBORHOOD FOUR, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	7/1	0	.035	1.09	.76	.33	
2	7/1	0	.020	.62	1.01		.39
3	7/2	0	.025	.78	.76	.02	
4	6/1	0	.040	1.25	1.01	.24	
5	7/1	0	.025	.78	.76	.02	
6	6/2	0	.030	.94	.76	.18	
7	7/2	0	.020	.62	.76		.14
8	5/1	0	.110	3.44	6.79		3.35
9	5/1	0	.100	3.12	6.29		3.17
10	5/2	0	.075	2.34	8.28		5.94
11	4/1	0	.125	3.91	5.02		1.11
12	UNDERWOOD COAL						

Table 61. PHYSICAL CHARACTERIZATIONS OF THE POPLAR CREEK (GLEN MARY) COAL OVERBURDEN AT HELENWOOD EXCAVATING'S MINE, NEIGHBORHOOD FIVE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A_1	0.0-0.6	Soil	2.5Y 6/4	1
B_{2t}	0.6-1.8	Soil	2.5Y 6/4	6
B_{3t}	1.8-2.7	Soil	2.5Y 7/4	8
C_1	2.7-4.2	Soil	2.5Y 7/4	7
C_2	4.2-6.2	MS	2.5Y 7/4	6
C_3	6.2-8.2	MR	10YR 7/4	2
1	8.2-10.2	SS	10YR 6/4	2
2	10.2-12.2	SH	10YR 6/3	2
3	12.2-14.2	SH	2.5Y 6/4	0
4	14.2-16.2	SH	10YR 6/4	1
5	16.2-18.0	MS	2.5Y 5/2	9
6	18.0-20.7	MS	5Y 5/1	9
7	20.7-21.6	MS	5Y 6/1	8
8	21.6-23.3	MS	5Y 8/1	9
9	23.3-25.1	MS	5Y 7/1	6
10	25.1-27.6	SH	5Y 7/1	3
11	27.6-28.5	SH	5Y 7/1	2
12	28.5-32.8	MR	5Y 6/1	2
13	32.8-33.7	MR	5Y 6/1	1
14	33.7-34.6	MR	5Y 5/1	3
15	34.6-36.3	MR	10YR 5/1	1
16	36.3-41.6	MR	5Y 5/1	1
17	41.6-45.1	MR	10YR 5/1	1
18	45.1-49.5	MR	10YR 5/1	1
19	49.5-50.4	MS	10YR 5/1	2
20	50.4-52.2	MS	10YR 5/1	2
21	52.2-54.9	MS	10YR 5/1	4
22	54.9-57.6	MR	10YR 5/1	2
23	57.6-60.3	SH	10YR 5/1	3
24	60.3-61.2	MS	10YR 4/1	6
POPLAR CREEK COAL				

Table 62. CHEMICAL CHARACTERIZATIONS OF THE POPLAR CREEK (GLEN MARY) COAL OVERBURDEN AT HELENWOOD EXCAVATING'S MINE, NEIGHBORHOOD FIVE

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	ment (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A_1	4.9	4.9	2.0	109	280	66	38	2.2
B_{2t}	4.7	4.8	2.0	117	80	72	32	2.2
B_{3t}	4.7	4.7	2.5	103	80	60	32	1.1
C_1	4.7	4.6	5.0	95	80	84	38	1.1
C_2	4.7	4.6	4.5	100	40	72	45	0.5
C_3	4.8	4.6	5.5	98	40	96	47	2.2
1	4.9	4.9	1.5	62	40	24	31	4.5
2	4.7	4.5	5.0	171	80	180	69	20.5
3	4.7	4.6	4.0	179	80	300	67	18.2
4	4.4	4.7	3.5	187	160	306	58	13.6
5	6.0	6.4	0.5	226	2240	792	238	33.0
6	4.8	5.1	0.5	252	1760	564	360	9.6
7	2.9	3.3	3.0	139	880	504	97	7.2
8	3.8	4.1	1.0	238	640	444	47	7.2
9	3.9	4.1	1.5	252	560	384	45	4.8
10	5.4	5.2	0.5	252	400	276	47	2.4
11	6.3	5.7	0.5	284	720	348	107	4.8
12	6.6	6.0	0.5	270	1120	336	346	2.4
13	6.7	6.2	0.5	317	1280	336	300	2.4
14	7.3	6.7	0	327	1600	456	320	2.4
15	7.6	7.1	0	327	2160	552	360	2.4
16	5.3	4.9	0.5	317	1600	552	294	2.4
17	7.0	6.5	0	317	1440	432	256	2.4
18	7.9	7.3	0	338	1680	552	238	2.4
19	6.7	6.6	0	293	1280	420	246	2.4
20	7.2	6.8	0	343	1360	456	246	1.2
21	7.2	6.7	0	327	1360	504	238	0.5
22	6.8	6.4	0.5	317	1120	456	167	0.5
23	6.6	6.1	0.5	302	1040	456	142	9.6
24	3.2	3.5	1.0	238	960	492	77	2.4
POPLAR CREEK COAL								

Table 63. ACID-BASE ACCOUNT OF THE POPLAR CREEK (GLEN MARY) COAL OVERBURDEN AT HELENWOOD EXCAVATING'S MINE, NEIGHBORHOOD FIVE.

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
A_1	6/4	0	.015	.47	- .25	.72	
B_{2t}	7/4	0	.015	.47	- 1.95	2.42	
B_{3t}	7/4	0	.015	.47	- .74	1.21	
C_1	7/4	0	.015	.47	- 1.71	2.18	
C_2	7/4	0	.010	.31	- 1.95	2.26	
C_3	7/4	0	.010	.31	- 2.70	3.01	
1	6/4	0	.005	.16	0	.16	
2	6/3	0	.010	.31	- .74	1.05	
3	6/4	0	.010	.31	- .50	.81	
4	6/4	0	.010	.31	- .74	1.05	
5	5/2	0	.025	.78	3.43		2.65
6	5/1	0	.065	2.03	4.41		2.38
7	6/1	0	1.100	34.37	0.49	33.88	
8	8/1	0	.180	5.62	6.12		.50
9	7/1	0	.200	6.25	0.98	5.27	
10	7/1	0	.015	.47	1.22		.75
11	7/1	0	.035	1.09	11.02		9.93
12	6/1	0	.040	1.25	7.10		5.85
13	6/1	0	.070	2.19	10.04		7.85
14	5/1	0	.030	.94	16.66		15.73
15	5/1	0	.060	1.87	16.42		14.55
16	5/1	0	.820	25.62	7.10	18.52	
17	5/1	0	.220	6.87	16.52		4.68
18	5/1	0	.040	1.25	12.25		11.00
19	5/1	0	.080	2.50	15.19		12.69
20	5/1	0	.040	1.25	24.01		22.76
21	5/1	0	.030	.94	20.32		19.38
22	5/1	0	.040	1.25	20.34		19.09
23	5/1	0	.040	1.25	15.20		13.95
24	4/1	0	.850	26.56	1.95	24.61	
POPLAR CREEK COAL							

Table 64. PHYSICAL CHARACTERISTICS OF POPLAR CREEK (GLEN MARY) COAL OVERBURDEN AT HELENWOOD EXCAVATING'S MINE, NEIGHBORHOOD FIVE, COLUMN TWO.

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-52.9	NOT SAMPLED		
1	52.9-54.7	MR	10YR 5/1	1
2	54.7-56.5	MR	10YR 5/1	3
3	56.5-57.4	MR	10YR 5/1	3
4	57.4-59.2	SH	10YR 5/1	3
POPLAR CREEK COAL				

Table 65. CHEMICAL CHARACTERISTICS OF THE POPLAR CREEK (GLEN MARY) COAL OVERBURDEN AT HELENWOOD EXCAVATING'S MINE, NEIGHBORHOOD FIVE, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	7.1	6.5	0	317	1200	456	246	1.2
2	7.2	6.8	0	327	1200	516	200	1.2
3	7.1	9.0	0	317	1120	492	183	0.5
4	6.7	6.3	0.5	312	1120	504	147	2.4
POPLAR CREEK COAL								

Table 66. ACID-BASE ACCOUNT OF THE POPLAR CREEK (GLEN MARY) COAL OVERBURDEN AT HELENWOOD EXCAVATING'S MINE, NEIGHBORHOOD FIVE, COLUMN TWO.

				Tons $CaCO_3$ Equivalent/Thousand Tons Material			
Sample No.	Value and Chroma	Fiz	%S	Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	5/1	0	.050	1.56	16.41		14.85
2	5/1	0	.030	.94	22.54		21.60
3	5/1	0	.030	.94	19.35		18.41
4	5/1	0	.100	3.12	12.50		9.38
POPLAR CREEK COAL							

Table 67. PHYSICAL CHARACTERIZATION OF THE BIG MARY (DEAN) COAL OVERBURDEN AT SPRADLIN'S MINE-15, NEIGHBORHOOD FIVE.

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A_1	0.0-0.8	Soil	10YR 6/4	3
B_1	0.8-1.6	Soil	10YR 7/6	3
B_{2t}	1.6-2.4	Soil	10YR 7/6	4
B_3	2.4-3.2	Soil	10YR 8/6	3
C	3.2-4.0	Soil	10YR 8/4	4
1	4.0-5.0	MS	10YR 7/3	1
2	5.0-8.0	MS	10YR 7/4	2
3	8.0-11.0	MS	10YR 7/4	3
4	11.0-14.0	MS	7.5YR 5/6	2
5	14.0-17.0	SS	10YR 6/4	3
6	17.0-20.0	SS	2.5Y 7/4	7
7	20.0-23.0	SS	2.5Y 7/4	8
8	23.0-26.0	SS	7.5YR 6/5	10
9	26.0-27.5	SS	10YR 6/6	9
10	27.5-29.0	SS	10YR 7/4	2
11	29.0-30.5	SS	10YR 6/4	2
12	30.5-32.0	SS	2.5Y 6/4	2
13	32.0-33.5	MR	5Y 6/1	1
14	33.5-35.0	MR	5Y 6/1	1
15	35.0-36.5	MR	5Y 6/1	1
16	36.5-38.0	MR	5Y 6/1	1
17	38.0-41.0	MR	5Y 6/1	1
18	41.0-44.0	MR	5Y 6/1	1
19	44.0-47.0	MR	5Y 6/1	1
20	47.0-50.0	MR	5Y 6/1	1
21	50.0-53.0	MR	5Y 6/1	1
22	53.0-56.0	MR	5Y 6/1	1
23	56.0-57.5	MR	5Y 6/1	1
24	57.5-59.0	MR	5Y 5/1	1
25	59.0-60.5	MR	5Y 5/1	1
26	60.5-62.0	MR	5Y 3/1	1
27	62.0-63.5	MR	5Y 5/1	2
28	63.5-64.0	MR	5Y 4/1	1
BIG MARY COAL				

Table 68. CHEMICAL CHARACTERIZATIONS OF THE BIG MARY (DEAN) COAL OVERBURDEN AT SPRADLIN'S MINE-15, NEIGHBORHOOD FIVE.

			Per Thousand Tons of Material					
			Lime Require-ment	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A_1	4.6	4.6	4.5	179	400	144	27	4.5
B_1	4.7	4.7	4.0	202	320	120	31	2.2
B_{2t}	4.6	4.8	4.0	175	280	144	27	2.2
B_3	5.1	4.7	5.0	150	160	144	32	2.2
C	4.4	4.6	5.5	150	160	216	25	0.5
1	4.6	4.8	5.0	153	160	300	32	0.5
2	4.8	4.9	2.5	153	280	288	65	4.5
3	4.7	4.9	4.5	128	244	324	48	2.2
4	4.9	5.1	2.0	167	360	528	56	25.0
5	5.0	4.8	2.2	139	320	114	54	9.5
6	4.8	4.5	1.0	160	160	216	52	21.2
7	5.0	4.7	1.0	187	720	408	153	56.0
8	6.1	5.6	0.5	64	400	144	62	25.8
9	6.4	6.0	0.5	58	320	72	48	11.8
10	6.9	6.2	0.5	49	160	30	60	7.2
11	6.3	6.1	0.5	53	480	48	82	9.5
12	6.8	6.4	0.5	60	1,840	96	300	4.8
13	7.8	7.4	0	183	8,960	372	47	4.8
14	7.9	7.7	0	206	10,080	348	26	2.4
15	8.0	7.8	0	214	10,240	336	24	4.8
16	7.9	7.8	0	222	10,880	324	26	4.8
17	8.1	7.7	0	206	10,720	300	24	2.4
18	8.0	7.8	0	222	10,560	300	29	2.4
19	8.0	7.7	0	238	9,920	384	62	2.4
20	8.0	7.6	0	317	4,160	588	294G	2.4
21	7.9	7.6	0	343	5,200	636	308G	2.4
22	7.1	7.7	0	348	4,160	612	308G	2.4
23	8.0	7.7	0	359	4,480	660	294G	2.4
24	7.9	7.7	0	364	4,640	696	256G	4.8
25	7.8	7.6	0	374	4,080	720	294G	4.8
26	7.2	7.4	0	385	5,760	696	385G	4.8
27	7.4	7.4	0	343	5,360	708	360G	2.4
28	7.5	7.4	0	405	4,720	768	385G	2.4
BIG MARY COAL								

Table 69. ACID-BASE ACCOUNT OF THE BIG MARY (DEAN) COAL OVERBURDEN AT SPRADLIN'S MINE-15, NEIGHBORHOOD FIVE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
A_1	6/4	0	.030	0.94	-1.47	2.41	
B_1	7/6	0	.015	0.47	-2.70	3.17	
B_{2t}	7/6	0	.010	0.31	-1.96	2.27	
B_3	8/6	0	.055	1.72	-1.96	3.68	
C	8/4	0	.010	0.31	-2.70	3.01	
1	7/3	0	.035	1.09	-1.96	3.05	
2	7/4	0	.035	1.09	-1.47	2.56	
3	7/4	0	.010	0.31	-0.98	1.92	
4	5/6	0	.005	0.16	-0.49		.33
5	6/4	0	.010	0.31	0.49		.18
6	7/4	0	.005	0.16	0	.16	
7	7/4	0	.005	0.16	1.23		1.07
8	5/6	0	.005	0.16	.24		.08
9	6/6	0	.010	0.31	0	.31	
10	7/4	0	.005	0.16	.24		.08
11	6/4	0	.010	0.31	.49		.18
12	6/4	0	.025	0.78	1.96		1.18
13	6/1	1	.050	1.56	32.59		31.03
14	6/1	3	.065	2.03	109.65		107.62
15	6/1	3	.070	2.19	110.94		108.75
16	6/1	3	.060	1.88	96.75		94.88
17	6/1	4	.085	3.66	103.20		100.54
18	6/1	3	.035	1.09	160.61		159.52
19	6/1	1	.050	1.56	33.32		31.76
20	6/1	1	.070	2.19	20.09		17.90
21	6/1	1	.070	2.19	21.07		18.88
22	6/1	1	.060	1.88	21.32		19.45
23	6/1	1	.080	2.50	21.32		18.82
24	5/1	1	.100	3.12	20.09		16.97
25	5/1	0	.175	5.47	16.91		11.44
26	3/1	0	.475	14.84	20.83		5.99
27	5/1	0	.350	10.94	19.11		8.17
28	4/1	0	.450	14.06	18.87		4.81
BIG MARY COAL							

Table 70. PHYSICAL CHARACTERISTICS OF THE BIG MARY (DEAN) COAL OVERBURDEN AT SPRADLIN'S MINE-15, NEIGHBORHOOD FIVE, COLUMN TWO.

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0–38.0		NOT SAMPLED	
1	38.0–41.0	MR	5Y 6/1	1
2	41.0–44.0	MR	5Y 6/1	1
3	44.0–47.0	MR	5Y 6/1	1
4	47.0–50.0	MR	5Y 6/1	1
5	50.0–53.0	MR	5Y 6/1	1
6	53.0–56.0	MR	5Y 6/1	1
7	56.0–59.0	MR	5Y 6/1	1
8	59.0–60.5	MR	5Y 4/1	1
9	60.5–62.0	MR	5Y 4/1	2
10	62.0–65.0	MR	5Y 4/1	1
11	65.0–68.0	MR	5Y 4/1	2
12	68.0–	Carb	5Y 2/1	0
BIG MARY COAL				

Table 71. CHEMICAL CHARACTERISTICS OF THE BIG MARY (DEAN) COAL OVERBURDEN AT SPRADLIN'S MINE-15, NEIGHBORHOOD FIVE, COLUMN TWO.

			Per Thousand Tons of Material					
			Lime Require-	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	ment (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	7.4	7.3	0	206	3680	204	320	28.2
2	7.9	7.8	0	202	9600	264	29	21.2
3	7.8	7.8	0	222	10,080	288	35	9.5
4	7.9	7.8	0	298	4320	600	294G	1.2
5	7.9	7.8	0	298	4400	552	256G	1.2
6	7.9	7.7	0	298	3360	540	216G	16.5
7	7.8	7.5	0	302	3520	648	246G	77.6
8	7.3	7.4	0	289	6000	636	385G	4.8
9	7.0	7.0	0	307	4960	720	385G	4.8
10	6.9	6.9	0	317	4560	684	372G	4.8
11	4.6	5.1	0.5	332	6800	648	385	4.8
12	3.7	4.0	2.0	156	2320	324	174G	9.5
BIG MARY COAL								

Table 72. ACID-BASE ACCOUNT OF THE BIG MARY (DEAN) COAL OVERBURDEN AT SPRADLIN'S MINE-15, NEIGHBORHOOD FIVE, COLUMN TWO.

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	6/1	0	.020	0.62	16.42		15.80
2	6/1	3	.050	1.56	117.65		116.09
3	6/1	2	.080	2.50	60.02		57.52
4	6/1	1	.070	2.19	28.30		26.11
5	6/1	1	.080	2.50	22.78		20.28
6	6/1	0	.080	2.50	18.86		16.36
7	6/1	1	.090	2.81	23.03		20.22
8	4/1	0	.425	13.28	21.80		8.52
9	4/1	0	.875	27.34	16.17	11.17	
10	4/1	0	1.500	46.88	14.21	32.66	
11	4/1	0	3.025	94.53	10.54	83.99	
12	2/1	0	5.125	160.16	2.20	157.96	
BIG MARY COAL							

Table 73. PHYSICAL CHARACTERIZATIONS OF THE GRASSY SPRING AND ROCK SPRING COAL OVERBURDEN AT THE McCALL ENTERPRISES' MINE, NEIGHBORHOOD FIVE.

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A_1	- 0.8	Soil	2.5Y 7/4	3
B_2	0.8- 2.0	Soil	2.5Y 7/4	6
B_{31}	0.2- 3.1	Soil	10YR 6/3	9
B_{32}	3.1- 3.9	Soil	10YR 6/2	6
C_1	3.9- 5.5	Soil	10YR 7/1	7
C_2	5.5- 6.5	Soil	10YR 7/4	4
1	6.5-12.0	MR	10YR 6/4	1
2	12.0-14.0	SS	10YR 5/6	1
3	14.0-16.0	MS	10YR 7/3	1
4	16.0-18.0	SS	5Y 7/1	
5	18.0-20.0	SS	5Y 7/1	
6	20.0-20.5	MR	5Y 6/1	1
7	20.5-21.4	GRASSY SPRING COAL		
8	21.4-23.9	Carb	10YR 4/1	2
9	23.9-25.9	GRASSY SPRING COAL		
10	25.9-26.8	MS	2.5Y 7/4	7
11	26.8-27.7	MS	2.5Y 7/4	7
12	27.7-28.6	MS	2.5Y 6/4	3
13	28.6-29.4	MS	2.5Y 6/4	4
14	29.4-30.3	MS	2.5Y 6/2	3
15	30.3-34.7	MR	5Y 6/1	1
16	34.7-36.4	MR	5Y 6/1	2
17	36.4-40.8	MR	5Y 6/1	2
18	40.8-44.3	MR	5Y 6/1	1
19	44.3-49.6	MR	5Y 6/1	3
20	49.6-50.4	MS	2.5Y 6/2	5
21	50.4-52.2	MS	2.5Y 5/4	5
22	52.2-53.1	MS	10YR 5/4	8
23	53.1-53.9	MS	10YR 6/6	8
24	53.9-54.8	MS	10YR 6/6	9
25	54.8-55.7	MS	10YR 6/4	7
	55.7-56.5	NOT SAMPLED		
26	56.5-59.2	MS	10YR 6/4	7
27	59.2-61.8	MS	10YR 5/6	5
28	61.8-63.5	MS	10YR 6/6	
29	63.5-67.0	MS	10YR 6/4	8
	67.0-85.4	NOT SAMPLED		

Table 73. (Continued)

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
30	85.4-88.1	MR	5Y 5/1	1
31	88.1-91.8	MR	10YR 5/2	1
32	91.8-94.5	MR	5Y 6/1	2
33	94.5-97.3	MR	5Y 6/1	2
34	97.3-98.2	MR	2.5Y 6/2	4
35	98.2-100.0	MR	5Y 6/1	1
36	100.0-100.9	MR	5Y 6/1	2
37	100.9-101.9	MR	5Y 6/1	1
38	101.9-102.8	MR	5Y 5/1	4
39	102.8-103.9	MR	5Y 5/1	3
40	103.9-104.6	MS	5Y 5/1	5
41	104.6-105.5	MS	5Y 4/1	6
42	105.5-106.0	MR	5Y 5/1	6
43	106.0-106.8	Carb	5Y 4/1	6
44	106.8-108.4	ROCK SPRING COAL		
45	108.4-109.2	SH	10YR 4/1	4
46	109.2-110.0	SH	10YR 5/1	1
47	110.0-110.8	Carb	5Y 2/1	1
48	110.8-113.0	ROCK SPRING COAL		

Table 74. CHEMICAL CHARACTERIZATIONS OF THE GRASSY SPRING AND ROCK SPRING COAL OVERBURDEN AT THE McCALL ENTERPRISES' MINE, NEIGHBORHOOD FIVE.

			Per Thousand Tons of Material					
			Lime Require- ment	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A_1	4.5	4.8	1.5	179	160	24	100	2.2
B_2	4.3	4.8	2.0	73	40	12	29	1.1
B_{31}	4.1	4.5	3.0	60	40	6	19	0.5
B_{32}	3.8	4.3	6.5	100	40	12	22	0.5
C_1	4.0	4.4	4.0	111	40	6	12	0.5
C_2	4.1	4.6	2.0	111	40	6	15	1.1
1	4.7	5.1	2.0	210	40	30	50	2.2
2	4.6	4.9	0.5	156	40	24	38	7.8
3	4.2	4.7	2.0	111	40	18	15	4.5
4	4.3	4.8	0.5	106	40	18	16	3.4
5	5.0	5.4	0.5	153	40	36	27	3.4
6	4.8	5.2	0.5	266	320	516	54	8.9
7	GRASSY	SPRING	COAL					
8	2.6	2.8	6.5	167	400	552	21	10.0
9	GRASSY	SPRING	COAL					
10	4.0	4.4	3.0	111	40	30	25	2.4
11	4.2	4.5	4.0	128	40	36	32	4.8
12	4.4	4.8	2.0	145	40	24	35	2.4
13	4.1	4.4	4.0	160	40	48	37	7.2
14	4.1	4.4	3.5	171	80	72	35	4.8
15	6.3	6.5	0	243	1200	468	294	4.8
16	6.5	6.6	0	230	1120	372	300	4.8
17	6.3	7.1	0	252	1120	336	308	2.4
18	6.7	7.1	0	261	1200	408	294	4.8
19	6.3	6.9	0	353	1200	444	308	2.4
20	4.9	5.3	1.0	327	480	300	137	4.8
21	5.1	5.2	1.5	289	400	324	85	4.8
22	4.4	4.8	1.5	234	200	168	48	9.6
23	4.1	4.5	2.5	160	160	144	40	12.0
24	4.2	4.5	3.0	226	240	168	75	14.2
25	4.2	4.5	2.0	275	240	222	65	7.2
26	4.6	4.9	3.0	202	240	96	56	4.8
27	4.5	4.7	3.5	256	80	84	58	4.8

Table 74. (continued)

Sample No.	pH (paste)	pH (1:1)	Per Thousand Tons of Material: Lime Requirement (tons)	Acid Extracted: K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	Bicarbonate Extracted P (lbs.)
28	4.8	5.0	3.5	289	40	72	75	4.8
29	4.7	5.1	2.0	293	160	204	72	7.2
30	7.1	8.0	0	243	2400	588	174G	2.2
31	6.0	6.4	0.5	187	960	528	100	6.8
32	7.1	7.6	0	289	2000	564	300G	2.2
33	7.7	7.8	0	369	3120	792	294G	2.2
34	6.5	6.9	0	247	6000	744	183	6.8
35	7.5	7.6	0	302	2320	564	294G	2.2
36	7.3	7.3	0	359	3520	576	385G	2.2
37	7.3	7.6	0	359	6400	816	360G	2.2
38	7.0	7.1	0	359	4080	588	385G	6.8
39	6.7	7.0	0	353	7520	696	372G	6.8
40	4.4	4.4	2.0	369	5600	696	372	13.6
41	6.1	6.5	0	238	1030	876	72	13.6
42	4.4	4.5	2.0	183	8000	720	385	15.9
43	4.0	3.4	4.5	106	4800	564	308G	18.2
44	ROCK SPRING COAL							
45	3.0	3.0	4.0	322	2080	660	25	9.1
46	3.0	3.0	4.0	327	2240	672	26	6.8
47	3.6	3.3	2.0	222	1600	456	21	6.8
48	ROCK SPRING COAL							

Table 75. ACID-BASE ACCOUNT OF THE GRASSY SPRING AND ROCK SPRING COAL OVERBURDEN AT THE McCALL ENTERPRISES' MINE, NEIGHBORHOOD FIVE.

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
A_1	7/4	0	.015	.47	- .74	1.21	
B_2	7/4	0	.020	.62	- 1.46	2.08	
B_{31}	6/3	0	.025	.78	- .74	1.52	
B_{32}	6/2	0	.045	1.40	- 4.40	5.80	
C_1	7/1	0	.010	.31	- 2.45	2.76	
C_2	7/4	0	.015	.47	- .74	1.21	
1	6/4	0	.020	.62	0	.62	
2	5/6	0	.015	.47	.25	.22	
3	7/3	0	.010	.31	- .50	.81	
4	7/1	0	.010	.31	- .25	.56	
5	7/1	0	.020	.62	- .74	1.36	
6	6/1	0	.040	1.25	.22	1.03	
7	GRASSY SPRING COAL						
8	4/1	0	.475	14.84	- 5.64	20.48	
9	GRASSY SPRING COAL						
10	7/4	0	.015	.47	- 0.97	1.44	
11	7/4	0	.020	.62	- 0.74	1.36	
12	6/4	0	.015	.47	- 0.50	.97	
13	6/4	0	.020	.62	- 0.97	1.59	
14	6/2	0	.025	.78	- 0.50	1.28	
15	6/1	0	.110	3.44	17.15		13.71
16	6/1	0	.080	2.50	17.15		14.65
17	6/1	0	.070	2.19	17.15		14.96
18	6/1	0	.080	2.50	14.95		12.45
19	6/1	0	.100	3.12	5.89		2.77
20	6/2	0	.050	1.56	0.99	.57	
21	5/4	0	.030	.94	1.24		.30
22	5/4	0	.035	1.09	0.25	.84	
23	6/6	0	.040	1.25	- 0.25	1.50	
24	6/6	0	.040	1.25	- 1.46	2.71	
25	6/4	0	.025	.78	0.25	.53	
26	6/4	0	.020	.62	- 0.50	1.12	
27	5/6	0	.030	.94	- 0.50	1.44	
28	6/6	0	.010	.31	- 0.25	.56	
29	6/4	0	.020	.62	0.25	.37	

Table 75. continued

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
30	5/1	0	.100	3.12	9.80		6.68
31	5/3	0	.030	.94	1.24		.30
32	6/1	0	.065	2.03	9.06		7.03
33	6/1	0	.055	1.72	10.54		8.82
34	6/2	0	.045	1.41	4.90		3.49
35	6/1	1	.065	2.03	24.01		21.98
36	6/1	0	.125	3.91	17.89		13.98
37	6/1	0	.160	5.0	12.23		7.23
38	5/1	0	.230	7.19	14.21		7.02
39	5/1	0	.250	7.81	18.39		10.58
40	5/1	0	1.450	45.31	13.74	31.57	
41	4/1	1	2.075	64.84	25.74	39.10	
42	5/1	0	2.600	81.25	10.05	71.20	
43	4/1	0	4.875	152.34	1.96	150.38	
44	ROCK SPRING COAL						
45	4/1	0	.600	18.75	.99	17.76	
46	5/1	0	.575	17.97	- .25	18.22	
47	2/1	0	2.500	78.12	- .74	78.86	
48	ROCK SPRING COAL						

Table 76. PHYSICAL CHARACTERISTICS OF THE COAL CREEK COAL OVERBURDEN AT AT THE OLLIS CREEK MINE, FLATWOODS SECTION, NEIGHBORHOOD FIVE.

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	- 8.0	NOT SAMPLED		
1	8.0-12.0	MS	2.5Y 6/6	3
2	12.0-16.0	MS	7.5YR 6/6	5
3	16.0-20.0	MR	5Y 7/3	2
4	20.0-22.0	SH	5Y 6/1	6
5	22.0-24.0	SH	7.5YR 4/2	5
5A	23.0-24.0	SH	5Y 5/1	1
6	24.0-26.0	SH	5Y 5/2	1
7	26.0-28.0	SH	5Y 6/1	
8	28.0-30.0	MR	10YR 5/1	1
9	30.0-32.0	MS	5Y 6/1	1
9A	31.8-32.0	SS	5Y 6/1	
10	32.0-34.0	SH	5Y 5/1	
11	34.0-36.0	SH	5Y 6/1	1
12	36.0-38.0	MR	5Y 6/1	1
13	38.0-40.0	MR	5Y 6/1	
14	40.0-42.0	MR	5Y 6/1	
15	42.0-44.0	SH	5Y 6/1	1
16	44.0-46.0	SH	5Y 6/1	1
17	46.0-48.0	SH	5Y 6/1	1
18	48.0-50.0	SH	2.5Y 5/2	1
19	50.0-52.0	SH	2.5Y 5/2	1
20	52.0-54.0	SH	5Y 6/1	1
21	54.0-56.0	SH	2.5Y 6/2	2
22	56.0-58.0	SH	2.5Y 5/2	1
	58.0-66.0	NOT SAMPLED		
	66.0-	COAL CREEK COAL		

Table 77. CHEMICAL CHARACTERISTICS OF THE COAL CREEK OVERBURDEN AT THE OLLIS CREEK MINE, FLATWOODS SECTION, NEIGHBORHOOD FIVE.

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	4.6	4.6	2.0	150	80	156	80	9.2
2	4.4	4.5	3.0	120	80	48	31	2.4
3	4.4	4.5	2.5	150	160	390	31	11.8
4	3.8	3.8	1.5	226	480	696	75	7.2
5	4.8	4.7	3.0	206	4320	1344	137	2.4
5A	7.1	7.1	0	266	2240	852	372	2.4
6	7.8	7.5	0	243	2240	936	308	4.8
7	7.3	7.1	0	261	1840	828	342	2.4
8	7.4	7.2	0	261	2800	948	372	4.8
9	7.2	7.1	0	298	2120	768	385	4.8
9A	7.0	7.3	0	142	1240	312	360	7.2
10	7.3	4.0	2.5	198	1520	624	372	4.8
11	3.9	6.9	0	191	640	504	174	26.0
12	7.0	7.1	0	252	2000	840	294G	7.2
13	7.0	7.1	0	266	2080	948	294G	2.4
14	7.6	7.6	0	247	2440	816	294G	4.8
15	7.7	7.6	0	261	2320	852	294G	2.4
16	7.2	7.2	0	280	2320	1008	300	2.4
17	7.3	7.2	0	280	2480	1092	360	4.8
18	7.1	7.3	0	261	2240	888	342	4.8
19	6.4	6.4	2.5	275	2400	972	300	26.0
20	5.7	5.6	0.5	247	2320	876	360	21.2
21	6.5	6.4	0.5	243	2640	1068	167	23.6
22	6.3	6.4	0.5	266	2400	888	294	4.8
COAL CREEK COAL								

Table 78. ACID-BASE ACCOUNT OF THE COAL CREEK OVERBURDEN AT THE OLLIS CREEK MINE, FLATWOODS SECTION, NEIGHBORHOOD FIVE.

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	6/6	0	.005	.16	- 2.20	2.36	
2	6/6	0	.005	.16	- 1.72	1.88	
3	7/3	0	.005	.16	- .25	.41	
4	6/1	0	.060	1.87	.49	1.38	
5	4/2	0	.490	15.31	18.52		3.21
5A	5/1	0	.050	1.56	14.63		13.07
6	5/2	0	.020	.62	17.32		16.70
7	6/1	0	.020	.62	6.34		5.72
8	5/1	0	.060	1.87	19.77		17.90
9	6/1	0	.040	1.25	7.08		5.83
9A	6/1	0	.050	1.56	2.94		1.38
10	5/1	0	.070	2.19	7.08		4.89
11	6/1	0	.090	2.81	.25	2.56	
12	6/1	0	.080	2.50	26.71		19.21
13	6/1	0	.870	2.19	15.36		13.17
14	6/1	0	.070	2.19	20.97		18.78
15	6/1	0	.070	2.19	15.12		12.93
16	6/1	0	.070	2.19	13.13		10.94
17	6/1	0	.080	2.50	17.30		14.80
18	5/2	0	.080	2.50	11.96		9.46
19	5/2	0	.210	6.56	10.24		3.68
20	6/1	0	.290	9.06	13.16		4.10
21	6/2	0	.180	5.62	26.34		20.72
22	5/2	0	.210	6.56	29.50		22.94
COAL CREEK COAL							

Table 79. PHYSICAL CHARACTERIZATIONS OF A MINESOIL RESULTING FROM STRIP MINING THE COAL CREEK COAL AT THE OLLIS CREEK MINE, FLATWOODS SECTION, NEIGHBORHOOD FIVE.

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
1-1	-0.25	Soil	10YR 6/4	9
1-2	0.25-0.50	Soil	2.5Y 7/4	9
2-1	-0.25	Soil	5Y 5/2	8
2-2	0.25-0.50	Soil	5Y 5/1	8
3-1	-0.25	Soil	2.5Y 5/2	8
3-2	0.25-0.50	Soil	2.5Y 6/2	6
4-1	-0.25	Soil	2.5Y 6/2	2
4-2	0.25-0.50	Soil	2.5Y 6/2	3
5-1	-0.25	Soil	2.5Y 5/2	5
5-2	0.25-0.50	Soil	2.5Y 5/2	5
6-1	-0.25	Soil	2.5Y 5/2	4
6-2	0.25-0.50	Soil	2.5Y 6/2	6
7-1	-0.25	Soil	5Y 5/2	5
7-2	0.25-0.50	Soil	2.5Y 6/2	6
8-1	-0.25	Soil	2.5Y 5/2	3
8-2	0.25-0.50	Soil	2.5Y 6/2	7
9-1	-0.25	Soil	2.5Y 7/4	7
9-2	0.25-0.50	Soil	2.5Y 7/4	6
10-1	-0.25	Soil	5Y 5/1	3
10-2	0.25-0.50	Soil	2.5Y 5/2	8
11-1	-0.25	Soil	2.5Y 5/2	1
11-2	0.25-0.50	Soil	2.5Y 6/2	2
12-1	0-.25	Soil	2.5Y 6/2	4
12-2	0.25-0.50	Soil	2.5Y 6/2	7

Table 80. CHEMICAL CHARACTERIZATIONS OF A MINESOIL RESULTING FROM STRIP MINING THE COAL CREEK COAL AT THE OLLIS CREEK MINE, FLATWOODS SECTION, NEIGHBORHOOD FIVE.

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1-1	4.3	4.3	3.0	160	480	384	72	13.2
1-2	4.5	4.3	2.5	136	160	192	52	8.9
2-1	3.2	3.1	5.0	122	1200	828	72	48.6
2-2	3.1	3.1	4.5	114	2320	996	67	55.2
3-1	3.8	3.9	1.5	183	1680	912	153	37.7
3-2	5.8	5.5	1.0	191	1760	1248	128	17.6
4-1	3.5	3.7	3.5	160	320	264	48	28.8
4-2	4.4	4.4	1.5	195	1120	612	111	28.8
5-1	3.0	2.9	4.5	114	1040	360	50	35.3
5-2	2.8	2.8	4.0	89	3160	468	56	33.0
6-1	3.0	3.1	5.0	103	680	432	58	48.6
6-2	2.9	2.9	5.0	98	480	528	42	28.8
7-1	7.0	6.9	0	284	2240	936	342	6.7
7-2	6.9	7.0	0	202	2280	1200	246	6.7
8-1	3.4	3.6	2.0	164	720	528	67	28.8
8-2	4.4	4.2	2.5	187	2320	1320	80	17.6
9-1	4.0	4.0	6.0	153	240	216	38	6.7
9-2	4.3	4.1	5.5	164	240	222	42	4.5
10-1	3.1	3.1	3.0	44	360	162	69	256.8
10-2	2.8	2.9	8.0	60	880	444	67	75.3
11-1	3.4	3.6	7.5	183	960	708	100	35.3
11-2	5.7	5.7	0.5	202	2240	1872	142	13.2
12-1	3.7	5.9	0.5	175	2560	1488	153	30.8
12-2	5.7	3.7	0.5	164	1040	672	80	8.9

Table 81. ACID-BASE ACCOUNT OF A MINESOIL RESULTING FROM STRIP MINING THE COAL CREEK COAL AT THE OLLIS CREEK MINE, FLATWOODS SECTION, NEIGHBORHOOD FIVE.

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1-1	6/4	0	.025	.78	0	.78	
1-2	7/4	0	.005	.16	- .78	.89	
2-1	5/2	0	.390	12.19	- 4.86	17.05	
2-2	5/1	0	.585	18.28	- 4.86	23.14	
3-1	5/2	0	.220	6.87	- 1.96	8.83	
3-2	6/2	0	.080	2.50	- 2.42	4.92	
4-1	6/2	0	.120	3.75	- 2.42	6.17	
4-2	6/2	0	.060	1.87	2.45		.58
5-1	5/2	0	.690	21.56	- 1.22	22.78	
5-2	5/2	0	.910	28.44	- .25	28.69	
6-1	5/2	0	.460	14.37	- 3.90	18.27	
6-2	6/2	0	.225	7.03	- 5.61	12.64	
7-1	5/2	0	.110	3.44	30.23		26.79
7-2	6/2	0	.085	2.66	30.23		27.57
8-1	5/2	0	.315	9.84	- .98	10.82	
8-2	6/2	0	.135	4.22	- 1.23	5.45	
9-1	7/4	0	.040	1.25	- 4.39	5.64	
9-2	7/4	0	.020	.62	- 1.72	2.34	
10-1	5/1	0	1.160	36.25	- 6.10	42.35	
10-2	5/2	0	.900	28.12	- 6.49	34.61	
11-1	5/2	0	.210	6.56	- 1.94	8.50	
11-2	6/2	0	.125	3.91	1.71	2.20	
12-1	6/2	0	.140	4.37	- 2.42	6.79	
12-2	6/2	0	.110	3.44	3.16	.28	

SECTION VIII

INTERIOR COAL PROVINCE: EASTERN REGION

SUMMARY

In this Basin our studies have concentrated on the big extensively-mined Illinois #6 (Kentucky #11, Indiana #6), and on the Davis and overlying DeKoven, the oldest major coals in the basin. The choice of Davis and DeKoven was dictated by the reputation of the overburden for acidity; the choice of 3 sampling Neighborhoods (Table 82) of the big coal producing #6, located 106.7 to 121.9 m (350 to 400 ft) higher in the geologic column, offered an opportunity for checking variability of the overburden, including glacial till and loess deposited on dissected pe-glacial landscapes.

At River Queen (Neighborhood 7, Figure 6), no glaciation but some windblown silt occurs. At Lynnville (Neighborhood 6), approaching the glacial boundary, a thin silt cap occurs, variable in thickness from less than 30.5 cm (1 ft) to as much as 1.5 m (5 ft). At Burning Star (Neighborhood 9), considering both the Walker and the DuQuoin pits, the thickness of loess and till combined ranges from 3.0 to 7.6 m (10 to 25 ft). Similar thicknesses, including outwash occur at Will Scarlet (Neighborhood 8), where Davis and DeKoven coals are mined, and loess is as much as 4.6 m (15 ft) thick, with no till at Eagle (Davis and DeKoven) (Neighborhood 8). None of this loess or till is acid-toxic. However, original subsoils were slowly pervious and clayey or contained fragipans, which are not desirable for near surface placement. New minesoils would benefit if they included some calcareous mudrocks and weak sandstones, to provide basic reactions and available potash, and to reduce surface erosion. Acid-toxic materials can be buried or blended with neutralizers. At River Queen several samples containing gypsum were noted in Tables 94 to 102 and maximum acid from sulphur was corrected accordingly since sulphur in gypsum is neutralized by calcium.

Outside the glacial border, original soils are most favorable at Eagle. Fragipan subsoils are undesirable at Lynnville and River Queen.

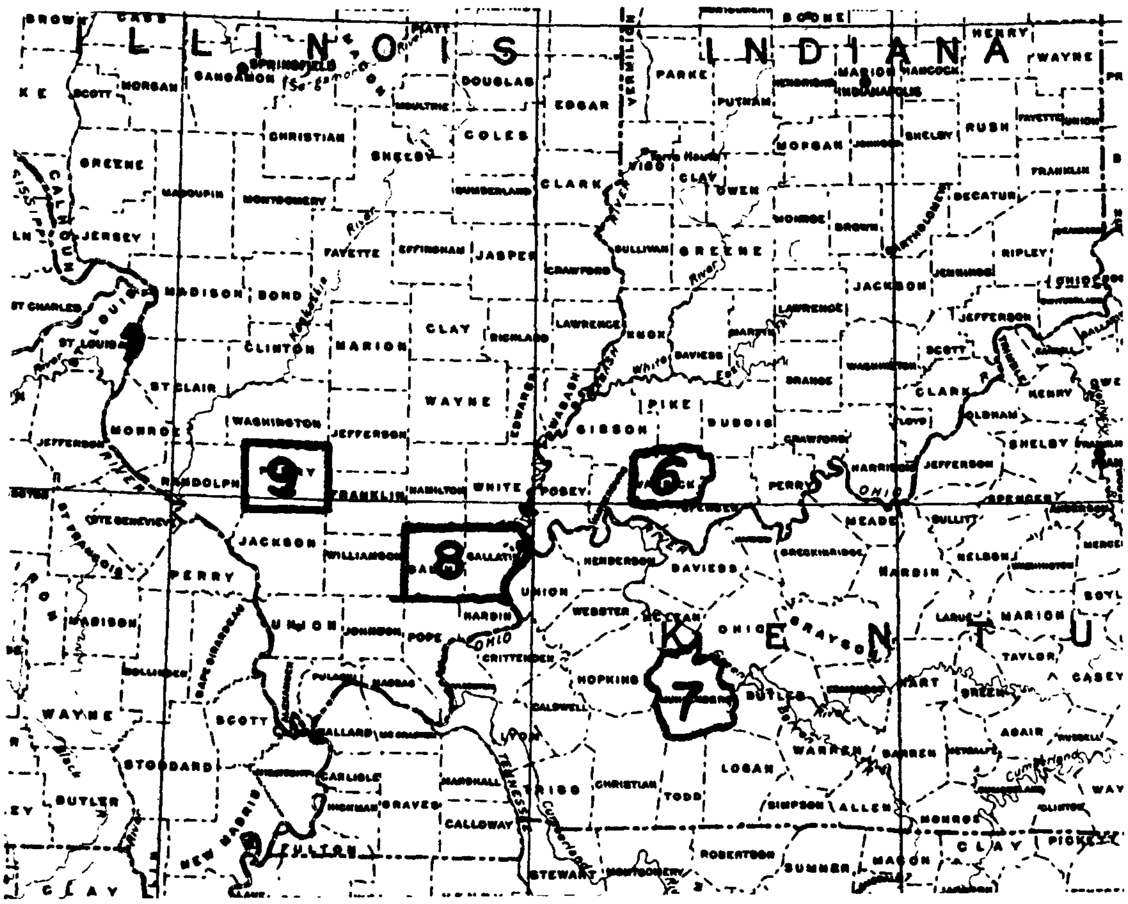


Figure 6. Neighborhoods in the Eastern Region, Interior Coal Province.

Comparing with Appalachian conditions (West Virginia University 1971) we would suggest that the Davis and DeKoven section in southern Illinois could be considered similar depositionally to Surface Mining Province #2 (Allegheny formation); and the zone including the big #6 coal would be similar to the central part of Surface Mining Province #3. Of course, the surficial covers of loess and glacial till introduce an important parameter not present in Central Appalachia.

NEIGHBORHOOD 6: LYNNVILLE MINE, WARRICK COUNTY, INDIANA.

The Indiana #6 (or Millersburg) coal is being mined at Lynnville. This is a split seam with a mudstone or interstratified mudstone and sandstone parting, thickening to the Northwest, to as much as 7.0 m (23 ft) where sampled west of the center of Pit 1150, #1. The #6 coal here and in Southern Illinois is the same as the Kentucky #11 being mined at River Queen in Muhlenberg County, Kentucky.

Acid-base accounting, Tables 86, 89, and 92, shows that most of the overburden is safe from acid toxicity, but toxic and potentially toxic shale, mudstone and sandstone layers do occur as indicated in the column, "Max. Needed". Since some of these horizons show high toxic potentials whereas excess neutralization potentials in safe mudstones and sandstones are not so high, safest disposal of these toxic materials would be deep burial.

Undisturbed soils before mining were acid, light colored, and relatively infertile (Tables 83-92) and where bedrock was deeper than 0.9 m (3 ft) the subsoils included fragipans, which would not be recommended for near-surface placement.

The most fertile and base-rich materials for creating new soils occur in the middle or lower parts of the columns. These mudstones and sandstones also show a tendency to slake in water (slaking values higher than 1) which should assure a favorable percentage of fines in the minesoils. Tough limestone rocks that would cause undesirable, large coarse fragments, are absent except between the coals where the parting is thin. Sandstones are relatively fine-grained and weak and should provide a favorable texture for minesoils.

The depth of oxidation weathering is clearly indicated by colors in all three columns studied at Lynnville. In Pit #5900 the Munsell color chroma of the powdered rock (Table 90) changed abruptly from a color chroma of 4(brown) at 5.0 m (16.5 ft) from the surface to a chroma of 1 or 0 (gray) at all deeper depths. Coincident with the drop in chroma, the percent sulfur jumped from .005 % (trace only) to .065%, or 13 times as much. The higher percentage remains relatively insignificant in this case, but the distinct change in chroma and percent sulfur at the same depth is a clear indication of weathering change.

The sharp weathering front indicated at 6.7 m (22 ft) in Column #1 from Pit #1150 (Table 86) is equally impressive, as in the change in chroma and sulphur at 11.0 m (36 ft) in column #2 (Table 89). Moreover, neutralizers (amount of calcium carbonate equivalent) increase at the same point, whereas the carbonate increase is one sample deeper in Pit #5900.

Three minesoil profiles that were excavated, described and sampled showed a predominant influence from mudstones, resulting in clayey textures. The pH was variable but averaged nearly 5.5. Coarse fragment percentages were lower than for many minesoils, evidently reflecting the general physical weakness of the rocks. They tend to shatter, slake in water, or to be cut by machinery, resulting in more than 50% fines in most horizons (Sencindiver, 1975).

NEIGHBORHOOD 7: RIVER QUEEN MINE, MULLENBERG COUNTY, KENTUCKY.

The coals being mined are, from the bottom up, Kentucky #11 and #12 with 1.5 to 1.8 m (5 to 6 ft) of limestone parting between. The general elevation of the top of the Kentucky #11 coal in this Neighborhood is 120.7 m (396 ft), with gentle regional dip northeastward. Correlating among contiguous States, Kentucky #11 and #12 apparently correspond with #6 (lower) and #6 (upper) of Indiana and Illinois, respectively.

The thin coal at 15.8 m (52 ft) in Table 94-96 should be the Kentucky #13, mined elswhere but not in this Neighborhood.

The prominent limestone between Kentucky #11 and #12 is recognized as a potential neutralizing resource if segregated and crushed for blending with potentially acid minesoils.

In order to utilize crushed limestone. or other carbonate-rich materials for prevention of acidity it is important to develop acid-base accounting information as illustrated in Tables 96, 99 and 102.

Natural soils in the Neighborhood include light-colored, strongly-acid, leached, shallow to moderately deep soils over sandstone or mixed colluvium. Subsoil fragipans occur below the 61 cm (2 ft) depth where soil material is deep enough over bedrock (Table 93).

Tables 94 through 102 indicate that some selectivity of materials is needed in order to assure consistently favorable minesoils. Greatest concentrations of potential acidity occur near the coals (including the thin #13). Closely associated zones, however, are rich in neutralizers and could be blended to create soils according to plan. The mudrocks and intercalate sandstones involved tend to disintegrate, providing soil fines and reactive particles. A farm disc is effective in cutting and mixing such materials. Where additional neutralizing capacity is needed, as mentioned, the rich limestone between the coals could be crushed and utilized.

Available plant nutrients are highly variable in the columns studied. A broad blend of materials calculated to provide a near neutral reaction (pH 5.5 to 8) and sufficient soil fines near the surface, would be expected to respond to fertilization with phosphorus and potash, as well as nitrogen to hasten initial ground cover until legume stands are established. If minesoils contain a high percentage of disintegrated sandstone, fertilization with potassium as well as phosphorus is likely to be critical. This same material might be extremely low in available magnesium (less than 100 lb per 1000 t) unless blended with more fertile mudrocks and intercalates.

NEIGHBORHOOD 8: WILL SCARLET AND EAGLE MINES, SALINE AND GALLATIN COUNTIES, ILLINOIS.

At Will Scarlet (Carrier Mills) and Eagle (Shawneetown mines), 32.2 km (20 mi) apart in Saline and Gallatin Counties, Illinois, the coals are Davis and DeKoven, overlain by Illinois #4, which is lower in the geologic column than Illinois and Indiana #5. The next higher coal, which is an extensive producer, is Illinois #6 being surface mined at Lynnville, Indiana as #6, and at River Queen as Kentucky #11. In Southern Illinois, the #6 is said to be 106.7 to 121.9 m (350 to 400 ft) above the Davis. Only minor coals occur below the Davis (Smith 1957), which is cut out in places by the Mississippian shelf of the Eastern Interior Basin.

The Interval between the Davis and DeKoven is said to range from 0.6 to 7.6 m (2 to 25 ft). At Will Scarlet (Tables 104-106), where the high wall was hand sampled, the distance was 2.1 m (7 ft) whereas at Eagle (Tables 108-110) it was 6.7 m (22 ft). Toxic or potentially toxic materials were associated with the coals at both mines, but only in the lower and the upper portions of the rock strata between coals at Eagle whereas the entire 2.1 m (7 ft) interval was toxic at Will Scarlet as well as 3.3 m (11 ft) of the light-colored (low chroma) sandstone above the DeKoven coal.

Natural undisturbed soils at both of these mines are developed in loess or unconsolidated silt. The soil profiles are acid and showed clay accumulation in the subsoil. Where sampled at Eagle, the soil was well drained whereas at Will Scarlet the soil was somewhat poorly drained because of a slowly pervious silty clay subsoil. This subsoil material would be less desirable for placement near the surface of new minesoils than the well-drained (not mottled) and more silty surface soil and parent material. Soil profile sample analyses are presented in Tables 103 and 107.

Potentially acid-toxic material occurs deeper than 17.7 m (58 ft) from the original surface at Will Scarlet (Table 104 and 106) and deeper than 21.3 m (70 ft) at Eagle (Table 108-110). This means the top of the DeKoven coal at Eagle, and the upper part of the light-colored (low chroma), thick-bedded sandstone at Will Scarlet. Above this thick-bedded sandstone the fragmented bedrock sandstone or mudstone would make favorable soil material (Tables 104 and 105). It would need fertilization with phosphorus and nitrogen. Blending with loess or relatively stone-free till would improve available phosphorus levels. The original subsoil (B horizon), of the somewhat poorly-drained natural soil would be undesirable if concentrated near the surface, because of high clay content and low permeability. The surface (A horizon) is moderately desirable, although acid and unfavorably affected in the lower part by impeded drainage. It would be difficult to segregate and use separately from the heavy subsoil.

At Will Scarlet, loess, till and outwash are relatively high in available phosphorus (bicarbonate extractable) but low in available potash (Tables 104 and 105). At Eagle, available phosphorus in loess is medium but potash is low (Table 108 and 109). Fertilization with potash as well as with phosphorus and nitrogen should aid establishment of needed grass and legume ground cover, prevention of erosion, and favorable forage.

Undisturbed soils observed, described and sampled at Eagle (Table 107) are well-drained, slightly acid and moderately pervious. The surface (A horizon) is not dark and deep enough to qualify as a true tall-grass prairie soil (Mollisol). Even so, the top few feet of original soil and underlying loess have enough desirable properties to encourage stockpiling for placement on or blending into the plant root zone of the new minesoil. A blend including alkaline, soft mudrocks from the middle part of the overburden would increase lime and potash levels in resulting minesoils and would favor subsoil perviousness and erosion control.

Man-made minesoils were excavated, described and sampled at Will Scarlet (2 profiles) and Eagle. These 3 minesoils were similar. They contained approximately 5% small coarse fragments. Profiles consisted primarily of loess and till. Since loess was 2.4 to 3.6 m (8 to 12 ft) thick at both mines, there was enough of this stone-free silt to account for properties of the minesoils. The glacial till and outwash at Will Scarlet amounted to as much as 6.1 m (20 ft) of depth, part of which was evident in the top few feet of minesoils. No concentrations were noted of mottled, undesirable silty clay subsoils from original poorly drained soils (Sencindiver 1975).

NEIGHBORHOOD 9: BURNING STAR #2 MINE, PERRY COUNTY, ILLINOIS.

The coal being mined at the Walker and DuQuoin pits of Burning Star #2 mine is #6 or Herrin Coal (Smith 1958). A thin layer of Jamestown Coal appears above the #6 in some places, but it is generally too thin to be strip mined economically. The #6 Coal ranges from 1.5 to 2.1 m (5.0 to 6.9 ft) in thickness and 112.5 to 122.8 m (369 to 403 ft) in elevation. In Illinois the #6 Coal seemingly corresponds to the #11 Coal in Kentucky and the #6 in Indiana.

The Herrin (#6) Coal and the Jamestown Coal are both located in the Carbondale Group of the Pennsylvania System. The #6 Coal is one of the most important coal seams in Perry County and surroundings (Smith 1958).

The #6 Coal is generally uniform in thickness in wide areas. Tables 112, 115, and 118 show that the overburden immediately above the #6 coal consists of dark-gray shales and carboliths. The acid-base accounts for the overburden at the Walker and DuQuoin Pits also reveal an abundance of limestone and calcareous mudstone. This is a common occurrence for the Herrin overburden. The tables also show some potentially toxic strata which are generally the dark-gray shale and carbolith areas immediately above the Herrin coal. The column (Table 112-114) for the Walker Pit shows other zones within the section that could be potentially toxic. However, all three sections have ample limestone or other high carbonate materials that can be mixed with the potentially toxic strata to produce non-acid or near neutral minesoils.

Natural soils around the Walker and DuQuoin pits are dominantly deep, imperfectly drained soils formed in loess and glacial till deposits. The surface textures are dominantly silty, and the subsoil is clayey in most cases with a few silty and loamy horizons. The soils are strongly acid, low in inherent fertility, and slowly permeable due to the heavy textured subsoil and the occurrence of fragipans in some soils (Table 111).

The columns studied in this neighborhood show that the loess and till have a higher extractable phosphorus level than the sedimentary bedrock. However, the loess and till do not necessarily have higher excess calcium carbonate equivalent or higher extractable K, Ca, and Mg (Tables 112-120). Therefore, a mixing or blending of materials would result in a near neutral minesoil with moderate to high amounts of these nutrients. Early vegetative cover should respond well to moderate amounts of phosphorus and nitrogen fertilization and maybe potassium in certain instances, as indicated by soiltests.

Table 82. LOCATIONS OF FIELD STUDY SITES IN NEIGHBORHOODS SIX THRU NINE, EASTERN REGION

Site	Latitude Longitude Surf. Elev.	Coal Seam	Detail of Site Location
Lynnville Mine (1150 #1 Pit)	38.1593°N 87.4028°W 470 ft	#6	3.2 km (2 mi) due east of Elberfeld's City Boundary, Warick Co., IN
Lynnville Mine (1150 #2 Pit)	38.1171°N 87.3646°W 460 ft	#6	7.2 km (4.5 mi) due north of Chandle's City Boundary, Warick Co., IN
Lynnville Mine (5900 Pit)	38.15°N 87.37°W 475 ft	#6	6.4 km (4 mi) southwest of Lynnville, Warick Co., IN
River Queen Mine	37.2786°N 87.1771°W 510-520 ft	#13,#12,#11	3.6 km (2.25 mi) from downtown Central City, Muhlenburg Co., KY
River Queen Mine	37.2786°N 87.1880°W 450-560 ft	#12,#11	5.6 km (3.5 mi) west southwest of downtown Central City, Muhlenburg Co., KY
Will Scarlet Mine	37.6617°N 88.7674°W 430-440 ft	DeKoven Davis	6.8 km (4.25 mi) northeast of Creal Springs, Williamson Co., IL
Eagle Mine	37.6250°N 88.2292°W 400 ft	DeKoven Davis	10.9 km (6.75 mi) due south of Junction, Gallatin Co., IL

Table 82. continued

Site	Latitude Longitude Surf. Elev.	Coal Seam	Detail of Site Location
Burning Star #2 Mine (Walker Pit)	38.0396°N 89.2937°W 450 ft	#6 (Herrin)	8.8 km (5.5 mi) southeast of Pinckneyville, Perry Co., IL
Burning Star #2 Mine (DuQuoin Pit)	38.0336°N 89.2531°W 450 ft	#6 (Herrin)	0.5 km (0.33 mi) north of northwest corner of DuQuoin City Boundary, Perry Co., IL
Burning Star #2 Mine (DuQuoin Pit)	38.0405°N 89.2500°W 450 ft	#6 (Herrin)	1.6 km (1 mi) north of DuQuoin's City Boundary, Perry Co., IL
Lynnville Mine Soil Profile	38.1578°N 37.3086°W 540 ft		3.2 km (2 mi) south southwest of Lynnville, Warick Co., IN
River Queen Mine Soil Profile	37.2764°N 87.1508°W 500 ft		2.6 km (1.6 mi) west southwest of Central City, Muhlenburg Co., KY
Will Scarlet Mine Soil Profile	37.6764°N 88.7561°W 410 ft		7.2 km (4.25 mi) southeast of Crab Orchard, Williamson Co., IL

Table 82. continued

Site	Latitude Longitude Surf. Elev.	Coal Seam	Detail of Site Location
Eagle Mine Soil Profile	32.6358°N 88.2267°W 410 ft		10.1 km (6.25 mi) south of Junction, Gallatin Co., IL
Burning Star #2 Mine (Walker Pit) Soil Profile	38.0403°N 89.2861°W 440 ft		8.8 km (5.5 mi) southeast of Pinkneyville, Perry Co., IL
Burning Star #2 Mine (DuQuoin Pit) Soil Profile	38.0367°N 89.2500°W 430 ft		1.6 km (1 mi) north of DuQuoin's City Boundary, Perry Co., IL

Table 83. PROPERTIES OF THE UNDISTURBED NATURAL SOIL AT THE LYNNVILLE MINE, NEIGHBORHOOD SIX

Soil Horizons	Depth (feet)	Color	pH, (paste)	Per Thousand Tons of Material: Lime Requirement (tons)	Acid Extracted: K (lbs)	Acid Extracted: Ca (lbs)	Acid Extracted: Mg (lbs)	Bicarbonate Extracted P (lbs)
Ap	0.0-0.5	10YR 6/4	4.4	3.0	187	1040	492	7.2
B_{21t}	0.5-1.5	10YR 6/6	4.6	2.5	128	1120	972	17.6
B_{22t}	1.5-2.1	10YR 6/6	4.6	3.0	100	880	864	23.6
B_x	2.1-3.8	10YR 6/6	4.6	2.0	78	640	756	23.6

Table 84. PHYSICAL CHARACTERIZATIONS OF THE NUMBER SIX COAL OVERBURDEN AT PEABODY COAL COMPANY'S LYNNVILLE MINE (PIT 1150 #1), NEIGHBORHOOD SIX

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
Ap	0.0-0.5	Soil	10YR 6/6	10
B2t	0.5-2.0	Soil	10YR 6/6	9
Bx	2.0-4.0	Soil	10YR 7/4	10
C1	4.0-5.0	Soil	7.5YR 5/6	10
C2	5.0-6.0	Soil	2.5Y 7/4	8
1	6.0-8.0	MS	5Y 7/3	1
2	8.0-11.0	MS	5Y 7/3	1
3	11.0-15.0	MS	2.5Y 7/4	1
4	15.0-17.0	MS	5Y 7/3	1
5A	17.0-22.0	MS	5Y 7/3	1
5B	19.5-21.5	MS	5Y 7/1	3
6	21.5-23.5	MS	5Y 7/1	3
7	23.5-25.5	MS	5Y 7/1	3
8	25.5-30.5	MS	5Y 7/1	6
9	30.5-32.5	SH	5Y 7/1	5
10	32.5-35.5	SH	5Y 7/1	2
11	35.5-38.5	SH	5Y 7/1	3
12	38.5-40.1	SH	N 7/0	1
13	40.1-41.8	SH	5Y 6/1	0
14	41.8-46.0	#6 COAL		
15	46.0-47.5	SS	N 8/0	3
16	47.5-49.0	MS	N 8/0	5
17	49.0-52.0	SH	N 8/0	0
18	52.0-59.0	SH	N 7/0	10
19	59.0-60.1	SS	5Y 7/1	2
20	60.1-61.2	SS	5Y 8/1	0
21	61.2-62.3	SS	N 8/0	5
22	62.3-63.4	SS	5Y 7/1	4
23	63.4-64.5	SS	N 8/0	3
24	64.5-65.6	SH	N 8/0	0
25	65.6-66.7	SH	N 7/0	0
26	66.7-67.8	SH	5Y 5/1	3
27	67.8-68.9	SH	5Y 5/1	4
28	68.9-74.0	#6 COAL		

Table 85. CHEMICAL CHARACTERIZATIONS OF THE NUMBER SIX COAL OVERBURDEN AT PEABODY COAL COMPANY'S LYNNVILLE MINE (PIT 1150 #1), NEIGHBORHOOD SIX

			Per Thousand Tons of Material					
			Lime Require-	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	ment (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
Ap	4.5	4.5	4.5	111	400	804	58	1.2
B2t	4.6	4.6	2.5	125	640	1188	54	2.4
Bx	5.3	5.2	0.5	84	1120	1440	56	2.4
C1	6.8	6.3	1.0	106	2400	2400	94	4.8
C2	7.4	7.2	0	109	3280	2352	192	7.2
1	7.5	7.3	0	142	3360	1704	308	25.8
2	7.6	7.4	0	171	3600	1584	342	37.6
3	7.5	7.5	0	179	3360	1416	308	2.4
4	7.7	7.8	0	195	4560	2208	342	0.5
5A	7.6	7.6	0	195	3680	1320	372	0.5
5B	8.3	8.3	0	364	3520	1116	308 G	4.8
6	8.2	8.1	0	385	3120	1020	300 G	2.4
7	8.4	8.5	0	312	3520	1128	174 G	2.4
8	8.0	8.0	0	364	3600	1140	342 G	2.4
9	8.4	8.2	0	353	2960	852	342 G	2.4
10	8.3	8.4	0	437	3440	900	360 G	2.4
11	8.5	8.6	0	364	3280	924	200 G	2.4
12	8.5	8.7	0	432	2560	684	300 G	4.8
13	7.6	7.6	0	327	6560	1188	115 G	7.2
14	#6 COAL							
15	5.7	5.7	0.5	198	400	168	34	0.5
16	5.6	5.7	0.5	243	640	252	42	2.4
17	9.2	9.0	0	120	7280	228	48	2.4
18	4.8	5.0	0.5	270	880	264	65	0.5
19	9.4	9.1	0	256	1120	216	246	0.5
20	9.1	8.9	0	175	1280	216	128	0.5
21	9.2	9.3	0	266	7200	312	174	0.5
22	9.4	9.4	0	234	1520	120	308	0.5
23	9.2	9.2	0	234	960	144	238	0.5
24	8.7	8.5	0	120	7040	264	32	0.5
25	8.8	8.6	0	145	3200	228	174	0.5
26	3.9	3.7	2.5	150	1120	480	147	2.4
27	3.6	3.6	4.5	139	880	444	23	2.4
28	#6 COAL							

Table 86. ACID-BASE ACCOUNT OF THE NUMBER SIX COAL OVERBURDEN AT PEABODY COAL COMPANY'S LYNNVILLE MINE (1150 #1), NEIGHBORHOOD SIX

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
A_p	6/6	0	.005	.16	- .23	.39	
B_{2t}	6/6	0	.005	.16	1.10		.94
B_x	7/4	1	.005	.16	4.77		4.61
C_1	5/6	0	.005	.16	8.77		8.61
C_2	7/4	0	.005	.16	6.52		6.36
1	7/3	0	.005	.16	8.77		8.61
2	7/3	1	.005	.16	6.27		6.11
3	7/4	1	.005	.16	9.02		8.86
4	7/3	1	.005	.16	9.27		9.11
5A	7/3	0	.005	.16	6.27		6.11
5B	7/1	0	.045	1.41	18.81		17.40
6	7/1	0	.060	1.88	9.66		7.78
7	7/1	0	.050	1.56	16.09		14.53
8	7/1	0	.020	.63	18.32		17.69
9	7/1	0	.255	7.97	21.78		13.81
10	7/1	0	.100	3.13	21.29		18.16
11	7/1	0	.060	1.88	29.70		27.82
12	7/0	0	.060	1.88	11.14		9.26
13	6/1	1	.975	30.47	29.20	1.27	
14	#6 COAL						
15	8/0	0	.200	6.25	- .24	6.49	
16	8/0	0	.315	9.84	3.72	6.12	
17	8/0	1	.035	1.09	30.44		29.35
18	7/0	0	1.310	40.94	12.62	28.35	
19	7/1	0	.020	.63	20.05		19.42
20	8/1	0	.080	2.50	23.02		20.52
21	8/0	1	.050	1.66	20.05		18.39
22	7/1	0	.020	.63	11.39		10.76
23	8/0	0	.005	.16	5.20		5.04
24	8/0	1	.065	2.03	20.79		18.76
25	7/0	0	.250	7.81	12.62		4.81
26	5/1	0	.600	18.75	9.16	9.59	
27	5/1	0	.500	15.63	1.74	13.89	
28	#6 COAL						

Table 87. PHYSICAL CHARACTERIZATIONS OF THE NUMBER SIX COAL OVERBURDEN AT PEABODY COAL COMPANY'S LYNNVILLE MINE (PIT 1150 #2), NEIGHBORHOOD SIX

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
B1	0.0-0.6	Soil	2.5Y 7/4	10
B21	0.6-2.5	Soil	2.5Y 8/4	10
B22t	2.5-4.5	Soil	2.5Y 7/4	10
B3	4.5-6.0	Soil	2.5Y 7/6	6
C	6.0-7.5	MS	2.5Y 7/4	3
1	7.5-9.0	SS	2.5Y 7/4	1
2	9.0-10.5	SS	2.5Y 7/4	0
3	10.5-12.0	SS	2.5Y 7/2	2
4	12.0-13.5	SS	2.5Y 7/4	1
5	13.5-15.0	SS	2.5Y 7/4	1
6	15.0-16.5	SS	2.5Y 7/2	1
7	16.5-18.0	SS	2.5Y 7/2	1
8	18.0-19.5	SS	10YR 6/6	1
9	19.5-25.0	SS	5Y 7/3	1
10	25.0-30.5	SS	5Y 7/3	1
11	30.5-36.0	SS	5Y 7/3	1
12	36.0-41.5	SS-I	5Y 7/1	1
13	41.5-47.0	SS-I	5Y 7/1	2
14	47.0-52.5	SS-I	5Y 7/1	1
15	52.5-55.5	MS	N 7/0	0
16	55.5-58.5	MS	N 7/0	0
17	58.5-61.5	MS	5Y 7/1	0
18	61.5-64.5	MS	5Y 4/1	3
19	64.5-67.0	#6 COAL		
20	67.0-69.5	LS	10YR 8/1	0
21	69.5-75.0	#6 COAL		

Table 88. CHEMICAL CHARACTERIZATIONS OF THE NUMBER SIX COAL OVERBURDEN AT PEABODY COAL COMPANY'S LYNNVILLE MINE (PIT 1150 #2), NEIGHBORHOOD SIX

			Per Thousand Tons of Material					
			Lime Require- ment	Acid Extracted				Bicartonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
B1	4.7	4.8	2.0	100	800	924	65	25.8
B21	6.2	6.3	1.0	69	1280	936	72	7.2
B22	5.8	5.8	1.0	89	2320	1752	111	2.4
B3	6.5	6.3	1.0	92	2800	2088	132	2.4
C	6.8	6.8	0	87	2720	1800	94	2.4
1	6.9	7.0	0	84	2480	1092	294	7.2
2	7.2	7.0	0	98	2480	1020	308	7.2
3	7.4	7.2	0	136	2960	1008	360	4.8
4	7.5	7.5	0	75	2240	756	294	7.2
5	7.7	7.6	0	78	2320	876	294	9.6
6	8.0	7.9	0	62	1600	564	308	4.8
7	8.5	8.5	0	67	1600	912	256	7.2
8	7.7	7.3	0	78	1680	1584	82	23.6
9	7.3	7.2	0	95	1280	612	342	4.5
10	7.6	7.6	0	98	1200	660	308	4.5
11	7.4	7.5	0	92	1440	588	360	4.5
12	7.8	7.6	0	222	2000	720	300G	2.2
13	8.0	8.0	0	243	2240	744	300G	2.2
14	8.0	7.9	0	175	2320	576	320G	2.2
15	8.4	8.4	0	410	3360	972	360G	2.2
16	8.4	8.4	0	405	2960	864	342G	2.2
17	8.3	8.3	0	405	2960	888	385G	2.2
18	2.8	2.8	4.5	95	2320	1056	238	4.5
19	#6 COAL							
20	7.7	7.8	0	117	12000	132	19	2.2
21	#6 COAL							

Table 89. ACID-BASE ACCOUNT OF THE NUMBER SIX COAL OVERBURDEN AT PEABODY COAL COMPANY'S, LYNNVILLE MINE (PIT 1150 #2), NEIGHBORHOOD SIX

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
B_1	7/4	0	.005	.16	2.48		2.32
B_{21}	8/4	0	.005	.16	3.22		3.06
B_{22t}	7/4	0	.005	.16	7.43		7.27
B_3	7/6	1	.025	.78	6.19		5.41
C	7/4	0	.005	.16	8.42		8.26
1	7/4	0	.005	.16	6.69		6.53
2	7/4	0	.005	.16	7.43		7.27
3	7/2	0	.005	.16	7.92		7.76
4	7/4	0	.005	.16	5.44		5.28
5	7/4	0	.005	.16	5.94		5.78
6	7/2	0	.005	.16	4.71		4.55
7	7/2	0	.005	.16	5.70		5.54
8	6/6	1	.020	.63	7.92		7.29
9	7/3	0	.005	.16	4.95		4.79
10	7/3	0	.005	.16	3.72		3.56
11	7/3	0	.005	.16	5.94		5.78
12	7/1	0	.070	2.19	8.91		15.92
13	7/1	1	.070	2.19	11.39		9.20
14	7/1	0	.055	1.72	13.12		11.40
15	7/0	0	.055	1.72	12.62		10.90
16	7/0	1	.040	1.25	9.66		8.41
17	7/1	0	.125	3.91	8.91		5.00
18	4/1	0	3.100	96.88	- 3.21	100.09	
19	#6 COAL						
20	8/1	4	.175	5.47	504.79		499.32
21	#6 COAL						

Table 90. PHYSICAL CHARACTERIZATIONS OF THE #6 COAL OVERBURDEN AT PEABODY COAL COMPANY'S LYNNVILLE MINE (PIT 5900), NEIGHBORHOOD SIX

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
Ap	0.0- 0.5	Soil	10YR 6/4	3
B	0.5- 2.5	Soil	10YR 6/6	9
Bx	2.5- 4.0	Soil	2.5Y 7/4	9
C	4.0- 6.0	Soil	10YR 5/6	6
1	6.0- 9.0	MS	10YR 7/6	6
2	9.0-12.5	MS	10YR 7/6	5
3	12.5-14.5	MS	2.5Y 7/2	3
4	14.5-16.5	MS	2.5Y 7/4	2
5	16.5-19.0	MS	5Y 7/1	2
6	19.0-21.5	MS	N 7/0	3
7	21.5-24.0	MS	2.5Y 7/1	1
8	24.0-27.5	MS	2.5Y 7/1	2
9	27.5-30.0	MS	5Y 7/1	4
10	30.0-32.5	MS	5Y 7/1	2
11	32.5-35.0	MS	5Y 7/1	
12	35.0-37.5	MS	5Y 7/1	2
13	37.5-40.0	MS	5Y 7/1	2
14	40.0-42.5	MS	N 7/0	1
15	42.5-45.0	MS	5Y 7/1	1
16	45.0-47.5	MS	N 7/0	0
17	47.5-50.0	MS	5Y 7/1	4
18	50.0-52.5	MS	5Y 7/1	3
19	52.5-55.0	MS	5Y 7/1	2
20	55.0-57.5	MS	5Y 7/1	2
21	57.5-60.5	#6 COAL		
22	60.5-61.0	SH	5Y 6/1	3
23	61.0-63.5	SS	5Y 7/1	0
24	63.5-64.0	Coal	5YR 2/1	
25	64.0-65.5	LS-I	5Y 7/1	0
26	65.5-66.5	SH	5Y 6/1	1
27	66.5-71.0	#6 COAL		

Table 91. CHEMICAL CHARACTERIZATIONS OF THE # SIX COAL OVERBURDEN AT PEABODY COAL COMPANY'S LYNNVILLE MINE (PIT 5900), NEIGHBORHOOD SIX

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
Ap	5.5	5.3	1.5	238	1760	240	34	11.4
B	5.0	4.8	1.5	106	880	480	48	6.8
Bx	5.4	5.5	1.0	67	800	960	67	9.1
C	6.3	6.1	1.5	73	1200	1092	119	6.8
1	6.4	6.4	1.0	60	1200	1008	103	6.8
2	6.7	6.6	0	98	1920	1632	103	4.5
3	7.0	6.9	0	145	3040	1320	342	6.8
4	7.1	7.1	0	134	2800	1584	246 G	11.4
5	7.4	7.3	0	234	2800	948	360 G	2.2
6	7.9	7.9	0	284	3200	1032	200 G	2.2
7	7.8	7.8	0	302	3120	960	256 G	2.2
8	7.9	7.9	0	317	5200	1752	320 G	0.5
9	8.0	8.0	0	359	3680	1344	246 G	2.0
10	8.2	8.1	0	302	2960	1200	147 G	0.5
11	7.9	7.9	0	322	3120	1008	308 G	2.2
12	8.0	8.0	0	338	3120	984	320 G	2.2
13	7.9	8.0	0	380	3600	1188	308 G	1.1
14	7.9	7.9	0	302	32-0	1044	192 G	2.2
15	7.9	7.8	0	302	2960	1032	183 G	2.2
16	7.8	7.9	0	332	3040	1008	308 G	2.2
17	7.6	7.8	0	390	3520	1200	372 G	2.2
18	7.6	7.7	0	374	3680	1200	360 G	2.2
19	7.5	7.5	0	390	3360	1164	342 G	2.2
20	7.9	8.0	0	380	3440	1200	308 G	1.1
21	#6 COAL							
22	2.7	2.7	7.0	134	6160	1056	342 G	300.0
23	7.5	7.4	0	92	12160	180	7	0.5
24	5.9							2.2
25	7.3	7.5	0	134	12800	288	7	6.8
26	2.8	2.9	6.0	106	1120	540	13	2.2
27	#6 COAL							

Table 92. ACID-BASE ACCOUNT OF THE #6 COAL OVERBURDEN AT PEABODY COAL COMPANY'S LYNNVILLE MINE (PIT 5900), NEIGHBORHOOD SIX

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
Ap	6/4	1	.020	.63	1.27		.64
B	6/6	0	.020	.63	- .48	1.11	
Bx	7/4	1	.005	.16	1.27		1.11
C	5/6	0	.005	.16	3.27		3.11
1	7/6	0	.005	.16	- 1.98	2.14	
2	7/6	0	.020	.63	5.02		4.39
3	7/2	0	.020	.63	6.52		5.89
4	7/4	0	.005	.16	6.52		6.36
5	7/1	0	.065	2.03	5.02		3.01
6	7/0	1	.065	2.03	14.26		12.23
7	7/1	0	.060	1.88	10.02		8.14
8	7/1	0	.060	1.88	13.26		11.38
9	7/1	1	.060	1.88	12.01		10.13
10	7/1	0	.035	1.09	18.26		17.17
11	7/1	0	.050	1.56	5.52		3.96
12	7/1	0	.055	1.72	8.27		6.55
13	7/1	1	.055	1.72	8.77		7.05
14	7/0	0	.040	1.25	9.02		7.77
15	7/1	0	.045	1.41	7.52		6.11
16	7/0	0	.060	1.88	14.01		12.13
17	7/1	0	.100	3.13	7.52		4.39
18	7/1	0	.150	4.69	8.27		3.58
19	7/1	1	.100	3.13	8.77		5.64
20	7/1	1	.115	3.59	16.76		13.17
21	#6 COAL						
22	6/1	0	2.200	68.75	3.27	65.48	
23	7/1	3	3.185	99.53	71.82	27.71	
24	2/1	0			3.27		
25	7/1	4	3.275	102.34	733.85		631.51
26	6/1	1	1.45	45.31	- .98	46.29	
27	#6 COAL						

Table 93. PROPERTIES OF TWO UNDISTURBED NATURAL SOIL PROFILES AT THE RIVER QUEEN MINE, NEIGHBORHOOD SEVEN

Soil Horizons	Depth (feet)	Color	pH (paste)	Per Thousand Tons of Material: Lime Requirement (tons)	Acid Extracted: K (lbs)	Acid Extracted: Ca (lbs)	Acid Extracted: mg (lbs)	Bicarbonate Extracted: P (lbs)
A_1	0.0-0.5	10YR 6/3	6.7	0	284	3280	192	14.2
B_{21}	0.5-1.7	10YR 6/6	6.7	0	405	2640	216	15.4
B_{22}	1.7-2.0	10YR 6/8	4.5	3.5	171	1120	468	9.6
B_x	2.0-3.6	10YR 6/6	4.4	2.5	92	640	804	9.6
C	3.6-4.3	10YR 7/4	4.6	4.5	64	480	768	4.8
A	0.0-0.3	10YR 5/4	6.5	0	191	1360	84	5.4
B	0.3-1.5	10YR 6/6	5.4	1.5	98	1680	360	5.4
B_x	1.5-2.2	10YR 6/6	4.5	3.0	103	400	672	11.8
C	2.2-4.2	10YR 6/6	4.6	2.5	106	560	456	7.2

Table 94. PHYSICAL CHARACTERIZATIONS OF THE NUMBER ELEVEN AND NUMBER TWELVE COAL OVERBURDENS AT PEABODY COAL COMPANY'S RIVER QUEEN MINE, NEIGHBORHOOD SEVEN

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A_1	0.0-0.3	Soil	10YR 7/6	1
B_1	0.3-0.6	Soil	10YR 7/6	10
B21	0.6-1.8	Soil	10YR 7/6	6
B22t	1.8-2.3	Soil	10YR 7/4	9
B3t	2.3-4.0	Soil	7.5YR 6/8	9
C	4.0-5.0	MS	10YR 8/3	7
1	5.0-8.0	SS	2.5Y 8/2	1
2	8.0-11.0	SS	2.5Y 8/2	1
3	11.0-14.0	SS	2.5Y 8/4	1
4	14.0-17.0	SS	2.5Y 7/6	0
5	17.0-20.0	SS	N 8/0	0
6	20.0-23.0	SS	2.5Y 7/4	0
7	23.0-26.0	SS	5Y 7/1	1
8	26.0-29.0	SS	5YR 6/3	0
9	29.0-32.0	SS	10YR 6/6	1
10	32.0-35.0	SS	5Y 7/1	0
11	35.0-38.0	SS	5Y 7/1	0
12	38.0-41.0	SS	5Y 7/1	0
13	41.0-44.0	SS-I	10YR 6/1	1
14	44.0-52.0	SS-I	2.5Y 6/2	1
15	52.0-53.0	#13 COAL		
16	53.0-56.0	Carb	10YR 3/1	1
17	56.0-59.0	MR-I	10YR 5/1	2
18	59.0-62.0	SS-I	5Y 7/1	1
19	62.0-65.0	SS	5Y 7/1	0
20	65.0-68.0	SS	5Y 7/1	1
21	68.0-71.0	SH	10YR 6/1	4
22	71.0-74.0	MS	5Y 7/1	4
23	74.0-77.0	#12 COAL		
24	77.0-80.0	MS/gyp	5Y 5/1	7
25	80.0-83.0	LS	5Y 7/1	0
26	83.0-86.0	MS/gyp	N 4/0	7
27	86.0-92.0	#11 COAL		

Table 95. CHEMICAL CHARACTERIZATIONS OF THE NUMBER ELEVEN AND NUMBER TWELVE COAL OVERBURDENS AT PEABODY COAL COMPANY'S RIVER QUEEN MINE, NEIGHBORHOOD SEVEN

			Per Thousand Tons of Material					
			Lime Require-	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	ment (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A1	4.3	4.3	4.0	160	2160	648	320	13.2
B1	4.3	4.3	2.0	125	640	216	47	4.5
B21	4.5	4.4	2.5	122	480	708	69	4.5
B22t	4.7	4.7	2.5	111	1120	1320	65	4.5
B3t	5.3	5.2	1.0	111	1680	1968	80	2.2
C	6.4	6.1	0.5	128	1680	1920	82	2.2
1	7.0	7.1	0	95	1600	144	52 G	2.2
2	5.0	5.4	0.5	103	160	72	56 G	2.2
3	5.2	5.2	0.5	106	160	120	54 G	2.2
4	5.3	6.7	0	100	160	48	67 G	7.2
5	6.5	6.8	0	106	80	36	69 G	7.2
6	5.7	5.7	0.5	92	160	60	56 G	0.5
7	4.5	4.5	0.5	55	240	36	52 G	0.5
8	5.8	5.9	0.5	71	160	96	38 G	4.8
9	4.4	4.4	0.5	92	160	36	67 G	4.8
10	5.6	5.6	0.5	81	320	132	88 G	35.4
11	6.6	6.6	0	106	1440	288	75 G	2.4
12	6.5	6.4	0.5	111	560	216	103 G	0.5
13	5.0	5.0	0.5	111	720	192	107 G	2.4
14	4.6	4.6	2.5	31	1760	1536	69 G	4.8
15	#13 COAL							
16	3.0	3.4	2.5	67	3200	720	80 G	4.8
17	5.8	6.3	0.5	136	7920	2160	45 G	2.4
18	7.3	7.4	0	191	7040	2400	58 G	2.4
19	7.5	7.2	0	92	5600	1320	88 G	0.5
20	7.0	6.7	0	98	4080	948	97 G	0.5
21	3.7	3.7	4.5	421	4800	1344	159 G	9.6
22	5.6	5.6	0.5	416	4560	1272	300 G	2.4
23	#12 COAL							
24	5.9	6.6	0	275	10400	1464	26	2.4
25	7.7	7.8	0	111	12160	264	58	2.4
26	4.7	5.2	0.5	390	10560	1248	385 G	47.2
27	#11 COAL							

Table 96. ACID-BASE ACCOUNT OF THE NUMBER ELEVEN AND NUMBER TWELVE COAL OVERBURDENS AT PEABODY COAL COMPANY'S RIVER QUEEN MINE, NEIGHBORHOOD SEVEN

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
A_1	7/6	0	.245	7.66	.58	7.08	
B_1	7/6	0	.030	.94	- .91	1.85	
B_{21}	7/6	0	.020	.62	.07	.55	
B_{22t}	7/4	0	.020	.62	1.32		.70
B_{3t}	6/8	0	.015	.47	5.06		4.59
C	8/3	0	.005	.16	5.34		5.18
1	8/2	0	.020	.62	2.06		1.44
2	8/2	0	.005	.16	.07	.09	
3	8/4	0	.015	.47	.58		.11
4	7/6	0	.015	.47	.07	.40	
5	8/0	0	.005	.16	.58		.42
6	7/4	0	.005	.16	.34		.18
7	7/1	0	.135	4.22	2.33	1.89	
8	6/3	0	.005	.16	2.57		2.41
9	6/6	0	.025	.78	1.58		.80
10	7/1	0	.165	5.16	1.82	3.34	
11	7/1	0	.125	3.91	10.53		6.62
12	7/1	0	.195	6.09	26.78		20.69
13	6/1	0	.190	5.94	7.56		1.62
14	6/2	0	2.300	71.87	23.54	48.33	
15	#13 COAL						
16	3/1	0	1.825	57.03	9.07	47.96	
17	5/1	0	1.475	46.09	85.01		39.92
18	7/1	0	1.025	32.03	82.03		50.00
19	7/1	0	.150	4.69	34.78		30.09
20	7/1	0	.195	6.09	13.06		6.97
21	6/1	0	2.775	86.72	8.57	78.15	
22	7/1	0	.795	24.84	23.04	1.80	
23	#12 COAL						
24	5/1	2	4.35	93.75	111.44	43.25	
25	7/1	3	.295	9.22	895.99		886.77
26	4/0	1	1.750	43.13	32.52	10.61	
27	#11 COAL						

Table 97. PHYSICAL CHARACTERIZATIONS OF THE NUMBER ELEVEN AND NUMBER TWELVE COAL OVERBURDENS AT PEABODY COAL COMPANY'S RIVER QUEEN MINE, NEIGHBORHOOD SEVEN, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-5.0	NOT SAMPLED		
1	5.0-9.0	MS	10YR 7/6	9
2	9.0-11.0	MS-I	7.5YR 5/4	8
3	11.0-13.0	MS-I	10YR 7/4	8
4	13.0-15.0	MS-I	10YR 7/8	6
5	15.0-17.0	MS-I	2.5Y 8/4	7
6	17.0-21.0	SS	N 7/0	6
7	21.0-25.0	SS-I	N 7/0	1
8	25.0-29.0	SS	5Y 7/1	1
9	29.0-33.0	SS	5Y 7/1	1
10	33.0-37.0	SS	5Y 7/1	1
11	37.0-42.0	MR	10YR 6/1	2
12	42.0-47.0	MR	10YR 6/1	2
13	47.0-52.0	MR/gyp	5Y 6/1	2
14	52.0-52.5	Carb	N 2/0	1
15	52.5-56.5	#12 COAL		
16	56.5-58.0	MS/gyp	5Y 7/1	7
17	58.0-59.0	SH/gyp	5Y 5/1	5
18	59.0-63.0	LS	N 7/0	1
19	63.0-64.0	MS/gyp	N 4/0	6
20	64.0-	#11 COAL		

Table 98. CHEMICAL CHARACTERIZATIONS OF THE NUMBER ELEVEN AND NUMBER TWELVE COAL OVERBURDENS AT PEABODY COAL COMPANY'S RIVER QUEEN MINE, NEIGHBORHOOD SEVEN, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Require- ment	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	5.2	5.0	1.5	92	960	312	52	2.4
2	4.5	4.5	3.5	84	640	876	35	2.4
3	6.3	6.3	0.5	95	1120	1200	80	2.4
4	5.0	4.7	0.5	87	720	480	65	19.0
5	5.1	5.0	0.5	92	800	444	47	11.8
6	5.0	5.1	1.5	92	880	636	69	0.5
7	6.1	6.0	0.5	75	400	96	48	16.7
8	6.0	5.5	0.5	64	720	132	192	0.5
9	5.1	5.0	0.5	71	320	84	37	2.4
10	4.6	4.7	0.5	71	1520	132	372G	4.8
11	6.3	6.1	0.5	302	4400	1344	308G	4.8
12	7.1	6.9	0	307	4240	1200	216G	4.8
13	5.3	5.3	0.5	317	4640	1344	256G	2.4
14	1.7	2.2	8.5	71	480	84	34	0.5
15	#12 COAL							
16	5.2	5.1	0.5	302	2320	372	62	0.5
17	6.0	6.5	0	111	10720	1116	20	1.2
18	7.6	7.5	0	103	11680	204	21	0.5
19	6.9	6.7	0	302	6880	756	47	7.2
20	#11 COAL							

Table 99. ACID-BASE ACCOUNT OF THE NUMBER ELEVEN AND NUMBER TWELVE COAL OVERBURDENS AT PEABODY COAL COMPANY'S RIVER QUEEN MINE, NEIGHBORHOOD SEVEN, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	7/6	0	.015	.47	.91		.44
2	5/4	1	.030	.94	.22	.72	
3	7/4	1	.010	.31	3.41		3.10
4	7/8	0	.005	.16	.44		.28
5	8/4	1	.010	.31	.91		.60
6	7/0	1	.020	.62	1.59		.97
7	7/0	1	.015	.47	.91		.44
8	7/1	1	.125	3.91	5.22		1.31
9	7/1	0	.010	.31	.47		.16
10	7/1	0	.090	2.81	3.41		.60
11	6/1	1	.694	21.69	34.03		12.34
12	6/1	1	.435	13.59	26.31		12.72
13	6/1	0	1.300	31.25	22.91	8.34	
14	2/0	0	4.300	134.37	- 4.31	138.68	
15	#12 COAL						
16	7/1	1	.595	12.50	2.50	10.00	
17	5/1	3	7.250	159.37	161.80		
18	7/0	4	.355	11.09	905.31		894.22
19	4/0	2	2.900	75.00	70.56	4.44	
20	#11 COAL						

Table 10Q. PHYSICAL CHARACTERIZATIONS OF THE NUMBER ELEVEN AND NUMBER TWELVE COAL OVERBURDENS AT PEABODY COAL COMPANY'S RIVER QUEEN MINE, NEIGHBORHOOD SEVEN, COLUMN THREE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-23.0			
1	23.0-28.0	SS	10YR 6/3	2
2	28.0-38.0	SS	2.5Y 7/2	1
3	38.0-43.0	MR	10YR 5/1	2
4	43.0-48.0	MR	10YR 5/1	1
5	48.0-53.0	MR	10YR 6/1	3
6	53.0-57.0	#12 COAL		
7	57.0-58.5	MS/gyp	5Y 5/1	6
8	58.5-60.0	MS/gyp	N 7/0	6
9	60.0-64.0	LS	10YR 6/1	0
10	64.0+	#11 COAL		

Table 101. CHEMICAL CHARACTERIZATIONS OF THE NUMBER ELEVEN AND NUMBER TWELVE COAL OVERBURDENS AT PEABODY COAL COMPANY'S RIVER QUEEN MINE, NEIGHBORHOOD SEVEN, COLUMN THREE

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	6.5	6.4	0.5	78	1280	348	183G	2.2
2	5.6	5.7	0.5	84	1120	240	159	2.2
3	5.5	5.7	0.5	380	3200	828	342	13.2
4	5.9	6.0	0.5	405	3440	1128	246G	11.0
5	6.5	6.6	0	374	3520	1320	111G	8.9
6	#12 COAL							
7	5.2	6.3	0.5	147	8800	1272	19	6.7
8	2.4	2.5	5.0	230	4000	684	38	4.5
9	7.4	7.7	0	95	12800	360	22	4.5
10	#11 COAL							

Table 102. ACID-BASE ACCOUNT OF THE NUMBER ELEVEN AND NUMBER TWELVE COAL OVERBURDENS AT PEABODY COAL COMPANY'S RIVER QUEEN MINE, NEIGHBORHOOD SEVEN, COLUMN THREE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	6/3	1	.200	6.25	33.57		27.32
2	7/2	0	.180	5.62	4.31	1.31	
3	5/1	0	1.240	38.75	15.66	23.09	
4	5/1	0	.940	29.37	21.09	8.28	
5	6/1	0	.570	17.81	23.81		6.00
6	#12 COAL						
7	5/1	2	4.350	64.06	51.25	12.81	
8	7/0	0	1.310	22.81	- .69	23.50	
9	6/1	5	.360	11.25	936.25		925.00
10	#11 COAL						

Table 103. PROPERTIES OF THE UNDISTURBED SOIL PROFILE AT THE WILL SCARLET MINE, NEIGHBORHOOD EIGHT

Soil Hori-zons	Depth (feet)	Color	pH (paste)	Per Thousand Tons of Material: Lime Require-ment (tons)	Acid Extracted K (lbs)	Acid Extracted Ca (lbs)	Acid Extracted Mg (lbs)	Bicarbonate Extracted P (lbs)
A_p	0.0-0.5	10YR 5/4	5.9	1.0	89	3200	264	4.8
B_{21}	0.5-1.1	10YR 6/6	4.3	4.0	111	800	432	4.8
B_{22}	1.1-2.2	10YR 6/4	4.3	5.5	136	720	864	5.4
B_3	2.2-2.7	10YR 6/6	4.5	3.5	114	960	1020	22.4
C	2.7+	10YR 6/6	5.1	2.0	81	1120	972	16.7

Table 104. PHYSICAL CHARACTERIZATIONS OF THE DEKOVEN AND DAVIS COAL OVERBURDENS AT PEABODY COAL COMPANY'S WILL SCARLET MINE (PIT # 8), NEIGHBORHOOD EIGHT

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
1	0.0-4.2	Loess	10YR 6/4	7
2	4.2-8.4	Loess	10YR 7/3	9
3	8.4-12.6	OW-Till	10YR 6/6	9
4	12.6-16.8	OW-Till	10YR 7/4	9
5	16.8-21.0	Till-OW	10YR 6/4	10
6	21.0-25.0	Till	2.5Y 7/6	8
7	25.0-28.0	Till	2.5Y 6/2	8
8	28.0-31.0	OW	2.5Y 6/4	5
9	31.0-32.0	LS	5Y 6/1	0
10	32.0-35.6	MS	5Y 7/1	2
11	35.6-39.2	SS	N 8/0	0
12	39.2-42.8	MS	10YR 5/2	3
13	42.8-46.4	MS	10YR 6/1	3
14	46.4-50.0	SS-I	10YR 6/1	2
15	50.0-54.1	MS	N 8/0	1
16	54.1-58.2	MS	N 8/0	1
17	58.2-62.3	SS	N 8/0	1
18	62.3-66.4	SS	5Y 6/1	1
19	66.4-70.5	SS	5Y 7/1	1
20	70.5-71.5	SS-I	N 7/0	1
21	71.5-73.5	UPPER DEKOVEN COAL		
22	73.5-76.0	Carb	10YR 3/1	-
23	76.0-77.3	LOWER DEKOVEN COAL		
	77.3-80.0	NOT SAMPLED		
24	80.0-82.5	DAVIS COAL		

Table 105. CHEMICAL CHARACTERIZATION OF THE DEKOVEN AND DAVIS COAL OVERBURDEN AT PEABODY COAL COMPANY'S WILL SCARLET MINE (PIT #8), NEIGHBORHOOD EIGHT

Sample No.	pH (paste)	pH (1:1)	Per Thousand Tons of Material: Lime Requirement (tons)	Acid Extracted: K (lbs.)	Acid Extracted: Ca (lbs.)	Acid Extracted: Mg (lbs.)	Acid Extracted: P (lbs.)	Bicarbonate Extracted P (lbs.)
1	5.1	5.0	2.0	150	2160	168	47	15.4
2	5.0	5.1	1.5	95	800	300	65	8.9
3	6.5	6.5	0	114	1920	672	111	22.0
4	6.6	6.6	0	84	1360	456	94	20.0
5	7.3	7.2	0	75	1040	252	80	6.7
6	7.4	7.5	0	167	3920	900	256	22.0
7	7.6	7.6	0	142	9600	900	56	6.7
8	7.7	7.7	0	153	7360	564	91M	4.5
9	7.4	7.6	0	167	9760	228	22	4.5
10	7.9	7.8	0	187	2400	552	85	2.2
11	8.4	8.0	0	171	3600	696	153G	2.2
12	7.8	7.9	0	234	5360	888	200G	4.5
13	6.7	6.7	0	261	3040	552	342G	2.2
14	7.3	7.8	0	167	4480	840	100M	4.5
15	6.9	7.2	0	160	2000	456	159G	2.2
16	7.6	7.9	0	147	6000	1560	100M	2.2
17	7.2	7.3	0	114	4000	1008	82M	2.2
18	2.7	3.2	3.0	114	2160	828	119G	8.9
19	3.9	4.2	0.5	71	1600	216	300	6.7
20	6.7	5.9	0.5	139	4080	1464	38	0.5
21	UPPER DEKOVEN COAL							
22	2.3	2.4	8.0	84	4640	1512	216G	22.0
23	LOWER DEKOVEN COAL							
24	DAVIS COAL							

Table 106. ACID-BASE ACCOUNT OF THE DEKOVEN AND DAVIS COAL OVERBURDENS AT PEABODY COAL COMPANY'S WILL SCARLET MINE (PIT #8), NEIGHBORHOOD EIGHT

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	6/4	0	.030	.94	2.52		1.58
2	7/3	1	.020	.63	1.27		.64
3	6/6	0	.005	.16	.27		.11
4	7/4	0	.005	.16	1.77		1.61
5	6/4	0	.005	.16	2.52		2.36
6	7/6	0	.005	.16	6.27		6.11
7	6/2	2	.060	1.88	337.42		333.54
8	6/4	2	.065	2.03	340.50		338.47
9	6/1	4	.565	17.66	500.43		482.77
10	7/1	0	.085	2.66	15.51		12.85
11	8/0	0	.005	.16	21.26		21.10
12	5/2	0	.090	2.81	15.26		12.45
13	6/1	0	.385	12.03	15.26		3.23
14	6/1	1	.205	6.41	22.26		15.85
15	8/0	1	.260	8.13	14.51		6.83
16	8/0	1	.120	3.75	44.50		40.75
17	8/0	1	.105	3.28	41.50		38.22
18	6/1	0	2.850	89.06	.77	88.29	
19	7/1	1	.300	9.38	.02	9.36	
20	7/0	1	1.875	58.59	46.50	12.09	
21	UPPER DEKOVEN COAL						
22	3/1	0	12.050	376.56	3.52	373.04	
23	LOWER DEKOVEN COAL						
24	DAVIS COAL						

Table 107. PROPERTIES OF REPLICATE UNDISTURBED NATURAL SOIL PROFILE HORIZONS SAMPLED AT INTERVALS ABOVE THE HIGH WALL OF THE EAGLE MINE

				Per Thousand Tons of Material				
				Lime Requirement	Acid Extracted			Bicarbonate Extracted
Soil Horizons	Depth (feet	Color	pH (paste)	(tons)	K (lbs)	Ca (lbs)	Mg (lbs)	P (lbs)
A_p	0.0-0.5	10YR 5/4	5.4	1.5	122	2000	216	5.4
B_1	0.5-1.1	10YR 5/6	5.7	1.5	114	2400	300	16.7
B_{21t}	1.1-1.9	10YR 5/6	5.7	1.5	139	2880	504	33.0
B_{22t}	1.9-2.8	10YR 5/6	5.7	1.5	139	2080	480	44.7
B_{3t}	2.8-4.9	10YR 5/6	5.4	1.5	136	2080	588	51.6
C	4.9+	10YR 6/6	5.4	1.0	145	1520	564	43.4
B	0.1-3.8	10YR 5/6	4.8	2.5	131	960	552	21.2
C	3.8+	10YR 6/6	4.9	3.0	95	1200	708	30.8
B	0.1-2.2	10YR 5/8	4.8	3.5	106	1040	744	27.0
C	2.2-3.5	10YR 6/4	7.3	0	49	6560	2400+	3.6
B	1.0-1.1	10YR 7/4	4.3	2.0	114	640	228	8.4
C	1.1+	10YR 7/6	4.5	2.5	120	880	636	8.4
A	0.0-0.5	10YR 5/4	5.4	2.0	120	1920	384	10.8
B	0.5-1.7	10YR 6/4	4.5	2.0	100	1120	300	9.6
A-B	3.5-4.1	10YR 5/4	5.2	1.5	87	1840	384	10.8

Table 108. PHYSICAL CHARACTERIZATIONS OF THE DEKOVEN AND DAVIS COAL OVERBURDENS AT PEABODY COAL COMPANY'S EAGLE MINE, NEIGHBORHOOD EIGHT

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
1	0.0-3.2	Loess	10YR 7/6	10
2	3.2-6.4	Loess	10YR 7/4	10
3	6.4-9.6	Loess	10YR 8/4	9
4	9.6-12.8	SS	10YR 8/1	0
5	12.8-16.0	MR	10YR 8/3	1
6	16.0-19.2	MR	10YR 7/4	2
7	19.2-22.4	MR	10YR 6/3	0
8	22.4-25.5	MR	10YR 6/4	3
9	25.5-28.0	Carb	N 2/0	1
10	28.0-32.0	MR	2.5Y 8/2	3
11	32.0-36.0	MR	5Y 8/1	1
12	36.0-40.0	MR	5Y 7/1	1
13	40.0-43.0	SS	N 8/0	1
14	43.0-46.0	SS	N 8/0	1
15	46.0-48.7	SS-I	10YR 6/1	0
16	48.7-51.4	SS-I	10YR 6/1	0
17	51.4-54.0	SS-I	10YR 7/1	0
18	54.0-56.7	MR	10YR 6/1	0
19	56.7-59.4	SS-I	5Y 6/1	1
20	59.4-62.0	SS-I	10YR 6/1	0
21	62.0-64.7	SS	10YR 7/1	0
22	64.7-67.4	SS-I	10YR 6/1	1
23	67.4-70.0	MR	10YR 6/1	1
24	70.0-73.0	DEKOVEN COAL		
25	73.0-75.5	MR	10YR 8/1	3
26	75.5-77.5	SS	10YR 8/1	0
27	77.5-79.5	SS	10YR 8/1	0
28	79.5-81.5	SS	10YR 8/1	1
29	81.5-85.5	SS-I	10YR 6/1	0
30	85.5-88.0	MR	10YR 6/1	0
31	88.0-90.5	MR	10YR 6/1	0
32	90.5-93.0	MR	10YR 6/1	0
33	93.0-95.5	Carb	10YR 4/1	1
34	95.5-98.5	DAVIS COAL		

Table 109. CHEMICAL CHARACTERIZATIONS OF THE DEKOVEN AND DAVIS COAL OVERBURDENS AT PEABODY COAL COMPANY'S EAGLE MINE, NEIGHBORHOOD EIGHT

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	4.8	4.7	1.0	125	1120	732	67	17.6
2	7.6	7.5	0	73	5600	2400	67	8.9
3	7.6	7.4	0	62	3120	1140	94	6.7
4	7.9	7.0	0	58	720	336	40	2.2
5	7.2	6.9	0	183	1920	756	119	11.0
6	7.2	6.9	0	167	2480	1020	115	15.1
7	7.1	6.9	0	179	2800	1104	132	26.5
8	7.3	7.1	0	293	2800	1152	183	40.0
9	6.2	5.8	2.5	275	7360	2400	103	13.2
10	7.5	7.3	0	179	1520	612	80	2.4
11	8.0	7.7	0	293	1840	420	300 G	2.4
12	7.8	7.3	0	243	1120	480	85 G	2.4
13	7.8	7.2	0	122	1280	288	183 G	2.4
14	8.1	7.7	0	147	2480	660	123 G	0.5
15	8.0	7.6	0	247	2640	864	200 G	0.5
16	7.9	7.4	0	275	2240	816	159 G	0.5
17	7.8	7.5	0	153	4160	1200	132 G	2.4
18	8.0	7.8	0	332	2400	960	147 G	1.2
19	7.9	7.5	0	175	4480	1272	123 G	2.4
20	7.8	7.4	0	266	2080	684	238 G	1.2
21	8.2	7.8	0	136	4720	2400	100 G	0.5
22	7.7	7.4	0	210	2160	660	200 G	0.5
23	7.6	7.2	0	247	1760	540	192 G	2.4
24	DEKOVEN COAL							
25	3.1	3.5	1.0	218	2000	660	45	2.4
26	7.1	7.1	0	103	5520	1800	72 G	0.5
27	7.1	6.7	0	139	600	192	115	0.5
28	7.3	6.9	0	100	1600	516	48 G	2.4
29	7.0	6.3	2.0	179	3120	1248	137 G	0.5
30	7.2	7.0	0	437	3280	900	360 G	0.5
31	7.0	6.9	0	405	6240	1704	294 G	0.5
32	7.1	6.9	0	364	7200	1944	183 G	0.5
33	7.1	6.2	0.5	353	7840	1968	132 G	7.2
34	DAVIS COAL							

Table 110. ACID-BASE ACCOUNT OF THE DEKOVEN AND DAVIS COAL OVERBURDENS AT PEABODY COAL COMPANY'S EAGLE MINE, NEIGHBORHOOD EIGHT

				Tons $CaCO_3$ Equivalent/Thousand Tons Material			
Sample No.	Value and Chroma	Fiz	%S	Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	7/6	0	.005	.16	2.33		2.17
2	7/4	1	.010	.31	154.54		154.23
3	8/4	0	.010	.31	6.07		5.76
4	8/1	0	.010	.31	1.58		1.27
5	8/3	0	.005	.16	3.82		3.66
6	7/4	0	.005	.16	5.06		4.90
7	6/3	0	.010	.31	6.31		6.00
8	6/4	0	.005	.16	5.33		5.17
9	2/0	0	.100	3.12	15.31		12.19
10	8/2	0	.020	.62	2.83		2.21
11	8/1	0	.090	2.81	6.82		4.01
12	7/1	0	.065	2.03	14.81		12.78
13	8/0	1	.050	1.56	6.58		5.02
14	8/0	1	.015	.47	18.48		18.01
15	6/1	1	.085	2.66	25.03		22.37
16	6/1	1	.100	3.12	23.78		20.06
17	7/1	1	.065	2.03	35.78		33.75
18	6/1	1	.045	1.41	16.56		15.15
19	6/1	0	.045	1.41	30.85		29.44
20	6/1	0	.100	3.12	15.79		12.67
21	7/1	0	.020	.62	27.53		26.91
22	6/1	0	.125	3.91	24.79		20.88
23	6/1	0	.050	1.56	29.04		27.48
24	DEKOVEN COAL						
25	8/1	0	.140	4.37	- 1.42	5.79	
26	8/1	0	.050	1.56	27.79		26.23
27	8/1	0	.015	.47	21.79		21.32
28	8/1	0	.040	1.25	6.31		5.06
29	6/1	1	.575	17.97	24.53		6.56
30	6/1	0	.600	18.75	25.03		6.28
31	6/1	1	1.750	54.69	19.80	34.89	
32	6/1	1	2.150	67.19	26.78	40.41	
33	4/1	1	3.025	94.53	40.75	53.78	
34	DAVIS COAL						

Table 111. PROPERTIES OF THE UNDISTRUBED NATURAL SOIL PROFILES AT THE WALKER AND DUQUOIN PITS OF THE BURNING STAR #2 MINE, NEIGHBORHOOD NINE

				Per Thousand Tons of Material				
				Lime				Bicarbonate
Soil				Require-	Acid Extracted			Extracted
Hori-	Depth		pH	ment	K	Ca	Mg	P
zons	(feet)	Color	(paste)	(tons)	(lbs)	(lbs)	(lbs)	(lbs)
A_1	0.0-1.0	10YR 6/3	6.4	1.0	668	5200	516	
B_{21t}	1.0-1.5	10YR 6/6	4.5	2.0	507	1520	444	33.1
B_{22t}	1.5-1.8	10YR 6/6	4.2	4.0	507	1040	336	10.8
B_{23tg}	1.8-2.1	10YR 7/3	4.0	5.5	596	1200	516	5.4
B_x	2.1-3.1	10YR 6/4	4.1	5.0	364	1360	996	7.2
C	3.1-5.0	10YR 6/6	4.4	3.0	139	1440	1176	24.8
			DUQUOIN PIT					
A_p	0.0-0.9	10YR 5/3	6.0	1.0	69	3360	252	10.8
A_{21}	0.9-1.5	10YR 6/2	4.4	2.5	55	1440	132	5.4
A_{22}	1.5-2.1	10YR 6/2	4.2	3.0	60	1200	204	8.4
B_{2t}	2.1-3.8	10YR 6/3	4.3	6.0	136	2000	636	4.8

Table 112. PHYSICAL CHARACTERIZATIONS OF THE NUMBER SIX (HERRIN) COAL OVERBURDEN AT CONSOLIDATED COAL COMPANY'S BURNING STAR NUMBER TWO MINE (WALKER PIT), NEIGHBORHOOD NINE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-41.5	NOT SAMPLED		
1	41.5-43.0	LS	5Y 8/1	0
2	43.0-45.2	LS	5Y 8/1	0
3	45.2-46.2	LS	5Y 8/1	0
4	46.2-46.9	LS	10YR 8/3	0
5	46.9-48.4	LS	5Y 8/1	0
6	48.4-49.2	LS	5Y 8/1	0
7	49.2-50.2	SH	5Y 7/1	8
8	50.2-51.5	SH	5Y 5/1	4
9	51.5-53.2	SH	5Y 5/1	4
10	53.2-54.8	SH	5Y 5/1	2
11	54.8-56.0	SH	5Y 4/1	0
12	56.0-57.0	LS	5Y 5/1	0
13	57.0-58.8	LS	5Y 5/1	0
14	58.8-60.5	MS	5Y 4/1	0
15	60.5-61.2	MS	10YR 4/1	0
16	61.2-61.7	Carb	N 2/0	0
17	61.7-62.2	Carb	5Y 2/1	0
18	62.2-64.2	LS	5Y 6/1	0
19	64.2-66.0	LS	5Y 6/1	0
20	66.0-68.8	LS	5Y 7/1	0
21	68.8-70.2	Carb	5Y 2/1	0
22	70.2-71.2	Carb	10YR 2/1	0
23	71.2-72.1	Carb	N 2/0	0
	CORE IS OFFSET AT THIS POINT			
24	70.5-70.8	Carb	5Y 2/1	0
25	70.8-73.0	SH	5Y 6/1	2
26	73.0-74.2	SH	10YR 4/1	1
27	74.2-79.5	#6 COAL (HERRIN)		
28	79.5-79.8	MS	5YR 5/1	8

Table 113. CHEMICAL CHARACTERIZATIONS OF THE NUMBER SIX (HERRIN) COAL OVERBURDEN AT CONSOLIDATED COAL COMPANY'S BURNING STAR NUMBER TWO MINE (WALKER PIT), NEIGHBORHOOD NINE

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	8.1	7.8	0	106	5760	198	22	2.2
2	7.9	8.0	0	78	9760	276	26	2.2
3	8.1	8.1	0	106	3600	120	24	4.5
4	8.3	8.2	0	87	6120	186	25	4.5
5	7.9	7.8	0	64	11040	240	22	2.2
6	8.2	8.0	0	71	2000	36	22	2.2
7	7.7	7.6	0	353	1520	288	372G	2.2
8	3.5	3.5	4.0	171	1840	504	320G	31.9
9	3.4	4.6	1.5	167	2240	672	238	15.9
10	3.5	3.8	2.5	252	920	288	360G	20.5
11	3.1	6.4	0.5	416	2240	486	372	13.6
12	7.5	7.7	0	198	7040	306	38	4.5
13	7.8	7.9	0	214	10560	552	31	4.5
14	7.6	7.4	0	302	5600	684	34	4.5
15	7.4	7.3	0	289	5520	570	34	4.5
16	5.1	6.6	0	307	3040	456	67	70.7
17	7.2	7.3	0	312	7400	888	35	4.5
18	7.2	7.8	0	183	5720	192	26	4.5
19	7.8	7.7	0	156	5960	168	24	4.5
20	7.9	7.7	0	98	2480	54	23	4.5
21	6.5	5.2	0.5	390	6200	1992	308	4.5
22	4.6	3.6	3.0	453	3440	1656	153	2.2
23	7.2	7.3	0	293	3240	1320	174	
		CORE IS OFFSET AT THIS POINT						
24	6.8	7.3	0	284	5880	1296	159	5.5
25	3.4	3.5	5.5	73	3840	1134	183G	49.0
26	2.4	2.6	6.5	87	1480	900	137G	41.0
27	#6 COAL (HERRIN)							
28	3.5	3.7	3.0	459	560	312	77	2.2

Table 114. ACID-BASE ACCOUNT OF THE NUMBER SIX (HERRIN) COAL OVERBURDEN AT CONSOLIDATED COAL COMPANY'S BURNING STAR NUMBER TWO MINE (WALKER PIT), NEIGHBORHOOD NINE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	8/1	5	.085	2.66	678.15		675.49
2	8/1	5	.195	6.09	676.86		670.77
3	8/1	5	.015	.47	534.06		533.59
4	8/3	5	.005	.16	688.22		688.06
5	8/1	5	.860	26.87	746.39		719.52
6	8/1	5	.280	8.75	689.51		680.76
7	7/1	2	1.415	44.22	15.07	29.15	
8	5/1	0	1.785	55.78	2.27	53.51	
9	5/1	0	3.360	105.00	.50	104.50	
10	5/1	0	2.740	85.62	1.77	83.85	
11	4/1	0	1.400	43.75	1.77	41.98	
12	5/1	5	1.570	49.06	297.35		248.29
13	5/1	5	.600	18.75	417.44		398.69
14	4/1	5	2.225	69.53	251.96		182.43
15	4/1	5	2.250	70.31	167.18		96.87
16	2/0	1	2.675	83.59	12.83	70.76	
17	2/1	4	2.500	78.12	60.89	17.23	
18	6/1	5	.550	17.19	707.05		689.86
19	6/1	5	.325	10.16	660.48		650.32
20	7/1	5	.150	4.69	850.11		845.42
21	2/1	0	1.625	50.78	11.82	38.96	
22	2/1	0	1.675	52.34	7.48	44.86	
23	2/0	1	3.750	117.19	29.14	88.05	
			CORE IS OFFSET AT THIS POINT				
24	2/1	0	1.850	57.81	35.93	21.88	
25	6/1	0	2.520	78.75	1.52	77.23	
26	4/1	0	3.250	101.56	- 13.81	115.37	
27	#6 COAL (HERRIN)						
28	5/1	0	.690	21.56	2.53	19.03	

Table 115. PHYSICAL CHARACTERIZATIONS OF THE NUMBER SIX (HERRIN) COAL OVERBURDEN AT CONSOLIDATED COAL COMPANY'S BURNING STAR NUMBER TWO MINE (DUQUOIN PIT), NEIGHBORHOOD NINE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A	0.0-0.5	Soil	2.5Y 7/2	7
B	0.5-2.4	Soil	10YR 7/2	10
C	2.4-4.3	Soil	2.5Y 7/2	10
1	4.3-6.3	LOESS	2.5Y 7/2	10
2	6.3-8.2	Till	2.5Y 7/2	10
3	8.2-10.1	Till	2.5Y 7/2	10
4	10.1-12.0	Till	2.5Y 7/4	9
5	12.0-13.9	Till	2.5Y 7/2	8
6	13.9-15.8	Till	2.5Y 7/2	8
7	15.8-17.8	Till	2.5Y 7/4	7
8	17.8-19.7	Till	2.5Y 7/6	8
9	19.7-21.6	Till	5Y 7/3	10
10	21.6-23.5	Till	2.5Y 7/6	10
11	23.5-24.8	Till	2.5Y 7/6	10
12	24.8-25.8	MS	2.5Y 8/2	9
13	25.8-27.7	MS	5Y 7/2	10
14	27.7-28.7	MS	5Y 7/2	10
15	28.7-30.6	MS	5Y 7/3	10
16	30.6-32.5	MS	5Y 7/3	10
17	32.5-34.4	MS	5Y 7/3	10
18	34.4-35.4	MS	5Y 7/3	10
19	35.4-35.8	MS	2.5Y 8/4	10
20	35.8-37.7	MS	5Y 7/3	10
21	37.7-39.6	MS	5Y 8/3	2
22	39.6-42.3	MS	2.5Y 7/8	2
23	42.3-44.4	LS	2.5Y 8/2	0
24	44.4-46.3	LS	2.5Y 8/2	2
25	46.3-48.3	LS	LOST SAMPLE	
26	48.3-50.2	LS	10YR 8/1	0
27	50.2-52.1	LS	10YR 8/1	0
28	52.1-53.1	MS	10YR 7/2	1
29	53.1-55.0	MS	5Y 7/1	3
30	55.0-56.9	MS	5Y 7/1	2
31	56.9-58.8	MS	5Y 7/1	2
32	58.8-59.8	MS	5Y 7/1	4
33	59.8-62.3	SH	5Y 6/1	0
34	62.3-64.2	LS	N 8/0	0
35	64.2-67.1	LS	5Y 7/1	0

Table 115. (continued)

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
36	67.1-	Carb	N 2/0	0
36A	-69.0	Carb	5Y 3/1	0
37	69.0-70.9	Carb	5Y 2/1	0
38	70.9-71.4	Carb	N 3/0	4
39	71.4-73.3	Carb	5Y 2/2	1
40	73.3-79.3	#6 COAL (HERRIN)		

Table 116. CHEMICAL CHARACTERIZATIONS OF THE NUMBER SIX (HERRIN) COAL OVERBURDEN AT CONSOLIDATED COAL COMPANY'S BURNING STAR NUMBER TWO MINE (DUQUOIN PIT), NEIGHBORHOOD NINE

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A	7.6	7.1	0	195	7520	948	111	32.0
B	4.7	4.3	3.0	153	2720	804	147	29.8
C	5.1	4.1	3.5	147	2320	744	183	66.5
1	5.4	5.1	1.5	134	2720	780	216	58.6
2	6.3	6.2	.5	100	3120	960	300	39.8
3	6.6	6.4	.5	95	3040	972	256	39.8
4	6.7	6.6	0	87	3680	1296	192	38.8
5	7.4	7.1	0	92	3600	1392	174	20.9
6	5.8	7.1	0	92	3840	1440	174	13.2
7	7.1	7.0	0	89	4560	1632	159	4.2
8	7.8	7.3	0	81	7760	1440	111	12.1
9	8.1	7.2	0	117	6560	1320	238	11.2
10	6.8	7.2	0	87	4320	1296	308	15.4
11	6.6	7.2	0	98	6160	1680	294	11.2
12	6.2	6.7	0	98	3040	1044	183	10.2
13	6.2	6.8	0	238	3120	1140	200	5.5
14	6.3	7.1	0	289	7760	1272	372	5.5
15	6.8	7.6	0	142	10560	1128	80	6.6
16	6.9	7.7	0	131	10400	1008	38	4.2
17	6.5	7.8	0	145	10560	1056	38	4.2
18	6.7	7.5	0	164	10720	1200	72	8.9
19	6.6	7.2	0	238	6080	1068	372	4.2
20	6.9	7.4	0	175	9600	1044	128	6.6
21	6.7	7.6	0	139	11360	984	34	5.5
22	6.9	7.3	0	120	11200	828	31	15.4
23	7.3	7.8	0	87	12480	228	16	5.5
24	7.5	7.8	0	89	12640	252	13	7.8
25	LOST SAMPLE							
26	7.8	8.0	0	78	13920	204	12	6.6
27	7.6	8.0	0	84	13600	240	10	5.5
28	7.1	7.4	0	187	10560	756	75	6.6
29	7.1	7.5	0	312	10080	804	246	4.2
30	7.4	7.6	0	338	7120	792	385	6.2
31	6.5	7.5	0	380	5600	804	342	2.2
32	6.7	7.6	0	474	3440	864	246	2.2

Table 116. (continued)

Sample No.	pH (paste)	pH (1:1)	Per Thousand Tons of Material: Lime Requirement (tons)	Acid Extracted: K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	Bicarbonate Extracted P (lbs.)
33	7.1	7.7	0	307	10400	852	21	3.4
34	7.7	8.3	0	125	16000	312	12	8.9
35	7.3	8.1	0	89	12640	240	7	3.4
36								
36A	5.9	6.3	.5	69	12640	360	18	18.8
37	3.0	3.4	4.5	117	4720	1080	342	6.6
38	3.0	3.0	3.5	92	4000	1320	342	20.9
39	2.8	3.0	6.0	78	3360	1008	360	11.2
40	#6 COAL (HERRIN)							

Table 117. ACID-BASE ACCOUNT OF THE NUMBER SIX (HERRIN) COAL OVERBURDEN AT CONSOLIDATED COAL COMPANY'S BURNING STAR NUMBER TWO MINE (DUQUOIN PIT), NEIGHBORHOOD NINE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
A	7/2	1	.030	.94	13.17		12.23
B	7/2	0	.015	.47	.75		.28
C	7/2	0	.005	.16	1.72		1.56
1	7/2	0	.005	.16	2.97		2.81
2	7/2	0	.005	.16	4.20		4.04
3	7/2	0	.010	.31	5.17		4.86
4	7/4	0	.005	.16	5.67		5.51
5	7/2	0	.005	.16	5.67		5.51
6	7/2	0	.005	.16	5.67		5.51
7	7/4	1	.005	.16	7.40		7.24
8	7/6	1	.005	.16	15.52		15.36
9	7/3	1	.005	.16	11.82		11.66
10	7/6	0	.005	.16	6.90		6.74
11	7/6	0	.005	.16	30.80		30.64
12	8/2	0	.125	3.91	3.70	.21	
13	7/2	0	.015	.47	5.80		5.34
14	7/2	0	.005	.16	14.05		13.89
15	7/3	4	.005	.16	105.19		105.03
16	7/3	4	.010	.31	148.50		148.19
17	7/3	4	.010	.31	137.36		137.05
18	7/3	2	.005	.16	35.72		35.56
19	8/4	0	.005	.16	9.62		9.46
20	7/3	1	.005	.16	35.97		35.81
21	8/3	4	.005	.16	74.25		74.09
22	7/8	5	.040	1.25	141.07		139.82
23	8/2	5	.025	.78	549.45		548.67
24	8/2	5	.015	.47	564.30		563.83
25	LOST SAMPLE						
26	8/1	5	.020	.62	628.65		628.03
27	8/1	5	.025	.78	594.00		593.22
28	7/2	1	.280	8.75	37.20		28.45
29	7/1	1	1.210	37.81	23.15	14.66	
30	7/1	0	.425	13.28	19.70		6.42
31	7/1	0	.435	13.59	18.97		5.38
32	7/1	0	.865	27.03	18.72	8.31	
33	6/1	4	.300	9.37	79.20		69.83

Table 117 (continued)

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
34	8/0	5	.155	4.84	644.74		639.90
35	7/1	5	.330	10.31	631.12		620.81
36					11.75		
36A	3/1	4			259.89		
37	2/1	0	2.950	92.19	- .72	92.91	
38	3/0	0	2.000	62.50	- .97	63.47	
39	2/2	0	1.900	59.37	- .72	60.09	
40	#6 COAL (HERRIN)						

Table 118. PHYSICAL CHARACTERIZATIONS OF THE NUMBER SIX (HERRIN) COAL OVERBURDEN AT CONSOLIDATED COAL COMPANY'S BURNING STAR NUMBER TWO MINE (DUQUOIN PIT), NEIGHBORHOOD NINE, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-2.0	NOT SAMPLED		
B	2.0-3.0	Soil	10YR 7/4	5
C	3.0-6.0	LOESS	10YR 7/3	10
1	6.0-9.0	Till	10YR 7/4	9
2	9.0-12.0	Till	10YR 7/4	10
3	12.0-15.0	LOST SAMPLE		
4	15.0-18.0	MS	5Y 8/2	
5	18.0-21.0	MS	2.5Y 8/2	10
6	21.0-24.0	MS	2.5Y 8/3	9
7	24.0-27.0	MS	N 8/0	
8	27.0-30.0	MS	2.5Y 8/2	4
9	30.0-33.0	LS	5Y 8/1	1
10	33.0-36.0	LS	5Y 8/1	0
11	36.4-38.5	MS	5Y 6/1	0
12	38.5-40.7	MS	5Y 5/1	0
13	40.7-41.3	MS	5Y 7/1	0
14	41.3-44.7	LS	5Y 7/1	0
15	44.7-48.0	LS	N 8/0	0
16	48.0-50.0	Carb	N 2/0	
17	50.0-51.8	Carb	N 2/0	
18	51.8-53.2	Carb	5Y 2/1	
19	53.2-54.5	SH	5Y 4/1	
20	54.5-60.8	#6 COAL (HERRIN)		
21	60.8-62.6	MS	N 8/0	0
22	62.6-64.4	MS	N 8/0	4

Table 119. CHEMICAL CHARACTERIZATIONS OF THE NUMBER SIX (HERRIN) COAL OVERBURDEN AT CONSOLIDATED COAL COMPANY'S BURNING STAR NUMBER TWO MINE (DUQUOIN PIT), NEIGHBORHOOD NINE, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
B	5.2	5.2	3.0	92	2000	528	45	1.2
C	7.9	8.3	0	109	3840	828	192	23.6
1	8.0	8.1	0	171	3040	840	142	23.6
2	7.6	7.6	0	142	2320	756	137	16.7
3	LOST SAMPLE							
4	7.9	7.8	0	109	9760	1440	38	2.4
5	7.8	7.8	0	218	10080	1392	34	2.4
6	7.8	7.8	0	134	9760	1584	32	2.4
7		7.6	0	410	10080	1584	21	0.5
8	7.6	7.2	0	222	5360	1344	27	0.5
9	8.3	8.2	0	139	12160	264	15	0.5
10	8.1	8.1	0	142	11200	180	15	2.4
11	7.4	7.2	0	234	5040	252	27	4.8
12	7.3	7.4	0	210	6080	234	26	9.6
13	7.4	7.4	0	214	7360	444	25	19.0
14	7.5	7.4	0	206	4400	168	29	2.4
15	7.7	7.6	0	73	6480	84	19	4.8
16	4.0	4.0	1.5	275	4480	612	385	2.4
17	7.0	6.9	0	275	7680	984	385	0.5
18	2.8	2.7	4.0	44	1360	552	320	1.2
19	3.0	2.9	5.5	27	2120	792	137G	2.4
20	#6 COAL (HERRIN)							
21	8.7	8.2	0	385	720	48	27	2.4
22	9.1	8.8	0	322	2720	108	26	

Table 120. ACID-BASE ACCOUNT OF THE NUMBER SIX COAL OVERBURDEN AT CONSOLIDATED COAL COMPANY'S BURNING STAR NUMBER TWO MINE (DUQUOIN PIT), NEIGHBORHOOD NINE, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
B	7/4	0	.035	1.09	1.54		.45
C	7/3	0	.030	.94	56.45		55.51
1	7/4	0	.030	.94	4.73		3.79
2	7/4	0	.020	.63	3.74		3.11
3	LOST SAMPLE						
4	8/2	2	.020	.63	49.54		48.91
5	8/2	3	.050	1.56	208.60		207.04
6	8/3	2	.020	.63	192.66		192.03
7	8/0	2	1.275	39.84	430.86		391.02
8	8/2	2	.310	9.69	351.16		341.47
9	8/1	4	.030	.94	243.89		242.95
10	8/1	4	.145	4.53	755.58		751.05
11	6/1	3	1.335	41.72	392.32		350.60
12	5/1	4	1.000	31.25	417.84		386.59
13	7/1	4	1.145	35.78	697.69		661.90
14	7/1	3	.950	29.69	611.49		581.80
15	8/0	4	.200	6.25	950.46		944.21
16	2/0	0			6.19		
17	2/0	0			20.54		
18	2/1	0			- 1.73		
19	4/1	0	2.525	78.91	- 7.17	86.06	
20	#6 COAL (HERRIN)						
21	8/0	4	1.250	39.06	607.39		568.33
22	8/0	4	.770	24.06	467.09		443.03

SECTION IX

INTERIOR COAL PROVINCE: WESTERN REGION

SUMMARY

Coals or horizons involved in the Western Interior Basin (Figure 7), within the middle part of the Pennsylvanian are as follows:

- Mulberry (Midway Mine) (Highest in the geologic section)
- Summit (Not mined, but present, 9.1 m (30 ft) above the Bevier coal at the Mark Twain Mine).
- Mulky (Mined at Bee Veer and Power Mines).
- Bevier (Mined at Bee Veer, Prairie Hill and Tebo).
- Wheeler (With Bevier at Bee Veer, Prairie Hill and Tebo).
- Croweburg (Sierra Mine, Oklahoma, Adjunct).
- Tebo (Power and Tebo Mines).
- Weir-Pittsburg (Power Mine) (Lowest in the geologic section).

Natural, original soils that might be worth stockpiling for use in the new minesoils would include the brown sandy loam soil and underlying weathered sandstones that occurs in the environs of the Tebo mine; and dark, thick (30 cm: 1 ft) fine silty surface soil horizons over clayey subsoils that occur commonly around Power, Tebo and Midway mines. The brown, sandy loam soil offers promise for improving clayey textures, especially because the upper part of the weathered bedrock (sandstone) could be included in some places. Clayey subsoils or claypans would be undesirable and might cause segregation of surface layers to be impractical.

Neutralizing materials are adequate to assure non-toxic minesoils and neutral waters at each site studied, either by burial of potentially toxic materials or by blending.

Horizons containing gypsum were identified by "Gyp" under rock type and calculations of potential acidity were corrected, accordingly, since sulphur in gypsum does not form more mineral acidity.

Acid-Base Accounting is needed in order to detect potentially acid-toxic horizons or to clarify observations, because such horizons

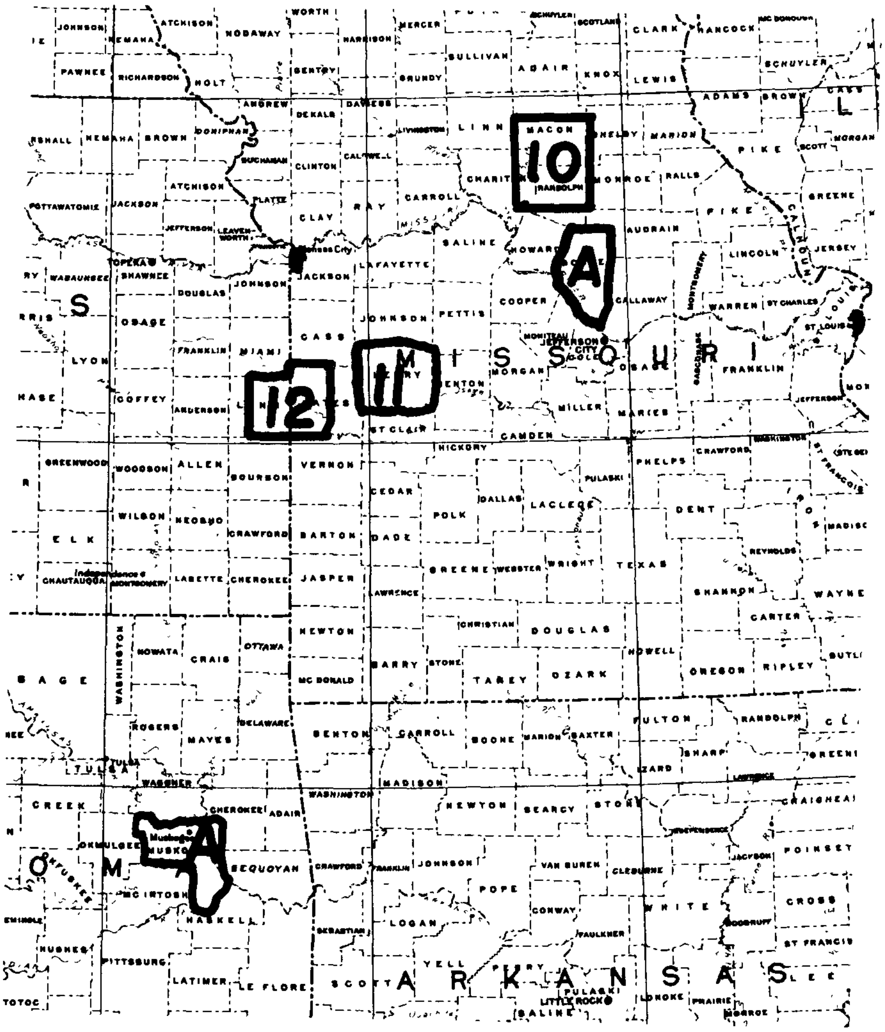


Figure 7. Neighborhoods in the Western Region, Interior Coal Province.

range in color values from black to white (Munsell Values 1 to 8) and in rock type from hard bone-coal (carbolith) to soft, massive mudstone.

It is known that phosphatic nodules occur in certain horizons of overburdens sampled, and phosphate concentrations may offer opportunities for creating minesoils rich in phosphorus as well as neutral in pH and high in other plant nutrients.

NEIGHBORHOOD 10: BEE VEER AND PRAIRIE HILL MINES, MACON AND RANDOLPH COUNTIES, MISSOURI.

The coal seams involved at Neighborhood 10 (Table 121) are called the Bevier (lower coal) and Mulky (upper coal), with an unnamed thin coal or carbolith horizon (called the Skyvein) approximately 7.6 m (25 ft) above the upper, mineable coal (Tables 122-127). From updated literature (Gentile 1967, pg. 19) it appears that the lower mineable coal could be interpreted as two coals, the Wheeler-Bevier coals (or the "Bevier of commerce") and the upper mineable coal as the Mulky. Then the Skyvein would correlate as the Summit horizon overlain by a thin roof and the Houx limestone member.

At the companion mine, Prairie Hill, 19.3 km (12 mi) southwest, only one coal is mined, which is locally correlated as the Bevier coal (Tables 128-133). In the overburden, a carbolith or coaly horizon is evident 5.8 to 7.0 m (19 to 23 ft) above and a thin unnamed coal occurs at 11.6 m (38 ft) above the named coal. Both the carbolith horizon and the unnamed coal are identifiable by dark color of the powdered material (Munsell value of 3 or lower), a build-up of total sulphur, and a net acid potential.

Comparing sections at Bee Veer and Prairie Hill, it seems likely that the lower, mineable coals correspond as Wheeler-Bevier at the two locations, and the upper thin coal corresponds with the Skyvein or Summit. The presence of the tough, relatively pure fossiliferous limestone immediately above the roof of the thin coal at both Bee Veer and Prairie Hill provides support for the correlation, as does the concentration of gypsum above the limestone at B.V. I (Tables 122-124), and P.H. I (Tables 128-130). Absence of gypsym at P.H. II (Tables 131-133) reflects glacial scouring and desposition of till on the limestone.

Overburdens at Bee Veer and at Prairie Hill are relatively safe from acid toxicities except close to the Wheeler-Bevier at Prairie Hill and the unmined coaly horizon at both mines. However, dark colored (carbolith) shales and mudrocks are not consistent indicators of potential toxicity. For example, with light colored (Munsell color values of 5 or 6) mudrock samples #3, #8 and #21 in overburden profile P.H. I (Tables 128-130), high potential acid toxicities were recorded, whereas with black carbolith samples #5 and #15 neutralizing capacities predominated.

Generally, neutralizers are predominant at Prairie Hill and Bee Veer. Even omitting resistant limestones, which would persist as coarse fragments, it is evident that neutral or alkaline mudrocks would overwhelm all potential acidity of the potentially acid materials, if thoroughly blended with the mudrocks. It would be difficult to isolate and dispose of potentially toxic materials because they occur in several separated zones, either above or below the different coals or carboliths.

The soil, A horizon, at Bee Veer and Prairie Hill was medium textured (Loam or silt loam), light brown, 12.7 to 20.3 cm (5 to 8 in) deep, and acid (pH near 5.2). The B horizon (subsoil) was a heavy, acid clay loam or clay, apparently an argillic horizon. Some low chroma mottling was present below 25.4 cm (10 in). The surface slope was 5 to 20 percent.

Glacial till containing about 20 percent coarse fragments (partly igneous or metamorphic cobbles) varied in thickness both at Bee Veer and Prairie Hill, from 7.6 m (25 ft) to essentially zero (unrecognizable). At Bee Veer (Table 122, Sample #1) an horizon of stratified sand and gravel was evident in the lower part of the unstratified glacial till, re presenting glacial outwash.

The glacial till was neutral or alkaline and relatively high in available phosphorus below the A and B horizons of the soil, but it would be questionable for use at the minesoil surface because of hard cobbles and clayey tendencies, unless sorted to avoid these difficulties.

The surface (A horizon) of the soil was too thin and eroded to be separated for placement on minesoils, and the mottled clay loam or clay subsoil, B horizon, contained more active clay than would be favored for a new soil.

Considering all properties, it appears that carbonate-rich mudrocks from the lower or middle part of the sections should make the best minesoils, especially if excessive limestone coarse fragments are segregated and removed. Ultimate textures of these materials are high in silt rather than clay. They show variable slaking tendencies in water, but enough to assure sufficient fines to form a good soil. Moreover, these materials are soft enough to cut or crush readily into soil texturial particles with a disk or other farm implement.

Available phosphorus levels by bicarbonate extraction are relatively low and should be remedied by fertilization. Individual horizon samples are higher. Slowly available, acid-extractable phosphates probably occur in tri-calcium form in alkaline mudrocks. Such phosphates should prevent extreme deficiencies and provide long range reserves, but do not eliminate the need for fertilization of forages with readily available phosphorus.

Excavated minesoil profiles in old spoils at Bee Veer confirm that neutralizers are generally dominant. However, barren acid minesoil patches are present which are readily explainable in terms of overburden properties noted in overburden samples. If the toxic or potentially toxic materials were blended with the carbonate-rich mudrocks, such patches would be prevented.

ADJUNCT TO NEIGHBORHOOD 10: MARK TWAIN MINE, BOONE COUNTY, MISSOURI.

This completed operation at the Mark Twain mine, Columbia, Mo., provided a 15.2 m+ (50 ft+) highwall above ponded water covering the Bevier coal horizon, and exposed upper residual horizons not previously available for sampling. We chose, therefore, to collect samples and to treat this section as an Adjunct to Neighborhood 10 (Tables 134-136). Hand sampling was accomplished by cliff-climbing techniques using a nylon rope, by experienced climber David Hall.

The relative dark, calcareous mudstone at 13.4 to 13.7 m (44 to 45 ft) with pyritic mudstones above and below is believed to be the Mulky coal horizon. The Bevier coal was approximately 3 m (10 ft) or more under ponded water at the base of the highwall. The 30.5 cm (ft) thick coal 8.8 m (29 ft) from the land surface is believed to be the Summit coal overlain by mudstone, the Houx limestone member and, at 3.3 to 6.1 m (11 to 20 ft) by reddish colored shale or mudrock of the Little Osage formation (Howe and Koenig 1961, p. 90).

Note that several horizons above the water level (presumably near the Mulky coal horizon) are potentially acid from pyritic sulphur (Table 136). Greater potential acidity is indicated through 1.5 m (5 ft) below the Summit coal. An additional concentration of sulphur occurs below limestone, at 2.4 to 3.3 m (8 to 11 ft). The maximum carbonate equivalent indicated as needed for neutrality is slightly excessive because part of this sulphur is recognizable gypsum. However, the horizon is acid in spite of close proximity to limestone, and abundant pyrite is present to form acid sulphates. Undoubtedly the observable gypsum formed here by reaction between sulphates caused by oxidation of pyritic minerals and calcium carbonate from the limestone or mudstones. This association between limestone and gypsum is closer to the land surface than at the Bee Veer mine in Randolph County where a gypsum horizon occurs on top of limestone but lower in the section.

The top 8.8 m (29 ft) of overburden at the Mark Twain Mine would blend to form neutral or alkaline minesoil, but the three limestone layers would probably cause resistant, large coarse fragments.

The surface soil at this site contained, chert, and large limestone slabs which created a discontinuous (ruptic lithic) bedrock situation in the soil. The steeply-rolling land supported mixed oak, hickory and cedar; regrowth woodland.

Northward 3.4 km (2.1 mi) in this same mining pit, no bedrock was evident. Approximately 9.1 m (30 ft) of glacial till and outwash sand or gravel constituted the highwall with all bedrock and coal buried under these unconsolidated glacial-fluvial materials.

Minesoil sloping from the ponded water at the base of the residual highwall sampled was well-vegetated with a grass-legume mixture of tall fescuegrass, redtop, alfalfa, sweetclover, and a few briers and other weeds. Cattle have grazed the revegetated minesoil but were not seen.

A minesoil profile, described in the Pedologic subsection of Section V and obtained 5 km (3.1 mi) north of this sampling site, was neutral in reaction and fine loamy in texture.

NEIGHBORHOOD 11: POWER AND TEBO MINES, HENRY COUNTY, MISSOURI.

The mined coals in this Neighborhood have been correlated as Weir-Pittsburg (lowest), Tebo (middle) and Bevier (upper). Tables 137 through 142 summarize data for overburden of the two lower coals. In places the Little Tebo is recognized between the Tebo and Bevier. An horizon,(2.1 or 2.4 m: 7 or 8 ft) above the Bevier at the Tebo Mine (Tables 146-151), contains prominent spherical nodules from 15.2 cm (6 in) to more than 30.5 cm (1 ft) in diameter. The nodules contain visible pyrite crystals and fizz in acid indicating abundant calcium carbonate. This zone is believed to correspond to the Mulky coal horizon.

The Tebo mine is approximately 21 km (13 mi) northeast of the Power Mine, which is immediately northwest of the town of Montrose. Coal elevations (Bevier Coal at Tebo, 243.2 m: 798 ft and the Weir-Pittsburg at Power 242.6 to 243.5 m 796 to 799 ft) indicate a significant dip to the northeast.

Undisturbed soils in this Neighborhood have dark gray or brown, acid surfaces (A horizons) from 20.3 to 40.6 cm (8 to 16 in) deep. Surface soil textures range from silty clay loam to fine sandy loam. Subsoils, generally, are slowly-permeable, plastic clays. Near the Tebo mine some undisturbed soils with fine sandy loam surface soils and sandy clay loam subsoils are moderately permeable and underlain by brown medium-textured sandstone, but the clay subsoils are more extensive, as would be expected from the dominance of mudstones or shales in the underlying geologic sections.

At these mines there was special interest in determining potentially toxic materials chemically because most partings between coals as well as overlying mudstones were light colored gray materials and not ordinarily expected to be potentially toxic. Powdered rock color shown in Tables 137 through 151 commonly show Munsell lightness values from 5 through 8, which suggest no concentrations of carbon (values of 3 or lower indicate carboliths), often thought to be an indication of potential toxicity. However, as shown in these tables, some of the light-colored mudstones already have toxic pH values below 4.0 and others show potentially toxic acid-base balances (more than 5 t needed for pH 7.0). The source of acidity is pyrite that can usually be seen by careful observation with a 10 power hand lens. Moreover, practical experiences with these light colored mudstones have confirmed that problems of acid toxicity are common unless favorable materials are placed on the surface. When these soft mudstones are placed near the surface they slake and disintegrate quickly, exposing the fine pyrite crystals to oxidation and formation of acid.

Acid-Base accounting indicates that the problem is similar for partings between the Weir-Pittsburg and Tebo coals at Power Mine (Tables 139 and 142) and for the parting between the Bevier and the dark nodular horizon (presumed Mulky) at the Tebo mine (Tables 148 and 151). At Power Mine, the problem is solved by top placement of materials upward from the limestone at 6.4 to 6.7 m (21 or 22 ft) (Table 137). Actually, the clear change from partially toxic to completely non-toxic occurs at 5.3 m (17.5 ft), where sulphur percentages drop dramatically (Table 139) and color chromas become consistently 2 or higher (except in poorly-drained subsoils at 0.9 to 1.5 m (3 to 5 ft). In the case of the Tebo mine, the mudstones become safe from toxicity at the dark nodular carbolith horizon (presumed Mulky) where neutralizers increase and pyritic sulphur decreases, (Tables 148 and 151). Apparently, also, the pyrite changes to bigger crystals with lower specific surface for oxidation.

Phosphorus fertilization is needed along with nitrogen for quick establishment of ground covers to prevent erosion. High phosphorus indicated by acid extraction should not be interpreted as indicating that available phosphorus is adequate in these neutral or alkaline materials, although the reserve of slowly-available tri-calcium phosphates and apatite, known to occur in this part of the geologic section, may favor long range productivity of minesoils formed from the mudstones.

Results for 4 old minesoils in this Neighborhood, selected to test predictions of potential toxicity from surface placement of light-colored mudstone parting materials, are given in Tables 143-145. Leaching to remove sulphates showed that considerable (55 to 69 percent) of the pyritic sulphur has been oxidized to sulphates during approximately 10 years (Table 145).

At a companion site in this Neighborhood, the Mulky coal has been mined, although this coal was not evident at the Tebo or Power Mines. Where mined, the Mulky occurred about 18.3 m (60 ft) above the Weir-Pittsburg coal. Its overburden consisted of 9.1 m (30 ft) of non-calcareous mudstone overlain by a thin, weak sandstone and moderately fine-textured (clay loam) soil with a pH of 5.5. Water in this pit was slightly alkaline. Detailed sampling and analyses of the Mulky overburden should be encouraged if further mining of this coal is planned.

In this entire Neighborhood the overburdens of the several coals as well as natural soils tend to be fine textured. For this reason it would be helpful to include all available sandy loam soils and weak sandstones into new minesoils because medium textured soils have greater long range potentials than fine textured soils.

Excessive packing of overburdens should be avoided. Materials represented here are inclined to restrict movement of water, air and plant roots unless left unpacked.

Diversion terraces and mulches may be needed on long slopes to prevent erosion and aid quick establishment of ground covers.

NEIGHBORHOOD 12: MIDWAY MINE, BATES COUNTY, MISSOURI AND LINN COUNTY, KANSAS.

This relatively new mine, of the Mulberry Coal (Howe and Koenig, 1961, p. 93) of the Marmaton group of the upper Pennsylvanian (possibly the uppermost mineable coal of Missouri) involves dominantly mudstone materials that are relatively high in neutralizing capacity throughout (Tables 152 through 157). The only horizons sampled that showed toxic acid potentials were the mudstone underlying the coal, the thin impure coal or bonecoal immediately above and below the coal, and the thin, discontinuous coal, coal blossom or smut that ranged from 4.6 to 9.1 m (15 to 30 ft) above the Mulberry coal in the highwall. This thin smut horizon was rich in pyrite and contained some gypsum. It was potentially toxic from pyrite, but too thin to constitute a serious problem since abundant neutralizers were present to overwhelm any developing acid. The mudstone under the coal was not a problem because it was not being excavated. Its possible use as soil material was considered but rejected.

Limestone occurred under the soil in the upper middle part of the section and replaced the calcareous mudstone in the lower part of the section in part of the pit. This lower limestone was tough, essentially massive for a thickness up to 1.5 m (5 ft), almost white, and not visibly crystalline. Its appearance was much the same as that of the much softer calcareous mudstones.

The original soil has a moderately deep 17.8 to 40.6 cm (7 to 16 in) and dark (dry color, 10YR, 5/2) (Tables 152 and 155) surface horizon of silty clay loam texture. However, it was quite variable laterally, had a slowly pervious clay subsoil, Bt horizon, and an underlying thick, fine-textured, claypan horizon with coarse prismatic structure. The surface horizon, although acid, might be desirable in the minesoil profile, especially if blended with calcareous mudstone, but the fine-textured pan and Bt horizons would not be desirable in the reformed minesoils because of unfavorable physical properties.

Big limestone fragments would restrict uses of the minesoil unless buried. Importance of such rock fragments would depend upon planned use of the land. Calcareous mudstone textures, neutral reaction and fertility would be favorable for forage production. Erosion on long slopes is serious unless vegetation is established quickly. Locally-grown hay and straw are an excellent source of mulching materials for erosion control and quick establishment of ground cover. Incompletely disintegrated mudstone at the surface can aid erosion control until vegetation takes over. Excessive compaction during grading can cause low perviousness and high runoff on this kind of material. Basic reaction and high fertility should help to maintain needed stands of legumes with grasses. Phosphorus fertilization is likely needed, although near surface placement of materials testing highest in phosphorus may be feasible as a possible substitute for adding fertilizer. Immediate phosphorus availability in this carbonate rich material should be determined by extraction with alkaline sodium bicarbonate rather than by acid extraction. It is known that phosphatic nodules occur in the Altamont formation above the Amoret limestone over the Bandera formation (Howe and Koenig 1961. p. 94), which might contribute to the supply of slowly available phosphorus.

Since neutralizing materials are abundant, any water quality difficulties can be remedied by retaining pit or minesoil runoff waters in contact with neutralizing mudstones until all sediments and potential toxins have time to oxidize, flocculate and precipitate.

Tough limestone coarse fragments on the surface may be detrimental to intended land use. However, it should be recognized that the calcareous mudstones (sometimes called impure or weakly-cemented limestones) are likely to disintegrate rapidly into the soil textural particles. Moreover, coarse fragments on the surface help prevent severe erosion.

Original subsoil from about 0.3 to 1.8 m (1 to 6 ft) deep is generally not desirable for placement near the minesoil surface because of claypan or fragipan characteristics, unless blended with calcareous mudstones occurring deeper in the overburden.

As indicated in Section X, the light brown limestone at 10.7 to 11.6 m (35 to 38 ft) (Table 152) (Probably the Worland member of the Altamont formation) (Howe and Koenig 1961, p. 94) showed 1000 parts per million (ppm) of total manganese, most of which proved to be soluble in hot, 0.25N hydrochloric acid, indicating its likely occurrences as a carbonate.

This concentration of manganese would be insoluble in near neutral or alkaline waters; however, slightly milky waters containing finely-powdered carbonates including manganese could be the source of manganese determined in waters collected and acidified for water quality analysis. Such manganese probably occurs in isomorphous substitution with ferrous iron, either in siderite or in ankerite impurities in the limestone. It would be essentially insoluble under natural conditions, converting slowly to the black oxidized forms of manganese dioxide that sometimes coat weathering rock surfaces and soil peds.

Where the minesoil was excavated and sampled following grading, the fines were found to be packed more than is ideal for water movement and root development. The problem of excessive packing is avoided by grading as much as possible during dry periods and by avoiding grading that is not essential.

It is important to leave considerable plant residue or animal manure on new forage stands on minesoils. Light grazing or early clipping without removal should help to establish desirable re-cycling through significant plant decay on the ground.

Marine fossils are prominent in certain limestones, mudstones and shales over the Mulberry coal. Pyrite is common in association with the fossils. However, where the overburden was sampled, carbonates were dominant over maximum acidity from pyrite. Even so, it should be remembered that neutralization capacity can change quickly in short distances, and that major changes have been noted in similar marine zones at other locations in Missouri, Illinois and Kentucky.

This means that a Neighborhood such as this, where relatively high pyrite concentrations are known to occur, should be checked in more detail whenever significant changes are noted in terms of: 1. rock type; 2. rock color; 3. pH of water; 4. composition of water; 5. fizz reaction of rock or soil in 10% hydrochloric acid. With distinct fizz reactions, the material is likely to contain at least 20 t calcium carbonate equivalent per 1000 t of material.

Some general suggestions regarding placement of materials to favor the particular planned use of the land after mining are given in Section V, under Criteria for New Soils.

ADJUNCT TO NEIGHBORHOOD 12: SIERRA MINE, MUSKOGEE COUNTY, OKLAHOMA.

We have chosen to consider this sampling location as an Adjunct to Neighborhood 12 rather than as an additional neighborhood of study. One reason for this is that we have only visited the mining operation once rather than two or more times as at most sites. In addition, we found practically no evidence of acid-toxic problems, but some similarity of conditions between here and the Midway Mine of Bates County, Missouri, identified as Neighborhood 12.

We are not attempting to correlate the Stigler Coal, possibly the same horizon as the McAllister, with coals in Missouri, although it was suggested that the Stigler may be considered to be in approximately the same geologic position as the Croweburg (above the Tebo and below the Bevier formation). Moreover, it has been indicated (Searight 1953 as cited by Smith 1961) that the Croweburg may be correlative with the remarkably persistent #2 Coal of Illinois.

One interesting point of similarity of the Sierra Mine and the Midway Mine is the presence of non-fissile (massive or blocky) mudstone immediately on top of the coal at both locations. The coal itself is acid but mudstones and shales (fissile) are neutral or alkaline all the way to the base of soil material (Tables 158-163).

At site II (Table 161) the undisturbed soil contained sandstone fragments and was relatively shallow over mudstone, but at site I (Table 158) the unconsolidated soil material was extraordinarily deep and contained a thick fragipan. At this point the depth of unstratified, medium textured material evidently represented geologic colluvium of uncertain source.

Two, 25 year old revegetated, woodland minesoil profiles were examined in detail where exposed by recent road improvement. These profiles were neutral or alkaline, consisted of a broad mixture of disordered mudstone and shales, and displayed excellent, deep tree root development continuing down below 1.8 m (6 ft). Trees planted for reclamation were yellow pines, but mixed hardwoods including black walnut were vigorous invaders.

Outstanding tree root development observed probably is related to the fact that spoil was not graded and smoothed and therefore was not compacted excessively before planting. As shown by early research (Chapman 1967), trees perform best on unpacked materials.

Table 121. LOCATIONS OF FIELD STUDY SITES IN NEIGHBORHOODS TEN THRU TWELVE AND THE ADJUNCTS, WESTERN REGION

Site	Latitude Longitude Surf.Elev.	Coal Seam	Detail of Site Location
Bee Veer Mine	39.6592°N 92.5033°W 770-810 ft	Skyvein Mulky Wheeler-Bevier	3.2 km (2 mi) northeast of Ardmore, Macon Co., MO
Bee Veer Mine	39.6706°N 92.4964°W 820-840 ft	Wheeler-Bevier Wheeler-Bevier	3.2 km (2 mi) south southwest of Macon, Macon Co., MO
Prairie Hill Mine	39.5269°N 93.3934°W 680-700 ft	Wheeler-Bevier	0.8 km (0.5 mi) northwest of Thomas Hill, Randolph Co., MO
Prairie Hill Mine	39.5225°N 92.6581°W 700-720 ft	Wheeler-Bevier	0.4 km (0.25 mi) northwest of Thomas Hill, Randolph Co., MO
Mark Twain Mine	38.96°N 92.27°W 800 ft	Summit Wheeler-Bevier	Colombia, MO
Power Mine	38.2664°N 92.6534PW 840 ft	Tebo Weir-Pittsburg	1.2 km (0.75 mi) northwest of Montrose, Henry Co., MO

Table 121. continued

Site	Latitude Longitude Surf. Elev.	Coal Seam	Detail of Site Location
Power Mine	38.2711°N 93.9948°W 840 ft	Tebo Weir-Pittsburg	1.6 km (1 mi) northwest of Montrose, Henry Co., MO
Tebo Mine (Pit 1050B)	38.4666°N 93.7075°N 810-820 ft	Bevier	7.1 km (4.4 mi) west of Calhoun, Henry Co., MO
Tebo Mine (Pit 5560)	38.4305°N 93.7255°W 840-850 ft	Bevier	3.2 km (2 mi) east northeast of Lewis, Henry Co., MO
Midway Mine	38.3336°N 94.5683°N 860-870 ft	Mulberry	2.4 km (1.5 mi) northwest of Amsterdam, Bates Co., MO
Sierra Mine	35.3903°N 95.2313°W 570 ft	Stigler	1.6 km (1 mi) northwest of Fields Cemetery, Muskogee Co., OK

Table 122. PHYSICAL CHARACTERIZATIONS OF THE MULKY AND WHEELER-BEVIER COAL OVERBURDENS AT PEABODY COAL COMPANY'S BEE VEER MINE, NEIGHBORHOOD TEN

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-22.0	NOT SAMPLED		
1	22.0-25.0	OW	5Y 8/1	10
2	25.0-27.3	SH	2.5Y 8/4	8
3	27.3-29.6	SH	5Y 7/3	6
4	29.6-32.0	SH	2.5Y 7/2	4
5	32.0-34.3	SH	10YR 7/1	4
6	34.3-36.7	SH /gyp	10YR 7/3	1
7	36.7-39.0	SH /gyp	N 7/0	4
8	39.0-39.7	Gyp	2.5Y 6/2	0
9	39.7-42.7	LS	10YR 8/1	0
10	42.7-43.2	Carb/gyp	10YR 3/1	0
11	43.2-43.7	Carb	10YR 3/1	0
12	43.7-44.7	SKYVIEN COAL		
13	44.7-46.7	SH	5Y 7/1	10
14	46.7-48.7	SH	5Y 8/1	10
15	48.7-50.7	SH	5Y 8/1	8
16	50.7-52.2	LS	N 8/0	0
17	52.2-55.4	MS	N 8/0	10
18	55.4-58.6	MS	5Y 7/1	2
19	58.6-61.9	MS	5Y 7/1	2
20	61.9-65.1	MS /gyp	5Y 7/1	2
21	65.1-69.3	LS	5Y 8/1	0
22	69.3-70.6	SH	10YR 5/1	0
23	70.6-71.9	Carb	N 3/0	0
24	71.9-73.2	Carb	5YR 2/1	0
25	73.2-75.0	MULKY COAL		
26	75.0-77.4	MS-I	N 8/0	1
27	77.4-79.8	MS	N 8/0	2
28	79.8-82.2	MS	N 8/0	3
29	82.2-84.6	MS	N 8/0	6
30	84.6-87.0	Carb	5YR 2/1	0
WHEELER-BEVIER COAL				

Table 123. CHEMICAL CHARACTERIZATIONS OF THE MULKY AND WHEELER-BEVIER COAL OVERBURDENS AT PEABODY COAL COMPANY'S BEE VEER MINE, NEIGHBORHOOD TEN

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH 91:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	6.8	6.6	0	114	640	216	85	2.4
2	6.0	6.3	0.5	147	224	1416	103	16.6
3	4.2	4.2	3.5	179	1200	912	77	47.2
4	3.8	3.8	6.5	218	880	684	85	30.8
5	3.7	3.7	7.0	280	960	588	91	23.6
6	3.2	3.2	8.5	280	5760	864	52	2.4
7	2.7	2.8	10.0	42	4320	1392	47	4.8
8	4.7	4.9	1.5	35	7360	1776	294 G	4.8
9	7.5	7.7	0	92	11360	156	24	2.4
10	7.3	7.3	0	480	9920	972	42	4.8
11	7.1	7.0	0	400	10520	900	123	16.6
12	SKYVIEN	COAL						
13	7.2	5.0	2.0	602	3440	1104	360	4.8
14	8.1	8.5	0	507	5280	720	37	2.4
15	8.4	8.6	0	557	7920	924	43	2.4
16	8.4	8.4	0	332	6640	2112	35	4.8
17	8.3	8.2	0	474	9280	792	40	2.4
18	8.3	8.6	0	535	9440	648	38	2.4
19	7.9	7.9	0	464	9120	624	34	2.4
20	7.7	7.7	0	480	8480	600	34	4.8
21	7.7	8.0	0	71	10560	144	21	2.4
22	7.2							2.4
23	3.4							86.8
24	5.5	4.8	0.5	60	11200	156	24	14.3
25	MULKY	COAL						
26	8.0	8.2	0	380	9760	672	29	2.4
27	9.0	9.0	0	453	7600	468	32	2.4
28	7.9	7.6	0	312	10560	360	25	1.2
29	7.9	7.7	0	380	9600	480	26	2.4
30	6.1	4.8	0.5	60	12480	132	19	2.4
WHEELER-BEVIER COAL								

Table 124. ACID-BASE ACCOUNT OF THE MULKY AND WHEELER-BEVIER COAL OVERBURDENS AT PEABODY COAL COMPANY'S BEE VEER MINE, NEIGHBORHOOD TEN

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCo_3$
1	8/1	0	.020	.62	7.56		6.94
2	8/4	0	.005	.16	6.82		6.66
3	7/3	0	.040	1.25	2.06		.81
4	7/2	0	.075	2.34	1.08	1.26	
5	7/1	0	.155	4.84	.07	4.77	
6	7/3	0	.575	4.22	- 4.42	8.64	
7	7/0	0	3.500	78.13	- 17.64	95.77	
8	6/2	1	10.650	96.88	34.03	62.85	
9	8/1	4	.235	7.34	921.43		914.09
10	3/1	1	1.700	46.88	71.78		24.90
11	3/1	1	1.276	39.87	42.50		2.63
12	SKYVIEN COAL						
13	7/1	1	1.025	32.03	9.31	22.72	
14	8/1	2	.955	29.84	107.35		77.51
15	8/1	2	.955	29.84	107.35		77.51
16	8/0	3	.420	13.12	241.24		228.12
17	8/0	3	1.765	55.16	156.48		101.32
18	7/1	2	1.020	31.87	78.53		46.66
19	7/1	2	.815	25.47	81.02		55.55
20	7/1	1	1.520	47.50	62.54		15.04
21	8/1	3	.230	7.19	894.35		887.16
22	5/1	0	1.300	40.62	6.82	33.80	
23	3/0	0	.975	30.46	16.30	14.16	
24	2/1	0	3.500	109.37	17.30	92.07	
25	MULKY COAL						
26	8/0	3	1.075	33.59	248.04		214.45
27	8/0	3	.850	26.56	127.10		100.54
28	8/0	3	1.350	42.19	196.61		154.42
29	8/0	3	1.080	33.75	137.61		103.86
30	2/1	0	3.350	104.69	14.76	89.93	
WHEELER-BEVIER COAL							

Table 125. PHYSICAL CHARACTERIZATIONS OF THE MULKY AND WHEELER-BEVIER COAL OVERBURDENS AT PEABODY COAL COMPANY'S BEE VEER MINE, NEIGHBORHOOD TEN, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-5.0	NOT SAMPLED		
1	5.0-7.5	SH	10YR 5/1	1
2	7.5-10.0	SH/gyp	2.5Y 6/2	1
3	10.0-12.5	SH/gyp	5Y 6/4	2
4	12.5-13.0	Gyp	5Y 6/3	0
5	13.0-16.0	LS	5Y 7/1	1
6	16.0-17.0	Carb	5Y 3/1	0
7	17.0-18.0	SKYVIEN COAL		
8	18.0-20.3	SH	N 7/0	10
9	20.3-22.6	SH	5Y 7/1	10
10	22.6-24.9	SH-I	N 7/0	1
11	24.9-27.2	SH	N 7/0	0
12	27.2-29.5	SH	5Y 7/1	8
13	29.5-31.8	SH	N 7/0	3
14	31.8-34.1	SH	N 7/0	2
15	34.1-36.4	SH	N 7/0	4
16	36.4-39.4	LS	N 8/0	0
17	39.4-41.7	Carb	N 3/0	0
18	41.7-44.0	Carb	10YR 3/1	0
19	44.0-47.0	MULKY COAL		
20	47.0-49.4	MS	5Y 7/1	5
21	49.4-51.8	MS	N 8/0	2
22	51.8-54.2	MS	N 8/0	6
23	54.2-56.6	MS	N 8/0	1
24	56.6-59.0	Carb	5 YR 2/1	0
	WHEELER-BEVIER COAL			

Table 126. CHEMICAL CHARACTERIZATIONS OF THE MULKY AND WHEELER-BEVIER COAL OVERBURDENS AT PEABODY COAL COMPANY'S BEE VEER MINE, NEIGHBORHOOD TEN, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	ment (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	4.1	4.2	4.5	247	400	192	75	32.0
2	3.8	4.0	6.5	198	3680	420	80	4.5
3	3.9	4.1	6.0	222	1280	408	54	2.2
4	6.8	6.7	0	98	11040	372	24	6.7
5	7.4	7.2	0	117	12480	312	24	6.7
6	7.0	5.6	0.5	395	7600	1728	128	4.5
7	SKYVIEN COAL							
8	7.8	6.3	0.5	427	10720	2208	24	2.2
9	7.7	8.0	0	512	6640	1020	38	2.2
10	8.2	8.4	0	317	8000	1008	31	4.5
11	8.3	8.3	0	298	7200	2088	31	4.5
12	7.9	8.0	0	502	4640	756	91	4.5
13	8.2	8.3	0	535	11520	756	38	4.5
14	7.8	7.9	0	518	10400	696	32	4.5
15	7.8	7.7	0	512	10400	816	34	2.2
16	8.0	7.9	0	307	11840	600	40	2.2
17	3.3	3.2	6.0	332	5040	1536	385	11.0
18	6.8	7.0	0	353	10880	1056	256	17.6
19	MULKY COAL							
20	8.5	8.8	0	490	8320	600	45	2.4
21	8.6	8.5	0	502	8800	540	37	2.4
22	9.0	8.8	0	442	2840	180	38	2.4
23	8.5	8.2	0	317	5080	276	31	0.5
24	2.8	2.8	7.0	69	10720	180	385M	0.5
WHEELER-BEVIER COAL								

Table 127. ACID-BASE ACCOUNT OF THE MULKY AND WHEELER-BEVIER COAL OVERBURDENS AT PEABODY COAL COMPANY'S BEE VEER MINE, NEIGHBORHOOD TEN, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	5/1	0	.095	2.97	- 3.23	6.20	
2	6/2	0	.675	12.66	- 2.99	8.46	
3	6/4	1	1.680	68.75	- 2.99	42.99	
4	6/3	4	6.400	31.69	441.44		429.25
5	7/1	3	1.175	36.72	716.40		679.68
6	3/1	2	1.100	34.37	43.73		9.36
7	SKYVIEN COAL						
8	7/0	3	1.060	33.12	120.68		87.56
9	7/1	3	1.140	35.62	115.55		79.93
10	7/0	3	.515	16.09	249.19		233.10
11	7/0	2	.805	25.16	92.95		67.79
12	7/1	1	1.650	51.56	43.71	7.85	
13	7/0	2	1.550	48.44	76.53		28.09
14	7/0	2	.850	26.56	79.31		52.75
15	7/0	3	1.625	50.78	74.51		23.73
16	8/0	4	.500	15.62	500.43		484.81
17	3/0	1	.850	26.56	3.58	22.98	
18	3/1	0	1.575	49.22	40.16	9.06	
19	MULKY COAL						
20	7/1	3	.600	18.75	96.70		77.95
21	8/0	3	.850	26.56	244.96		218.40
22	8/0	3	.675	21.09	151.34		130.25
23	8/0	4	.955	29.84	487.73		457.89
24	2/1	0	5.500	171.87	- 1.48	173.35	
WHEELER-BEVIER COAL							

Table 128. PHYSICAL CHARACTERIZATIONS OF THE WHEELER-BEVIER OVERBURDEN AT PEABODY COAL COMPANY'S PRAIRIE HILL MINE, NEIGHBORHOOD TEN

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
Bt	2.0	Soil	10YR 5/6	10
1	5.0-10.0	MR	2.5Y 7/8	1
2	10.0-15.0	MR	5Y 7/3	1
3	15.0-19.0	MR/gyp	5Y 6/1	1
4	19.0-22.0	LS	2.5Y 7/2	0
5	22.0-23.0	Carb	5Y 2/1	0
6	23.0-24.0	Carb	5Y 2/1	1
7	24.0-24.7	Coal	N 2/0	0
8	24.7-27.0	SH	10YR 5/1	10
9	27.0-31.0	MS	5Y 7/1	10
10	31.3-33.5	LS	5Y 7/1	0
11	33.5-36.0	MR	5Y 6/1	1
12	36.0-37.5	MR	5Y 6/1	1
13	37.5-40.0	LS	5Y 8/1	0
14	40.0-41.5	Carb	5Y 3/1	2
15	41.5-44.5	Carb	5Y 2/1	3
16	44.5-46.0	MR	5Y 7/1	10
17	46.0-48.5	MR	5Y 7/1	3
18	48.5-51.5	MR	5Y 7/1	1
19	51.5-54.5	MR	5Y 7/1	1
20	54.5-57.5	MR	5Y 7/1	1
21	57.5-60.5	MR	5Y 6/1	1
22	60.5-63.5	SH	5Y 5/1	1
	63.5-66.6	WHEELER-BEVIER COAL		

Table 129. CHEMICAL CHARACTERIZATIONS OF THE *WHEELER-BEVIER* COAL OVERBURDEN AT PEABODY COAL COMPANY'S PRAIRIE HILL MINE, NEIGHBORHOOD TEN

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
Bt	5.2	5.0	1.5	147	2480	672	80	4.3
1	6.5	6.1	0.5	134	2480	804	111	17.2
2	5.7	5.8	0.5	109	1200	924	88	12.9
3	5.9	5.6	1.0	416	5120	1320	385G	4.3
4	7.5	7.6	0	78	12320	180	45	6.4
5	5.9	7.0	0	353	9920	1632	360	14.1
6	6.4	6.4	0.5	125	9280	582	29	2.2
7	5.3	4.8	5.5	55	8480	648	37	3.2
8	7.0	6.0	0.5	608	1520	288	372	4.3
9	7.5	7.3	0	453	10400	1296	54	2.2
10	8.0	7.9	0	284	7520	540	31	4.3
11	7.6	7.5	0	437	15200	1248	32	3.2
12	7.5	7.5	0	459	6560	588	38	2.2
13	8.0	7.9	0	87	4240	48	23	4.3
14	6.1	6.4	0.5	690	2080	732	174	5.4
15	5.9	6.1	0.5	464	3200	828	192	8.6
16	7.5	7.5	0	453	2160	204	54	4.3
17	7.6	7.6	0	307	3120	612	35	4.3
18	7.2	7.1	0	198	1840	180	256	3.2
19	7.4	7.4	0	302	7200	1560	3	2.2
20	6.2	6.5	0	284	2160	504	385G	8.6
21	5.6	5.7	1.0	405	1200	264	385G	6.4
22	6.7	6.6	0	490	1440	396	385G	4.3
WHEELER-BEVIER COAL								

Table 130. ACID-BASE ACCOUNT OF THE WHEELER-BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S PRAIRIEHILL MINE, NEIGHBORHOOD TEN

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
Bt	5/6	0	.005	.16	4.16		4.00
1	7/8	0	.010	.31	6.13		5.82
2	7/3	0	.005	.16	2.45		2.29
3	6/1	0	1.390	38.44	12.25	26.19	
4	7/2	5	.200	6.25	922.87		916.62
5	2/1	1	1.450	45.31	157.90		112.59
6	2/1	2	2.750	85.94	84.75	1.19	
7	2/0	0	1.600	50.00	21.07	28.93	
8	5/1	0	1.340	41.88	8.82	33.06	
9	7/1	2	1.160	36.25	141.26		105.01
10	7/1	3	.670	20.94	652.09		631.15
11	6/1	3	.655	20.47	160.48		140.01
12	6/1	2	.820	25.62	93.65		68.03
13	8/1	5	.030	.94	962.73		961.79
14	3/1	0	.500	15.62	8.56	7.06	
15	2/1	0	.375	11.72	33.06		21.34
16	7/1	1	.235	7.34	36.75		29.41
17	7/1	3	.240	7.50	269.61		262.11
18	7/1	1	.390	12.19	9.55	2.64	
19	7/1	0	.285	8.91	5.63	3.28	
20	7/1	0	.420	13.12	9.07	4.05	
21	6/1	0	1.050	32.81	4.16	28.65	
22	5/1	0	.340	10.62	7.60	3.02	
WHEELER-BEVIER COAL							

Table 131. PHYSICAL CHARACTERIZATIONS OF THE WHEELER-BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S PRAIRIE HILL MINE, NEIGHBORHOOD TEN, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
Bt	2.0	Soil	10YR 5/6	10
1	5.0-11.7	TILL	2.5Y 7/4	6
2	11.7-18.4	TILL	2.5Y 7/4	5
3	18.4-25.0	TILL	2.5Y 7/4	6
4	25.0-28.5	LS	5Y 7/1	0
5	28.5-30.0	Carb	5Y 3/1	0
6	30.0-31.0	Carb	N 2/0	0
7	31.0-31.5	Coal	N 2/0	0
8	31.5-32.0	Carb	N 2/0	0
9	32.0-33.0	MR	5Y 5/1	10
	33.0-73.0	NOT SAMPLED		
	73.0-76.1	WHEELER-BEVIER COAL		

Table 132. CHEMICAL CHARACTERIZATIONS OF THE WHEELER-BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S PRAIRIE HILL MINE, NEIGHBORHOOD TEN, COLUMN TWO

			Per Thousand Tons of Material					
			Lime	Acid Extracted				Bicarbonate
Sample No.	pH (paste)	pH (1:1)	Requirement (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	Extracted P (lbs.)
Bt	5.2	5.1	2.0	145	1840	504	115	5.4
1	7.4	7.2	0	145	5440	414	42	4.3
2	7.5	7.4	0	145	8800	684	38	4.3
3	7.7	7.6	0	142	4200	288	40	4.3
4	7.7	7.7	0	67	5520	84	24	4.3
5	7.0	7.3	0	179	5200	204	31	3.2
6	7.0	7.1	0	266	5440	480	47	3.2
7	6.3	6.5	0	49	2800	60	18	2.2
8	6.4	7.0	0	44	3920	72	17	3.2
9	2.5	2.7	8.0	718	1800	552	80	4.3
WHEELER-BEVIER COAL								

Table 133. ACID-BASE ACCOUNT OF THE WHEELER-BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S PRAIRIE HILL MINE, NEIGHBORHOOD TEN, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material			
				Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
Bt	5/6	1	.015	.47	1.79		1.32
1	7/4	3	.065	2.03	136.61		134.58
2	7/4	3	.040	1.25	139.84		138.59
3	7/4	4	.030	.94	136.74		135.80
4	7/1	5	.195	6.09	971.37		965.28
5	3/1	5	3.150	98.44	298.64		200.20
6	2/0	1	.750	23.44	36.02		12.58
7	2/0	1	2.030	63.44	61.50	1.94	
8	2/0	0	2.030	63.44	10.54	52.90	
9	5/1	0	1.410	44.06	- 3.68	47.74	
WHEELER-BEVIER COAL							

Table 134. PHYSICAL CHARACTERIZATIONS OF THE WHEELER-BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S MARK TWAIN MINE, ADJUNCT TO NEIGHBORHOOD TEN

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A1	0.0-0.8	Soil	10YR 4/3	-
Bt	0.8-2.3	Soil	10YR 5/4	-
Rock	1.0-2.0	LS	10YR 8/2	-
C	2.3-3.0	Soil	10YR 5/6	-
1	3.0-4.0	MS	2.5Y 7/1	-
2	4.0-6.0	MS	2.5Y 7/6	5
3	6.0-8.0	MS-I	2.5Y 8/6	1
4	8.0-11.0	MS	5Y 7/1	5
5	11.0-14.0	SH	2.5YR 5/2	1
6	14.0-17.0	MR	2.5YR 5/4	1
7	17.0-20.0	SH	2.5YR 4/2	1
8	20.0-23.0	MS	N 7/0	3
9	23.0-26.0	LS	2.5Y 8/2	0
10	26.0-29.0	MS	5Y 5/1	4
11	29.0-30.0	SUMMIT COAL		
12	30.0-32.0	MS	N 7/0	10
13	32.0-35.0	MS	2.5Y 7/2	3
14	35.0-38.0	MS	5Y 7/1	10
15	38.0-40.0	LS	5Y 8/1	0
16	40.0-42.0	MS	5Y 7/1	2
17	42.0-44.0	MS	5Y 7/1	4
18	44.0-45.0	MR	5Y 4/1	2
19	45.0-47.0	MS	5Y 7/1	7
20	47.0-49.0	MS	N 8/0	3
21	49.0-52.0	MS	N 8/0	3
	52.0-62.0	MR	NOT SAMPLED	
	62.0+	WHEELER-BEVIER COAL		

Table 135. CHEMICAL CHARACTERIZATIONS OF THE WHEELER-BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S MARK TWAIN, ADJUNCT TO NEIGHBORHOOD TEN

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A_1	6.2	6.7	0	348	7920	456	137	15.6
Bt	6.3	6.7	0	171	6800	192	183	2.2
Rock	7.6	7.9	0	53	11680	60	23	2.2
C	7.1	7.6	0	89	9600	132	167	1.1
1	7.2	7.7	0	98	8160	372	65	2.2
2	7.7	7.7	0	131	11360	456	31	4.5
3	7.8	7.6	0	136	11360	492	26	4.5
4	5.6	2.5	8.0	106	2320	2400	294M	27.2
5	6.2	5.0	1.5	380	2800	864	67	6.8
6	6.9	7.2	0	569	3040	1032	342	1.1
7	7.1	7.5	0	557	2080	720	119	2.2
8	7.4	7.5	0	512	2640	744	132	4.5
9	7.3	7.4	0	142	12160	300	25	6.8
10	7.8	7.1	0	432	10720	1032	32	2.2
11	SUMMIT COAL							
12	5.0	2.9	5.0	410	7040	612	91	34.2
13	6.0	5.7	3.0	293	10400	600	45	128.0
14	6.5	7.5	0	480	8960	840	34	4.5
15	7.5	7.9	0	226	11520	360	22	3.4
16	7.6	7.7	0	400	10880	828	29	2.2
17	6.0	4.2	2.0	480	6960	972	360	54.6
18	6.9	6.6	0	459	11200	816	360	27.2
19	6.9	5.1	1.0	811	3040	1020	342	3.4
20	7.0	7.6	0	405	2080	840	97	2.2
21	6.8	7.3	0	485	1600	780	183	2.2
WHEELER-BEVIER COAL								

Table 136. ACID-BASE ACCOUNT OF THE WHEELER-BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S MARK TWAIN MINE, ADJUNCT TO NEIGHBORHOOD TEN

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
A_1	4/3	0	.020	.62	11.25		10.63
Bt	5/4	0	.020	.62	12.00		11.38
Rock	8/2	5	.010	.31	965.25		964.94
C	5/6	1	.020	.62	27.75		27.13
1	7/1	1	.025	.78	28.50		27.72
2	7/6	5	.010	.31	693.00		692.69
3	8/6	5	.080	2.50	779.62		777.12
4	7/1	0	9.500	296.88	- 13.70	310.58	
5	5/2	0	.230	7.19	1.50	5.69	
6	5/4	0	.025	.78	5.65		4.87
7	4/2	0	.010	.31	5.17		4.86
8	7/0	0	.110	3.44	19.62		16.18
9	8/2	5	.080	2.50	796.95		794.45
10	5/1	3	.460	14.38	73.01		58.63
11	SUMMIT COAL						
12	7/0	0	.730	22.81	- 5.85	28.66	
13	7/2	2	2.820	88.12	16.20	71.92	
14	7/1	3	.930	29.06	204.19		175.13
15	8/1	5	.300	9.38	754.87		745.49
16	7/1	3	1.040	32.50	236.73		204.23
17	7/1	0	.890	27.81	2.72	25.09	
18	5/1	2	.590	18.44	59.57		41.13
19	7/1	0	1.380	43.12	3.70	39.42	
20	8/0	0	.360	11.25	3.70	7.55	
21	8/0	0	.175	5.47	4.17	1.30	
WHEELER-BEVIER COAL							

Table 137. PHYSICAL CHARACTERIZATIONS OF THE TEBO AND WEIR-PITTSBURG COAL OVERBURDENS AT THE PEABODY COAL COMPANY'S POWER MINE, NEIGHBORHOOD ELEVEN

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
C_1	3.0- 4.0	Soil	N 7/0	9
C_2	4.0- 5.0	Soil	5Y 8/1	2
1	5.0- 8.0	MS	5Y 7/3	6
2	8.0-10.7	MS	5Y 7/2	1
3	10.7-13.3	MS	2.5Y 6/2	2
4	13.3-15.9	MR	2.5Y 7/2	1
5	15.9-17.3	MR	2.5Y 7/2	0
6	17.3-18.7	SH	10YR 5/2	2
7	18.7-20.1	SS	5Y 5/1	0
8	20.1-21.5	SS	N 4/0	1
9	21.5-22.5	LS	5Y 7/1	0
10	22.5-24.5	Carb.	N 2/0	0
11	24.5-26.5	SH-I	N 4/0	0
12	26.5-28.2	TEBO COAL		
13	28.2-30.4	MS	5Y 7/1	10
14	30.4-32.6	MS	5Y 6/1	4
15	32.6-34.8	MS	5Y 6/1	-
16	34.8-37.0	MS	5Y 7/1	9
17	37.0-39.3	MS	5Y 6/1	2
18	39.3-41.5	MS	5Y 5/1	2
19	41.5-43.7	MS	N 5.0	2
20	43.7-45.2	WEIR-PITTSBURGH COAL		

Table 138. CHEMICAL CHARACTERIZATIONS OF THE TEBO AND WEIR-PITTSBURG COAL OVERBURDENS AT PEABODY COAL COMPANY'S POWER MINE, NEIGHBORHOOD ELEVEN

			Per Thousand Tons of Material					
			Lime Require-	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	ment (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
C1	6.9	6.8	0	142	4640	1092	174	6.7
C2	6.9	7.0	0	191	4080	1272	159	4.5
1	7.5	7.3	0	153	4720	804	372	2.2
2	7.1	7.0	0	195	2520	894	320	4.5
3	7.1	7.1	0	307	4480	1392	372	4.5
4	7.7	7.6	0	103	10720	594	31	2.2
5	7.6	7.4	0	136	4320	528	77	2.2
6	6.7	6.4	0.5	302	2960	1020	192	22.0
7	7.5	7.5	0	453	2800	792	246G	6.7
8	7.4	7.5	0	540	4160	1128	372G	4.5
9	7.5	7.6	0	81	12480	144	24	4.5
10	6.8	7.0	0	574	2360	1062	142	4.5
11	5.2	6.6	0	696	5360	1416	294	4.5
12	TEBO COAL							
13	2.9	3.0	5.5	524	4160	828	159	4.5
14	7.5	7.7	0	836	3040	684	159	4.5
15	4.8	5.0	1.0	448	2640	444	174	4.5
16	7.7	7.8	0	507	2360	432	238	2.2
17	7.4	7.5	0	755	2880	552	167	4.5
18	3.3	7.1	0	518	4680	708	300G	4.5
19	4.6	2.7	7.0	275	5480	720	360G	22.0
20	WEIR-PITTSBURGH COAL							

Table 139 ACID-BASE ACCOUNT OF THE TEBO AND WEIR-PITTSBURG COAL OVERBURDENS AT PEABODY COAL COMPANY'S POWER MINE, NEIGHBORHOOD ELEVEN

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
C_1	7/0	0	.055	1.72	6.31		4.59
C_2	8/1	0	.035	1.09	4.56		3.47
1	7/3	0	.020	.62	7.56		6.94
2	7/2	0	.010	.31	5.57		5.26
3	6/2	0	.030	.94	7.32		6.38
4	7/2	2	.020	.62	70.70		70.08
5	7/2	0	.010	.31	6.58		6.27
6	5/2	0	.410	12.81	4.32	8.49	
7	5/1	0	.250	7.81	22.03		14.22
8	4/0	0	.925	28.91	9.31	19.60	
9	7/1	4	.525	16.41	746.73		730.32
10	2/0	0	1.700	53.12	35.02	18.10	
11	4/0	0	1.500	46.87	14.30	32.57	
12	TEBO COAL						
13	7/1	0	2.175	67.97	3.82	64.15	
14	6/1	0	.445	13.91	4.08	9.83	
15	6/1	0	2.900	90.62	2.33	88.29	
16	7/1	0	.220	6.87	5.33	1.54	
17	6/1	0	.135	4.22	3.58	.64	
18	5/1	0	.300	9.37	21.05		11.68
19	5/0	0	1.950	60.94	5.06	55.88	
20	WEIR-PITTSBURGH COAL						

Table 140. PHYSICAL CHARACTERIZATION OF THE OVERBURDEN BETWEEN THE TEBO AND WEIR-PITTSBURG COALS AT PEABODY COAL COMPANY'S POWER MINE, NEIGHBORHOOD ELEVEN, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-28.0	NOT SAMPLED		
TEBO COAL				
1	28.0-29.6	MS	N 7/0	10
2	29.6-31.2	MS	5Y 6/1	10
3	31.2-32.8	MS	5Y 7/1	5
4	32.8-34.4	MS	5Y 6/1	6
5	34.4-36.0	MS	N 8/0	1
6	36.0-37.6	SH	5Y 5/1	2
7	37.6-39.2	SH	5Y 4/1	1
8	39.2-40.8	Carb.	10YR 3/1	0
WEIR-PITTSBURG COAL				

Table 141. CHEMICAL CHARACTERIZATIONS OF THE OVERBURDEN BETWEEN THE TEBO AND WEIR-PITTSBURG COALS AT PEABODY COAL COMPANY'S POWER MINE, NEIGHBORHOOD ELEVEN, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
TEBO COAL								
1	5.2	7.8	0	552	20000	708	216	3.2
2	7.8	5.8	0.5	761	2560	900	342	6.4
3	2.3	2.5	7.5	327	2240	852	174	28.0
4	2.6	2.8	7.0	563	4040	1488	294	255.6
5	7.9	8.0	0	641	1760	864	80	4.3
6	7.9	8.0	0	729	1800	780	111	3.2
7	6.7	6.9	0	685	4720	792	385	5.4
8	2.1	2.4	7.5	150	2440	1140	80	10.8
WEIR-PITTSBURGH COAL								

Table 142. ACID-BASE ACCOUNT OF THE OVERBURDEN BETWEEN THE TEBO AND WEIR-PITTSBURG COALS AT PEABODY COAL COMPANY'S POWER MINE, NEIGHBORHOOD ELEVEN, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
TEBO COAL							
1	7/0	0	4.100	128.12	2.28	125.84	
2	6/1	0	1.600	50.00	5.27	44.73	
3	7/1	0	4.625	144.53	- 1.98	146.51	
4	6/1	1	1.225	38.28	4.78	33.50	
5	8/0	1	.155	4.84	18.77		13.93
6	5/1	0	.095	2.97	3.53		.56
7	4/1	0	.850	26.56	5.27	21.29	
8	3/1	0	1.775	55.47	2.77	52.70	
WEIR-PITTSBURGH COAL							

Table 143. PHYSICAL CHARACTERIZATIONS OF THE MINESOIL RESULTING FROM THE MINING OF THE TEBO AND WEIR-PITTSBURG COALS AT PEABODY COAL COMPANY'S POWER MINE, NEIGHBORHOOD ELEVEN

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
1-1	surface	Soil	5Y 7/1	8
1-2	0.8	Soil	5Y 6/1	10
2-1	surface	Soil	5Y 7/1	9
2-2	0.8	Soil	5Y 8/2	7
3-1	surface	Soil	5Y 7/1	9
3-2	0.8	Soil	5Y 6/1	8
4-1	surface	Soil	5Y 7/1	8
4-2	0.8	Soil	5Y 6/1	6

Table 144. CHEMICAL CHARACTERIZATIONS OF THE MINESOIL RESULTING FROM THE MINING OF THE TEBO AND WEIR-PITTSBURG COALS AT PEABODY COAL COMPANY'S POWER MINE, NEIGHBORHOOD ELEVEN

			Per Thousand Tons of Material					
			Lime	Acid Extracted				Bicarbonate
Sample No.	pH (paste)	pH (1:1)	Requirement (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	Extracted P (lbs.)
1-1	2.6	2.9	7.0	73	4320	432	200	62.8
1-2	2.3	2.4	9.5	89	5280	564	111	67.0
2-1	2.8	3.1	7.5	145	2800	282	56	9.6
2-2	2.8	2.9	5.5	230	5200	2112	77	43.2
3-1	2.8	2.8	4.5	160	2080	156	75	23.8
3-2	2.3	2.4	12.5	183	4640	1920	246	
4-1	3.0	3.0	7.0	131	6720	72	192	301.6
4-2	2.6	2.6	7.0	247	5760	348	174	304.0

Table 145. ACID-BASE ACCOUNT OF THE MINESOIL RESULTING FROM THE MINING OF THE TEBO AND WEIR-PITTSBURG COAL AT PEABODY COAL COMPANY'S POWER MINE, NEIGHBORHOOD ELEVEN

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1-1	7/1	0	2.025	63.28	- 8.90	72.18	
1-2	6/1	0	1.200	37.50	- 11.16	48.66	
2-1	7/1	0	1.550	48.44	- 4.92	53.36	
2-2	8/2	0	1.375	42.97	- 5.42	48.39	
3-1	7/1	0	.625	19.53	- 5.42	24.95	
3-2	6/1	0	1.350	42.19	- 20.40	62.59	
4-1	7/1	0	1.125	35.16	1.32	33.84	
4-2	6/1	0	.950	29.69	- 6.91	36.60	
AFTER LEACHING TO REMOVE SULPHATES							
1-1	7/1	0	.625	19.53	- 8.90	27.43	
1-2	6/1	0	.400	12.50	- 11.16	23.66	
2-1	7/1	0	.625	19.53	- 4.92	24.45	
2-2	8/2	0	.565	17.66	- 5.42	23.08	
3-1	7/1	0	.275	8.59	- 5.42	14.01	
3-2	6/1	0	.500	15.63	- 20.40	36.03	
4-1	7/1	0	.425	13.28	1.32	12.96	
4-2	6/1	0	.425	13.28	- 6.91	20.19	

Table 146. PHYSICAL CHARACTERIZATIONS OF THE BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S TEBO MINE (PIT 1050B), NEIGHBORHOOD ELEVEN

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-28.5	NOT SAMPLED		
1	28.5-29.5	Carb.	N 3/0	0
2	29.5-30.5	Carb.	N 3/0	0
3	30.5-31.5	MS	N 7/0	1
4	31.5-32.5	MS	N 7/0	2
5	32.5-33.5	MS	N 7/0	2
6	33.5-34.5	MS	N 6/0	1
7	34.5-35.5	MS	N 6/0	1
8	35.5-36.5	MS	N 6/0	1
9	36.5-37.5	MS	N 6/0	1
10	37.5-38.5	MS	N 5/0	2
BEVIER COAL				

Table 147. CHEMICAL CHARACTERIZATIONS OF THE BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S TEBO MINE (PIT 1050B), NEIGHBORHOOD ELEVEN

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	6.9	7.0	0	343	10880	564	77	2.2
2	7.1	7.2	0	437	9120	1056	372	4.5
3	3.5	3.9	3.0	405	4880	588	372G	5.5
4	2.8	2.8	6.5	156	5200	780	342G	8.9
5	2.8	2.7	5.5	136	3760	672	360G	5.5
6	2.7	2.7	5.5	238	3680	528	360G	1.1
7	2.7	2.7	7.5	111	3840	684	246G	6.7
8	2.8	2.7	5.5	183	3440	588	294G	20.0
9	2.9	2.6	7.0	111	3600	720	200G	14.3
10	2.7	2.5	7.0	87	4240	804	200G	8.9
BEVIER COAL								

148. ACID-BASE ACCOUNT OF THE BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S TEBO MINE (PIT 1050B), NEIGHBORHOOD ELEVEN

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	3/0	3	1.450	45.31	100.62		55.31
2	3/0	1	1.600	50.00	30.15	19.85	
3	7/0	0	3.400	106.25	5.02	101.23	
4	7/0	0	2.475	77.34	4.27	73.07	
5	7/0	0	2.625	82.03	2.02	80.01	
6	6/0	0	2.875	89.84	3.76	86.08	
7	6/0	0	2.300	71.87	2.78	69.09	
8	6/0	0	2.525	78.91	2.78	76.13	
9	6/0	0	2.575	80.47	0.51	79.96	
10	5/0	0	5.050	157.81	3.03	154.78	
BEVIER COAL							

Table 149. PHYSICAL CHARACTERIZATIONS OF THE BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S TEBO MINE (PIT 5560), NEIGHBORHOOD ELEVEN

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
	0.0-10.0	NOT SAMPLED		
1	10.0-11.0	Carb.	N 3/0	0
2	11.0-12.0	Carb.	N 2/0	0
3	12.0-13.0	Carb.	N 2/0	0
4	13.0-14.0	MS	N 5/0	1
5	14.0-15.0	MS	N 6/0	6
6	15.0-16.0	MS	N 6/0	6
7	16.0-17.0	MS	N 6/0	7
8	17.0-18.0	MS	N 6/0	2
9	18.0-19.0	MS	N 6/0	2
10	19.0-20.0	MS	N 6/0	1
	20.0-22.5	BEVIER COAL		
11	22.5+	MS	5Y 6/1	6

Table 150. CHEMICAL CHARACTERIZATIONS OF THE BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S TEBO MINE (PIT 5560), NEIGHBORHOOD ELEVEN

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
1	6.7	7.1	0	359	10400	1032	35	7.8
2	7.0	7.4	0	432	9920	840	308	4.5
3	7.2	7.4	0	390	9600	744	216	2.2
4	7.1	7.2	0	275	10720	468	27	2.2
5	6.5	6.5	0	312	9600	732	342	2.2
6	3.4	2.8	5.0	75	4240	1080	342	2.2
7	2.9	2.8	6.0	62	3680	1140	372	3.4
8	2.9	2.8	4.5	62	3520	1080	360	2.2
9	3.1	3.1	5.5	120	2960	948	372	5.5
10	3.2	2.8	6.0	75	2560	1032	308	2.2
	BEVIER COAL							
11	5.6	7.2	0	369	1200	312	159	11.0

Table 151. ACID-BASE ACCOUNT OF THE BEVIER COAL OVERBURDEN AT PEABODY COAL COMPANY'S TEBO MINE (PIT 5560), NEIGHBORHOOD ELEVEN

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
1	3/0	3	1.850	57.81	167.31		109.50
2	2/0	2	2.400	75.00	68.83	6.17	
3	2/0	2	1.850	57.81	78.38		20.57
4	5/0	4	3.500	109.37	186.15		76.78
5	6/0	1	2.100	65.62	16.08	49.54	
6	6/0	0	2.300	71.87	- 1.01	72.88	
7	6/0	0	2.475	77.34	- 1.77	79.11	
8	6/0	0	2.875	89.84	- 1.01	90.85	
9	6/0	0	1.600	50.00	1.01	48.99	
10	6/0	0	3.650	114.06	- 1.77	115.83	
	BEVIER COAL						
11	6/1	0	.975	30.47	2.78	27.69	

Table 152. PHYSICAL CHARACTERIZATIONS OF THE MULBERRY COAL OVERBURDEN AT THE PITTSBURG - MIDWAY COAL COMPANY'S MIDWAY MINE NEIGHBORHOOD TWELVE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
Ap	0.0- 0.7	Soil	10YR 5/2	2
Bt	0.7- 2.7	Soil	2.5Y 7/4	4
Bx	2.7- 4.3	Soil	2.5Y 7/4	10
C	4.3- 7.3	Soil	2.5Y 6/4	9
1	7.3-10.3	MS	2.5Y 7/4	9
2	10.3-13.3	MR	2.5Y 7/2	2
3	13.3-16.3	MR	10YR 6/3	1
4	16.3-19.3	MR	10YR 6/1	3
5	19.3-19.5	Carb.	5Y 3/1	2
6	19.5-20.0	Coal	N 2/0	1
7	20.0-20.3	MS/gyp	N 5/0	8
8	20.3-23.3	LS	N 7/0	1
9	23.3-26.3	LS	5Y 7/1	0
10	26.3-29.3	MR	N 7/0	1
11	29.3-32.3	LS	5Y 7/1	1
12	32.3-35.3	MS	N 8/0	7
13	35.3-38.3	LS	10YR 8/1	0
14	38.3-40.3	MS	5Y 5/1	8
15	40.3-42.3	LS	5Y 7/1	1
16	42.3-44.3	MS	5Y 6/1	7
17	44.3-47.3	MS	N 8/0	4
18	47.3-50.3	MS	2.5Y 7/1	5
19	50.3-53.3	MS/gyp	5Y 7/1	4
20	53.3-56.3	MS/gyp	5Y 7/1	1
21	56.3-56.5	Carb.	N 2/0	1
22	56.5-58.5	MULBERRY COAL		
23	58.5-60.0	MS	N 7/0	7

Table 153. CHEMICAL CHARACTERIZATIONS OF THE MULBERRY COAL OVERBURDEN AT THE PITTSBURG - MIDWAY COAL COMPANY'S MIDWAY MINE, NEIGHBORHOOD TWELVE

			Per Thousand Tons of Material					
			Lime Requirement	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
Ap	5.3	5.2	2.5	117	3120	876	82	3.2
Bt	6.4	6.3	2.0	103	4480	1752	128	0.5
Bx	7.2	7.0	0	89	5040	1044	153	10.2
C	7.5	7.4	0	122	3520	1296	174	4.5
1	7.9	7.7	0	95	10080	780	45	2.2
2	7.2	7.0	0	142	5360	948	372	2.2
3	7.4	7.1	0	139	5440	972	360	2.2
4	7.4	7.1	0	234	2960	528	360	0.5
5	3.1	2.9	4.5	198	3040	864	82	4.5
6	4.9	4.9	0.5	46	1200	192	174	4.5
7	4.2	4.0	2.0	374	3360	972	360	4.5
8	7.8	7.8	0	293	9920	516	35	0.5
9	7.7	7.8	0	261	11200	504	27	5.6
10	8.1	8.0	0	410	9440	888	72	0.5
11	8.1	8.0	0	332	10880	708	29	0.5
12	7.8	7.8	0	338	10880	780	31	0.5
13	8.2	8.0	0	62	11200	120	20	0.5
14	9.0	9.1	0	469	6960	996	372	2.2
15	9.0	9.2	0	416	9120	516	34	0.5
16	8.0	8.2	0	480	9440	720	42	0.5
17	9.1	9.2	0	256	10880	336	24	1.1
18	9.3	9.3	0	374	9600	444	31	0.5
19	8.7	8.7	0	343	10560	432	27	1.1
20	7.9	8.0	0	298	10240	384	29	1.1
21	2.4	2.7	7.0	87	1680	708	85G	6.8
22	MULBERRY COAL							
23	5.3	5.4	1.0	580	2480	804	372	1.1

Table 154. ACID-BASE ACCOUNT OF THE MULBERRY COAL OVERBURDEN AT THE PITTSBURG - MIDWAY COAL COMPANY'S MIDWAY MINE, NEIGHBORHOOD TWELVE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
Ap	5/2	0	.020	.62	4.75		4.13
Bt	7/4	0	.015	.47	9.56		9.09
Bx	7/4	0	.010	.31	6.81		6.50
C	6/4	0	.010	.31	9.97		9.66
1	7/4	2	.015	.47	50.35		49.88
2	7/2	1	.010	.31	10.88		10.57
3	6/3	1	.010	.31	11.34		11.03
4	6/1	1	.040	1.25	8.62		7.37
5	3/1	0	1.250	39.06	3.16	35.90	
6	2/0	0	1.300	40.62	2.50	38.12	
7	5/0	1	1.045	27.97	6.13	21.84	
8	7/0	2	.125	3.91	59.44		55.53
9	7/1	3	.275	8.59	412.17		403.58
10	7/0	1	.020	.62	29.50		28.88
11	7/1	4	.025	.78	299.15		298.37
12	8/0	3	.045	1.41	180.01		178.60
13	8/1	5	.010	.31	963.19		962.88
14	5/1	1	.040	1.25	30.45		29.20
15	7/1	2	.045	1.41	175.02		173.61
16	6/1	3	.120	3.75	129.12		125.37
17	8/0	5	.045	1.41	475.42		474.01
18	7/1	3	.045	1.41	86.95		85.54
19	7/1	2	.170	4.06	63.50		59.44
20	7/1	2	1.310	38.44	125.37		86.93
21	2/0	0	4.900	153.12	- 4.53	157.65	
22	MULBERRY COAL						
23	7/0	1	.190	5.94	7.47		1.53

Table 155. PHYSICAL CHARACTERIZATIONS OF THE MULBERRY COAL OVERBURDEN AT THE PITTSBURG - MIDWAY COAL COMPANY'S MIDWAY MINE, NEIGHBORHOOD TWELVE, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A1	0.0- 1.3	Soil	10YR 5/2	2
Bt	1.3- 3.3	Soil	10YR 6/3	4
Bx	3.3- 6.0	Soil	5Y 7/3	10
C	6.0- 9.0	MS	2.5Y 7/4	10
1	9.0-12.0	MS	2.5Y 7/4	1
2	12.0-14.0	MS	5Y 7/2	2
3	14.0-16.0	MS	2.5Y 7/2	6
4	16.0-18.0	MS	5Y 7/2	4
5	18.0-18.2	Carb.	5Y 3/1	1
6	18.2-18.7	Coal	N 2/0	0
7	18.7-19.0	MS/gyp	5Y 4/1	10
8	19.0-22.0	MS	5Y 7/1	4
9	22.0-25.0	MS	5Y 6/1	1
10	25.0-28.0	MS	5Y 7/1	1
11	28.0-31.0	MS	5Y 7/1	8
12	31.0-34.0	MS	N 8/0	10
13	34.0-35.5	LS	5Y 7/1	0
14	35.5-37.0	LS	N 8/0	0
15	37.0-38.0	MS	5Y 6/2	3
16	38.0-39.0	MS	5Y 5/1	3
17	39.0-42.0	MS	5Y 7/1	8
18	42.0-44.0	MS	5Y 7/1	0
19	44.0-48.7	MS	5Y 7/1	1
20	48.7-53.3	MS	5Y 7/1	0
21	53.3-58.0	MS	5Y 7/1	0
22	58.0-58.3	Carb.	5Y 2/1	0
23	58.3-60.3	MULBERRY COAL		
24	60.3-62.0	MS/gyp	5Y 7/1	9

Table 156. CHEMICAL CHARACTERIZATIONS OF THE MULBERRY COAL OVERBURDEN AT THE PITTSBURG - MIDWAY COAL COMPANY'S MIDWAY MINE NEIGHBORHOOD TWELVE, COLUMN TWO

			Per Thousand Tons of Material					
			Lime Require- ment	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A1	5.1	5.0	3.0	275	3160	678	47	5.6
Bt	6.7	6.7	0	139	3840	1560	132	0.5
Bx	7.3	7.2	0	81	3680	1008	137	10.2
C	7.5	7.2	0	109	4960	1344	183	6.8
1	7.8	7.8	0	67	7840	816	43	4.5
2	8.0	7.8	0	145	9440	792	67	0.5
3	7.1	6.8	0	206	2800	816	128	0.5
4	7.4	7.2	0	187	4080	792	308	0.5
5	2.5	2.6	7.5	128	4160	1080	82	9.2
6	3.5	3.3	0.5	40	480	84	47	4.5
7	3.0	3.1	5.5	453	2760	972	94	10.2
8	7.7	7.8	0	275	2240	444	320	2.2
9	7.7	7.7	0	348	16000	600	35	2.2
10	8.0	8.0	0	405	10880	708	52	2.2
11	8.0	8.0	0	464	9920	804	52	2.2
12	8.1	8.1	0	317	19760	744	159	2.2
13	7.9	7.9	0	122	12000	168	24	2.2
14	8.2	8.0	0	103	12480	132	31	4.5
15	9.0	8.8	0	284	8640	444	77	2.2
16	8.9	8.8	0	512	6800	660	385	2.2
17	7.8	7.6	0	432	9440	756	29	1.1
18	9.1	9.0	0	312	9920	360	26	0.5
19	9.3	9.0	0	317	9760	432	25	1.1
20	9.1	8.9	0	312	10240	444	25	2.2
21	8.8	8.7	0	298	10400	444	26	2.2
22	2.7	3.7	5.5	128	2440	1188	396 M	9.2
23	MULBERRY COAL							
24	4.6	4.4	1.5	502	3120	540	385	7.8

Table 157. ACID-BASE ACCOUNT OF THE MULBERRY COAL OVERBURDEN AT THE PITTSBURG - MIDWAY COAL COMPANY'S MIDWAY MINE, NEIGHBORHOOD TWELVE, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
Al	5/2	0	.045	1.41	5.90		4.49
Bt	6/3	0	.035	1.09	9.07		7.98
Bx	7/3	0	.005	.16	5.90		5.74
C	7/4	0	.005	.16	11.34		11.18
1	7/4	2	.005	.16	32.22		32.06
2	7/2	2	.005	.16	23.81		23.65
3	7/2	1	.020	.62	5.90		5.28
4	7/2	1	.020	.62	5.00		4.38
5	3/1	0	2.150	67.19	- .22	67.41	
6	2/0	0	1.875	58.59	2.72	55.87	
7	4/1	0	1.660	40.63	4.09	36.54	
8	7/1	1	.055	1.72	9.97		8.25
9	6/1	2	.045	1.41	56.25		54.84
10	7/1	2	.060	1.87	43.78		41.91
11	7/1	2	.010	.31	41.50		41.19
12	8/0	2	.010	.31	43.32		43.01
13	7/1	5	.045	1.41	804.39		802.98
14	8/0	4	.115	3.59	729.91		726.32
15	6/2	3	.025	.78	106.79		106.01
16	5/1	1	.035	1.09	23.45		22.36
17	7/1	3	.150	4.69	152.69		148.00
18	7/1	4	.045	1.41	461.70		460.29
19	7/1	3	.025	.78	141.47		140.69
20	7/1	3	.045	1.41	343.81		342.40
21	7/1	3	.040	1.25	398.45		397.20
22	2/1	0	4.725	147.66	4.31	143.35	
23	MULBERRY COAL						
24	7/1	1	.910	23.13	5.90	17.23	

Table 158. PHYSICAL CHARACTERIZATIONS OF THE STIGLER COAL OVERBURDEN AT SIERRA COAL CORPORATION'S MINE, ADJUNCT TO NEIGHBORHOOD TWELVE

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
Ap	0.0-0.7	Soil	10YR 5/3	10
Bt	1.2-3.2	Soil	10YR 6/6	9
Bt	3.2-4.7	Soil	10YR 7/6	8
Bx	4.7-5.7	Soil	10YR 7/6	8
Bx	5.7-6.9	Soil	10YR 7/4	7
C	6.9-8.9	Soil	2.5Y 7/4	8
C	8.9-10.9	Soil	2.5Y 8/2	10
C	10.9-13.0	Soil	2.5Y 7/2	4
1	13.0-15.0	MS-I	2.5Y 7/6	4
2	15.0-16.0	MS	2.5Y 7/4	1
3	16.0-18.0	MS	2.5Y 6/2	1
4	18.0-20.0	MS	2.5Y 6/2	0
5	20.0-22.0	MS	2.5Y 6/2	0
6	22.0-23.0	MS	10YR 6/1	0
7	23.0-25.0	MS	10YR 6/1	0
8	25.0-27.0	MS	10YR 6/1	0
9	27.0-29.0	MS	10YR 6/1	0
10	29.0-31.0	MS	10YR 6/1	0
11	31.0-33.0	MS	10YR 6/1	0
12	33.0-34.9	STIGLER COAL		
13	34.9-35.1	MS	10YR 6/1	1

Table 159. CHEMICAL CHARACTERIZATIONS OF THE STIGLER COAL OVERBURDEN AT SIERRA COAL CORPORATION'S MINE, ADJUNCT TO NEIGHBORHOOD TWELVE

			Per Thousand Tons of Material					
			Lime Require-ment	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	(tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
Ap	4.8	4.6	2.0	58	640	132	15	2.2
Bt	4.9	4.7	2.5	58	960	192	37	0.5
Bt	5.8	5.6	1.5	87	1200	456	80	1.1
Bx	5.8	5.7	1.5	92	1440	528	103	4.5
Bx	6.0	5.7	1.0	100	1440	528	82	2.2
C	6.4	5.8	1.5	125	1920	684	100	2.2
C	6.3	5.8	1.0	122	1760	636	88	2.2
C	6.4	6.1	1.0	122	480	168	75	3.4
1	6.3	6.3	1.5	103	1920	612	91	12.1
2	6.6	6.4	1.0	111	2880	852	147	11.0
3	7.0	6.8	0	114	3120	780	360	8.9
4	7.4	7.0	0	114	3920	972	360	6.7
5	8.1	7.8	0	145	2160	504	360	4.5
6	8.1	8.0	0	210	5680	816	360G	2.2
7	7.9	8.0	0	214	1760	324	360G	1.1
8	7.8	8.0	0	214	5120	900	360G	2.2
9	8.0	7.9	0	226	4240	852	342G	1.1
10	7.8	7.7	0	226	4800	888	300G	1.1
11	7.8	7.7	0	222	6400	912	372G	1.1
12	STIGLER COAL							
13	7.4	7.1	0	187	960	420	97	2.2

Table 160. ACID-BASE ACCOUNT OF THE STIGLER COAL OVERBURDEN AT SIERRA COAL CORPORATION'S MINE, ADJUNCT TO NEIGHBORHOOD TWELVE

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
Ap	5/3	0	.015	.47	.50		.03
Bt	6/6	0	.010	.31	- .47	.78	
Bt	7/6	0	.010	.31	1.37		1.06
Bx	7/6	0	.005	.16	1.72		1.56
Bx	7/4	0	.010	.31	2.47		2.16
C	7/4	0	.005	.16	2.97		2.81
C	8/2	0	.005	.16	3.45		3.29
C	7/2	0	.065	2.03	2.72		.69
1	7/6	0	.005	.16	4.20		4.04
2	7/4	0	.015	.47	8.75		8.28
3	6/2	0	.010	.31	10.35		10.04
4	6/2	0	.005	.16	10.60		10.44
5	6/2	0	.015	.47	7.90		7.43
6	6/1	1	.055	1.72	29.07		27.35
7	6/1	0	.050	1.56	14.55		12.99
8	6/1	0	.070	2.19	21.42		19.23
9	6/1	0	.060	1.87	17.12		15.25
10	6/1	0	.060	1.87	28.57		26.70
11	6/1	0	.760	23.75	24.40		.65
12	STIGLER COAL						
13	6/1	0	.580	18.12	4.45	13.67	

Table 161. PHYSICAL CHARACTERIZATIONS OF THE STIGLER COAL OVERBURDEN AT SIERRA COAL CORPORATION'S MINE, ADJUNCT TO NEIGHBORHOOD TWELVE, COLUMN TWO

Sample No.	Depth (feet)	Rock Type	Color	Water Slaking
A	0.0-0.7	Soil	2.5Y 4/4	10
B	1.0-3.0	Soil	10YR 5/6	10
1	3.0-5.0	MS	10YR 6/4	3
2	5.0-7.0	MS	2.5Y 7/2	3
3	7.0-9.0	SH	2.5Y 7/2	1
4	9.0-11.0	SH	2.5Y 6/6	1
5	11.0-13.0	SH	2.5Y 7/4	1
6	13.0-15.0	SH	2.5Y 6/4	1
7	15.0-17.0	SH	2.5Y 6/4	1
8	17.0-19.0	SH	2.5Y 6/2	2
9	19.0-20.5	MR	2.5Y 6/2	0
10	20.5-22.5	SH	2.5Y 6/2	0
11	22.5-24.5	SH	2.5Y 6/2	0
12	24.5-24.7	MR	10YR 5/4	0
13	24.7-27.0	MS	10YR 6/1	0
14	27.0-29.0	MS	10YR 6/1	0
15	29.0-31.0	MS	10YR 6/1	0
16	31.0-33.0	MS	10YR 6/1	0
17	33.0-35.0	MS	10YR 6/1	0
18	35.0-37.0	MS	10YR 6/1	0
19	37.0-39.0	MS	10YR 6/1	0
20	39.0-41.0	MS	10YR 5/1	0
21	41.0-43.0	MS	10YR 5/1	1
22	43.0-44.7	STIGLER COAL		
23	44.7-45.0	MS	10YR 6/1	1

Table 162. CHEMICAL CHARACTERIZATIONS OF THE STIGLER COAL OVERBURDEN AT SIERRA COAL CORPORATION'S MINE, ADJUNCT TO NEIGHBORHOOD TWELVE, COLUMN TWO

			Per Thousand Tons of Material					
			Lime	Acid Extracted				Bicarbonate Extracted
Sample No.	pH (paste)	pH (1:1)	Requirement (tons)	K (lbs.)	Ca (lbs.)	Mg (lbs.)	P (lbs.)	P (lbs.)
A	4.8	5.4	2.5	307	3520	684	27	2.2
B	5.2	4.4	6.0	69	1200	720	40	0.5
1	7.1	6.9	0	111	2800	1824	342	4.5
2	6.9	6.6	0	122	2560	1440	372	2.2
3	7.1	7.0	0	122	2800	1536	360	5.5
4	7.1	6.8	0	109	2560	1728	246	18.3
5	7.2	7.0	0	120	2560	1464	360	6.8
6	7.2	7.0	0	114	2400	1728	342	4.5
7	7.2	7.1	0	145	2040	1416	360	3.4
8	7.2	7.1	0	139	2400	2136	360	2.2
9	7.7	7.6	0	167	2000	1488	372	2.2
10	7.8	7.8	0	187	2480	1848	372	1.1
11	7.7	7.7	0	187	2560	1704	360	2.2
12	7.7	7.7	0	122	6080	672	52	4.5
13	7.9	7.9	0	238	3600	1416	300	1.1
14	7.9	7.8	0	226	3760	1320	300 G	1.1
15	8.0	7.8	0	230	3760	1272	360 G	2.2
16	7.9	7.8	0	243	4000	1272	320 G	1.1
17	7.8	7.8	0	210	3360	852	300 G	1.1
18	8.0	7.8	0	226	2880	996	342 G	2.2
19	7.9	7.7	0	206	4000	1128	300 G	2.2
20	7.3	7.3	0	247	2800	1224	294 G	2.2
21	7.5	7.4	0	234	3120	1272	294 G	2.2
22	STIGLER COAL							
23	7.9	7.7	0	187	1360	720	97	2.2

Table 163. ACID-BASE ACCOUNT OF THE STIGLER COAL OVERBURDEN AT SIERRA COAL CORPORATION'S MINE, ADJUNCT TO NEIGHBORHOOD TWELVE, COLUMN TWO

Sample No.	Value and Chroma	Fiz	%S	Tons $CaCO_3$ Equivalent/Thousand Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH 7)	Excess $CaCO_3$
A	4/4	0	.025	.78	3.70		2.92
B	5/6	0	.020	.62	- 2.82	3.44	
1	6/4	0	.010	.31	9.85		9.54
2	7/2	0	.020	.62	10.10		9.48
3	7/2	0	.010	.31	9.12		8.81
4	6/6	0	.005	.16	9.37		9.21
5	7/4	0	.010	.31	10.10		9.79
6	6/4	0	.010	.31	9.37		9.06
7	6/4	0	.015	.47	9.85		9.38
8	6/2	0	.015	.47	8.87		8.40
9	6/2	0	.010	.31	9.37		9.06
10	6/2	0	.015	.47	10.10		9.63
11	6/2	0	.005	.16	10.20		10.04
12	5/4	2	.015	.47	83.75		83.28
13	6/1	0	.075	2.34	28.82		26.48
14	6/1	0	.065	2.03	28.07		26.04
15	6/1	0	.060	1.87	27.10		25.23
16	6/1	0	.070	2.19	21.20		19.01
17	6/1	1	.065	2.03	24.75		22.72
18	6/1	0	.040	1.25	18.00		16.75
19	6/1	0	.050	1.56	27.60		26.04
20	5/1	0	.060	1.87	24.40		22.53
21	5/1	0	.440	13.75	29.32		15.57
22	STIGLER COAL						
23	6/1	0	.550	17.19	4.20	12.99	

SECTION X

TOXIC OR POTENTIALLY TOXIC MATERIALS

TOTAL CONTENTS OF MACRO- AND MICRO-METALS IN SELECTED ROCK SAMPLES FROM DIFFERENT NEIGHBORHOODS.

It is well known that trace and heavy metal content of a young soil is dependent on the composition of the parent rock and on the weathering processes. Most of these trace elements found in rock, whether or not they are essential for plant growth, are toxic above certain levels. As a result the determination and behavior of these elements in rock and soil is of considerable importance. Keeping these considerations in mind, total analyses for macro- and micro-elements in rock material collected from different locations was carried out. The other objective of this study was to determine the variability in the composition of similar rock materials from locality to locality. Results of this study are given in Tables 164-166.

Aluminum and Iron

The amount of aluminum (Al) in various rock materials varies from 0.33% to 20%. In general, the amount of Al in coal, limestone and sandstone was very low, whereas in mudstone and shale, it was quite high (12 to 20%). Al contents of mudstone and shale also vary from location to location. This is expected mainly due to the differences in the type and amounts of clay mineral content of these materials.

The total amount of iron (Fe) in various rock samples range from 0.55% to 8.4%. The highest amount of Fe was found in mudstone from the Prairie Hill mine. Generally the concentration of Fe in mudstone and shale varies between 4 and 6%, which is quite normal for this type of rock when it contains biotite, siderite and other (Fe) bearing minerals. Weathering of these rock materials will release (Fe), but distribution of (Fe) and other trace elements is controlled by the ionic potentials, so as a result, Al and Fe are generally precipitated during the processes of weathering and transportation. Because of their higher ionic potentials these elements rarely create any hazard except when the pH is very low.

Manganese

Concentrations of Manganese (Mn) in these rock materials varies between 125 ppm and 1750 ppm: The highest amount of Mn (1750 ppm) was found in shale from Mingo County, West Virginia (Peter White Mine). Limestone was collected from Midway mine, contained 1000 ppm Mn, which is quite high for this type of material. It is expected that most of this Mn is present in carbonate form because 0.5N hydrochloric acid dissolved almost all the Mn. This extraction of Mn from limestone with dilute acid further indicates the nature of Mn compounds present in limestone. Extraction of Mn from clay and other silicate mineral requires digestion with hydrofloric acid. This is because Mn present in the lattices of the clay mineral would be more difficult to displace compared to that present in a chemical compound such as carbonates. As a result of this, the availability of Mn will depend upon the rate of weathering of the minerals concerned. At the same time it can be said that solubility of Mn in carbonate will depend upon the pH of the extracting solution. Water alone will not be able to extract any appreciable amount of Mn from limestone. On weathering of rocks Mn generally occurs in soils in the form of insoluble oxides as a result, its availability in neutral or alkaline soils is very low. Mn becomes toxic to plants only under reduced or acid condition when Mn oxides can be solubilized. Analyses of these rock materials from different locations do not indicate any excessive amount of Mn. Butler reported Mn content of certain Lancashire Soils up to 1750 ppm (Butler, 1954).

Copper and Zinc

The total amount of Copper (Cu) in various rock material vary between 5 and 70 ppm which is quite normal for these various types of rock (Swaine and Mitchell 1960). The amount of Cu in soils developed from sandstone and shale varies between 5 to 20 ppm. Very rarely do the total content of Cu in soils exceed 100 ppm.

Distribution of Zinc (Zn) in various rocks range between 40 and 320 ppm. Total analyses of several West Virginia soils (Keefer et. al. 1972) showed Zn content between 105 to 360 ppm. Shale and mudstone collected from West Virginia was generally high in Zn (260 to 320 ppm) and mudstone collected from Missouri and Kansas was low in Zn (40 ppm). Most Zn bearing minerals are readily weathered and as a result Zn is retained in soils on the exchange complex and in organic matter. So availability of Zn to plants (Swaine and Mitchell 1960) depends upon soil pH, phosphorus content and organic matter content rather than to total Zn content. Because of this it is difficult to speculate on the availability of Zn from the total analyses. One thing is quite clear from the total analyses that Cu and Zn contents of these rocks are quite below the toxic levels. Weathering of these rocks will not produce toxic levels of Cu and Zn in the developing soils. Toxic levels of Zn and Cu may arise in soils developed from such rocks by industrial contamination or by application of Cu and Zn-rich materials such as sewage sludges under acid conditions.

Cadmium, Nickel, Chromium and Lead

In general the amount of total nickel (Ni) and lead (Pb) in all rock samples was quite normal. The amount of total Ni varies between 30 and 200 ppm and of Pb between 10 and 40 ppm which is quite normal for shale, mudstone and sandstone. Availability of Ni and Pb to plants is much higher under acid conditions and as a result toxic effects of these elements can be cured by adequate liming.

The range of cadium (Cd) in rock samples varies between 10 and 220 ppm. The level of Cd in most of the rocks was below 40 ppm. There was one mudstone sample from West Virginia which contained 1690 ppm Cd. This appears quite high for this type of rock material. There is very little information available at this time regarding Cd concentration in various rocks. It is difficult to derive any conclusion from this one sample regarding its influence on the developing soils.

Chromium (Cr) concentration in the rocks varies between 20 and 490 ppm with one exception which contained 1250 ppm (mudstone from Prairie Hill). It has been reported in the literature that soils developed from serpentine contained 3000 ppm Cr (Swaine and Mitchell 1960) and Russian Chernozems contained 400 ppm Cr (Kovda and Yevskaya 1958). Even though these large quantities of Cr have been reported in soils, there is no report of Cr toxicity to plants in the literature. Cr is present in soils in compounds which are not easily soluble.

Summary

Total analyses for various elements of these rock materials were carried out to determine if any of the elements is likely present in toxic levels. The total content can be a reasonable indication of trace element content of future soils from these rocks and consequently their potential availability to plants. Heavy metals do not easily leach out like calcium, magnesium and potassium from soils on weathering of parent material. Because of their nature and low solubility, they generally remain in soils and as a result many times, heavy metal analyses of soil have been used to identify the parent rock. Results of these studies indicate that most of the rock materials contain normal amounts of trace or heavy metals. There is very little likelihood of release of toxic levels of these heavy metals on weathering of these rocks at near-neutral reactions.

ACID-BASE ACCOUNTS

Acid-Base Accounts involve two basic measurements. (1) total or pyritic sulphur; and (2) neutralization potential or calcium carbonate equivalent of bases present in the material. The procedures for both measurements are noted in Section IV.

Materials are defined as being toxic or potentially toxic when the pH of the material is less than 4.0 or there is a net potential deficiency of 5.0 t of calcium carbonate equivalent or more per 1000 t of materials, by the Acid-Base Accounting method (Smith, et.al. 1974. pp. 72-129).

Figure 9 and 10 contain examples of data from two overburden columns in Preston County, West Virginia (adjacent to Neighborhood 1) in graphic form. Figure 9 contains the data from a Bakerstown coal overburden, while Figure 10 represents an Upper Freeport coal overburden. Figure 9 extending 12.2 m (40 ft) above the coal presents a clear picture of what the mining operator can effect of the overburden materials as to toxic and non-toxic zones, before mining operations begin.

The soil represented (Figure 9) is low in total sulfur and contains no neutralizers resulting in a net deficiency of calcium carbonate equivalent, but it is not deficient to the extent that it would be considered a toxic zone. Descending the column from approximately 1.2 to 7.0 m (4 to 23 ft), there is a zone of base-rich mudstone and shale containing a net excess as much as 10% calcium carbonate equivalent, although the total sulfur is high. The rest of the overburden, except for a 61 cm (2 ft) layer immediately below the base-rich zone, is extremely high in total sulfur and the net deficiency of neutralizers puts this material in the toxic or potentially toxic category.

Figure 10 representing the Upper Freeport coal overburden is not as simple as Figure 9. There are net deficiencies at several places on the graph (Figure 10), but only three zones can be considered toxic or potential toxic: (1) the 6.1 to 7.3 m (20 to 24 ft) depth; (2) the 15.5 to 15.8 m (51 to 52 ft) depth; (3) The Upper Freeport coal zone (17.7 to 20.7 m: 58-68 ft).

The soil, except for the surface 30.5 cm (12 in), has a net deficiency of neutralizers along with the rock to a depth of 3.0 m (10 ft). The next 3 m (10 ft) down the column is very low in both sulphur and bases indicating that the net excess of deficiency is too small to be recorded on the graph. This is the extent of the weathered zone in this column.

A base-rich zone occurs from 7.3 to 17.7 m (24 to 58 ft) with only a 30.5 cm (12 in) potentially toxic layer at the 15.8 m (52 ft) depth. There are two additional 30.5 cm (12 in) layers of rock in this section that have a net deficiency of neutralizers, but they are not potentially toxic by the definition given.

The Bakerstown overburden represented in Figure 9 illustrates one type of material placement during reclamation, while the data (Figure 10) indicate another type for the overburden of the Upper Freeport coal. For the Bakerstown site, segregation of the material from 1.5 to 7 m (5 to 23 ft) from the remainder of the overburden is indicated. During regrading operations this material would be placed back at the surface of the minesoil, covering the potentially toxic material. The original surface soil of the area, where the Bakerstown coal is stripmined, is normally acid with low fertility and, generally, sandstone cobbles and boulders.

The Upper Freeport overburden (Figure 10) offers two options for reclamation. The normal recommendation, especially in areas where the overburden is dominated by the Mahoning Sandstone, is to selectively remove part or all of the top 6.1 m (20 ft) (Weathered Zone) and place this material at the surface of the minesoil. Normal fertilization and liming, as would be recommended for a poor pasture in West Virginia, is all that would be needed for successful reclamation.

The second option available for overburden placement on this site (Figure 10) is selectively removing the potentially toxic material right below the weathered zone and bury it in the pit. The overburden from 7.6 to 17.7 m (25 to 58 ft) can be blended with the top 6.1 m (20 ft) and placed at the surface of the minesoil. This second option, generally, only exists when the overburden of the Upper Freeport coal consists primarily of shales and mudstones, such as in Figure 10.

This type of information can be obtained in advance of surface mining and will enable the operator to mine the coal and leave the most favorable minesoil possible (chemically). In view of pollution costs and ever increasing land values, the future potential of disturbed lands will dictate that this type of preplanning be done.

Table 164. THE TOTAL CONTENTS OF MACRO- AND MICRO-ELEMENTS IN ROCK SAMPLES FROM DIFFERENT NEIGHBORHOODS.
PART I. SAMPLE IDENTIFICATION.

Sample No.	Lab. I.D. No.	Mine Name and State	Rock Type
1	SM-I,1	Sierra, Oklahoma	Coal
2	SM-II,1	Sierra, Oklahoma	Coal
3	MW-I,2	Midway, Missouri-Kansas	Coal
4	BS-#2,9	Burning Star, Illinois	SH
5	PW-6,10	Mingo County, West Virginia	MR
6	MW-II,11	Midway, Missouri-Kansas	LS
7	MW-II,18	Midway, Missouri-Kansas	MS
8	BS-#2,19	Burning Star #2, Illinois	LS
9	PH-I,21	Praire Hill, Missouri	MS
10	RQ-1,17	River Queen, W. Kentucky	SS
11	BM-II,86	West Virginia*	MS
12	PW-5,57	Peter White, West Virginia	Carb
13	MW-1,25	Midway, Missouri-Kansas	Soil
14	BM-II,71	West Virginia*	MS
15	BM-II,67	West Virginia*	MS
16	PW-5,79	Peter White, West Virginia	Coal
17	PW-6,157	Peter White, West Virginia	SH
18	SM-II,18	Sierra, Oklahoma	SH
19	SM-I,14	Sierra, Oklahoma	SS
20	BS#2,14	Burning Star #2, Illinois	MS
21	PH-I,19	Praire Hill, Missouri	MS
22	BM-II,83	West Virginia*	MS
23	RQ-I,18	River Queen, Kentucky	SS

*Bethlehem Steel Corporation's exploritory core on Pecks Run, 2 km (1.25 mi) northwest of junction of secondary road with WV Route 20, Warren District, Upshur County, West Virginia.

Table 165. THE TOTAL CONTENTS OF MACRO- AND MICRO-ELEMENTS IN ROCK SAMPLES FROM DIFFERENT NEIGHBORHOODS.
PART II: COLOR AND MACRO-ELEMENTS

Sample No.	Color	S (%)	pH	Ca (%)	Mg (%)	K (%)
1	N 2/0	6.700	4.5	1.50	0.08	0.12
2	N 2/0	5.130	4.9	1.00	0.05	0.12
3	N 2/0	2.380	5.9	0.12	0.02	0.12
4	5Y 5/1	3.360	3.4	0.10	0.80	3.75
5	10YR 4/1	0.870	7.3	0.25	1.25	4.50
6	N 8/0	0.115	8.2	27.00	0.75	0.30
7	5Y 4/1	1.700	3.0	2.20	1.00	0.60
8	5Y 6/1	0.325	7.8	0.12	0.75	3.90
9	5Y 7/1	0.420	6.2	0.05	1.00	3.60
10	5Y 7/1	0.125	6.6	0.005	0.13	2.40
11	2.5YR 6/4	0.011	8.9	0.005	0.75	4.20
12	5Y 3/1	0.080	7.0	0.005	0.65	3.90
13	2.5Y 7/4	0.010	7.2	0.08	0.62	3.00
14	5Y 7/1	0.005	9.0	0.12	0.15	3.60
15	5YR 6/2	0.030	9.2	0.05	1.35	4.20
16	5Y 3/1	0.500	7.0	0.05	0.50	4.20
17	5Y 5/1	0.340	8.2	0.12	0.72	3.30
18	2.5Y 7/4	0.010	7.2	0.08	1.00	3.00
19	2.5Y 8/2	0.005	6.3	0.08	0.75	1.80
20	5Y 4/1	2.220	7.6	0.08	0.38	4.20
21	5Y 7/1	0.390	7.2	0.00	0.70	3.90
22	10YR 6/3	0.060	9.1	0.90	0.90	2.10
23	5Y 7/1	0.165	5.6	0.20	0.25	1.80

Table 166. THE TOTAL CONTENTS OF MACRO- AND MICRO-ELEMENTS IN ROCK SAMPLES FROM DIFFERENT NEIGHBORHOODS.
PART III: MICRO-ELEMENTS.

Sample No.	Al (%)	Fe (%)	Mn (ppm)	Cu (ppm)	Zn (ppm)	Cd (ppm)	Ni (ppm)	Cr (ppm)	Pb (ppm)
1	1.1	13.0	500	10.0	40	10	50	90	30
2	0.4	2.0	250	10.0	44	20	100	40	10
3	0.3	0.7	125	5.0	38	10	80	100	30
4	12.0	6.0	500	10.0	200	10	70	90	20
5	13.0	5.4	500	10.0	260	10	60	150	40
6	0.5	0.5	1000	10.0	112	10	90	20	40
7	0.7	0.7	750	8.0	40	10	30	10	40
8	10.8	2.2	250	10.0	60	10	50	250	30
9	10.6	4.0	500	11.5	112	100	100	1250	10
10	2.6	1.1	500	6.0	80	20	30	490	70
11	20.0	4.6	250	11.5	300	20	130	360	30
12	18.0	2.2	250	12.5	260	110	110	270	40
13	8.8	2.8	250	10.0	180	80	80	150	20
14	13.6	3.2	500	5.0	232	20	40	430	0
15	16.0	3.1	250	10.0	160	1690	70	390	30
16	17.0	1.8	250	10.0	220	20	90	140	40
17	8.8	4.4	1000	15.0	220	10	80	130	40
18	16.8	6.0	1750	11.0	320	40	30	200	30
19	8.8	2.0	500	6.5	240	220	80	110	10
20	17.5	1.6	250	70.0	60	20	200	130	10
21	18.8	8.4	250	10.0	160	20	110	30	20
22	5.6	1.5	500	7.5	60	110	80	20	20
23	3.4	1.3	500	5.0	40	20	40	40	10

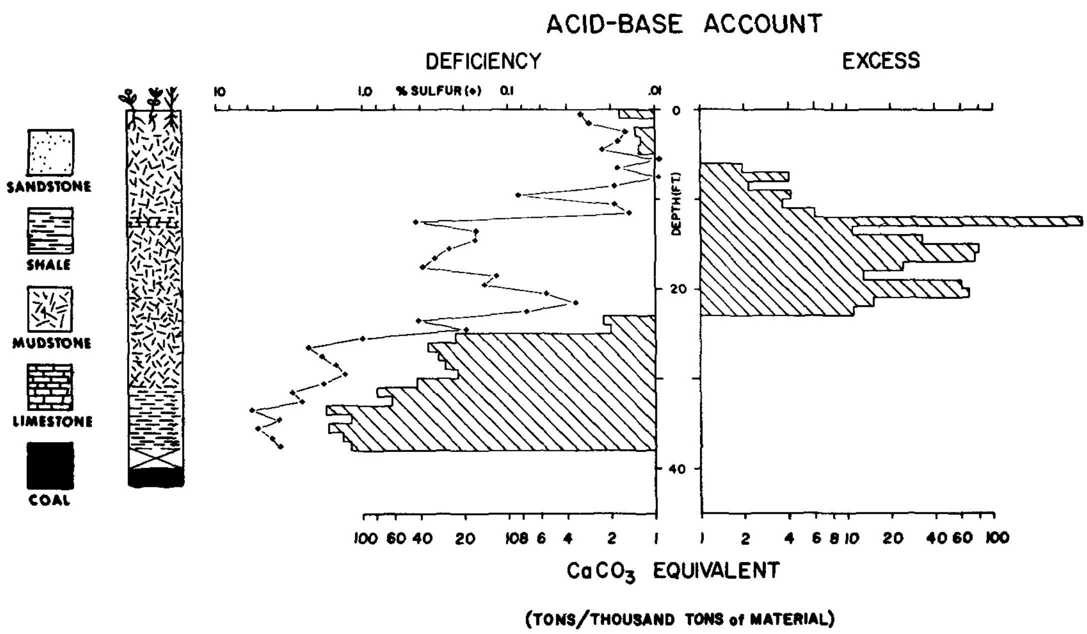


Figure 8. Acid-Base Account and rock type of the overburden above a Bakerstown coal seam.

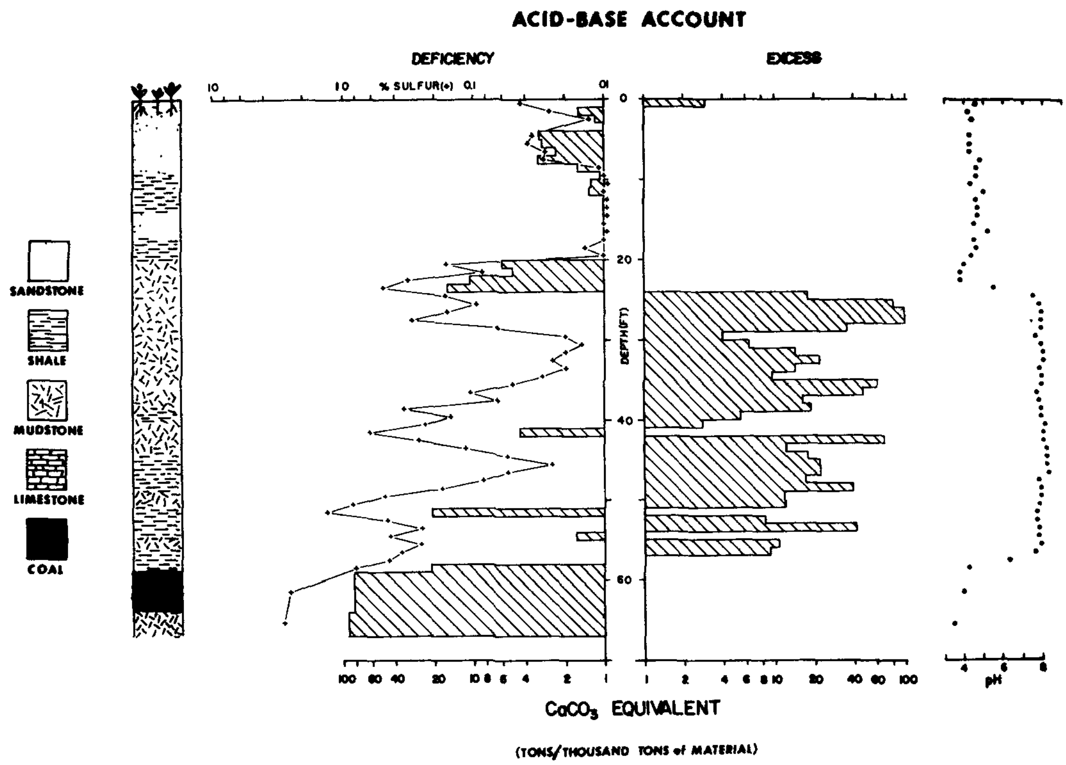


Figure 9. Acid-Base Account and rock type of the overburden above an Upper Freeport coal seam.

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SECTION XIII

GLOSSARY AND TABLE LEGEND DEFINITIONS

DEFINITIONS

Carbolith (Carb) - This name has been coined to cover dark colored sedimentary rocks that will make a black or very dark (Munsell color value of 3 or less) streak or mark on a white streak plate or hard rock like chert. Rocks included under this name include bonecoal, carbon-rich muds, and carbon-rich shales. An optional name is carbon-rock. In general, such rocks will be at least 25% organic matter.

Chert - A rock consisting dominantly of amorphous silica or extremely small (cryptocrystalline) quartz and hard enough to scratch glass or an ordinary knife blade (i.e., hardness of 6.5 to 7.0 on the Moh scale). Flint, Jasper, and other names related to rock color or weathering may be used to identify different kinds of chert.

Clayey - Containing large amounts of clay or having properties similar to those of clay.

Coarse fragments - Rock or mineral particles greater than 2.0 mm in diameter.

Fines - Material smaller than 2 mm in effective Stokes diameter.

Fissile - Having a tendency to split along parallel planes, into layers that are less than 5 mm thick.

Friable - Easily crumbled, as would be the case with rock that is poorly cemented.

Intercalate - This term is used as a composite noun to include rocks of different kinds that are so intimately interlayered or intercalated that they cannot be sampled or described separately. A sandstone-shale intercalate would be more than 50% sandstone whereas a shale-sandstone intercalate would be more than 50% shale. Other kinds of intercalate rocks would be described by other appropriate rock names.

Lime requirement - In an acid soil, the amount of lime ($CaCO_3$) or other base required to neutralize acidity in the range from the initial acid condition to a selected neutral or less acid condition.

Limestone (LS) - A sedimentary rock consisting dominantly of calcium or magnesium carbonate, which can be scratched readily with a knife, but not with the fingernail, and which is light colored or white (Munsell color value of 7 or higher) when powdered or streaked on a hard surface. Confirmation of identification may require testing for fizz in dilute (1 to 3 or 10%) hydrochloric acid, although other rocks such as calcareous mudstone may also fizz freely in acid.

Loess - A homogeneous, unindurated deposit consisting predominantly of silt, with subordinate amounts of very fine sand and/or clay.

Matrix - In a rock in which certain grains are much larger than the others, the grains of the smaller size comprise the matrix.

Mottling - Spots or blotches of different color or shades of color interspersed with the dominant color.

Mudrock (MR) - A broad general term for sedimentary rock which includes both mudstone and shale. This term is used when rock samples have not been definitely identified as to whether they are mudstones or shales.

Mudstone (MS) - A non-fissile sedimentary rock dominated by silt and (or) clay sized particles, without restrictions on mineralogy. This rock type may contain as much as 50% sand if properties are judged to be dominated by silt and (or) clay. If sand (grit) is noticeable by observation or feel, the rock may be called sandy mudstone. If silt dominates the make-up of the rock, it may be called silty mudstone or siltstone.

Outwash (OW) - Drift deposited by melting water streams beyond active glacier ice.

Sandstone (SS) - A sedimentary rock consisting dominantly of sand-sized, that is visible, grains that feel gritty when rubbed in water. Silt and clay combined may total as much as 50% of the total rock weight. When more than 15% of a sandstone consists of particles finer than sand, the rock may be called a muddy sandstone, silty sandstone, clayey sandstone, argillaceous sandstone, or other kind of descriptive name.

Schlick (Sck) - A mass or body of silt and (or) clay that would be called Schlickstone except that it is very soft when wet (hardness about 1.0) and may not fit popular concepts of stone or rock. From the standpoint of soil structure, Schlick is massive, although it may show some stratification.

Shale (SH) - A mudrock that appears prominently thin-layered or fissile. Shale often is more resistant to physical breakdown in water than non-fissile mudrock and usually is harder to scratch. Some indurated shale cannot be scratched with the fingernail.

ABBREVIATIONS

Aluminum -- (Al)
Cadmium -- (Cd)
Centimeter(s) -- (cm)
Chromium -- (Cr)
Copper -- (Cu)
Feet, Foot -- (ft)
Gram(s) -- (g)
Inch(es) -- (in)
Iron -- (Fe)
Kilogram(s) -- (kg)
Kilometer(s) -- (km)
Lead -- (Pb)
Manganese -- (Mn)
Meter(s) -- (m)
Mile(s) -- (mi)
Milligram(s) -- (mg)
Milliliter(s) -- (ml)
Millimeter(s) -- (mm)
Minute(s) -- (min)
Nickel -- (Ni)
Parts per million -- (ppm)
Pound(s) -- (lb)
Ton(s) -- (t)
Zinc -- (Zn)

TABLE LEGENDS

Although the symbols, conversion units, etc., are used and explained elsewhere in the report, it is in the interest of clarity and understanding that all information be presented together as follows:

Soil Horizons

A1- Mineral horizons, formed or forming at or adjacent to the surface, in which the feature emphasized is an accumulation of humified organic matter intimately associated with the mineral fraction.

A2- Mineral horizons in which the feature emphasized is loss of clay, iron, or aluminum, with resultant concentration of quartz or other resistant minerals in sand and silt sizes.

B1- A transitional horizon between B and A1 or between B and A2 in which the horizon is dominated by properties of an underlying B2 but has some subordinate properties of an overlying A1 or A2.

B2- That part of the B horizon where the properties on which the B is based are without clearly expressed subordinate characteristics indicating that the horizon is transitional to an adjacent overlying A or an adjacent underlying C or R.

B3- A transitional horizon between B and C or R in which the properties diagnostic of an overlying B2 are clearly expressed but are associated with clearly expressed properties characteristic of C or R.

C- A mineral horizon or layer, excluding bedrock, that is either like or unlike the material from which the solum is presumed to have formed.

Other horizons

Vertical subdivisions within an otherwise differential horizon are indicated by secondary arabic numbers assigned in order, from the topmost subdivision down, i.e., A_{21}, A_{22}, B_{21}, B_{22}, etc.

g- strong gleying (50% or more of the soil has a chroma of 2 or less).
p- plowing or other disturbance.

The symbol p is used as a suffix with A to indicate disturbances by cultivation or pasturing. Even though a soil has been truncated and the plow layer is clearly in what was once B horizon, the disignation Ap is used. When an Ap is subdivided, the arabic number suffixes follow, as Ap1 of Ap2, for the Ap is considered comparable to A1, A2, or B2.

t- Illuvial clay

Accumulation of translocation silicate clay are indicated by the suffix t (German ton, clay). The suffix t is used only with B, as B2t to indicate the nature of the B.

x- Fragipan character

The symbol x is used as a suffix with horizon designations to indicate genetically developed properties of firmness, brittleness, high density, and characteristic distribution of clay that are diagnostic of fragipans.

Rock Types

carb - carbolith
LS - limestone
MR - mudrock
MS - mudstone
Sh - shale
SS - sandstone
OW - glacial outwash

-/gyp - any rock type with gypsum crystals evident
-/I - any rock type intercalated or thinly interlayered with any other rock type.

Conversion Factors

All the units in the data tables are english for ease of reading and understanding. To convert these units into the metric system use the following conversion factors:

1. To change feet to meters multiply by 0.3048.
2. To change pounds/1000 tons to milligrams/kilogram, multiply by 0.5.
3. Tons/1000 tons is equal to grams/kilogram.

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

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16. ABSTRACT

Chemical, physical and mineralogical measurements and interpretations developed during previous studies in West Virginia have been improved and applied to coal overburden columns in 12 widely spaced Neighborhoods and 2 Adjunct locations in 10 states, from Pennsylvania on the Northeast to Alabama on the southeast and Oklahoma on the west.

Field studies in each Neighborhood and Adjunct location involved logging and sampling soil and rock horizons from surface to coal, testing and improving field clues, determining properties of mine soils and water resulting from mining operations, and checking reclamation. Results in different coal basins have broadened our perspectives and strengthened our conclusions. Refinements have been made in field observations, laboratory methods and interpretations related to kinds of minesoils and anticipated uses of mined lands.

Consistent overburden property relationships within basins and over particular named coals provide opportunities for generalizations and extrapolation between sampled sites.

It appears feasible to use detailed information from overburden sampling and analysis as an aid to pre-mining planning of surface mining operations including reclamation and projected land use.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
*Coal Mines, *Strip Mining *Overburden, *Chemical Properties, *Weathering	*Potential Toxicity, *Neutralization Potentials, *Available Nutrients, *Minesoils, Soil Formation, *Acid-Base Account Preplanning, Analytical Properties	8 G 13 B

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