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Mineral Resources of the Cranberry Wilderness Study Area, Pocahontas and Webster Counties, West Virginia

by

Charles R. Meissner, Jr., and John F. Windolph, Jr.,
U. S. Geological Survey

and

Peter C. Mory and Donald K. Harrison
U. S. Bureau of Mines

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with sections on:

Peat Resources

by

Cornelia C. Cameron and Andrew E. Grosz
U. S. Geological Survey

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Oil and Gas Potential

by

William J. Perry, Jr.
U. S. Geological Survey

--

Geochemical Survey

by

Frank G. Lesure
U. S. Geological Survey

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STUDIES RELATED TO WILDERNESS

STUDY AREAS

In accordance with the provisions of the Wilderness Act (Public Law 88-577), September 3, 1964) and the Joint Conference Report on Senate Bill 4, 88th Congress, and as specifically designated by PL93-622, January 3, 1975, the U.S. Geological Survey and U. S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Studies and reports of all primitive areas have been completed. Areas officially designated as "wilderness," "wild," or "canoe" when the Act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The Act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. This report discusses the results of a mineral survey of some national forest land in the Cranberry study area, West Virginia, that is being considered for wilderness designation (Public Law 93-622, January 3, 1975). The area studied is in the Monongahela National Forest in Pocahontas and Webster Counties.

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Charles R. Meissner, Jr., and John F. Windolph, Jr.,
U.S. Geological Survey

and

Peter C. Mory and Donald K. Harrison
U.S. Bureau of Mines

SUMMARY

Cranberry Wilderness Study Area comprises 14,702 ha in the Monongahela National Forest, Pocahontas and Webster Counties, east-central West Virginia. The area is in the Yew Mountains of the Appalachian Plateaus and is at the eastern edge of the central Appalachian coal fields. Cranberry Glades, a peatland of botanical interest lies at the southern end of the study area. All surface rights in the area are held by the U. S. Forest Service; nearly 90 percent of the mineral rights are privately-owned or subordinate to the surface rights.

Sedimentary rocks of Mississippian and Pennsylvanian age are exposed in the area and have a gentle regional dip to the northwest. The oldest rocks are of Late Mississippian age and are composed predominantly of red shale and siltstone, and sandstone, containing a few lenticular coal beds. They crop out in the southern part of the area and along the deeper river valleys to the north. Overlying Lower Pennsylvanian rocks of the Pocahontas and New River formations have a higher ratio of sandstone to shale and contain economically important coal beds. These rocks crop out in all but the southernmost part of the area.

Bituminous coal of coking coal quality is the most important mineral resource in Cranberry Wilderness Study Area. Estimated resources of coal 35 cm or more thick are about 100 million metric tons in nine coal beds (Figure 1). Most of the coal 70 cm or

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Figure 1. Map showing coal resources in Cranberry Wilderness Study Area.

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more thick (reserve base) lies in a 7 km wide east-west trending band across the center of the study area. The reserve base is 34,179 thousand metric tons. Reserves, which exist in seven coal beds, total 16,830 thousand metric tons and are recoverable by underground mining methods.

Mineral resources which have a low potential in the study area include peat, shale and clay suitable for building brick and lightweight aggregate, sandstone for low-quality glass sand and sandstone suitable for construction material.

Drilling evidence has shown practically no possibilities for oil and gas in the study area, and no evidence for metallic deposits was found during this investigation.

INTRODUCTION

Cranberry Wilderness Study Area comprises 14,702 ha in the Monongahela National Forest, east-central West Virginia. The area is in parts of Pocahontas and Webster Counties, about 13 km west of Marlinton, West Virginia (fig. 2). The study area can be

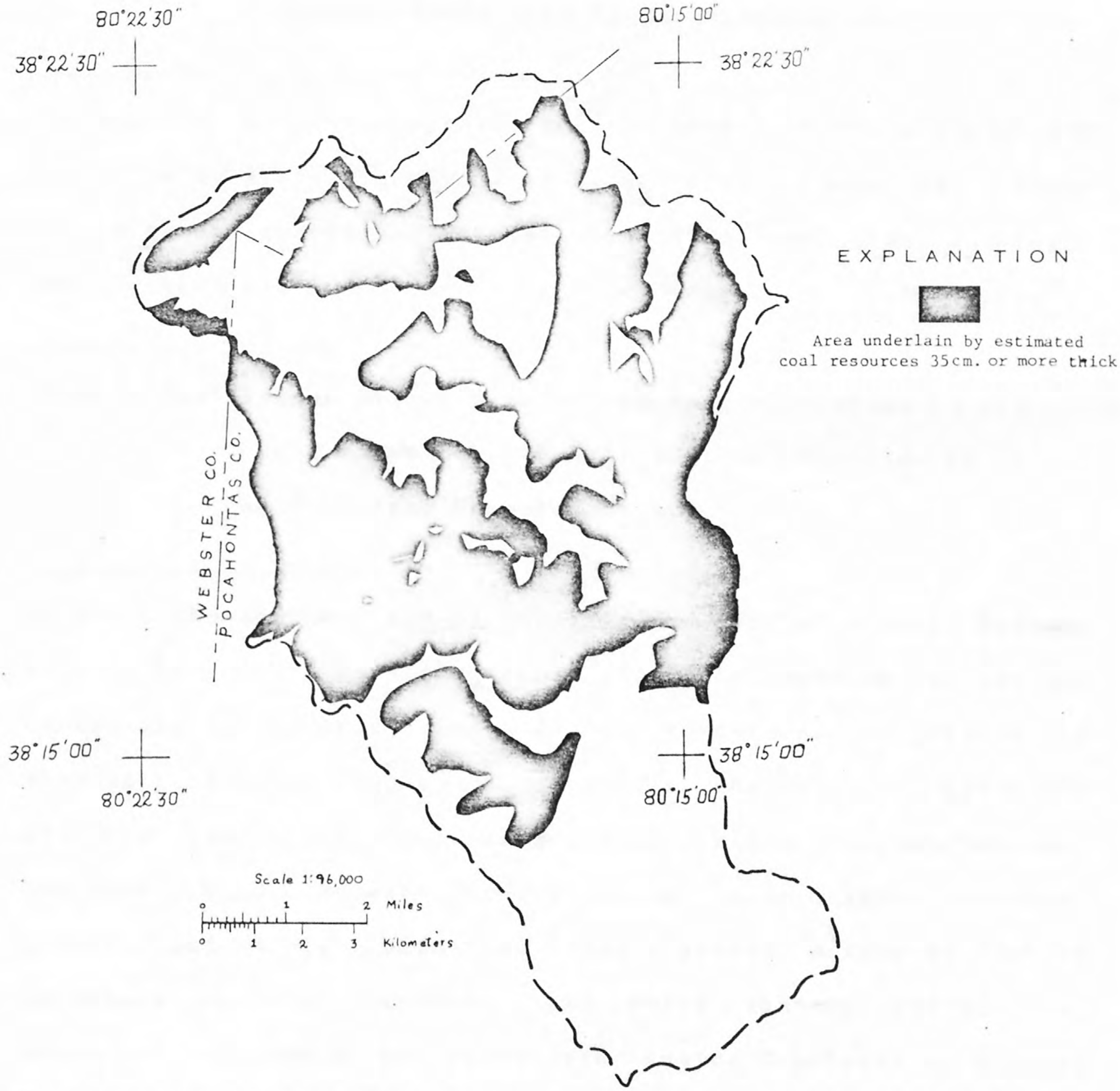


Figure 1. MAP SHOWING COAL RESOURCES IN CRANBERRY WILDERNESS STUDY AREA

Figure 2.--Index map showing the location of the Cranberry Wilderness Study Area in east-central West Virginia.

reached by several improved roads. Access to the northeastern corner is by State Highway 17 to U. S. Forest Route 86. Route 86, a graded gravel road, parallels the Williams River and forms the northern and northeastern boundary (fig. 3). State Highway

Figure 3.--View of Williams River, looking east along U. S. Forest Route 86. The cliff at the roadside is in the Princeton Sandstone (?).

39 abuts the southern end of the area and State Scenic Highway 150 follows the mountain crest along the southern and eastern boundaries of the study area. U. S. Forest Route 102, which extends from State Highway 39, parallels the Cranberry River and provides restricted vehicular traffic along the southwestern boundary. U. S. Forest Service Roads, old logging railroad grades, and a few primitive trails provide access by foot or horseback to the interior. All motor vehicle traffic or motorized equipment is prohibited inside Cranberry Wilderness Study Area.

The area is dominated topographically by the Yew Mountains of the Appalachian Plateaus and is at the eastern edge of the central Appalachian coal fields. Elevations range from about 730 m above sea level in the Middle Fork valley to 1,390 m above sea

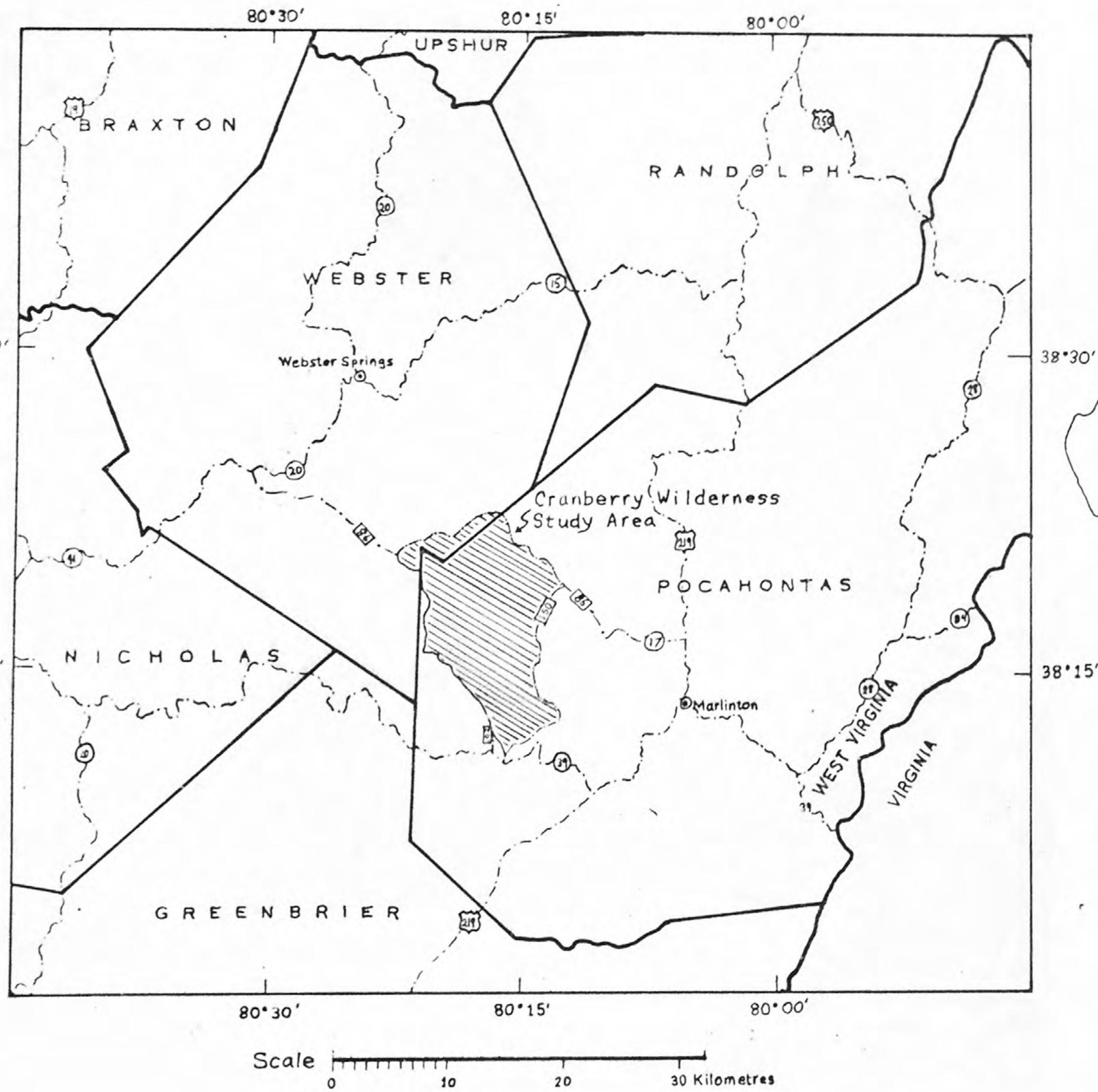


Figure 2. --Index map showing the location of the Cranberry Wilderness Study Area in east-central West Virginia.

FIGURE 3.--View of Williams River, looking east along U.S. Forest Route 86. The cliff at the roadside is in the Princeton Sandstone(?).

level on Black Mountain. Principal streams are the Williams, Middle Fork of the Williams, Cranberry, and the North Fork of the Cranberry River.

The lower mountain slopes are covered by a variety of second growth northern hardwood trees including yellow birch, maple, black ash, and oak. Large groves of red spruce dominate the mountain crests and are underlain by a thick carpet of moss. The area was heavily logged between 1910 and 1926 and little virgin forest remains. Small selected tracts totaling 245 ha were also logged in the early 1950's.

A major tourist attraction is the Cranberry Glades Botanical Area which covers about 304 ha at the southern end of the study area. These glades are likened to the tundra country of Alaska, containing peat, reindeer moss, sedges, high bush cranberry (vibernum) and other shrubs, as well as birds and animals native to more northern areas of the United States.

Surface and Mineral Ownership

All surface rights were purchased by the Federal government in the 1930's under authority of the Weeks Act of 1911 and are held by the U. S. Forest Service. Nearly 86 percent of the mineral rights are owned by Mid Allegheny Corporation. The remainder of the mineral rights are either owned outright (10 percent) by the U. S. Forest Service or are subordinate (4 percent) to the surface rights (Fig. 4). The owner of the mineral rights reserved the privilege to cross the subordinated area by underground openings or mine headings.

Figure 4.--Status of mineral ownership, Cranberry Wilderness Study Area.

Previous Investigations

Published works which include the geology and coal resources of the Cranberry Wilderness Study Area are the West Virginia Geological Survey's Webster County report by Reger, Tucker and Buchanan (1920), and the Pocahontas County report by Price and Reger (1929). Both reports include geologic maps of the entire county at a scale of 1/62,500. The configurations of three coal beds in the study area are shown on these county maps.

A very generalized but informative report on many aspects of coal and coal mining in West Virginia was prepared by Barlow (1974), giving regional characteristics of the coal that occurs in the study area.

An unpublished report prepared by the U. S. Forest Service (1975) describes the geology, and evaluates the coal resources of three areas within the Monongahela National Forest. These areas are the Cranberry Back Country and its environs, the Shavers Fork Area, and the Otter Creek Area. The Cranberry Wilderness Study Area covers about one-fourth of the Cranberry Back Country and its environs. Estimates of coal reserves, 70 cm or more thick, were made for the "Larger Cranberry Back Country" by the Forest Service; there are no direct comparisons with tonnage estimates currently made for the smaller wilderness study area.

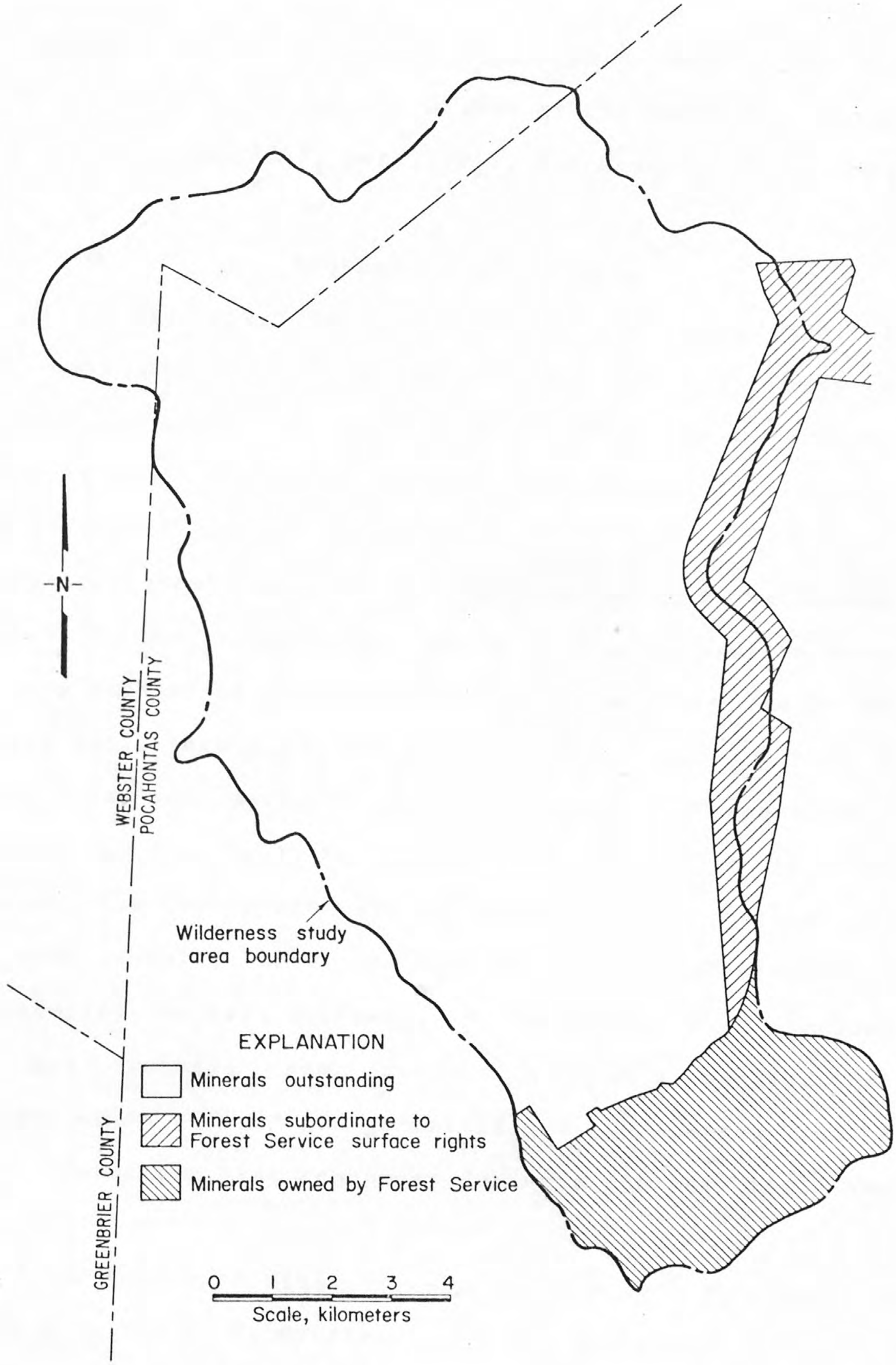


FIGURE 4.--Status of mineral ownership, Cranberry Wilderness Study Area.

Several reports have been published concerning the peat deposits of the Cranberry Glades at the south end of the study area (Darlington, 1943, Core, 1955, and Cameron, 1970, 1972).

Present Investigations

U. S. Geological Survey fieldwork and collection of data were done by C. R. Meissner, Jr., and J. F. Windolph, Jr., during the month of April 1977. This work consisted of reconnaissance geologic mapping, measuring of sections, and description of diamond drill cores. Coal beds were mapped, and correlated by relating them to mappable resistant sandstone units throughout the study area. Field mapping within the study area was supplemented by lithologic data obtained from more than 60 company drill core logs, and augmented by 20 U. S. Forest Service drill logs and maps of inactive mines. Geochemical survey sampling was done by F. G. Lesure, C. E. Brown, A. E. Grosz, and J. W. Whitlow during six days in April, 1977. Stream sediment and rock samples were analyzed in the U. S. Geological Survey laboratories, Denver, Colorado. W. J. Perry, Jr., examined oil and gas records and studied available publications for information on oil and gas potential. C. C. Cameron and A. E. Grosz evaluated peat resources during a one week field study in May, 1977.

U. S. Bureau of Mines field reconnaissance was conducted by P. C. Mory and D. K. Harrison with the assistance of M. L. Dunn, Jr., and P. T. Behum in the spring and summer of 1977. Prospects, mines, exposures, and drill sites in and near the area were examined with primary emphasis on evaluating coal beds. Fifty-four coal prospect trenches and adits in the area were examined and sampled at nine localities. Mine maps from the Bureau's Eastern Field Operations Center Mine Map Repository, Pittsburgh, Pa., were examined to determine the extent of coal mining in or near the study area, and to aid coal bed correlation. Thirty-one rock samples of sandstone, underclay, and shale were taken for analysis. Six peat samples from four bogs in Cranberry Glades were analyzed.

Coal and peat samples were tested by the Department of Energy, Division of Solid Fuel Mining and Preparation, Coal Analysis (formerly the U. S. Bureau of Mines, Coal Preparation and Analysis Group), Pittsburgh, Pennsylvania. The Bureau's Reno Metallurgy Research Center, Reno, Nevada, conducted spectrographic, chemical, atomic absorption, and radiometric analyses on rock and coal ash samples. Ceramic and lightweight aggregate evaluations of shale and clay samples were made by the U. S. Bureau of Mines, Tuscaloosa Metallurgy Research Center, Tuscaloosa, Alabama.

Acknowledgements

We are grateful to David T. Morrison, Executive Vice President and Forrest Jones, Geologist, of Mid Allegheny Corporation, Summerville, West Virginia, for supplying copies of drill logs and coal washability data. The West Virginia Geological Survey, Oil and Gas Division, made available oil and gas drill hole information. Appreciation is extended to U. S.

Forest Service personnel in the Eastern Region Office, Milwaukee, Wisconsin; Roger Johnson and Thomas R. Manley, Monongahela National Forest Headquarters Office, Elkins, West Virginia; and Ronald E. Scott, Gauley Ranger Station, Richwood, West Virginia, for providing surface and mineral ownership information, drill hole information, and access privileges to the study area.

GEOLOGY

Geologic Setting

The Cranberry Wilderness Study Area is in the Yew Mountains of the Appalachian Plateaus west of the northeast trending Deer Creek anticline. The mountains have been carved by erosion in coal-bearing Pennsylvanian and Mississippian age sedimentary rocks which have a gentle northwest dip (pl. 1, geologic map and cross-section). The oldest rocks exposed are of late Mississippian age and form the lower slopes of the more deeply incised mountains and underlie the peat-bearing Cranberry Glades in the southernmost part of the area. The glades are restricted to a relatively small part of the study area in flat lowlands along the headwaters of the Cranberry River. The overlying Pennsylvanian rocks form the higher slopes and ridges in the central and northern part of the area. Surficial deposits composed of colluvium cover much of the mountain sides and both colluvium and alluvium are found in the valley floors. Bedrock exposures are limited to a few localities along stream beds and ridge crests.

Mississippian Rocks

Late Mississippian sedimentary rocks exposed in or near the study area include, from older to younger, Greenbrier Limestone, Bluefield Formation, Hinton Formation, Princeton Sandstone (?), and Bluestone Formation (pl. 1, stratigraphic column). Total thickness of these rocks studied is about 728 m. They consist of a sequence of sandstone, siltstone, shale, and limestone with minor amounts of underclay and two or more lenticular beds of impure coal. These rocks represent deltaic-near shore, swamp, intertidal, and marine deposits.

Greenbrier Limestone

The Greenbrier Limestone of Late Mississippian age is exposed just south of the study area and was chosen as a starting point in the examination of the stratigraphic sequence because it is easily recognized and of widespread occurrence. An oil and gas test well located at the west-central edge of the study area penetrated a total thickness of 138 m of the formation. The upper 55 m of the formation are well exposed 1.5 km south of the study area on State Route 39. The Taggard Red Member (?), a castellated grayish-red, shaly siltstone is exposed near the base of the outcrop, and is a key bed in the Greenbrier Limestone (pl. 1, stratigraphic column). The Greenbrier consists of medium to dark gray, very finely to coarsely crystalline limestone, containing oolites, calcareous pellets, fossil fragments, quartz grains, and chert nodules. Interbeds of greenish-gray to grayish-red shale and siltstone are dominant near the top. The limestone units are mostly thick bedded to massive with some crossbedded detrital arenaceous zones. The contact between the Greenbrier and overlying Bluefield Formation is transitional.

Bluefield Formation

The Bluefield Formation is the oldest formation exposed in the study area. Approximately the upper 50 m of the formation crop out on the south side of Cranberry Glades (pl. 1, geologic map). The remaining approximately 267 m were examined above the Greenbrier Limestone along State Route 39 just south of the area. The formation consists of grayish-red and greenish-gray shale, partly calcareous, with interbeds of lenticular sandstone and siltstone (pl. 1, stratigraphic column). Dark gray to black argillaceous limestone occurs interbedded with shale at the base of the formation. Root zones with thin, bony, 1/ lenticular coal beds were found in the lower part of the unit. The formation is conformably overlain by the Stony Gap Sandstone Member (?) of the Hinton Formation.

1/ Bone, or bony coal is hard blocky coal with shale laminae.

Hinton Formation

The Hinton Formation crops out in the southern part of the study area along the lower slopes of the mountains, and adjacent valleys (pl. 1, geologic map). It is composed of grayish-red shale, with a few thin beds of gray to grayish-red sandstone and conglomerate lenses containing rounded to angular limestone pebbles (pl. 1, stratigraphic column). Maximum total thickness of the Hinton Formation is about 155 m. The basal Stony Gap Sandstone Member (?) exposed near the base of the mountains surrounding Cranberry Glades consists of light-greenish-gray, thin bedded sandstone, containing less carbonaceous material and dark minerals than sandstone in the underlying Bluefield Formation. The contact between the Bluefield and overlying Princeton Sandstone (?) is irregular due to channelling.

Princeton Sandstone (?)

The Princeton Sandstone(?) is exposed in the upper part of the mountains at the south end of the study area and because of regional dip is found at lower elevations along the mountainsides northwestward where it forms resistant outcrops in portions of the creek and river beds of the central and northern areas (pl. 1, geologic map). It dips below the stream valleys along the western side of the area. The Princeton (?) ranges in thickness from 12 to 24 m and is composed of medium-gray to light-greenish-gray thick-bedded to massive lenses of sandstone and conglomerate, containing rounded quartz and limestone pebbles as much as 2 cm long (pl. 1, stratigraphic column). The formation is resistant to weathering, forming ledges or prominent benches. The Princeton Sandstone (?) appears to be conformably overlain by the Pride Shale Member (?) of the Bluestone Formation.

Bluestone Formation

The Bluestone Formation in the study area includes three members with a thickness ranging from less than 60 m to 100 m or more. The formation is exposed in the top of the mountains located at the south end of the study area but because of regional dip, is found progressively lower northwestward, occurring at base level in the valleys in the western and northern part of the area (pl. 1, geologic map). The Pride Shale Member (?) occupies nearly the lower half of the formation in places (pl. 1, stratigraphic column). It consists of medium- to dark-gray and some grayish-red and greenish-gray shale, that grades locally to silty shale. The shale is evenly bedded containing marine pelecypod and ostracod fossils. A lenticular impure coal bed, as much as 61 cm thick in places, occurs at the top of the member just below the probable Glady Fork Sandstone Member (?). The Glady Fork Sandstone Member (?) was mapped near the south end of State Scenic Highway 150 and near the junction of the Cranberry River and the North Fork where it paves the streambed; however this member probably occurs extensively throughout the area near the middle of the Bluestone Formation. It consists of thick-bedded to massive lenses of sandstone and conglomerate, with an average thickness of 15 m, containing rounded quartz and limestone pebbles. The upper member of the formation is composed of grayish-red shale and sandstone with a few lenticular conglomerate beds. The uppermost part of the Bluestone Formation intertongues and grades laterally into lower beds of the Pocahontas Formation, of Pennsylvanian age. When intertonguing occurs, both formations are classified as Pennsylvanian. In some places where there is no Pocahontas Formation an unconformable contact separates the Bluestone from the New River Formation of Pennsylvanian age.

Pennsylvanian Rocks

Lower Pennsylvanian coal-bearing rocks of the Pocahontas and New River Formations crop out in all but the southernmost part of the study area (pl. 1, geologic map). They form the upper parts of the mountains where present in the south, and as a result of northwesterly regional dip comprise most of the exposed rock section in the mountains of the central and northern part of the area. The Lower Pennsylvanian rocks are mostly of continental origin and contain six major coal beds as well as several smaller beds of economic importance. Total thickness approximates 326 m. The rocks are mainly sandstone, shale, underclay, siltstone and conglomerate.

Pocahontas Formation

The Pocahontas Formation, a relatively thin unit in the area with a maximum thickness of about 21 m, is economically significant because it contains the Pocahontas No. 3 (?) coal bed. Exposures occur high in the mountains at the southern end but much lower northwestward where the formation is exposed along the sides of the deeper stream valleys (pl. 1, geologic map). This formation, previously unmapped in the study area, has been extended 25 km northeastward of mapped occurrences and pinches out along an east-west trend in the northern part of the study area. The formation is composed of gray to very dark gray shale and siltstone, coal, and underclay, and contains abundant plant material including leaf pinules of the Neuropteris pocahontas, (W.H. Gillespie, oral communication).

New River Formation

The majority of the rocks exposed in the study area are of the New River Formation which has a total thickness of over 300 m. Most of the important coal beds occur in this formation, including the Sewell, Little Raleigh (?), Beckley (?), and Fire Creek (?) (pl. 1, stratigraphic column). Four prominent sandstone and conglomerate beds were mapped to aid in the correlation of the coal beds: the basal sandstone and conglomerate believed to be the Pineville Sandstone Member; the sandstone and conglomerate below the Little Raleigh (?) coal; the sandstone and conglomerate above the Sewell coal; and an ortho-quartzite at the top of the section above the Hughes Ferry (?) coal. The basal sandstone and conglomerate bed, equivalent to the Pineville Sandstone Member, occurs in all but the northern quarter of the study area where it pinches out (pl. 1, geologic map). The bed is light gray, and in many places contains white, rounded quartz pebbles 3 cm or less in diameter. It forms a bench or ledge and has a maximum thickness of about 49 m.

The sandstone and conglomerate below the Little Raleigh (?) coal bed is similar to the Pineville. It is light gray, contains pebbles in places, is thick bedded to massive, and forms resistant benches. Erosion of the bed forms boulder colluvium. Maximum thickness is about 36 m, but the bed grades laterally into shale northwestward and pinches out in the northwestern corner of the study area.

The sandstone and conglomerate unit above the Sewell coal bed occurs extensively in the mountains in the northern part of the study area, being found in all of the highest knobs in the central mountains; it has been eroded completely away in the southern mountains. Maximum thickness is about 30 m and the sandstone locally contains two or more lenticular shale beds. This sandstone unit is conglomeratic containing conglomerate lenses with quartz pebbles up to 1 cm in diameter. It forms resistant ledges, cliffs, and benches, which weather into boulders and colluvium.

The youngest sandstone mapped occurs only on the crest of the mountain west of Laurelly Branch at the western border of the study area. It contains 80-90 percent quartz sand at the top and becomes less quartzose toward the base. This sandstone bed may be the basal part of the Nuttall Sandstone Member which is the uppermost member of the New River Formation.

Quaternary Deposits

Colluvium covers large areas of the mountainsides with a loose blanket of rock debris that allows for relatively few good bed rock exposures. No attempt was made to map these areas because of the limited time to trace their boundaries. Most of the stream valleys are boulder strewn, but patches of alluvium composed of sand, silt, mud and some coarse rock material, occur in headwaters of the Cranberry River, the North Fork of the Cranberry and along much of the Middle Fork of the Williams River (pl. 1, geologic map). A large pre-historic landslide was mapped in the Bluestone Formation on the east side of the Middle Fork near its junction with Laurelly Branch. Other recent landslides are known to have occured in the study area.

The Cranberry Glades containing peat bogs are a unique feature located at the south end of the study area. Their origin and characteristics are described separately in the chapter on mineral resources.

Structure

Structure contours were drawn at 40 foot (12 m) intervals through elevations or projected elevations on the base of the Beckley (?) coal bed in the study area (pl. 2). In the southern part of the area where there are no control elevations, or the Beckley (?) is absent, elevations were projected by average interval up or down from known points on older or younger beds. The resulting structure map, which probably reflects structure on all of the coal and rock beds in the area, reveals a northwesterly dipping monocline. Average strike of the beds is N 38 degrees E, and the dip is a little less than 2 degrees NW. The dip slope accounts for a drop in the elevation of the Beckley (?) coal bed of about 130 m per km northwestward. This means that the Beckley (?) coal and other formations drop in elevation

460 m or more from the southeastern to the northwestern part of the area. As to be expected, local variations in the amount of dip on the monocline range from about 1 degree to 4 degrees. Cleats 1/ in coal beds in the study area in most cases range from N 35 degrees W to N 10 degrees W for the face cleat, N 35 degrees E to N 60 degrees E for the butt cleat with dips from 82 degrees to vertical wavering from NE to SW for the face cleat and NW to SE for the butt cleat.

1/ Cleats are systems of joints, cleavage planes, or planes of weakness found in coal seams. The more pronounced joints are face cleats, the less pronounced are butt cleats.

MINERAL RESOURCES

Setting

Potential mineral resources in Cranberry Wilderness Study Area include coal, peat, shale and clay, high-silica sandstone and stone. The area has a low potential for gas and practically no potential for oil. A geochemical survey indicates no potential for metallic minerals.

Bituminous coal has been prospected extensively and constitutes the most important mineral resource in the study area. The locations of at least 65 drill holes, 54 prospect trenches, and 10 adits are known (fig. 5).

Figure 5.--Extent of coal exploration, Cranberry Wilderness Study Area.

Several inactive coal mines are within 2 km of the northern study boundary. There is no known commercial production from within the study area, although several small openings may have furnished coal for locomotives used in logging.

No mining or prospecting for metallic or nonmetallic resources in or near the study area is known. However, rock types similar to those within the area have previously been examined for possible mineral resource potential in West Virginia. McCue and others (1948) reported that shales and clays suitable for brick and tile are abundant throughout the state. Seventeen West Virginia clay horizons have been considered as possible sources of alumina (Tallon and Hunter, 1959). High-silica sandstones are present in portions of the State occupied by rocks of early Pennsylvanian and Mississippian age (Arkle and Hunter, 1957, p. 36). Unsuccessful attempts have been made to quarry building stone in southeastern Webster County (Reger and others, 1920).

Coal

Coal beds tentatively identified within the study area are the Pocahontas No. 3 (?), Pocahontas No. 3 rider (?), Little Fire Creek (?), Fire Creek (?), Beckley (?), Little Raleigh (?), Little Raleigh rider(?), Sewell, and Hughes Ferry (?).

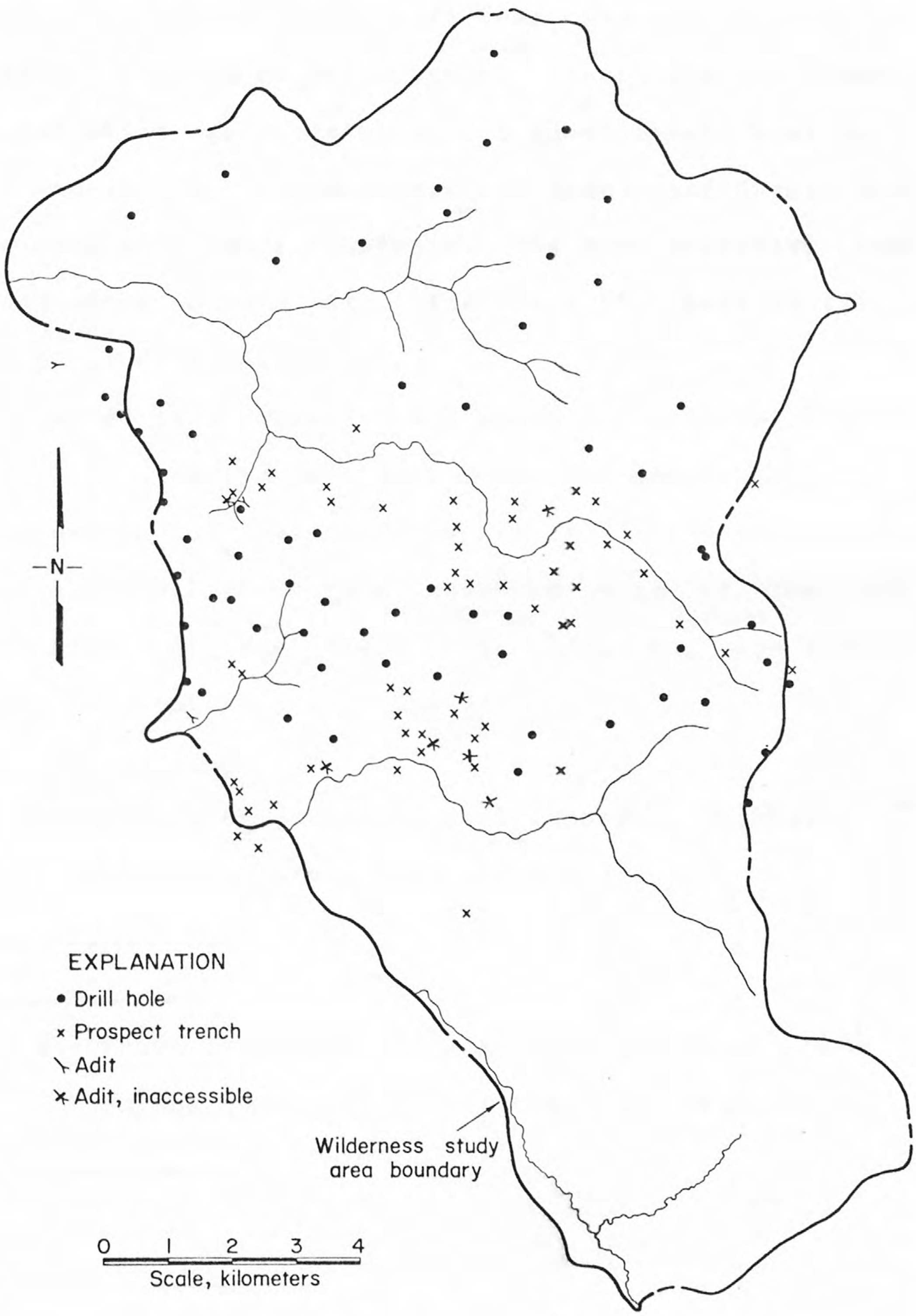


FIGURE 5.--Extent of coal exploration, Cranberry Wilderness Study Area.

The identity of these coal beds does not necessarily agree with earlier reports or local usage. Identities are based on the Sewell bed which was correlated from known Sewell west and south of the area. All beds except the Sewell and Hughes Ferry (?) contain coal of minable thickness. The most extensive beds are the Pocahontas No. 3 (?), Fire Creek (?), Beckley (?), Little Raleigh (?), and Sewell.

Estimated coal resources are about 100 million metric tons (pl. 3). The reserve base (demonstrated reserve base) is 34,179 thousand metric tons and reserves are 16,830 thousand metric tons (Table 1). Coal resources underlie most of the northern three-quarters of the study area (fig. 6); the reserve base underlies the central part (fig. 7).

Table 1.--Summary of estimated coal reserves, Cranberry Wilderness Study Area, West Virginia.

Figure 6.--Known coal resources distribution of all beds in the Cranberry Wilderness Study Area.

Figure 7.--Composite reserve base area of all coal beds.

Coal reserves would be recoverable by underground mining methods. By using appropriate mining techniques adverse

TABLE 1.--Summary of estimated coal reserves, Cranberry Wilderness Study Area, West Virginia by P. C. Mory and D. K. Harrison, U.S. Bureau of Mines, Nov. 15, 1977

Coalbed	Hectares of coal 70 centimeters or more thick	Reserve Base (thousand metric tons)			Reserves[1/] (thousand metric tons)
		Measured	Indicated	Total	
Little Raleigh rider (?)....	102	470	604	1,074	537
Little Raleigh (?)..........	724	6,631	1,818	8,449	4,225
Beckley (?).................	641	4,648	2,199	6,847	3,424
Fire Creek (?)..............	174	1,639	440	2,079	1,040
Little Fire Creek (?).......	150	875	744	1,619	810
Pocahontas No. 3 rider (?)..	42	375	150	525	263
Pocahontas No. 3 (?)........	820	5,229	8,357	13,586	6,531[2/]
Total tonnages..............		19,867	14,312	34,179	16,830

1/ Based on 50 percent recovery factor.
2/ Excludes isolated economically unrecoverable portions of coalbed.

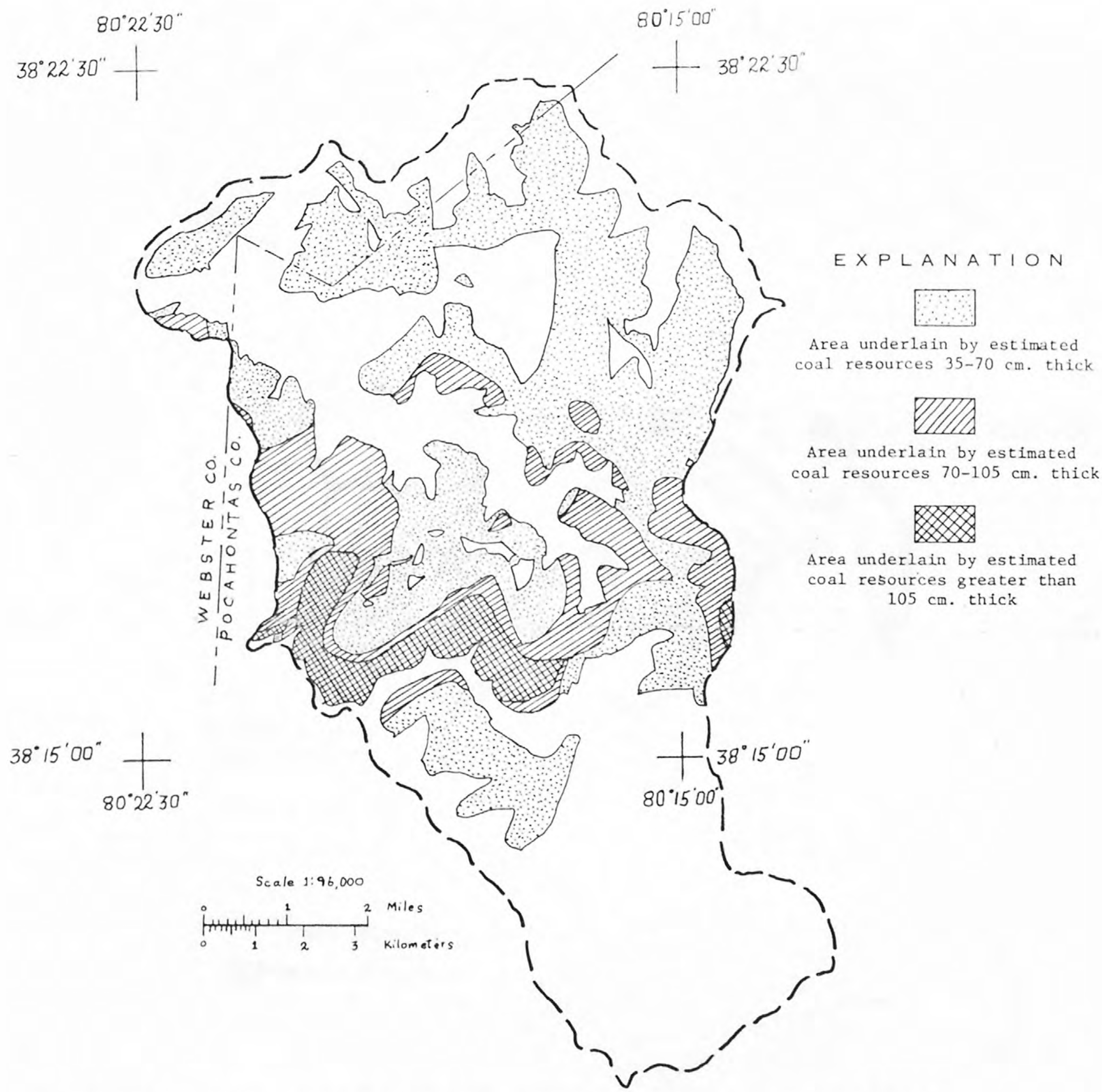
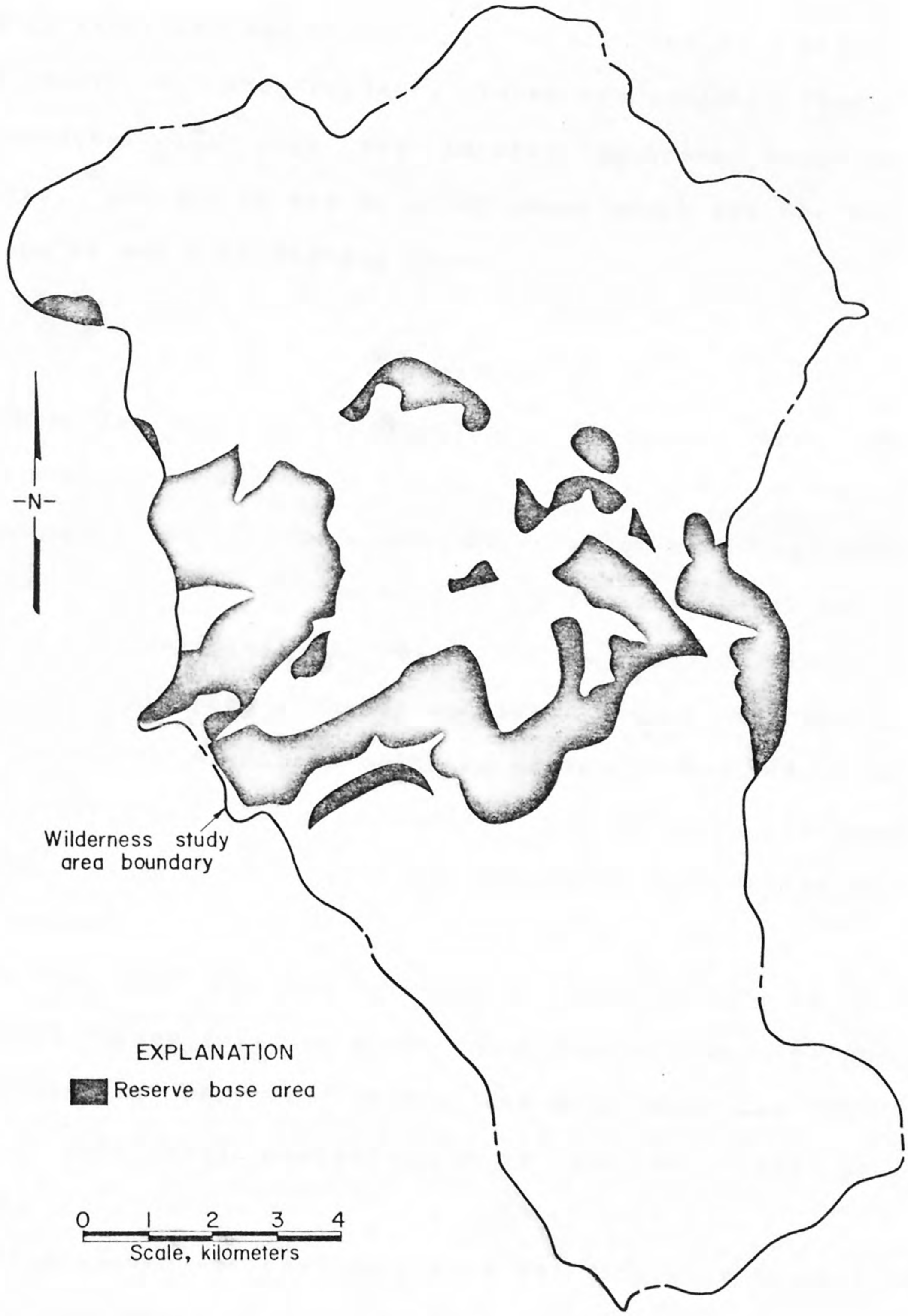


FIGURE 6.- KNOWN COAL RESOURCE DISTRIBUTION OF ALL BEDS IN THE CRANBERRY WILDERNESS STUDY AREA



'IGURE 7.--Composite reserve base area of all coal beds.

environmental impacts would be minimized. Surface disturbance would be temporary and limited to small areas. Drainage and water table of the Cranberry Glades are isolated from the coal reserve area. The bogs are located upstream from the coal reserves, and are up dip on older rocks which are not related to aquifers of the coal-bearing areas.

Procedure

Investigation and evaluation of coal beds was by reconnaissance surface geologic mapping and subsurface correlation of drill-core logs. Correlation and identification of coal beds and rock formations in the core holes was done by the U. S. Geological Survey. Surface mapping included the location of prospect trenches and adits made during earlier coal exploration. U. S. Bureau of Mines personnel located 54 prospect trenches and adits within the study area, 32 were reopened and examined. Six inactive mines and two adits outside the area were also examined.

A "bed map" prepared for each of the coal beds by the U. S. Geological Survey (pl. 3), shows thickness contours for the coal bed (excluding partings of rock and bony coal) for 35, 70, and 105 cm or more, areal distribution of the bed, and coal bed outcrop.

Calculations of coal resources for different categories are based on the amount of geologic data and degree of control for each coal bed. The "measured" category of coal is projected to extend 0.4 km from a point of surface or subsurface measurement;

"indicated" coal extends in a belt from more than 0.4 to 1.2 km from a measured point; and "inferred" coal is projected to extend in a belt that is more than 1.2 to 4.8 km from a measured point (U.S. Bureau of Mines and U.S. Geological Survey, 1976). Each area of measured, indicated, and inferred coal is subdivided into subareas of coal ranging in thickness from 35 to 70 cm, 70 to 105 cm, and 105 cm and above. No resources were determined for coal less than 35 cm thick.

The reserve base, a portion of the resources, for this report includes only coal beds 70 cm or more thick in the measured and indicated reliability categories. Coal beds of this thickness are considered recoverable by underground mining methods. Coal that could be strip mined is included in the reserve base and was not calculated separately. A 50 percent recovery factor was used to derive reserves (the amount of recoverable coal) from the reserve base. Reserve base maps were adapted by the U.S. Bureau of Mines from the individual bed maps. Past mining is considered negligible in the study area.

Analyses (table 2) indicate that coal in the study area can

Table 2.--Analyses of coal, Cranberry Wilderness Study Area, West Virginia.

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be tentatively ranked as medium-volatile to high-volatile A bituminous. All samples are low in sulfur and most are low in ash. Most of the raw coal is of premium grade coking coal quality and contains not more than 1.0 percent sulfur and 8.0

TABLE 2. - Analyses of coal, Cranberry Wilderness Study Area, West Virginia

[Analyses by Department of Energy, Division of Solid Fuel Mining and Preparation, Coal Analysis (formerly U.S. Bureau of Mines, Coal Preparation and Analysis Group), Pittsburgh, Pennsylvania. All samples are of weathered coal and were collected from either adits, prospect trenches, or outcrops. An attempt was made to penetrate the coalbed at least 0.3 meter to lessen the effects of weathering on analytical results.]

					Proximate (percent)			Ultimate (percent)							Sulfur forms (percent)[2]				
Sample number	Coalbed	Sample interval (centi-meters)	Specific gravity	Condition of sample[1]	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Calorific value Btu/lb	Sulfate	Pyritic	Organic	Ash softening temperature (°F)	Free-swelling index
				AR	6.3	27.0	60.9	5.8	5.3	75.2	1.5	11.5	0.8	13,213	0.01	0.19	0.56		
WVC-626	Little	106.7	1.37	MF	--	28.9	64.9	6.2	4.9	80.2	1.6	6.3	.8	14,098	.01	.21	.60	2,510	3.5
	Raleigh (?)			MAF	--	30.8	69.2	--	5.2	85.5	1.7	6.7	.9	15,027	.01	.22	.64		
				AR	6.7	27.9	60.3	5.1	5.3	75.1	1.5	12.1	.8	13,187	.01	.19	.57		
WVC-627	do.	105.4	1.36	MF	--	29.9	64.6	5.5	4.9	80.5	1.6	6.6	.8	14,136	.01	.21	.61	2,460	2.5
				MAF	--	31.6	68.4	--	5.2	85.2	1.7	7.0	.9	14,955	.01	.22	.64		
				AR	3.1	29.6	60.8	6.5	5.2	78.0	1.5	7.9	.9	13,873	.00	.23	.62		
WVC-659	do.	106.7	1.37	MF	--	30.6	62.7	6.7	5.0	80.5	1.5	5.3	.9	14,317	.00	.24	.64	2,910	8.0
				MAF	--	32.8	67.2	--	5.4	86.4	1.6	5.7	.9	15,352	.00	.26	.69		
				AR	4.5	28.5	61.4	5.6	5.5	78.8	1.3	7.8	.9	13,974	.01	.33	.53		
WVC-608	Beckley (?)	71.4	1.35	MF	--	29.8	64.3	5.9	5.3	82.5	1.4	4.0	.9	14,628	.01	.35	.56	2,800+	9.0
				MAF	--	31.7	68.3	--	5.6	87.6	1.5	4.3	1.0	15,539	.01	.37	.59		
				AR	8.1	26.4	58.8	6.7	5.3	74.6	1.3	11.6	.6	13,111	.01	.10	.50		
WVC-634	do.	71.1	1.35	MF	--	28.7	64.1	7.2	4.8	81.2	1.4	4.8	.7	14,264	.01	.11	.54	2,910	8.5
				MAF	--	30.9	69.1	--	5.2	87.5	1.5	5.1	.7	15,379	.01	.12	.58		
				AR	10.3	26.0	58.8	4.9	5.2	71.4	1.1	16.9	.5	12,312	.02	.04	.47		
WVC-651	do.	78.7	1.39	MF	--	29.0	65.6	5.4	4.6	79.6	1.2	8.7	.6	13,721	.02	.04	.53	2,910	.5
				MAF	--	30.7	69.3	--	4.8	84.1	1.3	9.2	.6	14,507	.02	.04	.56		
				AR	2.7	29.6	62.3	5.4	5.4	80.5	1.4	6.6	.7	14,383	.01	.17	.54		
WVC-613	Fire Creek (?)	147.3	1.34	MF	--	30.5	63.9	5.6	5.2	82.7	1.4	4.3	.7	14,777	.01	.17	.56	2,800+	9.0
				MAF	--	32.5	67.7	--	5.5	87.6	1.5	4.6	.8	15,650	.01	.18	.59		
				AR	2.4	29.8	61.7	6.1	5.4	80.3	1.4	6.2	.6	14,284	.01	.17	.46		
WVC-614	do.	144.8	1.34	MF	--	30.5	63.3	6.2	5.2	82.3	1.4	4.2	.7	14,628	.01	.17	.48	2,800+	9.0
				MAF	--	32.6	67.4	--	5.6	87.7	1.5	4.5	.7	15,597	.01	.18	.51		
				AR	5.4	25.7	61.3	7.6	5.0	74.8	1.4	10.3	.9	13,141	.01	.16	.68		
WVC-616	do.	35.6[3]	1.39	MF	--	27.2	64.8	8.0	4.6	79.1	1.5	5.8	.9	13,891	.01	.17	.72	2,800+	3.5
				MAF	--	29.6	70.4	--	5.0	86.0	1.7	6.3	1.0	15,106	.01	.19	.78		
				AR	4.3	25.8	59.9	10.0	5.0	74.4	1.4	8.6	.6	13,135	.01	.17	.46		
WVC-617	do.	50.8[4]	1.39	MF	--	26.9	62.6	10.5	4.7	77.7	1.5	5.0	.7	13,722	.01	.17	.48	2,800+	7.0
				MAF	--	30.1	69.9	--	5.2	86.8	1.6	5.6	.7	15,331	.01	.19	.53		
				AR	6.0	25.3	53.9	14.8	4.8	68.4	1.0	10.4	.7	12,043	.01	.16	.48		
WVC-623	Pocahontas	157.5	1.44	MF	--	26.9	57.4	15.7	4.4	72.8	1.0	5.3	.7	12,815	.01	.17	.52	2,800+	7.5
	No. 3 (?)			MAF	--	31.9	68.1	--	5.2	86.4	1.2	6.3	.8	15,209	.01	.20	.61		
				AR	3.5	15.5	66.7	14.3	4.9	71.4	1.0	7.6	.8	12,572	.01	.29	.47		
WVC-624	do.	153.7	1.40	MF	--	16.1	69.1	14.8	4.6	74.0	1.1	4.7	.8	13,022	.01	.30	.49	2,800+	9.0
				MAF	--	18.9	81.1	--	5.4	86.8	1.3	5.5	.9	15,288	.01	.36	.57		

1/ AR = As received; MF = Moisture free; MAF = Moisture and ash free.
2/ By atomic absorption analyses.
3/ Upper bench of coalbed at sample locality WVC-616 and 617.
4/ Lower bench of coalbed at sample locality WVC-616 and 617.

percent ash. Washability tests (table 3) performed on drill-core

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Table 3. Coal washability characteristics, Cranberry Wilderness Study Area, West Virginia.

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samples and on bulk samples from three adits indicate that coal not of premium quality can be cleaned to reduce sulfur and ash content.

Spectrographic analyses of coal ash for 39 elements and radiometric determination of U308 (table 4) indicate no abnormal concentrations.

Table 4.--Analyses of coal ash, Cranberry Wilderness Study Area, West Virginia.

Analyses compare favorably with averages for trace elements of coal ash in West Virginia reported by Abernethy and others (1969) and Swanson and others (1976).

Pocahontas No. 3 (?) coal bed

The Pocahontas No. 3 (?) coal bed (fig. 8) ranges in

Figure 8.--Pocahontas No. 3 (?) coal bed, sample locality WVC-623.

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thickness from 0 to 170 cm. In most areas, the bed is free of partings, but locally may have several bony coal layers 2 to 5 cm

TABLE 3.- Coal washability characteristics, Cranberry Wilderness Study Area, West Virginia[1/]

Sample locality number	Coalbed	Specific gravity fractions		Dry basis (percent)			Cumulative data (percent)						Remarks
							Float			Sink			
		Sink	Float	Weight	Ash	Sulfur	Weight	Ash	Sulfur	Weight	Ash	Sulfur	
Laurelly Branch adit,	Little Raleigh (?)									100.00	8.31	0.92	Plus 1/4 inch round =
same locality as		--	1.35	72.83	3.19	0.87	72.83	3.19	0.87	27.17	22.03	1.05	39.88% of total sample
WVC-626 and 627[2/]		1.35	1.40	6.81	12.48	.81	79.64	3.98	.86	20.36	25.22	1.13	
		1.40	1.45	10.05	17.58	.85	89.69	5.51	.86	10.31	32.67	1.40	
		1.45	1.50	2.47	20.85	.83	92.16	5.92	.86	7.84	36.39	1.58	
		1.50	1.55	.68	24.81	1.39	92.84	6.06	.87	7.16	37.49	1.60	
		1.55	--	7.16	37.49	1.60	100.00	8.31	.92				
Do.[2/]	do.									100.00	4.94	.97	1/4 inch round by 0 =
		--	1.35	83.86	2.21	.87	83.86	2.21	.87	16.14	19.15	1.51	60.12% of total sample
		1.35	1.40	5.89	10.05	.80	89.75	2.72	.87	10.25	24.38	1.92	
		1.40	1.45	4.21	14.45	.80	93.96	3.25	.86	6.04	31.30	2.71	
		1.45	1.50	1.47	17.59	.30	95.43	3.47	.86	4.57	35.71	3.32	
		1.50	1.55	.98	19.30	.82	96.41	3.63	.86	3.59	40.19	4.00	
		1.55	--	3.59	40.19	4.00	100.00	4.94	.97				
Do.[2/]	do.									100.00	6.29	.95	Calculated composite =
		--	1.35	79.46	2.57	.87	79.46	2.57	.87	20.54	20.66	1.27	100% of total sample
		1.35	1.40	6.26	11.10	.80	85.72	3.19	.86	14.28	24.85	1.47	
		1.40	1.45	6.54	16.37	.83	92.26	4.13	.86	7.74	32.02	2.01	
		1.45	1.50	1.87	19.31	.82	94.13	4.43	.86	5.87	36.07	2.39	
		1.50	1.55	.86	21.04	1.00	94.99	4.58	.86	5.01	38.65	2.63	
		1.55	--	5.01	38.65	2.63	100.00	6.29	.95				
Drill hole CW-104[3/]	do.	--	1.30	77.2	2.01	.85	77.2	2.01	.85	100.0	6.69	.84	Composite 3/4 inch round
		1.30	1.35	9.0	6.74	.92	86.2	2.50	.86	22.8	22.54	.79	by 0 = 100% of core
		1.35	1.40	2.8	9.43	.94	89.0	2.72	.86	13.8	32.85	.70	crushed to 3/4 inch
		1.40	1.45	1.3	13.02	.91	90.3	2.87	.86	11.0	38.81	.64	round
		1.45	1.50	1.7	21.93	1.02	92.0	3.22	.86	9.7	42.26	.61	
		1.50	1.55	1.5	27.86	.59	93.5	3.62	.86	8.0	46.58	.52	
		1.55	1.60	1.0	30.67	.59	94.5	3.90	.86	6.5	50.90	.51	
		1.60	--	5.5	54.58	.49	100.0	6.69	.84	5.5	54.58	.49	
Drill hole CW-110[3/]	do.	--	1.30	61.4	1.78	.78	61.4	1.78	.78	100.0	10.09	.72	Composite 3/4 inch round
		1.30	1.35	11.6	5.77	.79	73.0	2.41	.78	38.6	23.32	.63	by 0 = 100% of core
		1.35	1.40	7.6	10.87	.76	80.6	3.21	.78	27.0	30.86	.56	crushed to 3/4 inch
		1.40	1.45	4.1	13.03	.65	84.7	3.69	.77	19.4	38.69	.48	round
		1.45	1.50	2.2	14.16	.59	86.9	3.95	.77	15.3	45.57	.43	
		1.50	1.55	1.1	16.25	.40	88.0	4.11	.76	13.1	50.84	.40	
		1.55	1.60	1.0	24.31	.35	89.0	4.33	.76	12.0	54.01	.41	
		1.60	--	11.0	56.71	.41	100.0	10.09	.72	11.0	56.71	.41	

TABLE 3. - Coal washability characteristics, Cranberry Wilderness Study Area, West Virginia 1/ (continued)

Sample locality number	Coalbed	Specific gravity fractions		Dry basis (percent)			Cumulative data (percent)						Remarks
							Float			Sink			
		Sink	Float	Weight	Ash	Sulfur	Weight	Ash	Sulfur	Weight	Ash	Sulfur	
Drill hole CW-116 3/	Little Raleigh (?)	--	1.30	37.4	3.06	0.76	37.4	3.06	0.76	100.0	23.61	0.64	Composite 3/4 inch round by 0 = 100% of core crushed to 3/4 inch round
		1.30	1.35	17.0	6.90	.77	54.4	4.26	.76	62.6	35.89	.57	
		1.35	1.40	8.9	12.22	.72	63.3	5.38	.76	45.6	46.70	.49	
		1.40	1.45	4.0	16.78	.69	67.3	6.06	.75	36.7	55.06	.44	
		1.45	1.50	2.3	22.58	.78	69.6	6.60	.75	32.7	59.74	.41	
		1.50	1.55	1.7	26.81	.73	71.3	7.08	.75	30.4	62.55	.38	
		1.55	1.60	1.3	32.34	.78	72.6	7.54	.75	28.7	64.67	.36	
		1.60	--	27.4	66.20	.34	100.0	23.61	.64	27.4	66.20	.34	
Tumbling Rock Run adit, same locality as WVC-613 and 614 4/	Fire Creek (?)	--	1.40							100.00	8.04	.92	3/4 inch by 0 = total bulk sample
		1.40	1.45	92.57	5.00	.80	92.57	5.00	.80	7.43	45.94	2.37	
		1.45	1.50	1.95	16.32	1.36	94.52	5.24	.81	5.48	57.35	2.78	
		1.50	1.55	.62	24.93	1.31	95.14	5.35	.82	4.86	62.10	3.02	
		1.55	--	4.86	62.10	3.02	100.00	8.04	.92				
Drill hole CW-117 3/	Pocahontas No. 3 (?)	--	1.30	30.2	2.44	.66	30.2	2.44	.66	100.0	13.66	.55	Composite 3/4 inch round by 0 = 100% of core crushed to 1 inch round
		1.30	1.35	27.6	6.13	.61	57.8	4.20	.64	69.8	18.51	.51	
		1.35	1.40	8.9	10.51	.51	66.7	5.04	.62	42.2	26.61	.44	
		1.40	1.45	5.7	15.17	.47	72.4	5.84	.61	33.3	30.92	.43	
		1.45	1.50	3.7	19.95	.47	76.1	6.53	.60	27.6	34.17	.42	
		1.50	1.55	4.0	26.29	.55	80.1	7.51	.60	23.9	36.37	.41	
		1.55	1.60	5.3	31.59	.46	85.4	9.01	.59	19.9	38.40	.38	
		1.60	--	14.6	40.87	.35	100.0	13.66	.55	14.6	40.87	.35	
Drill hole CW-118 3/	do.	--	1.30	17.7	2.42	.74	17.7	2.42	.74	100.0	16.56	.59	Composite 3/4 inch round by 0 = 100% of core crushed to 3/4 inch round
		1.30	1.35	34.3	6.86	.66	52.0	5.35	.69	82.3	19.60	.56	
		1.35	1.40	18.8	11.29	.58	70.8	6.93	.66	48.0	28.71	.49	
		1.40	1.45	9.7	14.94	.50	80.5	7.89	.64	29.2	39.92	.43	
		1.45	1.50	4.6	18.77	.48	85.1	8.48	.63	19.5	52.35	.40	
		1.50	1.55	2.2	22.97	.44	87.3	8.85	.63	14.9	62.72	.38	
		1.55	1.60	1.3	24.93	.40	88.6	9.08	.62	12.7	69.61	.36	
		1.60	--	11.4	74.70	.36	100.0	16.56	.59	11.4	74.70	.36	
Hunting Run adit, same locality as WVC-624 4/	do.	--	1.35							100.00	17.17	--	3/4 inch by 0 = total bulk sample
		1.35	1.40	72.49	7.99	.91	72.49	7.99	.91	27.51	41.36	--	
		1.40	1.45	1.86	18.11	.94	74.35	8.24	.91	25.65	43.04	--	
		1.45	1.50	4.36	24.49	.96	78.71	9.14	.91	21.29	46.84	--	
		1.50	1.55	2.74	26.73	.85	81.45	9.73	.91	18.55	49.81	--	
		1.55	--	18.55	49.81	.74	100.00	17.17	.88				

1/ All washability data provided by Mid Allegheny Corporation, Summersville, W. Va. Data as reported with no independent rounding by the Bureau of Mines.
2/ Analyses performed by Standard Laboratories, Inc., Charleston, W. Va.
3/ Analyses performed by Commercial Testing and Engineering Co., Charleston, W. Va.
4/ Analyses performed by the Powellton Company, Mallory, W. Va.

TABLE 4.--Analyses of coal ash, Cranberry Wilderness Study Area, West Virginia

[Analyses performed by U.S. Bureau of Mines, Reno Metallurgy Research Center, Reno, Nevada. Elements tested for but occurring in amounts below the lower detection limit (in parentheses) include: As(.009), Bi(.08), Cd(.002), Ga(.001), La(.02), Mo(.004), Na(2), Nb(.05), P(.2), Pd(.001), Pt(.004), Sb(.05), Sc(.001), Sn(.007), Ta(.05), Te(.1), W(.06), Y(.007), Zr(.005). Si occurs in all samples in amounts greater than 29 percent. A possible error of plus 100 percent to minus 50 percent of reported concentration is assumed. Symbols used: >, greater than; <, less than].

Sample number	Coalbed	Sample interval (centimeters)	General spectrographic analyses (percent)																	
			Al	B	Ba	Be	Ca	Co	Cr	Cu	K	Li	Mg	Mn	Ni	Pb	Sr	Ti	V	Zn
WVC-626	Little Raleigh (?)	106.7	21	0.02	0.2	0.002	1.0	<0.001	0.02	0.03	3	<0.005	2.0	0.2	0.009	<0.03	0.04	2	0.08	0.04
WVC-627	do.	105.4	24	.02	.2	.002	1.0	<.001	.02	.02	9	<.005	1.0	.06	.01	<.03	.04	2	.08	.02
WVC-659	do.	106.7	26	.02	.2	.002	.7	.007	.03	.03	5	.03	1.0	<.001	.01	<.01	.07	2	.08	<.001
WVC-608	Beckley (?)	71.4	18	<.02	.4	.003	.9	.009	.02	.02	3	.02	1.0	.03	.01	.01	.2	1	.03	.04
WVC-634	do.	78.7	27	<.02	.4	.002	1.0	.006	.04	<.001	5	<.005	1.0	.04	.01	<.01	.2	2	.07	<.001
WVC-651	do.	71.1	24	<.02	.4	.002	2.0	.01	.02	.006	5	.01	2.0	.03	.02	<.01	.2	2	.02	.01
WVC-613	Fire Creek (?)	147.3	21	.02	.1	.002	.6	.001	.03	.09	4	.06	1.0	.007	.004	.02	.05	2	.05	.003
WVC-614	do.	144.8	24	.02	.1	.002	.5	<.001	.02	.06	5	.04	.9	.004	.004	.02	.05	2	.05	<.001
WVC-616	do.	35.6 1/	27	<.02	.09	.002	.8	<.001	.02	<.001	11	.02	1.0	.07	.008	<.01	.04	3	.05	<.001
WVC-617	do.	50.8 2/	22	<.03	.08	.002	.4	<.003	.02	<.001	3	<.005	1.0	<.001	.009	<.03	.03	2	.03	<.001
WVC-623	Pocahontas No. 3 (?)	157.5	>27	<.02	.2	.001	.5	<.001	.02	<.001	5	.03	1.0	.004	.006	<.01	.08	3	.02	.001
WVC-624	do.	153.7	24	.02	.04	<.001	.3	<.001	.02	.008	4	.07	1.0	.009	.005	<.01	.04	3	.02	<.001

1/ Upper bench of coalbed at sample locality WVC-616 and 617.
2/ Lower bench of coalbed at sample locality WVC-616 and 617.

Sample number	Spectrographic Ge (ppm)	Radiometric U_3O_8 (percent)
WVC-626	<10	0.003
WVC-627	12	.003
WVC-659	14	.003
WVC-608	45	.003
WVC-634	43	.004
WVC-651	20	.002
WVC-613	15	.004
WVC-614	17	.004
WVC-616	<10	.003
WVC-617	10	.003
WVC-623	10	.003
WVC-624	<10	.003

Figure 8.--Pocahontas No. 3 (?) coalbed, sample locality WVC-623. Coal extends from base of shovel to about 30 cm above top of handle.

thick. This coal bed crops out and is thickest along the north bank of the North Fork and is present near the Cranberry River westward from its junction with the North Fork. Most of the coal underlies the central part of the study area, although two small pods are located north of this central band (pl. 3). One pod is northeast of the headwaters of the Middle Fork of the Williams River; the other underlies a high ridge west of Laurelly Branch. Areas underlain by the reserve base are shown in figure 9.

Figure 9.--Reserve base area, Pocahontas No. 3(?) coal bed.

Coal resources..................	20,490,000 metric tons
Reserve base.....................	13,586,000 metric tons
Reserves.........................	6,531,000 metric tons 1/

1/ Reserves exclude the two small isolated blocks within the northeasternmost coal pod because they are too small to be considered economically minable.

The potential for mining this coal is high because of the large reserve tonnages and good surface access to the bed. Reserves would be minable only from mine entries within the study boundary.

Pocahontas No. 3 (?) coal bed samples WVC-623 and WVC-624 (table 2) were taken from outside caved adits. Raw coal is tentatively ranked as medium- volatile bituminous; however, fixed carbon values show a large variation which may be due to the

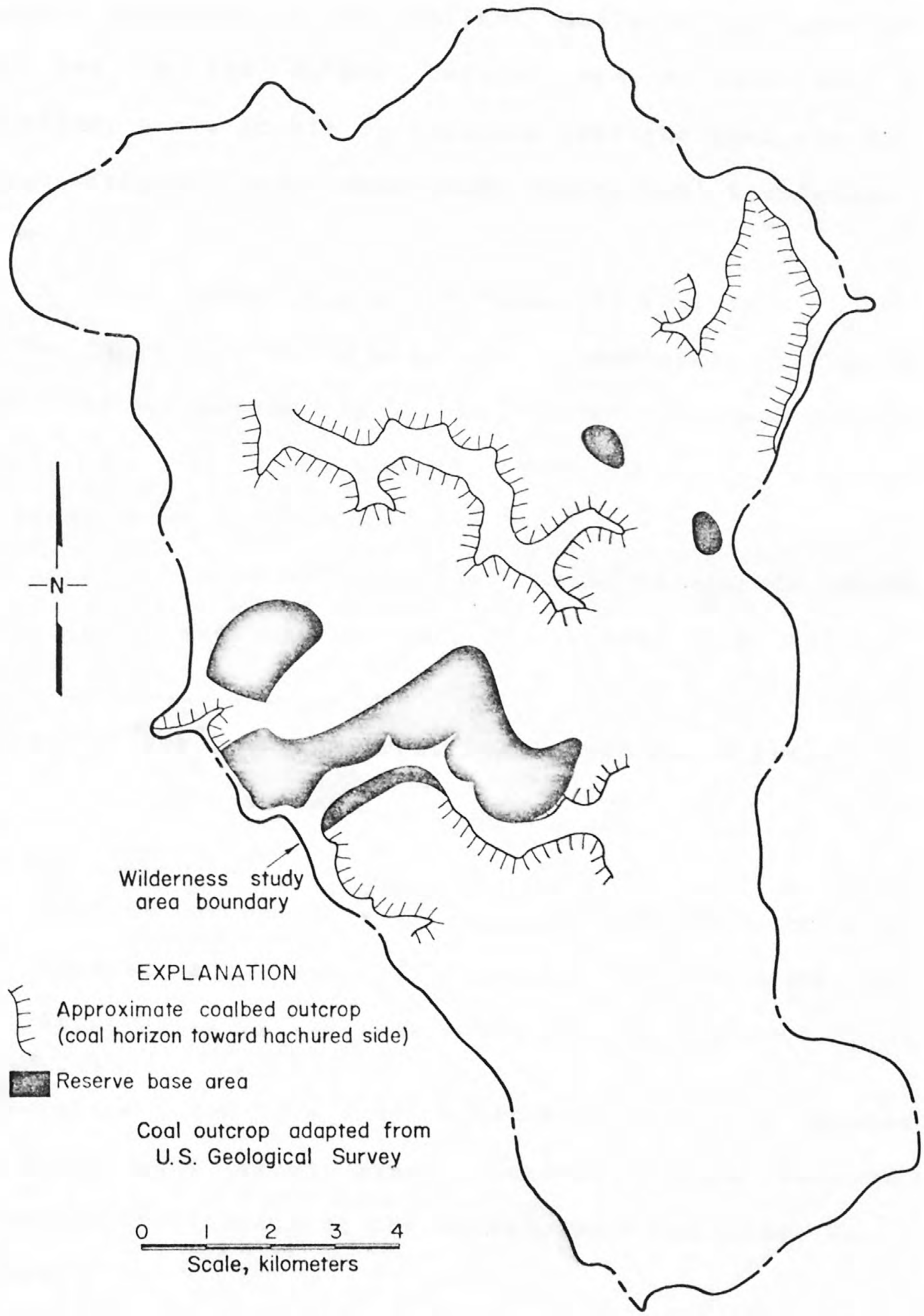

FIGURE 9.--Reserve base area, Pocahontas No. 3 (?) coalbed.

weathered condition of the samples. Analyses indicate that the coal has a low sulfur content and a high ash content. Washability tests (table 3) indicate that the coal can be cleaned to meet marginal- to premium-grade coking coal standards.

Pocahontas No. 3 rider (?) coal bed

The Pocahontas No. 3 rider (?) is generally present about 5 m above the Pocahontas No. 3 (?). Thickness ranges from 0 to 170 cm with a 5-8 cm shale parting present locally. Limited coal resources occur along the Cranberry River and near the east-central boundary (pl. 3). Coal of minable thickness is located in the west-central part of the area (fig. 10).

Figure 10.--Reserve base area, Pocahontas No. 3 rider (?) coal bed.

Coal resources..................	1,034,000 metric tons
Reserve base....................	525,000 metric tons
Reserves........................	263,000 metric tons

Reserves occur in a small block accessible to mining only from within the study area. Recovery could be possible in conjunction with mining of the underlying Pocahontas No. 3 (?) coal bed.

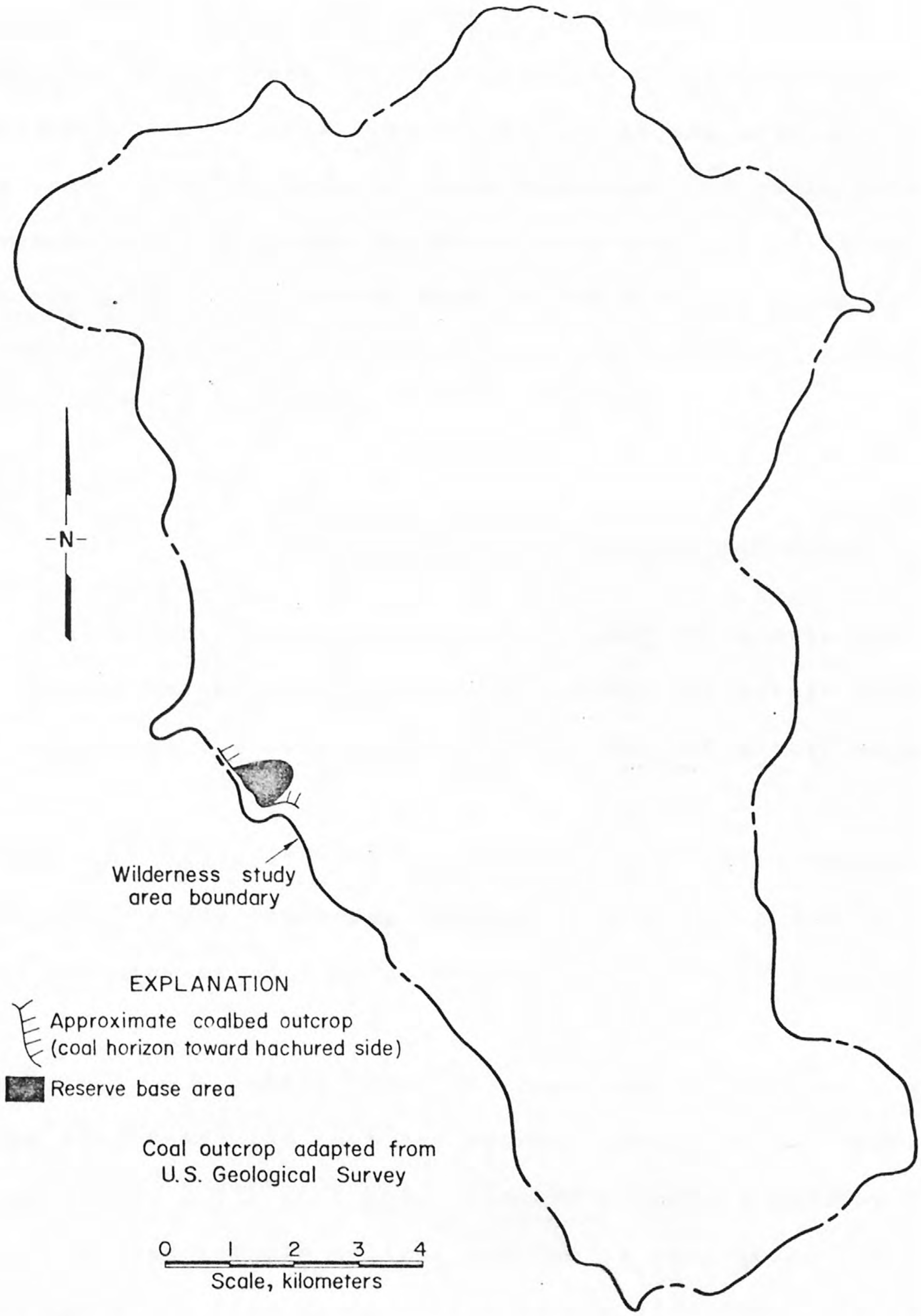

Figure 10.--Reserve base area, Pocahontas No. 3 rider (?) coal bed.

Little Fire Creek (?) coal bed

Little Fire Creek (?) coal bed lies about 32 to 49 m above the Pocahontas No. 3 (?). The bed ranges in thickness from 0 to 97 cm and locally contains thin bony coal and shale partings. Coal resources occur along the North Fork east of Cashcamp Run and at the head of the Middle Fork of the Williams River (pl. 3). Coal of minable thickness lies along the east- central boundary of the study area (fig. 11).

Figure 11.--Reserve base area, Little Fire Creek (?) coal bed.

Coal resources..................	3,865,000 metric tons
Reserve base....................	1,619,000 metric tons
Reserves........................	810,000 metric tons

This coal bed would be accessible to drift mining from outside the study boundary. Mining from within the area would require the sinking of a slope or shaft.

Fire Creek (?) coal bed

The Fire Creek (?) coal bed occurs about 60 m above the Pocahontas No. 3 (?) coal bed. The bed ranges in thickness from 0 to 147 cm, and locally splits into two or more beds. Although most of the study area is underlain by the Fire Creek (?), blocks of coal 35 cm or more thick are widely separated (pl. 3). The bed crops out on the mountainsides along the North Fork, Tumbling Rock Run, Cranberry, Williams, and Middle Fork of the Williams

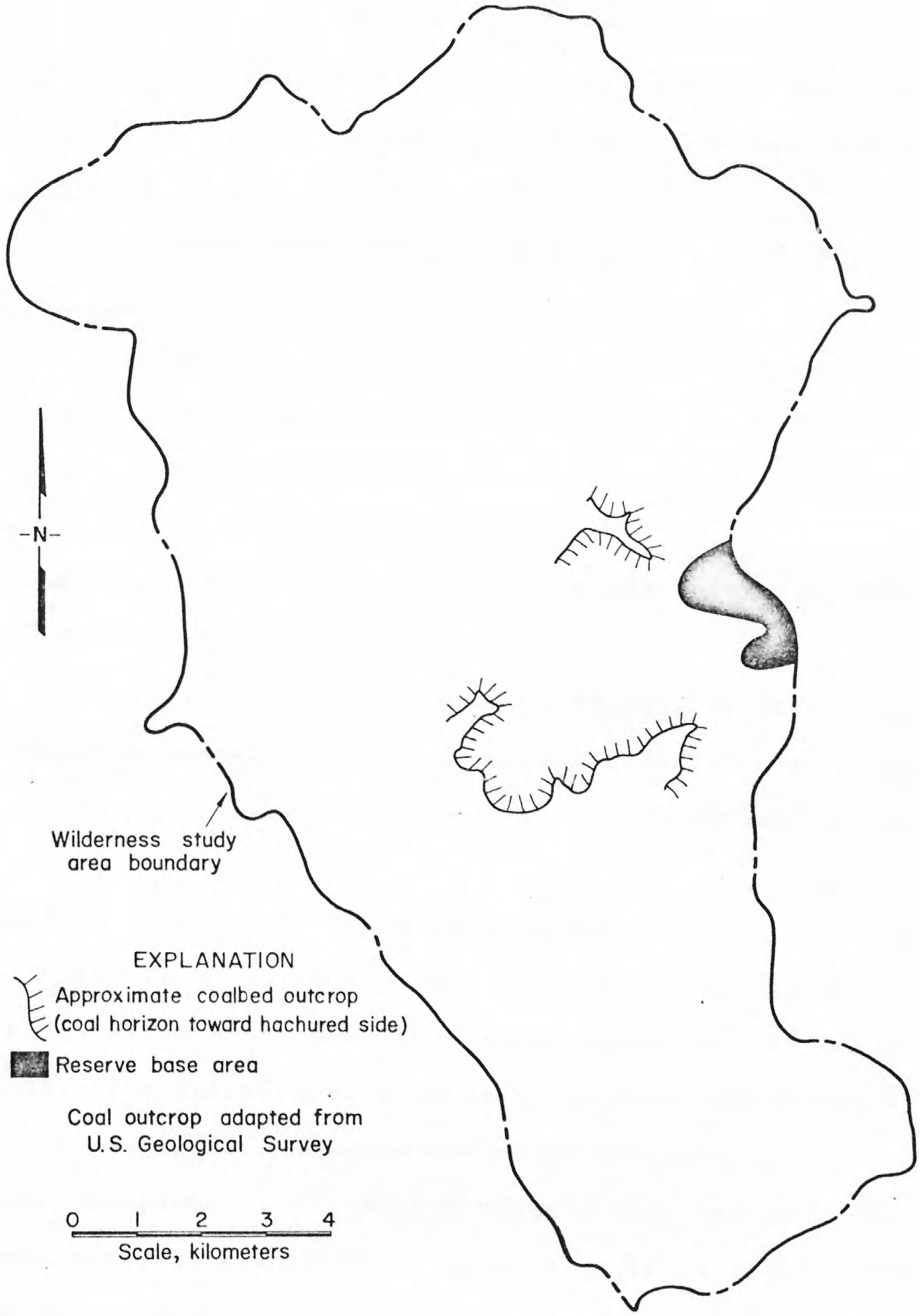

FIGURE 11.--Reserve base area, Little Fire Creek (?) coalbed.

Rivers. Reserves are mainly along Tumbling Rock Run but two small blocks also occur in the central and eastern parts of the area (fig. 12). Lateral extent of this coal bed has been defined

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Figure 12.--Reserve base area, Fire Creek (?) coal bed.

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by core drilling the mountains east of the Cranberry River and south of the North Fork where there has been no drilling. One surface prospect occurs in the Fire Creek (?) in these mountains to suggest that a block of coal exists. Isopachs projected southward from areas having both surface and subsurface data also indicate coal in this area.

Coal resources..................22,243,000 metric tons

Reserve base.................... 2,079,000 metric tons

Reserves........................ 1,040,000 metric tons

Coal reserves along Tumbling Rock Run would be accessible to mining only from entries within the area. The central reserve block has limited tonnage which lessens potential for recovery of this coal. The easternmost reserve block would be accessible to undergound mining from outside the study boundary.

Four samples of the Fire Creek (?) coal bed were collected and their analyses are shown in table 2. Tentatively, the raw coal is ranked as high- volatile A to medium-volatile bituminous. Samples WVC-613 and 614 were taken from opposite ribs at the face of the adit on Tumbling Rock Run (fig. 13). The coal has low sulfur and ash contents and is of premium coking coal quality.

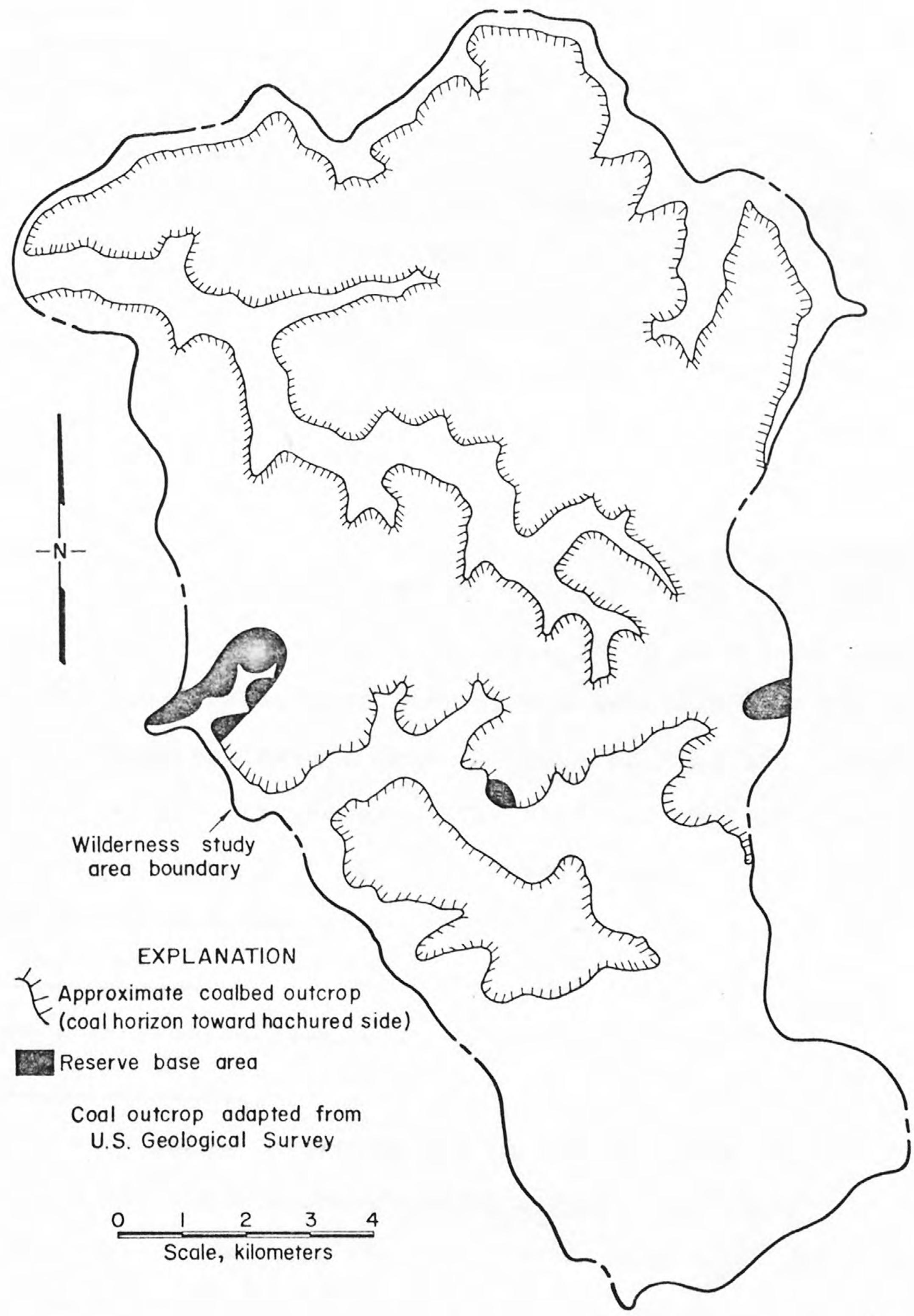

FIGURE 12.--Reserve base area, Fire Creek (?) coalbed.

Figure 13.--Adit along Tumbling Rock Run.

Samples WVC-616 and 617 were taken from outside a caved adit on the north side of North Fork; WVC-616 is of the upper coal bench, WVC-617 the lower coal bench. These benches are separated by 11 cm of underclay. Both samples are low in sulfur, but have a moderate ash content which may in part be due to the weathered condition of the coal sample.

Beckley (?) coal bed

The Beckley (?) coal bed is about 18 to 24 m above the Fire Creek (?) and underlies most of the northern half of the area (pl. 3). Thickness ranges from 0 to 145 cm and thin shale partings are locally present. The thickest part of the bed lies in the east-central part of the study area, where it is of minable thickness (fig. 14).

Figure 14.--Reserve base area, Beckley (?) coal bed.

In much of the northern quarter of the area the bed is less than 35 cm thick and locally may be absent. At least 30 prospect trenches are known in the Beckley (?) along the mountainsides north of North Fork and the upper tributaries of Middle Fork. South of North Fork there are no known drill holes or prospects in the Beckley (?), but isopachs projected from areas containing thickness data suggest the bed is thin or absent.

FIGURE 13.--Adit along Tumbling Rock Run.

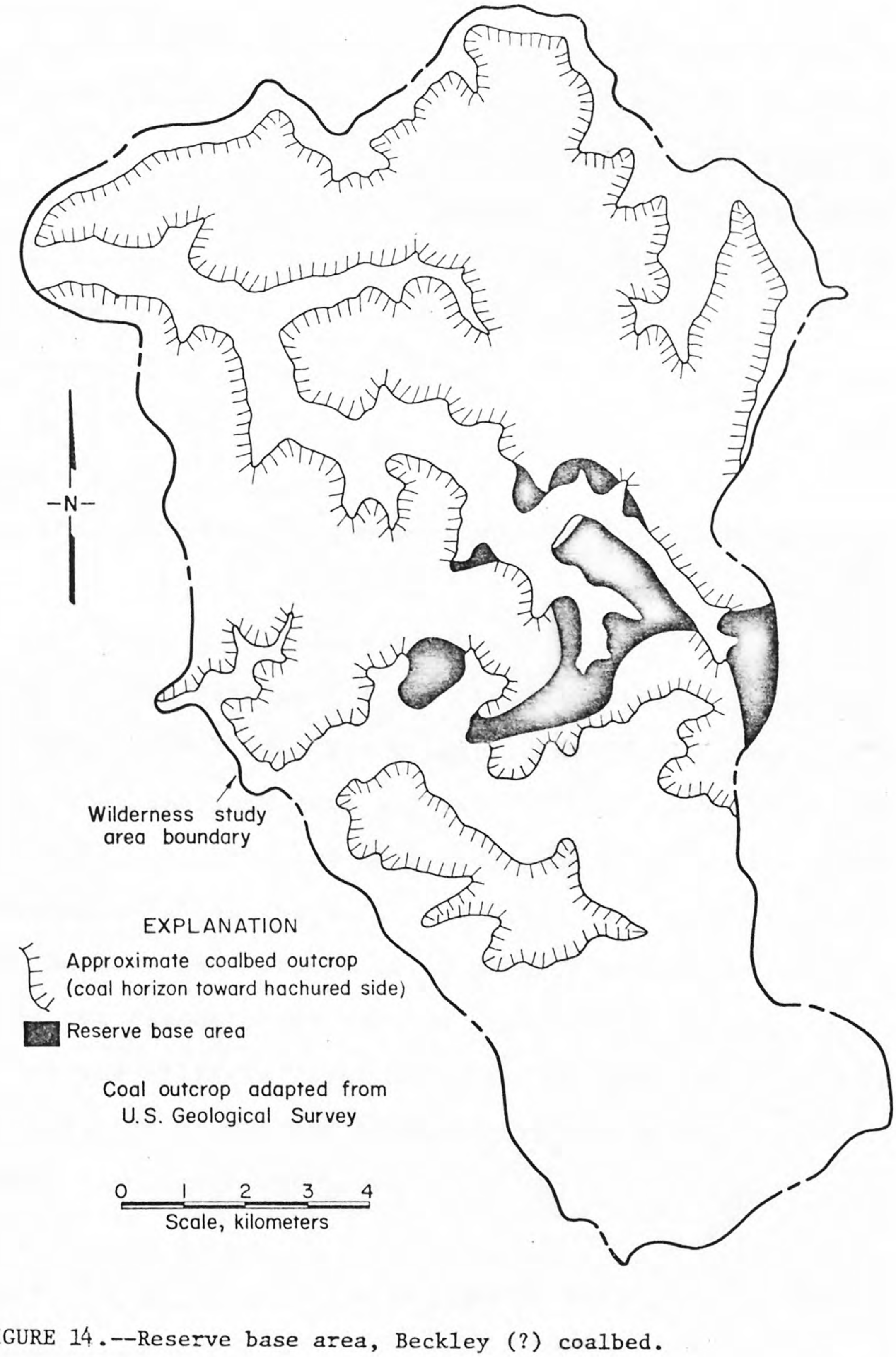

FIGURE 14.--Reserve base area, Beckley (?) coalbed.

Coal resources..................22,553,000 metric tons

Reserve base.................... 6,847,000 metric tons

Reserves........................ 3,424,000 metric tons

Reserves would be easily accessible to underground mining from entries within the study boundary. The easternmost block of coal could also be mined from outside the area.

Three sample analyses, WVC-608, 634, and 651 (table 2), indicate that the raw coal can be tentatively ranked as medium-volatile bituminous. The coal bed has a low sulfur and ash content and is of premium coking coal quality.

Little Raleigh (?) coal bed

The Little Raleigh (?) coal bed lies about 70 m above the Fire Creek (?). The bed ranges in thickness from 0 to 107 cm, and contains sporadic thin partings of shale and bony coal. A bony coal layer, 5 to 30 cm thick, occurs in several areas below and sometimes above the bed. The coal is split locally into three or more beds separated by up to 5 m of intervening strata. Most of the resource and reserve base lies between the Middle Fork of the Williams River and Tumbling Rock Run (pl. 3 and fig. 15). Portions of the bed have been partly or entirely removed as a result of channel washouts.

Figure 15.--Reserve base area, Little Raleigh (?) coal bed.

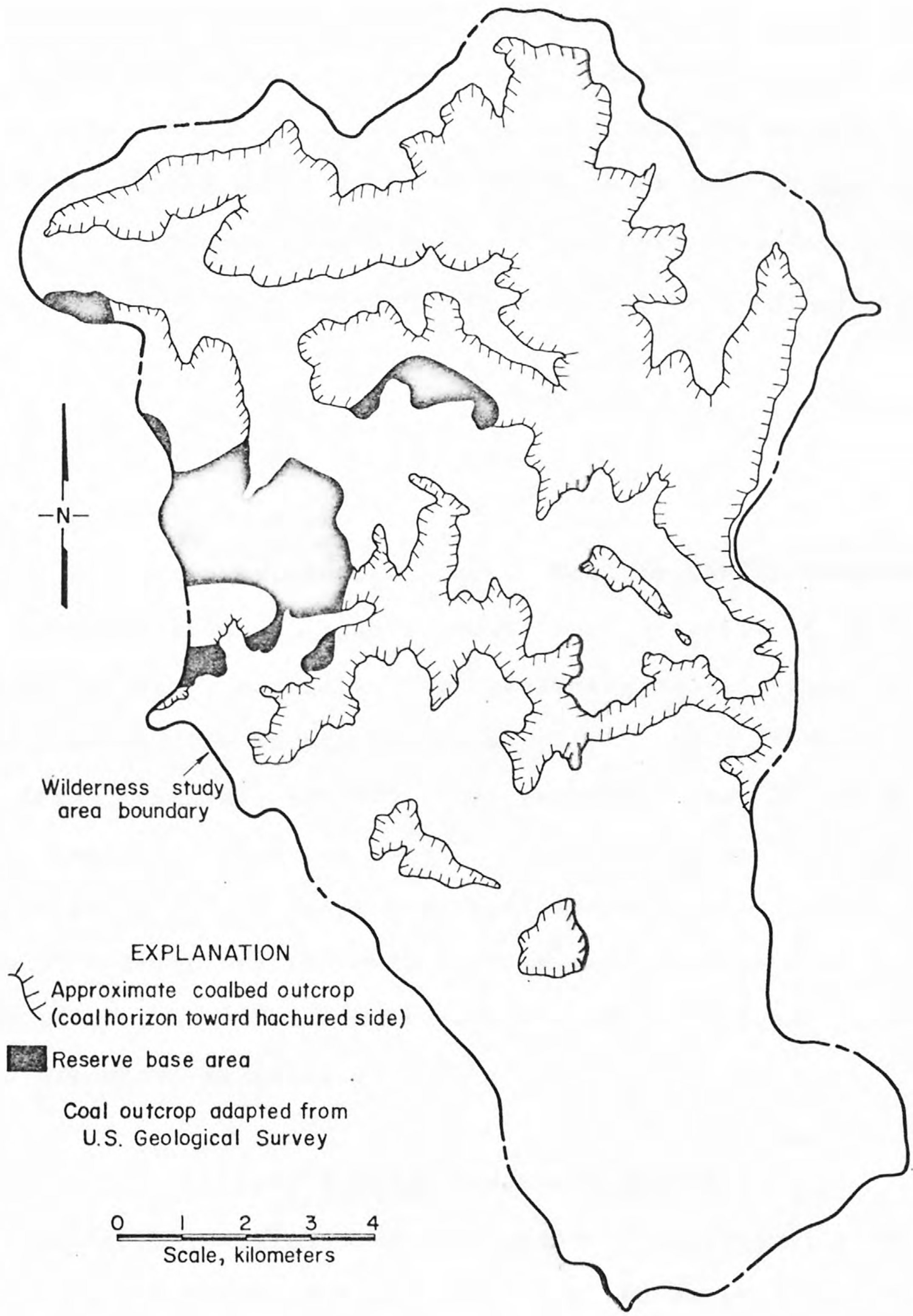

FIGURE 15.--Reserve base area, Little Raleigh (?) coalbed.

Coal resources..................17,193,000 metric tons

Reserve base................... 8,449,000 metric tons

Reserves....................... 4,225,000 metric tons

Areas having coal less than 70 cm thick and having a bony coal layer above or below the coal bed were excluded from these tonnages. Additional coal may be minable locally from these areas.

A high potential exists for mining this coal bed. Underground mining plans have been developed for the large reserve base block between Laurelly Branch and Tumbling Rock Run and for the northwesternmost block. Coal in the northwesternmost and southwesternmost blocks would be accessible to mining from outside the study boundary; the remaining coal could only be mined from entries within the area.

Three samples, WVC-626, 627, and 659 (table 2), from inside adits indicate the raw coal can tentatively be ranked as high-volatile A to medium-volatile bituminous. Sulfur and ash contents are low and the coal is of premium coking coal quality. Washability tests for a bulk sample from an adit and three drill holes are shown in table 3.

Little Raleigh rider (?) coal bed

The Little Raleigh rider (?) coal bed is generally from 6 to 12 m above the Little Raleigh (?). The bed ranges in thickness from 0 to 81 cm and in some areas consists of two or more splits separated by about 5 m. The coal for the most part is impure, with scattered thin shale and bony coal partings. Channel washouts have partly or completely removed the coal in places. The thickest coal is along the east-central edge of the study area where the bed is free of partings and up to 81 cm thick (pl. 3). A small resource block occurs northwest of Hateful Run in the north-central part of the area. The area underlain by the coal reserve base is show in figure 16.

Figure 16.--Reserve base area, Little Raleigh rider (?) coal bed.

Coal resources.................. 2,638,000 metric tons

Reserve base.................... 1,074,000 metric tons

Reserves........................ 537,000 metric tons

The limited reserve tonnage lessens the potential for mining of the Little Raleigh rider (?). Mining would have to be from entries within the study boundary because of restrictions on mining at shallow depths below State Scenic Highway 150.

Sewell coal bed

The Sewell coal bed occurs about 55 m above the Little Raleigh (?). The bed ranges in thickness from 0 to 71 cm, and locally contains thin bony coal and shale partings. Thickest coal occurs in two small pods; one in the northeast and the other in the west-central part of the study area (pl. 3). None of the coal is considered to be of minable thickness.

Coal resources..................10,044,000 metric tons

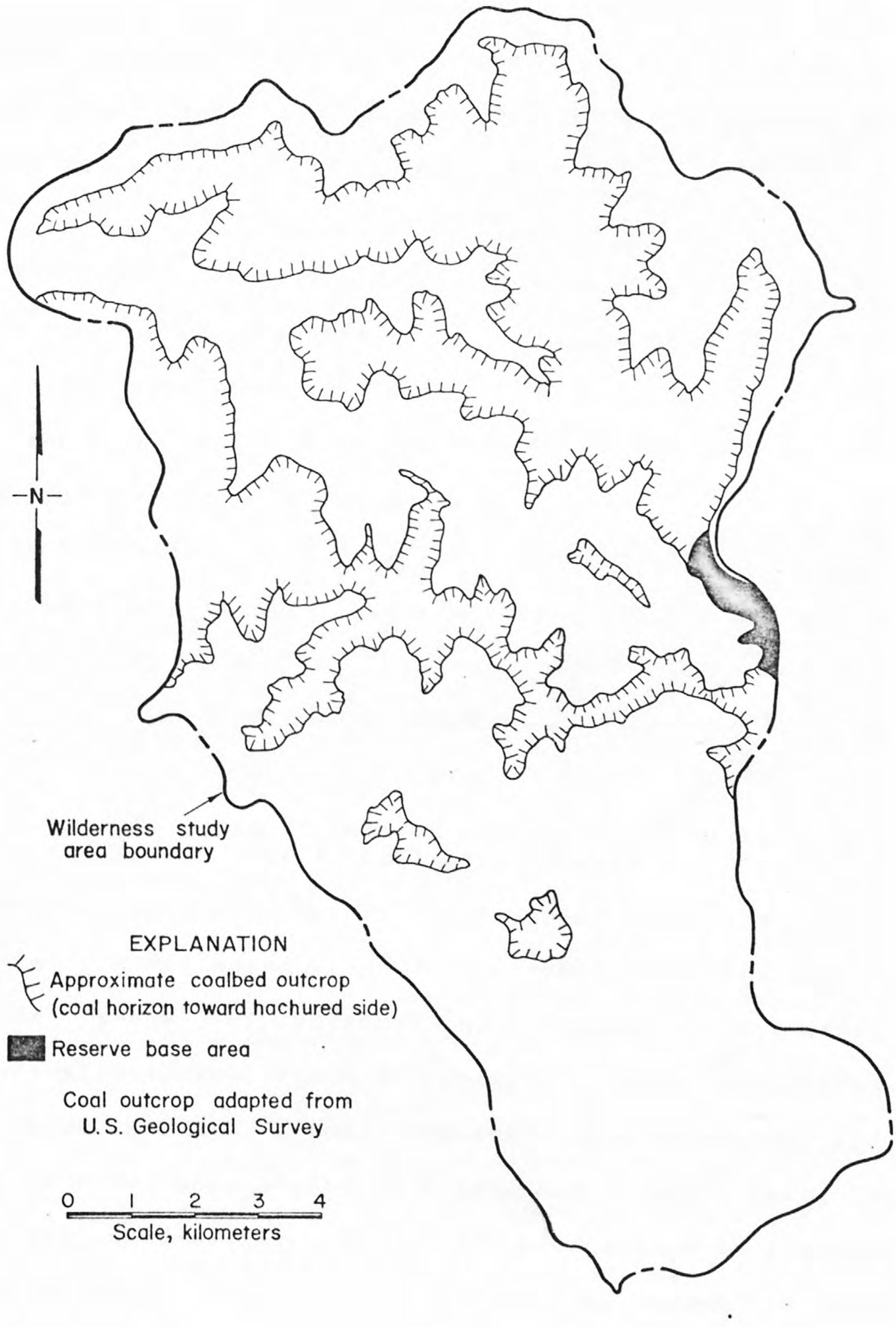

Figure 16.--Reserve base area, Little Raleigh rider (?) coal bed.

This coal bed was correlated into the area from known Sewell in mines and drill holes to the southwest. A prominent marker bed of conglomeratic sandstone occurring from 0 to 15 m above the coal aided in the correlation.

Hughes Ferry (?) coal bed

The Hughes Ferry (?) coal bed occurs from 104 to 113 m above the Sewell. The bed ranges in thickness from 48 to 61 cm, and locally contains shale partings. This coal bed occurs only in a small area near the top of a ridge between Little Fork and Laurelly Branch (pl. 3). None of the coal is considered to be of minable thickness.

Coal resources.................. 930,000 metric tons

PEAT

by

Cornelia C. Cameron and Andrew E. Grosz
U. S. Geological Survey

Peat, which is partly decomposed vegetable matter that accumulated under water or in a water-saturated environment, has a wide range of physical and chemical properties. For statistical purposes, the U.S. Bureau of Mines classifies peat into three general types. Material from decomposed *Sphagnum*, *Hypnum* or other moss groups is classified as moss peat; whereas that from reed-sedge, shrub, and tree groups is classified as reed-sedge peat. Humus peat is material so decomposed that its botanical identity is obscured and further oxidation of the material has been impeded. The American Society for Testing and

Materials restricts the classification of commercial quality peat to that having an ash content not exceeding 25 percent. Ash content consists of solids remaining after dry peat has been heated at 550 degrees C. High organic content combined with high water holding capacity makes peat valuable as a soil conditioner and horticultural material, uses upon which the peat industry is based.

The peat deposits in the Cranberry Wilderness Study Area are restricted to an area of approximately 304 ha, called the Cranberry Glades, on the valley floor of Cranberry River and its principle tributary, Charles Creek. This valley floor is about 8 km long and from one half to a little more than 1.5 km wide. It lies at an elevation between 1037 m at its upper or eastern end and 1021 m at the lower end.

The valley floor appears level, but it actually has a fall of about 14 m. Cranberry Glades includes several peat bogs that total about 46 ha-- (1) Big Glade (fig. 17), (2) Long Glade, (3) Round Glade, and (4) Flag Glade.

Figure 17.--View of Big Glade.

A bog forest consisting of red spruce, hemlock, yellow birch, and black ash borders these glades. Shrubs in the forest include winterberry, wild raisin, rhododendron, and yew. Sphagnum and other mosses grow over much of the forest floor. The principal deposits of commercial quality reed-sedge and moss peat occur in the form of open bogs. Their dominant floral cover

FIGURE 17.--View of Big Glade.

is sedge, grass, moss, high bush cranberry (vibernum), low shrubs, and dwarf trees.

The uniqueness of Cranberry Glades in the Southern Appalachians has stimulated study since 1898 (Core, 1955). The most extensive study was made by Darlington (1943) who conducted observations over a period of 12 years, and made pace and compass traverses. His profile data were obtained from 100 holes using a Hiller peat sampler. Cameron (1970, 1972) also made subsurface studies of the Glades using a Davis peat sampler and a Macaulay peat auger. This summary of peat resources in Cranberry Wilderness Study Area is based on previous studies together with current sampling and mapping during the spring of 1977.

The steep-sided, flat-floored valley containing Cranberry Glades is incised in sandstone and shale. Peat appears to have accumulated on a northwest dipping monocline where the dip sharply decreases. The area is drained down dip. Darlington (1943) suggested lateral erosion as a cause of widening of the Cranberry River system in shale and siltstone of the Bluefield Formation (fig. 18). Because of decrease in dip northwestward, the streams came to grade on the overlying more resistant flaggy Stony Gap Sandstone Member (?).

Figure 18.--Geologic map of Cranberry Glades and vicinity, Cranberry Wilderness Study Area.

A drop in the general ground water table accompanying down cutting of the hard layers of the flaggy Stony Gap Sandstone

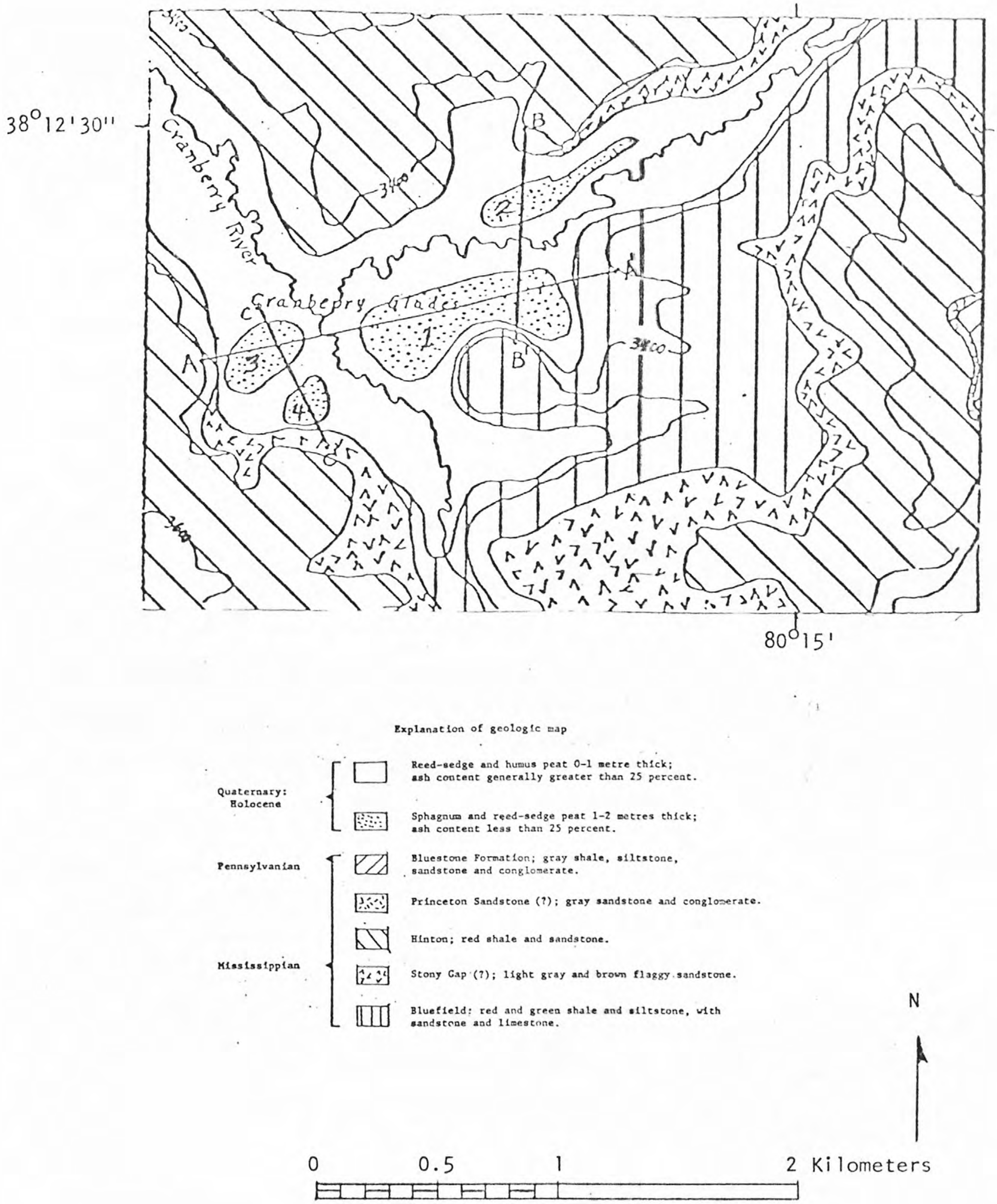

Figure 18. Geologic map of Cranberry Glades and vicinity, Cranberry Wilderness Study Area.

Member (?) just down stream from the glades is suggested by noticeable encroachment of the forest within the past 25 years. Cores of the peat deposits made during the present study show the following sequence from the bottom upward: alluvial silt, light blue-gray pond clay, peaty clay (at least 50 percent ash content), clayey peat (25 to 50 percent ash content), reed-sedge peat containing wood, and finally sphagnum-moss peat. The first peat began to form an estimated 10,000 years ago (Darlington, 1943). It formed in marshes developed on filled-in ponds and depressions behind natural levees. The moss peat developed raised bogs over the marsh surfaces. Note the location of the sphagnum and reed-sedge peat deposits in the interfluves on the geologic map (fig. 18). Profiles (a), (b), and (c) (fig. 19)

Figure 19.--Profiles of peat deposits showing relation to drainage.

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show the stratigraphy of the peat deposits and their positions relative to the modern stream system.

Although the reed-sedge and sphagnum peat reach maximum depths of 1 to 2.5 m in the four major bogs, thicknesses average 0.6 to 1.2 m (table 5). Tonnages range from 2,900 to 43,500

Table 5.--Size, thickness, and tonnages of four major bogs in Cranberry Glades.

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metric tons with a total of 74,200 tons of air-dried peat. A

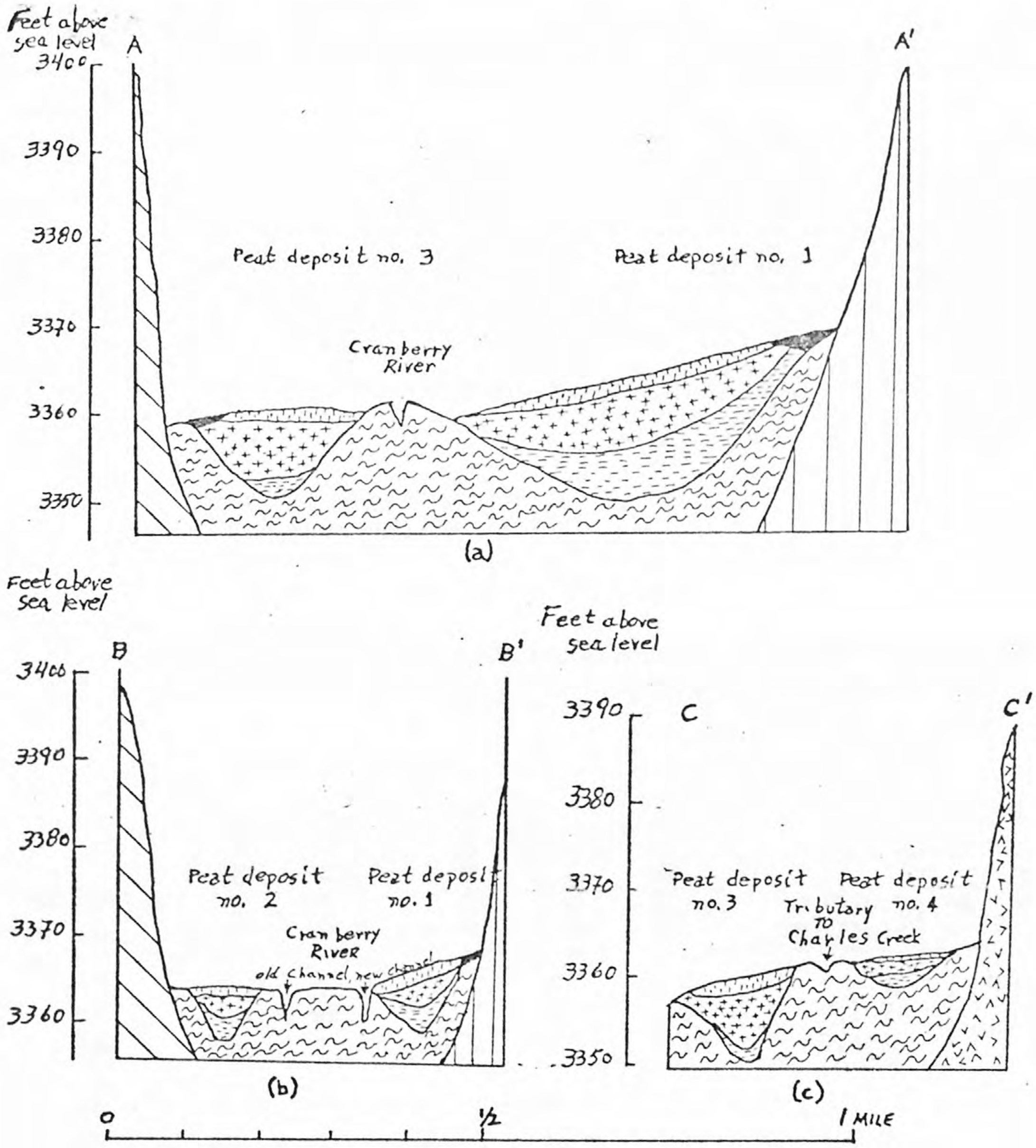

Figure 19 Profiles of peat deposits showing relation to drainage. Locations are shown on map (fig. 18). Deposits occupy abandoned stream channels behind natural levees in which present streams are entrenched.

Profile symbols

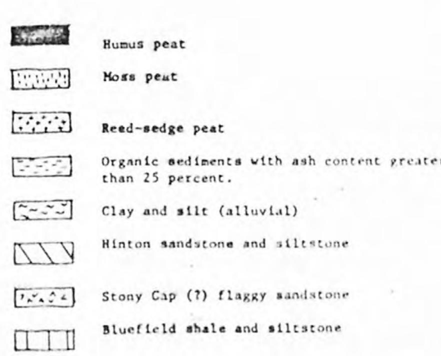

Table 5.--Size, thickness, and tonnages of four major bogs in Cranberry Glades.

Deposit number (see Fig. 18)	Size (Hectares)	Average thickness (meters)	Metric tons (Air-dried peat)
1. Big Glade	24	1.2	43,500
2. Long Glade	8	.6	7,500
3. Round Glade	11	1.2	20,300
4. Flag Glade	3	.6	2,900
		Total	74,200

TABLE 6. - Proximate analysis of peat samples, Cranberry Wilderness Study Area prepared by: Maynard L. Dunn, Jr.

[Analyses by Department of Energy, Division of Solid Fuel Mining and Preparation, Coal Analysis, (formerly U.S. Bureau of Mines, Coal Preparation and Analysis Group), Pittsburgh, Pennsylvania. Symbols used: AR, as received; MF, Moisture free; MAF, Moisture and ash free.]

Bog name and sample number	Condition of sample	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Calorific value (Btu/lb)1/
Round Glade WVC-662	AR	7.8	63.9	20.1	8.2	0.2	8,518
	MF	---	69.4	21.7	8.9	.2	9,242
	MAF	---	76.1	23.9	---	.3	10,141
Flag Glade WVC-661	AR	7.8	51.4	20.9	19.9	.4	7,153
	MF	---	55.7	22.7	21.6	.5	7,755
	MAF	---	71.1	28.9	---	.6	9,894
Big Glade WVC-642	AR	7.5	61.4	21.1	10.0	.3	8,224
	MF	---	66.4	22.8	10.8	.4	8,892
	MAF	---	74.4	25.6	---	.4	9,974
WVC-644	AR	9.7	63.1	23.6	4.6	.3	8,212
	MF	---	69.1	25.8	5.1	.3	8,994
	MAF	---	72.8	27.2	---	.3	9,475
WVC-666	AR	8.2	62.6	23.0	6.2	.3	8,250
	MF	---	68.2	25.1	6.7	.4	8,983
	MAF	---	73.1	26.9	---	.4	9,633
Long Glade WVC-667	AR	7.2	53.1	18.6	21.1	.2	7,377
	MF	---	57.2	20.1	22.7	.2	7,945
	MAF	---	74.0	26.0	---	.3	10,275

1/ Samples were oven-dried; consequently, heating values may be high.

thousand or two additional tons may lie in small scattered basins in Cranberry Valley alluvium mapped (fig. 18) as reed-sedge and humus peat 0 to 1.2 m thick with ash content generally greater than 25 percent.

Six peat samples were taken by the U. S. Bureau of Mines with a soil probe to achieve a balanced distribution of material through the profile. Proximate analyses of these samples (table 6) showed the peat to be of fuel quality having low ash and

Table 6.--Proximate analysis of peat samples, Cranberry Wilderness Study Area.

sulfur content and adequate heating value.

Peat resources in the Cranberry Wilderness Study Area are too small to consider exploiting commercially. Peat mines in the Appalachians of Maryland and Pennsylvania are in deposits generally 1.5 or more meters in average thickness. Unexploited deposits of more than 90,000 tons air-dried peat lie in Canaan Valley, West Virginia to the northeast (Cameron, 1970).

SHALE AND CLAY

Sixteen shale and underclay samples from the Bluefield, Hinton, Bluestone, and New River Formation, and from Quaternary deposits in the study area were subjected to standard preliminary ceramic tests (table 7, plate 4). Tests indicate that all samples except WVC-604 and 641 are suitable for building brick.

Table 7.--Evaluation of shale and clay samples, Cranberry Wilderness Study Area, West Virginia.

Sample WVC-606 is also considered marginally suitable for structural tile and sample 609 for floor brick. Two samples (WVC-609 and 643) expanded during the quick-firing bloating test, but only sample WVC-643 is considered suitable for lightweight aggregate in the short-firing range.

Underclay samples were analyzed for aluminum by atomic absorption (table 8). None of the tested samples showed a high

Table 8.--Analyses of rock samples from the Cranberry Wilderness Study Area.

enough content to be considered as a source of aluminum.

Because of the abundance of shale and clay in the State, these deposits could not compete economically with more readily available material outside the study area.

HIGH-SILICA SANDSTONE

Twelve sandstone and conglomeratic sandstone samples were taken from exposures and drill cores in the study area (plate 4). Analyses show that three samples have a silica (SiO_2) content greater than 90 percent but all have higher percentages of aluminum (Al), iron (Fe), magnesium (Mg), and titanium (Ti) than are considered suitable for high-silica sand (table 8). Locally,

TABLE 7. - Evaluation of shale and clay samples, Cranberry Wilderness Study Area, West Virginia[1/]

Sample number	Sample interval (meters)	Formation[2/]	Raw properties	Temp.[3/] °C	Munsell color	Mohs' hardness	Linear shrinkage (percent)	Absorption (percent)	Apparent porosity (percent)	Bulk density (gm/cc)	Potential use
				Slow firing test							
WVC-602	0.7	Pnr	Water of plasticity: 12.7%	1000	7.5 YR 8/4	3	2.5	13.4	26.3	1.94	Building brick
			Working properties: short	1050	7.5 YR 8/4	3	2.5	13.4	26.1	1.96	
			Drying shrinkage: 2.5%	1100	7.5 YR 7/6	3	2.5	11.3	22.9	2.03	
			Dry strength: fair	1150	7.5 YR 7/6	4	2.5	9.9	20.1	2.03	
			pH: 7.5	1200	7.5 YR 7/6	4	5.0	9.2	19.1	2.07	
			HCl effervescence: none	1250	2.5 Y 7/2	6	5.0	3.5	7.9	2.27	
WVC-604	1.7	Pnr	Water of plasticity: 17.4%	1000	7.5 YR 8/4	2	2.5	16.9	30.4	1.80	None, too soft below 1250°C
			Working properties: short	1050	5 YR 8/4	2	2.5	16.5	29.7	1.80	
			Drying shrinkage: 2.5%	1100	5 YR 7/6	3	2.5	14.5	26.9	1.86	
			Dry strength: poor	1150	5 YR 6/6	3	2.5	13.2	24.8	1.87	
			pH: 7.8	1200	5 YR 6/4	3	5.0	12.2	23.2	1.91	
			HCl effervescence: none	1250*	10 YR 5/2	6	7.5	3.0	6.6	2.24	
WVC-605	1.5	Pnr	Water of plasticity: 13.4%	1000	5 YR 8/4	3	2.5	15.8	29.7	1.88	Building brick
			Working properties: short	1050	5 YR 7/4	3	2.5	15.5	29.1	1.88	
			Drying shrinkage: 2.5%	1100	5 YR 7/6	3	5.0	12.6	24.6	1.96	
			Dry strength: fair	1150	5 YR 6/6	4	5.0	10.8	21.7	2.01	
			pH: 7.6	1200	5 YR 6/4	4	5.0	10.1	20.6	2.05	
			HCl effervescence: none	1250*	2.5 YR 6/2	6	5.0	3.3	7.0	2.14	
WVC-606	2.1	Pnr	Water of plasticity: 16.2%	1000	7.5 YR 9/2	3	5.0	15.4	29.1	1.82	Building brick
			Working properties: plastic	1050	7.5 YR 9/2	3	5.0	15.0	27.4	1.89	Structural tile
			Drying shrinkage: 2.5%	1100	7.5 YR 8/4	3	5.0	12.6	25.0	1.98	
			Dry strength: fair	1150	7.5 YR 8/4	4	5.0	10.4	21.4	2.06	
			pH: 7.5	1200	10 YR 7/4	4	5.0	7.0	14.7	2.09	
			HCl effervescence: none	1250	2.5 YR 7/2	5	5.0	4.8	10.9	2.24	
WVC-609	2.1	Pnr	Water of plasticity: 14.5%	1000	2.5 YR 6/4	3	5.0	29.0	49.0	1.69	Building brick
			Working properties: plastic	1050	2.5 YR 5/4	4	5.0	13.7	27.6	2.01	Floor brick
			Drying shrinkage: 2.5%	1100	2.5 YR 4/4	5	7.5	9.7	21.2	2.18	
			Dry strength: fair	1150	2.5 YR 3/4	5	7.5	7.5	16.7	2.23	
			pH: 7.5	1200	10 R 4/2	6	10.0	5.5	12.7	2.33	
			HCl effervescence: none	1250	10 R 3/1	7	10.0	1.4	3.4	2.38	
WVC-612	9.1	Mh	Water of plasticity: 18.6%	1000	2.5 YR 6/8	3	5.0	19.7	37.0	1.88	Building brick
			Working properties: plastic	1050	2.5 YR 5/8	4	7.5	8.2	17.6	2.16	
			Drying shrinkage: 5.0%	1100	2.5 YR 5/6	5	10.0	3.9	9.2	2.37	
			Dry strength: good	1150	2.5 YR 4/6	5	10.0	2.4	5.7	2.42	
			pH: 5.2	1200	-	-	Melted	-	-	-	
			HCl effervescence: none	1250	-	-	-	-	-	-	
WVC-615	7.6	PMb	Water of plasticity: 16.8%	1000	2.5 YR 6/8	3	5.0	15.8	26.2	1.66	Do.
			Working properties: plastic	1050	2.5 YR 6/8	3	5.0	11.4	23.4	2.06	
			Drying shrinkage: 5.0%	1100	2.5 YR 5/8	4	7.5	7.7	17.1	2.22	
			Dry strength: good	1150	2.5 YR 4/8	5	7.5	5.4	12.4	2.29	
			pH: 5.5	1200	2.5 YR 4/6	6	10.0	4.0	9.4	2.33	
			HCl effervescence: none	1250	2.5 YR 3/2	7	10.0	2.1	5.0	2.33	

TABLE 7. - Evaluation of shale and clay samples, Cranberry Wilderness Study Area, West Virginia[1/] (continued)

Sample number	Sample interval (meters)	Formation[2/]	Raw properties	Slow firing test: Temp.[3/] °C	Munsell color	Mohs' hardness	Linear shrinkage (percent)	Absorption (percent)	Apparent porosity (percent)	Bulk density (gm/cc)	Potential use
WVC-618	0.1	Pnr	Water of plasticity: 17.8%	1000	5 YR 8/4	3	2.5	13.4	25.8	1.93	Building brick
			Working properties: plastic	1050	5 YR 8/4	3	5.0	11.9	24.7	2.08	
			Drying shrinkage: 2.5%	1100	5 YR 7/6	5	5.0	7.2	15.5	2.15	
			Dry strength: good	1150	5 YR 6/6	6	7.5	4.9	10.9	2.22	
			pH: 5.6	1200	2.5 YR 5/4	6.5	10.0	2.4	5.5	2.28	
			HCl effervescence: none	1250	-	-	Melted	-	-	-	
WVC-636	3.0	PMb	Water of plasticity: 15.1%	1000	2.5 YR 6/8	3	2.5	16.6	30.5	1.83	Do.
			Working properties: plastic	1050	2.5 YR 5/8	3	5.0	11.9	24.2	2.03	
			Drying shrinkage: 2.5%	1100	2.5 YR 5/6	4	5.0	7.7	16.7	2.18	
			Dry strength: good	1150	2.5 YR 4/6	5	7.5	5.0	11.2	2.26	
			pH: 6.2	1200	2.5 YR 3/4	6	10.0	2.7	6.3	2.31	
			HCl effervescence: slight	1250	-	-	Melted	-	-	-	
WVC-639	6.1	PMb	Water of plasticity: 14.0%	1000	2.5 YR 6/8	3	2.5	16.6	30.5	1.83	Do.
			Working properties: plastic	1050	2.5 YR 5/8	4	5.0	11.9	24.2	2.03	
			Drying shrinkage: 2.5%	1100	2.5 YR 4/6	4	5.0	7.7	16.7	2.18	
			Dry strength: good	1150	2.5 YR 4/4	5	5.0	5.0	11.2	2.26	
			pH: 6.7	1200	10 R 4/2	6	5.0	2.7	6.3	2.31	
			HCl effervescence: slight	1250	-	-	Melted	-	-	-	
WVC-641	6.1	PMb	Water of plasticity: 13.0%	1000	2.5 YR 5/8	3	2.5	10.7	22.1	2.06	None, short firing range
			Working properties: plastic	1050	2.5 YR 5/8	3	2.5	10.1	21.6	2.13	
			Drying shrinkage: 2.5%	1100	2.5 YR 4/6	4	5.0	5.0	11.2	2.26	
			Dry strength: good	1150	2.5 YR 3/4	6	5.0	1.8	4.2	2.34	
			pH: 7.7	1200	-	-	Melted	-	-	-	
			HCl effervescence: high	1250	-	-	-	-	-	-	
WVC-643	0.3	Q	Water of plasticity: 23.8%	1000	7.5 YR 8/6	3	5.0	18.7	33.1	1.77	Building brick
			Working properties: plastic	1050	7.5 YR 8/6	3	5.0	18.1	32.2	1.78	
			Drying shrinkage: 2.5%	1100	5 YR 6/8	4	7.5	7.4	15.8	2.12	
			Dry strength: good	1150	5 YR 5/6	5	7.5	4.7	10.3	2.19	
			pH: 4.9	1200	5 YR 5/4	6	10.0	2.6	5.8	2.26	
			HCl effervescence: none	1250	-	-	Expanded	-	-	-	
WVC-645	2.4	PMb	Water of plasticity: 13.6%	1000	2.5 YR 6/8	3	2.5	15.6	29.5	1.89	Do.
			Working properties: plastic	1050	2.5 YR 6/8	3	5.0	15.3	29.2	1.91	
			Drying shrinkage: 0%	1100	2.5 YR 5/6	4	5.0	11.3	22.7	2.01	
			Dry strength: fair	1150	2.5 YR 4/4	5	5.0	6.6	14.1	2.15	
			pH: 6.6	1200*	2.5 YR 3/2	6	7.5	1.1	2.6	2.29	
			HCl effervescence: slight	1250	-	-	Melted	-	-	-	
WVC-654	0.8	Pnr	Water of plasticity: 15.7	1000	5 YR 7/6	3	2.5	14.2	27.4	1.93	Do.
			Working properties: short	1050	5 YR 7/6	3	2.5	13.7	26.6	1.95	
			Drying shrinkage: 2.5%	1100	2.5 YR 6/8	4	5.0	7.3	15.8	2.17	
			Dry strength: poor	1150	2.5 YR 5/8	5	5.0	6.2	13.6	2.21	
			pH: 5.7	1200	2.5 YR 5/4	6	7.5	4.3	9.8	2.26	
			HCl effervescence: none	1250	-	-	Melted	-	-	-	

TABLE 7. - Evaluation of shale and clay samples, Cranberry Wilderness Study Area, West Virginia[1/] (continued)

Sample number	Sample interval (meters)	Formation[2/]	Raw properties	Slow firing test: Temp.[3/] °C	Munsell color	Mohs' hardness	Linear shrinkage (percent)	Absorption (percent)	Apparent porosity (percent)	Bulk density (gm/cc)	Potential use
WVC-664	2.4	PMb	Water of plasticity: 17.0%	1000	2.5 YR 6/8	3	5.0	12.2	24.7	2.02	Building brick
			Working properties: plastic	1050	2.5 YR 6/8	3	5.0	11.6	23.7	2.04	
			Drying shrinkage: 5.0%	1100	2.5 YR 5/6	4	7.5	6.3	14.0	2.21	
			Dry strength: fair	1150	2.5 YR 4/6	5	10.0	5.8	12.7	2.21	
			pH: 7.0	1200	10 R 4/4	6	10.0	4.0	9.0	2.25	
			HCl effervescence: slight	1250	-	-	Melted	-	-	-	
WVC-668	1.8	Q	Water of plasticity: 24.9%	1000	5 YR 7/8	3	5.0	29.3	43.6	1.49	Do.
			Working properties: plastic	1050	5 YR 7/8	3	5.0	20.5	34.8	1.70	
			Drying shrinkage: 2.5%	1100	2.5 YR 6/8	4	7.5	18.7	32.0	1.71	
			Dry strength: good	1150	2.5 YR 5/8	4	7.5	11.6	22.4	1.94	
			pH: 4.9	1200	2.5 YR 5/6	4	10.0	8.6	17.2	2.00	
			HCl effervescence: none	1250*	10 YR 4/2	6	10.0	1.3	2.7	2.10	

Preliminary bloating test[4/]

Sample number	Temp. °C	Absorption (percent)	Bulk density (gm/cc)	Bulk density (lb/ft^3)	Remarks	Potential use
WVC-609	1000	10.4	1.75	109.4	Slight expansion	Not suitable for lightweight aggregate
	1050	10.5	1.65	103.2	Slight expansion	
	1100	10.2	1.59	99.2	Good pore structure (sticky)	
	1150	24.9	0.75	46.6	Some large pores (sticky)	
WVC-643	1100	7.8	1.85	115.3	Slight expansion	Marginal for lightweight aggregate
	1150	7.3	1.79	111.4	Good pore structure	
	1200	6.1	1.56	97.2	Good pore structure	
	1250	7.1	0.86	53.7	Some large pores	

1/ Analyses by the U.S. Bureau of Mines, Tuscaloosa Metallurgy Research Center, Tuscaloosa, Alabama. All data presented are based on preliminary laboratory tests and will not suffice for plant or process design.
2/ Pnr--New River Formation; PMb--Bluestone Formation; Mh--Hinton Formation; Q--Quaternary.
3/ Asterisk denotes abrupt vitrification prior to temperature noted.
4/ All samples except WVC-609 and 643 showed negative preliminary bloating test results.

602 - Drill core, medium gray underclay, about 228 meters below surface.
604 - Drill core, medium dark gray flinty underclay, about 92 meters below surface.
605 - Drill core, medium gray underclay, about 208 meters below surface.
606 - Drill core, light gray underclay, about 194 meters below surface.
609 - Outcrop, black carbonaceous shale.
612 - Roadcut, grayish-red shale.
615 - Outcrop, grayish-red shale.
618 - Outcrop, dark gray underclay.
636 - Outcrop, grayish-red shale.
639 - Roadcut, grayish-red and greenish-gray shale.
641 - Roadcut, grayish-red silty shale.
643 - Auger core, light gray underclay, below peat.
645 - Outcrop, medium gray shale.
654 - Roadcut, dark gray underclay.
664 - Roadcut, grayish-red and greenish-gray shale.
668 - Outcrop, light reddish-gray to light gray underclay, below peat.

TABLE 8. - Analyses of rock samples from the Cranberry Wilderness Study Area

[Analyses performed by U.S. Bureau of Mines, Reno Metallurgy Research Center, Reno, Nevada. Samples are random chips every 2 to 10 centimeters through interval noted. Elements tested for spectrographically and detected but less than the lower limit(s) of determination (unless otherwise noted in footnote) include: Ag (.002-.005), As (.006-.02), Au (.001-.004), B (.01-.03), Be (.001), Bi (.06-.5), Cd (.001-.004), Co (.001-.003), Cu (.001), Ga (.001-.002), La (.01-.03), Mo (.002-.007), Na (1-6), Nb (.002-.005), Ni (.001-.003), P (.2-.5), Pb (.03-.1), Pd (.001), Pt (.003-.009), Sb (.03-.1), Sc (.001-.002), Se (.9-3), Sn (.002-.01), Ta (.03-.1), Te (.01-.2), V (.001-.004), W (.04-.1), Y (.005-.01), Zr (.002-.009). All numbers given in percent. Si occurs in all samples greater than the upper detection limit (20-40 percent). A possible error of plus or minus 100 percent of reported concentration is assumed. Symbols used: <, detected but less than lower limit of determination; --, not looked for. The upper and lower limits of determination may vary because of interference corrections.]

Sample number	General spectrographic analyses (percent)												Atomic absorption 1/ (percent)		Neutron activation 1/ (percent)	Radiometric 1/ (percent)	Sample interval (meters)	Sample description
	Al	Ba	Ca	Cr	Fe	K	Li	Mg	Mn	Sr	Ti	Zn	Al_2O_3	Fe_2O_3	SiO_2	U_3O_8		
WVC-601	2	<0.002	<0.1	<0.001	3	<2	<0.001	0.1	0.02	<0.001	0.5	<0.001	--	--	89	0.001	11.7	Sandstone
WVC-602	12	.04	<.1	.005	3	3	.007	1	.01	.001	2	<.001	17	2.8	70.4	--	.7	Underclay
WVC-603	.8	<.002	<.1	<.002	4	<3	<.001	.04	.01	<.001	.2	<.001	1.2	1.4	96.2	.001	3.4	Sandstone
WVC-604	7	.01	<.1	.003	3	4	.006	2	.03	<.001	1	<.001	12.4	3.2	72.9	--	1.6	Underclay
WVC-605	8	.02	<.1	.005	3	4	.006	2	.04	.001	.9	<.001	18	4.3	63.5	--	1.5	Do.
WVC-606	14	.03	<.1	.004	4	<3	.01	1	.04	.001	2	<.001	19.8	4.7	57.6	--	2.1	Underclay
WVC-609	9	.03	<.1	<.004	13	4	<.004	.9	.3	<.001	1	<.001	--	--	--	.002	2.1	Shale-carbonaceous
WVC-612	11	.03	<.2	<.002	6	3	<.002	3	.03	.004	2	.001	18	7.7	--	--	9.1	Shale
WVC-615	14	.02	.2	.005	7	3	.008	2	.06	.002	1	<.001	18.7	7.7	--	--	7.6	Do.
WVC-618	13	.03	<.1	.002	3	6	.008	2	.02	.002	1	<.001	--	--	--	--	.1	Underclay
WVC-628	6	.008	3	<.002	4	<2	<.002	1	.2	.002	.7	<.001	--	--	--	.001	3.6	Sandstone
WVC-629	3	<.002	<.1	<.001	3	<2	<.001	.2	.01	<.001	.6	.001	--	--	--	.001	4.2	Do.
WVC-632	8	.01	<.1	<.001	5	<2	<.001	1	.03	<.001	1	<.001	--	--	--	--	3.6	Do.
WVC-633 2/	6	.004	<.1	<.001	4	<2	<.001	1	.03	<.001	.7	<.001	--	--	--	--	7.6	Do.
WVC-636	8	.02	.3	<.001	5	3	.003	3	.05	<.001	1	<.001	16.1	5.6	--	--	3	Shale
WVC-638	1	<.002	3	<.001	5	<2	<.001	.9	.1	<.001	.3	<.001	3.7	5.8	--	.001	4.2	Conglomerate
WVC-639	9	.02	1	<.004	7	<6	<.004	2	.07	<.001	2	<.001	16.7	8.4	--	--	7.6	Shale
WVC-640	8	.02	1	<.001	4	<2	<.001	1	.06	.001	.9	<.001	--	--	--	--	8.8	Sandstone
WVC-641	13	.02	2	<.004	7	<6	<.004	2	.07	.005	3	<.001	--	--	--	--	6.1	Shale
WVC-643	7	.02	<.1	.003	3	3	.001	2	.02	.004	.9	.01	16.1	3.7	--	--	.3	Underclay
WVC-645	9	.02	2	.002	5	3	.002	2	.09	.002	1	.003	--	--	--	--	2.4	Shale
WVC-646	1	<.002	<.1	<.001	5	2	<.002	.02	.02	<.001	.4	<.001	--	--	--	--	4.6	Sandstone
WVC-647	.6	<.002	<.1	<.001	1	<2	<.001	<.002	.004	<.001	<.3	<.001	1	.95	--	.001	7.9	Sandstone/conglomerate
WVC-654	12	.06	<.3	<.004	8	6	<.004	2	.07	.002	4	<.001	21.8	5.3	60.6	.001	.8	Underclay
WVC-655 3/	.7	<.004	<.2	<.002	4	3	<.002	.04	.06	<.001	<.3	<.001	--	--	--	.001	1.5	Sandstone/conglomerate
WVC-664	6	.02	.4	.004	4	3	.007	2	.05	.002	1	.005	16.6	7.7	--	--	2.4	Shale
WVC-668	5	.02	<.1	.003	3	2	.004	2	.02	.002	.9	.003	12.4	3.7	76.3	--	1.8	Underclay
WVC-671 4/	.3	<.007	<.3	<.004	3	<6	<.004	.02	.04	<.001	<.5	<.001	.74	2.3	96.2	.001	1.2	Sandstone/conglomerate
WVC-673	1	<.002	3	<.001	3	<2	<.001	.7	.1	.007	<.2	.008	2.7	2.3	81.1	.001	1.2	Conglomerate
WVC-674	<.2	<.002	<.1	.001	2	<2	.002	<.002	.01	<.001	<.2	.002	.42	1	97.6	--	1.5	Sandstone/conglomerate
WVC-675	8	.01	<.1	.003	4	<2	<.001	1	.07	.003	.7	.004	11.3	4.7	85.6	--	.4	Underclay

1/ Calculated value from elemental determination.
2/ Contains .02 percent Zr by spectrographic analysis.
3/ Contains .006 percent Ag by spectrographic analysis.
4/ Contains .006 percent Cu by spectrographic analysis.

some sandstones may qualify for low-quality glass sand; the great distance from markets reduces their economic potential.

STONE

Sandstone and conglomeratic sandstone suitable for construction purposes are present in the study area. According to Reger and others (1920, p. 540) attempts to quarry the Princeton (?) conglomerate in the southeastern quarter of Webster County for building blocks were not successful, but it was their opinion that the material seemed well adapted for concrete aggregate. The possibility of commercial development of any of the sandstone units in the study area is low because of abundance of stone throughout the State (Price, 1952, p. 10) and inaccessibility of the area.

The Greenbrier Limestone crops out southeast of the study area and is mined about 7 km to the southeast. This unit is not exposed in the study area, but was encountered in an oil and gas test well at a depth of 451 meters in the western portion of the study area. Because of this depth below the surface and abundance of limestone to the south and southeast, the Greenbrier Limestone is not considered a viable mineral resource in the study area.

Oil and Gas Potential

by

William J. Perry, Jr., U. S. Geological Survey

Exploration drilling (table 9) suggests a remote chance for

Table 9.--Table of test wells drilled for oil and gas near Cranberry Wilderness Study Area.

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gas and virtually no chance for oil in and near the Cranberry Wilderness Study Area.

Only one exploratory well Pocahontas No. 8, (table 9) has been drilled within the study area (fig. 20). This well was

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Figure 20.--Generalized geologic map of Cranberry Wilderness and surrounding area.

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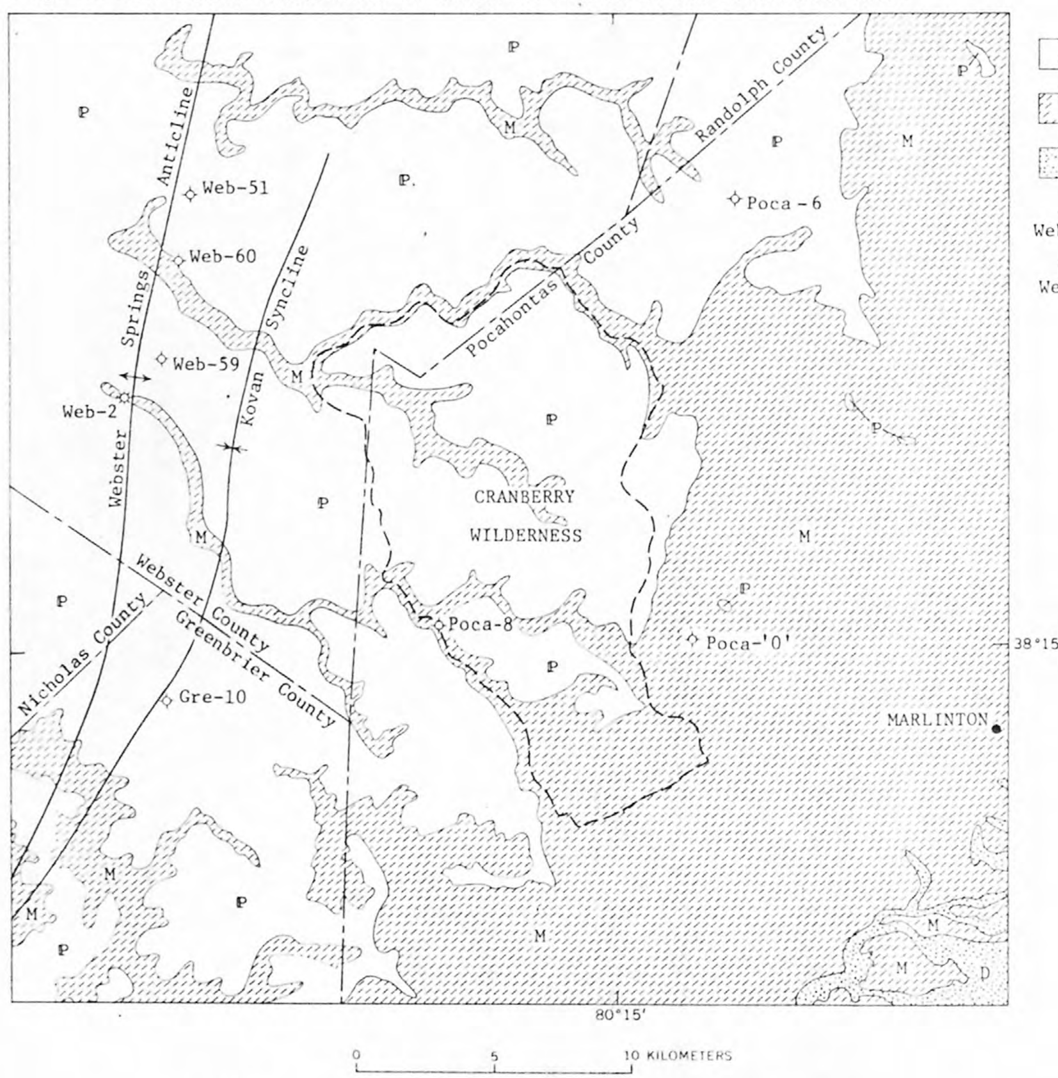
drilled to a depth of 1,289 m and bottomed in Upper Devonian beds. No shows of oil or gas were reported. A second exploratory well (Webster No. 2), drilled 7 km west of the western tip of the study area, encountered numerous shows of gas in Lower Mississippian sandstones as well as a show in the overlying Greenbrier Limestone. This well lies on the crest of the NNE trending Webster Springs anticline which does not cross the wilderness area (fig. 20). The gas in this area was probably structurally trapped, but was not present in sufficient quantities to warrant production. The closest current gas production is in western Webster County, approximately 19 km to

Table 9

TABLE OF TEST WELLS DRILLED FOR OIL OR GAS NEAR CRANBERRY WILDERNESS STUDY AREA

COUNTY AND PERMIT NO.	OPERATOR - LEASEE	ELEVATION (meters)	TOTAL DEPTH (meters)	LITHOLOGIC ZONES OR FORMATIONS (Depths in meters)	REMARKS (meters)
GREENBRIER -10	Columbian Carbon-Cherry River Boom & Lumber Co. #1 (GW-1247)	879 m	1423 m	'Big Lime' (Greenbrier Ls.) 492-626 Sandstone 633-638 "Broken" sandstone (with shale) 638-639 Redbeds 774-775 Benson sandstone 1373-1385	Slight show of gas @ 514 m Show gas @ 1383.5 m in Benson
POCAHONTAS -0 (No permit number) Source: Price (1929, p. 103-104)	Pocahontas Coal and Land Co. #1	1033 m	924 m	Greenbrier Limestone 185-351 Pocono Group 351-446 Hampshire Formation 446-712 "Chemung Series" 712-924 T.D.	oil show? in sandstones of lower Pocono Group
POCAHONTAS -6	Logan Gas Development Co.-Cherry Boom & Lumber Co. #1	1046 m	1373 m	'Big Lime' (Greenbrier Ls.) 367-444 Redbeds 444-446 Sandstone 461-469 Redbeds 675-767 Sandstone 1117-1177	Dry, with salt water
POCAHONTAS -8	Columbian Carbon-Gauley Co. #4 (GW-1269)	978 m	1389 m	Redbeds 365-369 'Big Lime' 451-589 Red sandstone 589-592 Redbeds 592-595	Dry, with salt water @ 501 m
WEBSTER -2	Hope Natural Gas Co.-W. Va. & Pittsburgh R. R. Co. #9227.	768 m	1946 m	Chiefly redbeds 13-232 'Big Lime' 239-419 Redbeds 419-423 Hard sandstone 438-450 Sandstone 636-649 Hard sandstone 701-711 Sandstone 722-728	Show gas @ 291 m Salt water @ 299 m Salt water 341.4 m Show gas @ 444.4 m Show gas @ 645 m Show gas @ 728 m Gas 733 m
WEBSTER -51	Columbian Carbon-Gauley Co. #3 (GW-1267)	823 m	1274 m	'Big Lime' 371-457 Sandstone 457-474 "Broken" sandstone 474-492 Sand 523-537 Sand 566-613 Sand 629-692	Dry, with gas show @ 457 m Salt water @ 595.6 Salt water @ 969 m in "gritty lime"
WEBSTER -59	Consolidated Gas Supply - Mid-Allegheny & W. Va. and Pittsburgh R. R. Co. #11,300	1095 m	2542 m	'Big Lime' Tully Ls. 2422-2426 Huntersville Chert 2447-2495 Oriskany Sandstone 2495-2527 Helderberg Ls. 2527-2542	Dry, with shows of gas in chert and Oriskany.
WEBSTER -60	Consolidated Gas-W. Va. and Pittsburgh R. R. Co. #11,431	828 m	2221 m	"Lime and shells" 386-459 'Big Lime' (?) 459-492 Redbeds 492-634 Sandstone and shale 1215-2153 Huntersville Chert and Onondaga Ls. 2171-2215 Oriskany Sandstone 2215-2221	Dry, with show of gas in chert.

Fig. 20 GENERALIZED GEOLOGIC MAP OF CRANBERRY WILDERNESS AND SURROUNDING AREA



EXPLANATION

- P — Pennsylvanian Age rocks
- M — Mississippian Age rocks
- D — Devonian Age rocks
- Web 51 — Oil & gas test-dryhole
- Web 2 — Oil & gas test-show of gas

Geologic contacts modified from Cardwell and others (1968) the northwest. A very old well, Pocahontas Land Company No. 1 (Poca-'O', fig. 20 and table 9), was drilled 2 km east of the study area. Price and Reger (1929, p. 103-104) questioned the show of oil reported in Lower Pocono Sandstone in this hole. No shows of oil have been subsequently reported in wells in the area during the succeeding 40 years of oil and gas exploration, and furthermore, no oil is anticipated in this area due to the high thermal maturity of the rock.

Shows of gas have been encountered in the Huntersville Chert (Middle Devonian) and underlying Oriskany Sandstone (Lower Devonian) in only two deeper wells west of the study area, Webster No. 59 and No. 60. These formations are unexplored under the study area but it is unlikely that sufficient porosity would be present to warrant deep exploration in the area. Natural gas may be present in the "Benson" or other Upper Devonian sands of the area but none has been found to date. Lower Mississippian natural gas is present to the west, but probably does not extend as far east as the Cranberry Wilderness Study Area based on the results of Pocahontas No. 8.

GEOCHEMICAL SURVEY

by

Frank G. Lesure, U. S. Geological Survey

Reconnaissance geochemical sampling of the Cranberry Wilderness Study Area was done to find indistinct or unexposed mineral deposits that might be recognized by their geochemical halos. No metallic deposits are reported to be in the study area, and none were found during the reconnaissance geologic mapping. The geochemical samples consist of 104 stream sediment, and 100 rock and mineral samples (plate 5).

Most small drainage basins within the study area and some adjacent were sampled by collecting handfuls of the finest sediment possible. The samples were dried and sieved in the laboratory; the minus 80-mesh fraction was used for analyses.

The rock samples are representative of the major rock types exposed in the area. The freshest samples are from core from three diamond drill holes in the northwestern part of the area (plate 5). Other rock samples are from road cuts, coal prospects, and natural outcrops. Samples are mostly composites of several small chips taken from a meter or more of a single rock unit.

All stream sediment and rock samples were analyzed by semiquantitative emission spectrographic methods for 30 elements and chemically for zinc. Equivalent uranium (eU) was determined by instrument. The analytical data are summarized in table 10, and the complete data are given in Motooka and others, 1978.

Table 10.--Range and median values for 26 elements in rock and stream sediment samples from Cranberry Wilderness Study Area, Pocahontas and Webster Counties, West Virginia.

Table 10.--Range and median values for 26 elements in rock and stream sediment samples from the Cranberry Wilderness Study area, Pocahontas and Webster Counties, W. Va. All analyses are by J. M. Motooka using semiquantitative spectrographic methods except zinc, which is by J. D. Sharkey and J. R. Groves using atomic absorption methods and equivalent uranium (eU), which is by J. C. Negri using instrumental methods. Spectrographic analyses are reported to the nearest number in the series 1, 1.5, 2, 3, 5, 7, and 10, which represent approximate midpoints of group data on a geometric scale. The assigned groups for the series will include the quantitative value about 30 percent of the time. Letter symbols: L, detected but below limit of determination (value shown in parenthesis after element symbol); N, not detected; G, greater than. Elements looked for but not found and their lower limits of determination: As(200), Au(20), Bi(10), Cd(20), Sb(100), and W(50).

Elements		Sandstone 59 samples				Shale 39 samples				Stream sediments 104 samples		
Percent		Low	High	Median	Average in sandstone[1,2]	Low	High	Median	Average in shale[2]	Low	High	Median
Ca	(0.05)	N	10	0.05	3.9	L	15	0.2	2.21	L	0.3	L
Fe	(0.05)	0.05	20	2	.98	1.5	10	3	4.72	1	10	3
Mg	(0.02)	0.02	1.5	0.3	.7	0.5	1.5	1.0	1.5	0.1	1.0	0.2
Ti	(0.002)	0.07	1.0	0.3	.15	0.5	0.7	0.5	.46	0.2	0.7	0.5
Elements Parts per Milion												
Ag	(0.5)	N	N	N	0.0X[3]	N	2	N	0.07	N	N	N
B	(10)	10	150	30	20-30	70	150	100	100	50	150	100
Ba	(20)	70	1500	200	300	150	G 5000	300	580	150	700	200
Be	(1)	N	3	1	2	1	3	3	3	L	7	2
Co	(5)	N	30	10	0.3	7	30	20	19	N	70	15
Cr	(10)	L	150	20	10-20	50	100	70	90	15	100	50
Cu	(5)	N	50	5	10-20	5	300	30	45	L	30	15
La	(20)	N	100	N	30	N	50	30	92	N	150	20
Mn	(10)	10	3000	500	500	150	5000	700	850	70	G 5000	1000
Mo	(5)	N	15	N	0.2	N	N	N	2.6	N	N	N
Nb	(20)	N	20	N	0.0X[3]	L	L	L	11	L	20	L
Ni	(5)	N	70	15	2	20	70	50	68	N	70	15
Pb	(10)	N	70	N	9	N	50	20	20	N	30	10
Sc	(5)	N	15	5	1	7	15	15	13	N	15	10
Sn	(10)	N	N	N	0.X[3]	N	N	N	6	N	15	N
Sr	(100)	N	150	N	20	N	300	L	300	N	200	N
V	(10)	15	200	50	10-20	50	200	150	130	30	150	100
Y	(10)	L	70	20	40	20	50	30	26	15	50	20
Zn	(5)	5	150	45	16	25	130	85	95	20	230	70
Zr	(10)	50	G 1000	200	200-250	150	1000	200	160	200	G 1000	300
eU	(20)	L	30	L	-	L	20	L	-	L	20	L

1/ Pettijohn, F. J. (1963, p. S11).

2/ Turekian, K. K., and Wedepohl, K. H. (1961).

3/ Order of magnitude estimated by Turekian and Wedepohl (1961).

Only normal background values of elements tested for were found in most of the rock and stream sediment samples. No metallic mineral deposits of economic importance are known in rocks of these formations in the surrounding area. An extensive sampling of similar rocks in the same general stratigraphic sequence along the New River from Hinton to Gauley Bridge, West Virginia, produced similar analytical results (Lesure and Whitlow, 1977).

A few samples of rock contain high values for some elements. One sample of green mudstone (WVC-139), from a layer 0.3 m thick enclosed in a thicker unit of red mudstone, contains 300 ppm copper and 2 ppm silver. The combination of Ag and Cu is a common association in some red bed sequences (Lesure, Motooka, and Weis, 1977, p. 613). Another sample of mottled green and red mudstone (WVC-161) 5 cm thick, contains more than 5000 ppm barium. These samples suggest the possibility of stratabound metallic deposits in this red bed sequence, but none has yet been found. Only a small part of the red bed sequence is exposed along the northeastern edge of the study area and along the southern margin.

A few rocks contained minor amounts of iron sulfides, but only two samples were collected. WVC-149 is a composite of thin pyrite concretions and seams along a bedding plane in gray shale; WVC-167 is a composite of pyrite concretions and replacement of crinoid (?) fossils in micaceous sandstone. WVC-149 contains 5 ppm Ag, 1000 ppm As, 1000 ppm Ba, 500 ppm Co, 150 ppm Cu, 20 ppm Mo, 300 ppm Ni and 100 ppm Pb. All are higher values than normal in sedimentary rocks, but not unusual for sedimentary sulfide concretions. WVC-167 has 1500 ppm Ba and only background values for other elements. The pyrite concretions are scattered along certain bedding planes or in certain beds and do not represent enough material to be considered economically important.

REFERENCES CITED

Abernethy, R. F., Peterson, M. J., and Gibson, F. H., 1969, Spectrochemical analyses of coal ash for trace elements: U.S. Bur. Mines Rept. Inv. 7281, 30 p.

Arkle, Thomas, Jr., and Hunter, R. G., 1957, Sandstones of West Virginia: W. Va. Geol. and Econ. Survey Rept. Inv. 16, 58 p.

Barlow, J. A., 1974, Coal and Coal Mining in West Virginia: W. Va. Geol. and Econ. Survey, Coal Geol. Bull. 2, 63 p.

Cameron, C. C., 1970, Peat resources of the unglaciated uplands along the Allegheny Structural Front in West Virginia, Maryland, and Pennsylvania: U. S. Geol. Survey Prof. Paper 700-D, p. D-153-D161.

____________ 1972, Diagenesis and quality of peat deposits: Proceedings of the 4th International Peat Congress; Helsinki, Finland, v. 1, Survey, classification, study, and conservation of peatlands, p. 233-245.

Cardwell, D. H., Erwin, R. B., and Woodward, H. P, 1968, Geologic map of West Virginia: W. Va. Geol. Survey, 2 sheets.

Core, E. L., 1955, Cranberry Glades Natural Area: Wild Flower, no. 31, p. 65-81.

Darlington, H. C., 1943, Vegetation and substrata of Cranberry Glades, West Virginia: Bot. Gaz., v. 104, no. 3, p. 371-393.

Lesure, F. G., Motooka, J. M., and Weis, P. L., 1977, Exploration geochemical studies of some sandstone copper-uranium deposits, Bradford, Columbia, and Lycoming Counties, Pennsylvania: U. S. Geol. Survey Jour. Research, v. 5, no. 5, p. 609-621.

Lesure, F. G. and Whitlow, J. W., 1977, Geochemical sample localities map and distribution of cobalt, chromium, and nickel, New River Gorge area, Fayette, Raleigh and Summers Counties, West Virginia, in Englund and others 1977, Mineral Resource, geological, and geophysical maps of New River Gorge area, Fayette, Raleigh, and Summers Counties, West Virginia: U. S. Geol. Survey open-file report, OF 77-76, Map I.

McCue, J. B., and others, 1948, Clays of West Virginia: W. Va. Geol. and Econ. Survey, v. XVIII, 234 p.

Motooka, J. M., Negri, J. C., Sharkey, J. D., and Lesure, F.G., 1978, Analyses and description of geochemical samples, Cranberry Wilderness Study Area, Pocahontas and Webster Counties, West Virginia: U. S. Geol. Survey, open-file report, OF 78-215, 23 p.

Pettijohn, F. J., 1963, Chapter 5. Chemical composition of sandstones--excluding carbonate and volcanic sands, in Fleischer, Michael, ed., Data of geochemistry 6th ed: U. S. Geol. Survey Prof. Paper 440-S, 21 p.

Price, P. H., 1952, Natural resources of West Virginia: W. Va. Geol. and Econ. Survey Spec. Pub., 17 p.

Price, P. H., and Reger, D. B., 1929, Pocahontas County: W. Va. Geol. Survey, (County Rept.), 531 p.

Reger, D. B., Tucker, R. C., and Buchanan, Margaret, 1920, Webster County and portion of Mingo District, Randolph County, south of Valley Fork of Elk River: W. Va. Geol. Survey (County Rept.), 682 p.

Swanson, V. E., Medlin, J. H., Hatch, J. R., Coleman, S. L., Wood, G. H., Jr., Woodruff, S. D., and Hildebrand, R. T., 1976, Collection, Chemical analyses, and evaluation of coal samples in 1975: U. S. Geol. Survey open-file report 76-468, 503 p.

Tallon, W. A., and Hunter, R. G., 1959, High alumina clays of West Virginia: W. Va. Geol. and Econ. Survey Rept. Inv. 17, 49 p.

Turekian, K. K., and Wedepohl, K. H., 1961, Distribution of the elements in some major units of the earth's crust: Geol. Soc. America Bull., v. 72, no. 2, p. 175-191.

U. S. Bureau of Mines and U. S. Geological Survey, 1976, Coal resource classification system of the U. S. Bureau of Mines and U. S. Geological Survey: U. S. Geol. Survey Bull. 1450-B, 7 p.

U. S. Forest Service, 1975, Coal Evaluation Study Monongahela National Forest: Forest Service, Eastern Region, U. S. Dept. of Agriculture, unpublished report, 45 p.