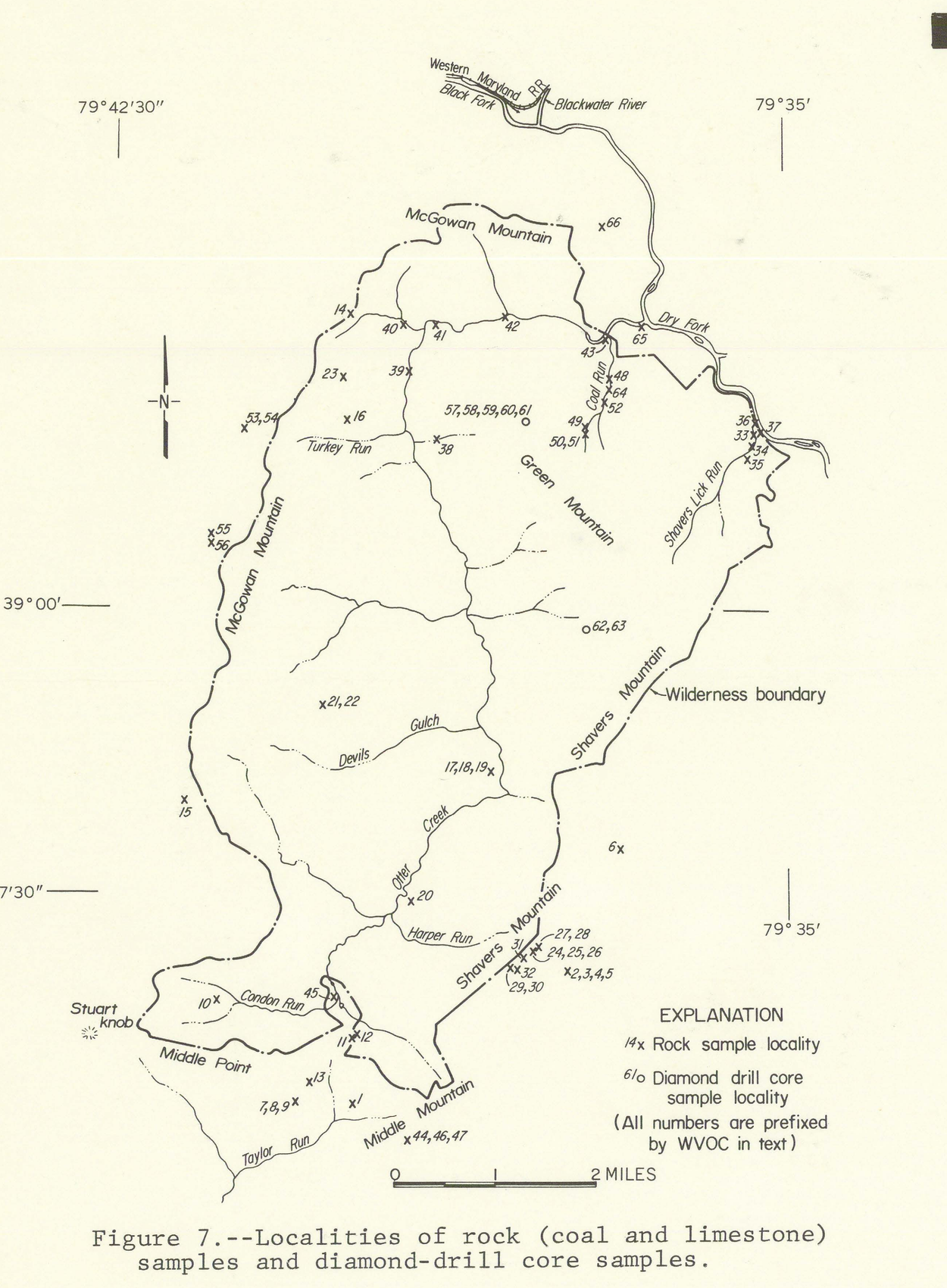


Figure 7.--Localities of rock (coal and limestone) samples and diamond-drill core samples.

EXPLANATION

28 Coal thickness line--Approximately located, interval 14 in., dashed where eroded

Approximate coalbed outcrop-Hachures toward coal

Reserve base area

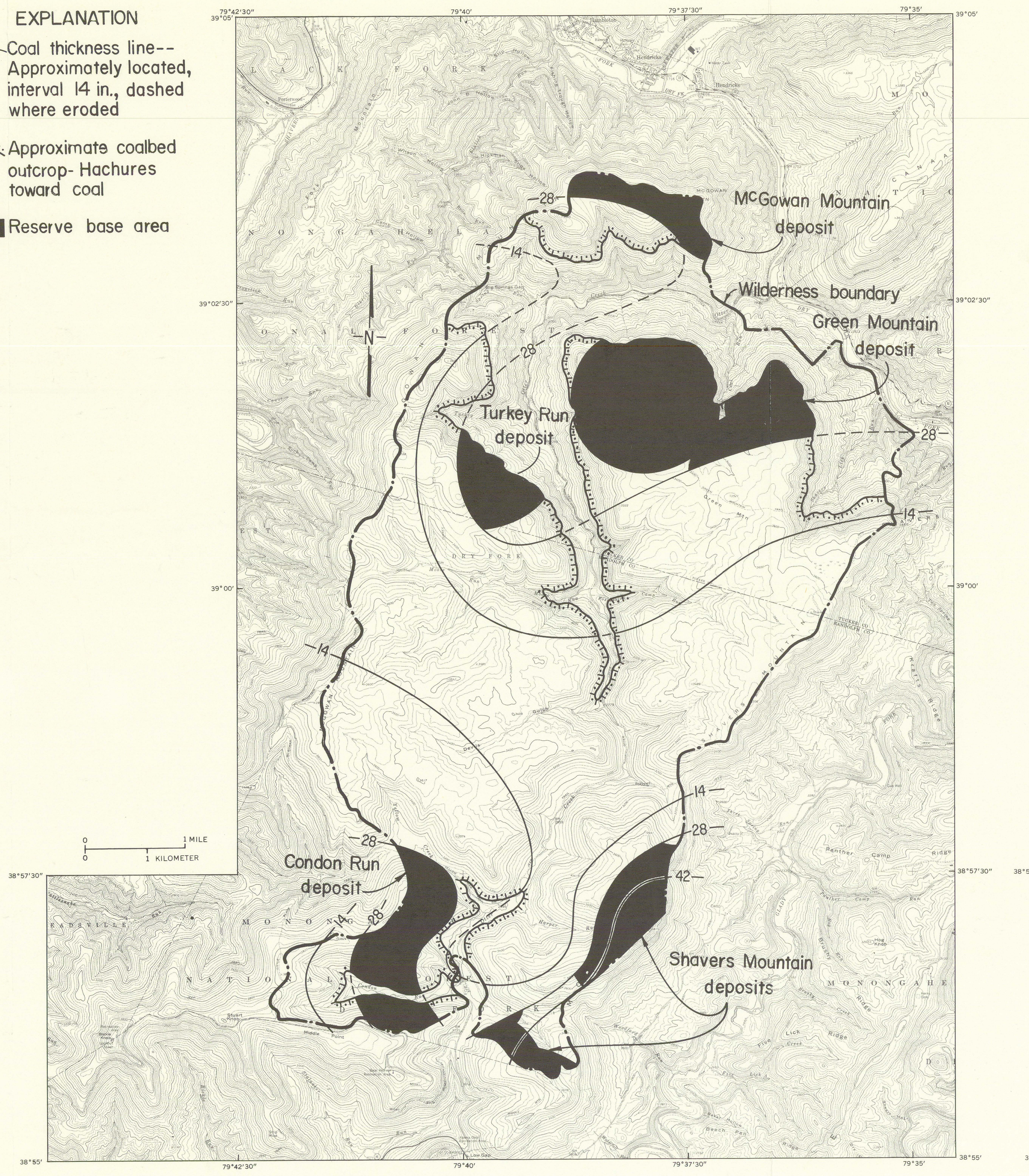


Figure 8.--Sewell(?) coal bed reserve base area.

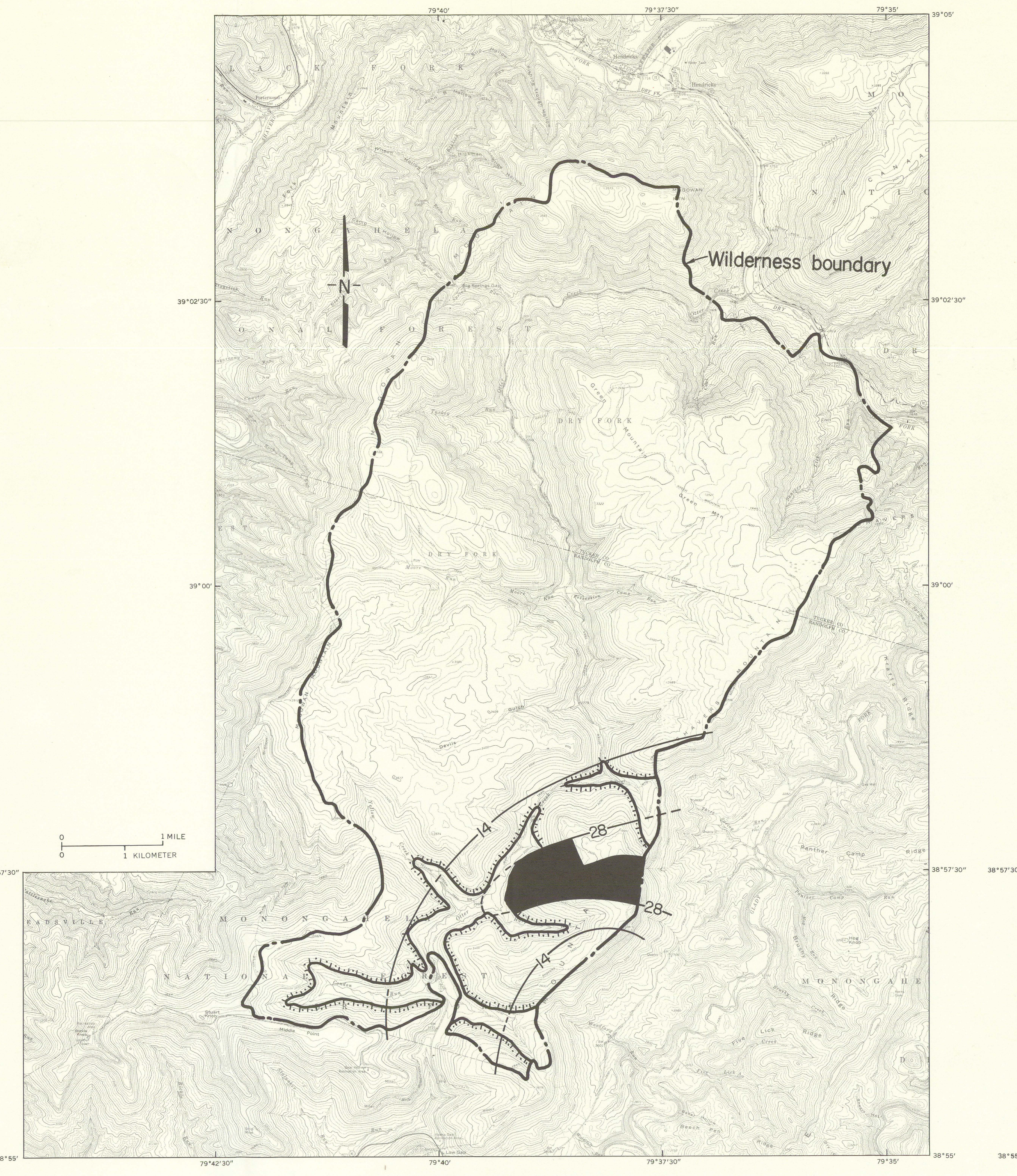


Figure 9.--Sewell(?) rider coal bed reserve base area.

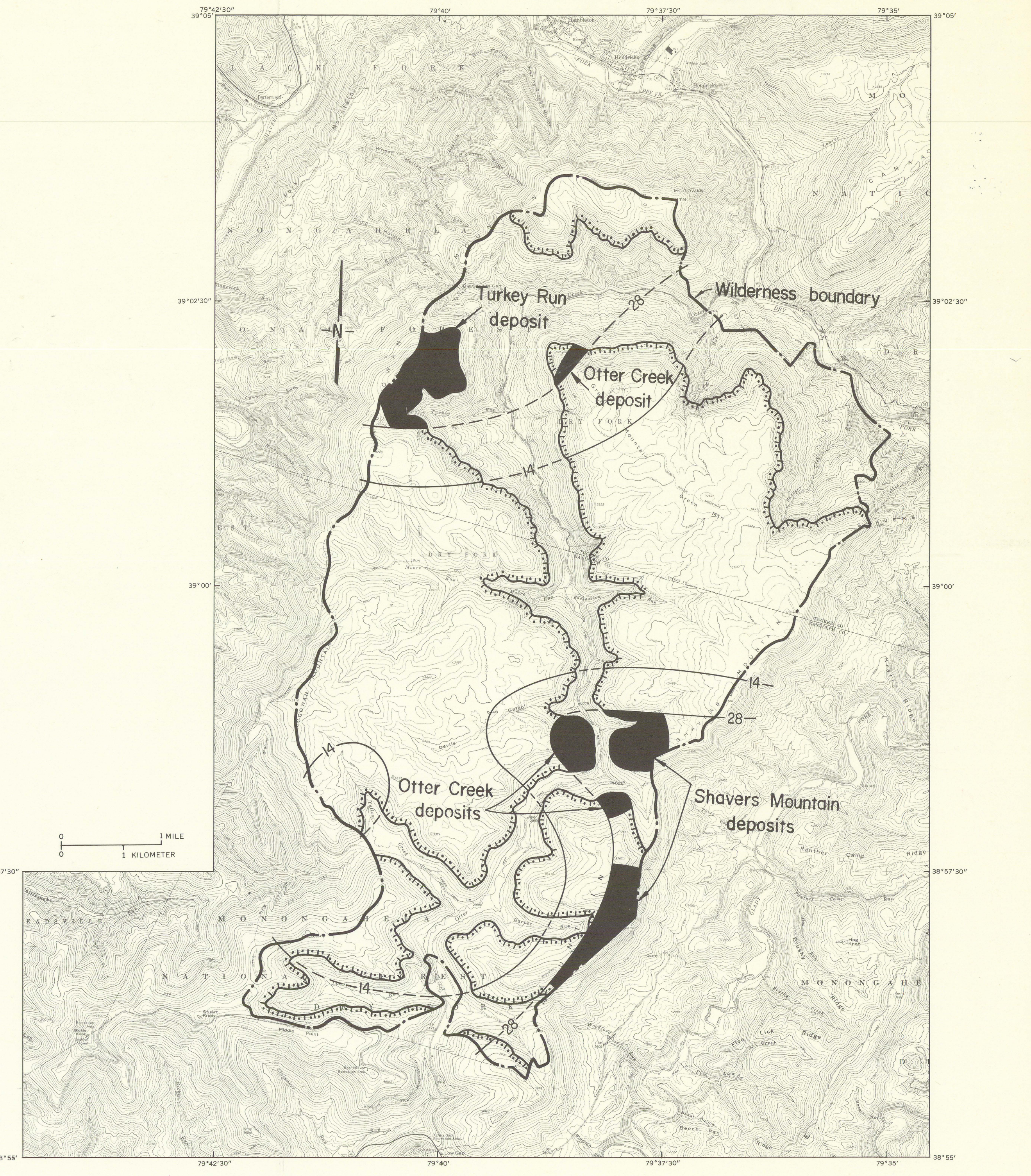
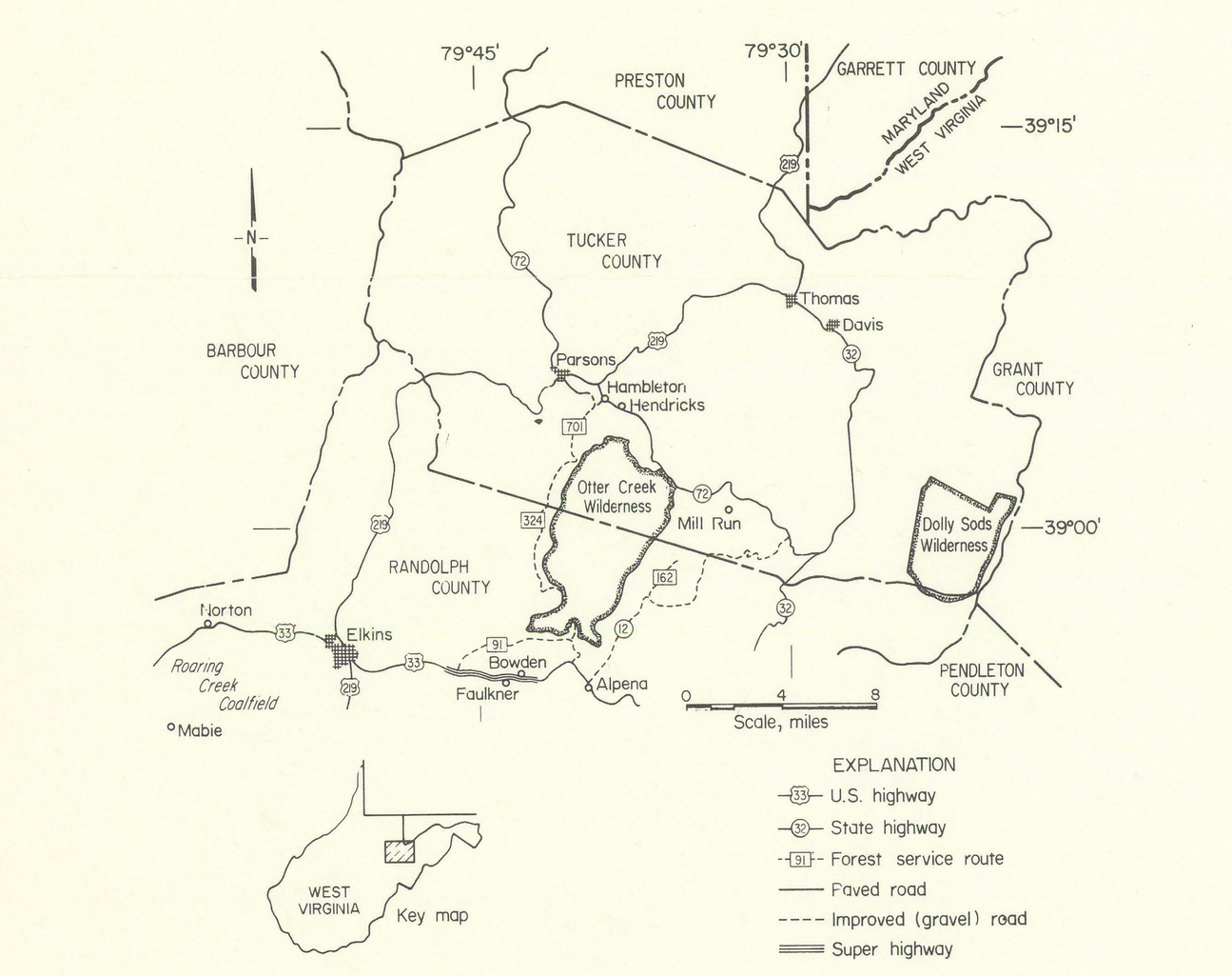


Figure 10.--C-1 coal bed reserve base area.

Table 3.--*Summary of estimated coal reserve base, Otter Creek Wilderness, West Virginia, as of April 28, 1979*

Coal bed	Acres of coal 28 inches or more thick	Reserve base (thousands of short tons) Measured	Indicated	Total[1]
C-2--------------	688	496	2,430	2,930
C-1--------------	977	954	2,690	3,650
Sewell(?) rider--	394	278	1,380	1,660
Sewell(?)--------	3,231	2,800	13,000	15,800
Total tonnage--		4,530	19,500	24,000

[1] Numbers may not total due to independent rounding.



INDEX MAP

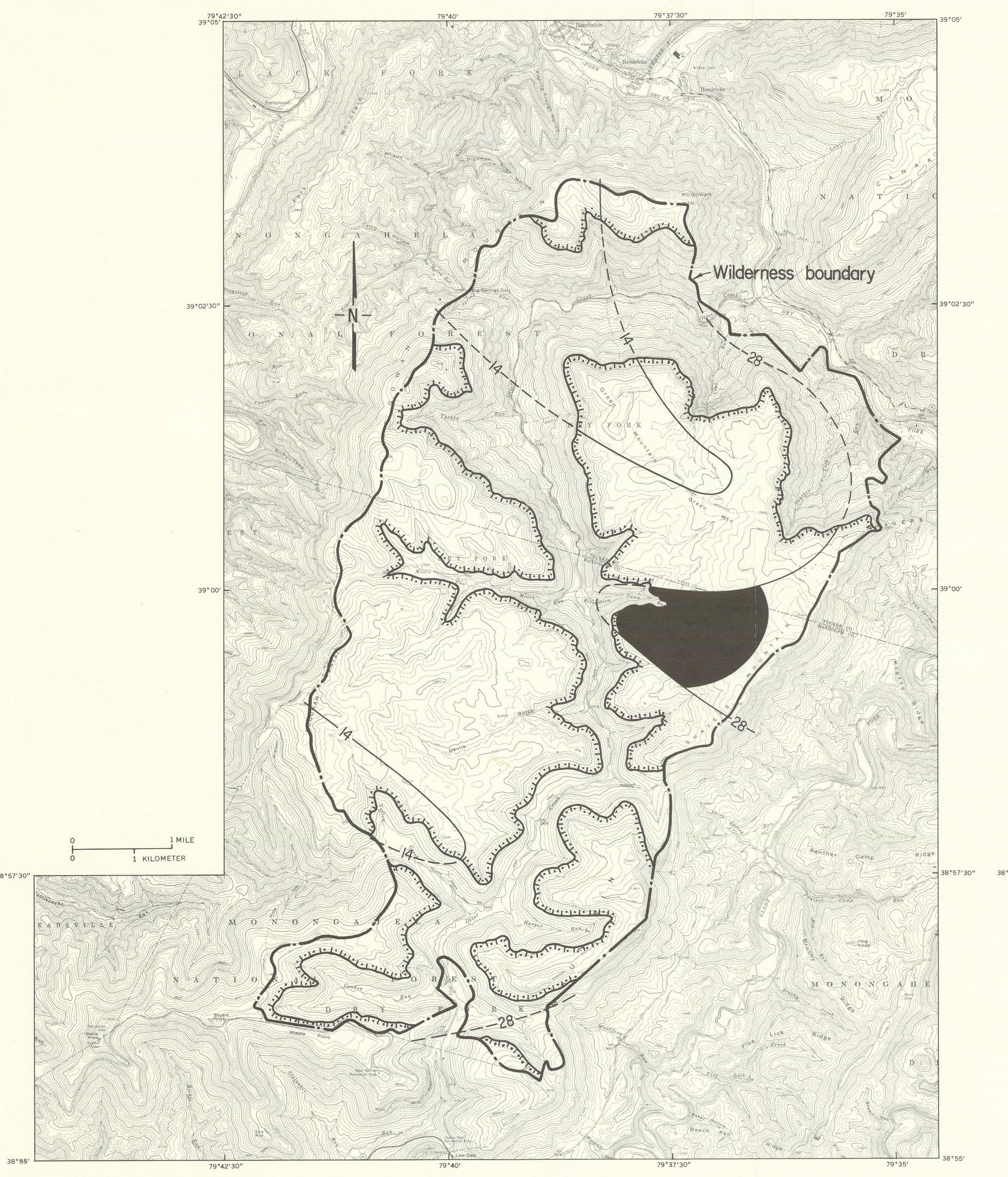


Figure 11.--C-2 coal zone reserve base area.

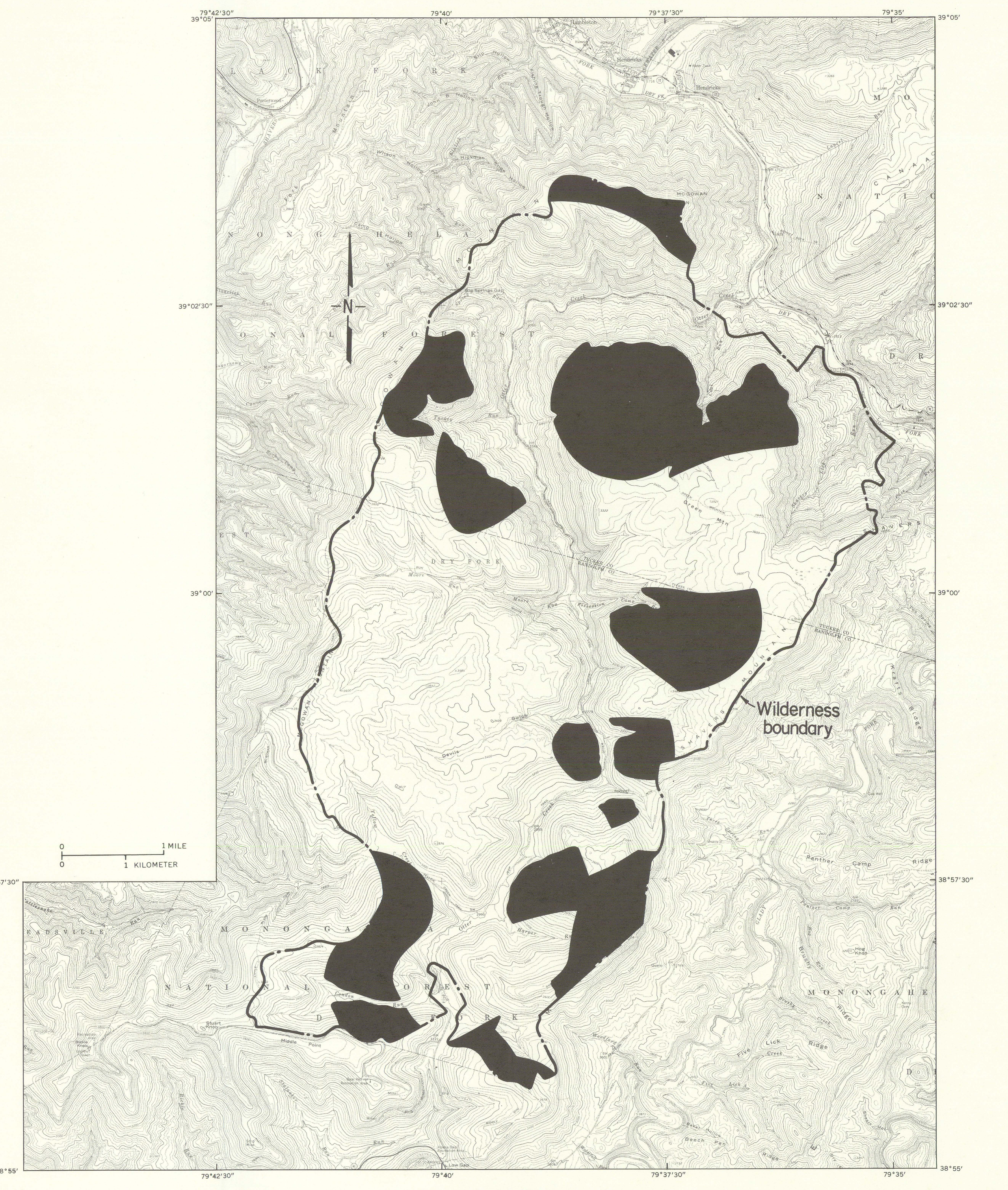
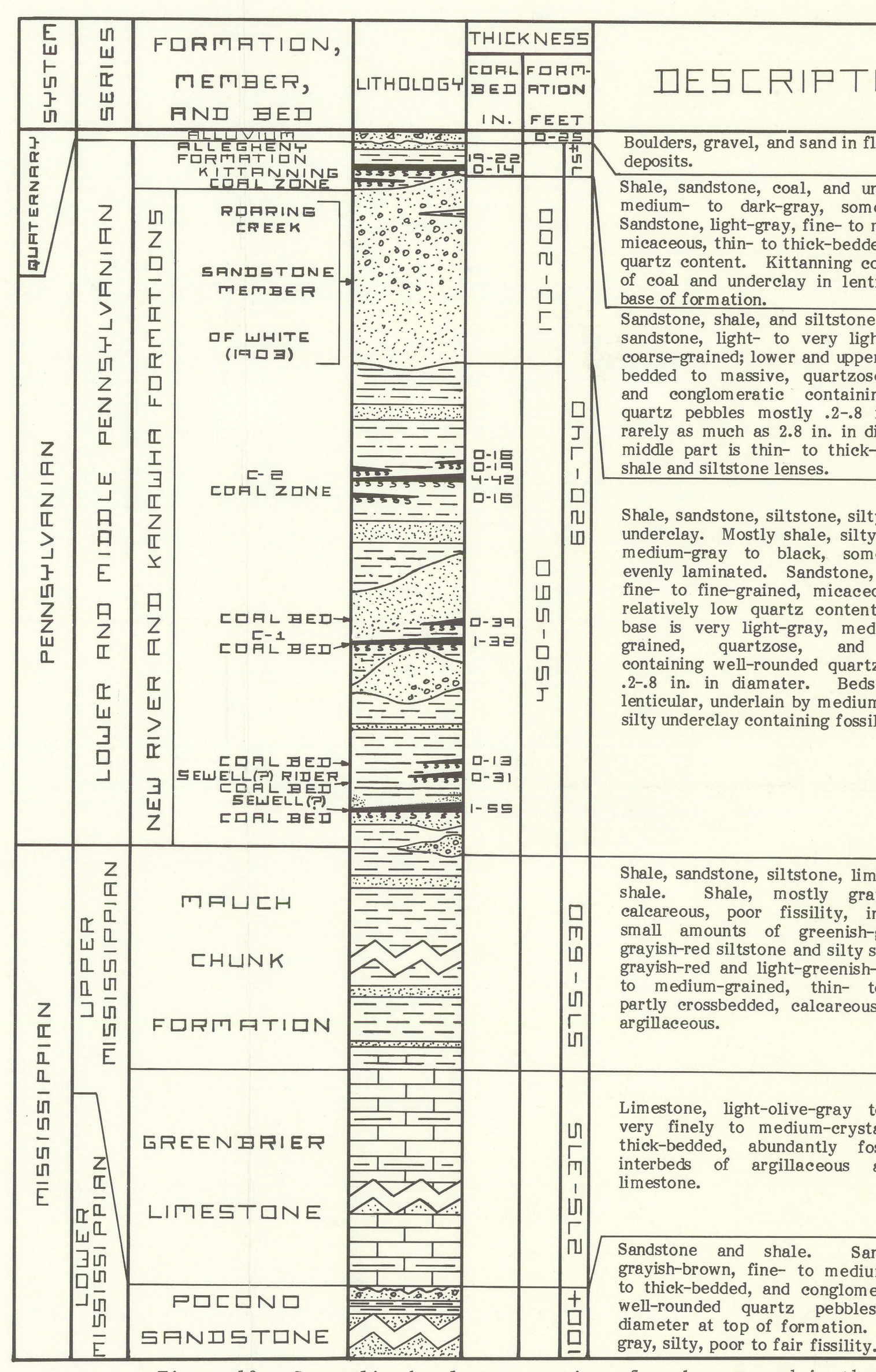


Figure 12.--Composite reserve base area.


SYSTEM
SERIES
FORMATION, MEMBER, AND BED
LITHOLOGY
THICKNESS
COAL BED IN.
FORMATION FEET
DESCRIPTION
QUATERNARY
PENNSYLVANIAN
LOWER AND MIDDLE PENNSYLVANIAN
NEW RIVER AND KANAWHA FORMATIONS
MISSISSIPPIAN
UPPER MISSISSIPPIAN
LOWER MISSISSIPPIAN
ALLUVIUM
ALLEGHENY FORMATION
KITTANNING COAL ZONE
ROARING CREEK
SANDSTONE MEMBER
OF WHITE (1903)
C-2 COAL ZONE
COAL BED
C-1 COAL BED
COAL BED
SEWELL(?) RIDER COAL BED
SEWELL(?) COAL BED
MAUCH CHUNK FORMATION
GREENBRIER LIMESTONE
POCONO SANDSTONE
0-25
19-22
0-14
75±
170-200
0-16
0-19
4-42
0-16
620-740
0-39
1-32
450-560
0-13
0-31
1-55
575-630
275-375
100+
Boulders, gravel, and sand in flood-plain and deposits.
Shale, sandstone, coal, and underclay. Shale, medium- to dark-gray, some carbonaceous. Sandstone, light-gray, fine- to medium-grained, micaceous, thin- to thick-bedded; relatively low quartz content. Kittanning coal zone consists of coal and underclay in lenticular beds near base of formation.
Sandstone, shale, and siltstone. Predominantly sandstone, light- to very light-gray, fine- to coarse-grained; lower and upper parts are thick-bedded to massive, quartzose, cliff-forming, and conglomeratic containing well-rounded quartz pebbles mostly .2-.8 in. in diameter, rarely as much as 2.8 in. in diameter. Upper middle part is thin- to thick-bedded, includes shale and siltstone lenses.
Shale, sandstone, siltstone, silty shale, coal, and underclay. Mostly shale, silty shale, siltstone; medium-gray to black, some carbonaceous, evenly laminated. Sandstone, light-gray, very fine- to fine-grained, micaceous, thin-bedded, relatively low quartz content. Sandstone near base is very light-gray, medium- to coarse-grained, quartzose, and conglomeratic containing well-rounded quartz pebbles mostly .2-.8 in. in diamater. Beds of coal, many lenticular, underlain by medium-gray, plastic or silty underclay containing fossil rootlets.
Shale, sandstone, siltstone, limestone, and silty shale. Shale, mostly grayish-red, partly calcareous, poor fissility, interbedded with small amounts of greenish-gray shale and grayish-red siltstone and silty shale. Sandstone, grayish-red and light-greenish-gray, very fine- to medium-grained, thin- to thick-bedded, partly crossbedded, calcareous, micaeous, and argillaceous.
Limestone, light-olive-gray to medium-gray, very finely to medium-crystalline, generally thick-bedded, abundantly fossiliferous; few interbeds of argillaceous and arenaceous limestone.
Sandstone and shale. Sandstone, mostly grayish-brown, fine- to medium-grained, thin- to thick-bedded, and conglomeratic containing well-rounded quartz pebbles .2-.4 in. in diameter at top of formation. Shale, medium-gray, silty, poor to fair fissility.
Figure 13.--Generalized columnar section of rocks exposed in the Otter Creek Wilderness. (from Warlow, 1981)

COAL RESERVE BASE

Economic deposits of coal tentatively ranked as medium-volatile bituminous occur in the Early to Middle Pennsylvanian Kanawha and New River Formations, undivided. Subeconomic deposits of medium-volatile bituminous coal are found in the Middle Pennsylvanian Allegheny Formation. These formations are preserved in the trough of the North Potomac syncline as a remnant of a sequence which was once continuous with the Pennsylvanian rocks to the west in the Appalachian Plateau. Otter Creek Wilderness occupies a part of this syncline in the central part of the Appalachian fold belt. Rocks in the wilderness dip moderately from 3° to 13° toward the axis of the syncline. No evidence of faulting was found.

Analyses indicate that most of the minable coal has low sulfur content and moderate ash content and is chemically suitable for marginal to premium-grade coking coal or compliance steam coal (less than 1.0 percent sulfur).

Coal beds that have been tentatively identified in the wilderness are the Sewell(?), Sewell(?) rider, and Kittanning coal zone. Identification was based on correlation of these beds with those tentatively identified in the Roaring Creek coal field (Englund, 1969). Two beds, termed the C-1 coal bed and the C-2 coal zone, have not been correlated with beds outside the wilderness. All these beds, except the Kittanning coal zone, contain coal of thickness suitable for mining by underground methods.

Several minor coal beds found during the investigation are not presently minable; because of a lack of information on their areal extent, no reserve base was determined for the beds.

The demonstrated reserve base for coal within the wilderness is 24 million short tons (table 3).

Available information indicates that about 60 percent of the coal reserve base would be accessible by driving drift entries into coal blocks from private or U.S. Government land outside the wilderness.

COAL EVALUATION PROCEDURE

To evaluate the coal resources of Otter Creek Wilderness, an attempt was made to locate and reopen all known mines and prospects in and near the wilderness (Behum and Mory, 1981). Many of the early prospects are caved and their locations are uncertain. U.S. Bureau of Mines personnel located and examined seven mines, two prospects, and seven coal exposures in the wilderness (fig. 7). In addition, eight inactive mines, 13 prospects, and three exposures outside the wilderness were investigated.

The degree of geologic control and distance from measured data points dictate the category in which coal resources are placed. Data points established during this investigation, published information, and unpublished U.S. Forest Service data were used to estimate the coal resources in the wilderness. This information was substantiated where possible by geologic inferences and reports from prospectors. The measured category of coal is projected to extend 0.25 mi from a measured data point; indicated coal extends in a belt from more than 0.25 mi to 0.75 mi from a measured point; inferred coal is projected to extend in a belt from more than 0.75 to 3 mi from a measured point (U.S. Bureau of Mines and U.S. Geological Survey, 1976).

Measured, indicated, and inferred resource areas were divided into thickness categories of 14-28 in., 28-42 in., and greater than 42 in. No resources were determined for coal less than 14 in. thick.

The reserve base constitutes that portion of the resources in the measured and indicated (demonstrated) categories at least 28 in. thick, that is considered minable by present underground methods. Only clean coal was considered in this thickness, except for the C-1 coal bed in which bony coal partings were included for determination of the extent of minable coal. Three mining operations in the wilderness have included these bony coal portions of the C-1 coal bed during mining. Reserve base maps (figs. 8-12) were adapted from individual bed maps (sheet 1, figs. 1-5). Because mining operations in or near the wilderness generally operated for only short periods of time, coal tonnage removed is considered negligible. Commercial mines south of Otter Creek Wilderness are not believed to have significant development in the wilderness.

During the field investigation, Bureau of Mines personnel collected 20 channel samples from adit entrances, prospect trenches, and outcrops (fig. 7). An attempt was made to penetrate the coal bed at least 1 ft to lessen the effects of weathering on analytical results. Coal analyses from this investigation are of weathered coal from outcrops, prospect trenches, and adit entrances. The samples were all oxidized and contained considerable moisture adhering to coal surfaces. Weathering drastically lowers free-swelling index and heating value and increases oxygen content in the ultimate analyses. Some coal analyses reported by others (Reger and others, 1923; Reger, 1931; U.S. Forest Service, 1975) are of less weathered samples from fresh exposures in prospect trenches or adits and from drill core. On the basis of reported analyses, coal in the Wilderness and vicinity can be tentatively ranked as medium-volatile bituminous.

Coals in this region are generally suitable for the manufacture of metallurgical coke (Wolfson and Ortuglio, 1969; Ortuglio and others, 1975; Sanner and Benson, 1979). Samples from this and other studies indicate that some of the raw coal within the wilderness has an ash and sulfur content within at least marginal grade coking coal quality, containing not more than 12 percent ash and 1.0 percent sulfur. Most of the raw coal would also be suitable for compliance steam coal, containing less than 1.0 percent sulfur.

Spectrographic analysis of raw coal and coal ash samples was conducted by U.S Bureau of Mines and U.S. Geological Survey laboratories.

Analyses of coal ash samples indicate that germanium is the only anomalous element in the wilderness area coal beds. Slightly anomalous values (greater than 0.04 percent GeO_2) were found sporadically in all mappable coal beds. However, germanium is not presently recovered from coal. Mercury was found by means of spectrographic analyses to be between 0.01 and 1 part per million (ppm) in all raw coal samples. Spectrographic and neutron activation analyses of the raw coal and coal ash found only minor amounts of fluorine. U.S. Bureau of Mines radiometric analyses of raw coal samples showed no U_3O_8 or ThO_2 above the lower detection limits of 0.001 and 0.002 percent, respectively.

Spectrograhic analyses of raw coal by the U.S. Geological Survey (Warlow and others, 1981) found thorium concentrations ranging from less than 3 ppm to 13 ppm and uranium ranging from 0.8 to 6.2 ppm; mercury in raw coal ranged from less than 0.01 ppm to 0.64 ppm.

Sewell(?) Coal Bed

Resources---------------- 36,900,000 short tons
Reserve base------------- 15,800,000 short tons

The Sewell(?) coal bed has the greatest potential for mining in the area because of the large reserve base blocks (fig. 8). Thickness of the bed ranges from 0 to 56 in. Minable coal in the McGowan Mountain deposit is accessible from outside the wilderness. Based on available information, minable blocks in the Green Mountain and Turkey Run deposits are only accessible from inside the wilderness. Sewell(?) coal in the Shavers Mountain deposit is probably recoverable from private land east of the wilderness, but mining would be difficult because it would extend down a 10 percent grade. The Shavers Mountain deposits may also be accessible by mining along the strike of the bed from Middle Mountain strip mine benches. Reserve base blocks in the Condon Run deposit can probably be mined from outside the wilderness from a strip mine bench on Middle Point, or possibly from adits northeast of Stuart Knob, south of the southern terminus of U.S. Forest Service Route 324.

Sewell(?) coal bed samples taken during this and previous investigations consistently have low sulfur content (less than 1.0 percent) where the coal is of minable thickness. Higher sulfur values were detected in some drill-hole samples from the central part of the area where the Sewell(?) coal bed is thin. Ash values are low where the bed is of minable thickness, becoming slightly higher to the north. Generally, raw coal from the Sewell(?) coal bed meets marginal to premium coking coal criteria for ash and sulfur content (less than 1.8 and 1.0 percent sulfur and less than 12 and 8 percent ash, respectively).

Washability tests (Deurbrouck, 1966) on samples from a mine near the wilderness indicate that some of this coal can be cleaned to meet premium-grade coking coal criteria. Although free-swelling indexes of most samples collected during the study are low due to weathering, one less weathered sample was found to have an index of 6.5, supporting the usability of this coal for coke production. The Sewell(?) coal could also be utilized as high-heating-value, compliance steam coal.

Sewell(?) Rider Coal Bed

Resources------------- 5,995,000 short tons
Reserve base---------- 1,660,000 short tons

The Sewell(?) rider coal bed occurs 72 ft above the Sewell(?) coal bed (fig. 13) and ranges in thickness from 0 to 31 in. in the study area. It attains sufficient thickness in the southern part of the area to constitute a considerable reserve base block (fig. 9).

Minable deposits of the Sewell(?) rider coal bed may be accessible from along Otter Creek or possibly from private land on Shavers Mountain. More prospecting would be required to verify the latter approach.

Analyses indicate that most Sewell(?) rider coal of minable thickness may be suitable for use as marginal to premium-grade coking coal. Sulfur content is low; 0.5 percent or less was found in raw coal. Localities where the coal bed contains interlayered shale, such as WVOC-24 (fig. 7), have a high ash content (21.6 percent as received), but cleaning would probably eliminate much of the shale impurities.

C-1 Coal Bed

Resources------------------ 15,680,000 short tons
Reserve base--------------- 3,650,000 short tons

The C-1 coal bed occurs about 210 ft above the Sewell(?) coal bed (fig. 13) and ranges in thickness from 0 to 35 in.

The Shavers Mountain deposit of the C-1 coal bed (fig. 10) is accessible from outside the wilderness, whereas the small blocks in the Otter Creek deposit on McGowan Mountain can be reached by driving entries into the outcrop along Otter Creek. The deposit north of Turkey Run would ideally be mined from adits near the previous mines and prospects above the Turkey Run Road (U.S. Forest Service Route 1331.2), but could possibly be reached by drift entires off U.S. Forest Service Route 324 outside the wilderness (see index map, sheet 1).

Analyses of sample WVOC-16 (fig. 7) from this coal bed show the upper bench to be of good quality (11.7 percent ash and 0.5 percent sulfur), but lower parts of this bed were below water and could not be sampled. Samples from mines at sample localities WVOC-17 through WVOC-19 (fig. 7) have a much higher ash content (26.6 percent composite raw material) than sample WVOC-16 because of abundant thin shale partings; sulfur content is low (0.6 percent). This coal would have to be cleaned to reduce the ash content before it could be utilized.

A 34-in. rider occurs 47 ft above the C-1 coal bed in drill hole E-2 (Behum and Mory, 1981, fig. 1), but could not be correlated with other beds in the area. Further exploration could possibly delineate a small minable block of this rider on Shavers Mountain.

C-2 Coal Zone

Resources----------------- 26,043,000 short tons
Reserve base-------------- 2,930,000 short tons

The base of the C-2 coal zone averages about 313 ft above the Sewell(?) coal bed (fig. 13). Access to the coal bed within the C-2 coal zone may be possible from outside the wilderness on Green and Middle Mountains (fig.11). More prospecting would be necessary to delineate the coal-bed outcrop east of the study area. From available information, the Middle Point coal deposit appears to be outside the wilderness, and it is not included in the resource and reserve base estimates for the Otter Creek Wilderness.

Analyses of samples from the C-2 coal zone indicate that these coals may qualify for marginal to premium-grade coking coal. Sulfur values are low, ranging from 0.9 to 1.1 percent in raw coal; ash values are also low where the main bed is of minable thickness.

Locally, an upper coal in the C-2 coal zone has a thickness of 50.5 in. excluding a total of 19.5 in. of partings (drill hole W-2, Behum and Mory, 1981, fig. 1). This upper coal occurs 17 ft above the main bed, but does not appear in other drill holes, and further prospecting would be necessary to delineate its extent. A small minable block may exist in the upper bed, but no resource or reserve-base estimates were determined.

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SHEET 2--COAL RESERVE BASE MAPS

By
Paul T. Behum[1] and Peter C. Mory[1]

MAPS SHOWING MINERAL RESOURCE POTENTIAL OF THE OTTER CREEK WILDERNESS, RANDOLPH AND TUCKER COUNTIES, WEST VIRGINIA

By
Ralph C. Warlow, Paul T. Behum[1], and Peter C. Mory[1]

1981

[1]U. S. Bureau of Mines

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1981