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# **Water-Quality and -Quantity Data for Abandoned Underground Coal Mines in Eastern Kentucky**

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## Technical Level



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## **Our Mission**

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# Water-Quality and -Quantity Data for Abandoned Underground Coal Mines in Eastern Kentucky

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## Abstract

Water-quality and -quantity analyses were performed between 1997 and 2003 by the Kentucky Geological Survey under contract from the Kentucky River Authority and the Kentucky Infrastructure Authority to study abandoned underground coal mines as possible water supplies for communities in the Eastern Kentucky Coal Field. The steep terrain of the coal field limits surface-water supplies, and groundwater systems are difficult to locate and often have too low a yield to provide community water supplies. KGS has been working with the Kentucky River Authority, the Kentucky Infrastructure Authority, and local government officials to search for water supplies in abandoned underground coal mines.

The data in the appendices of this report are interpreted in Cumbie and others (2006).

## Study Area

The study area is in the Eastern Kentucky Coal Field (Fig. 1), which is part of the coal-bearing rocks of the Appalachian Coal Field that underlie parts of Kentucky, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Alabama. The area is highly dissected by narrow stream valleys; a few larger streams have broad floodplains. Local relief increases from 300 ft in the north near the Ohio River to about 2,500 ft in the south along Pine Mountain near the Tennessee-Kentucky-Virginia borders (Price and others, 1962). The detailed study sites are located in Perry, Letcher, Knott, Clay, and Harlan Counties (Fig. 2).

## Study Sites

Water-quality and -quantity data were collected from seven sites throughout the coal field (Table 1). Production wells were drilled into a mine void, and pumping tests were performed at the Polly No. 4 Mine at Cow Branch (Fig. 3), BethEnergy No. 22 Mine at Crafts Colly (Fig. 4), BenCo No. 4 Mine in Hazard (Fig. 5), LeeCo No. 47 Mine in Manchester (Fig. 6), and Yocum Creek Coal Co. Mine in Evarts (Fig. 7). A pumping test

was also performed on an existing well at the Polly No. 4 Mine at Sand Lick (Fig. 8). An outflow from an abandoned mine portal at Polly in Letcher County (Fig. 9) was monitored for water quantity and quality. The remaining site, at Blue Diamond Mine in Leatherwood (Fig. 10), encompasses five large outflows (Jewel Mountain, Old House Branch, Barkcamp Branch, and Upper and Lower Lynn Fork).

## Methodology

The study sites were chosen according to the water-supply needs of the community and the potential for water supply from the abandoned underground mine. The mines were located by using geologic maps, topographic maps, mine maps, and field reconnaissance. Another resource was the people who lived in the area, and employees of the mining company. They provided us with valuable information about the mine layout and locations of possible outflows.

Once the mine boundary was located, field reconnaissance was performed to locate possible large outflows to be monitored. If outflows were present, an H-type flume was installed with a stilling well and

a pressure transducer was connected to a data logger to record water levels. If no outflows were present, a 10-in.-diameter well was installed into the mine at the lowest accessible location of the mine void. The well was instrumented with a water-level recorder. A pumping test was then performed by installing either a 6-in.-diameter submersible pump with a 15-hp motor or a 3-in.-diameter submersible pump with a 3-hp motor. All accessible domestic wells in the area were instrumented with water-level recorders. The durations of the pumping tests were determined by the drawdown rate in the wells.

Field water-quality measurements were made with a water-quality checker. It was calibrated daily during sampling. All laboratory analyses were performed by the KGS water-quality lab in accordance with U.S. Environmental Protection Agency–approved analytical methods. For dissolved constituent analysis, filtration was performed in the field using high-capacity in-line filters (45- $\mu\text{m}$  pore size). If sample preservation was required, the samples were acidified at the time of col-

lection, and kept at a temperature of 4°C until delivered to the KGS laboratory. Table 2 shows the laboratory analyses performed, and the methods used.

## Data Format

Appendix A lists all water-quality analyses for this project. Some of the samples were collected by outside agencies and are so noted. Unless noted otherwise, all results are reported in mg/L. Results containing the < symbol indicate a concentration below the method detection limit, followed by the value of the MDL. Appendices B through G are site-specific, containing water-level recorder data and field water-quality measurements collected during pumping tests. Appendix H contains data files collected from the Polly portal, an abandoned mine portal with two pressure transducers installed in a PVC pipe that was draining the mine. Appendix I contains data files from water-level recorders for each outflow monitored at the Blue Diamond Mine in Leatherwood.

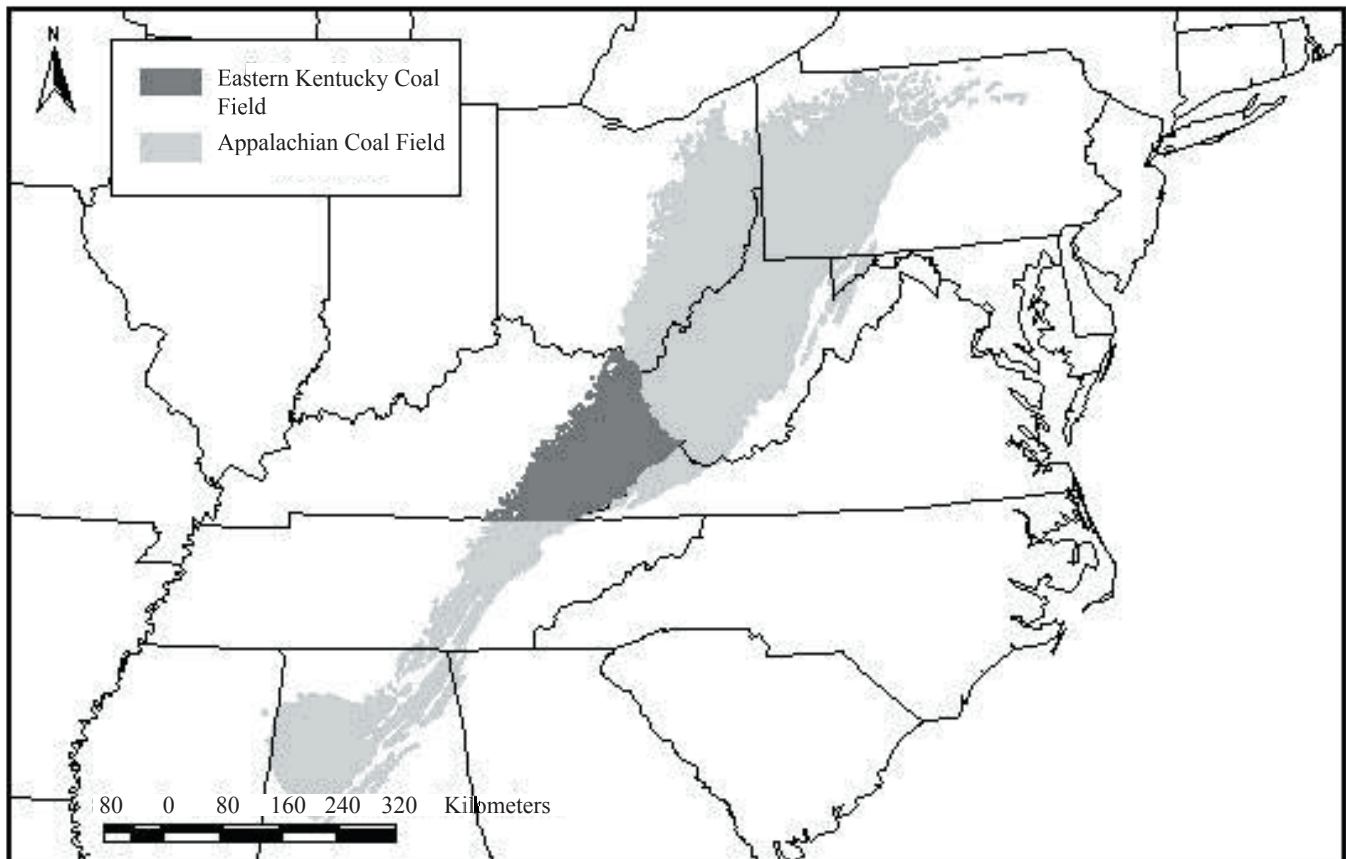


Figure 1. Location of the Eastern Kentucky Coal Field within the Appalachian Coal Field in the eastern United States.

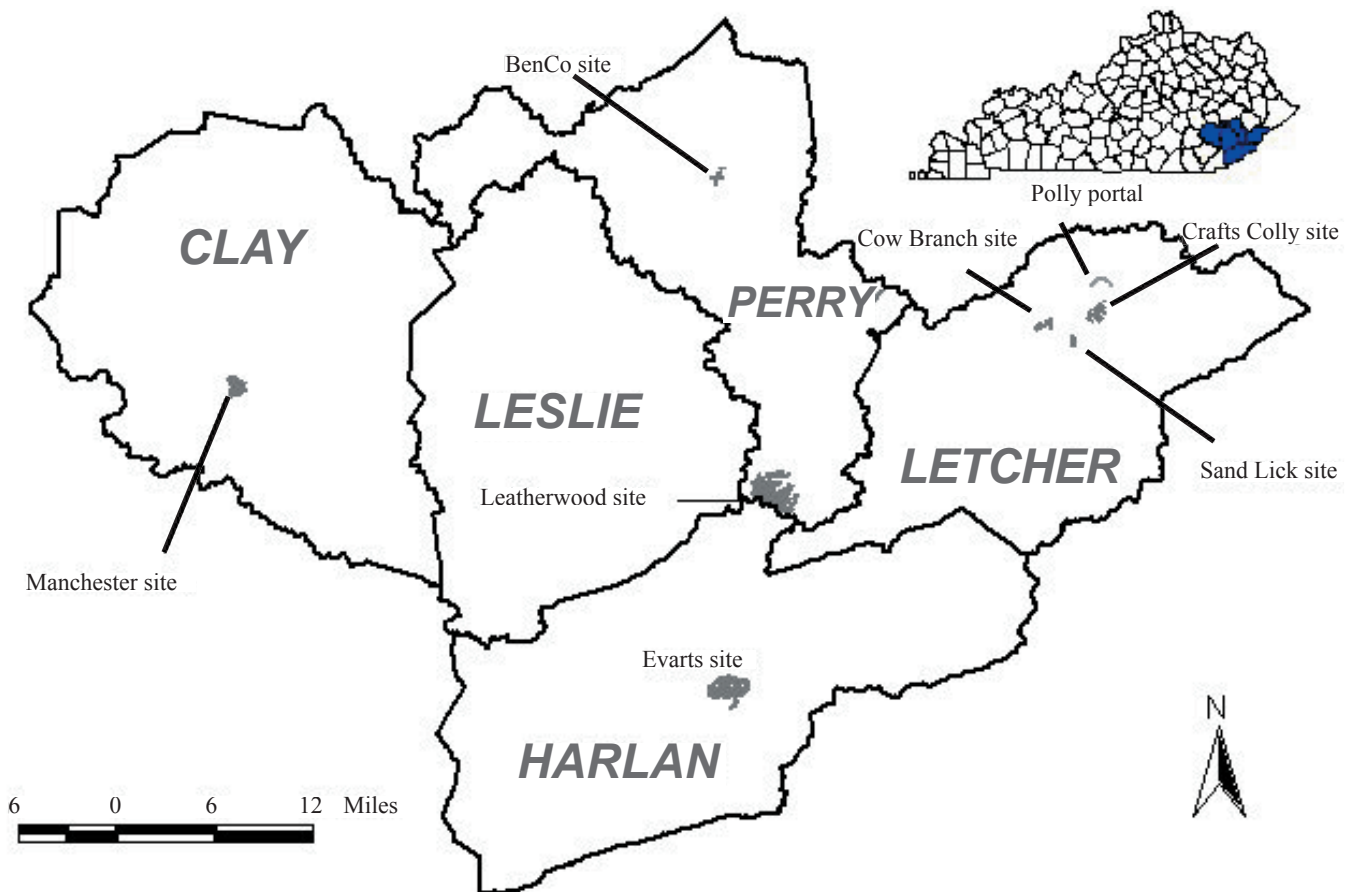


Figure 2. Locations of study sites.

Site	Mine Name	UTM Zone 17 (m northing)	UTM Zone 17 (m easting)	Elevation (ft asl)	Well depth (ft)
Sand Lick	Polly No. 4 Mine, Sand Lick	4114030	338035	1,276	16
Cow Branch	Polly No. 4 Mine, Cow Branch	4115890	334330	1,290	152
Crafts Colly	BethEnergy No. 22 Mine	4116879	340191	1,495	169
Polly portal	Polly No. 4 Mine	4119013	338320.5	1,228	
Manchester	LeeCo No. 47 Mine	4110066	257179	904	116
BenCo	BenCo No. 4 Mine	4113086	302584	962	76
Everts	Yocum Creek Coal Co. Mine	4081096	305342	1,480	54
Leatherwood	Blue Diamond Mine	4099477	315463	1,788	

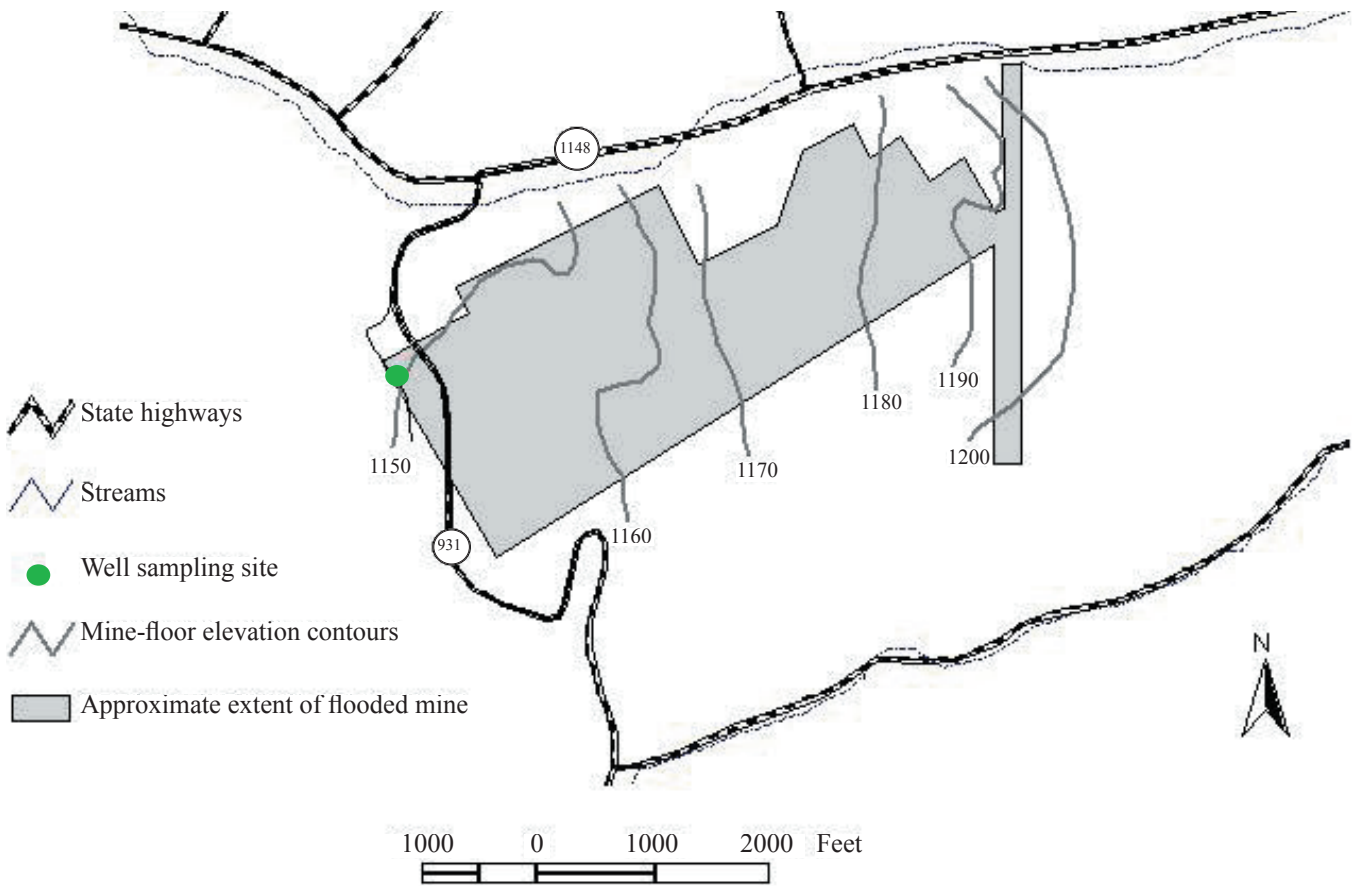


Figure 3. Diagram of Polly No. 4 Mine at Cow Branch in Letcher County, showing location of sample site. Samples were collected from the well.

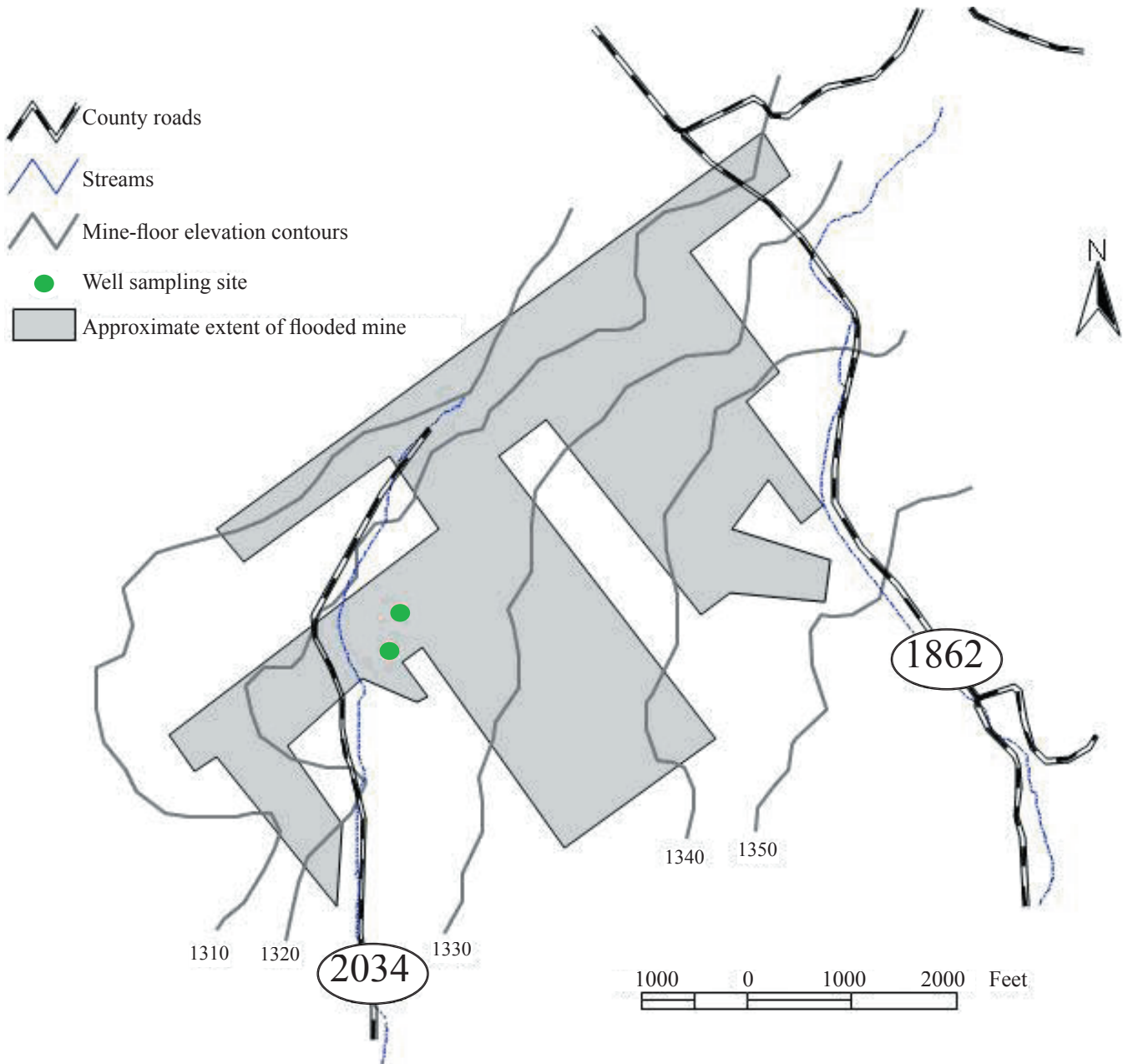


Figure 4. Diagram of BethEnergy No. 22 Mine at Crafts Colly in Letcher County. Sample ADAM-002 was collected from the southern well and the remaining ADAM samples were collected from the northern well.

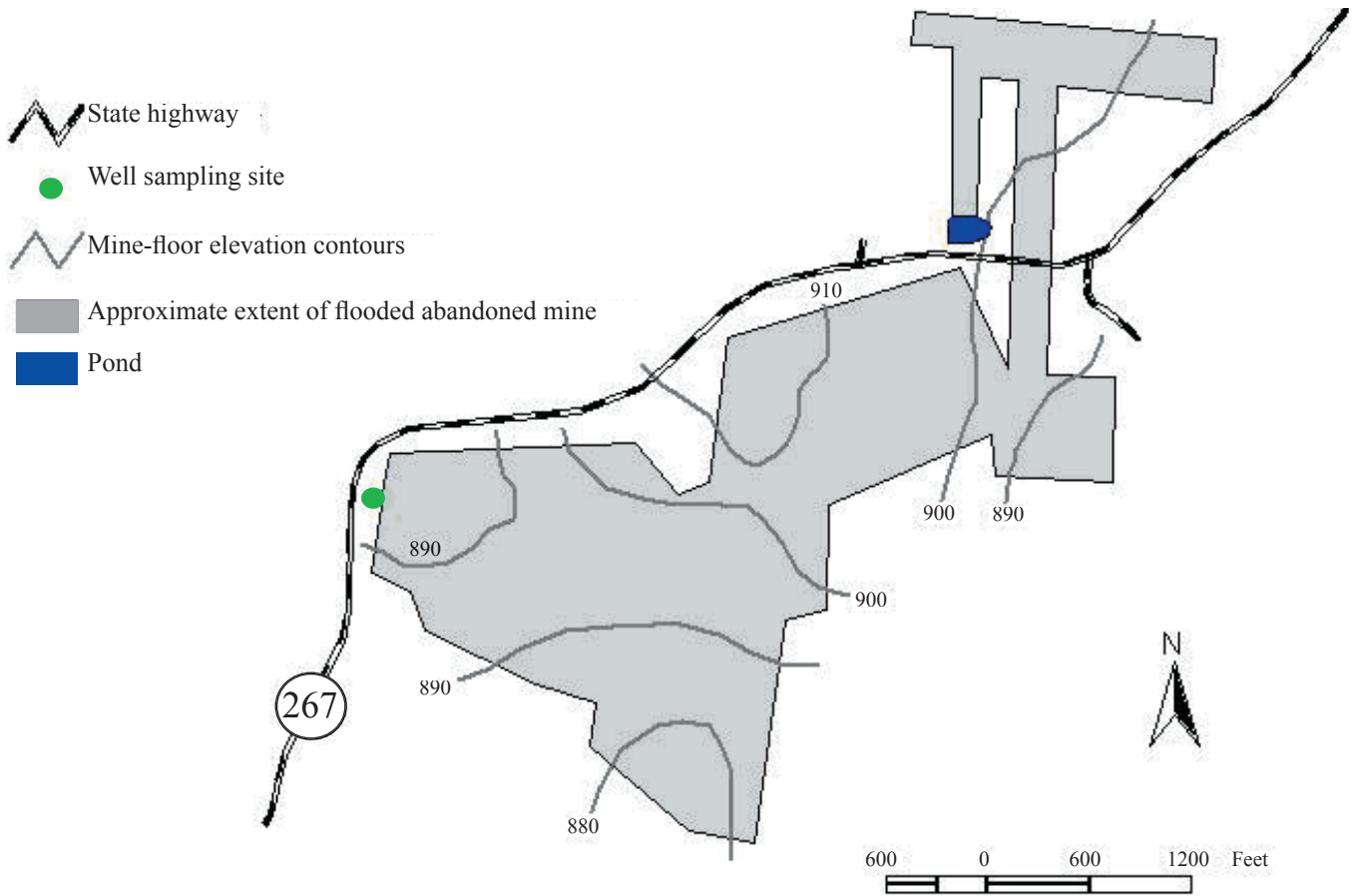


Figure 5. Diagram of BenCo No. 4 Mine at Hazard in Perry County. All samples were collected from the well.

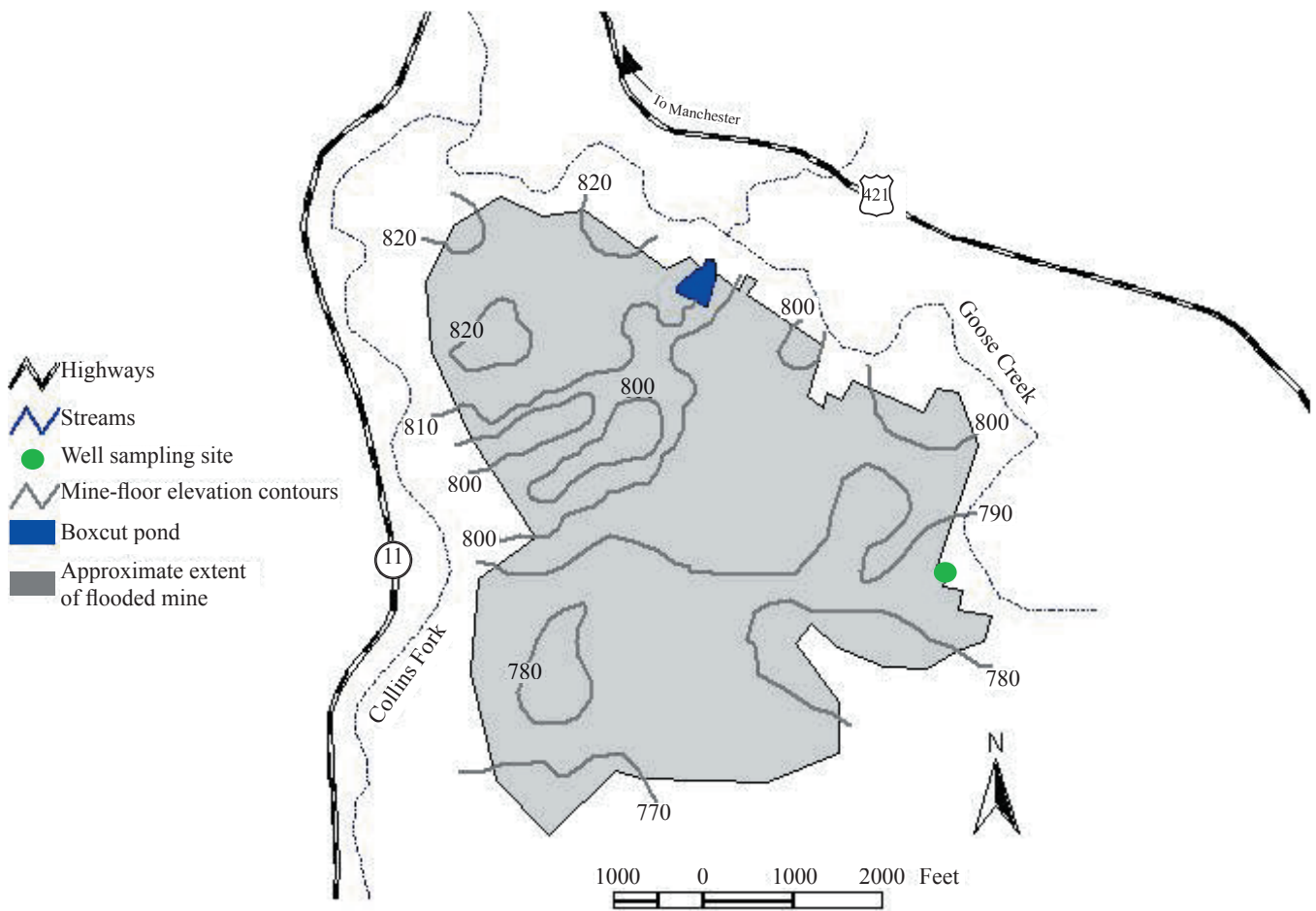


Figure 6. Diagram of LeeCo No. 47 Mine at Manchester in Clay County. All samples were collected from the well.

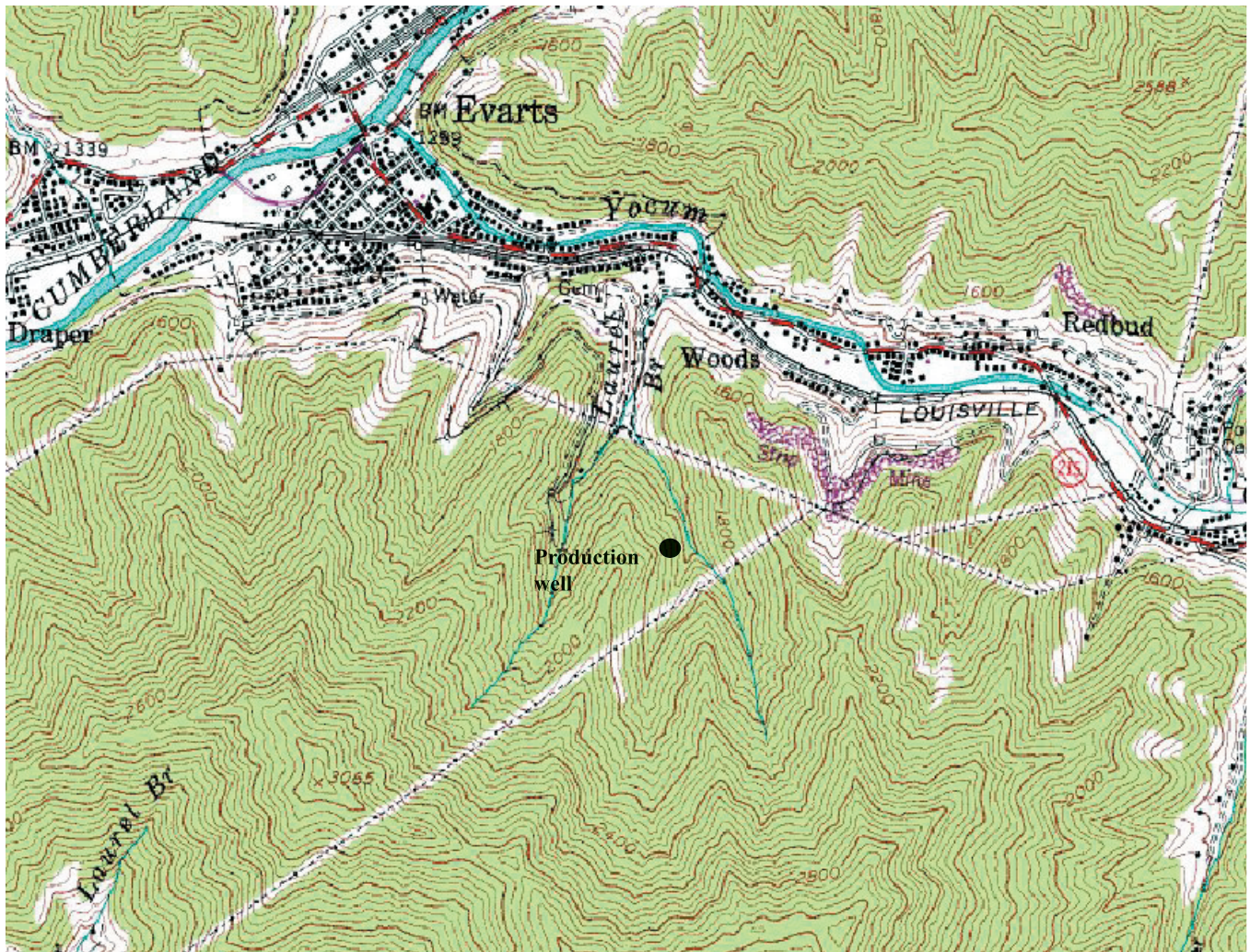


Figure 7. Location of well in Yocum Creek Coal Co. Mine at Evarts in Harlan County. Base map is the U.S. Geological Survey topographic map of the Mayking quadrangle.

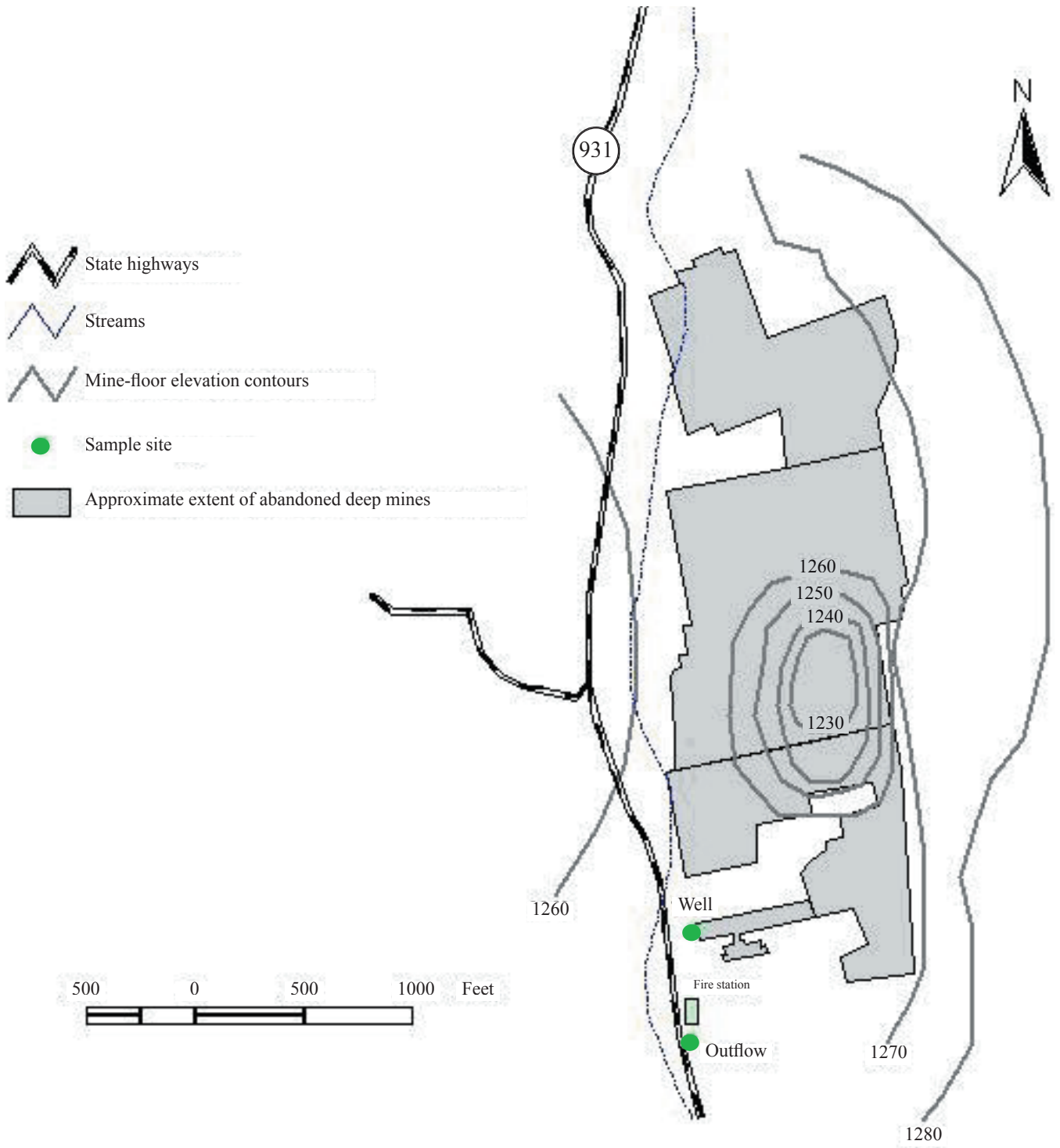


Figure 8. Diagram of Polly No. 4 Mine at Sand Lick in Letcher County, showing sample sites. SNDL samples were collected at the well and SLFS samples were collected at the outflow.

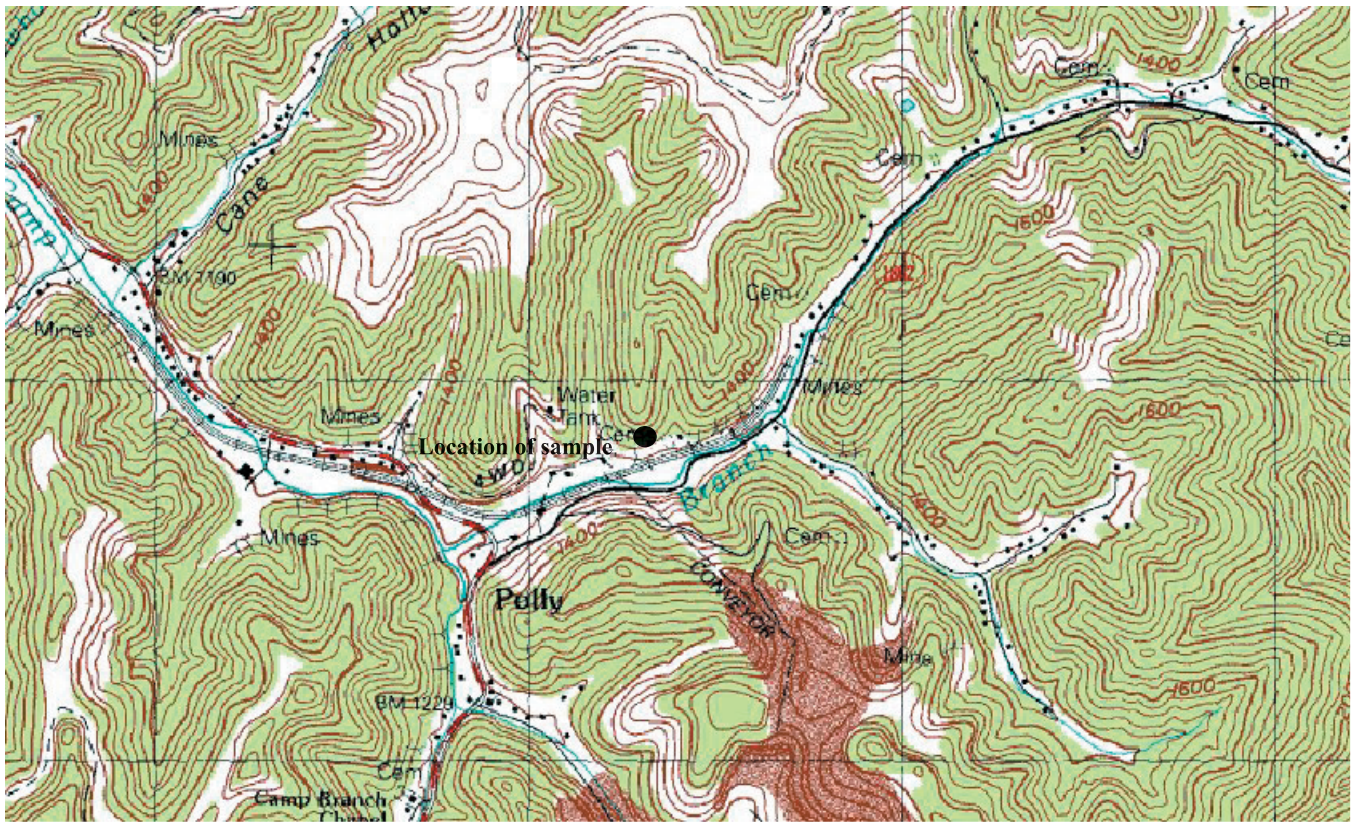


Figure 9. Location of sample site at the Polly portal outflow in Letcher County. All samples were collected from the PVC pipe exiting the mine. Base map is the U.S. Geological Survey topographic map of the Mayking quadrangle.

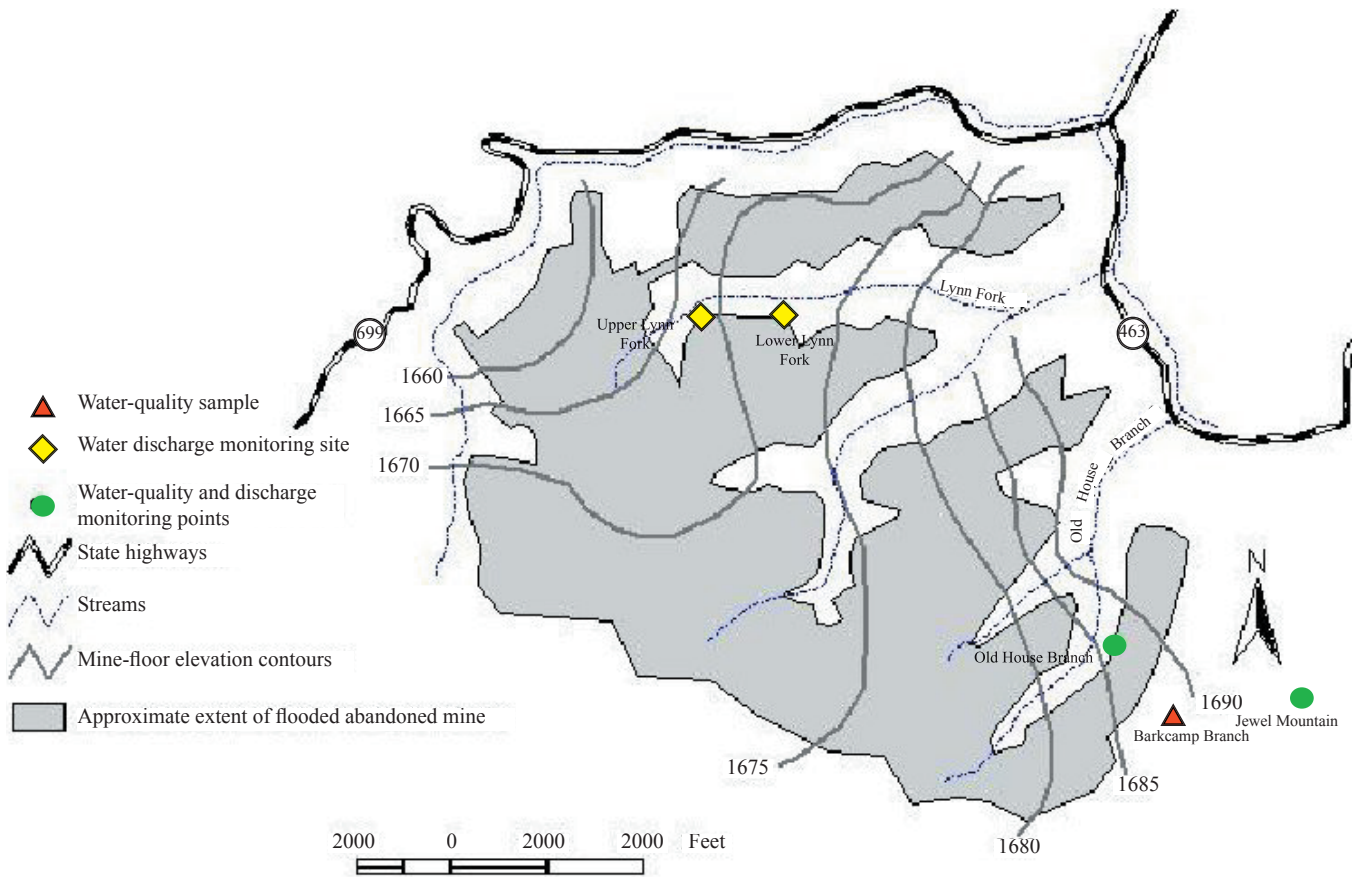


Figure 10. Location of mine-water discharge and water-quality sampling sites in the Blue Diamond Mine at Leatherwood in Perry County. Locations of Jewel Mountain and Barkcamp Branch samples are not drawn to scale.

<b>Analyte</b>		<b>Method</b>
Dissolved and total		SW846-6010A
Aluminum	Magnesium	Inductively coupled plasma
Antimony	Manganese	
Arsenic	Nickel	
Barium	Phosphorus	
Beryllium	Potassium	
Boron	Selenium	
Cadmium	Silicon	
Calcium	Silver	
Chromium	Sodium	
Cobalt	Strontium	
Copper	Sulfur	
Gold	Thallium	
Iron	Tin	
Lead	Vanadium	
Lithium	Zinc	
Chloride		
Bromide		SW846-9056
Fluoride		SW846-9056
Sulfate		SW846-9056
Alkalinity		EPA 310.1
Bicarbonate		Calculated
Nitrate-nitrogen		SW846-9056
Total dissolved solids		EPA 160.1

## References Cited

- Cumbie, D.H., Dinger, J.S., and Davidson, B., 2006, Assessing water-supply potential of abandoned underground coal mines in eastern Kentucky: Kentucky Geological Survey, ser. 12, Report of Investigations 12, 36 p.
- Price, W.E., Jr., Mull, D.S., and Kilburn, C., 1962, Reconnaissance of ground-water resources in the Eastern Coal Field region, Kentucky: U.S. Geological Survey Water-Supply Paper 1607, 56 p.