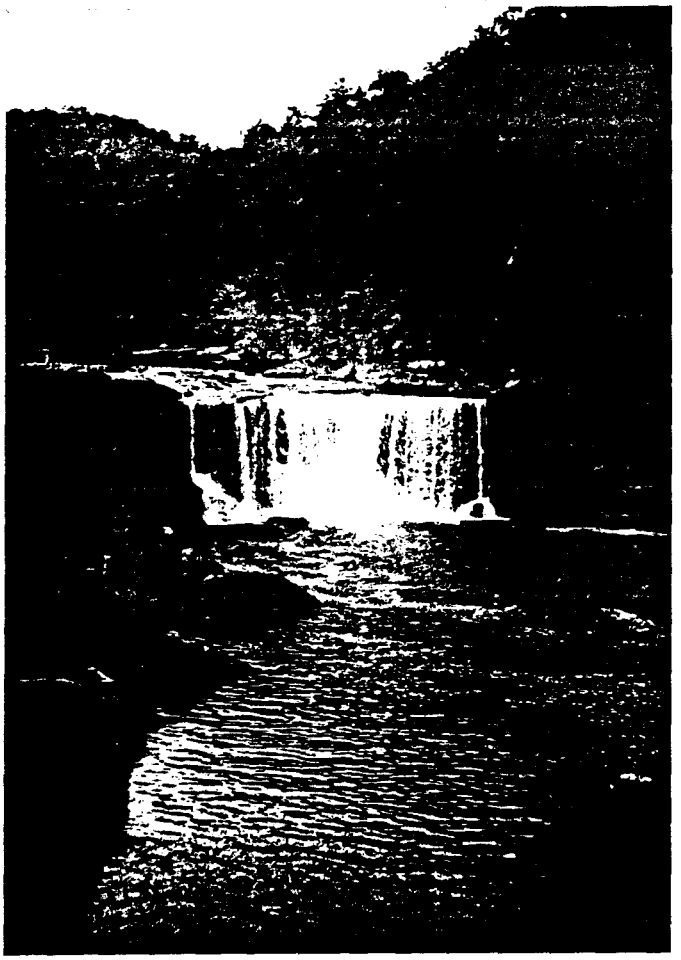
ENVIRONMENTAL INVENTORY

AND

MANAGEMENT PLAN

FOR

CUMBERLAND WILD RIVER, KENTUCKY



JUNE 1995

PREPARED BY
KENTUCKY STATE NATURE PRESERVES COMMISSION
AND
KENTUCKY DIVISION OF WATER
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET

Cover photo of Cumberland Falls by Ronald Cicerello. Cumberland Falls, probably the most distinctive feature within the wild river corridor, is a "caprock" type waterfall which is formed at a point where a less resistant bedrock meets a more resistant bedrock.

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Prepared for and Submitted to the
Kentucky Division of Water
Kentucky Natural Resources and Environmental Protection Cabinet

This project was financed by the Kentucky Division of Water through Memorandum of Agreement Number 010521. The contents do not necessarily reflect the views and policies of the Kentucky Division of Water.

ACKNOWLEDGEMENTS

Thanks to the following people for their contributions to this report: T. Anderson, J. Brumley, D. Hawkins, G. Miller, M. Mills, C. Schneider, Karen Smathers, T. VanArsdall and M. Wiley, Kentucky Division of Water; R. Cicerello, S. McMurray and D. White, Kentucky State Nature Preserves Commission; J. Campbell, Kentucky Chapter-The Nature Conservancy, R. Egedi, Sheltowee Trace Outfitters; R. Deaton, Whitley County Chamber of Commerce; A. Waters, McCreary County Employment Service; D. Brown and M. Lynn, Cumberland Falls State Resort Park; J. Hershel, I. Isom, S. Kickert, M. Melton, J. Stephens, J. Strojan and B. Strosnider, Daniel Boone National Forest; A. Fisk, University of Tennessee.

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I. INTRODUCTION

A. Statement of Purpose

More than 3.5 million miles (5.6 million kilometers) of rivers cross the United States; however, less than 2 percent are in a natural, free-flowing condition (Wilkins and Meyer 1992). Of the less than 2 percent of rivers that are in a relatively natural state, only one-third are provided some type of legal protection (Wilkins and Meyer 1992).

Kentucky protects nine of the state's most undisturbed streams under the Wild Rivers Statutes, passed in 1972 by the Kentucky General Assembly. Streams protected by Wild Rivers Statutes have been designated as state wild rivers to provide legal protection for their significant natural and cultural features. A 16.1 mi (25.9 km) corridor along the Cumberland River was protected in 1972 as part of the Wild Rivers Act. The protected portion of the Cumberland River stretches from Summer Shoals (River Mile 574.6) to the backwaters of Lake Cumberland (River Mile 558.5).

To ensure that the designated rivers are adequately protected, the Wild River Statutes require that a management plan be prepared for each (Kentucky Division of Water 1976, KRS 146.220). The goal of the management plan is to generate a long-range strategy for maintaining the high quality of the stream, its surrounding habitat and cultural features while also providing for appropriate recreation, education and scientific uses. A biological inventory and review of natural and cultural resources is included with the management plan for this wild river because this information is necessary for determining appropriate management of the area. Important and vulnerable areas are identified through the inventory to ensure that they will be properly protected. The Kentucky Division of Water (KDOW) of the Kentucky Natural Resources and Environmental Protection Cabinet (KNREPC) is responsible for administering the Wild Rivers System.

The KNREPC, through its development of the 1990-1992 Environmental Management Plan, identified the resources to fund the development of management plans for two wild rivers. This report is the culmination of the effort undertaken by the Kentucky State Nature Preserves Commission (KSNPC) through Memorandum of Agreement Number 11482 with the KDOW to develop a management plan and environmental inventory for the Cumberland Wild River.

B. Location

The Cumberland River originates in Harlan County, Kentucky at the confluence of the Poor Fork, the Clover Fork and Martins Fork of the Cumberland River, and flows through Kentucky and Tennessee for 736 miles (1,178 kilometers) to the Ohio River. The watershed of the Cumberland River above Cumberland Falls is approximately 1,977 square miles (5,140 square kilometers) (United States Forest Service [USFS] 1994). More than 85 percent of the upper watershed is in Kentucky; the rest is in Tennessee (USFS 1994). This watershed is 81 percent forested (USFS 1994).

The portion of the Cumberland River that has been designated as a Wild River is located in Whitley and McCreary counties, Kentucky in the south-central portion of eastern Kentucky (Fig. 1). The Cumberland Wild River Corridor is 16.1 mi (25.9 km) long, stretching from Summer shoals to the backwaters of Lake Cumberland. The river generally flows north through the designated wild river corridor. The Cumberland Wild River is entirely within the proclamation boundary of the Daniel Boone National Forest (DBNF), approximately 1,800 acres (728 hectares) of the approximately 2,760 acres (1,117 hectares) corridor are National Forest System lands. The proclamation boundary of the DBNF outlines an area that the United States Forest Service (USFS) has an intent to purchase; privately-owned land within the boundary is not under the control of the USFS. The area designated as the wild river corridor includes the river and "...the visual horizon from the river up to 2000 feet from the centerline of the river" (KDOW 1976)(Fig. 1).

C. Road and Trail Accessibility

1. Roads

Primary access to the Cumberland Wild River Corridor is provided by KY 90, which crosses the Cumberland River at Cumberland Falls State Park. From the east, KY 90 can be reached from US 25 west from I-75. From the west, KY 90 can be reached from US 27. The Redbird-Cumberland Falls Road (County Road 534) is the only other paved road that provides access to the wild river corridor. The Cumberland Wild River Corridor is 105 mi (170 km) south of Lexington, Kentucky and 70 mi (113 km) north of Knoxville, Tennessee via I-75. The nearest cities to the Wild River are Corbin (to the north) and Williamsburg (to the south). These two cities are located along I-75 and are each approximately 15 mi (24 km) from where KY 90 crosses the Cumberland River.

Additional paved roads provide access to the Cumberland River in the vicinity of the wild river corridor. Downstream from the corridor, KY 896, Sawyer School Road and United States Forest Service (USFS) Road 193 provide access to the east and west banks. Just past the upstream end of the corridor, KY 478 provides access to the south bank.

A number of USFS roads, privately maintained roads, unimproved roads, jeep trails and foot paths also provide access to the corridor (Fig. 2). In McCreary County, on the west bank of the river, several dirt and gravel roads provide access to the wild river corridor. USFS 5261 provides access to a ridgetop north of Big Branch, where a trail continues to the end of the ridgetop and ends before it reaches the river. A private road follows Dog Slaughter Ridge to the river; however, this road is gated and posted before it reaches the corridor. A USFS road leads south from the Dog Slaughter Ridge Road towards Center Rock Rapids. This road is closed due to a logging operation and ends before reaching the corridor. User-developed ATV roads access the river along Upper Mulberry Branch and north of Lower Mulberry Branch to Blue Bend. Sand Hill Road (between Marsh and Indian creeks) has recently been graveled and leads to the river. USFS 526 (Bearwallow School Road) is south of Marsh Creek and has four branches that

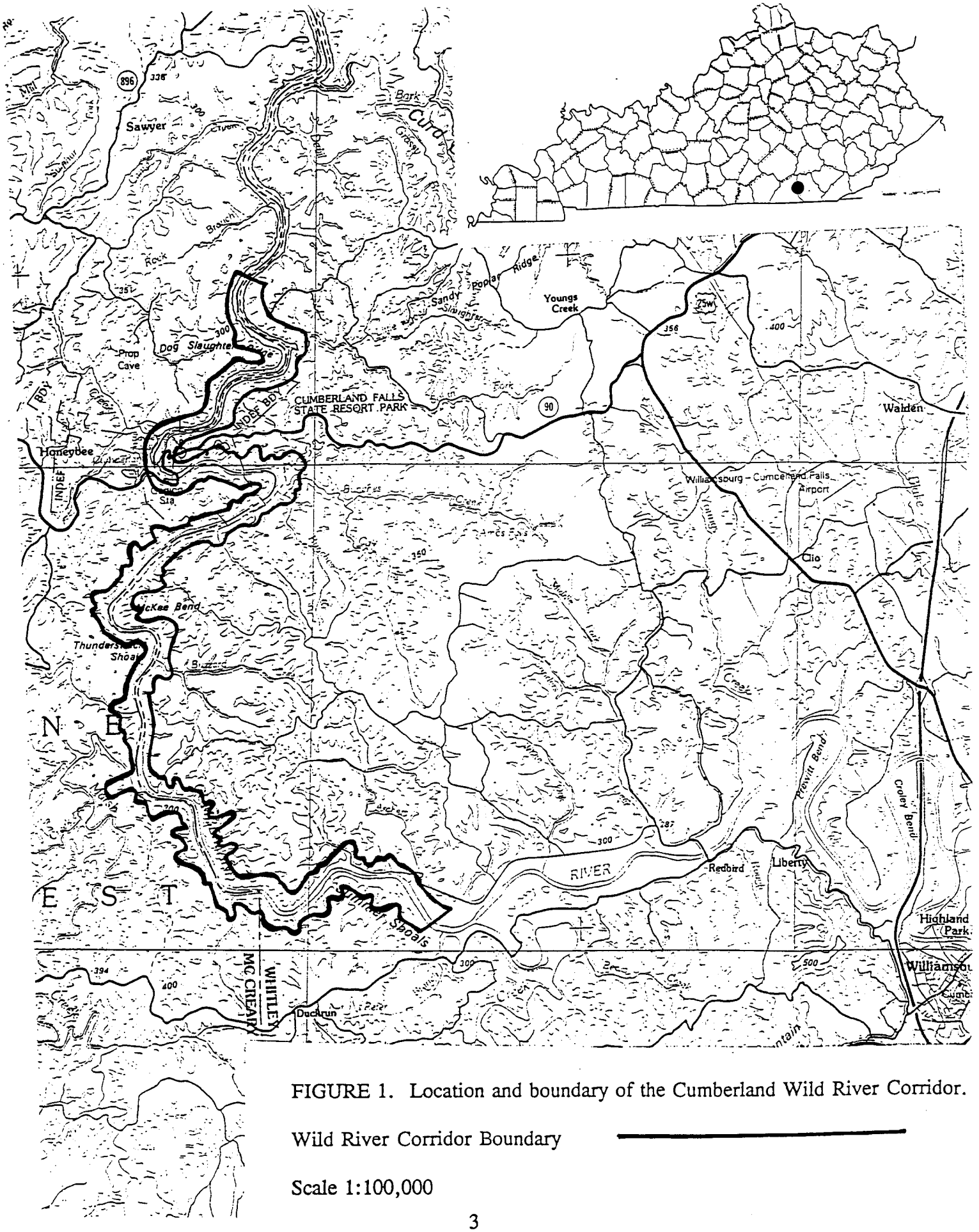

FIGURE 1. Location and boundary of the Cumberland Wild River Corridor.

Wild River Corridor Boundary

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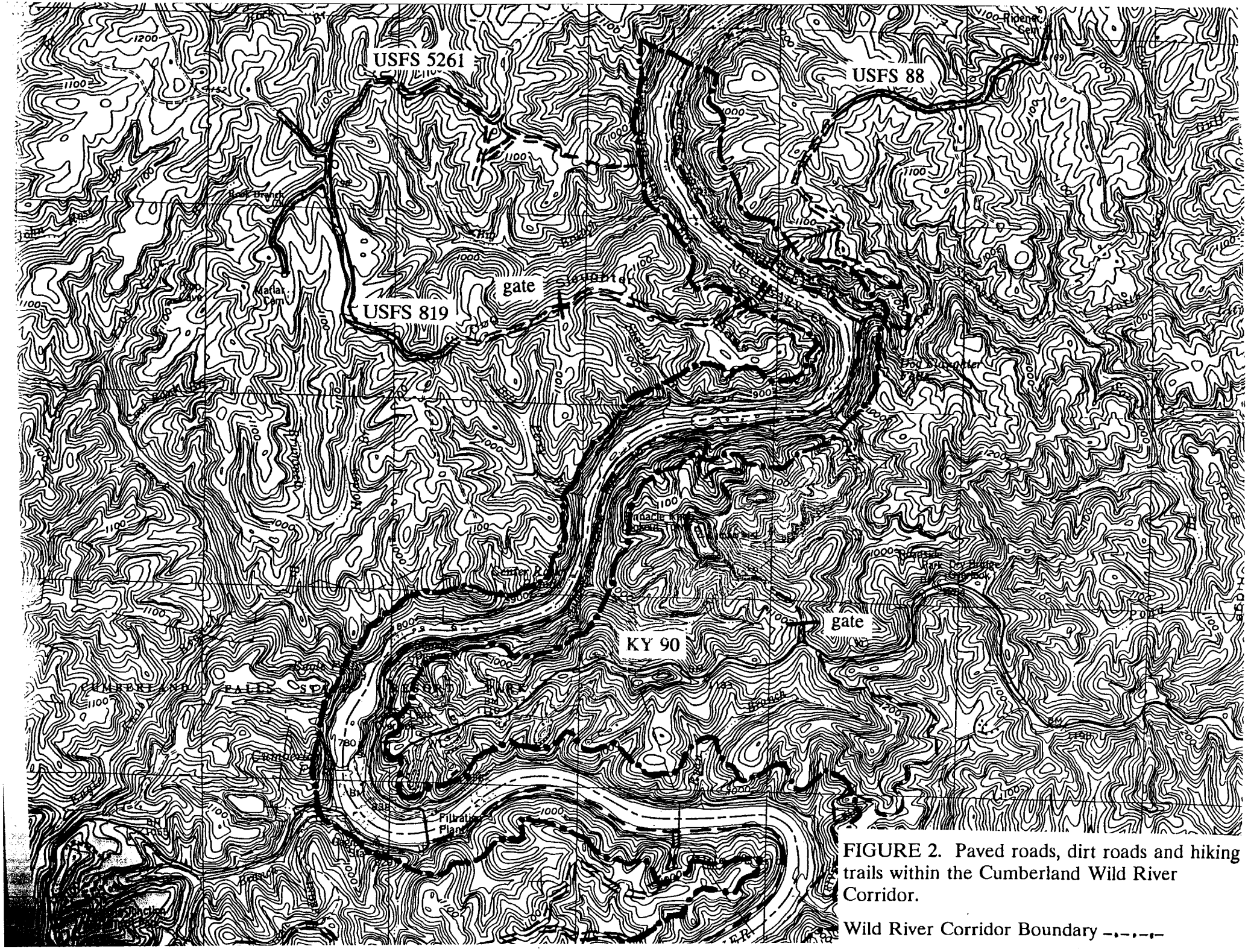
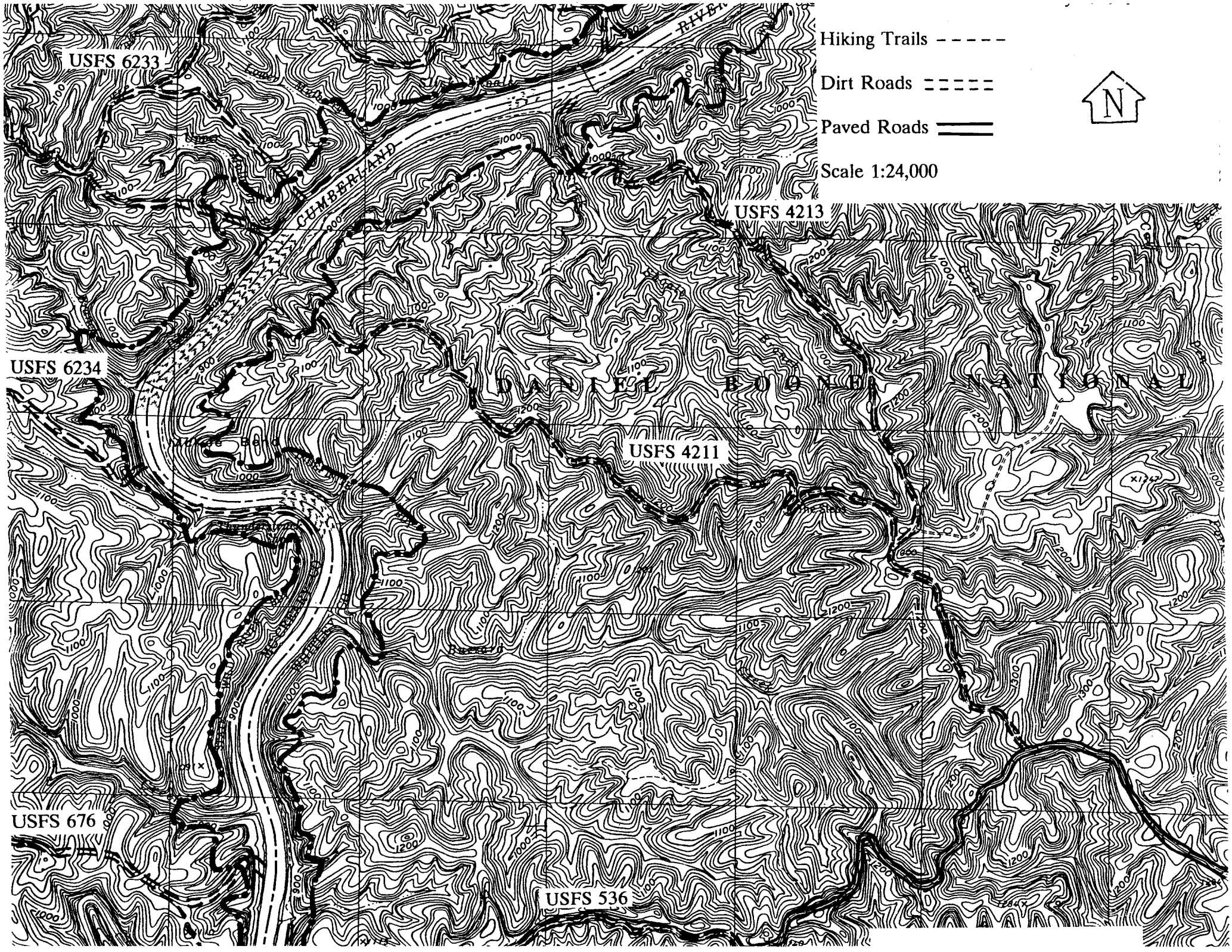
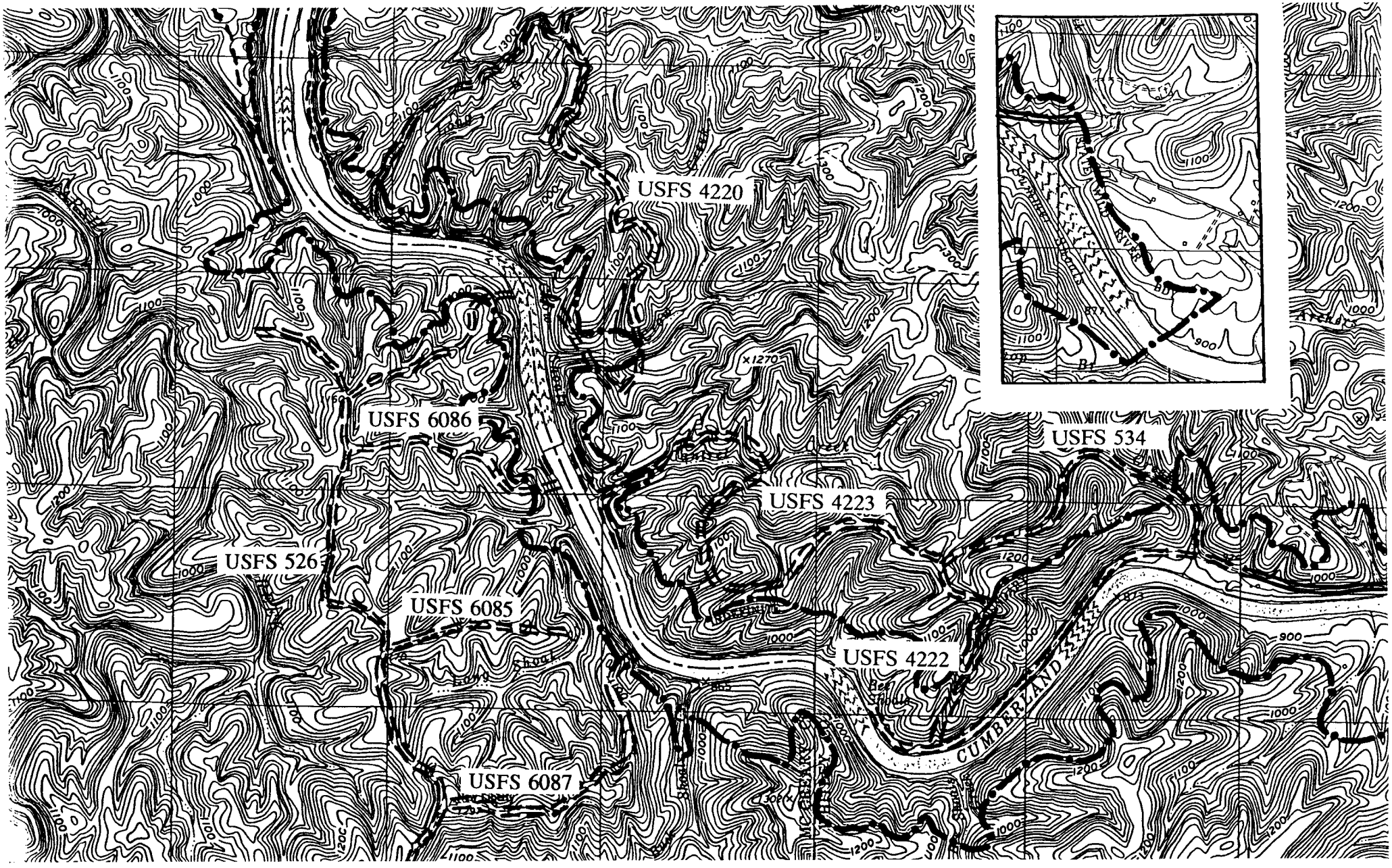


FIGURE 2. Paved roads, dirt roads and hiking trails within the Cumberland Wild River Corridor.

Wild River Corridor Boundary –·–·–·–


Hiking Trails - - - - -
Dirt Roads = = = = =
Paved Roads ═══
Scale 1:24,000
N
USFS 6233
USFS 4213
USFS 6234
DANIEL BOONE NATIONAL
USFS 4211
USFS 676
USFS 536
CUMBERLAND
RIVER
Miller Bend
Buffalo


USFS 4220
USFS 6086
USFS 534
USFS 4223
USFS 526
USFS 6085
USFS 4222
USFS 6087
CUMBERLAND

lead into the corridor, USFS roads 6085, 6086, 6087 and an unnumbered road.

In Whitley County, on the east bank of the river, eight unimproved roads lead into the wild river corridor. USFS 88, north of Dog Slaughter Creek, becomes a hiking trail just before it reaches the wild river corridor. This road connects with the Sheltowee Trace. USFS 846 heads north off of KY 90 to Pinnacle Knob lookout tower, this road is currently gated and becomes a hiking trail before reaching the corridor. USFS 4213 (Slick Shoals Branch Road) leads to the river and USFS 4211 (The Steps Road) ends at the boundary of the wild river corridor. USFS 536 (Long Branch Road) provides access to the river. Three dirt roads lead to the Cumberland River near the upstream end of the wild river corridor, USFS 4220 at Crow Creek, USFS 4223 at Cantrell Creek and USFS 4222 east of Bee Shoals. Table 1 provides a comprehensive listing of roads leading into the Cumberland Wild River Corridor including location and condition.

TABLE 1. Information on roads leading into the Cumberland Wild River Corridor.

Road Name	Location	Condition
USFS 88	Whitley County North of Dog Slaughter Creek	Road becomes foot before reaching the corridor.
USFS 4213	Whitley County North of Slick Shoals Branch	Rough dirt road, leads to the river.
USFS 4211	Whitley County South of Slick Shoals Branch	Very rough dirt road, leads to edge of corridor.
USFS 536	Whitley County North of Long Branch	Dirt road, leads to the river.
USFS 4220	Whitley County Along Crow Creek	Rough dirt road, leads to the river.
USFS 4223	Whitley County Along Cantrel Creek	Rough dirt road, leads to the river.

TABLE 1. continued.

Road Name	Location	Condition
USFS 4222	Whitley County At Bee Shoals	Old dirt road with no sign of recent use, leads to the river.
USFS 534	Whitley County Upstream end of corridor	Paved road.
USFS 5261	McCreary County North of Big Branch	Poorly maintained dirt road, becomes a trail before corridor, along National Forest System lands boundary.
USFS 819	McCreary County Dog Slaughter Ridge	Dirt road, leads to river, but gated on private property.
USFS 6233	McCreary County 3 branches near Blue Bend, 2 branches near Upper Mulberry Branch	Rough dirt roads leading to the river.
USFS 6234	McCreary County South of Pitch Branch	Very rough dirt road, leads to river, crosses private property.
USFS 676	McCreary County South of Indian Creek	Gravel road, leads to river.
USFS 6087	McCreary County North of Buck Shoals Creek	Dirt road, leads to river.
USFS 6085	McCreary County North of Long Shoal Creek	Dirt road, leads to edge of corridor.
USFS 6086	McCreary County South of Crow Shoals	Dirt road leads to river.
Unamed road	McCreary County North of USFS 6086	Dirt road, leads to river, on private property.

The dirt roads that lead to the river only provide access for vehicles with four-wheel-drive and high clearance. Some of the roads are only adequate for all-terrain-vehicles (ATVs) which can maneuver in narrower spaces. During periods of heavy rain, many of the roads leading to the river are not passable.

2. Trails

Many trails are present within the wild river corridor. It has been estimated that 85 percent of the Wild River length can be traversed by approximately 30 mi (50 km) of trails (Miller/Wihry/Lee, Incorporated 1980; Soil Systems, Incorporated 1980). The trails that are present include hiking and fishing trails as well as old logging roads. Fourteen mi (24 km) of trails are concentrated within the Cumberland Falls State Resort Park and the Cumberland Falls State Park Nature Preserve (Fig. 3). A portion of the park's longest trail, which passes over private property, is currently closed at the request of the landowner (D. Brown pers comm). The remaining 16 mi (26 km) of trails are primarily on National Forest System lands managed by USFS.

The 14 mi (24 km) of trails within the state park are day-use trails ranging from 0.25 mi (0.4 km) to 7 mi (11 km) long. There are also horseback riding trails within the state park, and stables are located 0.75 mi (1.2 km) east of Dupont Lodge on KY 90.

A portion of the 337 mi (537 km) Sheltowee Trace, a national recreation trail, is within the wild river corridor (Sandidge et al. 1989). The Sheltowee Trace follows the river on the east bank from the KY 90 bridge north to the end of the wild river corridor and continues south from the KY 90 bridge on the west bank of the river south to Thunderstruck Shoals. Additional information on USFS Trails is available from the Stearns District Ranger Headquarters.

D. Land Ownership - Public and Private

The Cumberland Wild River Corridor is within the proclamation boundaries of the Daniel Boone National Forest. The National Forest System lands comprise approximately 1,800 acres (728 hectares) within the wild river corridor. Cumberland Falls State Resort Park covers approximately 400 acres (162 hectares) within the corridor. The remaining 560 acres (227 hectares) of the wild river corridor are privately-owned. Table 2 lists private property tracts within the corridor; Figure 4 outlines approximate ownership boundaries for the corridor. Land ownership information was obtained from the McCreary and Whitley county Property Valuation Administrator offices.

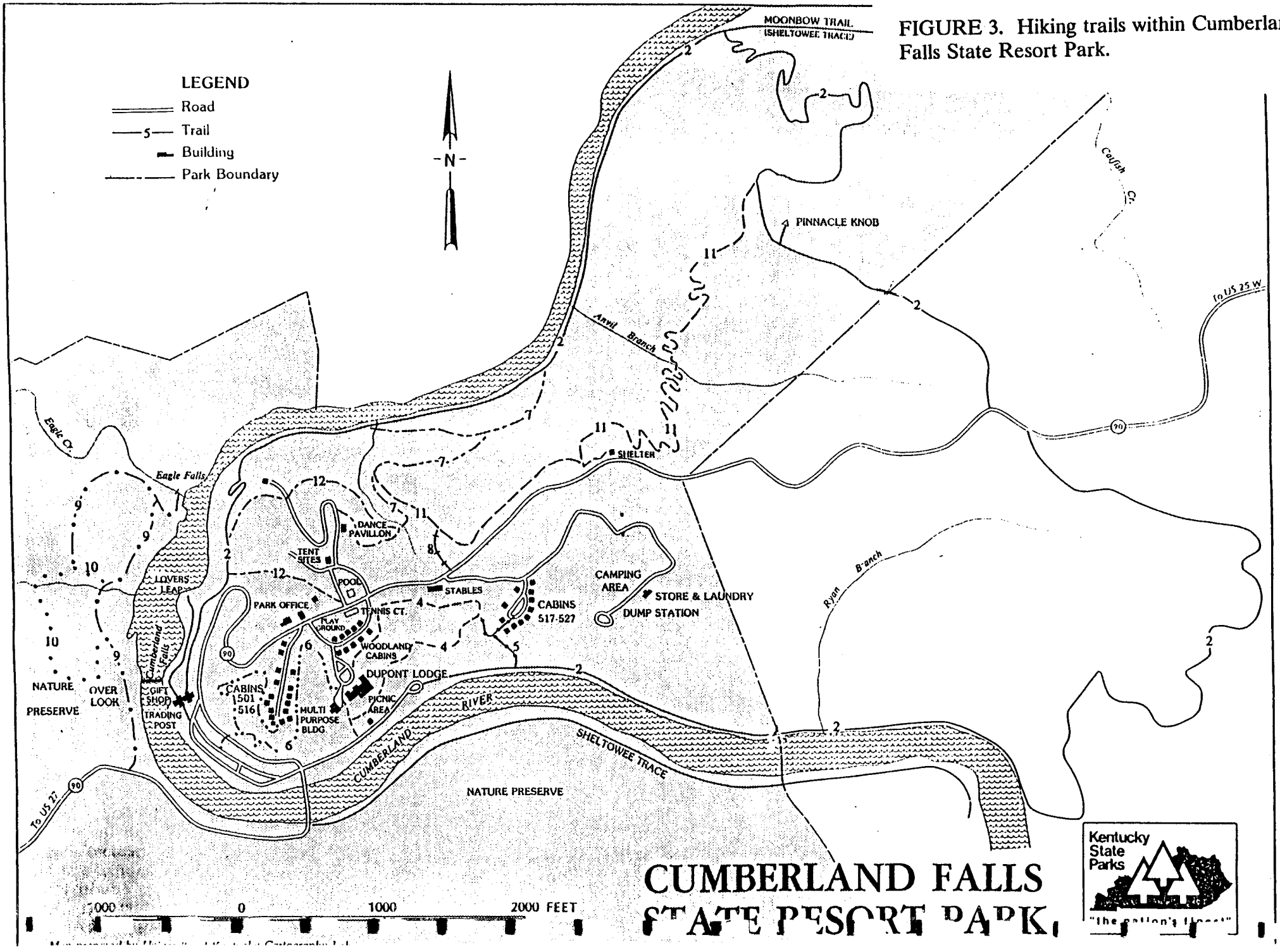


FIGURE 3. Hiking trails within Cumberland Falls State Resort Park.

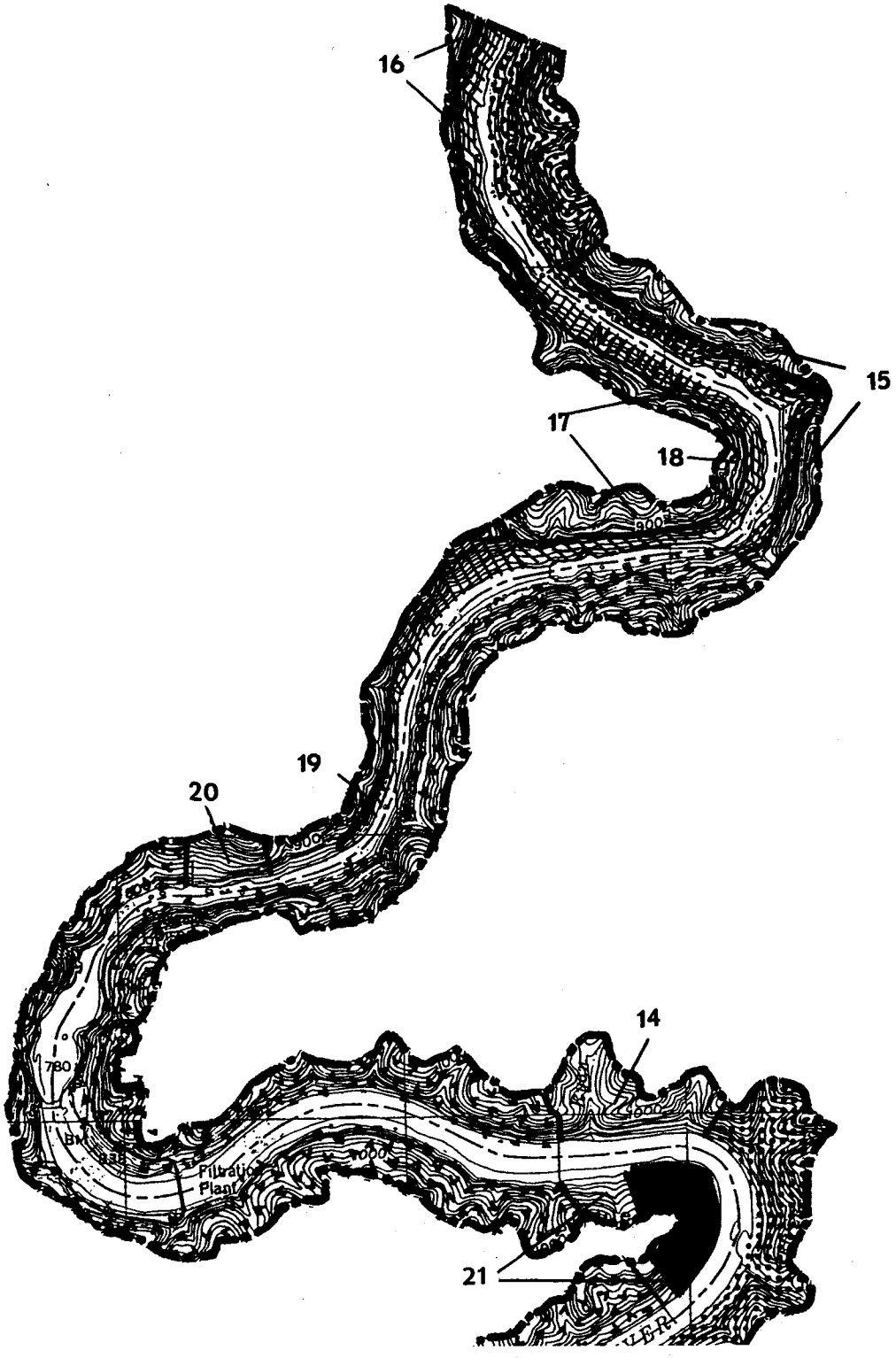
TABLE 2. Property ownership within the Cumberland Wild River Corridor, 1993 (See Fig. 4).

Tract	Ownership
1	Private
2	Private
3	Private
4	Private
5	Private
6	Private
7	Private
8	Private
9	Private
10	Private
11	Private
12	Private
13	Private
14	Private
15	Private
16	Private
17	Private
18	Private
19	Private
20	Private
21	Private
22	Private
23	Private
24	Private
25	Private
26	Private

* National Forest System lands, KSNPC, and Kentucky State Parks-owned land within the corridor are illustrated in Fig. 4.

E. Coordination with Other Agencies

A number of agencies are responsible for managing land within the Wild River Corridor. KDOW is responsible for periodically inspecting the wild river corridor to ensure that regulations protecting the area are upheld and to monitor the quality of the stream's water. More than half of the corridor is National Forest System lands that are within the Daniel Boone National Forest (DBNF). Kentucky State Parks also owns a significant portion of the corridor, 400 acres (162


16
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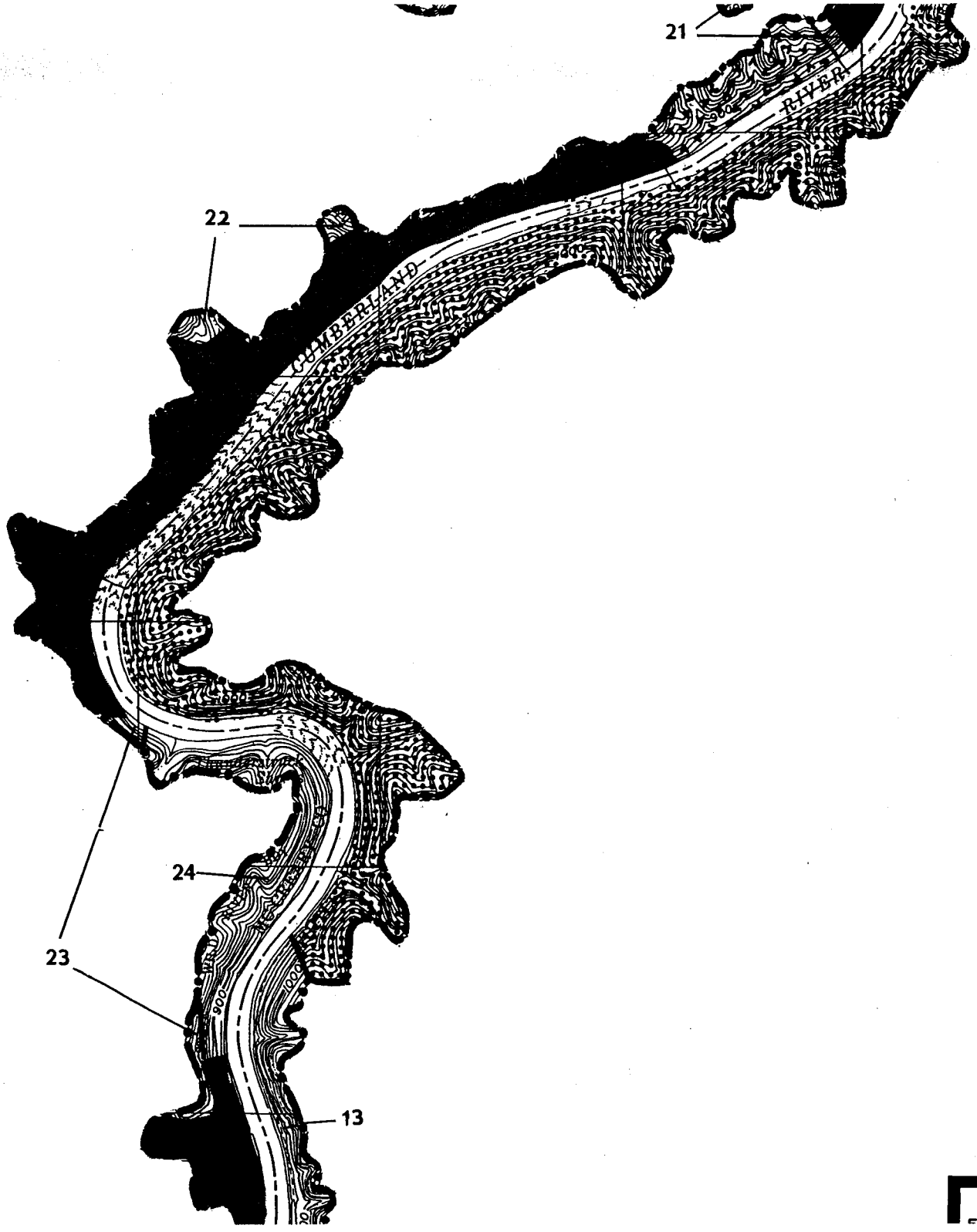
Plant



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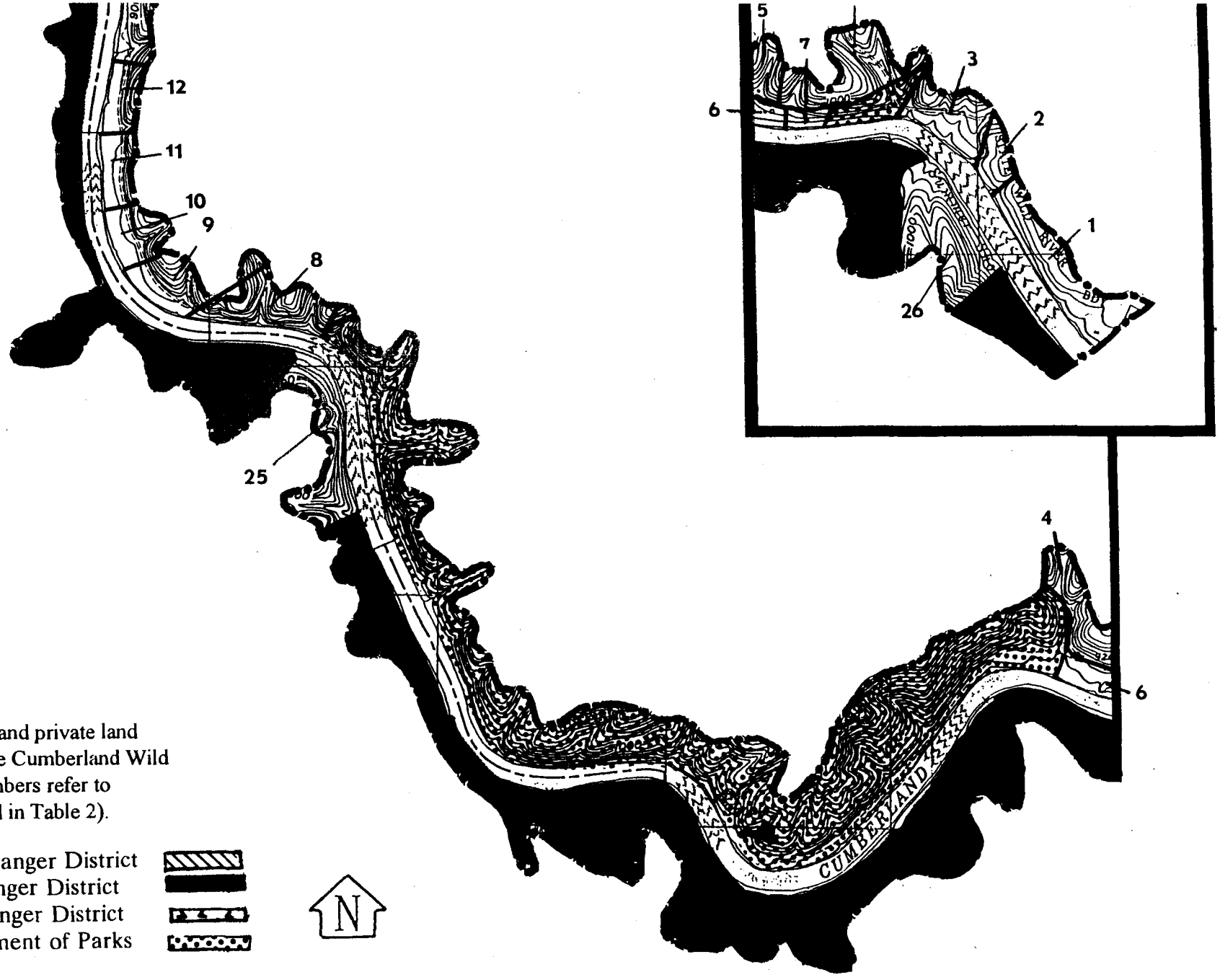


FIGURE 4. Public and private land ownership within the Cumberland Wild River Corridor (numbers refer to property tracts listed in Table 2).

Scale 1:24,000

hectares). A portion of the park has been dedicated as a State Nature Preserve by the Kentucky State Nature Preserves Commission. Approximately 175 acres (70 hectares) of the state park property within the wild river corridor is a dedicated state nature preserve. The dedicated portion of the park, including Cumberland Falls, is managed jointly by Kentucky Parks and Kentucky State Nature Preserves Commission. United States Army Corps of Engineers, Kentucky Department of Fish and Wildlife Resources, the Office of State Archaeology and Kentucky Heritage Council do not own property within the corridor; however, they share an interest in the area. All of these agencies were contacted and participated in developing this management plan for the corridor.

II. CULTURAL RESOURCES

A. Land Use

1. Regional

McCreary and Whitley counties surround the wild river corridor. There are no major urban areas in McCreary County, which has a population of 15,603 (1990 census). Whitley City is the largest community within the county and also is the county seat. The two urban areas in Whitley County are Williamsburg and Corbin with population sizes of 5,493 and 7,419 respectively (1990 census). Williamsburg is the county seat of Whitley County. Whitley County has a population size of 33,326 (1990 census).

The majority of land outside of these urban areas in Whitley and McCreary counties is forested. McCreary County is 94 percent forested and Whitley County is 73 percent forested (Alerich 1990). These counties are within the Eastern Coal Fields region of Kentucky which is 80 percent forested (Karan and Mather 1977). Sixty three percent of the land in McCreary County and 19 percent of the land in Whitley County is National Forest System land (Alerich 1990). The primary use of National Forest System land is timber production; however, the land also is used for recreation and wildlife management. McCreary County contains one of two designated wilderness areas within the DBNF, Beaver Creek Wilderness Area.

Less than five percent of the area of McCreary and Whitley counties is used for agriculture (Mayes, Sudderth and Etheredge, Incorporated 1975). Agricultural land in these counties primarily is used for hay/pasture, corn and tobacco (Kentucky Agricultural Statistics Service 1991).

Less than one percent of the land area of McCreary and Whitley counties is used for mining (Mayes, Sudderth and Etheredge, Incorporated 1975). While deep mining was more common between 1930 and 1950, strip mining is now more common in these counties. In McCreary County, mining is concentrated near Strunk and Whitley City. In Whitley County, mining is most common between Corbin and Williamsburg and south of Williamsburg (Soil Systems, Incorporated 1980).

In Whitley County, the major employers are Gatliff Coal and Cumberland College. There is only light industry in this county, e.g. plastics production and textile production (R. Deaton pers comm). The major employers in McCreary County are American Bag, which manufactures automobile airbags, and McCreary Manufacturing, which assembles shirts. The other major employers in McCreary County also produce textile products (A. Waters pers comm).

2. Local

The largest developed area within the Cumberland Wild River Corridor is Cumberland Falls State Park. The park includes a lodge, cabins, campground and other recreational facilities. The park has been in existence since 1930. A portion of the park, including Cumberland Falls, has been dedicated as a State Nature Preserve. Dedication legally protects land from development and other destructive land uses.

The only other developments within the corridor are in bottomland areas at the southern end of the corridor. Several of these areas have been cleared for agriculture, and there are houses and barns associated with these farms.

Approximately 1,800 acres (728 ha) within the wild river corridor are National Forest System lands managed by the USFS. The USFS primarily uses an even-aged system of timber harvesting within the Daniel Boone National Forest (DBNF) (USFS 1985). Four types of timber management areas have been identified within the DBNF, yellow pine, white pine, upland hardwood and cove hardwood. These areas are cut on a 50-100 year rotation, with intermediate thinning cuts to select for certain species and promote higher growth rates in the remaining trees. The management plan for the DBNF states that the maximum area for a clearcut will be 40 acres (16 ha) with at least 330 ft (100 m) between cut areas (USFS 1985). There are no planned timber sales within the Kentucky Wild River corridors on the DBNF for the remainder of the Land and Resource Management Plan period unless otherwise amended (USFS 1994)(Appendix A). A 14.9 mi (23.9 km) segment of the Cumberland River from Cane Creek to 4 mi (6.4 km) downstream from the falls has been nominated for inclusion as a National Wild and Scenic River (USFS 1994). If this section of the river is included in the National Wild and Scenic River System, a management guide will be developed to provide direction and become part of the Land and Resource Management Plan by amendment. Salvage sales may be conducted as necessary in the event of some disaster such as fire, insect, disease or weather related damage (USFS 1994). The management of National Forest System lands will be according to the Land and Resource Management Plan (USFS 1985).

A concentration of past logging activity is reported from two areas within the corridor (Soil Systems, Incorporated 1980). Several Pine-Oak and Appalachian Subxeric communities between Crow Shoals and Bee Shoals on both sides of the river were clearcut between 1973 and 1977 (Soil Systems, Incorporated 1980). Several Appalachian Subxeric and Pine-Oak communities on the southeast side of the river near Slick Shoals

were clearcut between 1943 and 1953 (Soil Systems, Incorpoprated 1980). In addition to these two areas of logging activity, the forests on the McCreary County side of the river between Slick Shoals and McKee Bend are reported to be in poor condition. This is the combined result of high grade logging and past fires (Soil Systems, Incorporated 1980). Past timber harvests within the corridor have primarily been above the cliffline where access and timber removal are easier.

Eleven fires have been recorded within the Cumberland Wild River Corridor, six within the Stearns Ranger District portion of the corridor (M. Melton pers comm), five within the London Ranger District portion of the corridor (J. Strojan pers comm) and none within the Somerset portion of the corridor (J. Stephens pers comm) (Fig. 5). None of these fires damaged a large area of forest and it is suspected that all were acts of arson. There also is evidence that a bluff top between Marsh Creek and the Cumberland River has experienced fires in the recent past. Trees in this pine savanna community show scars from past fires (M. Shea personal observations).

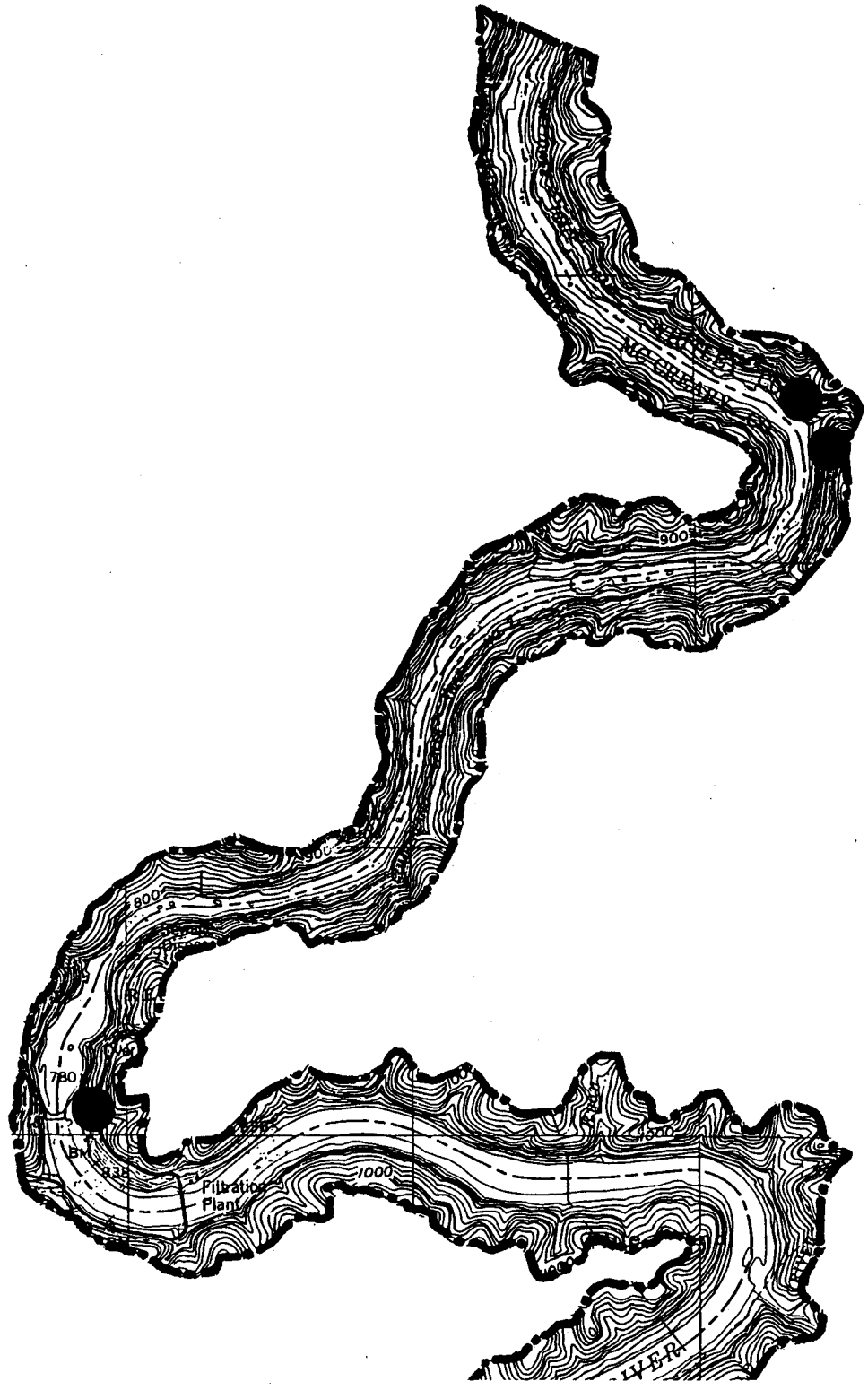
The DBNF has adopted a Cliffline Management Policy to protect essential habitat for rare bat species and other rare species associated with the clifflines (USFS 1990). Although rare bat species are not known from the cliffs of the Cumberland Wild River Corridor, five occurrences of a federal candidate plant species, *Ageratina luciae-brauniae*, are found along the cliffs downstream from Cumberland Falls (Kentucky State Nature Preserves Commission [KSNPC] 1993). The Cliffline Management Policy requires that the area 50 feet from the dripline of the cliff remains undisturbed. This policy also stipulates that an area of undisturbed forest is left above the cliff to maintain the hydrological conditions of the site (USFS 1990). Most recent clearcuts in the area are above the cliffline and outside of the wild river corridor.

Riparian areas, floodplains and wetlands are managed to comply with Presidential Executive Orders 11988, 11990, USFS policy and Congressional mandates (USFS 1985). Appropriate area of undisturbed forest, based on soil type and slope, are be left adjacent to rivers and streams to maintain thermal insulation and to provide a filter strip.

B. Archaeology

1. Prehistoric Perspective

A number of features of the Cumberland Wild River Corridor made the area desirable to prehistoric people. The forest provided wild game and plants as a source of medicine and food. The river provided water, fish and shellfish, and transportation. The many rockshelters that are found in the cliffs that line this section of the Cumberland River provided shelter. Thus, despite the rugged terrain, people have been drawn to this area for centuries.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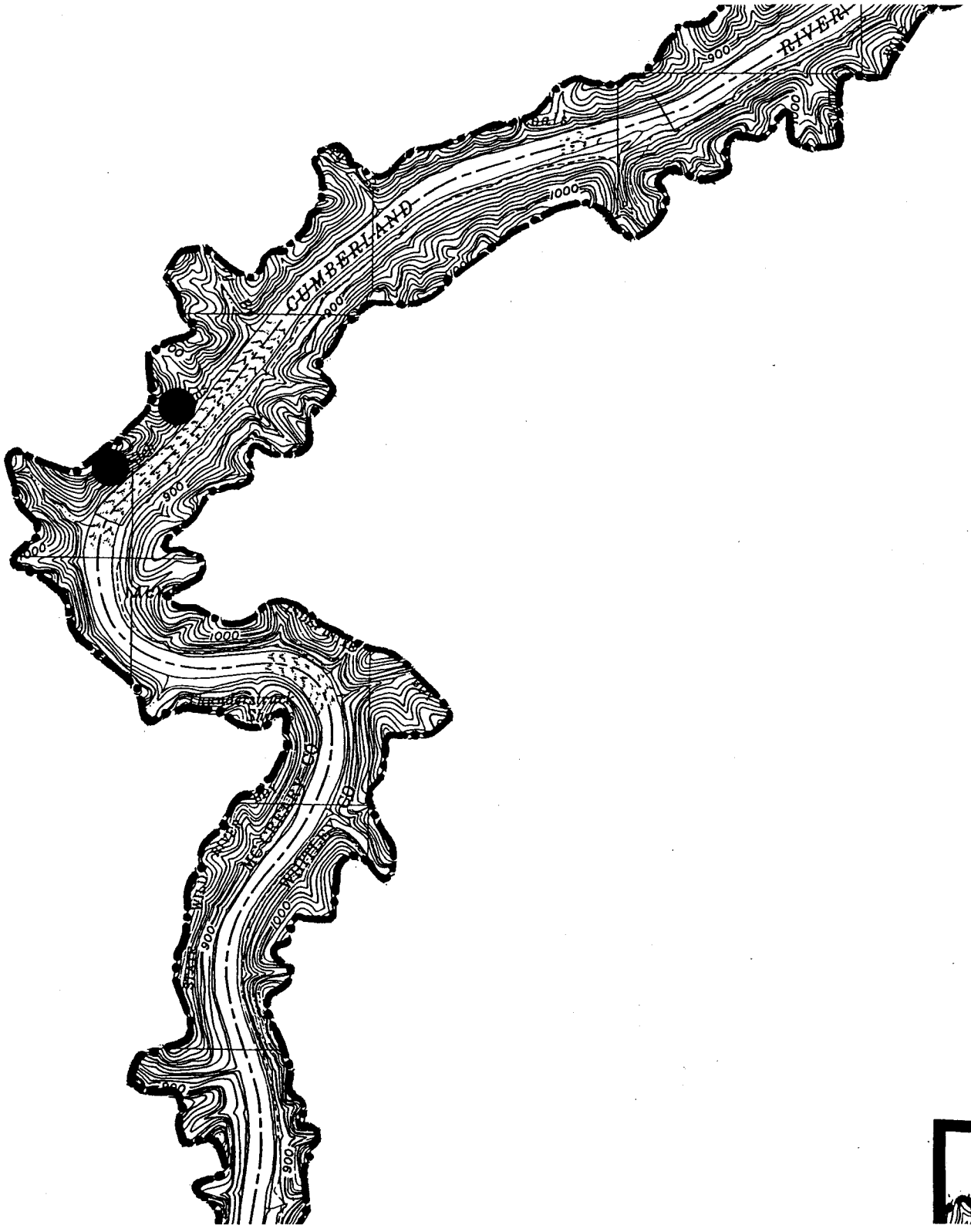

FIGURE 5. Location of fires reported within the Cumberland Wild River Corridor since 1970.

Fire Occurrence ●

Wild River Corridor Boundary —·—·—

Scale 1:24,000

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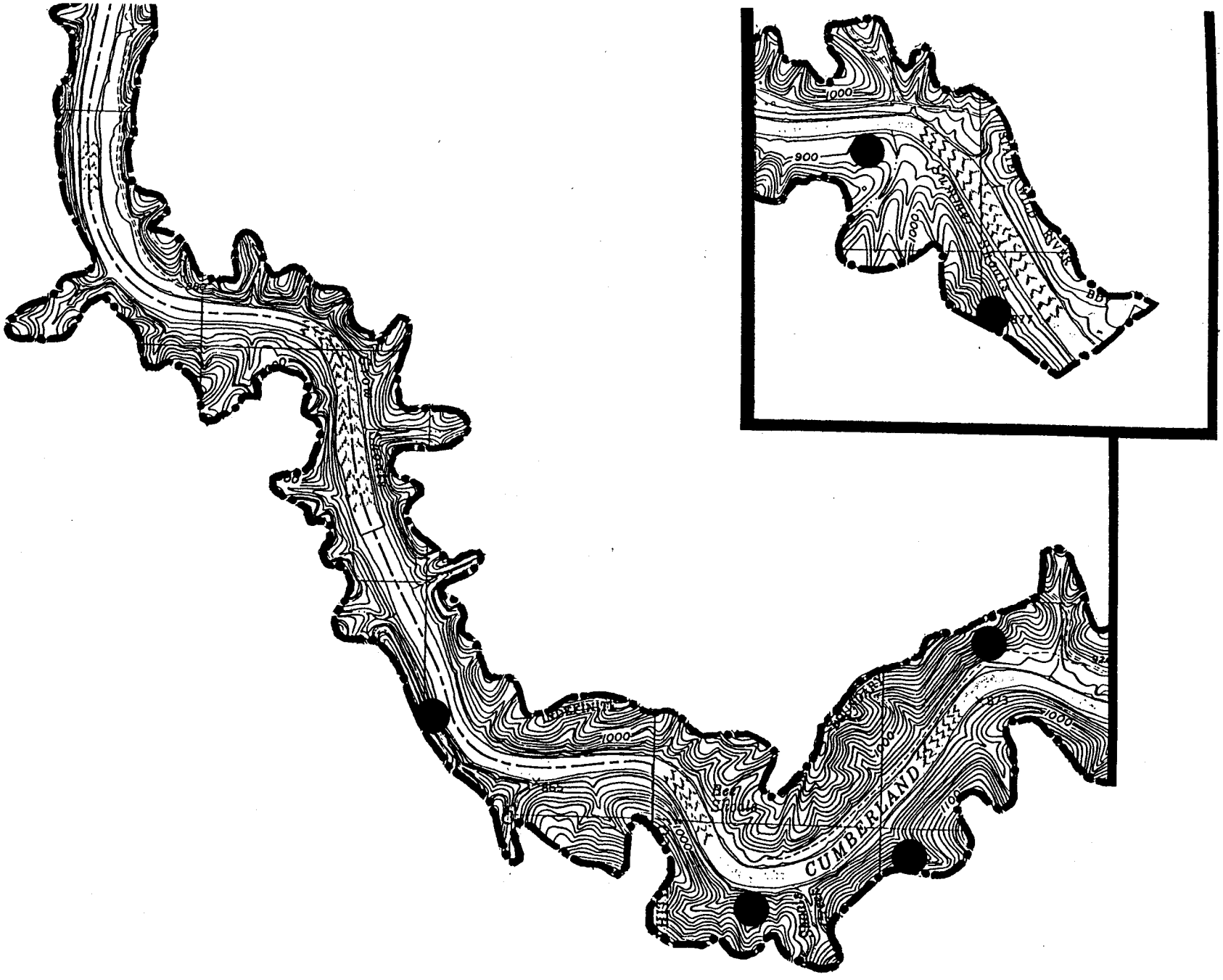

1000
900
CUMBERLAND
Red Bird
Creek

a. Regional

The Kentucky Heritage Council has divided the state into seven management areas based on major drainages and landform divisions. The Cumberland Wild River Corridor is within the Upper Cumberland Management Area. The Upper Cumberland Management Area includes the drainage of the upper Cumberland River from its headwaters in Harlan to the point where it crosses into Tennessee. A total of 1,132 archaeological sites have been recorded within this management area (Pollack 1990).

There were five major archaeological periods in Kentucky during prehistoric times: the Paleoindian, Archaic, Woodland, Mississippian and Fort Ancient periods. The Upper Cumberland Management Area of Kentucky contains sites from all periods but Fort Ancient (Pollack 1990).

Paleoindian Period (ca. 9500 BC - 8000 BC)

Paleoindians are the first people known to have lived in Kentucky. Because they were nomadic big-game hunters and gatherers, they left little cultural material. Projectile points and some tools are the evidence of their presence in Kentucky (Niquette and Henderson 1984). During this period, the last of the Pleistocene glaciers advanced and retreated. The climate in Kentucky was cooler and moister than it is now; however, toward the end of the period, climate was warming and the vegetation was changing from coniferous forests and grasslands to mixed deciduous hardwood forests, and the Pleistocene megafauna was becoming extinct (Pollack 1990).

There are no known Paleoindian sites reported from the Cumberland Wild River Corridor. However, there are 16 Paleoindian sites reported from the Upper Cumberland Management Area (Pollack 1990). Three of the sites are caves (Gatus 1983) and the remaining sites are from open habitation (Flanagan 1970, Foster and Schock 1976, Turnbow and Allen 1977, Allen and Griffin 1978, Gatus 1983).

Archaic Period (8000 BC - 1000 BC)

The people of this period were semi-nomadic hunters and gatherers; however, they travelled less than the Paleoindians and made more thorough use of all the resources in a smaller area. Wisconsin glaciation in North America had ended, and the climate by the end of the period was similar to today's. Group size increased during the period and ceremonies, especially those related to burials, became more important. Regionalization of cultures increased during this time, which is reflected in regional projectile point styles. The cultivation of local plants and animals began during this period, and a wider variety of tools was developed (Niquette and Henderson 1984, Pollack 1990).

Although no Archaic sites have been reported from the Cumberland Wild River Corridor, there are 121 Archaic sites known from the Upper Cumberland Management Area. This constitutes 6 percent of the known Archaic sites in Kentucky (Pollack 1990). Approximately 75 percent of the sites are in open habitation, approximately 20 percent of the sites are in rockshelters and approximately 3 percent of the sites are caves (Pollack 1990).

Woodland Period (1000 BC - 1000 AD)

During this period, gardening, hunting and gathering were used to obtain food. The technology of horticulture was developed during this period. Hunting was still important to survival, and it is thought that the bow and arrow were developed during the Woodland Period. A distinctive characteristic of this period is the appearance of fired ceramics which were usually cord-marked or fabric-impressed. Mortuary ceremonies became more elaborate throughout this period (Niquette and Henderson 1984, Pollack 1990).

Although no Woodland sites have been reported from the Cumberland Wild River Corridor, there are 123 Woodland sites in the Upper Cumberland Management Area. Open habitation sites make up 55.3 percent of the sites in this area and rockshelters account for 34.1 percent of the sites (Pollack 1990).

Mississippian Period (900 AD - 1700 AD)

Planned towns and complex social and political systems developed during the Mississippian period. These people were hunter-gatherer-farmers and represent the peak of prehistoric Indian culture in eastern North America (Niquette and Henderson 1984). There are 13 known sites from this period in the Upper Cumberland Management Area. Seventy six point two percent are open habitation sites, 15.4 percent are rockshelters and 7.7 percent are caves (Pollack 1990).

Fort Ancient Period (1000 AD - 1750 AD)

The people of this period focussed on the cultivation of corn and beans and were also hunters and fishers. They were only found in the eastern third of Kentucky, primarily residing in uplands along major drainages. Unlike the Mississippian cultures, they had no complex local and regional system of settlement. Their style of ceramics, tempered with shell, is a distinguishing feature of the group. There are no known sites from this period in the Upper Cumberland Management Area (Pollack 1990).

b. Local

A total of 46 prehistoric sites were located during an intensive survey of the wild river corridor completed in 1980 (Soil Systems, Incorporated 1980). No additional sites have been located since that time (C. Isom pers comm). Bottomlands, ridgetops and clifflines within the corridor were surveyed. The majority of the sites that were located, 40 of the 46 total sites, were in rockshelters along the clifflines. Three of the remaining sites were in bottomland areas, one was a stone mound and two were isolated finds. No sites were discovered on ridgetops. Rockshelters that were occupied were usually south-facing, dry and close to a source of water (Soil Systems, Incorporated 1980). Most of the rockshelter sites were used for specific activities such as processing game, making tools or overnight camps. A few of the large rockshelters were seasonal, repeatedly occupied habitation sites.

Evidence from the prehistoric sites that were discovered suggests that the Cumberland Wild River Corridor was occupied during the Archaic, Woodland and Mississippian periods (Soil Systems, Incorporated 1980). Additional information on specific sites can be found in the 1980 Environmental Inventory of the Cumberland Wild River (Soil Systems, Incorporated 1980).

c. Protection Needs

Two prehistoric sites that were discovered on state park property were tested and determined to be appropriate for nomination to the National Register of Historic Places. In addition, 13 sites on National Forest System lands have not been tested but are potentially eligible for nomination to the National Register of Historic Places (Soil Systems, Incorporated 1980). It is recommended that the two sites that were determined to qualify for National Register nomination should be nominated. As personnel and funding allow, further investigation should be made of the 13 sites on National Forest System lands to determine if they qualify for National Register nomination. However, until they can be properly evaluated, USFS will afford these sites the same protection as if they were listed on the National Register of Historic Places

The most severe threats to the archaeological sites within the wild river corridor are illegal digging by artifact hunters and construction of roads and campsites. Trail construction can indirectly threaten the sites by making access easier for artifact hunters. Any development within the corridor should first take the significant archaeological sites into consideration. If disturbance of a site is unavoidable, the material should first be excavated.

In order to discourage artifact hunters, information on the importance of these archaeological sites and the illegality of artifact hunting should be publicized by the state park and the USFS. An attempt should be made to reduce visits to

the rockshelters by posting information on the dangers associated with rockshelters and by routing new trails away from rockshelters when possible.

III. NATURAL RESOURCES

A. Physiography

The wild river corridor is within the Cumberland Plateau Section of the Appalachian Plateaus Physiographic Province (Fenneman 1938). The Appalachian Plateaus Province was originally a narrow band of flooded mountains during the Cretaceous Period. Over time, the mountains have been destroyed and uplifted repeatedly. The center area of the province is now lower than its margin in many places (Fenneman 1938).

The Cumberland Plateau Section covers the southern half of eastern Kentucky (Fenneman 1938) and is characterized by rolling hills dissected by the erosive action of rivers and streams. The Cumberland Wild River Corridor is within the Cliff Section of the Cumberland Plateau Section (Braun 1950). Huge cliffs of Pennsylvanian age sandstone dominate the Cliff Section.

B. Topography

Elevation within the wild river corridor ranges from 740 ft (225 m) to 1300 ft (400 m). The average depth of the river valley is 250 ft (75 m) upstream of the falls and 350 ft (107 m) downstream. The stream channel averages 300 ft (90 m) wide above the falls and is only 150 ft (45 m) wide below the falls. Although floodplain areas are rare throughout the wild river corridor, the few floodplain areas occur almost exclusively upstream from the falls.

C. Geology

1. Regional Geology

The Appalachian Plateaus Physiographic Province is underlain by Pennsylvanian-aged rock; sandstones with some conglomerates, shales and moderate amounts of coal. In addition to flowing water, rock type, jointing, undercutting and gravity have contributed to the large amount of erosion in this area. Due to its resistance to erosion, sandstones are frequently found at the surface. This physiographic province in Kentucky is rich in coal, natural gas and petroleum (Karan and Mather 1977).

2. Site Geology

Bedrock within the wild river corridor belongs to the Pennsylvanian Period, which dates from 280 to 310 million years ago. Rock types all belong to the Lee formation and include sandstone, conglomerate, shale and coal (Smith 1963). These rock types are sedimentary, formed when sediments washed from land and spread out on the bottom of the sea or over lowlands.

Seven unnamed units of sandstone and shale of the Lee Formation cover the majority of the corridor (Smith 1963). Rockcastle Conglomerate also is an important member of the Lee Formation within the corridor (Smith 1963). The Cumberland River flows for approximately 7 mi (11 km) over this sandstone, and it is the physical makeup of this rock that resulted in the formation of Cumberland Falls (Soil Systems, Incorporated 1980). Corbin sandstone and Beattyville Shale, other members of the Lee Formation, are exposed infrequently within the wild river corridor (Smith 1963).

Outcrops of coal are found in several areas within the corridor: in roadcuts on both sides of Cumberland Falls, along Indian Creek and at the mouth of Marsh Creek (Soil Systems, Incorporated 1980). The coal within the corridor is not considered to be economically important due to the depressed price of coal, its high sulfur content and access difficulty (USFS 1994).

In addition to coal, natural gas and oil deposits are present within the corridor; however, quantities of these mineral resources are reported to be low (USFS 1994).

D. Climate

1. Regional Climate

The Appalachian Plateaus Physiographic Province is classified as humid mesothermal, characterized by a mild, temperate rainy climate with no distinct dry season (Trewartha 1954). Precipitation in this region is generally a result of moisture bearing low pressure formations which move from the western Gulf of Mexico and travel in a northeasterly direction across Kentucky (Trewartha 1954). Fall is the driest season and spring is the wettest season within this region (Trewartha 1954). This portion of the state has the highest number of rainy days, averaging 150 days/year with precipitation (Karan and Mather 1977).

Climate information is from Williamsburg, Kentucky, approximately 14 mi (23 km) southeast of the wild river corridor, and is averaged over the years 1961-1990. The average temperature is 56° F (13.3° C), average July temperature is 75.3° F (24° C) and average January temperature is 34.2° F (1.2° C). The average number of frost free days is 178 and the average annual precipitation is 4.2 ft (1.27 m) with 0.7 ft (0.2 m) as snow (Kentucky Climate Center 1992).

2. Microclimates

Although the climate of the Cumberland River Valley within the wild river corridor has not been documented, some generalizations can be made about this area. The presence of a large volume of water and surrounding steep cliffs have a significant effect on the climate of the wild river corridor. The presence of a large quantity of water acts to moderate extremes of temperatures and also increases the local humidity. The steep cliffs that surround much of the gorge limit the sunlight that reaches the river valley and

can result in a cooler climate. However, south and west-facing slopes, receiving the force of prevailing winds and direct sunlight, will be warmer and drier.

E. Hydrology

1. Surface Water

The wild river segment of the Cumberland River is a sixth order stream (Soil Systems, Incorporated 1980), which drains nearly 2000 mi^2 (5200 km^2) (Mayes, Sudderth and Etheredge, Incorporated 1975). Approximately 84 percent of the drainage above the wild river is forested, with about 13 percent used in some type of agriculture operation, 2.5 percent used for mining, and 0.5 percent in urban type development (Mayes, Sudderth and Etheredge, Incorporated 1975). According to Miller/Wihry/Lee, Incorporated (1980) the portion of the wild river from Summer Shoals to Cumberland Falls has an average gradient of three feet per mile (0.6 m per kilometer). The area is characterized by long, moderately-deep, sluggish pools interspersed with large shallow shoals. The stream width ranges from 65 to more than 200 feet (19.5 to more than 60 meters). From Cumberland Falls downstream, the character of the stream changes dramatically. Under average flow conditions the falls are approximately 125 feet (37.5 meters) across and drop 67 feet (20.1 meters) (Miller/Wihry/Lee, Incorporated 1980). The stream below the falls narrows, ranging from 40 to 80 feet (12 to 24 meters) wide, and has an average gradient of 12 feet per mile (2.25 meters per kilometer) (Sehlinger 1978). In this area of the river, the pools are smaller and faster flowing; riffles are steep and cascading in some locations. Large boulders are scattered throughout this reach.

The United States Geological Survey (USGS) maintains a gaging station on the Cumberland River directly above Cumberland Falls. The hydrological information presented below was taken from (United States Geological Survey [USGS] 1993).

The annual mean discharge for the period of record is 3170 cubic feet per second (cfs). The period of record is from August, 1907 to December 1911 and from October, 1914 to the present. The highest annual mean discharge was 5196 cfs in 1927. The lowest annual mean discharge of 1324 cfs occurred during the drought of 1988. The highest daily mean discharge of 57,500 cfs occurred on January 18, 1918, while the lowest daily mean discharge of 4.0 cfs occurred on September 19, 1954. The present 7Q10 is 23 cfs (Ruhl and Martin 1991).

Average discharges are the greatest in the winter and spring, when they range between 3,000 to 12,000 cfs; they are the least in the summer and fall, ranging between 500 to 3,000 cfs (Miller/Wihry/Lee, Incorporated 1980). The large and predominately forested watershed and local springs provide the wild river segment with good low flow characteristics (Mayes, Sudderth and Etheredge, Incorporated 1975).

Published water quality data on the wild river segment is confined to a few sources. Kirkpatrick et al. (1963), Mayes, Sudderth and Etheredge, Incorporated (1975),

and Soil Systems, Incorporated (1980) provide limited water quality information. The USGS (1993) has flow and limited water quality data back to 1907. KDOW's (1992) Report to Congress on Water Quality, based on water quality and biological data collected from an ambient water quality station above Cumberland Falls, lists the wild river segment as meeting designated uses which are warmwater aquatic habitat (WAH), primary contact recreation (PCR), secondary contact recreation (SCR) and outstanding resource water (ORW). The KDOW and National Park Service (1992) conducted a statewide rivers assessment using ten major categories. These categories ranged from water quality based parameters to aesthetic based parameters. The wild river corridor scored highly in seven of the ten categories, reflective of the unique character of this river segment.

Only three permitted dischargers release treated domestic waste to the Cumberland River or tributary streams that flow into the wild river segment (Table 3). The Kentucky Department of Parks Wastewater Treatment Plant (WWTP) at Cumberland Falls State Resort Park (CFSRP) is the largest, with a design flow of 192,000 gallons per day (gpd). This plant only affects the lower portion of the wild river segment because it discharges to the river approximately 0.4 mi. downstream of the falls. The City of Williamsburg with a permitted discharge of 800,000 gpd, discharges at milepoint 589.4. This is the only major point source discharger within fifty miles of the wild river segment. Nutrients from the Williamsburg WWTP and non-point sources are believed to contribute to abundant algal growth observed at stations 18-2 and 18-3 during this study (see section IV).

TABLE 3. List of Active Permitted Dischargers to Cumberland River (303e Segment 02018)(gpd-gallons per day).

Name	County	Designed Flow (gpd)	Receiving Stream
Eagle Elementary School	McCreary	5,000 gpd	UT-Eagle Creek
Ky. Dept. of Parks	Whitley	192,000 gpd	Cumberland River
Holiday Motor Lodge	McCreary	6,000 gpd	Falls Branch

According to STORET, a national computerized water quality information system operated by the United States Environmental Protection Agency (USEPA), (1983-1993) bacteriological data, fecal coliform contamination of the wild river segment occurs sporatically. The origin of this contamination is believed to be from point and non-point sources upstream. A recent bacteriological study conducted in July and August, 1993 showed no fecal coliform contamination immediately upstream of the wild river segment. Thus, the wild river segment generally meets primary contact recreation (PCR) and secondary contact recreation (SCR) criteria.

Approximately 84 percent of the Cumberland River basin from the Wild River section upstream is forested (Mayes, Sudderth and Etheredge, Incorporated 1975). Silvicultural operations are common throughout the drainage. Those silvicultural operations occurring in the Daniel Boone National Forest are required to employ best management practices which are designed to minimize adverse water quality impacts (USFS 1985). However, logging operations on private lands are not required to follow any such standards, and this can cause serious negative stream impacts.

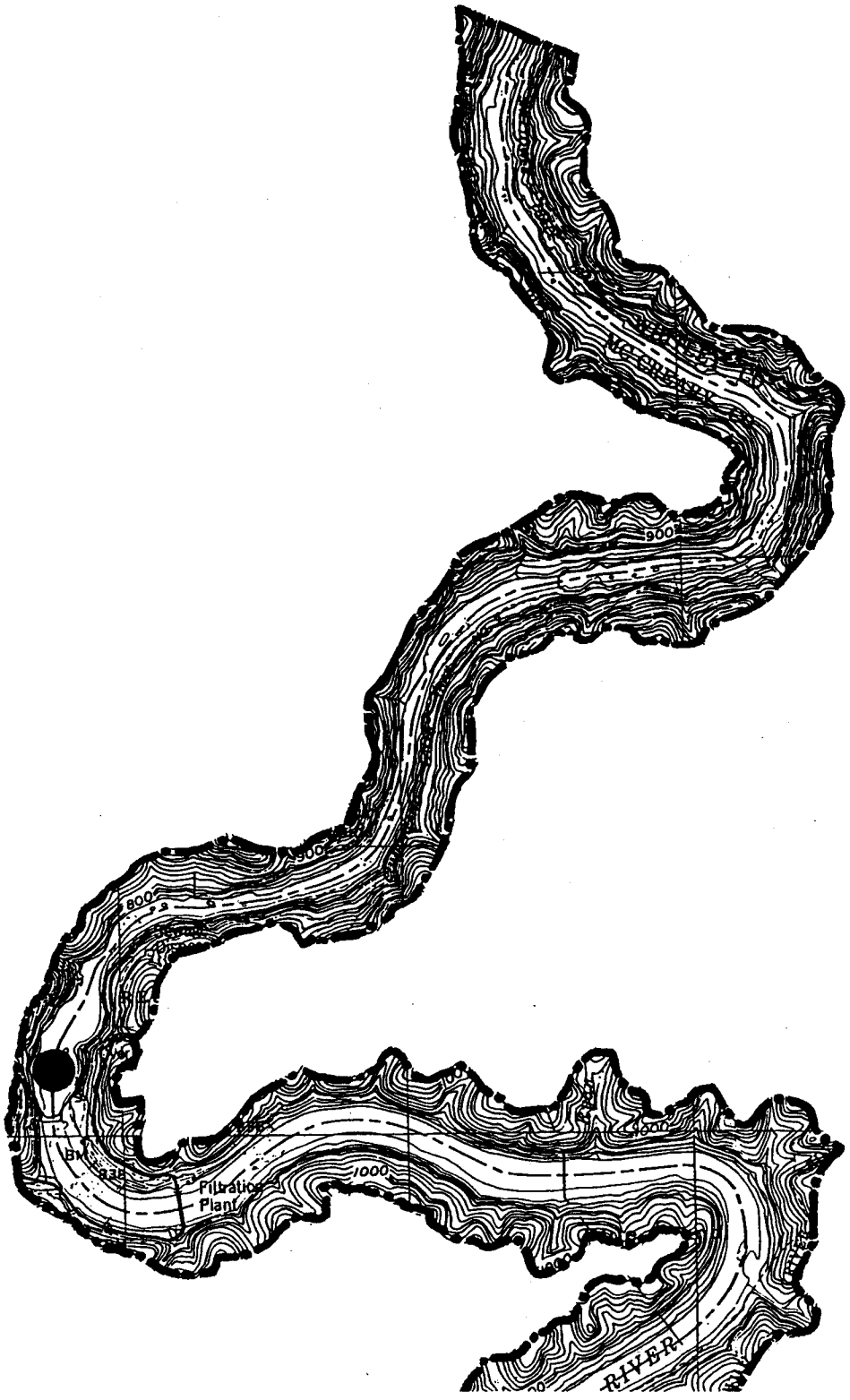
a. Methods

A water quality survey was conducted in late July and early August, 1993, by the Kentucky Division of Water (KDOW) with the help of the Kentucky State Nature Preserves Commission (KSNPC)(KDOW 1994). Three stations were established in the wild river portion of the Cumberland River (Fig. 6). These three stations were sampled once during a low flow period. The location of these stations, dates sampled and parametric coverage are given in Appendix B. Field physicochemical data were taken with a Yellow Springs Instruments Water Quality Logger, Model 3800 in accordance with manufacturer's instructions. Physicochemical samples, collected for laboratory analysis, were done so in accordance with KDOW standard operating procedures (1993).

The purposes of this investigation were to determine if this segment was meeting its designated stream uses and to compile background water quality for this segment. The Cumberland Wild River Corridor is presently designated by the Kentucky Department for Environmental Protection for warmwater aquatic habitat (WAH), primary contact recreation (PCR), secondary contact recreation (SCR), domestic water supply at the point of withdrawal (MP 562.6), and outstanding resource water (ORW) uses. The ORW designation is a reflection of the wild river status.

b. Results

Physicochemical data were collected by KDOW in July and August, 1993 during a low flow period. Analyses were conducted on 37 parameters (Table 4). These data were compared to STORET (1983-1993) physicochemical data (Appendix C) and Kentucky Surface Water Standards



18-1

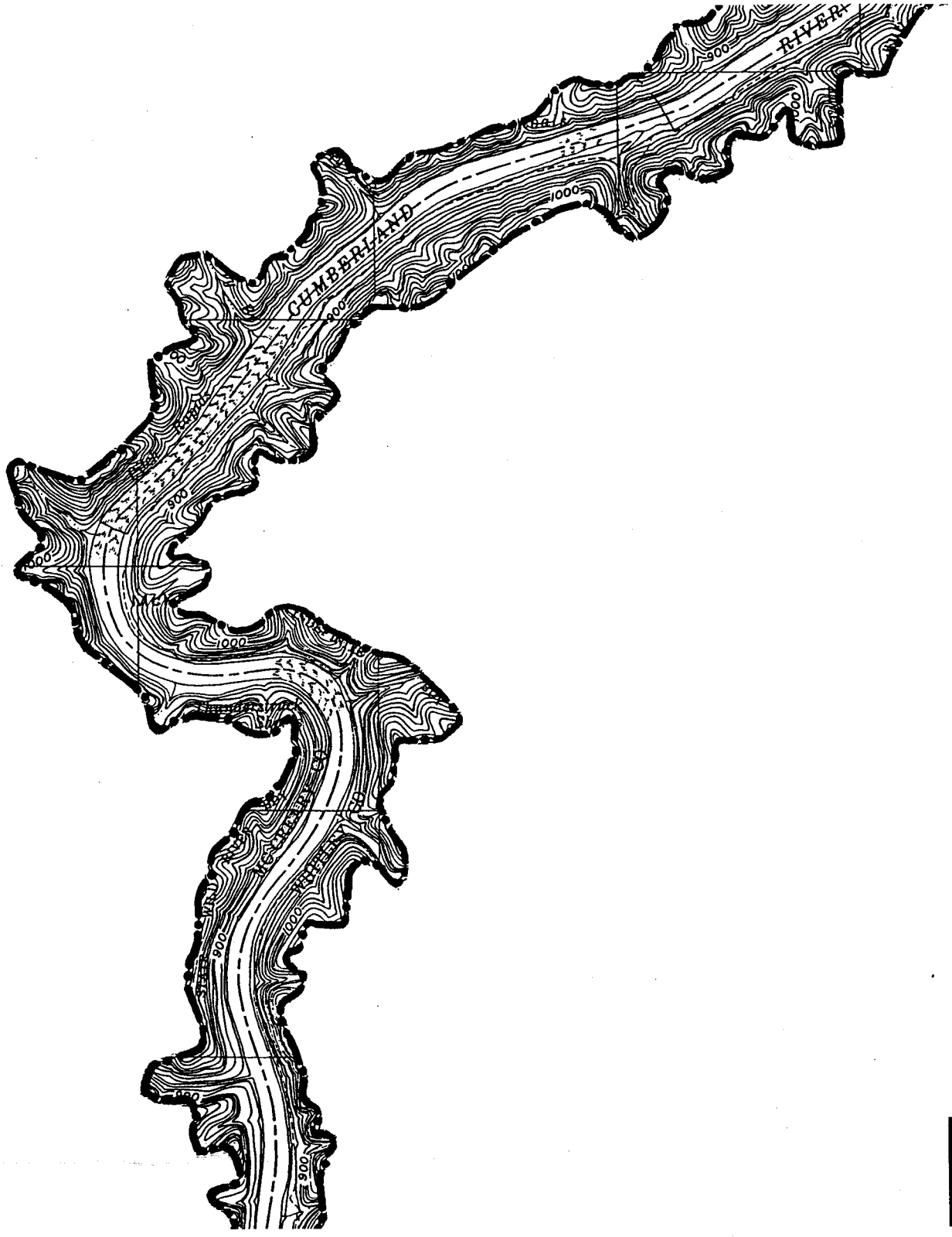


FIGURE 6. Aquatic sampling sites within the Cumberland Wild River Corridor.

Sampling Site ●

Wild River Corridor Boundary —·—·—

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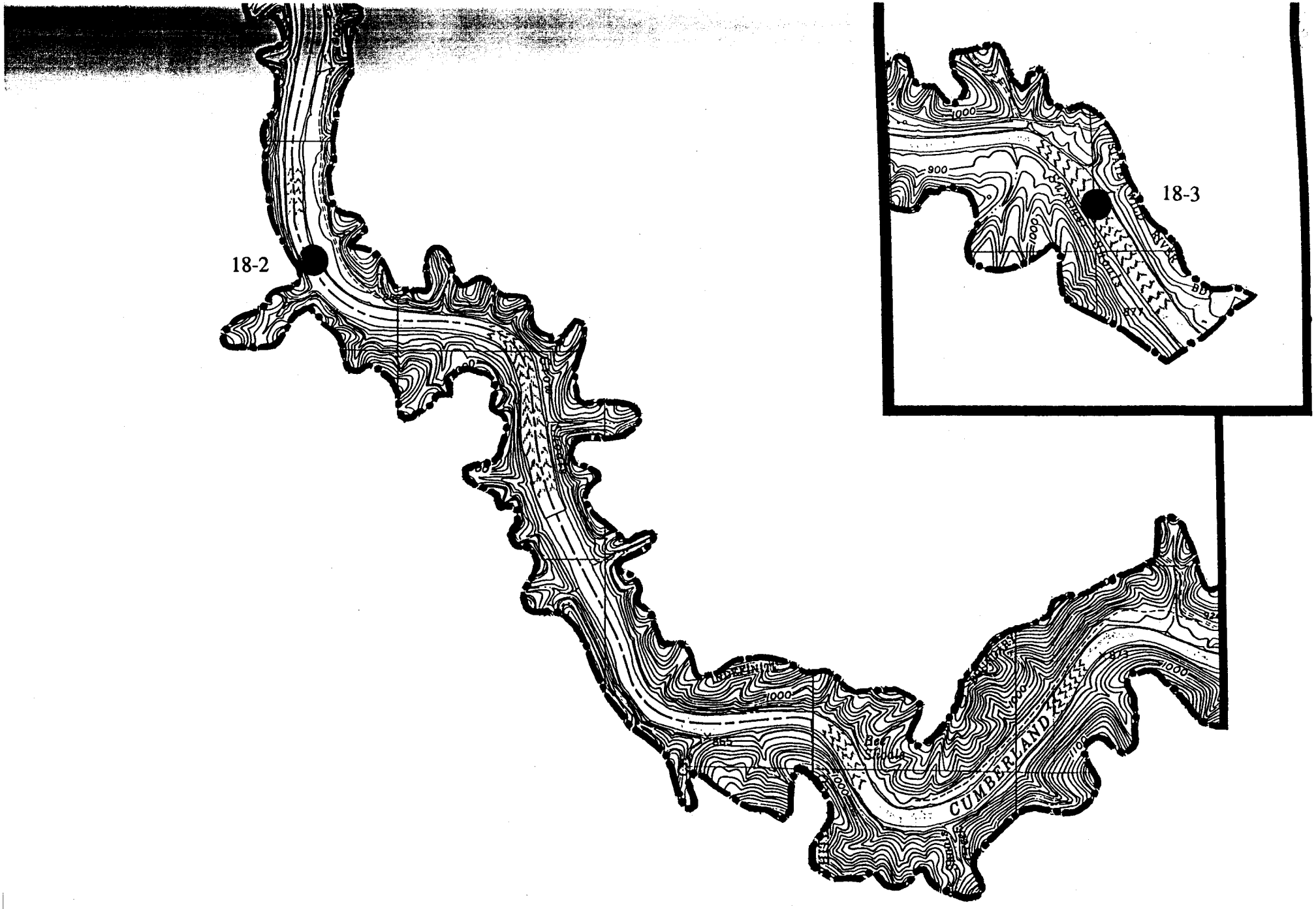

18-2
18-3
CUMBERLAND

(KSWS) found in 401 KAR:031. STORET is designed for the storage and retrieval of water quality data which, in Kentucky, are derived from 52 monitoring stations, 45 of which are currently active. The STORET data base used in this report was from 1983 to the present. Any parameter that exceeds the STORET (1983-1993) 75th percentile or a KSWS chronic or acute criteria is considered elevated and a potential problem parameter.

TABLE 4. Physicochemical Data for the Wild River Section of the Cumberland River, July and August, 1993.

	Stations		
Parameter (mg/l)*	**18-1**	**18-2**	**18-3**
Acidity	ND @ 0.1	0.7	ND @ 0.1
Alkalinity	92.9	153+	102
BOD5	ND	0.9	ND
Chloride	8.5	9.8	8.2
Conductivity (umhos/cm)	544+	523+	546+
Fluoride	0.16+	0.15	0.17+
Hardness, total	13.6	153	12.9
pH (SU)	8.2+	8.1+	8.3+
Total Suspended Solids	2	ND @1	4
Total Dissolved Solids	362+	413+	361+
Sulfate	151+	130+	145+
Organic Carbon	2.9	2.8	2.9
Turbidity (NTU)	2.8	3.4	4.0
Ammonia-Nitrogen	ND @0.05	ND @ 0.05	ND @ 0.05
Total Kjeldahl Nitrogen	0.151	ND @ 0.05	0.180
Nitrate	0.063	0.562	0.133
Phosphorus, ortho	ND	ND @ 0.005	ND
Phosphorus, total	0.019	ND @ 0.005	ND @ 0.005
Calcium	35.6	33.1	32.6
Magnesium	20.3+	17.6+	18.8+

TABLE 4. Physicochemical Data for the Wild River Section of the Cumberland River, July and August, 1993.

	Stations		
Parameter (mg/l)*	**18-1**	**18-2**	**18-3**
Potassium	4.01+	3.95+	3.91+
Sodium	39.6+	46.5+	44.5+
Aluminum	0.089	0.053	0.101
Arsenic	ND @0.002	ND @ 0.002	ND @ 0.002
Barium	0.044	0.052	0.044
Beryllium	ND @ 0.001	ND @ 0.001	ND @ 0.001
Cadmium	ND @ 0.001	ND @ 0.001	ND @ 0.001
Chromium	0.001	0.001	0.001
Copper	0.006+	0.005	0.004
Iron	0.130	0.120	0.128
Lead	0.002	ND @ 0.002	ND @ 0.002
Manganese	0.067	0.047	0.058
Mercury	ND @ 0.0001	ND @ 0.0001	ND @ 0.0001
Nickel	ND @ 0.002	ND @ 0.001	ND @ 002
Selenium	ND @ 0.002	ND @ 0.002	ND @ 002
Silver	ND @ 0.001	ND @ 0.001	ND @ 0.001
Zinc	0.015	0.032+	0.027

*Parameters in mg/l unless otherwise stated.
+Parameters that exceeded the STORET (1983-1993) 75th percentile.
ND - Not Determined

The physicochemical parameters listed in Table 5 were taken in the field during this study by KDOW personnel. These data were collected in August, 1993, during a low flow period. Dissolved oxygen levels did not violate KSWS, although the percent saturation was 90 percent or less at all stations. Generally, percent saturation approaches 100 percent in lotic (moving water) systems; however, the elevated water temperatures and low flow conditions probably account for the reduced saturation values. Conductivity and pH values are considered elevated. This is probably the result of upstream

activities.

Water quality data for the wild river corridor are presented by Kirkpatrick et al. (1963); Mayes, Sudderth and Etheredge, Incorporated (1975); Soil Systems, Incorporated (1980) and STORET (1983-1993). The USGS (1993) publishes conductivity, temperature, and discharge measurements. However, with the exception of the STORET (1983-1993) data, the physicochemical data are limited and should be considered primarily for historical purposes. For the purpose of data analysis, this report will concern itself with the STORET data from 1983 to 1993 and the data collected during this study.

TABLE 5. Field Physicochemical Data from Wild River Segment of the Cumberland River.

	Stations		
Parameter	**18-1**	**18-2**	**18-3**
Dissolved Oxygen (mg/l)	6.6	6.8	7.0
Percent Saturation (%)	83.2	82.7	90.0
pH (SU)	8.7	8.5	8.8
Conductivity (umhos/cm)	378	508	550
Salinity (ppt)	0.2	0.2	0.3
Water Temperature (°C)	26.3	24.7	27.5
Turbidity (NTU)	18	20	28

STORET maximum, minimum, mean, 25th percentile, 50th percentile, and 75th percentiles data from 1983 to 1993 for the Cumberland River at Cumberland Falls are found in Appendix C. Data are presented for 30 parameters. A review of the data presented in Appendix C shows that sulfates were continually elevated above the STORET (1983-1993) 75th percentile. Since 1989, the mean annual iron values have exceeded the KSWS chronic criterion, indicating a decline in water quality from past years. Generally speaking, all parameters show seasonal fluctuations. The maximum values usually occur during the periods of high flow, i.e., winter and spring, while the minimum values generally occur during the lower flow periods of summer and fall.

Physicochemical data collected during this study indicate that at the time of collection, the water quality in the wild river segment was good. All stations have a similar number of parameters that exceeded the STORET (1983-1993) 75th percentile (18-1 with 9 elevated parameters, 18-2 with 10, and 18-3 with 8). These parameters are marked with a "+" beside the concentration in Table 4. Several of these parameters (alkalinity, conductivity, pH, magnesium, potassium, and sodium) are not considered detrimental to the aquatic community at the concentrations observed. No parameter at any station exceeded KSWS.

Elevated concentrations for conductivity, dissolved solids, sulfates, and iron are a reflection of drainage activities, principally coal mining. Mayes, Sudderth, and Etheredge Incorporated (1975); United States Army Corps of Engineers (1976) and Soil Systems, Incorporated (1980) note that coal mining is the most serious water quality impact in the upper Cumberland River system, causing increased siltation and dissolved constituents, such as sulfates and iron.

c. Sediment Evaluation

Sediment samples were taken from all three stations in the wild river corridor during July and August, 1993. Analyses were conducted on 17 parameters (Table 6). The data were compared to United States Environmental Protection Agency (USEPA) (1977) Great Lakes Harbor Sediment Guidelines and STORET (1983-1993) sediment data.
Any parameters that met or exceeded USEPA (1977) moderately or heavily polluted categories or exceeded the STORET (1983-1993) 75th percentile are considered potential problem constituents.

TABLE 6. Sediment Data for the Wild River Section of the Cumberland River, July and August 1993.

	Stations		
Parameter* (mg/kg)	**18-1**	**18-2**	**18-3**
Cyanide, total	ND @ 0.72	ND @ 0.85	ND @ 0.84
Oil and Grease	249.51	85.9	120.77
Total Volatile Solids %	26.5	13.0	12.7
Organic Carbon	4,490	24,900	10,500
Ammonia-Nitrogen	7.25	24.8	27.7
Total Kjeldahl Nitrogen	416	286	1,250
Aluminum	3,530	4,080	6,390

Arsenic	5.03	5.34	6.44
Cadmium	2.94	3.15	3.89
Chromium	7.80	5.78	12.4
Copper	14.2	ND @ 0.599	13.8
Iron	12,300	15,100	16,900
Lead	13.0	ND @ 4.64	17.3
Manganese	677	968	1,380
Mercury	0.083	0.077	0.089
Nickel	28.9	23.6	29.4
Zinc	55.5	44.0	64.3

*Sediment parameters in mg/kg unless otherwise stated.

According to U.S. EPA (1977) guidelines, two parameters (total volatile solids and manganese) were in the heavily polluted category at all stations, while arsenic and nickel were in the moderately polluted category. Total Kjeldahl nitrogen was in the moderately polluted range at station 18-3.

Using the STORET (1983-1993) data, the following parameters exceeded the 75th percentile at the listed stations:

oil and grease (18-1),
total volatile solids (all stations),
total Kjeldahl nitrogen (18-3),
arsenic (18-3),
cadmium (all stations), and
nickel (18-1 and 18-3).

Using the information generated from both U.S. EPA (1977) and STORET (1983-1993), station 18-3 sediments were the most contaminated, while station 18-2 has the least number of elevated constituents. However, most of the sediment parameters at all three locations were below levels of concern.

2. Ground Water

Groundwater is moderately plentiful within the wild river corridor. There are several potential aquifiers underlying the region containing the corridor, but only the two most shallow systems are of any real importance locally. These two systems, the water table aquifer and the Lee Formation aquifiers, intersect the valley walls along the Wild River Corridor.

Infiltration is generally lowest during the wet winter and spring season. At these times it averages about 0.05 inch per hour, but this may decrease to as low as 0.02 inch per hour. An infiltration loss of 0.10 inch per hour, following an initial loss of 1.00 inch or more, is typical during the summer and early fall (United States Army Corps of Engineers [USACOE] 1964).

Neither aquifer system can be considered highly productive, as witnessed by the lack of any major springs in the river valley. There is also a small amount of karst flow within the corridor (P. O'Dell pers comm). However, the number of small springs, some of which flow year-round, indicates a fairly dependable, if limited, groundwater availability.

The most shallow regional aquifer consists of weathered rock, soil, and alluvium and contains water under water table conditions. Potential yield is variable according to topography, aquifer thickness, and constituent materials. Wells located in valleys are usually capable of furnishing sufficient supplies for domestic needs. Water from this aquifer is usually good and soft to moderately hard, but it frequently has a high iron content.

Various sandstone layers within the Lee Formation also contain water of sufficient quality and quantity to provide domestic supplies. These layers, most notably the Rockcastle Conglomerate and the Corbin Sandstone, normally contain water in small openings along joint systems, fractures and bedding planes. Some groundwater also occurs in the interstitial openings of the medium- and coarse-grained sandstones (Kilburn et al. 1962; Mayes, Sudderth and Etheredge, Incorporated 1975). Water quality is usually good from this aquifer. As is common with many sandstone aquifers, the water is normally soft, but it has a noticeable iron content.

Groundwater sources within the valley of the wild river corridor are effectively limited to springs at the base of sandstone units, primarily the Rockcastle Conglomerate, and the water table aquifer present in the valley floor alluvium and colluvium. These two shallow sources supply wells in the corridor with volumes adequate for modern domestic use (500 gpd). The water qualilty of these is generally good. The moderate permeability and limited solubility of the Pennsylvanian rocks prevent the quality of groundwater in the corridor from being readily altered (Mayes, Sudderth and Etheredge, Incorporated 1975). Although harder than spring water in the corridor, the well water is relatively soft (125-225 ppm hardness) and low in salt content (0-10 ppm chloride and 10-25 ppm sulfate) (Mayes, Sudderth and Etheredge, Incorporated 1975).

3. Potential Effects of Mining on Hydrology

According to Mayes, Sudderth and Etheredge, Incorporated (1975) only 2.5 percent of the watershed above the wild river is used for coal mining. Even though only a small portion of land is used for mineral extraction, coal mining is the major source of pollution in the upper Cumberland River basin, contributing large volumes of sediment to the water, and causing it to remain turbid for long periods of time (USACOE

1976). Information presented by Mayes, Sudderth and Etheredge, Incorporated (1975) and KDOW (1981) shows that acid mine drainage is a major pollutant in the upper Cumberland River basin above the wild river section. According to Mayes, Sudderth and Etheredge, Incorporated (1975) data, three acid mine degraded streams, Marsh Creek, Jellico Creek, and Clear Fork, either discharge directly to, or upstream of the wild river section. During this study, large quantities of coal particles were observed throughout the wild river segment. Sand and sediment deposits were also common in depositional areas.

F. Geomorphology

1. Introduction

Geomorphology is the study of landforms and how they develop. The study of geomorphology includes factors from the fields of geology, geography, hydrology and climatology. The erosive action of the river has been an important factor in the formation of the landforms within the wild river corridor. Bedrock, elevation, climate and time have also contributed to the physical geology of the area.

2. Features and Descriptions

Cumberland Falls is probably the most distinctive feature within the wild river corridor. This waterfall is a "caprock" type, which forms at a point where a less resistant bedrock meets a more resistant bedrock. The weaker Mississippian-aged shales and limestones eroded leaving the more durable Pennsylvanian-aged sandstone and conglomerate. Cumberland Falls-originally formed 45 mi (72 km) downstream from its present location at a juncture between Lee sandstone and more erodable Mississippi shales and limestones. At one time the falls were approximately 500 ft (150 m) high. After the erodable shale wore away, the turbulent water at the base of the falls undercut the more resistent sandstone. As a result of this undercutting, rock at the edge of the falls periodically fell. This process moved the falls upstream. Several factors have currently slowed this upstream migration of the falls, including the very resistent Rockcastle conglomerate bedrock that is found at the current location of the waterfall (Soil Systems, Incorporated 1980).

Other waterfalls also occur within the corridor, including a falls along Buzzard Creek that is also a "caprock" type. Another type of waterfall is the "hanging valley" type, which occurs when a tributary doesn't maintain the same level of downcutting as the primary stream and so is at a higher level. A falls at the mouth of Eagle Creek is this type of waterfall. A waterfall on Dog Slaughter Creek was formed by a combination of both these processes (Soil Systems, Incorporated 1980).

Another important feature of the corridor is the river valley itself. The formation of the steep cliffs that line much of the river valley is the result of the erosional patterns of sandstone (McGrain 1966). Sandstone primarily erodes as a result of frost heaving and gravity. These forces result in the very steep, often 90° cliff faces. Shale, which erodes more easily, is found on the lower slopes of the river valley. Because this rock is more

easily eroded, the lower slopes are more gently sloping.

A series of boulder fields and rapids occur along the length of the wild river corridor. Large boulders are created as the sandstone erodes, and these boulders form rapids. Approximately nine boulder fields and rapids occur upstream from the falls and four occur downstream from the falls.

Many rockshelters are found in the sandstone cliffs that line the Cumberland Wild River Corridor. Rockshelters differ from caves in that either the height or width is greater than the depth of penetration into the rock. No true caves have been found within the wild river corridor. Rockshelters often form when more erodable shales are washed away below more durable sandstone. Less often, rockshelters form when a block of sandstone breaks away from the cliff face.

G. Soils

1. Introduction

Detailed information on the soils within the wild river corridor can be found in the earlier Environmental Inventory of the Cumberland Wild River Corridor (Soil Systems, Incorporated 1980). A brief description of the soil series that are found within the corridor follows. Most soils within the corridor are well-drained and moderately sloping to steep.

2. Descriptions

Soil descriptions are from the Soil Survey of the McCreary-Whitley Area (Byrne et al. 1970).

a. Captina Series

These soils are deep, gently sloping, moderately well-drained and strongly acid with a moderate natural fertility and available moisture capacity. Within the corridor, these soils occur on the gently sloping terraces above the floodplains.

b. Clymer Series

These soils are moderately deep to deep, well drained and strongly acid with moderately low natural fertility, moderate permeability and moderate to high available moisture capacity. Within the corridor, these soils are found on the rolling ridgetops.

c. Cotaco Series

Cotaco soils are deep, moderately well-drained to poorly drained and strongly acid with moderate natural fertility. Permeability is moderate and available moisture capacity is high. This soil series is found in flat or gently sloping alluvial areas

within the corridor, especially along Marsh Creek, Jellico Creek, Clear Fork and their tributaries.

d. Dekalb Series

This soil type is moderately deep to deep, somewhat excessively drained and strongly acid with low natural fertility and organic matter content. Available moisture capacity is low to moderate and permeability is moderately rapid. These soil types are found on backbone-like ridgetops throughout the corridor.

e. Elk Series

These soils are deep, well-drained and strongly acidic with a high natural fertility and available moisture capacity. These soils occupy low stream terraces along the wild river corridor and are occasionally flooded.

f. Muse Series

Muse soils are deep, well-drained and strongly acid with a moderate natural fertility, high moisture capacity and moderately slow permeability. These soils are found on ridgetops, benches and side slopes within the corridor.

g. Philo Series

These are deep, moderately well-drained, strongly acid soils with moderately high natural fertility, medium permeability and high available moisture capacity. They occupy bottomlands along the wild river.

h. Pope Series

Pope soils are deep, well-drained and strongly acid with moderately high natural fertility and moderate permeability. These soils are on floodplains and streambanks of the wild river.

i. Tate Series

Tate Series soils are deep, well-drained and strongly acid with moderate natural fertility and permeability. These soils occur on stream terraces along the wild river.

j. Tilsit Series

Tilsit soils are deep, moderately well-drained and very strongly acid with moderate natural fertility and moisture capacity. This soil type occurs on the less sloping parts of the rolling uplands of the wild river corridor.

k. Trappist Series

These soils are moderately deep, well-drained and strongly acid with moderately low natural fertility, moderately slow permeability and moderate available moisture capacity. These soils are found on the rounded ridgetops and side slopes of the northern portion of the wild river corridor.

l. Wellston Series

Wellston series soils are well-drained and strongly acid with moderate natural fertility, moderate permeability and high available moisture capacity. These soils are on the broad ridgetops of the wild river corridor.

3. Suitability of Soils for Wildlife

Most of the soil series within the wild river corridor, such as Captina, Clymer, Cotaco, Elk, Philo, Pope, Tilsit and Wellston, are suitable for both woodland wildlife and openland wildlife (Byrne et al. 1970). Dekalb, Muse, Tate and Trappist soil series vary in their suitability for wildlife from good to poor (Byrne et al. 1970). None of the soil types found in the wild river corridor are suitable for creating ponds to attract wildlife (Byrne et al. 1970). Other elements of wildlife habitat include grain and seed crops, grasses and legumes, wild herbaceous upland plants, hardwood woody plants and evergreen woody plants. None of the soil types within the corridor are considered to be well suited for evergreen woody plants. Cotaco, Tilsit and Trappist soils also are considered unsuitable for wildlife habitat; Captina, Clymer, Elk and Philo soil series within the corridor are considered suitable for wildlife habitat. Muse, Pope, Tate and Wellston soils are considered suitable for grasses and legumes, wild herbaceous upland plants and hardwood woody plants but not grain and seed crops (Byrne et al. 1970).

4. Suitability of Soils for Woodland

The soil complexes of the wild river corridor are associated with a number of community types dominated by different tree species. The difficulty in harvesting timber lies in the steep slopes of much of the corridor. The slopes make access difficult and erosion a likely problem after harvesting and roadbuilding activities are initiated.

5. Suitability of Soils for Trails

Soils series within the wild river corridor that are most appropriate for trail development are Captina, Clymer, Cotaco, Elk, Tilsit and Wellston (Byrne et al. 1970). Delkalb, Muse, Tate and Trappist series soils within the corridor are less suitable for trails because of their steep slopes (Byrne et al. 1970). Philo and Pope series soils within the corridor are located in areas where there is a risk of flooding, which should be considered in developing trails (Byrne et al. 1970).

Detailed information on the suitability of each of the soil types within the wild river corridor for wildlife, woodland and trails can be found in an earlier environmental inventory of the Cumberland Wild River (Soil Systems, Incorporated 1980). Further information also can be found in the soil survey of the McCreary-Whitley area (Byrne et al. 1970).

IV. BIOLOGICAL INVENTORY

A. Aquatic Biology

1. Introduction

A biological survey was conducted in late July and early August, 1993, by the KDOW with the assistance of the KSNPC (KDOW 1994). Three stations were established in the wild river portion of the Cumberland River (Fig. 6). These three stations were sampled once during a low flow period. The location of these stations, dates sampled and parametric coverage are given in Appendix B.

2. Review of Data and Determination of Needs

Biological data was collected from three locations during this study. The location of these sites is presented in Figure 6 and Appendix B. Site descriptions are presented in the physical evaluation section of this report. Periphyton, macroinvertebrate, and fish data were collected at each site during this study. The periphyton and macroinvertebrate data were used to generate the biotic assessment index (BAI). The BAI is used to assess the biological integrity of the wild river segment. Because of the extreme difficulties sampling the large river habitats, the fish collections made during this study were not considered to accurately represent the fish community of the wild river segment, therefore, the index of biotic integrity (IBI) was not calculated and used in the BAI.

Algal, macroinvertebrate, and fish communities were collected and analyzed using the procedures described in "Methods for Assessing Biological Integrity of Surface Waters" (KDOW 1993).

a. Algae

The KDOW collected and identified one-hundred and fifteen algal taxa from the Cumberland River during the 1993 survey. Of these, six were green algae (Chlorophyta), four were bluegreen bacteria (Cyanophyta), and one hundred and five were diatoms (Bacillariphyceae)(Appendix D). *Cladophora glomerata*, a filamentous green alga, dominated the algal community at all three sites. Diatoms were enumerated and the community was analyzed to assess stream biotic integrity using methods described in KDOW (1993).

Through the Biological Monitoring Program (BMP) KDOW has collected biological data, including algae, from the Cumberland River above Cumberland Falls (MP 562.4) since 1979. Historical data show a diverse algal community with

high species richness indicative of good water quality. The diatom community of that site has been dominated by *Achnanthes minutissima, Cocconeis placentula,* and *Nitzschia* species, which were described as "typical stream diatoms characteristic of moderate to high dissolved oxygen levels and moderate nutrient enrichment" (KDOW unpublished data). The algal community in 1993, at site 18-2 (closest to the BMP site), is similar to the historical data, and the same diatom species are dominant.

The three sites studied in 1993 were relatively similar to one another, with percent community similarity (PS_c) values ranging from 40-62% (Table 7), and total number of diatom taxa (TDNT) ranging from 67 to 77 (Table 8). Diatom bioassessment indices (DBI) were calculated using the following metrics: total number of diatom taxa (TNDT), diversity, pollution tolerance index (PTI), percent sensitive species (%SS), and siltation index (%NNS) (KDOW 1993). The DBI score is the mean of the individual metric score. The DBI ranks site 18-1 as excellent and 18-2 and 18-3 as good (Table 8).

TABLE 7. Percent Community Similarity (PS_c) Values for Diatom Data.

	18-1	**18-2**
18-2	62.07	
18-3	40.68	47.31

TABLE 8. Diatom Community Metrics and Diatom Bioassessment Index (DBI) Scores.

	Stations		
Metric	**18-1**	**18-2**	**18-3**
TNDT	77 (4)	65 (4)	72 (4)
Diversity	3.66 (4)	2.47 (3)	4.49(5)
PTI	2.8 (4)	2.7 (3)	2.5 (3)
%SS	17.3 (5)	2.6 (4)	4.2 (5)
%NNS	24.4 (3)	25.6 (3)	45.6 (2)
DBI Score	4.0	3.4	3.8
biotic integrity	excellent	good	good

While all three stations supported uses, certain metrics indicated minor impairments to the algal community. The high percentage of silt-tolerant diatoms (*Navicula* + *Nitzchia* + *Surirella*), especially at station 18-3, is a result of upstream land disturbance from coal mining and possibly logging operations. In addition, the abundance of *Cladophora* at all three sites is indicative of nutrient enrichment from a variety of upstream point and non-point sources. The continuing sedimentation and nutrient inputs to the system may result in degradation of biological integrity in the future.

b. Macroinvertebrates

Invertebrate data consist principally of freshwater mussel collections. Unionid mussel data are presented by Wilson and Clark (1914), Neel and Allen (1964), and Stansbery (1969). Soils Systems, Incorporated (1980) provides additional macroinvertebrate data on crustaceans, gastropods, and aquatic insects.

During this study the KDOW (1994) collected and identified 120 taxa of macroinvertebrates (Appendix E). Annelids, mollusks, crustaceans, and aquatic insects were represented. The most diverse groups were the Diptera (flies), Trichoptera (caddisflies), and Ephemeroptera (mayflies), respectively.

Macroinvertebrate collections were made by Soil Systems, Incorporated 1980; however, their identifications were primarily to the generic level, making comparison difficult. Several of the macroinvertebrate species reported by Soil Systems, Incorporated (1980) are questionable, with the most notable being *Orconectes placidus*. They report three collections of *O. placidus* from above the falls. *Orconectes placidus* has an affinity for limestone streams and is quickly reduced or terminated with the encroachment of sandstone (Rhoades 1944). In Kentucky this species is reported only from the Cumberland River and its tributaries from Wayne County westward (Rhoades 1944; Hobbs 1989). It is believed that Soil Systems, Incorporated (1980) misidentified specimens of *O. putnami*, a species common to this portion of the Cumberland River, as *O. placidus*. They did not report *O. putnami* from any location in the wild river corridor.

Three papers prior to (KDOW 1994); Wilson and Clark (1914), Neel and Allen (1964), and Stansbery (1969); report mussel data from the wild river segment. The reach below Cumberland Falls, which is equivalent to the present study's 18-1, was sampled by all of the above authors. A total of 21 species are known from this area. Wilson and Clark (1914) reported 20 species, Neel and Allen (1964) found 15 species, and Stansbery (1969) observed 16 species. Stansbery (1969) noted that not only had the mussel fauna decreased since Wilson and Clark's (1914) early collections, but that the faunal composition had also changed dramatically. He attributed this change to the impacts of upstream coal

mining and downstream impoundment of Cumberland River to form Cumberland Lake. Recent collections made by the KSNPC yielded only nine species (R. Cicerello pers comm). This loss of 12 mussel species is believed to have resulted from intermittent acid mine drainage and heavy siltation arising from upstream coal mining operations, and downstream impoundment. The impoundment of Cumberland River destroyed the riverine mussel fauna that flourished in the Cumberland River from the headwaters of the impoundment to the state line. This destruction of the once diverse mussel fauna precludes any recruitment from downstream areas. These twelve species are now permanently lost from this portion of the river.

Cumberland Falls has provided a formidable barrier to the upstream movement of freshwater mussels (Neel and Allen 1964). Twenty-one species are reported from just downstream of Cumberland Falls (Stansbery 1969), while only eight species are reported from above the falls (Wilson and Clark 1914, Neel and Allen 1964, Harker et al. 1980, and Call and Parmalee 1981). Recent collections by KSNPC yielded only one species from the wild river segment, *Actinonaias pectorosa*. The demise of the mussel fauna above the falls is the result of intermittent discharges of acid mine drainage and siltation from upstream coal operations. Juvenile mussels are known to be extremely sensitive to even slight elevations in heavy metal concentrations and siltation. These are common constituents arising from upstream coal mining operations.

The Biological Monitoring Program has been collecting macroinvertebrate data from Cumberland River above Cumberland Falls (MP 562.4) since 1979. Those data show that this reach of the river supports a diverse macroinvertebrate fauna, including a good variety of the pollution tolerant groups, the ephemeropterans and trichopterans.

The three sites sampled during this study were relatively similar to each other, with PS_c values ranging from 45.1 to 52.9 (Table 9). Other metrics used to assess biotic integrity were also similar to one another (Table 10).

The macroinvertebrate bioassessment index (MBI) (Table 10) was used to assess biotic integrity at all three stations. The metrics used in the MBI are taxa richness (TR); total number of taxa (TNI); Ephemeroptera, Plecoptera, Trichoptera (EPT) index; dominance in common, ten (DIC_{10}); percent contribution of dominant taxa, five (PCD_5); percent community similarity (PS_c); and the Hilsenhoff Biotic Index (HBI) (KDOW 1993). The MBI score is the mean of the individual metric scores. The MBI classified all three sites (18-1, 18-2, and 18-3) as excellent. Excellent taxa diversity was present at all locations. However, the demise of the mussel fauna in the wild river segment indicates that there are intermittent periods of degraded water quality.

TABLE 9. Percent Community Similarity (PS_c) Values for Macroinvertebrate Data.

Stations	18-1	18-2
18-2	45.1	
18-3	46.5	52.9

TABLE 10. Macroinvertebrate Community Metrics and Macroinvertebrate Bioassessment Index (MBI) Scores.

	Stations		
Metrics	**18-1**	**18-2**	**18-3**
TR	68 (4)	78 (5)	73 (5)
TNI	852 (4)	1235 (5)	826 (4)
EPT	30 (5)	27 (5)	30 (5)
DIC_{10}	w/18-2 6 (4) w/18-3 6 (4)	w/18-1 6 (4) w/18-2 7 (4)	w/18-1 6 (4) w/18-2 7 (4)
PCD_5	46.7 (5)	62.5 (3)	46.5 (5)
PS_c	w/18-2 45.1 (4) w/18-3 46.5 (4)	w/18-1 45.1 (4) w/18-3 52.9 (5)	w/18-1 46.5 (4) w/18-2 52.9 (5)
HBI	4.8 (4)	4.7 (4)	4.4 (4)
MBI Score	4.3	4.4	4.5
Biotic Integrity Ranking	Excellent	Excellent	Excellent

w/ = compared with (station)

c. Fishes

Fish collections were made by KDOW from 1976 to 1987 from a site located above Cumberland Falls (KDOW 1988a). Additional fish data on the Wild River segment is presented by Jordan and Brayton (1878); Evermann (1918); Lachner and Jenkins (1971); Soil Systems, Incorporated (1980) and KDOW (1994).

Fish data from collections taken from the wild river segment are presented in Jordan and Brayton (1878); Evermann (1918); Lachner and Jenkins (1971); Soil

Systems, Incorportaed (1980) and KDOW (1988a). Data from KDOW (1994) is compared to Soil Systems, Incorporated (1980) (Table 11).

TABLE 11. Fishes Collected From Cumberland River.

Taxa	Soil Systems Inc. (1980)	KDOW 18-1	KDOW 18-2	KDOW 18-3
CLUPEIDAE				
Dorosoma cepedianum	X			
CYPRINIDAE				
Campostoma anomalum	X		2	3
Cyprinella spiloptera	X	66	14	39
Cyprinella whipplei	X			
Cyprinis carpio	X			
Luxilus chrysocephalus	X			6
Nocomis micropogon	X		2	6
Notropis rubellus	X	45	17	49
Notropis volucellus	X		5	29
Pimephales notatus	X		19	8
Semotilus atromaculatus	X			
CATOSTOMIDAE				
Hypentelium nigricans	X	6	3	2
Moxostoma erythrurum		1		7
Moxostoma macrolepidotum	X			
ICTALURIDAE				
Ictalurus punctatus	X			
Pylodictis olivaris		1		
SALMONIDAE				
Oncorhynchus mykiss	X			
POECILIIDAE				
Gambusia affinis	X			4
CENTRARCHIDAE				
Ambloplites rupestris	X	1	3	1
Lepomis cyanellus				2
Lepomis macrochirus	X		1	
Lepomis megalotis	X	2	5	7
Lepomis microlophus	X			
Micropterus dolomieu	X	10		4
Micropterus punctulatus	X	11	7	13
Micropterus salmoides	X			

PERCIDAE				
Etheostoma blennioides	X	1	6	2
Etheostoma kennicotti	X			1
Etheostoma stigmaeum	X			
Etheostoma baileyi	X			
Percina caprodes	X	4		

An Index of Biotic Integrity was not calculated with KDOW's (1994) fish data. It was determined by KDOW staff that the fish collections did not adequately represent the fish community of the wild river segment. Shoals were boulder-cobble dominated, making the substrate virtually impossible to move. Pools were deep and extremely difficult to properly seine.

The fish data, presented in Table 11, show that Soil Systems, Incorporated (1980) collected 28 species, while KDOW (1994) only found 20 species. Both groups found a good representation of minnows (Cyprinidae) and basses (Centrarchidae). Soil Systems, Incorporated (1980) reported five darter species (Percidae), while KDOW only found three. Three exotic species, the carp (*Cyprinis carpio*), the coosae bass (*Micropterus coosae*), and the rainbow trout (*Oncorhynchus mykiss*), were reported by Soil Systems, Incorporated (1980).

3. Discussion

The BAI classified the lower and upper portions of the wild river segment as excellent (Table 12) and the middle portion as good. Streams with classifications of good and excellent are considered to be supporting warmwater aquatic habitat (WAH) use designation. Therefore, the entire wild river segment (16.1 miles) is meeting the WAH use. Since the criteria for outstanding resource water (ORW) are the same as for WAH, this segment is also considered to support the ORW use. The wild river corridor provides a refuge for both plants and animals alike. Protection of the corridor allows riparian and large river aquatic communities to remain intact; thus providing an epicenter for reinvasion into areas disturbed by anthropogenic activities. However, the aquatic communities are subject to impacts from upstream areas. The most serious and long-lasting perturbation is coal mining. Coal mining activities are believed to be responsible for the extirpation of aquatic species from the wild river corridor.

TABLE 12. Biotic Assessment Index (BAI) Rankings for the Wild River Segment of the Cumberland River.			
	Stations		
	18-1	**18-2**	**18-3**
DBI Score	4.0	3.4	3.8
MBI Score	4.3	4.4	4.5
BAI Score	4.1	3.9	4.1
Biotic Integrity Ranking	Excellent	Good	Excellent

4. Rare Species

According to the KSNPC (1993), three rare invertebrates have been reported from the wild river corridor. These include one undescribed species of caddisfly, *Madeophylax* sp., and two freshwater mussels, *Alasmadonta atropurpurea* and *Villosa trabalis*.

The caddisfly *Madeophylax* sp. is an undescribed semi-aquatic species. According to Dr. Guenter Schuster (pers comm) this trichopteran was first observed in 1983 inhabiting the Rockcastle Sandstone cliffs around seeps and damp areas in the Cumberland Falls area. Dr. Schuster notes that this caddisfly is always associated with Pennsylvanian-aged, sandstone cliffs. *Madeophylax* constructs cylindrical stone cases, which it transports with it as it feeds on periphyton. This species is considered threatened by KSNPC (1992). It presently has no federal status.

The unionid mussel *Alasmadonta atropurpurea* (Cumberland elktoe) is endemic to the Cumberland River system. KSNPC (1993) records indicate that *A. atropurpurea* has been collected once from the wild river section of the Cumberland River. The sole collection was made in October, 1935, from just upstream of the falls. Call and Parmalee (1981) note that *A. atropurpurea* occupies various current regimes, but prefers areas of low flow in medium sized, moderate gradient, high quality streams. They observed it living buried from 1/2 to 1/3 in the mud, sand, and gravel that occupies the interstitial spaces between cobble/boulder substrate. This mussel is considered endangered by KSNPC (1992) and is presently undergoing status review by the United States Fish and Wildlife Service (USFWS) (KSNPC 1992). Williams et al. (1993) considered this mussel as endangered. This species has not been seen in the wild river corridor since 1935, thus indicating its possible extirpation from this portion of the Cumberland River.

Villosa trabalis, the Cumberland bean mussel, is known from two collections in that portion of the corridor below Cumberland Falls. The first collection was in 1910, and the other in September of 1948 (KSNPC 1993). This unionid typically inhabits medium to large streams in erosional areas (riffles and runs) laden with sand and gravel. This species is listed by both KSNPC (1992) and USFWS (1992) as endangered.

Williams et al. (1993) also considered this species as endangered. *Villosa trabalis* has not been collected from the wild river corridor since 1972 and is presumed extirpated from this region of the Cumberland river.

Neither Soils Systems, Incorporated nor KDOW (1994) found any fish species listed by KSNPC or USFWS. Two fish, the lake sturgeon (*Acipenser fulvescens*) and the johnny darter (*Etheostoma nigrum susanae*), considered endangered by KSNPC (1992), have been reported from the wild river segment. One additional species, the blackside dace (*Phoxinus cumberlandensis*), considered endangered by KSNPC (1992) and threatened by USFWS (1992), may move in and out of the corridor in small tributary streams.

Acipenser fluvescens, the lake sturgeon, was observed in the portion of the corridor below Cumberland Falls in August, 1954. Distributional records indicate that the lake sturgeon occurs in large rivers with gravel and sand bottoms (Burr and Warren 1986). This species is considered endangered by KSNPC and is under status review by the USFWS (KSNPC 1992). The fluctuating water quality of the upper Cumberland River and the impoundment of the river by Wolf Creek Dam may have resulted in the extirpation of the lake sturgeon from the wild river corridor.

A subspecies of the johnny darter (*Etheostoma nigrum susanae*) is known only from the upper Cumberland River above Cumberland Falls (Burr and Warren 1986). The habitat preference and spawning requirements; quiet, shallow pools under rocks, logs, or other objects (Burr and Warren 1986); may indicate that *E. n. susanae* is not a permanent resident of the Cumberland River in the wild river corridor. This darter probably moves into the river when small tributary flows are low or non-existent. The johnny darter is considered endangered by KSNPC and is under status review by the USFWS (KSNPC 1992).

5. Non-native Species

Soil Systems, Incorporated (1980) reported the occurrence of *Micropterus coosae*, the coosae bass, from two locations in the upper portion of the wild river segment. The presence of this introduced species at these locations in the Cumberland River is extremely unlikely and should be considered a misidentification. The coosae bass was stocked in the upper reaches of Martins Fork by Kentucky Department of Fish and Wildlife Resources (KDFWR) personnel in the late 1950's or early 1960's. This species has not been reported, before or since the Soil Systems, Incorporated (1980) report, in any portion of the upper Cumberland River drainage other than Martins Fork (KDOW 1994).

Two other non-native fishes (*Cyprinis carpio* [carp] and *Oncorhynchus mykiss* [rainbow trout]) were reported by Soil Systems, Incorporated (1980), but not found within the corridor by KDOW (1994). Also present in the wild river corridor is the introduced *Corbicula fluminea* (Asiatic clam)(KDOW 1994).

B. Fauna

1. Introduction

The Cumberland Wild River Corridor supports a diverse fauna, including eight species that are considered to be rare (KSNPC 1992). A total of 195 amphibians, reptiles, birds, and mammals have been reported from this area. The broad array of habitats available within the corridor contribute to the diversity of animal life.

2. Review of Data and Determination of Needs

Some of the information on terrestrial animals of the wild river corridor is from an Environmental Inventory of the Cumberland Wild River, Kentucky (Soil Systems, Incorporated 1980). Additional information on the fauna of the corridor is from the inventory of the London Ranger District of the Daniel Boone National Forest (Campbell et al. 1994) and KSNPC (1993). Information on rare species within the corridor was obtained from KSNPC (1993). Miscellaneous observations from other field work in the watershed provided additional information on terrestrial vertebrates including amphibians, reptiles, birds and mammals (S. Kickert pers comm)(Appendix F).

3. Field Collection Methods

Because the fauna of the corridor was sampled relatively recently (Soil Systems, Incorporated 1980), a complete survey of the area was not performed. Additional information on the fauna of the corridor is from the inventory of the London Ranger District of the Daniel Boone National Forest (Campbell et al. 1994) and KSNPC (1993).

4. Field Collection Results

The results of various surveys of the Cumberland Wild River Corridor, including the Environmental Inventory of the Cumberland Wild River, Kentucky (Soil Systems, Incorporated 1980), can be seen in Appendix F. Taxonomy for the reptiles and amphibians follows Collins (1990). A total of 195 amphibians, reptiles, birds, and mammals are reported from this area.

5. Discussion of Inventory Results

The large number of species comprising the fauna of the Cumberland Wild River Corridor indicates a high level of biological diversity. Use of best management practices for soil disturbing activities such as construction, mining and timber harvesting will preserve these habitats and the broad array of animal species associated with them.

6. Rare Species

Eight rare animal species are known from the wild river corridor. They are:

Accipiter striatus (sharp-shinned hawk), KSNPC special concern.

Sharp-shinned hawks nest across much of North America from central Canada, south through the United States into northern Mexico (AOU 1983). In Kentucky, this species appears to be fairly well distributed in the eastern part of the state, but it is much less common and widespread across most of the central and western parts (KSNPC 1993). These small hawks inhabit forested areas, especially coniferous and mixed coniferous-hardwood forest types (AOU 1983). Sharp-shinned hawks have been observed several times at Cumberland Falls State Park (S. Kickert pers comm). Nesting has not been confirmed, but small numbers likely nest in the extensive forests along the wild river corridor.

Cryptobranchus a. alleganiensis (eastern hellbender), USFWS C2 candidate.

The eastern hellbender is a large, entirely aquatic salamander that is found sporadically across the northeastern United States from southern New York south through the Appalachian Mountains to northern Georgia and Alabama, and west through the Ohio River Valley to central Missouri (Conant and Collins 1991). In Kentucky, it has been reported from about two-dozen drainages, mostly in the central and eastern parts of the state (KSNPC 1993). Hellbenders inhabit streams with moderate flow and rocky substrates, where they hide beneath large, flat rocks. They are seldom encountered, but one is occasionally caught by a fisherman. There is a single record of the eastern hellbender from the Cumberland River near Cumberland Falls. Habitat throughout the wild river corridor appears suitable, and a sizable population may exist.

Dendroica cerulea (cerulean warbler), USFWS C2 candidate.

This woodland warbler occurs across much of the eastern United States from northwestern Vermont and the southern Great Lakes west to the eastern Great Plains and south to central North Carolina, Georgia and north-central Texas (AOU 1983). It inhabits mature deciduous forest, typically on slopes and in bottomlands (Mengel 1965). The species has declined significantly over much of its range due to deforestation, and it was recently designated as a federal candidate for listing (USFWS 1991). In Kentucky the Cerulean Warbler is fairly widespread on the Cumberland Plateau and Mountains, but relatively local and quite uncommon across central and western portions of the state (KSNPC 1993). The species has been reported from Cumberland Falls State Park on several occasions (S. Kickert pers comm), and it likely nests within the wild river corridor.

Lampropeltis triangulum elapsoides (scarlet kingsnake), KSNPC threatened.

This beautifully-marked snake is found locally throughout the southeastern United States from central New Jersey, eastern Virginia and southern Kentucky, south to the Gulf Coast and west to the Mississippi River (Conant and Collins 1991). In Kentucky it has been reported from about ten counties, primarily in the southern Cumberland Plateau and Highland Rim (KSNPC 1993). Scarlet kingsnakes inhabit dry woodland, especially pine and mixed pine-hardwood, but they are largely fossorial and very difficult to find (Conant and Collins 1991). There are historical records from Cumberland Falls State Park, and forests along the wild river corridor would appear to offer excellent habitat.

Neotoma floridana magister (eastern woodrat), USFWS C2 candidate.

The eastern woodrat occurs sporadically across the eastern United States, occurring primarily in the Appalachian Mountains from southern New York, south into northern Alabama and Georgia (Hall 1981). However, it has declined throughout much of its range, especially the northern portion, prompting its designation as a federal listing candidate (USFWS 1991). The eastern woodrat occurs widely in eastern Kentucky, being locally common in the vicinity of caves, clifflines, and rock outcrops (Barbour and Davis 1974). In contrast, it is locally distributed throughout central and western Kentucky, generally in association with caves and clifflines. The eastern woodrat is known from a few localities along the wild river corridor, especially where clifflines and rock outcrops occur. Sign in the form of scat, nests, and food items cached on rock shelves can be found just about anywhere they are present.

Ophisaurus attenuatus longicaudus (eastern slender glass lizard), KSNPC threatened.

The eastern slender glass lizard is an uncommon inhabitant of dry woods and grasslands of the southeastern United States from eastern Virginia and central Kentucky south to the Gulf Coast and west to the Mississippi River (Conant and Collins 1991). In Kentucky, the species has been reported primarily from the southeastern Cumberland Plateau and the central Highland Rim (KSNPC 1993). Glass lizards are largely fossorial, burrowing in sandy soils, and are seldom encountered (Conant and Collins 1991). There are a number of road-kill records from the Cumberland Falls vicinity (KSNPC 1993), and dry, ridgetop habitats along the margin of the wild river corridor likely support a stable population.

Speyeria diana (diana fritillary), USFWS C2 candidate.

This butterfly is widespread in the central and southern Appalachian Mountains, and the Ozark Mountains of southern Missouri and Arkansas (Opler 1992). Historically the species also occurred in the Ohio River Valley and the Coastal Plain of North Carolina and Virginia, but these populations have been much reduced (Opler 1992). In Kentucky it remains well distributed throughout the Cumberland Plateau and Mountains, but no longer occurs in central and western parts of the state (C. Covell, Jr. pers comm). The diana fritillary larvae feed on violets (Opler 1992). The species exhibits striking sexual

dimorphism; the male is bright orange and black, while the female is predominantly black, with spots of pale blue on the hindwing. The diana fritillary has been observed at several localities within the wild river corridor and likely occurs throughout its length.

Ursus americanus (black bear), KSNPC special concern.

Although absent from Kentucky for many years, the black bear is making a comeback in the forested mountains of the eastern part of the state. Many of the individuals reported from eastern Kentucky may have originated from reintroduction efforts that have been undertaken in western Virginia and eastern Tennessee during the past decade (D. Yancy pers comm). In recent years, bears have been reported from numerous locations in eastern Kentucky (KSNPC 1993). An individual was observed in 1993 foraging along the river bank just upstream from Cumberland Falls.

7. Non-native Species

One problem that has been observed within the state park is pet dogs that are abandoned on the park property (S. Kickert pers comm). While this has not become a safety problem, these dogs are likely to be causing some adverse impact to the wildlife of the area. Two other non-native vertebrates (*Mus musculus* [house mouse] and *Rattus norvegicus* [Norway rat]) have been reported within the corridor but are not a problem at present.

C. Flora and Natural Communities

1. Introduction

The Cumberland Wild River Corridor contains a diverse array of plant species and natural community types. The river and its surrounding steep cliffs create a diversity of habitats that provide appropriate conditions for a wide variety of species. The corridor is within Braun's (1950) Mixed Mesophytic Forest Region. The forest association that dominates this region corresponds to the Appalachian Mesophytic Forest community type described below. The following section documents the plants and communities known from the corridor. Rare species, communities that warrant special protection, and communities that require active management will be identified in this section, and appropriate management will be discussed in the management plan portion of this report.

2. Review of Data

Much of the information on the flora and natural communities of the wild river corridor is from an Environmental Inventory of the Cumberland Wild River, Kentucky (Soil Systems, Incorporated 1980). Additional information on the flora of the corridor is from the inventory of the London Ranger District of the Daniel Boone National Forest (Campbell et al. 1994), KSNPC (1993) and from incidental observations (D. Taylor pers comm, J. Campbell pers comm). Information on rare species within the corridor was obtained from KSNPC (1993), the inventory of the London Ranger District (Campbell et al. 1994) and inventory work completed for this report. Two studies provided information

on the mosses and liverworts of the corridor (Baur 1933, Norris 1967).

3. Field Collection Methods

Terrestrial habitats within the wild river corridor were described and mapped in the Environmental Inventory of the Cumberland Wild River, Kentucky (Soil Systems, Incorporated 1980). These habitats were ground checked to determine the community type that they belonged to based on the Natural Community Classification System for Kentucky (M. Evans unpublished manuscript). Maps delineating habitat types within the corridor (Soil Systems, Incorporated 1980), aerial photographs and ground truthing were used to develop a map of the natural communities of the wild river corridor (Appendix G, in folder). Figure 7 illustrates the orientation of aerial photographs used to deliniate the natural communities of the Cumberland Wild River Corridor. High quality examples of the natural communities that occur within the corridor were listed in the Environmental Inventory of the Cumberland Wild River, Kentucky (Soil Systems, Incorporated 1980). These areas were visited to determine if they had experienced any major disturbances since their evaluation in 1980. Figure 8 indicates the highest quality examples of community types within the corridor.

Locations of rare plant species were visited to determine whether the occurrences still existed. Emphasis was placed on searching for occurrences that had been seen during the 1980 inventory, but that had not been rediscovered since that time. Appropriate habitat was searched for rare plant species known from the corridor. Searches also were made for rare species not previously known from this area but with potential to occur in the corridor based on their distributions and habitat preferences. *Minuartia cumberlandensis* and *Spiraea virginiana*, two USFWS listed species, were searched for but not found within the corridor. Results of the rare species inventory are included in the section on rare species.

4. Field Collection Results

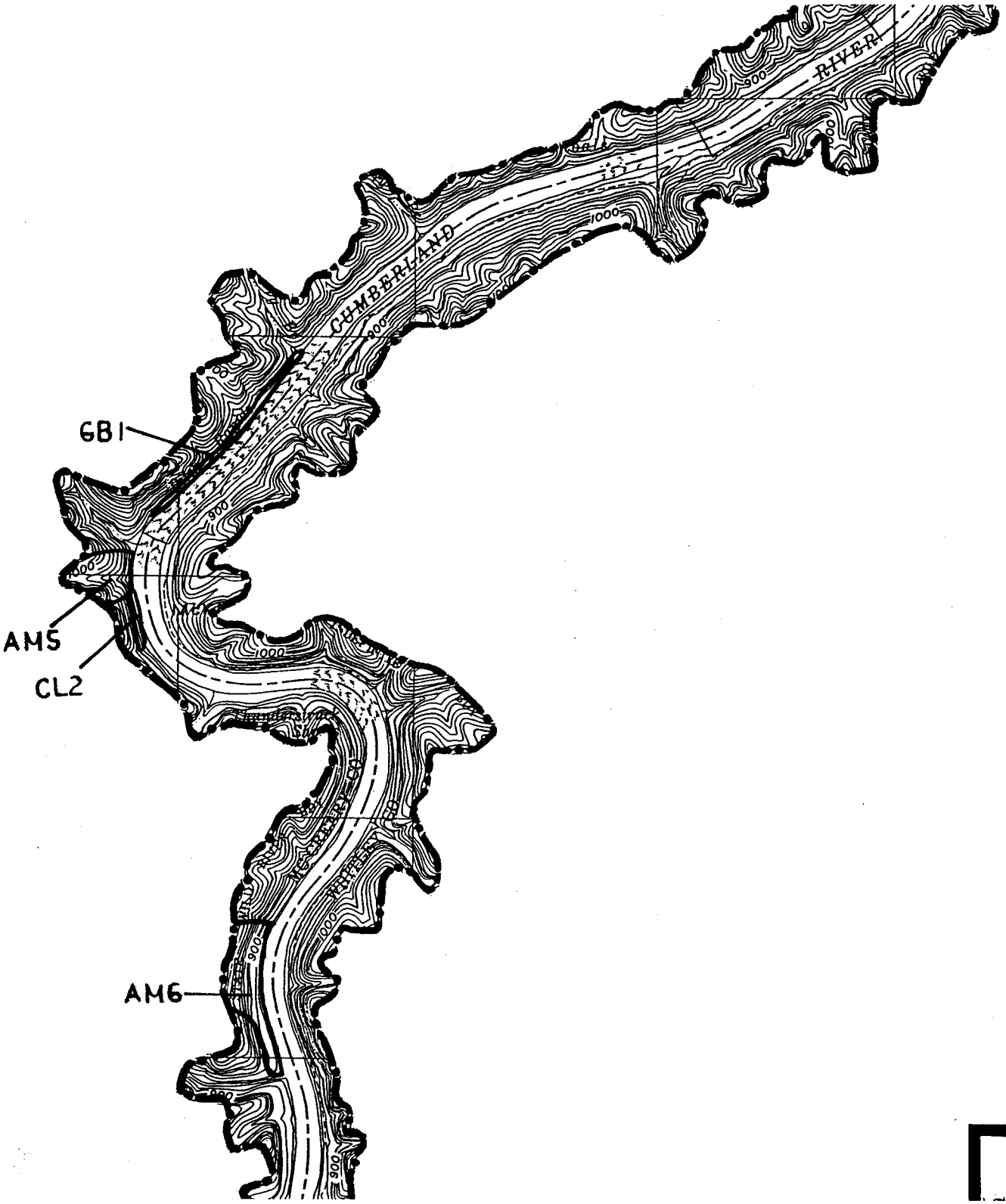
a. Description of Flora and Natural Communities

1. Liverworts and Mosses of Cumberland Wild River Corridor.

Fifty-eight species of liverworts and 159 species of mosses have been reported from the corridor (Appendix H)(Baur 1933, Norris 1967). Nomenclature follows Crum and Anderson (1981).

2. Vascular Plants of Cumberland Wild River Corridor and their Natural Communities.

Six-hundred and forty-four species of vascular plants are known from the Cumberland Wild River Corridor (Appendix I). Nomenclature follows Kartesz and Kartesz (1980). The column titled "habit" indicates the growth habit of the species (T=tree, S=shrub, V=vine, H=herb). The natural community type(s) in which each species occurs is identified in the final


CUMBERLAND
RIVER
GB1
AM5
CL2
AM6

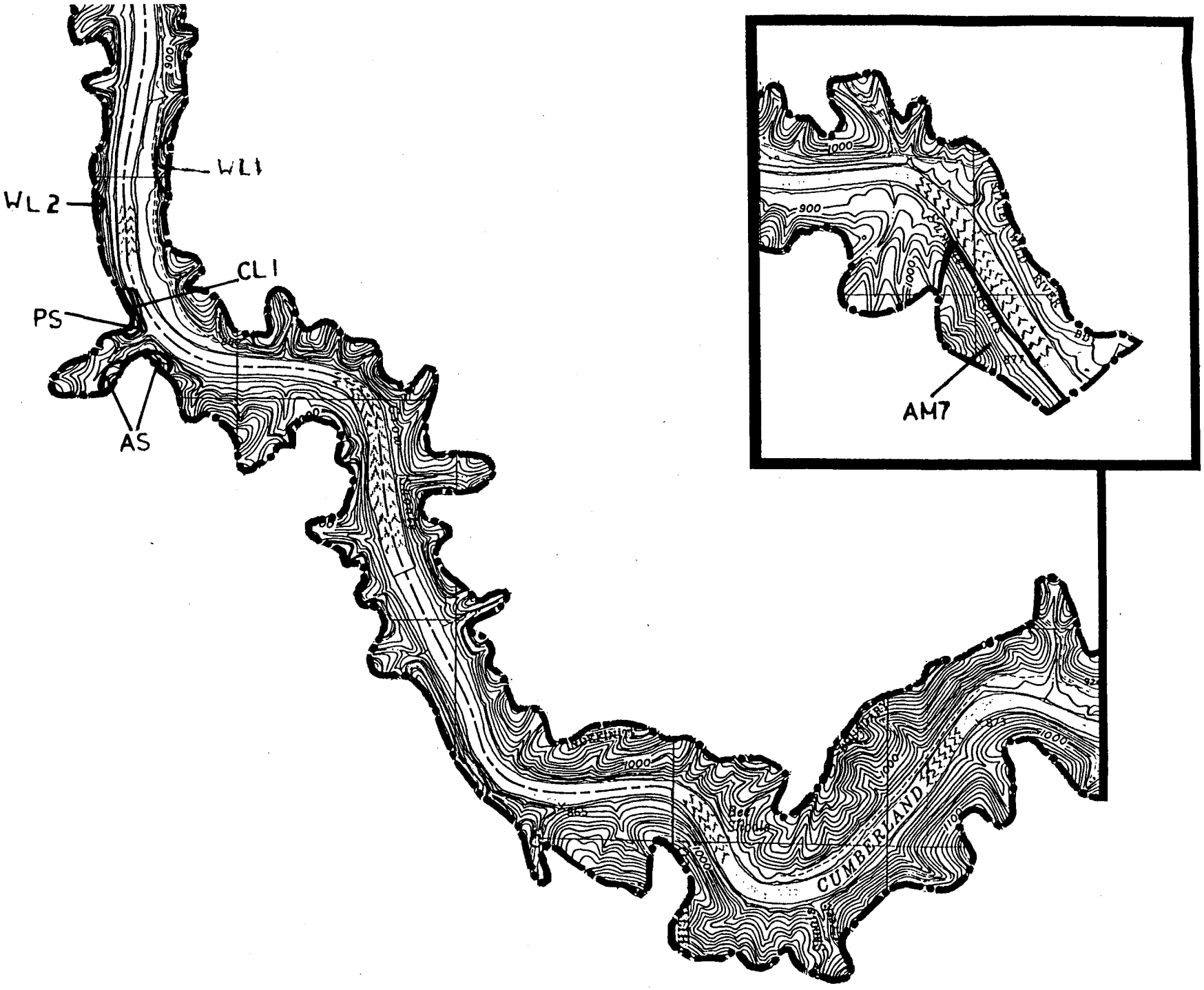

WL1
WL2
CL1
PS
AS
AM7
CUMBERLAND
1000
900

FIGURE 8. High quality examples of community types within the Cumberland Wild River Corridor.

AM Appalachian Mesophytic Forest
AS Appalachian Sub-xeric Forest
CL Dry/Moist Sandstone Cliff/Rock Outcrop
GB Cumberland Plateau Gravel/Cobble Bar
HM Hemlock Mixed Forest
PO Appalachian Pine-Oak Forest
PS Pine Savanna
RF Riparian Forest
WL Wetland

Scale 1:24,000

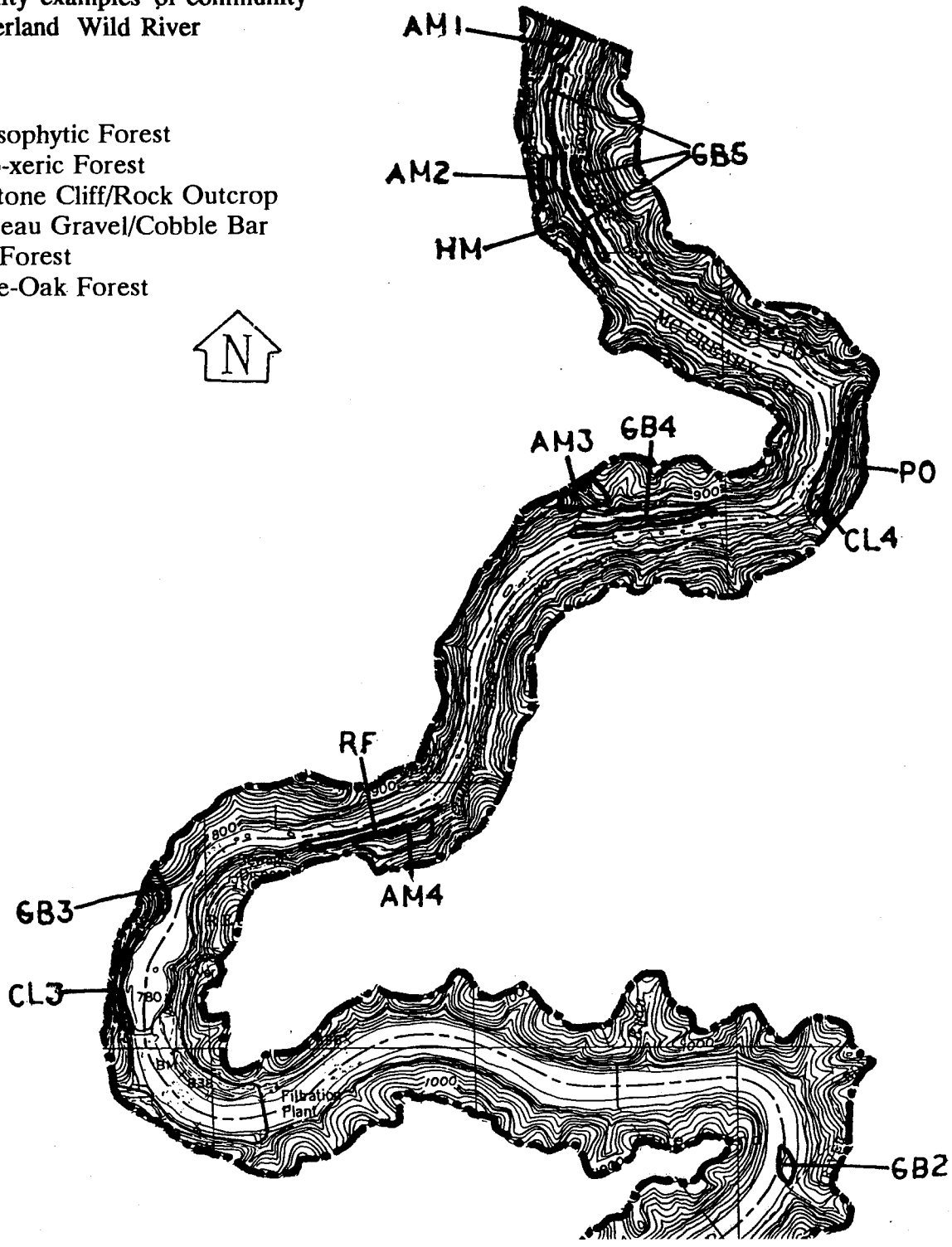
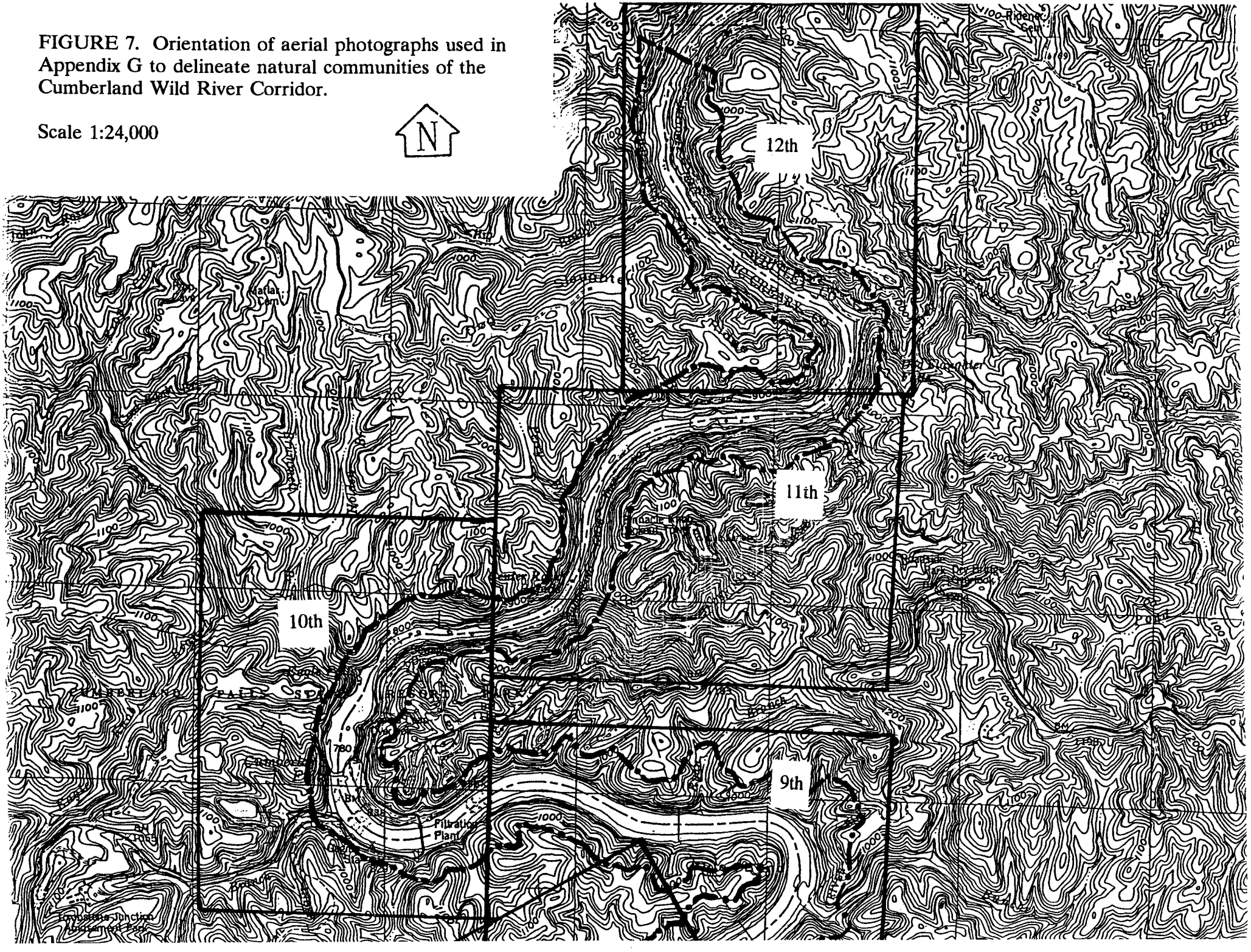
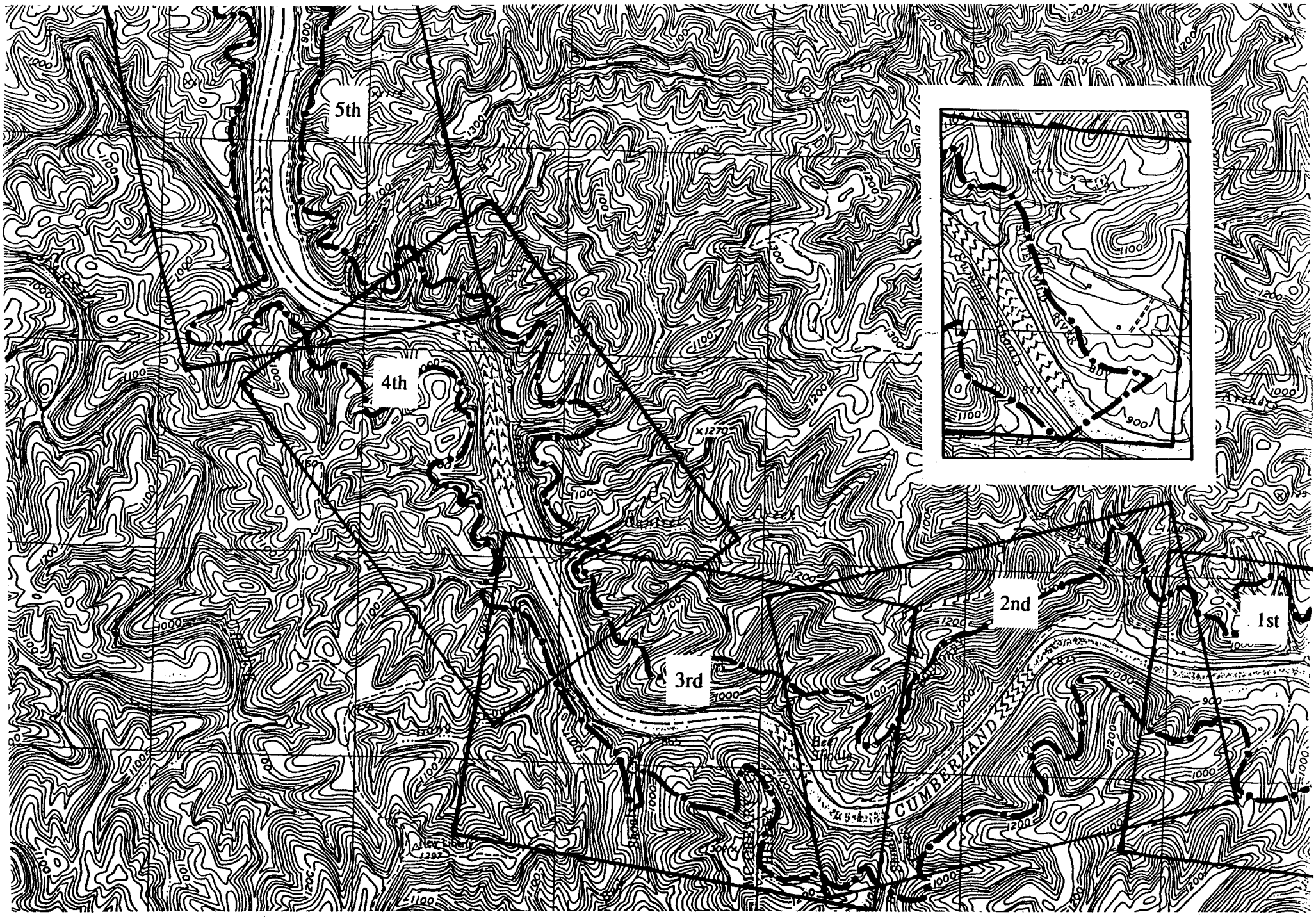


FIGURE 7. Orientation of aerial photographs used in Appendix G to delineate natural communities of the Cumberland Wild River Corridor.

Scale 1:24,000




8th
7th
6th
DANIEL BOONE NATIONAL


5th
4th
3rd
2nd
1st
CUMBERLAND

column. A key to abbreviations for the natural communities is at the end of Appendix I. The communities present are described in further detail in the next section.

b. Natural Community Classification

A natural community is a group of organisms interrelated with each other and with their environment (White 1978). Under similar environmental conditions, communities tend to repeat themselves and are thus recognizable as more or less distinct. Ten natural communities are recognized within the Cumberland Wild River corridor, based on the current classification system used for Kentucky (Evans unpublished manuscript)(Appendix G). Delineation of many of the communities is difficult because they have been recently disturbed and are in the early stages of recovery. The natural community classification system; however, is based on undisturbed communities (Evans unpublished manuscript). Young communities were classified based on their current composition.

Recent disturbances to the area, including grazing and logging, have affected microclimate, soil and seed availability; however, the recovery so far suggests that the area will return to community types similar to those present before disturbance. The disturbances to the area have created larger areas of more xeric habitat as a result of soil erosion and compaction and higher insolation. The extensive areas of pine dominated community present within the watershed reflect the impact of human disturbances. As recovery of the area progresses, the more mesic communities may expand and the drier communities may become less abundant.

Appendix G outlines the locations of community types within the corridor. The river, an Upper Perennial Riverine System (Cowardin et al. 1979), is the dominant natural community within the corridor. The Cumberland Plateau Gravel/Cobble Bar community type (approximately 47 acres [19 ha]) is found scattered along the length of the wild river portion of the Cumberland River and its tributaries, especially the portion of the river downstream from Cumberland Falls. Riparian Forest (approximately 116 acres [47 ha]) is found on low-lying areas adjacent to the Cumberland River. There is little of this community type within the corridor because of the limited floodplain. The few examples are primarily along the upstream end of the corridor. The dominant community types present on the lower slopes adjacent to streams are Hemlock-Mixed Forest (approximately 766 acres [309 ha]) and Appalachian Mesophytic Forest (approximately 626 acres [253 ha]). The upper slopes and mid slopes support Appalachian Sub-Xeric Forest dominated by oaks (approximately 445 acres [180 ha]) which sometimes grades into Appalachian Pine-Oak Forest (approximately 750 acres [303 ha]). Dry or moist (depending on aspect) Sandstone Cliff/Rock Outcrop communities are found on bare rock along ridgetops and along the steep cliffs that line portions of the river. These communities are dominated by lichens and mosses with vascular plants restricted to pockets of soil in cracks, depressions and ledges. There is no estimate of area for these communities because they often

are found on almost vertical cliffs; therefore, a map cannot be used to estimate their area. Adjacent to Marsh Creek is a thin band of open pine woods (approximately 2.9 acres [1 ha]). This appears to be a small remnant of a Pine Savanna/Woodland community.

The area covered by each community was estimated and is included to demonstrate the relative area covered by each community type. Since the area is approximated; their sum does not equal the total area of the wild river corridor (3300 acres [1336 ha]).

Descriptions of the community types are from Environmental Inventory Cumberland Wild River, Kentucky (Soil Systems, Incorporated 1980), Kentucky Ecological Communities (M. Evans unpublished manuscript), Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979) and observations made during field inventory for this report.

1. Upper Perennial Riverine System

An Upper Perennial Riverine System is characterized by a high gradient, fast water velocity and little floodplain development. These systems flow throughout the year and the substrate is composed of rock, cobble or gravel with occasional sand (Cowardin et al. 1979). Two classes of the Upper Perennial Riverine System are found within the wild river corridor, rock bottom and unconsolidated bottom (Cowardin et al. 1979).

River systems with a rock bottom are defined as having less than 30% vegetative cover and 75% or greater cover of stones, boulders or bedrock. Because this substrate is stable, a diversity of plants and animals are found in these areas. These areas are usually high energy and the water is well-aerated. Dominants of these areas usually include the freshwater sponges *Spongilla* and *Heteromeyenia*, the pond snail *Lymnaea*, the mayfly *Ephemerella*, midges of the Chironomidae genus *Eukiefferiella*, the caddisfly *Hydropsyche*, the leech *Helobdella*, the riffle beetle *Psephenus*, the crayfish *Procambarus*, and the black fly *Simulium* (Cowardin et al. 1979).

River systems with an unconsolidated bottom are defined as having less than 30% vegetative cover and 25% or greater cover of particles smaller than stones. This substrate is less stable than rock bottom and usually is found in low energy areas. Subclasses of the unconsolidated bottom class that have been identified within the wild river corridor include cobble-gravel and sand (Cowardin et al. 1979, Soil Systems, Incorporated 1980). Dominants of the cobble-gravel Subclass usually include the midge *Diamesia*, the stonefly-midge *Nemoura-Eukiefferiella*, chironomid midge-caddisfly-snail *Chironomus-Hydropsyche-Physa*, the pond snail *Lymnaea*, the mayfly *Baetis*, the freshwater sponge *Eunapius*, the oligochaete worm *Lumbriculus*, the scud *Gammarus* and the freshwater

mollusks *Anodonta*, *Elliptio* and *Lampsilis*. Dominants of the sand subclass include the snail *Physa*, the scud *Gammarus*, the oligochaete worm *Limnodrilus*, the mayfly *Ephemerella*, the freshwater mollusks *Elliptio* and *Anodonta* and the fingernail clam *Sphaerium* (Cowardin et al. 1979).

2. Cumberland Plateau Gravel/Cobble Bar

This community type is found on the rocky areas along the edge of the Cumberland Wild River and many of its tributaries. Gravel/cobble bars cover 90% of the riverbank of the wild river downstream from the falls and occur more sporadically upstream from the falls. These gravel/cobble bars frequently are found just downstream from the mouths of tributaries.

The Cumberland Plateau Gravel/Cobble Bar community type is periodically flooded and scoured. Despite this periodic flooding, gravel bars can be very xeric habitats, because water drains quickly from the coarse substrate. When silt and soil is deposited between the rocks, gravel bars can hold more water. Silt deposition usually is greater on the inside bends of a river where the water is moving slower. Gravel/cobble bars are rare and unique natural communities and some of them have a distinct prairie-like aspect.

The tree canopy is sparse or completely absent in this community type. Trees that are present include *Betula nigra* (river birch), *Catalpa speciosa* (catawba tree), *Fraxinus americana* var. *americana* (white ash), *Nyssa sylvatica* var. *sylvatica* (black gum), *Platanus occidentalis* (sycamore), *Robinia pseudoacacia* (black locust) and *Salix nigra* (black willow).

Characteristic understory species of this community include *Alnus serrulata* (hazel alder), *Bignonia capreolata* (cross vine), *Cephalanthus occidentalis* (buttonbush), *Cornus amomum* (silky dogwood), *Hamamelis virginiana* (witch hazel), *Hypericum prolificum* (shrubby St. John's wort), *Itea virginica* (Virginia willow), *Lyonia ligustrina* (maleberry), *Rhododendron arborescens* (sweet azalea), *Rhododendron periclymenoides* (pinxter-flower azalea), *Salix caroliniana* (coastal plain willow) and *Viburnum cassinoides* (northern witherod).

Herbaceous species common on gravel/cobble bars include *Andropogon gerardii* (big bluestem), *Apios americana* (groundnut), *Apocynum cannabinum* (Indian hemp), *Cicuta maculata* (water hemlock), *Coreopsis tripteris* (tall coreopsis), *Diodia virginiana* (buttonweed), *Hypoxis hirsuta* var. *hirsuta* (common yellow star-grass), *Juncus* spp. (rushes), *Justicia americana* (northern water-willow), *Osmunda regalis* var. *spectabilis* (royal fern), *Phlox maculata* (meadow phlox), *Physostegia*

virginiana (dragon's head), *Polygonum* spp. (smartweeds), *Pycnanthemum flexuosum* (slender mountain-mint), *Senecio pauperculus* (balsam groundsel), *Tephrosia virginiana* (goat's rue), *Trautvetteria carolinensis* (false bugbane) and *Viola cucullata* (bogbice violet).

There are many examples of this community type within the corridor, particularly downstream from the falls. These areas have no economic use and are not actively managed by the USFS. Gravel/cobble bars are used for recreation, however, and can be damaged by trampling as well as by high levels of pollution and litter in the river. The best examples of this community type have a diverse array of native plant species and concentrations of rare species. The highest quality examples of this community type are the rocky shelf at Pitch Rapids (GB1), Bunches Creek gravel bar (GB2), Eagle Creek (GB3), the south aspect downstream from Center Rock Rapids (GB4) and both sides of the river downstream of Dog Slaughter Creek (GB5) (Fig. 8). All of the listed examples of gravel/cobble bars are on National Forest System lands with the exception of the gravel bar along Eagle Creek which is within the state park.

3. Riparian Forest

Riparian Forest occurs on the periodically flooded deep soils adjacent to the river. This community type is poorly represented within the Cumberland Wild River Corridor. The upstream 1/3 of the corridor and Long Bottoms contain the best examples of this community type. Additional narrow bands of Riparian Forest occur scattered along the edge of the river. The habitat of these areas often is used for farming; therefore, most examples of this community type have been destroyed or severely altered. Some areas that were probably Riparian Forest in the past are now dominated by pine as a result of repeated disturbance.

Typical canopy species include *Acer negundo* (box elder), *Acer rubrum* (red maple), *Acer saccharinum* (silver maple), *Acer saccharum* (sugar maple), *Betula nigra* (river birch), *Carpinus caroliniana* (ironwood), *Fraxinus americana* var. *americana* (white ash), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tulip poplar), *Platanus occidentalis* (Sycamore), *Tilia americana* (American basswood), *Tilia heterophylla* (white basswood) and *Ulmus rubra* (slippery elm).

The shrub layer of this community typically is sparse and is dominated by *Bignonia capreolata* (cross vine), *Asimina triloba* (pawpaw), *Cornus amomum* (silky dogwood), *Dirca palustris* (leatherwood), *Itea virginica* (Virginia willow), *Lindera benzoin* (spicebush), *Pyrularia pubera* (buffalo-nut), *Toxicodendron radicans* (poison ivy) and *Xanthorhiza simplicissima* (yellow-root).

The herbaceous layer of this community is dense and diverse. The examples of this community within the corridor are dominated by *Aster divaricatus* var. *divaricatus* (white wood aster), *Circaea lutetiana* ssp. *canadensis* (enchanter's nightshade), *Clematis virginiana* (virgin's bower), *Cryptotaenia canadensis* (honewort), *Eupatorium fistulosum* (joe-pye-weed), *Eupatorium rugosum* (white snakeroot), *Helianthus decapetalus* (thinleaf sunflower), *Hypericum punctatum* (spotted St. John's wort), *Hystrix patula* (bottlebrush grass), *Impatiens capensis* (spotted jewelweed), *Laportea canadensis* (wood nettle), *Polygonum virginianum* (jumpseed), *Rudbeckia laciniata* (goldenglow), *Sanicula trifoliata* (trefoil snakeroot), *Scutellaria incana* (skullcap), *Senecio aureus* (squaw-weed) and *Silphium trifoliatum* (rosinweed).

The best example of this community type within the wild river corridor is just downstream from Cumberland Falls below the steep north-facing slopes (Fig. 8, RF1). This site is within the portion of Cumberland Falls State Resort Park that has been dedicated as a state nature preserve. The largest trees in this area of riparian forest are 2-2.5 ft DBH (diameter at breast height [4.5 feet {1.3 meters} off the ground]). Standing dead snags are present and the ground layer contains predominantly native species.

4. Hemlock-Mixed Forest

Hemlock-Mixed Forests are found in moist, narrow gorges of tributaries that enter into the Cumberland River and in moist areas along the Cumberland River. Examples of this community type within the Cumberland Wild River Corridor are dominated by *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech), *Ilex opaca* (American holly), *Tilia heterophylla* (white basswood) and *Tsuga canadensis* (eastern hemlock).

The mature Hemlock-Mixed Forest described by Braun (1935) was and still is for the most part dominated by *Tsuga canadensis* (eastern hemlock) with *Betula allegheniensis* var. *allegheniensis* (yellow birch) and *Liriodendron tulipifera* (tulip poplar) as frequent components. Other species that Braun described in the canopy of this community include *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Magnolia macrophylla* (bigleaf magnolia), *Oxydendrum arboreum* (sourwood), *Quercus alba* (white oak), *Quercus montana* (chestnut oak), *Quercus rubra* var. *borealis* (northern red oak), *Robinia pseudo-acacia* (black locust) and *Tilia heterophylla* (white basswood).

The understory often is a dense thicket of *Rhododendron maximum* (great rhododendron). Other components of the shrub layer include *Asimina triloba* (pawpaw), *Clethra acuminata* (sweet pepper bush),

Hamamelis virginiana (witch hazel), *Hydrangea arborescens* ssp. *arborescens* (wild hydrangea), *Ilex opaca* (American holly), *Pyrularia pubera* (buffalo-nut), *Toxicodendron radicans* (poison ivy) and *Viburnum acerifolium* (maple-leaf viburnum).

The herb layer is not as diverse in the Hemlock-Mixed community as in the Appalachian Mesophytic Forest, partly due to dense shade and the hemlock duff that forms on the forest floor (Braun 1935). Plants commonly found in the herb layer of the Hemlock-Mixed community include *Cypripedium acaule* (pink lady's slipper), *Dryopteris intermedia* (fancy fern), *Goodyera pubescens* (rattlesnake plantain), *Iris cristata* (dwarf crested iris) and *Medeola virginiana* (indian cucumber root). Other species known from this community include *Adiantum pedatum* (northern maidenhair fern), *Circaea lutetiana* ssp. *canadensis* (enchanter's nightshade), *Clintonia umbellulata* (Clinton's lily), *Lycopodium lucidulum* (shining clubmoss), *Mitchella repens* (partridge berry), *Polystichum acrostichoides* (Christmas fern), *Tiarella cordifolia* (foamflower), *Viola conspersa* (American dog violet) and *Viola rostrata* (long-spurred violet) (Braun 1935).

An excellent example of this community type is found along the west bank of the river at Big Branch (Fig. 8, HM) on National Forest System lands. The largest trees at this site are 2-3 ft DBH.

5. Appalachian Mesophytic Forest

This community is found in moist ravines and on moist, protected lower slopes, often where the soils of these valleys become clayey (Braun 1935). The species composition of the community is similar to that of the Hemlock-Mixed Forest; however, rather than hemlock dominating the community, many species are equally important.

This community is dominated by *Acer saccharum* (sugar maple), *Aesculus flava* (yellow buckeye), *Fagus grandifolia* (American beech), *Fraxinus americana* var. *americana* (white ash), *Liriodendron tulipifera* (tulip poplar), *Quercus alba* (white oak), *Quercus rubra* var. *borealis* (northern red oak), *Tilia heterophylla* (white basswood) and *Tsuga canadensis* (eastern hemlock).

The understory is sparser than that of the Hemlock-Mixed community; however, it is more diverse. The understory of this community is composed of *Asimina triloba* (pawpaw), *Clethra acuminata* (sweet pepperbush), *Cornus florida* (flowering dogwood), *Corylus americana* (American hazelnut), *Euonymus americanus* (strawberry-bush), *Hamamelis virginiana* (witch hazel), *Hydrangea arborescens* ssp. *arborescens* (wild hydrangea), *Lindera benzoin* (spicebush), *Magnolia*

acuminata var. *acuminata* (cucumber magnolia), *Magnolia macrophylla* (bigleaf magnolia) and *Parthenocissus quinquefolia* (Virginia creeper). In addition, Braun (1935) describes the following species from the understory of this community type: *Aesculus flava* (yellow buckeye), *Betula lenta* (sweet birch), *Carpinus caroliniana* (ironwood), *Magnolia tripetala* (umbrella tree), *Rubus allegheniensis* (blackberry), *Tilia heterophylla* (white basswood), *Viburnum acerifolium* (maple-leaf viburnum).

The herbaceous layer of this community is rich and diverse and is composed of many ferns including *Asplenium rhizophyllum* (walking fern), *Asplenium trichomanes* (maidenhair spleenwort), *Athyrium pycnocarpon* (glade fern), *Deparia acrostichoides* (silvery glade fern), *Osmunda cinnamomea* (cinnamon fern), *Polypodium virginianum* (rock cap fern), *Polystichum acrostichoides* (Christmas fern) and *Thelypteris hexagonoptera* (broad beech fern). Other herbaceous species present include *Arisaema triphyllum* (jack-in-the-pulpit), *Asarum canadense* (Canadian ginger), *Caulophyllum thalictroides* (blue cohosh), *Cimicifuga racemosa* (black cohosh), *Claytonia virginica* (common spring beauty), *Collinsonia canadensis* (horse-balm), *Cypripedium pubescens* (yellow lady's slipper), *Dentaria heterophylla* (early toothwort), *Disporum lanuginosum* (yellow mandarin), *Disporum maculatum* (nodding mandarin), *Erythronium americanum* (common trout lily), *Geranium maculatum* (wild geranium), *Hydrophyllum canadense* (common waterleaf), *Meehania cordata* (meehania), *Panax trifolius* (dwarf ginseng), *Smilacina racemosa* (false Solomon's seal), *Solidago flexicaulis* (zigzag goldenrod), *Stylophorum diphyllum* (celandine poppy), *Tiarella cordifolia* (foamflower), *Trillium erectum* (wake robin), *Viola blanda* (white violet), *Viola rostrata* (long-spurred violet) and *Viola rotundifolia* (yellow violet).

Seven high quality examples of the Appalachian Mesophytic Forest have been reported within the wild river corridor, along the west bank of the river at the downstream end of the corridor (AM1), on the west bank downstream from Big Branch (AM2), on the north bank at the mouth of Shanty Branch (AM3), on the south bank upstream from Center Rock Rapids (AM4), on the west bank at the mouth of Pitch Branch (AM5), on the west bank downstream from Indian Creek (AM6) and on the west bank at the upstream end of the corridor (AM7) (Fig. 8) (Soil Systems, Incorporated 1980; J. Campbell pers comm). Four of the best examples of Appalachian Mesophytic Forest (AM1, AM2, AM4 and AM7) are on National Forest System lands. Two of the best examples of this community type (AM3 and AM6) are partially on National Forest System lands and partially on privately-owned land. The remaining high quality example of this community type is within Cumberland Falls State Resort Park (AM5).

6. Dry Sandstone Cliff\Rock Outcrops

Dry Sandstone Cliff\Rock Outcrop communities have developed on the exposed bedrock along the ridgetops and on the steep cliffs that line much of the river. These cliffs are continuous within the corridor downstream from the falls and occur sporadically on the upstream end of the corridor. These communities most often are found on south or west facing aspects where exposure to sun and wind causes severe, dry conditions. Soil usually is absent with the exception of a shallow layer on ledges and under overhangs (rockshelters).

Lichens, mosses and ferns dominate this community. Ferns that are a part of this community include *Dennstaedtia punctilobula* (hay- scented fern), *Dryopteris intermedia* (fancy fern), *Dryopteris marginalis* (marginal shield fern), *Polypodium virginianum* (rock-cap fern) and *Pteridium aquilinum* (bracken fern). Vascular plants are limited to places where soil has developed or been deposited in cracks, depressions or ledges. Vascular plants present include *Acer rubrum* (red maple), *Epigaea repens* (trailing arbutus), *Gaultheria procumbens* (wintergreen), *Heuchera* spp. (alumroot), *Kalmia latifolia* (mountain laurel), *Mitchella repens* (partridge berry), *Pinus rigida* (pitch pine), *Pinus virginiana* (Virginia pine), *Rhus copallina* (winged sumac), *Sassafras albidum* (sassafras) and *Vaccinium* spp. (blueberries).

The best examples of the Dry and Moist Cliff/Rock Outcrop community types are listed in the description of the Moist Sandstone Cliff/Rock Outcrop community in the next section.

7. Moist Sandstone Cliff/Rock Outcrops

Moist Sandstone Cliff/Rock Outcrop communities are most often found on steep, north or east facing exposures that are protected from the sun and wind. Soil usually is absent with the exception of a shallow layer on ledges and under overhangs (rockshelters). Within the wild river corridor, cliffs are continuous downstream from the falls; however, they occur only sporadically on the upstream end of the corridor.

This community is dominated by lichens, mosses and ferns. Common ferns in this habitat include *Asplenium montanum* (mountain spleenwort), *Asplenium trichomanes* (maidenhair spleenwort), *Athyrium filix-femina* (southern lady fern), *Osmunda cinnamomea* (cinnamon fern) and *Osmunda regalis* var. *spectabilis* (royal fern). Vascular plants that compose this community include *Ageratina luciae-brauniae* (Lucy Braun's white snakeroot), *Clethra acuminata* (sweet pepperbush), *Heuchera parviflora* (rock-house alumroot), *H. villosa* (hairy alumroot), *Kalmia latifolia* (mountain laurel), *Mitchella repens* (partridge berry), *Silene*

rotundifolia (round-leaved firepink) and *Thalictrum clavatum* (cliff meadow rue).

The best examples of cliffline communities are at the mouth of Marsh Creek (east-facing) (CL1), across the river from McKee Bend (east-facing) (CL2), downstream of Cumberland Falls (east-facing) (CL3) and at the mouth of Dog Slaughter Creek (west-facing) (CL4) (Fig. 8) (Soil Systems, Incorporated 1980). Each of these examples is most likely a combination of moist and dry habitats; however, the dry community type is expected more frequently at west-facing sites and the moist at east-facing sites. Although these communities are not likely to be actively managed for timber, adjacent logging could have a negative impact on these communities. Three of these high quality clifflines (CL1, CL2 and CL4) are on National Forest System lands and the remaining example (CL3) is within Cumberland Falls State Resort Park.

8. Appalachian Sub-xeric Forest

Appalachian Sub-Xeric Forest is found on the upper slopes, ridges and on the saddles between ridges. These areas are fairly open and dry; however, they are not as dry as the bluff edges where Appalachian Pine-Oak community dominates. The canopy layer of this community is largely deciduous, the shrub layer is sparse and there is a diverse array of perennial herbs.

The canopy of the Appalachian sub-xeric forest is often somewhat open and is dominated by oaks, with hickories also present. Canopy species include *Carya glabra* (pignut hickory), *Carya tomentosa* (mockernut hickory), *Nyssa sylvatica* var. *sylvatica* (blackgum), *Oxydendrum arboreum* (sourwood), *Quercus alba* (white oak), *Quercus montana* (chestnut oak) and *Sassafras albidum* (sassafras).

The understory is dominated by *Aralia racemosa* (spikenard), *Asimina triloba* (pawpaw), *Hamamelis virginiana* (witch hazel), *Vaccinium arboreum* (sparkleberry), *V. pallidum* (late low blueberry) and *V. stamineum* var. *stamineum* (deerberry). The ground layer is composed of *Coreopsis major* (whorled-leaf coreopsis), *Cypripedium acaule* (pink lady's slipper), *Desmodium nudiflorum* (barestem beggar lice), *Hieracium venosum* (rattlesnake-weed), *Krigia biflora* (dwarf dandelion), *Lysimachia quadrifolia* (whorled loostrife), *Mitchella repens* (partridge berry), *Potentilla simplex* (cinquefoil), *Pteridium aquilinum* (bracken fern), *Smilax glauca* (sawbriar) and *Tephrosia virginiana* (goat's rue).

A high quality example of this community type is on the slopes to the southwest of the river just upstream from the mouth of Marsh Creek (Fig. 8, AS) (Soil Systems, Incorporated 1980). This site is on National

Forest System lands.

9. Appalachian Pine-oak Forest

This community type occurs between bluff edges and ridgetops. The habitat where this community occurs is very dry with a thin layer of soil.

The canopy of the Appalachian Pine-Oak Forest is dominated by *Pinus rigida* (pitch pine), *Pinus virginiana* (Virginia pine), *Quercus coccinea* (scarlet oak), *Quercus falcata* (southern red oak) and *Quercus montana* (chestnut oak).

The understory of this community is composed of *Amelanchier arborea* var. *arborea* (downy serviceberry), *Crataegus macrosperma* (hawthorn), *Gaylussacia baccata* (black huckleberry), *Gaylussacia brachycera* (box huckleberry), *Kalmia latifolia* (mountain laurel) and *Vaccinium stamineum* var. *stamineum* (deerberry).

The herbaceous layer is very sparse, but varied, with indicator species including *Chimaphila maculata* (spotted wintergreen), *Epigaea repens* (trailing arbutus) and *Gaultheria procumbens* (wintergreen).

The best example of the Pine-Oak Forest community type is along the slopes north and south of Dog Slaughter Creek (Fig. 8, PO) (Soil Systems, Incorporated 1980). This site is privately-owned.

10. Pine Savanna/Woodland

The Pine Savanna/Woodland has a canopy that consists of a very sparse layer of pines. The open nature of this community is maintained by the dry conditions of this southwest-facing ridgetop in combination with periodic fires. The canopy of this community is dominated by *Pinus rigida* (pitch pine) and *Pinus virginiana* (Virginia pine). Understory species include *Aronia arbutifolia* (red chokeberry), *Aronia melanocarpa* (black chokeberry), *Gaylussacia brachycera* (box huckleberry), *Hamamelis virginiana* (witch hazel), *Ilex montana* (mountain holly), *Ilex opaca* (American holly), *Kalmia latifolia* (mountain laurel), *Rhododendron periclymenoides* (pinxter-flower azalea), *Sassafras albidum* (sassafras), *Ulmus alata* (winged elm), *Vaccinium pallidum* (late low blueberry), *Vaccinium stamineum* var. *stamineum* (deerberry), and *Viburnum cassinoides* (northern witherod). The herbaceous layer includes *Gaultheria procumbens* (wintergreen), *Hypericum gentianoides* (pineweed), *Lechea* sp. (pinweed), *Liatris microcephala* (gayfeather) and *Tephrosia virginiana* (goat's rue).

The only known example of the Pine Savanna/Woodland within the corridor is along a narrow ridge between Marsh Creek and the Cumberland River (Fig. 8, PS). This site is on National Forest System lands.

5. Discussion

All of the communities within the Cumberland Wild River Corridor have been disturbed by humans to some extent. The most significant disturbance within the corridor has been timber removal. Logging has occurred most often above the cliffline since access below the cliffs is difficult. Timber removal has likely resulted in more dry habitat, because of soil losses from erosion. Community types that thrive in dry habitat, particularly pine dominated communities, appear to have become more abundant within the corridor as a result of disturbances. The moist and dry sandstone cliff communities probably are the least disturbed community within the corridor because these areas are not appropriate for logging or farming. Rockshelters, a portion of the sandstone cliff communities, have been severely disturbed as a result of trampling and disturbance by people searching for archaeological artifacts.

Fire has played a significant role in shaping forest composition within the southern Appalachians and what is now the DBNF (Martin 1990). Although there is no periodic "fire cycle" or "fire interval" within the forests of the southern Appalachians, lightning-fires occurred frequently enough to affect the communities. Current figures indicate that within the DBNF between 1960 and 1971 lightning fire occurrence averaged 5 per year per 1,000,000 acres (400,000 ha)(Martin 1990). Lightning fires on the DBNF tend to occur in the spring in ridgetop Pine-Oak communities (Martin 1990).

More recent human manipulation of fire also has affected the forests of this region. Suppression of lightning fires could result in an increase in dominance of fire-sensitive species and a decline in reproduction in Pine-Oak Forest communities (Martin 1990). Between 1936 and 1989, 98 percent of the fires within the DBNF were caused by humans (Martin 1990). These human-caused fires can damage communities because they occur more frequently than lightning fires and they occur in communities where lightning fires do not normally occur. Arson fires can result in an increase in erosion and changes in species composition. All of the fires recorded within the Cumberland Wild River Corridor were caused by humans; these fires are frequently started in brush piles along the Cumberland River (Fig. 5)(M. Melton pers comm, J. Strojan pers comm).

The spread of the chestnut blight had an enormous effect on the forests of the corridor, eliminating all mature *Castanea dentata* (American chestnut) trees during the 1930's. In addition to changing the species composition of the forests on dry slopes and ridgetops, the disappearance of *Castanea dentata* has affected wildlife by removing a significant source of wildlife food.

Kalmia latifolia (mountain laurel) plants have experienced some damage from a fungus (*Phyllosticta*) which attacks the leaves (S. Kickert pers comm). This fungus does not present a serious threat to the species, however. Other threats to tree species within the wild river corridor includes dogwood anthracnose and oak bacterial scorge (Kentucky

Environmental Quality Commission [KEQC] 1992). Populations of *Pinus echinata* (shortleaf pine) are thought to be declining, perhaps as a result of damage from pine beetles (S. Kickert pers comm).

6. Rare Species

Fifteen plant species considered to be endangered or threatened within the state of Kentucky have been found within the Cumberland Wild River Corridor (KSNPC 1993). No federally endangered or threatened species are known from the corridor; however, two candidates for federal listing, *Ageratina luciae-brauniae* (Lucy Braun's white snakeroot) and *Juglans cinerea* (white walnut) are found within the corridor. Protecting KSNPC listed species is as important ecologically as protecting federally listed species, although these efforts are not regulated, as is the case with federally listed species. Protecting species as they decline locally but before they have become rare throughout their range can be less expensive and have a greater chance of success than initiating recovery efforts when the species has declined throughout its range.

A small bog near Marsh Creek within the wild river corridor is the second known site in Kentucky for the moss species *Sphagnum cuspidatum* (A. Risk pers comm). No mosses are listed as endangered or threatened by the Kentucky Nature Preserves Commission at this time, although several mosses (including *S. cuspidatum*) are being considered for KSNPC listing in the near future.

Precise locations of rare species are not included within this report in order to protect the plants from illicit collection. Records of these locations are kept at the Kentucky State Nature Preserves Commission office in Frankfort, Kentucky. Within the corridor, a greater concentration of rare species is found below the falls than above the falls. A brief discussion of each rare species follows.

a. *Ageratina luciae-brauniae* (Lucy Braun's white snakeroot), KSNPC special concern, USFWS C2 candidate for listing.

Ageratina luciae-brauniae is a perennial herb in the Aster family (Asteraceae). The species is restricted to sandy floors of sandstone rockshelters within the Cliff Section of Kentucky and Tennessee. Most of Kentucky's 33 extant populations are in McCreary County, Kentucky (KSNPC 1993).

Five populations of *A. luciae-brauniae* are known from the wild river corridor. Three of these populations are within Cumberland Falls State Resort Park and the remaining two are on National Forest System lands. Four of the five populations of the species within the corridor were refound in 1993, and they appeared to be healthy. The fifth population was last seen in 1987 and was in fair health (KSNPC 1993).

Because rockshelters are popular spots for hikers and campers, populations of *A. luciae-brauniae* are threatened by heavy recreational use of their habitat.

Trampling by hikers and campers, and digging by archaeological looters threaten many of the populations of the species.

b. *Boykinia aconitifolia* (brook saxifrage), KSNPC threatened.

Boykinia aconitifolia is a perennial herb in the Saxifrage family (Saxifragaceae). The species grows on rocky streambanks and moist woods in Virginia, West Virginia, Kentucky, Tennessee, Georgia and Alabama (Gleason and Cronquist 1991).

Only five populations of the species are known from Kentucky (KSNPC 1993). The Kentucky populations are in Harlan and Pike counties in the Cumberland Mountains and Cumberland Plateau respectively and in McCreary County in the Cliff Section of the Cumberland Plateau (KSNPC 1993).

The only population of the species within the wild river corridor is along Eagle Creek and is large and healthy. The population, which is on State Park property that has been dedicated as a state nature preserve, was refound in 1993 and appeared vigorous. There are no apparent threats to the survival of this population.

c. *Coreopsis pubescens* var. *pubescens* (star tickseed), KSNPC special concern.

Coreopsis pubescens var. *pubescens* is a perennial herb in the Aster family. The species grows in the woods in sandy soil and is distributed from Virginia to southern Illinois and Oklahoma south to Florida and Louisiana (Gleason and Cronquist 1991). Populations from the wild river corridor are growing in sandy soil on gravel bars.

The species is known from 22 locations in southeast and southwest Kentucky (KSNPC 1993). Two of these locations are within the wild river corridor.

One of the two populations within the wild river corridor has not been seen since 1941. This population was searched for but not found in 1993. Because this population has not been seen in more than 50 years and because it is known from a developed site within the state park, it can be presumed that this population has been destroyed. The second population is on National Forest System lands. This population has not been seen since 1980 and was not found in 1993. Additional searches should be made to determine whether this population still exists.

Gravel bars are threatened by trampling by recreational users of the river; however, trampling does not appear to threaten the population of *C. pubescens* var. *pubescens* at this time.

d. *Gratiola pilosa* (shaggy hedge hyssop), KSNPC endangered.

Gratiola pilosa is a perennial herb in the Figwort family (Scrophulariaceae). The species is chiefly known from pine barrens on the coastal plain from Virginia to Florida and Texas and also is found inland from North Carolina to Kentucky and Arkansas (Gleason and Cronquist 1991).

Gratiola pilosa is known from five locations in Kentucky (KSNPC 1993). The Kentucky populations of the species occur in wet meadows, pond margins and river bank seeps. One population is known within the wild river corridor along a wet, open seep near the river bank. This population was refound in 1993 and appeared to be large and healthy. The population is on National Forest System lands.

The population appears to be threatened by trash that is carried to the site by the river and has collected along the population. The site also is threatened by ATV users who are riding very close to the population.

e. *Juglans cinerea* (white walnut), KSNPC special concern, USFWS C2 candidate for listing.

Juglans cinerea is a tree in the Walnut family (Juglandaceae). The species grows in rich woods, chiefly in the mountains, from New Brunswick to Minnesota and south to South Carolina, Georgia and Arkansas (Gleason and Cronquist 1991).

The species is reported to be declining throughout most of its range as the result of a highly infectious fungal disease. The disease has essentially eliminated the species from North and South Carolina and 13 of the 22 additional states where the species is found have reported diseased individuals (Anderson and LaMadeleine 1978).

The species formerly was frequent in moist areas along streams in Kentucky; however, it is now rarely seen (Braun 1950). There is no information available on the number of trees present within the wild river corridor; however, the species was reported from the corridor in 1980 (Soil Systems, Incorporated 1980). No *J. cinerea* trees were encountered in the wild river corridor during inventory work in 1993; although, it is likely that the species is still present. If the exact location of the species within the corridor is discovered, it should be determined whether the trees are diseased.

f. *Lathyrus palustris* (vetchling peavine), KSNPC endangered.

Lathyrus palustris is a rhizomatous perennial in the Pea family (Fabaceae). The habitat of the species is wet meadows, swamps, shores and wet woods. The circumboreal species is reported in America south to New Jersey, Pennsylvania, Ohio, Indiana, Missouri, Colorado, California and Kentucky (Gleason and Cronquist 1991, KSNPC 1993).

Five of the nine known populations of the species in Kentucky are within the wild river corridor (KSNPC 1993). Within the wild river corridor, the species grows on river banks and gravel bars.

One of the populations of the species was discovered in 1993 during an inventory of the London district of the DBNF (Campbell et al. 1994). This recently discovered population is within the Cumberland Falls State Resort Park.

Three of the populations of *L. palustris* within the wild river corridor were refound in 1993. The healthiest of these populations is on state park property that has been dedicated as a state nature preserve. The remaining two populations are small and are on National Forest System lands. Recreational use of gravel bars is a potential threat to the populations in the future; however, there were no indications of trampling damage at this time. The small size of several of the populations of *L. palustris* within the corridor may threaten their continued existence.

One of the populations of the species was not refound in 1993 or during a search in 1987. This site, located on National Forest System lands, shows no signs of recent significant disturbance. The site should be searched in upcoming years to determine whether the population is still present.

g. *Maianthemum canadense* (wild lily-of-the-valley), KSNPC threatened.

Maianthemum canadense is a perennial herb in the Lily family (Liliaceae). The species occurs in moist forests, primarily in the northeast U.S. and Canada; however, on the east coast it occurs as far south as Georgia and South Carolina (Gleason and Cronquist 1991).

Thirteen populations of the species are known from Kentucky and one is within the wild river corridor on National Forest System lands (KSNPC 1993). The population within the corridor is growing on a moist bank adjacent to a small tributary. The population was seen in 1993 and appeared to be healthy. There are no apparent threats to the population.

h. *Malus angustifolia* var. *angustifolia* (southern crabapple), KSNPC special concern.

Malus angustifolia var. *angustifolia* is a much-branched, often thorny shrub or small tree in the Rose family (Rosaceae). The species grows in sandy soil in open woods or thickets and its distribution is from Virginia to Florida, west to Kansas and Texas and irregularly to southern New Jersey, southern Ohio, Indiana, Illinois and Nebraska (Gleason and Cronquist 1991).

Twenty-four occurrences of this species have been reported in Kentucky, and three occurrences are within the wild river corridor (KSNPC 1993). The Kentucky occurrences of *Malus angustifolia* var. *angustifolia* most often are in dry

to mesic open woods, but the species also is found on gravel bars.

The three locations of this species within the wild river corridor were last seen in 1987 and 1989. Two of the locations are on National Forest System lands and one is on privately-owned land. The occurrences consist of one to several individuals. The occurrences were not searched for during inventory for this report. There are no known threats to the species within the corridor at this time.

i. *Melanthium parviflorum* (small-flowered false hellebore), KSNPC endangered.

Melanthium parviflorum is a perennial herb in the Lily family. The species' habitat is moist wooded slopes, and its distribution is Virginia, West Virginia, Kentucky, North Carolina and Tennessee (Gleason and Cronquist 1991).

Four populations of this species have been reported in Kentucky, one within the wild river corridor on National Forest System lands (KSNPC 1993). The population within the corridor is found in moist woods near the river. In 1993, the population within the corridor consisted of three plants. The population was the same size when it first was discovered in 1980 (Soil Systems, Incorporated 1980). The small size of this population may threaten its continued survival.

j. *Orontium aquaticum* (golden club), KSNPC threatened.

Orontium aquaticum is a perennial herb in the Arum family (Araceae). The species grows in swamps and shallow water, especially on the Coastal Plain. The species is found from Massachusetts to Florida and west to central New York, southwestern Pennsylvania, eastern Kentucky, western Tennessee and Louisiana (Gleason and Cronquist 1991).

Prior to the inventory for this report, one of the 23 populations of *O. aquaticum* in Kentucky had been discovered within the wild river corridor (KSNPC 1993). This population was in shallow water near a Cumberland River gravel bar on National Forest Sysytem lands; however, it was not refound in 1993. Two new populations of the species were discovered within the corridor in 1993, both on National Forest System lands. There are no apparent threats to the newly discovered populations.

k. *Platanthera integrilabia* (white fringeless orchid), KSNPC endangered.

Platanthera integrilabia is a perennial herb in the Orchid family (Orchidaceae). The species grows in areas with partial shade or open seepage areas, both wooded and herbaceous, including swamps, floodplain forests, and seepage slopes (KSNPC 1993). This species is found mostly in the Cliff Section of Tennessee, but there are scattered sites in Mississippi, Alabama, Georgia, Kentucky, and the Carolinas.

Seven populations of this species have been reported in Kentucky (KSNPC 1993). However, within the Cumberland Wild River Corridor this species has not been seen since 1949 in the state resort park. While this population is presumed extirpated, it should still be searched for in suitable habitat within the corridor.

l. *Podostemum ceratophyllum* (threadfoot), KSNPC threatened.

Podostemum ceratophyllum is a submersed aquatic plant of rapidly moving streams and rivers. It is a member of the Riverweed family (Podostemaceae). Threadfoot is currently known only from four populations (KSNPC 1993). This species grows on rocks in the rapids of rivers and larger creeks. Threadfoot is found in Nova Scotia and New Brunswick and Maine south to Georgia, west to southern Ontario, West Virginia, Kentucky, Oklahoma, and Louisiana and also West Indies and central America.

There are many old records of threadfoot which indicates its possible decline over time. The population in the wild river corridor was last observed in 1940. This species may be sensitive to reduced water quality which could account for old records which could not be relocated. *Podostemum ceratophyllum* should still be searched for periodically in suitable habitat.

m. *Scutellaria saxatilis* (rock skullcap), KSNPC special concern.

Scutellaria saxatilis is a perennial herb in the Mint family (Lamiaceae). The habitat of the species is woods, hillsides and moist cliffs and it is found from Delaware to Ohio, and southern Indiana south to South Carolina and Tennessee (Gleason and Cronquist 1991).

Two of the four known populations of *S. saxatilis* in Kentucky are known from the Cumberland Wild River Corridor and are on National Forest System lands (J. Campbell pers comm). The populations of *Scutellaria saxatilis* within the corridor are found in rocky moist to dry woods. There are no apparent threats to the populations at this time.

n. *Solidago spathulata* (sticky goldenrod), KSNPC special concern.

Solidago spathulata is a perennial herb in the Aster family. It grows in rock crevices and on sand dunes from Nova Scotia to northern Virginia and Kentucky, west to northern Indiana and across southern Canada to the Pacific (Gleason and Cronquist 1991).

There are 20 extant populations of the species in Kentucky and 8 are within the wild river corridor (KSNPC 1993, J. Campbell pers comm). Six of the populations within the corridor are on National Forest System lands and two of the populations are within Cumberland Falls State Resort Park. Seven of the

populations were last seen in 1987 and one population was discovered in 1993 (J. Campbell pers comm). The populations within the corridor grow on dry, open areas of sandstone banks of the Cumberland River and its major tributaries. Trampling by recreational users is a potential threat to the species, although there are no indications of damage to the populations at this time.

o. *Tephrosia spicata* (spiked hoary-pea), KSNPC endangered.

Tephrosia spicata is a perennial herb in the Pea family. The species is found in sandy fields, open woods and barrens from southern Delaware to Florida, east to southeastern Kentucky, southern Tennessee and Louisiana (Gleason and Cronquist 1991).

Five of the eight reported populations in Kentucky are within the wild river corridor (KSNPC 1993); three of these are on National Forest System lands and two are owned by Kentucky Department of Parks. The five populations within the corridor could not be relocated in 1993. One of the sites is on state park property in a disturbed area, and may have been destroyed. Searches should be repeated for the four remaining populations within the corridor to determine if they are still present. These four populations were last seen in 1987.

7. Non-native Species

Lonicera japonica (Japanese honeysuckle) is present on state park property, particularly between the lodge and Cumberland Falls. The species is a pernicious weed that often destroys native vegetation. *Lespedeza cuneata* (silky lespedeza), a native of Asia, is found on many of the gravel bars along the Cumberland River. At some sites this species threatens native vegetation and rare plant populations. *Eulalia vimineum*, a native of Asia, is present as an understory herb in the forested areas of the corridor. The species is an invasive weed that competes with native understory species, especially in second growth forests.

8. Wetlands

Several small wetland areas are found within the wild river corridor. These sites are too small to be considered natural communities; however, they do warrant mention. One of these wetland areas occurs on a ridgetop and is pure sphagnum moss with essentially no other associates (Fig. 8, W2). A second wetland also is found along a ridgetop, but has a very different species composition (Fig. 8, WL1). This site has no sphagnum moss and is composed of a hardwood pine canopy with little or no herb and shrub layers. *Acer rubrum* (red maple), *Liriodendron tulipifera* (tulip poplar) and *Pinus rigida* (pitch pine) dominate the canopy (Soil Systems, Incorporated 1980).

V. RECREATION

A. Use of the Area and Facilities

1. Traditional Use

A resort near Cumberland Falls, the Moonbow Inn, was built in the early 1860's during the Civil War and was used as a hospital during the war (Miller/Wihry/Lee Incorporated 1980). It burned down in 1949 and was not replaced (McConnell 1982). A second hotel, the Cumberland Falls Hotel, was built on the McCreary County side of the falls in the 1920's. The hotel burned down in 1947 and was not replaced (McConnell 1982). As early as the turn of the century, tour guides associated with the Inn led visitors on hikes to nearby scenic areas. Danny Vanover was one of the first tour guides, leading groups to many sites near Cumberland Falls (McConnell 1982).

In 1930, the area surrounding the falls was purchased by Mr. T. Coleman Dupont's estate and donated to the Commonwealth of Kentucky to create Kentucky's third state park. The purchase of this area protected it from a proposed hydroelectric dam above the falls (Miller/Wihry/Lee Incorporated 1980). The Civilian Conservation Corps was responsible for much of the work to develop the park including building the original Dupont Lodge and many of the trails. In 1940 Dupont Lodge burned to the ground and in 1941 another lodge was built by the Workman's Progress Administration (McConnell 1982). For a complete history of Cumberland Falls area, facilities, and important people see McConnell (1982).

2. Present Situation

Recreational use within the wild river corridor is concentrated around access points. The most frequent recreational uses in declining order are rafting, canoeing/kayaking, fishing, hiking, and ATV use (Table 13)(USFS 1993). Additional recreational uses of the area include hunting, horseback riding, camping and picnicking.

The sharp decrease in recreational use of the corridor seen between 1977 and 1988 probably is the result of different methods of estimation of Recreation Visitor Days (RVDs). Because of the potential error involved in estimates of RVDs, it is important to focus on trends in recreational use of the area and evidence of negative impact of recreational uses.

TABLE 13. Recreational use of the Cumberland Wild River Corridor (1988-1992) based on district observations, outfitter guide special use permit records, and discussions with users, in thousands of Recreation Visitor Days (RVD) (USFS 1993). Data from 1975 and 1977 from Miller/Wihry/Lee Incorporated (1980).

Cumberland River

	Rafting	Kayaks/ Canoes	Fishing	Hiking	ATV	Other
1992	9.2	3.3	0.8	2.1	0.4	0.6
1991	7.3	3.1	0.8	2.0	0.4	0.6
1990	6.1	3.1	0.8	2.0	0.3	0.6
1989	3.3	1.9	0.7	1.8	0.3	0.6
1988	3.8	2.4	0.6	1.6	0.3	0.5
1977	16.5	-	16.4	10.5	-	-
1975	14.9	-	7.6	7.7	-	-

Cumberland River Below the Falls

	Rafting	Kayaks/ Canoes	Fishing	Hiking	ATV	Other
1992	9.1	2.1	0.7	2.1	0.0	0.6
1991	7.2	2.0	0.7	2.0	0.0	0.6
1990	6.0	2.0	0.7	2.0	0.0	0.6
1989	3.3	0.8	0.6	1.8	0.0	0.6
1988	3.8	1.3	0.5	1.6	0.0	0.5

Cumberland River Above the Falls

	Rafting	Kayaks/ Canoes	Fishing	Hiking	ATV	Other
1992	0.1	1.2	0.1	0.0	0.4	0.0
1991	0.1	1.1	0.1	0.0	0.4	0.0
1990	0.1	1.1	0.1	0.0	0.3	0.0
1989	0.0	1.1	0.1	0.0	0.3	0.0
1988	0.0	1.1	0.1	0.0	0.3	0.0

Rafting/Canoeing/Kayaking

The Cumberland Wild River Corridor is a popular canoeing river. The upstream portion of the corridor is rated Class II on the International Scale of River Difficulty and is appropriate for canoeists with intermediate skills (Sehlinger 1978). This portion of the corridor is runnable from November to early June, or when the gauge at Williamsburg, Kentucky reads 400 cfs or more (Miller/Wihry/Lee Incorporated 1980). Access is at the KY 204 bridge at Redbird and the take out point is on the east side of the river at the KY 90 bridge. A new access point for canoes has been proposed at Archer's Creek (B. Strosnider pers comm) near the upstream end of the wild river corridor. The project design is complete; however, the project is on hold due to lack of funding (B. Strosnider pers comm).

The downstream portion of the corridor includes Class II and Class III rapids and should be attempted only by experienced boaters. This is the only whitewater river in Kentucky that is normally runnable all year (Sehlinger 1978). Access for this portion of the river is on state park property below the falls and the take out point is on the east bank at the mouth of Laurel River.

A private concession, licensed and permitted through the USFS, has operated rafting and canoe trips on the Cumberland River since 1985. A 16 km (10 mi) raft trip on the downstream portion of the corridor is available through this concessionaire. In addition, canoes can be rented for the upstream stretch of the corridor. In 1992, approximately 3,800 people rafted the downstream portion of the wild river corridor through this concession and an estimated 100 individuals canoed this portion of the corridor (R. Egedi pers comm). Approximately 275 people canoed the upstream portion of the corridor in 1992 (R. Egedi pers comm). Table 13 gives estimates of use of the wild river corridor for boating since 1975.

A carrying capacity of 16,344 craft annually for above the falls and 5,221 craft below the falls has been calculated for the wild river (Miller/Wihry/Lee Incorporated 1980). Recent values of use for the wild river are well below the estimated carrying capacities according to Kentucky Department of Local Government (KDLG) (1984). Canoeing opportunities reportedly exceed the demand for canoeing in Kentucky (Sandidge et al. 1989).

There is no evidence to indicate that boating use within the Cumberland Wild River corridor is excessive. Possible indicators of overuse of the area could include complaints by recreational users that the area is overcrowded, damage/erosion at put in/take out sites or damage to rare plants on gravel bars.

Fishing

The best fishing in the Cumberland River upstream from Lake Cumberland is between Cumberland Falls and the KY 204 bridge below Williamsburg (Carter and Jones 1978). Sport fish upstream from the falls include smallmouth bass, spotted bass, rock bass, longear sunfish, flathead catfish and channel catfish (Miller/Wihry/Lee Incorporated

1980). Downstream from the falls, sport fish include walleye, white bass, sauger and crappie (Sehlinger and Underwood 1980).

Table 13 indicates trends in the level of use of the corridor for fishing. A carrying capacity for fishing of 26,108 angler-days annually for the wild river above the falls and 4,494 angler-days annually for the wild river below the falls has been recommended (Miller/Wihry/Lee Incorporated 1980). Estimates of use of the corridor for fishing are well below carrying capacity.

There are no indications that fishing within the corridor is excessive. Possible indicators of overuse could include complaints of overcrowding by fishermen or other recreational users or depletion of fish populations. Statewide, fishing opportunities are reported to exceed demand (Sandidge et al. 1989). There is no reason to expect that excessive fishing within the corridor will become a problem in the near future.

Hiking

Table 13 gives estimates of hiking within the wild river corridor. Within Cumberland Falls State Resort Park, a total of 75 guided hikes with 472 participants were given in 1992 (M. Lynn pers comm). Although no figures are available for the number of people who hike the trails within the park outside of these guided hikes, 1 million people visited Cumberland Falls between May 1990 and May 1991, and 900,000 visited the falls between May 1991 and May 1992 (D. Brown pers comm). It is believed that less than 50% of these individuals utilize the state parks hiking trails.

A carrying capacity of 136,200 visitor-days annually for day use trails and 5,448 visitor-days annually for backpacking trails has been calculated for the wild river corridor (Miller/Wihry/Lee Incorporated 1980). Recent figures suggest that use is far below carrying capacity.

There is no evidence that there is excessive hiking activity within the wild river corridor. Possible indicators of excessive hiking use of the area could include erosion of trails, complaints by hikers of overuse or overcrowding of parking areas at trailheads. According to KDLG (1984) available hiking opportunities exceed demand for hiking in Kentucky.

All Terrain Vehicle (ATV) Use

Use of ATVs is prohibited within Cumberland Falls State Resort Park and on National Forest System lands within state wild river corridors. Despite these restrictions, ATV use is still common within the corridor. Table 13 gives estimates for ATV use within the corridor.

Observations of the corridor, particularly the portion upstream of the falls, during 1993 inventory work clearly indicate that ATV use is damaging the river corridor by increasing erosion, damaging plants and communities and diminishing the experience of other recreational users.

Hunting

Throughout the Daniel Boone National Forest (DBNF), 95 percent of all hunting is for deer (USFS 1985). Within the wild river corridor, however, gray squirrel is the more important game species because the area is heavily forested (Miller/Wihry/Lee Incorporated 1980). Other small game that are hunted within the Daniel Boone National Forest are quail, grouse, rabbit, woodcock, fox, raccoon and dove.

No recent estimates of use of the wild river corridor for hunting were available; however, approximately 20,100 visitor-days of hunting (big and small game) were estimated in the wild river corridor in 1977 (USFS 1978). Carrying capacity for hunting within the wild river corridor has been estimated to be 520 hunter-days annually for squirrel, 310 hunter-days annually for deer and 35 hunter-days annually for ruffed grouse (Miller/Wihry/Lee Incorporated 1980). It is not clear whether the carrying capacity for hunting is being exceeded because small game hunting was included in the visitor-days calculation but was not included in the calculation of carrying capacity.

Within Kentucky, demand for hunting opportunities exceeds available hunting opportunities; however, within the regions surrounding the wild river corridor hunting opportunities exceed demand (Sandidge et al. 1989).

The Department of Fish and Wildlife Resources and County Conservation Officers for Whitley and McCreary counties suggest that there is no indication of overuse of the wild river corridor by hunters (K. Mobley pers comm, S. Bryant pers comm). Indicators of overuse by hunters could include depletion of wildlife populations and complaints of overuse by hunters or other recreational users.

Horseback Riding

Within the state park, horseback riding is not permitted on any trails within the wild river corridor. Horseback riding is permitted on 8 km (5 mi) of trails within the park that are outside of the wild river corridor. Horseback riding is permitted along trails within the national forest. A private concessionaire leases horses, using some trails on National Forest System lands within the corridor. The concessionaire has a special use permit with the Stearns Ranger District of the DBNF. In exchange for use of National Forest System land, they have agreed to maintain the trails used (M. Melton pers comm).

There are no estimates available for visitor-days of horseback riding within the corridor. A carrying capacity of 5.5 groups per mile of trail has been calculated for the corridor (a group is considered to consist of 2-4 riders) (Miller/Wihry/Lee Incorporated 1980).

There is no evidence that horseback riding within the wild river corridor is excessive. Possbile indicators of excessive horseback riding within the corridor include excessive trail erosion or complaints of overuse by horseback riders or other recreational users. Supply of horseback riding opportunities exceeds demand in Kentucky (Sandidge et al. 1989).

Camping

Primitive camping is allowed on National Forest System lands, although camping is prohibited within 90 m (300 ft) of shoreline, trails and roads (USFS 1985). Primitive camping is not permitted within the state park (M. Lynn pers comm). However, there are unauthorized campsites at Blue Bend, part of the Cumberland Falls State Park Nature Preserve (M. Evans pers comm).

Within the wild river corridor, there were approximately 11,600 visitor-days of camping in 1977 (USFS 1978). More recent estimates of camping within the corridor are not available. An area of 9.3 ha (23 acres) per campsite has been recommended for primitive camping (Urban Research Development Corporation 1977).

There is no evidence of excessive primitive camping within the wild river corridor (e.g. many apparent campsites, complaints of overuse by campers or other recreational users).

There are two camping areas within the state resort park with a total of 50 sites. The camping areas are equipped for tents or recreational vehicles. Camping within the state park is only allowed within the designated camping areas. These sites are at 100% capacity during the summer months (D. Brown pers comm). Although these campsites are not within the wild river corridor, their availability may affect levels of primitive camping within the corridor.

Within the park, the carrying capacity of the developed campgrounds has been estimated to be 62,780 visitor-days annually (Miller/Wihry/Lee Incorporated 1980). Current use of 23,200 visitor-days annually does not exceed this limit (D. Brown pers comm).

Picnicking

The state park developed picnic ground is within the wild river corridor just upstream of the KY 90 bridge. There were approximately 6,100 visitor-days of picnicking in the wild river corridor in 1977 (USFS 1978). More recent estimates of use are not available. The carrying capacity for picnic facilities within Cumberland Falls State Resort Park has been estimated to be 16,555 visitor-days annually (Miller/Wihry/Lee Incorporated 1980). There is no evidence of excessive picnicking within the wild river corridor.

3. Future Projections

Nationwide, numbers of outdoor recreational visits have increased over the past 10 years. There has been an increase in the use of Kentucky's public forests for recreation in the past decade and the trend is expected to continue (Kentucky Environmental Quality Commission 1992). A small but steady increase in recreational use within the wild river corridors has been observed (USFS 1993). Kayaking, canoeing and ATV use within the corridor has increased significantly (Table 13)(USFS pers comm).

It is important that recreational activities are monitored to avoid harmful impacts such as erosion, litter, reduced water quality or loss of vegetation. A diminished quality of experience may occur for recreational users if carrying capacity is exceeded for recreational activities. Although quality of experience is difficult to measure, it should be considered and can be gauged by periodically interviewing recreational users of the area.

It is desirable that future recreational uses of the corridor continue to be at a primitive level. Any recreational facilities that become necessary (e.g. bridges along hiking trails, improved canoe access) should be simple and rustic so as not to detract from the natural setting.

Roads and trails are generally necessary to provide for recreation within the corridor. The USFS plans to reevaluate the roads within the corridor as part of a management plan for National Forest System lands within the Cumberland Wild River Corridor that they plan to develop (B. Strosnider pers comm). The USFS will consider will consider closing some of the USFS roads within the corridor if it is determined to be necessary and feasible (B. Strosnider pers comm).

Canoeing

The USFS has proposed developing a new access point near Archer's Creek at the upstream end of the corridor. Designs have been prepared for this project; however, plans are on hold because of a lack of funds (B. Strosnider pers comm). A take out point downstream from the corridor near Devil's Creek also is being considered but no plans have been prepared for this project and it also is on hold because of lack of funds (B. Strosnider pers comm).

Expansions of the canoe concession are expected to result in a doubling of the use of the downstream portion of the corridor in the next five years and use of the upstream portion of the corridor could increase even more rapidly (R. Egedi pers comm). Despite these projected increases in use, canoeing within the wild river corridor is not expected to exceed carrying capacity in the near future. Statewide, opportunities for canoeing are predicted to exceed demand through 1994 (Sandidge et al. 1989).

Fishing

It is not expected that the carrying capacity for fishing within the wild river corridor will be reached in the near future. On a statewide level, fishing opportunities are predicted to exceed demand through 1994 (Sandidge et al. 1989).

Hiking

Nationally, there is an expected increase in day hiking, 144% between 1987 and 2010 and 198% between 1987 and 2030 (Cordell et al. 1988). Between 1960 and 1982 there was a 200% increase in people participating in hiking and backpacking nationally (Hartman et al. 1988). Statewide, hiking opportunities are predicted to exceed demand

through 1994 (Sandidge et al. 1989). Hiking within the corridor is not expected to exceed the corridor's carrying capacity in the near future.

ATV Use

ATV use is the only recreational use of the wild river corridor that has been identified as causing a negative impact. Because ATV use is prohibited on public lands within the corridor, estimates of use have not been calculated. Observations of the area indicate that ATV use has risen considerably in the corridor over the past five years (personal observation).

Nationwide, ATV use has increased dramatically over the past several decades (Hammitt and Cole 1987). In 1960, ATV use was so uncommon that it was not included in a national survey on recreation; however, during the 1970's ATV use on national forest lands doubled to a level of 5.3 million visitor days (Hammitt and Cole 1987). It is expected that ATV use will continue to increase, along with the attendant negative impacts to the corridor, unless a plan to reduce access of vehicles into the corridor is implemented.

Hunting

The USFS predicts that within the DBNF there will be a 63 percent increase in demand for deer hunting and a 32 percent increase in demand for squirrel hunting in the next 50 years (USFS 1985). Statewide, hunting demand is predicted to exceed opportunities through 1994 (Sandidge et al. 1989). Information suggests that hunting may currently exceed carrying capacity within the corridor. Further studies should be made within the corridor to determine whether the level of hunting is excessive.

Horseback Riding

Estimates suggest that demand for horseback riding within the corridor will not exceed opportunities in the near future. Statewide, demand for horseback riding is not predicted to exceed opportunities through 1994 (Sandidge et al. 1989).

Camping

The demand for camping is predicted to exceed available camping in the state through 1994 (Sandidge et al. 1989). Carrying capacity for primitive camping within the corridor has not been calculated; therefore, it cannot be determined if use exceeds the capacity of the area.

Within the state park there are no plans to expand the camping areas, primarily due to a lack of appropriate space (D. Brown pers comm).

Picnicking

It is not expected that the demand for picnic facilities within the wild river corridor will exceed supply in the near future. Statewide, demand for picnicking is predicted to exceed supply through 1994 (Sandidge et al. 1989).

VI. MANAGEMENT PLAN

A. Introduction

In 1972, the Kentucky General Assembly passed Kentucky Revised Statutes Chapter 146.200 to 146.360, commonly known as the Wild Rivers Act. With this legislation, the General Assembly declared, "...in order to afford the citizens of the Commonwealth an opportunity to enjoy natural streams, to attract out-of-state visitors, to assure the well-being of our tourist industry, to preserve for future generations the beauty of certain areas untrammeled by man, it is in the interest of the Commonwealth to preserve some streams or portions thereof in their free-flowing condition because their natural, scenic, scientific, and aesthetic values outweigh their value for water development and control purposes now and in the future. For aesthetic as well as ecological reasons, the foremost priority shall be to preserve the unique primitive character of those streams in Kentucky which still retain a large portion of their natural and scenic beauty, and to prevent future infringement on that beauty by impoundments or other man-made works. Since the stream areas are to be maintained in a natural state, they will also serve as areas for the perpetuation of Kentucky's wild fauna and flora. Few such streams remain in the eastern portion of the United States, and the general assembly feels a strong obligation to the people of Kentucky to preserve these remnants of their proud heritage" (KDOW 1976).

This statement of legislative intent has served to guide the administration of the resulting Wild Rivers Program, including the promulgation of administrative regulations governing wild river management, Kentucky Administrative Regulations Title 401, Chapter 4, Sections .100 to .140 (401 KAR 4:100 - 4:140) (KDOW 1988b).

One of the five outstanding river segments originally designated as a state wild river is the 16.1-mile segment of the Cumberland River from Summer Shoals (River Mile 574.6) to the backwaters of Lake Cumberland (River Mile 558.5).

The Cumberland Wild River corridor includes world-renowned Cumberland Falls and much of its associated state resort park, numerous privately owned tracts and considerable acreage managed by the USFS as part of the Daniel Boone National Forest (DBNF). This segment is well known recreationally for its excellent canoeing opportunities above Cumberland Falls and exhilarating whitewater canoeing, kayaking, and rafting in the portion below Cumberland Falls.

By statute, a wild river is comprised of not only the designated river segment, but is actually a linear corridor, including all visible riverside lands up to 2,000 feet on either side of the designated stream. In the case of an entrenched river like the Cumberland, the designated corridor includes essentially all lands from the bordering ridgetops to the river itself (Fig. 2).

The Kentucky Natural Resources and Environmental Protection Cabinet's (KNREPC) Division of Water is responsible for administering the provisions of the Wild Rivers Act, including monitoring water quality, corridor land uses, and aquatic ecosystem health; increasing public awareness of the program and its benefits; and issuing permits to authorize changes of land use on private lands within the designated river corridor.

B. Management Objectives

The Kentucky General Assembly's charge to the Wild Rivers Program, as outlined in the introduction, requires a balancing of sometimes conflicting interests and goals. For example, the designated rivers are to be managed to preserve their natural, untrammelled qualities, while also stimulating the tourism industry. Effectively protecting the rivers' values while encouraging and facilitating recreational use can be difficult. Management decisions must be based on objectives (listed in no particular order as all are important), and a holistic approach must be taken as to the effects of various measures and strategies on the overall condition of the corridor. With this in mind, the management objectives for the Cumberland Wild River corridor are: 1) Prevent destructive land use to maintain the character of the river corridor; 2) Maintain or improve water quality; 3) Maintain healthy populations of the rare plant and animal species present and conduct additional inventories to assess population status; 4) Maintain or restore natural communities and populations of native plants and animals; 5) Protect archaeological resources; 6) Maintain the scenic quality of the corridor; 7) Provide the facilities necessary to enable recreational use of the area without compromising its natural integrity; 8) Educate river users and the general public about the Wild River corridor, its features and its responsible use; and 9) Respect the rights of private landowners. Each of these objectives will be detailed in this section. It will be apparent that many of these objectives are interrelated; for example, healthy populations of aquatic organisms require good water quality, and prevention of destructive land uses necessary to protect water quality and the scenic qualities of the river corridor.

1. Prevention of Destructive Land Use to Maintain the Character of the River Corridor

The Wild Rivers Act protects designated river corridors from destructive land uses (KRS 146.200 to 146.350) (KDOW 1976). Regulations adopted pursuant to this act (401 KAR 4:100 - 4:140) attempt to protect the natural features and environmental quality of the river corridors, while respecting private land-owners' rights (KDOW 1988b). The act limits the construction of new buildings and roads, prohibits surface mining of coal, clearcutting of timber, construction of dams and diversions, channelization, dredging, and other forms of instream disturbance or disruption of the free-flowing qualities of the river. Certain changes of land use, such as selective timber harvesting, oil and gas well development, and new agricultural use can be allowed, with issuance of a change-of-use permit by the KNREPC. These permits are conditioned to protect the water quality, scenic features, and biological integrity of the river corridor while allowing limited development and extractive-type activities to occur. The permits contain stringent operational requirements and erosion control and reclamation measures; and on-going operations are inspected regularly to ensure compliance with these conditions and standards.

a. Corridor Ownership and Management

As previously described, the Cumberland Wild River corridor is comprised of a mixture of public and private ownerships, with various agencies responsible for management. With respect to prevention of destructive land uses, the remainder of this section outlines these agencies and their responsibilities and the threats facing the corridor. Following each subsection, recommendations for accomplishing the management objective are offered. This format will continue throughout this document.

b. Cumberland Falls State Resort Park

The 1,794 acre Cumberland Falls State Resort Park includes roughly 400 acres that lie within the boundaries of the designated wild river segment. Developed public-use areas such as the falls and its associated walkways, observation platforms and parking lots, the gift shop and snack bar, picnic area, water and sewage treatment plants and several hiking trails all are found in the corridor. In addition, many acres of relatively undisturbed park land are located within corridor boundaries. The Wild Rivers Act requires the Department of Parks to comply with its provisions regarding development and maintenance of water quality and scenic features. Any new construction within the corridor, such as the new barricades and related structures associated with the recent visitor safety improvements in the falls area, must be reviewed and approved by KNREPC prior to initiation of construction.

These safety improvements were designed by an architect in consultation with a safety study committee comprised of the coordinator of the Wild Rivers Program, the stewardship coordinator of the KSNPC, various Department of Parks staff, personnel from the Tourism Cabinet, and Finance Cabinet staff. Such interagency working groups and consultation help to ensure that the management of the state park is in compliance with the provisions of the Wild Rivers Act.

Recommendation

It is recommended that the Department of Parks maintain a close working relationship with the Wild Rivers Program (WRP) to ensure that no inadvertent violations of the Wild Rivers Act and its associated regulations occur, and that the portions of the state park within the boundaries of the designated wild river corridor are managed so as to maintain the undisturbed character of the river corridor. If possible one staff position should be assigned as "construction reviewer" and be most familiar with WRP regulations, especially concerning mowing, trail maintenance, and other activities within the river corridor and the Cumberland Falls State Resort Park (CFSRP). Park and/or state naturalist(s) at CFSRP could develop programs to promote awareness of the corridor and WRP among park visitors. It would also

be important to review park plans to determine compliance with WRP regulations and CFSRP's own land management manual.

c. Kentucky State Nature Preserves Commission

A portion of the corridor has been dedicated as a state nature preserve. Dedication provides land with the highest level of protection available within the Commonwealth. The nature preserve comprises 1294 acres (518 ha) of Cumberland Falls State Resort Park, managed by the Kentucky Department of Parks. The nature preserve portion is jointly managed by the Department of Parks and KSNPC. The Nature Preserves Act (KRS 146.410 - 146.535) states that a nature preserve cannot be used in ways that are inconsistent with natural area preservation. Use of the area is limited to passive-type recreation, and potentially high-impact recreational activities such as camping, horseback riding, all-terrain vehicle (ATV) use, and rock climbing are expressly prohibited within the nature preserve.

The management of the state nature preserve is entirely consistent with the objectives of the Wild Rivers Program. The two agencies have developed a close and cooperative working relationship.

Recommendation

KSNPC and the WRP should continue their tradition of close cooperation in management of the portions of the corridor which are dedicated as a state nature preserve. They should also work closely with the Kentucky Department of Parks to insure that any activities or management practices are in agreement with WRP regulations. In addition, KSNPC and WRP should establish cooperative projects to initiate rare plant and animal inventories, status surveys, and possible cooperative land acquisition and protection projects where feasible. (More details will be provided in following sections.)

d. United States Forest Service

The United States Forest Service (USFS) manages approximately 1,800 acres of land within the Wild River corridor. This comprises some 52 percent of the total corridor acreage. KNREPC and USFS have entered into a Memorandum of Understanding (MOU) concerning the management of wild river corridor lands that are a part of the Daniel Boone National Forest (Appendix A). This MOU recognizes the USFS as the primary agency responsible for land acquisition and for determining the proper use of National Forest System lands within the corridor. In the MOU, the USFS agrees to make every effort to manage National Forest System lands within the intent of the Kentucky Wild Rivers Act as amended. Also, implementation of any recommendations of this plan that involve the management of National Forest System lands will be negotiated with the USFS in a revised MOU.

Much of the ATV use (detailed in a following section) and other recreational use which occurs within the corridor takes place on National Forest System lands. Because of the large amount of National Forest System lands within the corridor, and the relatively undeveloped character of most of these areas, the Forest Service plays a very important part in protecting the character of the wild river corridor. The USFS has issued a notice of area closure which prohibits all off-road vehicle use within the Cumberland Wild River Corridor (Appendix J).

Recommendations

In order to ensure continued long-term protection of National Forest System lands within the wild river corridor, it is recommended that during the upcoming forest plan revision the USFS remove lands within the wild river corridor from the classification as "Management Area 7" in the Daniel Boone National Forest Land and Resource Management Plan. Lands classified as "Management Area 7" are managed to optimize growing potential by using high- to medium-intensity practices for yellow and white pine and medium- to low-intensity practices for upland and cove hardwoods, with visual sensitivities stated as primarily moderate to low. Because of the unique character of this wild river corridor area, its environmental sensitivity, present recreational use, and special status as a state wild river, the corridor should be placed in a separate management area classification, such as "protected river corridor" or the existing category of "unsuited for timber production," with management direction and prescriptions developed accordingly and visual quality objectives of "retention." The natural communities within the corridor should be left to mature and to function as buffer zones to protect water quality and provide habitat for flora and fauna, whether threatened and endangered or more common.

A recent study (USFS 1994) of National Wild and Scenic Rivers includes the Cumberland Wild River Corridor. If this segment is designated a National Wild and Scenic River the KNREPC should be involved in the development of the River Management Plan. The USFS and KNREPC should renew and revise accordingly the current MOU concerning management of wild river corridor lands within DBNF and continue to strive for close cooperation on protection of these riparian areas. It is possible that some timbered areas could be restored once rotational cutting ceases. Also, road access to to corridor should be reviewed and an attempt made to close access roads appropriately.

e. Private Lands

Twenty-six parcels of land within the corridor are privately owned. These parcels range in size from several acres to several hundred acres. The Wild Rivers Act allows landowners within the corridor to continue pre-designation uses of their property; however, the law regulates new construction

and extractive uses within the corridor. Private lands are monitored for compliance with provisions of the Act via inspections by foot, four-wheel drive vehicle, canoe, and helicopter.

Landowners are contacted by the program through periodic issuance of a program newsletter and special mailings; however, these do not always reach their intended audience because of landownership changes and old or inadequate ownership records.

Recommendations

Routine monitoring of private lands within the wild river corridor should continue. If non-compliance with regulations and statutes becomes more frequent, KDOW should consider expanding corridor monitoring.

KDOW should investigate the feasibility and desirability of using Kentucky Department of Fish and Wildlife Resources Conservation Officers to assist in routine corridor monitoring during the performance of their normal job functions. At one time, conservation officers assisted KDOW by performing such inspections and documenting them on forms supplied by KDOW; however, in recent years this has ceased. Since the previous cooperative inspections were conducted before the initiation of detailed land use regulations, it may be necessary to provide a brief training session for the specific conservation officers that are likely to become involved to explain the regulations and objectives for the inspections.

KDOW program staff should investigate and initiate new methods of reaching the landowners within the corridor in order to ensure they are informed about the wild rivers program and its regulations, as well as to answer any questions and concerns these landowners may have. Direct mailings have not proven very successful to date; perhaps newspaper, radio advertisements, or presence at local festivals to promote informational meetings in each county bordering the river would yield a greater response. KDOW staff should also continue the present practice of contacting local officials, agency personnel, and other parties who can assist in passing information along to landowners and other interested parties.

2. Threats to Maintaining the Character of the River Corridor

a. All-Terrain Vehicles

ATV use is prohibited on National Forest System lands within the wild river corridor except on established roads, pursuant to Forest Supervisor's Order Number 86-3 (Appendix J). In addition, lands within Cumberland Falls State Resort Park and State Nature Preserves are closed to ATVs. Wild River regulations specify that private motorized vehicles are to be used on maintained roads only. Despite these restrictions, ATV use, from small "four-

wheelers" up to jeeps and pickups, is fairly heavy in portions of the corridor. The portion of the corridor upstream of Cumberland Falls is especially heavily used; downstream of the falls, the predominance of cliffs and relative scarcity of access roads and trails appears to effectively preclude much ATV use.

ATVs access the corridor in several ways: by using established roads and in many cases venturing off them on user-developed trails, by using logging roads and other non-official roads, and by user-established trails. This use has resulted in considerable adverse impact within the corridor, particularly soil erosion and compaction, rut and mudhole formation, tree scarring, and destruction of vegetation. ATVs are also going out into the river at old ford locations and driving around in the river bed during low water (D. Brown pers comm). Use of ATVs within the corridor also can result in increased trash in the corridor and can prevent non-motorized users from enjoying their recreational experiences.

As mentioned, regulations and restrictions are in place which limit this off-highway use; however, no reduction of such illegal activity is likely to occur without increased surveillance and enforcement activities by the managing agencies. Presently, manpower and funding limitations limit the amount of enforcement activities that can occur (J. Stephens pers comm).

Recommendations

It is recommended that access needs within the corridor be reviewed in cooperation with the USFS. Some roads within the corridor should be blockaded or gated to limit ATV access in order to protect the corridor and its flora and fauna. Table 1 (page 5) lists roads which lead into the corridor and the condition of these roads.

It is also recommended that USFS and KDOW establish a cooperative project to produce and install informational signs on roads and trails at the corridor boundary, detailing the wild river status of the area and the regulations and restrictions pertaining to ATV use in those areas. KSNPC has and will continue to work with USFS on common borders to block ATV access. Cumberland Falls State Park Nature Preserve, part of Cumberland Falls State Resort Park, near Cumberland Falls, has a serious problem with ATV traffic and its negative impact on the natural diversity of the area.

It is further recommended that KDOW and USFS, along with KSNPC and Kentucky Department of Parks, increase enforcement of ATV closure of the wild river area (i.e., no ATVs off of maintained roads), to ensure that motorized recreational vehicle users are aware of those restrictions. It will undoubtedly require increased funding and staffing to accomplish this recommendation. Although it will likely require many years and much funding and effort to significantly reduce ATV use within the river corridor, such measures are deemed necessary to protect the unique and irreplaceable features

and quality of the river corridor.

b. Horseback Riding

At its present level, horseback riding does not appear to be causing a significant negative impact upon the river corridor. Should use levels increase, or new and more fragile areas be used, problems could occur. The following recommendations are provided to help ensure these types of problems do not occur. Horseback riding is prohibited within the wild river corridor lands of Cumberland Falls State Resort Park because it contains a State Nature Preserve.

Recommendations

In order to minimize possible soil erosion and vegetative damage from horseback riding, it is recommended that USFS continue to evaluate its trails within the corridor to determine which are appropriately constructed and located for such use. Trails not suitable for horseback riding should be closed to such use and restrictions posted. Those trails determined to be able to withstand horse use should continue to be regularly maintained to lessen possible erosion. The USFS has an agreement with a local stable that allows use of National Forest System lands for riding in exchange for maintaining the trails. These trails should continue to be inspected by USFS a minimum of once a year to ensure they are receiving adequate maintenance.

A portion of the Sheltowee Trace Trail, on the west side of the river between McKee Bend and Lower Mulberry Branch, receives heavy horseback use. As this trail segment is also popular with hikers, it is recommended that this segment be maintained more frequently and possibly redesigned to better withstand horse traffic. If user conflicts or resource damage occurs on this or other trails within the corridor, the USFS should either increase trail maintenance or close the trail to horses.

c. Motorized Boating

The Wild Rivers Act, under KRS 146.290, prohibits travel upon a wild river by any means other than canoe, kayak, foot, or non-motorized boat. It has been reported to KDOW that personal watercraft such as jetskis have begun to enter the wild river portion of the Cumberland from Lake Cumberland. Such usage of the corridor is illegal and should be curtailed. In addition to the possibility of pollution from gas and oil spillage, the motor noise of these craft can detract from the wilderness setting of the corridor, and their presence can constitute a safety hazard for non-motorized boaters.

Recommendation

KDOW, in cooperation with the Division of Water Patrol (within the Department of Fish and Wildlife Resources) and USFS should investigate the reports of personal watercraft use in the corridor and take appropriate measures to stop such use. The USFS should consider erecting boundary limit buoys or signs indicating the downstream limits of the Wild River corridor. In addition, boat dock operators on Lake Cumberland should be notified of this illegal activity and asked to help inform users of the restrictions on motorized use of the corridor. Once the users have been adequately informed, if such illegal use continues, enforcement action, such as issuance of citations, should be undertaken.

3. Maintain or Improve Water Quality

The Wild Rivers Statutes, under KRS 146.200, require the KNREPC to provide proper management of the recreational, water and other resources of the wild river corridors. The criteria for inclusion of a river into the wild rivers system state, "The waters shall not be polluted beyond feasible correction and shall be kept unpolluted once corrected according to standards established by the Kentucky Department (now Cabinet) for Natural Resources and Environmental Protection" (KRS 146.230, KDOW 1976). In addition, many of the regulations governing wild river administration, allowable land uses, permit conditions and standards, and reclamation promulgated pursuant to the Wild Rivers Act, are intended to protect the water quality of designated rivers to the greatest extent possible.

a. Hydrologic Setting

The Wild River segment of the Cumberland River is a sixth-order stream (Soil Systems, Incorporated 1980). The 16.1 miles of the wild river comprise only a small portion of the total 736-mile length of the Cumberland River. Approximately 1,912 square miles of the Cumberland's 18,000-square-mile drainage basin lie above the Wild River segment (Soil Systems, Incorporated 1980). The watershed of the designated river corridor is heavily mined for coal, with timber harvesting, oil and gas well development, and other extractive activities quite common. In addition, the urban areas of Jellico, Tennessee, Middlesboro, Williamsburg, Pineville, Barbourville, Stearns, Whitley City, and Harlan, Kentucky, as well as numerous other more sparsely populated areas, all lie within the wild river's drainage area (Miller/Whiry/Lee, Incorporated 1980). Approximately 84 percent of the drainage above the wild river is forested, with some 13 percent used for agriculture, 2.5 percent used for mining, and 0.5 percent in urban areas (Mayes, Sudderth and Etheredge, Incorporated 1975). These factors make protection of water quality within the wild river segment a daunting task.

The portion of the Cumberland from Summer Shoals to Cumberland Falls has an average gradient of three feet per mile, and is made up of long,

moderately deep pools separated by large shoals. The stream width varies from 65 to 200 or more feet. For boating, this segment is classified as Class II (Sehlinger 1978). Below the falls, the river changes dramatically (Miller/Whiry/Lee, Incorporated 1980). This segment narrows to 40 to 80 feet in width, and the gradient steepens to average 12 feet per mile (Sehlinger 1978). This segment of river contains many large boulders, and the pools are smaller and faster-flowing; riffles steepen considerably (Miller/Whiry/Lee, Incorporated 1980). For boating, this segment of river is classified as Class III on the International Scale of Whitewater difficulty (Sehlinger 1978).

b. Monitoring and Evaluation

Water quality in the Cumberland Wild River is monitored monthly by KDOW, as part of the state-wide ambient sampling program. Samples are collected from the Highway 90 bridge, just upstream of Cumberland Falls. A wide variety of parameters are monitored, including metals, nutrients, and bacteriological levels. Data are stored in STORET, the computerized water quality data entry and retrieval system developed and maintained by the USEPA. In January 1994, the KDOW Water Quality Branch prepared a Water Quality Investigation Report on the Wild River segment of the Cumberland River. The report compared 10-year STORET data (1983-1993) with physicochemical data collected in late summer 1993 and concluded that at the time of collection, water quality in the wild river segment was good (KDOW 1994). Conductivity, dissolved solids, sulfate, and iron levels were elevated, reflecting the effects of coal mining in the upper watershed (KDOW 1994). This finding reflects those of Mayes, Sudderth and Etheredge, Incorporated (1975); USACOE (1976), Soil Systems, Incorporated (1980) and KDOW (1981) which all concluded that coal mining constituted the most serious impact to water quality in the upper Cumberland River basin.

There are three permitted dischargers of treated domestic wastewater within the wild river segment, all of which discharge directly to the river or to tributaries which enter below Cumberland Falls (Table 3). They are: Eagle Elementary School, discharging to an unnamed tributary of Eagle Creek, with a design flow of 5,000 gallons per day (GPD); Kentucky Department of Parks (CFSRP), discharging to the main stem river, with a design flow of 192,000 gpd; and Holiday Motor Lodge, discharging to Falls Branch, with a design flow of 6,000 gpd (KDOW 1994). The only major point source discharger within 50 miles upstream of the designated segment is the city of Williamsburg wastewater treatment plant, with a permitted discharge of 800,000 gpd (KDOW 1994).

According to the river basin plan for the upper Cumberland River, three acid mine drainage degraded streams discharge directly to or upstream of the designated section. These large tributaries are Marsh Creek, Jellico Creek, and Clear Fork (Mayes, Sudderth and Etheredge, Incorporated 1975).

Water quality degradation from acid mine drainage; sediment from mining, silviculture, agriculture, and construction activities; inadequately treated municipal sewage discharges; "straight pipe" (non-treated) sewage discharges; upstream trash dumping; and other pollution sources can all have serious deleterious effects on the water quality and aesthetics of the river corridor. River-deposited trash from upstream dumping can be seen throughout the corridor, but it is especially evident in the most heavily used portion of the wild river corridor, within Cumberland Falls State Resort Park. Also, huge piles of coal, sand, and silt accumulate immediately below the falls and after periods of high water, much debris remains in eddies and at the high water line immediately above and below Cumberland Falls. Park staff attempts to clean up these unsightly areas when and where possible. A cleanup day involving the public is held yearly. This cleanup often uses local residents, thus also acting to educate the public about the serious negative impacts of illegal trash dumping (D. Brown pers comm). A sign has been erected near the falls explaining that the trash deposited in the falls area is a result of lax enforcement of anti-dumping laws and general public apathy for these laws and that the park is attempting to keep its segment of river as clean as possible.

Recommendations

To improve water quality in tributary streams and the mainstem river upstream of the wild river segment, it is recommended that KDOW encourage establishment of regional sewage treatment facilities to help eliminate small "package" sewage plants and untreated "straight pipe" discharges.

During the field work portion of the water quality survey of the Cumberland River (Wild River segment), performed during July and August, 1993, luxuriant algal growth was noted at the upstream sampling station. Such growth is a possible indicator of nutrient enrichment of the stream. Because of the close proximity of the City of Williamsburg's wastewater treatment plant to the Wild River segment, it is recommended that the plant's discharge be frequently monitored by DOW, that effluent limits be strictly enforced, and that the necessity for imposing nutrient limits be assessed.

Because coal mining operations are the source of the most serious water quality impacts to the wild river segment, it is recommended that the Kentucky Department for Surface Mining Reclamation and Enforcement (DSMRE) and KDOW ensure that permit limits on all coal mining operations occurring upstream, or adjacent to the wild river segment, are strictly enforced. Additionally, any new mining operations within the watershed should be required to obtain individual permits containing stringent anti-erosion and water quality protection requirements, sufficient to protect water quality and aquatic life. KDOW and DSMRE should evaluate the frequency of their inspections of coal mining operations within the watershed and increase this frequency if deemed necessary.

Measures to control soil erosion within the watershed should be implemented in order to reduce sediment levels of the Cumberland River. The United States Department of Agriculture Natural Resources Conservation Service (NRCS) (formerly the Soil Conservation Service [SCS]) and the Farm Services Agency (FSA) (formerly the Agricultural Stabilization and Conservation Service [ASCS]) should continue to assist farmers and encourage implementation of best management practices and other innovative means of lessening erosion resulting from agricultural practices. However, the use of non-native plants to control soil erosion should be prohibited on lands within the corridor. Since NRCS and FSA compete for available funds, special emphasis should be given to projects within the watershed.

The Division of Forestry should continue to advocate the use of best management practices for silvicultural operations within the watershed, especially timber harvesting and its associated road-building activities. For projects that receive competitive federal funding, such as Agricultural Conservation Program (ACP) and Forest Incentives Program (FIP), higher ranking should be given to projects within the wild rivers watershed.

Some soil-disturbing activities within the watershed are covered by permits; for example, stormwater discharge permits are required for all construction projects disturbing five acres or more, Section 401/404 permits are required for all operations involving dredging or filling of wetlands or those involving disturbance of more than 200 linear feet of stream bank or channel, and floodplain construction permits are required for any construction within a floodplain or which can obstruct or fill a floodway. However, smaller operations, or those in minor tributaries often are not covered by one of these permits. When possible, KDOW field operations staff should inspect such operations to ensure that they do not violate surface water standards, as found in 401 KAR 5:031, with regards to protection of water quality and aquatic life and maintenance of designated uses (KDOW 1988b).

Abandoned mines (both underground and surface) which cause water quality degradation within the watershed by discharging acidic water and by increasing sediment loading in streams, should be addressed via implementation of innovative reclamation and treatment measures. The state Division of Abandoned Lands and the federal Office of Surface Mining should give priority to such projects within the watershed of the Cumberland Wild River, and appropriate the funds necessary to accomplish such measures.

KDOW should investigate the feasibility of using USEPA Section 319 (Nonpoint Source Pollution Control) funding to establish water quality improvement projects on facilities such as livestock operations within the watershed. In addition, Section 319 funds could be used to control and treat sources of poor quality water such as abandoned coal mines.

The Kentucky Department for Environmental Protection (KDEP) should work to promote recycling and mandatory universal garbage collection within counties in the watershed to reduce the amount of debris which enters the river.

DEP should encourage upstream county governments to take a stronger stance on enforcement of anti-dumping statutes and in cleaning up the numerous illegal road and streamside dumps which exist on the river and its tributaries. If possible the Wild Rivers Program (WRP) should work with solid waste coordinators in each county to identify dump sites and target cleanups.

4. Maintain Healthy Populations of the Rare and Endangered Species Present and Conduct Additional Biological Inventories to Assess Population Status

An important reason for maintaining the quality of the Cumberland Wild River Corridor is to protect the rare species present. The wild river corridor serves as a refugium for both plants and animals. By protecting the corridor, riparian and aquatic communities can be kept intact to provide a source of organisms to recolonize areas impacted by human activities (KDOW 1994). Such refugia are in extremely short supply in today's world, making areas such as the wild river corridor all the more valuable. This is one of the main purposes of the wild rivers system. The legislative intent of the Wild Rivers Act states, "Since the stream areas are to be maintained in a natural state, they will also serve as areas for the perpetuation of Kentucky's wild fauna and flora. Few such areas remain in the eastern portion of the United States, and the general assembly feels a strong obligation to the people of Kentucky to preserve these remnants of their proud heritage" (KDOW 1976). It is essential that this intent be foremost in the minds of administrators of the wild rivers system when making decisions on recreational developments, permitted activities and other measures that may adversely affect these values of the wild river corridor. Precise locations for rare species populations are not included in this report in order to protect them.

Recommendations

Populations of rare plant species within the wild river corridor should be monitored a minimum of once every 5 to 10 years, to ensure that such populations are present. If a decline in a population is noticed, a thorough study should be undertaken to determine the problem and the appropriate solution. Searches for new populations of rare plant species known from the corridor, as well as searches for rare species not known from the corridor, should be made. Additional inventories should be conducted to provide more complete data on the biodiversity of the area. USFS, Department of Parks and KSNPC should be jointly responsible for these continued inventories of rare plant species.

The Cumberland Plateau gravel/cobble bar community type provides habitat for 6 of the 13 rare plant species known from the wild river corridor. A number of the gravel bars within the corridor are being invaded by an exotic plant species, *Lespedeza*

cuneata. There is no indication that any of the rare plant populations within the corridor are declining due to competition with *L. cuneata*. When rare plant populations that occur on gravel bars are revisited every 5 to 10 years as recommended (more frequently if possible for gravel bar communities due to their dynamic nature and use by boaters), the impact of *L. cuneata* on rare species should be assessed. If populations of rare plants are determined to be declining, KSNPC together with the agency that manages the subject property should work to eradicate the invasive species. If any other exotic species threaten rare species management designed to protect these rare species should be implemented.

The Cumberland Plateau gravel/cobble bar community also is frequently used by boaters along the river. There is no indication that the current level of boating is harmful to this community; however, if levels of boating increase, these areas may be damaged. During monitoring of the rare plants of this community, observations also should be made to determine if the populations are being trampled or otherwise negatively impacted by recreational users of the area. If it is determined that rare plant populations are being damaged due to excessive recreational use, representatives of the agencies that manage land within the corridor should work together to develop a plan to reduce damage to the populations.

If USFS, KSNPC or Department of Parks plan to develop any new trails within the corridor, these trails should be routed away from populations of rare plants. Existing trails that are near populations of rare species should be rerouted if there is evidence that the presence of the trail is detrimental to the health of the population. Each agency should evaluate its own property concerning trails near rare plants. KSNPC will visit these areas every 5-10 years as a part of the rare plant monitoring and to re-evaluate areas.

Within the state park, the rocky riverbank above Cumberland Falls and adjacent to the falls parking lot was formerly the location of two rare plant species. These plants are no longer found at the site. Management of this area includes bush-hogging and burning of debris. Since this area is in a heavily used locality within Cumberland Falls State Resort Park this practice may be permitted until a better alternative becomes available. However, all plastics, tires, and other synthetic debris should be removed and disposed of properly prior to burning, and burning should be conducted in such a way that damage to trees and other vegetation is minimized.

Continued sampling and monitoring of algae, fish, and aquatic invertebrate populations are needed within the corridor. The three sampling sites within the corridor that were used during the KDOW (1994) study should continue to be used as sampling locations. Sampling should be repeated every five or ten years. Two rare fish species previously known from the corridor were not found during sampling in 1993. Sampling for these species should be repeated when possible to determine whether they are still present in the corridor. Sampling for mussels in 1993 did not result in the collection of two rare species previously reported from the corridor. It is likely that the two mussel species are extirpated from the corridor due to impoundment and surface mining run-off; therefore, sampling for these species should not be emphasized in the future.

Sampling of rare terrestrial animals within the Cumberland Wild River Corridor should be undertaken periodically to assure that their populations are being maintained. Sampling for known rare species should be repeated every 10 years.

It would be very helpful to have suitable habitats within the corridor inventoried for additional sites of documented or potentially occurring rare species. Of greatest need is a survey of the clifflines and smaller rock outcroppings within the wild river corridor. Most rare species of terrestrial animals associated with the corridor inhabit sheltered sandstone rockhouses, caves, and crevices. A comprehensive survey of suitable cliffline habitat would likely yield numerous records of rare species, and it could then be used for further management planning. To adequately determine the extent of its use by bats, clifflines should be inventoried for suitable habitat during the winter, and follow-up visits conducted to potential maternity sites in summer. Summer mist-netting along clifflines in the vicinity of suitable roost sites could yield additional information.

Mist-net surveys during spring, summer, and fall also would yield additional information about bat use of the wild river corridor overall. The Cumberland River itself is too large to net, but tributaries, old roads, and openings along clifflines should provide suitable survey sites.

Surveys also should be conducted within the corridor to determine the status of *Picoides borealis* (red-cockaded woodpecker), which is listed as endangered (USFWS 1992). The species is known to occur in pine-oak forests within several miles of the corridor, and the species could inhabit old-growth pine-oak forest communities within the corridor.

Most species of rare terrestrial animals occurring within the Cumberland Wild River Corridor would benefit by the maintenance and restoration of naturally occurring forest habitats. Supplemental management, including the creation of openings and ponds, would not seem necessary nor especially beneficial in the corridor. Trails should be situated away from rock outcroppings wherever rare bats and/or the undescribed and rare caddisfly, *Madeophylax* sp., occurs.

5. Maintain or Restore Natural Communities and Populations of Native Plants and Animals

Recommendations

It is recommended that the USFS remove the Cumberland Wild River corridor from its "Management Area 7" category and place it in a special category with management objectives other than timber production (e.g., riparian zone protection). See recommendation in Section VI.B.1 for more detail on this recommendation.

Certain community types are particularly at risk and should be a priority for protection. The Cumberland Plateau Gravel/ Cobble Bar community is important to protect because of the concentration of rare plant species that are associated with this community. Threats to gravel bars within the wild river corridor and means of

protecting these areas are discussed in the previous section on maintenance of rare species.

Few examples of Pine/Savanna Woodland community remain in Kentucky. The only example of this community type within the wild river corridor should be left in its natural state (Fig. 8). If it is determined to be necessary in the future, the USFS should consider using fire as a management tool to maintain this community.

Riparian Forest is uncommon within the wild river corridor since cliffs and steep slopes line much of the corridor. Most of this community type within the corridor is immature; however, despite the young age of these forests, they support a wide variety of wildlife. In addition to providing habitat for wildlife, this community prevents soil erosion into the river and provides aquatic organisms with nutrients, cover, and plays an important role in reproductive functions. Because of the many significant features of this community type and its rarity within the corridor, its occurrences within the wild river corridor should be left to mature. Many of the examples of Riparian Forest within the corridor are upstream of the falls and privately owned. Additional examples of this community type should be purchased from willing sellers by USFS,the Wild Rivers Program or the Department of Parks if adjacent to CFSRP (for more information on mechanisms to fund land purchase within the wild river corridor see Section VI.C.). The best example of Riparian Forest within the corridor (Fig. 8, FR1) is on state park land. It is recommended that the state park maintain this area in its natural state.

The best example of an Appalachian Pine-Oak Forest within the corridor is on privately owned land. The USFS or KDOW should make this a priority area for acquisition, as funding allows.

Two small heavily impacted wetland areas within the corridor are the only examples of this community type within the corridor (Fig. 8). The wetland labelled WL1 in Fig 8 is located on privately owned land. The wetland labelled WL2 (Fig. 8) is located on National Forest System lands. These sites should be protected and allowed to recover from previous disturbances.

It is recommended that lightning fires within the corridor be managed as a controlled burn unless they endanger human lives or private property. Although these natural fires are infrequent, they have likely played an important role in shaping community composition within the southern Appalachian forests, particularly Pine-Oak communities along ridgetops (Martin 1990).

The control of exotic species within the corridor, especially near rare plant populations, should be implemented. Exotic species which have the potential to become a problem in the corridor include: *Lespedeza cuneata, Eulalia vimineum, Lonicera japonica,* and *L. mackii*. The introduction of non-native species, specifically on agricultural lands and for erosion control measures, should be minimized. SCS and

ASCS should be aware of this recommendation in working with landowners along the corridor.

6. Maintain and Protect Archaeological Resources

The USFS, together with the Office of State Archeology, are responsible for management of cultural resources on federal land in accordance with 36 Code of Federal Regulations (CFR) 800. The Kentucky Heritage Council also shares an interest in protecting archaeological resources.

Recommendations

Thirteen archaeological sites on National Forest System lands were determined to have moderate to high potential for being eligible for nomination to the National Register of Historic Places (Soil Systems, Incorporated 1980). Test excavations of these sites should be made to determine if they are eligible for nomination to the National Register. The USFS should work with the Kentucky Heritage Council for a long range objective to complete these excavations.

Two prehistoric rockshelter sites on state park property were determined to be eligible for listing on the National Register of Historic Places (Soil Systems, Incorporated 1980). High priority should be given to protecting these two sites and the process of listing them should be initiated.

If a high quality site is threatened, excavation may be the only way to protect the artifacts. Closer observations of high quality sites should be made to determine threats to the sites and reasonable means of protecting them. Routing trails away from these rockshelters, covering the floor with a metal grate, or fencing the rockshelters are three additional potential means of protection.

Increased surveillance of such areas also is necessary to reduce damage to the sites. This work should be coordinated between the USFS, Kentucky Department of Parks and the Kentucky Heritage Council.

An ongoing effort to educate the public about the value of archaeological resources will help to protect these resources for the future. In order to discourage artifact hunters, information on the importance of these archeological sites and the illegality of artifact hunting should be made available by the state park and the USFS. An attempt should be made to reduce visitors to the rockshelters by posting information on the dangers associated with rockshelters and by keeping new trails away from rockshelters when possible. The USFS has placed signs along many forest service roads to ask the public not to remove historic or prehistoric artifacts.

7. Maintain Scenic Quality of Corridor

Maintenance of the scenic quality of the wild river corridor is closely tied to other management objectives including the prevention of destructive land uses, maintenance of water quality and maintenance of natural communities. The criteria for inclusion of streams within the wild river system, under Kentucky Revised Statutes Chapter 146.230, require that designated streams must have, "...shorelines and scenic vistas essentially primitive and unchanged, free from evidence of the works of man, and pleasing to the eye" (KDOW 1976). The attendant wild river regulations attempt to accomplish these goals by limiting development on private lands within the river corridor and ensuring that any permitted changes of land use are performed in such a manner as to minimize their impacts on corridor aesthetics. The Cumberland River corridor provides a relatively unique recreational opportunity in Kentucky - the opportunity to experience a large river ecosystem which is largely visually unimpacted by man's activities. With the exception of several scattered hunting/fishing cabins and an occasional primitive road, most of the corridor is undeveloped and highly scenic.

Recommendations

It has been recommended in the section titled "Prevention of Destructive Land Uses" that the USFS remove National Forest System lands within the wild river corridor from the land classification "suitable for intensive forest management" and place them in the category of "protected river corridor" or some similar classification. If enacted, this change would have a significant positive effect towards maintaining the scenic quality of the river corridor. At present, there is only limited evidence of past timber management practices visible from the river, and this is mostly limited to ridgetop areas not within the wild river corridor. These disturbed areas will become less evident with the passage of time, as the vegetation regrows and the buffer zones along the stream become more dense.

Relatively undisturbed river corridors, especially on large rivers like the Cumberland, are very rare in the Commonwealth; therefore, the corridor's natural resources should be protected for their aesthetic values as well as for their biological importance.

8. Provide Facilities Necessary to Enable Appropriate Recreational Use of the Area, Without Compromising its Natural Integrity

A discussion of the recreational facilities within the corridor is included in Section V of this report. There are no indications that any of the recreational uses of the corridor are exceeding their carrying capacities at this time; therefore, there is no need to increase recreational facilities, with the exception of the canoe put-in described in Section V and briefly below.

Recommendations

It would be advisable to develop a new canoe put-in area near the upper terminus of the corridor. Such a facility could also be designed specifically as a canoe launch, unlike the present area, to ensure safety of the users and to lessen soil erosion and bank damage resulting from such use.

Existing recreational facilities should be maintained. Hiking trails within the corridor should be maintained by the USFS, the Department of Parks and the Kentucky State Nature Preserves Commission in order to provide access into the corridor. The USFS should reduce the number of roads leading into the corridor in an attempt to curtail the use of motorized vehicles within the corridor. Roads within the corridor are discussed in more detail in the section of this report on preventing destructive land use.

It is desirable that future recreational uses of the corridor continue to be at a primitive level. Any recreational facilities that become necessary (e.g., bridges along hiking trails, improved canoe access) should be simple and rustic so as not to detract from the natural setting.

NOTE: Three other recreational uses of the wild river corridor, ATV and motorized boat use (both prohibited by the Wild Rivers Act, but occurring nonetheless) and horseback riding, are covered in a preceding section entitled "Prevention of Destructive Land Use to Maintain the Character of the River Corridor."

9. Education of Corridor Users and the General Public About Wild River Corridors, Their Features, and Their Responsible Use

At this time, there are no developed educational facilities along this segment of the Cumberland River. The falls area is visited by many tourists each year, including some school groups. However, no formal mechanism to educate visitors about the unique characteristics of the Cumberland River and its wild river status exists, other than several small display boards near the falls.

There is a definite need to increase the awareness of the general public, as well as affected landowners, about the provisions of the Wild Rivers Act. Such increased awareness would serve several purposes: it could build a constituency for the program; it could decrease the amount of inadvertent violations of the act and its associated regulations that occur; it could reduce the amount of trespassing which occurs on privately owned corridor lands; and it could reduce the damage to the corridor lands which occurs from inappropriate and uninformed recreational use (such as ATV damage).

Presently, wild river program staff present programs to school classes, civic groups, and user groups (canoe clubs, Sierra Club Chapters, etc.) upon demand.

Hundreds of requests for wild rivers- related information are answered each year. Requests are primarily received by mail or telephone. A slide/tape presentation about the program has been prepared and is presented statewide. Printed materials distributed include river management plans, environmental inventories, corridor land maps, fact sheets, a program brochure, and the Riverviews newsletter.

Recommendations

KDOW personnel should continue to make presentations to area schools regarding the Wild Rivers Program, as time allows and upon demand. A river conservation message should be an integral part of any such presentation. In addition, program personnel should strive to educate other groups: civic clubs, loggers, recreationists, local government officials, and landowners, about the Wild River Program, what it wants to accomplish, and why.

The Department of Parks will research the possibility of constructing a visitor center (or using an existing structure) in the vicinity of the snack bar and gift shop in the falls area. Programs offered in this setting could help to educate both local residents and out-of-state visitors about the river and its environment and disseminate a strong conservation message. Displays presented as part of this facility should make note of the wild river status and attempt to instill in visitors a sense of pride and wonder about this outstanding natural and scenic resource. The design of such displays should be a joint project between the Parks Department, KSNPC, and KDOW.

a. Safety

Safety is included with the Section on education since the two are so closely interrelated. Education and an increase in awareness of potential natural hazards can alleviate most of the safety concerns within the corridor. There have been a number of fatalities on the Cumberland River in recent years, tragically emphasizing the need to address safety issues. Canoeists must be prepared for swift water, rocks, and irregular currents, especially in the area downstream of the falls, which is much more technically demanding than the upper segment.

Cumberland Falls has claimed four lives over the last seven years. In response to the most recent death, the Department of Parks established an interagency safety study committee which helped draft a safety plan for the area. The Department of Parks closed off many of the access points to the river immediately above the falls, built a wall to keep tourists back from the water, and constructed a demountable barricade system, moveable to adjust for varied water levels, which helps to ensure that people stay safely back from the cliff edge. All these measures should significantly lower the potential danger of the falls area.

Recommendations

It is recommended that a display be set up at the falls area and launch sites, detailing the risks of canoeing the Cumberland River and the skill levels and equipment required to safely negotiate the river upstream and downstream from the falls.

Signs are needed near the falls to explain the danger of the falls; no swimming, wading, etc.

There is also a need for a warning sign or signs to be erected upstream from the KY 90 bridge to warn canoeists of the proximity of Cumberland Falls and the need to immediately exit on river right, well before the falls.

10. Respect for the Rights of Private Landowners

While wild river designation was developed partly to promote recreational use of the rivers, it does not give the public the right to use private lands without permission of the owners. The Wild Rivers Program has attempted to convey this message in all printed materials it disseminates, from brochures to river maps. However, some largely unintentional trespass does occur, and this has been a cause of landowner criticism of the Wild Rivers Program, and reluctance on the part of local residents to endorse new wild river proposals.

Recommendations

KDOW and program staff should continue to convey the message that entry into private lands without the owner's permission is a misdemeanor and is punishable under law. In short, private lands remain private, regardless of wild river status.

KDOW should investigate the feasibility of producing signs, to be placed at popular river access points, noting the need to obtain landowner's permission before entering private lands.

C. Land Acquisition/Easements

In order to provide for resource protection of tracts on which development activities are imminent, as well as to facilitate appropriate recreational use of the corridor (hiking, boating, and fishing), KDOW may wish to acquire land and/or easements within the corridor. Such land or easement acquisition could assist with accomplishing all of the management objectives detailed in the previous sections.

The Wild River Statutes, under KRS 146.220, grant KNREPC the authority to acquire fee title ownership or a lesser interest (i.e., easements) to lands within the boundaries of

designated wild river corridors. However, no permanent funding mechanism was established at the time of passage.

The 1994 Kentucky General Assembly passed an amendment to the Heritage Land Conservation Fund Act which provides state funding for the purchase of privately-owned lands with ecological or recreational significance from willing sellers. According to the amended act, one tenth of the total funds generated each year are to be used to acquire lands within designated Wild River corridors. It is hoped that this new funding source will allow acquisition of key tracts needed to protect scenic vistas and natural features and to provide recreational access. This marks the first regular funding source for wild river corridor land acquisition in the Commonwealth. Previously, only very limited funding of short duration was provided, and no lands were acquired.

Conservation easements, in which a landowner agrees to either donate or sell the development rights to a tract of land, can be a cost-effective way to ensure long-term land protection without the attendant high management costs which can occur if an agency acquires the tract. These types of agreements can be especially beneficial for state agencies that do not have the manpower or financial resources to administer widely scattered lands.

Recommendations

KDOW should use Heritage Land Conservation Fund (HLCF) monies to acquire land and/or easements where possible and where deemed necessary to ensure protection of the corridor. In addition, cooperative projects between USFS and KDOW towards land acquisition and management should be encouraged, as well as similar cooperative projects with the Department of Parks (for lands adjacent to Cumberland Falls SRP), KSNPC, the Department of Fish and Wildlife Resources and the Division of Forestry. (All are designated as recipients of portions of HLCF-generated funds.) Such joint projects would allow pooling of funds for land purchase and management as well as sharing of administrative responsibilities for tracts meeting the objectives of more than one agency.

It is a priority of the USFS to acquire lands from willing sellers within the wild river corridors (R. Strosnider pers comm). Such acquisition should be encouraged. The USFS does not utilize conservation easements to any great extent.

D. Management Responsibilities

Many agencies share the responsibility for managing the wild river corridor. The following section summarizes the responsibilities of each agency. More information on the responsibilities of each of these managing agencies is provided in the previous sections.

1. United States Forest Service

Administration of National Forest System lands is the responsibility of three ranger districts: London, Somerset, and Stearns. Management of National Forest System lands within the wild river corridor should continue to be accomplished in accordance with the Memorandum of Understanding between the Kentucky Natural Resources and Environmental Protection Cabinet and the USFS pertaining to wild rivers. This MOU recognizes the USFS as the primary agency responsible for land acquisition and for determining the proper use of National Forest System lands within the corridor. With the MOU, the Forest Service agrees to manage National Forest System lands within the corridor in accordance with the intent of the Wild Rivers Act.

Public Law (PL) 91-190 and the National Environmental Policy Act (NEPA) of 1969 requires government agencies to utilize a systematic interdisciplinary approach to achieve two objectives: (1) consider the impacts to the environment by management actions and (2) inform the public of those impacts. In compliance with Public Law (PL) 86-517 and the Multiple-Use Sustained-Yield Act of 1960 the USFS is required to manage its lands for all of the various renewable surface resources of the National Forests so that they are utilized in the combination that will best meet the needs of the American people.

2. Kentucky Department of Parks

The Department of Parks has the responsibility for management of the 1,794-acre Cumberland Falls State Resort Park, much of which lies within the wild river corridor boundary. The Parks Department should continue to manage the area in accordance with the guidelines of the Wild Rivers Act, and the staffs of the two agencies should strive to work together cooperatively to protect the resources and scenic qualities of the area.

3. Kentucky State Nature Preserves Commission

Cumberland Falls State Park Nature Preserve is managed jointly by the Department of Parks and the Nature Preserves Commission. This portion (1294 acres [518 ha]) of the wild river corridor has been dedicated as a state nature preserve, providing it with the highest level of land protection available in the state. The Kentucky State Nature Preserves Commission should continue to work together with KDOW Wild Rivers Program and Kentucky Department of Parks to protect the resources and scenic qualities of the area.

The Kentucky State Nature Preserves Commission also is responsible for cataloging and monitoring rare natural ecological communities as well as federal and state listed threatened and endangered species of plants and animals.

4. Kentucky Natural Resources and Environmental Protection Cabinet

The Kentucky Division of Water's Wild Rivers Program is responsible for administering, planning for, and promoting the state wild rivers system, established by the 1972 Wild Rivers Act (KRS 146.200 to 146.360) (KDOW 1976). In addition, several other divisions within this Cabinet have roles in implementing federal and state water pollution and related regulations that could affect the Cumberland Wild River Corridor.

The Kentucky Division of Water is responsible for implementing provisions of the Clean Water Act, PL-92-500, enacted in 1972, and ammended in 1977 and 1987. This includes issuance of Kentucky Pollution Discharge Elimination System (KPDES) permits for the discharge of treated wastewater. The Division also is responsible for monitoring these facilities for compliance with permit conditions.

The Kentucky Division of Water's Nonpoint Source Section is a federally-funded water pollution control program which encourages the implementation of best management practices to control nonpoint source pollution. The Section controls and abates runoff pollution by providing programs such as education, technical assistance, financial assistance, training, technology transfer, demonstration projects and enforcement. The Divisions of Conservation and Forestry, within the KNREPC, assist in implementing aspects of the state nonpoint source management program plan for control of nonpoint sources of pollution.

5. Kentucky Department of Fish and Wildlife Resources

The Kentucky Department of Fish and Wildlife Resources issues and enforces regulations pertaining to game and sport fisheries, including the setting of limits and seasons for hunting and fishing. The department also regulates trapping; controls the sale, propagation and/or possession of wildlife; regulates musselling operations; restores wildlife populations; and regulates the importation, transportation, or possession of endangered species. As previously mentioned, the Cumberland Wild River Corridor receives a large amount of use for hunting and fishing. County conservation officers can assist KDOW by reporting any potential violations of wild rivers regulations and statutes they may observe.

6. Kentucky Heritage Council - State Historic Preservation Office

The Kentucky Heritage Council was established to preserve Kentucky's heritage, including archaeological resources. The Heritage Council is responsible for gathering information on the archaeological and historical resources as well as ensuring that these resources are protected.

7. Office of State Archaeology

The Office of State Archaeology is housed within the University of Kentucky's Department of Anthropology. Kentucky statutes (KRS 164.730) require that any archaeological find be reported to this office. The office also issues permits for archaeological excavations on state land.

8. Department for Surface Mining Reclamation and Enforcement

The Department for Surface Mining Reclamation and Enforcement (DSMRE) is responsible for issuing permits for the surface mining of coal, pursuant to PL-95-97, the Surface Mining Control and Reclamation Act (SMCRA) of 1977. Permits are to contain conditions and standards sufficient to protect the aquatic life of potentially impacted streams. The agency also is responsible for ensuring the adequacy of post-mining land reclamation and for collecting and releasing bond monies for reclamation. DSMRE should help maintain the water quality of the river by attaching very stringent anti-erosion and water quality protection requirements, sufficient to protect water quality and aquatic life, to all permits it issues in the watershed of the wild river and closely monitoring these permits for compliance.

9. Division of Abandoned Lands

The Division of Abandoned Lands, within the Department for Surface Mining Reclamation and Enforcement, is responsible for reclaiming and restoring lands mined for coal prior to the passage of SMCRA. While there are no such lands within the wild river corridor itself, there is considerable acreage of such land within the watershed of the corridor. The Division should give high priority to accomplishing reclamation of as much abandoned mineland within the watershed as possible.

10. Division of Oil and Gas

The Division of Oil and Gas, within the Department of Mines and Minerals, is responsible for issuing permits for the drilling of oil and gas wells and for ensuring that there is compliance with the conditions placed upon these permits. The Division should ensure that all such permits within the watershed are as protective as possible, and they should monitor compliance with permit conditions. Discharge of any materials from oil and gas operations is regulated by KDOW.

11. Natural Resources Conservation Service (formerly the Soil Conservation Service)

The Natural Resources Conservation Service, within the United States Department of Agriculture, provides technical assistance in the planning and implementation of erosion control measures for farms and timberlands and also provides related technical assistance to landowners. The agency should give priority to projects within the

watershed of the Cumberland Wild River Corridor to help reduce erosion and sedimentation of the wild river and its tributaries.

12. Farm Services Agency (formerly the Agricultural Stabilization and Conservation Service)

The Agricultural Stabilization and Conservation Service, also within the United States Department of Agriculture, administers cost-sharing for soil erosion control measures with agricultural operators and administers federal agricultural product price supports and quotas. The agency should give priority to soil erosion control and abatement projects within the watershed of the Cumberland Wild River Corridor.

13. Kentucky Department of Transportation

This state agency is responsible for building and maintaining several roads in the immediate wild river area, including the KY 90 crossing just upstream of the falls and the KY 204 bridge just upstream of the wild river segment. The Department should consider the unique character of the wild river corridor when performing routine road maintenance such as brush cutting on rights-of-way. As with county governments, the Kentucky Department of Transportation is subject to the provisions and requirements of the Wild Rivers Act pertaining to road building and repair as detailed below.

14. County Governments

Two counties border the wild river, McCreary and Whitley. Several roads maintained by these counties enter into the wild river corridor. Under wild river regulations at 401 KAR 4:125, Section 12, any construction required to improve, repair, or replace existing state- or county-maintained roads or bridges shall require full environmental review by the Kentucky Division of Water and other appropriate state natural resource agencies prior to initiation of any construction activity (KDOW 1988b). In addition, under Section 13 of 401 KAR 4:125, state or local government entities which engage in or regulate any activity within the watershed of a wild river shall notify the Kentucky Natural Resources and Environmental Protection Cabinet prior to the initiation of any planned actions which may negatively affect the river and shall provide the Cabinet an opportunity to review proposals and plans for the new activity (KDOW 1988b).

Local governments and their activities can and do have potentially adverse affects on the wild river corridor, and KDOW should make a concentrated effort to keep county governments informed of their obligations and responsibilities under the Wild Rivers Act. Local governments can also be helpful (e.g., solid waste programs, source of people to do cleanups [jail, community service, etc.]). The KDOW also should take whatever action is necessary to ensure that the county governments comply with the obligations and responsibilities of the Wild Rivers Act, especially with regards to road and bridge

construction, reconstruction, and maintenance.

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APPENDIX A. United States Forest Service/Kentucky Natural Resources and Environmental Protection Cabinet Memorandum of Understanding.

MEMORANDUM OF UNDERSTANDING
Between the
KENTUCKY NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
and the
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Pertaining to the Following Kentucky Wild Rivers:
Cumberland, Little South Fork of the Cumberland, Red, Rockcastle and Rock Creek

This Memorandum of Understanding, made and entered into by and between the Commonwealth of Kentucky, with the Natural Resources and Environmental Protection Cabinet as its agent, hereinafter referred to as the Cabinet, and the Daniel Boone National Forest, Forest Service, U.S. Department of Agriculture (under the authority of Public Law 90-542, 16 USC 1276 and 16 USC 1282), hereinafter referred to as the Forest Service, is for the purpose of establishing and recording agreed-upon policies and procedures designed to promote and administer the protection, use, and enjoyment of the above named State Wild Rivers.

WHEREAS, the Cabinet is the state agency designated by the Kentucky General Assembly to administer and manage the Kentucky Wild Rivers System, as set forth in the Kentucky Wild Rivers Act (KRS 146.200 to 146.360), as amended, and

WHEREAS, the Forest Service administers the National Forest System, which includes the Daniel Boone National Forest, and is responsible for the management of the resources on the National Forest lands, of which certain responsibilities are nondelegable, and

WHEREAS, it is the mutual desire of the Cabinet and the Forest Service to work in harmony for the common purpose of maintaining and managing these Wild Rivers in a manner that shall benefit the people of Kentucky and of the United States;

NOW, THEREFORE, the parties hereto agree as follows:

A. The Cabinet shall:

1. Recognize the Forest Service as the agency responsible for the administration and management of National Forest lands in Kentucky.

2. Provide orientation on state laws and regulations for Forest Service personnel as requested.

3. On National Forest lands erect no signs, perform no construction and post no land lines except as approved by the Forest Service.

4. Include the Forest Service as a full participant in the study of any streams within the National Forest which are proposed for inclusion in the State Wild Rivers System.

5. Agree that implementation of Wild Rivers management plans on National Forest lands will be coordinated with and meet the direction of the Forest Land and Resource Management Plan (Forest Plan).

6. Provide the Forest Service with the Wild Rivers Program's annual work plan.

7. Consult with and use the Forest Service in the development of regulations for administration of the State Wild Rivers Programs.

8. In the performance of work on National Forest lands, comply with the Equal Opportunity provisions shown in Exhibit A, which is attached and made a part of this agreement. In the Exhibit, Contractor means the Cabinet; Contracting Officer and Contracting Agency mean the Forest Service.

9. Consult with and use the Forest Service as technical advisors during the preparation of state Wild River management plans for subject rivers within the National Forest which are added to the Wild Rivers system.

B. The Forest Service shall:

1. Make every effort to manage National Forest lands within the intent of the Kentucky Wild Rivers Act as amended.

2. Through the Forest Service public notification process, provide the Cabinet with information about the Forest Service annual program of work, and any additional activities within the Wild Rivers corridors.

3. Agree that there are no planned timber sales within the Kentucky Wild River corridors on the Daniel Boone National Forest for the remainder of the Forest Plan period unless otherwise amended. The said corridors are as designated on the maps so labeled in Exhibit B, which is attached and made part of this agreement. If a river is included in the National Wild and Scenic River System, a management guide will be developed to provide direction and become part of the Forest Plan by amendment.

If a river is determined unsuitable for inclusion into the National System by the Secretary of Agriculture, the management will continue under the current direction.

Salvage sales may be conducted as necessary in the event of some disaster such as fire, insect, disease or weather related damage.

4. Consistent with funding, consider acquisition of lands or interests in lands for river management and/or protection.

5. In addition to using the standards and guidelines in the Forest Land and Resource Management Plan, permit the Cabinet to recommend means of protecting the water quality, aesthetics, and other special features identified in the Wild River Management Plan.

6. If designated to study any river within the National Forest boundaries, for eligibility as a National Wild and Scenic River, consult with and include the Cabinet as a full participant with the interdisciplinary study team.

7. Provide to Cabinet personnel an orientation on National Forest management goals and the Forest Land and Resource Management Plan as requested.

8. Make available National Forest land ownership maps if requested.

9. Follow the Forest Land and Resource Management Plan for direction in managing National Forest lands within the state Wild Rivers corridors.

C. The Cabinet and Forest Service mutually agree:

1. The management of National Forest lands will be according to the Forest Land and Resource Management Plan.

2. To cooperate in the exchange of routine information related to the management of Kentucky Wild Rivers.

3. To cooperate to improve access, safety and information for the Kentucky Wild Rivers.

4. No contribution herein provided shall entitle the depositor to any share of interest in the said project other than the right to use the same under regulations of the Forest Service. Improvements on National Forest lands shall be and remain the property of the United States.

5. Nothing herein shall be construed as obligating the Forest Service or the Cabinet to expend, or as involving the United States or the Commonwealth of Kentucky in any contract or other obligation for the future payment of money in excess of appropriations authorized by law and administratively allocated for this work.

6. Nothing herein contained shall be construed as limiting or affecting, in any way, the authority of the Forest Supervisor in connection with the proper administration and protection of the National Forest, in accordance with the purpose for which the lands contained therein were acquired and reserved.

7. Nothing herein contained shall be construed as limiting or affecting, in any way, the authority of the Secretary of the Cabinet in properly administering and protecting State and private lands within the Wild River corridors, in accordance with the purpose and intent for which the lands contained therein were acquired or reserved.

8. No member of, or delegate to Congress or Resident Commissioner shall be admitted to any share or part of this agreement, or to any benefit to arise therefrom; but this provision shall not be construed to extend this agreement, if made with a corporation for its general benefit.

9. Public information materials and signs on rivers where there are National Forest lands and waters will inform the public about the cooperation between the Cabinet and Forest Service. The purpose of the material will be to inform the public about the Wild Rivers program, and safety.

10. Each agency will be responsible for acquisition of lands within Wild Rivers corridors. Periodically, ownership will be examined and lands may be exchanged to provide for consolidation of State and National Forest ownership.

11. The Forest Service and the Cabinet shall exercise their respective authority to regulate the public use of streams flowing through National Forest land. This exercise of authority shall not preclude the State from regulating the taking of fish and game or exercising any other authority not otherwise preempted by Federal law, nor shall this authority be deemed to affect the rights of the State or the Federal government regarding the ownership of submerged lands or the navigability of any streams within the State Wild Rivers System.

12. Each and every provision of the Memorandum of Understanding is subject to the laws of the Commonwealth of Kentucky and the laws of the United States.

13. This Memorandum of Understanding supersedes all previous Memorandums of Understanding pertaining to State Wild Rivers.

14. That this Memorandum of Understanding is not intended, nor shall it be construed, to give rise to any cause of action, in law or equity, between the parties hereto or any third party.

15. Amendments to the Memorandum of Understanding may be proposed by either party and shall become effective upon approval by both parties.

16. Either party may terminate this Memorandum of Understanding by providing 90 days written notice, following agreed upon disposition of all improvements constructed under the terms of this memorandum. Unless terminated by written notice, this agreement shall remain in effect indefinitely.

IN WITNESS WHEREOF, the parties have executed this Memorandum of Understanding, as of the last date written below.

Wm Guy Hart, Jr — 12/28/87 (Date)

William G. Hart, General Counsel
Office of General Counsel
Kentucky Natural Resources and
Environmental Protection Cabinet

Mary Helen Miller — 12/29/87 (Date)

MARY HELEN MILLER, Secretary
Kentucky Natural Resources and Environmental
Protection Cabinet

Richard H. Wengert — 10/30/87 (Date)

RICHARD H. WENGERT, Forest Supervisor
Daniel Boone National Forest
Forest Service, U.S. Dept. of Agriculture

APPENDIX B. Water Quality Sampling Site Information.

Site No: 02018001
Waterbody No: KY 5130101-009
Stream: Cumberland River
County: Whitley/McCreary
Location: Below Cumberland Falls
Latitude: 36-50-38
Longitude: 84-20-34
Stream Order: VI
USGS Topo Quad: Cumberland Falls, KY
DOW Map No.: 3-46
MP: 562.1
Sampling Dates: July 29, 1993

Type Sampling: Biological
Physicochemical
Sediment

Site No: 02018002
Waterbody No: KY 5130101-009
Stream: Cumberland River
County: Whitley/McCreary
Location: Below the confluence with Marsh Creek
Latitude: 36-46-54
Longitude: 84-21-00
Stream Order: VI
USGS Topo Quad: Cumberland Falls, KY
DOW Map No.: 3-46
MP: 569.1
Sampling Dates: August 10, 1993

Type Sampling: Biological
Physicochemical
Sediment

Site No: 02018003
Waterbody No: KY 5130101-009
Stream: Cumberland River
County: Whitley
Location: At Summer Shoals
Latitude: 36-15-34
Longitude: 84-17-25
Stream Order: VI
USGS Topo Quad: Cumberland Falls, KY
DOW Map No.: 3-46
MP: 573.6
Sampling Dates: August 10, 1993

Type Sampling: Biological
Physicochemical
Sediment

Site Descriptions

Station 18-1

Site 18-1, located at mile point (MP) 562.1, was directly downstream of, and within sight of Cumberland Falls. The river here was approximately 75 to 80 feet wide. Pools were 1 to 15 feet deep, and riffles were 2 inches to approximately 3 feet deep. Stream flow was low at the time of sampling, however current velocity in the riffles was fast. The substrate consisted of large boulders and cobble in the riffles and boulders, cobble, pebbles, gravel, and fine material in the pools. Two-inch and smaller sized coal and shale pebbles and coal fines were abundant in depositional areas of the pools and along the right bank. Detrital habitats included drift piles and submerged logs. Bank stability was excellent; banks consisted of very large (10-20') boulders and steep forested hillsides. Riparian vegetation consisted of trees and shrubs. Sandy "beach" areas along the banks were sparsely vegetated. Because of the width of the river, canopy cover was only 10-20%.

Station 18-2

Site 18-2 was located at MP 569.1, at the shoal below Marsh Creek. The river was approximately 100 feet wide. Pool depth ranged from 1 foot to greater than five feet deep, and riffle depth was 2 inches to 2 feet. Stream flow was low, and current velocity in the riffles was moderately fast. The substrate at this site consisted of boulder and cobble sized sandstone and bedrock in riffles and bedrock, various sized rocks, and sand in pools. Detrital habitats included drift piles and submerged logs. Filamentous green algae was abundant, covering the substrate in the riffles. Bank stability was excellent and riparian vegetation consisted of a mixture of trees and shrubs. The buffer zone on the left bank was a well forested hillside and on the right bank was 10-20 feet wide. Canopy cover was about 20%.

Station 18-3

Site 18-3 was located at Summer Shoals at MP 573.6. The river was approximately 100 feet wide. The riffle area was shallow (2 inches to 2 feet deep), with a substrate of sandstone bedrock ledges and boulder-cobble sized rock. The pool below the shoals was deep (3-10 feet) with a primarily bedrock substrate. Fine sediments covered much of the bedrock in the pool. Flow was low, but current velocity in the riffle was moderately fast. Filamentous green algae was abundant in the riffle. Habitats present included undercut rock ledges, submerged logs and drift piles. Tree roots were generally not submerged because of the low flow conditions. Bank stability was good, and riparian vegetation consisted of trees and shrubs. Banks sloped steeply and buffer zones were well developed on both sides of the river. A pathway along the right bank, approximately 6-10 feet from the water, was well worn by fishermen.

APPENDIX C. STORET (1983-1993) Values for Cumberland River Ambient Monitoring Station at Cumberland Falls.

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1983	Water Temp. (C)	Cond. (Umhos cm)	DO (mg/l)	pH (SU)	Turb (NTU)	Alk Total (mg/l)	C1 Total (mg/l)	SO_4 Diss. (mg/l)	Susp Sol. (mg/l)	TOC (mg/l)
No. of Samples	12	12	12	12	8	12	12	12	12	6
25th Percentile	6.00	195.00	7.20	7.20	0.30	36.50	3.50	49.10	4.00	4.40
50th Percentile	8.00	255.00	9.80	7.30	7.00	57.40	5.20	70.00	10.00	4.60
75th Percentile	17.00	447.00	10.40	7.80	36.00	78.60	13.10	111.00	56.00	5.10
Maximum	25.00	561.00	12.00	8.00	50.00	130.00	16.70	157.00	190.00	5.20
Minimum	5.00	179.00	6.50	6.90	0.18	31.70	3.16	45.80	2.00	4.40
Mean	13.00	323.25	9.37	7.48	19.39	63.38	8.14	88.42	44.75	4.82

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1984	Water Temp. (C)	Cond. (Umhos cm)	DO (mg/l)	pH (SU)	Turb (NTU)	Alk Total (mg/l)	C1 Total (mg/l)	SO_4 Diss. (mg/l)	Susp. Sol. (mg/l)	TOC (mg/l)
No. of Samples	11	11	11	11	11	10	10	10	10	10
25th Percentile	7.50	216.00	8.20	7.00	9.00	30.20	3.50	54.70	6.00	1.40
50th Percentile	13.00	297.00	9.20	7.10	24.00	36.00	6.15	65.60	37.00	2.20
75th Percentile	22.80	387.00	10.40	7.40	100.00	67.00	7.90	94.70	140.00	2.80
Maximum	24.00	534.00	11.90	7.80	100.00	98.00	52.10	174.00	266.00	11.10
Minimum	3.00	190.00	7.70	6.50	3.20	28.00	3.47	53.90	1.00	0.80
Mean	14.57	309.73	9.47	7.15	44.93	52.89	11.00	86.98	82.00	2.99

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1985	Water Temp. (C)	Cond. (Umhos cm)	DO (mg/l)	pH (SU)	Turb (NTU)	Alk Total (mg/l)	C1 Total (mg/l)	SO_4 Diss. (mg/l)	Susp. Sol. (mg/l)	TOC (mg/l)
No. of Samples	11	11	11	11	11	10	11	11	9	9
25th Percentile	8.50	237.00	8.50	6.80	7.60	36.40	4.10	72.10	4.00	1.20
50th Percentile	14.50	296.00	9.80	7.30	12.00	56.60	5.50	83.90	12.00	2.00
75th Percentile	24.00	298.00	12.50	7.60	36.00	74.10	6.20	91.60	19.00	2.90
Maximum	26.50	490.00	12.80	7.90	72.00	123.00	12.30	136.00	58.00	3.10
Minimum	2.00	197.00	7.20	6.40	2.60	27.90	2.61	58.10	2.00	1.10
Mean	14.91	293.64	10.14	7.19	22.32	62.80	5.62	86.57	20.67	2.02

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1986	Water Temp. (C)	Cond. (Umhos cm)	DO (mg/l)	pH (SU)	Turb (NTU)	Alk Total (mg/l)	Cl Total (mg/l)	SO_4 Diss. (mg/l)	Susp Sol. (mg/l)	TOC (mg/l)
No. of Samples	11	11	11	11	11	11	10	11	9	11
25th Percentile	7.50	260.00	8.20	7.00	6.30	47.30	1.30	74.30	2.00	1.30
50th Percentile	14.70	315.00	8.75	7.10	13.20	60.70	5.50	83.10	12.00	2.30
75th Percentile	24.50	381.00	10.20	7.20	26.00	73.60	7.20	98.90	15.00	2.80
Maximum	28.00	409.00	12.80	7.70	96.00	150.00	9.60	114.00	92.00	5.20
Minimum	6.00	225.00	6.20	6.90	2.40	30.90	1.17	16.80	1.00	1.20
Mean	16.11	318.27	9.24	7.16	25.61	64.60	5.19	81.01	19.00	2.43

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1983	Al Total (ug/l)	As Total (ug/l)	Br Total (ug/l)	Cd Total (ug/l)	Cr Total (ug/l)	Cu Total (ug/l)	Fe Total (ug/l)	Pb Total (ug/l)	Mn Total (ug/l)	Hg Total (ug/l)
No. of Samples	6	12	8	12	12	12	12	12	12	12
25th Percentile	50.00	1.00	34.00	1.00	1.00	2.00	60.00	3.00	40.00	0.10
50th Percentile	67.00	1.00	50.00	1.00	2.00	12.00	360.00	8.00	110.00	0.25
75th Percentile	196.00	1.00	96.00	2.00	4.00	24.00	1020.00	10.00	240.00	0.60
Maximum	391.00	3.00	141.00	20.00	8.00	40.00	3330.00	40.00	298.00	1.20
Minimum	50.00	1.00	32.00	1.00	1.00	2.00	20.00	1.00	30.00	0.10
Mean	150.00	1.25	68.13	3.08	2.58	16.00	826.17	9.75	143.58	0.40

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1984	Al Total (ug/l)	As Total (ug/l)	Br Total (ug/l	Cd Total (ug/l)	Cr Total (ug/l)	Cu Total (ug/l)	Fe Total (ug/l)	Pb Total (ug/l)	Mn Total (ug/l)	Hg Total (ug/l)
No. of Samples	11	11	11	11	11	11	10	11	10	10
25th Percentile	61.00	1.00	38.00	1.00	1.00	2.00	80.00	1.00	40.00	0.10
50th Percentile	232.00	1.00	42.00	1.00	1.00	5.00	300.0	1.00	160.00	0.10
75th Percentile	829.00	1.00	46.00	1.00	3.00	6.00	1260.00	2.00	220.00	0.40
Maximum	1340.00	1.00	48.00	1.00	6.00	60.00	2870.00	9.00	660.00	2.50
Minimum	17.00	1.00	33.00	1.00	1.00	1.00	40.00	1.00	30.00	0.10
Mean	475.36	1.00	41.91	1.00	2.09	9.45	848.00	2.27	186.00	0.49

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1985	Al Total (ug/l)	As Total (ug/l)	Br Total (ug/l)	Cd Total (ug/l)	Cr Total (ug/l)	Cu Total (ug/l)	Fe Total (ug/l)	Pb Total (ug/l)	Mn Total (ug/l)	Hg Total (ug/l)
No. of Samples	9	8	8	9	9	9	8	9	8	10
25th Percentile	55.00	1.00	9.00	1.00	1.00	2.00	120.00	1.00	40.00	0.10
50th Percentile	166.00	1.00	29.00	1.00	1.00	3.00	380.00	2.00	110.00	0.10
75th Percentile	364.00	1.00	37.00	1.00	2.00	4.00	1090.00	2.00	130.00	0.10
Maximum	705.00	7.00	38.00	1.00	4.00	11.00	1710.00	4.00	190.00	2.70
Minimum	43.00	1.00	1.00	1.00	1.00	1.00	90.00	1.00	40.00	0.10
Mean	258.67	1.88	26.38	1.00	1.56	3.78	772.50	1.89	110.00	0.37

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1986	Al Total (ug/l)	As Total (ug/l)	Br Total (ug/l)	Cd Total (ug/l)	Cr Total (ug/l)	Cu Total (ug/l)	Fe Total (ug/l)	Pb Total (ug/l)	Mn Total (ug/l)	Hg Total (ug/l)
No. of Samples	11	11	11	11	11	11	11	11	11	9
25th Percentile	78.00	1.00	21.00	1.00	2.00	1.00	200.00	1.00	60.00	0.10
50th Percentile	122.00	1.00	26.00	1.00	2.00	2.00	450.00	1.00	100.00	0.10
75th Percentile	281.00	2.00	34.00	1.00	4.00	4.00	640.00	2.00	160.00	0.10
Maximum	943.00	4.00	57.00	1.00	6.00	14.00	2480.00	2.00	240.00	0.30
Minimum	21.00	1.00	14.00	1.00	1.00	1.00	50.00	1.00	20.00	0.10
Mean	240.64	1.55	28.91	1.00	2.82	4.00	652.73	1.27	110.00	0.12

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1983	Zn Total (ug/l)	Ca Total (mg/l)	Mg Total (mg/l)	K Total (mg/l)	Na Total (mg/l)	Hard. Total (mg/l)	NH_3+ NH_4 Total (mg/l)	$N0_2$+ $N0_3$ Total (mg/l)	TKN (mg/l)	Phos. Total (mg/l)
No. of Samples	12	6	6	6	6	12	12	12	12	12
25th Percentile	15.00	17.60	10.00	1.96	8.80	70.00	0.06	0.17	0.27	0.04
50th Percentile	18.00	22.00	15.60	3.86	16.00	92.20	0.09	0.31	0.32	0.05
75th Percentile	31.00	37.80	19.30	4.57	29.40	158.00	0.10	0.43	0.37	0.07
Maximum	1200.0	41.50	20.80	5.09	35.80	176.00	0.23	0.44	1.64	0.16
Minimum	2.00	17.60	10.00	1.96	8.80	66.20	0.05	0.01	0.24	0.03
Mean	1020.33	27.98	15.67	3.75	19.70	114.38	0.11	0.29	0.46	0.06

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1984	Zn Total (ug/l)	Ca Total (mg/l)	Mg Total (mg/l)	K Total (mg/l)	Na Total (mg/l)	Hard. Total (mg/l)	NH_3+ NH_4 Total (mg/l)	NO_2+ NO_3 Total (mg/l)	TKN (mg/l)	Phos. Total (mg/l)
No. of Samples	10	10	11	10	11	11	11	11	11	11
25th Percentile	5.00	20.50	9.08	1.90	9.10	84.00	0.05	0.22	0.23	0.03
50th Percentile	9.00	23.00	12.70	2.21	11.90	101.00	0.05	0.33	0.30	0.07
75th Percentile	20.00	27.40	18.30	3.55	24.40	159.00	0.05	0.49	0.55	0.15
Maximum	33.00	69.50	20.60	4.58	47.50	176.00	0.07	0.53	0.81	0.27
Minimum	4.00	6.70	5.28	1.85	5.60	75.00	0.05	0.14	0.08	0.01
Mean	13.50	28.62	13.23	2.82	17.02	113.87	0.05	0.33	0.39	0.09

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1985	Zn Total (ug/l)	Ca Total (mg/l)	Mg Total (mg/l)	K Total (mg/l)	Na Total (mg/l)	Hard. Total (mg/l)	NH_3+ NH_4 Total (mg/l)	$N0_2$+ $N0_3$ Total (mg/l)	TKN (mg/l)	Phos. Total (mg/l)
No. of Samples	8	8	8	8	8	11	11	11	11	11
25th Percentile	8.00	22.10	10.10	1.76	12.00	93.00	0.05	0.18	0.13	0.02
50th Percentile	10.00	26.50	12.40	2.22	13.90	115.00	0.05	0.43	0.21	0.03
75th Percentile	12.00	30.20	13.80	2.39	21.70	187.00	0.05	0.50	0.27	0.05
Maximum	30.00	33.20	19.40	3.81	35.60	278.00	0.05	0.59	0.46	0.07
Minimum	6.00	20.90	9.64	1.56	9.00	73.00	0.05	0.15	0.10	0.01
Mean	12.50	26.94	13.07	2.39	18.28	136.96	0.05	0.36	0.22	0.03

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1986	Zn Total (ug/l)	Ca Total (mg/l)	Mg Total (mg/l)	K Total (mg/l)	Na Total (mg/l)	Hard. Total (mg/l)	NH_3+ NH_4 Total (mg/l)	NO_2+ NO_3 Total (mg/l)	TKN (mg/l)	Phos. Total (mg/l)
No. of Samples	11	11	11	11	11	11	11	11	10	11
25th Percentile	12.00	22.00	11.40	1.74	13.30	101.00	0.05	0.20	0.08	0.02
50th Percentile	14.00	27.40	11.83	2.37	17.10	124.00	0.05	0.42	0.16	0.02
75th Percentile	58.00	30.00	14.60	2.76	24.60	134.00	0.05	0.44	0.37	0.03
Maximum	71.00	33.40	17.30	3.09	34.80	144.00	0.05	0.63	0.47	0.07
Minimum	5.00	17.10	10.10	1.65	9.60	77.80	0.05	0.03	0.07	0.01
Mean	26.91	26.16	12.93	2.31	18.66	116.94	0.05	0.37	0.24	0.03

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1987	Water Temp. (C)	Cond. (Umhos)	DO (mg/l)	pH (Su)	Turb (NTU)	Alk Total (mg/l)	Cl Total (mg/l)	SO_4 (Diss) (mg/l)	Susp. Sol. (mg/l)	TOC (mg/l)
No. of Samples	12	12	12	12	12	12	12	12	12	12
25th Percentile	8.00	246.00	7.50	7.10	3.50	42.80	3.80	80.50	5.00	1.30
50th Percentile	12.00	321.00	9.00	7.20	6.00	78.00	6.16	97.70	5.00	2.79
75th Percentile	22.00	470.00	11.00	7.40	12.00	92.00	11.30	140.00	6.00	4.30
Maximum	27.00	612.00	13.00	7.90	95.00	114.00	25.30	155.00	74.00	8.68
Minimum	0.10	185.00	6.60	7.00	2.00	30.40	3.30	63.80	1.00	1.10
Mean	15.26	363.17	9.47	7.31	18.63	72.93	9.07	109.58	10.83	3.25

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1988	Water Temp. (C)	Cond. (Umhos)	DO (mg/l)	pH (Su)	Turb (NTU)	Alk Total (mg/l)	C1 Total (mg/l)	SO_4 (Diss) (mg/l)	Susp. Sol. (mg/l)	TOC (mg/l)
No. of Samples	12	12	12	12	12	12	11	12	11	12
25th Percentile	1.50	255.00	8.00	7.39	4.00	44.00	3.70	66.20	5.00	1.34
50th Percentile	11.10	302.00	9.30	7.90	8.00	52.80	6.90	92.30	7.00	1.88
75th Percentile	20.20	484.00	12.40	8.20	12.00	76.50	11.20	126.00	38.00	3.00
Maximum	29.00	600.00	13.30	8.77	110.00	103.00	12.50	140.00	135.00	3.70
Minimum	0.10	155.00	6.70	6.89	2.00	33.30	3.30	64.50	1.00	1.28
Mean	13.58	367.43	9.96	7.88	21.22	63.92	7.17	102.38	25.64	2.27

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1989	Water Temp. (C)	Cond. (Umhos)	DO (mg/l)	pH (Su)	Turb (NTU)	Alk Total (mg/l)	C1 Total (mg/l)	SO_4 (Diss) (mg/l)	Susp. Sol. (mg/l)	TOC (mg/l)
No. of Samples	12	12	12	12	12	12	11	12	12	10
25th Percentile	8.10	206.00	7.50	7.40	7.00	37.50	2.43	52.80	9.00	1.10
50th Percentile	13.50	230.00	8.30	7.50	12.00	43.60	3.34	69.30	16.00	1.62
75th Percentile	19.00	261.00	10.70	7.90	52.00	46.90	3.82	81.80	88.00	2.50
Maximum	28.20	417.00	12.80	8.00	210.00	78.80	6.60	132.00	270.00	4.40
Minimum	0.50	148.00	5.70	7.30	3.50	14.10	0.80	50.30	3.00	1.00
Mean	15.05	241.42	9.05	7.64	49.38	44.31	3.39	76.65	71.92	2.02

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1990	Water Temp. (C)	Cond. (Umhos)	DO (mg/l)	pH (Su)	Turb (NTU)	Alk Total (mg/l)	C1 Total (mg/l)	SO (Diss) (mg/l)	Susp. Sol. (mg/l)	TOC (mg/l)
No. of Samples	12	12	12	12	11	12	12	12	12	12
25th Percentile	6.10	220.00	8.20	7.20	8.50	37.20	1.04	58.30	10.00	1.20
50th Percentile	15.50	317.00	9.40	7.40	14.00	56.20	3.86	66.60	15.00	2.20
75th Percentile	18.00	331.00	10.60	8.00	21.00	71.50	5.19	86.80	24.00	3.10
Maximum	26.00	490.00	14.00	8.50	130.00	94.10	46.70	133.00	125.00	4.20
Minimum	5.00	201.00	7.20	6.90	6.50	31.10	0.10	52.80	4.00	0.10
Mean	15.13	316.33	9.84	7.62	24.91	55.53	7.04	80.63	33.33	2.38

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1987	Al Total (ug/l)	As Total (ug/l)	Ba Total (ug/l)	Cd Total (ug/l)	Cr Total (ug/l)	Cu Total (ug/l)	Fe Total (ug/l)	Pb Total (ug/l)	Mn Total (ug/l)	Hg Total (ug/l)
No. of Samples	12	12	12	12	12	12	12	12	12	12
25th Percentile	38.00	1.00	6.00	1.00	1.00	2.00	50.00	2.00	30.00	0.10
50th Percentile	88.00	1.00	23.00	1.00	1.00	3.00	220.00	3.00	60.00	0.10
75th Percentile	164.00	2.00	55.00	1.00	2.00	8.00	430.00	3.00	150.00	0.10
Maximum	1960.00	7.00	103.00	1.00	3.00	22.00	2140.00	9.00	270.00	2.30
Minimum	9.00	1.00	4.00	1.00	1.00	1.00	10.00	1.00	10.00	0.10
Mean	391.83	2.33	35.92	1.00	1.42	5.92	486.67	3.67	95.00	0.30

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1988	A1 Total (ug/l)	As Total (ug/l)	Ba Total (ug/l)	Cd Total (ug/l)	Cr Total (ug/l)	Cu Total (ug/l)	Fe Total (ug/l)	Pb Total (ug/l)	Mn Total (ug/l)	Hg Total (ug/l)
No. of Samples	12	12	12	12	12	12	12	12	12	11
25th Percentile	42.00	1.00	30.00	1.00	1.00	2.00	100.00	2.00	60.00	0.10
50th Percentile	99.00	2.00	38.00	1.00	2.00	4.00	240.00	3.00	100.00	0.20
75th Percentile	147.00	4.00	51.00	1.00	3.00	4.00	520.00	5.00	180.00	0.30
Maximum	4410.00	18.00	84.00	1.00	5.00	8.00	3080.00	12.00	300.00	2.10
Minimum	21.00	1.00	14.00	1.00	1.00	1.00	20.00	2.00	20.00	0.10
Mean	545.33	3.75	42.83	1.00	2.58	3.75	668.33	4.50	133.33	0.40

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1989	Al Total (ug/l)	As Total (ug/l)	Ba Total (ug/l	Cd Total (ug/l)	Cr Total (ug/l)	Cu Total (ug/l)	Fe Total (ug/l)	Pb Total (ug/l)	Mn Total (ug/l)	Hg Total (ug/l)
No. of Samples	12	12	12	12	12	12	12	12	12	10
25th Percentile	65.00	2.00	13.00	1.00	2.00	2.00	360.00	2.00	120.00	0.10
50th Percentile	353.00	2.00	39.00	1.00	2.00	3.00	760.00	2.00	210.00	0.10
75th Percentile	1470.00	2.00	72.00	1.00	5.00	4.00	2920.00	3.00	250.00	0.10
Maximum	4810.00	8.00	98.00	1.00	8.00	9.00	1020.00	8.00	890.00	0.10
Minimum	57.00	2.00	4.00	1.00	1.00	1.00	160.00	2.00	50.00	0.10
Mean	1366.42	2.75	44.67	1.00	3.42	3.75	2526.08	3.25	277.08	0.10

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1990	Al Total (ug/l)	As Total (ug/l)	Ba Total (ug/l)	Cd Total (ug/l)	Cr Total (ug/l)	Cu Total (ug/l)	Fe Total (ug/l)	Pb Total (ug/l)	Mn Total (ug/l)	Hg Total (ug/l)
No. of Samples	10	11	11	10	10	11	10	12	11	12
25th Percentile	160.00	2.00	21.00	1.00	1.00	2.00	524.00	2.00	62.00	0.10
50th Percentile	389.00	2.00	30.00	1.00	2.00	3.00	670.00	2.00	89.70	0.10
75th Percentile	788.00	3.00	50.90	1.00	2.00	3.00	1060.00	4.00	143.00	0.10
Maximum	2410.00	12.00	81.00	2.00	6.00	6.00	4410.00	14.00	240.00	4.60
Minimum	48.00	1.00	8.00	1.00	1.00	1.00	140.00	2.00	50.00	0.10
Mean	668.70	3.36	37.08	1.20	2.10	2.91	1172.70	3.92	106.97	0.48

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1987	Zn Total (ug/l)	Ca Total (mg/l)	Mg Total (mg/l)	K Total (mg/l)	Na Total (mg/l)	Hard. Total (mg/l)	NH_3+ NH_4 Total (mg/l)	$N0_2$+ NO_3 Total (ug/l)	TKN (mg/l)	Phos. Total (mg/l)
No. of Samples	12	12	12	12	12	12	12	12	12	12
25th Percentile	8.00	19.20	12.80	1.59	14.10	108.00	0.05	0.05	0.16	0.01
50th Percentile	13.00	31.90	14.40	2.99	26.70	121.00	0.05	0.19	0.27	0.01
75th Percentile	21.00	37.00	19.35	3.72	41.80	159.00	0.05	0.42	0.50	0.04
Maximum	125.00	47.90	23.67	4.76	50.80	188.00	0.06	0.54	0.87	0.09
Minimum	5.00	13.60	10.40	1.45	10.20	91.50	0.05	0.02	0.05	0.01
Mean	26.42	30.72	16.39	2.96	31.17	138.71	0.05	0.26	0.36	0.03

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1988	Zn Total (ug/l)	Ca Total (mg/l)	Mg Total (mg/l)	K Total (mg/l)	Na Total (mg/l)	Hard. Total (mg/l)	NH_3+ NH_4 Total (ug/l)	NO_2+ NO_3 Total (ug/l)	TKN (mg/l)	Phos. Total (mg/l)
No. of Samples	12	12	12	12	12	12	12	12	12	12
25th Percentile	9.00	24.30	11.80	2.03	13.10	104.00	0.05	0.08	0.13	0.01
50th Percentile	14.00	30.20	14.50	2.32	17.40	133.00	0.05	0.29	0.21	0.02
75th Percentile	24.00	35.40	19.00	3.76	33.20	160.00	0.05	0.40	0.26	0.03
Maximum	70.00	44.20	21.80	4.27	63.30	183.00	0.08	0.49	0.65	0.07
Minimum	6.00	19.30	10.30	1.51	10.70	94.60	0.05	0.02	0.05	0.01
Mean	23.50	30.93	15.78	2.82	26.13	135.72	0.05	0.26	0.23	0.03

APPENDIX C: STORET (1983-1993) Values for Cumberland River Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1989	Zn Total (ug/l)	Ca Total (mg/l)	Mg Total (mg/l)	K Total (mg/l)	Na Total (mg/l)	Hard. Total (mg/l)	NH_3+ NH_4 Total (mg/l)	NO_2+ NO_3 Total (ug/l)	TKN (mg/l)	Phos. Total (mg/l)
No. of Samples	11	12	12	12	12	12	12	12	12	12
25th Percentile	17.00	18.80	9.78	1.78	6.70	74.70	0.05	0.19	0.07	0.01
50th Percentile	23.00	21.50	11.90	1.93	10.90	98.80	0.05	0.28	0.16	0.01
75th Percentile	49.00	27.70	15.20	2.15	15.60	116.00	0.05	0.36	0.27	0.04
Maximum	289.00	40.90	18.70	3.06	25.80	168.00	0.07	0.84	0.53	0.12
Minimum	10.00	10.90	8.80	1.58	4.00	63.20	0.05	0.12	0.05	0.01
Mean	67.73	23.91	12.74	2.09	12.66	101.68	0.05	0.32	0.22	0.03

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1990	Zn Total (ug/l)	Ca Total (mg/l)	Mg Total (mg/l)	K Total (mg/l)	Na Total (mg/l)	Hard. Total (mg/l)	NH_3+ NH_4 Total (ug/l)	NO_2+ NO_3 Total (ug/l)	TKN (mg/l)	Phos. Total (mg/l)
No. of Samples	10	10	10	10	11	12	12	11	12	12
25th Percentile	10.00	18.80	9.95	1.79	12.10	93.70	0.05	0.25	0.20	0.01
50th Percentile	16.00	24.80	12.70	2.63	17.40	110.00	0.05	0.38	0.23	0.01
75th Percentile	20.00	34.40	16.80	3.18	22.20	129.00	0.05	0.51	0.26	0.03
Maximum	33.00	38.00	19.60	4.05	32.10	170.00	0.05	0.60	0.44	0.06
Minimum	9.00	16.10	9.24	1.44	8.72	80.90	0.05	0.19	0.13	0.01
Mean	17.80	27.06	13.60	2.70	17.50	117.02	0.05	0.37	0.25	0.02

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1991	Water Temp. (C)	Cond. (Umhos)	DO (mg/l)	pH (SU)	Turb (NTU)	Alk Total (mg/l)	Cl Total (mg/l)	SO_4 Diss. (mg/l)	Susp. Sol. (mg/l)	TOC (mg/l)
No. of Samples	12	11	9	12	12	12	12	12	12	11
25th Percentile	9.20	248.00	7.50	7.40	9.00	37.90	2.80	28.80	7.00	2.20
50th Percentile	14.80	312.00	8.60	7.90	16.00	57.90	3.40	90.30	20.00	2.50
75th Percentile	25.00	403.00	9.80	8.00	45.00	88.10	6.20	97.70	46.00	3.40
Maximum	27.50	588.00	12.60	8.20	500.00	127.00	12.50	145.00	594.00	4.70
Minimum	5.10	132.00	7.10	7.30	2.60	17.70	0.20	10.20	1.00	0.90
Mean	17.42	330.45	9.11	7.81	83.93	69.63	5.43	78.59	92.25	2.73

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1992	Water Temp. (C)	Cond. (Umhos)	DO (mg/l)	pH (SU)	Turb (NTU)	Alk Total (mg/l)	Cl Total (mg/l)	SO_4 Diss. (mg/l)	Susp. Sol. (mg/l)	TOC (mg/l)
No. of Samples	9	9	ND	9	9	9	9	8	9	7
25th Percentile	4.00	264.00	ND	7.30	5.50	44.70	0.50	70.50	2.00	2.30
50th Percentile	22.40	284.00	ND	7.70	14.50	64.20	3.40	84.40	11.00	2.70
75th Percentile	23.50	353.00	ND	7.90	63.00	75.90	4.40	89.60	48.00	3.60
Maximum	25.50	394.00	ND	8.20	103.00	82.80	5.20	115.00	85.00	4.70
Minimum	2.70	242.00	ND	7.30	5.00	38.30	0.10	62.20	1.00	1.50
Mean	17.16	310.11	ND	7.71	32.94	62.56	2.89	86.31	25.33	2.84

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1991	Al Total (ug/l)	Ag Total (ug/l)	Ba Total (ug/l)	Cd Total (ug/l)	Cr Total (ug/l)	Cu Total (ug/l)	Fe Total (ug/l)	Pb Total (ug/l)	Mn Total (ug/l)	Hg Total (ug/l)
No. of Samples	10	10	11	11	11	11	11	11	11	9
25th Percentile	148.00	2.00	37.00	1.00	1.00	3.00	420.00	2.00	63.00	0.10
50th Percentile	356.00	2.00	48.00	1.00	1.00	4.00	1180.00	3.00	112.00	0.10
75th Percentile	924.00	3.00	60.00	1.00	5.00	6.00	4140.00	6.00	252.00	0.10
Maximum	12900.00	7.00	542.00	1.00	18.00	26.00	2800.00	21.00	740.00	0.20
Minimum	32.00	1.00	20.00	1.00	1.00	1.00	136.00	1.00	27.00	0.10
Mean	2185.20	2.80	90.73	1.00	4.09	6.45	4463.91	4.73	204.09	0.11

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1992	Al Total (ug/l)	Ag Total (ug/l)	Ba Total (ug/l)	Cd Total (ug/l)	Cr Total (ug/l)	Cu Total (ug/l)	Fe Total (ug/l)	Pb Total (ug/l)	Mn Total (ug/l)	Hg Total (ug/l)
No. of Samples	9	9	9	9	9	9	9	9	9	9
25th Percentile	73.00	2.00	25.00	1.00	1.00	1.00	356.00	2.00	39.00	0.10
50th Percentile	197.00	2.00	31.00	1.00	2.00	2.00	972.00	2.00	149.00	0.10
75th Percentile	683.00	2.00	39.00	1.00	3.00	4.00	1760.00	3.00	172.00	0.10
Maximum	1230.00	7.00	47.00	1.00	5.00	10.00	3050.00	12.00	215.00	0.10
Minimum	42.00	2.00	22.00	1.00	1.00	1.00	198.00	2.00	29.00	0.10
Mean	381.89	2.56	33.44	1.00	2.67	3.33	1190.89	3.67	129.00	0.10

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1991	Zn Total (mg/l)	Ca Total (mg/l)	Mg Total (mg/l)	K Total (mg/l)	Na Total (mg/l)	Hard. Total (mg/l)	NH_3 + NH_4 Total (mg/l)	NO_2 + NO_3 Total (mg/l)	TKN Total (mg/l)	Phos. Total (mg/l)
No. of Samples	11	11	11	11	11	11	11	10	12	11
25th Percentile	9.00	22.70	10.90	2.20	10.80	101.60	0.05	0.07	0.13	0.01
50th Percentile	18.00	25.90	15.10	2.46	16.00	119.00	0.05	0.26	0.16	0.02
75th Percentile	35.00	34.20	17.10	3.95	29.90	139.00	0.05	0.39	0.29	0.05
Maximum	102.00	41.10	22.50	4.41	59.10	195.30	0.07	1.05	1.63	0.28
Minimum	1.00	12.40	7.39	2.15	3.80	48.20	0.05	0.01	0.05	0.01
Mean	26.64	26.94	14.66	3.01	23.22	119.14	0.05	0.36	0.35	0.05

APPENDIX C: STORET (1983-1993) Values for Cumberland River
Ambient Monitoring Station at Cumberland Falls

Parameters

Year/Value 1992	Zn Total (mg/l)	Ca Total (mg/l)	Mg Total (mg/l)	K Total (mg/l)	Na Total (mg/l)	Hard. Total (mg/l)	NH_3 + NH_4 Total (mg/l)	NO_2 + NO_3 Total (mg/l)	TKN Total (mg/l)	Phos. Total (mg/l)
No. of Samples	9	9	9	9	9	9	8	8	9	7
25th Percentile	5.00	22.80	9.80	1.77	11.20	95.90	0.05	0.20	0.05	0.01
50th Percentile	19.00	23.90	12.30	1.95	14.00	114.60	0.05	0.28	0.17	0.01
75th Percentile	20.00	27.50	14.00	2.03	19.40	123.70	0.05	0.38	0.19	0.02
Maximum	75.00	31.00	14.70	3.30	21.10	135.00	0.05	0.44	0.27	0.04
Minimum	5.00	20.00	9.21	1.53	9.82	91.50	0.05	0.18	0.05	0.01
Mean	21.11	25.19	12.07	2.15	15.21	112.56	0.05	0.29	0.14	0.01

APPENDIX D. Cumberland River Diatom Data, Summer 1993.

#	Species	18-1	18-2	18-3
1	*Achnanthes exigua*	*		
2	*Achnanthes lanceolata* var. *dubia*	0.8	0.2	0.4
3	*Achnanthes linearis*		*	
4	*Achnanthes microcephala*	3.3	0.2	
5	*Achnanthes minutissima*	43.1	57.1	13.6
6	*Amphipleura pellucida*	1.2		
7	*Amphora ovalis* var. *pediculus*		0.2	0.2
8	*Amphora perpusilla*	0.2		0.2
9	*Anomoeoneis vitrea*	0.2		
10	*Bacillaria paradoxa*	*	*	2.0
11	*Biddulphia laevis*			0.4
12	*Caloneis bacillum*	0.8	0.4	
13	*Capartogramma crucicula*	*	*	*
14	*Cocconeis pediculus*	0.2	1.8	2.8
15	*Cocconeis placentula var. euglypta*	2.1	8.6	15.2
16	*Cyclotella meneghiniana*	*		0.4
17	*Cyclotella pseudostelligera*	0.2	0.4	2.4
18	*Cyclotella striata* var. *ambigua*		*	
19	*Cymbella affinis*	0.2	0.2	*
20	*Cymbella cuspidata*	*		
21	*Cymbella delicatula*	0.4		0.2
22	*Cymbella minuta*	0.2		0.2
23	*Cymbella prostrata*	0.6		
24	*Cymbella silesiaca*		0.4	
25	*Cymbella* sp. (K)	*		0.2
26	*Cymbella tumida*	1.9	*	0.8

27	*Cymbella turgidula*	3.8	0.4	0.2
28	*Diatoma vulgare*		*	0.4
29	*Diploneis elliptica*			0.4
30	*Diploneis oblongella*	0.2		0.4
31	*Fragilaria vaucheriae*	0.2		*
32	*Frustulia rhomboides* var. *amphipleuroides*	*		
33	*Gomphonema affine*		*	
34	*Gomphonema angustatum*	*	*	4.2
35	*Gomphonema clevei*	0.8	0.4	0.2
36	*Gomphonema olivaceum*		*	
37	*Gomphonema parvulum*	3.1	2.0	3.8
38	*Gomphonema rhombicum*	7.9	0.2	0.8
39	*Gomphonema sphaerophorum*	0.4	*	
40	*Gomphonema truncatum*	0.4		
41	*Gyrosigma attenuatum*	*		0.2
42	*Gyrosigma nodiferum*	1.7	0.2	2.0
43	*Gyrosigma obtusatum*		*	1.0
44	*Gyrosigma spencerii* var. *curvula*	0.2	0.2	0.6
45	*Melosira varians*	1.2		0.8
46	*Meridion circulare*		*	
47	*Navicula auriculata*	0.2	0.2	1.4
48	*Navicula capitata*			0.4
49	*Navicula cryptocephala*	0.6		0.2
50	*Navicula cryptocephala* var. *veneta*	2.3	1.0	0.6
51	*Navicula decussis*			0.2
52	*Navicula elginensis*	*		*
53	*Navicula gregaria*	0.2	*	*
54	*Navicula menisculus* var. *upsaliensis*	0.2		
55	*Navicula notha*	*	0.2	3.0

56	*Navicula pelliculosa*			0.2
57	*Navicula pupula*	*		0.4
58	*Navicula radiosa* var. *parva*	0.2		
59	*Navicula radiosa* var. *tenella*	3.7	0.8	0.2
60	*Navicula rhynchocephala* var. *germanii*	*	0.2	2.6
61	*Navicula salinarum* var. *intermedia*	0.2	0.2	0.6
62	*Navicula savannahiana*	*		
63	*Navicula schroeteri* var. *escambia*	1.0	0.6	2.6
64	*Navicula secreta* var. *apiculata*	*	0.6	0.2
65	*Navicula tantula*			*
66	*Navicula tenelloides*		0.2	0.2
67	*Navicula tripunctata*	0.2	*	*
68	*Navicula tripunctata* var. *schizonemoides*	0.8		0.2
69	*Navicula viridula* var. *avenacea*	*	*	*
70	*Navicula viridula* var. *rostellata*	0.4	0.4	1.6
71	*Nitzschia amphibia*	0.6	*	
72	*Nitzschia angustata* var. *acuta*	0.2	0.6	1.2
73	*Nitzschia clausii*	0.2		0.2
74	*Nitzschia coarctata*	*	*	1.4
75	*Nitzschia dissipata*	0.4	0.6	8.0
76	*Nitzschia filiformis*	*	*	0.4
77	*Nitzschia fonticola*	5.6	16.8	12.8
78	*Nitzschia frustulum*		0.2	
79	*Nitzschia gandersheimiensis*		*	
80	*Nitzschia gracilis*	0.2	*	
81	*Nitzschia kutzingiana*	*		
82	*Nitzschia levidensis*	*	*	0.2
83	*Nitzschia linearis*			0.4
84	*Nitzschia lorenziana* var. *subtilis*	0.2		

85	*Nitzschia palea*	6.0	2.6	5.8
86	*Nitzschia rautenbachiae*	0.2		
87	*Nitzschia reversa*			0.2
88	*Nitzschia sigma*	0.2		*
89	*Nitzschia sigmoidea*		*	
90	*Nitzschia* spp.	0.4	*	
91	*Nitzschia* sp. 1	0.2	*	0.2
92	*Nitzschia tropica*			*
93	*Nitzschia tryblionella* var. *victoriae*	*	0.2	
94	*Rhoicosphenia curvata*	0.4	*	0.6
95	*Surirella linearis*			*
96	*Surirella linearis* var. *helvetica*			*
97	*Surirella ovata*	*	*	*
98	*Surirella robusta* var. *splendida*			0.2
99	*Surirella* spp.	*	0.2	
100	*Synedra famelica*	*	0.2	*
101	*Synedra fasciculata* var. *truncata*	*	*	
102	*Synedra pulchella*		*	
103	*Synedra rumpens* var. *fragilarioides*		1.0	
104	*Synedra ulna*	0.6	0.2	*
105	*Thalassiosira weissflogii*		0.2	*

APPENDIX E. Cumberland River Macroinvertebrate Data, Wild River Segment, Summer 1993.

PROPORTIONAL SIMILARITY INDEX- Raw Data, as Number of Individuals				
Basin:	CUMBERLAND			
Stream:	CUMBERLAND RIVER			
Location:	WILD RIVER SEGMENT 02018			
Order/Family	Taxa	18-1	18-2	18-3
Tricladida				
Planariidae	unidentified species			1
Haplotaxida				
Tudificidae	sp. 1		3	
	sp. 2		1	
Lumbriculida				
Lumbriculidae	*Eclipidrilus* sp.	2	9	2
Heterodonta				
Corbiculidae	*Corbicula fluminea*	19		
Mesogastropoda				
Ancilidae	*Ferrissia rivularis*		1	2
Pleuroceridae	*Elimia ebenum* (?)	1	58	121
	E. sp.		1	
Planorbidae	*Helisoma anceps*		1	
Viviparidae	*Campeloma decisum*		1	
Lymnophila				
Physidae	*Physella* sp.	1	3	
Isopoda				
Asellidae	*Lirceus fontinalis*	5		7
Decapoda				
Cambaridae	*Cambarus distans*		1	
	Orconectes putnami	1	6	13
Ephemeroptera				
Baetidae	*Acentrella* sp.	1	16	1

	Baetis intercalaris	6	95	35
	B. propinquus	1	15	3
	Centroptilum sp. 1		15	4
	C. sp. 2		12	3
	Heterocloeon curiosum	70	145	20
	Procloeon sp. 1	1		
Caenidae	*Brachycerus* sp.		1	
	Caenis hilaris	2	1	1
Heptageniidae	*Heptagenia maculipennis*	1	104	7
	Stenacron interpunctatun	15	19	8
	S. pallidum	3		
	Stenonema exiguum (?)	105	195	123
	S. mediopunctatum		1	4
	S. terminatum	2		
	S. sp.	1		
Oligoneuriidae	*Isonychia* sp.	49	215	43
Tricorythidae	*Tricorythodes* sp.	36	35	44
Plecoptera				
Perlidae	*Acroneuria abnormis* (?)			1
	Neoperla sp.	1		2
Pteronarcyidae	*Pteronarcys dorsata*			1
Odonata				
Calopterygidae	*Calopteryx angustipennis*	3	1	7
	C. maculata			3
	Heterina tititia	2		
Coenagrionidae	*Argia moesta* (?)	9		
	A. translata		12	6
	Enallagma exsulans		15	1
Aeshnidae	*Boyeria vinosa*	1	3	5
Cordulidae	*Cordula* sp.		1	
	Neurocordula alabamensis	10		

Gomphidae	*Dromogomphus spinosus*		6	1
	D. spoliatus	6		9
	Gomphus vastus			1
	Hagenius brevistylus		1	
	Progomphus sp.		1	1
Macromiidae	*Didymops transversa*		2	
Coleoptera				
Curculionidae	*Lixus* sp.			1
Dryopidae	*Helichus basalis*		1	2
	H. lithophilus	5	15	17
Dytisidae	*Deronectes* sp.			1
Elmidae	*Ancyronyx variegata*	2	3	
	Dubiraphia vitatta		8	3
	Macronychus glabratus	32	28	31
	Stenelmis crenata		1	
Gyrinidae	*Dineutis assimilis*	1		
	D. discolor	1		4
	D. nigrior			1
Hydrophilidae	*Tropisternis blatchleyi*		4	
Psephenidae	*Psephenus herricki*			2
Hemiptera				
Gerridae	*Metrobates hesperius*			1
Hebridae	*Merragata* sp.			1
Hydrometridae	*Hydrometra martini*		1	
Mesoveliidae	*Mesovelia mulsanti*		1	
Nepidae	*Ranatra buenoi*	1		
	R. nigra		2	2
Veliidae	*Rhagovelia obesa*	2	3	1
Orthoptera				
Tridactylidae	*Ellipes minuta*		1	
Megaloptera				

Corydalidae	*Corydalus cornutus*	51	37	7
	Nigronia serricornis	2	4	3
Tricoptera				
Brachycentridae	*Brachycentrus* sp.		1	14
Glossosomatidae	*Glossosoma* sp.		13	18
Helicopsychidae	*Helicopsyche borealis*		2	2
Hydropsychidae	*Cheumatopsyche* sp.	5	8	17
	Hydropsyche dicantha	2		
	H. hageni	25	7	29
	H. phalerata	13	7	70
	H. simulans	56	14	5
Hydroptilidae	*Hydroptila* sp.	1	4	15
Leptoceridae	*Oecetis avara*	3	2	2
	O. cinerascens	3		
	O. inconspicua	3		4
	Triaenodes tardus		5	8
Limnephilidae	*Pycnopsyche divergens*			1
Philopotamidae	*Chimarra aterrima* (?)	2		
	C. obscura (?)		1	
	Warmaldia sp.	1		
Polycentropididae	*Cyrnellus fraternus*	2		
	Neureclipsis sp.	29	1	
	Nyctiophylax sp.	1	3	
	Polycentropus sp.	3		
Psychomyiidae	*Lype diversa*			1
	Psychomyia nomada			1
Diptera				
Ceratopogonidae	*Atrichopogon* sp.		1	
Chironomidae	*Ablalesmyia mallochi*	10	1	1
	A. parajanta		1	
	Chironomus sp.	4		

	Conchapelopia sp.	5	3	1
	Cricotopus sp.	4		1
	Cryptochironomus fulvus gp.	1		
	Dicrotendipes neomodestus	14		2
	Eukiefferiella sp.	4	2	1
	Haysomia senata	2	3	
	Micropsectra sp.	3		
	Orthocladius obumbratus			1
	O. sp.	2		
	Phaenopsectra sp.		1	
	Polypedium convictum	38	5	23
	Procladius sublettei		1	
	Rheotanytarsus distinctissimus gp.	34	7	
	Stenochironomus hilaris	2	2	
	Stictochironomus divinctus	1		
	Tanytarsus sp.	6	2	5
	Thienemannimyia sp. gp.	3		2
	Tvetenia discloripes gp.		1	
Empididae	*Hemerodromia* sp.	3	1	1
Simuliidae	*Simulium tuberosum*	116	2	3
Tipulidae	*Antocha* sp.			1

APPENDIX F. Amphibians, reptiles, birds, and mammals of the Cumberland Wild River Corridor.

Scientific name	Common name
Salamanders	
Ambystoma maculatum	spotted salamander
α*A. opacum*	marbled salamander
Σ*Aneides aeneus*	green salamander
Σ*Cryptobranchus a. alleganiensis* 2	eastern hellbender
α*Desmognathus f. fuscus*	northern dusky salamander
α*D. monticola*	seal salamander
σ*D. ochrophaeus*	mountain dusky salamander
D. welteri	Black Mountain salamander
α*Eurycea cirrigera*	southern two-lined salamander
α*E. l. longicauda*	longtail salamander
α*E. lucifuga*	cave salamander
α*Gyrinophilus porphyriticus duryi*	Kentucky spring salamander
Hemidactylium scutatum	four-toed salamander
α*Notophthalmus v. viridescens*	red-spotted newt
Plethodon d. dorsalis	eastern zigzag salamander
α*P. glutinosus*	northern slimy salamander
P. richmondi	ravine salamander
α*P. r. ruber*	northern red salamander
Frogs and Toads	
α*Bufo a. americanus*	eastern American toad
σ*B. woodhousii fowleri*	Fowler's toad
Gastrophryne carolinensis	eastern narrowmouth toad
σ*Hyla chrysoscelis*	Cope's gray treefrog
α*Pseudacris brachyphona*	mountain chorus frog
σ*P. c. crucifer*	northern spring peeper
P. triseriata	western chorus frog
σ*Rana catesbeiana*	bullfrog
α*R. clamitans melanota*	green frog
α*R. palustris*	pickerel frog
α*R. sylvatica*	wood frog
Scaphiopus h. holbrooki	eastern spadefoot

APPENDIX F. (continued).

Scientific name	Common name
Reptiles	
Turtles	
Apalone s. spinifera	eastern spiny softshell
Chelydra s. serpentina	common snapping turtle
σ*Chrysemys picta marginata*	midland painted turtle
Graptemys geographica	common map turtle
Graptemys pseudogeographica ouachitensis	Ouachita map turtle
Pseudemys c. concinna	eastern river cooter
Sternotherus odoratus	common musk turtle
σ*Terrapene c. carolina*	eastern box turtle
Trachemys scripta elegans	red-eared slider
Lizards and snakes	
σ*Agkistrodon contortrix mokasen*	northern copperhead
Carphophis amoenus	worm snake
Cemophora coccinea copei	northern scarlet snake
ß*Coluber constrictor*	black racer
ß*Crotalus horridus*	timber rattlesnake
α*Diadophis punctatus edwardsii*	northern ringneck snake
α*Elaphe o. obsoleta*	black rat snake
**Eumeces a. anthracinus* 1	northern coal skink
α*E. fasciatus*	five-lined skink
**E. inexpectatus* 1	southeastern five-lined skink
E. laticeps	broadhead skink
ß*Heterodon platirhinos*	eastern hognose snake
σ*Lampropeltis getula nigra*	black kingsnake
Σ*L. t. elapsoides* 1	scarlet kingsnake
σ*L. t. triangulum*	eastern milk snake
σ*Nerodia s. sipedon*	northern water snake
ß*Opheodrys aestivus*	rough green snake
Σ*Ophisaurus attenuatus longicaudus* 1	eastern slender glass lizard
**Pituophis m. melanoleucus* 2	northern pine snake
ß*Regina septemvittata*	queen snake

APPENDIX F. (continued).

Scientific name	Common name
σ*Sceloporus undulatus hyacinthinus*	northern fence lizard
σ*Scincella lateralis*	ground skink
σ*Storeria d. dekayi*	northern brown snake
S. o. occipitomaculata	northern redbelly snake
α*Tantilla coronata*	southeastern crowned snake
α*Thamnophis s. sirtalis*	eastern garter snake
α*Virginia v. valeriae*	eastern earth snake
Birds (breeding)	
σ*Accipiter cooperii*	Cooper's hawk
ß*A. striatus* 1	sharp-shinned hawk
σ*Agelaius phoeniceus*	red-winged blackbird
σ*Aix sponsa*	wood duck
σ*Archilochus colubris*	ruby-throated hummingbird
Bombycilla cedrorum	cedar waxwing
σ*Bonasa umbellus*	ruffed grouse
ß*Bubo virginianus*	great horned owl
σ*Buteo jamaicensis*	red-tailed hawk
B. lineatus	red-shouldered hawk
σ*B. platypterus*	broad-winged hawk
σ*Butorides virescens*	green heron
σ*Caprimulgus vociferus*	whip-poor-will
σ*Cardinalis cardinalis*	northern cardinal
σ*Carduelis tristis*	American goldfinch
σ*Cathartes aura*	turkey vulture
σ*Ceryle alcyon*	belted kingfisher
σ*Chaetura pelagica*	chimney swift
Coccyzus americanus	yellow-billed cuckoo
C. erythropthalmus	black-billed cuckoo
σ*Colaptes auratus*	common flicker
σ*Contopus virens*	eastern wood-pewee
Coragyps atratus	black vulture
σ*Corvus brachyrhynchos*	American crow
σ*Cyanocitta cristata*	blue jay
ß*Dendroica cerulea* 2	Cerulean warbler
σ*D. discolor*	prairie warbler

APPENDIX F. (continued).

Scientific name	Common name
σ*D. dominica*	yellow-throated warbler
σ*D. pinus*	pine warbler
σ*D. virens*	black-throated green warbler
σ*Dryocopus pileatus*	pileated woodpecker
Dumetella carolinensis	gray catbird
σ*Empidonax virescens*	acadian flycatcher
Falco sparverius	American kestrel
Geothlypis trichas	common yellowthroat
σ*Helmitheros vermivorus*	worm-eating warbler
σ*Hirundo rustica*	barn swallow
σ*Hylocichla mustelina*	wood thrush
Icteria virens	yellow-breasted chat
I. spurius	orchard oriole
Limnothlypis swainsonii	Swainson's warbler
σ*Melanerpes carolinus*	red-bellied woodpecker
M. erythrocephalus	red-headed woodpecker
Meleagris gallopavo	wild turkey
σ*Melospiza melodia*	song sparrow
σ*Mniotilta varia*	black-and-white warbler
σ*Molothrus ater*	brown-headed cowbird
Myiarchus crinitus	great crested flycatcher
σ*Oporornis formosus*	Kentucky warbler
σ*Otus asio*	eastern screech-owl
σ*Parula americana*	northern parula
σ*Parus bicolor*	tufted titmouse
σ*P. carolinensis*	Carolina chickadee
Passer domesticus	house sparrow
σ*Passerina cyanea*	indigo bunting
**Picoides borealis* 3	red-cockaded woodpecker
σ*P. pubescens*	downy woodpecker
ß*P. villosus*	hairy woodpecker
σ*Pipilo erythrophthalmus*	rufous-sided towhee
σ*Piranga olivacea*	scarlet tanager
σ*P. rubra*	summer tanager
Polioptila caerulea	blue-gray gnatcatcher
σ*Sayornis phoebe*	eastern phoebe
σ*Scolopax minor*	American woodcock

APPENDIX F. (continued).

Scientific name	Common name
σ*Seiurus aurocapillus*	ovenbird
S. motacilla	Louisiana waterthrush
Setophaga ruticilla	American redstart
Sialia sialis	eastern bluebird
σ*Sitta carolinensis*	white-breasted nuthatch
Spizella passerina	chipping sparrow
ß*Stelgidopteryx serripennis*	rough-winged swallow
ß*Strix varia*	barred owl
σ*Thryothorus ludovicianus*	Carolina wren
σ*Toxostoma rufum*	brown thrasher
σ*Turdus migratorius*	American robin
Tyrannus tyrannus	eastern kingbird
Vermivora pinus	blue-winged warbler
ß*Vireo flavifrons*	yellow-throated vireo
V. griseus	white-eyed vireo
σ*V. olivaceus*	red-eyed vireo
ß*V. solitarius*	solitary vireo
σ*Wilsonia citrina*	hooded warbler
Zenaida macroura	mourning dove
Mammals	
σ*Blarina brevicauda*	short tailed shrew
ß*Castor canadensis*	American beaver
**Corynorhinos rafinesquii* 2	eastern big-eared bat
Cryptotis parva	least shrew
ß*Didelphis virginiana*	Virginia opossum
Eptesicus fuscus	big brown bat
Glaucomys volans	southern flying squirrel
Lasionycteris noctivagans	silver-haired bat
ß*Lasiurus borealis*	red bat
L. cinereus	hoary bat
ß*Lynx rufus*	bobcat
σ*Marmota monax*	groundhog
Mephitis mephitis	striped skunk
Microtus ochrogaster	prairie vole
M. pinetorum	woodland vole

APPENDIX F. (continued).

Scientific name	Common name
Mus musculus	house mouse
Mustela frenata	long-tailed weasel
M. vison	mink
**Myotis grisescens* 3	gray bat
M. septentrionalis	northern long-eared bat
**M. leibii* 2	small-footed bat
M. lucifugus	little brown bat
**M. sodalis* 3	Indiana bat
α*Neotoma floridana magister* 2	eastern wood rat
**Nycticeius humeralis* 1	evening bat
Ochrotomys nuttalli	golden mouse
σ*Odocoileus virginianus*	whitetail deer
σ*Ondatra zibethicus*	muskrat
Parascalops breweri	hairy-tailed mole
α*Peromyscus leucopus*	white-footed mouse
Pipistrellus subflavus	eastern pipistrelle
σ*Procyon lotor*	raccoon
Rattus norvegicus	Norway rat
Reithrodontomys humulis	eastern harvest mouse
Scalopus aquaticus	eastern mole
σ*Sciurus carolinensis*	eastern gray squirrel
S. niger	fox squirrel
σ*Sorex fumeus*	smoky shrew
α*Sorex hoyi*	pygmy shrew
Sorex longirostris	southeastern shrew
**Spilogale putorius* 1	eastern spotted skunk
σ*Sylvilagus floridanus*	cottontail rabbit
σ*Tamias striatus*	eastern chipmunk
ß*Urocyon cinereoargenteus*	eastern gray fox
Σ*Ursus americanus* 2	black bear
Vulpes vulpes	red fox

Sources: Soil Systems, Inc. 1980 (σ); Steve Kickert, personal communication 1994 (ß); Kentucky State Nature Preserves Commission Natural Heritage Database (Σ); London Ranger District Report 1994 (α); report questionable but good habitat exists within the Cumberland Wild River Corridor (*).

Key: 1. state listed as endangered, threatened, or special concern; 2. former federal candidate; 3. federally endangered.

APPENDIX G. Natural Communities of the Cumberland Wild River Corridor.

NOTE: Maps are arranged from the south end (1st) to the north end (12th) of the corridor (See Fig. 7).

APPENDIX H. Liverworts and mosses of the Cumberland Wild River Corridor.

Scientific name

Liverworts

Anthoceros laevis L., 2
Asterella tenella (L.) Beauv., 2
Bazzania denudata (Torr.) Trevis., 2
B. trilobata (L.) S. Gray, 1
Blepharostoma trichophyllum (L.) Dum., 2
Calypogeia arguta Nees. & Mont., 2
C. fissa (L.) Raddi, 1, 2
C. trichomanis (L.) Corda, 1, 2
Cephalozia bicuspidata (L.) Corda., 2
C. curvifolia (Dicks.) Dumort., 1
C. media Lindb., 1, 2
Chiloscyphus pallescens (Ehrh.) Dum., 2
Cololejeunea biddlecomiae (Aust.) Evans, 1, 2
Conocephalum conicum (L.) Lindb., 1, 2
Diplophyllum apiculatum (Evans) Steph., 1, 2
Dumortiera hirsuta (Sw.) Nees., 2
Fossombronia foveolata Lindb., 2
Frullania asagrayana Mont., 1, 2
F. brittoniae Evans, 1, 2
F. eboracebsis Gottsche, 1, 2
F. riparia Hampe., 2
F. squarrosa (R. Bl. & N.)Dumort, 1, 2
Geocalyx graveolens (Schrad.) Ness., 2
Hardia cronuliformis (Aust.) Lindb., 1
H. hyalina (Lyoll) Carringt., 1
Harpanthus acutatus (Web. & Mohr.) Spruce., 1
Herberta adunca (Dicks.) S.F. Gray var. *tenuis* (Warnst.) Miller, 2
Jamesoniella autumnalis (D.C.) Steph., 2
Jungermannin lanceolata L.,1
Jubula pennsylvanica (Steph.) Evans, 1, 2
Lejeunea cavifolia (Ehrh.) Lindb., 2
Leucolejeunea clypeata (Schwein.) Evans, 1, 2
L. unciloba (Lindenb.) Evans, 1, 2
Lophocolea heterophylla (Schrad.) Dumort, 1, 2

APPENDIX H. (continued).

Scientific name
Lophozia bicrenata (Schmid.) Dum., 2
Marchantia polymorpha L., 1
Marsupella sphacelata (Gies.) Lindb., 2
Metzgeria conjugata Lindb., 1, 2
M. crassipilis (Lindb.) Evans., 2
M. furcata (L.) Dumort., 1
Microlejeunea vullata (Tayl.) Evans, 2
M. laetevirens (Nees & Mont.) Evans, 1
M. ulicina (Tayl.) Evans, 2
Microlepidozia sylvatica (Evans) Joerg., 2
Nowellia curvifolia (Dicks.) Mitt., 2
Odontoschisma denudatum (Hart.) Dumort., 1, 2
O. prostratum (Sw.) Trev., 1, 2
Pallavacinia lyellii (Hook.) S. F. Gray, 1, 2
Pellia epiphylla (L.) Corda, 1, 2
Plagiochila asplenioides (L.) Dumort., 1, 2
P. austini Evans, 2
Porella pinnata L., 1, 2
P. platyphylloides (Schwein.) Lindb., 1, 2
Radula complanata (L.) Dum., 1
R. obconica Sull., 1
Riccardia multifida (L.) S.F. Gray., 2
R. pinguis (L.) S.F. Gray, 1
Scapania nemerosa (L.) Dum., 1, 2
Mosses
Amblystegium riparium (Hedw.) BSG, 1
A. serpens (Hedw.) BSG, 1
A. varium (Hedw.) Lindb., 1, 2
Andreae rothii Web & Mohr. 2
Anomodon attenuatus (Hedw.) Hub., 1, 2
A. minor (Hedw.) Fuernr., 2
A. rostratus (Hedw.) Schimp., 1, 2
Anthoceros laevis L., 2
Atrichum angustatum (Brid.) BSG, 1, 2

APPENDIX H. (continued).

Scientific name

A. undulatum (Hedw.), 1, 2
Aulacomnium heterostichum (Hedw.) BSG, 1, 2
A. palustre (Hedw.) Schwaegr., 1
Barbula convoluta Hedw., 2
Bartramia pomiformis Hedw., 1, 2
Brachelyma subulatum (P. Beauv.) Schimp. *ex* Card., 2
Brachythecium oxycladon (Brid.) Jaeg. and Sauerb., 2
B. plumosum (Hedw.) BSG, 2
B. salebrosum (Web & Mohr) BSG, 1, 2
Breidleria pratensis (Koch) Loesk, 1
Brotherella delicatula (James *ex* Sull.) Fleisch., 2
B. recurvans (Michx.) Fleisch., 2
B. tenuirostris (Bruch & Schimp. *ex* Sull.) Fl., 1
Bryhnia novae-angliae (Sull. & Lesq. *ex* Sull.) Grout., 2
Bryoandersonia illecebra (Hedw.), 1
Bryoxiphium norvegicum (Brid.) Mitt.
Bryum sp., 1
Campylium chrysophyllum (Brid.) J. Lange, 1, 2
C. hispidulum (Brid.) Mitt., 1, 2
Campylopus flexuosus (Hedw.) Brid., 2
Ceratodon purpureus (Hedw.) Brid., 2
Cirriphyllum illecebrum (Hedw.) L., 2
Clasmatodon parvulus (Hampe) Hook. & Wils. *ex* Sull., 1
Climacium americanum Brid., 1, 2
C. americanum Brid. var. *kindbergii* Ren. & Card., 2
Cryphaea glomerata B.S.G. *ex* Sull., 2
Ctenidium molluscum (Hedw.) Mitt., 1, 2
Desmatodon obtusifolius (Schwaegr) Schimp., 2
Dichodontium pellucidum (Hedw.) Schimp., 2
Dicranella heteromalla (Hedw.) Schimp., 1, 2
D. varia (Hedw.) Schimp., 2
Dicranodontium asperulum (Mitt.) Broth., 2
D. denudatum (Brid.) Britt. *ex* Williams., 2
Dicranum condensatum Hedw., 1
D. flagellare Hedw., 2
D. fulvum Hook., 1, 2

APPENDIX H. (continued).

Scientific name

D. fuscescens Turn., 2
D. montanum Hedw., 2
D. polysetum Sw., 2
D. scoparium Hedw., 1, 2
Diphyscium foliosum (Hedw.) Mohr., 2
D. sessile (Schmid.) Lindb., 1
Ditrichum pallidum (Hedw.) Hampe., 1, 2
Drummondia prorepens (Hedw.), 1, 2
Entodon sedutrix (Hedw.) C. Mull., 2
Eurhynchium hians (Hedw.) Sande Lac., 2
E. pulchellum (Hedw.) Jenn., 2
E. riparioides (Hedw.) Rich., 2
Fissidens adiantoides Hedw. 2
F. cristatus Wils. *ex* Mitt., 1, 2
F. bryoides Hedw., 1
F. minutulus Sull., 2
F. obtusifolius Wils., 1
F. osmundioides Hedw., 1, 2
F. ravenellii Sull. 2
F. subbasilaris Hedw. 2
F. taxifolius Hedw., 2
Fontinalis novae-angliae Sull., 1, 2
Forsstroemia immerea (Sull.) Lindb., 1
F. trichomitria (Hedw.) Lindb., 2
F. ohioensis (Sull.) Lindb., 1
F. trichomitria (Hedw.) Lindb., 1
Funaria hygrometrica (Hedw.), 1
Grimmia apocarpa Hedw., 2
G. laevigata (Brid.) Brid., 2
G. pilifera P.-Beauv., 1, 2
Gymnostomum aeruginosum Sm.,1
G. recurvirostrum Hedw., 2
Haplocladium virginianum (Brid.) Broth., 2
Haplohymenium triste (Ces. *ex* DeNot.) Kindb., 1, 2
Hedwigia ciliata (Hedw.) P.-Beauv., 1, 2

APPENDIX H. (continued).

Scientific name

Heterophyllium affine (Hook) Fleisch., 2
Hookeria acutifolia Hook. & Grev., 2
Hygroamblystegium fluviatile (Hedw.) BSG, 1, 2
H. tenax (Hedw.) Jenn., 2
Hygrohypnum eugyrium (BSG) Loeske, 2
Hyophila tortula (Hook.) Jaeg. and Sauerb., 2
Hypnum curvifolium Hedw., 1, 2
H. fertile Sendtn., 1, 2
H. imponens Hedw., 2
H. lindbergii Hedw., 2
H. pratense Koch *ex* Spruce, 2
Isopterygium elegans (Brid.) Lindb., 1
I. micans (Sw.) Broth., 2
I. muellerianum (Schimp.) Lindb., 2
I. tenerum (Sw.) Mitt., 1
Leptodictyum riparium (Hedw.) Warnst., 2
Leskea obscura Hedw., 1, 2
Leucobryum albidum (Brid. *ex* P. Beauv.) Lindb., 2
L. glaucum (Hedw.) Angstr., 1, 2
Leucodon brachypus Brid., 1, 2
L. julaceus (Hedw.) Sull., 1
Mnium affine Bland. *ex* Funck, *sensu lato*, 1, 2
M. cuspidatum Hedw., 2
M. hornum Hedw., 1, 2
M. medium BSG, 1
M. punctatum Hedw., 1, 2
M. spinulosum BSG, 1
Orthodioranum flagellare (Hedw.) Loesk., 1
Orthotrichum anomalum Hedw., 1
O. ohioense Sull. & Lesq. *ex* Aust., 1, 2
O. pumilum Sw., 1, 2
Philonotis longiseta (Michx.) Britt., 2
Physcomitruim pyriforme (Hedw.), 1
Plagiothecium denticulatum (Hedw.) BSG, 1
P. sylvaticum (Brid.) BSG, 2
Platygyrium repens (Brid.) BSG, 1, 2

APPENDIX H. (continued).

Scientific name

Pohlia nutans (Hedw.) Lindb., 1, 2
P. wahlenbergii (Web. & Mohr.) Andr., 2
Pogonatum pennsilvanicum (Hedw.) Paris., 2
Polytrichum commune Hedw., 2
P. juniperinum Hedw., 2
P. ohioense Ren. & Card., 1
Ptychomitrium incurvum (Schwaegr.) Spruce, 1, 2
Pylaisia sp., 1
Pylaisiella intircata (Hedw.) Grout., 2
Rhabdoweisia denticulata (Brid.) B.S.G., 2
Rhacomitrium aciculare (Hedw.) Brid., 2
Rhaphidostegium adnatum (Ex.) Bryol.eur., 1
Rhodobryum roseum (Hedw.) Limpr., 1, 2
Rhynchostegium serrulatum (Hedw.) Jaeg. & Sauerb., 1,
Schwetschkeopsis denticulata (Sull.) Broth., 2
S. fabronia (Schwaegr.) Broth., 1
Sciaromium lescurii (Sull.) Broth., 1, 2
Sematophyllum adnatum (Michx.) Britt., 2
S. carolinianum (C. Mull.) Britt., 2
S. demissum (Wils.) Mitt., 1
S. marylandicum (C. M.) E. G. Britt., 1
Sphagnum compactum Lam. and D.C., 2
S. cuspidatum Ehrh. *ex* Hoffm., 3
S. imbricatum Hornsch. *ex* Russ. var. *affine* (Ren. and Card.) Warnst., 2
S. palustre L., 2
S. subsecundum Nees *ex* Sturm., 2
Syrrhopodon texanus Sull., 1, 2
Taxiphyllum deplanatum (Schimp. *ex* C. Mull.) Fleisch., 2
Tetraphis pellucida Hedw., 1, 2
Thamnobryum alleghaniense (C. M.) Nieuwl., 1, 2
Thelia asprella Sull., 1, 2
T. hirtella (Hedw.) Sull., 1, 2
Thuidium delicatulum (Hedw.) BSG, 1, 2
T. recognitum (Hedw.) Lindb., 2
T. scitum (P.-Beauv.) Aust., 1
Tortella caespitosa (Schwaegr.) Limpr., ?

APPENDIX H. (continued).

Scientific name
T. humilis (Hedw.) Jenn., 2
Trematodon longicollis Michx., 2
Trichostomum tenuirostre (Hook and Tayl.) Lindb., 2
Ulota hutchinsiae (Sm.) Hamm., 1, 2
U. ulophylla (Ehrh.) Broth., 1
Weissia controversa Hedw., 1, 2

1. Baur 1933; 2. Norris 1967; 3. A. Risk, University of Tennessee, pers. comm., 1993.

APPENDIX I. Known Flora of the Cumberland Wild River Corridor.

Scientific name	Common name	Habit	Community
Acalypha virginica	three-seeded mercury	H	AM,HM
Acer negundo	box elder	T	GB,RF
Acer rubrum	red maple	T	AM,DC,HM,GB,RF
Acer saccharinum	silver maple	T	GB,RF
Acer saccharum	sugar maple	T	AM,HM,RF
Achillea millefolium	yarrow	H	DA
Actaea pachypoda	doll's eyes	H	AM,HM
Adiantum pedatum	northern maidenhair fern	H	AM,HM
Aesculus flava	yellow buckeye	T	AM,HM
Ageratina luciae-brauniae 3,4,6	Lucy Braun's white snakeroot	H	MC
Agrimonia sp.	harvest-lice	H	RF
Agrostis perennans	bent grass	H	GB
Ailanthus altissima *	tree of heaven	T	RF
Albizia julibrissin (*?)	mimosa	T	GB
Alisma plantago-aquatica var. *parviflorum*	water plantain	H	RF
Allium canadense var. *canadense*	wild garlic	H	GB,RF
Allium vineale *	field garlic	H	DA
Alnus serrulata	hazel alder	S	GB
Amaranthus sp. (*?)	amaranth	H	MC
Ambrosia artemisiifolia	common ragweed	H	DA
Ambrosia trifida	giant ragweed	H	RF
Amelanchier arborea var. *arborea*	downy serviceberry	T	AM,AX,GB,HM,PO
Amelanchier arborea var. *laevis*	smooth serviceberry	S	DC
Amorpha fruticosa	common indigobush	S	GB

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Amphicarpaea bracteata	southern hogpeanut	H	GB,RF
Andropogon furcatus	bluejoint turkeyfoot	H	RF
Andropogon gerardii	bluestem	H	AM,GB,HM,RF
Andropogon virginicus	broomsedge	H	PO,PS
Anemone lancifolia	lanceleaf windflower	H	RF
Anemone quinquefolia	American wood anemone	H	AM,HM,RF
Anemone virginiana	thimbleweed	H	AM,AX,HM,PO,RF
Angelica venenosa	common angelica	H	DA
Antennaria plantaginifolia var. *plantaginifolia*	pussy-toes	H	AM,AX,HM,PO
Antennaria solitaria	solitary pussy-toes	H	AM,HM
Apios americana	ground-nut	H	GB,RF
Aplectrum hyemale	puttyroot orchid	H	AM,HM
Apocynum cannabinum	Indian hemp	H	GB
Aquilegia canadensis	American columbine	H	MC
Arabis laevigata var. *laevigata*	smooth rock-cress	H	AM,DC,HM,MC
Aralia racemosa	spikenard	H	AM,AX,HM,MC,RF
Aralia spinosa	devil's walking stick	S	AM,AX,HM,PO
Arisaema dracontium	green dragon	H	RF
Arisaema triphyllum	jack-in-the-pulpit	H	AM,HM,RF
Aristolochia macrophylla	dutchman's pipe	V	AM,HM
Aristolochia serpentaria	Virginia snakeroot	H	AM,HM
Aronia arbutifolia	red chokeberry	S	AX.PO,PS
Aronia melanocarpa	black chokeberry	S	AX,DC,GB,PO,PS
Arthraxon hispidus *	arthraxon	H	RF
Aruncus dioicus	goat's beard	H	GB,RF

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Arundinaria gigantea ssp. *gigantea*	cane	H	RF
Arundinaria gigantea ssp. *tecta*	river cane	H	RF
Asarum canadense	Canadian ginger	H	AM,HM,RF
Ascelpias incarnata	swamp milkweed	H	AM,HM
Asclepias variegata	common milkweed	H	AM,AX,DC,HM,MC,PO
Asimina triloba	pawpaw	S	AM,AX,HM,PO,RF
Asplenium bradleyi	Bradley's spleenwort	H	MC
Asplenium montanum	mountain spleenwort	H	MC
Asplenium pinnatifidum	lobed spleenwort	H	MC
Asplenium platyneuron	brownstem spleenwort	H	AM,AX,HM,PO,RF
Asplenium rhizophyllum	walking fern	H	AM,HM
Asplenium trichomanes	maidenhair spleenwort	H	AM,HM,MC
Asplenium x *trudellii*	Trudell's spleenwort	H	MC OR DC
Aster cordifolius	heartleaf aster	H	AM,HM
Aster divaricatus var. *divaricatus*	white wood aster	H	AM,HM,RF
Aster dumosus	bushy aster	H	AM,GB,HM
Aster infirmus	cornel-leaf aster	H	AM,HM
Aster laevis var. *laevis*	smooth aster	H	RF
Aster lateriflorus	starved aster	H	AM,HM
Aster linariifolius	stiff-leaf aster	H	GB
Aster ontarionis	Ontario aster	H	RF
Aster patens	skydrop aster	H	AM,GB,HM
Aster paternus	white-topped aster	H	AX,PO
Aster pilosus	frost aster	H	PO

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Aster prenanthoides	crooked-stem aster	H	GB
Aster solidagineus	white-topped aster	H	AX,PO
Aster surculosus	creeping aster	H	AX,GB,PO
Aster undulatus	wave aster	H	AX,PO
Astragalus canadensis	Canada milkvetch	H	RF
Athyrium filix-femina	southern lady fern	H	MC
Aureolaria laevigata	smooth oak-leech	H	PO,PS
Aureolaria virginica	Virginia oak-leech	H	AM,AX,HM,PO
Barbarea vulgaris var. *vulgaris* *	bitter winter cress	H	AM,HM
Betula alleghaniensis var. *alleghaniensis*	yellow birch	T	HM
Betula lenta	sweet birch	T	AM,HM
Betula nigra	river birch	T	GB,RF
Bidens aristosa	tickseed	H	GB
Bidens frondosa	sticktight	H	GB
Bignonia capreolata	cross vine	V	AM,AX,DC,GB,HM,MC,PO,RF
Boehmeria cylindrica	false nettle	H	AM,GB,HM,RF
Botrychium virginianum	rattlesnake fern	H	AM,HM
Boykinia aconitifolia 2,6	brook saxifrage	H	GB
Bulbostylis capillaris	bulbostylis	H	DC,PO,PS
Cacalia atriplicifolia	pale Indian plantain	H	RF
Calystegia sepium var. *sepium*	hedge bindweed	H	RF
Camaesyce nutans	eyebane	H	AM,AX,HM,PO
Campanula divaricata	harebell	H	AM,HM,MC
Cardamine pensylvanica	Pennsylvania bittercress	H	MC
Carex albicans var. *albicans*	sedge	H	AM,HM

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Carex crinita var. *crinita*	fringed sedge	H	AM,HM
Carex lucorum	sedge	H	AX
Carex lupulina	sedge	H	AM,HM
Carex lurida	sedge	H	AM,HM
Carex plantaginea	plantain-leaf sedge	H	AM,HM
Carex platyphylla	sedge	H	AM,HM
Carex prasina	sedge	H	AM,GB,HM,RF
Carex stricta 6	sedge	H	GB,RF
Carex virescens	bright green sedge	H	PO
Carex vulpinoidea	sedge	H	AM,GB,HM
Carpinus caroliniana	ironwood	T	AM,HM,RF
Carya glabra	pignut hickory	T	AX,PO
Carya pallida	pale hickory	T	AX,PO
Carya tomentosa	mockernut hickory	T	AM,AX,HM,PO
Cassia fasciculata	partridge pea	H	AX
Cassia hebecarpa	American senna	H	GB
Cassia nictitans	wild sensitive plant	H	RF
Castanea dentata	American chestnut	T	AM,AX,HM,PO
Catalpa bignonioides *	indian cigar tree	T	AM,HM
Catalpa speciosa	catawba tree	T	GB,RF
Caulophyllum thalictroides	blue cohosh	H	AM,HM
Ceanothus americanus	New Jersey tea	S	GB
Celastrus scandens	American bittersweet	V	RF
Celtis tenuifolia	dwarf hackberry	S	AM,HM,RF
Cephalanthus occidentalis	buttonbush	S	GB,RF
Cerastium sp. (*?)	mouse-ear chickweed	H	AM,HM,MC

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Cercis canadensis	eastern redbud	T	AM,AX,HM,PO
Chamaelirium luteum	Devil's bit; fairy wand	H	AM,AX,HM,PO
Chasmanthium latifolium	river oats	H	RF
Chasmanthium laxum	spike uniola	H	RF
Chelone glabra	white turtlehead	H	RF
Chenopodium album	pigweed	H	RF
Chenopodium ambrosioides *	Mexican tea	H	RF
Chimaphila maculata	spotted wintergreen	H	AX,PO
Chionanthus virginicus	fringetree	S	AX,GB,PO
Chrysopsis mariana	golden aster	H	AM,HM
Cichorium intybus *	chicory	H	DA
Cicuta maculata	water hemlock	H	GB,RF
Cimicifuga racemosa	black cohosh	H	AM
Cinna arundinacea	wood reedgrass	H	AM,HM
Circaea lutetiana ssp. *canadensis*	enchanter's nightshade	H	HM,RF
Claytonia caroliniana	mountain spring beauty	H	AM,HM,MC
Claytonia virginica	common spring beauty	H	AM,HM
Clematis glaucophylla 6	leather-flower	H	AM,HM
Clematis viorna	leather-flower	H	GB
Clematis virginiana	virgin's bower	H	GB,RF
Clethra acuminata	sweet pepperbush	T	AM,HM,MC
Clintonia umbellulata	Clinton's lily	H	HM
Clitoria mariana	butterfly pea	H	AX,PO
Collinsonia canadensis	horse-balm	H	AM,RF
Commelina virginica	woods dayflower	H	RF
Conopholis americana	squaw-root; cancer-root	H	AM,HM

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Convallaria majalis *	lily of the valley	H	DA
Conyza canadensis	horseweed	H	AM,HM,RF
Coreopsis auriculata	eared coreopsis	H	GB
Coreopsis major	whorled-leaf coreopsis	H	AM,AX,HM,PO
Coreopsis pubescens var. *pubescens* 3	star tickseed	H	RF
Coreopsis tinctoria	calliopsis	H	GB
Coreopsis tripteris	tall coreopsis	H	GB
Cornus amomum	silky dogwood	S	GB,RF
Cornus amomum var. *obliqua*	pale dogwood	S	GB
Cornus drummondii	rough-leaf dogwood	S	RF
Cornus florida	flowering dogwood	T	AM,AX,HM,PO
Coronilla varia *	crown vetch	H	GB
Corylus americana	American hazelnut	S	AM,RF
Crataegus intricata	hawthorn	S	GB
Crataegus macrosperma	hawthorn	S	RF,PO
Crataegus uniflora	dwarf hawthorn	S	GB,MC,RF
Cryptotaenia canadensis	honewort	H	RF
Cunila origanoides	stonemint	H	AX,PO
Cuphea viscosissima (*C. petiolata*)	sticky waxweed	H	RF
Cuscuta cuspidata	dodder	H	GB
Cynoglossum virginianum	wild comfrey	H	AM,HM
Cyperus refractus	umbrella-sedge	H	AM,AX,HM,PO
Cyperus strigosus	flatsedge	H	AM,HM,RF
Cypripedium acaule	pink lady's slipper	H	AM,AX,HM,PO,RF
Cypripedium pubescens	yellow lady's slipper	H	AM,HM

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Cystopteris bulbifera	bulblet fern	H	MC
Cystopteris protrusa	lowland brittle fern	H	AM,HM,RF
Danthonia spicata	poverty-grass	H	AX,PO
Daucus carota *	Queen Anne's lace	H	PO,PS
Dennstaedtia punctilobula	hay-scented fern	H	AM,DC,HM
Dentaria diphylla	pepper-root	H	RF
Dentaria heterophylla	early toothwort	H	AM,HM,MC,RF
Dentaria laciniata	cutleaf toothwort	H	AM,HM
Deparia acrostichoides	silvery glade fern	H	AM,MC
Desmodium glutinosum	sticky tickclover	H	GB,RF
Desmodium laevigatum	beggar lice	H	PO
Desmodium nudiflorum	barestem beggar lice	H	AM,AX,HM,PO
Desmodium paniculatum	panicled tick trefoil	H	AM,HM
Desmodium perplexum	beggar's ticks	H	AX,PO
Desmodium rotundifolium	dollarleaf	H	AM,AX,HM,PO
Dicanthelium boscii	a panic grass	H	AM,AX,HM,PO
Dicanthelium clandestinum	a panic grass	H	AM,HM
Dicanthelium sphaerocarpon	a panic grass	H	AM,AX,HM,PO
Dicanthelium sphaerocarpon var. *isophyllum*	a panic grass	H	AX,PO
Digitaria ischaemum *	small crab-grass	H	DA
Digitaria sanguinalis *	crab-grass	H	DA
Diodia virginiana	buttonweed	H	GB,RF
Dioscorea quaternata	wild yam	H	AM,AX,DC,HM,MC,PO
Diospyros virginiana	persimmon	T	PO
Diplazium pycnocarpon	glade fern	H	AM,HM,RF

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Dirca palustris	leatherwood	S	GB,RF
Disporum lanuginosum	yellow mandarin	H	AM,HM,MC,RF
Disporum maculatum	nodding mandarin	H	AM
Dryopteris intermedia	fancy fern	H	AM,DC,HM
Dryopteris marginalis	marginal shield fern	H	AM,DC
Elephantopus carolinianus	elephant's-foot	H	RF
Elephantopus tomentosus	elephant's-foot	H	AM,AX,HM,PO
Eleusine indica *	goose grass	H	GB
Elymus intermedius	wild rye	H	AM,HM,RF
Elymus riparius	river-bank wild rye	H	RF
Epifagus virginiana	beech-drops	H	AM,HM
Epigaea repens	trailing arbutus	S	DC,PO
Equisetum arvense	field horsetail	H	GB
Erechtites hieraciifolia	fireweed	H	PO,RF
Erigenia bulbosa	harbinger-of-spring	H	AM,HM
Erigeron annuus	daisy fleabane	H	AM,HM,RF
Erigeron philadelphicus	swamp daisy fleabane	H	RF
Erigeron pulchellus	poor robin's-plantain	H	AM,HM
Erythronium americanum	common trout lily	H	AM,HM
Eulalia viminea *	eulalia	H	RF
Euonymus americanus	strawberry-bush	S	AM,AX,HM,PO,RF
Eupatorium coelestinum	ageratum	H	GB
Eupatorium fistulosum	joe-pye-weed	H	GB,RF
Eupatorium perfoliatum	boneset	H	AM,HM
Eupatorium purpureum	bluestem joe-pye-weed	H	DA
Eupatorium rotundifolium	thoroughwort	H	AX

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Eupatorium rugosum	white snakeroot	H	AM,RF
Eupatorium semiserratum	thoroughwort	H	AM,AX,GB,HM,PO
Eupatorium serotinum	white snakeroot	H	AM,HM,RF
Eupatorium sessilifolium	thoroughwort	H	AX,PO,RF
Euphorbia corollata var. *corollata*	flowering spurge	H	AM,AX,HM,PO
Euphorbia corollata var. *zinniiflora*	tramps spurge	H	GB
Fagus grandifolia	American beech	T	AM,HM,RF
Fimbristylis autumnalis	fimbristylis	H	AM,HM,RF
Fragaria virginiana	wild strawberry	H	AM,AX,DC,HM,MC,PO
Fraxinus americana var. *americana*	white ash	T	AM,AX,GB,HM,PO,RF
Fraxinus americana var. *biltmoreana*	biltmore ash	T	AM,HM
Fraxinus pensylvanica	red ash	T	AM,HM,RF
Galactia volubilis	downy milk-pea	H	GB
Galax urceolata	galax	H	AM,AX,DC,HM,MC,PO
Galearis spectabilis	showy orchis	H	AM,HM
Galinsoga quadriradiata *	peruvian daisy	H	RF
Galium aparine	catchweed	H	AM,HM,RF
Galium concinnum	pretty bedstraw	H	AM,HM
Galium lanceolatum	wild licorice	H	AM,HM
Galium pilosum var *pilosum*	hairy bedstraw	H	AM,AX,HM,PO
Gaultheria procumbens	wintergreen	S	AX,DC,PO,PS
Gaylussacia baccata	black huckleberry	S	AX,PO,VP
Gaylussacia brachycera	box huckleberry	S	AX,PO,PS

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Gentiana villosa	Sampson's snakeroot	H	AX,PO
Geranium carolinianum	Carolina cranesbill	H	DA
Geranium maculatum	wild geranium	H	AM,HM
Geum canadense	white avens	H	AM,HM
Glecoma hederacea *	ground ivy	H	RF
Gnaphalium obtusifolium	sweet everlasting	H	AX,PO
Goodyera pubescens	rattlesnake plantain	H	AM,HM,RF
Gratiola pilosa 1,6	shaggy hedge hyssop	H	GB
Hackelia virginiana	burseed; stick-weed	H	MC OR DC
Hamamelis virginiana	witch hazel	S	AM,AX,GB,HM,PO,PS
Hedyotis caerulea	common bluet	H	AM,GB,MC,RF
Hedyotis longifolia	longleaf bluet	H	AX,PO
Hedyotis nuttaliana	narrowleaf bluet	H	GB
Hedyotis purpurea	summer bluet	H	AM,AX,GB,HM,PO,RF
Helenium autumnale var. *autumnale*	sneezeweed	H	RF
Helenium flexuosum	sneezeweed	H	GB,RF
Helianthus decapetalus	thinleaf sunflower	H	RF
Helianthus divaricatus	sunflower	H	AM,HM
Helianthus hirsutus	rough sunflower	H	GB
Helianthus microcephalus	sunflower	H	AM,AX,HM,PO
Helianthus strumosus	woodland sunflower	H	AM,AX,HM,PO
Hemerocallis fulva *	day lily	H	RF
Hepatica nobilis	sharp-lobed liverleaf	H	AM,HM,MC
Hepatica nobilis var. *obtusa*	blunt-lobed liverleaf	H	AM,HM
Heuchera americana	American alumroot	H	AX,PO

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Heuchera parviflora	rock-house alumroot	H	DC,MC
Heuchera villosa	hairy alumroot	H	AM,HM,MC
Hexastylis arifolia	common ginger	H	AM,AX,HM,PO
Hexastylis arifolia var. *ruthii*	wild ginger	H	AM,HM,RF
Hibiscus laevis	halberd-leaf marsh mallow	H	RF
Hibiscus moscheutos	swamp rose mallow	H	GB
Hieracium gronovii	hairy hawkweed	H	AM,HM
Hieracium venosum	rattlesnake-weed	H	AX,PO
Hybanthus concolor	green violet	H	RF
Hydrangea arborescens ssp. *arborescens*	wild hydrangea	S	AM,HM,MC
Hydrastis canadensis 7	golden seal	H	AM,HM
Hydrophyllum canadense	common waterleaf	H	AM,HM,RF
Hypericum denticulatum var. *acutifolium*	St. John's wort	H	GB
Hypericum gentianoides	pineweed	H	AX,PO,PS
Hypericum hypericoides	St. Andrew's cross	S	AX,PO
Hypericum mutilum	St. John's wort	H	GB,RF
Hypericum prolificum	shrubby St. John's wort	S	GB
Hypericum punctatum	spotted St. John's wort	H	GB,RF
Hypericum stragalum	reclining St. John's wort	S	AX,DC,PO
Hypoxis hirsuta	common yellow star-grass	H	GB
Hystrix patula	bottlebrush grass	H	AM,HM,RF
Ilex ambigua	Carolina holly	S	AM,AX,HM,PO
Ilex montana	mountain holly	S	AX,PO,PS
Ilex opaca	American holly	T	AM,AX,HM,PO,PS,RF

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Ilex verticillata	winterberry	S	GB,RF
Impatiens capensis	spotted jewelweed	H	GB,RF
Impatiens pallida	pale jewelweed	H	RF
Ipomoea coccinea	small red morning glory	H	GB,RF
Ipomoea lacunosa	small white morning glory	H	GB,RF
Ipomoea nil	ivy-leaved morning glory	H	GB,RF
Ipomoea pandurata	man-root	H	GB,RF
Iris cristata	dwarf crested iris	H	AM,GB,HM,MC,RF
Iris pseudacorus	yellow flag	H	GB
Itea virginica	Virginia willow	S	GB,MC,RF
Iva annua var. *annua*	marsh-elder	H	RF
Juglans cinerea 3,4	butternut	T	AM,HM,RF
Juglans nigra	black walnut	T	AM,HM
Juncus acuminatus	a rush	H	GB,RF
Juncus effusus	soft rush	H	GB
Juncus tenuis	path rush	H	GB
Juncus tenuis var. *uniflorus*	a rush	H	AM,AX,HM,PO,RF
Juniperus virginiana	eastern red cedar	T	AX,PO
Justicia americana	northern water-willow	H	GB
Kalmia latifolia	mountain laurel	S	AX,DC,MC,PO,PS
Krigia biflora	dwarf dandelion	H	AX,PO
Kummerowia striata *	kummerowia	H	AM,HM
Lactuca floridana	wild lettuce	H	AM,HM
Laportea canadensis	wood nettle	H	AM,HM,RF
Lathyrus palustris 2,6	vetchling peavine	H	GB
Lechea sp.	pin-weed	H	AX,PO,PS

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Leersia oryzoides	a cutgrass	H	RF
Leersia virginica	a cutgrass	H	RF
Leiophyllum buxifolium 5	sand myrtle	S	AX,PO
Lespedeza cuneata *	silky bush clover	H	GB
Lespedeza intermedia	wandlike bush clover	H	AM,HM
Lespedeza repens	creeping bush clover	H	AM,HM
Lespedeza violacea	violet bush clover	H	AM,HM
Lespedeza virginica	slender bush clover	H	AM,HM
Leucanthemum vulgare *	ox-eye daisy	H	DA
Liatris microcephala	gayfeather	H	AX,PO,PS
Liatris spicata	spike gayfeather	H	GB
Ligusticum canadense	lovage	H	AM,AX,HM,PO
Ligustrum sp. *	privet	S	MC,RF
Lilium canadense	Canada lily	H	AM,HM
Lindera benzoin	spicebush	S	AM,HM,RF
Lindera dubia	false pimpernel	H	GB
Lindernia dubia var. *anagallidea*	false pimpernel	H	RF
Linum striatum	rigid flax	H	GB,RF
Linum virginianum	wild yellow flax	H	GB
Liparis lilifolia	lily-leaved twayblade	H	AM,HM
Liquidambar styraciflua	sweetgum	T	AM,AX,GB,HM,PO,RF
Liriodendron tulipifera	tulip poplar	T	AM,HM,RF
Lobelia cardinalis	cardinal flower	H	GB,RF
Lobelia inflata	Indian tobacco	H	RF
Lobelia puberula	lobelia	H	GB,RF
Lobelia siphilitica	great lobelia	H	AM,GB,HM

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Lonicera japonica *	Japanese honeysuckle	H	GB,RF
Ludwigia alternifolia	rattlebox	H	GB,RF
Ludwigia decurrens	primrose-willow	H	RF
Ludwigia palustris	marsh purslane	H	AM,HM,RF
Luzula bulbosa	woodrush	H	AM,AX,HM,PO,RF
Lycopodium digitatum	crowfoot; running-pine	H	AM,AX,HM,PO
Lycopodium lucidulum	shining clubmoss	H	AM,HM,MC
Lycopodium obscurum var. *obscurum*	groundpine	H	AM,AX,HM,PO,RF
Lycopodium tristachyum	ground-cedar	H	AX,PO
Lycopus americanus	American bugleweed	H	GB
Lycopus europaeus *	European bugleweed	H	RF
Lycopus virginicus	common bugleweed	H	GB,MC,RF
Lygodium palmatum	American climbing fern	H	AM,AX,DC,HB,HM,MC,PO,RF
Lyonia ligustrina	maleberry	S	GB
Lysimachia ciliata	fringed loosestrife	H	RF
Lysimachia hybrida	loosestrife	H	GB
Lysimachia lanceolata	lance-leaved loosestrife	H	AM,GB,HM
Lysimachia nummularia *	creeping Charlie	H	RF
Lysimachia quadrifolia	whorled loosestrife	H	AM,AX,HM,PO,RF
Magnolia acuminata var. *acuminata*	cucumber magnolia	T	AM,AX,HM,PO,RF
Magnolia fraseri	Fraser's magnolia	T	AM
Magnolia macrophylla	bigleaf magnolia	T	AM,AX,HM,PO,RF
Magnolia tripetala	umbrella tree	T	AM,RF

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Malus angustifolia var. *angustifolia* 3	southern crab apple	T	GB
Malus coronaria	sweet crab apple	S	AX,GB,PO
Manfreda virginica	rattlesnake-master	H	AM,HM
Medeola virginiana	indian cucumber-root	H	AM,HM,RF
Meehania cordata	meehania	H	AM,HM,RF
Melanthium parviflorum 1	small-flowered false hellebore	H	AM
Melica mutica	two-flower melic	H	AX,PO
Melilotus alba *	white sweet clover	H	DA
Melilotus officinalis *	yellow sweet clover	H	GB,RF
Menispermum canadense	moonseed	V	RF
Mimulus alatus	sharpwing monkeyflower	H	GB,RF
Mimulus ringens	allegheny monkeyflower	H	RF
Mitchella repens	partridge berry	H	AM,AX,DC,HM,MC,PO,RF
Mollugo verticillata *	carpet-weed	H	RF
Monarda clinopodia	white bergamot	H	AX,PO
Monotropa uniflora	indian pipe	H	AM,HM
Myosotis macrosperma	bigseed forget-me-not	H	RF
Nyssa sylvatica var. *sylvatica*	blackgum	T	AM,AX,GB,HM,PO
Obolaria virginica	pennywort	H	AM,HM
Oenothera biennis	common evening primrose	H	GB
Oenothera fruticosa ssp. *glauca*	sundrops	H	GB
Onoclea sensibilis	sensitive fern	H	GB,RF
Orontium aquaticum 2,6	golden club	H	GB
Osmorhiza claytonii	sweet cicely	H	AM,HM

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Osmunda cinnamomea	cinnamon fern	H	AM,GB,MC,RF
Osmunda claytoniana	interrupted fern	H	GB,RF
Osmunda regalis var. *spectabilis*	royal fern	H	GB,RF
Ostrya virginiana	hop-hornbeam	T	AM,HM,RF
Oxalis acetosella	common wood-sorrel	H	AM,HM
Oxalis corniculata	creeping lady's-sorrel	H	AM,AX,HM,PO,RF
Oxalis dillenii ssp. *dillenii*	oxalis	H	AM,AX,HM,PO,RF
Oxalis grandis	giant wood-sorrel	H	RF
Oxalis stricta	yellow wood-sorrel	H	RF
Oxalis violacea	violet wood-sorrel	H	AM,AX,HM,PO,RF
Oxydendrum arboreum	sourwood	T	AM,AX,HM,PO,PS
Oxypolis rigidior	pig-potato	H	AM,HM,RF
Pachysandra procumbens	allegheny spurge	H	RF
Panax quinquefolius 7	American ginseng	H	AM,HM
Panax trifolius	dwarf ginseng	H	AM,HM,RF
Panicum capillare	witchgrass	H	AM,AX,HM,PO,RF
Panicum rigidulum	a panic grass	H	AM,HM
Panicum virgatum	a panic grass	H	RF
Parthenocissus quinquefolia	Virginia creeper	V	AM,AX,DC,HM,MC,PO,RF
Paspalum fluitans	a paspalum	H	AM,HM,RF
Paspalum laeve var. *laeve*	a paspalum	H	AM,AX,HM,PO
Passiflora lutea	yellow passion-flower	H	AX,PO,RF
Pedicularis canadensis	wood-betony	H	AM,HM
Pellaea glabella	smooth cliff-brake	H	DC,MC
Penstemon canescens	gray beard-tongue	H	AM,AX,HM,PO
Penthorum sedoides	ditch stonecrop	H	RF

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Phacelia bipinnatifida	lavender phacelia	H	AM,HM
Phaseolus polystachyus	wild bean	H	AM,HM
Phlox maculata	meadow phlox	H	GB,RF
Phlox paniculata	perennial phlox	H	RF
Phryma leptostachya	lopseed	H	AM,HM
Phyla lanceolata	frog-fruit	H	AM,HM,RF
Physostegia virginiana	dragon's head	H	GB
Phytolacca americana	pokeweed	H	MC
Pinus echinata	shortleaf pine	T	AX,PO
Pinus rigida	pitch pine	T	DC,PO,PS,RF
Pinus virginiana	Virginia pine	T	DC,PO,PS,VP
Pityopsis graminifolia	grass-leaved goldaster	H	AM,AX,GB,HM,PO
Plantago rugellii	red-stemmed plantain	H	RF
Platanthera clavellata	small green wood-orchid	H	AM,HM
Platanthera flava var. *herbiola*	northern rain-orchid	H	AM,HM
Platanus occidentalis	sycamore	T	GB,RF
Poa autumnalis	autumn meadow-grass	H	AM,HM
Podophyllum peltatum	May-apple	H	AM,HM,RF
Podostemum ceratophyllum 2	riverweed	H	UP
Polygonatum biflorum	Solomon's seal	H	AM,AX,HM,PO
Polygonatum pubescens	Solomon's seal	H	AM,HM
Polygonum caespitosum *	knotweed	H	AM,GB,HM
Polygonum cuspidatum *	Japanese knotweed	H	AM,GB,HM
Polygonum hydropiperoides	water-pepper	H	AM,GB,HM
Polygonum pensylvanicum	pink knotweed	H	AM,GB,HM
Polygonum punctatum	water-smartweed	H	AM,GB,HM

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Polygonum sagittatum	arrow-vine	H	GB
Polygonum virginianum	jumpseed	H	RF
Polymnia uvedalia	bearsfoot	H	RF
Polypodium virginianum	rock-cap fern	H	AM,DC
Polystichum acrostichoides	Christmas fern	H	AM,HM,RF
Porteranthus stipulatus	Indian physic	H	AM,GB,HM
Porteranthus trifoliatus	bowman's root	H	AM,GB,GH
Potentilla canadensis	five-fingers	H	AM,AX,HM,PO
Potentilla norvegica	Norwegian cinquefoil	H	RF
Potentilla simplex	cinquefoil	H	AM,AX,GB,HM,PO,RF
Prenanthes sp.	white-lettuce	H	AM,HM
Prenanthes altissima	tall rattlesnake-root	H	AM,AX,HM,PO,RF
Prunella vulgaris *	self-heal	H	AM,HM,RF
Prunus americana	American plum	S	GB
Prunus serotina var. *serotina*	black cherry	T	AM,AX,HM,PO
Psoralea psoralioides var. *eglandulosa*	Sampson's snakeroot	H	GB
Pteridium aquilinum	bracken fern	H	AX,DC,PO,RF
Pycnanthemum flexuosum	slender mountain-mint	H	GB
Pycnanthemum incanum	white horse-mint	H	AX,PO
Pycnanthemum tenuifolium	narrow-leaved mountian mint	H	RF
Pyrularia pubera	buffalo-nut	S	AM,HM,RF
Quercus alba	white oak	T	AM,AX,HM,PO
Quercus coccinea	scarlet oak	T	AX,PO,VP
Quercus falcata	southern red oak	T	AX,PO,VP
Quercus montana	chestnut oak	T	AX,HM,PO

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Quercus rubra var. *borealis*	northern red oak	T	AM,AX,HM,PO
Quercus stellata	post oak	T	AX,PO
Quercus velutina	black oak	T	PO,PS
Ranunculus hispidus	bristly buttercup	H	HM
Rhexia mariana var. *mariana*	pale meadow-beauty	H	GB,RF
Rhododendron arborescens	sweet azalea	S	GB
Rhododendron maximum	great rhododendron	S	AM,HM,RF
Rhododendron minus	Carolina rhododendron	S	AX.PO
Rhododendron periclymenoides	pinxter-flower azalea	S	AX,GB,PO,PS
Rhus aromatica	fragrant sumac	S	AM,HM
Rhus copallina	winged sumac	S	AM,AX,DC,HM,PO
Rhus glabra	smooth sumac	S	AM,HM,RF
Rhynchospora capitellata	a beak-rush	H	AM,HM,RF
Robinia pseudo-acacia	black locust	T	GB,HM
Rorippa palustris ssp. *fernaldiana*	yellow cress	H	RF
Rosa carolina	wild rose	S	AM,HM
Rubus allegheniensis	blackberry	S	AM,HM
Rubus hispidus	swamp dewberry	S	AM,GB,HM,RF
Rudbeckia fulgida	orange coneflower	H	RF
Rudbeckia hirta	black-eyed Susan	H	AM,HM
Rudbeckia laciniata	goldenglow	H	RF
Ruellia caroliniensis	hariy wild petunia	H	RF
Rumex crispus	sour dock	H	RF
Sabatia angularis	rose-pink	H	GB
Sagittaria australis	southern arrowhead	H	GB
Sagittaria latifolia var. *latifolia*	duck-potato	H	GB

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Salix caroliniana	coastal plain willow	S	GB
Salix nigra	black willow	T	GB
Salvia lyrata	cancer-weed	H	AM,GB,HM,RF
Sambucus canadensis	elderberry	S	GB,RF
Sanguinaria canadensis	bloodroot	H	AM,HM,RF
Sanicula marilandica	black sanicle	H	RF
Sanicula trifoliata	trefoil snakeroot	H	RF
Sassafras albidum	sassafras	T	AM,AX,DC,HM,PO,PS
Saururus cernuus	lizard's-tail	H	GB
Saxifraga virginiensis	early saxifrage	H	DC OR MC
Schizachyrium scoparium	little bluestem	H	AM,GB,HM,RF
Schrankia microphylla	sensitive brier	H	GB
Scirpus cyperinus	woolgrass	H	AM,GB,HM
Scleria pauciflora	nut rush	H	AM,AX,HM,PO
Scutellaria elliptica	hairy skullcap	H	AM,AX,HM,PO
Scutellaria incana	skullcap	H	AM,HM,RF
Scutellaria integrifolia	narrow-leaved skullcap	H	GB
Scutellaria lateriflora	mad-dog skullcap	H	GB
Scutellaria saxatilis 3	rock skullcap	H	AM,HM,RF
Sedum ternatum	shepherd's cross	H	AM,HM,RF
Selaginella apoda	meadow spikemoss	F	GB,MC
Senecio anonymus	southern ragwort	H	AX,GB,PO
Senecio aureus	squaw-weed	H	RF
Senecio obovatus	ragwort	H	AM,HM
Senecio pauperculus	balsam groundsel	H	GB
Sicyos angulatus	bur-cucumber	H	RF

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Sida spinosa	prickly mallow	H	RF
Silene antirrhina	sleepy catchfly	H	DA
Silene rotundifolia	round-leaved firepink	H	MC
Silene stellata	starry campion	H	AM,HM,RF
Silene virginica	fire pink	H	AM,HM
Silphium trifoliatum	rosinweed	H	RF
Sisyrinchium angustifolium	common blue-eyed grass	H	RF
Smilacina racemosa	false Solomon's seal	H	AM,HM
Smilax bona-nox	catbrier	S	RF
Smilax ecirrhata	carrion-flower	H	AM,HM
Smilax glauca	sawbrier	S	AM,AX,HM,PO
Smilax herbacea	carrion flower	H	AM,HM
Smilax rotundifolia	common greenbrier	S	RF
Solanum carolinense	horse nettle	H	GB
Solidago arguta var. *arguta*	sharp-leaved goldenrod	H	AM,HM
Solidago caesia	blue-stemmed goldenrod	H	AM,HM
Solidago canadensis var. *scabra*	tall goldenrod	H	AM,HM
Solidago erecta	scepter goldenrod	H	GB,RF
Solidago flexicaulis	zigzag goldenrod	H	AM,HM
Solidago gigantea	giant goldenrod	H	AM,HM
Solidago juncea	plume goldenrod	H	GB
Solidago nemoralis	early goldenrod	H	AX,PO
Solidago odora	sweet goldenrod	H	AM,AX,GB,HM,PO,RF
Solidago rugosa var. *rugosa*	wrinkled goldenrod	H	AM,HM
Solidago spathulata 3,6	sticky goldenrod	H	GB
Sorghastrum nutans	Indian grass	H	PO

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Spartina pectinata	fresh-water cord-grass	H	GB
Stachys nuttallii	hairy stachys	H	AM,HM
Stachys tenuifolia	stachys	H	RF
Stellaria pubera	star chickweed; giant chickweed	H	AM,HM,RF
Stenanthium gramineum	featherbells	H	RF
Stewartia ovata	mountain camellia	S	AM,AX,GB,HM,PO,RF
Stylophorum diphyllum	celandine poppy	H	AM,HM,RF
Stylosanthes biflora	pencil-flower	H	GB
Styrax grandifolia 2	bigleaf snowbell	S	AM,HM
Symphoricarpos orbiculatus	coralberry	S	AM,HM
Tephrosia spicata 1,6	brownhair tephrosia	H	GB
Tephrosia virginiana	goat's rue	H	AX,GB,PO,PS,RF
Teucrium canadense	wood sage	H	RF
Thalictrum clavatum	cliff meadow rue	H	MC
Thalictrum pubescens var. *pubescens*	tall meadow rue	H	RF
Thalictrum thalictroides	rue anemone	H	AM,HM
Thaspium barbinode	common meadow parsnip	H	RF
Thaspium trifoliatum var. *atropurpureum*	meadow parsnip	H	RF
Thelypteris hexagonoptera	broad beech fern	H	AM
Thelypteris noveboracensis	New York fern	H	AM,HM,MC,RF
Tiarella cordifolia var. *collina*	foamflower	H	AM,HM
Tiarella cordifolia var. *cordifolia*	creeping foamflower	H	AM,HM
Tilia americana	American basswood	T	RF
Tilia heterophylla	white basswood	T	RF,HM,AM

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Tipularia discolor	crane fly orchid	H	AM,HM,RF
Toxicodendron radicans	poison ivy	V	AM,AX,DC,GB,HM,MC,PO,RF
Trachelospermum difforme	climbing dogbane	V	GB
Tradescantia ohiensis	prairie spiderwort	H	GB
Tradescantia subaspera	zigzag spiderwort	H	AM,HM,RF
Trautvetteria carolinensis	false bugbane	H	GB
Triandenum tubulosum	St. John's wort	H	RF
Trichomanes boschianum	bristle fern	H	MC
Trichostema dichotomum	blue-curls	H	AX,PO
Trifolium pratense *	red clover	H	DA
Trifolium repens *	white clover	H	RF
Trillium cuneatum var. *cuneatum*	little sweet Betsy	H	AM,HM,RF
Trillium erectum	wake robin	H	AM,HM,RF
Triodanis perfoliata	Venus'-looking-glass	H	DC
Tripsacum dactyloides	eastern gamagrass	H	AM,HM,RF
Tsuga canadensis	eastern hemlock	T	AM,HM,MC,RF
Typha latifolia	common cattail	H	GB
Ulmus alata	winged elm	T	AM,AX,GB,HM,PO,PS,RF
Ulmus americana	American elm	T	GB,RF
Ulmus rubra	slippery elm	T	RF
Uvularia perfoliata	wood merry-bells	H	AM,HM
Uvularia sessilifolia	little merry-bells	H	AM,HM,RF
Vaccinium arboreum	sparkleberry	S	AM,AX,GB,HM,PO,VP
Vaccinium corymbosum	highbush blueberry	S	DC
Vaccinium pallidum	late low blueberry	S	AM,AX,HM,PO,PS

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Vaccinium stamineum var. *stamineum*	deerberry	S	AX,PO,PS
Valerianella sp.	corn salad	H	DA
Verbascum blattaria *	moth mullein	H	DA
Verbascum thapsus *	woolly mullein	H	DC
Verbena urticifolia	white vervain	H	DA
Verbesina alternifolia	crown-beard	H	AM,HM,RF
Vernonia sp.	ironweed	H	RF
Vernonia gigantea ssp. *gigantea*	tall ironweed	H	AM,HM,RF
Veronica officinalis *	gypsyweed	H	AM,HM
Viburnum acerifolium	maple-leaf viburnum	S	AM,AX,HM,PO,RF
Viburnum cassinoides	northern witherod	S	AX,GB,PO,PS
Viburnum prunifolium	black haw	S	RF
Vicia caroliniana	wood vetch	H	RF
Viola affinis	leconte violet	H	GB
Viola blanda	white violet	H	AM
Viola conspersa	American dog violet	H	GB,HM,RF
Viola cucullata	bogbice violet	H	GB
Viola hastata	halberd-leaved violet	H	HM
Viola macloskeyi ssp. *pallens*	sweet white violet	H	AM,HM,MC,RF
Viola pedata	bird's-foot violet	H	GB
Viola primulifolia	primrose-leaved violet	H	AX,GB,PO
Viola pubescens var. *eriocarpa*	smooth yellow violet	H	RF
Viola rostrata	long-spurred violet	H	AM,HM
Viola rotundifolia	yellow violet	H	AM,HM
Viola scoria	common blue violet	H	GB,RF

APPENDIX H. (continued).

Scientific name	Common name	Habit	Community
Viola tripartita 6	tall yellow violet	H	AM,HM
Viteria appalachiana	Appalachian viteria	H	MC
Vitis aestivalis	summer grape	V	AX,PO
Vitis cinerea	pigeon grape	V	GB
Vitis labrusca	fox grape	V	AM,AX,HM,PO
Vitis rotundifolia	muscadine grape	V	AX,PO,RF
Vitis vulpina	frost grape	V	RF
Vulpia octoflora	six-weeks fescue	H	AX,PO
Waldsteinia fragarioides	barren strawberry	H	AM,AX,HM,PO,RF
Wistera frutescens	wisteria	V	GB,RF
Wisteria macrostachya	showy wisteria	V	GB
Woodsia obtusa	blunt-lobe cliff fern	H	MC
Woodwardia areolata	southern chain fern	H	AM,HM
Xanthium strumarium	common cocklebur	H	GB,RF
Xanthorhiza simplicissima	yellow-root	H	GB,RF
Yucca filamentosa *	bear-grass	H	RF
Zizia trifoliata	meadow parsnip	H	RF

Sources: Soil Systems Inc. 1980, Kentucky Narural Heritage Program Database (KNHPD) 1993, 1993 field work.

1. state endangered species; 2. state threatened species; 3. state special concern species; 4. federal candidate; 5. state historical; 6. Daniel Boone National Forest, sensitive species; 7. Daniel Noone National Forest, considered for sensitive species list.

* non-native species.

Habit: T=tree, S=shrub, V=vine, H=herb.

Community: AM = Appalachian Mesophytic Forest, AX = Appalachian Sub-xeric Forest, DA = Disturbed Area, DC = Dry Sandstone Cliff/Rock Outcrop, GB = Cumberland Plateau Gravel/Cobble Bar, HM = Hemlock Mixed Forest, MC = Moist Sandstone Cliff/Rock Outcrop, PO = Appalachian Pine-Oak Forest, PS = Pine Savanna/Woodland, RF = Riparian Forest, UP = Upper Perennial Riverine System.

APPENDIX J. Forest Supervisor's Order 86-3.

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

DANIEL BOONE NATIONAL FOREST

100 VAUGHT ROAD

WINCHESTER, KENTUCKY 40391

F O R E S T S U P E R V I S O R ' S O R D E R

NO 86-3

NOTICE OF AREA CLOSURE

Pursuant to the provisions of 16 U.S.C., Section 551, and 36 C.F.R., Section 261.50 (A) and (B), all off-road vehicular use is prohibited within the State Wild River Corridors within the Daniel Boone National Forest as follows:

1. The Red River Wild River
2. The Rockcastle River Wild River
3. Cumberland River Wild River
4. The Little South Fork of the Cumberland Wild River
5. Rock Creek Wild River

Established roads are open to motorized vehicular use, unless otherwise posted with restrictions or signed "closed to vehicles". This restriction shall not apply to vehicles used for National Forest Administration, Resource Management, Search and Rescue, Law Enforcement, and Wildlife Management.

Entering and using this area in violation of this order is prohibited by 36 C.F.R., Section 261.56 and 261.54(a) and is subject to punishment under 16 U.S.C., Section 551, by a fine of not more than $500 or imprisonment for not more than six (6) months or both.

Richard H. Wengert

RICHARD H. WENGERT
Forest Supervisor

4/22/86
Date

APPENDIX K. Cumberland Wild River River Environmental Inventory and Management Plan Public Hearing- Williamsburg, Kentucky
March 23, 1995
Summary of Oral Comments Received

Earl Timmons (hereinafter **ET**): Might be interested in subdividing his property, and selling off building lots by the river. Understands that now, with what we're doing, he won't be able to do this. If so, wants to know how much DOW will be giving them for their property.
Division of Water Representative (hereinafter **DOW**): The plan references the regulations, which have been in existence for a number of years. The plan itself will not change the regulations, which do not allow new construction in most cases.

ET: Bought his property in 1977; there was nothing on the deed nor was there any notification provided of restrictions on building, etc. Restrictions should have been noted on the deed, so a prospective buyer would be aware of restrictions that are in place.
DOW: DOW recognizes that process of notifying landowners was not done as well as it should have been. We are attempting to correct these shortcomings as much as possible at this time.

ET: It's too late. Should have been done before owners put improvements on their properties.

Elmer Patrick (hereinafter **EP**): If this is already law, since 1972, what is the purpose of the plan?
DOW: The plan is required by the Wild Rivers Act. In addition, the environmental inventory is deemed necessary to allow agencies to make informed decisions on the management of the river.

EP: If law is already in effect, and have the management plan, why would DOW even bother to come down to talk to residents?
DOW: DOW feels it is very important to get landowner's concerns addressed as part of the planning process. Mention made of DOW research at Whitley and McCreary County Property Valuation Administration (PVA) offices to identify landowners in the corridor and notify them of the initiation of the process.
DOW sent letters to all identified owners, asking for their input (a form was provided for their comments). DOW received three replies out of some 60 letters sent.

EP: Did DOW schedule a meeting in Williamsburg to notify people when soil samples were to be taken, mussels sampled, etc.?
DOW: With 3 replies, we were led to believe there was not much interest, therefore, no meeting was scheduled.

Gary Hinkle (hereinafter **GH**): There are more than 60 landowners in this section of river.
DOW: DOW only notified those on PVA records, which are not very good. They are in process of updating and computerizing records and revising maps.

EP: This is not only going to affect those people who live on the river, it will affect the entire county.

Unidentified speaker: The plan talks about the entire watershed. This affects anyone who owns land that drains into the Cumberland.

EP: The entire community should have been made aware of the meeting, since it affects them. This plan affects 60,000 people from Harlan on down.
DOW: The plan addresses the watershed because it is necessary to look at the entire watershed when addressing water quality. However, the plan does not give us control, nor does the Wild Rivers Program (hereafter WRP) have any direct control over what goes on in the watershed other than in the designated Wild River corridor.

EP: Wild River corridor used to come up to Cane Creek, now it's up to Summer Shoals. Now where will it go?
DOW: EP was made of the federal Wild and Scenic River study, which began at Cane Creek. Read portion of the Wild Rivers Act which specifically mentions Summer Shoals as the upstream endpoint (KRS 146.241(1)).

EP: This is misleading, because it mentions the endpoints, and then the water corridors leading to it.
DOW: Stated the definition of the "corridor": the visible sight distance from the river, not to exceed 2000 feet in either direction.

EP: What he is talking about is the watershed- the contributaries (sic) to--
DOW: Reiterated that the WRP has no direct control over what goes on in the watershed, apart from the designated Wild River corridor.

Unidentified speaker: That lady (Joan Garrison) mentioned that loggers could be cited in the watershed.
DOW: General water quality laws provide that if it can be proven that your activities are causing pollution of a stream, you're liable. This is completely separate from the Wild Rivers regulations.

GH: What is the eyesight from the center of the river?
DOW: Cannot definitively state for any given point- it varies depending on topography.

EP: What portions of WRP funding comes from the federal government?
DOW: Zero. Program is entirely funded by the state.

EP: EP reads excerpt from the plan-the introduction to the natural community classification section which states: "Recent disturbances to the area, including grazing and logging, have affected microclimate, soil and seed availability..."(end of reading). He is concerned about the statement that disturbances have affected seed availability; to him this indicates that "something is bad on someone".
DOW: This statement simply means that human disturbances have affected the natural communities, and that areas left to recover will recover. Natural community classification is simply a way of characterizing the native plants of a given area.

EP: What do we have to do to see that this (the Wild Rivers Act) is thrown in the trash can?
DOW: The General Assembly passed the Wild Rivers Act, and only they can repeal or modify it.

Blaine Stewart (Whitley County Judge-Executive-hereinafter **BS**): Why is it necessary that the state of Kentucky and the federal government have a wild rivers program on the same section of river? Is this not a duplication of effort?
DOW: Attempted to explain the differences between state and federal wild river designation.

BS: His biggest concern is with the portion of the plan that describes compliance inspections by way of air, boat, foot or 4 wheel-drive. He does not live in the corridor, but if he did, he would take considerable offense to the fact that DOW can enter onto private property without a landowner's permission, or without a warrant of the court. He does not believe that this applies to any other portion of Kentucky, nor can the federal government do this.
DOW: Informed him that the NREPC has the legal authority to enter onto private property during course of official business, if it is deemed to be necessary to enforce NREPC statutes.

BS: Would this be enforced in a state court?
DOW: Most probably.

BS: Referring to water quality monitoring and evaluation section, pertaining to the statement, "Because of the close proximity of the City of Williamsburg's wastewater treatment plant to the Wild River segment, it is recommended that the discharge be frequently monitored, that effluent permit limits be strictly enforced and that the necessity for imposing nutrient limits be assessed": questions whether this constitutes an "unfunded mandate". Feels that anything we recommend will result in regulations, and it will be another thing the City of Willliamsburg has to comply with.

DOW: The discharge from the City of Williamsburg wastewater treatment plant is already regulated by the Division of Water, and all this recommendation does is to recommend monitoring and enforcement of the existing law.

BS: Referring to recommendations in water quality and evaluation section, pertaining to coal mining and Department of Surface Mining Reclamation and Enforcement's regulation of coal mining operations, does DOW now intend to monitor and supervise by regulation surface mining operations?
DOW: Again, this statement simply calls for continued enforcement of existing regulations, and does not call for new regulations to be promulgated.

BS: Other than the fact that the law says we have to write a book and do a study, does this publication do anything to the local residents?
DOW: No. Residents were effected when the river was designated as a Wild River.

BS: Will this publication result in any regulation that will further infringe on the landowner's right to use their property?
DOW: No.

BS: Will this report result in the area within the Wild River corridor being expanded?
DOW: No. The Wild Rivers area could not be expanded without the concurrence of the General Assembly. DOW has no plans to seek the expansion of the Wild Rivers area.

BS: Does DOW intend to go onto a landowner's land within the corridor to perform an inspection?
DOW: Not without good reason. Joan Garrison stated that she always tries to get permission first. In cases where permission is not granted, we have obtained a warrant if deemed necessary or advisable.

BS: Referring to "Management Objectives" section: mention is made of "stringent operational requirements and erosion control and reclamation measures" to be imposed on practices allowed with a change-of-use permit: does this apply to the watershed, or just the designated segment? Are these restrictions intended to be more stringent than those placed on upstream or downstream portions?
DOW: These restrictions apply to the Wild River corridor only, not to the entire watershed. In many cases, they are not significantly more stringent than existing regulations (oil and gas well development was the example specifically cited by Judge Stewart), but the main area in which they differ is in the monitoring of the operation.

BS: How much did this study cost the taxpayers?
DOW: The entire agreement with Kentucky State Nature Preserves Commission was for $40,000- to do research, write the plan, and provide final copies.

BS: What portion of the Wild Rivers Program's budget is earmarked for the Cumberland?
DOW: Since there is no specific budget earmarked to the Wild Rivers Program, it is impossible to estimate how much of that is earmarked for the Cumberland.

BS: With all these efforts and money going into this 16.1 mile section of river, has there been any indication that there has been an increase in the use and enjoyment by humans of the river? That is, has this designation done anything to enhance the quality of life of the people who use the river?
DOW: We'd certainly like to think so. Explained that part of the impetus for passing the Wild Rivers Act was to protect the last vestiges of free-flowing streams in the state, lest they all be dammed.

EP: What is the next step in the process? How many people who produced the report live in the impacted area? Did it ever dawn on the preparers to get a local attorney or some other local resident involved in the plan's preparation?
DOW: Public comments will be addressed in the final report, to be issued later this year. While few local residents were involved in the early production of the plan, an attempt was made to get local involvement via sending out letters soliciting these comments. As previously mentioned, we were not successful in obtaining the input of local residents early in the planning process.

EP: Since the local residents did not have anyone representing them during the early phases of the plan preparation, why would DOW come to them now and tell them what they did? Why take $40,000 of the taxpayers money to put the report together?
DOW: We are seeking public input before finalizing the plan. The preparation of the report was mandated by the General Assembly, and is felt to be needed to guide long-term protection of the Wild River corridor.

BS: Suggest that the report come flat out and state that it is not our intent to increase the degree of regulation, the area of regulation nor the control of use of private lands by virtue of this report and any regulations which it may recommend. If this was stated in the beginning, instead of 100 pages of "gobbledygook", it would help us.
DOW: Recommendation so noted.

EP: Feels that on the heels of this report will come another stack of bureaucracy, more inspectors, and more taxes to take care of those inspectors, all to make their lives better.

Homer Collins (hereinafter **HC**): On any of the other Wild Rivers in which management plans have been prepared, have these plans resulted in additional regulations, restrictions or inspectors? HC was interested in not just what has happened

in Kentucky, but other states as well.
DOW: No, in this state no new regulations have resulted from the preparation of management plans. The most recently prepared plan, for Bad Branch, resulted in no changes in the management of the area. Can not answer for other states, since all state programs are different, and nor easily compared.

HC: Reference made to recommendation in land acquisition/easements section about investigating the feasibility of producing signs to post at popular access points, noting that it is necessary to obtain the landowner's permission before entering onto private lands. Is DOW planning to post such signs on private lands?
DOW: If such signs were produced, they would not be put on private lands unless the landowner permitted or requested them.

Jill Byrd: Would these signs say that this was a Wild River management area?
DOW: They would say something to the effect that this was a wild river area, regulated under KRS 146, and that entry onto private lands without the landowner's permission is against the law, just as it is anywhere else.

Unidentified speaker: The report says there are 26 parcels of privately-owned land within the corridor. Is that all there are? Why did you say that you sent out 60 letters to landowners?
DOW: The 26 landowners figure came from PVA records; we recognize that there are probably more owners we don't have record of. The statement that we sent out 60 letters was a rough estimate, it was probably less. However, since many tracts have multiple owners listed, such as is the case with heirships, more than 26 letters were sent out.

After much general discussion and one-on-one discussion with attendees, the meeting adjourned at approximately 9:30PM.