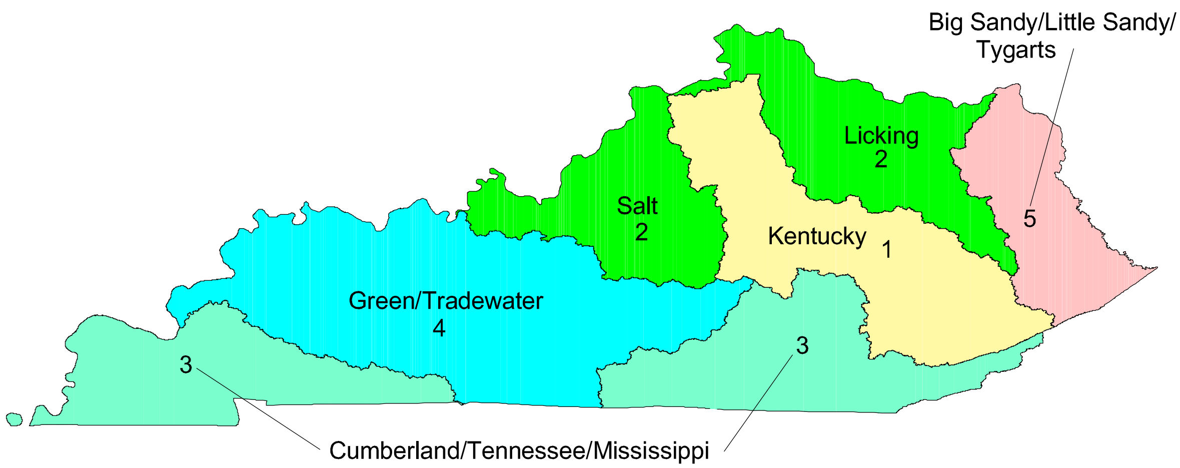
2002 Kentucky Report to Congress on Water Quality

with emphasis on the Salt/Licking and
Cumberland/Tennessee/Mississippi
Basin Management Units



Kentucky Natural Resources and
Environmental Protection Cabinet
Division of Water
September 2002

ACKNOWLDGEMENTS

This report includes the second and third years of an intensive inter-agency watershed monitoring effort with the support of state, federal, and local agencies. There are many people and organizations to thank for continuing to support this important effort. In particular, I wish to thank the Kentucky Department of Fish and Wildlife Resources and their district fisheries personnel for their substantial contribution. The U.S. Forest Service, Kentucky State Nature Preserves Commission, U.S. Fish and Wildlife Service, and the Nashville and Louisville districts of the U.S. Army Corps of Engineers contributed to both the planning and carrying out of the monitoring. The Kentucky Division of Environmental Services conducted the analyses of all surface water quality samples submitted by the Division of Water. Staff in the London, Hazard, Columbia, Bowling Green, Madisonville, and Paducah offices of the Field Operations Branch collected many of the surface water samples and analyzed many of the bacteria samples. Louisville's Metropolitan Sewer District provided data on waters in the greater Louisville area. The Nonpoint Source Program of the Kentucky Division of Water funded biological work by Eastern Kentucky University in the Sinking Creek and Buck Creek watersheds and biological and bacteria sampling by Murray State University in the Lower Cumberland and Tennessee river basins. Personnel from the Natural Resources Conservation Service, Kentucky Geological Survey, Kentucky Division of Conservation, Kentucky Division of Pesticides, Kentucky Division of Forestry, Kentucky Water Resources Research Institute, and the U.S. Geological Survey were involved in important planning stages. The USEPA National Health and Environmental Effects Research Laboratory in Corvallis, Oregon provided the random survey sampling design and analysis. Lee Colten, the Kentucky Division of Water's Watershed Coordinator, has worked diligently to promote the watershed effort. Steve Bolssen assisted in GIS applications. Last, but certainly not least, I want to thank all the staff of the Water Quality and Groundwater branches of the Kentucky Division of Water, including secretaries Dru Ellen Hawkins and Mariam Wiley, for their work.

Tom C. Van Arsdall
Kentucky 305(b) Coordinator
June 2002

TABLE OF CONTENTS

Page

TABLES

Page

FIGURES

Page

Chapter 1. Introduction

This report was prepared by the Kentucky Division of Water (DOW) for submittal to the U.S. Environmental Protection Agency (EPA) to fulfill requirements of Section 305(b) of the Federal Water Pollution Control (or Clean Water) Act of 1972 (P.L. 92-500), as subsequently amended. Section 305(b) of the Act requires states to assess and report current water quality conditions to EPA every two years.

The DOW initiated a five-year rotating watershed management approach in 1997. Results from the first basin management unit, the Kentucky River, were reported in the 2000 305(b) report. The current (2002) report consists primarily of results from monitoring in the second and third basin management units, the Salt/Licking unit in 1999 and the Cumberland/Tennessee/ Mississippi unit in 2000, and it also presents a summary of data from the entire state. Therefore, this report includes results of not only three years of intensive watershed data collection but also data collected prior to 1998 in the two basin management units that have not yet been sampled intensively (Green/Tradewater unit and Big Sandy/Little Sandy/Tygarts unit). Data collected by the Ohio River Valley Water Sanitation Commission (ORSANCO) were used to make assessments for the main stem of the Ohio River.

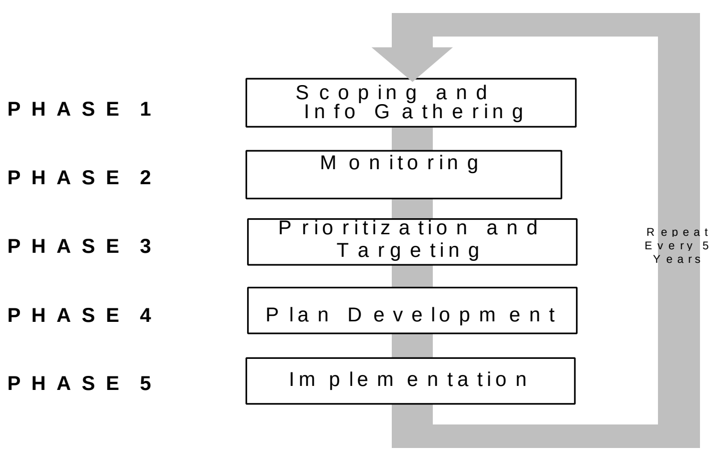
Most impaired waters identified by this report also are listed in the 2002 303(d) report (Kentucky Division of Water 2002a).   However, there are reasons that some impaired waters are not 303(d)-listed. For example, compliance problems at facilities with adequate permits are not on the 303(d) report because the total maximum daily load (TMDL) has already been calculated and accounted for in the permit. These issues are discussed in more detail in the 303(d) report.

Chapter 2. Watershed Management Framework

In order to better characterize the waters of the state and better coordinate resources toward addressing problems, Kentucky adopted a Watershed Management Framework in 1997. The purpose of this management framework is to use programs, people, information, and funds as efficiently as possible to protect, maintain, and restore water and land resources. This approach provides a framework in place and time within which participating individuals and institutions can link and support one another's efforts in watershed management.

According to the adopted framework, the state is divided into five basin management units (see Figure 2-1 and Schedule below) for the purposes of focusing management activities spatially. Activities within each unit follow a five-year schedule, staggered by one year, so that efforts can be better focused temporally within a basin. Phases in the cycle include collecting information about water resources in the basin, identifying priority watersheds, listing the watersheds in the basin in order of priority and deciding which problems can be solved with existing funds, determining how best to solve the problems in the watershed, developing an action plan, and carrying out the strategies in the plan. Public participation is also encouraged throughout the process, allowing citizens and organizations to stay informed and have an active role in management of the resource.

Monitoring and assessment take place in the second and third years, respectively, of the watershed cycle.



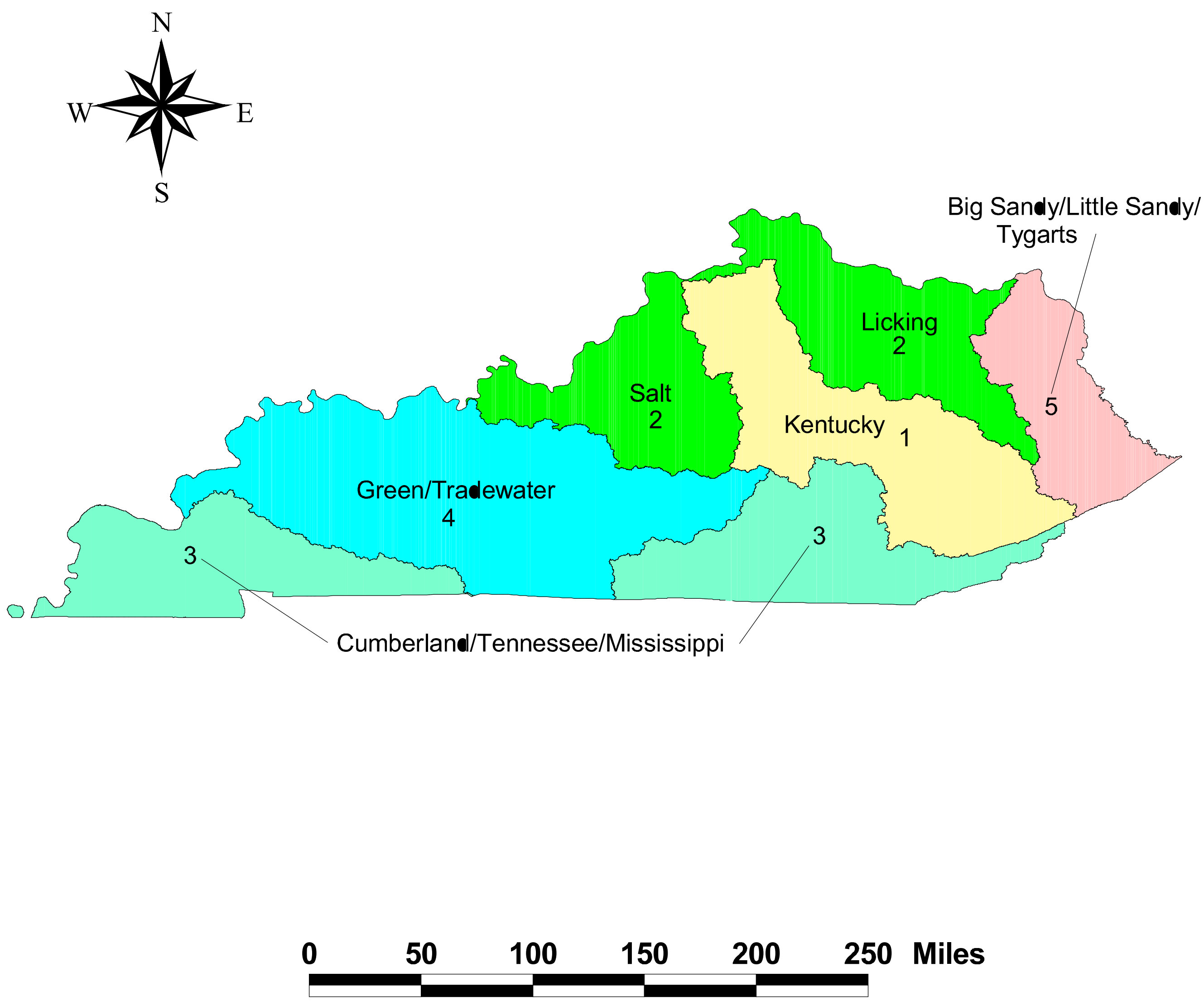
Each basin was phased into the Watershed Framework schedule as listed below. Monitoring activities begin in the second year of the cycle.

- July 1997 – Kentucky River basin
- July 1998 – Salt and Licking river basins
- July 1999 – Cumberland, Tennessee, and Mississippi river basins
- July 2000 – Green and Tradewater river basins
- July 2001 – Big Sandy River, Little Sandy River , and Tygarts Creek Basins

Benefits of this approach include:

- Better coordination of resource management activities around common basin management units and schedules
- Better ability to stretch limited dollars for implementation activities through partnering
- Better information about water resources without higher monitoring costs
- More data as monitoring efforts are coordinated – approximately a four-fold increase in assessment data has been realized since the inception of the watershed approach in 1998
- Better data as agencies standardize methods and procedures
- Greater opportunities for citizen involvement

Figure 2-1. Kentucky Basin Management Units



Chapter 3. Rivers and Streams

3.1 Data Collection

The water quality assessments of rivers and streams were based on the support of designated uses in waters depicted on U.S. Geological Survey (USGS) 1:100,000 scale topographic maps. According to EPA's National Hydrologic Dataset (NHD), these maps contain 49,171 stream miles for the entire state - 10,728 miles in the Salt/Licking unit and 12,741 miles in the Cumberland unit, distributed as follows in the major river basins:

Salt River basin (incl. Ohio River minor tributaries) ………………………4,425
Licking River basin (incl. Ohio River minor tributaries)…………………...6,303
Upper Cumberland River basin……………………………………………..6,539
Lower Cumberland River basin……………………………………………..1,951
Tennessee River basin (incl. Ohio River minor tributaries)……………….. 2,108
Mississippi River basin ……………………………………………………2,143

For this report, monitoring occurred in 21 of the state's 42 8-digit hydrologic (cataloging) units established by the U.S. Geological Survey (Figure 3-1). In the Licking River basin, 164 reaches on 105 streams were assessed (Figure 3-2), and 124 reaches on 86 streams were assessed in the Salt River basin (Figure 3-3). Totals for both these basins include the adjacent Ohio River minor tributaries. In the Cumberland unit, 244 reaches on 176 streams were assessed in the upper part of the unit (Figures 3-4 and 3-5), and 207 reaches on 138 streams were assessed in the lower part of the unit (Figure 3-6). Most of these assessments stemmed from intensive multi-agency watershed monitoring in 1999 and 2000. However, some data more than five years old were considered valid and were used for this reporting period, and some data were collected after 2000.

Volunteer monitoring bacteria data were used as a screening tool but were not used directly in assessments of use support. Additional bacteria data collections were made by the DOW and Section 319(h)-funded contractors on many of the streams identified as problematic by the volunteer data. As the volunteer monitoring program evolves, the DOW will review the manner in which these data are used.

Figure 3-1. 8-Digit HUCs Monitored in the Salt/Licking and Cumberland/Tennessee/Mississippi Basin Management Units

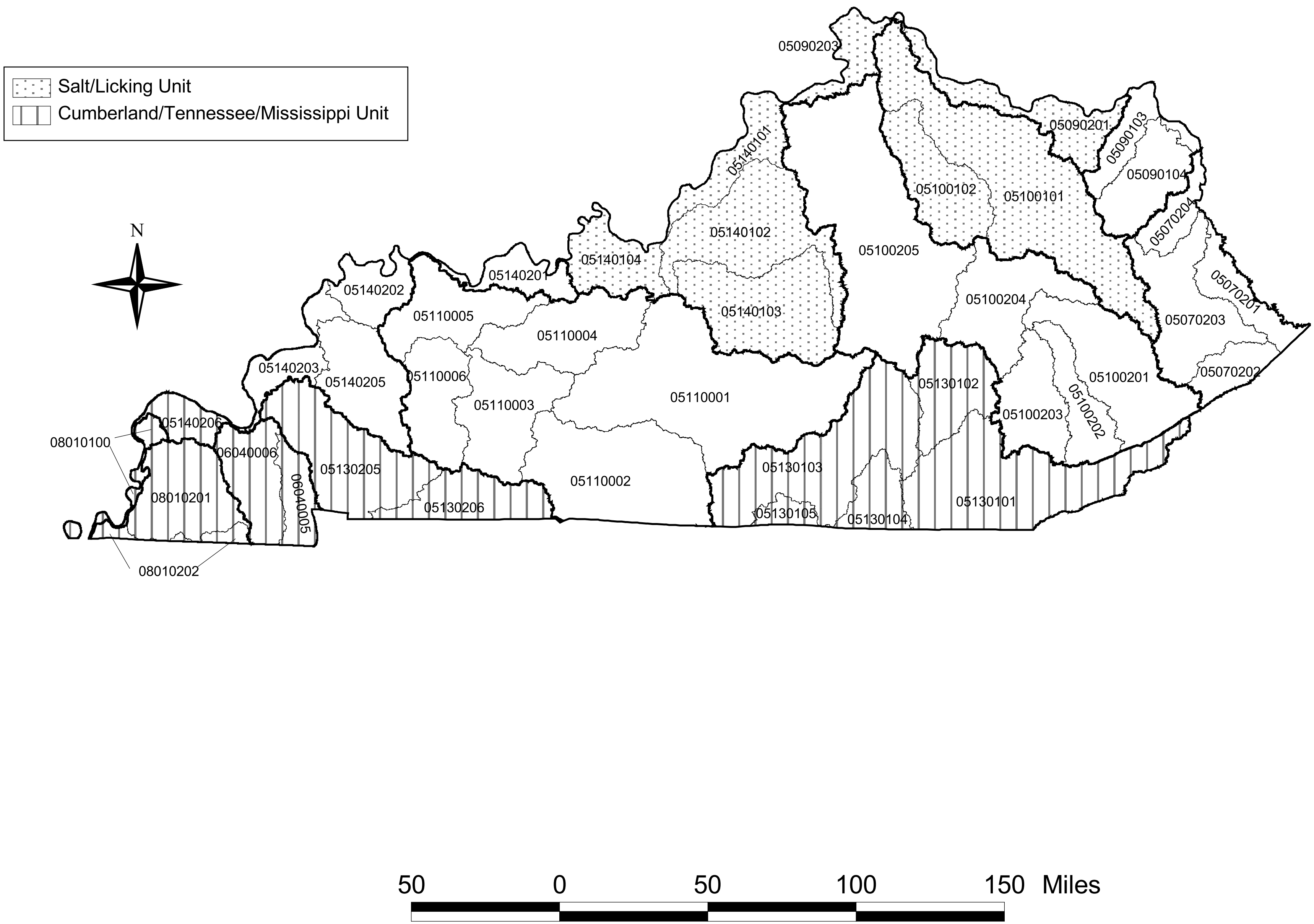


Figure 3-2. Monitoring Sites - Licking River Basin

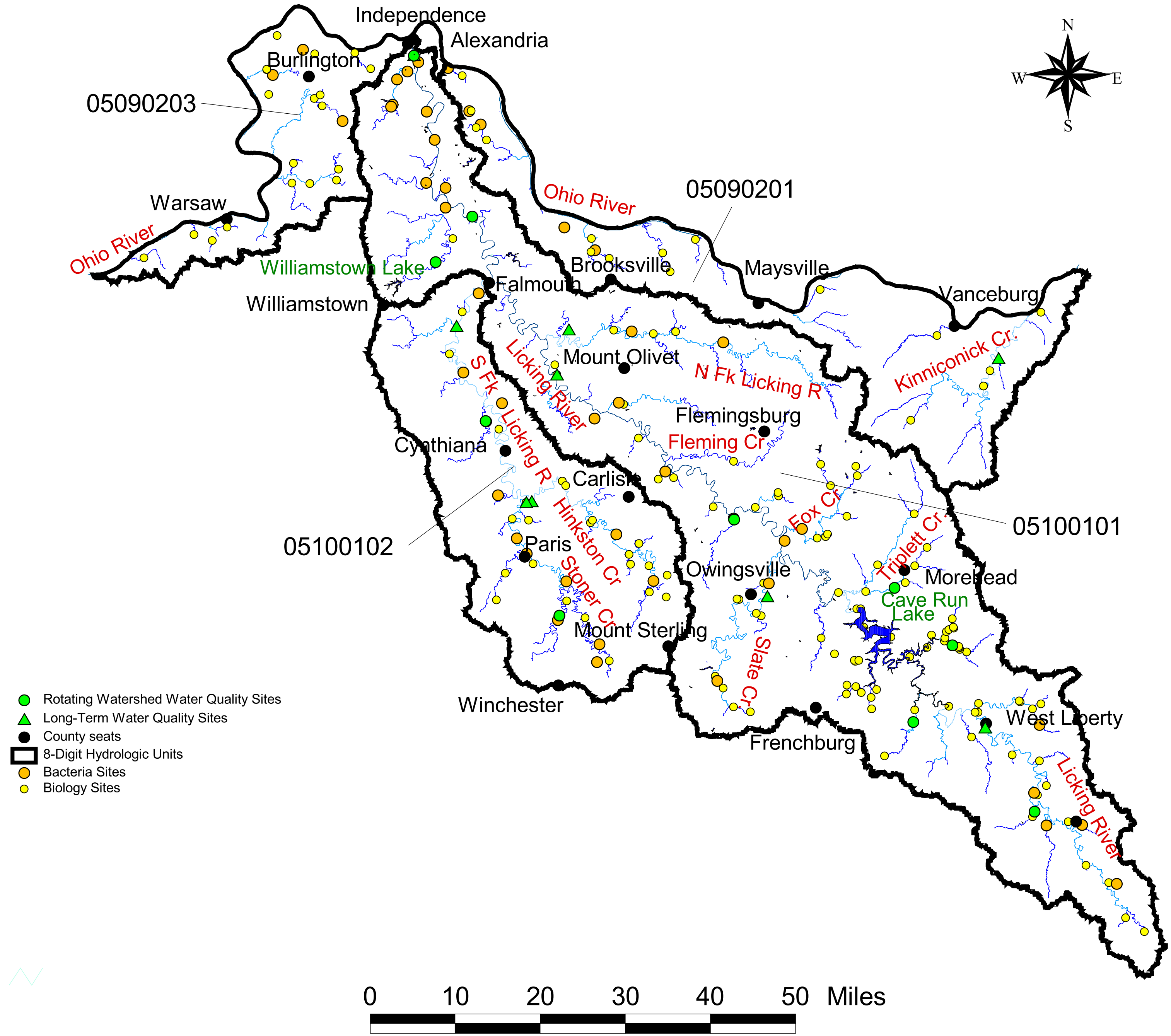


Figure 3-3. Monitoring Sites - Salt River Basin

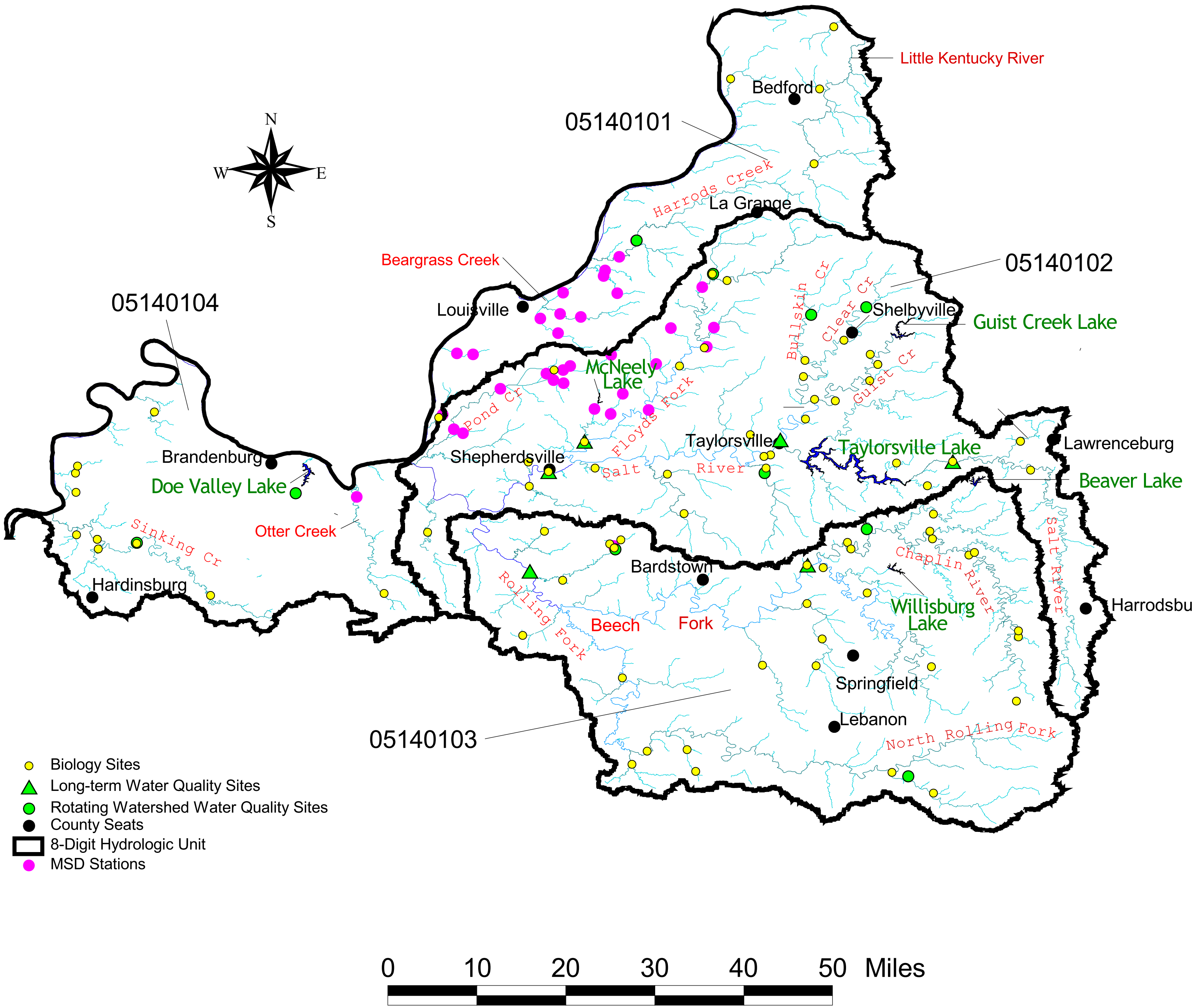


Figure 3-4.   Monitoring Sites - Upper Cumberland River Basin - Hydrologic Unit 05130101

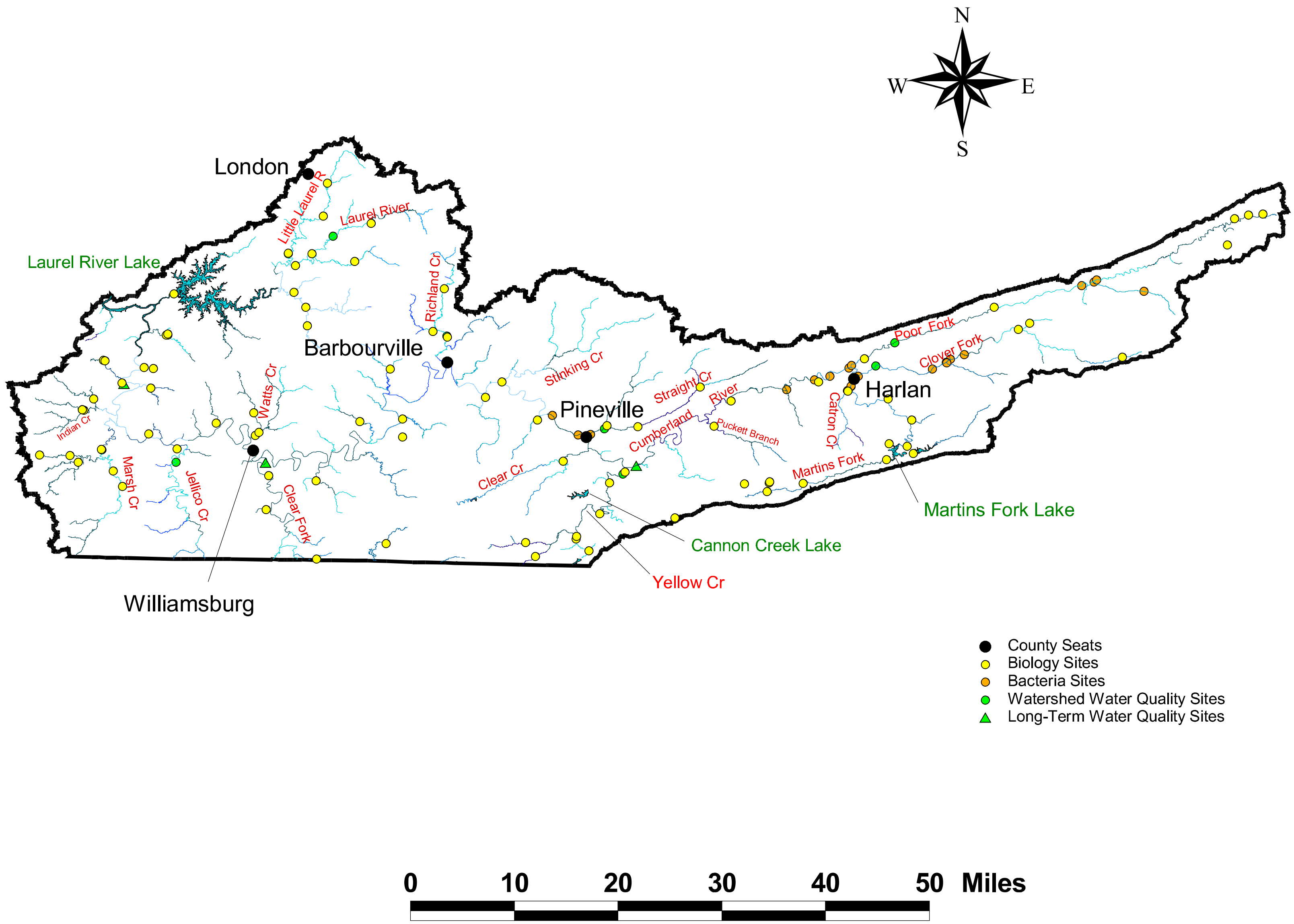


Figure 3-5. Monitoring Sites - Upper Cumberland River Basin - Hydrologic Units 05130102- 05

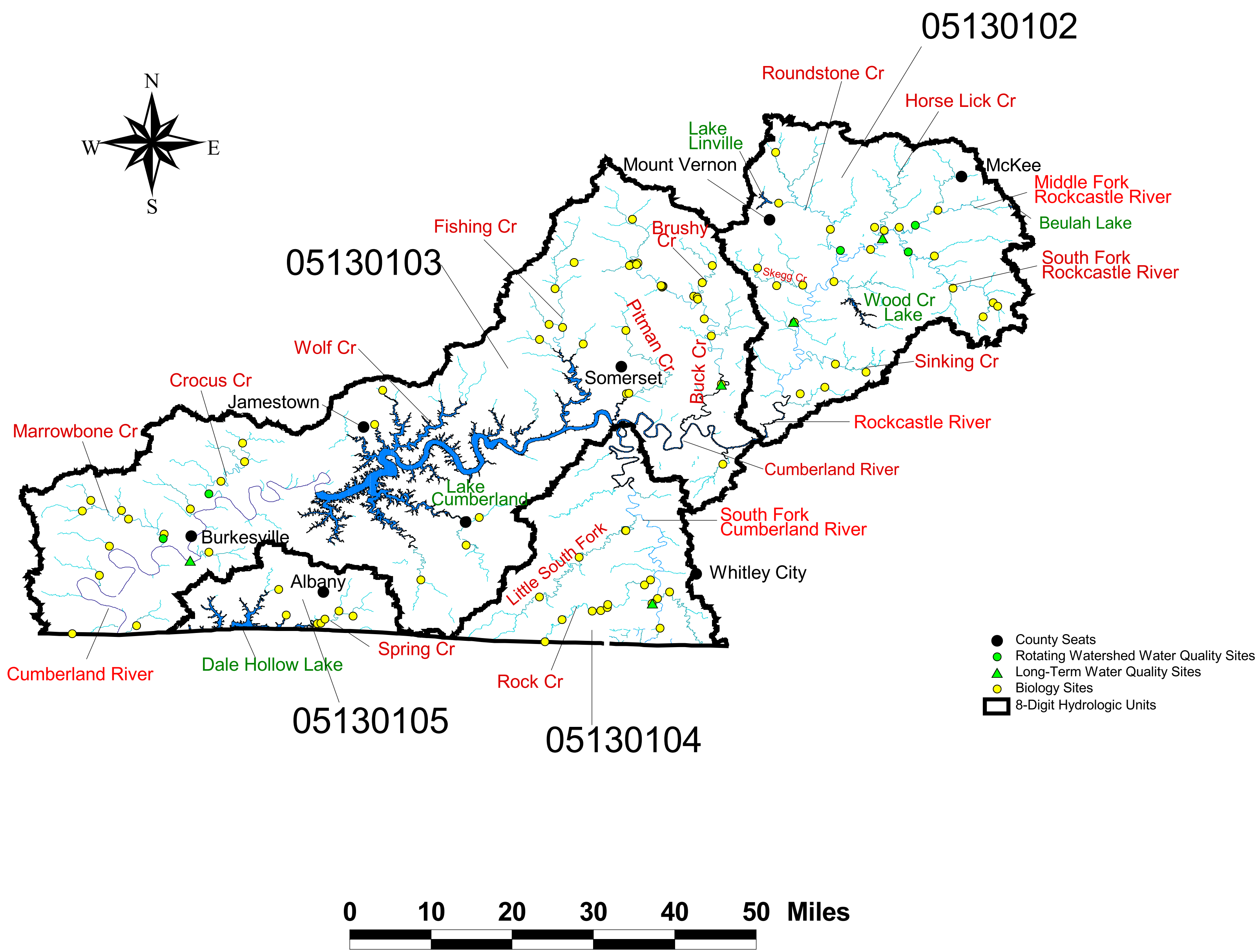
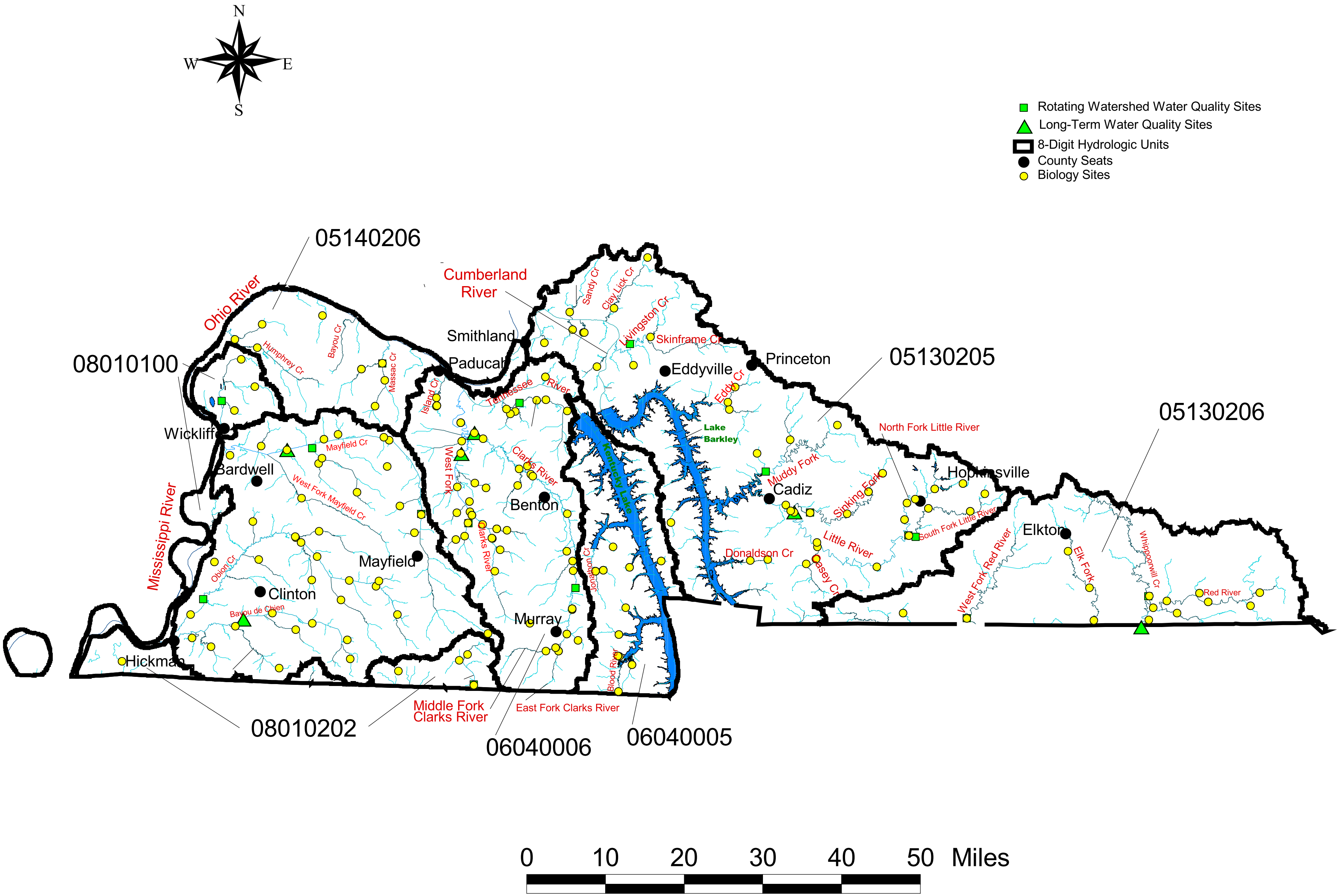


Figure 3-6. Monitoring Sites - Lower Cumberland, Tennessee and Mississippi River Basins



3.1.1 Ambient (Long-Term) Monitoring Network

Water Quality. DOW's statewide ambient water quality monitoring network was increased from 44 to 70 fixed stations with the initiation of intensive monitoring under the watershed approach in May 1998. Ambient stations are located in the downstream and mid-unit reaches of USGS 8-digit hydrologic (cataloging) units, upstream of major reservoirs, and in the downstream reaches of major tributaries. Each of the two basin management units contains 14 ambient stations (Table 3-1). The ambient stations of a particular watershed management unit are sampled monthly during the year the unit is in the monitoring phase of the watershed cycle. During the other four years of the watershed cycle, sampling frequency is reduced to bimonthly to devote more monitoring and laboratory resources to the rotating watershed water quality network (described later). Field measurements are taken for pH, dissolved oxygen, specific conductance, and temperature, and samples are analyzed for nutrients, metals, and also pesticides and herbicides if the streams are in predominantly agricultural areas. The purpose of the ambient water quality sampling is to assess long-term conditions and trends on rivers and the larger streams of the state.

In addition to DOW's network, long-term stations are maintained by ORSANCO on the lower Licking and Cumberland rivers and by the USGS on the lower Tennessee River.

Sediment Quality. Sediment quality is determined at the ambient stations during the year in which monitoring occurs in a watershed management unit. At this time, sediment data supplement other data types; the data are not used directly in assessments of use support.

Biology. Fish, macroinvertebrate, and algae data from the ambient stations provide long-term and trend information on mainstem rivers and many major tributaries. These stations will be revisited every five years. Most of the ambient biological stations are located on streams that also have water quality monitoring. Four of the ambient water quality stations at large river sites (three on the Cumberland and one on the Tennessee) were not sampled biologically because of the lack of adequate biological indices and the difficulty in obtaining representative samples from all habitats in large rivers.

Fish Tissue. Fish tissue samples were obtained from 14 sites in the Cumberland unit and 26 sites in the Salt/Licking unit. Tissue was analyzed for metals, including mercury, PCBs,

Table 3-1. Kentucky Primary Water Quality Monitoring Stations[a]

Major River Basin	Station	Hydro Unit	Mile-Point	Location	Latitude	Longitude	Drainage Area (mi^2)
Big Sandy							
Tug Fork	2	05070201	35.1	at Kermit, WV	37 50 16	82 24 35	1280
Tug Fork	3	05070201	77.7	at Freeburn	37 33 58	82 08 38	271
Levisa Fork	6	05070202	115	nr Pikeville	37 27 51	82 31 33	1232
Levisa Fork	64	05070203	29.6	nr Louisa	38 04 50	82 36 01	2326
Levisa Fork	94	05070203	75	at Auxier	37 43 44.2	82 45 16.1	1726
Beaver Creek	95	05070203	1	Allen	37 36 09.6	82 43 39.4	240
Johns Creek	96	05070203	26.6	at McCombs	37 39 19.1	82 31 33.2	168
Little Sandy							
Little Sandy River	49	05090104	13.2	Argillite	38 29 26	82 50 03	522
Tygarts Creek							
Tygarts Creek	48	05090103	23.5	nr Lynn	38 35 58.9	82 57 10.1	242
Ohio River Tributaries							
Kinniconick Creek	63	05090201	10.4	nr Tannery	38 32 37	83 13 28	230
Licking River							
Licking River	62	05100101	226	at West Liberty	37 54 53	83 15 43	335
Slate Creek	93	05100101	10	nr Owingsville	38 08 29.3	83 43 43	230
Licking River	61	05100101	78.2	at Claysville	38 31 14	84 11 00	1993
North Fork Licking River	60	05100101	6.9	nr Milford	38 35 50	84 09 20	290
South Fork Licking River	59	05100102	11.7	at Morgan	38 36 12	84 24 03	839
Hinkston Creek	102	05100102	0.2	at Ruddles Mill	38 18 16.6	84 14 16.5	260
Stoner Creek	101	05100102	0.6	nr Ruddles Mill	38 18 10.3	84 14 58.9	284
Salt River							
Salt River	29	05140102	22.9	at Sheperdsville	37 59 06	85 43 03	1197
Salt River	52	05140102	82.5	at Glensboro	38 00 08	85 03 35	172
Brashears Creek	105	05140102	1.2	at Taylorsville	38 02 14	85 20 26	262
Floyds Fork	100	05140102	7.4	nr Sheperdsville	38 02 06	85 39 34	259
Rolling Fork	57	05140103	12.3	nr Lebanon Jct	37 49 23	85 44 53	1375
Beech Fork	41	05140103	48.0	nr Maud	37 49 58	85 17 46	436
Kentucky River							
Eagle Creek	22	05100205	21.5	Glencoe	38 42 22	84 49 32	437
Kentucky River	24	05100205	64.8	Frankfort	38 12 46.3	84 52 21.5	5412
Kentucky River	66	05100205	30.5	Lockport	38 26 42	84 57 25	6180

Table 3-1 (cont)

Major River Basin	Station	Hydro Unit	Mile-Point	Location	Latitude	Longitude	Drainage Area (mi2)	Type
Cumberland River								
Cumberland River	**86**	**05130101**	**661**	**at Calvin**	**36 43 19.7**	**83 37 31.9**	**770**	**mid-hydrologic unit index site**
Cumberland River	**9**	**05130101**	**563**	**at Cumberland Falls**	**36 50 08**	**84 20 25**	**1977**	**hydrologic unit index site**
Cumberland River	**87**	**05130101**	**0.9**	**nr Williamsburg**	**36 43 33.2**	**84 08 32.6**	**370**	**major tributary**
Rockcastle River	**10**	**05130102**	**24.7**	**at Billows**	**37 10 17**	**84 17 48**	**604**	**hydrologic unit index site**
Horse Lick Creek	**51**	**05130102**	**0.1**	**nr Lamero**	**37 19 13.3**	**84 08 19.2**	**62**	**special interest watershed**
Cumberland River	**7**	**05130103**	**423**	**nr Burkesville**	**36 44 46.5**	**85 22 18.2**	**6053**	**hydrologic unit index site**
Buck Creek	**88**	**05130103**	**12.3**	**nr Dykes**	**37 03 36.3**	**84 25 34.9**	**294**	**major tributary**
South Fork Cumberland R	**8**	**05130104**	**44.8**	**at Blue Heron**	**36 40 13**	**84 32 56**	**954**	**hydrologic unit index site**
Little River	**43**	**05130205**	**24.4**	**nr Cadiz**	**36 50 26**	**87 46 39**	**269**	**major tributary**
Red River	**69**	**05130205**	**49**	**nr Keysburg**	**36 38 26.9**	**86 58 44.7**	**509**	**hydrologic unit index site**
Green River								
Green River	18	05110001	226	at Munfordville	37 16 07.2	85 53 07.0	1673	hydrologic unit index site
Green River	76	05110001	334	nr Neatsville	37 11 30.9	85 07 49.1	339	major reservoir inflow
Nolin River	21	05110001	80.9	at White Mills	37 33 18	86 01 52	357	major reservoir inflow; major trib
Russell Creek	77	05110001	10	nr Bramlett	37 10 04.1	85 28 12.6	289	major tributary
Little Barren River	78	05110001	6.3	nr Monroe	37 13 35.2	85 40 39.2	256	major tributary
Bear Creek	75	05110001	11.8	nr Huff	37 14 55.8	86 21 40.4	159	major tributary
Barren River	72	05110002	1	Woodbury	37 10 23.8	86 37 23.5	1968	hydrologic unit index site
Barren River	73	05110002	114	nr Holland	36 41 46.8	86 02 48.2	398	major reservoir inflow
Drakes Creek	74	05110002	8	nr Bowling Green	36 56 05.7	86 23 34.7	502	major tributary
Green River	55	05110003	72	at Livermore	37 29 03.1	87 08 04.0	6431	hydrologic unit index site
Mud River	56	05110003	17.4	nr Gus	37 07 24	86 54 02	268	major tributary
Green River	103	05110003	150	nr Woodbury	37 11 00.4	86.36.57.5	3140	hydrologic unit index site
Rough River	14	05110004	62.5	nr Dundee	37 33 46	86 46 15	757	mid-hydrologic unit index site
Rough River	54	05110004	1	nr Livermore	37 29 03.1	87 07 07.6	1068	hydrologic unit index site
Panther Creek	70	05110005	5.4		37 43 38.3	87 16 50.5	374	major tributary
Pond River	12	05110006	12.4	nr Sacramento	37 23 42	83 41 36	523	hydrologic unit index site
Ohio River Tributaries								
Highland Creek	71	05140102	5.5	nr Uniontown	37 47 00.7	87 52 08.5	237	major tributary
Tradewater River								
Tradewater River	53	05140205	15.1	nr Sullivan	37 28 46.0	87 57 13	861	hydrologic unit index site
Tennessee River								
Clarks River	**106**	**06040006**	**14.3**	**nr Sharpe**	**36 58 18.5**	**88 30 53.9**		**hydrologic unit index site**
West Fork Clarks River	**107**	**06040006**	**7.8**	**nr Symsonia**	**36 55 56.9**	**88 32 37.6**		**major trib**
Mississippi River								
Bayou de Chien	**37**	**08010201**		**nr Moscow**	**36 36 54.8**	**89 01 48.4**	**69**	**major tributary**
Mayfield Creek	**42**	**08010201**	**10.8**	**nr Magee Springs**	**36 55 47.6**	**88 56 34.7**	**300**	**major tributary**

[a]Stations in bold are in Salt/Licking and Cumberland/Tennessee/Mississippi basin management units

chlordane, and pesticides and herbicides. Results were used to determine if there are potential problems with contaminants in fish tissue that required further sampling. If results were not elevated, no further fish tissue sampling was conducted.

Other Water Quality Monitoring. Louisville's Metropolitan Sewer District (MSD 2000) sampled water quality including bacteria at 26 sites in Jefferson and adjacent counties (Figure 3-3).

3.1.2 Rotating Watershed Network

Water Quality. An inter-agency monitoring team established several objectives for the one-year watershed water quality monitoring stations. The objectives were to: (1) obtain an overall representation of the quality of the basin's water resources; (2) determine water quality conditions associated with major land cover/land uses such as forest, urban, agriculture, and mining; (3) characterize the basin's least impacted waters; and (4) collect data for establishing total maximum daily loads (TMDLs) as required by Section 303(d) of the Clean Water Act. Parameters analyzed were similar to those described earlier for the ambient network.

The Division of Environmental Services, the laboratory of the Kentucky Natural Resources and Environmental Protection Cabinet, analyzed water quality samples collected by the DOW. The rotating watershed water quality monitoring network consisted of 20 stations in the Salt/Licking unit and 33 in the Cumberland unit (Table 3-2). These usually were located at the downstream reaches of USGS 11-digit watersheds, and many were coupled with biological sampling and with USGS gaging stations. Monthly sampling, sometimes complemented by rain event sampling, was conducted over the 12-month watershed monitoring phase (April 1999 – March 2000 in the Salt/Licking unit and April 2000 – March 2001 in the Cumberland unit) to characterize the watershed represented by the sample site.

Section 319(h) nonpoint source grant monies were used to fund additional bacteriological monitoring by Morehead State University at 42 sites in the Licking River basin and adjacent Ohio River minor tributaries (Pass et al. 2000) and Murray State University at 33 sites in the Lower Cumberland, Tennessee, and Mississippi river basins (White et al. 2001). Site selection was based largely on bacteria problems indicated from data collected by the basin volunteer Watershed Watch groups and to obtain data on streams with recreation potential. Also, DOW

Table 3-2. Rotating Watershed Water Quality Sites - April 1999 to March 2001

Site ID	Stream	Latitude	Longitude	Milepoint	Description
		Licking River Basin (4/99 - 3/00)			
LRW001	Licking River	39.0631	-84.4954	2.0	upstream of Newport Steel loading area
LRW002	Licking River	38.7898	-84.3674	35.0	KY 177 bridge, Butler, KY
LRW003	South Fork Grassy Creek	38.712	-84.4469	15.3	Straight Shoot Road bridge
LRW004	Mill Creek	38.4413	-84.337	2.9	Poindexter Road bridge
LRW005	Strodes Creek	38.1093	-84.178	12.4	KY 57 bridge
LRW006	Flat Creek	38.2721	-83.8001	0.7	KY 1325 bridge
LRW007	Triplett Creek	38.1537	-83.4547	10.6	KY 2342 bridge
LRW008	Blackwater Creek	37.925	-83.4162	5.4	KY 1950 bridge
LRW009	North Fork	38.055	-83.3307	11.5	sampled off Leisure - Paragon Road
LRW010	Johnson Creek	37.77	-83.1578	1.5	KY 134 bridge
		Salt River Basin (4/99 - 3/00)			
SRW002	Chaplin River	37.8912	-85.1995	16.8	KY 1754 bridge
SRW003	Bullskin Creek	38.241	-85.2901	10.3	Scott Station - Antioch Road bridge
SRW004	Simpson Creek	37.9826	-85.3665	2.1	sampled off KY 652
SRW005	Sinking Creek	37.8691	-86.3881	14.8	KY 86/ 261 at Clifton Mills
SRW006	Harrods Creek	38.3617	-85.5749	6.8	KY 329 bridge
SRW007	Clear Creek	38.2528	-85.2007	17.5	above Shelby Lake, KY Hwy 55
SRW008	Currys Fork	38.3074	-85.4506	0.3	KY 1408 bridge
SRW009	Big South Fork	37.4886	-85.1322	2.1	Old Lick Creek Road bridge
SRW010	Wilson Creek	37.8586	-85.6094	12.2	Mt. Carmel Church Road ford
SRW011	Doe Run	37.9501	-86.1298	6.1	Doe Run Inn bridge
		Upper Cumberland River Basin (4/00 - 3/01)			
CRW008	Marrowbone Creek	36.7864	-85.4202	1.2	near Burkesville, KY Hwy 691
CRW009	Crocus Creek	36.8655	-85.3388	2.3	near Amandaville, county road
CRW010	Roundstone Creek	37.2987	-84.2137	0.5	at Livingston, KY Hwy 490
CRW011	Middle Fork Rockcastle River	37.3438	-84.0807	5.9	near Parrot, KY Hwy 2002
CRW012	South Fork Rockcastle River	37.2963	-84.0932	5.1	near Cornette, Bad Hill Rd
CRW013	Little Laurel River	37.0175	-84.1114	1.5	near mouth, KY Hwy 552
UCTMDL01	Little Laurel River	37.1029	-84.0558	12.7	KY 1006 bridge
CRW014	Laurel River	37.042	-84.0483	34.2	near Lily, Happy Hollow Rd
CRW015	Marsh Creek	36.7439	-84.371	7.1	near Whitley City, Laurel Creek Rd
CRW016	Jellico Creek	36.7271	-84.2675	5.2	near Williamsburg, KY Hwy 478
CRW017	Richland Creek	36.9029	-83.8897	3.5	near Barbourville, Old Railroad Grade Rd
CRW018	Straight Creek	36.7734	-83.6699	1.6	at Pineville, KY Hwy 66
CRW019	Yellow Creek	36.7101	-83.6447	1.0	near Ponza, KY Hwy 1534
CRW020	Poor Fork Cumberland River	36.8933	-83.2656	5.1	at Rosspoint, U.S. Hwy 119
CRW021	Clover Fork	36.8609	-83.2917	4.0	at Golden Ash, KY Hwy 58
CRW022	Martins Fork	36.8325	-83.3265	1.0	at Harlan, Sunshine Rd
		Lower Cumberland/Tennessee/Mississippi River Basins (4/00 - 3/01)			
JPTMDL01	Clarks River	36.6917	-88.2735	49.0	at Dexter, KY Hwy 1346
TRW001	Cypress Creek	37.0292	-88.413	3.2	near Calvert City, McFarland Road
TRW002	Panther Creek .	36.8054	-88.5222	1.2	near Hicksville, McKendree Church Rd
JPTMDL02	Massac Creek	37.094	-88.7313	4.2	near West Paducah, KY Hwy 358
ORW001	Shawnee Creek Slough	37.0151	-89.097	0.7	near Wickliffe, Corner Road
MRW001	Mayfield Creek	36.8191	-88.6305	35.3	near Hickory, West Plains Road
MRW002	Wilson Creek	36.9336	-88.8853	0.7	near Cunningham, KY Hwy 1820
MRW003	Obion Creek .	36.6494	-89.1223	8.5	at Whaynes Corner, Whaynes Corner Rd
MRW004	Terrapin Creek	36.5086	-88.4991	3.5	near Bell City, Alderdice Road
CRW005	Whippoorwill Creek	36.6972	-86.9633	4.3	near Dot, KY Hwy 2375
CRW004	West Fork Red River	36.6516	-87.3777	16.3	near Cadiz, Carter Road
LCTMDL01	South Fork Little River	36.8000	-87.4983	1.3	near Hopkinsville, Riverbend Rd (TMDL)
LCTMDL02	North Fork Little River	36.8019	-87.5144	0.1	near Hopkinsville, Gray Lane (TMDL)
CRW002	Muddy Fork	36.9138	-87.8442	7.5	near Cadiz, KY Hwy 139
CRW003	Sinking Fork	36.8408	-87.7409	4.2	near Cadiz, Kings Church Road
CRW001	Livingston Creek	37.143	-88.1633	5.8	near Dycusburg, KY Hwy 295

continued to sample 21 sites in the Upper Cumberland River basin on nine streams and three streams in the Northern Kentucky area with long-standing swimming advisories.

Biology. Unlike water quality monitoring, there was a relative abundance of resources available for biological monitoring. For targeted monitoring, these resources allowed sampling at 171 sites in the Salt/Licking unit (104 in the Licking River basin and 67 in the Salt River basin) in 1999, and 302 sites in the Cumberland unit (171 in the upper part of the unit and 131 in the lower part) in 2000. Also, a random or probabilistic survey approach was used to characterize wadeable (first to fifth-order) streams in the two basin management units by sampling macroinvertebrates at 125 sites.

For the watershed biological monitoring network, targeted stations were placed in the downstream reaches of fourth-order (on 1:24,000 scale USGS topographic maps) watersheds. One reason for this choice was that the number of fourth-order watersheds fairly closely matched the available monitoring resources. Another favorable attribute of fourth-order watersheds is that they are more hydrologically accurate and uniform in size than 11-digit watersheds. Most fourth-order streams were monitored for at least one component of the biological community (fish, macroinvertebrate, algae) and habitat.

In the Salt/Licking unit in 1999, the Kentucky Department of Fish and Wildlife Resources (KDFWR 2000) sampled fish at 93 stations, and the DOW collected fish, macroinvertebrates, and algae at 25 stations. Eastern Kentucky University (EKU) was funded by a Section 319(h) grant to perform additional biological work in the Salt River Basin (Schuster et al. 2000). The U.S. Forest Service (USFS 2000) and Kentucky State Nature Preserves Commission (2000) collected macroinvertebrate samples at 13 and 8 stations, respectively.

In the Cumberland unit in 2000, the DOW collected multi-assemblage data from 37 sites in the Upper Cumberland basin and 8 sites in the lower portion of the basin unit (Figures 3-4, 3-5, and 3-6). The KDFWR (2001) collected fish at 93 sites. The USFS sampled ten sites in 1999-2000, and assessments from previous sampling were carried forward for several other streams in the national forest. In addition, 319(h) nonpoint source grant monies were used to contract: 1) Murray State University for macroinvertebrate sampling at 47 sites in the lower Cumberland and Tennessee river basins (White et al. 2001a and 2001b); 2) EKU to collect fish and macroinvertebrates from the Upper Cumberland River basin at 5 sites in the upper Buck Creek basin in Lincoln and Pulaski counties (Moeykens and Schuster 1997); and 3) EKU to collect fish, macroinvertebrates, and mussels at 6 sites in the Sinking Creek watershed in Laurel County (Groves and Schuster 2000). The U.S. Army Corps of Engineers Nashville District contracted macroinvertebrate work at 17 inflow and 2 tailwater sites of Martins Fork, Laurel, Cumberland, Dale Hollow, and Barkley lakes (Pennington & Associates, Inc. 2000). TVA also collects routine biological data at several sites on tributaries to Kentucky Lake (Tennessee River) in Kentucky. Ten streams were sampled for fish in 1999-2000 (Tennessee Valley Authority 2001), and data collected in 1996 and assessed for the 1998 305(b) report were carried over for several other streams.

The DOW conducted a random survey of wadeable streams using locations generated by the EPA Office of Research and Development in Corvallis, Oregon. The "probabilistic" monitoring design is employed to statistically assess aquatic life use support on the majority of Kentucky's waters. This effort is designed for a basin unit, with criteria provided to make a random, statistically valid selection of potential target streams to collect samples that will reflect the basin as a whole. Kentucky commonly defines the potential target stream population as wadeable (first through fifth-order) streams.

Network design and sampling procedures developed by EPA's Environmental Monitoring and Assessment Program (EMAP) were used in Kentucky's random survey. Sampling locations are selected from EPA's River Reach File 3 (essentially blue lines on a 1:100,000 USGS scale), which provides the framework. In the design process, the number of sample sites needed to satisfy the confidence limit of the 95th percentile are determined so statistically valid extrapolation of the data can be made for the whole basin when assigning the miles of use attainment.

Once each segment is analyzed for use designation, calculations are made based on similar streams in the basin. For example, the results (full support, partial support and non-support) of first-order streams in the probabilistic assessment are extrapolated to total number of miles of first-order streams in the basin management unit, then second-order streams, etc. Nothing can be said about streams greater than fifth order in each basin, except for those stream reaches assessed by targeted sampling. Reaches typically extend from one significant tributary to another; occasionally, land use or a point source discharge will be the reach terminus.

The probabilistic network consisted of 70 stations in the Salt/Licking unit and 55 stations in the Cumberland unit (Figures 3-7 through 3-10). Macroinvertebrates were collected once at each station from late spring to early fall. Habitat also was characterized at each site. EPA provided sampling locations as latitude/longitude coordinates. According to EMAP protocols, sampling was conducted in a reach around the coordinates equal to 40 times the width of the stream channel. Sampling methods followed those of the DOW biological programs (Kentucky Division of Water 2002b). However, because available habitat was not necessarily similar to that sampled by usual sampling protocols that rely on sampling all habitat types (riffle, pool, run), best professional judgment was used to interpret results from sampling reaches dominated by pool habitat at a few sites.

In 1991, the DOW began a Reference Reach (RR) program to gather data from the state's least impacted streams. Biologists first identify potential least impacted waters representative of geographic regions of the state known as ecoregions. Then, data on chemical water quality, sediment quality, fish tissue residue, habitat condition, and biotic conditions are collected to (1) define the potential environmental quality for the streams of a particular ecoregion; and (2) allow other streams in the same ecoregion to be compared to the reference condition. Data from the reference reach program will provide the basis for the development of narrative and numerical biocriteria for the various ecoregions of the Commonwealth. Fifty-five stream sites from seven proposed ecoregions were initially sampled in the spring and fall of 1992-1993. Since that time, many more potential reference reach streams have been sampled. Some were adopted as reference reach streams; others were rejected because they did not possess adequate quality to represent a least impacted condition. Currently, there are 52 RR streams totaling 490 miles throughout the Commonwealth (Table 3-3). Another 80 streams totaling 399 miles will be considered for inclusion during the upcoming triennial review of water quality standards. There are 20 existing and 44 proposed RR streams in the river basins covered in this report.

River Basin	Current RR Streams	Proposed RR Streams
Licking	3	4
Salt	3	6
Upper Cumberland	8	24
Lower Cumberland	2	3
Tennessee	3	1
Mississippi	0	3
Ohio River minor tributaries	1	3

Figure 3-7. Probabilistic Monitoring Sites in the Licking River Basin

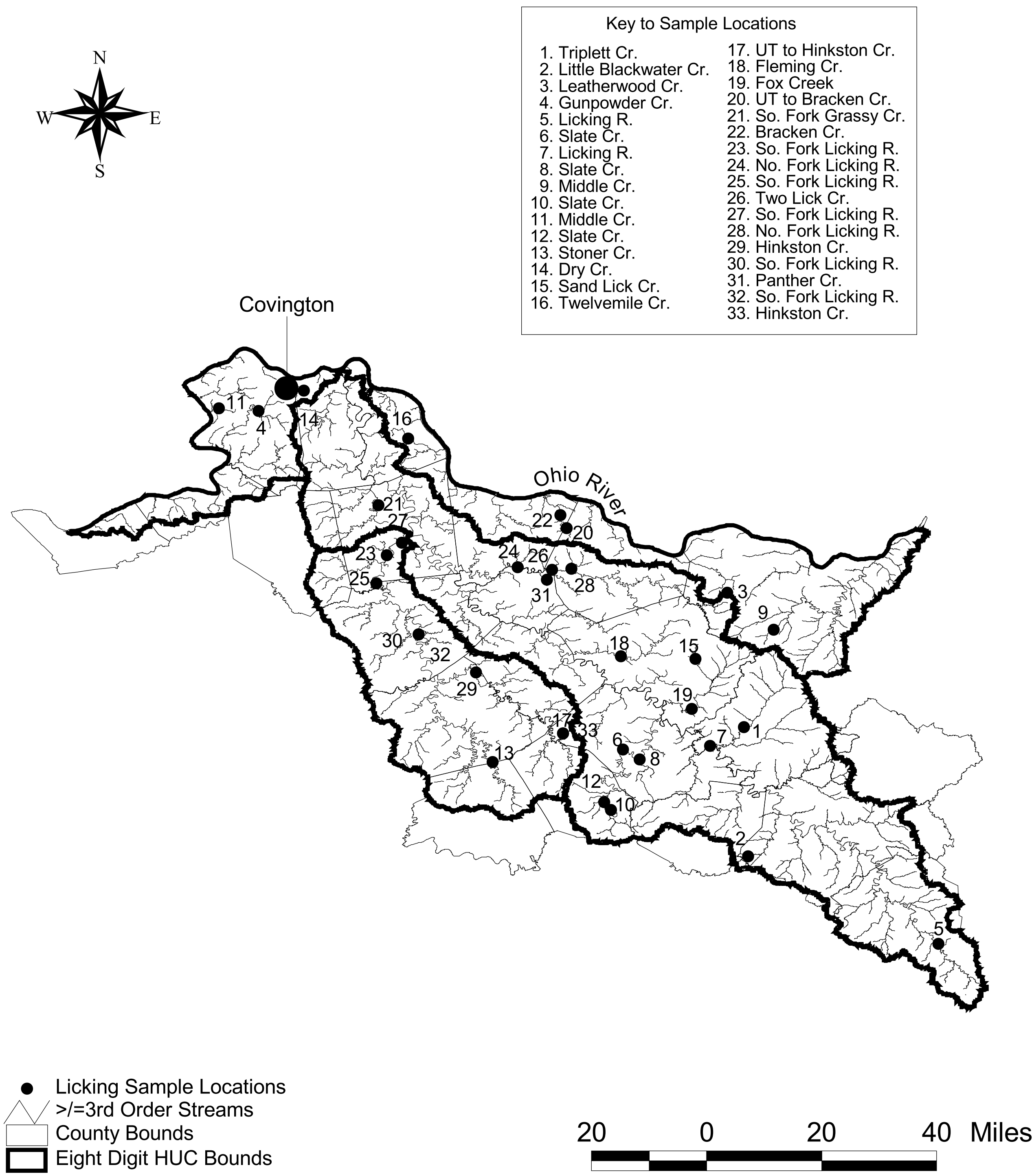


Figure 3-8. Probabilistic Monitoring Sites in the Salt River Basin

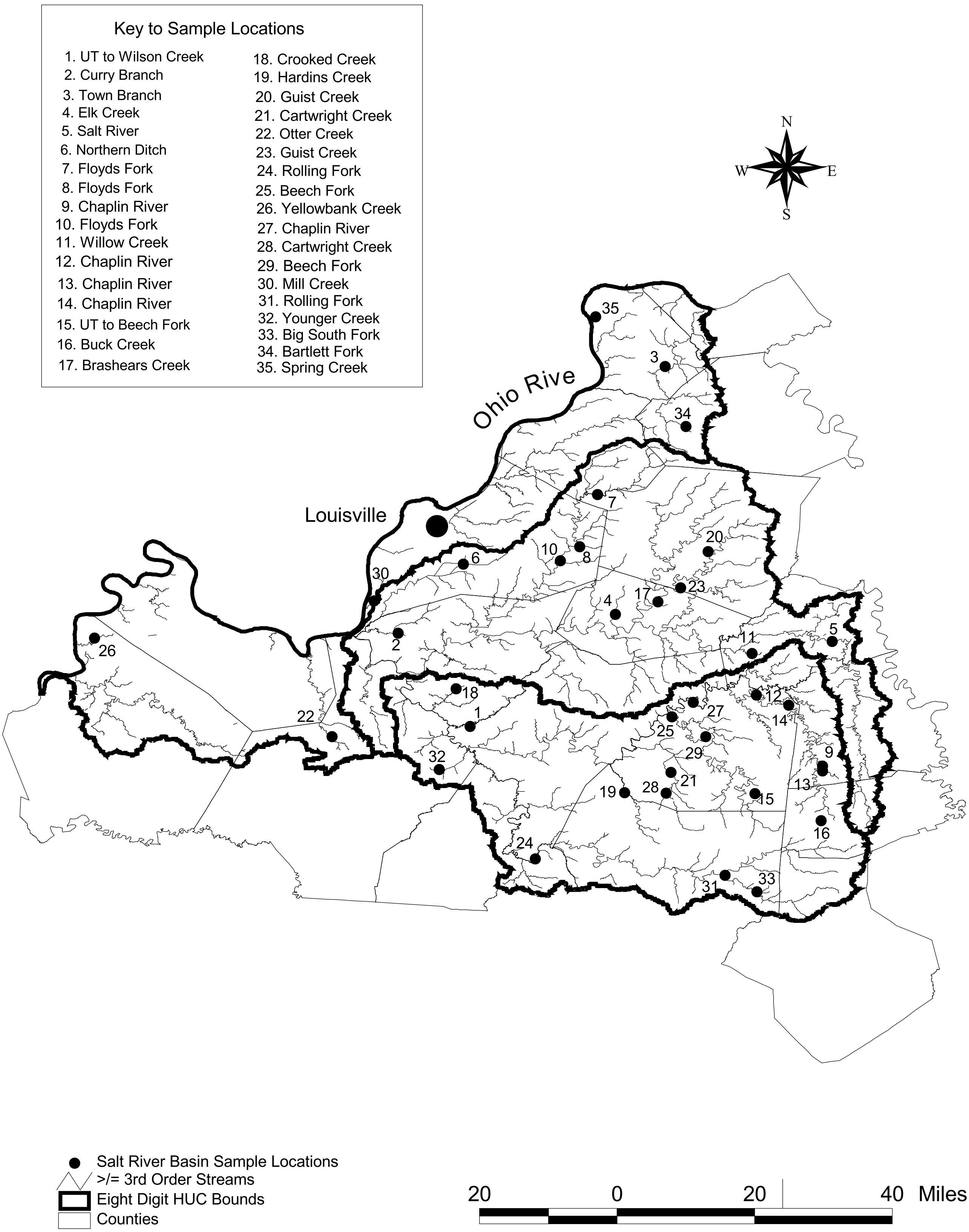


Figure 3-9. Probabilistic Monitoring Sites in the Upper Cumberland River Basin

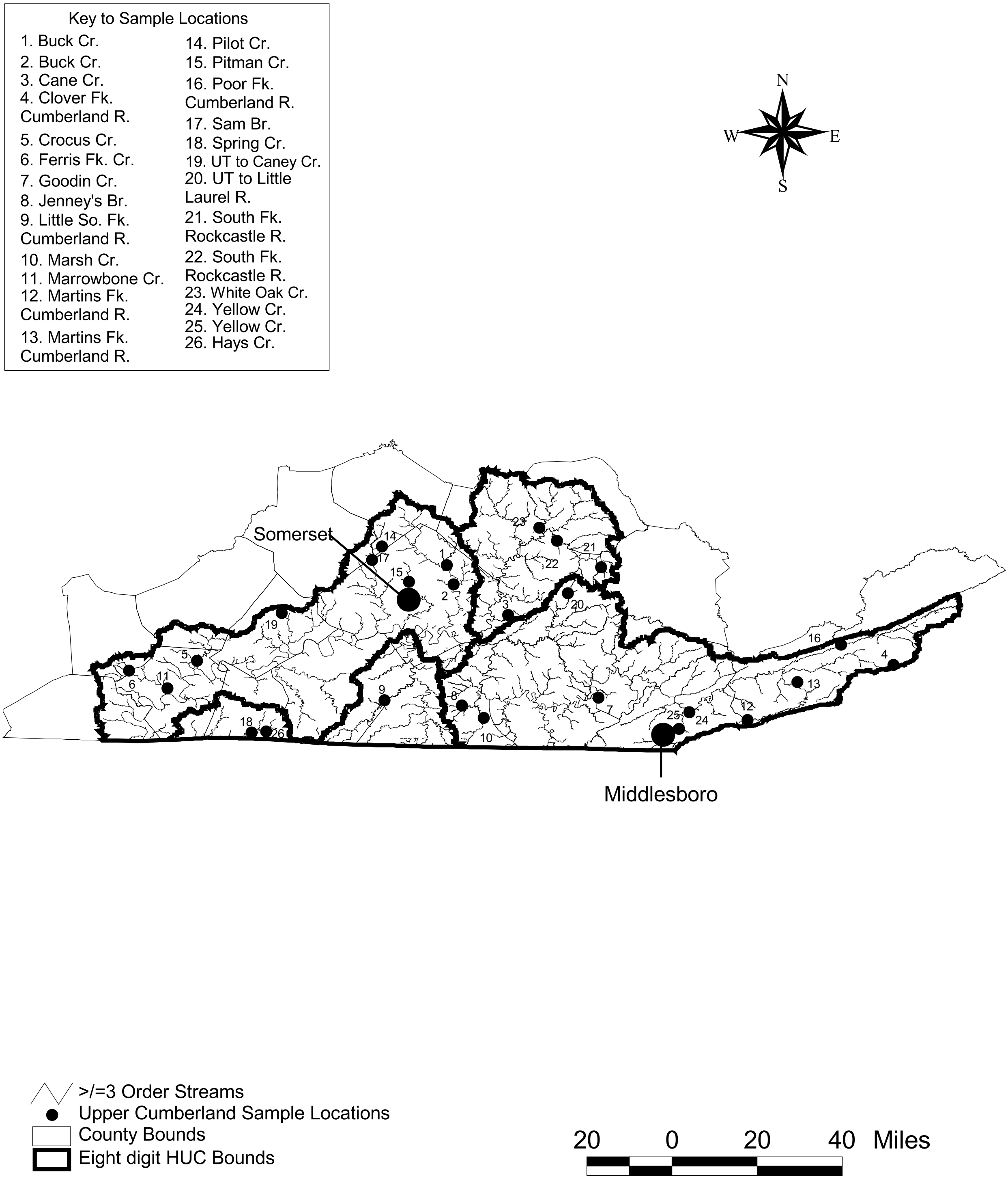


Figure 3-10. Probabilistic Monitoring Sites in the Lower Cumberland, Mississippi, Ohio and Tennessee Rivers Basins

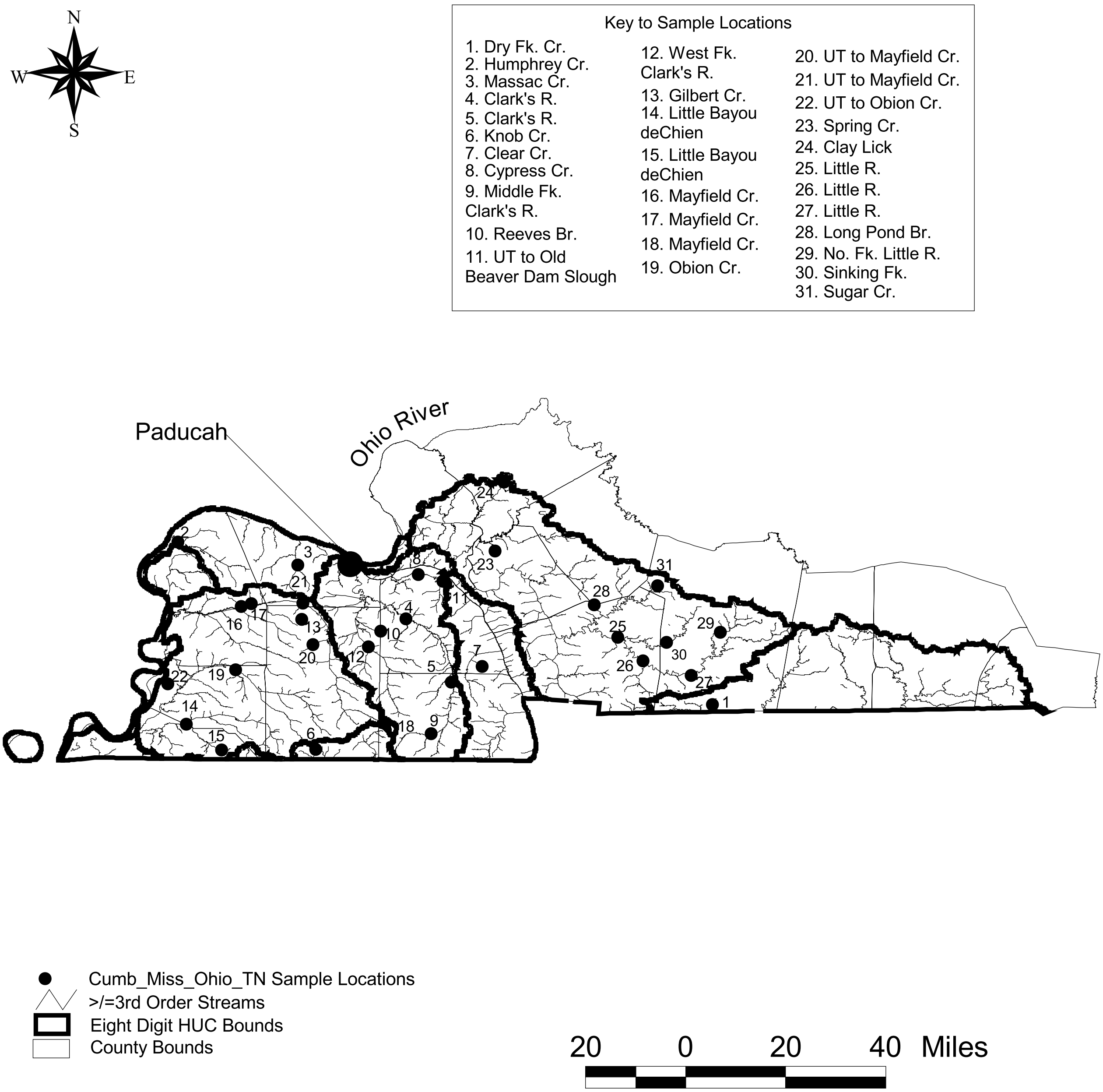


Table 3-3. Reference Reach Streams[a]

Stream	County	Location	Basin	Start Segment	End Segment	Total Miles
Cane Creek	**Whitley**	**0.1 mi below Daylight Branch**	**Upper Cumberland**	**11.5**	**7**	**4.5**
Bark Camp Creek	**Whitley**	**U.S. Forest Service Rd 193 bridge**	**Upper Cumberland**	**7.6**	**2.6**	**5**
Eagle Creek	**McCreary**	**KY 896 bridge**	**Upper Cumberland**	**6.3**	**3**	**3.3**
South Fork Dog Slaughter Creek	**Whitley**	**1000 ft above foot bridge (Dog Slaughter Falls Trail)**	**Upper Cumberland**	**4.6**	**0**	**4.6**
Buck Creek	**Pulaski**	**Off Bud Rainey Rd**	**Upper Cumberland**	**62.6**	**28.9**	**33.7**
Marsh Creek	**McCreary**	**KY 478 bridge**	**Upper Cumberland**	**26.2**	**12.6**	**13.6**
Horse Lick Creek	**Jackson**	**Horse Lick Creek Rd at first ford**	**Upper Cumberland**	**21.2**	**1.9**	**19.3**
Bad Branch	**Letcher**	**0.2 mi above KY 932 bridge**	**Upper Cumberland**	**3**	**0**	**3**
Beaverdam Creek	Edmonson	KY 101-259 bridge	Green	14	7.6	6.4
Gasper River	Logan	0.2 mi above Bucksville Rd bridge	Green	38	32.3	5.7
Trammel Fork	Allen	0.1 mi below Red Hill Rd bridge	Green	30.15	19.4	10.75
Lick Creek	Simpson	0.1 mi above HWY 585 (265) bridge	Green	9.9	5.3	4.6
Peter Creek	Barren	HWY 3179; Oil Well Rd	Green	18.05	13.05	5
Caney Fork	Barren	0.1 mi below Hwy 3179 (Oil Well Rd)	Green	6.6	0.8	5.8
Falling Timber Creek	Metcalfe	Hwy 640 bridge crossing	Green	16	11.5	4.5
Russell Creek	Adair	0.15 mi below KY Hwy 80 at Gentry's Mill	Green	68	23.8	44.2
Goose Creek	Casey	Off Brock Rd	Green	14.6	5.6	9
Drennon Creek	Henry	Flat Bottom Rd crossing	Kentucky	11.9	10.5	1.4
Indian Creek	Carroll	Hwy 36 bridge	Kentucky	4.7	0.55	4.15
Musselman Creek	Grant	Lawrenceville – Keefer Rd bridge	Kentucky	8.4	2.6	5.8
Clear Creek	Woodford	Hifner Rd bridge, 2.1 mi S of Mortonsville	Kentucky	19	4.1	14.9
Station Camp Creek	Estill	Off KY Hwy 1209 at Estill-Jackson County boundary	Kentucky	22.3	19	3.3
South Fork Station Camp Creek	Jackson	KY 89 bridge	Kentucky	48.6	5.3	43.3
Sturgeon Creek	Lee	Off Sturgeon Creek Rd	Kentucky	31.1	4	27.3
Gladie Creek	Menifee	0.2 mi upstream of bridge	Kentucky	8.4	0	8.4
East Fork Indian Creek	Menifee	1 mi upstream of West Fork Indian Cr	Kentucky	8.5	0	8.5
Wolfpen Branch	Menifee	at KY 715 bridge	Kentucky	3.3	0	3.3
Right Fork Buffalo Creek	Owsley	Off Whoopflarea Rd	Kentucky	11.2	0	11.2
Buffalo Creek	Owsley	Side road along mainsteam	Kentucky	12.8	0.8	12
Clemons Fork	Breathitt	Robinson Forest Rd	Kentucky	4.7	0	4.7
Coles Fork	Breathitt	in Robinson Forest	Kentucky	5.5	0	5.5
Sugar Creek	Leslie	Sugar Creek Rd	Kentucky	4.4	0.8	3.6

Table 3-3 (Cont)

Stream	County	Location	Basin	Start Segment	End Segment	Total Miles
Elisha Creek	Leslie	Elisha Creek Rd	Kentucky	3.3	0.95	2.35
Line Fork Creek	Letcher	off KY 160	Kentucky	27.5	17.3	10.2
North Fork Licking River	**Morgan**	**0.1 mi below Bucket Branch**	**Licking**	**21.3**	**13**	**8.3**
Bucket Branch	**Morgan**	**Leisure – Paragon Rd bridge**	**Licking**	**1.9**	**0**	**1.9**
Devils Fork	**Morgan**	**KY 711 bridge**	**Licking**	**7.8**	**0**	**7.8**
Big Sinking Creek	Carter	KY 986 bridge	Little Sandy	15.2	10.7	4.5
Arabs Fork	Elliott	KY 1620 bridge	Little Sandy	4.7	0	4.7
Big Caney Creek	Elliott	off KY 32, Binion Ford Rd	Little Sandy	15	2.2	12.8
Laurel Creek	Elliott	Carter School Rd bridge	Little Sandy	14.4	7.6	6.8
Yellowbank Creek	**Breckinridge**	**Cart-Manning Crossing Rd Wildlife Management Area**	**Ohio**	**11.9**	**4.4**	**7.5**
Soldier Creek	**Marshall**	**HWY 58 bridge**	**Tennessee**	**5.3**	**2.6**	**2.7**
Blood River	**Calloway**	**Grubbs Lane bridge; O.75 mi E of State Line Rd**	**Tennessee**	**15.65**	**15.1**	**0.55**
Panther Creek	**Calloway**	**KY 280 bridge**	**Tennessee**	**5.1**	**1.2**	**3.9**
Tradewater River	Christian	J. T. Sparkman Rd; 0.7 mi from Mt. Zoar Rd	Tradewater	132.3	126	6.3
Sandlick Creek	Christian	Mt. Carmel-Camp Cr. Rd; 0.75 mi W of KY Hwy 109	Tradewater	9	3.5	5.5
Wilson Creek	**Bullitt**	**Mt. Carmel Church Rd, first crossing**	**Salt**	**17**	**12.2**	**4.8**
Salt Lick Creek	**Marion**	**Off Salt Lick Rd**	**Salt**	**8.4**	**5.3**	**3.1**
Otter Creek	**Larue**	**0.1 mi below West Fork, Herbert-Howell Rd**	**Salt**	**2.7**	**1.75**	**0.95**
West Fork Red River	**Christian**	**Carter Rd bridge**	**Lower Cumberland**	**26.5**	**16.3**	**10.2**
Whippoorwill Creek	**Logan**	**KY Hwy 2375 bridge**	**Lower Cumberland**	**44.6**	**0**	**44.6**

[a]Streams in bold are within the Salt/Licking and Cumberland/Tennessee/Mississippi basin management units

In 1999-2000, the reference reach program sampled 20 streams in the Salt/Licking unit, 41 streams in the upper Cumberland unit, and 26 in the lower unit.

Federally Threatened and Endangered Species. Waters were reviewed to determine if federally threatened or endangered species populations have been extirpated or have significantly declined since November 1975. The latter date is important because a use is defined as an "existing use" in Kentucky water quality standards regulations if the use existed on that date, even if it has been lost or the current designated use is different.

3.1.3 Other Data Sources

Discharge Monitoring Reports. Discharge monitoring report (DMR) data, collected by Kentucky Pollutant Discharge Elimination System (KPDES) permit holders, were accessed through DOW's permit compliance system database. Depending on the relative sizes of the wastewater discharge and the receiving stream and the severity of the permit violations, it sometimes was possible to assess instream uses as threatened or impaired. Because instream data were usually not collected, stream assessments based only on DMR data are considered evaluated, not monitored.

Coal Mining Operations. Coal mining permits require instream monitoring when the mining activity has the potential to affect an Outstanding State Resource Water containing a federally listed threatened or endangered species. Biological and water quality monitoring extends from the pre-mining phase through bond release. These data are used to assess aquatic life use.

Effects of Effluent Toxicity on Aquatic Communities. Several streams were sampled in 1995 to test the hypothesis that failure of point source discharges to meet whole effluent toxicity permit limits results in instream biological impacts. Biological assemblages were sampled both up- and downstream of the point source discharges to determine differences in community metrics and use support.

3.2 Assessment Methodology

Overall use support was determined by following EPA (1997) guidelines that define fully supporting as fully supporting all uses for which data are available. If a segment supported one use but did not support another, it is listed as not supporting. For instance, if a segment supported Warm Water Aquatic Habitat (WAH) but not Primary Contact Recreation (PCR), it is listed as not supporting (or impaired). A segment is listed as partially supporting if any assessed use fell into that category even if another use was fully supported. Many waterbodies were assessed for only one use because data were not available to assess other uses.

3.2.1 Aquatic Life and Primary Contact Recreation Use Support

The water quality and biological data described in the preceding pages were used to assess use support in rivers and streams. Data were categorized as "monitored" or "evaluated." Monitored data were derived from site-specific surveys and were generally no more than five years old. In some instances where conditions were believed to have remained mostly unchanged, monitored data collected prior to 1995 were still considered valid, and waters described by these data were categorized as monitored. Also, data from the random survey network were used. More than 11,000 wadeable stream miles represented by this sampling in 1999-2000 are considered monitored waters. Like the targeted stations, each random survey station also was used to assess a limited reach of stream around the sample point. There are few evaluated waters remaining in the assessment database. All efforts in the watershed initiative are to gather defensible, monitored data. However, there were some monitoring data more than five years old, strong anecdotal information, and extrapolation of discharge data that resulted in evaluated assessments.

The total number of assessed stream miles was determined by adding the miles represented by the random survey and the miles assessed by the targeted monitoring in streams greater than fifth order that were not covered by the random survey approach. In other words, miles assessed by targeted monitoring in wadeable (first to fifth-order) streams are included in miles assessed by the random survey. However, results are given separately for targeted, random, and total miles.

Biological data were generally the determinant factor for establishing aquatic life use support in waters with both biological and water quality data. This was especially true when comparisons of total recoverable metals data to chronic water quality criteria disagreed with biological assessments. The DOW made this decision in recognition of the natural ability of surface waters to sequester metals, rendering them less available to aquatic life by reducing the more toxic "dissolved" fraction.

Water Quality Data. Chemical data collected by the DOW, MSD, and others were assessed according to EPA guidance (U.S. EPA 1997). Water quality data were compared to criteria contained in Kentucky Water Quality Standards Regulations (401 KAR 5:031). The segment fully supported WAH use when criteria for dissolved oxygen, un-ionized ammonia, temperature, and pH were not met in 10 percent or less of the samples collected (October 1997 through March 2001 for the ambient stations and 12 months for the rotating watershed stations). Partial support was indicated if any one criterion for these parameters was not met in 11-25 percent of the samples. A segment was not supporting if any one of these criteria was not met more than 25 percent of the time.

Data for mercury, cadmium, copper, iron, lead, and zinc were analyzed for violations of acute criteria listed in state water quality standards regulations using at least three years of data during the period October 1997 to September 2001. The segment fully supported WAH use if all criteria were met at stations with quarterly or less frequent sampling or if only one violation occurred at stations with monthly sampling. Partial support was indicated if any one criterion was not met more than once but in less than 10 percent of the samples. The segment was not supporting if criteria were exceeded in greater than 10 percent of the samples. The assessment criteria are closely linked to the way state and federal water quality criteria were developed. Aquatic life are considered to be protected if, on the average, the acute criteria are not exceeded more than once every three years.

Fecal coliform and pH data were used to indicate the degree of support for PCR (swimming) use. The use was fully supported if the fecal coliform bacteria criterion of 400 colonies per milliliter was not met in less than 20 percent of the samples, partially supported if the criterion was not met in 25-33 percent of the samples, and not supported if the criterion was not met in 33 percent or more of the samples. Streams with pH less than 6.0 or greater than 9.0 units in more than 10 percent of the samples were considered to not support swimming use.

Biological Data. Several community structure function metrics were analyzed for each assemblage (algae, macroinvertebrates, and fish) as described earlier in this chapter. As outlined in Table 3-4, the metric scores were used to determine biotic integrity and aquatic life use support for each stream reach monitored. Expectations for metric values are dependent on stream size, ecoregion, and habitat quality. Bioassessments integrate data from the biological community, habitat, physical environment, water quality, and professional judgment of aquatic biologists.

Biological data sometimes were judged to be indeterminate. This occurred on several occasions in the Salt/Licking unit in 1999 when only one assemblage (usually fish, the assemblage probably most affected by the drought) was sampled during the extreme drought conditions of that year. On other occasions the data were considered inadequate or the results borderline, and it was felt that re-sampling would be more appropriate than making a use support decision with existing data. Stations with inconclusive data are labeled “Maybe” or “Re-sample” in Appendices 3-1 and 3-2. These streams will be sampled again in the next watershed cycle.

Table 3-4. Biological Criteria for Assessment of Warm Water Aquatic Habitat Use Support[a]

Assemblage	Fully Supporting	Partially Supporting	Not Supporting
Algae	Diatom Bioassessment Index (DBI) Classification of excellent or good, biomass similar to reference/control or STORET mean.	DBI classification of fair, increased biomass (if nutrient enriched) of filamentous green algae.	DBI classification of poor, biomass very low (toxicity), or high (organic enrichment).
Macroinvertebrate	Macroinvertebrate Bioassessment Index (MBI) excellent or good, high EPT, sensitive species present.	MBI classification of fair, EPT lower than expected in relation to available habitat, reduction in RA of sensitive taxa. Some alterations of functional groups evident.	MBI classification of poor, EPT low, TNI of tolerant taxa very high. Most functional groups missing from community.
Fish	Index of Biotic Integrity (IBI) excellent or good, presence of rare, endangered or species of special concern.	IBI fair.	IBI poor, very poor, or no fish.

[a] Acronyms used in this table are: EPT = Ephemeroptera, Plecoptera, Trichoptera; RA = Relative Abundance; TNI = Total Number of Individuals

Federally Threatened and Endangered Species. Waters with federally threatened or endangered species in November 1975 have an existing “use” of Outstanding State Resource Water, and the loss or significant decline of one of these populations constitutes a use impairment.

3.2.2 Fish Consumption Use Support

Fish consumption is a category that, in conjunction with aquatic life use, assesses attainment of the fishable goal of the Clean Water Act. Assessment of the fishable goal was separated into these two categories in 1992 because a fish consumption advisory does not preclude attainment of the aquatic life use and vice versa. Separating fish consumption and aquatic life use support gives a clearer picture of actual water quality conditions.

Kentucky revised its methodology for issuing fish consumption advisories in 1998 to a risk-based approach patterned after the Great Lakes Initiative. The risk-based approach generally is more conservative than the Food and Drug Administration (FDA) action levels that were used previously. For example, the FDA action level for mercury is 1.0 ppm but the risk-based number for issuing an advisory is as low as 0.12 ppm.

As a result of this change in methodology, a statewide advisory was issued in April 2000 for children under six and women of childbearing age to not consume more than one meal a week of any fish from Kentucky waters because of mercury. However, EPA (2001a) issued a draft mercury water quality criterion expressed as a methylmercury concentration in fish tissue of 0.3 ppm. Therefore, for purposes of 305(b) reporting, waters were not considered impaired unless fish exhibited mercury tissue concentrations of at least 0.3 ppm. In other words, the fish tissue concentration triggering the statewide advisory (0.12 ppm) was considered more stringent than water quality standards, and according to the Consolidated Assessment and Listing Methodology draft guidance (EPA 2001b) states are advised to list these waters as threatened, not impaired.

Other than the statewide advisory for mercury explained above, the following criteria were used to assess support for the fish consumption use:

- Fully supporting - no fish advisories or bans in effect
- Partially supporting - “restricted consumption” fish advisory or ban in effect for general population or a subpopulation that potentially could be at a greater cancer risk (e.g. pregnant women, children). Restricted consumption is defined as limits on the number of meals consumed per unit time for one or more fish species
- Not supporting – “no consumption” fish advisory or ban in effect for general population or a subpopulation that potentially could be at greater risk, for one or more fish species, or a commercial fishing ban in effect

3.2.3 Drinking Water Use Support

Drinking water use support was determined in several ways. First, compliance with maximum contaminant levels (MCLs) in finished water was determined by the annual average of quarterly samples. Drinking water use assessments in reservoirs were supplemented by surveys of drinking water operators on any taste and odor problems and use of biocides. The routine application of a biocide or use of carbon filtration were reasons for assessing a water as not fully supporting the domestic water supply use. Instream water quality data generally were not available to assess drinking water use.

3.2.4 Causes and Sources

Causes and sources are categorized by codes given in national guidance. Causes for primary contact recreation, fish consumption, and water supply usually were easily identified. However, most waters not supporting aquatic life use were identified by biological monitoring, and causes were determined by the observations and judgment of the field biologists. All causes may not be evident in the field, and there may be other causes contributing to use impairment that are not listed. Sources of all types of use impairments are even more difficult to determine and should be considered as "probable" sources at the 305(b) stage. Sources are more fully identified once the impaired waters are 303(d)-listed, TMDL sampling is conducted, and a more comprehensive look is taken at activities and land uses within the watershed.

3.3 Use Support

3.3.1 Statewide

Targeted Monitoring. Statewide summary results from targeted monitoring (Table 3-5) now include three years of intensive watershed monitoring in the Kentucky, Salt/Licking, and Cumberland basin management units and mostly pre-1998 assessments from the Green/Tradewater and Big Sandy basin management units. Watershed monitoring for the latter two units will be reported in 2004. Full support of all uses was attained in 5,356 miles (55.8 percent), partial use impairment was found in 2,092 miles (21.8 percent), and uses were not supported in 2,149 miles (22.4 percent). As found in previous years, the highest percentage of use impairment was found for the primary contact recreation use (61.1 percent partial and non-

Table 3-5. Use Support Summary of Rivers and Streams (miles), Targeted Monitoring

	Assessed	Fully Supporting	Fully Supporting But Threatened	Partially Supporting	Not Supporting
Overall	9597.1	5167.6	188.4	2092.2	2148.9
Aquatic Life	8754.5	5989.5	244.3	1530.1	990.6
Fish Consumption	2369.9	1468.0	0.0	763.2	138.7
Primary Contact Recreation	2849.1	1036.2	71.6	479.7	1261.6
Domestic Water Supply	1610.1	1501.3	108.8	0.0	0.0

support). Aquatic life use was fully supported in 6,234 miles (71.2 percent) and partially or non-supporting in 2,521 miles (28.8 percent).

Fish consumption use was fully supported in 62 percent of the miles assessed. Besides the statewide fish consumption advisory for mercury, long-standing fish consumption advisories remain in effect in several rivers and streams throughout the state. PCBs in fish tissue affected 71.5 miles of Town Branch and Mud River in Logan, Butler, and Muhlenberg counties, 46.9 miles of West Fork Drakes Creek in Simpson and Warren counties, and 6.5 miles of Little Bayou Creek in McCracken County. Fish consumption advisories on the Ohio River are discussed in Section 3.3.3.

The leading causes of impairment were pathogens, siltation, priority organics (including PCBs), habitat alteration, nutrients, and organic enrichment (Table 3-6). Probable sources were most often identified as agriculture, waste disposal, urban runoff, and mining (Table 3-7).

Individual use support by major river basin is shown in Table 3-8. The percentages of miles fully supporting aquatic life and swimming uses for each basin are depicted in Figure 3-11. This analysis shows that the far western (Lower Cumberland, Tennessee, Mississippi river basins) and eastern (Big Sandy Basin) regions of the state have the lowest percentage of aquatic life use support. Primary contact recreation use support ranged between 54 and 65 percent in the Kentucky, Licking, and Salt river basins but was usually much lower in other basins. Preliminary indications are that the last two basin management units to be assessed using intensive watershed monitoring data (Green/Tradewater and Big Sandy/Little Sandy/Tygarts) will have a higher percentage of impaired waters than indicated by the pre-watershed monitoring data used for Table 3-8 and Figure 3-11.

.

Table 3-6. Causes of Impairment of Rivers and Streams

Cause/Stressor Category	Miles Impacted
Pathogens	1560.2
Siltation	1361.9
PCBs	781.0
Other habitat alterations	586.5
Organic enrichment/low DO	454.3
Nutrients	412.7
Metals	367.6
Cause Unknown	294.5
Flow alteration	235.1
Dioxin	194.4
pH	192.1
Salinity/TDS/Chlorides	123.8
Turbidity	115.8
Suspended solids	58.0
Unionized Ammonia	34.2
Algal/Growth/Chlorophyll *a*	24.5
Unknown toxicity	19.4
Priority organics	18.0
Nonpriority organics	14.6
Radiation	13.0
Chlorine	12.2
Oil and grease	9.6
Exotic species	8.4
Thermal modifications	6.5
Pesticides	5.3
Noxious aquatic plants	3.9

Table 3-7. Probable Sources of Impairment of Rivers and Streams

Source Category	Miles Impacted
Source Unknown	1500.4
Agriculture	1286.5
Crop-related sources	319.6
Grazing-related sources	434.5
Intensive animal feeding operations	81.8
Resource Extraction	773.0
Surface Mining	183.7
Acid Mine Drainage	91.1
Abandoned Mining	83.3
Inactive Mining	79.6
Subsurface Mining	79.3
Petroleum Activities	35.8
Dredge Mining	18.4
Land Disposal	427.9
Onsite Wastewater System (Septic Tanks)	290.8
Inappropriate Waste Disposal/Wildcat Dumping	12.9
Septage Disposal	1.5
Habitat Modification (other than Hydromodification)	461.2
Removal of Riparian Vegetation	266.9
Bank or Shoreline Modification	135.8
Drainage/Filling of Wetlands	1.8
Municipal Point Sources	420.9
Package Plants (Small Flows)	98.7
Minor Municipal Point Sources	40.2
Major Municipal Point Sources	95.1
Urban Runoff/Storm Sewers	348.4
Erosion and Sedimentation	28.6
Highway/Road/Bridge/Runoff	18.8
Industrial Permitted	5.2
Non-Industrial permitted	4.3
Other Urban Runoff	3.1
Hydromodification	262.4
Channelization	156.3
Dredging	37.7
Upstream Impoundment	26.5
Flow Regulation/Modification	17.7
Dam Construction	3.2
Industrial Point Sources	189.3

Table 3-7 (Cont.) Probable Sources of Impairment of Rivers and Streams

Source Category	Miles Impacted
Construction	171.8
Land Development	86.2
Highway/Road/Bridge Construction	30.3
Silviculture	153.8
Harvesting, Restoration, Residue Mgmt	111.7
Logging Road Construction/Maintenance	10.5
Silvicultural Point Sources	3.5
Recreation and Tourism (other than boating)	8.1
Golf Courses	3.7
Collection System Failure	39.2
Natural Sources	49.8
Combined Sewer Overflow	17.3
Spills	3.6
Sources outside State Jurisdiction or Borders	3.6
Highway Maintenance and Runoff	1.9

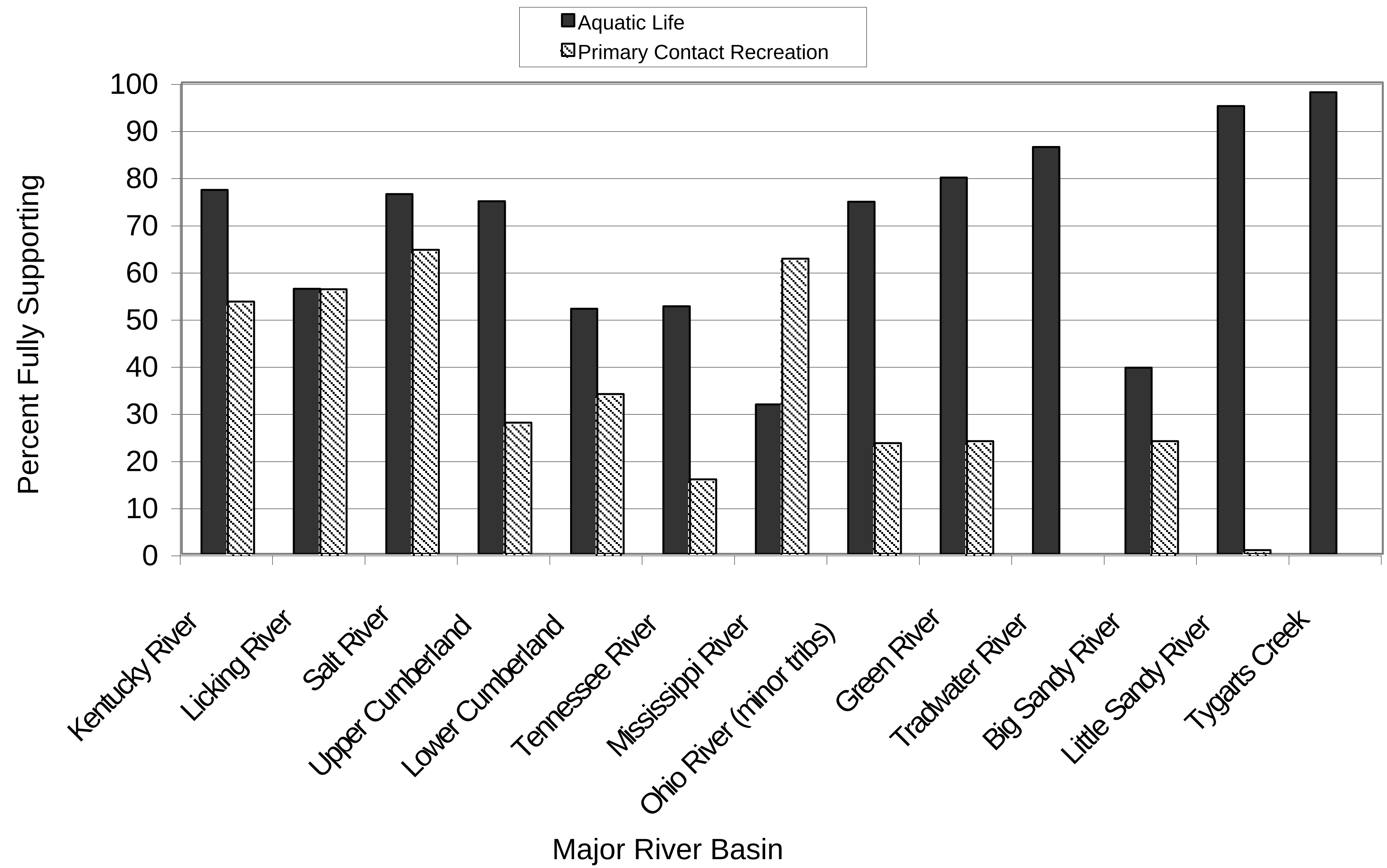
Table 3-8. Individual Use Support by Major River Basin (miles)

Basin	Total Assessed	Supporting	Threatened	Partially Supporting	Not Supporting
Kentucky River					
Aquatic Life	1805.4	1277.6	46.9	371.7	109.2
Fish Consumption	455.2	384.7	0.0	70.5	0.0
Swimming	609.2	317.5	1.0	81.6	209.1
Drinking Water	43.4	43.4	0.0	0.0	0.0
Licking River					
Aquatic Life	562.1	288.7	26.8	139.8	106.8
Fish Consumption	130.7	130.7	0.0	0.0	0.0
Swimming	512.0	289.6	0.0	39.0	183.4
Drinking Water	197.4	197.4	0.0	0.0	0.0
Salt River					
Aquatic Life	576.6	401.8	39.6	74.9	60.3
Fish Consumption	90.2	78.7	0.0	10.5	1.0
Swimming	194.3	122.9	2.5	1.6	67.3
Drinking Water	21.1	21.1	0.0	0.0	0.0
Upper Cumberland River					
Aquatic Life	1275.8	904.4	57.3	156.9	157.2
Fish Consumption	123.5	90.7	0.0	32.8	0.0
Swimming	239.2	86.8	0.0	14.2	138.2
Drinking Water	152.6	150.4	0.0	0.0	0.0
Lower Cumberland River					
Aquatic Life	308.5	159.8	0.0	83.6	65.1
Fish Consumption	18.2	8.7	0.0	9.5	0.0
Swimming	137.0	46.4	0.0	27.4	63.2
Drinking Water	38.1	38.1	0.0	0.0	0.0
Tennessee River					
Aquatic Life	336.9	165.6	3.6	126.6	41.1
Fish Consumption	17.5	11.5	0.0	6.0	0.0
Swimming	121.5	17.8	0.0	38.8	64.9
Drinking Water	5.1	5.1	0.0	0.0	0.0
Mississippi River					
Aquatic Life	249.8	79.4	0.0	100.6	69.8
Fish Consumption	17.2	17.2	0.0	0.0	0.0
Swimming	40.7	25.5	0.0	11.8	3.4
Drinking Water	0.0	0.0	0.0	0.0	0.0
Ohio River (minor tribs)					
Aquatic Life	583.0	420.7	14.6	61.3	86.4
Fish Consumption	43.0	36.5	0.0	0.0	6.5
Swimming	143.9	28.7	1.6	34.1	79.5
Drinking Water	0.0	0.0	0.0	0.0	0.0

Table 3-8. (Cont.)

Basin	Total Assessed	Supporting	Threatened	Partially Supporting	Not Supporting
Green River					
Aquatic Life	1392.6	1101.1	1.1	117.5	163.9
Fish Consumption	629.4	498.2	0.0	0.0	131.2
Swimming	358.2	85.6	0.0	39.4	233.2
Drinking Water	387.2	387.2	0.0	0.0	0.0
Tradewater River					
Aquatic Life	22.6	19.5	0.0	0.0	3.1
Fish Consumption	0.0	0.0	0.0	0.0	0.0
Swimming	3.1	0.0	0.0	0.0	3.1
Drinking Water	0.0	0.0	0.0	0.0	0.0
Big Sandy River					
Aquatic Life	666.1	208.8	54.4	288.9	114.0
Fish Consumption	108.7	108.7	0.0	0.0	0.0
Swimming	290.6	3.1	66.3	79.9	141.3
Drinking Water	107.8	89.8	18.0	0.0	0.0
Little Sandy River					
Aquatic Life	236.2	224.3	0.0	0.0	11.9
Fish Consumption	19.0	19.0	0.0	0.0	0.0
Swimming	26.2	0.0	0.2	26.0	0.0
Drinking Water	19.9	19.9	0.0	0.0	0.0
Tygarts Creek					
Aquatic Life	91.6	89.7	0.0	0.0	1.9
Fish Consumption	89.7	89.7	0.0	0.0	0.0
Swimming	46.5	0.0	0.0	45.7	0.8
Drinking Water	11.7	11.7	0.0	0.0	0.0

Figure 3-11. Aquatic Life and Primary Contact Recreation Use Support by Major River Basin



3.3.2 Salt/Licking and Cumberland Basin Management Units

Monitoring information is contained in Appendices 3-1 and 3-2. In the Licking River Basin, both swimming and aquatic life uses were fully supported in about 56 percent of the miles assessed for those uses (Table 3-8). Primary causes and sources of impairment are listed in Table 3-9. Use support was better in the Salt River Basin, with 77 percent fully supporting aquatic life use and 65 percent fully supporting swimming use. A high percentage of use support for aquatic life was found in the Upper Cumberland River Basin (75 percent) but support of swimming use was poor (36 percent) (Table 3-8). This is largely a result of poorly treated or untreated sanitary wastewater (Table 3-9). Use support of individual rivers and streams is depicted on Figure 3-14.

Aquatic life use support was not as good in the lower basin, with just over 50 percent of the miles having full support in the lower Cumberland and Tennessee and 32 percent in the Mississippi. Support of swimming use also was poor in this region (34 percent in the lower Cumberland and 15 percent in the Tennessee). Leading causes and sources of impairment are listed in Table 3-9. Use support of individual rivers and steams is depicted on Figure 3-15.

The probabilistic monitoring program assessed 5,628 miles for aquatic life use support in the Salt/Licking unit, with 61 percent of the miles fully supporting (Table 3-10). A total of 5,468 miles were assessed in the Cumberland unit. In the Upper Cumberland River Basin, only 49 percent of the miles fully supported the use. The lower portion of the Cumberland unit had an even lower percentage of aquatic life use support (29 percent).

Probabilistic and targeted monitoring results were fairly consistent in the Salt and Licking river basins but greatly different in the Cumberland basin management unit (Table 3-10). In the latter, the random survey approach yielded a much greater percentage of waters not fully supporting aquatic life use, probably because the random survey design includes many small (first and second-order) streams in western Kentucky that have been channelized and further impacted by agricultural practices. Except for the reference reach program, the targeted monitoring assessed mostly fourth and fifth-order streams.

Table 3-9. Leading Causes and Sources of Impairment in the Salt/Licking and Cumberland Basin Management Units

Causes	Miles	Sources	Miles
	Salt River Basin		
Siltation	213.9	Agriculture	231.3
Nutrients	187.5	Municipal Point Sources	158.4
Organic enrichment/Low DO	149.6	Urban Runoff/Storm Sewers	145.8
Pathogens	138.4	Habitat Modification	90.0
Flow Alteration	35	Land Disposal	87.5
	Licking River Basin		
Siltation	303.4	Agriculture	345.2
Pathogens	263.8	Source Unknown	122.7
Nutrients	218.2	Urban Runoff/Storm Sewers	78.2
Organic enrichment/Low DO	148.8	Silviculture	70.8
Other habitat alterations	57.3	Habitat Modification	66.6
	Upper Cumberland River Basin		
Siltation	273.5	Resource Extraction	204.9
Pathogens	173.9	Agriculture	155.5
Other habitat alterations	141.6	Construction	86.8
pH	75.2	Habitat Modification	83.2
Organic enrichment/Low DO	52.3	Municipal Point Sources	78.3
	LowerCumberland/TN/MS River Basin		
Siltation	223.6	Source Unknown	268.6
Pathogens	182.2	Agriculture	202.5
Cause unknown	136.3	Hydromodification	130
Other habitat alterations	128	Habitat Modification	118.5
Flow alteration	89.3	Municipal Point Sources	51.4

Table 3-10. Comparison of Probabilistic and Targeted Survey Monitoring Results for Aquatic Life Use in the Salt/Licking and Cumberland/Tennessee/Mississippi Basin Management Units 1999-00, Miles (Percent)

	Full Support		Partial Support		Non-Support	
River Basin	Prob	Target	Prob	Target	Prob	Target
Salt	2229 (65.1)	441 (76.6)	537 (15.7)	75 (13.0)	657 (19.2)	60 (10.5)
Licking	1205 (54.7)	316 (56.1)	510 (23.1)	140 (24.9)	490 (22.2)	107 (19.0)
Subtotal	3434 (61.0)	757 (66.5)	1047 (18.6)	215 (18.9)	1147 (20.4)	167 (14.7)
Upper Cumberland	1297 (48.7)	962 (75.4)	905 (34.0)	157 (12.3)	463 (17.4)	157 (12.3)
Lower Cumberland/ Tennessee/Mississippi	260 (9.3)	408 (45.6)	362 (12.9)	311 (34.8)	2181 (77.8)	176 (19.7)
Subtotal	1557 (28.5)	1370 (63.1)	1267 (23.2)	468 (21.6)	2644 (48.4)	333 (15.3)
Total	4991 (45.0)	2127 (64.3)	2314 (20.9)	683 (20.6)	3791 (34.2)	500 (15.1)

Swimming advisories remain in effect on several streams in the upper Cumberland River Basin and lower Licking River Basin.

Upper Cumberland River Basin

- Cumberland River from Hwy 2014 to Pineville Hwy 66 and from Hwy 219 to Harlan
- Martins Fork from Harlan to Cawood Water Plant
- Catrons Creek
- Clover Fork
- Straight Creek
- Poor Fork from Harlan to Looney Creek
- Looney Creek from mouth to Lynch Water Plant bridge

Lower Licking River Basin

- Licking River from Banklick Creek to Ohio River
- Banklick Creek
- Threemile Creek

Fish consumption use was partially supported in 10.5 miles in the Salt River Basin, 32.8 miles in the Upper Cumberland River Basin, 9.5 miles in the lower Cumberland River Basin, and 6.0 miles in the Tennessee River Basin (Table 3-8) because of mercury. The major source of the mercury is generally thought to be air emissions from coal-fired boilers. Because of the interstate issues, EPA is conducting national studies and will likely be involved in eventual efforts to calculate TMDLs and reduce mercury inputs.

3.3.3 Ohio River

ORSANCO assessed uses in the 664 miles of the Ohio River main stem that forms Kentucky's northern boundary (ORSANCO 2002). Drinking water use was met for the entire river, and aquatic life use was fully supported except in 7.0 miles in Lewis County in northeastern Kentucky. However, no reaches of the Ohio River fully supported all uses. All of the miles partially supported the fish consumption use because of limited fish consumption advisories for PCBs. Mercury in fish tissue was greater than 0.3 ppm at a few locations and thus is another cause of partial support of fish consumption for 119 miles. Recent water sampling resulted in 307 miles also listed as partial support because of dioxin, all upstream of the Cannelton Lock and Dam in Hancock County. However, chlordane, which was previously listed as a pollutant of concern along with PCBs for the entire length of the river, was eliminated as a cause because tissue concentrations have gradually declined, and the new risk-based approach resulted in slightly less stringent numbers that trigger an advisory. Of the 118.9 miles assessed for swimming use, 40.2 miles partially supported and 78.7 miles did not support, often because of combined sewer overflows during and immediately following rainfall events in and downstream of urban areas.

REFERENCES

Currens, J.D. 1999. Characterization and Quantification of Nonpoint Source Pollution in a Conduit-Flow Dominated Karst Aquifer Underlying an Extensive Use Agriculture Region – Phase III. Kentucky Geological Survey, Lexington, Kentucky.

Groves, K.M., and G.A. Schuster. 2000. Survey of the Unionidae and Bioassessment of Fish and Macroinvertebrates of Sinking Creek, Laurel County, Kentucky. Department of Biological Sciences, Eastern Kentucky University, Richmond, Kentucky.

Kentucky Department of Fish and Wildlife Resources. 2001. Annual Performance Report, Part II, Projects 2-6. District Fisheries Management, Fisheries Division, Frankfort, Kentucky.

_____. 2000. Annual Performance Report, Part II, Projects 2-8. District Fisheries Management, Fisheries Division, Frankfort, Kentucky.

Kentucky Division of Water. 2002. Methods for Assessing Biological Integrity of Surface Waters. Frankfort, Kentucky.

_____. 1998. 303(d) List of Waters for Kentucky. Frankfort, Kentucky.

Kentucky State Nature Preserves Commission. Personal communication with Kentucky Division of Water.

Limno-Tech, Inc. 1998. Water Quality Assessment of Banklick Creek and the Lower Licking River. Ann Arbor, Michigan.

Metropolitan Sewer District. 2000. Personal communication with Barry Nichols.

Moeykens, M.D., and G.A. Schuster. 1997. Bioassessment of the Fish and Macroinvertebrates of the Upper Mainstem of Buck Creek, Lincoln and Pulaski Counties, Kentucky. Department of Biological Sciences, Eastern Kentucky University, Richmond, Kentucky.

Ohio River Valley Water Sanitation Commission. 2002. Biennial Assessment of Ohio River Water Quality Conditions. Cincinnati, Ohio.

Pass, T., R. Wright, L. Hawkins, A. Polyczak, and B. Reeder. 2000. Expansion of Fecal Coliform Assessments in the Licking River Watershed. Water Testing Laboratory, Morehead State University, Morehead, Kentucky.

Pennington & Associates, Inc. 2000. Benthic Macroinvertebrate Surveys, Barkley Reservoir Project, Wolf Creek Reservoir Project, Martins Fork Project, Laurel River Project, and Dale Hollow Project. Prepared for U.S. Army Corps of Engineers. Nashville, Tennessee.

Schuster, G.A., D. Jones, M. Thomas, D. Jones, and P. Akers. 2000. Biological Monitoring Program Expansion, Salt River Basin. Department of Biological Sciences, Eastern Kentucky University, Richmond, Kentucky.

Tennessee Valley Authority 2001. Personal communications with Kentucky Division of Water.

U.S. Environmental Protection Agency. 2001a. Water Quality Criteria: Notice of Availability of Water Quality Criterion for the Protection of Human Health. Federal Register Vol. 66, No. 5, January 8, 2001, pp.1344-1359.

_____. 2001b. Consolidated Assessment and Listing Methodology. Draft for State Review and Comment. Office of Wetlands, Oceans, and Watersheds, Washington, D.C.

_____. 1997. Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates. Office of Water, Washington, D.C.

U.S. Forest Service. 2000. Personal communication with the Kentucky Division of Water.

White, D., K. Johnston, and G. Rice. 2001. Expansion of Fecal Coliform Assessments in the Lower Cumberland/Tennessee/Mississippi Watersheds. Center for Reservoir Research, Murray State University, Murray, Kentucky.

White, D., S. Entrekin, T. Timmons, and S. Hendricks. 2001a. Biological Baseline Conditions in the Little River Watershed. Center for Reservoir Research, Murray State University, Murray, Kentucky.

White, D., S. Entrekin, T. Timmons, and S. Hendricks. 2001b. Biological Monitoring Program Expansion in the Lower Cumberland and Tennessee River Basins. Center for Reservoir Research, Murray State University, Murray, Kentucky.

Appendix 3-1. Monitoring Information from the Salt/Licking Basin Management Unit

Monitoring Results
Salt/Licking Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]			
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS
Ohio River Minor Tributaries																
Briery Branch	05090201	Lewis	0.0 - 2.3	x							KDFWR	Aug-99	maybe			
Brush Creek	05090201	Campbell	0.0 - 1.6	x				x			KDFWR; MSU	May-Oct-99	FS	NS		
Cabin Creek	05090201	Mason	3.6 - 11.3	x	x						KDOW	Feb-97	NS			
Crooked Creek	05090201	Lewis	0.0 - 5.6	x							KDFWR	Aug-99	FS			
Fourmile Creek	05090201	Campbell	0.0 - 3.0	x				x			KDFWR; MSU	May-Oct-99	FS	NS		
Fourmile Creek	05090201	Campbell	3.0 - 8.3					x			MSU	Jun-Oct-99		NS		
Fourmile Creek	05090201	Campbell	8.4 - 9.4			x					TMDL	Jun-99 - Mar-00	FS			
Goose Creek	05090201	Bracken	0.0 - 1.9	x							KDFWR	Sep-99	PS			
Indian Creek	05090201	Lewis	0.0 - 9.4	x							KDRWR	Aug-96	FS			
Kinniconick Creek	05090201	Lewis	5.1 - 24.5	x	x	x	x	x	x		KDDW	Jul-85 - Jul-99	FS	FS	FS	
Kinniconick Creek	05090201	Lewis	24.5 - 38.9	x	x	x					KDOW	May-92 - Jul-99	FS			
Lee Creek	05090201	Mason	0.0 - 2.0	x							KDFWR	Aug-99	maybe			
Locust Creek	05090201	Bracken	0.0 - 4.1	x				x			KDFWR; MSU	May-Oct-99	FS	NS		
Locust Creek	05090201	Bracken	4.1 - 12.2	x							KDFWR	Sep-99	NS			
Salt Lick Creek	05090201	Lewis	0.0 - 9.0	x							KDFWR	Aug-99	FS			
Snag Creek	05090201	Bracken	0.5 - 5.5					x			MSU	May-Oct-99		NS		
Straight Fork	05090201	Lewis	0.0 - 1.9	x							KDFWR	Aug-96	FS			
Twelvemile Creek	05090201	Campbell	3.5 - 9.0		x						Prob	Jul-99	FS			
Allen Fork	05090203	Boone	2.0 - 4.6		x						KDOW	1996-97	PS			
Big Bone Creek	05090203	Boone	4.1 - 4.9	x							KDFWR	Aug-99	PS			
Big Bone Creek	05090203	Boone	6.8 - 11.6	x	x						KDOW	Mar-95	FS			
Big South Fork	05090203	Boone	0.8 - 3.0			x					RR	Jul-99	FS			
Craigs Creek	05090203	Gallatin	2.9 - 6.7	x							KDFWR	Aug-99	maybe			
Dry Creek	05090203	Boone	0.2 - 7.0	x	x						KDFWR; Prob	Jun-Aug-99	PS			
Dry Creek	05090203	Gallatin	1.1 - 3.0	x							KDFWR	Aug-99	PS			
Elijahs Creek	05090203	Boone	0.0 - 5.2				x				KDOW; DMRs	1998-2000	NS			
Gunpowder Creek	05090203	Boone	0.0 - 15.0	x	x	x					KDOW; Prob	Apr-95; Jun-99	NS			
Gunpowder Creek	05090203	Boone	15.0 - 16.6	x	x	x					KDOW; KDFWR	Apr-95; Aug-99	NS			
Gunpowder Creek	05090203	Boone	18.9 - 21.6	x	x						KDOW	Apr-95	PS			
McCools Creek	05090203	Carroll	0.0 - 6.7	x							KDFWR	Aug-99	maybe			
McCoys Fork	05090203	Boone	0.0 - 2.2	x							KDFWR	Aug-99	maybe			
Mudlick Creek	05090203	Boone	0.0 - 6.0	x					x		KDFWR	Aug-99	resample		FS	
Mudlick Creek	05090203	Boone	6.0 - 11.3	x							KDFWR	Aug-99	resample			
South Fork Gunpowder Creek	05090203	Boone	0.0 - 2.0	x							KDFWR	Aug-99	NS			
South Fork Gunpowder Creek	05090203	Boone	4.1 - 6.8					x			MSU	May - Oct-99		NS		
Stephens Creek	05090203	Gallatin	0.0 - 1.8	x							KDFWR	Aug-99	FS			
Woolper Creek	05090203	Boone	2.8 - 7.2	x				x	x		KDFWR; MSU	May-Oct-99	resample	NS	FS	
Woolper Creek	05090203	Boone	11.6 - 13.6		x			x			KDOW; MSU	May-Oct-99	NS	NS		

Monitoring Results
Salt/Licking Basin Management Unit

Stream	Hydro Unit	County	Segment Milepoints	Sample Type[a] Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW	Program[b]	Date	Use Support[c] WAH	PCR	FC	DWS
Licking River																
Allison Creek	05100101	Fleming	0.0 - 4.7		x			x			NPS	Jul-Oct-98	NS	NS		
Banklick Creek	05100101	Kenton	0.0 - 3.9	x	x	x		x			KDOW; SD#1	Jun-95 - Aug-99	PS	NS		
Banklick Creek	05100101	Kenton	3.9 - 8.2			x		x			SD#1; TMDL	1995-2000	NS	NS		
Banklick Creek	05100101	Kenton	8.2 - 19.0				x	x			TMDL	Apr-99 - Mar-00	NS	NS		
Beaver Creek	05100101	Menifee	10.0 - 14.4		x						USFS	Jun-99	PS			
Blackwater Creek	05100101	Morgan	1.0 - 8.3	x	x	x	x	x			RR; USFS; KDOW	Apr-99 - Mar-00	FS	FS		
Brushy Fork	05100101	Fleming	0.0 - 2.2	x							KDFWR	Aug-99	FS			
Brushy Fork	05100101	Menifee	0.5 - 3.8		x						USFS	Jun-99	FS			
Bucket Branch	05100101	Morgan	0.0 - 1.9	x	x	x					RR	May-99	FS			
Burnng Fork	05100101	Magoffin	0.0 - 2.9					x			MSU	May-Oct-99		NS		
Caney Creek	05100101	Morgan	0.0 - 4.2	x							KDFWR	Aug-99	PS			
Cassidy Creek	05100101	Fleming	0.0 - 3.9					x			NPS	May-98-Oct-98		NS		
Cassidy Creek	05100101	Nicholas	0.5 - 5.0	x							KDFWR	Aug-99	maybe			
Christy Creek	05100101	Rowan	0.0 - 4.3		x						USFS	Jun-99	PS			
Craintown Branch	05100101	Fleming	0.0 - 3.5		x			x			NPS	May-Jul-98	PS	PS		
Crane Creek	05100101	Fleming	0.0 - 3.1	x							KDFWR	Aug-99	maybe			
Craney Creek	05100101	Rowan	0.0 - 3.0		x						USFS	Jul-99	FS			
Craney Creek	05100101	Rowan	3.0 - 10.0	x	x						KDFWR; USFS	Jul-96 - Jul-99	FS			
Crooked Creek	05100101	Nicholas	0.0 - 9.1					x			MSU	May-Oct-99		NS		
Cruises Creek	05100101	Kenton	0.0 - 8.6	x				x			KSNPC; MSU	May-Oct-99	FS	FS		
Devils Fork	05100101	Morgan	0.0 - 3.6	x	x	x					RR	May-99	FS			
Doty Branch	05100101	Fleming	0.0 - 4.0		x			x			NPS	Jun-92	NS	NS		
Dry Creek	05100101	Rowan	0.0 - 0.5		x						USFS	Jun-99	PS			
Elk Fork	05100101	Morgan	0.0 - 4.9	x	x	x					KDOW	Jul-99	PS			
Elk Fork	05100101	Morgan	4.9 - 10.5	x							KDFWR	Aug-99	NS			
Elk Fork	05100101	Morgan	12.6 - 14.7	x							KDRWR	Aug-99	PS			
Flat Creek	05100101	Bath	0.0 - 0.9	x			x	x			KDFWR;KDOW; MSU	Apr-99 - Mar-00	FS	NS		
Fleming Creek	05100101	Fleming	9.5 - 12.6		x			x			NPS	Jul-Oct-98	PS	NS		
Fleming Creek	05100101	Fleming	12.6 - 15.9		x						Prob	Jul-99	PS			
Fleming Creek	05100101	Fleming	25.9 - 32.1					x			NPS	May- Oct-98		NS		
Fleming Creek	05100101	Fleming	32.8 - 39.2		x						NPS	Jul-98	NS			
Fox Creek	05100101	Fleming	0.0 - 8.8	x				x	x		KDFRW; MSU	May- Oct-99	PS	FS	FS	
Fox Creek	05100101	Fleming	20.1 - 22.7	x							KDFWR	Aug-99	NS			
Grassy Creek	05100101	Pendleton	0.0 - 1.3					x			MSU	May-Oct-99		FS		
Hillsboro Branch	05100101	Fleming	0.0 - 4.7	x							KDFWR	Aug-99	maybe			
Johnson Creek	05100101	Magoffin	0.0 - 3.1	x			x	x			KDFWR; MSU; KDOW	Apr-99 - Mar-00	maybe	NS		
Johnson Creek	05100101	Robertson	0.0 - 3.3	x				x			KDFWR; MSU	May-Oct-99	maybe	NS		
Left Fork White Oak Creek	05100101	Morgan	0.0 - 1.8	x							KDFWR	Aug-99	PS			
Lick Creek	05100101	Magoffin	0.0 - 2.2	x							KDFWR	Aug-99	maybe			
Licking River	05100101	Campbell	0.0 - 4.6				x	x			KDOW; ORSANCO	Oct-97 - Mar-00	PS	PS		
Licking River	05100101	Campbell	4.6 - 14.5					x		x	MSU; DW	May-Oct-99		PS		FS
Licking River	05100101	Campbell	14.5 - 21.2					x			MSU	May- Oct-99		FS		

Monitoring Results
Salt/Licking Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]			
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS
Licking River (cont)																
Licking River	05100101	Pendleton	21.2 - 51.6	x	x	x	x	x	x	x	KDOW; KSNPC; DW	Apr-99 - Mar-00	FS	FS	FS	FS
Licking River	05100101	Pendleton	51.6 - 71.6							x	DW	1999-2001				FS
Licking River	05100101	Harrison	71.6 - 106.8	x	x	x	x	x	x	x	KDOW; DW	Oct-97 - Mar-00	FS	FS	FS	FS
Licking River	05100101	Fleming	106.8 - 127.0					x		x	MSU; DW	May-Oct-99		FS		FS
Licking River	05100101	Fleming	127.0 - 141.2							x	DW	1998-2001				FS
Licking River	05100101	Fleming	141.2 - 144.3					x			MSU	May-Oct-99		FS		
Licking River	05100101	Bath	144.3 - 168.5		x						Prob	Jul-99	resample			
Licking River	05100101	Rowan	168.5 - 173.6							x	DW	1998 - 2001				FS
Licking River	05100101	Morgan	226.4 - 239.3	x	x	x	x	x	x	x	KDOW; DW	Oct-97 - Mar-00	FS	FS	FS	FS
Licking River	05100101	Magoffin	247.8 - 255.7	x							KDFWR	Sep-99	maybe			
Licking River	05100101	Magoffin	263.1 - 269.5	x							KDFWR	Sep-99	maybe			
Licking River	05100101	Magoffin	269.9 - 292.0		x						Prob; DW	Jul-99	resample			FS
Licking River	05100101	Magoffin	292.0 - 297.1	x							KDFWR	Aug-99	FS			
Little Flat Creek	05100101	Bath	0.0 - 2.3	x							KDFWR	Aug-99	FS			
Locust Creek	05100101	Fleming	0.0 - 5.7	x							KDFWR	Aug-99	FS			
Locust Creek	05100101	Fleming	5.7 - 11.7	x							KDFWR	Aug-99	PS			
Logan Run	05100101	Fleming	0.0 - 2.3	x				x			KDFWR; NPS	Jun-95 - Oct-98	NS	NS		
Middle Fork Licking River	05100101	Magoffin	0.0 - 2.5	x	x	x		x	x		KDOW; MSU	May-Oct-99	FS	NS	FS	
Mill Creek	05100101	Bath	0.0 - 2.6	x							KDFWR	Aug-99	FS			
Minor Creek	05100101	Morgan	0.0 - 6.4	x							KDFWR	Jul-96	FS			
North Fork	05100101	Morgan	9.9 - 14.2	x	x	x	x	x			RR; KDOW	Apr-92 - Mar-00	FS	FS		
North Fork Licking River	05100101	Bracken	2.2 - 18.1				x	x			KDOW	Oct-97 - Mar-00	FS	FS		
North Fork Licking River	05100101	Bracken	18.1 - 31.8		x			x			Prob; MSU	May-Oct-99	NS	NS		
North Fork Licking River	05100101	Mason	31.8 - 51.7		x			x			Prob; MSU	May-Oct-99	NS	NS		
North Fork Triplett Creek	05100101	Rowan	1.2 - 14.8		x						Prob	Jul-99	resample			
North Fork Triplett Creek	05100101	Rowan	14.9 - 15.9		x						USFS	Jun-99	FS			
Oakley Creek	05100101	Magoffin	0.0 - 0.9	x							KDFWR	Jul-99	maybe			
Passenger Branch	05100101	Rowan	0.0 - 1.8		x						USFS	Oct-93 - Sep-95	FS			
Phillips Creek	05100101	Campbell	0.0 - 5.3					x			MSU	May-Oct-99		NS		
Poplar Creek	05100101	Fleming	0.0 - 3.1					x			KDOW	May-Oct-98		NS		
Prickly Ash Creek	05100101	Bath	0.0 - 3.1	x							KDFWR	Aug-99	NS			
Puncheon Camp Creek	05100101	Magoffin	0.0 - 1.1					x			MSU	May-Oct-99		NS		
Raven Creek	05100101	Harrison	2.5 - 4.5	x							KDFWR	Jun-94	FS			
Rockhouse Creek	05100101	Morgan	0.0 - 4.6	x							KDFWR	Aug-99	maybe			
Rock Lick Creek	05100101	Fleming	0.0 - 0.8	x							KDFWR	Aug-99	maybe			
Salt Lick Creek	05100101	Bath	3.0 - 8.0		x						USFS	Jun-99	PS			
Sand Lick Creek	05100101	Fleming	0.0 - 5.8	x							KDFWR	Aug-99	FS			
Scrubgrass Creek	05100101	Nicholas	0.0 - 1.6	x							KDFWR	Aug-99	NS			
Slabcamp Creek	05100101	Rowan	0.0 - 3.4		x						USFS	Jun-93	FS			
Slate Creek	05100101	Bath	0.0 - 7.0					x			MSU	May-Oct-99		NS		
Slate Creek	05100101	Bath	7.0 - 13.4	x	x	x	x	x	x		KDOW	Apr-98 - Mar-00	FS	FS	FS	
Slate Creek	05100101	Bath	13.4 - 22.2	x						x	KDFWR; DW	Aug-99	FS			FS
Slate Creek	05100101	Montgomery	42.8 - 52.2					x			MSU	May-Oct-99		FS		

Monitoring Results
Salt/Licking Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]			
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS
Licking River (cont)																
Slate Creek	05100101	Menifee	52.2 - 56.6	x							KDFWR	Aug-99	resample			
Sleepy Run	05100101	Fleming	0.0 - 2.8					x			NPS	May-Oct-98		NS		
South Fork Grassy Creek	05100101	Pendleton	0.0 - 19.6	x	x	x	x	x			RR; KSNPC; KDOW	Apr-99 - Mar-00	FS	FS		
State Road Fork	05100101	Magoffin	0.0 - 1.1	x							KDFWR	Aug-99	maybe			
Stonecoal Branch	05100101	Rowan	0.0 - 2.5		x						USFS	Jul-96	FS			
Stony Creek	05100101	Nicholas	0.0 - 3.0	x							KDFWR	Sep-99	NS			
Straight Creek	05100101	Morgan	0.0 - 1.8	x							KDFWR	Aug-99	NS			
Threemile Creek	05100101	Campbell	0.5 - 4.7					x			MSU	May-Oct-99		NS		
Town Branch	05100101	Fleming	0.0 - 4.0					x			NPS	May-Oct-99		NS		
Trace Fork	05100101	Magoffin	0.0 - 3.1	x							KDFWR	Jul-99	PS			
Triplett Creek	05100101	Rowan	5.8 - 12.0	x	x	x	x	x			KDOW	Apr-99 - Mar-00	PS	NS		
Triplett Creek	05100101	Rowan	12.0 - 15.7							x	DW	1998-2001				FS
Triplett Creek	05100101	Rowan	15.7 - 20.5		x						USFS	Jun-99	FS			
West Creek	05100101	Robertson	0.0 - 9.5	x	x	x					RR	May-Jun-99	FS			
Williams Creek	05100101	Morgan	0.0 - 5.3	x				x			KDFWR; MSU	May-Oct-99	resample	NS		
Willow Creek	05100101	Pendleton	0.0 - 10.2	x	x	x					RR	Jun-93 - Jun-99	FS			
Wilson Run	05100101	Fleming	0.0 - 5.1					x			NPS	May-Oct-98		NS		
South Fork Licking River																
Blacks Creek	05100102	Bourbon	0.0 - 3.4	x							KDFWR	Aug-99	PS			
Boone Creek	05100102	Bourbon	0.0 - 5.0	x							KDFWR	Aug-99	PS			
Cooper Run	05100102	Bourbon	0.0 - 10.1	x							KDFWR	Aug-99	NS			
Flat Run	05100102	Bourbon	0.0 - 2.2	x							KDFWR	Aug-99	NS			
Grassy Lick Creek	05100102	Montgomery	0.0 - 4.5	x							KDFWR	Aug-99	PS			
Hinkston Creek	05100102	Bourbon	0.0 - 12.4	x	x	x	x	x	x		KDOW; Prob	Apr-98 - Mar-00	PS	FS	FS	
Hinkston Creek	05100102	Bourbon	13.0 - 16.4							x	DW	1998-2001				FS
Hinkston Creek	05100102	Bourbon	20.8 - 31.0	x				x			KDFWR; MSU	May-Oct-99	FS	PS		
Hinkston Creek	05100102	Bourbon	31.0 - 33.3	x							KDFWR	Aug-99	FS			
Hinkston Creek	05100102	Bourbon	41.8 - 49.1	x				x			KDFWR; MSU	May- Oct-99	PS	NS		
Hinkston Creek	05100102	Montgomery	51.5 - 65.9	x	x						KDOW; KDFWR	Oct-95; Aug-99	NS			
Hinkston Creek	05100102	Montgomery	68.0 - 70.8	x	x						KDOW	Oct-95	FS			
Houston Creek	05100102	Bourbon	0.0 - 9.0					x			MSU	May-Oct-99		NS		
Houston Creek	05100102	Bourbon	9.0 - 12.7	x							KDFWR	Aug-99	PS			
Hutchison Creek	05100102	Bourbon	0.0 - 5.4	x							KDFWR	Aug-99	maybe			
Little Stoner Creek	05100102	Clark	0.0 - 5.0					x			MSU	May- Oct-99		NS		
Mill Creek	05100102	Harrison	0.0 - 21.2				x	x			KDOW	Apr-99 - Mar-00	FS	FS		
Somerset Creek	05100102	Nicholas	0.0 - 4.4	x	x						KDOW; KDFWR	Oct-95; Aug-99	resample			
South Fork Licking River	05100102	Pendleton	2.0 - 6.8		x			x			Prob, MSU	May- Oct-99	FS	FS		
South Fork Licking River	05100102	Pendleton	6.8 - 11.3		x						Prob	Jul-99	FS			

Monitoring Results
Salt/Licking Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]			
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS
South Fork Licking River (cont)																
South Fork Licking River	05100102	Pendleton	11.3 - 16.6				x	x			KDOW	Oct-97 - Mar-00	FS	FS		
South Fork Licking River	05100102	Harrison	16.6 - 27.2		x			x			Prob; MSU	May- Oct-99	FS	FS		
South Fork Licking River	05100102	Harrison	35.0 - 46.4		x			x			Prob; MSU	May- Oct-99	FS	FS		
South Fork Licking River	05100102	Harrison	50.4 - 59.8							x	DW	1998-2001				FS
Stoner Creek	05100102	Bourbon	0.0 - 5.5	x	x	x	x	x	x	x	KDOW; DW	Apr-98 - Mar-00	FS	FS	FS	FS
Stoner Creek	05100102	Clark	5.5 - 15.0					x			MSU	May-Oct-99		NS		
Stoner Creek	05100102	Bourbon	15.1 - 17.2							x	DW	1998-2001				FS
Stoner Creek	05100102	Bourbon	17.2 - 29.8					x			MSU	May-Oct-99		FS		
Stoner Creek	05100102	Bourbon	44.8 - 60.5					x			MSU	May- Oct-99		FS		
Stoner Creek	05100102	Bourbon	60.5 - 72.2	x							KDFWR	Aug-99	maybe			
Strodes Creek	05100102	Bourbon	2.7 - 19.3	x	x	x	x	x	x		KDOW; MSU	Apr-99 - Mar-00	PS	NS	FS	
Townsend Creek	05100102	Harrison	0.0 - 4.8					x			MSU	May-Oct-99		NS		
Ohio River Minor Tributaries																
Beargrass Creek	5140101	Jefferson	0.0 - 1.5				x				inferred from MSD data	Dec-97 - Oct-99	NS			
Corn Creek	05140101	Trimble	0.0 - 4.1	x							KDFWR	Aug-99	FS			
Goose Creek	05140101	Jefferson	0.5 - 3.2		x		x	x			MSD	Dec-97 - Oct-99	PS	PS		
Goose Creek	05140101	Jefferson	3.2 - 12.2				x	x			MSD	Dec-97 - Oct-99	PS	NS		
Hardy Creek	05140101	Trimble	0.0 - 1.4	x							KDFWR	Aug-99	NS			
Harrods Creek	05140101	Jefferson	**3.2** - 6.1				x	x			MSD	Dec-97 - Oct-99	FS	FS		
Harrods Creek	05140101	Oldham	6.1 - 9.1				x	x			KDOW	Apr-99 - Mar-00	FS	FS		
Hite Creek	05140101	Jefferson	0.0 - 5.5	x	x						KDOW	Sep-95	NS			
Little Goose Creek	05140101	Jefferson	0.0 - 8.7				x	x			MSD	Dec-97 - Oct-99	FS	PS		
Little Kentucky River	05140101	Carroll	3.0 - 12.3	x	x	x					KDOW	Jun-95	FS			
Little Kentucky River	05140101	Henry	21.0 - 27.0	x							KDFWR	Aug-99	PS			
Locust Creek	05140101	Carroll	0.0 - 2.0	x							KDFWR	Aug-99	FS			
Middle Fork Beargress Creek	05140101	Jefferson	0.0 - 2.3	x	x			x			MSD	Dec-97 - Oct-99	NS	NS		
Middle Fork Beargress Creek	05140101	Jefferson	2.3 - 2.9				x	x			MSD	Dec-97 - Oct-99	FS	NS		
Middle Fork Beargress Creek	05140101	Jefferson	2.9 - 6.3				x	x			MSD	Dec-97 - Oct-99	FS	NS		
Mill Creek	05140101	Jefferson	1.1 - 4.7				x	x			MSD	Dec-97 - Oct-99	NS	NS		
Mill Creek Cutoff	05140101	Jefferson	0.0 - 2.3				x	x			MSD	Dec-97 - Oct-99	FS	NS		
Muddy Fork Beargress Creek	05140101	Jefferson	0.0 - 6.9				x	x			MSD	Dec-97 - Oct-99	FS	NS		
Pond Creek	05140101	Oldham	0.0 - 1.5	x	x						KDOW	May-94	PS			
South Fork Beargress Creek	05140101	Jefferson	0.0 - 2.7				x	x			MSD	Dec-97 - Oct-99	resample	NS		
South Fork Beargress Creek	05140101	Jefferson	4.7 - 6.5				x	x			MSD	Dec-97 - Oct-99	FS	NS		
UT to Carmon Creek	05140101	Trimble	0..9 - 1.9				x				DMRs	Oct-97 - Sep-99	NS			
UT to Pond Creek	05140101	Oldham	0.0 - 0.5	x	x		x				KDOW; DMRs	Jun-94 - Sep-99	NS			
UT to Pond Creek	05140101	Oldham	0.5 - 0.9	x	x						KDOW	Jun-94 - Jun-95	FS			
White Sulphur Creek	05140101	Henry	0.0 - 3.9	x							KDFWR	Aug-99	maybe			

Monitoring Results
Salt/Licking Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]			
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS
Salt River																
Brashears Creek	05140102	Spencer	0.0 - 13.0		x		x	x			KDOW; Prob	Apr-98 - Mar-00	FS	FS		
Brashears Creek	05140102	Spencer	13.0 - 25.5	x	x	x					KDOW	Jun-Jul-99	FS			
Brooks Run	05140102	Bullitt	0.0 - 2.5					x			TMDL	Aug-99		FS		
Brooks Run	05140102	Bullitt	2.5 - 4.1		x			x			TMDL	Aug-99	PS	PS		
Brooks Run	05140102	Bullitt	4.1 - 6.1		x			x			TMDL	Aug-99	PS	NS		
Bullitt Lick Creek	05140102	Bullitt	0.0 - 2.3	x							KDFWR	Sep-99	PS			
Bullskin Creek	05140102	Shelby	0.0 - 10.3	x			x	x			KDFWR; KDOW	Apr-99 - Mar-00	maybe	FS		
Cane Run	05140102	Jefferson	0.0 - 7.6	x	x						KDOW	Oct-96	FS			
Cedar Creek	05140102	Bullitt	0.0 - 5.1	x	x	x					RR	Jul-99	FS			
Cedar Creek	05140102	Jefferson	4.2 - 11.1				x	x			MSD	Dec-97 - Oct-99	FS	FS		
Chenoweth Run	05140102	Jefferson	1.8 - 5.2		x		x	x			MSD	Dec-97 - Oct-99	PS	NS		
Clear Creek	05140102	Shelby	0.0 - 11.0	x			x	x			KDFWR; KDOW	Apr-99 - Mar-00	NS	FS		
Cox Creek	05140102	Nelson	11.2 - 15.5	x							KDFWR	Sep-99	PS			
Crooked Creek	05140102	Spencer	1.0 - 10.1	x	x	x					RR	Jun-99	FS			
Currys Fork	05140102	Oldham	0.0 - 4.8	x	x	x	x	x			KDOW	Apr-99 - Mar-00	PS	NS		
East Fork Cox Creek	05140102	Bullitt	0.0 - 4.3	x							KDFWR	Sep-99	FS			
Fern Creek/Northern Ditch	05140102	Jefferson	0.0 - 7.5				x	x			MSD	Jan-94 - Dec-96	PS	NS		
Fern Creek/Northern Ditch	05140102	Jefferson	7.5 - 10.3				x	x			MSD	Dec-97 - Oct-99	resample	NS		
Fern Creek	05140102	Jefferson	10.5 - 11.9				x	x			MSD	Dec-97 - Oct-99	PS	NS		
Fishpool Creek	05140102	Jefferson	0.0 - 1.9				x	x			MSD	Jan-94 - Dec-96	FS	FS		
Floyds Fork	05140102	Bullitt	3.7 - 7.5	x	x	x	x	x	x		KDOW	Apr-98 - Mar-00	FS	FS	FS	
Floyds Fork	05140102	Jefferson	11.6 - 21.6		x		x	x			MSD	Dec-97 - Oct-99	NS	NS		
Floyds Fork	05140102	Jefferson	24.2 - 31.2		x						Prob	Jun-99	PS			
Floyds Fork	05140102	Jefferson	31.3 - 34.1		x		x	x			Prob; MSD	Dec-97 - Oct-99	PS	NS		
Guist Creek	05140102	Shelby	0.0 - 15.4	x	x	x					KDOW; Prob	Jun-Jul-99	FS			
Guist Creek	05140102	Shelby	15.4 - 27.6	x	x				x		KDFWR; Prob	Jun-Jul-99	PS		FS	
Hammond Creek	05140102	Anderson	0.0 - 5.2	x					x		KDFWR	Jul-99	maybe		FS	
Jeptha Creek	05140102	Shelby	0.0 - 0.7	x							KDFWR	Jul-99	NS			
Long Lick Creek	05140102	Bullitt	0.0 - 10.5	x							KDFWR	Sep-99	NS			
Long Run	05140102	Jefferson	0.0 - 3.0				x	x			MSD	Dec-97 - Oct-99	FS	NS		
Mill Creek	05140102	Hardin	6.0 - 7.0				x				DMRs	Mar-98 - Nov-00			NS	
Mill Creek	05140102	Hardin	7.0 - 11.8	x							KDFWR	Sep-99	FS			
Mill Creek	05140102	Hardin	11.8 - 23.6	x	x						KDOW	Nov-93	FS			
Mill Creek Branch	05140102	Hardin	0.0 - 0.7	x	x						KDOW	Nov-93	PS			
Pennsylvania Run	05140102	Jefferson	0.0 - 3.1				x	x			MSD	Dec-97 - Oct-99	PS	NS		
Pond Creek	05140102	Jefferson	5.1 - 8.1				x	x			MSD	Dec-97 - Oct-99	NS	NS		
Pond Creek	05140102	Jefferson	14.7 - 16.1				x	x			MSD	Dec-97 - Oct-99	FS	NS		
Pope Lick Creek	05140102	Jefferson	2.0 - 5.2				x	x			MSD	Dec-97 - Oct-99	FS	NS		
Salt River	05140102	Bullitt	11.5 - 25.5	x	x	x	x	x	x		KDOW	Oct-97 - Mar-00	FS	FS	FS	
Salt River	05140102	Spencer	49.7 - 55.4	x							KDFWR	Jun-99	FS			

Monitoring Results
Salt/Licking Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]			
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS
Salt River (Cont.)																
Salt River	05140102	Spencer	55.4 - 55.9	x	x	x			x		KDOW	Jun-99	FS		FS	
Salt River	05140102	Spencer	55.9 - 60.0							x	DW	1999-2001				FS
Salt River	05140102	Anderson	78.0 - 88.5	x	x	x	x	x	x		KDOW	Oct-97 - Mar-00	FS	FS	PS	
Salt River	05140102	Anderson	88.5 - 111.2	x	x	x					KDOW; Prob	Jul-97; Jun-99	FS			
Simpson Creek	05140102	Spencer	0.0 - 6.8	x			x	x			KDFWR; KDOW	Apr-99 - Mar-00	resample	FS		
Slop Ditch	05140102	Jefferson	0.0 - 1.9				x	x			MSD	Apr-94 - Jul-96	PS	NS		
Southern Ditch of Pond Creek	05140102	Jefferson	1.9 - 3.8				x	x			MSD	Dec-97 - Oct-99	FS	NS		
Spring Ditch (of Northrn Ditch)	05140102	Jefferson	0.0 - 2.7				x	x			MSD	Dec-97 - Oct-99	NS	NS		
Rolling Fork																
Beaver Creek	05140103	Anderson	0.0 - 20.9	x	x	x					RR	May-99	FS			
Beech Fork	05140103	Nelson	1.9 - 18.7	x							KSNPC	Jul-99	FS			
Beech Fork	05140103	Nelson	39.5 - 49.8	x	x	x	x	x	x		KDOW	Oct-97 - Mar-00	FS	FS	FS	
Beech Fork	05140103	Washington	49.7 - 56.5		x						Prob	Jun-99	FS			
Beech Fork	05140103	Washington	56.5 - 85.3?		x						Prob	Jun-99	FS			
Big South Fork	05140103	Marion	0.0 - 12.4				x	x			KDOW	Apr-99 - Mar-00	FS	NS		
Cartwright Creek	05140103	Washington	0.0 - 6.6	x	x	x			x		KDOW	Aug-99	PS		FS	
Cartwright Creek	05140103	Washington	6.6 - 12.6	x	x						EKU	Jun-99	PS			
Chaplin River	05140103	Nelson	0.0 - 22.7	x	x		x	x	x		KSNPC; KDOW; Prob	Apr-99 - Mar-00	FS	FS	FS	
Chaplin River	05140103	Washington	32.2		x						Prob	Jun-99	FS			
Chaplin River	05140103	Washington	40.1 - 53.7	x	x	x					RR; Prob	Jul-Aug-99	FS			
Chaplin River	05140103	Mercer	63.0 - 69.7	x	x						EKU	Jun-99	NS			
Chaplin River	05140103	Mercer	69.7 - 78.0		x						Prob	Jun-99	FS			
Chenoweth Run	05140103	Jefferson	1.8 - 5.2		x		x	x			MSD	Dec-97 - Oct-99	FS	NS		
Clear Creek	05140103	Hardin	0.0 - 4.4	x	x						EKU	Jun-99	NS			
Crooked Creek	05140103	Bullitt	5.6 - 12.8		x						Prob	Jun-99	NS			
East Fork Beech Fork	05140103	Washington	0.0 - 1.8	x	x						EKU	Jun-99	NS			
Hardins Creek	05140103	Washington	0.0 - 7.0		x						KSNPC	Jul-99	FS			
Harts Run	05140103	Bullitt	0.0 - 1.1	x	x	x					RR	May-99	FS			
Jones Creek	05140103	Marion	0.0 - 3.9	x	x						EKU	Jun-99	PS			
Middle Fork Otter Creek	05140103	Larue	0.0 - 4.2	x	x						EKU	Jun-99	FS			
Mussin Branch	05140103	Marion	0.0 - 1.7				x				KDOW	Jun-95	NS			
North Rolling Fork	05140103	Marion	0.0 - 3.7	x	x						EKU	Jun-99	FS			
North Rolling Fork	05140103	Boyle	16.7 - 20.9	x	x						EKU	Jun-99	FS			
Otter Creek	05140103	Larue	0.0 - 2.7	x	x	x					RR	Oct-96 - Jun-99	FS			
Overalls Creek	05140103	Bullitt	0.0 - 1.3	x	x						RR	May-99	FS			
Pope Creek	05140103	Marion	0.0 - 2.1	x							RR	May-01	FS			
Pottinger Creek	05140103	Nelson	0.0 - 5.0	x							KSNPC	Jul-99	FS			
Prather Creek	05140103	Marion	0.0 - 3.1	x	x						EKU	Jun-99	FS			
Road Run	05140103	Washington	0.0 - 3.4	x	x						EKU	Jun-99	PS			
Rolling Fork	05140103	Bullitt	10.0 - 15.0				x	x			KDOW	Oct-97 - Mar-00	FS	FS		
Rolling Fork	05140103	Nelson	38.4 - 41.8	x	x	x			x		KDOW	Jun-87-Aug-99	FS		FS	
Rolling Fork	05140103	Nelson	41.8 - 62.5	x	x						EKU	Jun-99	FS			

Monitoring Results
Salt/Licking Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]			
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS
Rolling Fork (Cont)																
Rolling Fork	05140103	Nelson	62.5 - 76.3		x						Prob	Jun-99	FS			
Rolling Fork	05140103	Marion	76.3 - 93.7	x							KSNPC	Jul-99	FS			
Rolling Fork	05140103	Marion	93.7 - 100.2							x	DW	1998-2001				FS
Rolling Fork	05140103	Marion	100.2 - 107.9		x						Prob	Jun-99	resample			
Rowan Creek	05140103	Nelson	0.0 - 7.1	x	x						KDOW	Oct-95	FS			
Salt Lick Creek	05140103	Marion	0.0 - 8.4	x	x	x					RR; KDOW	May-92 - Jul-99	FS			
Scrubgrass Branch	05140103	Boyle	0.2 - 0.7	x	x						EKU	Jun-99	FS			
Sulphur Creek	05140103	Anderson	0.0 - 9.7	x	x	x					RR	Jun-99	FS			
Town Creek	05140103	Nelson	0.0 - 4.0	x	x						KDOW	Oct-95	FS			
UT to Rolling Fork	05140103	Marion	0.0 - 0.6				x				TMDL	Oct-00	NS			
Wilson Creek	05140103	Bullitt	0.0 - 17.0	x	x	x	x	x			RR; KDOW; MSD	May-92 - Oct-99	FS	FS		
Ohio River Minor Tributaries																
Lick Run Creek	05140104	Breckinridge	0.0 - 3.5	x							KDFWR	Aug-99	PS			
Doe Run	05140104	Meade	4.1 - 7.9				x	x			KDOW	Apr-99 - Mar-00	FS	NS		
Hardins Creek	05140104	Breckinridge	0.0 - 5.0	x							KDFWR	Aug-99	NS			
Otter Creek	05140104	Meade	0.0 - 10.7	x	x	x	x	x			RR; MSD	ay-92; Dec-97 - Oct-	FS	PS		
Sinking Creek	05140104	Breckinridge	5.9 - 8.9	x							KDFWR	Aug-99	resample			
Sinking Creek	05140104	Breckinridge	8.9 - 15.6	x	x	x	x	x	x		KDOW	Apr-99 - Mar-00	PS	NS	FS	
Sinking Creek	05140104	Breckinridge	15.6 - 39.8	x							KDFWR	Aug-99	FS			
Wolf Creek	05140104	Meade	0.0 - 8.7	x							KDFWR	Aug-99	maybe			
Yellowbank Creek	05140104	Breckinridge	0.0 - 6.4	x	x	x					RR; KDFWR	May-92 - Aug-99	FS			

[a]Macroinvert = macroinvertebrates WQ = water quality Fecal = fecal coliform bacteria Tissue = fish tissue DW = drinking water

[b] KDOW = Kentucky Division of Water DMRs = Discharge monitoring reports submitted by permit holders EKU = Eastern Kentucky University
KDFWR = Kentucky Dept Fish & Wildlife KSNPC = Kentucky State Nature Preserves Commission MSD = Metropolitan Sewer District (Louisville)
MSU = Morehead State University NPS = Nonpoint Source Program (DOW) Prob = Probabilisitic (random) monitoring by DOW
SD#1 = Sanitation District #1 (Northern KY) TMDL = Sampling for purposes of determining total maximum daily load USFS = U.S. Forest Service

[c]WAH = warm water aquatic life PCR = primary contact recreation FC = fish consumption DWS = domestic water supply

Appendix 3-2. Monitoring Information from the Cumberland/Tennessee/Mississippi Basin Management Unit

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]				GNIS
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS	
Upper Cumberland River																	
Adams Branch	05130101	Whitley	0.0 - 1.5	x	x						Coal	Jun-94	FS				510215
Bad Branch	05130101	Letcher	0.0 - 3.0	x	x	x					RR	Jul-00	FS				486198
Bailey Creek	05130101	Harlan	0.0 - 2.5					x			KDOW	May-98 - Oct-00		NS			510346
Bark Camp Creek	05130101	Whitley	0.0 - 7.6	x	x	x					RR; COE	Oct-91-Jul-00	FS				510394
Bennetts Fork	05130101	Bell	0.0 - 7.5	x	x	x					KDOW; KDFWR	Aug-00	PS				486865
Bens Fork	05130101	Bell	0.0 - 2.4	x	x						USFS; KDFWR; Coal	Apr-00 - Oct-01	FS				486872
Big Indian Creek	05130101	Knox	0.0 - 5.1	x							KDFWR	Sep-00	NS				487197
Black Snake Branch	05130101	Bell	0.0 - 2.0	x	x						USFWS; KDFWR; Coal	Jun-94	FS				487425
Blake Fork	05130101	Whitley	0.0 - 4.6	x							KDFWR	Aug-00	Maybe				510776
Breedens Creek	05130101	Harlan	0.0 - 2.2	x	x						USFWS; Coal	Jun-95	FS				510901
Brownies Creek	05130101	Bell	9.0 - 16.0	x	x	x					RR	Jul-00	FS				488020
Brush Creek	05130101	Knox	0.0 - 2.8	x							KDFWR	Aug-00	NS				488072
Buck Creek	05130101	Whitley	0.4 - 2.8	x	x						USFWS; Coal	Oct-90 - Oct-99	FS				510998
Bucks Branch	05130101	Whitley	0.0 - 2.3		x						USFS	Feb-94 - Sep-95	NS				511033
Bunches Creek	05130101	Whitley	0.0 - 3.3	x	x	x					RR	Jul-00	FS				511064
Cane Creek	05130101	Whitley	0.0 - 1.0		x						RR; NPS	Apr-00	FS				511185
Cannon Creek	05130101	Bell	5.8 - 7.7	x	x					x	KSNPC; Coal; DW	Jan-96	FS			FS	488885
Catron Creek	05130101	Harlan	0.0 - **8.5**	x				x			KDFWR; KDOW	May-98 - Oct-00	FS	NS			489099
Clear Creek	05130101	Bell	1.2 - 3.4	x	x	x					KDOW	Aug-00	FS				489616
Clear Fork	05130101	Whitley	0.0 - 2.9	x	x	x	x				KDOW	Apr 00 - Mar 01	FS				511399
Clover Fork	05130101	Harlan	1.6 - 8.5				x	x			KDOW; DMR	Oct-97 - Sept-01	FS	NS			511423
Clover Fork	05130101	Harlan	8.5 - 10.6					x		x	KDOW; DW	May 98 - Oct 00		NS		FS	511423
Clover Fork	05130101	Harlan	10.6 - 15.0					x			KDOW	May 98 - Oct 00		NS			511423
Clover Fork	05130101	Harlan	15.0 - 21.6	x	x	x					KDOW	Jul-00	FS				511423
Clover Fork	05130101	Harlan	29.1 - 30.3		x						Prob	Jul-00	PS				511423
Cloverlick Creek	05130101	Harlan	0.0 - 5.0	x							KDOW	carryover	NS				511427
Cogur Fork	05130101	McCreary	0.0 - 7.9	x	x	x					RR	Jul-00	FS				511453
Colliers Creek	05130101	Letcher	0.0 - 3.9	x	x						USFWS; Coal	Jun-89 - Oct-01	FS				485675
Craig Creek	05130101	Laurel	7.7 - 9.8		x						COE	Jul-00	FS				511617
Crane Creek	05130101	Harlan	0.0 - 2.3		x						COE	Jul-00	FS				490282
Cranks Creek	05130101	Harlan	1.9 - 2.5		x						COE	Jul-00	PS				490293
Cumberland River	05130101	Whitley	562.2 - 569.3		x	x	x		x	x	KDOW; DW	Jul-97 - Sept-00	FS		FS	FS	517018
Cumberland River	05130101	Whitley	574.8 - 587.9							x	DW	1999- 2001				FS	517018
Cumberland River	05130101	Whitley	635.5 - 649.6							x	DW	1999- 2001				FS	51708
Cumberland River	05130101	Bell	649.6 - 653.1					x			KDOW	May 98 - Oct 00		NS			517018
Cumberland River	05130101	Bell	653.1 - 654.4					x			KDOW	May 98 - Oct 00		FS			517018
Cumberland River	05130101	Harlan	660.1 - 666.7				x				KDOW	May-98 - Mar-01	PS				517018
Cumberland River	05130101	Harlan	674.9 - 684.8	x	x	x			x		KDOW	Sep-97 - Aug-00	FS		FS		517018
Cumberland River	05130101	Harlan	684.8 - 687.5					x			KDOW	May 98 - Oct 00		FS			517018
Cumberland River	05130101	Harlan	687.5 - 691.3					x			KDOW	May 98 - Oct 00		NS			517018
Cumberland River	05130101	Harlan	691.3 - 693.8					x			KDOW	May 98 - Oct 00		NS			517018
Cumberland River	05130101	Harlan	693.8 - 694.2					x			KDOW; DMR	Oct-97 - Sept-01		NS			517018
Dog Slaughter Creek	05130101	Whitley	0.0 - 1.1	x	x	x					RR	Jun-Jul-00	FS				511853

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Stream	Hydro Unit	County	Segment Milepoints	Sample Type[a] Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW	Program[b]	Date	Use Support[c] WAH	PCR	FC	DWS	GNIS
Upper Cumberland River (Cont.)																	
Eagle Creek	05130101	McCreary	0.0 - 6.3	x	x	x					RR	May-91 - Jul-00	FS				511976
East Fork Lynn Camp	05130101	Knox	0.0 - 4.5	x							KDFWR	Sep-00	PS				511990
Ewing Creek	05130101	Harlan	0.0 - 2.7		x						RR; NPS	Apr-00	NS				491860
Franks Creek	05130101	Letcher	3.0 - 4.8		x						RR; NPS	Apr-00	FS				492462
Fugitt Creek	05130101	Harlan	0.5 - 4.9	x	x	x					RR; Coal	1996 - Jul-00	FS				512261
Goodin Creek	05130101	Knox	2.1 - 2.3		x						Prob	Jul-00	PS				492978
Greasy Creek	05130101	Bell	0.0 - 3.7	x				x			KDOW; KDFWR	1994 - Aug-00	Maybe	PS			493234
Hatchell Branch	05130101	McCreary	0.0 - 1.0		x						RR; NPS	Apr-00	PS				512583
Indian Creek	05130101	McCreary	2.3 - 6.7	x	x	x					RR; KDFWR	Jul-Aug-00	FS				512901
Jackie Branch	05130101	Whitley	0.0 - 1.7		x						RR; NPS	Apr-00	FS				512948
Jellico Creek	05130101	Whitley	0.0 - 4.6	x	x	x					KDOW	Sep-00	FS				512988
Jellico Creek	05130101	Whitley	4.6 - 5.8				x				KDOW	Apr-00 - Mar-01	FS				512988
Jenneys Branch	05130101	McCreary	0.0 - 3.4		x						Prob	Aug-00	PS				512993
Kilburn Fork	05130101	McCreary	0.0 - 6.3	x	x						USFS; KSNPC; USFWS	Jun-94 - Jul-99	FS				513138
Laurel Creek	05130101	McCreary	0.0 - 9.2	x							KDFWR	Aug-00	FS				513239
Laurel Fork	05130101	Whitley	4.3 - 10.3	x							KSNPC; RR	Jun-94 - Aug-01	FS				496040
Laurel Fork	05130101	Whitley	10.3 - 13.9	x							KDFWR	Aug-00	NS				496040
Laurel Fork	05130101	Whitley	16.9 - 19.1	x							KSNPC	Jun-94	FS				496040
Laurel Fork	05130101	McCreary	0.0 - 2.2	x							KDFWR	Aug-00	FS				513244
Laurel River	05130101	Laurel	0.0 - 2.3		x						COE	Jul-00	NS				513263
Laurel River	05130101	Laurel	24.9 - 27.9		x						COE	Jul-00	NS				513263
Laurel River	05130101	Laurel	31.7 - 36.6				x				KDOW	Apr-00 - Mar-01	FS				513263
Laurel River	05130101	Laurel	36.6 - 46.3	x	x		x				KDOW	Jul-00	NS				513263
Left Fork Straight Creek	05130101	Bell	0.0 - 6.5	x							KDFWR	Jul-00	NS				513326
Little Clear Creek	05130101	Bell	0.0 - 2.9	x	x						KDOW	1994	PS				496670
Little Laurel River	05130101	Laurel	0.0 - 8.3	x	x	x	x				KDOW; COE; TMDL	Apr-00 - Mar-01	NS				513497
Little Laurel River	05130101	Laurel	8.3 - 12.4	x							KDFWR	Sep-00	NS				513497
Little Laurel River	05130101	Laurel	12.4 - 14.6				x				TMDL	Apr-00 - Mar-01	NS				513497
Little Poplar Creek	05130101	Knox	0.0 - 2.8	x							KDFWR	Aug-00	PS				496830
Looney Creek	05130101	Harlan	0.0 - 2.8					x			KDOW	May-98 - Oct-00		NS			497165
Looney Creek	05130101	Harlan	3.8 - 5.5					x			KDOW	May 98 - Oct 00		PS			497165
Lynn Camp Creek	05130101	Laurel	0.8 - 2.9		x			x			COE; KDOW	May-96 - Jul-00	NS	NS			513739
Lynn Camp Creek	05130101	Knox	4.6 - 10.7	x							KDFWR	Sep-00	PS				513739
Marsh Creek	05130101	McCreary	0.0 - 8.6	x	x	x	x				KDOW	Apr-00 - Mar-01	FS				513798
Marsh Creek	05130101	McCreary	8.6 - 13.3	x	x	x					RR	Jul-00	FS				513798
Martins Fork	05130101	Harlan	0.0 - 1.2				x	x			KDOW	May-98 - Oct-00	FS	NS			497628
Martins Fork	05130101	Harlan	1.2 - 7.0		x						Prob	Jul-00	FS				497628
Martins Fork	05130101	Harlan	10.2 - 17.0		x					x	COE; DW	Jul-00	PS			FS	497628
Martins Fork	05130101	Harlan	17.0 - 19.8		x						COE	Jul-00	FS				497628
Martins Fork	05130101	Harlan	25.0 - 37.2	x	x	x					KDOW; Prob	Jul-Aug-00	FS				497628
MeaKDOW Creek	05130101	Whitley	0.0 - 6.8	x							KDFWR	Sep-00	PS				497981
Middle Fork Richland Creek	05130101	Knox	0.0 - 1.2	x							KDFWR	Sep-00	PS				498135
Mill Creek	05130101	McCreary	0.0 - 3.6	x							KDFWR	Jun-87	FS				513983
Moore Branch	05130101	Bell	0.0 - 0.4				x	x			DMR	Oct-97 - Sept-01	PS	PS			498528

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Stream	Hydro Unit	County	Segment Milepoints	Sample Type[a] Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW	Program[b]	Date	Use Support[c] WAH	PCR	FC	DWS	GNIS
Upper Cumberland River (Cont.)																	
Moore Creek	05130101	Knox	0.0 - 8.2	x	x						USFWS; KSNPC; Coal	Jun-94 - Jun-00	FS				498551
Mud Creek	05130101	Whitley	0.0 - 5.1	x							KDFWR	Aug-00	PS				514128
Mud Lick	05130101	Knox	0.0 - 2.2	x							KSNPC	Jun-93	FS				498997
North Fork Dog Slaughter Creek	05130101	Whitley	0.0 - 0.7	x	x	x					RR	Jul-00	FS				514288
Patterson Creek	05130101	Whitley	0.0 - 4.9	x							KDFWR	Sep-00	FS				514450
Patterson Creek	05130101	Whitley	7.4 - 8.6	x							KSNPC; USFWS	Jun-90	FS				514450
Poor Fork Cumberland River	05130101	Harlan	0.0 - 8.1	x	x	x	x		x	x	KDOW; DW	April-00 - Mar 01	FS		FS	FS	514707
Poor Fork Cumberland River	05130101	Harlan	14.9 - 16.3		x					x	Prob; DW	Jul-00	PS			FS	514707
Poor Fork Cumberland River	05130101	Harlan	16.3 - 23.7					x			KDOW	May-98 - Oct 00		NS			514707
Poor Fork Cumberland River	05130101	Harlan	25.1 - 27.5					x			KDOW	May-98 - Oct 00		NS			514707
Poor Fork Cumberland River	05130101	Letcher	41.4 - 51.7	x	x	x					RR	Jul-00	FS				514707
Presley House Br	05130101	Letcher	0.2 - 1.5		x						RR; NPS	Apr-00	FS				501293
Puckett Creek	05130101	Bell	0.0 - 5.1	x							KDFWR	Aug-00	FS				501413
Richland Creek	05130101	Knox	0.0 - 6.2	x			x				KDOW; KDFWR	Apr-00 - Mar-01	NS				514915
Richland Creek	05130101	Knox	11.2 - 14.3	x	x	x					KDOW	Jul-00	FS				514915
Robinson Creek	05130101	Laurel	8.2 - 11.8	x	x	x					KDOW	Jul-00	FS				515013
Rock Creek	05130101	McCreary	0.0 - 5.7	x	x						USFS; USFWS; KSNPC	Feb-93 - Aug-95	FS				515022
Ross Branch	05130101	Whitley	0.0 - 1.6	x							KSNPC; USFWS	Jun-85	FS				515113
Ryans Creek	05130101	McCreary	0.0 - 5.3	x							KDFWR; DSMRE	Feb-94 - Sep-95	NS	NS			515156
Shillalah Creek	05130101	Bell	0.0 - 5.5		x	x					RR	Jul-00	FS				503367
Sims Fork	05130101	Bell	0.0 - 5.2								Coal	Jun-94	NS				515430
South Fork Dog Slaughter Creek	05130101	Whitley	0.0 - 4.6	x	x	x					RR; KDFWR; KSNPC	Jun-90 - Jul-00	FS				515543
Stinking Creek	05130101	Knox	0.0 - 2.1	x	x	x					KDOW	Aug-00	PS				515716
Stoney Fork	05130101	Bell	0.0 - 2.4	x							KDFWR	Jul-00	NS				515733
Stony Fork	05130101	Bell	0.0 - 5.2	x							KDFWR	Aug-00	NS				504506
Straight Creek	05130101	Bell	0.0 - 1.7				x	x			KDOW	May-98 - Mar-01	FS	NS			515746
Straight Creek	05130101	Bell	4.0 - 11.3	x	x	x					KDOW	Aug-00	FS				515746
UT to Acorn Fork	05130101	Knox	0.0 - 0.9	x							Coal	Jun-00	FS				510201-1.8
UT to Bridge Fork	05130101	McCreary	0.0 - 0.1				x				DMR	Oct-97 - Sept-01	PS				510913-5.5
UT to Jenneys Branch	05130101	McCreary	0.0 - 1.1		x						RR; NPS	Apr-00	NS				512993-3.4
UT to Little Laurel River	05130101	Laurel	0.0 - 1.4		x						Prob	Jul-00	NS				513497-15.8
Watts Creek	05130101	Whitley	0.0 - 1.3	x	x	x					KDOW; KDFWR	Jul-Aug-00	FS				516250
Watts Creek	05130101	Harlan	2.2 - 4.3	x	x						NPS; KDFWR	Jun-94 - Mar-01	FS				516251
Whitley Branch	05130101	Laurel	0.0 - 1.0				x				KDOW	May-00 - Mar-01	NS				516339
Whitley Branch	05130101	Laurel	1.0 - 2.5					x			KDOW	1996-97		NS			516339
Wolf Creek	05130101	Whitley	0.0 - 1.8	x							KDFWR	Aug-00	NS				516433
Yellow Creek	05130101	Bell	0.1 - 0.8		x						Prob	Jul-00	PS				507211
Yellow Creek	05130101	Bell	0.8 - 3.2	x			x				KDFWR; KDOW	Jun-94; Apr-00 - Mar-01	PS				507211
Yellow Creek	05130101	Bell	8.9 - 10.3		x						Prob	Jul-00	FS				507211
Yellow Creek	05130101	Bell	14.9 - 16.0	x	x	x					KDOW; KDFWR	Aug-00	FS				507211
Yocum Creek	05130101	Harlan	0.0 - 6.5					x			KDOW	May-98 - Oct-00		NS			507228
Youngs Creek	05130101	Whitley	0.0 - 5.4	x							KDFWR	Aug-00	FS				516519

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Stream	Hydro Unit	County	Segment Milepoints	Sample Type[a]							Program[b]	Date	Use Support[c]				GNIS
				Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS	
Rockcastle River																	
Brush Creek	05130103	Rockcastle	1.1 - 7.5	x				x			USFS; Groundwater	1994-Aug-99	FS	NS			510966
Cane Creek	05130102	Laurel	0.0 - 11.5	x	x	x					RR; Prob	Jun-92 - Jul-00	FS				511189
Clear Creek	05130102	Rockcastle	3.4 - 6.4		x						USFS	May-00	FS				511394
Crooked Creek	05130102	Rockcastle	6.4 - 12.2		x						USFS	May-95	FS				511648
Dry Fork	05130102	Rockcastle	0.0 - 3.4	x							KDFWR	Aug-00	FS				511923
Horse Lick Creek	05130102	Jackson	0.0 - 12.2	x	x	x	x				USFS; RR; KDOW	Oct 92 - Mar-01	Maybe				512798
Laurel Fork	05130102	Jackson	0.0 - 12.2	x	x	x					RR; KSNPC; EKU	Jun-88 - Jul-00	FS				513257
Line Creek	05130102	Pulaski	0.0 - 1.6		x						USFS	Jun-00	FS				513433
Little Rockcastle River	05130102	Laurel	0.0 - 2.1	x	x	x					KDOW	Jul-00	FS				513518
Martin Creek	05130102	Clay	0.0 - 1.2	x							KDFWR	Aug-00	FS				513806
McCammon Branch	05130102	Jackson	0.0 - 2.7		x						USFS	May-00	FS				513844
Middle Fork Rockcastle River	05130102	Jackson	0.0 - 7.8	x	x	x	x				RR; KDOW	Apr-00 - Mar-01	FS				513937
Mitchell Creek	05130102	Laurel	0.0 - 3.6	x	x						EKU	Jun-Oct-99	NS				514033
Ned Branch	05130102	Laurel	0.0 - 1.9	x							KSNPC	Jun-93	FS				514209
Peter Branch	05130102	Jackson	0.0 - 1.2		x						USFS	Mar-94 - Feb-95	FS				514506
Pond Creek	05130102	Jackson	0.0 - 6.3	x							KDFWR	Aug-00	FS				514692
Powder Mill Creek	05130102	Laurel	0.0 - 4.6	x	x						EKU	Jun-Oct-99	FS				514748
Raccoon Creek	05130102	Laurel	0.0 - 2.7	x							KDFWR	Aug-00	PS				514818
Renfro Creek	05130102	Rockcastle	0.0 - 3.0	x							KDFWR	Aug-00	PS				514888
Rockcastle River	05130102	Laurel	12.5 - 16.9		x						USFS	Jun-00	FS				515038
Rockcastle River	05130102	Rockcastle	16.9 - 31.2	x	x	x	x		x		KDOW; COE	Oct-97 - Mar-01	FS		FS		515038
Rockcastle River	05130102	Rockcastle	43.9 - 51.5	x	x	x					KDOW	Aug-00	FS				515038
Roundstone Creek	05130102	Rockcastle	0.0 - 2.6				x				KDOW	April-00 - Mar-01	FS				515136
Roundstone Creek	05130102	Rockcastle	4.7 - 6.0	x	x	x					KDOW	Jun-00	FS				515136
Roundstone Creek	05130102	Rockcastle	16.9 - 23.7	x							KDFWR	Aug-00	PS				515136
Sinking Creek	05130102	Laurel	0.0 - 9.8	x	x	x					RR; USFS; EKU	Jun-99 - Sep-00	FS				515433
Sinking Creek	05130102	Laurel	9.8 - 13.1		x						USFS	Jun-00	FS				515433
Sinking Creek	05130102	Laurel	13.1 - 16.0	x	x						EKU	Jun-99 - Oct-99	FS				515433
Skegg Creek	05130102	Rockcastle	0.0 - 3.2	x		x					KDOW	Jun-00	PS				515451
Skegg Creek	05130102	Rockcastle	3.3 - 10.9	x							KDFWR	Aug-00	FS				515451
South Fork Rockcastle River	05130102	Jackson	4.4 - 5.6	x	x	x	x				KDOW; Prob	Apr-00 - Mar-01	FS				515548
South Fork Rockcastle River	05130102	Laurel	20.8 - 21.5		x						Prob	Jul-00	NS				515548
South Fork Rockcastle River	05130102	Laurel	21.5 - 25.5	x							KDFWR	Aug-00	PS				515548
UT to Pond Creek	05130102	Jackson	0.0 - 0.2				x				DMR	Oct-97 - Sep-01	PS				514692-6.0
UT to Pond Creek	05130102	Jackson	0.0 - 0.2				x	x			DMR	Oct-97 - Sep-01	PS	PS			514692-7.6
White Oak Creek	05130102	Laurel	0.0 - 1.0		x						USFS	Jun-00	NS				516320
White Oak Creek	05130102	Laurel	1.0 - 5.7	x	x						EKU	Jun-Oct-99	FS				516320
White Oak Creek	05130102	Rockcastle	0.9 - 1.9		x						Prob	Jul-00	FS				516322
Upper Cumberland River																	
Bear Creek	05130103	Cumberland	0.0 - 2.8	x							KDFWR	Jul-00	maybe				486551
Beaver Creek	05130103	McCreary	0.0 - 6.5	x	x	x					RR; USFS	Nov-93 - Jul-00	FS				510487
Beaver Creek	05130103	Wayne	21.0 - 21.4		x						COE	Jul-Aug-00	FS				510488
Beaver Creek	05130103	Wayne	21.4 - 38.8	x	x	x					KDOW	Jun-00	FS				510488

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]				GNIS
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS	
Upper Cumberland River (Cont.)																	
Bee Lick Creek	05130103	Pulaski	0.0 - 5.7	x							KDFWR	Sep-00	FS				486678
Big Clifty Creek	05130103	Pulaski	1.1 - 4.9	x							KDFWR	Sep-00	maybe				487156
Big Lily Creek	05130103	Russell	**4.7** - 11.0	x	x	x					KDOW	Jun-00	FS				487217
Big Renox Creek	05130103	Cumberland	0.0 - 5.8	x							KDFWR	Jul-00	PS				487232
Briary Creek	05130103	Pulaski	0.0 - 4.4	x							KDFWR; KDOW	May-Sep-00	PS				487880
Brushy Creek	05130103	Pulaski	0.0 - 7.8	x	x	x					RR; KDOW; KDFWR	May-99 -Sept-00	FS				510974
Buck Creek	05130103	Pulaski	5.0 - 32.1	x	x	x	x				RR; KDOW; Prob	May-92 - Jul-00	FS				511000
Buck Creek	05130103	Pulaski	32.0 - 39.2	x	x						Prob; EKU	May-96 - Jun-00	FS				511000
Buck Creek	05130103	Pulaski	39.2 - 44.9	x	x						EKU	May-Jul-96	FS				511000
Buck Creek	05130103	Pulaski	44.9 - 45.4	x	x	x			x		EKU; KDOW	May-96 - Sep-00	FS		PS		511000
Buck Creek	05130103	Pulaski	45.4 - 51.4	x	x						EKU	May-Jul-96	FS				511000
Buck Creek	05130103	Lincoln	52.8 - 58.6	x	x						EKU	May-Jul-96	FS				511000
Cane Branch	05130103	McCreary	0.0 - 2.0		x						USFS	Nov-93 - Aug-95	NS				511181
Casey Fork	05130103	Cumberland	0.0 - 2.0	x							KDFWR	Jun-00	FS				489048
Clifty Creek	05130103	Pulaski	0.0 - 2.7	x							KDOW	Jun-99	FS				511409
Crab Orchard Creek	05130103	Pulaski	0.0 - 1.0	x							KDOW	May-98 - May-00	FS				490243
Crocus Creek	05130103	Cumberland	0.0 - 4.8				x	x			KDOW	Apr-00 - Mar-01	FS	FS			490359
Crocus Creek	05130103	Cumberland	4.8 - 13.8		x						Prob	Jul-00	PS				490359
Crocus Creek	05130103	Adair	13.8 - 16.9	x							KDFWR	Jul-00	PS				490359
Cumberland River	05130103	Russell	385.6 - 460.7				x	x		x	KDOW; DW	Oct-98 - Mar-01	FS	FS		FS	517018
Dry Branch	05130103	Pulaski	0.0 - 0.3				x				DMR	Oct-97 - Sep-01	PS				491160
Elk Spring Creek	05130103	Wayne	0.0 - 7.8	x							KDFWR	Aug-00	NS				491678
Ferris Fork Creek	05130103	Cumberland	0.0 - 1.2		x						Prob	Jun-00	NS				492053
Fishing Creek	05130103	Pulaski	17.3 - 27.1	x	x	x					KDOW	Jun-00	FS				492127
Gilmore Creek	05130103	Lincoln	0.0 - 4.7	x							KDOW	May-98	PS				492855
Harrods Fork	05130103	Cumberland	0.0 - 5.3	x							KDFWR	Jul-00	FS				493829
Helton Branch	05130103	McCreary	0.0 - 1.0	x	x						USFS	Oct-93 - Sep-95	FS				512642
Indian Creek	05130103	Pulaski	0.0 - 4.1	x							KDOW	Sep-97 - May-00	PS				494919
Kettle Creek	05130103	Monroe	0.0 - 6.8	x							KDFWR	Jul-00	maybe				495698
Little Hurricane Fork	05130103	McCreary	0.0 - 3.9		x						USFS	Oct-93 - Sept-95	FS				513491
Marrowbone Creek	05130103	Cumberland	0.0 - 2.8		x		x	x			Prob; KDOW	Apr-00 - Mar-01	PS	FS			497560
Marrowbone Creek	05130103	Cumberland	3.8 - 8.9	x	x	x					KDOW	Jun-00	FS				497560
Marrowbone Creek	05130103	Cumberland	8.9 - 13.5	dry							KDOW	Aug-00	NA				497560
Marrowbone Creek	05130103	Cumberland	13.5 - 15.2	x							KDFWR	Jun-00	FS				497560
McFarland Creek	05130103	Monroe	0.8 - 6.2	x							KDFWR	Jul-00	FS				497849
Meshack Creek	05130103	Monroe	0.0 - 2.8	x							KDFWR	Jul-00	FS				498082
Mud Camp Creek	05130103	Cumberland	0.0 - 1.3	x	x	x					RR	Jun-00	FS				498997
Otter Creek	05130103	Wayne	14.5 - 22.0	x	x	x					KDOW	Jul-00	FS				500027
Pilot Creek	05130103	Lincoln	0.7 - 2.5		x						Prob	Jun-00	FS				500639
Pitman Creek	05130103	Pulaski	4.6 - 5.7	x	x	x	x				COE; KDOW; DMR	Oct-97 - Sep-01	PS				514627
Pitman Creek	05130103	Pulaski	5.7 - 28.1	x	x	x					KDOW	Jul-00	FS				514627
Pitman Creek	05130103	Pulaski	25.1 - 26.0		x						Prob	Jul-00	FS				514627

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]				GNIS
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS	
Upper Cumberland River (Cont.)																	
Pointer Creek	05130103	Pulaski	0.2 - 3.9	x							KDFWR	Sep-00	FS				500996
Rock Lick Creek	05130103	Pulaski	0.0 - 8.2	x							KDFWR	Sep-00	FS				502134
Sam Branch	05130103	Pulaski	0.1 - 0.5		x						Prob	Jun-00	PS				502871
Sinking Creek	05130103	Pulaski	0.0 - 1.8	x	x						KDOW	Oct-95	FS				503560
UT to Caney Fork	05130103	Russell	0.0 - 0.6		x						Prob	Jul-00	FS				488859-8.95
UT to Clifty Creek	05130103	Pulaski	0.0 - 0.5					x			DMR	Oct-97 - Sep-01		PS			511409-6.4
Wildcat Branch	05130103	Pulaski	0.0 - 2.1		x						USFS	Dec-93 - Jun-95	NS	NS			516359
South Fork Cumberland River																	
Bear Creek	05130104	McCreary	0.0 - 3.2	x	x						NPS	1996	NS				510462
Coffey Branch	05130104	McCreary	0.1 - 1.4		x						RR; NPS	Apr-00	FS				511447
Copperas Fork	05130104	McCreary	0.0 - 3.8		x						USFS	Feb-94 - Aug-95	NS				511533
Difficulty Creek	05130104	McCreary	0.0 - 3.5	x							KDFWR	Jun-96	FS				5130104
Little South Fork Cumberland River	05130104	McCreary	4.1 - 6.8		x						KDOW; COE	Jul-92 - Aug-00	FS				513527
Little South Fork Cumberland River	05130104	McCreary	6.8 - 9.3	x	x	x			x		KDOW	Sep-00	FS		FS		513527
Little South Fork Cumberland River	05130104	McCreary	14.9 - 16.3		x						Prob	Jul-00	Maybe				513527
Little South Fork Cumberland River	05130104	Wayne	18.3 - 35.6	x	x	x					RR	Jul-92 - July-00	FS				513527
Puncheoncamp Branch	05130104	McCreary	0.0 - 1.9		x						RR; NPS	May-00	FS				514797
Roaring Paunch Creek	05130104	McCreary	0.0 - 7.8	x	x	x					KDOW	Aug-00	FS				514993
Rock Creek	05130104	McCreary	0.0 - 4.1	x	x	x					KDOW	Sep-00	PS	PS			515024
Rock Creek	05130104	McCreary	4.1 - 11.1	x	x						NPS; KDFWR; KSNPC	Jun-94	FS				515024
Rock Creek	05130104	McCreary	16.6 - 21.9	x	x	x			x		KDOW	Aug-00	FS		PS		515024
South Fork Cumberland River	05130104	McCreary	43.9 - 49.5		x	x	x				KDOW	Oct-97 - Apr-01	FS				515542
South Fork Cumberland River	05130104	McCreary	49.5 - 55.1		x	x					KDOW	Aug-00	FS				515542
UT to Rock Creek	05130104	McCreary	0.0 - 1.4		x						RR; NPS	Apr-00	FS				515024-0.55
UT to Rock Creek	05130104	McCreary	0.0 - 1.2		x						RR	Apr-00	FS				515024-9.35
UT to Rock Creek	05130104	McCreary	0.0 - 1.9		x						RR; NPS	Apr-00	FS				515024-17.2
Watts Branch	05130104	McCreary	0.0 - 2.6		x						RR; NPS	Apr-00	FS				516249
Obey River/Dale Hollow Lake																	
Clear Fork Branch	05130105	Clinton	2.6 - 3.6					x			DMRs	Oct-98 - Sept 01		PS			489626
Hays Creek	05130105	Clinton	8.6 - 9.6		x						Prob	Jul-00	FS				493936
Howards Creek	05130105	Clinton	0.6 - 3.4	x	x	x					RR	Jun-00	FS				494681
Spring Creek	05130105	Clinton	2.5 - 3.7	x	x	x					RR; COE	Jul-Aug-00	FS				504128
Spring Creek	05130105	Clinton	3.7 - 7.3	x	x	x					RR; Prob	Nov-99 - Jun-00	FS				504128
Sulpher Creek	05130105	Clinton	1.7 - 5.1	x	x	x					RR	Jun-00	FS				504729
Lower Cumberland River																	
Casey Creek	05130205	Trigg	0.0 - 3.6		x			x			MSU; TMDL	Jun-00 - Oct-01	PS	FS			489043
Claylick Creek	05130205	Crittenden	2.0 - 4.8	x	x	x		x			RR; MSU	May-Oct-00	FS	NS			489591
Claylick Creek	05130205	Crittenden	4.8 - 10.6		x						MSU	Jun-00	maybe				489591
Claylick Creek	05130205	Crittenden	14.8 - 15.7		x						Prob	May-00	FS				489591
Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]				GNIS
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS	
Lower Cumberland River (Cont.)																	
Crooked Creek	05130205	Trigg	4.0 - 9.4	x	x	x					RR; TVA	Mar-96 - Jul-00	FS				490374

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Cumberland River	05130205	Livingston	0.0 - 30.5				x			x	ORSANCO; DW	Oct-97 - Sep-01	FS			FS	517018
Donaldson Creek	05130205	Trigg	6.0 - 9.6	x	x	x					RR; MSU	Mar-Jun-01	FS				491000
Donaldson Creek	05130205	Trigg	9.6 - 14.2		x						MSU	Jun-00	PS				491000
Dry Creek	05130205	Trigg	4.9 - 7.4		x						MSU	Jun-00	NS				491170
Dry Creek	05130205	Caldwell	0.0 - 3.5		x			x			MSU	May-Oct-00	PS	maybe			491176
Eddy Creek	05130205	Lyon	11.9 - 14.1					x			MSU	May-Oct-00		NS			491550
Eddy Creek	05130205	Caldwell	14.1 - 16.9		x						MSU	Jul-00	FS				491550
Eddy Creek	05130205	Caldwell	16.9 - 19.7		x			x			MSU; COE	May-Oct-00	PS	maybe			491550
Ferguson Creek	05130205	Livingston	0.0 - 1.1					x			MSU	May-Oct-00		NS			492034
Ferguson Creek	05130205	Livingston	1.1 - 2.2		x						MSU	Jun-00	PS				492034
Franklin Creek	05130205	Trigg	0.0 - 2.4	dry							KDOW	May-00	NA				492452
Fulton Creek	05130205	Lyon	2.6 - 6.0	x	x						TVA	Mar-96	FS				517018-52.7
Hammond Creek	05130205	Lyon	2.0 - 2.2								DMRs	Oct-98 - Oct-01	PS				493638
Hickory Creek	05130205	Livingston	0.0 - 3.8		x			x			MSU	May-Oct-00	FS	NS			494122
Kenady Creek	05130205	Trigg	0.0 - 3.9		x			x			MSU	May-Oct-00	PS	maybe			495638
Laura Furnace Creek	05130205	Trigg	0.0 - 2.9	dry							KDOW	May-00	NA				496992
Little River	05130205	Trigg	20.4 - 23.6		x						Prob; COE	Jun-Oct-00	NS				496838
Little River	05130205	Trigg	23.6 - 33.1	x	x	x	x	x	x		KDOW	Oct-98 - Oct-01	PS	FS	PS		496838
Little River	05130205	Trigg	33.1 - 34.4		x			x			Prob	Jun-00 - Oct-01	NS	PS			496838
Little River	05130205	Trigg	34.4 - 48.4		x			x			MSU; TMDL	Jul-00 - Oct-01	maybe	PS			496838
Little River	05130205	Christian	48.4 - 53.8		x						Prob	Jun-00	NS				496838
Little River	05130205	Christian	53.8 - 61.0		x			x			MSU; TMDL	Jun-00 - Oct-01	PS	NS			496838
Livingston Creek	05130205	Crittenden	4.6 - 7.0		x		x	x			KDOW; MSU	May-Oct-00	NS	NS			496913
Livingston Creek	05130205	Crittenden	11.6 - 15.4		x						MSU	Jun-00	PS				496913
Long Creek	05130205	Trigg	1.3 - 3.4	x	x						TVA	Mar-96	FS				497092
Long Pond Branch	05130205	Trigg	2.7 - 3.1		x						Prob	Jun-00	NS				497133
Lower Branch North Fork Little River	05130205	Christian	3.7 - 9.2		x						MSU	Jul-Dec-00	PS				497263
Muddy Fork Little River	05130205	Trigg	7.0 - 7.9				x	x			KDOW	Apr-00 - Mar-01	FS	FS			499043
Muddy Fork Little River	05130205	Trigg	14.5 - 26.6		x						MSU	Jun-00	NS				499043
North Fork Little River	05130205	Christian	0.0 - 0.3		x		x	x			MSU; TMDL; DMR	Oct-97 - Sep-01	NS	PS			499555
North Fork Little River	05130205	Christian	0.3 - 6.9		x						MSU	Jul-Sep-00	PS				499555
North Fork Little River	05130205	Christian	6.9 - 11.6		x		x				MSU; DMR	Oct-97 - Sep-01	NS				499555
North Fork Little River	05130205	Christian	11.6 - 12.3		x						Prob	Jun-00	NS				499555
North Fork Little River	05130205	Christian	12.3 - 18.6					x		x	TMDL; DW	Sept-00 - Oct-01		NS		FS	499555
Richland Creek	05130205	Livingston	0.6 - 5.3		x			x			MSU	May-Oct-00	maybe	NS			501820
Sandy Creek	05130205	Livingston	0.0 - 2.3		x			x			MSU	May-Oct-00	maybe	NS			502979
Sinking Fork	05130205	Trigg	2.2 - 5.6		x			x			KDOW; MSU	Apr-00 - Mar-01	PS	FS			503569
Sinking Fork	05130205	Christian	13.6 - 16.6		x						Prob	Jun-00	NS				503569
Sinking Fork	05130205	Christian	24.2 - 30.5		x						MSU	Jul-Sep-00	FS				503569
Skinframe Creek	05130205	Lyon	0.0 - 4.8		x						MSU	May-Oct-00	PS	NS			503607
Skinner Creek	05130205	Trigg	0.0 - 5.8		x						MSU	Jun-Sep-00	NS				503615
South Fork Little River	05130205	Christian	0.0 - 10.5		x			x			MSU; TMDL	Jul-00 - Oct-01	NS	NS			503934

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Stream	Hydro Unit	County	Segment Milepoints	Sample Type[a] Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW	Program[b]	Date	Use Support[c] WAH	PCR	FC	DWS	GNIS
Lower Cumberland River (Cont.)																	
South Fork Little River	05130205	Christian	10.5 - 19.9		x			x			MSU; TMDL	Jul-00 - Oct-01	PS	NS			503934
South Fork Little River	05130205	Christian	20.9 - 25.4		x						MSU	Jul-00	NS				503934
Spring Creek	05130205	Lyon	3.0 - 3.7		x						Prob	May-00	NS				504129
Sugar Creek	05130205	Christian	1.0 - 1.4		x						Prob	Jun-00	NS				504647
Sugar Creek	05130205	Livingston	2.1 - 6.7	x	x	x		x			RR; MSU	May-Oct-00	FS	PS			504655
Upper Branch North Fork Little River	05130205	Christian	0.0 - 2.7		x						MSU	Jun-Sep-00	PS				505861
Red River																	
Dry Fork Creek	05130206	Christian	5.0 - 5.8		x						Prob	Jun-00	NS				491216
Elk Fork	05130206	Todd	7.5 - 21.9	x	x	x					RR; KDRWR	Jul-Aug-00	FS				491660
Elk Fork	05130206	Todd	22.0 - 29.0	x							KDFWR	Jul-00	NS				491660
Little Whippoorwill Creek	05130206	Logan	0.0 - 4.2	x							KDFWR	Jun-00	FS				496894
Pleasant Grove Creek	05130206	Logan	0.0 - 2.2		x			x			NPS; UK(Curren)	Apr-94 - Apr-98	PS	NS			500832
Red River	05130206	Logan	50.1 - 54.2	x	x	x	x	x			KDFWR; KDOW	Aug-97 - Mar-01	PS	FS			501672
Red River	05130206	Logan	54.2 - 56.3	x							KDFWR	Jul-00	resample				501672
Red River	05130206	Logan	56.3 - 65.0	x	x	x			x		KDOW	Aug-00	FS		FS		501672
Red River	05130206	Logan	65.0 - 73.5	x							KDFWR	Jul-00	maybe				501672
Red River	05130206	Simpson	73.5 - 80.5	x							KDFWR	Jun-00	PS				501672
South Fork Red River	05130206	Logan	0.0 - 5.3	x							KDFWR	Jun-00	maybe				503943
South Fork Red River	05130206	Logan	5.3 - 6.5							x	DW	1998 - 2001				FS	503943
Sulpher Spring Creek	05130206	Simpson	0.0 - 6.6	x							KDFWR	Jun-00	FS				504760
West Fork Red River	05130206	Christian	14.5 - 26.4	x	x	x	x	x			RR; KDOW; KDFWR	Jun-94 - Apr-01	FS	FS			506445
Whippoorwill Cr	05130206	Logan	0.0 - 13.0	x	x	x	x	x			RR; KDOW	Oct-92 - Mar-01	FS	FS			506557
Ohio River Minor Tributaries																	
Bayou Creek	05140206	McCracken	0.0 - 6.5	x	x		x				UK; DOE	1988 - 2001	NS				486491
Clanton Creek	05140206	Ballard	0.0 - 4.9	x							KDFWR	Jul-00	NS				489524
Humphrey Creek	05140206	Ballard	0.0 - 3.4		x			x			MSU; Prob	May-Oct 00	PS	FS			494758
Humphrey Creek	05140206	Ballard	3.4 - 11.0	x	x	x		x			RR; MSU	May-Oct-00	FS	PS			494758
Humphrey Creek	05140206	Ballard	11.0 - 12.2				x	x			DMR	Oct-97 - Sep-01	PS	PS			494758
Little Bayou Creek	05140206	McCracken	0.0 - 6.5	x	x		x		x		UK; DOE		NS		PS		496607
Massac Creek	05140206	McCracken	3.6 - 4.2	x	x	x	x				RR; TMDL	May-00 - Mar-01	PS	FS			497670
Massac Creek	05140206	McCracken	4.2 - 7.1								Prob	May-00	FS				497670
Middle Fork Massac Creek	05140206	McCracken	0.0 - 6.2	x	x	x					RR	May-94 - May-00	FS				498130
Newtons Creek	05140206	McCracken	0.0 - 7.1	x							KDFWR	Jun-00	maybe				499457
UT to Humphrey Branch	05140206	Ballard	0.0 - 1.3				x	x			DMR	Oct-97 - Sep-01	PS	PS			494756-1.6
UT to Massac Creek	05140206	McCracken	0.0 - 0.4				x	x			DMR	Oct-97 - Sep-01	PS	PS			497670-5.2
UT to Massac Creek	05140206	McCracken	0.0 - 0.7				x	x			DMR	Oct-97 - Sep-01	PS	PS			497670-6.9
UT to Massac Creek	05140206	McCracken	0.0 - 1.7	x	x						DOW	Apr-02	FS				497670-12.1
UT to West Fork Massac Creek	05140206	McCracken	0.0 - 0.8				x	x			DMR	Oct-97 - Sep-01	PS	PS			506438-1.6
West Fork Massac Creek	05140206	McCracken	0.0 - 0.3				x				DMR	Oct-97 - Sep-01	PS				506438
West Fork Massac Creek	05140206	McCracken	0.3 - 5.4	x	x	x					RR	May-00	FS				506438

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]				GNIS
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS	
Tennessee River																	
Bear Creek	06040005	Marshall	3.1 - 6.3					x			MSU	May-Oct-00		NS			486553
Beechy Creek	06040005	Calloway	0.2 - 3.2	x	x						TVA	Jun-96 - Aug-00	FS				486757
Blood River	06040005	Calloway	8.3 - 15.7	x	x	x					RR	May-93 - May-00	FS				487489
Clear Creek	06040005	Marshall	1.7 - 2.7		x						Prob	May-00	maybe				489617
Jonathan Creek	06040005	Calloway	6.2 - 18.0	x	x						TVA	Mar-96 - Jun-99	PS				495443
Ledbetter Creek	06040005	Marshall	1.8 - 4.2	x	x						TVA	Mar-96	FS				496144
Little Jonathan Creek	06040005	Calloway	0.0 - 3.3	x	x						TVA	Mar-96 - Jul-99	FS				496775
Panther Creek	06040005	Calloway	0.2 - 5.1	x	x	x					TVA; RR	Jun-96 - Aug-00	FS				500152
Sugar Creek	06040005	Calloway	2.1 - 5.5		x						MSU	Jun-00	FS				504651
Turkey Creek	06040005	Trigg	1.0 - 3.0	x	x						TVA	Mar-96	FS				505586
Wildcat Creek	06040005	Calloway	1.6 - 6.3	x	x						TVA	Jun-96	FS				506731
Angle Creek	06040006	Marshall	0.0 - 0.7		x			x			MSU	May-Oct 00	PS	NS			485958
Bear Creek	06040006	Graves	0.6 - 1.6				x	x			DMR	Oct-97 - Sep-01	PS	PS			486552
Bee Creek	06040006	Calloway	0.0 - 1.8					x			MSU	May-Oct-00		NS			486666
Blizzard Pond	06040006	McCracken	0.0 - 3.7		x			x			MSU	May-Oct-00	maybe	NS			506426-1.4
Blizzard Pond	06040006	McCracken	4.5 - 5.5				x	x			DMR	Oct-97 - Sep-01	PS	PS			506426-1.4
Camp Creek	06040006	McCracken	0.0 - 5.4		x			x			MSU	May-Oct-00	PS	PS			488685
Champion Creek	06040006	McCracken	0.0 - 1.5	x	x						TVA	Jul-96 - Aug-00	NS				489324
Chestnut Creek	06040006	Marshall	0.0 - 3.0		x			x			MSU	May-Oct-00	PS	PS			489424
Clarks River	06040006	McCracken	5.0 - 12.7	x							TVA	Jul-94 - Aug-00	PS				489552
Clarks River	06040006	McCracken	12.7 - 19.3				x	x			KDOW	Apr-00 - Mar-01	FS	FS			489552
Clarks River	06040006	Marshall	26.6 - 28.4		x						Prob	Jun-00	FS				489552
Clarks River	06040006	Marshall	29.3 - 32.2	x							USFWS	Sep-Oct-00	FS				489552
Clarks River	06040006	Marshall	39.5 - 45.4	x							USFWS	Oct-00	FS				489552
Clarks River	06040006	Calloway	48.4 - 50.9		x		x				Prob; TMDL	May-00 - May-01	FS	FS			489552
Clarks River	06040006	Calloway	50.9 - 58.3	x	x	x			x		KDOW; TVA; USFWS	Jun-96 -Oct-00	PS		FS		489552
Clarks River	06040006	Calloway	58.3 - 61.9	x				x			USFWS; MSU	May-Oct-00	PS	PS			489552
Clayton Creek	06040006	Calloway	0.8 - 3.3		x						MSU	Jun-00	PS				489601
Clayton Creek	06040006	Calloway	3.3 - 7.1					x			MSU	May-Oct-00		NS			489601
Cypress Creek	06040006	Marshall	0.1 - 5.7				x	x			KDOW	Apr-00 - Mar-01	FS	FS			490528
Cypress Creek	06040006	Marshall	6.3 - 7.7		x						Prob	May-00	NS				490528
Cypress Creek	06040006	Marshall	7.7 - 9.7	x	x	x					KDOW	Aug-00	NS				490528
Damon Creek	06040006	Calloway	0.0 - 1.8		x			x			MSU	May-Oct-00	NS	NS			490545
Duncan Creek	06040006	Marshall	0.0 - 2.5		x			x			MSU	May-Oct-00	FS	maybe			491300
East Fork Clarks River	06040006	Calloway	0.0 - 2.7	x	x						TVA	May-96 - Aug-00	FS				491450
East Fork Clarks River	06040006	Calloway	5.7 - 6.7					x			DMR	Oct-97 - Sep-01		PS			491450
Guess Creek	06040006	Livingston	0.0 - 2.6	x	x						TVA	Jun-99	PS				493458
Island Creek	06040006	McCracken	1.0 - 5.5	x	x			x			TVA; MSU	Jul 96 - Oct 00	PS	NS			495045
Little Cypress Creek	06040006	Marshall	0.0 - 3.4		x			x			MSU	May-Oct-00	NS	PS			496700
Little Cypress Creek	06040006	Marshall	3.4 - 6.0		x						MSU	Jun-00	NS				496700
Little White Oak Creek	06040006	Marshall	0.9 - 1.9				x	x			DMR	Oct-97 - Sep-01	PS	PS			496895
Martin Creek	06040006	Marshall	0.0 - 0.9				x	x			DMR	Oct-97 - Sep-01	PS	PS			497627

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]				GNIS
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS	
Tennessee River (cont.)																	
Middle Fork Clarks River	06040006	Calloway	0.0 - 2.7	x	x			x			TVA; MSU	Jun-96 - Oct-00	PS	NS			498115
Middle Fork Clarks River	06040006	Calloway	2.7 - 4.9		x						Prob	May-00	PS				498115
Middle Fork Creek	06040006	Marshall	0.2 - 6.6		x			x			MSU	May- Oct-00	PS	NS			498118
Panther Creek	06040006	Graves	0.0 - 3.1	x	x	x	x	x			RR; KDOW; TVA	May-93 - Aug-00	FS	FS			500155
Panther Creek	06040006	Graves	3.1 - 4.2	x							KDFWR	Jun-00	FS				500155
Pryor Branch	06040006	Graves	0.0 - 3.0	x							KDFWR	Jun-00	FS				501399
Reeves Branch	06040006	Marshall	0.0 - 0.3		x						Prob	Jun-00	PS				501706
Rockhouse Creek	06040006	Calloway	0.0 - 4.9	x	x						TVA	Jun-96	FS				502188
Soldier Creek	06040006	Marshall	0.0 - 5.3	x	x	x					RR; TVA	May-94 - Aug-00	FS				503868
Spring Creek	06040006	Graves	0.0 - 1.8	x							KDFWR	Aug-00	PS				504124
Sugar Creek	06040006	Graves	0.0 - 4.0	x							KDFWR	Jun-00	FS				504652
Tennessee River	06040006	McCracken	4.3 - 10.1				x				USGS	Oct-97 - Sep-00	FS				517033
Tennessee River	06040006	McCracken	12.0 - 21.1	x							MSU	Jan-94 - ?	FS				517033
Tennessee River	06040006	McCracken	21.1 - 22.4	x							KDFWR	1998-2001	PS				517033
Trace Creek	06040006	Graves	0.0 - 3.0	x							KDFWR	Jun-94 - Jun-00	FS				505419
UT to Chestnut Creek	06040006	Marshall	0.0 - 0.7				x	x			DMR	Oct-97 - Sep-01	PS	PS			489424-2.8
UT to Old Beaver Dam Slough	06040006	Marshall	0.0 - 0.5		x						Prob	May-00	NS				499795-0.4
Wades Creek	06040006	Marshall	0.0 - 3.8	x	x						TVA	Jun-96	FS				506092
West Fork Clarks River	06040006	Graves	2.6 - 10.1		x			x			KDOW; MSU	May-Oct-00	FS	PS			506426
West Fork Clarks River	06040006	Graves	12.8 - 16.8		x			x			Prob; MSU	May-Oct-00	FS	NS			506426
West Fork Clarks River	06040006	Marshall	16.8 - 19.7		x						MSU	Jun-00	FS				506426
West Fork Clarks River	06040006	Marshall	19.7 - 22.7	x	x	x			x		TVA; KDOW	Jul-96 - Aug-00	FS		PS		506426
West Fork Clarks River	06040006	Calloway	22.7 - 27.3					x			MSU	May-Oct-00		PS			506426
West Fork Clarks River	06040006	Calloway	33.1 - 37.2		x						MSU	May-00	PS				506426
West Fork Clarks River	06040006	Graves	0.0 - 13.8	x							KDFWR	Jul-00	PS				506427
Mississippi River																	
Cane Creek	08010100	Ballard	0.0 - 3.8	x							KDFWR	Jul-00	PS				488772
Hazel Creek	08010100	Ballard	0.0 - 3.7	x							KDFWR	Jul-00	NS				493948
Shawnee Creek Slough	08010100	Ballard	0.0 - 3.0				x	x			KDOW	Apr-00 - Mar-01	NS	FS			503285
Shawnee Creek	08010100	Ballard	7.9 - 8.9				x	x			DMR	Oct-97 - Sep-01	PS	PS			503285
Shawnee Creek	08010100	Ballard	8.9 - 17.9	x	x	x					RR	May-95 - May-00	PS				503285
Bayou de Chien	08010201	Hickman	9.4 - 14.0				x	x			KDOW	Apr-00 - Mar-01	FS	FS			486489
Bayou de Chien	08010201	Fulton	14.0 - 25.9	x	x	x			x		RR; KDOW	Aug-00	FS		FS		486489
Brush Creek	08010201	Graves	0.0 - 8.3	x	x	x					RR	May-95 - May-00	PS				488070
Brush Creek	08010201	Hickman	0.0 - 6.0	x							KDFWR	Jul-00	PS				488071
Cane Creek	08010201	Hickman	0.0 - 5.4	x							KDFWR	Jul-00	PS				488768
Cane Creek	08010201	Graves	3.2 - 4.0				x	x			DMR	Oct-97 - Sep-01	PS	PS			488770
Central Creek	08010201	Carlisle	0.8 - 2.5					x			MSU	May-Oct-00		NS			489283
Cooley Creek	08010201	Graves	0.7 - 2.3					x			MSU	May-Oct-00		NS			490025
Gilbert Creek	08010201	Graves	1.8 - 3.5		x						Prob	Jun-00	NS				492817

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Stream	Hydro	County	Segment	Sample Type[a]							Program[b]	Date	Use Support[c]				GNIS
	Unit		Milepoints	Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW			WAH	PCR	FC	DWS	
Mississippi River (Cont.)																	
Goose Creek	08010201	Graves	0.0 - 4.4	x							KDFWR	Jun-00	PS				493008
Hurricane Creek	08010201	Carlisle	0.0 - 3.7	x							KDFWR	Jul-00	PS				494824
Jackson Creek	08010201	Graves	0.0 - 2.6	x	x	x					RR	May-00	FS				495118
Key Creek	08010201	Graves	0.0 - 1.8	x							KDFWR	Jun-00	maybe				495709
Lick Creek	08010201	Carlisle	0.0 - 2.2	x							KDFWR	Jul-00	maybe				496478
Little Bayou de Chien	08010201	Fulton	0.0 - 2.1		x						Prob	Aug-00	PS				496606
Little Bayou de Chien	08010201	Hickman	10.1 - 12.3		x						Prob	May-00	NS				496606
Little Creek	08010201	Carlisle	0.0 - 10.1	x							KDFWR	Jul-00	NS				496690
Little Cypress Creek	08010201	Hickman	5.8 - 9.3	x	x	x					RR	May-95 - Apr-01	FS				496697
Little Cypress Creek	08010201	Graves	0.0 - 2.0	x							KDFWR	Jun-00	NS				496699
Little Mud Creek	08010201	Fulton	0.0 - 1.8	x							KDFWR	Jul-00	PS				496810
Long Creek	08010201	Carlisle	0.0 - 0.8				x	x			DMR	Oct-97 - Sep-01	PS	PS			497091
Mayfield Creek	08010201	Carlisle	0.0 - 3.4	x							KDFWR	Jul-00	PS				497717
Mayfield Creek	08010201	Carlisle	8.2 - 13.5	x	x	x	x		x		KDOW	Apr-00 - Mar-01	NS		FS		497717
Mayfield Creek	08010201	Carlisle	13.5 - 14.8		x						Prob	Jun-00	NS				497717
Mayfield Creek	08010201	Carlisle	15.0 - 16.2		x						Prob	Jun-00	maybe				497717
Mayfield Creek	08010201	McCracken	17.4 - 32.9	x							KDFWR	Jun-00	PS				497717
Mayfield Creek	08010201	Graves	32.9 - 34.9	x							RR	Oct-00	PS				497717
Mayfield Creek	08010201	Graves	34.9 - 37.6				x	x			KDOW	Apr-00 - Mar-01	NS	FS			497717
Mayfield Creek	08010201	Calloway	57.7 - 59.8		x						Prob	May-00	NS				497717
Mud Creek	08010201	Fulton	0.0 - 6.4	x							KDFWR	Jul-00	NS				498982
Obion Creek	08010201	Fulton	1.3 - 15.8	x			x	x			KDFWR; KDOW	Apr-00 - Mar-01	NS	FS			499767
Obion Creek	08010201	Hickman	25.2 - 35.3	x	x	x					RR; NPS	Jun-00	FS				499767
Obion Creek	08010201	Hickman	38.6 - 42.0		x						NPS	May-00	NS				499767
Obion Creek	08010201	Hickman	42.0 - 47.6		x						NPS	May-02	PS				499767
Obion Creek	08010201	Hickman	47.6 - 53.2	x		x					KDOW	Aug-97; Aug-00	PS				499767
Opossum Creek	08010201	Graves	0.0 - 2.2	x							KDFWR	Jun-00	NS				499959
Sand Creek	08010201	Graves	0.0 - 3.6	x							KSNPC; USI	Oct-94	FS				502901
South Fork Bayou de Chien	08010201	Graves	2.0 - 7.2	x	x	x					RR	May-00	NS				503904
Stovall Creek	08010201	Ballard	0.0 - 3.8	x							KDFWR	Jul-00	FS				504539
Sugar Creek	08010201	Ballard	0.0 - 1.4	x							KDFWR	Jun-00	maybe				504653
Torian Creek	08010201	Graves	0.0 - 0.8				x	x			DMR	Oct-97 - Sep-01	PS	PS			505364
Truman Creek	08010201	Carlisle	2.0 - 3.0				x	x			DMR	Oct-97 - Sep-01	PS	PS			505525
UT to Mayfield Creek	08010201	Graves	1.1 - 3.5		x						Prob	Jun-00	NS				497717-25.6
UT to Mayfield Creek	08010201	McCracken	0.0 - 1.0		x						Prob	Jun-00	NS				497717-24.0
UT to Obion Creek	08010201	Hickman	1.6 - 2.2		x						Prob	May-00	NS				499767-16.3
West Fork Mayfield Creek	08010201	Carlisle	6.0 - 15.9			x					RR	May-95 - Apr-01	FS				506439
Wilson Creek	08010201	Carlisle	0.0 - 2.2				x	x			KDOW	Apr-00 - Mar-01	FS	FS			506898
Wilson Creek	08010201	Carlisle	2.2 - 8.0	x							KDFWR	Jul-00	FS				506898
Caldwell Creek	08010202	Graves	0.0 - 3.1	x							KDFWR	Jun-00	NS				488592
Knob Creek	08010202	Graves	1.1 - 2.2		x						Prob	Jun-00	NS				495836

Monitoring Results
Cumberland/Tennessee/Mississippi Basin Management Unit

Stream	Hydro Unit	County	Segment Milepoints	Sample Type[a] Fish	Macroinv	Algae	WQ	Fecal	Tissue	DW	Program[b]	Date	Use Support[c] WAH	PCR	FC	DWS	GNIS
Mississippi River (Cont.)																	
Running Slough	08010202	Fulton	0.0 - 15.3	x	x	x					RR	May-00	PS				502469
Terrapin Creek	08010202	Graves	2.8 - 7.0	x	x	x	x	x			KDOW; RR	May-95 - Oct-00	FS	FS			505081

[a]Macrinvert = macroinvertebrates WQ = water quality Fecal = fecal coliform bacteria Tissue = fish tissue
DW = finished drinking water data

[b]Coal = coal company data COE = U.S. Army Corps of Engineers DW = drinking water program of KDOW DMRs = discharge monitoring reports of permittees
KDOW = KY Division of Water KDFWR = KY Dept Fish & Wildlife Resources KSNPC = KY State Nature Preserves Comm. MSU = Murray State University
Prob = probability sampling of KDOW RR = reference reach program of KDOW TMDL = total maximum daily load development TVA = Tennessee Valley Authority
UK = University of Kentucky USFS = U.S. Forest Service USFWS = U.S. Fish & Wildlife Service USI = Univeristy of Southern Illinois
USGS = U.S. Geological Survey ORSANCO = Ohio River Valley Water Sanitation Com NPS = Nonpoint source program of KDOW

[c]WAH = warm water aquatic habitat PCR = primary contact recreation FC = fish consumption DWS = domestic water supply

Chapter 4. Lakes and Reservoirs

4.1 Introduction

Since the initiation of the rotating basin approach in 1998, the state's significant publicly owned reservoirs are monitored over a five-year cycle instead of the previous seven- to eight-year cycle. During this two-year reporting period, 19 reservoirs in the Salt and Licking river basins and 25 lakes and reservoirs in the Cumberland, Tennessee, and Mississippi river basins were monitored for trophic state and use support (Figures 4-1 through 4-14 in the back of this chapter). Most of the natural lakes in the state are shallow floodplain lakes and are found in the Mississippi River Basin.

Designated uses in lakes consist of Warm Water Aquatic Habitat (WAH) (sometimes in conjunction with Cold Water Aquatic Habitat (CAH) in lakes with a two-story fishery) and Primary and Secondary Contact Recreation (PCR and SCR). Many of the reservoirs also have a Domestic Water Supply (DWS) use.

4.2 Methods

Sampling was conducted seasonally three times during the growing season, typically in late April to early May, July, and late September to early October. Composite nutrient and chlorophyll *a* samples were collected from the photic zone (one percent of light penetration), and dissolved oxygen, temperature, pH, and specific conductivity measurements were obtained from profiles of the water column in the deepest part of the lake. Samples were taken in the area immediately upstream of the dam and at other locations on the main lake and major tributary embayments depending on the size and configuration of each reservoir. Trophic data also were provided by the U.S. Army Corps of Engineers (2001) and White et al. (1999) on lakes in the Cumberland basin management unit. TVA (2000, 2001) collected fecal coliform bacteria on 10 occasions from mid-June to mid-July in both 2000 and 2001 from 18 recreational locations in the Kentucky portion of Kentucky Lake.

4.3 Assessment of Trophic State and Use Support

Trophic status was assessed in lakes by using the Carlson Trophic State Index (TSI) for chlorophyll *a*. This method is convenient because it allows lakes to be ranked numerically according to increasing eutrophy, and it also provides for a distinction between oligotrophic, mesotrophic, eutrophic, and hyper-eutrophic lakes. The growing season (April – October) averaged TSI value was used to rank each lake. Areas of lakes that exhibited trophic gradients or embayment differences often were analyzed separately. Use support in lakes was determined by criteria listed in Table 4-1.

Table 4-1. Criteria for Lake Use Support Classification

Category	Warm Water Aquatic Habitat	Secondary Contact Water Recreation	Domestic Water Supply
Not Supporting:	(At least two of the following criteria)	(At least one of the following criteria)	(At least one of the following criteria)
	Fish kills caused by poor water quality	Widespread excess macrophyte/macro-scopic algal growth	Chronic taste and odor complaints caused by algae
	Severe hypolimnetic oxygen depletion	Chronic nuisance algal blooms	Chronic treatment problems caused by poor water quality
	Dissolved oxygen average less than 4 mg/l in the epilimnion		Exceeds drinking water MCL
Partially Supporting: (At least one of the following criteria)	Dissolved oxygen average less than 5 mg/l in the epilimnion	Localized or seasonally excessive macrophyte/macroscopic algal growth	Occasional taste and odor complaints caused by algae
	Severe hypolimnetic oxygen depletion	Occasional nuisance algal blooms	Occasional treatment problems caused by poor water quality
	Other specific cause (i.e. low pH)	High suspended sediment concentrations during the recreation season	
Fully Supporting:	None of the above	None of the above	None of the above

4.4 Results

4.4.1 Statewide

Tables 4-2, 4-3, and 4-4 present statewide summary statistics of use support and causes and sources of impairments of reservoirs and lakes in the state. The water quality assessment of lakes included more than 90 percent of the publicly owned lake acreage of Kentucky. Eighty-three of 123 lakes (67 percent) fully supported their uses, 33 (27 percent) partially supported uses, and 7 (6 percent) did not support one or more uses. On an acreage basis, more than 55 percent (120,372 acres) of the 217,597 assessed acres fully supported uses, 43 percent (93,311 acres) partially supported uses, and 2 percent (6,156 acres) did not support one or more uses (Table 4-2).

Mercury in fish tissue was the most frequent cause of uses in lakes not being fully supported (Table 4-3). Nutrients and organic enrichment/low dissolved oxygen were the second most frequent causes of use impairment, with agricultural runoff, land disposal, and septic tanks the principal sources of the nutrients (Table 4-4). A fish consumption advisory for PCBs affected one lake of considerable size (Green River Lake), resulting in a high percentage of lake acres impacted by priority organics (Table 4-3). Naturally shallow lake basins (habitat alterations and siltation when combined), which allow the proliferation of nuisance aquatic weeds that impair secondary contact recreation, accounted for the fifth highest cause of use nonsupport. Other natural conditions such as manganese releases from anoxic hypolimnetic water and nutrients in runoff from relatively undisturbed watersheds affected domestic water supply and secondary contact uses, respectively. Suspended solids from surface mining activities, which has decreased in severity as a source from previous years, impaired the secondary contact recreation use in only one eastern Kentucky reservoir.

4.4.2 Salt/Licking and Cumberland Basin Management Units

In the Salt/Licking unit, eleven reservoirs were eutrophic and eight were mesotrophic (Tables 4-5, 4-6, and 4-7). Eight of these reservoirs fully supported uses, nine partially supported uses, and two did not support uses (Figures 4-1 through 4-14 at the end of this chapter).

Table 4-2. Lake Use Support Summary, Acres (Number)

Use	Assessed	Fully Supporting	Partially Supporting	Not Supporting
Overall Support	217,597 (107)	120,372 (67)	93,311 (33)	3,914 (7)
Aquatic Life Support	217,597	207,646	6,176	3,775
Fish Consumption	203,513	115,688	87,825	0
Primary Contact Recreation	4,389	4,170	219	0
Secondary Contact Recreation	6,919	2,940	3,979	0
Drinking Water Supply	201,810	200,099	1,572	139

Table 4-3. Causes of Use Impairment in Lakes

Name	Acres Affected	Percent
Priority Organics	8,210	7
Metals	87,825	77
Nutrients	7,676	7
pH	219	<1
Siltation	1,368	1
Organic enrichment/Low DO	6,035	5
Other habitat alterations	413	<1
Taste and odor	811	1
Suspended solids	1,810	2
Algal Growth/Chlorophyll a	139	<1

Table 4-4. Sources of Impairment in Lakes

Name	Acres Affected	Percent
Industrial Point Sources	8,210	24
Municipal Point Sources	4,309	12
Agriculture	8,975	26
Resource Extraction	3,259	9
Land Disposal	4,196	12
Contaminated Sediments	18	<1
Internal nutrient cycling (primarily lakes)	3,366	10
Natural Sources	2,416	7

Table 4-5. Lakes in the Salt/Licking and Cumberland Basin Management Units Fully Supporting All Uses

Lake	Acres	County	Trophic State	Uses
Salt River Basin				
Beaver Lake	158	Anderson	Mesotrophic	WAH,PCR,SCR
Reformatory Lake	54	Oldham	Eutrophic	WAH,PCR,SCR
Sympson Lake	184	Nelson	Eutrophic	WAH,PCR,SCR,DWS
Long Run Lake	27	Jefferson	Mesotrophic	WAH,PCR,SCR
Willisburg Lake	126	Washington	Eutrophic	WAH,PCR,SCR
Licking River Basin				
A.J.Jolly (Campbell County) Lake	204	Campbell	Eutrophic	WAH,PCR,SCR
Lake Carnico	114	Nicholas	Mesotrophic	WAH,PCR,SCR
Williamstown Lake	300	Grant	Mesotrophic	WAH,PCR,SCR,DWS
Upper Cumberland River Basin				
Cannon Creek Lake	243	Bell	Oligotrophic	WAH,CAH,PCR,SCR,DWS
Chenoa Lake	37	Bell	Mesotrophic	WAH,PCR,SCR
Dale Hollow Reservoir	4300	Clinton	Oligotrophic	WAH,PCR,SCR
Lake Linville	273	Rockcastle	Eutrophic	WAH,PCR,SCR,DWS
Laurel Creek Lake	88	McCreary	Eutrophic	WAH,PCR,SCR,DWS
Laurel River Reservoir	6060	Whitley	Oligotrophic	WAH,CAH,PCR,SCR,DWS
Martins Fork Reservoir	334	Harlan	Oligotrophic	WAH,PCR,SCR
Tyner Lake	87	Jackson	Mesotrophic	WAH,CAH,PCR,SCR,DWS
Lower Cumberland River Basin				
Energy Lake	370	Trigg	Eutrophic	WAH,PCR,SCR
Honker Lake	190	Lyon	Hypereutrophic	WAH,PCR,SCR
Lake Barkley	45600	Lyon	Eutrophic	WAH,PCR,SCR,DWS
Lake Blythe	89	Christian	Mesotrophic	WAH,PCR,SCR,DWS
Lake Morris	170	Christian	Eutrophic	WAH,PCR,SCR,DWS
Tennessee River Basin				
Kentucky Lake	48100	Calloway	Eutrophic	WAH,PCR,SCR,DWS
Ohio River Basin				
Turner Lake	61	Ballard	Eutrophic	WAH,PCR,SCR
Buck Lake	19	Ballard	Eutrophic	WAH,PCR,SCR
Fish Lake	27	Ballard	Eutrophic	WAH,PCR,SCR
Long Pond	56	Ballard	Eutrophic	WAH,PCR,SCR
Mitchell Lake	58	Ballard	Eutrophic	WAH,PCR,SCR
Happy Hollow Lake	20	Ballard	Hypereutrophic	WAH,PCR,SCR
Mississippi River Basin				
Flat Lake	38	Ballard	Eutrophic	WAH,PCR,SCR
Burnt Pond	10	Ballard	Eutrophic	WAH,PCR,SCR
Beaverdam Lake	50	Ballard	Hypereutrophic	WAH,PCR,SCR
Shelby Lake	24	Ballard	Eutrophic	WAH,PCR,SCR
Arrowhead Lake	37	Ballard	Eutrophic	WAH,PCR,SCR

Table 4-6. Lakes in the Salt/Licking and Cumberland Basin Management Units Partially Supporting One or More Uses

Lake	Acres	County	Trophic State	Use Impaired[a]	Causes	Sources
Salt River Basin						
Marion Co Sportsman Lake	21	Marion	Mesotrophic	WAH	Nutrients	Other
McNeely Lake	51	Jefferson	Eutrophic	WAH FC	Nutrients Mercury	Internal Nutrient Cycling, Source Unknown
Lake Shelby	17	Shelby	Eutrophic	WAH	Nutrients	Agriculture, Internal Nutrient Cycling
Taylorsville Lake	3050	Spencer	Eutrophic	WAH	Nutrients	Agriculture
Licking River Basin						
Cave Run Lake	8270	Rowan	Mesotrophic	FC	Mercury	Source Unknown
Doe Run Lake	51	Kenton	Eutrophic	WAH	Nutrients	Source Unknown
Greenbriar Lake	66	Montgomery	Mesotrophic	WAH	Low DO	Agriculture, Natural Sources
Kincaid Lake	183	Pendleton	Mesotrophic	WAH	Nutrients	Source Unknown
Sand Lick Creek Lake	74	Fleming	Eutrophic	WAH	Low DO, Other Habitat Alterations	Agriculture, Internal Nutrient Cycling
Upper Cumberland River Basin						
Cranks Creek Lake	219	Harlan	Oligotrophic	WAH	pH	Abandoned Mine lands
Lake Cumberland	50250	Russell	Oligotrophic	FC	Mercury	Source Unknown
Wood Creek Lake	672	Laurel	Oligotrophic	DWS	Taste and Odor	Onsite Wastewater Systems (Septic tanks)
Ohio River Basin						
Metropolis Lake	36	McCracken	Eutrophic	FC	Mercury, PCBs	Source Unknown

[a] WAH = Warm Water Aquatic Life; FC = Fish Consumption; DWS = Domestic Water Supply

Of the 25 lakes and reservoirs monitored in the Cumberland unit, 19 fully supported uses, 3 partially supported uses, and 3 did not support uses (Tables 4-5, 4-6, and 4-7). The most common causes were mercury in fish tissue and nutrients (phosphorus, nitrogen, and carbon) that eventually result in depleted or lowered dissolved oxygen in the water column. In the Upper Cumberland River Basin, 2 reservoirs were eutrophic, 3 were mesotrophic, and 7 were oligotrophic. Of the other 13 lakes and reservoirs monitored in the Lower Cumberland, Tennessee, and Mississippi river basins, 2 were hyper-eutrophic, 10 were eutrophic, and 1 was mesotrophic.

Table 4-7. Lakes in the Salt/Licking and Cumberland Basin Management Units Not Supporting One Or More Uses

Lake	Acres	County	Trophic State	Use Impaired[a]	Causes	Sources
Salt River Basin						
Guist Creek Lake	317	Shelby	Eutrophic	WAH	Nutrients, Low Dissolved Oxygen	Agriculture, Natural Sources, Land Disposal, Onsite Wastewater Systems (Septic tanks)
Lake Jericho	137	Henry	Eutrophic	WAH	Nutrients	Agriculture
Upper Cumberland River Basin						
Corbin City Reservoir	139	Laurel	Mesotrophic	WAH	Nutrients, Algae Growth, Organic Enrichment/ Low Dissolved Oxygen	Agriculture, Internal Nutrient Cycling, Municipal Point Sources
				DWS	Taste and Odor	
Lower Cumberland River Basin						
Hematite Lake	90	Trigg	Eutrophic	WAH	Low Dissolved Oxygen	Natural Sources
Mississippi River Basin						
Swan Pond	193	Ballard	Eutrophic	WAH	Low Dissolved Oxygen	Agriculture, Natural Sources

[A] WAH = Warm Water Aquatic Habitat; DWS = domestic water supply

Figure 4-1. Reservoirs Monitored in the Licking River Basin

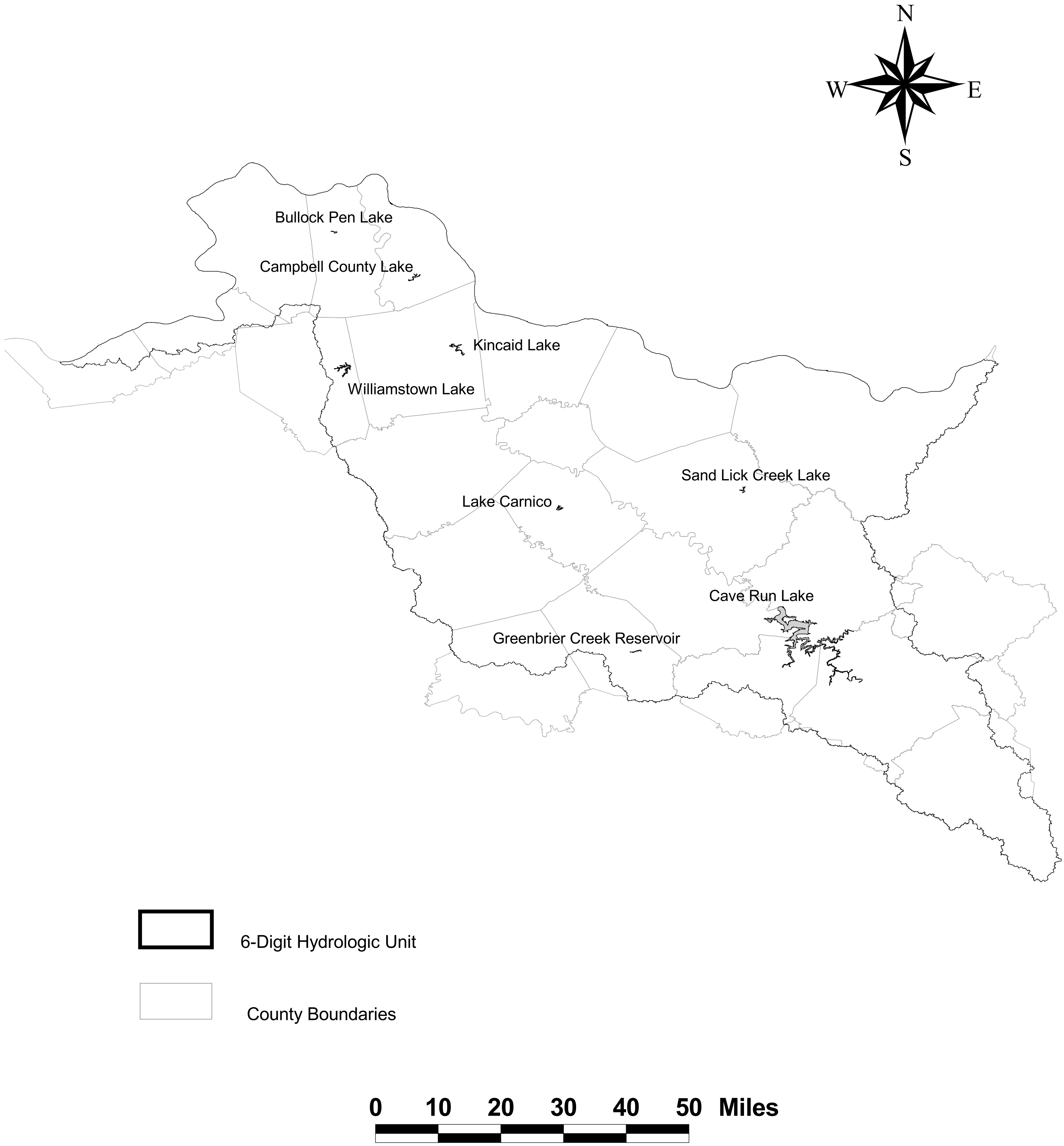


Figure 4-2. Monitoring Sites on Cave Run Lake

Figure 4-3. Monitoring Sites on Small Reservoirs in the Licking River Basin

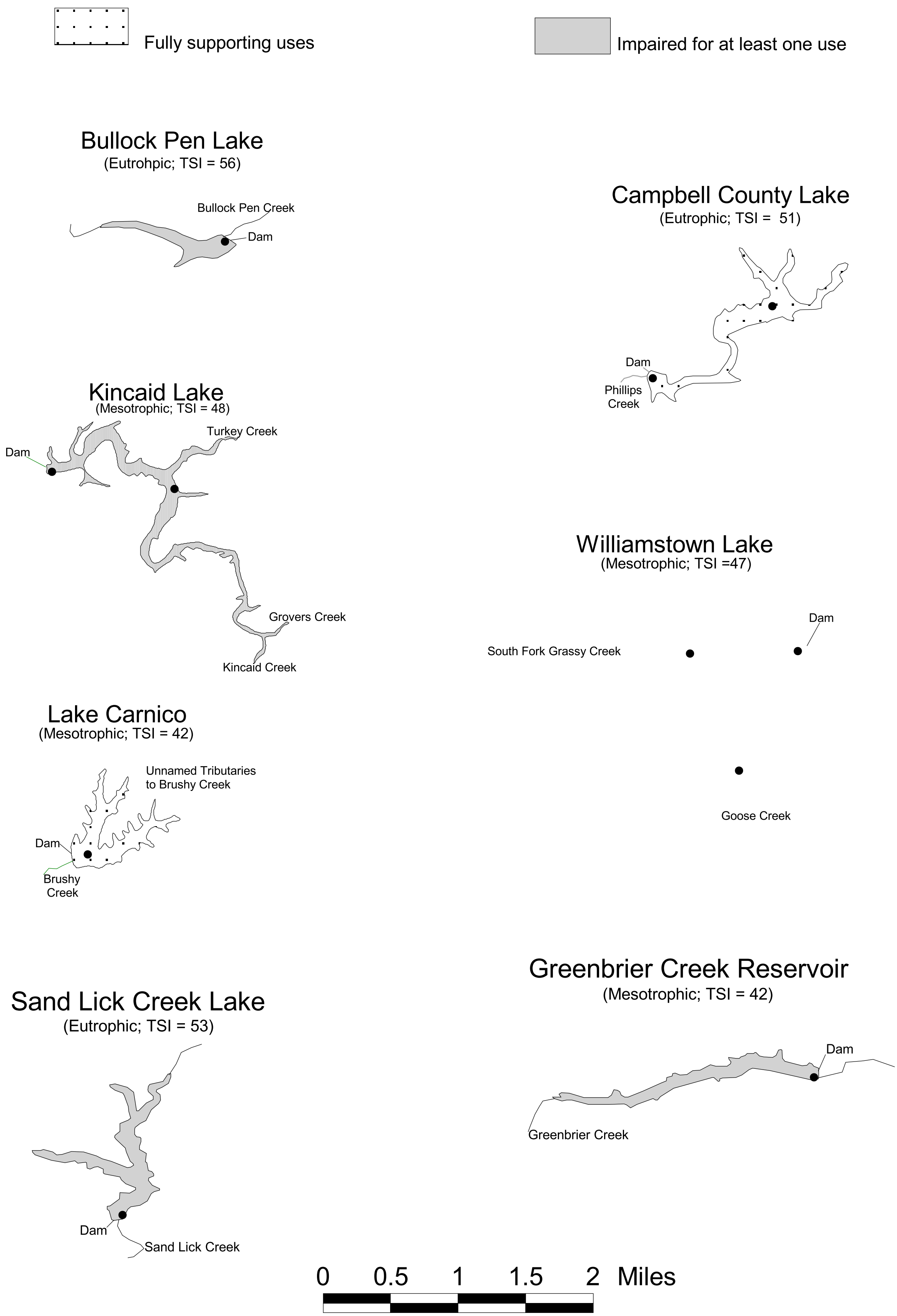


Figure 4-4. Reservoirs Monitored in the Salt River Basin

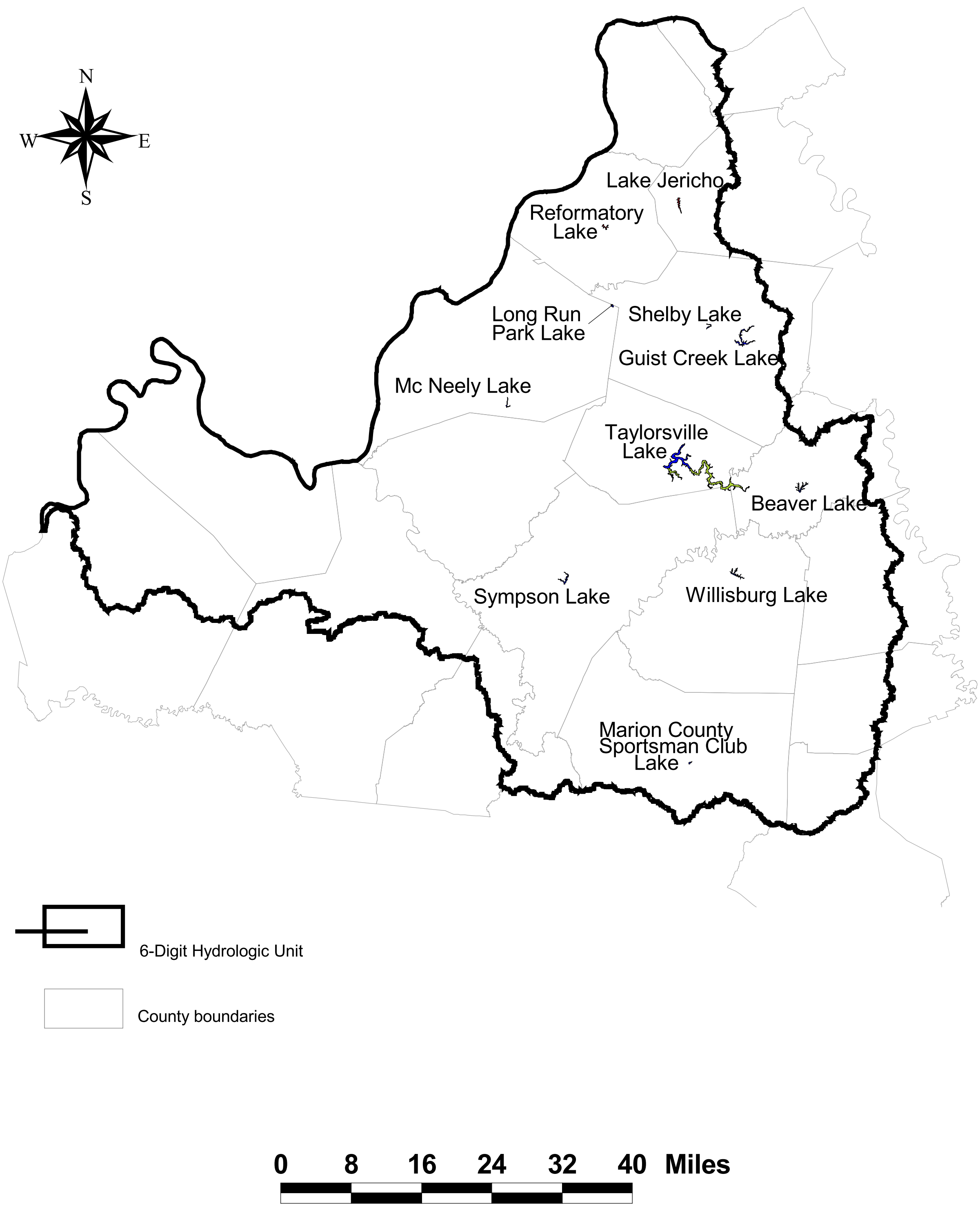


Figure 4-5. Monitoring Sites on Taylorsville Lake and Guist Creek Lake

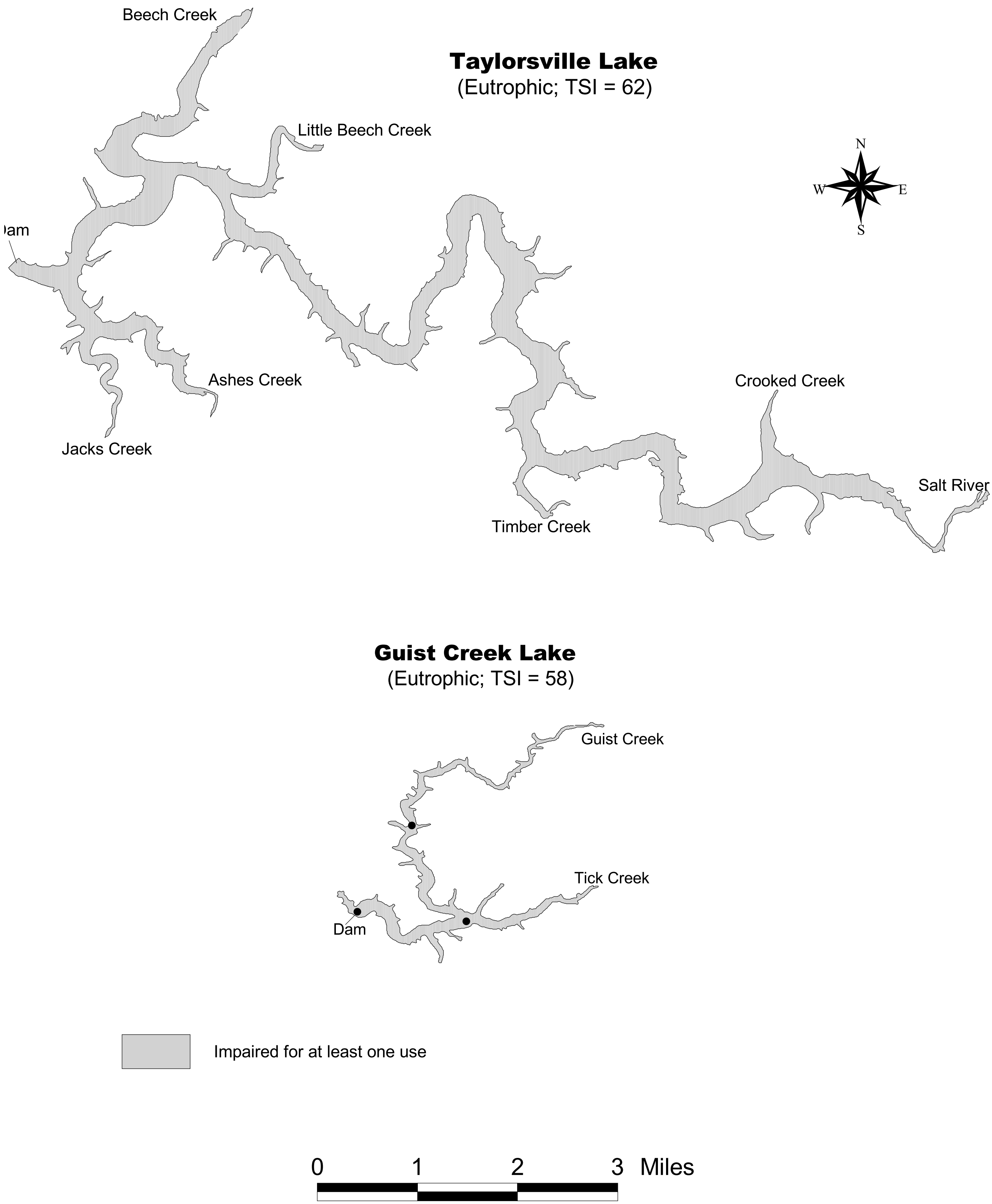


Figure 4-6. Monitoring Sites on Small Reservoirs in the Salt River Basin

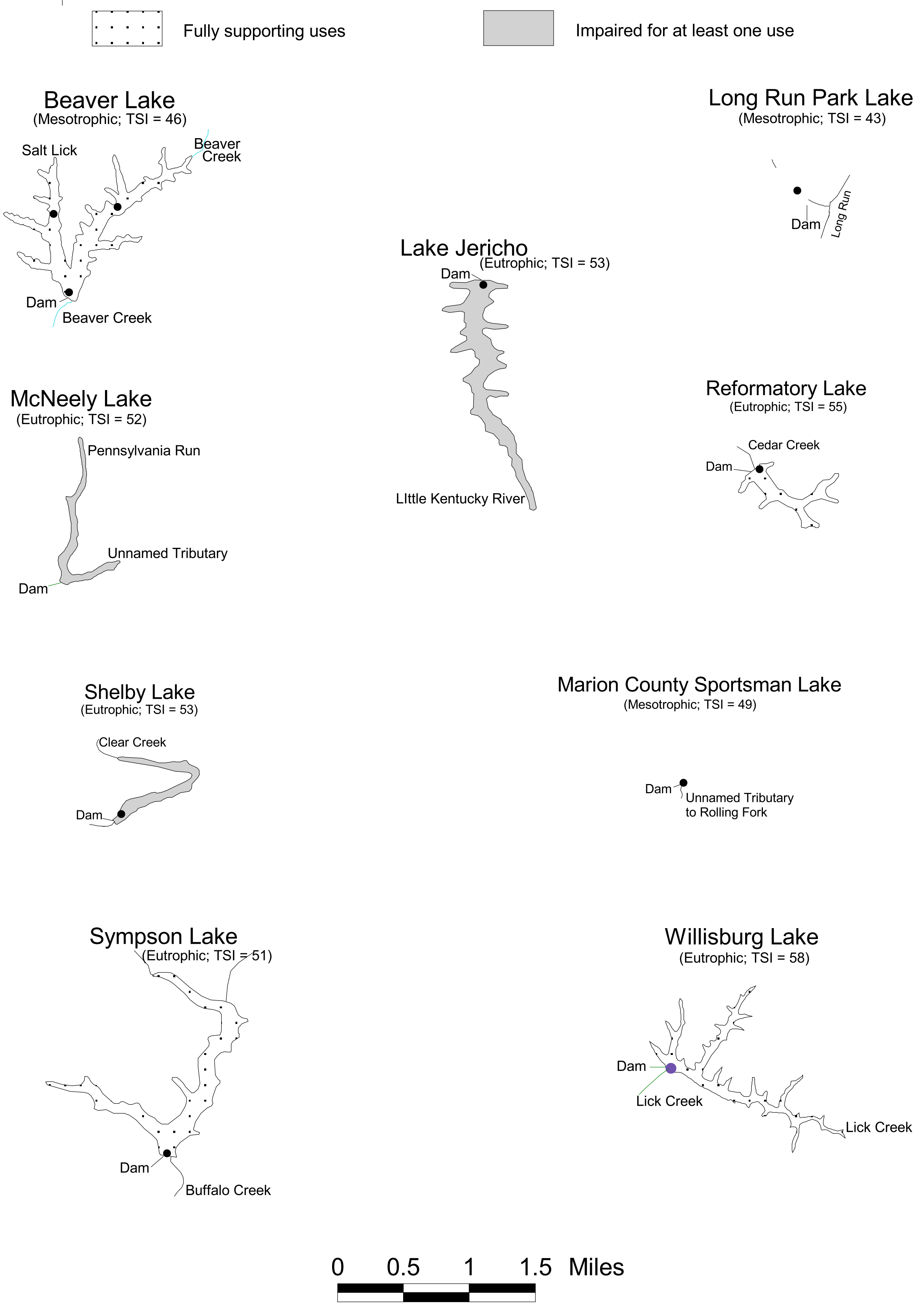


Figure 4-7. Reservoirs Monitored in the Upper Cumberland River Basin

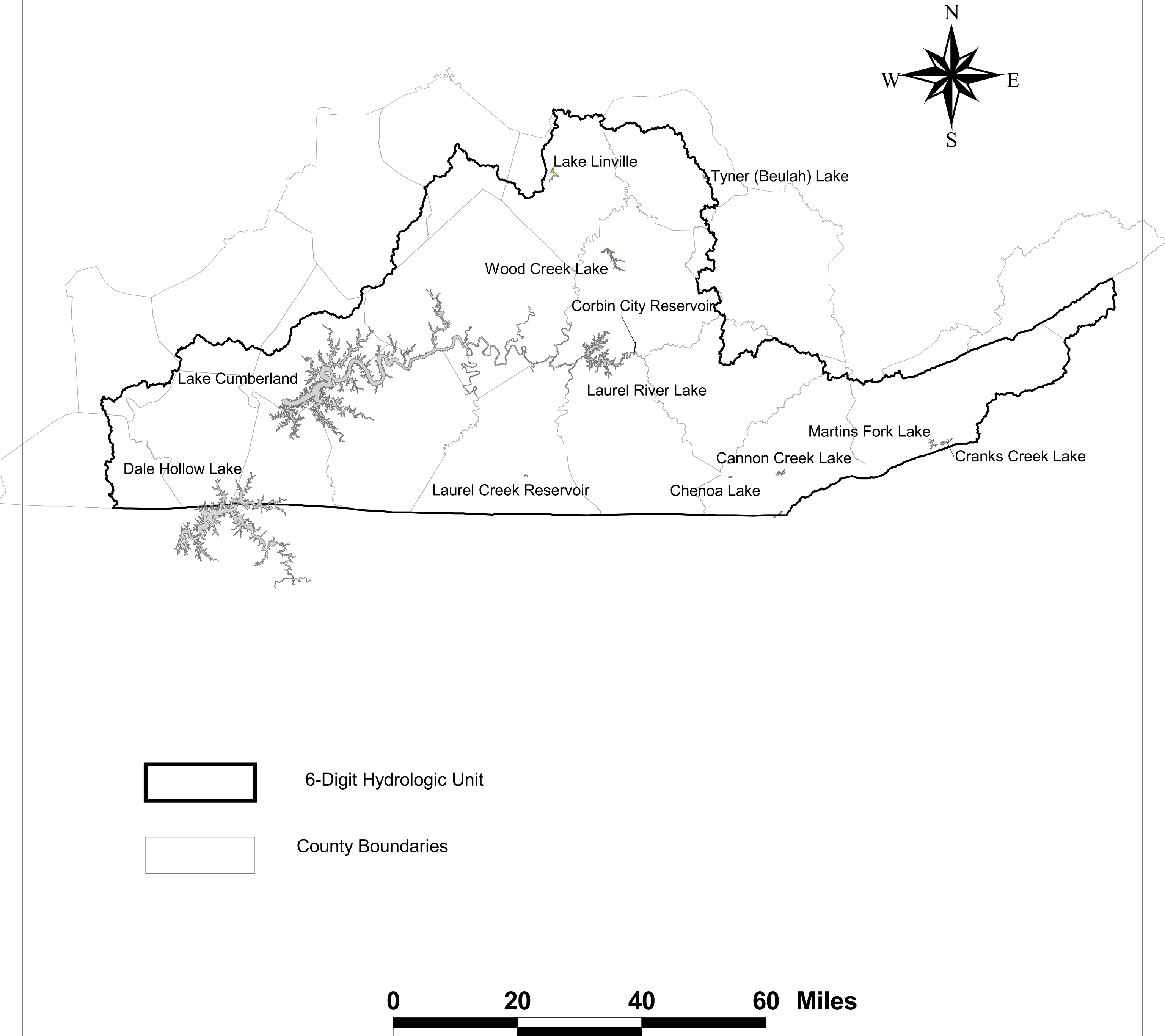


Figure 4-8. Monitoring Sites on Cumberland Lake and Dale Hollow Lake

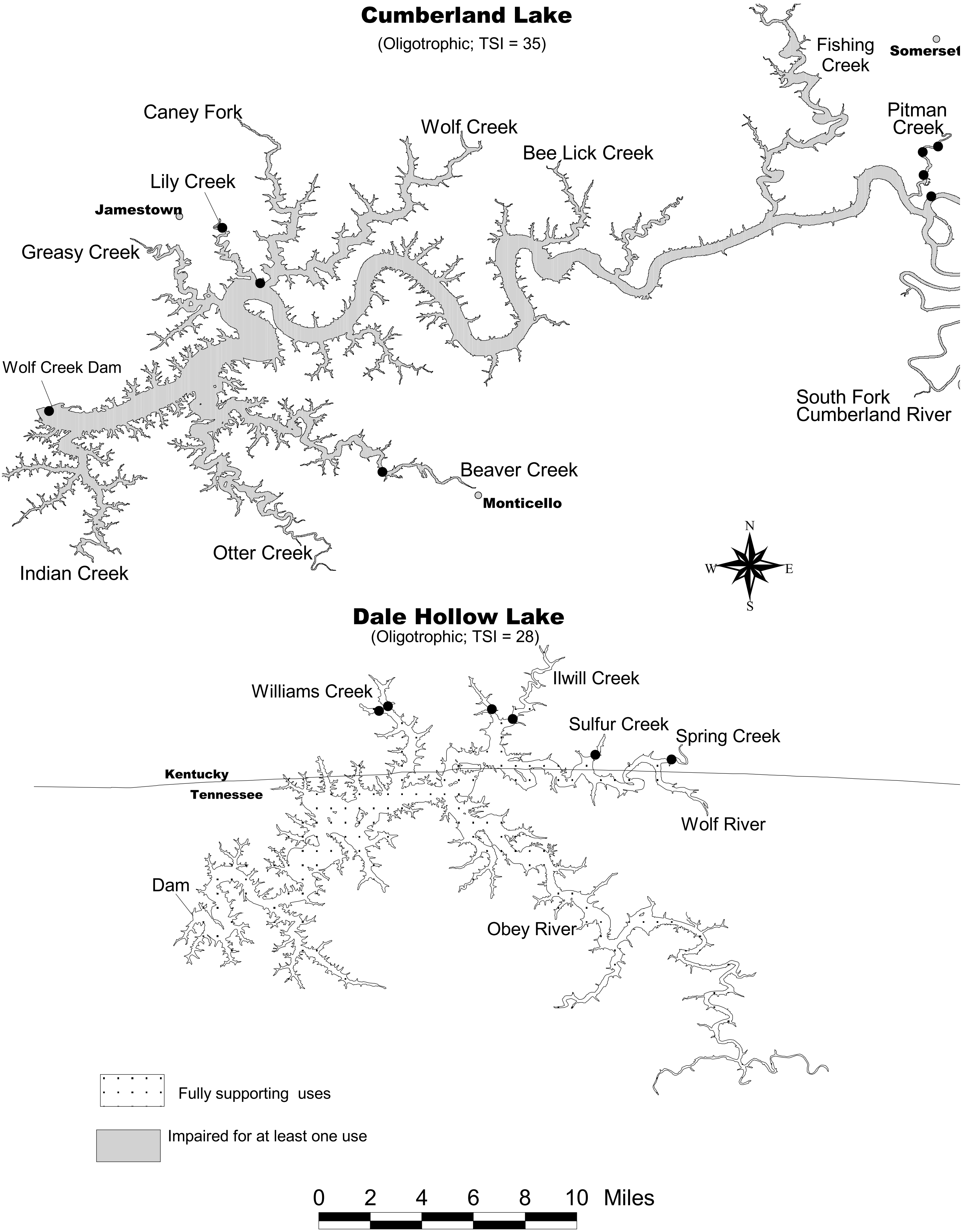


Figure 4-9. Monitoring Sites on Laurel River Lake and Wood Creek Lake

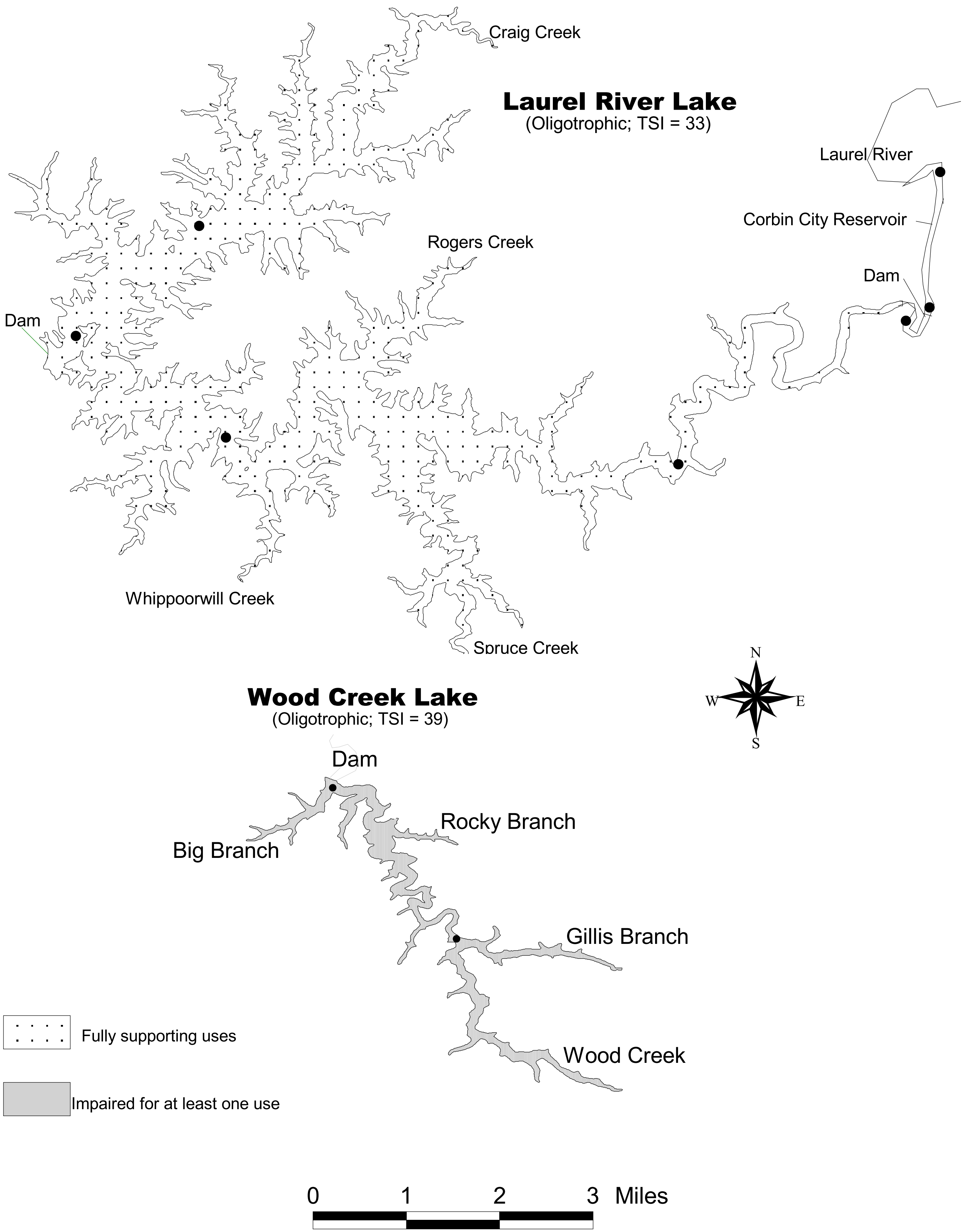


Figure 4-10. Monitoring Sites on Small Reservoirs in the Upper Cumberland River Basin

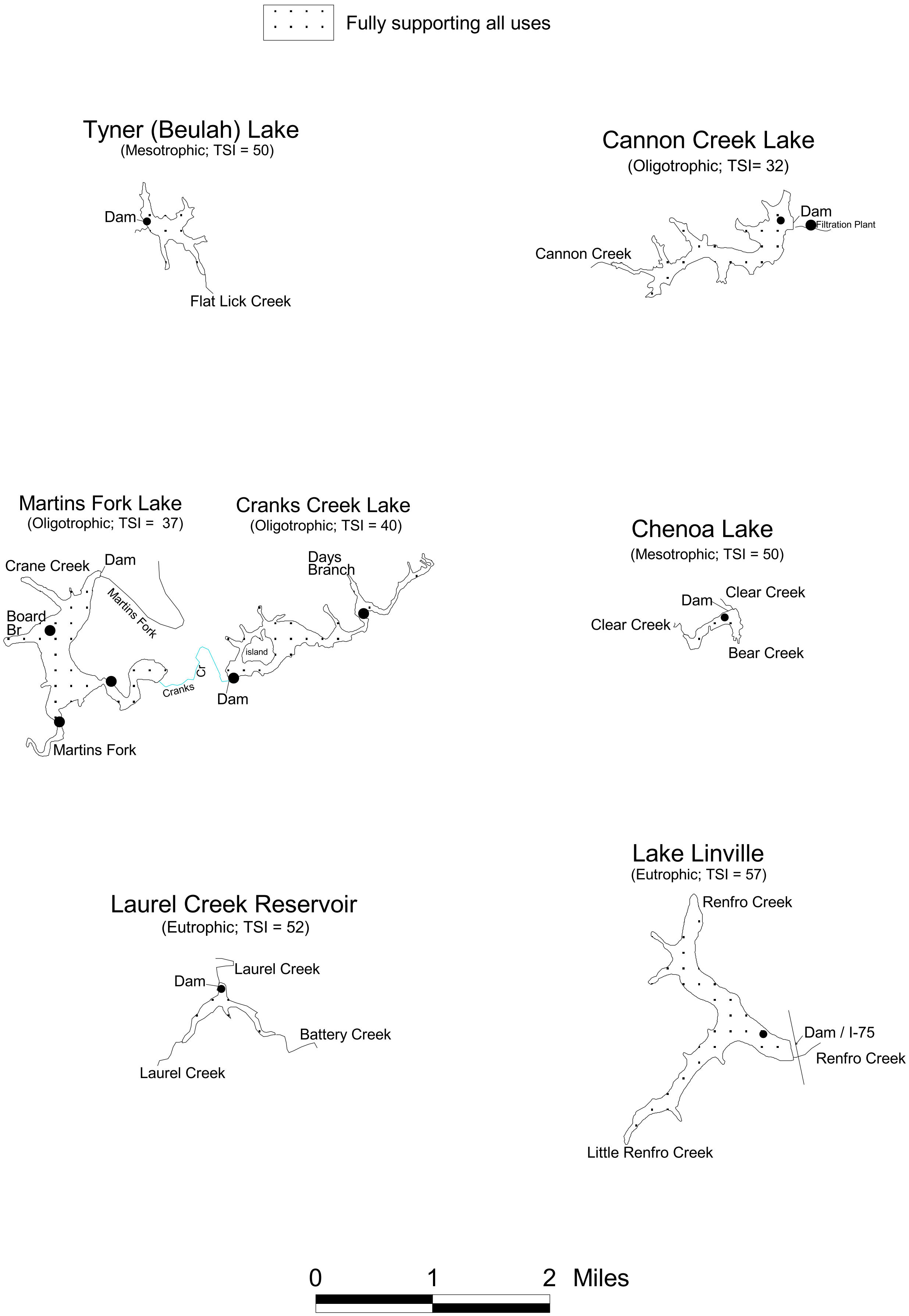
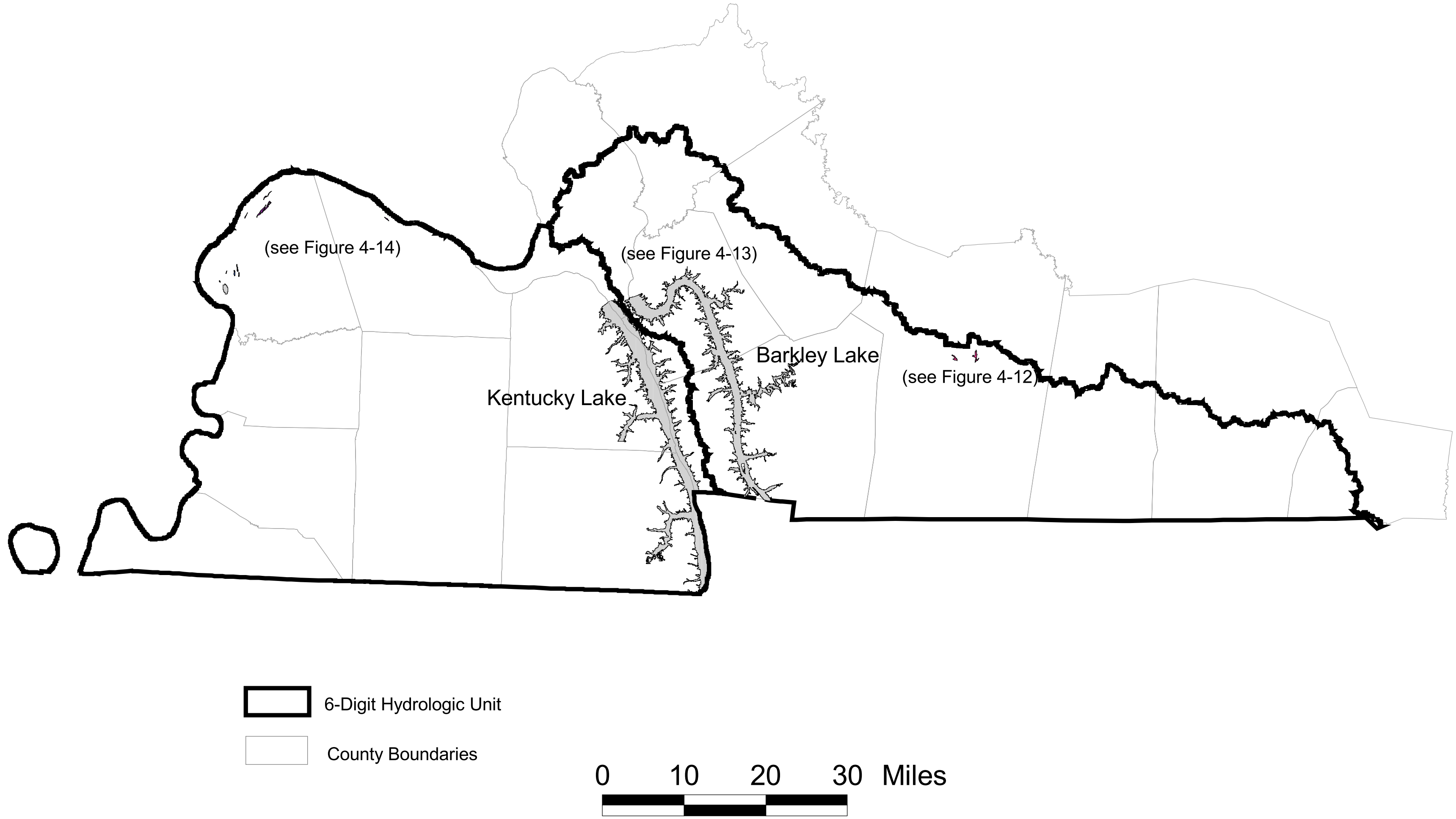
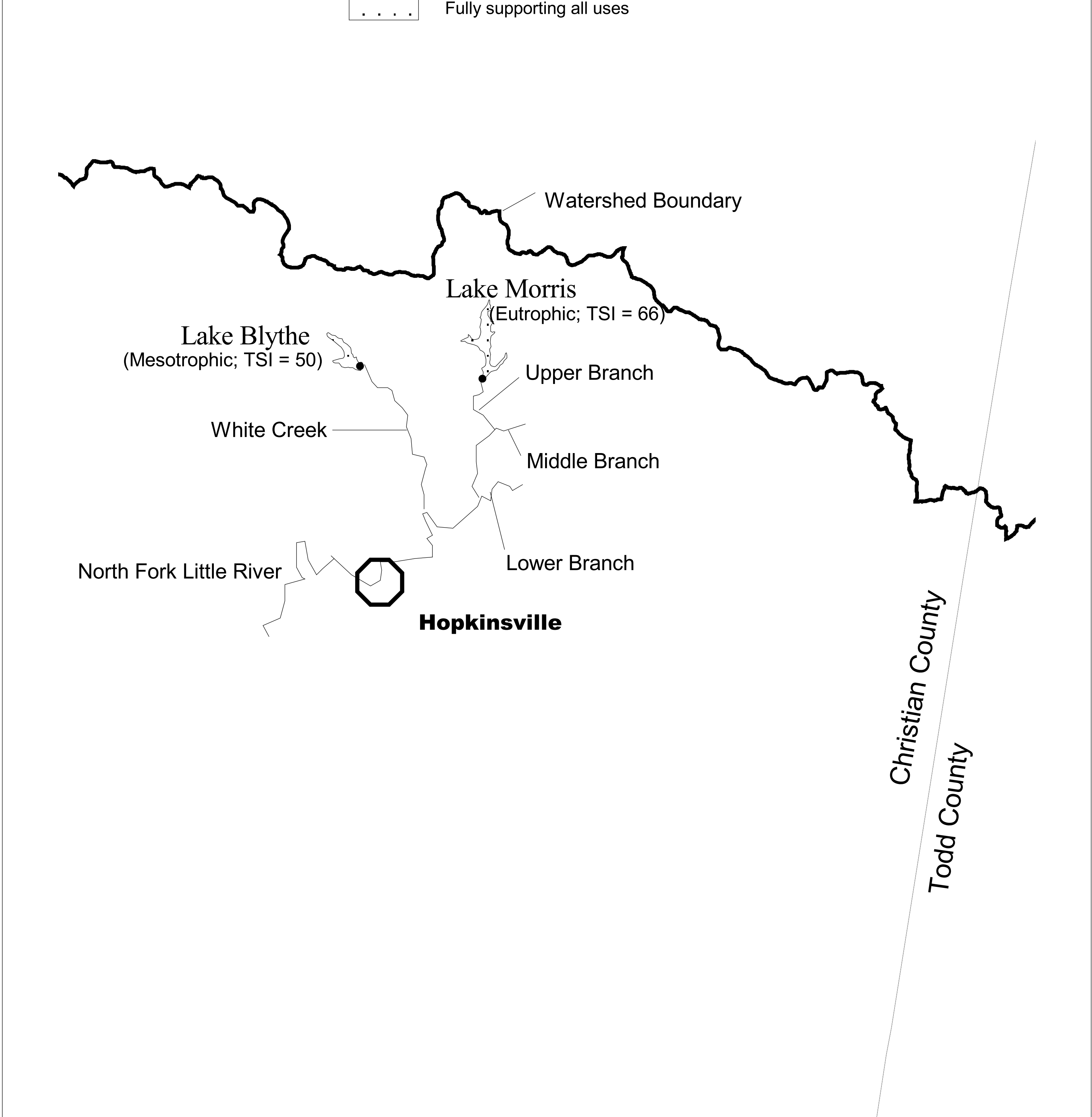
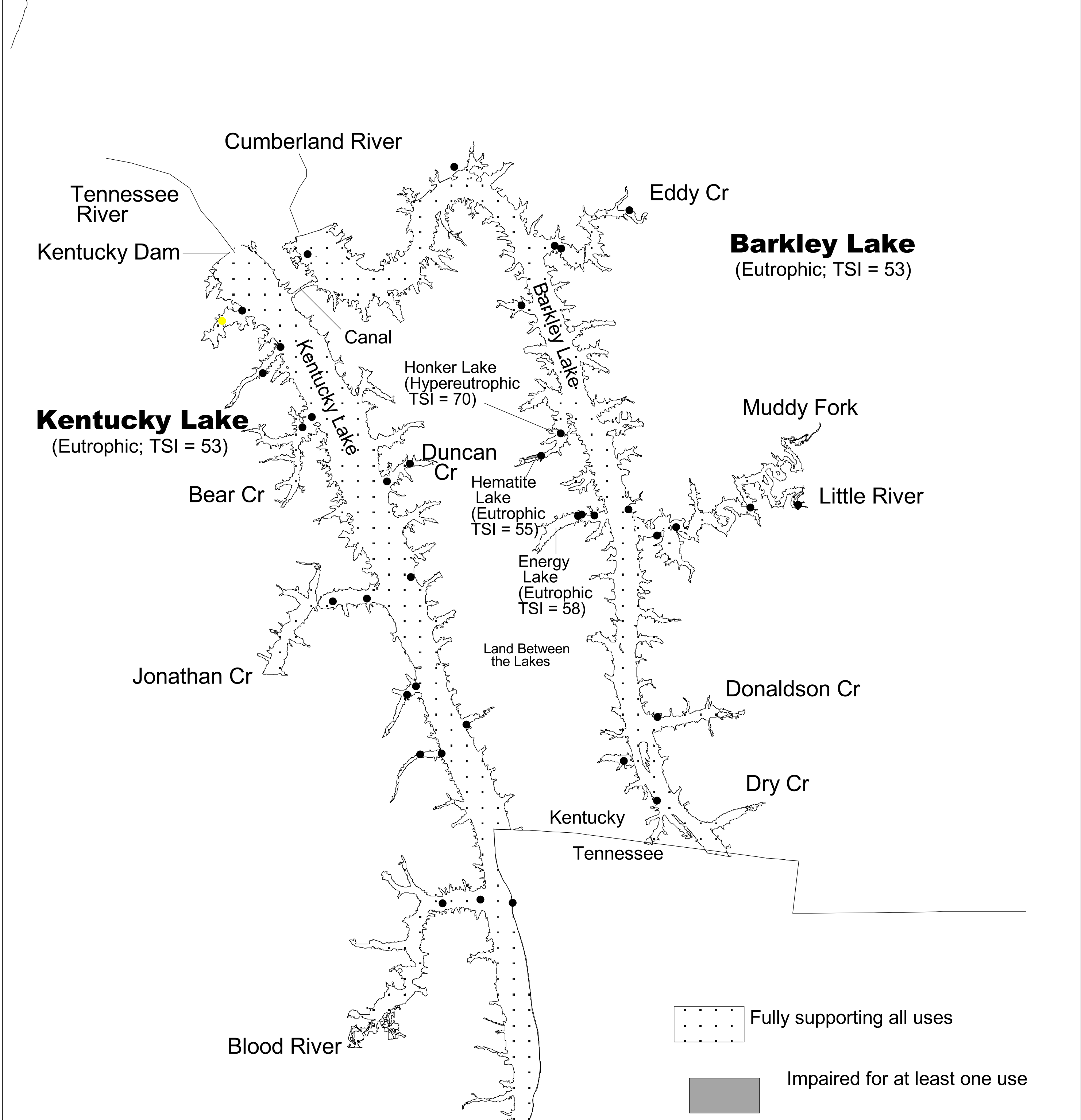


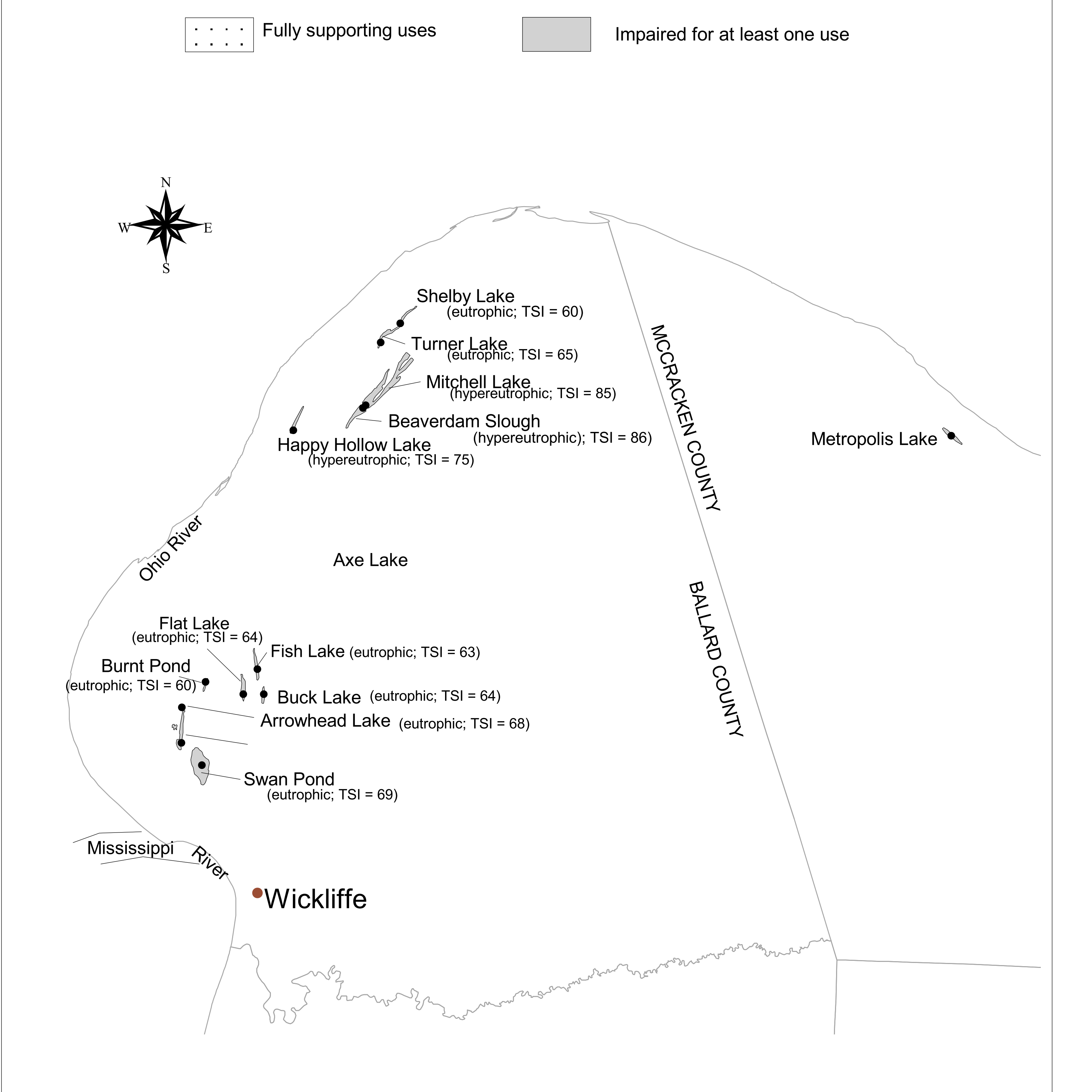
Figure 4-11. Lakes and Reservoirs Monitored in the Lower Cumberland, Tennessee, and Mississippi River Basins





. . . . Fully supporting all uses
Watershed Boundary
Lake Morris
(Eutrophic; TSI = 66)
Lake Blythe
(Mesotrophic; TSI = 50)
Upper Branch
White Creek
Middle Branch
Lower Branch
North Fork Little River
Hopkinsville
Christian County
Todd County


Cumberland River
Tennessee River
Kentucky Dam
Canal
Eddy Cr
Barkley Lake
(Eutrophic; TSI = 53)
Barkley Lake
Kentucky Lake
Kentucky Lake
(Eutrophic; TSI = 53)
Honker Lake
(Hypereutrophic
TSI = 70)
Muddy Fork
Duncan Cr
Hematite Lake
(Eutrophic
TSI = 55)
Bear Cr
Little River
Energy Lake
(Eutrophic
TSI = 58)
Land Between the Lakes
Jonathan Cr
Donaldson Cr
Dry Cr
Kentucky
Tennessee
Blood River
Fully supporting all uses
Impaired for at least one use


Fully supporting uses
Impaired for at least one use
N
W
E
S
Shelby Lake
(eutrophic; TSI = 60)
Turner Lake
(eutrophic; TSI = 65)
Mitchell Lake
(hypereutrophic; TSI = 85)
Beaverdam Slough
(hypereutrophic); TSI = 86)
Happy Hollow Lake
(hypereutrophic; TSI = 75)
MCCRACKEN COUNTY
BALLARD COUNTY
Metropolis Lake
Ohio River
Axe Lake
Flat Lake
(eutrophic; TSI = 64)
Fish Lake (eutrophic; TSI = 63)
Burnt Pond
(eutrophic; TSI = 60)
Buck Lake (eutrophic; TSI = 64)
Arrowhead Lake (eutrophic; TSI = 68)
Swan Pond
(eutrophic; TSI = 69)
Mississippi
River
Wickliffe

REFERENCES

Tennessee Valley Authority. 2000-2001. Personal communications with the Kentucky Division of Water.

U.S. Army Corps of Engineers. 2001. Personal communication, Nashville Division with the Kentucky Division of Water.

White, D., K. Johnston, and G. Rice. Water Quality Assessment of Lake Barkley and Selected Tributary Embayments. Center for Reservoir Research, Murray State University, Murray, Kentucky.

Chapter 5. Groundwater

5.1 Introduction

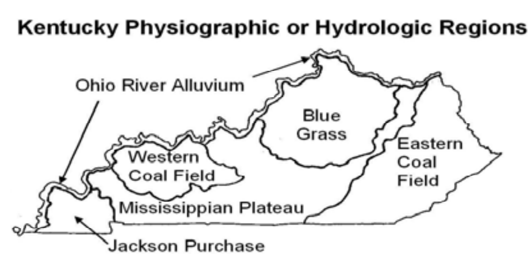
Current census data and estimates indicate 94.3 percent of Kentuckians receive their drinking water from a public water system or a well or a spring source that meets both primary and secondary drinking water standards for potable water (Table 5-1). The estimated numbers of well and spring sources that meet both primary and secondary standards for potable water were based on percentages of water wells and springs in the Department for Environmental Protection Consolidated Groundwater Database meeting those standards. Groundwater also provides water for industrial processes and irrigation and is a significant source for stream flow. Protection of this resource is crucial to Kentucky's economy, public health, and the environment.

Table 5-1. Census and Well Use Data[a,b,c]

Physiographic Region	Population on Wells[d]	Percent total Population
Bluegrass	45,760	2.5
Mississippian Plateau	134,620	20.6
Eastern Coalfield	276,333	43.9
Western Coalfield	30,592	10.1
Jackson Purchase	49,657	26.4
Statewide	505,254	13.7

[a]Total population 1990 Census: 3,685,296
[b]Total population 2000 Census: 4,041,769
[c]Water Supply Source: 1990 Census Data
[d]Extrapolation of 1990 census data to 2000 census data

5.2 Availability and Use



Naturally occurring potable groundwater is found throughout Kentucky, although quantities available for use vary considerably according to local geologic characteristics. Kentucky's groundwater resources exist in three aquifer types: granular aquifers that include continental deposits and river alluviums, karst aquifers that are dominated by rapid conduit flow, and fractured bedrock aquifers. High-yielding granular aquifers are typical of the Ohio River and Mississippi River valley that comprises the state's northern and western boundaries and in the continental (coastal plain) sediments of the Jackson Purchase Region. Granular aquifers generally provide adequate water for domestic, public, and industrial uses. Karst aquifers, developed in soluble rocks (e.g. limestone), occur under about 50 percent of Kentucky and are characterized by numerous shallow conduit-flow systems of generally limited extent. The most extensive karst aquifers are located in the Pennyroyal Region. Though usually less well developed, they also occur in the Inner Bluegrass Region. The karst aquifers generally provide sufficient water for domestic use, and some large karst springs supply municipal public water systems. In the Western and Eastern Coalfield regions, wells bored into fractured sedimentary rocks, primarily sandstones, shales, and siltstones, generally provide sufficient water for domestic use.

Approximately 500,000 persons depend on groundwater from wells and springs to supply individual households (Table 5-2). This number has remained stable because population growth has been offset by water line expansion. Households that depend upon private water wells for their drinking water are most numerous in eastern Kentucky and in the Jackson Purchase; these two regions account for more than 65 percent of all new well construction in the state (DOW groundwater database).

5.3 Groundwater Quality

In Kentucky, the quality of groundwater used by households for private domestic supplies appears to be generally good, although there are regions of the state where specific local problems exist. The principal, naturally occurring groundwater problems are microorganisms, nitrate, iron, sulfur, and high levels of dissolved solids ("salty" or "hard" water). Of these contaminants, the presence of nitrates and microorganisms in drinking water can represent serious potential health risks if consumed above maximum contaminant levels (MCLs) for an extended period of time or by persons vulnerable to infection or other health impacts (e.g. young children, the elderly, immuno-compromised people). On the other hand, iron, sulfur, and salt reflect more upon the aesthetic quality of water. In other words, water with relatively high levels of iron, sulfur, or salt may be unpleasant to use but not necessarily unhealthy. Assessing "potability" of water supplies therefore has two facets: (1) the issue of health concerns associated with specific contaminants and (2) the aesthetic water quality, in terms not only of taste, color, and odor but the effects upon clothing, fixtures and appliances, and household plumbing. Major sources of groundwater contamination in Kentucky are listed in Table 5-3.

Table 5-2. Estimates of Water Supply Sources for 1990 and 2000

	2000	Percent of State Population 2000	Percent Population on Potable Water Sources in 2000[a]	1990	Percent of State Population 1990	Percent Population on Potable Water Sources in 1990[a]
Service Connections	958,150	N/A	N/A	1,214,664	N/A	N/A
Population Served	3,512,049[b]	86.89	86.89	2,970,717	80.61	80.61
Population not served by a Community PWS[e]	529,720	13.11	7.21[d]	714,578	19.30	10.66[d]
Population on private Wells	374,547	9.27	5.23[d]	505,254	13.71	7.75[d]
Population on private springs and other sources	155,173	3.84	2.17[d]	209,324	5.68	3.21[d]
Total	4,041,769[c]	100.00	94.29	3,685,296	100.00	91.57

[a] Potable traditionally means water which poses no appreciable health risk (via pathogens or chemicals) for consumption. The assumption in this model is that all public water is "potable"; however, some public water systems do have occasional problems with Maximum Contaminant Levels (MCL) violations. Also, some public water systems fail secondary (non-enforceable) standards relating to taste and odor. These failures to meet secondary standards can be related to variations in source water quality and problems with treatment or the distribution system. Problems with public water systems (PWS) meeting secondary standards can be ongoing, but are more commonly occasional or intermittent. The Division of Water works with these systems to address secondary standard violations in order to bring these PWSs into compliance. For wells, springs, and other sources, other aesthetic considerations such as color, taste, and odor were considered in addition to pathogen or other contaminant issues in resolving the estimate of the number of people with access to potable drinking water sources.

[b] The population served by Community Public Water Systems is calculated by multiplying the total number of service connections by 2.6. N x 2.6 = PS, where N = the number of service connections, and PS = the estimated population served. The multiplier (2.6) represents the average number of people served per service connection.

[c] Number available from U.S. Census Bureau 2000.

[d] Based on Departmental studies, approximately 43.5% of all wells tested exceed the secondary standard for Iron. These studies tested pre-treatment water only and this number does not include water that is successfully treated via domestic treatment systems to meet or exceed primary and secondary standards. As the secondary standard for iron was the most common "potability" problem for private sources, we determined that this consideration would be the most conservative estimator of access to potable private sources. Please note that a well, spring, or cistern may have one or more conditions that affect the potability of the water.

[e] Population not served by a Community PWS includes those who depend on private wells, springs, cisterns, and hauled or bottled water.
Definitions: 1) "Community Public Water Systems" are public water systems serving an average of ≥ 25 people/day year-round or systems with ≥ 15 service connections; **2)** "Service connections" are individual homes and businesses connected to Community Public Water Systems; **3)** "Other sources" are springs, cisterns, and hauled water; and **4)** "Potable water" is water produced by any Community Public Water System and domestic and private water supplies which meets both the Primary Maximum Contaminant Levels and the Secondary Maximum Contaminant Levels.

Table 5-3. Major Sources of Groundwater Contamination

Contamination Source	Ten Highest Priority Sources	Factors Considered in Selecting a Contaminant Source[a]	Contaminants[b]
Agricultural Activities			
Agriculture Chemical Facilities			
Animal Feedlots	✔	I, III, V, VII	B, E, J, K, L
Drainage Wells			
Fertilizer Applications	✔	I, III, IV, V, VI, VII	E
Irrigation Practices			
Pesticides Applications	✔	I, III, IV, VI, VII	A, B
On-farm Agricultural Mixing and Loading Procedures			
Land Application of Manure (unregulated)			
Storage and Treatment Activities			
Land Application			
Material Stockpiles			
Storage Tanks (above ground)			
Storage Tanks (underground)	✔	I, III, IV, V, VI, VII	C, D, H
Surface Impoundment			
Waste Piles			
Waste Tailings			
Disposal Activities			
Deep Injection Wells			
Landfills	✔	I, III, IV, V, VI, VII	A, B, C, D, E, F, G, H, I, J, K, L, M (Leachate Compounds)
Septic Systems	✔	I, II, III, IV, V, VI, VII	A, B, C, D, E, F, G, H, J, K, L
Other			
Hazardous Waste Generators			
Hazardous Waste Sites			
Industrial Facilities	✔	I, III, IV, V, VII	A, B, C, D, E, F, G, H, I, J, K, L, M (TCE)
Material Transfer Operations			
Mining and Mine Drainage	✔	I, III, IV, V, VI, VII	G, H, M (Sediment and siltation runoff)
Pipelines and Sewer Lines			
Salt Storage and Road Salting			
Salt Water Intrusion			
Spills	✔	I, II, III, IV, V, VII	A, B, C, D, E, F, G, H, I, J, K, L, M (TCE)
Transportation of Materials			
Urban Runoff	✔	I, II, III, IV, V, VI, VII	A, B, C, D, E, F, G, H, J, L, M (Sediment)
Small-Scale Manufacturing and Repair Shops			

[a] **Factors**

I- Human health and/or environmental risk (toxicity)
II- Size of the population at risk
III- Location of the sources relative to drinking water sources
IV- Number and size of contaminant source
V- Hydrogeologic sensitivity
VI- State findings, other findings
VII- Best professional judgment

[b] **Contaminants**

A- Inorganic pesticides
B- Organic pesticides
C- Halogenated compounds
D- Petroleum compounds
E- Nitrate
F- Fluoride
G- Salinity / Brine
H- Metals
I- Radionuclides
J- Bacteria
K- Protozoa
L- Viruses
M- Other

In order to assess groundwater quality, several sources were used. These include: 1) well drillers' logs submitted to the DOW; 2) groundwater quality data collected from the DOW's ambient groundwater monitoring program and the inter-agency groundwater monitoring network; 3) groundwater quality data collected by DOW from Section 319(h) river basin studies; 4) sample data collected through various programs by the Kentucky Geological Survey (KGS); and 5) data derived from several smaller, local studies. A summary of the results of analysis of major parameters of concern in Kentucky is presented in Tables 5-4, 5-5 and 5-6. Water quality trends can be related to regional geology, land use, groundwater sensitivity, and well construction. Impacts on groundwater quality from human activities occur predominantly in the most sensitive (karst) areas and result primarily from agricultural activities. Persistent localized groundwater contamination from human activities occurs around older landfills, leaking underground storage tanks, poorly maintained septic systems and straight pipes, mining operations and drainage, and urban runoff. Less persistent, but still of concern locally, are spills and contamination from industrial facilities.

Table 5-4. Parameters of Interest: Summary

			SITES					SAMPLES				
Suite	Constituent	MCL (mg/L)	Number of Sites	Detects	Detects < ½ MCL	Detects >= ½ MCL	Detects > MCL	Number of Samples	Non-Detects	Detects < ½ MCL	Detects >= ½ MCL	Detects > MCL
	Fluoride		155	155	155	2	0	338	11	323	4	0
OTHER	Nitrate (as N)		184	171	143	39	7	387	37	118	232	7
	Nitrite (as N)		152	13	11	2	2	297	279	16	2	2
	Arsenic	0.010	316	50	36	15	0	825	763	43	19	0
	Barium		316	315	310	8	3	825	1	811	13	5
	Cadmium		316	14	14	0	0	825	799	26	0	0
	Chromium		316	97	97	1	0	825	628	196	1	0
	Copper[a]	1.0	316	243	243	0	0	825	367	458	0	0
	Iron[a]		317	310	174	203	162	826	41	406	379	272
RCRA METALS	Lead		319	60	50	15	9	828	757	56	15	9
	Manganese[a]		317	299	186	168	126	826	68	460	298	197
	Mercury		315	7	7	1	1	824	811	12	1	1
	Nickel[b]		316	135	134	1	1	825	585	239	1	1
	Selenium		315	11	11	0	0	824	805	19	0	0
	Silver[a,b]		314	54	54	0	0	804	744	60	0	0
	Zinc[a]		316	203	201	5	1	825	454	366	5	1
	Aroclor 1016	0.0005	240	0	0	0	0	704	704	0	0	0
	Aroclor 1221	0.0005	240	0	0	0	0	704	704	0	0	0
	Aroclor 1232	0.0005	240	0	0	0	0	704	704	0	0	0
	Aroclor 1242	0.0005	240	0	0	0	0	704	704	0	0	0
PCB	Aroclor 1248	0.0005	240	0	0	0	0	704	704	0	0	0
	Aroclor 1254	0.0005	240	0	0	0	0	704	704	0	0	0
	Aroclor 1260	0.0005	240	1	1	0	0	704	703	1	0	0
	Aroclor 1262	0.0005	240	0	0	0	0	704	704	0	0	0
	Aroclor 1268	0.0005	240	0	0	0	0	703	703	0	0	0
	Acetochlor[c]		229	12	12	0	0	693	676	17	0	0
	Alachlor		229	5	5	0	0	693	677	16	0	0
	Atrazine		229	55	55	5	0	693	506	182	5	0
PESTICIDES	Atrazine desethyl		229	57	57	0	0	693	482	211	0	0
	Cyanazine[b]		229	0	0	0	0	693	693	0	0	0
	Metalochlor[b]		229	28	28	0	0	692	596	96	0	0
	Simazine		229	28	28	4	3	693	639	49	5	3

Table 5-4 (Cont'd)

			SITES					SAMPLES				
Suite	Constituent	MCL (mg/L)	Number of Sites	Detects	Detects < ½ MCL	Detects >= ½ MCL	Detects > MCL	Number of Samples	Non-Detects	Detects < ½ MCL	Detects >= ½ MCL	Detects > MCL
SOC	Anthracene[c]	0.830	93	5	5	0	0	117	112	5	0	0
	Benzo[a]anthracene[c]		93	5	0	5	5	117	112	0	5	5
	Benzo[a]pyrene		94	6	2	5	3	119	112	2	5	3
	Fluorene[c]	0.110	92	4	4	0	0	116	112	4	0	0
	Naphthalene[b]		410	13	11	2	2	947	930	15	2	2
VOC	Benzene		374	17	7	11	10	889	866	8	15	13
	Chlorobenzene[c]		374	1	1	0	0	889	888	1	0	0
	Dichloromethane (Methylene chloride)		374	16	10	6	2	889	873	10	6	2
	Ethylbenzene		374	12	10	2	1	889	874	13	2	0
	Methyl-tert-butyl ether (MTBE)[c]		374	39	30	10	9	888	817	56	15	14
	Tetrachloroethane (1,1,1,2-)[b]		374	0	0	0	0	889	889	0	0	0
	Tetrachloroethene[c]	0.010	374	18	16	2	2	889	840	47	2	2
	Toluene		374	18	16	2	2	889	865	22	2	2
	Trichloroethane (1,1,1-)		374	6	5	1	1	889	868	20	1	1
	Trichloroethene		374	9	3	8	8	889	853	3	33	30
	Vinyl chloride		374	3	1	2	2	889	886	1	2	2
	Xylene (1,2-)		374	13	13	0	0	889	868	21	0	0
	Xylene (1,3- & 1,4-)		374	18	17	1	0	889	865	23	1	0

[a] Secondary Drinking Water Regulation
[b] Health Advisory Level
[c] DEP standard
(These standards used where MCL unavailable)

Table 5-5. Parameters of Interest: Summary of Public Water Supply Sites

			PWS SITES					SAMPLES				
Suite	Constituent	MCL (mg/L)	Number Of Sites	Detects	Detects < ½ MCL	Detects >= ½ MCL	Detects > MCL	Number Of Samples	Non-Detects	Detects < ½ MCL	Detects >= ½ MCL	Detects > MCL
OTHER	Fluoride		14	14	14	0	0	36	0	36	0	0
	Nitrate (as N)		14	13	12	2	0	34	8	19	7	0
	Nitrite (as N)		14	0	0	0	0	27	27	0	0	0
RCRA METALS	Arsenic	0.010	44	6	5	2	0	156	148	5	3	0
	Barium		51	51	51	1	0	156	0	155	1	0
	Cadmium		44	3	3	0	0	156	151	5	0	0
	Chromium		44	11	11	0	0	156	107	49	0	0
	Copper[a]	1.0	44	39	39	0	0	156	57	99	0	0
	Iron[a]		44	41	28	24	20	156	20	71	65	46
	Lead		44	10	10	2	1	156	142	12	2	1
	Manganese[a]		44	39	27	22	17	156	17	83	56	31
	Mercury		44	1	1	1	1	156	153	2	1	1
	Nickel[b]		44	17	17	0	0	156	118	38	0	0
	Selenium		44	2	2	0	0	156	152	4	0	0
	Silver[a,b]		44	9	9	0	0	150	141	9	0	0
	Zinc[a]		44	24	24	1	0	156	101	54	1	0
PCBs	Aroclor 1016	0.0005	43	0	0	0	0	151	151	0	0	0
	Aroclor 1221	0.0005	43	0	0	0	0	151	151	0	0	0
	Aroclor 1232	0.0005	43	0	0	0	0	151	151	0	0	0
	Aroclor 1242	0.0005	43	0	0	0	0	151	151	0	0	0
	Aroclor 1248	0.0005	43	0	0	0	0	151	151	0	0	0
	Aroclor 1254	0.0005	43	0	0	0	0	151	151	0	0	0
	Aroclor 1260	0.0005	43	0	0	0	0	151	151	0	0	0
	Aroclor 1262	0.0005	43	0	0	0	0	151	151	0	0	0
	Aroclor 1268	0.0005	43	0	0	0	0	151	151	0	0	0
PESTICIDES	Acetochlor[c]		43	1	1	0	0	151	150	1	0	0
	Alachlor		43	0	0	0	0	151	151	0	0	0
	Atrazine		43	8	8	2	0	151	109	40	2	0
	Atrazine desethyl		43	8	8	0	0	151	102	49	0	0
	Cyanazine[b]		43	0	0	0	0	151	151	0	0	0
	Metalochlor[b]		43	6	6	0	0	150	127	23	0	0
	Simazine		43	4	4	2	1	151	143	6	2	1

Table 5-5. (Cont'd)

Suite	Constituent	MCL (mg/L)	PWS SITES: Number of Sites	PWS SITES: Detects	PWS SITES: Detects < ½ MCL	PWS SITES: Detects >= ½ MCL	PWS SITES: Detects > MCL	SAMPLES: Number Of Samples	SAMPLES: Non-Detects	SAMPLES: Detects < ½ MCL	SAMPLES: Detects >= ½ MCL	SAMPLES: Detects > MCL
SOC	Anthracene[c]	0.830	2	1	1	0	0	2	1	1	0	0
	Benzo[a]anthracene[c]		2	1	0	1	1	2	1	0	0	1
	Benzo[a]pyrene		2	1	0	1	0	2	1	0	1	0
	Fluorene[c]	0.110	1	0	0	0	0	1	1	0	0	0
	Naphthalene[b]		88	1	1	0	0	216	215	1	0	0
VOC	Benzene		88	2	1	1	0	216	214	1	1	0
	Chlorobenzene[c]		88	0	0	0	0	216	216	0	0	0
	Dichloromethane (Methylene chloride)		88	7	4	3	1	216	209	4	3	1
	Ethylbenzene		88	1	1	0	0	216	215	1	0	0
	Methyl-tert-butyl ether (MTBE)[c]		88	8	7	2	1	216	205	9	2	1
	Tetrachloroethane (1,1,1,2-)[b]		88	0	0	0	0	216	216	0	0	0
	Tetrachloroethene[c]	0.010	88	6	6	0	0	216	195	21	0	0
	Toluene		88	2	2	0	0	216	214	2	0	0
	Trichloroethane (1,1,1-)		88	1	1	0	0	216	211	5	0	0
	Trichloroethene		88	2	0	2	2	216	214	0	2	2
	Vinyl chloride		88	0	0	0	0	216	216	0	0	0
	Xylene (1,2-)		88	1	1	0	0	216	215	1	0	0
	Xylene (1,3- & 1,4-)		88	3	3	0	0	216	213	3	0	0

[a] Secondary Drinking Water Regulation
[b] Health Advisory Level
[c] DEP standard
(These standards used where MCL unavailable)

Table 5-6. Finished Drinking Water Data on Groundwater Sources and Groundwater Under the Direct Influence of Surface Water, 2000 - 2001

Sites	Parameter Group	Total Number of Analyses	Non-Detects	Detects Less than MCL	Greater than MCL
153	VOC	10,574	10,467	66	6
138	SOC	10,001	9,929	64	8
126	IOC	2,765	2,407	330	3
247	NO_3	781	197	582[a]	2

[a] 83 of these values greater than 5 mg/l

5.3.1 Coliform Bacteria Data from Drillers' Logs

For any well built to supply potable water, according to 401 KAR 6:310, water well drillers are required to collect a water sample for coliform bacteria analysis. A report from the laboratory must be enclosed when the well record is submitted to DOW. Coliform sample results are available from the period between 1986 to the present for 20,868 of the water wells represented in the DOW groundwater database (Table 5-7). Drillers' reports indicate that approximately 7 percent of new wells constructed exhibited contamination from coliform bacteria at the time of installation. This number may be slightly higher or lower due to the relative ease of sample contamination during collection and the possibility that the disinfection products in the well might not have been cleared before sample collection. Although a water well driller is required to disinfect a new well, state plumbing regulations do not require a plumber to disinfect a new home plumbing system that is connected to the same well. This fact contributes to the high bacterial contamination numbers reported by some county health departments.

Table 5-7. Data on Bacteria and Odor Problems with New Wells

Region	Bacterial	Odor (sulfur)	Totals
Eastern Coalfield	17,685	829	18,514 (6.7%)
Bluegrass	5,812	73	5,885 (7.6%)
Mississippian Plateau	13,597	1,211	14,808 (10.5%)
Western Coalfield	1,671		1,671 (12.7%)
Jackson Purchase	2,533		2,533 (5.3%)
Totals[a]	41,298 (7.7%)	2,113 (0.4%)	43,411 (8.1%)

[a] Actual totals should be slightly less because some households have wells with multiple problems

Shallow, hand-dug wells, wells in karst (limestone and cave areas) terrain, and wells with insufficient casing are subject to the influence of surface water and are susceptible to bacterial contamination. It is important to note that bacterial contamination of a well and the plumbing system can be effectively treated by inexpensive and regular disinfection of the well and plumbing system.

5.3.2 Pesticides in Groundwater

Pesticides and herbicides are a significant groundwater quality concern in karst regions of Kentucky but are not routinely detected in other areas of the state. Herbicides are generally applied to row crops in the spring as a pre-emergent control for weed growth. Because precipitation, runoff, and infiltration also are high during that time of year, pesticides are detected more often in the spring.

Data collected from 1995 through 2000 indicate that atrazine (and its metabolites) and metolachlor are the most commonly detected herbicides. For example, 2,330 samples were analyzed for atrazine and 23 percent of samples (540) contained detectable atrazine levels, ranging from 0.001 - 5.26 µg/L. Metalochlor detections were not as common. Of 1,896 samples analyzed, 12.9 percent (245 samples) had detectable levels of metalochlor, ranging from 0.002 - 9.456 µg/L. The great majority of samples analyzed that contained detectable levels of atrazine and metalochlor were collected in karst springs and wells located in karst terrain.

Throughout Kentucky, sensitivity of the aquifer to impact from surface activities, which is largely a function of the groundwater flow regime and land use, appear to be the primary factors controlling the occurrence of pesticides. Results indicate that pesticide levels are generally highest and occur more frequently in karst areas, where anisotropic, turbulent flow through solution cavities and conduits predominates. These karst areas are generally coincident with areas of high row-crop production and pesticide use, especially in the Mississippian Plateau physiographic province of west-central and western Kentucky and are highly susceptible to impacts from surface activities. Elsewhere, in wells and non-karst springs, pesticide detections have been uncommon. Of particular note is that no pesticides were detected in the Eastern Kentucky Coal Field physiographic province, an area of slower, fracture-flow groundwater movement and of very limited row-crop production.

5.3.3 Nitrate in Groundwater

Nitrate-nitrogen has a Maximum Contaminant Level (MCL) of 10 mg/l. According to KGS data, there is a significant correlation between well depth and the concentration of nitrate-nitrogen. Ten percent of the relatively shallow hand-dug wells exceeded the MCL for nitrate-nitrogen, with significantly lower concentrations for drilled wells, generally decreasing with well depth. For all wells (0–500-ft category), approximately 4.5 percent exceeded the MCL. Approximately 3 percent of sampled springs (31 out of 1,018) exceeded the MCL for nitrate-nitrogen. Common sources of nitrate in water include plant and animal matter, human and animal waste, household septic systems, and fertilizers. Because it dissolves readily in water, nitrate from these sources is usually present at least in low concentrations in drinking-water supplies, regardless of the water source. Public water suppliers test for concentrations of nitrate. This testing is much less common for private water supplies, however. More than 1,500,000 people in Kentucky use groundwater supplies, including approximately 1,200,000 people supplied through public water systems and more than 500,000 using private wells or springs. Excess nitrate in drinking water has been found to cause methemoglobinemia, or Blue Baby Syndrome, in infants less than 6 months old (Kross and others 1992; Bruning-Fann and Kaneene 1993). EPA has established an MCL for nitrate in public drinking water because of health concerns. The MCL for nitrogen can be expressed as units of nitrate (NO_3 –) or as units of nitrogen (N), referred to as nitrate-nitrogen (nitrate-N or NO_3 -N). The MCL expressed as units of nitrate is 45 mg/L. The MCL expressed as units of nitrate-nitrogen is 10 mg/L (U.S. EPA 1994). Some laboratories use the term “parts per million” (ppm), which is essentially equivalent to mg/L in fresh water.

The time of year that samples are collected can affect the nitrate concentration detected. Some wells and springs have a greater concentration of nitrate from mid-December to mid-February. Some sites may also have a higher concentration within days or weeks of nearby use of fertilizers or application of manure. The physical and biological environment of a region affects the occurrence and movement of nitrate in groundwater and how quickly nitrate is reduced in the subsurface. Other factors can also have a local influence on contamination of groundwater. If a well is located near an inefficient septic system, nitrate may enter shallow groundwater at high concentrations. Frequent use of nitrate fertilizers or concentrated application of manure (animal feedlots, etc.) may also locally contaminate the groundwater. In addition, ineffective seals around well casings may allow unrestricted downward movement of contaminated shallow groundwater.

The MCL for nitrogen was exceeded in approximately 4.5 percent of all wells (0-500 ft deep). Ten percent of hand-dug wells (38 out of 391), 7 percent of wells from 0 to 50 ft deep (59 out of 842), 5 percent of wells from 51 to 100 ft deep (77 out of 1,506), 3 percent of wells from 101 to 150 ft deep (25 out of 737), and 1 percent of wells from 151 to 500 ft deep (7 out of 660) exceeded the MCL for nitrogen. Approximately 3 percent of sampled springs (31 out of 1,018) exceeded the MCL. These data show that the likelihood of well contamination is highly dependent on well depth. Hand-dug wells are especially prone to contamination because they are recharged by very shallow groundwater, and shallow groundwater generally has higher concentrations of nitrate than deep groundwater.

5.3.4 Secondary Contaminants in Groundwater

Iron is present in significant quantities in many rock formations and soils throughout the state. Iron gives the soil its reddish color and can be seen in rock formations as yellow, orange, and green coloration. Iron has a secondary drinking water standard of 0.3 mg/l based on taste, color, and staining. Secondary drinking water standards are recommended (non-enforceable) standards for finished water produced by public water systems. Low-grade iron ore was mined and smelted throughout the state in the past.

Data from the departmental groundwater quality database, regional, and Section 319(h) studies indicate that iron may represent an aesthetic problem for a large proportion of private groundwater users. Where total iron (both dissolved and suspended components) was concerned, less than half of all groundwater sources tested exceeded the secondary (aesthetic) MCL of 0.3 mg/l.

A recent Department for Environmental Protection study indicated 30 percent of the wells and springs (81 domestic water supplies) tested during a 2000-2001 study along the North Fork of the Kentucky River exceeded the secondary standard for total iron. The North Fork study also tested some of the iron levels after treatment and found that the iron levels were well below the secondary iron standard in almost every case. Iron well water concentrations above 10 mg/l are being successfully treated by a variety of different methods. Colloidal organic iron from iron reducing bacteria is often a large contributor to high total iron concentrations. This colloidal organic iron can be controlled by following the routine water well disinfection routines in the Generic Groundwater Protection Plan for Domestic Water Wells (401 KAR 5:037).

For dissolved iron, one-fourth of groundwater sources tested exceeded the standard. In two 1988 Department for Environmental Protection studies, iron exceeded the secondary standard in more than 40 percent of samples from both the Gateway ADD (100 wells) and Calvert City (62 wells).

The Kentucky Consolidated Groundwater Database shows 43.5 percent of the samples collected exceed the non-enforceable secondary drinking water standard for iron (Table 5-8). It should be noted that most data collection projects such as the Groundwater Monitoring Network, pesticide monitoring, and Section 319(h) nonpoint source studies all collect "raw water" or water before any domestic treatment. The percentage of water at the tap exceeding the secondary drinking water standard is probably much lower because of commonly used domestic water treatment systems. Very little data has been collected where both the raw and treated water is tested to determine the effectiveness of the domestic water treatment systems in the state. Iron is, however, a problem that can be satisfactorily treated in private household systems.

Table 5-8. Total Iron Values (mg/l) from Private Wells[a]

	Bluegrass	Eastern Coalfield	Purchase	Ohio R Alluvium	Western Coalfield	Mississippian Plateau	State
Greater or Equal to 0.3 mg/l	19 (11.3%)	103 (63.6%)	21 (24.7%)	32 (32.3%)	19 (35.2%)	37 (36.3%)	231 (43.5%)
Less than 0.3 mg/l	10 (88.7%)	59 (36.4%)	64 (75.3%)	67 (67.7%)	35 (64.8%)	65 (63.7%)	300 (56.5%)
Total number of samples	29	162	85	99	54	102	531

[a] from the DEP Consolidated Groundwater Database

Sulfurous odor is a term that can mean several things. Hydrogen sulfide, the rotten egg smell gas, can come from leaking sour gas formations below, sulfide-reducing bacteria in the area around the well bore, or rotting of organic materials in the aquifer. Sulfurous odors on the hot water side of a plumbing system can be formed because of use of an inappropriate anode in the hot water heater for the type of source water. Also, sulfurous odors may be caused by the development of sulfur bacteria in the hot water heater. The lower water heater temperatures used to save energy and protect against scalds combined with the lack of routine well and plumbing system disinfection allow sulfur-reducing bacteria to flourish in modern water heaters. Raising the temperature above 170^{o} for a couple of weeks every so often or routine disinfection of the plumbing system can eliminate this problem.

Aquifers that have sulfurous odors can be inexpensively treated by chlorination followed by filtration or by aeration. Commonly, the sulfurous odors can be greatly reduced simply by following the Generic Groundwater Protection Plan for Domestic Water Wells (401 KAR 5:037) and routinely disinfecting the well. Wells that have sulfurous natural gas can be treated with aeration followed by degassing. Sulfurous odors are reported only in 0.4 percent of the new wells drilled in the state.

Total dissolved solids (TDS) indicates the amount of dissolved minerals present in water but does not differentiate between minerals. The secondary (non-enforceable) drinking water standard for TDS is 500 mg/l to prevent the undesirable effects of hardness, deposits, colored water, staining, and salty taste in water. The Kentucky Consolidated Groundwater Database data indicates 3.5 percent of the springs and 20.5 percent of the wells tested exceed the 500-mg/L TDS standard (Table 5-9). When this problem is caused by hardness minerals (calcium, magnesium, iron, and manganese), the problem can be easily treated with standard water softening equipment.

The type of dissolved mineral(s) that causes the higher TDS levels is fundamental to the effects of the high TDS and the ability to treat or use the water. Water with a high TDS that is caused by calcium may have some problems with scale deposits but still be considered good water for drinking purposes. Water with the same high TDS that is caused by salts may be considered undrinkable and whole-house treatment cost would be considered cost prohibitive. Many families use a small inexpensive reverse osmosis system to produce water for drinking and cooking while using the "salty" water for sanitary purposes. Many public systems also exceed the TDS standard which creates the market for the "water conditioning industry" to remove hardness minerals. Table 5-9 summarizes the Groundwater Quality Database results for TDS.

The USGS (1966) produced a map titled "Fresh-Saline Interface in Kentucky," which shows that waters with TDS concentrations greater than 1000 mg/l occur at depths as shallow as 100 feet in some deeper valleys of the state. Areas that had extensive pre-law oil and gas production also tend to have higher TDS levels in shallow groundwater.

Table 5-9. Total Dissolved Solids Data (mg/l) from the Groundwater Quality Database

Spring Data

	Bluegrass	Eastern Coalfield	Purchase	Ohio R Alluvium	Western Coalfield	Mississipian Plateau	State
Greater or Equal to 500 mg/l	28 (6.8%)	24 (14.3%)	0	0	0	1 (0.1%)	53 (3.5%)
Less than 500 mg/l	386 (93.2%)	144 (85.7%)	9 (100%)	8 (100%)	25 (100%)	877 (99.9%)	1449 (96.5%)
Total number of Samples	414	168	9	8	25	878	1502

Well Data

	Bluegrass	Eastern Coalfield	Purchase	Ohio R Alluvium	Western Coalfield	Mississippian Plateau	State
Greater or Equal to 500 mg/l	12 (48.0%)	30 (28.8%)	48 (48.0%)	26 (12.1%)	5 (5.1%)	13 (11.7%)	134 (20.5%)
Less than 500 mg/l	13 (52.0%)	74 (71.2%)	52 (52.0%)	189 (87.9%)	93 (94.9%)	98 (88.3%)	519 (79.5%)
Total number of Samples	25	104	100	215	98	111	653

Properly constructed modern water wells are a viable source of drinking water in the state. A domestic water supply well requires a homeowner to take responsibility for maintenance and treatment. Well owners who do not maintain a well or a treatment system often have problems. The cost associated with treating the most common well water problems is minimal and many times this is only the cost of a gallon of bleach and some time for a yearly water well disinfection.

Currently, federal legislation is being discussed that would provide low-interest loans and grants to private well owners to replace wells and domestic treatment systems. If this legislation is enacted, many low-income families would be able to abandon shallow hand-dug wells and replace them with modern, properly constructed wells with modern point-of-entry domestic treatment systems.

Another commonly used, but surrogate measure of water quality is the number of "contaminated" sites such as the number of landfills with groundwater contamination, and the number of "regulated" groundwater sites, such as underground injection control wells (Figure 5-10). Tracking the number of such sites can be a useful tool for measuring programmatic success, and though less so, an effective surrogate measure of groundwater quality changes. In order to be very useful, changes in the number of sites should be tracked over a number of reporting periods. However, it should be noted that simply evaluating the total number of sites does not provide a very accurate measure of either programmatic progress nor groundwater quality.

5.4 Groundwater Protection Programs

Kentucky has established or is maintaining many programs that protect the Commonwealth’s groundwater resources (Table 5-11). Three programs are highlighted in the following paragraphs.

5.4.1 Ambient Groundwater Monitoring Network

Since 1995, the DOW has sampled groundwater at approximately 240 sites as part of the state’s ambient groundwater monitoring program. Monitoring sites include public and private water supplies, unregulated public access springs (i.e., "roadside springs"), and unused springs. Approximately 70 sites are sampled from one to six times per year, depending on the type of aquifer. Water quality parameters include nutrients, major inorganic ions (e.g., carbonate, sulfate, iron and manganese, chloride, sodium, calcium, and magnesium), metals, volatile and semi-volatile organics, and pesticides. Each year the Division of Water also conducts quarterly sampling at 30 additional sites on a watershed basis as part of an ongoing watershed initiative Section 319(h) cooperative effort. In addition, the DOW conducts quarterly groundwater monitoring at four sites under an agreement with the Division of Pesticides.

Table 5- 10. Groundwater Contaminated Sites Summary, 2000 - 2001

Source Type[a]	Number of Sites		Sites with Confirmed Releases	Sites with Groundwater Contamination	Contaminants[b]	Source
NPL	19		19	19	PCBs, SVOCs, VOCs, Metals, Inorganics, Pesticides, and Radionuclides	Division of Waste Management (DWM) Superfund Branch State Superfund Section
State Sites[c] / CERCLIS	1911		1271	111		
Non-UST Petroleum	984		899	46	Petroleum	
UST	4,731		2,827	810	BTEX, PAH, Lead	DWM - UST Branch
RCRA Corrective Action	91	**RCRA-D 32**	32	32	Organic Compounds	DWM - Solid Waste Branch
		RCRA-C 59	35	35	Pesticides, Cyanide, PCBs, VOCs, ABNs, PAHs, Metals, and Radionuclides	DWM – Hazardous Waste Branch
DOD/DOE	6		6	6		
UIC	Total 4365	**Class I 1** **Class II 3788** **Class V 3000**	N/A	N/A	Varied	EPA

[a]Source Type:

NPL - National Priority List

DOD - Department of Defense

DOE - Department of Energy

RCRA - Resource Conservation and Recovery Act

UIC - Underground Injection Control

UST - Underground Storage Tank

CERCLIS - Comprehensive Environmental Response, Compensation, and Liability Information System

[b]Contaminants:

PCB - Polychlorinated Biphenyl

SVOC - Semi Volatile Organic Compound

VOC - Volatile Organic Compound

BTEX - Benzene, Toluene, Ethylene, and Xylene

PAH - Poly Aromatic Hydrocarbons

ABN - Acid Base Neutral

[c]This number includes approximately 600 sites from CERCLIS that EPA has investigated. Approximately 500 of these sites have been closed by EPA and referred to Kentucky's State Superfund Program

5.4.2 Wellhead Protection Program

Kentucky's Wellhead Protection Program requires public water systems that rely on groundwater to develop a wellhead protection plan (WHP) for their source water. A WHP is designed to identify the recharge area of the well(s) or spring(s), identify the potential contaminant sources in the recharge area, and implement groundwater protection strategies for these areas. Wellhead protection is an integral part of Kentucky's Source Water Assessment Program (SWAP). Kentucky has been a national leader on source water protection; it was the first state in the nation to have its SWAP approved by the U.S. Environmental Protection Agency. All groundwater-dependent public water systems will have completed their wellhead protection plans by March 2003. Currently, approximately 500,000 Kentuckians are being served by public water systems in various phases of wellhead protection.

5.4.3 Groundwater Protection Plan Program

Kentucky's Groundwater Protection Plan (GPP) regulation requires entities conducting activities that have potential to pollute groundwater to develop and implement a groundwater protection plan. The GPP includes pollution prevention measures such as preventive maintenance, best management practices, spill response plans, accurate record keeping, and personnel training. Regular inspections ensure that the protective practices are in place and functioning properly. The Groundwater Branch has been focusing implementation of this broad program in wellhead protection areas and in areas where problems or threats are known (see Table 5-11).

Kentucky also has a program that requires all agriculture and silviculture operations to develop and implement best management practices in accordance with Kentucky's Agriculture Water Quality Act to prevent pollution of the waters of the Commonwealth. All agriculture and silviculture producers were required to have an Agriculture Water Quality Plan in place by October 2001. Implementation of this program is ongoing, and resources, including cost-share funds, are being focused at addressing problems, particularly in priority watersheds.

Table 5-11. Groundwater Protection Programs[a,b]

Programs or Activities	Implementation Status	Responsible State Agency
Active SARA Title III Program	✔ Continuing Efforts	Department for Environmental Protection Commissioner's Office
Ambient Groundwater Monitoring System	✔ **Continuing Efforts**	**Division of Water**
Aquifer Vulnerability Assessment	N/A	N/A
Aquifer Mapping	✔ Ongoing	Kentucky Geological Survey/Division of Water
Aquifer Characterization	✔ Ongoing	Kentucky Geological Survey/Division of Water
Comprehensive Data Management System	✔ Established	Division of Water
EPA-endorsed Core Comprehensive State Ground-Water Protection Program (CSGWPP)	N/A	N/A
Groundwater Discharge Permits	✔ Continuing Efforts	Division of Water
Groundwater Best Management Practices	✔ Established	Division of Conservation
Groundwater Legislation	✔ Implemented	Division of Water/Kentucky Geological Survey
Groundwater Classification	N/A	N/A
Groundwater Protection Program	✔ **Established**	**Division of Water**
Groundwater Quality Standards	✔ Developing	Division of Water
Groundwater Sensitivity Mapping	✔ Complete	Division of Water
Interagency Coordination for Groundwater Protection Initiatives	✔ Established	Interagency Technical Advisory Committee
Non-Point Source Controls	✔ Established	Division of Water
Pesticides State Management Plans	✔ Developing	Division of Pesticides
Pollution Prevention Program	✔ Implementing	Division of Water
Resource Conservation and Recovery Act (RCRA) Primacy	✔ Established	Division of Waste Management
Source Water Assessment Program	✔ Continuing Efforts	Division of Water
State Superfund	✔ Established	Division of Waste Management
State RCRA Program Incorporating more Stringent Requirements than RCRA Primacy	N/A	N/A
State Septic System Regulations	✔ Established/Developing new Standards	Cabinet of Health Services
Underground Storage Tank Installation Requirements	✔ Established	Division of Waste Management
Underground Storage Tank Remediation Fund	✔ Established	PSTEAF
Underground Storage Tank Permit Program	✔ Continuing Efforts	Division of Waste Management
Underground Injection Control Program	✔ Fully Established	EPA Region IV
Vulnerability Assessment for Drinking Water/Wellhead Protection	✔ Completed	Division of Water
Well Abandonment Regulations	✔ Continuing Efforts	Division of Water
Wellhead Protection Program (EPA-approved)	✔ **Established**	**Division of Water**
Well Installation Regulations	✔ Continuing Efforts	Division of Water

[a]Shaded programs are N/A (Not Applicable) at this time
[b]Bold-faced programs are elaborated on the preceding pages