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Letcher County Water Quality Assessment

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LETCHER COUNTY WATER QUALITY ASSESSMENT

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Prepared for:

Kentucky River Authority

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ABSTRACT

During 2000, PRIDE provided funds for the support of volunteer water quality sampling in the Kentucky River Basin as part of the 2000 Kentucky River Watershed Watch effort. This report summarizes the results of that sampling effort that focused on Letcher County.

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CHAPTER 1: INTRODUCTION

1.1 Overview

This report provide an overview of the current water quality conditions in that section of Letcher County drained by the Kentucky River. Letcher County is located in the southeast corner of Kentucky (see Figure 1.1). Letcher County is located in the Eastern Kentucky Coal Field physiographic region, characterized by mountainous terrain, rapid surface runoff, and moderate rates of groundwater drainage. This area is underlain by coals, sandstones, and shales and is generally conducive to productive wells, although water quality may be low for wells that draw from coal layers.

Three major river basins, the Kentucky, the Cumberland, and the Big Sandy share Letcher County as their headwaters (see Figure 1.2). Rockhouse Creek and the North Fork of the Kentucky River flow west towards Blackey where they unite and continue as the North Fork. Line Fork from the southwest portion of the county meets with the North Fork downstream of Blackey. Elkhorn Creek in northeast Letcher County flows northeast further into the Big Sandy River basin. The Poor Fork of the Cumberland River flows southwest into Harlan County and the Upper Cumberland River Basin.

1.2 Water Quality Standards

Water quality impacts within Letcher County may be evaluated on the basis of compliance with the Kentucky Water Quality Standards. KRS 224.10-100 requires the Kentucky Natural Resources and Environmental Protection Cabinet to develop and conduct a comprehensive program for the management of water resources and to provide for the prevention, abatement, and control of water pollution. This administrative regulation and 401 KAR 5:002, 5:026, 5:029, and 5:030 establish procedures to protect the surface waters of the Commonwealth, and thus protect water resources. This administrative regulation establishes water quality standards which consist of designated legitimate uses of the surface waters of the Commonwealth and the associated water quality criteria necessary to protect those uses. These water quality standards are minimum requirements that apply to all surface waters in the Commonwealth of Kentucky in order to maintain and protect them for designated uses. Physical and chemical parameters and criteria used by the Kentucky Division of Water to determine use support status are shown in Table 1.1.

1.3 Kentucky Water Quality Criteria

Kentucky's Water Quality Criteria are based on the designated use of the stream. Both general and separate criteria and limits for various physiochemical constituents or indicators have been developed for the following general categories: 1) Aquatic Life (both warm water and cold water habitats), 2) Water Based Recreation (both primary and secondary contact), 3 Domestic Water Supply, and 4) Outstanding State Resource Waters. In addition to water quality criteria based on these designated use categories, the Regulations also provide criteria for protection against constituent contamination from fish consumption.

1.4 Designated Uses

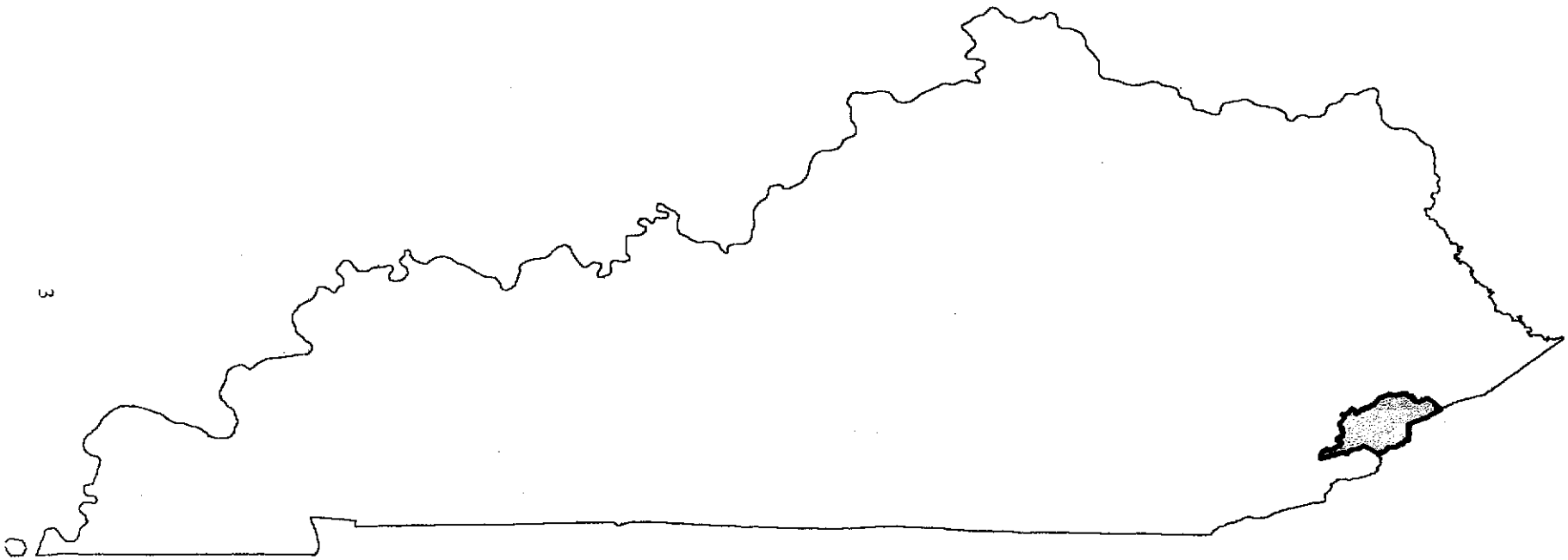
Kentucky lists water bodies (i.e. rivers, streams, lakes) according to specific uses in its water quality standards regulations. These uses include Warm Water Aquatic Habitat (WWAH), Cold Water Aquatic Habitat (CWAH), Domestic Water Supply (DWS), Primary Contact Recreation (PCR), Secondary Contact Recreation (SCR), and Outstanding Resource Waters (ORW). Those waters not specifically listed are classified (by default) for use as Warm water aquatic habitat, Primary and Secondary Contact Recreation, and Domestic Water Supply.

Table 1.1 Physical and Chemical Parameters and Criteria Used to Determine Use Support Status At Fixed Stations

Parameter	Criterion [a]
Dissolved Oxygen	4.0 mg/l
Temperature	30°C
pH	6 to 9 units
Un-ionized Ammonia-N	0.05 mg/l
Mercury	2.4 ug/l
Cadmium	$e^{(1.28 \ln x - 3.828)b}$
Copper	$e^{(.9422 \ln x - 1.464)b}$
Lead	$e^{(1.273 \ln x - 1.460)b}$
Zinc	$e^{(.8473 \ln x + .8604)b}$
Fecal Coliform Bacteria	400 colonies/100 ml (May 1 thru Oct 1)

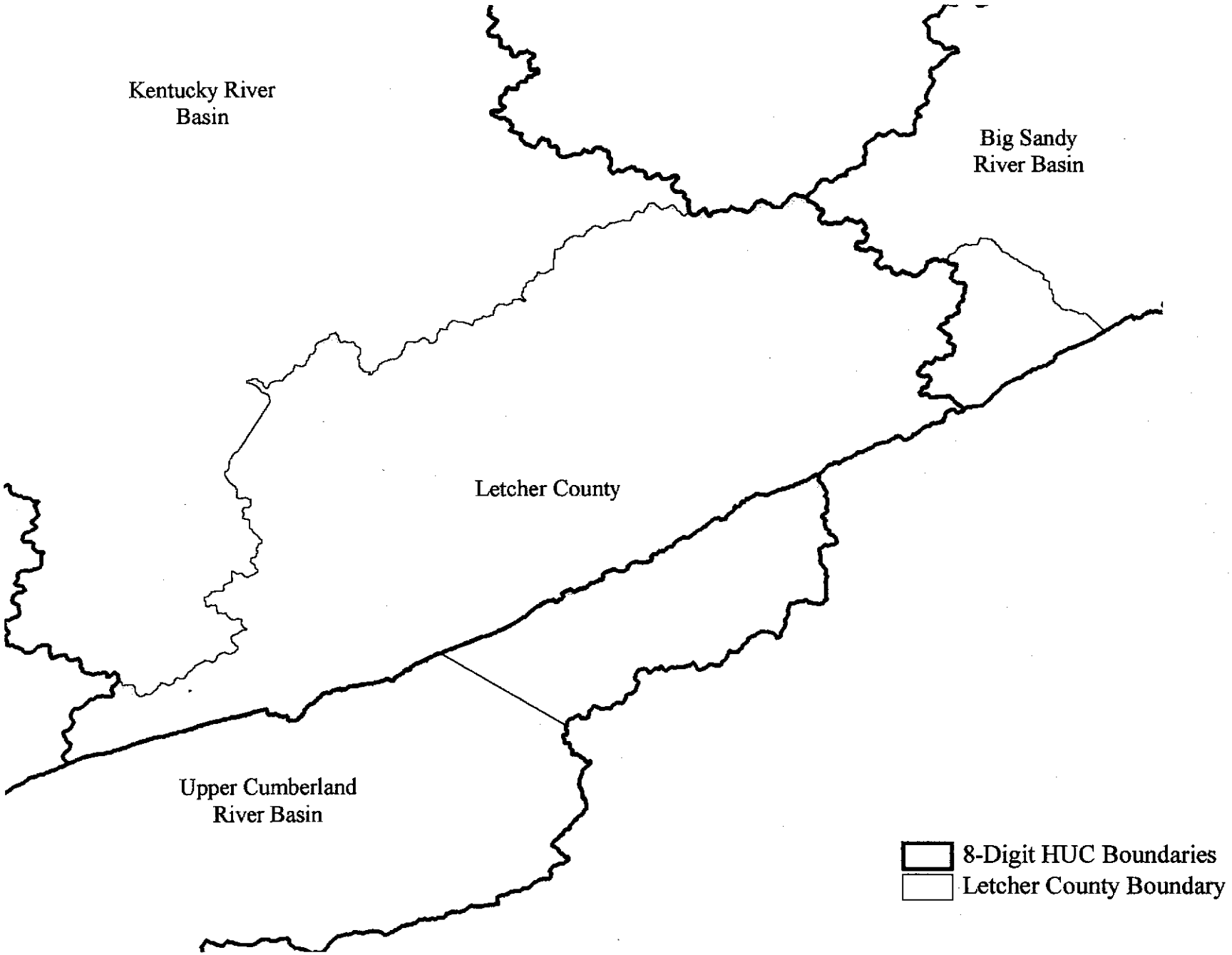
[a] from Ky Water Quality Standards
[b] x = hardness in mg/l as $CaCO_3$

Figure 1.1 Location of Letcher County



Letcher County Boundary
Kentucky State Boundary

Figure 1.2 Letcher County



CHAPTER 2:ENVIRONMENTAL PROBLEMS

2.1 Kentucky 305(b) Report

Section 305(b) of the Federal Water Pollution Control Act of 1972 (P.L. 92-500), as subsequently amended and commonly known as the Clean Water Act, requires that states submit to the U.S. Environmental Protection Agency (EPA) on a biennial basis a report assessing current water quality conditions. The water quality assessment of rivers and streams is based on the support of designated uses in state waters depicted on U.S. Geological Survey (USGS) 1:100,000 scale topographic maps, excluding the Mississippi River.

In evaluating the extent to which the streams in the State are supporting their designated uses, Kentucky employs four assessment classes: 1) aquatic life (which focuses on warm water aquatic habitat), 2) fish consumption (which serves as a measure of compliance with the fish consumption criteria), 3) swimming (which represents the most restrictive of the primary and secondary contact recreation designated uses), and 4) drinking water. Different assessment methods are used to determine the use support for each class. In general, the assessment methods employ both physiochemical and biological data.

Based on a stream's designated use, the stream may be classified as 1) fully supporting, 2) partially supporting, or 3) not supporting. Overall use support of a particular stream is determined by following EPA guidelines that define fully supporting as fully supporting all uses for which data are available. If a segment supports one use but not another, it is listed as not supporting. For instance, if a segment supports a warm water aquatic habitat use but not a primary contact recreation use, it is listed as not supporting. A segment is listed as partially supporting if any assessed use falls into that category even if another use was fully supported. Many waterbodies are assessed for only one use because data were not available to assess other uses. Those streams within Letcher County that did not meet the criteria for one or more of their assessment classes (generally their designated use) in 2000 are shown in Table 2.1. As can be seen from the table, a significant number of streams are not meeting their designated use due to pathogen, nutrient, and pH impairment mostly likely caused by ineffective wastewater systems and/or ineffective or historical mining operations. Potential sources of these associated impairments are discussed in the following sections.

2.3 Wastewater Treatment/Package Plants

There are 3 major wastewater treatment plants and 19 major package plants in Letcher County (see Figure 2.1). Statistics on each of the wastewater treatment plants are provided in Table 2.2. Historically, a significant source of pathogen impairment in the streams of Eastern Kentucky has been the improper operation of many of these treatment plants. During the 1990s, the Division of Water initiated a program of monitoring and fines that resulted in significant reductions of fecal coliforms in both the North Fork of the Kentucky River and the Upper Cumberland River Basin.

Figure 2.1 Major Wastewater Treatment Plants in Letcher County

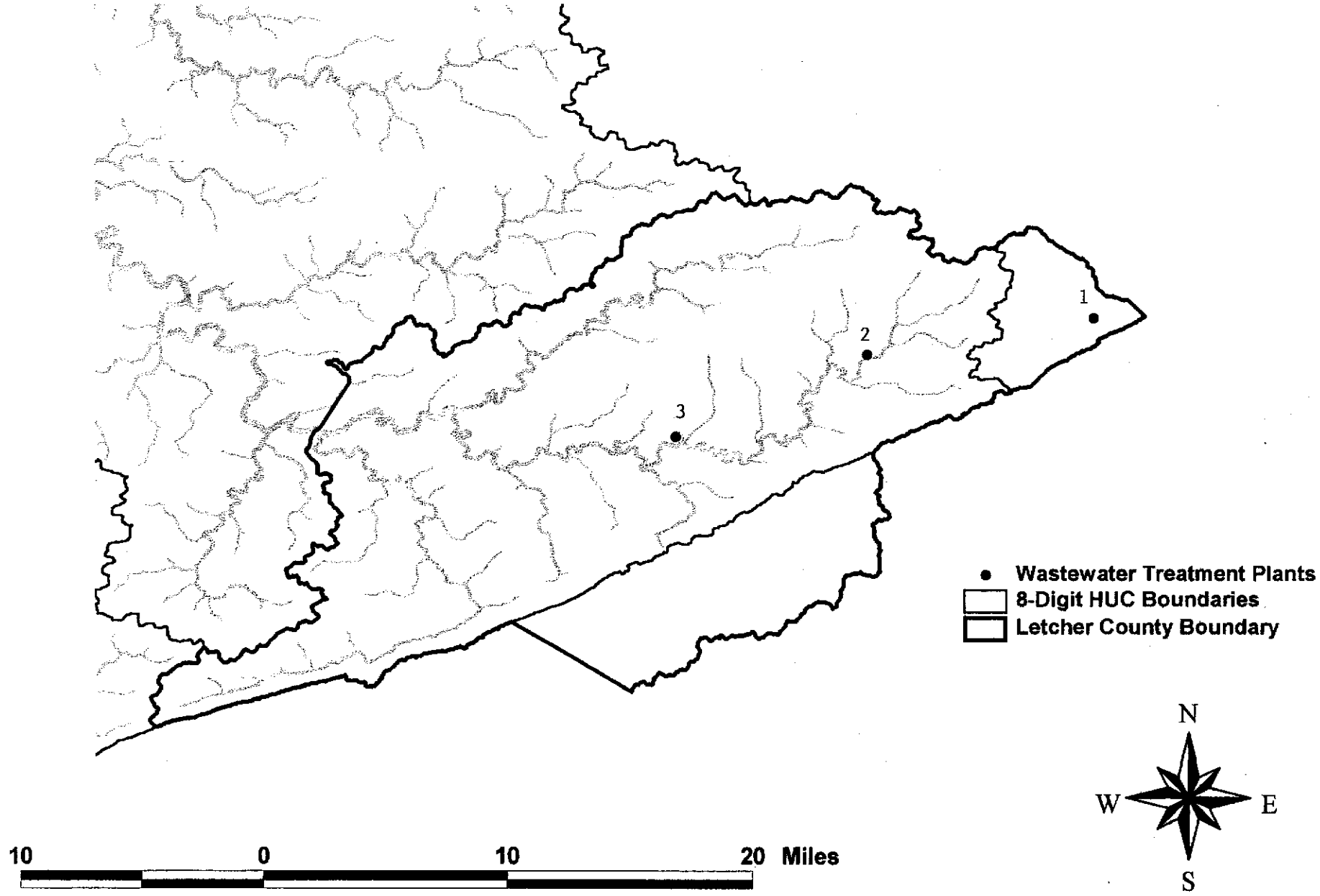


Table 2.1 Impaired Waters in Letcher County as Identified in the Kentucky 305(b) Report

Stream Name	River Miles	Cause of Impairment
Left Fork Millstone	1.5-2.7	PH, Siltation
Line Fork	11.6-27.5	Pathogens
North Fork of the Kentucky	142-158	Siltation
Potter Fork	0-4.4	Low DO
Rockhouse Creek	0-3.6	Siltation
Rockhouse Creek	20.5-21.5	Salinity/TDS/Chlorides

Table 2.2 Major Wastewater Treatment Plants in Letcher County

Name	Watershed	Receiving Stream	KPDES #	Capacity MGD
1. Jenkins	05070202060	Elkhorn Creek	KY0038571	0.600
2.Fleming Neon	05100201010	Boone Fk Creek	KY0027405	0.520
3. Whitesburg	05100201010	North Fk of KY	KY0023183	0.500

2.4 Straight Pipes

A straight pipe consists of a sewer line from a house or building that discharges raw sewage directly into a receiving stream or river. As a result, straight pipes constitute a significant source of pathogen impairment of streams. Based on data collected by the regional area development districts, it is estimated that there are at least 1,700 straight pipes in Letcher county

2.5 Failing Septic Systems

Based on data collected by the regional area development districts, it is estimated that there are at least 200 failing septic systems in Letcher County. In many cases, such systems can have as significant impact on nearby streams as ineffective package plants or straight pipes.

2.6 Illegal Dumps

Based on data collected by the regional area development districts, it is estimated that there are approximately 60 illegal dumps in Letcher County. In addition to detracting from the natural beauty of eastern Kentucky, such dumps can be a source of chemical contamination of nearby streams as well as a breeding ground for insects.

2.7 Mining Operations

As of June 30, 2000, there were approximately 185 permitted coal mines and 7 permitted non-coal mines in Letcher county. Improperly operated mining operations can contribute to acid mine drainage and erosion and siltation which can severely impact aquatic species.

CHAPTER 3: WATER QUALITY SAMPLING

3.1 Overview

This chapter documents the results of water quality sampling in Letcher County which was conducted during 2000 and which was partially supported by a grant by PRIDE to Kentucky Watershed Watch. The Kentucky Water Research Institute and the Kentucky River Watershed Watch steering committee provided coordination and oversight of the sampling effort. The sampling effort was conducted so as to be consistent with the scientific study plan developed by the Kentucky River Watershed Watch scientific advisory board which describes the monitoring objectives, methods, parameters, quality assurance, and data management. A copy of the plan may be found at the project web site: http://water.nr.state.ky.us/watch/2000/plan_of_work.htm. Detailed sampling results for 2000 are posted on the project web site at: http://water.nr.state.ky.us/watch/2000/ky.htm.

3.2 Sample Area

As indicated earlier, portions of Letcher County lie in the Kentucky, Upper Cumberland, and Big Sandy River Basins (see Figure 1.2). This chapter focuses on sampling that was conducted at sites that lie within Letcher County. A map of the various monitoring sites is provided in Figure 3.1 while a list of the sites is provided in Table 3.1.

3.3 Sample Data and Collection Dates

Water quality data were collected across the county at five different times extending through the spring, summer, and fall of 2000. A listing of the sample dates and types of data collected during each sample period is provided in Table 3.2. A summary of the types and number of samples at each individual site is provided in Table 3.3.

Table 3.2 2000 Letcher County Sample Data and Collection Dates

Type of Date Collected	Sample Dates	Sites	Samples
1. Metals Data	3/7/00-3/18/00	K97,K98,K99	9
2. Metals Data	9/10/00	K167	1
3. AMD Data	6/28/00	KL1	1
4. AMD Data	8/28/00 – 9/6/00	KL2-KL11	27
5. Fecal Coliform/Strep	3/26 - 3/31	K100-K115	39
6. Fecal Coliform/Strep	6/19 - 6/26	K100-K111,K116 - K119	46
7. Fecal Coliform	8/28/00-9/6/00	KP18-KP19	6

Figure 3.1 Letcher County Kentucky River Watershed Watch Sampling Locations

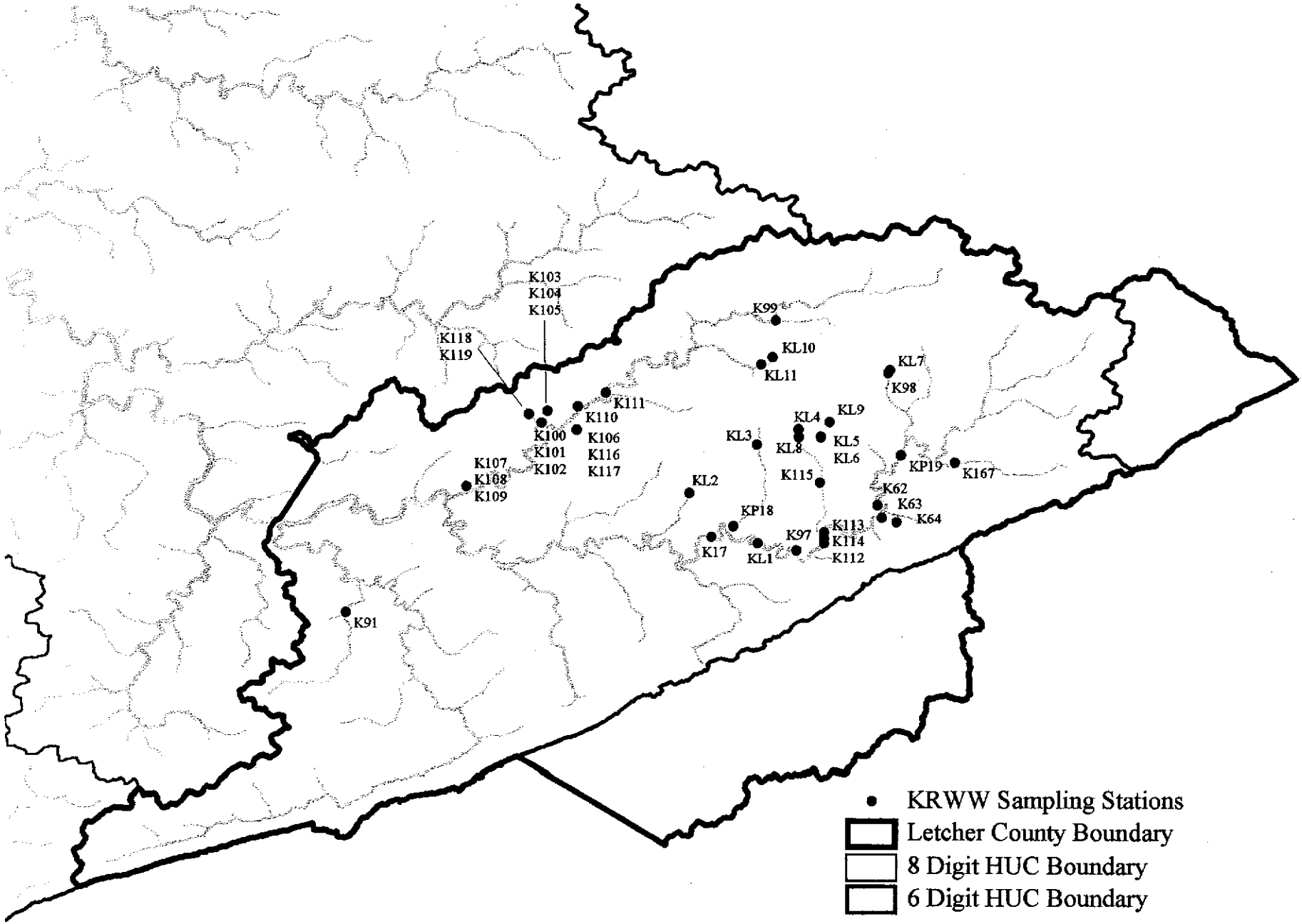


Table 3.1 Letcher County Watershed Watch Sampling Sites

Sample ID #	Stream Name	Site Location	Longitude (dec. deg.)	Latitude (dec. deg.)
K97	North Fork Kentucky River	Ermine	-82.8058	37.1134
K98	Millstone Creek	Millstone Transfer Station	-82.7620	37.1986
K99	Rockhouse Creek	Rockhouse Creek and Love's Branch	-82.8158	37.2237
K100	Rockhouse Creek		-82.9280	37.1750
K101	Rockhouse Creek	Above Doty Creek	-82.9280	37.1750
K102	Doty Creek	Mouth of Doty	-82.9280	37.1750
K103	Rockhouse Creek	Below Blair Branch	-82.9252	37.1807
K104	Rockhouse Creek	Above Blaire Branch	-82.9252	37.1807
K105	Blair Branch	Mouth of Blair Branch	-82.9252	37.1807
K106	Blair Branch	Mouth of Tooter Branch	-82.9113	37.1715
K107	Rockhouse Creek	Below Crases Branch	-82.9635	37.1448
K108	Rockhouse Creek	Above Crases Branch	-82.9635	37.1448
K109	Rockhouse Creek	Mouth of Crases Branch	-82.9635	37.1448
K110	Rockhouse Creek	Below Ison	-82.9108	37.1827
K111	Rockhouse Creek	Above Ison	-82.8973	37.1893
K112	North Fork Kentucky River	Below Colly Creek	-82.7928	37.1167
K113	North Fork Kentucky River	Above Colly Creek	-82.7928	37.1222
K114	Colly Creek	At the mouth	-82.7928	37.1192
K115	Allen Branch	At the mouth	-82.7947	37.1461
K116	Blair Branch	Above Tooter Branch	-82.9113	37.1715
K117	Blair Branch	Below Ison Branch	-82.9113	37.1715
K118	Doty Creek	Left Fork	-82.9340	37.1792
K119	Doty Creek	Right Fork	-82.9340	37.1792
K167	Boone Fork	HWY15 - KY 205 Intersection	-82.7300	37.1556
KP18	Boone Fork	At Kona	-82.8365	37.1253
KP19	Sandlick	At Whitesburg	-82.7559	37.1590
KL1	North Fork Kentucky River	Appalshop, Near Heritage Chair Factory	-82.8244	37.1169
KL2	Little Dry Fork	Route 15 near Hazard, at Little Dry Fork Road	-82.8577	37.1412
KL3	Sandlick Creek	At the Sandlick Firehall	-82.8250	37.1643
KL4	Crafts Colly	On Magnolia Road	-82.8050	37.1715
KL5	Company Fork	At the trail along Bony Piles	-82.7942	37.1680
KL6	Company Fork	At the trail along Bony Piles	-82.7942	37.1678

Table 3.1 Letcher County Watershed Watch Sampling Sites

Sample ID #	Stream Name	Site Location	Longitude (dec. deg.)	Latitude (dec. deg.)
KL7	Millstone Creek	Near millstone Transfer Station	-82.7610	37.1998
KL8	Crafts Colly		-82.8047	37.1677
KL9	Company Fork	Fork Road	-82.7900	37.1750
KL10	Camp Branch	Near Donnie Proffitt's property and Golden Oak property	-82.8172	37.2062
KL11	Camp Branch	Tipple Driveway	-82.8227	37.2027

Table 3.3 Types and Number of Samples

Sample ID #	Field Physical / Chemical Data # Samples	March Focus Fecal Coliform Sampling # Samples	Chemical Sampling # Samples	June Focus Fecal Sampling # Samples	September Focus Fecal Sampling # Samples	AMD Data # Samples	Letcher Metals Sampling # Samples
K97	6		3				3
K98	6		3				3
K99	6		3				3
K100	7	3		3			
K101	7	3		3			
K102	6	3		3			
K103	6	3		3			
K104	6	3		3			
K105	6	3		3			
K106	6	3		3			
K107	7	3		3			
K108	7	3		3			
K109	4	3		3			
K110	7	3		2			
K111	7	3		2			
K112	3			2			
K113	3			2			
K114	2			2			
K115	3			2			
K116	5	1					
K117	4	3					
K118	6	3					
K119	6	3					
K167	1						1
KP18					3		
KP19					3		
KL1	1						
KL2	3					3	
KL3	3					3	
KL4	3					3	
KL5	3					3	
KL6	3					3	
KL7	3					3	
KL8	3					3	
KL9	3					3	
KL10	3					3	
KL11						3	
# Sites Sampled per Event out of Total 37 Sites	34	16	3	16	2	10	4

3.4 Physical/Chemical Field Data

General physical/chemical field data (flow, water temperature, pH, and dissolved oxygen) were collected at each sample site during the seven separate sample periods. A summary of the physical/chemical data collected during this period is provided in Table 3.4. With the exception of stations KL3, KL4, and KL7 all stations had oxygen levels greater than 5.0. For the average observed stream temperatures, all dissolved oxygen values should be less than 10. Thus, those sites with readings in excess of 10 are most likely due to measurement error. In general, all stations had pH values greater than 6. However, station KL4 had average pH readings of 3.5, indicating significant AMD impacts.

3.5 Metals Analysis

In addition to general physical/chemical data, detailed metals analyses were performed on the samples collected at sites K97, K98, K99, and K167 as part of the normal watershed watch annual baseline sampling effort. The results of these analyses are shown in Table 3.5. In general, most of the metals are below the maximum limits associated with applicable water quality standards. However, site K99 has excessive values for Iron (> 1mg/l), Chromium (>0.01 mg/l) and Manganese (> 0.05 mg/l).

3.6 AMD Analysis

In addition the previously described physical/chemical and metals analysis, additional chemical analyses were performed at 11 separate sites that were located downstream of AMD sites. These sites included KL1 – KL11. The results of these analyses are shown in Table 3.6. In general, all sites indicated very high levels of conductivity (> 800 umhos/cm) , total dissolved solids (> 750 mg/l) , sulfate (> 250 mg/l), iron (> 1 mg/l) and manganese (> 0.05 mg/l), thus indicating significant AMD impacts. Of particular impact were those sites located in the Crafts Colly Watershed (i.e. KL4, KL5, KL6, KL8, and KL9).

3.7 Bacteriological Indicators

Two separate indicators were used to evaluate the possibility of bacteriological contamination in the streams located in Letcher County. These included fecal coliform and fecal streptococci.

3.7.1. Fecal Coliform

Total coliform bacteria are a collection of relatively harmless microorganisms that live in large numbers in the intestines of man and warm- and cold-blooded animals. They aid in the digestion of food. A specific subgroup of this collection is the fecal coliform bacteria, the most common member being *Escherichia coli*. These organisms may be separated from the total coliform group by their ability to grow at elevated temperatures and are associated only with the fecal material of warm-blooded animals.

The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of man or other animals. At the time this occurred, the source water may have been contaminated by pathogens or disease producing bacteria or viruses which can also exist in fecal material. Some waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis and hepatitis A. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or non-point sources of human and animal waste. The state criteria for fecal coliform are based on the designated use of the particular stream and may be summarized as follows:

Primary Contact Recreation (swimming from May 1 thru Oct 31): fecal coliform shall not exceed 200 colonies per 100 ml as a monthly geometric mean based on not less than 5 samples per month; nor exceed 400 colonies per 100 ml in 20 percent or more of all samples taken during the month. [note as a result of the sampling frequency requirement with the first criteria, the state of Kentucky uses the 400 colonies per 100 ml criteria for classifying streams in the 305(b) report].

Secondary Contact Recreation (fishing and boating): fecal coliform content shall not exceed 1000 colonies per 100 ml as a monthly geometric mean based on not less than 5 samples per month; nor exceed 2000 colonies per 100 ml in 20 percent or more of all samples taken during the month.

Domestic Water Supply: fecal coliform content shall not exceed 2000 colonies per 100 ml as a monthly geometric mean based on not less than 5 samples per month.

3.7.2. Fecal Streptococci and the FC/FS Ratio

In the mid-70s, a general hypothesis was established that the ratio of two indicator bacteria in fecal wastes – fecal coliforms (FC) and fecal streptococci (FS) – was characteristic of particular animal wastes. In human wastes, the fecal coliform/streptococci ratio (FC/FS ratio) was determined to be greater than 4.0. In domesticated animals, like cattle, the ratio was identified to range between 0.1 and 4.0. In wild animals, the ratio was less than 0.1. Since that time, many attempts have been made to use the ratio to determine the source of fecal bacteria in contaminated waters. However, such applications should be limited to those cases where the following conditions are strictly enforced (Coyne and Howell, 1994):

1) Sampling needs to occur soon after manure deposition (within 24 hours if possible) because the fecal bacteria die off at different rates.
2) It becomes difficult to distinguish fecal streptococci in wastes from fecal streptococci that are naturally present in the soil and water when fewer than 100 fecal streptococci/100 ml of water are present, thus comparisons should generally only be done when the fecal strep values are greater than 100..

3) The water pH needs to be between 4 and 9 because fecal coliforms die off quicker than fecal streptococci in acid or alkaline water.
4) In typical agricultural settings, the FC/FS ratio from a single sample has little diagnostic use. The conclusions drawn must be carefully evaluated because so many environmental factors affect it. For example, warm shallow streams, high in organic carbon, permit fecal coliform re-growth and increase the FC/FS ratio. Samples taken in these conditions can give misleading values. Consequently, the mean FC/FS ratio for a site can be largely meaningless when the range of FC/FS ratios is so great.

3.8 Bacteriological Sampling

Three different sets of fecal coliform/fecal strep sampling were conducted in Letcher County during the summer of 2000. The first set of data were collected at sites K100-K115 during the end of March. These results are shown in Table 3.7. The second set of data were collected at sites K100-K111 and sites K116-K119 during the end of June. These results are shown in Table 3.8. Finally, two additional sites (KP18 and KP19) were sampled at the outlets of Boone Fork and Sandlick Creek respectively. The results of the analyses are shown in Table 3.9. In general, the fecal results in June were much higher than those in March. However, in both cases many sites had fecal coliform levels in excess of the 200 colonies per 100 ml limit. During the month of June all sites had levels well in excess of this limit. Both KP18 and KP19 consistently indicated fecal levels well in excess of the acceptable limit. Finally, an examination of Tables 3.7 and 3.8 reveals that several sites had fecal coliform to fecal strep ratios in excess of 4.0 which is generally indicative of human sources. In particular, nearly all the sites in March had average ratios greater than 4.0.

Table 3.4 - Letcher County Physical / Chemical Field Data

SampleID#	Collection Date	Sampler's Description and Comments	Flow Conditions*	Water Temperature* (F)	pH*	Dissolved Oxygen* (mg/L)
K97	3/7/00	Low and clear	Low	-	-	-
K97	3/11/00	Normal flow and clear	Normal	-	-	-
K97	3/18/00	Swollen and discolored, swiftly flowing water	Normal	-	-	-
K98	3/7/00	Low and clear	Low	-	-	-
K98	3/11/00	Swollen and discolored, swiftly flowing water	Bank Full	-	-	-
K98	3/18/00	Normal flow and clear	Normal	-	-	-
K99	3/7/00	Silt-ridden, low	Low	-	-	-
K99	3/11/00	Swiftly-flowing, swollen, muddy water due to large sediment load	Bank Full	-	-	-
K99	3/18/00		Bank Full	-	-	-
K100	3/29/00	Normal flow and clear	Normal	-	-	-
K100	3/31/00	Normal flow and clear	Normal	-	-	-
K100	6/19/00	Cloudy	Low	-	-	-
K100	6/21/00	Clear	Low	-	7.2	7.0
K100	6/26/00	Muddy	Low	-	6.0	7.4
K100	6/28/00	Muddy / Fast	Bank Full	-	7.4	7.0
K100	6/30/00	Murky	Bank Full	-	7.5	7.0
K101	3/29/00	Normal flow and clear	Normal	-	-	-
K101	3/31/00	Normal flow and clear	Normal	-	-	-
K101	6/19/00	Cloudy	Low	-	-	-
K101	6/21/00	Clear	Low	-	7.3	6.5
K101	6/26/00	Muddy	Low	-	7.3	6.0
K101	6/28/00	Muddy / Fast	Bank Full	-	7.4	7.0
K101	6/30/00	Murky	Bank Full	-	7.3	7.5
K102	3/29/00	Normal flow and clear	Normal	-	-	-
K102	3/31/00	Low and clear	Low	-	-	-
K102	6/19/00	Cloudy	Low	-	-	-
K102	6/26/00	Muddy	Low	-	7.3	7.0
K102	6/28/00	Muddy / Swift	Bank Full	-	7.4	7.5
K102	6/30/00	Clear	Low	-	7.4	7.5
K103	3/29/00	Normal flow and clear	Normal	-	-	-
K103	3/31/00	Normal flow and clear	Normal	-	-	-
K103	6/21/00	Clear	Low	-	7.3	8.0

Table 3.4 - Letcher County Physical / Chemical Field Data

SampleID#	Collection Date	Sampler's Description and Comments	Flow Conditions*	Water Temperature* (F)	pH*	Dissolved Oxygen* (mg/L)
K103	6/26/00	Milky	Low	-	7.3	8.0
K103	6/28/00	Muddy / Fast	Bank Full	-	7.5	8.0
K103	6/30/00	Murky	Bank Full	-	7.4	8.0
K104	3/29/00	Normal flow and clear	Normal	-	-	-
K104	3/31/00	Normal flow and clear	Normal	-	-	-
K104	6/21/00	Clear	Low	-	7.3	7.5
K104	6/26/00	Milky	Low	-	7.3	7.0
K104	6/28/00	Muddy / Fast	Bank Full	-	7.4	7.5
K104	6/30/00	Murky	Bank Full	-	7.4	7.5
K105	3/29/00	Normal flow and clear	Normal	-	-	-
K105	3/31/00	Low and clear	Low	-	-	-
K105	6/21/00	Clear	Low	-	7.2	8.5
K105	6/26/00	Milky	Low	-	7.2	7.5
K105	6/28/00	Muddy / Swift	Bank Full	-	7.4	8.0
K105	6/30/00	Clear	Low	-	7.2	7.5
K106	3/29/00	Normal flow and clear	Normal	-	-	-
K106	3/31/00	Normal flow and clear	Normal	-	-	-
K106	6/21/00	Clear	Low	-	7.4	8.0
K106	6/26/00	Milky	Low	-	7.6	7.0
K106	6/28/00	Muddy / Swift	Bank Full	-	7.5	7.0
K106	6/30/00	Murky	Bank Full	-	7.5	7.5
K107	3/29/00	Normal flow and clear	Normal	-	-	-
K107	3/31/00	Normal flow and clear	Normal	-	-	-
K107	6/19/00	Clear, very low	Low	-	-	-
K107	6/21/00	Clear	Low	-	7.4	9.0
K107	6/26/00	Muddy and flowing swiftly	Normal	-	7.4	8.0
K107	6/28/00	Muddy / Fast	Bank Full	-	7.5	8.0
K107	6/30/00	Murky	Bank Full	-	7.4	8.0
K108	3/29/00	Normal flow and clear	Normal	-	-	-
K108	3/31/00	Normal flow and clear	Normal	-	-	-
K108	6/19/00	Clear, very low	Low	-	-	-
K108	6/21/00	Clear	Low	-	7.4	9.0

Table 3.4 - Letcher County Physical / Chemical Field Data

SampleID#	Collection Date	Sampler's Description and Comments	Flow Conditions*	Water Temperature* (F)	pH*	Dissolved Oxygen* (mg/L)
K108	6/26/00	Muddy and flowing swiftly	Normal	-	7.4	8.0
K108	6/28/00	Muddy / Fast	Bank Full	-	7.5	8.0
K108	6/30/00	Murky	Bank Full	-	7.4	8.5
K109	3/31/00	Low and clear	Low	-	-	-
K109	6/26/00	Low and clear	Ponded	-	7.5	7.5
K109	6/28/00	Fast / Murky	Bank Full	-	7.5	8.0
K109	6/30/00	Clear	Normal	-	7.5	7.0
K110	3/26/00	Clear and normal flow	Normal	-	-	-
K110	3/31/00	Normal flow and clear	Normal	-	-	-
K110	6/19/00	Cloudy	Low	-	-	-
K110	6/21/00	Clear	Low	-	7.4	8.0
K110	6/26/00	Muddy	Low	-	7.4	7.0
K110	6/28/00	Muddy / Fast	Bank Full	-	7.5	7.5
K110	6/30/00	Murky	Bank Full	-	7.4	7.5
K111	3/26/00	Clear and normal flow	Normal	-	-	-
K111	3/31/00	Normal flow and clear	Normal	-	-	-
K111	6/19/00	Cloudy	Low	-	-	-
K111	6/21/00	Cloudy	Low	-	7.5	6.5
K111	6/26/00	Muddy	Low	-	7.5	6.0
K111	6/28/00	High / Muddy	Bank Full	-	7.5	7.0
K111	6/30/00	Murky	Bank Full	-	7.4	7.0
K112	3/26/00	Normal flow and clear	Normal	-	-	-
K112	3/31/00	Low and clear	Low	-	-	-
K113	3/26/00	Normal flow and clear	Normal	-	-	-
K113	3/31/00	Low and clear	Low	-	-	-
K114	3/31/00	Normal flow and clear	Normal	-	-	-
K115	3/26/00	Normal flow and clear	Bank Full	-	-	-
K115	3/31/00	Milky sheen on surface, white algae abundant on bed	Normal	-	-	-
K116	6/19/00	Muddy	Normal	-	-	-
K116	6/21/00	Clear	Low	-	7.4	8.0
K116	6/26/00	Milky	Low	-	7.5	7.0
K116	6/28/00	Muddy / Swift	Bank Full	-	7.4	7.5

Table 3.4 - Letcher County Physical / Chemical Field Data

SampleID#	Collection Date	Sampler's Description and Comments	Flow Conditions*	Water Temperature* (F)	pH*	Dissolved Oxygen* (mg/L)
K116	6/30/00	Murky	Low	-	7.5	7.4
K117	6/21/00	Clear	Low	-	7.4	8.0
K117	6/26/00	Milky	Low	-	7.4	7.0
K117	6/28/00	Muddy / Swift	Bank Full	-	7.4	7.5
K117	6/30/00	Murky	Bank Full	-	7.5	7.5
K118	6/19/00	Clear	Low	-	-	-
K118	6/21/00	Clear	Low	-	7.3	7.0
K118	6/26/00	Low and clear	Low	-	7.3	7.0
K118	6/28/00	Murky / Swift	Bank Full	-	7.4	7.5
K118	6/30/00	Clear	Low	-	7.4	7.5
K119	6/19/00	Clear	Low	-	-	-
K119	6/21/00	Clear	Low	-	7.4	7.0
K119	6/26/00	Clear	Low	-	7.4	7.0
K119	6/28/00	Murky / Swift	Bank Full	-	7.4	7.5
K119	6/30/00	Clear	Low	-	7.3	7.5
K167	7/29/00	Clear, moderate flow	Normal	-	-	-
K167	9/10/00	Clear, good flow	Normal	22	-	-
KL2	8/14/00	-	swift	62	7.1	9
KL2	8/28/00	-	swift	63	6.9	8
KL2	8/31/00	-	swift	62	6.9	8
KL3	8/14/00	-	swift	65	6.2	3
KL3	8/28/00	-	swift	64	6.0	2
KL3	8/31/00	-	swift	64	5.9	3
KL4	8/14/00	-	swift	70	3.5	4
KL4	8/28/00	-	slight	68	3.9	7
KL4	8/31/00	-	slight	65	3.7	5
KL5	8/14/00	-	swift	70	6.6	7
KL5	8/21/00	-	swift	69	6.7	9
KL5	8/28/00	-	swift	68	6.5	8
KL6	8/14/00	-	swift	67	6.6	7
KL6	8/21/00	-	swift	66	6.3	11
KL6	8/28/00	-	swift	66	6.0	9

Table 3.4 - Letcher County Physical / Chemical Field Data

SampleID#	Collection Date	Sampler's Description and Comments	Flow Conditions*	Water Temperature* (F)	pH*	Dissolved Oxygen* (mg/L)
KL7	8/17/00	-	low	-	6.3	5.5
KL7	8/28/00	-	low	-	6.5	4
KL7	8/31/00	-	slight	-	6.0	5
KL8	8/21/00	-	slight	66	2.7	11
KL8	8/28/00	-	slight	64	2.5	11
KL8	8/31/00	-	slight	64	2.9	11
KL9	8/21/00	-	swift	68	6.4	11
KL9	8/28/00	-	swift	67	6.2	9.5
KL9	8/31/00	-	swift	67	6.0	8.5
KL10	8/23/00	-	swift	60	6.7	9
KL10	8/28/00	-	swift	61	6.5	8
KL10	8/31/00	-	swift	61	6.9	8
KL11	8/23/00	-	slight	64	7.4	7
KL11	8/28/00	-	slight	65	7.0	8
KL11	8/31/00	-	slight	65	7.2	8

Notes

1. (*) - Dashed values indicates no data available
2. Based on observed temperature values, the dissolved oxygen reading should be < 10. Values in excess of 10 are assumed to be attributed to measurement error.

Table 3.5 Letcher County Metals Sampling Results

Sample ID #	Collection Date	Aluminum Total by ICP (mg/L)	Arsenic Total by ICP (mg/L)	Barium Total by ICP (mg/L)	Cadmium Total by ICP (mg/L)	Chromium Total by ICP (mg/L)	Copper Total by ICP (mg/L)	Iron Total by ICP (mg/L)	Lead Total by ICP (mg/L)	Magnesium Total by ICP (mg/L)	Manganese Total by ICP (mg/L)	Mercury Total (mg/L)	Potassium Total by ICP (mg/L)	Selenium Total by ICP (mg/L)	Sodium Total by ICP (mg/L)	Zinc Total by ICP (mg/L)
K97	03/07/00	BDL	BDL	0.05	BDL	BDL	BDL	0.37	BDL	32	0.09	BDL	3.6	BDL	38	BDL
K97	03/11/00	0.3	BDL	0.05	BDL	BDL	BDL	0.54	BDL	29	0.1	BDL	3.9	BDL	37	BDL
K97	03/18/00	0.08	BDL	0.04	BDL	BDL	0.014	0.37	BDL	21	0.08	BDL	2.8	BDL	21	BDL
K98	03/07/00	BDL	BDL	0.04	BDL	BDL	BDL	0.66	BDL	79	0.11	BDL	5.9	BDL	54	BDL
K98	03/11/00	5.8	BDL	0.09	BDL	BDL	0.012	12	BDL	63	0.39	BDL	6.4	BDL	39	0.06
K98	03/18/00	0.07	BDL	0.04	BDL	BDL	BDL	0.24	BDL	68	0.26	BDL	5.3	BDL	38	BDL
K99	03/17/00	0.31	BDL	0.05	BDL	BDL	BDL	0.92	BDL	42	0.7	BDL	4.5	BDL	56	BDL
K99	03/11/00	24	BDL	0.26	BDL	0.4	0.45	38	BDL	55	0.95	BDL	8.8	BDL	23	0.22
K99	03/18/00	0.67	BDL	0.05	BDL	BDL	BDL	1.1	BDL	28	0.28	BDL	3.2	BDL	26	BDL
K167	9/10/00	0.12	BDL	BDL	BDL	BDL	BDL	0.18	BDL	10	0.05	BDL	6.4	BDL	17	BDL

* BDL = Below Detectable Limit

Table 3.6 Letcher County AMD Sampling Results

Station ID	Date	pH	Acidity (mg/L)	Alkalinity (mg/L)	Conductivity (mho/cm)	TDS (mg/L)	Sulfates (mg/L)	Total Iron (mg/L)	Dissolved Iron (mg/L)	Total Manganese (mg/L)	Dissolved Manganese (mg/L)
KL1	6/28/00	7.6	BDL	96	670	18	180	0.61	-	0.42	-
KL2	8/28/00	7.4	0	366	1599	800	575	0.3	<.01	0.35	0.33
KL2	8/31/00	6.9	0	369	1736	868	430	0.38	0.12	0.37	0.34
KL2	9/6/00	7.2	0	361	1738	870	610	0.78	<.01	0.34	0.34
KL3	8/28/00	7.4	0	298	1262	632	200	4.77	<.01	0.62	0.54
KL3	8/31/00	6.9	0	306	1243	622	180	4.92	<.01	0.62	0.61
KL3	9/6/00	7.4	0	294	1252	628	290	2.19	<.01	0.69	0.44
KL4	8/28/00	4.9	50	0	671	337	250	8.09	<.01	0.84	0.73
KL4	8/31/00	4.5	45	0	657	329	280	9.26	6.85	0.77	0.74
KL4	9/6/00	3.7	55	0	674	337	230	8.69	2.72	0.81	0.77
KL5	8/28/00	6.6	0	127	1000	502	575	4.08	<.01	0.93	0.1
KL5	8/31/00	5.9	0	119	1054	527	450	4.12	0.07	0.83	0.26
KL5	9/6/00	6.4	0	116	1025	514	480	1.44	<.01	0.75	0.4
KL6	8/28/00	6.9	0	120	1062	532	600	0.38	0.07	0.36	0.27
KL6	8/31/00	6.3	0	123	1055	528	470	0.59	<.01	0.41	0.38
KL6	9/6/00	7.2	0	111	1017	510	440	0.48	<.01	0.61	0.54
KL7	8/28/00	6.9	0	354	1342	672	425	10.4	0.03	1.24	1.11
KL7	8/31/00	6.4	0	374	1421	711	320	2.67	0.01	1.45	1.41
KL7	9/6/00	7	0	353	1373	688	290	4.35	0.01	1.38	1.36
KL8	8/28/00	3.6	405	0	1101	552	800	2.51	1.21	3.06	2.99
KL8	8/31/00	3.4	135	0	1274	637	840	2.42	2.18	3.33	3.18
KL8	9/6/00	3.3	135	0	1236	619	680	2.7	1.46	3.2	3.14
KL9	8/28/00	6	0	35	996	498	675	0.61	0.02	1.21	1.21
KL9	8/31/00	5.5	5	33	1074	537	580	0.67	0.06	1.29	1.26
KL9	9/6/00	6.1	0.5	30	1051	527	530	0.61	0.08	1.4	1.32
KL10	8/28/00	6.7	0	343	1525	760	375	26.83	<.01	0.93	0.82
KL10	8/31/00	6.2	0	285	1804	902	270	40.48	1.88	1.23	1.19
KL10	9/6/00	7.2	0	294	1786	895	490	6.01	<.01	0.89	0.84
KL11	8/28/00	6.8	0	179	1082	544	425	1.77	0.02	0.16	0.13
KL11	8/31/00	6.4	0	178	988	494	360	1.41	<.01	0.12	0.12
KL11	9/6/00	7.3	0	165	982	492	440	0.56	<.01	0.13	0.12

Table 3.6 Letcher County AMD Sampling Results

Station ID	Date	Dissolved Calcium (mg/L)	Dissolved Magnesium (mg/L)	Dissolved Sodium (mg/L)	Dissolved Potassium (mg/L)	Chlorine (mg/L)	Aluminum (mg/L)	Hardness (mg/L)
KL1	6/28/00	59	33	-	-	-	0.09	290
KL2	8/28/00	51.12	32.88	288.57	7.9	18.4	0.019	-
KL2	8/31/00	44.33	23.88	304.4	8.25	14.8	0.005	-
KL2	9/6/00	32.7	29.15	327.75	9.15	14	0.004	-
KL3	8/28/00	53.94	35.28	178.16	6.4	7.6	<.001	-
KL3	8/31/00	55.62	26.15	233.43	6.83	6.8	0.01	-
KL3	9/6/00	65.5	33.3	243.85	10.9	4	0.007	-
KL4	8/28/00	30.4	30.22	29.55	4.24	5.6	2.74	-
KL4	8/31/00	36.69	23.09	-	5.63	6.8	4.21	-
KL4	9/6/00	27.35	22.6	49.65	7.3	4	4.29	-
KL5	8/28/00	86.24	59.76	60.66	7.47	5.2	0.401	-
KL5	8/31/00	83.78	45.65	64.62	8.55	4.8	1.65	-
KL5	9/6/00	79.35	47.75	95.55	12.05	2.4	0.061	-
KL6	8/28/00	84.05	60.38	61.67	7.58	4.4	<.001	-
KL6	8/31/00	85.91	43.47	60.27	8.1	3.6	0.028	-
KL6	9/6/00	87.75	50.1	83.4	10.3	2.8	0.044	-
KL7	8/28/00	131.4	76.98	110	9.57	68	0.035	-
KL7	8/31/00	122.06	59.9	76.44	9	35.6	0.004	-
KL7	9/6/00	128.3	60.65	105.05	10.8	40	0.017	-
KL8	8/28/00	48.44	67.48	44.48	4.22	17.2	25.1	-
KL8	8/31/00	61.22	57.83	36.11	5.43	3.6	31.5	-
KL8	9/6/00	50.6	47.05	51.25	6.4	2.8	27	-
KL9	8/28/00	77.82	58.62	59.76	6.65	9.2	14.5	-
KL9	8/31/00	81.83	51.12	53.69	7.4	3.6	14	-
KL9	9/6/00	70.2	54.95	92.2	11.7	3.6	11.4	-
KL10	8/28/00	40.46	19.04	303.82	8.48	22.8	0.72	-
KL10	8/31/00	57.96	17.87	291.66	9.33	20.8	0.233	-
KL10	9/6/00	36.9	12.1	374.1	12.9	16.4	0.222	-
KL11	8/28/00	90.98	52.3	45.86	8.56	4.4	0.029	-
KL11	8/31/00	89.78	39.96	45.08	7.94	6	0.003	-
KL11	9/6/00	74.5	38.9	39.71	11.5	3.2	<.001	-

Table 3.7 Letcher County Focus Fecal Coliform / Fecal Strep Sampling Results - March 2000

Sample ID #	Collection Date	Fecal Coliform Count (col/100 mL)	Fecal Strep Count* (col/100 mL)	Fecal / Strep Ratio*
K100	3/26/00	460	260	1.769
K100	3/29/00	1000	40	25.000
K100	3/31/00	1100	190	5.789
K101	3/26/00	400	280	1.429
K101	3/29/00	400	70	5.714
K101	3/31/00	1200	150	8.000
K102	3/26/00	500	180	2.778
K102	3/29/00	2700	30	90.000
K102	3/31/00	2700	80	33.750
K103	3/26/00	16000	370	43.243
K103	3/29/00	130	230	0.565
K103	3/31/00	42000	320	131.250
K104	3/26/00	350	300	1.167
K104	3/29/00	800	60	13.333
K104	3/31/00	700	150	4.667
K105	3/26/00	17000	110	154.545
K105	3/29/00	22000	600	36.667
K105	3/31/00	54000	1000	54.000
K106	3/26/00	>60000	120	>500
K106	3/29/00	2500	1000	2.500
K106	3/31/00	1200	210	5.714
K107	3/26/00	360	110	3.273
K107	3/29/00	800	90	8.889
K107	3/31/00	190	90	2.111
K108	3/26/00	500	210	2.381
K108	3/29/00	450	60	7.500
K108	3/31/00	260	60	4.333
K109	3/26/00	300	80	3.750
K109	3/29/00	400	40	10.000
K109	3/31/00	100	1500	0.067
K110	3/29/00	500	90	5.556
K110	3/31/00	300	130	2.308
K111	3/29/00	900	20	45.000
K111	3/31/00	140	20	7.000
K112	3/29/00	1800	210	8.571
K112	3/31/00	440	150	2.933
K113	3/29/00	1700	230	7.391
K113	3/31/00	290	210	1.381
K114	3/29/00	1000	70	14.286
K114	3/31/00	450	130	3.462
K115	3/29/00	300	330	0.909
K115	3/31/00	BDL	200	-

Notes

1. (*) - Dashed values indicates no data available

Table 3.8 Letcher County Focus Fecal Coliform / Fecal Strep Sampling Results - June 2000

Sample ID #	Collection Date	Fecal Coliform Count (col/100 mL)	Fecal Strep Count* (col/100 mL)	Fecal / Strep Ratio*
K100	6/19/00	12000	8000	1.500
K100	6/21/00	1500	600	2.500
K100	6/26/00	4500	2800	1.607
K101	6/19/00	5000	7000	0.714
K101	6/21/00	2300	600	3.833
K101	6/26/00	3900	200	19.500
K102	6/19/00	6000	20000	0.300
K102	6/21/00	1000	600	1.667
K102	6/26/00	700	400	1.750
K103	6/19/00	2000	6000	0.333
K103	6/21/00	700	600	1.167
K103	6/26/00	2900	1500	1.933
K104	6/19/00	2900	9000	0.322
K104	6/21/00	1500	600	2.500
K104	6/26/00	4400	1200	3.667
K105	6/19/00	21000	25000	0.840
K105	6/21/00	16000	600	26.667
K105	6/26/00	2600	3600	0.722
K106	6/19/00	29000	65000	0.446
K106	6/21/00	2400	600	4.000
K106	6/26/00	3700	2900	1.276
K107	6/19/00	320	9000	0.036
K107	6/21/00	250	450	0.556
K107	6/26/00	4200	3200	1.313
K108	6/19/00	340	1000	0.340
K108	6/21/00	270	600	0.450
K108	6/26/00	4100	2700	1.519
K109	6/19/00	2300	6000	0.383
K109	6/21/00	2400	600	4.000
K109	6/26/00	600	1900	0.316
K110	6/19/00	2800	7000	0.400
K110	6/21/00	150	500	0.300
K110	6/26/00	2800	1900	1.474
K111	6/19/00	33000	35000	0.943
K111	6/21/00	7000	600	11.667
K111	6/26/00	1100	900	1.222
K116	6/26/00	2400	2500	0.960
K117	6/19/00	28000	57000	0.491
K117	6/21/00	2000	600	3.333
K117	6/26/00	1900	5200	0.365
K118	6/19/00	3500	25000	0.140
K118	6/21/00	700	600	1.167
K118	6/26/00	500	2900	0.172
K119	6/19/00	70000	15000	4.667
K119	6/21/00	1800	600	3.000
K119	6/26/00	1200	1400	0.857

Notes

1. (*) - Dashed values indicates no data available

Table 3.9 Letcher County Focus Fecal Coliform Sampling Results - September 2000

Sample ID #	Collection Date	Fecal Coliform Count (col/100 mL)
KP18	9/5/00	60000
KP18	9/6/00	60000
KP18	9/7/00	15000
KP19	9/5/00	60000
KP19	9/6/00	60000
KP19	9/7/00	7000

CHAPTER 4: CONCLUSIONS AND RECOMMENDATIONS

This report summarizes the results of the 2000 Kentucky Watershed Watch Sampling effort for Letcher County. As part of this sampling effort, 129 separate samples were collected from a total of 37 different sites. The various samples were analyzed for various physical/chemical parameters as well as for metals, AMD parameters, and fecal coliform and fecal strep. These results indicate that Letcher County has significant water quality problems related to both straight pipes and AMD sites.

One of the most severely impacted creeks appears to be Crafts Colly Creek which flows into the North Fork of the Kentucky River approximately one mile above the intake of the Whitesburg Water Treatment Plant. Between 150 and 200 households reside along Crafts Colly or of its numerous tributaries. Public water and sewer service is not available. As many as 100 households in this area dispose of their household wastewater directly into the adjacent creek via a straight pipe discharge.

The water quality of Crafts Colly Creek is degraded further by numerous acid mine drainage (AMD) sites scattered throughout the watershed. The Letcher County Water and Sewer District has identified and analyzed 5 discharges containing high levels of sulfate, iron, and aluminum. With pH levels as low as 2.7, little aquatic life survives near these discharges. These sites range in flow rates between 30 and 1000 gallons per minute, all discharging into Crafts Colly and then into the North Fork. Analysis of drinking wells near the AMD discharges reveal pH levels as low as 3, far too acidic to meet public drinking water standards.

Despite mandatory garbage pickup, dumping along Crafts Colly continues to persist. Household garbage and abandoned tires clog the stream and its tributaries after heavy rain, restricting water flow and causing flooding. Extensive flooding occurred along the creek in July 2000, prompting a citizen delegation to petition the Letcher County Fiscal Court for assistance in cleaning out the streambeds and culverts to reduce the likelihood of recurrent flooding.

Crafts Colly Creek is currently one of the most degraded streams in Letcher County. Water quality analyses along its length reveal high levels of fecal coliform bacteria due to straight pipe discharges and pollutants resulting from an extensive history of deep and surface mining for coal. These conditions represent a health threat to the residents living along the stream as well as to the customers of the Whitesburg municipal water system. As a result, it is recommended that actions be taken to improve the quality of life for the residents of Crafts Colly by clearing garbage and debris from stream banks and riparian properties, restoring aquatic life to a dead stream by treating acid mine drainage discharges at feasible locations; and helping to protect the municipal water supply for the city of Whitesburg by educating residents of Crafts Colly about septic system technology and available loans through the PRIDE program.