2013

A Summary of the Kentucky River Watershed Watch 2013 Water Sampling Results

Kentucky Water Resources Research Institute

A Summary of the

Kentucky River Watershed Watch

2013 Water Sampling Results

Watershed Watch is a non-profit organization that was formed in 1997 to support a citizen monitoring effort, improve and protect water quality by raising community awareness, and promote the goals of the Clean Water Act and other water quality initiatives.

Report Produced by the
Kentucky Water Resources Research Institute
Funded by the
Kentucky River Authority

TABLE OF CONTENTS

Chapter 1: Introduction 5

Background
2013 Sampling Site Overview
2013 Flow Conditions

Chapter 2: Data Collection and Analysis 7

Physical/Chemical Field Data 7

Herbicide Indicators 8

Bacteriological Indicator 9

Chemical Indicators 10

Nutrient Indicators 11

Metal Indicators 13

Chapter 3: Executive Summary 14

2013 KRWW Sites of Concern 15

APPENDIX A: FIGURES 16

APPENDIX B: TABLES 31

APPENDIX C: METAL SAMPLING PARAMETERS 57

APPENDIX A: FIGURES

Figure 1	Kentucky River Basin , Counties and Sub-Basins (8-digit HUCs)	16
Figure 2	Kentucky River Basin and Sub-Basins (8-digit HUCs)	17
Figure 3	Kentucky River Northern Region	18
Figure 4	Kentucky River Central Region	19
Figure 5	Kentucky River Southern Region	20
Figure 6	2013 Kentucky River Watershed Watch Sampling Sites	21
Figure 7	Mean Daily Streamflow at North Fork Kentucky River, Whitesburg	22
Figure 8	Mean Daily Streamflow at Red River, Clay City	22
Figure 9	Mean Daily Streamflow at Wolf Run, Lexington	22
Figure 10	Mean Daily Streamflow at South Elkhorn Creek, Midway	23
Figure 11	Mean Daily Streamflow at Kentucky River, Frankfort	23
Figure 12	2013 KRWW Herbicide Sampling Results	24
Figure 13	2013 KRWW Synoptic Pathogen Sampling Results	25
Figure 14	2013 KRWW Follow-Up Pathogen Sampling Results	26
Figure 15	2013 KRWW Nitrate-Nitrogen Sampling Results	27
Figure 16	2013 KRWW Total Phosphorus Sampling Results	28
Figure 17	2013 KRWW Sulfate Sampling Results	29
Figure 19	2013 KRWW Sampling Sites of Concern	30

APPENDIX B: TABLES

Table 1	2013 KRWW Sampling Site Information	31
Table 2	Summary of 2013 KRWW Sampling Events	5
Table 3	2013 KRWW Field Sampling Results	34
Table 4	2013 KRWW Herbicide Sampling Results	41
Table 5	2013 KRWW Synoptic Pathogen Sampling Results (by site ID#)	42
Table 6	2013 KRWW Synoptic Pathogen Sampling Results (by descending E coli concentrations)	45
Table 7	2013 KRWW Follow-Up Pathogen Sampling Results (by site ID#)	48
Table 8	2013 KRWW Chemical Sampling Results	50
Table 9	2013 KRWW Nutrient Sampling Results	52
Table 10	2013 KRWW Metal Sampling Results	54

CHAPTER 1: INTRODUCTION

Background

This report documents the results of the 2013 Kentucky River Watershed Watch sampling effort, which was supported through funding and other contributions from the Kentucky River Authority, the Kentucky Division of Water, Bluegrass PRIDE, Bluegrass Community Foundation, the Kentucky Waterways Alliance, the Lexington-Fayette Urban County Government, and the Virginia Environmental Endowment. Kentucky River Watershed Watch is a volunteer organization with the following goals:

- To provide current data on general water quality conditions to local stream based organizations working to protect their watershed.
- To provide widespread screening for potential water quality problems to resource management agencies.
- To provide auxiliary information to assist resource management agencies in meeting specific operational and management objectives.
- To identify specific impacts to water quality through targeted observations and measurements.

The 2013 sampling effort was conducted according to KRWW's Annual Workplan. (See "About," then "Work Plan" on organization's website at www.krww.org.) Detailed sampling results for 2013 and past years are also posted on the KRWW web site at http://www.krww.org.

2013 Sampling Site Overview

During 2013, Kentucky River Watershed Watch volunteers collected water samples from streams, rivers and lakes throughout the Kentucky River Basin. A total of 144 sites were sampled during the spring, summer and fall sampling events.

The Kentucky River Basin extends over much of the central and eastern portions of the state and is home to approximately 710,000 Kentuckians. The watershed includes all or part of 42 counties and drains over 7,000 square miles with a tributary network of more than 15,000 miles. A map of the watershed with the associated counties is shown in Figure 1 (see Appendix A for all figures). For the purpose of watershed management, the River Basin has been subdivided into smaller sub-basins and watersheds using the USGS Hydrologic Unit Code (HUC) classification system. A map showing the 8-digit sub basins is shown in Figure 2. A more detailed description of the smaller 11-digit HUC watersheds is provided in Figures 3-5.

An index of the 2013 KRWW sampling sites is provided in Table 1 (see Appendix B for all tables with the exception of Table 2), and the locations of the 144 sites sampled in 2013 are shown in Figure 6. The 2013 sampling sites were highly concentrated in the central Palisades and Elkhorn Creek regions of the Kentucky River Basin.

Water quality data were collected at four different times between May and September of 2013. A listing of the sample dates and types of data collected during each sample period is provided in Table 2 below.

Table 2: Summary of 2013 Kentucky River Watershed Watch Sampling Events

Sampling Event	Dates	# of Sites Sampled
Spring Herbicide Event	May 17-19, 2013	15 (NEW sites)
Synoptic Pathogen Event	July 12-14, 2013	127
Follow-Up Pathogen Event	August 9-10, 2013	67
Fall Nutrients/Chemistry Event	September 19-23, 2013	93
Metals Event	September 15-21, 2013	33

2013 Flow Conditions

In order to provide a basis for interpreting the sampling results, it is important to understand the associated stream flow conditions. For example, data collected during low flow or dry conditions may be more indicative of the impact of “point source” discharges, mainly from pipes. Data collected following a storm may be more reflective of the impacts of “non-point” pollutant discharges, or pollution that is picked up from stormwater runoff.

An indication of the stream flow conditions during the sampling period may be obtained by examination of USGS (United States Geological Survey) stream flow records. For the purposes of this study, five separate USGS gaging stations were selected to provide an indication of the stream flow conditions during the sampling period. Stream flow plots for each station showing the flow rates during each of the different sampling efforts are shown in Figures 7-11. (Daily stream flow values for these tables can be found on the USGS website at http://ky.water.usgs.gov.).

The flow graphs illustrate the varying flow conditions present during the 2013 KRWW sampling season. Typically, lower flows indicate that a concurrent sampling event is more likely to capture point sources, such as sewage from leaking sanitary sewer infrastructure or straight pipes. Higher flows can indicate a recent precipitation event, and sampling may capture more nonpoint source contributions, such as septic system runoff, livestock waste from pastureland or fertilizer runoff from lawns or crops.

Following a peak flow in early May, streamflow levels during the Spring Sampling Event had declined at all gaging stations. This flow pattern could result in lower detected herbicide concentrations, due to a prior pollutant “flush.”

The flow during the first (synoptic) pathogen sampling in July was also declining, following recent high flow levels. The second (follow-up) pathogen sampling event occurred just after a peak flow at most locations, but appears to have taken place during a peak flow at the Whitesburg location on the North Fork of the Kentucky River.

Low flows were observed at gaging stations across the basin during the fall nutrient/chemical/metals sampling event in September. This observation may indicate a higher concentration of pollutants associated with lower flow rates, which are typical in the fall. It is also more likely to suggest pollution from point sources, rather than nonpoint, or runoff sources. Higher pollutant concentrations during these base flow conditions may also result from groundwater contributions.

CHAPTER 2: DATA COLLECTION AND ANALYSIS

Physical/Chemical Field Data

General physical/chemical field data (dissolved oxygen, pH, water temperature, and observed flow level) were collected at each sample site during the four separate basin wide sampling periods. A summary of the physical/chemical data collected during this period is provided in Table 3. The table also includes conductivity and turbidity results for some of the sampling sites.

Dissolved Oxygen

A dissolved oxygen value less than 5.0 mg/L is problematic for aquatic organisms, causing increased susceptibility to environmental stresses, reduced growth rates, mortality and an alteration in the distribution of aquatic life. **Six percent of the sites (15 of 233 sites) displayed a dissolved oxygen value less than 5.0 mg/L**. The 15 sampling sites with 2013 readings less than 5.0 mg/L are noted in Table 3.

pH

A pH value less than 6 signifies acidic conditions in which toxic heavy metals are more soluble, and therefore more available for uptake by aquatic life. At pH values greater than 9, toxic ammonia concentrations increase. Thus, a pH between 6 and 9 indicates that the waterbody is within a safe pH range for the survival of aquatic life. **None of the reported pH readings for 2013 were less than 6 or greater than 9.**

Temperature

In addition to having its own toxic effect, water temperature affects the solubility and the toxicity of many other water quality parameters. Generally, the solubility of solids increases with increasing temperature, while gases tend to be more soluble in cold water. An important physical relationship exists between the amount of dissolved oxygen in a body of water and its temperature. The warmer the water, the less dissolved oxygen. Colder water can maintain greater dissolved oxygen concentrations.

None of the sites had a temperature reading that exceeded 31.7° Celsius, the water quality standard for protection of aquatic life in warm water streams.

Flow

Based on visual observations, the flow rate in the streams was assessed using the following numerical equivalents:

0 – Dry

1 – Ponded

2 – Low

3 – Normal

4 – Bank Full

5 – Flood

The visual flow assessments during the 2013 KRWW sampling season were mainly low (2) to bankfull (4), with very few ponded (1) or flood level (5) observations.

Spring Sampling Event: Flows were mainly normal for the spring herbicide event, with some reports of up to 0.5 inch of recent rainfall.

Synoptic Pathogen Sampling Event: The first pathogen sampling event in July was also conducted during mainly normal conditions, with some higher flows and rainfall amounts reported in parts of the upper (southeastern) parts of the basin.

Follow-Up Pathogen Sampling Event: Flows were generally higher during the second pathogen sampling event, as were reported rainfall amounts. These conditions could result in E coli findings contributed from runoff sources, such as septic systems and livestock pastures.

Fall Sampling Event: Lower flows were reported during the September sampling event, as expected, since September and October are usually the driest months in Kentucky. Typically, a flow observation of dry, or 0, is not reported, as a dry site prevents collection of the water sample and submission of the field report (or chain of custody form). Higher pollutant results collected during lower flow levels and with minimal recent rainfall may illustrate point source pollution. These results also show the potential for concentrated pollutant levels as stream flows decrease.

Conductivity

Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current. Conductivity measurements are used to determine levels of total inorganic dissolved solid ions, such as nutrients, metals, or other compounds. Indirect effects of high conductivity levels are primarily the elimination of plants needed for food or habitat and the decline of sensitive aquatic species, such as mayflies and fish.

Some volunteers have field equipment to measure conductivity onsite. **Forty-eight percent (or 130/271) of the field conductivity readings during the 2013 sampling season were at 500 microSiemens/cm (**mS/cm) **or greater**. This conductivity level is the EPA's newly established criterion for streams in Central Appalachia. In central Appalachia, the conductivity of headwater streams is naturally between 100 and 200 mS/cm. This is important because the plants, insects and animals in local streams have adapted to living in this level of conductivity. Recent studies conducted by the EPA show that when the conductivity in central Appalachian streams rises to about 300 mS/cm, the plants, insects and animals begin to be affected. When the conductivity of these streams goes above 500 mS/cm, the plants, insects and animals are drastically affected. And when the conductivity measures above 1,000 mS/cm, everything in the stream is effectively dead. [NOTE: KDOW sampling has shown that some pollutant-tolerant aquatic life is present at conductivity levels greater than 1,000 mS/cm.] In other regions of the country the natural conductivity may be higher or lower than in central Appalachia, and the plants, insects and animals there will have adapted over thousands of years to live within those natural conductivity levels.

Turbidity

Turbidity is a measure of water clarity and how much the material suspended in the water decreases the passage of light through the water. Suspended materials include soil particles (clay, silt and sand), algae, plankton, microbes, and other substances. Higher turbidity increases water temperatures, because suspended particles absorb more heat. This, in turn, reduces the concentration of dissolved oxygen because warm water holds less dissolved oxygen than cold water. Higher turbidity also reduces the amount of light penetrating the water, which reduces photosynthesis and the production of oxygen. Suspended materials can clog fish gills, reducing resistance to disease in fish, lowering growth rates, and affecting egg and larval development. As the particles settle, they can blanket the stream bottom, especially in slower waters, and smother fish eggs and benthic macroinvertebrates. Sources of turbidity include soil erosion, waste discharge, urban runoff, eroding streambanks, large numbers of bottom feeders which stir up bottom sediments and excessive algal growth (USEPA, www.epa.gov/owow/monitoring/volunteer/stream/vms55.html). The state of Kentucky has not issued water quality standards for turbidity.

Turbidity results were based on subjective observations at the time of sampling. Volunteers rated the turbidity of the waterbody on a scale of 0 (clear) to 3 (turbid). Most 2013 observations indicated clear (0) to slightly turbid conditions (1).

Herbicide Indicators

During the spring sampling event of May 2013, 15 sampling sites were tested for Triazines to evaluate the possibility of potential pollution from rural and/or urban herbicide applications.

Triazine (or Atrazine) is a selective triazine herbicide used to control broadleaf and grassy weeds in corn and other crops, and in conifer reforestation plantings. It is also used as a nonselective herbicide on non-cropped industrial lands and on fallow lands. Atrazine is moderately soluble in water. The main route of breakdown is chemical hydrolysis, followed by biodegradation. Atrazine is highly persistent in soil. Chemical hydrolysis followed by microbial breakdown accounts for most of its degradation in soil. Although hydrolysis is rapid in acidic or basic soil environments, it is slower at neutral pHs.

The EPA's drinking water standard maximum contaminant level for Atrazine is 3 mg/L (http://www.epa.gov/safewater/mcl.html). EPA's Office of Water has published a draft ambient water quality criteria document for atrazine containing acute and chronic criteria recommendations for the protection of aquatic life in both freshwater and saltwater. The procedures described in the "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" indicate that, except possibly where a locally important species is very sensitive, freshwater aquatic life and their uses should not be affected unacceptably if the one-hour average concentration does not exceed 350 ug/L more than once every three years on the average (acute criterion). If the four-day average concentration of atrazine does not exceed 12 ug/L more than once every three years on the average (chronic criterion).

Herbicide Sampling Results

Herbicide data were collected at 15 sites during May of 2013. **Three of the 15 sites had detectable levels of Triazine. The detections were observed at stream sites in Franklin, Madison and Woodford Counties in the central region of the Kentucky River Basin. None of the triazine detections exceeded recommended water quality standards.**

The locations of the three sites with herbicide detections are shown in Figure 12. A summary of the results for the herbicide data collection effort is provided in Table 4.

Bacteriological Indicator

A number of pathogenic (disease causing) viruses, bacteria, and protozoans can enter a water body via fecal contamination. Human illness can result from drinking water or swimming in water that contains pathogens. Eating shellfish harvested from such waters may also result in human illness.

Unfortunately, direct testing for pathogens is impractical. Pathogens are rarely present in large numbers, and many are difficult to cultivate in the lab. Instead, microbiologists look for "indicator" species – so called because their presence indicates that fecal contamination may have occurred. The indicators most commonly used today include: total coliforms, fecal coliforms, Escherichia coli, fecal streptococci, and enterococci. Each of these bacteria are normally prevalent in the intestines and feces of warm-blooded animals, including humans. The indicator bacteria themselves are not usually pathogenic. All but E. coli are composed of a number of species of bacteria that share common characteristics such as shape, habitat, or behavior. E. coli is a single species in the fecal coliform group. It should be pointed out that when a water sample is determined to contain E. coli, that does not necessarily mean that the dangerous strain (i.e. E. coil O157:H7) is actually present, it is probably not, however this would indicate recent fecal contamination.

Escherichia coli (E. coli)

The bacteria, E. coli, is commonly found in intestines of healthy humans and animals and produces the K and B– complex vitamins that are then absorbed for nutritional benefit. The presence of E. coli in water indicates fecal contamination and the potential for waterborne disease. EPA recommends E. coli as the best indicator of health risk from water contact in recreational waters. Kentucky has transitioned from a fecal coliform standard to an E. coli standard. Recently, Akasapu and Ormsbee (2013) developed a mathematical approximation between fecal coliform values (FC) and E. Coli values for samples in the Kentucky River Basin which can be used to relate past fecal coliform values to "equivalent" E. coli values. The relationship is: $E.coli= 1.435*FC^{0.8093}$

The state criteria for E. coli 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): E. coli shall not exceed 130 colonies per 100 ml as a monthly geometric mean based on not less than 5 samples per month; nor exceed 240 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 240 colonies per 100-ml criteria for classifying streams in the 305(b) report].

Bacteriological Sampling Results

E coli sampling was conducted twice in the Kentucky River basin during the summer of 2013. The first round of sampling, or the synoptic event, was available for all samplers at all sampling sites. The second round, or follow-up event, was only available at those sites that produced E coli results greater than 240 cfu/100 ml during the synoptic sampling event. The results of each sampling effort are discussed in the following sections.

Synoptic Pathogen Sampling

As in past years, a synoptic round of E coli samples was collected at all sampling locations during the month of July. The sample locations are shown in Figure 13. The individual results for each site are shown in Table 5. A ranking of the stations by the magnitude of the E. coli results is shown in Table 6. **Sixty-one percent of the synoptic samples exceeded the state's safe swimming/wading standard.**

Follow-Up Pathogen Sampling

Based on the observation of **high readings at 77 of 127 of the synoptic E. coli sites** (i.e., >240 CFU/100 ml), an additional round of pathogen sampling was conducted in August for those sites with exceedances.
The results of this sampling effort are provided in Table 7. **Results indicated continuing pathogen-related problems at 64 of 67, or 95%, of the re-sampled sites.** The follow-up sampling sites are mapped in Figure 14.

.

Chemical Indicators

General chemical data (alkalinity, chlorides, conductivity, and total suspended solids) were collected at 93 sampling locations during the month of September. The individual results for each sample are shown in Table 8.

Alkalinity

Alkalinity refers to the degree to which the water sample is basic, or has a pH greater than 7, and affects the capability of water to neutralize acid. In most natural water bodies in Kentucky the buffering system is carbonate-bicarbonate. Alkalinity is important for fish and aquatic life because it protects or buffers against rapid pH changes. Higher alkalinity levels in surface waters will buffer acid rain and other acid wastes and prevent pH changes that are harmful to aquatic life. Kentucky's water quality criteria state that for protection of aquatic life, the buffering capacity should be at least 20 mg/L. If alkalinity is naturally low, (less than 20 mg/L) there can be no greater than a 25% reduction in alkalinity. **During the 2013 KRWW sampling season, alkalinity values ranged from 88 mg/L at Site #3006 on Lower Howard Creek in Clark County to 772 mg/L at Site #1221 on Cane Run in Scott County.**

Chlorides

Chlorides are salts resulting from the combination of the gas chlorine with a metal. Fish and aquatic communities cannot survive in waters with high levels of chlorides. The state of Kentucky requires that chloride levels be less than 250 mg/L in domestic water supplies. Criteria for protection of aquatic life require levels of less than 600 mg/L for chronic (long-term) exposure and 1200 mg/L for short-term exposure. **During the 2013 KRWW sampling season, chloride values ranged from 4.5 mg/L at Site #833 at a spring in Woodford County to 270 mg/L at Site #1139 at Vaughn's Branch in Fayette County.** A Vaughn's Branch sampling site also produced the highest chloride levels during the 2010 and 2011 sampling seasons.

Conductivity

Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current. Conductivity measurements are used to determine mineralization, or total dissolved solids. Indirect effects of excess dissolved solids are primarily the elimination of desirable food plants and habitat-forming plant species. For Kentucky, water quality criteria have been established only for the mainstem of the Ohio River. The limit is 800 microsiemens/cm or 500 mg/L total dissolved solids. The USEPA also recently established conductivity criteria for support of aquatic life in Central Appalachian streams of 500 microsiemens/cm.

During the 2013 KRWW sampling season, conductivity values ranged from 356 mS/cm **at site #978 on Muddy Creek in Madison County to 2,003** mS/cm **at site #945 at Lost Creek in Breathitt County. Eighty-seven percent of the lab readings of conductivity were greater than the KRWW unofficial aquatic life standard of 500** mS/cm**.**

Total Suspended Solids**:**

One of the biggest sources of water pollution in Kentucky is suspended solids. Suspended solids include inorganic particles (silts, clays, etc.) and organic particles (algae, zooplankton, bacteria, and detritus) that are carried along by water as it runs off the land. The inorganic portion is usually considerably higher than the organic. Both contribute to turbidity, or cloudiness of the water. High values of TSS cause multiple environmental impacts, including clogging fish gills, reducing light penetration, and siltation of stream bottoms and associated habitats. Indirectly, the suspended solids affect other parameters such as temperature and dissolved oxygen. Suspended solids also interfere with effective drinking water treatment. High sediment loads interfere with coagulation, filtration, and disinfection, and more chlorine is required to effectively disinfect turbid water.

There are no quantitative criteria for TSS. The Kentucky Water Quality Standards for aquatic life state that suspended solids "shall not be changed to the extent that the indigenous aquatic community is adversely affected" and "the addition of settleable solids that may adversely alter the stream bottom is prohibited." The National Academy of Sciences has recommended that the concentration of TSS should not reduce light penetration by more than 10%. In a study in which TSS were increased to 80 mg/L, the macroinvertebrate population was decreased by 60%. **During the 2013 sampling season, total suspended solids concentrations ranged from less than the detection limit of 3 mg/L at five different sites to 31 mg/L at Site #990 at on an unnamed tributary in Madison County.**

Nutrient Indicators

Oxygen demanding materials and plant nutrients are among the most common substances discharged to the environment by man's activities, through wastewater facilities and by agricultural, residential, and storm water runoff. The most important plant nutrients, in terms of water quality, are phosphorus and nitrogen. In general, increasing nutrient concentrations increase the potential for accelerated growth of aquatic plants, including algae. Nuisance plant growth can create imbalances in the aquatic community, as well as cause aesthetic and access issues. High densities of phytoplankton (algae) can cause wide fluctuations in pH and dissolved oxygen.

Total phosphorus (TP) is commonly measured to determine phosphorus concentrations in surface waters. TP includes all of the various forms of phosphorus (organic, inorganic, dissolved, and particulate) present in a sample. Phosphorus is one of the key elements necessary for growth of plants and animals. Phosphates are made up of phosphorus and exist in three forms: orthophosphate, metaphosphate (or polyphosphate) and organically bound phosphate. Each compound contains phosphorous in a different chemical formula. *Ortho* forms are produced by natural processes and are found in sewage. *Poly* forms are used for treating boiler waters and in detergents. In water, they change into the *ortho* form. Organic phosphates are important in nature. Their occurrence may result from the breakdown of organic pesticides that contain phosphates. They may exist in solution, as particles, loose fragments, or in the bodies of aquatic organisms.

In addition to man-made sources, some phosphorus loadings may occur naturally from the watershed soils and underlying geology. Due to background levels of total phosphorus in the Kentucky River Basin as high as 0.25 mg/L, those sites with average total phosphorus concentrations of 0.3 mg/L can be noted as potentially problematic. The informal total phosphorus standard of 0.3 mg/L has been adopted by the KRWW Scientific Advisory Committee as an appropriate level of concern for water quality sampling conducted in the Kentucky River Basin. This value has also been recommend for use by the Kentucky Division of Water.

Nitrogen is routinely analyzed at most Kentucky ambient sampling sites in the forms of ammonia and ammonium (NH_3/NH_4), total Kjeldahl nitrogen (TKN), and nitrite and nitrate (NO_2/NO_3). Ammonia and ammonium are readily used by plants. TKN is a measure of organic nitrogen and ammonia in a sample. Nitrate is the product of aerobic transformation of ammonia, and is the most common form used by aquatic plants. Nitrite is usually not present in significant amounts. Nitrates can react directly with hemoglobin in the blood of humans and other warm-blooded animals to produce methemoglobin, which destroys the ability of red blood cells to transport oxygen. This condition is especially serious in babies under three months of age and causes a condition known as methemoglobinemia, or "blue baby" disease.

Nutrient delivery, particularly during the months of April through June, has been identified as one of the primary factors controlling the size of the hypoxic zone that forms during the summer in the northern Gulf of Mexico. The Gulf hypoxic zone is an area where oxygen levels drop too low to support most life in bottom and near-bottom waters. A Mississippi River/Gulf of Mexico Watershed Nutrient Task Force was created in 1997 to address the Massachusetts-size dead zone that is threatening the Gulf's fisheries. In 2013, the Task Force identified Kentucky and Indiana as two of the top six among 31 states contributing excess nitrogen and phosphorus to the Gulf from sources such as sewage treatment plants, farms and power plant emissions. It recommended that Kentucky, and other states contributing the most to the problem, enact new nutrient reduction strategies by 2013.

Kentucky currently has no official numerical standards or criteria for phosphorus or nitrogen in state waterways, but is working toward developing these standards. The state drinking water supply standard for nitrate-nitrogen, which is a measurement of the nitrogen potion of the nitrate (NO_3) molecule, is 10 mg/L. In order to monitor nutrient effects on aquatic life, KRWW is using a proposed standard of 3 mg/L, because this nitrate level has been demonstrated to produce nutrient-rich conditions supporting algal blooms, along with other aquatic habitat threats.

Sulfur is another essential plant nutrient. Aquatic organisms utilize sulfur, and reduced concentrations have a detrimental effect on algal growth. The most common form of sulfur in well-oxygenated waters is sulfate. Sulfates ($SO4^{--2}$) can be naturally occurring or the result of municipal or industrial discharges. When naturally occurring, they are often the result of the breakdown of leaves that fall into a stream, of water passing through rock or soil containing gypsum and other common minerals, or of atmospheric deposition. Point sources include sewage treatment plants and industrial discharges such as tanneries, pulp mills, and textile mills. Runoff from coal mining operations and fertilized agricu tural lands also contributes sulfates to water bodies.

A sulfur cycle exists, which includes atmospheric sulfur dioxide (SO_2), sulfate ions (SO_4^{-2}) and sulfides (S^-). Sulfides, especially hydrogen sulfide (H_2S), are quite soluble in water and are toxic to both humans and fish. They are produced under conditions where there is a lack of oxygen (anaerobic). Because of their foul "rotten egg" smell they are avoided by both fish and humans. Sulfides formed as a result of acid mine runoff from coal or other mineral extraction and from industrial sources may be oxidized to form sulfates, which are less toxic.

When sulfate is less than 0.5 mg/L, algal growth will not occur. On the other hand, sulfate salts can be major contaminants in natural waters. The state water quality standard for sulfate in drinking water supplies is 250 mg/L.

Nutrient Sampling Results

In addition to chemical data, general nutrient data (nitrate-nitrogen, total nitrogen, total phosphorus and sulfate) were also collected at sampling sites during September. A summary of the nutrient data collected during this period is provided in Table 9. **Twenty of the 93 sampling results exceeded the nitrate-nitrogen level of 3 mg/L. As illustrated in Figure 15, the highest nitrate-nitrogen reading of 12.9 mg/L was recorded at #753 on Clarks Run in Boyle County.**

As shown in Figure 16, **30 of 93 stations had phosphorus readings in excess of 0.3 mg/l. The highest recorded phosphorus reading was 1.41 mg/l, which occurred at station #3144 on South Elkhorn Creek in Scott County.**

Nine of the 93 sulfate concentrations exceeded the state drinking water supply standard of 250 mg/L. Sulfate results are displayed in Figure 17. The greatest sulfate reading of 333 mg/L was taken at site #943 on Quicksand Creek in Breathitt County. Typically, KRWW sites that have exceeded the drinking water supply standard for sulfate are located in the coal mining region of southeastern Kentucky.

Metal Indicators

In addition to chemical and nutrient data, metals data were collected at 15 sampling sites (for total recoverable metals) in September 2013. Out of the 28 different metals tested during the 2013 KRWW sampling season, 14 metals are associated with specific water quality limits (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, nickel, selenium, silver, thallium, zinc). Drinking water supply standards are available for twelve metals (antimony, arsenic, barium, beryllium, cadmium, copper, iron, lead, nickel, selenium, thallium and zinc). Warm water aquatic life standards are available for ten metals (arsenic, cadmium, chromium, copper, iron, lead, nickel, selenium, silver and zinc).

Descriptions of each of the metals sampling parameters and the water quality standards are provided in **Appendix C.** The sampling results for metals are provided in Table 10. **There were no detections of 13 of the 28 metal parameters.**

Detections of the barium, iron, and nickel were the only metal readings with associated water quality standards. Only the iron detections were greater than a relevant water quality standard. Some of the iron results were greater than the associated drinking water supply standard for iron of 0.3 mg/L. And, three of the iron results were above the chronic aquatic life standard of 1.0 mg/L. The highest iron result of 1.22 mg/L was detected at a site on an unnamed tributary of West Hickman Creek (#3216).

CHAPTER 3: EXECUTIVE SUMMARY

During the summer of 2013, multiple agencies and organizations provided funds for the support of volunteer water quality sampling in the Kentucky River Basin as part of the Kentucky River Watershed Watch effort. This report summarizes the results of that sampling effort. As part of this sampling effort, 144 separate sites were sampled at up to four different times for three main groups of parameters: herbicides, pathogens, and chemicals/nutrients/metals. In most cases, the stream was also sampled for basic physical and chemical parameters such as pH, temperature, and dissolved oxygen. None of the stations had a pH reading less than 6 or greater than 9. Only six percent (15 of 233) of the dissolved oxygen readings were below the minimum threshold of 5 mg/l that is recommended for supporting aquatic life.

Fifteen sites were sampled for the Triazine herbicide. Triazine was detected at three of the sampling sites. None of the samples exhibited a concentration greater than the EPA Maximum Contaminant Limit for Atrazine.

In 2013, E coli was analyzed for 127 sites in July. During this synoptic sampling event, 60% of sites analyzed for E. coli exceeded the primary contact recreation standard of 240 cfu/100 ml. The follow-up pathogen sampling event, which included 67 sites with previously high pathogen levels, showed that 68% of the re-sampled sites continued to exceed the standards for E coli.

The chemical analysis of samples in September showed that 58% had high conductivity values (e.g. > 500mS/cm). The highest conductivity value of 1,049 mS/cm was recorded for Site #3019 at Vaughn's Branch in Fayette County.

Twenty of the 93 sampled sites exceeded a proposed aquatic life standard for nitrate-nitrogen of 3 mg/L, and one site on Town Branch in Fayette County (#3140) exceeded the drinking water supply standard for nitrate-nitrogen of 10 mg/L. This site also produced the highest nitrate-nitrogen result in 2012. Thirty of 93 sites displayed total phosphorus levels of concern (above 0.3 mg/L) for support of aquatic life. And, nine sites produced sulfate results that were greater than the associated drinking water supply standard of 250 mg/L.

Flows were generally higher during the 2013 sampling season, and there were some peaks in streamflow just prior to the herbicide and pathogen sampling events. The pathogen sampling events in July and August occurred after precipitation events in some areas of the basin, and may have captured pathogens from runoff (nonpoint) sources, such as livestock pasture and septic systems.

In summary, the following water bodies have been targeted for more in-depth sampling and water quality management efforts due to 2013 sampling results of concern. These sites are indicated on the map in Figure 18.

2013 KRWW Sites of Concern

Overall Water Quality Problems (pathogens, nutrients, conductivity)

- **South Elkhorn Creek Watershed**
  - Steele's Branch, Fayette County (#811)
  - Vaughn's Branch, Fayette County (#1139, 3019)
- **Glenn's Creek Watershed**
  - Glenn's Creek, Woodford County (#1198)

Nutrient Problems (nitrate-nitrogen, total phosphorus, conductivity)

- Clarks Run, Boyle County (#753)
- Glenn's Creek Watershed, Woodford County (#823, 954, 3214)
- South Elkhorn Creek Watershed, Fayette/Scott Counties (#765, 796, 1129, 1136, 1195, 2970, 3144)
- Shannon Run, Woodford County (#1048)

Pathogen Problems

- Benson Creek, Franklin County (#3234)
- Cane Run, Scott County (#744)
- Knoblick Creek, Lincoln County (#963)
- Muddy Creek Watershed, Madison County (#918, 919, 972, 973, 990?)
- North Fork Ky River, Letcher County (#848)
- Town Branch, Fayette County (#3139)
- West Hickman Creek, Fayette County (#1021)
- Wolf Run, Fayette County (#915, 1028)

APPENDIX A: FIGURES

Figure 1—Kentucky River Basin, Counties and Sub-Basins (8-Digit HUCs)

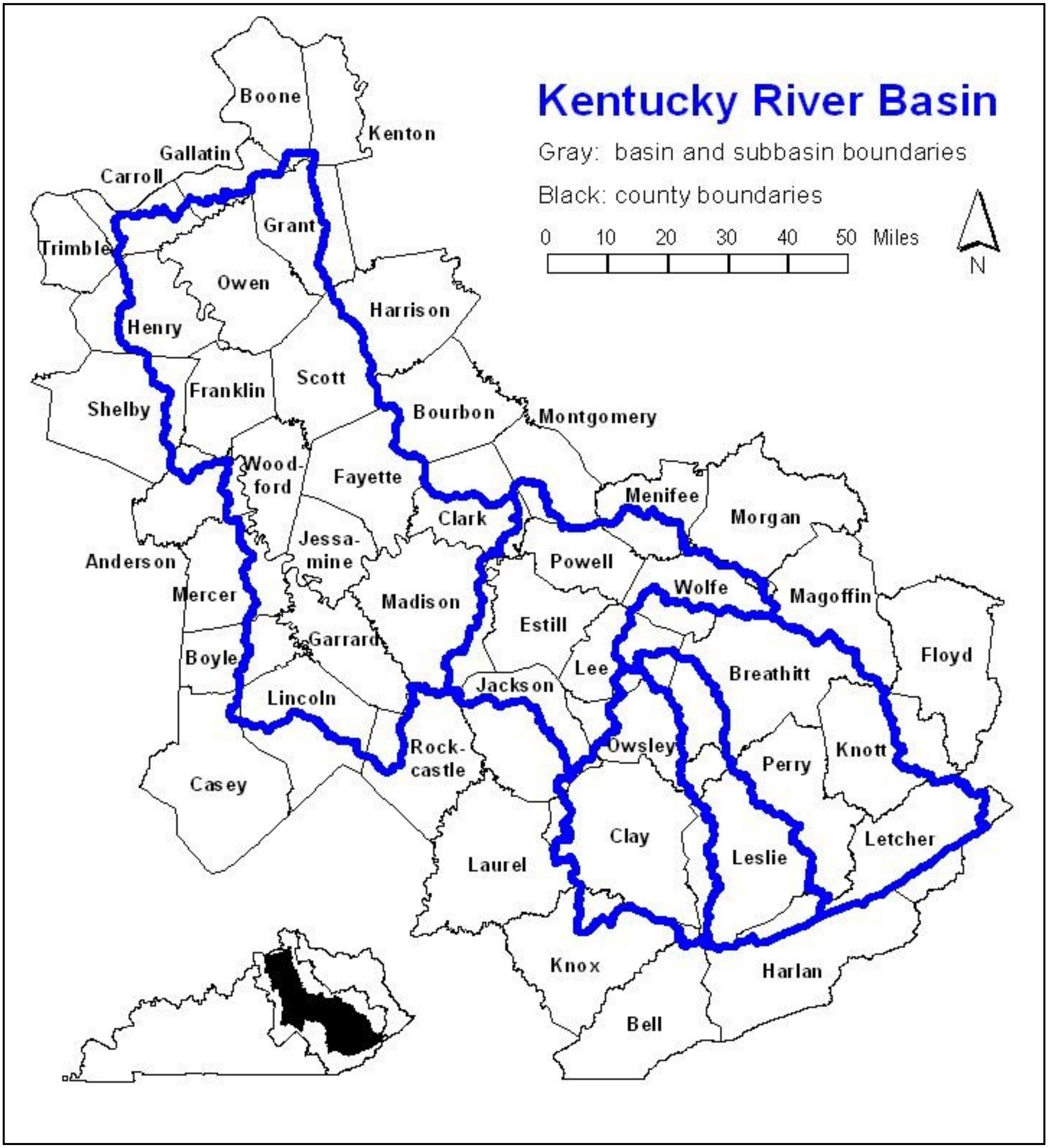


Figure 2—Kentucky River Basin and Sub-Basins (8-Digit HUCs)

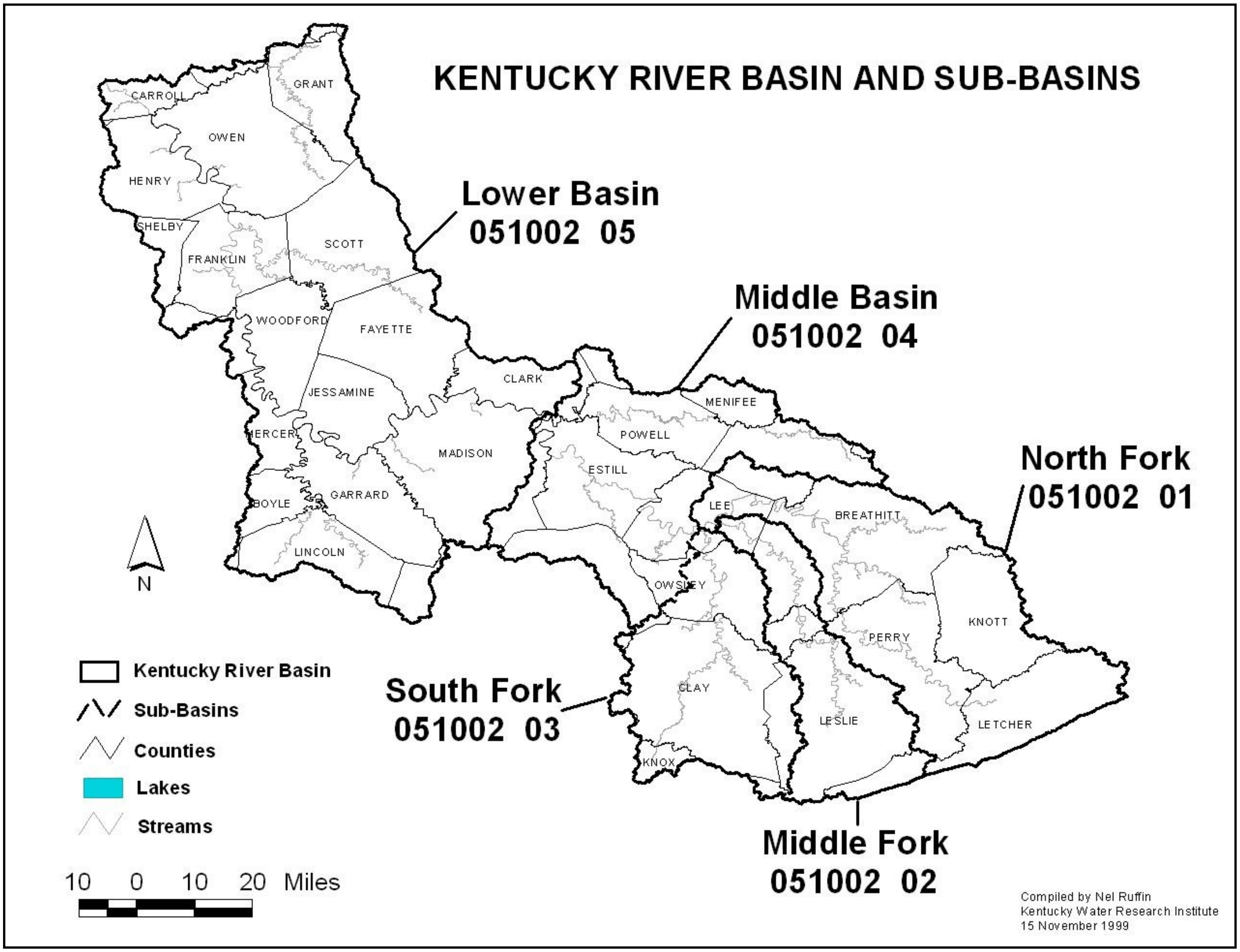


Figure 3—Kentucky River Northern Region

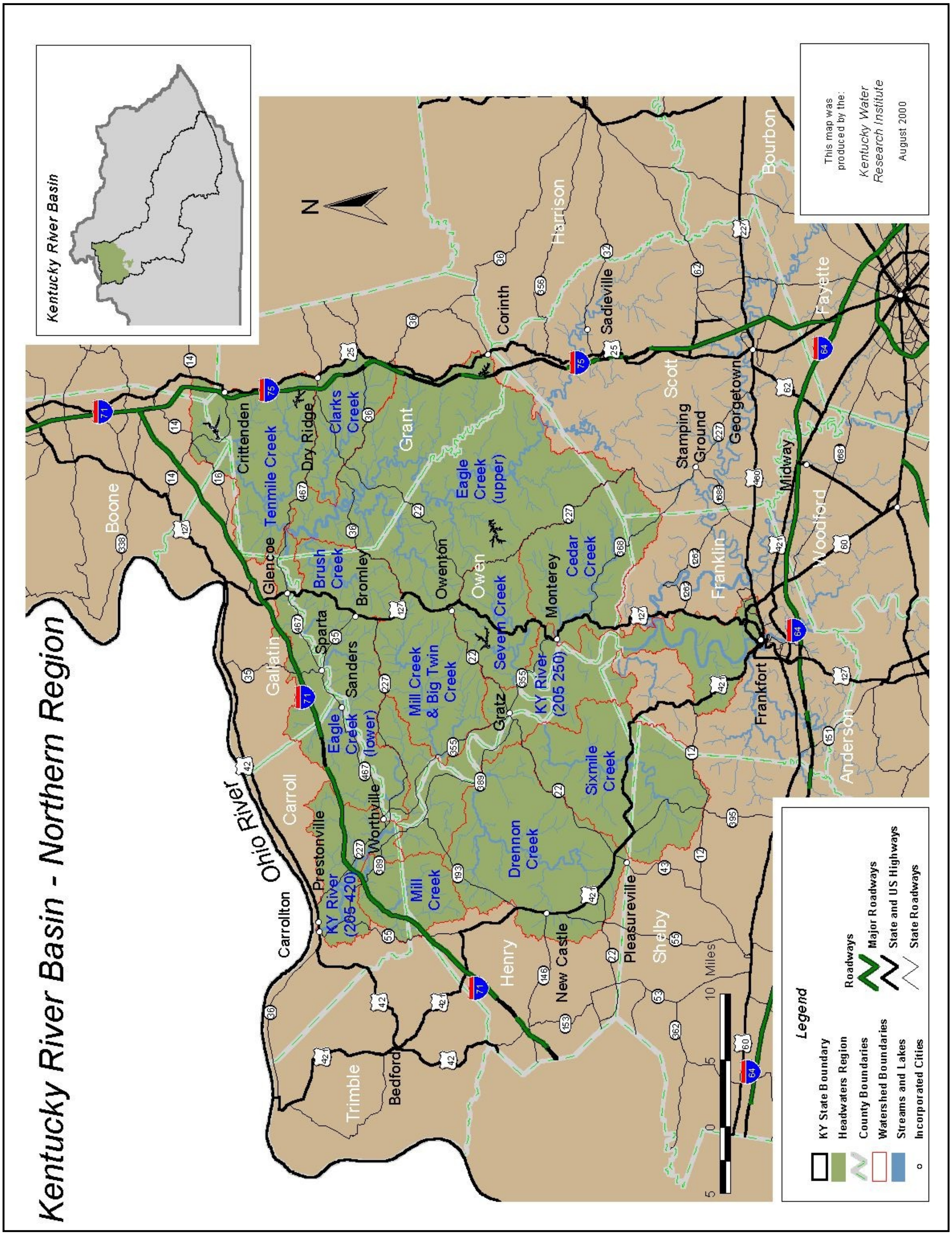


Figure 4—Kentucky River Central Region

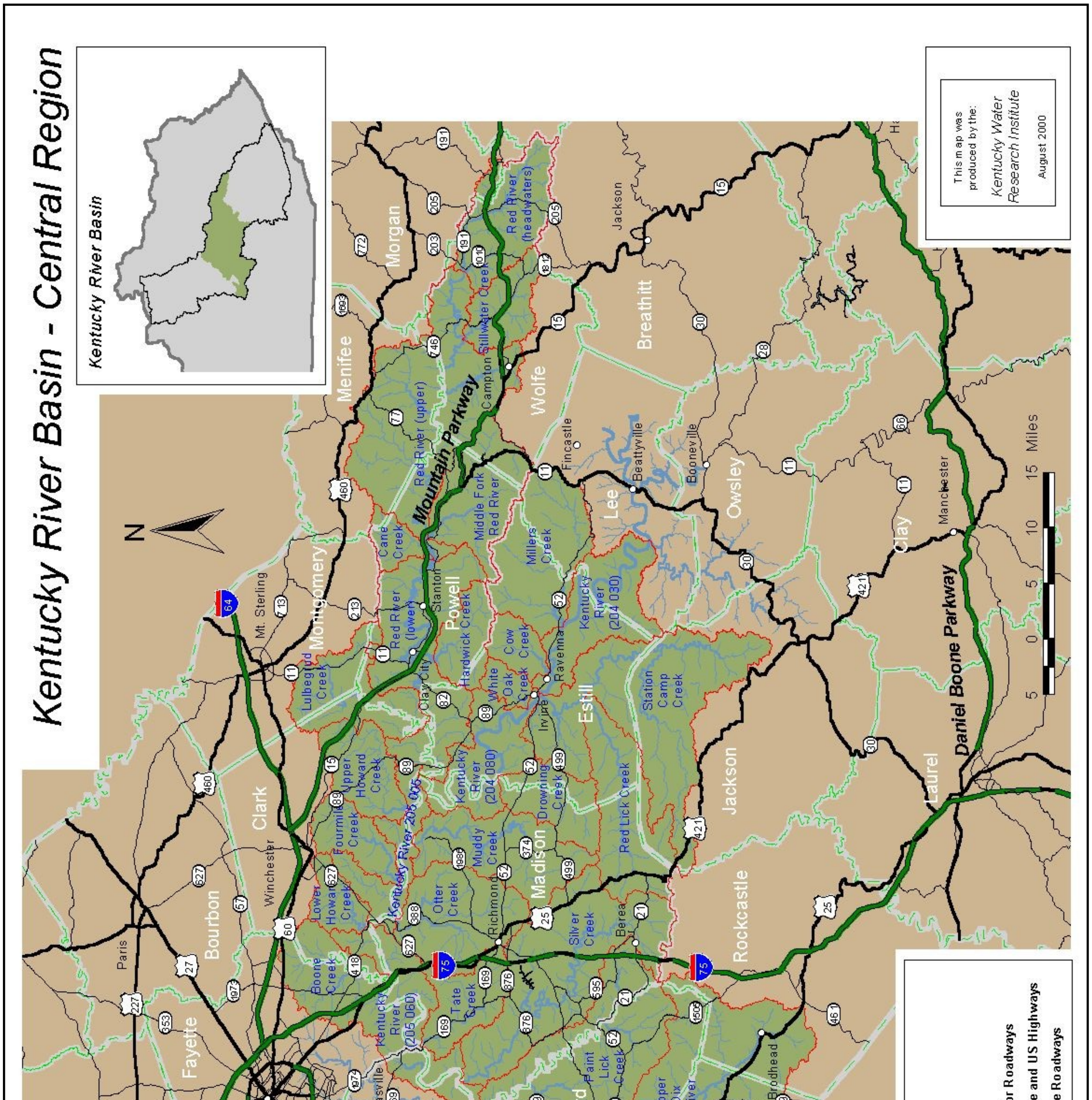


Figure 5—Kentucky River Southern Region

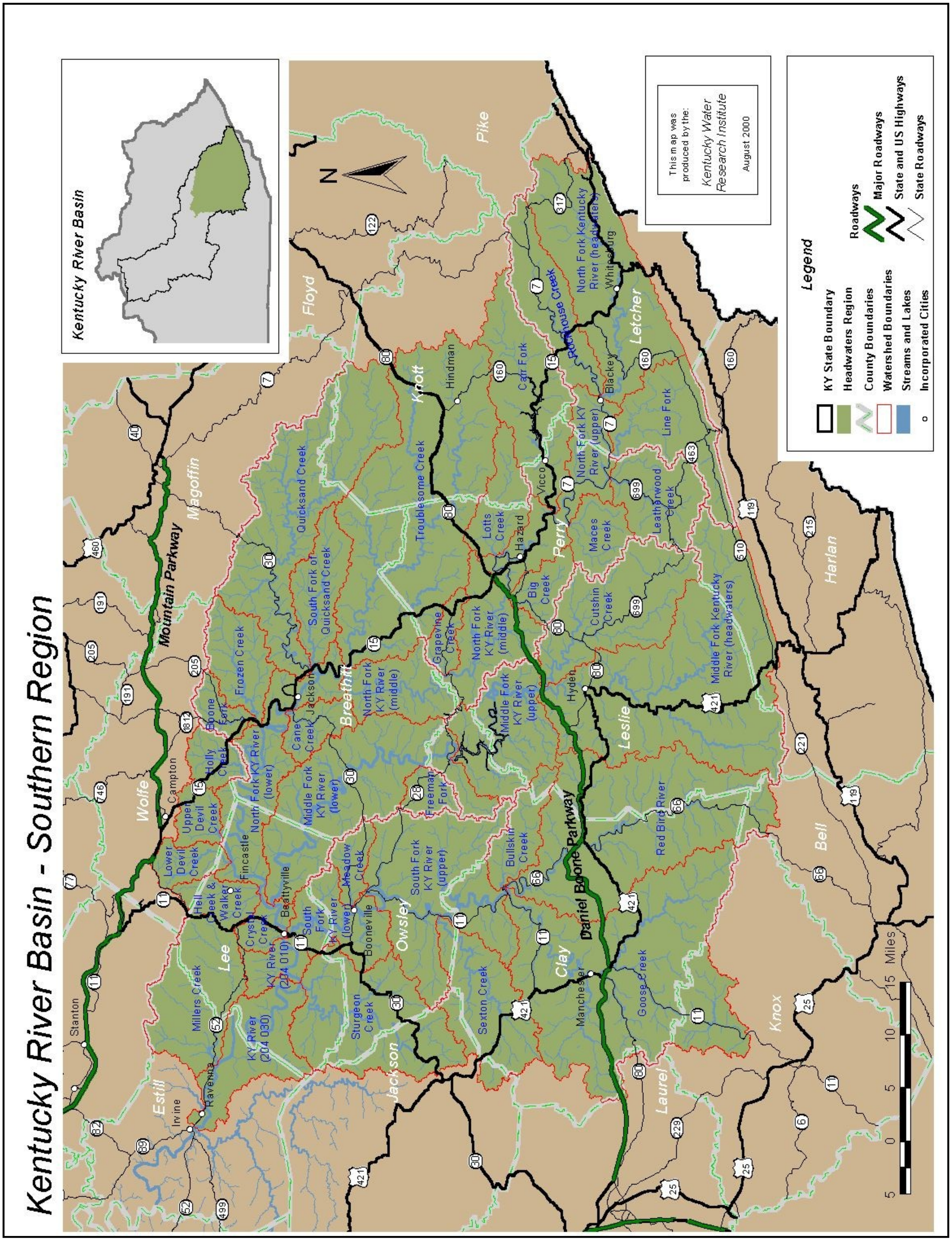


Figure 6—2013 Kentucky River Watershed Watch Sampling Sites

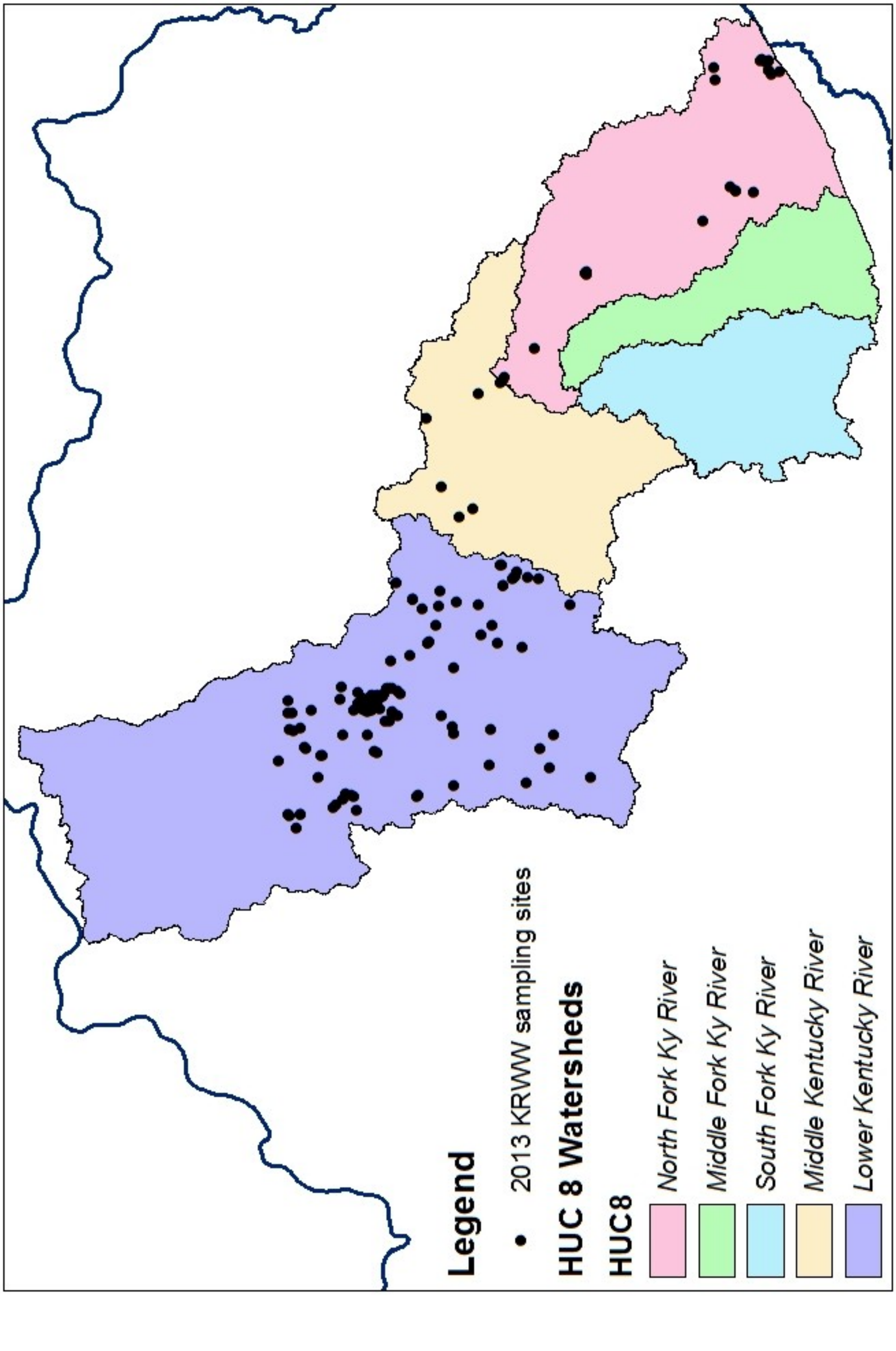


Figure 7

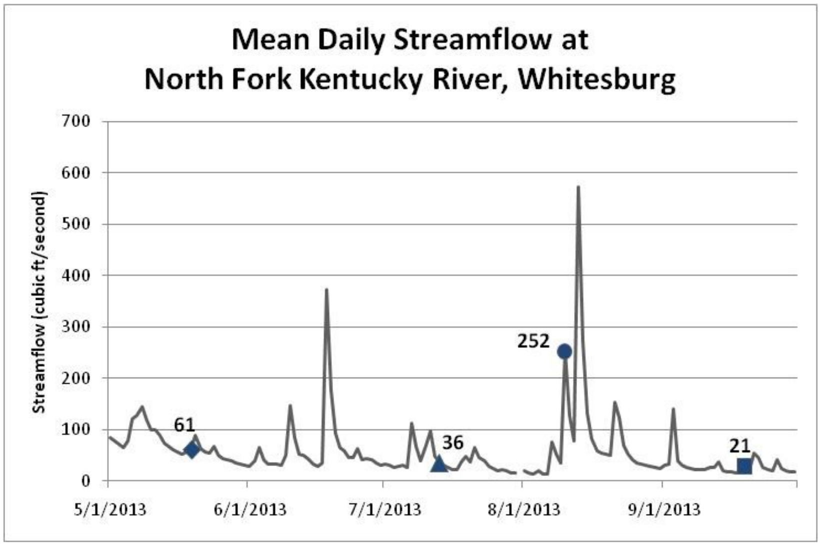


Figure 8

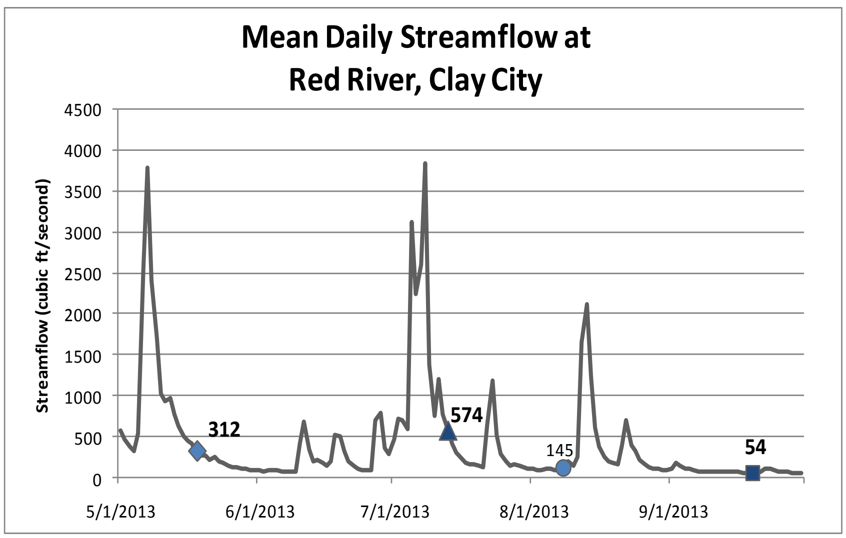


Figure 9

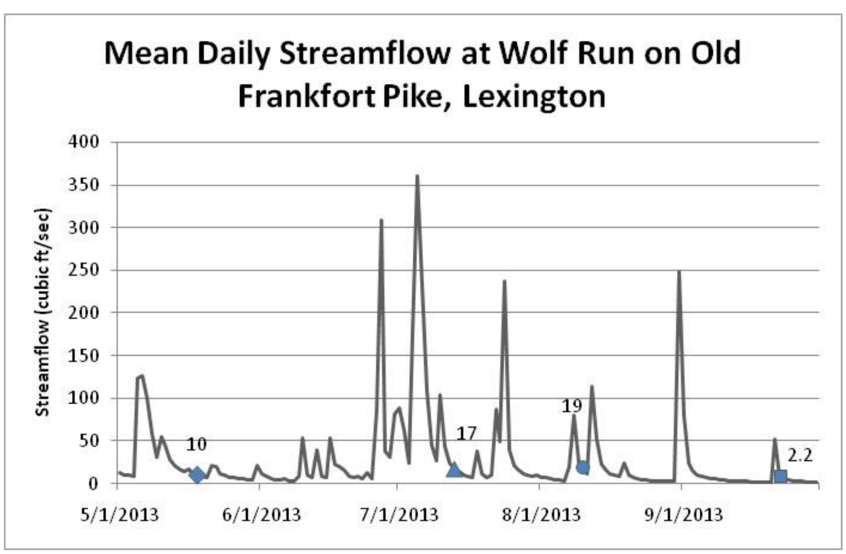


Figure 10

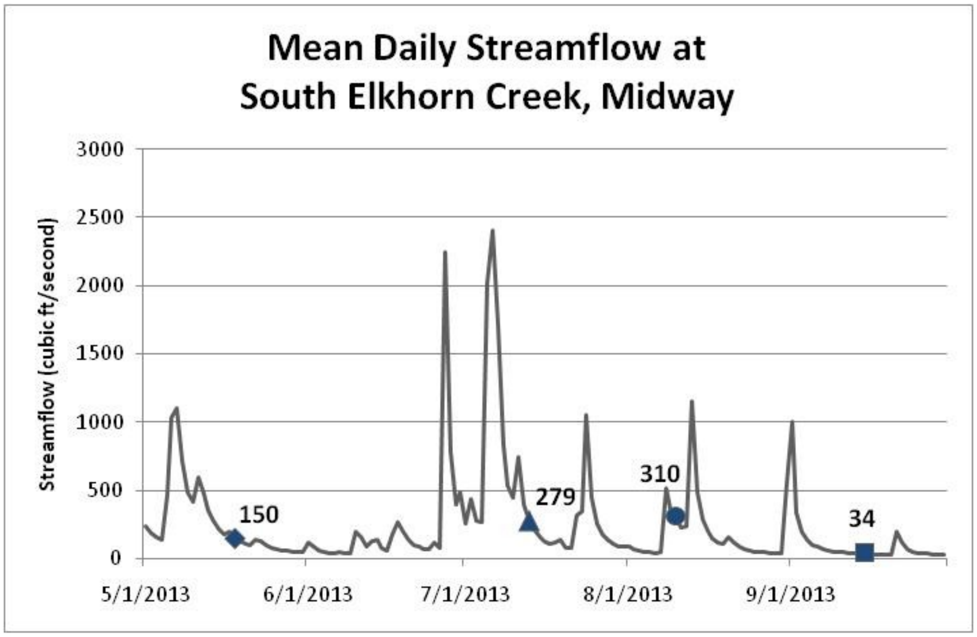


Figure 11

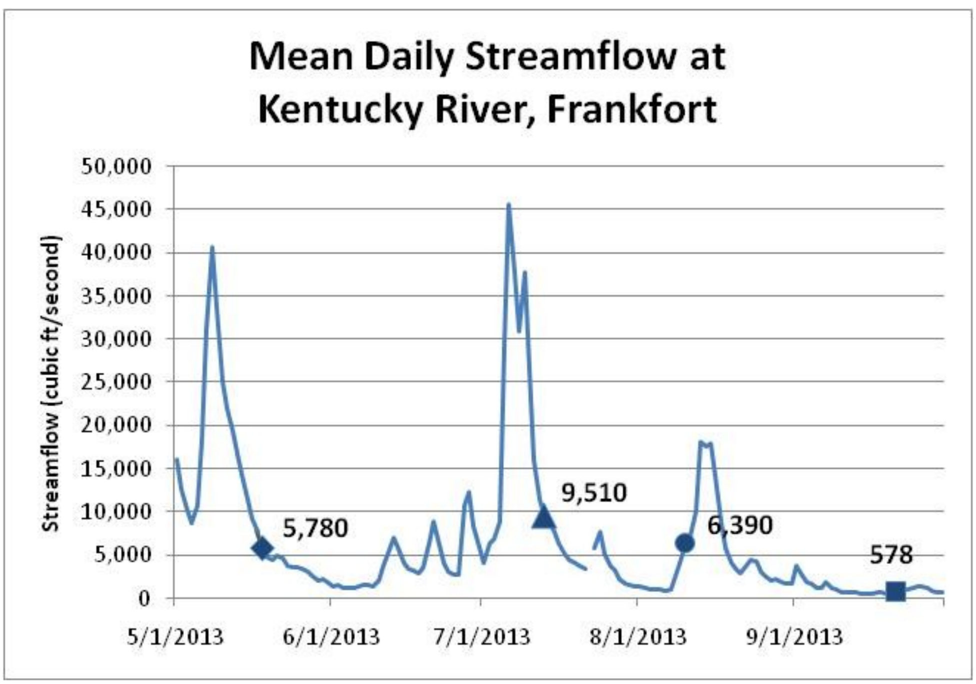


Figure 12
2013 KRWW Herbicide Sampling Results

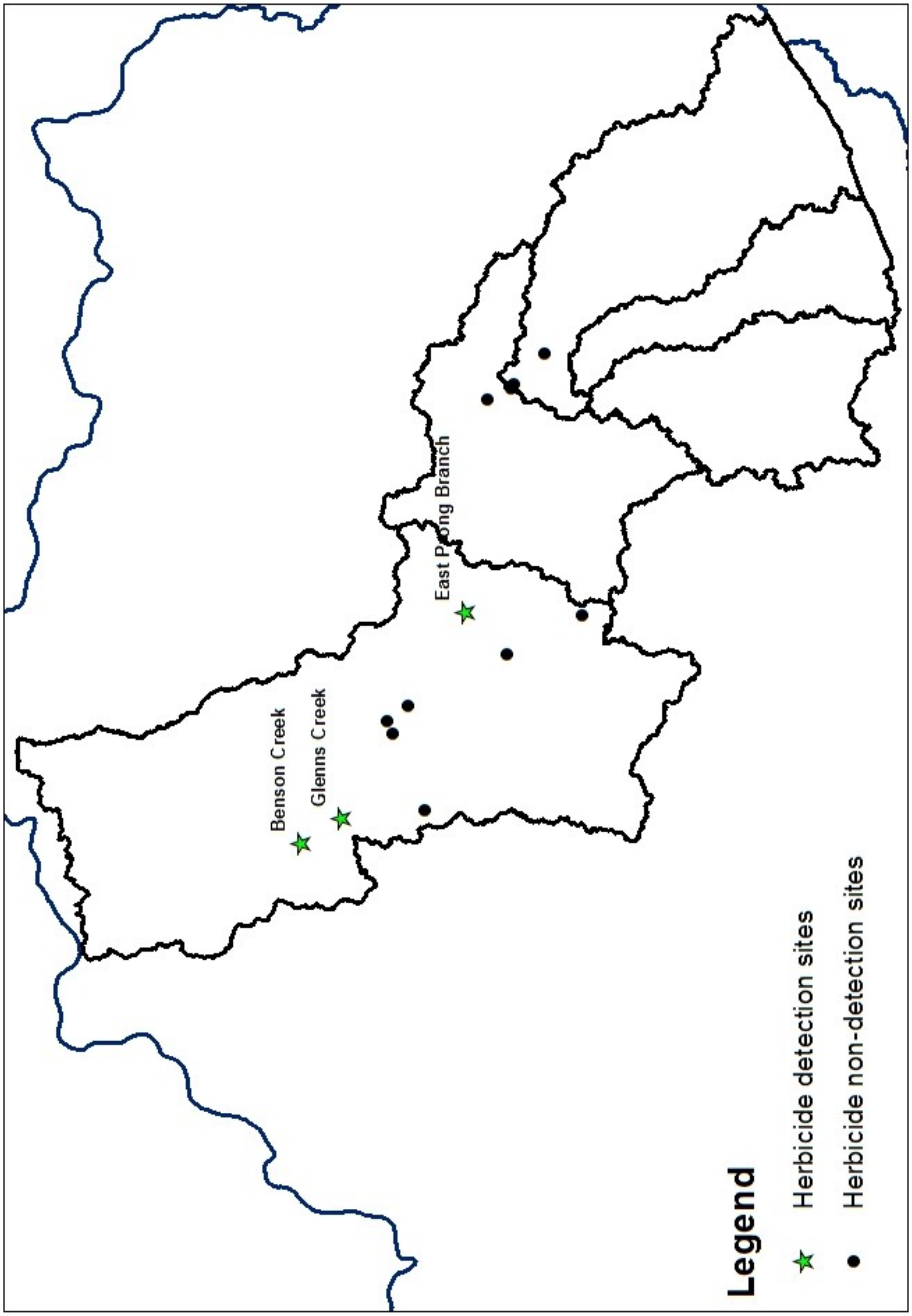


Figure 13
2013 KRWW Synoptic Pathogen Sampling Results

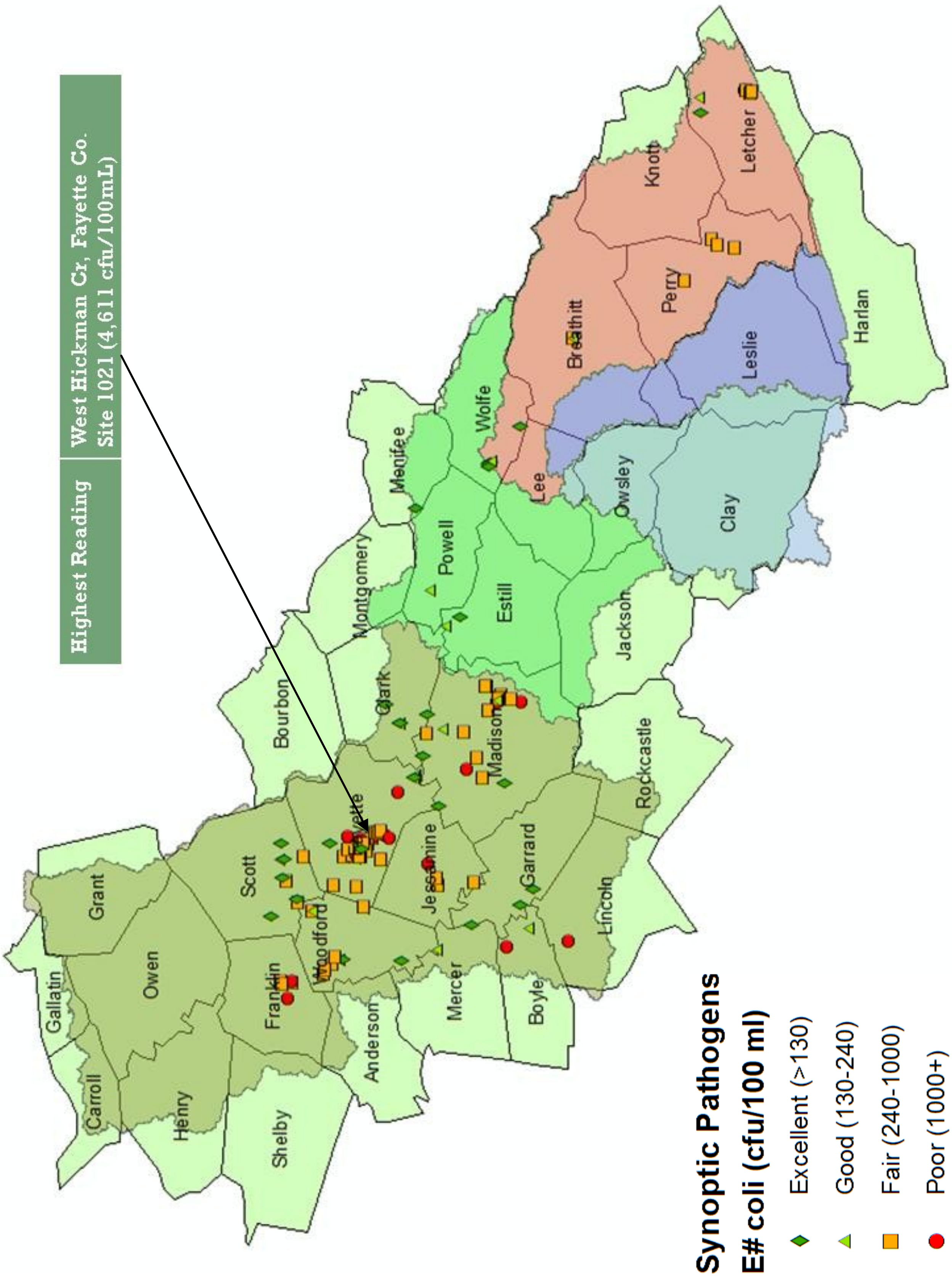


Figure 14
2013 KRWW Follow-Up Pathogen Sampling Results

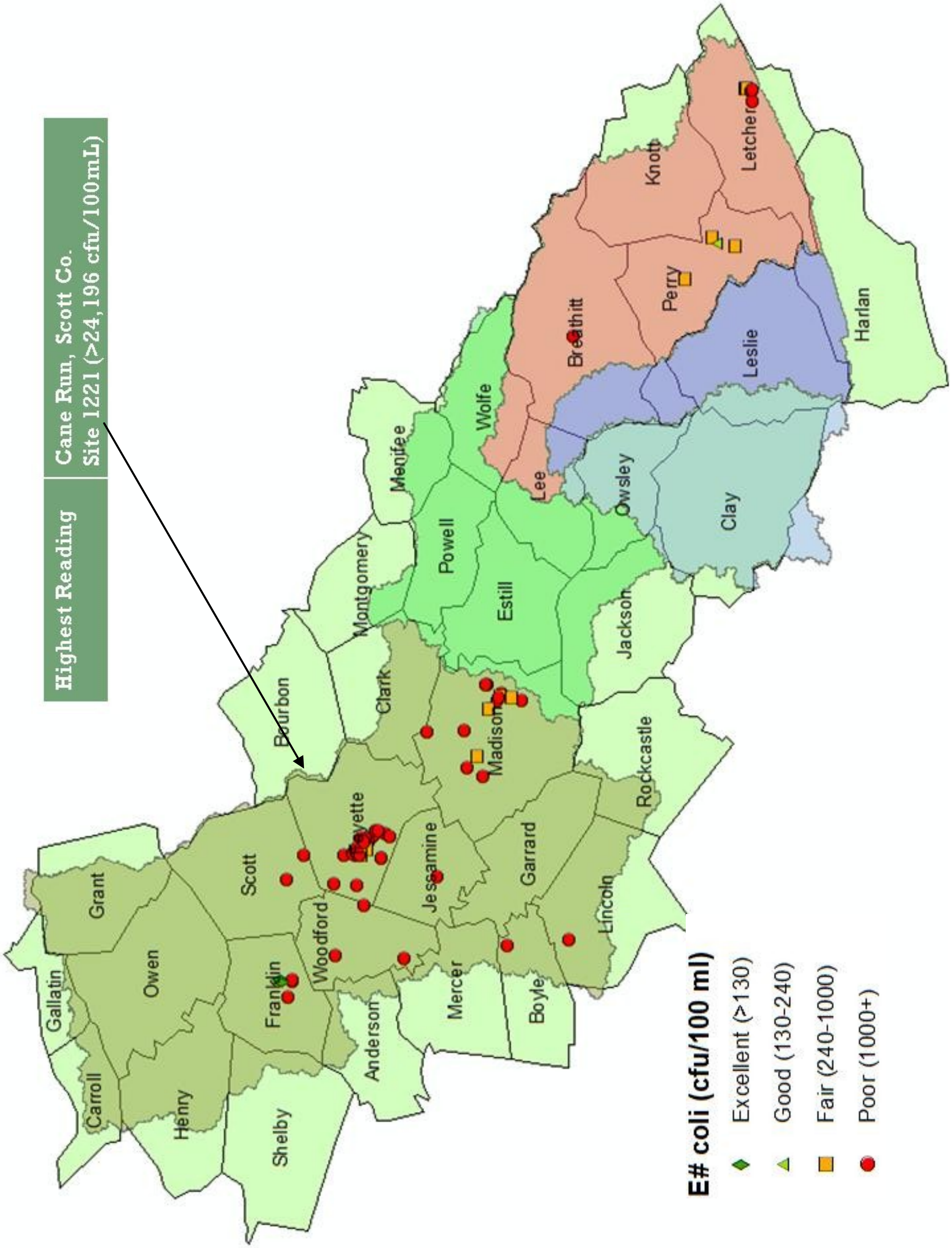


Figure 15
2013 KRWW Nitrate-Nitrogen Sampling Results

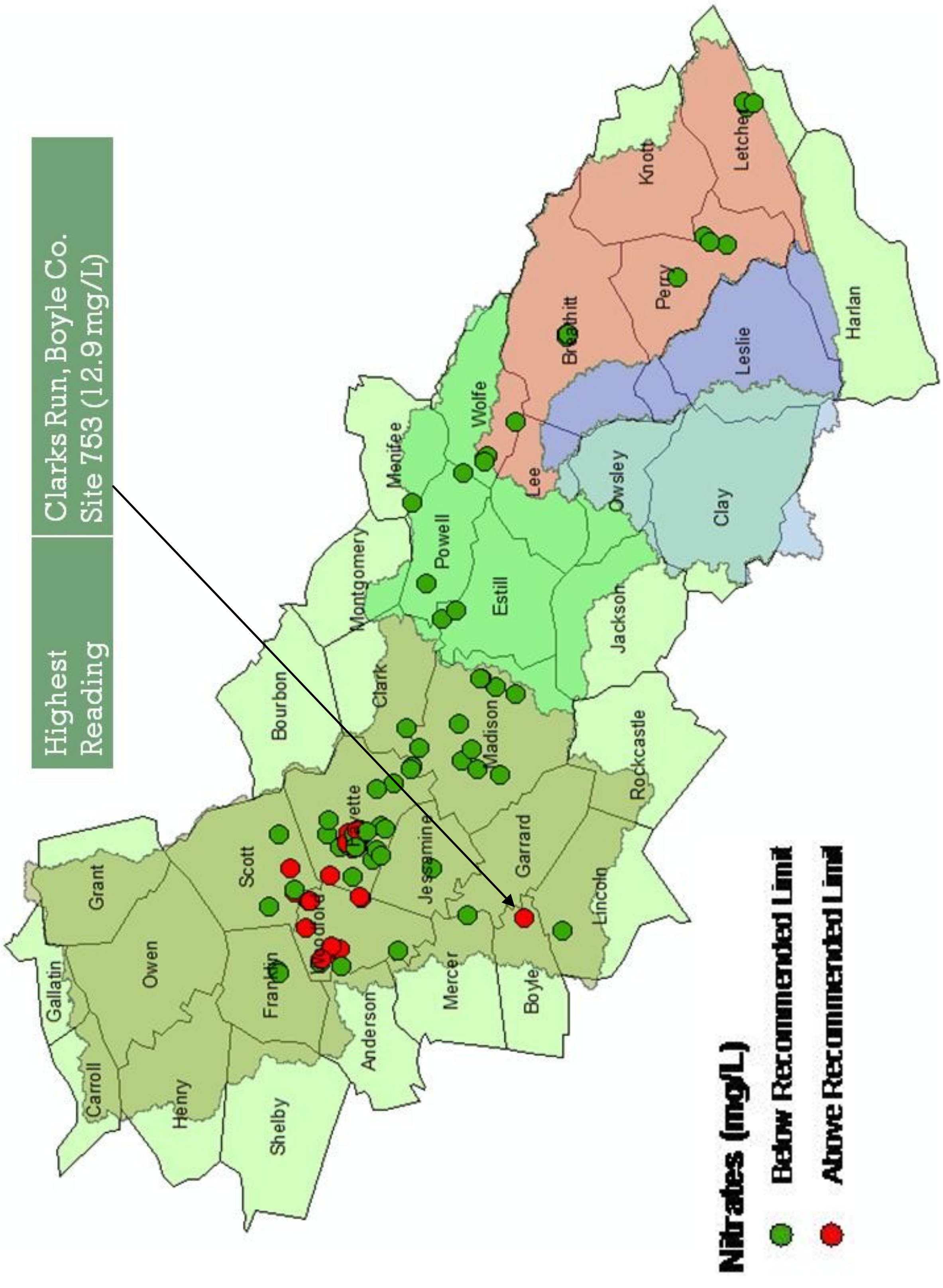


Figure 16
2013 KRWW Total Phosphorus Sampling Results

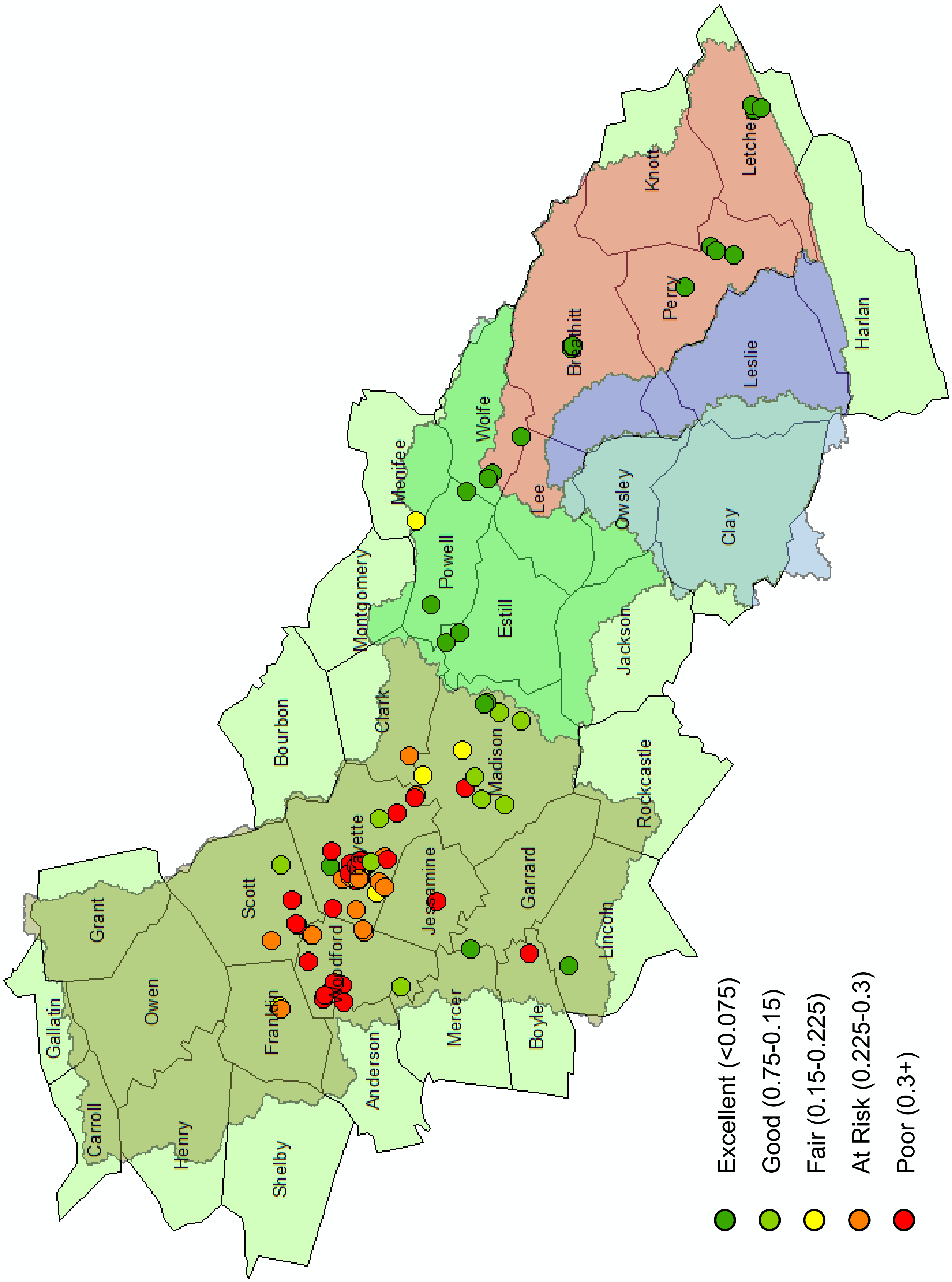


Figure 17
2013 KRWW Sulfate Sampling Results

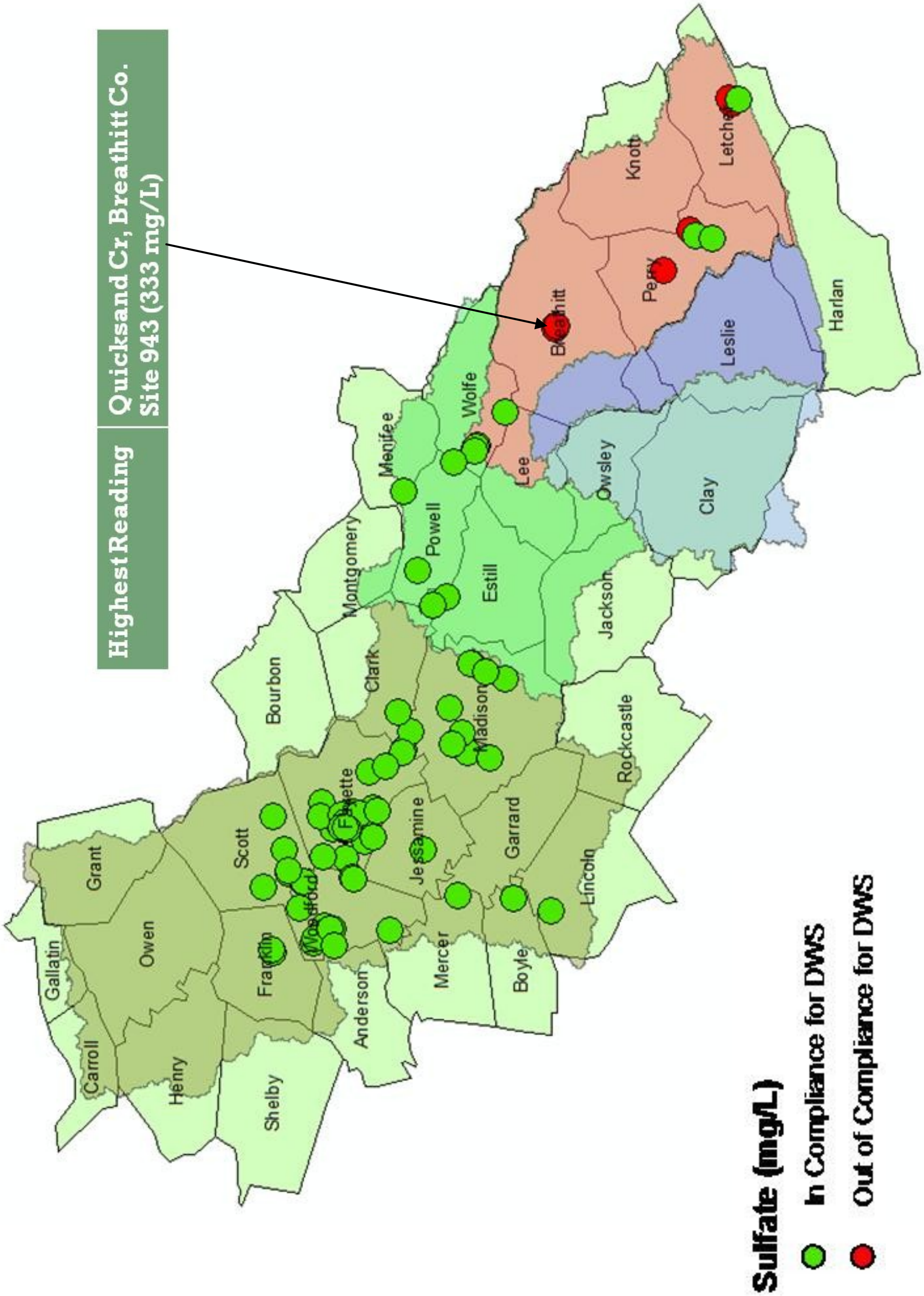
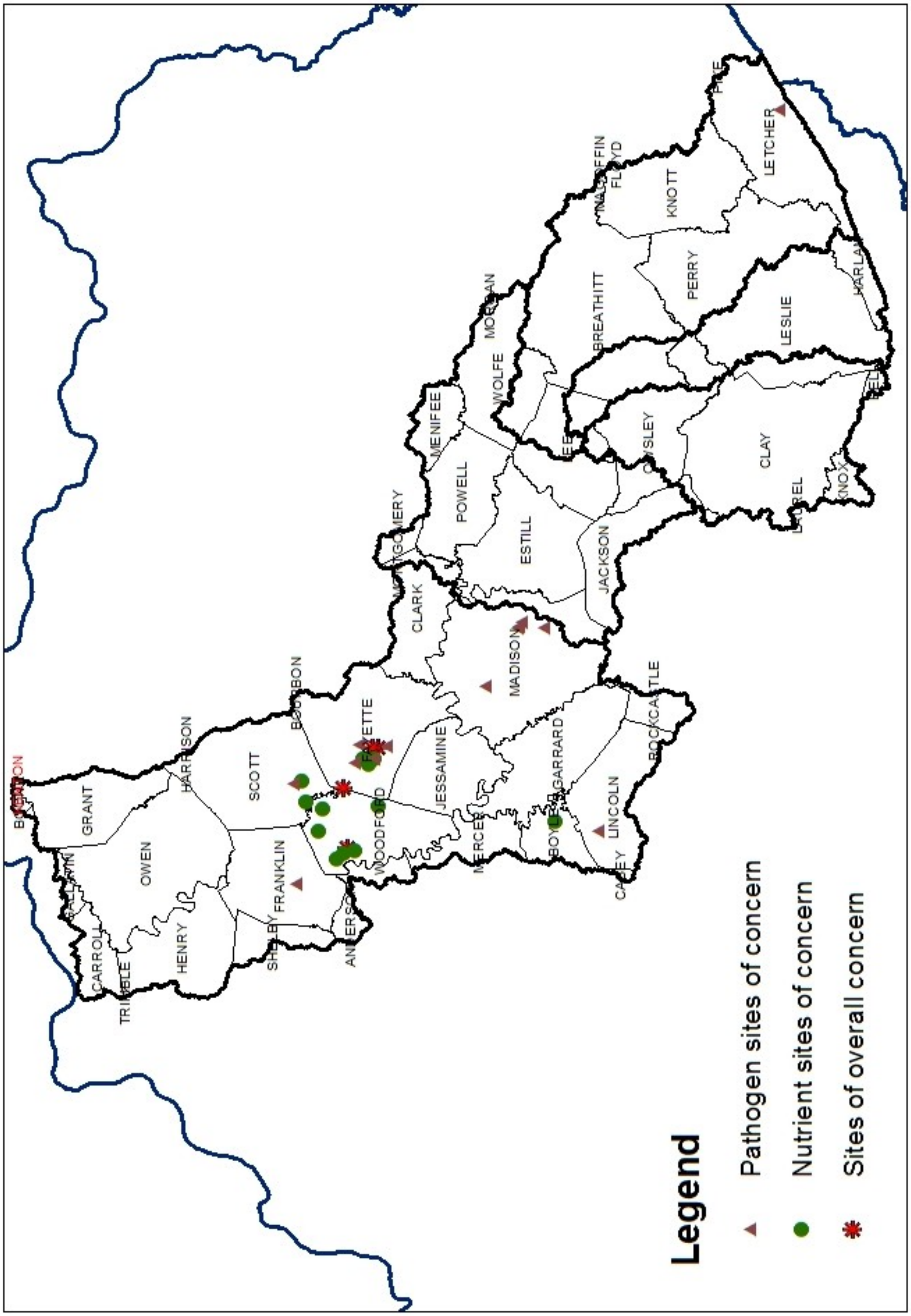


Figure 18
2013 KRWW Sampling Sites of Concern



APPENIDIX B: TABLES

Table 1: 2013 KRWW Sampling Site Information

Site Id	Stream	Location	County	Latitude	Longitude	Sampler
741	Lees Branch	150 yards downstream of Stephens Street	Woodford	38.1491	-84.6822	John Delfino
744	Cane Run	2/10ths of a mile upstream of 460 Bridge.	Scott	38.20944	-84.61074	Cindy King
753	Clarks Run	Upstream bridge on Goggin Ln	Boyle	37.63897	-84.72178	Chris Barton
755	North Elkhorn Creek	At Great Crossings	Scott	38.21564	-84.6058	Cindy King
759	Hickman Creek	Between UT and mouth of Hickman	Jessamine	37.76886	-84.61263	Chris Muesing
760	Town Branch	Just below New WWTP, Nicholasville	Jessamine	37.85299	-84.62239	Chris Muesing
763	South Elkhorn Creek	Upstream of US 60 near Airport	Fayette	38.04231	-84.62588	John Larmour
765	South Elkhorn Creek	.5mi upstream of SR 341	Scott	38.18069	-84.6596	Don Dampier
767	Clear Creek	1/2 mile downstream Hifner bridge.	Woodford	37.9325	-84.79488	Guy Kemper
772	Unnamed Tributary	behind residence of 124 Creekside Drive in Ironworks Estates	Scott	38.18278	-84.65559	Don Dampier
793	McConnell Spring	WR-M2 McConnell Spring	Fayette	38.05539	-84.51903	Sandy Conners
796	Spring Station	At spring on Beals Run	Woodford	38.15527	-84.74323	John Delfino
801	North Fork Kentucky River	Mayking, at Old Regular Baptist Church	Letcher	37.1364	-82.7645	Jennifer Honeycutt
802	Pine Creek	near mouth at Mayking Baptist Church	Letcher	37.1334	-82.7635	Jennifer Honeycutt
803	Cram Creek	At Mouth of Cram Cr & Pert Fk	Letcher	37.1249	-82.7699	Jim Dentinger
810	South Elkhorn Creek	US 68 Harrodsburg Rd Bridge	Fayette	37.9956	-84.5854	John Webb
811	Steeles Branch	Redd Rd Bridge off Old Frankfort Pk	Fayette	38.09835	-84.62191	Ken Cooke
815	Cane Creek	Gordon Property on the Meniffee/Powell Co Line	Menifee	37.90223	-83.739945	William Gordon
820	North Fork Kentucky River	Perry County Park	Perry	37.27592	-83.2078	John Hoppe
823	Glenns Creek	Church	Woodford	38.10066	-84.80528	Hank Graddy
827	Quicksand Creek	Below Hwy 15 bridge	Breathitt	37.53799	-83.34781	Chet Sygiel
831	Lower Red River	at Twin Creek	Estill	37.83296	-84.01583	Jack Stickney
832	Red River	Below bridge, Rt 15, Clay City	Powell	37.86907	-83.93072	Jack Stickney
833	Spring	Graddy Spring on Greenwood Farm, Steele Road, Woodford Co.	Woodford	38.08186	-84.7942	Hank Graddy
834	North Fork Kentucky River	confluence of Hammonds Br.	Letcher	37.1134	-82.80577	Alex DeSha
848	North Fork Kentucky River	County Central HS	Letcher	37.11857	-82.79277	Regina Donour
850	Colley Creek	at the mouth beside Ermine Post Office below bridge	Letcher	37.11917	-82.79278	Regina Donour
861	Glenns Creek	Millville, KY	Woodford	38.12056	-84.82694	Hank Graddy
869	Maces Creek	Road under bridge.	Perry	37.16167	-83.13194	Pam Brashear
875	Right Fork Carr Creek	Downstream from Vicco, Hwy 15 pullover. Below Acup Creek	Perry	37.21328	-83.11306	John Hoppe
888	Fourmile Creek	At mouth of creek	Clark	37.87795	-84.22387	Lanny Evans
891	North Elkhorn Creek	At Hwy 25	Scott	38.22	-84.56	Cindy King
914	Holly Spring	WR-H1 Across Wolf Run from Gardenside Park Tennis Court	Fayette	38.03517	-84.5431	Bob Edwards
915	Wolf Run	WR-S5 At Gardenside Park above foot bridge	Fayette	38.03318	-84.5421	Bob Edwards
918	Muddy Creek	outflow at Army Depot	Madison	37.70735	-84.17483	Alice Jones
919	Muddy Creek	inflow at Army Depot	Madison	37.65792	-84.19299	Alice Jones
921	Otter Creek	750' upstream from where Beaver Drive meets Otter Creek.	Madison	37.79276	-84.26245	Laura Melius
938	Silver Creek	at Curtis Road	Madison	37.69662	-84.38475	Pierce Johnson
941	Deep Branch Creek	off Lower Howards Creek behind Halls Resturant	Clark	37.97462	-84.19928	M. Clare Sipple
942	Lower Howard Creek	Church Road.	Clark	37.9391	-84.2439	M. Clare Sipple
943	Quicksand Creek	Quicksand Creek.	Breathitt	37.53877	-83.34146	Chet Sygiel
944	South Fork Quicksand Creek	Quicksand creek.	Breathitt	37.53611	-83.34084	Chet Sygiel
954	Spring	at Welcome Hall	Woodford	38.0753	-84.7954	Hank Graddy
955	Elk Lick Creek	Just below falls branch at Nature Sanctuary.	Fayette	37.902863	-84.363499	Laura Baird
963	Knoblick Creek	Fork.	Lincoln	37.54709	-84.75078	Chris Barton
969	South Fork Viny Fork	Bluegrass Army Depot	Madison	37.68239	-84.18731	Tom Edwards
970	North Fork Viny Fork	Bluegrass Army Depot	Madison	37.70958	-84.18337	Tom Edwards
972	Unnamed Tributary	Bluegrass Army Depot - Route 3B area. Trib to Muddy Creek	Madison	37.71455	-84.19123	Tom Edwards
973	Muddy Creek	Bluegrass Army Depot - D area bridge.	Madison	37.71328	-84.18697	Tom Edwards
974	Unnamed Tributary	Bluegrass Army Depot - Rt 10F area - trib to Muddy Creek	Madison	37.73623	-84.21252	Tom Edwards
975	Unnamed Tributary	Bluegrass Army Depot - Rt 10E area - trib to Muddy Creek	Madison	37.73623	-84.21252	Tom Edwards
977	Muddy Creek	at culvert where creek exits Central Ky Wildlife Management Area.	Madison	37.7383	-84.1541	Alice Jones
978	Muddy Creek	at Highway 52	Madison	37.742	-84.1546	Alice Jones
982	Lanes Run	Just upstream of guage station on Hwy 460.	Scott	38.2181	-84.5237	Steve Lombardo
984	Twin Creek	1/4 mile above confluence of Red River on the Stickney farm.	Estill	37.799987	-83.993882	Jack Stickney
990	Unnamed Tributary	behind Alice Jones property.	Madison	37.7877	-84.3488	Alice Jones
1018	Penitentiary Branch	US 127 North and Thornhill bypass - towards Owenton.	Franklin	38.22246	-84.84418	Debbie Bramlage

Table 1: 2013 KRWW Sampling Site Information

1020	West Hickman Creek	At Zandale and Heather Way.	Fayette	38.00554	-84.51028	Suzette Walling
1021	West Hickman Creek	at Zandale and Libby lane	Fayette	38.0045	-84.50774	Suzette Walling
1028	Wolf Run	at Old Frankfort Pike (USGS site).	Fayette	38.07327	-84.55445	Robert Garnham
1048	Shannon Run	at brige on Briarwood Street in Sycamore Estates.	Woodford	38.0233	-84.6753	Henry Duncan
1055	Muddy Creek	bluegrass army depot, L-Range below mouth of tributary.	Madison	37.71384	-84.1891	Tom Edwards
1106	Little Cowan Creek	300 meters from Hwy 119 intersection with Little Cowan Road	Letcher	37.09571	-82.79818	Alex DeSha
1109	Carr Fork	confluence of Carr Fork and KY River.	Perry	37.2012	-83.1253	Karyn Knecht
1124	Marble Creek	just off Marble Creek Lane	Jessamine	37.849	-84.4383	Tom Campbell
1128	Cardinal Run	WR-C1 At Deveonport Dr. Crossing	Fayette	38.0489	-84.5536	Curtis Jones
1129	Cardinal Run	WR-C2 Below Chinquapin Ln Bridge off Parker's Mill Rd.	Fayette	38.0431	-84.5573	Bruce Hutcheson
1131	Wolf Run	WR-L4 1875 Goodrich Ave at end of walk before RR Track	Fayette	38.0158	-84.5226	Brian Radcliffe
1132	Wolf Run	Branch	Fayette	38.0535	-84.5509	Curtis Jones
1133	Wolf Run	WR-S10 Lafayette Parkway at Rosemont	Fayette	38.023	-84.5286	John Dempsey
1134	Spring Branch	WR-S8 Springs Branch at end of Faircrest Drive	Fayette	38.0294	-84.5374	Anita Dennis
1136	Culvert	Neighborhood	Fayette	38.033	-84.5431	Bob Edwards
1137	Vaughns Branch	WR-V1 25 feet upstream of mouth at Valley Park	Fayette	38.0548	-84.5497	Curtis Jones
1138	Vaughns Branch	WR-V2 Park at end of Tazzwell Drive	Fayette	38.0448	-84.536	Bob Edwards
1139	Vaughns Branch	WR-V3 25 feet upstream of Nicholsasville Road	Fayette	38.0224	-84.5124	Bethany Overfield
1151	Cram Creek	Creek Rd (Hwy 3410) and Great Oak Rd	Letcher	37.1193	-82.7666	Jim Dentinger
1152	Cram Creek	Cram Creek Rd (Hwy 3410) and Great Oak Rd	Letcher	37.1193	-82.7661	Jim Dentinger
1159	Carr Fork	on Hwy 15.	Perry	37.20154	-83.12526	Karyn Knecht
1174	Royal Springs	intersection of West Main and South Water Street.	Scott	38.20988	-84.56189	Cindy King
1175	Calloway Creek	Calloway Creek north of confluence with Smith Fork.	Madison	37.8879	-84.3188	Howard Bowden
1184	Spring Branch	WR-S85 Supstream of Sheridan Drive Culvert.	Fayette	38.02172	-84.54073	Ken Cooke
1191	Kentucky River	cummins ferry road marina	Mercer	37.853027	-84.771233	Ruth Webb
1195	Lees Branch	in front of Midway College.	Woodford	38.14568	-84.68171	John Delfino
1198	Glenns Creek	at 4845 McCracken Pike	Woodford	38.0929	-84.7888	Gary Betts
1215	Herrington Lake	Jewett dock at 897 Hardin Heights - south end.	Mercer	37.77402	-84.71389	David Jewett
1221	Cane Run	intersect of Coleman Lane and Hwy 25.	Scott	38.1666	-84.5532	Cindy King
1226	Rocky Fork	at the headwaters on the south side of Rocky Fork.	Garrard	37.62979	-84.63012	Mike Rose
1227	Rocky Fork	at Rose Dock	Garrard	37.658777	-84.669163	Mike Rose
1246	Cardinal Run	WR-Upstream of Lexington School soccer field bridge	Fayette	38.0344	-84.5542	Bruce Hutcheson
1274	Elk Lick Creek	upstream from Quarry Branch	Fayette	37.90624	-84.37038	Beverly James
1275	Unnamed Tributary	Drive.Trib to West Hickman.	Fayette	37.97563	-84.50349	John Webb
1301	North Elkhorn Creek	Ground in Scott County.	Scott	38.24162	-84.69436	Lisa Morris
1307	Jessamine Creek	Short Shun Crossing.	Jessamine	37.855794	-84.605073	Mary Miller
1314	Wolf Run	at Roanoke Drive and Greenway.	Fayette	38.04534	-84.55074	Wendy Havens
2924	Tates Creek	just upstream of K407. At the outflow of St. Andres Pond.	Madison	37.76423	-84.3214	Mike Galliers
2931	Boggs Fork	where it meets with KY 1973.	Fayette	37.94731	-84.40307	Kyle Witten
2962	Cold Harbor Creek	behind College Park Subdivision.	Franklin	38.1953	-84.84707	Michael Soto
2963	Cold Harbor Creek	upstream from Cold Harbor subdivision at the FPB garage.	Franklin	38.19475	-84.84662	Michael Soto
2970	Prestons Cave Spring	Dunkirk Drive.	Fayette	38.05737	-84.54246	Steve Shannon
2993	West Hickman Creek	Lansdowne Shopping center.	Fayette	37.99933	-84.49552	Allen Kirkwood
2994	West Hickman Creek	Shopping Center.	Fayette	37.99337	-84.49555	Allen Kirkwood
3005	McConnell Branch	Ditch line off Red Mile Road south of Horseman's Lane	Fayette	38.04225	-84.52547	Laurie Thomas
3006	Lower Howard Creek	upstream of suspected pipe	Clark	37.9391	-84.2439	M. Clare Sipple
3007	Lower Howard Creek	downstream of suspected pipe.	Clark	37.9391	-84.2439	M. Clare Sipple
3013	Shannon Run	Sycamore subdivision- Lavy Lot as it leaves Sycamore Estates	Woodford	38.02749	-84.66952	Henry Duncan
3019	Vaughns Branch	Ave Greenway Railroad Culvert.	Fayette	38.03358	-84.51431	Ken Cooke
3050	Buck Run	at bridge at the end of Buck Run Road	Woodford	38.07089	-84.83459	Curt Welling
3053	Loves Branch	1.7 miles south of Hwy 7 in Colson KY	Letcher	37.2409	-82.77945	Ellis Keyes
3059	Gardenside Branch	downstream of Darien Drive Culvert at head of Cross Keys Park.	Fayette	38.03785	-84.55526	Ellen Hannifan
3060	Vaughns Branch	end of parking lot behind Harrodsburg Road fire station.	Fayette	38.02573	-84.52256	Mark Felice
3067	East Hickman Creek	intersection of Macadam Drive and Tates Creek Road	Fayette	37.98764	-84.49499	Maxine Rudder
3068	Jessamine Creek	at the end of Jefferson street.	Jessamine	37.87769	-84.57118	Chris Muesing
3084	Unnamed Tributary	behind residence at 1609 Loves Branch, Democrat, KY	Letcher	37.23777	-82.81661	Ellis Keyes
3085	St Clair Spring	yards down before the railway crossing.	Fayette	38.10283	-84.52433	Robert Garnham
3127	Unnamed Tributary	Clays Mill Road, Lexington, KY.	Fayette	37.98802	-84.56126	JC Miller
3128	Unnamed Tributary	located at 1380 Higbee Mill Road, Lexington, KY.	Fayette	37.98716	-84.56199	JC Miller

Table 1: 2013 KRWW Sampling Site Information

3133	Mocks Branch	corner of Gwinn Island Road and Rt. 33.	Boyle	37.69114	-84.76387	Deborah Larkin
3134	Lower Howard Creek	behind Hall's on the River.	Clark	37.91825	-84.2728	Kim Wildman
3137	Wolf Run	behind the parking lot at 2134 Nicholasville Road.	Fayette	38.00915	-84.51588	William Neal
3139	Town Branch	where it emerges from underground channel	Fayette	38.06481	-84.50568	Carl Vogel
3140	Town Branch	at New Circle Road	Fayette	38.06481	-84.53715	Carl Vogel
3144	South Elkhorn Creek	at Moore's Mill Road	Scott	38.191667	-84.602917	Tricia Spencer
3146	Cane Run	at Coldstream Park	Fayette	38.099438	-84.489336	Ashley Bandy
3163	Unnamed Tributary	a major stream supplying water to the reservoir in Jacobson Park.	Fayette	37.98857	-84.41638	Frank Huggins
3172	Tates Creek	Near entrance to Baldwin Farms near Crutcher Pike Road.	Madison	37.75071	-84.37138	Ann Galliers
3174	East Prong Branch	immediately upstream of confluence with Otter Cr	Madison	37.84087	-84.25561	Tyler Sanslow
3180	Spring	at Cove Spring park	Franklin	38.21818	-84.85136	Christena Taylor
3187	Otter Creek	at mouth of creek	Madison	37.881504	-84.26643	Lanny Evans
3198	Clear Creek	at pool 5. 1.24 miles upstream from 1779 McCouns Ferry Road	Mercer	37.9367	-84.79806	Nick Barker
3203	Evans Branch	just upstream from confluence with Elk Lick Creek.	Fayette	37.90625	-84.37079	Josie Miller
3211	Silver Creek	at the 1016 crossing bridge in Berea.	Madison	37.58764	-84.269	Jessica Bevins
3214	Glenns Creek	at the Millville Community Center	Woodford	38.11592	-84.81942	J.G. Webb
3216	Unnamed Tributary	east from the wier at the lower end of the large Waterford pond.	Fayette	37.96807	-84.50882	John Baggerman
3221	Lower Devil Creek	at North Fork	Wolfe	37.6577	-83.54834	Tricia Coakley
3222	Unnamed Tributary	Muir Valley Calvin Hollow	Wolfe	37.72791	-83.63501	Tricia Coakley
3223	Unnamed Tributary	Muir Valley from behind Rogers Elementary	Wolfe	37.73302	-83.63853	Tricia Coakley
3224	Unnamed Tributary	Muir Valley downstream of beaver dams	Wolfe	37.72448	-83.62997	Tricia Coakley
3225	Creek	Muir Valley headwaters	Wolfe	37.73327	-83.64237	Tricia Coakley
3227	Whittleton Branch	just beyond Natural Bridge Park boundaries off Highway 11.	Powell	37.783537	-83.670943	Anne Frances Miller
3230	South Elkhorn Creek	across from Ramsey's restaurant. At the intersection of Bowman's	Fayette	38.00337	-84.58691	Michele Heinz
3231	South Elkhorn Creek	Bowman's Mill and Harrodsburg Road. Site is downstream from	Fayette	38.01591	-84.552	Michele Heinz
3234	Benson Creek	boat dock where KY River and Benson Creek meet.	Franklin	38.205	-84.88551	Tiffany Ogunsanya
3241	Moberly Spring	at Allendale Drive Greenway	Fayette	38.0311	-84.53864	Anita Dennis
3252	South Elkhorn Creek	Clays Crossing Subdivision.	Jessamine	37.97578	-84.57315	John Larmour

Table 3
2013 KRWW Field Sampling Results

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
741	Lees Branch	9/22/2013	3	0.1	0	7	7.5	17	500
741	Lees Branch	7/12/2013	4	1	0	8	7.2	15	420
744	Cane Run	7/13/2013	4	zero	1	8.6	7.9	22.9	478
744	Cane Run	8/9/2013		>1.5	0	6.6	7.8	24.9	394
753	Clarks Run	9/19/2013	3	zero	0		8.5		**740**
753	Clarks Run	7/12/2013	4	0.5	1	8.6	8.0	21	**530**
755	North Elkhorn Creek	7/13/2013	4	zero	0	9.2	7.8	22.2	467
759	Hickman Creek	7/12/2013	3		3	6	7.2	12.2	**840**
760	Town Branch	7/12/2013	3	0.1	2	7.8	6.8	11.1	**720**
763	South Elkhorn Creek	8/9/2013		>1.5	3	6	7.5	20	**760**
763	South Elkhorn Creek	9/20/2013	2	zero	0	7	7.5	19	**590**
763	South Elkhorn Creek	7/12/2013	4	zero	1	9.1	7.5	19	375
765	South Elkhorn Creek	9/21/2013	3	>1.5	2	6.8	7.3	20	**660**
765	South Elkhorn Creek	7/12/2013	4	0.5	3	6.6	8.3	20	480
765	South Elkhorn Creek	8/10/2013	4	>1.5	3				
767	Clear Creek	8/9/2013		>1.5	3	6.8	7.9	24	410
772	Unnamed Tributary	9/21/2013	3	>1.5	1	5.8	7.5	22	390
772	Unnamed Tributary	7/12/2013	4	0.5	0	**4.8**	7.5	26	320
793	McConnell Spring	7/15/2013	3		1	**4.3**	7.0	17	**700**
793	McConnell Spring	9/21/2013	4	0.1	3	**4.4**	6.8	19	340
796	Spring Station	9/22/2013	3	0.1	0	9	7.0	16	**510**
796	Spring Station	7/12/2013	4	1	3				
801	North Fork Kentucky River	8/9/2013	3	1.5	2	7.4	7.3	20	**670**
801	North Fork Kentucky River	7/12/2013	4	0.5	2	6.2	8.0	20	**660**
802	Pine Creek	7/12/2013	4	0.5	1				450
802	Pine Creek	8/9/2013	3	1.5	2	5	7.5	22	430
803	Cram Creek	7/12/2013	4	0.5	1				340
803	Cram Creek	8/9/2013	3	1.5	1				
810	South Elkhorn Creek	9/20/2013	2	0.1	0	5.62	8.0	19.2	**634**
811	Steeles Branch	9/20/2013	2	zero	0				450
811	Steeles Branch	7/13/2013	3	zero	2		7.7	17.49	364
811	Steeles Branch	8/9/2013	3	1.5	2				
815	Cane Creek	9/21/2013	4	>1.5	3		7.4	4	120
815	Cane Creek	7/13/2013	3	0.1	0		7.6	16.1	
820	North Fork Kentucky River	8/9/2013	3	0.5	2	7.2	7.5	22	**910**
820	North Fork Kentucky River	9/20/2013	3	0.5	2	7.7	7.3	19	**850**
820	North Fork Kentucky River	7/12/2013	4	0.5	2	8.2	7.0	16	**610**
823	Glenns Creek	9/23/2013	3	0.5	0	7.9	7.8	12	**630**
823	Glenns Creek	7/13/2013	4		1	8.5	7.8	17	460
827	Quicksand Creek	9/20/2013	2	zero	0		7.7		**860**
827	Quicksand Creek	7/12/2013	4	0.5	1	7.4	7.4	22	430

2013 KRWW Field Sampling Results

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
831	Lower Red River	9/20/2013	2	zero	1		7.5	19	240
831	Lower Red River	7/13/2013	4	0.5	2		7.5	20	190
832	Red River	9/20/2013	2	zero	1		7.0	19	220
832	Red River	7/13/2013	4	0.5	2		7.4	20	180
833	Spring	9/22/2013	3	0.5	0	6.1	6.0	12	**570**
833	Spring	7/13/2013	4		0	5.7	6.8	14	440
834	North Fork Kentucky River	9/21/2013	3	0.1	1	7.2	8.1	19.5	**860**
848	North Fork Kentucky River	9/20/2013	2	0.1	0	8.3	8.0	20	**830**
848	North Fork Kentucky River	8/9/2013	3	1.5	2	7.4	8.0	22	**670**
850	Colley Creek	9/20/2013	2	0.1	0	8.2	7.5	23	**730**
850	Colley Creek	8/9/2013	3	1.5	1	6.9	7.8	22	**530**
861	Glenns Creek	9/23/2013	3	0.5	0	7.6	7.8	12	**570**
861	Glenns Creek	7/13/2013	4		1	9	7.8	16	460
869	Maces Creek	9/20/2013	3	0.1	0			20	**600**
869	Maces Creek	7/12/2013	3	0.5	1	7.5	8.5	20	410
869	Maces Creek	8/9/2013	2		1				
875	Right Fork Carr Creek	8/9/2013	2	0.5	1	6.4	7.5	20	**1020**
875	Right Fork Carr Creek	9/20/2013	3	0.5	1	8.1	7.5	18	**790**
875	Right Fork Carr Creek	7/12/2013	4	0.5	3	8.9	7.5	12	**610**
888	Fourmile Creek	7/13/2013	4	zero	0	5.8	8.5	20	410
891	North Elkhorn Creek	7/13/2013	3	zero	0	7.2	7.7	21.8	407
914	Holly Spring	9/20/2013	2	zero	0	7	6.5	15	**520**
914	Holly Spring	7/12/2013	3	1		5.6	6.5	12	420
915	Wolf Run	9/20/2013	2	zero	0	7.6	8.6	22	**640**
915	Wolf Run	7/12/2013	3	1		7.8	8.0	18	**580**
915	Wolf Run	8/9/2013		>1.5	0	7.4	7.5	24	250
918	Muddy Creek	9/21/2013	3	0.5	1	6.73	7.5	19.86	393
918	Muddy Creek	7/13/2013	4	0.1	2	8.55	6.7	19.4	391.8
918	Muddy Creek	8/10/2013		>1.5	3				
919	Muddy Creek	9/21/2013	3	0.5	2	5.07	7.1	20.2	**566**
919	Muddy Creek	7/13/2013	4	0.1	2	8.51	6.4	18.47	421.1
919	Muddy Creek	8/10/2013		>1.5	3				
921	Otter Creek	9/21/2013	4	0.5	2	5.7	7.6	16	**600**
921	Otter Creek	8/10/2013	3	1	1	6	7.8	18	470
921	Otter Creek	7/13/2013	3	zero	0	6.1	8.0	16	
938	Silver Creek	9/21/2013	3	0.5	0	6.2	7.5	21	460
938	Silver Creek	7/13/2013			1	6.2	7.5	21	420
941	Deep Branch Creek	7/13/2013	3	0.1		5	8.0	20	**570**
942	Lower Howard Creek	7/13/2013	4	0.1	0	**4**	8.5	20	430
943	Quicksand Creek	9/20/2013	2	zero	0		7.4		**830**
943	Quicksand Creek	8/10/2013	3	1.5	1	6.5	7.3	24	**750**
943	Quicksand Creek	7/12/2013	4	0.5	1	8.2	7.3	22	380
944	South Fork Quicksand Creek	9/20/2013	2	zero	0		7.9		**910**
944	South Fork Quicksand Creek	7/12/2013	4	0.5	1	8.8	7.8	21.5	**580**

2013 KRWW Field Sampling Results

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
954	Spring	9/22/2013	3	0.5	0	8.2	7.3	13	**620**
954	Spring	7/13/2013	3		0	6	6.8	14	480
955	Elk Lick Creek	9/20/2013	2		0	7.2	7.8	18	**680**
955	Elk Lick Creek	7/12/2013	3	1	0	7	7.8	17	**640**
963	Knoblick Creek	9/19/2013	2			8.2	8.0	21	430
963	Knoblick Creek	8/10/2013		>1.5	3	6.8	8.0	23	320
963	Knoblick Creek	7/12/2013	4	0.5	2	7.6	8.0	19	310
969	South Fork Viny Fork	7/13/2013	4	zero	0	7.7	7.4	20	410
969	South Fork Viny Fork	8/10/2013		>1.5	1			22	380
970	North Fork Viny Fork	8/10/2013		>1.5	1			21	400
970	North Fork Viny Fork	7/13/2013	4	zero	0	8.2	7.6	18	400
972	Unnamed Tributary	7/13/2013	4	zero	0	7.2	7.2	18	450
972	Unnamed Tributary	8/10/2013	5	>1.5	1			21	440
973	Muddy Creek	7/13/2013	4	zero	0	7.4	7.6	19	450
973	Muddy Creek	8/10/2013	5	>1.5	3			22	350
974	Unnamed Tributary	7/13/2013	4	zero	0	7.1	7.3	19	**510**
974	Unnamed Tributary	8/10/2013		>1.5	2			22	470
975	Unnamed Tributary	7/13/2013	4	zero	0	7.4	7.4	19	470
975	Unnamed Tributary	8/10/2013		>1.5	1		7.0	23	400
977	Muddy Creek	9/21/2013	3	0.5	1	7.18	7.4	19.7	**516**
977	Muddy Creek	7/13/2013	3	0.1	2	6.34	6.7	17.84	396.4
977	Muddy Creek	8/10/2013		>1.5	3				
978	Muddy Creek	9/21/2013	3	0.5	2	7.22	7.7	20.1	406
978	Muddy Creek	7/13/2013	3	0.1	2	9.28	7.3	20.9	382.1
978	Muddy Creek	8/10/2013		>1.5	3				
982	Lanes Run	9/20/2013	2	zero	1	8.2	7.5	27	**650**
982	Lanes Run	7/13/2013	3	zero	0	6.3	7.5	21.5	**530**
984	Twin Creek	9/20/2013	2	zero	0		7.3	18	340
984	Twin Creek	7/13/2013	3	0.5	0		7.4	18	300
990	Unnamed Tributary	7/13/2013	3	0.1	1	7.32	6.7	17.6	**612**
990	Unnamed Tributary	9/21/2013	4	0.5	3	9.02	7.6	19.09	416
990	Unnamed Tributary	8/10/2013		>1.5	2				
1018	Penitentiary Branch	8/8/2013	3	0.1	0		7.5	15	**640**
1018	Penitentiary Branch	9/23/2013		zero			7.5	13	**630**
1018	Penitentiary Branch	7/12/2013	4	1	1		7.5	17	500
1020	West Hickman Creek	7/13/2013	3	1	1	7.4	7.3	18	**930**
1020	West Hickman Creek	8/10/2013	3	>1.5	1	6.8	7.3	21	**760**
1021	West Hickman Creek	8/10/2013	3	>1.5	1	6.6	7.3	20	**580**
1021	West Hickman Creek	7/13/2013	3	1	1	7	7.3	17	**520**
1028	Wolf Run	7/12/2013	3	0.1	0	7.2	8.0	20	**600**
1028	Wolf Run	8/9/2013	3	0.1	1	5.75	7.5	21	390
1028	Wolf Run	9/20/2013	2	zero	0	7.6	8.0	21	
1048	Shannon Run	9/20/2013	3	zero	1	7.8	7.5	18	480

2013 KRWW Field Sampling Results

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
1048	Shannon Run	7/13/2013	4	1	1	9.2	7.5	15	380
1055	Muddy Creek	7/13/2013	4	zero	0	7	7.3	22	400
1078	Kentucky River	7/13/2013	4	zero	0				
1106	Little Cowan Creek	9/21/2013	2	0.1	0	7	8.0	19	**674**
1109	Carr Fork	9/20/2013	3	0.5	1	8.6	7.8	19	**790**
1109	Carr Fork	7/12/2013		0.5	2	7.4	7.0	18	**590**
1124	Marble Creek	7/13/2013	3	zero	0	9.2	7.3	22	460
1128	Cardinal Run	8/10/2013	3	1.5	0	5	7.5	20	450
1128	Cardinal Run	9/21/2013	4	1	2	**4**	7.5	20	370
1129	Cardinal Run	9/21/2013							**540**
1129	Cardinal Run	7/13/2013							
1131	Wolf Run	9/23/2013	2	zero	0	12.5	8.5	23	**990**
1131	Wolf Run	7/12/2013	2		0				**780**
1131	Wolf Run	8/10/2013	3	>1.5	0	9.4	7.7	24	**640**
1132	Wolf Run	7/13/2013	3	zero	0	**4.8**	8.0	18	**560**
1132	Wolf Run	9/21/2013	4	1	0	**3.6**	7.5	20	210
1133	Wolf Run	7/12/2013	2		0				**680**
1133	Wolf Run	9/20/2013	2	0.1	1	16.72		25.9	**510**
1133	Wolf Run	8/9/2013	3	>1.5	2				350
1134	Spring Branch	7/15/2013	2	0.1	0			20	**560**
1134	Spring Branch	8/9/2013	5	>1.5	0	7.8	7.5	18	420
1134	Spring Branch	9/21/2013	3	0.1	1			23.3	310
1135	Wolf Run	7/15/2013	3	0.1	1			22.2	**610**
1135	Wolf Run	8/9/2013		>1.5	0	7	7.5	23	260
1135	Wolf Run	9/21/2013	2	0.1	2			22.2	200
1136	Culvert	8/9/2013	5	>1.5	0	7.4	8.8	20	**600**
1136	Culvert	9/20/2013		zero		7.6	8.6	18	**550**
1136	Culvert	7/12/2013		1		7.4	7.5	17.5	**510**
1137	Vaughns Branch	7/13/2013	2	zero	0	5.8	8.0	20	**630**
1137	Vaughns Branch	8/10/2013	3	1.5	0	**2.5**	7.5	21	480
1137	Vaughns Branch	9/21/2013	4	1	0	**4.6**	7.5	19	170
1138	Vaughns Branch	9/20/2013	2	zero	0	5.2	7.5	18	**530**
1138	Vaughns Branch	7/12/2013	3	1		8	7.5	19	480
1138	Vaughns Branch	8/9/2013	4	>1.5	0	5.4	7.5	24	140
1139	Vaughns Branch	7/12/2013	3		0				**850**
1139	Vaughns Branch	8/9/2013	3	>1.5	1	5.25	7.0	22	**620**
1139	Vaughns Branch	9/23/2013	2	zero	1	8.2	7.3	15.5	**620**
1151	Cram Creek	8/9/2013	3	1.5	2		7.8	20	**670**
1151	Cram Creek	7/12/2013	4	0.5	1	6.4	8.0	21	**530**
1152	Cram Creek	7/12/2013	4	0.5	1		8.0		300
1152	Cram Creek	8/9/2013	3	1.5	1				
1159	Carr Fork	8/9/2013	3	0.5	1	6.7	7.5	22	**800**
1159	Carr Fork	9/20/2013	3	0.5	1	8	7.5	19	**770**

2013 KRWW Field Sampling Results

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
1159	Carr Fork	7/12/2013	4	0.5	2	8.2	7.2	11	**600**
1174	Royal Springs	7/13/2013	4	zero	0	5	7.1	19.2	476
1175	Calloway Creek	9/21/2013	1	0.5	3	5.2	7.5	20	**570**
1175	Calloway Creek	7/13/2013	3	zero	1	7.5	8.0	19	**560**
1184	Spring Branch	7/13/2013	3	zero	0		6.9	16.02	**522**
1184	Spring Branch	8/9/2013	3	1.5	0				
1191	Kentucky River	7/13/2013	4	zero	1	**3**	7.5	20	270
1195	Lees Branch	9/22/2013	3	0.1	0	6.4	7.0	21	460
1195	Lees Branch	7/12/2013	4	1	0	7	7.2	18	440
1198	Glenns Creek	9/20/2013	3	0.5	1	7.2	7.6	19.5	**690**
1198	Glenns Creek	8/9/2013		>1.5	2	8.5	8.2	20	**520**
1198	Glenns Creek	7/12/2013	4	0.1	1	9.5	6.8	17.5	490
1215	Herrington Lake	9/20/2013	3	zero	0	6.8	8.0	24	370
1215	Herrington Lake	7/12/2013	5	0.5	3	10.6	8.2	28	260
1221	Cane Run	7/13/2013	4	zero	0	10	7.8	22	482
1221	Cane Run	8/9/2013	4	>1.5	1	6.4	7.5	21.7	476
1226	Rocky Fork	7/12/2013	5	zero	3	9	8.0	23	
1227	Rocky Fork	7/12/2013	5	zero	2	8.4	8.0	23	
1246	Cardinal Run	9/20/2013	2	zero	0				**700**
1246	Cardinal Run	8/10/2013	3	1	0		7.3	22.27	**544**
1246	Cardinal Run	7/13/2013							
1274	Elk Lick Creek	9/20/2013	2	zero	0	7.2	7.6	18	**840**
1274	Elk Lick Creek	7/12/2013	3	1	0	7.8	7.9	17	**810**
1275	Unnamed Tributary	9/20/2013	2	0.1	0		8.0	19.1	**831**
1275	Unnamed Tributary	8/10/2013	3	>1.5	0	7	7.7	21	**560**
1275	Unnamed Tributary	7/13/2013	2	zero	0	7.1	7.8	18	69
1301	North Elkhorn Creek	9/20/2013	3	0.1	0	5	8.0	18.5	**590**
1301	North Elkhorn Creek	7/13/2013	3		2	6.4	7.9	19	480
1307	Jessamine Creek	9/21/2013	4	0.1	3	7.4	7.4	24	**510**
1307	Jessamine Creek	8/10/2013	4	>1.5	3		7.4	20	500
1307	Jessamine Creek	7/13/2013	4	zero	0	9.2	7.9	20	480
1314	Wolf Run	7/13/2013	3	zero	0	8.8	7.5	15	**510**
1314	Wolf Run	8/10/2013	3	1	1	7	7.0-7.5	20	400
1314	Wolf Run	9/21/2013	4	1.5	1	8.4	7.2	19	120
2924	Tates Creek	7/12/2013	3	1	0	7.8	7.8	20.2	**615**
2924	Tates Creek	8/10/2013	4	1.5	1	7	7.6	21.5	**595**
2924	Tates Creek	9/20/2013	1	zero	0	12.4	7.9	27	**530**
2931	Boggs Fork	9/20/2013	2	0.1		6	7.5	22	**530**
2931	Boggs Fork	7/12/2013	4	1.5	2	7.12	7.5	18	470
2962	Cold Harbor Creek	7/13/2013	3	0.5	0	8	7.0	18.5	
2963	Cold Harbor Creek	8/10/2013	3	1	0	7.4	7.0	21	**670**
2963	Cold Harbor Creek	7/13/2013	3	0.5	0	7.4	7.0	19.5	
2970	Prestons Cave Spring	7/15/2013	3		1	6.1	7.2	18	**710**

2013 KRWW Field Sampling Results

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
2970	Prestons Cave Spring	9/21/2013	4	0.1	2	5.2	6.7	17	**650**
2993	West Hickman Creek	7/13/2013	3	zero	0	6.4	6.6	15	**600**
2993	West Hickman Creek	8/10/2013	3	1.5	0	5.4	8.0	18	**530**
2994	West Hickman Creek	7/13/2013	3	zero	0	6.6	7.5	15	**650**
2994	West Hickman Creek	8/10/2013	3	1	0	5.8	8.0	18	**570**
3005	McConnell Branch	7/15/2013	2		1	6.5	7.0	23	470
3005	McConnell Branch	9/21/2013	4	0.1	3	**4**	7.3	20	350
3006	Lower Howard Creek	7/13/2013	4	0.1		5.8	8.0	20	450
3007	Lower Howard Creek	7/13/2013	4	0.1	0	5.8	8.0	20	450
3013	Shannon Run	9/20/2013	3		0	7.6	8.5	20	460
3013	Shannon Run	7/13/2013	4	1	1	9.1	7.5	16	380
3013	Shannon Run	8/7/2013	3	0.1	1			20.1	
3019	Vaughns Branch	7/13/2013	3	zero	0		8.2	20.89	**1115**
3019	Vaughns Branch	9/20/2013	2	zero	0				**950**
3019	Vaughns Branch	8/9/2013	3	1.5	0				
3050	Buck Run	9/21/2013	3	0.5	1	9.5	7.5	19	320
3059	Gardenside Branch	9/21/2013							220
3059	Gardenside Branch	7/13/2013							
3060	Vaughns Branch	7/15/2013	3	0.1	0	6.8	8.3	23	**740**
3060	Vaughns Branch	8/10/2013	3	1	0	6	7.7	21	**710**
3067	East Hickman Creek	7/13/2013	3	zero		8	7.5	18	**580**
3068	Jessamine Creek	7/12/2013	3	0.1	1	7	7.4	10.5	**720**
3084	Unnamed Tributary	7/13/2013	3	0.5	0				
3085	St Clair Spring	9/20/2013	1	zero	0	5.2	7.0	21	**520**
3085	St Clair Spring	7/12/2013	2	0.1	1	11.7	8.0	26	410
3127	Unnamed Tributary	7/12/2013	4	0.5	0	6	7.0	18	**560**
3127	Unnamed Tributary	8/9/2013	4	>1.5	1	5	7.0	20	320
3127	Unnamed Tributary	9/20/2013	0	zero					
3128	Unnamed Tributary	9/20/2013	2	zero	0	5.2	7.0	20	**710**
3128	Unnamed Tributary	7/12/2013	3	0.5	0	6	7.0	18	**630**
3128	Unnamed Tributary	8/9/2013	4	>1.5	2	5	7.0	21	300
3133	Mocks Branch	7/12/2013	4	0.1	1	9.4	7.3	15.5	**520**
3133	Mocks Branch	8/9/2013	4	>1.5	3				
3134	Howard''s Creek	9/21/2013	2	0.5	1	9.5	8.0	19.5	**520**
3137	Wolf Run	9/21/2013	3	0.1	0	6.4	7.0	19	330
3139	Town Branch	7/12/2013	3	zero	0	8.1	7.5	16.1	**730**
3140	Town Branch	7/12/2013	4	zero	0	8.01	7.5	22.1	
3144	South Elkhorn Creek	9/20/2013	3	zero	2	8	7.0	20	**780**
3144	South Elkhorn Creek	8/10/2013	5	>1.5	3				
3146	Cane Run	9/20/2013	3	0.1	1	**4.5**	7.0	21	**600**
3147	Cane Run	9/20/2013	0	0.1					
3163	Unnamed Tributary	9/20/2013	3	0.1	0	5	7.0	18.5	500
3172	Tates Creek	9/20/2013	3	zero	0	9.7	7.9	23.5	**655**

2013 KRWW Field Sampling Results

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
3172	Tates Creek	7/12/2013	3	1	1	7.8	7.8	19.2	**565**
3172	Tates Creek	8/10/2013	4	1.5	1	7	7.8	21.5	**560**
3172	Tates Creek	5/17/2013	3	0.1	0	10	7.9	18	**530**
3174	East Prong Branch	5/17/2013	3		0	12	7.8	15	480
3174	East Prong Branch	7/13/2013	3	0.1	1	8.8	8.0	22	440
3180	Spring	9/20/2013	3	0.1	0	10	8.0	20	**730**
3180	Spring	8/9/2013	2	0.5		10	8.0	20	**670**
3180	Spring	7/12/2013	3	0.1	0	10	8.0	20	**530**
3187	Otter Creek	7/13/2013	4	zero	0	7.2	8.5	20	490
3187	Otter Creek	8/10/2013	4	1.5	1	5.9	8.5	24	410
3198	Clear Creek	7/13/2013	4	0.5	1	4	7.5	20	440
3198	Clear Creek	5/17/2013	4	0.1	1	7.5	8.0	18	440
3198	Clear Creek	9/20/2013		0.1	1	5.75	7.0	25	390
3203	Evans Branch	9/20/2013	2	zero	0	7	7.6	18	**510**
3211	Silver Creek	5/17/2013	3	0.5	0	10	7.0	21	260
3214	Glenns Creek	9/22/2013	3	1.5	1	6	7.9	15	**540**
3214	Glenns Creek	5/19/2013	4	0.5	1	9.2	8.2	17.5	490
3216	Unnamed Tributary	7/13/2013	3	zero	1	6.6	8.0	16	**720**
3216	Unnamed Tributary	8/10/2013	3	1	2	7.6	7.5	19	**540**
3216	Unnamed Tributary	5/17/2013	3	0.5	2	6.7	7.5	14	500
3216	Unnamed Tributary	9/21/2013	4	1	3	**4.8**	7.0	17	180
3221	Lower Devil Creek	9/15/2013	2	zero	0	8.2	7.5	16	310
3221	Lower Devil Creek	5/19/2013	3	0.5	0	9	7.0	16	220
3221	Lower Devil Creek	7/14/2013	3	0.1	1	7.9	7.1	22	190
3222	Unnamed Tributary	5/19/2013	3	0.5	1	7.4	7.1	14	110
3222	Unnamed Tributary	7/14/2013	3	zero	1	7.6	7.1	21	100
3222	Unnamed Tributary	9/15/2013	1	zero	0	8.5	7.0	13	70
3223	Unnamed Tributary	9/15/2013	2	zero	0	9	7.2	15	100
3223	Unnamed Tributary	7/14/2013	2	0	1	7.1	7.2	25	90
3223	Unnamed Tributary	5/19/2013	3	0.5	0	8.2	7.0	15	90
3224	Unnamed Tributary	9/15/2013	2	zero	0	8.8	7.2	15	130
3224	Unnamed Tributary	5/18/2013	3	zero	1	6.6	6.8	19.5	110
3224	Unnamed Tributary	5/19/2013	3	0.5	1	7.7	6.6	16	90
3225	Creek	9/15/2013	1	zero	0	8	7.5	15	230
3225	Creek	7/14/2013	2	zero	0	7.5	7.5	20	190
3225	Creek	5/19/2013	3	0.5	0	8.5	7.5	15	190
3227	Whittleton Branch	9/21/2013	3	1	0	8.5	7.6	16	150
3227	Whittleton Branch	5/18/2013	3	0.5	0	9.2	7.5	13	130
3230	South Elkhorn Creek	5/18/2013	4	0.5	1	8.4	8.0	19	490
3231	South Elkhorn Creek	5/18/2013	4	0.5	1	8	8.0	19	490
3234	Benson Creek	5/19/2013	3	0.1	2	**3**	8.0	22	420
3234	Benson Creek	7/12/2013	3	1	3	7.8	8.0	23	360
3234	Benson Creek	8/9/2013	3	0.1	3	8.2	8.0	21	330
3241	Moberly Spring	7/15/2013	2	0.1	1			18.33	**700**
3252	South Elkhorn Creek	9/20/2013	3	zero	1	8.8	7.5	24	440

Table 4

2013 Kentucky River Watershed Watch Herbicide Sampling Results

Site ID#	Sampling Date	Stream	County	Triazines by Immunoassay
Minimum Detection Limit				**0.06 micrograms/L (or 0.06 parts per billion)**
Water Quality Standards				**3.0 for DWS * 350 for Acute AL* 12 for Chronic AL**
3172	17-May-13	Tates Creek	Madison	Less Than MDL
3174	17-May-13	East Prong Branch	Madison	**0.28**
3198	17-May-13	Clear Creek	Mercer	Less Than MDL
3211	17-May-13	Silver Creek	Madison	Less Than MDL
3214	19-May-13	Glenns Creek	Woodford	**0.21**
3216	17-May-13	Unnamed Tributary to West Hickman	Fayette	Less Than MDL
3221	19-May-13	Upper Devil Creek	Wolfe	Less Than MDL
3222	19-May-13	Unnamed Tributary	Wolfe	Less Than MDL
3223	19-May-13	Unnamed Tributary	Wolfe	Less Than MDL
3224	19-May-13	Unnamed Tributary	Wolfe	Less Than MDL
3225	19-May-13	Unnamed Tributary	Wolfe	Less Than MDL
3227	18-May-13	Upper Devil Creek	Wolfe	Less Than MDL
3230	18-May-13	South Elkhorn Creek	Fayette	Less Than MDL
3231	18-May-13	South Elkhorn Creek	Fayette	Less Than MDL
3234	19-May-13	Benson Creek	Franklin	**0.14**

*** DWS = Drinking Water Standard**
AL = Aquatic Life Standard (Acute refers to short-term effects. Chronic refers to long-term effects.)

Table 5

2013 Kentucky River Watershed Watch Synoptic Pathogen Sampling Results (by Site ID#)

Site #	Sampling Date	Stream	County	E. coli (cfu/100 ml)
741	07/12/2013 10:20:00	Lees Branch	Woodford	**292**
744	07/13/2013 12:00:00	Cane Run	Scott	**345**
753	07/12/2013 12:32:00	Clarks Run	Boyle	187
755	07/13/2013 11:35:00	North Elkhorn Creek	Scott	121
759	07/12/2013 09:30:00	Hickman Creek	Jessamine	**305**
760	07/12/2013 00:00:00	Town Branch	Jessamine	**404**
763	7/12/2013	South Elkhorn Ck	Fayette	432
765	07/12/2013 10:35:00	South Elkhorn Creek	Scott	**350**
772	07/12/2013 09:48:00	Unnamed Tributary	Scott	97
793	07/15/2013 14:18:00	McConnell Spring	Fayette	63
801	07/12/2013 11:39:00	North Fork Kentucky River	Letcher	**1,317**
802	07/12/2013 12:21:00	Pine Creek	Letcher	**450**
803	07/12/2013 12:44:00	Cram Creek	Letcher	**820**
811	07/13/2013 10:18:00	Steeles Branch	Fayette	**571**
815	07/13/2013 08:54:00	Cane Creek	Menifee	86
820	07/12/2013 08:59:00	North Fork Kentucky River	Perry	**934**
823	7/13/2013	Glenns Creek	Woodford	560
827	07/12/2013 08:54:00	Quicksand Creek	Breathitt	181
831	07/13/2013 08:00:00	Lower Red River	Estill	216
832	07/13/2013 10:00:00	Red River	Powell	231
833	7/13/2013	Spring	Woodford	200
861	7/13/2013	Glenns Creek	Woodford	460
869	07/12/2013 10:30:00	Maces Creek	Perry	**480**
875	07/12/2013 10:07:00	Right Fork Carr Creek	Perry	**309**
888	07/13/2013 08:35:00	Fourmile Creek	Clark	85
891	07/13/2013 10:54:00	North Elkhorn Creek	Scott	169
914	07/12/2013 11:21:00	Holly Spring	Fayette	144
915	07/12/2013 11:58:00	Wolf Run	Fayette	**1,246**
918	07/13/2013 08:17:00	Muddy Creek	Madison	**275**
919	07/13/2013 07:45:00	Muddy Creek	Madison	**2,613**
921	07/13/2013 09:30:00	Otter Creek	Madison	**512**
938	07/13/2013 08:09:00	Silver Creek	Madison	52
941	07/13/2013 09:30:00	Deep Branch Creek	Clark	98
942	07/13/2013 08:50:00	Lower Howard Creek	Clark	86
943	07/12/2013 08:03:00	Quicksand Creek	Breathitt	**311**
944	07/12/2013 07:32:00	South Quicksand Creek	Breathitt	173
954	7/13/2013	Spring	Woodford	60
955	07/12/2013 09:50:00	Elk Lick Creek	Fayette	134
963	07/12/2013 11:58:00	Knoblick Creek	Lincoln	**1,396**
969	07/13/2013 07:14:00	South Fork Viny Fork	Madison	**650**
970	07/13/2013 07:00:00	North Form Viny Fork	Madison	**241**

2013 Kentucky River Watershed Watch Synoptic Pathogen Sampling Results
(by Site ID#)

Site #	Sampling Date	Stream	County	E. coli (cfu/100 ml)
972	07/13/2013 08:34:00	Unnamed Tributary	Madison	**1,019**
973	07/13/2013 08:29:00	Muddy Creek	Madison	**495**
974	07/13/2013 08:10:00	Unnamed Tributary	Madison	**557**
975	07/13/2013 07:33:00	Unnamed Tributary	Madison	**816**
977	07/13/2013 08:00:00	Muddy Creek	Madison	**295**
978	07/13/2013 08:36:00	Muddy Creek	Madison	**393**
982	07/13/2013 10:17:00	Lanes Run	Scott	119
984	07/13/2013 07:45:00	Twin Creek	Estill	97
990	07/13/2013 09:05:00	Unnamed Tributary	Madison	**1,334**
1018	7/12/2013	Penitentiary Branch	Franklin	342
1020	07/13/2013 08:06:00	West HIckman Creek	Fayette	**425**
1021	07/13/2013 08:41:00	West Hickman Creek	Fayette	**4,611**
1028	07/12/2013 14:27:00	Wolf Run	Fayette	**350**
1048	07/13/2013 08:30:00	Shannon Run	Woodford	199
1055	07/13/2013 07:51:00	Muddy Creek	Madison	233
1109	07/12/2013 12:09:00	Carr Fork Kentucky River	Perry	226
1124	07/13/2013 10:00:00	Marble Creek	Jessamine	41
1128	07/13/2013 10:11:00	Cardinal Run	Fayette	**259**
1129	07/13/2013 09:30:00	Cardinal Run	Fayette	132
1131	07/12/2013 08:48:00	Wolf Run	Fayette	**450**
1132	07/13/2013 11:13:00	Wolf Run	Fayette	**557**
1133	07/12/2013 08:37:00	Wolf Run	Fayette	**637**
1134	07/15/2013 10:49:00	Spring Branch	Fayette	**595**
1135	07/15/2013 10:58:00	Wolf Run	Fayette	**480**
1136	07/12/2013 12:25:00	Culvert	Fayette	**1,236**
1137	07/13/2013 12:25:00	Vaughns Branch	Fayette	**987**
1138	07/12/2013 13:00:00	Vaughns Branch	Fayette	**1,086**
1139	07/12/2013 08:22:00	Vaughns Branch	Fayette	**399**
1151	07/12/2013 12:36:00	Cram Creek	Letcher	**743**
1152	07/12/2013 12:40:00	Cram Creek	Letcher	**712**
1159	07/12/2013 11:08:00	Carr Fork	Perry	**327**
1174	07/13/2013 11:12:00	Royal Springs	Scott	74
1175	07/13/2013 08:00:00	Calloway Creek	Madison	122
1184	07/13/2013 09:08:00	Spring Branch	Fayette	**487**
1191	7/13/2013	Kentucky River	Mercer	220
1195	07/12/2013 10:37:00	Lees Branch	Woodford	199
1198	7/12/2013	Glenns Creek	Woodford	710
1215	07/12/2013 08:00:00	Herrington Lake	Mercer	31
1221	07/13/2013 12:31:00	Cane Run	Scott	**697**
1226	07/12/2013 13:10:00	Rocky Fork	Garrard	10
1227	07/12/2013 13:30:00	Rocky Fork	Garrard	10
1246	07/13/2013 09:30:00	Cardinal Run	Fayette	**677**

2013 Kentucky River Watershed Watch Synoptic Pathogen Sampling Results
(by Site ID#)

Site #	Sampling Date	Stream	County	E. coli (cfu/100 ml)
1274	07/12/2013 11:05:00	Elk Lick Creek	Fayette	145
1275	07/13/2013 10:09:00	Unnamed Tributary	Fayette	**1,334**
1301	7/13/2013	North Elkhorn Creek	Scott	100
1307	07/13/2013 08:45:00	Jessamine Creek	Jessamine	**767**
1314	07/13/2013 10:30:00	Wolf Run	Fayette	**1,145**
2924	07/12/2013 11:43:00	Tates Creek	Madison	**583**
2931	07/12/2013 07:30:00	Boggs Fork	Fayette	**1,607**
2962	7/13/2013	Cold Harbor Creek	Franklin	580
2963	7/13/2013	Cold Harbor Creek	Franklin	1,100
2970	07/15/2013 14:30:00	Prestons Cave Spring	Fayette	132
2993	07/13/2013 08:55:00	West Hickman Creek	Fayette	**464**
2994	07/13/2013 09:40:00	West Hickman Creek	Fayette	**384**
3005	07/15/2013 13:57:00	McConnell Branch	Fayette	86
3006	07/13/2013 08:25:00	Lower Howard Creek	Clark	175
3007	07/13/2013 08:10:00	Lower Howard Creek	Clark	110
3013	07/13/2013 09:00:00	Shannon Run	Woodford	**279**
3019	07/13/2013 09:19:00	Vaughns Branch	Fayette	**1,553**
3053	07/13/2013 00:00:00	Loves Branch	Letcher	153
3059	07/13/2013 09:30:00	Gardenside Branch	Fayette	**432**
3060	07/15/2013 15:30:00	Vaughns Branch	Fayette	**602**
3067	07/13/2013 08:15:00	East HIckman Creek	Fayette	**882**
3068	07/12/2013 09:05:00	Jessamine Creek	Jessamine	**1,250**
3084	07/13/2013 08:30:00	Unnamed Tributary	Letcher	96
3085	07/12/2013 14:37:00	St Clair Spring	Fayette	63
3124	07/15/2013 11:10:00	Moberly Spring	Fayette	74
3127	07/12/2013 08:40:00	Unnamed Tributary	Fayette	**246**
3128	07/12/2013 07:35:00	Unnamed Tributary	Fayette	**393**
3133	07/12/2013 08:30:00	Mocks Branch	Boyle	**1,607**
3139	07/12/2013 11:24:00	Town Branch	Fayette	**4,610**
3140	07/12/2013 12:20:00	Town Branch	Fayette	**269**
3172	07/12/2013 11:07:00	Tates Creek	Madison	**743**
3174	07/13/2013 09:25:00	East Prong Branch	Madison	187
3180	07/12/2013 13:00:00	Spring	Franklin	**269**
3187	07/13/2013 07:45:00	Otter Creek	Madison	**309**
3198	7/13/2013	Clear Creek	Mercer	60
3203	07/12/2013 11:05:00	Evans Branch	Fayette	86
3214	7/13/2013	Glenns Creek	Woodford	400
3216	07/13/2013 08:28:00	Unnamed Tributary	Fayette	**1,296**
3221	7/14/2013	Lower Devil's Creek	Wolfe	50
3222	7/14/2013	Unnamed Trib	Wolfe	102
3223	7/14/2013	Unnamed Trib	Wolfe	50
3224	7/14/2013	Middle Fk of Lower Devils Cr	Wolfe	190
3225	7/14/2013	Middle Fk of Lower Devils Cr	Wolfe	52
3234	7/12/2013	Benson Creek	Franklin	3,152

Table 6

2013 Kentucky River Watershed Watch Synoptic Pathogen Sampling Results (by decreasing E. coli result)

Site #	Sampling Date	Stream	County	E. coli (cfu/100 ml)
1021	07/13/2013 08:41:00	West Hickman Creek	Fayette	**4,611**
3139	07/12/2013 11:24:00	Town Branch	Fayette	**4,610**
3234	7/12/2013	Benson Creek	Franklin	**3,152**
919	07/13/2013 07:45:00	Muddy Creek	Madison	**2,613**
2931	07/12/2013 07:30:00	Boggs Fork	Fayette	**1,607**
3133	07/12/2013 08:30:00	Mocks Branch	Boyle	**1,607**
3019	07/13/2013 09:19:00	Vaughns Branch	Fayette	**1,553**
963	07/12/2013 11:58:00	Knoblick Creek	Lincoln	**1,396**
990	07/13/2013 09:05:00	Unnamed Tributary	Madison	**1,334**
1275	07/13/2013 10:09:00	Unnamed Tributary	Fayette	**1,334**
801	07/12/2013 11:39:00	North Fork Kentucky River	Letcher	**1,317**
3216	07/13/2013 08:28:00	Unnamed Tributary	Fayette	**1,296**
3068	07/12/2013 09:05:00	Jessamine Creek	Jessamine	**1,250**
915	07/12/2013 11:58:00	Wolf Run	Fayette	**1,246**
1136	07/12/2013 12:25:00	Culvert	Fayette	**1,236**
1314	07/13/2013 10:30:00	Wolf Run	Fayette	**1,145**
2963	7/13/2013	Cold Harbor Creek	Franklin	**1,100**
1138	07/12/2013 13:00:00	Vaughns Branch	Fayette	**1,086**
972	07/13/2013 08:34:00	Unnamed Tributary	Madison	**1,019**
1137	07/13/2013 12:25:00	Vaughns Branch	Fayette	**987**
820	07/12/2013 08:59:00	North Fork Kentucky River	Perry	**934**
3067	07/13/2013 08:15:00	East HIckman Creek	Fayette	**882**
803	07/12/2013 12:44:00	Cram Creek	Letcher	**820**
975	07/13/2013 07:33:00	Unnamed Tributary	Madison	**816**
1307	07/13/2013 08:45:00	Jessamine Creek	Jessamine	**767**
1151	07/12/2013 12:36:00	Cram Creek	Letcher	**743**
3172	07/12/2013 11:07:00	Tates Creek	Madison	**743**
1152	07/12/2013 12:40:00	Cram Creek	Letcher	**712**
1198	7/12/2013	Glenns Creek	Woodford	**710**
1221	07/13/2013 12:31:00	Cane Run	Scott	**697**
1246	07/13/2013 09:30:00	Cardinal Run	Fayette	**677**
969	07/13/2013 07:14:00	South Fork Viny Fork	Madison	**650**
1133	07/12/2013 08:37:00	Wolf Run	Fayette	**637**
3060	07/15/2013 15:30:00	Vaughns Branch	Fayette	**602**
1134	07/15/2013 10:49:00	Spring Branch	Fayette	**595**
2924	07/12/2013 11:43:00	Tates Creek	Madison	**583**
2962	7/13/2013	Cold Harbor Creek	Franklin	**580**
811	07/13/2013 10:18:00	Steeles Branch	Fayette	**571**
823	7/13/2013	Glenns Creek	Woodford	**560**
974	07/13/2013 08:10:00	Unnamed Tributary	Madison	**557**
1132	07/13/2013 11:13:00	Wolf Run	Fayette	**557**
921	07/13/2013 09:30:00	Otter Creek	Madison	**512**
973	07/13/2013 08:29:00	Muddy Creek	Madison	**495**
1184	07/13/2013 09:08:00	Spring Branch	Fayette	**487**
869	07/12/2013 10:30:00	Maces Creek	Perry	**480**
1135	07/15/2013 10:58:00	Wolf Run	Fayette	**480**

2013 Kentucky River Watershed Watch Synoptic Pathogen Sampling Results (by decreasing E. coli result)

Site #	Sampling Date	Stream	County	E. coli (cfu/100 ml)
2993	07/13/2013 08:55:00	West Hickman Creek	Fayette	**464**
861	7/13/2013	Glenns Creek	Woodford	**460**
802	07/12/2013 12:21:00	Pine Creek	Letcher	**450**
1131	07/12/2013 08:48:00	Wolf Run	Fayette	**450**
763	7/12/2013	South Elkhorn Ck	Fayette	**432**
3059	07/13/2013 09:30:00	Gardenside Branch	Fayette	**432**
1020	07/13/2013 08:06:00	West HIckman Creek	Fayette	**425**
760	07/12/2013 00:00:00	Town Branch	Jessamine	**404**
3214	7/13/2013	Glenns Creek	Woodford	**400**
1139	07/12/2013 08:22:00	Vaughns Branch	Fayette	**399**
978	07/13/2013 08:36:00	Muddy Creek	Madison	**393**
3128	07/12/2013 07:35:00	Unnamed Tributary	Fayette	**393**
2994	07/13/2013 09:40:00	West Hickman Creek	Fayette	**384**
765	07/12/2013 10:35:00	South Elkhorn Creek	Scott	**350**
1028	07/12/2013 14:27:00	Wolf Run	Fayette	**350**
744	07/13/2013 12:00:00	Cane Run	Scott	**345**
1018	7/12/2013	Penitentiary Branch	Franklin	**342**
1159	07/12/2013 11:08:00	Carr Fork	Perry	**327**
943	07/12/2013 08:03:00	Quicksand Creek	Breathitt	**311**
875	07/12/2013 10:07:00	Right Fork Carr Creek	Perry	**309**
3187	07/13/2013 07:45:00	Otter Creek	Madison	**309**
759	07/12/2013 09:30:00	Hickman Creek	Jessamine	**305**
977	07/13/2013 08:00:00	Muddy Creek	Madison	**295**
741	07/12/2013 10:20:00	Lees Branch	Woodford	**292**
3013	07/13/2013 09:00:00	Shannon Run	Woodford	**279**
918	07/13/2013 08:17:00	Muddy Creek	Madison	**275**
3140	07/12/2013 12:20:00	Town Branch	Fayette	**269**
3180	07/12/2013 13:00:00	Spring	Franklin	**269**
1128	07/13/2013 10:11:00	Cardinal Run	Fayette	**259**
3127	07/12/2013 08:40:00	Unnamed Tributary	Fayette	**246**
970	07/13/2013 07:00:00	North Form Viny Fork	Madison	**241**
1055	07/13/2013 07:51:00	Muddy Creek	Madison	233
832	07/13/2013 10:00:00	Red River	Powell	231
1109	07/12/2013 12:09:00	Carr Fork Kentucky River	Perry	226
1191	7/13/2013	Kentucky River	Mercer	220
831	07/13/2013 08:00:00	Lower Red River	Estill	216
833	7/13/2013	Spring	Woodford	200
1048	07/13/2013 08:30:00	Shannon Run	Woodford	199
1195	07/12/2013 10:37:00	Lees Branch	Woodford	199
3224	7/14/2013	Middle Fork of Lower Devils Creek	Wolfe	190
753	07/12/2013 12:32:00	Clarks Run	Boyle	187
3174	07/13/2013 09:25:00	East Prong Branch	Madison	187
827	07/12/2013 08:54:00	Quicksand Creek	Breathitt	181
3006	07/13/2013 08:25:00	Lower Howard Creek	Clark	175
944	07/12/2013 07:32:00	South Quicksand Creek	Breathitt	173

2013 Kentucky River Watershed Watch Synoptic Pathogen Sampling Results
(by decreasing E. coli result)

Site #	Sampling Date	Stream	County	E. coli (cfu/100 ml)
891	07/13/2013 10:54:00	North Elkhorn Creek	Scott	169
3053	07/13/2013 00:00:00	Loves Branch	Letcher	153
1274	07/12/2013 11:05:00	Elk Lick Creek	Fayette	145
914	07/12/2013 11:21:00	Holly Spring	Fayette	144
955	07/12/2013 09:50:00	Elk Lick Creek	Fayette	134
1129	07/13/2013 09:30:00	Cardinal Run	Fayette	132
2970	07/15/2013 14:30:00	Prestons Cave Spring	Fayette	132
1175	07/13/2013 08:00:00	Calloway Creek	Madison	122
755	07/13/2013 11:35:00	North Elkhorn Creek	Scott	121
982	07/13/2013 10:17:00	Lanes Run	Scott	119
3007	07/13/2013 08:10:00	Lower Howard Creek	Clark	110
3222	7/14/2013	Unnamed Trib	Wolfe	102
1301	7/13/2013	North Elkhorn Creek	Scott	100
941	07/13/2013 09:30:00	Deep Branch Creek	Clark	98
772	07/12/2013 09:48:00	Unnamed Tributary	Scott	97
984	07/13/2013 07:45:00	Twin Creek	Estill	97
3084	07/13/2013 08:30:00	Unnamed Tributary	Letcher	96
815	07/13/2013 08:54:00	Cane Creek	Menifee	86
942	07/13/2013 08:50:00	Lower Howard Creek	Clark	86
3005	07/15/2013 13:57:00	McConnell Branch	Fayette	86
3203	07/12/2013 11:05:00	Evans Branch	Fayette	86
888	07/13/2013 08:35:00	Fourmile Creek	Clark	85
1174	07/13/2013 11:12:00	Royal Springs	Scott	74
3124	07/15/2013 11:10:00	Moberly Spring	Fayette	74
793	07/15/2013 14:18:00	McConnell Spring	Fayette	63
3085	07/12/2013 14:37:00	St Clair Spring	Fayette	63
954	7/13/2013	Spring	Woodford	60
3198	7/13/2013	Clear Creek	Mercer	60
938	07/13/2013 08:09:00	Silver Creek	Madison	52
3225	7/14/2013	Middle Fork of Lower Devils Creek	Wolfe	52
3221	7/14/2013	Lower Devil's Creek	Wolfe	50
3223	7/14/2013	Unnamed Trib	Wolfe	50
1124	07/13/2013 10:00:00	Marble Creek	Jessamine	41
1215	07/12/2013 08:00:00	Herrington Lake	Mercer	31
1226	07/12/2013 13:10:00	Rocky Fork	Garrard	10
1227	07/12/2013 13:30:00	Rocky Fork	Garrard	10

Primary Contact Recreation Std. = 240 cfu/100 ml

77 sites > 240 cfu/100 ml
127 total sites
61% of sites > 240 cfu/100 ml

Table 7

2013 Kentucky River Watershed Watch Follow-Up Pathogen Sampling Results (by Site ID#)

Site ID#	Sample Date	Stream	County	E. coli Result (cfu/100 ml)
744	8/9/2013	Cane Run	Scott	**4,611**
763	8/9/13 11:55	South Elkorn Creek	Fayette	**3,720**
767	8/9/13 15:05	Clear Creek	Woodford	**1,720**
801	08/09/2013 10:00:00	North Fork Kentucky River	Letcher	**959**
802	08/09/2013 09:45:00	Pine Creek	Letcher	**932**
803	08/09/2013 09:29:00	Cram Creek	Letcher	**1,081**
811	08/09/2013 14:47:00	Steeles Branch	Fayette	**1,071**
820	08/09/2013 12:13:00	North Fork Kentucky River	Perry	**272**
848	08/09/2013 08:45:00	North Fork Kentucky River	Letcher	**3,076**
850	08/09/2013 08:20:00	Crafts Colley Cr.	Letcher	**2,909**
869	08/09/2013 09:55:00	Maces Creek	Perry	**336**
875	08/09/2013 10:25:00	Right Fork Carr Creek	Perry	**801**
915	8/9/2013	Wolf Run	Fayette	**3,784**
918	08/10/2013 08:54:00	Muddy Creek	Madison	**8,664**
919	08/10/2013 08:29:00	Muddy Creek	Madison	**11,199**
921	08/10/2013 08:51:00	Otter Creek	Madison	**1,050**
943	08/10/2013 08:33:00	Quicksand Creek	Breathitt	**1,918**
963	08/10/2013 09:44:00	Knoblick Creek	Lincoln	**2,613**
969	08/10/2013 07:53:00	South Fork Vinyl Fork	Madison	**959**
970	08/10/2013 07:45:00	North Fork Vinyl Fork	Madison	**860**
972	08/10/2013 07:30:00	Unnamed Tributary	Madison	**3,130**
973	08/10/2013 07:37:00	Muddy Creek	Madison	**6,867**
974	08/10/2013 07:00:00	Unnamed Tributary	Madison	**1,354**
975	08/10/2013 07:17:00	Unnamed Tributary	Madison	**932**
977	08/10/2013 08:41:00	Muddy Creek	Madison	**2,046**
978	08/10/2013 09:17:00	Muddy Creek	Madison	**1,785**
990	08/10/2013 09:46:00	Unnamed Tributary	Madison	**4,611**
1018	8/8/13 11:28	Penitentiary Branch	Franklin	104
1020	08/10/2013 08:50:00	West HIckman Creek	Fayette	**2,481**
1021	08/10/2013 09:23:00	West HIckman Creek	Fayette	**1,553**
1028	8/9/2013	Wolf Run	Fayette	**5,172**
1128	08/10/2013 09:35:00	Cardinal Run	Fayette	**1,376**
1131	08/10/2013 10:00:00	Wolf Run	Fayette	**1,607**
1133	8/9/2013	Wolf Run	Fayette	**2,851**
1134	8/9/2013	Spring Branch	Fayette	**2,495**
1135	8/9/2013	Wolf Run	Fayette	**3,255**
1136	8/9/2013	Culvert	Fayette	**1,119**
1137	08/10/2013 10:13:00	Vaughns Branch	Fayette	**1,539**
1138	8/9/2013	Vaughns Branch	Fayette	**9,804**
1139	8/9/2013	Vaughns Branch	Fayette	**2,247**
1151	08/09/2013 09:01:00	Cram Creek	Letcher	**2,851**
1152	08/09/2013 09:16:00	Cram Creek	Letcher	**1,019**

2013 Kentucky River Watershed Watch Follow-Up Pathogen Sampling Results (by Site ID#)

Site ID#	Sample Date	Stream	County	E. coli Result (cfu/100 ml)
1159	08/09/2013 11:25:00	Carr Fork	Perry	226
1184	08/09/2013 14:16:00	Spring Branch	Fayette	**631**
1198	8/9/13 9:30	Glenns Creek	Woodford	**4,764**
1221	8/9/2013	Cane Run	Scott	**>24,196**
1246	08/10/2013 10:45:00	Cardinal Run	Fayette	**341**
1275	08/10/2013 10:02:00	Unnamed Tributary	Fayette	**3,076**
1307	08/10/2013 09:00:00	Jessamine Creek	Jessamine	**1,935**
1314	08/10/2013 08:55:00	Wolf Run	Fayette	**2,014**
2924	08/10/2013 08:46:00	Tates Creek	Madison	**908**
2962	8/10/13 10:48	Cold Harbor Creek	Franklin	**1,860**
2963	8/10/13 11:05	Cold Harbor Creek	Franklin	**2,380**
2993	08/10/2013 08:15:00	West HIckman Creek	Fayette	**1,455**
2994	08/10/2013 09:00:00	West HIckman Creek	Fayette	**1,354**
3013	8/7/2013	Shannon Run	Woodford	**3,654**
3019	08/09/2013 14:25:00	Vaughns Branch	Fayette	**1,291**
3059	08/10/2013 11:10:00	Gardenside Branch	Fayette	**1,086**
3060	08/10/2013 10:45:00	Vaughns Branch	Fayette	**3,255**
3127	8/9/2013	Unnamed Tributary	Fayette	**1,317**
3128	8/9/2013	Unnamed Tributary	Fayette	**3,255**
3133	8/9/2013	Mocks Branch	Boyle	**9,208**
3172	08/10/2013 08:12:00	Tates Creek	Madison	**1,137**
3180	08/09/2013 14:03:00	Spring	Franklin	86
3187	08/10/2013 07:55:00	Otter Creek	Madison	**3,255**
3216	08/10/2013 08:29:00	Unnamed Tributary	Fayette	**8,664**
3234	8/9/13 7:34	Benson Creek	Franklin	**17,328**

Table 8

2013 Kentucky River Watershed Watch Chemical Sampling Results

Site ID#	Collection Date	Stream	Alkalinity (mg/L as CaCO3)	Chloride (mg/L)	Conductivity (uS/cm)	Total Suspended Solids (mg/L)
Water Quality Standard			**>20 for AL***	**250 for DWS* 1,200 for acute AL 600 for chronic AL**	**500 uU/cm****	**N/A*****
Method Detection Limit*			**4 mg/L** Method EPA 310.1	**1.0 mg/L** Method EPA 300	**1 uU/cm** Method EPA 120.1	**3 mg/L** Method EPA 160.2
741	22-Sep-13	Lees Branch	230	9.6	448	4
753	19-Sep-13	Clarks Run	173	64.7	**624**	MDL
763	20-Sep-13	South Elkhorn Creek	224	31.1	**533**	MDL
765	21-Sep-13	South Elkhorn Creek	147	50	**562**	16
772	21-Sep-13	Unnamed Tributary	147	14.7	317	18
793	21-Sep-13	McConnell Spring	92	25.9	295	**60**
796	23-Sep-13	Spring Station	229	14.7	470	8
810	20-Sep-13	South Elkhorn Creek	244	35.9	**567**	MDL
811	20-Sep-13	Steeles Branch	192	16.2	420	4
815	21-Sep-13	Cane Creek	59	1.3	111	**147**
820	20-Sep-13	N Fk Kentucky River	156	21.6	**744**	13
823	23-Sep-13	Glenns Cr	193	52.8	**547**	6
827	20-Sep-13	Quicksand Cr	151	6.1	**702**	MDL
831	20-Sep-13	Lower Red River	93	10.8	203	6
832	20-Sep-13	Red River	83	10.5	193	4
833	22-Sep-13	Spring	267	4.6	**504**	MDL
834	21-Sep-13	N Fk Kentucky River	188	15.5	**781**	MDL
848	20-Sep-13	N Fk Kentucky River	185	14	**765**	MDL
850	20-Sep-13	Colley Creek	87	12.1	**685**	MDL
861	23-Sep-13	Glenns Cr	192	46.8	**517**	MDL
869	20-Sep-13	Maces Creek	102	11.7	**512**	MDL
875	20-Sep-13	Right Fk Carr Creek	134	8	**693**	3
914	20-Sep-13	Holly Spring	193	30	470	MDL
915	20-Sep-13	Wolf Run	218	49.8	**572**	MDL
918	21-Sep-13	Muddy Cr	187	9.2	311	9
919	21-Sep-13	Muddy Cr	286	10.3	492	10
921	21-Sep-13	Otter Creek	210	28.5	**514**	**21**
938	21-Sep-13	Silver Creek	159	23.9	390	6
943	20-Sep-13	Quicksand Cr	124	6.5	**943**	3
944	20-Sep-13	S Fk Quicksand Cr	267	4.8	**798**	MDL
954	22-Sep-13	Spring	267	10.3	**560**	10
955	20-Sep-13	Elk Lick Creek	227	35.6	**595**	MDL
963	19-Sep-13	Knoblick Creek	161	14.5	359	MDL
977	21-Sep-13	Muddy Creek	232	9.3	435	16
978	21-Sep-13	Muddy Creek	182	10.5	389	5
982	20-Sep-13	Lanes Run	191	54.5	**645**	MDL
984	20-Sep-13	Twin Creek	132	7.2	355	MDL
990	21-Sep-13	Unnamed Tributary	137	26.2	402	**85**

2013 Kentucky River Watershed Watch Chemical Sampling Results

Site ID#	Collection Date	Stream	Alkalinity (mg/L as CaCO3)	Chloride (mg/L)	Conductivity (uS/cm)	Total Suspended Solids (mg/L)
1018	23-Sep-13	Penitentiary Branch	219	33.4	**544**	MDL
1028	20-Sep-13	Wolf Run	229	56.1	**702**	MDL
1048	20-Sep-13	Shannon Run	201	15	**512**	4
1106	21-Sep-13	Little Cowan Creek	189	59.4	**669**	MDL
1109	20-Sep-13	Carr Fork	135	7.9	**804**	MDL
1128	21-Sep-13	Cardinal Run	121	24.4	359	5
1129	21-Sep-13	Cardinal Run	190	31.6	**576**	3
1131	23-Sep-13	Wolf Run	97	**255**	**999**	**52**
1132	21-Sep-13	Wolf Run	71	12.6	217	5
1133	20-Sep-13	Wolf Run	165	47.9	**543**	8
1134	21-Sep-13	Spring Branch	90	14	283	7
1135	21-Sep-13	Wolf Run	51	9.7	162	MDL
1136	20-Sep-13	Culvert	225	82.3	**809**	3
1137	21-Sep-13	Vaughns Branch	55	8.6	168	4
1138	20-Sep-13	Vaughns Branch	208	29.5	**554**	MDL
1139	23-Sep-13	Vaughns Branch	133	79.7	**586**	8
1159	20-Sep-13	Carr Fork	152	13.6	**798**	12
1175	21-Sep-13	Calloway Creek	223	29.5	**604**	13
1195	22-Sep-13	Lees Branch	205	6.7	407	4
1198	20-Sep-13	Glenns Creek	177	64.5	**657**	MDL
1215	20-Sep-13	Herrington Lake	94	9.3	359	MDL
1246	20-Sep-13	Cardinal Run	183	43.3	**759**	MDL
1274	20-Sep-13	Elk Lick Creek	239	55.4	**828**	MDL
1275	20-Sep-13	Unnamed Tributary	256	93.4	**858**	MDL
1301	20-Sep-13	North Elkhorn Cr	198	35.9	**560**	MDL
1307	21-Sep-13	Jessamine Creek	204	16.7	**513**	19
1314	21-Sep-13	Wolf Run	44	5.8	124	6
2924	20-Sep-13	Tates Creek	190	36.3	**559**	11
2931	20-Sep-13	Boggs Fork	251	14.6	**560**	**60**
2970	21-Sep-13	Prestons Cave Spring	199	56.2	**673**	**38**
3005	21-Sep-13	McConnell Spring	96	9.5	361	**26**
3013	20-Sep-13	Shannon Run	199	16	**514**	3
3019	20-Sep-13	Vaughns Branch	170	116	**1049**	MDL
3050	21-Sep-13	Buck Run	166	3.5	346	4
3059	21-Sep-13	Gardenside Branch	75	11.5	222	6
3085	20-Sep-13	St. Clair Spring	206	19	**511**	8
3128	20-Sep-13	Unnamed Tributary	255	47.3	**717**	MDL
3134	21-Sep-13	Lower Howard Cr	154	11.9	431	4
3137	21-Sep-13	Wolf Run	75	37.2	**597**	MDL
3144	20-Sep-13	South Elkhorn Creek	153	70.3	**744**	6
3146	20-Sep-13	Cane Run	187	49.7	**583**	MDL
3163	20-Sep-13	Unnamed Tributary	189	20.1	**501**	8
3172	20-Sep-13	Tates Creek	218	42.7	**665**	MDL
3180	20-Sep-13	Spring	255	46.8	**715**	MDL
3198	20-Sep-13	Clear Creek	116	7.7	365	11
3203	20-Sep-13	Evans Branch	220	11.5	487	7
3214	22-Sep-13	Glenns Creek	196	47.5	**550**	**90**
3216	21-Sep-13	Unnamed Tributary	57	8.6	150	**22**
3221	15-Sep-13	Lower Devil Creek	41	28.6	283	MDL
3222	15-Sep-13	Unnamed Tributary	**24**	1.9	65	4
3223	15-Sep-13	Unnamed Tributary	35	4.4	94	5
3224	15-Sep-13	Unnamed Tributary	47	4.9	115	MDL
3225	15-Sep-13	Middle Fk Lower Devil C	82	11.2	211	3
3227	21-Sep-13	Whittleton Branch	52	3.4	113	MDL
3252	20-Sep-13	South Elkhorn Creek	212	9.4	430	5

2013 Kentucky River Watershed Watch Chemical Sampling Results

Site ID#	Collection Date	Stream	Alkalinity (mg/L as CaCO3)	Chloride (mg/L)	Conductivity (uS/cm)	Total Suspended Solids (mg/L)
3214	22-Sep-13	Glenns Creek	196	47.5	**550**	**90**
3216	21-Sep-13	Unnamed Tributary	57	8.6	150	**22**
3221	15-Sep-13	Lower Devil Creek	41	28.6	283	MDL
3222	15-Sep-13	Unnamed Tributary	**24**	1.9	65	4
3223	15-Sep-13	Unnamed Tributary	35	4.4	94	5
3224	15-Sep-13	Unnamed Tributary	47	4.9	115	MDL
3225	15-Sep-13	1iddle Fk Lower Devil C	82	11.2	211	3
3227	21-Sep-13	Whittleton Branch	52	3.4	113	MDL
3252	20-Sep-13	South Elkhorn Creek	212	9.4	430	5

* AL = Aquatic Life Standard; DWS = Drinking Water Supply Standard
** There is no official Kentucky water quality standard for conductivity. 500 micromohs/cm is a benchmark level
**There is no official standard for total suspended solid concentrations. The ten greatest concentrations measured during the 2013 KRWW fall sampling effort are noted in bold text.

NOTE: The least value for Alkalinity and the greatest values for Chloride, Conductivity and Total Suspended Solids are shaded in grey. Values that exceed water quality standards or benchmarks are also noted in bold text.

Table 9

2013 Kentucky River Watershed Watch Nutrient Sampling Results

Site ID#	Collection Date	Stream	Nitrate-N (NO_3-N) (mg/L)	Total Recoverable Phosphorus (mg/L)	Sulfate (mg/L)
Water Quality Standard			**10 mg/L (DWS*) 3 mg/L (AL* - KRWW unofficial)**	**0.3 mg/L (AL* - KRWW unofficial)**	**250 mg/L (DWS*)**
Method Detection Limit			**0.004 mg/L** Method EPA300	**0.02 mg/L** Method ASTM D515	**5 mg/L** Method EPA300
741	22-Sep-13	Lees Branch	2.55	0.3	22.9
753	19-Sep-13	Clarks Run	**12.9**	**0.32**	34.3
763	20-Sep-13	South Elkhorn Creek	1.76	0.29	37.3
765	21-Sep-13	South Elkhorn Creek	**8.54**	**1.13**	69.4
772	21-Sep-13	Unnamed Tributary	0.74	**0.34**	14.3
793	21-Sep-13	McConnell Spring	**3.19**	**0.69**	26.4
796	23-Sep-13	Spring Station	**4.23**	**0.44**	18.6
810	20-Sep-13	South Elkhorn Creek	1.47	0.22	35.7
811	20-Sep-13	Steeles Branch	**3.55**	**0.39**	19.2
815	21-Sep-13	Cane Creek	0.38	0.16	9.3
820	20-Sep-13	N Fork Kentucky River	0.18	0.03	**288**
823	23-Sep-13	Glenns Creek	**4.38**	**0.63**	42.7
827	20-Sep-13	Quicksand Creek	0.04	Less Than MDL	**324**
831	20-Sep-13	Lower Red River	0.27	Less Than MDL	23.2
832	20-Sep-13	Red River	0.27	0.05	21.1
833	22-Sep-13	Spring	**3.21**	**0.39**	16.1
834	21-Sep-13	N Fork Kentucky River	0.47	0.03	**296**
848	20-Sep-13	N Fork Kentucky River	0.65	0.03	**281**
850	20-Sep-13	Colley Creek	0.16	Less Than MDL	**323**
861	23-Sep-13	Glenns Creek	2.91	**0.65**	41.8
869	20-Sep-13	Maces Creek	0.68	Less Than MDL	193
875	20-Sep-13	Right Fork Carr Creek	0.41	Less Than MDL	**307**
914	20-Sep-13	Holly Spring	**3.98**	**0.45**	27.6
915	20-Sep-13	Wolf Run	2.82	0.23	46.1
918	21-Sep-13	Muddy Creek	0.11	0.1	8.9
919	21-Sep-13	Muddy Creek	0.11	0.11	12.8
921	21-Sep-13	Otter Creek	0.47	0.19	51
938	21-Sep-13	Silver Creek	0.38	0.14	29.8
943	20-Sep-13	Quicksand Creek	0.09	Less Than MDL	**333**
944	20-Sep-13	S Fork Quicksand Cr	0.13	Less Than MDL	**260**
954	22-Sep-13	Spring	**6.33**	**0.55**	22.7
955	20-Sep-13	Elk Lick Creek	0.43	0.3	85.6
963	19-Sep-13	Knoblick Creek	0.41	0.06	32.3
977	21-Sep-13	Muddy Creek	0.11	0.06	23.9
978	21-Sep-13	Muddy Creek	0.11	0.05	16
982	20-Sep-13	Lanes Run	0.59	0.15	63.3
984	20-Sep-13	Twin Creek	0.07	Less Than MDL	44
990	21-Sep-13	Unnamed Tributary	1.11	**0.41**	24.7
1018	23-Sep-13	Penitentiary Branch	2.67	0.22	47.3
1028	20-Sep-13	Wolf Run	1.69	0.27	61.6
1048	20-Sep-13	Shannon Run	**5.67**	0.25	21.2

2013 Kentucky River Watershed Watch Nutrient Sampling Results

Site ID#	Collection Date	Stream	Nitrate-N (mg/L)	Total Recoverable Phosphorus (mg/L)	Sulfate (mg/L)
1106	21-Sep-13	Little Cowan Creek	0.41	Less Than MDL	73.8
1109	20-Sep-13	Carr Fork	0.27	Less Than MDL	**298**
1128	21-Sep-13	Cardinal Run	1.4	**0.33**	18.7
1129	21-Sep-13	Cardinal Run	**5.17**	**0.5**	46.1
1131	23-Sep-13	Wolf Run	0.88	0.04	69
1132	21-Sep-13	Wolf Run	0.99	0.25	15.6
1133	20-Sep-13	Wolf Run	2.06	0.25	36.5
1134	21-Sep-13	Spring Branch	1.4	0.18	22.8
1135	21-Sep-13	Wolf Run	0.72	0.15	9.6
1136	20-Sep-13	Culvert	**4.38**	0.16	41.8
1137	21-Sep-13	Vaughns Branch	0.86	0.24	10.5
1138	20-Sep-13	Vaughns Branch	1.45	**0.48**	22.4
1139	23-Sep-13	Vaughns Branch	**3.5**	**0.45**	62.1
1159	20-Sep-13	Carr Fork	0.32	0.02	243
1175	21-Sep-13	Calloway Creek	0.04	0.16	62.5
1195	22-Sep-13	Lees Branch	**4.99**	0.29	15.1
1198	20-Sep-13	Glenns Creek	**4.52**	**1**	56
1215	20-Sep-13	Herrington Lake	0.18	0.02	72.3
1246	20-Sep-13	Cardinal Run	0.65	**0.38**	125
1274	20-Sep-13	Elk Lick Creek	0.7	**0.34**	115
1275	20-Sep-13	Unnamed Tributary	0.63	0.27	54
1301	20-Sep-13	North Elkhorn Cr	1.26	0.3	36.2
1307	21-Sep-13	Jessamine Creek	0.27	**0.34**	36.3
1314	21-Sep-13	Wolf Run	0.97	0.21	7.3
2924	20-Sep-13	Tates Creek	Less Than MDL	0.12	41.1
2931	20-Sep-13	Boggs Fork	0.93	**0.52**	22.4
2970	21-Sep-13	Prestons Cave Spring	**4.59**	**0.44**	59
3005	21-Sep-13	McConnell Spring	0.59	**0.66**	61.1
3013	20-Sep-13	Shannon Run	**6.03**	0.27	26.3
3019	20-Sep-13	Vaughns Branch	**4.38**	**0.62**	176
3050	21-Sep-13	Buck Run	0.84	**0.67**	10.1
3059	21-Sep-13	Gardenside Branch	1.49	0.26	11.3
3085	20-Sep-13	St. Clair Spring	0.05	0.04	31.2
3128	20-Sep-13	Unnamed Tributary	0.81	0.29	49.2
3134	21-Sep-13	Lower Howard Cr	1.26	0.27	50.4
3137	21-Sep-13	Wolf Run	0.7	0.09	13.4
3144	20-Sep-13	South Elkhorn Creek	**12.3**	**1.41**	76.7
3146	20-Sep-13	Cane Run	0.36	**0.34**	37.7
3163	20-Sep-13	Unnamed Tributary	0.38	0.09	34.6
3172	20-Sep-13	Tates Creek	Less Than MDL	0.12	77.3
3180	20-Sep-13	Spring	2.24	0.23	49.7
3198	20-Sep-13	Clear Creek	0.59	0.1	57.2
3203	20-Sep-13	Evans Branch	0.34	**0.31**	41.7
3214	22-Sep-13	Glenns Creek	**4.09**	**1.06**	39.9
3216	21-Sep-13	Unnamed Tributary	0.5	**0.47**	9.8
3221	15-Sep-13	Lower Devil Creek	0.05	Less Than MDL	59.4
3222	15-Sep-13	Unnamed Tributary	0.43	Less Than MDL	8.8
3223	15-Sep-13	Unnamed Tributary	0.09	Less Than MDL	11.2
3224	15-Sep-13	Unnamed Tributary	0.11	Less Than MDL	9.9
3225	15-Sep-13	iddle Fk Lower Devil C	0.25	Less Than MDL	8.3
3227	21-Sep-13	Whittleton Branch	0.29	Less Than MDL	6
3252	20-Sep-13	South Elkhorn Creek	1.11	0.25	16.2

Table 10

2013 KRWW Metals Sampling Results

Site ID#	Sampling Date	Stream	Aluminum (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Calcium (mg/L)
Water Quality Standard*			N/A	0.0056 (DWS)	0.010 (DWS); 0.34 (AL-acute); 0.15 (AL - chronic)	1.0 (DWS)	0.004 (DWS)	N/A	N/A	N/A
MDL** (EPA 200.7)			0.061	0.012	0.014	0.003	0.001	0.008	0.001	0.002 mg/L
811	20-Sep-13	Steeles Branch	< than MDL	No Detections	No Detections	0.02	No Detections	0.02	No Detections	75.3
820	20-Sep-13	N Fk Kentucky River	0.27			0.06		0.03		66.8
827	20-Sep-13	Quicksand Cr	< than MDL			0.05		0.02		67.8
831	20-Sep-13	Lower Red River	0.16			0.03		0.02		29.5
832	20-Sep-13	Red River	0.19			0.04		0.02		28.5
834	21-Sep-13	N Fk Kentucky River	0.23			0.06		0.04		78.2
848	20-Sep-13	N Fk Kentucky River	< than MDL			0.06		0.03		73.1
850	20-Sep-13	Colley Creek	0.08			0.05		0.03		67.6
869	20-Sep-13	Maces Cr	< than MDL			0.05		0.02		56.3
875	20-Sep-13	Right Fk Carr Cr	< than MDL			0.04		0.03		63.7
943	20-Sep-13	Quicksand Cr	< than MDL			0.04		0.02		68.3
944	20-Sep-13	South Fk Quicksand Cr	< than MDL			0.06		0.02		61.4
955	20-Sep-13	Elk Lick Cr	< than MDL			0.02		0.04		97.4
984	20-Sep-13	Twin Creek	< than MDL			0.02		0.04		41.5
1106	21-Sep-13	Little Cowan Cr	< than MDL			0.06		0.02		63.4
1109	20-Sep-13	Carr Fork	0.07			0.04		0.02		62.1
1159	20-Sep-13	Carr Fork	0.28			0.06		0.03		56.4
3019	20-Sep-13	Vaughns Branch	< than MDL			0.04		0.06		92.2
3144	20-Sep-13	South Ekhorn Creek	0.09			0.02		0.1		76.4
3163	20-Sep-13	Unnamed Tributary	0.13			0.03		0.03		69.3
3172	20-Sep-13	Tates Creek	< than MDL			0.02		0.09		75.6
3180	20-Sep-13	Spring	< than MDL			0.02		0.03		99.6
3198	20-Sep-13	Clear Creek	0.18			0.03		0.04		41.2
3203	20-Sep-13	Evans Branch	0.23			0.02		0.02		85.1
3214	22-Sep-13	Glenns Creek	0.42			0.02		0.11		75.6
3216	21-Sep-13	Unnamed Tributary	1.11			0.02		0.02		21
3221	15-Sep-13	Lower Devil Creek	< than MDL			0.04		0.03		22.6
3222	15-Sep-13	Unnamed Tributary	0.22			0.01		0.01		6.8
3223	15-Sep-13	Unnamed Tributary	< than MDL			0.02		0.02		9.5
3224	15-Sep-13	Unnamed Tributary	< than MDL			0.03		0.02		13.7
3225	15-Sep-13	Middle Fk Lower Devil Cr	< than MDL			0.03		0.02		29.8
3227	21-Sep-13	Whittleton Branch	0.24			0.03		0.015		16.9
3252	20-Sep-13	South Ekhorn Creek	0.15			0.02		0.03		76.5

** AL = Aquatic Life Standard, DWS = Drinking Water Supply Standard*

***< than MDL = less than Laboratory's "Method (Minimum) Detection Limit"*

NOTE: The only water quality exceedances of a metal reading were for iron. These results are highlighted in red text and are shaded.

Table 9 - 2013 KRWW Metals Sampling Results

Chromium III (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Gold (mg/L)	Iron (mg/L)	Lead (mg/L)	Lithium (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Nickel (mg/L)
1.803 (AL-acute); 0.086 (AL-chronic)	**N/A**	**1.3 (DWS); 0.014 (AL-acute); 0.00933 (AL-chronic)**	**N/A**	**0.3 (DWS); 4 (AL-acute); 1 (AL-chronic)**	**0.015 (DWS); 0.082 (AL-acute); 0.00318 (AL-chronic)**	**N/A**	**N/A**	**N/A**	**0.61 (DWS); 0.469 (AL-acute); 0.052 (AL-chronic)**
0.024	**0.001**	**0.005**	**0.034**	**0.002**	**0.01**	**0.001**	**0.001**	**0.001**	**0.002**
No Detections	**No Detections**	**No Detections**	**No Detections**	0.13	**No Detections**	< than MDL	5.54	0.025	< than MDL
				0.54		0.01	39.3	0.067	< than MDL
				0.27		0.008	87.7	0.083	< than MDL
				0.83		< than MDL	5.99	0.05	< than MDL
				1.07		0.002	5.56	0.12	< than MDL
				0.62		0.03	45.1	0.07	< than MDL
				0.2		0.03	41.5	0.03	< than MDL
				0.25		0.03	39.2	0.06	0.003
				0.2		< than MDL	29.8	0.05	< than MDL
				0.28		0.01	42.3	0.16	< than MDL
				0.27		0.008	67.9	0.1	< than MDL
				0.23		0.01	75.8	0.04	< than MDL
				0.02		0.01	12.4	0.008	< than MDL
				0.03		0.003	12	0.014	0.008
				0.28		0.005	16.2	0.04	< than MDL
				0.24		0.01	40.5	0.11	< than MDL
				0.55		0.01	30.4	0.066	< than MDL
				0.02		0.004	21.9	0.003	< than MDL
				0.11		0.003	11.9	0.03	0.002
				0.24		< than MDL	8.48	0.07	< than MDL
				0.03		0.005	17.1	0.01	< than MDL
				0.05		< than MDL	9.13	0.016	< than MDL
				0.28		0.002	10.7	0.09	< than MDL
				0.24		1.76	8.71	0.11	< than MDL
				0.52		0.005	6.85	0.067	< than MDL
				1.22		0.002	1.94	0.16	0.003
				0.27		0.003	10.2	0.066	< than MDL
				0.39		0.002	1.67	0.058	< than MDL
				0.38		0.001	2.34	0.062	< than MDL
				1.04		< than MDL	2.46	0.38	< than MDL
				0.11		< than MDL	2.29	0.03	< than MDL
				0.43		0.001	1.86	0.03	< than MDL
				0.26		0.001	5.78	0.044	< than MDL

2013 KRWW Metals Sampling Results

Potassium (mg/L)	Selenium (mg/L)	Silicon (mg/L)	Silver (mg/L)	Sodium (mg/L)	Strontium (mg/L)	Thallium (mg/L)	Tin (mg/L)	Vanadium (mg/L)	Zinc (mg/L)
N/A	**N/A**	**N/A**	**0.00378 (AL-acute)**	**N/A**	**N/A**	**0.00024 (DWS)**	**N/A**	**N/A**	**N/A**
0.191	**0.011**	**0.009**	**0.003**	**0.058**	**0.01**	**0.041**	**0.012**	**0.008**	**0.002**
1.91	**No Detections**	3.04	**No Detections**	8.73	0.11	**No Detections**	**No Detections**	**No Detections**	0.003
5.37		1.85		58	1.06				0.004
5.87		2.27		8.76	0.4				0.003
2.67		2.68		7.11	0.08				0.004
2.47		2.69		6.84	0.08				0.005
5.85		3.34		45.3	1.66				0.005
5.85		3.27		44.8	1.6				0.004
4.44		4.91		26.7	1.07				0.003
3.81		3.65		12	0.22				0.004
4.46		2.9		37.7	0.94				0.003
5.36		2.35		9.16	0.39				0.003
7.91		2.08		6.83	0.38				0.003
2.98		2.31		17.4	0.41				0.002
3.39		5.3		5.22	0.08				0.003
2.69		4.25		42.1	0.34				0.002
4.34		2.7		36.9	0.91				0.004
4.8		1.76		50	0.9				0.005
6.29		3.86		63.6	0.36				0.03
7.65		2.66		145	0.19				0.02
3.53		1.88		11.3	0.15				0.003
3.71		1.04		28.2	0.33				0.003
2		3.33		24.7	0.3				< than MDL
3.34		2.96		8.16	0.16				0.004
1.76		2.84		5	0.16				0.004
4.18		3.77		31.1	0.15				0.01
1.79		2.5		4.88	0.04				0.01
2.39		2.89		11.6	0.21				0.003
1.64		4.69		1.6	0.02				0.005
1.66		3.24		3.56	0.02				0.004
1.76		2.7		3.23	0.03				0.004
2.5		2.61		6.48	0.04				0.003
1.25		3.94		2.61	0.03				0.005
1.84		2.59		5.24	0.12				0.002

APPENDIX C: METAL SAMPLING PARAMETERS

Antimony is a USEPA priority pollutant that can be toxic to plants and animals. In addition to the natural occurrence of antimony in bedrock and streambed sediments in the Knobs Region of the Kentucky River Basin, antimony salts are used in the fireworks, rubber, textile, ceramic, glass, and paint industries.
The proposed maximum contaminant level (MCL) in finished drinking water for antimony ranges from 5 to 10 micrograms per liter.

Arsenic occurs naturally in rocks and soil, water, air and plants and animals. It can be further released into the environment through natural activities, such as volcanic action, erosion of rocks, and forest fires, or through human actions. Approximately 90 percent of industrial arsenic in the U.S. is currently used as a wood preservative, but arsenic is also used in paints, dyes, metals, drugs, soaps and semi-conductors. High arsenic levels can also come from certain fertilizers and animal feeding operations. Industry practices, such as copper smelting, mining and coal burning also contribute to arsenic in our environment. Arsenic levels tend to be higher in ground water than in surface water (lakes and rivers). Levels also tend to be higher in the western United States.

Barium is a yellowish-white alkaline earth metal. It combines with water to produce barium hydroxide and is found in nature as barites ($BaSO_4$), witherite ($BaCO_3$), and other ores. Barium and its salts are often used in metallurgical industries for special alloys, in paints, and concrete. Because of the insolubility of most of its compounds, it is not considered to be an ecological threat.

Beryllium is an uncommon alkaline-earth element that is recognized as a USEPA priority pollutant and potential carcinogen. The USEPA has proposed a MCL of 1.0 micrograms per liter for beryllium, and Kentucky has adopted the USEPA lowest-observed effect levels (LOEL) for protection of aquatic life, which are 130 micrograms/liter (1.3 mg/L) and 5.3 micrograms/liter (0.053 mg/L) for acute and chronic toxicity, respectively. In addition, Kentucky water-quality criteria establish a beryllium criterion of 0.117 micrograms per liter for the protection of human health from the consumption of fish tissue. The criterion is based upon an acceptable risk level of no more than one additional cancer case in a population of 1 million people.

Cadmium s a non-essential element and it diminishes plant growth. It is considered a potential carcinogen. It also has been shown to cause toxic effects to the kidneys, bone defects, high blood pressure, and reproductive effects. Cadmium is widely distributed in the environment at low concentrations. It can be found in fairly high concentrations in sewage sludge. Primary industrial uses for cadmium are plating, battery manufacture, pigments, and plastics.

Chromium is ubiquitous in the environment, occurring naturally in the air, water, rocks and soil. It is used in stainless steel, electroplating of chrome, dyes, leather tanning and wood preservatives. It occurs in several forms, or oxidation states. The two most common are chromium VI and chromium III. The form depends on pH. Natural sources of water contain very low concentrations of chromium. It is a micronutrient (or essential trace element). High doses of chromium VI have been associated with birth defects and cancer; however, chromium III is not associated with these effects. Plants and animals do not bioaccumulate chromium; therefore, the potential impact of high chromium levels in the environment is acute toxicity to plants and animals. In animals and humans this toxicity may be expressed as skin lesions or rashes and kidney and liver damage.

Copper is a USEPA priority pollutant that is a micronutrient for the growth of plants and animals, but even small concentrations of copper in surface water can be toxic to aquatic life. Copper sulfate is frequently used to control nuisance growths of algae in water supply reservoirs. The toxicity of copper is a function of the total hardness of the water, because copper ions are complexed by anions that contribute to water hardness. Although detectable concentrations of copper in water are not known to have an adverse effect on humans, the MCL for copper has been established at 1,000 micrograms/liter, which corresponds with the taste threshold concentration for this element (National Academy of Sciences National Academy of Engineering, 1972). [USGS]

Iron is the fourth most abundant element, by weight, in the earth's crust. Natural waters contain variable amounts of iron depending on the geological area and other chemical components of the waterway. Iron in groundwater is normally present in the ferrous or bivalent form (Fe^{2+}), which is soluble. It is easily oxidized to ferric iron (Fe^{3+}) or insoluble iron upon exposure to air. This precipitate is orange-colored and often turns streams orange. Iron is a trace element required by both plants and animals. It is a vital part of the oxygen transport mechanism in the blood (hemoglobin) of all vertebrate and some invertebrate animals. Ferrous Fe^{2+} and ferric Fe^{3+} irons are the primary forms of concern in the aquatic environment. Other forms may be in either organic or inorganic wastewater streams. The ferrous form can persist in water void of dissolved oxygen and usually originates from groundwater or mines that are pumped or drained. Iron in domestic water supply systems stains laundry and porcelain. It appears to be more of a nuisance than a potential health hazard. Taste thresholds of iron in water are 0.1 mg/L for ferrous iron and 0.2 mg/L for ferric iron, giving a bitter taste or an astringent taste. Water to be used in industrial processes should contain less than 0.2 mg/L iron. Black or brown swamp waters may contain iron concentrations of several mg/L in the presence or absence of dissolved oxygen, but this iron form has little effect on aquatic life.

Lead is primarily found in nature as the mineral galena (lead sulfide). It also occurs as carbonate, as sulfate and in several other forms. The solubility of these minerals and also of lead oxides and other inorganic salts is low. Major modern day uses of lead are for batteries, pigments, and other metal products. In the past, lead was used as an additive in gasoline and became dispersed throughout the environment in the air, soils, and waters as a result of automobile exhaust emissions. For years, this was the primary source of lead in the environment. However, since the replacement of leaded gasoline with unleaded gasoline in the mid-1980's, lead from that source has virtually disappeared. Mining, smelting, and other industrial emissions and combustion sources and solid waste incinerators are now the primary sources of lead. Another source of lead is paint chips and dust from buildings built before 1978 and from bridges and other metal structures.

Nickel is a USEPA priority pollutant that can adversely affect humans and aquatic organisms. Nickel is an important industrial metal that is used extensively in stainless steel. Substantial amounts of nickel can be contributed to the environment by waste disposal (Hem, 1989) and atmospheric emissions. Nickel ions are toxic, particularly to plant life, and can exhibit synergism when present with other metallic ions (National Academy of Sciences National Academy of Engineering, 1972). [USGS]

Selenium is a nonmetallic trace element that is listed as a primary pollutant by the USEPA. Selenium is an essential micronutrient for plants and animals, but can be toxic in excessive amounts. Selenium is a relatively rare element, and concentrations of selenium in natural waters seldom exceed 1.0 microgram/liter (Hem, 1989). Sources of selenium in the Kentucky River Basin include sedimentary rocks and fly ash from coal-fired power plants that operate in Kentucky.

Silver is a USEPA priority pollutant that is extensively used for photography and various industrial and commercial purposes. Although average concentrations of silver in natural waters are small (0.3 micrograms/liter), elevated silver concentrations can be acutely or chronically toxic to aquatic organisms, and sublethal amounts can bioaccumulate in fish and invertebrate organisms (Hem, 1989). [USGS]

Thallium is a USEPA priority pollutant that can be toxic to humans and aquatic life. Thallium salts are used as poison for rats and other rodents, as well as in dyes, pigments in fireworks, and optical glass (National Academy of Sciences National Academy of Engineering, 1972).

Zinc is found naturally in many rock-forming minerals. Because of its use in the vulcanization of rubber, it is generally found at higher levels near highways. It also may be present in industrial discharges. It is used to galvanize steel, and is found in batteries, plastics, wood preservatives, antiseptics, and in rat and mouse poison (zinc phosphide). Zinc is an essential element in the diet. It is not considered very toxic to humans or other organisms.