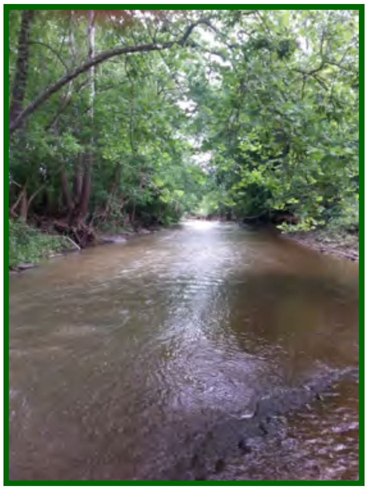
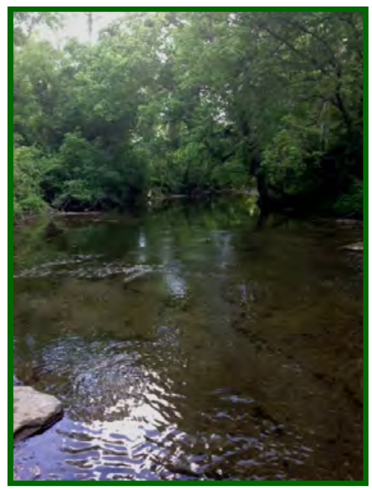
Summary of the Kentucky River Watershed Watch 2015 Water Sampling Results

Kentucky Water Resources Research Institute



A Summary of the

Kentucky River Watershed Watch

2015 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

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CHAPTER 1: INTRODUCTION

Background

This report documents the results of the 2015 Kentucky River Watershed Watch sampling effort, which was supported through funding and other contributions from the Kentucky River Authority, the Kentucky Division of Water, 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 2015 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 2015 and past years are also posted on the KRWW web site at http://www.krww.org.

2015 Sampling Site Overview

During 2015, Kentucky River Watershed Watch volunteers collected water samples from 163 sites at streams, rivers and lakes throughout the Kentucky River Basin, from Letcher County in the southeastern region to Carroll County in the northernmost region.

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 and sub-basins 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, or watersheds, using the USGS Hydrologic Unit Code (HUC) classification system. The sub-basins shown in Figure 1 are classified as HUC-8 watersheds and include the South, Middle and North Forks of the Kentucky River, the Central Kentucky River and Lower Kentucky River Basins. These areas can be further subdivided to outline smaller 11-digit HUC watersheds, which drain into the larger HUC-8 waterways, as shown in Figures 2-4. Most KRWW samplers focus on these smaller watersheds when assessing and applying their water quality findings.

Water quality data were collected during four different events between May and September of 2015. A listing of the types of data collected, sampling dates, and number of samples is provided in the table below.

Table 1: Summary of 2015 Kentucky River Watershed Watch Sampling Events

Sampling Event	Dates	# of Sites Sampled
Spring Herbicide Event	May 15-16, 2015	10 (NEW sites)
Synoptic Pathogen Event	July 9-12, 2015	101
Follow-Up Pathogen Event	August 6-11, 2015	109
Fall Nutrients/Chemistry Event	September 11-18, 2015	103
Metals Event	September 11-23, 2015	27

The location of the 163 sites sampled in 2015 are shown in Figure 5. The 2015 sampling sites were highly concentrated in the central and southeastern regions of the Kentucky River Basin. An detailed index of the 2015 KRWW sampling sites is provided in Table B1 (see Appendix B).

2015 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. To begin to understand streamflow variation during the 2015 sampling season, five separate USGS gaging stations were selected. Stream flow plots for each station, showing the flow rates during each of the different sampling efforts, are shown in Figures 6-10. (Daily stream flow values for these tables can be found on the USGS website at http://ky.water.usgs.gov). Figure 11 shows a comparison of flow levels at each of the 5 stations during the four separate sampling events.

The flow graphs illustrate the varying flow conditions present during the 2015 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.

It is important to realize that generalizations about flow levels relative to pollutant concentrations can be complicated by a variety of factors, and as with most scientific investigations, will require more data to fine tune the meaning of the sampling results. Complicating factors include:

- Higher flows can mobilize pollutants that have accumulated in the stream, raising their concentrations.
- Higher flows can cause sanitary sewer overflows that can increase pollutants (i.e., pathogens, nutrients).
- Long term sampling results help explain connections between elevated pollutant levels and higher water volumes. For example, if the measured concentration is lower during high flows is this due to dilution or have the pollutant sources actually been reduced? If the measured concentration is higher during higher flows, is this due to stormwater runoff carrying more pollutants into the stream, or are instream pollutants (perhaps in the stream sediments) being mobilized by the higher flows?

Regardless, it is important to consider flow levels, as well as flow rates and precipitation records, when evaluating the meaning of water sampling results.

Spring Sampling Event: Moderately high flows were observed at the time of the Spring Sampling Event in May 2015. However, 48-hour rainfall recordings were zero to minimal, so it is unlikely that this sampling event captured runoff sources of pesticides.

Synoptic Pathogen Sampling Event: The flows during the first (synoptic) pathogen sampling in July were the highest of all sampling events, except at the North Fork Kentucky River station (headwaters region). Since rainfall was reported leading up this sampling event, higher E. coli readings could be attributed to runoff (nonpoint source) contributions.

Follow-Up Pathogen Sampling Event: Flows were generally lower during the second (follow-up) pathogen sampling event, with less recently occurring rainfall. Recent precipitation reported by samplers may again show that some of the higher E. coli levels could be due to runoff pollution.

Fall Sampling Event: In general, lower flows were observed across the basin during the fall nutrient/chemical/metals sampling event in September. However, the streamflow readings in the North Fork, Wolf Run and South Elkhorn stations show that storms occurred a few days prior to sampling, which could have flushed a lot of pollutants from the streams, thus possibly resulting in lower readings of some water quality indicators.

CHAPTER 2: DATA COLLECTION AND ANALYSIS

Physical/Chemical Field Data

General physical/chemical field data (dissolved oxygen, pH, water temperature, observed flow level, recent rainfall and conductivity) 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 B2.

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. The normal range for dissolved oxygen in freshwater streams is between 6.5 mg/L and 8.5 mg/L.

Dissolved oxygen is inversely proportional to water temperature, with higher levels of dissolved oxygen corresponding to lower temperatures. According to temperature, there are maximum dissolved oxygen concentrations, with 14.6 mg/L being the absolute maximum. Thus, dissolved oxygen results greater than 14.6 mg/L are not possible. Additionally, samplers can check the likelihood of their findings by cross-checking it with a dissolved oxygen vs temperature table (see http://water.epa.gov/type/rsl/monitoring/vms52.cfm).

Twenty-eight sites produced a dissolved oxygen value less than 5.0 mg/L, the level at which aquatic life becomes critically stressed. The sampling sites with 2015 readings less than 5.0 mg/L are noted in bold font in Table B2.

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. **One of the pH readings, for site #744 on Cane Run in Scott County, was greater than 9, and none of the sites had readings below 6.**

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, which is Kentucky's water quality standard for protection of aquatic life in warm water streams.

Flow/Rainfall

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 2015 KRWW sampling season varied greatly, with generally higher flows observed during the summer pathogen sampling events.

Recent rainfall was also recorded by samplers, as an estimate of precipitation during the 48-hour period prior to the sampling event. Results were recorded as zero, 0.1, 0.5, 1.0, 1.5 or > 1.5 inches.

Spring Sampling Event: Flows were mainly normal (3) to low (2) for the spring herbicide event, with reports of 0 to 0.1 inches of recent rainfall.

Synoptic Pathogen Sampling Event: The first pathogen sampling event in July was conducted during bank full to flood conditions. Rainfall recordings showed between 0.5 and greater than 1.5 inches during the prior 48-hour period.

Follow-Up Pathogen Sampling Event: Flows were reported as mainly normal during the August pathogen event, with some reports of bankfull flows throughout the basin. Recent rainfall was reported at nearly all sampling sites, with higher amounts of > 1.5 inches in the central to southern portion of the basin. Recent rainfall conditions could result in E. coli findings from runoff sources, such as septic systems and livestock pastures.

Fall Sampling Event: Low to normal flows were reported during the September sampling event, which is typical in the fall. Recent rainfall recordings varied greatly for the fall event, with reports from zero to >1.5 inches at several locations. Thus, the influence of runoff contributions must be assessed on a site-by-site basis for the fall nutrient and metal sampling results.

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.

The USEPA recently established a criterion of 500 mS/cm 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.

Field conductivity readings at 86 of 162 separate sampling sites were reported as being greater than 500 microSiemens/cm (mS/cm).

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).

Herbicide Indicators

During the spring sampling event of May 2015, 10 sampling sites were tested for Triazine to evaluate the possibility of potential pollution from rural and/or urban herbicide applications. Triazine (or Atrazine) is a selective 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. 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 maximum contaminant level for Atrazine in drinking water is 3 micrograms/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 10 new sampling sites during May of 2015. **Two of the ten sites had detectable levels of Triazine, but neither of the triazine detections exceeded recommended water quality standards. The detections were observed at stream sites in Fayette and Jessamine Counties,** and the locations are shown in Figure 12. A summary of the results for the herbicide data collection effort is provided in Table B3.

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, and Escherichia coli. 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, it does indicate recent fecal contamination.

Escherichia coli (E. coli)

The bacteria, E. coli, is commonly found in the 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.

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 .

Bacteriological Sampling Results

E. coli sampling was conducted twice in the Kentucky River basin during the summer of 2015. 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 (with the exception of a few sites, for which volunteers had been unable to sample in July). 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 during the month of July. **Eighty-four percent of the 102 synoptic samples taken exceeded the state's safe swimming/wading standard.** These sample locations and results are shown on the map in Figure 13.

Follow-Up Pathogen Sampling

During the August sampling event, **results indicated pathogen-related problems at 78% (86 of 109) of the sites.** The follow-up sampling sites are mapped in Figure 14. E. coli sampling results from both pathogen sampling events are listed in Table B4, along with the associated rainfall and flow estimates.

Chemical Indicators

General chemical data (alkalinity, chlorides, conductivity, total suspended solids, and sulfate) were collected at 103 sampling locations during the month of September. The individual results for samples analyzed at the KGS lab are show in Table B5, and the results from the Fouser Lab are shown in Table B6.

Alkalinity

Alkalinity refers to the capability of water to neutralize acids (i.e. molecules that when placed in water disassociate and release hydrogen ions (H^+) which cause the pH of the water to drop. Alkalinity is made up of several anions in the water (i.e. HCO_3, CO_3, and OH). However, for convenience, alkalinity is typically expressed in terms of an equivalent concentration of $CaCO_3$, however alkalinity is not the concentration of $CaCO_3$ in the water The alkalinity of natural waters is due primarily to weak acids, although strong bases may also contribute. Bicarbonates represent the major form of alkalinity. Under certain conditions, natural waters may contain appreciable amounts of carbonate and hydroxide alkalinity. This condition is particularly true in surface waters where algae are flourishing. During the day, the algae remove carbon dioxide from the water to the extent that pH values of 9 to 10 are often obtained. 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 2015 KRWW sampling season, alkalinity values ranged from 25 mg/L at Site #3222 on an Unnamed Tributary in Wolfe County to 271 mg/L at Site #990 on an Unnamed Tributary in Madison County.** Thus, all results indicated a safe alkalinity level for aquatic life.

Chlorides

Chlorides are salts resulting from the combination of the gas chlorine with a metal. However, the chloride that is measured in the water sample is actually not the salt, but the dissolved (or dissociated) chloride anion (Cl^-). 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 2015 KRWW sampling season, the highest chloride value of 197 mg/L was observed at Vaughn's Branch in Fayette County.** (It is notable that a Vaughn's Branch sampling site also produced the highest chloride levels during the 2010, 2011 and 2014 sampling seasons.) No results exceeded the drinking water or aquatic life criteria.

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 2015 KRWW sampling season, conductivity values ranged from 96 mS/cm at site #3222 on an Unnamed Tributary in Wolfe County to 1,261 mS/cm at site #1139 at Vaughn's Branch in Fayette County. Fifty-one 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 the treatment processes of 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 2015 sampling season, the highest total suspended solids concentration of 65 mg/L was observed at Site #793 at McConnell Spring in Fayette County.**

Sulfate:

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 agricultural lands also contributes sulfates to water bodies.

High levels of sulfate in drinking water (> 250 mg/L) can produce an objectionable, astringent taste and can have laxative effects. Generally, older children and adults become accustomed to sulfate in drinking water, but infants are more sensitive to its effects and water high in sulfate (> 400 mg/L) should not be used for baby formula. Sulfate can be removed from drinking water through processes involving ion exchange, reverse osmosis or distillation, but carbon filtration does not remove it.

When sulfate is less than 0.5 mg/L, algal growth will not occur. The state water quality standard for sulfate in drinking water supplies is 250 mg/L. Typically, KRWW sites that exceed the drinking water supply standard for sulfate are located in the coal mining region of southeastern Kentucky and result from groundwater flowing through bedrock with higher sulfur content.

Only one of the 103 sulfate concentrations exceeded the state drinking water supply standard of 250 mg/L. The greatest sulfate reading of 303 mg/L occurred at site #801 on the North Fork Kentucky River in Letcher County. Sulfate results are displayed in <u>Tables B5 and B6</u>.

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 increases 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 total phosphorus levels in the Kentucky River Basin of 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 recommended for use as an unofficial benchmark 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.

Nutrient transport, 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 2008, 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. A reassessment report was released in 2013, detailing progress made and outlining continuing plans to reduce nutrient impacts to the Gulf hypoxic zone (http://water.epa.gov/type/watersheds/named/msbasin/upload/hypoxia_reassessment_508.pdf).

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 portion 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 for total nitrogen, because this level has been demonstrated to produce nutrient-rich conditions supporting algal blooms, along with other aquatic habitat threats.

Nutrient Sampling Results

In addition to chemical data, general nutrient data were also collected at sampling sites during September. A summary of the nutrient data collected during this period is provided in Tables B7 and B8. **Twenty-six of 99 (26%) of the sampling results exceeded the aquatic life benchmark total nitrogen level of 3 mg/L.** As shown in Table B7, the highest total nitrogen reading reported from the KGS lab of 6.11 mg/L was recorded at #1221 on Cane Run in Scott County. **Ten of the nitrate results reported by the KGS lab were above the 10 mg/L drinking water standard for the state of Kentucky.** Several high total nitrogen *estimates* were determined by the Fouser Lab, including the highest recorded level of 15 mg/L at Site #1014 on Elkhorn Creek in Fayette County. Figure 15 displays a map of sites below and above the 3 mg/L threshold.

As shown in Figure 16, **42 of 99 stations (or 42%) had total phosphorus readings in excess of 0.3 mg/l.** The highest recorded phosphorus reading by the KGS lab was 1.34 mg/l, at station #793 at McConnell Spring in Fayette County, and the highest value reported by the Fouser lab was 1.75 mg/L at site #3410 on South Elkhorn Creek in Franklin County.

Metal Indicators

In addition to chemical and nutrient data, metals data were collected at 27 sampling sites in September 2015. Out of the 30 different metals tested during the 2015 KRWW sampling season, 14 metals are associated with specific water quality limits (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, nickel, silver, thalium, zinc). Drinking water supply standards are available for thirteen metals (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, nickel, selenium, thallium and zinc). Warm water aquatic life standards are available for eleven metals (aluminum, arsenic, cadmium, chromium, copper, iron, lead, nickel, selenium, silver and zinc). Descriptions of each of the metals sampling parameters are provided in **Appendix C.**

The sampling results for metals are provided in Table B9 and Figure 17. **There were no detections of 10 of the 30 metal parameters; Antimony, Arsenic, Beryllium, Cadmium, Chromium, Gold, Selenium, Silver, Thallium and Tin. Detections of four different metal parameters showed exceedances of related water quality standards.** The following table summarizes these findings.

Metal	# of Drinking Water Standard Exceedances	# of Acute (short-term) Aquatic Life Exceedances	# of Chronic (long-term) Aquatic Life Exceedances	Site with Highest Reading	Location
Aluminum	0	1	N/A	#820	North Fork Kentucky River, Perry Co.
Copper	0	1	1	#3349	Waterside Lake, Fayette Co.
Iron	6	1	1	#820	North Fork Kentucky River, Perry Co.
Lead	0	0	1	#820	North Fork Kentucky River, Perry Co.

Biological and Habitat Assessments

KRWW volunteers are also given the opportunity to continue their water quality training and gain a better understanding of their chosen waterway by completing a Phase II Certification in biological and habitat assessment. This training workshop teaches samplers scientific procedures to understand how aquatic macroinvertebrates signify background water quality conditions. Some macroinvertebrates are "high tolerance," and can withstand significant levels of contaminants; whereas other macroinvertebrates are "low tolerance" and cannot survive significant pollutant contamination. Because these organisms must withstand ongoing water quality conditions, their presence is indicative of longer term water quality than a single grab sample event. Whereas a grab sample might miss pollution occurrences, an assessment of the variety and abundance of the biological community in the stream can better capture the overall quality of a stream over time.

A habitat assessment is another way to measure the health of a stream. Its purpose is to look at individual features that provide habitat in a particular length of a stream and determine how well they are functioning. Measurements of these functions are then combined into an overall rating of how livable the stream is for aquatic organisms.

Performing the biological and habitat assessments annually allows volunteers to identify changes that may affect stream health. The most comprehensive information about a stream is gained when samplers are able to combine results from chemical, biological and habitat assessments.

In June of 2015, KRWW volunteers who had received advanced (Phase II) training to conduct biological and habitat assessments of their streams assessed 5 separate stream segments. These assessments provide further insights into the quality of the water and current and potential threats to water quality. A summary of these assessments is included in the following table.

2015 KRWW Habitat and Biological Assessments

Site ID	Stream	County	Habitat Rating	Biological Rating
763	South Elkhorn	Fayette	good	fair
1301	North Elkhorn	Scott	good	fair
3198	Clear Creek	Woodford		fair
3227	Whittleton Branch	Powell	fair	good
3252	South Elkhorn	Jessamine	fair	fair

CHAPTER 3: EXECUTIVE SUMMARY

During the summer of 2015, 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, 163 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, dissolved oxygen and conductivity. None of the reported pH readings for 2015 were less than 6, and only one reading was greater than 9. Thirteen percent (39 of 294) of the dissolved oxygen readings were below the minimum threshold of 5 mg/l that is recommended for supporting aquatic life.

Ten new sites were sampled for the Triazine herbicide. Triazine was detected at two of the sampling sites. Neither of the samples resulted in concentrations that were greater than the water quality standards for drinking water supplies or aquatic life protection.

In 2015, E. coli was analyzed for 102 sites in July. During this synoptic sampling event, 84% of sites analyzed for E. coli exceeded the primary contact recreation standard of 240 cfu/100 ml. The follow-up pathogen sampling event in August showed that 78% of the sites exceeded the standard for E. coli.   It may be helpful to consider accompanying rainfall and flow data during each of these sampling events, as heavy precipitation events occurred during the summer of 2015, especially leading up to the July event.

The chemical analysis of samples in September showed that 51% had high laboratory-measured conductivity values (e.g. > 500mS/cm). This result is comparable to the 46% of sites that produced high conductivity readings through the use of field meters.

Twenty-six of 99 sampled sites (26%) exceeded a proposed aquatic life standard for total nitrogen of 3 mg/L, and 10 of the sites exceeded the drinking water supply standard for nitrate-nitrogen of 10 mg/L. Forty-two of 99 sites (42%) displayed total phosphorus levels of concern (above 0.3 mg/L) for support of aquatic life.

Metals were analyzed for water samples from 27 sampling sites in September 2015. Some metal readings exceeded associated water quality standards, including those for aluminum, copper, iron, and lead. Site #820 on the North Fork Kentucky River in Perry County showed exceedances for three different metals.

KRWW volunteers also conducted biological and habitat assessments at five different sites in the Kentucky River Basin during June of 2015. Most habitat ratings were fair to good, and most biological ratings were fair.

Flows were generally higher during the 2015 sampling season, with some peaks in streamflow just prior to the pathogen sampling events in July and August.   These conditions may enable a comparison of E. coli levels during prior drier years, such as 2014, to consider the likelihood of nonpoint runoff pathogen sources (evident in the wetter years) versus the likelihood of point sources, such as sewer line leakage (evident in the drier years).

In summary, the following sampling sites have been targeted for more in-depth sampling and water quality management efforts due to 2015 sampling results of concern. These sites are indicated on the map in Figure 18.

2015 KRWW Sites of Concern

- **Cane Run Watershed (Scott County)**

  Sites #1174, 1221—Results from these sites indicate concern regarding high pathogen and nutrient levels (nitrogen and phosphorus).

- **Carr Fork (Perry County)**

  Site #875– Results indicate concern about conductivity, pathogens and metals.

- **North Fork Kentucky River (Perry County)**

  Site #820– Results from this site indicate concern regarding pathogens and metals.

- **South Elkhorn Creek Watershed (Fayette County)**

  Wolf Run

  Sites 793, 915, 1129, 1132, 1137, 1138, 1139—Results from these sites indicate concern about low dis solved oxygen levels, high conductivity readings, and high pathogen and nutrient concentrations.

APPENDIX A: FIGURES

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

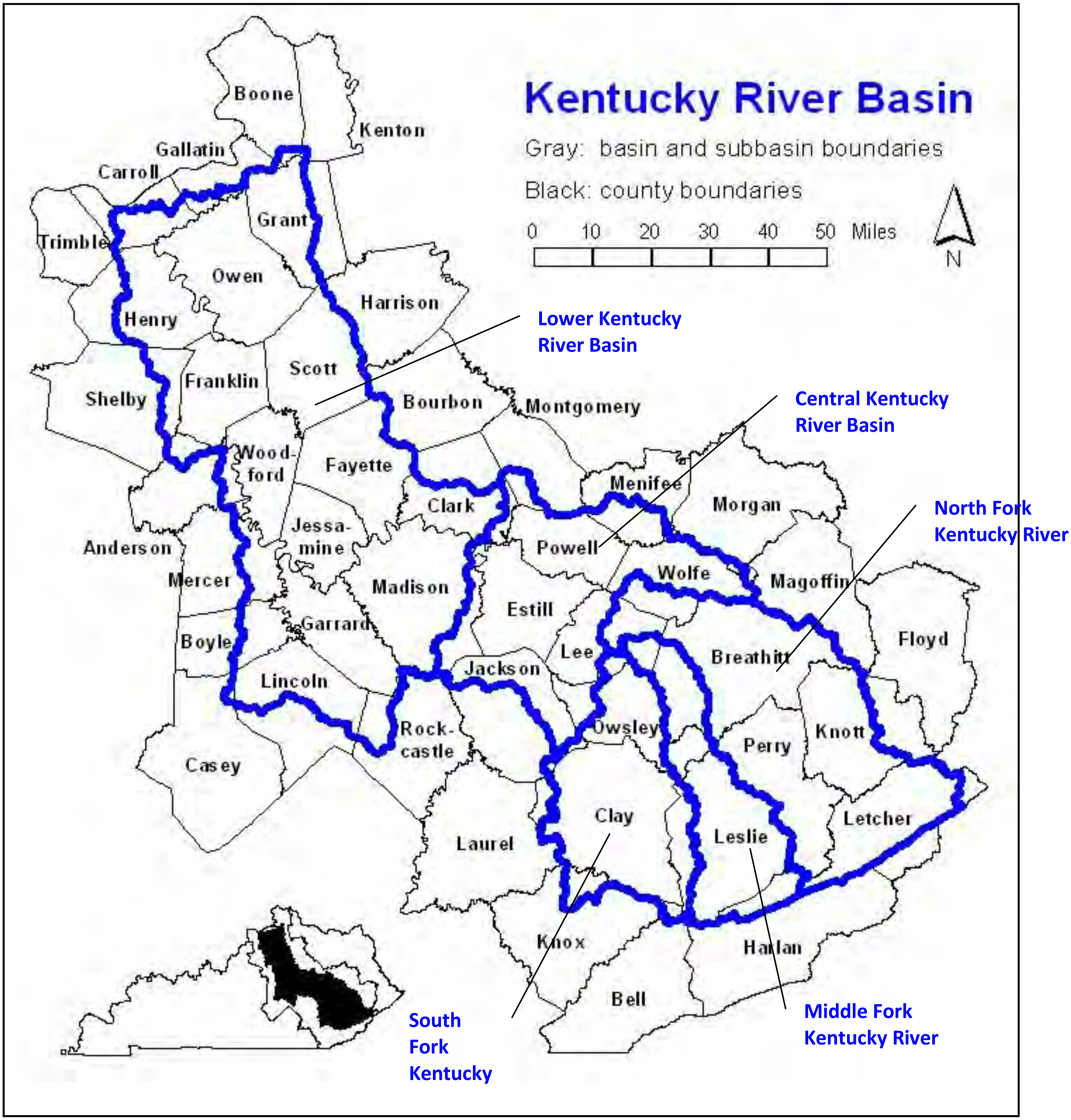


Figure 2—Kentucky River Northern Region

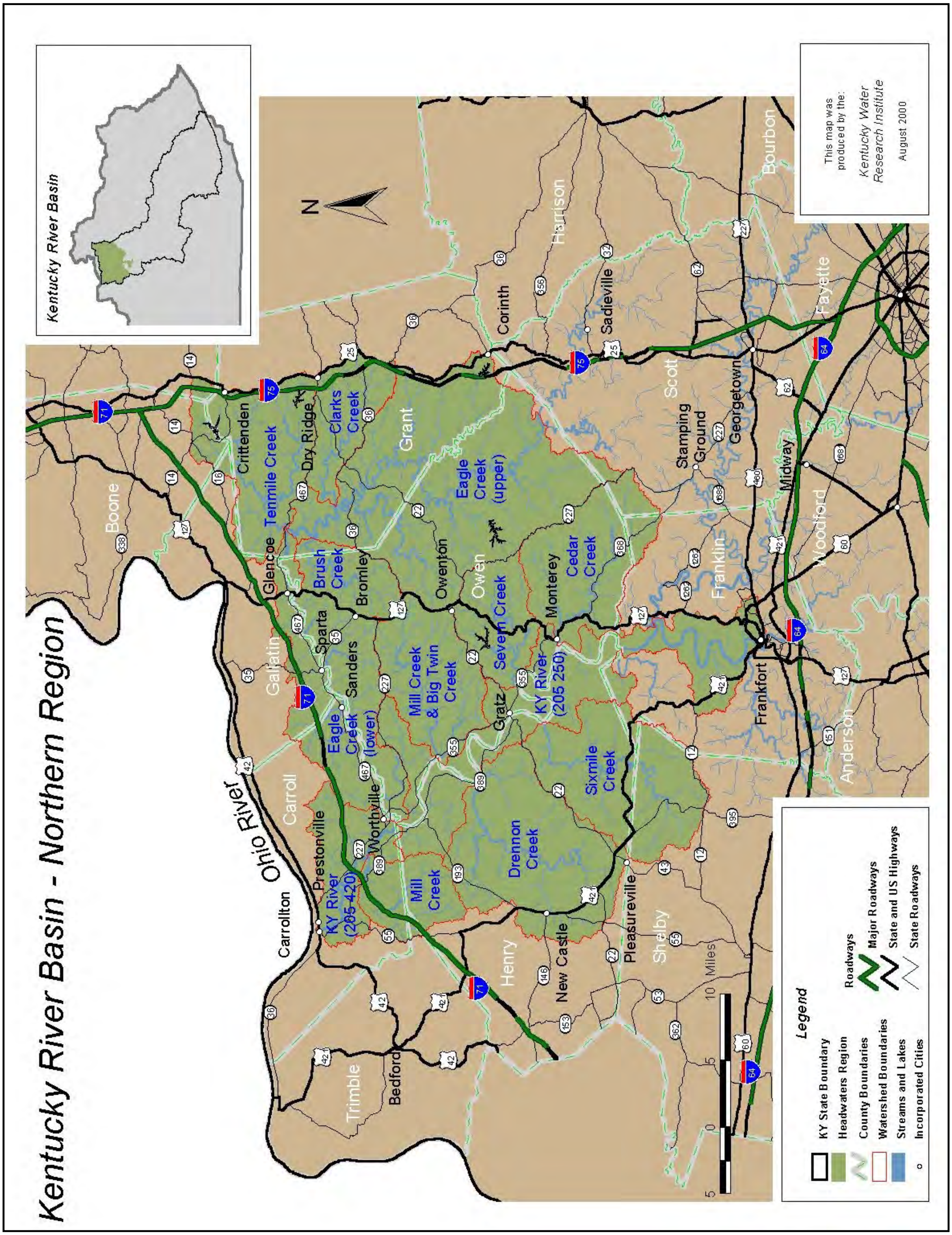


Figure 3—Kentucky River Central Region

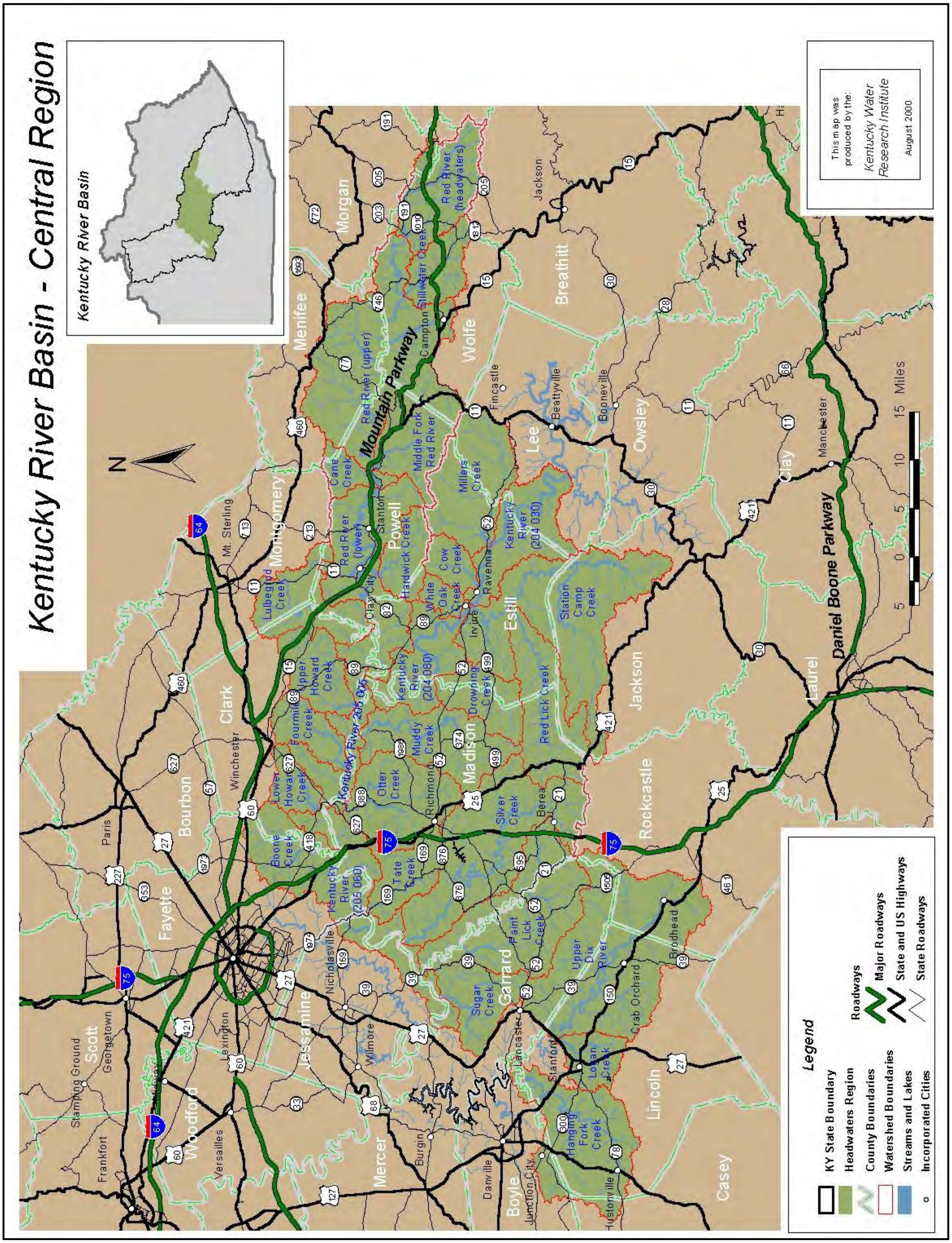


Figure 4—Kentucky River Southern Region

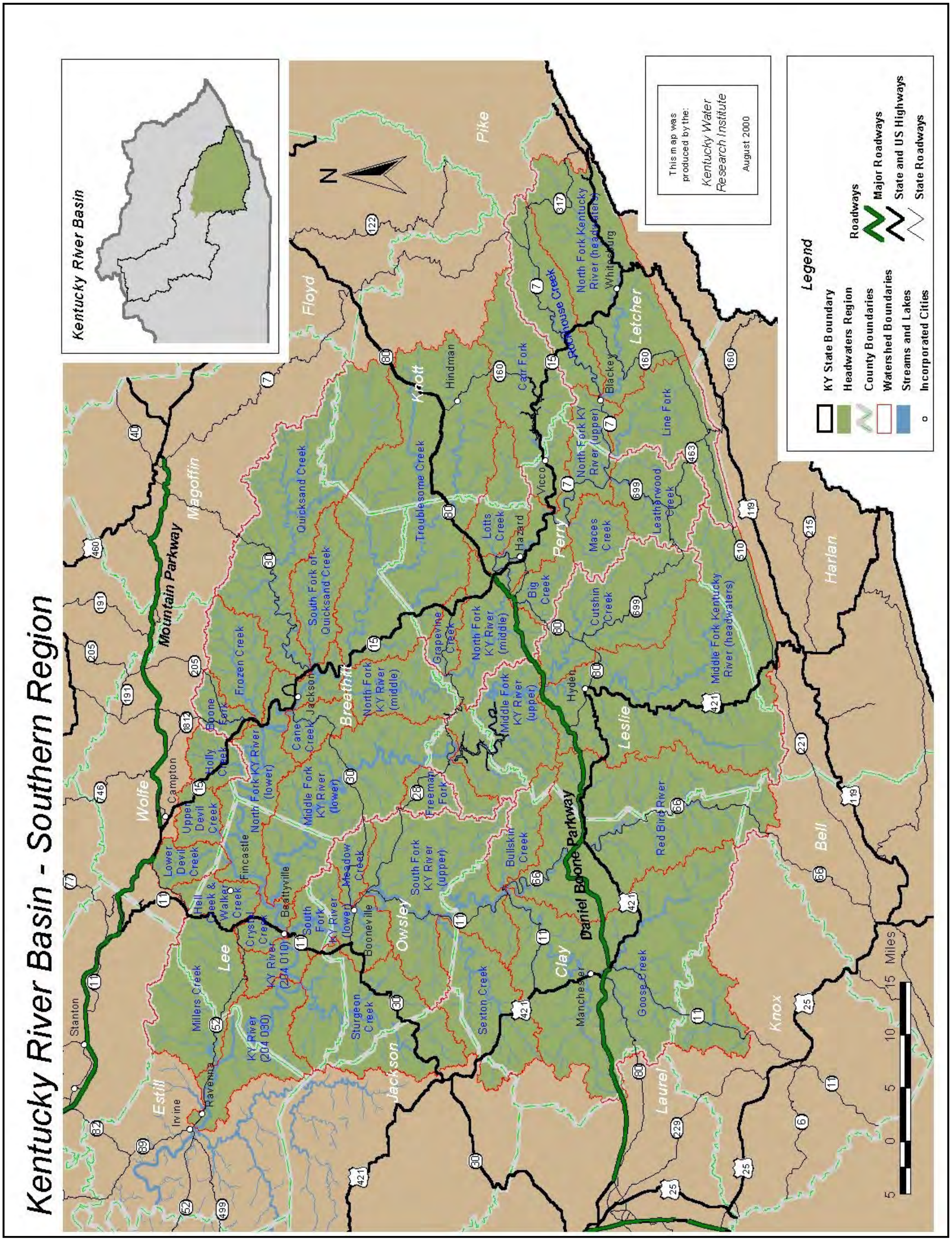


Figure 5
2015 Kentucky River Watershed Watch Sampling Sites

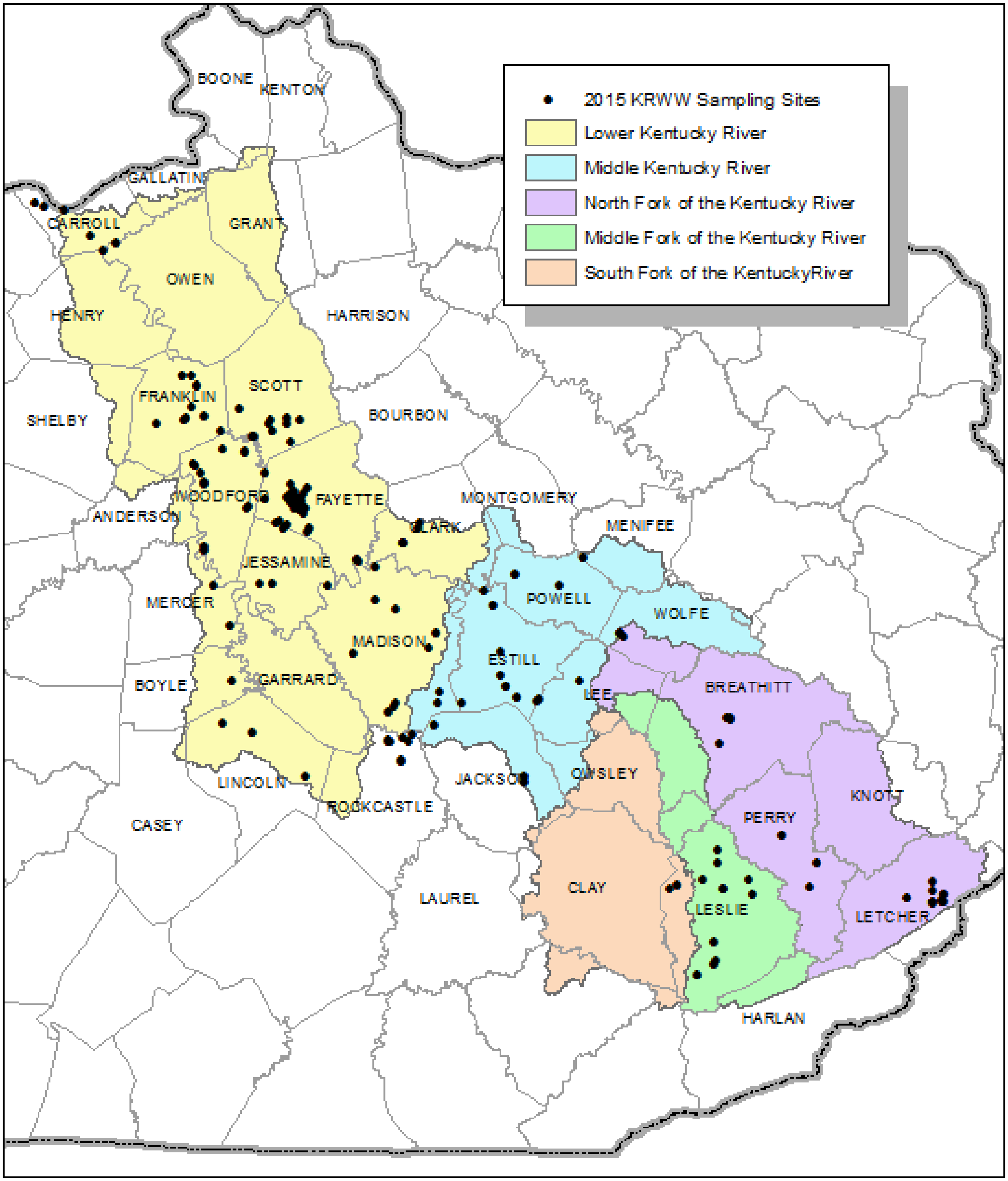


Figure 6

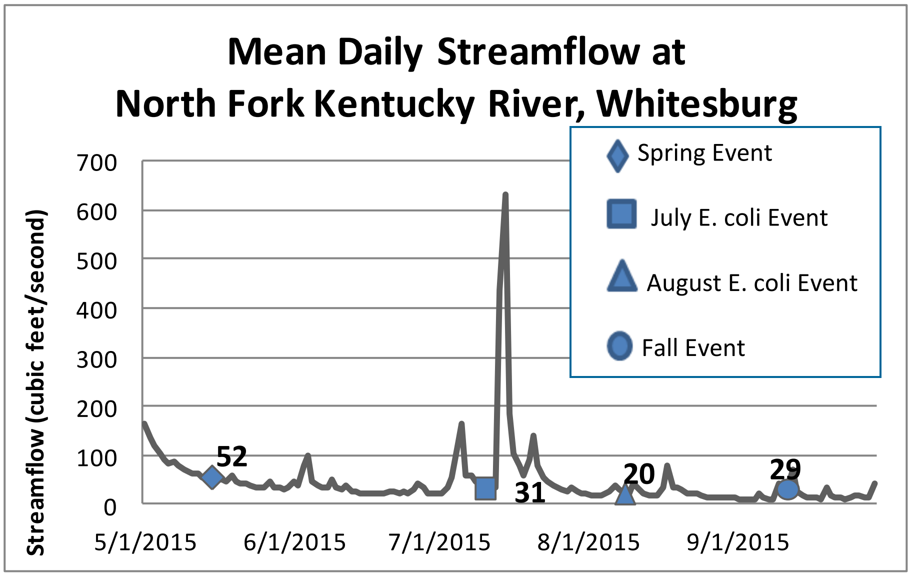


Figure 7

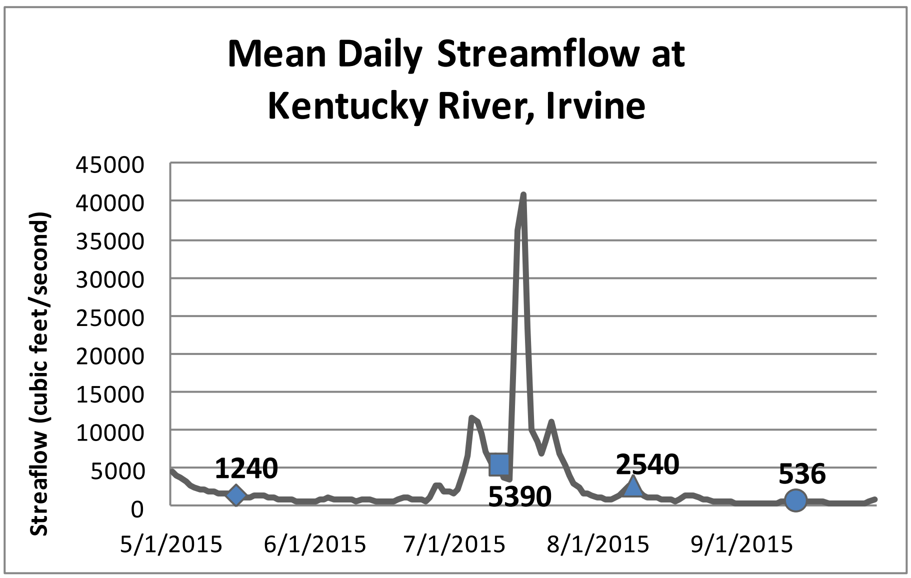


Figure 8

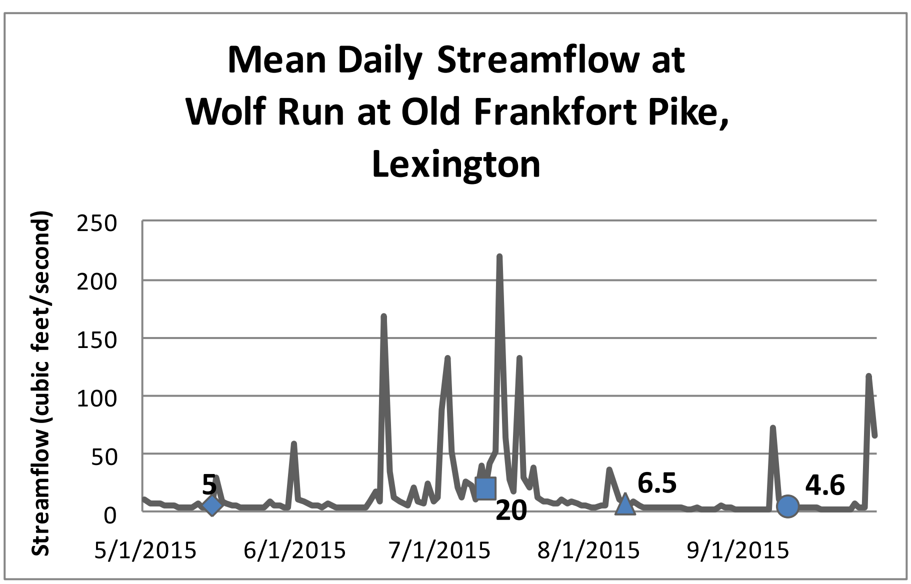


Figure 9

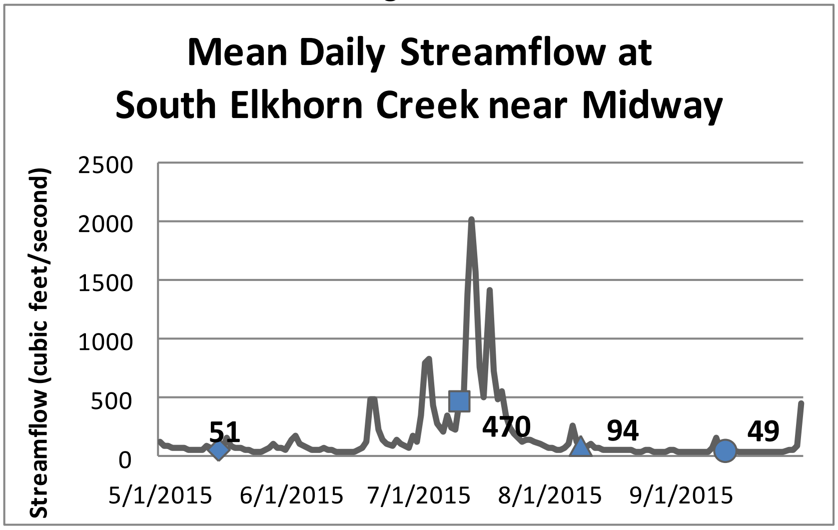


Figure 10

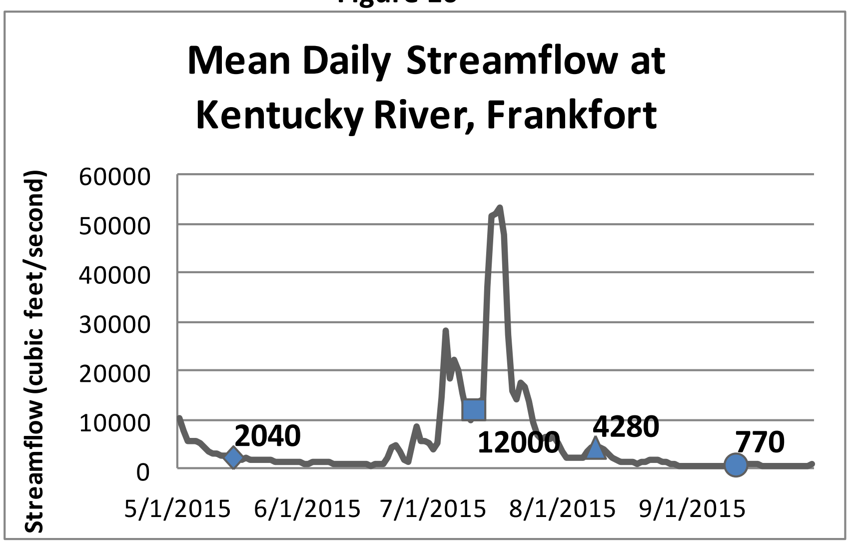


Figure 11

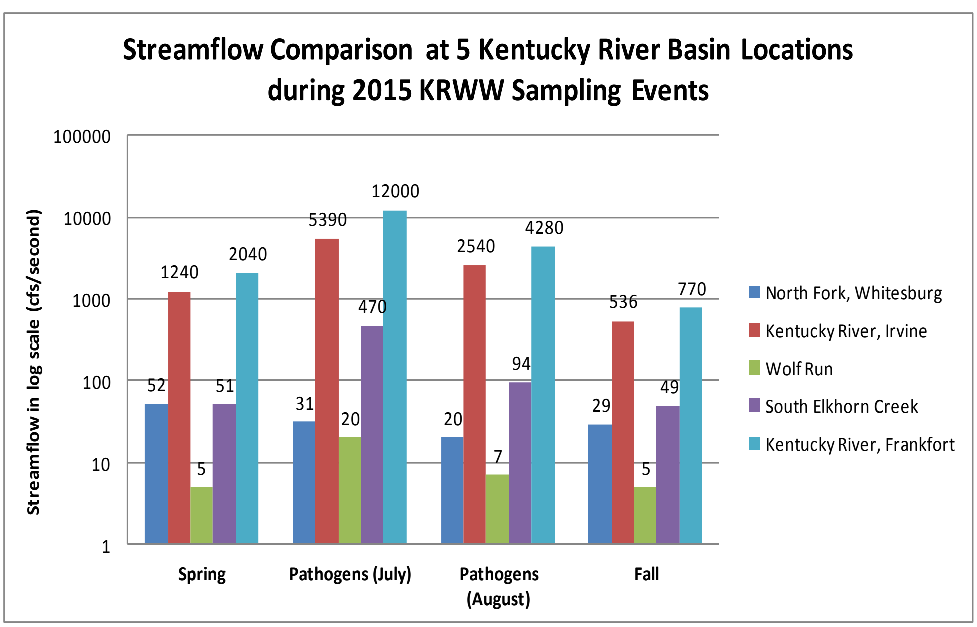


Figure 12
2015 KRWW Herbicide Sampling Results

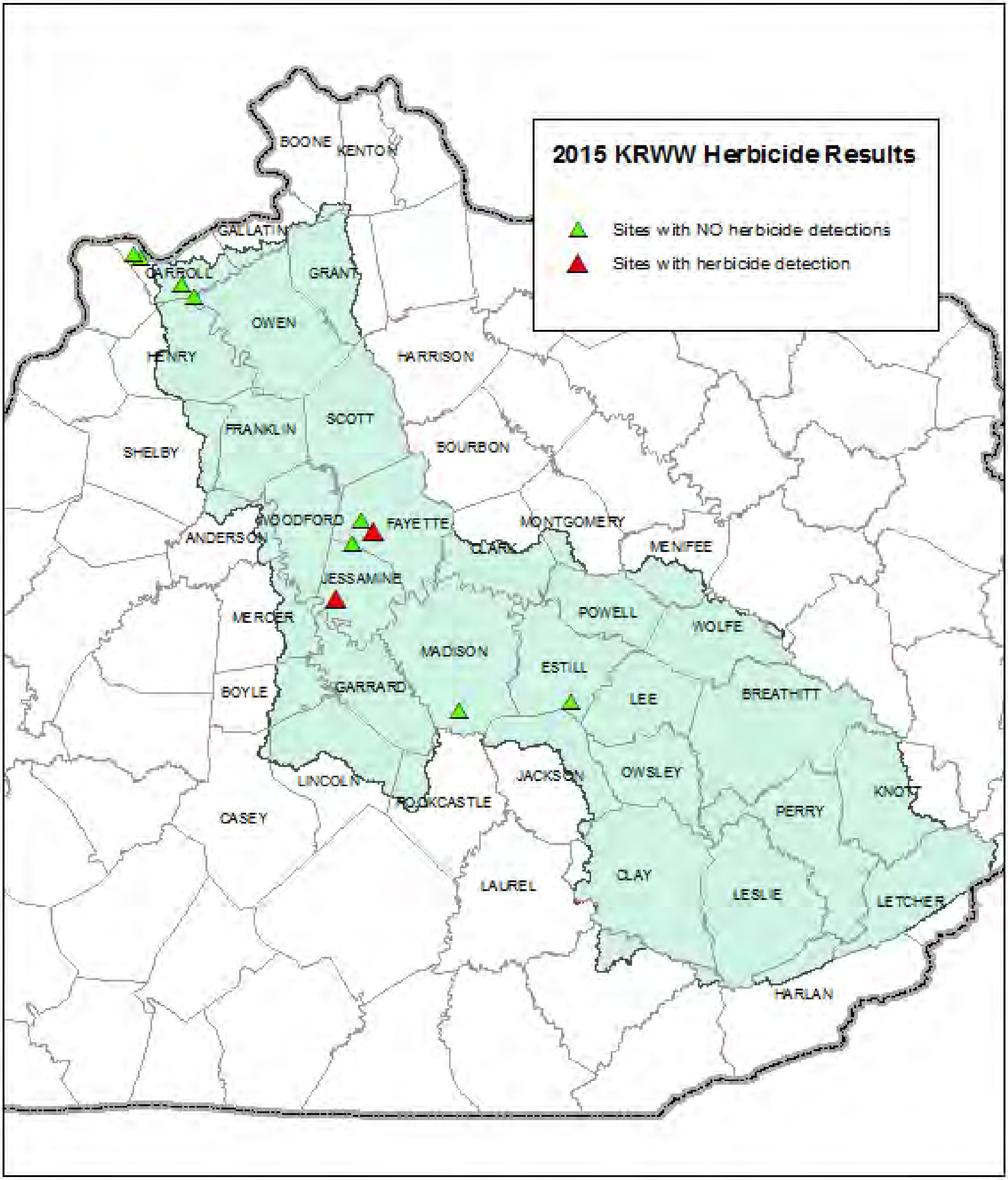


Figure 13
2015 KRWW Synoptic Pathogen Sampling Results

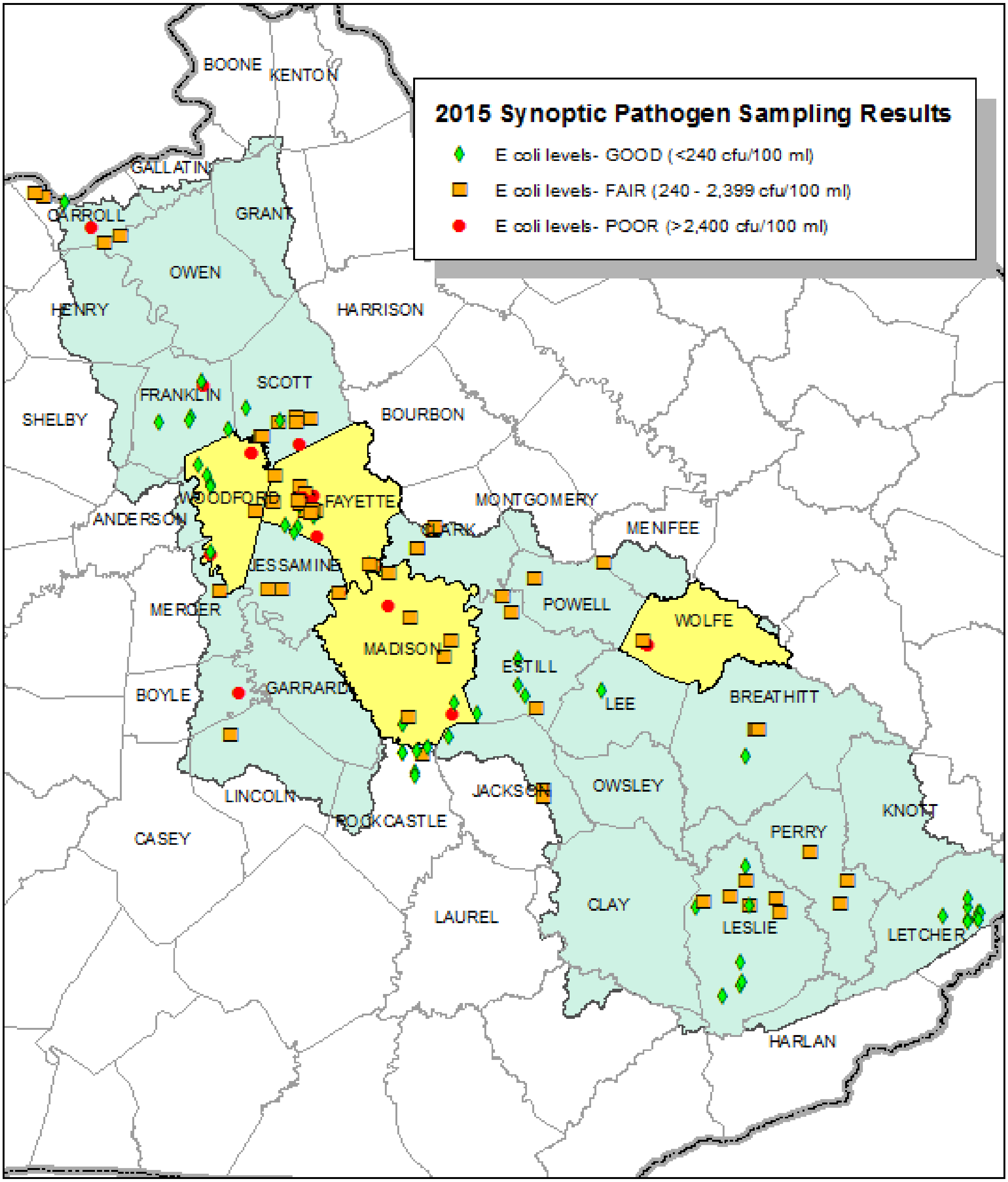


Figure 14
2015 KRWW Follow-Up Pathogen Sampling Results

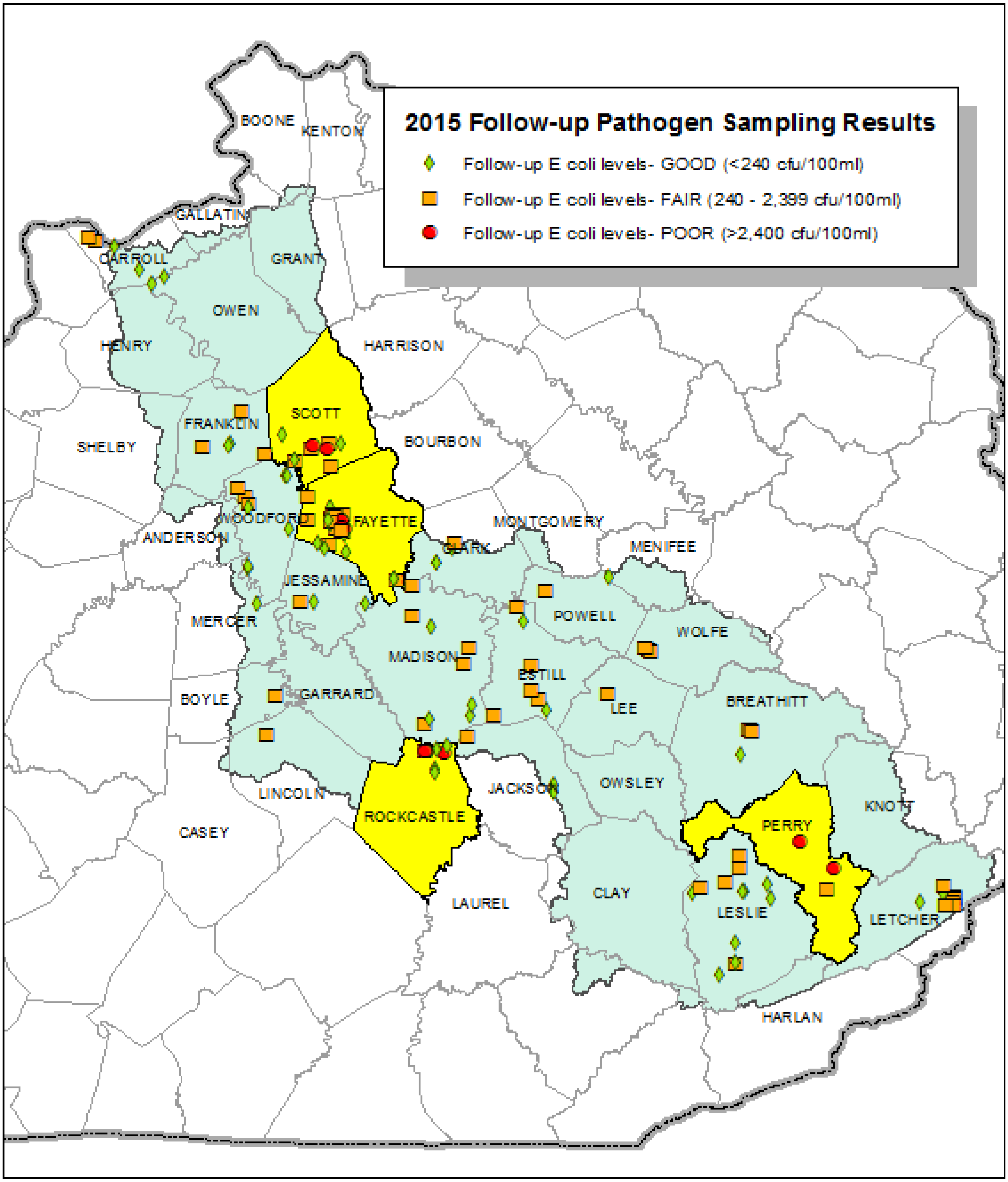


Figure 15
2015 KRWW Nitrogen Sampling Results

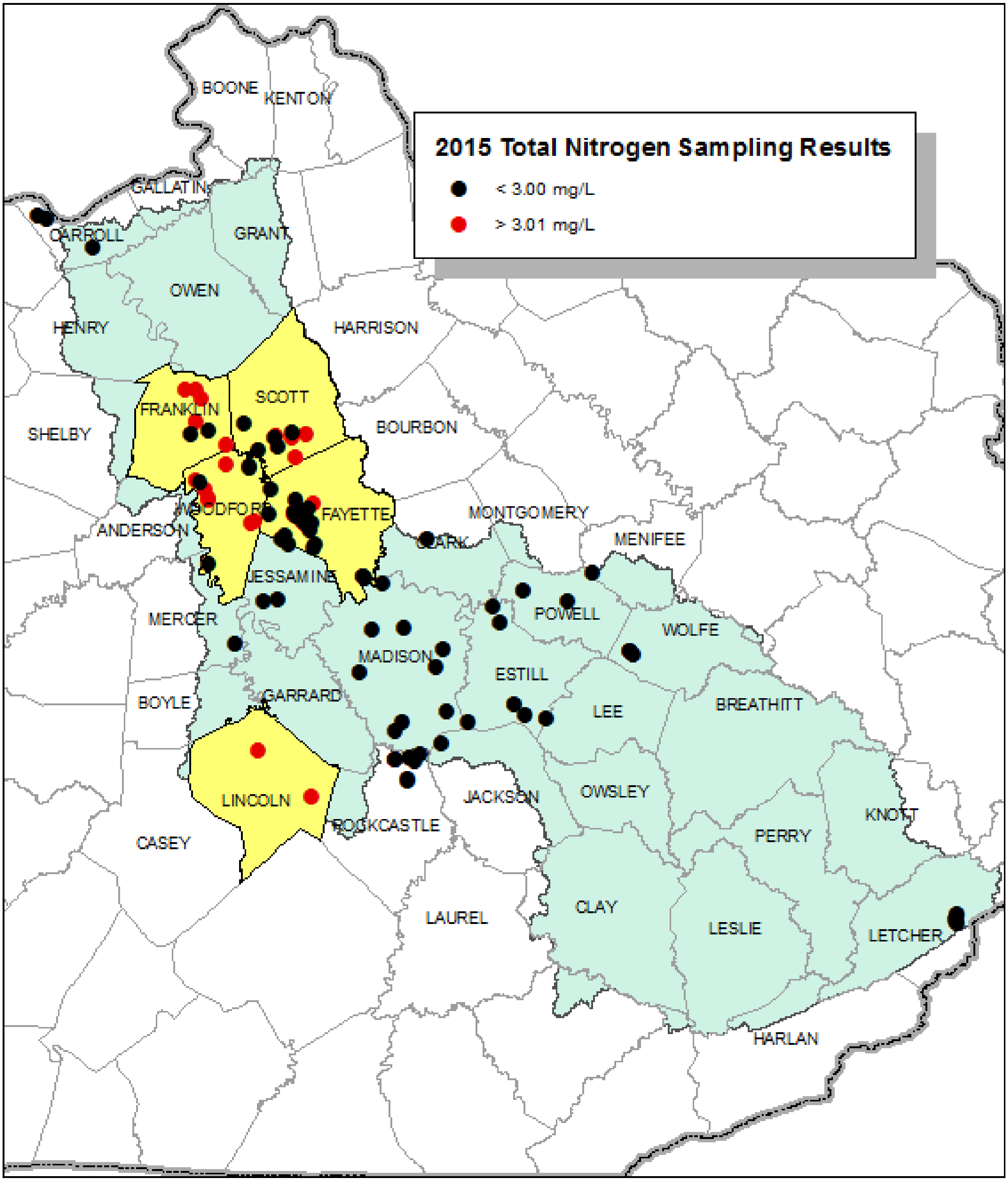


Figure 16
2015 KRWW Phosphorus Sampling Results

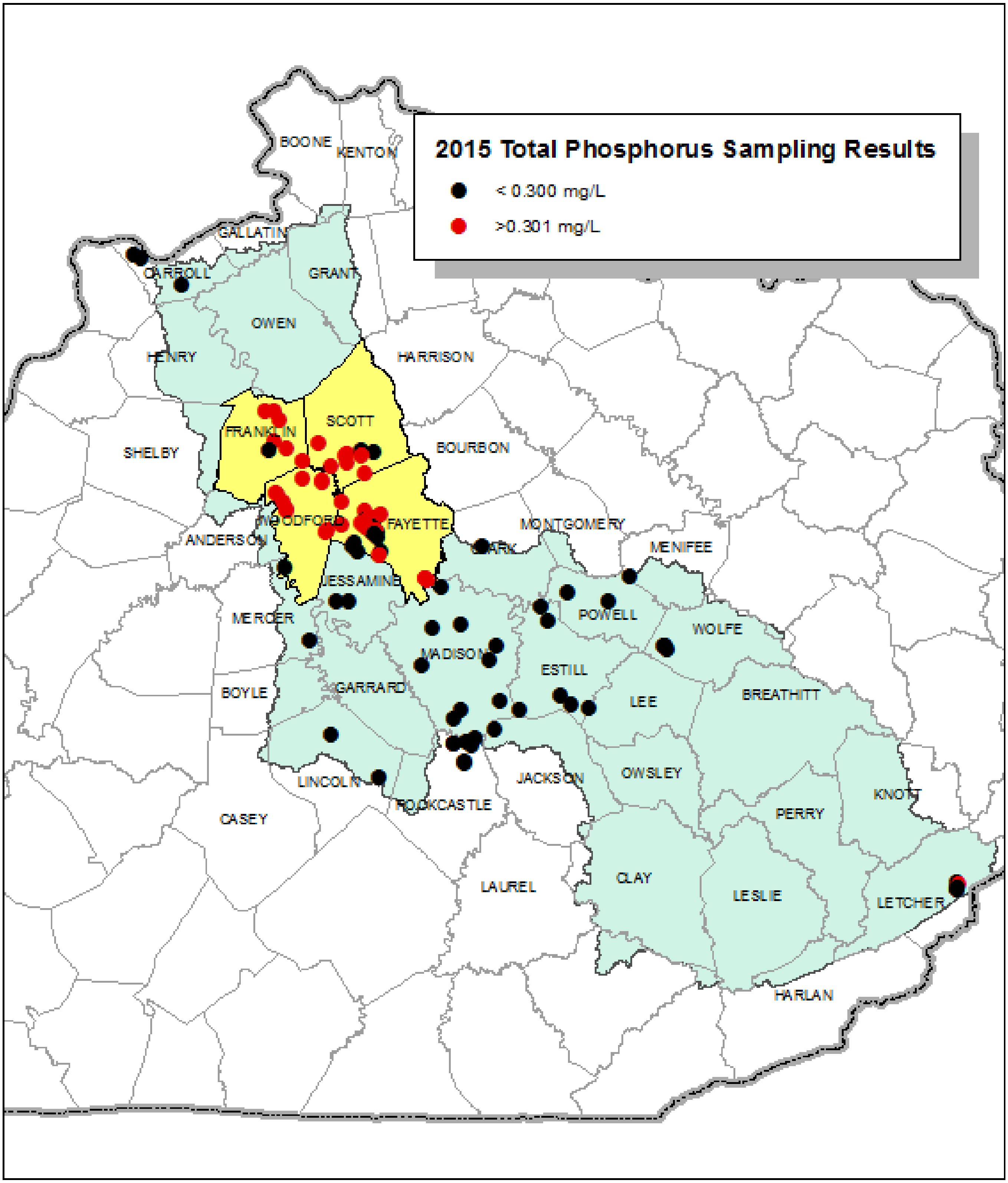


Figure 17
2015 KRWW Metals Sampling Results

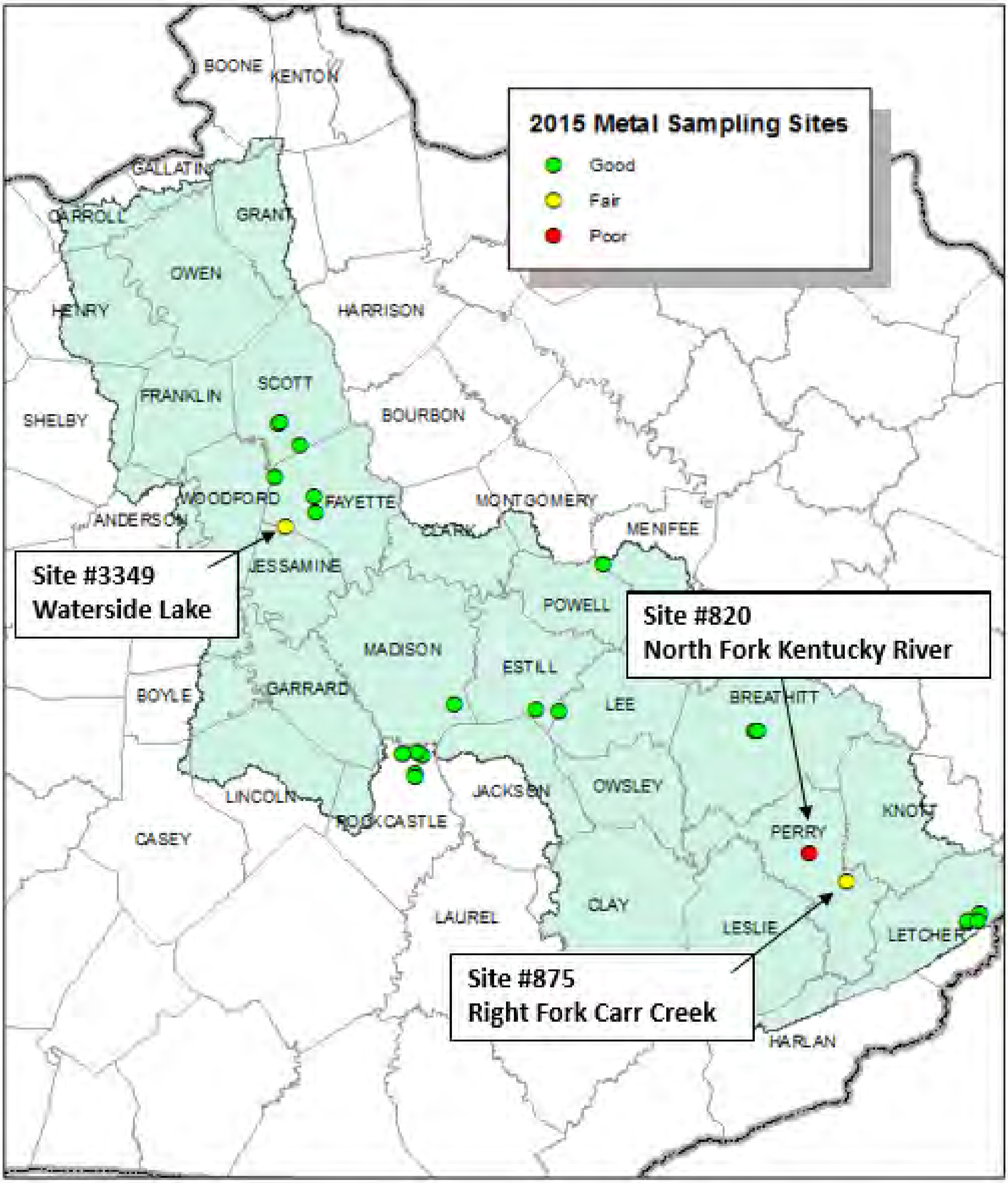
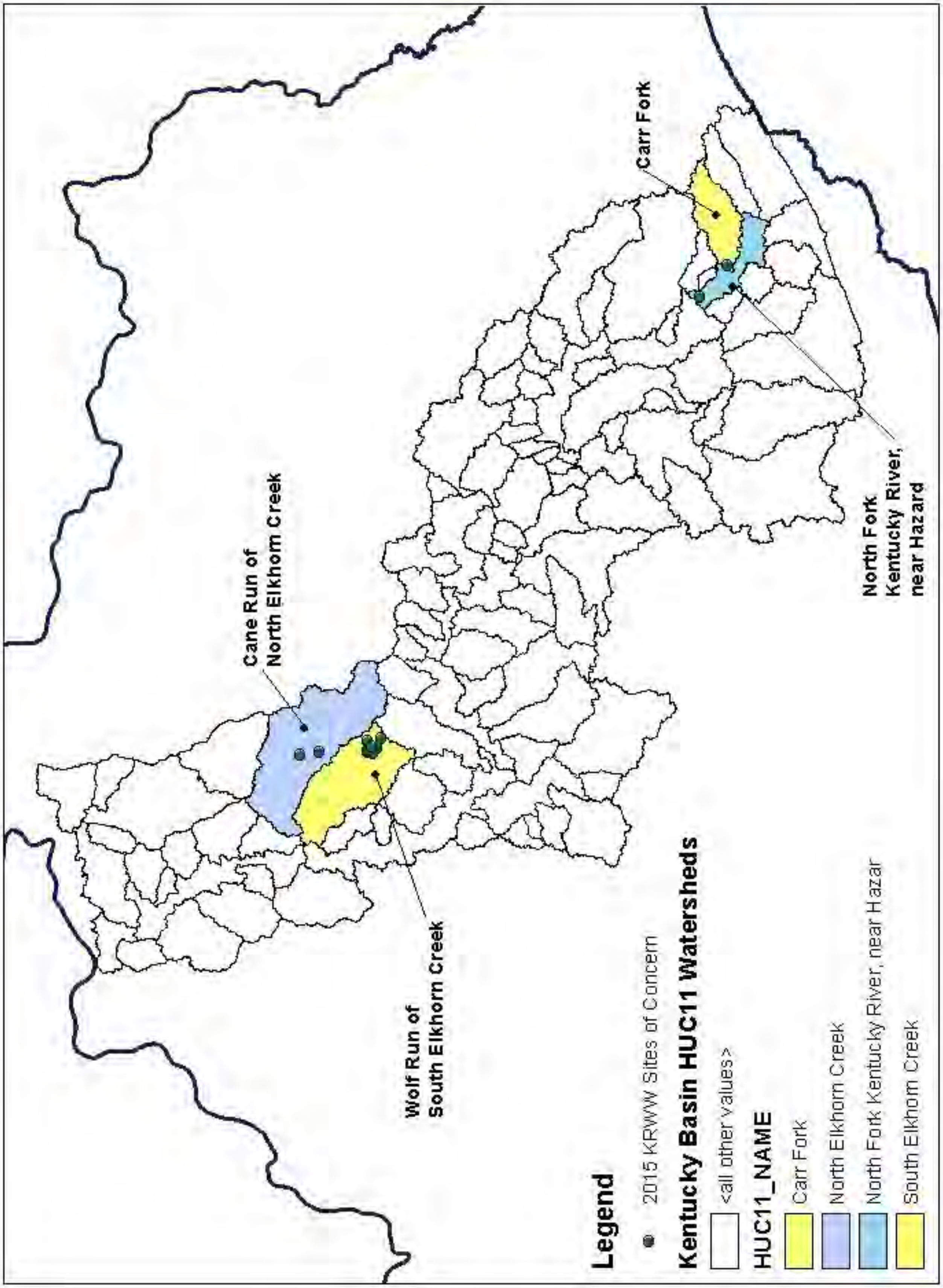


Figure 18
2015 KRWW Sampling Sites of Concern



APPENIDIX B: TABLES

Table B1

2015 KRWW Sampling Sites					
Site ID#	Stream	County	Latitude	Longitude	Sampler
741	Lees Branch	Woodford	38.1491	-84.6822	John Delfino
744	Cane Run	Scott	38.20944	-84.61074	Cindy King
753	Clarks Run	Boyle	37.63897	-84.72178	Chris Barton
755	North Elkhorn Creek	Scott	38.21564	-84.6058	Cindy King
763	South Elkhorn Ck	Fayette	38.04231	-84.62588	John Larmour
765	South Elkhorn Ck	Scott	38.18069	-84.6596	Don Dampier
767	Clear Creek	Woodford	37.9325	-84.79488	Guy Kemper
772	Unnamed Trib	Scott	38.18278	-84.65559	Don Dampier
786	Eagle Creek	Carroll	38.61184	-85.03471	Bill Osborne
793	McConnells Spring	Fayette	38.05539	-84.51903	Steven Rogers
796	Spring Station	Woodford	38.15527	-84.74323	John Delfino
801	North Fork Kentucky River	Letcher	37.1364	-82.7645	Jennifer Honeycutt
802	Pine Creek	Letcher	37.1334	-82.7635	Jennifer Honeycutt
803	Cram Creek	Letcher	37.1249	-82.7699	Jim Dentinger
810	South Elkhorn Creek	Fayette	37.9956	-84.5854	John Webb
811	Steeles Branch	Fayette	38.09835	-84.62191	Ken Cooke
814	Red River	Powell	37.84209	-83.80894	William Gordon
815	Cane Creek	Menifee	37.90223	-83.73995	William Gordon
820	North Fork Kentucky River	Perry	37.27592	-83.2078	John Hoppe
823	Glenns Creek	Woodford	38.10066	-84.80528	Hank Graddy
825	War Fork	Jackson	37.42106	-83.9167	Tammy Wiggs
827	Quicksand Creek	Breathitt	37.53799	-83.34781	Chet Sygiel
831	Lower Red River	Estill	37.83296	-84.01583	Jack Stickney
832	Red River	Powell	37.86907	-83.93072	Jack Stickney
833	Spring	Woodford	38.08186	-84.7942	Hank Graddy
848	North Fork Kentucky River	Letcher	37.11857	-82.79277	Regina Donour
850	Colley Creek	Letcher	37.11917	-82.79278	Regina Donour
851	Allen Branch	Letcher	37.14611	-82.79472	Tarence Ray
861	Glenns Creek	Woodford	38.12056	-84.82694	Hank Graddy
869	Maces Creek	Perry	37.16167	-83.13194	Pam Brashear
875	Right Fork Carr Creek	Perry	37.21328	-83.11306	John Hoppe
891	North Elkhorn Creek	Scott	38.22	-84.56	Cindy King
914	Holly Spring	Fayette	38.03517	-84.5431	Bob Edwards
915	Wolf Run	Fayette	38.03318	-84.5421	Bob Edwards
918	Muddy Creek	Madison	37.70672	-84.17444	Alice Jones
921	Otter Creek	Madison	37.79276	-84.26245	Laura Melius
938	Silver Creek	Madison	37.69662	-84.38475	Pierce Johnson
940	Big Sinking Creek	Lee	37.62829	-83.75535	Cheri Wolfe
941	Deep Branch Creek	Clark	37.97462	-84.19928	M. Clare Sipple
942	Lower Howard Creek	Clark	37.9391	-84.2439	M. Clare Sipple
943	Quicksand Creek	Breathitt	37.53877	-83.34146	Chet Sygiel
944	South Fork Quicksand Creek	Breathitt	37.53611	-83.34084	Chet Sygiel
954	Spring	Woodford	38.0753	-84.7954	Hank Graddy
955	Elk LIck Creek	Fayette	37.90286	-84.3635	Laura Baird
963	Knoblick Creek	Lincoln	37.54709	-84.75078	Chris Barton
978	Muddy Creek	Madison	37.742	-84.1546	Alice Jones
982	Lanes Run	Scott	38.2181	-84.5237	Steve Lombardo
984	Twin Creek	Estill	37.79999	-83.99388	Jack Stickney
990	Unnamed Tributary	Madison	37.81668	-84.31893	Alice Jones
999	Elkhorn Creek	Franklin	38.2464	-84.827	David McElrath
1000	Elkhorn Creek	Franklin	38.22828	-84.79321	David McElrath
1014	Elkhorn Creek	Franklin	38.31811	-84.82663	Hannah Helm

Site ID#	Stream	County	Latitude	Longitude	Sampler
1018	Penitentiary Branch	Franklin	38.22246	-84.84418	Debbie Bramlage
1028	Wolf Run	Fayette	38.07327	-84.55445	Robert Garnham
1048	Shannon Run	Woodford	38.0233	-84.6753	Henry Duncan
1124	Marble Creek	Jessamine	37.848086	-84.453633	Liz Hobson
1127	Unnamed Tributary	Fayette	38.02029	-84.53903	Ken Cooke
1128	Cardinal Run	Fayette	38.0489	-84.5536	Curtis Jones
1129	Cardinal Run	Fayette	38.0431	-84.5573	Bruce Hutcheson
1131	Wolf Run	Fayette	38.0158	-84.5226	Karen Fawcett
1132	Wolf Run	Fayette	38.0535	-84.5509	Curtis Jones
1133	Wolf Run	Fayette	38.023	-84.5286	John Dempsey
1134	Spring Branch	Fayette	38.0294	-84.5374	Layton Register
1135	Wolf Run	Fayette	38.0301	-84.5373	Layton Register
1136	Culvert	Fayette	38.033	-84.5431	Ken Cooke
1137	Vaughns Branch	Fayette	38.0548	-84.5497	Curtis Jones
1138	Vaughns Spring	Fayette	38.0448	-84.536	Bob Edwards
1139	Vaughns Branch	Fayette	38.0224	-84.5124	Bethany Overfield
1148	Little Dry Fork	Letcher	37.1289	-82.863	Tarence Ray
1151	Cram Creek	Letcher	37.1193	-82.7666	Jim Dentinger
1152	Cram Creek	Letcher	37.1193	-82.7661	Jim Dentinger
1174	Royal Springs	Scott	38.20988	-84.56189	Cindy King
1175	Calloway Creek	Madison	37.8879	-84.3188	Howard Bowden
1184	Spring Branch	Fayette	38.02172	-84.54073	Ken Cooke
1185	North Fork Kentucky River	Letcher	37.1167	-82.79278	Mary Estes
1191	Kentucky River	Mercer	37.85303	-84.77123	Ruth Webb
1195	Lees Branch	Woodford	38.14568	-84.68171	John Delfino
1199	Vaughns Branch	Fayette	38.03695	-84.52271	Ken Cooke
1221	Cane Run	Scott	38.1666	-84.5532	Cindy King
1246	Cardinal Run	Fayette	38.0344	-84.5542	Bruce Hutcheson
1270	Unnamed Tributary	Lincoln	37.42696	-84.52076	Jane Vanhook
1271	Herrington Lake	Mercer	37.76237	-84.72451	Emily Steer
1274	Elk Lick Creek	Fayette	37.90624	-84.37038	Beverly James
1275	Unnamed Tributary	Fayette	37.97563	-84.50349	John Webb
1301	North Elkhorn Ck	Scott	38.24162	-84.69436	Lisa Morris
1307	Jessamine Creek	Jessamine	37.85579	-84.60507	Mary Miller
1314	Wolf Run	Fayette	38.04534	-84.55074	Wendy Havens
2925	Brushy Fork	Madison	37.56633	-84.28927	Glen Dandeneau
2954	St. Asaph's Creek	Lincoln	37.52838	-84.66695	Garlan Vanhook
2970	Prestons Cave Spring	Fayette	38.05737	-84.54246	Steve Shannon
3004	Vaughns Branch	Fayette	38.05153	-84.54563	Ken Cooke
3005	McConnell Branch	Fayette	38.04225	-84.52547	Sandy Conners
3006	Lower Howard Creek	Clark	37.9391	-84.2439	M. Clare Sipple
3007	Lower Howard Creek	Clark	37.9391	-84.2439	M. Clare Sipple
3013	Shannon Run	Woodford	38.02749	-84.66952	Henry Duncan
3059	Gardenside Branch	Fayette	38.03785	-84.55526	Ellen Hannifan
3060	Vaughns Branch	Fayette	38.02573	-84.52256	Mark Felice
3128	Unnamed Tributary	Fayette	37.98716	-84.56199	JC Miller
3137	Wolf Run	Fayette	38.00915	-84.51588	Karen Fawcett
3139	Town Branch	Fayette	38.06481	-84.50568	Daniel Durick
3144	South Elkhorn Ck	Scott	38.191667	-84.602917	Tricia Spencer
3180	Spring	Franklin	38.21818	-84.85136	Andrew Cammack
3198	Clear Creek	Mercer	37.937307	-84.796538	Nick Barker
3203	Evans Branch	Fayette	37.90625	-84.37079	Josie Miller
3211	Silver Creek	Madison	37.58764	-84.269	Jessica Bevins
3214	Glenns Creek	Woodford	38.11592	-84.81942	J.G. Webb

Site ID#	Stream	County	Latitude	Longitude	Sampler
3216	Unnamed Tributary	Fayette	37.96807	-84.50882	John Baggerman
3222	Unnamed Trib	Wolfe	37.72791	-83.63501	Tricia Coakley
3223	Unnamed Trib	Wolfe	37.73302	-83.63853	Tricia Coakley
3224	Middle Fork of Lower Devils Creek	Wolfe	37.72448	-83.62997	Tricia Coakley
3225	Middle Fork of Lower Devils Creek	Wolfe	37.73327	-83.64237	Tricia Coakley
3252	South Elkhorn Creek	Jessamine	37.97584	-84.57299	John Larmour
3271	North Fork Kentucky River	Breathit	37.482373	-83.373069	Henrietta Sheffel
3282	Elkhorn Creek	Franklin	38.29124	-84.81197	David Hurt
3283	Headwaters Lower Howard Creek	Clark	37.98467	-84.19479	Lanny Evans
3296	Kentucky River	Estill	37.69881	-83.97538	Crystal Renfro
3298	Red Lick Creek	Estill	37.61887	-83.95901	Tom Bonny
3299	Locust Branch	Estill	37.58491	-84.0867	Francine Bonny
3300	Ross Creek	Lee	37.59	-83.8708	Robin Reed
3313	Elkhorn Creek	Franklin	38.31804	-84.85549	Hannah Helm
3343	Buck Lick Branch	Lee	37.58725	-83.87395	Robin Reed
3349	Waterside Lake	Fayette	37.98984	-84.5932	Vicki Holmberg
3350	Town Creek	Jessamine	37.85514	-84.64512	Mary Miller
3352	Company Branch	Letcher	37.16556	-82.79483	Tarence Ray
3363	Silver Creek	Madison	37.57862	-84.27281	Deborah Payne
3364	Station Camp Creek	Estill	37.59528	-83.93108	Hannah Eaton
3366	Hill & Dale Kids Creek	Fayette	38.01909	-84.52764	Karen Fawcett
3369	Kentucky River	Carroll	38.628826	-85.110524	Chris Rose
3370	Notch Lick	Carroll	38.694411	-85.238757	Angela Baker
3371	Locust Creek	Carroll	38.70227	-85.26224	Angela Baker
3373	Kentucky River	Owen	38.59579	-85.07389	Chris Rose
3375	Retention Pond	Fayette	38.04543	-84.56154	Jane Madden
3390	Wildcat Chase	Fayette	38.04522	-84.55912	Jerry Weisenfluh
3393	Middle Fork Kentucky River	Leslie	37.246914	-83.382386	Angela Muncy
3394	Big Creek	Leslie	37.1641	-83.51819	Angela Muncy
3395	Osborne Fork	Leslie	37.18485	-83.42563	Fred Davidson
3396	Hollins Fork	Leslie	37.17366	-83.49718	Fred Davidson
3397	Middle Fork Kentucky River	Leslie	37.16348	-83.37269	Jackie Howard
3398	Rockhouse Creek	Leslie	37.16291	-83.37408	Jackie Howard
3400	Bull Creek	Leslie	37.21849	-83.38374	Frank Baker
3401	Cutshin Creek	Leslie	37.17853	-83.3029	Connie Sizemore
3402	Middle Fork Kentucky River	Leslie	37.04394	-83.40249	Marie Muncy
3403	Middle Fork Kentucky River	Leslie	36.97207	-83.4491	Marie Muncy
3404	Stone Coal Branch	Leslie	36.995852	-83.403001	Phyllis Mosley
3405	Beech Fork	Leslie	37.00153	-83.39928	Phyllis Mosley
3406	Cutshin Creek	Leslie	37.14694	-83.29396	Lynda Rose
3407	Ohio River	Carroll	38.68364	-85.1802	Bill Osborne
3410	South Elkhorn Ck	Franklin	38.195665	-84.744706	Elise Zuidema
3413	Red Lick Creek	Madison	37.58584	-84.15365	Linda Murdoch
3415	Clear Creek	Rockcastle	37.50135	-84.2352	April Morales
3416	Spring	Rockcastle	37.51597	-84.22341	April Morales
3419	Unnamed Tributary	Jackson	37.40625	-83.91465	Erik Wiggs
3432	Scherer Hollow	Rockcastle	37.50898	-84.25202	Clint Patterson
3433	Owsley Fork	Jackson	37.53585	-84.16494	Robert Warren
3434	Unnamed Tributary	Estill	37.64264	-83.97523	Robin Reed
3438	Spring	Rockcastle	37.50366	-84.28797	Tabea Wolf-Fourman
3439	Unnamed Tributary	Rockcastle	37.50467	-84.28952	Tabea Wolf-Fourman
3440	Unnamed Tributary	Rockcastle	37.50392	-84.28933	Tabea Wolf-Fourman
3441	Clear Creek	Rockcastle	37.46215	-84.25794	Susana Lein
3442	Unnamed Tributary	Rockcastle	37.4565	-84.2588	Susana Lein
3446	Unnamed Tributary	Madison	37.608088	-84.147524	Xyara Asplen
3449	Elkhorn Creek	Fayette	38.29801	-84.81276	Heather Warman
3450	Benson Creek	Franklin	38.2137	-84.92913	Aaron Koch

Table B2

2015 KRWW Field Sampling Results

*NOTE: Values that exceed water quality standards or benchmarks are noted in **bold** text.*

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L) **	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*	**Assessment** *R (red)=poor Y(yellow)=fair G(green)=good*
741	Lees Branch	7/10/2015	3	0.1	0	6.2	8	19	410	G
741	Lees Branch	9/11/2015	2	zero	0	5.4	8.5	19	480	
744	Cane Run	7/10/2015	4	0.5	0	8.2	8.58	23.8	**503**	Y
744	Cane Run	8/7/2015		1	1	10.4	**9.25**	23.8	444	
744	Cane Run	9/11/2015	2	0.1	0	6.9	8.71	24.4	496	
753	Clarks Run	7/10/2015	4		3	7.8	7.5	24	450	Y
753	Clarks Run	8/7/2015	4	0.5	2	8	7	20	**510**	
755	North Elkhorn Creek	7/10/2015	4	0.5	1	8.7	8.58	22	490	Y
755	North Elkhorn Creek	8/7/2015	4	1	0	8.6	8.44	23	428	
755	North Elkhorn Creek	9/11/2015	4	0.1	0	6.8	8.67	25.2	**621**	
763	South Elkhorn Creek	7/10/2015	4	0.1	2	7	7.8	18	450	G
763	South Elkhorn Creek	8/7/2015	3	0.5	0	6.2	7.8	18.9	380	
763	South Elkhorn Creek	9/11/2015	2	0.5	0	5.4	7.6	19	490	
765	South Elkhorn Creek	7/9/2015	4	>1.5		6	7.5	20		Y
765	South Elkhorn Creek	8/7/2015	4	1.5	3	6.4	7.5	24	**690**	
765	South Elkhorn Creek	9/12/2015	0							
767	Clear Creek	7/11/2015	5	>1.5	3	8	7.7	16	360	G
772	Unnamed Tributary	7/9/2015	4	>1.5	0	6.2	7.5	20		G
772	Unnamed Tributary	8/7/2015	3	1.5	0	5.8	7.5	22	440	
772	Unnamed Tributary	9/11/2015	2	zero	0	5.4	8	23	410	
786	Eagle Creek	7/9/2015	5	>1.5	3	7.3	7.5	24	315	G
786	Eagle Creek	8/6/2015	3	0.1	2	6.3	8	26	270	
793	McConnell Spring	7/11/2015	2	0.5	1	**4.6**	7	19	**560**	R
793	McConnell Spring	8/8/2015	2	zero	0	**4.6**	7	19	**560**	
793	McConnell Spring	9/13/2015	2	0.1	0	**1.8**	7	17	**710**	
796	Spring Station	9/11/2015	2	zero	0	6.6	7	15	490	G
801	North Fork Kentucky River	8/8/2015	3	0.1	0		7.3	21	**790**	R
801	North Fork Kentucky River	9/11/2015	3	0.1	1	6.2	7.8	22	**980**	
802	Pine Creek	8/8/2015	3	0.1		8	7.5	19	**580**	Y
802	Pine Creek	9/11/2015	3	0.1	0	5.2	7.5	23	**670**	
803	Cram Creek	8/8/2015	3	0.1	0	6.8	7.5	19	380	Y
803	Cram Creek	9/11/2015	3	0.1	0	5.6	7.2	22	**530**	
810	South Elkhorn Creek	9/11/2015	2	1.5	0	7.2	7.7	25	**540**	Y
811	Steeles Branch	7/11/2015	3	0.5	1		8.16	17.3	393	G
811	Steeles Branch	8/7/2015	3	0.5	0		8.19	19.68	449	
811	Steeles Branch	9/11/2015	2	zero	0	6.48		21.7	490	
814	Red River	9/14/2015	3	0.1	3	7.5	6.7	20	200	G
815	Cane Creek	7/10/2015	4	>1.5	3					G
815	Cane Creek	8/8/2015	3	1	0	11	7.1	18.9	200	
815	Cane Creek	9/14/2015	2	0.1	0	7	6.9	14	220	
820	North Fork Kentucky River	7/10/2015	3	0.5	2	8.4	7.5	23	490	G
820	North Fork Kentucky River	8/7/2015	4	1	3	8.6	7.5	21	500	
820	North Fork Kentucky River	9/11/2015	3	zero	3	7	7	22	390	
823	Glenns Creek	8/8/2015	4		2	7.5	7.5	17	470	Y
823	Glenns Creek	9/12/2015	3	zero	0		7.5	14	**850**	
825	War Fork	7/11/2015	3	1	1					No data
827	Quicksand Creek	7/10/2015	4	0.5	3	7.9	7.6	23	300	Y
827	Quicksand Creek	8/7/2015	4	0.5	1	8.5	7.7	22.5	**520**	
827	Quicksand Creek	9/11/2015	2	0.1	0	8.2	7.7	23.5	**810**	

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L) **	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*	Assessment
831	Lower Red River	7/10/2015	4	1	3		7.4	21	170	
831	Lower Red River	8/7/2015	4	1	2		7.2	23	190	G
831	Lower Red River	9/11/2015	3	1	2	5	7.25	22	290	
832	Red River	7/10/2015	4	1	2		7.5	21	140	
832	Red River	8/7/2015	4	1	2		7.5	22	180	G
832	Red River	9/11/2015	3	1	2	**4**	7.5	23	240	
833	Spring	8/8/2015	4		2	5.7	6.5	15	450	Y
833	Spring	9/12/2015	3	zero	0		6.5	12	**570**	
848	North Fork Kentucky River	8/8/2015	3	0.1	0	7.8	7.5	20	**750**	R
848	North Fork Kentucky River	9/11/2015	3	0.5	0	6	7.5	22	**920**	
850	Colley Creek	8/8/2015	3	0.1	0	7	7.5	21	**770**	R
850	Colley Creek	9/11/2015	2	0.5	1	5.4	7.3	24	**650**	
851	Allen Branch	8/8/2015	3	0.1	1	**3.5**	6.5	18.9	**552**	Y
861	Glenns Creek	8/8/2015	4		2	8.5	7.75	17.9	470	Y
861	Glenns Creek	9/12/2015	3	zero	0		7.5	14	**830**	
869	Maces Creek	7/11/2015		0.5	0		7.5	22.5	490	G
869	Maces Creek	8/8/2015								
875	Right Fork Carr Creek	7/10/2015	3	0.5	2	9.8	7.5	21	**790**	
875	Right Fork Carr Creek	8/7/2015	4	1	3	8.8	7.5	19	**640**	R
875	Right Fork Carr Creek	9/11/2015	3	zero	1	9.2	7.5	23	**1120**	
891	North Elkhorn Creek	7/10/2015	4	1	0	7.5	8.54	22.8	451	
891	North Elkhorn Creek	8/7/2015	4	1	0	7.8	8.34	23.5	437	Y
891	North Elkhorn Creek	9/11/2015	3	0.1	0	**3.7**	8.27	24.9	**536**	
914	Holly Spring	7/10/2015	3	0.5	0	7.4	7	17	450	Y
914	Holly Spring	9/11/2015	3	zero	0	9.4	6.5	15	**580**	
915	Wolf Run	7/10/2015	3	0.5	0	9	8.5	20	**570**	
915	Wolf Run	8/7/2015	3	1	0	7.8	8	19	**650**	R
915	Wolf Run	9/11/2015	2	zero	0	7.9	8.5	19	**730**	
918	Muddy Creek	7/11/2015	4	1	3			13		
918	Muddy Creek	8/8/2015	3	0.1	2					No data
918	Muddy Creek	9/11/2015	2	zero						
921	Otter Creek	7/11/2015	4	0.5	1	7	7.6	17		G
921	Otter Creek	9/12/2015	3	0.5	2	5.9	7.5	15	260	
938	Silver Creek	9/11/2015	3	1.5	1	**4.8**	7.5	22	480	Y
940	Big Sinking Creek	8/8/2015	3	0.5	2	7	7.3	21	480	G
941	Deep Branch Creek	7/11/2015		0.5		6	8.5	20	**580**	Y
942	Lower Howard Creek	7/11/2015	4	0.5	1	6	8.5	20	500	G
943	Quicksand Creek	7/10/2015	4	0.5	2	8.2	7.4	23	270	
943	Quicksand Creek	8/7/2015	4	0.5	1	8.2	7.6	23	**510**	Y
943	Quicksand Creek	9/11/2015	2	0.1	1	7.9	7.8	23.5	**830**	
944	South Fork Quicksand Creek	7/10/2015	4	0.5	3	9	7.9	22	440	
944	South Fork Quicksand Creek	8/7/2015	4	0.5	1	8.4	7.9	22	**600**	R
944	South Fork Quicksand Creek	9/11/2015	2	0.1	1	7.9	7.9	23	**690**	
954	Spring	8/8/2015	4		0	5.5	6.5	14	**520**	Y
954	Spring	9/23/2015	3	zero	0		7	12	**650**	
955	Elk Lick Creek	7/10/2015	4	0.5	0	8	8.3	20	440	
955	Elk Lick Creek	8/7/2015	3	0.1	0	7.9	8.3	19.9	**640**	Y
955	Elk Lick Creek	9/11/2015	2	1	0	6.5	8.1	19	**630**	
963	Knoblick Creek	7/10/2015	4		3	7	7.5	24	260	G
963	Knoblick Creek	8/7/2015	3	0.5	0	6	7	21	340	
978	Muddy Creek	7/11/2015	4	1	2			14		
978	Muddy Creek	8/8/2015		0.1	1					No data
978	Muddy Creek	9/11/2015	2		0					

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L) **	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*	Assessment
982	Lanes Run	7/10/2015	4	1	1	7.8	7.5	24.5	**510**	Y
982	Lanes Run	9/14/2015	3	0.1	1	8.4	7.5	17.5	**780**	
984	Twin Creek	7/10/2015	4	1	1		7.5	22	280	
984	Twin Creek	8/7/2015	3	0.5	0		7.3	21	310	Y
984	Twin Creek	9/11/2015	1	0.5	0	**3**	7.5	20	430	
990	Unnamed Tributary	7/11/2015	3	0.5	3			11		
990	Unnamed Tributary	8/8/2015		0.1	1					No data
990	Unnamed Tributary	9/11/2015	2	zero	1					
999	Elkhorn Creek	9/11/2015	3	0.1	1	8	8	25	**890**	Y
1000	Elkhorn Creek	9/11/2015	3	0.1	2	6	8	25	**600**	Y
1014	Elkhorn Creek	9/14/2015	3	zero	1	7.1	7.1	24	**730**	Y
1018	Penitentiary Branch	7/11/2015	4	1	3					G
1018	Penitentiary Branch	9/14/2015	2	0.1	1		7.5	14	140	
1028	Wolf Run	7/11/2015	2	1	2	5.8	8	20	**520**	
1028	Wolf Run	8/8/2015	3	zero	2	6	8	20	**520**	No data
1028	Wolf Run	9/13/2015	2	0.1	0	6.8	8	19	**690**	
1048	Shannon Run	7/13/2015	5	>1.5	3	7	7.4	16	360	G
1048	Shannon Run	9/11/2015	2	0.5	0	8.1	8	21	490	G
1124	Marble Creek	7/11/2015	4	1.5		8	7.5	20	460	
1124	Marble Creek	8/8/2015	2	0.1	0	7.25	7	23	430	G
1124	Marble Creek	9/11/2015	0							
1127	Unnamed Tributary	7/11/2015	3	0.5	0		7.74	22.3		G
1128	Cardinal Run	7/11/2015	3	>1.5	0	**4.2**	7.5	19	**530**	
1128	Cardinal Run	8/8/2015	3	0.5	0	5.8	7.5	19.9	**580**	Y
1128	Cardinal Run	9/12/2015	3	0.1	0	**2.8**	7.5	18	**620**	
1129	Cardinal Run	7/11/2015	3	0.1	0	7.31	7	16.4	460	
1129	Cardinal Run	8/8/2015	3	0.1	0	8.08	7.5	16.1	490	Y
1129	Cardinal Run	9/11/2015	1	0.1	0	7.58		17.8	**550**	
1131	Wolf Run	7/11/2015	3	1	1	9	7.5	23	**610**	Y
1131	Wolf Run	8/8/2015	3	0.5	1	8.6	8	25	**730**	
1132	Wolf Run	7/11/2015	3	>1.5	0	**4**	7.5	19	500	
1132	Wolf Run	8/8/2015	3	0.5	0	5.6	7.5	18.9	**540**	R
1132	Wolf Run	9/12/2015	3	0.1	0	**3.2**	7.5	18	**590**	
1133	Wolf Run	7/11/2015	3	1	1	8.44	7.2	21	**590**	
1133	Wolf Run	8/8/2015	3	0.5	0	7.04	7.2	21.6	**770**	Y
1133	Wolf Run	9/12/2015	2	0.1	0	7.17	7.3	19.9	480	
1134	Spring Branch	8/11/2015	3	0.1	0	7.4	7.6	19.9	**590**	Y
1134	Spring Branch	9/11/2015	2	zero	0	7.6	7.7	19	**710**	
1135	Wolf Run	8/11/2015	2	0.1	0	8.6	8.1	23	**630**	Y
1135	Wolf Run	9/11/2015	2	zero	0	7	8.5	22	**810**	
1136	Culvert	7/11/2015		>1.5		7.4	8.5	18	**520**	Y
1136	Culvert	8/7/2015	3	1	0	7.6	8.5	20	**730**	
1137	Vaughns Branch	7/11/2015	3	>1.5	0	**3.5**	7.5	20	**580**	
1137	Vaughns Branch	8/8/2015	3	0.5	0	**4.6**	7.5	18	**630**	R
1137	Vaughns Branch	9/12/2015	3	0.1	0		7.5	17	**690**	
1138	Vaughns Branch	7/10/2015	1	0.5	0	6.2	7.5	20	480	
1138	Vaughns Branch	8/7/2015	3	1		6.9	7.5	20	490	Y
1138	Vaughns Branch	9/11/2015	2	zero	0	5.8	7.5	19	**560**	
1139	Vaughns Branch	7/11/2015	3	0.5	0	6	7	20	**800**	
1139	Vaughns Branch	8/7/2015	3	0.5	0	7.2	7	20	**1140**	R
1139	Vaughns Branch	9/14/2015	2	zero	0	10	7	20	**1220**	

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	***Dissolved Oxygen (mg/L) ****	*pH*	*Temperature (°C)*	***Conductivity (microsiemens /cm)***	Assessment
1148	Little Dry Fork	8/8/2015	3	0.1	2	6	7.5	15	**1230**	R
1151	Cram Creek	8/8/2015	2	0.1	0	8	7.5	18	**560**	Y
1151	Cram Creek	9/11/2015	3	0.1	0	**4.75**	7.5	22	**590**	
1152	Cram Creek	8/8/2015	3	0.1	0	7.2	7.5	18	310	G
1152	Cram Creek	9/11/2015	3	0.1	0	5	7.2	21	430	
1174	Royal Springs	7/10/2015	4	1	1	6	8.06	19.5	**507**	Y
1174	Royal Springs	8/7/2015	3	1	0	5	8.1	20.9	365	
1174	Royal Springs	9/11/2015	3	0.1	0	5.4	7.98	20.3	**630**	
1175	Calloway Creek	7/11/2015	3	1	3	7.2	8	20	**520**	Y
1175	Calloway Creek	8/8/2015	3	0.5	1	7.8	8	20	**550**	
1175	Calloway Creek	9/11/2015	1	0.1	0	**3.8**	7.5	24	**510**	
1184	Spring Branch	7/11/2015	3	0.5	0		7.23	17.9	392	Y
1184	Spring Branch	8/7/2015	3	0.5	0		7.51	21.1	**600**	
1185	North Fork Kentucky River	8/8/2015	3	0.1	1	5	7.5	21	**760**	Y
1191	Kentucky River	7/10/2015	4	0.5	3	14	7.5	21	260	G
1191	Kentucky River	8/8/2015	4	1	2	10	7.5	25	330	
1195	Lees Branch	7/10/2015	2	0.1	0	5	7.5	19	400	Y
1195	Lees Branch	9/11/2015	2	zero	0	**4**	7.5	20	450	
1199	Vaughns Branch	7/11/2015	3	0.5	0		7.8	22	483	Y
1199	Vaughns Branch	8/7/2015	3	0.5	0		7.97	22.4	**826**	
1199	Vaughns Branch	9/13/2015	1	0.1	0	8.6	8	17.5	**910**	
1221	Cane Run	7/10/2015	4	1	0	8.8	8.44	22.7	477	Y
1221	Cane Run	8/7/2015	4	1			8.6	22.7	484	
1221	Cane Run	9/11/2015	3	0.1	0	10	8.89	27	**566**	
1246	Cardinal Run	7/11/2015	3	0.1	0	8.13	7.5	20	**510**	Y
1270	Unnamed Tributary	9/11/2015	2	>1.5	0	5.9	8.5	18	**540**	Y
1271	Herrington Lake	9/10/2015	4	1	0	9	8.25	27	350	G
1274	Elk Lick Creek	7/10/2015	4	0.5	1	8	8.1	22	490	Y
1274	Elk Lick Creek	9/11/2015	2	1	0	6.8	7.7	18.5	**930**	
1275	Unnamed Tributary	9/11/2015	2	1.5	0	6.1	7.7	21	**630**	Y
1301	North Elkhorn Creek	7/10/2015	4	1	2	6.6	7.9	20	420	Y
1301	North Elkhorn Creek	9/13/2015	2	0.1	1	6.6	8	17	**680**	
1307	Jessamine Creek	7/10/2015	4	0.1	2	5.8	7.6	23	500	Y
1307	Jessamine Creek	8/8/2015	2	zero	0	6.8	7.35	22	**520**	
1307	Jessamine Creek	9/15/2015	2	zero	0	7.8	7.4	26	**550**	
1314	Wolf Run	7/11/2015	3	1	1	7.6	7.2	19	440	Y
1314	Wolf Run	8/8/2015	3	0.5	0	7.4	7.5	19	**520**	
1314	Wolf Run	9/12/2015	3	0.1	0		7.5	19	**570**	
1318	Kentucky River	9/20/2015	3	zero	1					
2925	Brushy Fork	8/7/2015	3	>1.5	2	6.4	7.8	12	280	G
2925	Brushy Fork	9/11/2015	3	>1.5	2	6.5	7.8	7	320	
2954	St. Asaph''s Creek	9/11/2015	3	>1.5	0	7	6	15	240	G
2970	Prestons Cave Spring	7/11/2015	4	1	2	5.8	7	20	**740**	Y
2970	Prestons Cave Spring	8/8/2015						20	**970**	
3004	Vaughns Branch	7/11/2015	3	1	2	6.8	7	22	**780**	Y
3004	Vaughns Branch	8/8/2015	3	0.5	0				**930**	
3005	McConnell Branch	7/11/2015	2	0.5	0	5.1	6.8	20	**560**	Y
3005	McConnell Branch	8/7/2015	1	0.5	0	6.2	6.9	19.9	**620**	
3005	McConnell Branch	9/14/2015	0	zero	3					
3006	Lower Howard Creek	7/11/2015	4	0.5	1	6	8.5	20	500	G
3007	Lower Howard Creek	7/11/2015	4	0.5	1	6	8.5	20	500	G
3013	Shannon Run	7/13/2015	5	>1.5	3	7	7.5	17	360	G
3013	Shannon Run	9/11/2015	2	0.5	1	9	8.5	20	480	

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3059	Gardenside Branch	7/11/2015	3	0.1	0	8.93	7	18.6	**510**	Y
3059	Gardenside Branch	8/8/2015	3	0.1	0	9.1	7	18.2	**550**	
3059	Gardenside Branch	9/11/2015	2	0.1	0	7.76		19.7	**620**	
3060	Vaughns Branch	7/11/2015	4	1	1	6	8	20.5	**690**	Y
3060	Vaughns Branch	8/7/2015	3	0.5	1		7.95	21.47	**869**	
3060	Vaughns Branch	9/13/2015	2	0.1	0	7.4	7.5	16.5	**860**	
3128	Unnamed Tributary	8/7/2015	3	1	0	**4.5**	7	20	390	Y
3137	Wolf Run	7/11/2015	3	1	1	6.6	7	22	**720**	Y
3137	Wolf Run	8/8/2015	3	0.5	2	6.6	7.5	22	**830**	
3137	Wolf Run	9/10/2015	3	0.5	0	6.8	8	23	**770**	
3139	Town Branch	9/13/2015	2	0.1	1	7	7.4	18	**880**	Y
3144	South Elkhorn Creek	9/11/2015	2	0.5	2				480	G
3180	Spring	7/10/2015	3	0.5	0	7.8	7.5	18	**630**	Y
3198	Clear Creek	7/10/2015	4	>1.5	3	6.5	7	22	390	G
3198	Clear Creek	9/11/2015	2	1	1		7		440	
3203	Evans Branch	7/10/2015	4	0.5	0	7.3	8.1	19	410	G
3203	Evans Branch	8/7/2015	3	0.1	0	7.8	8.2	20	400	
3203	Evans Branch	9/11/2015	2	1	0	8	8.3	19	390	
3211	Silver Creek	9/11/2015	2	1.5	1	7.1	8	25	310	G
3214	Glenns Creek	7/11/2015	5							Y
3214	Glenns Creek	9/14/2015	3	zero	0	8.4	7.4	15	**690**	
3216	Unnamed Tributary	7/11/2015	3	0.5	2	8.2	7.7	17	**520**	Y
3216	Unnamed Tributary	8/6/2015	3	1	2	6	7.5	19.5	440	
3216	Unnamed Tributary	9/11/2015	3	1	1	3.8	7.5	19	**590**	
3221	Lower Devil Creek	7/12/2015	5							no data
3222	Unnamed Tributary	7/12/2015	4	1	2	7.4	7.5	14	140	G
3222	Unnamed Tributary	8/6/2015	3	1.5	0	7	7.1	15	90	
3222	Unnamed Tributary	9/13/2015	2	0.5	1	7.8	7	14	100	
3223	Unnamed Tributary	7/12/2015	4	1	2	7.8	7.5	14	100?	G
3223	Unnamed Tributary	8/6/2015	3	1.5	3	7.4	7.1	17	100?	
3223	Unnamed Tributary	9/13/2015	2	0.5	0	8.4	7.3	14	100?	
3224	Unnamed Tributary	7/12/2015	4	1	3	7.2	7.5	14	120	G
3224	Unnamed Tributary	8/6/2015	3	1.5	0	6.5	6.8	19.9	130	
3224	Unnamed Tributary	9/13/2015	2	0.5	1	8	7.5	15	120	
3225	Creek	7/12/2015	4	1	2	7.8	7.5	15	110	G
3225	Creek	8/6/2015	3	1.5	0	7.6	7.3	16	120	
3225	Creek	9/13/2015	2	0.5	1	8.2	8	15	180	
3252	South Elkhorn Creek	8/7/2015	3	0.5	0	7	7.8	18.9	380	G
3252	South Elkhorn Creek	9/11/2015	2	0.5	0	5.8	7.6	18	500	
3271	North Fork Kentucky River	8/7/2015	3	0.5	3	10	7.4	23	**870**	Y
3282	Elkhorn Creek	7/11/2015	5	>1.5	3	5.1	7	20	370	G
3283	Lower Howards Creek	7/10/2015	3	0.5	0	6.9	7.5	20	**760**	Y
3283	Lower Howard Creek	8/8/2015	3	1.5	0		8	19	**710**	
3283	Lower Howard Creek	9/12/2015	2	0.5	0	**4**	8	17	**810**	
3296	Kentucky River	8/7/2015	4	1	3	8.6	7	23	400	G
3298	Red Lick Creek	8/7/2015	4	>1.5	2	5.8	7.4	22	250	G
3298	Red Lick Creek	9/11/2015	4	>1.5	2	5.2	7.5	23	270	
3299	Locust Branch	8/7/2015	4	>1.5	2	7.8	7.4	20	220	G
3299	Locust Branch	9/11/2015	3	>1.5	0	7.1	7.4	20	350	
3300	Ross Creek	9/11/2015	2	>1.5	1	7.6	7.9	18.5	**800**	Y
3313	Elkhorn Creek	9/14/2015	3	zero	1	5.8	7	18	**650**	Y
3343	Buck Lick Branch	9/11/2015	2	>1.5	1	7.4	8.4	20	**800**	Y
3349	Waterside Lake	5/15/2015	3	zero	0	6	7.25	26	360	Y
3349	Waterside Lake	8/8/2015	2	0.5	0	**4.5**	7.25	25	370	
3349	Waterside Lake	9/11/2015	2	1	0	5.5	7.25	27	410	

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L) **	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*	Assessment
3350	Town Creek	5/16/2015	2	0.1	0	7.1	7.35	23	**660**	Y
3350	Town Creek	7/10/2015	2	0.1	0	6.2	6.8	16	**690**	
3350	Town Creek	8/8/2015	2	zero	0	6	7	17	**670**	
3350	Town Creek	9/15/2015	2	zero	0	7	7.3	20	**670**	
3352	Company Branch	8/8/2015	3	0.1	1	5	7	15	**771**	Y
3357	Kentucky River	9/20/2015	3	zero	1					no data
3358	Kentucky River	9/20/2015	3	zero	1					no data
3363	Silver Creek	5/15/2015	3	zero	0	7.4	7.5	18	350	G
3363	Silver Creek	7/12/2015	3	0.5	0	6	7.3	21	250	
3364	Station Camp Creek	5/15/2015	3	0.1	0	7.6	6.5	18	210	G
3364	Station Camp Creek	7/10/2015	4	0.5	0	8	6.5	20	160	
3364	Station Camp Creek	8/7/2015	4	>1.5	0	7.2	6	23	290	
3364	Station Camp Creek	9/11/2015	2	1	0	5.2	6	24	330	
3366	Hill & Dale Kids Creek	5/16/2015	3		1	6	7.5	23	90	G
3366	Hill & Dale Kids Creek	7/11/2015	4	1	1	5.2	7.25	19.5	410	
3366	Hill & Dale Kids Creek	8/8/2015	1	0.1	1	7	7.75	23	460	
3366	Hill & Dale Kids Creek	9/10/2015	3	0.5	0	6.8	8	23	**515**	
3369	Kentucky River	5/15/2015	3	zero	1	8.86	8.03	20.6	380	R
3369	Kentucky River	7/9/2015	4	1	3	6.5	7.67	24.5	**950**	
3369	Kentucky River	8/6/2015	3	0.5	1	6.36	7.28	26	**1420**	
3369	Kentucky River	9/15/2015	2	zero	0	**4.13**	7.53	24.3	350	
3370	Notch Lick	5/16/2015	2	zero	1	5.4	8.1	18	**610**	R
3370	Notch Lick	7/9/2015	3	1	1	6.4	8	18	**610**	
3370	Notch Lick	8/6/2015	1	0.5	1	**2.4**	7.8	22	**640**	
3370	Notch Lick	9/14/2015	1		0	**3.4**	7.7	18	**630**	
3371	Locust Creek	5/16/2015	2	zero	1	6.6	8.3	21	**510**	Y
3371	Locust Creek	7/9/2015	3	1	1	7.4	8.4	19	**590**	
3371	Locust Creek	8/6/2015	2	0.5	1	**2.5**	7.6	24	**530**	
3371	Locust Creek	9/14/2015	1		1	6	7.6	21	**520**	
3373	Kentucky River	5/15/2015	3	zero	1	8.83	7.88	20.2	380	Y
3373	Kentucky River	7/9/2015	4	1	3	6.75	7.58	23.7	**890**	
3373	Kentucky River	8/6/2015	3	0.5	1	6.18	7.72	25.7	310	
3375	Retention Pond	9/12/2015	2	1	0	5	7.3	18	**870**	Y
3390	Wildcat Chase	5/16/2015	2	0.1	0	10.7	8	24	**770**	Y
3390	Wildcat Chase	7/11/2015	3	1	1	6.9	8	23.5	**890**	
3390	Wildcat Chase	8/8/2015	3		1	7.5	7.7	23	**780**	
3390	Wildcat Chase	9/12/2015	0	1						
3393	Middle Fork Kentucky River	8/7/2015	4		3	7	7	20	450	Y
3394	Big Creek	7/9/2015	4	>1.5	1	9	7.5	18	160	G
3395	Osborne Fork	7/9/2015	3	>1.5	2	5.1	7.5	21	130	G
3395	Osborne Fork	8/7/2015	4	1	1	7	8	20	190	
3396	Hollins Fork	7/9/2015		>1.5		5	7.3	20	120	G
3396	Hollins Fork	8/7/2015	4	1	1	7.1	8.1	20.5	200	
3397	Middle Fork Kentucky River	7/9/2015	4	>1.5	3	9.5	7.6	20	210	G
3398	Rockhouse Creek	7/9/2015	4	>1.5	3	10	7.5	25	170	G
3400	Bull Creek	7/9/2015	3	>1.5	1	8.2	7.6	17.9	140	G
3400	Bull Creek	8/7/2015	3		1	7	7	18.9	210	
3401	Cutshin Creek	7/9/2015	4	>1.5	3	10	7.5	25	**840**	Y
3402	Middle Fork Kentucky River	7/9/2015	3	1	2	6	7.5	20	290	G
3403	Middle Fork Kentucky River	7/9/2015	3	1	1	**3**	7.5	20	**510**	Y
3404	Stone Coal Branch	8/7/2015	3		0	8.5	7	19.9	140	G
3405	Beech Fork	7/9/2015	3	>1.5	1	7.2	8	20	160	G
3406	Cutshin Creek	7/9/2015	4	>1.5	3	11	7.4	20	380	G

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L) **	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*	Assessment
3407	Ohio River	7/9/2015	4	>1.5	3	6.2	7.8	22	305	G
3410	South Elkhorn Creek	8/8/2015	4		1	**4.6**	8.1	21	**580**	Y
3410	South Elkhorn Creek	9/11/2015	3	0.5	0	6.4	8	24	**690**	Y
3413	Red Lick Creek	7/11/2015	3	0.5	1	6.2	7.5	23	290	G
3414	Red Lick Creek	7/8/2015	3	0.5	2	6.8	7.7	22	270	G
3415	Clear Creek	7/11/2015	3	1	0	8.2	7.5	20	250	G
3415	Clear Creek	8/8/2015	3		0	6.6	7.5	19.5	240	
3415	Clear Creek	9/12/2015	2	0.5	0	6.4	7.5	19.5	260	
3416	Spring	7/11/2015		1		6.3	7.5	23	340	G
3416	Spring	9/12/2015	3	0.5	0	6	7.5	19	350	
3419	Unnamed Tributary	7/11/2015	3		2	6.6	7	20	100	G
3432	Scherer Hollow	8/7/2015	3	>1.5	0	8.4	7.8	18.9	180	G
3432	Scherer Hollow	9/11/2015	3		0	8.2	8	19	220	
3433	Owsley Fork	8/7/2015	3	>1.5	1	7.6	8.3	18.9	410	Y
3433	Owsley Fork	9/11/2015	2	>1.5	0	**4.9**	7.4	20.5	**540**	
3434	Unnamed Tributary	8/7/2015	3	1	1	8	7.8	20	380	G
3438	Spring	8/7/2015	4	>1.5	2	**2.5**	7.2	14	390	Y
3438	Spring	9/14/2015	2	0.1	1	**1.3**	7.8	14	440	
3439	Unnamed Tributary	8/7/2015	3	>1.5	1	**3.5**	7.8	19	310	Y
3439	Unnamed Tributary	9/14/2015	2	0.1	0	**1.4**	7.6	14	350	
3440	Unnamed Tributary	8/7/2015	3	>1.5	1	**2**	7.7	17	310	Y
3440	Unnamed Tributary	9/14/2015		0.1	1	**1.4**	7.6	15	430	
3441	Clear Creek	8/7/2015	3	>1.5	0	9	7.3	14	210	G
3441	Clear Creek	9/14/2015	3	0.1	0	**2**	7.7	13	200	
3442	Unnamed Tributary	8/7/2015	3	>1.5	0	**2.1**	7.8	17	200	Y
3442	Unnamed Tributary	9/14/2015	2	0.1		**0.4**	7.7	13	210	
3446	Unnamed Tributary	8/8/2015	3		1	**3.4**	7.2	20	220	Y
3446	Unnamed Tributary	9/14/2015	2		1	**2**	7.3	15	230	
3449	Elkhorn Creek	8/8/2015	3	0.5	2	7.2	8	23	480	Y
3449	Elkhorn Creek	9/13/2015	2	0.5	0	9	8	19	**740**	
3450	Benson Creek	8/8/2015	2	0.5	0	10	8.5	24	340	G

Table B3

Spring 2015 KRWW Pesticide Sampling Results

Sample ID	Collection Date/time	Stream	County	Triazines by Immunoassay (micrograms/L)
3349	5/15/2015 11:00	Waterside Lake	Fayette	Less Than MDL
3350	5/16/2015 9:53	Town Creek	Jessamine	0.13
3363	5/15/2015 9:45	Silver Creek	Madison	Less Than MDL
3364	5/15/2015 9:15	Station Camp Creek	Estill	Less Than MDL
3366	5/16/2015 15:00	Hill & Dale Kids Creek	Fayette	0.34
3369	5/15/2015 10:30	Kentucky River	Carroll	Less Than MDL
3370	5/16/2015 10:57	Notch Lick	Carroll	Less Than MDL
3371	5/16/2015 11:45	Locust Creek	Carroll	Less Than MDL
3373	5/15/2015 9:30	Kentucky River	Owen	Less Than MDL
3375	5/16/2015 10:27	Retention Pond	Fayette	Less Than MDL

MDL = Method Detection Limit, Results of Less than MDL are less than 0.06 micrograms/L, which is the laboratory's minimum detection limit for Triazines.

Water Quality Standards for Triazines

Drinking Water Supply Source = 3.0 micrograms/L
Acute (Short-Term Exposure) Aquatic Life = 350 micrograms/L
Chronic (Long-Term Exposure) Aquatic Life = 12 micrograms/L

Table B4

2015 KRWW Pathogen Sampling Results (July & August)

Site ID#	Stream Name	County	July E. coli Results (CFU/100 ml)	July Flow Rate	July 48-Hour Recorded Rainfall (inches)	August (Follow-Up) E. coli Results (CFU/100 ml)	August Flow Rate	August 48-Hour Recorded Rainfall (inches)
741	Lees Branch	Woodford	**7,308**	3				
744	Cane Run	Scott	**1,022**	4	0.5	**1,187**		1
753	Clarks Run	Boyle	**7,270**			**689**	4	0.5
755	North Elkhorn Creek	Scott	146	4	1	**2,489**	4	0.5
763	South Elkhorn Ck	Fayette	**1,204**	4		**601**	3	0.5
765	South Elkhorn Ck	Scott	**242**	4	>1.5	**584**	4	1.5
767	Clear Creek	Woodford	**7,746**	5	>1.5			
772	Unnamed Trib	Scott	**476**	4	>1.5	214	3	1.5
786	Eagle Creek	Carroll	**1,733**	5	>1.5	131	3	
793	McConnells Spring	Fayette	**3,255**	2	0.5	**820**	2	
801	North Fork Kentucky River	Letcher				**1,414**	3	
802	Pine Creek	Letcher				**395**	3	
803	Cram Creek	Letcher				**959**	3	
811	Steeles Branch	Fayette	**794**	3	0.5	**1,081**	3	0.5
815	Cane Creek	Menifee	**1,334**	4	>1.5	160	3	1
820	North Fork Kentucky River	Perry	**1,071**	3	0.5	**3,448**	4	1
823	Glenns Creek	Woodford				**976**	4	
825	War Fork	Jackson	**546**	3	1			
827	Quicksand Creek	Breathitt	**801**	4	0.5	**650**	4	0.5
831	Lower Red River	Estill	**933**	4	1	**907**	4	1
832	Red River	Powell	**1,223**	4	1	**1,223**	4	1
833	Spring	Woodford				**264**	4	
848	North Fork Kentucky River	Letcher				**620**	3	
850	Colley Creek	Letcher				**368**	3	
851	Allen Branch	Letcher				20	3	
861	Glenns Creek	Woodford				**590**	4	
869	Maces Creek	Perry	**249**		0.5	**281**		
875	Right Fork Carr Creek	Perry	**364**	3	0.5	**2,755**	4	1
891	North Elkhorn Creek	Scott	**644**	4	1	**839**	4	1
914	Holly Spring	Fayette	101	3	0.5			
915	Wolf Run	Fayette	**988**	3	0.5	**2,046**	3	1
918	Muddy Creek	Madison	**305**	4	1	**272**	4	1
921	Otter Creek	Madison	**855**	4	0.5			
940	Big Sinking Creek	Lee				**259**	3	0.5
941	Deep Branch Creek	Clark	**281**		0.5			
942	Lower Howard Creek	Clark	**556**	4	0.5			
943	Quicksand Creek	Breathitt	**1,723**	4	0.5	**583**	4	0.5
944	South Fork Quicksand Creek	Breathitt	**663**			**703**		
954	Spring	Woodford				62	4	
955	Elk LIck Creek	Fayette	**285**	4	0.5	**464**	3	
963	Knoblick Creek	Lincoln	**2,187**	4		**780**	3	0.5
978	Muddy Creek	Madison	**594**	4	1	**857**		

Flow Rate:	
0	Dry
1	Ponded
2	Low
3	Normal
4	Bank Full
5	Flood

Safe Swimming Standard:
240 cfu/100 ml
Standard exceedances are noted in bold text.

Site ID#	Stream Name	County	July E. coli Results (CFU/100 ml)	July Flow Rate	July 48-Hour Recorded Rainfall (inches)	August (Follow-Up) E. coli Results (CFU/100 ml)	August Flow Rate	August 48-Hour Recorded Rainfall (inches)
982	Lanes Run	Scott	**1,376**	4	1			
984	Twin Creek	Estill	**305**	4	1	226	3	0.5
990	Unnamed Tributary	Madison	**>24,196**	3	0.5	**1,935**		
1018	Penitentiary Branch	Franklin	**?**	4	1			
1028	Wolf Run	Fayette	**1,616**	2	1	10	3	
1048	Shannon Run	Woodford	**1,466**	5	>1.5			
1124	Marble Creek	Jessamine	**504**	4	1.5	2		
1127	Unnamed Tributary	Fayette	Non-detect	3	0.5			
1128	Cardinal Run	Fayette	**1,162**	3	>1.5	**538**	3	0.5
1129	Cardinal Run	Fayette	**1,223**	3		**1,334**	3	
1131	Wolf Run	Fayette	**1,162**	3	1	**613**	3	0.5
1132	Wolf Run	Fayette	**4,106**	3	>1.5	**1,046**	3	0.5
1133	Wolf Run	Fayette	**1,259**	3	1	**520**	3	0.5
1134	Spring Branch	Fayette				**591**	3	
1135	Wolf Run	Fayette				**4,884**	2	
1136	Culvert	Fayette	**512**		>1.5	**1,722**	3	1
1137	Vaughns Branch	Fayette	**2,723**	3	>1.5	**1,178**	3	0.5
1138	Vaughns Spring	Fayette	**1,850**	1	0.5	**3,448**	3	1
1139	Vaughns Branch	Fayette	**959**	3	0.5	**5,794**	3	0.5
1148	Little Dry Fork	Letcher				Non-detect	3	
1151	Cram Creek	Letcher				**>24196**	2	
1152	Cram Creek	Letcher				**670**	3	
1174	Royal Springs	Scott	**305**	4	1	**>24196**	3	1
1175	Calloway Creek	Madison	**1,616**	3	1	**457**	3	0.5
1184	Spring Branch	Fayette	**1,145**	3	0.5	**1,354**	3	0.5
1185	North Fork Kentucky River	Letcher				**594**	3	
1191	Kentucky River	Mercer	**292**	4	0.5	62	4	1
1195	Lees Branch	Woodford	**6,152**	2				
1199	Vaughns Branch	Fayette	**14,136**	3	0.5	**7,701**	3	0.5
1221	Cane Run	Scott	**3,654**	4	1	**1,371**	4	1
1246	Cardinal Run	Fayette	Non-detect	3				
1274	Elk Lick Creek	Fayette	160	4	0.5			
1301	North Elkhorn Ck	Scott	192	4	1			
1307	Jessamine Creek	Jessamine	**669**	4		228	2	
1314	Wolf Run	Fayette	**4,352**	3	1	**3,076**	3	0.5
2925	Brushy Fork	Madison				**1,112**	3	>1.5
2970	Prestons Cave Spring	Fayette	**2,282**	4	1	**860**		
3004	Vaughns Branch	Fayette	**4,884**	3	1	**908**	3	0.5
3005	McConnell Branch	Fayette	**17,329**	2	0.5	**7,270**	1	0.5
3006	Lower Howard Creek	Clark	**836**	4	0.5			
3007	Lower Howard Creek	Clark	**910**	4	0.5			
3059	Gardenside Branch	Fayette	**1,565**	3		**1,296**	8	
3060	Vaughns Branch	Fayette	**1,565**	4	1	**4,884**	3	0.5
3128	Unnamed Tributary	Fayette				**464**	3	1
3137	Wolf Run	Fayette	**235**	3	1	173	3	0.5
3180	Spring	Franklin	218	3	0.5			
3198	Clear Creek	Mercer	220	4	>1.5			
3203	Evans Branch	Fayette	**416**	4	0.5	171	3	
3216	Unnamed Tributary	Fayette	**3,448**	3	0.5			
3222	Unnamed Trib	Wolfe	**19,560**	4	1	**448**	3	1.5
3223	Unnamed Trib	Wolfe	**2,924**	4	1	**3,255**	3	1.5
3224	Middle Fork of Lower Devils Creek	Wolfe	**30,760**	4	1	**359**	3	1.5
3225	Middle Fork of Lower Devils Creek	Wolfe	**2,382**	4	1	**1,236**	3	1.5
3252	South Elkhorn Creek	Jessamine				132	3	0.5

Site ID#	Stream Name	County	July E. coli Results (CFU/100 ml)	July Flow Rate	July 48-Hour Recorded Rainfall (inches)	August (Follow-Up) E. coli Results (CFU/100 ml)	August Flow Rate	August 48-Hour Recorded Rainfall (inches)
3271	North Fork Kentucky River	Breathit				63	3	0.5
3282	Elkhorn Creek	Franklin	**7,746**	5	>1.5			
3283	Headwaters Lower Howard Creek	Clark	**2,224**	3	0.5	**399**	3	1.5
3296	Kentucky River	Estill				**749**	4	1
3298	Red Lick Creek	Estill				**1,785**	4	>1.5
3299	Locust Branch	Estill				**907**	4	>1.5
3349	Waterside Lake	Fayette				20	2	0.5
3350	Town Creek	Jessamine	**2,359**	2		**663**	2	
3352	Company Branch	Letcher				**1,722**	3	
3363	Silver Creek	Madison	**855**	3	0.5			
3364	Station Camp Creek	Estill	**295**	4	0.5	195	4	>1.5
3366	Hill & Dale Kids Creek	Fayette	**754**	4	1	**624**	1	
3369	Kentucky River	Carroll	**2,909**	4	1	150	1	
3370	Notch Lick	Carroll	**613**	3	1	**687**	1	0.5
3371	Locust Creek	Carroll	**816**	3	1	**580**	1	0.5
3373	Kentucky River	Owen	**1,187**	4	1	96	3	0.5
3390	Wildcat Chase	Fayette	**932**	3	1	185	3	
3393	Middle Fork Kentucky River	Leslie				**933**	4	
3394	Big Creek	Leslie	228	4	>1.5			
3395	Osborne Fork	Leslie	**529**	3	>1.5	**1,515**	4	1
3396	Hollins Fork	Leslie	**598**		>1.5	**1,664**	4	1
3397	Middle Fork Kentucky River	Leslie	**323**	4	>1.5			
3398	Rockhouse Creek	Leslie	146	4	>1.5			
3400	Bull Creek	Leslie	**414**	3	>1.5	**488**	3	
3401	Cutshin Creek	Leslie	**676**	4	>1.5			
3402	Middle Fork Kentucky River	Leslie	148	3	1			
3403	Middle Fork Kentucky River	Leslie	86	3	1			
3404	Stone Coal Branch	Leslie				**393**	3	
3405	Beech Fork	Leslie	84	3	>1.5			
3406	Cutshin Creek	Leslie	**402**	4	>1.5			
3407	Ohio River	Carroll	172	4	>1.5			
3410	South Elkhorn Ck	Franklin				**296**	4	
3413	Red Lick Creek	Madison	**2,410**	3	0.5			
3415	Clear Creek	Rockcastle	**282**	3	0.5	**3,448**		
3416	Spring	Rockcastle	Non-detect		1			
3419	Unnamed Tributary	Jackson	**309**	3				
3432	Scherer Hollow	Rockcastle				97	3	>1.5
3433	Owsley Fork	Jackson				**341**	3	>1.5
3434	Unnamed Tributary	Estill				**327**	3	1
3438	Spring	Rockcastle				**>24,196**	4	>1.5
3439	Unnamed Tributary	Rockcastle				**393**	4	>1.5
3440	Unnamed Tributary	Rockcastle				**2,909**	3	>1.5
3441	Clear Creek	Rockcastle				98	3	>1.5
3442	Unnamed Tributary	Rockcastle				148	3	>1.5
3446	Unnamed Tributary	Madison				107	3	
3449	Elkhorn Creek	Fayette				**482**	3	0.5
3450	Benson Creek	Franklin				**268**	2	0.5

Table B5

2015 KRWW Chemical Sampling Results - KGS

Site ID#	Collection Date/time	Stream	County	Alkalinity	Chloride	Conductivity	Total Suspended Solids	Sulfate	Assessment
Method Detection Limit (MDL)				2 mg/L	1.0 mg/L	1 mS/cm	3 mg/L	5.00 mg/L	
Water Quality Standard/ Benchmark				**Aquatic Life should be >20**	**Drinking Water Supply=250 Acute Aquatic Life=1,200 Chronic Aquatic Life= 600**	**Aquatic Life Benchmark= 500 microsiemens/ cm***	**No Std. Available**	**Drinking Water Supply= 250 mg/L**	**R (red) = poor Y (yellow) = fair G (green) = good**
744	9/11/2015	Cane Run	Scott	193	41.9	**549**	4	33.7	G
755	9/11/2015	North Elkhorn Creek	Scott	180	62.2	**681**	3	50.6	Y
793	9/13/2015	McConnell Spring	Fayette	194	98.1	**766**	65	77.4	Y
801	9/11/2015	North Fork Kentucky River	Letcher	201	15	**923**	4	**303**	R
802	9/11/2015	Pine Creek	Letcher	175	7.97	**629**	Less Than MDL	174	Y
803	9/11/2015	Cram Creek	Letcher	197	6.16	494	Less Than MDL	65.6	G
810	9/11/2015	South Elkhorn Creek	Fayette	181	37.4	**576**	Less Than MDL	40.8	Y
811	9/11/2015	Steeles Branch	Fayette	198	22.6	409	Less Than MDL	28.3	G
814	9/14/2015	Red River	Powell	71	8.59	206	9	19.8	G
815	9/14/2015	Cane Creek	Menifee	109	2.34	226	7	10.5	G
831	9/11/2015	Lower Red River	Estill	79	10.1	234	13	16.8	G
832	9/11/2015	Red River	Powell	82	12.4	234	30	11.5	G
891	9/11/2015	North Elkhorn Creek	Scott	191	38.7	**590**	5	41.5	Y
914	9/11/2015	Holly Spring	Fayette	175	42.9	**568**	Less Than MDL	39.2	Y
915	9/11/2015	Wolf Run	Fayette	200	68.8	**728**	Less Than MDL	64.8	Y
918	9/11/2015	Muddy Creek	Madison	203	21.2	433	28	9.7	G
921	9/12/2015	Otter Creek	Madison	87	11.3	246	34	26.8	G
938	9/11/2015	Silver Creek	Madison	137	32.2	439	7	44.1	G
955	9/11/2015	Elk Lick Creek	Fayette	199	45.6	**711**	16	97.2	Y
978	9/11/2015	Muddy Creek	Madison	187	10.9	389	4	13.6	G
982	9/14/2015	Lanes Run	Scott	217	94.6	**821**	9	75.5	Y
984	9/11/2015	Twin Creek	Estill	192	6.83	439	Less Than MDL	25.2	G
990	9/11/2015	Unnamed Tributary	Madison	271	64.8	**793**	49	57	Y
1028	9/13/2015	Wolf Run	Fayette	210	73.8	**745**	12	96.8	Y
1128	9/12/2015	Cardinal Run	Fayette	220	52.3	**630**	Less Than MDL	34.6	Y
1129	9/11/2015	Cardinal Run	Fayette	190	36.1	**538**	4	68.7	Y
1132	9/12/2015	Wolf Run	Fayette	198	45.2	**582**	4	75.9	Y
1133	9/12/2015	Wolf Run	Fayette	134	51.5	485	4	47.6	G
1134	9/11/2015	Spring Branch	Fayette	209	50	**659**	Less Than MDL	59	Y
1135	9/11/2015	Wolf Run	Fayette	191	91.4	**807**	Less Than MDL	70	Y
1137	9/12/2015	Vaughns Branch	Fayette	211	74.1	**682**	6	48.7	Y
1138	9/11/2015	Vaughns Branch	Fayette	180	41	**525**	8	30.8	Y
1139	9/14/2015	Vaughns Branch	Fayette	182	197	**1261**	13	216	R
1151	9/11/2015	Cram Creek	Letcher	249	4.83	**584**	6	82.2	Y
1152	9/11/2015	Cram Creek	Letcher	147	7.53	394	6	54.8	G
1174	9/11/2015	Royal Springs	Scott	205	47.6	**675**	24	75.1	Y
1175	9/11/2015	Calloway Creek	Madison	218	30.7	**581**	20	55.8	Y
1199	9/13/2015	Vaughns Branch	Fayette	130	102	**843**	11	181	Y
1221	9/11/2015	Cane Run	Scott	209	36.4	**595**	Less Than MDL	52.4	Y
1270	9/11/2015	Unnamed Tributary	Lincoln	225	13.2	471	Less Than MDL	18.7	G
1271	9/10/2015	Herrington Lake	Mercer	80	6.93	301	3	68.7	G
1274	9/11/2015	Elk Lick Creek	Fayette	223	102	**1078**	8	206	Y
1275	9/11/2015	Unnamed Tributary	Fayette	173	71.5	**636**	Less Than MDL	43.4	Y
1301	9/13/2015	North Elkhorn Creek	Scott	204	60.9	**639**	10	48.7	Y
1314	9/12/2015	Wolf Run	Fayette	192	47.8	**589**	5	56.5	Y
2925	9/11/2015	Brushy Fork	Madison	71	19.1	332	11	71.5	G

Site ID#	Collection Date/time	Stream	County	Alkalinity	Chloride	Conductivity	Total Suspended Solids	Sulfate	Assessment
2954	9/11/2015	St. Asaph's Creek	Lincoln	85	6.81	232	Less Than MDL	9.83	R
3059	9/11/2015	Gardenside Branch	Fayette	167	37.2	**600**	7	95.1	Y
3060	9/13/2015	Vaughns Branch	Fayette	168	99.2	**850**	9	148	Y
3137	9/10/2015	Wolf Run	Fayette	168	139	**875**	Less Than MDL	53.4	Y
3139	9/13/2015	Town Branch	Fayette	200	106	**886**	9	119	Y
3203	9/11/2015	Evans Branch	Fayette	188	10.8	434	4	29.3	G
3211	9/11/2015	Silver Creek	Madison	92	14.1	300	10	42.2	G
3216	9/11/2015	Unnamed Tributary	Fayette	183	40.5	**561**	5	47.6	Y
3222	9/13/2015	Unnamed Tributary	Wolfe	25	10.8	96	7	10.3	G
3223	9/13/2015	Unnamed Tributary	Wolfe	32	5.9	100	5	11.9	G
3224	9/13/2015	Unnamed Tributary	Wolfe	42	7.08	118	7	11.1	G
3225	9/13/2015	Middle Fork Lower Devil Cr	Wolfe	64	14.7	177	8	10.2	G
3283	9/12/2015	Lower Howards Creek	Clark	238	55.4	**849**	10	144	Y
3298	9/11/2015	Red Lick Creek	Estill	88	5.54	243	37	25.5	G
3299	9/11/2015	Locust Branch	Estill	85	12.5	308	4	53.9	G
3343	9/11/2015	Buck Lick Branch	Lee	153	4.98	317	Less Than MDL	9.41	G
3349	9/11/2015	Waterside Lake	Fayette	134	20.6	347	6	19.1	G
3364	9/11/2015	Station Camp Creek	Estill	126	5.02	281	Less Than MDL	16.9	G
3366	9/10/2015	Hill-N-Dale Kids Creek	Fayette	189	40.2	**568**	4	42.7	Y
3375	9/12/2015	Retention Pond	Fayette	248	152	**870**	9	38.8	Y
3415	9/12/2015	Clear Creek	Rockcastle	118	3.74	237	7	9.96	G
3416	9/12/2015	Spring Branch	Rockcastle	180	2.09	278	5	5.73	G
3432	9/11/2015	Scherer Hollow	Rockcastle	115	2.69	223	6	8.87	G
3433	9/11/2015	Owsley Fork	Jackson	219	7.83	360	6	14.6	G
3438	9/14/2015	Spring	Rockcastle	209	7.05	422	16	27.8	G
3439	9/14/2015	Unnamed Tributary	Rockcastle	178	4.58	279	5	6.64	G
3440	9/14/2015	Unnamed Tributary	Rockcastle	204	7.51	397	10	6.56	G
3441	9/14/2015	Clear Creek	Rockcastle	150	1.77	231	Less Than MDL	7.69	G
3442	9/14/2015	Unnamed Tributary	Rockcastle	160	1.88	203	Less Than MDL	6.16	G
3446	9/14/2015	Unnamed Tributary	Madison	54	2.77	215	Less Than MDL	67.5	G

* There is no official Kentucky water quality standard for conductivity. 500 micromohs/cm is a benchmark level that has been shown to have detrimental effects on aquatic life.

NOTES:

1) Highest values for each parameter are shaded.

2) Bolded values exceed a water quality standard or benchmark.

Table B6

2015 KRWW Chemical Sampling Results - Fouser

Site ID#	Collection Date/time	Stream	County	Alkalinity	Chloride	Conductivity	Total Suspended Solids	Sulfate	Assessment
Method Detection Limit (MDL)				10 mg/L	1 mg/L	10 mS/cm	2 mg/L	1 mg/L	
Water Quality Standard/ Benchmark				Aquatic Life should be >20	Drinking Water Supply=250 Acute Aquatic Life=1,200 Chronic Aquatic Life= 600	Aquatic Life Benchmark= 500 microsiemens/cm*	No Std. Available	Drinking Water Supply= 250 mg/L	R (red) = poor Y (yellow) = fair G (green) = good
741	9/11/2015	Lees Branch	Woodford	187	12	478	<2	16	G
763	9/11/2015	South Elkhorn Ck	Fayette	160	31	449	<2	33	G
765	9/12/2015	South Elkhorn Ck	Scott	*No sample taken, stream dry.*					
772	9/11/2015	Unnamed Triburary	Scott	114	32	405	<2	36	G
796	9/11/2015	Spring Station	Woodford	185	14	487	<2	15	G
823	9/23/2015	Glenns Creek	Woodford	179	110	**857**	<2	83	Y
833	9/23/2015	Spring	Woodford	28	3	**547**	<2	13	Y
861	9/23/2015	Glenns Creek	Woodford	184	100	**803**	<2	75	Y
954	9/23/2015	Spring	Woodford	31	11	**628**	5	26	Y
999	9/11/2015	Elkhorn Creek	Franklin	146	85	**822**	<2	120	Y
1000	9/11/2015	Elkhorn Creek	Franklin	170	40	**534**	<2	39	Y
1014	9/14/2015	Elkhorn Creek	Franklin	155	60	**678**	<2	79	Y
1018	9/14/2015	Penitentiary Branch	Franklin	184	47	**643**	<2	46	Y
1048	9/11/2015	Shannon Run	Woodford	187	17	488	<2	19	G
1195	9/11/2015	Lees Branch	Woodford	184	6	448	<2	13	G
1307	9/15/2015	Jessamine Creek	Jessamine	171	28	**530**	<2	56	Y
3013	9/11/2015	Shannon Run	Woodford	185	18	469	<2	20	G
3144	9/11/2015	South Elkhorn Ck	Scott	131	32	426	<2	38	G
3198	9/11/2015	Clear Creek	Mercer	101	9	425	<2	104	G
3214	9/14/2015	Glenns Creek	Woodford	162	81	**687**	<2	59	Y
3252	9/11/2015	South Elkhorn Ck	Jessamine	193	14	469	<2	18	G
3313	9/14/2015	Elkhorn Creek	Franklin	152	57	**678**	<2	85	Y
3350	9/15/2015	Town Creek	Jessamine	193	42	**661**	<2	58	Y
3369	9/15/2015	Kentucky River	Carroll	102	9	346	7	58	G
3370	9/14/2015	Notch Lick	Carroll	195	21	**600**	<2	40	Y
3371	9/14/2015	Locust Creek	Carroll	164	16	499	<2	68	G
3410	9/11/2015	South Elkhorn Ck	Franklin	125	84	**854**	<2	136	Y
3449	9/13/2015	Elkhorn Creek	Franklin	157	62	**708**	3	88	Y

Table B7

2015 KRWW Nutrient Sampling Results (from KGS lab)

Site ID#	Collection Date/time	Stream	County	Nitrate (NO3)	Total Nitrogen	Total Recoverable Phosphorus	Assessment
Method Detection Limit (MDL)				0.1 mg/L	0.6 mg/L	0.03 mg/L	
Water Quality Standard/ Benchmark				Drinking Water Supply = 10 mg/L*	Aquatic Life Support = 3.0 mg/L**	Aquatic Life Support = 0.3 mg/L**	**R (red) = poor Y (yellow) = fair G (green) = good**
744	9/11/2015	Cane Run	Scott	0.5	1.25	**0.4**	Y
755	9/11/2015	North Elkhorn Creek	Scott	8.52	**4.03**	**0.7**	R
793	9/13/2015	McConnell Spring	Fayette	9.96	2.68	**1.34**	R
801	9/11/2015	North Fork Kentucky River	Letcher	1.79	0.64	0.05	Y
802	9/11/2015	Pine Creek	Letcher	0.19	Less Than MDL	**0.4**	Y
803	9/11/2015	Cram Creek	Letcher	0.94	Less Than MDL	0.03	G
810	9/11/2015	South Elkhorn Creek	Fayette	7.15	2.92	0.27	Y
811	9/11/2015	Steeles Branch	Fayette	8.11	2.11	**0.43**	Y
814	9/14/2015	Red River	Powell	0.75	Less Than MDL	0.03	G
815	9/14/2015	Cane Creek	Menifee	Less Than MDL	Less Than MDL	Less Than MDL	G
831	9/11/2015	Lower Red River	Estill	1.02	2.54	0.03	G
832	9/11/2015	Red River	Powell	1.07	1.06	0.05	G
891	9/11/2015	North Elkhorn Creek	Scott	4.57	2.35	0.24	G
914	9/11/2015	Holly Spring	Fayette	**16.4**	**5.82**	**0.44**	R
915	9/11/2015	Wolf Run	Fayette	**11.1**	**4.54**	0.29	Y
918	9/11/2015	Muddy Creek	Madison	Less Than MDL	Less Than MDL	0.08	G
921	9/12/2015	Otter Creek	Madison	2.49	1.2	0.16	G
938	9/11/2015	Silver Creek	Madison	0.61	0.6	0.15	G
955	9/11/2015	Elk Lick Creek	Fayette	0.93	1.93	**0.45**	Y
978	9/11/2015	Muddy Creek	Madison	Less Than MDL	Less Than MDL	0.04	G
982	9/14/2015	Lanes Run	Scott	**18.8**	**5.81**	0.26	R
984	9/11/2015	Twin Creek	Estill	Less Than MDL	2.29	Less Than MDL	G
990	9/11/2015	Unnamed Tributary	Madison	2.14	2.26	0.23	G
1028	9/13/2015	Wolf Run	Fayette	6.32	2.01	**0.4**	Y
1128	9/12/2015	Cardinal Run	Fayette	4.43	1.18	**0.36**	Y
1129	9/11/2015	Cardinal Run	Fayette	**11.5**	**3.03**	**0.46**	Y
1132	9/12/2015	Wolf Run	Fayette	3.72	1.46	0.3	G
1133	9/12/2015	Wolf Run	Fayette	4.23	1.45	0.15	G
1134	9/11/2015	Spring Branch	Fayette	**13.8**	**3.75**	0.3	Y
1135	9/11/2015	Wolf Run	Fayette	7.39	2.86	0.29	G
1137	9/12/2015	Vaughns Branch	Fayette	3.45	0.92	**0.35**	Y
1138	9/11/2015	Vaughns Branch	Fayette	7.42	**3.71**	**0.5**	Y
1139	9/14/2015	Vaughns Branch	Fayette	1.08	0.69	0.07	G
1151	9/11/2015	Cram Creek	Letcher	0.94	Less Than MDL	0.03	G
1152	9/11/2015	Cram Creek	Letcher	0.73	Less Than MDL	Less Than MDL	G
1174	9/11/2015	Royal Springs	Scott	6.24	**3.93**	**0.51**	Y
1175	9/11/2015	Calloway Creek	Madison	Less Than MDL	0.66	0.21	G
1199	9/13/2015	Vaughns Branch	Fayette	2.54	0.77	0.3	G
1221	9/11/2015	Cane Run	Scott	**16**	**6.11**	**0.96**	R
1270	9/11/2015	Unnamed Tributary	Lincoln	2.16	**3.53**	0.18	Y
1271	9/10/2015	Herrington Lake	Mercer	Less Than MDL	0.79	Less Than MDL	G

Site ID#	Collection Date/time	Stream	County	Nitrate (NO3)	Total Nitrogen	Total Recoverable Phosphorus	Assessment
1274	9/11/2015	Elk Lick Creek	Fayette	2.73	1.1	**0.35**	Y
1275	9/11/2015	Unnamed Tributary	Fayette	2.67	1	0.22	G
1301	9/13/2015	North Elkhorn Creek	Scott	7.04	2.29	**0.49**	Y
1314	9/12/2015	Wolf Run	Fayette	6.95	1.92	**0.32**	Y
2925	9/11/2015	Brushy Fork	Madison	0.92	Less Than MDL	0.03	G
2954	9/11/2015	St. Asaph's Creek	Lincoln	**16.3**	**4.21**	0.06	R
3059	9/11/2015	Gardenside Branch	Fayette	5.01	1.57	**0.37**	Y
3060	9/13/2015	Vaughns Branch	Fayette	2.5	1.51	**0.33**	Y
3137	9/10/2015	Wolf Run	Fayette	7.98	2.08	0.1	G
3139	9/13/2015	Town Branch	Fayette	**12.8**	**3.61**	**0.37**	Y
3203	9/11/2015	Evans Branch	Fayette	0.38	Less Than MDL	**0.41**	Y
3211	9/11/2015	Silver Creek	Madison	0.32	Less Than MDL	Less Than MDL	G
3216	9/11/2015	Unnamed Tributary	Fayette	5.03	1.87	**0.44**	Y
3222	9/13/2015	Unnamed Tributary	Wolfe	1.16	Less Than MDL	Less Than MDL	G
3223	9/13/2015	Unnamed Tributary	Wolfe	1.19	Less Than MDL	Less Than MDL	G
3224	9/13/2015	Unnamed Tributary	Wolfe	0.66	Less Than MDL	Less Than MDL	G
3225	9/13/2015	Middle Fork Lower Devil Cr	Wolfe	1.21	Less Than MDL	0.03	G
3283	9/12/2015	Lower Howards Creek	Clark	0.36	Less Than MDL	0.08	G
3298	9/11/2015	Red Lick Creek	Estill	0.69	1.04	0.17	G
3299	9/11/2015	Locust Branch	Estill	Less Than MDL	Less Than MDL	Less Than MDL	G
3343	9/11/2015	Buck Lick Branch	Lee	0.25	Less Than MDL	Less Than MDL	G
3349	9/11/2015	Waterside Lake	Fayette	0.79	1.18	0.27	G
3364	9/11/2015	Station Camp Creek	Estill	0.13	Less Than MDL	Less Than MDL	G
3366	9/10/2015	Hill-N-Dale Kids Creek	Fayette	**14.6**	**3.63**	0.24	R
3375	9/12/2015	Retention Pond	Fayette	2.16	1.21	**0.48**	Y
3415	9/12/2015	Clear Creek	Rockcastle	0.35	Less Than MDL	Less Than MDL	G
3416	9/12/2015	Spring Branch	Rockcastle	0.12	Less Than MDL	Less Than MDL	G
3432	9/11/2015	Scherer Hollow	Rockcastle	0.57	Less Than MDL	Less Than MDL	G
3433	9/11/2015	Owsley Fork	Jackson	0.47	Less Than MDL	Less Than MDL	G
3438	9/14/2015	Spring	Rockcastle	**18.1**	**4.55**	0.06	R
3439	9/14/2015	Unnamed Tributary	Rockcastle	0.62	Less Than MDL	Less Than MDL	G
3440	9/14/2015	Unnamed Tributary	Rockcastle	6.37	1.17	Less Than MDL	G
3441	9/14/2015	Clear Creek	Rockcastle	3.02	0.7	Less Than MDL	G
3442	9/14/2015	Unnamed Tributary	Rockcastle	1.56	Less Than MDL	Less Than MDL	G
3446	9/14/2015	Unnamed Tributary	Madison	0.62	Less Than MDL	Less Than MDL	G

NOTES:

* Kentucky Division of Water Water Quality Standard

* *Non-regulatory Kentucky River Watershed Watch Benchmark

1) Highest values for each parameter are shaded.

2) Bolded values exceed a water quality standard or benchmark.

Table B8

2015 KRWW Nutrient Sampling Results (from Fouser lab)

Site ID#	Collection Date	Stream	County	Nitrate-Nitrite (NO_3-NO_2)	Total Keldjahl Nitrogen (TKN)	Total Nitrogen	Total Recoverable Phosphorus	Assessment
Method Detection Limit (MDL)				1 mg/L	1 mg/L	2 mg/L *	0.03 mg/L	
Water Quality Standard/ Benchmark				N/A	N/A	Aquatic Life Support = 3.0 mg/L**	Aquatic Life Support = 0.3 mg/L**	**R (red) = poor Y (yellow) = fair G (green) = good**
741	9/11/2015	Lees Branch	Woodford	2	<1	*3.0*	**0.39**	Y
763	9/11/2015	South Elkhorn Ck	Fayette	2	<1	*2.0*	**0.35**	Y
765	9/12/2015	South Elkhorn Ck	Scott	*No sample taken, stream dry.*				
772	9/11/2015	Unnamed Triburary	Scott	2	<1	*3.0*	**0.81**	Y
796	9/11/2015	Spring Station	Woodford	3	<1	***4.0***	**0.4**	Y
823	9/23/2015	Glenns Creek	Woodford	4	4	***8.0***	**1.57**	R
833	9/23/2015	Spring	Woodford	3	1	***4.0***	**0.44**	Y
861	9/23/2015	Glenns Creek	Woodford	3	2	***5.0***	**1.26**	R
954	9/23/2015	Spring	Woodford	4	3	***7.0***	**0.43**	R
999	9/11/2015	Elkhorn Creek	Franklin	10	<1	***11.0***	**1.36**	R
1000	9/11/2015	Elkhorn Creek	Franklin	<1	<1	*2.0*	**0.31**	G
1014	9/14/2015	Elkhorn Creek	Franklin	5	10	***15.0***	**0.85**	R
1018	9/14/2015	Penitentiary Branch	Franklin	2	<1	*3.0*	0.24	G
1048	9/11/2015	Shannon Run	Woodford	5	<1	***6.0***	**0.33**	Y
1195	9/11/2015	Lees Branch	Woodford	2	<1	*3.0*	**0.41**	Y
1307	9/15/2015	Jessamine Creek	Jessamine	1	<1	*2.0*	<.125	G
3013	9/11/2015	Shannon Run	Woodford	5	<1	***6.0***	**0.32**	R
3144	9/11/2015	South Elkhorn Ck	Scott	2	<1	*3.0*	**0.75**	Y
3198	9/11/2015	Clear Creek	Mercer	<1	<1	*2.0*	<.125	G
3214	9/14/2015	Glenns Creek	Woodford	2	<1	*3.0*	**0.93**	Y
3252	9/11/2015	South Elkhorn Ck	Jessamine	1	<1	*2.0*	0.29	G
3313	9/14/2015	Elkhorn Creek	Franklin	5	<1	***6.0***	**0.82**	R
3350	9/15/2015	Town Creek	Jessamine	<1	<1	*2.0*	0.3	G
3369	9/15/2015	Kentucky River	Carroll	<1	<1	*2.0*	0.13	G
3370	9/14/2015	Notch Lick	Carroll	<1	<1	*2.0*	0.25	G
3371	9/14/2015	Locust Creek	Carroll	<1	<1	*2.0*	<.125	G
3410	9/11/2015	South Elkhorn Ck	Franklin	12	<1	***13.0***	**1.75**	R
3449	9/13/2015	Elkhorn Creek	Franklin	6	<1	***7.0***	**1**	R

* Value is an estimate, based on NO3-NO2 + TKN.

**Non-regulatory Kentucky River Watershed Watch Benchmark

1) Highest values for each parameter are shaded.

2) Bolded values exceed a water quality standard or benchmark.

Table 9

2015 KRWW Metal Sampling Results

Site ID#	Stream	County	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium
Method Detection Limit (MDL)			0.061 mg/L	0.012 mg/L	0.014 mg/L	0.003 mg/L	0.001 mg/L	0.008 mg/L	0.001 mg/L
Water Quality Standard/ Benchmark (mg/L) *AL=Aquatic Life Standard (Acute/Short-term and Chronic/Long-term) DWS=Drinking Water Supply Standard*			**0.75 (AL-acute)** *EPA recommended*	**0.0056 (DWS)**	**0.010 (DWS); 0.34 (AL-acute); 0.15 (AL - chronic)**	**1.0 (DWS)**	**0.004 (DWS)**	**N/A**	**0.005 (DWS); 0.0021 (AL-acute); 0.00027 (AL-chronic)**
744	Cane Run	Scott	0.09	**No detections.**	**No detections.**	0.04	**No detections.**	0.04	**No detections.**
755	North Elkhorn Creek	Scott	0.2			0.04		0.12	
793	McConnell Spring	Fayette	0.24			0.05		0.03	
802	Pine Creek	Letcher	0.09			0.06		0.03	
811	Steeles Branch	Fayette	0.08			0.03		0.02	
815	Cane Creek	Menifee	0.21			0.02		0.04	
820	North Fork Kentucky River	Perry	**9.26**			0.11		0.05	
827	Quicksand Creek	Breathitt	0.13			0.05		0.02	
848	North Fork Kentucky River	Letcher	0.061			0.07		0.05	
850	Colley Creek	Letcher	0.08			0.06		0.02	
875	Right Fork Carr Creek	Perry	0.1			0.05		0.03	
943	Quicksand Creek	Breathitt	0.1			0.05		0.02	
944	South Fork Quicksand Cr	Breathitt	0.28			0.05		0.03	
1139	Vaughns Branch	Fayette	Less than MDL			0.06		0.08	
1152	Cram Creek	Letcher	0.12			0.07		0.02	
1221	Cane Run	Scott	Less than MDL			0.03		0.07	
3300	Ross Creek	Lee	Less than MDL			0.03		0.02	
3349	Waterside Lake	Fayette	0.09			0.02		0.02	
3364	Station Camp Creek	Estill	0.07			0.04		0.01	
3415	Clear Creek	Rockcastle	Less than MDL			0.02		0.02	
3432	Scherer Hollow	Rockcastle	Less than MDL			0.02		Less than MDL	
3438	Spring	Rockcastle	0.51			0.02		0.02	
3439	Unnamed Tributary	Rockcastle	0.066			0.02		0.01	
3440	Unnamed Tributary	Rockcastle	0.4			0.02		0.01	
3441	Clear Creek	Rockcastle	0.42			0.01		0.01	
3442	Unnamed Tributary	Rockcastle	0.07			0.02		0.008	
3446	Unnamed Tributary	Madison	0.19			0.01		0.02	

NOTES:
1) Highest values for each parameter are shaded.
2) Bolded values exceed a water quality standard or benchmark.

2015 KRWW Metal Sampling Results

Site ID#	Calcium	Chromium	Cobalt	Copper	Gold	Iron	Lead	Lithium	Magnesium
MDL	0.002 mg/L	0.024 mg/L	0.001 mg/L	0.005 mg/L	0.034 mg/L	0.002 mg/L	0.010 mg/L	0.001 mg/L	0.001 mg/L
Water Quality Standards	**N/A**	**0.1 (DWS); 1.8 (AL - acute); 0.086 (AL-chronic)**	**N/A**	**1.3 (DWS); 0.014 (AL-acute); 0.0093 (AL-chronic)**	**N/A**	**0.3 (DWS); 4 (AL-acute); 1 (AL-chronic)**	**0.015 (DWS); 0.082 (AL-acute); 0.0032 (AL-chronic)**	**N/A**	**N/A**
744	75.9	**No detections.**	Less than MDL	Less than MDL	**No detections.**	0.13	Less than MDL	0.02	8.53
755	83.8		Less than MDL	Less than MDL		0.19	Less than MDL	0.02	9.5
793	99.3		Less than MDL	Less than MDL		0.26	Less than MDL	0.02	9.47
802	75.1		Less than MDL	Less than MDL		0.1	Less than MDL	0.02	29.8
811	82.2		Less than MDL	Less than MDL		0.06	Less than MDL	0.01	6.8
815	34.8		Less than MDL	Less than MDL		0.23	Less than MDL	0.01	6.9
820	39		0.006	0.008		**15**	**0.01**	0.03	19.4
827	74.4		Less than MDL	Less than MDL		**0.33**	Less than MDL	0.02	61.4
848	80.6		Less than MDL	Less than MDL		0.18	Less than MDL	0.03	40.5
850	77.8		Less than MDL	Less than MDL		0.19	Less than MDL	0.03	38.8
875	125		Less than MDL	Less than MDL		0.18	Less than MDL	0.03	82
943	79.4		Less than MDL	Less than MDL		0.28	Less than MDL	0.015	62.2
944	52.7		Less than MDL	Less than MDL		**0.54**	Less than MDL	0.01	59
1139	135		Less than MDL	Less than MDL		0.06	Less than MDL	0.016	21.5
1152	58.5		Less than MDL	Less than MDL		0.24	Less than MDL	0.01	10.8
1221	89.7		Less than MDL	Less than MDL		0.06	Less than MDL	0.005	9.33
3300	57.6		Less than MDL	Less than MDL		0.05	Less than MDL	0.02	8.92
3349	53.4		Less than MDL	**0.05**		0.18	Less than MDL	0.003	5.04
3364	46.1		Less than MDL	Less than MDL		0.26	Less than MDL	0.004	5.6
3415	39.6		Less than MDL	Less than MDL		0.23	Less than MDL	0.001	5.55
3432	41.3		Less than MDL	Less than MDL		0.06	Less than MDL	0.002	4.12
3438	66.9		Less than MDL	Less than MDL		**0.57**	Less than MDL	0.002	15.9
3439	44.9		Less than MDL	Less than MDL		0.07	Less than MDL	0.002	16.9
3440	58.7		Less than MDL	Less than MDL		0.4	Less than MDL	0.002	16.8
3441	43.9		Less than MDL	Less than MDL		**0.56**	Less than MDL	Less than MDL	3.95
3442	37.4		Less than MDL	Less than MDL		0.05	Less than MDL	0.001	3.66
3446	22.9		0.01	Less than MDL		**0.6**	Less than MDL	0.004	9.3

2015 KRWW Metal Sampling Results

Site ID#	Manganese	Nickel	Phosphorus	Potassium	Selenium	Silicon	Silver	Sodium	Strontium
MDL	0.001 mg/L	0.002 mg/L	0.009 mg/L	0.191 mg/L	0.011 mg/L	0.009 mg/L	0.003 mg/L	0.058 mg/L	0.010 mg/L
Water Quality Standards	**N/A**	**0.61 (DWS); 0.47 (AL-acute); 0.052 (AL-chronic)**	**N/A**	**N/A**	**0.17 (DWS); 0.258 (AL-acute)**	**N/A**	**0.0038 (AL-acute)**	**N/A**	**N/A**
744	0.17	Less than MDL	0.43	5.09	**No detections.**	1.12	**No detections.**	25.8	0.13
755	0.14	0.002	0.67	7.48		1.98		40.9	0.18
793	0.08	Less than MDL	0.38	3.14		3.27		48.9	0.17
802	0.12	Less than MDL	0.03	4.3		3.57		13.5	0.41
811	0.02	Less than MDL	0.43	2.42		3.39		12	0.12
815	0.01	Less than MDL	Less than MDL	1.9		3.97		2.14	0.05
820	0.31	0.01	0.49	5.81		12.8		25.5	0.49
827	0.1	Less than MDL	0.01	6.42		2.64		7.69	0.44
848	0.04	Less than MDL	0.03	6.7		3.8		45.1	1.61
850	0.05	Less than MDL	0.01	5.28		5.24		31.1	1.17
875	0.07	Less than MDL	0.02	8.74		2.86		57.7	1.71
943	0.11	Less than MDL	0.009	6.16		2.64		8.48	0.46
944	0.06	Less than MDL	0.02	7.76		2.59		4.33	0.36
1139	0.06	Less than MDL	0.07	5.9		1.31		98.6	0.48
1152	0.026	Less than MDL	0.02	2.97		4.96		9.82	0.32
1221	0.025	Less than MDL	0.96	4.4		2.66		25.5	0.15
3300	0.002	Less than MDL	Less than MDL	1.55		4.37		2.86	0.13
3349	0.25	Less than MDL	0.31	2.42		0.8		12.7	0.1
3364	0.14	Less than MDL	0.01	1.99		2.62		4.64	0.11
3415	0.01	Less than MDL	Less than MDL	2.15		3.02		2.37	0.08
3432	0.005	Less than MDL	Less than MDL	1.24		3.58		1.24	0.06
3438	0.02	Less than MDL	0.05	1.21		5.21		2.44	0.07
3439	0.004	Less than MDL	0.004	1.14		4.81		2.73	0.05
3440	0.02	Less than MDL	0.01	1.11		5.01		2.85	0.06
3441	0.025	Less than MDL	0.02	0.71		4.17		0.77	0.07
3442	0.006	Less than MDL	Less than MDL	1.1		3.15		1.12	0.06
3446	1.6	0.02	Less than MDL	3.65		7.33		2.55	0.04

2015 KRWW Metal Sampling Results

Site ID#	Sulfur	Thallium	Tin	Vanadium	Zinc	Assessment
MDL	0.014 mg/L	0.041 mg/L	0.012 mg/L	0.008 mg/L	0.002 mg/L	
Water Quality Standards	**N/A**	**0.00024 (DWS)**	**N/A**	N/A	**7.4 (DWS); 0.12 (acute/ chronic AL)**	**R (red) = poor Y (yellow) = fair G (green) = good**
744	9.79	**No detections.**	**No detections.**	Less than MDL	Less than MDL	G
755	15.9			Less than MDL	0.005	G
793	21.6			Less than MDL	Less than MDL	G
802	51.3			Less than MDL	Less than MDL	G
811	7.55			Less than MDL	Less than MDL	G
815	2.34			Less than MDL	Less than MDL	G
820	42.6			0.009	0.04	R
827	99.1			Less than MDL	Less than MDL	G
848	89			Less than MDL	Less than MDL	G
850	104			Less than MDL	Less than MDL	G
875	197			Less than MDL	Less than MDL	Y
943	112			Less than MDL	Less than MDL	G
944	54.3			Less than MDL	Less than MDL	G
1139	67.7			Less than MDL	Less than MDL	G
1152	18.4			Less than MDL	Less than MDL	G
1221	14.1			Less than MDL	Less than MDL	G
3300	6.04			Less than MDL	0.02	G
3349	4.44			Less than MDL	Less than MDL	Y
3364	4.35			Less than MDL	Less than MDL	G
3415	2.05			Less than MDL	Less than MDL	G
3432	1.4			Less than MDL	Less than MDL	G
3438	1.35			Less than MDL	Less than MDL	G
3439	1.99			Less than MDL	Less than MDL	G
3440	1.77			Less than MDL	Less than MDL	G
3441	2.06			Less than MDL	0.02	G
3442	1.48			Less than MDL	Less than MDL	G
3446	16.8			Less than MDL	0.009	G

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 ($BaSO4$), witherite ($BaCO3$), 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.