



Cumberland Piedmont Network Water Quality Report; Third Serial

Abraham Lincoln Birthplace National Historic Site



ON THE COVER

Brenda Wells measures discharge at North Branch Knob Creek, November 6, 2007

Photograph by: Joe Meiman

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Abraham Lincoln Birthplace National Historic Site

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Introduction

This is the third serial report on water quality of Abraham Lincoln Birthplace National Historic Site (ABLI) generated by the Cumberland Piedmont Network (CUPN) Water Quality monitoring Program. The first report, submitted to the park in February 2005, presented the initial results of the water quality inventory, beginning in November 2003 (contact the CUPN office for details on program design). The second report (January 2007) updated the status of water quality following the second round of sampling. This report will include those early findings as well as data gathered in fiscal year 2008 and display these results in graphic form (accompanied with a brief interpretation), and concludes with a water quality summary and recommendations. Results from the FY 2008 sampling round were generated by CUPN Data Manager Brenda Wells.

Water quality is measured six times per year (bi-monthly) on alternate years at three sites; Sinking Spring, Knob Creek and North Branch Knob Creek. Based upon program requirements and findings of the water quality inventory, a set of parameters were chosen for long-term monitoring; including the field measures of water temperature, specific conductance, pH, and dissolved oxygen. Samples were also collected for laboratory analysis for bacteria *Escherichia coli* and nitrate-nitrogen. An additional sample was collected from one site per round as a quality assurance – quality control provision.

Sampling Sites

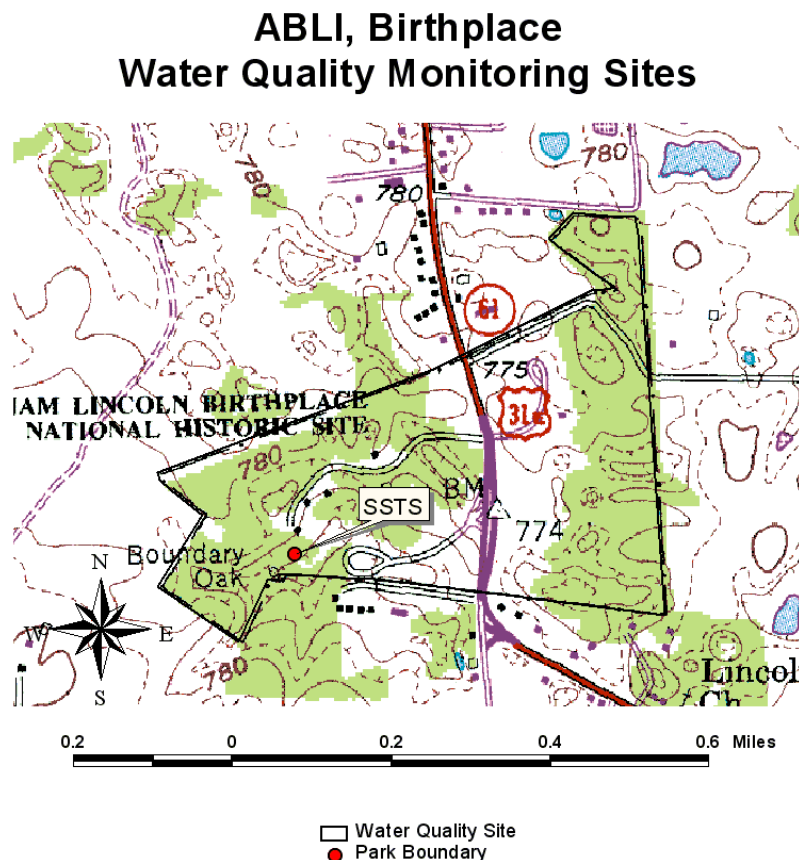


Figure 1: Map of water quality sampling sites at ABLI Birthplace Unit

Abraham Lincoln Boyhood Home at Knob Creek Water Quality Monitoring Sites

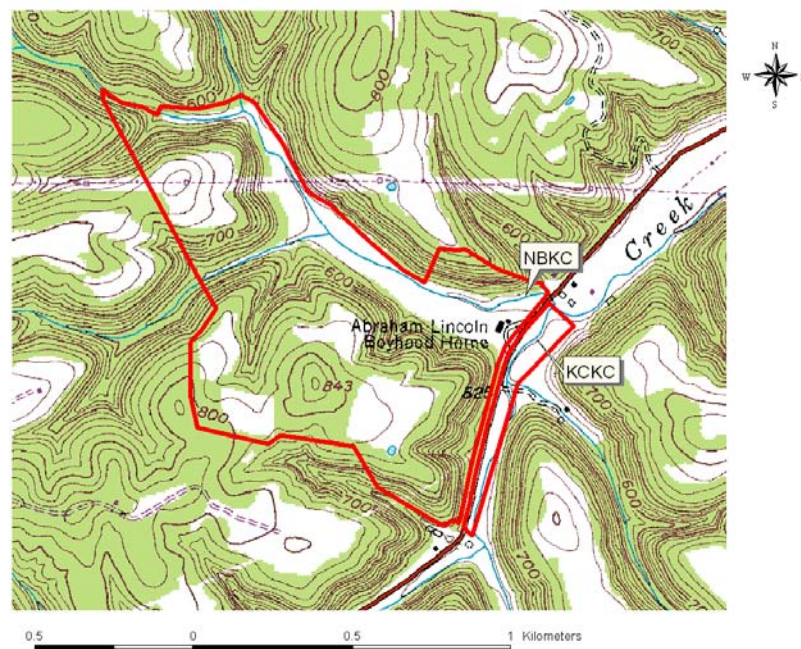


Figure 2: Map of water quality sampling sites at ABLI Boyhood Home Unit

Description of Sampling Sites

Sinking Spring (SSTS)

Located near the center of the main park unit, Sinking Spring is the major natural resource attraction in the park – interpreted as the first drink of water taken by baby Abraham. While no longer a drinking water source, protecting water quality at Sinking Spring is very important to park management goals.

North Branch Knob Creek (NBKC)

Located within the Boyhood Home Unit of the park, the North Branch of Knob Creek is the largest stream. The watershed is primarily comprised of forested land in the uplands and open pasture in the bottoms. Samples are taken in this stream (which may dry in the late summer-early autumn) at the extreme downstream end of the branch. While not overtly promoted, the public can gain access to this ephemeral stream along its course through the park.

Knob Creek (KCKC)

The Boyhood Home Unit crosses US31E, and for a short segment, includes the main stem of Knob Creek. The site is immediately upstream of its confluence with the North Branch. While public access is not prohibited, this stream lies across a busy road (31E) and does not have trail access.

Stream Designated Uses

Each water body sampled within the CUPN has either been assigned a designated use by the state, or, by using the same ranking criteria, by this author. The US Environmental Protection Agency, besides mandating these rankings, also directed the states to develop water quality standards for each designated use. We can use these water quality standards as a minimum to track water quality trends in CUPN parks. By adapting the state standards, we can also track park water quality trends within the states, regions, or watersheds.

For more information on Kentucky water quality standards, please see:
Kentucky: 401 KAR 5:026. Designation of Uses of Surface Waters.

Table 1: The table below shows that none of the park's three sites appear on the state's list of designated uses. The USEPA does not require a state list each waterbody. The author, using the same criteria used by the state process "listed" designated uses for each park site, for purposes of water quality comparison.

<i>Park</i>	<i>Code</i>	<i>Site</i>	<i>State</i>	<i>Designated Use</i>
ABLI	SSTS	Sinking Spring	KY	<i>Coldwater Aquatic Habitat</i>
ABLI	KCKC	Knob Creek	KY	<i>Warmwater Aquatic Habitat Secondary Contact Recreation</i>
ABLI	NBKC	North Branch Knob Creek	KY	<i>Warmwater Aquatic Habitat Secondary Contact Recreation</i>

Results

Bi-monthly sampling commenced in November 2003 and continued until September 2004. After a one-year hiatus six more rounds were collected between November 2005 and September 2006. Following the biennial pause, collection of six additional rounds occurred between November 2007 and September 2008, for a total of 18 sampling events.

Water quality results are displayed in time series graphs showing all data for each site for a given parameter. The data gaps are caused by the planned one-year pause between sampling series. As the Water Quality Program continues, trends may emerge from these time series graphs.

If state standards exist for a particular parameter they will be displayed. In addition, in a cursory attempt to show an element of data error, each plot is assigned error bars, representing the minimum potential error associated with the measurement.

Water Temperature

Water temperatures of ABLI are considered to be within range to support native aquatic life. The compressed temperature ranges at Sinking Spring (SSTS) is a function of longer retention times of groundwater recharging the spring. The two main creeks, Knob (KCKC) and the North Branch of Knob Creek (NBKC) display a wider range of temperatures reflective of normal seasonal variations. Note that occasionally there are no data for the stream sites – September 2008 for example. These streams are ephemeral and during times of drought are dry.

ABLI 2003 - 2008

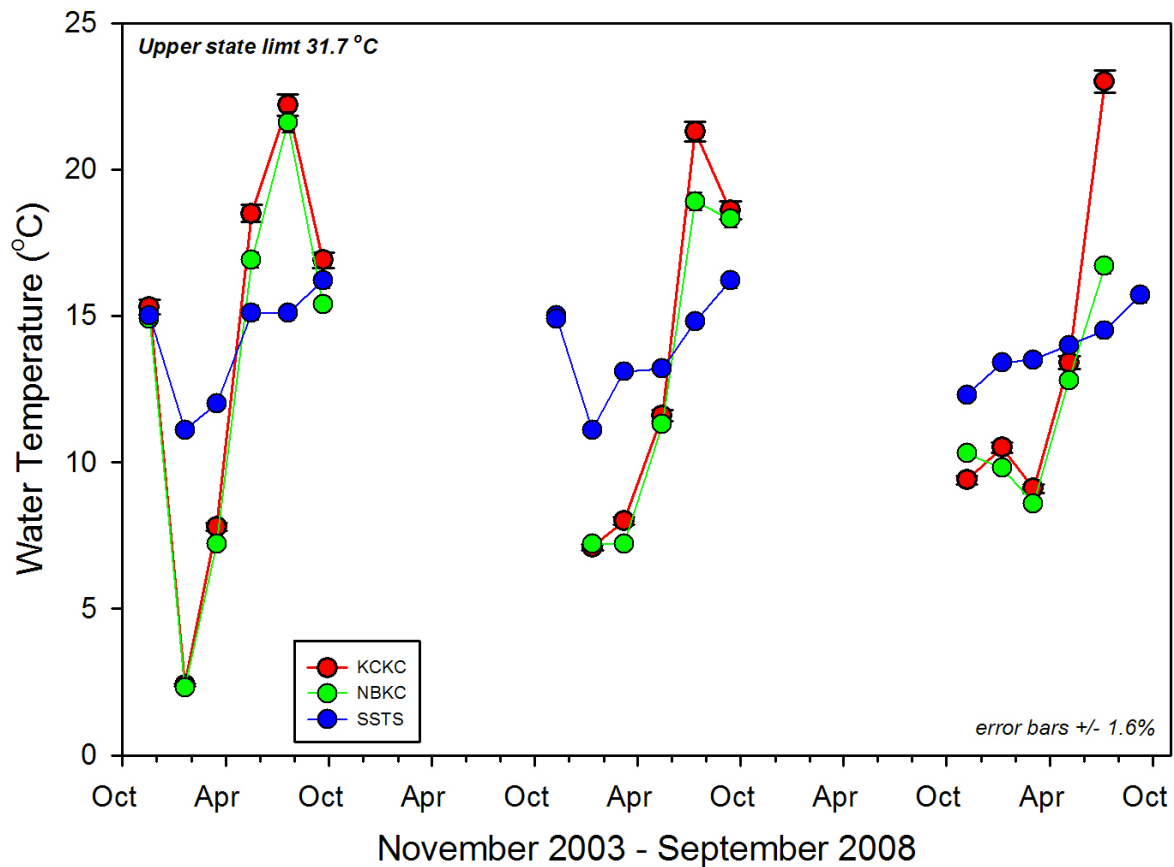


Figure 3. Water Temperature at ABLI

Specific Conductance

The distribution of specific conductance (SpC) of ABLI is reflective of the amount of dissolved solids, which is primarily controlled by watershed lithology and water residence time. The longer water is in contact with soluble strata, the higher the dissolved ionic load, thus the higher SPC values. In general, the limestone-rich waters of Sinking Spring have higher SpC values than the two streams of the Boyhood Home Unit, which are relatively high in dissolved ions as there are also plentiful carbonates within their watersheds.

ABLI 2003 - 2008

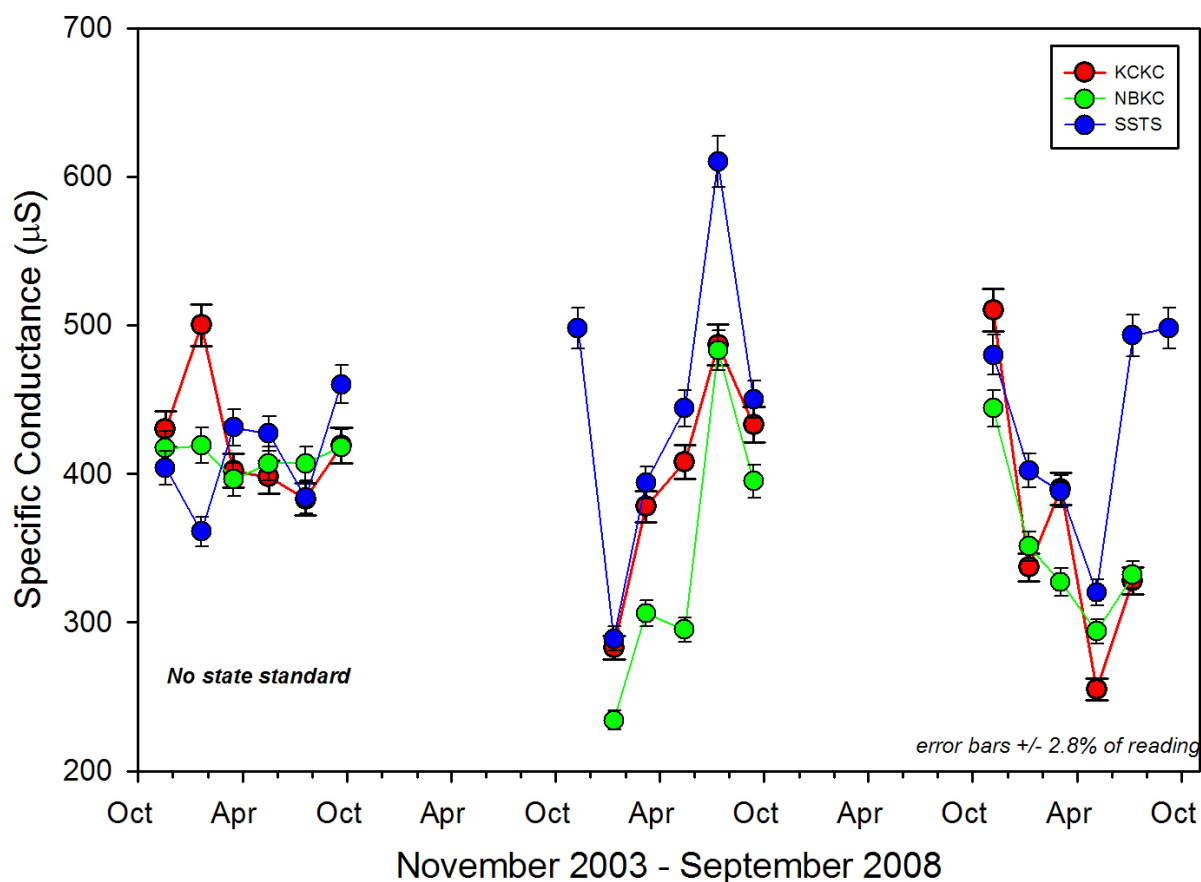


Figure 4. Specific Conductance at ABLI

pH

The waters of ABLI are slightly alkaline and within the state limits of 6.0 and 9.0 SU. This is not surprising due to the amount of contact the waters have with carbonate rock, whose dissolution liberates bicarbonate ions, thus buffering the solution. It is interesting that the pH of Sinking Spring declined during the low-flow summer of 2008, where diminished discharge is typically matched with higher pH as seen in previous sampling years.

ABLI 2003 - 2008

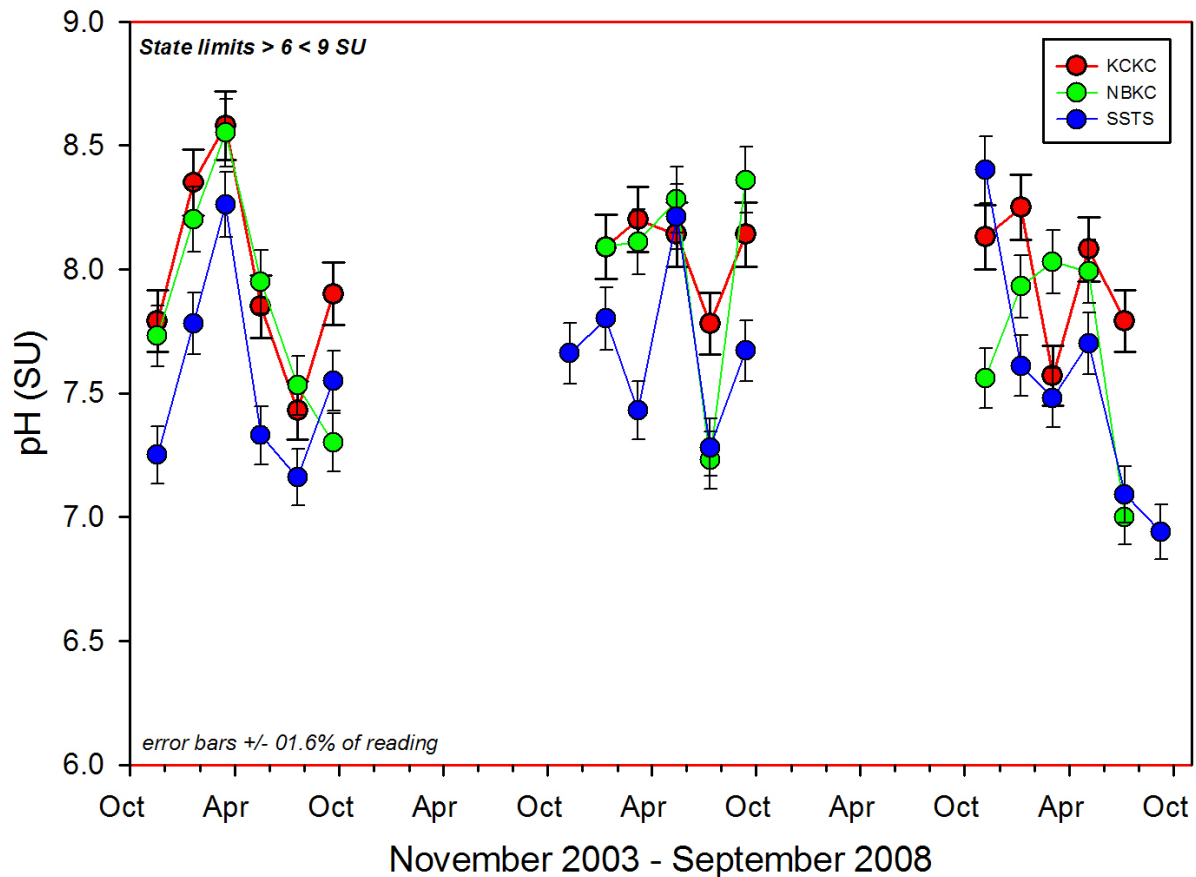


Figure 5. pH at ABLI

Dissolved Oxygen

All waters monitored at ABLI are saturated, or supersaturated with oxygen. The state limit is 5.0 mg/l for dissolved oxygen for cold water habitat (SSTS) and 4.0 mg/l for warm water habitat (KCKC and NBKC). In general dissolved oxygen concentrations are the highest during the winter months and fall through the summer and autumn months. This is a typical response as warm water can hold less dissolved oxygen than cold water. The only times of low dissolved oxygen were associated with the North Branch of Knob Creek – both during July and both during times of no flow. The stream at these times was reduced to a series of disconnected pools. This should not be considered a violation of state water quality standards.

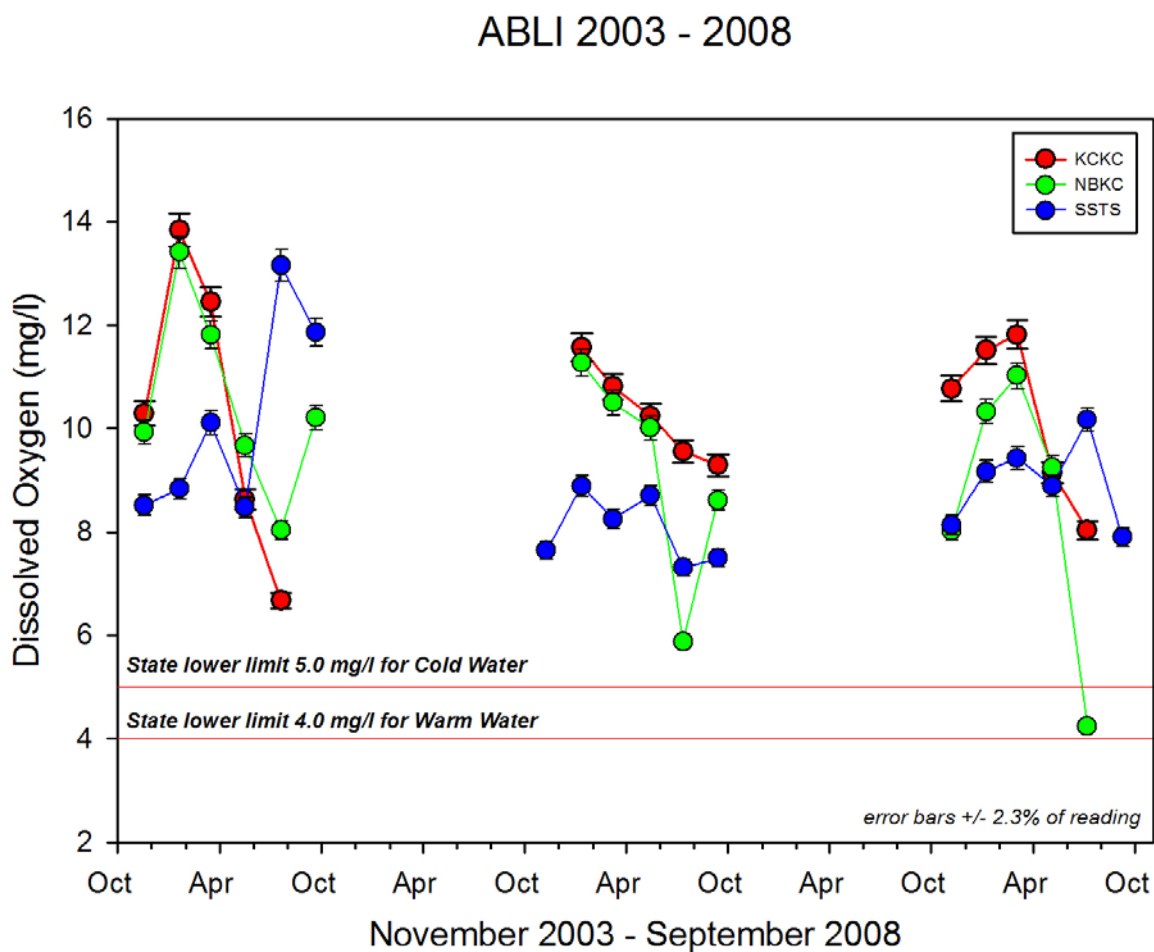


Figure 6. Dissolved Oxygen at ABLI

Bacteria

In November 2005 the CUPN began testing for *Escherichia coli* bacteria. This eliminated the highly unreliable fecal coliform analysis and still provides an indicator of overall bacterial load. While *E. coli* is a more reliable test of fecal contamination, there is no current state standard. The USEPA recommends a single sample for infrequent recreational contact waters not to exceed 476 CFU (colony forming units) per 100 ml.

It is common that *E. coli* levels are highest immediately following a rainstorm – as animal wastes on the land surface are carried into the streams. This was the case at Sinking Spring (SSTS) as the highest *E. coli* values were found in May and September 2008 following rains of 8 and 2 cm the preceding week. High bacteria levels during or immediately after rains are indicative of non-point sources, such as animal wastes or fertilizers.

ABLI 2005 - 2008

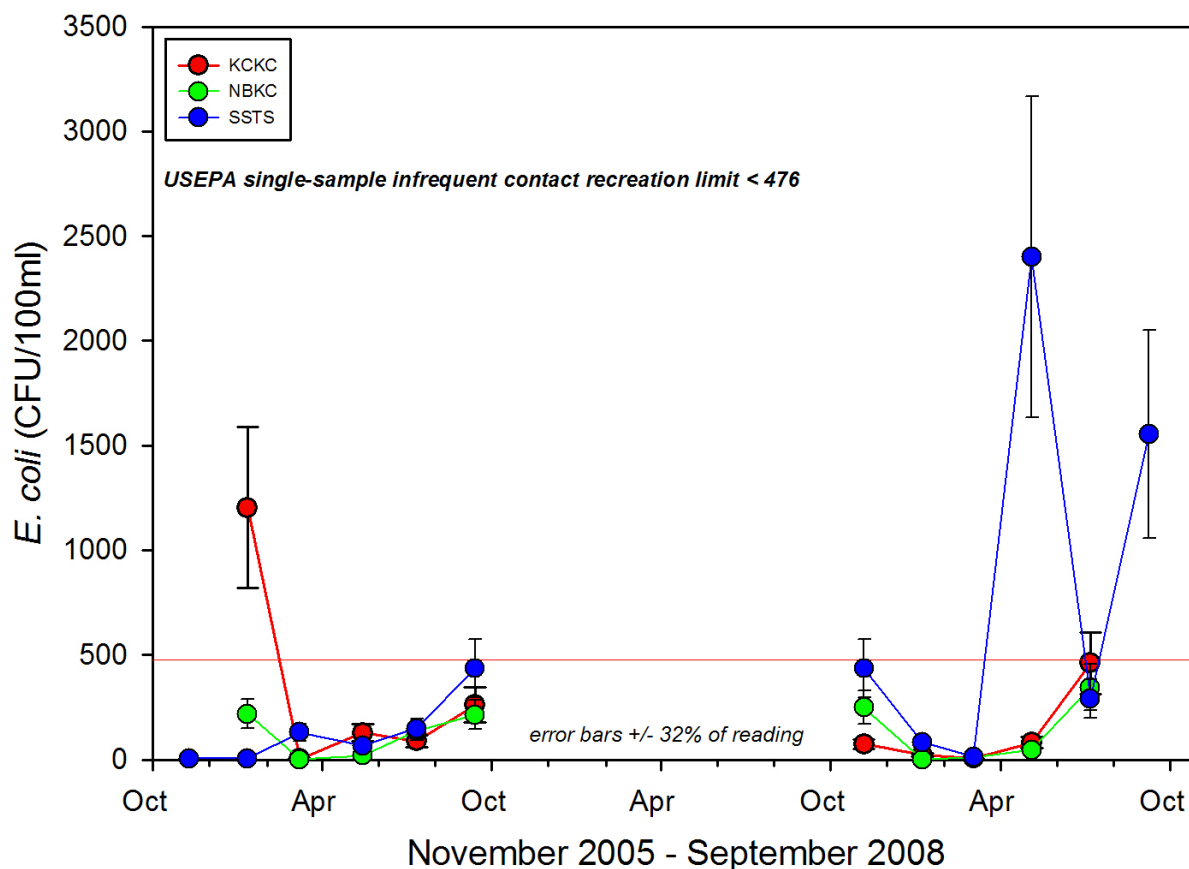


Figure 7. Bacteria at ABLI

Nitrate

Surprisingly there is no state standard for nitrate in freshwaters for the assigned designated uses. The Kentucky nitrate limit for drinking water is 45 mg/l (or 10 mg/l as expressed as N). Nitrate levels at Sinking Spring, exceeded the drinking water level in January 2008, and are always higher than the two surface streams. Potential sources include runoff from fertilizers, animal wastes and septic tanks. It appears that nitrate levels in Sinking Spring have increased over the past five years. There does not appear to be a correlation between flow condition and nitrate

ABLI 2003 - 2008

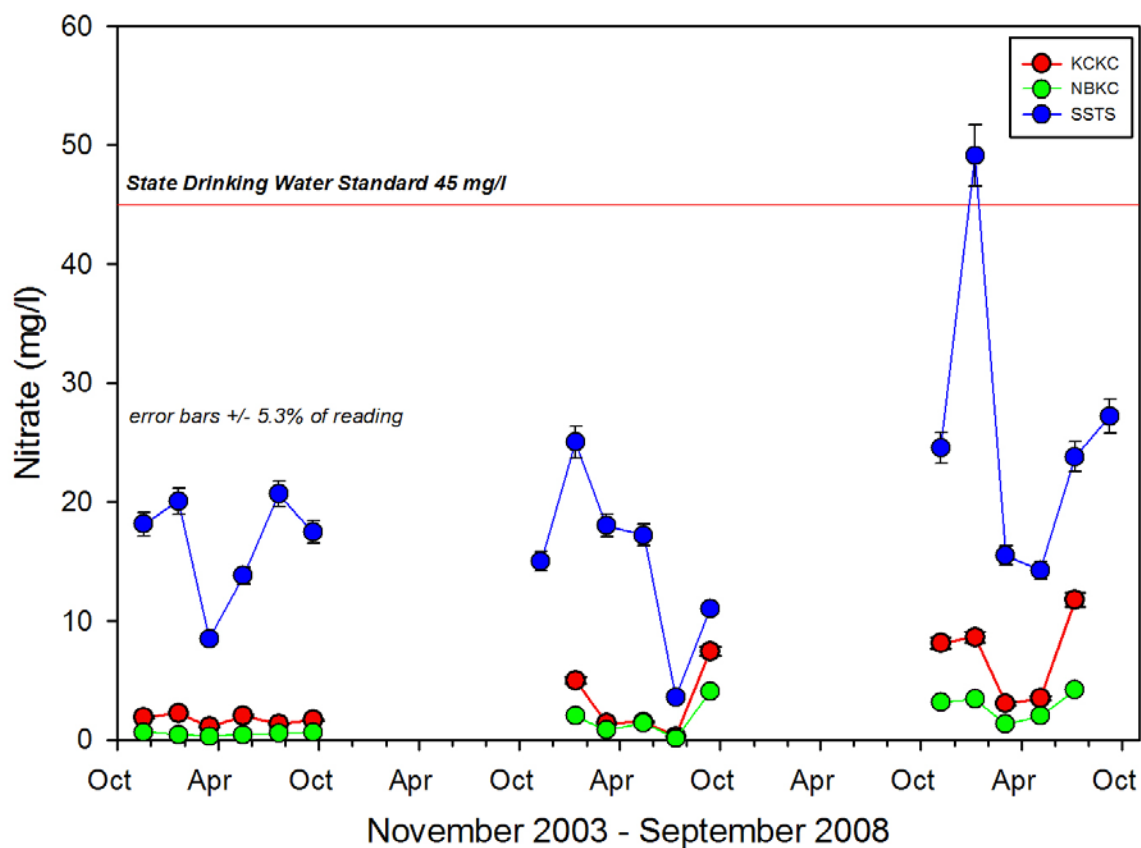


Figure 8. Nitrate at ABLI

General Water Quality Status

These data show that the water quality of Sinking Spring, Knob Creek and the North Branch of Knob Creek are meeting designated use standards. Nitrate levels at Sinking Spring are consistently higher than those of the Boyhood Home Unit streams, and appear to have increased over the past five years

Likewise, while there is no public contact with Sinking Spring, we should consider the USEPA recommended single-sample infrequent recreational contact limit for *Escherichia coli* of 476 CFU/100ml as a reasonable guideline. In this light, three of the six samples exceeded this level. At times high *E. coli* levels are met with high nitrate, other times not.

Aside from the nitrate and *E. coli* levels at Sinking Spring, the waters of ABLI are meeting designated use standards and appear to be in good shape.

Future Water Quality Monitoring Recommendations

The CUPN is required in accord with the national water quality program to monitor water temperature, specific conductance, pH, and dissolved oxygen. In addition, there is sufficient reason to continue to monitor *Escherichia coli* and nitrate. Previous CUPN Water Quality reports have stated “*Although these two parameters are generally below state water quality standards, long-term data may serve to alert the park to impending water quality issues.*” It appears that we are indeed seeing a possible upward trend in nitrate and bacterial levels at Sinking Spring. The CUPN will work with ABLI staff in identifying and eliminating sources within the groundwater watershed of Sinking Spring. Regularly scheduled water quality will resume at ABLI in FY 2010.