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Johnson County
Stormwater Management

Water-Quality Assessment of Streams in Johnson County, Kansas

A cooperative study between the

Johnson County Stormwater Management Program (Kent Lage, Eileen Hack, Andy Sauer) and the

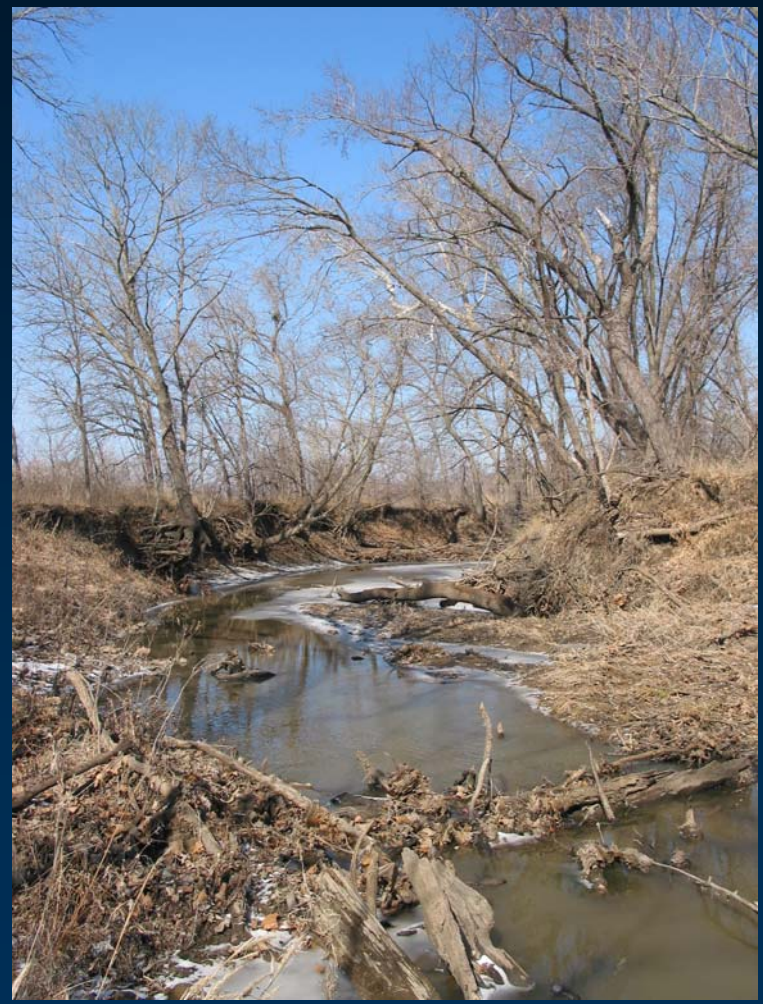
U.S. Geological Survey, Lawrence, Kansas (Teresa Rasmussen, Casey Lee, Andy Ziegler, Barry Poulton, David Mau)

U.S. Department of the Interior
U.S. Geological Survey

September 21, 2005

Study Objectives

- Describe current stream-water quality in Johnson County
- Identify contaminant source areas
- Estimate contaminant concentrations and loads
- Monitor long-term changes in stream-water quality



Captain Creek near 119th St

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Benefits

Results of this study are being used by Johnson County to:

- Assess current stream-water quality in Johnson County
- Identify and address water-quality issues and source areas
- Monitor and document long-term changes in stream-water quality
- Develop and implement watershed-based strategies for managing water quality

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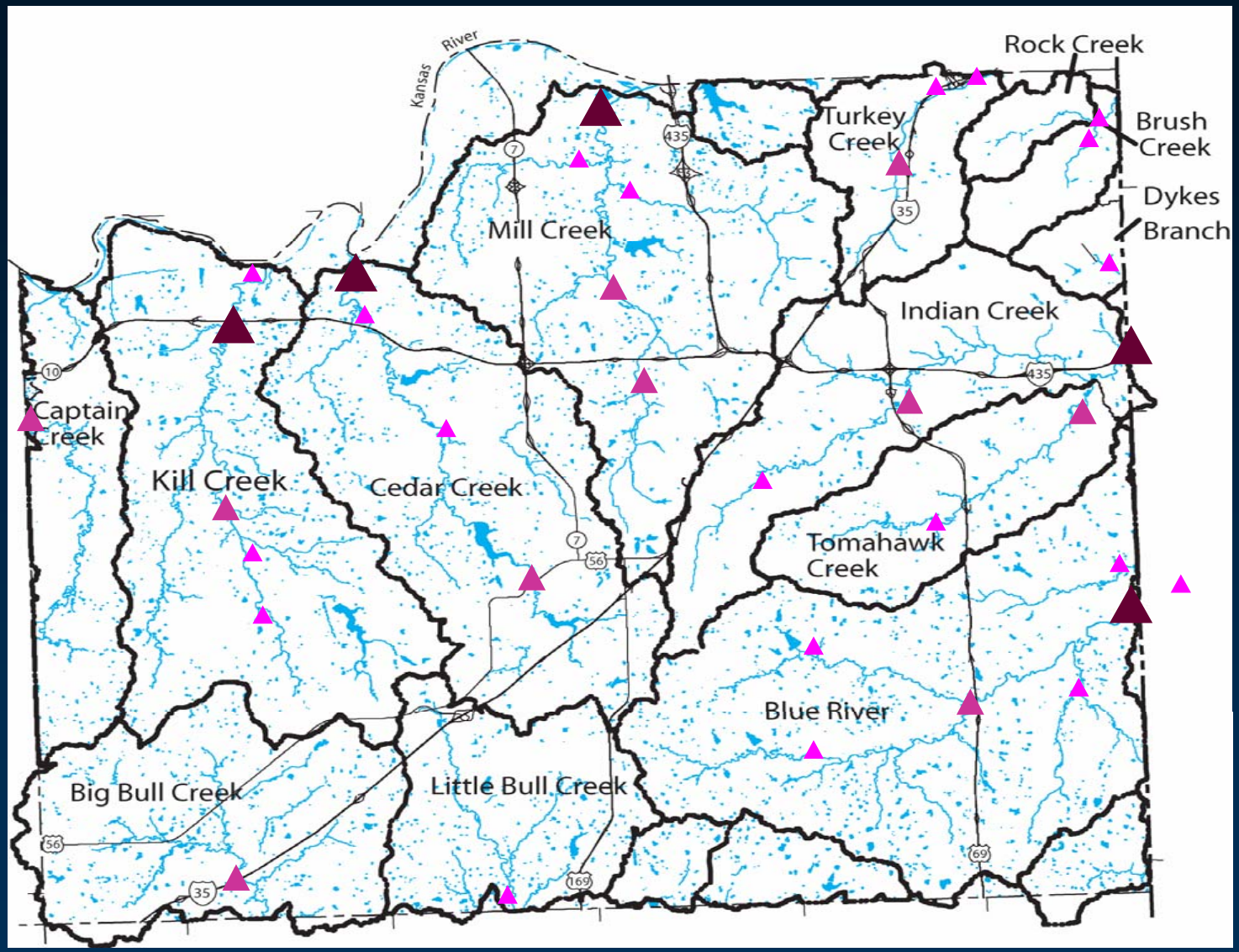
Sampling sites



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Study Components

1. Identify contaminant sources – point and nonpoint sources, land use

Water samples

Sediment samples

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Study Components

2. Bioassessment – to describe biological impairments and to better define stream-water quality

Benthic macroinvertebrate samples

Damselfly nymph

Stonefly nymph

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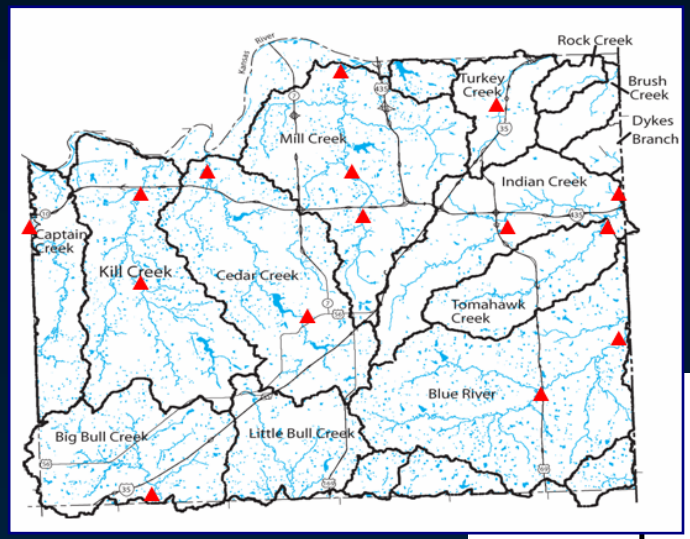
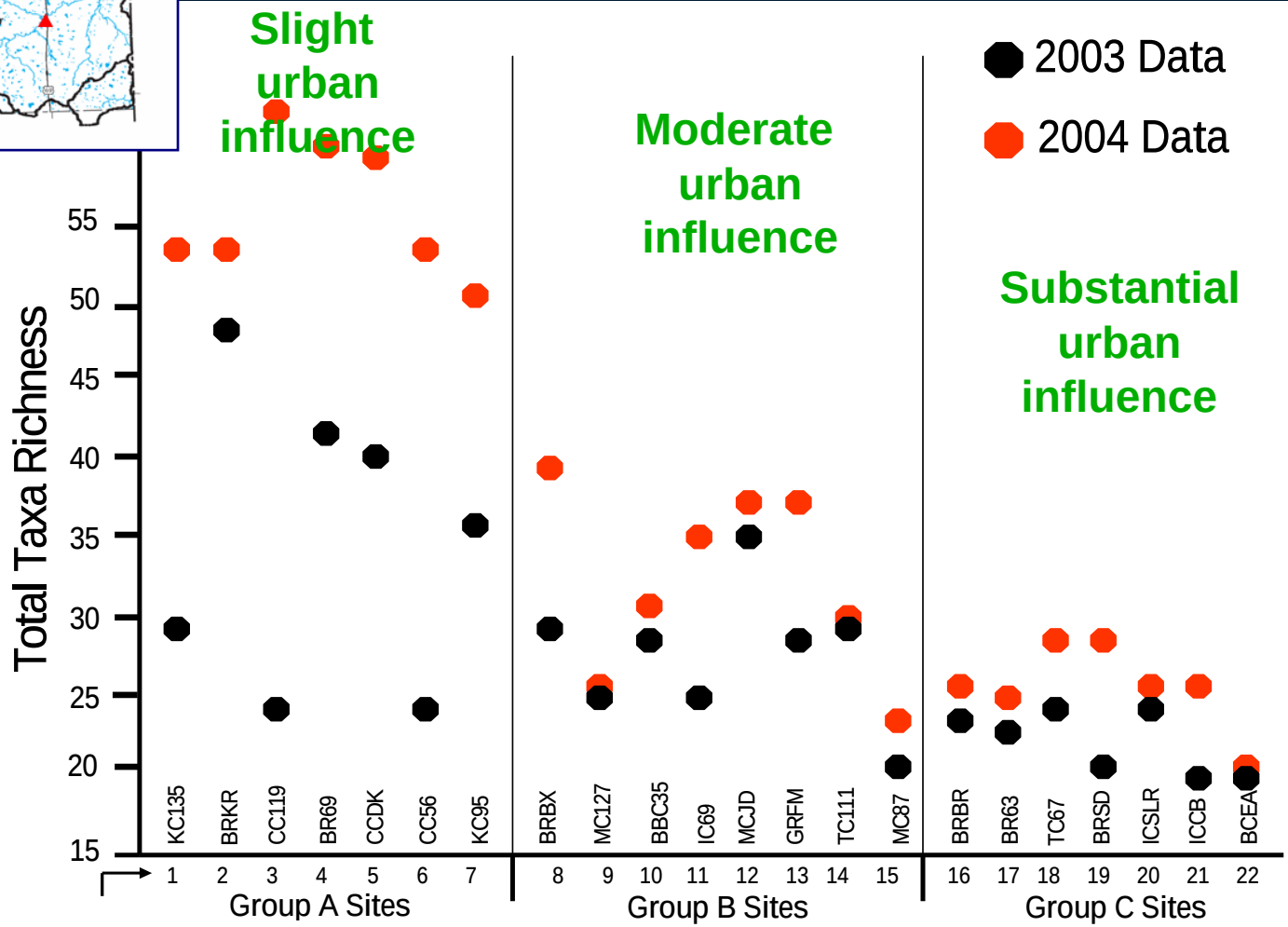
Bioassessment





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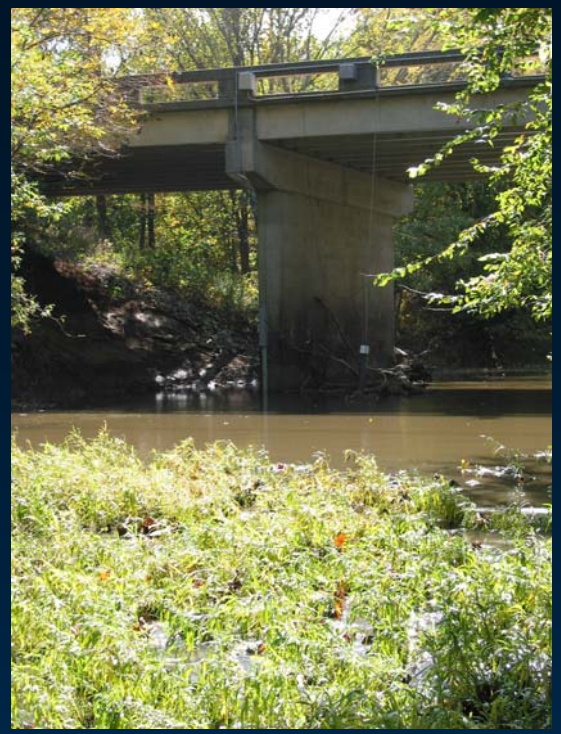
Study Components

3. Continuous stream-water quality monitoring – to provide continuous estimates of constituent concentrations and loads, define variability, and monitor changes



Blue River at Kenneth Rd

Kill Creek at 95th St

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Continuous stream-water quality monitoring

Cedar Creek at 83rd St

- Install water-quality monitors at selected stream sites
- Collect discrete samples over range of hydrologic conditions
- Develop regression models using collected samples and sensor values
- Estimate concentrations and loads on the basis of regression models
- Display real-time estimates, uncertainty, and probability on the Web
- Continued sampling to verify relations

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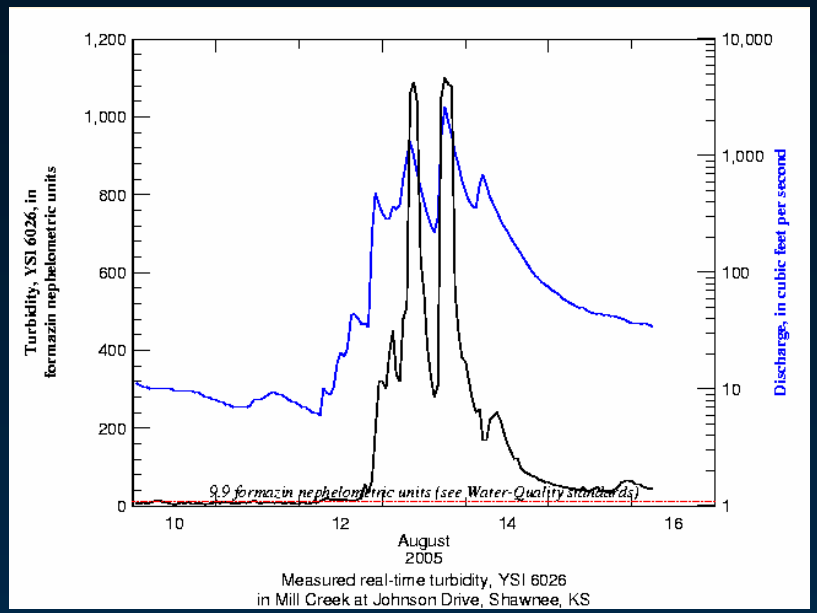
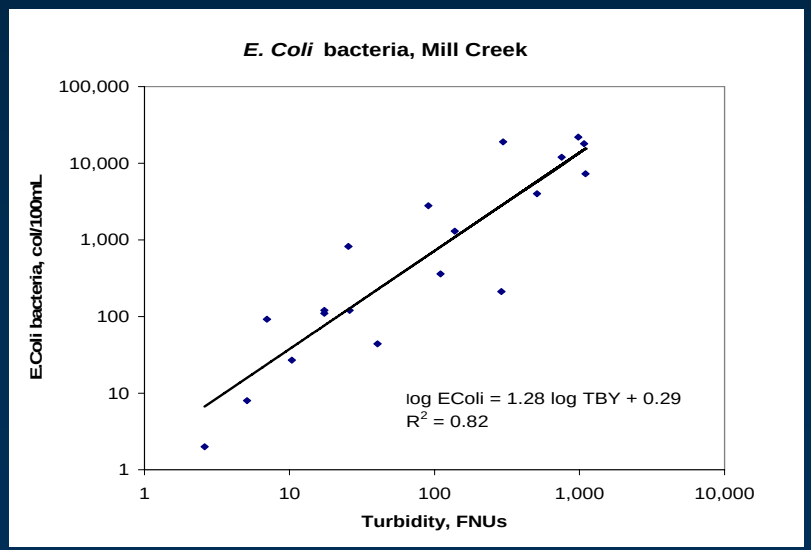
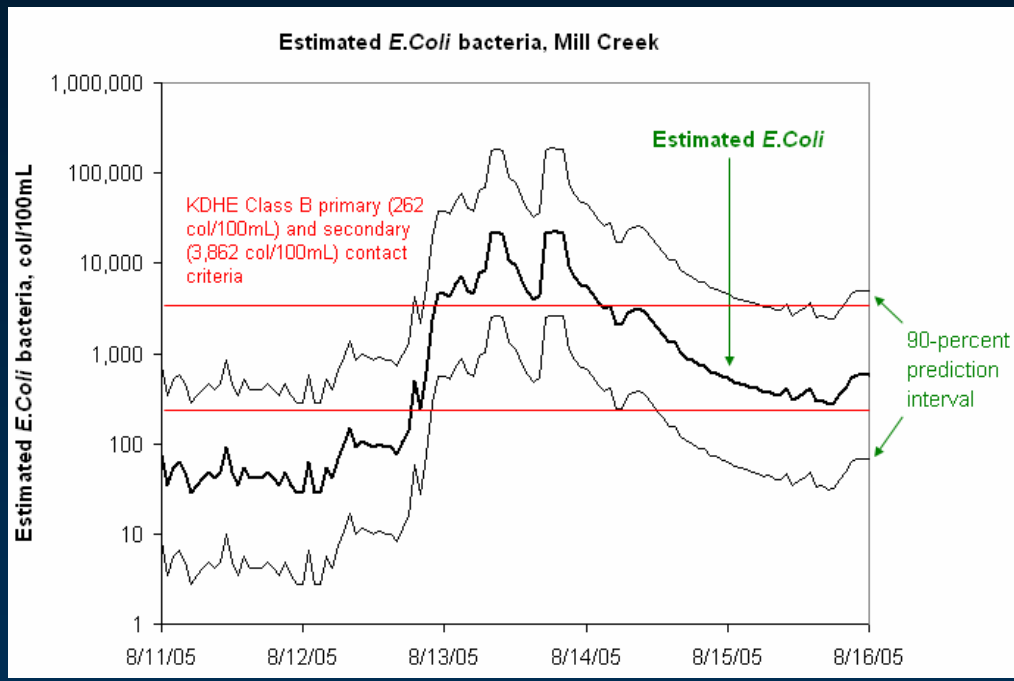
Continuous stream-water quality monitoring







Continuous data available in real time at:
http://ks.water.usgs.gov/Kansas/rtqw

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Study timeline

October 2002	Began continuous monitoring at two sites (Cedar, Mill); 1st synoptic water sampling
March 2003	1st macroinvertebrate sampling; sediment sampling
July 2003	2nd synoptic water sampling
February 2004	Began continuous monitoring at 3 additional sites (Blue, Indian, Kill)
March 2004	2nd macroinvertebrate sampling
2004 - 2010	Ongoing operation of continuous monitors and stream-water sampling at continuous monitoring sites
September, 2005	Report #1 – Contaminant sources, land use
December, 2006	Report #2 – Bioassessment
December, 2006	Report #3 – Continuous monitoring, concentrations, loads
2006 – 2008	Sediment sources study

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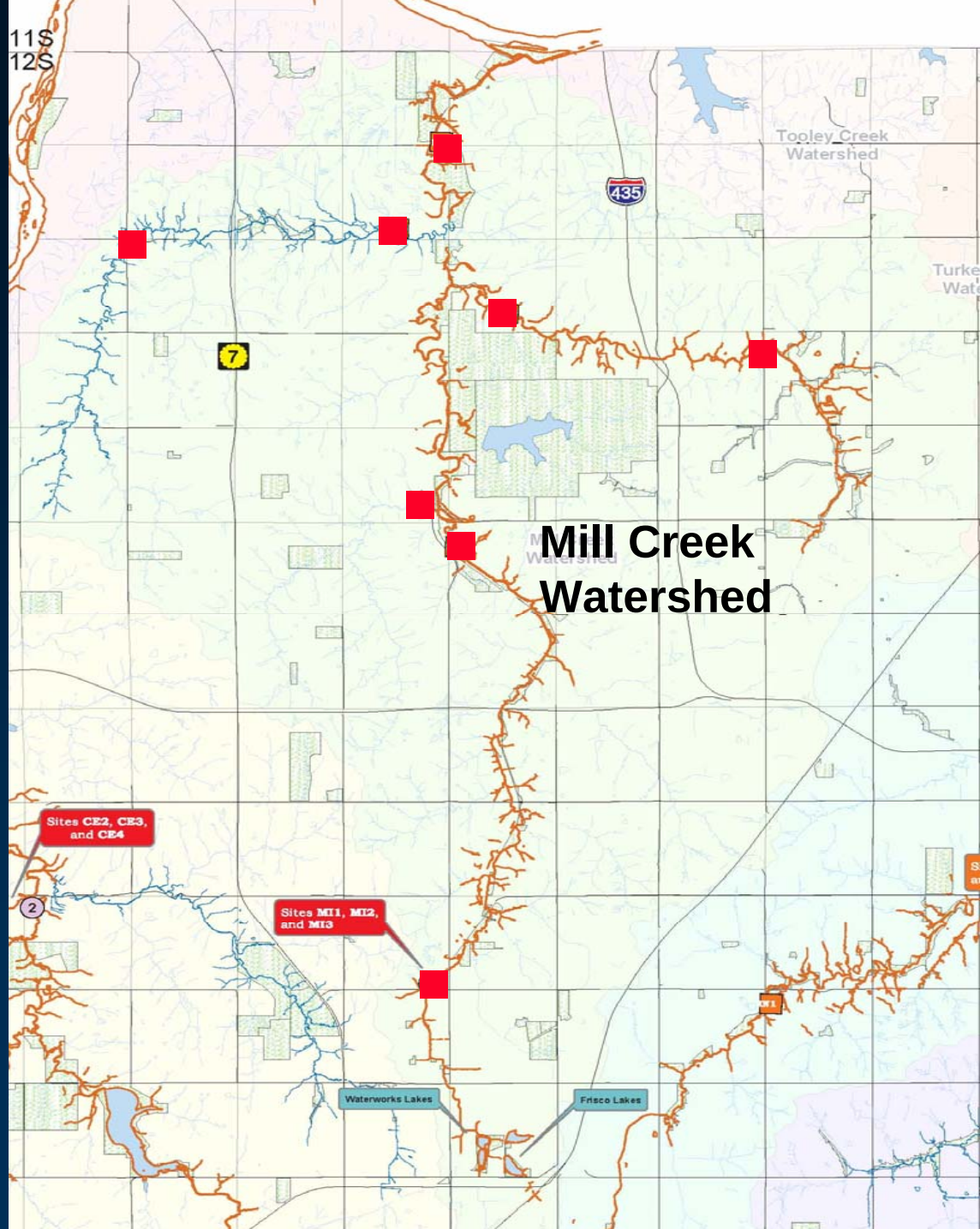
Sediment sources study

- Monitor sediment loads throughout the Mill Creek watershed
- Use chemical tracers to estimate sources of suspended sediment
- Will help county officials implement appropriate best management practices



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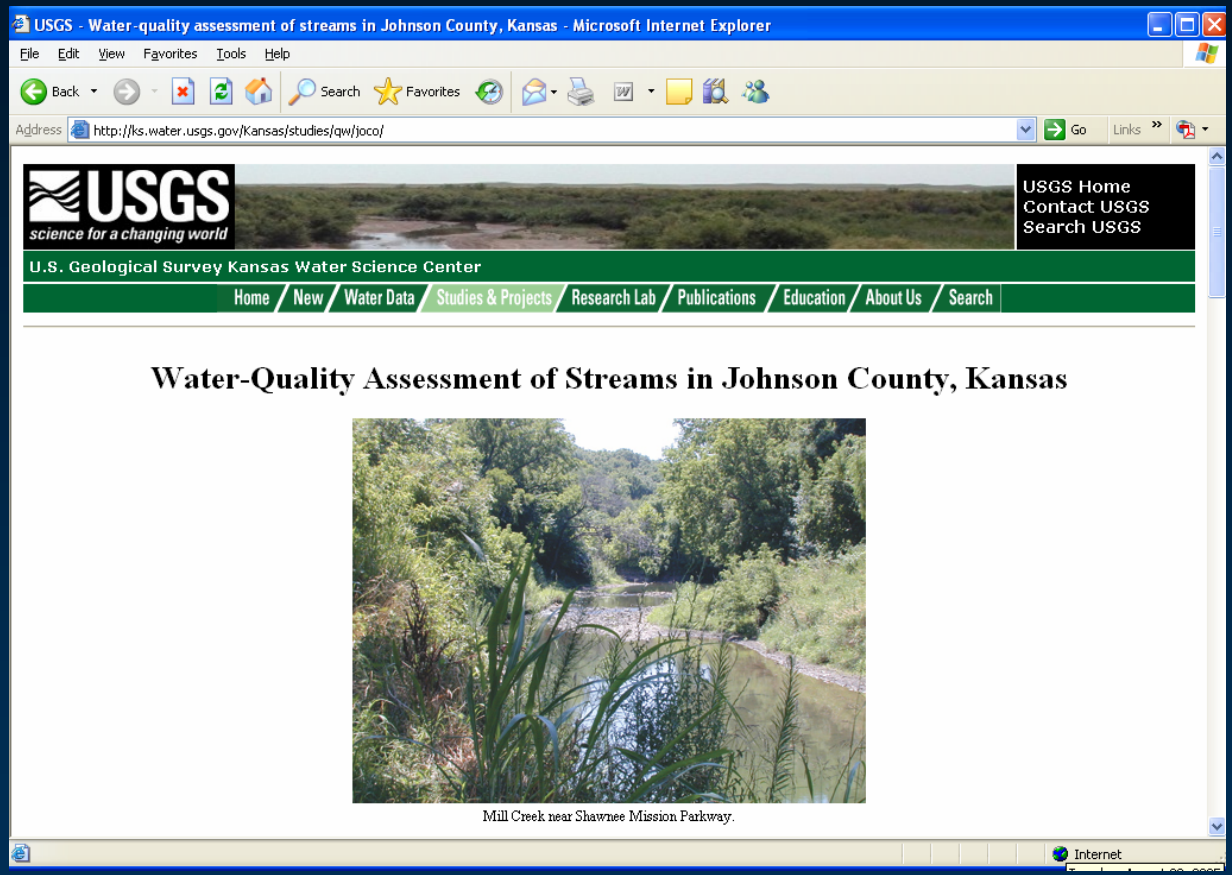
http://ks.water.usgs.gov/Kansas/studies/qw/joco/



- General study information
- Data
- Reports, fact sheets

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Effects of Nonpoint and Selected Point Contaminant Sources on Stream-Water Quality and Relation to Land Use in Johnson County, Northeastern Kansas, October 2002 Through June 2004

Prepared in cooperation with the Johnson County Stormwater Management Program

Casey J. Lee, David P. Mau, and Teresa J. Rasmussen,
U.S. Geological Survey, Lawrence, Kansas

USGS Scientific Investigations Report 2005-5138

USGS Fact Sheet 2005-3080

U.S. Department of the Interior
U.S. Geological Survey

Study Goals/Design

- Evaluate base-flow water-quality conditions
  - Two synoptic base-flow samples collected throughout Johnson County
- Examine effects of stormwater on Johnson County streams
  - Several stormflow samples collected at 6 sites
- Look at combined (base- and stormflow) effects on Johnson County streams
  - 15 streambed-sediment samples collected at 15 sites
    - Point and nonpoint sources of water-quality contamination are related to land use

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What we looked for

- **Streamflow**

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What we looked for

- **Suspended sediment**

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What we looked for

- **Dissolved solids and major ions**

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What we looked for

- Nutrients

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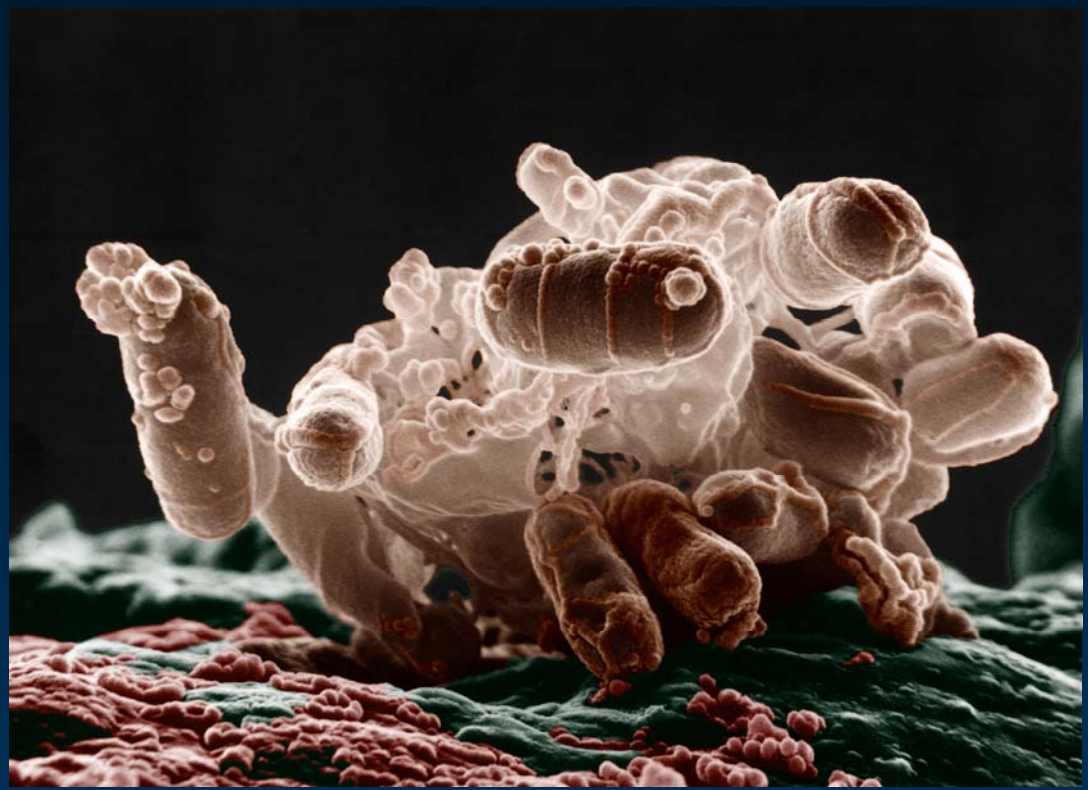
What we looked for

- **Indicator bacteria**



Colorized low-temperature electron micrograph of a cluster of *E. coli* bacteria. (U.S. Department of Agriculture)

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What we looked for

- Pesticides

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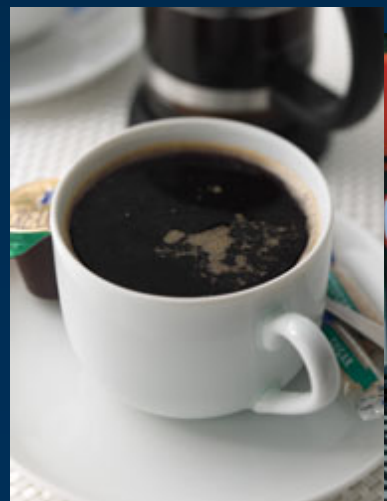
What we looked for

- Wastewater-indicator and other organic compounds



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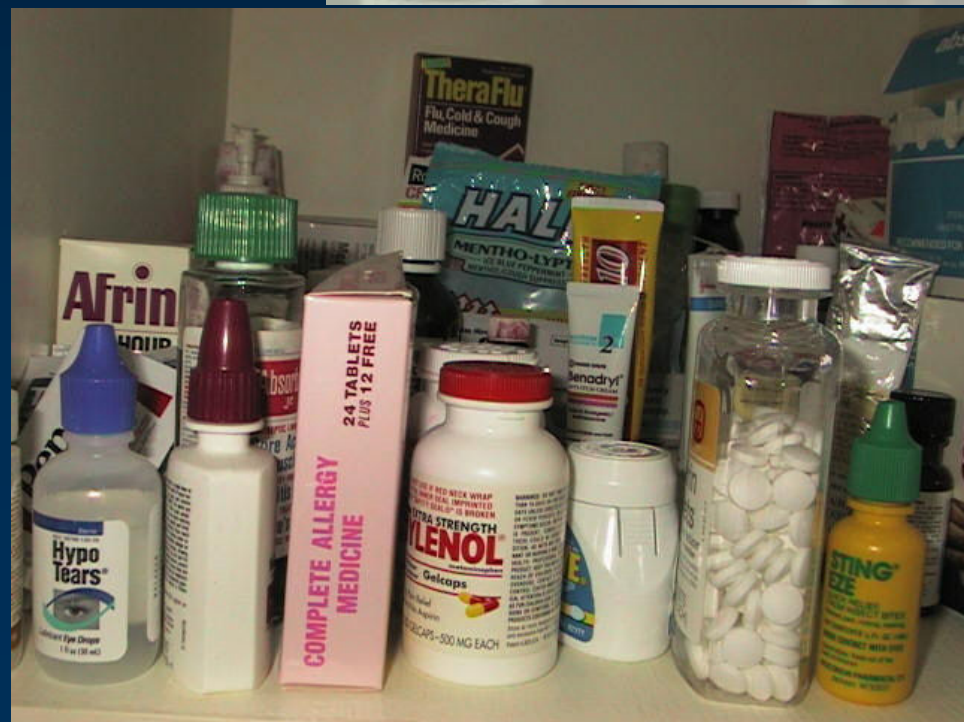
What we looked for

- **Prescription and nonprescription pharmaceuticals**



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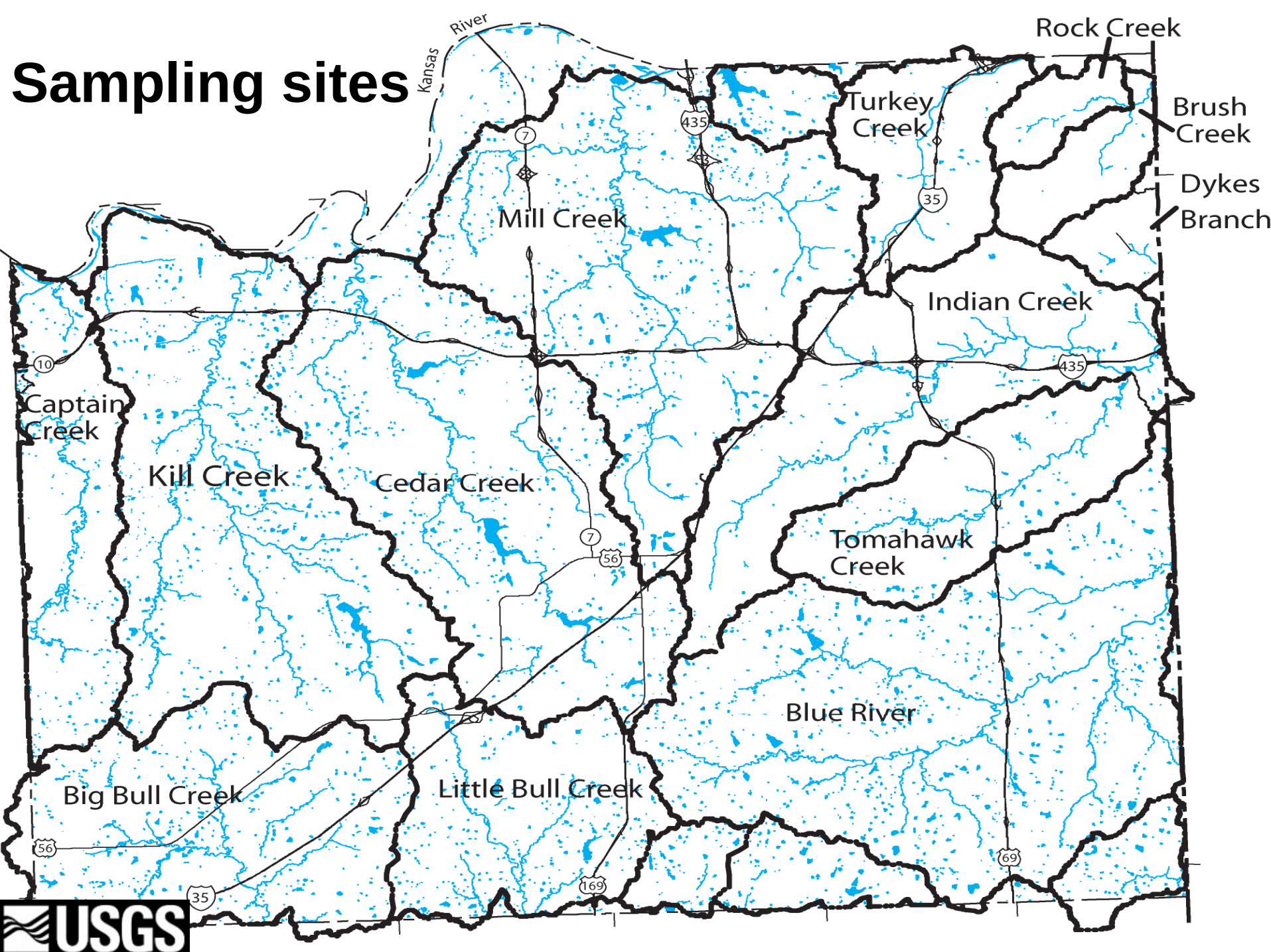
Sampling sites



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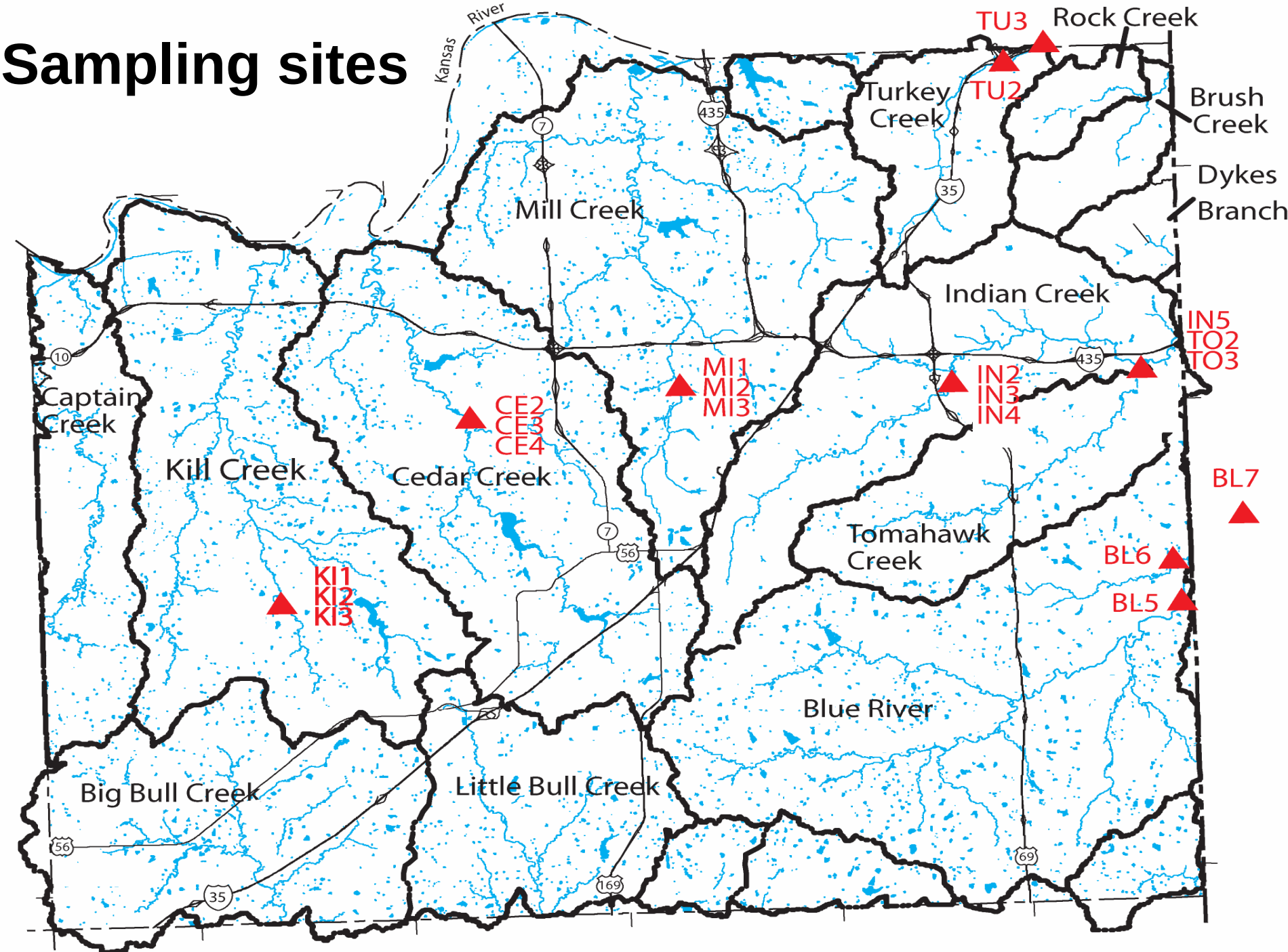
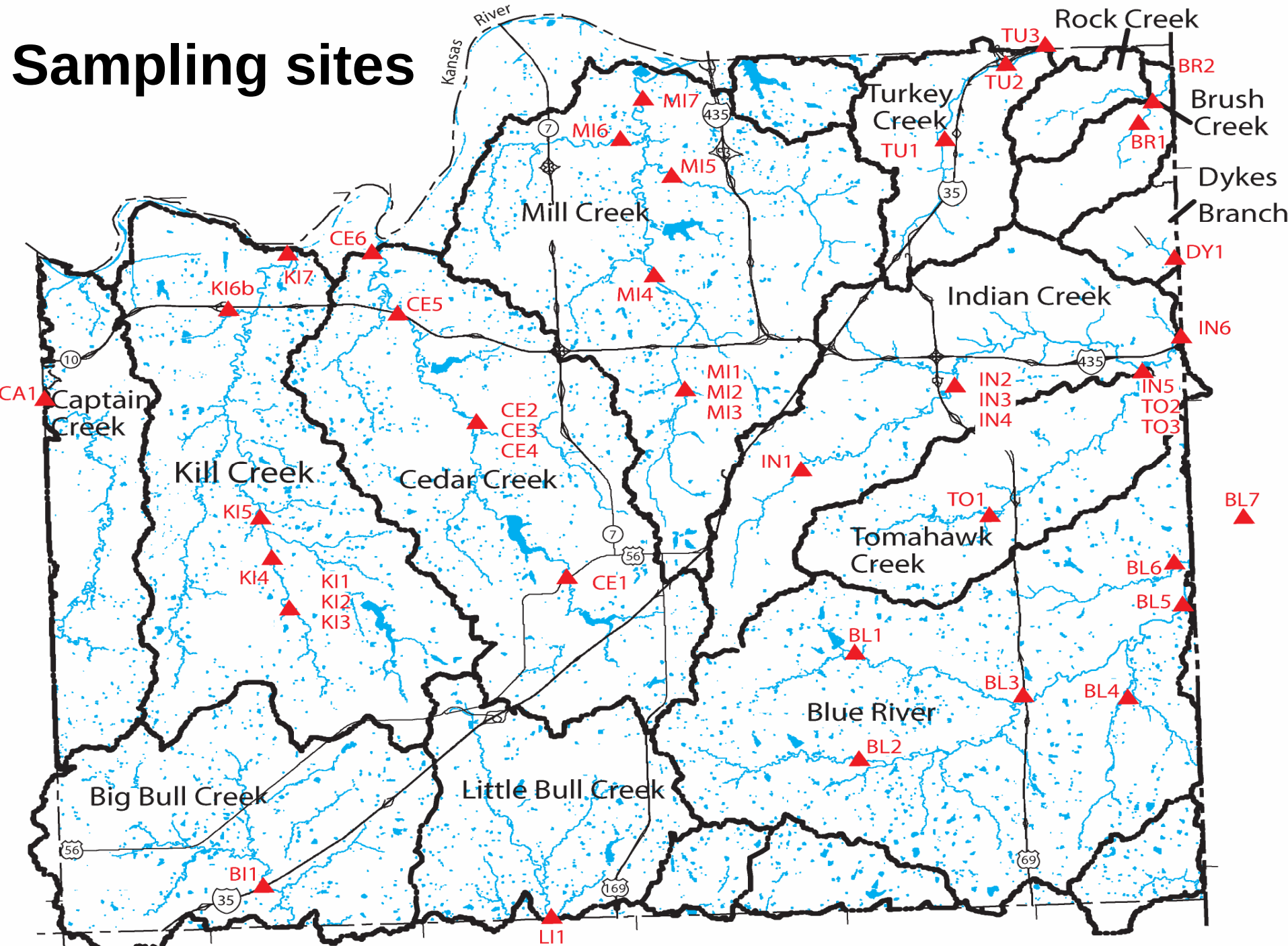
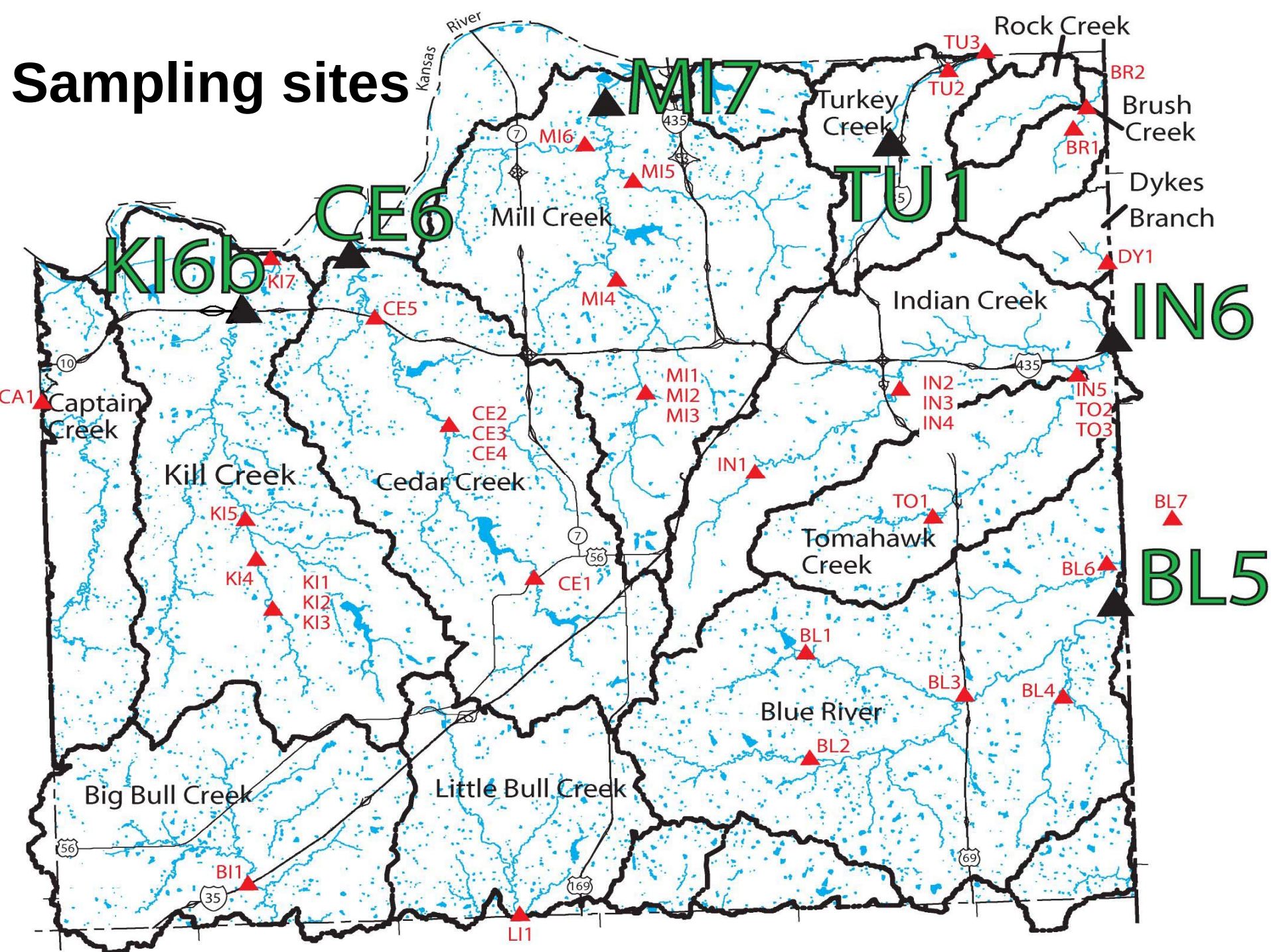
Sampling sites

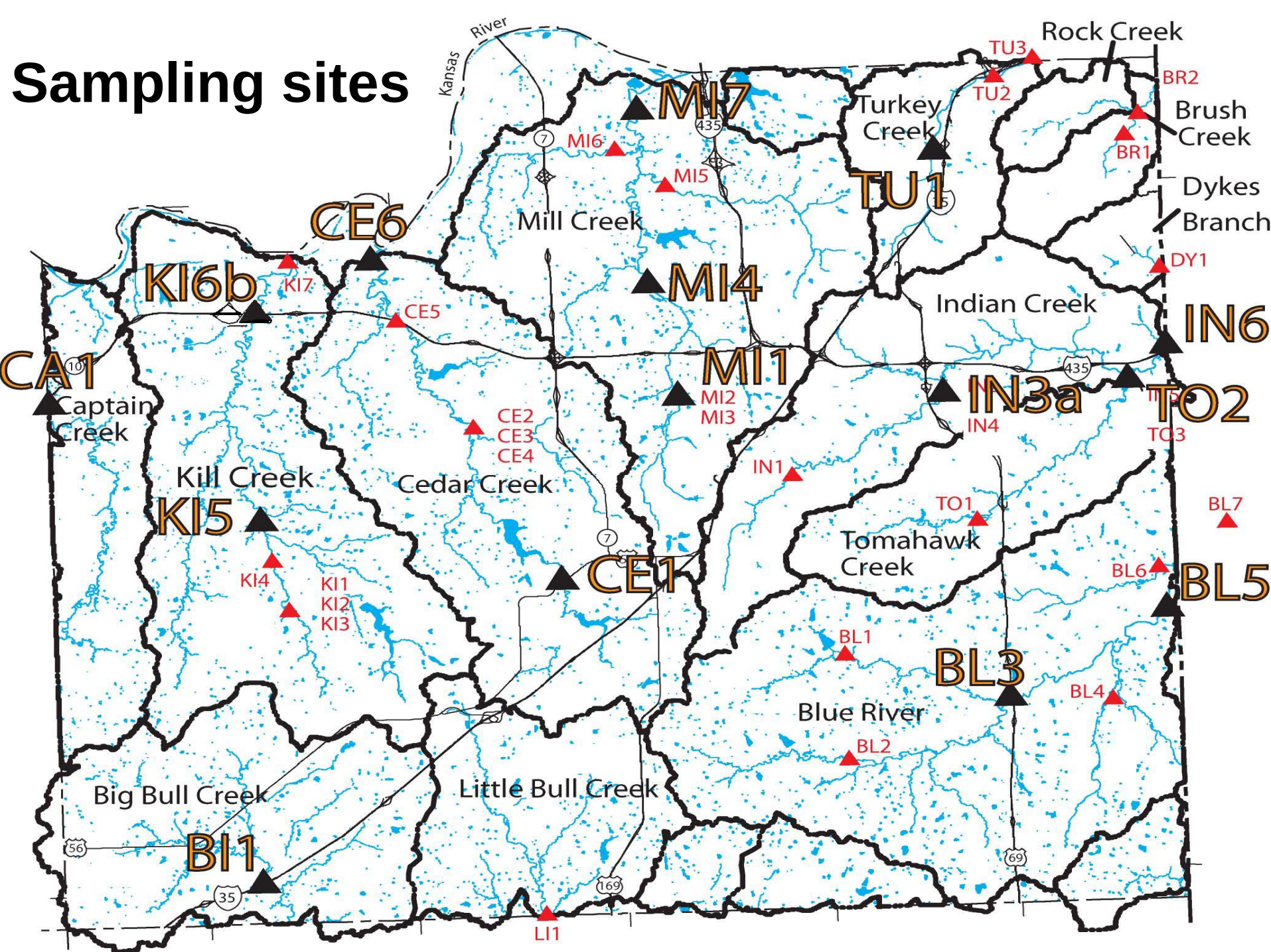


Sampling sites

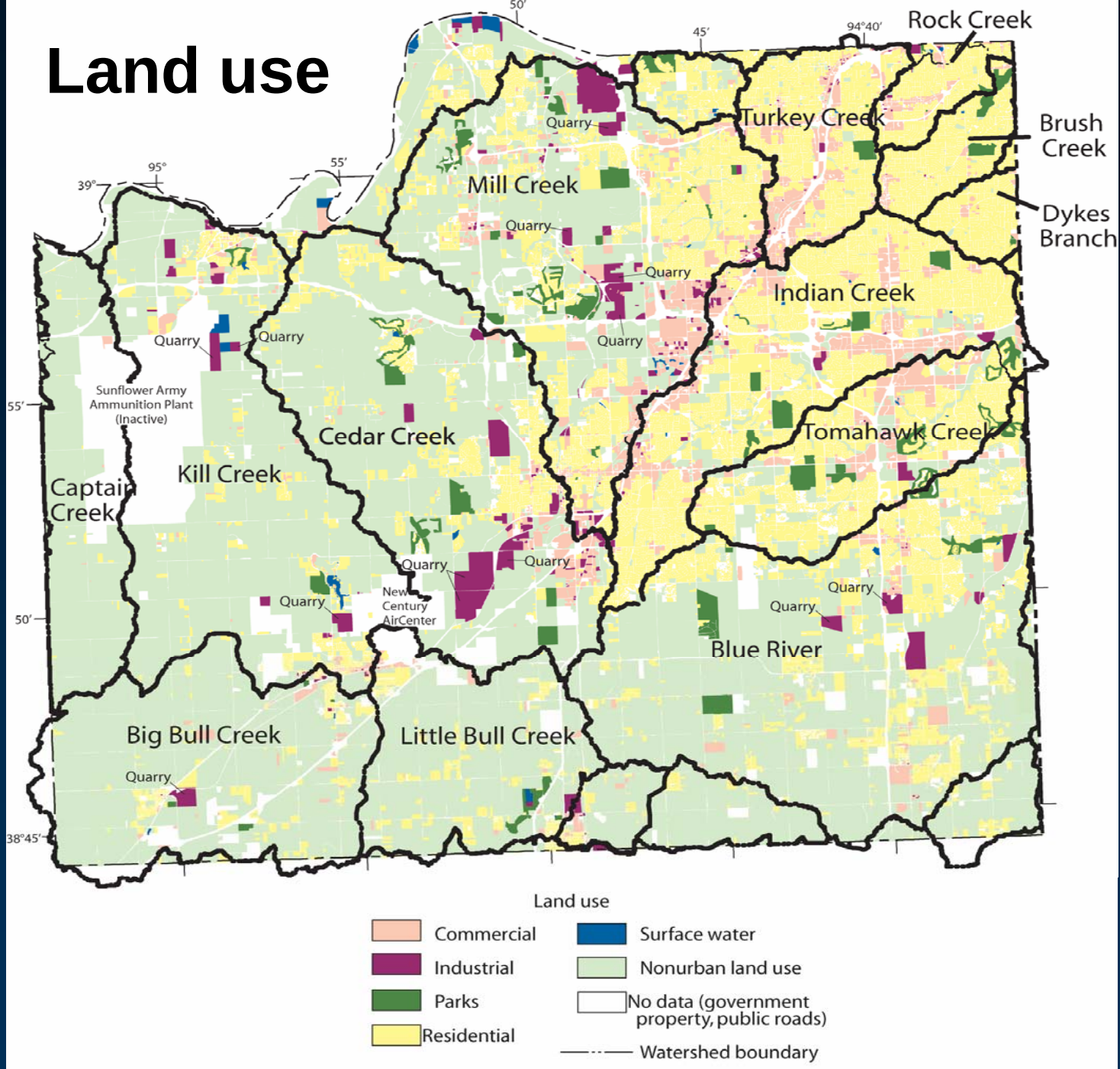



Sampling sites
Kansas River
MI7
CE6
KI6b
TU1
IN6
BL5
Rock Creek
Turkey Creek
Brush Creek
Dykes Branch
Mill Creek
Indian Creek
Captain Creek
Kill Creek
Cedar Creek
Tomahawk Creek
Blue River
Big Bull Creek
Little Bull Creek
TU3
TU2
BR2
BR1
MI6
MI5
DY1
KI7
MI4
CE5
MI1
MI2
MI3
IN2
IN3
IN4
IN5
TO2
TO3
CA1
CE2
CE3
CE4
IN1
TO1
BL7
KI5
KI4
KI1
KI2
KI3
CE1
BL6
BL1
BL3
BL4
BL2
BI1
LI1
10
435
7
56
35
169
69

Sampling sites



Land use



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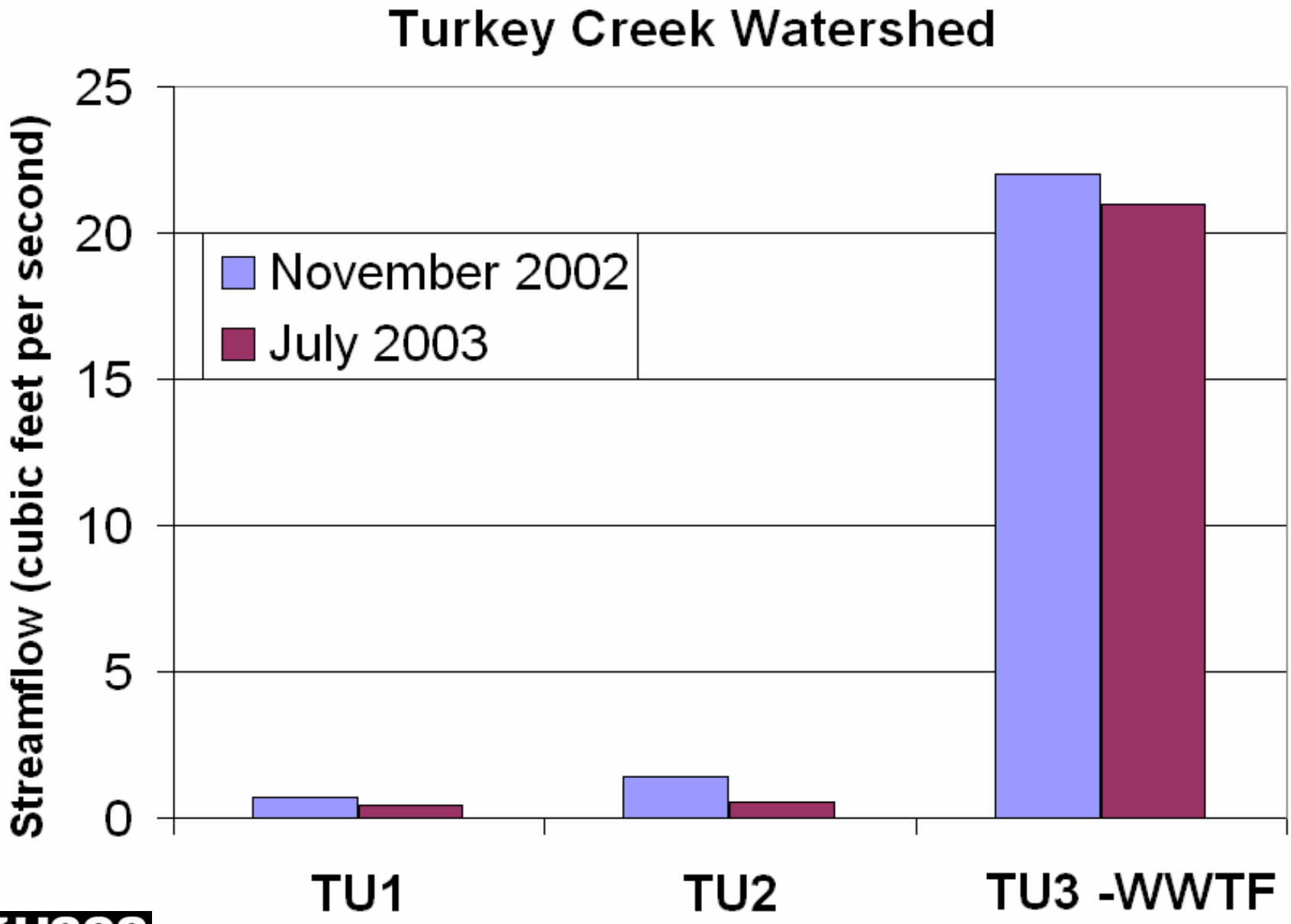
Point Sources – Base Flow



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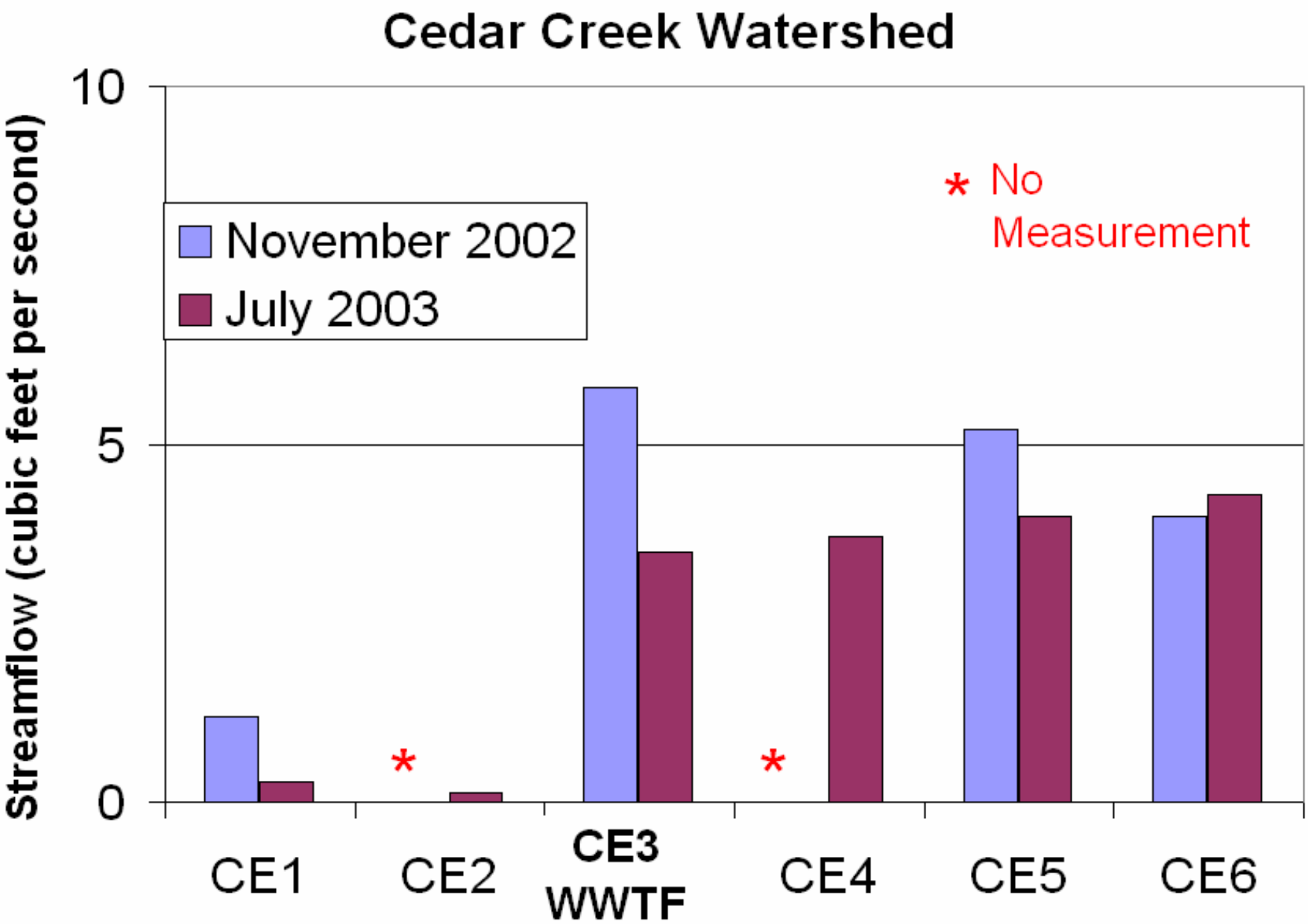
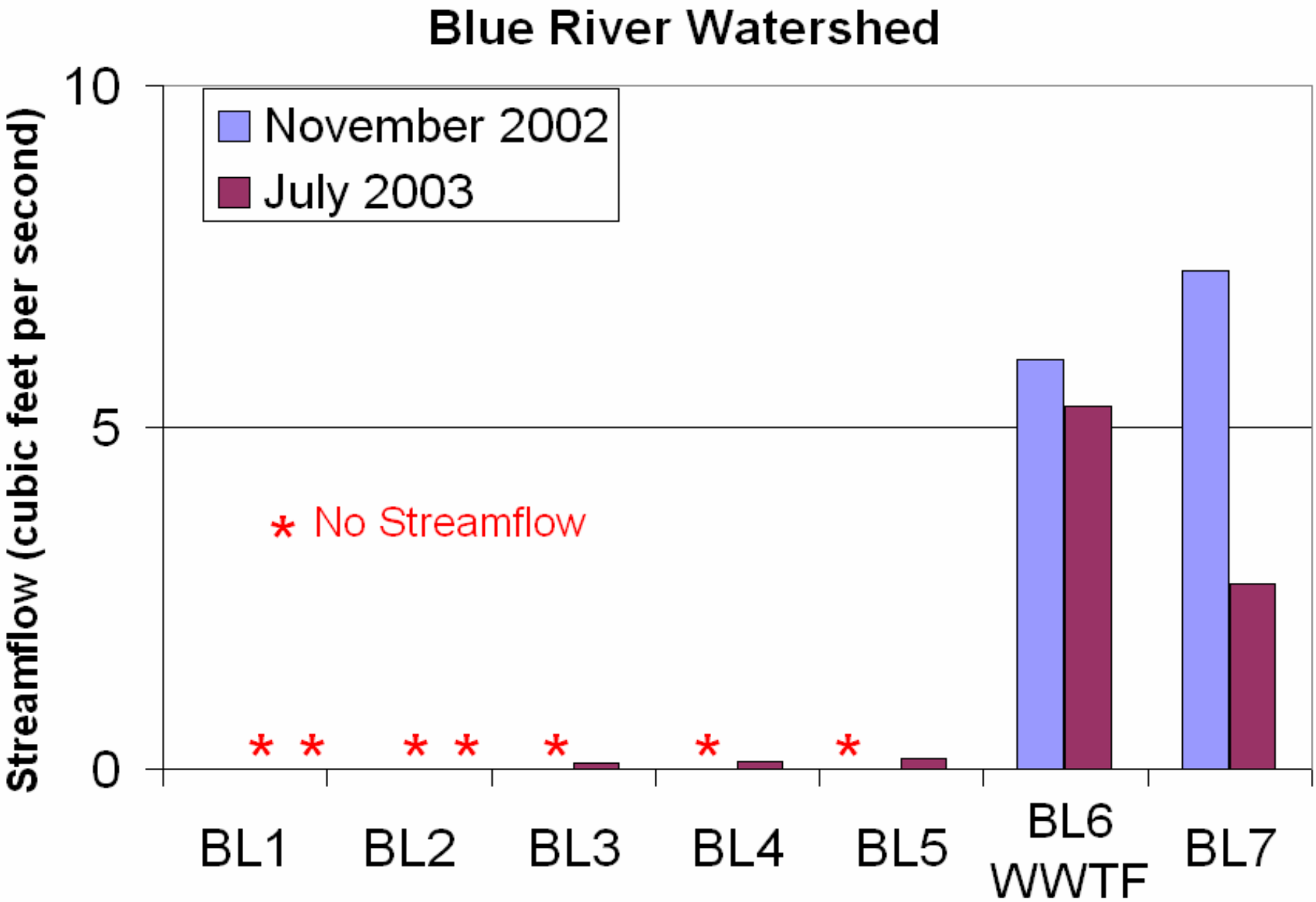
Point Sources – Base Flow



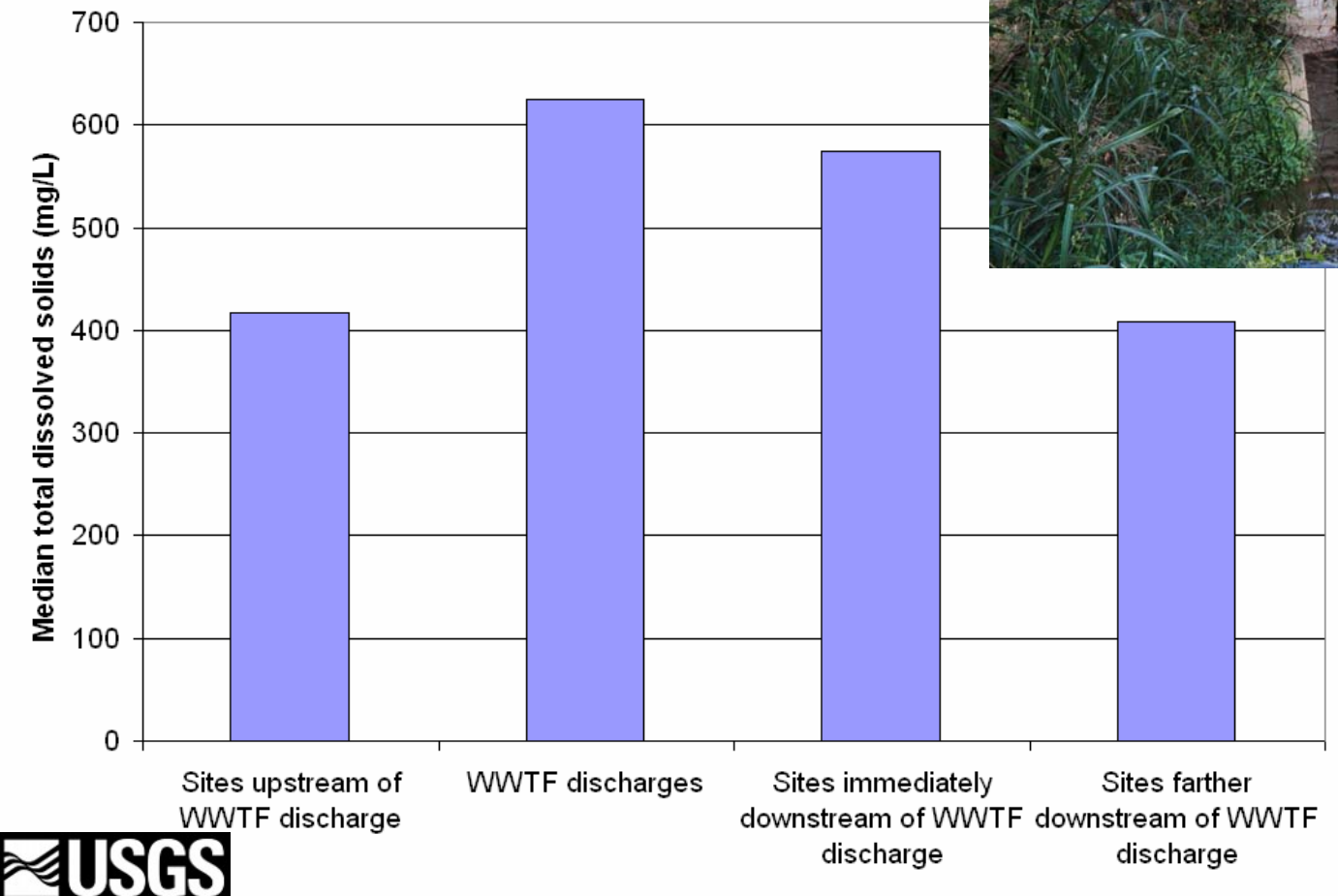
Point Sources – Base Flow



Point Sources – Base Flow

- **Dissolved solids/major ion concentrations were largest at WWTF discharge**

Indian Creek Middle Basin WWTF



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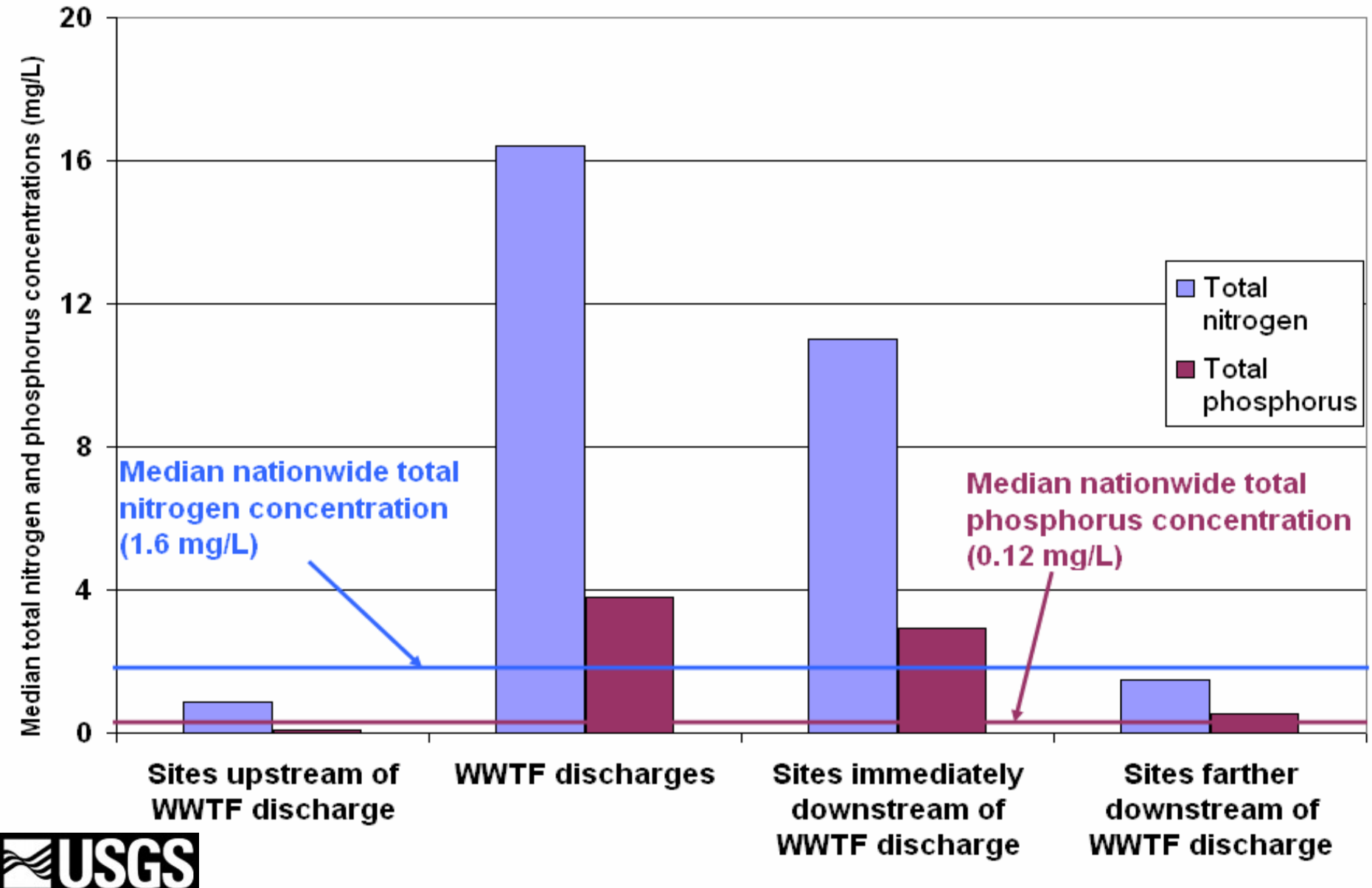
Point Sources – Base Flow

- WWTFs had large concentrations of nutrients



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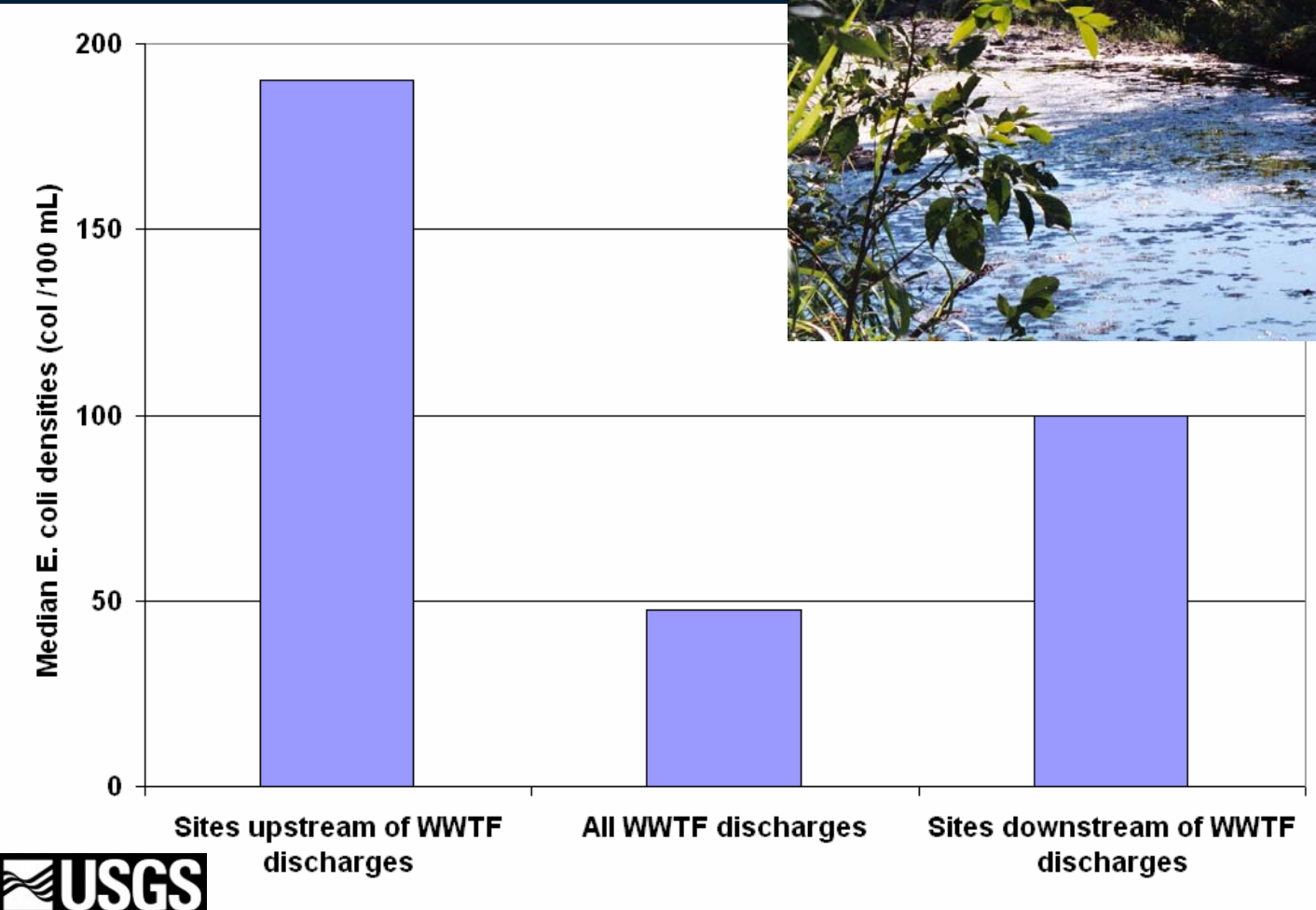
Point Sources – Base Flow

- **Bacteria and sediment concentrations were largest upstream of WWTF discharges**



Turkey Creek near I-635

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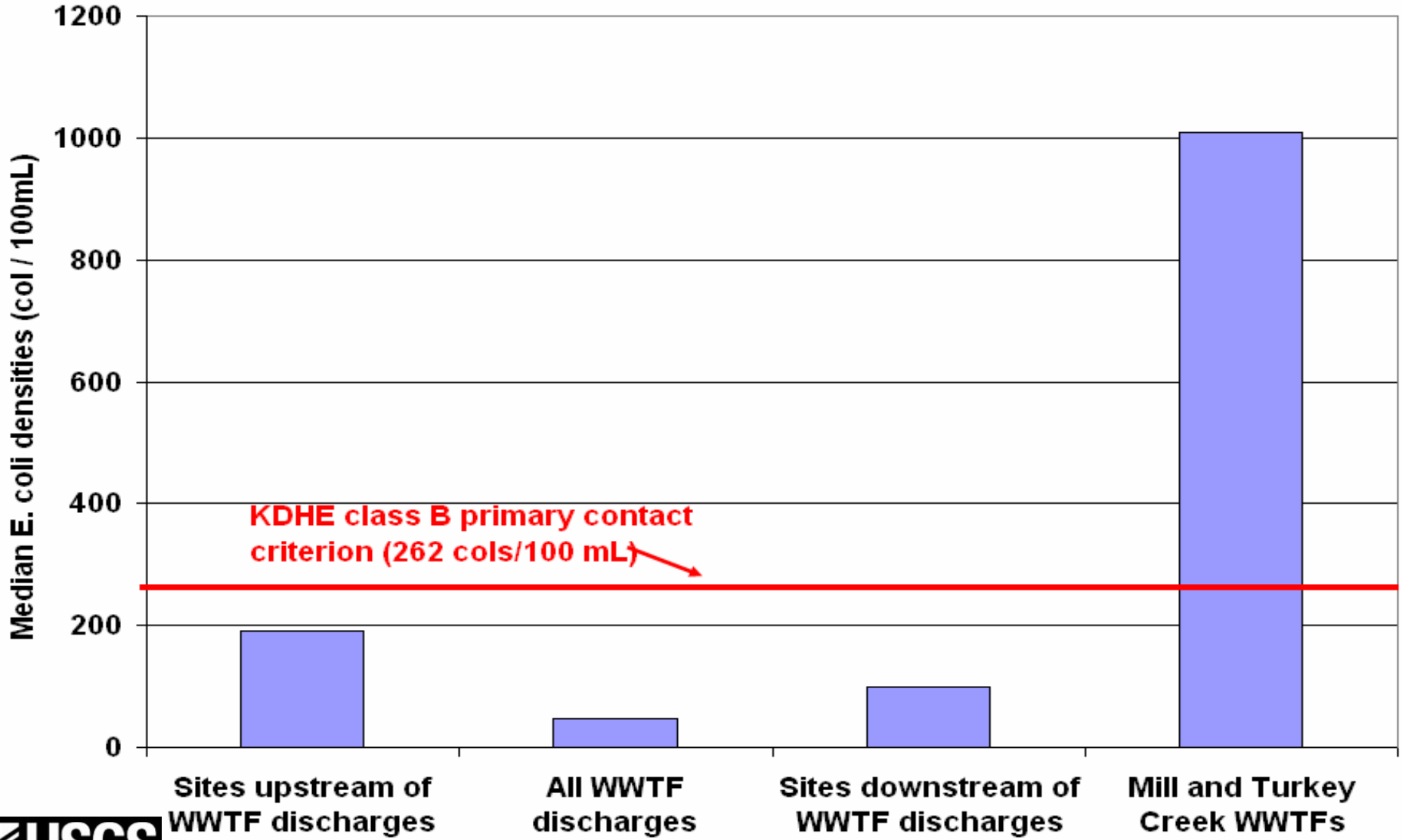
Point sources – Base Flow

- Mill and Turkey Creek WWTFs had the largest *E. coli* densities



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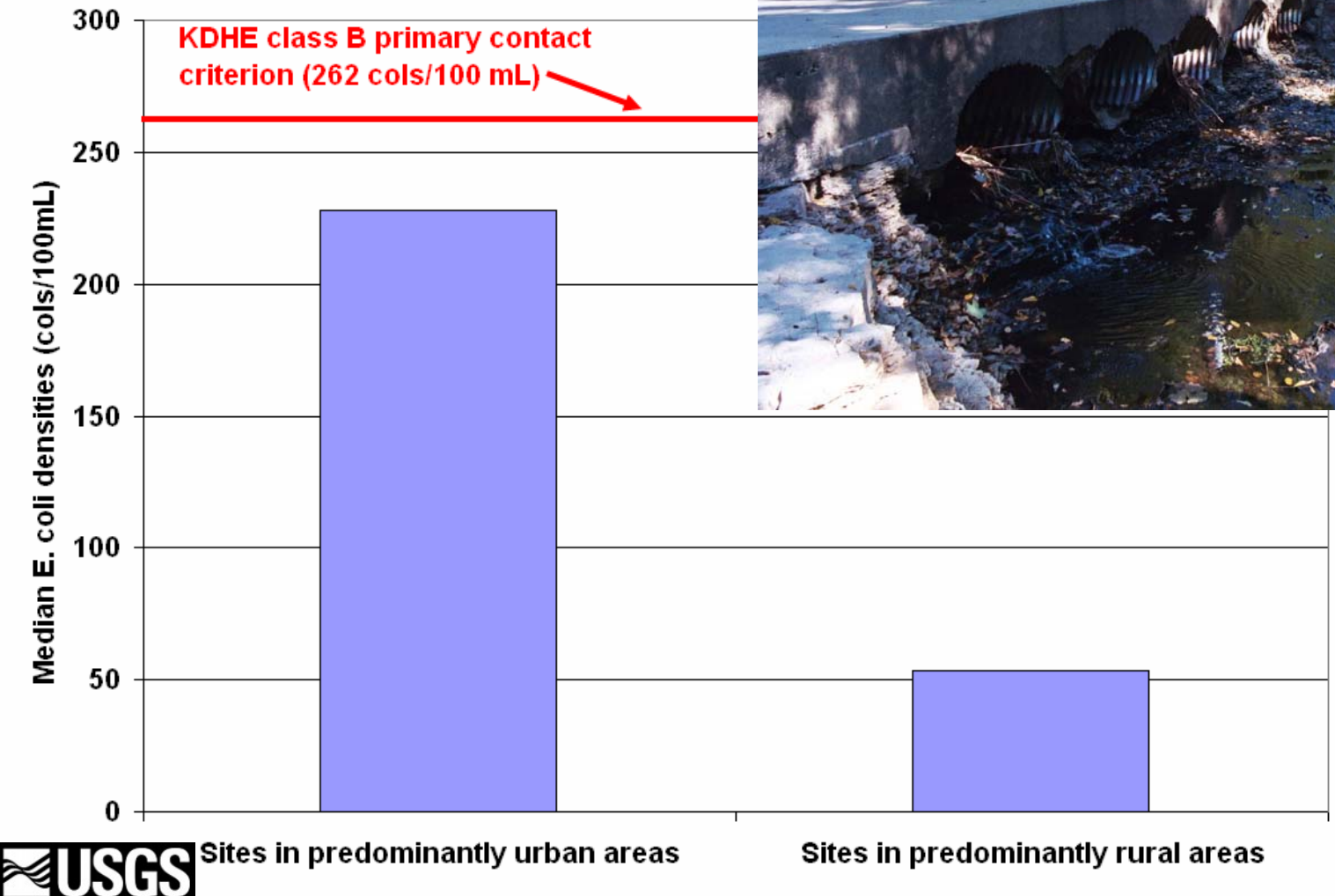
Point Sources – Base Flow

- Bacteria and wastewater compounds were larger in urban watersheds

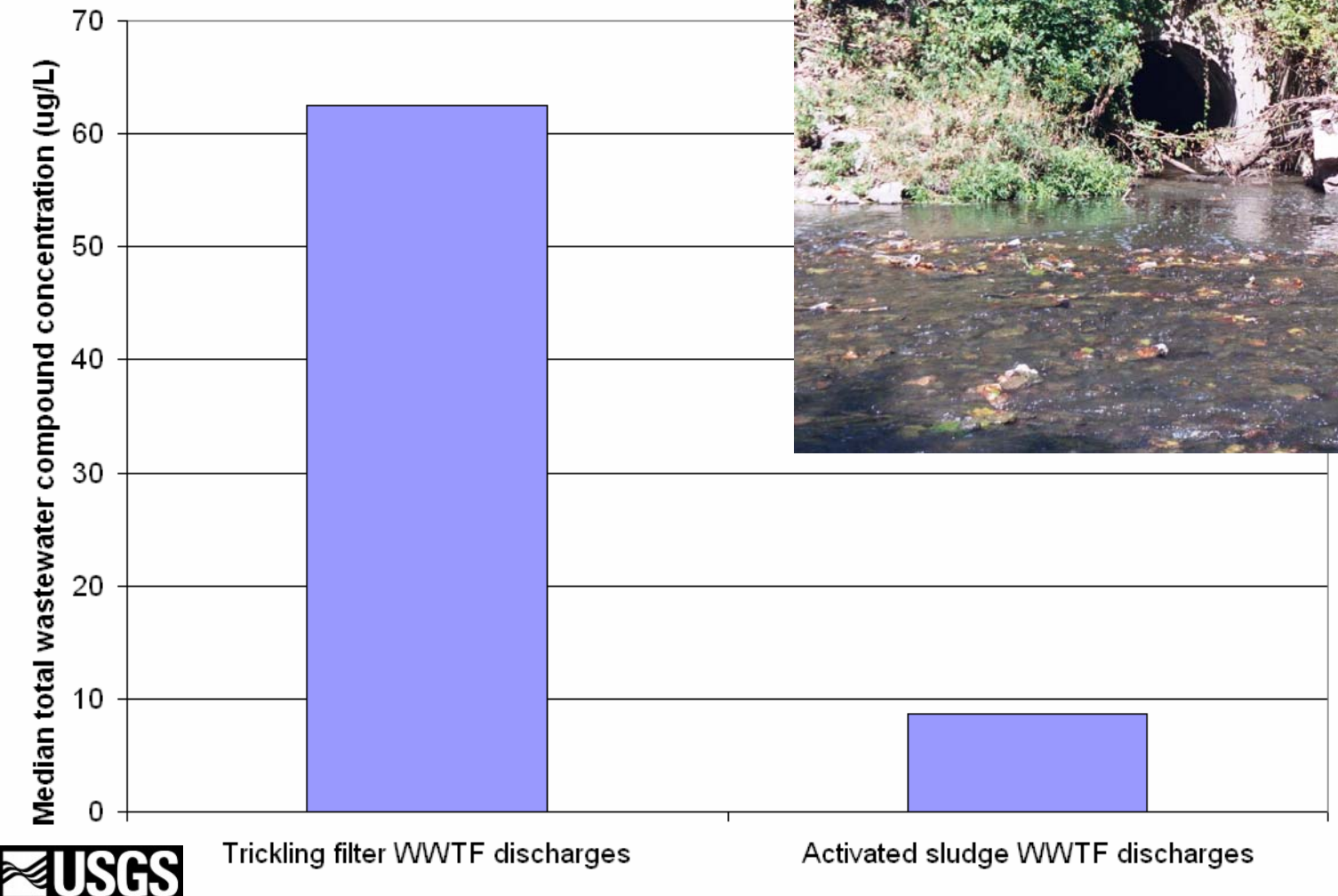
Brush Creek at 63rd St.



Point Sources – Base Flow

- Trickling filter WWTFs had elevated concentrations of wastewater and pharmaceutical compounds

Tomahawk Creek WWTF discharge



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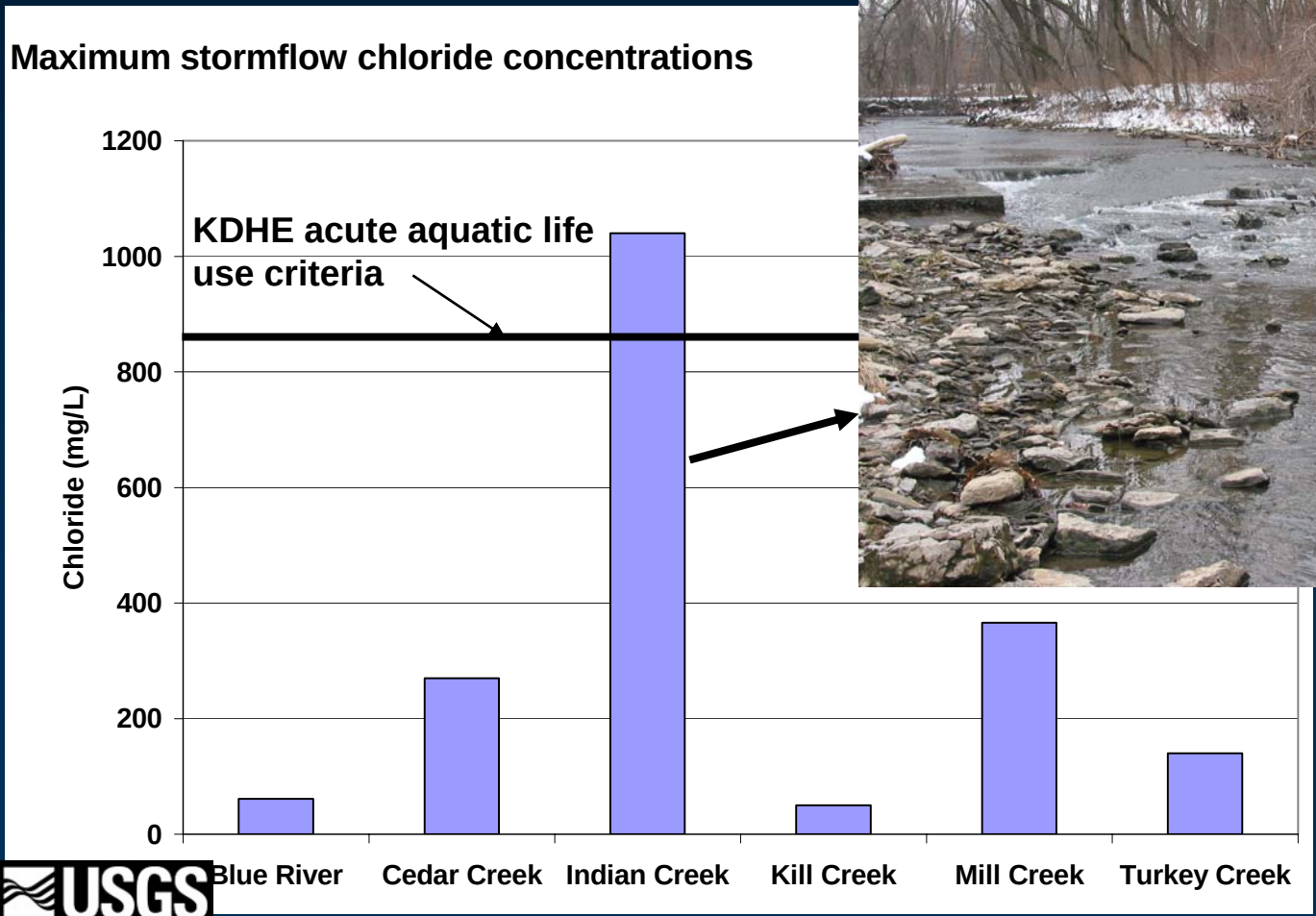
Nonpoint Sources- Stormflow

- Road salt caused largest concentrations of selected major ions (chloride, magnesium, sodium)



Indian Creek near 111th St

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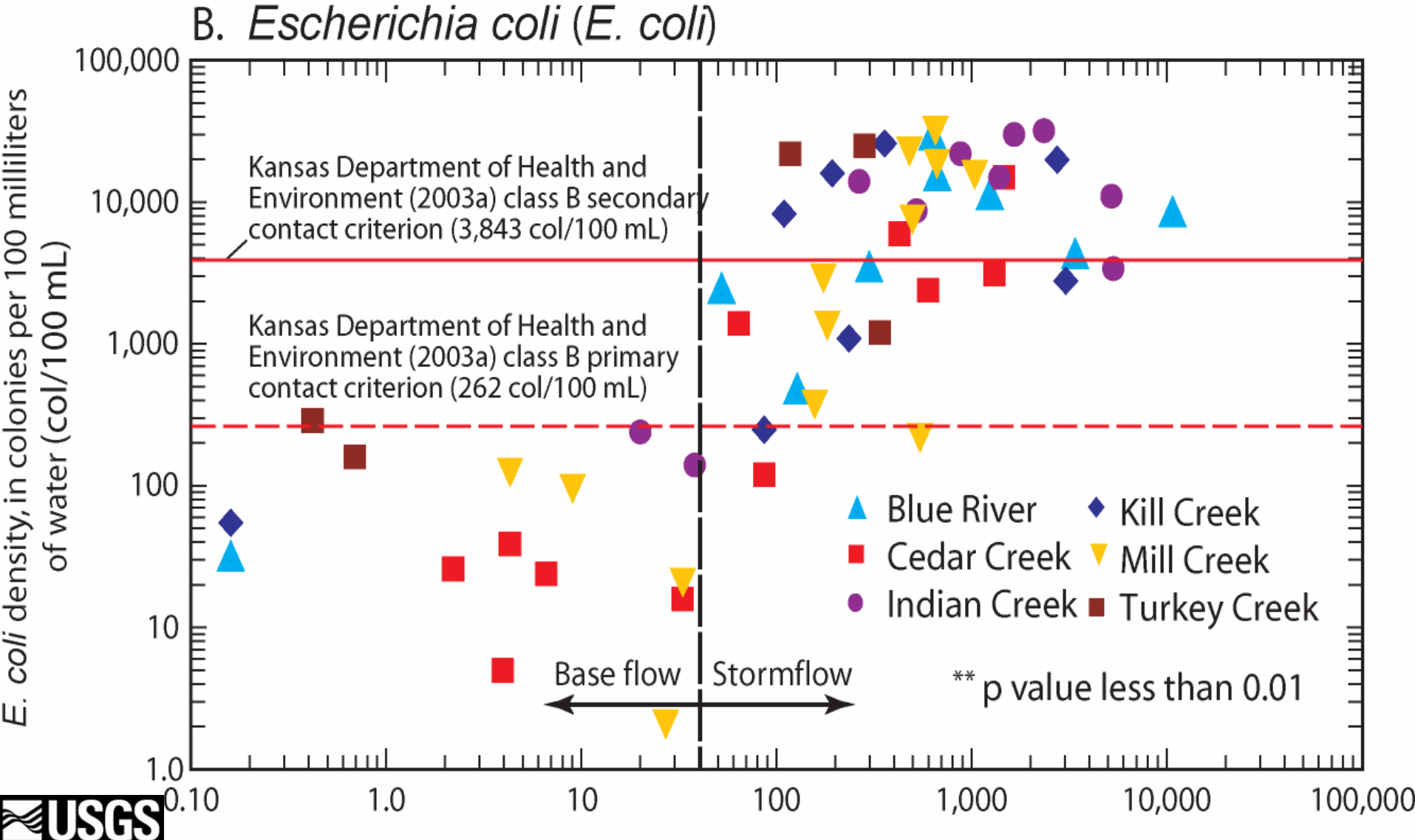
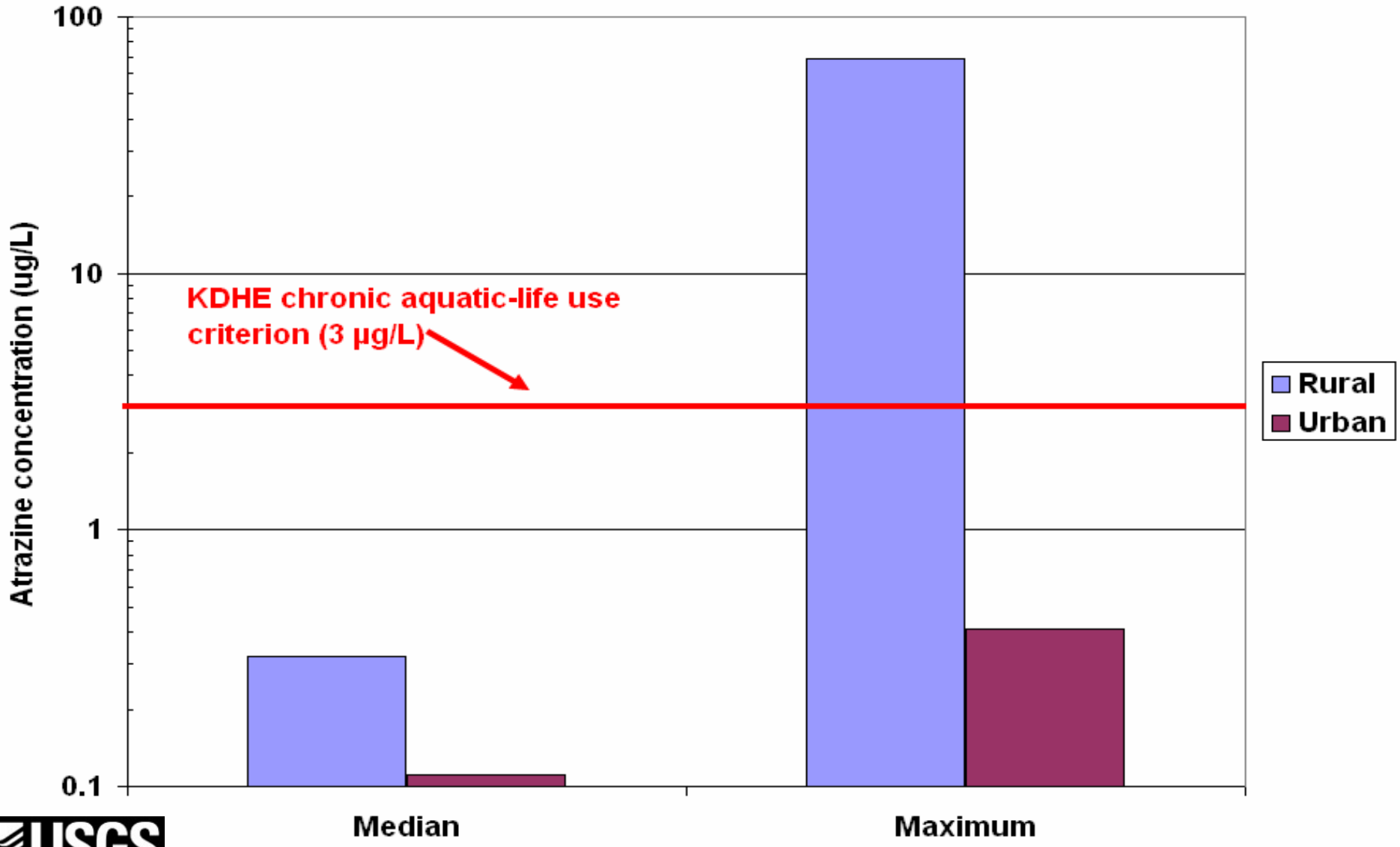
Nonpoint Sources – Stormflow

- **Nutrients, bacteria and sediment were 10 to 10,000x larger in stormflow**



Nonpoint Sources – Stormflow

- Pesticides were largest in spring, rural samples



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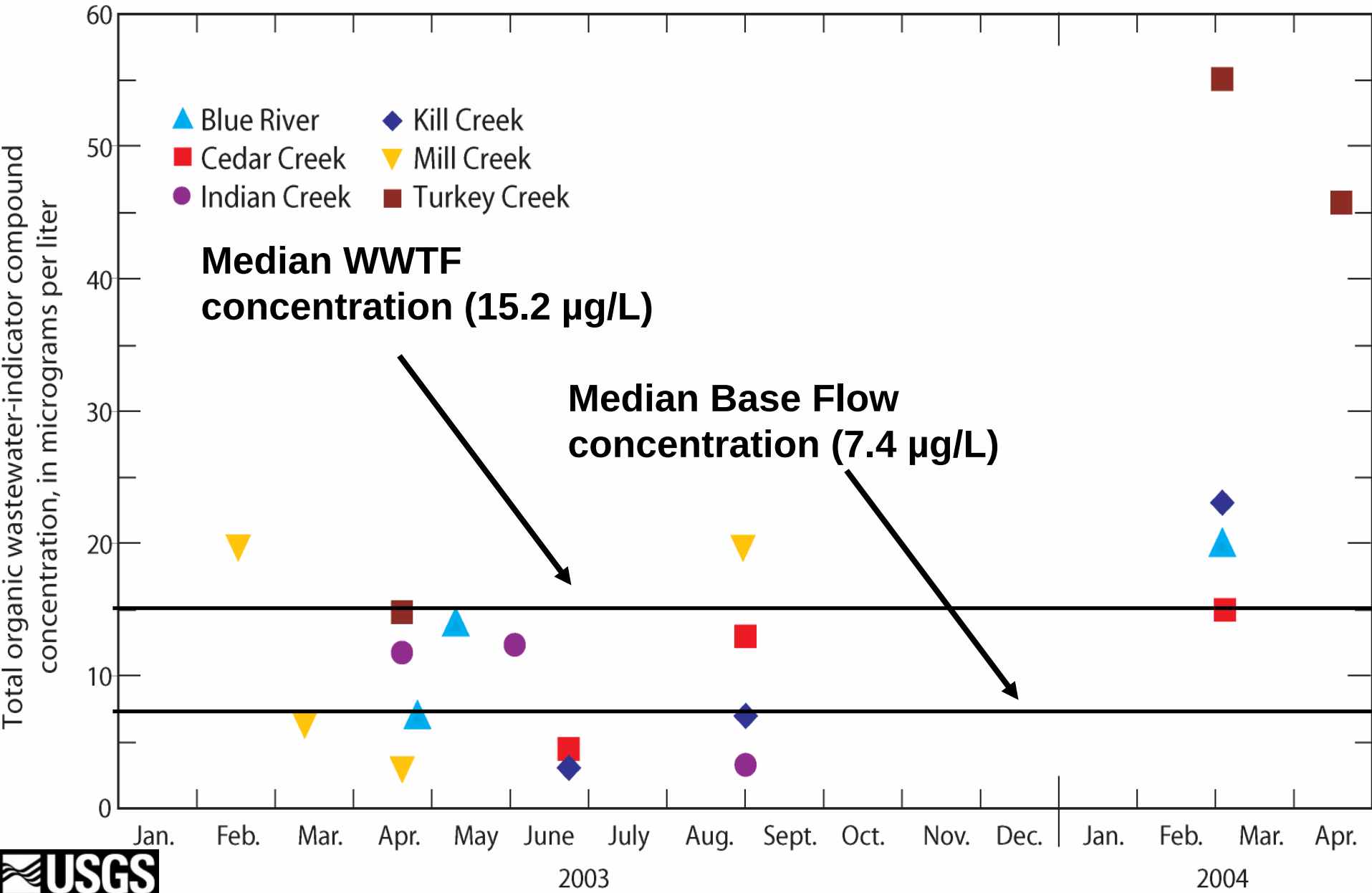
Nonpoint Sources – Stormflow

- Wastewater compounds have nonpoint sources



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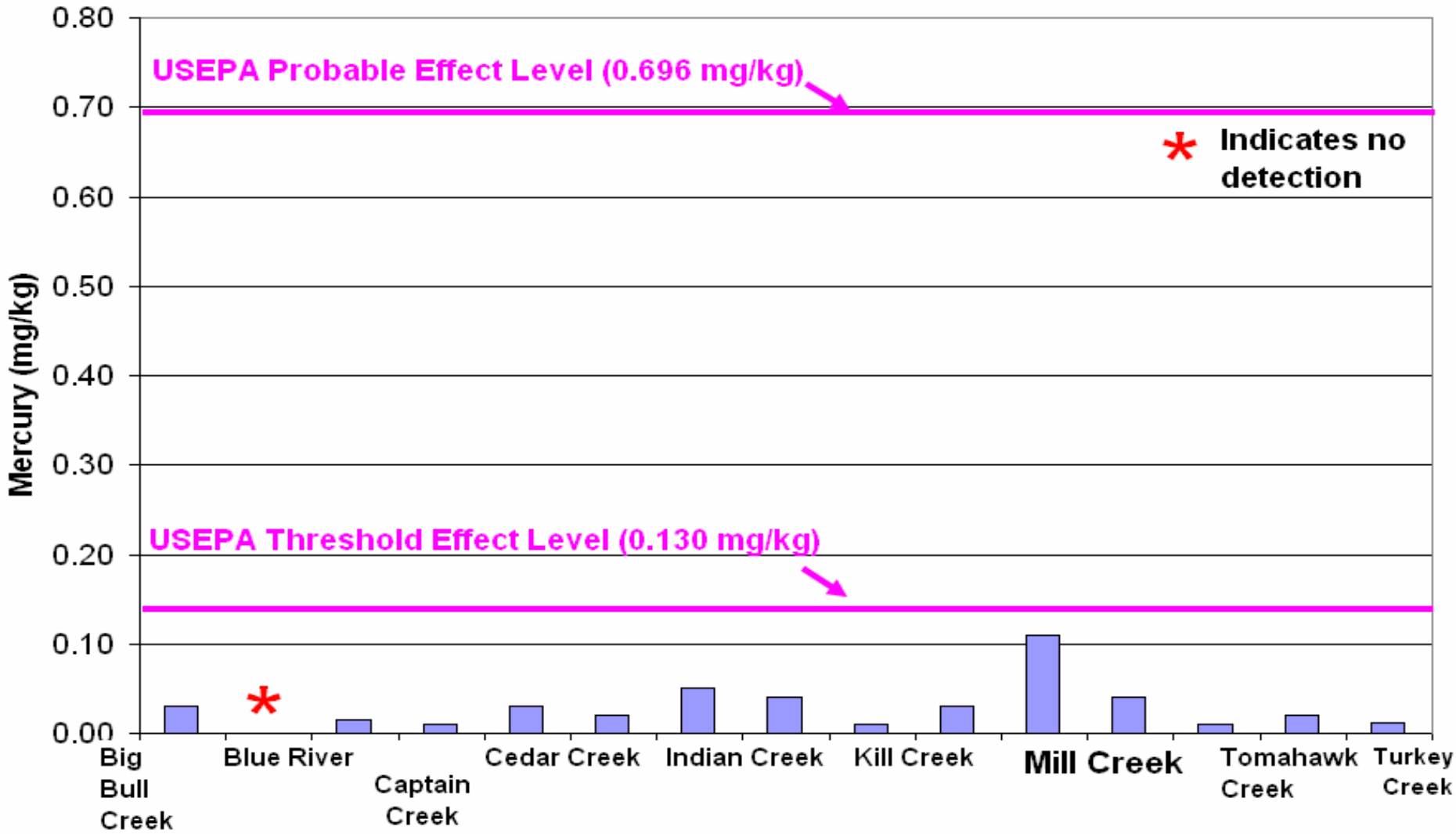
Nonpoint Sources – Streambed Sediment

- Mercury concentrations were small in streambed sediment



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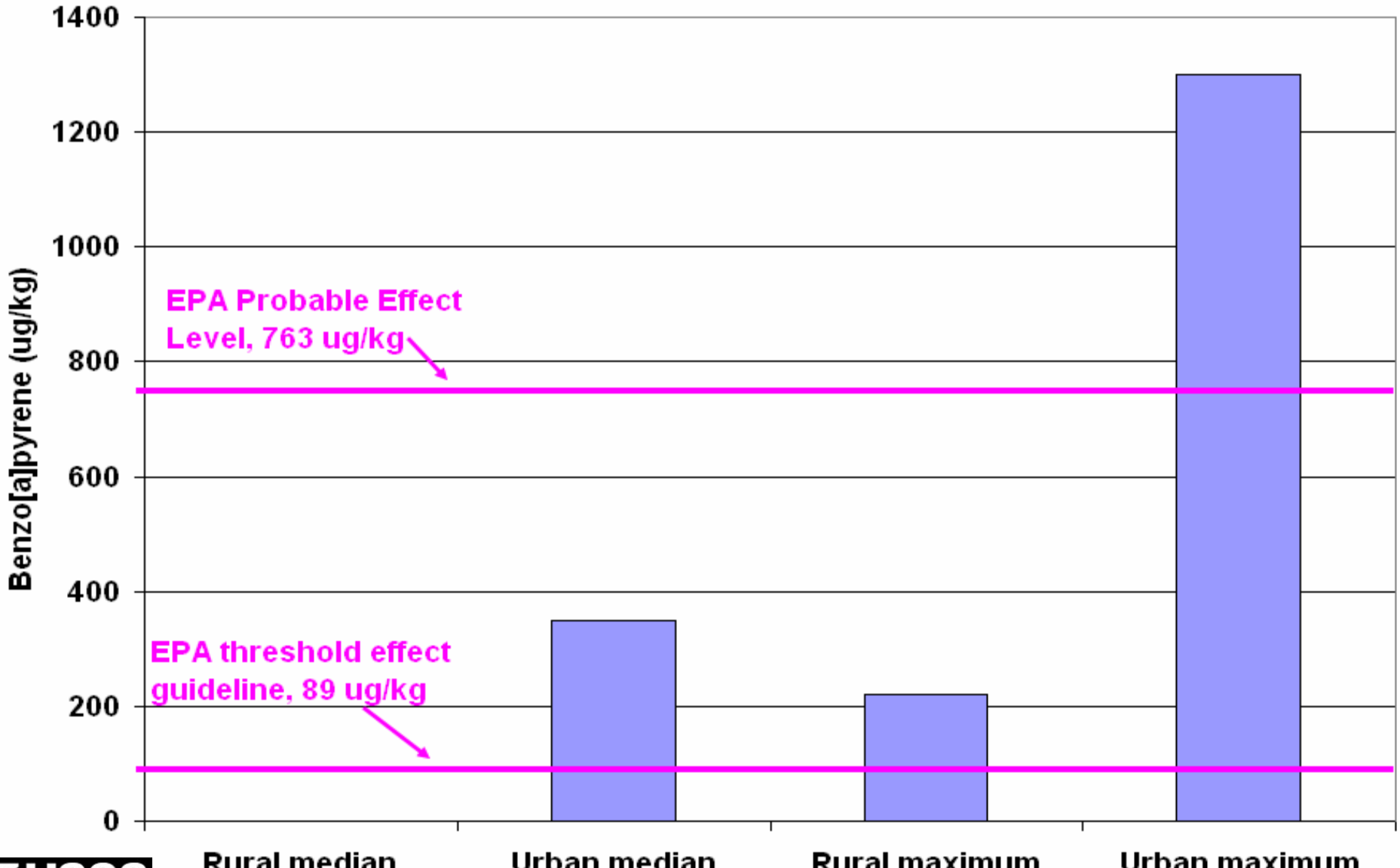
Nonpoint Sources – Streambed Sediment

- Polyaromatic hydrocarbons exceeded streambed sediment guidelines



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Conclusions

- Point sources
  - WWTF discharges were the largest source of streamflow during base-flow conditions
  - WWTF discharges were the source of elevated concentrations of dissolved solids/major ions, nutrients, and wastewater and pharmaceutical compounds
  - WWTF discharges diluted suspended sediment and bacteria concentrations
  - Secondary treatment processes affected wastewater and pharmaceutical compound concentrations

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Conclusions

- Nonpoint sources
  - Upstream of WWTFs, urban areas had increased bacteria and wastewater compounds
  - Road salt caused largest dissolved solids/major ions in winter, urban samples
  - Sediment, nutrients, and indicator bacteria had large nonpoint sources
  - Pesticides were largest in spring, rural stormflow samples
  - Some wastewater compounds (detergents, PAHs) had substantial nonpoint sources

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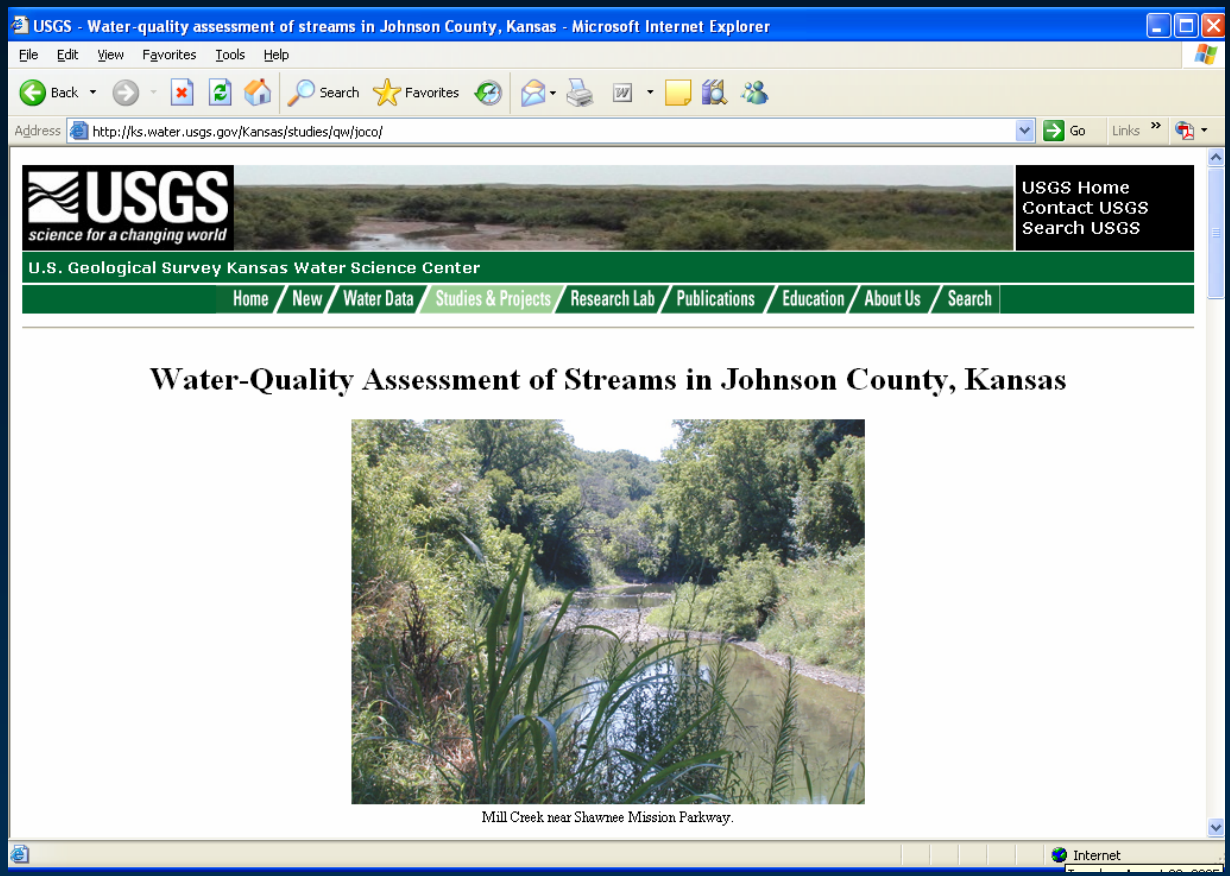
http://ks.water.usgs.gov/Kansas/studies/qw/joco/



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