

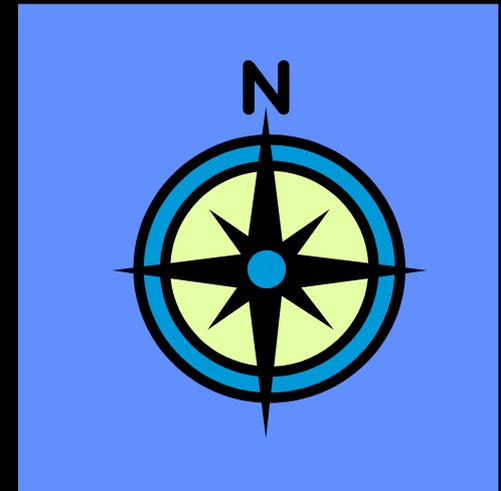
Multiple-Source Tracking

Investigating Sources of Pathogens, Nutrients, and Sediment in the South Fork Little River Basin, KY



Outline of Talk

- Introduction
- Study Purpose, Scope, and Objectives
- The What's and Why's of...
 - Microbial-Source Tracking?
 - Sediment Fingerprinting?
 - Stable Isotopes?
- Study Approach
- Partnerships

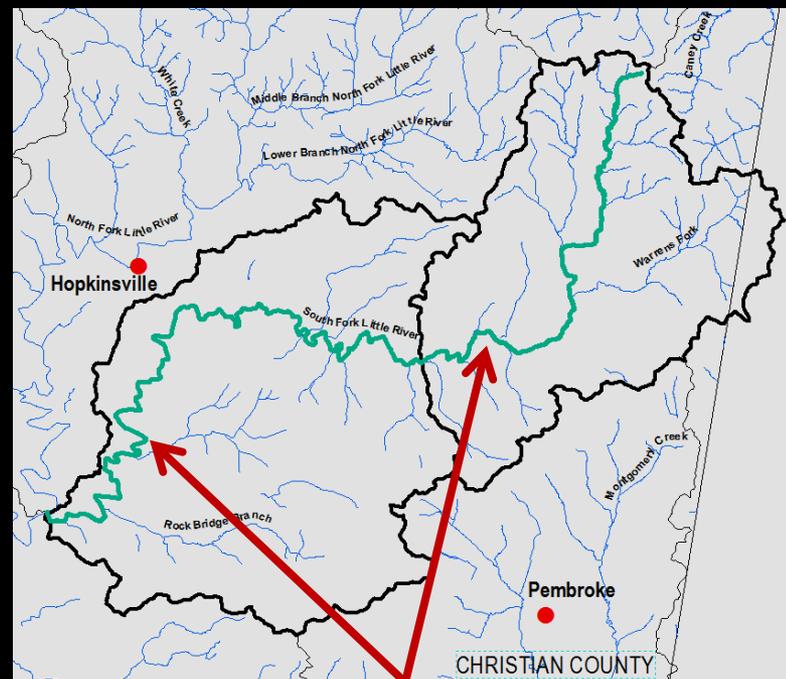


Why a Water-Quality Study in this Basin?

- **KDOW 303 (d) List of Impaired Waters**

<u>Cause of Impairment</u>	<u>Cause of Impairment Group</u>	<u>Designated Use(s)</u>	<u>State TMDL Development Status</u>
Fecal Coliform	Pathogens	Primary Contact Recreation Water	Completed (2009)
Nutrient/Eutrophication Biological Indicators	Nutrients	Warm Water Aquatic Habitat	TMDL needed
Other Cause	Other Cause	Warm Water Aquatic Habitat	TMDL needed
Sedimentation/Siltation	Sediment	Warm Water Aquatic Habitat	TMDL needed

- **Concerns from basin stakeholders about the approved pathogen TMDL**
- **Encouragement from KDOW to basin stakeholders to develop a Watershed Plan**
 - Contributing sources need to be identified and quantified to explore restoration options
- **Involvement by basin stakeholders**
 - Formed Little River WQ Consortium



SF Little River

WATER QUALITY

Physical Issues

Sediment,
turbidity



Chemical Issues

Nutrients

- NH_3
- TKN
- NO_3
- TP
- orthoP

Biological Issues

Pathogens
(*E. coli*)

Scope and Objectives

Three-year study with two years of water-quality sampling

- Apply a multiple-source tracking approach to identify various source(s) of pathogens, nitrogen, and sediment
 - Microbial-source tracking for pathogen sources
 - Stable isotopes for characterizing nitrogen sources
 - Various tracers for potential sources of fine-grained suspended sediment
- Study benefit: Help guide placement of effective best management practices in the basin



WHAT IS MICROBIAL-SOURCE TRACKING (MST)?

- A technique used in diagnosing the sources of fecal contamination in water



Match microbes from a polluted site and an animal source to suggest the origin of the fecal pollution

WHY MICROBIAL-SOURCE TRACKING?

- SF Little River listed as impaired for Primary Contact Recreation use due to pathogens
- Remediation requires knowing the 'source' of the problem
- Science-based procedures are needed to assist in source identification



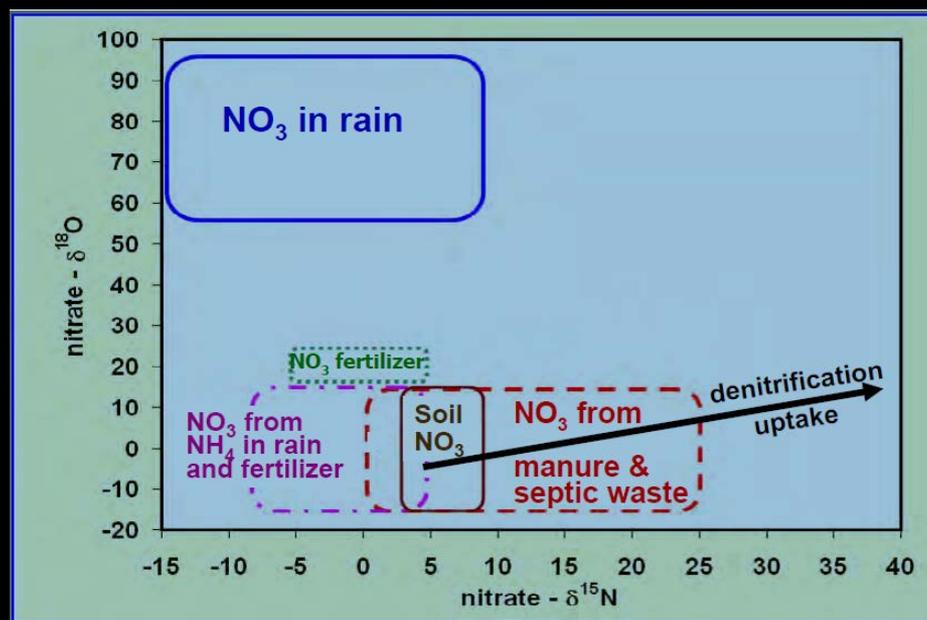
What are stable isotopes?

- **Isotope:** Elements with the same number of protons but varying numbers of neutrons
- **Stable isotopes**
 - Not radioactive
 - Decay rate **VERY** slow
 - Same chemical properties but don't have the same atomic mass

^{14}N 14.00307 99.63%	^{15}N 15.0001 0.37%
Stable	Stable

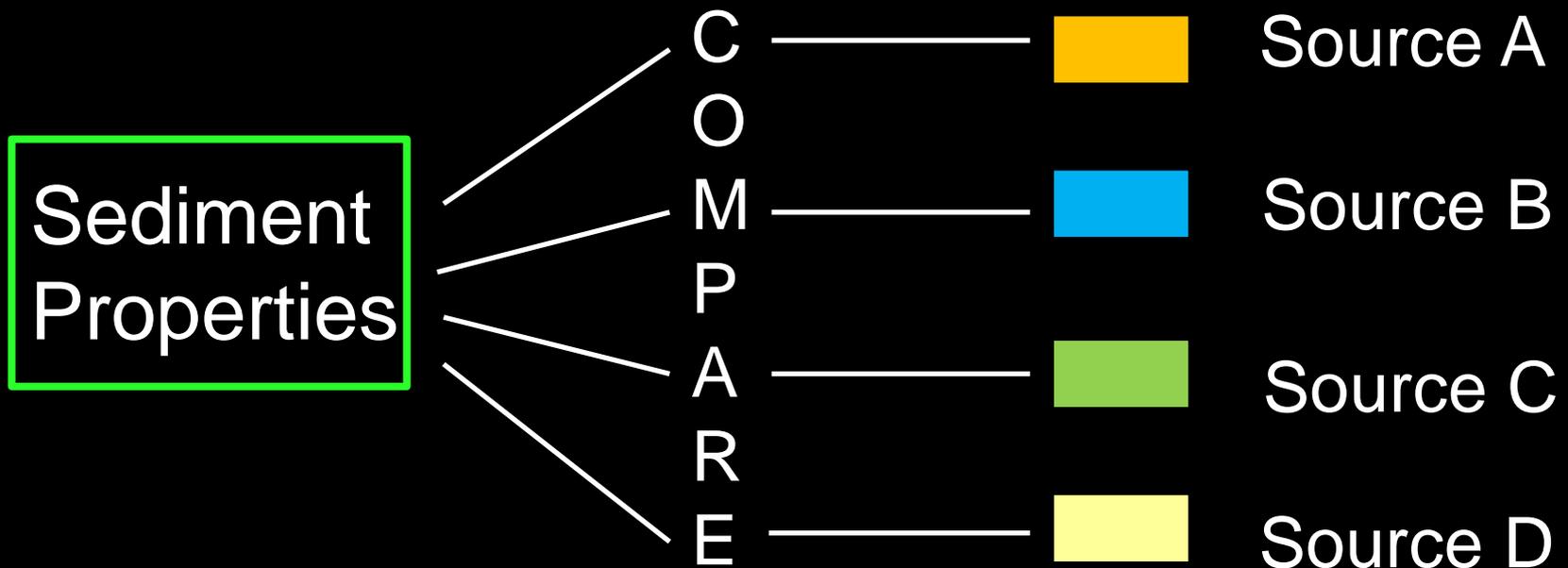
Why stable isotopes?

- Many different sources of nutrients have distinctive isotope ratios
- Many different process (e.g., denitrification, nitrification) change the isotope ratio of the reactants and products;
- In other words, different sources of nitrate often have **distinctive isotope “fingerprints”** that can provide a better understanding of the system than just chemical data alone.



What is Sediment-Source Fingerprinting?

Concept: Characterize potential fine-grained sediment sources in a watershed using a number of diagnostic physical and chemical properties (tracers)



Why Sediment Fingerprinting?

Leading Pollutants Impairing Assessed Rivers and Streams in Kentucky in 2010

<u>Cause of Impairment Group Name</u>	<u>Number of Causes of Impairment Reported</u>
<u>Sediment</u>	661
<u>Nutrients</u>	433
<u>Pathogens</u>	414
<u>Salinity/Total Dissolved Solids/Chlorides/Sulfates</u>	371
<u>Organic Enrichment/Oxygen Depletion</u>	223
<u>Cause Unknown</u>	170
<u>Turbidity</u>	99

Approach

1. Field data collection
2. Investigate nutrient (nitrate) sources using stable isotopes
3. Investigate pathogen source(s) using microbial-source tracking
4. Investigate sediment sources using sediment fingerprinting

Approach: Real-time Data

- **Real-time streamflow gages**

- Three on SF Little River
- Two on NF Little River
- One on Little River mainstem near Cadiz



- **Continuous water-quality monitors**

- Two real-time monitors (water temp., turbidity)
- Two in-situ monitors (water temp., turbidity)

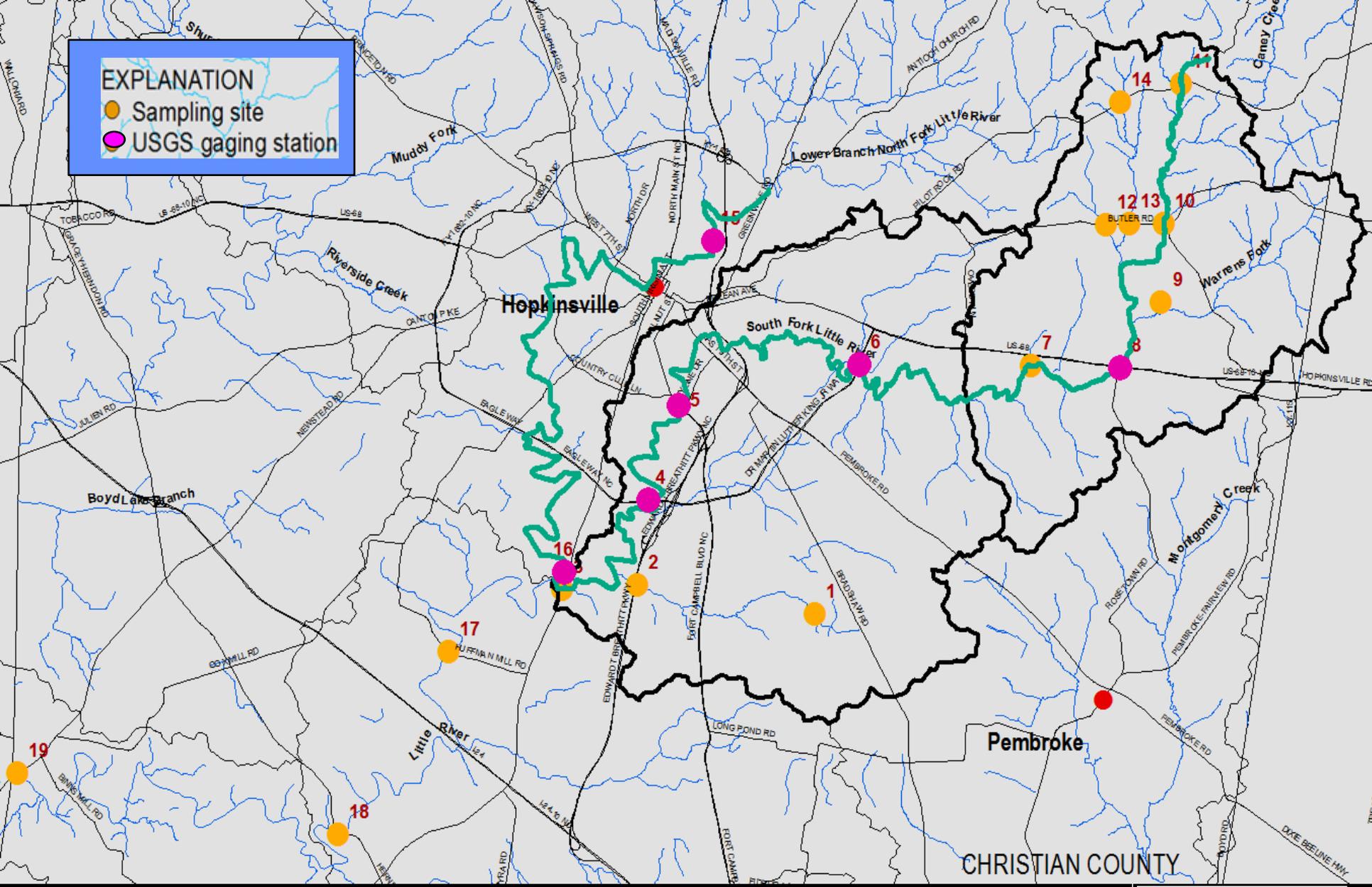


Water-quality monitor



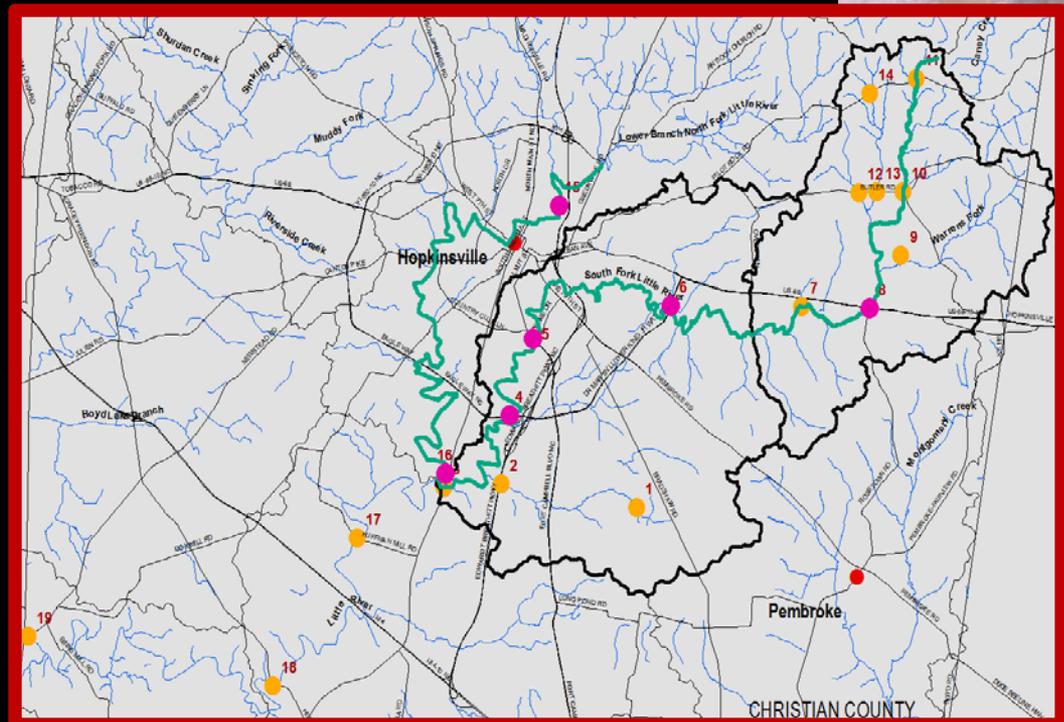
EXPLANATION

- Sampling site
- USGS gaging station



Approach: Routine water-quality sampling

- Monthly nutrient, stable isotope, and sediment sampling at 19 sites
- Collect water and sediment *E. coli* samples (May-October)
- Field parameters
 - Streamflow
 - Water Temperature
 - pH
 - Dissolved Oxygen
 - Conductance
 - Turbidity



Microbial-Source Tracking

- Collect *E.coli* samples from sampling sites during various hydrologic and seasonal conditions
- Collect fecal reference samples from each potential source group (human, canine, geese, dairy cattle, poultry)

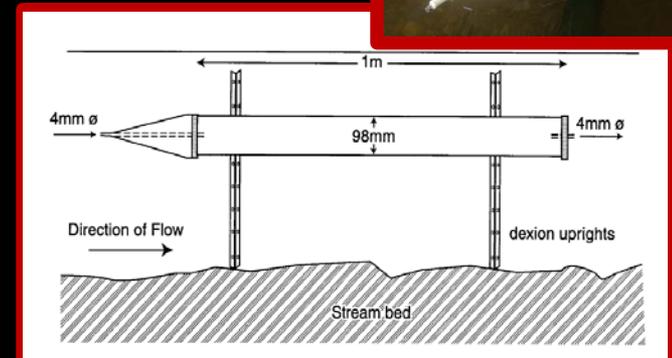


Sediment Fingerprinting

- Collect sediment source samples from identified source areas (i.e. agriculture, forest) and from stream banks and bed
- Collect fine sediment samples from select stream sampling sites using passive samplers
- Samples analyzed for trace elements, carbon and nitrogen isotopes, and specific radionuclides (cesium, lead, etc.)



Passive
sediment
sampler



Why source-tracking studies?

- Tell us things about water resources that we didn't know before
- Tell us things about water resources that contradict what we thought we knew before
- Increase the likelihood that any proposed remediation plans will be effective—because the correct source was identified

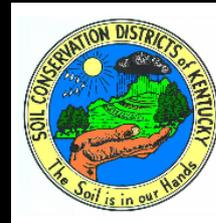
Partnerships

Little River Water-Quality Consortium



County Agriculture Development Boards

- Christian
- Trigg
- Todd



And many others

Thank You

