Turning Monitoring Data into Watershed Priorities

National Water Quality Monitoring Conference

Cincinnati, OH

Mindy Scott, SD1

Carrie Turner, LimnoTech

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SD1

LimnoTech

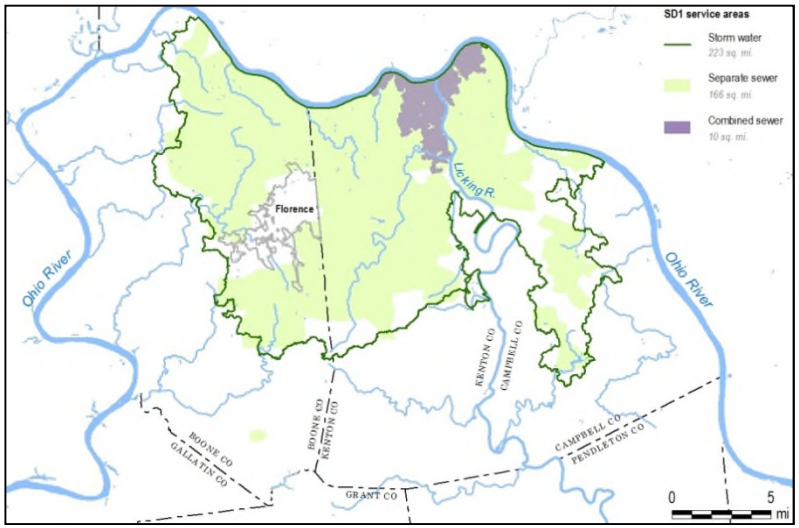
Water Environment | Scientists Engineers

Outline

- Background
- Data Collection
- Data Analysis
- Benefits

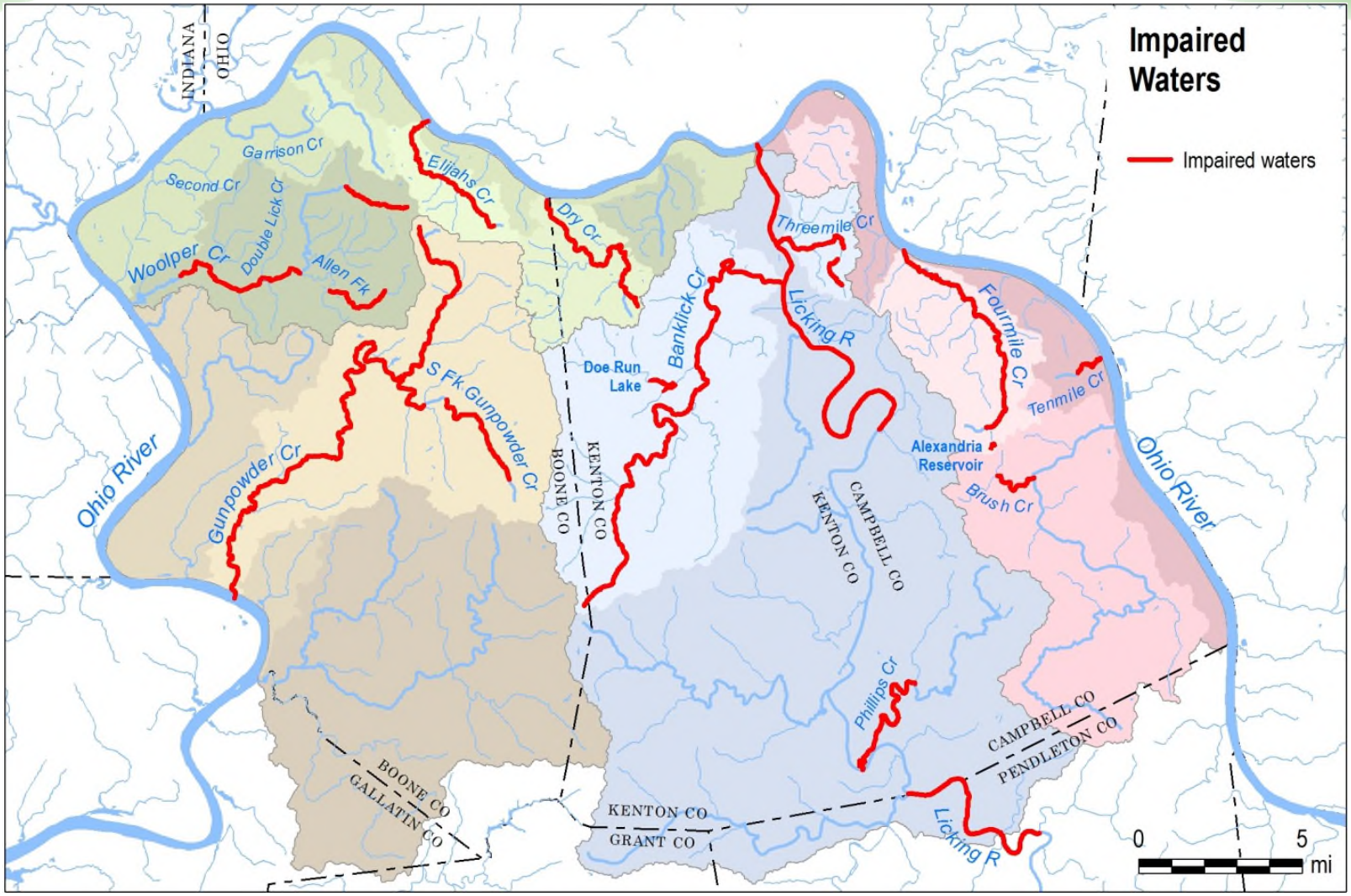
SD1 Background

- **Wastewater Utility**
  - Consolidated sanitary/combined sewers under SD1 in 1995
  - 35 jurisdictions (32 cities and 3 counties)
  - 176 square mile service area
  - 1700 miles of sewer, 142 PS & 11 WWTPs
- **Storm Water Utility**
  - Formed regional utility in 2003
  - Began transfer of ownership and maintenance of infrastructure in 2009
  - 32 MS4 Phase II Co-permittees (29 cities and 3 counties)
  - 218 square mile service area
  - 435 miles of sewer and 31,000 structures



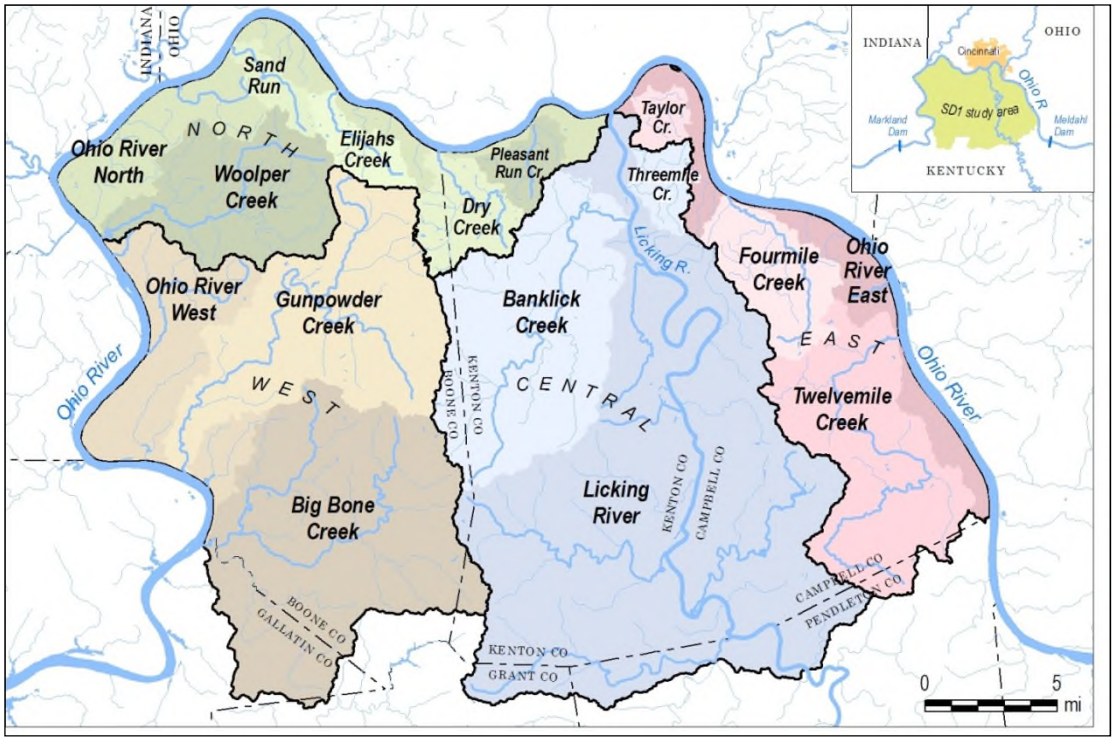
SD1 Primary Challenges

- **Combined Sewer Overflows**
  - ✓ 95 CSO Locations
  - ✓ 1.9 Billion Gallons Annually
- **Sanitary Sewer Overflows**
  - ✓ 179 SSO Locations
  - ✓ 240 Million Gallons Annually
- **Storm Water Runoff (MS4 & NPS)**
  - ✓ Hydromodification
  - ✓ Flooding
- **Impaired Waters**
  - ✓ Primary Pollutants of Concern (Bacteria, Solids & Nutrients)



Note: The segments of the Ohio River adjacent to the Cincinnati/Northern Kentucky area are listed as impaired from the Fourmile Creek confluence (Campbell County) downstream to the Big Bone Creek confluence (Boone County).

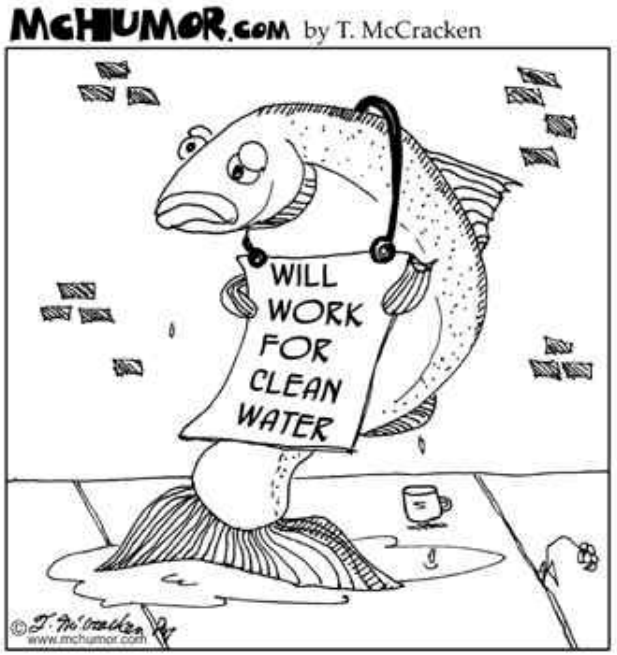
Consent Decree



- Signed April 18, 2007
- Requires SD1 to develop plans to address CSOs and SSOs by basin (overall goal to improve water quality)
- Unique – First CD to use watershed-based approach

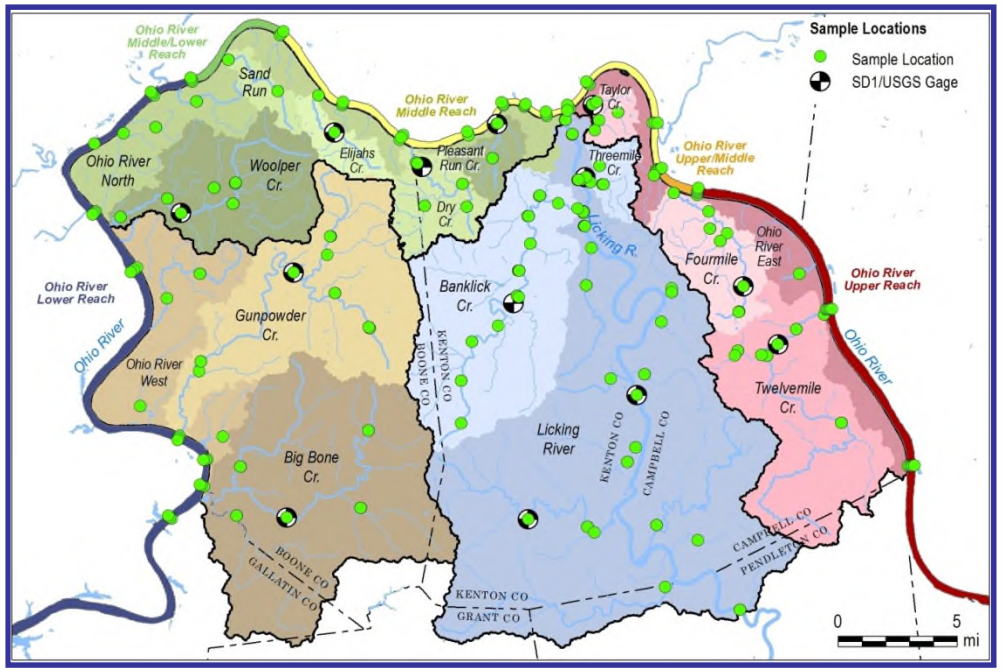
Consent Decree Challenges

- How to prioritize controls and projects?
  - Large geographical area (590 sq. mi)
- What watersheds need improvement and for what parameters?
  - 6 of 16 watersheds had no water quality data
  - Need to consider both recreation and aquatic life
- Need for tools and models to manage and synthesize information across study area



Monitoring Program

- Perform water quality, biological, hydromodification and habitat surveys to assess stream conditions or *"health"*
- Conduct monitoring activities during 5-year rotating cycles
  - NKY watersheds, 590 miles^2 at approximately 75 sites
  - Ohio River, 90 stream miles at approximately 25 sites
- Used 4 study basins from Consent Decree consisting of 16 major watersheds to manage data collection efforts



Water Quality Monitoring

- Base Flow (dry weather conditions)
- Event-based (wet weather conditions)

Biological Monitoring

- Habitat Assessments
- Fish Population
- Macroinvertebrate Population

Hydromodification

- Cross-section & Profile Surveys
- Pebble Counts

Continuous Monitoring Program

- USGS Cooperative Agreement
- 13 Stations
- Real-time (15 minute) flow and water quality measurements

USGS science for a changing world

USGS Home | Contact USGS | Search USGS

National Water Information System: Web Interface

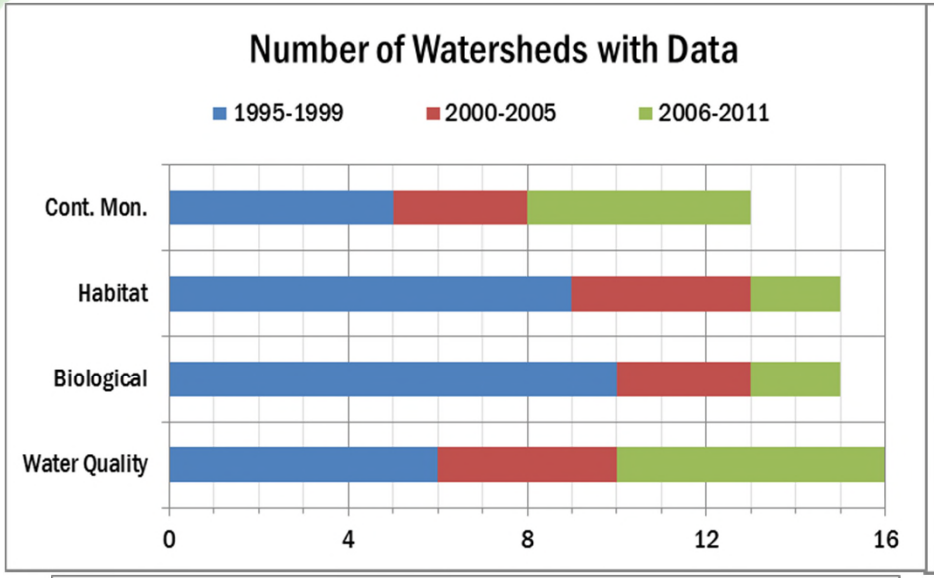
USGS Water Resources

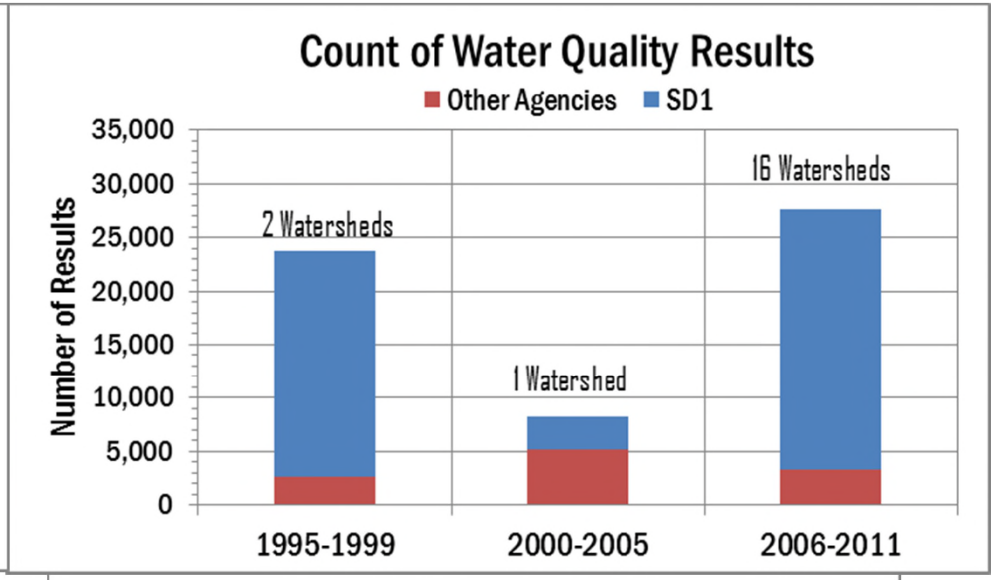
Data Category: Real-time | Geographic Area: Kentucky | GO

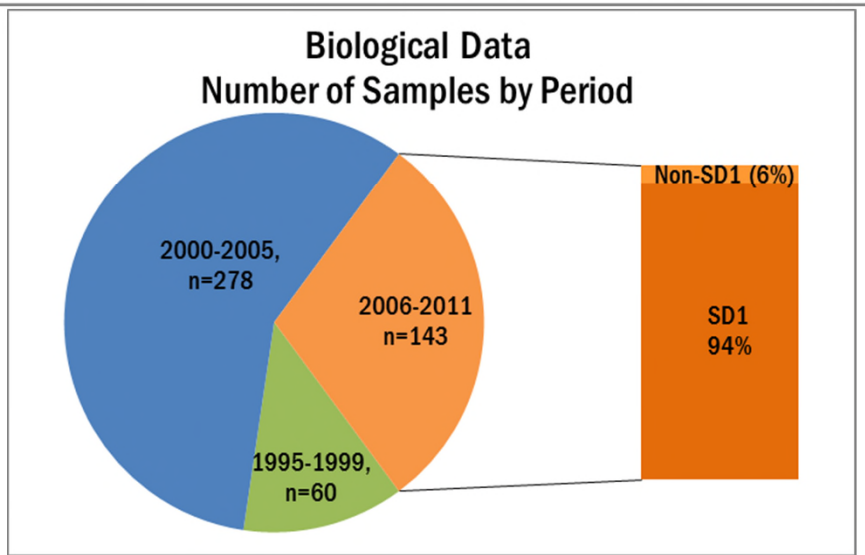
Station Number	Station name	Date/Time	Gage height, feet	Dis-charge, ft3/s		Precipitation in inches during the previous 24 hours	Temper-ature, water, deg C	Dis-solved oxygen, mg/L	Dis-solved oxygen, percent of sat-uration	pH, water, unfltrd field, std units	ic conduc-tance, wat unf uS/cm @ 25 degC	ity, IR LED light, det ang 90 deg, FNU
● Boone County												
03260100	ELIJAHS CREEK @ ELIJAHS CREEK RD NR HEBRON, KY	11/10 09:00	1.51	1.2			10.5	10.5	95	6.6	624	--
03262001	WOOLPER CREEK AT WOOLPER ROAD NEAR BURLINGTON, KY	11/10 08:45	1.23	4.5			10.1	10.7	96	7.2	583	0.3
03277075	GUNPOWDER CR AT CAMP ERNST RD NR UNION, KY	11/10 09:00	1.02	13	0		11.0	9.8	91	6.3	616	4.9
03277130	MUD LICK CR AT HWY 42 NR BEAVERLICK, KY	11/10 08:45	1.23	8.2	0		10.4	10.8	--	8.1	398	11
● Campbell County												
03238140	TAYLOR CREEK AT DONNERMEYER DRIVE AT BELLEVUE, KY	11/10 08:30	1.20	0.50	0		11.3	8.5	79	7.1	1,160	0.1
03238745	TWELVEMILE CREEK AT HIGHWAY 1997 NR ALEXANDRIA, KY	11/10 08:45	1.73	10	0		--	--	--	--	--	--
03238772	FOURMILE CREEK AT POPLAR RIDGE RD NR ALEXANDRIA,KY	11/10 09:00	1.22	0.56	0		--	--	--	--	--	--
03254520	LICKING RIVER AT HWY 536 NEAR ALEXANDRIA, KY	11/10 08:30	8.75	--	0		10.9	11.2	103	8.0	324	13
03254695	THREEMILE CREEK AT HWY 9 AT COVINGTON, KY	11/10 08:30	1.64	--	0		10.2	9.7	87	8.8	983	3.5
● Kenton County												
03254480	CRUISES CREEK AT HWY 17 NR PINER, KY	11/10 08:45	2.73	1.5	0		--	--	--	--	--	--
03254550	BANKLICK CREEK @ HIGHWAY 1829 NR ERLANGER, KY	11/10 09:00	3.65	12	0		10.2	9.5	86	8.1	669	150
03260015	PLEASANT RUN CREEK AT OAK STREET NEAR LUDLOW, KY	11/10 08:30	1.18	1.6	0		10.4	8.6	78	7.3	978	3.3
03260050	DRY CREEK AT SEWAGE PLANT NEAR ERLANGER, KY	11/10 08:30	1.35	1.5	0		9.8	11.2	101	6.7	913	0.0

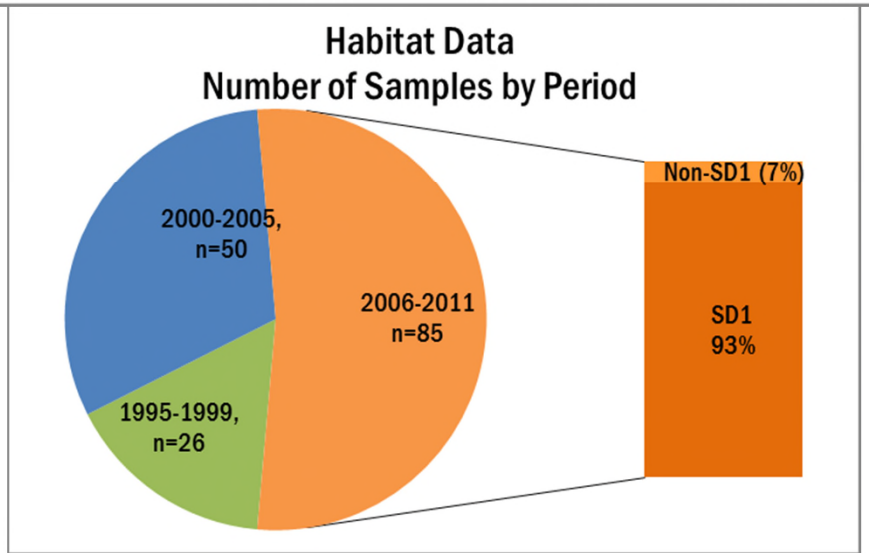
Data status codes:
-- Parameter not determined

Monitoring Accomplishments





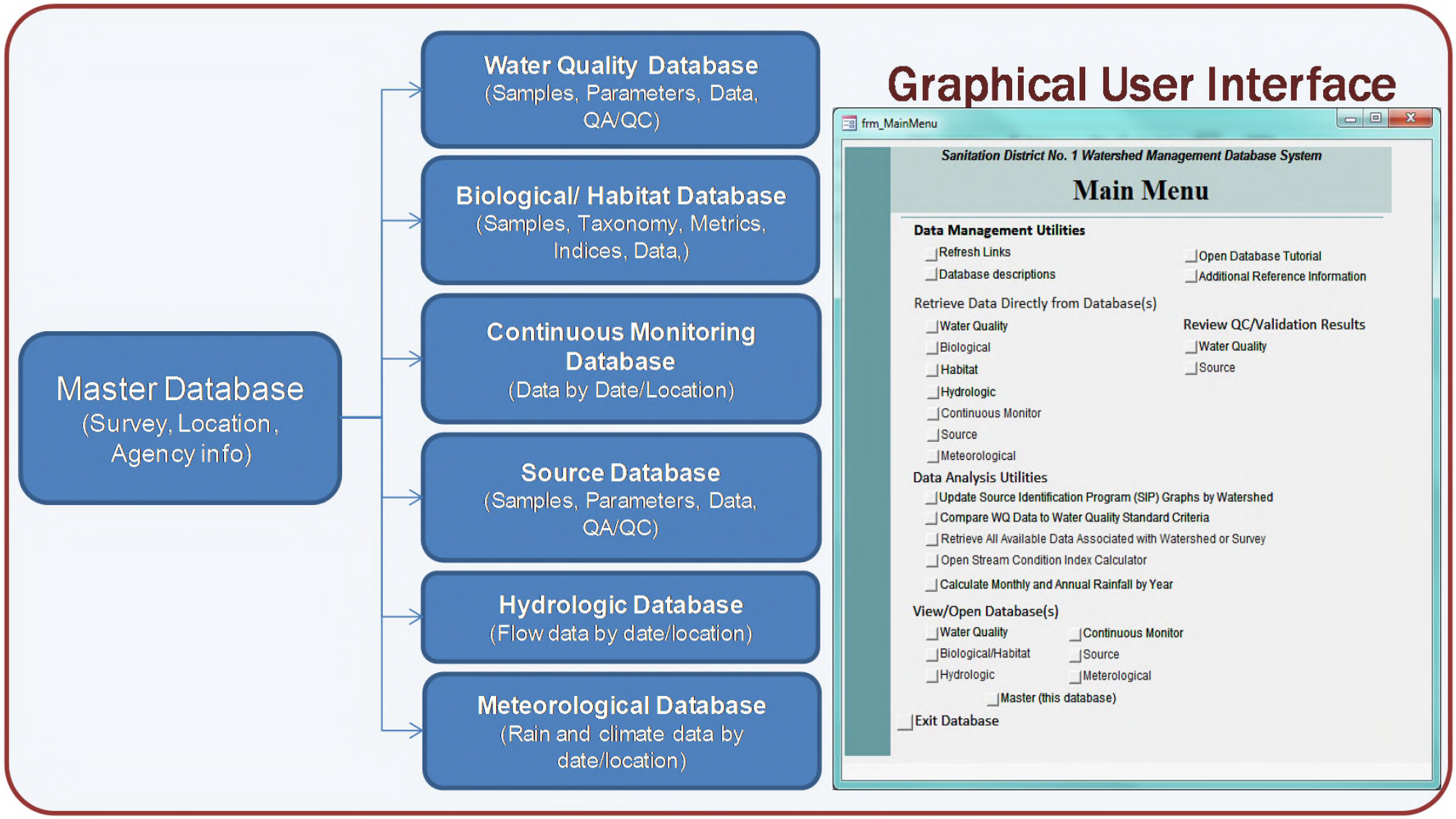




Data Management

- Lots of water quality data
  - Over 3,000 samples
  - 12 - 20 parameters
  - Nearly 40,000 results
- Data management strategy
  - Organization
  - Centralized
  - Readily accessible

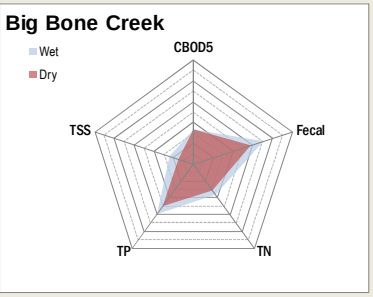
Data Management Framework

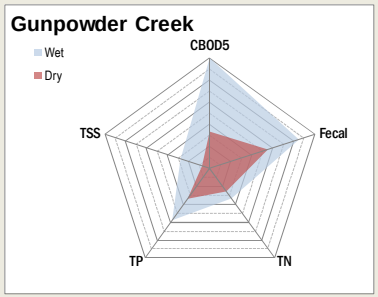


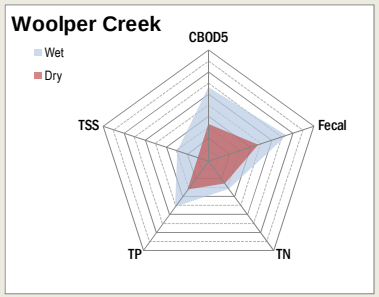
What Did We Want to Learn from WQ Data?

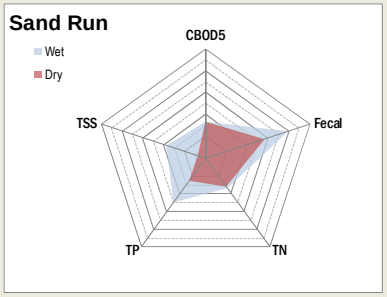
- What parameters are most important in each watershed?
- What watersheds are most impacted by pollutants?
- What is the relative importance of dry and wet weather pollutant sources in each watershed?
- Are there correlations between watershed characteristics and in-stream water quality conditions?

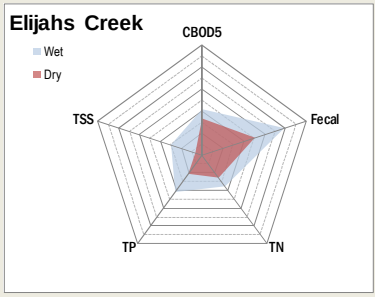
Water Quality Monitoring Results

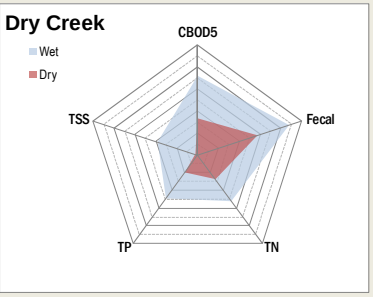


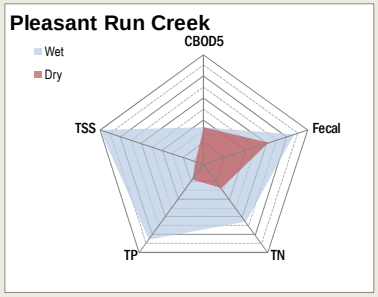


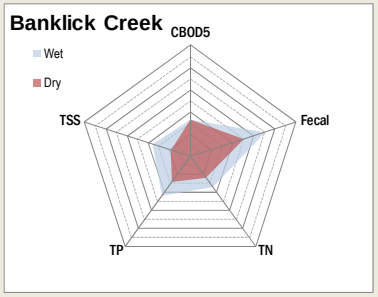


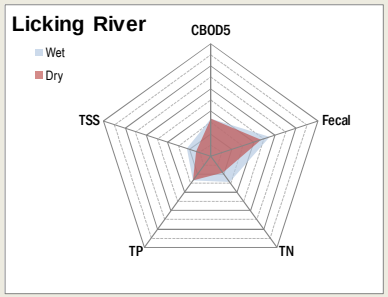


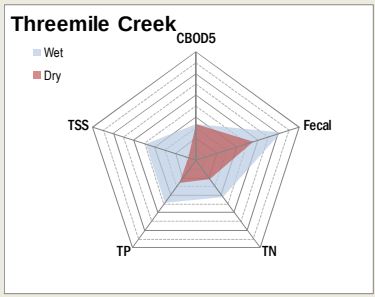


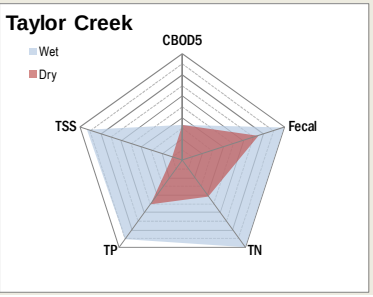


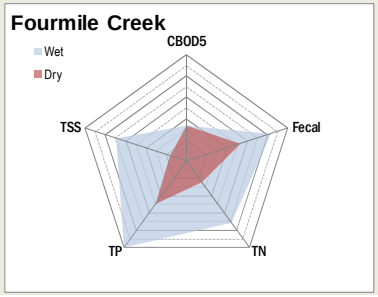


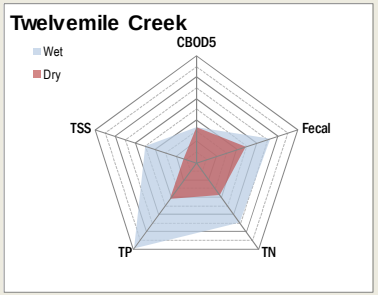


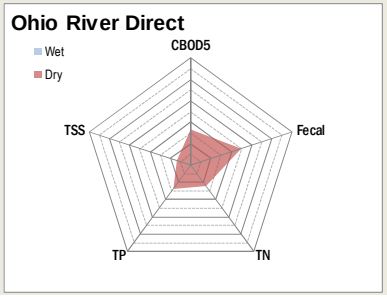


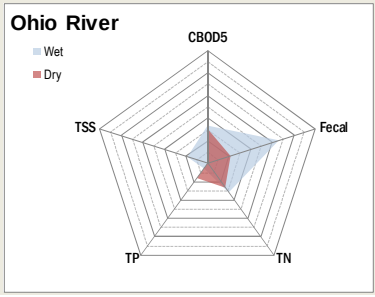




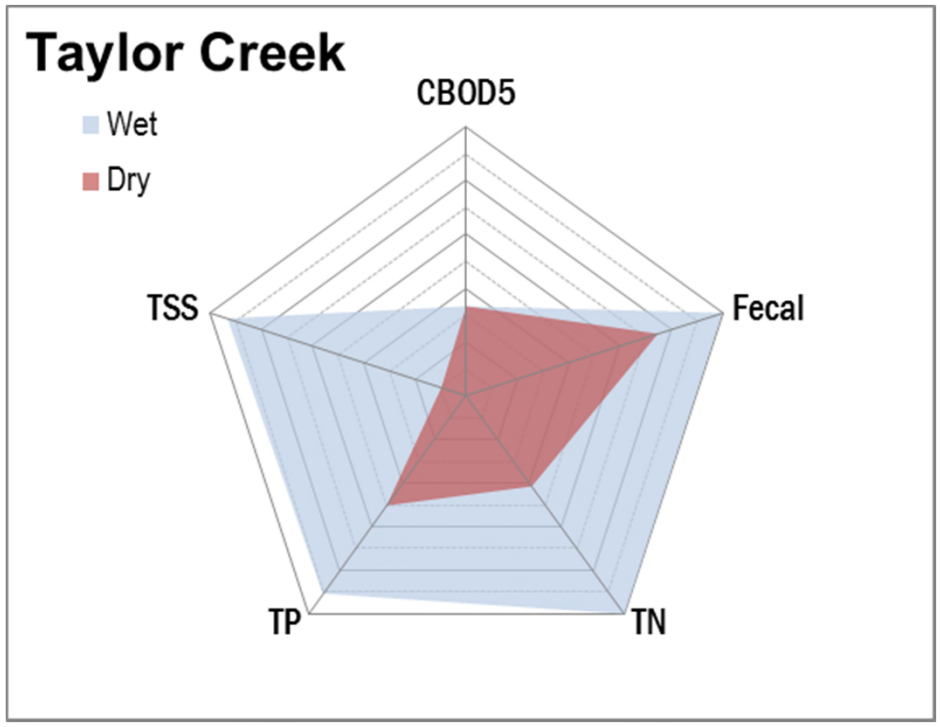


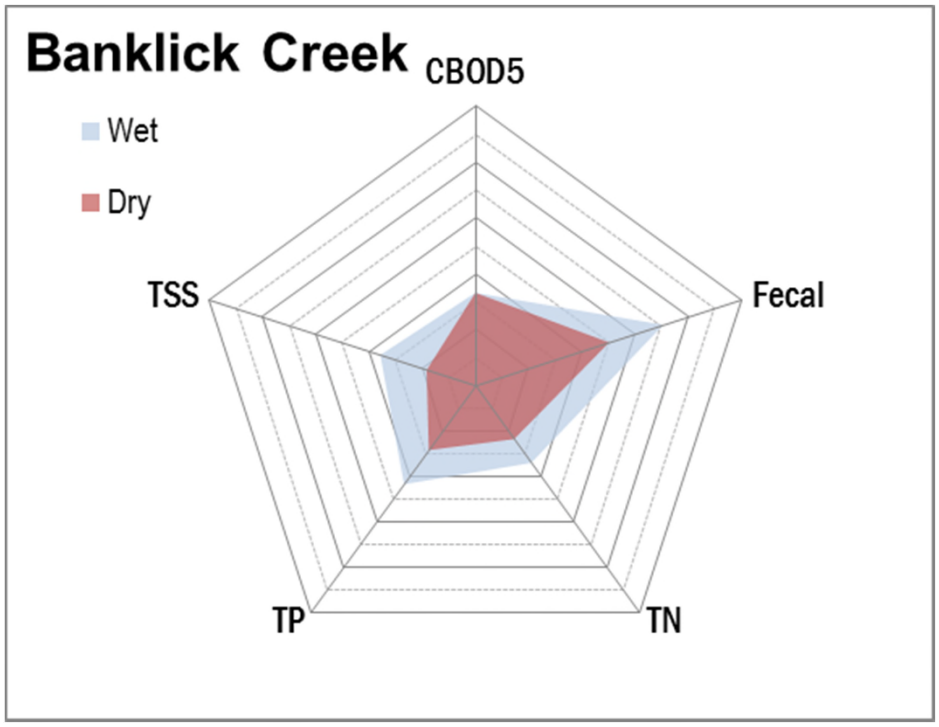




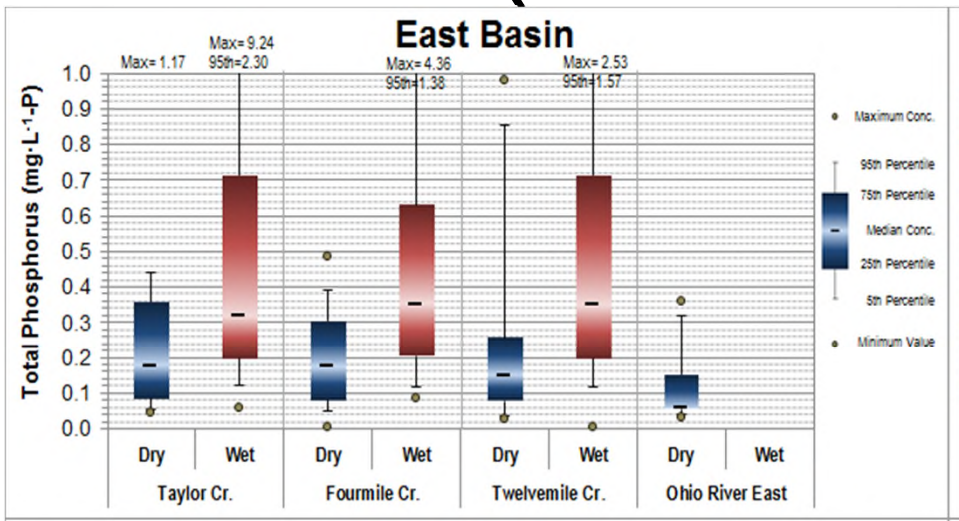


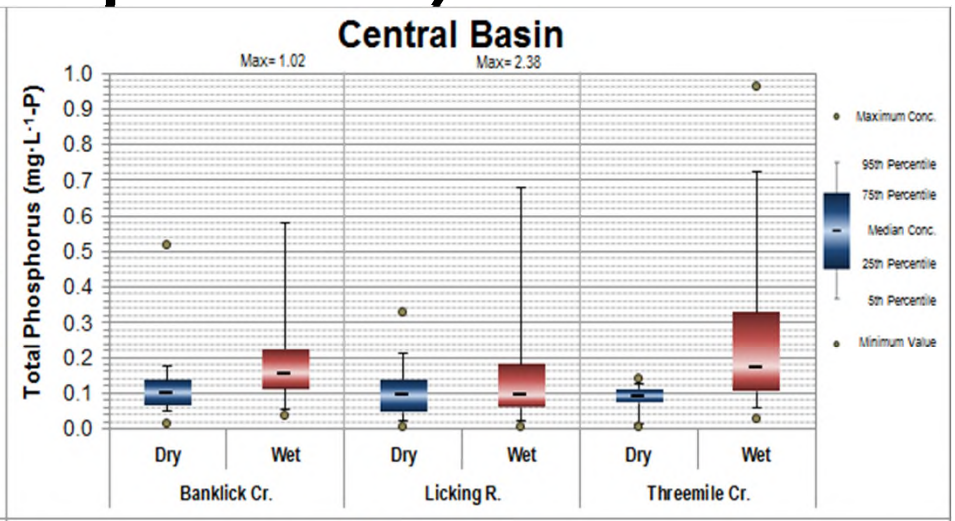
A Tale of Two Watersheds

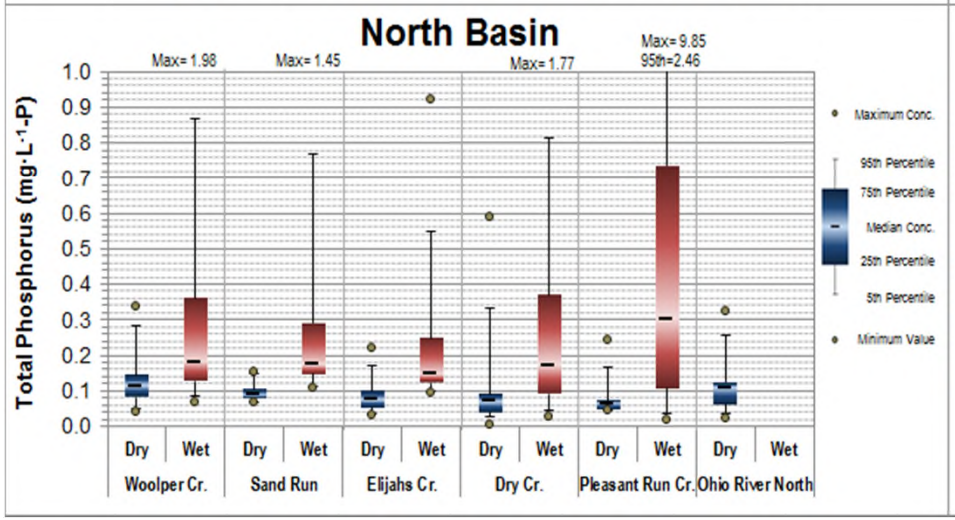


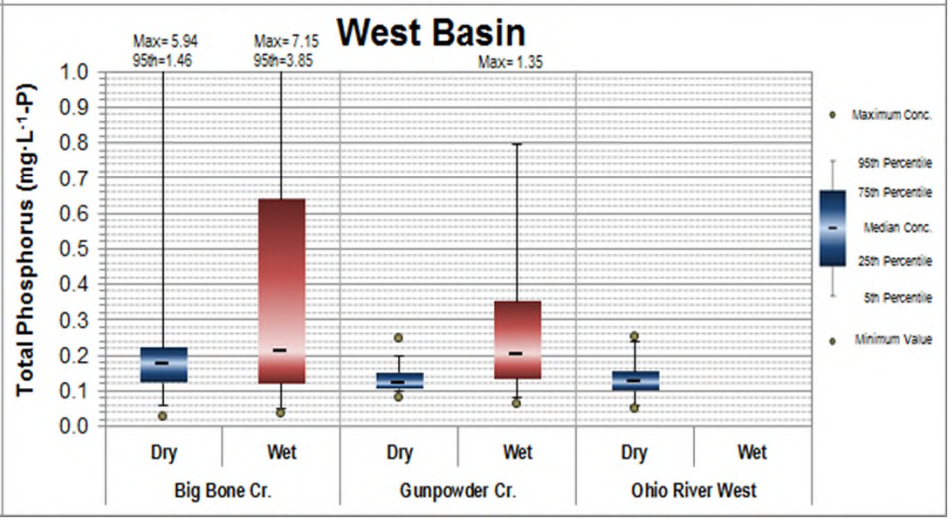


Comparisons Across Watersheds (Total Phosphorus)

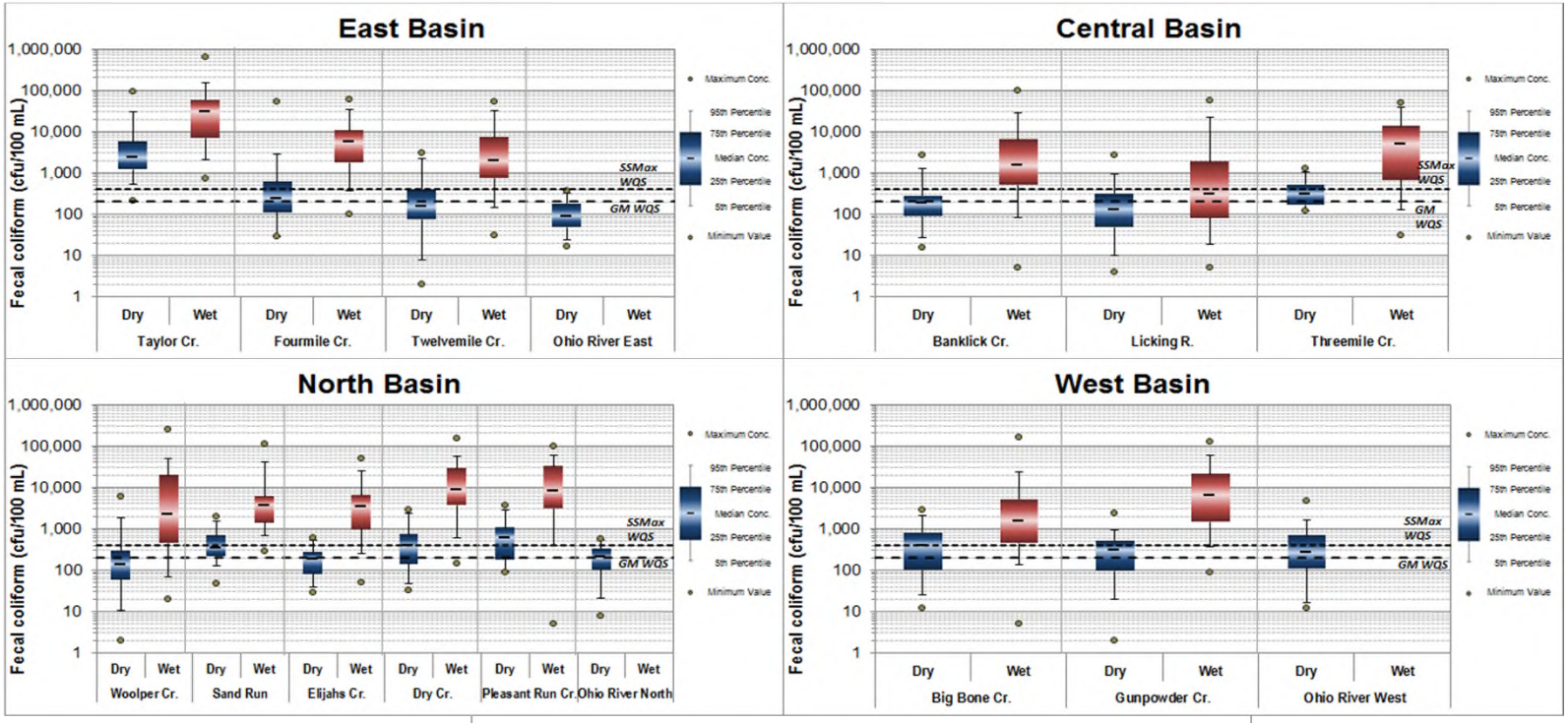




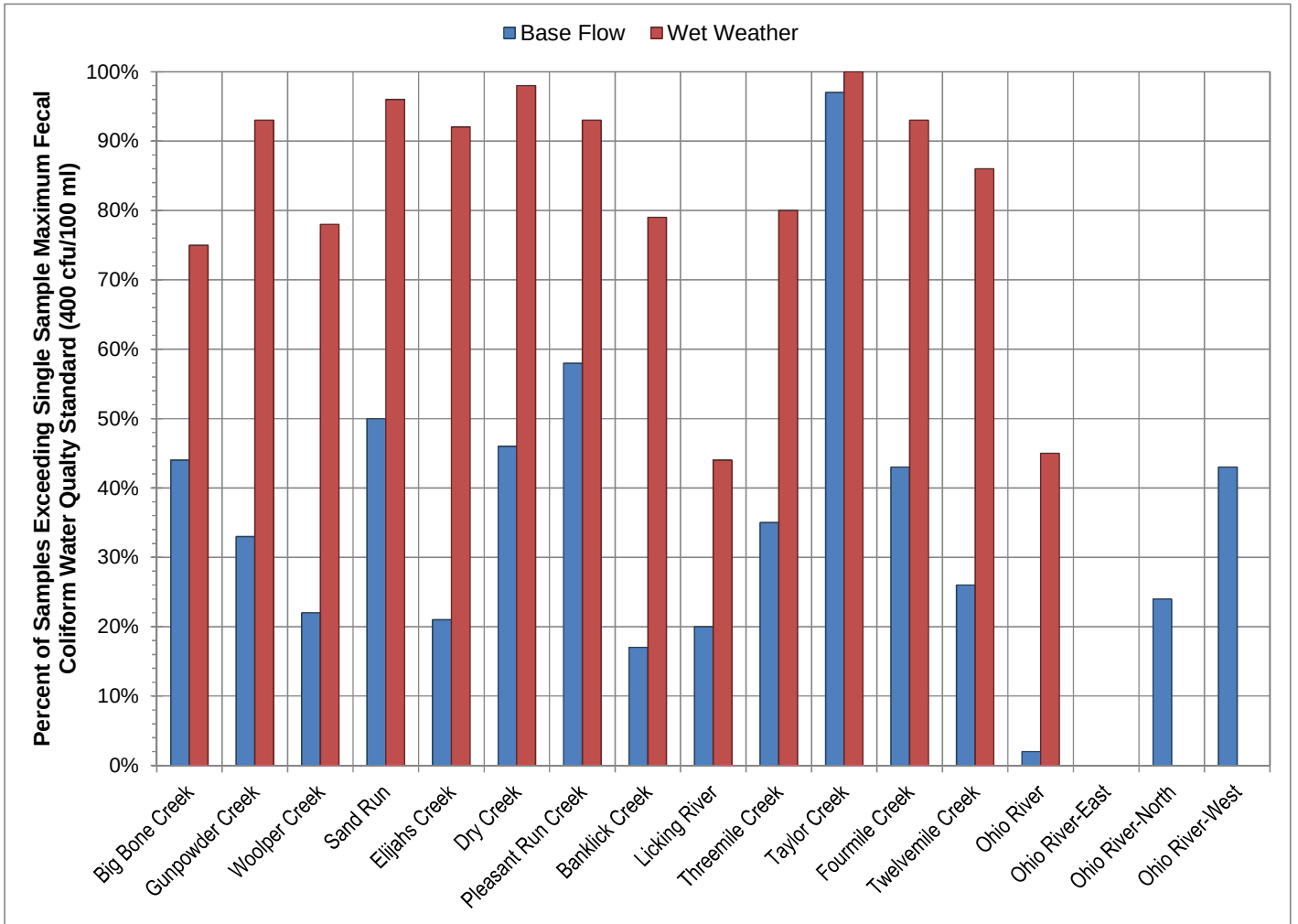


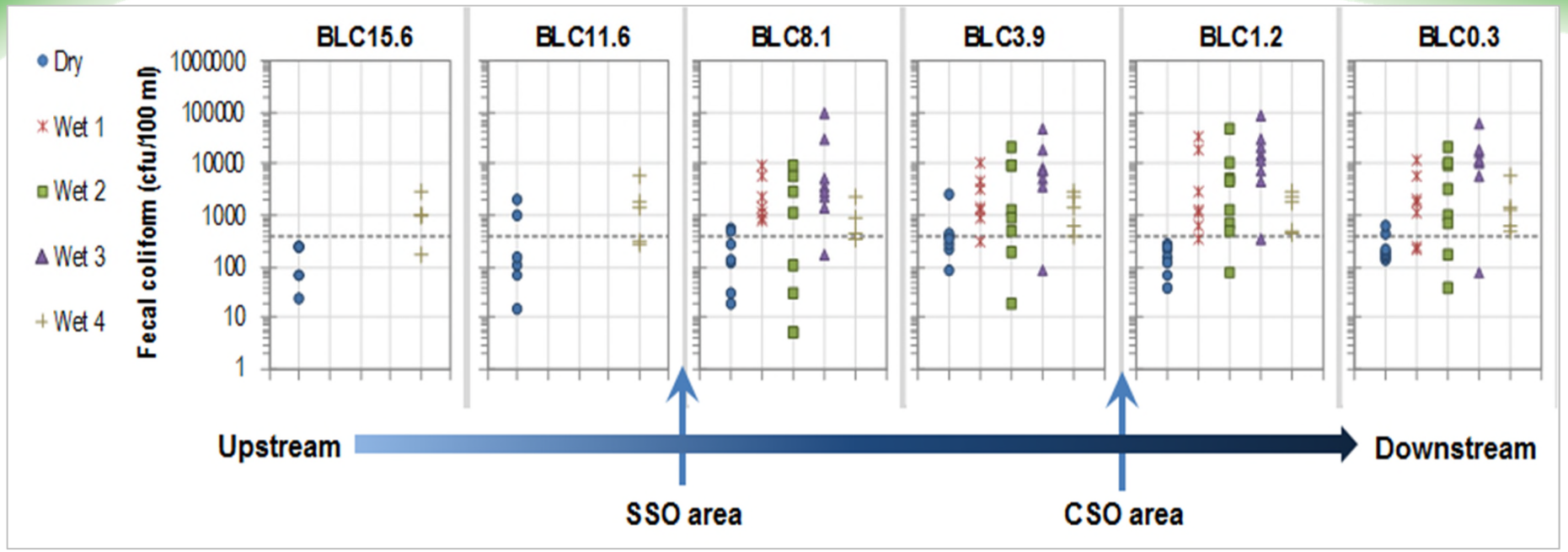


Fecal coliform Box-and-Whisker Plots



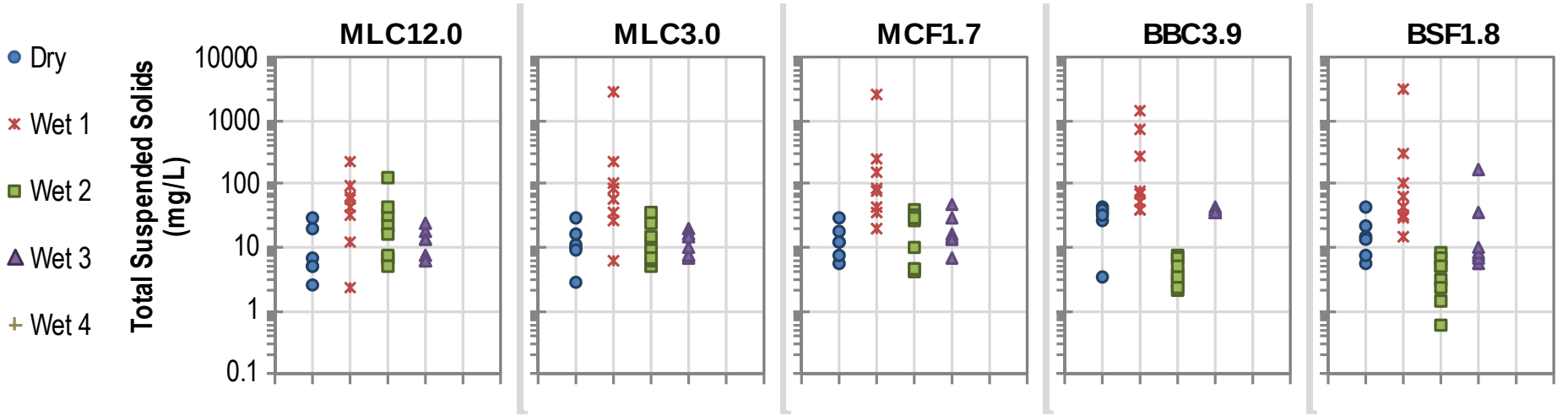
Comparison to WQ Standards (Fecal coliform)

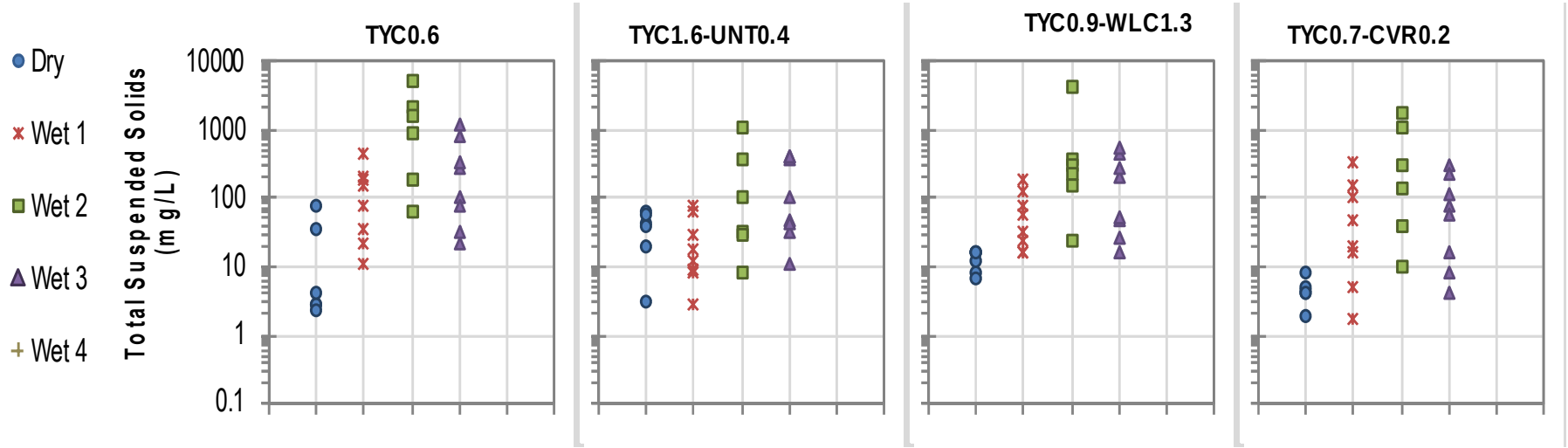




- High bacteria levels in dry and wet weather
- Wet weather sources important
- Non-SD1 sources also important

Comparisons Within Watersheds (TSS)





Major Findings

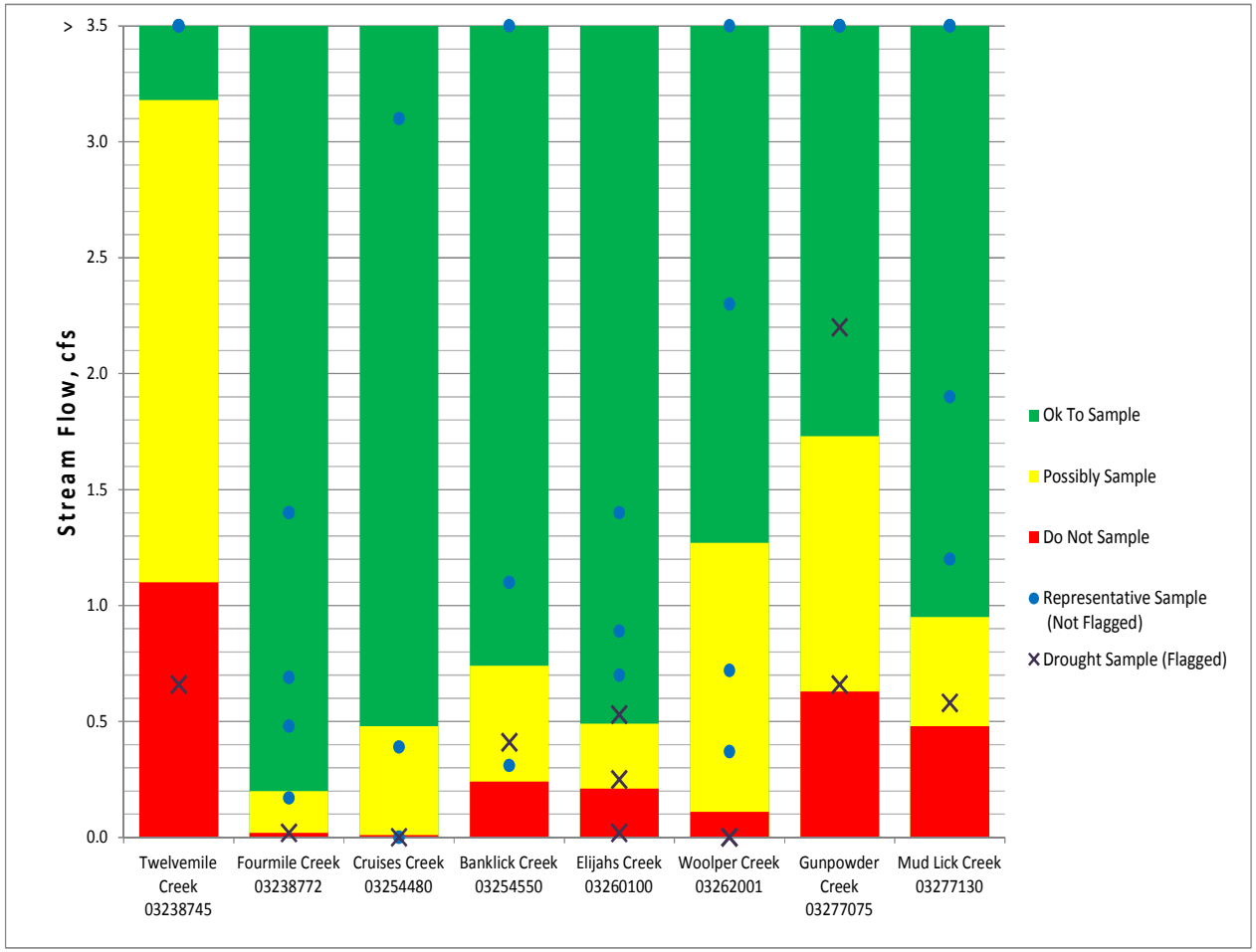
- Bacteria is a pollutant of concern in nearly all watersheds
  - In some watersheds, the highest levels were measured upstream of CSO and SSO inputs
- Nutrient levels vary a lot between and within watersheds
- Very few DO, pH or metals values exceeded water quality standards in any watershed
- Wet weather sources impact all watersheds
  - Watersheds most impacted by wet weather tend to have more imperviousness and more development
  - Bacteria, solids and phosphorus showed largest response to rainfall
  - Pollutant loads roughly correlate to storm size for most parameters
- Dry weather sources also important in some watersheds

Challenges

- Sites becoming unavailable due to construction or other access issues
- Field instrumentation
- Making the “go/no go” decision for wet weather
- Sampling representative conditions

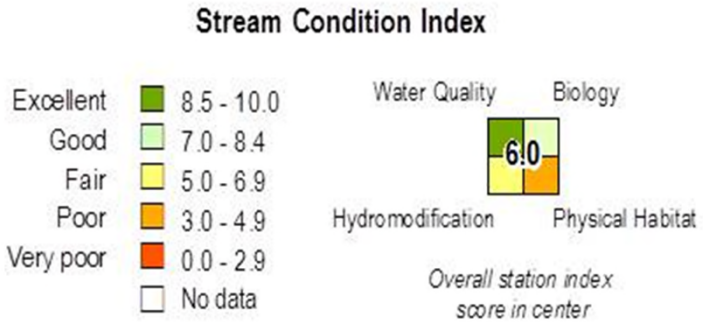
Sampling Representative Conditions

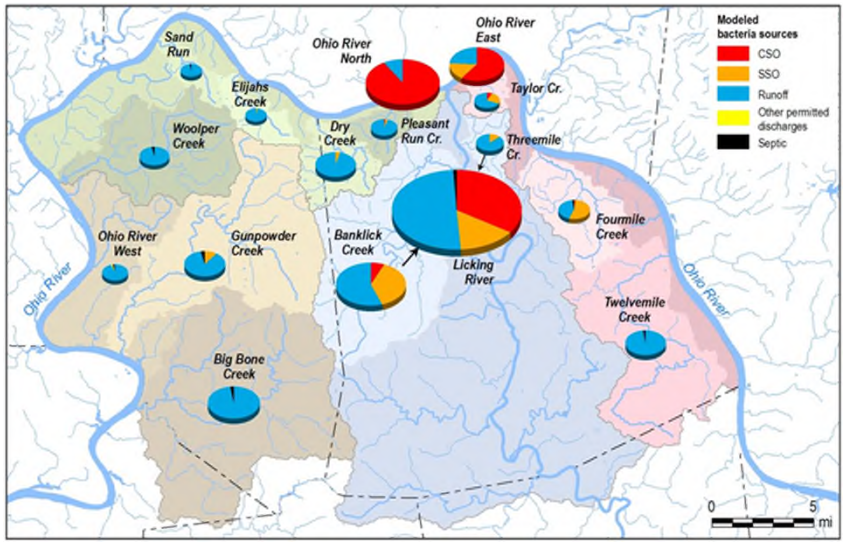
- Not too wet, not too dry

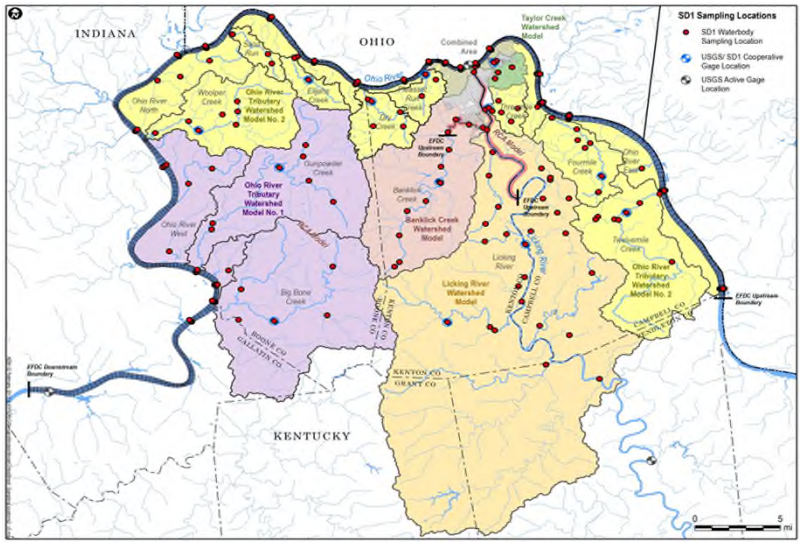


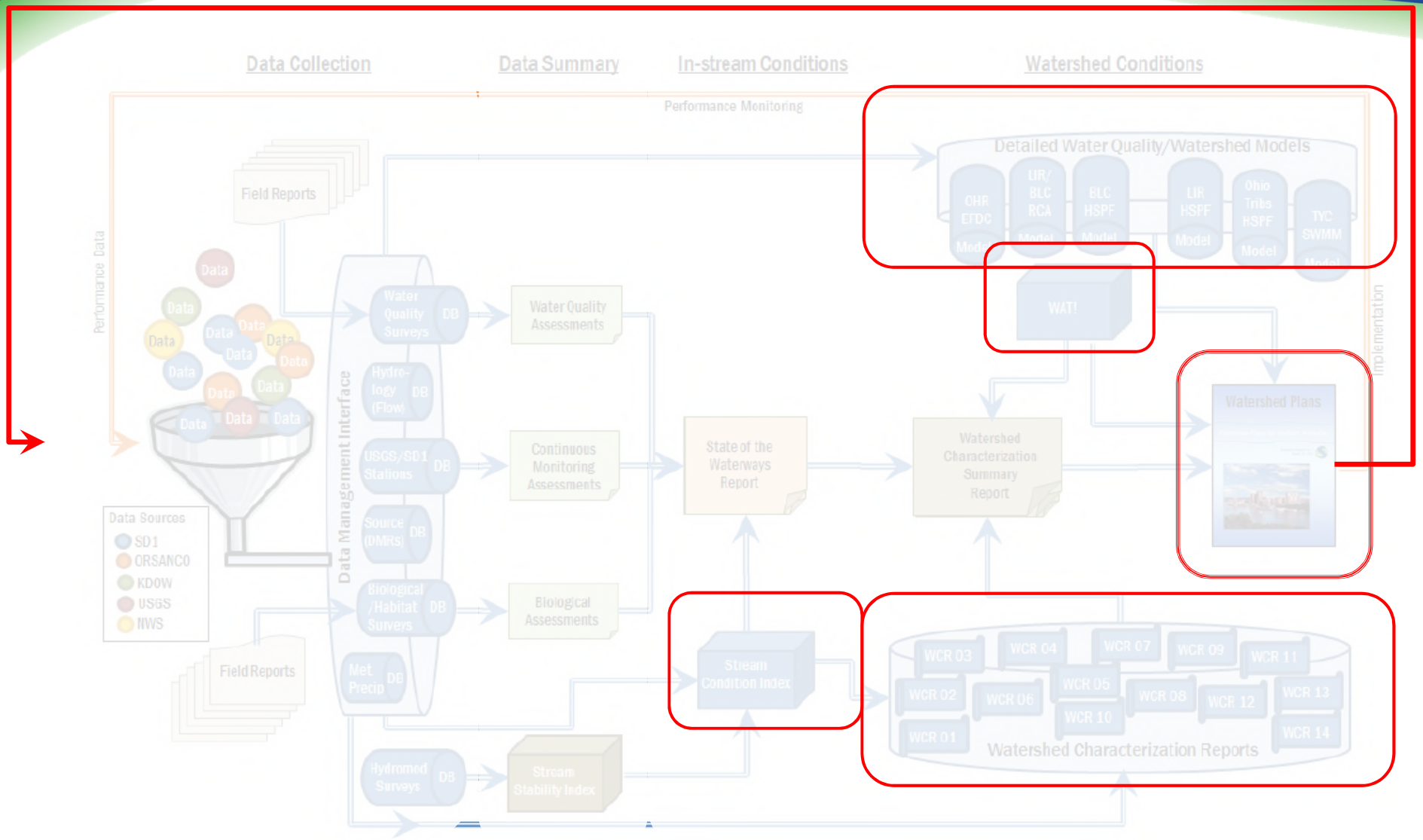
Planning Tools

- Stream Condition Index
- Watershed Assessment Tool
- Watershed/Water Quality Models

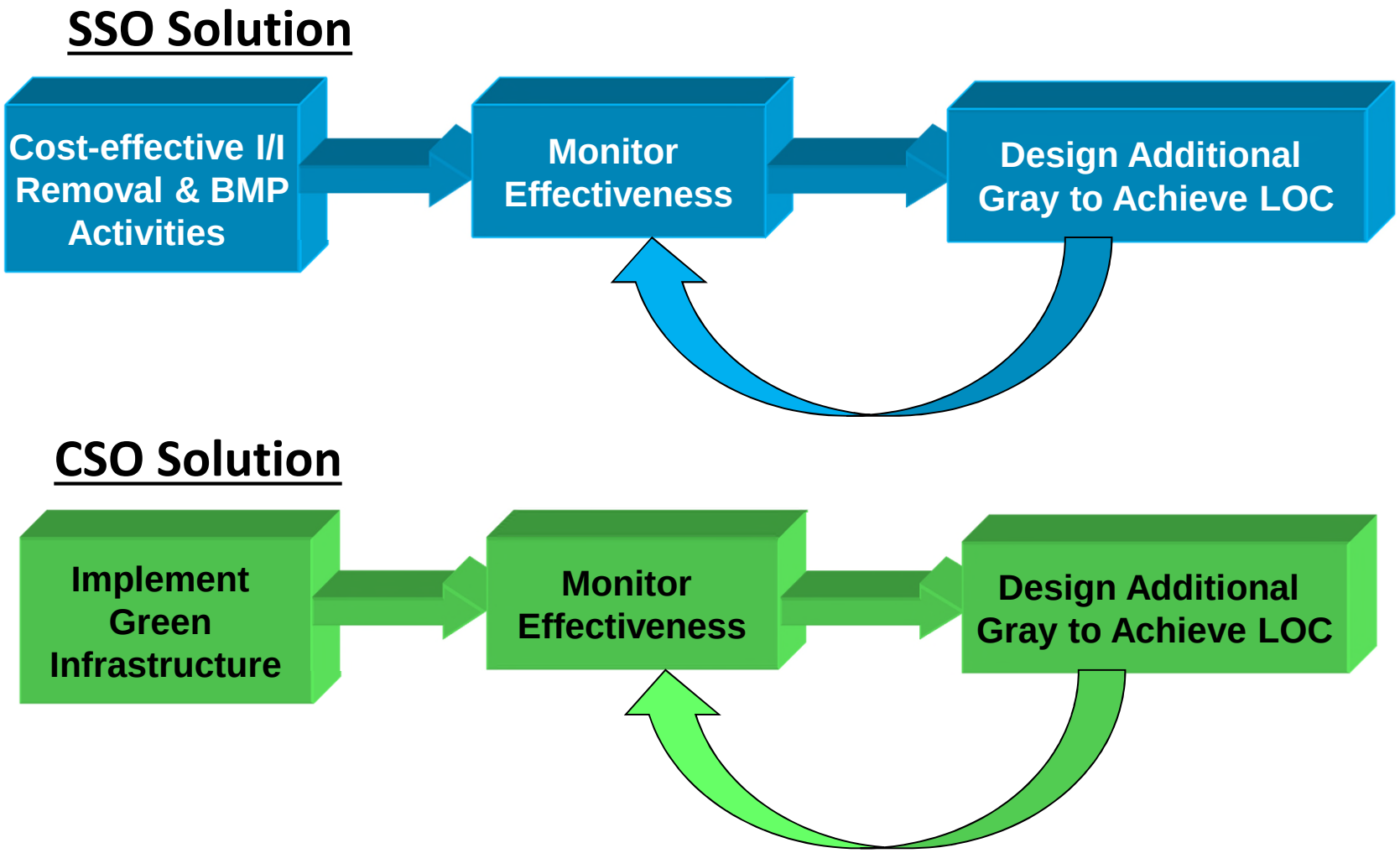







Data Collection
Data Summary
In-stream Conditions
Watershed Conditions
Performance Monitoring
Performance Data
Implementation
Field Reports
Data Sources
SD1
ORSANCO
KDOW
USGS
NWS
Data Management Interface
Water Quality Surveys
DB
Hydro-logy (Flow)
USGS/SD1 Stations
Source (DMRs)
Biological /Habitat Surveys
Met Precip
Hydromod Surveys
Water Quality Assessments
Continuous Monitoring Assessments
Biological Assessments
Stream Stability Index
State of the Waterways Report
Stream Condition Index
Detailed Water Quality/Watershed Models
OHR EFDC Model
LIR/ BLC RCA Model
BLC HSPF Model
LIR HSPF Model
Ohio Tribs HSPF Model
TYC SWMM Model
WAT!
Watershed Characterization Summary Report
Watershed Plans
WCR 01
WCR 02
WCR 03
WCR 04
WCR 05
WCR 06
WCR 07
WCR 08
WCR 09
WCR 10
WCR 11
WCR 12
WCR 13
WCR 14
Watershed Characterization Reports

Integrated Plan Implementation Strategy



Benefits of Sampling Program

- Confirmed anecdotal information about watersheds
  - Taylor Creek most impacted
- Increased understanding about stressors and conditions across all watersheds
- Used to develop analysis tools and inform detailed water quality models
- Establishes baseline to quantify improvements from control projects
- Communicate conditions to public and other stakeholders
- Confirmed the adaptive approach of the Consent Decree
  - Multiple pollutant sources warrant integrated plan to improve WQ

Questions?

Mindy Scott
SD1
mscott@sd1.org
(859) 578-6743

Carrie Turner
LimnoTech
cturner@limno.com
(734) 332-1200

Acknowledgements

Jim Gibson (SD1)
Matt Wooten (SD1)
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