WATER QUALITY ASSESSMENT & NEW MONITORING APPROACH FOR JOHNSON COUNTY, KS

2019 Kansas City Urban Stormwater Conference
February 4, 2019
Johnson County Stormwater Management Program
  - Flood damage reduction projects
  - MS4 permit support to cities

Initial MS4 Phase II permits issued in 2004 in Johnson County
  - Water quality monitoring not required
  - Various water quality studies by USGS from 2002-2010
    - Contaminant source identification
    - Continuous Water Quality Monitoring
    - Biological Assessments
REGULATORY MONITORING REQUIREMENTS

- Regulatory requirement for water quality monitoring began in 2014
  - MS4 Phase II permits with TMDL responsibilities
- Permit dictated waterbodies sampled at the inflow and outflow boundaries of municipalities
- KDHE allowed us to propose an alternative for next permit term
- Stormwater Management Program 2016 Strategic Plan
  - Watershed based approach
  - Water quality improvement projects
USGS PRELIMINARY WATER QUALITY ASSESSMENT

**MS4 SAMPLING APPROACH**

- 2015 and 2016 Data Collection
- 27 Monitoring Sites (25 Stream, 2 Lake)
  - Discrete Sediment, Nutrients, Bacteria, Chlorophyll
  - 4 Wet-Weather Samples per Site (Rising Limb)
  - Base Flow Grab Samples during March
- 1 Monitoring Site
  - Continuous Temperature, DO, Conductivity, Turbidity, Nitrate
USGS PRELIMINARY WATER QUALITY ASSESSMENT

GENERAL RECOMMENDATIONS

- Watershed Approach
- Increase Sampling Frequency
  - Routine Baseflow Samples to Help Identify Patterns and Sources
  - Additional Stormwater Data
    - Conduct Statistical Evaluations
    - Identify Hot Spots and Data Gaps
    - Quantify Reduction Goals

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**Table 5.** Summary of valuable and limiting attributes of the current water-quality monitoring program in Johnson County, Kansas, and possible approaches for making improvements.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Valuable attributes</th>
<th>Limiting attributes</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm sampler from many sites across the country</td>
<td>Data from multiple watersheds provide a country-wide perspective and allows comparison across the county.</td>
<td>Monitoring sites located along jurisdictional boundaries</td>
<td>Some locations are not suitable or of strategic value for addressing questions on source and BMP effectiveness.</td>
</tr>
<tr>
<td>Routine Baseflow Samples to Help Identify Patterns and Sources</td>
<td>Identifying sites with recurring elevated concentrations.</td>
<td>Storm samples from many sites located across the county</td>
<td>Presents logistical challenges for collection and analysis of large number of samples in short time frames associated with storm events.</td>
</tr>
<tr>
<td>Additional Stormwater Data</td>
<td>Data from multiple sites within a watershed allows some speculation about sources.</td>
<td>Fixed-stage samplers</td>
<td>Does not characterize conditions near storm hydrograph.</td>
</tr>
<tr>
<td></td>
<td>Consistent approach without unnecessary duplication of effort among municipalities.</td>
<td>Base-flow samples</td>
<td>Number of samples is too small to be representative of site conditions; does not describe temporal and hydraulic variability.</td>
</tr>
<tr>
<td></td>
<td>Facilities sampling at multiple sites during single event and allows data comparison during comparable flow conditions.</td>
<td>Additional stormwater data and models</td>
<td>Sample set too small to detect changes over time. Not likely to identify or characterize non-point sources.</td>
</tr>
<tr>
<td></td>
<td>Best method for characterizing variability in concentrations, loads, and hydrology.</td>
<td></td>
<td>Not likely to demonstrate BMP effectiveness.</td>
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</table>

**Possible improvement approaches**

- Redesign sampling network based on watersheds rather than jurisdictional boundaries.
- Incorporate nested designs (watershed, sub-watershed, and BMP scales) and adjust sampling frequency depending on site type.
- Collect a larger number of samples at fewer sites.
- Install continuous water-quality monitors at more sites.
- Incorporate different sampling methods such as nested, Lagrangian
  *high-frequency* and source-targeted approaches into sampling design.

*Sampling for some period of time as a means demonstration.*
EXISTING MONITORING SITES

- Discrete Water Quality (10+ samples since 2006)
  - 27 USGS TMDL Sites
  - 8 USGS Non-TMDL Sites
  - 27 EPA Sites
  - 6 KDHE Sites

- Continuous/Regression Models
  - 5 USGS Gages (4 discontinued)
  - 1 Active (Mill Creek at Johnson Dr.)

- 22 USGS Biological Sites (2002-2010)

- Hydrologic
  - 10 USGS Gages
  - 62 StormWatch Sites
USGS AND STORET DATA

- 303 Sites
- 27 TMDL Monitoring Sites
- 10 USGS Gage Stations
- ~8,100 Sampling Events
- >250,000 data records
- Collection Agencies
  - KDHE
  - EPA
  - USGS
  - Blue River Watershed Association
IMPAIRED WATERS IN JOHNSON COUNTY (TMDL & 303(D))

- Total Phosphorus ⭐
- Nitrate ⭐
- Eutrophication
- Dissolved Oxygen
- Biology
- Total Suspended Solids ⭐
- Sediment ⭐
- Bacteria ⭐
- Chloride
- Mercury
- Atrazine ⭐ MS4 TMDL Parameters
FLOW CONDITIONS

- 10 USGS gage stations
- Countywide average
- High Flow Samples: <60%
- Low Flow Samples: >=60%

Mill Creek at Johnson Drive (06892513)
E. COLI HIGH FLOW

High Flow

E. coli (cfu/100 mL)

PCR-A = 160  
PCR-C = 427
E. COLI LOW FLOW
DATA GAPS

- Parameter Gaps
  - Limited chloride data
  - Nutrient & response linkages

- Spatial Gaps
  - Some significant streams unmonitored
  - Source characterization

- Temporal Gaps
  - Seasonality
  - Hydrologic conditions
  - Storm event variability
WATER QUALITY MONITORING PROGRAM CONSIDERATIONS

- Spatial Resolution
- Sampling Frequency
- Hydrologic Conditions
- Water Quality Parameters
- Watershed Model Calibration
RECOMMENDED WATER QUALITY MONITORING PROGRAM

- Station Types
  - Permanent, Long-Term
  - Supplemental Rotating Basin

- Sampling Approach
  - Routine, Ambient
  - Targeted Wet Weather

- Continuous Monitoring

- Budget Limitations
**MONITORING RECOMMENDATIONS**

**MONITORING FREQUENCY AND PERIODS**

- Monitoring Program Budget Tool to evaluate three monitoring options
- Routine monthly sampling
  - Permanent sites – All years
  - Rotating basin sites – During rotational year (5-year cycle)
- Wet weather sampling – 4x/year
  - Rotating basin sites – During rotational year (5-year cycle)
- Continuous monitoring site

### Basin Recommendations

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<tr>
<th>Basin</th>
<th>Rotation Year</th>
<th>Station Name</th>
<th>Existing Station ID</th>
<th>Fixed</th>
<th>Rotating</th>
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BENEFITS OF WATER QUALITY MONITORING PROGRAM UPDATE

- Characterize overall water quality conditions in Johnson County
- Inform MS4 program controls that improve both dry and wet weather conditions
- Identify water quality priority subbasins, issues, and improvement opportunities
- Guide proactive protection measures
- Calibration of future watershed models