Prepared for

City of South Bend, Indiana

CSO LTCP Re-evaluation Advisory Committee Meeting

12 November 2015

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Agenda

- Introduction of New CSO LTCP Director
- St. Joseph River Water Quality Analysis
- Potential Financial Impacts of LTCP Compliance
- Overview/Analysis of CSO LTCP Implementation Options
- Next Steps/60-day Look Ahead

CSO LTCP Director – Kieran Fahey

- Named to position 9/14/2015
- Previous positions:
  - Environmental Enforcement, EPA of Ireland
  - Scientific Research Officer, Irish Dept. of Agriculture, Food, and the Marine
- Education:
  - BS, Agricultural and Environmental Science, University College Dublin
  - MS, Environmental Science and Postgraduate Diploma in Environmental Engineering, Trinity College Dublin
- Chartered Engineer, Engineers Ireland

CSO LTCP Re-evaluation

St. Joseph River Water Quality Analysis

Water Quality is driving the CSO LTCP

- Primary objective: limit time St. Joseph River is not in compliance with water quality standards due to CSOs
- Current consent decree:
  - achieve $\leq$ 4 overflows in the typical year (1992) and
  - provide for solids removal and disinfection of all overflows
  - achieve compliance with *E. coli* water quality standard
- Proposed changes to the LTCP must demonstrate equal or better environmental outcome

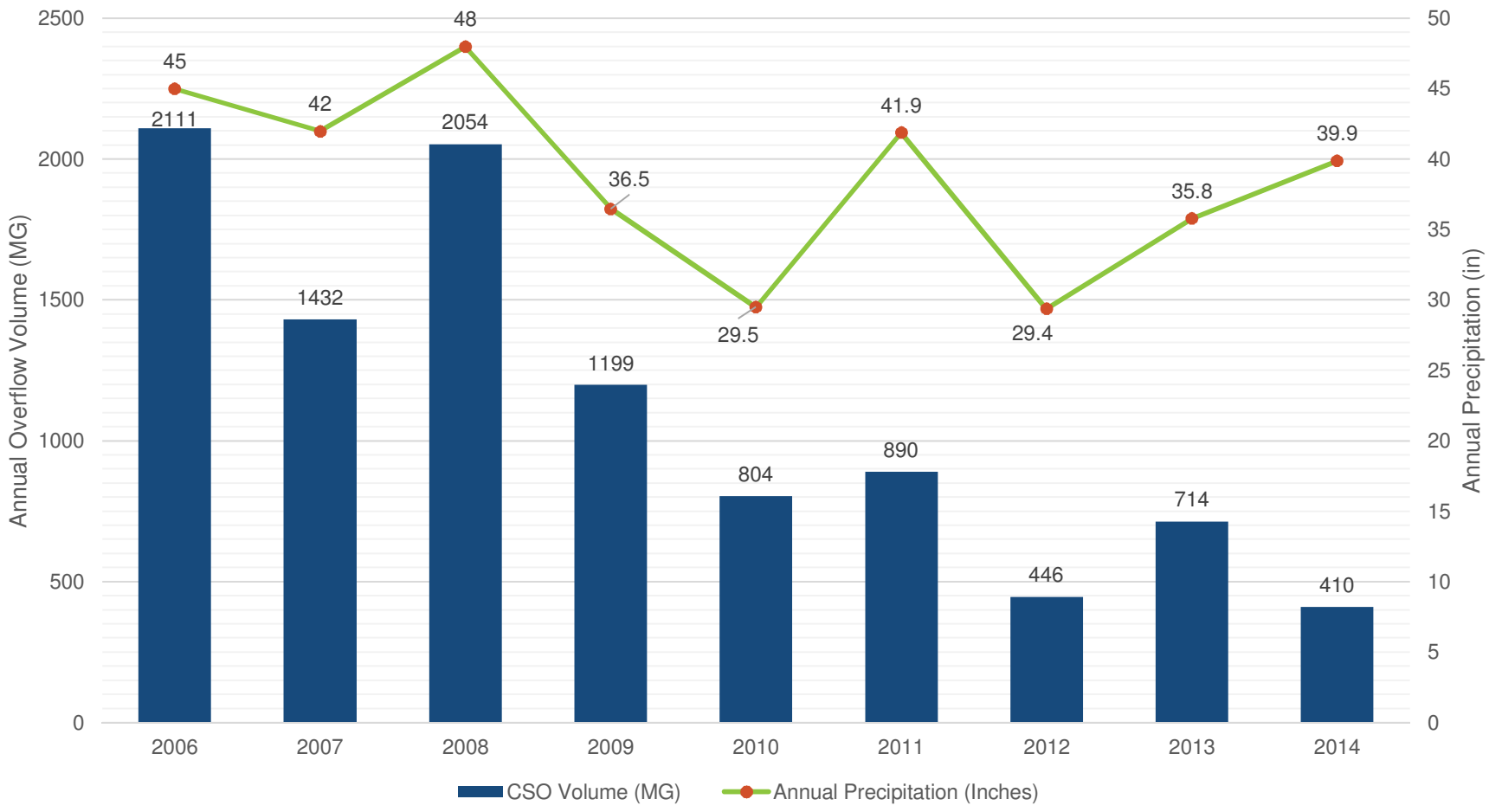
Water Quality Standards - Indiana

- The impaired designated use for the St. Joseph River is for fullbody contact recreational use during the recreation season, April 1 through October 31.
- 327 IAC 2-1.5-8(e)(2):
  - "*E. coli* bacteria, using membrane filter (MF) count, shall not exceed **one hundred twenty-five (125) per one hundred (100) milliliters** as a geometric mean based on not less than five (5) samples equally spaced over a thirty (30) day period nor exceed **two hundred thirty-five (235) per one hundred (100) milliliters** in any **one (1) sample in a thirty (30) day period**."
- Under rule 327 IAC 5-2-11.3 (a), Indiana is responsible for not causing the pollution of a downstream water.

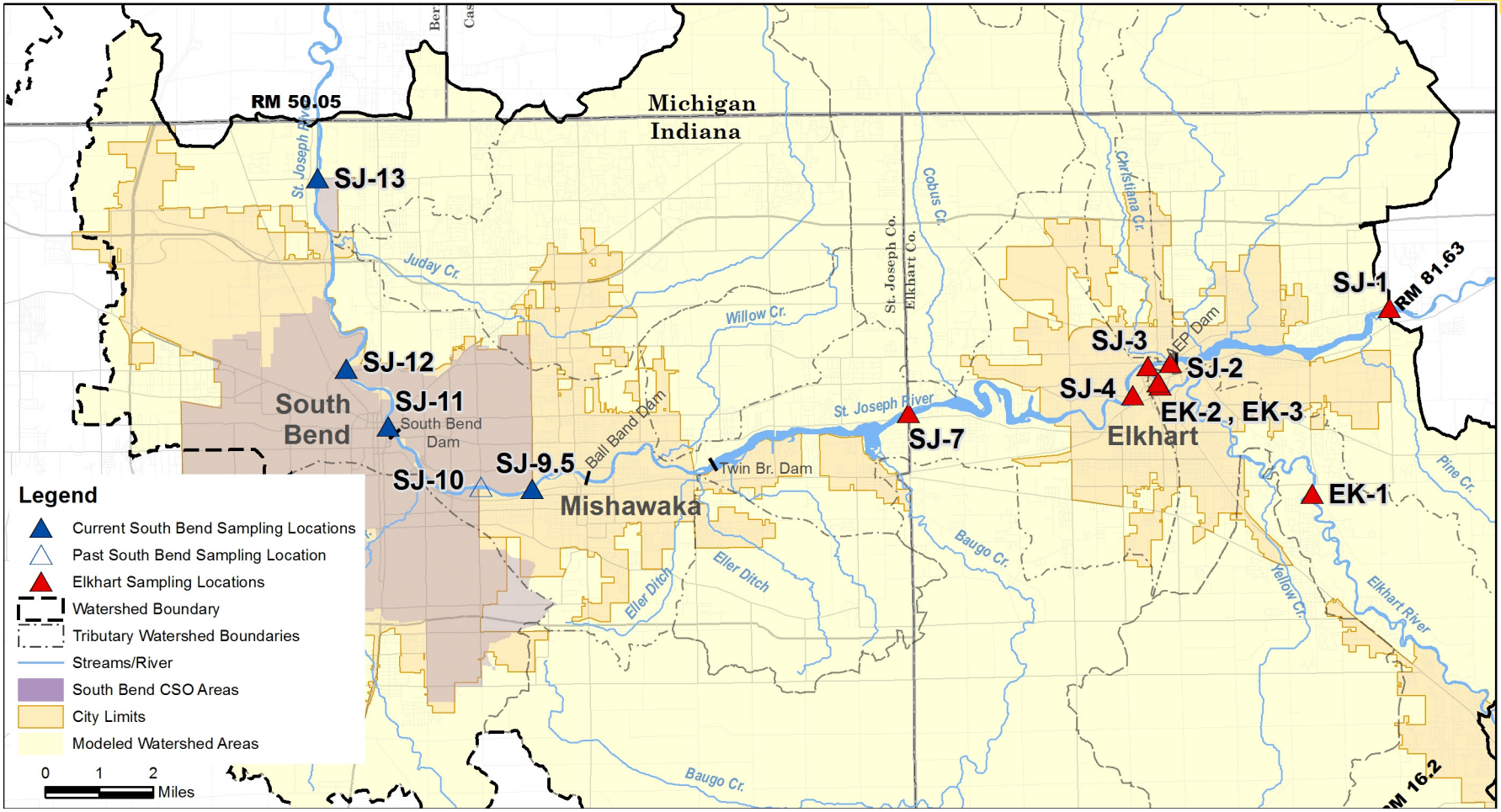
Water Quality Standards - Michigan

- Under Rule 100 of the Michigan WQS, the St. Joseph River must be protected for total body contact recreation from May 1 to October 31.
- R 323.1062 Microorganisms.
  - All waters of the state protected for total body contact recreation shall not contain more than **130 E. coli per 100 ml**, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during five or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of three or more samples taken at representative locations within a defined sampling area. At no time shall the waters of the state protected for total body contact recreation contain more than a maximum of **300 E. coli per 100 ml**. Compliance shall be based on the **geometric mean of three or more samples** taken during the same sampling event at representative locations within a defined sampling area.

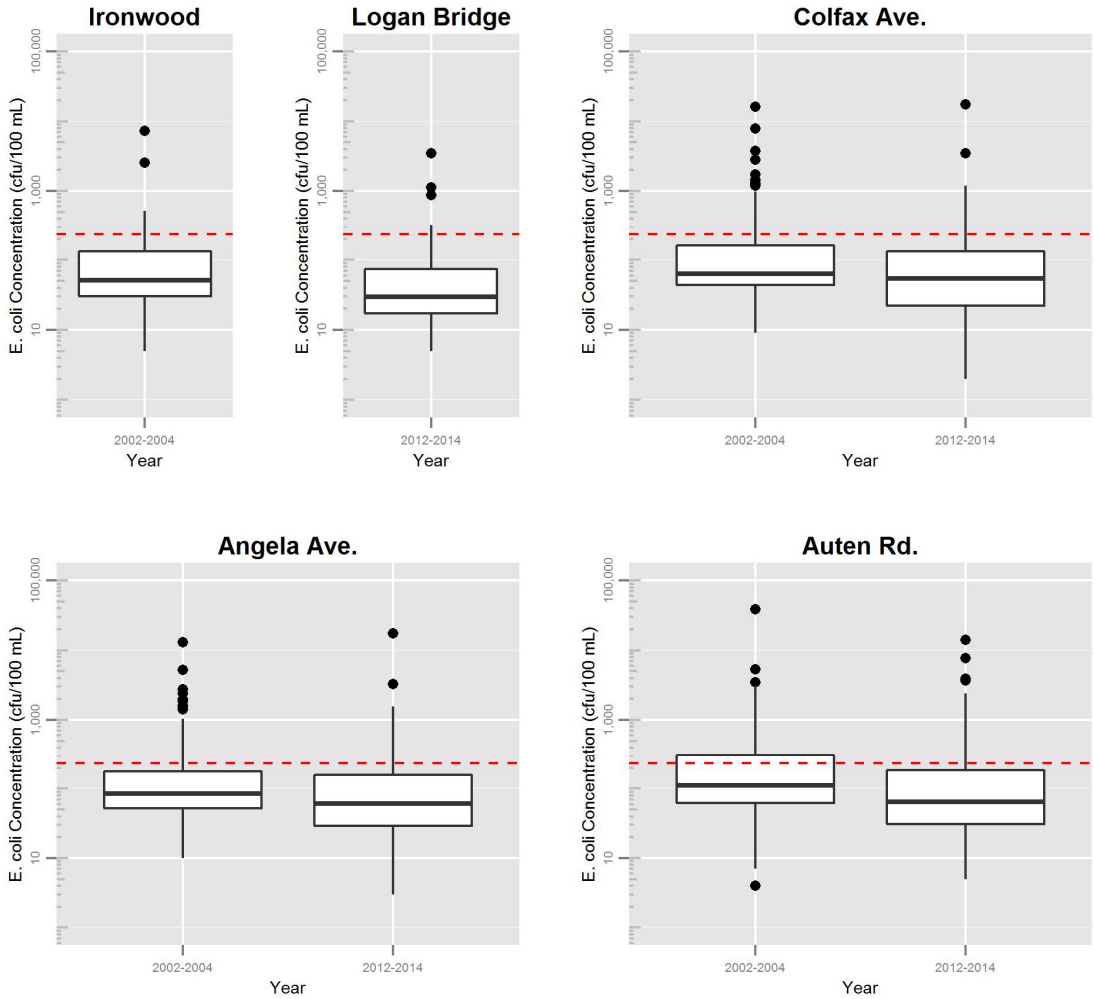
Water Quality Improvements



Water Quality Sampling Locations



Water Quality Data Analysis



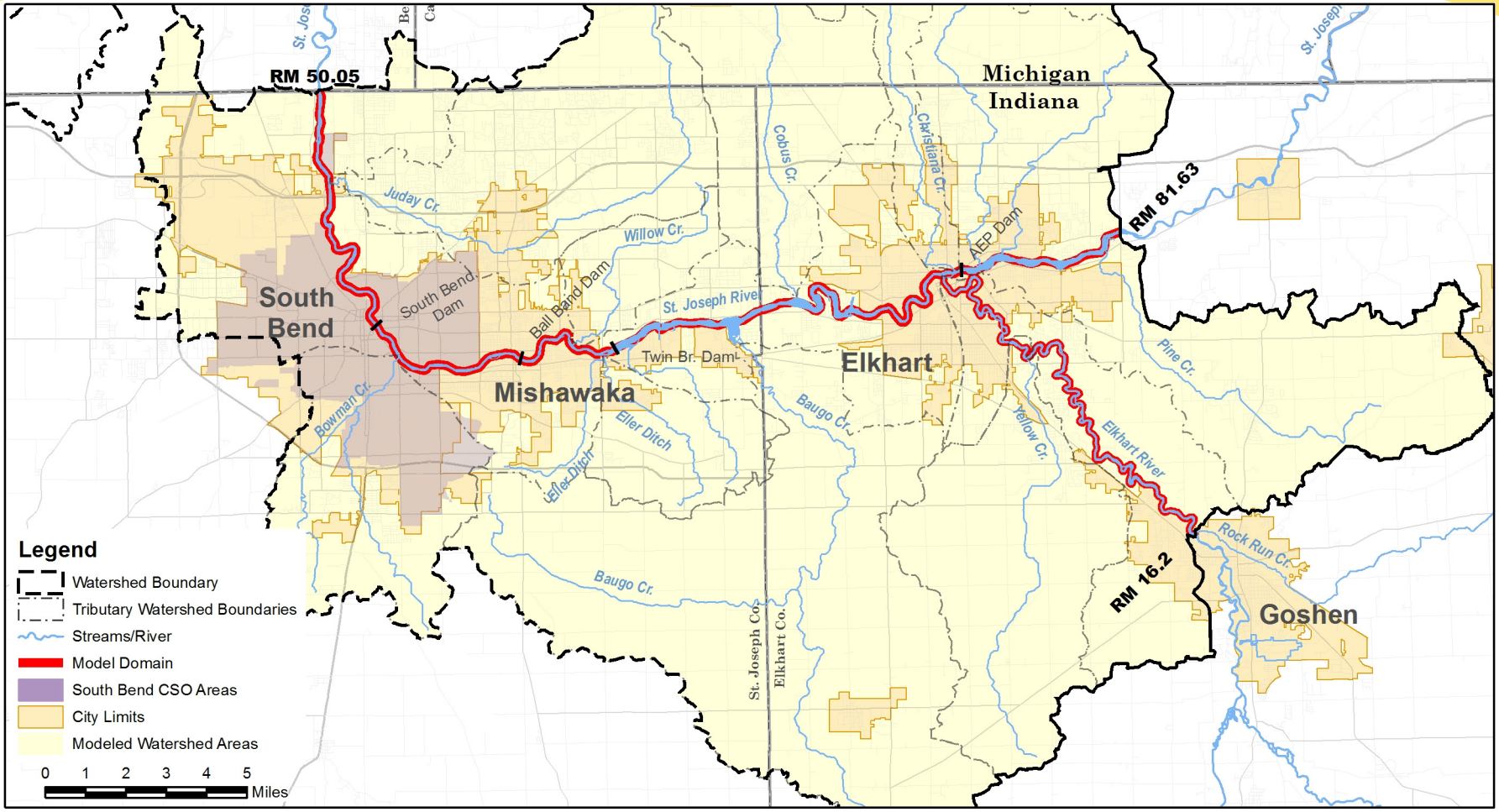
Water Quality Model Background

- Water quality modeling efforts of the St. Joseph River began in the early 1990s, when South Bend initiated their first combined sewer overflow (CSO) study.
- A joint effort between South Bend, Mishawaka, & Elkhart was adopted in the early 2000s in response to regulatory requirements.
  - Phase I: Developed In-Stream Water Quality Model on St. Joseph & Elkhart Rivers
  - Phase II: Developed a watershed model for the tributaries to evaluate the impact of those sources.
- Most recent WQ model update was in 2007 to evaluate revisions to the LTCPs for all three Cities.
- Last calibration period was from July 2002 to May 2003.

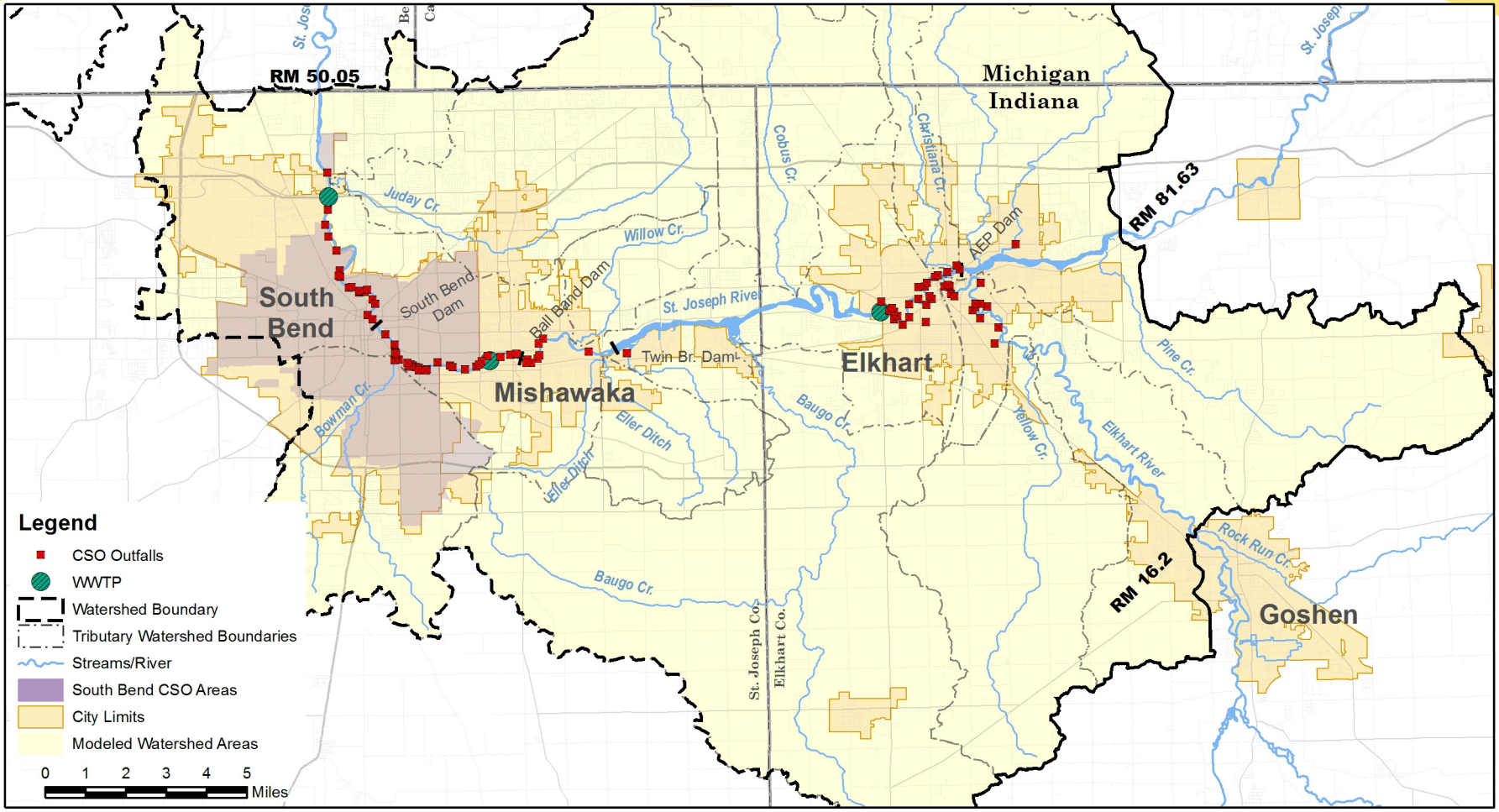
Water Quality Model Goals

- Model Updates Needed
  - New (reduced) overflow volumes
  - Incorporate Mishawaka and Elkhart control programs into upstream conditions
  - Include assumption about nonpoint source reductions
  - Calibrate model to new in-stream data
- Provide a consistent endpoint to evaluate the water quality impact of the LTCP alternatives being developed.
  - Optimize water quality benefits of Integrated Planning

Water Quality Model Domain



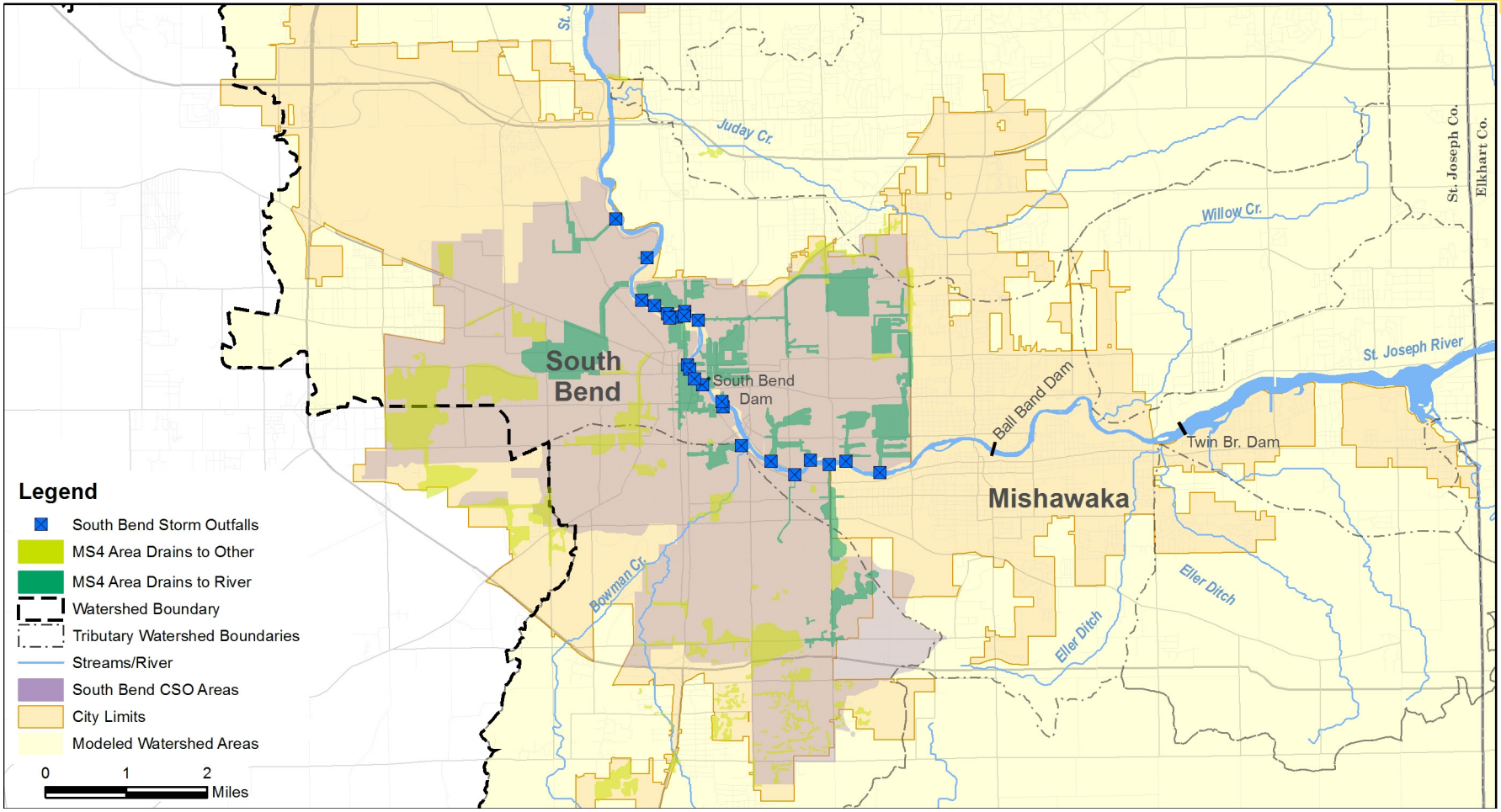
CSO & WWTP Sources



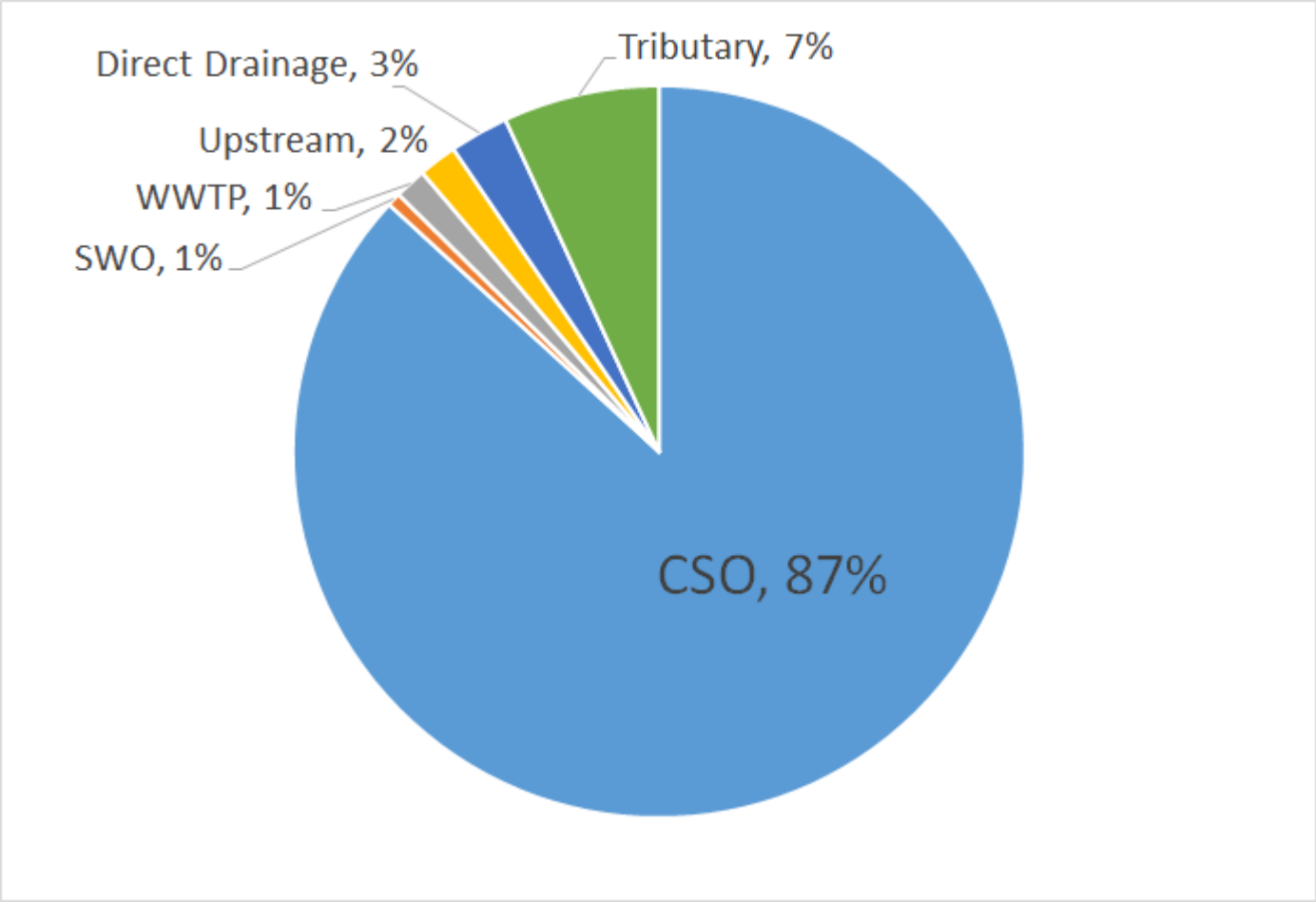
CSO Discharge Volumes

	South Bend	Mishawaka	Elkhart
2012 Total CSO Volume (Million Gallons)	446.1	4.7	89.5
2013 Total CSO Volume (Million Gallons)	713.7	22.2	177.6
Total 2012-2013 CSO Volume (Million Gallons)	**1159.8**	**26.9**	**267.0**
	79.8%	**1.9%**	**18.4%**

Stormwater Sources



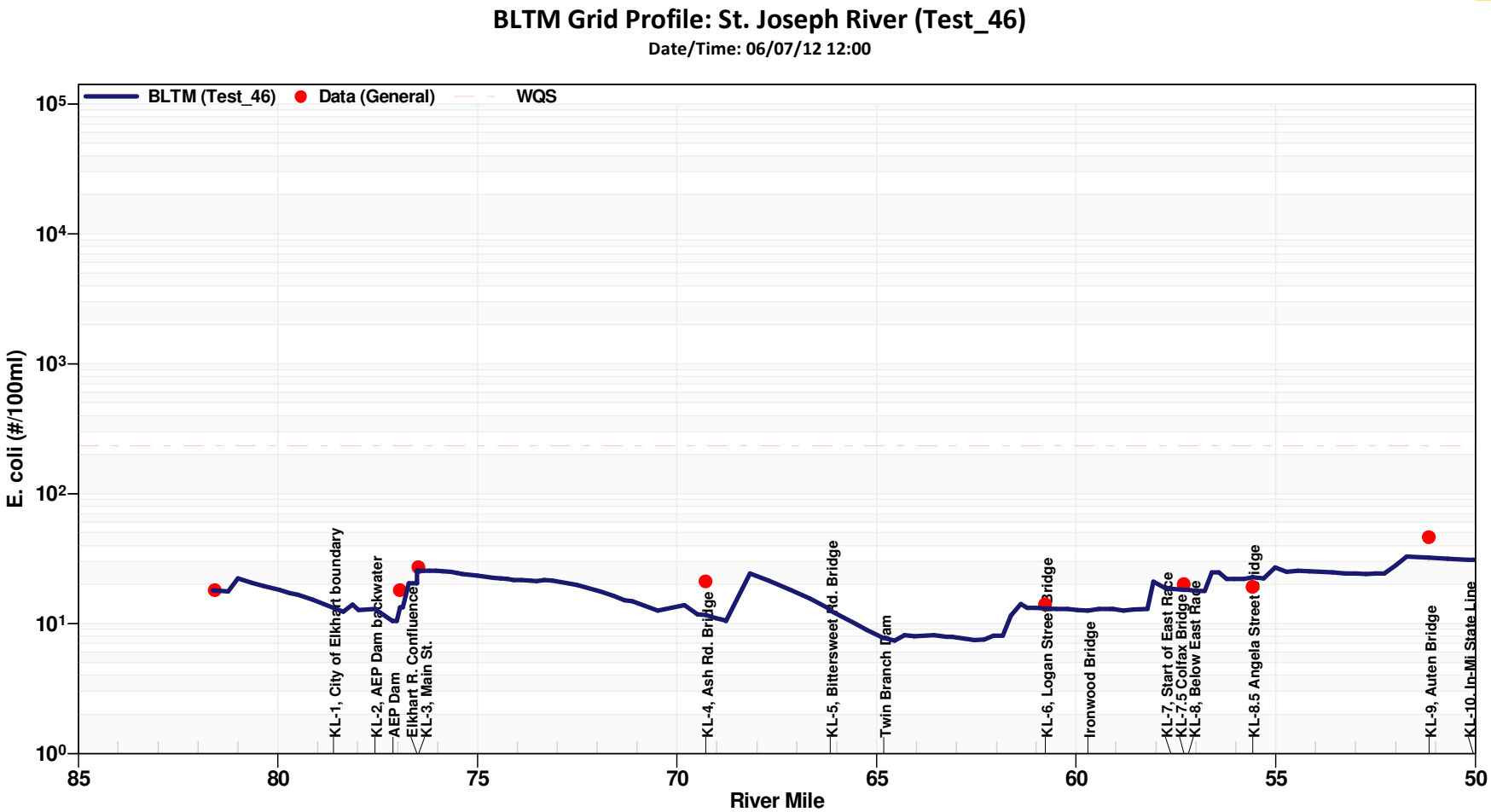
Estimated Sources of *E. coli* Discharges



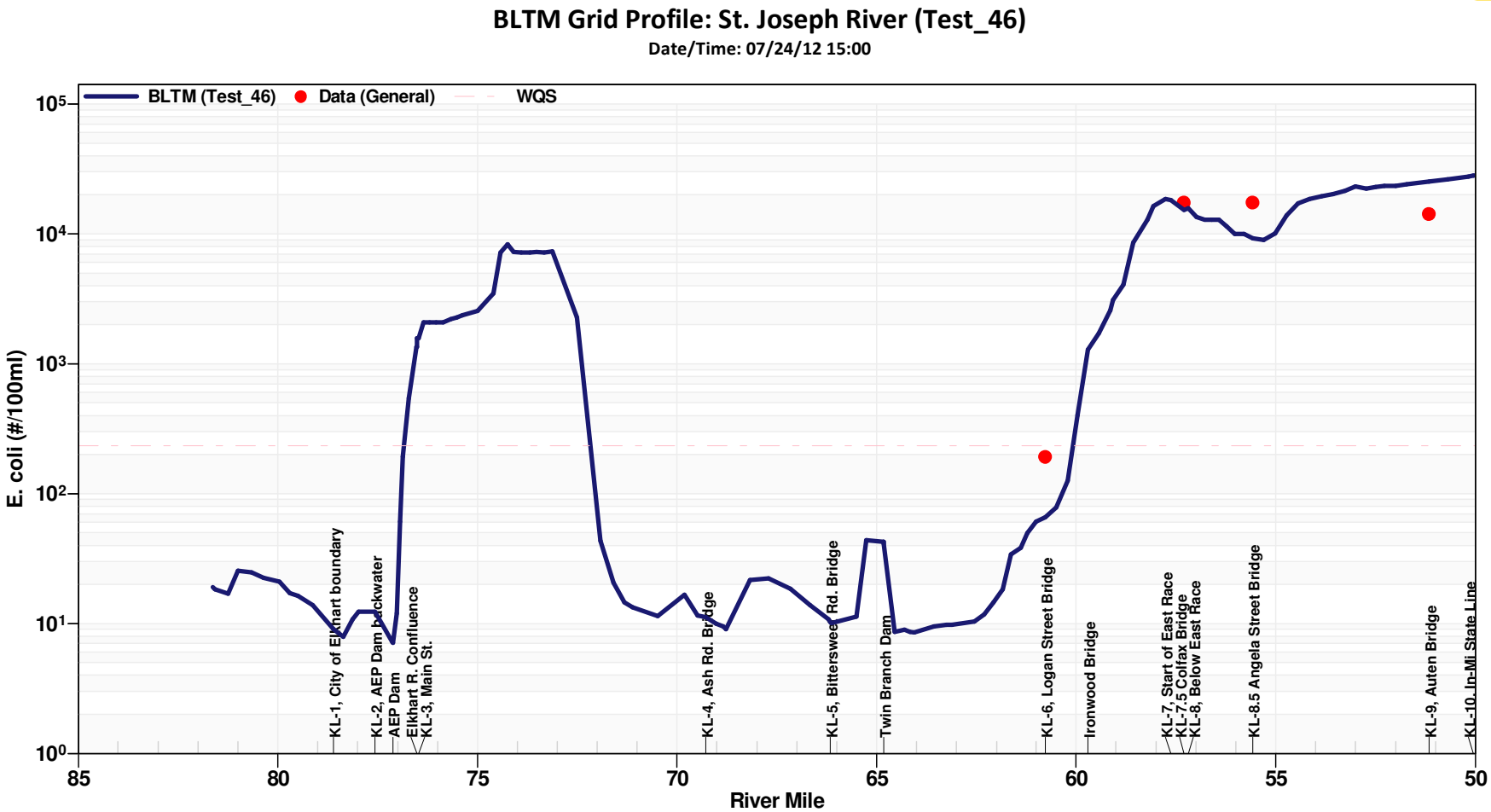
Model Calibration

- The purpose of model calibration is to adjust certain model parameters to match the data to the best extent possible.
- Calibration period of 1/1/2012 – 12/31/2013
  - Selected to cover two full recreation seasons, and based on data available.
  - Covers a variety of environmental conditions
  - Based on data available for inputs (e.g. CSO & WWTP reports, weather data)
- Utilized both statistical & graphical methods to verify the model calibration.
- The model will be used to make predictions of future conditions when data is not available using “Typical Year” inputs for environmental conditions.

Model Calibration – Dry Weather Profile



Model Calibration – Wet Weather Profile



Hours of Exceedance of WQS

	Logan Bridge		East Race		IN – MI State Line	
	2012	2013	2012	2013	2012	2013
April	11	92	34	127	55	146
May	16	12	26	47	35	71
June	0	53	23	93	64	113
July	19	22	99	45	141	67
August	13	27	74	54	117	71
September	4	37	35	43	59	53
October	19	40	71	85	91	120
Total Rec Season	**82**	**283**	**362**	**494**	**562**	**641**
% Rec Season	**1.6%**	**5.5%**	**7.0%**	**9.6%**	**10.9%**	**12.5%**

Conclusions

- Updated model provides a reasonable estimation of *E. coli* concentrations in the river over a range of environmental conditions.
- The model was successfully calibrated to an extensive water quality data set.
- The calibration of the model indicates that it is capable of reproducing the timing and magnitude of most of the observed data.
- The water quality model is a suitable tool for assessing impacts of various CSO control strategies being considered as alternatives to the current LTCP and expected compliance with water quality standards.

CSO LTCP Re-evaluation

Potential Financial Impacts of LTCP Compliance

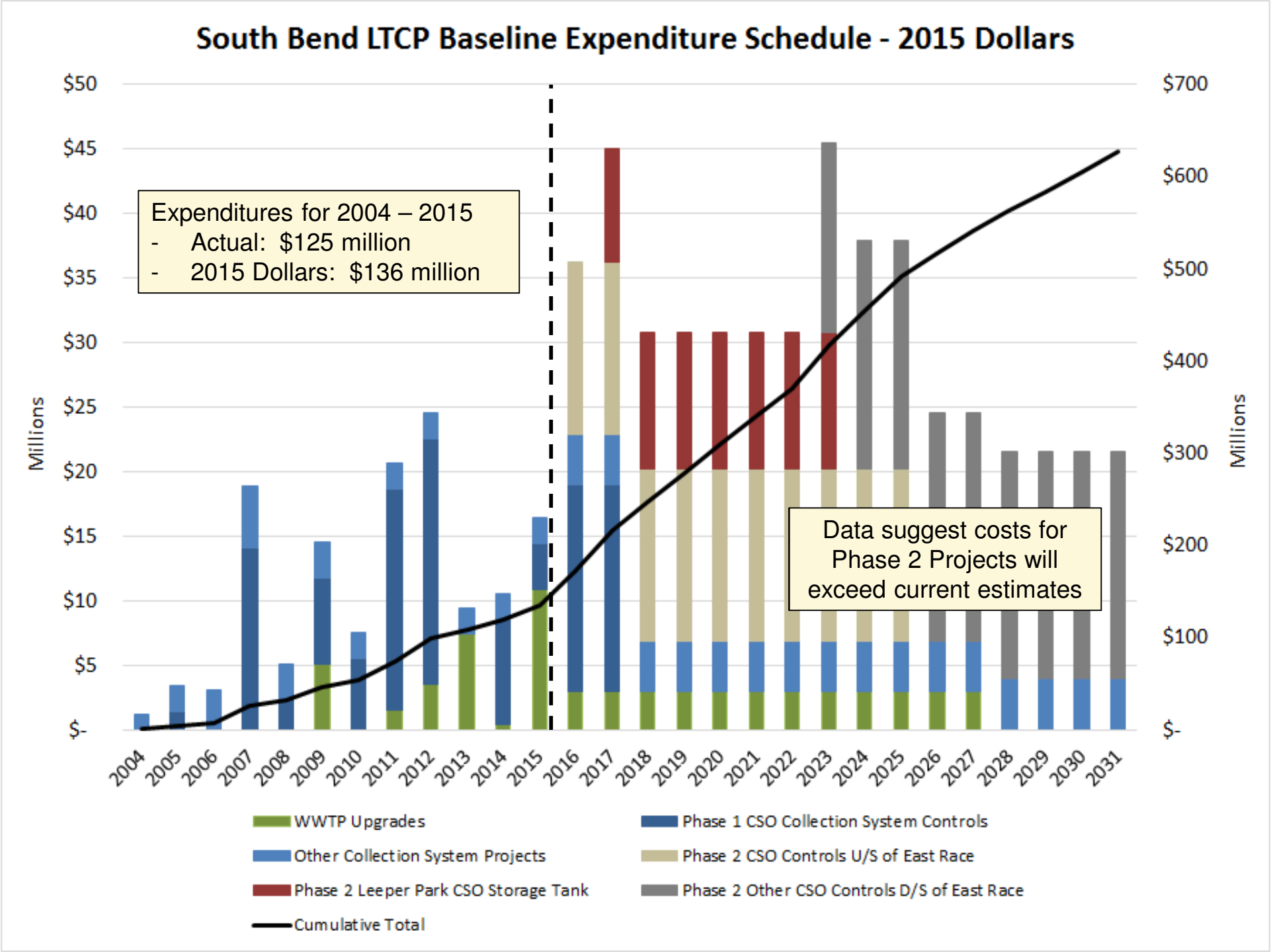
What are the financial impacts of LTCP compliance on the City of South Bend?

Engineering Analysis

- Capital Cost
  - Cost of engineering and construction expressed in constant base year dollars
  - Base year costs typically adjusted based on cost indices
- Operating and Maintenance (O&M) Costs
  - Cost of operating and maintaining facilities over planning period
- Life Cycle Cost
  - Present worth cost of capital and O&M needs considering time value

Cost to Rate Payers

- Direct Capital Expenditures
- Annual Operating and Maintenance Expenditures
- Debt Service
  - Principal
  - Interest
  - Other Financing Costs


South Bend LTCP Baseline Expenditure Schedule - 2015 Dollars
Expenditures for 2004 – 2015
- Actual: $125 million
- 2015 Dollars: $136 million
Data suggest costs for Phase 2 Projects will exceed current estimates
Millions
$50
$45
$40
$35
$30
$25
$20
$15
$10
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$700
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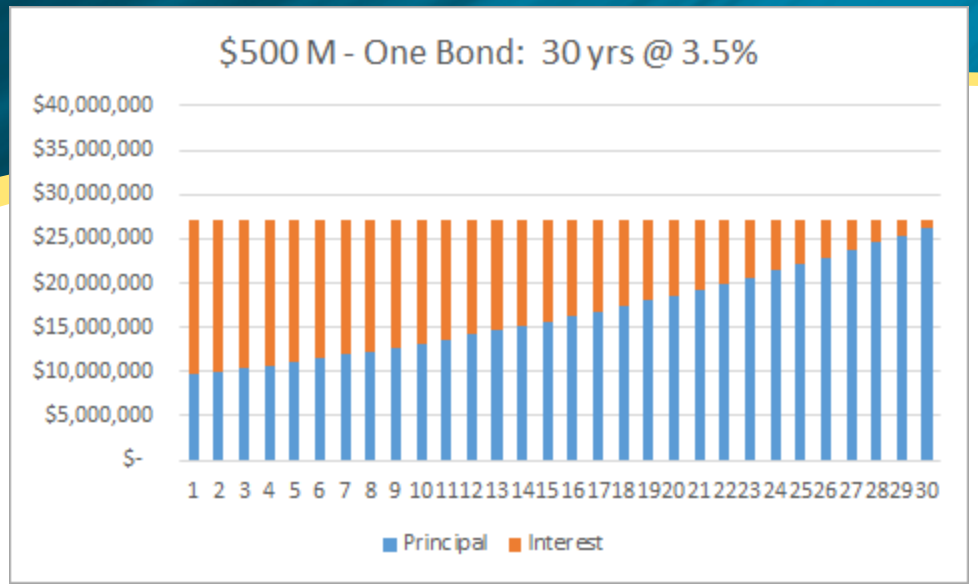
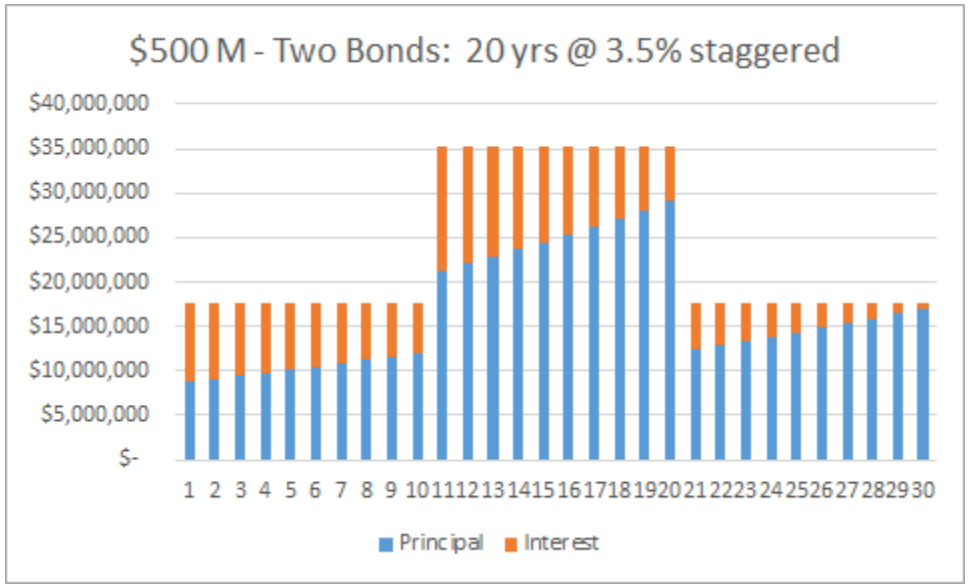
WWTP Upgrades
Phase 1 CSO Collection System Controls
Other Collection System Projects
Phase 2 CSO Controls U/S of East Race
Phase 2 Leeper Park CSO Storage Tank
Phase 2 Other CSO Controls D/S of East Race
Cumulative Total

Hypothetical Financing Variations



- $500 million principal
- One 30-year bond
- 3.5% interest rate
- Total interest: $316 million

- $500 million principal
- Two 20-year bonds
- Year 1, Year 11
- 3.5% interest rate
- Total interest: $204 million



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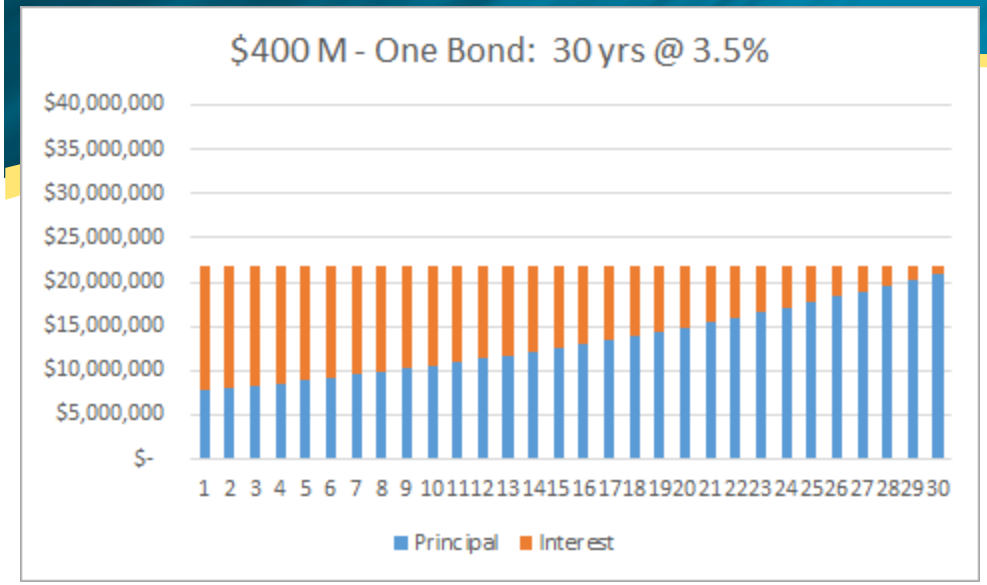
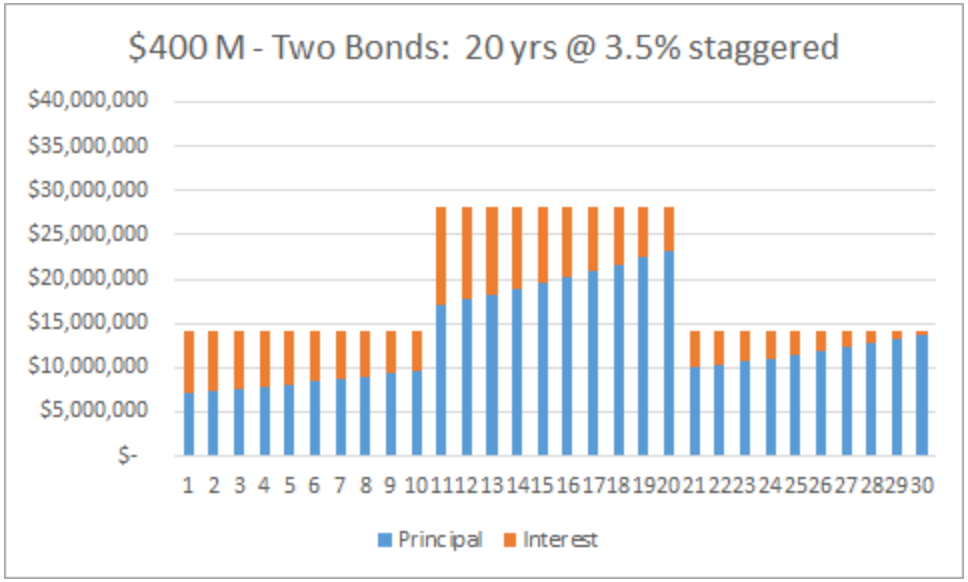


- $400 million principal
- One 30-year bond
- 3.5% interest rate
- Total interest: $252 million

- $400 million principal
- Two 20-year bonds
- Year 1, Year 11
- 3.5% interest rate
- Total interest: $163 million



CSO LTCP Re-evaluation

Analysis of LTCP Implementation Options

CSO LTCP Implementation Options

Baseline LTCP

2012 2031

Modified LTCP: ± 15% Cost Reduction

2012 2036

Modified LTCP: Cost Reduction to be determined

2012 2036

Level of Control Considerations

Level of Control

- No of overflow events allowed in a typical year
- Presumed to define conditions that will comply with water quality standards
- “knee of the curve” analysis cannot be used to define level of control

Indiana Consent Decrees

- South Bend: 4 overflows/year
- Elkhart: 9 overflows/year
- Mishawaka: 0 overflow/year
- Indianapolis: 2-4 overflows/year
- Fort Wayne: 1-4 overflows/year
- Muncie: 0 overflows/year
- Anderson: 6-8 overflows/year

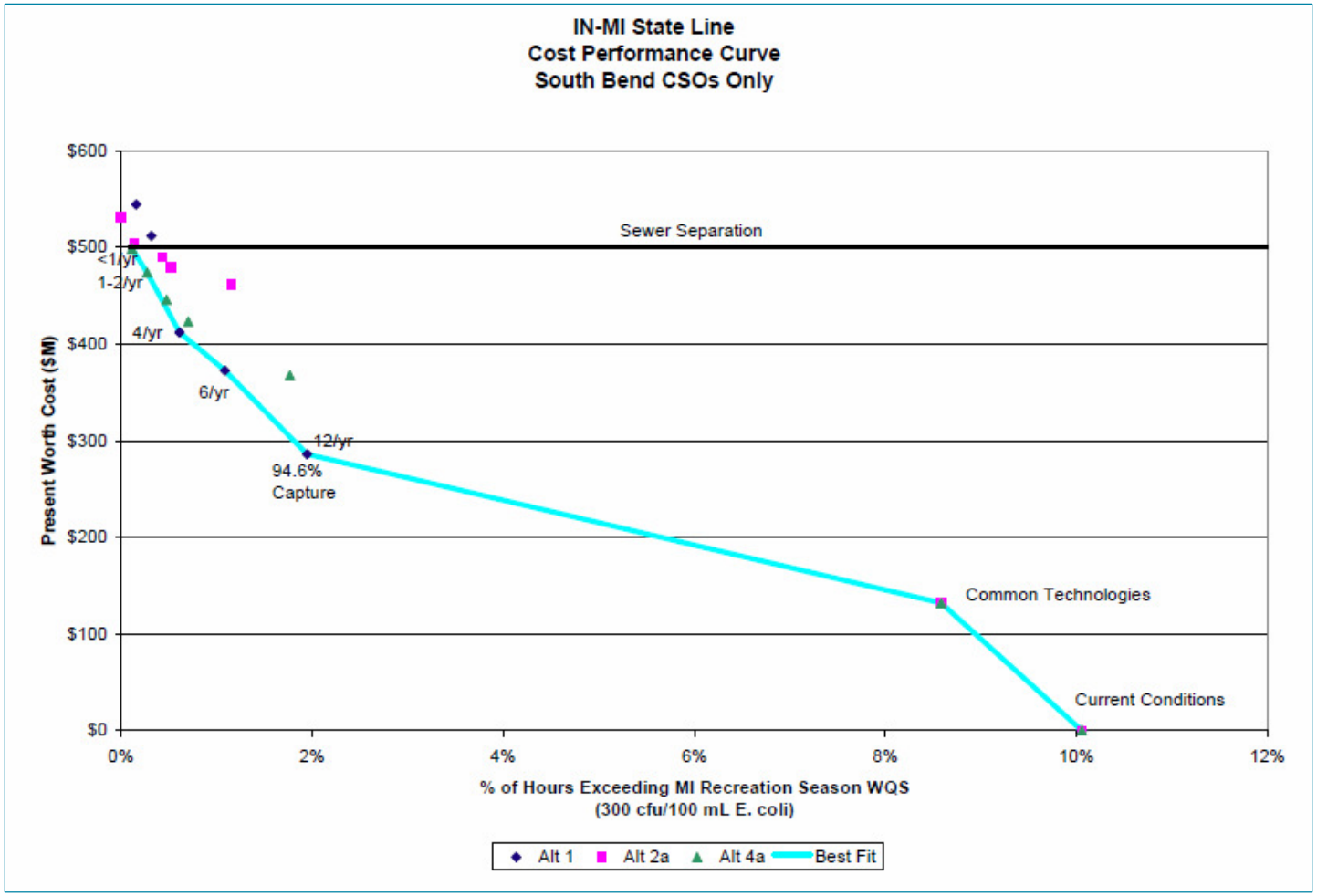
Overflow Disinfection Considerations

- Consent Decree requires South Bend to disinfect all overflows
- Requirement to disinfect overflows adds costs to proposed CSO control facilities for chemical feed systems (up to $0.5 - $1.0 million per site) and consolidation piping (tens of millions of dollars)
- Common forms of disinfection would require chemical facilities at overflow points

CSO LTCP Implementation Options

Project	Spent to Date	Baseline LTCP	Modified LTCP: Minimum Volume	Modified LTCP: Alternative Strategy
WWTP Improvements	$22.4 M	100 mgd	100 mgd	?
Phase 1/Other System Controls	$113.8 M	Various	Various	✓
CSO Tank Storage	$0.0 M	20.4 MG	13.8 MG	?
Linear Storage	$0.0 M	12.5 MG	7.5 MG	↓
Diversion Structures	$0.0 M	✓	↓	↓
Connecting Sewers	$0.0 M	✓	↓	↓
Screening	$0.0 M	✓	↓	↓
Disinfection	$0.0 M	✓	↓	?
Parallel Interceptor	$0.0 M	✓	↓	↓

"Knee of the Curve"



Triple Bottom Line Considerations

Current LTCP – Satellite Storage

- Economic
  - Allows for staged construction
  - Potential for multiple contracts
- Environmental
  - Water quality benefits
  - Potential impacts to parks
- Social
  - Enhanced health and safety
  - Potential impacts to parks
  - Construction disruption

Alternative LTCP – Increased Tunnel

- Economic
  - Major investment to get benefits
  - Specialized construction
- Environmental
  - Water quality benefits
  - Reduced impacts to parks
- Social
  - Enhanced health and safety
  - Reduced impacts to parks
  - Reduced construction disruption

CSO LTCP Re-evaluation

Phase 1 Completion Plan

Phase 1 Completion Plan

- Sewer System Model Calibration
- High Level Assessment of Alternatives
- Coordination of Advisory Committee
- Update of Financial Capability and Integrated Planning Impacts
- Formulation of Regulatory Strategy

Prepared for

City of South Bend, Indiana

CSO LTCP Re-evaluation Council Committee Update

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Water Quality Monitoring Data

- South Bend has an in-stream water quality monitoring program on the St. Joseph River
- There are four (4) current sampling locations in the City
  - Logan St. Bridge (Boundary with Mishawaka)
  - Colfax Ave. Bridge
  - Angela Ave. Bridge
  - Auten Road Bridge (Downstream of City WWTP)
- Samples are taken weekly and analyzed for E. coli concentration
- Samples from 2012 – 2014 compared with samples from 2002 – 2004 to review impact of LTCP projects implemented

Water Quality Data Analysis

- Median Concentrations are lower in 2012-2014 than in 2002-2003
  - Fewer CSO discharge events collected in sampling data lowers the median *E. coli* concentrations.
- Highest Concentrations are similar between both time periods.
  - When CSOs discharge, the maximum concentrations is similar to past years.
- The range of normally encountered concentrations is lower in 2012-2014 than in 2002-2004.
  - There are improvements upstream and in the watershed that have lowered the incoming *E. coli* concentrations.
- There is an increase in *E. coli* concentrations as the river travels through the City, both during dry weather, and wet weather.

Water Quality Model Inputs

Source	Flow Data	*E. coli* Concentration Data
St. Joseph River-Upstream	USGS gauge (04101000) at Johnson St. Bridge adjusted by drainage area of gage to drainage area at model boundary	Sampling data from station SJ-1 (Six Span Bridge)
Elkhart River-Upstream	USGS gauge (04100500) at Goshen	Estimated from sampling data at station EK-1 (County Rd 18. Bridge)
Tributaries	HSPF watershed model USGS Gauge (04101370) Juday Creek	HSPF watershed model
Direct Drainage Areas	Calculated based on Drainage Area Ratio (DAR) from USGS Gage on Juday Creek	HSPF watershed model, Literature and BPJ (varied seasonally)

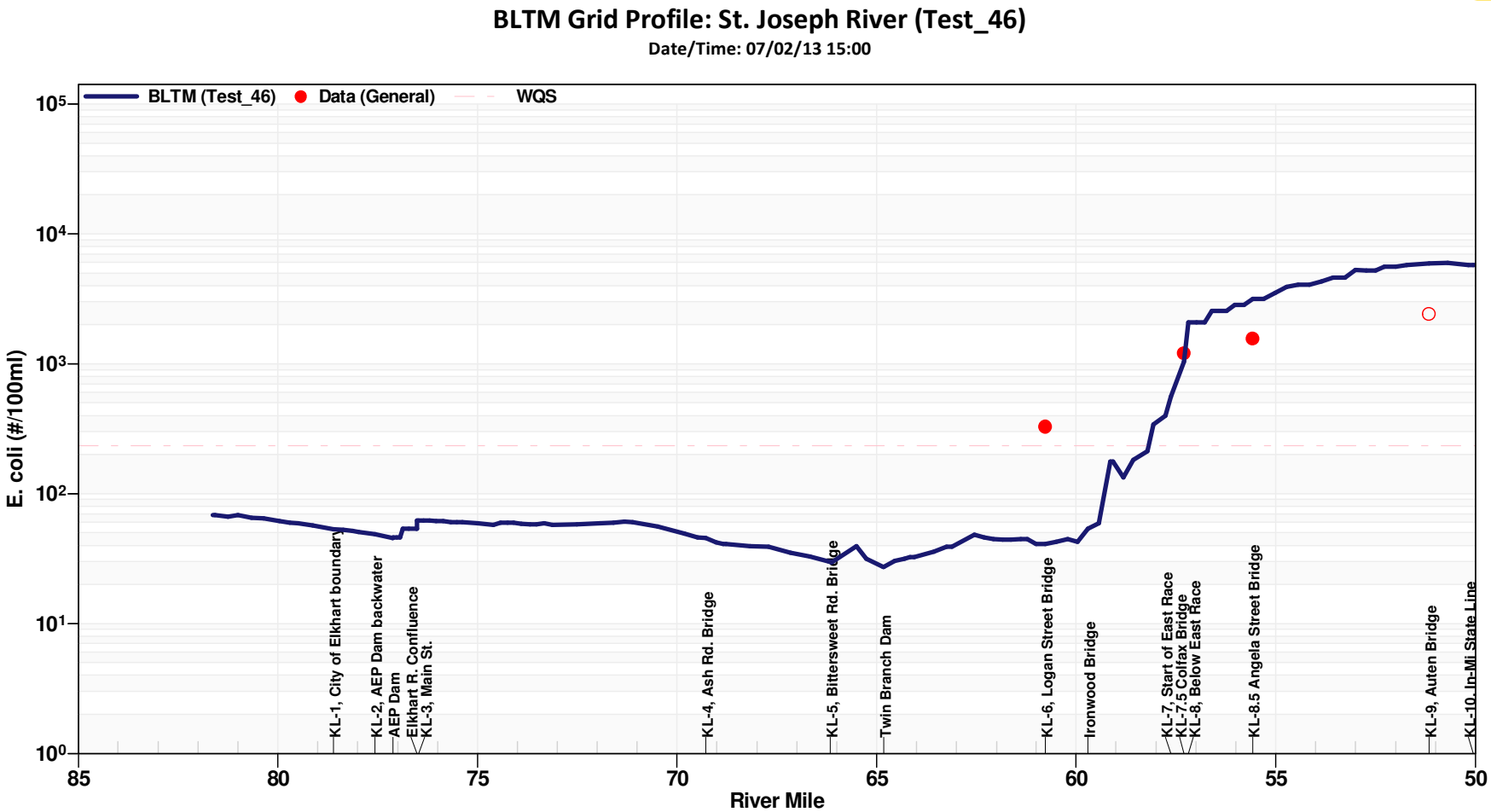
Water Quality Model Inputs

Source	Flow Data	*E. coli* Concentration Data
CSOs	IDEM Reports (Estimated by collection system models & Monitoring Data at 5 South Bend CSOs)	Literature and BPJ EMC = 750,000 (CFU/100mL)
Storm Water Outfalls	Rational method (Q=ciA)	Literature EMC = 2,600 (CFU/100mL)
WWTP	IDEM Reports - Monitoring data	Monitoring data

Stormwater Sources

- Areas within the CSO districts where the storm sewers been separated are not accounted for in the tributary watershed models.
- These areas have been expanded since the model was last developed as a part of the ongoing implementation of the LTCP.
- Review of the City's Sewer GIS data and topographic data by the project team updated the tributary area delineations for the separated storm areas.
- There are currently approximately 1800 acres of separated storm sewer areas that drain to the river.

Model Calibration – Wet Weather Profile



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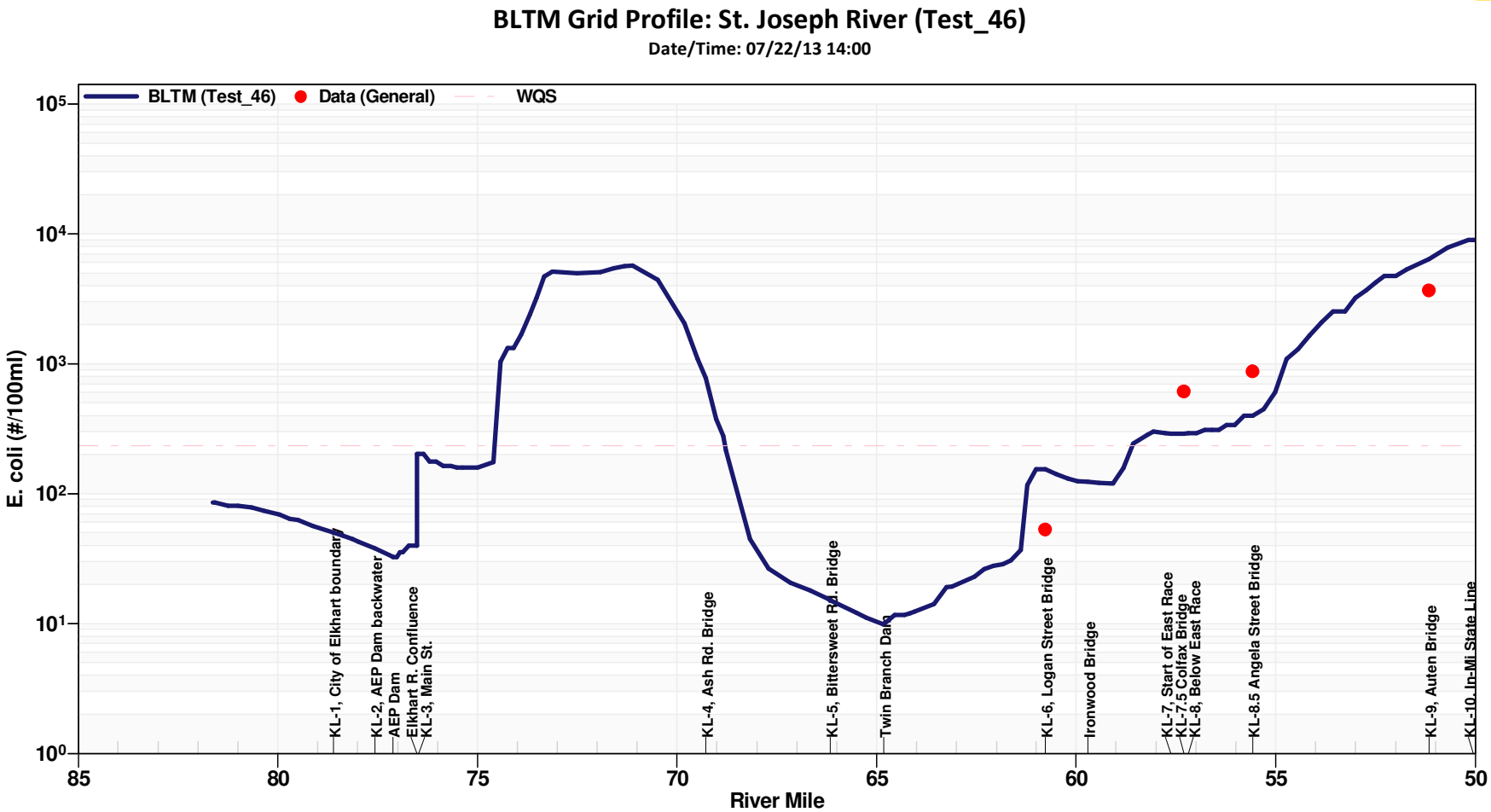
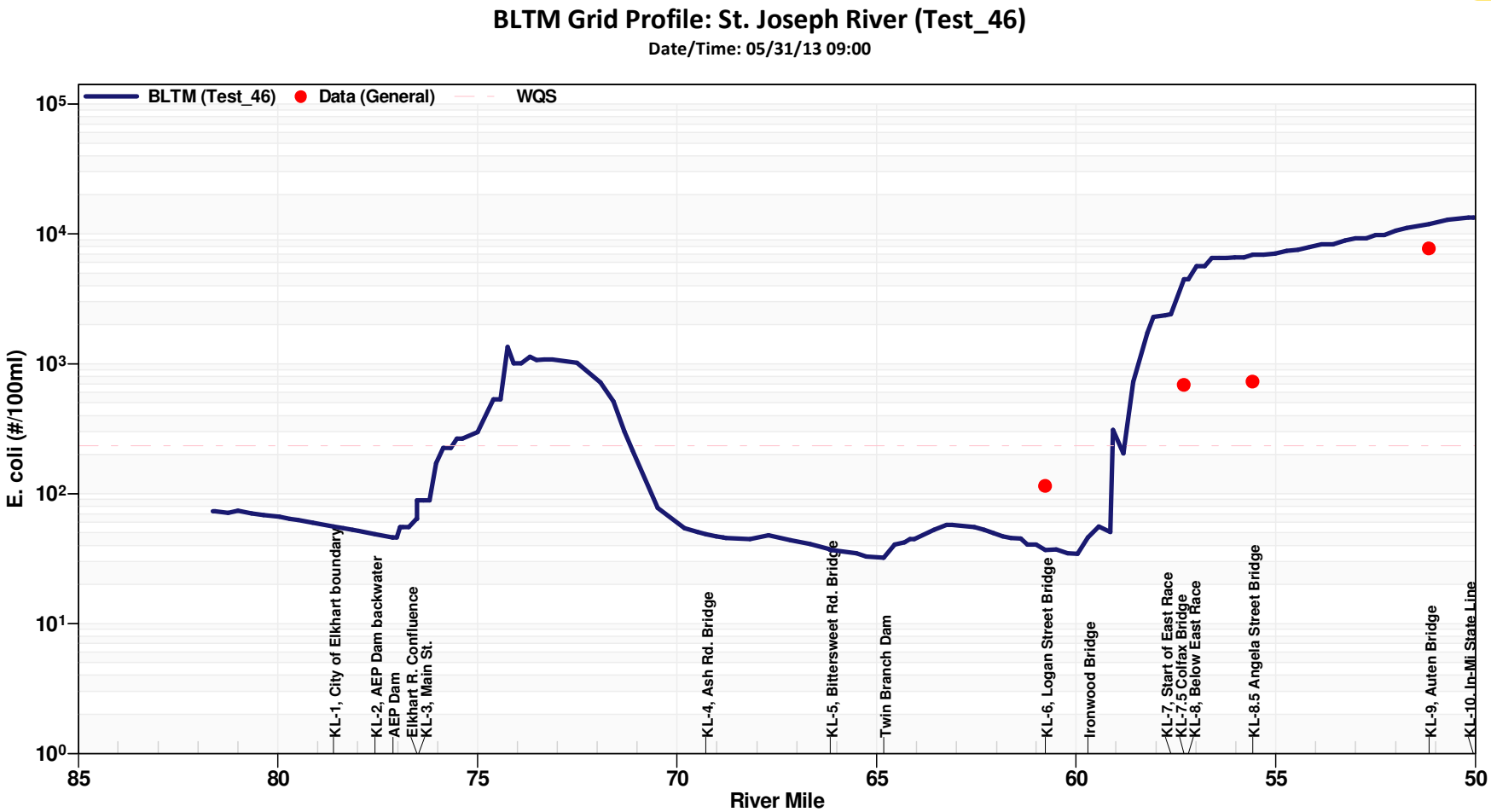
Model Calibration – Wet Weather Profile