

# Upper South Branch Kishwaukee Water Quality & Modeling

December 10, 2019 Stakeholder Meeting  
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APPLIED ECOLOGICAL SERVICES, INC.

# Key Discussion Topics

- Designated Uses and Impairments
- Wastewater Treatment Plant
- Water Quality Monitoring Locations
- Water Quality Summary
- Pollutant Loading Model
- “Hot Spot” SMUs
- Water Quality Targets
- Potential Goal Topics



# Water Quality in Illinois

Federal Clean Water Act requires states to submit to assess and report water quality bi-annually.

Must describe how Illinois assessed water quality and whether assessed waters meet water quality standards specific to each “Designated Use” of a stream or lake.

If a waterbody is determined through biological and/or physical-chemical sampling to be impaired, IEPA must list potential causes and sources for impairment.



# IEPA Designated Uses & Impairments (2018)

- Upper South Branch Kishwaukee is Not Supporting for Fish Consumption (mercury, PCBs)
- Upper half of Kishwaukee is also Not Supporting for Aesthetic Quality (bottom deposits)

Designated Use	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
<b>South Branch Kishwaukee River: IL_PQC-02</b>				
<i>Aquatic Life</i>	Fully Supporting	No	None	N/A
<i>Fish Consumption</i>	Not Supporting	Yes	Mercury, PCBs	Source Unknown
<i>Primary Contact Recreation</i>	Not Assessed	-	-	-
<i>Aesthetic Quality</i>	Fully Supporting	No	None	-
<b>South Branch Kishwaukee River: IL_PQC-13</b>				
<i>Aquatic Life</i>	Fully Supporting	No	None	N/A
<i>Fish Consumption</i>	Not Supporting	Yes	Mercury, PCBs	Source Unknown
<i>Primary Contact Recreation</i>	Not Assessed	-	-	-
<i>Aesthetic Quality</i>	Not Supporting	Yes	Bottom Deposits	Source Unknown



# Point Sources

Point sources are identified as any discharge that comes from a pipe or permitted outfall, such as municipal and industrial discharges.

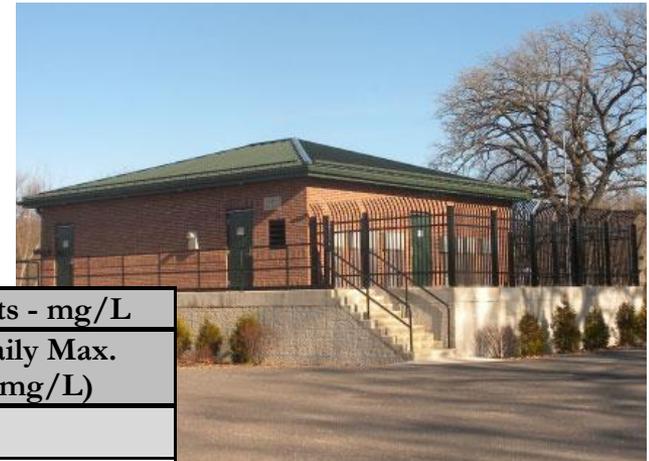
Regulated by Illinois EPA Bureau of Water under the National Pollutant Discharge Elimination System (NPDES) program.

Separate and apart from the purposes of this watershed planning process, which is focused on non-point source pollution.



# Wastewater Treatment Plant

KWRD NPDES permit requirements:



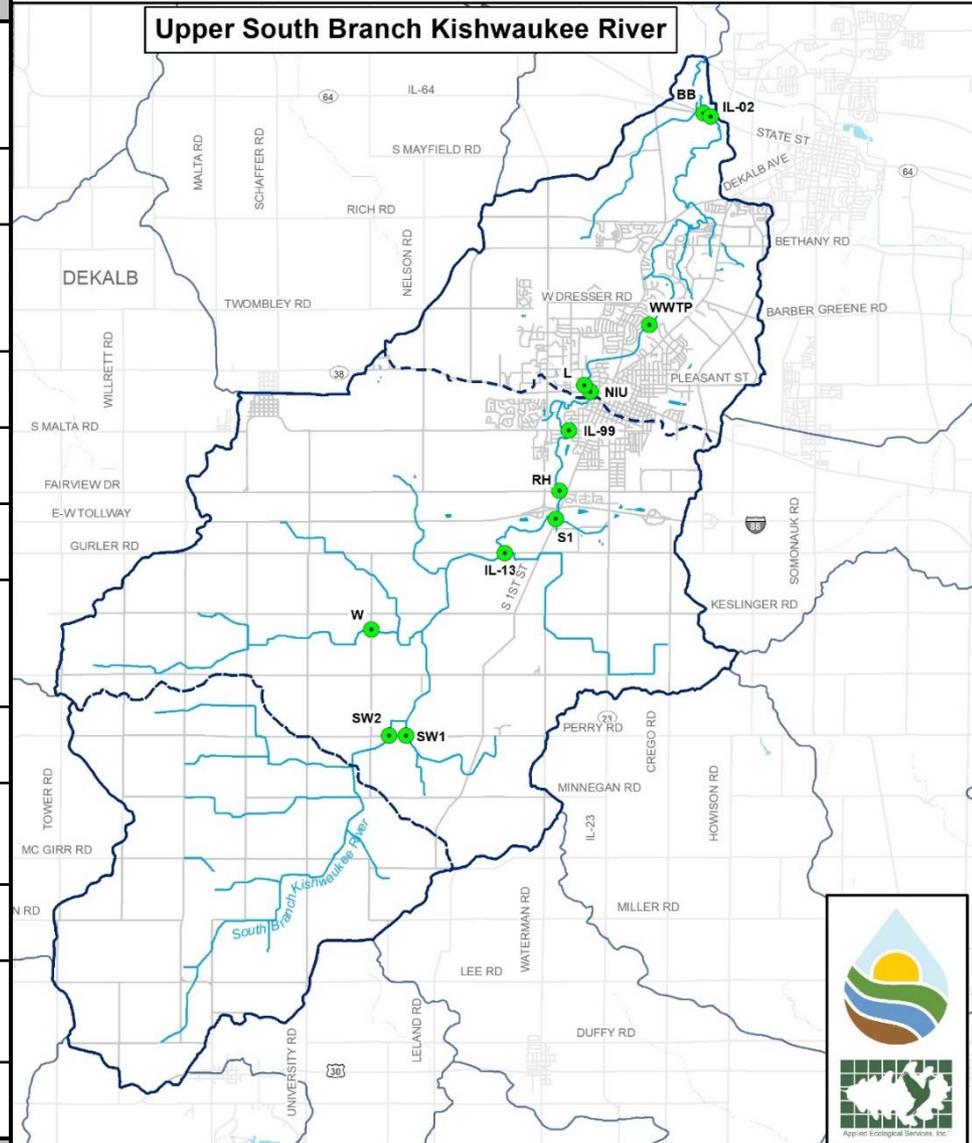
Parameter	Load Limits - lbs/day DAF (DMF)		Concentration Limits - mg/L	
	Monthly Ave. (lbs/day)	Daily Max. (lbs/day)	Monthly Ave. (mg/L)	Daily Max. (mg/L)
<b>Flow: 8.63 MGD ave. &amp; 18.13 MGD max.</b>				
CBOD	720 (1512)	1439 (3024)	10	20
Suspended Solids	864 (1814)	1727 (3629)	12	24
pH	Shall be in the range of 6 to 9 Standard Units			
Fecal Coliform	Monthly mean $\leq$ 200 per 100 mL and no more than 10% of samples shall exceed 400 per 100mL (May through October)			
Chlorine Residual	-	-	-	0.05
Ammonia Nitrogen				
<i>Mar-May/ Sept-Oct</i>	108 (227)	432 (907)	1.5	6.0
<i>June-August</i>	72 (151)	396 (832)	1.0	5.5
<i>Nov-Feb</i>	259 (544)	561 (1179)	3.6	7.8
Total Phosphorus	72 (151)	-	1.0	-
Total Nitrogen	Monitor only			
Dissolved Oxygen			Not less than	Daily Minimum
<i>March-July</i>				5.0
August- February	-	-	6.0	4.0



# Water Quality Monitoring Locations

Site ID	Site Name	Sampling Entity	Date Range	Sampled Parameters
BB	Broken Bridge (SP 4)	NIU, AES/KWR D	May 2018 – Aug 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness, TKN, total nitrogen, <i>E. coli</i> , BOD, TSS, chloride, phosphorus
L	Lagoon (SP 2)	NIU	June 2018 – Mar 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness
NIU	Northern Illinois University campus	NIU, AES/KWR D	June 2018 – Aug 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness, TKN, total nitrogen, <i>E. coli</i> , BOD, TSS, chloride, phosphorus
RH	River Heights Golf Course (SP 14)	NIU	June 2018 – April 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness
S1	South First Street (SP 15)	NIU	June 2018 – April 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness
SW1	Southwest 1 (SP18)	NIU	June 2018 – April 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness
SW2	Southwest 2 (SP 17)	NIU, AES/KWR D	July 2018 – Aug 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness, TKN, total nitrogen, <i>E. coli</i> , BOD, TSS, chloride, phosphorus
W	Western (SP 16)	NIU	June 2018 – April 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness
WWTP	WKRD (SP 3)	NIU, KWRD	June 2018 – Aug 2019	pH, EC, LDO, turbidity, ammonia, nitrite, nitrate, sulphate, sulfide, calcium, phosphate, total hardness, BOD, TSS, chloride, phosphorus
IL-02	IL_EPA-PQC-02; 1.5 MI W SYCAMORE	Illinois EPA	2011, 2016	Intensive Basin, Special Study
IL-13	IL_EPA-PQC-13; GURLER RD 2MI SW DE KALB	Illinois EPA	2016	Intensive Basin, Special Study
IL-99	IL_EPA-PQC-99; TAYLOR ST IN DE KALB	Illinois EPA	2011, 2016	Intensive Basin, Special Study

**Sampling Abbreviations:** EC= electrical conductivity, LDO=luminescent dissolved oxygen, TKN=total Kjeldahl nitrogen, BOD=biochemical oxygen demand, TSS=total suspended solids



# Numeric Standards

In the absence of numeric standards, proposed or recommended standards from USEPA and USGS were used.

- Phosphorus (USEPA):  
<0.0725 mg/L
- Nitrogen (USEPA):  
<2.461 mg/L
- Total suspended solids (USGS):  
<19 mg/L
- *E. coli* (IEPA):  
<235 MPN/100mL



# NIU Water Chemistry Data Averages 2018-19

Site ID/ Parameter	Statistical, Numerical, or General Use Guidelines	SW1	SW2	W	S1	RH	L	NIU	WWTP	BB
Average of pH	>6.5 or <9.0*	8.2	8.4	8.2	8.4	8.2	8.2	8.3	7.8	8.0
Average of EC (uS/cm)	<1,667 µmhos/cm	428.9	296.7	354.0	451.0	429.6	456.0	517.0	496.3	522.8
Average of LDO (mg/L)	>5.0 mg/l*	9.8	10.3	10.0	9.8	9.5	9.9	10.4	9.0	9.2
Average of Turbidity (NTU)	<14 NTU**	9.0	8.2	34.6	42.6	13.0	23.5	13.6	10.4	31.1
Average of Ammonia (ppm)	<15 mg/l* (<15.017 ppm)	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.4	0.0
Average of Nitrite (NO2) (ppm)	<i>see NO2+NO3 below</i>	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.5	0.1
Average of Nitrate (NO3) (ppm)	<i>see NO2+NO3 below</i>	12.9	16.2	20.5	6.6	15.9	10.2	10.0	18.7	18.0
Average of NO2+NO3 (calculated)	1.798 mg/L** (1.800 ppm)	12.9	16.3	20.7	6.7	16.0	10.2	10.0	19.2	18.1
Average of Sulphate (ppm)	N/A	43.8	31.5	55.7	26.3	29.4	21.1	29.1	18.4	29.9
Average of Sulfide (ppm)	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average of Calcium (ppm)/Total Hardness	N/A	240.3	273.0	248.4	212.6	232.0	224.1	267.0	239.6	259.5
Average of Phosphate (ppm)	0.222 ppm (converted from phosphorus standard)**	0.2	0.2	0.2	0.2	0.1	0.2	0.1	1.8	0.7
Average of Total Hardness	N/A	166.7	252.5	221.7	166.7	166.7	137.8	145.0	166.7	253.3



# AES & KWRD Sample Results July 18, 2019

Baseline sampling:

ID Code/ Parameter	Statistical, Numerical, or General Use Guidelines	SW2	NIU	WWTP Upstream	WWTP Downstream	BB
pH	>6.5 or <9.0*	7.56	7.86	7.84	7.82	7.78
BOD (mg/L)	N/A	1	7.1	15.5	7.2	6.3
TSS (mg/L)	<19 mg/l***	11	127	180	184	42
Chloride (mg/L)	<500 mg/l*	24.8	32.3	40.2	42.3	80.4
Phosphorus (mg/L)	<0.0725 mg/l**	0.035	0.25	0.341	0.518	0.662
Ammonia (mg/L)	<i>see TN below</i>	ND	0.19	0.18	0.342	0.36
Nitrite (mg/L)	<i>see TN below</i>	0.0389	0.0408	-	-	0.209
Nitrate (mg/L)	<i>see TN below</i>	9.82	5.08	-	-	7.73
Total Kjeldahl Nitrogen (mg/L)	<i>see TN below</i>	ND	2.85	-	-	5.83
Total Nitrogen (TN) (mg/L) calculated	<2.461 mg/l**	9.82	7.92	-	-	13.6
<i>E. coli</i> (MPN/ 100mL)	<235 MPN/100mL*	320	>1000	-	-	>1000

-Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines

\* Illinois EPA General Use Standard

\*\* Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)

\*\*\* Present and Reference Concentrations and Yields of Suspended Sediment in Streams in the Great Lakes Region and Adjacent Areas (USGS 2006)

# AES & KWRD Sample Results Aug 27, 2019

After 1" rain event:

ID Code/ Parameter	Statistical, Numerical, or General Use Guidelines	SW2	NIU	WWTP Upstream	WWTP Downstream	BB
pH	>6.5 or <9.0*	7.5	7.58	7.37	7.55	7.43
BOD (mg/L)	N/A	2.7	3.8	4	5.5	5.5
TSS (mg/L)	<19 mg/l***	8	40	14	14	20
Chloride (mg/L)	<500 mg/l*	26.5	87	110	228	186
Phosphorus (mg/L)	<0.0725 mg/l**	0.067	0.18	0.157	1.03	0.569
Ammonia (mg/L)	<i>see TN below</i>	ND	ND	0.111	0.653	0.15
Nitrite (mg/L)	<i>see TN below</i>	0.183	0.0443	-	-	0.12
Nitrate (mg/L)	<i>see TN below</i>	4.78	ND	-	-	2.66
Total Kjeldahl Nitrogen (mg/L)	<i>see TN below</i>	1.7	2.05	-	-	4.46
Total Nitrogen (TN) (mg/L) calculated	<2.461 mg/l**	6.48	2.05	-	-	7.12
<i>E. coli</i> (MPN/ 100mL)	<235 MPN/100mL*	248.9	1553.1	-	-	1986.3

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# IEPA Water Chemistry Averages 2011-16

ID Code/ Parameter	Statistical, Numerical, or General Use Guidelines	IL-13	IL-99	IL-02
Average of pH	>6.5 or <9.0*	7.9	7.8	7.9
Average of Dissolved Oxygen (mg/L)	>5.0 mg/l*	10.4	7.8	8.9
Average of TSS (mg/L)	<19 mg/l***	12	10	18
Average of Chloride (mg/L)	<500 mg/l*	41.5	38.7	119
Average of Phosphorus (mg/L)	<0.0725 mg/l**	0.0688	0.086	0.8305
Average of Ammonia (mg/L)	<i>see TN below</i>	0.01	ND	0.01
Average of NO <sub>2</sub> +NO <sub>3</sub>	1.798 mg/L**	15.7	7.5	11.3
Average of Total Kjeldahl Nitrogen (mg/L)	<i>see TN below</i>	0.7	0.7	1.07
Average of Total Nitrogen (TN) (mg/L), calculated	<2.461 mg/l**	16.41	8.20	12.38

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\* Illinois EPA General Use Standard

\*\* Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)

\*\*\* Present and Reference Concentrations and Yields of Suspended Sediment in Streams in the Great Lakes Region and Adjacent Areas (USGS 2006)



# Water Quality Summary

Based on average results of each parameter at most downstream locations, the nonpoint source averages are:

- Phosphorus averages 0.288 mg/L vs target of 0.0725 mg/L
- Nitrogen averages 5.195 mg/L vs target of <2.461 mg/L
- TSS averages 20.9 mg/L vs target of <19 mg/L



# Pollutant Loading Model

- Watershed-wide pollutant loading was modeled using USEPA's STEPL tool (Spreadsheet Tool to Estimate Pollutant Loads).
- Model uses land use/land cover category types, precipitation, soils information, stream data, existing BMPs, and other data.
- Estimates total loads for nitrogen, phosphorus, and sediment.



# Pollutant Loading & Water Quality

- Water quality monitoring captures all sources of pollution, both point and non-point
- STEPL modeling does not include point source discharges
- Used permit monitoring data from KWRD to estimate their contribution to pollutant loading

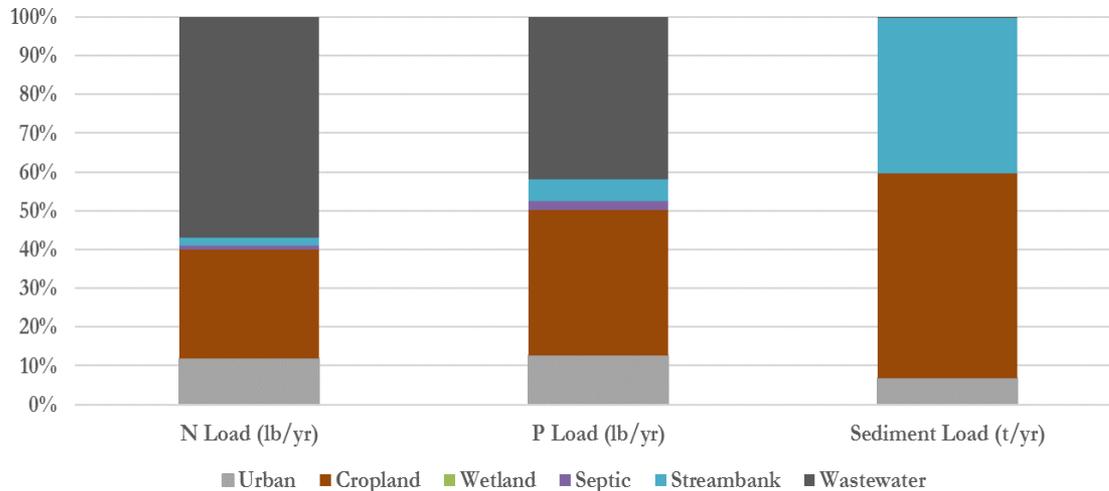
Average Flow MGD	Average Concentration (mg/l)			Annual Pollutant Load*		
	TN (mg/l)	TP (mg/l)	TSS (mg/l)	TN Load (lbs/yr)	TP Load (lbs/yr)	TSS (t/yr)
7.07	21.82	2.45	6.02	469,281	52,692	64.7

\*Average daily flow (MGD) × average concentration (mg/l) × 3,042 (L-d-lb/gal-y-mg) = average annual load (lb-t/y)

**NOTE: KWRD does an excellent job of staying within their permit limits.**



# Pollutant Loading Model



## *Excluding wastewater:*

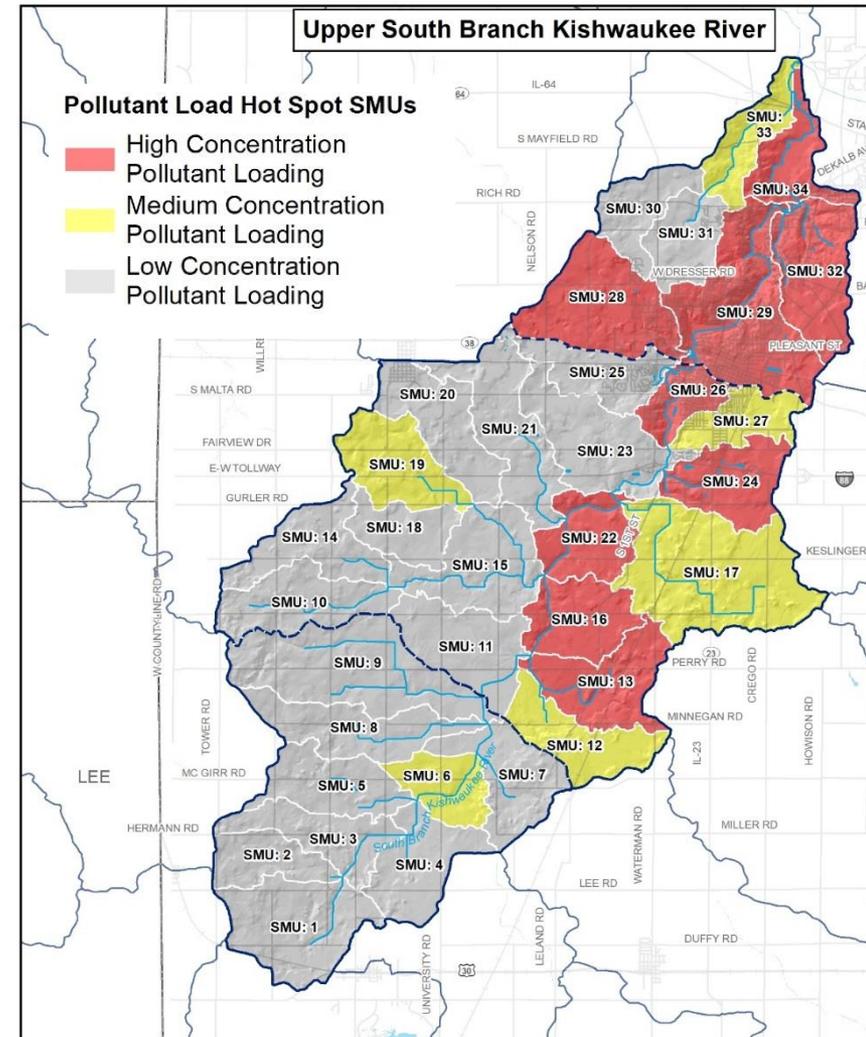
- 28% of nitrogen, 37% of phosphorus, and 53% of TSS comes from Cropland.
- Streambanks contribute 40% of sediment load.
- 12% and 13% of TN and TP and 7% of TSS come from urban land uses.

STEPL Source	N Load (lbs/yr)	% of Total Load	P Load (lbs/yr)	% of Total Load	Sediment (tons/yr)	% of Total Load
Urban	98,634	11.9%	15,964	12.7%	2,334	6.9%
Cropland	231,584	28.0%	47,159	37.4%	17,813	52.7%
Wetland	94	0.0%	38	0.0%	25	0.1%
Septic	7,660	0.9%	3,000	2.4%	0	0.0%
Streambanks	18,411	2.2%	7,088	5.6%	13,538	40.1%
*Wastewater	469,281	56.8%	52,692	41.8%	65	0.2%
<b>Total</b>	<b>825,666</b>	<b>100.0%</b>	<b>125,941</b>	<b>100.0%</b>	<b>33,775</b>	<b>100.0%</b>



# Nonpoint Source “Hot Spot” SMUs

- SMUs 13, 16, 22, and 34 are dominated by cropland.
- SMUs 24, 26, 28, 29, and 32, pollutant concentrations are generally driven by combination of urban and cropland areas.
- All “High Concentration” SMUs contain either a significant amount of stream length or streambanks with higher levels of erosion.



# Watershed Impairment Reduction Targets

Based on water quality data near outlet of the watershed and the results of the STEPL modeling, we need the following reductions from nonpoint source pollution:

- 75% reduction in phosphorus (54,790 lbs/yr)
- 53% reduction in nitrogen (187,459 lbs/yr)
- 9% reduction in sediment (3,000 tons/yr)

These are the reduction goals that we will be aiming for when recommending restoration projects throughout the watershed.



# Watershed Goal Topics

Goals are general actions, or better yet, an outcome towards which we strive

Surface Water  
Quality

Education,  
Stewardship, &  
Communication

Agriculture

Green Infrastructure  
Network & Habitat

Groundwater

Flooding



# Goal Workshop Agenda

## Watershed Goals & Prioritization

- Review Watershed Conditions (briefly)
- Places of the Heart/Flood problem area mapping
- Introduce Goal Topics
- Prioritize Watershed Goal Topics
- World Café Exercise
- Potential Causes & Sources of Impairment

Typically a full two hours.

Consider evening or weekend gathering.



# Schedule

*February* – Stakeholder/Goal-building workshop

*April* – Critical Areas, Action Plan, & tour of potential project sites

*June* – Information & Education Plan, Monitoring Plan, & Milestones



Questions?



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