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Numeric Nutrient Criteria (NNC) for Lakes

Implementation
and
Reasonable Potential Analysis

TMDL and Water Quality Modeling Unit

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Reasonable Potential Analysis for Point Source Facilities

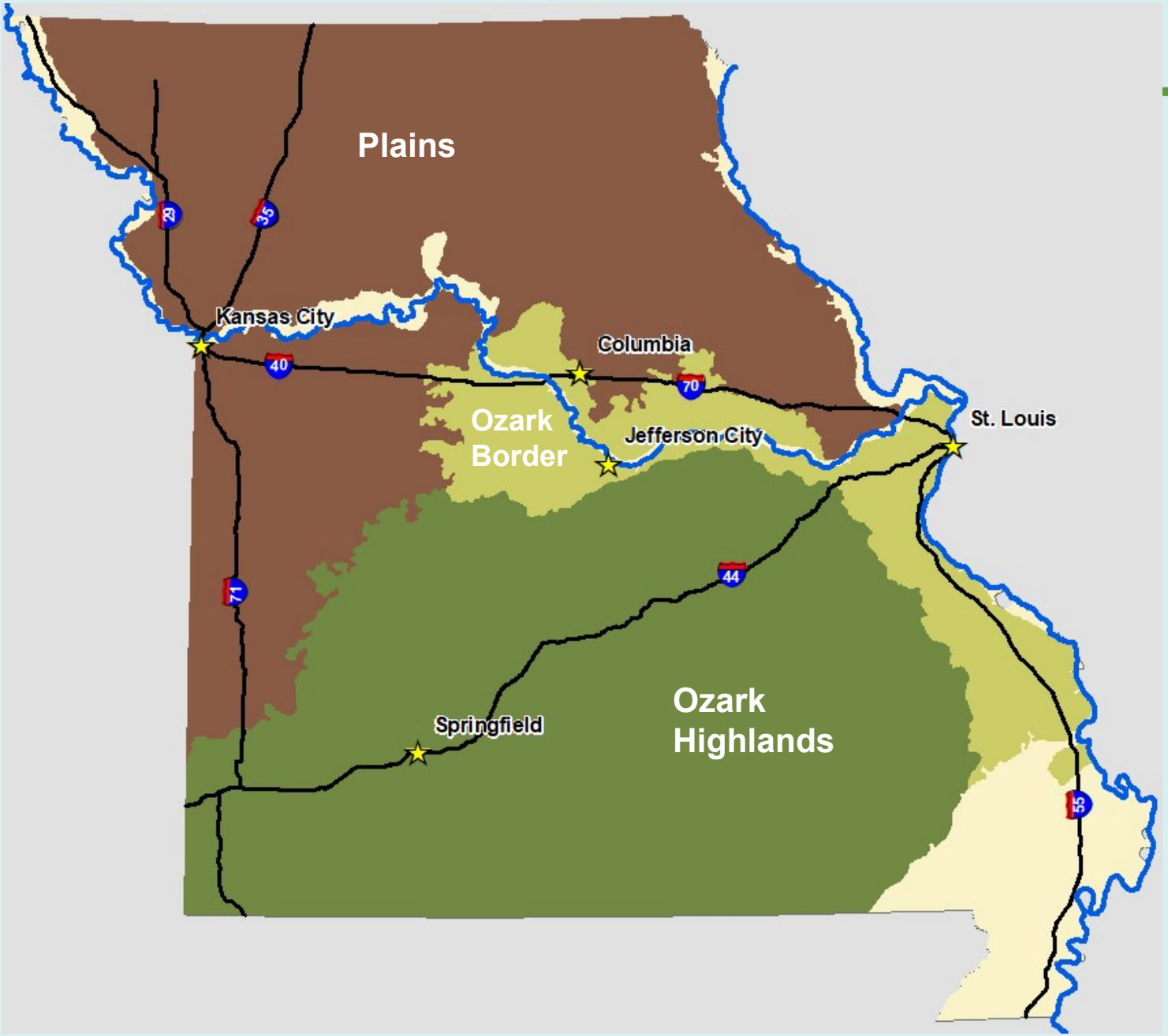
Effluent Regulations at 10 CSR 20-7.015(9)(D)7 require:

Statewide Monitoring for Nutrients.

Point sources that have the **design capacity of greater than one hundred thousand (100,000) gpd that typically discharge nitrogen and phosphorus** shall collect and analyze influent and effluent samples for total phosphorus, ammonia, total kjeldahl nitrogen and nitrate plus nitrite…

If the facility is determined to have reasonable potential to cause or contribute to violations lake nutrient criteria,

point source facilities should expect effluent *limits in future permits.*


Plains
Kansas City
Columbia
Ozark
Border
Jefferson City
St. Louis
Springfield
Ozark
Highlands
29
35
40
70
71
44
55

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Lake Nutrient Criteria

Lake Ecoregion	Chl-a (µg/L = ppb)
Plains	30
Ozark Border	22
Ozark Highland	15

Lake Ecoregion	Total Phosphorus (µg/L)	Total Nitrogen (µg/L)	Chl-a (µg/L)
Plains	49	843	18
Ozark Border	40	733	13
Ozark Highland	16	401	6

- Eutrophication-related mortality and morbidity for fish or other aquatic organisms
- Exceedances of dissolved oxygen or pH criteria
- Cyanobacteria counts >100,000 cells/mL (as algal toxins)
- Observed shifts in aquatic diversity attributed to eutrophication
- Excessive mineral turbidity (inorganic suspended solids) May-September

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N + P = Chl-a = Algae Blooms

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Reasonable Potential Analysis for Point Source Facilities Located in Lake Watersheds

The purpose of this presentation is to show the technical process for determining whether facilities have the potential to cause or contribute to the Chl-a impairment in the receiving lake.

- ❑ Follow the process = the methods = the steps
- ❑ Understand how the steps lead to results

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Reasonable Potential Analysis for Point Source Facilities Located in Lake Watersheds

Step 1: Does the facility discharge nutrients directly to surface waters?

Step 2: Do nutrients from facility effluent account for a substantial portion of nutrient loading in the lake watershed?

Step 3: BATHTUB Model

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Reasonable Potential Analysis Process

Step 1: Does the facility discharge nutrients directly to surface waters?

Eliminates facilities that:

- Only land apply biosolids
- Use effluent for irrigation
- Have reported no discharge May-September for 3-5 years
- Industrial facilities with trace concentrations in effluent

Facilities that do not discharge nutrients to surface waters do not have reasonable potential to cause or contribute to the Chl-a impairment in the lake.

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Reasonable Potential Analysis Process

Step 2: Do nutrients from facility effluent account for a substantial portion of nutrient loading in the lake watershed?

- Estimate nonpoint source loading using a watershed model (e.g., STEPL or SWAT+)
- Using an Excel spreadsheet, compare the maximum potential nutrient contribution from each point source facility with the estimated nonpoint nutrient load for the watershed
- Facilities that account for <1% of nutrient contribution to the *designated downstream point* and that cumulatively account for <1% of nutrient contribution within the entire lake watershed are eliminated from further analysis

Facilities that individually or collectively account for less than 1% of nutrient loading in the watershed do not have reasonable potential to cause or contribute to the Chl-a impairment in the lake.

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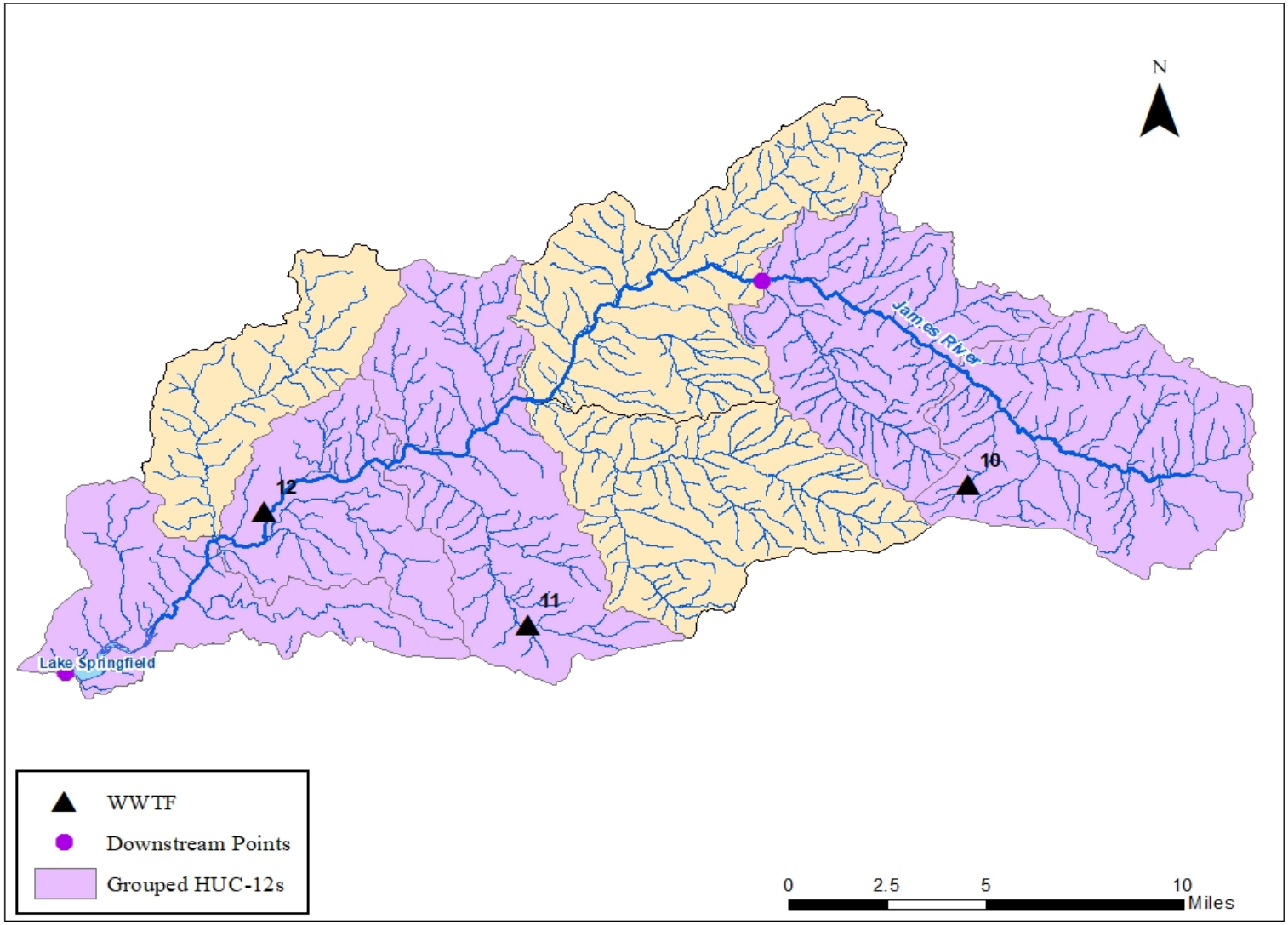

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Reasonable Potential Analysis Process

Step 2 – Excel Spreadsheet

- Nonpoint TN and TP loads in pounds per year are entered based on watershed model (STEPL or SWAT+) estimates
- Point source facility characteristics are entered at maximum potential
  - Facility Design Flow
  - Maximum or mean of maximum TP entered for facilities that have consistently monitored TP, otherwise 30% of TSS permit limit is used for TP effluent estimate
  - Permit Effluent Limits for Ammonia, or maximum recorded TN for facilities that have at least 3 years of monitored TN
  - Estimated facility TN is equal to Ammonia + Nitrate/Nitrite using a default concentration of 20 mg/L Nitrate/Nitrite

Springfield_FacilityLoadsfromHUC12sheet - Excel

	HU_12_NAME	STEPL Lbs/year TN	STEPL Lbs/year TP	Facility TN Lbs/year	Facility TP Lbs/year	Facility %TN	Facility %TP	Facility
2	Headwaters James River	180,407	23343.126	10027	207	3.618%	0.555%	Diggins WWTF
3	Dry Creek-James River	96,744	14011.336					None
4	**W1, W2 Sum**	**277,151**	**37,354**					
5					**W1-W2 Total**	**1.719%**	**0.260%**	
6								
7								
8								
9	Sawyer Creek-James River	128,521	17,339	7020	155	2.29%	0.37%	Rogersville WWTF
10	Turner Creek-James River	92,304	12,345	644	14	0.21%	0.03%	James Valley Sub
11	Lake Springfield-James River	85,378	12,627					None
12	**W3, W4, W5 Sum**	**306,203**	**42,311**	**7664**	**169**			
13					**W1-W5 Total**	**2.5%**	**0.4%**	
14								Total
15								
16								
17			**Facilities**	**17691**	**376**	**3.033%**	**0.47%**	
18								
19	**W1-W5 total**	**583,353**	**79,665**					
20								
21								

	Facility	Design Flow GPD	Design Flow cfs	Percent Flow	Apr-Sept NH4 mg/L	Oct-Mar NH4 mg/L	Apr-Sept NH4 Lbs/day	Oct-Mar NH4 Lbs/day	NO3 mg/L	NO3 Lbs/day	TN mg/L	TN Lbs/day	TSS mg/L	TP mg/L	TP Lbs/day
2	**Diggins WWTF**	**136,000**	0.21	100.00%	1.4	2.8	1.59	3.18	20	22.70		27.47		0.5	0.57
3	None														
4															
5															
6															
7															
8															
9	**Rogersville WWTF**	960000	1.49	99.1%	1.2	2.4	9.62	19.23	20	160.27	**2.40**	19.23		0.053	0.42
10	James Valley Sub	9000	0.01	0.9%	1.2	2.3	0.09	0.17	20	1.50		1.77		0.5	0.04
11	None														
12															
13															
14	Total	969000													
15															

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Table 4. Discharging Municipal and Domestic Wastewater Treatment Facilities in the Watershed

Map ID	Permit	Facility	Design Flow (GPD)	% TN to Downstream Point	% TP to Downstream Point	Distance to Lake (miles)	Expiration
10	MO-0129828	Diggins WWTF	(45,000) 136,000 Actual*	1.72	0.26	33.6	3/31/2021
11	MO-0102679	Rogersville WWTF	960,000	2.29**	0.37*	16.2	6/30/2021
12	MO-0100315	James Valley Farms Subdivision WWTF	9,000	0.21	0.03	5.8	9/30/2020
Total Domestic Wastewater Loading to the Lake Springfield Watershed				<3.03%	<0.47%		

***Analysis was based on actual flow using conservative TN and TP concentrations (no percent loss).**

****Percentage after percent loss per distance analysis.**

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Site Description	TN (mg/L)	TP (mg/L)	TN % Loss	TP % Loss
2013 Wasteload Allocation				
Wentzville WWRC	13.5	3.35	NA	NA
McCoy Creek 0.47 miles Downstream	8.71	1.95	56.45%	67.50%
Mccoy Creek 1.40 miles Downstream	7.21	1.74	17.22%	10.77%
McCoy Creek 2.70 miles Downstream	6.61	1.47	8.32%	15.52%

Site Description	Distance Miles	TN (mg/L)	TP (mg/L)	TN % Loss	TP % Loss
Wright City South		20	6	NA	NA
0.47 miles Downstream		8.71	1.95	56.45%	67.50%
1.40 miles Downstream		7.2101	1.74	17.22%	10.77%
2.70 miles Downstream		6.6103	1.4699	8.32%	15.52%
Plus 1.3 miles	4	6.0603	1.3116	8.32%	10.77%
Plus 1.3 miles	5.3	5.5561	1.1704	8.32%	10.77%
Plus 1.3 miles	6.6	5.0938	1.0443	8.32%	10.77%
Plus 1.3 miles	7.9	4.8819	0.9881	4.16%	5.38%
Plus 1.3 miles	9.2	4.6788	0.935	4.16%	5.38%
Plus 1.3 miles	10.5	4.4842	0.8847	4.16%	5.38%
Plus 1.3 miles	11.8	4.3909	0.8663	2.08%	2.69%
Plus 1.3 miles	13.1	4.2996	0.8482	2.08%	2.69%
Plus 1.3 miles	14.4	4.2101	0.8306	2.08%	2.69%
Estimated Final Concentration	**15.7**	**4.123**	**0.813**		

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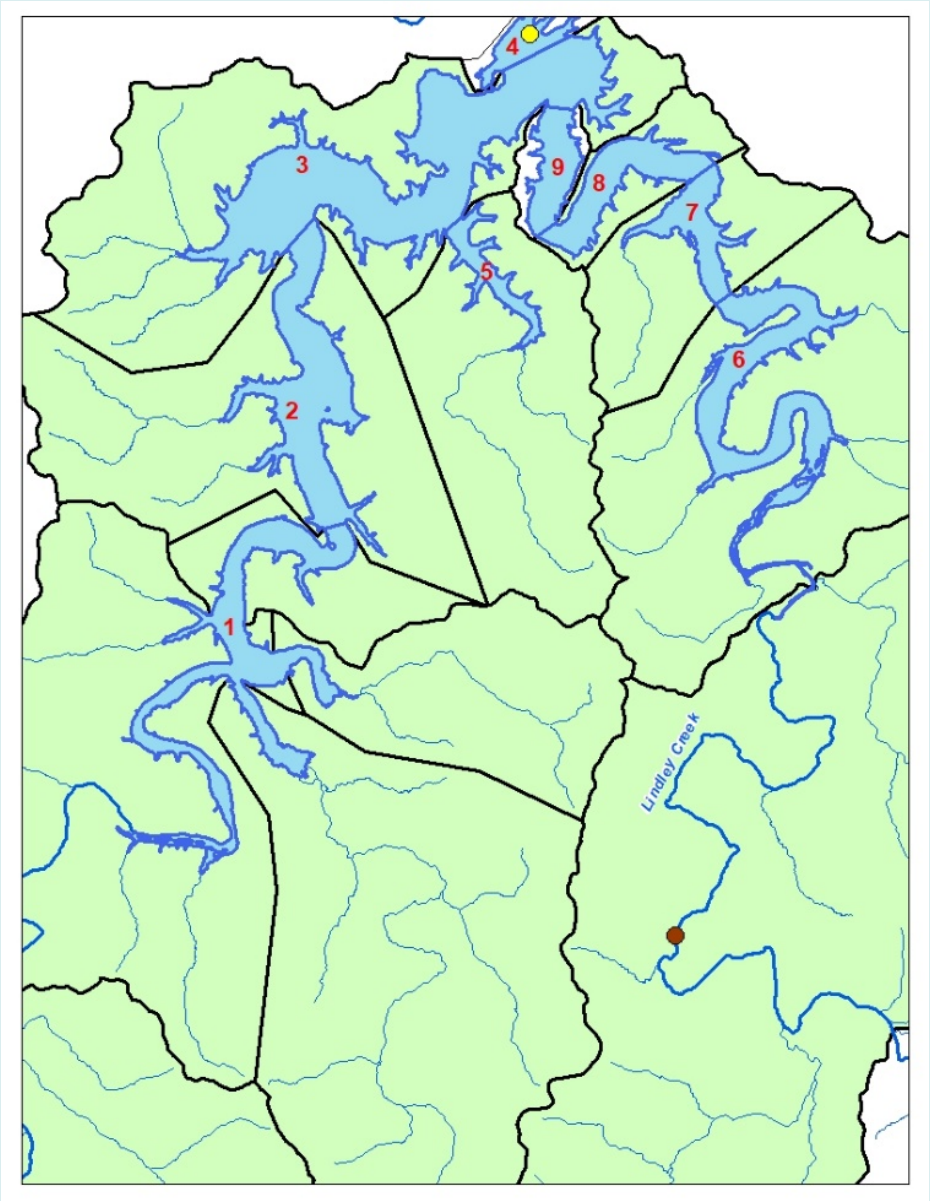
Step 3 – BATHTUB Model

Eight Lake Segments based on depth and flow direction

- Upper Lake
- Middle Lake
- Lower Lake
- Decker Branch
- Upper Lindley
- Shallow Lindley
- Out Lindley

Nineteen Tributaries

- 12 Nonpoint Source subwatersheds
- Pomme de Terre River and Lindley Creek Monitored Inflows
- Five Point Source Inflows



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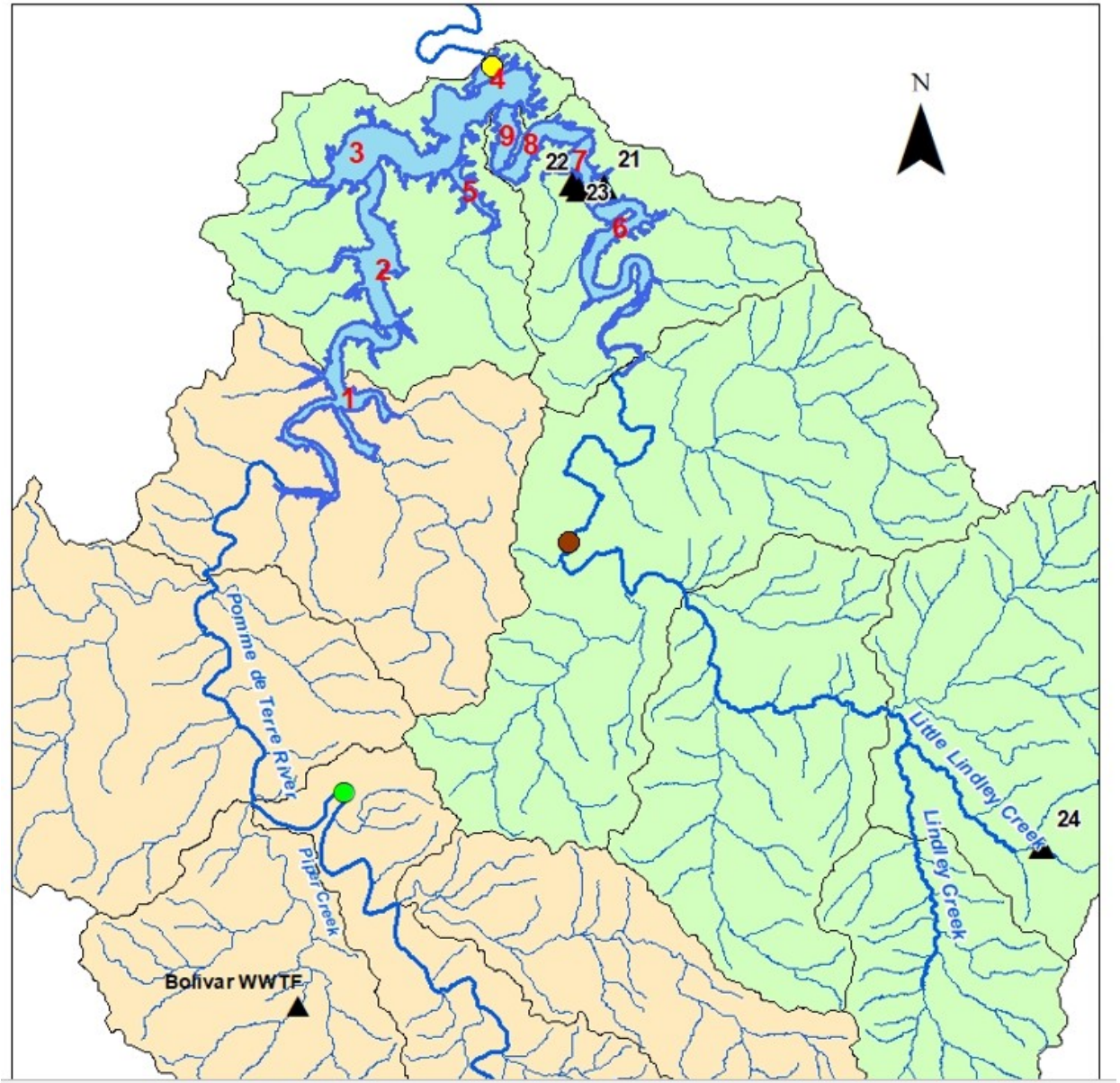

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Pomme de Terre Lake BATHTUB Model Outputs

Metric	2018 Lake Data	Calibrated Model (all NPS, Streams, and WWTFs)	Nemo Bridge Resort Removed	USCOE Nemo Park WWTF Removed	Fugate Mobile Home Park Removed	Bolivar WWTF Removed
TP (ppb)	17	17	17	17	17	16
TN (ppb)	543	543	543	542	541	519
Chl-a (ppb)	15	15	15	15	15	15
Secchi (m)	1.1	1.1	1.1	1.1	1.1	1.1

Bolivar WWTF = No Reasonable Potential

Lake St. Louis BATHTUB Model Outputs

Metric	2018 Mean Lake Data at Dam	Calibrated Model	Wright City inputs removed	Wright City Scenario 1 TN=20 mg/L TP=5 mg/L	Wright City Scenario 2 TN=15 mg/L TP=3 mg/L	Wright City Scenario 3 TN=10 mg/L TP=3 mg/L
TP (ppb)	70	70	68	70	69	69
TN (ppb)	730	730	696	730	719	709
Chl-a (ppb)	31	31	29	30	30	29
Secchi (m)	0.3	0.3	0.4	0.3	0.3	0.3

Wright City WWTF = Yes, Reasonable Potential

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Site Description	Distance Miles	TN (mg/L)	TP (mg/L)	TN % Loss	TP % Loss
Wright City South		10	3	NA	NA
0.47 miles Downstream		4.355	0.975	56.45%	67.50%
1.40 miles Downstream		3.6051	0.87	17.22%	10.77%
2.70 miles Downstream		3.3051	0.735	8.32%	15.52%
Plus 1.3 miles	4	3.0301	0.6558	8.32%	10.77%
Plus 1.3 miles	5.3	2.778	0.5852	8.32%	10.77%
Plus 1.3 miles	6.6	2.5469	0.5222	8.32%	10.77%
Plus 1.3 miles	7.9	2.4409	0.4941	4.16%	5.38%
Plus 1.3 miles	9.2	2.3394	0.4675	4.16%	5.38%
Plus 1.3 miles	10.5	2.2421	0.4423	4.16%	5.38%
Plus 1.3 miles	11.8	2.1955	0.4331	2.08%	2.69%
Plus 1.3 miles	13.1	2.1498	0.4241	2.08%	2.69%
Plus 1.3 miles	14.4	2.1051	0.4153	2.08%	2.69%
Estimated Final Concentrations at Lake	**15.7**	**2.061**	**0.407**		

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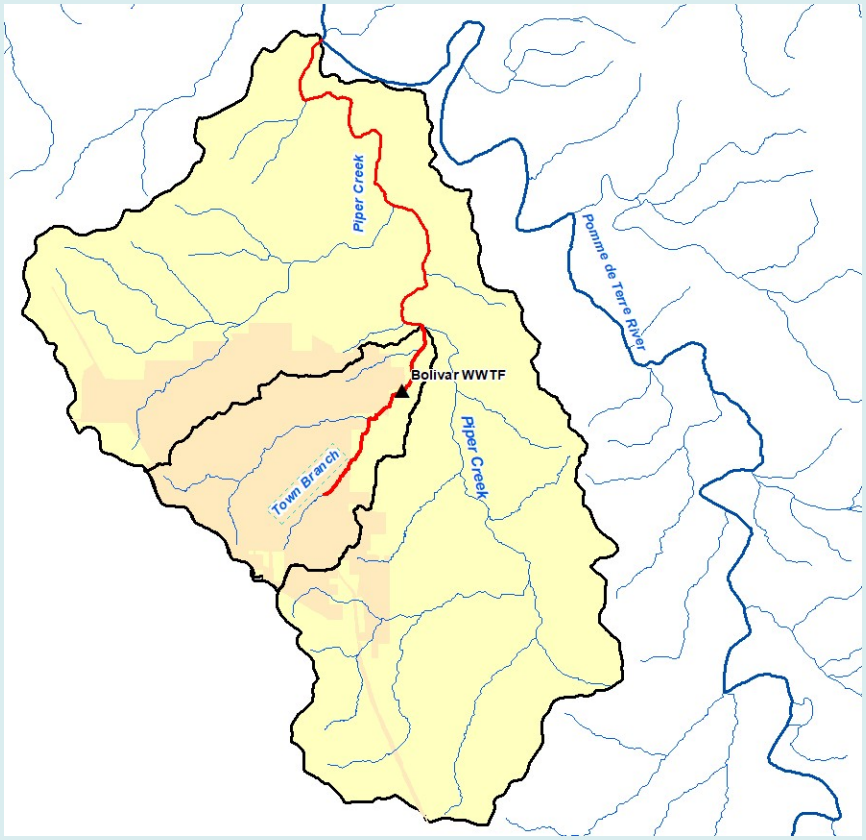

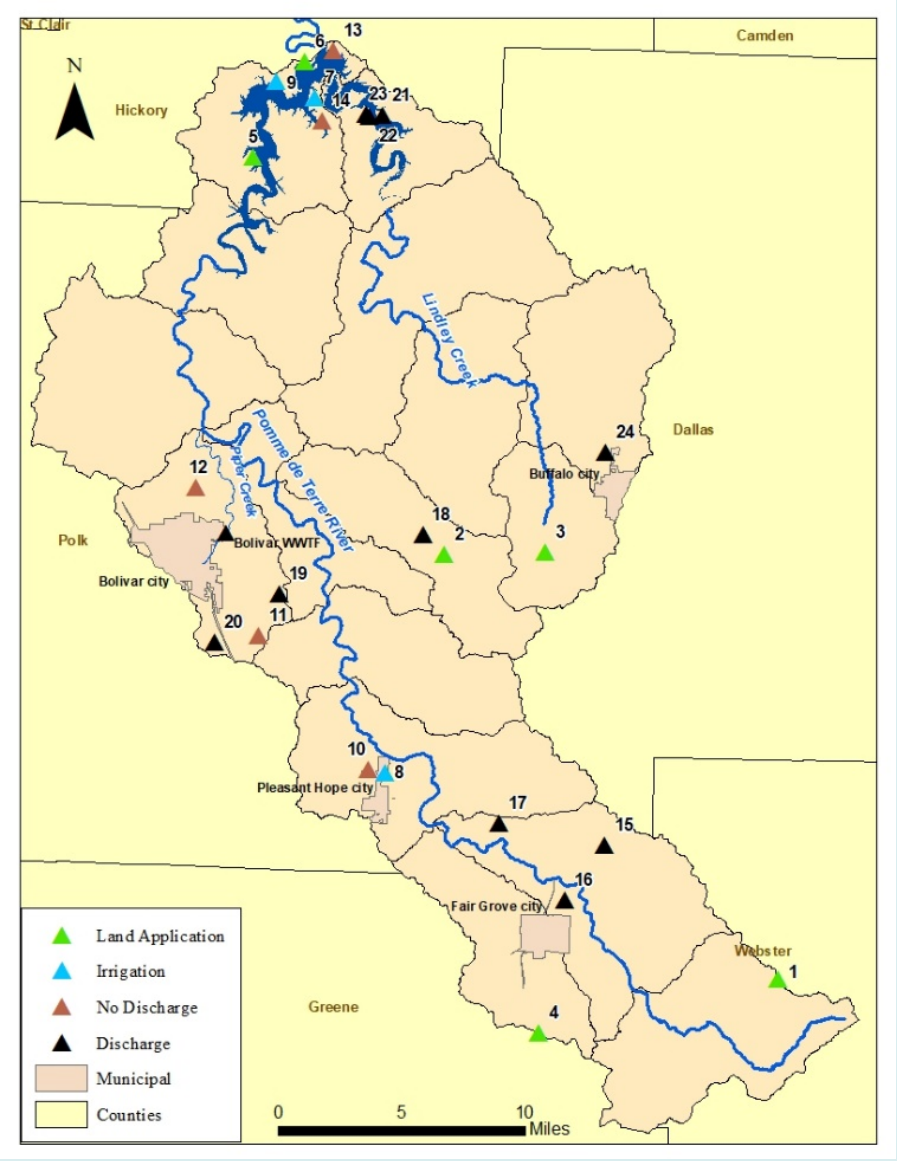

Facilities that are determined not to have reasonable potential to cause or contribute to lake impairments may still have permit effluent limits for nutrients due to downstream impairments.

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Questions?

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