



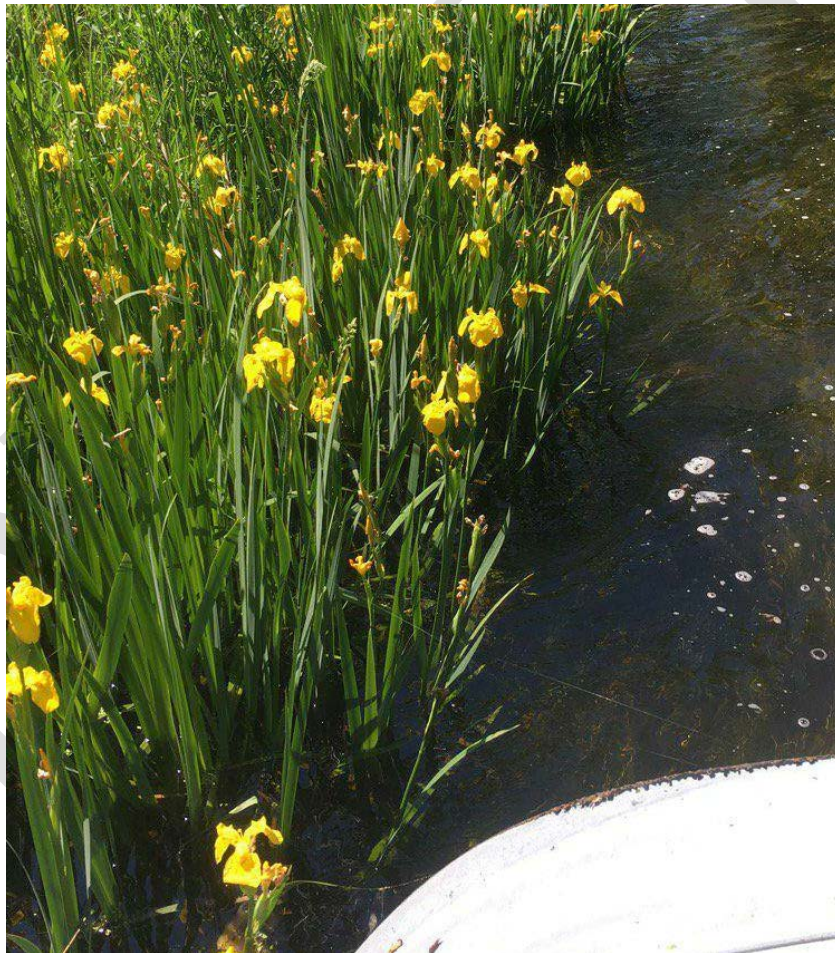
*Aquatic Enhancement  
& Survey, Inc.*

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**Draft 2020 Water Quality Sampling Report  
Steuben County Lakes Council  
Steuben County, Indiana**

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December 3, 2020



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## **Acknowledgements**

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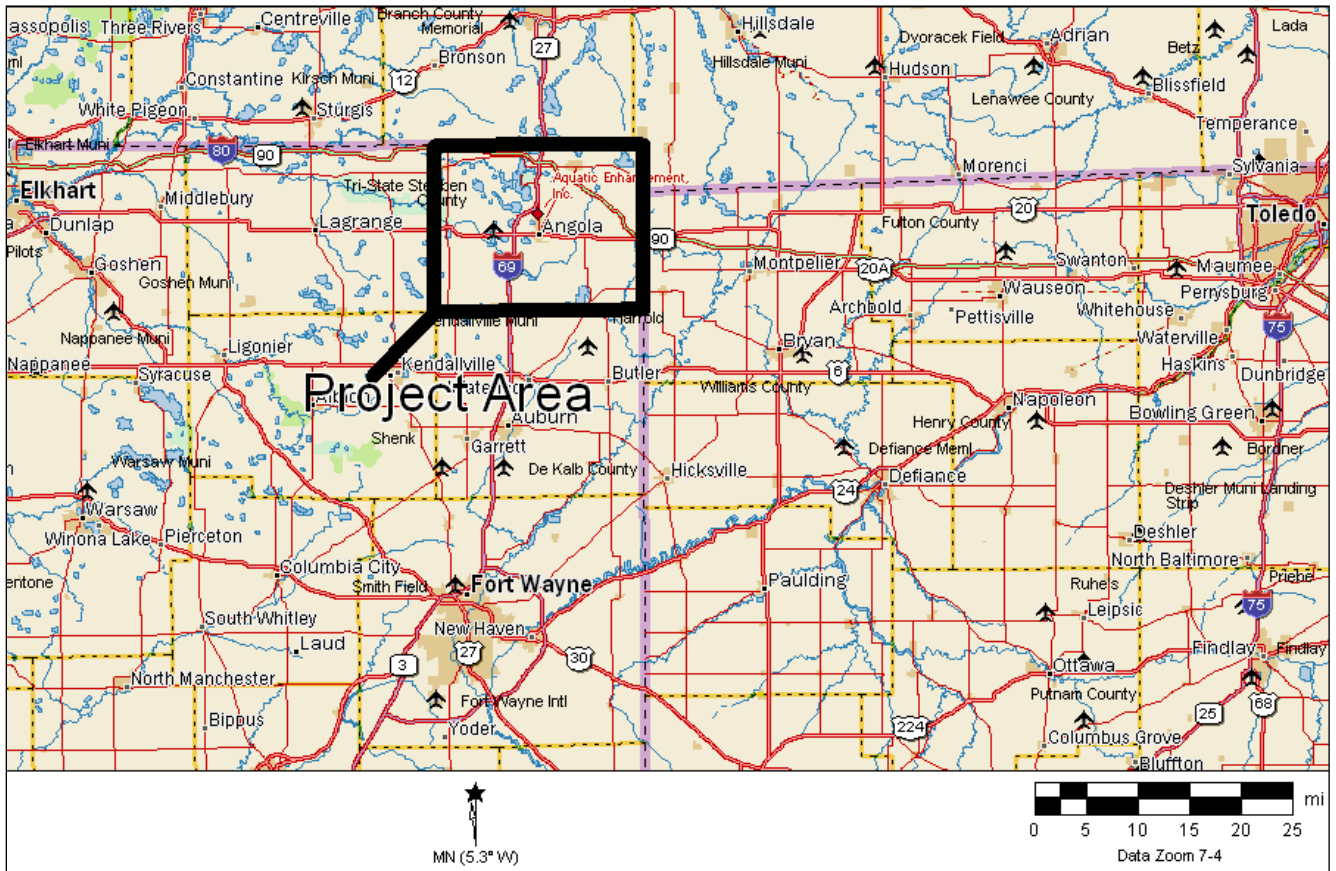
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**Figure 1 Project location map**

## 1. Project Overview and Purpose:

This project was completed by Aquatic Enhancement & Survey, Inc. under contract with the Steuben County Lakes Council (SCLC) and Angola/Trine MS4. Also partnered with the SCLC in support of this work was the Steuben County Surveyor's Office, and the Clear Lake Township Land Conservancy. Basic water quality data and stream flow (discharge) measurements were collected from a total of 61 sites on several streams and lakes in Steuben County, Indiana, LaGrange County, Indiana, and Branch County, Michigan. An additional site (site 74) was targeted for sampling, but no sampling occurred due to a lack of flow during the sampling periods. The sampling reported in this work was completed in May, July, and August of 2020. Figure 2 (page 6) displays sampling locations and associated surface water features. For most sites, measured parameters included total phosphorus, total suspended solids, pH, dissolved oxygen, temperature, specific conductance, and E-coli. A basic measurement of stream flow-rate (discharge) at each sampling site was taken when conditions permitted.

Total phosphorus and total suspended solids loading figures were calculated for certain sites at which these measurements were detectable and at which a flow measurement was taken. The purpose of the sampling was to gain a basic understanding of the fate and source of contaminants in these systems with a goal of directing future sampling or directing remediation of watershed point and non-point pollution sources. Table 1 provides a site key showing brief written descriptions of each numbered sampling site. Collected data and calculated loading rates are provided in tables 1-6.

## **2. Methods:**

All samples collected were grab samples. All samples were placed on ice immediately after collection. Measurements for temperature, dissolved oxygen, and specific conductance were taken in the field using a meter. Measurements of pH were taken in the field using a meter or measured in the laboratory. Meters were calibrated at the beginning of each sampling day. Where possible, stream flows were calculated using measurements of the stream cross-sectional area and stream velocity. Stream flow cross-sectional area was calculated by measuring stream width using a tape measure and calculating average stream depth by measuring depth at multiple equidistant points using a measuring staff or tape measure. Quality Assurance Procedures and EPA method codes for laboratory analysis are available upon request.

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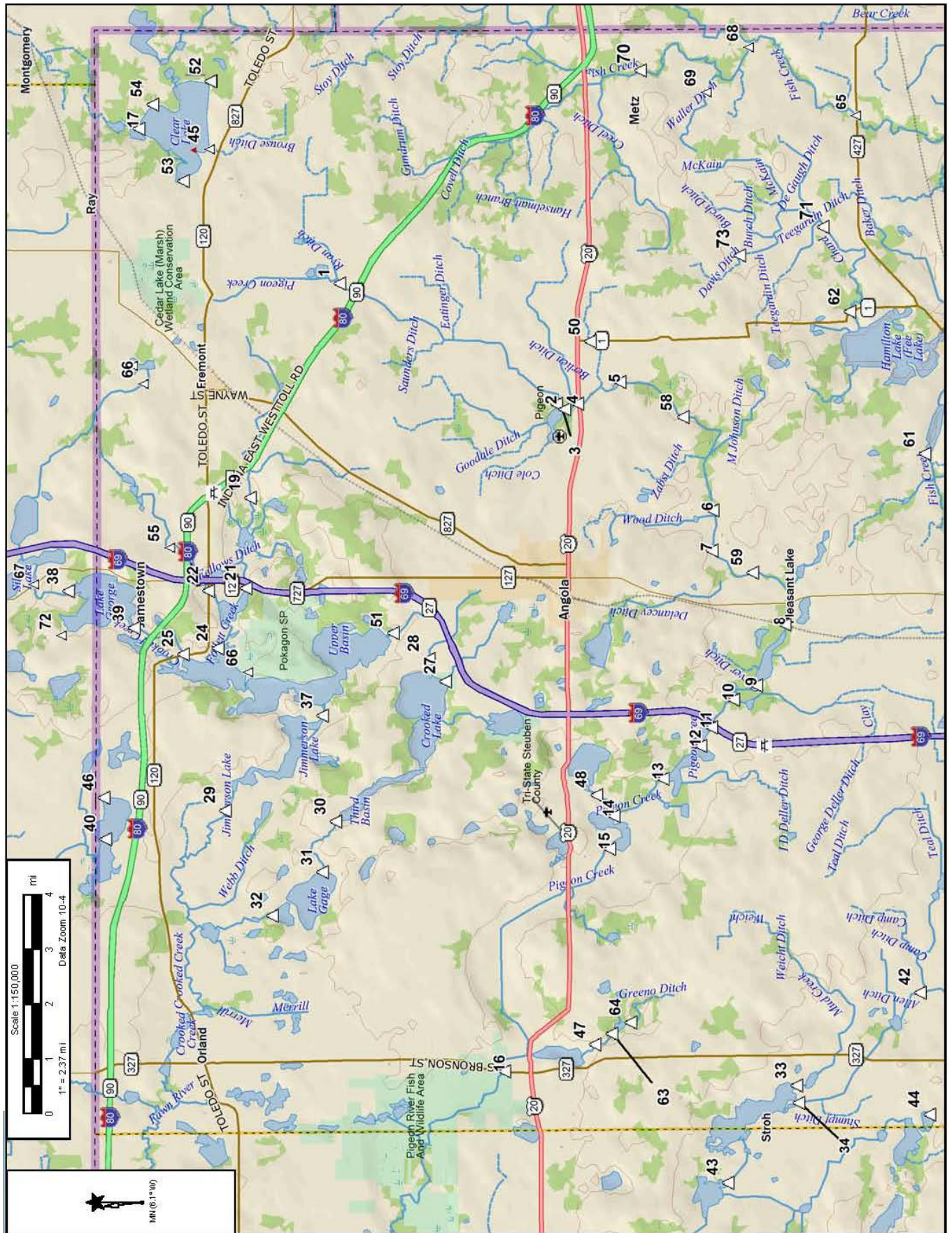


Figure 2 Sampling site map

Samp. Site	SCLC funded	At or near HUC 12 Outlet (10)	At or near HUC14 Outlet Site (13)	Steuben Surveyor Funding (6)	MS4 Funding (4 sites)	Clear Lake funding (2)	Ham. Funding (2)	George Funding (2)	Snow Funding (1)	Location Description
1.	yes		yes							Pigeon, East Ray Clark Road at culvert, below juncture with the Ryan Ditch.
2.	yes									Pigeon Creek, Pigeon Lake Inlet.
3.*	yes									Pigeon Creek, Pigeon Lake Outlet. *2 samples
4.	yes	yes	yes							Pigeon, U.S. 20 Bridge, Below juncture with Berlien Ditch.
5.	yes									Pigeon Creek, Metz Road.
6.		yes	yes		yes					Pigeon Creek, Bill Deller Road.
7.					yes					Pigeon Creek, Meridian Road.
8.	yes									Pigeon Creek, Long Lake Inlet.
9.*	yes									Pigeon Creek, Long Lake Outlet. *2 samples
10.	yes	yes	yes							Pigeon Creek, Mud Lake Outlet just west of Long Lake, Johnson Ditch from Ashley.
11.*	yes									Pigeon Creek, Big Bower Lake Inlet. *2 samples
12.	yes									Pigeon Creek, Big Bower Lake Outlet/Golden Lake Inlet.
13.*	yes									Pigeon Creek, Golden Lake Outlet. *2 samples
14.	yes									Pigeon Creek, Hogback Lake Inlet.
15.	yes	yes	yes							Pigeon Creek, Hogback Lake Outlet.
16.	yes	yes*	yes*							Pigeon Creek at 327.
17.	yes		yes							Clear Lake Outlet.
19.	yes									Crane Marsh Outlet, (tributary to Marsh Lake).
21.	yes									Follet Creek, Little Otter Lake Inlet.
22.	yes									Walter's Lakes Drain (tributary to Big Otter Lake).
24.	yes									Follet Creek, Snow Lake Inlet.
25.	yes									Crooked Creek at 120 (Tributary to Snow Lake).
27.	yes									Carpenter Ditch (Tributary to Crooked Lake).
28.	yes									Palfreyman Ditch (Tributary to Crooked Lake).
29.*	yes	yes*	yes*							Crooked Ck (Jimm. Outlet Nevada Mills). *2 samples
30.	yes									Concorde Creek (Outlet from Crooked Lake).
31.	yes									Concorde Creek (Inlet to Lake Gage).
32.	yes	yes*	yes*							Concorde Creek (Outlet from Lime Lake).
33.	yes									Dewitt Ditch (Tributary to Big Turkey Lake).
34.	yes									Turkey Creek (Tributary to Big Turkey Lake).
37.	yes									Crooked Creek (James Outlet, Jimmerson Inlet at 4 corners).
38.	yes									Lake George NE tributary (from Silver Lake).
39.	yes		yes							Crooked Creek (Lake George Outlet).
40.	yes									Lake Pleasant.
42.	yes	yes	yes							Turkey Ck at 700S east of 800W, below Little Turkey and Deetz Ditch juncture.
43.	yes	yes*	yes*							Big Turkey Outlet at 350S on curve north of Stroh or west of Turkey Lake Tavern.
44.	yes									Trib. To McClish Lake (east end).
45.	yes									Trib. To Clear Lake (Cyrus Brouse Ditch).
46.	yes									Trib. To Lake Pleasant (East End).
47.	yes									Trib. To West Otter (Between Arrowhead and Otter).
48.	yes									Trib. Between Silver and Hogback.
50.	yes									William Jack Ditch (at State Rd. 1).
51.	yes									Croxton Ditch (at West 275 North).
52.				yes						Clear Lake Trib. (Harry Teeters Ditch).
53.						yes				Clear Lake Trib. (Peter Smith Ditch).
54.						yes				Clear Lake Trib. (Alvin Patterson Ditch).
58.					yes					Pigeon Creek at Hanselman.
59.					yes					Pigeon Creek at 400 South.
61.				yes						Tributary to Ball Lake.
62.				yes						Black Creek, Tributary to Hamilton Lake.
63.	yes									Tributary just downstream of Arrowhead Lake.
64.				yes						Tributary to Arrowhead Lake at south end of Arrowhead Lake
65.	yes									Fish Creek at 427
66.								yes		Pokagon Effluent Outlet
67.								yes		Silver Lake Outlet at S. Angola Rd.
68.										Fish Creek at E 400 S
69.										Fish Creek at S 850 E (5/19/17 upstream of S 850 E)
70.										Fish Creek at E Metz Rd.
71.							yes			Black Creek at S 600 E
72.								yes		Trib. to Lake George at 150 W, N. of launch
73.							yes			Davis Ditch, Trib. To Black Creek at S 550 E
74.	yes									Trib. to Little Long Lake at Mead Rd.

**Table 1 Descriptions of numbered sampling sites**

Site	Date	E-coli	CFM Discharge	Total Phos. (ppm)	Total Phos. Loading (kg/day)	TSS (ppm)	TSS Loading (kg/day)	D.O.	pH	Temp (F)	Specific Conductance	Post rain event *
		(CFU or colonies/100 ml)										
1	5/27/20	307.6	nd	0.140	nd	42.0	nd	7.6	7.57	64.9	544	
2	5/27/20	686.7	1515.57	0.124	7.66	47.0	2904.89	8.3	7.77	64.9	569	
3	5/27/20	59.8	3038.81	0.074	9.17	8.1	1003.79	9.2	7.90	69.4	524	
4	5/27/20	30.9	1725.30	0.085	5.98	21.0	1477.54	8.5	7.88	71.7	532	
5	5/27/20	63.7	3046.88	0.081	10.06	11.3	1404.07	8.2	7.82	70.8	503	
6	5/27/20	80.9	3657.72	0.123	18.35	30.0	4474.94	7.2	7.82	71.0	533	
7	5/27/20	104.6	2827.38	0.148	17.06	44.0	5073.32	7.3	7.78	70.6	632	
8	5/27/20	152.9	nd	0.140	nd	32.0	nd	7.6	7.83	70.8	621	
9	5/27/20	16.0	nd	0.058	nd	2.2	nd	8.2	7.99	75.0	566	
10	5/27/20	45.5	nd	0.082	nd	7.6	nd	7.3	7.79	74.4	605	
11	5/27/20	48.0	nd	0.083	nd	10.6	nd	6.5	7.81	73.8	586	
12	5/27/20	40.8	nd	0.077	nd	4.6	nd	6.8	7.88	73.8	578	
13	5/27/20	8.5	nd	0.082	nd	3.5	nd	8.2	8.15	70.7	551	
14	5/28/20	21.6	nd	0.076	nd	4.2	nd	4.5	7.73	69.8	526	
15	5/28/20	8.5	13912.71	0.073	41.42	3.0	1702.11	6.7	7.89	72.7	521	
16	5/28/20	50.4	nd	0.071	nd	7.7	nd	6.5	7.81	69.4	531	
17	5/26/20	2.0	673.66	0.018	0.49	1.0	27.47	9.2	8.30	69.8	335	
19	5/29/20	137.6	761.38	0.057	1.77	8.6	267.03	7.0	8.02	64.2	691	*
21	5/29/20	35.5	1566.64	0.030	1.92	1.5	95.83	5.2	7.92	69.9	576	*
22	5/28/20	517.2	363.93	0.097	1.44	2.4	35.62	5.2	7.69	72.0	601	
24	5/28/20	26.5	nd	0.029	nd	1.0	nd	7.2	8.08	75.1	565	
25	5/29/20	62.4	2442.43	0.026	2.59	1.8	179.29	6.5	8.00	70.3	406	*
27	5/29/20	123.6	247.22	0.107	1.08	15.2	153.24	7.2	7.96	65.9	467	*
28	5/29/20	1553.1	135.51	0.095	0.52	11.1	61.34	7.0	7.98	69.8	616	*
29	5/29/20	39.3	nd	0.023	nd	11.6	nd	7.1	8.03	71.5	478	*
30	5/29/20	52.1	771.84	0.045	1.42	13.0	409.19	6.1	7.76	72.1	369	*

**Table 2 May data for sites 1 through 30. The notation “nd” denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8). An asterisk (\*) in the post rain event column indicated sample collection occurred within 48 hours of .5 inches of rainfall or more.**



Site	Date	E-coli	CFM Discharge	Total Phos. (ppm)	Total Phos. Loading (kg/day)	TSS (ppm)	TSS Loading (kg/day)	D.O.	pH	Temp (F)	Specific Conductance	Post rain event *
		(CFU or colonies/100 ml)										
31	5/29/20	127.4	1336.15	0.039	2.13	4.1	223.41	6.8	7.91	70.3	366	*
32	5/29/20	70.8	1187.76	0.012	0.58	1.7	82.34	7.3	8.16	70.5	352	*
33	5/29/20	63.1	nd	0.043	nd	2.5	nd	6.8	7.83	67.0	536	*
34	5/29/20	129.1	nd	0.092	nd	6.1	nd	5.7	7.82	67.4	498	*
37	5/29/20	34.1	nd	0.017	nd	6.1	nd	8.5	8.34	69.5	482	*
38	5/28/20	275.5	1465.67	0.025	1.49	1.0	59.77	4.8	7.64	73.6	378	
39	5/28/20	13.5	1611.46	0.027	1.77	1.7	111.72	7.8	8.29	72.1	288	
40	5/28/20	73.8	nd	0.016	nd	1.2	nd	7.7	8.23	73.6	364	
42	5/29/20	224.7	1475.80	0.106	6.38	7.9	475.46	6.0	7.71	66.2	453	*
43	5/29/20	35.9	5372.25	0.036	7.89	5.2	1139.24	7.0	8.14	71.4	460	*
44	5/29/20	90.6	88.37	0.048	0.17	4.0	14.42	6.8	7.41	55.2	648	*
45	5/26/20	157.8	65.39	0.070	0.19	10.1	26.93	8.5	7.79	60.5	268	
46	5/28/20	1986.3	92.55	0.055	0.21	4.9	18.49	5.8	7.41	59.5	526	
47	5/28/20	87.8	369.21	0.067	1.01	2.6	39.15	5.7	7.85	71.7	435	
48	5/28/20	42.0	901.26	0.023	0.85	2.1	77.18	6.2	8.00	75.2	383	
50	5/26/20	143.4	64.86	0.093	0.25	9.4	24.86	10.1	7.65	64.2	453	
51	5/29/20	201.4	178.99	0.025	0.18	2.9	21.17	8.2	7.87	62.2	587	*
52	5/26/20	351.5	134.51	0.235	1.29	8.7	47.72	6.6	7.74	68.2	557	
53	5/26/20	6.3	19.42	0.082	0.06	2.2	1.74	7.2	7.23	62.0	436	
54	5/26/20	1046.2	nd	0.113	nd	1.4	nd	3.9	7.34	64.7	377	
58	5/26/20	72.3	2810.97	0.104	11.92	19.0	2178.04	8.9	7.84	72.2	465	
59	5/26/20	90.8	6150.37	0.152	38.12	37.0	9280.23	7.6	7.76	71.7	532	
61	5/26/20	232.4	588.21	0.180	4.32	9.2	220.69	8.3	7.92	70.2	483	
62	5/26/20	821.2	395.69	0.136	2.19	11.8	190.41	8.7	8.03	67.6	330	
63	5/28/20	290.9	nd	0.056	nd	1.8	nd	6.0	7.81	72.1	473	
64	5/28/20	472.1	344.23	0.098	1.38	9.1	127.75	6.9	7.81	64.0	531	
65	5/26/20	222.4	3031.26	0.148	18.30	5.8	716.98	8.0	7.92	68.2	497	
66	5/29/20	160.7	nd	0.133	nd	4.0	nd	6.9	7.55	60.0	366	*
67	5/28/20	66.3	1140.96	0.023	1.07	2.4	111.67	6.9	8.06	74.5	288	
68	5/26/20	209.8	nd	0.122	nd	8.9	nd	8.0	7.82	68.7	507	
69	5/26/20	163.2	2780.56	0.145	16.44	7.6	861.79	7.7	7.89	69.1	499	
70	5/26/20	315.2	nd	0.098	nd	10.6	nd	8.6	7.71	66.5	353	
71	5/26/20	2827.2	314.14	0.158	2.02	21.0	269.03	8.7	7.88	72.3	443	
72	5/28/20	1119.9	9.93	0.056	0.02	2.1	0.85	5.9	7.27	63.5	436	
73	5/26/20	232.4	55.51	0.129	0.29	13.1	29.66	8.2	7.69	72.8	336	

**Table 3 May data for sites 31 through 73. The notation “nd” denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8). An asterisk (\*) in the post rain event column indicated sample collection occurred within 48 hours of .5 inches of rainfall or more.**

Site	Date	E-coli	CFM Discharge	Total Phos.	Total Phos. Loading	TSS	TSS Loading	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *
		(CFU or colonies/100 ml)		(ppm)	(kg/day)	(ppm)	(kg/day)					
1	7/23/20	2419.6	261.51	0.071	0.76	28.0	298.61	7.3	7.76	64.9	766	
2	7/23/20	579.4	268.12	0.034	0.37	7.4	80.91	8.4	7.98	68.4	767	
4	7/23/20	228.2	551.84	0.085	1.91	9.5	213.79	6.0	7.94	78.4	606	
5	7/23/20	88.4	483.82	0.077	1.52	4.7	92.73	5.0	7.83	77.7	637	
6	7/23/20	290.9	634.41	0.073	1.89	3.6	93.14	6.9	7.97	75.3	634	
7	7/23/20	218.7	1287.24	0.096	5.04	8.2	430.46	6.0	7.87	74.6	878	
8	7/23/20	129.1	1136.82	0.070	3.25	2.3	106.63	8.1	7.99	75.0	816	
10	7/23/20	37.9	1815.44	0.060	4.44	5.4	399.79	6.8	8.03	81.5	704	
12	7/23/20	20.3	2604.86	0.070	7.44	6.4	679.86	9.1	8.12	80.4	696	
14	7/24/20	33.1	3355.68	0.043	5.88	1.9	260.01	4.8	7.84	78.2	658	
15	7/24/20	6.3	2648.82	0.029	3.13	4.5	486.09	8.3	8.34	80.6	595	
16	7/24/20	117.8	3676.75	0.015	2.25	2.6	389.85	6.7	7.98	72.4	613	
17	7/21/20	4.1	188.62	0.024	0.18	1.7	13.08	6.4	8.49	77.6	315	
19	7/28/20	260.3	305.54	0.089	1.11	5.8	72.27	7.8	8.30	68.2	871	
21	7/28/20	110.6	1037.41	0.039	1.65	1.7	71.92	5.1	7.97	76.0	704	
22	7/28/20	172.6	nd	0.188	nd	4.4	nd	3.9	7.54	72.9	717	
24	7/28/20	50.4	nd	0.026	nd	2.1	nd	6.0	8.02	79.0	630	
25	7/28/20	86.0	540.66	0.029	0.64	1.8	39.69	5.0	7.90	80.2	387	
27	7/28/20	435.2	25.51	0.076	0.08	1.7	1.77	7.1	8.31	71.7	631	
28	7/28/20	43.7	nd	0.043	nd	2.9	nd	8.9	8.41	73.5	826	
30	7/24/20	40.4	102.84	<.01	nd	3.5	14.68	6.5	7.94	84.0	379	

**Table 4 July data for sites 1 through 30. The notation “nd” denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8). An asterisk (\*) in the post rain event column indicated sample collection occurred within 48 hours of .5 inches of rainfall or more.**

Site	Date	E-coli	CFM Discharge	Total Phos.	Total Phos. Loading	TSS	TSS Loading	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *
		(CFU or colonies/100 ml)		(ppm)	(kg/day)	(ppm)	(kg/day)					
31	7/24/20	1553.1	130.55	0.017	0.09	6.7	35.67	6.9	8.11	78.2	424	
32	7/24/20	19.5	185.03	0.110	0.83	<1.0	nd	6.1	8.22	83.8	433	
33	7/2/20	54.5	nd	0.039	nd	6.8	nd	8.2	8.31	80.7	597	
34	7/2/20	185.0	1632.27	0.114	7.59	3.0	199.70	7.5	7.91	75.6	557	
37	7/24/20	27.9	nd	<.01	nd	3.4	nd	6.8	8.28	82.3	481	
38	7/1/20	218.7	101.33	0.062	0.26	<1.0	nd	5.3	7.65	83.2	357	
39	7/1/20	39.9	243.66	0.036	0.36	2.1	20.87	6.3	8.14	83.4	355	
40	7/1/20	21.1	nd	0.018	nd	2.3	nd	nd	8.70	nd	nd	
42	7/2/20	579.4	462.54	0.127	2.40	5.1	96.20	8.8	8.02	73.8	579	
43	7/2/20	90.8	1392.22	0.040	2.27	2.9	164.65	8.9	8.48	82.9	535	
44	7/2/20	547.5	26.05	0.045	0.05	12.0	12.75	8.3	7.56	60.2	724	
45	7/21/20	24196.0	172.06	0.116	0.81	20.0	140.33	7.6	7.87	65.0	700	
46	7/1/20	344.8	40.02	0.121	0.20	79.0	128.93	8.1	7.81	75.2	629	
47	7/24/20	275.5	35.20	0.010	0.01	2.9	4.16	5.3	8.00	76.2	494	
48	7/24/20	307.6	117.91	0.010	0.05	5.5	26.45	5.2	7.99	79.8	403	
50	7/21/20	579.4	7.62	0.147	0.05	34.0	10.57	6.8	7.75	69.2	778	
51	7/28/20	344.8	76.22	0.019	0.06	1.8	5.59	9.4	8.06	67.6	821	
52	7/21/20	1095.0	8.14	0.368	0.12	50.0	16.60	6.4	7.67	69.3	541	
53	7/21/20	8.6	4.39	0.040	0.01	2.1	0.38	7.3	7.23	58.5	597	
54	7/21/20	96.0	nd	0.137	nd	2.3	nd	4.3	7.36	68.6	403	
58	7/21/20	78.9	900.25	0.061	2.24	2.2	80.77	7.7	8.03	79.3	617	
59	7/21/20	48.0	1957.18	0.088	7.02	5.7	454.95	7.5	7.92	76.6	770	
61	7/21/20	293.4	86.76	0.068	0.24	4.4	15.57	8.9	8.07	70.1	665	
62	7/21/20	488.4	19.82	0.082	0.07	3.9	3.15	7.7	7.85	68.7	768	
63	7/24/20	101.7	nd	0.095	nd	2.7	nd	4.4	7.78	83.5	511	
64	7/24/20	686.7	33.87	0.129	0.18	4.0	5.52	7.5	8.03	76.0	572	
65	7/21/20	980.4	522.40	0.154	3.28	10.6	225.82	7.5	8.45	73.7	659	
66	7/28/20	<1.0	7.76	1.150	0.36	1.2	0.38	7.5	7.86	72.8	233	
67	7/1/20	56.5	162.63	0.027	0.18	1.1	7.30	6.6	8.00	83.6	330	
68	7/21/20	325.5	nd	0.120	nd	14.0	nd	6.9	8.09	73.1	678	
69	7/21/20	613.1	788.78	0.132	4.25	9.9	318.45	7.4	8.17	73.5	663	
70	7/21/20	866.4	444.26	0.091	1.65	8.2	148.56	8.3	7.86	70.0	698	
71	7/21/20	1034.4	11.20	0.198	0.09	14.0	6.39	5.7	7.94	78.5	659	
72	7/1/20	1203.3	3.97	0.055	0.01	6.3	1.02	5.8	7.56	76.3	622	
73	7/21/20	nd		nd	nd	nd	nd	nd	nd	nd	nd	
74	7/28/20	nd		nd	nd	nd	nd	nd	nd	nd	nd	

**Table 5 July data for sites 31 through 74. The notation “nd” denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8). An asterisk (\*) in the post rain event column indicated sample collection occurred within 48 hours of .5 inches of rainfall or more. A double asterisk indicates a second sampling performed within the same month.**

Site	Date	E-coli	CFM Discharge	Total Phos.	Total Phos. Loading	TSS	TSS Loading	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *
		(CFU or colonies/100 ml)		(ppm)	(kg/day)	(ppm)	(kg/day)					
1	8/25/20	770.1	111.03	0.073	0.33	22.0	99.61	7.90	7.86	63.0	774.0	
2	8/25/20	1203.3	155.41	0.026	0.16	4.4	27.89	7.90	7.90	67.9	693.0	
4	8/25/20	209.8	289.88	0.061	0.72	4.1	48.47	5.10	7.82	76.5	607.0	
5	8/25/20	59.4	328.20	0.090	1.20	3.9	52.20	10.20	8.27	76.1	625.0	
6	8/25/20	686.7	445.36	0.092	1.67	6.0	108.97	7.00	8.01	75.7	641.0	
7	8/25/20	193.5	1047.49	0.083	3.55	2.8	119.61	7.00	7.93	75.3	1102.0	
8	8/25/20	96.0	855.16	0.068	2.37	1.7	59.29	7.70	8.01	75.1	937.0	
10	8/25/20	48.8	702.73	0.049	1.40	4.8	137.56	8.40	8.20	80.0	684.0	
12	8/25/20	6.3	773.78	0.053	1.67	4.3	135.69	7.70	8.53	80.3	674.0	
14	8/28/20	21.3	1656.53	0.082	5.54	4.6	310.75	7.80	7.77	78.5	607.0	
15	8/28/20	6.3	2174.22	0.069	6.12	1.7	150.73	7.00	8.31	79.8	539.0	
16	8/27/20	114.5	2589.00	0.043	4.54	1.0	105.58	7.50	8.22	71.1	607.0	
17	8/21/20	11.9	nd	0.022	nd	1.4	nd	7.10	8.18	75.9	272.0	
19	8/26/20	727.0	278.15	0.077	0.87	10.0	113.43	7.60	8.10	66.1	864.0	
21	8/26/20	70.8		0.038	0.00	1.3	0.00	3.90	7.68	74.2	673.0	
22	8/26/20	117.8	67.37	0.050	0.14	1.9	5.22	2.80	7.51	70.3	650.0	
24	8/26/20	86.0	nd	0.026	nd	1.8	nd	5.90	8.01	78.1	607.0	
25	8/26/20	166.4	nd	0.025	nd	1.3	nd	6.50	7.82	70.3	555.0	
27	8/27/20	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
28	8/27/20	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
30	8/27/20	1299.7	nd	0.062	nd	9.0	nd	2.50	7.53	76.4	423.0	

**Table 6 August data for sites 1 through 30. The notation “nd” denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8). An asterisk (\*) in the post rain event column indicated sample collection occurred within 48 hours of .5 inches of rainfall or more.**

Site	Date	E-coli	CFM Discharge	Total Phos. (ppm)	Total Phos. Loading (kg/day)	TSS (ppm)	TSS Loading (kg/day)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *
		(CFU or colonies/100 ml)										
31	8/27/20	1046.2	17.03	0.034	0.02	1.5	1.04	7.90	8.27	69.0	585.0	
32	8/27/20	16.0	34.44	0.025	0.04	2.3	3.23	6.20	8.18	78.4	420.0	
33	8/24/20	119.8	nd	0.063	nd	4.4	nd	7.30	7.93	75.0	494.0	
34	8/24/20	1046.2	470.09	0.148	2.84	1.6	30.67	6.00	7.78	69.6	564.0	
37	8/27/20	9.5	nd	0.030	nd	5.9	nd	6.30	8.08	77.3	468.0	
38	8/26/20	613.1	73.28	0.039	0.12	1.5	4.48	4.00	7.45	75.1	363.0	
39	8/26/20	48.7	nd	0.061	nd	1.4	nd	4.60	7.86	76.0	361.0	
40	8/26/20	2.0	nd	0.028	nd	1.5	nd	5.80	8.59	80.7	381.0	
42	8/24/20	1732.9		0.121	0.00	6.9	0.00	8.20	7.99	69.5	626.0	
43	8/24/20	98.8	221.05	0.041	0.37	1.6	14.42	5.40	7.80	76.8	437.0	
44	8/24/20	488.4	12.28	0.038	0.02	3.3	1.65	7.90	7.66	65.2	736.0	
45	8/21/20	1627.5	11.52	0.074	0.03	19.0	8.93	8.50	8.04	60.2	697.0	
46	8/26/20	46.4	20.61	0.024	0.02	5.6	4.71	4.20	7.47	62.7	627.0	
47	8/24/20	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
48	8/24/20	920.8	67.83	0.032	0.09	3.7	10.23	6.60	8.42	83.4	379.0	
50	8/21/20	387.3	3.76	0.070	0.01	8.4	1.29	7.20	7.74	64.0	782.0	
51	8/27/20	307.6	76.82	0.024	0.08	2.1	6.58	8.40	7.95	64.9	798.0	
52	8/21/20	nd	nd	nd	nd	nd	nd	nd		nd	nd	
53	8/21/20	16.0	2.34	0.042	0.00	3.2	0.31	6.00	7.31	57.9	572.0	
54	8/21/20	187.2	nd	0.117	nd	6.7	nd	4.10	7.37	65.2	397.0	
58	8/25/20	292.4	280.42	0.073	0.83	4.7	53.75	6.70	8.11	74.7	636.0	
59	8/25/20	143.9	646.33	0.085	2.24	2.9	76.44	5.80	7.90	75.8	1073.0	
61	8/26/20	1732.9	54.92	0.090	0.20	13.0	29.12	9.80	8.16	68.3	665.0	
62	8/21/20	172.2	11.19	0.070	0.03	12.0	5.48	7.40	7.90	64.2	808.0	
63	8/24/20	122.3	nd	0.193	nd	6.0	nd	5.10	7.70	76.8	495.0	
64	8/24/20	307.6	6.28	0.113	0.03	4.5	1.15	8.60	8.20	73.9	572.0	
65	8/21/20	365.4	397.15	0.035	0.57	7.1	114.99	7.70	8.24	69.1	627.0	
66	8/26/20	21.6	0.94	0.573	0.02	<1	nd	8.20	7.94	69.9	2566.0	
67	8/26/20	307.6	74.78	0.033	0.10	10.0	30.50	5.60	7.64	77.9	318.0	
68	8/21/20	307.6	nd	0.093	nd	7.4	nd	7.60	8.17	67.9	668.0	
69	8/21/20	275.5	365.43	0.107	1.59	4.9	73.02	8.00	8.22	68.4	653.0	
70	8/21/20	686.7	349.54	0.079	1.13	8.4	119.74	7.50	7.86	66.4	684.0	
71	8/21/20	419.6	nd	0.237	nd	12.0	nd	6.30	8.09	74.7	584.0	
72	8/26/20	1373.4	nd	1.990	nd	190.0	nd	7.60	8.12	74.8	542.0	
73	8/21/20	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
74	8/21/20	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	

**Table 7 August data for sites 31 through 74. The notation “nd” denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8). An asterisk (\*) in the post rain event column indicated sample collection occurred within 48 hours of .5 inches of rainfall or more.**

<b>Parameter</b>	<b>Target</b>	<b>Reference/other information</b>
<b>Temperature</b>	Dependent on time of year and whether stream is designated as a coldwater fishery	Indiana Administrative Code (IAC)
<b>Dissolved Oxygen (DO)</b>	Min: 4.0 mg/L Max: 12.0 mg/L	Indiana Administrative Code (IAC)
	Min: 6.0 mg/L in cold water fishery streams	Indiana Administrative Code (IAC)
	Min: 7.0 mg/L in spawning areas of cold water fishery streams	Indiana Administrative Code (IAC)
<b>E. coli</b>	Max: 235 CFU/ 100mL in a single sample,	Indiana Administrative Code (IAC)
	Max: <u>Geometric Mean</u> of 125 CFU/ 100mL from 5 equally spaced samples over a 30-day period	
<b>Total Phosphorus</b>	Max: 0.076 mg/L	U.S. EPA recommendation
	0.07 mg/L	Dividing line between mesotrophic and eutrophic streams (Dodd et al. 1998)
	Max: 0.08 mg/L	Ohio EPA recommendation to protect aquatic biotic integrity in WWH
	Max: 0.3 mg/L	IDEM draft TMDL target
<b>Total Suspended Solids (TSS)</b>	Max: 80.0 mg/L	Wawasee Area Conservancy Foundation recommendation to protect aquatic life in lake systems
	Max: 30.0 mg/L	IDEM draft TMDL target
	Range: 25.0-80.0 mg/L	Concentrations within this range reduce fish concentrations (Waters, 1995)
	Max: 40.0 mg/L	New Jersey criteria for warm water streams
	Max: 46.0 mg/L	Minnesota TMDL criteria for protection of fish/macroinvertebrate health
<b>Turbidity</b>	Max: 10.4 NTU	U.S. EPA recommendation

**Table 8 Indiana Department of Environmental Quality Table of Water Quality Targets. Standards shaded on results tables correspond to standards shaded in this table.**

### 3. Results: May Sampling

May sampling occurred at 60 sites. May sampling results are listed in tables 2 and 3. Samples collected represented baseline-flow conditions at 44 sites and elevated rainfall-event flows at 17 sites. Table 8 contains a variety of stream water quality targets provided by the Indiana Department of Environmental Management (IDEM) for comparison with the 2020 season data. Also provided for comparison is table 9 containing averages of stream data from the IDEM probabilistic data set. The data used to calculate these averages was collected from Indiana Streams within the St. Joseph River watershed from year 2000 to 2005. Most of the collection sites included in the 2020 data are also within the St. Joseph River watershed and therefore represent somewhat similar soil types, topography, and land uses. This allows some amount of judgment to be made as to whether the 2020 samples were “below average”, “average” or “above average” in terms of Northern Indiana stream water quality. In May several sites did not conform to the standards listed in table 8. Fourteen sites exceeded the E-coli standard of 235 MPN/100 ml and 32 sites exceeded the total phosphorus standard of .076 ppm. In May, 2019 these standards were exceeded at 5 and 27 sites respectively.

Parameter	IDEM Mean Stream Data St. Joseph Wtrshd 2000-2005
pH	n/d
D.O. (ppm)	7.14
Temp. (deg C)	19.91
Specific conductance umho/cm	764.19
Total Suspended Solids (ppm)	36
Total Phosphorus (ppm)	0.382
E-coli (CFU/100ml)/(MPN)	1895.58

**Table 9 Average of IDEM-collected probabilistic Indiana stream data for the St Joseph River Watershed 2000-2005**

### 4. Results: July Sampling

July sampling was scheduled to include 57 sampling sites. A total of 55 sites were sampled. Two were omitted due to dry conditions. July sampling results are listed in tables 4 and 5. Precipitation was minimal in July. All sites represented “baseline” flow conditions. E-coli standards were exceeded at 36 sites. Total phosphorus standards were exceeded at 23 sites. This compares to 36 and 30 sites with standards exceeded respectively in July of 2019. An E-coli sample collected from a tributary to Clear Lake, Cyrus Brouse Ditch, returned a result of 24,196 MPN/100 mL. This is one of the highest measurements recorded since sampling began in 2007.

### 5. Results: August Sampling

August sampling was scheduled to include 57 sampling sites. Samples were collected at 51 sites. Six were omitted due to dry conditions. Sampling results are listed in tables 6 and 7. Precipitation was minimal in August. All sites represented “baseline” flow conditions. E-coli standards were exceeded at 25 sites while total phosphorus standards were exceeded at 18 sites.

This compares to 25 and 31 sites with standards exceeded respectively in August of 2019. It should be noted that a significant number of samples in 2019 were “rain” samples.

## 6. Conclusions

A number of notable observations were made during the 2020 season sampling. The standard typically used for maximum E-coli is 235 CFU. Ideally waters are not to exceed this count. A notable number of sites returned E-coli measurements of over 10,000 CFU in May of 2018. Five of these were from various Fish Creek and Black Creek sites in the Fish Creek watershed in southeastern Steuben County. The highest measurement recorded was 48,392 from a sample from Fish Creek at 427. Since then members of the SCLC water quality committee have been taking steps toward ongoing watershed improvements in this region, working with landowners and regulators. In 2019 E-coli measurements from this region were considerably lower. The highest measurement in this region in 2019 was 3635 from an August 26 sample collected from site 71, Black Creek at South 600 East. In 2020 the highest measurement among these sites was lower again with a maximum measurement of 2827.2 from a May 21 sample collected from Black Creek at S 600 E.

E-coli measurements above the 235 CFU standard on Pigeon Creek have decreased for the fourth third year in a row. A total of 54 Pigeon Creek samplings were performed each season in 2017 through 2019 with 46 Pigeon Creek samples collected in 2020. In the 2019 season 14 (26%) were above 235, in the 2018 season 19 (35%) were above 235, and in the 2017 season 30 (56%) returned results above 235. In 2020 only 8 (17%) were above 235.

The magnitude of E-coli counts on the upper reach of the Pigeon have also been generally trending downward in recent years and in 2020 were comparable to 2019. Out of 27 sampling events on the upper Pigeon (sites 1-11 above Big Bower Lake) 8 (30%) exceeded the E-coli standard. The was essentially identical to 2019 when 30% also exceeded the standard. The percentage exceeding the standard was 39 in 2018, 67 in 2017, 30 in 2016 and 48 in 2015, 34 in 2014 and 41 in 2013. These numbers do vary according to rainfall conditions, but the average for the last eight years is 40% of sites being over the standard. This places 2020 well below the average. The highest E-coli count recorded on the upper Pigeon reach was 2419.6 recorded at East Ray Clark Rd. on July 23. This was somewhat higher than the 686.7 “high count” recorded at site 2, the Pigeon Lake inlet in July of 2019.

With regard to total phosphorus on the upper Pigeon, 2020 measurements were generally significantly lower in than in 2019, yet still much higher than in most previous seasons. Of 27 samples 15 (56%) exceeded the standard of .076 ppm. In the 2019 season 73% exceeded the standard. The previous figures were 27% in 2018, 42% in 2017, 3% in 2016, and 9% in 2015. Phosphorus levels are to be expected to some extent with the rain event flow rates of 2017 through 2020, while the 2016 and 2015 samplings all represented baseline flow conditions.

E-coli measurements for the tributary to Ball Lake were more moderate than in the past several seasons with the May measurement of 232.4 falling below the standard of 235. In 2016 through 2019 every sampling at the Ball Lake tributary had exceeded 235. Measurements in July and August also were significantly lower than the count of 19,862.9 recorded in August of 2015. The peak count was 1732.9 recorded on August 26. This was somewhat lower than the 3465.80 “highest” measurement from the same date in 2019. Supplemental sampling efforts by the Ball Lake residents to track potential pollution sources in that watershed are still recommended.



Over several years the SCLC has built an extensive body of local water quality data. There are many ways to examine the statistical content of the data and glean information to assist in meeting the needs of local lake residents, government agencies, and land users. The SCLC is encouraged to continue to convey the water quality information through its website, meetings, and other outlets, fostering cooperative community water-quality improvement efforts and encouraging new input and ideas to direct future sampling.

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