

St. Louis River Area of Concern Beneficial Use Impairment Monitoring,

Faxon Creek Bacterial Source Identification

Final Report

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Prepared by Matt Steiger

SLRAOC Coordinator

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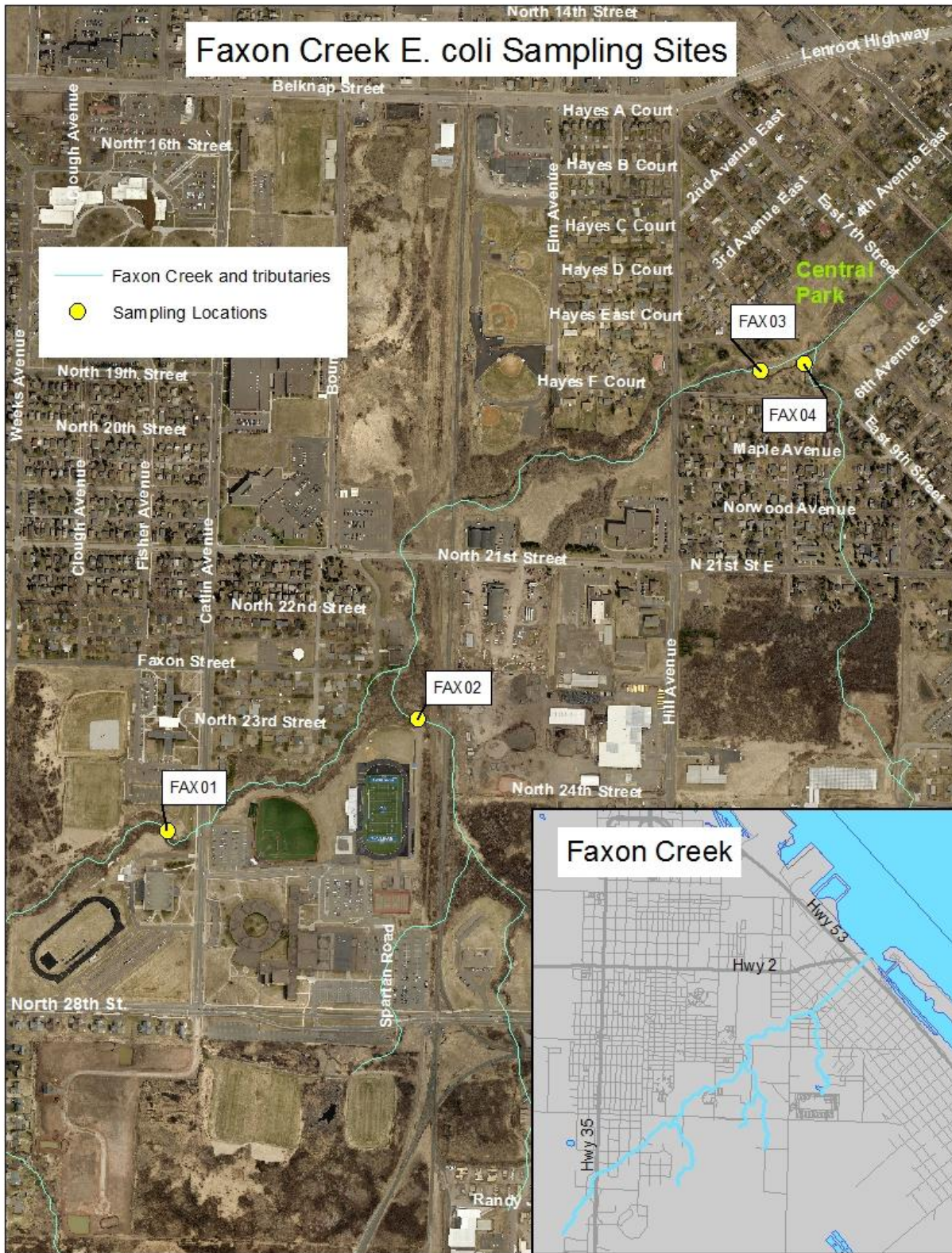
Purpose

In 2015, a bacteria source tracking study was undertaken at impaired beaches in the St. Louis River Area of Concern (SLRAOC) to identify *E. coli* problems and their sources using sanitary surveys, *E. coli* sampling and DNA analysis (Grant ID: GL00E01312 sub 2). The purpose of that effort was to identify sites with controllable human sources as defined in the SLRAOC Remedial Action Plan Beach Closings and Body Contact Restrictions Beneficial Use Impairment (BUI) (MPCA and WDNR, 2020). One recommendation of the study was to further investigate Faxon Creek, Douglas County, WI (WBIC 2843700) as a source of bacteria impairment to Barkers Island Beach. The mouth of the creek was sampled twice weekly during the 2015 and 2016 beach seasons. The results of the 2015 and 2016 sampling indicated a significant *E. coli* source, however mixing with the St. Louis River complicated the interpretation of the data. The objective of this effort was to investigate Faxon Creek and determine if a significant *E. coli* source was coming from the creek and if it could be attributed to a controllable human source and therefore may be contributing to the BUI.

Study design

[Faxon Creek](#) is a small tributary of the St. Louis River that runs 3.21 miles through commercial and residential areas in the City of Superior (Figure 1). Faxon Creek receives a substantial amount of stormwater and is crossed by sanitary sewer lines in multiple places. The study was designed with the help of City staff to identify segments of the creek and smaller tributaries that would produce results that could narrow down potential sources of human contamination. Four sites were selected and sampled weekly during the summer of 2017. Sampling protocols and quality assurance procedures were adopted from the Bacterial Source Tracking Quality Assurance Project Plan (UW-Superior LSRI, 2015). The bacterial source tracking team was responsible for interpreting the results and recommending any further action in relation to the BUI. The team consisted of beach program and AOC staff from WDNR, UW-Superior Lake Superior Research Institute (LSRI) and staff from Dr. Sandra McLellan's lab at UW-Milwaukee. Results of the study were communicated to the SLRAOC coordinators during a monthly coordinator meeting.

Figure 1: Sampling Location Map, Faxon Creek and Tributaries, Douglas Co, WI



Sampling and Data Collection

E. coli samples and relevant visual and in situ water quality parameters (conductivity) were collected by Wisconsin DNR staff at four locations (Table 1). *E. coli* samples were transported on ice to UW-Superior for analysis within 24 hours. If

samples exceeded the recreational threshold of 235 CFU/100ml a filter was frozen and saved to be considered for DNA analysis at the end of the season. All *E. coli* results were uploaded to the SWIMS database (Project ID 145844982).

Table 1: Faxon Creek sample location information.

Sample ID	Location	Station ID	Lat/Long
FAX01	Faxon Creek 40M Upstream Catlin Ave.	10048629	46.70883, -92.08839
FAX02	Unnamed Tributary to Faxon Ck	10030752	46.71080, -92.08274
FAX03	Faxon Creek in Central Park	10047268	46.71642, -92.07519
FAX04	Unnamed Tributary to Faxon Creek entering in Central Park	10048628	46.71652, -92.07400

For the purposes of identifying potential bacterial sources, each sample was considered a “wet” or “dry” sample. If 0.5 inches of rain was recorded in the previous 24-hour period it was considered a wet weather sample and the presence of stormwater sources was likely. Rainfall data was sourced from the nearest weather station to the project site. Weather underground – “WU Bong” was the preferred source of rainfall data. During the sampling, the WU Bong station was offline during some of the project duration and “WU KWISUPER5” was used. Rainfall data was recorded for the previous 12-hour, 24-hour and 48-hour periods.

A total of 13 sample events were collected between 6/14/17 and 9/7/17 including five wet weather and eight dry weather samples (Table 2). Samples were collected on the same day each week regardless of weather conditions to eliminate any sample bias and to sample across a variety of conditions.

On one occasion (7/6/17) a gray colored water was seeping into the creek out of a storm drain near a sampling site. This was sampled separately and named Fax 02 ST.

E. coli results

Table 2: Field sample dataset. *E. coli* is reported as number of Colony Forming Units per 100 milliliters (CFU/100mL)

Date	Sample ID	e. coli	Time	Conductivity	Filtered	ml filtered	12 hr precip	24 hr precip	48 hr precip	DNA?	Notes	rainfall data source
6/14/2017	FAX01	1553.1	1450	Not collected	y	151	0.44	0.44	0.44	y		WU Bong
6/14/2017	FAX02	1986.3	1430	Not collected	y	151	0.44	0.44	0.44	y		WU Bong
6/14/2017	FAX03	>2419.6	1410	Not collected	y	152	0.44	0.44	0.44	y		WU Bong
6/14/2017	FAX04	>2419.6	1405	Not collected	y	180	0.44	0.44	0.44	y		WU Bong
6/20/2017	FAX01	4106	1120	Not collected	y	400	0	0.01	0.09	Y		WU KWISUPERS
6/20/2017	FAX02	435	1110	Not collected			0	0.01	0.09			WU KWISUPERS
6/20/2017	FAX03	464	1100	Not collected			0	0.01	0.09			WU KWISUPERS
6/20/2017	FAX04	379	1055	Not collected			0	0.01	0.09		some foam/scum on water surface below walking path culvert	WU KWISUPERS
6/20/2017	FAX01DUP	5172	1120	Not collected	y	400	0	0.01	0.09	Y	Field Duplicate	WU KWISUPERS
6/29/2017	FAX01	6488	1000	490	y	125	0.24	1.75	1.75	y	vac truck on Catlin Ave in storm sewer, downstream of sample site	WU KWISUPERS
6/29/2017	FAX02	1918	0950	270	y	110	0.24	1.75	1.75	y	grey storm water entering from left bank conductivity 475	WU KWISUPERS
6/29/2017	FAX03	4884	0935	410	y	115	0.24	1.75	1.75			WU KWISUPERS
6/29/2017	FAX04	3076	0930	316	y	110	0.24	1.75	1.75	y	vac truck on Laurel Ave- looked to be working upstream in the storm sewer that is being sampled	WU KWISUPERS
6/29/2017	FAXFB		0935	NA							Field Blank	
7/6/2017	FAX01	3076	1520	521	y	200	0.27	0.97	0.97	y		WU KWISUPERS
7/6/2017	FAX02	2359	1500	293	y	131	0.27	0.97	0.97	y		WU KWISUPERS
7/6/2017	FAX03	3255	1442	396	y	144	0.27	0.97	0.97	y		WU KWISUPERS
7/6/2017	FAX04	813	1439	288	y	200	0.27	0.97	0.97	y		WU KWISUPERS
7/6/2017	FAX03DUP	4352	1442	396	y	144	0.27	0.97	0.97		Field Duplicate	WU KWISUPERS
7/6/2017	FAX02 ST	3255	1503	479	y	163	0.27	0.97	0.97	y	Grey stormwater coming from Left bank, just upstream of FAX02	WU KWISUPERS
7/6/2017	FAX04 Analysis Dup	1106	NA	NA							Analysis Duplicate	
7/13/2017	FAX01	767	1342	523	n		0.01	0.51	0.51			WU KWISUPERS
7/13/2017	FAX02	373	1330	211	n		0.01	0.51	0.51			WU KWISUPERS
7/13/2017	FAX02DUP	345	1330	211	n		0.01	0.51	0.51			WU KWISUPERS
7/13/2017	FAX03	620	1250	387	n		0.01	0.51	0.51			WU KWISUPERS
7/13/2017	FAX04	697	1245	354	n		0.01	0.51	0.51			WU KWISUPERS
7/20/2017	FAX01	435	1415	903	n		0	0	0.35		close to baseflow	WU KWISUPERS
7/20/2017	FAX02	285	1400	362	n		0	0	0.35		close to baseflow	WU KWISUPERS
7/20/2017	FAX03	1210	1350	701	y	200	0	0	0.35	Y	close to baseflow	WU KWISUPERS
7/20/2017	FAX04	161	1345	469	n		0	0	0.35		close to baseflow	WU KWISUPERS
7/26/2017	FAX01	2359	1040	710	y	200	0.06	0.06	0.06	Y		WU KWISUPERS
7/26/2017	FAX02	833	1025	412	n		0.06	0.06	0.06			WU KWISUPERS
7/26/2017	FAX03	3076	1010	426	y	200	0.06	0.06	0.06	Y		WU KWISUPERS
7/26/2017	FAX04	313	1005	475	n		0.06	0.06	0.06			WU KWISUPERS
7/26/2017	FAX04DUP	171	1005	475	n		0.06	0.06	0.06		Field Duplicate	WU KWISUPERS
8/2/2017	FAX01	836	1118	507	N		0	0	0		Baseflow conditions	WU KWISUPERS
8/2/2017	FAX02	591	1100	723	N		0	0	0		Baseflow conditions	WU KWISUPERS
8/2/2017	FAX03	420	1035	1165	N		0	0	0		Baseflow conditions	WU KWISUPERS
8/2/2017	FAX04	84	1030	705	N		0	0	0		Baseflow conditions	WU KWISUPERS
8/9/2017	FAX01	2419.6	1250	556	y	250	0	0	0	Y		WU KWISUPERS
8/9/2017	FAX02	1299.7	1304	623	y	200	0	0	0	Y		WU KWISUPERS
8/9/2017	FAX03	547.5	1325	645	n		0	0	0			WU KWISUPERS
8/9/2017	FAX04	110.6	1320	548	n		0	0	0			WU KWISUPERS
8/17/2017	FAX01	9804	1335	290	y	172	0.53	0.86	0.86	y	close to bankful	WU Bong
8/17/2017	FAX01DUP	6867	1335	290	y	147	0.53	0.86	0.86		close to bankful, field dup	WU Bong
8/17/2017	FAX02	3448	1315	230	y	137	0.53	0.86	0.86	y	close to bankful	WU Bong
8/17/2017	FAX03	1773	1300	296	y	153	0.53	0.86	0.86		close to bankful	WU Bong
8/17/2017	FAX04	2909	1255	322	y	225	0.53	0.86	0.86	y	close to bankful	WU Bong
8/21/2017	FAX01	272	1135	806	N		0	0	0			WU Bong
8/21/2017	FAX02	160	1120	330	N		0	0	0			WU Bong
8/21/2017	FAX03	456	1105	584	N		0	0	0			WU Bong
8/21/2017	FAX04	41	1103	556	N		0	0	0			WU Bong
8/29/2017	FAX01	266	1115	not collected	N		0	0	0.53			WU Bong
8/29/2017	FAX02	399	1105	not collected	N		0	0	0.53			WU Bong
8/29/2017	FAX03	960	1045	not collected	N		0	0	0.53			WU Bong
8/29/2017	FAX04	134	1040	not collected	N		0	0	0.53			WU Bong
8/29/2017	FAXFB	<1	1050	not collected							Field Blank	
9/7/2017	FAX01	206.4	1015	934	N		0	0	0			WU Bong
9/7/2017	FAX02	214.3	1035	332	N		0	0	0			WU Bong
9/7/2017	FAX03	307.6	1008	665	N		0	0	0			WU Bong
9/7/2017	FAX04	118.7	1005	591	N		0	0	0			WU Bong

DNA results

After all *E. coli* data was collected, the project team evaluated the results and chose a representative dataset of 22 filters to send for further DNA analysis (qPCR). *E. coli* results above 1000 CFU/100ml are preferred. Other factors considered include type of sample (wet, dry), flow conditions, timing and observed field conditions. qPCR is measured in copy number (CN) per 100 ml of sample.

Benchmarks for identifying a likely human bacterial source (diluted sewage) using qPCR have been established by UW-Milwaukee. Human indicator concentration is considered positive for the presence of human fecal contamination if human Bacteroides (HF183) is >1,000 CN/100 ml and human Lachnospiraceae (Lachno2) is >1,500 CN/100 ml. When one human marker is found in high concentration and the other in low concentration, we attribute this to marker cross-reactivity with a non-human fecal source (commonly raccoon or dog sources). These benchmarks are a guide to help managers identify contamination and are not intended for regulatory purposes.

The UW-Milwaukee lab was in development of a human Lachnospiraceae (Lachno3) assay and used the Faxon Creek samples as an opportunity to run that analysis.

Table 3: Results of the DNA analysis from a subset of 22 filters analyzed by UW Milwaukee. Highlighted cells indicate the threshold for the human DNA marker was exceeded. BLQ is 'Below Limit of Quantitation' (qPCR detects marker, but CN is too low to quantify). When zero is reported, nothing was detected for a marker

SAMPLE ID	Collection Date	<i>E. coli</i> MPN/100mL	SAMPLE SITE ID	HUMAN BACTEROIDES (CN/100ml) (HF183)	HUMAN LACHNOSPIRACEAE (CN/100ml) (LACHNO2)	HUMAN LACHNOSPIRACEAE (CN/100ml) (LACHNO3)	ENTEROCOCCUS (CN/100ml)
061417_Fax-01	6/14/2017	1553.1	Fax01	BLQ	944	0	47473
061417_Fax-02	6/14/2017	1986.3	Fax02	0	0	0	94523
061417_Fax-03	6/14/2017	> 2419.6	Fax03	BLQ	1022	0	116196
061417_Fax-04	6/14/2017	> 2419.6	Fax04	0	0	0	97221
062017_Fax-01	6/20/2017	4106	Fax01	0	228	0	19899
062017_Fax-01 DUP	6/20/2017	5172	Fax01	0	254	0	18968
062917_Fax-01	6/29/2017	6488	Fax01	863	11330	0	448385
062917_Fax-02	6/29/2017	1918	Fax02	515	BLQ	0	85529
062917_Fax-04	6/29/2017	3076	Fax04	596	1095	0	184083
070617_Fax-01	7/6/2017	3076	Fax01	BLQ	2425	0	235072
070617_Fax-02	7/6/2017	2359	Fax02	BLQ	0	0	71911
070617_Fax-03	7/6/2017	3255	Fax03	324	2278	0	399029
070617_Fax-04	7/6/2017	813	Fax04	BLQ	BLQ	0	74289
070617_Fax-02 ST	7/6/2017	3255	Fax02-ST	0	0	0	148446
072017_Fax-03	7/20/2017	1210	Fax03	0	BLQ	0	42059
072617_Fax-01	7/26/2017	2359	Fax01	0	295	0	63744
072617_Fax-03	7/26/2017	3076	Fax03	BLQ	292	0	110073
080917_Fax-01	8/9/2017	2419.6	Fax01	0	0	0	21611
080917_Fax-02	8/9/2017	12997	Fax02	0	503	0	17547
081717_Fax-01	8/17/2017	9804	Fax01	BLQ	1122	0	131460
081717_Fax-02	8/17/2017	3448	Fax02	0	0	0	50826
081717_Fax-04	8/17/2017	2909	Fax04	0	369	0	21931

Conclusions

E. coli results from this and other sampling efforts suggest that there is a bacteria problem in Faxon Creek. This urban creek is considered impaired for *E. coli* and the DNA results show that it is likely not caused by a persistent human source (leaky pipe, discharge, etc.) Likely sources of *E. coli* pollution originate from the urban setting including trash, urban wildlife, and domestic animals. The data suggest that stormwater flow is a significant factor in *E. coli* levels in the creek as all (20/20) wet weather samples exceeded the recreational advisory level of 235 CFU/100mL.

Bacterial source identification by DNA analysis show that none of the samples met the benchmark for the presence of human fecal contamination (HF183 and Lachno2). This was further corroborated by no human Lachnospiraceae (Lachno3) detected in any of the samples.

For the AOC program, the source of the bacteria is a key factor in determining if further action is needed. As defined by the SLRAOC Remedial Action Plan, Faxon Creek is not contributing to the Beach Closings and Body Contact Restrictions BUI and no further AOC action is needed. WDNR will continue to monitor this site as a 303(d) listed waterbody. Efforts by the City of Superior to upgrade sanitary infrastructure, install green infrastructure, and educate residents about stormwater and cleaning up after pets will continue to reduce the *E. coli* in Faxon Creek.

References

UW Superior LSRI, 2015. Bacterial Source Tracking QAPP

<https://dnr.wi.gov/water/wsSWIMSDocument.ashx?documentSeqNo=122863467>

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https://widnr.widen.net/content/tsmr1ygmbp/pdf/GW_SLR_RAP2020.pdf