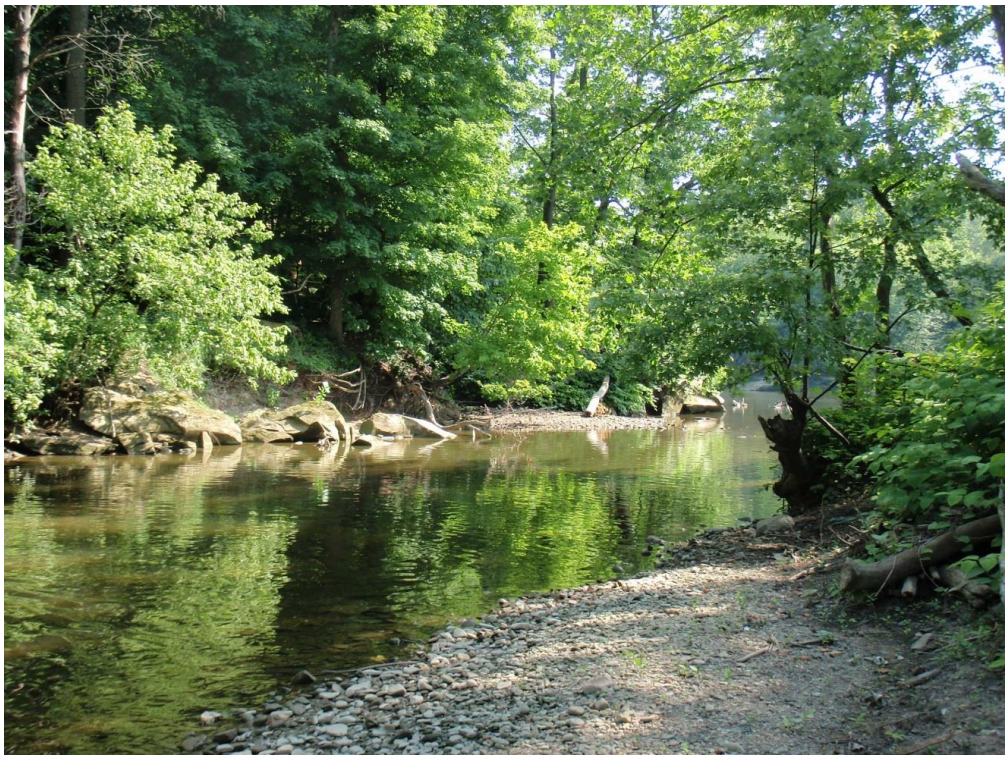
Ohio Environmental Protection Agency

Biological and Water Quality Study of the Black River Basin, 2012

Ashland, Cuyahoga, Huron, Lorain, and Medina Counties, Ohio



Black River at Elyria at Cascade Park (RM 14.95)

Division of Surface Water
Ecological Assessment Section
October 2016

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Prepared by
State of Ohio Environmental Protection Agency

Division of Surface Water
Lazarus Government Center
50 West Town Street, Suite 700
P.O. Box 1049
Columbus, Ohio 43216-1049

Ecological Assessment Section
4675 Homer Ohio Lane
Groveport, Ohio 43125

Division of Surface Water
Northeast District Office
2110 East Aurora Road
Twinsburg, OH 44087

John R. Kasich, Governor
State of Ohio

Craig W. Butler, Director
Ohio Environmental Protection Agency

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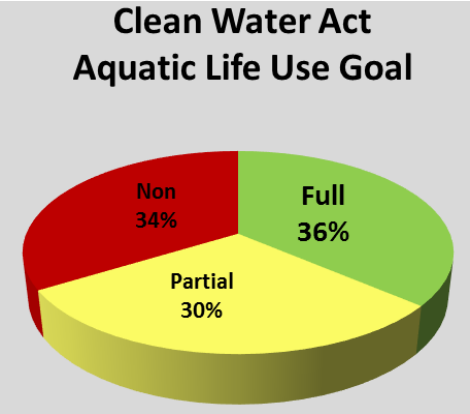
EXECUTIVE SUMMARY

Rivers and streams in Ohio support a variety of beneficial uses, including aquatic life, recreation, human health, and public water supply. Ohio EPA evaluates each stream to determine the appropriate beneficial use designation and to also determine if the use is meeting the goals of the federal Clean Water Act. In 2012, 27 streams in the Black River watershed, located in Ashland, Cuyahoga, Huron, Lorain, and Medina counties, were evaluated for aquatic life, recreation, sport fish consumption, and, where applicable, public water supply use potential (see Figure 1 and Table 1 for sampling locations).



The summer of 2012 was hallmarked by flows that were well below the historical median (Figure 5, page 33), and were the lowest of the preceding 10 years (USGS 2014). This phenomenon was evident in the water chemistry, as exceedances of the minimum Water Quality Standards (WQS) criterion for dissolved oxygen were common throughout the watershed due to reduced stream flows. In terms of aquatic life uses, out of 80 sites assessed, only 29 (34%) were fully meeting the designated or recommended use, with 24 (32%) in partial attainment, and 27 (34%) in non-attainment.

Full attainment of the Warmwater Habitat (WWH) aquatic life use was achieved at four of five sites sampled on the free-flowing portion of the Black River mainstem. The site at river mile (RM) 9.80 at Ford Road downstream from the Elyria Wastewater Treatment Plant (WWTP) was impaired for macroinvertebrates, scoring an Invertebrate Community Index (ICI) score of 26. A decline in mayfly diversity and abundance was noted on both the artificial and natural substrates, which suggested elevated conductivity (>1000 µmhos/cm) as a contributor to the impairment. Median specific conductance in this reach measured 1231 µmhos/cm, while water quality sondes deployed in separate 24-hour June and July sampling events captured values ranging from 1500-2300 µmhos/cm. In the Lake Erie-influenced lower 6.6 miles of the Black River, much of which is managed and maintained for commercial and recreational navigation, biological integrity as indicated by lacustuary fish and macroinvertebrate targets indicated poor macroinvertebrate communities and mostly fair to marginally good fish communities at six sampling locations.

Biological integrity of the tributaries to the Black River was essentially a tale of two branches. The East Branch Black River subwatershed was generally higher quality, with 19 of 34 sites assessed that met the prescribed biocriteria. All but three sites on the East Branch Black River proper were fully meeting the WWH aquatic life use. The three impaired sites were affected by either dam impoundments or by limiting natural habitat (bedrock). The remaining impaired tributary sites were impacted by either interstitial flows, organic enrichment, or flashy hydrology. Conversely, the West Branch Black River subwatershed saw impairment at nearly every site assessed, with only three of 27 sites having met the prescribed biocriteria. Sedimentation from past agricultural practices impacted fish assemblages in the West Branch Black River mainstem. Future recovery of fish communities in the West Branch may be limited due to waterfalls at the confluence of the East and West branches, which serve as a passage barrier and thus prevents recruitment from the Black River mainstem. Impaired tributaries to the West Branch Black River were primarily impacted by either nutrient enrichment from failing septic systems and WWTPs or from sedimentation due to storm water runoff. French Creek, a direct tributary to the lower Black River mainstem, was impaired in its headwaters due to a combination of nutrients and channel modifications.

New revisions to the recreation use rules in Ohio became effective on January 4, 2016. However, as sampling to assess the recreation use for the Black River study area was designed and carried out when the previous

rules were in effect, the assessment of data and determination of recreation use attainment status provided in this report were based on the prior rules. As such, bacteriological sampling of *Escherichia coli* (*E. coli*) in 2011 and 2012 revealed that non-attainment of the Primary Contact Recreation (PCR) use was nearly ubiquitous in the Black River study area. Of the 64 sites sampled for bacteria, results at only 10 (16%) reflected geometric mean *E. coli* levels below the WQS criterion and, thus, fully supported the PCR use. Agriculture and septic systems were dominant causes of non-attainment in the upper parts of the watershed. In the lower section of the Black River, combined sewer overflows (CSOs) and urbanization became the predominant sources for non-attainment of the recreational use.

Sport fish were collected and analyzed for bioaccumulated contaminants in the Black River, East Branch Black River, and West Branch Black River in 2012. Based on this data, one meal per month consumption advisories were issued for the Black River mainstem for freshwater drum, channel catfish, and common carp collected from Homewood Park to U.S. Rt. 6. From U.S. Rt. 6 to the confluence with Lake Erie, one meal per two months is advised for common carp. In the East Branch Black River, one meal per month advisories were issued for rock bass, smallmouth bass, yellow bullhead, and common carp 23" and over. In the West Branch Black River, one meal per month is advised for common carp and rock bass. For all other species, the statewide advisory applies. In addition to the consumption advisories, three 12-digit Hydrologic Unit Code assessment units had data sufficient to determine human health use attainment. All three assessment units were found to be impaired, with the lower East Branch assessment unit impaired by mercury, and the lower West Branch and the Black River assessment units impaired for PCBs.

Two public water systems, Oberlin and Wellington, withdraw surface water for treatment in the Black River study area and were thus assessed for the Public Water Supply (PWS) use. The village of Oberlin has intakes on both the West Branch Black River and on the Parsons Road Reservoir. Nitrates were below the WQS criterion for samples collected in 2012 and 2013. Atrazine ranged from below detection limit (BDL) to 9.11 ug/L, but had insufficient data to produce quarterly averages in 2012 and 2013; as such, the WQS criterion could not be evaluated. The village of Wellington has intakes on Charlemont Creek and the Village Reservoir. Nitrates were below the WQS criterion for samples collected in 2012 and 2013. Atrazine ranged from BDL to 14.7 ug/L. While the data were insufficient to construct a quarterly average to evaluate PWS use status, one result was more than four times the WQS criterion, resulting in Charlemont Creek at the Wellington Water Treatment Plant (WTP) intake being placed on the watch list for atrazine. Microcystin samples collected in 2012 and 2013 in the Wellington Village Reservoir were all below detection.

Table 1. Sampling locations for the Black River basin study area, 2012.

Assessment Unit/ Site Name	HUC 12	River Code	River Mile	Drainage Area	EA3 Station	Latitude	Longitude	USGS Quad	Sampling
Black R. at Elyria @ Cascade Park	041100010602	20-001-000	14.95	396.00	501520	41.37932	-82.10772	Avon	F_2,M_{HD},Q_O,T,S
Black R. dst. Elyria, Spring Valley Golf Club	041100010602	20-001-000	11.50	398.00	B01S09	41.39690	-82.09780	Avon	F_2,M_{HD},C_O,T
Black R. 250 Ft. upst. Elyria WWTP	041100010602	20-001-000	10.70	401.00	B01W07	41.40625	-82.09530	Avon	F_2,M_{HD},C_O,S,D
Elyria WWTP Outfall To Black R.	041100010602	20-001-000	10.65	401.00	B01E01	41.40825	-82.09243	Avon	C_O
Black River @ Ford Rd.	041100010602	20-001-000	9.80	412.00	501510	41.41148	-82.09520	Elyria	F_2,M_{HD},T,$Q_{O,L}$,S
Black River dst Elyria, 0..25 miles dst I-90	041100010602	20-001-000	9.30	413.00	B01K53	41.41196	-82.10387	Elyria	C
Black River @ North Ridge Rd.	041100010602	20-001-000	8.35	418.00	B01S07	41.42462	-82.09520	Elyria	F_2,M_{HD},T,D
Black R. at Lorain @ E. 31st St.	041100010602	20-001-000	6.20	424.00	B01S06	41.44294	-82.10620	Elyria	C,B
Black R. at Lorain, upst. French Creek	041100010602	20-001-000	5.40	425.00	B01S15	41.45500	-82.11330	Avon	Lacustuary, C,T
Black R. at Lorain, dst. French Creek	041100010602	20-001-000	4.80	464.00	B01K50	41.46030	-82.12170	Avon	Lacustuary
					B01K51				C
Black R. upst. US Steel 002, dst. Island	041100010602	20-001-000	3.70	466.00	B01S22	41.45420	-82.13500	Lorain	Lacustuary, C,T
Black R. at Lorain, dst. E. 21st St.	041100010602	20-001-000	1.65	469.00	B01K32	41.45750	-82.16580	Lorain	Lacustuary, C
Black R. at Lorain, 0.15 mi dst RR bridge	041100010602	20-001-000	0.90	469.00	BO1K29	41.46860	-82.17330	Lorain	C
Black R. at Lorain, 0.18 Mi. upst. Erie St.	041100010602	20-001-000	0.60	470.00	B01K27	41.46830	-82.17250	Lorain	Lacustuary,T
Black R. at Lorain @ Mouth	041100010602	20-001-000	0.30	470.00	B01K26	41.47038	-82.17803	Lorain	Lacustuary, C
RM 10.18 Trib. Black R. @ Gulf Rd.	041100010602	20-001-001	0.68	10.20	301954	41.40547	-82.08607	Avon	F,M_Q,C,B
French Creek @ Mills Rd.	041100010601	20-002-000	10.41	11.80	B01P19	41.41879	-82.01340	Avon	F,M_Q,C
French Creek @ Riegelsberger Rd.	041100010601	20-002-000	9.02	17.20	B01P18	41.43496	-82.00290	Elyria	F,M_Q,C,B
French Creek @ Bridge Point Tr.	041100010601	20-002-000	5.50	25.40	301953	41.45708	-82.04079	Elyria	F_2,M_{HD},C
French Creek @ Camp Wahoo Dr.	041100010601	20-002-000	3.75	31.20	B01P32	41.46655	-82.06910	Elyria	C,B
French Creek @ Abbe Rd (SR 301)	041100010601	20-002-000	3.20	32.30	B01P32	41.46663	-82.06910	Avon	F_2,M_{HD},D
French Creek @ Gulf Rd.	041100010601	20-002-000	0.54	38.60	B01S14	41.45829	-82.10570	Elyria	F,M_Q,Q_L,T
Heider Ditch @ Electric Blvd	041100010603	13-006-000	0.25	7.84	301955	41.50995	-82.01940	Avon	F,M_Q,C_E,B
Gable Ditch @ Electric Ave.	041100010603	13-010-000	0.30	1.39	301956	41.51065	-82.00636	Avon	F,M_Q,C_E,B
Powdermaker Ditch @ Electric Ave	041100010603	13-011-000	0.15	4.25	301958	41.50301	-82.05202	Avon	F,M_Q,C_E,B
E. Br. Black R. @ Shaw Rd. (Twp 99)	041100010303	20-010-000	41.45	68.00	B01S34	41.08640	-82.06890	Lodi	F_2,M_{HD},C,B,T,D
E. Br. Black R. @ Old Mill Rd (Twp 68)	041100010303	20-010-000	40.47	72.00	B01K07	41.08590	-82.06920	Lodi	F_2,M_{HD},C,D
RM 39.06 Trib. EB Black R @ Garver Rd. (2013)	041100010303	20-010-010	3.60	3.20	B01K13	41.12530	-82.04310	Lodi	M_Q
RM 39.06 Trib. EB Black R @ Spencer Lake Rd.	041100010303	20-010-010	2.16	4.66	Q01K04	41.11316	-82.05757	Lodi	F,M_Q,C

Assessment Unit/ Site Name	HUC 12	River Code	River Mile	Drainage Area	EA3 Station	Latitude	Longitude	USGS Quad	Sampling
Coon Creek @ River Corners Rd	041100010303	20-013-000	0.88	10.20	301933	41.09605	-82.09456	Lodi	F,M_Q,C,B
RM 41.41 Trib. EB Black R. @ Shaw Rd. (Lower)	041100010303	20-010-011	0.35	1.77	302006	41.07514	-82.04606	Lodi	F,MQ,C
E. Br. Black R. @ River Corners Rd.	041100010401	20-010-000	36.80	96.00	201591	41.10856	-82.09430	Lodi	F_2,M_{HD},C
E. Br. Black R. @ Smith Rd. (Lorain/Medina County Line)	041100010401	20-010-000	32.42	104.00	B01S33	41.13665	-82.11660	LaGrange	F_2,M_{HD},Q_L,T
Rm 28.65 Trib. E. Br. Black R. @ Foster Rd.	041100010401	20-010-008	1.50	5.30	201599	41.15706	-82.08950	LaGrange	F,M_Q,C,B
E. Br. Black R. @ Short Rd.	041100010402	20-010-000	24.60	136.00	201589	41.18948	-82.29780	LaGrange	F_2,M_{HD},C,T
E. Br. Black R. @ Vermont Ave.	041100010402	20-010-000	18.94	158.00	B01S32	41.23435	-82.08160	LaGrange	F_2,M_{HD},C,B,T
RM 22.65 Trib. E. Br. Black R. @ Vermont Rd.	041100010402	20-010-006	0.60	6.40	B01K09	41.20376	-82.07730	LaGrange	F,M_Q,C,B
Salt Creek @ Chamberlain Rd.	041100010402	20-011-000	0.53	6.73	301934	41.23024	-82.06224	LaGrange	F,M_Q,C,B
Crow Creek @ Vermont Rd.	041100010402	20-012-000	0.80	3.70	201602	41.18640	-82.08180	LaGrange	F,M_Q,C,B
E. Br. Black R. @ Parsons Rd.	041100010404	20-010-000	11.34	179.00	B01S31	41.27152	-82.06680	Grafton	F_2,M_{HD},C,T,D
E. Br. Black R. dst. Grafton WWTP @ Indian Hollow Park	041100010404	20-010-000	10.50	180.00	B01S30	41.27855	-82.07540	Grafton	F_2,M_{HD},Q
E. Br. Black R. upst. Brentwood Trib. (Adj. Robson Rd.)	041100010404	20-010-000	6.00	185.00	B01S29	41.32537	-82.07629	Grafton	F_2,M_{HD},C,B
E. Br. Black R. @ Fuller Rd.	041100010404	20-010-000	3.07	217.00	B01S11	41.34711	-82.09480	Grafton	F_2,M_{HD},Q_L,T
E. Br. Black R. at Elyria @ E. Bridge St.	041100010404	20-010-000	1.14	222.00	B01P10	41.36976	-82.09870	Grafton	C_O,S
E. Br. Black R. at Elyria @ Washington St.	041100010404	20-010-000	0.36	222.00	B01P07	41.36875	-82.10640	Grafton	F_2,M_{HD},C_O,B,T,S,D
RM 5.89 Trib. E. Br. Black R. (Brentwood Trib.) @ Waterfall Dr.	041100010404	20-010-002	1.00	4.45	301936	41.31855	-82.07265	Grafton	F,M_Q,C
RM 5.89 Trib. E. Br. Black R. (Brentwood Trib.) @ Robson Rd.	041100010404	20-010-002	0.10	7.19	301937	41.32533	-82.07559	Grafton	F,M_Q,C,B
Willow Creek upst. Eaton Estates @ Island Rd	041100010403	20-010-001	6.49	2.99	301935	41.31461	-82.00140	Grafton	F,M_Q,C,B
Willow Creek @ Durkee Rd.	041100010403	20-010-001	2.85	13.30	B01S38	41.32649	-82.05070	Grafton	F,M_Q,C,B,D
E. Fk. E. Br. Black R. @ Chippewa Rd.	041100010301	20-014-000	5.84	7.60	B01W12	41.07709	-82.02211	Lodi	F,M_Q,C
E. Fk. E. Br. Black R. @ Lodi City Park	041100010301	20-014-000	2.67	12.90	B01S36	41.03654	-82.01210	Lodi	F,M_Q,C,B
E. Fk. E. Br. Black R. upst. Lodi WWTP	041100010301	20-014-000	1.73	13.90	B01W11	41.03794	-82.02030	Lodi	F,M_Q,C,D
E. Fk. E. Br. Black R. dst. Lodi WWTP	041100010301	20-014-000	1.60	14.00	B01S35	41.03827	-82.02037	Lodi	F,M_Q,C,D
E. Fk. E. Br. Black R. at Mouth @ Richmond Rd.	041100010301	20-014-000	0.06	15.20	B01W10	41.05004	-82.03440	Lodi	C,B,D
W. Fk. E. Br. Black R. @ T391	041100010302	20-015-000	13.97	14.10	301931	41.05104	-82.20172	Sullivan	F,M_Q,C
W. Fk. E. Br. Black R. @ SR 301	041100010302	20-015-000	8.90	25.00	201609	41.03861	-82.12602	Sullivan	F_2,M_{HD},C

Assessment Unit/ Site Name	HUC 12	River Code	River Mile	Drainage Area	EA3 Station	Latitude	Longitude	USGS Quad	Sampling
W. Fk. E. Br. Black R. @ SR 421	041100010302	20-015-000	2.30	41.10	201607	41.02750	-82.04120	Lodi	F_D,M_{HD},C
W. Fk. E. Br. Black R. @ Hidden Hollow Park	041100010302	20-015-000	1.20	41.50	201606	41.03902	-82.03970	Lodi	F_D,M_{HD},C
W. Fk. E. Br. Black R. @ Sanford Rd.	041100010302	20-015-000	0.34	42.20	B01W13	41.04573	-82.03566	Lodi	F_D,M_{HD},C,B
Clear Creek @ Pawnee Rd.	041100010302	20-016-000	1.80	6.20	201615	41.01438	-82.07790	Lodi	F,M_Q,C,B
W. Br. Black R. S of Rochester @ Stewart Rd.	041100010502	20-020-000	48.10	4.30	201627	41.08612	-82.31990	Nova	F,M_Q,C
W. Br. Black R. at Rochester @ St. Rt. 511	041100010502	20-020-000	41.67	16.00	B01S41	41.13342	-82.30670	Brighton	F,M_Q,C,T
W. Br. Black R. S of Brighton @ St. Rt. 511	041100010502	20-020-000	37.30	28.00	201624	41.15451	-82.31020	Brighton	F_2,M_{HD},C
W. Br. Black R. NW of Wellington @ Pitts Rd.	041100010502	20-020-000	28.50	37.00	B01K21	41.18572	-82.24240	Wellington	F_2,M_{HD},Q_L,T
East Creek @ Stocking Rd	041100010502	20-020-003	0.56	5.40	B01W23	41.13792	-82.33210	Brighton	F,M_Q,C,B
Buck Creek SE of Rochester @ Bursley Rd.	041100010502	20-025-000	0.95	4.80	B01S46	41.11547	-82.28320	Nova	F,M_Q,C,B
W. Br. Black R. N of Wellington @ St. Rt. 58	041100010504	20-020-000	25.30	67.00	B01S40	41.20572	-82.21712	Wellington	F_2,M_{HD},C,T
W. Br. Black R. @ St. Rt. 303	041100010504	20-020-000	19.60	80.00	201620	41.23720	-82.19850	Wellington	F_2,M_{HD},C
W. Br. Black R. @ West Rd (Nickel Plate Rd.)	041100010504	20-020-000	16.56	83.00	B01W19	41.26517	-82.17970	Oberlin	F_2,M_{HD},Q_L,T
W. Br. Black R. E. of Oberlin @ Parsons Rd.	041100010506	20-020-000	14.39	130.00	B01S39	41.27940	-82.16230	Oberlin	PWS
W. Br. Black R. @ Metroparks Equestrian Area	041100010506	20-020-000	10.60	132.00	201619	41.29502	-82.14860	Oberlin	F_2,M_{HD},C,T,D
W. Br. Black R. Near Oberlin @ Butternut Ridge Rd.	041100010506	20-020-000	7.68	161.00	B01P01	41.31387	-82.16140	Oberlin	F_2,M_{HD},C,T,D
W. Br. Black R. upst. Elyria @ Oberlin-Elyria Rd.	041100010506	20-020-000	4.18	169.00	B01S13	41.33680	-82.12090	Grafton	F_2,M_{HD},C,B
W. Br. Black R. at Elyria, upst. Third St.	041100010506	20-020-000	1.20	172.00	B01K18	41.36520	-82.11220	Grafton	F_2,M_{HD},C,B,T
Elk Creek @ Metropark Property off Parsons Rd.	041100010506	20-022-000	0.15	7.55	301945	41.27940	-82.16230	Oberlin	F,M_Q,C
Kelner Ditch @ Parsons Rd.	041100010506	20-020-001	3.00	4.40	201629	41.27468	-82.13218	Oberlin	F,M_Q,C,D
Kelner Ditch @ Nickel Plate Diagonal Rd.	041100010506	20-020-001	1.00	9.40	B01W15	41.29237	-82.13978	Oberlin	F,M_Q,C,B
Charlemont Creek @ Baker Rd	041100010501	20-024-000	8.55	10.80	301938	41.11935	-82.25751	Nova	F,M_Q,C
Charlemont Creek @ Wellington WTP Intake	041100010501	20-024-000	3.00	22.00	301939	41.16493	-82.24760	Wellington	PWS
Charlemont Creek @ Pitts Rd.	041100010501	20-024-000	2.20	22.60	201634	41.17492	-82.24260	Wellington	F,M_Q,C,B,D
Charlemont Creek @ Peck-Wadsworth Rd.	041100010501	20-024-000	0.39	25.80	B01P05	41.18975	-82.22740	Wellington	F_2,M_{HD},Q_L
RM 0.51 Trib. To Charlemont Creek Ust Wellington WWTP	041100010501	20-024-001	1.00	1.75	301940	41.17570	-82.22850	Wellington	F,M_Q,C
Wellington WWTP 001 Outfall	041100010501	20-024-001	0.92		301941	41.17923	-82.22689	Wellington	C
RM 0.51 Trib. To Charlemont Creek Dst Wellington WWTP	041100010501	20-024-001	0.76	1.75	301943	41.17923	-82.22689	Wellington	F,M_Q,C
Wellington Creek @ Bursley Rd.	041100010503	20-023-000	17.10	5.20	201633	41.11618	-82.20950	Sullivan	F,M_Q,Q

Assessment Unit/ Site Name	HUC 12	River Code	River Mile	Drainage Area	EA3 Station	Latitude	Longitude	USGS Quad	Sampling
Wellington Creek @ Cemetery Rd.	041100010503	20-023-000	13.09	10.50	B01S43	41.19984	-82.17680	Wellington	F,M_Q,C,B
Wellington Creek @ Webster Rd.	041100010503	20-023-000	8.40	19.70	201632	41.26524	-82.16830	Oberlin	F_2,M_{HD},C
Wellington Creek Near Mouth @ Nickel Plate Rd.	041100010503	20-023-000	0.60	29.60	201630	41.11618	-82.20950	Oberlin	F_2,M_{HD},Q
Plum Creek at @ Morgan St.	041100010505	20-021-000	5.57	4.77	301944	41.28860	-82.20890	Oberlin	F,M_Q,C,B
Plum Creek upst. Oberlin WWTP @ St. Rt. 511	041100010505	20-021-000	3.19	7.60	B01P03	41.29568	-82.18396	Oberlin	F,M_Q,C,D
Oberlin WWTP Outfall to Plum Creek	041100010505	20-021-000	2.85	7.90	B01W03	41.29580	-82.18250	Oberlin	C
Plum Creek Just dst. Oberlin WWTP	041100010505	20-021-000	2.80	7.90	B01S10	41.30077	-82.15970	Oberlin	F,M_Q,C
Plum Creek @ Oberlin-Elyria Rd.	041100010505	20-021-000	0.71	9.28	B01P02	41.28860	-82.20890	Oberlin	F,M_Q,Q_L

Key for Table 1 Sample Type column:

- C - Chemistry site (5 rounds, base flow), "Stream_Survey" template
- C_O - Water chemistry as listed above plus 2 rounds water column organics[1]
- C_E - Water chemistry as listed above plus chlorophyll *a* and dissolved ortho P
- PWS - Public water supply, 10 rounds "Stream_Survey" template and water column organics[1]: 5 rounds summer 2012, 5 rounds spring 2013
- B - *E. coli* bacteria assessment site (5 rounds)
- F - One-pass fish Site (EAS)
- F_2 - Two-pass fish site (for reference sites and/or drainage area 20 sq. miles or greater)
- M_Q - Qualitative macroinvertebrate site – qualitative sample
- M_{HD} - Hester-Dendy quantitative macroinvertebrate site
- T - Fish tissue site
- Q - Sentinel Site: flow monitoring, chemistry (10 rounds), *E. coli* bacteria (10 rounds), Datasonde® continuous data recorder
- Q_O - Sentinel Site: same parameters and frequency as listed above, plus 2 rounds water column organics[1]
- Q_L - Sentinel Site: same parameters and frequency as listed above, plus continuous water level logger
- D - Datasonde® continuous data recorder
- S - Sediment sampling location
- Lacustuary - Biological sampling by Lake Erie monitoring staff. Include 2 passes for fish, and Hester-Dendy quantitative macroinvertebrate evaluation.

1 Water column organics sampling includes BNA (525), pesticides (608), PCB's (608), Cyanazine (525.2), Herbicides (525.2), Carbamates (531.1), and Glyphosate (547)

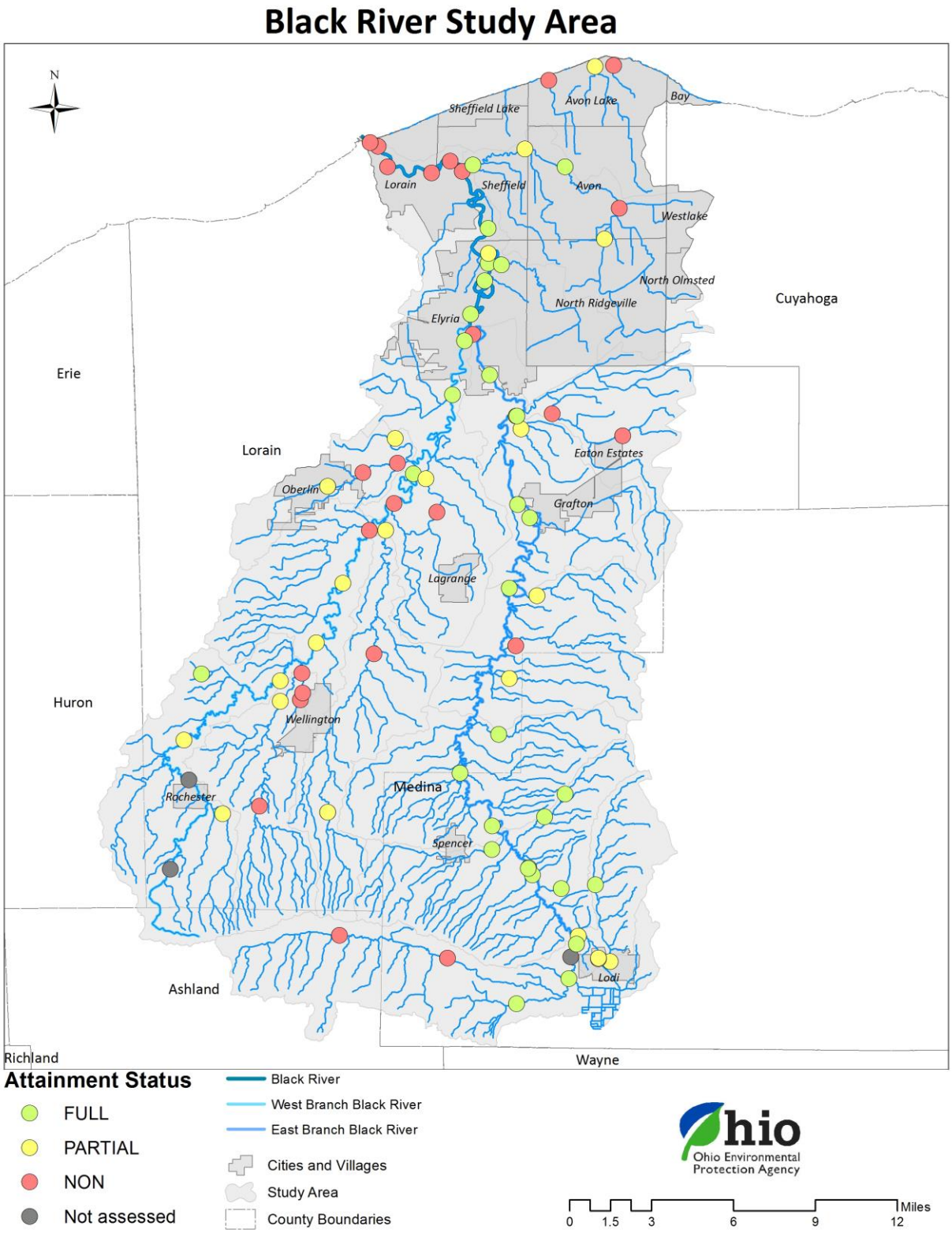


Figure 1. Map of the aquatic life use attainment status at sampling locations in the Black River basin, 2012.

Table 2. Aquatic life use attainment status for stations sampled in the Black River basin based on data collected July-October 2012. The Index of Biotic Integrity (IBI), Modified Index of well-being (MIwb), and Invertebrate Community Index (ICI) are scores based on the performance of the biotic community. The Qualitative Habitat Evaluation Index (QHEI) is a measure of the ability of the physical habitat to support a biotic community. All sites are located within the Erie-Ontario Lake Plain (EOLP) ecoregion. Yellow fill indicates sites associated with lacustuary targets and breakpoints; biocriteria are not applicable, so attainment status is based upon a narrative determination of the designated use. If impairment has occurred, the cause(s) and source(s) of the impairment are noted.

Location	River Mile^	Drain. Area	ALU	IBI	MIwb[a]	QHEI	ICI[b]	Attain. Status[c]	Causes	Sources
Black R. at Elyria at Cascade Park	14.95 (501520)	396.00[B]	WWH	45	9.44	83.0	36	FULL		
Black R. dst. Elyria, near Spring Valley Golf Club	11.50 (B01S09)	398.00[B]	WWH	42	9.55	72.5	36	FULL		
Black R. 250 ft. upst. Elyria WWTP	10.70 (B01W07)	401.00[B]	WWH	41	9.87	81.5	--	(FULL)		
Black R. dst. Elyria WWTP at Ford Rd.	9.80 (501510)	412.00[B]	WWH	45	9.46	79.5	26*	**PARTIAL**	Specific Conductance Nutrient/eutrophication biological indicators	Municipal point source discharge
Black R. at Sheffield at North Ridge Rd.	8.35 (B01S07)	418.00[B]	WWH	43	10.18	76.5	32[NS]	FULL		
Black R. at Lorain, upst. French Creek (Lacustuary)	5.40 (B01S15)	425.00[B]	WWH	47	9.53	45.5	14*	**NON**	Other flow regime alterations	Habitat modification other than hydromodification
Black R. at Lorain, dst. French Creek (Lacustuary)	4.80 (B01K50)	464.00[B]	WWH	34*	7.94*	39.0	16*	**NON**	Other flow regime alterations	Habitat modification other than hydromodification
Black R. upst. U.S. Steel 002, dst. Island (Lacustuary)	3.70 (B01S22)	466.00[B]	WWH	41*	8.73	--	16*	**NON**	Other flow regime alterations	Habitat modification other than hydromodification
Black R. at Lorain at E. 21st St. (Lacustuary)	1.84 (501540)	468.00[B]	WWH	41*	8.62	31.5	18*	**NON**	Other flow regime alterations	Habitat modification other than hydromodification
Black R. at Lorain, 0.18 mi. upst. Erie St. (Lacustuary)	0.60 (B01K27)	470.00[B]	WWH	42	8.11*	39.5	14*	**NON**	Other flow regime alterations	Habitat modification other than hydromodification
Black R. at Lorain, near mouth (Lacustuary)	0.3 (B01K26)	470.50[B]	WWH	32*	6.81*	8.0	14*	**NON**	Other flow regime alterations	Habitat modification other than hydromodification
Trib. Black R. (RM 10.18) at Gulf Rd.	0.68 (301954)	10.20[H]	WWH[+]	50	n/a	54.0	G	FULL		
French Creek E of Elyria at Mills Rd.	10.41 (B01P19)	11.80[H]	WWH	38[NS]	n/a	49.5	LF*	**PARTIAL**	Nutrient/eutrophication biological indicators Direct habitat alterations	On-site treatment systems (septic) Channelization
French Creek SE of Avon at Riegelsberger Rd.	9.02 (B01P18)	17.20[H]	WWH	32*	n/a	57.0	LF*	**NON**	Nutrient/eutrophication biological indicators Direct habitat alterations	On-site treatment systems (septic) Channelization
French Creek at Bridge Point Trail	5.50 (301953)	25.40[W]	WWH	34[NS]	8.02	81.3	34	FULL		

Location	River Mile^	Drain. Area	ALU	IBI	MIwb[a]	QHEI	ICI[b]	Attain. Status[c]	Causes	Sources
French Creek NE of Lorain at Abbe Rd. (St. Rt. 301)	3.20 (B01P32)	32.30[W]	WWH	30*	6.21*	72.5	36	**PARTIAL**	Impairment unknown	Source unknown
French Creek near Lorain at E. River Rd.	0.54 (B01S14)	38.60[W]	WWH	35[NS]	8.51	87.0	38	FULL		
Heider Ditch at Electric Ave.	0.25 (301955)	7.84[H]	WWH+	38[NS]	n/a	54.3	LF*	**PARTIAL**	Direct habitat alterations	Channel erosion from upstream hydromodifications
Gable Ditch at Electric Ave.	0.30 (301956)	1.39[H]	WWH+	26*	n/a	55.8	P*	**NON**	Direct habitat alterations	Channel erosion from upstream hydromodifications
Powdermaker Ditch at Electric Ave.	0.15 (301958)	4.25[H]	WWH+	32*	n/a	54.5	P*	**NON**	Direct habitat alterations	Channel erosion from upstream hydromodifications Loss of riparian habitat
E. Br. Black R. NW of Lodi at Shaw Rd. (Twp. Rd. 99)	41.45 (B01S34)	68.00[W]	WWH	42	8.51	63.5	F*	**PARTIAL**	Sedimentation/siltation	Dam or impoundment
E. Br. Black R. NW of Lodi, upst. Old Mill Dam (Twp. Rd. 68)	40.80 (302107)	72.00[B]	WWH	36[NS]	8.15	56.5	--	FULL		
E. Br. Black R. NW of Lodi at Old Mill Rd. (Twp. Rd. 68)	40.47 (B01K07)	72.00[W]	WWH	35[NS]	9.62	67.5	34	FULL		
E. Br. Black R. W of Spencer Lake at River Corners Rd.	36.80 (201591)	96.00[W]	WWH	36[NS]	9.07	69.5	46	FULL		
E. Br. Black R. at Lorain/Medina Co. line (Smith Rd.)	32.42 (B01S33)	104.0[W]	WWH	--	--	--	38	(FULL)		
E. Br. Black R. SE of LaGrange at Short Rd.	24.60 (201589)	136.0[W]	WWH	37[NS]	9.40	65.0	G	FULL		
E. Br. Black R. E of LaGrange at Vermont St. (Co. Rd. 62)	18.94 (B01S32)	158.0[W]	WWH	38	8.27	65.5	52	FULL		
E. Br. Black R. at Grafton at Parsons Rd.	11.34 (B01S31)	179.0[W]	WWH	46	9.57	81.0	50	FULL		
E. Br. Black R. dst. Grafton WWTP at Indian Hollow Park	10.50 (B01S30)	180.0[W]	WWH	36[NS]	9.15	68.5	38	FULL		
E. Br. Black R. S of Elyria, upst. Brentwood Trib.	6.00 (B01S29)	185.0[W]	WWH	31*	9.09	51.5	52	**PARTIAL**	Natural conditions (flow or habitat)	Natural sources
E. Br. Black R. upst. Elyria at Fuller Rd.	3.07 (B01S11)	217.0[W]	WWH	40	9.59	70.0	34	FULL		
E. Br. Black R. at Elyria at Washington St.	0.36 (B01P07)	222.0[B]	WWH	33*	7.68*	64.5	8*	**NON**	Sedimentation/siltation	Dam or impoundment
Trib. to E. Br. Black R. (RM 41.41) at Shaw Rd. (Lower)	0.35 (302006)	1.77[H]	CWH+	44	n/a	60.0	VG	FULL		
Trib. to E. Br. Black R. (RM 39.06) at Spencer Lake Rd. (2013)	3.60 (B01K13)	3.20[H]	CWH+	n/a	n/a	n/a	MG	FULL		
Trib. to E. Br. Black R. (RM 39.06) at Spencer Lake Rd.	2.16 (Q01K04)	4.66[H]	CWH+	38[NS]	n/a	69.3	G	FULL		

Location	River Mile^	Drain. Area	ALU	IBI	MIwb[a]	QHEI	ICI[b]	Attain. Status[c]	Causes	Sources
Coon Creek at River Corners Rd.	0.88 (301933)	10.20[H]	WWH	40	n/a	73.0	MG[NS]	FULL		
Trib. to E. Br. Black R. (RM 28.65) at Foster Rd.	1.50 (201599)	5.30[H]	WWH+	38[NS]	n/a	45.5	MG[NS]	FULL		
Crow Creek NE of Penfield at Vermont Rd.	0.80 (201602)	3.70[H]	WWH	42	n/a	48.0	F*	**PARTIAL**	Natural conditions (flow or habitat)	Natural sources
Trib. to E. Br. Black R. (RM 22.65) at Vermont Rd.	0.60 (B01K09)	6.40[H]	WWH+	30*	n/a	54.5	LF*	**NON**	Natural conditions (flow or habitat)	Natural sources
Salt Creek at Chamberlain Rd.	0.53 (301934)	6.73[H]	WWH	40	n/a	58.0	F*	**PARTIAL**	Natural conditions (flow or habitat)	Natural sources
Trib. to E. Br. Black R. (RM 5.89) (Brentwood Trib.) at Waterfall Dr.	1.00 (301936)	4.45[H]	WWH+	44	n/a	58.0	F*	**PARTIAL**	Natural conditions (flow or habitat)	Natural sources
Trib. to E. Br. Black R. (RM 5.89) (Brentwood Trib.) at Robson Dr.	0.10 (301937)	7.19[H]	WWH+	46	n/a	57.5	MG[NS]	FULL		
Willow Creek upst. Eaton Estates at Island Rd.	6.59 (301935)	2.99[H]	WWH	26*	n/a	41.0	P*	**NON**	Organic Enrichment Sedimentation/siltation Direct habitat alterations	On-site treatment systems (septic) Agriculture Channelization
Willow Creek SE of Elyria at Durkee Rd. (upst. crossing)	2.85 (B01S38)	13.30[H]	WWH	22*	n/a	62.5	F*	**NON**	Organic enrichment Sedimentation/siltation Direct habitat alterations	On-site treatment systems (septic) Agriculture Channelization
E. Fk. E. Br. Black R. N of Lodi at Chippewa Lake Rd.	5.84 (B01W12)	7.60[H]	WWH	38[NS]	n/a	70.5	G	FULL		
E. Fk. E. Br. Black R. at Lodi at Lodi City Park	2.67 (B01S36)	12.90[H]	WWH	36[NS]	n/a	52.5	F*	**PARTIAL**	Other flow regime alterations	Urban runoff/storm sewers
E. Fk. E. Br. Black R. 75 ft. upst. Lodi WWTP	1.73 (B01W11)	13.90[H]	WWH	36[NS]	n/a	77.0	F*	**PARTIAL**	Other flow regime alterations	Urban runoff/storm sewers
E. Fk. E. Br. Black R. dst. Lodi WWTP	1.60 (B01S35)	14.00[H]	WWH	52	n/a	82.0	F*	**PARTIAL**	Other flow regime alterations	Urban runoff/storm sewers
E. Fk. E. Br. Black R. at mouth at Richmond Rd.	0.06 (B01W10)	15.20[H]	WWH	44	n/a	52.5	F*	**PARTIAL**	Sedimentation/siltation	Urban runoff/storm sewers
W. Fk. E. Br. Black R. at Twp. Rd. 391	13.97 (301931)	14.10[H]	WWH	24*	n/a	59.0	F*	**NON**	Organic enrichment Natural conditions (flow or habitat)	Livestock (grazing or feeding operations) Natural sources
W. Fk. E. Br. Black River at Homer at St. Rt. 301	8.90 (201609)	25.00[W]	WWH	28*	7.76[NS]	49.0	LF*	**NON**	Organic enrichment Natural conditions (flow or habitat)	Livestock (Grazing or feeding operations) Natural sources
W. Fk. E. Br. Black River W of Lodi, dst. St. Rt. 421 and railroad	2.30 (201607)	41.10[W]	WWH	41	9.19	83.5	38	FULL		
W. Fk. E. Br. Black River W of Lodi at Hidden Hollow Park	1.15 (201606)	41.7[W]	WWH	--	--	--	VG	--		

Location	River Mile^	Drain. Area	ALU	IBI	MIwb[a]	QHEI	ICI[b]	Attain. Status[c]	Causes	Sources
W. Fk. E. Br. Black River at Sanford Rd.	0.34 (B01W13)	42.20[W]	WWH	39	9.30	71.5	36	FULL		
Clear Creek SW of Lodi at Pawnee Rd.	1.80 (201615)	6.20[H]	WWH	42	n/a	69.5	MG[NS]	FULL		
W. Br. Black R. S of Rochester at Stewart Rd.	48.10 (201627)	4.30[H]	WWH[+]	--	n/a	--	LF*	--		
W. Br. Black R.at Rochester at St. Rt. 511 (upst. crossing)	41.67 (B01S41)	16.00[H]	WWH[+]	--	n/a	--	MG[NS]	--		
W. Br. Black R. S of Brighton at St. Rt. 511 (dst. crossing)	37.30 (201624)	28.00[W]	WWH[+]	32*	6.75*	63.5	MG[NS]	**PARTIAL**	Sedimentation/siltation	Agriculture
W. Br. Black R. NW of Wellington at Pitts Rd.	28.50 (B01K21)	28.50[W]	WWH[+]	28*	6.82*	64.0	G	**PARTIAL**	Sedimentation/siltation	Agriculture
W. Br. Black R. N of Wellington at St. Rt. 58	25.30 (B01S40)	67.00[W]	WWH[+]	30*	6.05*	70.30	36	**PARTIAL**	Sedimentation/siltation	Agriculture
W. Br. Black R. E of Pittsfield at St. Rt. 303	19.60 (201620)	80.00[W]	WWH[+]	29*	6.79*	67.3	42	**PARTIAL**	Sedimentation/siltation	Agriculture
W. Br. Black R. at West Rd. (Kipton Nickel Plate Rd.)	16.56 (B01W19)	83.00[W]	WWH[+]	27*	6.58*	61.3	34	**NON**	Sedimentation/siltation Fish passage barrier	Agriculture Dam or impoundment
W. Br. Black R. at Metro Parks Equestrian Area	10.60 (201619)	132.0[W]	WWH	35[NS]	8.02	65.5	42	FULL		
W. Br. Black R. at Butternut Ridge Rd.	7.68 (B01P01)	161.0[W]	WWH	32*	7.10*	67.5	40	**PARTIAL**	Sedimentation/siltation Fish passage barrier	Agriculture Dam or impoundment
W. Br. Black R. upst. Elyria at Oberlin-Elyria Rd.	4.18 (B01S13)	169.0[W]	WWH	35[NS]	8.61	60.0	32[NS]	FULL		
W. Br. Black R. at Elyria, upst. Third St.	1.20 (B01K18)	172.0[W]	WWH	--	--	80.0	46	(FULL)		
Buck Creek SE of Rochester at Bursley Rd.	0.95 (B01S46)	4.80[H]	WWH	38[NS]	n/a	47.3	F*	**PARTIAL**	Natural conditions (flow or habitat)	Natural sources
Charlemont Creek at Baker Rd.	8.55 (301938)	10.80[H]	WWH	28*	n/a	65.0	F*	**NON**	Nutrient/eutrophication biological indicators	On-site treatment systems (septic)
Charlemont Creek W of Wellington at Pitts Rd.	2.20 (201634)	22.60[W]	WWH	32*	7.01*	64.5	G	**PARTIAL**	Nutrient/eutrophication biological indicators	On-site treatment systems (septic)
Charlemont Creek dst. of Wellington at Peck-Wadsworth Rd.	0.39 (B01P05)	25.80[W]	WWH	27*	6.09*	64.5	28*	**NON**	Nutrient/eutrophication biological indicators	Municipal point source discharge
Trib. to Charlemont Creek (RM 0.51) upst. Wellington WWTP	1.00 (301940)	1.75[H]	WWH[+]	26*	n/a	70.5	F*	**NON**	Impairment unknown	Source unknown
Trib. to Charlemont Creek (RM 0.51) dst. Wellington WWTP	0.76 (301943)	1.75[H]	WWH[+]	38[NS]	n/a	64.0	P*	**NON**	Nutrient/eutrophication biological indicators	Municipal point source discharge
Wellington Creek at Bursley Rd.	17.10 (201633)	5.20[H]	WWH	28*	n/a	57.0	LF*	**NON**	Natural conditions (flow or habitat)	Natural sources

Location	River Mile^	Drain. Area	ALU	IBI	MIwb[a]	QHEI	ICI[b]	Attain. Status[c]	Causes	Sources
Wellington Creek at Wellington at Cemetery Rd.	13.09 (B01S43)	10.50[H]	WWH	26*	n/a	62.3	LF*	**NON**	Natural conditions (flow or habitat)	Natural sources
Wellington Creek NE of Wellington at Webster Rd.	8.40 (201632)	19.70[H]	WWH	30*	n/a	60.0	MG[NS]	**PARTIAL**	Nutrient/eutrophication biological indicators	On-site treatment systems (septic)
Wellington Creek near mouth at Nickel Plate Rd.	0.60 (201630)	29.60[W]	WWH	33*	7.37[NS]	65.0	MG[NS]	**PARTIAL**	Nutrient/eutrophication biological indicators	On-site treatment systems (septic)
Elk Creek at Metro Park property off Parsons Rd.	0.15 (301945)	7.55[H]	WWH+	26*	n/a	61.0	MG[NS]	**NON**	Nutrient/eutrophication biological indicators Direct habitat alterations	Agriculture Channelization (upstream)
Plum Creek at Oberlin at Morgan St.	5.57 (301944)	4.77[H]	WWH	24*	n/a	52.5	F*	**NON**	Sedimentation/siltation	Urban runoff/storm sewers
Plum Creek upst. Oberlin WWTP at St. Rt. 511	3.19 (B01P03)	7.60[H]	WWH	34*	n/a	63.0	F*	**NON**	Sedimentation/siltation	Urban runoff/storm sewers
Plum Creek just dst. Oberlin WWTP	2.80 (B01S10)	7.90[H]	WWH	32*	n/a	66.0	F*	**NON**	Sedimentation/siltation	Urban runoff/storm sewers
Plum Creek E of Oberlin at Oberlin-Elyria Rd.	0.83 (B01P02)	9.28[H]	WWH	38[NS]	n/a	75.5	F*	**PARTIAL**	Bacterial slimes	Landfills
Kelner Ditch E of Oberlin at Parsons Rd.	3.0 (201629)	4.40[H]	WWH+	30*	n/a	62.5	F*	**NON**	Nutrient/eutrophication biological indicators	On-site treatment systems (septic) Agriculture
Kelner Ditch E of Oberlin at Nickel Plate Diagonal Rd.	1.0 (B01W15)	9.40[H]	WWH+	28*	n/a	67.3	G	**PARTIAL**	Nutrient/eutrophication biological indicators	On-site treatment systems (septic) Agriculture

a - MIwb is not applicable to headwater streams with drainage areas ≤ 20 mi².

b - An evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition was used when quantitative data was not available or considered unreliable. P=Poor, LF=Low Fair, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional

c - Attainment is given for the proposed aquatic life use when a change is recommended. WWH = Warmwater Habitat; CWH = Coldwater Habitat

e - No biological criteria for lacustuaries are promulgated in the Ohio WQS: IBI, MIwb, and ICI targets are used to help determine a narrative assessment of the designated WWH aquatic life use status.

ns - Nonsignificant departure from biocriteria (≤4 IBI or ICI units, or ≤0.5 MIwb units).

* - Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

^ - Letters in superscript refer to the fish site type and associated biocriteria as indicated in the table below. B = boat; W = wading; and H = headwater.

+ - Recommended aquatic life use based on data from this survey.

Biological Criteria/Targets - Erie-Ontario Lake Plain			
Index – Site Type	**EWH**	**WWH**	**MWH**
IBI - Headwaters	50	40	24
IBI - Wading	50	38	24
IBI - Boat	48	40	24
IBI – Lacustuary Target	-	42	-
MIwb - Wading	9.4	7.9	6.2
MIwb - Boat	9.6	8.7	5.8
MIwb – Lacustuary Target	-	8.6	-
ICI	46	34	22
ICI – Lacustuary Target	-	34	-

BENEFICIAL USE RECOMMENDATIONS

The streams in the Black River basin study area currently listed in the Ohio Water Quality Standards (WQS) are assigned the Warmwater Habitat (WWH) aquatic life use designation. The aquatic life use designation of many of these streams had been previously verified using biological data, with the exception of Elk Creek and a portion of the West Branch Black River (headwaters to RM 16.56). These two streams were originally designated for aquatic life use in the 1978 and 1985 Ohio WQS but the techniques used then did not include standardized approaches to the collection of instream biological data or numerical biological criteria. Powdermaker Ditch, Gable Ditch, Heider Ditch, unnamed tributary to Black River (RM 10.18), unnamed tributaries to East Branch Black River (RM 5.89 [Brentwood Tributary], RM 22.65, RM 28.65, RM 39.06, and RM 41.41), unnamed tributary to Charlemont Creek (RM 0.51), and Kelner Ditch have never been designated for aquatic life use. This study used biological and habitat data to evaluate, establish, and confirm aquatic life uses for streams in the Black River basin study area (Table 1, Table 2).

Twenty-seven streams in the Black River basin study area were evaluated for aquatic life and recreational use potential in 2012 (Table 3). Significant findings include the following:

- Two unnamed tributaries to East Branch Black River (RM 39.06 and RM 41.41) were not listed in the Ohio WQS but were included as part of the 2012 sampling effort. Biological sampling results indicated that the Coldwater Habitat (CWH) aquatic life use would be appropriate for these streams (Table 3). The unnamed tributary to East Branch Black River (RM 39.06) had four cold-water macroinvertebrates (*Dicranota* sp., *Zavrelimyia* sp., *Parametriochemus* sp., and *Paratanytarsus longistylus*) and one fish species (mottled sculpin). Three cold-water fish (mottled sculpin, redside dace, and southern redbelly dace) and two cold-water macroinvertebrates (*Leuctra* sp. and *Ceratopsyche slossonae*) were found in the unnamed tributary to the East Branch Black River (RM 41.41). Based upon the presence of these taxa, the two unnamed tributaries to East Branch Black River (RM 39.06 and RM 41.41) are recommended for the CWH aquatic life use.

- Fifteen streams with an existing WWH use designation should be maintained (Table 3). These streams include the Black River, French Creek, East Branch Black River, Willow Creek, Salt Creek, Crow Creek, Coon Creek, East Fork East Branch Black River, West Fork East Branch Black River, Clear Creek, West Branch Black River, Plum Creek, Wellington Creek, Charlemont Creek, and Buck Creek. Only a portion of West Branch Black River from RM 14.42 to the mouth had been previously verified as WWH; however, 2012 biological sampling confirmed WWH for the remainder of the stream (Table 3).

- Elk Creek currently has an unverified WWH aquatic life use dating back to the 1985 Ohio WQS. Biological sampling conducted on Elk Creek verified that WWH is appropriate (Table 3). As noted above, only a portion of West Branch Black River had been verified in the WQS, but 2012 sampling confirmed WWH is appropriate for the rest of the stream.

- The remaining nine streams from the 2012 study – Powdermaker Ditch, Gable Ditch, Heider Ditch, unnamed tributary to Black River (RM 10.18), unnamed tributaries to East Branch Black River (RM 5.89 [Brentwood Tributary], RM 22.65, and RM 28.65), unnamed tributary to Charlemont Creek (RM 0.51), and unnamed tributary to Charlemont Creek (RM 0.51) – were not listed in the Ohio WQS but were included as part of the 2012 sampling effort. Biological monitoring indicated that the WWH aquatic life use is appropriate and are recommended for these streams (Table 3).

- The State Resource Water (SRW) designation for two waterbodies (three stream reaches) in the Black River basin is recommended for removal (Table 3). Ohio EPA is in the process of re-assigning

waterbodies currently listed as SRW in the use designation rules (rules 3745-1-08 to 32 of the OAC) to a new antidegradation tier under Ohio's antidegradation rule (rule 3745-1-05 of the OAC). In 2012, Ohio EPA completed biological and habitat surveys of these two waterbodies, Wellington Creek and the West Branch Black River, and can assess the appropriateness of the SRW designation in the designated reaches (Wellington Creek within the boundaries of Findley State Forest [RMs 16.60-14.69] and the West Branch Black River from Parsons Rd. [RM 14.39] to U.S. Rt. 20 [RM 7.85]). The resulting data, along with any historical data available, demonstrated that these two waterbodies have attributes consistent with the general high quality water (GHQW) antidegradation category. The current SRW designation, therefore, no longer has any significance for these waterbodies. Consistent with paragraph (A)(25) of rule 3745-1- 05 of the OAC, the SRW designation for the waterbody segments is recommended for removal.

All 27 streams in this study should retain or be assigned the Primary Contact Recreation use (Class A for the Black River, East Branch Black River [St. Rt. 162 RM 38.73 to the mouth], and West Branch Black River [Hughes Rd. RM 18.10 to the mouth] and Class B for all other streams and stream reaches)[2], along with the Agricultural Water Supply and Industrial Water Supply uses (Table 3).

2 New revisions to the recreation use rules in Ohio became effective on January 4, 2016. However, as sampling to assess the recreation use for the Black River basin study area was designed and carried out when the previous rules were in effect, the assessment of data and determination of recreation use attainment status provided in this report were based on the prior rules.

Table 3. Waterbody use designation recommendations for the Black River basin. Designations based on the 1978 and 1985 water quality standards appear as asterisks (*). A plus sign (+) indicates a confirmation of an existing use and a triangle (Δ) denotes a new recommended use based on the findings of this report. Designated use based on justification other than the result of a biological field assessment performed by the Ohio EPA appears as an open circle (o). The Ohio EPA is re-assigning waterbodies currently listed as SRW in the use designation rules to the antidegradation tier GHQW, and these are shown on the table as asterisks (*) shaded in gray.

Waterbody Segment	Use Designations													Comments
		Aquatic Life Habitat						Water Supply			Recreation			
	SRW	WWH	EWH	MWH	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR	
Powdermaker Ditch		Δ							Δ	Δ		Δ		
Gable Ditch		Δ							Δ	Δ		Δ		
Heider Ditch		Δ							Δ	Δ		Δ		
Black River		+			+				+	+		+		
Trib. Black R. (RM 10.18)		Δ							Δ	Δ		Δ		
French Creek - Gulf rd. to mouth		+			+				+	+		+		
- all other segments		+							+	+		+		
East Branch		+							+	+		+		
Willow Creek (East Branch RM 5.56)		+							+	+		+		
Trib. to E. Br. Black River (RM 5.89) (Brentwood Trib.)		Δ							Δ	Δ		Δ		
Salt Creek		+							+	+		+		
Trib. to E. Br. Black R. (RM 22.65)		Δ							Δ	Δ		Δ		
Crow Creek		+							+	+		Δ		
Trib. to E. Br. Black R. (RM 28.65)		Δ							Δ	Δ		Δ		
Coon Creek		+							+	+		+		
Trib. to E. Br. Black R. (RM 39.06)						Δ			Δ	Δ		Δ		
Trib. to E. Br. Black R. (RM 41.41)						Δ			Δ	Δ		Δ		
East Fork		+							+	+		+		
West Fork		+							+	+		+		
Clear Creek		+							+	+		+		
West Branch - U.S. Rte. 20 to the Black River		+							+	+		+		
- Parsons rd. to U.S. Rte. 20	*	+							+	+		+		
- at RM 14.42	*	+						o	+	+		+		PWS intake - Oberlin
- all other segments		*\+							*\+	*\+		*\+		
Plum Creek		+							+	+		+		
Elk Creek		*\+							*\+	*\+		*\+		
Wellington Creek - Findley State Forest boundaries	*	+							+	+		+		
- all other segments		+							+	+		+		
Charlemont Creek - at RM 2.97		+						o	+	+		+		PWS intake - Wellington
- all other segments		+							+	+		+		
Trib. to Charlemont Creek (RM 0.51)		Δ							Δ	Δ		Δ		
Buck Creek		+							+	+		+		
Kelner Ditch		Δ							Δ	Δ		Δ		

INTRODUCTION

The Black River basin, delineated by United States Geological Survey as four 10-digit hydrological unit code (HUC) sub-watersheds (0411000103, 0411000104, 0411000105, and 0411000106), is located in north-central Ohio in Ashland, Cuyahoga, Huron, Lorain, and Medina counties (Figure 2). The Black River mainstem, French Creek, and the Outer Harbor are designated as an Area of Concern (AOC) by the International Joint Commission. A Remedial Action Plan (RAP) is currently in progress to address beneficial use impairments identified for the AOC. The Black River watershed was previously assessed by Ohio EPA in 1992 (Ohio EPA 1993) and 1997 (Ohio EPA 1998). Additional water quality assessments were conducted for portions of the watershed on various occasions, but the results of these studies have not been comprehensively compiled.

Figure 2. Location of the Black River basin in Ohio.

In 2012, the Ohio EPA conducted a water resource assessment of the Black River mainstem and tributaries using standard Ohio EPA protocols as described in Materials and Methods of the companion appendices to this report. Included in this study are assessments of the biological, habitat, surface water, sediment, and recreational (bacterial) condition. The Black River mainstem and 27 tributaries were evaluated with a total of 83 biological, 81 habitat, 22 fish tissue, 87 water chemistry, 4 sediment, and 52 recreation stations within the study area. Six stations were sampled in the Black River lacustuary in 2012 as part of a Great Lakes Restoration Initiative (GLRI) grant (#GL00E00569) received by Ohio EPA. A total of 59 National Pollutant Discharge Elimination System (NPDES) permitted wastewater facilities discharge in the Black River watershed.

Specific objectives of the evaluation were to:

- Monitor and assess the chemical, physical, and biological integrity of the principal drainage network of the Black River watershed in support of the TMDL process;
- Assess physical habitat influences on stream biotic integrity;
- Assess water quality for the support of recreational uses and assign appropriate recreational use designations for water bodies in the watershed;
- Provide data to evaluate progress in addressing the identified beneficial use impairments in the Area of Concern;
- Provide updated data to determine the effectiveness of long term measures to control combined sewer outfall (CSO) discharges in the city of Elyria and the village of Avon Lake as well as bypasses from permitted NPDES dischargers;
- Evaluate the appropriateness of existing use designations and assign uses to undesignated streams;
- Evaluate the effectiveness of stream restoration and preservation efforts in the watershed;
- Characterize the amount of resource degradation attributable to various land uses, including agricultural practices and urbanization;
- Determine any aquatic impacts from known potential sources, including point source dischargers and unsewered communities;
- Collect fish tissue samples for the Ohio Sport Fish Health and Consumption Advisory program; and
- Document any changes in the biological, chemical, and physical conditions of the study areas where historical information exists.

STUDY AREA DESCRIPTION

The northeast Ohio climate, where the Black River is located, is affected by its proximity to Lake Erie. The lake acts as a heat sink by moderating potential extremes in seasonal air temperatures. The average temperature is 50^0F with values rarely exceeding 90^0F or falling below 0^0F. The total yearly precipitation averages about 34.5 inches of rain and 43 inches of snow. Although the annual precipitation is moderate, occasionally large amounts of rain and snowfall are seen in areas closest to the lake in a phenomenon called "lake effect" precipitation.

The Black River watershed drains 467 mi^2 in Lorain County as well as portions of Ashland, Medina, Cuyahoga and Huron counties. Most streams in the Black River basin are designated with the WWH aquatic life beneficial use. The maximum gradient in the Black River basin is about 29.8 feet/mile in Charlemont Creek. The average gradient of the watershed ranges from approximately 9.5 feet/mile in the East and West branches to 7.6 feet/mile in the lower French Creek and mainstem sub-basins. (Lorain County Community Development Department 2011). There are some steep valleys located along streambanks, old beach ridges, and two waterfalls near the East and West branch confluences in Elyria, but generally, the relief of the watershed is low. The flatness of the topography limits the overland transport of water and encourages the formation of flooded zones and wetlands in low-lying areas.

Generally, little of the Black River's flow of water comes from ground water, owing to the low permeability of the clay soils and the shale bedrock that dominate the underlying geology. There is little opportunity for surface water to percolate into the aquifers. The vast majority of its water comes from storm runoff, which leaves the river naturally susceptible to wide fluctuations in stream flow throughout the year. Ground water resources yield only five to 25 gallons per minute from sandstone and shale bedrock and glacial end moraines. The exceptions to this are in the extreme southeast where 100 to 500 gallons per minute are available from a buried valley aquifer and, conversely, in the area near the mouth of the Black River where clay and silt deposits yield less than five gallons per minute (Ohio EPA 1998).

The entire Black River basin lies within the Erie-Ontario Lake Plain ecoregion. Like most of north central and northwest Ohio, geographic relief, formed by glacial advances and retreats, is mainly flat to gently rolling in the southern edges of the watershed, where glacial end moraines were formed. The soil associations of Mahoning, Trumbull and Ellsworth silt loams comprise 90% of the soils in the watershed. These glacial till soils are classified as somewhat poorly drained to moderately well-drained.

Many of the better drained soils are ancient sandy beach ridges, remnants of ancestral versions of present day Lake Erie. Between these sandy ridges, extensive swales of poorly to very poorly drained hydric soils exist. Historically in these flat areas, drainage is a problem and wetness is the main limitation to crop production in surface soils that are typically medium to fine textured silt loam or silty clay loam. Throughout the watershed, these areas have been extensively drained in order to be suitable for agricultural production.

Directly south of the city of Lodi and the glacial end moraines that surround the community park is an expanse of land known as "muckland." This muckland is a product of geology and glaciation. The glaciers created the terminal moraines in and around Lodi. The hillier terrain created by these moraines surround lower areas where water drains off and become trapped in the muckland expanses. The unique muckland areas have attracted species typically encountered in bogs or prairie kettles (Lorain County Community Development Department 2011).

Aside from these muckland sites, the Black River watershed has lost a substantial portion of its natural wetlands over time, as is the case in much of Ohio. Preservation of remaining original wetlands should be a

priority. Ohio's "no net loss" wetland policy often results in the removal of a wetland in one area and "restoring" it in an area that is sufficiently far away as to completely eliminate any functional ecological benefit for the original location. The destruction of any wetlands in the Black River watershed should result in the requirement to 'restore' or construct wetlands in the same 8-digit HUC basin.

A myriad of land uses can be seen in the watershed. The two largest land uses are agricultural land at 49.3% and forested land at 22.5%. Other land uses include developed land at 19.6% and wetlands at 6.7% (Figure 4).

The predominant soil types tend to erode readily; however, soil erosion is not uniform across the watershed. It varies as a function of local soil type, land slope, and land use. The soils in the watershed have an average soil loss tolerance of 3 tons/acre/year. Studies conducted by the Northeast Ohio Area Wide Coordinating Agency (NOACA) indicate that the area of greatest soil loss is the rolling till plain of western Medina County and southern Lorain County. This area comprises much of the upper portion of the Black River basin along both the East and West branches. The subbasins within these areas have greater than 20% of their land area eroding at a rate of more than 5 tons/acre/year. Over 17,000 acres were eroding at excessive levels in these basins. Cropland accounted for 82% of this total, followed by open space categories (*e.g.*, grasslands, forestlands, and pastures) at 14% and developed lands at 4%. These open space categories are areas least disturbed by human activities and are representative of background erosion problems. Therefore, naturally occurring erosion and sedimentation rates are high in much of the upper basin where steeper slopes and deep soil depths combine to create erosive conditions. Background erosion rates are considered to be one of the major sources of sediment loading in the watershed (Ohio EPA 1998).

Erosion on cropland can be substantial given that some commonly used agricultural practices result in the ground lying bare for extended periods of the year. This is a major problem in the Black River watershed. Much of the mainstem areas are urban and industrial, but much of the land in the upper watersheds is used for agricultural purposes. As shown in Figure 4, predominant land use in the AOC watershed is for agricultural enterprises (cropland and pastureland), at about 52% of the watershed. Forested areas are becoming more disconnected, but forests still account for 23% of the land use. Residential and urban development comprise about 18% of the land use in the watershed. The southern two thirds of the watershed (roughly south of U.S. Route 20) remain predominantly rural and agricultural (Black River Remedial Action Plan Coordinating Committee 2011).

In agricultural areas, plowing fields to the edge of waterways can cause significant soil loss into local streams by direct erosion of destabilized banks and loss of filtration of surface runoff. Sudden sediment loads can totally change a stream bottom habitat directly impacting the entire aquatic community, and sediments carry adsorbed nutrients. Allowing livestock access to streams accelerates bank erosion and increases nutrient levels in the water. Runoff from feed lots, animal waste piles or improper manure applications contributes nutrients to local streams. Over application or untimely application of herbicides/pesticides stresses or eliminates aquatic organisms.

Vegetation along the embankments of streams and lakes offers many benefits to both aquatic and terrestrial biota, including lower sedimentation rates through stream bank stabilization, filtration of runoff waters, food source, cooler water temperatures and more stable flows, and habitat enhancement. Protection of existing riparian corridors is as important as the need to reestablish vegetation. Conservation easements, land trusts, education, zoning ordinances and other responsible legislation are valuable tools for riparian corridor protection.

Soil erosion is detrimental in many ways. Soil loss from fertile cropland not only harms productivity, but does considerable damage to the drainage network throughout the watershed. Furthermore, sediment deposited on stream bottoms smothers benthic habitat sites and interferes with the reproductive cycle of many fish species, irritates and clog the gills of many fish species, and reduces the amount of light available to aquatic plants and therefore reduces the diversity and numbers of species in the aquatic environment. In addition, cropland runoff and discharges from treatment facilities are adding excessive levels of nutrients to the watershed. The Ohio EPA Phosphorus Reduction Strategy for Lake Erie ranks this watershed as a "Priority 1" area. The Black River is estimated to contribute 107 metric tons of phosphorus each year into Lake Erie (Ohio EPA 1993).

Construction activities such as individual houses, residential developments, commercial properties and industrial sites occur sporadically throughout the Black River watershed. Typically, the northern East Branch subwatersheds have seen more construction activities and that is expected to increase with the completion of the new Lorain County Rural Wastewater District sewage collection system in Carlisle and Eaton townships. Within the past decade, much of this area, located primarily in the Black River, French Creek and Heider Ditch-Frontal Lake Erie 12-digit HUCs, has been and continues to be converted to extensive residential, commercial and industrial uses. The increased impervious surfaces coupled with the already poorly drained hydric soils cause serious flooding problems for the communities in these areas.

As evidenced by the flow hydrograph (Figure 3) from the USGS gauging station in Elyria, the Black River may be in a period of instability. While precipitation rates in the region have remained relatively constant, the river flow has been increasing. This instability is likely caused by increased discharge flow from municipal treatment plant and changes in land uses. The flashy flow leads to increased flooding and the force of additional flow within dredged and channelized streams leads to more stream bank erosion.

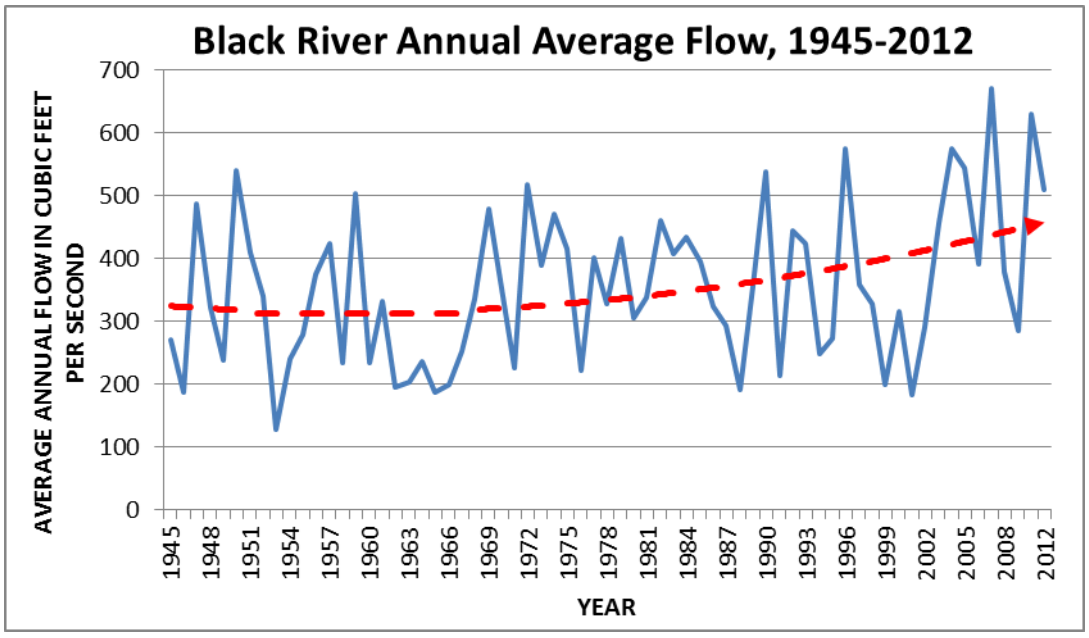


Figure 3. Annual average flow in the Black River, (Source: USGS flow gage for Black River at Ford Road).

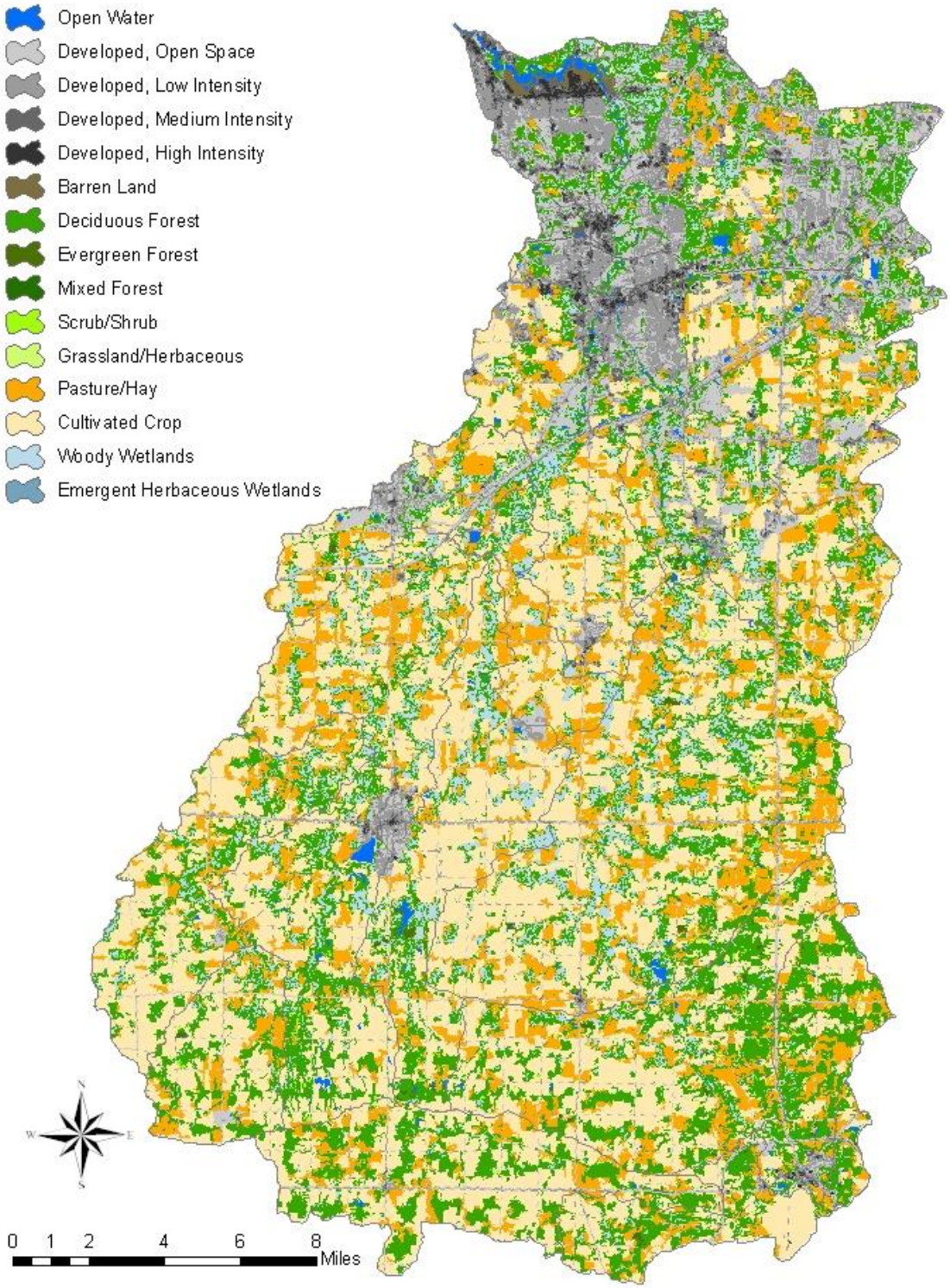


Figure 4. Land use in the Black River watershed, (Source: National Land Cover Database 2011 [Homer et al., 2015]).

Conversion of fields and open space to developed land creates more impervious surface, which contributes more water volume to the river in a shorter period of time. The low permeability of the soils means that the streams and rivers within the watershed are heavily affected by overland and effluent-driven flow. This creates "flashy" flow situations where periods of low or moderate flow can rapidly morph into high flow during heavy rain or snowmelt events. Additional volume and velocity contributions from increased urbanization can lead to severe flooding problems during even moderate rain events. Flow instability throws off the natural stream mechanics and can create down cutting and bank destabilization problems at the source, and excessive sedimentation/deposition further downstream.

Uncontrolled storm water runoff from disturbed land can carry tons of soil into local streams, which can devastate an aquatic community. If the excavated area is to exceed 5 acres, then an NPDES permit must be filed with Ohio EPA and a storm water plan developed. Each of the local Soil and Water Conservation Districts are to work with the Ohio EPA and developers to minimize soil loss from these properties.

A high percentage of the septic systems in this watershed are well beyond 20 years in age (the expected life of a system). Additionally, high percentages of clay content in the local soils further contribute to high failure rates of septic systems. Inadequately treated sewage impacts the water quality of roadside ditches, wetlands, streams and lakes. This can cause health hazards in drinking and recreational waters, decreased oxygen levels, excessive aquatic plant growth and offensive odors.

For more than 150 years, industries have discharged industrial wastes to the mainstem. By 1989, degradation of the water resource had become so severe that the International Joint Commission designated the lower six miles of the Black River and its harbor as one of four Areas of Concern (AOC) on Ohio's Lake Erie shoreline. This designation, which categorized the lower Black River as one of the most degraded resources in the Great Lakes, necessitated the formation of a Remedial Action Plan (RAP) to resolve the severe degradation. During the formation of the local AOC Coordinating Committee, it was decided to enlarge the AOC to encompass the entire Black River watershed into the AOC due to additional watershed concerns and their input and effect on the lower mainstem. Of 14 possible AOC Beneficial Use Impairments (BUIs), the Black River Coordinating Committee identified nine:

Fish tumors and other deformities	Degradation of benthos	Beach closings (recreational use)
Restrictions on fish consumption	Restrictions on dredging activities	Degradation of aesthetics
Degradation of fish populations	Eutrophication or undesirable algae	Loss of fish and wildlife habitat

Since its inception, the Black River AOC Committee has seen many improvements that have allowed a redesignation of the Fish Tumors and Other Deformities BUI from impaired to in recovery phase, the removal of the Degradation of Benthos BUI impairment in the East Branch subbasin and the lifting of the dermal contact advisory, due to chemical contamination, in the mainstem, and the removal of the East and West branches from the AOC delineation, as degraded conditions in these sub-basins had dramatically improved. Two important remediation plans have recently been developed by the Black River AOC Committee and other local stakeholders - the Lower Black River Ecological Restoration Master Plan and the state-endorsed Black River Watershed Action Plan. Since the Master Plan was developed in 2009, the city of Lorain has completed several projects designed to improve aquatic and streambank habitat conditions and has contracted to complete several more. As these projects mature and the new projects are completed, considerable improvements in biocriteria scores in the mainstem are expected. The endorsed Watershed Action Plan has been designed to focus on developing locally-driven remedial strategies to restore aquatic and terrestrial habitats, improve stream function, and, ultimately, enhance the quality of the Black River watershed resource.

RESULTS AND DISCUSSION

NPDES PERMITTED FACILITIES

A total of fifty-four National Pollutant Discharge Elimination System (NPDES) permitted facilities discharge sanitary wastewater, industrial process water, and/or industrial storm water into the Black River watershed within Lorain, Medina, and Ashland counties (Table 11). There are five wastewater treatment facilities which discharge over one million gallons per day (MGD) and two steel mills which discharge over one MGD of cooling and process wastewater; these seven facilities are the major dischargers within the basin. There are two other wastewater treatment facilities which discharge over 0.250 MGD: Wellington WWTP (0.750 MGD) and the Lagrange WPCP (0.363 MGD). Each facility is required to monitor their discharges according to sampling and monitoring conditions specified in their NPDES permit and report results to the Ohio EPA in a Discharge Monitoring Report (DMR). The larger facilities are discussed in greater detail below.

Elyria WWTP (3PD00034)

The Elyria wastewater plant is an advanced treatment facility with an average daily design flow of 13.0 MGD. Wet stream processes are screening, grit and scum removal, ferric chloride addition for phosphorus removal, primary settling, biological treatment with trickling filters and activated sludge aeration, secondary clarification, disinfection by chlorination, dechlorination and post-aeration. Solid stream processes include anaerobic digestion, dewatering by belt filter press, and sludge disposal at the PPG Lime Lakes Reclamation Facility. Elyria implements an Ohio EPA-approved industrial pretreatment program. There are four categorical industrial users and five significant non-categorical industrial users discharging to the wastewater plant.

Elyria's collection system is approximately 94 percent separate sanitary sewers and 6 percent combined sewers. Twenty-seven combined sewer overflows (CSOs) are authorized in the City's NPDES permit. A 1.6 million gallon wet weather storage tank is available at the Elyria plant to store flows greater than 30 MGD for subsequent treatment. The operating practice at the plant includes automatic diversion of any flow greater than 30 MGD to the wet weather storage tank, with bypass to the stream through station 003 occurring if the tank becomes full.

Under the terms of its previous NPDES permit, the City submitted an operational plan that documented implementation of the nine minimum CSO control measures, which was approved in May 1997, and submitted a long-term control plan for its CSOs on June 29, 1998. The City also completed certain recommendations of the plan under the terms of its previous NPDES permit including:

- Completed a dry weather outfall survey of entire Black River within Elyria city limits. Investigated and, where possible, eliminated all sources of pollution;
- Installed sumped catch basins in combined sewer areas tributary to East Avenue and 4th Street siphon to keep grit out of the collection system;
- Raised weir 18 inches at West River and Bond Street Overflow regulator CSO 130A, and raised weir 5 inches at the Barres Lane and West Avenue flow regulator number 143; and
- Maximized the Mussey Avenue sewer by diverting CSO 104 from existing 15-inch sewer to a 27-inch sewer.

The City's current NPDES permit includes a compliance schedule to address both CSOs and SSOs in a comprehensive, system-wide study.

Table 4. Effluent statistics for the Elyria WWTP.

Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
Outfall 001 to Black River (RM 10.6)				
TDS (mg/l)	1990	2797.5	2860	Monitor
Total Suspended Solids	5.0	17.0	20	30
Ammonia, Summer (mg/l)	0	0.8	1.5 (May-Sept) 3.0 (Apr, Oct, Nov) 8.0 (Dec-Mar)	2.0 (May-Sept) 5.0 (Apr, Oct, Nov) 12.0 (Dec-Mar)
Ammonia, Winter (mg/l)	0	2.3		
Nitrate (mg/l)	33.0	61.8	Monitor	Monitor
Phosphorus (mg/l)	0.48	1.29	1.0	1.5
Flow (MGD)	6.95	17.9	Monitor	Monitor

A compliance evaluation for the time period 2008 to 2012 indicated the following permit violations at the Elyria WWTP:

Outfall	Parameter	Months with Violations	Total Limit Violations	Qty. Violations	Conc. Violations
001	Chlorine	6	8	0	8
001	Fecal Coliform	3	3	0	3
001	Mercury, Total (Low Level)	1	1	0	1
001	Ammonia	3	7	0	7
001	Selenium	1	1	0	1
001	Total Suspended Solids	1	1	1	0
001	pH, Minimum	1	1	0	1

French Creek WWTP (3PD00043)

The French Creek WWTP was constructed in 1975 as a tertiary treatment plant and the last major modification was in 2003. The facility has a design flow of 11.25 MGD. The French Creek WWTP receives sewage from North Ridgeville, Avon, and the village of Sheffield. Treatment processes at the plant include automatic screens, flow equalization, grit removal, conventional activated sludge, biological phosphorus removal, addition of ferric chloride, secondary clarification, tertiary treatment using rapid sand filters, ultraviolet disinfection, and post-aeration. Sludge is stabilized by aerobic digestion and dried on sludge drying beds. The sludge is then land applied at agronomic rates under an approved sludge management plan.

The French Creek WWTP collection system is 100% separate sanitary sewer. The current average inflow and infiltration (I&I) rate is estimated to be 400,000 gallons per day. There are satellite communities that discharge to the French Creek WWTP. To minimize I&I, a satellite sewer discharge control program (SSDCP) was developed. The French Creek WWTP pretreatment program was approved by the Ohio EPA on June 19, 1996. The City has three metal finishers as well as other general industrial users.

Table 5. Effluent statistics for the French Creek WWTP.

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
Outfall 001 to French Creek (RM 2.6)				
Total Suspended Solids	1.8	8.0	8.0	12.0
Ammonia, Summer (mg/l)	0	1.01	1.0	1.5
Ammonia, Winter (mg/l)	0	1.03	2.7	4.0
Nitrate (mg/l)	33.0	61.8	Monitor	Monitor
Phosphorus (mg/l)	0.33	0.67	0.67	1.0
Flow (MGD)	4.52	8.34	Monitor	Monitor

A compliance evaluation for the time period 2008 to 2012 indicated the following permit violations at the French Creek WWTP:

Outfall	Parameter	Months with Violations	Total Limit Violations	Qty. Violations	Conc. Violations
001	Dissolved Oxygen	2	2	0	2
001	Mercury	7	9	2	7
001	Ammonia (NH3)	1	1	0	1
001	Total Suspended Solids	2	3	1	2
001	pH, Minimum	1	1	0	1

Grafton WWTP (3PB00024)

The Grafton WWTP was constructed in 1930 with the most current upgrade completed in 2001. The design flow is 1.5 MGD. The wet stream processes consist of bar screen, influent pumping, sequencing batch reactor, filtration, and ultraviolet disinfection. Solid stream processes are aerobic digestion, and dewatering using belt filter press. Ultimate sludge disposal is by municipal solid waste land filling.

The Grafton WWTP is served by a 100% separate sanitary sewer system that has unintentional bypasses or overflows. The village of Grafton is following the recommendations of the 2000 Modified Consent Order to minimize sources of infiltration and inflow (I&I). The current average I&I is 80 gallons per day (gpd). There are five industrial users (three categorical and two non-categorical) that discharge to this treatment works. The village of Grafton is not required to implement an approved pretreatment program.

Table 6. Effluent statistics for the Grafton WWTP.

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
Outfall 001 to East Branch Black River (RM 11.2)				
Total Suspended Solids (mg/l)	1.2	11.8	12.0	18
Ammonia, Summer (mg/l)	0.017	1.32	1.0	1.5
Ammonia, Winter (mg/l)	0.0398	1.68	3.0	4.5
Nitrate (mg/l)	6.2	16.3	Monitor	Monitor
Phosphorus (mg/l)	0.12	3.93	1.0	1.5
Flow (MGD)	0.934	1.83	Monitor	Monitor

A compliance evaluation for the time period 2008 to 2012 indicated the following permit violations at the Grafton WWTP:

Outfall	Parameter	Months with Violations	Total Limit Violations	Qty. Violations	Conc. Violations
001	Dissolved Oxygen	1	1	0	1
001	Mercury	2	3	1	2
001	Phosphorus	1	1	1	0
001	Total Suspended Solids	2	5	4	1

Lorain Black River WWTP (3PE00005)

The Black River WWTP has an average daily design flow of 15.0 MGD. The current wet stream processes include comminution, grit removal, pre-aeration, scum removal, primary sedimentation, phosphorus removal by ferrous chloride addition, conventional activated sludge, secondary clarification, post-aeration, chlorination and dechlorination. Solid stream processes are gravity thickening, dewatering by filter press, anaerobic digestion, and digester gas utilization. The digested sludge is disposed of at a mixed solid waste landfill or by land application at agronomic rates.

The Black River plant is served by separate sanitary and storm sewers.

The City implements an Ohio EPA-approved industrial pretreatment program at the Black River plant. Based on information in the 2011 annual program report, three categorical industrial users and eight significant non-categorical industrial users discharge to the treatment plant.

Table 7. Effluent statistics for the Lorain Black River WWTP.

Discharger/ Parameter	50^{th} Percentile	95^{th} Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
Outfall 001 to Black River (RM 0.08)				
Total Suspended Solids	7.8	19.0	20.0	30.0
Ammonia, Summer (mg/l)	7.2	16.6	12.0	Monitor
Ammonia, Winter (mg/l)	8.61	16.2	Monitor	Monitor
Nitrate (mg/l)	2.6	6.31	Monitor	Monitor
Phosphorus (mg/l)	0.52	1.03	1.0	1.5
Flow (MGD)	11.8	25.0	Monitor	Monitor

A compliance evaluation for the time period 2008 to 2012 indicated the following permit violations at the Lorain Black River WWTP:

Outfall	Parameter	Months with Violations	Total Limit Violations	Qty. Violations	Conc. Violations
001	Dissolved Oxygen	23	116	0	116
001	Mercury	16	29	14	15
001	Total Suspended Solids	2	2	2	0
001	pH, Minimum	2	6	0	6

Oberlin Water Environment Protection Facility (3PD00025)

The Oberlin WEPF operates under an average daily design flow of 1.5 MGD. The current plant was upgraded to advanced treatment in 1989 with the last major modification to the plant being completed and on-line in 2000. The current wet stream treatment processes consist of bar screens, grit removal, comminution, flow equalization, primary sedimentation, activated sludge (contact stabilization) alum addition to secondary treatment, secondary clarification, biological nitrification (separate stage nitrification towers), sand filtration and ultraviolet disinfection.

Under high flow situations due to (I&I) within the collection system, a portion of the influent to the wastewater treatment plant may be diverted to the equalization basins. From the equalization basins, the excess water is returned to the head of the plant when influent flows subside. If the basins become full, wastewater is diverted from primary and secondary treatment and blended into the flow from secondary treatment prior to ultraviolet disinfection. In accordance with monthly operating report data submitted by the City, the annual number of internal plant bypasses occurred as follows.

Year	**Number of Occurrences**
2010	31
2011	1
2012	2

The solid stream treatment processes incorporated at the Oberlin WEPF consist of aerobic digestion of sludge from secondary clarification processes, anaerobic digestion of sludge from primary clarification process, gravity thickening, sludge storage lagoons and land application at agronomic rates. The sludge is land applied in accordance with an approved sludge management plan.

The Oberlin WEPF collection system is reported to be 100% separate sanitary sewers. The current NPDES permit required the city of Oberlin to study and reduce I&I to its collection system, which previously contributed to overflows or bypasses within the collection system.

There are seven industrial users identified that discharge to the Oberlin WEPF collection system. Two of these are categorical industrial users and five are non-categorical, significant industrial users. Oberlin does not operate under or is required to have an approved Ohio EPA pretreatment program in place.

Table 8. Effluent statistics for the Oberlin Water Environment Protection Facility.

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
Outfall 001 to Plum Creek (RM 2.9)				
Total Suspended Solids	1.0	5.24	12.0	18.0
Ammonia, Summer (mg/l)	0	1.91	2.0	3.0
Ammonia, Winter (mg/l)	0.409	3.93	4.0	6.0
Nitrate (mg/l)	15.1	28.7	Monitor	Monitor
Phosphorus (mg/l)	0.48	0.886	1.0	1.5
Flow (MGD)	0.986	2.86	Monitor	Monitor

A compliance evaluation for the time period 2008 to 2012 indicated the following permit violations at the Oberlin Water Environment Protection Facility:

Outfall	Parameter	Months with Violations	Total Limit Violations	Qty. Violations	Conc. Violations
001	Mercury	4	6	2	4
001	Ammonia	8	15	14	1
001	Phosphorus	3	4	3	1
001	Total Suspended Solids	6	7	7	0
001	pH, Minimum	1	1	0	1

Republic Steel – Lorain Plant (3ID00028)

Republic Steel-Lorain is an integrated steel mill in operation in Lorain, Ohio. This facility consists of two blast furnaces for iron production, an electric arc furnace, a pig caster, two basic oxygen process vessels for steel production, a vacuum degasser, two continuous casters, a primary rolling mill, a 9”/10” bar mill and associated ancillary conditioning operations. Steel is cast into blooms and formed into ingots at the facility.

The process operations performed at this facility are classified by the Standard Industrial Classification (SIC) codes 3312, "Steel Works, Blast Furnace, Rolling" and 3317, "Steel Pipe and Tube." Discharges resulting from process operations are therefore subject to Federal Effluent Guideline (FEG) Limitations, contained in Chapter 40 of the CFR, Part 420, "Iron and Steel Manufacturing" Industrial Category.

The facility NPDES permit contains the following discharge outfalls:

002 Design flow 16.2 MGD. Non-contact cooling water (NCCW), continuous casting spray water emergency overflow, continuous casting make-up filter backwash, softener regenerant, raw water sludge dewatering, ground water, storm water, steam condensate, off-site discharges from the city of Lorain, discharge from the steelmaking wastewater treatment system (Outfall 612), non-contact cooling tower blowdown, boiler blowdown and boiler water treatment residuals prior to mixing with the Black River (Lat: 41 N 27' 15"; Long: 82 W 08' 20")

003 Design flow 44.78 MGD. Final effluent of discharges from internal monitoring station 603, NCCW, boiler blowdown, storm water, ground water, and steam condensate at the Ore Dock prior to mixing with the Black River (Lat: 41 N 27' 05"; Long: 82 W 09' 00")

004 Design flow 40.8 MGD. Final effluent of discharges from internal station 602, NCCW, boiler blowdown, boiler water treatment residuals, storm water, ground water, steam condensate at the Ore Dock prior to mixing with the Black River (Lat: 41 N 27' 06"; Long: 82 W 08' 55")

005 Design flow 8.68 MGD. Final effluent from Bar Mills prior to discharging to the Clinton Avenue storm sewer concrete catch basin, which may include discharges from internal outfall 605, NCCW, storm water, ground water, service water, and steam condensate (Lat: 41 N 27' 15"; Long: 82 W 07' 53")

007 Final effluent from the backwash strainers for Intake House No. 2.

008 Final effluent from the backwash strainers for Intake House No. 3.

009 Outfall from surface drainage to city of Lorain 21st Street storm sewer. (Lat: 41 N 27' 31"; Long: 82 W 07' 11")

010 Overflow of open drainage conveyance at concrete wall prior to commingling with discharges from outfall 005 in the Clinton Avenue storm sewer concrete catch basin. Discharges may include storm water runoff from outfalls 014 and 015, other storm water from the Lorain plant, discharges from internal monitoring station 604 (via outfall 014), ground water, service water, steam condensate

and off-site discharges from the city of Lorain sewerage system (Lat: 41 N 27' 15"; Long: 82 W 07' 50")

602 Blowdown from the blast furnace treatment system prior to mixing with other process and cooling water and after all diversions for slag cooling. Discharged to 004.

603 Treatment system for No.1 and 2 continuous casters, the steel plant, and vacuum degasser prior to mixing with cooling waters and prior to discharge to Reservoir No. 2. Discharged to 003.

604 Blowdown from the Primary Mill WWTP prior to discharge to outfall 014.

605 Blowdown from the Bar Mills WWTP prior to discharge to outfall 005.

612 Treatment system for No.1 and 2 continuous casters, the Steel Plant, and vacuum degasser prior to mixing with cooling waters and prior to discharge to Reservoir No. 2. Discharged to 002.

Table 9. Effluent statistics for the Republic Steel – Lorain Plant.

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
Outfall 002 to Black River (RM 3.47)				
Thermal Discharge (Million BTU/hr)	44.0	73.9	Monitor	120
Total Suspended Solids	26.0	125.0	Monitor	Monitor
Ammonia, Summer (mg/l)	0.315	1.2	Monitor	Monitor
Ammonia, Winter (mg/l)	0.375	1.51	Monitor	Monitor
Chlorine (mg/l)	0	0.02	0.014	0.024
Flow (MGD)	18.4	24	Monitor	Monitor
Outfall 003 to Black River (RM 2.56)				
Thermal Discharge (Million BTU/hr)	181.0	430.0	Monitor	634
Total Suspended Solids	28.0	130.0	Monitor	Monitor
Ammonia, Summer (mg/l)	0.32	1.19	Monitor	Monitor
Ammonia, Winter (mg/l)	0.40	1.11	Monitor	Monitor
Chlorine (mg/l)	0	0	0.013	0.024
Flow (MGD)	37.9	68.4	Monitor	Monitor
Outfall 004 to Black River (RM 2.64)				
Thermal Discharge (Million BTU/hr)	187.0	444.0	Monitor	634
Total Suspended Solids	38.0	158.0	Monitor	Monitor
Ammonia, Summer (mg/l)	0.42	1.4	Monitor	Monitor
Ammonia, Winter (mg/l)	0.50	1.5	Monitor	Monitor
Chlorine (mg/l)	0	0	0.013	0.024
Flow (MGD)	27.6	44.4	Monitor	Monitor
Outfall 005 to Black River (RM 3.85)				
Thermal Discharge (Million	17.8	29.0	Monitor	40
Total Suspended Solids	26.0	134.0	Monitor	Monitor
Chlorine (mg/l)	0	0	0.016	0.027
Flow (MGD)	9.02	10.30	Monitor	Monitor

A compliance evaluation for the time period 2008 to 2012 indicated the following permit violations at the Republic Steel – Lorain Plant:

Outfall	Parameter	Months with Violations	Total Limit Violations	Qty. Violations	Conc. Violations
004	pH	1	1	0	1
005	Acute Toxicity, *Ceriodaphnia*	1	1	0	1
005	Oil and Grease	2	2	0	2
602	Phenolic 4AAP	1	1	1	0
602	Zinc	1	2	2	0
605	pH	1	2	0	2

Republic Steel - Lorain indefinitely ceased operations in March 2016.

U.S. Steel - Lorain Tubular Operations (3ID00074)
U.S. Steel-Lorain owns and operates a seamless steel pipe and tube manufacturing operation in Lorain, Ohio. The facility currently consists of two pipe and tube mills utilizing the hot forming process (heat treating, tempering and finishing) to produce its product. Additionally, U.S. Steel-Lorain manages a closed landfill site (D2 landfill) on its property which contains contaminated dredged material from the Black River and various industrial operation wastes. The draft NPDES permit addresses control/management of leachate and seeps from the D2 landfill site.

The process operations performed at this facility are classified by the Standard Industrial Classification (SIC) code 3317, "Steel Pipe and Tube." Discharges resulting from process operations are therefore subject to Federal Effluent Guideline Limitations, contained in Chapter 40 of the Code of Federal Regulations (CFR), Part 420, "Iron and Steel Manufacturing" Industrial Point Source Category, specifically, 40 CFR 420.77 addressing the hot forming process.

The facility NPDES permit contains the following discharge outfalls:

001 D2 landfill leachate treated by: neutralization; coagulation; sedimentation; carbon adsorption; filtration; filter press
002 Storm water
003 Storm water
004 Storm water
005 Storm water
006 Seamless mill process and non-contact cooling water; seamless scrubber blowdown; quench and temper blowdown and non-contact cooling water; seamless hydrotester blowdown; storm water treated by: sedimentation; oil skimming; cooling
007* D2 landfill surface seeps treated by: pH adjustment and/or neutralization; scale inhibition. *Facility first reported flow from this outfall in July 2011. This outfall required monitoring with no effluent limits during the timeframe surrounding the 2012 survey. Final effluent limits are included in the permit as of 2014.

Table 10. Effluent statistics for the U.S. Steel Corporation – Lorain Tubular Operations.

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
Outfall 001 to Black River (RM 5.35)				
COD (mg/l)	7.41	25.4	35	50
Ammonia, Summer (mg/l)	2.74	5.39	10	15
Ammonia, Winter (mg/l)	1.15	4.1	10	15
Silver (µg/l)	0	10.1	1.3	7.4
CBOD5, Summer (mg/l)	6.8	15.2	10	15
CBOD5, Winter (mg/l)	3.75	14.7	10	15
Flow (MGD)	0.003	0.011	Monitor	Monitor
Outfall 006 to Black River (RM 5.03)				
Thermal Discharge (Million BTU/hr)	7.44	25.8	Monitor	Monitor
Total Suspended Solids	8.0	17.0	Monitor	Monitor
Zinc (µg/l)	31.6	103.0	Monitor	Monitor
Chlorine (mg/l)	0.048	0.454	Monitor	Monitor
Flow (MGD)	2.07	3.62	Monitor	Monitor
Outfall 007 to Black River (RM 5.35)				
Ammonia, Summer (mg/l)	3.02	6.87	Monitor	Monitor
Ammonia, Winter (mg/l)	2.55	3.49	Monitor	Monitor
Copper (µg/l)	15.3	27.4	Monitor	Monitor
2,4-Dimethylphenol (µg/l)	26.3	54.5	Monitor	Monitor
Flow (MGD)	0.0226	0.0979	Monitor	Monitor

A compliance evaluation for the time period 2008 to 2012 indicated the following permit violations at the U.S. Steel – Lorain Tubular Operations:

Outfall	Parameter	Months with Violations	Total Limit Violations	Qty Violations	Conc Violations
001	CBOD 5-day	1	1	0	1
006	CBOD 5-day	1	1	0	1

U.S. Steel Lorain Tubular Operations indefinitely ceased operations in March 2016.

Table 11. List of individual NPDES permitted facilities in the Black River watershed.

Facility Name	Ohio EPA Permit No.	Major	Flow (mgd)	County	HUC 12	Stream
A-1 Construction Apts	3PW00027	No	0.003	Lorain	041100010504	West Branch
Alco Mfg Corp	3IS00123	No	0.007	Lorain	041100010506	West Branch
Barr Elem School	3PT00015	No	0.00324	Lorain	041100010602	Black River
BFI Lorain County Resource Recovery Complex	3PR00394	No	0.008	Lorain	041100010505	Plum Creek
Black River Local Schools	2PT00015	No	0.025	Ashland	041100010302	West Fork E Branch
Brentwood Lake WWTP	3PH00024	No	0.12	Lorain	041100010404	East Branch
Buckeye Local Schools - Litchfield Preschool	3PT00099	No	0.009	Medina	041100010401	Center Creek
Buckeye Terminals LLC - Lorain	3IN00059	No	Storm Water	Lorain	041100010403	Willow Creek
Butternut Ridge Apartments	3PW00033	No	0.0015	Lorain	041100010404	East Branch
Butternut Terrace Apts	3PW00038	No	0.0075	Lorain	041100010404	East Branch
Chatham Township Community Center	3PT00092	No	0.003	Medina	041100010301	East Fork E Branch
Circle K 5317	3PR00494	No	0.0025	Lorain	041100010403	Willow Creek
Cleveland Illum Co Westwood Facility	3IN00224	No	Ash Disposal	Lorain	041100010403	Willow Creek
Country Stage Campground	2PR00121	No	0.006	Ashland	041100010502	West Branch
Crane Aerospace Lear Romec Division	3IS00118	No	NCCW	Lorain	041100010404	East Branch
Cresthaven Homes WWTP	3PG00051	No	0.08	Lorain	041100010702	Beaver Creek
D'Tanglez Studio Beauty Shop	3PR00326	No	0.0015	Lorain	041100010506	West Branch
Eaton Homes WWTP	3PH00023	No	0.2	Lorain	041100010403	Willow Creek
Educational Service Center of Lorain County	3PT00104	No	0.008775	Lorain	041100010506	West Branch
Elyria Foundry Co	3ID00070	No	Storm Water	Lorain	041100010506	West Branch
Elyria Hauling Company	3PR00185	No	0.007	Lorain	041100010404	East Branch
Elyria Motel	3PR00191	No	0.002	Lorain	041100010506	West Branch
Elyria WWTP	3PD00034	Yes	13	Lorain	041100010602	Black River
EMSNET Business Center	3PT00103	No	0.0066	Lorain	041100010402	East Branch
Findley State Park WWTP	3PP00004	No	0.025	Lorain	041100010503	Wellington Creek
Forest Hills Country Club	3PZ00055	No	0.005	Lorain	041100010506	West Branch
French Creek WWTP	3PD00043	Yes	11.25	Lorain	041100010601	French Creek
Grafton WWTP	3PB00024	Yes	1.5	Lorain	041100010404	East Branch
Kalt Manufacturing Co	3IS00079	No	0.005	Lorain	041100010602	Black River
LaGrange WPCP	3PB00061	No	0.363	Lorain	041100010506	West Branch
Lodi WWTP	3PB00027	No	0.8	Medina	041100010301	East Fork E Branch
Lorain Black River WWTP	3PE00005	Yes	15	Lorain	041100010602	Black River

Facility Name	Ohio EPA Permit No.	Major	Flow (mgd)	County	HUC 12	Stream
Lorain County Landfill LLC	3IN00335	No	Storm Water	Lorain	041100010505	Plum Creek
Mac's Convenience Stores LLC DBA Circle K No 5312	3PR00434	No	0.0025	Lorain	041100010506	West Branch
Medina Meats	3IH00110	No	0.0029	Medina	041100010402	Crow Creek
National Bronze and Metals of Ohio Inc	3IN00316	No	Storm Water	Lorain	041100010602	Black River
Oberlin Water Environment Protection Facility	3PD00025	Yes	1.5	Lorain	041100010505	Plum Creek
Oberlin WTP	3IW00061	No	0.03 (lime sludge lagoons)	Lorain	041100010506	West Branch
Parker Marine	3PR00476	No	0.0015	Lorain	041100010601	French Creek
Pheasant Run Association	3PW00001	No	0.1	Lorain	041100010503	Wellington Creek
Remediation and Liability Mgmt Co Inc (REALM)	3II00200	No	Storm Water (closed LF)	Lorain	041100010506	West Branch
Republic Steel - Lorain Plant	3ID00028	Yes	16.2	Lorain	041100010602	Black River
Republic Technologies International LLC	3ID00076	No	NCCW, Process, Storm	Lorain	041100010602	Black River
SBS Garage	3PR00213	No	0.0015	Lorain	041100010602	Black River
Sheffield Middle School	3PT00088	No	0.025	Lorain	041100010601	French Creek
Spencer Forge and Manufacturing	3IS00087	No	Contact Cooling Water	Medina	041100010401	East Branch
Spencer WWTP	3PA00018	No	0.09	Medina	041100010401	East Branch
Sterling Foundry Inc	3ID00052	No	NCCW, Storm Water	Lorain	041100010504	West Branch
The Activity Center	3PR00487	No	0.0023	Lorain	041100010403	Carpenter Ditch
Town and Country Co-Op Inc	3IG00085	No	Storm Water	Lorain	041100010506	West Branch
United Initiators Inc	3IN00340	No	0.0432 (GW pump & treat)	Lorain	041100010506	West Branch
US Steel Lorain Tubular Operations	3ID00074	Yes	2.334 and Storm Water	Lorain	041100010602	Black River
Wellington WTP	3IV00200	No	0.014 (sludge lagoons)	Lorain	041100010501	Charlemont Creek
Wellington WWTP	3PC00014	No	0.75	Lorain	041100010501	Charlemont Creek
Westfield Allotment WWTP	3PA00024	No	0.025	Lorain	041100010602	Black River

WATER CHEMISTRY

Surface water chemistry samples were collected from the Black River basin study area from March through October 2012 at 85 locations; sampling included the standard suite of parameters, and complete lists of sample results are located in the appendices to this report. Additional sampling for organic chemical parameters was conducted at eight sites within the watershed. Stations were established in free-flowing sections of the stream and were primarily collected from bridge crossings. Surface water samples were collected directly into appropriate containers, preserved and delivered to Ohio EPA's Environmental Services laboratory. Collected water was preserved using appropriate methods, as outlined in: Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 2012).

Data from the USGS Black River at Elyria gage was used to show flow trends in the Black River watershed during the 2012 survey (Figure 5). Dates when water samples were collected in the study area are noted on the graph. Flow conditions during the summer field season were typically lower than the historic median. Low flow conditions were recorded from May through October with some minor rain events elevating flow above the historic median. Water samples captured a variety of flow conditions in the study area during the field season. Bacteria was collected during the recreation use season (May 1 through October 31) and was typically collected during low flows.

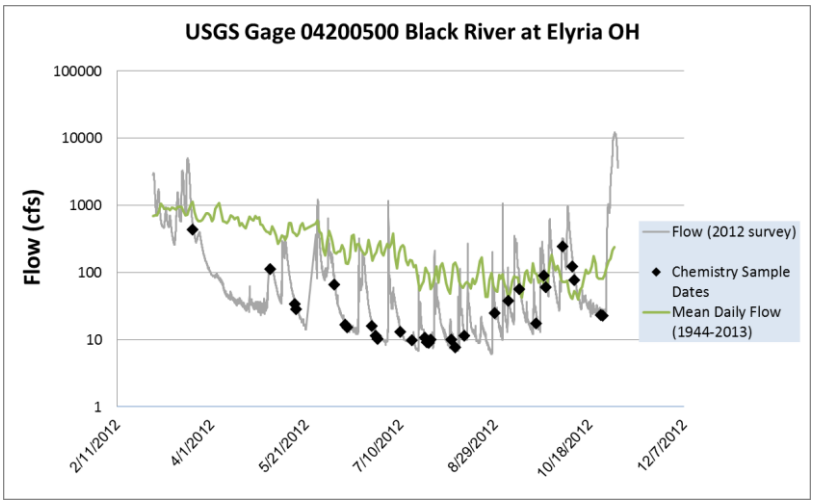


Figure 5. Flow conditions in the Black River during the 2012 field season.

Surface water samples were analyzed for metals, nutrients, polychlorinated biphenyls (PCBs), semi-volatile organic compounds, organochlorinated pesticides, bacteria, pH, temperature, conductivity, dissolved oxygen (D.O.), percent D.O. saturation, and suspended and dissolved solids (Appendix Tables 1-2, 5). Parameters which were in exceedance of the Ohio WQS criteria are reported in Table 12. Bacteriological samples were collected from 54 locations, and the results are reported in the Recreation Use section. Datasonde® water quality recorders were placed at seven locations to monitor hourly levels of dissolved oxygen, pH, temperature, and conductivity (Appendix Table 6).

Metals were measured at 85 stream locations with seventeen parameters tested (Appendix Table 1). A zinc exceedance was detected in the Black River at RM 6.2 (Table 12). The WQS for zinc is 245 µg/l (based on hardness); the sample result was 2060 µg/l. Additional sampling at same location had results of 5 and 32 µg/l, well below the WQS criterion. The highest measured zinc downstream from RM 6.2 in the Black River had a concentration of 35 µg/l (RM 3.7). The majority (73%) of zinc sample results in the watershed were below detection. Overall, the median zinc result was below detection and the average concentration was 15.0 µg/l. If the extremely elevated value is removed from the data set as an outlier, the average zinc value was 9.4 µg/l.

Nutrients were measured at each water sampling location, and included ammonia-N, nitrate+nitrite-N, total phosphorus, and total Kjeldahl nitrogen (TKN). Summary statistics for ammonia-N, nitrate+nitrite-N, and total phosphorus in the Black River watershed are detailed in Table 13. Nutrient levels were elevated above target levels (Figure 6) throughout the Black River watershed (Ohio EPA 1999). Nitrate was consistently elevated independent of drainage area, while phosphorus showed greater elevated levels in headwater streams. There were also a number of exceedances detected for the D.O. minimum WQS criterion. Given that 2012 was a year of low flow, coupled with elevated nutrients, this was not unexpected.

Table 12. Exceedances of Ohio Water Quality Standards criteria (OAC 3745-1) for chemical/physical parameters measured in the Black River basin study area, 2012. Bacteria exceedances are presented in the Recreation Use Section.

Stream / RM	**Location**	**Parameter (value is in ug/l unless noted)**
Black River	*WWH Existing*	
10.70	Upstream Elyria WWTP	Dissolved Oxygen, 2.49 mg/l (7-16-12) [b]
6.2	E. 31st St.	Zinc, 2060 (6-28-12) [b]
West Fork E. Br. Black R.	*WWH Existing*	
13.97	T.R. 391	Dissolved Oxygen, 3.71 mg/l (7-10-12) [b]
Willow Creek	*WWH Existing*	
6.49	Island Rd.	Dissolved Oxygen, 0.89 and 2.86 mg/l (7-10-12, 7-25-12) [b]
East Branch Black R.	*WWH Existing*	
40.47	Old Mill Rd.	Dissolved Oxygen, 3.91 mg/l (7-25-12) [b]
32.42	Smith Rd.	Dissolved Oxygen, 0.57 and 1.8 mg/l (7-10-12, 7-26-12) [b]
18.94	Vermont Ave.	Dissolved Oxygen, 3.96 mg/l (7-10-12) [b]
Coon Creek	*WWH Existing*	
0.88	River Corners Rd.	Dissolved Oxygen, 3.41 mg/l (7-10-12) [b]
RM 28.65 Trib. East Br. Black R.	*WWH Existing*	
1.5	Foster Rd.	Dissolved Oxygen, 3.28 and 3.24 mg/l (7-10-12, 7-25-12) [b]
RM 22.65 Trib. East Br. Black R.	*WWH Existing*	
0.60	Vermont Ave.	Dissolved Oxygen, 1.75 and 2.88 mg/l (7-10-12, 7-25-12) [b]
Salt Creek	*WWH Existing*	
0.53	Chamberlain Rd.	Dissolved Oxygen, 3.41 mg/l (7-25-12) [b]
Crow Creek	*WWH Existing*	
0.80	Vermont Ave.	Dissolved Oxygen, 3.39 mg/l (7-25-12) [b]
RM 5.89 Trib. East Br. Black R.	*WWH Existing*	
1.0	Waterfall Dr.	Dissolved Oxygen, 3.53 mg/l (7-26-12) [b]
Charlemont Creek	*WWH Existing*	
8.55	Baker Rd.	Dissolved Oxygen, 2.75 mg/l (9-25-12) [b]
3.00	Wellington WTP Intake	Dissolved Oxygen, 1.81 and 0.53 mg/l (8-6-12, 9-5-12) [b]
0.39	Peck-Wadsworth Rd.	Dissolved Oxygen, 2.9 mg/l (8-6-12) [b]
West Branch Black R.	*WWH Existing*	
48.10	Stewart Rd.	Dissolved Oxygen, 1.79 and 1.46 mg/l (7-23-12, 8-6-12) [b]

Table 12. Exceedances of Ohio Water Quality Standards criteria (OAC 3745-1) for chemical/physical parameters measured in the Black River basin study area, 2012. Bacteria exceedances are presented in the Recreation Use Section.

Stream / RM	Location	Parameter (value is in ug/l unless noted)
28.50	Pitts Rd.	Selenium 8.6 (7-26-12) [a], Dissolved Oxygen, 0.81, 3.48 and 2.44 mg/l (7-26-12, 9-5-12, 10-24-14) [b]
19.6	St. Rt. 303	Dissolved Oxygen, 3.84 mg/l (7-23-12) [b]
16.56	Kipton-Nickel Plate Rd.	Dissolved Oxygen, 3.77, 3.32, and 3.92 mg/l (7-23-12, 7-26-12, 8-6-12) [b]
Buck Creek	*WWH Existing*	
0.95	Bursley Rd.	TDS 1,930 and 1,960 mg/l (7-23-12, 8-6-12) [a], Dissolved Oxygen, 2.78 mg/l (8-6-12) [b]
Wellington Creek	*WWH Existing*	
17.10	Bursley Rd.	Dissolved Oxygen, 2.8, 0.02, and 3.08 mg/l (7-23-12, 9-25-12, 10-24-12) [b]
13.09	Cemetary Rd.	Dissolved Oxygen, 1.51 and 2.89 mg/l (7-23-12, 8-6-12) [b]
8.40	Webster Rd.	Dissolved Oxygen, 3.83 and 3.63 mg/l (7-23-12, 8-6-12) [b]
0.60	Nickel Plate Rd.	Dissolved Oxygen, 3.04 mg/l (10-24-12) [b]
Plum Creek	*WWH Existing*	
5.57	Morgan St.	Dissolved Oxygen, 2.75 mg/l (7-23-12) [b]
Gable Ditch	*WWH Existing*	
0.30	Electric Ave.	Selenium, 6.1 (6-28-12) [a]

[a] Exceedance of the aquatic life Outside Mixing Zone Average water quality criterion.

[b] Exceedance of the aquatic life Outside Mixing Zone Maximum water quality criterion; for dissolved oxygen, this is a minimum value.

Table 13. Summary statistics for select nutrient water quality parameters sampled in the Black River basin, 2012. Highlighted values are above statewide nutrient targets for nitrate-nitrogen and total phosphorus (Ohio EPA 1999).

			Average of Result (mg/l)		
Site	River Mile	Drainage Area (mi^2)	Ammonia	Nitrate+ nitrite	Total Phosphorus
BLACK R. AT ELYRIA @ CASCADE PARK	14.95	396.0	0.034	2.495	0.069
BLACK R. DST. ELYRIA, NEAR SPRING VALLEY GOLF CLUB	11.50	398.0	0.037	3.050	0.072
BLACK R. 250 FT. UPST ELYRIA WWTP	10.70	401.0	0.040	4.397	0.105
BLACK R. DST. ELYRIA @ FORD RD.	9.80	412.0	0.061	19.533	0.246
BLACK R AT LORAIN @ E. 31ST ST.	6.20	424.0	0.037	21.897	0.191
BLACK R. AT LORAIN, UPST FRENCH CREEK	5.40	425.0	0.025	7.420	0.132
BLACK R. AT LORAIN, TRANSECT 4.81, NODE A	4.81	464.0	0.086	7.403	0.159
BLACK R. UPST. US STEEL 002, DST. ISLAND	3.70	466.0	0.041	7.025	0.122
BLACK R. AT LORAIN, DST. E. 21ST ST.	1.65	469.0	0.125	4.580	0.075

Table 13. Summary statistics for select nutrient water quality parameters sampled in the Black River basin, 2012. Highlighted values are above statewide nutrient targets for nitrate-nitrogen and total phosphorus (Ohio EPA 1999).

			Average of Result (mg/l)		
Site	River Mile	Drainage Area (mi^2)	Ammonia	Nitrate+ nitrite	Total Phosphorus
BLACK R. AT LORAIN, 0.15 MI. DST RR BRIDGE	0.90	470.0	0.156	3.688	0.055
BLACK R. AT LORAIN, NEAR MOUTH	0.30	470.0	0.193	3.723	0.053
BRENTWOOD TRIB (RM 5.89 Trib E Br) @ WATERFALL DR	1.00	4.45	0.307	0.617	0.155
BRENTWOOD TRIB (RM 5.89 Trib E Br) @ ROBSON RD	0.10	7.19	0.025	1.953	0.316
BUCK CREEK SE OF ROCHESTER @ BURSLEY RD.	0.95	4.80	0.127	1.950	0.107
CHARLEMONT CREEK @ BAKER RD.	8.55	10.80	0.053	1.177	0.066
CHARLEMONT CREEK @ WELLINGTON WTP INTAKE	3.00	22.00	0.056	0.168	0.022
CHARLEMONT CREEK W OF WELLINGTON @ PITTS RD.	2.20	22.60	0.025	0.830	0.031
CHARLEMONT CREEK DST. WELLINGTON @ PECK-WADSWORTH RD.	0.39	25.80	0.041	11.668	0.684
CLEAR CREEK SW OF LODI @ PAWNEE RD.	1.80	6.20	0.040	1.377	0.050
COON CREEK @ RIVER CORNERS RD	0.88	10.20	0.045	0.587	0.037
CROW CREEK NE OF PENFIELD @ VERMONT RD.	0.80	3.70	0.975	1.457	0.160
E. BR. BLACK R. NW OF LODI @ SHAW RD.	41.45	68.0	0.025	2.423	0.058
E. BR. BLACK R. NW OF LODI @ OLD MILL RD.	40.47	72.0	0.025	0.870	0.075
E. BR. BLACK R. W OF SPENCER LAKE @ RIVER CORNERS RD	36.80	96.00	0.025	1.213	0.043
E. BR. BLACK R. @ LORAIN/MEDINA COUNTY LINE (SMITH RD.)	32.42	104.0	0.083	0.557	0.070
E. BR. BLACK R. SE OF LAGRANGE @ SHORT RD..	24.60	136.0	0.067	0.780	0.058
E. BR. BLACK R. E OF LAGRANGE @ VERMONT AVE.	18.94	158.0	0.085	0.717	0.060
E. BR. BLACK R. AT GRAFTON @ PARSONS RD.	11.34	179.0	0.025	0.403	0.155
E. BR. BLACK R. DST. GRAFTON WWTP @ INDIAN HOLLOW PARK	10.50	180.0	0.025	1.419	0.072
E. BR. BLACK R. S OF ELYRIA, UPST. BRENTWOOD TRIB.	6.00	185.0	0.025	0.493	0.049
E. BR. BLACK R. UPST. ELYRIA @ FULLER RD.	3.07	217.0	0.034	1.014	0.080
E. BR. BLACK R AT ELYRIA @ E. BRIDGE ST.	1.14	222.0	0.037	0.810	0.260
E. BR. BLACK R. AT ELYRIA @ WASHINGTON ST.	0.36	222.0	0.025	0.803	0.072
E. FK. E. BR. BLACK R. N OF LODI @ CHIPPEWA LAKE RD.	5.84	7.60	0.025	1.243	0.072
E. FK. E. BR. BLACK R. AT LODI @ LODI CITY PARK	2.67	12.90	0.025	1.180	0.022
E. FK. E. BR. BLACK R. 75 FT. UPST. LODI WWTP	1.76	13.90	0.025	1.327	0.033
E. FK. E. BR. BLACK R. DST. LODI WWTP	1.60	14.00	0.054	11.883	0.680
E. FK. E. BR. BLACK R. AT MOUTH @ RICHMOND RD.	0.06	15.20	0.025	5.500	0.167
EAST CREEK @ STOCKING RD.	0.56	5.40	0.025	0.830	0.026
ELK CREEK @ METROPARK PROPERTY OFF PARSONS RD.	0.15	7.55	0.070	0.813	0.230
FRENCH CREEK E OF ELYRIA @ MILLS RD.	10.41	11.80	0.052	1.307	0.096
FRENCH CREEK SE OF AVON @ RIEGELSBERGER RD.	9.02	17.20	0.051	17.263	0.919
FRENCH CREEK @ BRIDGE PT. TR.	5.50	25.40	0.037	6.767	0.290
FRENCH CREEK NE OF LORAIN @ ABBE RD. (ST. RT. 301)	3.75	31.20	0.033	3.473	0.183
FRENCH CREEK NEAR LORAIN @ GULF RD.	0.54	38.60	0.040	12.779	0.295
GABLE DITCH @ ELECTRIC AVE.	0.30	1.39	0.050	1.267	0.261

Table 13. Summary statistics for select nutrient water quality parameters sampled in the Black River basin, 2012. Highlighted values are above statewide nutrient targets for nitrate-nitrogen and total phosphorus (Ohio EPA 1999).

			Average of Result (mg/l)		
Site	River Mile	Drainage Area (mi^2)	Ammonia	Nitrate+ nitrite	Total Phosphorus
HEIDER DITCH @ ELECTRIC AVE.	0.25	7.84	0.051	1.303	0.084
KELLNER DITCH E OF OBERLIN @ PARSONS RD.	3.00	4.40	0.218	1.877	0.203
KELNER DITCH E OF OBERLIN @ NICKEL PLATE DIAGONAL RD.	1.00	9.40	0.050	1.063	0.173
PLUM CREEK @ MORGAN ST.	5.57	4.77	0.066	0.730	0.175
PLUM CREEK UPST. OBERLIN WWTP @ ST. RT. 511	3.19	7.60	0.043	0.670	0.087
PLUM CREEK JUST DST. OBERLIN WWTP	2.80	7.90	0.042	14.623	0.360
PLUM CREEK E OF OBERLIN @ OBERLIN - ELYRIA RD	0.71	9.28	0.046	9.768	0.243
POWDERMAKER DITCH @ ELECTRIC AVE.	0.15	4.25	0.025	0.435	0.012
RM 10.18 TRIB. BLACK RIVER @ GULF RD.	0.68	10.2	0.025	1.847	0.101
RM 22.65 TRIB E. BR. BLACK R. @ VERMONT RD.	0.60	6.40	3.496	2.207	0.836
SALT CREEK @ CHAMBERLAIN RD	0.53	6.73	0.041	1.243	0.050
TRIB TO E BR BLACK R (39.06) @ SPENCER LAKE RD	2.16	4.66	0.025	0.987	0.037
TRIB. TO CHARLEMONT CREEK (0.51) UPST. WELLINGTON WWTP	1.00	1.70	0.066	0.553	0.068
TRIB. TO E. BR. BLACK R. (RM 28.65) @ FOSTER RD.	1.50	5.30	0.103	0.940	0.055
TRIB. TO E. BR. BLACK R. (RM 41.41) @ SHAW RD.	0.35	1.83	0.025	1.240	0.013
TRIB. TO CHARLEMONT CREEK (0.51) DST. WELLINGTON WWTP	0.76	1.75	0.025	15.033	0.830
W. BR. BLACK R. @ STEWART RD.	48.10	4.30	0.262	1.310	0.036
W. BR. BLACK R. @ ST. RT. 511 - UST CROSSING	41.67	16.00	0.051	0.800	0.026
W. BR. BLACK R. @ ST. RT. 511 - DST CROSSING	37.30	28.00	0.052	1.047	0.029
W. BR. BLACK R. UST PITTS RD. AND FAILING SEPTIC	28.60		0.025	0.150	0.041
W. BR. BLACK R. NW OF WELLINGTON @ PITTS RD.	28.50	37.00	0.063	2.931	0.054
W. BR. BLACK R. N OF WELLINGTON @ ST. RT. 58	25.30	67.00	0.055	7.127	0.389
W. BR. BLACK R. E OF PITTSFIELD @ ST. RT. 303	19.60	80.00	0.056	2.227	0.109
W. BR. BLACK R. @ WEST RD. (KIPTON NICKEL PLATE RD.)	16.56	83.00	0.053	1.690	0.095
W. BR. BLACK R. E OF OBERLIN @ PARSONS RD.	14.39	130.0	0.032	1.163	0.093
W. BR. BLACK R. @ METROPARKS EQUESTRIAN AREA	10.60	132.0	0.035	1.343	0.096
W. BR. BLACK R. @ BUTTERNUT RIDGE RD.	7.68	161.0	0.040	3.417	0.091
W. BR. BLACK R. UPST. ELYRIA @ OBERLIN-ELYRIA RD.	4.18	169.0	0.066	1.858	0.069
W. BR. BLACK R. AT ELYRIA, UPST. THIRD ST.	1.20	172.0	0.062	1.103	0.066
W. FK. E BR. BLACK R. @ T391	13.97	14.10	0.042	4.123	0.129
W. FK. E. BR. BLACK R. AT HOMER @ ST. RT. 301	8.90	25.00	0.025	1.557	0.071
W. FK. E. BR. BLACK R. W OF LODI, DST. ST. RT. 421 AND RR	2.30	41.10	0.103	1.873	0.049
W. FK. E. BR. BLACK R. @ SANFORD RD.	0.34	42.20	0.025	1.407	0.028
WELLINGTON CREEK @ BURSLEY RD.	17.10	5.20	0.076	1.187	0.032
WELLINGTON CREEK AT WELLINGTON @ CEMETERY RD.	13.09	10.50	0.317	0.898	0.089
WELLINGTON CREEK NE OF WELLINGTON @ WEBSTER RD.	8.40	19.70	0.072	0.393	0.071

Table 13. Summary statistics for select nutrient water quality parameters sampled in the Black River basin, 2012. Highlighted values are above statewide nutrient targets for nitrate-nitrogen and total phosphorus (Ohio EPA 1999).

			Average of Result (mg/l)		
Site	River Mile	Drainage Area (mi^2)	Ammonia	Nitrate+ nitrite	Total Phosphorus
WELLINGTON CREEK NEAR MOUTH @ NICKEL PLATE RD.	0.60	29.60	0.056	1.679	0.147
WILLOW CREEK UST EATON ESTATES @ ISLAND RD	6.49	2.99	0.472	0.180	0.213
WILLOW CREEK SE OF ELYRIA @ DURKEE RD. (UPST. CROSSING)	2.85	13.30	0.037	0.920	0.345
				Nutrient Targets	
Headwater: Drainage Area < 20 mi^2				1.000	0.080
Wadeable: Drainage Area 20 mi^2 < 200mi^2				1.000	0.100
Small River: Drainage Area 200 mi^2 < 1000mi^2				1.500	0.170

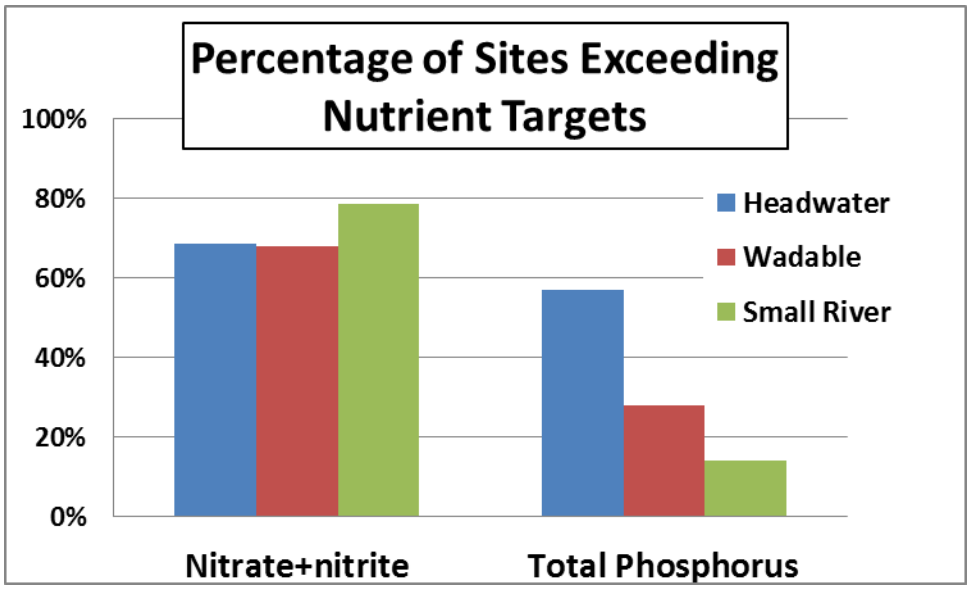
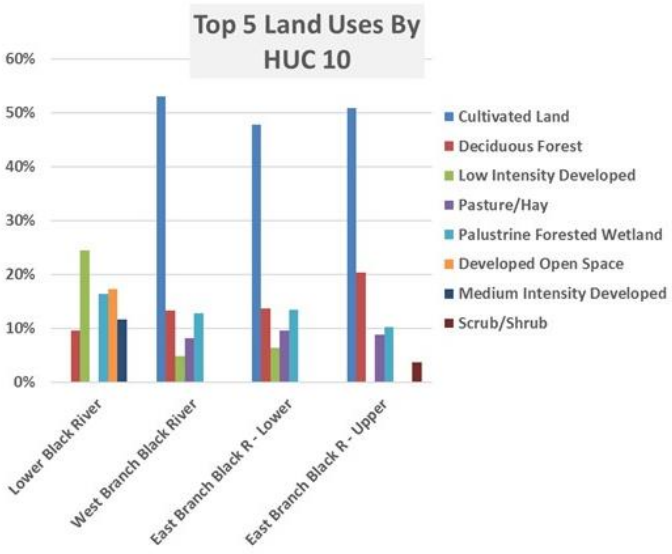


Figure 6. Percentage of sites exceeding target level by watershed size category.

Water Chemistry by HUC-10

The Black River is comprised of four 10-digit USGS Hydrologic Unit Code (HUC-10) subwatersheds. These subwatersheds vary in land use, with the upper three HUC-10 areas dominated by cultivated land and the lower Black River HUC-10 having the highest percentages of developed land. Chemistry results also tended to reflect a general summation of upstream watersheds. When comparing averages of all HUC-10 results, independent of upstream drainage area, 16 (53%) of the highest average results for the standard suite of parameters were in the lower Black River HUC-10. Figure 7 shows the top five land uses and chemistry

results based on the HUC-10 watershed unit. Chlorophyll-*a* and pheophytin-*a* were not included in the typical suite of parameters analyzed at each site.



Parameter	Average of Result			
	Lower Black River	West Branch Black River	East Branch Black R - Lower	East Branch Black R - Upper
Alkalinity	126.130	147.987	151.752	192.113
Aluminum	442.436	275.775	408.056	174.457
Ammonia	0.060	0.072	0.261	0.037
Arsenic	2.443	3.078	3.251	2.920
Barium	72.970	37.240	45.803	64.652
Cadmium	0.175	0.101	0.107	0.100
Calcium	58.584	70.992	65.268	99.457
Chloride	100.692	65.755	78.048	110.898
Chlorophyll_a	24.988	1.900	10.550	5.300
Chromium	1.435	1.110	1.024	1.039
COD	20.813	18.696	18.708	15.652
Conductivity	859.333	757.241	745.854	1035.933
Copper	5.253	2.919	3.100	2.409
Hardness, Total	211.208	270.140	245.930	377.370
Iron	845.158	587.659	856.901	430.478
Lead	1.270	1.029	1.045	1.000
Magnesium	16.374	22.756	20.141	31.348
Manganese	61.426	197.419	180.958	117.565
Nickel	5.152	4.781	4.415	4.113
Nitrate+nitrite	7.741	3.353	0.973	2.471
Nitrite	0.051	0.023	0.022	0.019
Pheophytin_a	10.577	2.967	5.650	3.100
Potassium	17.586	12.355	8.250	11.000
Selenium	1.121	1.103	1.000	1.030
Sodium	95.050	50.172	51.718	72.065
Strontium	238.851	463.550	278.606	478.239
Sulfate	113.967	125.902	88.001	156.876
TKN	0.945	0.794	1.069	0.753
Total Dissolved Solids	555.010	485.970	452.959	660.133
Total Phosphorus	0.172	0.162	0.147	0.099
Total Suspended Solids	21.323	13.915	18.255	8.052
Zinc	32.366	9.326	6.634	6.522

Figure 7. Land use and chemistry results by USGS 10-digit Hydrologic Unit Code (HUC-10). Shaded values represent the highest average result for the four HUC-10s within the Black River basin study area, 2012.

Water Chemistry by Drainage Area

Streams can also be broadly classified by drainage area. Three general stream size classes used by Ohio EPA are headwater (0-20 mi^2), wadeable (20-200 mi^2), and small river (200-1,000 mi^2). Water chemistry results were evaluated using this drainage area classification independent of HUC-10 watershed location (Table 14). The smaller watersheds are typically influenced by land use and ground water, while the larger watersheds represent an accumulation of upstream sources and the larger point source discharges associated with bigger cities. Chemistry results based on averages for each watershed size showed a random distribution of values, no one watershed size dominated with higher averages. Nitrate was highest in small river group while phosphorus was highest in the wadeable group.

Table 14. Chemistry results grouped by watershed size. Shaded values represent the highest average result for the three watershed size categories within the Black River basin study area, 2012.

Parameter	Units	Headwater	Wadeable	Small River
Alkalinity	mg/L	157.60	163.03	120.80
Aluminum	ug/L	253.44	645.73	643.77
Ammonia	mg/L	0.19	0.06	0.06
Arsenic	ug/L	3.29	2.78	2.25
Barium	ug/L	41.24	46.00	90.89
Cadmium	ug/L	0.10	0.10	0.18
Calcium	mg/L	78.97	69.17	53.27
Chloride	mg/L	87.90	69.12	73.41
Chromium	ug/L	1.08	1.36	1.47
COD	mg/L	17.83	17.75	20.30
Conductivity	umhos/cm	885.27	778.21	735.16
Copper	ug/L	3.00	3.44	4.82
Hardness, Total	mg/L	299.25	258.51	197.58
Iron	ug/L	591.56	1171.06	1128.20
Lead	ug/L	1.13	1.28	1.47
Magnesium	mg/L	24.78	20.83	15.66
Manganese	ug/L	192.34	140.01	79.32
Nickel	ug/L	4.48	4.95	4.65
Nitrate+Nitrite	mg/L	3.19	3.33	6.34
Nitrite	mg/L	0.03	0.02	0.05
Potassium	mg/L	7.21	6.88	7.64
Selenium	ug/L	1.06	1.07	1.05
Sodium	mg/L	63.94	46.20	74.65
Strontium	ug/L	434.86	355.06	222.35
Sulfate	mg/L	137.15	99.54	112.91
Temperature, water	° C	19.49	20.71	22.31
TKN	mg/L	0.92	0.84	0.91
Total Dissolved Solids	mg/L	554.58	463.70	471.11
Total Phosphorus	mg/L	0.55	0.83	0.13
Total Suspended Solids	mg/L	10.54	26.77	22.97
Zinc	ug/L	8.42	10.33	9.67

Water Quality Sonde Summary

Two low flow, warm-temperature surveys were completed in the 2012 assessment year using multi-parameter water quality sondes. Water measurements of dissolved oxygen (D.O.), temperature, pH, and specific conductance were internally programmed to be taken hourly. Sonde deployments typically span a 40-48-hour duration from Tuesday morning/mid-day to Thursday morning/mid-day of a given survey week. For both surveys, one from June 26-28 and the second from July 24-26 of 2012, there were 28 sondes deployed throughout the Black River basin (Figure 8).

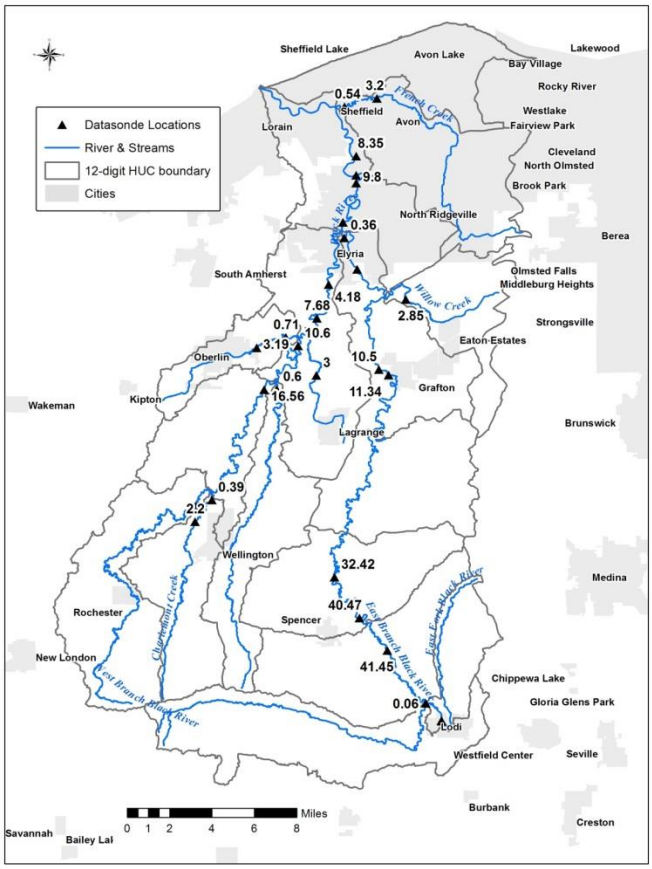


Figure 8. Sonde locations for the two surveys conducted in the Black River basin study area, 2012. River miles are shown next to each location symbol.

Ohio EPA typically deploys a maximum of 30-35 sondes per survey. Goals for both surveys were the same and sought to cover all 12-digit HUC outlets and to bracket WWTP outfalls. WWTP bracketing ideally would sample upstream and two downstream locations – near-field and far-field. WWTPs bracketed in both surveys included (# sondes/sites): Oberlin (3), Elyria (3), North Ridgeville (2), Lodi (3), Grafton (2), Wellington (2), Eaton Estates (1), and LaGrange (1).

Further, the dam pool from a low-head dam in the upper East Branch Black River drainage (around RM 40-41) was bracketed with two sondes. Outfall locations of Elyria CSOs and the potential seepage and runoff producing zones from Chemical Recovery Systems Incorporated, a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) site, were bracketed on the lower East Branch Black River. A second CERCLA site, the Ford Road landfill (a legacy landfill for Lorain County), was assessed downstream from its potential seepage zone on the mainstem of the Black River.

An attempt to survey the inflow to the reservoir in Findley Lake State Park on Wellington Creek was unsuccessful for both events due to extremely low flow conditions (only interstitial pools existed). Public drinking water supply intakes (Oberlin and Wellington) were not surveyed with sondes. Overall, the distribution of sondes produced 11 sites each for the East and West Branch Black River systems; the latter included Charlemont, Wellington, and Plum creeks. The Black River mainstem was monitored at four locations and French Creek at two locations (Figure 8). The most downstream site of the survey – the Black River mainstem at RM 8.35 – was upstream from the lacustuary (considered the lower 6.6 miles of the mainstem before entering Lorain Harbor and Lake Erie). In addition, chlorophyll-*a* samples were taken for one event during each survey from both benthic (rock) and sestonic (water column) environments.

Sampling the critical condition for dissolved oxygen stress on aquatic life is targeted and is achieved when flow conditions are low (critical) and the water temperature is warm. For critical low flow conditions, a

typical statistic is the lowest stream flow during a 7-day interval that has a frequency of occurring one time every 10 years ($_7Q_{10}$). The weakest stream re-aeration, then, would occur during the critical low flow. There exists one continuous recording stream flow gage in the basin operated by the U.S. Geological Survey – *Black River at Elyria OH* (ID 04200500, 396 mi^2). The summer (May-November) $_7Q_{10}$ for this gage is 4.28 cfs based on 70 years of daily flow data (1944-2013). Observed average stream flow at this site for the 3-day sonde sampling period was 11.33 and 9.3 cfs for the June and July surveys, respectively. During the June survey, maximum air temperatures ranged from 74-96^oF (June normal of 84^oF), and 7- and 14-day antecedent precipitation totals were 0.13 and 1.77 inches, respectively. During the July survey, maximum air temperatures ranged from 83-91^oF (July normal of 85^oF), and 7- and 14-day antecedent precipitation totals were 0.55 and 0.56 inches, respectively. In conclusion, both June and July surveys captured critical, low-flow D.O.-stress conditions.

The following figures include a 24-hour sampling period, from 0300 of day 1 to 0200 hours of day 2, and represent a subset of the 40-48 sampling interval. The start time of 0300 is selected because it represents a typical local minimum in the dissolved oxygen diel "swing"; the succedent local minimum is approximately 24 hours later in time.

Dissolved Oxygen

East Branch Black River including East Fork East Branch Black River and Willow Creek
(Figure 9 and Figure 10; Table 15 and Table 16)

For June 2012, the sondes surrounding the Lodi WWTP showed an elevated D.O. range (6.29 mg/L) and was indicative of nutrient enrichment in the near-field downstream from the outfall (RM 1.60 of the East Fork of the East Branch Black River) (Figure 16); this range was reduced in the far-field downstream location at RM 0.06. In the July 2012 survey, the near-field instrument failed and no data were reported. However, the far-field location showed a D.O. range indicative of enrichment (7.06 mg/L).

The dam pool in the upper East Branch Black River exhibited low D.O. (exceedance of both minimum and average WWH criteria) and a high range (6.2 mg/L) in the June 2012 survey. Recovery occurred downstream from the dam at RM 40.47. However, in the July 2012 survey, the minimum D.O. criterion was exceeded downstream from the dam at this location. At both upstream and downstream locations, average D.O. was close to exceeding the criterion.

Enrichment was evident via high D.O. ranges both upstream and downstream from the Grafton WWTP in June 2012. The D.O. range was extremely large downstream from the WWTP, measuring 11.61 mg/L. At both locations, however, the D.O. averages and minimums met the criteria. Unfortunately, the downstream instrument failed in the July 2012 survey and no results were reported.

Results for both June and July 2012 surveys in Willow Creek to determine the impact of the Eaton Estates WWTP did not indicate an enrichment impact. The D.O. ranges, averages, and minimums were acceptable.

Sondes were deployed at the most downstream site of the East Branch Black River to assess impacts from Elyria CSOs and the closed CERCLA site, Chemical Recovery Systems, Incorporated (CRS). Discussion of other parameters – pH, specific conductance, and temperature – occurs elsewhere in this section. The June 2012 survey results were acceptable; however, the July 2012 result showed potential organic enrichment. The averages and minimums were just above the WWH criteria, whereas the D.O. swing was quite small (2.12 mg/L).

Overall, for the East Branch Black River system, the D.O. minimum and average criteria were protected for most of its length. D.O. range increased longitudinally toward the lower segments and the magnitude was depressed in the July relative to the June survey, especially in the upper segments.

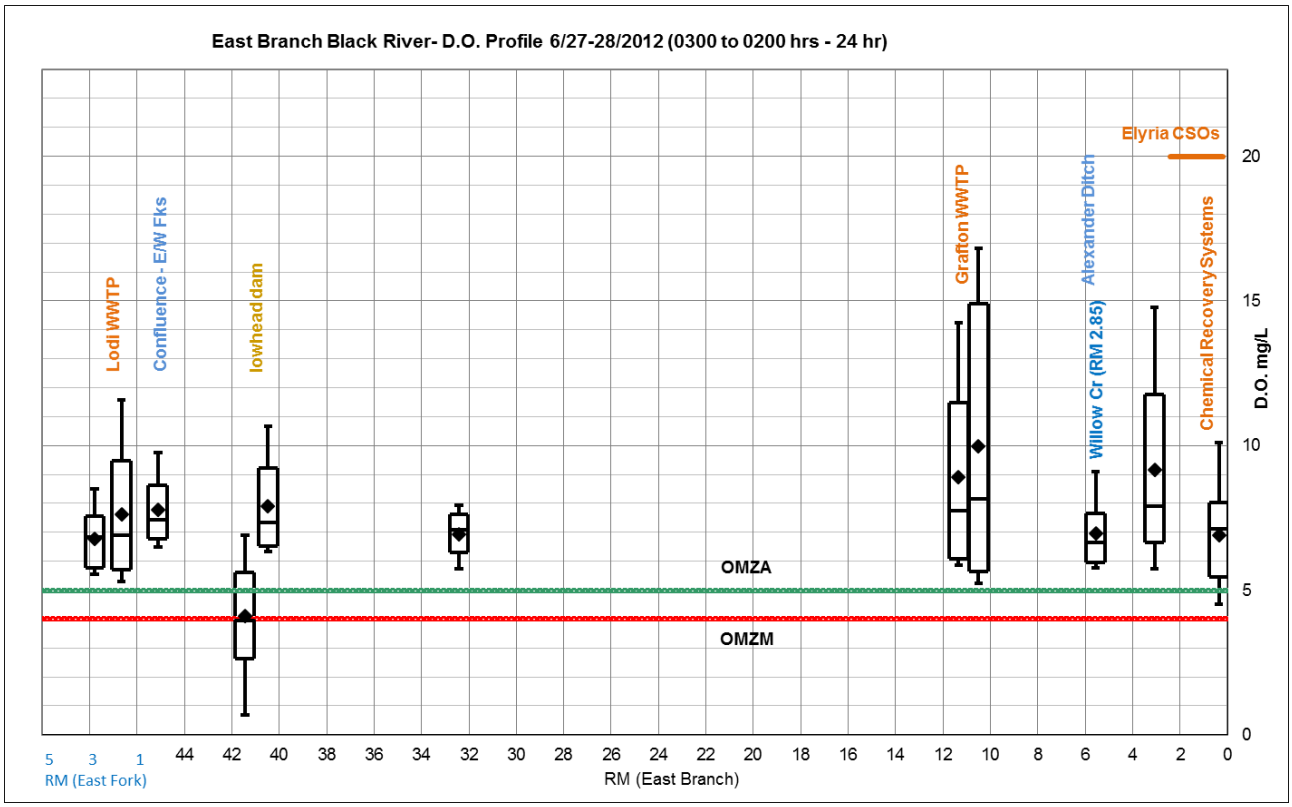


Figure 9. Longitudinal trace using a box-and-whisker plot of time-distributed D.O. measurements for the East Branch Black River, including its upper East Fork and Willow Creek. Results are based on June 26-28, 2012 sampling survey and a time subset of 24 hours. Also shown are the WWH OMZA (outside mixing zone average-green line) and OMZM (outside mixing zone minimum-red line). Legend for box-and-whisker icon: center diamond=average over period, center bar=median, upper box end=75th percentile, lower box end=25th percentile, upper tail=maximum, lower tail=minimum.

Table 15. Summary results for time-distributed D.O. measurements for the East Branch Black River, including its upper East Fork and Willow Creek. Results based on June 26-28, 2012 sampling survey. Values highlighted in red-bold indicate either an exceedance of the WWH WQS criterion or an elevated D.O. range. For WWH, average and minimum D.O. criteria are 5.0 and 4.0 mg/L, respectively. D.O. ranges above 6 mg/L are considered elevated.

Stream	East Fork	East Fork	East Fork	East Branch	East Branch	East Branch	East Branch	East Branch	Willow Creek	East Branch	East Branch
RM	1.73	1.60	0.06	41.45	40.47	32.42	11.34	10.50	2.85	3.07	0.36
Max	8.51	11.59	9.74	6.90	10.66	7.95	14.24	16.83	9.11	14.77	10.11
75th %ile	7.54	9.46	8.63	5.63	9.21	7.61	11.48	14.89	7.66	11.76	8.03
Median	6.83	6.91	7.44	3.95	7.34	7.08	7.76	8.17	6.65	7.90	7.13
Average	6.77	7.61	7.78	**4.09**	7.90	6.94	8.91	9.96	6.95	9.15	6.90
25th %ile	5.76	5.69	6.77	2.63	6.54	6.30	6.08	5.65	5.97	6.66	5.46
Min	5.56	5.30	6.48	**0.70**	6.33	5.74	5.87	5.22	5.78	5.74	4.52
Range	2.95	**6.29**	3.26	**6.20**	4.33	2.21	**8.37**	**11.61**	3.33	**9.03**	5.59

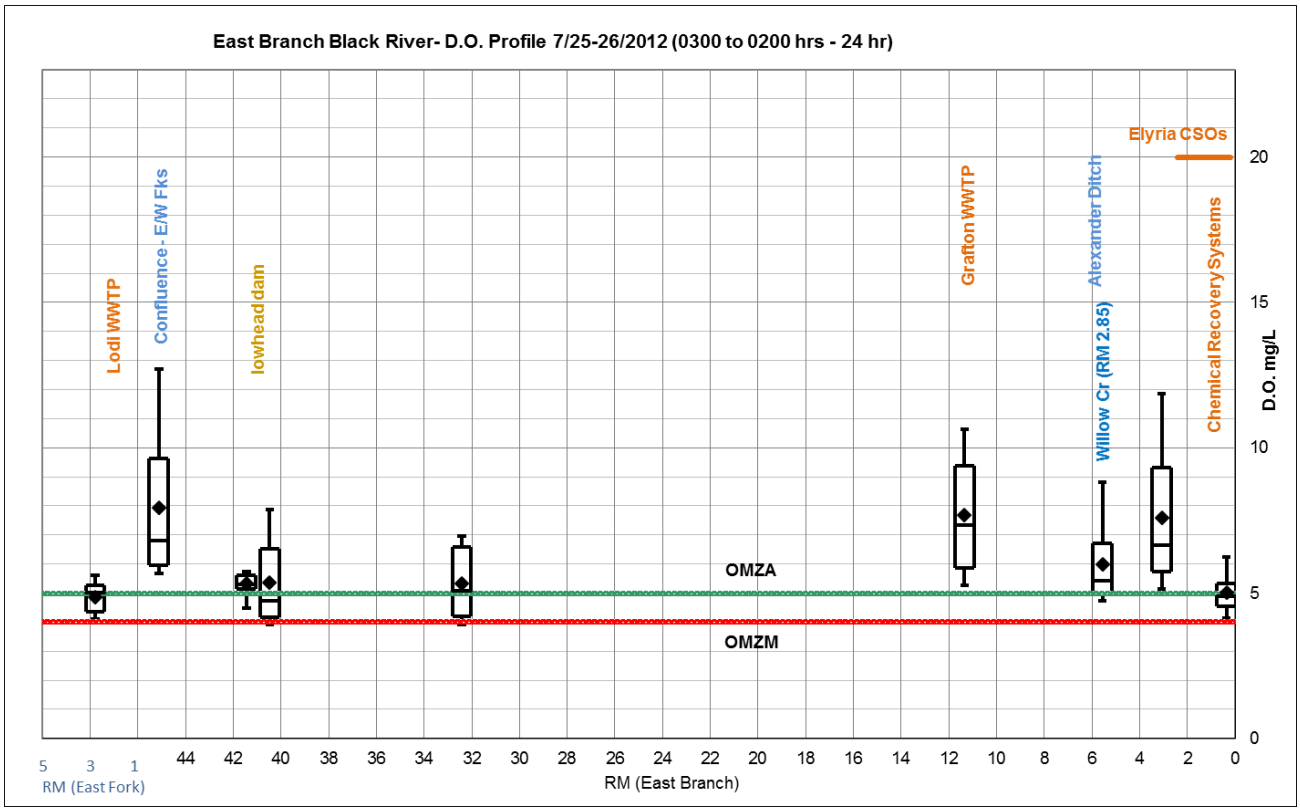


Figure 10. Longitudinal trace using a box-and-whisker plot of time-distributed D.O. measurements for the East Branch Black River, including its upper East Fork and Willow Creek. Results based on July 24-26, 2012 sampling survey and a time subset of 24 hours. See Figure 9 for additional explanation of the graph.

Table 16. Summary results for time-distributed D.O. measurements for the East Branch Black River, including its upper East Fork and Willow Creek. Results based on July 24-26, 2012 sampling survey. Values highlighted in red-bold indicate either an exceedance of the WWH WQS criterion or an elevated D.O. range. For WWH, average and minimum D.O. criteria are 5.0 and 4.0 mg/L, respectively. D.O. ranges above 6 mg/L are considered elevated.

Stream	East Fork	East Fork	East Fork	East Branch	East Branch	East Branch	East Branch	East Branch	Willow Creek	East Branch	East Branch
RM	1.73	1.60	0.06	41.45	40.47	32.42	11.34	10.50	2.85	3.07	0.36
Max	5.62	No data	12.72	5.75	7.88	6.97	10.64	No data	8.80	11.87	6.25
75th %ile	5.28	No data	9.63	5.61	6.51	6.60	9.39	No data	6.72	9.32	5.34
Median	**5.01**	No data	**6.81**	**5.29**	**4.74**	**5.09**	**7.35**	No data	**5.42**	**6.64**	**4.91**
Average	**4.87**	No data	**7.94**	**5.32**	**5.37**	**5.33**	**7.70**	No data	**6.00**	**7.60**	**5.01**
25th %ile	4.36	No data	5.96	5.15	4.18	4.20	5.86	No data	5.00	5.75	4.56
Min	4.09	No data	5.66	4.48	**3.93**	**3.92**	5.27	No data	4.72	5.15	4.13
Range	1.53	No data	**7.06**	1.27	3.95	3.05	5.37	No data	4.08	**6.72**	2.12

West Branch Black River, including Wellington Creek, and Black River mainstem
(Figure 11 and Figure 12; Table 17 and Table 18)

Surprisingly, the June 2012 survey showed no exceedances of the D.O. average and minimum criteria, but the D.O. range increased in a downstream direction. Elevated D.O. range (> 6 mg/L) was found in the lower West Branch Black River at RM 4.18 and in the Black River mainstem downstream from the Ford Road landfill at RM 10.7, and in the most downstream site of the survey at RM 8.35.

D.O. results were nearly mirrored in the July 2012 survey; the exception being an exceedance of both the D.O. average and minimum criteria in the uppermost location of the West Branch Black River at RM 28.5. D.O. range was extremely high (10.81 mg/L) in the uppermost location of the Black River mainstem at RM 14.95, and can possibly be attributed to Elyria CSOs, as this site collects the lower reaches of both the West and East branches of the watershed draining the Elyria urban area. As in the June 2012 survey, the D.O. range below the Ford Road landfill at RM 10.7 was high, declined downstream from the Elyria WWTP outfall (Figure 12), and then increased again at the most downstream site at RM 8.35.

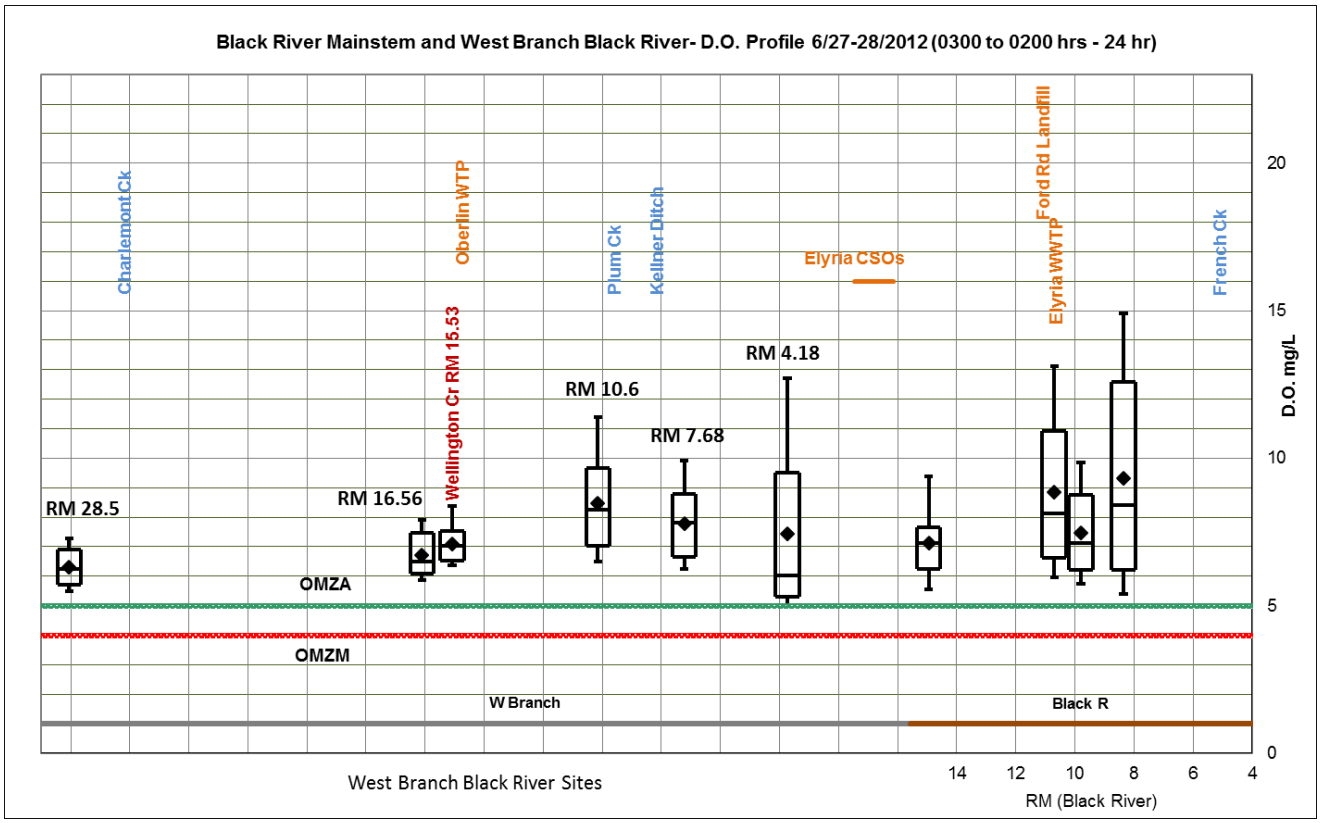


Figure 11. Longitudinal trace using a box-and-whisker plot of time-distributed D.O. measurements for the West Branch Black River (river miles indicated parenthetically), including Wellington Creek, and the Black River mainstem (river miles indicated on x-axis). Results based on June 26-28, 2012 sampling survey and a time subset of 24 hours. See Figure 9 for additional explanation of the graph.

Table 17. Summary results for time-distributed D.O. measurements for the West Branch Black River, including Wellington Creek, and the Black River mainstem. Results based on June 26-28, 2012 sampling survey. Values highlighted in red-bold indicate either an exceedance of the WWH WQS criterion or an elevated D.O. range. For WWH, average and minimum D.O. criteria are 5.0 and 4.0 mg/L, respectively. D.O. ranges above 6 mg/L are considered elevated.

Stream	West Branch	West Branch	Wellington Creek	West Branch	West Branch	West Branch	Black River	Black River	Black River	Black River
RM	28.5	16.56	15.53	10.60	7.68	4.18	14.95	10.70	9.80	8.35
Max	7.28	7.90	8.38	11.39	9.91	12.72	9.38	13.13	9.86	14.92
75th %ile	6.91	7.46	7.54	9.67	8.78	9.50	7.65	10.91	8.76	12.58
Median	**6.25**	**6.50**	**7.03**	**8.26**	**7.81**	**6.02**	**7.12**	**8.13**	**7.14**	**8.41**
Average	**6.31**	**6.72**	**7.08**	**8.48**	**7.78**	**7.43**	**7.12**	**8.86**	**7.47**	**9.31**
25th %ile	5.72	6.08	6.52	7.02	6.64	5.31	6.26	6.63	6.20	6.23
Min	5.49	5.86	6.37	6.50	6.24	5.01	5.57	5.97	5.74	5.40
Range	1.79	2.04	2.01	4.89	3.67	**7.71**	3.81	**7.16**	4.12	**9.52**

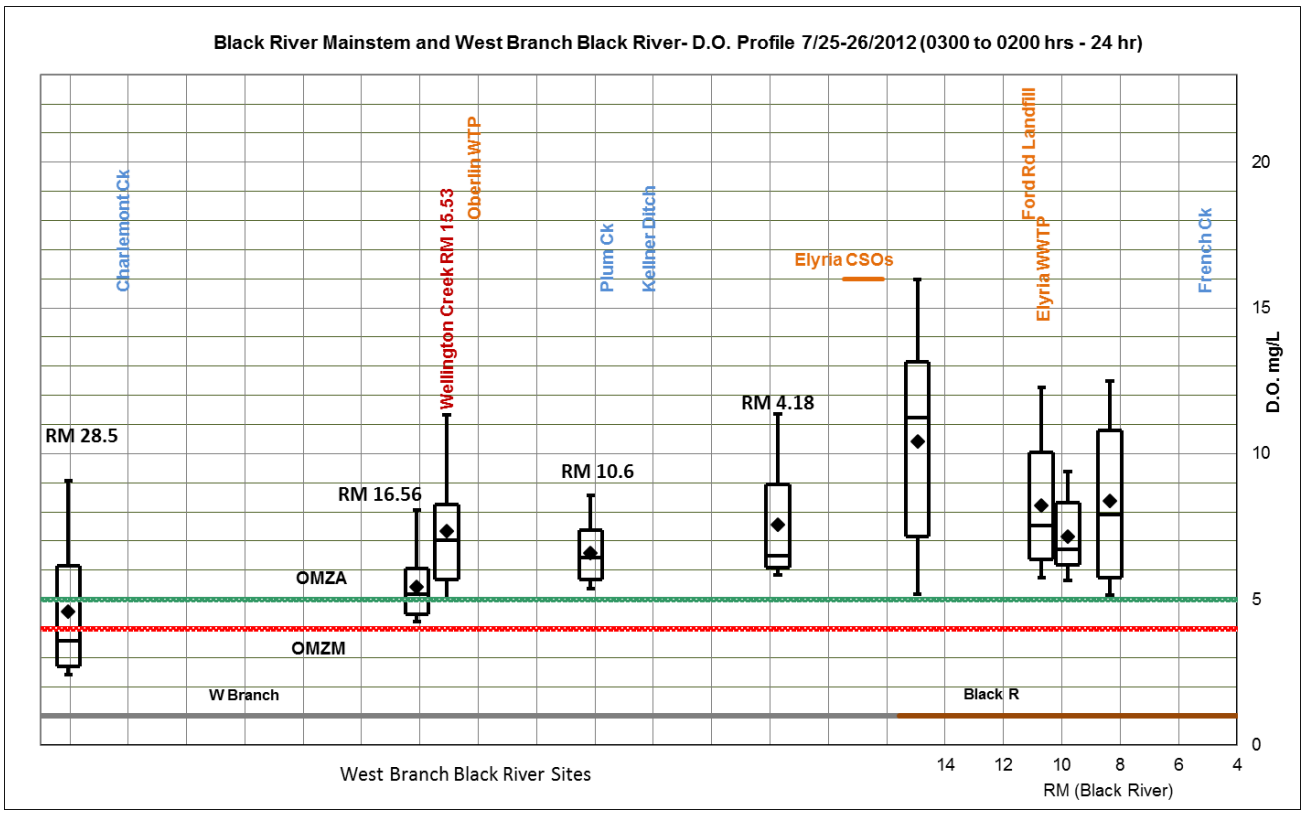


Figure 12. Longitudinal trace using a box-and-whisker plot of time-distributed D.O. measurements for the West Branch Black River (river miles indicated parenthetically), including Wellington Creek, and the Black River mainstem (river miles indicated on x-axis). Results based on July 25-27, 2012 sampling survey and a time subset of 24 hours. See Figure 9 for additional explanation of the graph.

Table 18. Summary results for time-distributed D.O. measurements for the West Branch Black River, including Wellington Creek, and the Black River mainstem. Results based on July 25-27, 2012 sampling survey. Values highlighted in red-bold indicate either an exceedance of the WWH WQS criterion or an elevated D.O. range. For WWH, average and minimum D.O. criteria are 5.0 and 4.0 mg/L, respectively. D.O. ranges above 6 mg/L are considered elevated.

Stream	West Branch	West Branch	Wellington Creek	West Branch	West Branch	West Branch	Black River	Black River	Black River	Black River
RM	28.5	16.56	15.53	10.6	7.68	4.18	14.95	10.7	9.8	8.35
Max	9.06	8.06	11.32	8.57	No data	11.36	15.98	12.26	9.38	12.49
75th %ile	6.16	6.05	8.26	7.36	No data	8.95	13.15	10.03	8.30	10.79
Median	**3.57**	**5.18**	**7.05**	**6.43**	No data	**6.50**	**11.25**	**7.54**	**6.73**	**7.91**
Average	**4.59**	**5.43**	**7.36**	**6.59**	No data	**7.56**	**10.43**	**8.24**	**7.16**	**8.37**
25th %ile	2.69	4.50	5.68	5.68	No data	6.08	7.15	6.38	6.19	5.73
Min	2.43	4.25	5.01	5.36	No data	5.85	5.17	5.74	5.64	5.15
Range	**6.63**	3.81	**6.31**	3.21	No data	5.51	**10.81**	**6.52**	3.74	**7.34**

Other Monitored Tributaries
(Figure 13 and Figure 14; Table 19 and Table 20)

Sondes were deployed in Plum Creek bracketing the Oberlin WWTP outfall. In both the June and July surveys, D.O. concentrations were very low, with minimum and average concentrations well below the WQS criteria. However, in both surveys, flow volume was quite low and corresponding flow velocity was weak as this zone was approaching interstitial flow conditions.

No D.O. issues were found downstream from the Wellington WWTP outfall in Charlemont Creek at RM 0.39; the actual D.O. magnitudes increased and were likely due to the augmentation of flow from the outfall in an otherwise critical low flow summer. Regarding the French Creek WWTP in North Ridgeville, D.O. at RM 0.54 downstream from the outfall was acceptable, though in the June survey, the D.O. range was approaching elevated status at 4.52 mg/L. In both surveys, the upstream location at RM 3.20 had much higher D.O. ranges of over 6 mg/L. The Kelner Ditch sonde was deployed to evaluate the effects of the LaGrange WWTP. D.O. issues were present in both surveys – the June survey showed an elevated range of 6.11 mg/L and the July survey produced a D.O. minimum WQS criterion exceedance of 3.86 mg/L.

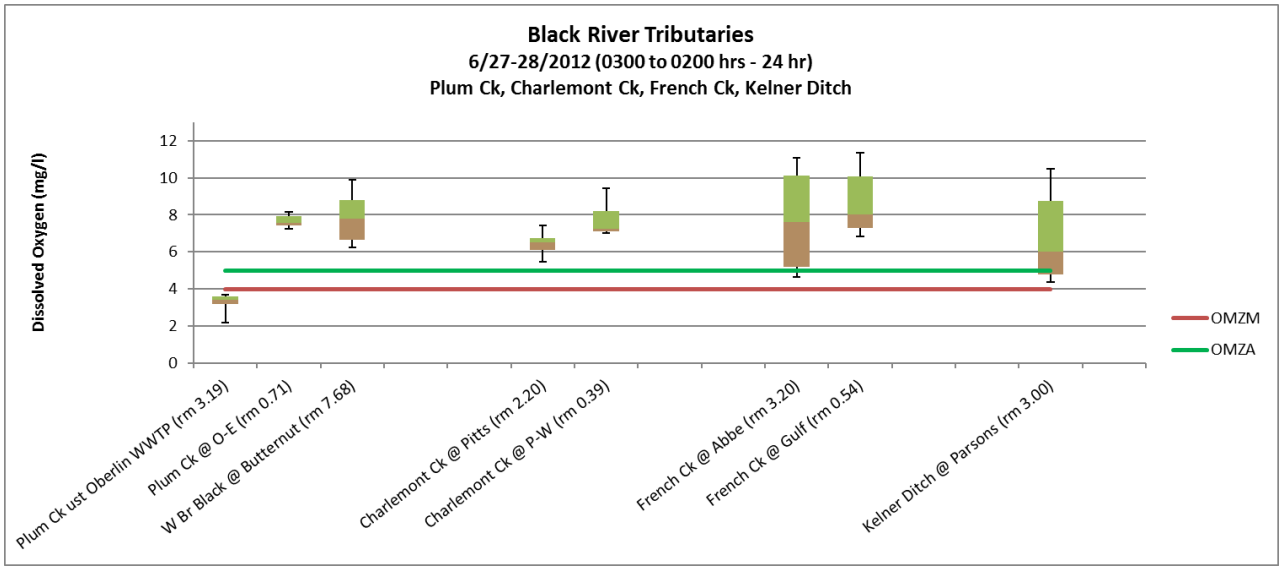


Figure 13. Longitudinal trace using a box-and-whisker plot of time-distributed D.O. measurements for monitored tributaries in the Black River watershed. Results based on June 26-28, 2012 sampling survey and a time subset of 24 hours. See Figure 9 for additional explanation of the graph.

Table 19. Summary results for time-distributed D.O. measurements for other monitored tributaries in the Black River watershed. Results based on June 26-28, 2012 sampling survey. Values highlighted in red-bold indicate either an exceedance of the WWH WQS criterion or an elevated D.O. range. For WWH, average and minimum D.O. criteria are 5.0 and 4.0 mg/L, respectively. D.O. ranges above 6 mg/L are considered elevated.

Stream	Oberlin WWTP bracket			Wellington WWTP bracket		French Creek WWTP bracket		Kellner Ditch
RM	3.19	0.71	7.68	2.20	0.39	3.20	0.54	3.00
Max	3.70	8.17	9.91	7.41	9.45	11.06	11.33	10.47
75th %ile	3.59	7.92	8.78	6.73	8.21	10.12	10.06	8.77
Median	**3.43**	**7.54**	**7.81**	**6.50**	**7.26**	**7.61**	**8.01**	**6.02**
Average	**3.35**	**7.66**	**7.78**	**6.46**	**7.71**	**7.70**	**8.65**	**6.76**
25th %ile	3.20	7.40	6.64	6.10	7.09	5.19	7.31	4.79
Min	**2.19**	7.26	6.24	5.45	7.00	4.65	6.81	4.36
Range	1.51	0.91	3.67	1.96	2.45	**6.41**	4.52	**6.11**

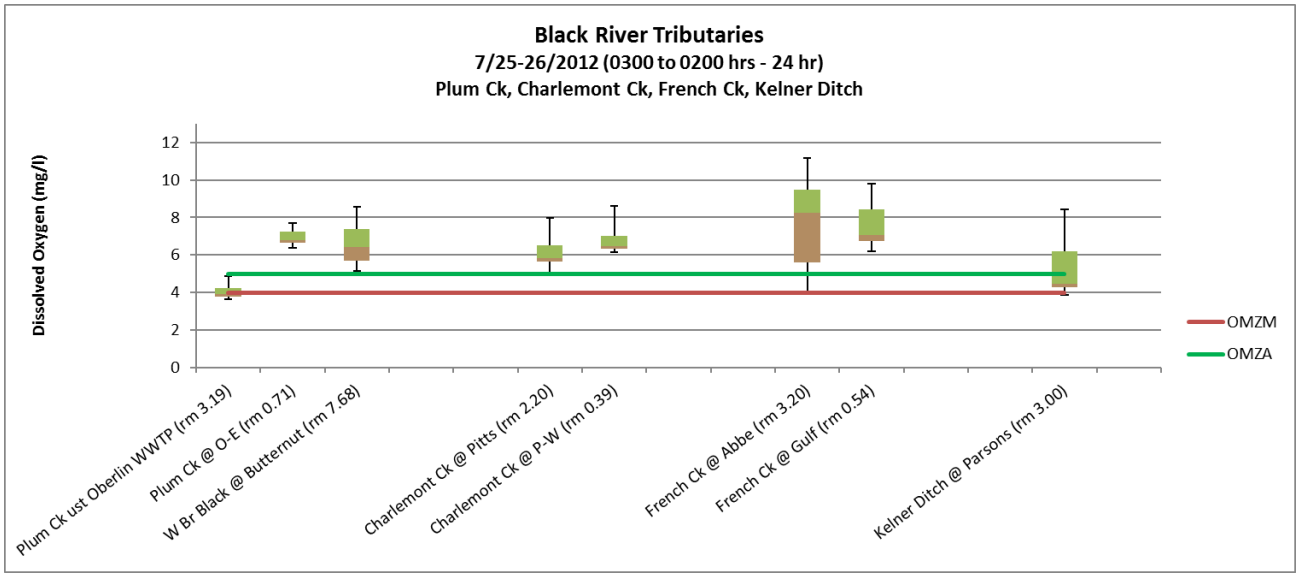


Figure 14. Longitudinal trace using a box-and-whisker plot of time-distributed D.O. measurements for other monitored tributaries in the Black River watershed. Results based on July 24-26, 2012 sampling survey and a time subset of 24 hours. See Figure 9 for additional explanation of the graph.

Table 20. Summary results for time-distributed D.O. measurements for other monitored tributaries in the Black River watershed. Results based on July 24-26, 2012 sampling survey. Values highlighted in red-bold indicate either an exceedance of the WWH WQS criterion or an elevated D.O. range. For WWH, average and minimum D.O. criteria are 5.0 and 4.0 mg/L, respectively. D.O. ranges above 6 mg/L are considered elevated.

Stream	Oberlin WWTP bracket			Wellington WWTP bracket		French Creek WWTP bracket		Kellner Ditch
RM	3.19	0.71	7.68	2.20	0.39	3.20	0.54	3.00
Max	4.88	7.72	8.57	7.99	8.60	11.16	9.79	8.42
75th %ile	4.25	7.26	7.36	6.53	7.04	9.46	8.41	6.19
Median	**3.91**	**6.81**	**6.43**	**5.82**	**6.49**	**8.26**	**7.05**	**4.48**
Average	**4.05**	**6.94**	**6.55**	**6.16**	**6.79**	**7.78**	**7.54**	**5.26**
25th %ile	3.79	6.64	5.68	5.63	6.33	5.60	6.75	4.28
Min	**3.66**	6.37	5.14	5.07	6.13	4.03	6.21	**3.86**
Range	1.22	1.35	3.43	2.92	2.47	**7.13**	3.58	4.56

Temperature

In addition to D.O. monitoring, water temperature was recorded hourly over the same time period. The general Lake Erie basin temperature limits for this time period are 27.8°C (82°F) average and 29.4°C (85°F) maximum. In the June 2012 survey, there were no exceedances of the temperature criteria. However, the two stations bracketing the Grafton WWTP (RMs 11.34 and 10.5) on the East Branch Black River produced a maximum very close to the criterion during the 24-hour monitoring window. Conversely, for the July 2012 survey, several locations exceeded the maximum criterion. The sites surrounding the Grafton WWTP measured 29.84°C upstream and 30.63°C downstream from the outfall, respectively. The East Branch Black River at RM 3.07 also exceeded the maximum temperature at 30.27°C. The Black River mainstem sonde deployed at RM 10.70 recorded a maximum close to the criterion (28.12°C).

Specific Conductance and pH

Specific locations in the study area were evaluated using specific conductance and pH as markers of dissolved constituents that have both an inorganic and organic origin. Areas of interest included the Black River downstream from the Ford Road Landfill (RM 10.7), the East Branch Black River at RM 0.36 and the Black River downstream from Elyria CSOs and CRS at RM 14.95. Normal stream values of specific conductance are 300-900 µS/cm; downstream from WWTP mixing zones, values could range from 800-1200 µS/cm, whereas values above 3000 µS/cm are exceptionally high.

Two regions showed abnormally high and variable specific conductance and both were situated downstream from WWTP mixing zones – namely, below the Elyria WWTP (RM 9.80 of the Black River) and below the Lodi WWTP (RM 1.60 of the East Fork East Branch Black River). At Elyria, values ranged from 1500 to 1900 µmhos/cm in June and from 1800 to 2300 µmhos/cm in July (Figure 15**;** July only). The high specific conductance persisted downstream to RM 8.35 on the Black River mainstem, with similar ranges over both events. At Lodi, specific conductance was trending upward over the 40+ hour sampling interval, with a range from 1800 to 2100 µmhos/cm in June and from 2200 to 2400 µmhos/cm in July (Figure 16; June only). A similar trend and magnitude persisted further downstream to RM 0.06 of the East Fork East Branch Black River. All other locations in the study area showed specific conductance values that were approximately constant over the time period and below 1000 µmhos/cm.

Normal stream pH is 6 to 9 IU; for all locations and both events, measured pH was within the normal range.

Chlorophyll-a

Chlorophyll-*a* is an indicator of primary production which is subsequently driven by nutrient enrichment. Both benthic (rock) and sestonic (water column) algae are sampled to determine enrichment, though the benthic component is a stronger indicator in streams of the size found in the Black River basin. Benthic samples are prepared from defined scrape zones of rocks which are randomly collected in the stream substrate over several riffle/pool sequences. The result is measured as a mass per unit area of scraped surface. Sestonic samples are prepared from instantaneous water column grabs and the result is measured as a mass per liquid volume.

Due to the labor intensive nature of benthic collections, only a subset of sonde sampling sites were selected for chlorophyll-*a* analysis (
Table **21**). The sampling subset targeted stream segments downstream from WWTP mixing zones. High values for benthic chlorophyll-*a* were observed downstream from Grafton, Lodi, Eaton Estates, Oberlin, French Creek, and Elyria WWTPs. The exceptions were LaGrange and Wellington WWTPs. As for sestonic chlorophyll-*a*, the lower reaches of the West Branch Black River and Black River mainstem were high. In the presence of nutrient enrichment, pooled stream conditions are conducive to high sestonic primary production.

These abnormally high chlorophyll-*a* values suggested nutrient over-enrichment and excessive primary production by algae. Also, observations of high production require that the stream be limited by neither light (through shading) nor velocity (through scouring or short growth duration). With high production, D.O. stress will result due to larger day-time maximums and lower night-time minimums. A lower night-time minimum results from excess algal respiration and decomposition, both of which consume D.O. By amplifying the daily maximum and minimum, the daily D.O. range also increases. The presence of both lower D.O. minimums and higher D.O. ranges invoke metabolic stress on aquatic life.

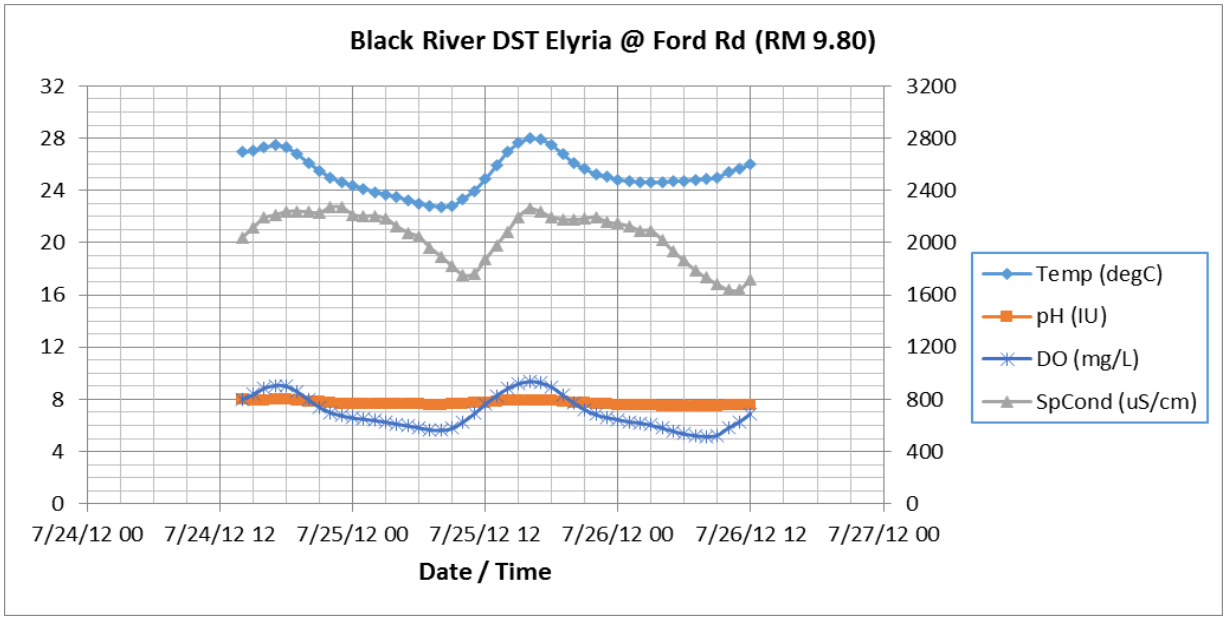


Figure 15. Hourly time trace of sonde readings for temperature (°C), pH (IU), dissolved oxygen (mg/L), and specific conductance (µS/cm; right axis only) for the Black River RM 9.80, July 24-26, 2012.

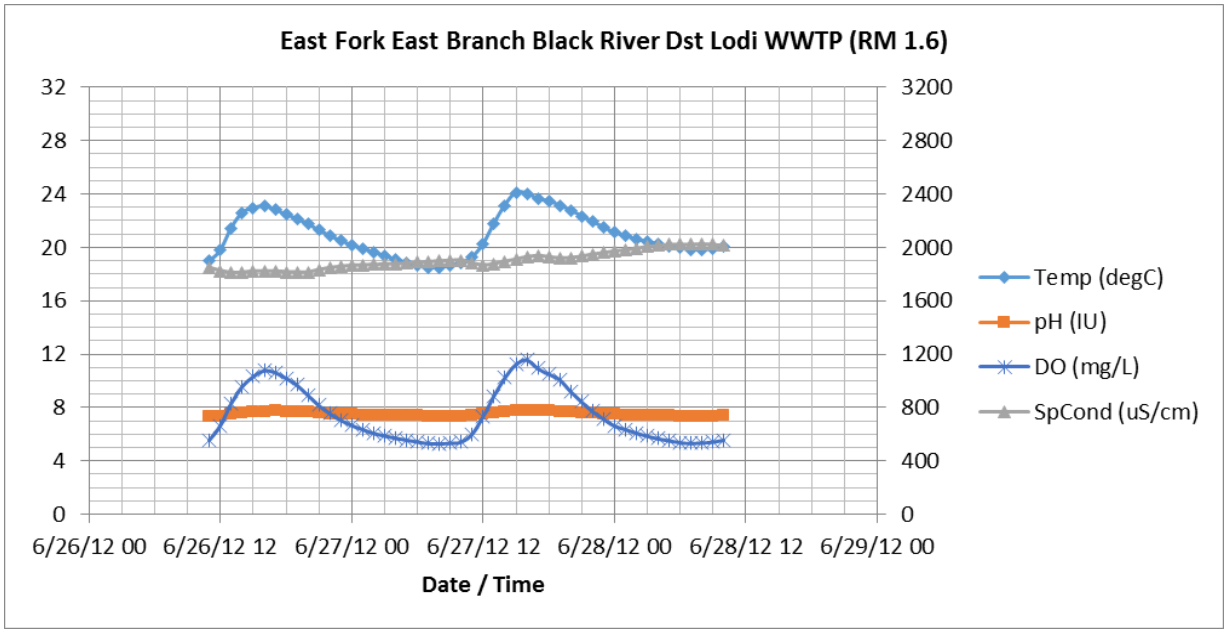


Figure 16. Hourly time trace of sonde readings for temperature (°C), pH (IU), dissolved oxygen (mg/L), and specific conductance (µS/cm; right axis only) for the East Fork East Branch Black River RM 1.60, June 26-28, 2012.

Table 21. Benthic (rock) and sestonic (water column) chlorophyll-*a* yields and concentrations for selected sites in the Black River watershed assessed during the June and July, 2012 sonde surveys. Benthic values above 120 and 183 mg/m^2 are considered high (green) and very high (red), respectively. Sestonic values above 20 µg/L are considered high (red).

			benthic chl-*a* (mg/m^2)		sestonic chl-*a* (µg/L)		
Stream	**RM**	**# Events**	**avg**	**max**	**avg**	**max**	**Upstream WWTP**
Black River	9.8	2	**264.3**	**299**	16.2	**21.7**	Elyria WWTP
French Creek	0.54	2	86.1	**170**	5.1	8.7	French Creek WWTP
West Branch Black River	7.68	1	--	98.1	--	**31.5**	Oberlin WWTP (far-field)
West Branch Black River	16.56	1	--	--	--	**27.8**	
West Branch Black River	28.5	1	--	83.8	--	**21.4**	
Plum Creek	0.71	2	**166.2**	**249**	1.1	1.4	Oberlin WWTP (near-field)
Kellner Ditch	3.0	2	66.2	78.7	0.75	0.8	LaGrange WWTP
Wellington Creek	0.6	1	--	100	--	3.9	
Charlemont Creek	0.39	2	54.5	77.9	3.5	3.6	Wellington WWTP
East Branch Black River	10.5	2	**176**	**228**	16.7	17.9	Grafton WWTP
East Fork East Branch Black River	0.06	2	**238**	**244**	9.0	12.6	Lodi WWTP
Willow Creek	2.85	2	**156.9**	**221**	3.8	4.4	Eaton Estates WWTP

Long-Term Trends

Ohio EPA has maintained one long-term ambient sampling site in the Black River basin. The site is located on the Black River mainstem at Ford Road (Station #501510 at RM 9.8). The station is downstream from Elyria and upstream from Lorain. The station has been monitored consistently since 1973. Looking at nutrient results, there are several definite trends directly resulting from WWTP upgrades (Figure 17). Ammonia levels in the stream were elevated, often above WQS criteria, until plant upgrades resulted in a dramatic decrease in concentrations. Improvements in the treatment of ammonia resulted in increased nitrate concentrations in the late 1980s; values are now consistently above the target concentration of 1.5 mg/l. Upgrades at the Elyria WWTP (discharging upstream at river mile 10.65) resulted in better removal of ammonia, which shifted the mass balance of nitrogen to nitrate. Phosphorus also shows a shift in concentrations in the late 1980s. Phosphorus limits recommended by the International Joint Commission required an effluent limit of 1.0 mg/l at large wastewater treatment plants.

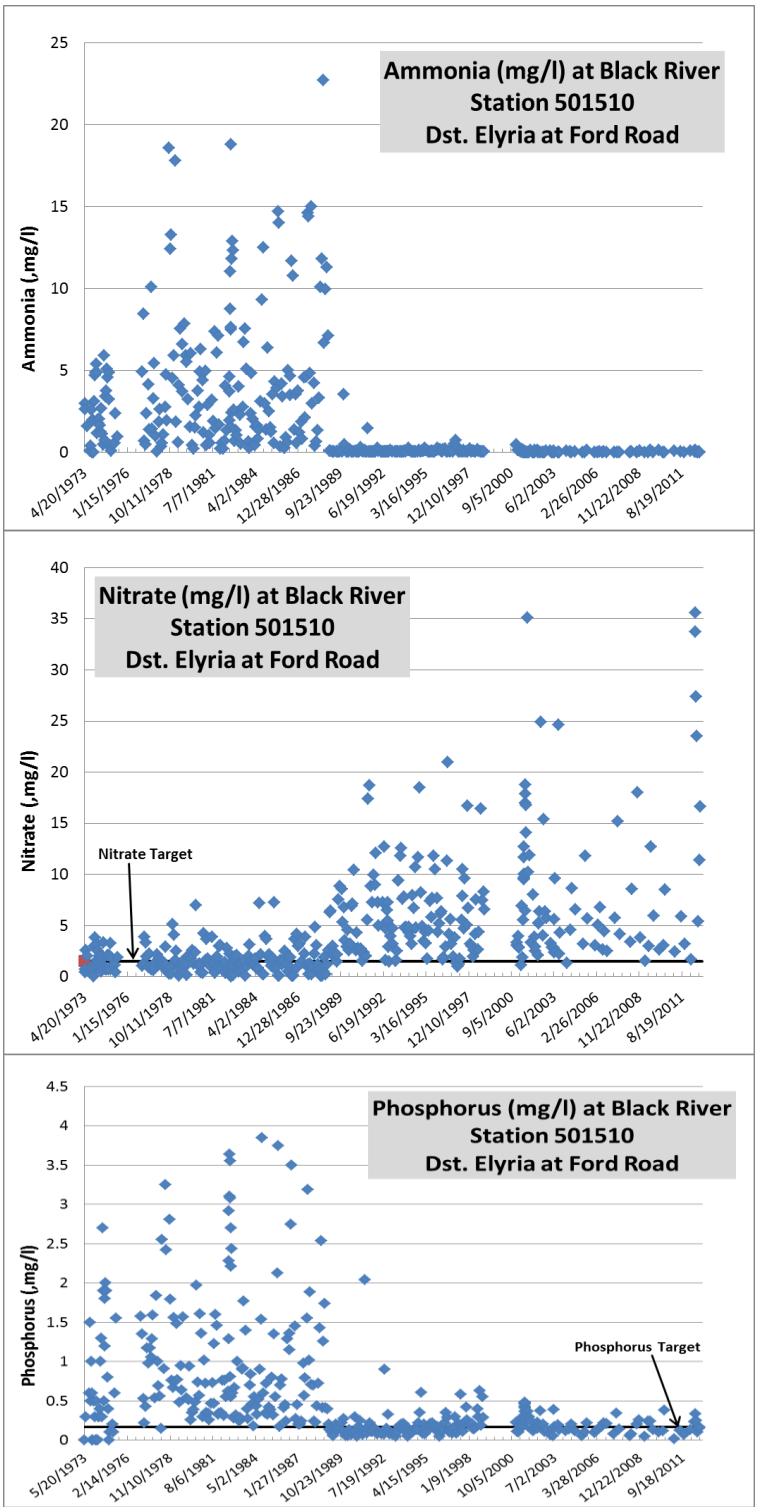


Figure 17. Long-term trends in nutrient concentrations (ammonia, nitrate and phosphorus) in the Black River at Ford Road, RM 9.8.

Water Column Organic Contaminants

Water column samples were collected at eight sites in the watershed and analyzed for a suite of organic parameters including volatile organic compounds, semi-volatile organic compounds, pesticides and herbicides, and PCBs (99 individual parameters). Of the 2059 individual results, 24 were above the detection limits (1.1%). Table 22 lists the organic sample results that were found above detection limits; complete results are included in Appendix Table 2.

Table 22. Organic sampling results above detection limits in the Black River watershed, 2012.

Station Name	Sample Date	Parameter	Result	Units	Non-Detect	Qualifier	Lab Comments
BLACK R. 250 FT. UPST ELYRIA WWTP	6/28/2012	BHC-beta	0.012	ug/L	< 0.002		
BLACK R. 250 FT. UPST ELYRIA WWTP	7/16/2012	BHC-delta	0.0028	ug/L	< 0.0021		
BLACK R. AT ELYRIA @ CASCADE PARK	10/10/2012	BHC-delta	0.0028	ug/L	< 0.0021		
BLACK R. DST. ELYRIA @ FORD RD.	10/10/2012	BHC-delta	0.0048	ug/L	< 0.0022		
BLACK R. DST. ELYRIA, NEAR SPRING VALLEY GOLF CLUB	10/10/2012	BHC-delta	0.003	ug/L	< 0.0021		
CHARLEMONT CREEK @ WELLINGTON WTP INTAKE	7/23/2012	Atrazine	0.8	ug/L	< 0.21		
CHARLEMONT CREEK @ WELLINGTON WTP INTAKE	7/23/2012	bis(2-ethylhexyl) phthalate (DEHP)	1.09	ug/L	< 0.53		
CHARLEMONT CREEK @ WELLINGTON WTP INTAKE	7/23/2012	Metolachlor	0.53	ug/L	< 0.21		
CHARLEMONT CREEK @ WELLINGTON WTP INTAKE	7/23/2012	Simazine	0.21	ug/L	< 0.21	J	Simazine estimated due to poor QC recovery.
CHARLEMONT CREEK @ WELLINGTON WTP INTAKE	8/06/2012	Atrazine	0.57	ug/L	< 0.21		
CHARLEMONT CREEK @ WELLINGTON WTP INTAKE	8/06/2012	Metolachlor	0.34	ug/L	< 0.21		
CHARLEMONT CREEK @ WELLINGTON WTP INTAKE	9/05/2012	Atrazine	0.34	ug/L	< 0.22		
CHARLEMONT CREEK @ WELLINGTON WTP INTAKE	9/05/2012	Metolachlor	0.23	ug/L	< 0.22		
CHARLEMONT CREEK @ WELLINGTON WTP INTAKE	9/25/2012	BHC-alpha	0.0024	ug/L	< 0.0021		525: herbicide analytes estimated due to improper sample preservation. 625: All compounds estimated due to low surrogate recovery.
E. BR. BLACK R. AT ELYRIA @ E. BRIDGE ST.	9/24/2012	BHC-delta	0.0031	ug/L	< 0.0021		
E. BR. BLACK R. AT ELYRIA @ WASHINGTON ST.	9/24/2012	BHC-delta	0.0043	ug/L	< 0.002		
W. BR. BLACK R. E OF OBERLIN @ PARSONS RD.	7/23/2012	Acetochlor	0.26	ug/L	< 0.21		
W. BR. BLACK R. E OF OBERLIN @ PARSONS RD.	7/23/2012	Atrazine	0.62	ug/L	< 0.21		
W. BR. BLACK R. E OF OBERLIN @ PARSONS RD.	7/23/2012	bis(2-ethylhexyl) phthalate (DEHP)	0.65	ug/L	< 0.53		
W. BR. BLACK R. E OF OBERLIN @ PARSONS RD.	7/23/2012	Metolachlor	0.32	ug/L	< 0.21		
W. BR. BLACK R. E OF OBERLIN @ PARSONS	8/06/2012	Atrazine	0.5	ug/L	< 0.22		

Station Name	Sample Date	Parameter	Result	Units	Non-Detect	Qualifier	Lab Comments
RD.							
W. BR. BLACK R. E OF OBERLIN @ PARSONS RD.	8/06/2012	bis(2-ethylhexyl) phthalate (DEHP)	0.61	ug/L	< 0.54		
W. BR. BLACK R. E OF OBERLIN @ PARSONS RD.	9/05/2012	Atrazine	0.26	ug/L	< 0.22		
W. BR. BLACK R. E OF OBERLIN @ PARSONS RD.	9/25/2012	BHC-delta	0.0023	ug/L	< 0.0021		

RECREATION USE

Water quality criteria for determining attainment of recreation uses are established in the Ohio Water Quality Standards (Table 7-13 in OAC 3745-1-07) based upon the presence or absence of bacteria indicators (*Escherichia coli*) in the water column. New revisions to the recreation use rules in Ohio became effective on January 4, 2016. However, as sampling to assess the recreation use for the Black River basin study area was designed and carried out when the previous rules were in effect, the assessment of data and determination of recreation use attainment status provided in this section were based on the prior rules.

Escherichia coli (*E. coli*) bacteria are microscopic organisms that are present in large numbers in the feces and intestinal tracts of humans and other warm-blooded animals. *E. coli* typically comprises approximately 97 percent of the organisms found in the fecal coliform bacteria of human feces (Dufour, 1977), but there is currently no simple way to differentiate between human and animal sources of coliform bacteria in surface waters, although methodologies for this type of analysis are becoming more practicable. These microorganisms can enter water bodies where there is a direct discharge of human and animal wastes, or may enter water bodies along with runoff from soils where these wastes have been deposited.

Pathogenic (disease causing) organisms are typically present in the environment in such small amounts that it is impractical to monitor them directly. Fecal indicator bacteria by themselves, including *E. coli*, are usually not pathogenic. However, some strains of *E. coli* can be pathogenic, capable of causing serious illness. Although not necessarily agents of disease, fecal indicator bacteria such as *E. coli* may indicate the potential presence of pathogenic organisms that enter the environment through the same pathways. When *E. coli* are present in high numbers in a water sample, it invariably means that the water has received fecal matter from one source or another. Swimming or other recreational-based contact with water having a high fecal coliform or *E. coli* count may result in ear, nose, and throat infections, as well as stomach upsets, skin rashes, and diarrhea. Young children, the elderly, and those with depressed immune systems are most susceptible to infection.

The streams of the Black River watershed evaluated in this survey are all designated or recommended for the Primary Contact Recreation (PCR) use in OAC Rule 3745-1-27. The West Branch Black River at River Mile 14.42 and Charlemont Creek at River Mile 2.97 are designated Public Water Supply for Oberlin and Wellington, respectively.

Water bodies with a designated recreational use of PCR "...are waters that, during the recreation season, are suitable for one or more full-body contact recreation activities such as, but not limited to, wading, swimming, boating, water skiing, canoeing, kayaking and SCUBA diving" [OAC 3745-1-07 (B)(4)(b)]. At the time of the survey in the Black River basin, the Ohio Water Quality Standards specified three classes of PCR use to reflect differences in the potential frequency and intensity of use. Streams designated PCR Class A typically have identified public access points and support primary contact recreation. Streams designated PCR Class B support, or potentially support, occasional primary contact recreation activities. Streams designated PCR Class C are water bodies that support, or potentially support, infrequent primary contact recreation activities such as, but not limited to, wading. The Black River is designated Class A PCR waters. Other Class A PCR waters in the Black River watershed include the East Branch from RM 38.73 to the mouth, and the West Branch from RM 18.1 to the mouth. All other PCR streams assessed during this survey are designated Class B waters. The *E. coli* criteria that apply to PCR Class A and B streams include a seasonal geometric mean of 126 and 161 cfu/100 ml, respectively, and maximum values of 298 and 523 cfu/100 ml, respectively. The geometric mean is based on two or more samples and is used as the basis for determining attainment status when more than one sample is collected.

There was no 12-digit HUC that had all assessed sites in full attainment of recreational WQS criteria. Of the 64 sites sampled in 2011 and 2012, only 10 (16%) were in full attainment of the PCR recreation use. Agriculture and septic systems are dominant causes of non-attainment in the upper parts of the watershed. In the lower section of the Black River, CSOs and urbanization become dominant sources of the non-attainment observed. Summarized bacteria results are listed in Table 23 and Table 24, and the complete dataset is reported in Appendix Table 5.

Table 23. Summary of *E. coli* bacteria data for locations sampled in the Black River watershed, 2012. Recreation use attainment is based on comparing the geometric mean to the Primary Contact Recreation (PCR) Class A (126 cfu/100 ml) or Class B (161 cfu/100 ml) geometric mean water quality criterion (Ohio Administrative Code 3745-1-07). Red shaded values exceed the applicable PCR geometric mean criterion.

HUC 10/ Assessment Unit	Stream	Station	River Mile	No. of Samples	Geometric Mean (cfu/100ml)	% Samples > Max WQS	PCR Class*	Attainment†	Probable Source(s)‡
0411000103	**Headwaters East Branch Black River**								
01	***East Fork of East Branch Black River***								
East Fork E. Br.		B01S36	2.67	5	48	0.0%	PCR B	FULL	
		B01W10	0.06	6	369	16.7%	PCR B	NON	Ag, LS
02	***Headwaters West Fork East Branch Black River***								
West Fork E. Br.		301931	13.97	5	179	20.0%	PCR B	NON	Ag, LS,HSTS
		201609	8.90	5	415	40.0%	PCR B	NON	Ag, LS,HSTS
		B01W13	0.34	6	245	16.7%	PCR B	NON	Ag, LS,HSTS
Clear Creek		201615	1.80	6	164	16.7%	PCR B	NON	Ag, LS,HSTS
03	***Coon Creek-East Branch Black River***								
East Branch		B01S34	41.45	6	190	33.3%	PCR B	NON	Ag, LS,HSTS
		B01K07	40.47	2	97	0.0%	PCR B	FULL	
RM 41.41 Trib. E. Br.		302006	0.35	5	152	20.0%	PCR B	FULL	
Coon Creek		301933	0.88	6	84	16.7%	PCR B	FULL	
0411000104	**East Branch Black River**								
01	***Town of Litchfield-East Branch Black River***								
East Branch		B01S33	32.42	10	345	30.0%	PCR A	NON	Ag, LS,HSTS
RM 39.06 Trib. E. Br.		201599	1.50	6	266	33.3%	PCR B	NON	Ag, LS,HSTS
02	***Salt Creek-East Branch Black River***								
East Branch		B01S32	18.94	5	365	40.0%	PCR A	NON	Ag, LS,HSTS
RM 26.25 Trib. E. Br.		B01K09	0.60	6	261	33.3%	PCR B	NON	Ag, LS,HSTS
Salt Creek		301934	0.53	6	450	33.3%	PCR B	NON	Ag, LS,HSTS
Crow Creek		201602	0.80	5	340	40.0	PCR B	NON	Ag, LS,HSTS
03	***Willow Creek***								
Willow Creek		301935	6.49	6	729	66.7%	PCR B	NON	Ag, LS,HSTS
		B01S38	2.85	6	530	16.7%	PCR B	NON	Ag, LS,HSTS
04	***Jackson Ditch-East Branch Black River***								
East Branch		B01S30	10.50	10	204	30.0%	PCR A	NON	Ag, LS,HSTS
		B01S29	6.00	6	333	33.3%	PCR A	NON	Ag, LS,HSTS
		B01S11	3.07	11	1,022	90.9%	PCR A	NON	Ag, LS,HSTS
		B01P07	0.36	7	130	28.6%	PCR A	NON	Ag, LS,HSTS
RM 5.89 Trib. E. Br. (Brentwood)		301937	0.10	6	249	16.7%	PCR B	NON	HSTS,U
0411000105	**West Branch Black River**								
01	***Charlemont Creek***								
Charlemont Creek		301938	8.55	6	569	33.3%	PCR B	NON	Ag, LS,HSTS
		201634	2.20	8	295	33.3%	PCR B	NON	Ag, LS,HSTS

HUC 10/ Assessment Unit	Stream	Station	River Mile	No. of Samples	Geometric Mean (cfu/100ml)	% Samples > Max WQS	PCR Class*	Attainment†	Probable Source(s)‡
		B01P05	0.39	12	879	66.7%	PCR B	NON	Ag, LS,HSTS
02	***East Creek-West Branch Black River***								
West Branch		B01S41	41.67	7	72	0.0%	PCR B	FULL	
		B01K21	28.50	11	92	10.1%	PCR A	FULL	
East Creek		B01W23	0.56	4	32	0.0%	PCR B	FULL	
Buck Creek		B01S46	0.95	5	245	16.7%	PCR B	NON	Ag,HSTS
03	***Wellington Creek***								
Wellington Creek		201633	17.10	10	371	50.0%	PCR B	NON	Ag, LS,HSTS
		B01S43	13.09	7	235	28.6%	PCR B	NON	Ag, LS,HSTS
		201630	0.60	11	447	36.4%	PCR B	NON	Ag, LS,HSTS
04	***Middle West Branch Black River***								
West Branch		201620	19.60	5	370	20.0%	PCR A	NON	Ag, LS,HSTS
		B01W19	16.56	10	596	40.0%	PCR A	NON	Ag, LS,HSTS
05	***Plum Creek***								
Plum Creek		301944	5.57	5	422	40.0%	PCR B	NON	Ag,HSTS
		B01P03	3.19	5	815	60.0%	PCR B	NON	U,HSTS
		B01P02	0.71	10	675	70.0%	PCR B	NON	U,HSTS
06	***Elk Creek-West Branch Black River***								
West Branch		201619	10.60	5	277	20.0%	PCR A	NON	Ag, LS,HSTS
		B01S13	4.18	10	187	40.0%	PCR A	NON	Ag,U,HSTS
		B01K18	1.20	5	175	20.0%	PCR A	NON	Ag,CSO,U,HSTS
Kelner Ditch		B01W15	1.00	5	510	40.0%	PCR B	NON	Ag, LS,HSTS
0411000106	**Black River**								
01	***French Creek***								
French Creek		B01P18	9.02	6	115	0.0%	PCR B	FULL	
		B01P32	3.75	5	206	0.0%	PCR B	NON	HSTS,U
		B01S14	0.54	10	329	30.0%	PCR B	NON	HSTS,U
02	***Black River***								
Black River		501520	14.95	11	285	36.4%	PCR A	NON	CSO,U
		501510	9.80	10	527	30.0%	PCR A	NON	CSO,U
		B01S06	6.20	6	119	33.3%	PCR A	FULL	
RM 10.18 Trib. Black R.		301954	0.68	6	738	66.7%	PCR B	NON	HSTS,U
03	***Heider Ditch-Frontal Lake Erie***								
Heider Ditch		301955	0.25	6	1,739	83.3%	PCR B	NON	Ag,HSTS,U
Powdermaker Ditch		301958	0.15	6	267	33.3%	PCR B	NON	Ag,U
Gable Ditch		301956	0.30	6	2,046	100.0%	PCR B	NON	Ag,U

*- Recreation use class may include Primary Contact Recreation class (PCR A, PCR B or PCR C); Bathing Waters (BW); or Secondary Contact Recreation (SCR).

† - Attainment status is determined based on the seasonal geometric mean. The status cannot be determined at locations where fewer than two samples were collected during the recreation season.

‡ - Probable Sources: Ag – agricultural runoff; LS – impacts from livestock in stream or runoff from livestock operations; HSTS – failing home sewage treatment systems; CSO – combined sewer overflows; U – impacts from urban/sub-urban runoff

Table 24. Summary of *E. coli* bacteria data for locations sampled in the headwaters of the East Branch Black River watershed, 2011. Recreation use attainment is based on comparing the geometric mean to the Primary Contact Recreation (PCR) Class A (126 cfu/100 ml) or Class B (161 cfu/100 ml) geometric mean WQS criterion (Ohio Administrative Code 3745-1-07). Red shaded values exceed the applicable PCR Class A or Class B geometric mean criterion; results in bold font indicate geometric means that exceed the PCR single sample maximum criterion of 298 cfu/100 ml for Class A or 523 cfu/100 ml for Class B waters.

HUC 10/ *Assessment Unit*	Stream	Station	River Mile	No. of Samples	Geometric Mean (cfu/100 ml)	% Samples > Max WQS	PCR Class*	Attainment†	Probable Source(s)‡
0411000103	**Headwaters East Branch Black River**								
01	***East Fork of East Branch Black River***								
East Fork E. Br.		B01W12	5.84	3	**557**	33.0%	PCR B	NON	Ag, LS,HSTS
		301601	2.41	3	**883**	67.0%	PCR-B	NON	
		B01K17	2.30	3	**1646**	67.0%	PCR B	NON	Ag, LS,HSTS
		B01W10	0.06	3	**595**	33.0%	PCR B	NON	Ag, LS,HSTS
02	***Headwaters West Fork East Branch Black River***								
West Fork E. Br.		201610	15.10	4	**839**	75.0%	PCR B	NON	Ag, LS,HSTS
		B01W14	10.11	3	324	33.0%	PCR B	NON	Ag, LS,HSTS
		301599	5.74	3	124	0.0%	PCR B	FULL	
		301603	2.45	3	**552**	33.0%	PCR B	NON	Ag, LS,HSTS
		B01W13	0.34	3	230	0.0%	PCR B	NON	Ag, LS,HSTS
Clear Creek		201615	1.80	3	313	0.0%	PCR B	NON	Ag, LS,HSTS
03	***Coon Creek-East Branch Black River***								
East Branch		B01S34	41.45	3	832	67.0%	PCR-B	NON	
		B01K06	38.74	3	186	0.0%	PCR B	NON	Ag, LS,HSTS

* - Recreation use class may include Primary Contact Recreation class (PCR A, PCR B or PCR C); Bathing waters (BW); or Secondary Contact Recreation (SCR).

† - Attainment status is determined based on the seasonal geometric mean. The status cannot be determined at locations where fewer than two samples were collected during the recreation season.

‡ - Probable Sources: Ag – agricultural runoff; LS – impacts from livestock in stream or runoff from livestock operations; HSTS – failing home sewage treatment systems

SEDIMENT

Surficial sediment samples were collected by the Ohio EPA at two locations in the East Branch on December 3, 2012 and at four locations in the Black River mainstem on August 13, 2012 (Figure 18). The data quality objective of the sampling in the East Branch and the upper Black River was to determine if any releases had occurred from the Chemical Recovery CERCLA remediation site that might be contributing to sediment contamination in that vicinity. No samples were collected from the lower West Branch since the lower portion of the stream running through the city of Elyria is characterized by exposed bedrock with few, if any, depositional areas. Sediment sampling locations in the lower portions of the free-flowing reach of the Black River mainstem were selected to bracket the Ford Road Landfill remediation site and the Elyria WWTP. Sampling locations were co-located with biological sampling sites, except for the upstream (Bridge St.) location on the East Branch (station B01P10). A suitable sediment sample could not be collected from this location because of the predominant bedrock substrates downstream from Bridge St. (RM 1.14). Therefore, the sediment sample for the Bridge St. location was collected from the pool upstream from the dam located just upstream from Bridge St. at RM 1.20. Samples were analyzed for percent solids, total organic carbon (TOC), metals, semi-volatile organic compounds, PCBs, and pesticides. Specific chemical parameters tested and results are listed in Appendix Tables 3 and 4.

Sediment data were evaluated using Ohio Sediment Reference Values (SRVs; Ohio EPA 2008a), along with guidelines established in *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald *et.al*. 2000), and *Ecological Screening Levels (ESLs)* (USEPA 2003). The consensus-based sediment guidelines define two levels of ecotoxic effects. A *Threshold Effect Concentration* (TEC) is a level of sediment chemical quality below which harmful effects are unlikely to be observed. A *Probable Effect Concentration* (PEC) indicates a level above which harmful effects are likely to be observed. ESL values, considered protective benchmarks, were derived by USEPA, Region 5 using a variety of sources and methods.

Sediment samples were conservatively sampled by focusing on depositional areas of fine grain material (silts and clays). These areas typically are represented by higher contaminant levels, compared to coarse sands and gravels. Fine grained depositional areas were not a predominant substrate type at all of the sites. However, fine substrates were common along the river margins and suitable samples were collected from all of the sampling locations.

Data for heavy metals in the sediment samples are presented in Table 25. Analyses from the upstream reference sample collected from the East Branch upstream from Bridge St. (RM 1.20) appear to represent background conditions. None of the metals in the analysis exceeded the ecoregional SRVs, and only zinc exceeded the TEC. In contrast, the sample collected from the Black River mainstem at Cascade Park (RM 14.95) just downstream from the confluence of the East Branch and the West Branch had highly elevated concentrations of metals. The majority of the metals in the analyte group (12 of 15) exceeded the ecoregional SRVs; seven constituents exceeded the TEC, and cadmium also exceeded the PEC. Longitudinal assessment of the data (Figure 19, Table 25) indicates that sediment metals concentrations were highest at the Cascade Park (RM 14.95) site, with an apparent decay pattern in concentration moving downstream. The number of sediment metals constituents exceeding the TEC also decreased in conjunction with the concentrations moving downstream from Cascade Park. However, concentrations continued to exceed SRVs and TECs for chromium, copper, and nickel downstream to Ford Rd. (RM 9.80). Most notably, the concentration of cadmium in sediment exceeded the PEC for all of the samples collected from the free-flowing portion of the Black River mainstem.

The longitudinal pattern of sediment metal concentrations in the sample data (Figure 19) suggested a common source for the observed elevated levels. Potential sources included urban runoff, combined or

sanitary sewer overflows (CSOs and SSOs) in the city of Elyria, illicit industrial discharges, or legacy pollutant contamination from past activities in the watershed. The location of the source was likely located between Bridge St. on the East Branch (RM 1.14) and Cascade Park on the Black River mainstem (RM 14.95). Comparison of the sediment data to the distribution of CSO and SSO locations in the city of Elyria and urban drainage patterns (Figure 18) indicated that the observed degree and pattern of elevated metals concentrations was not likely the result of general urban runoff, NPDES permitted discharges, or releases from CSOs or SSOs. These sources in the vicinity of the sampling locations either have no industrial contributions or have been determined not to discharge. Urban runoff would be unlikely to contain the suite of contaminants observed to be elevated in the sediments and would not likely be different upstream from the Bridge St. dam pool (Figure 18). Therefore, the most likely sources were either illicit industrial discharges or releases from past or current industrial practices located in the vicinity. Neither the Ford Rd. landfill site (RMs 10.75 – 10.95 of the Black River) nor the discharge from the Elyria WWTP (RM 10.44) had any apparent effect upon sediment metals concentrations.

Given the flow regimes and channel characteristics of the lower East Branch and upper Black River mainstem, it is likely that sediment deposits in the streams are extremely transitory. Therefore, it is probable that the source loading for the sediment metals contamination is ongoing. Analysis of the surface water data did not reveal any elevated metals concentrations in the water column that could be contributing to the concentrations observed in the sediment. However, the stream flows for the period when water sampling was conducted in 2012 were extremely low. Further investigation of the extent and nature of the sediment metals contamination, potential sources, and the potential effect on the biota is warranted to determine if actions are necessary to remedy the situation.

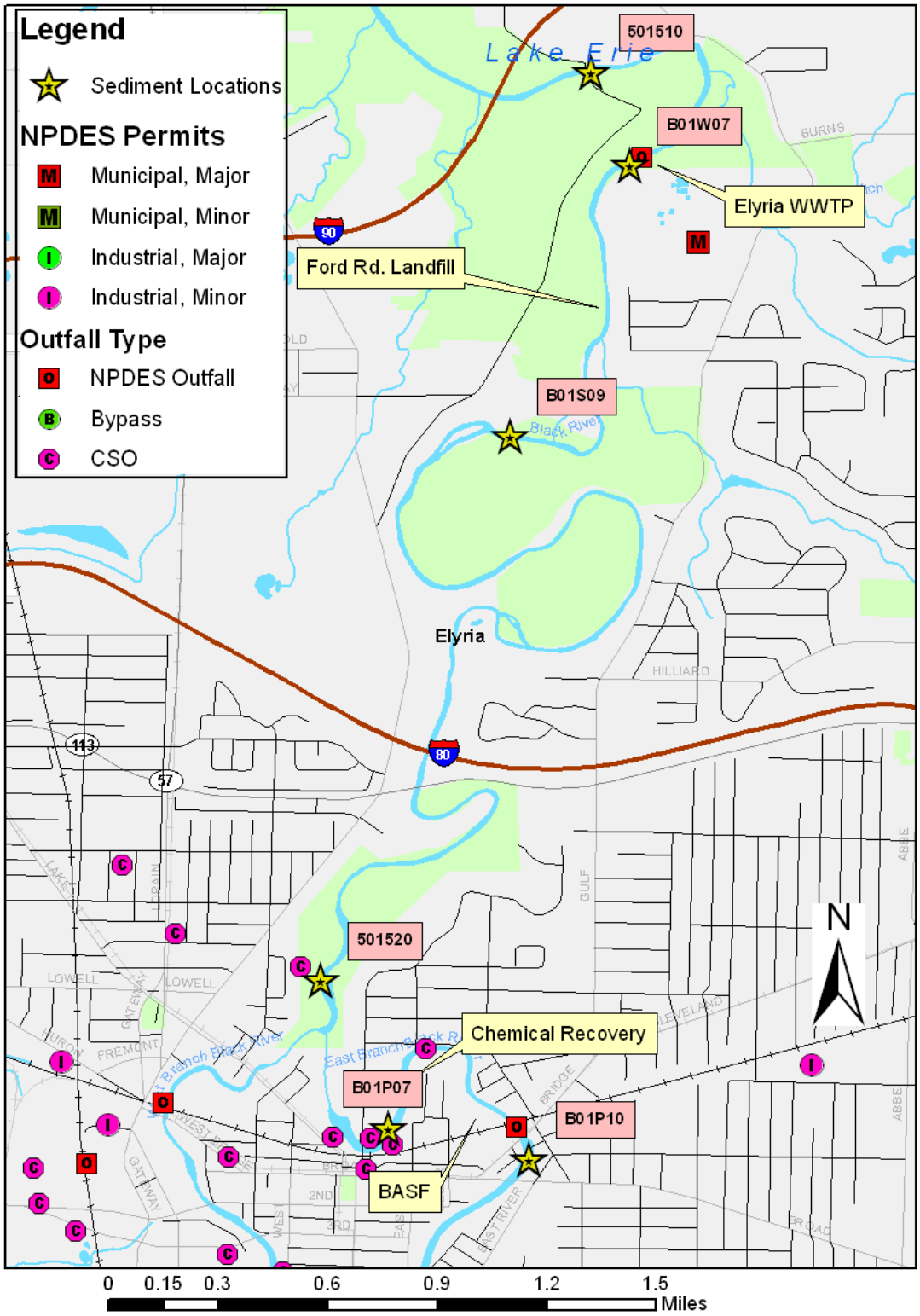


Figure 18. Sediment sampling locations for the East Branch and free-flowing section of the Black River, 2012. Locations of potential sediment contaminant sources are indicated.

Table 25. Sediment metal results from the lower East Branch and the free-flowing mainstem of the Black River, 2012. All values are in mg/kg except for % Solids. Contamination levels were determined for parameters using Ohio Sediment Reference Values (SRVs) (Ohio EPA 2008a), consensus-based sediment quality guidelines (MacDonald, et.al., 2000) and ecological screening levels (USEPA 2003). Data are differentiated where concentrations exceed benchmarks as follows: SRV - bold font, TEC/ESL - yellow shading, PEC - red shading.

Stream	**East Branch**		**Black River**			
Location (Sta. ID)	**Bridge St. (B01P10)**	**Washington St. (B01P07)**	**Cascade Park (501520)**	**Spring Valley CC (B01S09)**	**Upstream Elyria WWTP (B01W07)**	**Ford Rd. (501510)**
River Mile	**1.20**	**0.40**	**14.95**	**11.50**	**10.70**	**9.80**
% Solids	41.7	50.3	15.3	45.1	53.7	34.3
Aluminum	13,500	7,340	18,100	11,800	8,630	9,610
Arsenic†	9.7	7.0	21.7	12.2	12.0	14.8
Barium	92.0	60.9	**198.0**	89.2	65.5	72.4
Cadmium†	**0.92**	**2.63**	**19.60**	**9.74**	**7.21**	**4.28**
Chromium†	19.4	28.1	**76.4**	**55.5**	**45.5**	**32.4**
Copper†	29.2	**56.6**	**97.3**	**78.3**	**71.2**	**40.7**
Iron	27,400	17,600	**53,000**	33,600	23,200	29,200
Lead†	27.2	29.1	**81.0**	**54.8**	39.5	28.3
Magnesium	5,220	3,800	**11,300**	5,030	3,930	4,470
Manganese	583	356	1,000	558	409	611
Mercury†	0.055	0.051	**0.331**	**0.170**	0.114	0.149
Nickel†	28.3	21.2	**62.2**	**39.3**	29.6	**36.2**
Selenium†	<1.8	<1.5	**12.4**	**3.1**	<1.4	<2.1
Strontium	<27	<23	**81**	31	25	<31
Zinc†	142	124	**356**	**204**	152	**194**
# > SRV	*1*	*2*	*12*	*8*	*3*	*5*
# > TEC/ESL	*2*	*3*	*7*	*6*	*6*	*5*
# > PEC	*0*	*0*	*2*	*1*	*1*	*0*

† - Priority pollutant (Appendix A, 40 CFR Part 423)

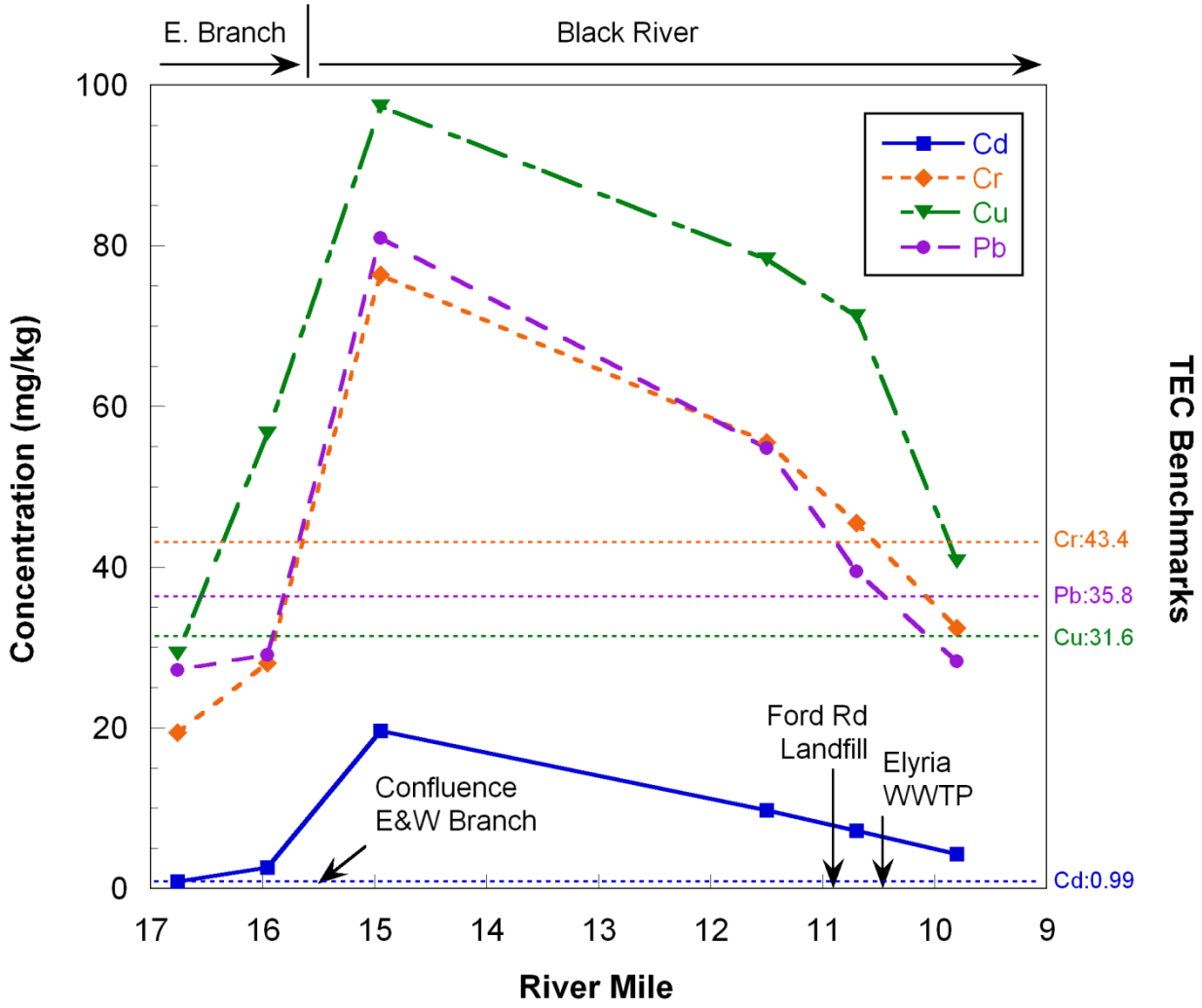


Figure 19. Concentrations of selected metals in sediment of the East Branch and the Black River, 2012. Corresponding TEC benchmark screening levels are indicated for each constituent. [Note that the river mile locations for the East Branch are altered in order to provide longitudinal continuity. The confluence of the East and West Branches is located at RM 15.56. Therefore, RM 16.00 on the figure is equivalent to RM 0.44 of the East Branch, etc.]

Sediment samples were also analyzed for 112 organic compounds, percent solids, and percent total organic carbon (TOC). The analyte list included 66 of the 126 priority pollutant compounds listed in Appendix A of 40 CFR Part 423, including 13 polycyclic aromatic hydrocarbon (PAH) compounds, 16 pesticides, and 7 PCB compounds. No analyses were performed for volatile organic compounds (VOCs). Complete results for the chemical analysis of the sediment samples can be found in Appendix Table 4. The results for all organic contaminants found to be above the analytical detection limit in the sediment samples are listed in Table 266.

Table 26. Concentrations of organic chemicals found at detectable concentrations in sediment from the East Branch and the Black River, 2012. All values are in mg/kg except as noted. Contamination levels were determined for parameters using consensus-based sediment quality guidelines (MacDonald, et.al., 2000) and ecological screening levels (USEPA, 2003). Data are differentiated where concentrations exceed benchmarks as follows: ESL – orange shading, TEC/ESL - yellow shading, PEC - red shading.

Stream	**East Branch**		**Black River**			
Location	**Bridge St. (B01P10)**	**Washington St. (B01P07)**	**Cascade Park (501520)**	**Spring Valley CC (B01S09)**	**Upstream Elyria WWTP (B01W07)**	**Ford Rd. (501510)**
River Mile	**1.20**	**0.40**	**14.95**	**11.50**	**10.70**	**9.80**
% Solids	52.6	57.7	64.9	61	61.9	57.8
TOC (%)	2.1	2.2	2.4	1.9	2.2	3.0
PAH Chemicals:						
Anthracene†	*ND*	0.83	*ND*	*ND*	*ND*	*ND*
Benz[a]anthracene†	*ND*	1.09	0.89	*ND*	*ND*	*ND*
Benzo[a]pyrene†	*ND*		1.00	*ND*	*ND*	0.81
Benzo[b]fluoranthene†	1.01	1.24	1.05	*ND*	*ND*	0.81
Benzo[g,h,i]perylene†	*ND*	0.79	0.76	*ND*	*ND*	*ND*
Benzo[k]fluoranthene†	*ND*	*ND*	0.84	*ND*	*ND*	*ND*
Chrysene†	0.91	1.07	1.08	*ND*	*ND*	0.84
Fluoranthene	1.79	0.35	2.22	0.89	*ND*	0.97
Indeno[1,2,3-cd]pyrene†	*ND*	0.35	0.69	*ND*	*ND*	*ND*
Phenanthrene†	0.85	0.35	1.19	*ND*	*ND*	*ND*
Pyrene†	1.44	0.35	1.72	0.72	*ND*	0.91
Other Organic Chemicals:						
bis(2-Ethylhexyl)phthalate†		*ND*	*ND*	*ND*	*ND*	0.80
Di-n-butylphthalate†	1.64	*ND*	*ND*	*ND*	*ND*	*ND*
4,4'-DDT (µg/kg) †	*ND*	*ND*	*ND*	37.7	*ND*	*ND*
PCB-1242 (µg/kg)†‡	*ND*	*ND*	60.8	*ND*	*ND*	*ND*
PCB-1260 (µg/kg)†‡	*ND*	*ND*	*ND*	*ND*	50.3	*ND*
# > Detection Limit	**6**	**8**	**11**	**3**	**1**	**6**
# > ESL	**1**	**2**	**3**	**1**	**0**	**1**
# > TEC/ESL	**3**	**3**	**4**	**1**	**0**	**4**
# > PEC	**0**	**1**	**2**	**0**	**0**	**0**

†Priority pollutant (Appendix A, 40 CFR Part 423)

‡Concentrations of PCB compounds compared to screening levels for total PCB's

A total of 16 organic pollutant compounds were detected in the sediments from the study area (Table 26). All of the organic compounds detected from East Branch and Black River sediment samples are listed as priority pollutants by U.S.EPA, except for fluoranthene. The main contaminants detected in the samples were PAH compounds. As with the metals results, the observed sediment contamination was again most pronounced in the sample from the Black River at Cascade Park (RM 14.95). However, the East Branch sediments exhibited a higher degree of contamination for organic constituents than for metals, with six compounds detected in the sediment from the location upstream from the Bridge St. dam (RM 1.20) and eight contaminants detected at the Washington St. site (RM 0.40). As observed with the concentrations of metals in the sediments, the degree of contamination with respect to organic compounds decreased

markedly downstream from Cascade Park. Although the sample collected from the Black River just downstream from the Ford Rd. landfill and upstream from the Elyria WWTP (RM 10.70) exhibited the lowest level of contamination for organic constituents, the sample from the Ford Rd. location (RM 9.80) had six detected contaminants. This indicated that either there was a greater pooling of contaminants in the sediments exported from upstream in Elyria at the downstream location or there was a localized effect related to releases from the Ford Rd. landfill, or both.

The most likely sources of the organic pollutants found in the stream sediments were releases and erosion of historically contaminated soils from the industrial area in the vicinity of BASF/Chemical Recovery (legacy pollution). Urban runoff may also play an important role for loadings of the contaminants to the streams. The Ford Rd. landfill site also cannot be ruled out as a potential source for the contaminants observed at the downstream location at RM 9.80.

PHYSICAL HABITAT FOR AQUATIC LIFE

Stream habitat conditions were assessed at 75 Black River basin fish sampling sites in 2012 (Table 27). Additionally, habitats in three small Lake Erie tributaries with confluences immediately east from the Black River mouth were also evaluated. Based on the functional ability to support fish, each site's substrate, instream cover, and channel characteristics were graded and composited using the Qualitative Habitat Evaluation Index (QHEI, Ohio EPA 1989). Generally, good QHEI scores above 60 are typical of habitat conditions associated with WWH aquatic communities. Poor QHEI scores less than 45 are consistent with the MWH aquatic life use, while very good QHEI values above 75 are correlated with the EWH aquatic life use. QHEI scores are most meaningful when considered in aggregate groups. For instance, an average of several QHEIs from a river reach or the trend among many small streams in close proximity is more informative than relying on any single location QHEI score. It's unlikely for any one site with particularly good or poor habitat to exert the same extreme influences on its resident aquatic community. Instead, aquatic assemblages at unique habitat locations tend to reflect the wider ambient condition.

Very good habitat conditions were present in the Black River. An average QHEI score ($\bar{x}$=78.6) for five 2012 Black River sites was unchanged from the conditions present in 1997 (QHEI $\bar{x}$=78.0, n=4) and in 1992 (QHEI $\bar{x}$ =84.4, n=4). A good mix of coarse aggregate substrate was distributed in well-defined riffle-run reaches dividing long bedrock-based pools throughout the free-flowing Black River from Cascade Park (RM 15.5) downstream to the Lake Erie backwater (RM 6.5). Much of this nine-mile course is flanked by parkland. The natural attributes of the riparian corridor were echoed by extensive amounts of instream cover at all Black River lotic sites. However, overall sluggish flow conditions limited the function of instream cover. Excessive silt deposition and embeddedness were observed at all Black River sample sites.

Ohio EPA adopted the term "lacustuary" to describe freshwater estuary areas where rivers meet Lake Erie. Herein, the Black River lacustuary is the reach downstream from East 31st St. (RM 6.6) to the Lake confluence. The Lower Black River Habitat Restoration effort encompasses this historically polluted region (http://www.lorainblackriver.com/). Lacustuary habitat conditions were evaluated at five locations in 2012 using the lacustuary QHEI (L-QHEI, Ohio EPA 2010). Like the QHEI, L-QHEI scores provide a means to interpret habitat factors in regard to biological community index performance.

As with stream QHEI scores, the aggregate habitat condition in a lacustuary area is more important than values from individual sites. In 2012, Black River L-QHEI scores upstream from Erie St. averaged 38.9 (RM 5.4-RM 0.6, n=4). Downstream, a low score (L-QHEI=8 at RM 0.3) represented the lack of habitat attributes in an active shipping channel. Both banks in this often dredged, deep, short reach are armored with steel sheet piling. Little capacity for pollutant assimilation exists and habitat for aquatic life was absent in this vicinity immediate to Lake Erie.

The Black River lacustuary upstream from Erie St. has benefited from many remedial efforts. In 2002, the Lorain Port Authority created an 800' fish habitat shelf as part of the Black River Landing facility. Since then, the city of Lorain secured $10 million in eight federal grants to install additional fish habitat shelves to improve riverbanks, remove invasive plants, reclaim slag dumps, and acquire riparian preservation property. All of these projects are situated between French Creek (RM 5.1) and the Black River Landing (RM 0.6). Midwest Biodiversity Institute (MBI) evaluated the biological influence of the projects in a 2013 report (Smith, et al. 2013). They determined Black River lacustuary habitat conditions are improving, and future bioassessments may verify this trend.

Table 27. Qualitative Habitat Evaluation Index (QHEI) matrix with totals and ratios of Warmwater Habitat (WWH) and Modified Warmwater habitat (MWH) aquatic life use attributes for the Black River study area, 2012.

Key QHEI types		WWH Attributes											MWH Attributes																					
													High Influence						Moderate Influence																
RM	QHEI	No Channelization or Recovered	Boulder/ Cobble/ Gravel Substrates	Silt Free Substrates	Good/ Excellent Development	Moderate/ High Sinuousity	Extensive/ Moderate Cover	Fast Current/ Eddies	Low Normal Overall Embeddedness	Maximum Depth > 40 cm	Low Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt Muck Substrates	No Sinuosity	Sparse No Cover	Maximum Depth < 40 cm (Wade, HW)	**Total High Influence MWH Attributes**	Recovering Channel	Heavy/ Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/ Moderate Overall Embeddedness	High/ Moderate Riffle Embeddedness	No Riffle	**Total Moderate Influence MWH Attributes**	(MWH High Influence+1)/ (WWH+1) Ratio	(MWH Mod. Influence+1)/ (WWH+1) Ratio
Black River																																	
15.0	**83.0**	□	□		□	□	□		□	□	□	8						0		○							○	○			3	0.11	0.56
11.5	**72.5**	□	□		□	□	□			□	□	7	◊					1		○							○	○			3	0.25	0.63
10.7	**81.5**	□	□		□	□	□			□	□	7						0		○							○	○			3	0.13	0.63
9.8	**79.5**	□	□		□	□	□		□	□		7						0		○							○	○	○		4	0.13	0.75
8.4	**76.5**	□			□	□	□		□	□	□	7						0		○							○	○			3	0.13	0.63
East Branch Black River (Black River Tributary at RM 15.55)																																	
41.5	**63.5**	□	□			□	□			□		5						0		○			○				○	○		○	5	0.17	1.17
40.8	**56.5**	□	□			□	□			□		5						0		○			○				○	○		○	5	0.17	1.17
40.5	**67.5**	□	□			□	□			□		5						0		○			○				○	○	○		5	0.17	1.17
36.8	**69.5**	□	□		□	□	□		□	□		7						0		○							○	○	○		4	0.13	0.63
24.6	**65.0**	□	□			□	□			□		5						0		○			○				○	○	○		5	0.17	1.17
18.9	**65.5**	□	□				□			□		4						0		○			○	○			○	○		○	6	0.20	1.40
11.3	**81.0**	□	□		□	□	□		□	□	□	8						0		○							○	○			3	0.11	0.44
10.5	**68.5**	□			□		□		□	□		5						0		○			○	○			○	○	○		6	0.17	1.17
6.0	**51.5**	□								□		2				◊		1		○			○	○		○	○	○	○		7	0.67	2.67
3.1	**70.0**	□			□	□	□		□	□	□	7						0		○							○	○			3	0.11	0.63
0.4	**64.5**	□	□			□	□			□		5						0		○			○				○	○		○	5	0.17	1.17
East Fork East Branch Black River (East Branch Black River Tributary at RM 45.06)																																	
5.8	**70.5**	□	□		□	□	□			□	□	7						0	○	○			○				○	○		○	6	0.25	0.88
2.7	**52.5**	□	□			□			□		□	5				◊	◊	2					○	○			○		○	○	5	0.50	1.00
1.7	**77.0**	□	□		□	□	□			□		6						0		○							○	○		○	4	0.14	0.71
1.6	**82.0**	□	□		□	□	□			□	□	7						0		○							○	○			3	0.13	0.50
0.1	**52.5**	□	□				□			□		4						0		○			○	○		○	○	○	○		7	0.20	1.60
West Fork East Branch Black River (East Branch Black River Tributary at RM 45.06)																																	
14.0	**59.0**	□	□			□	□			□		5	◊		◊			2		○			○				○	○	○	○	6	0.50	1.17
8.9	**49.9**	□	□			□	□			□		5			◊			1		○			○			○	○	○		○	6	0.33	1.17
2.3	**83.5**	□	□		□	□	□		□	□		7						0									○	○	○		3	0.13	0.50
0.3	**52.5**	□	□		□	□	□			□		6						0		○							○	○	○		4	0.14	0.71
Clear Creek (West Fork East Branch Black River Tributary at RM 3.56)																																	
1.8	**69.5**	□	□		□	□	□		□	□	□	8						0					○			○	○				3	0.11	0.44
East Branch Black River Tributary at RM 41.41																																	
0.4	**60.0**	□				□	□			□		4				◊		1		○			○			○	○	○	○	○	7	0.40	1.80

Table 16. continued.

Key QHEI types		WWH Attributes											MWH Attributes																					
													High Influence						Moderate Influence																	
RM	**QHEI**	No Channelization or Recovered	Boulder/ Cobble/ Gravel Substrates	Silt Free Substrates	Good/ Excellent Development	Moderate/ High Sinuousity	Extensive/ Moderate Cover	Fast Current/ Eddies	Low Normal Overall Embeddedness	Maximum Depth > 40 cm	Low Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt Muck Substrates	No Sinuosity	Sparse No Cover	Maximum Depth < 40 cm (Wade, HW)	**Total High Influence MWH Attributes**	Recovering Channel	Heavy/ Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/ Moderate Overall Embeddedness	High/ Moderate Riffle Embeddedness	No Riffle	**Total Moderate Influence MWH Attributes**	(MWH High Influence+1)/ (WWH+1) Ratio	(MWH Mod. Influence+1)/ (WWH+1) Ratio
East Branch Black River Tributary at RM 39.06																																		
2.2	**83.0**	□	□		□	□	□		□	□	□	8						0		○							○	○			3	0.11	0.56
Coon Creek (East Branch Black River Tributary at RM 38.01)																																		
0.9	**73.0**	□	□		□	□	□			□		6						0		○							○	○	○	○	5	0.14	1.00
East Branch Black River Tributary at RM 28.65																																		
1.5	**45.5**	□	□			□						3				◊	◊	2		○		○			○	○	○	○		○	6	0.75	1.75
Crow Creek (East Branch Black River Tributary at RM 24.39)																																		
0.8	**48.0**					□	□			□		3		◊				1	○	○		○			○	○	○	○			7	0.75	2.00
East Branch Black River Tributary at RM 22.65																																		
0.6	**54.0**	□	□			□						3				◊	◊	2		○		○				○	○		○	5	0.75	1.50
Salt Creek (East Branch Black River Tributary at RM 18.17)																																		
0.5	**58.0**	□	□		□	□						4		◊			◊	2		○		○				○	○	○	○	6	0.60	1.40
East Branch Black River Tributary at RM 5.89 (Brentwood Tributary)																																		
1.0	**58.0**	□	□			□	□			□		5				◊		1		○		○			○	○	○	○	○	7	0.33	1.33
0.1	**57.5**	□	□			□			□		□	5				◊	◊	2		○		○	○			○	○	○		6	0.50	1.17
Willow Creek (East Branch Black River Tributary at RM 5.56)																																		
6.6	**41.0**						□			□		2	◊	◊	◊			3		○			○	○			○	○	○		6	1.33	2.33
2.8	**62.5**				□	□	□	□		□		5		◊				1	○	○			○					○	○		5	0.50	1.17
West Branch Black River (Black River Tributary at RM 15.55)																																		
37.3	**63.5**	□	□			□	□			□		5				◊		1		○			○				○	○		○	5	0.33	1.17
28.5	**64.0**	□	□			□	□			□		5						0		○			○				○	○		○	5	0.17	1.00
25.3	**70.3**	□	□		□	□	□			□		6						0		○		○	○				○	○	○		6	0.14	1.00
20.5	**67.3**	□	□		□	□	□			□		6						0		○		○	○				○	○	○	○	7	0.14	1.14
16.6	**65.5**	□	□			□	□			□		5						0		○		○	○				○	○	○		6	0.17	1.17
10.6	**65.5**	□	□		□		□			□		5				◊		1		○		○	○	○			○	○	○		7	0.33	1.50
7.7	**67.5**	□	□		□	□	□			□		6						0		○		○	○				○	○		○	6	0.14	1.00
4.2	**60.0**	□	□		□	□			□	□	□	7				◊		1		○			○			○	○	○			5	0.25	0.75
1.2	**80.0**	□	□		□	□	□		□	□	□	8						0		○							○	○			3	0.11	0.44
Buck Creek (West Branch Black River Tributary at RM 43.52)																																		
1.0	**47.3**	□	□							□		3				◊		1		○			○	○		○	○	○		○	7	0.50	2.25
Charlemont Creek (West Branch Black River Tributary at RM 26.65)																																		
8.6	**65.0**	□	□			□	□			□	□	6				◊		1		○			○				○	○	○	○	6	0.29	1.14
2.2	**64.5**	□	□			□	□			□		5						0		○			○				○	○		○	5	0.17	1.17
0.4	**64.5**	□	□				□			□		4						0		○			○	○			○	○	○		6	0.20	1.40

Table 16. continued.

Key QHEI types		WWH Attributes											MWH Attributes: High Influence						MWH Attributes: Moderate Influence														
RM	QHEI	No Channelization or Recovered	Boulder/ Cobble/ Gravel Substrates	Silt Free Substrates	Good/ Excellent Development	Moderate/ High Sinuosity	Extensive/ Moderate Cover	Fast Current/ Eddies	Low Normal Overall Embeddedness	Maximum Depth > 40 cm	Low Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt Muck Substrates	No Sinuosity	Sparse No Cover	Maximum Depth < 40 cm (Wade, HW)	**Total High Influence MWH Attributes**	Recovering Channel	Heavy/ Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/ Moderate Overall Embeddedness	High/ Moderate Riffle Embeddedness	No Riffle	**Total Moderate Influence MWH Attributes**	(MWH High Influence+1)/ (WWH+1) Ratio	(MWH Mod. Influence+1)/ (WWH+1) Ratio
Charlemont Creek Tributary at RM 0.51																																	
1.0	**70.5**	□	□		□	□	□	□		□		7						0		○						○		○	○		4	0.13	0.63
0.8	**64.0**	□	□		□	□	□	□		□		7						0		○								○	○		3	0.13	0.63
Wellington Creek (West Branch Black River Tributary at RM 15.53)																																	
17.1	**57.0**	□				□	□			□	□	5		◊		◊		2		○			○	○			○	○	○	○	7	0.50	1.50
13.1	**62.3**	□			□	□	□			□	□	6		◊				1		○			○				○	○	○	○	6	0.29	1.14
8.4	**60.0**	□	□			□				□		4				◊		1		○			○			○	○	○	○		6	0.40	1.60
0.5	**65.0**	□	□							□		3				◊		1		○			○	○			○	○		○	6	0.50	1.75
Elk Creek (West Branch Black River Tributary at RM 14.59)																																	
0.2	**61.0**	□	□			□	□					4				◊	◊	2		○			○				○	○		○	5	0.60	1.20
Plum Creek (West Branch Black River Tributary at RM 10.06)																																	
5.6	**52.5**	□	□			□						3				◊	◊	2		○			○				○	○		○	5	0.75	1.50
3.2	**63.0**	□	□			□	□			□		5						0		○			○				○	○		○	5	0.17	1.00
2.8	**66.0**	□	□			□	□			□		5						0		○			○				○	○	○		5	0.17	1.00
0.8	**75.5**	□	□		□	□	□			□		6						0		○							○	○	○		4	0.14	0.71
Kelner Ditch (West Branch Black River Tributary at RM 8.61)																																	
3.0	**62.5**	□	□			□	□			□		5						0		○			○	○		○	○	○	○		7	0.17	1.50
1.0	**67.3**	□	□			□	□			□		5						0		○			○				○	○	○	○	6	0.17	1.33
Black River Tributary at RM 10.18																																	
0.7	**54.0**		□			□			□	□		4	◊			◊		2		○			○			○	○	○	○		6	0.60	1.40
French Creek (Black River Tributary at RM 5.10)																																	
10.4	**49.5**							□		□	□	3				◊		1	○	○			○	○		○		○	○		7	0.75	2.25
9.0	**57.0**		□							□		2				◊		1	○	○			○	○			○	○	○		7	1.00	3.00
5.6	**81.3**	□	□		□	□	□		□	□	□	8						0		○							○	○	○		4	0.11	0.56
2.6	**72.5**	□	□		□	□	□			□		6						0		○						○	○	○	○		5	0.14	0.86
0.5	**87.0**	□	□		□	□	□	□		□		7						0										○	○		2	0.13	0.38
Gable Ditch																																	
0.4	**55.8**	□				□			□		□	4				◊	◊	2					○				○				2	0.60	0.60
Heider Ditch																																	
0.2	**54.3**	□	□		□		□		□	□	□	7				◊		1					○	○		○	○	○	○		6	0.25	0.88
Powdermaker Ditch																																	
0.2	**54.5**		□		□	□	□			□		5				◊		1	○	○						○	○	○	○		6	0.50	1.17

Many of the Black River lacustuary remedial activities were outlined in the 2009 *Lower Black River Ecological Restoration Master Plan* (URS and Thoma 2009). The report includes a complete assessment of 2008 lacustuary habitat conditions downstream from 31st St. and within the area adjacent to the Lake Erie confluence. L-QHEI values in 2008 were tabulated according to a 110-point scale. The L-QHEI score range was revised in 2010, recognizing maximum scores in five different categories so that the overall score is limited to 100. Once separate slope and depth scores are now combined within the shoreline metric. The average depth subdivisions were increased, creating a zero-point scenario for measurements less than 50 cm. For reaches commensurate with the 2012 survey, the 2008 L-QHEI scores were adjusted according to current L-QHEI guidance in Table 28.

In 2008, the average L-QHEI score upstream from Erie St. (L-QHEI $\bar{x}$=43.3, RM 5.7-RM 0.7, n=9) was similar to the 2012 average value. Both series of habitat evaluations noted the upstream presence of intermixed gravel cobble substrates which transitioned to sand and hardpan downstream. Deep water cover conditions were enhanced by moderate amounts of overhanging vegetation, root wads, and logs throughout the reach, while boulders were particularly evident across the downstream fish shelf. A consistent appraisal of wide to narrow riparian widths with little bank erosion in an urban setting was documented in both surveys. Likewise, aquatic vegetation was absent in both lacustuary assessments. Differences in shoreline morphology interpretation were factors in the variability between the 2008 and 2012 average L-QHEI scores. Better definition and careful evaluation of shoreline slope conditions are needed to improve application of the L-QHEI. Differences in the shoreline scores within the shipping channel (2 in 2012 vs. 6 in 2008) were due to changes in the notation of shoreline modification from the earlier to current version of the L-QHEI form.

The lack of appropriate aquatic vegetation in the Black River lacustuary is an important habitat deficiency. Submerged and emergent aquatic plants require clear water and suitable shoreline substrates to thrive. Once established, these plants moderate erosive shoreline current, filter and process waterborne nutrients and pollutants, and provide refuge for many aquatic animals. Historically, both banks of the Black River lacustuary were flanked by aquatic plants. Now, a large mat of cattails upstream from the Black River Wharf (RM 1.6) was the only aquatic vegetation within the 2012 sampled zones. This growth resulted in a negative L-QHEI metric score (-2) because these monotypic mats effectively exclude other plants and have few redeeming functional attributes. Propagation of underwater shoreline aquatic vegetation in the Black River lacustuary is a laudable endeavor.

Table 28. Lacustuary Qualitative Habitat Evaluation Index (L-QHEI) metric scores for the Black River study area, 2008-2012. L-QHEI scores reported in the *Lower Black River Ecological Restoration Master Plan* (URS and Thoma 2009) were adapted to fit the L-QHEI scoring methods established in *Methods of Assessing Habitat in Lake Erie Shoreline Waters Using the Qualitative Habitat Evaluation Index (QHEI) Approach (Version2.1,* Ohio EPA 2010).

RM	Black Lacustuary Location	L-QHEI Metrics					**L-QHEI Score**
		Substrate	Cover	Shoreline	Riparian	Vegetation	
			2012				
5.8	Dst. Trail Bridge	15	11	13	6.5	0	**45.5**
4.8	Dst. French Creek	7	11	15	6	0	**39.0**
1.6	Black River Wharf	7	10	11.5	5	-2	**31.5**
0.6	Black River Landing	10	11	14.5	4	0	**39.5**
	Average	**9.8**	**10.8**	**13.5**	**5.4**	**0**	**38.9**
0.3	Near mouth	1	2	2	3	0	**8.0**
			2008				
5.7	Dst. Trail Bridge (3-9)	6	10	20	4	0	**40.0**
5.6	Ust. French Creek (3-5)	6	13	20	5.5	0	**44.5**
4.7	Dst. French Creek (3-3)	6	10	20	9.5	0	**45.5**
4.6	Opposite Marina (3-10)	6	10	17	5	0	**38**
4.5	Adj. Marina (3-2)	11	5	13	4.5	0	**33.5**
1.7	Black River Wharf (1-21)	7	10	17	10	0	**44.0**
1.6	Black River Wharf (1-20)	8	11	17	9	0	**45.0**
0.8	Black River Landing (1-16)	6	11	20	5.5	0	**42.5**
0.7	Black River Landing (1-15)	17	12	19	9	0	**57.0**
	Average	**8.1**	**10.2**	**18.1**	**6.9**	**0**	**43.3**
0.2	Near mouth (1-9)	1	1	6	6	0	**14.0**
0.1	At mouth (1-14)	0	2	6	3	0	**11.0**
	Average	**0.5**	**1.5**	**6**	**4.5**	**0**	**12.5**

Like the mainstem, the presence of good habitat qualities in both Black River branches has remained essentially unchanged for 20 years. The 2012, 1997 and 1992 East Branch average QHEI scores were almost identical (QHEI $\bar{x}$=65.7, n=11 in 2012, QHEI $\bar{x}$=65.6, n=8 in 1997 and QHEI $\bar{x}$=66.6, n=11 in 1992). The 2012, 2001 and 1992 West Branch average QHEI values were also nearly the same (QHEI $\bar{x}$=67.1, n=9 in 2012, QHEI $\bar{x}$=63.5, n=6 in 2001 and QHEI $\bar{x}$=63.8, n=7 in 1992). Previous assessments and this study determined that fine silt, sand and clay deposition universally limited substrate function in both Black River branches. All sampling locations exhibited moderate or extensive embeddedness. Good aggregate variety at most sites, along with moderate to extensive amounts of instream cover, including deeper pools, helped to offset the pervasive silt. The lack of optimal current, also noted previously, was especially evident at upper reach sites where flow was insufficient to maintain riffle function. Monotonous slow current speeds further diminished the quality of run habitat in both the East and West branches. Hardpan ledges were most prevalent in the West Branch.

Small tributary stream habitat conditions have been consistent with the patterns observed in the principal Black River branches. All Black River watershed small streams were affected by silt-embedded substrates and limited flow. Good habitat scores resulted at sites where embeddedness was mitigated by substrate

size variability and moderate to extensive amounts of cover in association with deep pools. Otherwise, fair QHEI values were recorded with one exception. Extensive silt at the channelized upstream Willow Creek site resulted in a poor QHEI score. These qualities were ameliorated at a downstream Willow Creek location where more flow and a good QHEI value was noted.

In 2012, habitat quality in French Creek improved from fair to very good with increasing drainage (QHEI $\bar{x}$ =69.5, n=5). The same upstream fair to downstream very good habitat change was evident in Plum Creek (QHEI $\bar{x}$=64.3, n=4 in 2012). Since 1992, in five linear assessments (1992, 1994, 1997, 2001, and 2012), the most upstream Plum Creek location has typically received fair QHEI scores ($\bar{x}$=56.5) while the most downstream site has earned very good marks (QHEI $\bar{x}$=80.4). The trend of habitat improvement with larger drainage was confounded by declining QHEI values at the most downstream sample sites on the East and West forks of the East Branch Black River (QHEI $\bar{x}$=66.9, n=5 and QHEI $\bar{x}$=65.8, n=4, respectively in 2012). However, the repetitive aspect of these declines has been routinely documented since 1992. Good habitat (QHEI $\bar{x}$=61.0, n=4) upstream subsequently improved (QHEI $\bar{x}$=73.6, n=5) before declining to fair (QHEI $\bar{x}$ =52.8, n=4) at the most downstream East Fork East Branch Black River site. Likewise, good (QHEI $\bar{x}$=61.0, n=3) upstream West Fork East Branch Black River habitat improved to very good (QHEI $\bar{x}$=83.2, n=4) before falling to fair (QHEI $\bar{x}$=56.9, n=4) at the downstream sampling location. These consistent shifts have also been evident in Wellington and Charlemont creeks, but the pattern has been subdued. In 2012, fair habitat quality in Wellington Creek increased to good with more drainage (QHEI $\bar{x}$=61.1, n=4) while good habitat quality was repeated at three Charlemont Creek sites (QHEI $\bar{x}$=64.7). Previous studies noted the improving downstream Wellington Creek trend and confirmed the good average Charlemont Creek habitat status. Excluding sites on the above mentioned streams, Black River watershed habitat quality was evaluated at 19 additional locations in 2012. Habitat conditions in these small streams with drainage areas from 13.3 mi^2 to 1.7 mi^2 (mi^2 $\bar{x}$=5.9) was often fair or good (QHEI $\bar{x}$=59.1).

The drop in QHEI scores at the lower sites on East Fork East Branch Black River and West Fork East Branch Black River, along with smaller streams in the study area, was at least partially attributed to reduced stream flow. Low stream flow in the Black River watershed is a chronic condition that has been exacerbated by agricultural drainage and flood control efforts. The Black River watershed is uniquely positioned so that it receives less rain fall compared to Ohio's northeastern snow belt or southern regions where prevailing weather patterns yield more annual precipitation. Nevertheless, the area's evenly distributed rain fall is sufficient for row crops, and climate near Lake Erie offers a longer growing season suitable for vegetable and nursery operations. The generally flat watershed topography is also favorable for agricultural interests, though, initially, more than one third of Lorain County was once considered swamp. Thus, since European settlement, effort to improve agricultural production through drainage improvement has been an obvious necessity.

Organized drainage improvements began in 1870 and by 1946, nearly two-thirds of Lorain County had benefited from organized drainage (Turk 1947). In addition to draining the land for agricultural purposes, forests were reduced from 59% in 1853 (Leue 1886) to only 7% by 1946 (Turk 1947). In 2012, half of Lorain County's farm crop was in soybeans, and a third was in corn (55,492 acres and 29,000 acres, respectively, of the 102,718 acres in agricultural production, USDA 2012). Land in agricultural production has continued to decline since the 1960s. Presently, 38% of Lorain County is devoted to crop production, while 23% is forested (ODSA 2013).

The significant amount of drainage operations undertaken over time in the study area has influenced water quality as artificial drainage across a broad area alters stream hydrology. A lower water table may facilitate agricultural operations, but the consequences of dewatering small streams are generally overlooked. In

Basin Description and Flow Characteristics of Ohio Streams (Schiefer 2002), the author commented that the Black River's mean annual runoff was relatively low (11.5 inches):

> Base flows of the Black River at Elyria are moderately low with 90-percent duration flow of 0.03 cfs per square mile and 7-day, 2-year low-flow index of 0.02. East Branch has significantly lower base flow than the main stem and apparently derives little ground water from the moraine in headwater areas…
> The 50-percent duration flows of streams tributary to Lake Erie between the Sandusky River and the Cuyahoga River are in the middle to lower range for streams in Ohio and consistent with the limited amounts of ground-water storage in the basins. The 50-percent duration flow for East Branch Black River of 0.12 cfs per square mile is exceptionally low indicating minimal amounts of ground water storage exists in the basin.

Good Black River basin habitat scores occurred in concert with better flow. The improving downstream trends in French and Plum creeks both reflected the additional flow from WWTPs. Flow from the Lodi WWTP and from a small amount of ground water alluded to by Schiefer (2002) in the East and West forks of the East Branch Black River spurred better habitat assessments in the immediate reaches. However, this additional pulse was diminished downstream as indicated by declining QHEI values. Flows in Wellington and Charlemont creeks were unaffected by WWTPs or glacial deposits. Similar habitat scores in these streams resulted from the limited flow conditions. Future improvements in habitat scores are unlikely unless the anthropogenic influences on flow (i.e., tile drainage) are ameliorated.

FISH COMMUNITY

Fish communities in the Black River watershed were evaluated at 75 sites in 2012 (Table 29, Appendix Tables 7-10). Very good mainstem fish assemblages were present at five locations upstream from the Black River lacustuary (IBI $\bar{x}$=43, MIwb $\bar{x}$=9.7). Lacustuary fish community performance, as determined via evaluation using proposed lacustuary targets, was fair (L-IBI $\bar{x}$=40, L-MIwb $\bar{x}$=8.3, n=6). Generally good East Branch Black River fish communities (IBI $\bar{x}$=37, MIwb $\bar{x}$=8.9, n=11) differed from typically fair West Branch Black River communities (IBI $\bar{x}$=31, MIwb $\bar{x}$=7.1, n=8). Likewise, small East Branch tributary streams tended to support marginally good fish communities (IBI $\bar{x}$=38, n=21) while small West Branch streams supported fair fish assemblages (IBI $\bar{x}$=30, n=17). An exceptional array of fish (IBI=50) was collected in one sample from an unnamed tributary which joins the Black River at RM 10.18 downstream from the confluence of the East and West branches. French Creek joins the Black River further downstream at RM 5.1. Performance of the French Creek fish assemblage was marginally good (IBI $\bar{x}$=34, MIwb $\bar{x}$=7.6, n=5).

The fish communities in three small Lake Erie tributaries with confluences east of the Black River mouth were also evaluated in 2012. Heider Ditch flanks Avon Lake's High School and Bleser Park before joining Lake Erie near the U.S. Rt. 6 and St. Rt. 83 intersection. Marginally good fish community performance (IBI=38) was obtained in one collection. Less than a mile to the east, a poor fish assemblage (IBI=26) was noted in a single sample from Gable Ditch. Powdermaker Ditch sustained a fair fish assemblage (IBI=32) at one site. Powdermaker Ditch lies west of Heider Ditch and joins Lake Erie via a culvert under the Avon Lake power generation facility.

In 2012, generally fair fish community performance was apparent throughout the West Branch subbasin. Under the IBI scoring system, balance is expected among types of species, trophic guilds, and among proportional attributes within the fish community. As detailed in the trends section below, over one-fourth of the West Branch fish community has been extirpated. Restoration of these species is fundamental to better West Branch biological integrity.

Between 1982 and 2012, Ohio EPA identified 89,750 fish among 32 fish species that presently reside in the West Branch subbasin. Three additional species, channel catfish (1), black crappie (18), and yellow perch (12), were first collected in 2012. These likely pond escapees are not considered permanent West Branch residents at this time. Three infrequently collected species, denoted by year and number obtained, are included among these current West Branch resident fish:

Central mudminnow	White sucker	Redfin pickerel	Common carp
Golden shiner	Creek chub	Western blacknose dace	Southern redbelly dace 1994 (3), 2006 (4)
Redfin shiner	Spotfin shiner	Common shiner	Bigmouth shiner
Sand shiner	Bluntnose minnow	Fathead minnow	Central stoneroller
Yellow bullhead	Black bullhead	White crappie	Brown bullhead 1994 (2), 2012 (2)
Rock bass	Largemouth bass	Smallmouth bass	Green sunfish
Bluegill sunfish	Blackside darter	Pumpkinseed sunfish	Johnny darter
Greenside darter	Mottled sculpin	Rainbow darter	Brook stickleback 1994 (16)

Between 1982 and 2012, Ohio EPA identified 111,388 fish allocated among 35 East Branch subbasin resident fish species. Four fish species, gizzard shad (2), redfin pickerel (2), channel catfish (3), and yellow perch (1), first collected in 2012, were not considered resident species. The presence of one redfin pickerel in both sampling passes from the West Fork East Branch at SR 421 (RM 2.3) was surprising. This pollution tolerant fish, present in small but increasing numbers in the West Branch, is oddly sensitive to channelization. Although it resides in many Ohio ditches, the process of ditching and attendant siltation is, in most situations, detrimental to redfin pickerel (Trautman 1981, Scott and Crossman 1973).

Fish Trends

Ohio EPA identified 40,301 fish in the Black River between 1982 and 2012. Prior to the 2012 survey, the Black River mainstem was sampled extensively in 1982 and 1997 (Figure 20). Significant improvements in fish community biometrics are evident since the first survey in 1982. Only one darter species, the logperch darter, was collected from the Black River mainstem in 1982. In 2012, six darter species including rainbow, johnny, greenside, blackside, fantail and logperch darters were collected. The establishment of these riffle obligate species indicated improved habitat and water quality conditions in the Black River mainstem over time.

The significant improvement in the fish community of the Black River mainstem is not mirrored throughout the watershed in part due to the waterfalls of the East and West branches, which inhibit fish migration upstream from the Black River mainstem into the Branches. Therefore, as much of the fish community throughout the Black River basin was characterized as poor to fair during surveys in the 1980s and early 1990s, the full potential recovery is limited in the East and West branches by the existing species present in those subbasins. Recruitment from the Black River mainstem and its tributaries downstream from the falls into the subbasins above the falls is not possible.

Comparison of historical records from the early 1900s and Ohio EPA data reveals at least eight minnow species are extirpated from the West Branch subbasin:

River chub	Bigeye chub	Emerald shiner
Rosyface shiner	Mimic shiner	Blacknose shiner
Spottail shiner	Silverjaw minnow	

Siltation eliminated these turbidity-intolerant fish from the West Branch. Their absence reflects the impact of historical agricultural land use practices to aquatic life. This evidence has been obscured in other Ohio streams because fish are migratory. Improved technology in agricultural practices has led to water quality improvement in many streams, which becomes apparent when once displaced species return. This recovery signature is prevented in the East and West branches of the Black River by the East Branch and West Branch falls.

One tributary to the Black River mainstem, Crow Creek, received an IBI of 32 in 1996, which improved to an IBI of 42 in 2012. In 1996, brook stickleback and mottled sculpin, both cold-water fish species, were collected. In 2012, mottled sculpin and redside dace were collected, but no brook sticklebacks. However, only one cold-water macroinvertebrate species has been collected at the site, which occurred in 1996. No cold-water macroinvertebrates were collected in 2012.

Several other tributaries have been sampled over time, and most have shown improvements or maintained stable communities (Table 30). The fish communities of Plum Creek and French Creek, both tributaries to the Black River mainstem, improved over time from poor to fair. The East Branch Black River and its tributaries, the East Fork East Branch Black River, and the West Fork East Branch Black River have generally maintained stable fish communities over time. However, the fish community of the unnamed tributary to East Branch Black River RM 22.65 declined from narratively very good to fair between 1996 and 2012. While only one sample was collected in 2012 and in 1996, the decline of cold-water fish species and overall reduction in the total number of species collected in the most recent survey is concerning. In 1996, 15 species were collected at RM 1.7 and included two cold-water species, redside dace and mottled sculpin. In 2001, 17 and nine species, respectively, were collected at RMs 0.6 and 2.7, with brook stickleback, mottled sculpin, and redside dace collected at RM 0.6 and redside dace and mottled sculpin collected at RM 2.7. In 2012, only seven species were collected at RM 0.6 and mottled sculpin were the only cold-water fish

present. The QHEI for RM 0.6 completed in 2012 described the stream as a series of pools with trickles of water connecting each pool and no riffles present. The QHEI for the same site in 1996 indicated the presence of riffles and pools reaching depths of 50 cm. The reduction in total fish species and cold-water taxa may be an artifact of the fish moving to more suitable pools during the low flow conditions.

In 2012, East Branch subbasin fish community performance tended to score marginally good to good along a biological condition gradient. In comparison, the fish community of the West Branch Black River was considered narratively poor throughout its length in the 1980s, and has improved to fair in the upper reaches and marginally good in the lower reaches. Tributaries to the West Branch Black River, Wellington Creek and Charlemont Creek, showed slight improvements over time, similar to the upper reaches of the West Branch Black River. The disparity in index scores between the East and West branches was primarily due to two suckers, a dace, and a darter. These fish exist in one subbasin, but not in the other. Golden redhorse and northern hog suckers have not been present in the West Branch since the 1950s. Fantail darter populations were decimated throughout its native range due to drainage practices, loss of aquatic vegetation and siltation. The male fantail darter must keep the egg cavity silt-free for up to a month for successful fry development. Increased siltation in the West Branch made this an insurmountable task.

Redside dace, present in the East Branch subbasin and not in the West Branch subbasin, signify good stream health. Redside dace in combination with other species distinguish very good to exceptional conditions. In Ohio, Trautman noticed redside dace and southern redbelly dace were best populated along the escarpment in small clear streams with moderate or high gradient. Listed among Ohio EPA headwater species, their presence indicates habitat permanence. These fish require stable environments and reliable stream flow. Redside dace were recorded at 13 East Branch sites and southern redbelly dace were recorded at two sites in 2012. Biological integrity at these sites was good.

Exchange the silverjaw minnow for a bigmouth shiner and the list of missing West Branch minnows applies equally to the East Branch. Including logperch darter and redfin pickerel, at least ten fish species are absent from the East Branch subbasin. Nearly one fourth of the East Branch fish community has been extirpated. Restoration of these species is fundamental to discerning whether good East Branch biological integrity is a reflection of average water quality or is an artifact of yesterday's land use. Lacking a natural cohort of fish species, the branches of the Black River are intractably mired in perceptions of polluted mediocrity.

At least one-fourth of the fish species known from the branches of the Black River were extirpated as a consequence of soil erosion spurred by the conversion of forests to farms and hastened by artificial drainage. The list of fish now extirpated from the Black River mainstem would begin with the sand darter. The last known record was indicated by Trautman as being taken from the Black River near the French Creek confluence between 1924 and 1954 (Trautman 1981). The demise of sand darters in the Black River was due to upland soil erosion. Conversion of forests to agricultural fields delivered large quantities of silt into the Black River and its tributaries. Then, artificial drainage exacerbated stream turbidity and increased fine sediment bedload. The amount of sediment pollution exceeded a tolerance threshold and sand darters were eliminated from the immediate vicinity. Across the state, sand darters have recently returned to the Maumee River in Ohio after an absence of 65 years (Tessler et al. 2012). The authors suggested changing agricultural practices may be credited for helping reduce silt from sandy areas. Sediment particle sizes were positively correlated with sand darter abundance. Likewise, Ohio EPA has witnessed a renewed sand darter presence at many locations across the state where the species was formerly absent for decades.

While northern pike have never been collected from the Black River mainstem, in 1982, one adult northern pike was collected in French Creek, a short distance upstream from the Black River. This fish was one of 10,495 identified from French Creek in the thirty-year period from 1982-2012. Wetlands that once

bordered the Black River were critical spawning sites for northern pike and many more species. Thus, the list of Black River extirpates encompasses fish dependent on habitat eliminated by a ship channel and industrialization. A few northern pike were collected in the lower Huron River in 1982, 1993, and 2002. Northern pike are becoming more abundant in the upper Cuyahoga River. The North East Ohio Regional Sewer District (NEORSD) documented juvenile and adult northern pike in the lower 15 miles of the Cuyahoga River in each year between 2010 and 2013. The Black River lacustuary remedial efforts have been tangible first steps toward providing needed ecological function. These projects' success can be measured quite literally, one species after another, as reestablishment by former species occurs.

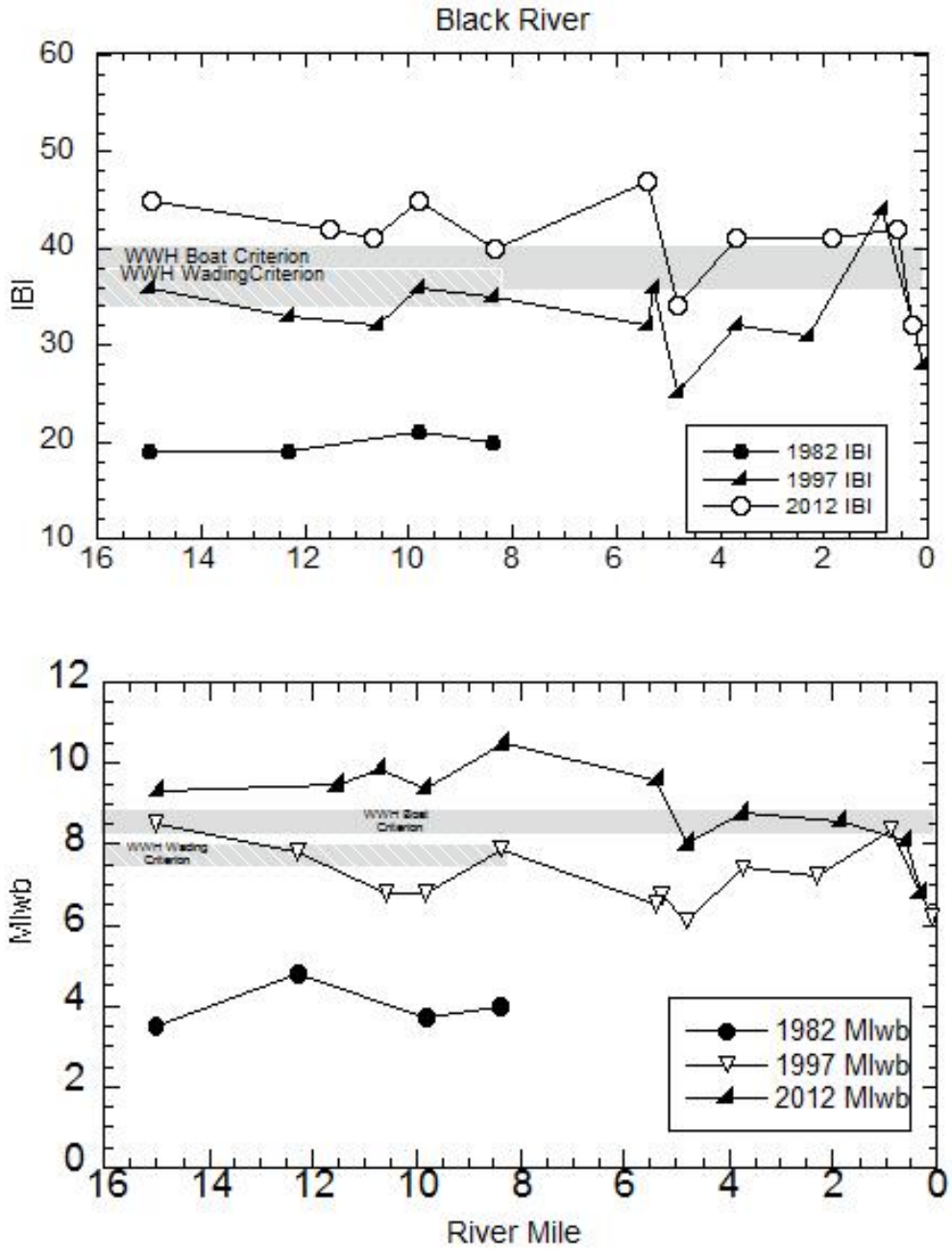


Figure 20. Historical IBI and MIwb scores for the Black River, 1982, 1997, and 2012. All samples in the lowest six miles were sampled using the boat method with electro-sphere array. Samples collected in 1982 and 2012 between RMs 8.0-15.0 were collected using the boat method with a straight array, while samples collected in 1997 between RMs 8.0-15.0 were collected using the wading method.

Table 29. Summary of fish community data based on pulsed D.C. electrofishing samples collected in the Black River study area, 2012. Total including non-native species is cumulative where multiple samples were obtained. Relative number or weight (kg) is normalized to 300-meter sampling distances for wading[W] and headwater[H] sites or 1000 meters for boat[B] or lacustuary sites[L]. Weights are not recorded and the Modified Index of well-being is not applicable at headwater locations. Biocriteria and narrative ranges are in Table 2.

Stream RM[a]	mi[2b]	Total Species	Relative Number/ less tolerants[c]	Relative Weight	QHEI	MIwb	IBI	Narrative Evaluation
	Predominant species (percent of catch)							
Black River								
15.0[B]	396.0	35	687/ 538	314.5	83.0	9.4	45	V Good
	spotfin shiner (17%), golden redhorse (13%), common carp (11%)							
11.5[B]	398.0	27	710/ 537	121.5	72.5	9.6	42	V Good-Good
	golden redhorse (20%), gizzard shad (15%), bluntnose minnow (10%)							
10.7[B]	401.0	37	989/ 666	155.1	81.5	9.9	41	Except.-Good
	gizzard shad (17%), golden redhorse (15%), bluntnose minnow (12%)							
9.8[B]	412.0	34	731/ 608	202.0	79.5	9.5	45	V Good
	golden redhorse (37%), gizzard shad (9%), white sucker (8%)							
8.4[B]	418.0	33	910/ 717	78.5	76.5	10.2	43	Except.-Good
	white sucker (13%), golden redhorse (10%), gizzard shad (9%)							
5.4[L]	425.0	26	386/ 352	71.8	-	9.5	47	Except.-V Good
	gizzard shad (24%), bluegill sunfish (16%), largemouth bass (14%)							
4.8[L]	464.0	23	190/ 158	98.5	-	7.9*	34*	Fair
	gizzard shad (28%), bluegill sunfish (14%), common carp (10%)							
3.4[L]	466.0	21	599/ 468	115.3	-	8.7	41[ns]	Good-M Good
	gizzard shad (26%), bluegill sunfish (17%), largemouth bass (10%)							
1.6[L]	4618.0	30	666/ 548	110.1	-	8.6	41[ns]	Good-M Good
	bluegill sunfish (37%), pumpkinseed sunfish (19%), green sunfish (9%)							
0.6[L]	470.0	20	405/ 373	77.6	-	8.1[ns]	42	M Good-Good
	largemouth bass (34%), gizzard shad (15%), bluegill sunfish (12%)							
0.3[L]	470.5	12	210/ 203	52.0	-	6.8*	32*	Fair
	emerald shiner (49%), gizzard shad (15%), spotted sucker (11%)							
East Branch Black River (Black River Tributary at RM 15.55)								
41.5[W]	68.0	22	538/ 321	30.2	63.5	8.5	42	Good
	white sucker (20%), common shiner (9%), bluegill sunfish (8%)							
40.8[B]	71.0	18	504/ 290	97.5	56.5	8.15	36[ns]	M Good
	white sucker (38%), golden redhorse (23%), bluegill sunfish (13%)							
40.5[W]	72.0	28	2969/ 1514	37.2	67.5	9.6	35[ns]	Except.-M Good
	bluntnose minnow (36%) silverjaw minnow (10%), creek chub (10%)							
36.8[W]	96.0	22	1763/ 1070	12.2	69.5	9.1	36[ns]	V Good-M Good
	bluntnose minnow (28%), central stoneroller (15%), greenside darter (14%)							
24.6[W]	136.0	25	2185/ 1130	54.7	65.0	9.4	37[ns]	Except.-M Good
	bluntnose minnow (29%), creek chub (12%), golden redhorse (8%)							
18.9[W]	158.0	19	659/ 409	23.4	65.5	8.3	38	Good
	bluntnose minnow (32%), golden redhorse (13%), redfin shiner (9%)							

Stream RM[a]	mi[2b]	Total Species	Relative Number/ less tolerants[c]	Relative Weight	QHEI	MIwb	IBI	Narrative Evaluation
	Predominant species (percent of catch)							
East Branch Black River (continued)								
11.3[W]	179.0	21	1559/ 1207	51.8	81.0	9.6	46	Except.-V Good
	greenside darter (32%), bluntnose minnow (17%), smallmouth bass (7%)							
10.5[W]	180.0	22	4400/ 1956	53.7	68.5	9.2	36[ns]	V Good-M Good
	bluntnose minnow (53%), greenside darter (25%), smallmouth bass (4%)							
6.0[W]	185.0	23	7850/ 4735	16.4	51.5	9.1	31*	V Good-Fair
	bluntnose minnow (33%), greenside darter (26%), sand shiner (16%)							
3.1[W]	217.0	28	5546/ 3128	44.8	68.1	9.6	40	Except.-Good
	bluntnose minnow (32%), greenside darter (32%), sand shiner (9%)							
0.4[B]	222.0	16	354/ 192	186.6	64.5	7.7*	33*	Fair
	golden redhorse (21%), green sunfish (17%), common carp (13%)							
East Fork East Branch Black River (East Branch Black River Tributary at RM 45.06)								
5.8[H]	7.6	13	1184/ 458	-	70.5	-	38[ns]	M Good
	creek chub (33%), central stoneroller (20%), green sunfish (17%)							
2.7[H]	12.9	9	1960/ 976	-	52.5	-	36[ns]	M Good
	central stoneroller (31%), blacknose dace (21%), white sucker (17%)							
1.7[H]	13.9	16	1400/ 478	-	77.0	-	36[ns]	M Good
	bluntnose minnow (44%), creek chub (16%), central stoneroller (15%)							
1.6[H]	14.0	18	3851/ 3351	-	82.0	-	52	Exceptional
	central stoneroller (81%), creek chub (6%), blacknose dace (3%)							
0.1[H]	15.2	18	2454/ 1644	-	52.5	-	44	Good
	central stoneroller (49%), creek chub (19%), white sucker (7%)							
West Fork East Branch Black River (East Branch Black River Tributary at RM 45.06)								
14.0[H]	14.1	10	582/ 18	-	59.0	-	24*	Poor
	creek chub (90%), blacknose dace (3%), central stoneroller (2%)							
8.9[W]	25.0	18	3068/ 766	15.4	49.0	7.8[ns]	28*	M Good-Fair
	bluntnose minnow (50%), central stoneroller (15%), creek chub (12%)							
2.3[W]	41.3	24	2878/ 2176	22.0	83.5	9.2	41	V Good-Good
	central stoneroller (44%), bluntnose minnow (10%), Johnny darter (8%)							
0.3[W]	42.4	24	1661/ 959	18.0	71.5	9.3	39	V Good-Good
	bluntnose minnow (23%), central stoneroller (21%), creek chub (11%)							
Clear Creek (West Fork East Branch Black River Tributary at RM 3.56)								
1.8[H]	6.2	11	1024/ 538	-	60.0	-	42	Good
	creek chub (34%), central stoneroller (24%), mottled sculpin (18%)							
East Branch Black River Tributary at RM 41.41								
0.4[H]	1.8	11	522/ 128	-	60.0	-	44	Good
	creek chub (52%), blacknose dace (14%), white sucker (7%)							
East Branch Black River Tributary at RM 39.06								
2.2[H]	4.8	10	636/ 308	-	69.3	-	38[ns]	M Good
	creek chub (27%), mottled sculpin (25%), blacknose dace (21%)							

Stream RM[a]	mi[2b]	Total Species	Relative Number/ less tolerants[c]	Relative Weight	QHEI	MIwb	IBI	Narrative Evaluation
	Predominant species (percent of catch)							
Coon Creek (East Branch Black River Tributary at RM 38.01)								
0.9[H]	10.2	16	348/ 128	-	73.0	-	40	Good
	creek chub (28%), fantail darter (14%), white sucker (14%)							
East Branch Black River Tributary at RM 28.65								
1.5[H]	5.3	12	953/ 345	-	45.5	-	38[ns]	M Good
	creek chub (42%), Johnny darter (14%), blacknose dace (12%)							
Crow Creek (East Branch Black River Tributary at RM 24.39)								
0.8[H]	3.7	12	532/ 286	-	48.0	-	42	Good
	central stoneroller (23%), creek chub (20%), white sucker (11%)							
East Branch Black River Tributary at RM 22.65								
0.6[H]	6.4	7	333/ 78	-	54.5	-	30*	Fair
	creek chub (74%), Johnny darter (13%), fantail darter (4%)							
Salt Creek (East Branch Black River Tributary at RM 18.17)								
0.5[H]	6.7	14	2088/ 730	-	58.0	-	40	Good
	white sucker (39%), central stoneroller (21%), creek chub (13%)							
East Branch Black River Tributary at RM 5.89 (Brentwood Tributary)								
1.0[H]	4.5	15	809/ 289	-	58.0	-	44	Good
	creek chub (29%), central stoneroller (16%), green sunfish (14%)							
0.1[H]	7.2	16	1242/ 290	-	57.5	-	46	V Good
	creek chub (62%), white sucker (10%), central stoneroller (10%)							
Willow Creek (East Branch Black River Tributary at RM 5.56)								
6.6[H]	3.0	9	254/ 72	-	41.0	-	26*	Poor
	creek chub (43%), green sunfish (25%), bluegill sunfish (13%)							
2.8[H]	13.3	8	592/ 142	-	62.5	-	22*	Poor
	creek chub (42%), green sunfish (16%), Johnny darter (12%)							
West Branch Black River (Black River Tributary at RM 15.55)								
37.3[W]	28.0	20	1174/ 367	15.5	63.5	6.8*	32*	Fair
	white sucker (26%), creek chub (24%), common shiner (17%)							
28.5[W]	37.0	23	1178/ 335	10.3	64.0	6.8*	28*	Fair
	creek chub (28%), bluntnose minnow (19%), white sucker (17%)							
25.3[W]	67.0	18	643/ 164	35.5	70.3	6.1*	30*	Fair
	white sucker (33%), bluntnose minnow (23%), common shiner (14%)							
20.5[W]	80.0	24	1472/ 280	31.6	67.3	6.8*	29*	Fair
	bluntnose minnow (41%), white sucker (25%), creek chub (12%)							
16.6[W]	83.0	23	1127/ 253	18.6	61.3	6.6*	27*	Fair-Poor
	bluntnose minnow (41%), creek chub (18%), white sucker (13%)							
10.6[W]	132.0	25	829/ 419	18.6	65.5	8.0	35[ns]	Good-M Good
	bluntnose minnow (15%), white sucker (13%), Johnny darter (12%)							
7.7[W]	161.0	22	290/ 170	21.8	67.5	7.1*	32*	Fair
	rock bass(16%), green sunfish (14%), bluntnose minnow (13%)							
4.2[W]	169.0	26	2361/ 1060	12.1	60.0	8.6	35[ns]	Good-M Good
	bluntnose minnow (40%), greenside darter (18%), sand shiner (10%)							

Stream RM[a]	mi[2b]	Total Species	Relative Number/ less tolerants[c]	Relative Weight	QHEI	MIwb	IBI	Narrative Evaluation
	Predominant species (percent of catch)							
Buck Creek (West Branch Black River Tributary at RM 43.52)								
1.0[H]	4.8	16	2496/ 574	-	47.3	-	38[ns]	M Good
	creek chub (33%), white sucker (22%), blacknose dace (13%)							
Charlemont Creek (West Branch Black River Tributary at RM 26.65)								
8.6[H]	10.8	13	490/ 104	-	65.0	-	28*	Fair
	creek chub (43%), white sucker (19%), common shiner (13%)							
2.2[W]	22.6	22	920/ 264	11.3	64.5	7.0*	32*	Fair
	creek chub (36%), white sucker (14%), bluntnose minnow (12%)							
0.4[W]	25.8	19	763/ 149	9.3	64.5	6.1*	27*	Fair-Poor
	bluntnose minnow (31%), white sucker (22%), creek chub (19%)							
Charlemont Creek Tributary at RM 0.51								
1.0[H]	1.7	7	1175/ 5	-	70.5	-	26*	Poor
	creek chub (60%), blacknose dace (32%), green sunfish (7%)							
0.8[H]	1.8	13	1859/ 63	-	64.0	-	38[ns]	M Good
	creek chub (74%), blacknose dace (16%), white sucker (4%)							
Wellington Creek (West Branch Black River Tributary at RM 15.53)								
17.1[H]	5.2	12	779/ 180	-	57.0	-	28*	Fair
	creek chub (52%), white sucker (13%), central stoneroller (13%)							
13.1[H]	10.5	14	1238/ 124	-	62.3	-	26*	Poor
	creek chub (36%), white sucker (18%), green sunfish (16%)							
8.4[H]	19.7	14	720/ 192	-	60.0	-	30*	Fair
	creek chub (43%), bluntnose minnow (11%), white sucker (10%),							
0.6[W]	29.6	21	678/ 282	4.3	65.0	7.4[ns]	33*	M Good-Fair
	bluntnose minnow (25%), common shiner (19%), creek chub (16%)							
Elk Creek (West Branch Black River Tributary at RM 14.59)								
0.2[H]	7.5	13	1260/ 142	-	61.0	-	26*	Poor
	creek chub (63%), white sucker (14%), Johnny darter (10%)							
Plum Creek (West Branch Black River Tributary at RM 10.06)								
5.6[H]	4.8	11	1062/ 54	-	52.5	-	24*	Poor
	creek chub (48%), green sunfish (20%), white sucker (14%)							
3.2[H]	7.6	13	2090/ 62	-	63.0	-	34*	Fair
	creek chub (57%), green sunfish (21%), white sucker (9%)							
2.8[H]	7.9	17	2342/ 92	-	66.0	-	32*	Fair
	creek chub (52%), white sucker (24%), green sunfish (10%)							
0.8[H]	9.0	22	2121/ 575	-	75.5	-	38[ns]	M Good
	bluntnose minnow (23%), creek chub (23%), white sucker (9%)							
Kelner Ditch (West Branch Black River Tributary at RM 8.61)								
3.0[H]	4.4	11	1266/ 162	-	62.5	-	30*	Fair
	creek chub (64%), green sunfish (12%), bluegill sunfish (9%)							
1.0[H]	9.4	13	796/ 186	-	67.3	-	28*	Fair
	creek chub (39%), white sucker (15%), bluegill sunfish (14%)							
Black River Tributary at RM 10.18								

Stream RM[a]	mi[2b]	Total Species	Relative Number/ less tolerants[c]	Relative Weight	QHEI	MIwb	IBI	Narrative Evaluation
	Predominant species (percent of catch)							
0.7[H]	10.2	18	3318/ 2216	-	54.0	-	50	Exceptional
	central stoneroller (56%), creek chub (14%), white sucker (8%)							
French Creek (Black River Tributary at RM 5.10)								
10.4[H]	11.8	16	550/ 394	-	49.5	-	38[ns]	M Good
	sand shiner (51%), silverjaw minnow (15%), fathead minnow (10%)							
9.0[H]	17.2	13	228/ 142	-	57.0	-	32*	Fair
	central stoneroller (37%), creek chub (14%), sand shiner (11%)							
5.5[W]	25.4	17	1272/ 824	11.7	81.3	8.0	34[ns]	Good-M Good
	central stoneroller (38%), white sucker (20%), round goby (13%)							
2.6[W]	32.6	13	894/ 316	8.2	72.5	6.2*	30*	Fair
	white sucker (27%), green sunfish (26%), round goby (17%)							
0.5[W]	38.6	20	971/ 590	18.8	87.0	8.5	35[ns]	Good-M Good
	round goby (21%), green sunfish (20%), central stoneroller (16%)							
Gable Ditch								
0.4[H]	1.4	2	834/ 268	-	55.8	-	26*	Poor
	creek chub (68%), central stoneroller (32%)							
Heider Ditch								
0.2[H]	7.8	12	1375/ 998	-	54.3	-	38[ns]	M Good
	central stoneroller (63%), creek chub (10%), white sucker (10%)							
Powdermaker Ditch								
0.2[H]	4.3	4	5434/ 3886	-	54.5	-	32*	Fair
	central stoneroller (71%), creek chub (28%)							

a- RM: River mile.

b - mi^2: Drainage area in square miles.

c - Relative Number less pollution tolerant fish is an IBI metric. MIwb calculations exclude these fish considered tolerant: central mudminnow, white sucker, common carp, goldfish, golden shiner, blacknose dace, creek chub, bluntnose minnow, fathead minnow, green sunfish, yellow bullhead, brown bullhead, and eastern banded killifish.

ns- Nonsignificant departure from biocriteria (≤4 IBI units, or ≤0.5 MIwb units).

*- Indicates significant departure from applicable biocriteria (>4 IBI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Table 30. Tributary average IBI score over time.

Stream	1982(n)	1987(n)	1992(n)	1996(n)	1997(n)	2001(n)	2012(n)
French Creek	--	--	27(4)	--	27(6)	--	34(6)
Plum Creek	--	23(4)	26(10)	--	28(6)	31(8)	32(4)
East Branch Black River (Boat) RMs 5.2-mouth	29(9)	--	30(6)	--	--	--	33(2)
East Branch Black River (Wading) RMs 41.5-3.1	--	43(3)	36(14)	--	39(15)	--	38(18)
East Fork East Branch Black River	--	38(3)	--	--	33(5)	--	41(5)
Trib. to East Branch Black River RM 22.65	--	--	--	48(1)	--	39(3)	30(1)
West Fork East Branch Black River	--	--	36(2)	--	--	35(3)	35(6)
West Branch Black River (Boat) RMs 3.0-mouth	24(4)	--	32(2)	--	30(2)	--	38(1)
West Branch Black River (Wading) RMs 37.3-3.0	--	26(1)	28(10)	--	--	29(5)	31(17)
Wellington Creek	--	--	24(4)	--	--	33(2)	30(5)
Charlemont Creek	--	29(2)	33(5)	--	--	35(2)	30(7)

Fish and Mussel Abundance

In 2005-2006, researchers from Cleveland State University (CSU), Department of Biological, Geological, and Environmental Sciences, obtained shells for 21 freshwater mussel species in the Black River basin; representatives of 11 species were alive (Lyons et al. 2007). Freshwater mussel status is allied with water quality and the prevalence of fish species co-opted as hosts for their parasitic glochidia. Since some mussels parasitize particular fish, their fates are intertwined. Living freshwater mussels were only present at one of six Black River mainstem sample sites. Two of the five mussel species living there (fragile papershell and pink heelsplitter) have been speculated to preferentially use freshwater drum as a host. These mussels and freshwater drum are absent upstream from the East Branch and West Branch falls.

The three other living mussel species in the Black River (fat mucket, white heelsplitter, and creek heelsplitter) were also present at sites in both East and West branches and in French Creek. Living specimens of the numerically predominant Wabash pigtoe and the rainbow shell were only present in the East Branch and were associated with the higher gradient downstream reach. Eight living species among ten shell types were present in the East Branch. Living specimens of all seven shells were documented in the West Branch.

In total, 2,920 mussel shells (671 living) were identified from 42 Black River basin sites: 6 mainstem sites, 3 French Creek sites, 19 East Branch sites, and 14 locations in the West Branch subbasin by the CSU researchers. Mussels from the East Branch comprised 82% (n=2,401) of the collection. Wabash pigtoe specimens in the East Branch accounted for 35% (n=1,026) of the entire collection. The three living species common to the watershed (fat mucket, while heelsplitter, and creek heelsplitter) accounted for 38% (n=1,115) of all shells. Three species living in both Branches (giant floater, creeper, and cylindrical papershell) made up 18% (n=515) of the documented fauna. Rainbow shells (n=119), restricted to the East Branch, fragile papershells (n=43), limited to the Black River mainstem, and pink heelsplitters (n=26) combined were 6% of the identifications. One living spike (*Elliptio dilatata*) was found in the West Branch. Relic shells of eight species were only obtained in the Black River. Shells of two other species were only present in the East Branch.

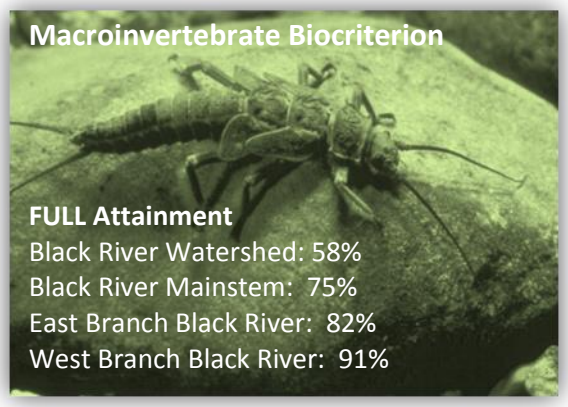
Results of the mussel survey were compared with Black River basin fish communities to determine whether known fish hosts were depauperate. Aside from the two mussels inferred to infest freshwater drum, the nine other living mussels have general host specificity (Watters et al. 2009). Some have stronger associations with centrarchids or are known to have attached to creek chubs or darters, but exclusivity was

not evident. Similarly, a few living mussels had some deference to flow conditions or stream size, but broadly, all were among the more pollution tolerant forms. The absence of living freshwater mussels intolerant to water pollution in the Black River basin was mirrored by a similar dearth of intolerant fish species in the Black River basin.

The CSU researchers compiled a list of 29 historical freshwater mussels known from the Black River watershed based on shells recovered from an archeological site dating to 1350 adjacent to the Black River, from Robert Baird's Oberlin College voucher specimens (1895-1904), and from Ohio State Museum of Biological Diversity records. Among 10 circa 1350 freshwater mussel species identified from the archeological site, only one lake inhabitant was unique to that era. A different lake-oriented species and six mussels, which are now rare throughout Ohio, were only known from the Black River via Baird's 1895-1904 vouchers. An additional, now rare, species was present in both of these collections. Among the 21 freshwater mussels documented in the CSU 2005-2006 study, seven were extant in the Black River in 1350 and at the turn of the 19th century. After 650 years of Black River persistence, only one of the seven mussels, the highly adaptable fat mucket, continues as a viable population today. Two freshwater mussels (fragile papershell and deertoe), thought to infest freshwater drum, were not recorded in earlier Black River surveys.

Ohio EPA has recorded 263 freshwater drum in the Black River since 1982. Ten were present in two Cascade Park samples in 1992. Otherwise, Black River freshwater drum have tended to reside in the downstream lake-influenced reach. Four "young of the year" longnose gar were noted in four separate 1997 samples. A small adult longnose gar was collected in 2003. All longnose gar were downstream from the free flowing Black River. Young freshwater drum were common in the free flowing Black River according to McCormick (1892).

MACROINVERTEBRATE COMMUNITY



The macroinvertebrate communities from 72 locations in the free-flowing reaches of the Black River basin were sampled in 2012, with some follow-up monitoring conducted in 2013. Six locations in the Black River lacustuary and three small direct Lake Erie tributaries just to the east of the Black River watershed were also sampled as part of this survey. The 2012 study represented the first comprehensive re-evaluation of the watershed by Ohio EPA since the 1997 biosurvey. Qualitative multi-habitat composite samples were collected from all sampling locations. Quantitative Hester-Dendy artificial substrate samples were collected from sites with drainage areas that were larger than 20 square miles. A summary of the macroinvertebrate data is presented in Table 32 and is also represented spatially by narrative evaluation in Figure 21. The macroinvertebrate raw data are presented in Appendix Tables 11-13. Data from sampling locations were evaluated using the Invertebrate Community Index (ICI) biological criterion or narrative equivalent for the current or recommended Warmwater Habitat (WWH) aquatic life use, as well as Coldwater Habitat (CWH) narrative benchmarks, where applicable. Overall, 58% of the sites were achieving the applicable biocriterion. The Black River mainstem, exclusive of the Lake Erie influenced lacustuary portion, was in full attainment of the WWH use at 75% of the locations sampled. The East and West branches were achieving macroinvertebrate community expectations for the current or recommended aquatic life use at 82% and 91% of their sampling locations, respectively. Impaired benthic communities were primarily influenced by habitat alterations, sedimentation, eutrophication, and low flows.

Black River Mainstem

The Black River proper begins at the confluence of the East and West branches in Elyria and is 15.56 miles long. The lower approximately 6.6 miles is considered to be the Lake Erie lacustuary portion of the river, and the remainder is free-flowing. Within the free-flowing portion of the river, four sites were sampled and assessed in 2012. Of those sites, three produced Invertebrate Community Index (ICI) scores that met the applicable WWH biocriterion, while one was in non-attainment (Table 2). The lone non-attaining site, at RM 9.80, is located downstream from the Elyria WWTP (RM 10.65) and also from the Ford Road Landfill at RM 10.7. This site scored an ICI of 26, which was a 10-point decline from the next upstream station at RM 11.50, and an 18-point decline from the ICI scored at the same location in 1997 (Figure 22).

Mayfly diversity and abundance were noticeably reduced on the artificial substrates at RM 9.80, with a loss of five taxa and a reduction of mayfly percentage from 27.6% at RM 11.50 to just 1.4% at RM 9.80. In 1997, mayfly percentage was only slightly higher at 2.4%, but mayfly diversity was considerably higher, with eight taxa in 1997, versus only two in 2012. Mayflies as a group have been shown to be particularly sensitive to elevated total dissolved solids (TDS) and conductivity (Pond et. al. 2006, Pond 2010, and Ohio EPA 2008b). For field grab sampling events in 2012, TDS doubled from a median of 440 mg/l at RM 11.50 to 990 mg/l at RM 9.80. The corresponding median specific conductivity values were 619 µmhos/cm and 1231 µmhos/cm, respectively. Water quality sondes were not deployed at RM 11.5, but instead were deployed at RM 10.7, which was upstream from the Elyria WWTP but downstream from the Ford Road Landfill. During the June and July 2012 deployments, conductivity ranged between 630 and 655 µmhos/cm in June and 670 and 685 µmhos/cm in July at RM 10.7. Downstream from the WWTP at RM 9.8, values ranged between 1500 and 1900 µmhos/cm in June and 1800-2300 µmhos/cm in July. These high conductivity values persisted downstream to RM 8.35, where the ICI was in non-significant departure of the WWH biocriterion.

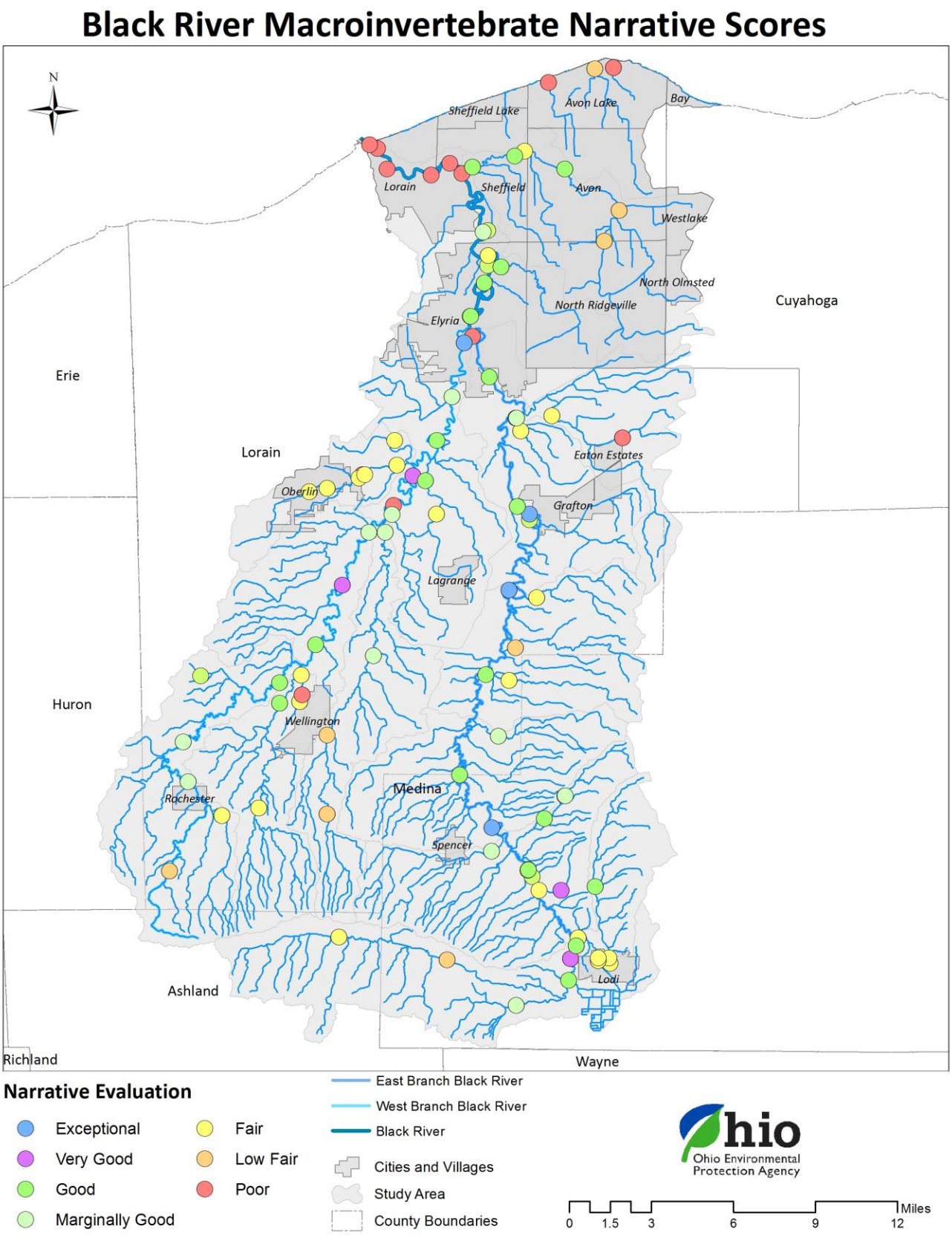


Figure 21. Macroinvertebrate narrative evaluations by location within the Black River basin, 2012.

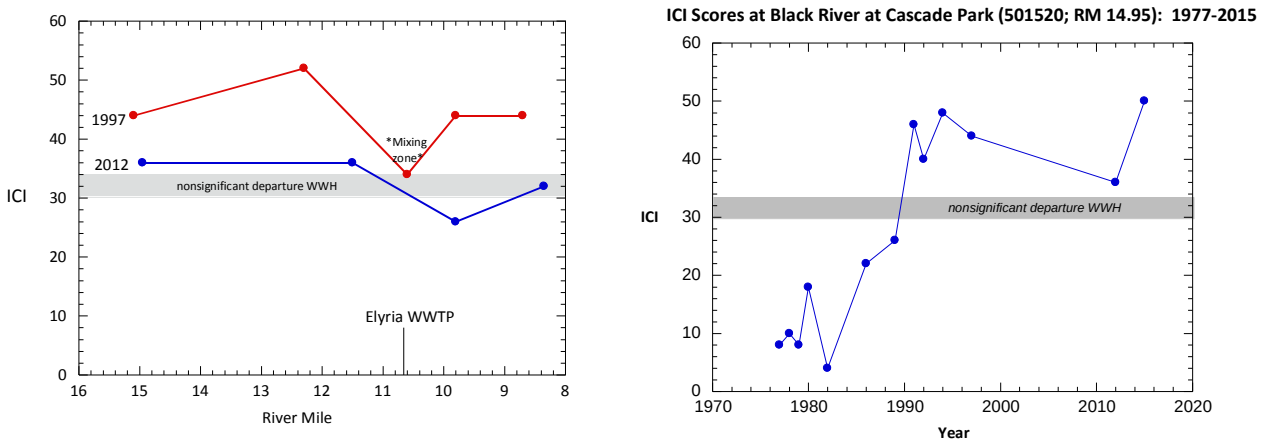


Figure 22. Left: Longitudinal performance of the ICI in the free-flowing portion of the Black River, 1997 (red) and 2012 (blue). Significant tributaries and effluent dischargers are noted on the x-axis. The ICI is estimated where quantitative data are not available. Right: Historical ICI scores from station 501520 (Black River at Cascade Park, RM 14.95), 1977-2015.

Site-to-site ICI scores in 2012 were consistently lower than those of 1997 (Figure 22) and the mean ICI for the river dropped from 46 in 1997 to 32 in 2012. Analysis of the preceding 10 years of flow data revealed that stream flow in the Black River during summer 2012 was the lowest in that period of record (USGS 2014). The lower flows provided less dilution and thus allowed for less assimilation of pollutants, which may explain the decline in those sites upstream from the Elyria WWTP. Downstream from the WWTP, the river became even more effluent-dominated, and, in addition to the issues with specific conductance discussed above, the effects of nutrient enrichment were also exacerbated via wide diel D.O. swings and high benthic chlorophyll. These impacts manifested in the macroinvertebrate community as higher biomass of facultative and tolerant organisms, which also contributed to the ICI score of 26 and partial WWH attainment at the site. Follow-up monitoring conducted in 2015, a higher flow year, on the Black River at Cascade Park (station 501520; RM 14.95) resulted in an ICI score that was comparable to those of the late 1990s (Figure 22).

The Black River mainstem becomes affected by Lake Erie backwater (lacustuary) around RM 6.6. Six stations were sampled in the lacustuary during 2012 (Table 32 and Figure 23). None of the macroinvertebrate communities were meeting the interim lacustuary target (34), with L-ICI scores that ranged from 18 (RM 1.84) to 14 (RMs 5.4, 0.6, and 0.3) and an average L-ICI score of 15 (poor). In 2010-12, Midwest Biodiversity Institute (MBI) assessed the fish and macroinvertebrate assemblages and habitat quality in the Black River lacustuary. Their primary purpose was to provide a pre- and post-construction assessment for the American Recovery and Reinvestment Act (ARRA) and National Oceanic and Atmospheric Administration (NOAA) Phase I grant projects and to establish the pre-construction baseline for NOAA Phase III. A detailed report was compiled by MBI of their biological assessment of the fish and macroinvertebrate assemblages and habitat quality in the Black River lacustuary during 2010-2012 (Smith et al. 2013). The report provides further analysis of the lacustuary sites and relates results of prior Ohio EPA surveys conducted between 1992 and 1997 to results obtained in their 2010-2012 survey.

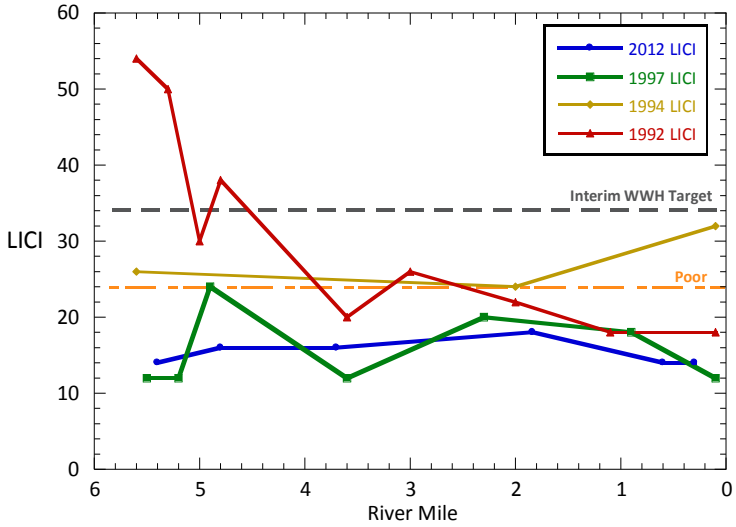


Figure 23. Longitudinal performance of the LICI in the Black River lacustuary, 1992, 1994, 1997 and 2012.

Direct Black River Tributaries

Tributary to Black River at RM 10.18

One site was assessed on this unnamed tributary. The site at RM 0.68 received a narrative assessment of good, due to the abundance of EPT taxa and the predominance of sensitive taxa collected from the natural substrates.

French Creek

Five sites were sampled on French Creek, a direct tributary to the Black River at RM 5.10. The two uppermost sites, RM 10.41 at Mills Road and RM 9.02 at Riegelsberger Road, were not meeting WWH expectations with narratives of low fair. Both locations were predominated by tolerant taxa and contained very few sensitive and EPT[3] taxa. The Mills Road location lacked riparian cover upstream from Mills Road, and the stream channel appeared to have been straightened with little access to the floodplain. Blankets of algae coated sections of the water's surface and a septic odor was noticeable. Numerous pipes were observed emptying into the stream; at least one of the pipes appeared to be actively emptying sewage into the stream (Figure 24). Slightly better habitat conditions were encountered downstream at the Riegelsberger Road location, but community performance remained comparable to Mills Road. Based on the poor habitat conditions and evidence of septic discharges into the upper reach of French Creek, both RM 10.41 and RM 9.02 are considered to be impaired by both habitat alterations and nutrient enrichment. The three lower sites at RMs 5.50, 3.20, and 0.54 all fared considerably better. With caddisflies and mayflies becoming more numerous in the riffles and runs, the ICI scores at all three locations scored well within WWH expectations.

[3] EPT stands for Ephemeroptera-Plecoptera-Trichoptera, the orders of invertebrates commonly known as mayflies, stoneflies, and caddisflies, respectively. Their collective presence and abundance in the benthos is generally considered an indicator of high resource quality.

Figure 24. French Creek, RM 10.41 at Mills Road, downstream view. Inset photo shows a close-up view of French Creek just below a suspected septic outlet. Note the black, anoxic sediment accumulated at the water's edge.

Historically, French Creek was sampled at the same three lower locations in 1997 as in 2012, with an additional sample collected at RM 3.20 in 2001. Benthic community performance was generally consistent across this time period, with similar numbers of qualitative EPT taxa and slightly higher numbers of qualitative sensitive taxa at all sites. ICI scores were available only at RM 3.20 during the 1997-2012 period of record. Scores meeting the WWH biocriterion were calculated at that location on all three sampling occasions.

Direct Lake Erie Tributaries

Although not a part of the Black River watershed, three direct tributaries to Lake Erie were also sampled as part of the Black River survey. The three streams sampled, Heider, Gable, and Powdermaker ditches, all flow through the city of Avon Lake just east of the Black River watershed before they drain into Lake Erie. Mean taxa richness for all three streams (one site per stream) was just 16 taxa and no sensitive taxa were collected. While nutrient enrichment was evident in all three streams via either large growths of bryozoans (Gable and Heider ditches) or algal mats (Powdermaker Ditch), all three streams were deeply entrenched. This disconnection from the floodplain, in combination with a loose shale substrate, appeared to alter the streams' assimilative capacities. Addressing upstream sources (channelization in the headwaters, storm water, urban runoff, etc.) that have contributed to the downstream entrenchment of these streams would prove beneficial to overall resource quality.

East Branch Black River Watershed

East Branch Black River

The East Branch Black River mainstem was sampled at 11 locations in 2012. All but the most upstream and downstream sites were fully meeting the WWH macroinvertebrate criterion, which accounts for 82% full

attainment. The two underperforming sites, located at Shaw Road (RM 41.40) in the headwaters and at Washington Street (RM 0.36) in Elyria, scored below expectations due to the presence of low head dams. The site at RM 0.36 was likely additionally influenced by CSOs and urban runoff, but the impounded conditions made it difficult to determine the extent of impact from those sources. Nonetheless, biological integrity at both sites would be greatly improved by the removal of these dams.

The reach of the East Branch that encompasses RMs 11.34-3.07 warrants discussion due to dramatic fluctuations in the ICI scores (Table 31). The ICI of 38, calculated downstream from the Grafton WWTP discharge at RM 10.5, represented a 12-point drop from the upstream sampling location at RM 11.34. Full recovery was documented four miles downstream at RM 6.00, where the ICI scored similarly to RM 11.34 (52). However, the ICI dropped another 18 points at the next location downstream at RM 3.07, which is downstream from two smaller tributaries that contribute effluent discharges to the East Branch. Low flows compromised dilution in the East Branch in 2012, and likely contributed to the lower scores at both RMs 10.5 and 3.07. However, all scores in this reach were still fully meeting the WWH biocriterion.

The East Branch Black River was previously sampled in 1997, with some limited sampling conducted in 2001 (Figure 25). Mean ICI scores, excluding the dam-impounded reaches from 2012, were slightly lower in 2012 ($\bar{x}$=43) when compared to 1997 ($\bar{x}$=46). This was likely due to the very low flows of 2012, but, overall, ICI scores in the free-flowing sections of this stream have steadily remained in the good to exceptional range over the past 15 years.

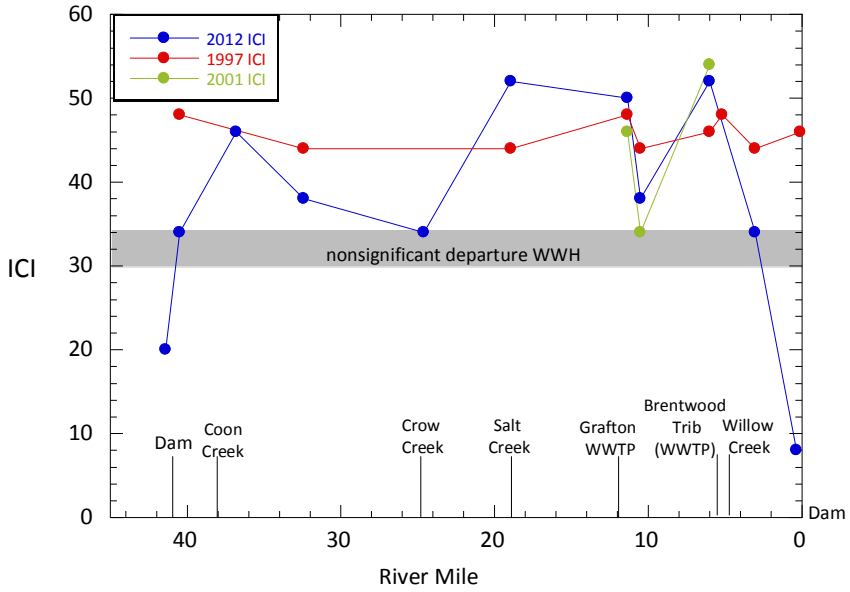


Figure 25. Longitudinal performance of the ICI in the East Branch Black River, 1997, 2001, and 2012. Significant tributaries and effluent dischargers are noted on the x-axis. The ICI is estimated where quantitative data are not available.

East Fork East Branch Black River

Five sites were sampled in 2012 on the East Fork East Branch Black River. Only the uppermost site at Chippewa Road (RM 5.84) was meeting WWH expectations with a narrative evaluation of good. The remaining sites, which bracket the town of Lodi, all performed in the fair range. None of the three sites from RMs 2.67-1.60 supported any caddisfly taxa in 2012. This phenomenon was initially attributed to low to near interstitial flows; however, flows downstream from the Lodi WWTP were normal due to discharge from the facility, yet caddisflies still were not collected. In order to better assess potential impacts from the

Lodi WWTP discharge, RMs 1.73 and 1.60 were resampled in 2013 when flow conditions were normal for both sites. Marginal gains in sensitive and EPT taxa were realized for both locations, including the collection of at least one caddisfly taxon at both sites. However, in spite of riffles with moderate flow, low embeddedness, and good substrate size, neither site supported any net-spinning caddisfly taxa, especially those of the family Hydropsychidae. Given that hydropsychid caddisflies tend to be ubiquitous in lotic systems (Wiggins 1996), their absence from otherwise ideal habitat conditions was unusual. The lack of a thriving hydropsychid caddisfly population may indicate that the riffle either goes dry periodically, experiences scouring flows, or both. More investigation is needed to ascertain the source of these flow alterations, but this response may be attributed to storm water runoff.

The lowermost site at Richman Road (RM 0.15) was impaired due to sedimentation as a result of entrenchment due to upstream sources. A stream mitigation project was completed on the East Fork East Branch in 2002. The mitigation included the installation of a grade control structure upstream from the Lodi WWTP that would give the stream better access to its floodplain. It was expected that eventually the downstream reach would passively recover. Thus far, the Richman Road site has not realized appreciable change in the benthic communities between 1997 and 2012. Similar communities with regard to sensitive (2 and 3, respectively) and EPT (6 and 7, respectively) taxa were collected both years, although taxa richness was higher in 2012.

Table 31. Selected macroinvertebrate community attributes, East Fork East Branch Black River, RM 2.67, 1997-2012.

Year	Total Taxa	Qual. EPT taxa	Qual. sensitive taxa
2012	34	5	6
2001	46	19	18
1997	37	14	10

RMs 2.67 and 0.15 were sampled by Ohio EPA in 1997, with an additional sample collected at RM 2.67 in 2001. Benthic community performance was similar for both years at RM 0.15, but sharp declines were noted for RM 2.67 in 2012 compared to the preceding sampling events. Taxa richness, qualitative EPT, and sensitive taxa all dropped considerably in 2012 (Table 31). These changes are likely due to the reasons discussed in the preceding paragraphs.

West Fork East Branch Black River

The West Fork East Branch Black River was sampled at five locations in 2012. The uppermost sites were not meeting the WWH biocriterion due to intermittent flow conditions. The lower three sites with continuous flow all performed within WWH expectations. A very good community with 68 qualitative taxa and 17 EPT taxa was collected at the Water Resource Restoration Sponsor Program (WRRSP)-funded restoration reach located in Hidden Hollow Park at RM 1.30. This was a considerable improvement over the last sampling event in 2001 where 46 qualitative and 8 EPT taxa were collected.

One tributary to West Fork East Branch Black River was sampled in 2012. Clear Creek, a direct tributary to the stream at RM 3.56, was sampled at Pawnee Road at RM 1.80. A marginally good community comprised of 42 total taxa and 9 EPT taxa was collected from very low flow conditions.

Other Direct East Branch Black River Tributaries

Eleven sites on nine direct tributaries to the East Branch Black River were sampled for macroinvertebrates in 2012, with an additional site sampled in 2013 (Table 32). These streams – unnamed tributaries at RMs 41.41, 39.06, 28.65, 22.65, and 5.89; as well as Coon, Crow, Salt, and Willow creeks - generally supported higher quality benthic communities in the headwater area as opposed to those located further downstream. High ground water influx likely accounted for the marginally good to very good communities collected in the unnamed tributaries at RMs 41.41, 39.06 and 28.65, and in Coon Creek. The unnamed tributaries all supported at least two cold-water taxa and had flowing, functional riffles in spite of dry conditions. Coon Creek, although interstitial, was evaluated as marginally good due to an appreciable

number of EPT and a predominance of mayfly taxa in spite of only consisting of pool habitat. While this stream was not flowing, the pools remained cool via subsurface flow.

Moving downstream, the effects of ephemerality were much more pronounced in the unnamed tributaries at RMs 22.65 and 5.89, and in Crow and Salt creeks. Fair communities with much lower numbers of sensitive and EPT taxa were collected from these streams, though the most downstream site at RM 0.1 on the unnamed tributary at RM 5.89 was evaluated as marginally good. This reach, located downstream from the Brentwood WWTP discharge at RM 0.85, was flow augmented and not interstitial like its upstream counterpart at RM 1.0 and, therefore, supported a more diverse community.

The only tributary to the East Branch Black River not to be influenced by flow condition was Willow Creek. Two sites were sampled on this most downstream tributary to the East Branch in 2012. The upstream site at RM 6.49 supported the lowest quality macroinvertebrate community in the entire Black River watershed. Only 20 total taxa, 15 of which were tolerant, were collected from this muck-bottomed stream. No sensitive or EPT taxa were collected. Oligochaetes, leeches, and pond snails, all of which are highly tolerant to organic enrichment, comprised most of the community collected from the natural substrates. Agricultural runoff and failing septic systems are suspected contributors to conditions at this location. Downstream at RM 2.85, Willow Creek was much improved, but the combination of fine substrates and persistent siltation kept benthic performance below WWH expectations with a narrative evaluation of fair. Any impact from the Eaton Estates WWTP discharge, located at RM 6.0, was not immediately discernable. Willow Creek was sampled at these same locations in 1997, with an additional sampling event at RM 4.90. The macroinvertebrate communities then were comparable to those of 2012.

West Branch Black River Watershed

West Branch Black River

Eleven sites were sampled on the West Branch Black River as part of the 2012 biosurvey (Table 32). All but the uppermost site at RM 48.10 (Stewart Road south of Rochester) were at least marginally meeting the WWH biocriterion for macroinvertebrates. The Stewart Road site was intermittent on the July 30, 2012 sampling event, and as such, only three EPT taxa (no caddisflies) were collected and the community was predominated by highly tolerant pond snails. Low to interstitial flows were persistent at the next two downstream sites, but marginally good communities were collected at both locations. In general, biological integrity, as indicated by the benthic community, increased in a downstream direction. The most notable departure from this trend, however, was at RM 4.18 at Oberlin-Elyria Road, which is located north of Elyria. Here, the ICI score experienced an 8-point drop from the ICI of 40 that was scored at Butternut Ridge Road (RM 7.68). The largest number of organisms collected from the artificial substrates in the entire survey occurred at this location. More than half of the organisms from the artificial substrate sample were flatworms, the cnidarian *Hydra*, and the tanytarsini midges *Rheotanytarsus* and *Tanytarsus glabrescens species group 7*. Flatworms comprised the majority of the organisms observed inhabiting natural substrates. While the reach was fairly encumbered with silt, this level of production in the benthic community indicated a source of excess nutrients in the system. The Elyria Country Club and Forest Hill golf courses are present upstream from Oberlin-Elyria Road and could be potential sources of nutrients via runoff of lawn chemicals. Future monitoring efforts in the West Branch Black River should include the Oberlin-Elyria Road site at RM 4.18 to track the status of the macroinvertebrate community which only minimally met WWH expectations in 2012.

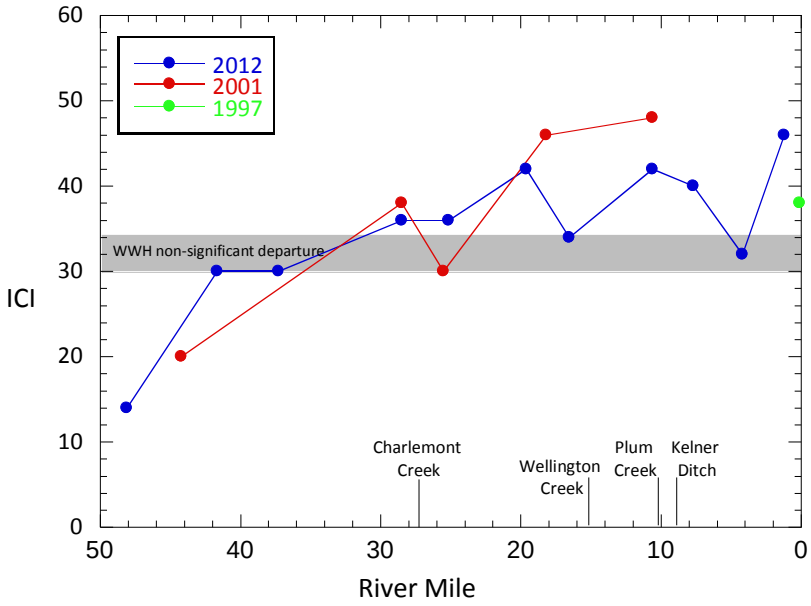


Figure 26. Longitudinal performance of the ICI in the West Branch Black River, 1997, 2001, and 2012. Significant tributaries and effluent dischargers are noted on the x-axis. The ICI is estimated where quantitative data are not available.

Only one site was monitored on the West Branch Black River in 1997, and sampling was limited to mostly the upper reaches of the river in 2001 (Figure 26). In general, the trend in benthic performance was comparable across all three years. Of note was the improvement of the ICI downstream from Charlemont Creek at RM 25.15 (SR 58 north of Wellington), which improved from a marginally good ICI score of 30 to a good ICI score of 36.

West Branch Black River Tributaries

Seventeen sites on seven tributaries to the West Branch Black River were assessed as part of the 2012 sampling effort (Table 32). Of these, only five sites were at least within non-significant departure of the WWH biocriterion. Impacts to streams or stream reaches were caused by ephemerality, siltation, bacterial residues, and septic or effluent discharges. Headwater streams or stream reaches situated in the southernmost portion of the watershed appeared to be the most impacted by ephemerality. Interstitial to intermittent flows affected macroinvertebrate communities in Buck Creek and in the headwater reaches of Wellington and Charlemont creeks. Absent from the communities collected at these locations were the rheophilic taxa expected to be present when the stream is flowing normally, such as hydropsychid caddisflies and baetid mayflies. Elk Creek within the conservation area at RM 0.15 was also interstitial, but a marginally good community was collected that consisted of an abundance of case-building caddisfly taxa. This stream would probably support much greater diversity with normal flows. These streams were last sampled in 2001 and similar conditions and communities were present at corresponding sites.

Plum Creek

Plum Creek was impacted by siltation at three of the four locations sampled. In general, substrates were fine-textured and unstable, and coated with layers of fine silt. Due to these conditions, colonization was limited at these locations, and EPT taxa were almost entirely facultative in terms of pollution sensitivity. Eroded banks and downed trees were indicative of flashy streams flows, which likely contributed to the conditions encountered in Plum Creek. Siltation was less profound at the lowermost location at RM 0.83 (Oberlin-Elyria Road), owing in part to a larger size assortment of substrates, but a slimy substance that was

coating the substrates seemed to limit colonization. The Elyria County landfill just upstream may be a potential source of this phenomenon. The Oberlin WWTP, which is also upstream, does not appear to be a source of the slime, as this condition was not observed on the substrates just downstream from the plant's discharge at RM 2.80.

In spite of the performance of the benthos in Plum Creek in 2012, overall conditions were much improved compared to the last sampling event that took place in 2001. Very poor communities were collected at RMs 5.90 and 3.19, with only 14 and 15 total taxa collected in 2001, respectively. While flows were interstitial then, organisms were very sparse, save for large numbers of scuds and flatworms in the riffle remnants at the uppermost site. The community was slightly improved by flows from the Oberlin WWTP at RM 2.8, but the community remained in the fair range in part due to poor habitat quality. At the lowermost station at RM 0.70 in 2001, an ICI of 42 was calculated, while the qualitative sample included only 4 EPT and 3 sensitive taxa. This disconnect suggested that the natural instream habitat was inferior to that provided by the artificial substrates. Overall, Plum Creek appeared to be trending upward in 2012. If the overriding issues of siltation and instream substrate quality are addressed, Plum Creek stands to fully achieve WWH macroinvertebrate community expectations in the near future.

Lower Charlemont Creek Subwatershed

The Wellington WWTP had an impact to both its receiving stream, the unnamed tributary to Charlemont Creek at RM 0.51, and to Charlemont Creek proper downstream from the confluence with the unnamed tributary. Half the community collected at the downstream location on the unnamed tributary (confluence with Charlemont Creek at RM 0.76) was comprised of tolerant taxa, and only one EPT and zero sensitive taxa were found. While the upstream site at RM 1.0 was evaluated as fair due to an unknown source (potential illicit discharge upstream), there were six EPT and two sensitive taxa collected and overall greater diversity with less tolerant taxa. The difference in community compositions in spite of relatively short distance between reaches suggested that the WWTP was complicit in the impact to the benthic community. The effects of the WWTP discharge had a further reaching effect on the Charlemont Creek site at Peck-Wadsworth Road (RM 0.39). While the ICI of 28 was in the fair range, what was more compelling was the dramatic drop in qualitative EPT and sensitive taxa from the Pitts Road site at RM 2.20 upstream from the WWTP tributary. EPT taxa dropped from sixteen to just three, and sensitive taxa declined from eleven to only two. This impact equated with that of the 2001 sampling event, where diversity noticeably declined downstream from the WWTP. That year, the ICI declined from 32 to 12, and qualitative EPT and sensitive taxa dropped from ten and four to two and one, respectively, from upstream to downstream.

Kelner Ditch

Kelner Ditch was sampled at two locations in both 2012 and in 2001. The site at RM 3.0, located at Parsons Road, did not achieve WWH macroinvertebrate community expectations in either sampling year. Gross pollution, likely resulting from failing septic systems, was evident in 2001 when no EPT or sensitive taxa were collected and red midges, leeches and pond snails predominated the community, resulting in an evaluation of very poor. The benthos was somewhat improved in 2012, as five EPT and two sensitive taxa were collected, but the evaluation of fair still did not meet the WWH benchmark. Septic systems, as evidenced by a strong odor and numerous outlets in the reach, along with agricultural runoff from upstream land uses, were suspected sources of impairment. Macroinvertebrate communities were much improved in both downstream samples from 2012 and 2001, with evaluations improving to good and marginally good, respectively.

Table 32. Summary of macroinvertebrate data collected from artificial substrates (quantitative data) and natural substrates (qualitative data) in the Black River basin, July-September, 2012 and June, 2013.

Location	River Mile	Drain. (mi^2)	Total Taxa	Qual EPT	Qual Sens	Qual Tolrnt	CW Taxa	Substrate Density[a]	ICI[b]	Narrative Evaluation	Observations[c]
Black R. at Elyria at Cascade Park	14.95	396.00	62	15	11	6	0	1352	36	Good	Hydropsychid caddisflies, midges, baetid mayflies, riffle beetles, and bryozoa predominant.
Black R. dst. Elyria, near Spring Valley Golf Club	11.50	398.00	55	15	14	8	0	610	36	Good	Hydropsychid and philopotamid caddisflies, midges, and riffle beetles predominant.
Black R. dst. Elyria WWTP at Ford Rd.	9.80	412.00	61	9	6	15	0	1527	26*	Fair	Hydropsychid caddisflies, midges, and riffle beetles predominant.
Black R. at Sheffield at North Ridge Rd.	8.35	418.00	52	8	7	8	0	1210	32[ns]	Marginally Good	Portions of reach have bedrock substrate. Hydropsychid caddisflies and midges predominant.
Black R. at Lorain, upst. French Creek (lacustuary)	5.4	425.00	22	1	0	7	0	2175	14	Poor	Aquatic worms and midges predominant.
Black R. at Lorain, dst. French Creek (lacustuary)	4.8	464.00	23	1	0	4	0	1470	16	Poor	Aquatic worms and midges predominant.
Black R. uspt. U.S. Steel 002, dst. Island (lacustuary)	3.7	466.00	27	2	2	11	0	1790	16	Poor	Aquatic worms and midges predominant.
Black R. at Lorain at E. 21st St. (lacustuary)	1.84	468.00	29	1	1	7	0	2127	18	Poor	Aquatic worms, midges, zebra mussels, and aquatic snails predominant.
Black R. at Lorain, 0.18 mi. upst. Erie St. (lacustuary)	0.6	470.00	23	1	0	7	0	1972	14	Poor	Aquatic worms, midges, and zebra mussels predominant.
Black R. at Lorain, near mouth (lacustuary)	0.3	470.50	17	1	0	4	0	488	14	Poor	Aquatic worms and flatworms predominant.
Trib. Black R. (RM 10.18) at Gulf Rd.	0.68	10.20	51	11	5	17	0	Moderate	n/a	Good	Philopotamid and hydropsychid caddisflies, baetid mayflies, midges, and aquatic sow bugs predominant.
French Creek E of Elyria at Mills Rd.	10.41	11.80	38	4	1	14	0	Moderate	n/a	Low Fair*	Flatworms, midges, and water mites predominant.
French Creek SE of Avon at Riegelsberger Rd.	9.02	17.20	33	4	1	14	0	Moderate-low	n/a	Low Fair*	Flatworms, midges, and Asian clams predominant.
French Creek at Bridge Point Trail	5.50	25.40	40	7	1	9	0	680	34	Good	Hydropsychid caddisflies and midges predominant.
French Creek NE of Lorain at Abbe Rd. (St. Rt. 301)	3.20	32.30	49	7	3	10	0	1239	36	Good	Hydropsychid caddisflies, baetid mayflies, midges predominant.
French Creek near Lorain at E. River Rd.	0.54	38.60	43	5	2	10	0	489	38	Good	Hydropsychid caddisflies predominant.

Location	River Mile	Drain. (mi^2)	Total Taxa	Qual EPT	Qual Sens	Qual Tolrnt	CW Taxa	Substrate Density[a]	ICI[b]	Narrative Evaluation	Observations[c]
Heider Ditch at Electric Ave.	0.25	7.84	24	4	0	6	0	Low	n/a	**Low Fair***	Flatworms, bryozoa, and aquatic sow bugs predominant.
Gable Ditch at Electric Ave.	0.30	1.39	9	2	0	1	0	Low	n/a	**Poor***	Baetid mayflies and bryozoa predominant.
Powdermaker Ditch at Electric Ave.	0.15	4.25	14	1	0	5	0	Low	n/a	**Poor***	Flatworms predominant.
E. Br. Black R. NW of Lodi at Shaw Rd. (Twp. Rd. 99)	41.45	68.00	41	3	1	20	0	Low	--	**Fair***	No riffle or run within reach due to small dam approx. 0.1 mi. downstream. Midges predominant in pools and margins.
E. Br. Black R. NW of Lodi at Old Mill Rd. (Twp. Rd. 68)	40.47	72.00	68	9	9	13	0	998	34	**Good**	Foul odor within reach. Hydropsychid caddisflies and midges predominant.
E. Br. Black R. W of Spencer Lake at River Corners Rd.	36.80	96.00	75	16	16	9	0	171	46	**Exceptional**	Hydropsychid and philopotamid caddisflies and pleurocerid snails predominant.
E. Br. Black R. at Lorain/Medina Co. line (Smith Rd.)	32.42	104.00	88	10	11	16	0	1312	38	**Good**	Hydropsychid caddisflies and midges predominant.
E. Br. Black R. SE of LaGrange at Short Rd.	24.60	136.00	50	11	8	11	0	Moderate-low	--	Good	Hydropsychid caddisflies, baetid mayflies, and midges predominant.
E. Br. Black R. E of LaGrange at Vermont St. (Co. Rd. 62)	18.94	158.00	77	16	18	7	0	329	52	**Exceptional**	Hydropsychid caddisflies, baetid and heptageniid mayflies, and midges predominant.
E. Br. Black R. at Grafton at Parsons Rd.	11.34	179.00	85	22	19	11	0	1832	50	**Exceptional**	Hydropsychid and philopotamid caddisflies, bryozoa, and midges predominant.
E. Br. Black R. dst. Grafton WWTP at Indian Hollow Park	10.50	180.00	69	17	12	15	0	1430	38	**Good**	Flatworms, hydropsychid caddisflies, and philopotamid caddisflies predominant.
E. Br. Black R. S of Elyria, upst. Brentwood Trib.	6.00	185.00	84	25	20	14	0	632	52	**Exceptional**	Hydropsychid caddisflies, bryozoa, and midges predominant.
E. Br. Black R. upst. Elyria at Fuller Rd.	3.07	217.00	67	15	11	11	0	631	34	**Good**	Hydropsychid caddisflies, riffle beetles, and midges predominant.
E. Br. Black R. at Elyria at Washington St.	0.36	222.00	38	2	0	15	0	1448	8*	**Poor**	Low dissolved oxygen and foul odor within stream reach. No riffle or run. Midges, damselflies, and beetles predominant in margins.
E. Fk. E. Br. Black R. N of Lodi at Chippewa Lake Rd.	5.84	7.60	53	13	10	11	1	Low	n/a	**Good**	Midges predominant.
E. Fk. E. Br. Black R. at Lodi at Lodi City Park	2.67	12.90	34	5	6	5	3	Moderate-low	n/a	**Fair***	Midges and water mites predominant.
E. Fk. E. Br. Black R. 75 ft. upst. Lodi WWTP (2012/2013)	1.73	13.90	47/ 56	2/6	1/5	16/18	0/3	Low/low	n/a	**Low Fair*/ Fair***	Water mites predominant in 2012 and midges and riffle beetles predominant in 2013.

Location	River Mile	Drain. (mi^2)	Total Taxa	Qual EPT	Qual Sens	Qual Tolrnt	CW Taxa	Substrate Density[a]	ICI[b]	Narrative Evaluation	Observations[c]
E. Fk. E. Br. Black R. dst. Lodi WWTP (2012/2013)	1.60	14.00	44/ 49	2/7	3/5	16/17	0/2	Low/low	n/a	**Low Fair*/ Fair***	Midges and flatworms predominant in 2012 and 2013.
E. Fk. E. Br. Black R. at mouth at Richmond Rd.	0.06	15.20	47	7	3	11	0	Low	n/a	**Fair***	Hydropsychid caddisflies and riffle beetles predominant.
W. Fk. E. Br. Black R. at Twp. Rd. 391	13.97	14.10	34	6	2	18	0	High	n/a	**Fair***	Stream intermittent within reach. Water mites and midges predominant in pools and margins.
W. Fk. E. Br. Black River at Homer at St. Rt. 301	8.90	25.00	38	3	0	15	0	Moderate-low	--	**Low Fair***	Stream intermittent within reach and characterized with stagnant pools with bacterial film covering surface. Midges predominant in pools and margins.
W. Fk. E. Br. Black River W of Lodi, dst. St. Rt. 421 and railroad	2.30	41.10	88	17	13	18	0	981	38	**Good**	Hydropsychid and philopotamid caddisflies predominant.
W. Fk. E. Br. Black River W of Lodi at Hidden Hollow Park	1.15	41.7	68	17	11	20	0	Moderate	--	**Very Good**	Hydropsychid and philopotamid caddisflies and bryozoa predominant.
W. Fk. E. Br. Black River at Sanford Rd.	0.34	42.20	84	21	16	10	1	271	36	**Good**	Hydropsychid and philopotamid caddisflies predominant.
Clear Creek SW of Lodi at Pawnee Rd.	1.80	6.20	42	9	8	11	0	Moderate-low	n/a	**Marginally Good[ns]**	Hydropsychid and philopotamid caddisflies and midges predominant.
Trib. to E. Br. Black R. (RM 41.41) at Shaw Rd. (Lower)	0.35	1.77	58	17	13	9	2	Moderate-low	n/a	**Very Good**	*Caenis* mayflies and midges predominant.
Trib. To E. Br. Black R. (RM 39.06) at Garver Road (2013)	3.60	3.20	49	9	10	10	4	Moderate-low	n/a	**Marginally Good[ns]**	Midges and hydropsychid caddisflies predominant.
Trib. to E. Br. Black R. (RM 39.06) at Spencer Lake Rd.	2.16	4.66	43	16	13	5	3	Low	n/a	**Good**	Midges predominant in very shallow riffle.
Coon Creek at River Corners Rd.	0.88	10.20	41	8	4	13	0	Moderate	n/a	**Marginally Good[ns]**	Stream interstitial within reach; sampled the pools and margins. Heptageniid mayflies and midges predominant in pools and margins.
Trib. to E. Br. Black R. (RM 28.65) at Foster Rd.	1.50	5.30	52	10	7	17	3	Low	n/a	**Marginally Good[ns]**	Riffle beetles and midges predominant.
Crow Creek NE of Penfield at Vermont Rd.	0.80	3.70	39	4	2	19	0	Low	n/a	**Fair***	Stream interstitial within reach. Hydropsychid caddisflies, pouch snails, and riffle beetles predominant.
Trib. to E. Br. Black R. (RM 22.65) at Vermont Rd.	0.60	6.40	24	2	0	11	0	Low	n/a	**Low Fair***	Stream interstitial/intermittent within reach. No riffles or runs, but midges predominant in pools and margins.

Location	River Mile	Drain. (mi^2)	Total Taxa	Qual EPT	Qual Sens	Qual Tolrnt	CW Taxa	Substrate Density[a]	ICI[b]	Narrative Evaluation	Observations[c]
Salt Creek at Chamberlain Rd.	0.53	6.73	42	6	3	13	0	Low	n/a	**Fair***	Stream interstitial within reach. Hydropsychid caddisflies predominant.
Trib. to E. Br. Black R. (RM 5.89) (Brentwood Trib.) at Waterfall Dr.	1.00	4.45	41	6	3	19	0	Moderate	n/a	**Fair***	Stream interstitial within reach; no runs or riffles but heptageniid mayflies and aquatic sow bugs predominant in pools and margins.
Trib. to E. Br. Black R. (RM 5.89) (Brentwood Trib.) at Robson Dr.	0.10	7.19	42	10	5	10	1	Moderate-low	n/a	**Marginally Good[ns]**	Aquatic sow bugs and midges predominant.
Willow Creek upst. Eaton Estates at Island Rd.	6.59	2.99	20	0	0	15	0	Moderate	n/a	**Poor***	Stream appeared to be recovering from prior channelization and foul odor noted within reach. No riffle or run but flatworms, midges, and oligochaetes predominant in pool.
Willow Creek SE of Elyria at Durkee Rd. (upst. crossing)	2.85	13.30	39	6	1	13	0	Low	n/a	**Fair***	Heavy siltation within reach. Hydropsychid caddisflies, flatworms, and midges predominant.
W. Br. Black R. S of Rochester at Stewart Rd.	48.10	4.30	39	3	1	12	1	Moderate-low	n/a	**Low Fair***	Stream interstitial within reach and characterized by sandy/clayey pools with low dissolved oxygen. Chironominae midges and pleurocerid snails predominant in pools and margins.
W. Br. Black R.at Rochester at St. Rt. 511 (upst. crossing)	41.67	16.00	39	11	7	6	0	Moderate-low	n/a	**Marginally Good[ns]**	Stream with low flow throughout riffle within reach. Hydropsychid and *Helicopsyche* caddisflies predominant.
W. Br. Black R. S of Brighton at St. Rt. 511 (dst. crossing)	37.30	28.00	49	44	7	13	0	Moderate-low	--	**Marginally Good[ns]**	Stream interstitial within reach; riffle very dry but polycentropid and *Helicopsyche* caddisflies, heptageniid and *Caenis* mayflies, midges, and beetles predominant in pools and margins.
W. Br. Black R. NW of Wellington at Pitts Rd.	28.50	28.50	50	15	15	8	0	Moderate	--	**Good**	Hydropsychid caddisflies, midges, and riffle beetles predominant.
W. Br. Black R. N of Wellington at St. Rt. 58	25.30	67.00	53	7	5	8	0	635	36	**Good**	Hydropsychid caddisflies, baetid mayflies, and riffle beetles predominant.
W. Br. Black R. E of Pittsfield at St. Rt. 303	19.60	80.00	76	11	7	12	0	611	42	**Very Good**	Hydropsychid caddisflies, midges, and riffle beetles predominant.
W. Br. Black R. at West Rd. (Kipton Nickel Plate Rd.)	16.56	83.00	60	10	2	13	0	390	34	**Good**	Hydropsychid caddisflies and riffle beetles predominant.

Location	River Mile	Drain. (mi^2)	Total Taxa	Qual EPT	Qual Sens	Qual Tolrnt	CW Taxa	Substrate Density[a]	ICI[b]	Narrative Evaluation	Observations[c]
W. Br. Black R. at Metro Parks Equestrian Area	10.60	132.00	79	13	13	11	0	140	42	**Very Good**	Philopotamid and hydropsychid caddisflies, flatworms, and fingernail clams predominant.
W. Br. Black R. at Butternut Ridge Rd.	7.68	161.00	65	16	19	7	0	730	40	**Good**	Hydropsychid and philopotamid caddisflies and baetid mayflies predominant.
W. Br. Black R. upst. Elyria at Oberlin-Elyria Rd.	4.18	169.00	64	13	10	11	0	2690	32[ns]	**Marginally Good**	Hydropsychid caddisflies, flatworms, and midges predominant.
W. Br. Black R. at Elyria, upst. Third St.	1.20	172.00	74	16	12	16	0	1932	46	**Exceptional**	*Rheotanytarsus* midges, philopotamid caddisflies, and flatworms predominant.
Buck Creek SE of Rochester at Bursley Rd.	0.95	4.80	42	5	1	16	0	Low	n/a	**Fair***	Stream interstitial within reach. Hydropsychid caddisflies and midges predominant.
Charlemont Creek at Baker Rd.	8.55	10.80	33	5	3	10	1	Moderate-low	n/a	**Fair***	Stream interstitial within reach; reach reduced to a series of long, muddy/cobble pools. Midges and heptageniid and *Caenis* mayflies predominant in pools and margins.
Charlemont Creek W of Wellington at Pitts Rd.	2.20	22.60	53	16	11	9	0	Moderate-low	--	**Good**	Hydropsychid caddisflies, midges, and riffle beetles predominant.
Charlemont Creek dst. of Wellington at Peck-Wadsworth Rd.	0.39	25.80	47	3	2	9	0	476	28*	**Fair**	*Rheotanytarsus* midges, hydropsychid caddisflies, and baetid mayflies predominant.
Trib. to Charlemont Creek (RM 0.51) upst. Wellington WWTP	1.00	1.75	34	6	2	5	1	Low	n/a	**Fair***	Hydropsychid caddisflies and midges predominant.
Trib. to Charlemont Creek (RM 0.51) dst. Wellington WWTP	0.76	1.75	26	1	0	12	0	Moderate	n/a	**Poor***	Midges predominant.
Wellington Creek at Bursley Rd.	17.10	5.20	30	4	1	11	1	Moderate-low	n/a	**Low Fair***	Stream intermittent within reach; reduced to long pool surrounding the bridge. Heptageniid mayflies and midges predominant within pools and margins.
Wellington Creek at Wellington at Cemetery Rd.	13.09	10.50	39	3	0	20	0	Moderate	n/a	**Low Fair***	Stream intermittent within reach. Midges, scuds, *Caenis* mayflies, and damselflies predominant.
Wellington Creek NE of Wellington at Webster Rd.	8.40	19.70	42	10	3	10	1	Low	n/a	**Marginally Good[ns]**	Stream interstitial within reach. Hydropsychid caddisflies and riffle beetles predominant.
Wellington Creek near mouth at Nickel Plate Rd.	0.60	29.60	46	10	9	9	0	Moderate-low	--	**Marginally Good[ns]**	Stream almost interstitial within reach. Hydropsychid caddisflies, riffle beetles, and pleurocerid snails predominant.

Location	River Mile	Drain. (mi^2)	Total Taxa	Qual EPT	Qual Sens	Qual Tolrnt	CW Taxa	Substrate Density[a]	ICI[b]	Narrative Evaluation	Observations[c]
Elk Creek at Metro Park property off Parsons Rd.	0.15	7.55	38	10	8	9	0	Moderate-low	n/a	**Marginally Good[ns]**	Stream interstitial within reach. Midges and hydropsychid caddisflies predominant.
Plum Creek at Oberlin at Morgan St.	5.57	4.77	35	8	2	7	0	Moderate-low	n/a	**Fair***	Stream was nearly interstitial within reach. Hydropsychid caddisflies, riffle beetles, and aquatic sow bugs predominant.
Plum Creek upst. Oberlin WWTP at St. Rt. 511	3.19	7.60	33	7	1	9	0	Low	n/a	**Fair***	Baetid mayflies and riffle beetles predominant.
Plum Creek just dst. Oberlin WWTP	2.80	7.90	34	5	0	8	0	Moderate-low	n/a	**Fair***	*Rheotanytarsus* midges and hydropsychid caddisflies predominant.
Plum Creek E of Oberlin at Oberlin-Elyria Rd.	0.83	9.28	36	8	1	7	0	Moderate-low	n/a	**Fair***	Baetid mayflies and riffle beetles predominant. Slimy substrates (esp. in riffle).
Kelner Ditch E of Oberlin at Parsons Rd.	3.0	4.40	39	5	2	12	0	Low	n/a	**Fair***	Hydropsychid caddisflies, flatworms, and riffle beetles predominant.
Kelner Ditch E of Oberlin at Nickel Plate Diagonal Rd.	1.0	9.40	63	12	6	16	0	Moderate-low	n/a	**Good**	Hydropsychid caddisflies and riffle beetles predominant.

a - Relative density of benthos on natural substrates estimated via narrative (high, moderate, low) where quantitative data are not available.

b - Invertebrate Community Index. ICI not available for sampling locations with drainage area <20mi^2 (excluding reference sites), and are indicated by n/a. Stations located in the Black River lacustuary were evaluated with the lacustuary ICI (LICI) score against established WWH benchmarks.

Dashed lines (--) indicate sites where quantitative data were not available due to vandalism, desiccation, or some other disturbance of Hester Dendy artificial substrates (HDs).

c - Predominant taxa are those observed on natural substrates. Please refer to Appendix table XX for predominant taxa on artificial substrates.

ns - Nonsignificant departure from biocriterion (≤4 ICI units) or equivalent aquatic life use narrative.

* - Indicates significant departure from applicable biocriterion (>4 ICI units) or equivalent aquatic life use narrative. Underlined scores are in the Poor or Very Poor range.

FISH TISSUE CONTAMINATION

Ohio has been sampling streams annually for sport fish contamination since 1993. Fish are analyzed for contaminants that bioaccumulate in fish and that could pose a threat to human health if consumed in excessive amounts. Contaminants analyzed in Ohio sport fish include mercury, PCBs, DDT, mirex, hexachlorobenzene, lead, selenium, and several other metals and pesticides. Other contaminants are sometimes analyzed if indicated by site-specific current or historic sources. For more information about the chemicals analyzed, how fish are collected, or the history of the fish contaminant program, see State Of Ohio Cooperative Fish Tissue Monitoring Program Sport Fish Tissue Consumption Advisory Program, Ohio EPA, January 2010 (http://www.epa.state.oh.us/portals/35/fishadvisory/FishAdvisoryProcedure10.pdf).

Fish contaminant data are primarily used for three purposes: 1) to determine sport fish consumption advisories; 2) to determine attainment with the Ohio Water Quality Standards (WQS) human health criteria; and 3) to examine trends in fish contaminants over time.

Fish Advisories

Fish contaminant data are used to determine a meal frequency that is safe for people to consume (*e.g.*, two meals a week, one meal a month, do not eat), and a fish advisory is issued for applicable species and locations. Because mercury mostly comes from nonpoint sources - primarily aerial deposition - Ohio has had a statewide one meal a week advisory for most fish since 2001. Most fish are assumed to be safe to eat once a week unless specified otherwise in the fish advisory, which can be viewed at http://www.epa.state.oh.us/dsw/fishadvisory/index.aspx.

The minimum data requirement for issuing a fish advisory is 3 samples of a single species from within the past 10 years. For species without enough data to post an advisory, or if the data do not warrant a species-specific advisory, the statewide advisories apply, which are: two meals a week for sunfish (*e.g.*, bluegill) and yellow perch, one meal a week for most other fish, and one meal a month for flathead catfish 23" and over, and northern pike 23" and over.

Black River advisories

Previous advisories (last sampled 2002):

Common carp under 23": one meal per month due to PCBs
Common carp 23" and over: one meal per two months due to PCBs
Freshwater drum: one meal per month due to mercury and PCBs.

2014 advisory updates (based on 2012 sampling):

Freshwater drum: does not change.
Channel catfish: added one meal per month advisory due to PCBs.
Common carp: correlation changed from length to location, frequency remains similar (Table 33).

Table 33. Fish consumption advisories for the Black River, 2014.

Reach	Species	One meal per	Contaminant
I-80 to Homewood Park (Lorain) (Lorain Co)	Channel catfish	Month	PCBs
	Freshwater drum	Month	Mercury, PCBs
Homewood Park (Lorain) to Erie St/US Rt 6 (Lorain Co)	Common carp, channel catfish	Month	PCBs
	Freshwater drum	Month	Mercury, PCBs
Erie St/US Rt 6 to mouth (Lake Erie) (Lorain Co)	Common carp	2 months	PCBs
	Channel catfish	Month	PCBs
	Freshwater drum	Month	Mercury, PCBs

East Branch Black River advisories

Previous advisories (last sampled 2002):

Rock bass, smallmouth bass, yellow bullhead: one meal per month due to mercury.

Common carp 23" and over, between Foster Road and State Route 10 (Lorain County): one meal per month due to mercury.

2014 advisory updates (based on 2012 sampling):

Common carp 23" and over: has been extended to entire sampled reach (Richman Road to mouth) (Lorain and Medina counties).

West Branch Black River advisories

Previous advisories (last sampled 2002):

None.

2014 advisory updates (based on 2012 sampling):

Common carp and rock bass: added one meal per month.

Human Health (Fish Consumption) Use Attainment

In addition to determining safe meal frequencies, fish contaminant data are also used to determine attainment with the human health WQS criteria pursuant to OAC Rules 3745-1-33 and 3745-1-34. The human health WQS criteria are presented in water column concentrations of µg/Liter, and are then translated into fish tissue concentrations in mg/kg. [See Ohio's 2010 Integrated Report, Section E (http://www.epa.state.oh.us/portals/35/tmdl/2010IntReport/Section%20E.pdf) for further details of this conversion.]

In order to be considered in attainment of the WQS criteria, the sport fish caught within a HUC-12 in the Lake Erie basin must have a weighted average concentration of the geometric means for all species below 0.35 mg/kg for mercury, and below 0.023 mg/kg for PCBs.

Within the Black River study area, fish tissue data were adequate to determine attainment status for three of the ten HUC-12s. At least 2 samples from species in both trophic levels 3 and 4 are needed. Based on contaminant status in fish tissue, assessment units are assigned category 1 (unimpaired), category 5 (impaired), category 1h or 5h (unimpaired-historical and impaired historical), or category 3 or 3i (no data or insufficient data).

Most of the assessments in place for the Black River basin are based on historic data (greater than 10 years old); in addition, assessments previous to 2010 used larger assessment units (HUC-10s). When the use of smaller assessment units was instituted in 2010, the category of each HUC-10 was assigned to each HUC-12 within that HUC-10. As a result, some HUC-12s may be listed as historically impaired (category 5h) or historically unimpaired (category 1h) based on data that was collected outside of that HUC-12.

The impairment status for the 10 HUC-12 assessment units for the East Branch, West Branch, and Black River mainstem are listed in Table 34.

Table 34. Attainment status for assessment units in the Black River study area.

Assessment Unit (HUC-12)	Assessment Unit Name	Area (acres)	Area (Mi^2)	Previous Category	Current Category	Impairment
041100010301	East Fork of East Branch Black River	9069.22	14.17	5h	5h	
041100010302	Headwaters West Fork East Branch Black River	27783.09	43.41	5h	5h	
041100010303	Coon Creek-East Branch Black River	24515.34	38.31	1h	1h	
041100010401	Town of Litchfield-East Branch Black River	23076.23	36.06	5h	5h	
041100010402	Salt Creek-East Branch Black River	21718.1	33.93	5h	5h	
041100010404	Jackson Ditch-East Branch Black River	21524.91	33.63	5h	5	Mercury: 0.379 mg/kg
041100010502	Upper West Branch Black River	25685.81	40.13	5h	5h	
041100010504	Middle West Branch Black River	16433.91	25.68	5h	5h	
041100010506	Lower West Branch Black River	25076.6	39.18	5h	5	PCBs: 0.040 mg/kg
041100010602	Black River	22646.06	35.38	5	5	PCBs: 0.132 mg/kg

Fish Contaminant Trends

Fish contaminant levels can be used as an indicator of pollution in the water column at levels lower than laboratory reporting limits for water concentrations but high enough to pose a threat to human health from eating fish. Most bioaccumulative contaminant concentrations are decreasing in the environment because of bans on certain types of chemicals like PCBs, and because of stricter permitting limits on dischargers for other chemicals. However, data show that PCBs continue to pose a risk to humans who consume fish, and mercury concentrations have been increasing in some locations because of increases in certain types of industries for which mercury is a byproduct that is released to air and/or surface water.

For this reason, it is useful to compare the results from the survey presented in this report with the results of the previous survey(s) conducted in the study area. Recent data can be compared against historical data to determine whether contaminant concentrations in fish tissue appear to be increasing, decreasing, or staying the same in a water body or watershed.

Average fish tissue concentrations of mercury, arsenic, and total PCBs are given for the three waterbodies in the study area and separated by trophic levels 3 and 4 fish species.

Black River

Mercury concentrations appear generally stable across time, with some slight upward trend. Arsenic in fish tissue has increased but still would not warrant a consumption advisory beyond the statewide "one meal per week" level[4]. PCBs have fluctuated with time, especially in trophic level 3 fish. Current data shows lower levels than in 2002 and do not warrant a consumption advisory beyond the statewide advisory (Table 35). Select fish tissue data from 2012 Black River sampling is shown in Table 36.

[4] For this summary, trophic level average contaminant concentrations are compared to fish consumption advisory thresholds. Note that advisories are not issued according to trophic level averages, but according to species-specific averages.

Table 35. PCBs, mercury, and arsenic concentrations by year and fish trophic level for tissue samples collected from the Black River.

Year	TL 3 Fish				TL 4 Fish			
	PCBs (mg/kg)	Mercury (mg/kg)	Arsenic (mg/kg)	Samples	PCBs (mg/kg)	Mercury (mg/kg)	Arsenic (mg/kg)	Samples
1980	0.164	NA	NA	5	NA	NA	NA	0
1981	1.28	NA	NA	1	NA	NA	NA	0
1982	2.65	NA	NA	3	NA	NA	NA	0
1987	2.76	NA	NA	1	0.103	NA	NA	1
1992	0.313	NA	NA	13	0.054	NA	NA	5
1994	0.43	0.086	NA	11	0.14	0.158	NA	7
2002	0.561	0.084	0.022	18	0.193	0.178	0.028	20
2012	0.161	0.102	0.096	28	0.094	0.193	0.186	12

Table 36. Select fish tissue data from the Black River, 2012. The shading indicates the advisory category that would apply: Green = two meals per week, yellow = one meal per week, orange = one meal per month, red = one meal per two months.

Site	Species	Trophic Level	Arsenic (mg/kg)	Mercury (mg/kg)	Total PCBs (mg/kg)
Black R. @ Spring Valley Golf Course	Bluegill sunfish	3	0.067	0.049	ND
Black R. @ U.S. Rt. 6	Bluegill sunfish	3	0.144	0.045	ND
Black R. upst. Elyria WWTP	Bluegill sunfish	3	0.068	0.043	ND
Black R. @ Fish Shelf	Brown bullhead	3	ND	0.052	0.138
Black R. @ U.S. Rt. 6	Brown bullhead	3	ND	0.071	0.064
Black R. upst. French Creek	Brown bullhead	3	ND	0.057	0.051
Black R. @ Fish Shelf	Channel catfish	3	0.155	0.178	0.951
Black R. @ Spring Valley Golf Course	Channel catfish	3	0.055	0.109	0.216
Black R. @ U.S. Rt. 6	Channel catfish	3	0.101	0.077	0.213
Black R. upst. Elyria WWTP	Channel catfish	3	ND	0.033	0.055
Black R. upst. French Creek	Channel catfish	3	0.099	0.115	0.671
Black R. @ Fish Shelf	Common carp	3	0.162	0.09	0.420
Black R. @ I-90	Common carp	3	0.124	0.09	0.203
Black R. @ St. Rt. 254/North Ridge Rd.	Common carp	3	0.077	0.213	ND
Black R. @ U.S. Rt. 6	Common carp	3	0.263	0.139	1.064
Black R. upst. Elyria WWTP	Common carp	3	0.075	0.117	ND
Black R. upst. French Creek	Common carp	3	0.19	0.095	0.317
Black R. @ Cascade Park	Rock bass	3	0.077	0.193	ND
Black R. @ I-90	Rock bass	3	0.076	0.109	ND
Black R. @ I-90	Rock bass	3	0.071	0.079	ND
Black R. @ Spring Valley Golf Course	Rock bass	3	0.071	0.125	ND
Black R. @ St. Rt. 254/North Ridge Rd.	Rock bass	3	0.067	0.067	ND
Black R. @ U.S. Rt. 6	Rock bass	3	0.177	0.161	ND
Black R. upst. Elyria WWTP	Rock bass	3	0.072	0.051	ND
Black R. upst. French Creek	Rock bass	3	0.18	0.189	ND
Black R. @ Fish Shelf	Smallmouth buffalo	3	0.094	0.04	0.157
Black R. @ Spring Valley Golf Course	White crappie	3	0.086	0.086	ND
Black R. upst. Elyria WWTP	Yellow bullhead	3	ND	0.192	ND
Black R. @ U.S. Rt. 6	Freshwater drum	4	0.431	0.161	0.307

Site	Species	Trophic Level	Arsenic (mg/kg)	Mercury (mg/kg)	Total PCBs (mg/kg)
Black R. upst. French Creek	Freshwater drum	4	0.457	0.214	0.457
Black R. @ Cascade Park	Largemouth bass	4	0.129	0.243	0.050
Black R. @ Fish Shelf	Largemouth bass	4	0.148	0.13	0.051
Black R. @ U.S. Rt. 6	Largemouth bass	4	0.212	0.199	ND
Black R. @ Cascade Park	Smallmouth bass	4	0.121	0.191	ND
Black R. @ Cascade Park	Smallmouth bass	4	0.142	0.339	ND
Black R. @ I-90	Smallmouth bass	4	0.112	0.105	ND
Black R. @ Spring Valley Golf Course	Smallmouth bass	4	0.116	0.127	ND
Black R. @ St. Rt. 254/North Ridge Rd.	Smallmouth bass	4	0.12	0.163	0.065
Black R. upst. Elyria WWTP	Smallmouth bass	4	0.097	0.151	ND
Black R. @ U.S. Rt. 6	White bass	4	0.142	0.291	0.198

East Branch Black River

Mercury concentrations have risen slightly in trophic level 4 fish, although the sample size for 2002 was very small, so comparisons are difficult. Arsenic concentrations are higher but still low. Mercury levels are at the "one meal per month" level for both trophic levels. PCB concentrations have historically been non-detectable in most fish from the East Branch, and this remained the case in 2012 (Table 37). Select fish tissue data from 2012 East Branch Black River sampling is shown in Table 38.

Table 37. PCBs, mercury, and arsenic concentrations by year and fish trophic level for tissue samples collected from the East Branch Black River.

Year	Trophic Level 3				Trophic Level 4			
	PCBs (mg/kg)	Mercury (mg/kg)	Arsenic (mg/kg)	Samples	PCBs (mg/kg)	Mercury (mg/kg)	Arsenic (mg/kg)	Samples
1921	0.91	NA	NA	2	0.84	NA	NA	1
1992	0.045	NA	NA	6	ND	NA	NA	2
2000	ND	0.198	<.04	19	ND	0.343	<.04	7
2002	0.019	0.218	<.04	3	ND	0.407	<.04	1
2012	ND	0.221	0.051	17	ND	0.498	0.102	7

Table 38. Select fish tissue data from the East Branch Black River, 2012. The shading indicates the advisory category that would apply: Green = two meals per week, yellow = one meal per week, orange = one meal per month.

Site	Species	Trophic Level	Arsenic (mg/kg)	Mercury (mg/kg)	Total PCBs (mg/kg)
E. Br. Black R. @ E. Bridge St.	Bluegill sunfish	3	0.052	**0.09**	ND
E. Br. Black R. @ Jones Rd.	Bluegill sunfish	3	0.074	**0.068**	ND
E. Br. Black R. @ E. Bridge St.	Common carp	3	0.091	**0.233**	ND
E. Br. Black R. @ Fuller Rd.	Common carp	3	0.095	**0.232**	ND
E. Br. Black R. @ Jones Rd.	Common carp	3	ND	**0.124**	ND
E. Br. Black R. @ Parsons Rd.	Common carp	3	0.123	**0.27**	ND
E. Br. Black R. @ E. Bridge St.	Pumpkinseed sunfish	3	0.061	**0.124**	ND
E. Br. Black R. @ E. Bridge St.	Rock bass	3	ND	**0.317**	ND
E. Br. Black R. @ Fuller Rd.	Rock bass	3	0.056	**0.135**	ND

Site	Species	Trophic Level	Arsenic (mg/kg)	Mercury (mg/kg)	Total PCBs (mg/kg)
E. Br. Black R. @ Fuller Rd.	Rock bass	3	ND	**0.287**	ND
E. Br. Black R. @ Parsons Rd.	Rock bass	3	ND	**0.371**	ND
E. Br. Black R. @ Short Rd.	Rock bass	3	0.058	**0.191**	ND
E. Br. Black R. @ Vermont Ave.	Rock bass	3	0.062	**0.315**	ND
E. Br. Black R. @ E. Bridge St.	Yellow bullhead	3	ND	**0.404**	ND
E. Br. Black R. @ Jones Rd.	Yellow bullhead	3	ND	**0.255**	ND
E. Br. Black R. @ Parsons Rd.	Yellow bullhead	3	ND	**0.136**	ND
E. Br. Black R. @ Short Rd.	Yellow bullhead	3	ND	**0.209**	ND
E. Br. Black R. @ E. Bridge St.	Smallmouth bass	4	0.086	**0.391**	ND
E. Br. Black R. @ E. Bridge St.	Smallmouth bass	4	0.088	**0.507**	ND
E. Br. Black R. @ Fuller Rd.	Smallmouth bass	4	0.082	**0.542**	ND
E. Br. Black R. @ Jones Rd.	Smallmouth bass	4	0.086	**0.461**	ND
E. Br. Black R. @ Parsons Rd.	Smallmouth bass	4	0.117	**0.312**	ND
E. Br. Black R. @ Short Rd.	Smallmouth bass	4	0.12	**0.547**	ND
E. Br. Black R. @ Vermont Ave.	Smallmouth bass	4	0.133	**0.724**	ND

West Branch Black River

Mercury and arsenic concentrations have fluctuated slightly since 2002, although the trophic level 4 sample sizes have been very small, limiting the ability to make direct comparisons. As with the East Branch, PCB concentrations in the West Branch were non-detectable in 2012 (Table 39). Select fish tissue data from 2012 West Branch Black River sampling is shown in Table 40.

Table 39. PCB, mercury, and arsenic concentrations by year and fish trophic level for tissue samples collected from the West Branch Black River.

Year	Trophic Level 3				Trophic Level 4			
	PCBs (mg/kg)	Mercury (mg/kg)	Arsenic (mg/kg)	Samples	PCBs (mg/kg)	Mercury (mg/kg)	Arsenic (mg/kg)	Samples
1992	0.082	NA	NA	4	ND	NA	NA	1
2000	0.02	0.283	<.04	11	0.054	0.449	<.04	2
2002	0.023	0.151	<.04	3	ND	0.198	<.04	2
2012	ND	0.213	0.046	14	ND	0.166	0.058	1

Table 40. Select fish tissue data from the West Branch Black River, 2012. The shading indicates the advisory category that would apply: Green = two meals per week, yellow = one meal per week, orange = one meal per month.

Site	Species	Trophic Level	Arsenic (mg/kg)	Mercury (mg/kg)	Total PCBs (mg/kg)
W. Br. Black R. @ St. Rt. 511	Common carp	3	0.048	**0.351**	ND
W. Br. Black R. @ St. Rt. 58	Common carp	3	0.062	**0.131**	ND
W. Br. Black R. @ Carisle Metropark	Common carp	3	0.122	**0.137**	ND
W. Br. Black R. @ St. Rt. 511	Green sunfish	3	ND	**0.176**	ND
W. Br. Black R. @ Pitts Rd.	Rock bass	3	ND	**0.285**	ND

Site	Species	Trophic Level	Arsenic (mg/kg)	Mercury (mg/kg)	Total PCBs (mg/kg)
W. Br. Black R. @ St. Rt. 58	Rock bass	3	ND	**0.103**	ND
W. Br. Black R. @ Butternut Ridge Rd.	Rock bass	3	0.079	**0.136**	ND
W. Br. Black R. @ Butternut Ridge Rd.	Rock bass	3	0.075	**0.376**	ND
W. Br. Black R. @ Carisle Metropark	Rock bass	3	0.06	**0.403**	ND
W. Br. Black R. @ St. Rt. 58	White crappie	3	ND	**0.14**	ND
W. Br. Black R. @ Pitts Rd.	Yellow bullhead	3	ND	**0.305**	ND
W. Br. Black R. @ St. Rt. 511	Yellow bullhead	3	ND	**0.15**	ND
W. Br. Black R. @ St. Rt. 58	Yellow bullhead	3	ND	**0.148**	ND
W. Br. Black R. @ Carisle Metropark	Yellow bullhead	3	ND	**0.145**	ND
W. Br. Black R. @ Carisle Metropark	Largemouth bass	4	0.058	**0.166**	ND

LAKE SAMPLING

Findley Lake and the Wellington Upground Reservoir were sampled in 2012 and 2013 as part of the Black River watershed survey. Findley Lake is designated Exceptional Warmwater Habitat (EWH) and Primary Contact Recreation (PCR) while Wellington Upground Reservoir is designated Warmwater Habitat (WWH), Primary Contact Recreation (PCR) and Public Water Supply (PWS).

Findley Lake (Figure 27) was constructed by the Ohio Division of Parks. Its impoundment is formed by a dam at River Mile 14.88 on Wellington Creek with an upstream drainage area of 6.31 square miles. The earthen dam was built during 1954 and 1955, with the gates closed in April 1956. Findley Lake holds 93 acres of water. The north end of the lake is fairly deep, with depths measured to 21 feet. The southern end of the lake is relatively shallow with depths measuring generally less than six feet. The ODNR Division of State Parks operates and maintains launch ramps, hiking trails, a disc golf course, a swimming beach, and picnic areas. Boating with electric motors only is permitted on the 93-acre lake. Two launch ramps provide access to the lake. Canoes, rowboats, and 2-person kayaks can be rented at the marina. The dominant land use in the Findley Creek HUC-12 (04110001 05 03) is row crops (48%).

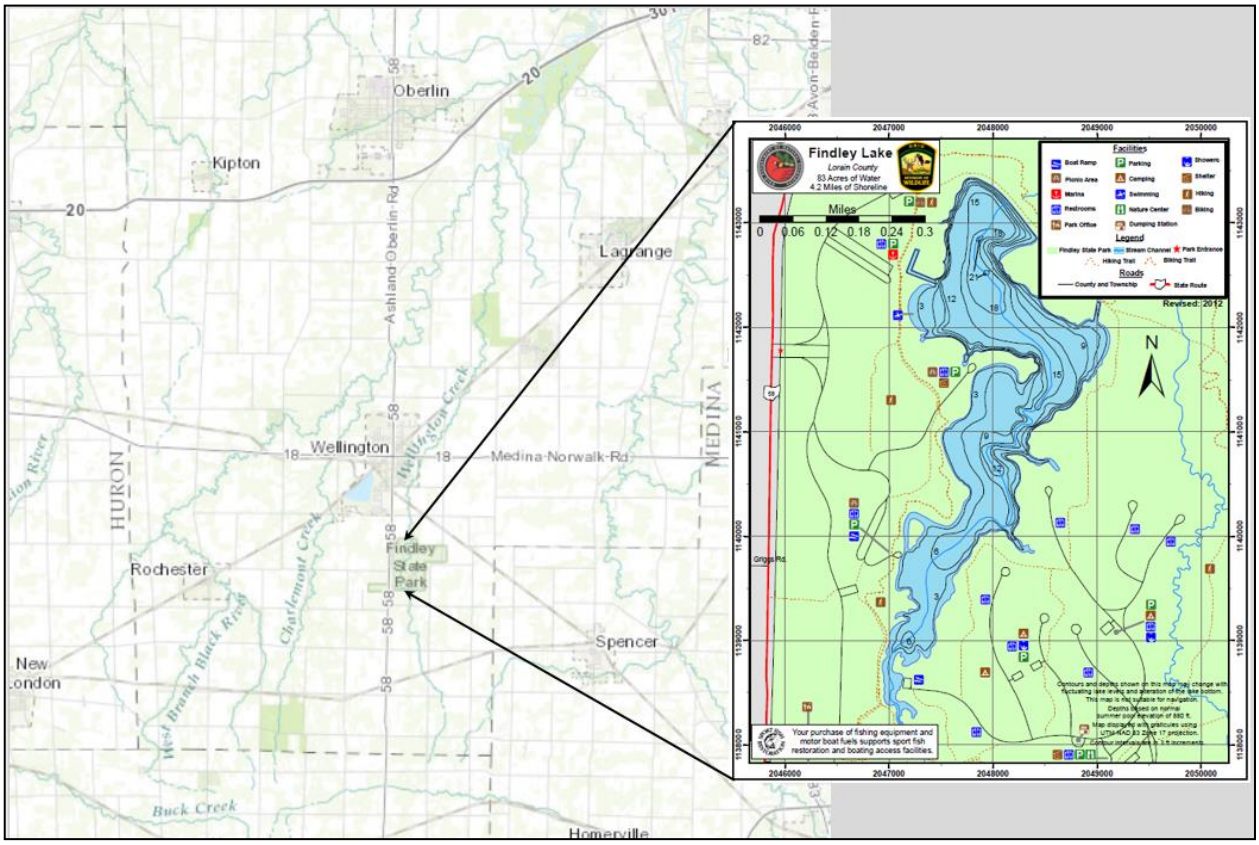


Figure 27. Findley Lake.

Wellington Upground Reservoir (Figure 28) is located in Lorain County. The upground reservoir is supplied with water from the West Branch Charlemont Creek, a tributary to the West Branch Black River, with an upstream drainage area of 10.36 square miles. The watershed is fed by runoff from the southwest part of Lorain County and parts of Ashland and Huron counties. Water is pumped from the stream during the winter months (typically January to March) to the 1.5 billion gallon reservoir. The Water Treatment Plant was placed in service in 1996, and includes chemical coagulation, flocculation, disinfection with chlorine,

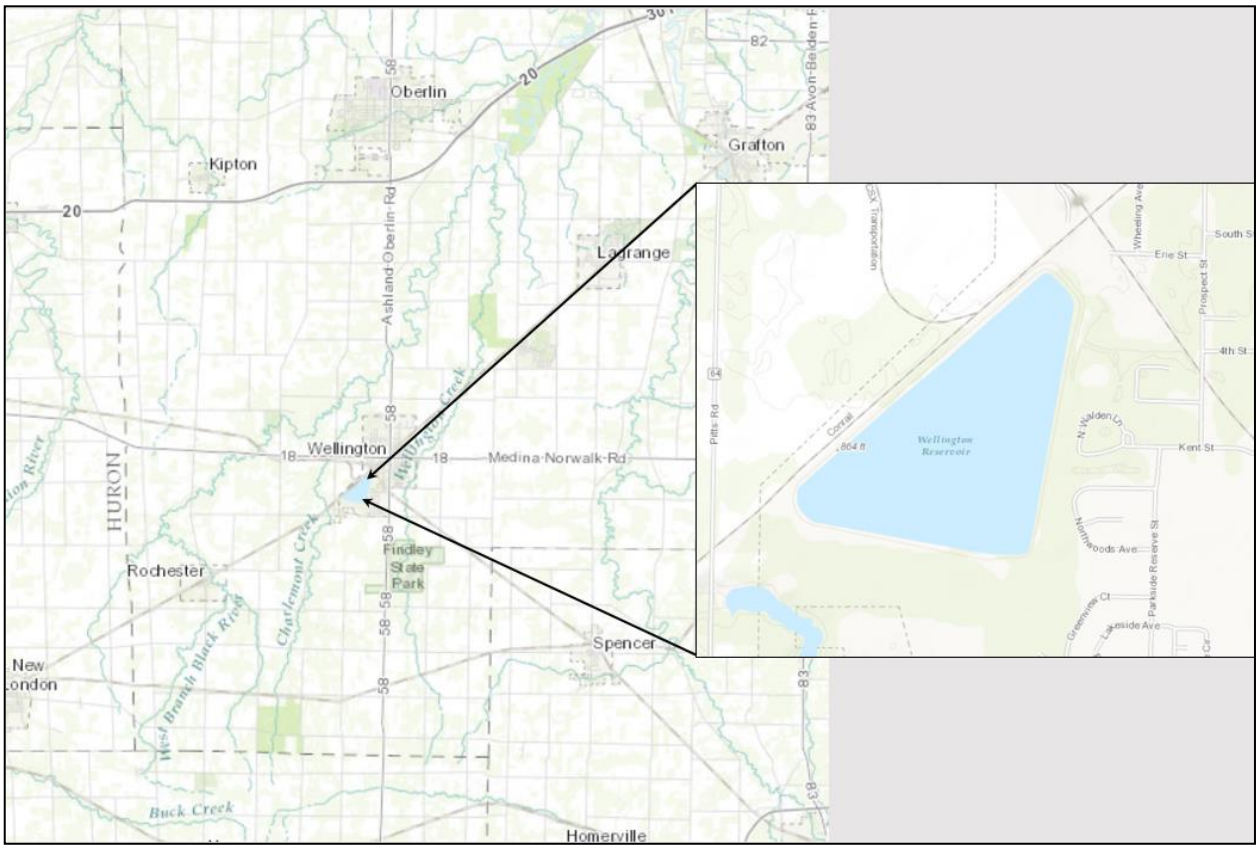


Figure 28. Wellington Upground Reservoir.

fluoridation, pH adjustment, and multiple phase filtration, including activated carbon filters. Public swimming is prohibited in the reservoir as is the personal use of gasoline powered boat engines.

The reservoir is 160 acres in size and approximately 35 feet deep at its deepest point. The dominant land use in the Charlemont Creek HUC-12 (04110001 05 01) is row crops (43%).

Inland Lakes Monitoring

Ohio EPA has implemented a sampling strategy that focuses on evaluating chemical conditions near the surface and physical conditions in the water column of inland lakes. Physical profile measurements are summarized either for the entire water column or the epilimnion, depending on thermal stratification. The sampling target consists of an even distribution of a total of ten sampling events divided over a two-year period and collected during the index period of May 1 – September 30. Key parameters used to determine the aquatic life use attainment status of lakes include chlorophyll-*a*, ammonia, dissolved oxygen, pH, total dissolved solids and various metals. Other parameters used to evaluate the degree of support or non-support include secchi depth, total phosphorus and total nitrogen. Details of the sampling protocol are outlined in Appendix 1 of the Ohio EPA Surface Water Field Sampling Manual, available on Ohio EPA's web page at http://epa.ohio.gov/Portals/35/documents/Inland_Lake_Sampling_Manual.pdf .

Water Quality Standards for the Protection of Aquatic Life and Primary Contact Recreation in Lakes

Presently, lakes in Ohio are designated as Exceptional Warmwater Habitat (EWH) with respect to the aquatic life use designation. The numeric chemical criteria to protect the proposed Lake Habitat use will remain the same as the criteria to protect the EWH use that currently applies to lakes, with a suite of

nutrient criteria added. A set of numeric criteria that applies to all surface waters for the protection of aquatic life, regardless of specific use designation, also apply to inland lakes and are referred to as "base aquatic life use criteria" in the proposed WQS rules. The base aquatic life use criteria will be the same aquatic life numeric criteria that currently apply to lakes. Examples include various metals such as copper, lead, and cadmium, as well as organic chemicals such as benzene and phenol. *Escherichia coli* (*E. coli*) bacteria counts (colony forming units [cfu] per 100 ml) are measured to determine compliance with the Primary Contact Recreation criteria in the Ohio Water Quality Standards.

Tables 41 and 42 include the status of key parameters for Findley Lake and Wellington Reservoir, respectively, which have been proposed to determine the aquatic life and recreation status of the two inland lakes. Of the two lakes, Wellington Reservoir fared best on the parameters proposed to determine aquatic life use status. All parameters generally met expectations with the exception of total phosphorus, which would place the lake in the watch list category for that parameter. Conversely, two parameters measured in Findley Lake exceeded target expectations (chlorophyll-*a* concentration and pH) which would indicate aquatic life use impairment, while three others would be considered in watch list status.

Recreation use assessments at both lakes were similar. Findley Lake was sampled for *E. coli* bacteria to assess the Bathing Water beneficial use at the swimming beach; nine samples over the two years had a geometric mean of 5.1 cfu/100 ml with a maximum value of 14 cfu/100 ml. Both values were well below Ohio Water Quality Standards criteria. Wellington Upground Reservoir was sampled for *E. coli* bacteria to assess the Primary Contact Recreation use at the boat docks. Nine samples collected over the two years had a geometric mean of 2.4 cfu/100 ml with a maximum value of 10 cfu/100 ml. Both these values were also well below Ohio Water Quality Standards criteria.

Table 41. Assessment of lake data collected from Findley Lake in 2012 and 2013. Light green highlighted cells are results reported below the reporting limit; the number reported in column is ½ of the reporting limit. Green highlighted cells indicate that the sampling station would meet the proposed Lake Habitat use designation while red highlighted cells do not. Yellow highlighted cells are considered to be on a watch list for possible impairment.

	Findley Lake (L1 Surface)							Recreation Use
Sample Date	Secchi depth (m)	Chlorophyll a (µg/l)	Total Nitrogen (mg/l)	Total Phosphorus (mg/l) RL 0.01	Dissolved Oxygen (mg/l)	pH (S.U.)	NH3 (mg/l) RL 0.05	*E. coli (CFU/100 ml) RL 1.0*
5/02/2012	0.77	21	0.880	0.028	10.86	8.34	0.025	10
6/25/2012	0.77	32.5	1.060	0.078	8.46	8.73	0.025	3
7/24/2012	0.54	81.4	1.300	0.082	10.21	9.12	0.025	5
8/29/2012	0.58	88.7	7.230	0.067	8.16	8.94	0.025	4
10/09/2012	0.75	65	1.470	0.064	7.17	7.93	0.145	12
5/23/2013	0.79	42.5	3.050	0.036	8.85	8.6	0.025	3
6/25/2013	-	36.9	2.320	0.029			0.025	-
7/16/2013	0.69	44.2	4.180	0.062	12.57	9.1	0.025	14
7/18/2013	-	31	3.050	0.252			0.025	-
8/26/2013	0.86	23.2	4.980	0.032	9.06	8.65	0.025	4
8/28/2013	-	35.9	2.690	0.067			0.025	-
9/05/2013	0.75	31.5	1.760	0.018	8	8.14	0.025	2
9/17/2013	-	52	3.750	0.052			0.058	-
	100% not meeting	Median 36.9	Median 2.69	69% not meeting	100% meeting	22% not meeting	100% meeting	Geometric Mean 5.1
	Findley Lake (L2 Surface)							Recreation Use
5/23/2013	-	27.3	1.84	0.027			0.025	-
6/25/2013	-	54.1	1.05	0.042			0.050	-
7/10/2013	-	68.4	1.35	0.077			0.025	-
7/18/2013	-	44.3	1.08	0.058			0.025	-
8/28/2013	-	52	0.95	0.034			0.025	-
9/17/2013	-	67.1	1.05	0.042			0.025	-
		Median 53.0	Median 1.065	83% not meeting			100% meeting	
	Findley Lake (L3 Surface)							Recreation Use
Sample Date	Secchi depth (m)	Chlorophyll a (µg/l)	Total Nitrogen (mg/l)	Total Phosphorus (mg/l) RL 0.01	Dissolved Oxygen (mg/l)	pH (S.U.)	NH3 (mg/l) RL 0.05	*E. coli (CFU/100 ml) RL 1.0*
5/23/2013	-	34.9	1.7	0.02			0.025	-
6/25/2013	-	37.1	1.11	0.049			0.088	-
7/18/2013	-	50.5	0.83	0.051			0.192	-
8/28/2013	-	33.2	0.98	0.042			0.025	-
9/17/2013	-	47.7	1.2	0.043			0.025	-
9/17/2013	-	48	1.26	0.04			0.025	-
		Median 42.4	Median 1.155	83% not meeting			100% meeting	
Lake Habitat Criteria	**1.19 (min)**	**14 (median)**	**0.74 (median)**	**0.034**	**5 Min. / 6 Ave.**	**6.5 - 9.0**	**Calc. Criterion**	**126**

Table 42. Assessment of lake data collected from Wellington Upground Reservoir in 2012 and 2013. Light green highlighted cells are results reported below the reporting limit; the number reported in column is ½ of the reporting limit. Green highlighted cells indicate that the sampling station would meet the proposed Lake Habitat use designation while red highlighted cells do not. Yellow highlighted cells are considered to be on a watch list for possible impairment.

	Wellington Upground Reservoir (Surface)							Recreation Use
Sample Date	Secchi depth (m)	Chlorophyll-*a* (µg/l)	Total Nitrogen (mg/l)	Total Phosphorus (µg/l) RL 0.01	Dissolved Oxygen (mg/l)	pH (S.U.)	NH3 (mg/l) RL 0.05	*E. coli (CFU/100mL) RL 1.0*
5/02/2012	4.45	3.8	0.74	0.012	10.59	8.36	0.03	2 (RL 4)
6/27/2012	5.47	2.1	0.7	0.01	9.23	8.71	0.03	1
7/12/2012	7.41	1.3	0.59	0.01	8.31	8.7	0.03	
8/08/2012	5.42	2	0.44	0.01	8.82	8.82	0.03	2
9/11/2012	4.67	3.2	10.44	0.16	7.97	8.77	0.03	10
5/28/2013	2.48	3.9	1.72	0.013	8.82	8.56	0.082	5
6/12/2013	6.8	1.1	1.55	0.01	7.98	8.24	0.09	1
7/16/2013	4.46	3.8	1.32	0.01	8.84	8.7	0.03	6
8/26/2013	6.35	2.2	0.85	0.01	9.02	8.72	0.03	1
9/05/2013	5.86	2.6	0.97	0.023	8.55	8.7	0.03	0
	10% not meeting	Median 2.4	Median 0.91	20% not meeting	0% not meeting	0% not meeting	0% not meeting	Geometric Mean 2.4
Lake Habitat Criteria	**2.6 (min)**	**6 (median)**	**1.225 (median)**	**0.018**	**5 Min. / 6 Ave.**	**6.5 - 9.0**	**Calc. Criterion**	**126**

PUBLIC DRINKING WATER SUPPLIES

The Public Water Supply (PWS) beneficial use in the Ohio WQS (OAC 3745-1-33) currently applies within 500 yards of drinking water intakes and for all publicly owned lakes. Ohio EPA has developed an assessment methodology for this beneficial use which focuses on source water contaminants not effectively removed through conventional treatment methods. The methodology for assessing the PWS beneficial use was first presented in the 2006 Integrated Water Quality Monitoring and Assessment Report (IR). Updates to the methodology were included in subsequent IRs. For more detail on how the method was first developed and rationale for indicator selection and exclusion, please refer to the initial methodology at
http://www.epa.ohio.gov/portals/35/tmdl/2006IntReport/IR06_app_C_PDWSmethodology.pdf .

Impaired source waters may contribute to increased human health risk or treatment costs. For the case when stream water is pumped to a reservoir, the stream and reservoir will be evaluated separately. These assessments are designed to determine if the quality of source water meets the standards and criteria of the Clean Water Act. Monitoring of the safety and quality of treated finished drinking water is regulated under the Safe Drinking Water Act and evaluated separately from this assessment. For those cases when the treatment plant processes do not specifically remove a source water contaminant, the finished water quality data may be considered representative of the raw source water directly feeding into the treatment plant. There are two public water systems (the villages of Oberlin and Wellington) directly served by surface water sources within the study area. Table 43 provides a summary of exceedances for the PWS use while Appendix Table 14 contains all of the water quality analytical results.

Village of Oberlin

The village of Oberlin operates a community public water system that serves a population of approximately 8,200 people through almost 2,600 service connections. The village of Oberlin has intakes on the West Branch Black River and on the Parsons Road Reservoir, a 386-million-gallon reservoir located east of the Village. The system's treatment capacity is approximately 2.25 million gallons per day, but current average production is 750,000 gallons per day. Oberlin's treatment processes include rapid sand filtration, coagulation, and sedimentation (for particulate removal); gaseous chlorination and UV radiation (for disinfection); lime-soda ash and recarbonation (for softening); permanganate and powdered activated carbon (for taste and odor control); hexametaphosphate (for corrosion control); and fluoridation.

To assess the PWS beneficial use, samples were analyzed for nitrate and pesticides. Ohio EPA collected a total of eleven water quality samples to be tested for nitrate and nine water quality samples to be tested for atrazine on the West Branch Black River near Oberlin's public water supply intake during 2012 and 2013. Nitrate ranged from 0.23 mg/L to 8.28 mg/L and averaged 2.41 mg/L. All results were below the WQS drinking water criterion for nitrate (10.0 mg/L). Atrazine ranged from below detection limits (BDL) to 9.11 ug/L. Atrazine samples were only collected during the summer quarter of 2012 and the spring quarter of 2013, so an annual quarterly average could not be determined.

Village of Wellington

The village of Wellington operates a community public water system that serves a population of approximately 4,700 people through 1,782 service connections. Wellington has intakes on Charlemont Creek (a tributary to the West Branch Black River) and on the Village Reservoir, a 1.3-billion-gallon reservoir located southwest of the Village. The system's treatment capacity is approximately 1.15 million gallons per day, but current average production is 504,000 gallons per day. Wellington's treatment processes include rapid sand filtration, coagulation, and sedimentation (for particulate removal); gaseous chlorination (for disinfection); granular activated carbon (for organics removal); and fluoridation.

To assess the PWS beneficial use, samples were analyzed for nitrate and pesticides. Ohio EPA collected a total of eleven water quality samples to be tested for nitrate and ten water quality samples to be tested for atrazine in Charlemont Creek near Wellington's public water supply intake during 2012 and 2013. Nitrate ranged from BDL to 5.57 mg/L and averaged 1.19 mg/L. All results were below the WQS drinking water criterion for nitrate (10.0 mg/L). Atrazine ranged from BDL to 14.7 ug/L. Because one atrazine result was more than four times the WQS drinking water criterion, Charlemont Creek at the Wellington WTP intake will be on the watch list for atrazine. Atrazine samples were only collected during the summer quarter of 2012 and the spring quarter of 2013, so an annual quarterly average could not be determined.

Starting in 2014, a new core indicator, based on algae and associated cyanotoxins, was initiated for PWS assessments. Wellington's village reservoir was sampled for evidence of harmful algal blooms in 2012 and 2013. Four samples (two each year) were collected and analyzed for microcystin. All results were below detection.

Table 43. Summary of available water quality data for parameters of interest at sampling sites near/at PWS intakes in the Black River basin, 2012-2013.

Location(s)	PWS Parameters of Interest					
	Nitrate-Nitrite Criterion = 10 mg/L[1]		Atrazine Criterion = 3.0 ug/L[2]			
	Average (sample count)	Maximum (# samples >WQC)	Average (sample count)	Quarterly Average (2012)[3]	Quarterly Average (2013)[3]	Maximum Single Detect.
W. Branch of the Black River @ Oberlin WTP Intake	2.41 mg/L n=11	8.28 mg/L (0)	2.39 ug/L (9)	Insufficient data	Insufficient data	9.11 ug/L
Charlemont Creek @ Wellington WTP Intake	1.19 mg/L n=11	5.57 mg/L (0)	2.18 ug/L (10)	Insufficient data	Insufficient data	**14.7 ug/L**

1 - Nitrate WQS drinking water criterion evaluated as maximum value not to be exceeded, impaired waters defined as having two or more excursions about the criterion. Bold indicates addition to the watch list for nitrate.

2 - Atrazine WQS drinking water criterion evaluated as annual average of the quarterly averages. Bold indicates addition to the watch list for atrazine.

3 - Atrazine data was only collected for only the summer quarter in 2012 and only the spring quarter in 2013. No annual quarterly average for atrazine could be calculated.

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