Biological and Water Quality Study of the Sandy Creek Watershed, 2010

Carroll, Columbiana, Stark and Tuscarawas Counties

OHIO EPA Technical Report EAS/2013-01-01

Division of Surface Water
May 17, 2013

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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

State of Ohio Environmental Protection Agency
Ecological Assessment Section
4675 Homer Ohio Lane
Groveport, Ohio 43125

State of Ohio Environmental Protection Agency
Northeast District Office
2110 East Aurora Road
Twinsburg, Ohio 44087

Mail to:
P.O. Box 1049
Columbus, Ohio 43216-1049

John R. Kasich, Governor
State of Ohio

Scott J. Nally, Director
Ohio Environmental Protection Agency

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Supporting information and data appendices available in a separate document at http://www.epa.ohio.gov/dsw/document_index/psdindx.aspx .

EXECUTIVE SUMMARY

Rivers and streams in Ohio support a variety of uses such as recreation, water supply, and aquatic life. Ohio EPA evaluates each stream to determine the appropriate use designation and to also determine if the use is meeting the goals of the federal Clean Water Act. In 2010, 48 streams sites in the Sandy Creek watershed, located in Columbiana, Stark, Carroll and Tuscarawas counties, were evaluated for aquatic life and recreation use potential. (See Figure 2 and Table 1 for sampling locations).

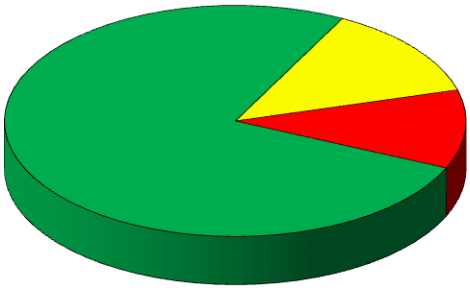


Figure 1. Sandy Creek basin aquatic life use attainment status at 45 sampling locations, 2010. Green- Full / Yellow- Partial / Red- Non

Of the 45 biological stations that were assessed, 34 sites (76%) were fully meeting the designated or recommended aquatic life use, 6 (13%) were in partial attainment and 5 (11%) were in non-attainment (Figure 1). Channelization, agriculture and coal mining activities in addition to impoundments from low-head dams contributed to the partial and non-attainment of several streams. Table 2 includes biological assessment scores and causes/sources of impairments.

A summary of *E. coli* data for 18 locations sampled in the Sandy Creek watershed was based on comparing the geometric mean to the Primary Contact Recreation (PCR) Classes A or B. Evaluation of *E. coli* results revealed that all locations exceeded the applicable geometric mean and, thus, were in non-attainment of the designated recreation use. Sources of bacteria causing impairment of the designated recreation use include discharges from failing septic systems and unsewered communities throughout the watershed.

Table 1. Sandy Creek watershed sampling locations, 2010. The color of the site number corresponds to the narrative biological score. Blue is exceptional to very good (meets EWH goals). Green is good to marginally good (meets WWH goals). Yellow is fair, orange is poor and red is very poor (fair, poor and very poor do not meet the goals of WWH). White denotes that no biological scores were obtained. The Site No. corresponds to the site location in Figure 2.

Site No.	Stream Name and Sampling Location	River Mile	Latitude	Longitude
1	SANDY CREEK DST. KENSINGTON @ U.S. RT. 30	39.73	40.7351460	-80.9577300
2	SANDY CREEK @ LIPPINCOTT RD.	36.91	40.7413920	-81.0066470
3	SANDY CREEK AT EAST ROCHESTER @ WEST TOWNSHIP PARK	34.70	40.7494000	-81.0450000
4	SANDY CREEK @ STUMP RD.	32.06	40.7444330	-81.0815610
5	SANDY CREEK AT MINERVA UPST. U.S. RT. 30/ST. RT. 183	30.50	40.7333000	-81.0992000
6	SANDY CREEK UPST. MINERVA WWTP, UPST. STILL FORK	29.20	40.7178000	-81.1072000
7	SANDY CREEK DST. MINERVA WWTP	28.90	40.7167000	-81.1097000
8	SANDY CREEK DST. MINERVA WWTP @ SUMMITVILLE TILE	28.20	40.7128000	-81.1189000
9	SANDY CREEK AT ONEIDA @ BLADE RD.	25.13	40.6997000	-81.1506000
10	SANDY CREEK AT MALVERN, JUST UPST. PIPE RUN	22.40	40.6872000	-81.1864000
11	SANDY CREEK @ CITRUS RD.	22.05	40.6855000	-81.1920000
12	SANDY CREEK @ GREER RD.	18.20	40.6717000	-81.2466000
13	SANDY CREEK AT WAYNESBURG @ ST. RT. 183	17.34	40.6725000	-81.2600000
14	SANDY CREEK AT MAGNOLIA @ ST. RT. 183	13.90	40.6506000	-81.3025000
15	SANDY CREEK DST. NIMISHILLEN CREEK @ CO. RD. 104	7.49	40.6339000	-81.3731000
16	SANDY CREEK E OF BOLIVAR, JUST DST. BOLIVAR DAM	0.57	40.6511000	-81.4342000
17	PLEASANT VALLEY RUN SE OF NORTH INDUSTRY @ GREENPORT RD.	5.35	40.7179400	-81.3041100
18	PLEASANT VALLEY RUN N OF MAGNOLIA @ GROVEDELL RD.	0.89	40.6738700	-81.2947600
19	BEAR RUN 2 MI. E OF BOLIVAR @ MOUTH	0.01	40.6625000	-81.4108000
20	LIMESTONE CREEK @ DOWNING ST.	3.68	40.6776000	-81.3798000
21	LIMESTONE CREEK @ DUEBER RD.	0.10	40.6553000	-81.4057000
22	INDIAN RUN @ ST. RT. 43	2.20	40.6983000	-81.2707000
23	L. SANDY CREEK @ HILL CHURCH ST.	5.82	40.7234000	-81.2505000
24	L. SANDY CREEK N OF WAYNESBURG, UPST. CHAPEL ST.	3.60	40.7095420	-81.2417750
25	L. SANDY CREEK N OF WAYNESBURG @ ELSON ST.	1.73	40.6897000	-81.2511000
26	BLACK RUN @ STUCKY ROBERTSVILLE RD.	4.81	40.7809410	-81.1775420
27	BLACK RUN AT MAPLETON @ LOTZ AVE.	0.10	40.7456000	-81.2408000
28	ARMSTRONG RUN @ ST. RT. 43	0.63	40.6906000	-81.1928000
29	PIPE RUN @ ARROW RD.	6.28	40.6414000	-81.1136000
30	PIPE RUN AT LEYDA @ BELLFLOWER RD.	3.95	40.6704000	-81.1352000
31	PIPE RUN E OF MALVERN @ ST. RT. 43	2.20	40.6838440	-81.1480940
32	HUGLE RUN @ ST. RT. 172	7.14	40.7934000	-81.1261000
33	HUGLE RUN E OF ROBERTSVILLE @ BAIRD RD.	4.11	40.7547000	-81.1447000
34	HUGLE RUN N OF ONEIDA @ LIBERTY CHURCH RD.	1.30	40.7250000	-81.1497000
35	MIDDLE BRANCH SANDY CREEK @ ST. RT. 172	3.72	40.7967920	-81.0698060
36	MIDDLE BRANCH SANDY CREEK @ KURTZ RD	0.10	40.7515720	-81.0693750
37	CONSER RUN @ SPEIDEL RD.	4.71	40.7776290	-80.9740990
38	CONSER RUN N OF EAST ROCHESTER @ KNOX SCHOOL RD.	1.08	40.7575000	-81.0303000
39	STILL FORK @ MARK RD	12.80	40.6339690	-80.9858170
40	STILL FORK SANDY CREEK NEAR PATTERSONVILLE @ BELLFLOWER RD.	7.08	40.6800000	-81.0533000

Site No.	Stream Name and Sampling Location	River Mile	Latitude	Longitude
41	STILL FORK SANDY CREEK S OF MINERVA @ ARROW RD. (IMPOUNDED)	0.50	40.7131000	-81.1017000
42	STILL FORK SANDY CREEK S OF MINERVA @ MOUTH	0.01	40.7164000	-81.1086000
43	MUDDY FORK @ REEF RD.	5.12	40.7057370	-81.0031860
44	MUDDY FORK @ AUGUSTA RD.	3.95	40.6997490	-81.0219750
45	MUDDY FORK SE OF MINERVA @ BELLFLOWER RD.	2.70	40.7028000	-81.0436000
46	REEDS RUN @ ST. RT. 9	0.73	40.6718780	-81.0319830
47	PIPES FORK @ RUSH RD.	0.43	40.6464000	-81.0276000
48	FRIDAY CREEK @ CHANNEL RD.	0.64	40.6264890	-81.0031830

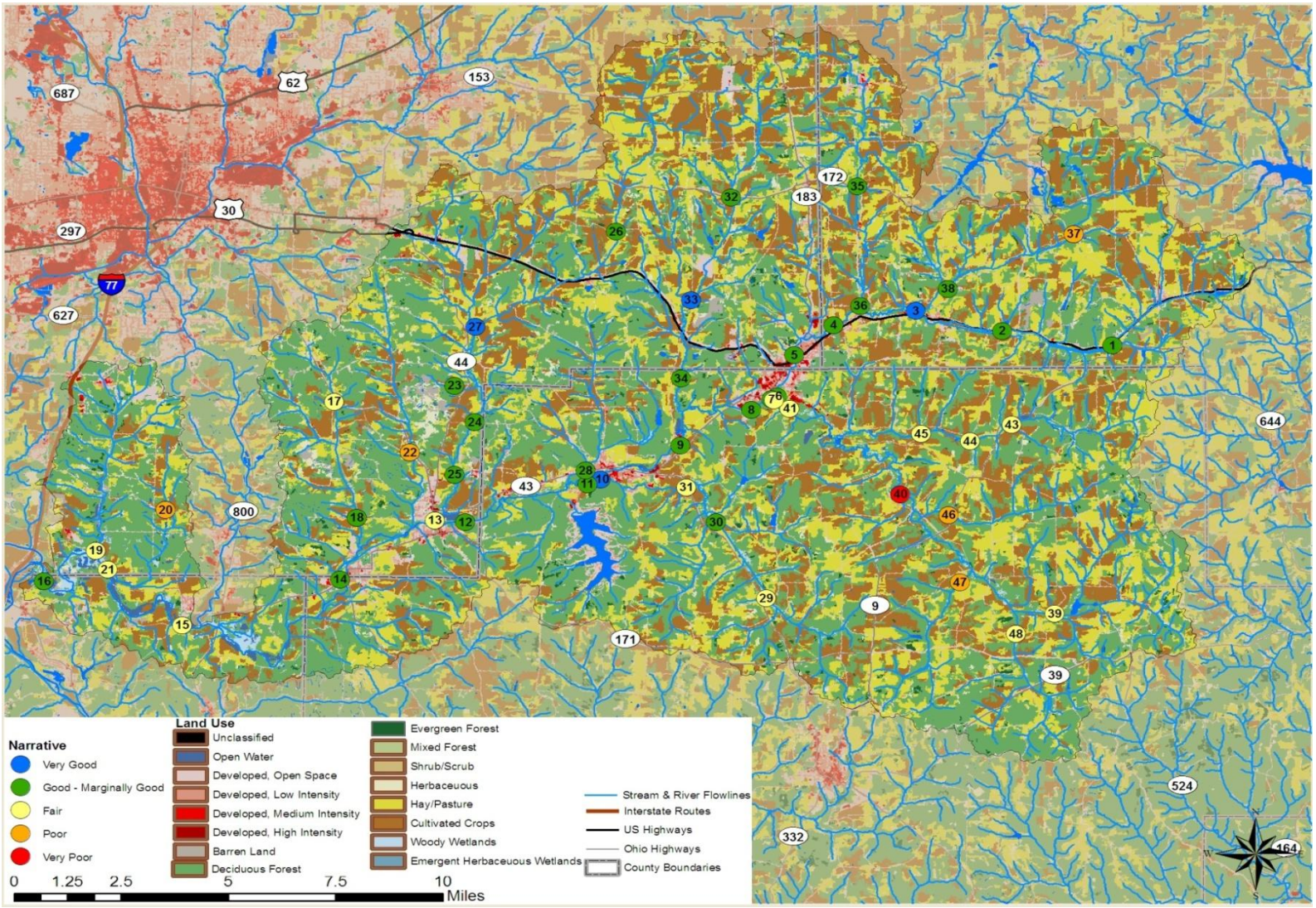


Figure 2. Land use and overall narrative scores of sampling locations in the Sandy Creek watershed, 2010. Sample location numbers correspond to Table 1.

Table 2. Aquatic life use attainment status for sampling locations and habitat type in the Sandy Creek watershed, 2010. The Index of Biotic Integrity (IBI), Modified Index of Well-being (Mlwb)and Invertebrate Community Index (ICI) scores are based on the performance of the biological community. The qualitative Habitat Index (QHEI) reflects the ability of the stream to support a biological community. The Sandy Creek watershed is located in the Erie-Ontario Lake Plain and Western Allegheny Plateau ecoregions. If biological impairment has occurred, the cause(s) and source(s) of the impairment are noted.

Stream	River Mile Fish/Macro.	Habitat Type	Aquatic Life Use Designation and Ecoregion	Attainment Status[a]	IBI	Mlwb[b]	ICI[c]	QHEI	Cause/Source of Impairment Recommended use change
Basin & Code: 17-450-000 (Confirmed WWH)									
Sandy Creek	39.38	Headwater	WWH / WAP	--	--	NA	MG[ns]	--	
Sandy Creek	36.9 / 36.91	Headwater	WWH / WAP	Partial	38*	NA	MG[ns]	60.3	**Causes:** Sedimentation/siltation **Sources:** Channelization
Sandy Creek	34.7	Wading	WWH / WAP	Full	52	9.25	42	58.8	
Sandy Creek	32.1 / 32.06	Wading	WWH / WAP	Full	45	10.2	G	67.5	
Sandy Creek	30.5	Wading	WWH / WAP	Full	51	9.98	38	61.0	
Sandy Creek	29.3 / 29.5	Wading	WWH / WAP	Full	48	9.38	40	80.5	
Sandy Creek	28.9	Wading	WWH / WAP	Full	46	9.39	40	80.5	
Sandy Creek	28.3	--	WWH / WAP	(Full)	--	--	40	--	
Sandy Creek	25.0 / 25.1	Wading	WWH / WAP	Full	42[ns]	9.17	44	83.5	
Sandy Creek	22.5	Boat	WWH / WAP	(Full)	44	9.4	--	76.5	
Sandy Creek	22.05	Boat	WWH / WAP	(Full)	39[ns]	8.14[ns]	--	79.5	
Sandy Creek	17.8 / 18.2	Boat	WWH / WAP	Full	42	9.25	VG	86.3	
Sandy Creek	17.0 / 17.3	Boat	WWH / WAP	Partial	38 [ns]	7.76*	40	73.0	**Causes:** Sedimentation/siltation nutrients **Sources:** Flow alterations from water diversion, municipal point source discharges
Sandy Creek	13.9	Boat	WWH / WAP	Full	39 [ns]	8.24 [ns]	MG [ns]	71.3	

Stream	River Mile Fish/Macro.	Habitat Type	Aquatic Life Use Designation and Ecoregion	Attainment Status[a]	IBI	MIwb[b]	ICI[c]	QHEI	Cause/Source of Impairment Recommended use change
Sandy Creek	7.40 / 7.49	Boat	WWH / WAP	Partial	30*	6.84*	G	78.5	**Causes:** Sedimentation/siltation nutrients **Sources:** Flow alterations from water diversion, municipal point source discharges
Sandy Creek	0.40 / 0.57	Boat	WWH / WAP	Full	42	9.42	38	64.5	
Basin & Code: 17-450-001 (Confirmed WWH)									
Pleasant Valley Run	5.35	Headwater	WWH / WAP	--	--	NA	HF*	--	
Pleasant Valley Run	0.89	Headwater	WWH / WAP	--	--	NA	MG^{ns}	--	
Basin & Code: 17-451-000 (Recommend MWH-Channel Modification)									
Bear Run	0.1 / 0.09	Headwater	WWH / WAP	Full	32	NA	HF	37.0	
Basin & Code: 17-453-000 (Confirmed WWH)									
Limestone Creek	3.7 / 3.68	Headwater	WWH / WAP	NON	28*	NA	P*	43.0	**Causes:** Natural conditions **Sources:** Natural wetland conditions
Limestone Creek	0.10	Headwater	WWH / WAP	NON	30*	NA	LF*	40.5	**Causes:** Natural conditions **Sources:** Natural wetland conditions
Basin & Code: 17-454-000 (Confirmed WWH)									
Indian Run	2.0	Headwater	WWH / WAP	NON	24*	NA	F*	49.8	**Causes:** High iron, manganese, nutrients **Sources:** Coal mining, agriculture
Basin & Code: 17-455-000 (Confirmed WWH)									
Little Sandy Creek	5.8 / 5.82	Wading	WWH / WAP	Full	40^{ns}	8.19^{ns}	40	63.0	
Little Sandy Creek	3.60	Wading	WWH / WAP	Full	42^{ns}	7.95^{ns}	42	69.0	

Stream	River Mile Fish/Macro.	Habitat Type	Aquatic Life Use Designation and Ecoregion	Attainment Status[a]	IBI	MIwb[b]	ICI[c]	QHEI	Cause/Source of Impairment Recommended use change
Little Sandy Creek	1.7 / 1.84	Wading	WWH / WAP	Full	42[ns]	7.93[ns]	42	55.0	
Basin & Code: 17-456-000 (Confirmed WWH)									
Black Run	4.5 / 4.81	Headwater	WWH / WAP	Full	50	NA	G	80.5	
Black Run	0.1	Headwater	WWH / WAP	Full	48	NA	52	54.5	
Basin & Code: 17-458-000 (Confirmed WWH)									
Armstrong Run	0.7 / 0.63	Headwater	WWH / WAP	Full	50	NA	G	81.5	
Basin & Code: 17-459-000 (Confirmed WWH)									
Pipe Run	6.3 / 6.28	Headwater	WWH / WAP	NON	30*	NA	HF*	48.5	**Causes:** Natural conditions **Sources:** Natural wetland conditions
Pipe Run	4.0 / 3.95	Headwater	WWH / WAP	Full	40[ns]	NA	MG[ns]	54.3	
Pipe Run	2.2 / 2.21	Wading	WWH / WAP	Partial	46	6.97*	38	63.3	**Causes:** Natural conditions **Sources:** Natural wetland conditions
Basin & Code: 17-465-000 (Confirmed WWH)									
Hugle Run	6.7 / 7.14	Headwater	WWH / WAP	Full	44	NA	MG[ns]	68.0	
Hugle Run	4.1 / 4.41	Headwater	WWH / WAP	Full	48	NA	VG	62.0	
Hugle Run	1.3 / 1.33	Headwater	WWH / WAP	Full	46	NA	G	74.0	
Basin & Code: 17-466-000 (Confirmed WWH)									
Middle Branch Sandy Creek	3.70 / 3.72	Headwater	WWH / EOLP	Full	40	NA	MG [ns]	68.8	
Middle Branch Sandy Creek	0.1	Headwater	WWH / EOLP	Full	48	NA	38	69.8	
Basin & Code: 17-467-000 (Confirmed WWH)									
Conser Run	4.70 / 4.71	Headwater	WWH / EOLP	Partial	26*	NA	MG [ns]	69.0	**Causes:** Natural conditions **Sources:** Natural wetland conditions

Stream	River Mile Fish/Macro.	Habitat Type	Aquatic Life Use Designation and Ecoregion	Attainment Status[a]	IBI	MIwb[b]	ICI[c]	QHEI	Cause/Source of Impairment Recommended use change
Conser Run	1.1 / 0.01	Headwater	WWH / EOLP	Full	56	NA	MG [ns]	67.0	
Basin & Code: 17-470-000 (Recommend MWH-Channel Modification)									
Still Fork	12.8 / 12.83	Headwater	WWH / WAP	Full	32	NA	HF	29.0	
Still Fork	7.1 / 7.08	Wading	WWH / WAP	NON	26	4.21*	26	39.0	**Causes:** Sedimentation/Siltation nutrients, natural wetland conditions **Sources:** Channelization, livestock grazing, natural wetland conditions
Basin & Code: 17-470-000 (Recommend MWH-Impounded)									
Still Fork	0.5	Boat	WWH / WAP	Full	28	7.48	--	43.5	
Still Fork	0.01	Boat	WWH / WAP	Full	--	--	26	--	
Basin & Code: 17-471-000 (Recommend MWH-Channel Modification)									
Muddy Fork	5.1 / 5.12	Headwater	WWH/ WAP	Full	30	NA	MG	44.5	
Muddy Fork	4.0 / 3.95	Headwater	WWH / WAP	Full	34	NA	MG	41.0	
Basin & Code: 17-471-000 (Confirmed WWH)									
Muddy Fork	2.7 / 2.64	Headwater	WWH / WAP	Partial	36*	NA	46	48.0	**Causes:** Sedimentation/siltation nutrients, natural wetland conditions **Sources:** Channelization, livestock grazing, natural wetland conditions
Basin & Code: 17-474-000 (Recommend MWH-Channel Modification)									
Reeds Run	0.1 / 0.73	Headwater	WWH / WAP	Full	26	NA	HF	25.5	
Basin & Code: 17-475-000 (Recommend MWH-Channel Modification)									
Pipes Fork	0.4 / 0.41	Headwater	WWH / WAP	Full	26	NA	HF	35.0	
Basin & Code: 17-476-000 (Recommend MWH-Channel Modification)									
Friday Creek	0.7 / 0.55	Headwater	WWH / WAP	Full	28	NA	HF	22.0	

a - Attainment is given for the proposed status when a change is recommended.

b - Mlwb is not applicable to headwater streams with drainage areas ≤ 20 mi^2.

c - A narrative 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. VP=Very Poor, P=Poor, LF=Low Fair, F=Fair, HF=High Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional.

ns - No significant 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.

Biological Criteria

Index - Site Type	Western Allegheny Plateau				Erie-Ontario Lake Plain	
	EWH	WWH	MWH (Channelized)	MWH (Impounded)	EWH	WWH
IBI - Headwaters	50	44	24	-	50	40
IBI - Wading	50	44	24	-	50	38
IBI -Boat	48	40	24	30	48	40
Mlwb - Wading	9.4	8.4	6.2	-	9.4	7.9
Mlwb - Boat	9.6	8.6	5.8	6.6	9.6	8.7
ICI	46	36	22	-	46	34

RECOMMENDATIONS

The streams in the Sandy Creek study area are currently assigned the Warmwater Habitat (WWH) aquatic life use in the Ohio Water Quality Standards (WQS).

The mainstem of Sandy Creek was found to be in full attainment of WWH at 12 sites and in partial attainment at three sites. The mainstem is characterized by good to very good aquatic habitat. Development encroaching upon the riparian corridor outside urban areas is minimal with vegetation dominated by large trees. This provides cover and lower water temperatures which in turn increases dissolved oxygen concentrations. The Minerva WWTP at RM 29.1 significantly decreased its ammonia-N pollutant loadings in 1996 thus improving the biological health of the aquatic community. It is recommended that the WWH use designation be maintained for the mainstem of Sandy Creek.

Nine streams with an existing WWH use designation should be maintained. These streams include Conser Run, Middle Branch Sandy Creek, Hugle Run, Armstrong Run, Little Sandy Creek, Black Run, Indian Run, Pleasant Valley Run and Limestone Creek.

Still Fork and several of its tributaries (Friday Creek, Pipes Fork, Reeds Run, and Muddy Fork) are currently designated as WWH. The soils of Still Fork are poorly drained and composed of lacustrine deposits. The tributaries Friday Creek, Pipe Fork, and Reeds Run had historically been modified by channelization. Lowhead dams on Still Fork near the mouth of Sandy Creek impound approximately four miles of upstream waters. Factoring in a gradient of only 9.5 feet/mile, the drainages of Still Fork, Friday Creek, Pipes Creek and Reeds Run can be best described as a natural wetland complex with historical channelization efforts to enhance drainage. It is recommended that these streams be reclassified as Modified Warmwater Habitat (MWH) for channelized reaches or impoundments, as applicable.

For Muddy Fork, the best resolution is to recognize two stream reaches; an upper MWH reach and a lower WWH reach, based on habitat qualities and biological performance. Muddy Fork conditions improved from upstream to downstream. Although the entire stream appears to have been historically modified to improve drainage, the impact of those practices had naturally attenuated more at Bellflower Rd. than at upstream sites. At Bellflower Rd., an array of pollution sensitive and EPT macroinvertebrate taxa were sufficient to earn an exceptional ICI score (46). The fair fish community (IBI=36) was improved from upstream and included pollution intolerant hornyhead chubs (*Nocomis biguttatus*) and many large rock bass (*Ambloplites rupestris*). The presence of sensitive species, macroinvertebrate biocriterion achievement, and an improving water quality trend support assignment of the WWH aquatic life use in the lower part of Muddy Fork from the confluence with Stony Hollow at RM 3.0 to the mouth. Conversely, the degraded upstream reach demonstrated the recommended MWH aquatic life use characteristics and should be, thus, designated MWH from the headwaters to the confluence with Stony Hollow at RM 3.0.

The upper reach of Pipe Run, a Sandy Creek tributary near Malvern, was influenced by beaver activity, was inhabited by expected species, and displayed habitat qualities appropriate for a

wetland-like stream. Although the calculated biological scores imply impairment, the observed suite of stream attributes was deemed to be consistent with those of a functional natural wetland reach of stream. Downstream at RM 4.0 the presence of riffles and substrates comprised by rubble and boulders helped the aquatic community improve to marginally good (ICI=MG, IBI=40). At the most downstream sampling location (RM 2.2), the absence of riffles and an abundance of woody debris supported an impression that this low gradient reach was stressed by sporadic high flows. The density and diversity of the aquatic biota declined, resulting in partial achievement of the WWH criteria (ICI=38, IBI=46, MIwb=7.0). Pipe Run should retain the WWH designation.

Bear Run flows south and enters Sandy Creek at RM 2.19. Bear Run has high gradient flow and is extensively channelized. The sand and silt banks are continuously sluffing away and creating turbid conditions. Bear Run flows through extensive strip mining areas, most notable in the headwaters beyond the confluence of Sulphur Run (RM 3.2). Coal fines are found in the substrate but pH is normal and there are no signs of acid mine impacts to the biotic community. Nonetheless, the lack of quality habitat (QHEI = 37) severely depresses the density and diversity of the aquatic biota. It is recommended that Bear Run be reclassified from WWH to MWH due to its channelized condition.

All study area streams should retain the existing recreational (Class A for Sandy Creek from U.S. Rt. 30 in Minerva to the Tuscarawas River and Class B for the remainder of Sandy Creek and all other streams) and water supply use designations. Table 3 contains use designation recommendations for the Sandy Creek watershed.

IMPROVEMENTS TO WATER QUALITY

Improvements may be made to water quality throughout the study area by addressing the causes and sources identified within the aquatic life use attainment table (Table 2). Funding opportunities should be sought to improve flow and decrease nutrient inputs to the watershed and could include the following:

- Removal of the lowhead dams on Still Fork at RMs 0.5 and 0.11 would improve flow and reduce siltation in the dam pools, and

- Installation of livestock exclusion fencing in the watershed will help to decrease nutrient enrichment, especially in the headwaters of Indian Run where livestock have been documented with direct access to the stream.

All sites were found to be in non-attainment for the recreation use. Management of failed septic systems and unsewered communities should be undertaken by the county health departments throughout the watershed (Figure 3).

Figure 3. Raw sewage on the banks of Conser Run near the mouth of Sandy Creek. On-site septic system failures are common throughout the watershed.

Table 3. Waterbody use designation recommendations for the Sandy Creek watershed. Designations based on the 1978 and1985 water quality standards appear as asterisks (*). A plus sign indicates a confirmation of an existing use and triangle (▲) denotes a new recommended use based on the findings of this report.

Water Body Segment	Use Designations												Comments
		Aquatic Life Habitat						Water Supply			Recreation			
	SRW	WWH	EWH	MWH	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR	
Sandy Creek		+							+	+		+		
Conservation Run		*/+							*/	*/+		*/+		
Middle Branch Sandy Creek		*/+							*/	*/+		*/+		
Still Fork (Headwaters to RM 3.9)		*		▲+					*/	*/+		*/+		WAP ecoregion-channel modification
Still Fork (RM 3.9 to mouth)		*		▲+					*/	*/+		*/+		WAP ecoregion-impounded
Friday Creek		*		▲+					*/	*/+		*/+		WAP ecoregion-channel modification
Pipes Fork		*		▲+					*/	*/+		*/+		WAP ecoregion-channel modification
Reeds Run		*		▲+					*/	*/+		*/+		WAP ecoregion-channel modification
Muddy Fork (Headwaters to RM 3.0)		*		▲+					*/	*/+		*/+		WAP ecoregion-channel modification
Muddy Fork (RM 3.0 to mouth)		*/+							*/	*/+		*/+		
Hugle Run		*/+							*/	*/+		*/+		
Pipe Run		*/+							*/	*/+		*/+		
Armstrong Run		*/+							*/	*/+		*/+		
Little Sandy Creek		*/+							*/	*/+		*/+		
Black Run		*/+							*/	*/+		*/+		
Indian Run		*/+							*/	*/+		*/+		
Pleasant Valley Run		*/+							*/	*/+		*/+		
Limestone Creek		*/+							*/	*/+		*/+		
Bear Run		*		▲+					*/	*/+		*/+		WAP ecoregion-channel modification

INTRODUCTION

During 2010, Ohio EPA conducted a water resource assessment of the Sandy Creek basin, a watershed tributary to the Tuscarawas River in northeast Ohio (Figure 4). Forty-eight stream sampling locations were evaluated in Carroll, Columbiana, Stark and Tuscarawas counties. Sixteen sites on the mainstem of Sandy Creek were sampled along with 32 locations on 16 tributaries. A total of 35 National Pollutant Discharge Elimination System (NPDES) permitted facilities discharge sanitary wastewater, industrial process water and/or industrial storm water into the Sandy Creek watershed.

Figure 4. Sandy Creek watershed is located in northeast Ohio.

All monitoring and data collection activities adhered to standard Ohio EPA protocols. Included in this study were assessments of the biological, surface water, surficial sediment, and recreational (bacterial) condition. A total of 48 biological and water chemistry and 14 bacterial stations were sampled in the Sandy Creek study area. All of the biological, chemical and bacteria results can be downloaded from the Ohio EPA GIS interactive maps at the following link http://www.epa.state.oh.us/dsw/gis/index.aspx.

Specific objectives of the evaluation were to:

- Ascertain the present biological conditions in the Sandy Creek study area by evaluating fish and macroinvertebrate communities,
- Identify the relative levels of organic, inorganic and nutrient parameters in the sediments and surface water,
- Evaluate influences from NPDES outfall discharges,
- Assess physical habitat influences on stream biotic integrity,
- Determine recreational water quality,
- Compare present results with historical conditions, and
- Determine beneficial use attainment status and recommend changes if appropriate.

STUDY AREA DESCRIPTION

The study area lies within two ecoregions: the Western Allegheny Plateau (WAP) comprises most of the watershed while the Erie-Ontario Lake Plain (EOLP) lies within several stream segments north of the Sandy Creek mainstem. The eastern half of the Sandy Creek mainstem bisects these two ecoregions. The soils of the Sandy Creek mainstem and its northern tributaries are deep and well drained and were formed in glacial outwash consisting of sand and gravel. The soils in the tributaries south of Sandy Creek are deep, usually poorly drained, and were formed from lacustrine sediments on slack water terraces. The glacial geology in the Sandy Creek basin plays an important role in the physical and substrate characteristics of the streams.

Land use in the Sandy Creek watershed is predominantly deciduous forest followed by hay and pasture land and cultivated cropland (Figure 2). Bolivar Dam (Sandy Creek RM 0.7), built in 1937 by the USACE with its attendant Magnolia and East Sparta Levees, is part of a large flood control system initiated at the behest of the Muskingum Watershed Conservancy District (MWCD). The dam is currently being remediated to correct potentially catastrophic deficiencies. Although operated as a dry dam, its six gates allow creation of a 10 mi^2 impoundment extending 17 miles upstream through Waynesburg. Because regulation of Ohio River flooding with interest to facilitate unhampered navigation is an underlying objective, the frequency of pool conditions behind Bolivar Dam is independent from local rainfall. Consequently, the relationship of Sandy Creek basin storms and the resulting Bolivar pool duration is often disproportional. How this unnatural flood pulse affects aquatic life, disturbs stream sediment transport, influences nutrient processing, etc. and whether alternative operational strategies could promote better water quality are tangible considerations.

Less apparent but also worth understanding is whether the historical existence of the Sandy and Beaver Canal has any contemporary water quality influence. The 73.5 mile long canal used a five mile Sandy Creek reach as part of its otherwise parallel course. Operational between 1845 and 1853, the canal employed 10 Sandy Creek dams and disrupted many tributary junctures. In 2010, timber and stone canal relics were noticed at two sample sites - the present Number 6 dam (RM 16.3) backwater extended upstream through the sampled reach near Little Sandy Creek (RM 17.4), and the incised channel near Kensington which retains canal-like features. Additionally, Sandy Creek is artificially pooled upstream from Malvern and, in appearance, resembles a borrow pit. The utility and rationale of such a feature was not readily apparent.

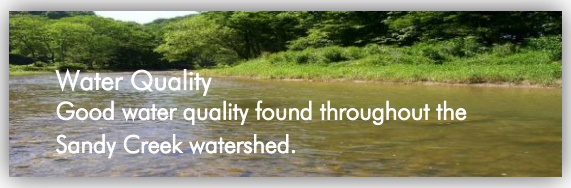
Sandy Creek drains 504 mi^2 including the Nimishillen Creek watershed (188 mi^2, not assessed in this study) and Still Fork (71 mi^2). Sandy Creek in Minerva downstream from Still Fork (RM 29.1) drains 135 mi^2. It increases to 202 mi^2 downstream from Malvern with the addition of Hugle, Pipe, and Armstrong runs, and grows to 253 mi^2 with the addition of Little Sandy Creek in Waynesburg. Sandy Creek's character is different in the reaches upstream from Still Fork, over the 11.7 miles downstream to Little Sandy Creek, and from there to Bolivar Dam. The half mile reach between Bolivar Dam and the Tuscarawas River also differs from the upstream reaches. The Sandy Creek corridor is aligned with the first European travel route into Ohio. Sandy Creek

towns are among Ohio's oldest. The anthropogenic changes within the Sandy Creek basin coupled with the purposeful modifications to the stream itself are now so fused with any natural vestiges that, aside from recognizing the unique reach attributes, specific reference conditions are indistinguishable from the alterations. Although this scenario is common in Ohio, it is deceptively subtle in Sandy Creek where layers of natural attenuation are intermixed with historical renovation and modern intervention.

All sites were originally designated for aquatic life uses in the 1978 Ohio WQS. The techniques used then did not include standardized approaches to the collection of instream biological data or numerical biological criteria. This study used biological data to evaluate and establish aquatic life uses for these streams. It is through these methods that the above mentioned recommendations for changes in the aquatic life use for Bear Run, Still Fork, Muddy Fork, Reeds Run, Pipes Fork and Friday Creek occur.

All designated streams in the Sandy Creek study area are currently assigned as Primary Contact Recreation (PCR) Class A or Class B, Agricultural Water Supply (AWS) and Industrial Water Supply (IWS). The findings of this evaluation may factor into regulatory actions taken by Ohio EPA (e.g. NPDES permits, Director's Orders, or the Ohio Water Quality Standard [OAC 3745-1], and may eventually be incorporated into State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, Total Maximum Daily Loads (TMDLs), and the biennial Integrated Water Quality Monitoring and Assessment Report (305[b] and 303[d] report).

WATER CHEMISTRY RESULTS



Surface water chemistry samples were collected from the Sandy Creek study area from May 2010 through November 2011 at 48 locations. Stations were established in free-flowing sections of the stream and were primarily collected from bridge crossings. Surface water samples were collected using appropriate containers, preserved, and delivered to Ohio EPA's Environmental Services laboratory. Collected water was preserved using appropriate methods, as outlined in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 2009). Interactive maps of surface water chemical data, downloadable to excel files, are available at the following link: http://www.epa.ohio.gov/dsw/gis/index.aspx .

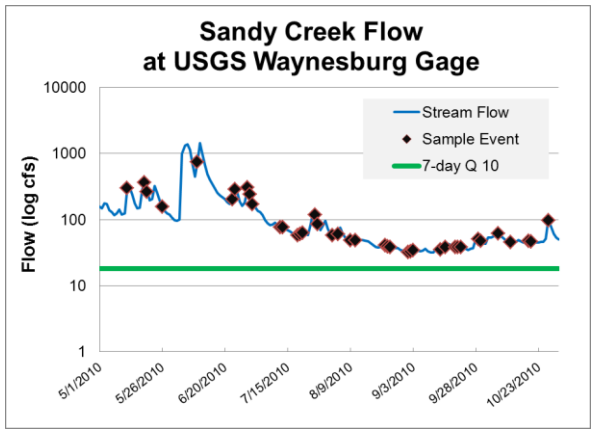


Figure 5. Sandy Creek flows at USGS gage with 2010 sample events superimposed.

USGS gage data from Sandy Creek at Waynesburg at St. Rt. 183 were used to show flow conditions in the Sandy Creek watershed during the 2010 survey (Figure 5).

Dates when water samples and bacteria samples were collected in the study area are noted on the graph. Flow conditions during the summer field season remained above the 7-day 10-year (Q7,10) low flow discharge. 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 lower flows.

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, and 4). Parameters which were in exceedance of the Ohio WQS criteria are reported in Table 4. Bacteriological samples were collected from eighteen locations, and the results are reported in the Recreation Use section. DataSonde® water quality recorders were placed at twenty-five locations to monitor hourly levels of dissolved oxygen, pH, temperature, and conductivity (Appendix Table 3).

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 selected nutrients measured in the Sandy Creek watershed are detailed in Table 5. Nutrient levels at the 48 sample sites in 2010 indicated elevated nitrate+nitrite at 23 of 48 sites (48%) and elevated phosphorus at 11 of 48 sites (23%).

Table 4. Exceedances of Ohio Water Quality Standards criteria (OAC 3745-1) for chemical/physical parameters measured in the Sandy Creek watershed study area, 2010. Exceedance determinations are based on the existing or recommended aquatic life use. Bacteria exceedances are presented in the Recreation Use Section.

Stream/RM	**Location**	**Parameter (value – ug/l unless noted)**
Sandy Creek	WWH Existing	
36.91	Sandy Creek @ Lippincott	DO (1.84 mg/L [a,b], 4.02 mg /L, 4.64 mg/L [a])
34.7	Sandy Creek at East Rockchester @ West Township Park	Ammonia (2.35 mg/L[a])
7.49	Sandy Creek dst. Nimishillen Creek @ Co. Road 104	
Bear Run	MWH Recommended	
0.1	Bear Run @ Gracemont	DO (3.2 mg//L [b])
Friday Creek	MWH Recommended	
0.84	Friday Creek @ Channel Road	DO (3.98 mg/L [b], 2.31 mg/L [a,b])
Hugle Run	WWH Existing	
7.35	Hugle Run @ SR 172	DO (3.38 mg/L [a,b], 4.21 mg/L [b])
Little Sandy Creek	WWH Existing	
1.84	Little Sandy Creek @ Elson Street	Iron (6430 [d])
Limestone Creek	WWH Existing	
3.68	Limestone Creek @ Downing St.	Iron (8230 [d])
0.1	Limestone Creek @ Duebler Ave.	DO (0.16 mg/L [a,b])

Table 4. Exceedances of Ohio Water Quality Standards criteria (OAC 3745-1) for chemical/physical parameters measured in the Sandy Creek watershed study area, 2010. Exceedance determinations are based on the existing or recommended aquatic life use. Bacteria exceedances are presented in the Recreation Use Section.

Stream/RM	**Location**	**Parameter (value – ug/l unless noted)**
Muddy Fork	MWH Recommended	
3.95	Muddy Fork @ Augusta Rd.	Iron (6150 [d])
Pipe Run	WWH Existing	
6.28	Pipe Run @ Arrow Road	DO (4.6 mg/L, 4.67 mg/L, 4.71 mg/L [b])
0.21	Pipe Run @ SR 43	DO (3.87 mg/L [a,b], 4.58 mg/L [b])
Pipes Fork	MWH Recommended	
4.3	Pipes Fork @ Rush Rd.	Copper (31.6 [a,b,c])

Outside Mixing Zone Maximum (OMZM) exceedance = [a]	Outside Mixing Zone Average (OMZA) exceedance = [b]	Inside Mixing Zone Maximum (IMZM) exceedance = [c]	OMZA (agriculture) exceedance = [d]

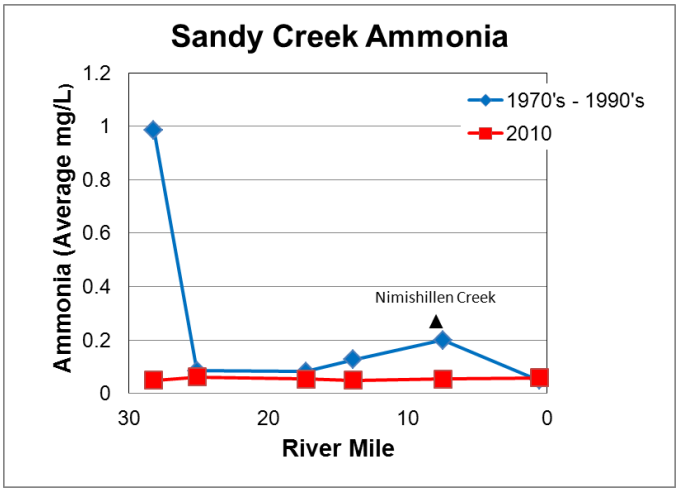
Table 5. Nutrient summary statistics for Sandy Creek watershed, 2010. Highlighted cells for nitrate+nitrite and total phosphorus exceed statewide reference targets established for WWH streams and rivers (Ohio EPA 1999).

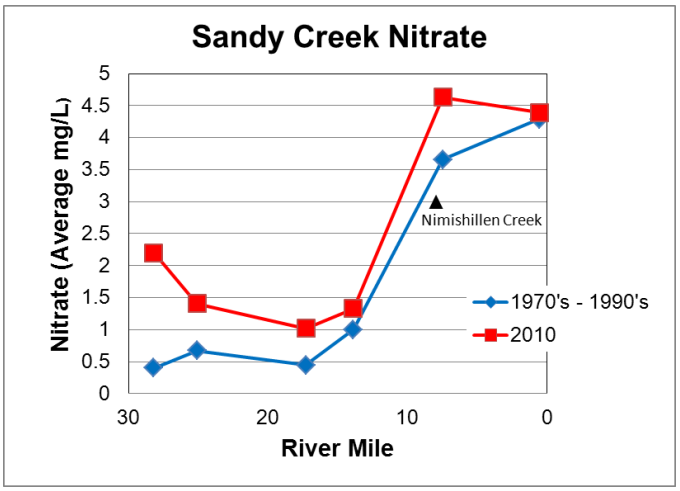
		Average of Results (mg/L)	
Station Name		**Nitrate+Nitrite**	**Total Phosphorus**
Armstrong Run @ SR 43	Wading	0.62	0.03
Bear Run @ Gracemont	Headwater	0.95	0.02
Black Run @ Stucky Robertsville Rd	Headwater	0.84	0.02
Black Run at Mapleton @ Lotz Ave.	Headwater	0.74	0.03
Conser Run @ Knox School Rd.	Headwater	**1.46**	0.05
Conser Run @ Speidel Rd.	Headwater	**1.21**	0.05
Friday Creek @ Channel Rd,	Headwater	0.74	**0.11**
Hugle Run @ Baird Rd.	Headwater	0.82	0.02
Hugle Run @ SR.172	Headwater	**1.01**	0.05
Hugle Run @ Liberty Church Rd.	Wading	0.83	0.03
Pleasant Valley Run @ Grovedell St.	Headwater	0.72	0.01
Pleasant Valley Run @ SR 43	Headwater	0.89	0.02
Indian Run @ SR 43	Headwater	0.83	**0.13**
Limestone Creek @ Downing St.	Headwater	**1.29**	0.07
Limestone Creek @ Duebler Ave.	Headwater	**5.13**	**0.33**
Little Sandy Cr. @ Chapel St.	Wading	**1.07**	0.01
Little Sandy Cr.@ Elson St.	Wading	0.69	0.02
Little Sandy Creek @ Hill Church	Wading	0.92	0.01
Middle Branch Sandy Creek @ Kurtz Rd	Headwater	**1.13**	0.04
Middle Branch Sandy Creek @ SR 172	Headwater	**1.31**	0.03
Muddy Fork @ Augusta Rd.	Headwater	0.93	0.07
Muddy Fork @ Reef Rd.	Headwater	0.56	0.04
Muddy Fork @ Bellflower Rd.	Wading	**1.26**	0.10

Table 5. Nutrient summary statistics for Sandy Creek watershed, 2010. Highlighted cells for nitrate+nitrite and total phosphorus exceed statewide reference targets established for WWH streams and rivers (Ohio EPA 1999).

		Average of Results (mg/L)	
Station Name		**Nitrate+Nitrite**	**Total Phosphorus**
Nimishillen Creek @ Farber Rd.	Wading	**6.69**	**0.55**
Pipe Run @ Arrow Rd.	Headwater	0.61	**0.10**
Pipe Run @ Bellflower Rd.	Headwater	0.82	**0.09**
Pipe Run @ SR 43	Wading	0.62	0.10
Pipes Fork @ Rush Rd.	Headwater	0.81	0.08
Reeds Run @ SR 9	Headwater	0.70	0.08
Sandy Creek @ Lippincott Rd.	Headwater	0.55	0.04
Sandy Creek @ US 30 Dst. Kensington	Headwater	**1.50**	0.04
Sandy Creek @ Blade Rd.	Wading	**1.40**	**0.12**
Sandy Creek @ Citrus Rd.	Wading	**1.33**	0.07
Sandy Creek @ NYC RR Trestle	Wading	**1.11**	0.03
Sandy Creek @ Stump Rd.	Wading	**1.32**	0.04
Sandy Creek at East Rockchester @ West Township Park	Wading	**1.56**	0.04
Sandy Creek at Pekin @ SR 183	Wading	**1.33**	**0.20**
Sandy Creek dst. Minerva WWTP @ Summitville Tile	Wading	**2.20**	**0.33**
Sandy Creek at Malvern @ SR 183	Wading	**1.23**	0.07
Sandy Creek at Minerva @ U.S. Rt. 30	Wading	**1.42**	0.06
Sandy Creek at Magnolia @ SR 183	Small River	1.33	0.05
Sandy Creek at Waynesburg @ SR 183	Small River	1.02	0.06
Sandy Creek dst. Nimishillen Creek @ Co. Rd. 104	Small River	**4.63**	**0.35**
Sandy Creek dst. Bolivar Dam	Small River	**4.39**	**0.29**
Still Fork Sandy Creek @ Mark Rd.	Headwater	**1.47**	0.06
Still Fork Sandy Creek @ Bellflower Rd.	Wading	0.85	0.10
Still Fork Sandy Creek @ Arrow Rd.	Wading	0.79	0.04
Still Fork Sandy Creek @ Mouth	Wading	0.71	0.05
Statewide Reference Targets			
Headwater Streams (<20 mi^2 drainage)		**1.00**	**0.08**
Wading Streams (20 - 200 mi^2 drainage)		**1.00**	**0.10**
Small Rivers (200 - 1000 mi^2 drainage)		**1.50**	**0.17**

Water quality trends (Figure 6) were evaluated for ammonia, nitrate+nitrite, and phosphorus in Sandy Creek between river miles 28.2 and 0.0 (mouth). Average values from the time period 1975-1998 were compared to the 2010 survey data. Ammonia concentrations show a decrease at the upper site (RM 28.2) and at the site below the confluence of Nimishillen Creek (RM 7.49). Upgrades at the Minerva and Canton wastewater treatment plants were likely responsible for these decreases. Nitrate trends indicate increases in average concentrations during the same time period. With better treatment and removal of ammonia, increases in nitrate are expected as ammonia is converted to nitrate. Improvement in treatment is also likely responsible for decreases in phosphorus although it is still above reference values at both the upper and lower sampling sites.





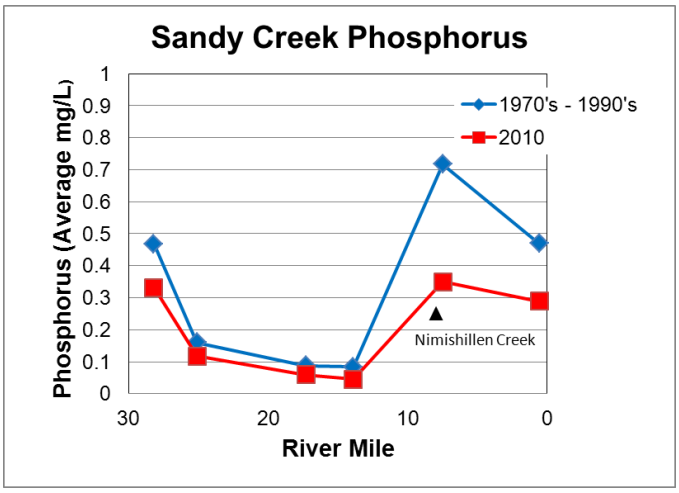


Figure 6. Trends of ammonia, nitrate, and phosphorus in Sandy Creek, 1970s-1990s compared with 2010.

Chemistry Results by Watershed Size

Chemistry results for the 2010 Sandy Creek watershed survey were compared by watershed size. Results are presented in Table 6. As watershed size increases, the concentrations of nutrients also increase. There is a large contribution of nutrients from Nimishillen Creek which is dominated by flow from wastewater treatment plants and several industrial dischargers in Canton. Increases in chloride, sodium, conductivity, and total dissolved solids also follow the same pattern. Dischargers and urban runoff are influencing these parameters. Manganese is higher in headwater streams, an indicator of groundwater influences associated with these smaller watersheds.

Table 6. Selected water chemistry results by watershed size category in the Sandy Creek basin, 2010.

	Average of Result		
	Headwater (<20 sq. mi.)	Wading (20-200 sq. mi.)	Small River (>200 sq. mi.)
Aluminum	259.91	355.97	341.42
Ammonia	0.06	0.07	0.03
Chloride	33.82	33.32	83.28
COD	17.74	11.41	11.80
Conductivity	587.23	510.61	749.74
Manganese	662.53	265.50	235.54
Nitrate+nitrite	1.07	1.05	2.69
Sodium	22.60	20.62	49.73
Total Dissolved Solids	378.70	313.81	464.77
Total Phosphorus	0.06	0.07	0.18
Zinc	7.98	7.46	18.11

SEDIMENT CHEMISTRY RESULTS

Surficial sediment samples were collected at six locations in the Sandy Creek watershed by the Ohio EPA on October 12 and October 20, 2010. Sampling locations were co-located with biological sampling sites. Site locations are listed in Table 7.

Table 7. Sediment sampling locations in the Sandy Creek basin, 2010.

Stream	Location	River Mile
Sandy Creek	US 30 dst. Kensington	39.73
Sandy Creek	Minerva @ US 30	30.50
Sandy Creek	@ Summitville Tile	28.20
Sandy Creek	Pekin @ SR. 183	27.70
Bear Run	Gracemont Rd.	0.10
Little Sandy Creek	Elson St.	1.84

Samples were analyzed for total analyte list inorganics (metals), volatile organic compounds, semivolatile organic compounds, PCBs, and total petroleum hydrocarbons. Specific chemical parameters tested and results are listed in Appendix Table 5. Sediment data were evaluated using Ohio Sediment Reference Values (SRVs) (Ohio EPA 2003), 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 sites; however, fine substrates were common along the stream margins. Metals, semivolatile organic compounds, and PCBs above screening benchmarks are highlighted in Table 8. All sediment monitoring results are included as Appendix Table 5. All six sediment sampling locations in the Sandy Creek basin exhibited some degree of elevated sediment chemical levels. Several metal and PAH compounds were reported above TEC, SRV, and/or ESL levels, which would suggest the potential for some impairment to biological communities. However, good biological integrity was documented at all assessed sediment sampling locations where these elevations were noted. The sparse deposits of fine grained material at each sampling site likely contributed to low exposure levels of sediment contaminants to biological communities. Based on the sampling results of this survey, contaminated stream sediments did not cause impairment to the biological communities in the Sandy Creek watershed.

Sediment sample results from 2010 were compared to results of samples collected as part of the last Sandy Creek survey in 1993 (Ohio EPA 1995). Seven sites were sampled in 1993, five in Sandy Creek and two in Still Fork Sandy Creek. Biological communities at all 2010 sediment sites were in full attainment of the designated or recommended aquatic life use. Similar conditions were observed in 1993 at similar sites where, again, all Sandy Creek sites were in full aquatic life use attainment with the exception of the site downstream from the Minerva WWTP (RM 28.2). However, impairment was determined to be caused by WWTP organic loads due to poorly treated waste water and not a result of contaminated sediment. Improvements in plant treatment since 1996 have resulted in significant decreases in pollutants, especially ammonia, and full WWH use attainment was recorded in 2010 below the Minerva WWTP.

Table 8. Selected sediment results with highlighted values above screening benchmarks at Sandy Creek basin sampling locations, 2010.

Parameter	Units	Bear Run @ Gracemont Rd. RM 0.10	Little Sandy Creek @ Elson St. RM 1.73	Sandy Creek @ US 30 dst. Kensington RM 39.73	Sandy Creek at Minerva @ US 30 RM 30.50	Sandy Creek dst. Minerva WWTP @ Summitville Tile RM 28.20	Sandy Creek at Pekin @ SR 183 RM 27.60
3&4-Methylphenol	mg/kg	BRL	BRL	BRL	BRL	BRL	1.23
Aluminum	mg/kg	14600	5250	13600	4520	5570	10400
Ammonia	mg/kg	360	59	290	140	89	1500
Anthracene	mg/kg	0.74	BRL	BRL	BRL	BRL	BRL
Arsenic	mg/kg	**12**	8.31	**48.1**	**11.2**	**11.1**	**11.6**
Barium	mg/kg	89.4	67.2	240	61.6	90.6	161
Benz[a]anthracene	mg/kg	1.3	BRL	BRL	BRL	BRL	BRL
Benzo[a]pyrene	mg/kg	1.09	BRL	BRL	BRL	BRL	BRL
Benzo[b]fluoranthene	mg/kg	0.82	BRL	BRL	BRL	BRL	BRL
Benzo[k]fluoranthene	mg/kg	0.73	BRL	BRL	BRL	BRL	BRL
Cadmium	mg/kg	0.978	0.401	**1.55**	0.311	0.54	**1.86**
Calcium	mg/kg	5020	BRL	32700	8360	3760	8200
Chromium	mg/kg	21.5	7.78	30.1	15.6	11.7	22.6
Chrysene	mg/kg	1.25	BRL	BRL	BRL	BRL	BRL
Copper	mg/kg	22.1	10.8	**312**	9.81	18.8	30.9
Fluoranthene	mg/kg	2.68	BRL	BRL	0.95	BRL	BRL
Iron	mg/kg	45800	20300	59300	23200	24500	28600
Lead	mg/kg	26.2	23	**293**	16.2	28.4	**98.5**
Manganese	mg/kg	2760	580	2230	434	954	830
Nickel	mg/kg	**82.5**	18.5	**35.1**	14	19.7	**31.7**
PCB-1242	ug/kg	83.2	BRL	BRL	BRL	BRL	92.3
PCB-1254	ug/kg	BRL	BRL	BRL	BRL	37.4	BRL
PCB-1260	ug/kg	BRL	BRL	BRL	BRL	BRL	62.3
Phenanthrene	mg/kg	2.3	BRL	BRL	BRL	BRL	BRL
Pyrene	mg/kg	2.68	BRL	BRL	0.78	BRL	BRL
Toluene	mg/kg	BRL	BRL	BRL	BRL	BRL	0.291
Total Phosphorus	mg/kg	839	313	1770	362	937	1550
Zinc	mg/kg	**284**	101	**2620**	77.3	107	**186**

Bold	**Above a TEC value**
Yellow Highlight	Above an SRV
Underlined	Above US EPA Region 5 ESL

DATASONDE® RESULTS

Deployments of multi-parameter water quality sondes, DataSondes®, took place in 2010 and 2011 to better understand the nature of instream dissolved oxygen (D.O.) levels in impaired streams in the Sandy Creek watershed. The D.O. data measured in these deployments are intended to aid in the understanding of the severity and nature by which the causes of impairment are impacting aquatic life.

The D.O. data in this section are examined for three metrics; average, minimum, and range. For WWH streams, the 24-hour average should be at least 5 mg/L and the minimum should be at least 4 mg/L. The corresponding MWH criteria are 4 mg/L average and 3 mg/L minimum. All the sites where the DataSondes® were deployed are currently from WWH streams as listed in the Ohio WQS, though the MWH aquatic life use has been recommended for several of them.

On each D.O. plot shown in the following figures, the WWH D.O. criteria are shown and any observed deviations are noted in the text. The causes and sources of any impairments are also mentioned. Non-attainment of D.O. criteria can be caused by high BOD loading, nutrient enrichment, high sediment oxygen demand, poor reaeration (stagnant water), or a combination of these factors. Nutrient enrichment will generally cause a stream's daily D.O. concentration range (maximum minus minimum) to increase. When this happens, corresponding minimum D.O. concentrations can fall below critical levels needed to support aquatic life. A diel swing in D.O. greater than 7.0 mg/l has been identified by Ohio EPA to be a good indicator of nutrient enrichment (Miltner, 2010).

Sandy Creek

DataSondes® were deployed on the Sandy Creek mainstem at a total of nine sites during three surveys conducted in 2010 and 2011 (Figure 7). Eight sites were monitored during the June 29-July 1, 2010 survey (Figure 8). Four sites were monitored from August 31 to September 2, 2010 (Figure 9), and two from July 5 to July 7, 2011 (Figure 10).

The three Sandy Creek surveys showed that dissolved oxygen was in attainment at all of the Sandy Creek mainstem sites. The highest daily D.O. variation occurred at RM 30.5 during the 8/31/10-9/2/10 survey (6.5 mg/L).

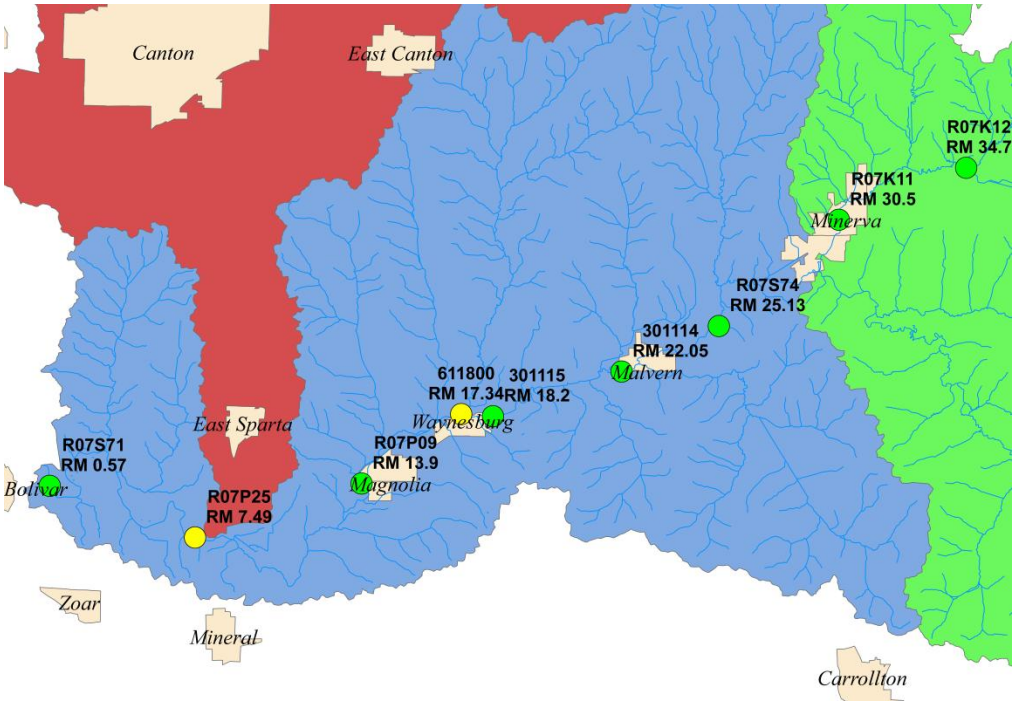


Figure 7. Sandy Creek mainstem DataSonde® sites, 2010-2011. Site colors indicate aquatic life use attainment status at co-located sites: green for full attainment and yellow for partial attainment.

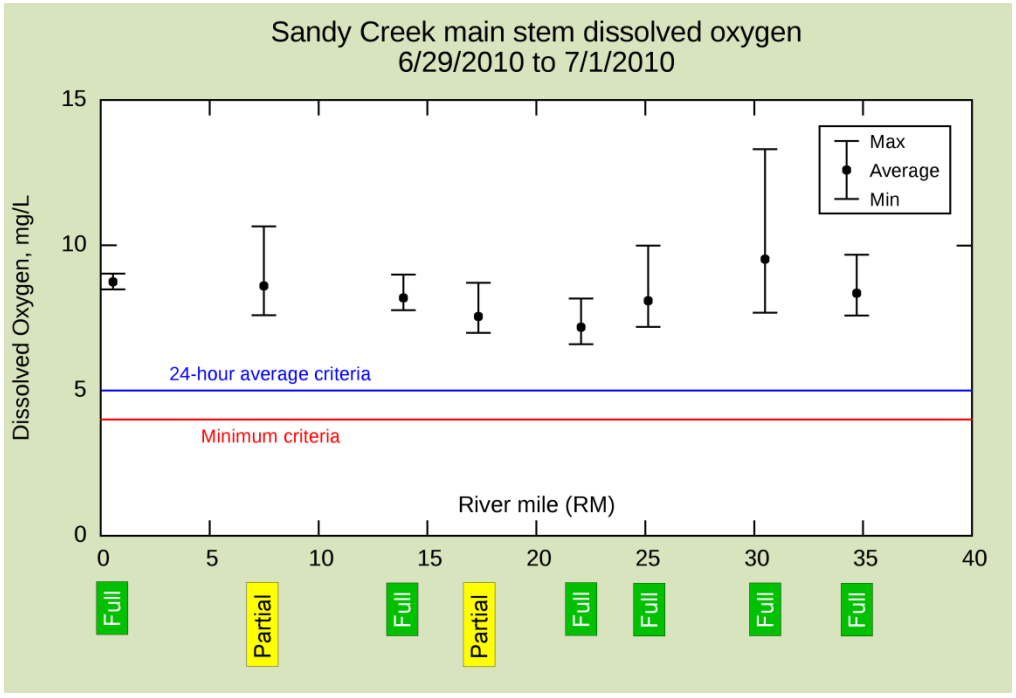


Figure 8. Sandy Creek mainstem DataSonde® results, June 29 to July 1, 2010. Aquatic life use attainment status at co-located sites is indicated: green for full attainment and yellow for partial attainment.

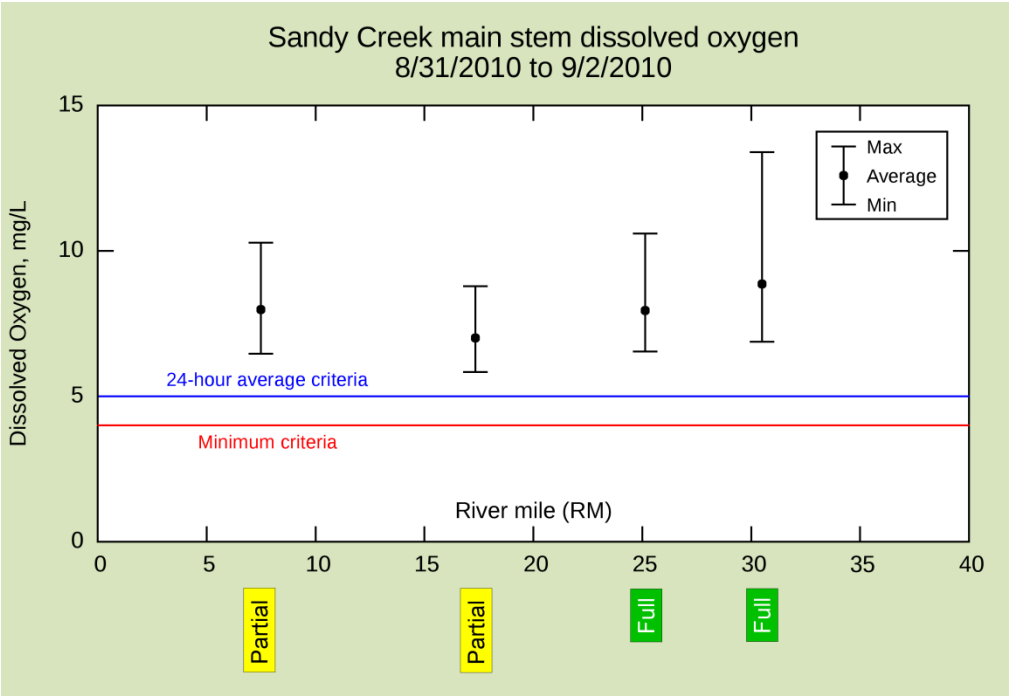


Figure 9. Sandy Creek mainstem DataSonde® results, August 31 to September 2, 2010. Aquatic life use attainment status at co-located sites is indicated: green for full attainment and yellow for partial attainment.

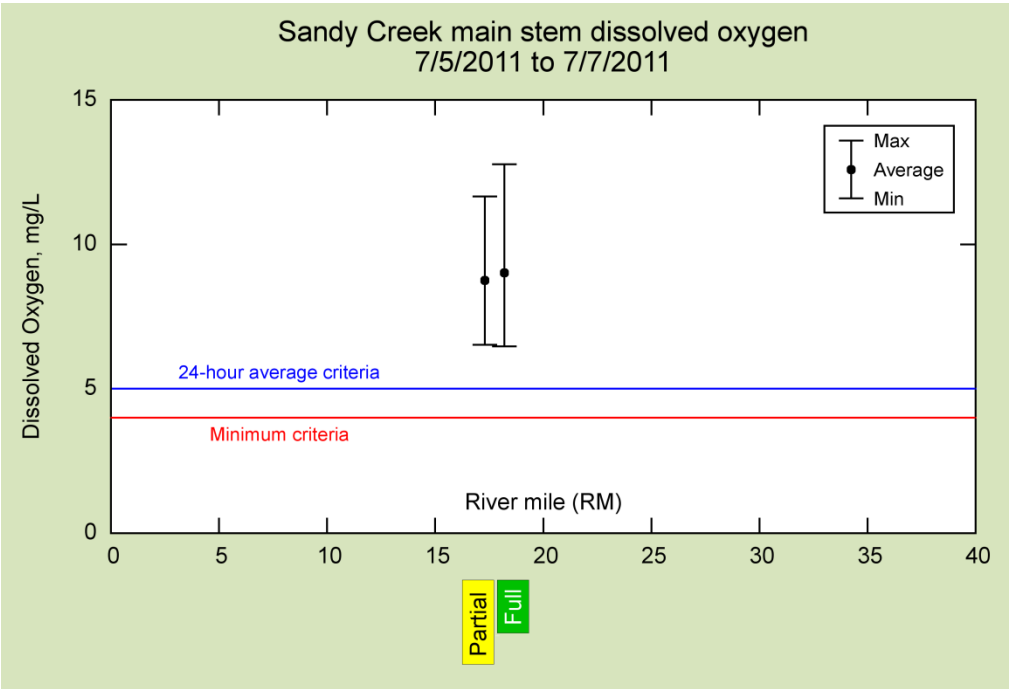


Figure 10. Sandy Creek mainstem DataSonde® results, July 5 to July 7, 2011. Aquatic life use attainment status at co-located sites is indicated: green for full attainment and yellow for partial attainment.

Still Fork

DataSondes® were deployed on the Still Fork mainstem at a total of four sites during two surveys conducted in 2010 (Figure 11). Four sites were monitored during the June 29 to July 1, 2010 survey (Figure 12), and three sites were monitored from July 5 to July 7, 2011 (Figure 13).

During the June 29 to July 1, 2010 survey, daily average dissolved oxygen fell just below the 5.0 mg/L daily average WWH criterion at RM 0.5. The average D.O. at this site was 4.95 mg/L. In terms of its aquatic life use attainment status, this site was still in full attainment. Dissolved oxygen was above criteria at the other Still Fork sites. The highest daily D.O. variation was 4.1 mg/L at RM 0.01 during the July 5 to July 7, 2011 survey. The MWH designation is being recommended for Still Fork.

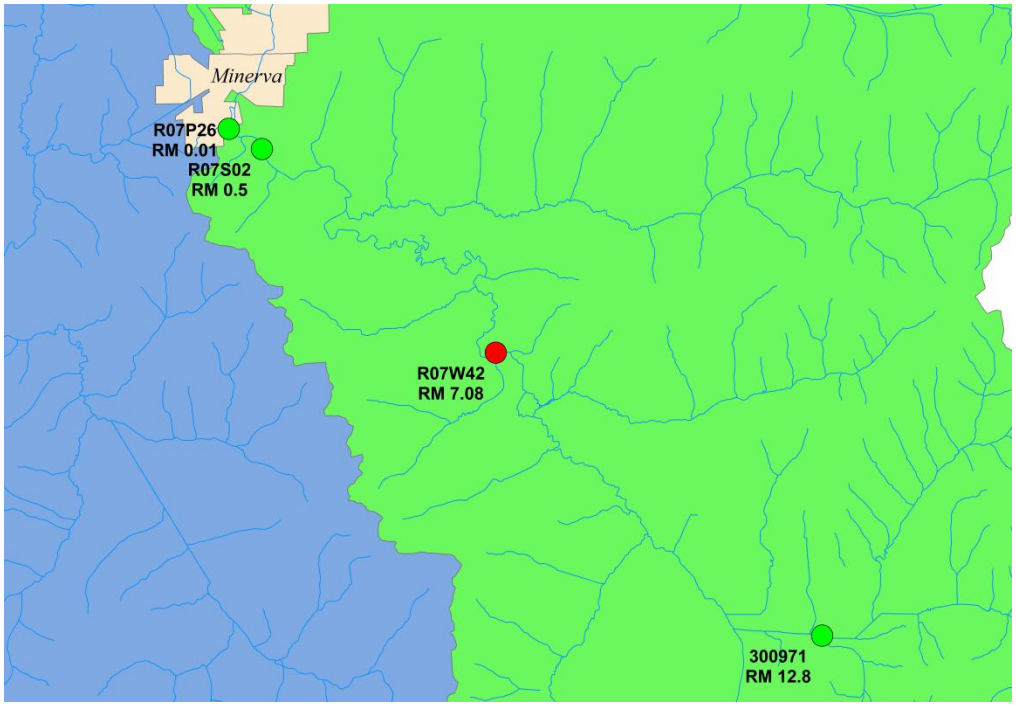


Figure 11. Still Fork DataSonde® sites, 2010-2011. Site colors indicate aquatic life use attainment status at co-located sites: green for full attainment and red for non-attainment.

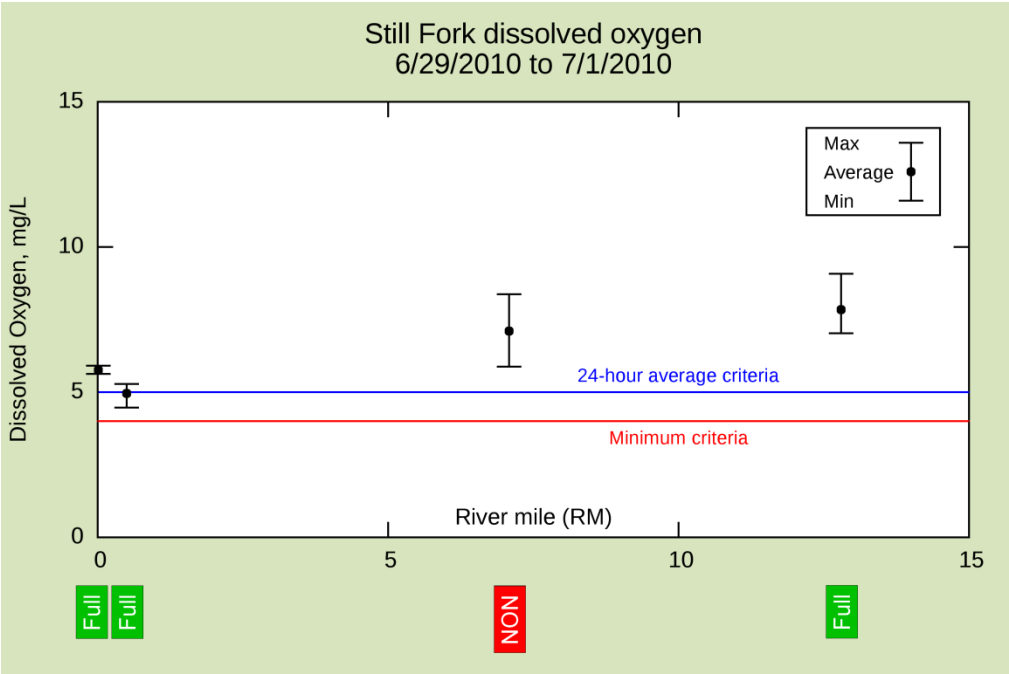


Figure 12. Still Fork DataSonde® results, June 29 to July 1, 2010. Aquatic life use attainment status at co-located sites is indicated: green for full attainment and red for non-attainment.

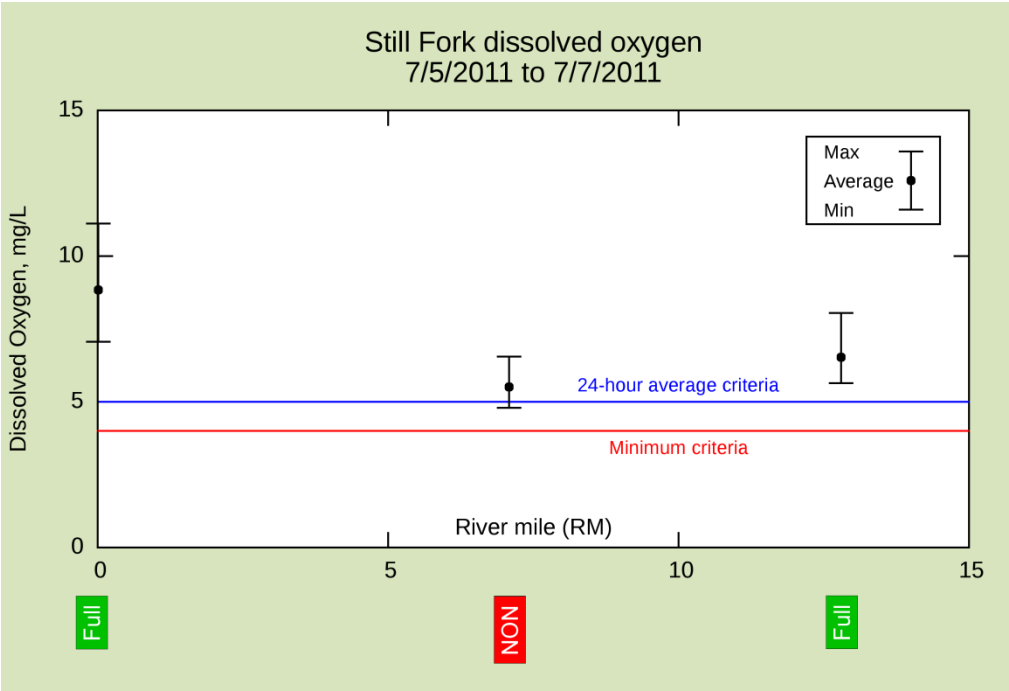


Figure 13. Still Fork DataSonde® results, July 5 to July 7, 2011. Aquatic life use attainment status at co-located sites is indicated: green for full attainment and red for non-attainment.

Pipe Run

DataSondes® were deployed on Pipe Run at two sites during three surveys conducted in 2010-2011 (Figure 14). One site was monitored during the June 29-July 1, 2010 survey (Figure 15). Two sites were monitored from August 31 to September 2, 2010 (Figure 16), and again from July 5 to July 7, 2011 (Figure 17).

The results of the three Pipe Run surveys showed that dissolved oxygen was not meeting Ohio WQS criteria during the 8/31/10-9/2/10 survey at RM 2.2. The average D.O. at this site was 3.8 mg/L, and the minimum was 2.6 mg/L. The highest D.O. daily variation was 2.8 mg/L at the same point. This site has a partial attainment status of its WWH aquatic life use. The cause of the impairment was determined to be natural in origin (wetland-like physical habitat conditions).

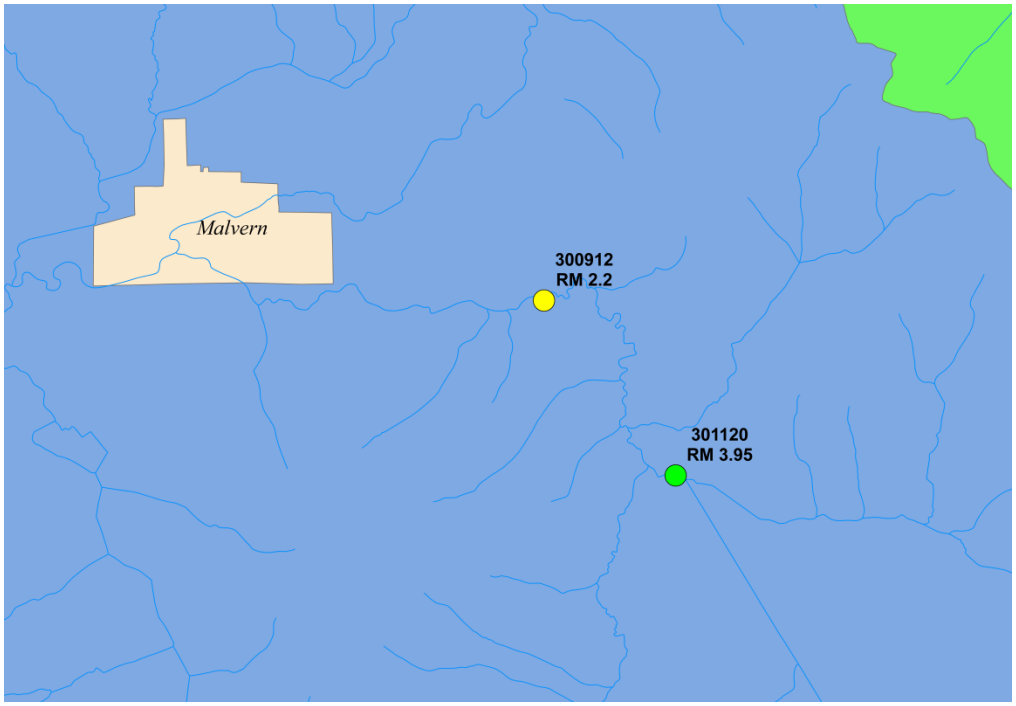


Figure 14. Pipe Run DataSonde® sites, 2010-2011. Site colors indicate aquatic life use attainment status at co-located sites: green for full attainment and yellow for partial attainment.

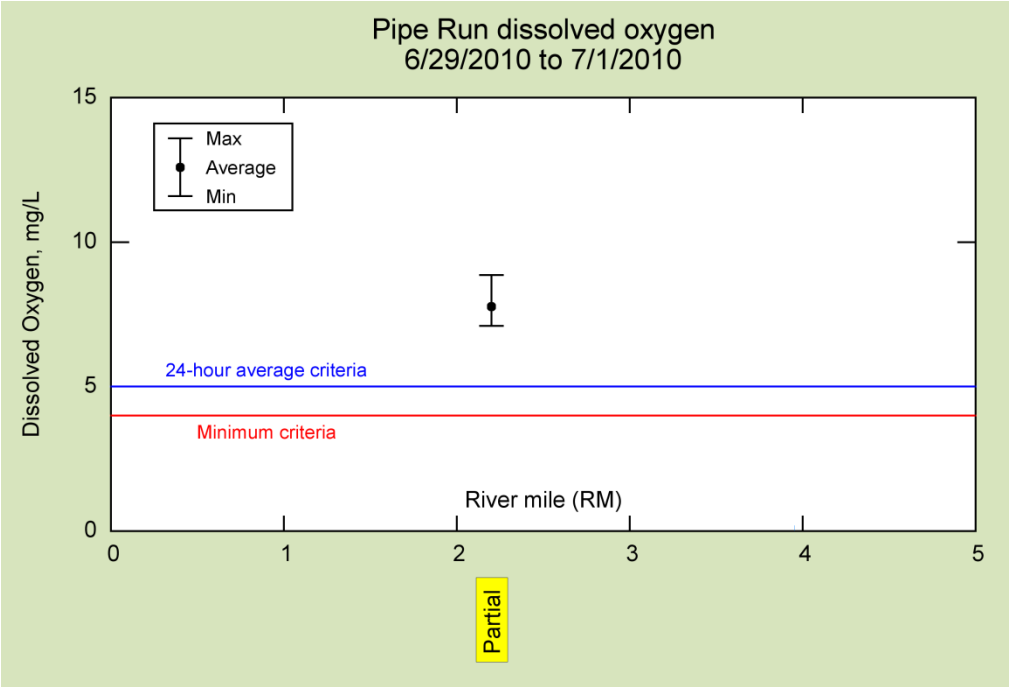


Figure 15. Pipe Run DataSonde® results, June 29 to July 1, 2010. Aquatic life use attainment status at co-located sites is indicated: green for full attainment and yellow for partial attainment.

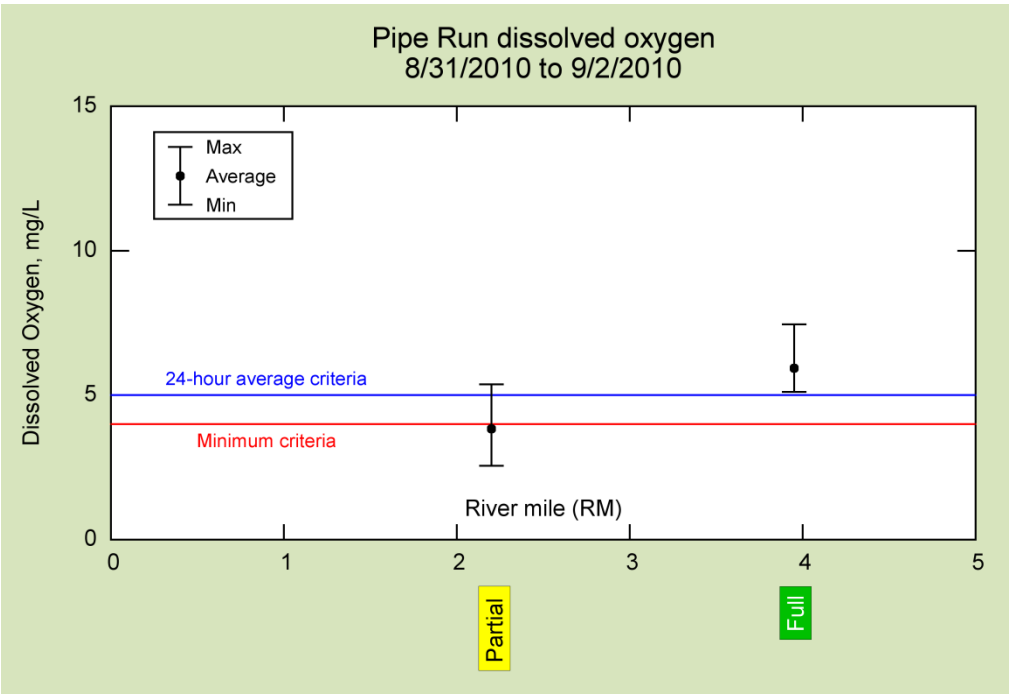


Figure 16. Pipe Run DataSonde® results, August 31 to September 2, 2010. Aquatic life use attainment status at co-located sites is indicated: green for full attainment and yellow for partial attainment.

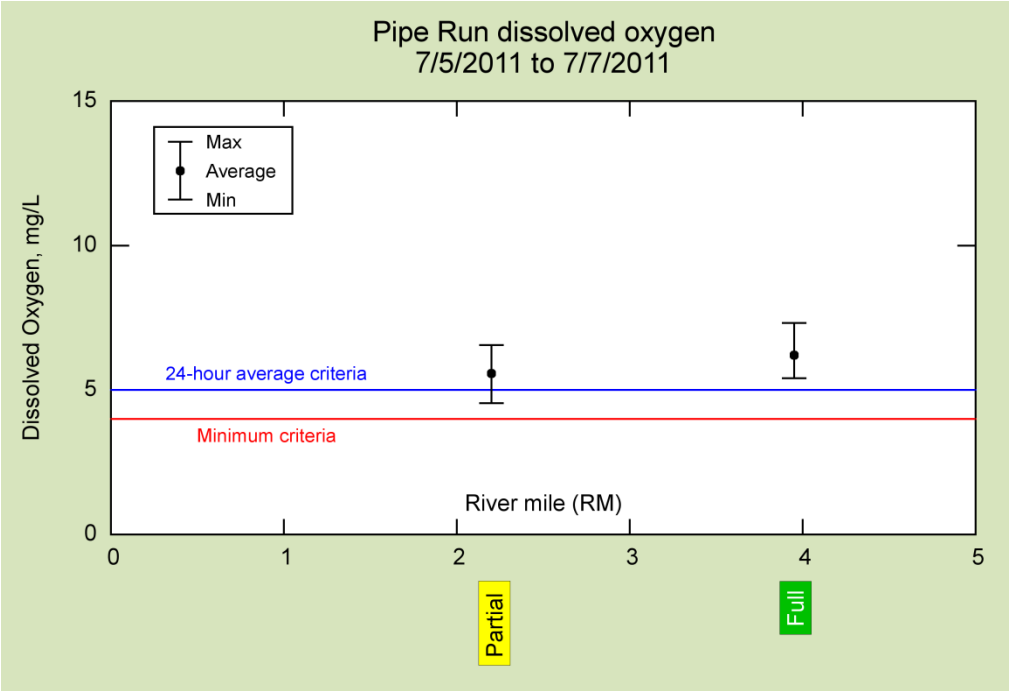


Figure 17. Pipe Run DataSonde® results, July 5 to July 7, 2011. Aquatic life use attainment status at co-located sites is indicated: green for full attainment and yellow for partial attainment.

Additional Sandy Creek Tributaries

DataSondes® were deployed on other Sandy Creek tributaries during each of the three surveys (Figure 18). Ten other tributary sites were monitored during the June 29-July 1, 2010 survey (Table 9). Only one other tributary site was monitored from August 31 to September 2, 2010 (Table 10), and two other sites from July 5 to July 7, 2011 (Table 11).

D.O. was not meeting the Ohio WQS WWH criteria at only one of the sites. This was the Friday Creek site during the 7/5/11-7/7/11 survey. Average D.O. at this site was 4.5 mg/L, with a minimum of 2.7 mg/L. Despite this, Friday Creek had full aquatic life use attainment. Friday Creek is a Still Fork tributary, and has been recommended for the MWH use.

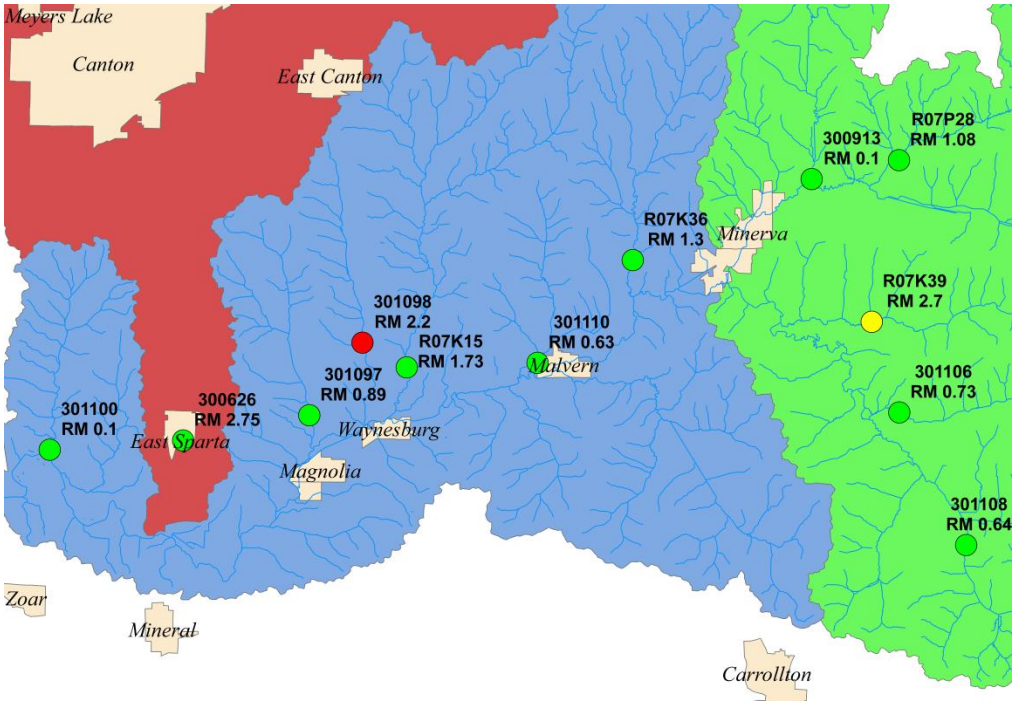


Figure 18. Additional Sandy Creek tributary DataSonde® sites, 2010-2011. Site colors indicate aquatic life use attainment status at co-located sites: green for full attainment, yellow for partial attainment, and red for non-attainment.

Table 9. Sandy Creek tributaries DataSonde® dissolved oxygen results, June 29 to July 1, 2010.

Station Code	Name	River Mile	Dissolved Oxygen, mg/L, Min / Avg / Max	Range, mg/L	Attainment Status
301110	ARMSTRONG RUN @ ST. RT. 43	0.63	8.1 / 8.6 / 9.3	1.2	Full
301100	BEAR RUN @ GRACEMONT	0.09	7.4 / 8.8 / 11.7	4.3	Full*
R07P28	CONSER RUN N OF EAST ROCHESTER @ KNOX SCHOOL RD.	1.08	7 / 7.8 / 8.9	1.9	Full
R07K36	HUGLE RUN N OF ONEIDA @ LIBERTY CHURCH RD.	1.3	7.3 / 8.2 / 9.9	2.6	Full
301097	PLEASANT VALLEY RUN @ GROVEDELL ST.	0.89	7.6 / 8 / 8.6	1.0	---
301098	INDIAN RUN @ ST. RT. 43	2.2	7.8 / 8.2 / 8.7	0.9	NON
R07K15	L. SANDY CREEK N OF WAYNESBURG @ ELSON ST.	1.73	8.2 / 8.7 / 9.5	1.3	Full

Table 9. Sandy Creek tributaries DataSonde® dissolved oxygen results, June 29 to July 1, 2010.

Station Code	Name	River Mile	Dissolved Oxygen, mg/L, Min / Avg / Max	Range, mg/L	Attainment Status
300913	MIDDLE BRANCH SANDY CREEK @ KURTZ RD	0.1	7.1 / 8.3 / 10.8	3.7	Full
R07K39	MUDDY FORK SE OF MINERVA @ BELLFLOWER RD.	2.7	7.2 / 8.2 / 10.2	3.0	Partial
300626	NIMISHILLEN CREEK AT EAST SPARTA @ FARBER RD.	2.75	7.5 / 9 / 12.5	5.0	---

*Attainment status is for Station R07P10 at RM 0.1.

Table 10. Sandy Creek tributaries DataSonde® dissolved oxygen results, August 31 to September 2, 2010.

Station Code	Name	River Mile	Dissolved Oxygen, mg/L, Min / Avg / Max	Range, mg/L	Attainment Status
R07K15	L. SANDY CREEK N OF WAYNESBURG @ ELSON ST.	1.73	6.7 / 7.4 / 8.6	2.0	Full

Table 11. Sandy Creek tributaries DataSonde® dissolved oxygen results, July 5 to July 7, 2011.

Station Code	Name	River Mile	Dissolved Oxygen, mg/L, Min / Avg / Max	Range, mg/L	Attainment Status
301108	FRIDAY CREEK @ CHANNEL RD.	0.64	2.7 / 4.5 / 6.8	4.2	Full
301106	REEDS RUN @ ST. RT. 9	0.73	4.6 / 5.1 / 5.8	1.2	Full

PUBLIC DRINKING WATER SUPPLIES

The public water supply 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 2010 Integrated Water Quality Monitoring and Assessment Report describes this methodology and is available on OEPA's website: http://www.epa.state.oh.us/dsw/tmdl/OhioIntegratedReport.aspx.

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 no Public Water System intakes within the Sandy Creek watershed. There are, however, seven municipal public water systems using ground water wells. These are listed in Table 12. Drinking water source protection areas, public water system wells, and intakes in the Sandy Creek watershed are shown in Figure 19.

Table 12. Public water systems using groundwater in Sandy Creek survey area.

PWS ID	County	PWS Name
OH1000812	Carroll	Mohawk Utilities
OH1000112	Carroll	Village of Malvern
OH1000012	Carroll	Village of Carrollton
OH7603112	Stark	Village of Magnolia
OH7605712	Stark	Village of Waynesburg
OH7603812	Stark	Village of Minerva
OH7901612	Tuscarawas	TCMSD-Wilkshire Hills

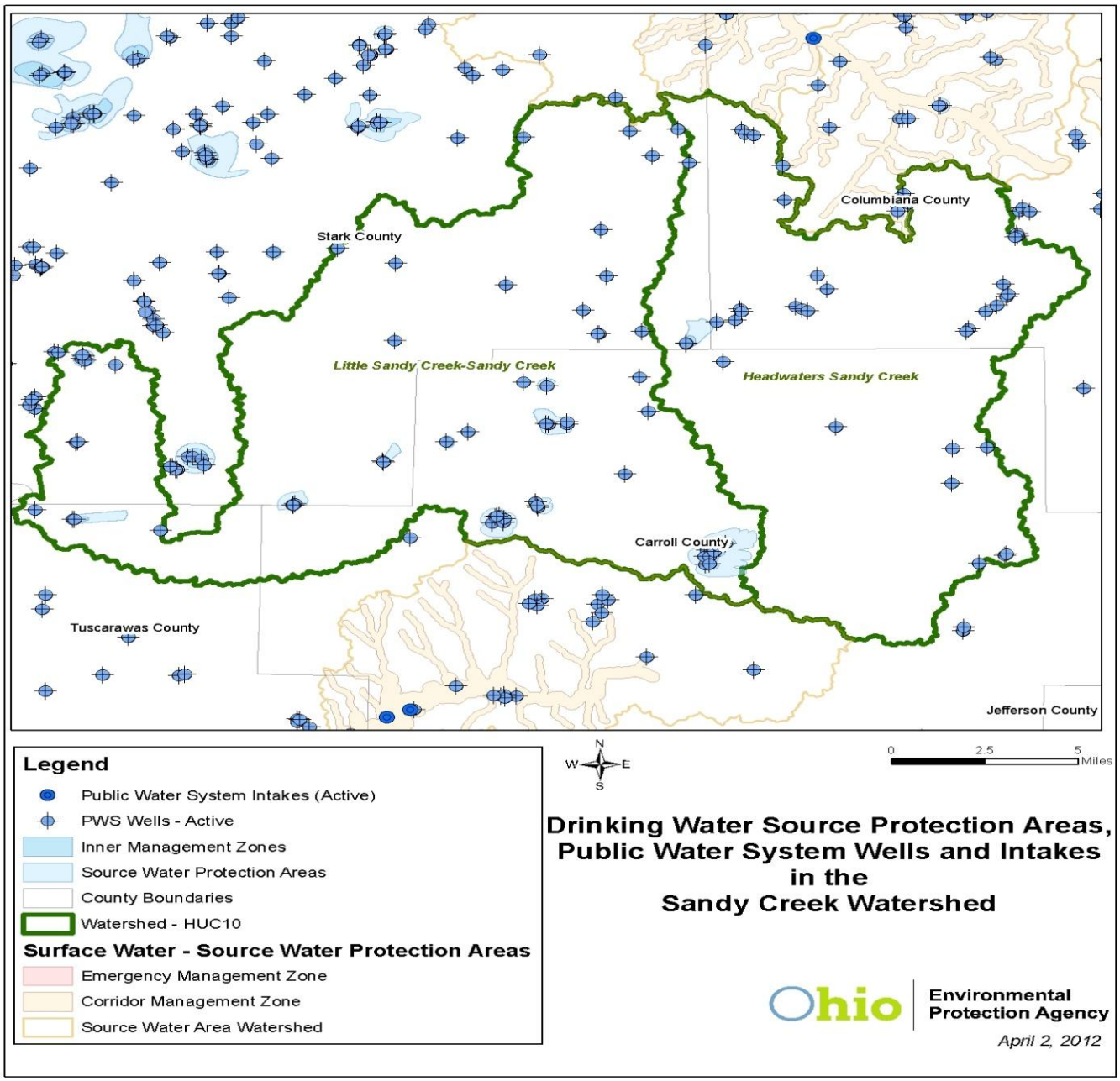


Figure 19. Drinking water source protection areas, public water system wells and intakes in the Sandy Creek watershed.

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 fish advisories; 2) to determine attainment with the water quality standards; and 3) to examine trends in fish contaminants over time.

Fish Consumption 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 three samples of a single species from within the past 10 years. For Sandy Creek, common carp, largemouth bass, northern pike, rock bass, and smallmouth bass met this requirement. Largemouth bass and northern pike were in the one meal a week advisory category for both mercury and PCB contamination. Common carp and rock bass were in the one meal a month advisory category for PCB contamination. Smallmouth bass were in the one meal a month advisory category for both mercury and PCB contamination. For all other species, 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.

For a listing of fish tissue data collected from Sandy Creek in support of the advisory program, and how the data compare to advisory thresholds, see Table 14.

Human Health (Fish Contaminants) Beneficial Use Attainment

In addition to determining safe meal frequencies, fish contaminant data are also used to determine attainment with the human health water quality criteria pursuant to OAC Rules 3745-1-33 and 3745-1-34. The human health water quality 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 water quality standards, the sport fish caught within a HUC12 must have a weighted average concentration of the geometric means for all species below 1.0 mg/kg for mercury, and below 0.054 mg/kg for PCBs. Fish tissue data in the Sandy Creek study were adequate to determine attainment status. At least 2 samples from each trophic level 3 and 4 are needed, and two of thirteen HUC12s in the Sandy Creek basin met that data requirement. The two HUC12s that were evaluated for human health use attainment were Headwaters Sandy Creek (05040001 04 06) and Armstrong Run-Sandy Creek (05040001 06 05). Concentrations of mercury and PCBs and the associated attainment status are listed in Table 13 below. Weighted average PCB concentrations in both HUC12s triggered non-attainment of the Human Health (Fish Contaminants) beneficial use.

Table 13. Attainment status of HUC 12s for Human Health (Fish Contaminants) beneficial use.

HUC12	Mercury (mg/kg)	PCBs (mg/kg)	Attainment
05040001 04 06 Headwaters Sandy Cr.	0.162	**0.248**	Non-Attainment
05040001 06 05 Armstrong Run-Sandy Cr.	0.145	**0.065**	Non- Attainment

While weighted average mercury concentrations were below the use impairment threshold, the concentrations of mercury in fish from Sandy Creek increased between 1993-97 and 2010 (0.078 mg/kg to 0.158 mg/kg, respectively). Part of that increase may be attributable to an increase in the size of fish caught, from an average of 339 mm in 1993-97 to 411 mm in 2010. Both HUC12s were in non-attainment of the Human Health (Fish Contaminants) beneficial use due to PCB contamination in excess of the Ohio WQS based threshold of 0.054 mg/kg PCBs in fish tissue.

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) done 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.

Fish tissue had previously been collected from Sandy Creek in 1993, 1996 and 1997. Those data covered the same study area as the 2010 data, from West Township Park at RM 34.7 to downstream from the Bolivar Dam at RM 0.5. The weighted average concentration of PCBs in Sandy Creek fish was approximately the same between the two study periods, 0.167 mg/kg in 1993-97 and in 2010.

Table14. Select fish tissue data (mg/kg) from Sandy Creek sampling sites, 2010. The shading indicates the advisory category that applies beyond the statewide advisory for the fish species with enough data to assess. Green = two meals per week, yellow = one meal per week, orange = one meal per month, no shading = not enough data to assess. The most stringent of the advisories should apply for any individual fish species.

Year	Location	River Mile	Species	Mercury	PCBs
2010	Sandy Creek downstream Bolivar Dam	0.57	Black Crappie	0.121	0.275
2010	Sandy Creek at Summitville Tile	27.4	Black Crappie	0.115	0.106
2010	Sandy Creek downstream Bolivar Dam	0.57	Channel Catfish	0.322	0.514
2010	Sandy Creek upstream TRW Company	33	Common Carp	0.126	0.075
2010	Sandy Creek upstream TRW Company	33	Common Carp	0.114	0.122
2010	Sandy Creek at Summerville Tile	27.4	Common Carp	0.055	0.593
2010	Sandy Creek at Summerville Tile	27.4	Common Carp	0.062	0.887
2010	Sandy Creek downstream Bolivar Dam	0.57	Common Carp	0.083	0.625
2010	Sandy Creek downstream Malvern Wastewater Treatment Plant	22	Common Carp	0.147	0.191
2010	Sandy Creek upstream TRW Company	33	Common Carp	0.095	0.075
2010	Sandy Creek upstream Malvern Wastewater Treatment Plant	22.5	Common Carp	0.138	0.399
2010	Sandy Creek at Summerville Tile	27.4	Goldfish	0.124	0.641
2010	Sandy Creek upstream TRW Company	33	Largemouth Bass	0.085	0.145
2010	Sandy Creek at Summerville Tile	27.4	Largemouth Bass	0.175	0.143
2010	Sandy Creek at Summerville Tile	27.4	Largemouth Bass	0.188	0.208
2010	Sandy Creek downstream Bolivar Dam	0.57	Largemouth Bass	0.145	0.025
2010	Sandy Creek downstream Bolivar Dam	0.57	Northern Pike	0.104	0.247
2010	Sandy Creek downstream Malvern Wastewater Treatment Plant	22	Northern Pike	0.170	0.105

Year	Location	River Mile	Species	Mercury	PCBs
2010	Sandy Creek upstream Malvern Wastewater Treatment Plant	22.5	Northern Pike	0.101	0.077
2010	Sandy Creek upstream Minerva Wastewater Treatment Plant	29.2	Rock Bass	0.143	0.616
2010	Sandy Creek upstream Malvern Wastewater Treatment Plant	22.5	Rock Bass	0.150	0.050
2010	Sandy Creek upstream Malvern Wastewater Treatment Plant	22.5	Rock Bass	0.205	0.050
2010	Sandy Creek upstream Minerva Wastewater Treatment Plant	29.2	Smallmouth Bass	0.312	0.200
2010	Sandy Creek upstream TRW Company	33	Smallmouth Bass	0.348	0.134
2010	Sandy Creek downstream Malvern Wastewater Treatment Plant	22	Smallmouth Bass	0.377	0.078
2010	Sandy Creek upstream Minerva Wastewater Treatment Plant	29.2	Smallmouth Bass	0.318	0.793
2010	Sandy Creek upstream Malvern Wastewater Treatment Plant	22.5	Smallmouth Bass	0.306	0.077
2010	Sandy Creek downstream Bolivar Dam	0.57	Yellow Bullhead	0.155	<0.050
2010	Sandy Creek downstream Bolivar Dam	0.57	Yellow Perch	0.106	<0.050

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.

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 Sandy Creek watershed evaluated in this survey are designated as Primary Contact Recreation (PCR) use in OAC Rule 3745-1-24. 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)]. There are 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. The Sandy Creek mainstem is designated Class A PCR waters from U.S. Rt. 30 in Minerva to the Tuscarawas River; the remainder of Sandy Creek and all other streams assessed during this survey are designated Class B PCR waters. The *E. coli* criteria that apply to PCR Class A and B streams include a geometric mean of 126 and 161 cfu/100 ml, and a maximum value 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 (Table 15.)

Summarized bacteria results are listed in Table 15, and the complete dataset is reported in Appendix Table 4. Downloadable bacteria results are also available from the Ohio EPA GIS interactive maps at the following link: http://www.epa.ohio.gov/dsw/gis/index.aspx. Eighteen locations in the Sandy Creek study area were sampled for *E. coli* four to seventeen times, from May 19 to October 27, 2010. Evaluation of *E. coli* results revealed that none of the eighteen locations attained the applicable geometric mean criterion, and, thus, were in non-attainment of the PCR use.

Table 15. *A summary of E. coli data for locations sampled in the Sandy Creek watershed, May 19th to October 27, 2010. Recreation use attainment is based on comparing the geometric mean to the Primary Contact Recreation (PCR) Class A or B geometric mean water quality criterion of 126 or 161 cfu/100 ml (Ohio Administrative Code 3745-1-07). All values are expressed in colony forming units (cfu) per 100 ml of water. Gray shaded values exceed the applicable PCR Class A or B geometric mean criterion.*

Location	River Mile	Recreation Use*	# of Samples	Geometric Mean†	Maximum Value	Recreational Attainment Status	Probable Source(s) of Bacteria
HUC 0504000040 06 - Upper Sandy Creek							
Sandy Creek	34.7	PCR B	13	1132.5	9900	**NON**	Septic, Livestock
Sandy Creek	32.06	PCR B	13	876.3	16000	**NON**	
HUC 0504000060 05 - Armstrong Run-Sandy Creek							
Sandy Creek	25.1	PCR A	13	620.0	22000	**NON**	Septic, Livestock
Sandy Creek	22.1	PCR A	4	282.7	3100	**NON**	
HUC 0504000060 06 - Indian Run-Sandy Creek							
Sandy Creek	17.3	PCR A	13	273.1	1600	**NON**	Septic, Livestock
Sandy Creek	13.9	PCR A	11	349.9	2700	**NON**	

Location	River Mile	Recreation Use*	# of Samples	Geometric Mean†	Maximum Value	Recreational Attainment Status	Probable Source(s) of Bacteria
HUC 0504000060 07 - Beal Run-Sandy Creek							
Sandy Creek	7.49	PCR A	13	431.1	9800	**NON**	Septic, Livestock
Sandy Creek	0.57	PCR A	13	567.7	20000	**NON**	
HUC 0504000040 01 - Conser Run							
Conser Run	0.38	PCR B	5	1360.8	10000	**NON**	Septic, Livestock
HUC 0504000040 02 - Middle Branch Sandy Creek							
Middle Branch Sandy Creek	0.1	PCR B	13	1166.0	46000	**NON**	Septic, Livestock
HUC 0504000040 03 - Pipes Fork-Still Fork							
Still Fork	12.83	PCR B	5	2985.9	73000	**NON**	Septic, Livestock
HUC 0504000040 04 - Muddy Fork							
Muddy Fork	2.64	PCR B	17	657.2	9800	**NON**	Septic, Livestock
HUC 0504000040 05 - Reeds Run-Still Fork							
Still Fork	7.08	PCR B	13	1301.0	14000	**NON**	Septic, Livestock
Still Fork	0.51	PCR B	5	454.1	6900	**NON**	
HUC 0504000060 04 - Little Sandy Creek							
Little Sandy Creek	1.84	PCR B	12	550.5	1700	**NON**	Septic, Livestock
HUC 0504000060 01 - Hugle Run							
Hugle Run	1.33	PCR B	13	557.6	28000	**NON**	Septic, Livestock
HUC 0504000060 02 - Pipe Run-Middle Run							
Pipe Run	0.22	PCR B	13	595.8	24000	**NON**	Septic, Livestock
HUC 0504000060 03 - Black Run							
Black Run	0.1	PCR B	15	701.6	4500	**NON**	Septic, Livestock

* *Recreation class may include primary contact recreation classes (A, B or 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.*

NPDES PERMITTED FACILITIES

A total of twenty-two individual National Pollutant Discharge Elimination System (NPDES) permits and thirteen general NPDES permits have been issued for sanitary wastewater, industrial process water, and/or industrial storm water discharges into Sandy Creek and its tributaries. A list of permits in the Sandy Creek basin is included as Table 16. Nimishillen Creek is a large tributary to Sandy Creek and it has a number of large discharges including the City of Canton, The Timken Company, and Ashland Petroleum. Discussion of these entities is not included here but may be found in the U.S. EPA approved TMDL report for the Nimishillen Creek basin available at http://epa.ohio.gov/portals/35/tmdl/NimishillenCreekTMDL_final_oct09_wo_app.pdf. 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). Summarized effluent results from the larger dischargers are listed in Table 17.

Table 16. *NPDES permits in the Sandy Creek watershed (excluding the Nimishillen Creek subwatershed).*

Individual Permits:			
Facility Name	**Ohio EPA No.**	**USEPA No.**	
American Landfill Inc.	3IN00169	OH0107221	
Bear Creek Campground & Toboggan Club Inc.	3PR00169	OH0117773	
BTM Sewer District	3PB00102	OH0051144	
Carroll Co Home Golden Age Retreat	3PR00171	OH0116688	
Colfor Manufacturing Inc., Malvern Operations	3IS00115	OH0107263	
Fohl Village MHP	3PV00080	OH0117731	
Glenn Whiteleather LLC Properties	3PT00075	OH0126381	
Imperial Zinc Corporation	3II00196	OH0139408	
Liberty Tire Services of Ohio LLC	3IN00203	OH0111791	
Magnolia Village WWTP	3PH00053	OH0091847	
Mineral City Loading Facility	0IN00234	OH0124982	
Minerva STP	3PC00023	OH0021849	
Northrop Grumman Systems Corp.	3ID00060	OH0084018	
Oakhill Manor Care Center	3PR00177	OH0123412	
Rosebud Mining Company	3IL00018	OH0121801	
Sandyville-East Sparta WWTP	0PJ00007	OH0048615	
Skyland Hills MHP	3PG00149	OH0044482	
Skyland Hills MHP WTP	3IY00161	OH0126055	
Spread Eagle Tavern Inc	3PR00470	OH0140422	
Town & Country Park Estates	3PV00124	OH0137014	
United Local School District	3PT00066	OH0126071	
Valley Mining, Inc. - East Sparta	3II00201	OH0140708	
General Permits:			
Facility Name	**Ohio EPA No.**	**USEPA No.**	**Permit Type**
American Landfill Inc.	3GM00055	3GM00055	Coal Surface Mine
Bolivar Dam	0GT00002	0GT00002	Temporary Discharge
Buckeye Industrial Mining - Hamilton	3GM00126	OHGM00209	Coal Surface Mine
Buckeye Industrial Mining Co	3GM00067	3GM00067	Coal Surface Mine
Buckeye Industrial Mining Co - Beaver Excavating	3GM00123	3GM00123	Coal Surface Mine
Buckeye Industrial Mining Co - Berlin Minerals	3GM00115	3GM00115	Coal Surface Mine
Buckeye Industrial Mining Co - Finnie	3GM00092	3GM00092	Coal Surface Mine
Buckeye Industrial Mining Co - Freed Street	3GM00124	3GM00124	Coal Surface Mine
Buckeye Industrial Mining Co - Mapleton	3GM00122	3GM00122	Coal Surface Mine
Buckeye Industrial Mining Co - Wilson	3GM00120	3GM00120	Coal Surface Mine
Campbell Oil Minerva Bulk	3GB00001	3GB00001	Petroleum Bulk Storage Facility
Liberty Tire Services of Ohio	3GT00003	3GT00003	Temporary Discharge
Valley Mining Inc - ENZ Inc.	3GM00017	3GM00017	Coal Surface Mine

Table 17. *Concentrations of monitored chemicals in effluent discharged from five facilities in the Sandy Creek study area. Results are reported for the time period 2000-2010.*

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
BTM Sewer District (Ohio EPA Permit #3PB00102)				
Outfall 001 to Sandy Creek (RM 22.15, lat/long at 40.6859 / -81.1900)				
Ammonia – Winter	0.23 mg/L	2.9 mg/L	3 mg/L	5 mg/L
Ammonia Summer	0.21 mg/L	1.76 mg/L	2 mg/L	3 mg/L
Phosphorus	2.51 mg/L	4.95 mg/L	Monitor	Monitor
Total Suspended Solids	6 mg/L	30 mg/L	16 mg/L	24 mg/L
cBOD 5 day	3 mg/L	7 mg/L	12 mg/L	19 mg/L
Flow Rate	0.343 MGD	0.484 MGD	0.800 MGD	Monitor
Magnolia Village WWTP (Ohio EPA Permit #3PH00053)				
Outfall 001 to Sandy Creek (RM 14.1, lat/long at 40.6552 / -81.3094)				
Ammonia – Winter	20.96 mg/L	28.59 mg/L	Monitor	Monitor
Ammonia Summer	3.23 mg/L	18.83 mg/L	Monitor	Monitor
Phosphorus	3.09 mg/L	4.23 mg/L	Monitor	Monitor
Total Suspended Solids	11.6 mg/L	49.3 mg/L	65 mg/L	90 mg/L
cBOD 5 day	10 mg/L	25.27 mg/L	25 mg/L	40 mg/L
Flow Rate	0.227 MGD	0.39 MGD	0.33 MGD	
Minerva WWTP (Ohio EPA Permit #3PC00023)				
Outfall 001 to Sandy Creek (RM 29.06, lat/long 40.7167 / -81.1090)				
Ammonia – Winter	0.26 mg/L	1.944 mg/L	Monitor	Monitor
Ammonia Summer	0.26 mg/L	1.873 mg/L	5.9 mg/L	8.9 mg/L
Phosphorus (2005-2010)	3.545 mg/L	10.846 mg/L	Monitor	Monitor
Total Suspended Solids	5 mg/L	13.8 mg/L	30 mg/L	45 mg/L
cBOD 5 day	2 mg/L	5 mg/L	25 mg/L	40 mg/L
Flow Rate	0.704 MGD	1.312 MGD	0.93 MGD	
Sandyville-East Sparta WWTP (Ohio EPA Permit #0PJ00007)				
Outfall 001 to Sandy Creek (RM 8.1, lat/long 40.6335 / -81.3624)				
Ammonia – Winter	0.08 mg/L	0.3 mg/L	Monitor	Monitor
Ammonia Summer	0.08 mg/L	0.6 mg/L	Monitor	Monitor
Total Suspended Solids	5 mg/L	14 mg/L	30 mg/L	45 mg/L
cBOD 5 day	3 mg/L	5.65 mg/L	25 mg/L	40 mg/L
Flow Rate	0.292 MGD	0.506 MGD	0.50 MGD	
Northrop Grumman Systems Corp. (Ohio EPA Permit #3ID00060)				
Outfall 001 to Sandy Creek via an unnamed tributary (enters Sandy Cr.@ RM 31.4, lat/long 40.7418 / -81.0911)				
1,1-Dichloroethane	0 µg/L	1.5 µg/L	5 µg/L	10 µg/L
Trichloroethylene	0 µg/L	4.32 µg/L	5 µg/L	10 µg/L
Vinyl Chloride	0 µg/L	0 µg/L	5 µg/L	10 µg/L
C-1,2-Dichloroethene	3.65 µg/L	25.75 µg/L	20 µg/L	30 µg/L
Total Volatile Organics	3.7 µg/L	31.475 µg/L	Monitor	Monitor
Flow Rate	1.561 MGD	1.872 MGD	1.728 MGD	

Sandy Creek is not an effluent dominated stream as illustrated in Figure 20. When permitted dischargers to the stream, located above the USGS gage at Waynesburg (RM 17.35), are compared to the overall stream flow, they comprise approximately 16% of the stream flow. This dilution is often reflected in NPDES permits for facilities which can have loading calculations result in permit limits less stringent than in other more effluent dominated streams. Several permits are discussed in greater detail below.

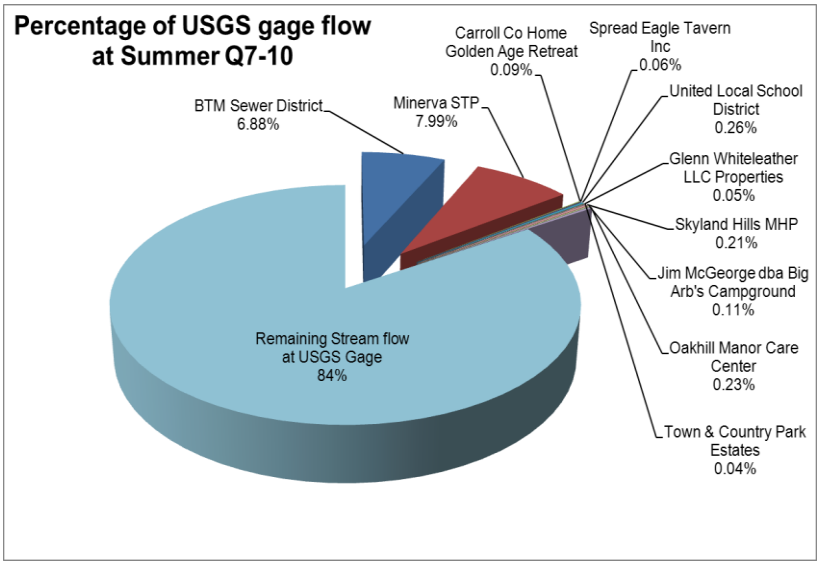


Figure 20. *Stream flow composition at USGS Waynesburg gage*.

BTM Sewer District (Ohio EPA Permit # 3PB00102)

The BTM Sewer District operates a 0.800 mgd publically-owned treatment plant located in Carroll County. The facility serves approximately 4,500 residents in the Village of Malvern, as well as Brown and Harrison townships. The facility is operated by Carroll County Environmental Services and discharges to Sandy Creek at approximately RM 22.15. The plant was constructed in 1979. A Permit-To-Install (PTI) was issued in 1999 to allow for the expansion of the plant from 0.350 mgd to the current 0.800 mgd. Part of the flow contributing to the expansion came from elimination of the Lake Mohawk WWTP. Construction was completed in 2001. As can be seen in Figure 21, reported violations decreased following completion of plant upgrades in 2001. Current treatment consists of a bar screen followed by a primary rotating basket screen. Secondary treatment includes extended aeration and clarification followed by tertiary sand filters and UV disinfection.

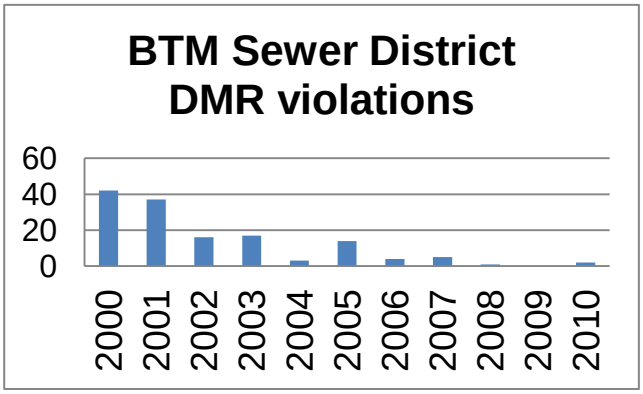


Figure 21. *Violations at the BTM Sewer District*.

Magnolia Village WWTP (Ohio EPA Permit # 3PH00053)

The Magnolia Village WWTP is a 0.33 mgd facility owned and operated by the Stark County Sanitary

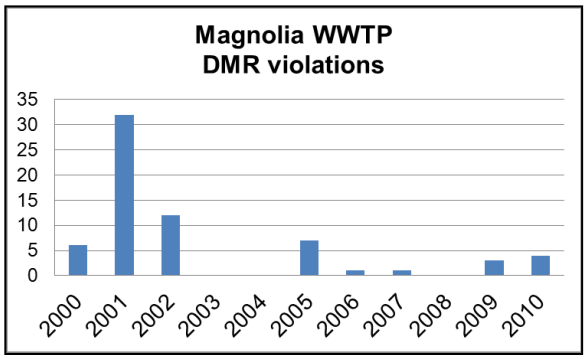


Figure 22. *Violations at the Magnolia WWTP.*

Engineer. The WWTP serves approximately 2,300 residents in the villages of Magnolia and Waynesburg. The plant discharges treated wastewater to Sandy Creek at RM 14.16. The current plant was constructed in 1988 and consists of a bar screen, comminution, and four aerated lagoons in series prior to discharge to Sandy Creek. The facility uses chlorination to disinfect with no dechlorination. The compliance record at the plant has been generally good since 2002 (Figure 22).

Minerva STP (Ohio EPA Permit # 3PC00023)

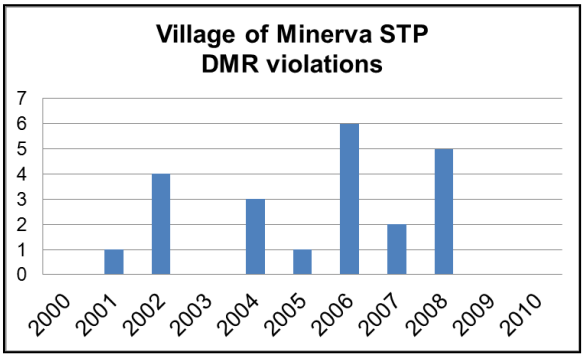


Figure 23. *Violations at the Minerva STP.*

The Village of Minerva Sewage Treatment Plant provides secondary treatment of municipal and pretreated industrial wastewater. The plant discharges treated wastewater to Sandy Creek at RM 29.08, immediately upstream from the confluence with the Still Fork. The plant was built in the 1920's with the last major improvements completed in September, 1996. The improvements included influent pumps, fine screens, activated sludge aeration with new blowers and fine bubble diffusers, periphery feed circular final clarifiers, U-V disinfection, and effluent flow metering. Additional improvements included converting all abandoned settling tanks to sludge holding and digestion tanks. The design flow of the STP is 0.93 mgd. The compliance record at the plant has been generally very good since 2000, with no reported violations in 2009 and 2010 (Figure 23).

Sandyville-East Sparta WWTP (Ohio EPA Permit # 0PJ00007)

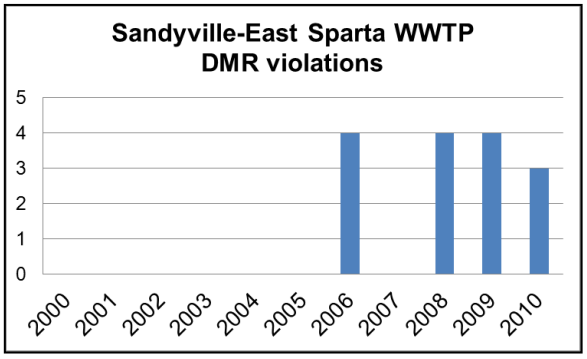


Figure 24. *Violations at the Sandyville-East Sparta WWTP.*

The Sandyville-East Sparta WWTP is owned and operated by the Tuscarawas County Commissioners. The plant, initially constructed in 1979, discharges to Sandy Creek at approximately RM 8.04, upstream of the Nimishillen Creek – Sandy Creek confluence. The facility is located at 4489 Dover-Zoar Road NE, Mineral City, Ohio, Tuscarawas County. This wastewater treatment plant serves approximately 3200 residents in the Sandyville/Crossroads area of Sandy Township along with the East Sparta Area in Stark County. The separate sanitary sewer system serving these areas flows to a wastewater treatment plant that was constructed in 1979 with an average daily design flow of 0.50 MGD. The wastewater treatment plant consists of two comminutors, extended aeration, Final settling, clorination, dechlorination, aerobic sludge digestion/sludge holding tanks and land application of sludge. Final effluent is disinfected using chlorine gas and then dechlorinated using sulfur dioxide gas. The back-up generator for the facility serves only the laboratory building on-site. The Tuscarawas County Commissioners are

working to ensure back-up power is supplied to the entire wastewater treatment plant during power outages. The compliance record at the plant has been generally good since 2000, reported violations are included in Figure 24.

Northrop Grumman Systems Corp (Ohio EPA Permit # 3ID00060)

In August, 1981, TRW notified U.S. EPA and Ohio EPA of its discovery of polychlorinated biphenyls (PCBs) in the soils. Significant concentrations were found in some areas of the site. Volatile organics were discovered in ground water on and off site in 1984. Volatile organics were used at the TRW site during materials processing and handling. The major contaminants detected in the water are tetrachloroethene (PCE), trichloroethene (TCE), trans-1,2-dichloroethene (trans-1,2-DCE), 1,1-dichloroethene (1,1-DCE), vinyl chloride (VC), 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1-DCA), and chloroethane (CA).

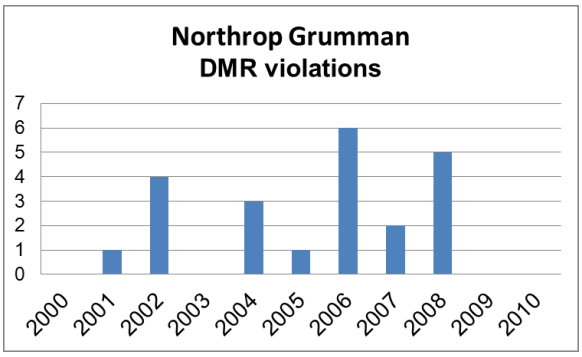


Figure 25. *Violations at Northrop Grumman*.

The site has been evaluated and remediation is being implemented under review of both Ohio EPA and U.S. EPA. The most recent review of the site by Ohio EPA's Superfund group can be found at: http://www.epa.gov/superfund/sites/fiveyear/f05-05053.pdf

A groundwater extraction and treatment system was constructed in 1986. It includes eight recovery wells pumping at a combined rate of 1,200 gallons per minute. Recovered ground water is pumped to an air stripper located on the TRW property. This system has been in operation since February 1987 and has an NPDES permitted flow of 1.728 mgd. Annual discharge rates from 2000 to 2010 average 1.47 mgd. Reported violations are included in Figure 25.

AQUATIC LIFE AND PHYSICAL HABITAT

Aquatic life use designation and attainment status were assessed at 48 sites within the Sandy Creek watershed study area. Confirmation of or recommended revisions to aquatic life uses are presented in Table 3 and aquatic life use attainment status at Sandy Creek basin sites is included in Table 2. A summary of fish community collection results can be found in Table 18, and a summary of macroinvertebrate collection results can be found in Table 19. Additional information is included in the appendices to this report. Appendix 6 depicts the Qualitative Habitat Evaluation Index (QHEI) physical habitat attribute matrix which is used to support aquatic life use designation and attainment status decisions. Appendix 7 tabulates Index of Biotic Integrity (IBI) scoring. Fish species collected by site are listed in Appendix 8. Invertebrate Community Index (ICI) scoring and macroinvertebrate community attributes are tabulated in Appendices 9 and 10, respectively, and the macroinvertebrate taxa recorded at each site are listed in Appendix 11.

Sandy Creek

Ohio EPA has evaluated Sandy Creek aquatic community performance at selected sites during eight separate assessment efforts since 1983. Larger studies occurred in 1993 and in 1996. The 2010 survey was the first comprehensive watershed investigation where the entire mainstem was evaluated in the same sampling period.

In 2010, Sandy Creek habitat conditions were generally good at 14 sampling locations (QHEI $\bar{x}$ =73.0). Overall, aquatic community performance was also good (IBI $\bar{x}$=42.6, Mlwb $\bar{x}$=9.0, ICI $\bar{x}$ =40.25). However, the different reaches were affected by local influences. At four sites within and upstream from Minerva, Sandy Creek appears to be a riffle/run oriented stream with good flow (QHEI $\bar{x}$=61.9). Recovery from past channel modification is incomplete but sufficient to warrant expectation of WWH aquatic life use achievement (IBI $\bar{x}$=46.5, Mlwb $\bar{x}$=9.8, ICI $\bar{x}$=40). The fair fish assemblage at Lippincott Road (IBI=38, RM 36.9) included 18 species but only three that depend on good riffle conditions. Riffles enhance water quality through sand filtration, gaseous diffusion, and as a dense surface area for biological respiration. Riffle inadequacy compounded by excessive siltation trapped within the deeply incised former canal hinders water quality in the uppermost reach of Sandy Creek. Strong continuous flow through run and glide areas sustained marginally good facultative macroinvertebrate assemblages in this part of Sandy Creek.

The best habitat conditions in Sandy Creek were recorded at six sites in the reach from Minerva to the upstream extent of the Number 6 dam pool. Well defined riffles separated from deep pools by runs and glides were enhanced by cobble and gravel substrate in this reach (QHEI $\bar{x}$ =81.1). Aquatic community performance at all six locations achieved the relevant biocriteria (IBI $\bar{x}$=43.5, Mlwb $\bar{x}$=9.1, ICI $\bar{x}$=41.4). In 1996, no fish were present downstream from the Minerva WWTP (IBI=12, Mlwb=0, RM 28.2). The fish absence was an initial response to WWTP effluent toxicity following significant operational failures. Facility challenges were evident in the earlier 1993 Sandy Creek study (Ohio EPA 1995). That survey documented poor biological scores downstream from the WWTP (IBI=23, Mlwb=5.5, ICI=10). After the 1996 sample with no fish, marginal operational improvements were recorded in 1997 (IBI=28, Mlwb=6.9, RM 28.2) and further downstream in 1998 (IBI=36, Mlwb=5.5, RM 10.3). The success of facility upgrades were apparent in 2010 (IBI=46, Mlwb=9.5, ICI=40, RM 28.9).

Undefined riffles graded into deeper swales at three Sandy Creek sites in the reach from Waynesburg to the Bolivar Dam (QHEI $\bar{x}$=74.33). All of this reach is sporadically impounded by Bolivar Dam. With a homogeneous sandy pea gravel stream bed, abundant woody debris and plenty of bank oriented cover, the stream's wetland qualities seemed to be enhanced by the unique flood pulse attributable to the Bolivar control structure. Aquatic community biological index scores were influenced by the atypical conditions in this reach (IBI $\bar{x}$=36.0, Mlwb $\bar{x}$=7.6, ICI $\bar{x}$=Good). The macroinvertebrate community included pollution sensitive Ephemeroptera, Plecoptera, and Trichoptera (EPT) and midge taxa represented by the state endangered caddisfly *Brachycentrus numerosus* and mayflies of the genera *Maccaffertium* and *Isonychia*. While the macroinvertebrate density was low, taxa diversity was high. Conversely, the fish

assemblage diversity was consistently moderate, devoid of species intolerant of pollution, and notably under represented by redhorse and other sucker species. The pervasive number of pollution tolerant omnivorous fish in this reach was especially apparent at Co. Rd. 104 (RM 7.4) where the community did not achieve the IBI biocriterion. A significant proportion of the fish population (2%) also displayed external anomalies associated with environmentally induced stress at this location downstream from Nimishillen Creek.

The fish community failed to achieve the MIwb biocriterion in the Number 6 dam pool at Waynesburg (RM 17.34) and at RM 7.4. This measure of the distribution of weight and species within the population was influenced by minimal component values. For instance, in the first dam pool sample, only one smallmouth bass (*Micropterus dolomieu*), two black crappie (*Pomoxis nigromaculatus*), and one or two individuals of several other species comprised the 16 species assemblage. In the second dam pool sample, four smallmouth bass, one black crappie and the same under-representation comprised the 13 collected species. In the first dam pool collection, 45 northern hog suckers (*Hypentelium nigricans*) were present, while 30 were noted in the second. The same low individual abundance within species (14 and 12 species, respectively) and unequal weight distribution (77 and 44 hog suckers, respectively) within the community was demonstrated downstream at the RM 7.4 location. In all samples, these skewed species and biomass distributions were characteristic of environmental instability.

Often an MIwb score imbalance like this is accompanied by low top carnivore presence. Conceptually, prey limitations and shifting environmental quality act to preclude adult piscivores. However, this co-occurrence was not evident in Sandy Creek. Instead, northern pike (*Esox lucius*) were well represented by several individuals in each collection. Indeed, the Sandy Creek northern pike population rivals that of any Ohio stream. In 1985, Ohio EPA collected four northern pike in nine samples within this lower reach of Sandy Creek. Poor to fair MIwb scores (3.2-7.0) with similar species and weight distributions were typical then. In 1998, no northern pike were present in two samples with poor MIwb scores (5.3-5.4). In 2010, 27 northern pike were documented in six lower reach samples with fair to good MIwb performance (6.7-8.6). Furthermore in 2010, 31 northern pike were among five Sandy Creek samples in the reach upstream from Waynesburg. MIwb scores at these sites were generally good (7.8-9.7). In summary, subpar MIwb scores in the Bolivar Dam influenced reach of Sandy Creek have only marginally improved despite a notable increase in northern pike abundance. Unfortunately, point source pollution impacts emanating from the Nimishillen Creek watershed, first observed by Ohio EPA in 1985, continue to degrade the lower reach of Sandy Creek water quality 25 years later (see Appendix D, p. D1-34 in Ohio EPA 2000).

Good habitat conditions downstream from Bolivar Dam were accompanied by good aquatic community performance in 2010 at RM 0.57 (QHEI=64.5, ICI=38, IBI=42, MIwb=9.4). Ohio EPA previously sampled fish communities in this location (RM 0.4) in 1983 (IBI=25, MIwb=5.5) and in 1989 (IBI=33, MIwb=7.3). Water quality is altered by temporary impoundment, subsequent flow through the dam infrastructure, and by the flow across riffles immediately downstream from the dam. The poor to fair conditions at this location in the 1980s were especially due to pollution

emanating from Nimishillen Creek. The Bolivar dam did not appear to exert an additional influence at that time. Now, the much improved water quality downstream from the dam suggests that flow control is influential.

Conser Run

Conser Run presented some puzzling contrasts between biological sampling results at two sites (RMs 4.7 and 1.1). Beaver-influenced wetland characteristics were evident throughout Conser Run, as was ample groundwater recharge and a mix of natural and modified stream attributes. Upstream, the highly sinuous stream was enclosed under a second growth canopy and flanked by buttonbush margins. An absence of riffles, indiscernible current and functionless cover suggested the shallow low gradient stream may have been impounded. Downstream, a beaver dam was present within the sampled reach. Riffles, moderate flow, and better substrates below the beaver pool offered a variety of functional aquatic habitat. However, the prevailing upland wetland, low gradient stream qualities at both sites produced good QHEI scores that only differed by two points (QHEI $\bar{x}$=68.0).

The collection of coldwater macroinvertebrate taxa (the stonefly *Leuctra* and caddisfly *Ceratopsyche slossonae*) and some sensitive taxa at both sites supported the same marginally good (MG) narrative assessments. Nevertheless, the upstream prevalence of pollution tolerant aquatic worms and midge taxa (*Glyptotendipes* and *Procladius)* was indicative of some degradation. This disparity was more profound between the upstream poor fish assemblage (IBI=26) and the downstream exceptional community (IBI=56). Comparison of the 11 upstream fish species to the 21 downstream suggested the upstream riffle absence was an important factor. Upstream, the presence of only one darter species was insufficient to bolster several affected IBI metric scores. Downstream, six darter species buoyed the best scores across at least one third of the IBI metrics. An overall low number of fish upstream in contrast to a moderate number downstream was also influential in the different IBI values. The depauperate abundance is a compelling factor implicating some suppression beyond wetland limitations was a factor in the poor upstream fish community performance.

Middle Branch Sandy Creek

Strong continuous groundwater-derived base flow kept Middle Branch Sandy Creek water temperatures cool and promoted good reaeration. Consequently, several pollution sensitive or cold water macroinvertebrate taxa and fish species were present at two sample sites (RMs 3.7 and 0.1). The downstream Middle Branch Sandy Creek location was home to 25 fish species, the most recorded at any 2010 Sandy Creek tributary study site. Good habitat conditions supported overall good fish and marginally good macroinvertebrate performance (QHEI $\bar{x}$=69.3, IBI $\bar{x}$=44, macroinvertebrates=MG).

Still Fork

Sandy Creek upstream from Still Fork drains 63 mi^2. Still Fork, the second largest Sandy Creek tributary, drains 71 mi^2. Since the pre-resettlement era, there was awareness that streams flowing south to join Sandy Creek had gravel and sand substrates attributable to glacial drift

origination. Sandy Creek tributaries flowing northerly were understood to drain shale seams by way of clay bottomed stream valleys. By inference, it seems likely that the Sandy Creek appellation respected a substrate type and the Still Fork name may have recognized its wetland attributes. However, in the absence of compelling historical accounts, Still Fork may alternatively have been named for a forgotten whisky distillery once located along its bank. In any case, Sandy Creek downstream from Still Fork is twice as large as either of the principal branches and the character of each fork is noticeably different.

Figure 26. *Lowhead dams impact about four miles of the Still Fork. This is the second lowhead dam located at RM 0.11.*

Still Fork has been further transformed by drainage enhancement efforts and by impoundments affecting the lower few miles of stream. The Still Fork dams (Figure 26), one located a few hundred yards upstream from its mouth and the other at RM 0.11, impound water in the lower four miles of the fork. The incongruences between historical efforts to promote drainage and the tolerance for the flow impediment caused by the dams are puzzling. The earliest grist and sawmills, often associated with instream dams, were located in Pekin, Oneida, and (East) Rochester. The Still Fork dams seem to be conceived as a way to create a recreational fishing attraction for the adjacent Minerva Sportsman's Club.

Ohio EPA evaluated the Still Fork dam pool in 1984, 1993, and in 2010. The similarity between fish assemblages in six collections over 26 years is surprising. With the exception of two individual fish, the same 13 species were present in a remarkably consistent pattern of low abundance in each year of assessment. With low numbers of fish, subtle shifts in feeding guilds and pollution tolerance can have a substantive influence on biotic integrity calculations. In 1984 and 2010, the respective average collection of 41 and 50 white suckers (*Catostomus commersoni*) compared to 14 in 1993. Additionally, 51 and 46 bluegill sunfish (*Lepomis macrochirus*) were collected in 1984 and 2010, respectively, versus 160 in 1993. This resulted in catches with higher percentages of omnivores and tolerant fishes in 1984 and 2010 rather than more insectivores and less pollution tolerance in 1993. These discrepancies were fundamental to the observed IBI trend. The MIwb is sensitive to shifts in diversity and biomass distribution. This measure has consistently indicated Still Fork only harbors fair water quality conditions. The calculated MIwb differences between survey years were influenced by a changing largemouth bass (*Micropterus salmoides*) population. Proportionally, the presence of these carnivores has remained steady (12% $\bar{x}$=6 in 1984, 14% $\bar{x}$=28 in 1996 and 10% $\bar{x}$=13 in 2010) but fewer juveniles were present in 2010. Essentially, the 2010 Still Fork impoundment

was inhabited by a fish community skewed toward fewer large individuals and underpopulated by younger fish.

The most significant trend regarding the 26-year span is that water quality in the Still Fork dam pool has consistently been assessed as fair. While measurable water quality improvements have occurred in Sandy Creek, the same expectations have been precluded in Still Fork. From a recreational fishing perspective, the absence of northern pike (*Esox lucius*) in the Still Fork is disappointing. Early historical accounts routinely lament the disappearance of pike due to mill dam construction.

Habitat conditions in the impoundment are poor (QHEI=43.5). The silty muck substrates offer no interstitial voids necessary for most aquatic life. Lacking better stream bed aggregate, the moderate amount of cover has little function and was further diminished by the barely perceptible flow. These poor conditions were unchanged since 1993 (QHEI=40.0). Still Fork is a wetland-type stream. While removal of the dams would not produce riffle/run WWH-type habitat, it would facilitate fish movement to better upstream spawning areas. Wetland streams have reduced assimilative capacity compared to more common Ohio streams. The Still Fork impoundment squanders this pollution buffer producing algal rich water with an increased oxygen demand. Doubtless, a few memorable largemouth bass and bluegill have been caught in the pool, but these fish would inhabit the reach regardless of the dams. Considering the northern pike in the adjacent Pipe Run subbasin and in Sandy Creek, these fish would certainly inhabit a free-flowing Still Fork.

Aquatic life use attainment precepts an attainable use and a measurement of how well the use is achieved. An MWH aquatic life use designation is less than the expectation put forth by the CWA. Ohio EPA is lawfully obliged to work to restore stream conditions where less than WWH aquatic life uses are designated. Alternatively, Ohio adopted a tiered use system specifically because the WWH aquatic life use is an unrealistic goal for some waters. An impoundment perfectly fits this duality of reason. In cases where a dam exists as a monument to a former mill, it is appropriate to expect WWH attainment and recommend dam removal if necessary to achieve that use. Some dams function as part of a local water supply. Obviously, that use has priority and MWH is an appropriate expectation. With the Still Fork dam, the apparent recreational purpose may warrant priority but it seems a disservice to some of the fishing public to accept the existing MWH condition. Nevertheless, until local residents express desire to restore Still Fork water quality, the MWH aquatic life use is the best fit for the impounded reach. Biological performance in 2010 achieved the relevant criteria.

Still Fork was also assessed at two locations upstream from the impoundment (RMs 12.8 and 7.1). Altered wetland stream conditions were prevalent throughout the subbasin (QHEI $\bar{x}$=34.0). Heavy siltation and embeddedness, unstable substrates, and severe bank erosion were common in the Still Fork. The low gradient system lacks energy to transport an entrained bedload and any riffle feature was smoothed by silt strewn with organic debris. The fair aquatic assemblage at both sites (macroinvertebrates=fair, IBI $\bar{x}$=29.0) was similar to performance

recorded in 1993 at RM 5.7 (ICI=30, IBI=37, MIwb=7.1). The macroinvertebrates were dominated by facultative and pollution tolerant taxa. The primarily omnivorous ($\bar{x}$=45%) fish included mostly pollution tolerant species ($\bar{x}$=63%). A poor MIwb score (4.4) at RM 7.1 was due to a significantly low number of fish at the site. Recognizing the existing historically modified stream habitat and the corresponding aquatic community performance, it is accurate to characterize the Still Fork as an MWH stream. Even so, the 2010 poor MIwb score at RM 7.1 failed to achieve the recommended MWH aquatic life use criterion. Efforts to restrict livestock stream access and reduce soil erosion, recommended in the previous Sandy Creek study (Ohio EPA 1995), are reiterated.

Friday Creek, Pipes Fork, and Reeds Run

The principle tributaries to Still Fork are Friday Creek (Figure 27), Pipes Fork, Reeds Run, and Muddy Fork. All of these streams have been widened and deepened, and have had riparian vegetation removed to enhance drainage for agriculture. Single sample locations were assessed on Friday Creek, Pipes Fork, and Reeds Run. Discussion of Muddy Creek follows under the subheading below.

Figure 27. *Friday Creek at RM 0.55 is typical of tributaries in the Still Fork subwatershed*.

Collectively, the most degraded habitat conditions in the 2010 Sandy Creek survey were evident in Friday Creek, Pipes Fork, and Reeds Run (QHEI $\bar{x}$=27.5). These low gradient channelized streams were smothered by silt, devoid of riffles, and offered only the sparsest amount of cover. Draining 9 mi^2, 8 mi^2, and 6 mi^2, respectively, the assimilative capacity of these three streams has been effectively eliminated. Instead, they serve as conduits for transfer of polluted water to the Still Fork.

Aquatic community performance was similarly fair to poor in all three streams (macroinvertebrates=fair, IBI $\bar{x}$=26.7). All assemblages were comprised of facultative and pollution tolerant macroinvertebrate taxa. All assemblages were comprised by mostly pollution tolerant fish ($\bar{x}$=70%) and lacked many species typical for area headwater streams. Instead, Friday Creek and Pipes Fork were inhabited by non-native western mosquitofish (*Gambusia affinis*). Generally, these short-lived fish are presumed to die during colder Ohio winters. Their presence suggests purposeful stocking; however, western mosquitofish (left) were also collected in Still Fork and in Limestone Creek.

In 2004, Ohio EPA documented the presence of these fish in a roadside puddle near the Limestone Creek confluence with Sandy Creek. Considering the wide 2010 distribution and the

multiyear persistence, western mosquitofish appear to have become naturalized in the Sandy Creek watershed. Friday Creek, Still Fork and Limestone Creek were also the only Sandy Creek tributaries where common carp (*Cyprinus carpio*) were collected. This non-native fish has disappeared from many Ohio streams with improving water quality.

Given the absence of fundamental stream traits necessary to support or any indication of inhabitation by a WWH aquatic community, it is appropriate to recommend Friday Creek, Pipes Fork, and Reeds Run be designated with the MWH aquatic life use. Efforts to reduce pollutant export from these streams are encouraged.

Muddy Fork

Muddy Fork seems aptly named. At three 2010 sampling sites, the stream was universally mucky and overwhelmed by silt. Extensively embedded substrates with limited distinction between riffles or pools represented a marginal wooded wetland stream that was much encroached upon by livestock and crop production. The poor habitat conditions (QHEI $\bar{x}$=44.5) coupled with chronic nutrient enrichment affected the fish community more than it limited the generally good macroinvertebrate performance. Muddy Fork was inhabited by the least diverse fish assemblage in the Sandy Creek study area. At Reef and Augusta roads (RMs 5.1 and 4.0, respectively), only 10 species were present while 15 were noted downstream at Bellflower Rd. (RM 2.7). The low richness with numerical paucity resulted in overall fair fish index values (IBI $\bar{x}$ =33).

The disparity between macroinvertebrate and fish indices scores presents factors which defy routine aquatic life use attainability assessment. For Muddy Fork the best resolution is to recognize two stream reaches - an upper MWH reach and a lower WWH reach, based on habitat qualities and biological performance. Muddy Fork conditions improved in a downstream direction. Although the entire stream appears to have been historically changed to improve drainage, the impact of those practices had naturally attenuated more at Bellflower Rd. than at upstream sites. At Bellflower Rd., an array of pollution sensitive and EPT macroinvertebrate taxa were sufficient to earn an exceptional ICI score (46). The fair fish community (IBI=36) was nevertheless improved from upstream and included intolerant hornyhead chubs (*Nocomis biguttatus*) and many large rock bass (*Ambloplites rupestris*). The presence of sensitive species, macroinvertebrate biocriterion achievement, and an improving water quality trend support confirmation of the WWH aquatic life use in the lower part of Muddy Fork. Conversely, the habitat degraded upstream reach and corresponding fair fish communities justified the recommended MWH aquatic life use.

Armstrong Run

Among small streams in the 2010 Sandy Creek study, Armstrong Run was distinguished by its very good habitat quality with exceptional to good biological performance (QHEI=81.5, IBI=50, macroinvertebrates=good) and for being home to the richest fish community (23 species) including the only recorded presence of least brook lamprey (*Lampertra aeryptera*) in the watershed. Brook lamprey are sensitive to a variety of water quality perturbations and require

clean silt-free substrates. Their presence with numerous pollution sensitive macroinvertebrate taxa indicated Armstrong Run had good assimilative capacity.

Hugle Run

Good to very good stream habitat and aquatic community index scores were registered at three Hugle Run sites (QHEI $\bar{x}$=68.0, IBI $\bar{x}$=46, macroinvertebrates=good). The most upstream site at St. Rt. 172 (RM 7.14) was incised and recovering from past channelization. However, good flow, a mix of functional cover, and a variety of larger substrates offset the deleterious historic modification. Area agricultural practices were a likely source of modest nutrient enrichment evidenced by an abundance of pollution tolerant macroinvertebrates. Downstream at Baird Rd. (RM 4.1), EPT and pollution sensitive macroinvertebrate taxa were twice as numerous. Mottled sculpin require colder water temperatures. These fish increased by half at the center site and were twice as numerous at the most downstream site at Liberty Church Rd. (RM 1.3). By inference, groundwater contribution with increasing drainage area helped dilute the agricultural influence. Improving habitat quality also provided better assimilative capacity at downstream locations. Coal fines amongst the substrates indicated mining operations have occurred in the subbasin. Contemporary impact from this industry was not otherwise obvious.

Indian Run

Aquatic life use assessment occurred at one Indian Run location at St. Rt. 43 (RM 2.2) located downstream from a landfill. Excessive bank erosion attributed to high storm flows resulted in a heavy stream bedload of fine sediments. Overland runoff and construction activities further contributed to stream sedimentation. A fair QHEI score (49.8) also resulted from limited sinuosity, little definition between riffle or pool reaches, and a sparse amount of cover. These habitat limitations with other plausible stressors were deemed sufficient to cause the fish community to perform poorly (IBI=28) and the macroinvertebrate community to be rated fair.

Limestone Creek

Bolivar Dam is a Sandy Creek flood control structure. Routine operation often results in its backwater completely inundating the lower reaches of several Sandy Creek tributaries. With its confluence three miles upstream from the dam, Limestone Creek is one of the affected tributary streams. About two miles of Limestone Creek are regularly flooded, but the dam backwater is able to extend at least another mile upstream in response to extreme flooding. Limestone Creek is small (5.3 mi^2). In 2010, two sites were assessed for aquatic life use status. The upstream location at Downing St. (RM 3.7) was completely enclosed and generally hidden by tall grass in combination with some shrubs or thicketed by tightly interwoven brush. The slow flowing trickle of water emanating from the surrounding wetland was difficult to find and just as challenging to sample. The downstream location at Duebler Ave. (RM 0.1) flowed through a forested wetland floodplain. The entire area was blanketed under fine depositional sand, silt and organic material. Sampling was arduous as each foot fall penetrated above the ankle into the stream bed. The overwhelming backwater residues obscured definition between pools or riffles and reduced cover to a functionless presence. Overall, Limestone Creek habitat quality was poor (QHEI $\bar{x}$=41.8).

Limestone Creek originates in a patchwork of degraded sedge wetlands, livestock pastures, and rural residential lots. These land uses easily overwhelm the wetland tributary's assimilative capacity. Despite the absence of any overt activity to maintain the stream, its size and low gradient are insufficient to impart the energy necessary to retain habitat qualities necessary for warm water fish communities. However, lacking deliberate efforts to maintain the stream in a modified condition, assignment of the WWH aquatic life use is the most appropriate use designation. The same logic applies to the downstream reach. Despite the unnatural repetitive flooding, the stream is not channelized and the WWH aquatic life use is the most appropriate use designation here also.

Fair fish assemblages at both sites failed to achieve the WWH criterion (IBI $\bar{x}$=29). The macroinvertebrate community was predominated by facultative dragonfly nymphs and pollution tolerant aquatic beetles. The upstream poor macroinvertebrate community and the low fair community at the downstream site did not achieve WWH expectations.

Bear Run

Bear Run was evaluated at one location (Gracemont St.) near its confluence with Sandy Creek. Bear Run is channelized and maintained to facilitate flood flow within the Bolivar Dam backwater. It exhibited homogenous simplified poor habitat (QHEI=37.0). Substrates were smothered by fine sand, silt and organic detritus. Repetitive flooding, associated bedload deposition and the routine need to excavate the stream in concert with the Bolivar Dam operation prevented better aquatic community performance (IBI=32, macroinvertebrates=fair). Only 12 macroinvertebrate taxa and 10 fish species were collected at the site. Recognizing the priority of flood control and the significant public investment in Bolivar Dam, it is appropriate to accept Bear Run's modified condition and designate it with the MWH aquatic life use. The fair biological assemblages achieved the relevant recommended MWH criteria and expectations.

Little Sandy Creek

Fish sampling was conducted at four Little Sandy Creek locations. Macroinvertebrate assemblages were evaluated at three of the sites. Upstream at Hill Church Road (RM 5.8), habitat was influenced by historic channelization. Narrow runs have developed between wide glides in a reach otherwise overrun by sand and fine gravel substrates. Instances of extensive bank erosion were largely unchecked as riparian vegetation was absent or limited. The historical modification was less apparent at downstream sites but fine grained substrates were pervasive throughout the stream. Overall, good habitat conditions were judged to be sufficient to support WWH expectations (QHEI $\bar{x}$=62.4). Marginally good fish community performance was consistent at all locations (IBI $\bar{x}$=40.8, Mlwb $\bar{x}$=8.0). The macroinvertebrate communities consistently achieved good scores (ICI $\bar{x}$=41.3) and was well represented by pollution intolerant species.

Pipe Run

The upstream Pipe Run site at Arrow Rd. (RM 6.3) was in a low gradient wetland type stream reach. The continuous linear pool here was covered by lily pads. The macroinvertebrate community included 25 pollution tolerant taxa predominated by water boatman, scuds, and bloodworms (macroinvertebrates=fair). The fair fish community (IBI=30) was abundant with golden shiners (*Notemigomus crysoleucas*) and yellow bullhead (*Ictalurus natalis*). These species accounted for almost 60% of the total catch. Both species favor low gradient, well vegetated streams with clear water. Likewise, northern pike (*Esox lucius*) also demonstrate a preference for this habitat type especially during spawning and as a protective nursery. Documenting 13 northern pike in the reach affirmed this observation, but these traits did not offset an otherwise fair habitat assessment (QHEI $\bar{x}$=55.4, n=3).

So many Ohio wetland type streams have been modified that those which remain in a natural condition are notable. The upper reach of Pipe Run was influenced by beaver activity, was inhabited by expected species, and displayed habitat qualities appropriate for a wetland type stream. Its normalcy in this regard was incongruent with fair biological and habitat scores. In this case, the inadequacy is due to the measurement tools rather than degraded environmental quality. It is untenable to evaluate a functional wetland stream against metrics developed for more conventional riffle/run WWH type streams. Although the calculated biological scores imply impairment, the observed suite of stream attributes was deemed to be consistent with those of a functional natural wetland stream reach with a WWH aquatic life use designation.

Downstream at Bellflower Rd. (RM 4.0), the presence of riffles and substrates consisting of rubble and boulders helped the aquatic community to improve to marginally good (macroinvertebrates=marginally good, IBI=40). At the most downstream sampling location at St. Rt. 43 (RM 2.2), the absence of riffles and an abundance of woody debris supported an impression that this low gradient reach was stressed by sporadic high flows. The density and diversity of the aquatic biota declined, resulting in partial achievement of the WWH criteria (ICI=38, IBI=46, MIwb=7.0).

Black Run

Two Black Run sites at Stucky Robertsville Rd. and Lotz Ave. (RMs 4.8 and 0.1, respectively) supported an abundance of EPT and sensitive macroinvertebrate taxa (macroinvertebrates=very good). Stream habitat scores were generally good (QHEI $\bar{x}$=67.5). These sites exhibited good riffles with substrates composed of rubble and coarse gravel. Very good fish communities were present at both sample locations (IBI $\bar{x}$=49). Overall, the biological performance in Black Run was better than in any other Sandy Creek tributary in 2010.

Pleasant Valley Run

Macroinvertebrate assemblages in Pleasant Valley Run were assessed at two sampling locations – Greenport Rd. and Grovedell Rd. (RMs 5.35 and 0.89, respectively). An upstream fair community improved to marginally good at the downstream location. Both sites included facultative EPT and an abundance of aquatic beetle taxa. Limited resources and the end of the field sampling season prevented fish community assessment at these sites and, as such, assessment of the designated WWH aquatic life use was not completed.

Table 18. Fish community summaries based on D.C. pulsed electrofishing sampling conducted by Ohio EPA in the Sandy Creek watershed, 2010. Relative numbers and weight are per 0.3 km for wading and headwaters and 1.0 km for boat sites. Poor and very poor IBI and MIwb results are underlined.

Stream	River Mile	Drainage Area	Average Number of Species	Relative Weight (kg)	Relative Number[1]	(All) Relative Number[1]	QHEI	IBI	MIwb[2]	Narrative
Sandy Creek	36.91	17.6	18	--	232	482	60.3	38	--	Fair
Sandy Creek	34.70	36.3	25	16.0	1158	1556	58.8	52	9.3	Exceptional/Very Good
Sandy Creek	32.06	54.4	26	42.5	2027	3389	67.5	45	10.2	Good/Exceptional
Sandy Creek	30.50	62.0	20.5	68.9	2355	2644	61.0	51	10.0	Exceptional/Exceptional
Sandy Creek	29.30	63.0	24	51.0	2046	2400	80.5	48	9.4	Very Good/Exceptional
Sandy Creek	28.90	135.0	21.5	86.6	2165	2505	80.5	46	9.4	Very Good/Exceptional
Sandy Creek	25.00	161.0	21	64.6	2331	2582	83.5	42	9.2	Marg. Good/Very Good
Sandy Creek	22.40	163.0	19	138.0	599	797	76.5	44	9.4	Good/Exceptional
Sandy Creek	22.05	191.0	16.5	98.1	354	495	79.5	39	8.1	Marg. Good/Marg. Good
Sandy Creek	18.20	214.0	23	57.0	812	1084	86.3	42	9.2	Good/Very Good
Sandy Creek	17.34	253.0	14.5	36.7	193	287	73.0	38	7.8	Marg. Good/Fair
Sandy Creek	13.90	279.0	18	98.9	313	471	71.3	39	8.2	Marg. Good/Marg. Good
Sandy Creek	7.49	481.0	13	46.5	194	339	78.5	30	6.8	Fair/Fair
Sandy Creek	0.57	504.0	19.5	174.9	406	468	64.5	42	9.4	Good/Very Good
Conser Run	4.71	5.8	11	--	53	178	69.0	26	--	Poor
Conser Run	1.08	12.7	21	--	478	634	67.0	56	--	Exceptional
Middle Br. Sandy Cr.	3.72	10.9	18	--	1541	4511	68.8	40	--	Good
Middle Br. Sandy Cr.	0.10	15.5	25	--	608	1182	69.8	48	--	Very Good
Still Fork	12.80	12.4	17	--	406	1357	29.0	32	--	Fair
Still Fork	7.08	47.0	12	--	78	178	39.0	26	4.2	Poor/Very Poor
Still Fork	0.50	70.0	11.5	37.5	179	312	43.5	28	7.5	Fair/Fair
Friday Creek	0.64	8.9	12	--	222	725	22.0	28	--	Fair
Pipes Fork	0.43	8.0	11	--	165	535	35.0	26	--	Poor
Reeds Run	0.73	5.1	13	--	108	378	25.5	26	--	Poor
Muddy Fork	5.12	6.0	10	--	98	811	44.5	30	--	Fair

Stream	River Mile	Drainage Area	Average Number of Species	Relative Weight (kg)	Relative Number[1]	(All) Relative Number[1]	QHEI	IBI	MIwb[2]	Narrative
Muddy Fork	3.95	8.0	10	--	189	399	41.0	34	--	Fair
Muddy Fork	2.70	12.0	15	--	384	712	48.0	36	--	Fair
Hugle Run	7.14	5.9	17	--	870	1934	68.0	44	--	Good
Hugle Run	4.10	12.0	15	--	796	1212	62.0	48	--	Very Good
Hugle Run	1.30	19.6	17	--	642	1282	74.0	45	--	Good
Pipe Run	6.28	9.6	14	--	124	492	48.5	30	--	Fair
Pipe Run	3.95	16.5	18	--	463	775	54.3	40	--	Marg. Good
Pipe Run	2.20	26.0	15	8.7	58	92	63.3	46	7.0	Very Good/Fair
Armstrong Run	0.63	10.3	23	--	990	1752	81.5	50	--	Exceptional
Little Sandy Creek	5.80	29.7	22	7.3	782	2036	63.0	40	8.2	Marg. Good/Marg. Good
Little Sandy Creek	3.60	33.7	20	10.8	431	941	65.8	41	7.9	Marg. Good/Marg. Good
Little Sandy Creek	1.73	36.0	22	7.3	467	1530	55.0	42	7.9	Marg. Good/Marg. Good
Black Run	4.81	10.1	20	--	2076	3458	80.5	50	--	Exceptional
Black Run	0.10	16.4	20	--	1200	3112	54.5	48	--	Very Good
Indian Run	2.20	6.1	10	--	318	660	40.5	30	--	Fair
Limestone Creek	3.68	1.6	5	--	4	328	43.0	28	--	Fair
Limestone Creek	0.10	5.3	10	--	318	660	40.5	30	--	Fair
Bear Run	0.10	9.8	10	--	460	666	37.0	32	--	Fair

1 – Relative Number excludes tolerant fish in the sample. (All) Relative Number includes all fish in the sample.

2 - Mlwb is not applicable for streams $< 20 mi^2$

Table 19. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Sandy Creek study area, June-August, 2010.

Location	River Mile	Drainage (mi^2)	Total Taxa	Qual EPT	Total Sens	Total Tol	CW Taxa	Organism Density[a]	ICI[b]	Narrative Evaluation	Predominant Taxa[c]
HUC 050400010401 - Conser Run											
Conser Run @ Speidel Road	4.71	5.7	31	7	5	7	2	moderate	n/a	Fair	hydropsychids, corixids, and midges
Conser Run @ Mouth of Sandy Creek	0.01	15.4	20	8	3	1	0	moderate	n/a	Fair	*Stenacron*, hydropsychids
HUC 050400010402 – Middle Branch Sandy Creek											
Middle Branch Sandy Creek @ SR 172	3.72	10.9	34	8	5	8	1	low to moderate	n/a	Fair	hydropsychids, corixids, and midges
Middle Branch Sandy Creek @ Kurtz Road	0.10	15.5	46	9	4	5	0	moderate	38	Good	*Stenacron*, hydropsychids, damselflies, and midges
HUC 050400010403 – Pipes Fork/Friday Creek											
Pipes Fork @ Rush Road	0.41	8.0	27	6	2	9	0	moderate	n/a	Fair	scuds and damselflies
Friday Creek @ Channel Road	0.55	8.9	31	2	1	9	0	moderate	n/a	Low Fair	corixids, midges, and scuds
HUC 050400010404 – Muddy Fork											
Muddy Fork @ Reefs Road	5.12	6.0	43	9	4	14	0	moderate	n/a	Marginally Good	hydropsychids, scuds, and midges
Muddy Fork @ Augusta Road	3.95	8.7	45	10	5	15	0	low to moderate	n/a	Marginally Good	baetids and hydropsychids
Muddy Fork @ Bellflower Road	2.70	12.0	55	12	6	6	0	moderate	46	Exceptional	hydropsychids, scuds, and midges
HUC 050400010405 – Reed Run/Still Fork											
Reed Run @ SR 9	0.73	5.1	27	5	2	18	0	moderate	n/a	Fair	hydropsychids and *Sphaerium*
Still Fork @ Mark Road	12.83	12.5	28	4	0	11	0	moderate	n/a	High Fair	hydropsychids and *Sphaerium*
Still Fork @ Bellflower	7.08	47.0	42	6	0	2	0	moderate	26	High Fair	*Stenacron*, tanytarsini midges, and corixids
Still Fork @ Mouth of Sandy Creek	0.01	71.4	65	15	7	15	0	moderate	26	High Fair	scuds and midges
HUC 050400010406 – Sandy Creek to ust. Minerva WWTP											
Sandy Creek @ US Rt. 30 dist. of Kensington	39.38	10.4	55	11	3	14	0	moderate	n/a	Marginally Good	baetids, *Sphaerium*, and scuds

Location	River Mile	Drainage (mi^2)	Total Taxa	Qual EPT	Total Sens	Total Tol	CW Taxa	Organism Density[a]	ICI[b]	Narrative Evaluation	Predominant Taxa[c]
Sandy Creek @ Lippincott Road	36.91	33.0	33	10	5	2	0	moderate	n/a	Marginally Good	hydropsychids, *Stenacron*, and *Rheotanytarsus*
Sandy Creek @ West Twp. Park E. Rochester	34.70	36.3	53	14	10	1	0	moderate to high	42	Very Good	hydropsychids, baetids, corixids and scuds
Sandy Creek @ Stump Road	32.06	61.7	50	17	8	13	0	moderate	n/a	Good	hydropsychid, baetids, midges, and scuds
Sandy Creek ust. of 1st Pedestrian Bridge @ US 30	30.50	61.7	48	10	8	7	0	high	38	Good	*Rheotanytarsus*, baetids, and scuds
Sandy Creek @ NYC RR Trestle dst. US 30	29.50	62.9	50	16	10	4	0	high	40	Good	*Rheotanytarsus*, baetids, and scuds
HUC 050400010601 **– Armstrong/Hugle Run**											
Armstrong Run @ SR 43	0.63	10.3	41	13	9	7	0	moderate	n/a	Good	*Rheotanytarsus*, midges, and scuds
Hugle Run @ SR 172	7.14	5.9	36	8	7	6	1`	moderate	n/a	Marginally Good	hydropsychids, baetids, and midges
Hugle Run @ Baird Road	4.41	12.2	53	17	13	3	1	moderate	n/a	Very Good	hydropsychids, baetids, and midges
Hugle Run @ Liberty Church Road	1.33	20.1	42	14	9	2	1	moderate	n/a	Good	hydropsychids, baetids, damselflies, and scuds
HUC 050400010602 - Pipe Run											
Pipe Run @ Arrow Road	6.28	9.6	46	3	0	25	0	moderate	n/a	High Fair	scuds, corixids, and midges
Pipe Run @ Bellflower Road @ RR Tracks	3.95	16.5	47	10	7	11	0	low to moderate	n/a	Marginally Good	hydropsychids and *Stenacron*
Pipe Run @ SR 43	2.21	25.6	38	5	3	5	0	low	38	Good	*Stenacron*, corixids, and hydropsychids
HUC 05040010603 – Black Run											
Black Run @ Stucky/Robertsville Road	4.81	10.1	46	16	10	9	2	moderate	n/a	Good	baetids, midges, and corixids
Black Run @ Orchard View Drive	0.10	16.4	61	21	20	7	2	low to moderate	52	Exceptional	baetids, midges, damselflies, and scuds
HUC 050400010604 Little Sandy Creek											
Little Sandy Creek @ Hill Church	5.82	29.7	51	17	13	9	1	moderate to high	40	Good	*Rheotanytarsus* and damselflies

Location	River Mile	Drainage (mi^2)	Total Taxa	Qual EPT	Total Sens	Total Tol	CW Taxa	Organism Density[a]	ICI[b]	Narrative Evaluation	Predominant Taxa[c]
Little Sandy Creek @ Chapel	3.60	34.3	50	17	10	2	1	low to moderate	42	Very Good	*Rheotanytarsus* and damselflies
Little Sandy Creek @ Elson Street	1.84	36.1	42	13	12	1	0	moderate	42	Very Good	*Rheotanytarsus*, *Stenacron*, elmid beetles
HUC 050400010605 – Sandy Creek – Greer Road											
Sandy Creek @ SR 183 dst. Minerva WWTP	28.90	135.0	42	19	14	2	0	high	40	Good	*Rheotanytarsus*, *Stenacron*, scuds
Sandy Creek @ Pekin (Summerville Tile)	28.30	135.0	55	12	11	7	0	high	40	Good	*Rheotanytarsus*, *Stenacron*, scuds
Sandy Creek @ Blade Road ust. of Oneida	25.10	161.0	56	19	17	8	1	moderate	44	Very Good	hydropsychids, *Rheotanytarsus*, *Stenacron*, scuds, midges
Sandy Creek @ Greer Road	18.20	214.0	54	17	12	7	0	moderate to high	n/a	Very Good	hydropsychids, *Rheotanytarsus*, *Stenacron*, scuds midges
HUC – 050400010606 – Sandy Creek – Magnolia Levee /Pleasant Valley/Indian Run											
Sandy Creek @ SR 183	17.30	214.0	50	24	8	5	0	moderate	40	Good	hydroptilids, midges, scuds, *Corbicula*
Sandy Creek @ Magnolia Levee	13.90	278.0	39	9	6	3	0	moderate to high	n/a	Marginally Good	leptocerids, scuds, midges
Indian Run @ SR 43/Ridgeview Drive	2.20	6.1	32	5	4	6	0	low to moderate	n/a	Fair	hydropsychids, midges
Pleasant Valley Run@ Greenport Rd.	5.35	1.3	30	6	5	6	1	moderate to high	n/a	High Fair	hydropsychids midges
Pleasant Valley Run@ Grovedell Road	0.89	10.1	31	8	3	3	0	low to moderate	n/a	Marginally Good	hydropsychids, *Sphaerium*, beetles, midges
HUC – 050400010607 – Limestone Creek/Bear Run - Sandy Creek - Bolivar Dam											
Limestone Creek @ Downing Street	3.68	1.6	15	1	0	9	0	moderate	n/a	Poor	scuds, planorbid snails, midges
Limestone Creek @ Duebler Avenue	0.10	5.3	16	2	0	8	0	low	n/a	Low Fair	scuds
Bear Run @ Gracemont Street	0.10	10.3	12	3	2	4	0	low to moderate	n/a	High Fair	midges, corixids, scuds
Sandy Creek @ Sandyville Road (C107)	7.49	481.0	39	15	10	3	0	moderate	n/a	Good	hydropsychids, scuds, midges

Location	River Mile	Drainage (mi^2)	Total Taxa	Qual EPT	Total Sens	Total Tol	CW Taxa	Organism Density[a]	ICI[b]	Narrative Evaluation	Predominant Taxa[c]
Sandy Creek @ Bolivar Dam	0.57	503.0	27	8	4	3	0	moderate	38	Good	*Stenacron*, midges, scuds

a – Observed relative density of benthos on natural substrates. Please refer to Appendix Table 11 for relative densities collected from artificial substrates (where 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. Dashed lines (--) indicate sites where quantitative data were not available due to vandalism, dessication, or some other disturbance of the artificial substrate samplers.
c – Predominant taxa are those observed on natural substrates. Please refer to Appendix Table 11 for predominant taxa collected from artificial substrates.

SANDY CREEK BIOLOGICAL TREND ASSESSMENT

Compared to historical collections from the mainstem of Sandy Creek between RMs 35 and 25 in 1996 and 1997 (Ohio EPA 1998), 2010 sampling documented substantial improvement in the aquatic biota over that period. As physical habitat quality remained excellent (QHEI ≥ 75) over the sampling periods, upgrades to the Minerva WWTP were likely most responsible for the improvements. Large numbers of blackflies (S*imulium*), indicative of nutrient enrichment, were collected in 1996 but are now being replaced with pollution sensitive midges and caddisflies. Figure 28 illustrates the dramatic increase in the ICI from 1996 to 2010.

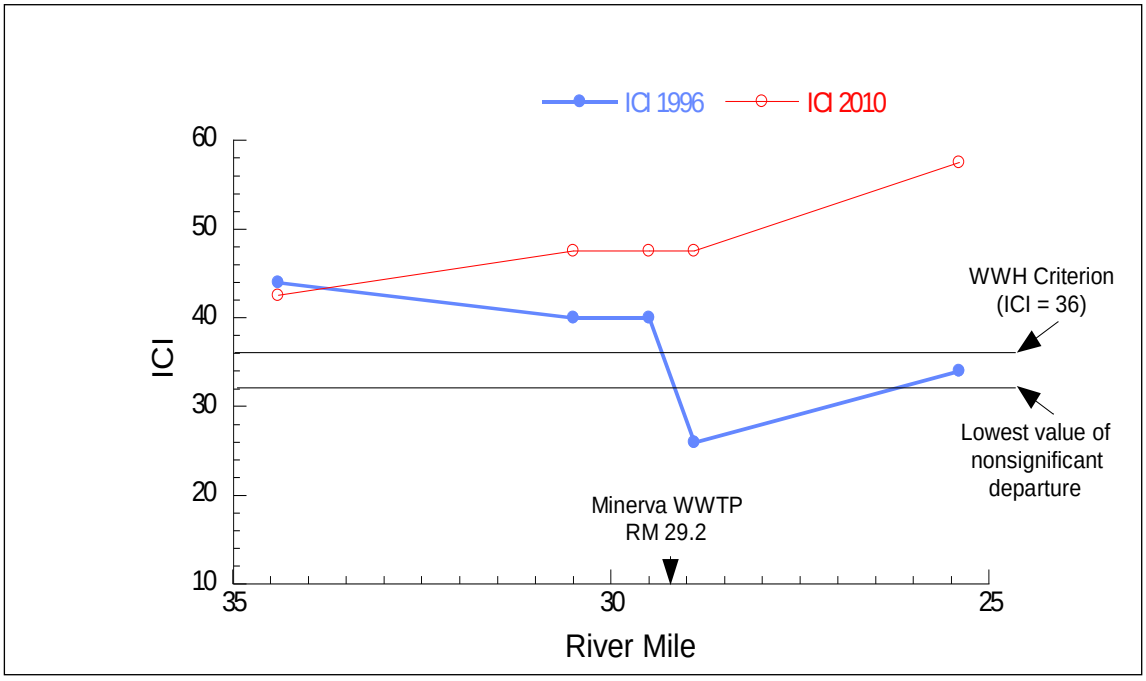


Figure 28. Trend graph comparing ICI scores between 1996 and 2010 surveys for the Sandy Creek mainstem, RMs 35-25.

The fish community results of 2010 still showed a decline in IBI scores at sites downstream from the WWTP at RM 29.2 (Figure 29). However, the decline was not as precipitous as in 1996. The 2010 IBI scores decreased from exceptional at sites upstream from the WWTP to marginally good, but still achieving WWH biocriteria, a few miles downstream. This decrease suggests that factors other than the WWTP impacts may play a part in influencing the fish community in this reach. Good flow is present but functionality seemed to be lacking. Riffles were essentially deep glides and pools were depressions in sand and gravel bedloads. Fish populations tended to be small in size with few large individuals. Notwithstanding, improvements at the Minerva WWTP have had a positive effect upon the biological communities in this reach of the lower Sandy Creek mainstem.

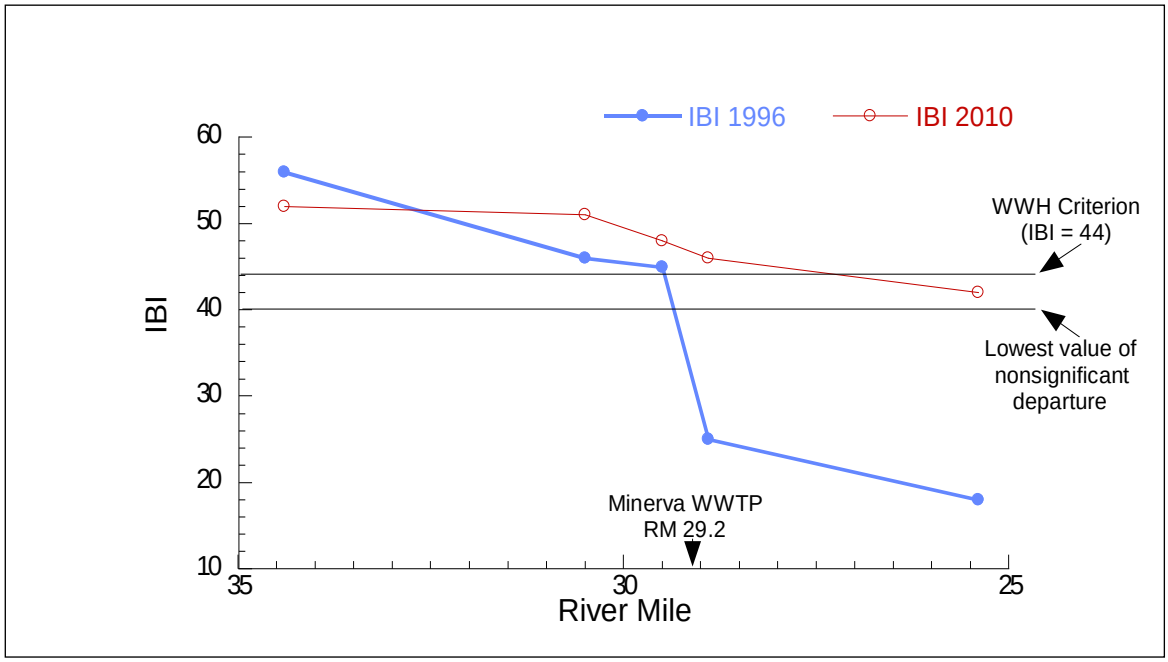


Figure 29. Trend graph comparing IBI scores between 1996 and 2010 surveys for the Sandy Creek mainstem, RMs 35-25.

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