Biological and Water Quality Study

of

Southeast Ohio River Tributaries

2010 & 2011

Jackson, Scioto, and Lawrence Counties

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Biological and Water Quality Study of the Southeast Ohio River Tributary Watersheds 2010 & 2011

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(EXCEPTIONAL, VERY GOOD, ETC.) WERE BASED UPON THE CORRESPONDING IBI AND MIWB RELATIVE TO THE DRAINAGE AREA, ECOREGION, AND THE ASSIGNED ALU. THE QUALITATIVE HABITAT EVALUATION INDEX (QHEI) IS A MEASURE OF THE ABILITY OF THE PHYSICAL HABITAT TO SUPPORT A BIOTIC COMMUNITY. RELATIVE NUMBERS AND WEIGHTS ARE PER 0.3 KM FOR WADING AND HEADWATER SITES, AND PER 1.0 KM FOR BOAT SITES. 54

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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 beneficial use designations and to also determine if the uses are meeting the goals of the federal Clean Water Act. In 2010 and 2011, 31 streams in the southeast Ohio River tributaries (SEORT) study area, located in Jackson, Lawrence and Scioto counties, were evaluated for aquatic life and recreation use potential (Table 1).

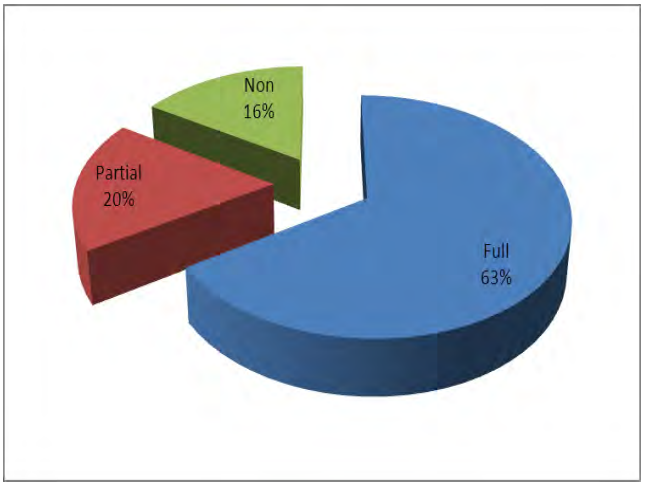

Figure 1. Percent ALU attainment of biological sampling stations in the SEORT watershed, 2010 and 2011.

Of the 49 biological stations assessed, 31 sites (63%) were fully meeting the designated or recommended aquatic life use (ALU), 10 (20%) were partially attaining, and 8 (16%) were not attaining (Figure 1, Figure 2 and Table 2). Problems associated with acid mine drainage (AMD) such as low dissolved oxygen (D.O.), low pH, and metals were found to have caused impairment at six of the sites not meeting the designated ALU. Excessive sediment and silt caused impairment at three sites. Six sites were impaired by organic enrichment associated with unsewered communities and home septic systems. Storm drainage from urban runoff caused impairment at two sites (Table 2).

Twenty-four locations in the watershed were tested for *E. coli* levels four to twelve times between May and October 2010. Evaluation of *E. coli* results revealed that 18 of the 24 locations sampled failed to attain the applicable geometric mean Primary Contact Recreation use criterion, indicating an impairment of the recreation use at these locations as listed in Table 7. Sources of elevated bacteria concentrations were ubiquitous and most likely due to a variety of inputs including agriculture (livestock, manure application), unsewered areas and home sewage treatment systems (HSTS) and municipal wastewater treatment plants (WWTP). The highest bacteria concentrations were found in Sugarcamp Creek RM 0.10 where cattle have unrestricted access to the stream (Table 7).

Water quality samples were collected from 53 sites in the SEORT study area (Table 1). All sites were sampled a minimum of five separate occasions, typically at two week intervals, from June 2010 to August 2010. Dissolved oxygen violations were found at thirteen sample locations throughout the watershed. This was mostly attributed to organic enrichment from unsewered areas, home sewage treatment systems (HSTS), and AMD.

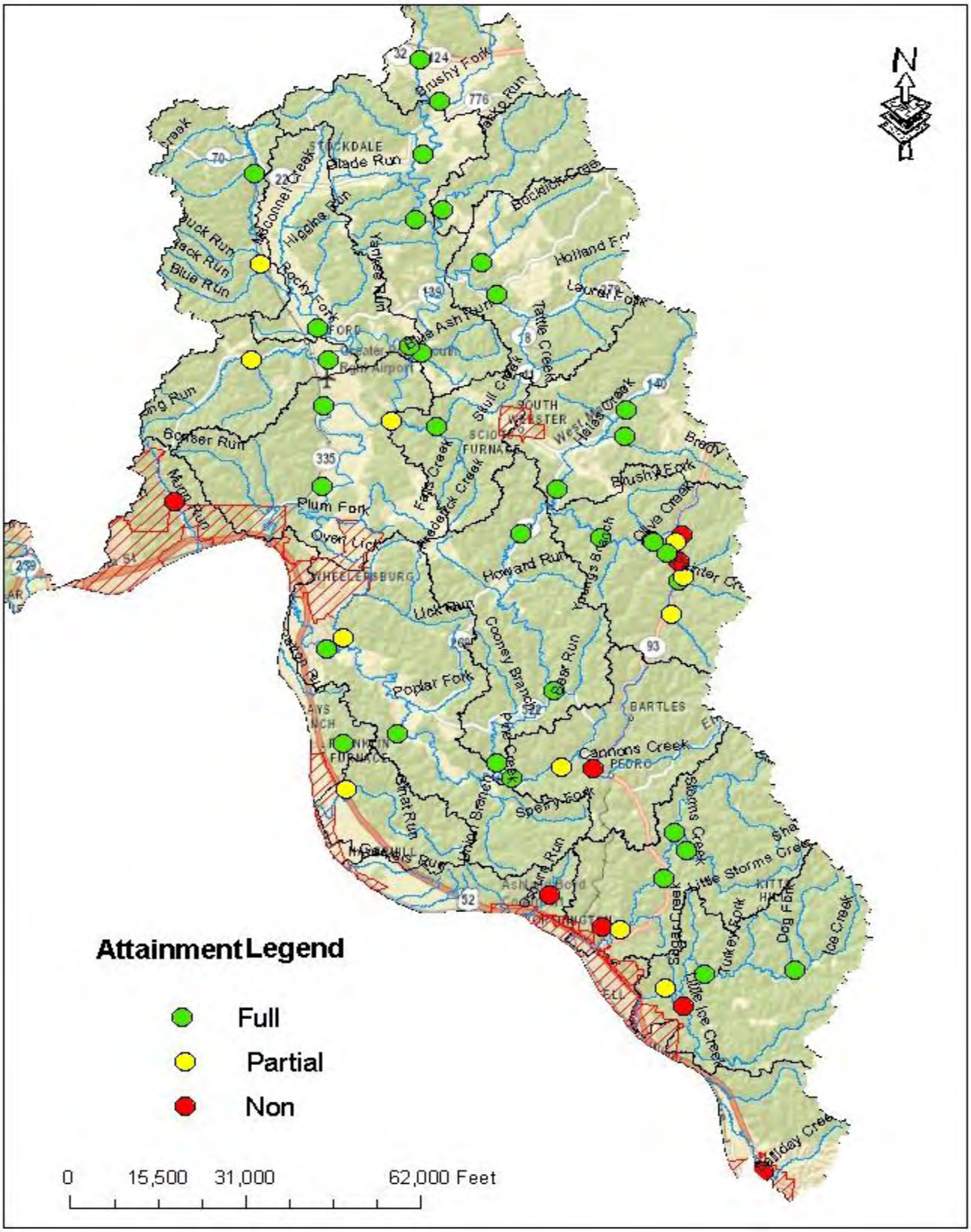

Figure 2. ALU attainment map for biological stations sampled in the SEORT watershed, 2010 & 2011.

Table 1. Sampling stations listed from west to east for the SEORTwatershed with sample types indicated, where X = sample type.

Storet	River Code	Location	RM	DA mi^2	Latitude	Longitude	Fish	Bugs	Chem	Ba-T	Sond	Sent	HUC_12
201512	09-001-000	Munn Run at Eden Park and Hinkley Hollow Rd.	2.20	3.0	38.77510	-82.94180	X	X	X	X			050901030606
301085	09-300-000	L. Scioto R. @ Allen Rd.	35.28	9.3	38.98964	-82.78608	X	X	X	X	X		050901030501
W01K05	09-300-000	L. Scioto River upst. McDowell Creek @ Johnson Rd. Covered Bridge	31.50	24.5	38.95870	-82.78770	X	X	X		X		050901030504
W01K04	09-300-000	L. Scioto River upst. Sugarcamp Creek @ Millstone Rd. ford	27.20	43.0	38.92400	-82.79300	X	X	X		X		050901030504
W01K03	09-300-000	L. Scioto R. upst. Rocky Fork @ Stockham Rd.	18.80	108.0	38.85370	-82.78860	X	X	X	X	X	X	050901030504
W01S02	09-300-000	L. Scioto R. @ Wheelers Mill, dst. Wheelers Mill Rd.	12.70	200.0	38.82591	-82.84914	X	X	X		X		050901030605
300827	09-300-000	L. Scioto R. @ Dixon Mill Rd, CR 15	5.51	210.0	38.78357	-82.84960	X	X	X	X	X	X	050901030605
301127	09-342-000	Brushy Fork @ Glade Rd.	0.38	9.8	38.98636	-82.77835	X	X	X				050901030501
301086	09-329-000	Sugarcamp Creek Millstone Rd.	0.10	14.0	38.91998	-82.78071	X	X	X	X	x		050901030502
301128	09-330-000	Holland Fork dst. Rt. 139	2.80	25.1	38.88493	-82.74222	X	X	X				050901030503
301129	09-331-000	Bucklick Creek @ Comer Schoolhouse Rd./Charles Russ Road TR505	0.80	6.7	38.90171	-82.75178	X	X	X				050901030503
301062	09-310-000	Rocky Fork L. Scioto R. @ Fallen Timber Rd.	14.15	11.2	38.94814	-82.89290	X	X	X				050901030601
301087	09-310-000	Rocky Fork L. Scioto River @ BLUE RUN RD	10.20	20.4	38.90022	-82.88910	X	X	X	X			050901030601
W01K06	09-310-000	Rocky Fork L. Scioto R. @ St. Rt. 139	6.44	45.9	38.86680	-82.85350	X	X	X		X		050901030603
W01S06	09-310-000	Rocky Fork L. Scioto R. near mouth @ Glades Run Rd.	0.60	68.8	38.85760	-82.79630	X	X	X	X	X	X	050901030603
301643	09-311-000	Long Run Near Clarktown @ Furnace Creek Rd.	4.51	8.9	38.85044	-82.89738	X	X					050901030602
301088	09-311-000	Long Run @ Bennett Rd. (CR12)	0.95	17.1	38.84979	-82.84667	X	X	X	X			050901030602
301089	09-306-000	Frederick Creek Adj Frederick Creek Rd. CR 17	1.40	15.9	38.81460	-82.78828	X	X	X	X	x		050901030604
301124	09-307-000	Skull Creek @ mouth - Frederick Rd bridge	0.05	4.59	38.814964	-82.779298	X	X	X	X			050901030604

Storet	River Code	Location	RM	DA mi^2	Latitude	Longitude	Fish	Bugs	Chem	Ba-T	Sond	Sent	HUC_12
W01S17	09-400-000	Pine Creek @ ST. RT. 93 just north TR207	45.68	8.0	38.73450	-82.62880	X	X	X		X		050901030202
W01K13	09-400-000	Pine Creek dst. Youngs Branch, adj. Pine Creek Rd.	41.30	29.6	38.75680	-82.67680	X	X	X	X	X		050901030202
W01K12	09-400-000	Pine Creek @ Haven Rd (Salters Creek Rd.)	36.40	69.0	38.75930	-82.72660	X	X	X	X	X	X	050901030204
W01K11	09-400-000	Pine Creek @ Superior @ St. Rt. 522 just South Clinton Furnace Rd TR257	25.90	95.0	38.67630	-82.70600	X	X	X		X		050901030204
W01S01	09-400-000	Pine Creek SE of Powellsville @ Kellys Mill Rd. Cr.43	20.40	104.0	38.63790	-82.74076	X	X	X	X	X		050901030204
W01K09	09-400-000	Pine Creek SW OF Powellsville @ Powellsville Rd.	13.40	157.0	38.65340	-82.80240	X	X	X		X		050901030205
W01K08	09-400-000	Pine Creek @ Sandhill, upst. Mill Rd.	5.10	168.0	38.69760	-82.84680	X	X	X	X	X	X	050901030205
W01S24	09-425-000	Sawmill Run south of Buckhorn @ mouth adj SR93 just south CR14	0.10	3.0	38.71680	-82.63300	X	X	X				050901030202
W01S23	09-422-000	Painter Creek south of Buckhorn, @ Painter Creek Rd.	0.03	3.4	38.73620	-82.62570	X	X	X				050901030202
W01S22	09-421-000	Negro Creek at mouth adj. TR 166 Negro Creek Rd.	0.20	1.7	38.744625	-82.628688	X	X	X				050901030202
W01S21	09-424-000	Kimble Creek, Kimble Cr Rd. TR258 sign	0.89	4.2	38.75850	-82.62680	X	X	X				050901030202
W01K18	09-424-000	Kimble Creek, SR 93 south of TR258	0.60	4.3	38.75480	-82.63050	X	X	X				050901030202
W01S19	09-424-000	Kimble Creek, at Buckhorn @ mouth	0.01	4.5	38.748978	-82.635658		X	X				050901030202
301132	09-420-000	Olive Creek @ Buckhorn-Pine Creek Rd CR34	0.11	2.3	38.75498	-82.64381	X	X	X				050901030202
301134	09-419-000	Brushy Fork (trib to Pine Creek) @ Buckhorn-Pine Creek Rd. CR 34	0.13	4.1	38.75570	-82.64551	X	X	X				050901030202
301130	09-415-000	Hales Creek upst. Brady Run Brady Run Rd.	4.35	14.2	38.81094	-82.67511	X	X	X				050901030201
301084	09-415-000	Hales Creek @ Lick Run - Lyra Bloom Rd CR2 near Great Meadow Rd CR51	1.00	31.8	38.78239	-82.70381	X	X	X	X	X		050901030201
301131	09-416-000	Brady Run @ at Brady Creek Rd. TR289	0.90	7.1	38.81013	-82.66211	X	X	X				050901030201
301700	09-408-000	Little Pine Creek	2.9	25.1	38.63640	-82.70090	X						050901030203
300826	09-408-000	Little Pine Creek @ SR 650	0.75	29.2	38.63040	-82.73154	X	X	X	X	X	X	050901030203

Storet	River Code	Location	RM	DA mi^2	Latitude	Longitude	Fish	Bugs	Chem	Ba-T	Sond	Sent	HUC_12
301133	09-423-000	Ellisonville Creek @ CR25 White Oak Rd.	0.20	11.3	38.63495	-82.68179	X	X	X		X		050901030203
W01K15	09-401-000	Lick Run near Garden City @ ST. RT. 522	0.9	10.3	38.70370	-82.83660	X	X	X				050901030205
301136	09-096-000	Chandlers Run - Big Pete Rd.	1.30	0.99	38.647832	-82.834825	X	X	X				050901030507
300959	09-002-000	Patton Run Burkes Lane	2.35	1.34	38.673735	-82.856317	X	X	X	X			050901030107
300958	09-003-000	Ginat Run adj. Back Rd.	2.80	8.6	38.62495	-82.82483	X	X	X	X			050901030106
300957	09-006-000	Osborne Run (AKA Osburn Run) @ SR 650	1.3	8.6	38.567197	-82.708586		X	X				050901030105
300954	09-007-000	Storms Creek, access Rd. dst. Lake Vesuvius	10.10	11.2	38.60174	-82.63078	X	X	X		X		050901030104
300955	09-007-000	Storms Creek @ SR 93	6.80	22.8	38.57791	-82.63753	X	X	X	X			050901030104
W01P02	09-007-000	Storms Creek at Porter Gap Rd.	3.30	28.9	38.54789	-82.65931	X	X	X		X		050901030104
W01K01	09-007-001	L. Storms Creek (upper trib. at RM 9.23) Upst. Gravel lane near mouth	0.10	8.6	38.59230	-82.62300	X	X	X				050901030104
300956	09-008-000	Little Storms Cr (Lower Trib at RM 1.8)	0.40	5.4	38.55033	-82.67385	X	X	X		X		050901030104
300953	09-011-000	Ice Creek @ CR 6, Deering Bald Knob Rd.	10.30	12.5	38.52907	-82.55612	X	X	X				050901030103
W02K02	09-011-000	Ice Creek SW OF Kitts Hill @ lane off Co. Rd. 52	6.10	19.2	38.52700	-82.61210	X	X	X	X	X	X	050901030103
W02K01	09-011-000	Ice Creek N. of Coal Grove, adj. Co. Rd. 181 (historical bio)	2.30	37.0	38.51950	-82.63680	X	X	X		X		050901030103
301135	09-013-000	Little Ice Creek Adj TR 102 Little Ice Creek Rd.	0.60	11.1	38.51129	-82.62556	X	X	X				050901030203
300952	09-019-000	Solida Creek (AKA Salliday Creek) @ Solida Road	3.52	6.5	38.42301	-82.57490	X	X	X	X			050901030101

Table 2. Aquatic life use attainment status for sampling locations in the SEORT watershed, 2010 & 2011. The Index of Biotic Integrity (IBI), Modified Index of Well-being (MIwb), and Invertebrate Community Index (ICI) scores are based on the performance of the biological community. The Qualitative Habitat Evaluation Index (QHEI) is based on the ability of the stream habitat to support a biological community. The SEORT watershed is located in the Western Allegheny Plateau (WAP) ecoregion. If biological impairment has occurred, the cause(s) and source(s) of the impairment are noted.

Stream	River Mile	Sampling Type	Aquatic Life Use Designation	Aquatic Life Attainment Status[b]	IBI	MIwb	ICI[a]	QHEI	Cause/Source of Impairment
Munn Run	2.2/1.4	Headwater	WWH	NON	36*	NA	F*	57.0	Organic Enrichment/On-site septic
Little Scioto River	35.3	Headwater	WWH	FULL	50	NA	G	83.0	
Little Scioto River	31.4	Wading	WWH	FULL	50	8.8	44	74.5	
Little Scioto River	27.2	Wading	WWH	FULL	41[ns]	8.5	44	73.0	
Little Scioto River	18.8	Wading	WWH	FULL	47	9.2	38	73.3	
Little Scioto River	12.7	Wading	WWH	FULL	51	9.2	44	78	
Little Scioto River	5.5	Wading	WWH	FULL	51	9.3	46	80.5	
Brushy Fork (trib to L. Scioto River)	0.38	Headwater	WWH	FULL	52	NA	MG[ns]	60.3	
Sugarcamp Creek	0.1/0.6	Headwater	WWH	FULL	48	NA	E	64.0	
Holland Fork	2.8	Wading	WWH	FULL	50	8.5	52	75.5	
Bucklick Creek	0.8	Headwater	WWH	FULL	42[ns]	NA	E	83.3	
Rocky Fork L. Scioto River	14.2	Headwater	WWH	FULL	46	NA	E	81.0	
Rocky Fork L. Scioto River	10.2	Wading	WWH	Partial	36*	7.7*	52	74.5	Natural Conditions (Flow or Habitat)/Natural Sources
Rocky Fork L. Scioto River	6.4	Wading	WWH	FULL	52	9.5	E	83.5	
Rocky Fork L. Scioto River	0.6	Wading	WWH	FULL	55	9.9	44	76.5	
Long Run	4.51	Headwater	WWH	Partial	58	NA	F*	66.0	Organic Enrichment/On-site septic
Long Run	0.95	Headwater	WWH	FULL	48	NA	G	80.0	
Frederick Creek	1.4	Headwater	WWH	FULL	52	NA	G	77.5	
Skull Creek	0.05	Headwater	WWH	FULL	44	NA	VG	70.5	
Pine Creek	45.7	Headwater	WWH	FULL	44	NA	VG	72.8	
Pine Creek	41.3	Wading	WWH	FULL	44	8.0[ns]	44	61.8	
Pine Creek	36.4	Wading	WWH	FULL	50	9.0	48	78.8	

Stream	River Mile	Sampling Type	Aquatic Life Use Designation	Aquatic Life Attainment Status[b]	IBI	MIwb	ICI[a]	QHEI	Cause/Source of Impairment
Pine Creek	25.9	Wading	WWH	FULL	46	8.6	G	78.0	
Pine Creek	20.35	Wading	WWH	FULL	42[ns]	9.0	42	72.3	
Pine Creek	13.36	Wading	WWH	FULL	46	8.4	52	78.8	
Pine Creek	5.05	Wading	WWH	FULL	49	9.1	48	80.5	
Sawmill Run	0.01	Headwater	Undesignated/ WWH-R	Partial	38*	NA	MG[ns]	60.5	Organic Enrichment, DO/ On-site septic, Urban runoff, Storm sewer
Painter	0.03	Headwater	WWH	Partial	34*	NA	MG[ns]	81.5	Manganese/AMD
Negro	0.2	Headwater	WWH	-	-	NA	P*	-	Macroinvertebrates impacted by DO, pH/AMD
Kimble Creek	0.9	Headwater	Undesignated/ WWH-R	NON	24*	NA	G	75.5	DO/AMD
Kimble Creek	0.6	Headwater	Undesignated/ WWH-R	Partial	34*	NA	MG[ns]	62.0	DO, Manganese/AMD
Kimble Creek	0.01	Headwater	Undesignated/ WWH-R	-	-	-	G	-	
Olive Creek	0.11	Headwater	WWH	-	-	-	MG[ns]	-	
Brushy Fork (trib to Pine Creek)	0.1	Headwater	WWH	NON	26*	NA	G	66.0	Manganese/AMD
Hales Creek	4.35	Headwater	WWH	FULL	44	NA	E	64.3	
Hales Creek	1.0	Wading	WWH	FULL	44	8.8	48	40.5	
Brady Run	0.9	Headwater	WWH	FULL	40[ns]	NA	G	74.5	
L. Pine Creek	2.9	Wading	WWH	Partial	42[ns]	6.42*	-	72.0	pH, Manganese, Aluminum/AMD
L. Pine Creek	0.7	Wading	WWH	FULL	48	8.3	52	81.0	
Ellisonville Creek	0.2	Headwater	Undesignated/ WWH-R	NON	26*	NA	MG[ns]	68.0	pH, Manganese, Aluminum/AMD
Lick Run	0.9	Headwater	WWH	Partial	46	NA	F*	81.5	Sedimentation siltation/Unknown
Chandlers Run	1.3	Headwater	Undesignated/ WWH-R	-	-	-	MG[ns]	-	
Patton Run	2.35	Headwater	WWH	-	-	-	E	-	
Ginat Run	2.8	Headwater	WWH	Partial	36*	NA	G	76.0	Organic Enrichment, DO/ On-site septic
Osborne Run	1.3	Headwater	WWH/LRW-R	-	-	-	P	-	Macroinvertebrates affected by pH, Manganese, Al, pH/AMD
Storms Creek	10.1	Headwater	WWH	FULL	52	NA	G	81.5	
Storms Creek	6.8	Wading	WWH	FULL	51	9.0	E	80.0	
Storms Creek	3.12/3.7	Wading	WWH	Partial	44	7.7*	G	59.0	Sedimentation siltation/Dam or Impoundment

Stream	River Mile	Sampling Type	Aquatic Life Use Designation	Aquatic Life Attainment Status[b]	IBI	MIwb	ICI[a]	QHEI	Cause/Source of Impairment
L. Storms Creek (upper at RM 9.23)	0.3	Headwater	Undesignated/ WWH-R	FULL	42[ns]	NA	G	69.5	
L. Storms Creek (lower at RM 1.8)	0.4	Headwater	WWH	NON	28*	NA	F*	67.3	pH, Siltation, Manganese/AMD
Ice Creek	10.3	Headwater	WWH	FULL	44	NA	G	78.5	
Ice Creek	6.1/6.5	Headwater	WWH	FULL	48	NA	G	77.5	
Ice Creek	2.3	Wading	WWH	Partial	42[ns]	7.6*	40	71.5	Sedimentation siltation/Dam or Impoundment
L. Ice Creek	0.6	Headwater	WWH	NON	40	NA	P*	76.5	Organic Enrichment/ On-site septic
Salliday Creek	3.62	Headwater	WWH	NON	26*	NA	F*	63.0	Organic Enrichment/ On-site septic, Urban runoff, Storm sewer

Biological Criteria

Western Allegheny Plateau		
Index – Site Type	**EWH**	**WWH**
IBI – Headwaters	50	44
IBI – Wading	50	44
IBI – Boat	48	40
MIwb – Wading	9.4	8.4
MIwb – Boat	9.6	8.6
ICI	46	36

a - 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 due to current velocities less than 0.3 fps flowing over the artificial substrates.) VP=Very Poor, P=Poor, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional

b - Attainment status derived from one organism group is parenthetically expressed.

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

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

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

\- No sample taken.

Sample collected in 2011.

Water Quality Use Designations and Recommendations

The streams in the SEORT watershed study area currently listed in the Ohio Water Quality Standards (WQS) are assigned Warmwater Habitat (WWH) aquatic life use designations. The aquatic life use designations of the streams in this survey have been previously verified using biological data with the exception of Sawmill Run, Kimble Creek, Ellisonville Creek, Chandlers Run, Osborne Run, and Little Storms Creek (upper at RM 9.23). These streams were originally designated for WWH aquatic life use in the 1978 Ohio WQS but 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 streams in the SEORT study area.

Thirty-one streams in the SEORT study area were evaluated for aquatic life and recreational use potential in 2010 & 2011 (Table 1). Significant findings include the following**:**

- Twenty-five streams with an existing WWH use designation should retain that aquatic life use. These streams are the following: Munn Run, Little Scioto River, Brushy Fork (tributary to Little Scioto River), Sugarcamp Creek, Holland Fork, Bucklick Creek, Rocky Fork Little Scioto River, Long Run, Frederick Creek, Skull Creek, Pine Creek, Painter Creek, Negro Creek, Olive Creek, Brushy Fork (tributary to Pine Creek), Hales Creek, Brady Run, Little Pine Creek, Patton Run, Ginat Run, Storms Creek, Little Storms Creek (lower at RM 1.8), Ice Creek, Little Ice Creek, and Salliday Creek (AKA Solida Creek).

- Five streams which had unverified WWH aquatic life uses are confirmed WWH based upon biological sampling completed in 2010. These streams include the following: Sawmill Run, Kimble Creek, Ellisonville Creek, Chandlers Run, and Little Storms Creek (upper at RM 9.23).

- Osborne Run is listed as a WWH stream based on the 1978 water quality standards. In 2010, macroinvertebrate scores met Limited Resource Water (LRW) but did not meet the WWH use designation. Osborne Run is also heavily impacted by AMD and the habitat is modified by channelization. Most of the stream length becomes backed up by the Ohio River during high water. The Ohio Department of Natural Resources, Division of Mineral Resources Management has no future plans to allocate funds into restoring Osborne Run. It is therefore recommended that the use designation be changed from WWH to LRW for Osborne Run.

All of the streams in this study should retain the Primary Contact Recreation use, along with the Agricultural Water Supply (AWS) and Industrial Water Supply (IWS) uses.

General Recommendations

Once a watershed's condition has been studied and any impairments identified, it is useful to examine ways to correct the problems. In this section, some general recommendations for the SEORT watershed are discussed. More specific, quantified recommendations may result from the Total Maximum Daily Load project (TMDL). Recommendations are not limited to this chapter. Recommendations for changes at specific locations that would benefit stream resource quality (for example, riparian and streamside buffer practices and landuse changes) are interspersed throughout this document. The greatest concerns to water quality identified by this study were nutrient enrichment and bacteria, storm water runoff, AMD, and sedimentation.

Managing Storm Water

The SEORT watershed and the overall water quality downstream are directly affected by storm water drainage and the ways the watershed is buffered from precipitation events. Reduction of sediment, nutrients, fertilizers/chemicals, erosion, and hydrologic modifications can be accomplished through proper storm water management.

Re-establishing natural riparian buffers (wetland and wooded riparian corridors) in the watershed to help slow storm water and filter pollutants before they reach the surface waters are positive mechanisms to reduce storm water pollution. In addition to restoring riparian buffers an effort should be made to take advantage of the stream's natural assimilative capacities. Natural development of stream channels provides an array of beneficial services including settling fine sediments into adjacent floodplains, processing of nutrients into productive biomass instead of nuisance algae, improved water quality, creation of natural instream habitats to increase carrying capacity of biomass, and ultimately and most importantly evolution into a stable channel and the slowing of erosion. Streams which were impaired by storm water pollution were Sawmill Run and Salliday Creek (AKA Solida).

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Organic Enrichment and Bacteria

Organic enrichment was a problem detected in this watershed study. Unsewered communities were the biggest contributors to organic enrichment; however, unrestricted livestock access to streams was also a source of impairment. It is recommended to build or upgrade municipal WWTPs in these unsewered communities and restrict in stream livestock access. Streams found to be impaired by organic enrichment included: Munn Run, the headwaters of Long Run, Sawmill Run, Ginat Run, Little Ice Creek, and Salliday Creek (AKA Solida Creek).

A sanitary sewer system project is underway in Scioto County and will treat sewage from the towns of Minford, Muletown, Clarktown, Rubyville and adjacent neighborhoods in Clay, Harrison, Jefferson, and Madison townships. The project area is located in the Little Scioto River watershed adjacent to Long Run along State Route 139. Other named streams in the project area include Harrison Furnace Creek, Sweet Run, and Tattle Creek, all of which are direct tributaries to Rocky Fork Little Scioto River. This project is expected to be completed in two years.

Another sanitary sewer project is in progress at the town of Eden Park adjacent to Munn Run along State Route 139 and Rosemont Road. The projected completion time for the project is one year.

Acid Mine Drainage

Eight streams impacted by AMD were identified by this study and are recommended for restoration work. These streams included: Painter Creek, Kimble Creek, Brushy Fork, Ellisonville Creek, Osborne Run, Negro Creek, Little Pine Creek, and Little Storms Creek (lower at RM 1.8).

Silt and Sedimentation

Three streams (Lick Run, lower Ice Creek and lower Storms Creek) were found to be impaired by sedimentation. The source of sedimentation in Lick Run was undetermined by this study. Sedimentation in the lower sections of Ice and Storms creeks was caused by Ohio River back-water flooding events. Methods to reduce sedimentation can be found under the Storm Water Management section above.

Table 3. Waterbody use designation recommendations for the SEORT watershed. Designations based on the 1978 and 1985 water quality standards appear as asterisks (*). A plus sign (+) indicates a confirmation of an existing use and a triangle (▲) 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	
| | | | | | | |														
Munn run		+							+	+		+		
Little Scioto river	*	+							+	+		+		
Swauger Valley run		+							*	*		*		
Bonser run		+							*	*		*		
Plum fork		+							*	*		*		
Oven lick		+							*	*		*		
Dry run		+							+	+		+		
Frederick creek		+							+	+		+		
Skull creek		+							+	+		+		
Falls creek		+							*	*		*		
Rocky fork	*	+							+	+		+		
Long run		+							+	+		+		
Harrison Furnace creek		+							*	*		*		
Tattle creek		+							*	*		*		
Yankee run		+							*	*		*		

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	
| | | | | | | |														
Sweet run		+							*	*		*		
Higgins run		+							*	*		*		
McConnel creek		+							*	*		*		
Bull run		+							*	*		*		
Blue run		+							*	*		*		
Back run		+							*	*		*		
Buck run		+							*	*		*		
Fallen Timber creek		+							*	*		*		
Hunting run		+							*	*		*		
Owl creek		+							*	*		*		
Sand run		+							*	*		*		
Laurel Lick run		+							*	*		*		
Blue Ash run		+							*	*		*		
Bear run	*	+							+	+		+		
Holland fork		+							+	+		+		
Bucklick creek		+							+	+		+		
Little Bucklick creek		+							*	*		*		
Tattle creek		+							*	*		*		
Scaffold lick		+							*	*		*		
Laurel fork		+							*	*		*		

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	
| | | | | | | |														
Buckhorn creek		+							*	*		*		
Sugarcamp creek		+							+	+		+		
Jacko run		+							*	*		*		
Millstone run		+							*	*		*		
Glade run		+							*	*		*		
Dry run		+							*	*		*		
Polecat creek		+							*	*		*		
McDowell creek		+							*	*		*		
Brushy fork		+							*	*		*		
Pine creek	*	+							+	+		+		
Lick run		+							+	+		+		
Sugar creek		*							*	*		*		
North fork		*							*	*		*		
Duck creek		*							*	*		*		
Poplar fork		*							*	*		*		
Sperry fork		*							*	*		*		
Union branch	*	*							*	*		*		
Little Pine creek		+							+	+		+		
Ellisonville creek		▲							+	+		+		

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	
| | | | | | | |														
Darby creek	*	*							*	*		*		
Cannons creek		*							*	*		*		
Cooney branch	*	*							*	*		*		
Bear run	*	*							*	*		*		
Turkeyfoot run		*							*	*		*		
Howard run	*	*							*	*		*		
Hales creek	+	+							+	+		+		
Brady run	*	*							*	*		*		
Jackson fork		*							*	*		*		
Youngs branch	*	*							*	*		*		
Brushy fork	+	+							+	+		+		
Olive creek	+	+							+	+		+		
Negro creek	+	+							+	+		+		
Kimble creek		▲							+	+		+		
Sawmill run		▲							+	+		+		
Painter creek	+	+							+	+		+		
Chandlers run		▲							+	+		+		
Patton run		+							+	+		+		
Ginat run		+							+	+		+		
Gervais run		*							*	*		*		

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	
| | | | | | | |														
Norman run		*							*	*		*		
Osburne run		*					▲		+	+		+		Acid mine drainage. Varied criteria year around: exempt from the WWH total dissolved solids, pH, iron and zinc criteria.
Storms creek - headwaters to downstream boundary of Wayne national forest (RM 8.3)	+	+							+	+		+		
- all other segments		+							+	+		+		
Little Storms creek (upper trib. at RM 9.23)		▲							+	+		+		
Little Storms creek (lower trib. at RM 1.8)	+	+							+	+		+		
Hecla branch		+							*	*		*		
Paddle fork	*	+							*	*		*		
Ice creek		+							+	+		+		
Hog run		+							*	*		*		
Little Ice creek		+							+	+		+		
Sugar creek		+							*	*		*		
Turkey fork		+							*	*		*		
Ned fork		+							*	*		*		
Dog fork		+							*	*		*		
Lick creek		+							+	+		+		
Salliday creek		+							+	+		+		

SRW = state resource water; WWH = warmwater habitat; EWH = exceptional warmwater habitat; MWH = modified warmwater habitat; SSH = seasonal salmonid habitat; CWH = coldwater habitat; LRW = limited resource water; PWS = public water supply; AWS = agricultural water supply; IWS = industrial water supply; BW = bathing water; PCR = primary contact recreation; SCR = secondary contact recreation

Introduction

During 2010 and 2011, Ohio EPA conducted a water resource assessment of thirty-two streams in the SEORT study area using standard Ohio EPA protocols as described in Appendix F. Included in this study were assessments of the biological, surface water and recreational (bacterial) condition. A total of 55 biological, 55 water chemistry, and 24 bacterial stations were sampled in the SEORT study area. All of the biological, chemical and bacterial results can be downloaded from the Ohio EPA GIS interactive maps at the following link:

Figure 3. State of Ohio map with SEORT study area outlined.

http://www.epa.state.oh.us/dsw/gis/index.aspx.

Specific objectives of the evaluation were to:

- establish the present biological conditions in the selected sites in the SEORT study area by evaluating fish and macroinvertebrate communities,
- assess physical habitat influences on stream biotic integrity,
- determine recreational water quality, and
- determine the attainment status of ALUs and recommend changes if appropriate.

The findings of this evaluation may factor into regulatory actions taken by the Ohio EPA (e.g. NPDES permits, Director's Orders, or the Ohio Water Quality Standards (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.

All of the streams listed in the Ohio Water Quality Standards for the study area are assigned the Warmwater Habitat (WWH) aquatic life use designation. Soliday Creek, Osborne Run, Ginat Run, Patton Run, Painter Run, Negro Creek, Olive Creek, Brushy Fork, Brady Run, Hales Creek, Little Pine Creek and Munn Run 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. Many streams (Chandlers Run, Sawmill Run, Kimble Creek, Ellisonville Creek, and Little Storms Creek (upper tributary at RM 9.23)) in the study area are currently undesignated in the Ohio WQS, while all other streams within the study area were previously designated using biological data to evaluate and establish aquatic life uses. Most streams in the SEORT study area are listed as Primary Contact Recreation (PCR), Agricultural Water Supply (AWS) and Industrial Water Supply (IWS) in the Ohio WQS based on a desktop review. Little Scioto River, Pine Creek, Storms Creek, and Ice Creek have been verified for the PCR, AWS, and IWS uses.

Study Area Description

The SEORT study area includes Little Scioto River, Pine Creek, Storms Creek, Ice Creek and other direct tributaries to the Ohio River. Ice Creek enters the Ohio River at RM 657.15, is 14.5 miles long and encompasses 39.1 square miles. Little Ice Creek was sampled within the Ice Creek watershed. Storms Creek enters the Ohio River at RM 653.41, is 15.5 miles long and drains 37 square miles. Two different tributaries to Storms Creek, both called Little Storms Creek (differentiated as upper tributary at RM 9.23 and lower tributary at RM 1.8), were sampled within the Storms Creek watershed. Pine Creek enters the Ohio River at RM 634.50, is 48 miles long and encompasses 184 square miles. Kimble Creek, Negro Creek, Painters Creek, Sawmill Run, Olive Creek, Brady Creek, Hales Creek, Brushy Fork, Ellisonville Creek, Little Pine Creek and Lick Run were sampled within the Pine Creek watershed. Little Scioto River enters the Ohio River at RM 632.25, is 41.3 miles long and drains 233 square miles. Brushy Fork, Sugarcamp Creek, Bucklick Creek, Holland Fork, Long Run, Rocky Fork, Skull Creek and Frederick Creek were sampled within the Little Scioto River watershed. Other tributaries within the SEORT study area discharge directly into the Ohio River and include Solida Creek, Osborne Run, Ginat Run, Chandlers Run, Patton Creek and Munn Run.

The SEORT study area is located entirely within the Western Allegheny Plateau ecoregion and situated within Jackson, Lawrence and Scioto counties (Figure 3). Land-use within the study area is comprised of 19.95% agriculture, 3.8% grassland, 8.85% urban developed land and 65.17% forested areas (Figure 4 and Figure 5). The other 2.23% is composed of barren lands, open water, wetlands, and shrub/scrub areas. Almost all urbanized areas are along the Ohio River, with smaller villages of Minford and South Webster located further up into the Little Scioto River watershed. The Wayne National Forest – Ironton District encompasses a large part of Storms Creek watershed and a smaller portion of upper Pine Creek.

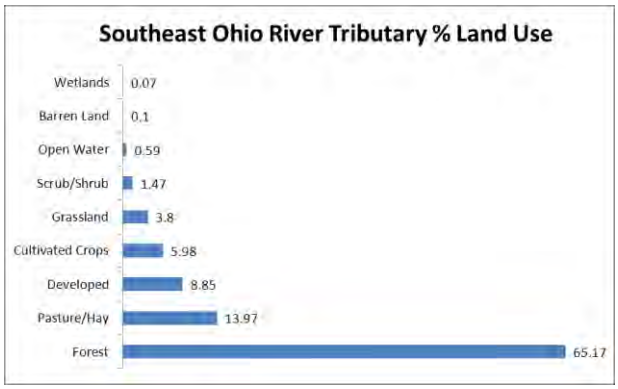


Figure 4. Percentages of land uses in the SEORT study area.

A total of eleven National Pollutant Discharge Elimination System (NPDES) permitted facilities discharge sanitary wastewater, industrial process water, and/or industrial storm water into the SEORT watershed within Lawrence and Scioto counties (facility descriptions on pg. 30). There are numerous other NPDES permitted facilities within the watershed which all discharge directly to the Ohio River, including large publicly owned sanitary wastewater plants, natural gas power plants, chemical plants and other large industrial facilities.

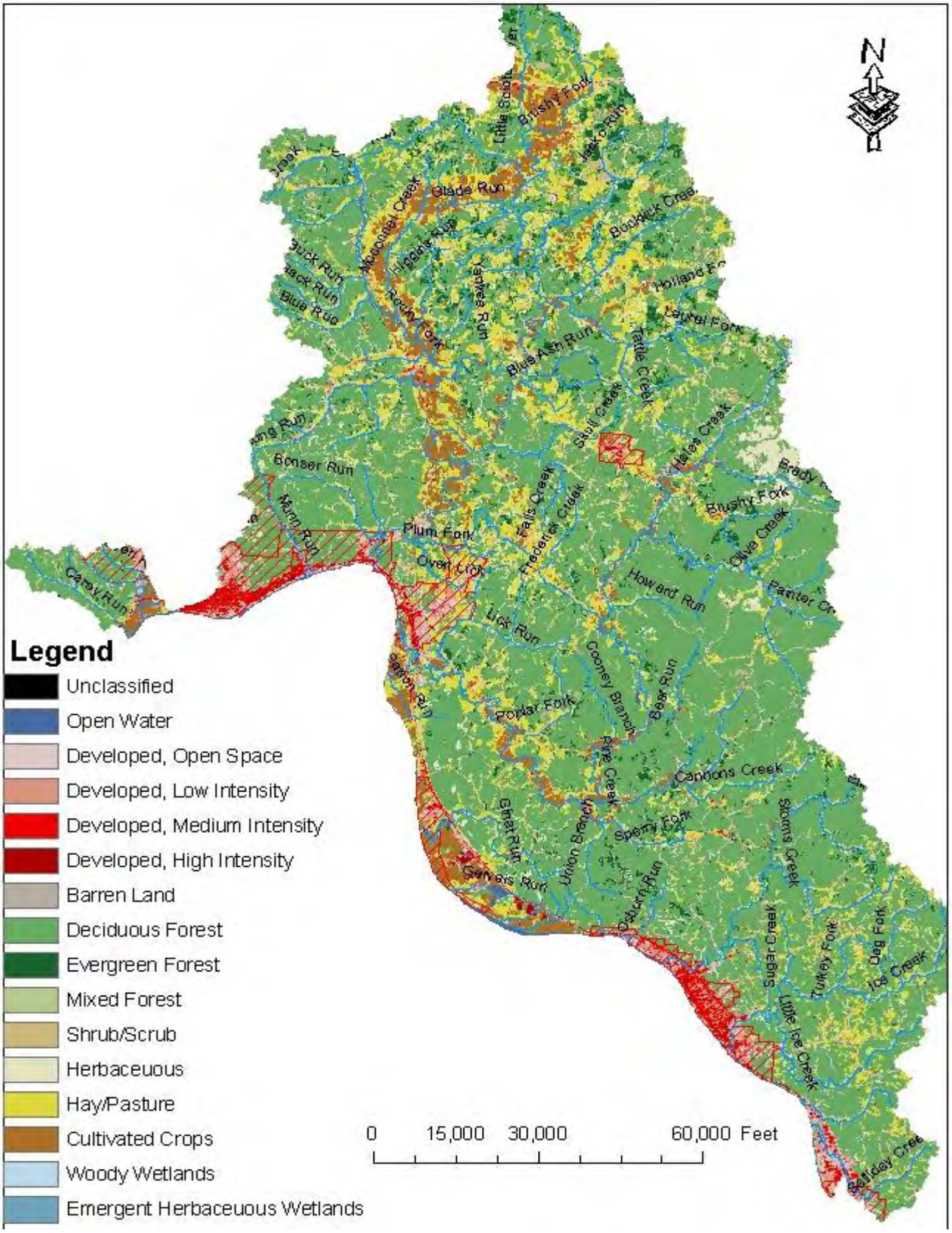


Figure 5. Land use coverage map within the SEORT watershed.

Water Chemistry

Surface water chemistry samples were collected five times from the SEORT study area at 53 locations between June 30 and October 7, 2010. Additionally, monthly samples were collected from seven sentinel sites, from January thru December in 2010. Stations were established in free-flowing sections of the stream and were primarily collected from bridge crossings. Surface water samples were collected, preserved and delivered to Ohio EPA's Environmental Services laboratory. Collected water was preserved using appropriate methods, as outlined in Part II and Part III of the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 2006d). Interactive maps of surface water chemical data, downloadable to excel files, are available at the following link: http://www.epa.state.oh.us/dsw/gis/index.aspx.

A United States Geological Survey (USGS) gage station, located on Symmes Creek in Aid, Ohio (just east of the study area), was used to show flow trends during the 2010 sampling season (Figure 6). 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 show large flow fluctuations thru the summer months with flows as low as 1.7 cubic feet per second (cfs) on July 11th up to 2,390 cfs on July 21st. Through most of the summer the flows were above the historic median. September through November ended below the historic median; however, both water and bacteria samples captured a variety of flow conditions in the study area during the field season.

Water Quality
Numerous Dissolved Oxygen, pH and Iron Water Quality Standard violations were detected.

Surface water samples were analyzed for metals, nutrients, bacteria, pH, temperature, conductivity, dissolved oxygen, percent saturation, and suspended and dissolved solids (Appendix G). Bacteriological samples were collected from all 24 locations, and the results are reported in the Recreational Use section.

Exceedances of the WQS criteria are shown in Table 4. Elevated iron and low pH values may be a result of past coal or clay mining that occurred throughout much of the study area. Osborne Run, Painters Run, Kimble Creek, Brushy Fork (tributary to Pine Creek), Little Pine Creek, Negro Run, Little Storms Creek (lower tributary to Storms Creek at RM 1.8) and Ellisonville Creek all show conditions normally occurring in coal mining areas as shown in Table 6.

Dissolved Oxygen (D.O.) violations occurred throughout the study area during the sampling season. The low D.O. values are a result of nutrient inputs from agricultural activities or from densely populated areas with failing home septic systems. Munn Run had an elevated Nitrate-Nitrite- N result above the target reference value. Numerous sites including Sawmill Run, Kimble Creek, Ginat Run, Solida Creek and Munn Run has single sample results above the target reference values which validate the enriched conditions noted during sampling (Appendix G). All of these streams, except Kimble Creek, have numerous homes with no centralized sanitary sewer system. Nutrient reference target results are shown in Table 5.

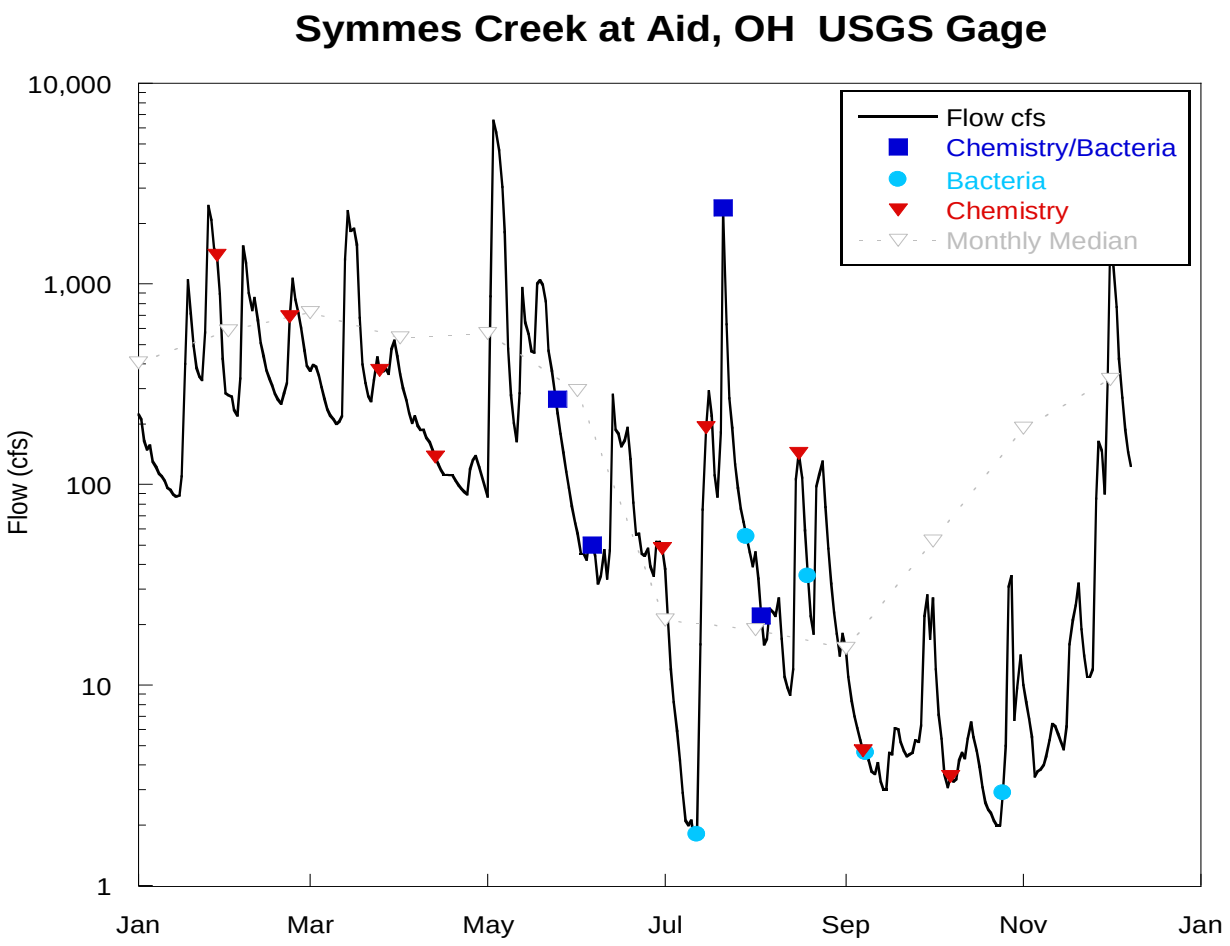


Figure 6. Water column chemistry and bacteria sampling plotted along flow trends for the 2010 sampling season. Flow trend data taken from the nearest USGS gaging station located in Aid, OH on Symmes Creek.

Table 4. Exceedances of Ohio Water Quality Standards criteria (OAC3745-1) for chemical/physical parameters measured in the SEORT study area, 2010.

Stream	River Mile	Location	Parameter (ug/l unless noted)
Munn Run	2.2	Hinkley Hollow Road	
Little Scioto River	35.3	Allen Road	
Little Scioto River	27.2	Millstone Road ford	D.O. (mg/L) 4.3, 3.8
Little Scioto River	18.8	Stockham Road	Cu 15.1; Fe 7040; pH 6.32 S.U.
Little Scioto River	12.7	Wheelers Mill Road	
Little Scioto River	5.5	Dixon Mill Road	Cu 14; pH 6.47 S.U.
Brushy Fork	0.4	Glades Road	D.O. (mg/L) 4.16
Sugarcamp Creek	0.1	Millstone Road	D.O. (mg/L) 3.8, 3.7
Holland Fork	2.8	State Route 139	
Bucklick Creek	0.8	Comer Schoolhouse Rd.	
Rocky Fork L. Scioto River	14.2	Fallen Timber Road	
Rocky Fork L. Scioto River	10.2	Blue Run Road	
Rocky Fork L. Scioto River	6.4	State Route 139	
Rocky Fork L. Scioto River	0.6	Glades Run Road	Fe 6940; pH 6.48 S.U.
Long Run	1.0	Bennet Road	
Frederick Creek	1.4	Adj. Frederick Creek Rd.	
Skull Creek	0.1	Frederick Creek Rd.	
Pine Creek	45.7	State Route 93	D.O. (mg/L) 4.7
Pine Creek	41.3	Adj. Pine Creek Road	D.O. (mg/L) 4.6, 4.3
Pine Creek	36.4	Haven Road	Cu 11.5; Fe 19300; D.O. (mg/L) 4.51
Pine Creek	25.9	State Route 522	
Pine Creek	20.4	Lane off SR 650	D.O.(mg/L) 4.9, 4.7
Pine Creek	13.4	Powellsville Road	
Pine Creek	5.1	Upst. Mill Road	Cu 12.4; Fe 18400
Sawmill Run	0.1	Adj. State Route 93	D.O. (mg/L) 3.61, 1.56
Painters Creek	0.1	Painters Creek Road	pH 5.28 S.U.
Negro Creek	0.2	Adj. Negro Run Road	D.O. (mg/L) 1.62; pH 6.25 S.U.
Kimble Creek	0.9	Kimble Creek Road	D.O. (mg/L) 4.38, 0.66
Kimble Creek	0.6	Kimble Creek Road	D.O. (mg/L) 4.39, 2.78
Kimble Creek	0.1	State Route 93	
Olive Creek	0.11	Buckhorn-Pine Creek Rd.	D.O. (mg/L) 0.94
Brushy Fork	0.1	Buckhorn-Pine Creek Rd.	
Hales Creek	4.4	Brady Creek Rad	
Hales Creek	1.0	Lick Run-Lyra Bloom Rd.	D. O. (mg/L) 4.0, 3.6
Brady Run	0.9	Brady Creek Road	
Little Pine Creek	0.8	State Route 650	
Ellisonville Creek	0.2	White Oak Road	pH 6.4 S.U.
Lick Run	0.9	State Route 522	
Chandlers Run	1.3	Big Pete Road	
Patton Run	2.35	Patton Run Burkes Road	Cu 12.2; Fe 12000
Ginat Run	2.8	Back Road	
Osborne Run	1.3	State Route 650	pH 5.4 S.U., 5.62 S.U.
Storms Creek	10.1	Adj. Access Road	Fe 1800
Storms Creek	6.8	State Route 93	
Storms Creek	3.3	Porter Gap Road	
Little Storms Creek (lower)	0.1	Gravel lane near mouth	
Little Storms Creek (upper)	0.4	Little Storms Creek Road	
Ice Creek	10.3	County Road 181	
Ice Creek	6.1	Lane off County Road 52	
Ice Creek	2.3	Deering Bald Road	
Little Ice Creek	0.6	Adj. Little ice Creek Road	
Solida Creek	3.52	Solida Road	

Table 5. Nutrient sampling results in the SEORT watershed, summer 2010. The 90th percentile value from reference sites located within the Western Allegheny Plateau ecoregion is shown for comparison. Values above applicable reference values are highlighted in yellow.

			Ammonia-N	Nitrate-Nitrite-N	Phosphorus-T	Phosphorus -Ortho
Stream	**River Mile**	**Drainage Area***	**Geo-Mean**	**Geo-Mean**	**Geo-Mean**	**Geo-Mean**
Munn Run	2.2	3.0	0.040	1.08	0.041	ns
Little Scioto River	18.8	108	0.040	0.49	0.028	0.007
Little Scioto River	12.7	200	0.040	0.29	0.056	ns
Little Scioto River	5.5	210	0.039	0.27	0.049	0.006
Holland Fork	2.8	25.1	0.029	0.11	0.021	ns
Bucklick Creek	0.8	6.7	0.037	0.14	0.015	ns
Rocky Fork	14.2	11.2	0.025	0.38	0.013	ns
Rocky Fork	10.2	20.4	0.029	0.12	0.012	ns
Rocky Fork	6.4	45.9	0.055	0.25	0.022	ns
Rocky Fork	0.6	68.8	0.034	0.24	0.021	0.005
Long Run	1.0	17.1	0.052	0.45	0.032	ns
Frederick Creek	1.4	15.9	0.025	0.16	0.017	0.005
Pine Creek	36.4	69	0.037	0.13	0.017	0.005
Pine Creek	5.1	168	0.038	0.26	0.016	0.005
Little Pine Creek	0.8	29.2	0.040	0.15	0.017	ns
Sawmill Run	0.1	3.0	0.030	0.14	0.011	ns
Lick Run	0.9	10.3	0.030	0.17	0.023	ns
Chandlers Run	1.3	0.99	0.025	0.22	0.022	ns
Ginat Run	2.8	8.6	0.047	0.37	0.027	ns
Storms Creek	3.3	29.4	0.035	0.15	0.012	ns
Ice Creek	6.5	19.2	0.025	0.09	0.014	0.005
Little Ice Creek	0.6	11.1	0.040	0.35	0.026	ns
Solida Creek	3.52	6.5	0.036	0.22	0.064	ns
Reference Value (headwater/wading/small river)			0.06/0.06/0.174	0.606/1.054/1.46	0.09/0.11/0.16	

ns – no samples taken

*headwater ≤ 20 miles^2; wadeable >20 miles^2 ≤ 200 miles$^{2;}$ small river > 200 miles^2 ≤ 1000 miles^2

Table 6. *Summary statistics for select AMD inorganic and field chemistry water quality parameters sampled in the SEORT study area, 2010. The 90th percentile value from reference sites from the Western Allegheny Plateau ecoregion is shown for comparison. Values above reference conditions are shaded.*

		Iron	Manganese	Aluminum	pH	Acidity[2]	Alkalinity[3]
Units		µg/l	µg/l	µg/l	S.U.	µg/l	µg/l
Stream[1]	**River Mile**	Mean	Mean	Mean	Minimum	Mean	Mean
Little Storms Cr.	0.40	1177	1124	298	6.49	2.5[4]	33
Osborne Run	1.20	1467	2404	1892	5.44	7.8	14
Painters Run	0.03	545	795	151	7.18	2.5	39
Negro Run	0.20	1306	1640	234	6.25	3.6	5
Kimble Creek	0.89	716	171	127	7.31	2.5	71
Kimble Creek	0.60	1514	718	100	6.99	2.5	56
Olive Creek	0.11	607	528	133	7.4	2.5	109
Brushy Fork	0.13	774	1218	100	7.05	2.5	60
Little Pine Creek[W]	0.75	650	449	332	6.4	4.3	52
Ellisonville Creek	0.20	722	2001	1746	5.92	11.3	24
Pine Creek	45.68	807	378	100	7.46	2.5	78
Pine Creek[W]	41.30	920	306	124	7.26	2.5	126
Headwater/Wadeable		1266/1820	379/610	750[a]	6.5[b]	-20	20

1 - W- Wadeable >20 & ≤200 square mile drainage area
2 – A net acidity of -20 mg/l was set in the Raccoon Creek TMDL to protect the biological WWH use designation.
3 - Minimum of 20 mg/l of alkalinity was set in the Raccoon Creek TMDL to protect the biological WWH use designation.
4 – Values listed as 2.5 mg/l for acidity are results below detection limit.
a – U.S. EPA maximum criteria. 750 ug/l
b – Ohio Water Quality Standard minimum value.

Recreational Use

Water quality criteria for determining attainment of recreational 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 feasible. 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.

Bacteria

Elevated bacteria counts were found throughout the watershed. Sewage discharges in unsewered areas, inadequate manure management and unrestricted cattle access to streams are the most likely sources of bacteria.

Pathogenic (disease causing) organisms are typically present in the environment in such small amounts that it is impractical to monitor every type of pathogen. Fecal indicator bacteria, including *E. coli*, by themselves 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 *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.

Streams within the SEORT study area are designated with the 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 support, or potentially support, frequent primary contact recreation activities. Streams designated PCR Class B support, or potentially support, occasional primary contact recreation activities. Streams designated as PCR class C support, or potentially support, infrequent primary contact recreation activities. Streams designated as SCR use are rarely used for water-based recreation.

The SEORT study area is all designated Class B PCR waters. The *E. coli* criteria that apply to PCR Class B streams include a geometric mean of <161 cfu/100 ml and

maximum value ≤ 523cfu/100 ml. 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.

Figure 7. Hales Creek cattle access to stream.

Summarized bacteria results are listed in Table 7 and the complete dataset is reported in Appendix G. Downloadable bacteria results are also available from the Ohio EPA GIS interactive maps at the following link: http://www.epa.state.oh.us/dsw/gis/index.aspx. Twenty-four locations in the SEORT study area were tested for *E. coli* levels 2 to 10 times, from May 25th – October 25th, 2010. Evaluation of *E. coli* results revealed that 18 of the 24 locations sampled failed to attain the applicable geometric mean criterion indicating an impairment of the recreation use at these locations. The locations not attaining the recreational use were most likely due to unsanitary conditions from failing HSTS and/or agricultural activities such as pasture land runoff, livestock with free access to the stream and manure land application.

Pine Creek at RM 38.49, Storms Creek, Osborne Run, Holland Fork, Frederick Creek and Little Scioto River at RM 5.51 were the only locations meeting the Class B use criteria. Most of these streams have very low developed land-use and are heavily forested.

Most sites sampled had extensive amounts of agricultural land in the stream valleys with heavily forested, steep, hill sides. Hales Creek and Sugarcamp Creek both had cattle in the stream during the sampling season (Figure 7). Other sites had livestock grazing in fields along the streams with no fences to limit cattle access to the stream. On one occasion it was noted that manure was being stockpiled along the Little Scioto River bank and within the access way for a stream crossing, while part of the pile was in the stream along State Route 139, RM 22.2 (Figure 8). Lowland flood plain areas which were cultivated in row crops had greatly reduced or absent wooded/vegetated riparian buffers along the stream bank.

Salliday Creek, Long Run and Munn Run flow through heavily populated residential unsewered areas. These three areas have a good potential for the installation of central sewers since they are close to communities with central sewers. Other areas listed in Table 7 as failing HSTS may need individual system improvements or up-grades to reduce bacterial and nutrient discharges.

Figure 8. Manure piles along the edge of the Little Scioto River banks, adjacent State Route 139, RM 22.2.

Table 7. *A summary of E. coli data for locations sampled in the SEORT watershed study area, May 25 – October 25, 2010. Recreation use attainment is based on comparing the geometric mean to the Primary Contact Recreation (PCR) Classes B geometric mean water quality criterion of 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 use.*

Location	**RM**	Recreation	# of Samples	Geometric Mean	Maximum Value	Recreational Attainment Status	Source(s) of Bacteria
Solida Creek	3.52	PCR Class B	5	496	1700	**NON**	Unsewered Area
Ice Creek	6.1	PCR Class B	9	219	4700	**NON**	HSTS
Storms Creek	6.8	PCR Class B	5	152	1100	FULL	
Osborne Run	1.2	PCR Class B	5	20	1400	FULL	
Ginat Run	2.8	PCR Class B	5	374	3500	**NON**	HSTS
Patton Creek	2.35	PCR Class B	5	206	6800	**NON**	HSTS
Hales Creek	1	PCR Class B	5	170	690	**NON**	Livestock
Little Pine Creek	0.75	PCR Class B	9	427	2600	**NON**	HSTS
Pine Creek	38.5	PCR Class B	5	87	190	FULL	
Pine Creek	36.4	PCR Class B	10	174	9000	**NON**	Livestock
Pine Creek	20.4	PCR Class B	3	253	660	**NON**	Livestock
Pine Creek	19.1	PCR Class B	2	365	430	**NON**	Livestock
Pine Creek	5.1	PCR Class B	10	164	6900	**NON**	Livestock
Sugarcamp Cr.	0.1	PCR Class B	4	1435	86000	**NON**	Livestock
Holland Fork	0.15	PCR Class B	5	136	1200	FULL	
Rocky Fork	10.2	PCR Class B	5	289	1100	**NON**	Livestock
Rocky Fork	0.6	PCR Class B	10	337	10000	**NON**	Livestock
Long Run	0.95	PCR Class B	5	199	1700	**NON**	Unsewered Areas/ Livestock
Frederick Creek	1.4	PCR Class B	5	68	690	FULL	
Skull Creek	0.05	PCR Class B	5	165	840	**NON**	Livestock
Little Scioto River	35.3	PCR Class B	3	632	1400	**NON**	Livestock
Little Scioto River	18.8	PCR Class B	10	529	16000	**NON**	Livestock
Little Scioto River	5.51	PCR Class B	10	92	1800	FULL	
Munn Run	2.2	PCR Class B	5	1323	3000	**NON**	Unsewered Area

NPDES Permitted Dischargers

A total of eleven National Pollutant Discharge Elimination System (NPDES) permitted facilities discharge sanitary wastewater, industrial process water, and/or industrial storm water to the SEORT watershed within Lawrence and Scioto Counties. There are numerous other NPDES permitted facilities within the watershed which all discharge directly to the Ohio River, including large publicly owned sanitary wastewater plants, gas fired power plants, chemical plants and other large industrial facilities. The eleven NPDES facilities which discharge directly to SEORT basin streams include three publicly owned sanitary wastewater plants, three industrial wastewater plants and two small package plants serving an airport and apartment complex. The three sanitary wastewater dischargers consist of the Village of South Webster facility which discharges treated sanitary waste water to Skull Creek, Tanglewood Subdivision (tributary to Little Scioto River) and Purtee Acres (tributary to Wards Run), both owned by the Scioto County Commissioners. Three public schools are Deering Elementary School (tributary to Little Ice Creek), Rockhill Local School District (Ellisonville Creek) and Minford Local School District (Long Run) which have sanitary wastewater treatment plants. The three industrial dischargers are Hanging Rock Landfill which discharges stormwater from the closed landfill to Osborne Run and Little Storms Creek (lower tributary at RM 1.8)), Norfolk & Western Railway Co. (tributary to Patton Run) and KSA Cross-Tie Plant (Little Scioto River), both discharge stormwater from their stockyards. Two small sanitary package plants service the Portsmouth Regional Airport and Minford Village Apartments. 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 Monthly Operating Report (MOR). A summary of NPDES effluent results are listed in Appendix H.

Deering Elementary School (Ohio EPA Permit # 0PT00041)
Deering Elementary School is located at 4503 State Route 243 in Lawrence County. The sanitary wastewater is generated at the restrooms and kitchen. The treatment system consists of a 10,000 gallons per day (gpd) extended aeration wastewater treatment plant with chlorination/dechlorination. The wastewater is discharged to an unnamed tributary of Little Ice Creek at RM 1.3. The summary of NPDES effluent results in Appendix H has shown that the discharge has caused no noticeable impact to the water quality of the tributary to Little Ice Creek.

Hanging Rock Landfill Co. Inc. (Ohio EPA Permit # 0IN00116)
Hanging Rock Landfill is located along State Route 650, Hanging Rock in Lawrence County. The industrial solid waste section of the landfill was closed in 1993 and the exempt non-toxic foundry sand section of the landfill was closed in 1996. The landfill is currently in post-closure. The landfill is situated within an old strip coal mine area. The treatment works consisted of three sedimentation ponds. Pond 001 discharges into a tributary to Little Storms Creek at RM 0.80 and is designed to treat 6.580 gpd. Pond 002 discharges into a tributary to of Osborne Run at RM 0.35 and is designed to treat 8,000 gpd. Pond 003 discharges into a tributary to Little Storms Creek (lower tributary at RM 1.8) at RM 0.50 and is designed to treat 6.580 gpd. The summary of NPDES effluent results in Appendix H has shown that the discharge has caused no noticeable impact to the water quality of the receiving streams.

Rockhill Local School District (Ohio EPA Permit # 0PT00055)
Rockhill Local School District facility is located on County Road 26, Elizabeth Township in Lawrence County. The sanitary wastewater is generated at the restrooms and kitchens which serve 2,000 faculty and students. The treatment system consists of a 30,000 gallons per day (gpd) extended aeration wastewater treatment plant with UV disinfection. The wastewater is discharged to an unnamed tributary of Ellisonville Creek at RM 2.6. The summary of NPDES effluent results in Appendix H has shown that the discharge has caused no noticeable impact to the water quality of the receiving stream.

Norfolk & Western Railway Co. – Wheelersburg Terminal (Ohio EPA Permit # 0IL00010)
The Norfolk & Western Wheelersburg Terminal is located at 914 Hayport Road in Wheelersburg, Lawrence County. The terminal stockpiles coal prior to transport. Storm water from the 68 acre facility is directed into a sedimentation pond before discharging into a tributary to of Patton Run at RM 0.1. The summary of NPDES effluent results in Appendix H has shown that the discharge has caused no noticeable impact to the water quality of the receiving stream.

Minford Local School District (Ohio EPA Permit # 0PT00056)
Minford High School Complex is located on Falcon Road (Township Road 501) Minford, in Scioto County. The sanitary wastewater is generated at the restrooms and kitchen. The treatment system consists of a 40,000 gpd extended aeration wastewater treatment plant with chlorination/dechlorination. The wastewater is discharged to Long Creek at RM 2.3. The summary of NPDES effluent results in Appendix H has shown that the discharge has caused no noticeable impact to the water quality of the receiving stream.

Joshua Landing Apartments (Ohio EPA Permit # 0PW00014)
Joshua Landing Apartments is located at 338 High Street, Minford, in Scioto County. The domestic sanitary wastewater is generated at the apartment complex. The treatment system consists of a 10,000 gpd extended aeration wastewater treatment plant with chlorination/dechlorination. The wastewater is discharged to Long Creek at RM 2.3. The summary of NPDES effluent results in Appendix H has shown that the discharge has caused no noticeable impact to the water quality of the receiving stream.

Portsmouth Regional Airport (Ohio EPA Permit # 0PG00059)
Portsmouth Regional Airport is owned by the Scioto County Commissioners and is located at 30 Barklow Road, Portsmouth, in Scioto County. The domestic sanitary wastewater is generated at the airport. The treatment system consists of a 5,000 gpd extended aeration wastewater treatment plant with chlorination/dechlorination. The wastewater is discharged to Shumway Hollow at RM 0.85. The summary of NPDES effluent results in Appendix H has shown that the discharge has caused no noticeable impact to the water quality of the receiving stream.

Village of South Webster WWTP (Ohio EPA Permit # 0PA00085)
Village of South Webster WWTP is located along County Road 12, South Webster in Scioto County. The domestic sanitary wastewater is generated by the approximately 760 residents of South Webster. The treatment system consists of a 150,000 gpd sequencing batch reactor wastewater treatment plant with UV disinfection. The wastewater is discharged to Skull Creek at RM 2.87. The summary of NPDES effluent results in Appendix H has shown that the discharge has caused no noticeable impact to the water quality of the receiving stream.

Tanglewood Subdivision (Ohio EPA Permit # 0PG00050)
Tanglewood Subdivision WWTP is owned and operated by the Scioto County Commissioners and is located west of County Road 241 and southeast of Boyer Road, Harrison Township, in Scioto County. The domestic sanitary wastewater is generated by 42 residences. The treatment system consists of a 50,000 gpd activated sludge - extended aeration wastewater treatment plant with chlorination/dechlorination. The wastewater is discharged to a tributary to Little Scioto River at RM 1.6. The summary of NPDES effluent results in Appendix H has shown that the discharge has caused no noticeable impact to the water quality of the receiving stream.

Purtee Acres (Ohio EPA Permit # 0PG00051)
Purtee Acres (Subdivision) WWTP is owned and operated by the Scioto County Commissioners and is located at 1951 Kittle Road, Portsmouth, in Scioto County. The domestic sanitary wastewater is generated by 99 residences. The treatment system consists of a 40,000 gpd activated sludge - extended aeration wastewater treatment plant with chlorination/dechlorination. The wastewater is discharged to a tributary to Ward's Run at RM 0.01. The summary of NPDES effluent results in Appendix H has shown that the discharge has caused no noticeable impact to the water quality of the receiving stream.

KSA Partner (Ohio EPA Permit # 0IN00182)
KSA Cross-Tie Plant is located at 6501 Pershing Avenue, Portsmouth, Scioto County. Sanitary waste water goes to the City of Portsmouth. The plant manufactures precast, pre-stressed concrete railroad cross tie. The plant also repairs and reconditions wood railroad cross ties. The 22 acre facility has outdoor storage and loading facilities. The process and storm water goes to a retention pond designed to discharge 350,000 gpd. The wastewater is discharged to the Little Scioto River at RM 1.88. The summary of NPDES effluent results in Appendix H has shown that the discharge has caused no noticeable impact to the water quality of the receiving stream.

Sediment Quality

Sediment samples were collected from seven locations in the SEORT study area by the Ohio EPA on July 19 and August 11, 2010. Samples were analyzed for metals, nutrients, and particle size at all sites and base neutral acid extractable compound (BNA) at Holland Fork only. Specific chemical parameters tested and results are listed in Table 8. Sediment data were evaluated using guidelines established in *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald *et.al*. 2000), and *Ohio Specific Sediment Reference Values (SRVs)* for metals (Ohio EPA 2003). The consensus-based sediment guidelines define two levels of eco-toxic effects. A *Threshold Effect Concentration* (TEC) is a level of sediment chemical quality below which harmful effects are unlikely to be observed, and is comparable to background conditions.

Sediment Organic Chemicals
Were all below detectable level

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 sands and gravels. All sediment sampling occurred in areas along the stream bank, which were represented by sparse deposits of fine grained material. These nearbank areas comprised only a small fraction of the bottom substrates of the streams surveyed. Bottom substrates at some sediment sites were dominated by sand and gravel material. Inorganic chemical parameters were tested at both sampling locations (Table 8). All organic chemicals at Holland Fork were reported as not detected.

Table 8. Chemical parameters detected in sediment samples collected from selected SEORT study area sampling locations, 2010. Results are reported in mg/kg dry weight. Contamination levels were determined for parameters using consensus-based sediment quality guidelines (MacDonald et.al. 2000). Sediment reference values are listed in the Ohio EPA Guidance on Evaluating Sediment Contaminant Results (2010).

Parameter	SRV/TEC	Ice Creek	Pine Creek	Little Pine Creek	Little Scioto River
		RM 6.10	RM 5.1	RM 0.75	RM 5.51
Aluminum	53,000/---	4970	5700	10,600	2060
Arsenic	19/9.79	8.57	5.05	11.9	2.61
Cadmium	0.8/0.99	0.319	0.364	0.723	0.139
Chromium	53/43.4	13.3	7.95	14.6	5.42
Copper	33/31.6	11.0	12.4	25.8	4.42
Iron	51,000/---	29,900	16,900	20,100	7010
Lead	47/35.8	13.8	11.0	22.8	4.87
Nickel	61/22.7	14.2	17.3	34.4	5.28
Selenium	2.6/---	<1.36	<1.37	2.17	<1.08
Zinc	170/121	71.8	62.1	126	33.5
Ammonia	----	46	68	59	35
Total Phosphorus	----	411	360	359	148

Lakes Results

Lake Vesuvius is located within the Wayne National Forest. The 121 acre lake is an impoundment of Storms Creek. The dam was completed in 1940. The maximum depth is about 22 feet. The lake has a swimming beach and one boat launch. No gasoline boat engines are allowed. Primary land use of the contributing watershed is forest.

Inland Lakes Monitoring

Ohio EPA has implemented a sampling strategy that focuses on evaluating the water quality conditions present in the epilimnion of inland lakes. The sampling target consists of an even distribution of a total of ten sampling events divided over a two-year period and collected during the summer months. Key water quality parameters sampled include total phosphorus, total nitrogen, chlorophyll a, Secchi depth, ammonia, dissolved oxygen, pH, total dissolved solids, and various metals such as lead, mercury, and copper. Details of the sampling protocol are outlined in the Inland Lakes Sampling Procedure Manual, available on Ohio EPA's web page at:
http://www.epa.ohio.gov/dsw/inland_lakes/index.aspx

Water Quality Standards for the Protection of Aquatic Life in Lakes

Presently, lakes in Ohio are designated as Exceptional Warmwater Habitat (EWH) with respect to the aquatic life habitat use designation. Revisions to Ohio's WQS that would change the aquatic life use from EWH to Lake Habitat (LH) were proposed for adoption in December, 2011, but were subsequently withdrawn. A future rulemaking is anticipated but the timeframe is unknown. A primary reason for this revision is that in Ohio, a set of biological criteria applies to rivers and streams, whereas no biocriteria apply to lakes. The numeric chemical criteria to protect the LH use will remain the same as the criteria to protect the EWH use that currently applies to lakes, with a suite of nutrient criteria added. A set of numeric criteria that applies to all surface waters for the protection of aquatic life, regardless of specific use designation, will also apply to inland lakes and are referred to as "base aquatic life use criteria" in the proposed WQS rules. The base aquatic life use criteria will be the same aquatic life numeric criteria that currently apply to lakes. Examples include various metals such as copper, lead, and cadmium as well as organic chemicals such as benzene and phenol. Specific details concerning the progress of revisions to Ohio's Water Quality Standards involving the proposed Lake Habitat aquatic life use and associated criteria can be found at the following Ohio EPA web site as information becomes available:
http://www.epa.ohio.gov/dsw/rules/draftrules.aspx. The chemical criteria specific to the LH aquatic life use in the proposed Water Quality Standards rules are presented in Table 9.

Table 9. Proposed Lake Habitat use criteria. Note: All criteria are outside mixing zone averages unless specified differently. As of the finalization of this report, the proposed Lake Habitat use and these criteria have not been adopted into the Ohio Water Quality Standards and all discussion of such use and criteria in this report should be considered as examples of how the adopted use and criteria would be applied.

Parameter **Lake type**	**Form[1]**	**Units[2]**	**Statewide criteria**	**Ecoregional criteria**				
				ECBP	EOLP	HELP	IP	WAP
Ammonia	T	mg/l	Table 43-4	--	--	--	--	--
Chlorophyll a [3]								
Dugout lakes	T	µg/l	6.0	--	--	--	--	--
Impoundments	T	µg/l	--	14.0	14.0	14.0	14.0	6.2
Natural lakes	T	µg/l	14.0	--	--	--	--	--
Upground reservoirs	T	µg/l	6.0	--	--	--	--	--
Dissolved oxygen [4] All lake types	T	mg/l	5.0 OMZM 6.0 OMZA	--	--	--	--	--
Nitrogen [3]								
Dugout lakes	T	µg/l	450	--	--	--	--	--
Impoundments	T	µg/l	--	930	740	930	688	350
Natural lakes	T	µg/l	638	--	--	--	--	--
Upground reservoirs	T	µg/l	1,225	--	--	--	--	--
pH								
All lake types	--	s.u.	A	--	--	--	--	--
Phosphorus [3]								
Dugout lakes	T	µg/l	18	--	--	--	--	--
Impoundments	T	µg/l	--	34	34	34	34	14
Natural lakes	T	µg/l	34	--	--	--	--	--
Upground reservoirs	T	µg/l	18	--	--	--	--	--
Secchi disk transparency [5]								
Dugout lakes	--	m	2.60	--	--	--	--	--
Impoundments	--	m	--	1.19	1.19	1.19	1.19	2.16
Natural lakes	--	m	1.19	--	--	--	--	--
Upground reservoirs	--	m	2.60	--	--	--	--	--
Temperature								
All lake types	--	--	B	--	--	--	--	--

1 T = total.
2 m = meters; mg/l = milligrams per liter (parts per million); µg/l = micrograms per liter (parts per billion); s.u. = standard units.
3 These criteria apply as lake medians from May through October in the epilimnion of stratified lakes and throughout the water column in unstratified lakes.
4 For dissolved oxygen, OMZM means outside mixing zone minimum and OMZA means outside mixing zone minimum twenty-four-hour average. The dissolved oxygen criteria apply in the epilimnion of stratified lakes and throughout the water column in unstratified lakes.
5 These criteria apply as minimum values from May through October.
A pH is to be 6.5-9.0, with no change within that range attributable to human-induced conditions.
B At no time shall the water temperature exceed the average or maximum temperature that would occur if there were no temperature change attributable to human activities.

Sampling

Sampling was conducted according to procedures described in the Ohio EPA Lake sampling manual available at: http://www.epa.ohio.gov/portals/35/inland_lakes/Lake%20sampling%20Procedures%206-19-06_2.pdf. The sampling station designated L1 was at the deepest part of the lake immediately adjacent to the dam. Field measurements of temperature, conductivity, dissolved oxygen and ph were measured in a vertical profile at one meter intervals. Clarity was measured with a secchi disc from the surface. Samples for laboratory analysis were collected at one half meter below the surface and one half meter above the bottom. Samples were collected for *E.coli.* analysis at the L1 station and at the swimming beach. Water quality field measurements were made and water samples were collected for laboratory analysis five times in 2010. *E. coli.* samples for recreation use attainment were collected four times in 2010.

Lake Habitat Tiered Aquatic Life Use

Results of tiered aquatic life use parameters are presented in Table 10 and indicate the following:

1) Secchi disc watch list: 5 of 5 samples below minimum value of 2.16 for WAP.
2) Chlorophyll-a impairment: Median of 9.1 which exceeds WAP standard of 6.2 ug/l
3) Total nitrogen, total phosphorus, *E.coli*, and ammonia met standards.
4) 3 of 5 D.O. samples (profiles) were below outside mixing zone average (OMZA) of 6.0 mg/l above the thermocline (metalimnion).
5) pH impairment: Median of 9.1 which is outside the acceptable range of 6.5 - 9.0.

Table 10. Lake Vesuvius Proposed Lake Habitat Use and Recreation Use attainment. Note - As of the finalization of this report, the proposed Lake Habitat aquatic life use and the associated criteria have not been adopted into the Ohio Water Quality Standards and all discussion of such use and criteria in this report should be considered as examples of how the adopted use and criteria would be applied.

	Proposed Lake Habitat Aquatic Life Criteria							**Recreation Use**
	Secchi depth M.	Chlorophyll a ug/l	Total Nitrogen ug/l	Total Phosphorus ug/l	D.O (mg/l)	pH	Nh3 mg/l	*E.coli*
Criteria	2.16 minimum	6.2 median	350 median	14 median	6.0 average	6.5 - 9.0 median	temperature dependent	126 cfu/100ml.
Date								L1/ Beach
5/26/2010	0.83	0.83	150	5	7.3	7.9	<0.050	
6/10/2010	1.28	9.1	150	5	7.6	10.1	<0.050	
6/16/2010								20/ 70
7/13/2010	1.82	6.6	330	5	5	9.1	<0.050	
7/14/2010								40/ 60
8/18/2010	0.63	13	43	20	5.2	8.34	<0.050	
8/19/2010								NS /10
9/21/2010	0.88	12	390	21	4.4	6.91	<0.050	
9/22/2011								<10/ <10
Median		9.1	150	5	3 of 5	2 of 5	Below detect	16/21 geomean
Narrative	watch list	impaired	meets	meets	impaired	impaired	meets	meets

Base Aquatic Life Criteria

No exceedances of base aquatic life criteria of arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc standards were found (Table 11).

Table 11. Lake Vesuvius base aquatic life criteria.

Criteria	TDS mg/l	As ug/l	Se ug/l	Cd ug/l	Cr ug/l	Cu ug/l	Pb ug/l	Ni ug/l
Date								
5/26/2010	106	<2.0	<2.0	<0.2	<2.0	<2.0	<2.0	<2.0
6/10/2010	106	<2.0	<2.0	<0.2	<2.0	6.8	<2.0	<2.0
7/13/2010	150	<2.0	<2.0	<0.2	<2.0	<2.0	<2.0	<2.0
8/18/2010	116	<2.0	<2.0	<0.2	<2.0	2.5	<2.0	3
9/21/2010	98	<2.0	<2.0	<0.2	<2.0	<2.0	<2.0	<2.0

Recreation Use

Lake Vesuvius is in attainment of current recreation use standards. All samples were well below the recreation use standard of 126 cfu/l for the designated PCR Class A and Bathing Water recreation uses. Three samples were collected from the primary L1 sampling station and four from the swimming beach. Results are presented in Table 10. For more information about recreation use attainment please see: http://www.epa.state.oh.us/portals/35/tmdl/2010IntReport/Section%20F.pdf.

Stream Physical Habitat

Stream habitat was evaluated at 49 fish sampling locations throughout the SEORT study area in 2010 & 2011. The SEORT sites consisted mainly (96%) of good to excellent stream habitats (Table 12). Good to excellent stream habitat was recorded at 47 sites with only one site each scoring fair and poor quality stream habitats - Storms Creek (RM 3.12) and Hales Creek (RM 1.0), respectively. The average QHEI score for the SEORT was 72.7 which showed the overall good habitat quality in the study area (Appendix A).

The fair quality habitat (QHEI = 59.0) at Storms Creek RM 3.12 was related to both stream substrate material and the upstream impoundment. Stream substrates at the site were almost entirely comprised of fine sediment, mainly sand (Figure 9). Sandy streams in a region such as this with rolling terrain and moderate to high gradients have unstable channels and moving bed-loads of fine materials. Interstitial spaces created from allochthonous material, such as woody debris from the adjacent riparian floodplain provide some of the only habitat available for aquatic organisms. Instream cover seldom remains stable downstream from impoundments where flows can be flashy. A large pool, approximately 50m in length, at the end of the 200m fish sampling zone had moved completely out of the sampling reach after a storm event between the first (7/20/10) and second (8/10/10) sampling events. This sample site was downstream from Lake Vesuvius.

Figure 9. Fair quality habitat at Storms Creek (RM 3.12) which was largely attributed to the substrates being dominated by fine sediment, eliminating most interstitial habitat niches.

Poor quality habitat at Hales Creek (RM 1.0) was mainly attributed to substrate quality and type and no riffle. The substrates were dominated by fine silt and sediment throughout the 200m sampling zone. Historic channelization was evident, although, strong signs of recovery were also apparent. Besides scoring low on channel sinuosity, riffle habitats were absent from the site and riffle species of fish were not collected. It is believed that the modified habitat attributes and lack of riffles are a reflection of natural ecological conditions from an active beaver population in the area. A large beaver dam was found at the upstream end of the zone and there is a strong possibility for more downstream which may help explain the lack of riffle habitat and deep sluggish channel (Figure 10). Full biological attainment was scored at this site indicating good overall water quality which further emphasized a natural reason for the poor habitat scored here (Table 2).

Figure 10. Poor quality habitat (QHEI = 40.5) at Hales Creek RM 1.0.

Table 12. Summarized results of QHEI scores for the SEORT study area, 2010 & 2011.

Stream Name	RM	Sampling Type	QHEI
Excellent			
ROCKY FORK L. SCIOTO R. @ ST. RT. 139	6.44	Wading	83.50
L. SCIOTO R. @ DIXON MILL RD. (CO. RD. 15)	5.50	Wading	80.50
PINE CREEK AT SAND HILL @ MILL RD.	5.05	Wading	80.50
STORMS CREEK @ ST. RT. 93	6.80	Wading	80.00
PINE CREEK @ HAVEN RD.	36.42	Wading	78.80
PINE CREEK SW OF POWELLSVILLE @ POWELLSVILLE RD.	13.36	Wading	78.80
L. SCIOTO R. AT WHEELERS MILL @ WHEELERS MILL RD.	12.70	Wading	78.00
PINE CREEK AT SUPERIOR @ ST. RT. 522	25.90	Wading	78.00
ROCKY FORK L. SCIOTO R. NEAR MOUTH @ GLADES RUN RD.	0.57	Wading	76.50
HOLLAND FORK DST. RT 139 @ RM 2.8	2.80	Wading	75.50
BUCKLICK CREEK @ COMER SCHOOLHOUSE RD/CHARLES RUSS RD (TR50)	0.80	Headwater	83.30
L. SCIOTO R. @ ALLEN TWP. RD. 288	35.28	Headwater	83.00
PAINTER CREEK SE OF BUCKHORN @ PAINTER CREEK RD.	0.03	Headwater	81.50
LICK RUN NEAR GARDEN CITY @ ST. RT. 522	0.90	Headwater	81.50
STORMS CREEK @ ACCESS ROAD DST. LAKE VESUVIUS	10.10	Headwater	81.50
ROCKY FORK L.SCIOTO R. @ FALLEN TIMBER RD.	14.15	Headwater	81.00
LITTLE PINE CREEK @ ST. RT. 650	0.70	Headwater	81.00
LONG RUN @ BENNETT RD. (CO. RD. 12)	0.95	Headwater	80.00
ICE CREEK @ CO. RD. 6 (DEERING BALD KNOB RD.)	10.30	Headwater	78.50
FREDERICK CREEK ADJ. FREDERICK CREEK RD. (CO. RD. 17)	1.40	Headwater	77.50
ICE CREEK SW OF KITTS HILL @ LANE OFF CO. RD. 52	6.10	Headwater	77.50
LITTLE ICE CREEK ADJ. TWP. RD. 102 (LITTLE ICE CREEK RD.)	0.60	Headwater	76.50
GINAT RUN ADJ. BACK RD.	2.80	Headwater	76.00
KIMBLE CREEK UPST AMD LEACHATE, ADJ. KIMBLE CREEK RD.	0.89	Headwater	75.50
BRADY RUN @ BRADY CREEK RD. (TWP. RD. 289)	0.90	Headwater	74.50
PINE CREEK UPST. CONFL PAINTER CREEK, ADJ ST. RT. 93	45.68	Headwater	72.80
SKULL CREEK @ MOUTH (FREDERICK RD SOUTH WEBSTER)	0.05	Headwater	70.50
Good			
L. SCIOTO R. UPST. MCDOWELL CREEK @ JOHNSON RD. COVERED BRDG	31.40	Wading	74.50
ROCKY FORK L.SCIOTO R @ BLUE RUN RD CR 29	10.20	Wading	74.50
L. SCIOTO R. UPST. ROCKY FORK @ STOCKHAM RD.	18.80	Wading	73.30
L. SCIOTO R. UPST. SUGARCAMP CREEK @ MILLSTONE RD. FORD	27.20	Wading	73.00
PINE CREEK SE OF POWELLSVILLE @ KELLYS MILL RD (UPST L PINE)	20.35	Wading	72.30
LITTLE PINE CREEK AT LAWCO @ FARM LANE	2.90	Wading	72.00
ICE CREEK N OF COAL GROVE, ADJ. CO. RD. 181 (HOG RUN RD.)	2.30	Wading	71.50
PINE CREEK DST. YOUNGS BRANCH, ADJ. PINE CREEK RD.	41.30	Wading	61.80
L. STORMS CREEK (UPPER) UPST. GRAVEL LANE NEAR MOUTH	0.30	Headwater	69.50

Stream Name	RM	Sampling Type	QHEI
ELLISONVILLE CREEK @ CO. RD. 25 (WHITE OAK RD.)	0.20	Headwater	68.00
LITTLE STORMS CREEK (CONFLUENCE RM 1.8) @ LITTLE STORMS RD.	0.40	Headwater	67.30
LONG RUN NEAR CLARKTOWN @ FURNACE CREEK RD.	4.51	Headwater	66.00
BRUSHY FORK @ BUCKHORN-PINE CREEK RD. (CO. RD. 34)	0.13	Headwater	66.00
HALES CREEK UPST. BRADY RUN @ BRADY RUN RD.	4.35	Headwater	64.30
SUGARCAMP CREEK @ MILLSTONE RD. (TWP. RD. 201)	0.10	Headwater	64.00
SOLIDA CREEK AT SOUTH POINT @ SOLIDA RD.	3.62	Headwater	63.00
KIMBLE CREEK DST. AMD DISCHARGE, ADJ. ST. RT. 93	0.60	Headwater	62.00
SAWMILL RUN S OF BUCKHORN @ MOUTH	0.01	Headwater	60.50
BRUSHY FORK (TRIB. TO L. SCIOTO R.) @ GLADE RD.	0.38	Headwater	60.30
MUNN RUN AT EDEN PARK @ HINKLEY HOLLOW RD.	2.20	Headwater	57.00
Fair			
STORMS CREEK N OF IRONTON @ PORTER GAP RD.	3.12	Wading	59.00
Poor			
HALES CREEK @ LICK RUN-LYRA BLOOM RD. (CO. RD. 2)	1.00	Wading	40.50

General narrative ranges assigned to QHEI scores.			
Narrative		QHEI Range	
Rating		Headwaters (≤20 sq. mi)	Larger Streams
Excellent		≥70	≥75
Good		55 to 69	60 to 74
Fair		43 to 54	45 to 59
Poor		30 to 42	30 to 44
Very Poor		<30	<30

Physical Habitat Trends (1996-2010)

Limited historical habitat data exists for the SEORT in providing site specific data to compare against the 2010 data. Twelve out of the forty-nine sampling locations from 2010 were sampled historically and analyzed for trends. Munn Run and Kimble Creek were the only two streams (4 out of 12 sites) which displayed significant differences in QHEI scores compared to historical data (Figure 11).

Munn Run (RM 2.2) scored a 40.5 in 1997 compared to a 57 in 2010. In 2010 there was a moderate to extensive amount of cover available to the fish community which was scored as only sparse in 1997. The stream channel is beginning to show signs of recovery from channelization which was unapparent in 1997 (Appendix A and Figure 11).

Physical habitat in Kimble Creek scored improvements from the 1997 assessment at RM 0.6. More WWH attributes were scored in 2010 than 1997 with the habitat notably improving from the effects of channelization; there were no modified habitat attributes scored as part of the QHEI assessment (Appendix A and Figure 11).

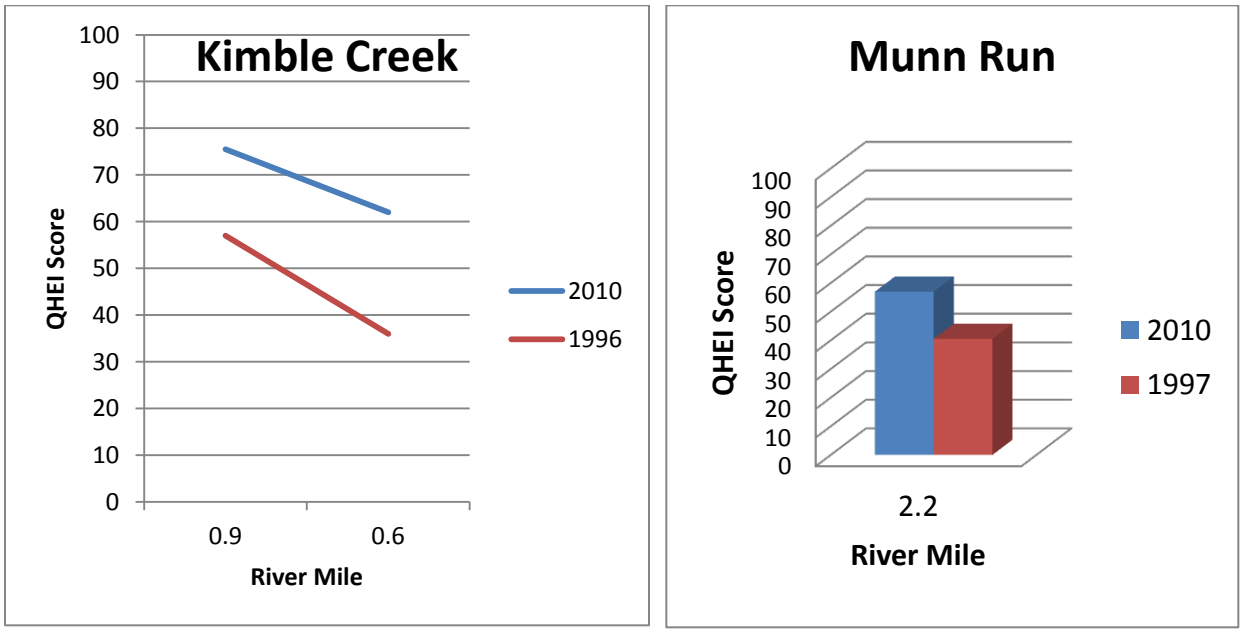


Figure 11. Comparison of QHEI trends for Kimble Creek and Munn Run, 1996-2010.

Spills and Fish Kills

A total of 5 spills which resulted in 5 fish kills were reported in the SEORT study area between 1983 and 2005 (Table 13). No evidence or reports of fish kills occurred during the 2010 & 2011 study.

Table 13. Documented fish kills in the SEORT watershed, 1983-2005.

Stream	Date	RM	Length Affected	# Killed	Operation	Pollutant	Source
Ginat Creek	8/4/2005	5.7	0.23	40	Residence	Unknown oil substance	Trash dumped along creek
Ice Creek	6/17/2004	11.97	0.14	378	Residence	Chemicals, oils, poisons, thermal	Runoff from extinguishing house fire
Brushy Fork	7/20/2000	0.65	0.17	Unknown	Hog-farm	Manure	Manure lagoon runoff
Long Run	4/8/1997	6.61	4.03	250	Scioto Water Inc.	Unknown	Suspect water line
Long Run	6/18/1983	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

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 advisories

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

The minimum data requirement for issuing a fish advisory is 3 samples of a single species from within the past 10 years. Four SEORT were sampled for fish tissue in 2010. Of those four, Little Scioto River, Pine Creek, and Rocky Fork Little Scioto River had enough data to evaluate issuing advisories. For the Little Scioto River, smallmouth bass and spotted bass were both in the one meal a month advisory category due to mercury contamination. Channel catfish were in the one meal a month advisory category for both mercury and PCB contamination. In Pine Creek, sauger and spotted bass are both in the one meal a month advisory category due to mercury contamination. In the Rocky Fork Little Scioto River, spotted bass are in the one meal a month advisory category due to mercury 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 and northern pike 23” and over.

For a listing of fish tissue data collected from the SEORT in support of the advisory program, and how the data compare to advisory thresholds, see Table 15.

Fish tissue/human health 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 Ohio water quality standards (WQS) criteria, 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 were adequate to determine attainment status. At least 2 samples from each trophic level 3 and 4 are needed, and four of twenty-three HUC 12s in the SEORT study area met that data requirement. The four HUC 12s that were evaluated for human health use attainment were 0509010301 03, 0509010302 04, 0509010302 05, and 0509010306 05. A concentration of mercury and PCBs and the associated attainment status is listed in Table 14 below.

Table 14. Attainment status of HUC 12s for fish tissue/human health use.

HUC 12	Mercury (mg/kg)	PCBs (mg/kg)	Attainment
0509010301 03	0.124	0.121	Non-Attainment
0509010302 04	0.228	Not detected	Attainment
0509010302 05	0.187	0.026	Attainment
0509010306 05	0.235	0.172	Non-Attainment

Two of the four HUC12s for which the human health attainment status was determined were in non-attainment of the human health use due to PCB contamination in excess of the WQS criterion 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 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 the SEORT in 1995, except for Ice Creek, which had never been assessed for fish tissue prior to 2010. In 1995, Little Scioto River had fish tissue collections from RM 31.4 at Johnson Road covered bridge, down to RM 12.9, upstream of Wheelers Mill Road. Upstream coverage was less extensive and downstream coverage more extensive, in 2010, beginning at RM 24.9 at Winter Road and ending at RM 0.5 upstream of U.S. Route 52. For a comparison of 1995 and 2010 fish tissue data in Little Scioto River, only overlapping segments were used, which was from approximately RMs 24.9 to 12.6. The weighted average concentration of mercury in Little Scioto River fish was approximately the same for the two study periods, 0.347 mg/kg in 1995 versus 0.357 mg/kg in 2010. PCBs were detected in one freshwater drum from Little Scioto River in 1995, and were not detected in any fish from that stretch of the Little Scioto River in 2010.

In 1995, Pine Creek had fish tissue collections from RM 25.9 at State Route 522 to RM 1.5 at Hayport Road. Sites in 2010 overlapped with the 1995 sites with the exception of the downstream-most site, which in 2010 was at RM 5.1 upstream of Mill Road. All fish tissue samples were compared between the two study periods except for the downstream-most site from 1995, since the 2010 study did not include that site. The weighted average concentration of mercury in Pine Creek fish was similar between the two study periods, 0.150 mg/kg in 1995 and 0.198 mg/kg in 2010. The increase between the two study periods may be partially attributable to a slight size difference in the fish collected, which averaged 253 mm in 1995 and 266 mm in 2010. PCBs were detected only in sauger during both study periods, with average concentrations in sauger declining from 0.073 mg/kg in 1995 to 0.032 mg/kg in 2010. All other fish were non-detect for PCBs in both study periods.

Data for Rocky Fork Little Scioto River were inadequate to compare between the two study periods, with only three and four samples taken in 1995 and 2010 respectively, and from two different locations within the stream.

Table 15. Select fish tissue data from 2010 SEORT sampling (mg/kg).

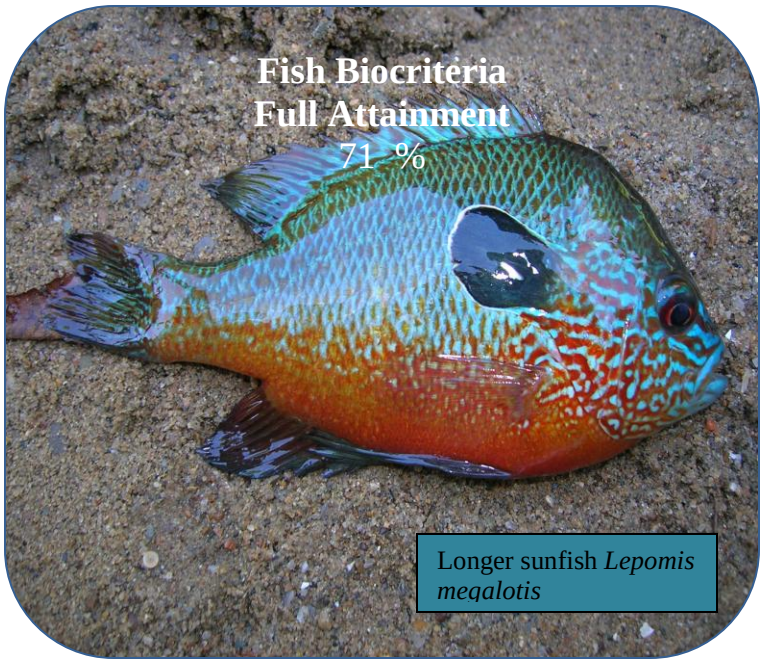
Year Collected	Location	River Mile	Species	Mercury	PCBs
	Ice Creek				
2010	Ice Creek	1.5	Channel Catfish	0.073	0.178
2010	Ice Creek	1.5	Channel Catfish	0.152	0.457
2010	Ice Creek	1.5	Freshwater Drum	0.355	0.069
2010	Ice Creek	1.5	Largemouth Bass	0.190	0.084
	Little Scioto River				
2010	Little Scioto River upstream U.S. Route 52	0.5	Bowfin	0.104	0.287
2010	Little Scioto River upstream U.S. Route 52	0.5	Channel Catfish	0.556	1.219
2010	Little Scioto River upstream U.S. Route 52	0.5	Channel Catfish	0.063	0.166
2010	Little Scioto River upstream U.S. Route 52	0.5	Channel Catfish	0.079	0.116
2010	Little Scioto River upstream U.S. Route 52	0.5	Common Carp	0.383	0.081
2010	Little Scioto River upstream U.S. Route 52	0.5	Muskellunge	0.219	<0.05
2010	Little Scioto River at Stockham Road	18.8	Rock Bass	0.318	<0.05
2010	Little Scioto River upstream U.S. Route 52	0.5	Sauger	0.224	0.055
2010	Little Scioto River at Wheelers Mill Road	12.6	Smallmouth Bass	0.400	<0.05
2010	Little Scioto River at Wheelers Mill Road	12.6	Smallmouth Bass	0.477	<0.05
2010	Little Scioto River at Wheelers Mill Road	12.6	Smallmouth Bass	0.556	<0.05
2010	Little Scioto River at Winter Road	24.9	Spotted Bass	0.484	<0.05
2010	Little Scioto River at Wheelers Mill Road	12.6	Spotted Bass	0.387	<0.05
2010	Little Scioto River at Winter Road	24.9	Spotted Bass	0.355	<0.05
2010	Little Scioto River upstream U.S. Route 52	0.5	Spotted Bass	0.140	<0.05
	Pine Creek				
2010	Pine Creek at State Route 522	25.9	Bluegill Sunfish	0.082	<0.05
2010	Pine Creek at State Route 522	25.9	Rock Bass	0.206	<0.05
2010	Pine Creek upstream Junior Furnace Road	13.4	Rock Bass	0.162	<0.05
2010	Pine Creek upstream Mill Road	5.1	Rock Bass	0.142	<0.05
2010	Pine Creek at State Route 522	25.9	Largemouth Bass	0.502	<0.05
2010	Pine Creek upstream Mill Road	5.1	Largemouth Bass	0.231	<0.05
2010	Pine Creek at State Route 522	25.9	Sauger	0.506	<0.05
2010	Pine Creek upstream Junior Furnace Road	13.4	Sauger	0.488	<0.05
2010	Pine Creek upstream Mill Road	5.1	Sauger	0.329	0.052
2010	Pine Creek upstream Mill Road	5.1	Smallmouth Bass	0.232	<0.05
2010	Pine Creek upstream Mill Road	5.1	Smallmouth Bass	0.133	<0.05
2010	Pine Creek at State Route 522	25.9	Spotted Bass	0.153	<0.05

Year Collected	Location	River Mile	Species	Mercury	PCBs
2010	Pine Creek at State Route 522	25.9	Spotted Bass	0.585	<0.05
2010	Pine Creek upstream Junior Furnace Road	13.4	Spotted Bass	0.323	<0.05
2010	Pine Creek upstream Junior Furnace Road	13.4	Spotted Bass	0.151	<0.05
	Rocky Fork Little Scioto River				
2010	Rocky Fork Little Scioto River at Glade Road	0.6	Sauger	0.410	<0.05
2010	Rocky Fork Little Scioto River at Glade Road	0.6	Spotted Bass	0.231	<0.05
2010	Rocky Fork Little Scioto River at Glade Road	0.6	Spotted Bass	0.242	<0.05
2010	Rocky Fork Little Scioto River at Glade Road	0.6	Spotted Bass	0.242	<0.05

The shading indicates where each sample result would fall based on advisory category. Green = two meals per week, yellow = one meal per week, orange = one meal per month, red = one meal every two months.

Fish Community

Fish sampling was conducted at 49 sites in the SEORT study area, 2010 & 2011. Relative numbers of fish species collected per location are presented in Appendix C. IBI and MIwb scores are presented in Table 2 and Table 16 and the IBI metric breakdowns can be found in Appendix B. Sampling locations were evaluated using Warmwater Habitat (WWH) biocriteria. A summary of the fish data are presented in Table 16.



Longer sunfish *Lepomis megalotis*

SEORT sites sampled during 2010 & 2011 achieved the applicable fish biocriterion at 35 of the 49 sites evaluated (71%). Fish communities partially achieved the applicable biocriterion at three wading (>20 sq. mi.) sites or 6% [Little Pine Creek (RM 2.9), Storms Creek (RM 3.12), and Ice Creek (RM 2.3)]. Eleven sites (wading and headwater) were not achieving the applicable biocriterion, representing 22% of the fish sites [Munn Run (RM 2.2), Rocky Fork Little Scioto River (RM 10.2), Sawmill Run (RM 0.01), Painter Creek (RM 0.03), Kimble Creek (RMs 0.9 & 0.6), Brushy Fork (RM 0.2), Ellisonville Creek (RM 0.2), Ginat Run (RM 2.8), Little Storms Creek (lower tributary, confluence at RM 1.8) (RM 0.4), and Salliday Creek (RM 3.62]. The average IBI score among the SEORT was 43.

Good quality habitat was found at Little Pine Creek (RM 2.9); however, the fish community at the site was only partially achieving the WWH aquatic life use because of poor chemical water quality parameters including low pH from adjacent and upstream AMD. Ice Creek (RM 2.3), partially achieved the biocriterion with an IBI=42, but a low MIwb score (7.6) resulted from silt and sediment impairment. No intolerant fish were collected and <200 individuals were collected during the first pass (Table 2 and Appendix B). Similarly, Storms Creek (RM 3.12) also had a fish community affected by sedimentation due to Ohio River backwaters with less than 200 individuals caught on the first sample pass (Table 2 and Appendix B). Sedimentation during early spring rains could be the reason both sites scored lower with fewer than 200 individuals in earlier June sampling runs compared with higher scores in the second sample pass later in the summer.

Of the eleven sites not scoring adequately for either fish index or being a headwater site with a non-attaining IBI score, there were three different causes for impairment. Six

sites were impaired by AMD, four sites from failing HSTS and storm runoff, and the last one was from natural sources (Table 2). Species known to be tolerant of pollution were the only fish caught in the following streams which were impaired by AMD - Painter Creek (RM 0.03), Kimble Creek (RMs 0.9 & 0.6), Brushy Fork (RM 0.2), Ellisonville Creek (RM 0.2), and Little Storms Creek (lower tributary, confluence at RM 1.8) (RM 0.4). Good quality habitat was scored at all of these AMD affected sites; however, chemical water quality conditions were poor and could not sustain healthy fish communities due to parameters such as low pH and elevated levels of manganese draining from the adjacent mines (Table 2, Appendices B and C).

Organic enrichment due to elevated solids and nutrients discharging from home sanitary treatment systems in Munn Run (RM 2.2), Sawmill Run (RM 0.01), Ginat Run (RM 2.8), and Salliday Creek (RM 3.62) created poor water quality conditions, such as low D.O. (Table 2). These four streams consisted of fish communities dominated by species tolerant of pollution (Appendix B and C).

Rocky Fork Little Scioto River at RM 10.2 had homogeneous habitat which naturally limited the fish community (Appendix A). Intolerant fish and top carnivores were absent from the community (Appendix B). The substrates were comprised entirely of bedrock having very few interstitial spaces. Much of the sampling zone was a wide shallow riffle area with very few fractured sections of bedrock which could have provided refuge for fish if present.

Narrative fish community evaluations, based on IBI and MIwb scores, are provided in Table 16. Descriptive evaluations allow for the comparison of fish communities from site to site. Six (12%) sites scored exceptional fish communities out of the 49 total sites. Fifty-nine percent of fish sites scored within the narrative very good to marginally good range. Sites that were scored within the very good, good and marginally good categories would meet WWH expectations for fish. Twenty-nine percent were found to have only fair to poor fish communities which were found to be degraded predominately from failing HSTS, backwater conditions from the Ohio River, and AMD (Table 2).

Table 16. Fish community status for stations sampled in the SEORT basins based on data collected in 2010 & 2011. The Index of Biotic Integrity (IBI) and Modified Index of well-being (MIwb) are scores based on the performance of the fish community. The narrative fish evaluations (Exceptional, Very Good, etc.) were based upon the corresponding IBI and MIwb relative to the drainage area, ecoregion, and the assigned ALU. The Qualitative Habitat Evaluation Index (QHEI) is a measure of the ability of the physical habitat to support a biotic community. Relative numbers and weights are per 0.3 km for wading and headwater sites, and per 1.0 km for boat sites.

River Mile	Sample Type	Number of Species*	Relative Weight	Relative Number	(all) Relative Number	QHEI	IBI	MIwb	IBI Narrative		MIwb Narrative	Drainage Area
09-001-000 *Munn Run*												
Warmwater												
2.20	E	5.0	NA	1586.00	3552.00	57.00	36	NA	Fair	:	NA	2.9
09-003-000 *Ginat Run*												
Warmwater												
2.80	E	18.0	NA	200.00	486.00	76.00	36	NA	Fair	:	NA	8.6
09-007-000 *Storms Creek*												
Warmwater												
10.10	E	21.0	NA	230.00	256.00	81.50	52	NA	Exceptional	:	NA	11.2
6.80	D	22.0	12.30	309.80	381.80	80.00	51	9.00	Exceptional	:	Very Good	22.8
3.12	E	19.5	3.00	219.00	260.30	59.00	44	7.70	Good	:	Fair	29.4
09-007-001 *Little Storms Creek (Upper tributary at RM 9.23)*												
Warmwater												
0.30	E	14.0	NA	294.00	400.00	69.50	42	NA	Marginal	:	NA	8.6
09-008-000 *Little Storms Creek (Lower tributary at RM 1.8)*												
Warmwater												
0.40	E	12.0	NA	93.00	240.00	67.30	28	NA	Fair	:	NA	5.4
09-013-000 *Little Ice Creek*												
Warmwater												
0.60	E	16.0	NA	414.00	1420.00	76.50	40	NA	Marginal	:	NA	11.1
09-011-000 *Ice Creek*												
Warmwater												
10.30	E	18.0	NA	294.00	478.00	78.50	44	NA	Good	:	NA	12.5

River Mile	Sample Type	Number of Species*	Relative Weight	Relative Number	(all) Relative Number	QHEI	IBI	MIwb	IBI Narrative		MIwb Narrative	Drainage Area
6.10	E	20.0	NA	474.00	676.00	77.5	48	NA	Very Good	:	NA	19.2
2.30	D	19.0	8.70	175.50	216.00	71.5	42	7.60	Marginal	:	Fair	37.0
09-019-000 *Solida Creek (AKA Salliday Creek)*												
Warmwater												
3.62	E	11.0	NA	75.00	240.00	63.0	26	NA	Poor	:	NA	6.5
09-300-000 *Little Scioto River*												
Warmwater												
35.28	E	20.0	NA	332.00	644.00	83.0	50	NA	Exceptional	:	NA	9.3
31.40	E	25.0	7.90	703.00	894.00	74.5	50	8.80	Exceptional	:	Good	24.5
27.20	E	24.0	3.00	783.00	1032.80	73.0	41	8.50	Marginal	:	Good	43.0
18.80	D	27.5	10.60	631.50	819.00	73.3	47	9.20	Very Good	:	Very Good	108.0
12.70	D	26.5	17.00	546.00	593.30	78.0	51	9.20	Exceptional	:	Very Good	200.0
5.50	D	28.0	12.20	630.80	741.00	80.5	51	9.30	Exceptional	:	Very Good	210.0
09-306-000 *Frederick Creek*												
Warmwater												
1.40	E	18.5	NA	309.00	465.00	70.5	44	NA	Good	:	NA	15.9
09-307-000 Skull Creek												
Warmwater												
0.05	E	19.0	NA	298.00	810.00	70.5	44	NA	Good	:	NA	4.6
09-310-000 *Rocky Fork Little Scioto River*												
Warmwater												
14.15	E	17.0	NA	396.00	652.00	81.0	46	NA	Very Good	:	NA	11.2
10.20	E	18.0	2.00	420.80	661.50	74.5	36	7.70	Fair	:	Fair	20.4
6.44	D	25.0	9.60	1074.00	1231.50	83.5	52	9.50	Exceptional	:	Exceptional	45.9

River Mile	Sample Type	Number of Species*	Relative Weight	Relative Number	(all) Relative Number	QHEI	IBI	MIwb	IBI Narrative		MIwb Narrative	Drainage Area
0.57	D	32.0	21.40	1989.80	2164.50	76.5	55	9.90	Exceptional	:	Exceptional	68.8
09-311-000 *Long Run*												
Warmwater												
4.51	E	20.0	NA	1216.00	1640.00	66.0	58	NA	Exceptional	:	NA	9.5
0.95	E	20.0	NA	1652.00	1972.00	80.0	48	NA	Very Good	:	NA	17.1
09-329-000 *Sugarcamp Creek*												
Warmwater												
0.10	E	19.0	NA	332.00	454.00	64.0	48	NA	Very Good	:	NA	14.4
09-330-000 *Holland Fork*												
Warmwater												
2.80	D	21.0	8.20	273.00	369.00	75.5	50	8.65	Exceptional	:	Good	25.1
09-331-000 *Bucklick Creek*												
Warmwater												
0.80	E	17.0	NA	168.00	366.00	83.3	42	NA	Marginal	:	NA	6.7
09-342-000 *Brushy Fork*												
Warmwater												
0.38	E	20.0	NA	255.00	345.00	60.3	52	NA	Exceptional	:	NA	9.8
09-400-000 *Pine Creek*												
Warmwater												
45.68	E	17.0	NA	264.00	514.00	72.8	44	NA	Good	:	NA	8.0
41.30	D	20.0	9.20	159.00	183.00	61.8	44	8.0	Very Good	:	Marginal	29.6
36.42	D	24.5	9.50	339.80	407.30	78.8	50	9.00	Exceptional	:	Very Good	69.0
25.90	D	30.0	15.40	300.00	346.50	78.0	46	8.60	Very Good	:	Good	95.0
20.35	D	25.0	8.70	381.80	486.00	72.3	42	9.00	Marginal	:	Very Good	104.0
13.36	D	23.0	12.10	162.80	230.30	78.8	46	8.40	Very Good	:	Good	157.0
5.05	D	26.0	18.20	495.80	516.00	80.5	49	9.10	Very Good	:	Very Good	168.0
09-401-000 *Lick Run*												

River Mile	Sample Type	Number of Species*	Relative Weight	Relative Number	(all) Relative Number	QHEI	IBI	MIwb	IBI Narrative		MIwb Narrative	Drainage Area
Warmwater												
0.90	E	19.0	NA	246.00	334.00	81.5	46		Very Good	:	NA	10.3
09-408-000 *Little Pine Creek*												
Warmwater												
2.90	E	20.0	1.10	100.50	229.50	72.0	42	6.20	Marginal	:	Fair	25.1
0.70	D	23.0	7.20	196.50	267.00	81.0	48	8.30	Very Good	:	Marginal	29.2
09-415-000 *Hales Creek*												
Warmwater												
4.35	E	20.0	NA	232.80	242.40	64.3	44		Good	:	NA	14.2
1.00	D	21.0	21.40	225.00	285.80	40.5	44	8.80	Good	:	Good	31.8
09-416-000 *Brady Run*												
Warmwater												
0.90	E	18.0	NA	398.00	704.00	74.5	40	NA	Marginal	:	NA	7.1
09-419-000 *Brushy Fork (tributary to Pine Creek)*												
Warmwater												
0.13	E	8.0	NA	32.00	174.00	66.0	26	NA	Poor	:	NA	4.1
09-422-000 *Painter Creek*												
Warmwater												
0.03	E	11.0	NA	74.00	458.00	81.5	34	NA	Fair	:	NA	3.4
09-423-000 *Ellisonville Creek*												
Warmwater												
0.20	E	9.0	NA	78.00	230.00	68.0	26	NA	Poor	:	NA	11.3
09-424-000 *Kimble Creek*												
Warmwater												
0.890	E	6.0	NA	16.00	174.00	75.5	24	NA	Poor	:	NA	4.2
0.600	E	12.0	NA	104.00	494.00	62.0	34	NA	Fair	:	NA	4.3
09-425-000 *Sawmill Run*												
Warmwater												
0.01	E	12.0	NA	144.00	510.00	60.5	38	NA	Fair	:	NA	3.0

Narrative ranges and WWH biocriteria (bold) for the WAP ecoregion. Exceptional (EWH biocriteria), very good (EWH nonsignificant departure), poor and very poor evaluations are common statewide. For WWH, the ranges of marginally good and nonsignificant departure are the same.

IBI			**MIwb**		**Narrative Evaluation**
Headwater	Wading	Boat	Wading	Boat	
50-60	50-60	48-60	≥9.4	≥9.6	Exceptional
46-49	46-49	44-47	8.9-9.3	9.1-9.5	Very Good
Western Allegheny Plateau					
44-45	**44**-45	**40**-43	**8.4**-8.8	**8.6**-9.0	Good
40-43	40-43	36-39	7.9-8.3	8.1-8.5	Marginally Good
28-39	28-39	26-35	5.9-7.8	6.4-8.0	Fair
18-27	18-27	16-25	4.5-5.8	5.0-6.3	Poor
12-17	12-17	12-15	0-4.4	0-4.9	Very Poor

NA - Headwater site, MIwb is not applicable, no weights taken
E - Electro-fishing with Longline
D - Electro-fishing with Roller Beast
* - Relative number

Fish Community Trends

Limited data is available for historical trends analysis for overall fish community results with only 12 of the 49 fish sites having been previously sampled. Comparisons for selected sites yielded both positive and negative IBI trends between 1990 and 2011 (Figure 12 and Figure 13). Three streams (Munn Run, Storms Creek, and Ice Creek) scored identical IBIs and four streams (Little Scioto River, Rocky Fk. Little Scioto River, Sawmill Run, and Pine Creek) displayed limited variability in IBI score. IBI scores in Kimble Creek at RM 0.6 improved greatly between 1996 (IBI=12, 0 fish species) and 2010 (IBI=34, 12 fish species, 247 individuals) likely due to a reduction in AMD impacts (Figure 12). However, the fish community at this Kimble Creek site is still not attaining WWH expectations. The 2010 fish community at the upstream site (RM 0.9) on Kimble Creek reflected even greater signs of AMD impact (IBI=24) and until the pollution source is remediated, it will be difficult for either site to fully attain the WWH aquatic life use (Table 2).

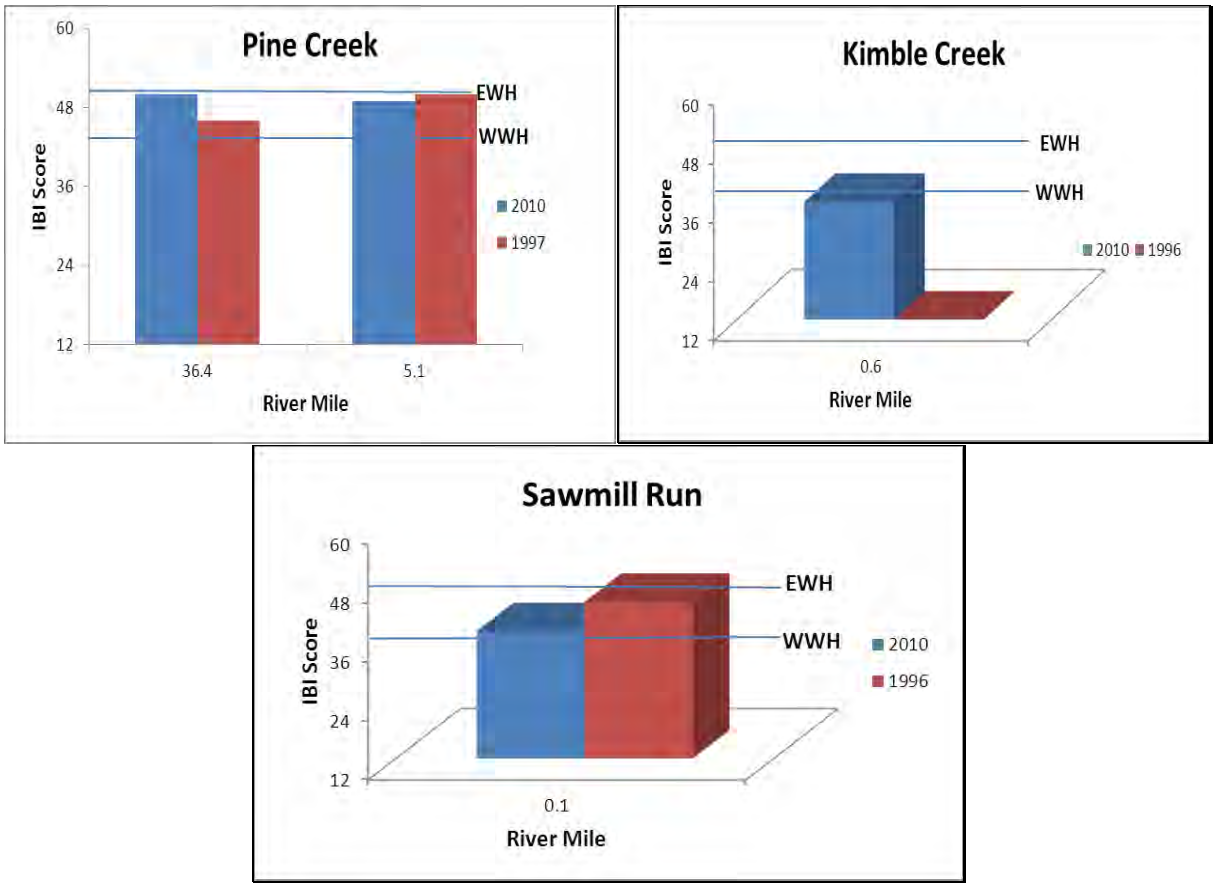


Figure 12. SEORT IBI trends listed by tributary and RM, 1996-2010.

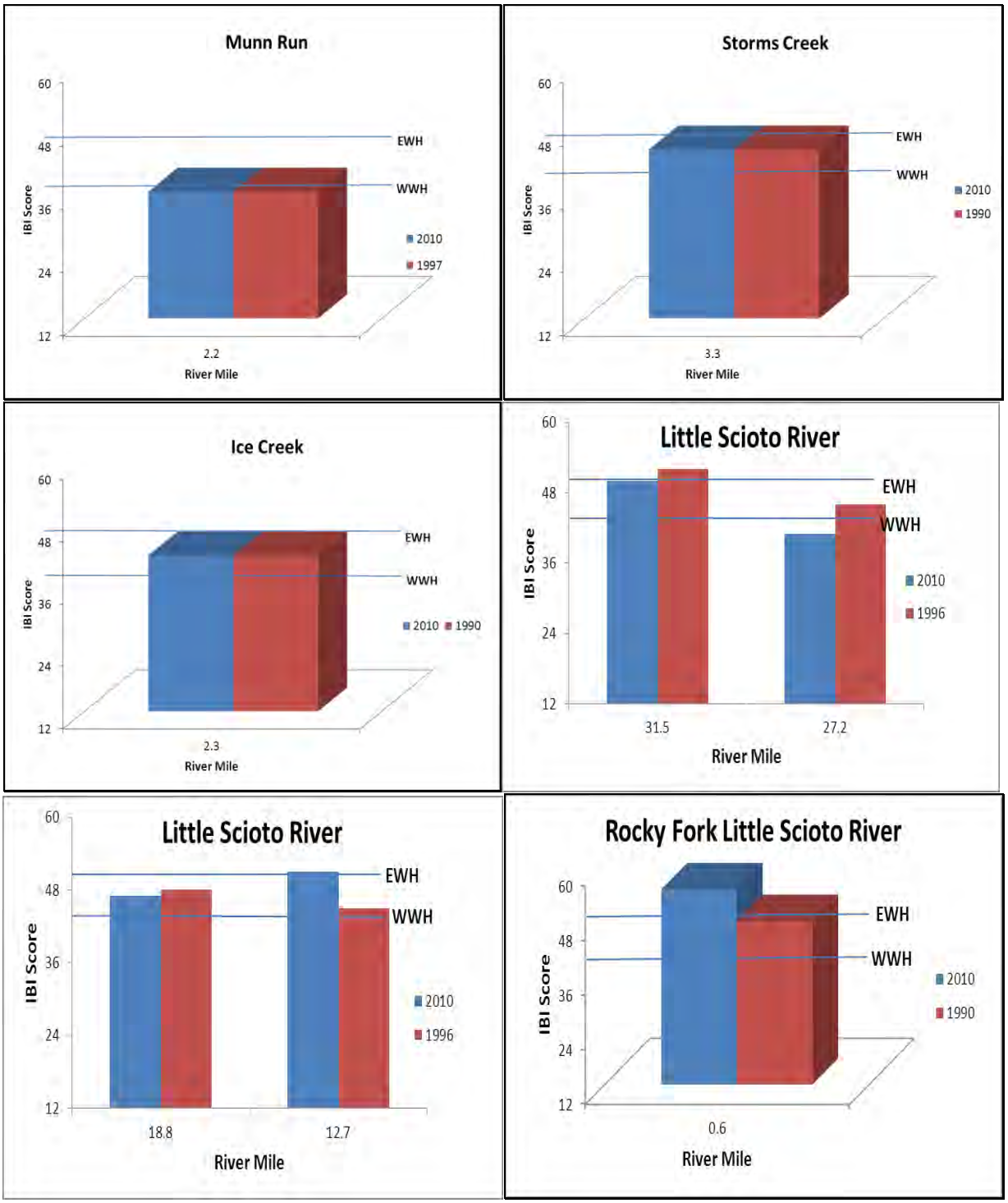


Figure 13. SEORT IBI trends listed by tributary and RM, 1990-2010.

Macroinvertebrate Community

Macroinvertebrate communities were evaluated at 54 stations in the SEORT study area (Table 17 and Appendices D and E). The community performance was evaluated as exceptional at 15 stations, very good at 8, good at 16, marginally good at 7, fair at 5 and poor at 3 stations. The station with the highest total mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Trichoptera) taxa richness (EPT) was the Little Scioto River at Dixon Mill Road (RM 5.5) with 30 taxa. The station with the highest number of total sensitive taxa was on Little Scioto River at Dixon Mill Road (RM 5.5) and at Rocky Fork Little Scioto River at Glades Run Road with 28 taxa. The intolerant or uncommonly collected sensitive taxa collected during this survey included the mayflies Acentrella turbida at Little Scioto R. RM 35.28 and Rocky Fk. RM 14.15; Diphetor hageni at Skull Cr. RM 0.05, Patton Run RM 2.35, and L. Storms Cr. (@ RM 9.23) RM 0.1; Paracloeodes fleeki at Pine Cr. RM 13.4, Storms Cr. RM 3.7, and Ice Cr. RM 10.3; Paracloeodes minutus at Storms Cr. RM 3.7 and Ice Cr. RM 2.3; Plauditus dubius or P. virilis at Little Scioto R. RM 35.28, Rocky Fk. RM 14.15, and Ice Cr. RM 10.3; and Habrophleboides sp. at Rocky Fk. RM 6.44. Also of note were the midges Polypedilum (C.) ontario at Holland Fk. RM 2.8 and Rocky Fk. RM 0.6, and Robackia demeijerei at Storms Cr. RM 3.7 and Ice Cr. RM 2.3. The midge *Xestochironomus subletti* Borkent was collected from Pine Creek at Kellys Mill Road (RM 20.4). This was the first time that this genus has been collected from Ohio. Until now, it has only been collected from the southern United States from Texas to North Carolina (Borkent, 1984; Caldwell et al., 1997). The state endangered freshwater mussel *Villosa lienosa* (little spectaclecase)

inhabits Pine Creek, but was not found during this study. The six species of mussels that were collected live or fresh-dead during this study were *Fusconaia flava* (wabash pigtoe), *Lampsilis cardium* (plain pocketbook), *Lampsilis radiata luteola* (fat mucket),

Leptodea fragilis (fragile papershell), *Potamilus alatus* (pink heelsplitter), and *Quadrula quadrula* (mapleleaf).

Little Scioto River Main Stem
The Little Scioto River main stem was sampled at six stations in 2010. All of the stations were achieving the WWH macroinvertebrate biocriterion with an average ICI score of 43.2 (very good).

Little Scioto River Tributaries
Macroinvertebrate communities were sampled from tributaries of the Little Scioto River at 12 stations in eight streams. Eleven of these stations were meeting or marginally meeting WWH expectations with evaluations ranging from marginally good to exceptional.

Long Run was sampled at Bennett Road (RM 0.95) in 2010 and at Furnace Creek Road (RM 4.5) in 2011. The upstream station was not meeting WWH expectations with low EPT (8) and sensitive taxa (5) diversity and the riffle habitat was predominated by facultative taxa. Based on adjacent and upstream land use, organic enrichment from failing septic systems draining to the stream was the most likely cause of the observed community impairment. The downstream station improved into the good range with EPT (16) and sensitive taxa (14) diversity meeting WWH expectations.

Pine Creek Main Stem
The Pine Creek main stem was sampled at seven stations in 2010. All of the stations were achieving the WWH macroinvertebrate biocriterion with an average ICI score of 46.8 (exceptional).

Pine Creek Tributaries
Macroinvertebrate communities were sampled from tributaries of Pine Creek at 14 stations in 11 streams. Twelve of these stations were meeting or marginally meeting WWH expectations with evaluations ranging from marginally good to exceptional.

The community evaluated in Negro Creek (RM 0.2) was not meeting WWH expectations with very low EPT (2) and sensitive taxa (2) diversity and was considered to represent a poor community. This community response was considered consistent with impairment from AMD and sedimentation.

Kimble Creek was sampled at three stations to evaluate impact from a known AMD seep. The station (RM 0.6) immediately downstream from the seep had a decline in EPT (10) and sensitive taxa (9) diversity compared to the upstream station (15 and 15, respectively), but was considered marginally meeting WWH expectations. The station farther downstream near the mouth (RM 0.01) improved into the good range (16 and 14,

respectively) and was similar to the most upstream station. The AMD seep appeared to have had a slight to moderate impact at most on the macroinvertebrate community.

The community evaluated in Lick Run (RM 0.9) was not meeting WWH expectations with low EPT (6) and sensitive taxa (4) diversity and was considered to represent a fair community. Heavy siltation was noted on the substrates on 15 July, two days after a rain event. Excessive siltation may be the primary cause of the below expected community performance.

Ohio River Tributaries

Macroinvertebrate communities were sampled from tributaries to the Ohio River at 15 stations in 11 streams. Ten of these stations were meeting or marginally meeting WWH expectations with evaluations ranging from marginally good to exceptional. One station (Osborne Run) was meeting the proposed LRW (AMD) use designation.

The community evaluated in Munn Run (RM 1.4) was not meeting WWH expectations with low EPT (6) and sensitive taxa (2) diversity and the riffle habitat was predominated by facultative and tolerant taxa. The stream substrates were mostly clean with little algae or bugs, reminiscent of a sewage effluent dominated stream. The community response in this stream was consistent with a mild toxic impact, possibly from home septic systems.

The community evaluated in Osborne Run (RM 1.3) was not meeting WWH expectations with very low EPT (3) and sensitive taxa (2) diversity and was considered to represent a poor community. This community response was considered consistent with impairment from AMD and sedimentation. This stream is currently designated LWH (AMD) and is recommended to become LRW (AMD).

The community evaluated in Little Storms Creek (lower trib. @ RM 1.8) (RM 0.4) was not meeting WWH expectations with low EPT (6) and sensitive taxa (5) diversity and was considered to represent a fair community. Excessive sedimentation was observed in the stream channel and was probably the primary contributor to the impacted community.

The community evaluated in Little Ice Creek (RM 0.6) was not meeting WWH expectations with very low EPT (3) and sensitive taxa (1) diversity and was considered to represent a poor community. Above normal sedimentation was observed at this station and cows had unrestricted access to the stream.

The community evaluated in Solida Creek (RM 3.52) was not meeting WWH expectations with low EPT (8) and sensitive taxa (5) diversity and was considered to

represent a fair community. The stream channel was incised due to channelization at this station.

Macroinvertebrate Trends

The 2010 survey was the first time these basins were systematically sampled. Previous sampling in this study area was restricted to single collections on several streams. Little Scioto River (RM 12.7) improved from an ICI=38 in 1983 to an ICI=44 in 1990 and 2010. Rocky Fork Little Scioto River (RM 0.6) had an exceptional macroinvertebrate community in 1990 and received an ICI=44 in 2010. Pine Creek (RM 20.4) improved from an ICI=40 in 1990 to an ICI=42 in 2010. Storms Creek (RM 3.3) received an ICI=40 in 1990 and scored narratively good in 2010. Ice Creek (RM 6.1) received an ICI=54 in 1990 and scored narratively good in 2010. All of these evaluations met or exceeded the WWH expectations and were similar to the results from this study.

Table 17. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the SEORT study area, July to October, 2010 & 2011.

Stream RM	Dr. Ar. (sq. mi.)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Munn Run (09-001)										
1.4	4.5	-	28	6	2	L-M	1	Sow bugs (T), midges (F), baetid mayflies (F)	-	Fair
Little Scioto River (09-300)										
35.28	9.3	-	44	18	12	L-M	1	Hydropsychid caddisflies (F), midges (F)	-	Good
31.5	24.5	8	57	13 / 16	11 / 13	L / 315	0	Midges (F), heptageniid mayflies (F)	44	
27.2	43	-	61	22 / 23	17 / 18	M / 308	0	Caddisflies (MI,F), mayflies (MI,F), midges (F)	44	
18.8	108	-	68	19 / 20	21 / 23	L / 300	0	Caddisflies (MI,F), heptageniid mayflies (MI), midges (F)	38	
12.7	200	-	68	25 / 27	23 / 25	M / 1971	0	Caddisflies (MI,F), heptageniid mayflies (MI), midges (F)	44	
5.5	210	-	67	29 / 30	25 / 28	M / 1725	0	Caddisflies (F,MI), mayflies (F,MI), midges (F)	46	
Brushy Fork (09-342)										
0.38	9.8	-	45	12	8	M	0	Hydropsychid caddisflies (F), baetid mayflies (F), midges	-	Marg. Good
Sugarcamp Creek (09-329)										
0.6	14.2	-	46	22	18	M	0	Caddisflies (MI,F), mayflies (MI,F), midges (F,MI)	-	Exceptional

Stream RM	Dr. Ar. (sq. mi.)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Holland Fork (09-330)										
2.8	25.1	-	50	18 / 20	14 / 19	L / 274	0	Caddisflies (MI,F), mayflies (MI), midges (F)	52	
Bucklick Creek (09-331)										
0.8	6.7	-	50	23	18	L-M	1	Mayflies (MI,F)	-	Exceptional
Rocky Fork (09-310)										
14.15	11.2	-	57	23	23	M	2	Caddisflies (F,MI), baetid mayflies (F), midges (F)	-	Exceptional
10.2	20.4	-	52	21 / 23	18 / 21	M / 243	0	Caddisflies (MI,F), baetid mayflies (F), midges (F)	52	
6.44	45.9	-	65	22	19	M	1	Caddisflies (F,MI), mayflies (F,MI), midges (F)	-	Exceptional
0.6	68.8	6	66	21 / 25	20 / 28	M	0	Caddisflies (MI,F), mayflies (F,MI), midges (F)	44	
Long Run (09-311)										
4.5[a]	9.5	-	39	8	5	M	1	Hydropsychid caddisflies (F), baetid mayflies (F), midges (F)	-	Fair
0.95	17.1	-	46	16	14	M	0	Caddisflies (F,MI), baetid mayflies (F), flatworms (F)	-	Good
Frederick Creek (09-306)										
1.4	15.9	-	42	13	14	L	0	Heptageniid mayflies (F,MI), hydropsychid caddisflies (F), midges (F)	-	Good

Stream RM	Dr. Ar. (sq. mi.)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Skull Creek (09-307)										
0.05	4.6	-	46	19	15	L-M	1	Caddisflies (F,MI), mayflies (F,MI), riffle beetles (F)	-	Very Good
Pine Creek (09-400)										
45.68	8.0	-	45	19	14	L	1	Hydropsychid caddisflies (F), midges (F)	-	Very Good
41.3	29.6	15	37	12 / 15	9 / 12	L	0	Odonates (F), scuds (F), leptocerid caddisflies (F)	44	
36.4	69	-	52	19 / 21	15 / 19	L-M / 185	0	Caddisflies (MI,F), *Isonychia* mayflies (MI), midges (F)	48	
25.9	95	-	56	16	14	L-M	0	Caddisflies (MI,F), mayflies (MI), midges (F)	-	Good
20.4	104	-	55	18 / 19	15 / 18	L / 321	0	Caddisflies (F,MI), midges (F)	42	
13.4	157	-	49	16 / 18	17 / 18	L-M	0	Caddisflies (MI), mayflies (MI), midges (F)	52	
5.1	168	-	45	17 / 19	13 / 15	L	0	Mayflies (MI), caddisflies (MI,F), midges (F)	48	
Sawmill Run (-9-425)										
0.1	3.0	-	32	13	8	L	2	Hydropsychid caddisflies (F), baetid mayflies (F), midges (F)	-	Marg. Good
Painter Creek (09-422)										
0.03	3.4	-	34	10	7	L	2	Hydropsychid caddisflies (F)	-	Marg. Good
Negro Creek (09-421)										

Stream RM	Dr. Ar. (sq. mi.)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
0.2	1.7	-	25	2	2	L	3	Hydropsychid caddisflies (F), midges (T,F)	-	Poor
Kimble Creek (09-424)										
0.89	4.2	-	49	15	15	L-M	5	Caddisflies (F,MI)	-	Good
0.6	4.3	-	35	10	9	L	0	Leptophlebiid mayflies (MI)	-	Marg. Good
0.01	4.5	-	42	16	14	L-M	2	Hydropsychid caddisflies (F), mayflies (MI), midges (F)	-	Good
Olive Creek (09-420)										
0.11	2.3	-	32	12	9	L	2	Hydropsychid caddisflies (F)	-	Marg. Good
Brushy Fork (09-419)										
0.13	4.1	-	45	16	11	L	0	Hydropsychid caddisflies (F), mayflies (MI)	-	Good
Hales Creek (09-415)										
4.35	14.2	-	55	23	20	M	2	Mayflies (MI), caddisflies (F,MI), midges (F)	-	Exceptional
1.0	31.8	15	55	16 / 18	12 / 13	M	0	Mayflies (MI), caddisflies (F,MI), midges (F)	48	
Brady Run (09-416)										
0.9	7.1	-	53	19	16	L	0	*Caenis* mayflies (F), hydropsychid caddisflies (F), midges (F)	-	Good
Little Pine Creek (09-408)										
0.7	29.2	-	36	17 / 19	12 / 15	L / 451	0	Caddisflies (MI,F), *Isonychia* mayflies (MI), midges (F)	52	

Stream RM	Dr. Ar. (sq. mi.)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Ellisonville Creek (09-423)										
0.2	11.3	-	43	12	7	L	2	Hydropsychid caddisflies (F), midges (F)	-	Marg. Good
Lick Run (09-401)										
0.9	10.3	-	45	6	4	L	1	Hydropsychid caddisflies (F), baetid mayflies (F), midges (MI,F,T)	-	Fair
Patton Run (09-002)										
2.35	1.3	-	51	20	17	L-M	3	Hydropsychid caddisflies (F), baetid mayflies (F,MI), midges (F,MI)	-	Exceptional
Chandlers Run (09-096)										
1.3	1.0	-	33	9	5	L	4	Midges (F), hydropsychid caddisflies (F), baetid mayflies (F)	-	Marg. Good
Ginat Run (09-003)										
2.8	8.6	-	52	17	14	L-M	0	Hydropsychid caddisflies (F), midges (F,MI)	-	Good
Osborne Run (09-006)										
1.3	8.6	-	13	3	2	L	3	Hydropsychid caddisflies (F)	-	Poor
Storms Creek (09-007)										
10.1	11.2	-	42	14	8	L	0	Caddisflies (MI,F), midges (F)	-	Good
6.8	22.8	-	64	22	19	L	0	Caddisflies (MI,F), *Isonychia* mayflies (MI), midges (F)	-	Exceptional
3.7	29.4	-	50	17	18	L	0	Caddisflies (F,MI), mayflies (MI)	-	Good
Little Storms Creek (upper trib. @RM 9.23) (09-098 / 09-007-001)										

Stream RM	Dr. Ar. (sq. mi.)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
0.1	8.6	-	48	17	13	L-M	3	Hydropsychid caddisflies (F), midges (F)	-	Good
Little Storms Creek (lower trib. @RM 1.8) (09-008)										
0.4	5.4	-	29	6	5	L	2	Hydropsychid caddisflies (F), midges (F)	-	Fair
Ice Creek (09-011)										
10.3	12.5	-	43	14	10	L-M	1	Hydropsychid caddisflies (F), midges (F), baetid mayflies (F)	-	Good
6.5	19.0	-	44	15	12	L-M	2	Caddisflies (F,MI), midges (F)	-	Good
2.3	37	4,12	41	16 / 16	9 / 12	L / 260	2	Caddisflies (F,MI), midges (F)	40	
Little Ice Creek (09-013)										
0.6	11.1	-	33	3	1	L-M	0	Midges (F), hydropsychid caddisflies (F)	-	Poor
Solida Creek (09-019)										
3.52	6.5	-	32	8	5	L	2	Midges (F)	-	Fair

RM: River Mile.
Dr. Ar.: Drainage Area
Data Codes: 4=2 HD Only, 6=4 HD Only, 8=Non-Detectable Current, 12=Suspected High Water Influence, 15=Current >0.0 fps but <0.3 fps.
Ql.: Qualitative sample collected from the natural substrates.
Sensitive Taxa: Taxa listed on the Ohio EPA Macroinvertebrate Taxa List as MI (moderately intolerant) or I (intolerant).
Qt.: Quantitative sample collected on Hester-Dendy artificial substrates, density is expressed in organisms per square foot.
Density Ql./Qt.: Qualitative sample relative density where: L=Low, M=Moderate, H=High.
CW: Cold Water.
Tolerance Categories: VT=Very Tolerant, T=Tolerant, MT=Moderately Tolerant, F=Facultative, MI=Moderately Intolerant, I=Intolerant
[a] Sample was collected in 2011

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