Biological and Water Quality Survey of the Lower Muskingum Tributaries 2013

Washington, Morgan, Noble, Muskingum and Athens Counties, Ohio

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Introduction

As part of the TMDL process and in support of the basin approach for NPDES permitting, an intensive ambient assessment will be conducted during the 2013 field sampling season within the Lower Muskingum River Tributaries. The study area is composed of all or portions of 20 HUC 12 watershed assessment units. Additionally, 23 tributaries that are designated as unverified Exceptional Warmwater Habitat (EWH) will be assessed in the watershed as part of a 106 USEPA funded grant. A total of 67 sampling stations are allocated to this effort and will provide for the assessment of 51 named stream (Table 1). Ambient biology, macrohabitat quality, water column chemistry, and bacteriological data will be collected concurrently from most of these sites. Diel water quality (DO, pH, conductivity, and temperature), sediment chemistry (metals, organics, and particle size), nutrients, and fish tissue will be evaluated at selected sampling locations.

Sampling Objectives

1) Systematically sample and assess the principal drainage network of the Lower Muskingum River Tributaries in support of both the TMDL process and NPDES permits,

2) Gather ambient environmental information (biological, chemical, and physical) from undesignated water bodies, so as to recommend an appropriate suite of Beneficial Uses (e.g., aquatic life, recreational, water supply),

3) Verify the appropriateness of existing, unverified, Beneficial Use Designations, and recommend appropriate use designation to undesignated waters.

4) Establish and evaluate baseline ambient biological conditions at selected reference stations to evaluate the effectiveness of past, on-going and future pollution abatement efforts,

5) Document any changes in the biological, chemical, and physical conditions of the study areas where historical information exists, thus expanding the Ohio EPA data base for statewide trends analysis (e.g., 305[b]).

Issues

Total Maximum Daily Load (TMDL)

Information collected as part of this survey will support TMDL development for the study area. The objectives of the TMDL process are to estimate pollutant loads from the various sources within the basin, define or characterize allowable loads to support the various beneficial uses, and to allocate pollutant loads among different pollutant sources through appropriate controls (e.g., NPDES permitting, storm water management, 319 proposals, NPS controls or other abatement strategies).

The components of the TMDL process supported by this survey are primarily the identification of impaired waters, verification (and redesignation if necessary) of beneficial use designations, gathering ambient information that will factor into the

wasteload allocation, and ascribing causes and sources of use impairment. These data are necessary precursors to the development of effective control or abatement strategies.

Aquatic Life Use Designations
Designated aquatic life uses for over half of the streams contained within the study area were made prior to standardized approaches to the collection of in-stream biological data or numerical biological criteria. As a result, most of the existing aquatic life use designations for streams within the study area are classified as unverified. The Ohio EPA is obligated to review, evaluate, or recommend (where appropriate) beneficial uses prior to basing any permitting actions on existing, unverified designations, or wholly unclassified water bodies. Much of the sampling effort for this survey is allocated to fulfill this obligation.

NPDES Permits
Significant, major and minor NPDES permitted facilities will be evaluated as part of this study. These include both publically owned treatment works and private entities. A list of selected permitted facilities is presented in Table 2.

Mining Impacts
Historic mining impacts are prevalent in several of the lower Muskingum River tributaries most notably in the Meigs Creek subwatershed. A watershed action plan (WAP) was developed for the Meigs Creek subwatershed by ILGARD (partnered with ODNR, OEPA, MBI and ODOT) in 2005. As resources permit, we will duplicate sampling locations to look at trends within this subwatershed and we will also partner with ODNR-MRM to identify areas for potential reclamation projects.

Agricultural Impacts
The Wolf Creek subwatershed has the most intensive agricultural pressures of the Muskingum River tributaries survey area with both row crops and livestock. During the 2006 Muskingum River survey, elevated bacteria levels were found downstream from Wolf Creek so it is likely that we will see impairment in Wolf Creek as well. Additionally nutrient sampling will be focused in the Wolf Creek watershed. The very first state endorsed WAP was completed by the Morgan County SWCD for Wolf Creek in 2003. As resources allow we will duplicate sampling locations in the WAP to evaluate trends. We will also coordinate with the Morgan and Washington County SWCD to identify areas of concern and conservation projects.

Sampling Effort

Field and Laboratory samples
Summarized field and laboratory samples (stations, number of samples, and parameters for analysis, etc.) can be found in Table 3. All scheduled locations and necessary stipulations are provided in Tables 4

Water Quality
Water column chemistry samples will be collected from 44 ambient stations within the study areas. Water column grab samples and standard field parameters will be

collected/measured five times from all locations. Field parameters will also be collected from 23 sites that are being sampled under the supplemental 106 grant. The collection of water samples for bacteriological analysis is schedules for 20 stations (Tables 4). Sampling frequency station density, flow regime, and other field considerations shall comport with the most recent recreational use rule changes.

Datasonde deployment is requested for 21 locations. The deployment of continuous monitors should coincide with typical low summer/fall flows (i.e., approaching $Q_7$10). The Modeling section will be responsible for deployment of the data center units.

Nutrients

Water column samples in support of nutrient monitoring and assessment efforts will be collected at nine locations (Table 4). DSW Modeling staff is responsible for the collection of specific parameters supporting nutrient monitoring and assessment. Substrate and water column samples for the analysis of benthic and sestonic chlorophyll-a, dissolve phosphorus, alkalinity, and $cBOD_{20}$ must be collected concurrently with either the Datasonde set or retrieval or the interval between these two activities.

Sediment Chemistry

Sediment samples are to be collected from approximately eight locations within the study area. Analysis will include a full organic scan (BNAs, PCBs, TOC, and Pesticides), a full metals scan (excluding mercury), and sediment particle size. Please note, due to very limited practical benefit, demonstrated over many years, analysis for sediment VOCs is not recommended for any sediment samples. Given the limited laboratory allocation, sediment and metal-organic sampling stations were chosen to evaluate areas likely to demonstrate contamination, aid in elucidating longitudinal trends in sediment contamination relative to a known source(s), characterization of sentinel sites, and characterization ecoregional sediment reference sites. Locations of selected sediment sampling stations are listed in Tables 4. The allocation and placement of additional sediment sampling within the study area will be at the discretion SEDO field staff.

Benthic Macroinvertebrate Assessment

The condition of the macrobenthos will be evaluated at 73 locations. Artificial substrate samples (quantitative) will be deployed and retrieved by MEG staff at 17 stations within the study area. Qualitative benthic macroinvertebrate samples (natural substrates) will be collected at 56 stations. Locations of benthic macroinvertebrate sampling stations and type of sample required are listed in Tables 4.

Fish Community Assessment

The condition of the fish assemblages within the study area will be evaluated at 73 locations. Multiple pass fish community samples will be collected at 17 sites by Ohio EPA FEG staff. Single pass fish community samples will be collected at 56 stations (24 of the 56 single pass fish site will be collected by SEDO under the 106 supplemental grant). Single pass evaluations are limited to headwaters, baring reference sites or

significant permit issues. The locations of all fish sampling stations are listed in Tables 4.

Sentinel Sites

To aid in the development of a TMDL models(s), sentinel sites have been established at five designated locations. At each sentinel site, samples are collected monthly beginning in May and will continue to be monitored until May 2014. Analysis test for routine water chemistry parameters, pesticides (methods 525.2, 531.1, and 547) and stream stage is measured to the nearest 100^{th} of a foot, as the water line against a designated bridge piling or abutment. Sampling events at sentinel sites should cover the range of stream flow from the 10^{th} to 90^{th} percentiles. If conditions warrant, Bacteriological sampling at all Sentinel Sites may be expanded beyond five runs. The locations of sentinel sites are indicated in Tables 4.

QUALITY ASSURANCE

Ohio EPA Manuals

All biological, chemical, EPA laboratory, data processing, and data analysis methods and procedures adhere to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 2006), Biological Criteria for the Protection of Aquatic Life, Volumes II – III (Ohio Environmental Protection Agency 1987, 1989a, 1989b), The Qualitative Habitat Evaluation Index (QHEI); Rationale, Methods, and Application (Rankin 1989) for habitat assessment, Ohio EPA Sediment Sampling Guide and Methodologies (Ohio EPA 2001), and Ohio EPA Fish Collection Guidance Manual (Ohio EPA 2004). All methods are summarized in Table 7.

Use Attainment

Attainment/non-attainment of aquatic life uses will be determined by using biological criteria codified in Ohio Administrative Code (OAC) 3745-1-07, Table 7-17. Numerical biological criteria are based on multimetric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community.

Performance expectations for the basic aquatic life uses (Warmwater Habitat [WWH], Exceptional Warmwater Habitat [EWH], and Modified Warmwater Habitat [MWH] were developed using the regional reference site approach (Hughes et al. 1986; Omernik 1987). This fits the practical definition of biological integrity as the biological performance of the natural habitats within a region (Karr and Dudley 1981). Attainment of an aquatic life use is FULL if all three indices (or those available) meet the applicable criteria, PARTIAL if at least one of the indices did not attain and performance did not fall below the fair category, and NON if all indices either fail to attain or any index indicates poor or very poor performance.

Recreational use attainment will be determined using *E. coli* bacteria. *E. coli* is now the primary indicator organism for the potential presence of pathogens in surface water resulting from the presence of untreated human or animal wastes, and is the basis for

recreational use water quality criteria in Rule 3745-1-07 of the Ohio Administrative Code (OAC).

Stream Habitat Evaluation

Physical habitat is evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989). Various attributes of the available habitat are scored based on their overall importance to the establishment of viable, diverse aquatic faunas. Evaluations of type and quality of substrate, amount of in-stream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality, and stream gradient are among the metrics used to evaluate the characteristics of a stream segment, not just the characteristics of a single sampling site. As such, individual sites may have much poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values higher than 60 were generally conducive to the establishment of warmwater faunas while those which scored in excess of 75-80 often typify habitat conditions which have the ability to support exceptional faunas.

Biological Community Assessment

Macroinvertebrates will be collected from artificial substrates and from the natural habitats. Quantitative sampling will be conducted at reference sites and at sites with drainage areas in excess of 20 mi^2. Qualitative sampling will be conducted in headwater sites with drainages smaller than 20 mi^2. The artificial substrate collection provides quantitative data and consists of a composite sample of 5 modified Hester-Dendy (HD) multiple-plate samplers colonized for six weeks. At the time of the artificial substrate collection, a qualitative multi-habitat composite sample is also collected. This sampling effort consists of an inventory of all observed macroinvertebrate taxa from the natural habitats at each site with no attempt to quantify populations other than notations on the predominance of specific taxa or taxa groups within major macrohabitat types (e.g., riffle, run, pool, and margin). Fish will be sampled at each sampling location with pulsed DC current. Two passes will be conducted at sites larger than 20 mi^2 and at reference sites. Detailed biological sampling protocols are documented in the Ohio EPA manual Biological Criteria for the Protection of Aquatic Life, Volume III (1989).

Sediment

Fine grained multi-incremental sediment samples will be collected in the upper 4 inches of bottom material using either decontaminated stainless steel scoops or Ekman dredges. Collected sediment will be placed into appropriate containers, placed on ice (to maintain 4^oC) and shipped to the Ohio EPA lab. Sampling and decontamination protocols will follow those listed in the Ohio EPA Sediment Sampling Guide and Methodologies, November, 2001.

Surface Water

Surface water grab samples will be collected from the upper 12 inches of river water into appropriate containers. Collected water will be preserved using appropriate methods, as outlined in Parts II and III of the Manual of Ohio EPA Surveillance Methods

and Quality Assurance Practices (Ohio EPA 2006) and shipped overnight via courier to the Ohio EPA lab for analysis. Field measurements of dissolved oxygen, pH, temperature, and conductivity will be made using YSI 556MPS meters along with all grab samples for surface water chemistry. Datasonde© continuous recorders will be placed at select locations to evaluate diurnal measurements of dissolved oxygen, pH, temperature, and conductivity.

Bacteria

Water samples will be collected into appropriate containers, cooled to 4°C, and transported to and submitted to the lab for analysis within 6 hours of collection. All samples will be analyzed for *E. coli* bacteria using U.S.EPA approved methods (STORET Parameter Code 31648).

Field Quality Control Samples

Ten percent of the sediment, water, and bacteria samples will be submitted to the lab as field duplicates. One Datasonde ® recorder site will have two instruments placed in the river as field duplicates. Field blanks will occur at a minimum of 5 percent of the water samples. Field instruments will be calibrated daily, using manufacturer guidelines and requirements noted in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 2006). Matrix spike duplicates will be collected for organic water samples at a minimum of 5 percent.

Field Staff and Other Contacts

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Hospitals (see attached maps)

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Table 1. Total samples for Muskingum River Tribs 2013.

HUC_12	HU_12_NAME	# of samples	Fish2X	Fish 1X	HD	Qual	Chem	Grant	sonde
50400040701	Mans Fork	3	1	2	1	2	3		1
50400040702	Headwaters Meigs Creek	3	1	2	1	2	3		1
50400040703	Dyes Fork	4	2	2	2	2	4		2
50400040704	Fourmile Run-Meigs Creek	5	2	3	2	3	5		1
50400040806	Oilspring Run-Muskingum River	1		1		1	1		
50400040807	Bald Eagle Run	1		1		1	1		1
50400040808	Bell Creek-Muskingum River	2		2		2	2		
50400040809	Olney Run-Muskingum River	1		1		1	1		
50400040901	South West Branch Wolf Creek	2	1	1	1	1	2		1
50400040902	Headwaters South Branch Wolf Creek	6	1	5	1	5	5	1	2
50400040903	Plumb Run-South Branch Wolf Creek	3	2	1	2	1	2	1	2
50400041001	Headwaters West Branch Wolf Creek	8		8		8	4	5	1
50400041002	Aldridge Run-West Branch Wolf Creek	4	1	3	1	3	3	4	1
50400041003	Coal Run	5	1	4	1	4	3	3	1
50400041004	Hayward Run-Wolf Creek	9	3	6	3	6	5	6	2
50400041101	Headwaters Olive Green Creek	3		3		3	3		2
50400041102	Keith Fork	2		2		2	1	1	1
50400041103	Little Olive Green Creek	3		3		3	1	2	1
50400041104	Reasoners Run-Olive Green Creek	5	2	3	2	3	3	3	1
50400041105	Congress Run-Muskingum River	3		2		2	2		
Totals		**73**	**17**	**56**	**17**	**56**	**54**	**24**	**21**

Table 2. Major (Bold) and minor facilities regulated under the NPDES within the lower Muskingum River Tribs basin.

OEPANO	PTYPE	FACILITY	Receiving Stream	COUNTY	LOCLAT	LOCLNG
0PX00007	Industrial	White Oak Sewer Assn Inc	South Branch Wolf Creek	Washington	39.40256	-81.66437
0PR00107	Municipal	Hervida 4-H Camp Inc	South Branch Wolf Creek	Washington	39.497415	-81.665511
0ID00038	Industrial	Solsil Inc	West Brach Wolf Creek	Washington	39.529284	-81.664383
0IB00027	Industrial	**Waterford Energy LLC**	unnamed tribs to Wolf Creek	Washington	39.53426	-81.71639
0IN00134	Industrial	BP Amoco Oil Corp Bulk Plant Beverly No 69479	Sherman Run	Washington	39.566593	-81.654126
0ID00005	Industrial	Globe Metallurgical Inc	unnamed trib of Hayward Run	Washington	39.58496	-81.67924
0PW00025	Municipal	West Bank Apartments	Muskingum River?	Morgan	39.606565	-81.816744
0PT00058	Municipal	Morgan Jr & Sr HS	Unnamed trib to the Muskingum River	Morgan	39.61191	-81.82016
0IL00038	Industrial	Central Ohio Coal Co Muskingum Mine	Dyes Fork	Morgan	39.64546	-81.71728
0PA00015	Municipal	McConnelsville Hawk National Guard Base	Unnamed trib to Bell Creek	Morgan	39.6721	-81.83767

Table 3. Ohio EPA laboratory and field sampling load for the 2013 lower Muskingum River Tributaries survey. Total number of water column analytes does not include field parameters.

Sample Type	No. of Lab Parameters	No. Sites	Passes	Total Samples/Parameters
Conventional Water Quality (total) AMD Template	45	53	5	265/11,925
Pathogen (*E. coli***)**[a]	1	21	5-10	125
Nutrients[b]	7	7	1	16
Water Column Organics				-/-
BNA, Pesticides (including chlordane) and PCBs	–	-	-	-/-
Datasonde	–	21	1	NA
Sediment	–	5	1	-/-
Sediment Metals**	10	5	1	-/40
Sediment Organic	(Full Scan)#	5	1	-/Full Scan
Sediment Particle Size	NA	5	1	-/-
Fish Tissue				
Metals, including Hg	(FT Suite)	TBD	1	-/-
Organics, including chlordane	(Full Scan)	TBD	1	-/Full Scan
Fish Stations (total)	–	73	1-2	90/-
2x	–	17	2	34/-
1x	–	56	1	56/-
Macrobenthos (total)†	–	73	NA	90 (HDs and Equivalents)/-
Quantitative (Hester Dendy)	–	17	NA	34/-
Qualitative (Natural Substrates)	–	56	NA	56 (2 HD Equivalents)/-

a - Bacteriological measures will include a minimum of five *E. coli* runs for all stations.

b - Nutrient analysis shall include, dissolved phosphorus, alkalinity, cBOD5, and sestonic chlorophyll-a. Furthermore, water column sample for these parameters must be concurrent with either the set or retrieval of the Datasonde, continuous monitor.

** - Ohio EPA sediment samples will be analyzed for the following metals: Al, As, Cd, Cr, Cu, Pb, Fe, Mn, Ni, and Zn.

- Full Scan includes BNAs, PCBs, Pesticides, and TOC. Please note, due to very limited utility, demonstrated over many years, analysis for sediment VOCs sediment samples.

† - The ratio of HD Equivalents and HD is 3:1.

Table 4. Sampling locations for Muskingum River Tribs 2013.

Site#	STORET	Basin	Stream	Trib	NAME	RM	DA	Sample	County	LATITUDE	LONGITUDE	HUC12
1	R16G69	17	001	001	BALD EAGLE NEAR STOCKPORT BRIDGE @ TIEBER RD.	0.65	10.1	F,M,C,B,D	Morgan	39.55470	-81.79740	050400040807
2	R16G66	17	001	014	BELL CREEK AT MCCONNELSVILLE @ S.R. 376	0.03	3.8	F,M,C,B	Morgan	39.64140	-81.84220	050400040808
3	302277	17	017	000	Cushing Run L-WWH @ Tick Hill Rd	1.65	0.6	F,M	Washington	39.57166	-81.59857	050400041105
4	302278	17	018	000	Congress Run at Culver Run Road	1.05	2.3	F,M,C,B	Washington	39.53841	-81.61308	050400041105
5	R19K20	17	030	000	WOLF CREEK @ ST. RT. 339 (2ND BRIDGE UPST. MOUTH)	1.08	227	F,M,C,B,D.S,N	Washington	39.54120	-81.64180	050400041004
6	302157	17	031	000	Hayward Run (Trib. to Wolf Cr. @ RM 0.05	0.57	3.4	F,M	Washington	39.54935	-81.65695	050400041004
7	302158	17	032	000	Duck Creek (Trib. to Wolf Cr. @ RM 1.51	0.10	2.8	F,M	Washington	39.53472	-81.64329	050400041004
8	302159	17	034	000	Flint Run (Trib. to Wolf Cr. @ RM 2.42	0.14	2.8	F,M	Washington	39.53478	-81.66099	050400041004
9	201294	17	035	000	S. BR. WOLF CREEK SW OF WATERTOWN @ CO. RD. 2	16.2	27.2	F,M,C,B,D	Washington	39.42367	-81.61235	050400040902
10	R19S03	17	035	000	S. BR. WOLF CREEK NW OF WATERTOWN @ CAMP HERVIDA RD.	4.8	76	F,M,C,B,D.S,N	Washington	39.49773	-81.66437	050400040903
11	R19K22	17	035	000	S. BR. WOLF CREEK SW OF WATERTOWN @ ST. RT. 339	0.78	79	F,M,C,D	Washington	39.52470	-81.65840	050400040903
12	302160	17	036	000	Painter Run (Trib. to S.Br. Wolf Cr. @ RM 10.10	0.4	2.8	F,M	Washington	39.46503	-81.62842	050400040903
13	201296	17	037	000	SOUTHWEST FORK SW OF WATERTOWN @ TWP. RD. 288	5.8	9.4	F,M,C,	Washington	39.42617	-81.68795	050400040901
14	201295	17	037	000	SOUTHWEST FORK SW OF WATERTOWN @ MOUTH	0.1	21.5	F,M,C,B,D	Washington	39.45477	-81.64015	050400040901
15	201297	17	038	000	S. FK. S. BR. WOLF CREEK S OF WATERTOWN @ TWP. RD. 261 Demming	0.8	7.6	F,M,C,D,N	Washington	39.43287	-81.64675	050400040902
16	302255	17	039	000	Browns Run @ FARMLANE OFF ANDERSON RD.	0.35	8.35	F,M,C	Washington	39.40861	-81.59992	050400040902
17	302161	17	040	000	Turkeyhen Run (Trib. to S.Br. Wolf Cr. @ RM 19.46	1.2	3.3	F,M	Washington	39.41593	-81.57151	050400040902
18	302256	17	041	000	Horse Run Benedict Rd	0.33	13	F,M,C	Washington	39.41781	-81.58670	050400040902
19	201298	17	042	000	HALFWAY RUN SE OF WATERTOWN @ CO. RD. 459	1	8.4	F,M,C,	Washington	39.42697	-81.57265	050400040902
20	201304	17	044	000	W. BR. WOLF CREEK SW OF MCCONNELSVILLE @ CO. RD. 16	39.2	19.2	F,M,C,B,D	Morgan	39.60927	-81.92736	050400041001
21	201302	17	044	000	W. BR. WOLF CREEK SW OF BEVERLY, 600 M UPST ST. RT. 377	24.5	72	F,M,C,B,D	Morgan	39.50257	-81.86456	050400041002
22	R19S01	17	044	000	W. BR. WOLF CREEK AT PATTEN MILLS @ CO. RD. 206	13.9	115	F,M,C,	Washington	39.45567	-81.78316	050400041004
23	R19K21	17	044	000	W. BR. WOLF CREEK SW OF WATERFORD @ TWP. RD. 68	0.25	144	F,M,C,B,D,S,N	Washington	39.52770	-81.65830	050400041004
24	201305	17	044	001	TRIB. TO W. BR. WOLF CREEK (33.33) @ TWP. RD. 104	0.5	8.6	F,M,C	Morgan	39.56197	-81.92876	050400041001
25	302163	17	045	000	Lucas Run (Trib. to W.Br. Wolf Cr. @ RM 6.36	0.80	4.1	F,M,C	Washington	39.49147	-81.73414	050400041004
26	302164	17	046	000	Whitewater Creek (Trib. to W.Br. Wolf Cr. @ RM 8.82	0.10	3.6	F,M	Washington	39.47784	-81.73129	050400041004
27	302165	17	047	000	Laurel Run (Trib. to W.Br. Wolf Cr. @ RM 12.90	0.05	6.8	F,M,C	Washington	39.45454	-81.76963	050400041004
28	201307	17	048	000	COAL RUN SE OF CHESTERHILL @ ST. RT. 555	4.9	16.9	F,M,C	Washington	39.45977	-81.82316	050400041003
29	201306	17	048	000	COAL RUN N OF PATTEN MILLS @ TWP. RD. 203	0.6	21.8	F,M,C,B,D,N	Washington	39.47197	-81.78956	050400041003
30	201308	17	049	000	SHRADER RUN AT MOUTH @ TWP. RD. 1	0.1	2.3	F,M	Washington	39.46197	-81.82126	050400041003
31	302168	17	050	000	N. Br. Coal Run (Trib. to Coal Run @ RM 5.60	1.8	4.3	F,M,C,	Washington	39.46274	-81.85412	050400041003
32	302169	17	052	000	Mile Run (Trib. to Coal Run @ RM 8.37	0.72	1.3	F,M	Washington	39.42168	-81.82850	050400041003
33	201309	17	053	000	ALDRIDGE RUN S OF STOCKPORT, DST. TWP. RD. 466	0.1	12.1	F,M,C	Washington	39.48397	-81.79236	050400041002
34	302170	17	054	000	Scott Run (Trib. to Aldridge Run @ RM 1.90 at mouth fr. Aldridge Run at Co. R	0.05	3	F,M	Morgan	39.50309	-81.80478	050400041002
35	201310	17	057	000	GOSHEN RUN SW OF STOCKPORT AT MOUTH, ADJ. CO. RD. 73	0.1	9.3	F,M,C	Morgan	39.51287	-81.86266	050400041002
36	201311	17	059	000	L. WOLF CREEK SW OF PENNSVILLE, DST. CO. RD. 13	1	10.6	F,M,C	Morgan	39.56677	-81.87236	050400041001
37	302172	17	060	000	Chaneyville Run (Trib. to L. Wolf Cr. @ RM 4.50	0.05	1.4	F,M	Morgan	39.61110	-81.89370	050400041001
38	302173	17	061	000	Buck Run (Trib. to W.Br. Wolf Cr. @ RM 38.90	0.10	5.5	F,M,C	Morgan	39.60597	-81.92880	050400041001
39	302174	17	063	000	Hedgehog Creek (Trib. to W.Br. Wolf Cr. @ RM 41.43	0.10	2.5	F,M	Morgan	39.63774	-81.93926	050400041001
40	302175	17	064	000	Kickapoo Creek (Trib. to W.Br. Wolf Cr. @ RM 43.58	0.10	2.3	F,M	Morgan	39.66277	-81.94868	050400041001
41	302176	17	065	000	Peeper Run (Trib. to W.Br. Wolf Cr. @ RM 47.50		0.9	F,M	Morgan	39.67624	-82.01163	050400041001
42	203861	17	070	000	OLIVE GREEN CREEK DST. TRIB. (18.20)	18.1	8.9	F,M,C	Noble	39.69310	-81.62500	050400041101
43	R19G11	17	070	000	OLIVE GREEN CREEK UPST. SHARON FORK @ JAKE FORTY RD.	14.43	12.7	F,M,C,D	Morgan	39.65550	-81.60540	050400041101
44	R19G04	17	070	000	OLIVE GREEN CREEK @ CENTER BEND RD.	13.71	31.5	F,M,C	Morgan	39.64530	-81.60720	050400041104
45	R19S02	17	070	000	OLIVE GREEN CREEK NW OF BEVERLY @ ST. RT. 83	2.08	81	F,M,C,B,D,S,N	Morgan	39.58610	-81.65220	050400041104
46	302177	17	071	000	Cow Run (Trib. to Olive Green Cr. @ RM 1.13 Twp. Rd. 633 (New Rd.)	0.10	1.4	F,M	Morgan	39.59422	-81.66266	050400041104
47	R19G02	17	073	000	LITTLE OLIVE GREEN CREEK @ CENTER BEND RD.	2.18	16.2	F,M,C,B,D	Morgan	39.62498	-81.63917	050400041103
48	302178	17	074	000	Scott Run (Trib. to L. Olive Green Cr. @ RM 3.05	0.10	3.0	F,M	Morgan	39.63333	-81.64989	050400041103

Table 4. Sampling locations for Muskingum River Tribs 2013.

Site#	STORET	Basin	Stream	Trib	NAME	RM	DA	Sample	County	LATITUDE	LONGITUDE	HUC12
49	302179	17	075	000	Allen Run (Trib. to L. Olive Green Cr. @ RM 4.97	0.60	1.5	F,M	Morgan	39.66073	-81.66878	050400041103
50	302180	17	076	000	Stony Creek (Trib. to Olive Green Cr. @ RM 6.13	0.50	1.0	F,M	Morgan	39.58807	-81.61690	050400041104
51	302181	17	077	000	Reasoners Run (Trib. to Olive Green Cr. @ RM 11.10	0.05	4.6	F,M,C	Morgan	39.62286	-81.59367	050400041104
52	R19G05	17	078	000	KEITH FORK NEAR MOUTH @ CONFLUENCE OF LIMESTONE RUN	0.37	13.6	F,M,C,B,D	Morgan	39.64290	-81.60190	050400041102
53	302182	17	079	000	Limestone Run (Trib. to Keith Fork @ RM 0.37	0.2	1.2	F,M	Morgan	39.64934	-81.60154	050400041102
54	R19G06	17	080	000	SHARON FORK AT MORRIS LANE	0.76	17.56	F,M,C,B,D,N	Morgan	39.66380	-81.60500	050400041101
55	302288	17	081	000	Dinner Fork at TR 34	1.22	2.5	F,M	Noble	39.71473	-81.59345	050400041101
56	302251	17	083	000	Doudna Run at Doudna Rd	0.25	3.2	F,M,C	Morgan	39.61609	-81.84270	050400040808
57	R16G63	17	087	000	OILSPRING RUN NW OF MCCONNELSVILLE @ ST. RT. 669	0.1	6.2	F,M,C,B	Morgan	39.68390	-81.89140	050400040806
58	R16G78	17	920	000	MEIGS CREEK SE OF MUSEVILLE @ DRAKE AND MARTIN RD.	19.84	18	F,M,C	Muskingum	39.78240	-81.79210	050400040702
59	R16G77	17	920	000	MEIGS CREEK UPST. MANS FORK @ ST. RT. 78	11.19	35.6	F,M,C,B,D,S,N	Morgan	39.69200	-81.75170	050400040702
60	R16S17	17	920	000	MEIGS CREEK AT UNIONVILLE, UPST. DYES FORK @ CO. RD. 11	5.43	73	F,M,C,	Morgan	39.62830	-81.72030	050400040704
61	R19S10	17	920	000	MEIGS CREEK AT MILL GROVE @ BRIDGE	2.28	136	F,M,C,B,D,S	Morgan	39.60110	-81.71190	050400040704
62	R16G71	17	921	000	ONION RUN @ MCMANNIS-RIGGS RD.	0.68	4.2	F,M,C,	Morgan	39.61270	-81.70680	050400040704
63	R16G72	17	923	000	PERRY RUN AT MILL GROVE @ ST. RT. 60	0.11	3.9	F,M,C,	Morgan	39.60300	-81.71630	050400040704
64	R16G74	17	924	000	FOURMILE RUN SW OF UNIONVILLE @ LINDIMORE RD.	0.54	12.2	F,M,C,	Morgan	39.61920	-81.73720	050400040704
65	302267	17	926	000	DYES FORK AT WOODGROVE RD CR 27	11.7	16.7	F,M,C,D	Morgan	39.72146	-81.67001	050400040703
66	R19S12	17	926	000	DYES FORK N OF UNIONVILLE @ ST. RT. 78/83	5.76	38	F,M,C	Morgan	39.68170	-81.69860	050400040703
67	203910	17	926	000	DYES FORK AT UNIONVILLE, ADJ. STEGNER LANE	0.3	45	F,M,C,B,D,S,N	Morgan	39.63310	-81.72220	050400040703
68	R16G50	17	927	000	HORSE RUN NE OF BRISTOL @ ST. RT. 83	2.9	5.6	F,M,C	Morgan	39.71970	-81.71580	050400040703
69	R16G40	17	933	000	MANS FORK @ BONE RD. (UPPER CROSSING)	5.81	12.6	F,M,C,	Morgan	39.70190	-81.81970	050400040701
70	R19S13	17	933	000	MANS FORK NE OF MCCONNELSVILLE NEAR MOUTH @ GERLACH RD.	0.31	28	F,M,C,B,D,S	Morgan	39.68810	-81.75670	050400040701
71	R16G38	17	934	000	BEAR RUN AT TOWN OF MEIGS @ ST. RT. 78	0.19	3.2	F,M,C,	Morgan	39.69220	-81.77120	050400040701
72	R16G79	17	935	000	GUYST FORK SE OF MUSEVILLE AT MOUTH @ RURAL DALE RD.	0.05	6.1	F,M,C	Muskingum	39.78280	-81.79170	050400040702
73	R16G70	17	919	000	MILL RUN W OF LUKE CHUTE @ ST. RT. 266	0.3	3.1	F,M,C,B	Morgan	39.53750	-81.74970	050400040809
					Highlighted sites are supplimental grant sites - Kelly will do fish							

Table 5. List of chemical/physical water quality parameters to be analyzed/measured in surface water, sediment, and fish tissue samples from the St. Joseph River basin sampling locations. Not all sites will be samples for all parameters. Water samples will be collected 5 times (organics once), sediment once. Bacteria samples will be collected 5 times during the recreation season (5-10 times at sentinel sites). Select sampling locations will be monitored for dissolved oxygen, pH, temperature, and conductivity using Datasonde© continuous recorders.

Parameters	Test Method	Water	Sediment	Fish Tissue
cBOD, 5 day	SM 5210B	X		
SOLIDS, DISSOLVED (TDS)	USEPA 160.1	X		
SOLIDS, SUSPENDED (TSS)	USEPA 160.2	X		
AMMONIA	USEPA 350.1	X		
Alkalinity	USEPA 305.1	X		
Acidity	USEPA 305.1	X		
TKN	USEPA 351.2	X		
NITRATE-NITRITE	USEPA 353.1	X		
Nitrite	USEPA 354.1	X		
Chloride	USEPA 325.1	X		
COD	USEPA 410.4	X		
TOTAL PHOSPHORUS	USEPA 365.4	X		
DISSOLVED PHOSPHORUS	USEPA 365.4	X		
GLYPHOSATE	USEPA 547	X		
ICP 1 (Al,Ba,Ca, Fe, Mg, Mn, Na, Ni, K, Sr, Zn, Hardness)	USEPA 200.7	X		
Water Column chlorophyll-a	USEPA 455	X		
ICP 3 (Al,Ba,Ca,Fe,Mg,Mn,Na,K,Sr,Zn)	USEPA 200.7		X	
ICPMS 1 (As,Cd,Cr,Cu,Ni,Pb,Se)	USEPA 200.9, SM 3113B	X		X
ICPMS 2 (As,Cd,Cr,Cu,Ni,Pb,Se)	USEPA 200.9, SM 3113B		X	
MERCURY, TOTAL	USEPA 245.1,7470A,7471A			X (245.1)
pH – grab	YSI 556MPS meter	X field		
Conductivity – grab	YSI 556MPS meter/ USEPA 120.1	X field/lab		
Dissolved Oxygen – grab	YSI 556MPS meter	X field		
Temperature – grab	YSI 556MPS meter	X field		
Herbicides	USEPA 525.2	X		
SVOCs (BNAS)	USEPA 625/ USEPA 8270C	X	X	
Pesticides/PCBs/ Chlordane	USEPA 608/ USEPA 8081A, 8082	X (PCBs only)	X	X (OEPA 590.1)
E. coli	USEPA 1103.1/ 640.1	X		
Percent Solids	SM 2540G		X	X

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