2007 Study Plan for the Lower Little Miami River

Clermont, Clinton, Hamilton, and Warren Counties, Ohio

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- Clermont: 513-732-2231 (emergency dial 911)
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- Hamilton: 513-825-1500
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Hospitals

- Clermont Mercy Hospital: 3000 Hospital Drive, Batavia, OH; 513-732-8200
- Clinton Memorial Hospital: 610 W Main St, Wilmington OH; 937-382-1008
- University Hospital Cincinnati: 234 Goodman Street, Cincinnati, OH; 513-584-1000

INTRODUCTION

During the 2007 field season (June through October) chemical, physical, and biological sampling will be conducted in the Lower Little Miami River (Lower LMR) basin to assess and characterize water quality conditions. As a Total Maximum Daily Load (TMDL) basin, this survey will incorporate a study design and some assessment techniques which are more comprehensive than a targeted sampling strategy alone would entail.

A State and National Scenic River, the Lower LMR and tributaries have not been assessed since 1998 and will be thoroughly evaluated, with the exception of the East Fork sub-basin. The sampling effort is structured to characterize point source and nonpoint source impacts, including those from unsewered communities and agricultural activities. Table 1 contains a list of NPDES facilities in the basin. Sampling locations and types of sampling scheduled for the study area are listed in Table 2. Samples locations with geographical coordinates are included in Table 3.

Sampling Objectives:

- Monitor and assess the chemical, physical, and biological integrity of the water bodies within the Lower LMR study area.
- Assess physical habitat influences on stream biotic integrity.
- Determine recreational water quality.
- Evaluate the appropriateness of existing use designations and assign uses to undesignated streams.
- Characterize the amount of aquatic resource degradation attributable to various land uses, including agricultural practices and urbanization.
- Determine any aquatic impacts from known potential sources, including point source dischargers, and from unsewered communities.
- Collect fish samples for the Ohio Sport Fish Tissue Monitoring Program (used to assess chemical contaminant levels in fish).

SAMPLING ACTIVITIES

Chemical/Physical Water and Sediment
Chemical sampling locations within the study area are listed in Table 2. Conventional chemical/physical water quality samples will be collected 5 times at each designated location. Sediment samples will be collected at 10 locations, with Dave Altfater and Mike Gray of DERR collecting sediment at the Peter's Cartridge sites (see Table 2). Datasondes© will be deployed at 25 locations, with 5 located at the nutrient (chlorophyll a) sites. Chemical parameters to be tested are listed in Table 2. Surface water sampling will occur across a variety of flow conditions, from lower flows to moderate and higher flows. Public Water Supply intakes will be evaluated at two locations and will be tested for pesticides in addition to the normal suite of parameters. DDAGW will coordinate with SWDO staff for sampling times that occur before the official sampling season begins in June.

Chlorophyll a
Periphyton and water column samples for determination of chlorophyll a concentrations are planned for 5 sites. These sites require at least one water column or periphyton sample collected between late July and early September following a minimum of two weeks of stable, low-flow. For a given sampling event (either periphyton or water column), one composite sample per site will be split among three filters for later analysis. Attention district staff: on the day you collect the water column chlorophyll sample, please also collect a dissolved P sample. Datasondes© are requested for each nutrient site.

Bacteriological Sampling
Water samples will be collected at 37 sites for bacteriological analyses to determine the attainment status of the Primary Contact recreational use of the Lower LMR mainstem and associated tributaries. Testing will include *Escherichia coli* (E. coli) bacteria. Each site will be sampled 5 to 10 times with at least 5 samples collected during a 30-day period.

Macroinvertebrate and Fish Assemblages
Macroinvertebrate sampling methods will be used as listed in Table 2. Fish assemblages will be sampled as listed in Table 2. QHEI scores will be calculated on the habitat at all fish sampling locations.

Fish Tissue
Fish tissue samples will be collected from 4 locations as part of the Ohio Fish Tissue Consumption Monitoring Program. Fillet samples of edible size sport fish will be tested for organochlorinated pesticides, PCBs, mercury, lead, cadmium, arsenic, and selenium. Results will be used in the Ohio Sport Fish Consumption Advisory Program.

QUALITY ASSURANCE/SAMPLING METHODS

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) .

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. The results will be compared to WWH biocriteria for the Eastern Corn Belt Plains (ECBP) and Interior Plateau (IP) ecoregions.

Recreational use attainment will be determined using fecal coliform bacteria and *E. coli* bacteria. Both types of organisms are indicator organisms for the potential presence of pathogens in surface water resulting from the presence of untreated human or animal wastes, and they are 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 instream 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 mi². Qualitative sampling will be conducted in headwater sites with drainages smaller than 20 mi². 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 multihabitat 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, margin). Fish will be sampled at each sampling location with pulsed DC current. Two passes will be conducted at sites larger than 20 mi² 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 glass jars with teflon lined lids, placed on ice (to maintain 4°C) and delivered 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 and sampled directly 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 delivered to the Ohio EPA lab for analysis. 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 directly from the river into sterilized polyethylene containers, cooled to 4°C, and transported to the Ohio EPA lab in Columbus within 6 hours of sample collection. All samples will be analyzed for *E. coli* bacteria using U.S.EPA approved methods (STORET Parameter Code 31633).

Fish Tissue

Tissue fillet samples will be collected from fish of edible size, and species preferred for analysis include spotted bass, largemouth bass, smallmouth bass, flathead catfish, walleye, saugeye, white bass, common carp, freshwater drum, and channel catfish. When possible, composite samples (by species) will be collected using a minimum of three fish and a minimum of 150 grams of material. At each sampling location, an attempt will be made to collect five fish species for fillet tissue analysis. Fish will be sampled using electrofishing boat methods. Sampling locations are listed in Table 2.

Fish used for tissue analysis will be filleted in the field using decontaminated stainless steel fillet knives. Filleted samples will be wrapped in aluminum foil, placed in a sealed plastic bag, and placed on dry ice. Sampling and decontamination protocols will follow those listed in the Ohio EPA Fish Collection Guidance Manual (2004); however, it is not necessary to clean aluminum foil which is used directly from the roll. Fish tissue samples will be stored in chest freezers at the Ohio EPA Groveport Field Facility prior to delivery to DES.

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. Equipment blanks for sediment samples will occur at a minimum of 5 percent. 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). An acid blank will be run on new lots of acid ampules. Matrix spike duplicates will be collected for organic water samples at a minimum of 5 percent.

Table 1. Facilities regulated by the National Pollution Discharge Elimination System in the Lower LMR basin.

Facility	Permit #	Receiving Stream	River Mile*	Capacity/Ave. Daily Flow (MGD)	Comments
EMD Chemicals Inc	1IN00019*ED	Duck Creek	4 - 6	N/A	Multiple outfalls / Storm Water
Hadronics Inc	1IC00041*CD	Duck Creek	4 - 6	- / 0.004	Storm & Cooling
Milacron-Cimcool	1IN00275*AD	Duck Creek	4 - 6	- / 0.001	Cooling
Cincinnati Galbraith Road MSD Site	1PX00022*AD	Duck Creek and LMR	LMR 3.7-7	N/A	Multiple CSOs
Martinsville-Midland WWTP	1PH00031*AD	E. Fork of Todd Fork	14.2	0.152 / -	Controlled Discharge
Cincinnati PWS	1IV00040*DD	Little Miami River	0.7	- / 3.0	usually discharge to Ohio R
Milford WWTP CSO	1PC00005	Little Miami River	13.0	N/A	CSO
Milford Waterworks	1IW00110*ED	Little Miami River	13.6	- / 0.027	
Indian Hill PWS	1IX00050*DD	Little Miami River	14.8	- / 0.118	Brine backwash
MGS Water Sub District	1IX00030*DD	Little Miami River	17.8	- / 0.024	
Lake Remington MHP	1PV00101*AD	Little Miami River	18.8	0.024 / -	
Arrowhead Park WWTP	1PH00014*GD	Little Miami River	21.0	0.14 / 0.053	
Miami Trails WWTP	1PW00023*CD	Little Miami River	22.6	0.4 / 0.232	
Deerfield-Hamilton WTP	1IY00162*DD	Little Miami River	29.9	- / 0.025	
Lebanon WWTP	1PC00003*FD	Little Miami River	32.12	6.0 / 2.8	
Western Water Co	1IZ00050*ED	Little Miami River	37.5	- / 0.059	
Shadow Lake Village MHP	1PV00040*ED	Little Muddy Creek	4.0-4.5	0.055 / 0.056	
Wilmington Sanitary Landfill	1II00129*AD	Lytle Creek	6.6	N/A	Storm Water
Wilmington WWTP	1PD00013*MD	Lytle Creek	6.83	3.0 / 2.54	
ABX Air Inc / DHL	1II00031*FD	Lytle Creek/Indian Run	N/A	N/A	Stormwater collection; Mercury spill, spring 2006
Mason WWTP No 2	1PC00004*HD	Muddy Creek	2.3	8.97 / 5.2	NPDES permit 13.0 MGD
O'Bannon Creek Regional WWTP	1PK00017*ID	O'Bannon Creek	2.57	4.4 / 2.1	
Polk Run WWTP	1PK00019*FD	Polk Run - L. Miami River	LMR 21.8	8.0 / 5.3	
Blanchester WWTP	1PB00003*FD	Second Creek	10.1	0.99 / 0.68	
Lower Little Miami WWTP	1PK00018*GD	Simpson Creek / L. Miami River	0.14 / 28.14	7.28 / 5.6	application for expansion
MidWestern Childrens Home	1PT00093*BD	Stony Run Creek	4.45	0.016 / 0.011	
Sycamore Creek WWTP	1PK00005*ID	Sycamore Creek / L. Miami River	0.26 / 19.22	9.0 / 7.1	Upgrade in progress
Clarksville WWTP	1PA00024*BD	Todd Fork	15.4	0.09 / 0.033	
Thousand Trails Inc Wilmington Preserve WWTP	1PX00010*DD	Todd Fork	20.9	0.012 / 0.0063	
Senco Products Inc	1IS00003*CD	trib to gravel pit to the L. Miami	LMR 10.5	0.01 / 0.005	
Combs Inc Country Kitchen WWTP	1PR00049*DD	Turtle Creek	10.5	0.02 / 0.002	
Cincinnati Steel Treating Co.	1IN00237*AD	Unnamed trib of L. Miami River	LMR 5.9	0.014 / -	Cooling
SUMCO Phoenix Corp Cincinnati	1IN00174*CD	Unnamed trib of L. Miami River	LMR 29.2	- / 0.129	

Facility	Permit #	Receiving Stream	River Mile*	Capacity/Ave. Daily Flow (MGD)	Comments
Keebler and Co	1IH00022*CD	Unnamed trib of L. Miami River	LMR 5.9	- / 0.523	Cooling
Wilmington WTTP	1IW00240*DD	Unnamed trib of Lytle Creek	Lytle 7.9	- / 0.153	
Senco Products Inc Plt No 2	1IS00004*CD	Unnamed trib to L. Miami River	LMR 10.7	001 0.028/0.1164 002 0.205/0.219	001 sanitary 002 industrial
St Thomas Episcopal Church	1PR00108*AD	Unnamed trib to L. Miami River	LMR 12.2	0.0018/ 0.002	
TEPPCO Lebanon Terminal	1IG00026*BD	Unnamed trib to Turtle Creek	Turtle 2.9	N/A	Storm water
Indian Lookout WWTP	1PG00041*GD	Unnamed trib. - L. Miami River	LMR 16.8	0.045 / 0.103	
Wards Corner Regional WWTP	1PK00021*AD	Unnamed trib. - Little Miami River	LMR 16.8	2.0 / -	new regional
ODOT Rest Area No 08-37	1PZ00066*BD	unnamed tributary of Turtle Creek	Turtle 12.4	0.01 / 0.005	
ODOT Rest Area 08-38	1PZ00073*BD	unnamed tributary of Turtle Creek	Turtle 12.4	0.04 / 0.005	
Walton Creek Condos WWTP	1PW00025*BD	Walton Creek	LMR 7.7	0.001 / 0.005	

*River miles of facilities/outfalls are estimated.

Table 2. Lower Little Miami River basin sampling sites, by 11-digit Hydrologic Unit Code (HUC).

River	ALU*	River Mile	Location	Drain. (mi^2)	Sample Type	Issue(s)	USGS Quad	Storet
HUC 05090202 – Little Miami River Mainstem								
Little Miami River	EWH	83.14	Jacoby Road	118.0	C,F2,MT	Status Check	Yellow Springs	M01S09
Little Miami River	EWH	63.3	Spring Valley at Roadside Park	360.0	CN,F2,MT,D, T	Nutrient, Fish tissue; Upper LMR trend evaluation	Waynesville	610530
Little Miami River	EWH	54.3	Ust. Waynesville WWTP	395.0	C,F2,MT,B	Ust. Waynesville WWTP	Waynesville	M01P29
Little Miami River	EWH	53.15	Dst. Waynesville WWTP	402.0	C,F2,MT,D,B	Dst. Waynesville WWTP	Waynesville	M01S29
Little Miami River	EWH	51.2	Ust. Caesar's Creek	413.0	C,F2,MT	Trend	Waynesville	M01W55
Little Miami River	EWH	50.25	Dst. Caesar Creek	658.0	C,F2,MT,D,S, B	Sentinel	Oregonia	M05K01
Little Miami River	EWH	43.76	St. Rt. 350	680.0	CN,F2,MT,D, S,B	Reference, Nutrient	South Lebanon	M05S12
Little Miami River	EWH	38.50	Dst. Todd Fork and SR 123	949.0	C,F2,MT,S	Geometric	South Lebanon	M05P02
Little Miami River	EWH	35.98	Stubbs Mill Rd.	964.0	C,F2,MT,S,B	Geometric, Reference	South Lebanon	610520
Little Miami River	EWH	32.5	Ust Lebanon WWTP	1035.0	C,F2,MT,B	Ust. Lebanon WWTP	South Lebanon	M05W14
Little Miami River	EWH	31.96	Ust. Muddy Creek, N of King's Mill	1036.0	C,F2,MT,D,B	Dst. Lebanon WWTP	South Lebanon	M05W15
Little Miami River	EWH	31.5	Ust. Peter's Cartridge	1050.0	S,F2,MT	Peter's Cartridge Sediment: Altfater/Gray	South Lebanon	
Little Miami River	EWH	30.8	Ust. Grandin Rd, at Kings Mills	1054.0	T	Fish Tissue	South Lebanon	M01W45
Little Miami River	EWH	30.4	adj Peter's Cartridge	1054.0	S,F2,MT	Peter's Cartridge sediment; Altfater/Gray	South Lebanon	
Little Miami River	EWH	28.9	Dst. Peter's Cartridge	1059.0	C,S,F2,MT,B	Peter's Cartridge sediment; Altfater/Gray, UST Lower LMR WWTP	Mason	M05W24
Little Miami River	EWH	27.9	Foster Road, Dst. SR 22/3	1069.0	C,F2,MT,D,B	Dst. Lower Little Miami WWTP	Mason	M05S07
Little Miami River	EWH	27.0	Dst. Simpson Cr.	1071.0	T	Fish Tissue	Mason	
Little Miami River	EWH	24.10	upst. O'Bannon Creek	1085.0	C,F2,MT	Geometric	Mason	M05W34

River	ALU*	River Mile	Location	Drain. (mi²)	Sample Type	Issue(s)	USGS Quad	Storet
Little Miami River	EWH	22.30	Ust. Loveland-Kemper Road	1150.0	C,F2,MT,B	Ust. Polk Run WWTP	Mason	M05S39
Little Miami River	EWH	21.8	Loveland-Kemper Rd. WWTP outfall	1150.0	F2,MT	Polk Run WWTP mixing zone	Mason	M05W37
Little Miami River	EWH	21.45	Branch Hill New Guinea Road	1160.0	C,D,B	Dst. Polk Run WWTP	Madeira	600540
Little Miami River	EWH	20.6	Adj. Lake Isabella	1161.0	C,F2,MT,B	Ust. Sycamore Creek	Madeira	M05W40
Little Miami River	EWH	18.14	SR 126 near Miamiville	1187.0	CN,F2,MT,D,B	Dst. Sycamore Creek, Nutrients	Madeira	M05P10
Little Miami River	EWH	13.07	Wooster Pike – Milford gage	1203.0	C,F2,MT,D,S,B	Sentinel	Madeira	M05P11
Little Miami River	EWH	8.2	At Newton Road	1713.0	C,F2,MT	Long. Coverage	Madeira	M05W07
Little Miami River	EWH	8.0	Dst. Newton Rd.	1713.0	T	Fish Tissue	Madeira	M05P12
Little Miami River	EWH	3.5	Beechmont Road	1744.0	C,F2,MT	Geometric	Newport	600580
HUC 05090202 060 – Downstream Caesar Creek to downstream Turtle Creek								
Turtle Creek	WWH	7.43	East St.	12.3	C,F,M	Geometric	Lebanon	
Turtle Creek	WWH	6.23	Glosser Rd.	21.3	C,F2,MT,S,B	Geometric, Reference	Lebanon	M05S17
Turtle Creek	WWH	4.85	McClure Rd.	30.0	C,F2,MT	Geometric	Lebanon	
Turtle Creek	WWH	0.52	US 48	58.0	C,F2,MT,D,S,B	Geometric, Sentinel	South Lebanon	M05S14
Dry Run	WWH	1.79	Snook Rd.	4.2	C,F2,MT,S,B	Geometric, Reference	Lebanon	M05S19
Dry Run	WWH	0.18	Main St.	7.3	C,F,M	Geometric	South Lebanon	
L. Muddy Creek	***WWH***	3.22	Hamilton Rd.	11.7	C,F,M	Geometric	Monroe	
L. Muddy Creek	***WWH***	1.0	SR 42	20.2	C,F2,MT	Long. Coverage, ALU assignment	Monroe	
HUC 05090202 070 – Todd Fork –Headwaters to upstream East Fork Todd Fork								
Todd Fork	WWH	32.72	Starbuck Rd.	14.4	C,F,M	Geometric	Wilmington	
Todd Fork	WWH	25.17	SR 73	29.1	C,F2,MT	Geometric	Wilmington	200528
Todd Fork	WWH	19.48	St. Rt. 22, Ust. Lytle Cr.	56.0	C,F2,MT,S,B	Geometric, Reference	Clarksville	M03S06
Todd Fork	WWH	17.10	dst. Cowan Cr., adj. Creek Rd	135.0	C,F2,MT,B	Geometric, Ust. Clarksville WWTP	Clarksville	
Todd Fork	WWH	15.1	Spring Hill Rd	142.0	C,F2,MT,D,B	Dst .Clarksville WWTP	Clarksville	M03S20
Dutch Creek	***EWH***	0.28	Todd Fork Rd.	14.7	C,F,M	Geometric	Clarksville	M03P23

River	ALU*	River Mile	Location	Drain. (mi^2)	Sample Type	Issue(s)	USGS Quad	Storet
Lytle Creek	WWH	9.3	Adj. Townsend Field	3.0	C,F,M,S	Outfall 002 ABX	Wilmington	M03S26
Lytle Creek	WWH	7.01	Nelson Rd.	8.1	C,F,M,B	Geometric, Ust. Wilmington WWTP	Wilmington	M03P07
Lytle Creek	WWH	6.83	WWTP Effluent	8.2	C	Wilmington WWTP	Wilmington	M03W02
Lytle Creek	WWH	5.94	Dst. Wilmington WWTP and landfill	9.3	C,F,M,D,B	Dst. Wilmington WWTP and landfill	Wilmington	M03W03
Lytle Creek	WWH	2.76	Ogden Rd, near Wilmington	15.9	CN,F,M,D	Geometric, Nutrient	Clarksville	M03S02
Lytle Creek	WWH	0.65	Clarksville Road	19.8	C,F2,MT,D,S,B	Sentinel	Clarksville	M03P09
Indian Run	WWH	2.9	Denver Road	1.1	C,M,S	Mercury spill/ABX	Wilmington	
Indian Run	WWH	0.2	Jenkins Road	4.1	C,F,M,S	Mercury Spill/ABX	Wilmington	M03S25
Cowan Creek	WWH	16.62	School Rd.	15.1	C,F,M	Geometric	Wilmington	
Cowan Creek	WWH	13.15	Jenkins Rd.	26.0	C,F2,MT	Geometric	Wilmington	M03S24
Cowan Creek	WWH	12.45	Adj. Jenkins Rd.	32.0	C,F2,MT,S,D,PWS	Mercury spill/ABX,Wilmington PWS	Wilmington	M03S23
Cowan Creek	WWH	6.8	Ust. Champlin Rd	40.0	C,F2,MT,S	Train derailment/NaOH	Wilmington	M03P21
Cowan Creek	WWH	3.0	Old State Road	51.0	C,F2,MT,S	Dst. old landfill	Clarksville	
Cowan Creek	WWH	0.65	Clarksville Rd.	54.0	C,F2,MT,D,S,B	Geometric, Sentinel	Clarksville	M03P12
HUC 05090202 080 – Todd Fork –Upstream East Fork Todd Fork to Mouth								
Todd Fork	WWH	12.2	Gum Grove Road	192.0	C,F2,MT	Trends	Oregonia	
Todd Fork	WWH	8.53	Ust. Middleboro Rd.	198.0	C,F2,MT	Trends	Pleasant Plain	M03S19
Todd Fork	WWH	5.6	Roachester-Osceola Rd.	200.0	C,F2,MT	Trends	Pleasant Plain	M99Q16
Todd Fork	WWH	2.65	Achterman Rd.	239.0	CN,F2,MT,D	Long. Coverage, Nutrients	Pleasant Plain	M03S18
Todd Fork	WWH	0.14	St. Rt. 22/3	261.0	C,F2,MT,D,S,B	Geometric, Sentinel	South Lebanon	600530
E. Fk. Todd Fork	WWH	18.29	Greene Rd.	7.8	C,F,M	Geometric	Martinsville	
E. Fk. Todd Fork	WWH	17.28	Gibbon Rd.	14.6	C,F,M	Geometric	Martinsville	
E. Fk. Todd Fork	WWH	11.46	U.S. Rt. 68	27.9	C,F2,MT	Geometric	Blanchester	
E. Fk. Todd Fork	WWH	7.2	Reeder's Road	35.0	C,F2,MT,B	Dst. CAFO?	Blanchester	
E. Fk. Todd Fork	WWH	1.6	SR 132	37.3	C,F2,MT,D,S,B	Sentinel	Clarksville	M03P19
Lick Run	***EWH***	1.28	St. Rt. 132	12.3	C,F,M	Geometric	Pleasant Plain	M03P01

River	ALU*	River Mile	Location	Drain. (mi²)	Sample Type	Issue(s)	USGS Quad	Storet
Whittaker's Run	n/a	1.2	Dst. Blanchester PWS	1.5	C,M,S,D, PWS	Blanchester PWS evaluation	Blanchester	
Second Creek	***WWH***	10.94	Columbus St.	6.8	C,F,M,B	Geometric, Ust. Blanchester WWTP	Blanchester	M03S16
Second Creek	***WWH***	9.45	Dst. WWTP	11.0	C,F,M,D,B	Dst. Blanchester WWTP	Pleasant Plain	M03S14
Second Creek	***WWH***	6.55	Gustin-Rider Rd.	13.2	C,F,M	Geometric	Pleasant Plain	M03S13
Second Creek	***WWH***	1.53	Cozaddale Rd., NR Butlerville	19.0	C,F,M	Long. Coverage	Pleasant Plain	M03P14
First Creek	***WWH***	3.83	Volkerding Rd.	13.8	C,F,M	Geometric	Pleasant Plain	
HUC 05090202 090 – Downstream Turtle Creek to downstream O'Bannon Creek								
Muddy Creek	WWH	2.5	Ust. Mason WWTP	10.2	C,F,M,B	Ust. Mason WWTP	Mason	M05S02
Muddy Creek	WWH	0.54	Mason -Morrow Rd.	15.2	C,F,M,D,B	Geometric, Sentinel, Dst. Mason WWTP	South Lebanon	M05P06
O'Bannon Creek	WWH	10.14	Linton Rd.	8.1	C,F,M	Geometric	Goshen	
O'Bannon Creek	WWH	8.27	St. Rt. 132	14.3	C,F,M	Geometric	Goshen	
O'Bannon Creek	WWH	4.37	Gibson Rd.	28.1	C,F2,MT,B	Geometric, Ust O'Bannon WWTP	Goshen	M05W60
O'Bannon Creek	WWH	1.84	O'Bannonville Rd.	55.6	C,F2,MT,B	Geometric, Dst O'Bannon WWTP	South Lebanon	M05P19
O'Bannon Creek	WWH	0.26	SR 48	59.0	C,F2,MT,D,S, B	Reference, Sentinel	Mason	M05P18
HUC 05090202 140 – Downstream O'Bannon Creek to Mouth								
Sycamore Creek	WWH	1.10	adj Sycamore Cr. Rd., dst. trib.	10.4	C,F,M	Geometric	Madeira	M05P17
Sycamore Creek	WWH	0.50	Dst. N. Fk. Sycamore Creek	20.7	C,F2,MT,B	Ust. Sycamore Creek WWTP	Madeira	M05S41
Sycamore Creek	WWH	0.01	at mouth	23.3	C,F2,MT,B	Geometric, Dst. Sycamore Creek WWTP	Madeira	
Duck Creek	LRW	3.43	Brotherton Rd. (poss. cement channel)	7.3	C,F,M	Geometric	Cincinnati East	
Duck Creek	WWH	0.95	Eastern Ave.	15.1	C,F,M	Geometric	Newport	M05S24
Clough Creek	***WWH***	0.4	SR 125	8.3	C,F,M	Poor biology	Withamsville	
HUC 05090202 130 – East Fork LMR								
E.Fk. Little Miami River	EWH	0.77	S. Milford Rd.	498.0	C,F2,MT,D,S, B	Sentinel	Madeira	610530

* - ALU - aquatic life use. Those in bold italics are not verified uses. EWH=Exceptional Warmwater Habitat; WWH=Warmwater Habitat; LRW=Limited Resource Water
C – Chemistry site
CN - Chemistry Nutrient site, therefore include dissolved phosphorous, and water column Chlorophyll a.
B – Bacteria site
PWS – Chemistry site for Drinking Water assessment. Normal suite of parameters plus pesticides, specifically: atrazine, simazine, cyanizine, metachlor, and metribuzin.
F – Fish Site
F2 – Two-pass fish site (for reference and nutrient sites, or drainage area 20 sq. miles or greater)
M – Macroinvertebrate site
MT – Macroinvertebrate quantitative site (for reference and nutrient sites, or drainage area 20 sq. miles pr greater)
S – Sediment site
D – Datasonde site
T – Fish Tissue

Type	Number of Sites
Total	86
Water chemistry	80
Bacteria	37
Fish	76 (49 two-pass)*
Macroinvertebrate	78 (49 Quantitative)*
Fish Tissue	4
Sediment	7*
Nutrients (chlorophyll a)	5
Datasonde©	25

*these numbers do not include Peter's Cartridge sampling, which will be conducted by DERR.

Table 3. Lower LMR site locations, by stream, with geographical coordinates.

River	River Mile	Location	Drain. Area	Sample Type	Latitude	Longitude
Clough Creek	0.4	SR 125	8.3	C,F,M	39.10628	-84.3972
Cowan Creek	16.62	School Rd.	15.1	C,F,M	39.4031	-83.7542
Cowan Creek	13.15	Jenkins Rd.	26.0	C,F2,MT	39.4072	-83.7978
Cowan Creek	12.45	Adj. Jenkins Rd.	32.0	C,F2,MT,S,D, PWS	39.40306	-83.8033
Cowan Creek	6.8	Upst. Champlin Rd.	40.0	C,F2,MT,S	39.38272	-83.8631
Cowan Creek	3.0	Old State Rd.	51.0	C,F2,MT,S	39.39326	-83.9301
Cowan Creek	0.65	Clarksville Rd.	54.0	C,F2,MT,D,S,B	39.4133	-83.9586
Dry Run	1.79	Snook Rd.	4.2	C,F2,MT,S,B	39.3836	-84.2042
Dry Run	0.18	Main St.	7.3	C,F,M	39.3717	-84.2169
Duck Creek	3.43	Brotherton Rd. (poss. cement channel)	7.3	C,F,M	39.1506	-84.4081
Duck Creek	0.95	Eastern Ave.	15.1	C,F,M	39.1219	-84.4108
Dutch Creek	0.28	Todd Fork Rd. (TR 260)	14.7	C,F,M	39.4619	-83.9133
E. Fk. Little Miami River	0.77	S. Milford Rd.	498.0	C,F2,MT,D,S,B	39.1553	-84.2889
E. Fk. Todd Fork	18.29	Greene Rd.	7.8	C,F,M	39.3422	-83.8097
E. Fk. Todd Fork	17.28	Gibbon Rd.	14.6	C,F,M	39.3317	-83.8211
E. Fk. Todd Fork	11.46	U.S. Rt. 68	27.9	C,F2,MT	39.3458	-83.8894
E. Fk. Todd Fork	7.2	Reeders Road	35	C,F2,MT,B	39.36044	-83.939
E. Fk. Todd Fork	1.6	SR 132	37.3	C,F2,MT,D,S,B	39.3986	-83.9827
First Creek	3.83	Volkerding Rd.	13.8	C,F,M	39.3111	-84.1167
Indian Run	2.9	Denver Rd.	1.1	C,M,S	39.43931	-83.7672
Indian Run	0.2	Jenkins Rd.	4.1	C,F,M,S	39.41091	-83.7963
L. Muddy Creek	3.22	Hamilton Rd.	11.7	C,F,M	39.41071	-84.2956
L. Muddy Creek	1.0	SR 42	20.2	C,F2,MT	39.39601	-84.2611
Lick Run	1.28	St. Rt. 132	12.3	C,F,M	39.3278	-84.0678
Little Miami River	83.14	Jacoby Road	118.0	C,F2,MT	39.7642	-83.9018
Little Miami River	63.3	Spring Valley at Roadside Park	360.0	CN,F2,MT,D,T	39.6056	-84.0136
Little Miami River	54.3	Upst. Waynesville WWTP	395.0	C,F2,MT,B	39.5267	-84.0803
Little Miami River	53.15	Dst. Waynesville WWTP	402.0	C,F2,MT,D,B	39.51677	-84.0928
Little Miami River	51.2	Upst. Caesars Creek	413.0	C,F2,MT	39.4977	-84.1019
Little Miami River	50.25	Dst. Caesar Creek confluence	658.0	C,F2,MT,D,S,B	39.4866	-84.1104
Little Miami River	43.76	St. Rt. 350	680.0	CN,F2,MT,D,S,B	39.4069	-84.1011

River	River Mile	Location	Drain. Area	Sample Type	Latitude	Longitude
Little Miami River	38.5	Dst. Todd Fork and SR 123	949.0	C,F2,MT,S	39.35629	-84.1316
Little Miami River	35.98	Stubbs Mill Rd.	964.0	C,F2,MT,S,B	39.3633	-84.1739
Little Miami River	32.5	Adj. Peters Cartridge Facility	1035.0	C,F2,MT,S,B	39.3661	-84.2325
Little Miami River	31.96	Upst. Muddy Creek, N of Kings Mill	1036.0	C,F2,MT,D,B	39.36528	-84.2413
Little Miami River	31.5	Ust. Peter's Cartridge	1050.0	S,F2,MT		
Little Miami River	30.8	Upst. Grandin Rd., at Kings Mills	1054.0	T	39.3526	-84.2408
Little Miami River	30.4	Adj. Peters Cartridge Facility	1054.0	F2,MT,S	39.3506	-84.2486
Little Miami River	28.9	Dst. Peters Cartridge Facility	1059.0	C,F2,MT,S,B	39.3317	-84.2533
Little Miami River	27.9	Foster Rd., Dst. SR 22/3	1069.0	C,F2,MT,D,B	39.31827	-84.251
Little Miami River	27.0	Dst. Simpson Creek	1071.0	T	39.30647	-84.2574
Little Miami River	24.1	Upst. O'Bannon Creek	1085.0	C,F2,MT	39.27127	-84.2594
Little Miami River	22.3	Upst. Loveland Kemper Road	1150.0	C,F2,MT,B	39.25368	-84.2798
Little Miami River	21.8	Loveland-Kemper Road WWTP outfall	1150.0	F2,MT	39.25084	-84.289
Little Miami River	21.45	Branch Hill New Guinea Rd.	1160.0	C,D,B	39.24686	-84.2948
Little Miami River	20.6	Adj. Lake Isabella	1161.0	C,F2,MT,B	39.23585	-84.2988
Little Miami River	18.14	SR126 Near Miamiville	1187.0	CN,F2,MT,D,B	39.21093	-84.3116
Little Miami River	13.07	Milford USGS gage (Wooster Pike)	1203.0	C,F2,MT,D,S,B	39.1717	-84.2986
Little Miami River	8.2	At Newton Rd.	1713.0	C,F2,MT	39.13632	-84.3529
Little Miami River	8.0	Dst. Newton Road	1713.0	T	39.1378	-84.3552
Little Miami River	3.5	Beechmont Rd.	1744.0	C,F2,MT	39.10921	-84.4011
Lytle Creek	9.3	Adj. Townsend Field	3.0	C,F,M,S	39.43784	-83.8189
Lytle Creek	7.01	Nelson Rd.	8.1	C,F,M,B	39.4383	-83.8514
Lytle Creek	6.83	Effluent WWTP	8.2	C	39.43856	-83.8536
Lytle Creek	5.94	Dst. WWTP and landfill	9.3	C,F,M,D,B	39.44102	-83.8664
Lytle Creek	2.76	Ogden Rd., near Wilmington	15.9	CN,F,M,D	39.43009	-83.9099
Lytle Creek	0.65	Clarksville Rd.	19.8	C,F2,MT,D,S,B	39.4275	-83.9406
Muddy Creek	2.5	Upst. of Mason's new WWTP outfall	10.2	C,F,M,B	39.37412	-84.2746
Muddy Creek	0.54	Mason-Morrow Rd.	15.2	C,F,M,D,B	39.3703	-84.2486
O'Bannon Creek	10.14	Linton Rd.	8.1	C,F,M	39.2217	-84.1397
O'Bannon Creek	8.27	St. Rt. 132	14.3	C,F,M	39.2292	-84.1633
O'Bannon Creek	4.37	Gibson Rd.	28.1	C,F2,MT,B	39.2492	-84.2014
O'Bannon Creek	1.84	O'Bannonville Rd.	55.6	C,F2,MT,B	39.2647	-84.2325
O'Bannon Creek	0.26	St. Rt. 48	59.0	C,F2,MT,D,S,B	39.26889	-84.2561
Second Creek	10.94	Columbus St.	6.8	C,F,M,B	39.2992	-83.9869
Second Creek	9.45	Dst. WWTP	11.0	C,F,M,D,B	39.291	-84.0075

River	River Mile	Location	Drain. Area	Sample Type	Latitude	Longitude
Second Creek	6.55	Gustin-Rider Rd.	13.2	C,F,M,	39.3069	-84.0392
Second Creek	1.53	Cozaddale Rd., NR Butlerville	19.0	C,F,M	39.32365	-84.0907
Sycamore Creek	1.1	Adj . Sycamore Creek Rd., Dst. trib.	10.4	C,F,M	39.2169	-84.3319
Sycamore Creek	0.5	Dwnst. North Fork Sycamore Creek	20.7	C,F2,MT,B	39.22357	-84.3261
Sycamore Creek	0.01	At mouth	23.3	C,F2,MT,B	39.2247	-84.32
Todd Fork	32.72	Starbuck Rd.	14.4	C,F,M	39.4769	-83.7867
Todd Fork	25.17	SR 73	29.1	C,F2,MT	39.4697	-83.8830
Todd Fork	19.48	St. Rt. 22, Upst. Lytle Creek	56.0	C,F2,MT,S,B	39.4358	-83.9444
Todd Fork	17.1	Dst. Cowan Creek, adj. Creek Rd.	135.0	C,F2,MT,B	39.4156	-83.9683
Todd Fork	15.1	Spring Hill Rd.	142.0	C,F2,MT,D,B	39.40555	-83.9907
Todd Fork	12.2	Gum Grove Rd.	192.0	C,F2,MT	39.38281	-84.0196
Todd Fork	8.53	Upst. Middleboro Rd.	198.0	C,F2,MT	39.36237	-84.0579
Todd Fork	5.6	Roachester- Osceola Rd.	200.0	C,F2,MT	39.35144	-84.0751
Todd Fork	2.65	Achterman Rd.	239.0	CN,F2,MT,D	39.34066	-84.1039
Todd Fork	0.14	St. Rt. 22/3	261.0	C,F2,MT,D,S,B	39.35337	-84.1293
Turtle Creek	7.43	East St.	12.3	C,F,M	39.4311	-84.2042
Turtle Creek	6.23	Glosser Rd.	21.3	C,F2,MT,S,B	39.4314	-84.2253
Turtle Creek	4.85	McClure Rd.	30.0	C,F2,MT	39.4217	-84.2425
Turtle Creek	0.52	US 48	58.0	C,F2,MT,D,S,B	39.3718	-84.2266
Whittakers Run	1.2	Dst. Blanchester PWS Clinton/Wright	1.5	C,M,S,D,PWS	39.28766	-83.981

Table 4. List of chemical/physical water quality parameters to be analyzed/measured in surface water, sediment, and fish tissue from the Lower LMR, 2007. Water samples will be collected 5 times (organics twice), sediment once. Bacteria samples will be collected 5 - 10 times, with at least 5 samples in a thirty-day period to determine the recreational use. Select sampling locations will be monitored for dissolved oxygen, pH, temperature, and conductivity using Datasonde© continuous recorders (Table 2).

Parameters	Test Method	Water	Sediment	Fish Tissue
Acidity	USEPA 305.1	X		
Alkalinity	USEPA 310.1	X		
BOD, 5-DAY	SM 5210B	X		
SOLIDS, DISSOLVED (TDS)	USEPA 160.1	X		
SOLIDS, SUSPENDED (TSS)	USEPA 160.2	X		
AMMONIA	USEPA 350.1/ SM 4500	X	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		
Sulfate	USEPA 375.4	X		
TOTAL PHOSPHORUS	USEPA 365.4/ USEPA 365.4	X	X	
DISSOLVED PHOSPHORUS	USEPA 365.4	X		
ICP 1 (Al,Ba,Ca,Cr,Cu,Fe, Mg, Mn, Na, Ni, K, Sr, Zn, Hardness)	USEPA 200.7	X		
ICP 3 (Al,Ba,Ca,Cr,Cu,Fe,Mg,Mn,Na,Ni,K,Sr,Zn,Pb)	USEPA 200.7		X	
SIMA 1 (As,Cd,Pb,Se)	USEPA 200.9, SM 3113B	X		X
SIMA 2 (As, Cd, Se)	USEPA 200.9, SM 3113B		X	
MERCURY, TOTAL	USEPA 245.1,7470A,7471A	X	X	X (245.1)
pH - grab	Hanna HI9811 meter	X - field		
Conductivity - grab	Hanna HI9811 meter/ USEPA 120.1	X - field / lab		
Dissolved Oxygen - grab	YSI 55 meter	X - field		
Temperature - grab	YSI 55 meter	X - field		
VOCs	-	NOT RECOMMENDED	NOT RECOMMENDED	
SVOCs	USEPA 625/ USEPA 8270C	X	X	
Pesticides/PCBs/ Chlordane	USEPA 608/ USEPA 8081A, 8082	X	X	X (OEPA 590.1)
E.coli	USEPA 1103.1/ 640.1	X		
Percent Solids	SM 2540G		X	X

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