



FINAL

Study Plan Muskingum River 2006

Coshocton, Muskingum, Morgan,
Washington Counties

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CONTACTS

Ohio EPA

- Ohio Environmental Protection Agency
Division of Surface Water
Lazarus Government Center
122 South Front St., Columbus, OH 43215
Mail to:
P.O. Box 1049, Columbus, OH 43216-1049
- David Altfater (Coordinator) 614 -836-8786
Mike Gray 614-836-8773
Ecological Assessment Section
4675 Homer Ohio Lane
Groveport, OH 43125
- Joann Montgomery 740-380-5433
Kelly Capuzzi 740-380-5283
Division of Surface Water
Southeast District Office
2195 Front Street
Logan, OH 43138

Ohio DNR – Wildlife Officers District Four (740-589-9930)

- Coshocton: Garth Goodyear (740-589-9982)
- Muskingum: Michael Reed (740-589-9991)
- Morgan: Jerry Rolli (740-589-9990)
- Washington: Eric Bear (740-589-9998)

Sheriffs

- Coshocton: 740-622-2411
- Muskingum: 740-452-3637
- Morgan: 740-962-4044
- Washington: 740-373-2833

Police Departments

- Zanesville: 740-455-0700
- Marietta: 740-373-4141

Hospitals (maps attached at end)

- Coshocton County Memorial: ER: 740-623-4124, Gen: 740-623-2416
- Zanesville Genesis Bethesda: ER: 740-454-4215, Gen: 740-454-4000
- Zanesville Genesis Good Samaritan: ER: 740-454-5880, Gen: 740-454-5000
- Marietta Memorial: ER 740-374-1598, Gen: 740-374-4000

INTRODUCTION

During the 2006 field season (June thru October) chemical, physical, and biological sampling will be conducted in the Muskingum River mainstem to assess and characterize water quality conditions.

The entire length of the Muskingum River has not been completely assessed since 1988 and therefore will have a thorough assessment of the mainstem. Table 1 contains a list of all the NPDES facilities on the mainstem. The sampling effort is structured to characterize point source and non point source impacts, including those from unsewered communities and agricultural activities

Sampling locations, geographical coordinates, and types of sampling scheduled for the study area are listed in Table 2.

Sampling Objectives:

- Monitor and assess the chemical, physical and biological integrity of the entire length of the Muskingum River.
- Assess conditions in both impounded sections of river and free-flowing segments.
- Determine aquatic impacts from known potential pollution sources including point source dischargers.
- Assess physical habitat influences on stream biotic integrity.
- Determine recreational water quality.
- 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, and organic parameters tested twice at four locations during the survey. Sediment samples will be collected at 12 locations (organics at 4 locations), largely at impounded flow sites or at depositional locations in free-flowing sites. Datasondes® will be deployed at six locations, with four locations bracketing the two larger power plants on the river and two located at the nutrient (chlorophyll a) sites. Chemical parameters to be tested are listed in Table 3. Surface water sampling will occur across a variety of flow conditions, from lower flows to moderate and higher flows. See table 5 for USGS flow statistics.

Chlorophyll a

Periphyton and water column samples for determination of chlorophyll a concentrations are planned for two 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 16 sites on the Muskingum River for bacteriological analyses to determine the attainment status of the Primary Contact recreational use. Testing will include fecal coliform bacteria and *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

Quantitative macroinvertebrate sampling methods will be used as listed in Table 2. Fish assemblages will be sampled twice as listed in Table 2. QHEI scores will be calculated on the habitat at all fish sampling locations. Fish sampling locations upstream from the most upstream dam (Ellis dam) will be collected during daylight hours. All other downstream fish locations will be sampled using night electrofishing. HD sampling in free-flowing sections of river will follow Ohio EPA standardized procedures. Macroinvertebrate sampling in impounded sections of river will incorporate the following procedures: at each sampling location, two HDs will be set – one mid-channel to capture the best flow conditions, and one nearer shore as a backup set.

Fish Tissue

Fish tissue samples will be collected from 20 locations in the Muskingum River 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 Western Allegheny Plateau ecoregion.

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

The macroinvertebrates will be sampled quantitatively. Macroinvertebrates will be collected from artificial substrates and from the natural habitats. 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 twice at each sampling location with pulsed DC current. Night electrofishing will occur at all sampling locations downstream

from Ellis Dam. 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. Continuous temperature recorders will be placed for a minimum of 6 weeks (with the placement of HD samplers) at four sites – sites located upstream and downstream from the Conesville and Muskingum power plants. In addition, one temperature recorder will be placed in the river in the vicinity of Dresden Energy.

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 fecal coliform and *E. coli* bacteria using U.S.EPA approved methods (STORET Parameter Codes 31611 and 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 on the Muskingum River.

Facility Name	Ohio EPA Permit No.	County	River Mile	Comments
Coshocton WWTP	0PD00004*FD	Coshocton	108.56	Wastewater
AK Steel - Coshocton	0ID00014*HD	Coshocton	105.88	Process – stainless steel
AEP Conesville	0IB00013*HD	Coshocton	102.89	Cooling
Dresden WWTP	0PB00012*ED	Muskingum	91.6	Wastewater
Dresden Energy LLC	0IB00031*AD	Muskingum	89.8	Cooling
United Technologies	Superfund Site	Muskingum	78.3	TCE
AK Steel Corp - Zanesville	0ID00002*FD	Muskingum	78.06	Process - steel
Zanesville WWTP – CSOs	0PE00000*JD	Muskingum	76.25-74.5	Sewer overflows
Zanesville WWTP	0PE00000*JD	Muskingum	74.07	Wastewater (river right)
Riverview Manor	0PV00029*AD	Muskingum	74.07	Nursing home (river left)
Dun-Falls Association	0PX00000*FD	Muskingum	67.3	Housing subdivision
Dana Glacier Vandervell N. American	0IC00027*AD	Morgan	51.9	Groundwater treatment
Miba Bearings US LLC	0IC00000*HD	Morgan	51.74	Groundwater treatment
Malta Well Field	0IN00155*AD	Morgan	50.2	dischg from contaminated well
Malta CSO Collection System	0PA00095	Morgan	50.48-48.15	Sewer overflows
McConnelsville WWTP	0PC00000*ED	Morgan	48.10	Wastewater
Columbus Southern (Waterford Energy Facility)	0IB0027*BD	Washington	33.8	Cooling
Ohio Power Co. Muskingum River Plant	0IB00003	Washington	28.53-27.09	Cooling, fly ash
Globe Metallurgical, Inc.	0ID00005	Washington	27.81	
Duke Energy Washington, LLC	0IB00028*AD	Washington	27.1	Cooling
BP Oil, Beverly Plant	0IN00134	Washington	25.8	
Beverly WWTP	0PB00002*FD	Washington	23.25	Wastewater
Lowell WWTP	0PB00022*ED	Washington	13.1	Wastewater
Magnum Magnetic	To be drafted	Washington	6.7	Flexible magnetic material
Devola WWTP	0PG00019	Washington	4.36	Wastewater
RJF International	0IQ00020	Washington	3.39	mfg - vinyl plastic products
Marietta WTP	0IW00080	Washington	1.8	

Table 2. Muskingum River sampling locations.

River Mile	Sample Type	Location	Latitude	Longitude	Flow Conditions	Drainage Area (sq. mi.)	Purpose
110.0	FT, F, M, S	Plum St., Roadside Park area	40 15 35.7	81 52 18.0	Free	4,856	Baseline/ Ust. Coshocton WWTP
108.7	C, B	Coshocton Boat Ranp	40.24145809	81.87259989	Free	4,857	Baseline/ Ust. Coshocton WWTP
106.4	F, M, C, B, D,N	@ Tyndell	40 13 5.3	81 52 47.6	Free	4,868	Dst. Coshocton WWTP
105.2	FT, F, M, T	Dst. AK Steel/ RR bridge	40 12 9.5	81 52 16.6	Free	4,871	Dst. AK Steel
103.5	C, CO, B, D	CR 273 - Conesville	40 11 16.1	81 53 16.5	Free	4,875	Ust. Conesville EGS
101.8	F, M, S, SO, D,T	Upstream Wills Creek	40 09 59.1	81 53 16.4	Free	4,883	Dst. Conesville EGS
98.0	F	Upstream Stilwell Road	40 08 40	81 55 58	Free	5,744	Dst. Wills Creek
97.1	M, C, S, D,N	Stilwell Road	40 08 9.6	81 56 45.2	Free	5,745	Dst. Wills Creek
92.2	FT, F, M	Upstream SR 208	40 07 25.3	81 59 58.7	Free	5,993	Dst. Wakatomika Cr./ Ust. Dresden
92.0	C, B	SR 208	40 07 14.4	82 00 0.3	Free	5,993	Dst. Wills Creek/ Dresden
88.6	C,B, T	Ust Copland Isle Dst Dresden Energy	40.0793	81.9973	Free	6,008	Background Chem & Temp
86.0	F, M, S	Upstream Ellis Dam	40 03 26.1	81 58 21.0	Impounded	6,040	Impounded – Ellis dam pool
Ellis Dam – RM 84.9							
84.8	FT, F ^N , M, C	Downstream Ellis Dam	40 02 32.2	81 58 45.1	Free	6,042	Tailwaters @ Ellis Dam
78.9	F ^N , M	Upst. AK Steel & United Technology	39 58 24.2	81 59 32.4	Impounded	6,066	Upst. AK Steel/United Technologies
77.5	FT, F ^N , M, S	Dst. AK Steel & United Technology	39 57 15.0	81 59 52.7	Impounded	6,066	Dst. AK Steel/United Tech - Impound
Zanesville Dam RM 76.3							
76.0	FT, F ^N , M	Dst. Zanesville Dam/ Dst. Licking R.	39 56 17.9	82 00 42.0	Free	6,847	Tailwaters @ Zanesville Dam
75.7	C, CO, B	US 22	39 56 7.2	82 00 22.3	Impounded	6,847	Tailwaters @ Zanesville Dam
74.0	B	SR 555	39 54 38.8	82 00 8.0	Impounded	7,175	Impounded – Dst. Zanesville
73.5	C, B	Immediately upst. Moxahala Creek	39 54 17.6	82 00 9.6	Impounded	7175	Impounded – Dst. Zanesville WWTP
72.0	FT, F ^N , M, S,SO	Near Frazier, Dst. Zanesville WWTP	39 52 19.4	81 56 14.7	Impounded	7,185	Impounded – Philo dam pool
Philo Dam – RM 67.55							
67.4	F ^N , M, C, B	Dst. Philo Dam/ @Bridge St. (CR 32)	39 52 8.7	81 54 32.2	Free	7,196	Tailwaters @ Philo Dam
62.7	F ^N , M, C, B, S	SR 376 – Gaysport	39 48 14.2	81 53 36.6	Impounded	7,357	Impounded – Rokeby dam pool
Rokeby Dam – RM 56.6							
56.4	FT, F ^N , M	Dst. Rokeby Dam	39 43 52.8	81 54 23.7	Free	7,386	Tailwaters @ Rokeby Dam
52.5	F ^N , M	Upstream McConnellsville	39 40 59.4	81 53 20.0	Impounded	7,406	Impounded – McConnellsville dam pool
49.8	FT, C, B	SR 78 - McConnellsville	39 39 9.5	81 51 43.4	Impounded	7,421	Impounded – McConnellsville dam pool
McConnellsville Dam – RM 49.0							
48.8	FT, F ^N , M	Dst. McConnellsville Dam	39 38 31.1	81 50 47.1	Free	7,422	Tailwaters @ McConnellsville Dam
48.0	B	Dst. McConnellsville @ DNR boat ramp	39 38 5.0	81 50 13.4	Free	7,425	Dst. McConnellsville/Malta CSOs

Table 2. Continued.

River Mile	Sample Type	Location	Latitude	Longitude	Flow Conditions	Drainage Area (sq. mi.)	Purpose
43.5	FT, F ^N , M, S	@ Taylor Hollow Tributary	39 35 28.0	81 47 38.2	Impounded	7,440	Impounded – Stockport dam pool
39.7	C, B	SR 266 – Stockport	39 32 53.7	81 47 19.4	Impounded	7,457	Impounded – Stockport dam pool
Stockport Dam – RM 39.6							
39.5	C	Dst. side of lock	39 32 48.7	81 47 18.1	Free	7457	Sample only if/when foaming occurs
39.3	FT, F ^N , M	Dst. Stockport Dam	39 32 36.7	81 47 22.4	Free	7,457	Tailwaters @ Stockport Dam
36.5	F ^N , M	Near Roxbury	39 31 24.1	81 44 55.0	Impounded	7,468	Impounded – Luke Chute dam pool
Luke Chute Dam – RM 33.7							
33.5	FT, F ^N , M	Dst. Luke Chute Dam	39 32 22.3	81 43 19.4	Free	7,470	Tailwaters @ Luke Chute Dam
29.2	F ^N , M,D,T	Dst. Meigs Cr./ Upstream Ohio Power	39 35 12.4	81 41 39.3	Impounded	7,622	Impounded, ust. Ohio Power EGS
26.3	FT,F ^N , M,D,S, SO,T	Dst. Ohio Power	39 33 59.4	81 39 53.0	Impounded	7,711	Impounded, dst. Ohio Power EGS
Beverly Dam – RM 24.9							
24.8	FT, F ^N , M	Dst. Beverly Dam	39 33 9.8	81 38 47.0	Free	7,713	Tailwaters @ Beverly Dam
24.0	C, CO, B	SR 339 – Beverly	39 32 39.3	81 38 28.0	Impounded	7,714	Near Beverly tailwaters
19.0	FT, F ^N , M, S	Near Coal Run	39 33 45.3	81 34 57.2	Impounded	7,960	Impounded – Lowell dam pool
Lowell Dam – RM 14.1							
14.0	FT, F ^N , M	Dst. Lowell Dam	39 31 42.7	81 30 49.6	Free	7,983	Tailwaters @ Lowell Dam
13.6	C, B	New Bridge St. – Lowell	39 31 36.1	81 30 30.3	Free	7,983	Tailwaters @ Lowell Dam
9.4	FT, F ^N , M, S	Near March Run, ust. Devola	39 29 20.6	81 27 45.2	Impounded	8,009	Impounded – Devola dam pool
Devola Dam – RM 5.8							
5.7	FT, F ^N , M	Dst. Devola Dam	39 28 9.2	81 29 17.1	Free	8,036	Tailwater @ Devola Dam
0.9	FT,C,CO,B, S,SO	Washington St. – Marietta	39 25 10.6	81 27 47.9	Impounded	8,050	Impounded – Ohio River

C – Chemistry Site
 CO – Chemistry organic
 B – Bacteria site
 F – Fish Site (Daytime)
 F^N – Fish Site (Nighttime)
 FT – Fish Tissue Samples
 M – Macroinvertebrate Site
 S – Sediment site
 SO – Sediment organic site
 D – Datasonde© site (continuous recorder sampler for D.O., pH, temperature, and conductivity)
 T – Temperature recorder
 N – Chlorophyll a / Nutrient site

Type	Number of Sites
Water chemistry	17 (4 organics)
Bacteria	16
Fish	28 (21 night)
Macroinvertebrate	28
Fish Tissue	20
Sediment	12 (4 organics)
Nutrients (chlorophyll a)	2
Temperature recorder	5
Datasonde©	6 (2 associated with chlorophyll a sites)

Table 3. List of chemical/physical water quality parameters to be analyzed/ measured in surface water, sediment, and fish tissue from the Muskingum River, 2006. 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		
Fecal coliform	SM 9222 D/ 610.1	X		
Percent Lipids	OEPA 581.5			X
Percent Solids	SM 2540G		X	

Table 4. Boat access points on the Muskingum River, 2006.

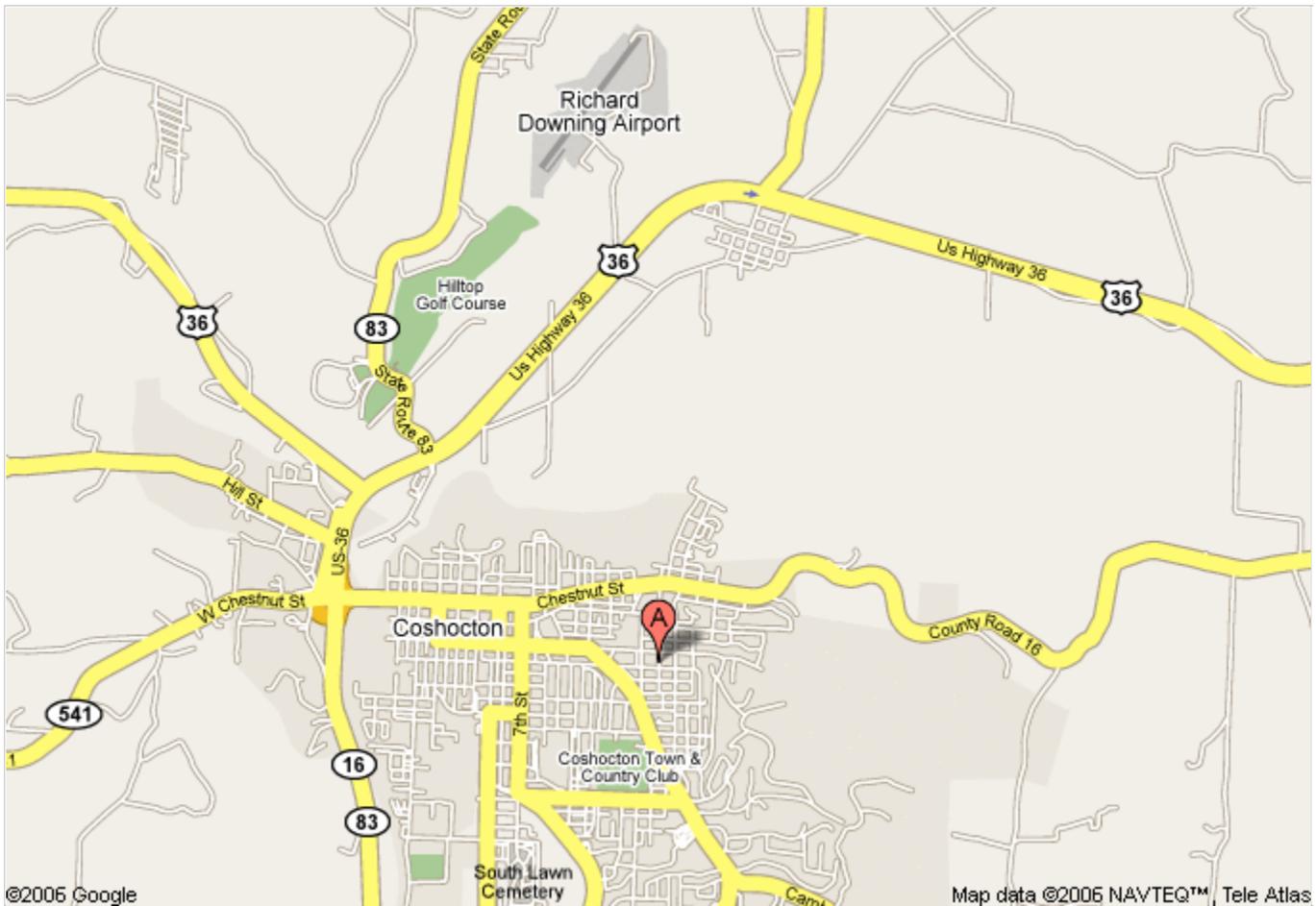
Ramp Name	River Mile	River Side	Latitude	Longitude	Type	Locked
Coshocton ramp	108.6	Left	40.24145809	-81.87259989	Public – free	No
AEP Conesville ramp	102.8	Left	40 10 47.6	-81 52 50.9	Private	Yes
Dresden – SR 208	92.0	Right	40.12065481	-81.99915907	Public – dirt	No
Ellis Dam Upstream	85.0	Right	40.04393473	-81.976632895	Public – dirt	No
Ellis Dam ramp	84.8	Right	40 02 34.3	-81 58 46.2	Public – free	No
Zanesville Waterworks Ramp (Riverside Park)	78.1	Left	39.961842625	-81.993837114	Public – free	No
Putnam Crossing Ramp	75.5	Right	39.93263488	-82.004437773	Public – free	No
Private Marina/Ramp	73.1	Right	39 53 56.1	-82 00 4.5	Public – Cost?	??
Sealover Lane Ramp	70.3	Right	39 52 21.3	-81 57 40.5	Private	Check w/ owner
Duncan Falls Ramp	67.0	Left	39 51 56.6	-81 54 3.2	Private	@ Salt Creek – check on access
Gaysport Ramp	62.8	Left	39 48 21.6	-81 53 31.6	Public - \$4	No
Private Ramp	62.5	Right	39 48 5.8	-81 53 42.2	Private	Check w/ owner
Private Ramp	54.3	Left	39 42 32.7	-81 52 59.5	Private	Check w/ owner
Malta Ramp	49.5	Right	39.64890428	-81.85984294	Public - free	No
McConnelsville Ramp	48.0	Left	39.634722	-81.837058384	Public – free	No
Hooksburg Ramp – Private	42.3	Right	39 34 41.7	-81 47 11.3	Public - \$2	??
Stockport Ramp	39.5	Left	39.54706728	-81.78829785	Public – free	No
Luke Chute Ramp	33.6	Right	39 32 15.6	-81 43 15.3	Public – free	No
AEP Beverly Ramp	28.8	Right	39 35 27.6	-81 41 9.2	Private	Yes
AEP Park Ramp	28.7	Left	39 35 33.1	-81 41 7.1	Private – Park	yes
Beverly Ramp	24.2	Left	39.54630931	-81.64214971	Public – free	No
Campground Ramp	15.3	Left	39 31 46.2	-81 32 15.2	Private	??
Lowell Access	13.6	Left	39.52716473	-81.50689502	Public - free	Yes – NEED PLANKS - sandy
Muskingum Twp. Ramp	8.1	Left	39.48941909	-81.48551724	Public – free	No – call Mr. Gray (740-374-9669)
Devola Dam Access	5.8	Left	39.47077412	-81.49140634	Public –free	No – dirt access upst. side of dam
Marietta Ramp	1.8	Left	39.43251224	-81.47076906	Public – free	No – open 6AM-11PM (call police)

Table 5. Muskingum River flow statistics at two USGS gaging stations.

Flow Gage	20%ile (cfs)	50%ile (cfs)	80%ile (cfs)
Coshocton	740 (Sept – Nov)	1200 (Sept – Nov)	2500 (Sept – Nov)
03140500	1100 (June – Aug)	1900 (June – Aug)	3900 (June – Aug)
McConnelsville	1000 (Sept – Nov)	1700 (Sept – Nov)	3700 (Sept – Nov)
03150000	1600 (June – Aug)	2900 (June – Aug)	6100 (June – Aug)

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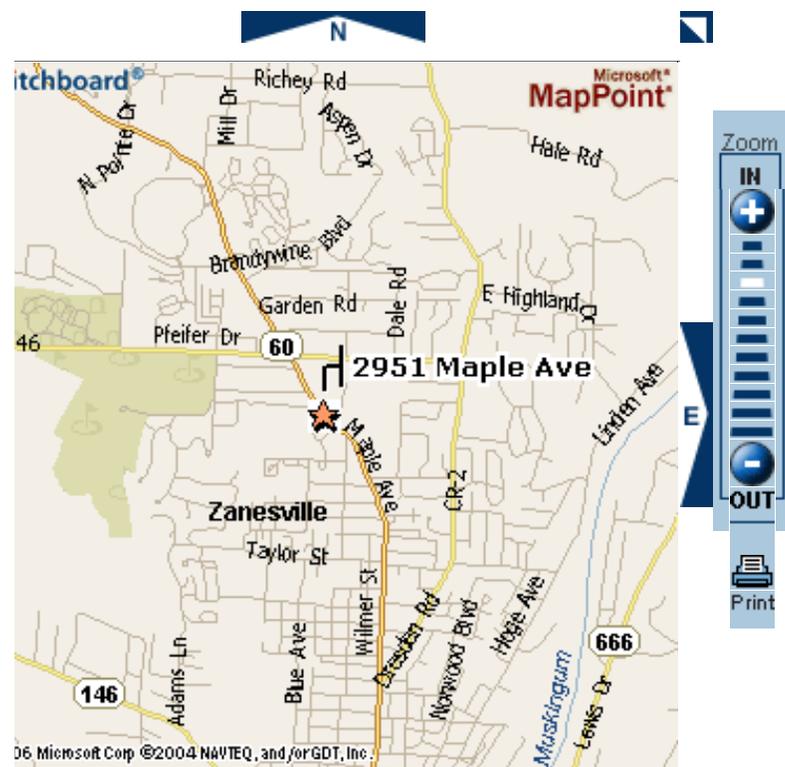
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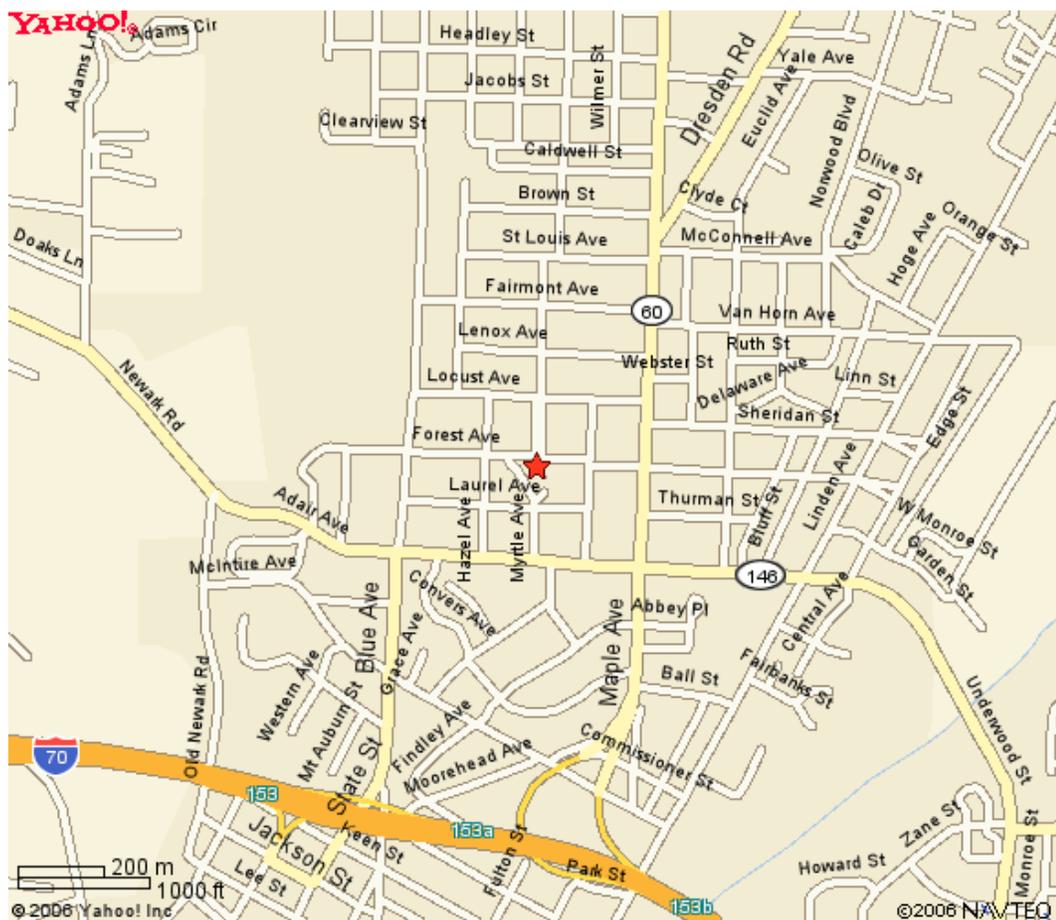
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