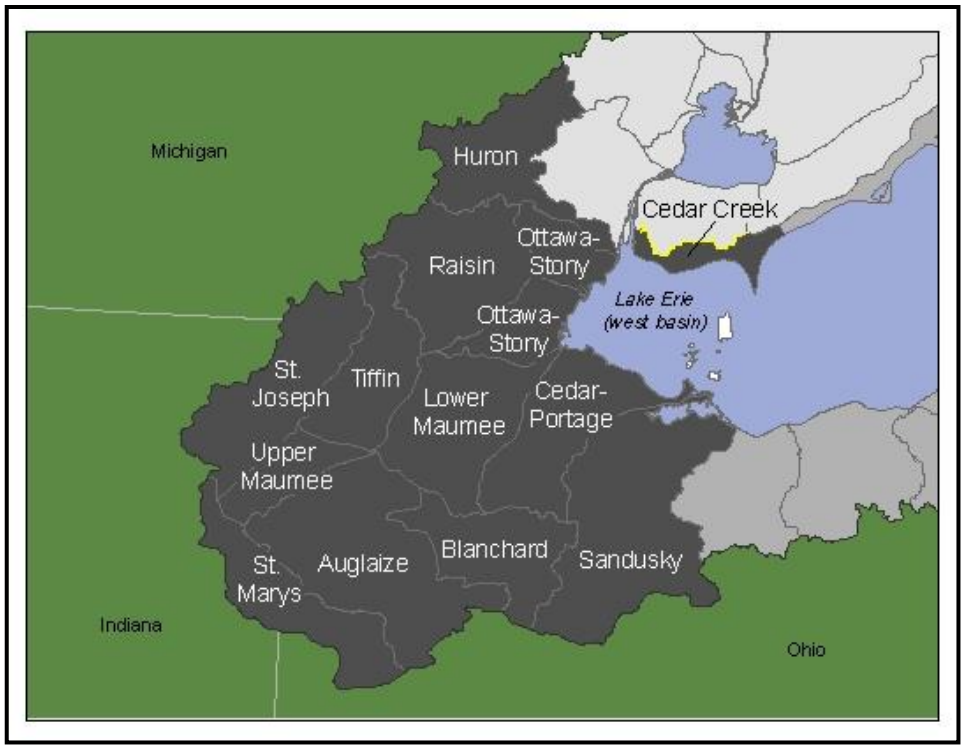
Enhanced Tributary Monitoring in the Western Lake Erie Basin



Division of Surface Water
July 1, 2015

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Ohio Environmental Protection Agency
Division of Surface Water

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Introduction

A significant reduction in phosphorus loading to the Western Basin of Lake Erie is being recommended to address an increase in harmful algae blooms over the last decade. The collection of water quality data from tributary streams is needed to measure if goals are being met. Data will be used to establish baseline conditions and determine effectiveness of management actions that are implemented. Initially data will be used simply to improve phosphorus monitoring in the basin, providing a better picture of where the largest phosphorus loads are coming from and how much reduction will be needed from various areas to protect the lake. To the extent that resources are available and project timing appropriate, the data could also be used for predictive modeling (e.g. modeling implementation scenarios for TMDLs using watershed models like the Soil Water Assessment Tool).

An enhanced level of monitoring is planned in five targeted watersheds identified by Ohio DNR; Blanchard (upper), Swan, South Turkeyfoot, Auglaize (lower) and Sandusky (lower). These watersheds are slated to receive funding to incentivize farmers to implement conservation practices. Enhanced monitoring stations will be located at the appropriate spatial scale necessary to track water quality improvements resulting from conservation actions.

Water Quality Sampling

Monthly Grab Samples

Monthly grab samples will be collected by Ohio EPA Northwest District Office water quality staff. Stations that will be sampled are listed in Table 1. Sampling during winter months will only be done if the stations are ice free and weather permits safe travel. An effort will be made to collect samples under a variety of streamflow conditions to support later data analysis efforts (e.g. load duration curves, flow-weighted mean concentration trend analysis). This will be done by keeping track of real time streamflow data for Ohio published by USGS on the World Wide Web at http://waterdata.usgs.gov/oh/nwis/rt. The web page categorizes streamflow from low to high using a color coded map. Monthly sampling at the enhanced stations will be initiated sometime in the spring of 2015 after flow gages are installed by USGS.

Stations will have chemical conditions measured in the field with YSI® Pro Series meters. The field data will be logged electronically and also recorded in writing on a lab sample submission form. The sample time will also be written on the lab form. A summary of the field measurements is listed in Table 2. Water samples submitted for lab analysis will be tested for the parameters listed in Table 3. Samples will be collected either by wading and directly filling the containers or by using a clean intermediate container such as a bucket lowered from a bridge.

Upon return to the office, the sample collector(s) will access the USGS streamflow web page and record gage height and discharge readings closest to the actual sample collection time on the sample submission form.

Runoff Event Sampling

OEPA will also use automatic samplers to collect samples during runoff or snowmelt events primarily during the spring to provide some understanding of the variability of nutrients during runoff events. The central office Modeling and Assessment staff will be responsible for these deployments, with assistance from NWDO staff as available.

When it is determined a storm is likely to result in increased stream flow, one or at most two crews will travel to the four sites chosen for runoff sampling. Those sites are the West Creek (P10K07), South Turkey Foot (302836), Flatrock (P06S35) and Little Flatrock (302837) sites. The plan of study, which will be mostly canned and ready to go, will be gathered and lab sheets and chain of custody printed from Cyberintern (system for prefilling lab sheets) if possible otherwise done by hand and crew(s) deployed.

Upon arriving at the site a pre-sample meter reading (temp., pH, D.O. conc. and conductivity) will be taken, then the samplers will be setup and iced and a determination will be made on the sampler start time and interval, i.e. wait X number of hours before turning on then running on X hour intervals. If it is unclear what interval should be used two samplers can be setup with different intervals (e.g. one sampler set to 1 hour intervals and the other to 2 hour intervals). Twenty four aliquots will be taken and the sample interval will determine how long the sampler will be deployed; i.e. if intervals are ½ hour the sampler will run for 12 hours (24 aliquots x 0.5 hrs = 12 hour deployment).

Samples will then be collected from the sampler depending on the sampler interval and composited according to the hydrograph breaks, first, upward, top and post flush for instance. Samples will be packed in ice, a post-sample meter reading will be taken, and crews will return to headquarters and deliver samples to lab based on previous communications with the lab.

Quality Assurance

All water quality sample collection and preservation methods will follow guidelines established in the *Surface Water Field Sampling Manual* (Ohio EPA, 2013b). Field QC requirements for duplicates and blanks are summarized in Table E-1 of the manual. An Excel Data Validation Tool will be used to determine if data needs to be rejected or qualified as estimated based on relative percent difference (RPD). Acceptable RPD is parameter specific and depends on the method reporting limit and how close the concentration is to that limit. A link to the manual is included in the reference section on Page 5.

The Division of Environmental Services laboratory does the initial data review on all data. The Division of Environmental Services laboratory may qualify data based on laboratory QA/QC alone or with feedback from the sampler (regarding specific sampling procedures, variable sampling matrix, conditions, blank contamination, duplicate agreement, matrix spike recovery, etc.). The Division of Environmental Services laboratory points out potential QA/QC issues but leaves much of the final data qualification to the sampler/data user (supposing that data may be useable for some purposes and not for others). The data user can evaluate the data given their knowledge of sampling conditions, expected variability given location and matrix, data uses, etc.

Data Management

Knowledge of DSW's Cyberintern and Ecological Assessment and Analysis Application (EA3) programs is needed to manage data. The station ID numbers that are assigned to each sampling location are created using EA3. Project names are also created in EA3 so stations can be grouped together to facilitate data assessment. Sampling trips are organized using the Cyberintern program. The sample collector selects the stations to be sampled to create a run. The software assigns an external ID number and bar code specific to each sample and prints the laboratory sample submission forms and container labels. Samples delivered to the DES are logged with a scanner that reads the external ID bar code printed on the label. The samples are then assigned a lab ID number used to track them through the system.

Field data will be collected with YSI® Pro Series units that have an internal file storage system. A site list based on station ID # is first created using YSI® Pro Series Data Manager V1.1.8 software installed on a desktop PC. The field meter is then connected to the PC via a USB port so the site list can be uploaded to the meter. Data is saved in the field by selecting the correct station from the menu. After sampling is completed the files are downloaded to the Data Manager software. They are then exported as an Excel file to the DSWs Water Quality Data Acquisition Manager and uploaded to the Ohio EPA SQL server database. Stream flow data is manually coded to the spreadsheet before it gets uploaded.

After water samples are analyzed and the results are approved by the lab QA Officer the data is loaded into the Laboratory Information Management System (LIMS). Individual lab sheets are also posted on a web based server accessible by the DSW. Once the lab data is available in LIMS it can be imported into EA3. Before the chemistry data is imported it's important to verify that field data has been uploaded since the system uses the external ID number tag to merge the two datasets. Once the sheets are imported the sample collector reviews them for accuracy, edits if necessary, validates field QC and approves the sheet. All data approved in EA3 will be sent to the U.S. EPA Water Quality Exchange.

Limitations on use of the data will be communicated to decision makers and data users via the final project report as well as through data qualifiers and explanatory comments attached to the stored data. Additionally, our records will maintain the original data as well as metadata regarding collection personnel, field notes, interpretation techniques, statistical evaluation, etc. This public information will be available to data users or any interested parties.

Quality Objectives & Criteria for Measurement Data

Nutrient concentration data will be used to determine 1) how much of the overall load to Lake Erie is being contributed by these smaller watersheds, and 2) if the nutrient loads are decreasing over time as best management practices are implemented in the focus areas. Simple trend charts and comparison charts (e.g. pie charts showing percentage of load from contributing areas) will be used initially. Ultimately, for flow weighted mean concentrations may be used for determining trends in nutrients. Load duration curves (LDCs) may also be used to characterize pollutant loadings and help determine where additional best management practices could be effective in reducing the nutrient loads from individual watersheds. Future modeling efforts for the Maumee basin could benefit from this data collection effort as well (SPARROW updates, SWAT modeling for TMDL implementation, etc.). While no specific commitments have been made at this time, the data quality is expected to be sufficient for those models as well as the load duration curves.

<u>Data Quality Objectives for load duration curves</u>
Load duration curves characterize pollutant loading under varying hydrologic conditions and sort pollutant loading into flow-related categories. As they are an empirical approach, the quality of a LDC output is a direct result of the quality of data that constitute the basis of a load duration curve: 1) in-stream chemistry sampling and 2) stream flow measurements. The quality of in-stream chemistry results rely upon analytical QA/QC protocols established by the Division of Environmental Services and field staff following Division of Surface Water's established sampling protocols. The flow data will be generated by the USGS gages installed at these sites, and will follow their rigorous protocols.

Special Training Requirements/Certifications

District and Modeling staff are trained in sampling consistent with procedures in the division Quality Management Plan (QMP) and the *Surface Water Field Sampling Manual* (Ohio EPA, 2013b). No special training requirements or certifications are necessary for this project.

Table 1. List of enhanced water quality stations located in the Western Lake Erie Basin study area.

Description	Location	USGS #	OEPA #	Hydrologic Unit	Area (mi^2)	N. Latitude	W. Longitude
Ai Creek near Swanton	State Route 2	04193994	P11W15	04100009-07-01	44.7	41˚34' 56.89"	-83˚51' 40.90"
Blue Creek near Whitehouse	Finzel Road	04193997	P11P13	04100009-08-02	44.6	41˚31' 37.88"	-83˚46' 51.17"
Wolf Creek near Toledo	Holland Sylvania	04193999	P11P18	04100009-08-03	24.8	41˚36' 34.71"	-83˚41' 2.24"
S. Turkeyfoot Creek near Shunk	Henry CR N	04192599	302836	04100009-01-06	116	41˚21' 22.52"	-84˚3' 1.43"
Bad Creek near Delta	County Rd 8-1	04192695	P11S09	04100009-03-02	35.0	41˚35’48”	-84˚01’23”
West Creek near Hamler	State Route 109	04192574	P10K07	04100009-01-01	15.5	41˚15' 42.93"	-84˚2' 11.89"
Flatrock Creek near Payne	State Route 613	04191100	P06S35	04100007-12-05	144	41˚05' 30.46"	-84˚41' 36.44"
Little Flatrock Creek near Junction	Emerald TR 139	04191444	302837	04100007-12-07	15.3	41˚11' 7.69"	-84˚29' 43.41"
The Outlet above Findlay	Biglick TR 251	04188399	302838	04100008-02-02	36.5	41˚02' 8.00"	-83˚31' 12.56"
Rock Creek near Republic	Seneca CR 43	04197152	U04G18	04100011-11-01	15.2	41˚06' 6.06"	-83˚03' 14.17"
Wolf Creek near Kansas	Liberty TR 103	04197277	302839	04100011-10-04	42.7	41˚12' 50.40"	-83˚17' 38.34"

Table 2. List of field measurements that will be recorded at enhanced water quality stations sampled by Ohio EPA.

Parameter	PCS#	RL	Units
Temperature	00010	0.01	C
Dissolved Oxygen	00300	0.01	mg/L
Dissolved Oxygen	00301	0.01	%
Conductivity	00094	0.01	µS/cm
Specific Conductance	00095	0.01	µS/cm
pH	00400	0.1	SU

Table 3. List of parameters that will be analyzed in enhanced water quality samples collected by Ohio EPA.

Parameter	PCS#	Method	RL	Units	Container	Preservative	Hold
Alkalinity, Total (as $CaCO_3$)	00410	USEPA 310.1	5	mg/L	1L LDPE	cool ≤6˚C	14d
Ammonia, Total (as N)	00610	USEPA 350.1	0.05	mg/L	1L LDPE	2 ml H_2SO_4 to pH<2, cool ≤6˚C	28d
Chloride, Total (as Cl)	00940	USEPA 325.1	5	mg/L	1L LDPE	cool ≤6˚C	28d
Chemical Oxygen Demand	00340	SM 5220 D	20	mg/L	1L LDPE	2 ml H_2SO_4 to pH<2, cool ≤6˚C	28d
Nitrite, Total (as N)	00615	USEPA 353.2	0.02	mg/L	1L LDPE	cool ≤6˚C	48 hr.
Nitrate-Nitrite, Total (as N)	00630	USEPA 350.1	0.5	mg/L	1L LDPE	2 ml H_2SO_4 to pH<2, cool ≤6˚C	28d
Kjeldahl, Total (as N)	00625	USEPA 351.2	0.2	mg/L	1L LDPE	2 ml H_2SO_4 to pH<2, cool ≤6˚C	28d
Solids, Total Dissolved	70300	SM 2540 C	10	mg/L	1L LDPE	cool ≤6˚C	7d
Solids, Total Suspended	00530	SM 2540 D	5	mg/L	1L LDPE	cool ≤6˚C	7d
Sulfate, Total (as SO_4)	00945	USEPA 375.2	10	mg/L	1L LDPE	cool ≤6˚C	28d
Phosphorus, Total (as P)	00665	USEPA 365.4	0.01	mg/L	1L LDPE	2 ml H_2SO_4 to pH<2, cool ≤6˚C	28d
Orthophosphate, Dissolved (as P)	00671	US EPA 365.1	0.01	mg/L	1L LDPE	filter, cool ≤6˚C	48 hr.

REFERENCES

Ohio EPA. 2009. DSW Field Data Uploading Application Instruction Manual. Division of Surface Water. Columbus, Ohio.

Ohio EPA. 2013. Surface Water Field Sampling Manual, Version 4.0. Division of Surface Water, Columbus, Ohio. http://epa.ohio.gov/Portals/35/documents/SW_SamplingManual.pdf