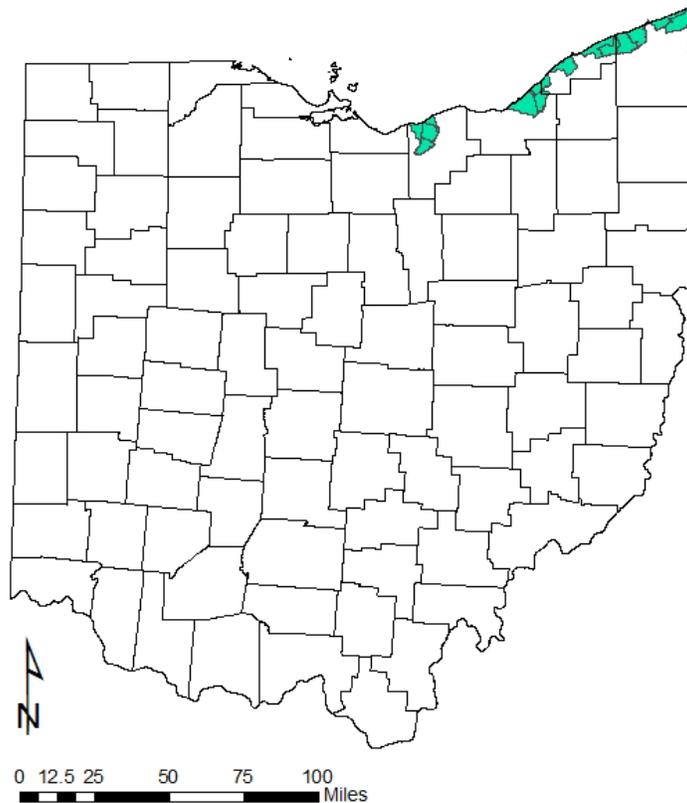


Biological and Water Quality Survey of the Lake Erie Central Basin Tributaries Lorain, Cuyahoga, Lake, and Ashtabula Counties, Ohio



Division of Surface Water
June 11, 2015

Study Plan for the
2015 Biological and Water Quality Survey
of the Lake Erie Central Basin Tributaries

Lorain, Cuyahoga, Lake, and Ashtabula Counties, Ohio

June 11, 2015

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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 2015 field sampling season within the Lake Erie Central Basin Tributaries. The study area is composed **15** HUC 12 watershed assessment units (Figures 1-4 and Table 1). A total of **65** sampling stations are allocated to this effort and will provide for the assessment of **40** named stream (Table 2). If sampling resources are available, eight sites located on an additional eight undesignated small streams will be evaluated for the appropriate aquatic life use designation. 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, continuous temperature, and fish tissue will be evaluated at selected sampling locations.

Sampling Objectives

- 1) Systematically sample and assess the principal drainage network of the select Lake Erie Central Basin 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]),
- 6) Collect fish samples for the Ohio Sport Fish Consumption Advisory Program (used to assess chemical contaminant levels in fish) from four locations on Conneaut Creek at river miles (RM) 23.24, 12.27, 6.69, and 2.56,
- 7) Evaluate pre-construction conditions for planned 319 and GLRI funded projects on Doan Brook, Euclid Creek, and an unnamed tributary to Euclid Creek (at RM 8.1). Post-construction sampling for previously funded 319 projects will occur on East Branch Euclid Creek and Doan Brook, and
- 8) If sampling resources are available, eight sites located on an additional eight undesignated small streams will be evaluated for the appropriate aquatic life use designation. Biological sampling will occur at all sites and continuous temperature will be collected at five of the eight sites.

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

Aquatic Life Use (ALU) designations have been verified or otherwise affirmed for eight of the 40 named streams in this study area. The remaining 32 waterbodies are classified as either unverified (identified in the WQS, but have not been subjected to a use attainability analysis) or not listed (absent from the WQS). 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.

NPDES Permits

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 map of the permitted facilities is shown in Figures 5-8 and a list is presented in Table 3. A map of the Northeast Ohio Regional Sewer District (NEORS) combined sewer overflows (CSO) within their service area, including Doan Brook and Euclid Creek watersheds, is shown in Figure 9.

Nutrients

In support of the ongoing process of nutrient criteria development and to provide more objective and robust characterization of the sources and effects of nutrient loads in the Lake Erie Central Basin Tributaries, select stations will be sampled.

Sampling Effort

Geo-Referenced Site Labels

The sites listed in the study plan table are coded with EA3 Station IDs that link data across several tables. They must be included on all field, lab and sample sheets and reported with all data results. If for some reason a location other than the one listed in the study plan is sampled, and that location is a trivial distance away from the one listed in the table and is fully representative of the EA3 Station, use the river mile listed in the study plan, and simply record the location information separately. An exact river mile can be assigned later to an Absolute Location Point (ALP) if warranted. If the location is not representative of the site listed on the study plan due to distance or a confounding factor, it should probably not be sampled, but if it is, it should be separated as a new station. It is also imperative that, if a new station is sampled, the study plan coordinator be notified so that this information can be distributed to all the study team.

Field and Laboratory Load

Summarized field and laboratory load (stations, number of samples, and parameters for analysis, etc.) can be found in Tables 2 and 4. All scheduled locations and necessary stipulations are provided in Table 4.

Water Quality

Water column chemistry samples will be collected from **57** ambient stations within the study area. Water column grab samples and standard field parameters will be collected/measured six times from all locations. The collection of water samples for bacteriological analysis is scheduled for **42** stations at least five times during the recreational season (Table 4).

Datasonde[®] deployment is requested for **29** locations, **six** sentinel and **16** nutrient monitoring sites. 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 Datasondes[®].

Nutrients

The DSW modeling staff will collect chlorophyll-a samples from benthic substrate scrapings and sestonic water samples (concurrently with the Datasondes[®]) at **16** locations in the Lake Erie Central Basin Tributaries study area (Table 4). At the same time water column samples in support of nutrient monitoring and assessment efforts will be collected from these locations and will be analyzed for the modeler's suite of parameters (including BOD₅).

Sediment Sampling

One set of sediment samples will be collected at sites indicated in the table of sampling locations (Table 4) using procedures outlined in Ohio EPA (2015a Appendix III). Fine grained multi-incremental sediment samples will be collected in the upper four inches of bottom material using either clean stainless steel scoops or dredges. Samples will be homogenized and split into 500 ml amber glass jars with Teflon lined lids for organic compound testing and 250 ml HPDE containers for metals testing. They will then be secured inside coolers with wet ice and delivered to the Ohio EPA Division of Environmental Services for analysis. Pollutants to be tested and their analytical methods are listed in the table of chemical/physical parameters (Table 5).

Data will primarily be used as a resource to help determine causes and sources of aquatic life impairment. More detailed follow up studies may be recommended in some instances. To determine the potential for sediment contaminants to exert adverse effects the data will first be compared to Ohio sediment reference values and consensus based sediment quality guidelines. This constitutes a Tier I assessment as described in *Guidance on Evaluating Sediment Contaminant Results* (Ohio EPA, 2010). No further assessment is needed if the sediment passes the screening. If not, it's considered above levels of concern and further evaluation is needed using the Tier II process. This process estimates bioavailability using total organic carbon to normalize pollutant concentrations.

Benthic Macroinvertebrate Assessment

The condition of the macrobenthos will be evaluated at **59** locations and if resources are available, eight sites located on an additional **eight** undesignated small streams will be evaluated for the appropriate aquatic life use designation. Artificial substrate samples (quantitative) will be collected by MEG staff at **20** stations within the study area. Qualitative benthic macroinvertebrate samples (natural substrates) will be collected at **39** locations and at the eight undesignated small streams. Locations of benthic macroinvertebrate sampling stations are listed in Table 2.

Fish Community Assessment

The condition of the fish assemblages within the study area will be evaluated at **59** locations and if resources are available, **eight** sites located on an additional eight undesignated small streams will be evaluated for the appropriate aquatic life use designation. Multiple pass fish community samples will be collected at **20** sites by OEPA FEG staff. Single pass fish community samples will be collected at **39** stations and at the eight undesignated small streams. Single pass evaluations are limited to headwaters, barring reference sites or significant permit issues. The locations of all fish sampling stations are listed in Table 2.

Sentinel Sites

To aid in the development of a TMDL models(s), sentinel sites have been established at **six** designated locations. At each sentinel site, samples are collected monthly beginning prior to the routine field season that typically begins on June 15th to test for routine water chemistry parameters, pesticides (methods 525.2, 531.1, and 547) and stream stage is measured to the nearest 100th 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 10th to 90th 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 2.

QUALITY ASSURANCE

Ohio EPA Manuals

All biological, chemical, data processing, and data analysis methods and procedures adhere to those specified in the Surface Water Field Sampling Manual for water column chemistry, bacteria and flows (Ohio EPA 2015a), Biological Criteria for the Protection of Aquatic Life, Volumes II - III (Ohio EPA 1987, 1989a, 2015b), 2015 Updates to the Biological Criteria for the Protection of Aquatic Life, Volume II (Ohio EPA 2015c), The Qualitative Habitat Evaluation Index (QHEI); Rationale, Methods, and Application (Ohio EPA 1989b, 2006) for habitat assessment, Surface Water Field Sampling Manual – Appendix III for sediment sampling (Ohio EPA 2015a), and Ohio EPA Fish Tissue Collection Guidance Manual (Ohio EPA 2012) for fish tissue sampling.

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 (Ohio EPA 1989b). 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 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 five 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, and 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 Ohio EPA (2015b).

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°C) and shipped to the Ohio EPA lab. Sampling and decontamination protocols will follow those listed in Ohio EPA (2015a Appendix III).

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 Ohio EPA (2015a) 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

Five percent of the water 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 Ohio EPA (2015a). Matrix spike duplicates will be collected for organic water samples at a minimum of 5 percent.

CONTACTS**Study Team:**

Study Plan Coordinator:	Sarah Macy, EAS	(614) 836-8813
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Resource:		
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	Greg Orr, NEDO	(330) 963-1189
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Other Contacts:		
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Lorain County – Randy White (330) 245-3032		Lorain – (440) 329-3709
Cuyahoga County – Ryan Donnelly (330) 245-3033		Cuyahoga – (216) 443-6066
Lake County - Marino Pelligrini (330) 245-3034		Lake – (440) 350-5500
Ashtabula County – Jason Warren (330) 245-3036		Ashtabula (440) 576-0055
Hospitals:		
Lorain County:		
Mercy Allen Hospital 200 West Lorain St. Oberlin, OH 44074 (440) 775-1211		EMH Elyria Medical Center 630 East River St. Elyria, OH 44035 (440) 329-7500
Cuyahoga County:		
University Hospitals 11100 Euclid Ave. Cleveland, OH 44106	Metro Health System 2500 MetroHelth Dr. Cleveland, OH 44109	St. Vincent Charity Medical Hospital 2351 E 22 nd St. Cleveland, OH 44115
Lake County:		
Lake Hospital System 7956 Tyler Blvd. Mentor, OH 44060		Lake Health Tripoint Med Center 6270 N Ridge Rd Madison, OH 44057
Ashtabula County:		
UH Conneaut Medical Center 158 W Main St Conneaut, OH 44030		UH Geneva Medical Center 870 W Main St Geneva, OH 44041

Other Contacts continued:	
Watershed Contacts:	
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Marsh, Arcola, McKinley Creek Watershed Coordinator Maurine Orndorff (440) 350-5863 morndorff@lakecountyohio.gov	Conneaut Creek Scenic Rivers Watershed Coordinator Matthew Smith (330) 298-9195 matthew.smith@dnr.state.oh.us
Turkey Creek, McKinley Creek, Conneaut Creek Conserved Land Brett Rodstrum Western Reserve Land Conservancy brodstrom@wrlandconservancy.org (440) 867-6659	

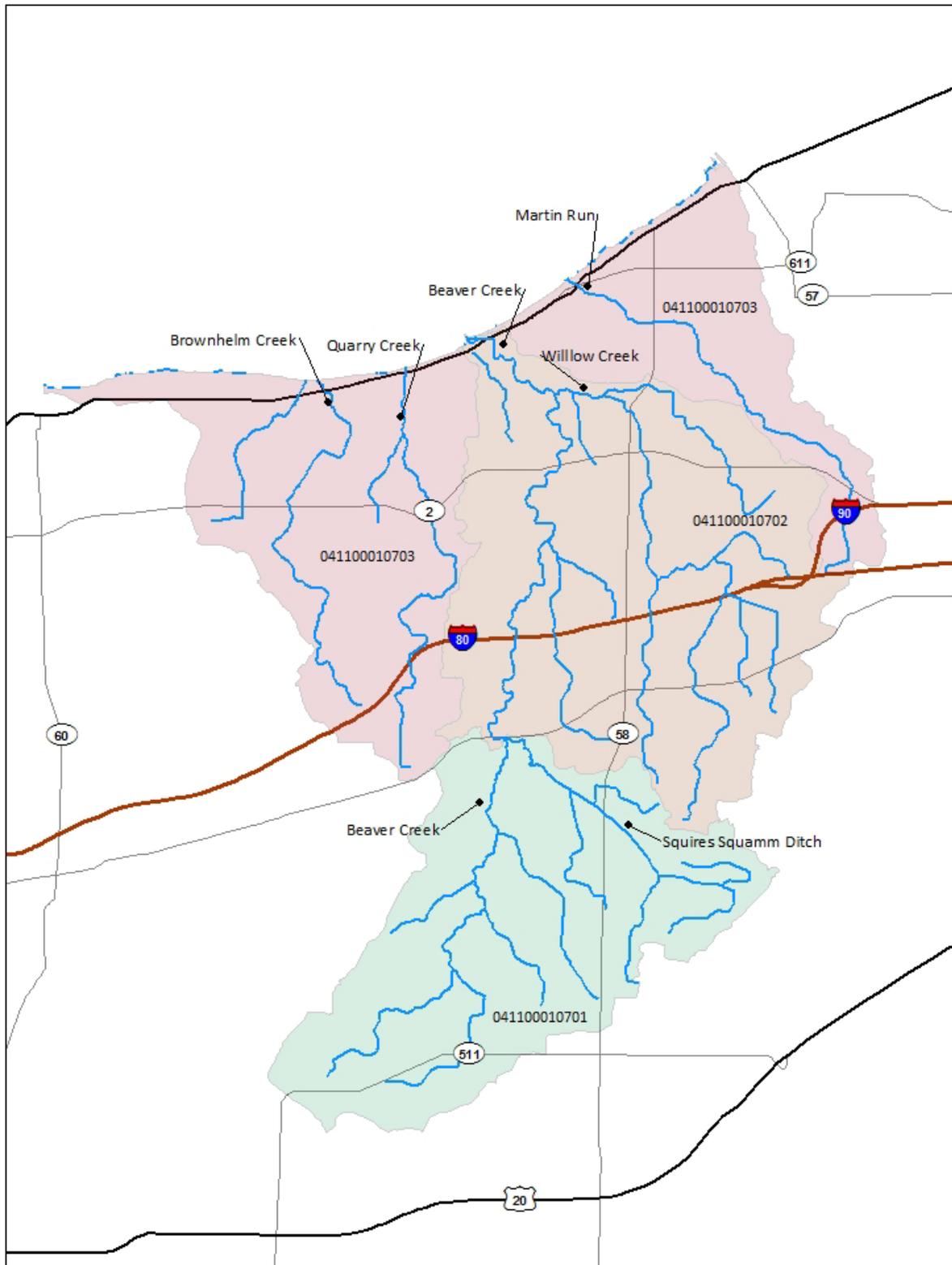


Figure 1. HUC 12 assessment units for the Beaver Creek subbasin of the 2015 Lake Erie Central Basin Tributaries survey.

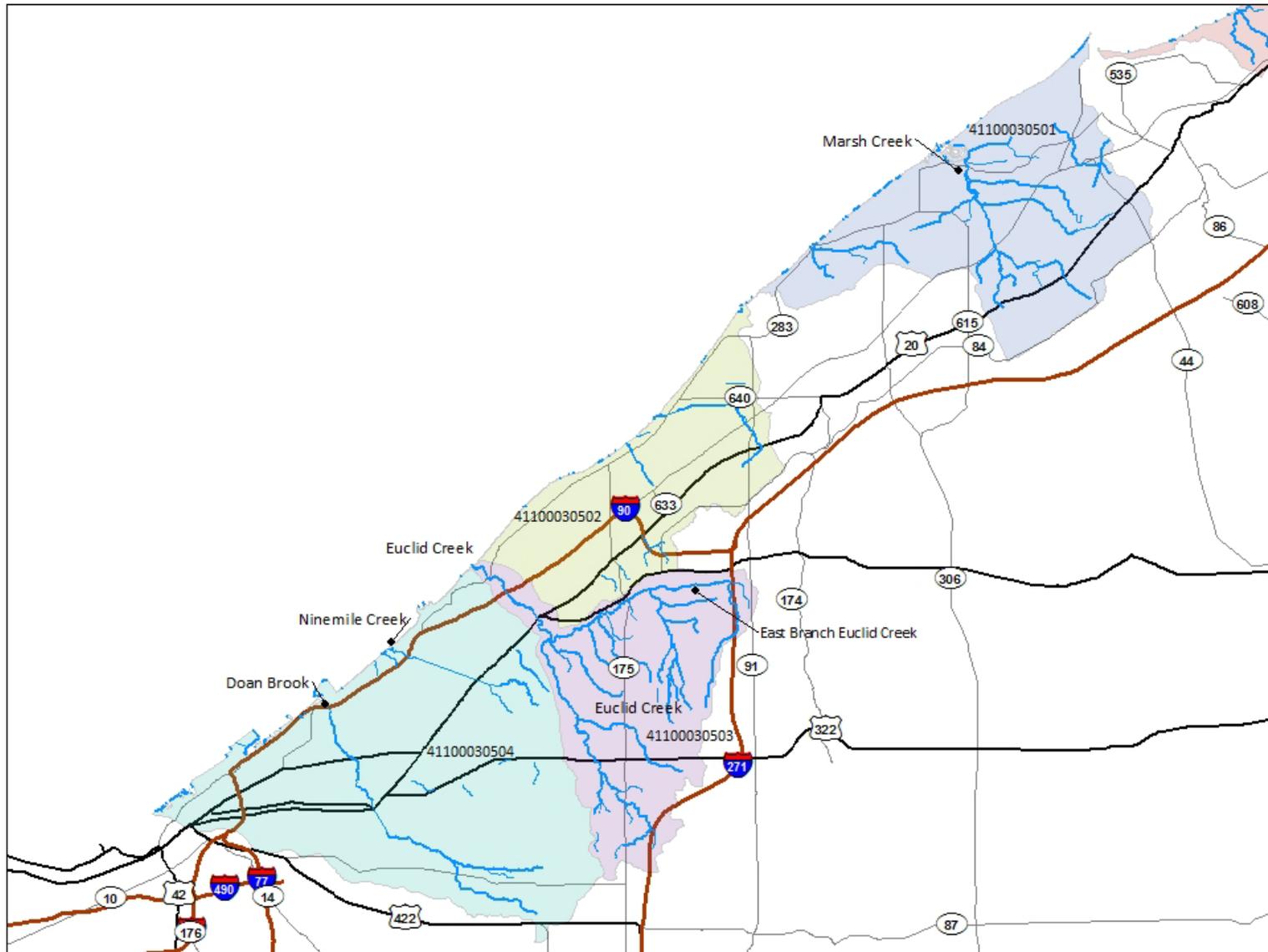


Figure 2. HUC 12 assessment units for the Euclid Creek subbasin of the 2015 Lake Erie Central Basin Tributaries survey.

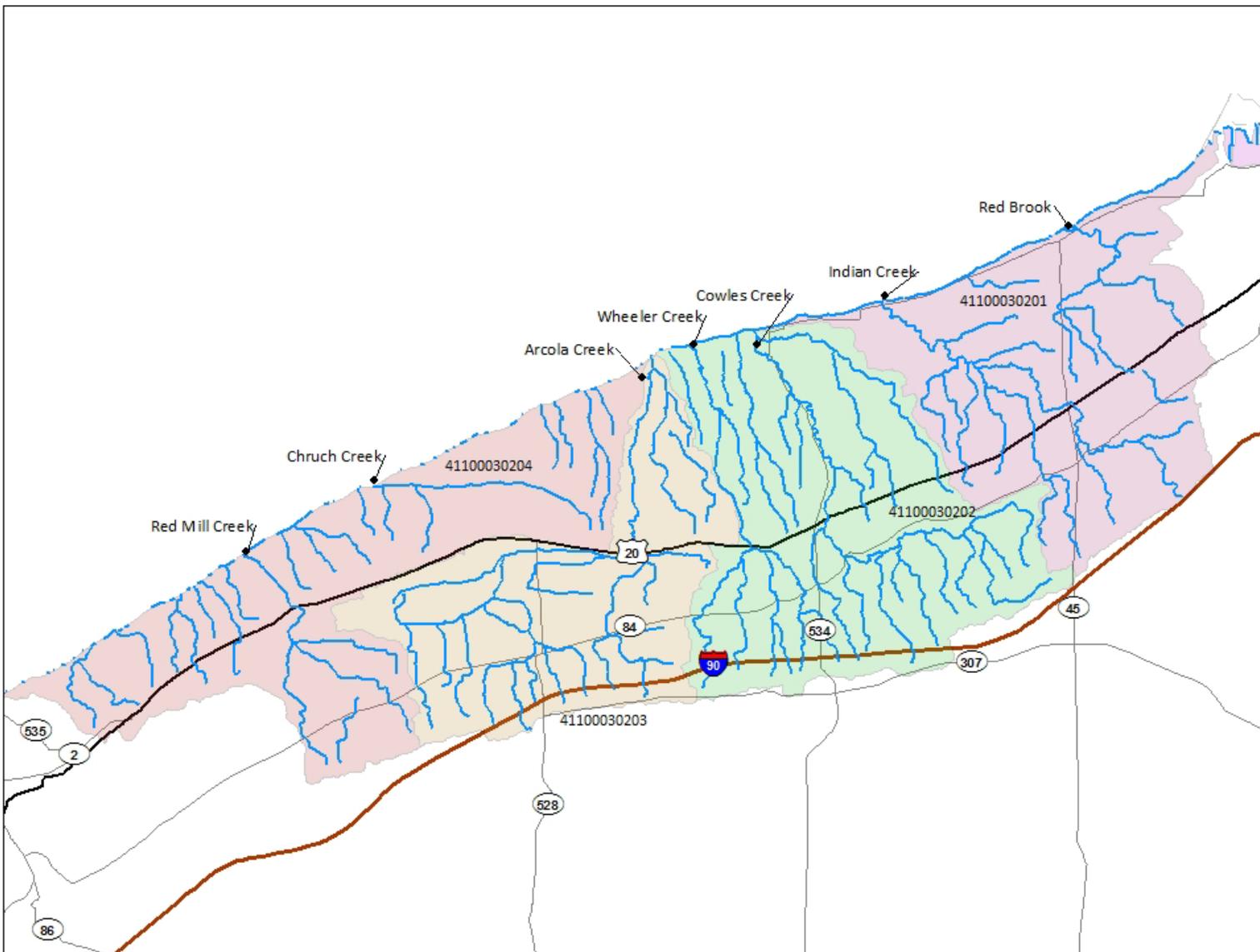


Figure 3. HUC 12 assessment units for the Arcola Creek subbasin of the 2015 Lake Erie Central Basin Tributaries survey.

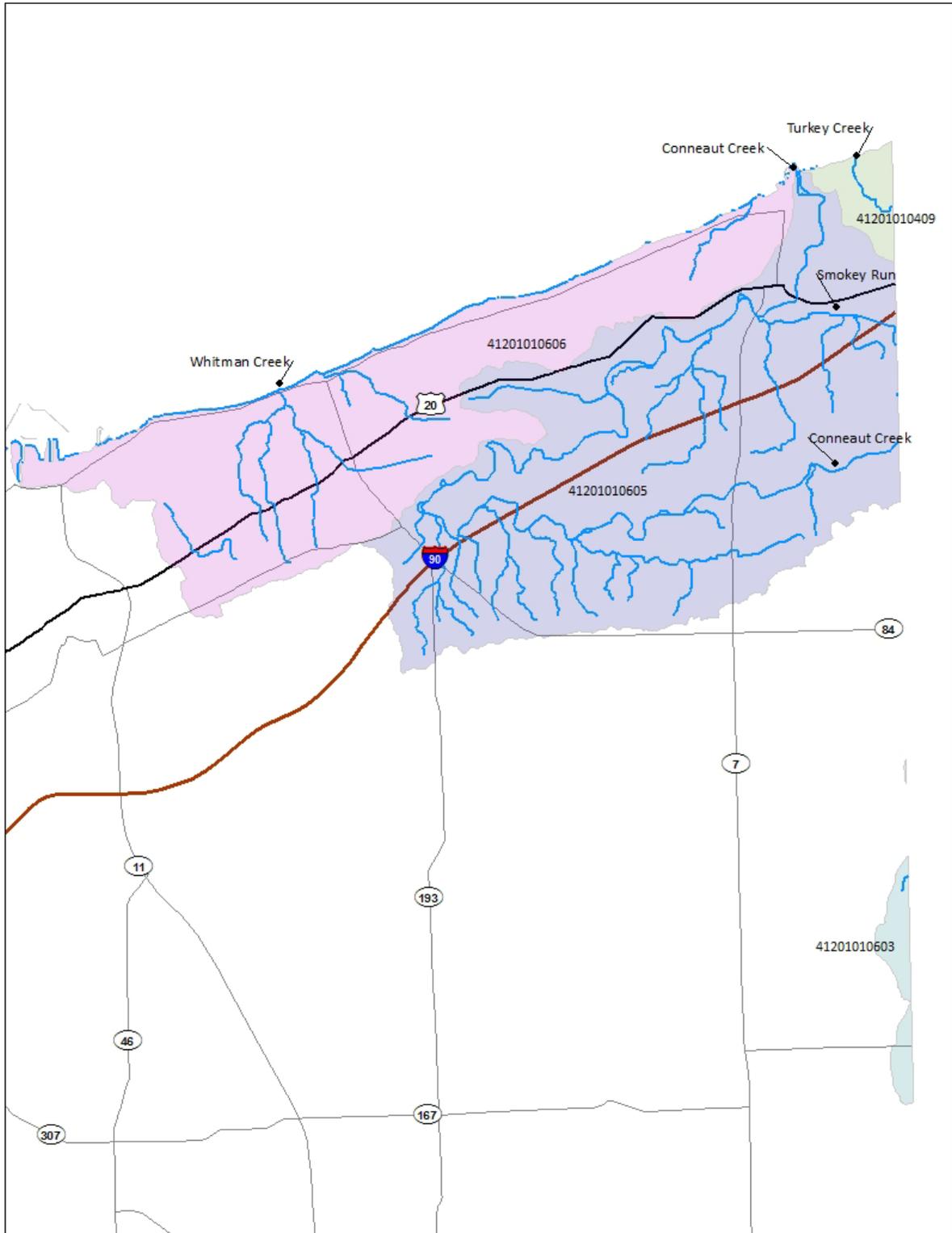


Figure 4. HUC 12 assessment units for the Conneaut Creek subbasin of the 2015 Lake Erie Central Basin Tributaries survey.

Table 1. Waterbodies and allocated biological sampling effort for each assessment unit (HUC 12)

HUC 12	Sites	Comments	Waterbodies
041100010701	5		Beaver Creek, Squires Squamm Ditch
041100010702	4		Beaver Creek, Willow Creek
041100010703	4		Brownhelm Creek, Martin Run, Quarry Creek
041100030501	2		Marsh Creek
041100030502	0	No streams of significant size to warrant sampling in this HUC 12	
041100030503	9		Euclid Creek, E. Br. Euclid Creek
041100030504	6		Ninemile Creek, Doan Brook
041100030201	5		Red Brook, Indian Creek
041100030202	5		Cowles Creek, Wheeler Creek
041100030203	7		Arcola Creek
041100030204	2		Church Creek, Red Mill Creek
041201010603	0	Majority of HUC 12 in PA; no OH streams of significant size to warrant sampling	
041201010605	8		Conneaut Creek, Smokey Run
041201010606	1		Whitman Creek
041201010409	1		Turkey Creek

Table 2. Lake Erie Central Basin Tributaries sampling stations, 2015. Sites highlighted in light green are sites selected for pre- and post-construction monitoring for 319 and GLRI funded projects. Sites highlighted in light orange are small streams that will be evaluated for an appropriate aquatic life use if resources are available.

HUC12	Station	Station Name	RM	DA	Lat	Long	Sampling
Squires Squamm Ditch (20-003-002)							
41100010701	303266	at Annis Road	1.3	5.47	41.34968	-82.23022	B, C, F, Mq
Beaver Creek (20-003-000)							
41100010701	303263	Quarry Road	13.75	6.3	41.31481	-82.25782	B, C, F, Mq, Sd
41100010701	Y01S26	Russia Road	11.02	11.5	41.33830	-82.24440	B, C, D, F, Mq, N
41100010702	Y01S25	S of Amherst @ Middle Ridge Rd.	6.95	23	41.38110	-82.24030	C, D, F2, MQ, N
41100010701	303265	New upst Amherst WWTP site; access via WWTP	4	26.7	41.40721	-82.23330	B, C, D, F2, MQ, N
41100010701	303264	New dst Amherst WWTP site; access via WWTP	3.8	26.7	41.40969	-82.23110	B, C, D, F2, MQ, N
41100010702	Y01S23	N of Amherst @ Cooper Forest Park Rd.	2.9	28	41.41690	-82.22580	C, D, F2, MQ, N
41100010702	Y01S22	dst. Amherst, dst. Willow Creek @ Longbrook Rd. (Yorktown Rd.)	1.75	43.0	41.42610	-82.23310	B, C, D, F, Mq, Sd, Sn
Willow Creek (Beaver RM 2.0) (20-005-000)							
41100010702	303267	SR 58	1.25	10.7	41.42246	-82.20877	B, C, F, Mq, Sd
Brownhelm Creek (20-100-000)							
41100010703	303268	adjacent Baumhart Road	0.9	5.2	41.41965	-82.28294	B, C, D, F, Mq, Sd
Quarry Creek (20-101-000)							
41100010703	303271	via FirstEnergy's access road	0.25	5.1	41.42809	-82.26841	B, C, D, F, Mq, Sd
Martin Run (20-004-000)							
41100010703	303269	at Towers Road	2.35	2.34	41.43255	-82.19004	B, C, F, Mq
41100010703	303270	at Meister Road	0.9	5.3	41.44167	-82.20971	B, C, D, F, Mq
Doan Brk (19-039-000)							
41100030504	F01G52	at Shaker Heights, Dst Lee Rd	6.64	1.3	41.48400	-81.56560	B, C, F, Mq, Sd
41100030504	301696	At Shaker Heights @ Coventry Rd.	5.5	4.4	41.49096	-81.58421	F, Mq
41100030504	200137	at Cleveland @ Wade Park	2.7	7.7	41.50920	-81.61360	B, C, F, Mq, Sd
41100030504	303287	Within 319 project area; adjacent Martin Luther King Jr. Dr.	2.27	8.12	41.51720	-81.61899	F, Mq
41100030504	301428	at Cleveland @ St. Clair Ave.	0.75	9.1	41.53300	-81.62960	B, C, D, F, Mq, N, Sd
S. Br. Doan Brook (19-039-001)							
41100030504	301429	at Shaker Heights @ Attleboro Rd	1.31	3.4	41.47506	-81.59758	B, C, Sd
Ninemile Creek (19-040-001)							
41100030504	301432	at Cleveland @ Lake Shore Blvd	0.34	11.8	41.55770	-81.60039	B, C, D, F, Mq, Sd
Euclid Creek (19-041-000)							
41100030503	303284	Upstream project area and Cedar Road	9.2	1.3	41.500504	-81.48774	F, Mq

HUC12	Station	Station Name	RM	DA	Lat	Long	Sampling
Euclid Creek (19-041-000) continued							
41100030503	303285	Within project area dst Cedar Road at Acacia Reservation	8.9	1.5	41.502234	-81.49138	F, Mq
41100030503	303286	Conservation easement; downstream project area	8.7	1.5	41.504549	-81.49365	F, Mq
41100030503	F01G47	dst. Mayfield Golf Course @ Mayfield Rd	7.1	3.4	41.51980	-81.51150	B, C, Sd
41100030503	F01G48	at Euclid Park Blvd.; upst E. Br. Euclid Creek	3.3	8.8	41.56120	-81.53160	C, D, F, Mq, N, Sd
41100030503	F01A47	upst. Lake Shore Blvd.	0.66	23.0	41.58190	-81.55890	B, C, D, F2, MQ, N, Sd, Sn
Trib. to Euclid Creek (5.49) (19-041-003)							
41100030503	302508	at Lyndhurst @ Richmond Rd	1.35	1.2	41.53200	-81.49700	B, C, Sd
Trib. to Euclid Creek (8.1) (19-041-004)							
41100030503	303299	Via drive to subdivision pool off Golfway Ln	0.5	0.15	41.510346	-81.49091	F, Mq
41100030503	303298	Within Mayfield Sand Ridge Golf Club	0.15	0.3	41.509567	-81.49996	F, Mq
East Branch Euclid Creek (19-041-001)							
41100030503	303283	at SR 175/US 6	2.75	7.0	41.57428	-81.49479	B, C, F, Mq, Sd
41100030503	301678	Near mouth, upst. old dam (free-flowing)	0.2	12.5	41.56040	-81.52985	B, C, D, F, Mq, N, Sd
Marsh Creek (03-026-000)							
41100030501	303281	Hendricks Road	1.5	5.6	41.70493	-81.33220	C, D, F, Mq
41100030501	303282	at SR 283	0.2	14.18	41.72002	-81.33904	B, C, F, Mq, Sd
Red Mill Creek (07-024-000)							
41100030204	303280	at US 20	1.7	6.3	41.78537	-81.13575	B, C, D, F, Mq
Church Creek (07-022-000)							
41100030204	303278	at McMackin Road	0.65	4.0	41.81788	-81.09479	B, C, F, Mq, Sd
Arcola Creek (07-011-000)							
41100030203	A01K18	at Madison @ Middle Ridge Rd.	7.4	7.8	41.78860	-81.06390	B, C, D, F2, MQ, N, Sd
41100030203	A01W22	Dst. Madison WWTP	7.05	7.9	41.79360	-81.06060	B, C, D, F2, MQ, N
41100030203	A01W24	US 20 behind Madison Industrial Park	5.1	11.1	41.79884	-81.02957	C, F2, MQ
41100030203	A01W25	NE OF North Madison @ Cunningham Rd.	2.02	19.8	41.82542	-81.01433	B, C, D, F2, MQ, N, Sd, Sn
41100030203	A01K17	Near mouth, dst. Lake Rd. (Cashen Rd.)	0.7	20.3	41.84310	-81.00670	C, D, F2, MQ, N, Sd
Trib. to Arcola (0.22) (07-011-002)							
41100030203	303277	at County Line Road	0.2	3.3	41.84651	-81.00224	B, C, CT, F, Mq
Trib. to Arcola (4.32) (07-011-003)							
41100030203	303278	adjacent US 20	0.1	4.94	41.79781	-81.01303	C, F, Mq
Wheeler Creek (07-006-000)							
41100030202	303276	at Center Road	2.75	6.77	41.82593	-80.98279	B, C, F, Mq, Sd

HUC12	Station	Station Name	RM	DA	Lat	Long	Sampling
Cowles Creek (07-007-000)							
41100030202	502700	Upst. Geneva @ Barnum Rd.	7.24	6.8	41.79810	-80.92310	B, C, D, F2, MQ, Sd
41100030202	502710	at Geneva @ North Ave.	4.83	11.2	41.81220	-80.94310	B, C, D, F2, MQ, N
41100030202	502720	Dst. Geneva @ Maple Ave.	3.56	12.5	41.82580	-80.94440	B, C, D, F2, MQ, N
41100030202	A01P17	upst. Geneva-on-the-Lake at SR 534	0.9	14.2	41.85030	-80.96220	B, C, F2, MQ, Sd, Sn
Trib. to Cowles (0.2) (07-007-001)							
41100030201	303274	access from Geneva On-Lake Municipal Golf Course	0.9	5.6	41.85713	-80.95231	C, F, Mq
Indian Creek (07-008-000)							
41100030201	303272	at Ninevah Road	3.65	5.12	41.84772	-80.88654	B, C, D, F, Mq
41100030201	303108	at North Bend Rd. (Rt. 24)	1.65	14.2	41.85434	-80.90681	Sn
41100030201	303107	at Myers Road	0.65	15.3	41.86130	-80.91656	B, C, D, F, Mq, Sd
Trib. to Indian (3.53) (07-008-001)							
41100030201	303275	at Ninevah Road	0.15	4.5	41.84546	-80.88672	C, F, Mq
Red Brook (07-009-000)							
41100030201	303273	at Wade Road	2.3	7.9	41.87404	-80.83997	B, C, D, F, Mq, Sd
Whitman Creek (07-012-000)							
41201010606	303297	at Middle Rd.	1.2	1.6	41.90894	-80.70581	F, Mq, CT
41201010606	A01P15	W of Kingsville-on-the-Lake @ SR 531	0.06	8.5	41.92138	-80.71299	B, C, F, Mq, Sd
Trib. to Whitman Creek (0.32) (07-012-001)							
41201010606	A01P14	at LaBounty Rd	1.24	1.7	41.91180	-80.72537	C, Sd
Trib. to Lake Erie (1124.54) (07-025-000)							
41201010606	303296	at SR 531	0.3	1.8	41.92553	-80.69446	F, Mq, CT
Trib. to Lake Erie (1117.00) (07-026-000)							
41201010606	303295	at SR 531 (Lake Rd.)	0.2	1.9	41.96099	-80.56521	F, Mq
Conneaut Creek (07-100-000)							
41201010605	502900	Near Ohio/PA Border @ Furnace Rd.	23.24	151.0	41.90390	-80.52940	B, C, FT, F2, MQ, Sd
41201010605	A01P09	at State Rd. (Turnpike Rd.)	17.2	158.0	41.88640	-80.62080	C, F2, MQ
41201010605	502890	near Kingsville at Ridge Road	13.2	169.0	41.89253	-80.66787	B, C, D, F2, MQ
41201010605	303288	@ Big D Campground	12.27	171.0	41.90190	-80.65282	C, FT, F2, MQ
41201010605	502870	Near Conneaut @ Keefus Rd.	6.69	175.0	41.92710	-80.60430	B, C, D, F2, FT, MQ, N, Sd, Sn
41201010605	A01P07	at Conneaut at Main Street	2.56	187.0	41.94358	-80.55053	B, C, FT, F2, MQ
Trib. to Conneaut (4.67) (07-100-004)							
41201010605	303292	Daniels Ave.	0.7	2.8	41.92680	-80.58340	F, Mq, CT

HUC12	Station	Station Name	RM	DA	Lat	Long	Sampling
Trib. to Conneaut (7.39) (07-100-005)							
41201010605	303293	adjacent Creek Road	0.1	1.7	41.91893	-80.61157	F, Mq, CT
Trib. to Conneaut (13.61) (07-100-006)							
41201010605	303290	at Mill Rd. (Kingsbury Rd.)	0.2	1.35	41.88955	-80.66385	F, Mq
Trib. to Conneaut (14.82) (07-100-007)							
41201010605	303291	at Fox Rd.	0.85	1.0	41.88490	-80.64218	F, Mq, CT
Trib. to Conneaut (17.1) (07-100-003)							
41201010605	303289	at State Road	0.3	3.6	41.88360	-80.61868	C, CT, F, Mq
Smokey Run (07-100-001)							
41201010605	A01P05	S of Conneaut @ Welton Rd	0.2	6.0	41.93593	-80.56051	B, C, CT, D, F, Mq
Trib. to Smokey (0.31) (07-100-008)							
41201010605	303294	at Dorman Rd.	0.55	3.3	41.93595	-80.54902	F, Mq, CT
Turkey Creek (07-200-000)							
41201010409	A01P03	at State Line Road	1.37	7.8	41.96163	-80.51948	C, F, Mq

B- bacteria sampling

D- DataSonde continuous monitors

F2- two pass fish sampling

N- nutrient sampling

C- water chemistry sampling

FT- fish tissue sampling

Mq- macroinvertebrate qualitative sampling only

Sd- sediment sample

CT- HOBO w temperature sampling

F- single pass fish sampling

MQ- macroinvertebrate quantitative sampling

Sn- sentinel site

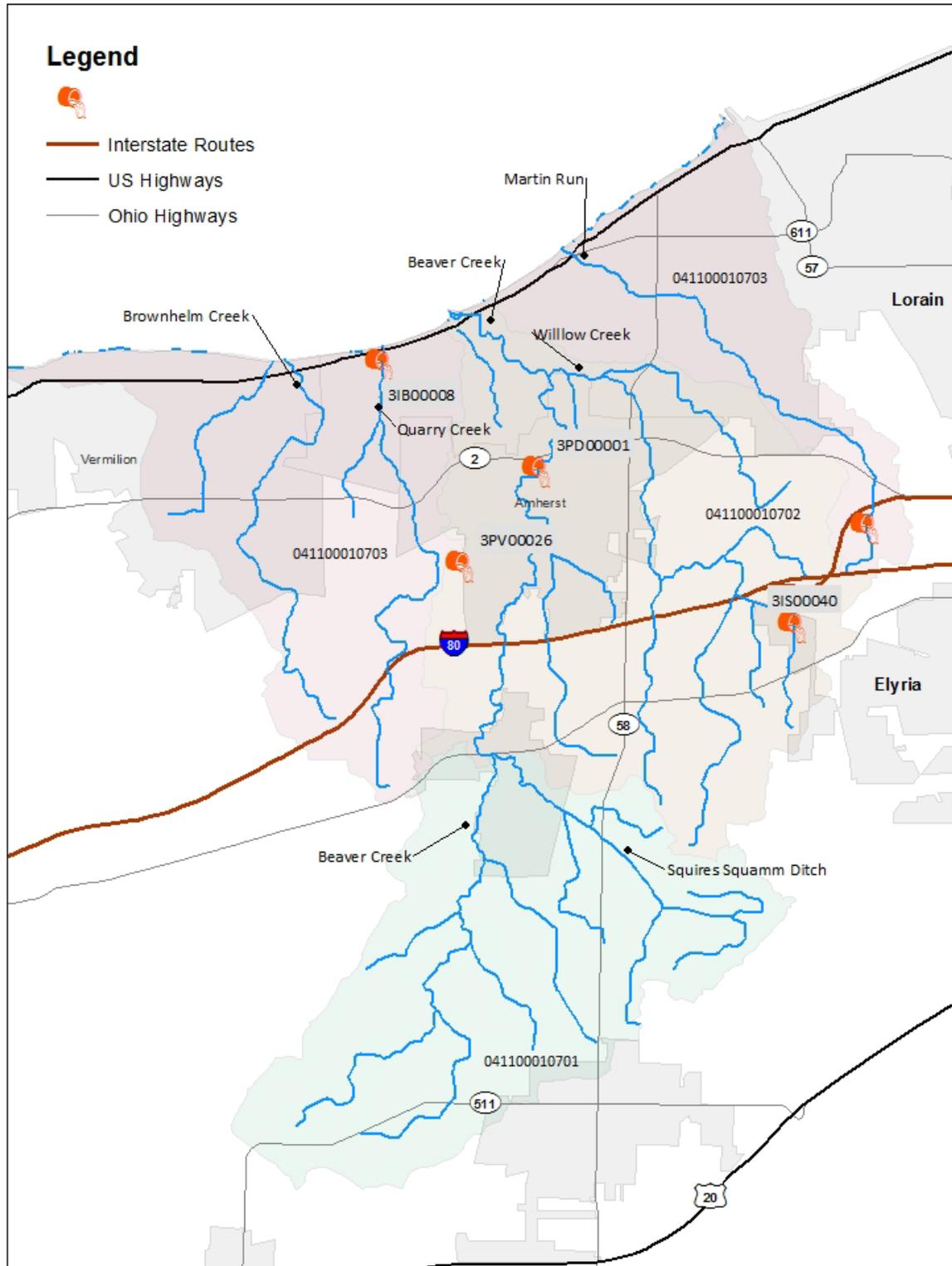


Figure 5. Location of NPDES permitted dischargers in the Beaver Creek subbasin of the 2015 Lake Erie Central Basin Tributaries survey.

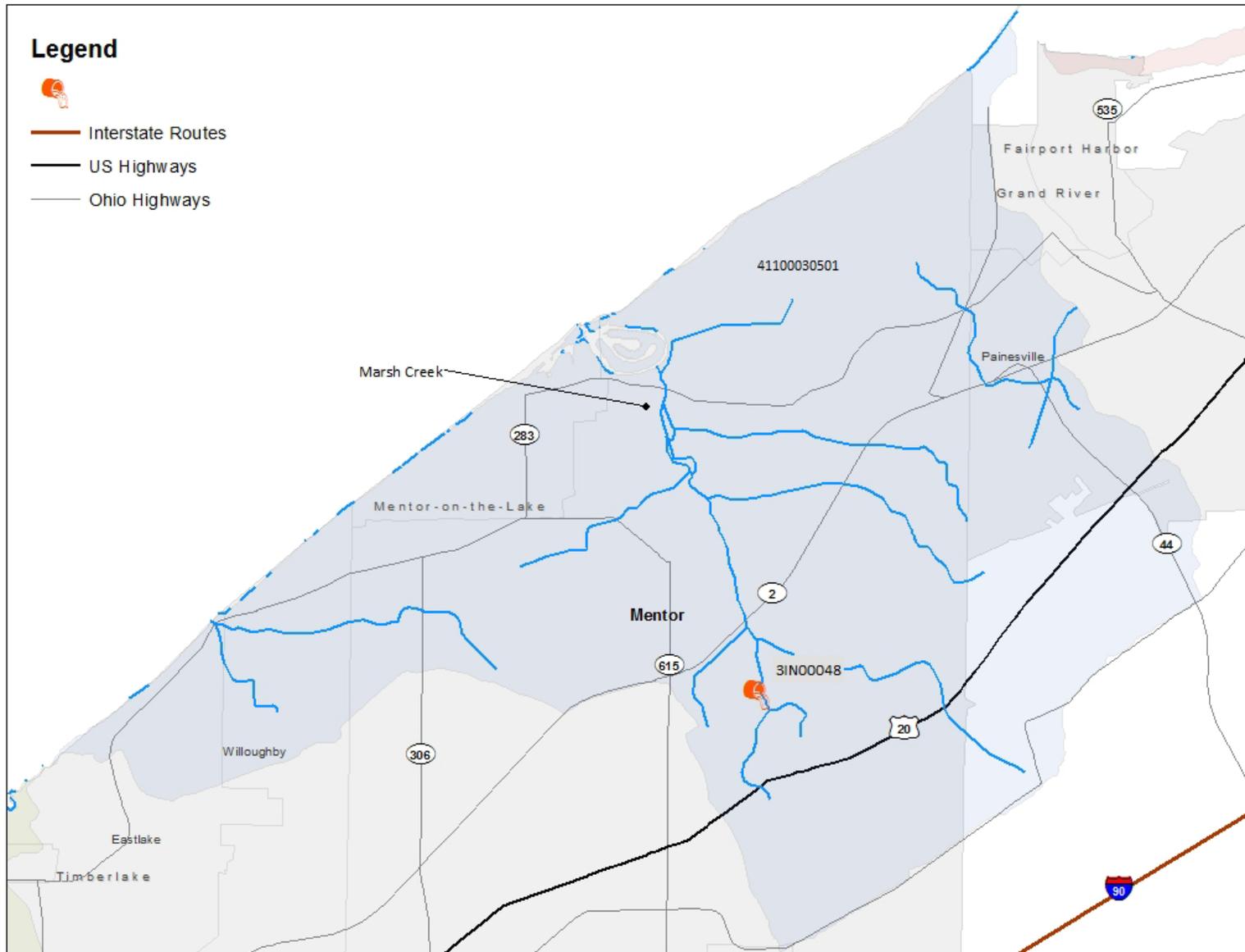


Figure 6. Location of NPDES permitted dischargers in the Marsh Creek subbasin of the 2015 Lake Erie Central Basin Tributaries survey.

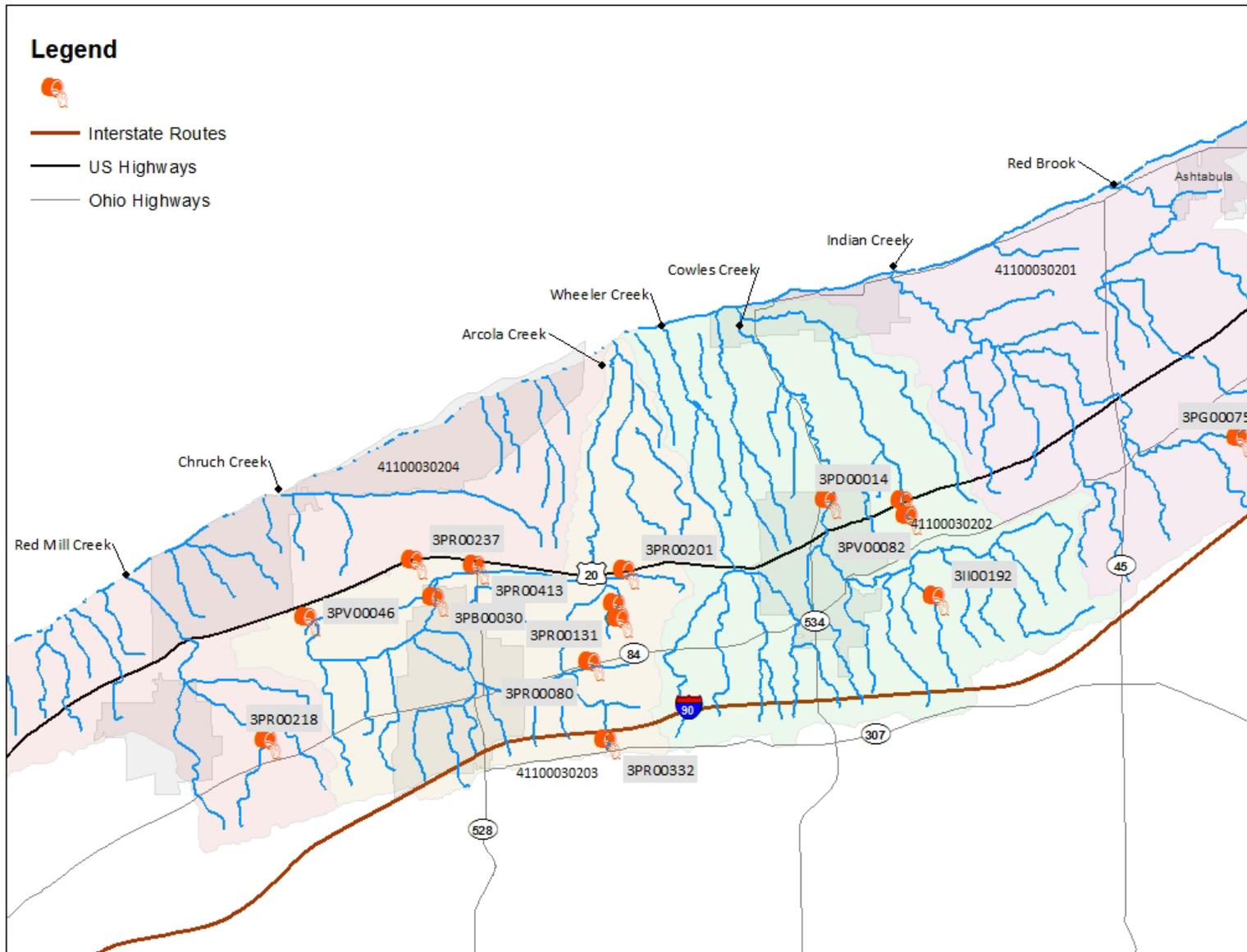


Figure 7. Location of NPDES permitted dischargers in the Arcola Creek subbasin of the 2015 Lake Erie Central Basin Tributaries survey.

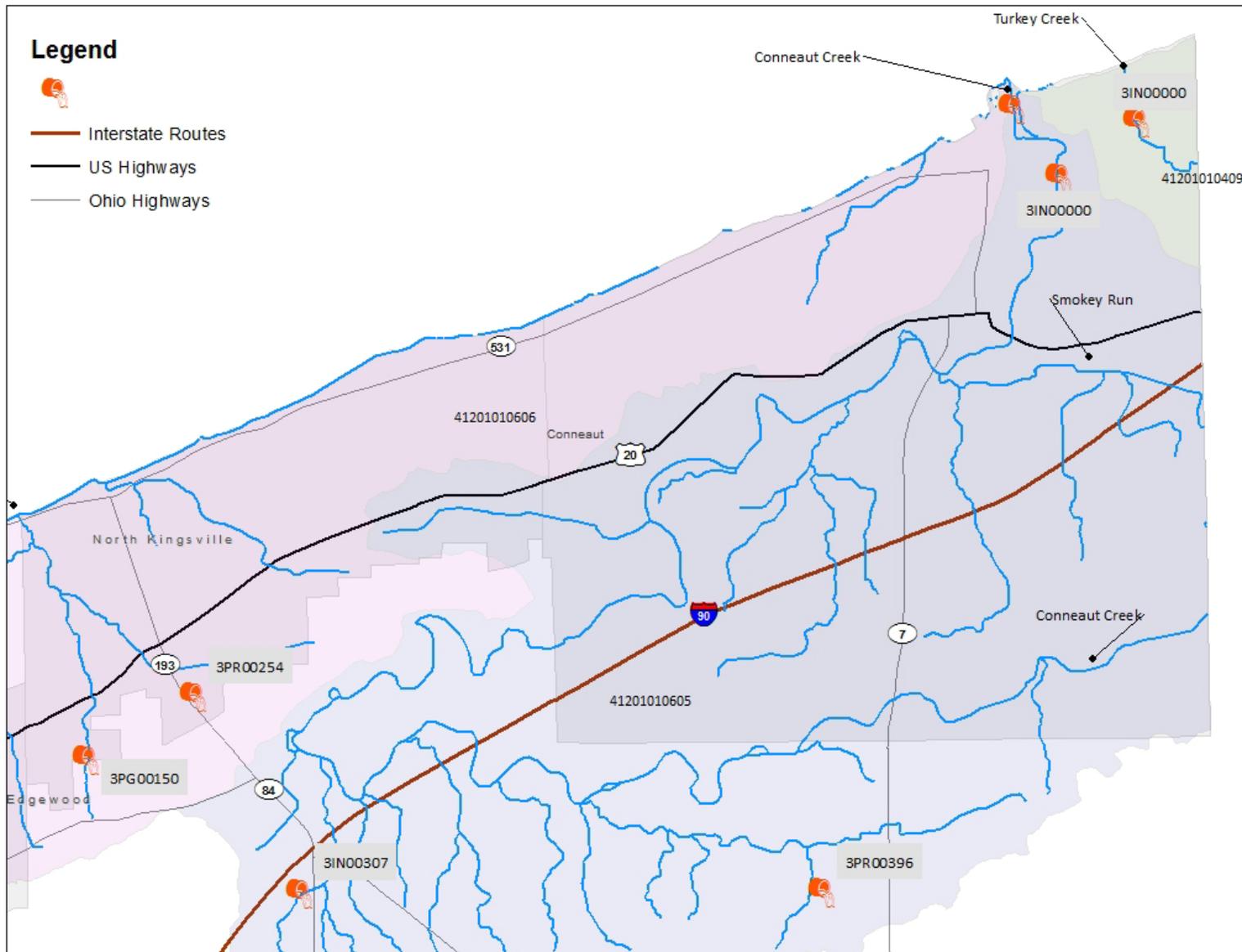


Figure 8. Location of NPDES permitted dischargers in the Conneaut Creek subbasin of the 2015 Lake Erie Central Basin Tributaries survey.

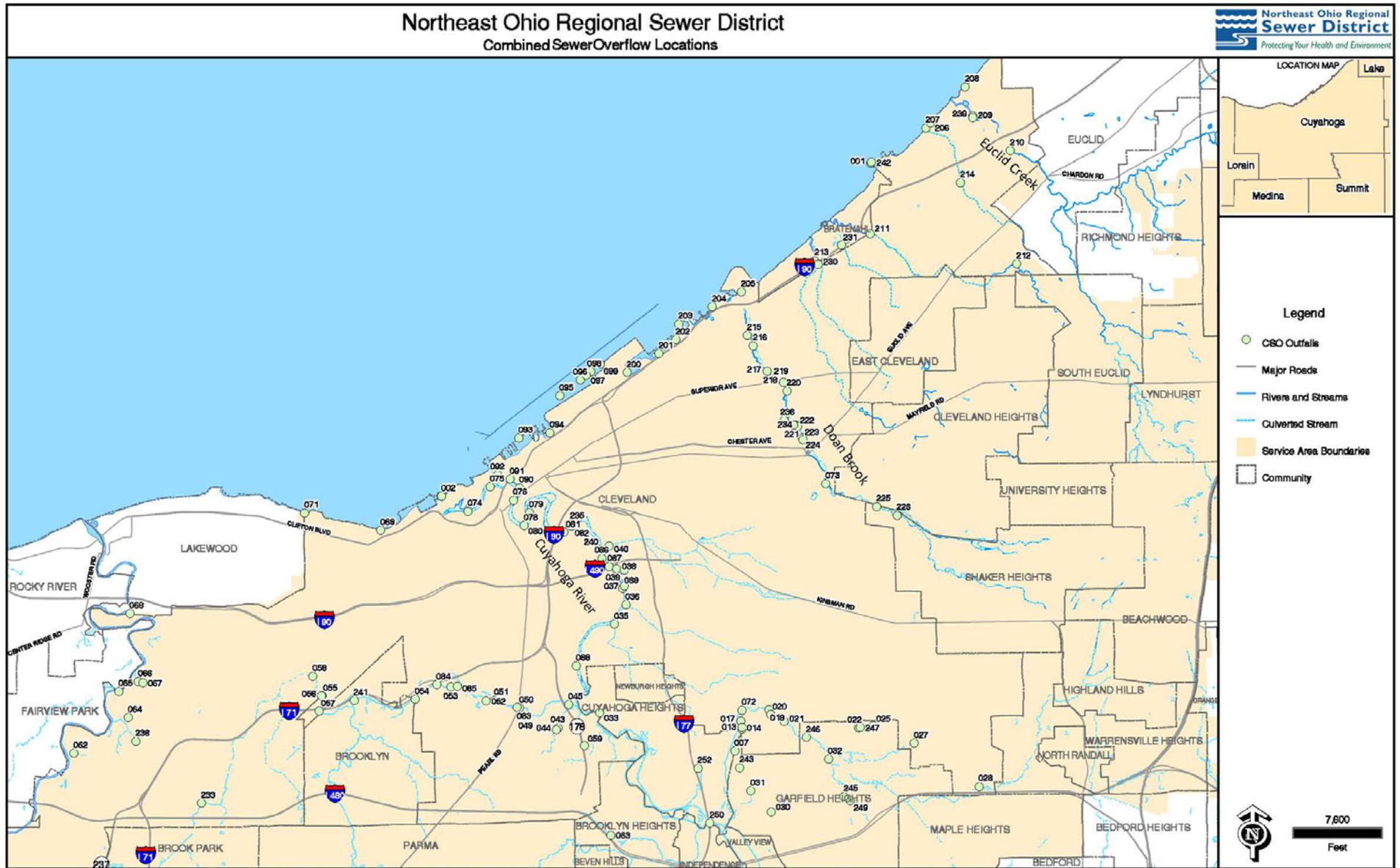


Figure 9. Location of CSOs within the NEORS D survey area.

Table 3. Facilities regulated by an Individual NPDES permit in the Lake Erie Central Basin Tributaries study area.

HUC 12 Assessment Unit/ Facility Name	Ohio EPA Permit No.	USEPA Permit No.	Stream	RM	Type	Class	Expiration
041100010703							
First Energy LLC	3IB00008FD	OH0032808	Quarry Creek	0.28	I	Minor	5/31/2016
Cresthaven Homes WWTP	3PG00051HD	OH0026131	Martin Run	6.0	P	Minor	7/31/2018
041100010702							
Amherst WPC	3PD00001KD	OH0021628	Beaver Creek	3.85	P	Major	1/31/2015
Westwood MHP	3PV00026GD	OH0045128	Beaver Creek	6.1	P	Minor	8/31/2015
Nelson Stud Welding	3IS00040GD	OH0021610	Battenhouse Ditch	1.0	I	Minor	5/31/2017
041100030501							
OsAIR Inc.	3IN00048FD	OH0083674	UT to Marsh Cr	3.0	I	Minor	12/30/2015
041100030204							
New Avenues to Independence	3PR00218CD	OH0128236	Red Mill Creek	2.59	P	Minor	12/31/2015
041100030203							
Village of Madison WWTP	3PB00030ND	OH0023515	UT to Arcola Creek	0.6	P	Minor	6/29/2017
Madison Health Care, INC.	3PR00080ED	OH0084158	UT to Arcola Creek	0.4	P	Minor	9/30/2015
Broadfield Care Center	3PR00131DD	OH0098124	UT to Arcola Creek	0.5	P	Minor	11/30/2015
The Pub	3PR00201CD	OH0126021	UT to Arcola Creek	0.6	P	Minor	9/30/2015
Dean's Restaurant	3PR00237CD	OH0128759	UT to Arcola Creek	7.0	P	Minor	9/30/2015
Stewart Lodge Nursing Home	3PR00332CD	OH0133132	UT to Arcola Creek	0.8	P	Minor	2/28/2018
Living Opportunities Nursing	3PR00374CD	OH0134635	UT to Arcola Creek	1.1	P	Minor	8/30/2019
De Rubertis Party Center	3PR00413BD	OH0137073	Arcola Creek	6.1	P	Minor	12/31/2015
Sahara MHP	3PV00046ED	OH0098159	UT to Arcola Creek	8.9	P	Minor	2/19/2019
041100030201							
Meadowood WWTP	3PG00075FD	OH0043800	UT to Indian Creek	9.76	P	Minor	1/31/2016
041100030202							
Geneva Landfill	3II00192DD	OH0129739	UT to Cowles Cr	0.9	I	Minor	2/28/2017
Rustic Cove MHP	3PV00082DD	OH0122106	UT to Cowles Cr	5.5	P	Minor	10/31/2017
Geneva MHP	3PV00117BD	OH0134317	UT to Cowles Cr	5.24	P	Minor	3/31/2016
Geneva WWTP	3PD00014RD	OH0020109	Cowles Creek	4.74	P	Major	7/31/2017
041201010606							
Ashcraft WWTP	3PG00150ED	OH0117552	Whitman's Creek	2.5	P	Minor	12/31/2015
N. Kingsville Shopping Center	3PR00254CD	OH0129101	UT to Whitman's Cr	0.3	P	Minor	2/29/2016
041201010605							
Pittsburgh Dock Co.	3IN00000HD	OH0000175	Conneaut Creek	1.2	I	Major	5/30/2016
Kingsville TA	3IN00307DD	OH0125971	UT to Conneaut Cr	0.4	I	Minor	10/30/2018
Conneaut Church of God	3PR00396BD	OH0136824	UT to Conneaut Cr	0.34	P	Minor	8/30/2016

Table 4. Ohio EPA laboratory and field sampling load for the 2015 Lake Erie Central Basin 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)	31	57	3-5	360/1160
Pathogen (<i>E. coli</i>)	–	42	5	210
Chlorophyll-a (benthic and sestonic)	1	16	1	16/32
Water Column Organics				
BNA	Full Scan ¹	12	1	12/-
Pesticides	Full Scan ²	12	1	12/-
PCBs	Full Scan ³	12	1	12/-
Glyphosate ^A	-	12	1	-
Datasonde®	–	29	1	29
Sediment	–	30	1	-/-
Sediment Inorganics*	Full Scan	30	1	30/-
Sediment Organics**	Full Scan	30	1	30/-
Sediment Particle Size	-	30	1	30/-
Continuous Temperature	-	8	-	-/-
Fish Tissue				
Metals, including Hg	5	4	1	4/20
PCPs, pesticides, % lipids	–	4	1	4/-
Fish Stations (total)	–	59	1-2	79/-
2x	–	20	2	40/-
1x	–	39	1	39/-
Macrobenthos (total)	–	59	–	–
Quantitative (Hester Dendy)	–	20	–	–
Qualitative (Natural Substrates)	–	39	–	–
Second Tier	–	8	–	
1x fish	–	8	1	8
Qualitative macrobenthos	–	8	–	–

1- BNA Method 625, Wastewater Analysis

2- Pesticide Method 608, Wastewater Analysis and Atrazine ELISA Method

3- PCBs Method 608, Wastewater Analysis

A - Glyphosate Method 547, Drinking Water Analysis

*Particle Size, % Solids, TOC, Ammonia, Total P, ICP3, ICPMS2

**BNA 8270. Pesticides 8081, PCBs 8082 – SW846 Analysis

Table 5. List of chemical/physical water quality parameters to be analyzed/ measured in surface water, sediment, Lake and fish tissue from the Lake Erie Central Basin Tributaries study area, 2015. Water samples will be collected from streams 6 times (organics once), sediment once, and fish tissue once. Bacteria samples will be collected 5 times during the recreational use period.

Parameters	Test Method	Water (RL)	Sediment (RL)	Lake	Fish Tissue
Alkalinity	USEPA 310.1	X (5 mg/l)		X	
Carbonaceous BOD, 20-day	OEPA 310.2	X (3 mg/l)			
Turbidity	OEPA 180.1			X	
Solids, Dissolved (TDS)	SM 2540C	X (10 mg/l)		X	
Solids, Suspended (TSS)	SM 2540D	X (5 mg/l)		X	
Solids, Volatile Suspended	SM 2540 D/E			X	
Organic Carbon	SM 5310 B			X	
Carbonate/Bicarbonate	SM 2320 B			X	
Ammonia-N	USEPA 350.1	X (0.05 mg/l)		X	
Total Kjeldahl Nitrogen (TKN)	USEPA 351.2	X (0.2 mg/l)		X	
Nitrate-Nitrite	USEPA 350.1	X (0.5 mg/l)		X	
Nitrite	USEPA 353.2	X (0.02 mg/l)		X	
Chloride	USEPA 325.1	X (5 mg/l)		X	
Chemical Oxygen Demand (COD)	USEPA 410.4	X (20 mg/l)			
Sulfate	USEPA 375.2	X (10 mg/l)		X	
Total Phosphorus	USEPA 365.4	X (0.01 mg/l)	X (50 mg/kg)	X	
Orthophosphate (as P)	USEPA 365.1	X (0.01 mg/l)		X	
ICP 1 (Al,Ba,Ca,Fe, Mg, Mn, Na, K, Sr, Zn, Hardness)	USEPA 200.7	X		X	
ICP 3 (Al,Ba,Ca,Fe,Mg,Mn,Na,K,S,Zn)	USEPA 200.7		X		
ICPMS 1 (As,Cd,Cr,Cu, Ni,Pb,Se)	USEPA 200.8	X		X	
ICPMS 5 (As,Be,Cd,Co,Cr,Cu,Ni,Pb,Se)	USEPA 6020A		X		
BNA Organics (SVOCs)	USEPA 625	X	X (USEPA 8270)		
Herbicides (including Atrazine)	USEPA 525.2	X		X	
Microcystins	OEPA 701.0			X	
pH	Field Meter	X		X	
Conductivity	Field Meter	X		X	
Dissolved Oxygen (mg/l and % saturation)	Field Meter	X		X	
Temperature	Field Meter	X		X	
E.coli	USEPA 1603	X		X	
Chlorophyll a	USEPA 445.0	X		X	
Percent Solids	SM 2540G		X		
Total organic carbon	OEPA 335.2		X (0.1%)		
Cadmium, Copper, Lead, Nickel, Silver, Zinc	USEPA 200.8/ USEPA 200.7		X		
ICPMS 6 (As,Cd,Pb,Se)	USEPA 200.8/ SM3113B				X
Mercury	USEPA 245.1		X (USEPA 7471A)		X
PCBs	OEPA 590.1				X
Pesticides	OEPA 590.1				X
Percent Lipids	OEPA 581.5				X

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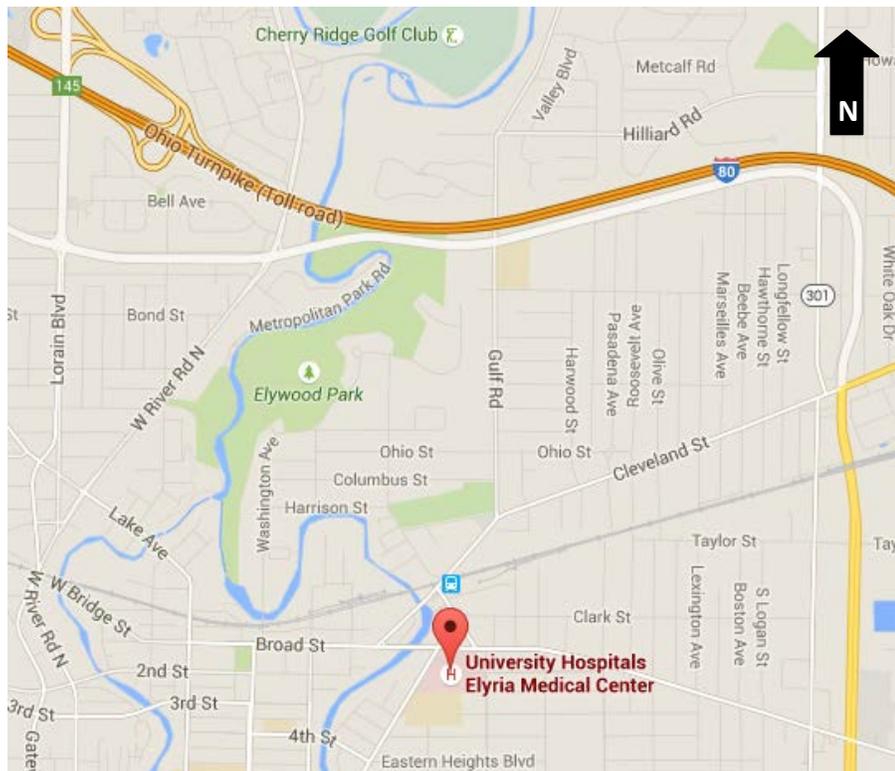
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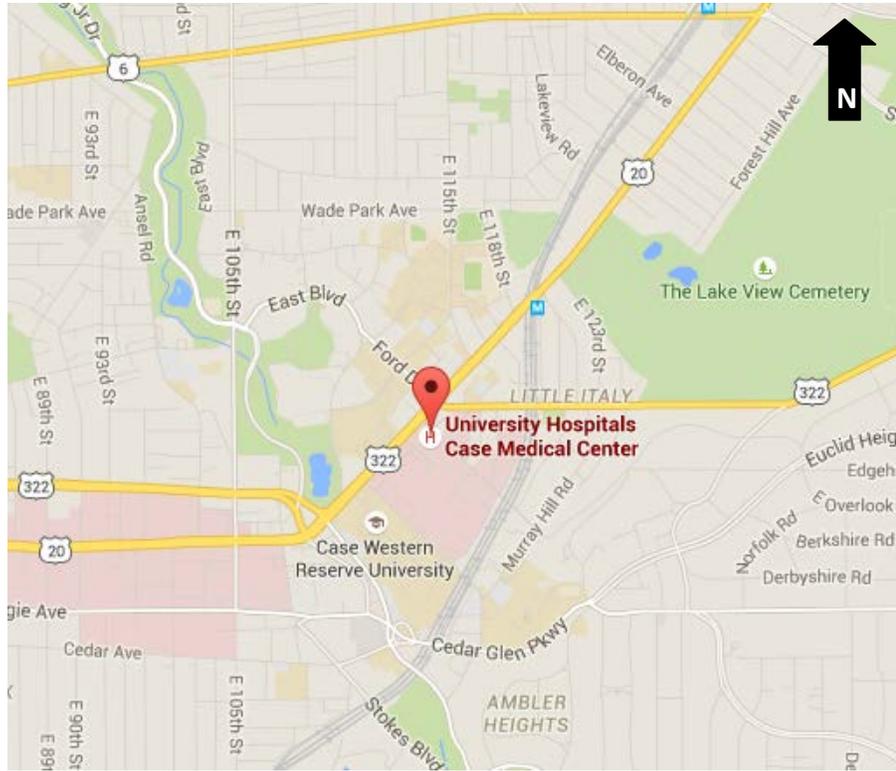
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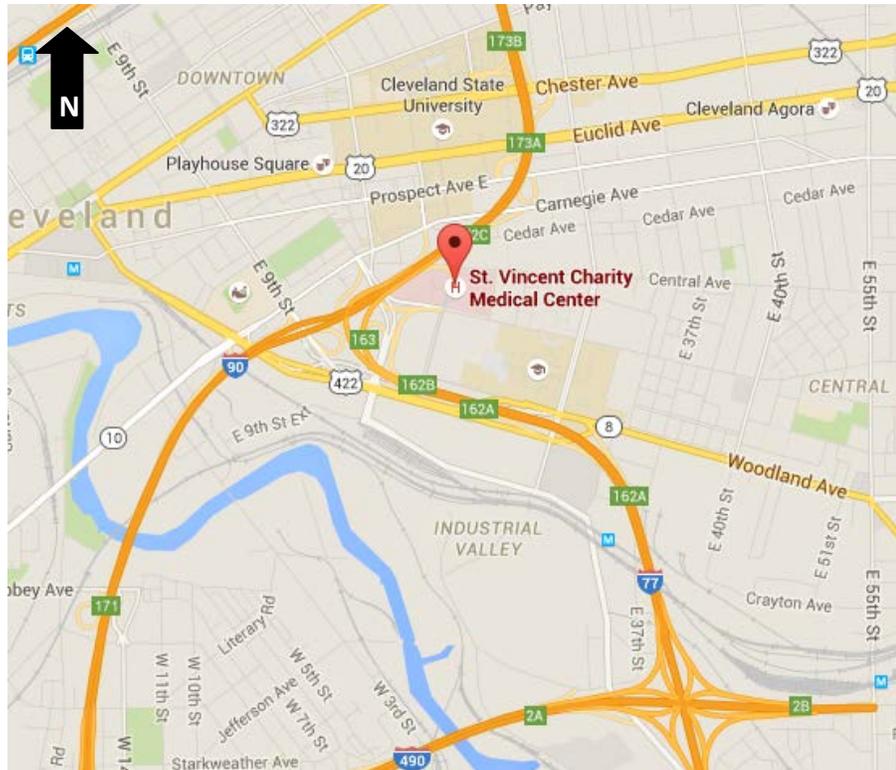
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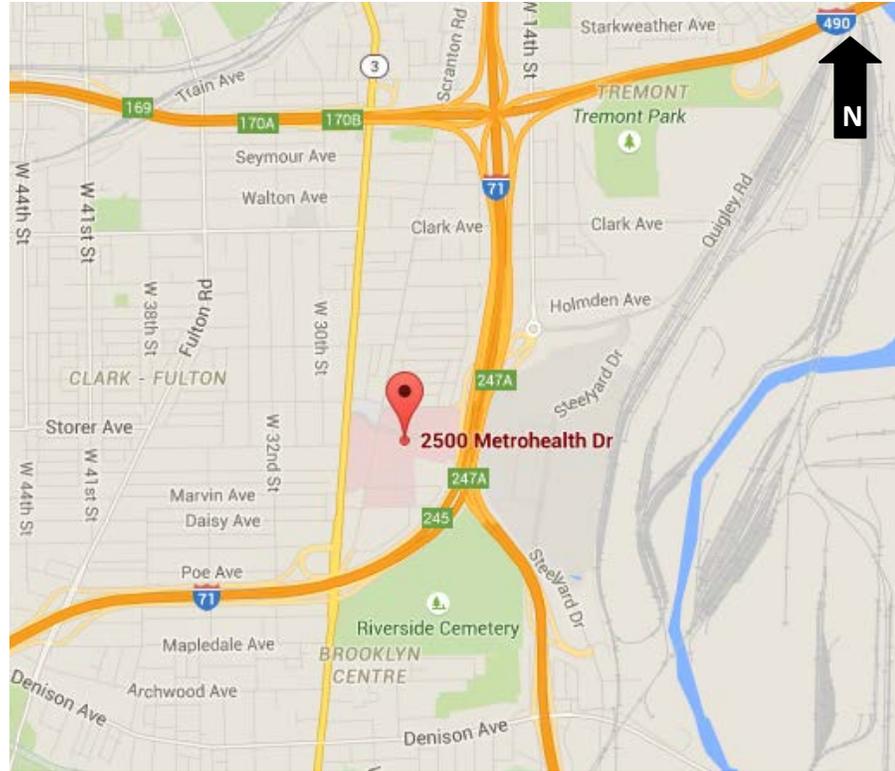
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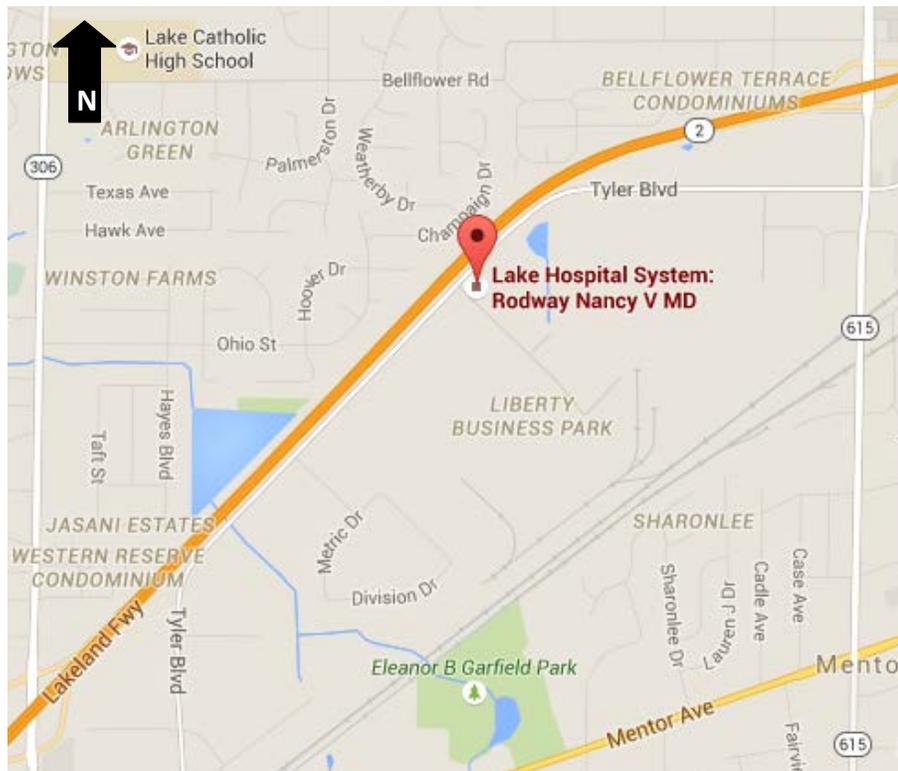
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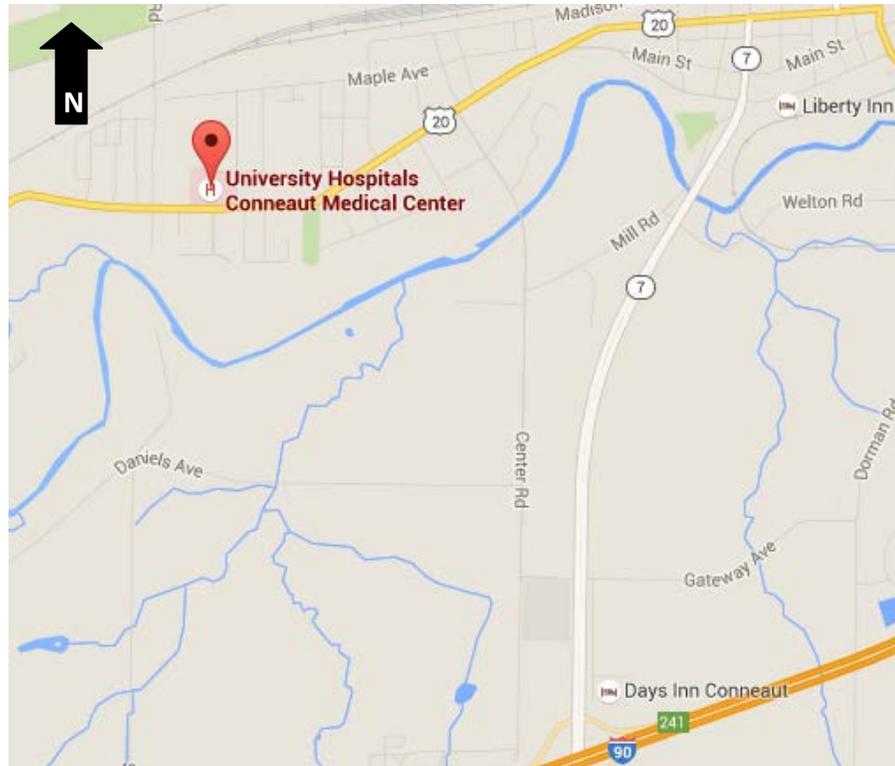
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