Northeast Ohio Regional Sewer District
Protecting Your Health and Environment

Level 3 Project Study Plan

2006 Cuyahoga River Electrofishing & Benthic Macroinvertebrate Surveys

(1) Objectives

The study will be conducted by the Northeast Ohio Regional Sewer District's (NEORSD) Water Quality and Industrial Surveillance department (WQIS) during the 2006 field season. The purpose of the survey is to evaluate the fish and benthic macroinvertebrate communities at the locations listed below and assign a characterization of the overall fish community health and macroinvertebrate assemblage based on potential ecological and toxicological effects from point and nonpoint sources of pollution. These results will be used in conjunction with water quality data collected through other sampling efforts described in section three. Additionally, the study will define existing fish distribution and community structure.

NEORSD has been collecting benthic macroinvertebrate community data (specifically, quantitative sampling producing Invertebrate Community Index (ICI) scores) at sites upstream and downstream of Southerly Wastewater Treatment Center (WWTC) on the Cuyahoga River since 1988. NEORSD has also been collecting fish community data (specifically, Index of Biotic Integrity (IBI) and Modified Index of Wellbeing (MIwb) scores) at sites upstream and downstream of Southerly WWTC since 1990. Information gained through the 2006 surveys will add to NEORSD's storehouse of temporal trend data collected on nearly an annual basis through the last two decades. This data is especially critical since the lower Cuyahoga River has been designated as one of 42 Great Lakes areas of concern (AOC) by the International Joint Commission (IJC). Additionally, previous monitoring has indicated impairment of aquatic biota in the river segment(s) to be studied and has been the basis of a Total Maximum Daily Load (TMDL) plan for the Lower Cuyahoga River.

Temporally intensive monitoring can ultimately show improvements in the biota which would be expected after decades of elimination and permitting of point sources. Less frequent monitoring by other agencies is likely to be more affected by unusual events such as extreme weather or flow conditions, spills, or other one-time effects on the fish and macroinvertebrate communities. In the 2006 macroinvertebrate invertebrate study, NEORSD will collect data from additional sites further upstream and downstream of Southerly WWTC to increase our ability to evaluate spatial trends as well as the effects of specific point sources and habitat variation.

Conduct Qualitative Habitat Evaluation Index (QHEI) scoring and quantitative fish sampling on the Cuyahoga River upstream and downstream of the confluence with the Southerly WWTC effluent channel and upstream and downstream of the confluence with Big Creek.

Conduct quantitative and qualitative benthic macroinvertebrate sampling on the Cuyahoga River at Old Riverview Road, downstream of Granger Road, upstream and downstream of the confluence with the Southerly Wastewater Treatment Center (WWTC) effluent channel, and approximately 1,900 feet upstream of the Big Creek Interceptor (BCI) crossing.

The electrofishing survey results will be compiled and utilized to evaluate fish community health through the application of two Ohio Environmental Protection Agency (Ohio EPA) indices, the IBI and the MIwb. The benthic macroinvertebrate survey results will be compiled and used to calculate the ICI. Results will be compared to historic data to show temporal as well as spatial trends. This data may also be utilized in conjunction with a diagnostic tool such as United States Environmental Protection Agency's (USEPA) *Stressor Identification Guidance Document* in order to identify impacts to the communities.

(2) Nonpoint/Point Sources that may Influence Ecological Conditions in the Study Area

Point Sources	**Nonpoint Sources**
Big Creek (RM 7.20)	Urban runoff
Ohio Canal (RM 8.78)	Landfills
Southerly WWTC (RM 10.57)	Spills
West Creek (RM 11.30)	Agriculture
Mill Creek (RM 11.40)	
Combined Sewer Overflows	
Storm Sewer Outfalls	

Other point sources (upstream of Mill Creek) include the Akron Wastewater Treatment Plant (RM 37.45), Combined Sewer Overflows in Akron, and numerous tributaries to the Cuyahoga River (see *Total Maximum Daily Loads for the Lower Cuyahoga River* for a complete list of tributaries and their locations).

(3) Parameters Covered

Fish specimens will be identified to species level, weighed, counted and examined for the presence of external anomalies including DELTs, which include deformities, eroded fins, lesions and tumors.

Stream habitat will be measured by scoring components of the QHEI, including the substrate, instream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle/run quality and gradient.

Water quality samples will be collected one time at each electrofishing site during one of the passes. Parameters to be analyzed are listed in Appendix A. Field measurements for dissolved oxygen, pH, temperature and specific conductance will also be performed. Furthermore, NPDES permit-required water quality samples collected between the first and last electrofishing pass and during the macroinvertebrate colonization period upstream and downstream of Southerly WWTC will also be used to also assess the quality of water.

Cuyahoga River flow will be recorded during each electrofishing pass utilizing data from the United States Geological Survey (USGS) gage station in Independence, Ohio.

Macroinvertebrate community assemblages will be collected and shipped to EA Engineering, Science and Technology for identification and enumeration. EA Engineering, Science and Technology will identify the specimens to the level of taxonomy recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989).

Quantitative fish sampling will not be conducted at Old Riverview Road, Granger Road on the Cuyahoga River due to the lack of historical data, time and personnel availability.

Macroinvertebrate sampling will not be conducted upstream and downstream of the Big Creek confluence due to the lack of historical data, time and personnel availability.

(4) Field Collection and Data Assessment Techniques

Field collections for fish will be conducted with a 17-foot Coffelt electrofishing boat (Smith-Root 5.0 GPP Electrofisher). Boat electrofishing will consist of shocking all habitat types within a sampling zone, which is 0.5 kilometers in length, while moving from upstream to downstream. In zones which have extensive woody debris and abundant cover, a slower boat speed will be necessary to maneuver the boat. The stunned fish will be collected and put in an on-board live well for later identification. Each boat sampling zone will be electroshocked two or three times during the field season (June 15 - October 15).

Fish will be identified to species level, weighed, counted, and examined for the presence of external anomalies including DELTs, which include deformities, eroded fins, lesions, and tumors. Fish easily identified (commonly collected from year to year) will be returned to the site from which they are collected. Subsamples of difficult to identify species will be brought back to the laboratory for verification by NEORSD personnel and if necessary, sent to The Ohio State

University College Museum of Biological Diversity for verification by the Curator of Fish. Two voucher specimens will be kept for each species collected during sampling and when new range extensions are detected. Endangered species and those too large for preservation will not be collected as voucher specimens but will instead be photographed. Photographed vouchers will include features that will permit definitive identification of the particular species.

Fish will be preserved in 10 percent formalin in the field and soaked in tap water for 24 to 48 hours after 5 to 7 days, then transferred to solutions of 30 and 50 percent ethanol for 5 to 7 days each and finally to 70 percent ethanol for long-term storage. Specimens larger than six inches will be slit along the right side, and then soaked in formalin for approximately 10 to 14 days before being transferred to solutions of 30, 50 and 70 percent ethanol. Label information will include location (description and coordinates), date, time, collectors' names and sample identification code for each specimen collected.

Macroinvertebrate sampling will be conducted using quantitative and qualitative sampling techniques. Quantitative sampling will include installation of a five Hester-Dendy multi-plate artificial substrate sampler assemblage (HD) that is colonized for a six-week period. Five Surber square-foot samples may be used in place of a HD sampler where deemed uncollectible due to the HD sampler having been vandalized, buried, etc. Surber samples, if supplemented for a HD sampler, will be used for informational purposes only. Qualitative sampling will be conducted using a D-frame dip net when HD samplers are retrieved. Macroinvertebrate community assemblages will be collected and shipped to EA Engineering, Science and Technology for identification and enumeration. EA Engineering, Science and Technology will identify the specimens to the level of taxonomy recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989). Stream flow will be measured when the HD samplers are installed and retrieved. Water quality samples will not be collected in conjunction with the macroinvertebrate sampling. However, NPDES permit-required water quality samples collected on the Cuyahoga River will be utilized to assess water quality conditions upstream and downstream of Southerly WWTC's effluent discharge.

A detailed description of the sampling and analysis methods utilized in the fish community and macroinvertebrate surveys, including calculations of the IBI, MIwb and ICI, can be found in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987, updated January 1, 1988) and *III* (1987, updated September 30, 1989).

The QHEI, as described in Ohio EPA's, *The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application* (1989) will be used to assess aquatic habitat conditions at each sample location.

Water quality sampling and chemical analyses performed during one of the electrofishing passes will follow the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2006). Chemical and bacteriological water quality samples from each electrofishing site will be collected with two 4-liter disposable polyethylene cubitainers with disposable polypropylene lids and sterile 250 mL bottles, respectively. A YSI-556 MPS Multi-Parameter Water Quality Meter will be used to measure dissolved oxygen, water temperature, conductivity and pH at the time of sampling. Unless otherwise noted, all water quality samples will be collected as grab samples. Appendix A lists the analytical method and detection limit for each parameter analyzed.

Where possible, data assessment will include an analysis of temporal and spatial trends in the collected data. Species assemblages and the evaluation of individual metrics will be analyzed. Graphs that show current and historic QHEI, IBI, MIwb and ICI scores and how these scores compare to attainment status of biocriteria will be prepared. These graphs will be used to identify whether point and/or nonpoint source are impacting the habitat and fish community and to attempt to quantify such impacts. Water quality data collected will be compared to Ohio water quality standards to determine whether any excursions from the applicable water quality criteria have occurred.

(5) Sampling Locations

The following electrofishing and macroinvertebrate sample locations, listed from upstream to downstream on the Cuyahoga River, will be surveyed during the 2006 field season. YSI 6600 EDS data sondes are deployed longterm at all the locations except the site upstream of the confluence with Big Creek. Permit-required water quality samples are collected at the sites upstream and downstream of Southerly WWTC, twice per month.

Location	Latitude	Longitude	River Mile	Description	Quadrangle	Purpose
Riverview Road Site 23	N41°21.945’	W81°36.767’	~16.8	Downstream of Tinkers Creek, in an area of known biological attainment	Northfield	Background data macroinvertebrates
Downstream of Granger Road Site 22.91	N41°26.765’	W81°41.182’	~11.7	First run/riffle area downstream of Granger Road, at the mixing zone of Mill Creek with the Cuyahoga River	Cleveland South	Evaluate Mill Creek discharge on macroinvertebrates
Upstream of Southerly WWTC	N41.4196°	W81.6547°	~11.3	Upstream of Southerly WWTC, downstream of Mill Creek and West Creek	Cleveland South	Evaluate Mill/West Creek discharges on fish, habitat and macroinvertebrates
*Downstream of Southerly WWTC	N41.4242°	W81.6638°	~10.1	Downstream Southerly WWTC	Cleveland South	Evaluate Southerly WWTC discharge on fish, habitat and macroinvertebrates
Upstream of the confluence with Big Creek	N41.4437°	W81.6822°	~8.3	Upstream of the confluence with Big Creek	Cleveland South	Evaluate Big Creek discharge on fish and , habitat
Downstream of the confluence with Big Creek	N41.4497°	W81.6815°	~7.10	Downstream of the confluence with Big Creek	Cleveland South	Evaluate Big Creek discharge on fish and habitat
* denotes two macroinvertebrate sites within electrofishing zone						

(6) Schedule

Two to three electrofishing surveys will be conducted between June 15 and October 15, 2006. Each survey will be conducted four to five weeks apart. Specific dates have not been scheduled. River flow and weather conditions will be assessed weekly to determine when each electrofishing pass will be conducted. Prior to or on the day of the first electrofishing survey, a start point and an end point will be marked with a handheld global positioning system unit, and QHEI scores will be determined at each electrofishing site.

Artificial substrate samplers will be installed on the Cuyahoga River at all of the macroinvertebrate sites in July 2006 and retrieved six weeks later. Specific dates have not been scheduled. River flow and weather conditions will be assessed weekly to determine when the HD sampler installations will be conducted.

(7) QA/QC

Quality assurance and quality control of sampling and analysis methods for habitat, fish, and macroinvertebrate evaluations will follow Ohio EPA's *Biological Criteria for the Protection of Aquatic Life*, *Volumes II* (1987, updated January 1, 1988) and *III* (1987) and *The Qualitative Habitat Evaluation (QHEI): Rationale, Methods, and Application* (1989) and USEPA's *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish*, Second Edition (1999) EPA 841-B-99-002.

Electrofishing equipment will follow the guidelines listed in the operation and maintenance manual provided by Smith-Root, Inc. Malfunctioning equipment will not be used to collect data. Proper steps will be taken to correct the problem as soon as possible, whether by repairing in the field or at the NEORSD Environmental & Maintenance Services Center or by contacting the supplier or an appropriate service company.

Subsamples of difficult to identify species will be brought back to the laboratory for verification by NEORSD personnel and if necessary, sent to The Ohio State University College Museum of Biological Diversity for verification by the Curator of Fish. Two voucher specimens will be kept for each species collected during sampling. Endangered species and those too large for preservation will not be collected as voucher specimens but will instead be photographed. Photographed vouchers will include features that will permit definitive identification of the particular species.

Water quality samples collected at the electrofishing sites during one of the electrofishing passes and from the NPDES permit-required water quality sites will be placed on ice and submitted for analyses to NEORSD Analytical Services immediately. The NEORSD Analytical Services Quality Manual is in Appendix B. Control copies of Analytical Service's Quality Manual or Standard Operating Procedures (SOPS) can be reviewed or audited on-site. Copies of the Quality Manual and SOPS can only be given to a third party as uncontrolled copies, due to the fact that all information is time sensitive and may be revised at any time. The Quality Assurance Officer at Analytical Service should be contacted for updates, revisions and any information on document control at 216-641-6000.

Macroinvertebrate community assemblages will be collected and shipped to EA Engineering, Science and Technology for identification and enumeration. EA Engineering, Science and Technology will identify the specimens to the level of taxonomy recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life*, *Volume III* (1987, updated September 30, 1989). The EA Engineering, Science and Technology QA/QC manual is attached (Appendix C). All macroinvertebrate specimens will be returned to NEORSD by EA

Engineering, Science and Technology. Voucher specimens for each site will be separated into individual vials. The remaining specimens for each site will be returned in a single container labeled with the site number and the date of collection. All specimens and accompanying chain-of-custody documentation will be retained by NEORSD and stored at the Environmental & Maintenance Services Center (EMSC).

(8) Work Products

Following the completion of the project, a spreadsheet that presents data including species, numbers, weights, pollution tolerances and the incidence of DELT anomalies will be produced for fishes collected on the Cuyahoga River. A spreadsheet that presents the types and numbers of macroinvertebrates collected at each site will also be produced. Reports summarizing, interpreting, graphically presenting, and discussing the QHEI, IBI, MIwb, and ICI scores and any excursions from water quality standards will be prepared.

(9) Qualified Data Collectors

The following Level 3 Qualified Data Collectors will be involved with this study:

Name	Address	Email Address	Phone Number	QDC Specialty
Kathryn Crestani	4747 East 49th Street Cuyahoga Hts., Ohio 44125	crestanik@neorsd.org	216-641-6000	CWQA - 011 [6] BMB
[1]Seth Hothem	4747 East 49th Street Cuyahoga Hts., Ohio 44125	hothems@neorsd.org	216-641-6000	CWQA - 010 [6] FCB
[2]Tiffany Moore	4747 East 49th Street Cuyahoga Hts., Ohio 44125	mooret@neorsd.org	216-641-6000	CWQA - 017 BMB (QDC -017)
[3]John W. Rhoades	4747 East 49th Street Cuyahoga Hts., Ohio 44125	rhoadesj@neorsd.org	216-641-6000	CWQA - 008 [6] FCB
[4]Tom Zablotny	4747 East 49th Street Cuyahoga Hts., Ohio 44125	zablotnyt@neorsd.org	216-641-6000	CWQA - 018 FCB - 018
Cathy Zamborsky	4747 East 49th Street Cuyahoga Hts., Ohio 44125	zamborskyc@neorsd.org	216-641-6000	CWQA - 009 [6] SHA -
[5]Marty Sneen	EA Engineering, Science and Technology 444 Lake Cook Road Suite #18 Deerfield, IL 60015	msneen@eaest.com	847-945-8010	QDC# 026

[1] Chemical Water Quality Assessment (CWQA) Project Manager
[2] Benthic Macroinvertebrate Biology (BMB) Project Manager
[3] Lead Project Manager
[4] Fish Community Biology (FCB) Project Manager
[5] Benthic Macroinvertebrate Identification
[6] Pending
Stream Habitat Assessment (SHA)

The following is a list of persons not qualified as level 3 data collectors who may be involved in the project. Prior to the start of sampling, the project managers will conduct training with each of these and any other individuals on the proper methods for electrofishing and macroinvertebrate collections. The lead project manager will be responsible for reviewing all reports and data analysis prepared by these individuals prior to completion.

Name	Address	Email Address	Phone Number
Joseph Broz	4747 East 49th Street Cuyahoga Hts., Ohio 44125	brozj@neorsd.org	216-641-6000
Tim Dobriansky	4747 East 49th Street Cuyahoga Hts., Ohio 44125	dobrianskyt@neorsd.org	216-641-6000
Rae Grant	4747 East 49th Street Cuyahoga Hts., Ohio 44125	grantr@neorsd.org	216-641-6000
Lateefah Hafeez	4747 East 49th Street Cuyahoga Hts., Ohio 44125	hafeezl@neorsd.org	216-641-6000
Eric Hinton	4747 East 49th Street Cuyahoga Hts., Ohio 44125	hintone@neorsd.org	216-641-6000
Mike Pavlik	4747 East 49th Street Cuyahoga Hts., Ohio 44125	pavlikm@neorsd.org	216-641-6000
Francisco Rivera	4747 East 49th Street Cuyahoga Hts., Ohio 44125	riveraf@neorsd.org	216-641-6000
Kevin Roff	4747 East 49th Street Cuyahoga Hts., Ohio 44125	roffk@neorsd.org	216-641-6000
Frank Schuschu	4747 East 49th Street Cuyahoga Hts., Ohio 44125	schuschuf@neorsd.org	216-641-6000
Elizabeth Toot-Levy	4747 East 49th Street Cuyahoga Hts., Ohio 44125	toot-levye@neorsd.org	216-641-6000
Wolfram vonKiparski	4747 East 49th Street Cuyahoga Hts., Ohio 44125	vonkiparskiw@neorsd.org	216-641-6000
Timothy Whipple	4747 East 49th Street Cuyahoga Hts., Ohio 44125	whipplet@neorsd.org	216-641-6000
Mohammad Zachariah	4747 East 49th Street Cuyahoga Hts., Ohio 44125	zachariahm@neorsd.org	216-641-6000

(10) Documentation of approval of project managers as level 3 qualified data collector

See attached (Appendix D).

(11) Contract laboratory contact information

Any fish that is not positively identified in the field or NEORSD laboratory will be sent to The Ohio State University College Museum of Biological Diversity for verification by the Curator of Fish. Fish will be identified to the species level.

Dr. Ted Cavender, Curator of Fish
1315 Kinnear Road, Columbus, Ohio 43212
cavender.1@osu.edu
614-292-7873

Marty Sneen, Benthic Specialist (QDC# 026)
EA Engineering, Science and Technology
444 Lake Cook Road Suite #18
Deerfield, IL 60015
msneen@eaest.com
847-945-8010 ext. 108

(12) Copy of ODNR collector's permit

See attached (Appendix E).

(13) Catalog Statement

A digital photo catalog of all sampling locations will be maintained for 10 years and will include photos of the specific sampling location(s), the riparian zone adjacent to the sampling location(s) and the general land use in the immediate vicinity of the sampling location(s).

Signature:__________________________ Date:_____________

(14) Voucher Specimen Statement

Based on Ohio EPA's Final Responsiveness Summary of the Credible Data Rules (3/24/06), NEORSD is requesting approval of an alternative vouchering protocol, as follows:

NEORSD will maintain a single voucher collection which includes two specimens of each species or taxa collected in the course of biological sampling at any location. A separate collection for each sampling event will not be maintained. However, if any additional new species are encountered during the course of sampling, representatives will either be collected or an appropriate photo voucher taken. The lead project manager will provide specimens to the Director upon request. This collection will be stored at the NEORSD laboratory in the Environmental Maintenance and Services Center.

Signature:__________________________ Date:_____________

(15) Trespassing Statement

I, ____________________, have not been convicted or pleaded guilty to a Violation of section 2911.21 of the Revised Code (criminal trespass) or a substantially similar municipal ordinance within the previous five years.

Signature:_________________________ Date:_____________

I, ____________________, have not been convicted or pleaded guilty to a Violation of section 2911.21 of the Revised Code (criminal trespass) or a substantially similar municipal ordinance within the previous five years.

Signature:_________________________ Date:_____________

I, ____________________, have not been convicted or pleaded guilty to a Violation of section 2911.21 of the Revised Code (criminal trespass) or a substantially similar municipal ordinance within the previous five years.

Signature:_________________________ Date:_____________

I, ____________________, have not been convicted or pleaded guilty to a Violation of section 2911.21 of the Revised Code (criminal trespass) or a substantially similar municipal ordinance within the previous five years.

Signature:_________________________ Date:_____________

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Signature:_________________________ Date:_____________

I, ____________________, have not been convicted or pleaded guilty to a Violation of section 2911.21 of the Revised Code (criminal trespass) or a substantially similar municipal ordinance within the previous five years.

Signature:_________________________ Date:_____________

Appendix A

Parmeter	Test	Detection Limit
E. coli	SM 9213 D	(value reported in) cfu/100ml.
Alkalinity	EPA 310.2	5 mg/L
COD	EPA 410.4	1 mg/L
Hex Chrome	SM 3500	10 ug/L
Mercury	EPA 245.2	0.05 ug/L
NH3	EPA 350.1	0.01 mg/L
NO2	EPA 354.1	0.01 mg/L
NO3	EPA 353.2	0.01 mg/L
Soluble-P	SolPO4	0.01 mg/L
Total-P	EPA 365.2	0.01 mg/L
CBOD	EPA 405.1 (5 Day)	2 mg/L
TDS	EPA 160.1	1 mg/L
Ag	EPA 200.7	1 µg/L
Al	EPA 200.7	5 µg/L
As	EPA 200.7	2 µg/L
Be	EPA 200.7	0.5 µg/L
Ca	EPA 200.7	50 µg/L
CaCO3	EPA 200.7	1 µg/L
Cd	EPA 200.7	1 µg/L
Co	EPA 200.7	1 µg/L
Cr	EPA 200.7	1 µg/L
Cu	EPA 200.7	1 µg/L
Fe	EPA 200.7	1 µg/L
K	EPA 200.7	50 µg/L
Mg	EPA 200.7	20 µg/L
Mn	EPA 200.7	1 µg/L
Mo	EPA 200.7	2 µg/L
Na	EPA 200.7	20 µg/L
Ni	EPA 200.7	1 µg/L
Pb	EPA 200.7	3 µg/L
Sb	EPA 200.7	5 µg/L
Se	EPA 200.7	5 µg/L
Sn	EPA 200.7	10 µg/L
TMET	EPA 200.7	(sum of Cr+Cu+Ni+Zn)
Ti	EPA 200.7	10 µg/L
Tl	EPA 200.7	10 µg/L
V	EPA 200.7	1 µg/L
Zn	EPA 200.7	1 µg/L
TS	EPA 160.3	1 mg/L
TSS	EPA 160.2	1 mg/L
Turbidity	SM 2130B	0.1 NTU
pH		(value reported in) s.u.
Field pH		(value reported in) s.u.
Field Conductance	SM 2510A	(value reported in) µs/cm
Field D.O.	SM 4500-0 G	(value reported in) mg/L
Field Temperature	EPA 170.1	(value reported in) °C
Flow		(value reported in) fps/cfs

Appendix B

Northeast Ohio Regional
Sewer District
Protecting Your Health and Environment

Analytical Services
4747 East 49th Street
Cuyahoga Hts., OH 44125

SOP 5001-0 Quality Assurance Manual

Effective Date: April 10, 2006

This manual is applicable to the Quality Assurance System governing the Analytical Services Department of the Northeast Ohio Regional Sewer District Analytical Services Department.

Approvals:

Superintendent of
Environmental Services: Richard Connnelly — Date: 4/11/06

Manager of Analytical Services: Mark Citriglia — Date: 4/10/06

Quality Assurance Specialist: Carol Turner — Date: 4/10/06

Supervising Chemist: Eva Hatvani — Date: 4/10/06

Supervising Chemist: Oljeg Jamnicky — Date: 4/10/06

Supervising Chemist: Cheryl Soltis-Muth — Date: 4/10/06

Logistics Chemist: Cynthia Williams — Date: 4/10/06

Analytical Services
4747 East 49th Street
Cuyahoga Hts., OH 44125

Quality Assurance Manual
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1.0 Quality Assurance Policy

1.1 The Analytical Services Department provides performs analytical testing for the various departments within the Northeast Ohio Regional Sewer District (NEORSD). The Analytical Services Department also performs work for external sources on a limited basis. The analytical information generated is used for daily operation of the wastewater treatment facilities, and Provides compliance monitoring for the treatment facilities as required by the Ohio Environmental Protection Agency. Additionally the laboratory monitors materials introduced into the collection system and monitors water quality throughout the service area form samples submitted from the Water Quality and Industrial Surveillance Department.

1.2 The management staff of Analytical Services is committed to operating the laboratory in a safe, professional and proficient manner. To attain these goals, management is committed to and has adopted policies and procedures in accordance with the National Environmental Laboratory Accreditation Conference (NELAC).

1.3 The goal of management is to generate information of the highest quality that is legally defensible and presents the laboratory and its employees as ethical and competent. The management staff is responsible for ensuring that policies and objectives are communicated to, understood and implemented by all laboratory personnel.

1.4 The Quality System is documented and defined in the Quality Assurance Manual. The Quality Assurance Manual, Standard Operating Procedures and supplemental instructions for the performance of duties are available to the laboratory personnel. Every employee of the NEORSD Analytical Services department is responsible to read, understand and follow the policies defined in the Quality Assurance Manual.

2.0 Organization and Management Structure

2.1 The ***Superintendent of Environmental Services*** is the final authority for laboratory operations. The ***Superintendent*** has assigned daily management of the laboratory to the ***Manager of Analytical Services.***

2.2 The ***Manager of Analytical Services*** reports directly to the ***Superintendent of Environmental Services***. The manager is responsible for addressing the technical issues of the laboratory and assuring that the technical operations of the laboratory are conducted within the guidelines of the Quality Assurance System. ***Manager of Analytical Services*** is responsible for implementing actions necessary to bring operations into compliance with the Quality Assurance System.

2.3 The ***Quality Assurance Specialist*** reports directly to the ***Manager of Analytical Services***. The ***Quality Assurance Specialist*** is responsible for monitoring laboratory compliance with those requirements set forth in this Quality Assurance Manual. The ***Quality Assurance Specialist*** has the authority to issue requests for corrective action on items or activities found to be out of compliance with the Quality Assurance System. The ***Quality Assurance Specialist*** has the final authority on issues dealing with the quality of the data. The ***Quality Assurance Specialist*** has the authority to suspend analyses or require re-analyses.

2.4 The ***Supervising Chemist*** is considered the technical director of the areas under his/her direct supervision. Responsibilities include assisting and training of laboratory personnel with the various approved EPA methods utilized within the laboratory. Management of the day to day analytical activities of chemists, biologist and wastewater analysts. Evaluation, review and approval of data, and quality control statistics for the analyses performed in the laboratory. The Supervising Chemists report directly to the Manager of Analytical Services. A detailed job description for this position is on file with the Employee Resources Department.

2.5 The ***Logistic Chemists*** assists the Manager of Analytical Services and the QA/QC Specialist with coordination of administrative and operational functions including chemical inventory, disposition of laboratory equipment and supplies, data reporting, Chain of Custody procedures, project management, and scheduling. The Logistics Chemist reports directly to the QA/QC Specialist. A detailed job description for this position is on file with the Employee Resources Department.

2.6 The ***Advanced Instrumentation Chemist*** (AI Chemist) performs qualitative, and quantitative chemical analyses utilizing advanced instrumentation such as ICP, GFAA, Automated Analyzers, TOC and other instrumentation. The AI Chemist is responsible for troubleshooting and training on the advanced instrumentation. The AI Chemist reports directly to a Supervising Chemist. A detailed job description for this position is on file with the Employee Resources Department.

2.7 ***Chemists*** are responsible for the analysis of water samples such as municipal and industrial wastewater and sludge sample for various chemical analyses, including wet chemistry, physical properties and instrumental analyses. Chemist follow defined laboratory standard operating procedures and utilize good analytical techniques. They will also collect samples and transport samples utilizing chain of custody procedures defined by the laboratory. Chemists report directly to the Supervising Chemist. A detailed job description for this position is on file with the Employee Resources Department.

2.8 **Biologist** analyze water samples such as municipal and industrial wastewater and sludge sample for various bacteriological and microbiological components, bioassay, and physical and chemical, including wet chemistry, physical properties and instrumental analyses. Follow standard methods and good analytical techniques. Biologist follow defined laboratory standard operating procedures and utilize good analytical techniques. They will also collect samples and transport samples utilizing chain of custody procedures defined by the laboratory. The biologist report directly to the supervising chemist. A detailed job description for this position is on file with the Employee Resources Department

2.9 **Wastewater Analysts III** analyze water samples such as municipal and industrial wastewater and sludge sample for various chemical analyses, including wet chemistry, physical properties and instrumental analyses. Analysts follow defined laboratory standard operating procedures and utilize good analytical techniques. Wastewater Analyst will also collect samples and transport samples utilizing chain of custody procedures defined by the laboratory A detailed job description for this position is on file with the Employee Resources Department

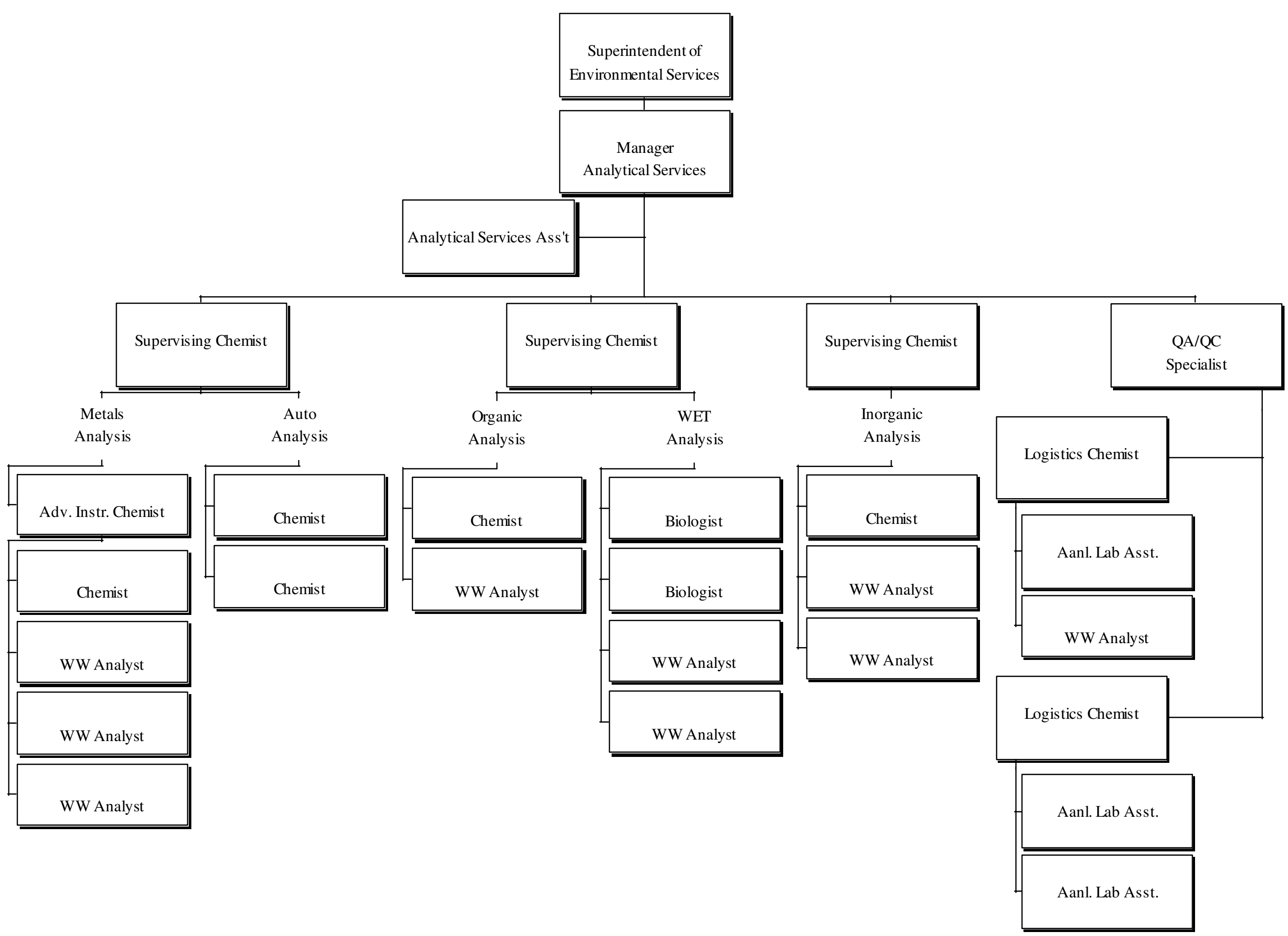
2.10 ***Wastewater Analyst (I, II)*** analyzes water samples such as municipal and industrial wastewater and sludge sample for various chemical analyses, including wet chemistry, physical properties. Analysts follow defined laboratory standard operating procedures and utilize good analytical techniques. Wastewater Analyst will also collect samples and transport samples utilizing chain of custody procedures defined by the laboratory. A detailed job description for this position is on file with the Employee Resources Department.

2.11 The ***Sample Control Specialist***, administers, coordinates, documents, and participates in the chain of custody program controlling wastewater, sludge, industrial, and surface water samples submitted to Analytical Services. The Sample Control Specialist reports directly to the QA/QC Specialist. A detailed job description for this position is on file with the Employee Resources Department.

2.12 The ***Analytical Laboratory Assistant***, cleans, organizes and maintains laboratory glassware, sampling equipment, vehicles, refrigerator and general areas within the laboratory facilities. The lab assistant distributes and disposes of supplies and samples as directed. The Analytical Laboratory Assistant reports directly to the Logistic Chemist. A detailed job description for this position is on file with the Employee Resources Department

2.13 The ***Analytical Services Assistant*** assists the management staff of Analytical Services with the coordination of administrative tasks, operational functions, data reporting, document management and storage for compliance reports. A detailed job description for this position is on file with the Employee Resources Department

2.14 Table of Organization



3.0 Documents Control

3.1 Maintenance and management of the document control system is the responsibility of the Quality Assurance Specialist. Documents related to analysis, calibration, calculations and reports are maintained to allow for historical reconstruction of data.

3.2 The following documents are considered controlled documents and are to be maintained by the document control system

3.2.1 Quality Assurance Manual
3.2.2 Standard Operating Procedures
3.2.3 Analytical Data Sheets, Forms and Notebooks
3.2.4 Instrument Printouts and Run Logs
3.2.5 Batch records
3.2.6 Calibration curves and records
3.2.7 Method detection limits records
3.2.8 Training Records
3.2.9 Instrument Maintenance logs

3.3 Document Control System

3.3.1 Controlled documents are maintained by the document control system. Controlled documents exist as procedures or forms. Logs are maintained of both types of documents to prevent duplication, for reference and organization. Controlled documents must be issued and revised by use of the document control system.

3.3.2 Controlled documents must be approved by the Quality Assurance Specialist and must have a unique identifying number and reflect revision and or effective date.

3.3.3 The document control system is designed so only the current revision of each document is available for use. The document control system is a computerized system. The Quality Assurance Specialist maintains the control of documents on the computer network via password protection. Documents are available on the laboratory information management system as read only documents. Approved copies of controlled operating procedures are distributed throughout the laboratory. These documents are managed by the Quality Assurance Specialist. All analysts receive approved controlled copies of pertinent operating procedures that are stored in the Analytical Services Handbook. These operating procedures are managed by the Quality Assurance Specialist.

3.3.4 When a new revision is issued the original signed hard copy is marked obsolete. The obsolete document is retained in the historic record to provide for reconstruction of laboratory activities. A new controlled copy of the analytical procedures will be placed in the area and the original copy will be destroyed. When a new revision of pertinent operating procedures has been issued, the Quality Assurance Specialist will collect any old version, and distribute the new controlled version of the operating procedure. The Quality Assurance Specialist will maintain the documentation needed for tracking of controlled copies of any operating procedures. Operating procedure that must be distributed to all Analytical Services Personnel will be performed during general meetings.

3.3.5 Support activities are documented on forms and maintained as controlled documents. Support activities include Quality Assurance assignments such as reagent standardization, equipment maintenance and thermometer and balance calibrations.

3.3.6 Records will reflect the dates, times, observations and identify the individual making the entries and observations. All controlled documents and records are retained for five years unless alternative arrangements are made.

4.0 Critical Staff Positions

4.1 The Manager of Analytical Services has authorized the establishment of the Quality Assurance System for the purpose of developing, monitoring and continually improving the quality control and documentation systems used within the laboratory. The Manager of Analytical Services will be informed of any non-compliance of the requirements of the Quality Assurance System. Enforcement of the requirements of the Quality Assurance System ultimately is the responsibility of the Manager of Analytical Services.

4.2 The Supervising Chemist of Analytical Services exercises actual day-to-day supervision of laboratory operations and reporting of results. These include:

4.2.1 Monitoring standards of performance in quality control and quality assurance.

4.2.2 Monitoring the validity of the analyses performed and data generated in the laboratory to assure reliable data.

4.2.3 Provide support to laboratory in the review and response to corrective actions.

4.2.4 Provide technical support for development and improvement of methodologies.

4.2.5 Provide the focal point for technical training of employees.

4.3 Quality Assurance Specialist manages the Quality Assurance System as follows:

4.3.1 Reviewing Standard Operating Procedures for analytical and Quality Assurance procedures, assuring conformance with document control procedures.

4.3.2 Planning and conducting, if necessary, the training of analysts in good laboratory practices and test method requirements.

4.3.3 The analysis of trends in the laboratory precision and accuracy that are demonstrated by the results of analysis of quality control samples.

4.3.4 Serving as a focal point for the reporting and disposition of non-conformances.

4.3.4 Coordinating responses to Corrective Action Requests.

4.3.5 Suggesting actions to be taken in order to correct a problem with an analytical procedure.

4.3.6 Informing the Manger of Analytical Services of out-of-control situations: this includes the authority to require the laboratory to discontinue a procedure until corrective action brings the analysis back into control.

4.3.7 Maintaining the laboratory quality files and preparing routine Quality Control reports for review by the Manager and Superintendent.

4.4 Laboratory personnel are responsible to follow the Quality Assurance Manual and the related Standard Operating Procedures (SOP) as written. All laboratory personnel must adhere to issued quality control practices and procedures as stipulated by management and dictated by good laboratory practices. It is the responsibility of all laboratory personnel to advise management of observations that may result in the laboratory performance not attaining the objectives of the Quality Assurance System.

5.0 Traceability of Analytical Measurements

5.1 Analytical testing performed within the Analytical Services Department is performed on a batch basis. Each batch will be identified with a unique number for traceability. SOP-5010-1 Sample Batch Determination defines the procedures for creating preparation and analytical batches.

5.2 Samples are grouped based on matrix and time. Influent, effluent and pretreatment samples are all classified as a wastewater matrix. Sludge, grits and soils are classified as solid matrix. Each batch of samples is monitored by specified quality control activities.

5.3 Analytical measurements are recorded on controlled forms, or entered directly into the laboratory's Information Management System (LIMS) that collects all measurements and quality control activities associated with the batch. The date and time the analysis was performed, measurements obtained and calculations used to obtain the result are recorded.

4.4 Calibration curves are part of the document control system. Calibration dates are recorded thus analytical data can be traced to specific calibration curves.

4.5 Following data review the batch records become part of the record retention and filed for future retrieval. All records are stored on site for two years and then moved to off-site storage as defined in the District's record retention policy.

4.6 All recording and data corrections will be documented according to generally recognized good laboratory practices. These practices include recording in ink, dating, initialing entries and all correction will be made with a single-line through the old data and dated and initialed. The correction must not obscure the original entry.

6.0 Methods Performed

6.1 Analytical procedures are performed according to issued Standard Operating procedures derived from *Standard Method for the Examination of Water and Wastewater*, 20th ed and *Methods for Chemical Analysis of Water and Wastes* EPA 600/4-79-020

TEST NAME	TEST METHODOLOGY
pH 150.1	EPA 150.1
Bisulfite-B601-93	AWWA-B601-93
Hypochlorite-B300-64	AWWA-B300-64
Alkalinity-310.2	EPA-310.2
TSS-160.2 + TVSS-160.4	EPA -160.4
TS 160.3	EPA 160.3
TDS - 160.1	EPA 160.1
Alkalinity-310.1	EPA 310.1
TDS-160.1 +TDVS - 160.4	EPA 160.4
Chloride-325.3	EPA 325.3
TS 160.3 + TVS - 160.4	EPA 160.3 & 160.4
Sulfate 375.4	EPA 375.4
%TVS-SM 2540E	Standard Methods 20th Ed.
Hexavalent Chrome-SM 3500	Standard Methods 20th Ed.
Setteable Solids-160.5	EPA 160.5
%TS-SM 2540B	Standard Methods 20th Ed.
Phenol EPA 420.4	EPA 420.4
Oil & Grease -1664	EPA 1664
Fecal Coliform -9222 D.	Std Methods 19th 9222 D.
COD-EPA 410.4	EPA 410.4
E. Coli-9213 D	Std Methods, 20 ed. 9213 D
Total Coliform - 9222 B.	Std Methods 20th, 9222 B.
Fecal Strep - 9230 C.	Std Methods 20th, 9230 C
Total Chlorine Residual - 4500-Cl G.	Std Method 20th, 4500-Cl G.
Total Chlorine Residual -4500-Cl F.	Std Methods 20th, 4500-Cl F.
BOD-Total - 5 Day - 405.1	EPA 405.1
Conductivity SM 2510B	SM 2510B
Turbidity SM 2130B	SM 2130B
Fluoride-9214	EPA 9214
Phosphorus Total-365.2	EPA 365.2
Phosphorus-Soluble EPA 365.2	EPA 365.2
Phosphorus Ortho-365.2	EPA 365.2
Acidity-305.1	EPA 305.1
Field Conductance SM 2510A	SM 2510A
Cyanide Total-335.2	EPA 335.2
BOD-Carbonaceous - 5 DAY - 405.1	EPA-405.1
BOD-Soluble - 5 Day - 405.1	EPA-405.1
Cyanide WAD-335.2	EPA - 335.2
Nitrogen NH3-350.1	EPA-350.1
Nitrogen-NO3 + NO2 353.2	EPA 353.2
Nitrogen Nitrite354.1	EPA 354.1
Field D.O. SM 4500-0 G	SM 4500-0 G
Field Temperature EPA 170.1	EPA 170.1
Field Turbidity EPA 180.1	EPA 180.1
Field TDS EPA 160.1	EPA 160.1
GFAA As EPA 206.2	EPA 206.2

TEST NAME	TEST METHODOLOGY
GFAA Ag-EPA 272.2	EPA 272.2
Cyanide- Amenable SM 4500 CN G	SM 4500 CN G
ICP-Daily Metals-200.7	EPA-200.7
ICP-Total Metals-200.7	EPA-200.7
Cyanide 1677	EPA 1677
Mercury 245.2	EPA 245.2
Mercury 1631	EPA 1631
Nitrogen TKN-351.1	EPA-351.1
BOD-Winkler-Azide Modification Method	STM 20th edition 4500-O C.
TSS 160.2	EPA 160.2
Mercury 1631-Dissolved	EPA 1631
Oil & Grease -SGT HEM 1664	EPA 1664
GFAA Se EPA 270.2	EPA 270.2
Phosphorus-Soluble-Automated	EPA 365.2

7.0 Capabilities Review for Addition to Methods Performed

7.1 Tests may be added to methods performed after a review of resources and capabilities.

7.2 The Manager of Analytical Services is to review equipment, space and personnel resources to determine the capabilities of the laboratory to add methods.

7.3 The Quality Assurance Specialist is to review the method for proper quality control activities to be instituted for routine method performance evaluation.

7.4 The Quality Assurance Specialist and the Supervising Chemist are to review method validation requirements such as calibration requirements, method detection limit determination, training needed, accuracy and precision of the method for desired use of the data.

7.5 Following a determination that resources are satisfactory for successful performance, a test may be added. Standard Operating Procedures and method detection limit studies are to be added to the appropriate documentation.

8.0 Traceability of Calibration and Method Validation

8.1 Method Linearity Studies

8.1.1 Linearity studies are performed were appropriate to define the working range of the method and demonstrate that the response is linearly proportional to the analyte concentration.

8.1.2 Standards traceable to the National Institute of Standards are used for linearity studies. Vendor certification is retained for reference.

8.1.3 The correlation coefficient of the calibration curve must be 0.995 or better unless specified in individual Standard Operating Procedure. The linearity studies will also define the working range of the method.

8.1.4 The reporting level of a method must be included in the calibration curve, or must be verified each day of use with a control sample at the reporting level with 70%-130% recovery.

8.2 Method Specificity

8.2.1 Methods used at Northeast Ohio Regional Sewer District Laboratory are approved for monitoring and reporting to the Ohio Environmental Protection Agency.

8.2.1. Specificity is not monitored directly. Method bias is monitored by performing duplicate and spike analysis. Individual Standard Operating Procedures define the frequency and limits for variability and recoveries.

8.3 Method Accuracy

8.3.1 Method accuracy is monitored by the analysis of standards with each batch of samples. Individual Standard Operating Procedures define the acceptable performance.

8.3.2 The laboratory participates in proficiency test programs where sample are analyzed without prior knowledge of certified concentrations. Results are evaluated after the completion of the studies and any problem identified are addressed with corrective actions.

8.4 Method Precision

8.4.1 Method precision may be evaluated by the use of control samples of known concentration.

8.4.2 Sample matrix effects may create a positive bias or a negative bias. Method precision on specific samples is measured by the used of duplicates, spikes and spike duplicates. The accuracy is measured by the recovery and reproducibility of the recoveries.

8.5 Reagents and Standards

8.5.1 The type and purity of chemicals, reagents and solvents shall be dictated by the analytical method. Chemicals, reagents, and reference standards are purchased based upon the method specifications for each analysis regarding the purity of the material to be used in the analytical procedure. If a method does not specify the purity, then reagent grade (or better) chemicals, reagents and reference standards are purchased.

8.5.2 A reagent or chemical that does not meet the method specifications or is beyond the expiration date shall not be used.

8.5.3 The purity of reagents and solvents shall be monitored through reagent blanks that are analyzed with each set of samples.

8.5.4 Reference materials (standards) used to calibrate instruments or validate and monitor analytical methods must be National Institute of Standards Technology (NIST) traceable or equivalent.

8.5.5 When the laboratory receives a chemical the chemical is labeled with the following information:

8.5.5.1 Date of receipt,
8.5.5.2 Open date,
8.5.5.3 Expiration date,
8.5.5.4 Analyst initials.
8.5.5.5 Unique Trace ID

8.5.6 Reagents are prepared in a controlled room for most analytical procedures. All procedures are documented and reagents are labeled prior to use in the laboratory.

8.5.7 Buffers are discarded 6 months after being opened or after the manufacturer's expiration date. All other chemical reagents are maintained for six years after receipt, or according to manufacturer's expiration date, which ever comes first.

9.0 Sample Receipt and Handling

9.1 Samples analyzed at the within the Analytical Services Departments are not limited to pretreatment samples, plant influent, plant effluent, plant process control samples and receiving water from the treatment facility. Other sample types include sludge, soils, sediments and industrial wastes.

9.2 Samples are collected in designated containers, labeled with the date and delivered to the laboratory.

9.3 Chain of Custody procedures are defined in **SOP-5005-X Chain of Custody**.

9.3 Laboratory personnel track samples by the sampling location and the sampling date. A unique sample identifier is assigned by the LIMS.

9.4 If analysis is delayed samples are preserved and/or stored in refrigeration units until processed. Individual Standard Operating Procedures specify preservation and holding times. The hold time for grab samples starts from the time of sampling. The hold time for composite samples is measured from the time the sampling was completed.

9.5 Samples transferred to contract laboratories will be collected in bottles provided by the contract laboratory, and chain of custody forms. Sample storage will be performed at the instruction of the contracting laboratory.

10.0 Facility and Equipment

10.1 The laboratory facility is heated and cooled to maintain stable conditions throughout the year. Thermostats are programmable and provide control for laboratory and office spaces.

10.2 Hot and cold water are provided throughout the laboratory. Sinks are located throughout the laboratory to accommodate need. Laboratory water consists of a main Reverse Osmosis/Deionization (RO/DI) system.

10.3 Laboratory areas are limited access areas. Safety design was given top priority in the facility. Emergency showers, eye wash stations, and fire extinguishers are located throughout the laboratory.

10.4 Exhaust hoods are located in the laboratory for use when fume or odors are of concern. General fume hoods and local dedicated venting systems are located throughout the laboratory to provide adequate space for safe handing of materials and prevent exposure.

11.0 Equipment Calibration and Maintenance

11.1 Preventive maintenance is a scheduled program of actions taken to maintain analytical instruments and equipment and is performed whether or not the performance of the equipment indicates a need for. This maintenance is designed to eliminate the downtime that might occur from instrument failure.

11.2 The Management Staff of Analytical Services is responsible for ensuring all preventive maintenance is performed according to laboratory procedures. Instrument specific-standard operating procedures detail the maintenance program that is in place at the Northeast Ohio Regional Sewer District Laboratory.

11.2 Analytical balances are serviced under contact with the manufacturer. The calibration records are maintained as specified in the document control system.

11.3 Thermometers are calibrated annually and traceable to the National Institute of Standard. The maintenance and calibration of thermometers is addressed in specific Standard Operating procedure(s).

11.4 Ovens, refrigerators and incubators are monitored daily for acceptable performance. Adjustments are made as needed to meet specifications. Equipment needing continual adjustment is scheduled for servicing. The Quality Assurance Officer is responsible for reviewing records for performance compliance.

12.0 Data Verification and Internal Quality Control Activities

12.1 Each analyst is responsible for verifying the correctness of the data produced by any method. This verification includes reviewing the acceptability of produced data with respect to:

12.1.1 Correctness of numerical input
12.1.2 Numerical correctness of calculations
12.1.3 Acceptability of quality assurance/quality control data
12.1.4 Instrument operation according to method specifications (calibrations, performance checks, etc.)
12.1.5 Documentation of dilutions, standard concentrations, etc.

12.2 The analyst is further required to perform data review for each batch of samples. This review includes the prescribed QC activities, calculations and supporting documentation as specified by internal procedures. If changes are made to data or reports the changes will be clearly marked to show that they are to replace previously submitted data.

12.3 Data will be archived to allow the easy retrieval for submittal when requested. Raw data shall be kept with batch records. All files will be archived for five years, unless previous arrangements have been made with the customer.

12.4 Method Blanks (MB) are processed and analyzed with each analytical batch. Method blanks are used in the evaluation of contamination control practices. Method blanks with values ± the method reporting level are considered in control and related data can be reported without qualifiers. Data associated with methods blanks that do not meet acceptance criteria can only be reported as specified in specific procedures.

12.5 Initial Calibration Verification (ICV) standards are analyzed with each batch in order to evaluate stability of the calibration curve. This standard must be from an independent source.

12.6 Continuing Calibration Verification Standards (CCV) are analyzed with each batch in order to evaluate stability of the calibration curve. The acceptance criteria for each analytical method are specified in individual SOPs.

12.7 Laboratory Control Standard (LCS) is analyzed with each batch as required by standard operating procedures. An LCS is used to evaluate the methodology. If an LCS is in control it is considered evidence that the procedure was in control when performed. The limits for the control standard are specified in individual method SOPs. An LCS may not be available for some methods such as dissolved oxygen. Individual SOPs will specify activities to be performed.

12.8 Matrix Spikes and Matrix Spike Duplicates (MS/MSD) are analyzed in order to determine matrix effect and to evaluate precision. Alternatively, a duplicate and a spike, if appropriate, are performed per batch. The limits for spike recovery and precision are dependent on the analyte and method. Individual SOPs specify limits and actions to be taken. Methods such as pH and suspended solids cannot be spiked. Individual SOPs will specify activities to be performed.

12.9 Raw analytical data are recorded, dated, initialed, or signed on analytical data sheets. Data from instrument output is dated and initialed. Analytical data sheets include provisions for the QC data, including calibration data, method blank data, duplicate data, spike data, and laboratory control standard data, as appropriate for each analytical procedure.

12.10 On-going quality control data generated is tracked per standard operating procedures. Generation of control charts is the responsibility of the analysts. Review of the control charts is the responsibility of the Supervising Chemist. When anomalies or out of control conditions arise, the Quality Control Specialist is contacted to initiate required corrective action as prescribed in individual standard operating procedures.

12.11 Reagents and chemicals used are of the purity specified in the procedure. Method blanks are carried through analysis procedures as an evaluation of contamination and stability of reagents.

13.0 Corrective Actions

13.1 The Quality Assurance Specialist is responsible for the administration of the corrective action system. The system is to be used to assign responsibility, document action taken and to track activities in order to ensure completion of assignments and meeting of deadlines.

13.2 Method specific corrective action is specified in individual procedural SOPs. Method specific corrective actions mainly address quality control activities that do not meet acceptance criteria specified in the individual standard operating procedures. If these actions fail to correct the observed non-compliance then the corrective action system is to be followed.

13.3 The corrective action system can be used to respond to findings of internal, customer or regulatory audits. The corrective action system can be used to respond to adverse events in the processing of materials. Corrective action may be used to respond to customer complaints. The corrective action system is used whenever departures from documented policies or procedures occur. Changes in the Quality System are documented using the Corrective Action System.

13.4 Completed corrective action are documented and maintained by the Quality Assurance Specialist. Records are maintained with the other controlled documents for 5 years.

14.0 Control of Data Generated from non-Conforming Activities

14.1 The Quality Assurance Specialist is responsible for responding to activities (i.e. calibration, analysis) that are non-conforming to policy and specifications. The Quality Assurance Specialist is to be responsible for the gathering of information needed to assess the impact of the non-conformance on data and laboratory performance.

14.2 The Manager of Analytical Services, the Quality Assurance Specialist and addition individuals at the discretion of the Superintendent are to evaluate the significance of the non-conformance and the corrective action.

14.3 The review must include if client notification is necessary, if work must be recalled and when work can resume.

14.4 The response to the non-conformance is to be documented and handled through the corrective action system.

15.0 Complaints

15.1 Complaints are to be directed to the Manager of Analytical Services or the Quality Assurance Specialist. The Manager of Analytical Services or the Quality Assurance Specialist will determine if the complaint merits a response.

15.2 When a complaint raises doubt concerning the laboratory's compliance with the laboratory's policies or procedures or with the quality of the laboratory's results, those areas involved will be audited.

15.3 When the complaint meets the criteria above the corrective action system will be used to initiate, track and respond to the complaint and its findings.

16.0 Confidentiality and Public Access

16.1 Northeast Ohio Regional Sewer District Laboratory is part of a public entity and as such the information generation by the laboratory may be public information.

16.2 All external requests for laboratory data from agencies not currently working with the District must be directed to the Districts Legal Department. All other request can be directed to the Manager of Analytical Services for resolution.

17.0 Data Review and Audits

17.1 The Quality Assurance Specialist will be responsible for audits. Northeast Ohio Regional Sewer District Laboratory personnel may perform audits or an outside auditor may be contracted to perform audits.

17.2 The audits are to verify if the laboratory is in compliance with the requirements of the laboratory's quality system as defined in the Quality Manual and standard operating procedures. The results of the audits are considered internal information and not released during audits or inspections.

17.3 Response to findings during an audit is handled through the Corrective Action System.

18.0 Training and Demonstration of Capability

18.1 The Quality Assurance Specialist is responsible for an annual review of the performance records of the laboratory personnel.

18.2 A review of the performance on required quality control activities on each analytical procedure will be used to evaluate an analyst's capability. If the last four laboratory control samples are in control this will be considered sufficient evidence that the analyst is capable of performing the procedure.

18.3 If one the last four laboratory control samples do not meet the method acceptance criteria then training may be required by the Quality Assurance Specialist. Required training is to be documented as corrective action.

18.4 Demonstration of capability to add a new method will be accomplished by analyzing a laboratory control sample four times. The average recovery and standard deviation will be calculated and if the laboratory values are within the published limits the procedure can be performed in the laboratory. Corrective action must be performed and the analysis repeated until it can be demonstrated that the laboratory can generate the expected performance data.

19.0 Ethical Conduct

19.1 It is the policy of Northeast Ohio Regional Sewer District Laboratory to perform our duties in a manner that will reflex our commitment to highest possible ethical standard. We will perform and report our work in a manner that accurately reflects the results obtained in the laboratory.

19.2 Management will provide and document training on the ethical conduct expected in the performance of laboratory duties. Ethics training includes examples of unacceptable conduct, how to report observed misconduct and possible penalties.

19.3 It is the responsibility of every employee to report only his or her own data and to report it accurately. Every employee has the responsibility to notify management when they become aware of unethical conduct by another employee.

20.0 Reporting of Data

20.1 Northeast Ohio Regional Sewer District Laboratory provides service to the Director of Operations and Maintenance for regulatory reporting, and facility operation. Report services for the pretreatment and stream monitoring programs are provided to the Manager of Water Quality and Industrial Surveillance. Reports will be in a format that will allow the Superintendent to meet these goals. Release of information to a third party is at the instruction of the Director of Operations and Maintenance and the District's Legal Department.

20.2 Reports will clearly reflect the sample identification; date sampled, results obtained and reporting units.

Appendix C

Standard Operating Procedures

Laboratory Processing of Benthic Samples

Upon arrival at the laboratory, the Hester-Dendy (H-D), Surber, and qualitative samples were logged in and accounted for. Prior to sorting and identification, each sample was rinsed on a No. 60 (0.250 mm openings) U.S. Standard Testing Sieve to remove the preservative and the H-D plates were scraped to remove the organisms. Sorting of each H-D and Surber sample was conducted in a white enamel pan first under a magnifier lamp and finally under a compound dissecting scope. If necessary, a Folsum sample splitter was used to subsample the H-Ds and Surbers until a more manageable number of organisms was achieved. Prior to splitting, the sample was pre-picked to remove any large and/or rare taxa. In all a minimum of 250 organisms in representative proportions were removed from the fractionated samples. Organisms were sorted to higher taxonomic levels (generally Class or Order level) and preserved separately in labeled vials containing 70% ethyl alcohol. To assure a consistent level of quality and sorting efficiency, senior EA personnel checked all samples. The qualitative samples contained very little detrital matter and therefore were simply rinsed prior to identification.

Macroinvertebrate identifications were made to the lowest practical taxonomic level using the most current literature available (see attached list of taxonomic literature). Whenever possible, the level of identifications followed those recommended by Mr. Jeffery DeShon of the Ohio EPA (pers. comm., 1998). Chironomidae larvae were cleared in warm 10% potassium hydroxide and mounted in CMC-10 prior to identification. Generally, 100 chironomids from any single sample were mounted for identification. For all sample types, specimens were enumerated, coded and recorded on a standard laboratory bench sheet for data processing.

Data Analyses

The Invertebrate Community Index (ICI) was used as the principal measure of overall macroinvertebrate community condition. Developed by the Ohio EPA, the ICI is a modification of the Index of Biotic Integrity for fish (Ohio EPA 1987). The ICI consists of ten individually scored structural community metrics:

1. Total number of taxa
2. Total number of mayfly taxa
3. Total number of caddisfly taxa
4. Total number of dipteran taxa
5. Percent mayflies
6. Percent caddisflies
7. Percent Tanytarsini midges
8. Percent other dipterans and non-insects
9. Percent tolerant organisms
10. Total number of qualitative EPT taxa.

Scoring criteria for all ten metrics is dependent upon drainage area. The scoring of an individual sample was based on the relevant attributes of that sample compared to equivalent data from 232 reference sites throughout Ohio. Metric scores range from six points for values comparable to exceptional community structure to zero points for values that deviate strongly from the expected range of values based on scoring criteria established by Ohio EPA (1989a). The sum of the individual metric scores resulted in the ICI score for that particular location.

Calculation of the ICI was conducted using a computer program written for the software SAS® by EA in 1994. This program is continuously tested and updated to ensure its accuracy. Although the ICI is most often used to analyze the combination of H-D and qualitative data from a particular location, for this study, the ICI was also calculated for the combination of Surber and qualitative data when H-D data were not available.

The only other statistical comparison used was the relative abundance (or percent composition) of individual taxa from each site and sample type. Relative abundance was calculated for both sample types as:

$$\text{Rel. Abund.(\%)} = 100 \times \frac{\text{\# Individuals of a Taxa}}{\text{Total \# of Individuals in Sample}}$$

All sample processing and data analysis were completed by permanent and full-time EA Engineering, Science, & Technology, Inc. staff working our Deerfield, Illinois office and laboratory. Specific staff members that worked on this project and relevant experience are listed below by task:

Task	**EA Personnel**	**Years of Experience**
Login	Sarah Olson	1.5
Sorting	Nick Wood	1
Chironimid Mounting	Paul Hauser	2
	Sarah Olsen	1.5
Identification	Marty Sneen	17
Data Analysis	Matt Poore	1
	Joe Vondruska	22
	Marty Sneen	17

Selected Ohio EPA Reporting Requirements

Item 12-Taxonomic literature

Although EA's taxonomic library contains substantially more references than are listed here, the following list only includes taxonomic literature used to identify the benthos in samples from Big Creek, Doan Brook, Euclid Creek, and Mill Creek.

Bednarik, A.F. and W.P. McCafferty. 1979. Biosystematic revision of the genus Stenonema (Ephemeroptera: Heptageniidae). Canadian Bulletins of Fisheries and Aquatic Sciences 201:1-73.

Bode, R.W. 1983. Larvae of North American Eukiefferiella and Tvetenia (Diptera: Chironomidae). New York State Museum Bulletin 452:1-40.

Bolton, M.J. 1998. Guide to the identification of larval Chironomidae (Diptera) in the temperate eastern Nearctic north of Florida. Ohio EPA, Division of Surface Water, Ecological Assessment Section, Columbus, Ohio.

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Item 13-Reference Collection

A reference collection was not necessary for identification of these specimens. However, if a reference collection had been needed to verify any specimens, EA maintains a sizable macroinvertebrate voucher collection with over 1800 specimens representing over 700 taxa. If this taxonomic library proved to be insufficient, every reasonable attempt would be made to have the specimen(s) identified or verified by a noted authority.

Item 16-Chironomidae Identification

Chironomidae larvae were cleared in warm 10% potassium hydroxide and mounted in CMC-10 prior to identification. Generally, 100 chironomids from any single sample are mounted for identification. Species level identifications generally follow those suggested by Ohio EPA.

Item 17-Copies of Raw Data

Copies of the laboratory bench sheets are appended to the hard copy of this document.

Item 18-ICI Calculation

The Invertebrate Community Index (ICI) was used as the principal measure of overall macroinvertebrate community condition. Developed by the Ohio EPA, the ICI is a modification of the Index of Biotic Integrity for fish (Ohio EPA 1987). The ICI consists of ten individually scored structural community metrics:

1. Total number of taxa
2. Total number of mayfly taxa
3. Total number of caddisfly taxa
4. Total number of dipteran taxa
5. Percent mayflies
6. Percent caddisflies
7. Percent Tanytarsini midges
8. Percent other dipterans and non-insects
9. Percent tolerant organisms
10. Total number of qualitative EPT taxa.

Scoring criteria for all ten metrics is dependent upon drainage area. The scoring of an individual sample was based on the relevant attributes of that sample compared to equivalent data from at least 232 reference sites throughout Ohio. Metric scores range from six points for values comparable to exceptional community structure to zero points for values that deviate strongly from the expected range of values based on scoring criteria established by Ohio EPA (1989a). The sum of the individual metric scores resulted in the ICI score for that particular location.

Calculation of the ICI was conducted using a computer program written for the software SAS® by EA in 1994. This program is continuously tested and updated to ensure its accuracy.

Item 20-Statistical Analyses

The only other statistical comparison used was the relative abundance (or percent composition) of individual taxa per site and sample type. Relative abundance was calculated for both sample types as:

$$\text{Rel. Abund.} = \frac{\text{\# Individuals of a Taxa}}{\text{Total \# of Individuals in Sample}}$$

Item 21-Results

Complete results are appended to the hard copy of this document.

Item 25-Electronically Formatted Data

For convenience, the data and text are provided in electronic format as Word 2003® files via email and on the enclosed CD-RW.