Quality Assurance Project Plan
Title and Approval Sheet
Final Draft, August 26, 2002
Cuyahoga River Old Channel Assessment

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QAPP Distribution List

Each of the following individuals will receive a hard copy of this Quality Assurance Project Plan (QAPP). A copy of the final signed QAPP should be retained by each of these individuals until the completion of laboratory analysis and final acceptance of the data report. All individuals listed below must receive a hard copy of any changes or addendums to the QAPP.

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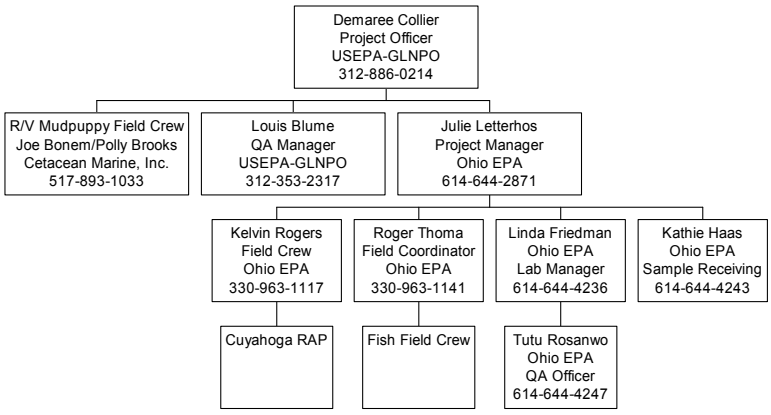
A. Project Management

A.1. Project Organization

Figure 1 provides a summary of the project organization for this study.

Figure 1. Project Management Organization



Ohio EPA is the principal investigating agency for this survey. Ohio EPA is responsible for the development, coordination and implementation of the sampling plan and QAPP, and is the principal client for the final data. Sediment cores will be collected in association with U.S. EPA – GLNPO and the use of the *R/V Mudpuppy.* The Ohio EPA, Division of Environmental Services, will provide all analytical services. Staff associated with this project and their responsibilities include:

Person:	**Responsibilities:**
Demaree Collier U.S.EPA – GLNPO 77 W. Jackson Blvd. (G-17J) Chicago, IL 60604 Phone: 312-886-0214 Collier.demaree@epa.gov	Project Officer Grant oversight and budgeting Coordinating sediment collection Technical guidance Field Team member Review and approval of final deliverables
Louis Blume U.S. EPA – GLNPO 77 W. Jackson Blvd (G-17J) Chicago, IL 60604 Phone: 312-353-2317 Blume.louis@epa.gov	GLNPO QA Manager Review and approve QAPP
Julie Letterhos Ohio EPA – DSW P.O. Box 1049 Columbus, OH 43216-1049 Phone: 614-644-2871 julie.letterhos@epa.state.oh.us	Project Manager Grant oversight and budgeting Coordinate Ohio EPA support Prepare QAPP Review Final Report Field Team Member Coordinate delivery of field samples to lab

Roger Thoma Ohio EPA – NEDO 2110 East Aurora Rd. Twinsburg, OH 44087 Phone: 330-963-1141 Roger.thoma@epa.state.oh.us	Fish Field Coordinator Conduct fish community sampling Conduct fish tissue sampling Provide SOP for electro-fishing Review QAPP Analyze fish community data Review Final Report Ensure all QA/QC procedures for fish sampling are followed in the field
Kelvin Rogers Ohio EPA – NEDO 2110 East Aurora Rd. Twinsburg, OH 44087 Phone: 330-963-1117 Kelvin.rogers@epa.state.oh.us	Cuyahoga River RAP coordinator Field Team Member Prepare historical use study Review QAPP Prepare Final Report Communicate with Cuyahoga RAP
Linda Friedman Ohio EPA – DES OSU, Murray Hall 1517 Perry St. Columbus, OH 43210 Phone: 614-644-4236 Linda.friedman@epa.state.oh.us	Laboratory Manager Provide lab SOPs Review QAPP Provide all analytical support
Tutu Rosanwo Ohio EPA – DES OSU, Murray Hall 1517 Perry St. Columbus, OH 43210 Phone: 614-644-4247 Tutu.rosanwo@epa.state.oh.us	Ohio EPA QA Officer Review QAPP Ensure all analytical procedures adhere to approved laboratory QA/QC methods Review data quality indicators Review final analytical data
Kathie Haas Ohio EPA – DES OSU, Murray Hall 1517 Perry St. Columbus, OH 43210 Phone: 614-644-4243 Kathie.haas@epa.state.oh.us	Assure the integrity of samples once received at the lab and that appropriate chain of custody is followed Provide all sample bottles and preservatives Coordinate with field team for sample delivery

A.2. Background and Problem Definition

The Cuyahoga River flows into the central basin of Lake Erie at Cleveland, Ohio. Within the Lake Erie basin, the Cuyahoga River has long been considered the single most environmentally disturbed system and is a Great Lakes area of concern. Considerable modification of the physical habitat of the lower river has occurred, particularly as a result of navigation needs. In 1827, a bypass channel was dredged allowing the river to enter the lake approximately one mile above the natural mouth. This eased some navigation problems, but the bypass channel diverted river flow and the natural mouth was filled in, leaving the original course of the river a blind channel. Both the old channel and the lower main stem of the river are now heavily used navigation channels lined with factories, commercial docks and storage facilities, marinas and entertainment complexes. These segments of the river have been severely modified by deep

dredging, bank-shaping and shoreline structures of steel sheet piling, cement seawall and limestone rip-rap.

In spite of the massive physical alterations and decades of pollutant discharge, the area at the upper end of the old channel has returned to some semblance of naturalness by regaining beds of submerged aquatic vegetation. Fish community surveys over the past several years indicate the potential for the old channel to support a diverse fish community. However, the fish that populate this area display high levels of DELT anomalies. Brown bullhead, observed in the old channel by both USGS-BRD and Ohio EPA, have a high incidence of tumors. Much of the old channel is continually dredged to maintain a depth of 21 ft., and it is assumed that this would reduce the potential for contaminants to concentrate there. However, the upper blind end of the channel is much shallower, rarely dredged and has little circulation or flushing. Lake Erie seiches also contribute to backflow and the potential to direct polluted water from the main river channel into the old channel. There is also the potential that sediments along the stream banks adjacent to the dredged channel may harbor elevated levels of contaminants. Existing sediment data for the old channel is limited to several sites sampled by the Corps of Engineers in the dredged navigation channel. This project will focus on the approximately one-mile long old channel.

The high incidence of brown bullhead tumors and DELTs in other species suggests that a serious contamination problem exists. Ohio EPA proposes a screening assessment of the old channel portion of the Cuyahoga River navigation channel to determine the potential presence and sources of contaminants that may be causing a high incidence of tumors and DELT anomalies in brown bullhead and other fish. The results of this project will assist Ohio EPA in determining if additional actions are needed to characterize contaminant problems in the old channel. The results will also assist the Cuyahoga River RAP to better document the beneficial use impairments in the old channel and the need for remedial actions.

A.3. Project/Task Description

Ohio EPA proposes to conduct a screening assessment of the old channel of the Cuyahoga River to provide a background environmental status report. Ohio EPA will collect fish community and fish tissue data, and coordinate with U.S. EPA/GLNPO to collect sediment core samples using the *R/V Mudpuppy*. Ohio EPA will also conduct a reconnaissance survey to compile the potential past and present sources of contaminants to the area. A map of the old channel and the approximate sampling locations is presented as Figure 2. Specific tasks are listed below.

A.3.1. Historical Reconnaissance Survey of Old Channel and Adjacent Properties

A history of the area will be compiled to investigate past and present industrial use, presence of landfills or abandoned disposal sites, past spills or “pollution events” (i.e. warehouse fire), dredging history (401/404 permits), marina development, current use and location of discharges (NPDES permits), and history of the relocation of the river mouth. The preliminary results of this study will provide background documentation to identify potential source areas and may help to better position the sampling sites. This task will also include compilation of any existing environmental data for the old channel.

A.3.2. Sediment Chemistry Sampling

The Ohio EPA proposes to sample 18 sites in the old river channel for sediment analysis. Seven sites will be in the shallow upstream, non-dredged area; five sites will be located between the dredged channel and the riverbank; and six sites will be in the slips adjacent to the old channel. Sample locations are approximate and the actual sample site locations will be recorded in the field. Two to three subsamples will be collected per sediment core, with the 0-1 ft. horizon initially established. Remaining subsamples will be collected at the discretion of the field crew based on appearance of the sediment cores and suspected zones of contamination. Each sample will consist of subsamples from the selected horizon that are composited and homogenized and then placed in sample containers. All sediment samples will be analyzed for total metals (including

mercury), particle size, total organic carbon, VOCs, PCBs and organochlorine pesticides and BNAs (including PAHs). Also, in order to remain comparable to historical data, surface grabs using a Ponar will be collected at sites within each of the six representative zones.

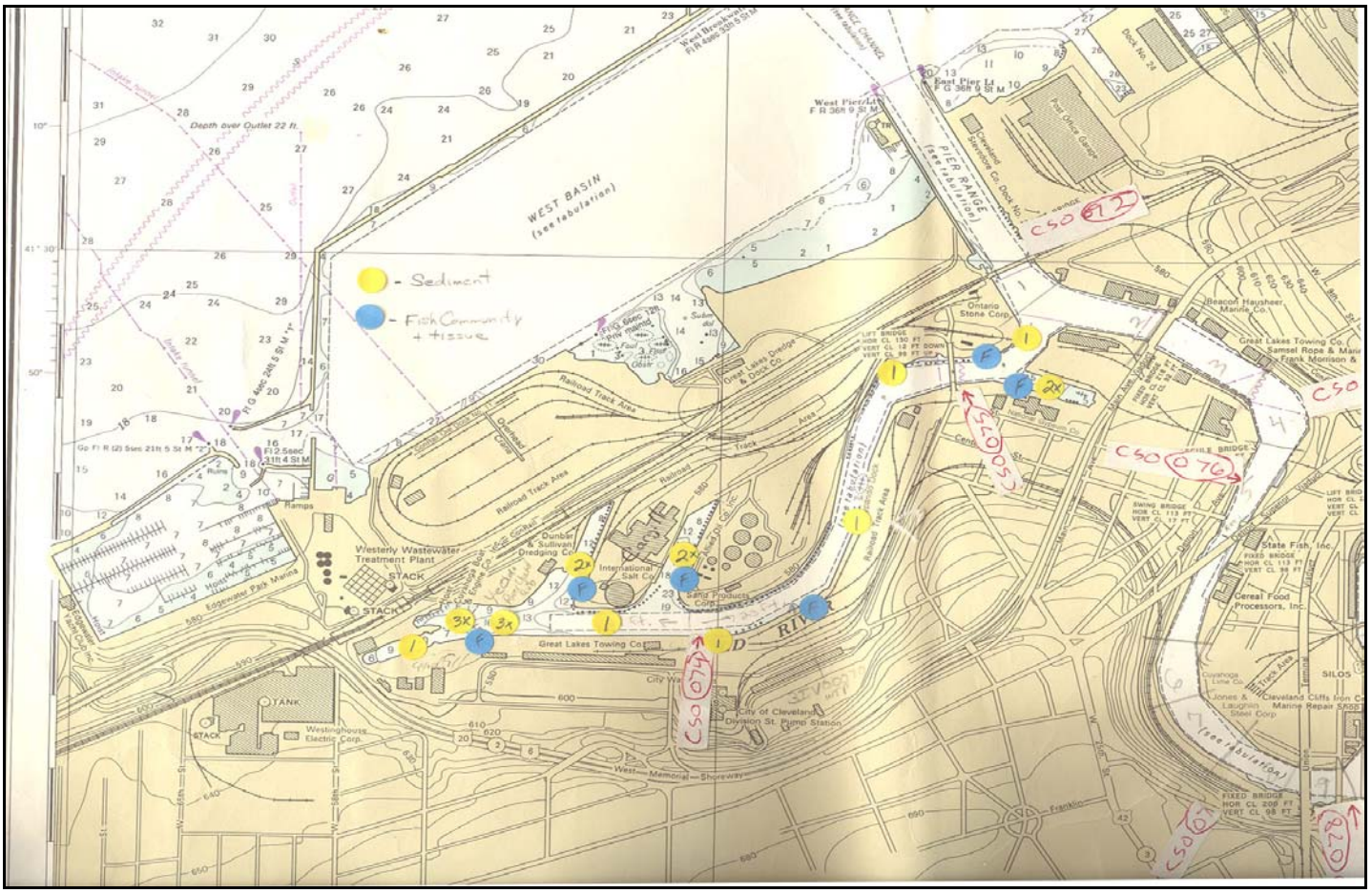
A.3.3. Fish Community Sampling

Six zones, approximately 400 to 500 meters long and within one meter of shore, will be surveyed for fish community composition. Electro-fishing gear will be used and all fish collected will be identified to species, counted, measured, weighed and checked for DELTs and external tumors. The six zones will cover the length of the old channel.

A.3.4. Fish Tissue Sampling

Fish tissue samples will be collected in each of the six fish community zones. Samples will consist of a composite of whole body carp. Samples will be analyzed for the bioaccumulative metals, (mercury, selenium, cadmium, arsenic and lead), PCBs and organochlorine pesticides. Fish tissue will not be analyzed for PAHs as they tend to metabolize rather than bioaccumulate.

Figure 2. Map of Cuyahoga Old Channel with approximate locations of sampling sites and fish zones. (yellow dots are sediment sites; blue dots are fish sites)



A.3.5. Project Schedule

Table 1. Tentative Project Schedule

Task	Completion Date
QAPP development and sign-off	April 30, 2002
Preliminary Historical Use report	May 5, 2002
Sediment sampling	Week of May 13, 2002
Fish community and fish tissue sampling	Week of May 6, 2002
Obtain analytical results	August 2002
Submit progress report to Project Officer	September 2002
Review results and prepare draft report	November 2002
Submit final report and recommendations for next steps	February 2002
Project End	February 2002

A.4. Data Quality Objectives and Criteria

A.4.1. Historical Use Reconnaissance Survey

Records of Ohio EPA, USEPA-EDO, local agencies, local libraries, Cuyahoga RAP, etc. will be searched to provide a history of any activities that may have contributed contaminants to the old channel. Particular interest is in identifying any sources of PAHs and PCBs.

A.4.2. Sediment Chemistry

Sediment chemistry data will be compared to existing sediment quality quidelines (SQGs) as referenced in MacDonald et al. (2000) and Persuad et al. (1993). They will also be compared to background concentrations in the Lake Erie basin sediment project report (Ohio EPA and Heidelberg College 1998). Of particular concern will be screening for levels of contaminants that may be associated with tumor development – PAHs and PCBs. Since this is a screening survey, the sediment data will be used to determine if the contaminants of concern exist at elevated levels that may contribute to tumor development in brown bullhead and/or trigger further investigations. Results will also be discussed with Dr. Paul Baumann, USGS-BRD, per their connection to fish tumor occurrence.

A.4.3 Fish Tissue Sampling

Fish tissue chemistry analysis will be conducted following Ohio EPA analytical methods used statewide so results will be comparable to any existing recent data. Levels of contaminants will be compared to guidelines used by the Ohio Department of Health to determine fish consumption advisories, and also to the Fish Consumption Beneficial Use Impairment Report prepared for the Lake Erie Lakewide Management Plan (LaMP) (Lambert, 1999).

A.4.4. Fish Community Survey

Fish community surveys will be conducted in accordance with the SOP presented in Appendix A. Ohio EPA has developed fish monitoring methodology specifically for the lower tributary and harbor areas (lacustuaries). IBIs and MIWBs will be calculated for this area and compared to the "lacustuary" values developed by Ohio EPA (Thoma, 1999). The percentage of DELT anomalies and external tumors will also be recorded to estimate the general health of the resident fish community. A qualitative habitat evaluation (QHEI) will also be conducted.

All field and laboratory procedures will adhere to those developed and approved by Ohio EPA. Definitions of precision, accuracy and completeness are contained in Ohio EPA's QAPP Integrated Work Program (Ohio EPA, 1995). Standard Operating Procedures (SOPs) for all field sampling and laboratory analytical work are contained in the Manual of Laboratory Standard Operating Procedures, Volumes I, II and III (Ohio EPA, 2001).

A.5. Special Personnel, Training and Equipment Requirements

Sediment sampling will require the use of the U.S.EPA/GLNPO's *R/V Mudpuppy* and her captain and crew.

Ohio EPA staff will conduct fish community surveys using electro-fishing methodology designed specifically for Lake Erie lake-effect tributaries and harbors (lacustuaries).

A.6. Documentation and Records

The Ohio EPA project manager will ensure that all the appropriate project personnel have the most current approved version of the QAPP and that all staff are aware of scheduling and their responsibilities.

The project manager will maintain a project field notebook to contain all planning meeting notes, field data sheets, copy of ship's log, historical background report, copies of laboratory chain of custody forms, field expenses, and any other communication that may be important to preparation of the final project report. Field data sheets will be completed for each sediment sampling station, each fish tissue sampling area, and each fish community zone. Latitude and longitude will be recorded for each station using GPS to ensure accurate interpretation of where contaminant problems exist. Copies of field data sheets and forms to be used are included in Appendix B.

Copies of all laboratory records documenting sample handling and analysis will be submitted to the project manager and maintained in the permanent project file. All laboratory reports and analytical data will be handled as outlined in the Ohio EPA QAPP Integrated Work Program (Ohio EPA 1995).

All data will be entered into Ohio EPA databases and submitted to USEPA/GLNPO in MS Excel format. Per GLNPO project/grant guidelines, a final copy of the project report will be provided in hard copy, electronic and html versions.

B. Data Generation and Acquisition

B.1 Sampling Process Design and Rationale

A high incidence of tumors in brown bullhead observed by Ohio EPA and USGS-BRD in separate surveys suggests that contamination is present in the old channel. Lack of sediment data and environmental background information in general make it impossible to determine the reason for the fish tumors. This screening assessment was designed to determine if contaminated sediment is present, what contaminants are present, and if contamination is high enough to initiate additional site characterization and remediation. **Sites were chosen based on proximity to potential sources, whether the area has been or is regularly dredged, and the location of aquatic vegetation**. The sites were also chosen to provide representative coverage of the various channel characteristics, i.e. shallow upper channel, area adjacent to the regularly dredged commercial navigation channel, and slips off the river. Fish community surveys will be conducted in six zones to cover the basic habitat types and to determine the diversity available, as well as the general condition of the fish community (i.e. DELTs and tumors).

Using the rationale and SOPs in Ohio EPA 2001 and Ohio EPA 1994a, samples for fish tissue analyses will be collected of whole body carp. Each sample will be comprised of a composite of five fish of similar size. The only variance from the SOP will be that the aluminum foil used to wrap the fish samples will not be decontaminated with acetone. Tests by the Ohio EPA lab determined that this step is no longer necessary. Fish tissue SOPs are presented in Appendix D.

Sediment cores will be collected at 18 sites. Seven sites will be in the most upstream shallow area where deep sediment is expected and where contaminants may have accumulated over time since little to no maintenance dredging is done in this area. Five sites will be along the edge of the navigation channel and six sites will be in the three slips adjacent to the channel. Cores were chosen rather than grab samples to provide an indication of past contaminant loading and the preliminary depths as to where contaminants might exist. Pictures will be taken of each core and labeled for reference when preparing the final project report. In order to comply with limited resources, each core will be split into two to three subsections. Subsamples from each section will be composited and homogenized. Sediment samples will be collected using SOPs in Appendix C. VOCs are not typically found in sediments in the Lake Erie watershed, so only minimal screening will be done unless the background reconnaissance survey suggests that VOCs may be a contaminant of concern.

The fish zones will cover the length of the approximately one-mile-long channel, and each will be 400-500 meters long and one meter from shore. Samples will be collected once, in the spring, to coincide with when brown bullhead will be in the area.

B.1.2. Definition of Sample Types

Three types of sediment samples will be collected during this survey: routine field samples (RFS); field replicates (FR); and field duplicates (FD). Each sample type is described below.

Routine Field Samples (RFS): Routine field samples will be collected by splitting a core into several sections, taking subsamples from each portion and homogenizing them, and filling all required sample jars. Routine field samples will be collected at 18 locations, with two to three samples collected at each site.

Field Duplicates (FD): Prepared by filling a second set of sample jars from a homogenized core subsample. Four FDs will be collected.

Field Replicates (FR): Prepared by collecting a second, separate sediment core sample, homogenizing the material separate from the RFS and filling the required sample jars. FRs will be collected at two locations.

B.1.3. Type and Number of Samples

Table 2 summarizes the type and number of samples to be collected during this project. The estimated number of samples includes all RFS, FD, and FRs.

Table 2. Summary of Type and Number of Samples to be Collected

Sample Type	Number of Samples	Sample Matrix	Analysis Required
Sediment Chemistry from Cores and Surface Grabs	69	Sediment	Total PCBs, BNAa(PAHs), metals, TOC, Particle size, Organochlorine pesticides
Sediment VOCs	20	Sediment	VOCs
Whole Body Carp	6	Fish Tissue	Total PCBs, metals, organochlorine pesticides
Fish Community	6	Water	Identified to Species

All of the data listed in Table 2 is considered critical to the success of this assessment-screening project.

B.2 Sampling Methods

SOPs for all field measurements are contained in Ohio EPA, 1991 or 2001. At each sediment site, measurements will be taken for latitude/longitude location. This data is critical for use in determining where sediment samples were collected. The two Differential Global Positioning Systems (DGPS) onboard the R/V Mudpuppy are both capable of ascertaining horizontal locations with < 5 meters of accuracy. To achieve this accuracy, it is important that the DGPSs are in good working order and are obtaining strong satellite signals. The R/V Mudpuppy field team will be responsible for checking the satellite signal strength for the DGPS systems prior to recording this data and for ensuring that the two systems are recording equivalent horizontal locations. Any problems with signal strength of differences between the two systems shall be recorded in the field sample log. A qualitative description should also be provided in the field log utilizing any available permanent landmarks. Ohio EPA will collect other field data including a water column profile for temperature, dissolved oxygen, pH, and conductivity. Water depth will also be recorded.

Sediment cores will be collected utilizing the vibracorer sampling device located on the *R/V Mudpuppy.* Appendix C contains the equipment needs, the SOPs, and the decontamination procedures for the collection of sediment core samples. Sediment cores will be split with subsamples of the upper 1-foot composited and homogenized as one sample, and subsamples of two or three sections of the lower core composited and homogenized as additional samples. In the unexpected event that it is not possible to obtain a core sample, a ponar sample will be taken instead following the SOP in Appendix C.

The fish community will be surveyed in six 400-500 meter zones using the SOP in Appendix A.

Fish tissue samples will be collected for whole body carp using the SOP for fish tissue included in Appendix D.

B.3. Sample Handling and Custody

B.3.1 Sample Containers

After processing, sediment samples will be placed into the appropriate sample containers as summarized in Table 3. A field sample data sheet will be completed for each sampling location. All containers, lab analytical request sheets, and chain-of-custody forms will be provided by Ohio EPA, Division of Environmental Services (DES). Notify Kathie Haas, DES, 24 hours in advance for supply pick-up. Coolers will be provided by Ohio EPA, Northeast District Office, Division of Surface Water.

Table 3. Sediment Sample Volume and Container Type

Parameter	Sample Volume	Container Type	Holding Time
VOCs	60 mls	60 ml wide mouth glass vial with Teflon lined lid. Fill to eliminate head space	Extracted within 14 days
Semi-volatiles and PAHs	100 g	500 ml wide mouth amber glass jar with Teflon lined lid	Extracted within 14 days
Pesticides/PCBs	100 g	500 ml wide mouth amber glass jar with Teflon lined lid	Extracted within 14 days
Metals	250 g	500 ml wide mouth glass jar with Teflon lid	Hg – 28 days All other metals – 6 months
Particle Size	500 g	Plastic ziplock bag or 500 ml HDPE	
TOC	125 g	125 ml glass jar with Teflon lined lid	14 days

All samples except particle size will be immediately stored on ice in coolers and shipped to the lab within 48 hours.

Fish tissue samples will be wrapped in foil packages, frozen with dry ice and delivered to the lab within 48 hours.

All sample handling and custody results will be followed as referenced in Ohio EPA, 1995 and 2001.

B.3.2. Sample Labeling

All sample containers will be labeled with the site name/sample ID as it appears on the laboratory submission form and field data sheets, date, time (military), type of sample and name of collector. All labeling will be done using tape or waterproof labels and indelible blue or black ink.

B.4. Analytical Methods Requirements

EPA approved standard methods will be used. Quantitative methods to be employed include atomic absorption (AA), emission spectroscopy (ICP), and manual cold vapor for heavy metals, GC/MS for semi-volatiles, VOCs and PAHs, and GC for PCBs and organochlorine pesticides. Quantitative analyses will be performed by the Ohio EPA, Division of Environmental Services (DES) as referenced in Ohio EPA 2001.

Methods and RLs are included in Appendix E.

B.5 Quality Control Requirements

All analytical procedures are documented in writing as SOPs, and each SOP includes QC information that addresses the minimum QC requirements for the procedure. The internal QC checks might differ slightly for each individual procedure. Examples of some of the QC samples that will be used during this project include:

- Method blanks
- Reagent/preparation blanks
- Surrogate standards
- Analytical spikes
- Field replicates
- Field duplicates
- Laboratory duplicates
- Matrix spike/matrix spike duplicate
- Laboratory quality control check standards

The actual QC sample requirements will be dictated by the method requirements. Details on the use of each QC check are provided in the analytical SOPs provided for each measurement (see Ohio EPA 2001).

B.6. Instrument/Equipment Testing, Inspection and Maintenance Requirements

The purpose of this section is to discuss the procedures used to verify that all instruments and equipment are maintained in sound operating condition, and are capable of operating at acceptable performance levels.

As part of the Ohio EPA, Division of Environmental Services QA/QC program, a routine preventative maintenance program will be conducted to minimize the occurrence of instrument failure and other system malfunctions. All laboratory instruments are maintained in accordance

with manufacturer's specifications and the requirements of the specific method employed. This maintenance is carried out on a regularly scheduled basis.

B.7. Instrument Calibration and Frequency

Parameter specific calibration procedures and frequency requirements for quantitative analyses are defined in the method SOPs and contained in Ohio EPA 2001.

B.8. Inspection/Acceptance Requirements for Supplies and Consumables

The purpose of this section is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the project.

Supplies for sediment core collection and handling will be provided by the crew of the R/V Mudpuppy. All sample bottles and distilled/deionized water will be provided by Ohio EPA, DES. The Ohio EPA laboratory will use high quality supplies (i.e. gases, reagents, etc.) during the analysis of samples from this project. Water purification systems are tested on a regular basis and solvent blanks are run to verify the purity of solvents used in organic analyses. The lab will utilize their standard practices to handle, process and analyze samples.

B.9. Data Acquisition Requirements

Information collected from files and documents for the historical use report will be documented and listed in the References section of the report. Any existing data that is collected for the old channel area will be reviewed for data quality, methods and detection limits.

B.10. Data Management

Data reduction, data validation and data reporting policies and procedures will adhere to those established by the Ohio EPA, DES for quantitative analysis procedures and are contained in Ohio EPA, 1995, Section 10.1.

C. Assessment and Oversight

C.1. Assessment and Response Actions

During the planning process, many options for sampling design, sample handling, sample cleanup and analysis, and data reduction are evaluated and chosen for the project. In order to ensure that the data collection is conducted as planned, a process of evaluation and validation is necessary. This section of the QAPP describes the internal and external checks necessary to ensure that:

- All elements of the QAPP are correctly implemented as prescribed.
- The quality of the data generated by implementation of the QAPP is adequate.
- Corrective actions, when needed, are implemented in a timely manner and their effectiveness is confirmed.

The most important part of this section is documenting all planned internal assessments. Generally, internal assessments are initiated or performed by the QA Officer. Two types of assessments can be performed as described below:

Management Systems Review (MSR). A form of management assessment, this process is a qualitative assessment of a data collection operation or organization to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring that the type and quality of data needed are obtained. The MSR is used to ensure

that sufficient management controls are in place and carried out by the organization to adequately plan, implement, and assess the results of the project.

Readiness Reviews. A readiness review is a technical check to determine if all components of the project are in place so that work can commence on a specific phase.

It is anticipated that routine readiness review by the laboratory manager as described in the laboratory quality assurance plan will be sufficient for this project. No management systems review is anticipated for this project.

Assessment of Project Activities
Assessment of project activities can involve the following tasks:

- Surveillance
- Technical Systems Audit (TSA)
- Performance Evaluation (PE)
- Audit of Data Quality (ADQ)
- Peer Review
- Data Quality Assessment.

Surveillance will be the primary assessment technique of project activities. This will most readily occur by the Lab Manager and QA Officer.

Number, Frequency, and Types of Assessments
Due to the short-term nature of this project no types of assessments are planned other than general surveillance.

Assessment Personnel
External and internal laboratory audits are coordinated by the laboratory QA Officer.

Schedule of Assessment Activities
External audits by the GLNPO QA Officer and/or the GLNPO Project Manager is up to his/her discretion. The scheduling of regular internal audits at the lab is at the discretion of the QA Officers.

Reporting and Resolution of Issues
Any audits or other assessments that reveal findings of practice or procedure that do not conform to the written QAPP need to be corrected as soon as possible. The Project Manager and QA Officer need to be informed immediately of critical deviations that compromise the acceptability of the test.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem will be responsible for notifying the project manager. Implementation of corrective actions will be confirmed in writing through the same channels.

Corrective actions in the laboratory may occur prior to, during, and after initial analysis. A number of conditions, such as broken sample containers, multiple phases, and potentially high concentration samples may be identified during sample log-in or just prior to analysis. Following consultation with laboratory analysts and section leaders, it may be necessary for the Laboratory QA Officer to approve the implementation of corrective actions. The submitted SOPs specify some conditions during or after analysis that may automatically trigger corrective actions of samples, including additional sample extract cleanup and automatic re-injection/reanalysis when certain quality control criteria are not met.

Corrective actions are required whenever an out-of-control event or potential out-of-control event is noted. The investigative action taken is somewhat dependent on the analysis and the event.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy
- Blanks contain target analytes above acceptable levels
- Undesirable trends are detected in spike recoveries or RPD between duplicates
- There are unusual changes in detection limits
- Deficiencies are detected by the Laboratory and/or GLNPO QA Officer(s) during any internal or external audits or from the results of performance evaluation samples
- Inquires concerning data quality are received.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, experimental set-up, and so on. If the problem persists or cannot be identified, the matter is referred to the Laboratory Manager and/or Laboratory QA Officer for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the Laboratory QA Officer.

These corrective actions are performed prior to release of the data from the laboratory. The corrective actions will be documented in both the laboratories corrective action log and the narrative data report sent from the laboratory.

C.2. Reports to Management

DES shall provide analytical results to the Ohio EPA Project Manager. Unless otherwise noted, it will be assumed that all QA/QC results have met the approved Laboratory standards (Ohio EPA 1995 and 2001). Written QC data and appropriate QA/QC reports generated by Ohio EPA, DES shall be included in the Analytical Data Report provided to the Ohio EPA Project Manager as needed.

Any serious QA problems needing immediate decisions will be discussed orally between the Project Manager and laboratory staff, with such discussions recorded in the overall project file. These problems will be noted in the final project report.

A summary of QA/QC information will be provided in the final written report to USEPA. This report will include information on adherence of measurements to the QA objectives. The final report will contain detailed discussions of QA/QC issues, including any changes in the QAPP, a summary of the contract laboratories QA/QC reports, results of any internal performance audits, any significant QA/QC problems, detailed information on how well the QA objectives were met, and their ultimate impact on decision making. The following is a list of items that should be included in the final project report:

- Changes in the QAPP
- Results of any internal system audits
- Significant QA/QC problems, recommended solutions, and results of corrective actions
- Data quality assessment in terms of precision, accuracy, representativeness, completeness, and sensitivity
- Indication of fulfillment of QA objectives
- Limitations on the use of the measurement data

D. Data Validation and Usability

The project manager will make a final decision regarding the validity and usability of the data collected during this project. The project manager will evaluate the entire sample collection, analysis, and data reporting processes to determine if the data is of sufficient quality to meet project objectives, and determine if representative hypotheses were met. Data validation involves all procedures used to accept or reject data after collection and prior to use. These include screening, editing, verifying, and reviewing through external performance evaluation audits. Data validation procedures ensure that objectives for data precision and bias will be met, that data will be generated in accordance with the QA project plan and SOPs, and that data are traceable and defensible. The process is both qualitative and quantitative and is used to evaluate the project as a whole.

Procedures Used to Validate Field Data
Procedures to evaluate field data for this project primarily include checking for transcription errors and reviewing field logs.

Procedures Used to Validate Laboratory Data
The laboratory QA Officer will conduct a systematic review of the analytical data for compliance with the established QC criteria based on the spike, duplicate, and blank results provided by the laboratory. All technical holding times will be reviewed, the laboratory analytical instrument performance will be evaluated, and results of initial and continuing calibration will be reviewed and evaluated.

The data review will identify any out-of-control data points and data omissions, and the Laboratory QA Officer will interact with the laboratory to correct data.

The Ohio EPA QA Officer will compare all field and laboratory duplicates for RPD. Based on the results of these comparisons, the QA Officer will determine the acceptability of the data. One hundred percent of the analytical data will be validated.

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Appendix A

Fish Community Sampling Methods for Ohio's Lake Erie Nearshore Waters, Harbors, and Lacustuaries

Fish field sample collection methods:

All fish collected will be identified to species, enumerated, examined for external anomalies, and either returned to the lake, preserved as voucher specimens and stored at the Ohio State University Museum of Biodiversity, or used for fish tissue samples. Weights will be taken on a representative sub-sample if more than 15 individuals of a species are captured. All fish will be weighed if 15 or less individuals of a species are captured.

Electro-fishing

Electro-fishing consistently catches more species and individuals in less time and effort than other sampling methods used by Ohio EPA. It is a method that can be used under all habitat conditions thus yielding a database that was easily comparable (in terms of catch/effort) under the variable conditions encountered. Previous Ohio EPA work indicates that night electro-fishing captures as many species and individuals as day electro-fishing in lacustuary habitats.

General electro-fishing methodologies

A 5.8-meter modified V-hull john boat will be used for electro-fishing. Electrical current is provided by a 7,000 watt generator and Smith-Root pulsator. Controls are set on DC current, 60 pulses per second, 240-340 volts, and run at 5 to 6 amps. In low conductivity conditions the voltage is increased to 360-500 volts and the frequency increased to 120 pulses per second in order to maintain 5 to 6 amps. Anodes are two separately charged 1 m circumference electrospheres. Two articulated booms supported by distal floats are positioned about 2.1 m in front of the boat on articulated booms (3 m total length), one to the port and one to the starboard side at angles of approximately 20 degrees from the center line. Sampling will not be conducted under wave conditions of 0.6 m or more.

Each sampling site will be 400 to 500 meters long and within 1 meter of the shore. A set sampling time will not be used and time may vary between 2,000 and 5,000 seconds. The greater the number of fish captured in the zone and the greater the complexity of the shore line the longer it will take to complete the sample. A crew of three individuals will be used in all electro-fishing efforts. During sampling one individual will be positioned on the bow of the boat with a dip net and serve as the principal collector of fish captured in the electrical field, a second person will be at mid-ship and serve as an assistant that will collecte any fish missed by the principal netter, while the third person will operate the outboard motor, pulsator controls, and collected any fish that surface at the back of the boat. All fish will be placed in live-wells supplied with fresh water from a pump. Common carp will be placed in their own live-well to avoid excess oxygen consumption and the death of small fish that otherwise frequently are trapped in common carp mouths and crushed.

The anode and cathode array deployments used in this study are different from those used in previous Ohio EPA sampling efforts. Anodes are two separately charged electrospheres, 1 m in circumference, and constructed with two stainless steel salad bowls approximately 2 mm thick. The anodes will be suspended 5 cm below the surface, 2.1 m in front of the boat on articulated booms, one to each side. Three sets of cathodes, each to be used at different depths, will be used. All have electrified portions 1.6 m in length. The cathode sets are designed to be deployed with the electrified surface at a maximum of 1.8 m, 3 m, and 7.3 m deep. Cathodes 1.8 m long, are used under all conditions where bottom depths are 2.5 m or less and 3 m cathodes are used in depths greater than 3 m. Cathodes are deployed in one of two ways: 1) in most areas eight cathodes are deployed from the sides of the boat at mid-ship (1.8 and 3 m cathodes), four on each side, 2) in ship channel areas, four, 7.3 m depth cathodes are deployed from the front of the boat.

Appendix B

Copies of field data sheets and Chain of Custody Form

(See hard copy for copies of field data sheets)

Appendix C
Sampling SOPs for Sediment

SURFICIAL SEDIMENT SAMPLING
USING A PONAR DREDGE SAMPLER
ONBOARD THE *R/V MUDPUPPY*

Overview
The following Standard Operating Procedure (SOP) explains the technique for collecting sediment samples using a ponar dredge sampling device. The procedures cover the following activities:

- Positioning of Vessel
- Securing the Vessel for Sampling
- Sample Collection Procedures

NOTE: This SOP only illustrates the technique for collecting surficial sediment samples (i.e., to an approximate depth of 6 inches). Details regarding the labeling and transport of sediment samples should be addressed by individual project leads in the project specific Quality Assurance Project Plan (QAPP).

Sample Handling and Preservation
Due to the expense of operating a vessel to collect sediment samples and the costs of analytical sample analysis, every sediment sample is considered important. Any contamination through mishandling or lack of preservation could cause biases in data results.

The following considerations should be addressed.

- At a minimum, nitrile gloves and Saranac coveralls should be worn during sampling and sub-sampling activities.
- Sample containers must be kept free of contamination and should remain sealed until use.
- Preservatives should be fresh and labeled.
- Samples should be stored in coolers and freeze packs or ice as soon as possible.
- Cooler temperatures should be checked at a minimum frequency of twice a day to ensure that the appropriate temperature is maintained.
- Mode of sample transport must maintain the integrity of the samples.

Safety
In any field operation, emphasis should be placed on safety. Site operators must be aware of the potential safety hazards to which they will be subjected. The Great Lakes National Program Office has developed a safety manual specific to R/V Mudpuppy operations. All personnel on board must be familiar with the contents of this document prior to implementing any data collection activities. Additionally, onboard personnel must follow all safety protocols and equipment guidelines, and be prepared for emergency situations. The ship's captain is the primary authority during vessel operations. The Captain is also responsible for determining whether a sampling activity will be undertaken during inclement weather. Sampling personnel are responsible for their safety from potential hazards including, but not limited to:

- **Electrical Hazards.** For obvious hazards or problems (fire, scorching, blown fuses, etc.), turn off power for the circuit involved and notify the Captain who will take the lead in responding to the hazard. Never attempt electrical repairs.
- **Personal Protective Equipment**. Sampling personnel should be prepared to work with large and/or heavy equipment where safety shoes, head, hand, protective clothing (Tyvek or Saranac suits), and eye protection are necessary. Some sites may require respirators. Sampling personnel should have clothing available in the event of weather extremes.
- **Sampling Equipment**. Never force glassware with unprotected hands. Care should be taken around the sampling equipment to avoid injuries and slipping overboard while positioning sampling equipment.
- **Chemical Dangers**. Organic solvents and acids are occasionally used to decontaminate sampling equipment. These materials should not be ingested nor come into contact with bare skin or flames (if flammable). Sampling personnel should be familiar with the Material Safety Data Sheets for each and every chemical used during sampling.

Equipment and Supplies
The following equipment and supplies are required for the collection of a single sediment sample at a typical sampling location.

- Ponar Dredge Sampler
- Winch
- Stainless Steel Bowls, Spoons, and Spatulas
- High Density Polyethylene (HDPE) Sediment Sample Bottles(1)
- Glass Sample Bottles (for Organic Contaminant Samples) (1)
- Coolers/Ice Chests(1)
- Sample Labels(1)
- Indelible Markers and Pencils(1)
- Global Positioning System or Locational Equipment
- Generator (230 Volt, 60 Hz, 3-Phase, 14 Amps)
- Safety Equipment (including: Hard Hat with Face Shield, gloves, safety glasses(2), Saranac/Tyvek suit, Steel-Toed Boots(2), and Boot Covers)

Notes:
(1) Must be provided by Grantee
(2) Must be provided by each individual user

Sample Collection Procedures
A sampling activity may consist of collecting more than one type of sample at a particular site. This procedure will detail the collection of surficial sediment samples (to an approximate depth of 6 inches) from a single location. When benthic organism samples are being collected at the same site, it is important to collect the benthic organism samples prior to the collection of sediment samples in order to minimize the disturbances to the benthic organisms.

Every attempt should be made to stabilize the vessel as much as possible in order to collect vertical sediment samples. When the vessel is moving, the dredge may enter the sediments at an angle.

Sample Location
The sample location may be defined either prior to sampling, where the R/V Mudpuppy would be destined for a specific location, or the site may be selected during the sampling process. Generally, sites can be located with an onboard GPS system that is accurate to within 1-3 meters. If the vessel is headed to a pre-determined site, the locational equipment shall be used to locate the site. However, the actual locational readings for the site should be recorded after the vessel is anchored at the sampling site since waterway conditions, obstructions, boat traffic, or other circumstances may influence the exact sampling location. The ultimate location of the sample collection shall be determined by the Captain of the R/V Mudpuppy in consultation with the sampling crew.

Securing the Vessel
Once at the sampling site, the vessel must be secured in order to avoid drifting and rotation that could cause the sample device to enter the sediment at an angle.

Procedures are as follows:

- Triple anchor the vessel as instructed by the Captain
- Establish the exact sampling location with locational equipment (if location does not need to be accurately predetermined, the reading can be taken during sampling activities).

Sampling Procedures - Ponar Dredge Sampler

The following sampling procedure is used to collect surficial sediment samples on the R/V Mudpuppy.

1. Measure and Record Water Depth.
2. Remove the straight (locking) bolt from the sampler, place Ponar into its open position and insert the spring loaded bolt into the assembly.
3. Lift the ponar sampler into a vertical position using the Winch so that the sampler is suspended just off of the bow of the sampling vessel.
4. Lower the sampler with the winch until the sampler is imbedded in the sediments.
5. Using your hands, pull up on the winch cable to close the sampler and raise the ponar above the sediment surface.
6. Maintain hand tension on the cable while slowly reversing the winch to remove the slack from the cable.
7. Slowly lift the sampler back above the water surface until the sampler is in a vertical position just off of the bow of the sampling vessel
8. Tip the ponar sampler to drain excess water from the sample.
9. Place a stainless steel bowl under the ponar sampler and lower the sampler into the bowl.
10. Press down on hinge arms to open sampler and discharge the sediment sample.
11. Replace straight (locking) bolt into the ponar sampler and set aside.
12. Handle and subsample the sediment sample as described in the QAPP.
13. Wash the sampler, bowl, spoons, deck, and other equipment using site water pump through onboard garden hoses or include other decontamination as required by the project QAPP. (Note: The R/V Mudpuppy and its crew supplies only site water and hoses for decontamination. Accompanying personnel are responsible for providing all other decontamination equipment and supplies required by the QAPP.)

LONG CORE SEDIMENT SAMPLING USING A VIBRO-CORER ONBOARD THE *R/V MUDPUPPY*

Overview

The following Standard Operating Procedure (SOP) explains the technique for collecting sediment core samples (up to 15 feet in length) using a Rossfelder Vibro-corer. The procedures cover the following activities:

- Positioning of Vessel
- Securing the Vessel for Sampling
- Sample Collection Procedures

Questions regarding sampling methods or operation of sampling equipment should be directed to:

Dr. Marc Tuchman
U.S. EPA Great Lakes National Program Office
77 West Jackson Blvd. (G-17J)
Chicago, IL 60604
Phone: 312/353-1369
Fax: 312/353-2018

NOTE: This SOP only illustrates the technique for sampling and sub-sampling long sediment core samples (i.e., up to 15 feet in length). Details regarding the labeling and transport of sediment samples should be addressed by individual project leads in the project specific Quality Assurance Project Plan (QAPP).

Sample Handling and Preservation

Due to the expense of operating a vessel to collect sediment samples and the costs of analytical sample analysis, every sediment sample is considered important. Any contamination through mishandling or lack of preservation could cause biases in data results.

The following considerations should be addressed.

- At a minimum, nitrile gloves and Saranac coveralls should be worn during sampling and sub-sampling activities.
- Sample containers must be kept free of contamination and should remain sealed until use.
- Preservatives should be fresh and labeled.
- Samples should be stored in coolers and freeze packs or ice as soon as possible.
- Cooler temperatures should be checked at a minimum frequency of twice a day to ensure that the appropriate temperature is maintained.
- Mode of sample transport must maintain the integrity of the samples.

Safety

In any field operation, emphasis should be placed on safety. Site operators must be aware of the potential safety hazards to which they will be subjected. The Great Lakes National Program Office has developed a safety manual specific to R/V Mudpuppy operations. All personnel on board must be familiar with the contents of this document prior to implementing any data collection activities. Additionally, onboard personnel must follow all safety protocols

and equipment guidelines, and be prepared for emergency situations. The ship's captain is the primary authority during vessel operations. The Captain is also responsible for determining whether a sampling activity will be undertaken during inclement weather. Sampling personnel are responsible for their safety from potential hazards including, but not limited to:

- **Electrical Hazards.** For obvious hazards or problems (fire, scorching, blown fuses, etc.), turn off power for the circuit involved and notify the Captain who will take the lead in responding to the hazard. Never attempt electrical repairs.
- **Personal Protective Equipment**. Sampling personnel should be prepared to work with large and/or heavy equipment where safety shoes, head, hand, protective clothing (Tyvek or Saranac suits), and eye protection are necessary. Some sites may require respirators. Sampling personnel should have clothing available in the event of weather extremes.
- **Sampling Equipment**. Never force glassware with unprotected hands. Care should be taken around the sampling equipment to avoid injuries and slipping overboard while positioning sampling equipment.
- **Chemical Dangers**. Organic solvents and acids are occasionally used to decontaminate sampling equipment. These materials should not be ingested nor come into contact with bare skin or flames (if flammable). Sampling personnel should be familiar with the Material Safety Data Sheets for each and every chemical used during sampling.

Equipment and Supplies
The following equipment and supplies are required for the collection of a single sediment core at a typical sampling location.

- Vibrocorer
- Rolling Box for Vibrating Head
- Winch
- 4" Acetate Butyrate Core Tubes
- Stainless Steel Bowls, Spoons, and Spatulas
- High Density Polyethylene (HDPE) Sediment Sample Bottles(1)
- Glass Sample Bottles (for Organic Contaminant Samples) (1)
- Coolers/Ice Chests(1)
- Sample Labels(1)
- Indelible Markers and Pencils(1)
- Global Positioning System or Locational Equipment
- Generator (230 Volt, 60 Hz, 3-Phase, 14 Amps)
- Heavy Duty Riveter and Steel Rivets
- Battery Powered Cordless Drill
- Battery Powered Cordless Saw
- Safety Equipment (including: Hard Hat with Face Shield, gloves, safety glasses(2), Saranac/Tyvek suit, Steel-Toed Boots(2), and Boot Covers)
- Core Caps

Notes:
(1) Must be provided by Grantee
(2) Must be provided by each individual user

Sample Collection Procedures
A sampling activity may consist of collecting more than one type of sample at a particular site. This procedure will detail the collection of long sediment core samples (up to 15 feet) from a single location. When benthic organism samples are being collected at the same site, it is important to collect the benthic organism samples prior to the collection of sediment samples in order to minimize the disturbances to the benthic organisms.

Every attempt should be made to stabilize the vessel as much as possible in order to collect vertical sediment cores. When the vessel is moving, the cores may enter the sediments at an angle.

Sample Location
The sample location may be defined either prior to sampling, where the R/V Mudpuppy would be destined for a specific location, or the site may be selected during the sampling process. Generally, sites can be located with an onboard GPS system that is accurate to within 1-3 meters. If the vessel is headed to a pre-determined site, the locational equipment shall be used to locate the site. However, the actual locational readings for the site should be recorded after the vessel is anchored at the sampling site since waterway conditions, obstructions, boat traffic, or other circumstances may influence the exact sampling location. The ultimate location of the sample collection shall be determined by the Captain of the R/V Mudpuppy in consultation with the sampling crew.

Securing the Vessel
Once at the sampling site, the vessel must be secured in order to avoid drifting and rotation that could cause the coring device to enter the sediment at an angle.

Procedures are as follows:

- Triple anchor the vessel as instructed by the Captain
- Establish the exact sampling location with locational equipment (if location does not need to be accurately predetermined, the reading can be taken during sampling activities).

Sampling Procedures - Vibrocorer

The following sampling procedure is used to collect long core sediment samples on the R/V Mudpuppy.

1. Measure and Record Water Depth.
2. Lift the Vibrating Head into a vertical position using the Winch so that the Vibrating Head is Suspended Just Off of the Bow of the Sampling Vessel.
3. Insert the Core Tube into the Vibrating Head, Making sure that the Tube Slides into the Check Valve.
4. Tighten the Collar to the Vibrocorer (Two Bolts on Each Side of the Assembly).
5. Lower the Entire Assembly until the Core Nose is just above the Sediment Surface. Turn on the Generator and the Vibrating Head.
6. Slowly Lower the Vibrocorer by running out 6-10 Inches of cable at a time. Monitor Core Tube Penetration by feeling for slack in the cable.
7. When the Vibrocorer ceases to penetrate the sediment (i.e., the Unit stops lowering or is “Refused”), or the Vibrating Head is near the sediment surface, reverse the winch and pull

the unit from the sediment. Do Not Allow the Vibrating Head to become Imbedded in the Sediment.

8. Turn off Power to the Vibrating Head and the Generator when the Core "Breaks Free" of the Sediment Surface.
9. Lift the Entire Assembly so that the Sediment/Water Interface is Visible. Drill Holes through the Core Tube at the Sediment/Water Interface to Decant Water from the Tube.
10. Disengage the Core Tube.
11. Lay Sediment Core on the Deck of the Vessel, Saw off the Excess Core Tube at the Sediment Surface and Cap the Top of the Tube with a Red Cap Plug.
12. Lower the vibracore head back into its holding cart.
13. Handle and Subsample the Sediment Core as Desired, Either On-Board the R/V Mudpuppy or at a Shore Location. (R/V Mudpuppy is equipped to roughly section the sediment core into sub-sections of six (6) inches or greater using a battery powered circular saw. Subsamples can be homogenized onboard using stainless steel bowls and spoons.)
14. Dispose of excess sediments back into the water body.
15. Wash the sampler, bowl, spoons, deck, and other equipment using site water pump through onboard garden hoses or include other decontamination as required by the project QAPP. (Note: The R/V Mudpuppy and its crew supplies only site water and hoses for decontamination. Accompanying personnel are responsible for providing all other decontamination equipment and supplies required by the QAPP.)

Appendix D

Fish Tissue SOP

Fish Tissue Monitoring Program Guidance Manual

Ohio EPA Technical Bulletin MAS/1994-11-1

State of Ohio Environmental Protection Agency
Monitoring and Assessment Section
Ecological Assessment Unit
1685 Westbelt Drive
Columbus, Ohio 43228
November 30, 1994

(Includes only pages 5 and 6 of the manual, referencing collection of whole body fish tissue samples)

Fish Tissue Sample Collection Methodology

In this section we will discuss the actual methods used to prepare a fish tissue sample following the collection of the fish from the waterbody. As discussed previously, there are three different types of fish tissue composite samples.

Whole Body Composite (WBC)
Skin-on Fillet Composite (SOFC)
Skin-off Fillet Composite (SFFC)

We will discuss each of these three types of composite samples in detail exploring the types of fish species to collect, the length categories to collect, and sample preparation techniques. In all cases, the lab requires about 150 **grams of** sample to perform the required analyses. Make sure to obtain enough fish for a properly sized sample if possible.

Whole Body Composites (WBC)

The whole body composite sample is the easiest of the three types of samples to prepare because it does not involve cutting the fish. Instead, the fish is preserved whole for later analysis. Ohio EPA is the only agency that should be obtaining WBC samples as they are the sole agency overseeing the Fish Tissue Baseline Monitoring Program.

The primary fish species we are interested in collecting for WBC samples include (in order of preference):

Common carp *(Cyprinus carpio)*
Channel catfish *(Ictalurus punctatus)*
Bullheads *(Ameiurus* spp.)
Redhorse *(Moxostoma* spp.)
Buffalo *(Icticbus* spp.)
White sucker *(Catostomus commersoni)*

The WBC sample consists of up to five (5) fish of the **same species** with a minimum of two (2) fish for a sample. An attempt should be made to collect the same species within an entire subbasin. In order to reduce variability in the sample, it is also important to collect fish of the same length grouping. To accomplish this, we ask that each of the fish be premeasured to determine their appropriateness for the sample. The smallest fish in the WBC sample should be within at least 10% of the total length of the largest fish chosen for the sample. For example:

On a sampling run in Mack Creek you collect 8 carp of the following lengths (in millimeters); 325; 330, 340; 350, 360, 600, 650, ar~d 660. Which ones do you use for the W13C sample? There are two obvious length groups to choose from here.

The 325, 330, 340; 350, and 360 length carp (325 mm is within 36 mm or 360 mm), or the 600, 650 and 660 length carp (600 mm is within 66 mm of 660). The larger fish are probably older and therefore have been exposed to pollutants longer (although this is not alwavs true) and may provide a better sample than the smaller fish.

Since length correlates well with age, we can be reasonably sure that fish of a similar length are of a similar age class and have therefore been "exposed" to contamination in their surroundings for approximately the same amount of time (if possible, it is also preferable to have fish from the same size range throughout the entire subbasin). These same two generalizations will be true for the two types of fillet composite samples (SOFC, SFFC).

Once you have collected the appropriate fish and determined which ones are to be kept for the sample, then you are ready to prepare the WBC sample. First, obtain a bucket of water from the stream which the fish were removed. Dip the fish in the water to rinse any residue (sediment, organic matter, etc.) off of the outside of the fish. Sacrifice the fish by applying a blow to the nape using the fiberglass fish club. This will break the fish's neck and kill it. Take care to strike the fish with some restraint as you do not want to cause bleeding or other unnecessary fluid losses. It does not take a heavy blow to break the neck of most fish, except carp. Try lighter blows at first to experiment with the right amount of force.

After sacrificing the fish, weigh the entire fish on the 1000 gram (to the nearest gram) or 10 kg scale (to the nearest 50 grams) and measure the length again, to the nearest millimeter using the measuring board. These weights and measures should then be recorded on the sample label.

Following this, wrap the fish in decontaminated aluminum foil (decontaminated side in towards the fish) and tape the ends of the foil to secure the wrapping. Number the fish according to its place in the composite sample *(i.e.,* 1 of 5, 2 of 5,...5 of 5) with a permanent marker. Wrap the fish together with tape and affix the sample label ensuring that the label is **securely** fixed to the sample (NOTE: If the fish happen to be large, you may need to label each individual fish in the composite as it will be impossible to tape all of the fish together and store them properly). Quickly place the fish in the sample cooler after affixing the label.

The cooler should be filled with about 40 pounds of dry ice (enough for about 4 days in the field) which will serve to freeze the fish. Dry ice should be placed on the top of the fish initially to provide for quicker freezing. Keep an eye on the dry ice to ensure that it does not run too low, thus causing the fish to thaw **(Safety Note:** Dry ice is very co1d! Do not handle it with your bare hands or else severe burns may result. Ask the dry ice vendor to wrap each 20 pound block in paper as this will ease handling.)

Appendix E

Analytical Methods and MDLs

(See hard copy. Appendix E is not available electronically.)