Plan

OU1-3 Long-Term Monitoring Sampling and Analysis Plan

Lower Fox River and Green Bay Site

Project I.D.: 18G007

P.H. Glatfelter Company
Green Bay, Wisconsin

Revision 2

June 2018

Foth

Foth
Green Bay Location

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June 4, 2018

Mr. Pablo Valentin
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Superfund Division/SR-6J
77 West Jackson Blvd.
Chicago IL 60604-3507

Ms. Beth Olson
Project Coordinator
Wisconsin Department of Natural Resources
2984 Shawano Ave.
Green Bay WI 54313

Dear Mr. Valentin & Ms. Olson:

RE:
OU1-3 Long-Term Monitoring Sampling and Analysis Plan, Lower Fox River and Green Bay Site - Revision 2

Enclosed please find the *OU1-3 Long-Term Monitoring Sampling and Analysis Plan, Lower Fox River and Green Bay Site - Revision 2*. This document has been prepared as an addendum to both the December 2009 Long-Term Monitoring Plan, included as Appendix I of the *Lower Fox River Remedial Design 100 Percent Design Report* (Anchor QEA, et al., 2009a) and the June 2011 Lower Fox River Operable Unit 1 – Long-term Monitoring Plan, included as Appendix F of *Lower Fox River Operable Unit 1 – Integrated Final Design and Remedial Action Work Plan for Post-2009 Response Work* (Foth and CH2M HILL, Inc., 2011).

The revisions in this document combine details from both of the above referenced plans, as well as capture recommended changes documented in the *Lower Fox River Operable Units 2-3 – 2014 Long-Term Monitoring Summary Report* (Foth, 2016) and lessons learned through adaptive management working co-operatively with the Agencies Oversight Team since commencing the long-term monitoring work.

Please do not hesitate to contact us if you should have any questions or would like additional information.

Sincerely,

Foth Infrastructure & Environment, LLC

Denis Roznowski, P.E.
Project Coordinator

Sharon V.F. Kozicki, P.G., P.M.P
Project Manager

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OU1-3 Long-Term Monitoring

Sampling and Analysis Plan

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OU1-3 Long-Term Monitoring
Sampling and Analysis Plan

Project ID: 18G007

Prepared for

P.H. Glatfelter Company

Prepared by

Foth Infrastructure & Environment, LLC

Revision 2

June 2018

OU1-3 Long-Term Monitoring

Sampling and Analysis Plan - Revision 2

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List of Abbreviations, Acronyms, and Symbols

°C	degrees Celsius
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CIL	chemical isolation layer
COC	chain of custody
DGPS	differential global positioning system
EDL	Estimated Detection Limit
Foth	Foth Infrastructure & Environment, LLC
FR-LTMP	*Fox River Long-Term Monitoring Plan*
Glatfelter	P.H. Glatfelter Company
GPS	global positioning system
LFR	Lower Fox River
LIMS	Laboratory Information Management System
LTM	long-term monitoring
LW	Lake Winnebago
LWB	Lake Winnebago Background
mg/kg	milligrams per kilogram
MDL	method detection limit
MNR	monitored natural recovery
NAD83	North American Datum 1983
OU	operable unit
OU1-LTMP	*Operable Unit 1 Long-Term Monitoring Plan*
PCB	polychlorinated biphenyls
Plant	Sediment Desanding and Dewatering Plant
PM	project manager
QAM	Quality Assurance Manager
QC	quality control
RA	remedial action
RAO	remedial action objective
RI/FS	Remedial Investigation/Feasibility Study
RM	river mile
ROD	*Record of Decision*
RTK-GPS	real time kinematic-global positioning system
SAP	*OU1-3 Long-Term Monitoring Sampling and Analysis Plan - Revision 2*
SOP	Standard Operating Procedure
SOW	scope of work
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WDNR	Wisconsin Department of Natural Resources
WTM27	Wisconsin Transverse Mercator NAD27
YOY	young of year

1 Introduction

P.H. Glatfelter Company (Glatfelter) is performing long-term monitoring (LTM) activities in Lake Winnebago, and Operable Units (OU) 1, 2 and 3, as well as Upper OU4 (also known as "OU4A") beginning with the 2018 LTM event. There are no planned LTM activities in OU4A until 2020 per the current LTM schedule prepared by the U.S. Environmental Protection Agency (USEPA)/Wisconsin Department of Natural Resources (WDNR), dated March 2018. This schedule is provided as Table 1-1. Glatfelter retained Foth Infrastructure & Environment, LLC (Foth) to prepare this *OU1-3 Long-Term Monitoring Sampling and Analysis Plan - Revision 2* (*SAP*) to present the sampling strategies for monitoring the post-remediation recovery of surface water and biota in OUs 1, 2, and 3 of the Lower Fox River (LFR), shown on Figure 1-1. The SAP is termed *Revision 2* as it has been modified from a previous version (*OU1-3 Long-Term Monitoring Sampling and Analysis Plan – Revision 1,* [Foth, 2015]) which detailed LTM sampling and analysis procedures for only OUs 2 and 3, for work previously conducted in those OUs by the Lower Fox River Remediation LLC.

The *SAP* addresses surface water and fish tissue sampling in Lake Winnebago (background reference, also referred to as "LW" or "LWB"), OU1, OU2, and OU3. In addition, the methodologies and procedures for evaluating monitored natural recovery of sediments in OU2 and chemical isolation layer (CIL) confirmation in "Type B" cap areas in OU3 are addressed. Monitoring will be performed to assess progress toward achieving the remedial action objectives (RAO) specified in two *Records of Decision* (*ROD*) (USEPA, 2002 and 2003) issued in December 2002 and June 2003, for OUs 1-2 and OUs 3-5, respectively; and two *ROD Amendments* (USEPA, 2007 and 2008) issued in June 2007 and June 2008, for OUs 2-5 and OU1, respectively, by the USEPA and the WDNR (collectively, the "Response Agencies") under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended.

Post-remediation monitoring on the Fox River and Green Bay system in LW and OU1 is guided by the *Lower Fox River Operable Unit 1 – Integrated Final Design and Remedial Action Work Plan for Post-2009 Response Work*, Appendix F, *Lower Fox River Operable Unit 1 – Long-term Monitoring Plan* (*OU1-LTMP*) (Foth and CH2M HILL, Inc., 2011), and in OU2-3 is guided by the *Lower Fox River Remedial Design 100 Percent Design Report* – Appendix I, *Long-Term Monitoring Plan* (Anchor QEA, et al., 2009a), generally referred to as the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*). This *SAP* combines elements of both LTM plans, providing additional guidance regarding monitoring in LW, OU1, OU2, and OU3, and should be considered an addendum to those plans.

1.1 Purpose

The purpose of this *SAP* is to describe the sampling strategies and methods to be employed during respective surface water, fish tissue, sediment, and cap monitoring events, including sample quantities, monitoring locations, sampling schedules, sample labeling and field and laboratory procedures. These sampling strategies may be adjusted or modified through adaptive management and the CERCLA 5-year review process. For example, environmental media or fish species may be added, reduced, or discontinued based on an ongoing evaluation of progress toward risk reduction goals.

This *SAP* addresses:

- Surface water quality sampling in LW, OU1, OU2, and OU3;
- Fish tissue sampling in LW, OU1, OU2, and OU3;
- Sediment sampling in monitored natural recovery (MNR) areas of OU2;
- Cap CIL confirmation sampling in representative areas with "Type B" caps in OU3;
- Sample handling and custody requirements; and
- Laboratory analytical methods.

1.2 Scope of Work

The scope of work (SOW) is the sampling and analysis necessary to provide data to evaluate the post-remediation recovery of surface water and biota in OU1, OU2, and OU3 of the LFR. This includes surface water and fish tissue in LW, OU1, OU2, and OU3, and sediment sampling in OU2. It also includes CIL cap testing at selected "Type B" cap areas in OU3 to confirm design assumptions. Descriptions and methodologies for the required sampling are discussed in detail in Section 3.

2 Project Background

2.1 Site History

The LFR extends 39 miles from the outlet of Lake Winnebago over a series of locks and dams to the mouth of the river where it discharges into Green Bay. It is the most industrialized river in Wisconsin. Since the early 1900s, water quality has been degraded by expanding industries and communities discharging sewage and industrial wastes into the river. Polychlorinated biphenyls (PCB) were discovered in the LFR in the 1970s.

The LFR is divided into five OUs as shown on Figure 1-1:

- OU1 is also known as Little Lake Butte des Morts. The Neenah and Menasha Dams control the pool elevation of Lake Winnebago and discharge to the upstream end of OU1 at river mile (RM) 39.

- OU2 extends from the Appleton Locks at RM 31.9 to the Little Rapids Dam at RM 13.1. This unit contains the majority of locks and dams in the LFR system and the greatest elevation drop and gradient. Sediments have a very patchy distribution in this reach with extensive intervening bedrock exposures.

- OU3 extends from the Little Rapids Dam to the De Pere Dam at RM 7.1. Soft sediment covers most of this unit.

- OU4 extends from the De Pere Dam to the river mouth at Green Bay. The area around OU4 is highly urbanized, including the city of Green Bay metropolitan area.

- OU5 begins at the river mouth and includes the entirety of Green Bay.

Remedial action (RA) construction was completed in OU1 in 2009, OU2 in 2009, and OU3 in 2011. LTM in OU1 began in 2010. Implementation of the *FR-LTMP* was delayed for OU2 in order to be concurrent with OU3 and required initiating LTM for both OUs in 2012. RA construction is underway in OU4 and is anticipated to be completed in 2019, after which LTM will also include OU4 and OU5.

LTM data is being collected to evaluate progress toward achieving the RAOs of reduced risk to humans and the environment. The data collection effort is focused on water, fish tissue, and sediment, these being critical components of all major bioaccumulation risk pathways. Water and sediment are media of concern through which many aquatic organisms, including benthic and pelagic fish, may be exposed to PCBs at the Site. Water and sediment are also the media through which contaminants in the LFR are entrained and transported out into Green Bay. Fish are the medium of exposure for bioaccumulation risk in higher-level organisms, including humans, mammals, and birds, as well as the fish themselves.

Progress toward achieving the RAOs is evaluated, in part, through statistical comparison of monitoring data with baseline data obtained in 2006-2007, as presented in the *Baseline*

Monitoring Data Report 2006-2007 (Anchor QEA et al., 2009b). To facilitate the statistical comparison, several aspects of this *SAP* (for example, water quality sampling locations and fish species) are pre-determined by choices made during baseline data collection.

2.2 Chemicals of Concern

Due to their persistence in the environment, PCBs are the chemicals of concern and are the focus of current remediation efforts in the river.

3 Field Sampling Plan

The following sections present the descriptions and methodologies for the required field sampling at LW, OU1, OU2 and OU3. Surface water, fish tissue, and sediment sampling, as well as CIL cap design confirmation sampling are discussed. The respective sample locations, quantities, labeling, field procedures, and schedules are described for each media to be sampled or tested.

3.1 Water Quality Sampling

3.1.1 Sampling Locations

Representative transects and associated water monitoring stations in LW, OU1, OU2, and OU3 will be sampled in general accordance with U.S. Geological Survey (USGS) "quarter point" sampling methods. Water quality sampling transects are located to the extent possible in areas assumed to be characterized by relatively uniform and well mixed flow. In a uniform, well-mixed cross-section, an area-weighted sampling design provides a reasonable approximation of a flow-weighted design.

There is one water monitoring transect sited in LW, one transect in OU1, three transects in OU2, and one transect in OU3.

- Lake Winnebago
  - Near the northwest shoreline of Lake Winnebago where it flows into the Fox River (Figure 3-1)

- OU1
  - Reach between Lake Winnebago and Upper Appleton Dam, downstream of all completed RA areas in OU1 (Figure 3-2)

- OU2
  - OU2A − Reach between Upper Appleton Dam and Upper Kaukauna Dam (Figure 3-3)
  - OU2B − Reach between Upper Kaukauna Dam and Rapide Croche Dam (Figure 3-4)
  - OU2C – Reach between Rapide Croche Dam and Little Rapids Dam (Figure 3-5)

- OU3
  - Reach between Little Rapids Dam and De Pere Dam (Figure 3-6)

The coordinates for the LW, OU1, OU2, and OU3 water quality sampling stations along each sampling transect are presented in Table 3-1. Note that the North American Datum 1983 (NAD83) Wisconsin State Plane Central coordinate system is used in the field, and then converted to the Wisconsin Transverse Mercator NAD27 (WTM27) and Wisconsin Transverse Mercator NAD83 (WTM8391) coordinate systems afterwards, as required by the A/OT.

3.1.2 Sampling Frequency, Completeness, and Schedule

Monthly water samples will be collected at all LW, OU1, OU2, and OU3 monitoring stations during the eight warm-weather months (April through November). In general, the *FR-LTMP* states that the "completeness" objective for the water quality sampling program will be a minimum of seven out of eight possible sampling events at each station.

Sampling will be "systematic" in design, to provide representative and unbiased coverage. Specific runoff events will not be targeted but a random and representative range of flows is expected to be captured during the course of the monitoring program. Water sampling will be scheduled during the first two weeks of each month. The river water samples will be collected in order from upstream to downstream monitoring stations (i.e., LW, OU1, OU2A, OU2B, OU2C, and OU3) over as short a period of time as practical, typically three to four days. Table 3-2 presents water sampling details.

3.1.3 Sample Identification

Water quality samples will be identified (or coded) using a scheme designed to sort alphabetically in time and space. Table 3-2 illustrates the water sampling identification scheme for the LW, OU1, OU2, and OU3 sampling locations.

3.1.3.1 Laboratory Composite

The water quality sample analyzed by the laboratory will be a composite of aliquots from different distances and depths along each channel transect. The aliquots will be submitted separately to the analytical laboratory for compositing. A composite sample will be identified as follows:

AAAA-YY-MMDD

where "AAAA" is a 3 to 4 letter code that identifies the OU (OU2) or subunit (OU2A); "YY" is the two-digit year (e.g., -18 for 2018); and "MMDD" is the month and day of the sample collection. For example, "OU2A-18-1008" is a (composite) water sample from the OU2A station collected on October 8, 2018.

3.1.3.2 Field Aliquots

Each of six separate field aliquots collected from different distances and depths along a sampling transect will be field labeled with a consecutive letter (A, B, C, D, E, and F) progressing from top to bottom and west to east in the following format:

AAAA-YY-MMDD-B

where the “B” suffix letter identifies the aliquot sample point and depth along a transect. For example, "OU2A-18-1008-A" is a water sample aliquot from the top of the west sample point along the OU2A transect collected on October 8, 2018. The aliquots will be submitted separately to the analytical laboratory for compositing.

3.1.3.3 Replicates and Rinsates

Replicates will be coded with a "D" in the initial letter string (e.g., OU2BD or OU3D) such that the time stamp at the end of the name is preserved. For example, "OU2AD-18-1008" is a replicate (composite) water sample from the OU2A station collected on October 8, 2018.

The code for field rinsate blanks will replace the OU designation.at the beginning of the sample identification code and will retain the time stamp. For peristaltic pump rinsate blanks the code is:

RBP-YY-MMDD (for peristaltic pump)

Replicates and field rinsate blanks are discussed further in Section 3.1.5.

3.1.4 Sample Collection Procedure

Samples will be collected using the procedures described below. Additional details are provided in the *OU1-LTMP and FR-LTMP*.

3.1.4.1 Location Control

Water quality monitoring stations will be located to within a target accuracy of two (2) meters using a differential global positioning system (DGPS) calibrated to known shoreline benchmarks before and after each sampling transect. Water depths will be determined using either a lead line or a calibrated echo sounder recorded to the nearest 0.1 foot. Project-specific location control requirements, calibration protocols, and quality indicators are described in the *Location Control Using Differential Global Positioning System* Standard Operating Procedure (SOP) located in Appendix A-1a.

3.1.4.2 Quarter Point Sampling Method

The LW, OU1, OU2, and OU3 transects of the LFR will be sampled in general accordance with USGS "quarter point" sampling procedures as described in the *OU1-LTMP* and *FR-LTMP*. The channel cross-sections are divided into three equal areas based on bathymetric data. Water sampling stations (designated W, M, and E for west, middle, and east, respectively) are positioned at the midpoint of each of the three flow areas; the coordinates of these stations are listed in Table 3-1. In the LFR, discrete water samples will be collected at 0.2 and 0.8 times the depth of the water column. Sampling procedures are described in the *Trace PCB Sampling of Surface Water* SOP located in Appendix A-2, the *Water Quality Meter Use* SOP located in Appendix A-3, and the *Field Log Book* SOP located in Appendix A-4.

3.1.4.3 Sample Compositing

The compositing strategy is described in the remainder of this subsection. Based on previous work, a thermocline is not expected to be encountered in LW and OUs 1, 2, and 3.

Discrete water subsamples (or aliquots) will be collected at each of the six "quarter point" locations and depths (i.e., 2 depths x 3 stations = 6 subsamples) for each transect, and then

shipped to the analytical laboratory where the compositing will be performed under clean laboratory conditions. A 2-liter bottle will be collected at each of the six subsampling locations/depths (six bottles total) and a second, redundant set of bottles will be collected and held in refrigerated storage near the sampling site until it has been determined that the original bottle set arrived safely at the analytical laboratory.

3.1.4.4 Field Equipment

Samples will be collected using a peristaltic pump with one set of dedicated tubing for each transect used for that transect throughout the sampling field season.

3.1.4.5 Field Parameters

The following field parameters will be measured at each of the "quarter-point" locations on each sampling transect:

- Temperature
- Turbidity

These field parameters will be monitored from water surface to river bed at nominal 3-foot intervals to assess water column stratification and spatial heterogeneity in each cross section of the river at the time of sampling.

3.1.5 Field Replicates and Rinsates

3.1.5.1 Field Replicate

To provide an overall assessment of the field and analytical precision associated with PCB congener analysis, a field replicate sample will be collected from each of the LW, OU1, OU2A, OU2B, OU2C, and OU3 transects at least once during the monitoring year (eight replicates total). All six sampling points on a transect (A through F) will be sampled for the primary sample. For replicates, a second sample aliquot will be collected immediately after the primary sample at each location.

The sample ID scheme for replicates is discussed in Section 3.1.3.

3.1.5.2 Field Rinsate

To provide an assessment of ambient field contamination caused by low but ubiquitous levels of PCBs in the regional background of the Site, field rinsate blanks will be collected. A rinsate blank will be collected each month from a clean unused section of Teflon™ tubing to assess field contamination associated with water sampling. The laboratory will provide ultra-pure water to the field crew for use in preparing rinsate blanks for high-resolution congener analysis.

The sample ID scheme for rinsate blanks is discussed in Section 3.1.3.

3.2 Fish Tissue Sampling

3.2.1 Sampling Locations

Fish tissue sampling will occur in LW, OU1, OU2, and OU3 locations as shown on Figures 3-7 through 3-12. These locations are generally described as follows:

- Lake Winnebago
  - Several locations along the west side of Lake Winnebago. (Historic LTM fishing results indicate bountiful fish populations in the northwest portion of LW, near the water sampling transect and outlet to Little Lake Butte des Morts. This will be the primary initial focus of fishing efforts in LW.) (Figure 3-7)

- OU1
  - Reach between Lake Winnebago and Upper Appleton Dam (Figure 3-8)

- OU2
  - OU2A − Reach between Upper Appleton Dam and Upper Kaukauna Dam (Figure 3-9)
  - OU2B − Reach between Upper Kaukauna Dam and Rapide Croche Dam (Figure 3-10)
  - OU2C – Reach between Rapide Croche Dam and Little Rapids Dam (Figure 3-11)

- OU3
  - Reach between Little Rapids Dam and De Pere Dam (Figure 3-12)

The (recommended) fish collection sites shown on Figures 3-7 through 3-12 are based on the catches obtained during the baseline monitoring data collection with preference near the surface water transects in each OU. However, fishing locations may be adjusted as needed in the field based on species availability, habitat, river conditions, seasonal migration patterns, or other field conditions. Because of these variables and habitat preferences, it is assumed that different species will be collected from different parts of the OUs. However, fish have free access within the entire OU or subunit that they represent; therefore, they should be representative of the general environmental conditions in the OU or subunit.

3.2.2 Sample Quantity and Completeness

Table 3-3 summarizes the completeness goal range for LW, OU1, OU2, and OU3. Table 3-4 illustrates the optimum number of fish samples per OU or subunit. The completeness goal is described below:

Optimum Completeness Goal. The following number of primary fish samples will be targeted at each OU or subunit:

- Walleye (human health index species): 15 individual fish

- Carp (ecological index species): 35 individual fish, to be composited into 7 groups of 5 fish each. Maximum number of alternate (22 to 24 inches) carp retained for possible analysis will be capped at 14

- Gizzard shad (young-of-year [YOY] forage fish): 175 individual fish, to be composited into 7 groups of 25 fish each

Minimum Completeness Goal. Reasonable efforts will be made to obtain the optimum numbers of target species. However, if sufficient numbers of fish cannot be collected at certain OUs or subunits, after consideration of alternate fish sizes and other contingency actions to improve the harvest, the following minimum numbers of fish will be collected to satisfy project completeness goals, while still providing a reasonable level of statistical power:

- Walleye: Minimum of 8 individual fish

- Carp: Minimum of 14 individual fish, to be composited into 7 groups of 2 fish each

- Gizzard shad: Minimum of 25 individual fish, to be composited into 5 groups of 5 fish each

3.2.3 Target Fish Species and Size Ranges

Target fish species and size ranges for LW, OU1, OU2, and OU3 are summarized in Table 3-5. Three fish species will be analyzed during the LTM program, including a human health index species, an ecological index species, and a YOY forage fish species. The YOY forage fish species is intended to provide an early indication of recovery in the river because these fish best represent current conditions unburdened by legacy contaminants. The three primary species that will be targeted during the LTM program at LW, OU1, OU2, and OU3 are:

- Walleye (human health index)
- Carp (ecological index for LFR)
- Gizzard shad (YOY forage fish)

The following secondary species may be considered if the corresponding primary species are difficult to obtain or unavailable during a particular monitoring event:

- Smallmouth bass (human health index)
- Drum (ecological index for LFR)

Secondary species will be retained and archived during field collection activities until the entire catch is evaluated and it can be determined that the completeness objectives for the primary species are fulfilled.

In addition, substitute human health species may be selected for monitoring after walleye have achieved their monitoring goals, to better support the evaluation of fish consumption advisories.

The WDNR collects fish from the various OUs frequently to assess PCB tissue levels as it pertains to health advisories. From time to time WDNR may have excess fish available to help meet completeness goals for the OU1-3 LTM work.

3.2.4 Sampling Schedule

Fish will be collected in late summer/early fall, between August 15 and September 15. Every fish sampling event will target this same seasonal sampling window to control for seasonal variability in the monitoring data. Sample collection activities may be extended an additional month (through October 15) if necessary to fill data gaps. Fish tissue collection starts in Lake Winnebago and proceeds through OU1, OU2A, OU2B, OU2C, and OU3 – upstream to downstream. Two contiguous days of fishing are performed in each OU starting with Lake Winnebago. If some stations still lack the full complement of target species and sizes, then a field contingency strategy will be implemented, as described in the *Quality Assurance Project Plan – Revision 2* (Tetra Tech, et al., 2016) to optimize follow-up sampling efforts.

3.2.5 Sample Identification

With the exception of gizzard shad, each individual fish will be given a unique sample ID, as follows:

LLLL-YY-SP-NN

where [LLLL] is the location code describing the OU or subunit (LW, OU1, OU2A, OU2B, OU2C, OU3), [YY] is the two-digit year (i.e., 18 is 2018), [SP] is the species identification code (WA = walleye, SB = smallmouth bass, CA = carp, and DR = drum), and [NN] is a sequential number assigned to each individual fish in a given OU. For example, OU2A-18-WA-11 is the 11th walleye collected at the OU2A subunit during a monitoring event in 2018. Gizzard shad from a particular sampling location will be bagged in groups of 25 fish or less and each bag of fish will be assigned a sample number in accordance with this convention (with the species code GS = gizzard shad). For alternate sizes collected (those outside the target size range), the unique sample IDs will remain as described above with a sequential number assigned beginning with 50. For any WDNR-collected sample, the sequential numbering will begin with 100.

Composite sample IDs will follow a similar convention as the IDs assigned to individual fish, except the last two characters will be changed to identify a composite sample:

LLLL-YY-SP-C#

where C# represents composite samples Cl, C2, C3, etc. These IDs will be assigned in the laboratory where the compositing will be performed at the direction of the Respondent Project Manager (PM), or his/her designee, in consultation with the Response Agencies.

3.2.6 Fish Sampling and Preparation

3.2.6.1 Location Control

The beginning, end, and turning points of fishing transects will be located to within a target accuracy of 10 meters using a DGPS as well as references to shoreline landmarks. Project-specific location control requirements for fish sampling activities are described in the *Location Control Using Differential Global Positioning System* SOP located in Appendix A-1a. Because fish migrate freely within an OU or subunit, location control requirements are less stringent for fish collection.

3.2.6.2 Fish Sampling Methods

Primary and secondary target fish species are listed in Section 3.2.3 and are included in Table 3-5. Retained secondary species will be archived during field collection activities until the entire catch is evaluated and it can be determined that the completeness objectives for the primary species are fulfilled. Fish will be collected using the following methods based on the experience gained during the baseline monitoring data collection (see Table 3-6):

- Electrofishing (all species)
- Trawls (all species)
- Seine nets (gizzard shad)
- Rod and reel (bass and potentially other species)

Methods may be modified as needed based on field conditions at the time of sampling. Fish collection, handling and preservation techniques are provided in the *Fish Collection* SOP located in Appendix A-5.

The date, coordinates, time, and water depth of the starting point, ending point, and turning points of each fishing run will be recorded in field logs. The coordinates, water depth, and time of deployment and recovery will be logged for stationary equipment, if used, such as set lines, fixed nets, etc.

The following data will be recorded for each individual fish (with the exception of gizzard shad):

- Unique individual sample ID
- Time of collection
- Length
- Weight
- Abnormalities (i.e., tumors, lesions)

Because of their small size and large numbers, YOY gizzard shad will not be logged individually. All gizzard shad fingerlings from a particular fishing location will be combined in groups of 25 or less and forwarded to the analytical lab for compositing.

3.2.6.3 Compositing

The Respondent PM, or his/her designee, in consultation with the Response Agencies, will select the fish to be used for composite samples and will direct the laboratory in their preparation. Details on the laboratory methods of preparing composite samples are provided in the Pace Analytical Laboratories, Inc.'s *Biological Tissue and Plant Preparation* SOP, located in Appendix A-6.

Carp and drum (ecological index species), and gizzard shad (YOY forage fish species) will be analyzed as composite samples. Carp composites (optimum) will consist of 7 composites with 5 individuals in each composite (i.e., 35 fish total), drum composites (optimum, if prepared) will consist of 5 composites with 2 individuals in each composite (i.e., 10 fish total), and gizzard shad composites will consist of 7 composites with 25 individuals in each composite (i.e., 175 fish total). To the extent possible, fish will be collected that are representative of the size classes listed in Table 3-5. Ideally, composites would be prepared for each of the 2-inch classes in the target length window. However, some compositing classes may be represented by two or more samples, whereas other classes may contain no samples, depending on the catch.

The individual fish will be archived (frozen) until the fishing season is completed, and the entire catch may be evaluated. The fish will then be assigned to compositing groups. Similarly sized individuals (within 2-inch size classes, if possible) will be grouped together for compositing. To the extent possible, gizzard shad composites will be prepared using fish obtained from a single fishing site. Carp and drum composites, on the other hand, may be combined from multiple fishing sites; the primary consideration for these larger and older fish is preparing composites based on a relatively narrow range of fish lengths. In no case will fish be composited across OUs or across subunits in OU2.

3.2.6.4 Fish Tissue Preparation

Walleye (and bass, if analyzed) will be prepared as skin-on fillets. These human health species will be analyzed on an individual basis to be consistent with methods used in the State Fish Consumption Advisory Program. Carp and drum (ecological species) and gizzard shad will be analyzed as composite samples of whole fish.

3.2.6.5 Tissue Archiving

For human health species (i.e., walleye or bass), a single skin-on fillet will be analyzed and the other will be archived. For ecological species (i.e., carp and drum), each fish will be individually homogenized, then equal masses of tissue will be drawn from the individual samples to prepare the composite sample. For gizzard shad, groups of 25 individual fish are homogenized and an aliquot of the homogenate will be analyzed.

Aliquots of all homogenized fish tissue samples (including both individual and composited samples) will be set aside and archived (frozen) for possible future analysis. Homogenized fish tissue samples will be archived for a minimum of one CERCLA 5-year review cycle. The status of the homogenized samples will be considered during the 5-year review process, at which time

the samples may be designated for continued archiving over another review cycle, or else discarded.

3.2.7 Field Replicates

After the fish collection inventory is available for the sampling event, fish will be paired to create primary and duplicate individual or composite samples for each species of fish as indicated in Table 3-4. For those species analyzed on an individual basis (i.e., walleye or bass), a pair of fish specimens from the same haul, and nearly identical in size (i.e., within 1 inch in length, if possible), will be designated as a primary specimen and a replicate specimen. For those species analyzed on a composited basis (i.e., carp, drum, and gizzard shad), a replicate composite grouping will be prepared from a second group of fish in the same size class. For carp and drum, replicate composite groups may be prepared from multiple hauls, but they must be from the same monitoring event (i.e., within a 30 to 60 day collection period). For gizzard shad, replicate composite groups should be prepared from the same haul as the original sample to the extent possible.

3.3 OU2 Sediment Sampling

Sediment sampling will be completed in OU2 during LTM sampling activities. A summary of the OU2 sediment sampling program is presented in Table 3-7.

3.3.1 Sediment Sampling Locations

Ten sediment sampling stations in OU2 will be monitored, focusing on those areas that were reported in the Remedial Investigation/Feasibility Study (RI/FS) as containing surface sediment PCB concentrations (total Aroclors) above 1 milligram per kilogram (mg/kg), and that were selected for MNR. The rationale for these sample locations was discussed in the September 21, 2012 memorandum, *Fox River OU2 MNR Sediment Sampling Objectives* (Foth, 2012). To the extent possible, sediment MNR sampling locations are co-located with surface water and fish monitoring stations. The sediment sampling locations are shown on Figures 3-13 through 3-15. The locations identified on these figures are the same locations as used during the 2014 sampling event. The 2014 sampling locations were adjusted based on 2012 sediment sampling, as no soft sediment was present at two locations (ID 2X3.1 in OU2B and ID DD2.1 in OU2C) (Foth, 2012). The purpose of these samples is to assess if surface PCB concentrations are decreasing over time in OU2, where MNR is the primary remedy, as approved in the *ROD*.

3.3.2 Sampling Frequency, Completeness, and Schedule

Ten composite surficial sediment samples from OU2 will be collected once during one of the eight months of the LTM period each year. For consistency with LTM work that commenced in 2012, the fall months (September and October) will be targeted. Sediment samples will be collected using a ponar grab sampler.

3.3.3 Sample Identification

The sediment samples analyzed by the laboratory will be a composite of five grab samples each at different distances from the original sediment sampling location. The grab samples will be

composited and submitted to the analytical laboratory for testing. The composite sample will be identified as follows:

AAAA-YY-MMDD-location ID

where "AAAA" is a 3 to 4 letter code that identifies the OU (OU2) or subunit (OU2B); "YY" is the two-digit year (e.g., -18 for 2018) and "MMDD" is the month and day of the sample collection; and "location ID" identifies the location within the OU or subunit where the sample was collected. For example, "OU2A-18-1008-2003-04A" is a (composite) sediment sample from location 2003-04A collected on October 8, 2018 from subunit OU2A.

3.3.3.1 Replicate and Rinsates

To provide an overall assessment of the field and analytical precision associated with PCB aroclor analysis, one duplicate sample will be collected during the sediment sampling activities. Duplicates will be coded with a "2" after the location ID (e.g., A2). For example, "OU2A-18-1008-2003-04A2" is a duplicate (composite) sediment sample from location 2003-04A collected on October 8, 2018 from subunit OU2A.

One rinsate blank will be collected from the ponar grab sampler to ensure non-dedicated equipment is being sufficiently decontaminated. A rinsate blank will be collected from a cleaned ponar and any additional cleaned non-disposable equipment to assess field decontamination procedures. The rinsate blank will be collected by pouring deionized water over a cleaned ponar sampler and collecting the rinsate water in a pail. Deionized water will also be poured over any additional cleaned non-disposable equipment and collected in a pail to assess field decontamination procedures. The code for field rinsate blanks will replace the OU designation.at the beginning of the sample identification code and will retain the time stamp. For ponar grab sampler rinsate blanks, the code is:

RBP-YY-MMDD (for ponar grab sampler).

The S*ediment Sampling Equipment Cleaning and Decontamination* SOP is provided in Appendix A-7.

3.3.4 Sample Collection Procedure

3.3.4.1 Location Control

Sediment sampling locations will be located to within a target accuracy of 1 meter using a DGPS calibrated to known shoreline benchmarks before and after each sampling transect. Water depths will be determined using either a pole fitted with a 6-inch diameter disc or a lead line and recorded to the nearest 0.1 foot. Project-specific location control requirements, calibration protocols, and quality indicators are described in the *Location Control Using Differential Global Positioning System* SOP located in Appendix A-1a.

3.3.4.2 Sampling Method

At each sampling station, a ponar sampler will be used to collect five surface samples from the top 6 inches (15 centimeters) of sediment to track reductions in average PCB concentrations over time. The *Sediment Sampling – Ponar Dredge* SOP is provided as Appendix A-8.

3.3.4.3 Sample Compositing

A total of five samples will be collected from each of the ten sediment sample locations. These locations will be offset from each other by approximately 5 feet.

Each sample will be transferred from the ponar bucket to a 5-gallon plastic bucket as described in the *Sediment Sampling – Ponar Dredge* SOP #A-8. Each 5-gallon bucket may be lined with a single use plastic bag to prevent cross-contamination. The samples will be homogenized using decontaminated or disposable one-time use utensils for mixing. After homogenization is complete, a composite sample will be prepared for laboratory analysis by taking equal aliquots from each of the five sample buckets from the location and placing them into a double Ziploc® bag or sample jars provided by the lab to form one composite sample in accordance with the sample containers, holding times, and preservation requirements as described in Section 4. The sample container will be labeled with the sample identification, kept on ice or refrigerated at 4°C and submitted to the analytical laboratory for PCB analysis. Field duplicates shall be collected in a similar manner. Unused sediment may be returned to the river at the completion of sample collection compositing at each location.

Investigative waste material, including any residual sediment, plastic bucket liners, disposable utensils and gloves, etc., will be transported to the OU2-5 Sediment Desanding and Dewatering Plant (Plant) and disposed of with the dewatered sediment and other investigative waste generated at the Plant. When the Plant is no longer in operation, the investigative waste material will be disposed of appropriately at an alternate location.

3.3.4.4 Sample Archiving

Sediment samples will be archived (in frozen storage) in case additional or repeat analyses are called for during data review and evaluation. Samples will be archived for a minimum of one CERCLA 5-year review cycle. The status of the samples will be considered during the 5-year review process, at which time the samples may be designated for continued archiving over another review cycle, or else discarded.

3.4 OU3 Chemical Isolation Layer Sampling

CIL monitoring will be performed in representative areas with "Type B" caps to confirm basic cap design assumptions (i.e., proper installation of the cap and resistance to chemical diffusion through from underlying contaminated sediments). Given the short timeframe since installation of the caps, this sampling is more focused to address proper installation of the cap as diffusion is less likely to occur within this short timeframe. "Type B" caps contain a basal layer of mixed cap material and sediment overlain by a clean CIL and a final armor layer; these types of caps

are typically installed over mid-range sediment PCB concentrations (between 10 and 49.99 mg/kg). Figure 3-16 provides a detail of the "Type B" cap design.

An OU3 CIL sampling summary is presented in Table 3-8.

3.4.1 Chemical Isolation Layer Sampling Locations

Three CIL "Type B" cap locations will be sampled in OU3. The proposed locations are shown on Figures 3-17 through 3-19. The sample locations were chosen based on their proximity to CIL samples collected in 2011 following placement of the sand layer of the cap and prior to armor stone placement.

The three CIL samples to be collected are located such that no more than a single CIL sample falls within an OU3 Type B cap area. Within a given cap area, the location of the CIL sample was chosen at the same location as the 2011 CIL sample nearest the center of the cap area. To reduce the potential for sampling in previously disturbed areas of the CIL (the exact previously sampled location), a minimum offset of 3 feet, but no greater than 5 feet, from the previously sampled coordinates (i.e., 2011, 2012, and 2014) will be maintained. (Note: The CIL sampling location F 12-3-CB5-1-1-C3 was moved approximately 14 feet in 2012 to collect a more representative Cap B CIL sample. The modified location serves as the basis for future CIL sampling.)

PCB sediment sample results as given in the Fox Core Chemistry Database are also presented on Figures 3-17 through 3-19. As illustrated on the figures, sample results of the Fox Core Chemistry Database generally fall below 10 mg/kg near the cap areas, without significant information regarding the spatial distribution of higher concentrations. Therefore, in locating the CIL samples, more emphasis is placed on positions proximal to 2011 construction confirmation samples (original CIL sample locations) so direct comparisons may be performed. This further supports the focus of this effort to confirm proper installation of the cap rather than test retardation of diffusion.

3.4.2 Sampling Frequency, Completeness, and Schedule

Three CIL samples from "Type B" caps in OU3 will be collected once during the fall. CIL samples will be collected using a vibrocore or vacuum push core sampler. Table 3-8 provides a summary of CIL sampling information.

3.4.3 Sample Identification

The CIL samples analyzed by the laboratory will be discrete samples. The samples will be processed and submitted to the analytical laboratory for testing. The sample will be identified as follows:

F YY-OU#- cap area-CCU-CCM-sample location-sample interval

Foth (F) is the contractor who collected the sample; "YY" is the two-digit year (e.g., -18 for 2018); "OU#" is operating unit in which the sample is located; then the ID includes the cap area,

CCU, and CCM; this is followed by the sample location and finally the sample interval. For example, "F 18-3-CB3B-1-1-C3(2-4)" is a (discrete) CIL sample from cap CB3B, CCU 1, CCM 1, location C3, from 2 to 4 inches collected by Foth in 2018 from OU3.

3.4.3.1 Replicates and Rinsates

To provide an overall assessment of the field and analytical precision associated with PCB Aroclor analysis, one replicate sample will be collected during the CIL sampling activities.

Replicates will be coded with a "REP" after the location ID (e.g., A). For example, "F-18-3-CB3B-1-1-C3(2-4)REP" is a replicate (discrete) sediment sample from cap location CB3B-1-1-C3.

One rinsate blank will be collected from the CIL sampler to ensure non-dedicated equipment is being sufficiently decontaminated. The code for field rinsate blanks will replace the OU designation at the beginning of the sample identification code and will retain the time stamp.

3.4.4 Sample Collection Procedure

3.4.4.1 Location Control

CIL sampling locations will be located to within a target accuracy of 1 meter using a RTK-GPS calibrated to known shoreline benchmarks before and after each sampling transect. As stated in Section 3.4.1, the actual locations of CIL LTM sample collection are intended to be between 3 and 5 feet from any previously collected CIL sample. Water depths will be determined using either a pole fitted with a 6-inch diameter disc or a lead line and recorded to the nearest 0.1 foot. Project-specific location control requirements, calibration protocols, and quality indicators are described in the *Location Control Using RTK-Global Positioning System* SOP, located in Appendix A-1b.

3.4.4.2 Sampling Method

It is proposed that divers will first clear an area of armor stone, exposing the sand CIL. Divers will inspect the armor stone surface to ensure the surface has not been disturbed and is, therefore, representative of typical cap Type B design. The divers will then guide the barrel of a vibrocore or vacuum push core sampler to the cleared area and set the barrel on top of the sand layer. As stated in the *Chemical Isolation Layer Sampling – Cap B* SOP (Appendix A-9), the target push depth of the CIL core samples will be 24 inches from the top of the CIL sand surface with the intent of acquiring the full sand CIL layer, plus a minimum of 6 inches of underlying sediment. Following removal of the armor layer of the cap by divers, CIL samples will be collected using vibrocore or vacuum push core sampling techniques. The *Vibrocore Sampling* SOP is provided in Appendix A-10. The *Vacuum Push Core Sampling* SOP is provided in Appendix A-11. Once the core sample has been collected, the diver will replace the armor stone over the core location to the extent practicable.

4 Sample Handling and Laboratory Analytical Methods

The following sections describe the procedures for sample handling, preservation, transportation, and storage (see *Shipping and Packaging of Non-Hazardous Samples* SOP provided in Appendix A-13). Sample Chain of Custody (COC) procedures are also described in the *Sample Chain of Custody* SOP provided in Appendix A-14.

4.1 Sample Handling, Preservation, Transportation, and Storage

Table 4-1 lists the required sample containers, preservation requirements, and holding times for the specified analytical methods and sample matrices. Sample bottles will be provided by the laboratory and prepared in accordance with *The Samplers Guide to the CLP Program* (USEPA, 2001). Sample containers will be provided by the laboratory pre-cleaned to requirements of the USEPA Office of Solid Waste and Emergency Response Directive 9240.05A. Sample containers will be kept closed and in a cooler until used.

Vendor certificates of cleanliness for sampling supplies will be accepted and on file at the analytical laboratories.

4.1.1 Sample Packaging

Sample packaging and shipping procedures are designed to ensure that the samples and their accompanying COC will arrive at the laboratory intact. A temperature blank is required in all coolers. Packaging, marking, labeling, and shipping of samples will comply with the regulations of the U.S. Department of Transportation in 49 Code of Federal Regulations (CFR) 171-177. The *Shipping and Packaging of Non-Hazardous Samples* SOP is provided in Appendix A-13.

4.1.2 Shipping Airbills

If samples are shipped, airbills will be retained to provide a record of sample shipment to the laboratory. Completed airbills will accompany shipped samples to the laboratory and will be forwarded along with data packages. Airbills will be kept as part of the data packages in the project files. Core samples will be maintained in a vertical orientation and transported to a local processing facility (Foth's De Pere, Wisconsin, office laboratory).

Sealing, handling, transporting, opening, segmenting, and sampling of material from the core is addressed in the SOPs located in Appendix A (A-13 and A-14).

4.1.3 Chain of Custody

Proper sample and data custody procedures will be followed during the LTM program. Custody is addressed during field sample collection, during data analyses in the laboratory, and through proper handling of project files. Persons will have custody of samples when samples are in their physical possession, in their view after being in their possession, or in their possession and secured to prevent tampering. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

COC forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. Field personnel designated as responsible for sample custody will fill out COC forms at each sampling site, at a group of sampling sites, or at the end of each day of sampling. Original COC forms will accompany samples to the laboratory. Copies will be forwarded to the project files.

4.1.4 Field Custody Procedures

A COC form will be required for all samples. The sample processing team will record the sample's unique identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. Original COC forms, signed by the field team, will accompany the samples to the laboratory. A copy of relinquished COC forms will be retained with the field documentation. COC forms will remain with the samples at all times. Samples and signed COC forms will remain in the possession of the field team until samples are delivered to the express carrier (e.g., Federal Express), hand delivered to the laboratory, or placed in secure storage. Refer to the *Sample Chain of Custody* SOP, which is provided in Appendix A-14.

4.1.5 Laboratory Sample Receipt and Storage

Upon sample receipt, the laboratory sample custodian will verify package seals, open the packages, check temperature blanks (and record temperatures), verify sample integrity, and inspect contents against COC forms. Note that samples requiring preservation at 4 degrees Celsius (°C) may be recorded as "received on ice" if solid ice is present in the cooler at the time the samples are received, in lieu of temperature measurements, per Wisconsin Administrative Code NR 149.11(4). The laboratory PM will be contacted to resolve any discrepancies between sample containers and COCs. After confirming the shipment and COC are in agreement, the sample custodian will initiate an internal COC as well as supply the laboratory Quality Assurance Manager (QAM) with a sample acknowledgement letter. If the sample temperatures are outside the required range, the laboratory will contact the laboratory QAM to determine the proper course of action.

Samples will be logged into the Laboratory Information Management System (LIMS), which assigns a unique laboratory number to each sample. LIMS will be used by all laboratory personnel handling samples to ensure all sample information is tracked and recorded.

After the laboratory labels the samples, they will be moved to secured refrigerators where they will be maintained at 4°C or frozen, as appropriate. Access to refrigerators and freezers will be limited to authorized laboratory personnel.

4.2 Laboratory Analytical Methods

4.2.1 Order of Analysis

To minimize cross-contamination within a sample batch, the analytical laboratory will be directed to analyze the water samples in order from the least to the most contaminated:

- LW (analyze first)
- OU1
- OU2A
- OU2B
- OU2C
- OU3 (analyze last)

The data validation process will verify that the designated analysis order was followed, and if it is not, the potential effect on the data of the out-of-order analysis will be assessed.

4.2.2 Water Analysis

Water column samples (once a month from April through November) will be collected at the LW, OU1, OU2, and OU3 monitoring stations, plus the specified number of quality control (QC) samples for each sampling round and monitoring event.

4.2.2.1 Analytical Parameters

All water column samples will be analyzed for the following:

- PCB Congeners (209 total) by EPA Method 1668A (HRGC/MS)
- TSS by Method SM2540D
- Total Organic Carbon (TOC) by Method SM5310C

Water sampling analytical parameters are summarized in Tables 3-2 and 4-2.

4.2.2.2 Methods and Reporting Limits

Analytical methods and reporting limits for water analyses are summarized in Table 4-2. Estimated detection limits (EDL) and reporting limits for PCB congeners by Method 1668A are listed in Table 4-3. Two-liter samples will be analyzed to improve reporting limits.

4.2.3 Fish Tissue Analysis

Fish will be collected from the locations shown on Figures 3-7 through 3-12 between August 15 and September 15 as described in Section 3.2.

4.2.3.1 Analytical Parameters

Fish tissue samples will be analyzed using the following methods:

- Tissue Extraction (USEPA Method 3541)
- PCB Aroclors (EPA Method 8082A)
- Lipid Content (EPA 2000)

Fish tissue sampling analytical parameters are summarized in Tables 3-4 and 4-2.

4.2.3.2 Methods and Reporting Limits

Analytical methods and reporting limits for fish tissue analysis are summarized in Table 4-2.

Detected values above the method detection limit (MDL) but below the reporting limit (also known as the limit of quantitation) will be reported by the laboratory as estimated values with a J flag qualifier to indicate that the reported value is less accurate in this region of measurement. Matrix effects should be considered in assessing the laboratory's compliance with MDLs and reporting limits. The laboratory will provide a discussion of all failures to meet sensitivity specifications in the data package narrative. If a sample dilution results in non-detected values for analytes that had been detected in the original analysis, the results of the original run and the dilution will be reported with the appropriate notations in the case narrative.

4.2.4 Sediment Analysis

Sediment samples will be collected from ten locations shown on Figures 3-13 through 3-15 in OU2 as described in Section 3.3.

4.2.4.1 Analytical Parameters, Methods, and Reporting Limits

Sediment samples will be analyzed using the following methods:

- PCB Aroclors (Fox River Method)

Sediment sampling analytical parameters are summarized in Tables 4-1 and 4-2.

4.2.5 Chemical Isolation Layer Analysis

CIL testing will be completed at three Type B caps in OU3 shown on Figures 3-17 through 3-19 as described in Section 3.4.

4.2.5.1 Analytical Parameters, Methods, and Reporting Limits

CIL samples will be analyzed using the following methods:

- PCB Aroclors (Fox River Method)
- TOC – Sediment (EPA 9060A)
- Grain Size (ASTM D422)

In the event that PCB concentration is detected in the CIL and it becomes necessary to assess correlation of PCB concentration to particle size distribution and TOC levels in the CIL samples, grain size and TOC analyses will be performed on the CIL and underlying sediment samples. CIL sampling analytical parameters are summarized in Tables 4-1 and 4-2.

5 References

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Tables

Table 1-1

USEPA/WDNR Lower Fox River PCB Project
Long Term Chemical Monitoring Schedule
March 12, 2018

This table identifies the USEPA/WDNR requirements regarding when monitoring functions are to be completed e.g., caps, fish tissue, etc.
If an Operable Unit is completed earlier or later than expected then the USEPA/WDNR will revise this monitoring schedule.

Calendar Year	EPA 5 Year Report	OU1 Fish, and Water (Construction Completed 2009)	OU2 Fish, Water, and MNR Sediment (Construction Completed 2009)	OU3 Fish, Water, and Isolation-Layer (Construction Completed 2011)	OU4 Fish, Water, and Isolation-Layer (Construction Completed 2019)	OU5 Fish, Water, and MNR Sediment (Construction Completed Upstream 2019)
2009	Yes					
2010		Fish Tissue-OU1-Year 0 Water-OU1-Year 0				
2011						
2012		Fish Tissue-OU1-Year 2 Water-OU1-Year 2	Fish Tissue-OU2-Year 0 Water-OU2-Year 0 MNR Sediment-OU2-Year 0	Fish Tissue-OU3-Year 0 Water-OU3-Year 0 Isolation-Layer-OU3-Year 0		
2013						
2014	Yes		Fish Tissue-OU2-Year 2 Water-OU2-Year 2 MNR Sediment-OU2-Year 2	Fish Tissue-OU3-Year 2 Water-OU3-Year 2 Isolation-Layer-OU3-Year 2		
2015						
2016						
2017						
2018		Fish Tissue-OU1-Year 8 Water-OU1-Year 8	Fish Tissue-OU2-Year 6 Water-OU2-Year 6 MNR Sediment-OU2-Year 6	Fish Tissue-OU3-Year 6 Water-OU3-Year 6 Isolation-Layer-OU3-Year 6		
2019	Yes					

USEPA/WDNR Lower Fox River PCB Project
Long Term Chemical Monitoring Schedule
March 12, 2018

This table identifies the USEPA/WDNR requirements regarding when monitoring functions are to be completed e.g., caps, fish tissue, etc.
If an Operable Unit is completed earlier or later than expected then the USEPA/WDNR will revise this monitoring schedule.

Calendar Year	EPA 5 Year Report	OU1 Fish, and Water (Construction Completed 2009)	OU2 Fish, Water, and MNR Sediment (Construction Completed 2009)	OU3 Fish, Water, and Isolation-Layer (Construction Completed 2011)	OU4 Fish, Water, and Isolation-Layer (Construction Completed 2019)	OU5 Fish, Water, and MNR Sediment (Construction Completed Upstream 2019)
2020					Fish Tissue-OU4-Year 0 Water-OU4-Year 0 Isolation-Layer-OU4-Year 0	Fish Tissue-OU5-Year 0 Water-OU5-Year 0 MNR Sediment-OU5-Year 0
2021						
2022		Fish Tissue-OU1-Year 12 Water-OU1-Year 12	Fish Tissue-OU2-Year 10 Water-OU2-Year 10 MNR Sediment-OU2-Year 10	Fish Tissue-OU3-Year 10 Water-OU3-Year 10 Isolation-Layer-OU3-Year 10	Fish Tissue-OU4-Year 2 Water-OU4-Year 2 Isolation-Layer-OU4-Year 2	Fish Tissue-OU5-Year 2 Water-OU5-Year 2 MNR Sediment-OU5-Year 2
2023						
2024	Yes					
2025						
2026						
2027		Fish Tissue-OU1-Year 17 Water-OU1-Year 17	Fish Tissue-OU2-Year 15 Water-OU2-Year 15 MNR Sediment-OU2-Year 15	Fish Tissue-OU3-Year 15 Water-OU3-Year 15 Isolation-Layer-OU3-Year 15	Fish Tissue-OU4-Year 7 Water-OU4-Year 7 Isolation-Layer-OU4-Year 7	Fish Tissue-OU5-Year 7 Water-OU5-Year 7 MNR Sediment-OU5-Year 7
2028						
2029	Yes					
2030						
2031						
2032		Fish Tissue-OU1-Year 22 Water-OU1-Year 22	Fish Tissue-OU2-Year 20 Water-OU2-Year 20 MNR Sediment-OU2-Year 20	Fish Tissue-OU3-Year 20 Water-OU3-Year 20 Isolation-Layer-OU3-Year 20	3Fish Tissue-OU4-Year 12 Water-OU4-Year 12 Isolation-Layer-OU4-Year 12	Fish Tissue-OU5-Year 12 Water-OU5-Year 12 MNR Sediment-OU5-Year 12
2033						
2034	Yes					

USEPA/WDNR Lower Fox River PCB Project
Long Term Chemical Monitoring Schedule
March 12, 2018

This table identifies the USEPA/WDNR requirements regarding when monitoring functions are to be completed e.g., caps, fish tissue, etc.
If an Operable Unit is completed earlier or later than expected then the USEPA/WDNR will revise this monitoring schedule.

Calendar Year	EPA 5 Year Report	OU1 Fish, and Water (Construction Completed 2009)	OU2 Fish, Water, and MNR Sediment (Construction Completed 2009)	OU3 Fish, Water, and Isolation-Layer (Construction Completed 2011)	OU4 Fish, Water, and Isolation-Layer (Construction Completed 2019)	OU5 Fish, Water, and MNR Sediment (Construction Completed Upstream 2019)
2035						
2036						
2037		Fish Tissue-OU1-Year 27 Water-OU1-Year 27	Fish Tissue-OU2-Year 25 Water-OU2-Year 25 MNR Sediment-OU2-Year 25	Fish Tissue-OU3-Year 25 Water-OU3-Year 25 Isolation-Layer-OU3-Year 25	Fish Tissue-OU4-Year 17 Water-OU4-Year 17 Isolation-Layer-OU4-Year 17	Fish Tissue-OU5-Year 17 Water-OU5-Year 17 MNR Sediment-OU5-Year 17
2038						
2039	Yes					
2040						
2041						
2042		Fish Tissue-OU1-Year 32 Water-OU1-Year 32	Fish Tissue-OU2-Year 30 Water-OU2-Year 30 MNR Sediment-OU2-Year 30	Fish Tissue-OU3-Year 30 Water-OU3-Year 30 Isolation-Layer-OU3-Year 30	Fish Tissue-OU4-Year 22 Water-OU4-Year 22 Isolation-Layer-OU4-Year 22	Fish Tissue-OU5-Year 22 Water-OU5-Year 22 MNR Sediment-OU5-Year 22
2043						
2044	Yes					
2045						
2046						
2047		**Repeat year 2042 monitoring for fish tissue, water, chemical isolation-layer, and monitored natural recovery sediment every five (5) years in perpetuity.**				
2048						
2049	Yes					

USEPA/WDNR Lower Fox River PCB Project
Long Term Cap Monitoring Schedule
March 12, 2018

This table identifies the USEPA/WDNR requirements regarding when monitoring functions are to be completed e.g., caps, fish tissue, etc.
If an Operable Unit is completed earlier or later than expected then the USEPA/WDNR will revise this monitoring schedule. Note: Cap Monitoring in OU2 is not required.

Calendar Year	EPA 5 Year Report	OU1 Caps (Construction Completed 2009)	OU3 Caps (Construction Completed 2011)	OU4 Caps 2013 - 2014 (Construction Completed 2014)	OU4 Caps 2015 - 2017 (Construction Completd 2017)	OU4/OU5 Caps 2019 (Construction Completed 2019)
2009	Yes					
2010		Caps-OU1-Year 0 Note: Year zero for OU1 is the year after construction is completed.				
2011		Caps-OU1-Year 1 Note: Bathymetric Survey Triggered by 5 year recurrence flow rate.	Caps-OU3-Year 0			
2012		Caps-OU1-Year 2 Note: Bathymetric Survey of cap waived because of the 2011 Bathymetric Survey results for 5 year recurrence flow rate.				
2013						
2014	Yes		Caps-OU3-Year 3	Caps-OU4-Year 0 (2013-2014)		
2015						
2016				Caps-OU4-Year 2 (2013-2014)		
2017					Caps-OU4-Year 0 (2015-2017)	
2018		Caps-OU1-Year 8	Caps-OU3-Year 7	Caps-OU4-Year 4 (2013-2014)	Caps-OU4-Year 1 (2015-2017)	
2019	Yes					Caps-OU4/OU5-Year 0 (2018)

USEPA/WDNR Lower Fox River PCB Project
Long Term Cap Monitoring Schedule
March 12, 2018

This table identifies the USEPA/WDNR requirements regarding when monitoring functions are to be completed e.g., caps, fish tissue, etc.
If an Operable Unit is completed earlier or later than expected then the USEPA/WDNR will revise this monitoring schedule. Note: Cap Monitoring in OU2 is not required.

Calendar Year	EPA 5 Year Report	OU1 Caps (Construction Completed 2009)	OU3 Caps (Construction Completed 2011)	OU4 Caps 2013 - 2014 (Construction Completed 2014)	OU4 Caps 2015 - 2017 (Construction Completd 2017)	OU4/OU5 Caps 2019 (Construction Completed 2019)
2020						Caps-OU4/OU5-Year 1 (2018)
2021						
2022		Caps-OU1-Year 12	Caps-OU3-Year 11	Caps-OU4-Year 8 (2013-2014)	Caps-OU4-Year 5 (2015-2017)	Caps-OU4/OU5-Year 3 (2018)
2023						
2024	Yes					
2025						
2026						
2027		Caps-OU1-Year 17	Caps-OU3-Year 16	Caps-OU4-Year 13 (2013-2014)	Caps-OU4-Year 10 (2015-2017)	Caps-OU4/OU5-Year 8 (2018)
2028						
2029	Yes					
2030						
2031						
2032		Caps-OU1-Year 22	Caps-OU3-Year 21	Caps-OU4-Year 18 (2013-2014)	Caps-OU4-Year 15 (2015-2017)	Caps-OU4/OU5-Year 13 (2018)
2033						
2034	Yes					

USEPA/WDNR Lower Fox River PCB Project
Long Term Cap Monitoring Schedule
March 12, 2018

This table identifies the USEPA/WDNR requirements regarding when monitoring functions are to be completed e.g., caps, fish tissue, etc.
If an Operable Unit is completed earlier or later than expected then the USEPA/WDNR will revise this monitoring schedule. Note: Cap Monitoring in OU2 is not required.

Calendar Year	EPA 5 Year Report	OU1 Caps (Construction Completed 2009)	OU3 Caps (Construction Completed 2011)	OU4 Caps 2013 - 2014 (Construction Completed 2014)	OU4 Caps 2015 - 2017 (Construction Completd 2017)	OU4/OU5 Caps 2019 (Construction Completed 2019)
2035						
2036						
2037		Caps-OU1-Year 27	Caps-OU3-Year 26	Caps-OU4-Year 23 (2013-2014)	Caps-OU4-Year 20 (2015-2017)	Caps-OU4/OU5-Year 18 (2018)
2038						
2039	Yes					
2040						
2041						
2042		Caps-OU1-Year 32	Caps-OU3-Year 31	Caps-OU4-Year 28 (2013-2014)	Caps-OU4-Year 25 (2015-2017)	Caps-OU4/OU5-Year 23 (2018)
2043						
2044	Yes					
2045						
2046						
2047		**Repeat year 2042 monitoring for Caps every five (5) years in perpetuity.**				
2048						
2049	Yes					

Table 3-1

Lake Winnebago and OU1-3 Water Sampling Locations

Transect	Position	X_WTM27	Y_WTM27	X_WTM8391	Y_WTM8391
LW	W	625571	392512	645559	412726
	M	626486	393942	646474	414157
	E	627390	395354	647378	415569
OU1	W	624566	399927	644554	420141
	M	624583	399885	644571	420100
	E	624618	399838	644606	420053
OU2A	W	632719	404099	652707	424314
	M	632733	404036	652721	424251
	E	632749	403969	652736	424184
OU2B	W	642374	408027	662362	428242
	M	642413	407981	662400	428197
	E	642452	407936	662440	428151
OU2C	W	649030	415114	669017	435329
	M	649070	415075	669057	435290
	E	649103	415044	669090	435259
OU3	W	653989	422665	673977	442881
	M	654035	422628	674022	442844
	E	654090	422584	674077	442799

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the Lake Winnebago (LW) and OU1-3 scope of work.

Sample location OU1 W was adjusted due to insufficient water depth at the location provided in the *FR-LTMP* .

Sampling location coordinates shown above are based on the Wisconsin Transverse Mercator NAD 27 (WTM27) coordinate system. Coordinates referenced to the Wisconsin Transverse Mercator NAD 1983 (WTM8391) coordinate system are also provided.

Prepared by: RLP1
Checked by: SVF
Updated by: TMK1 (added LW & OU1)
Checked by: DMR

Table 3-2

Lake Winnebago and OU1-3 Water Sampling Details

Sample ID	Sample Frequency	Sampling Order for Each Monthly Event	Number of Monthly Samples	Number of Field Replicates[4]	Total Number of Analyses	Field Parameters (temperature, turbidity)	Total Suspended Solids (SM2540D)[5]	Total Organic Carbon (SM5310C)[6]	PCB Congeners (EPA 1668A)
Laboratory Identification									
LWB-yy-mmdd[1]	Monthly (April-Nov)	1st	8	3	11		X	X	X
OU1-yy-mmdd[1]	Monthly (April-Nov)	2nd	8	1	9		X	X	X
OU2A-yy-mmdd[1]	Monthly (April-Nov)	3rd	8	1	9		X	X	X
OU2B-yy-mmdd[1]	Monthly (April-Nov)	4th	8	1	9		X	X	X
OU2C-yy-mmdd[1]	Monthly (April-Nov)	5th	8	1	9		X	X	X
OU3-yy-mmdd[1]	Monthly (April-Nov)	6th	8	1	9		X	X	X
Field Identification									
LWB-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	1st	16[3]			X			
OU1-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	2nd	16[3]			X			
OU2A-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	3rd	16[3]			X			
OU2B-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	4th	16[3]			X			
OU2C-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	5th	16[3]			X			
OU3-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	6th	16[3]			X			

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the Lake Winnebago (LW) and OU1-3 scope of work.

[1]Sample ID for composite of field collected "quarter point" aliquots. Compositing performed at laboratory .

[2]Field collected "quarter point" aliquots.

[3]Required to field collect two redundant sets of "quarter point" aliquots per transect for PCBs per monthly sampling event.

[4]Field replicates rotate between sample location (i.e., LW, OU1, OU2A, OU2B, OU2C, OU3).

[5]Previous TSS method EPA 160.2 referenced in *FR-LTMP* tables no longer valid as of 2006.

[6]Previous TOC method EPA 415.1 referenced in *FR-LTMP* tables no longer valid as of 2006.

Prepared by: RLP1
Checked by: SVF
Updated by: TMK1 (added OU1 & LW)
Checked by: SDJ

Table 3-3
Optimum and Minimum Completeness Goals for Individual Primary Fish Species

	Optimum	Minimum
Primary:		
Walleye	15 individual fish	8 individual fish
Carp[1]	35 individial fish, to be composited into 7 groups of 5 fish each	14 individual fish, to be composited into 7 groups of 2 fish each
Gizzard shad	175 individual fish, to be composited into 7 groups of 25 fish each	25 individual fish, to be composited into 5 groups of 5 fish each
Alternate:		
Smallmouth Bass	15 individual fish	15 individual fish
Drum[2]	10 individial fish, to be composited into 5 groups of 2 fish each	5 individual fish

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the OU1-3 scope of work. Lake Winnebago (LW) completeness goals are the same.

After the fish collection inventory is available, fish will be paired to create primary and duplicate individual or composite samples for each species of fish.

Refer to Figure 3-1 in the *FR-LTMP* for the Field Decision Flowchart for fish sampling.

[1]The maximum number of alternate 22-24 inch carp, retained for possible analysis, will be capped at 14. Minimum number of fish changed from "seven individual fish, to be analyzed separately (no compositing)" in the *FR-LTMP* to "14 individual fish, to be composited into seven groups of two fish each" as a result of availability of fish at the desired sizes during the 2012 and 2014 sampling events and the subsequent recommendations from the Agencies.

[2]For LW and OU1-3, drum optimum number of fish changed from "25 individual fish, to be composited into five groups of five fish each" in the *FR-LTMP* to "10 individual fish, to be composited into five groups of two fish each" as a result of availability of fish at the desired sizes and the excessive number of drum retrieved (creating a large amount of waste) during the 2012 and 2014 sampling events and the subsequent recommendations from the Agencies.

Prepared by: SDJ
Checked by: SVF
Updated by: TMK1
Checked by: DMR

Table 3-4
Fish Tissue Sampling and Analysis Matrix

Sample ID	Number of Composites	No. Fish per Composite	No. Individual Fish	Total Number of Analyses	No. of Field Replicates[1]	Minimum Size (inches)	Maximum Size (inches)	Preparation Method	PCB Aroclors (8082A/SLOH)	Lipid Content (EPA 2000)	Archive (Freeze)
Walleye											
LWB-YY-WA-000	na	na	15	15	1	12	22	SOF	x	x	x
OU1-YY-WA-000	na	na	15	15	1	12	22	SOF	x	x	x
OU2A-YY-WA-000	na	na	15	15	1	12	22	SOF	x	x	x
OU2B-YY-WA-000	na	na	15	15	1	12	22	SOF	x	x	x
OU2C-YY-WA-000	na	na	15	15	1	12	22	SOF	x	x	x
OU3-YY-WA-000	na	na	15	15	1	12	22	SOF	x	x	x
Walleye Subtotal:			90	90	6						
Carp											
LWB-YY-CA-000	7	5	35	7	1	12	22	WF	x	x	x
OU1-YY-CA-000	7	5	35	7	1	12	22	WF	x	x	x
OU2A-YY-CA-000	7	5	35	7	1	12	22	WF	x	x	x
OU2B-YY-CA-000	7	5	35	7	1	12	22	WF	x	x	x
OU2C-YY-CA-000	7	5	35	7	1	12	22	WF	x	x	x
OU3-YY-CA-000	7	5	35	7	1	12	22	WF	x	x	x
Carp Subtotal:			210	42	6						
Drum											
LWB-YY-DR-000	5	2	10	5	1	12	22	WF	x	x	x
Gizzard Shad Subtotal:			10	5	1						
Gizzard Shad											
LWB-YY-GS-000	7	25	175	7	1	2	4	WF	x	x	x
OU1-YY-GS-000	7	25	175	7	1	2	4	WF	x	x	x
OU2A-YY-GS-000	7	25	175	7	1	2	4	WF	x	x	x
OU2B-YY-GS-000	7	25	175	7	1	2	4	WF	x	x	x
OU2C-YY-GS-000	7	25	175	7	1	2	4	WF	x	x	x
OU3-YY-GS-000	7	25	175	7	1	2	4	WF	x	x	x
Gizzard Shad Subtotal:			1050	42	6						

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the Lake Winnebago and OU1-3 scope of work.

CA = Carp
DR = Drum
GS = Gizzard Shad
LWB = Lake Winnebago
na = Not Applicable
SOF = Skin-On Fillet
WA = Walleye
WF = Whole Fish

1. Number represents individual fish or composites of fish as per Table 3-3.

Prepared by: RLP1
Checked by: SVF
Updated by: TMK1
Checked by: DMR

Table 3-5
Target Fish Species, Size Classes, and Compositing Plan

		2 -4"	4 - 6"	6 - 8"	8 - 10"	10 - 12"	12 - 14"	14 - 16"	16 - 18"	18 - 20"	20 - 22"	22 - 24"	Skin-On Fillet	Whole Fish	No. Individual Fish (Target)	No. Individual Fish (Minimum)	No. of Composites	No. of Fish per Composite (Target)	No. of Fish per Composite (Minimum)
Primary Species	**Objective**	**Per OU Sampling Transect**																	
Walleye	Human Health												x		15	8	0	na	na
Carp[1]	Ecological													x	35	14	7	5	2
Gizzard Shad	Young of Year													x	175	25	7	25	5

Alternate Species	**Objective**	**Per OU Sampling Transect**																	
Smallmouth Bass	Human Health												x		15	15	0	na	na
Drum	Ecological													x	10	5	5	2	1

This table was adapted from the Fox River Long-Term Monitoring Plan (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the OU1-3 scope of work and also apply to Lake Winnebago.

na = Not Applicable (Walleye and Bass will not be composited)
= Target Size Class
= Alternate Size Class

[1]Carp alternate (22-24 inches) maximum - 14 individual fish retained for possible analysis.

Prepared by: RLP1
Checked by: SVF
Updated by: TMK1
Checked by: SDJ

Table 3-6
Fish Habitat and Collection Methods

Species	Species	Electrofish	Trawl	Rod and Reel	Seine Net	Other
Walleye	Below dams, near discharges, submerged weed beds, hard rocky substrates, bridge pillars and abutments	x	x	x		
Carp	Muddy flats and bays, aquatic vegetation and weed beds, below dams, near discharges, bridge pillars, creek mouths	x	x			
Drum	Diverse and wide-ranging habitat, aquatic vegetation and weed beds, along reefs, below dams, near discharges, boulders, bridge pillars	x	x	x		
Gizzard Shad	Nearshore areas, aquatic vegetation and weed beds, along reefs, below dams, near discharges, bridge abutments, creek mouths	x	x		x	
Smallmouth Bass	Aquatic vegetation and weed beds, rocky substrates, below dams, near discharges, deep holes with structure (instream logs, rocks, outcrops), docks, bridge abutments	x	x	x		

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the OU1-3 scope of work and also apply to Lake Winnebago.

Prepared by: RLP1
Checked by: SVF
Updated by: TMK1
Checked by: DMR

Table 3-7
OU2 Sediment Sampling Summary

	No. Sampling Events	No. Sampling Locations	No. of Field Replicates	Total Number of Analyses	PCB Aroclors (Fox River method)	Drying and Grinding
OU2A OU2B OU2C	1	10	1	11	x	x

See Figures 3-13 through 3-15 for MNR sediment sampling locations.

Prepared by: RLP1
Checked by: SVF

Table 3-8

OU3 Chemical Isolation Layer Sampling Summary

	No. Sampling Events	No. Sampling Locations	No. of Field Replicates	Total Number of Analyses	Grain Size	Total Organic Carbon (EPA 9060)	PCB Aroclors (Fox River method)	Drying and Grinding
OU3	1	3	1	4	x	x	x	x

Prepared by: RLP1
Checked by: SVF

Table 4-1

Sample Containers, Holding Times, and Preservation Requirements

Parameter	Analytical Method	Matrix	Container	Preservation	Minimum Sample	Maximum Holding
TOC - water	SM5310C	Water	Polyethylene / Glass	4º C, H_2SO_4 or H_3PO_4 to pH <2	100 mls	28 days
TSS	SM2540D	Water	1-Liter Polypropylene. Certified Clean	None	1000 mls	7 days
PCB Congeners	EPA 1668A	Water	2-Liter Amber Glass with Teflon® lined cap. Certified clean	4º C. Residual chlorine will be tested at the lab upon receipt. If residual chlorine is present, add 80 mg Sodium Thiosulfate.	1000 mls	1 year
PCB Aroclors	SW 8082A w/automated Soxhlet extraction (EPA 3541)	Fish	Clean Glass Container or Polyethylene Bags	Stored frozen	20 grams	Stored frozen until extraction and analyzed within 40 days of extraction.
Lipid Content	EPA 2000	Fish	Plastic Bags	Stored frozen	20 grams	Stored frozen until extraction and analyzed within 40 days of extraction.
PCB Aroclors	Fox River method	Sediment	Plastic Bags	4º C or frozen	100 g wet.	14 days or 1 year frozen
TOC - sediment	EPA 9060A	Sediment	Plastic Bags	Stored frozen	100 g wet.	28 days
Grain Size	ASTM D422	Sediment	Plastic Bags	Stored frozen	1 gallon	—

Prepared by: RLP1
Checked by: SVF

Table 4-2
Analytical Methods, Detection Limits, and Control Limits

Analytical Parameter	Matrix	Proposed Laboratory	Analysis Method(s)	Laboratory SOP Number	Reporting Limit	Method Detection Limit	Units
Aroclor 1016	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	S-GB-O-052 & S-GB-L-001	25.0	12.50	µg/kg
Aroclor 1221	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	S-GB-O-052 & S-GB-L-001	25.0	12.50	µg/kg
Aroclor 1232	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	S-GB-O-052 & S-GB-L-001	25.0	12.50	µg/kg
Aroclor 1242	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	S-GB-O-052 & S-GB-L-001	25.0	12.50	µg/kg
Aroclor 1248	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	S-GB-O-052 & S-GB-L-001	25.0	12.50	µg/kg
Aroclor 1254	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	S-GB-O-052 & S-GB-L-001	25.0	12.50	µg/kg
Aroclor 1260	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	S-GB-O-052 & S-GB-L-001	25.0	12.50	µg/kg
Lipids	Tissue	Pace	Pace SOP	S-GB-L-001 & S-GB-L-003	0.1	0.1	%
TOC	Water	Pace	SM5310C	S-GB-I-063	0.84	0.252	mg/L
TSS	Water	Pace	SM2540D	S-GB-I-068	20.0	4.75	mg/L
PCB Congeners	Water	TestAmerica	EPA 1668A	KNOX-ID-0013 & KNOXOP0021r1	0.020 - 0.031 (See Table 4-3)	0.020 - 0.031 (See Table 3-11)	ng/L
TOC	Sediment	Pace	EPA 9060A	S-GB-I-073	646.6	193.97	mg/kg
Aroclor 1016	Sediment	Pace	Fox River Method	S-GB-O-048	50.0	25.00	µg/kg
Aroclor 1221	Sediment	Pace	Fox River Method	S-GB-O-048	50.0	25.00	µg/kg
Aroclor 1232	Sediment	Pace	Fox River Method	S-GB-O-048	50.0	25.00	µg/kg
Aroclor 1242	Sediment	Pace	Fox River Method	S-GB-O-048	50.0	25.00	µg/kg
Aroclor 1248	Sediment	Pace	Fox River Method	S-GB-O-048	50.0	25.00	µg/kg
Aroclor 1254	Sediment	Pace	Fox River Method	S-GB-O-048	50.0	25.00	µg/kg
Aroclor 1260	Sediment	Pace	Fox River Method	S-GB-O-048	50.0	25.00	µg/kg

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the OU1-3 scope of work.

Originally prepared by: RLP1
Updated by: John Renolds-Test America 3/13/18 and Tod Noltmyer -Pace Analytical 3/13/18
Checked by: SDJ

Table 4-3
PCB Congener Reporting Limits

CAS Registry	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Method Detection Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
2051-60-7	1	0.00128	0.02	0.02	NA	50-150
2051-61-8	2	0.00114	0.02	0.02	NA	
2051-62-9	3	0.00105	0.02	0.02	NA	50-150
13029-08-8	4	0.01263	0.03	0.0314	NA	50-150
16605-91-7	5	0.0079	0.02	0.02	NA	
25569-80-6	6	0.00726	0.02	0.02	NA	
33284-50-3	7	0.00759	0.02	0.02	NA	
34883-43-7	8	0.0073	0.03	0.0269	NA	
34883-39-1	9	0.00763	0.02	0.02	NA	
33146-45-1	10	0.00783	0.02	0,02	NA	
2050-67-1	11	0.00755	0.03	0.0239	NA	
2974-92-7	12	0.0073	0.04	0.0259	NA	
2974-90-5	13	0.00729	0.04	0.0259	NA	
34883-41-5	14	0.00719	0.02	0.02	NA	
2050-68-2	15	0.00637	0.02	0.02	NA	50-150
38444-78-9	16	0.00731	0.02	0.02	NA	
37680-66-3	17	0.00589	0.02	0.02	NA	
37680-65-2	18	0.00487	0.04	0.0224	NA	
38444-73-4	19	0.00636	0.02	0.02	NA	50-150
38444-84-7	20	0.00216	0.04	0.02	NA	
55702-46-0	21	0.00223	0.04	0.02	NA	
38444-85-8	22	0.00234	0.02	0.02	NA	
55720-44-0	23	0.0024	0.02	0.02	NA	
55702-45-9	24	0.00427	0.02	0.02	NA	
55712-37-3	25	0.00203	0.02	0.02	NA	
38444-81-4	26	0.00224	0.04	0.02	NA	
38444-76-7	27	0.00416	0.02	0.02	NA	
7012-37-5	28	0.00216	0.04	0.02	NA	
15862-07-4	29	0.00224	0.04	0.02	NA	
35693-92-6	30	0.00487	0.04	0.0224	NA	
16606-02-3	31	0.0022	0.02	0.02	NA	
38444-77-8	32	0.00382	0.02	0.02	NA	
38444-86-9	33	0.00223	0.04	0.02	NA	
37680-68-5	34	0.00233	0.02	0.02	NA	
37680-69-6	35	0.00231	0.02	0.02	NA	
38444-87-0	36	0.00216	0.02	0.02	NA	
38444-90-5	37	0.00193	0.02	0.02	NA	50-150
53555-66-1	38	0.00221	0.02	0.02	NA	
38444-88-1	39	0.00205	0.02	0.02	NA	
38444-93-8	40	0.00226	0.06	0.02	NA	
52663-59-9	41	0.00226	0.06	0.02	NA	
36559-22-5	42	0.0025	0.02	0.02	NA	
70362-46-8	43	0.00207	0.04	0.02	NA	
41464-39-5	44	0.00203	0.06	0.02	NA	
70362-45-7	45	0.00236	0.04	0.02	NA	
41464-47-5	46	0.00275	0.02	0.02	NA	

Table 4-3
PCB Congener Reporting Limits

CAS Registry	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Method Detection Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
2437-79-8	47	0.00203	0.06	0.02	NA	
70362-47-9	48	0.00226	0.02	0.02	NA	
41464-40-8	49	0.00193	0.04	0.02	NA	
62796-65-0	50	0.00227	0.04	0.02	NA	
68194-04-7	51	0.00236	0.04	0.02	NA	
35693-99-3	52	0.00217	0.02	0.02	NA	
41464-41-9	53	0.00227	0.04	0.02	NA	
15968-05-5	54	0.00342	0.02	0.02	NA	
74338-24-2	55	0.0017	0.02	0.02	NA	
41464-43-1	56	0.00168	0.02	0.02	NA	
70424-67-8	57	0.00167	0.02	0.02	NA	
41464-49-7	58	0.00163	0.02	0.02	NA	
74472-33-6	59	0.00164	0.06	0.02	NA	
33025-41-1	60	0.00165	0.02	0.02	NA	
33284-53-6	61	0.00158	0.08	0.02	NA	
54230-22-7	62	0.00164	0.06	0.02	NA	
74472-34-7	63	0.00156	0.02	0.02	NA	
52663-58-8	64	0.00164	0.02	0.02	NA	
33284-54-7	65	0.00203	0.06	0.02	NA	
32598-10-0	66	0.00155	0.02	0.02	NA	
73575-53-8	67	0.00146	0.02	0.02	NA	
73575-52-7	68	0.00151	0.02	0.02	NA	
60233-24-1	69	0.00193	0.04	0.02	NA	
32598-11-1	70	0.00158	0.08	0.02	NA	
41464-46-4	71	0.00226	0.06	0.02	NA	
41464-42-0	72	0.00161	0.02	0.02	NA	
74338-23-1	73	0.00207	0.04	0.02	NA	
32690-93-0	74	0.00158	0.08	0.02	NA	
32598-12-2	75	0.00164	0.06	0.02	NA	
70362-48-0	76	0.00158	0.08	0.02	NA	
32598-13-3	77	0.00145	0.02	0.02	NA	50-150
70362-49-1	78	0.00161	0.02	0.02	NA	
41464-48-6	79	0.00136	0.02	0.02	NA	
33284-52-5	80	0.00145	0.02	0.02	NA	
70362-50-4	81	0.0016	0.02	0.02	NA	50-150
52663-62-4	82	0.00358	0.02	0.02	NA	
60145-20-2	83	0.00371	0.04	0.02	NA	
52663-60-2	84	0.00362	0.02	0.02	NA	
65510-45-4	85	0.00256	0.06	0.02	NA	
55312-69-1	86	0.00257	0.12	0.02	NA	
38380-02-8	87	0.00257	0.12	0.02	NA	
55215-17-3	88	0.00319	0.04	0.02	NA	
73575-57-2	89	0.00346	0.02	0.02	NA	
68194-07-0	90	0.00268	0.06	0.02	NA	
68194-05-8	91	0.00319	0.04	0.02	NA	
52663-61-3	92	0.00324	0.02	0.02	NA	

Table 4-3
PCB Congener Reporting Limits

CAS Registry	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Method Detection Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
73575-56-1	93	0.00313	0.04	0.02	NA	
73575-55-0	94	0.00342	0.02	0.02	NA	
38379-99-6	95	0.00313	0.02	0.02	NA	
73575-54-9	96	0.00238	0.02	0.02	NA	
41464-51-1	97	0.00257	0.12	0.02	NA	
60233-25-2	98	0.00318	0.04	0.02	NA	
38380-01-7	99	0.00255	0.04	0.02	NA	
39485-83-1	100	0.00313	0.04	0.02	NA	
37680-73-2	101	0.00268	0.06	0.02	NA	
68194-06-9	102	0.00318	0.04	0.02	NA	
60145-21-3	103	0.00293	0.02	0.02	NA	
56558-16-8	104	0.00231	0.02	0.02	NA	50-150
32598-14-4	105	0.00141	0.02	0.02	NA	50-150
70424-69-0	106	0.00157	0.02	0.02	NA	
70424-68-9	107	0.00139	0.02	0.02	NA	
70362-41-3	108	0.00154	0.04	0.02	NA	
74472-35-8	109	0.00257	0.12	0.02	NA	
38380-03-9	110	0.00227	0.04	0.02	NA	
39635-32-0	111	0.00218	0.02	0.02	NA	
74472-36-9	112	0.00255	0.02	0.02	NA	
68194-10-5	113	0.00268	0.06	0.02	NA	
74472-37-0	114	0.00125	0.02	0.02	NA	50-150
74472-38-1	115	0.00227	0.04	0.02	NA	
18259-05-7	116	0.00256	0.06	0.02	NA	
68194-11-6	117	0.00256	0.06	0.02	NA	
31508-00-6	118	0.00131	0.02	0.02	NA	50-150
56558-17-9	119	0.00257	0.12	0.02	NA	
68194-12-7	120	0.0021	0.02	0.02	NA	
56558-18-0	121	0.00229	0.02	0.02	NA	
76842-07-4	122	0.00162	0.02	0.02	NA	
65510-44-3	123	0.0013	0.02	0.02	NA	50-150
70424-70-3	124	0.00154	0.04	0.02	NA	
74472-39-2	125	0.00257	0.12	0.02	NA	
57465-28-8	126	0.00159	0.02	0.02	NA	50-150
39635-33-1	127	0.00143	0.02	0.02	NA	
38380-07-3	128	0.0022	0.04	0.02	NA	
55215-18-4	129	0.00225	0.08	0.02	NA	
52663-66-8	130	0.00286	0.02	0.02	NA	
61798-70-7	131	0.00288	0.02	0.02	NA	
38380-05-1	132	0.00281	0.02	0.02	NA	
35694-04-3	133	0.00264	0.02	0.02	NA	
52704-70-8	134	0.00288	0.04	0.02	NA	
52744-13-5	135	0.00405	0.04	0.02	NA	
38411-22-2	136	0.003	0.02	0.02	NA	
35694-06-5	137	0.00215	0.02	0.02	NA	
35065-28-2	138	0.00225	0.08	0.02	NA	

Table 4-3
PCB Congener Reporting Limits

CAS Registry	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Method Detection Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
56030-56-9	139	0.00242	0.04	0.02	NA	
59291-64-4	140	0.00242	0.04	0.02	NA	
52712-04-6	141	0.00256	0.02	0.02	NA	
41411-61-4	142	0.00283	0.02	0.02	NA	
68194-15-0	143	0.00288	0.04	0.02	NA	
68194-14-9	144	0.00396	0.02	0.02	NA	
74472-40-5	145	0.00307	0.02	0.02	NA	
51908-16-8	146	0.00232	0.02	0.02	NA	
68194-13-8	147	0.00233	0.04	0.02	NA	
74472-41-6	148	0.00404	0.02	0.02	NA	
38380-04-0	149	0.00233	0.04	0.02	NA	
68194-08-1	150	0.00294	0.02	0.02	NA	
52663-63-5	151	0.00405	0.04	0.02	NA	
68194-09-2	152	0.0029	0.02	0.02	NA	
35065-27-1	153	0.00198	0.04	0.02	NA	
60145-22-4	154	0.00347	0.02	0.02	NA	
33979-03-2	155	0.00281	0.02	0.02	NA	50-150
38380-08-4	156	0.00175	0.04	0.02	NA	50-150
69782-90-7	157	0.00175	0.04	0.02	NA	50-150
74472-42-7	158	0.00172	0.02	0.02	NA	
39635-35-3	159	0.00181	0.02	0.02	NA	
41411-62-5	160	0.00201	0.08	0.02	NA	
74472-43-8	161	0.00188	0.02	0.02	NA	
39635-34-2	162	0.00181	0.02	0.02	NA	
74472-44-9	163	0.00225	0.08	0.02	NA	
74472-45-0	164	0.00215	0.02	0.02	NA	
74472-46-1	165	0.00205	0.02	0.02	NA	
41411-63-6	166	0.0022	0.04	0.02	NA	
52663-72-6	167	0.00154	0.02	0.02	NA	50-150
59291-65-5	168	0.00198	0.04	0.02	NA	
32774-16-6	169	0.00174	0.02	0.02	NA	50-150
35065-30-6	170	0.00198	0.02	0.02	NA	
52663-71-5	171	0.00255	0.04	0.02	NA	
52663-74-8	172	0.00258	0.02	0.02	NA	
68194-16-1	173	0.00255	0.04	0.02	NA	
38411-25-5	174	0.00239	0.02	0.02	NA	
40186-70-7	175	0.00229	0.02	0.02	NA	
52663-65-7	176	10.00182	0.02	0.02	NA	
52663-70-4	177	0.00256	0.02	0.02	NA	
52663-67-9	178	0.00246	0.02	0.02	NA	
52663-64-6	179	0.0018	0.02	0.02	NA	
35065-29-3	180	0.00167	0.04	0.02	NA	
74472-47-2	181	0.00239	0.02	0.02	NA	
60145-23-5	182	0.00232	0.02	0.02	NA	
52663-69-1	183	0.00229	0.04	0.02	NA	
74472-48-3	184	0.00169	0.02	0.02	NA	

Table 4-3
PCB Congener Reporting Limits

CAS Registry	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Method Detection Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
52712-05-7	185	0.00229	0.04	0.02	NA	
74472-49-4	186	0.00184	0.02	0.02	NA	
52663-68-0	187	0.00217	0.02	0.02	NA	
74487-85-7	188	0.00176	0.02	0.02	NA	50-150
39635-31-9	189	0.0016	0.02	0.02	NA	50-150
41411-64-7	190	0.00185	0.02	0.02	NA	
74472-50-7	191	0.0018	0.02	0.02	NA	
74472-51-8	192	0.00195	0.02	0.02	NA	
69782-91-8	193	0.00195	0.04	0.02	NA	
35694-08-7	194	0.00209	0.02	0.02	NA	
52663-78-2	195	0.00229	0.02	0.02	NA	
42740-50-1	196	0.00313	0.02	0.02	NA	
33091-17-7	197	0.00229	0.02	0.02	NA	
68194-17-2	198	0.00311	0.04	0.02	NA	
52663-75-9	199	0.00311	0.04	0.02	NA	
52663-73-7	200	0.00229	0.02	0.02	NA	
40186-71-8	201	0.00228	0.02	0.02	NA	
2136-99-4	202	0.00241	0.02	0.02	NA	50-150
52663-76-0	203	0.00287	0.02	0.02	NA	
74472-52-9	204	0.00235	0.02	0.02	NA	
74472-53-0	205	0.00146	0.02	0.02	NA	50-150
40186-72-9	206	0.00146	0.02	0.02	NA	50-150
52663-79-3	207	0.00132	0.02	0.02	NA	
52663-77-1	208	0.00127	0.02	0.02	NA	50-150
2051-24-3	209	0.00096	0.02	0.02	NA	50-150

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the OU1-3 scope of work.

[1] MS/MSD or LCS/LCSD not required by method

EDL = estimated detection limit

NA = Not applicable.

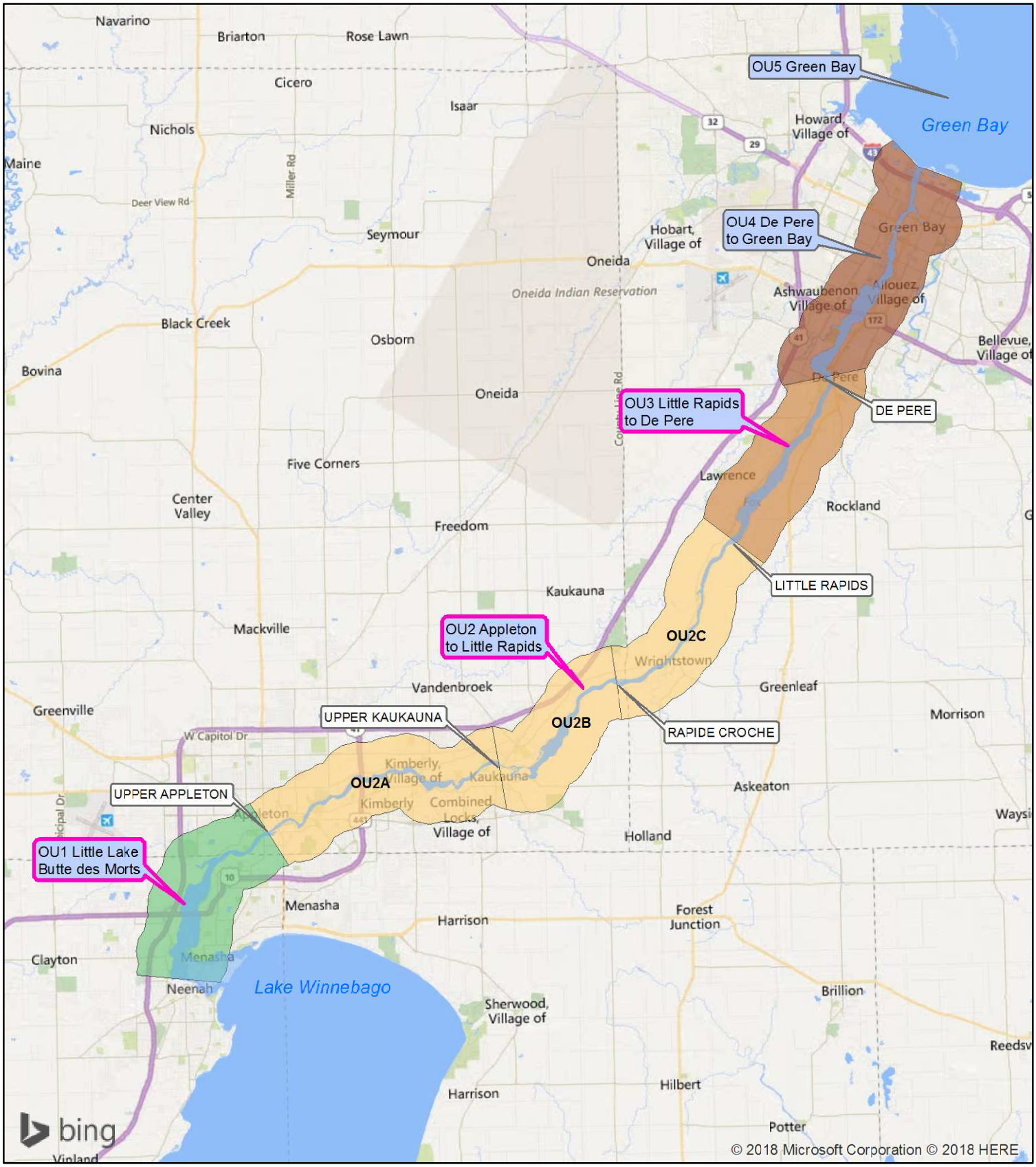
RPD = relative percent difference

Originally prepared by: BMS1

Updated by: John Reynolds-TestAmerica 3/13/18

Checked by: SDJ

Figures



NOTES:
1. Base Data from Wisconsin DNR and esri basemaps.

N

Foth

P.H. GLATFELTER COMPANY

FIGURE 1-1

OU1-3 SAMPLING & ANALYSIS PLAN
FOX RIVER REMEDIATION OPERABLE UNITS
LOWER FOX RIVER, WISCONSIN

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

0 2 4 Miles

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 1-1 Operable Units.mxd Date: 3/26/2018

SOURCE:
1. Basemaps by esri and its data suppliers.
2. Coordinates System:NAD 1983 Wisconsin State Plane Central, Feet

LEGEND

◎ Proposed Transect Water Sample Locations

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

Foth

0 1,500 3,000 Feet

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FIGURE 3-1

OU1-3 SAMPLING & ANALYSIS PLAN
LAKE WINNEBAGO SURFACE WATER TRANSECT
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-1 LW Surface Water Transect.mxd Date: 3/26/2018

SOURCE:
1. Basemaps by esri and its data suppliers.
2. Coordinates System:NAD 1983 Wisconsin State Plane Central, Feet

LEGEND

Proposed Transect Water Sample Locations

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

Foth

0 150 300
Feet

P.H. GLATFELTER COMPANY

FIGURE 3-2

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 1 SURFACE WATER TRANSECT
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-2 OU1 Surface Water Transect.mxd Date: 3/26/2018

SOURCE:
1. Basemaps by esri and its data suppliers.
2. Coordinates System:NAD 1983 Wisconsin State Plane Central, Feet

LEGEND

◎ Proposed Transect Water Sample Locations

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

Foth

0 150 300
Feet

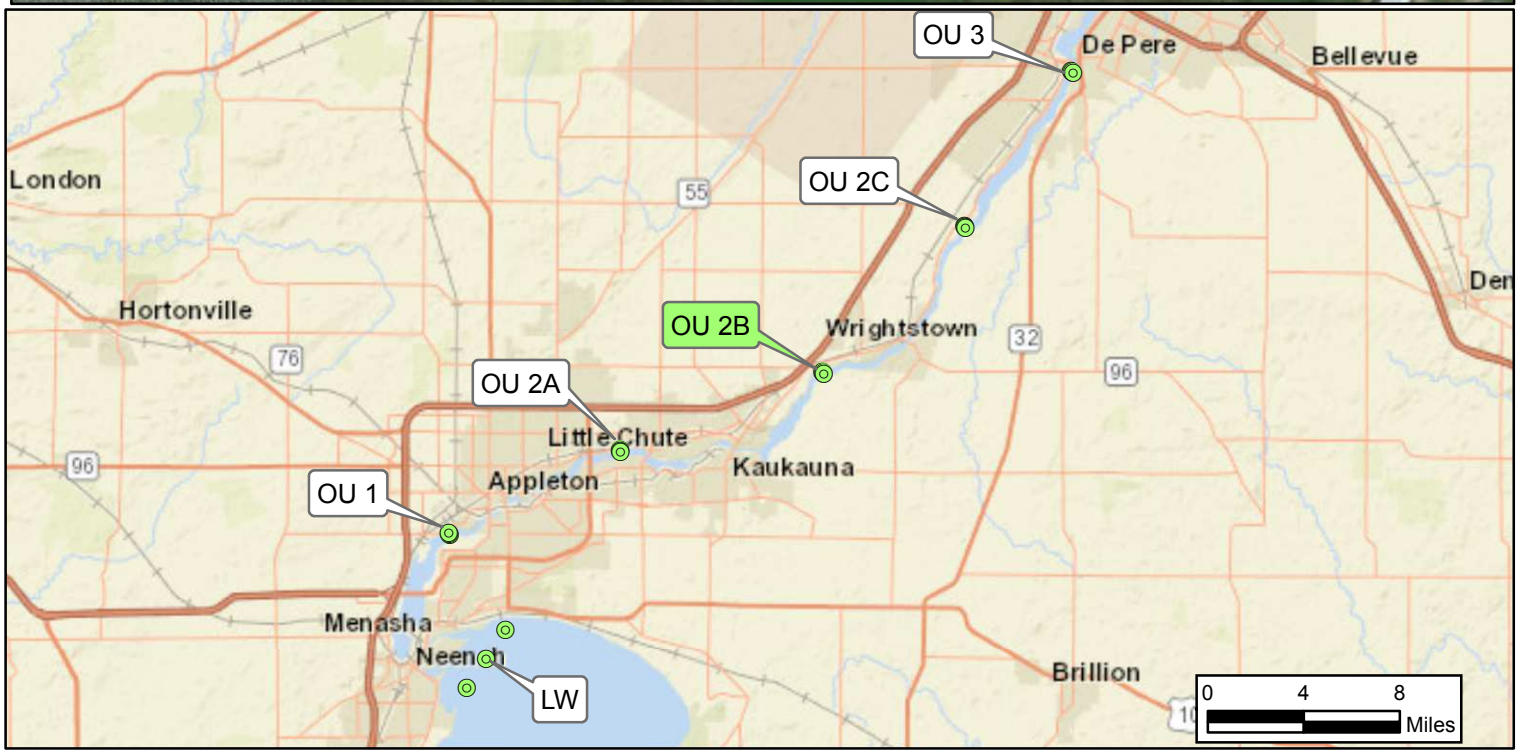
P.H. GLATFELTER COMPANY

FIGURE 3-3

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 2A SURFACE WATER TRANSECT
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-3 OU2A Surface Water Transect.mxd Date: 3/26/2018



SOURCE:
1. Basemaps by esri and its data suppliers.
2. Coordinates System:NAD 1983 Wisconsin State Plane Central, Feet

LEGEND

Proposed Transect Water Sample Locations

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

Foth

0 150 300
Feet

P.H. GLATFELTER COMPANY

FIGURE 3-4

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 2B SURFACE WATER TRANSECT
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-4 OU2B Surface Water Transect.mxd Date: 3/26/2018

SOURCE:
1. Basemaps by esri and its data suppliers.
2. Coordinates System:NAD 1983 Wisconsin State Plane Central, Feet

LEGEND

Proposed Transect Water Sample Locations

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

Foth

0 150 300
Feet

P.H. GLATFELTER COMPANY

FIGURE 3-5

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 2C SURFACE WATER TRANSECT
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-5 OU2C Surface Water Transect.mxd Date: 3/26/2018

SOURCE:
1. Basemaps by esri and its data suppliers.
2. Coordinates System:NAD 1983 Wisconsin State Plane Central, Feet

LEGEND

Proposed Transect Water Sample Locations

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

Foth

0 150 300
Feet

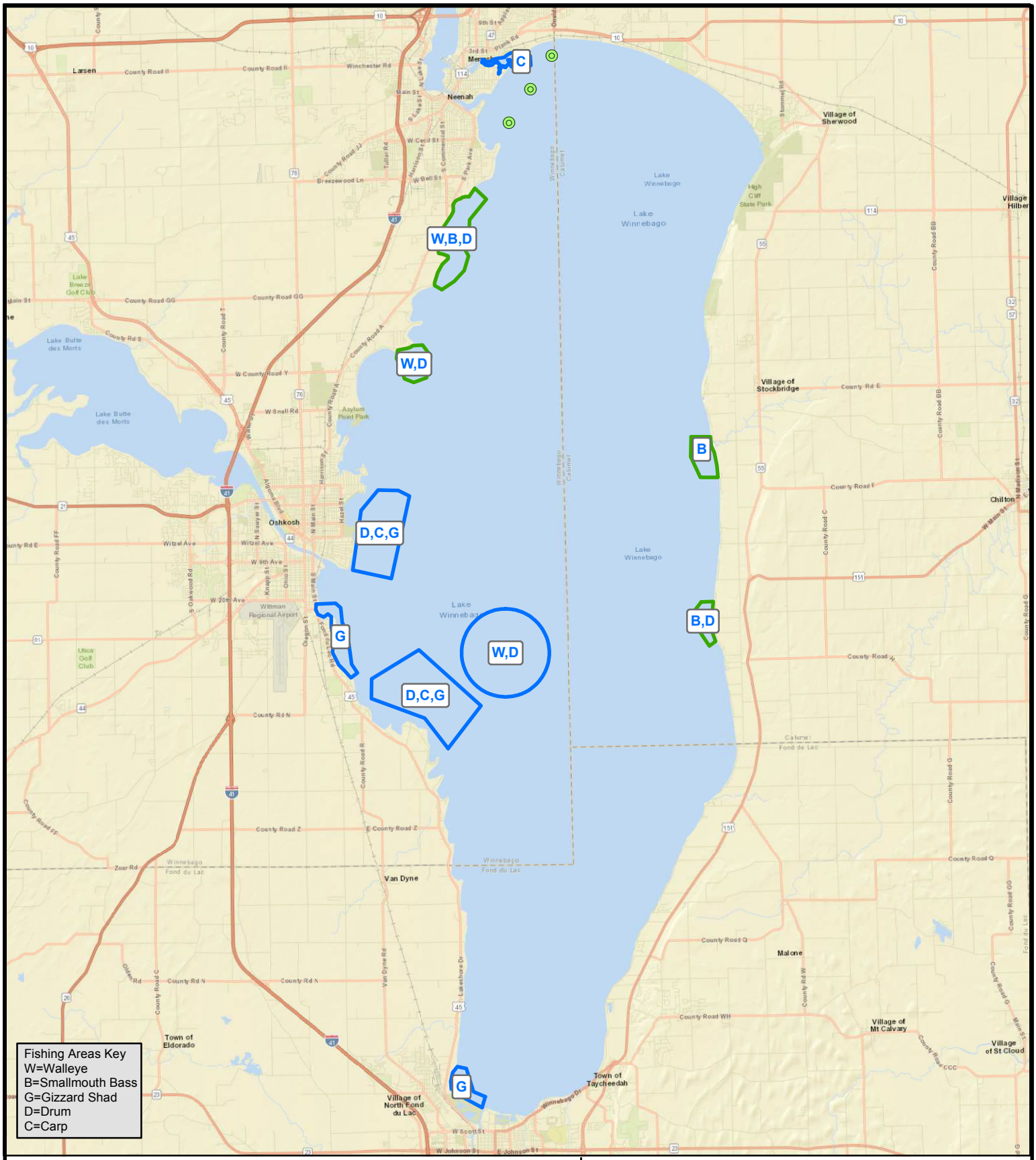
P.H. GLATFELTER COMPANY

FIGURE 3-6

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT OU3 SURFACE WATER TRANSECT
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-6 OU3 Surface Water Transect.mxd Date: 3/26/2018



LEGEND

- Proposed Transect Water Sample Locations

Suggested Fishing Areas

- Fall (Aug-Oct)
- Spring (Jun)

SOURCE:
1. Basemap by esri
2. NAD83 SPC Feet

N

Foth

0 9,000 18,000 Feet

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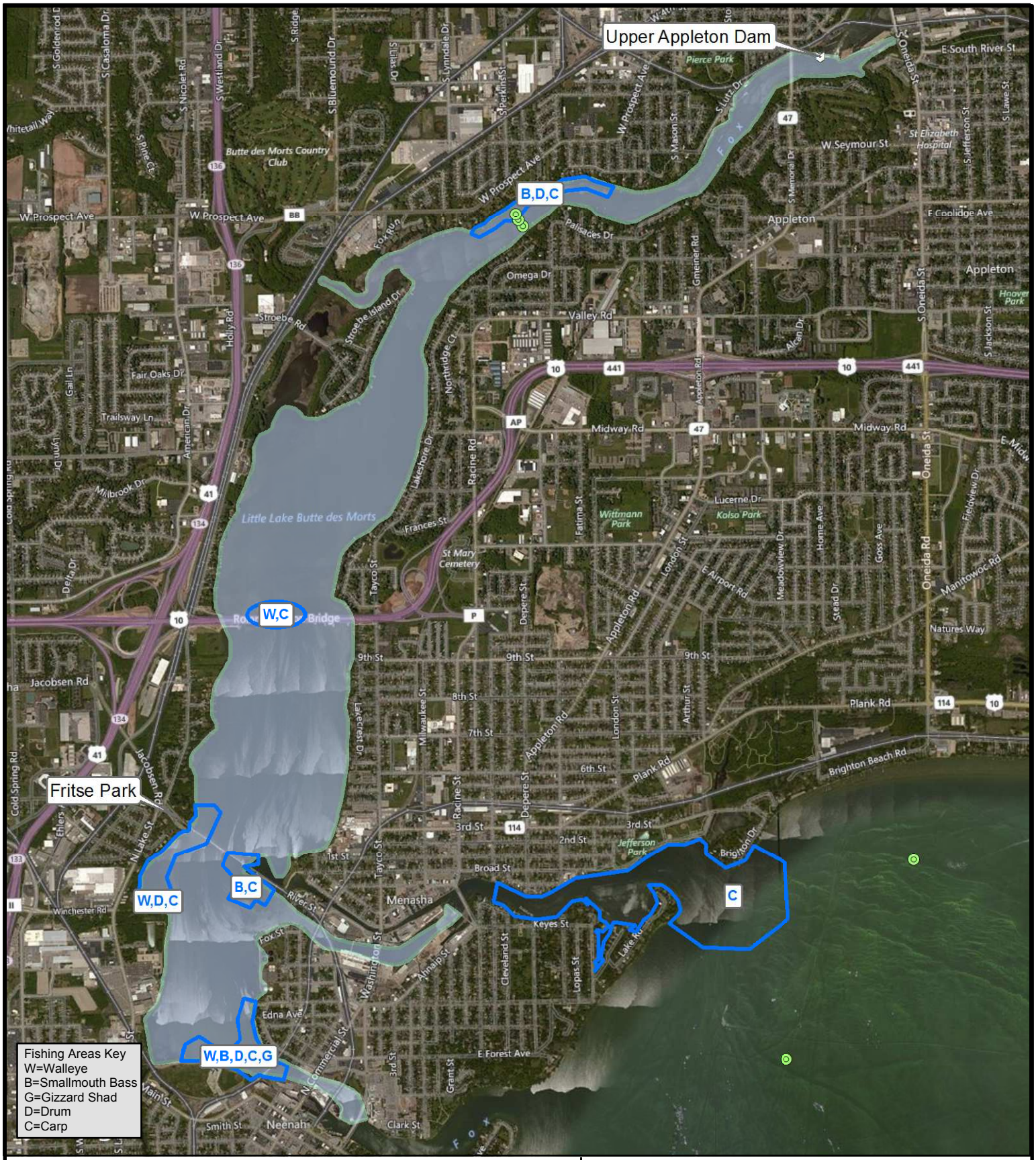
FIGURE 3-7

OU1-3 SAMPLING & ANALYSIS PLAN
LAKE WINNEBAGO FISH SAMPLING AREAS
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-7 LW Fish Sampling Areas.mxd Date: 3/26/2018



LEGEND

- Proposed Transect Water Sample Locations
- Dams
- Suggested Fishing Areas (Fall, Aug-Oct)

SOURCE:
1. Basemaps by esri
2. NAD83 SPC Feet

Foth

N

0 1,500 3,000 Feet

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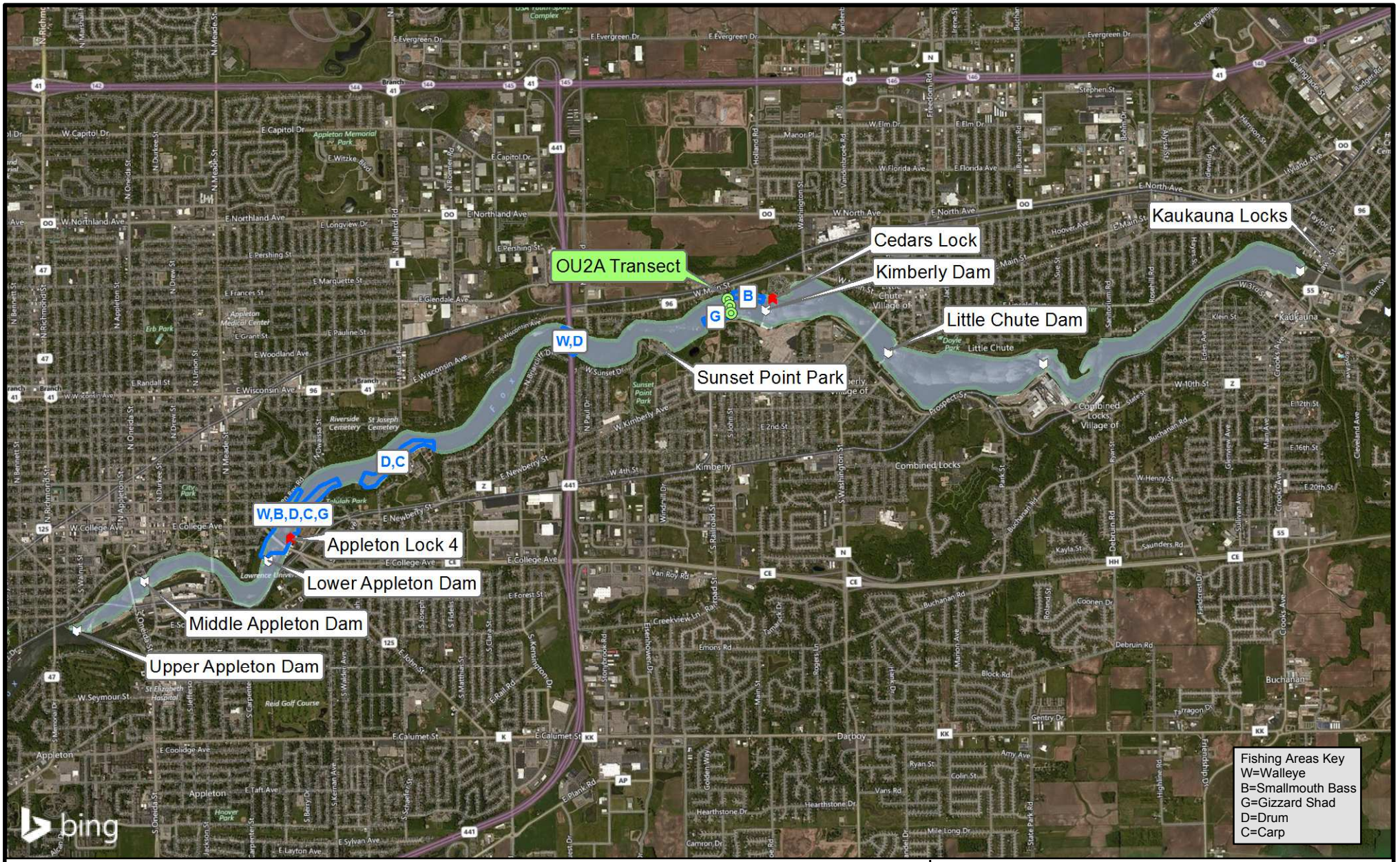
FIGURE 3-8

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 2A FISH SAMPLING AREAS
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-8 OU1 Fish Sampling Areas.mxd Date: 3/26/2018



LEGEND

- Proposed Transect Water Sample Locations
- Locks
- Dams
- Suggested Fishing Areas (Fall, Aug-Oct)

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SOURCE:
1. Basemaps by esri
2. NAD83 SPC Feet

N

Foth

0 2,000 4,000 Feet

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FIGURE 3-9

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 2A FISH SAMPLING AREAS
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-9 OU2A Fish Sampling Areas.mxd Date: 3/26/2018

LEGEND

- Proposed Transect Water Sample Locations
- Locks
- Dams
- Suggested Fishing Areas (Fall, Aug-Oct)

SOURCE:
1. Basemaps by esri
2. NAD83 SPC Feet

Foth

N

0 1,500 3,000 Feet

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FIGURE 3-10

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 2B FISH SAMPLING AREAS
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-10 OU2B Fish Sampling.mxd Date: 3/26/2018

LEGEND

- Proposed Transect Water Sample Locations
- Locks
- Dams
- Suggested Fishing Areas (Fall, Aug-Oct)

SOURCE:
1. Basemaps by esri
2. NAD83 SPC Feet

N

Foth

0 1,500 3,000 Feet

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

P.H. GLATFELTER COMPANY

FIGURE 3-11

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 2C FISH SAMPLING AREAS
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-11 OU2C Fish Sampling.mxd Date: 3/26/2018

LEGEND

- Proposed Transect Water Sample Locations
- Locks
- Dams
- Suggested Fishing Areas (Fall, Aug-Oct)

SOURCE:
1. Basemaps by esri
2. NAD83 SPC Feet

Foth

N

0 1,500 3,000 Feet

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

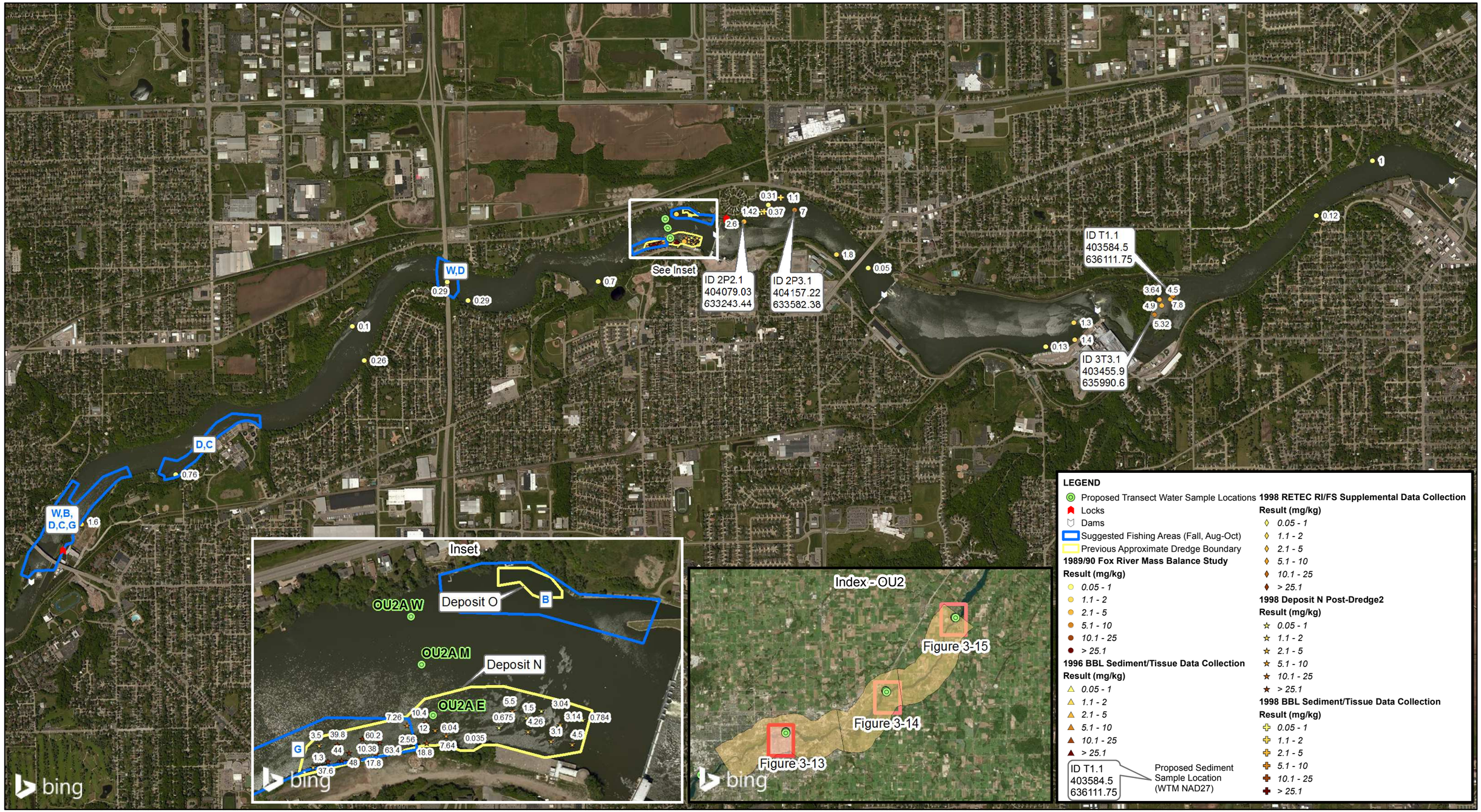
P.H. GLATFELTER COMPANY

FIGURE 3-12

OU2-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 3 FISH SAMPLING AREAS
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-12 OU3 Fish Sampling.mxd Date: 3/26/2018



NOTES:

1. NAD 1927 Wisconsin TM
2. Data illustrates surface sediment results from WDNR Fox River Environmental Database and Document Archive
3. Basemap supplied by esri and its data suppliers
4. Callout boxes illustrate coordinates of proposed MNR sampling locations

N

Foth

0 1,000 2,000 Feet

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

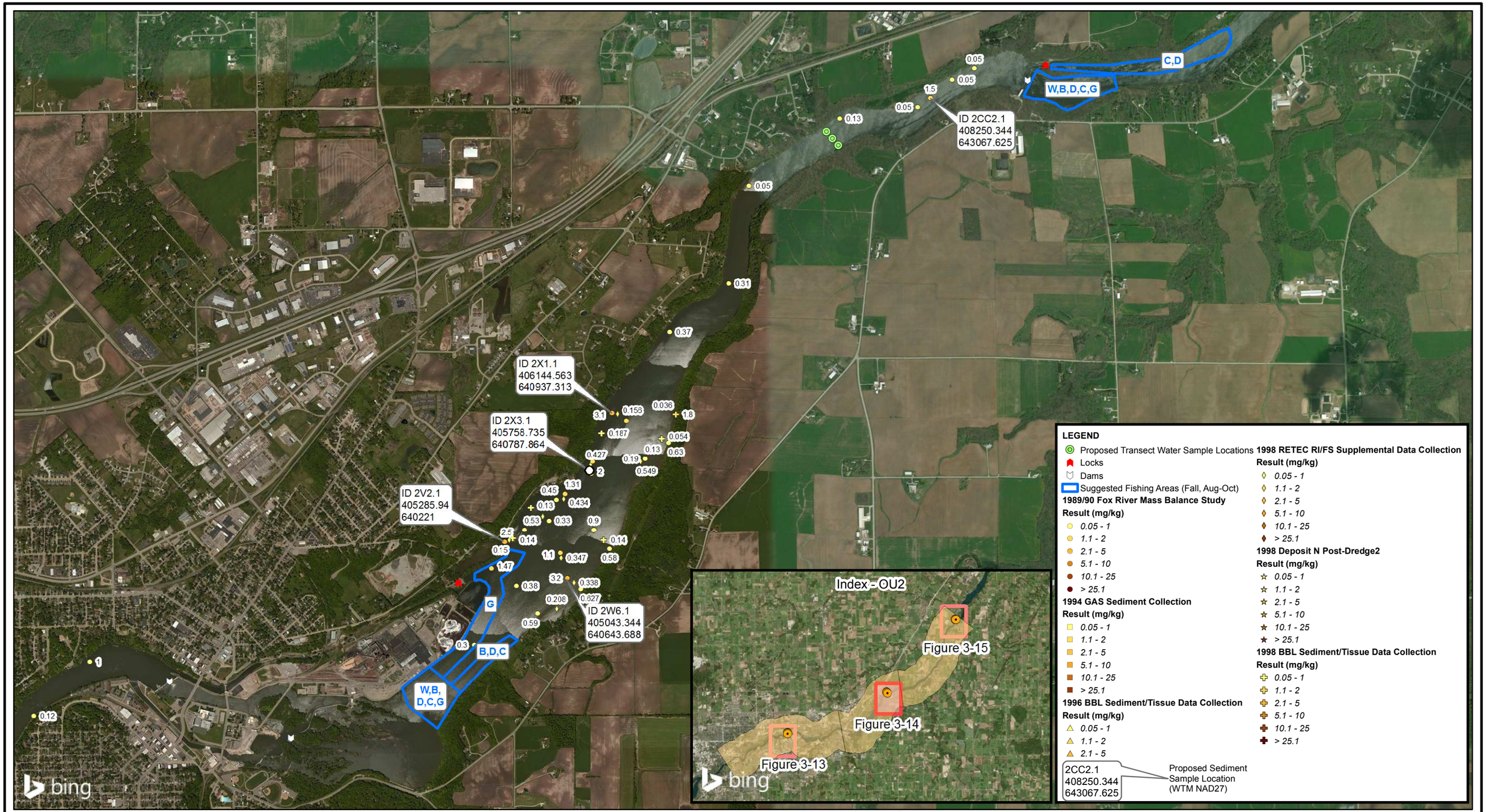
P.H. GLATFELTER COMPANY

FIGURE 3-13

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 2A SEDIMENT SAMPLE LOCATIONS
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-13 OU2A Sediment Sampling.mxd Date: 3/26/2018



LEGEND

- Proposed Transect Water Sample Locations
- Locks
- Dams
- Suggested Fishing Areas (Fall, Aug-Oct)

1989/90 Fox River Mass Balance Study
Result (mg/kg)
- *0.05 - 1*
- *1.1 - 2*
- *2.1 - 5*
- *5.1 - 10*
- *10.1 - 25*
- *> 25.1*

1994 GAS Sediment Collection
Result (mg/kg)
- *0.05 - 1*
- *1.1 - 2*
- *2.1 - 5*
- *5.1 - 10*
- *10.1 - 25*
- *> 25.1*

1996 BBL Sediment/Tissue Data Collection
Result (mg/kg)
- *0.05 - 1*
- *1.1 - 2*
- *2.1 - 5*

1998 RETEC RI/FS Supplemental Data Collection
Result (mg/kg)
- *0.05 - 1*
- *1.1 - 2*
- *2.1 - 5*
- *5.1 - 10*
- *10.1 - 25*
- *> 25.1*

1998 Deposit N Post-Dredge2
Result (mg/kg)
- *0.05 - 1*
- *1.1 - 2*
- *2.1 - 5*
- *5.1 - 10*
- *10.1 - 25*
- *> 25.1*

1998 BBL Sediment/Tissue Data Collection
Result (mg/kg)
- *0.05 - 1*
- *1.1 - 2*
- *2.1 - 5*
- *5.1 - 10*
- *10.1 - 25*
- *> 25.1*

2CC2.1
408250.344
643067.625
Proposed Sediment Sample Location (WTM NAD27)

NOTES:
1. NAD 1927 Wisconsin TM
2. Data illustrates surface sediment results from WDNR Fox River Environmental Database and Document Archive
3. Basemap supplied by esri and its data suppliers
4. Callout boxes illustrate coordinates of proposed MNR sampling locations
5. ID 2X3.1 location depicted is a different location than sampled during the Mass Balance Study. Location was moved during 2012 LTM due to lack of sediment at original proposed location.

N

Foth

0 1,000 2,000 Feet

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

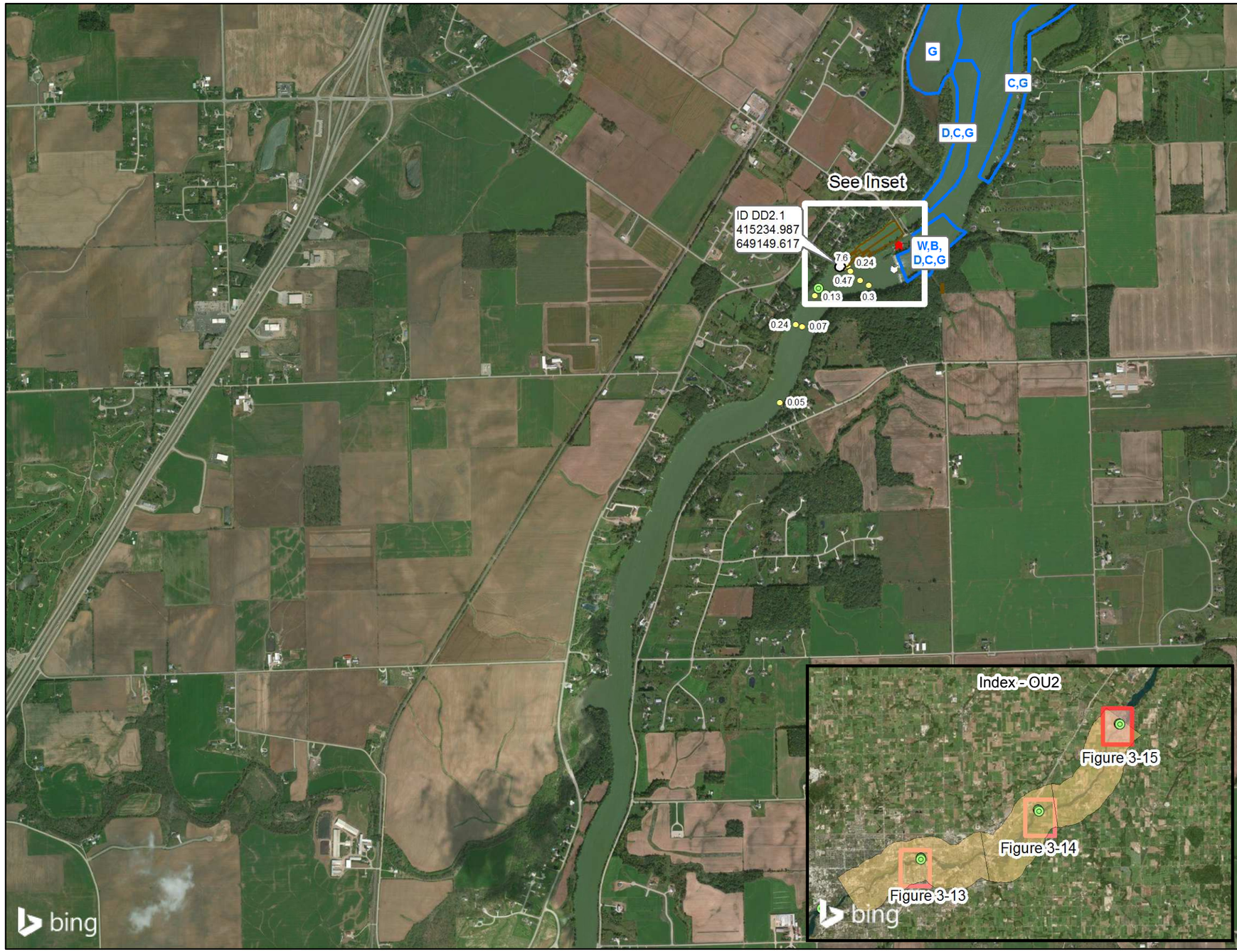
P.H. GLATFELTER COMPANY

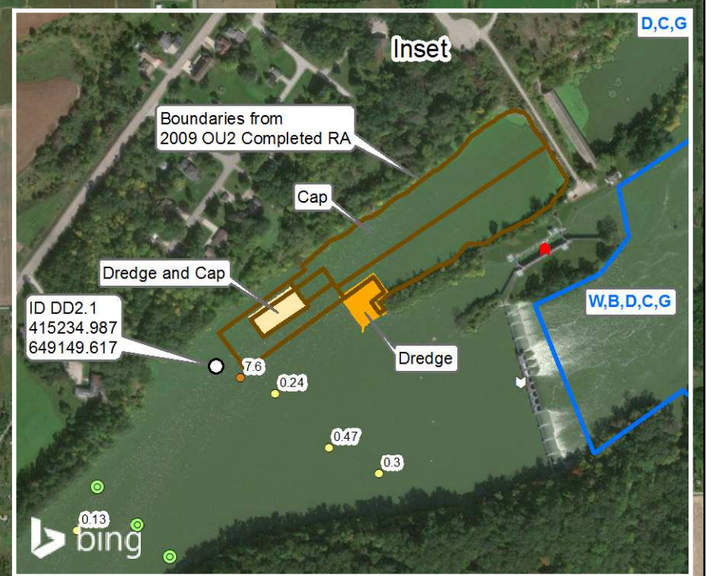
FIGURE 3-14

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 2B SEDIMENT SAMPLE LOCATIONS
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-14 OU2B Sediment Sampling.mxd Date: 3/26/2018





LEGEND

- Proposed Transect Water Sample Locations
- Locks
- Dams
- Suggested Fishing Areas (Fall, Aug-Oct)

1989/90 Fox River Mass Balance Study
Result (mg/kg)
- *0.05 - 1*
- *1.1 - 2*
- *2.1 - 5*
- *5.1 - 10*
- *10.1 - 25*
- *> 25.1*

1996 BBL Sediment/Tissue Data Collection
Result (mg/kg)
- *0.05 - 1*
- *1.1 - 2*
- *2.1 - 5*
- *5.1 - 10*
- *10.1 - 25*
- *> 25.1*

ID DD2.1
415234.987
649149.617 — Proposed Sediment Sample Location (WTM NAD27)

1998 RETEC RI/FS Supplemental Data Collection
Result (mg/kg)
- *0.05 - 1*
- *1.1 - 2*
- *2.1 - 5*
- *5.1 - 10*
- *10.1 - 25*
- *> 25.1*

1998 Deposit N Post-Dredge2
Result (mg/kg)
- *0.05 - 1*
- *1.1 - 2*
- *2.1 - 5*
- *5.1 - 10*
- *10.1 - 25*
- *> 25.1*

1998 BBL Sediment/Tissue Data Collection
Result (mg/kg)
- *0.05 - 1*
- *1.1 - 2*
- *2.1 - 5*
- *5.1 - 10*
- *10.1 - 25*
- *> 25.1*

NOTES:
1. NAD 1927 Wisconsin TM
2. Data illustrates surface sediment results from WDNR Fox River Environmental Database and Document Archive
3. Basemap supplied by esri and its data suppliers
4. Callout boxes illustrate coordinates of proposed MNR sampling locations
5. ID DD2.1 location depicted is a different location than sampled during the Mass Balance Study. Location was moved during 2012 LTM due to lack of sediment at original proposed location.

N

Foth

0 1,000 2,000 Feet

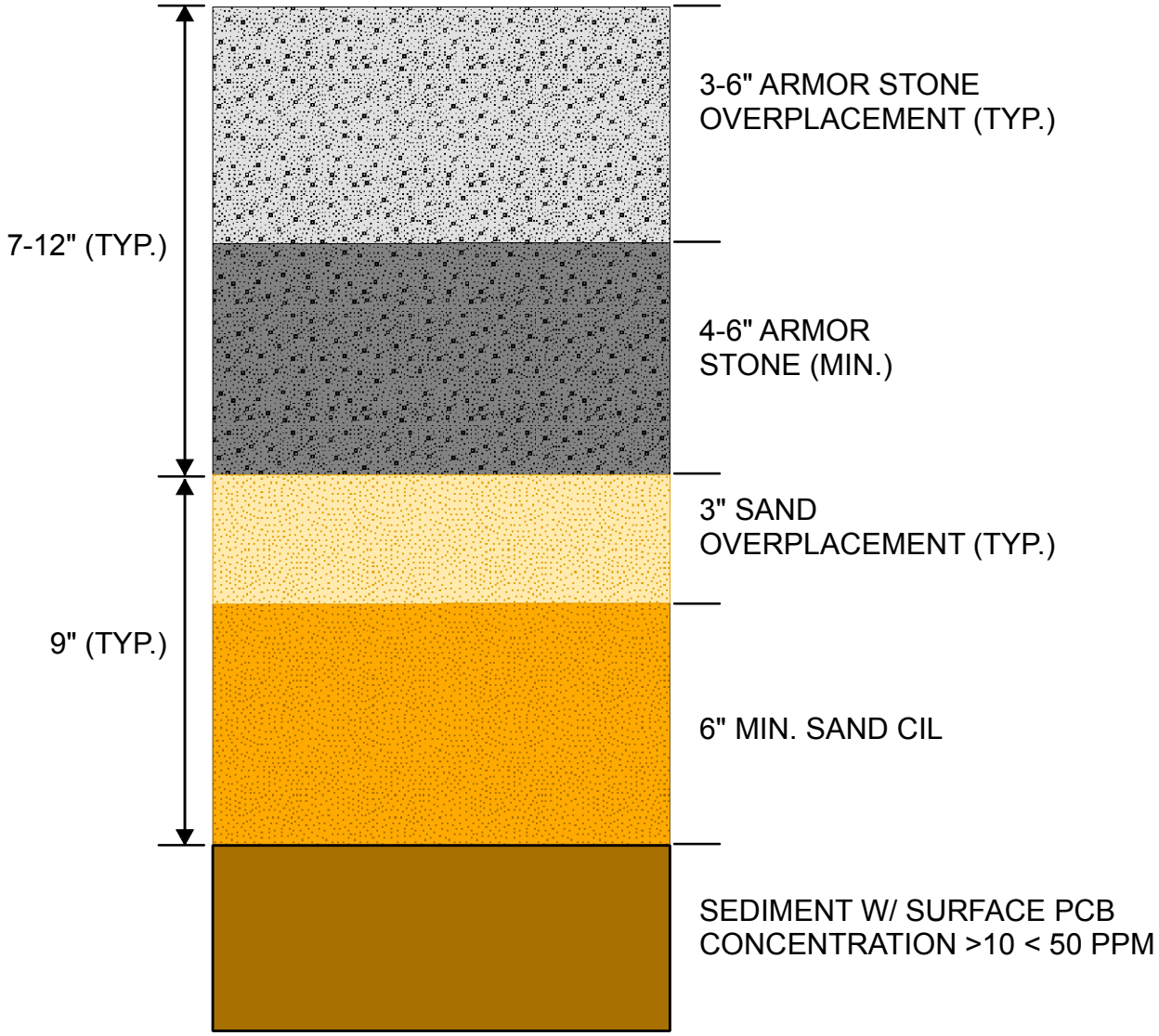
P.H. GLATFELTER COMPANY

FIGURE 3-15

OU1-3 SAMPLING & ANALYSIS PLAN
OPERABLE UNIT 2C SEDIMENT SAMPLE LOCATIONS
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-15 OU2C Sediment Sampling.mxd Date: 3/26/2018



P.H. GLATFELTER COMPANY

FIGURE 3-16

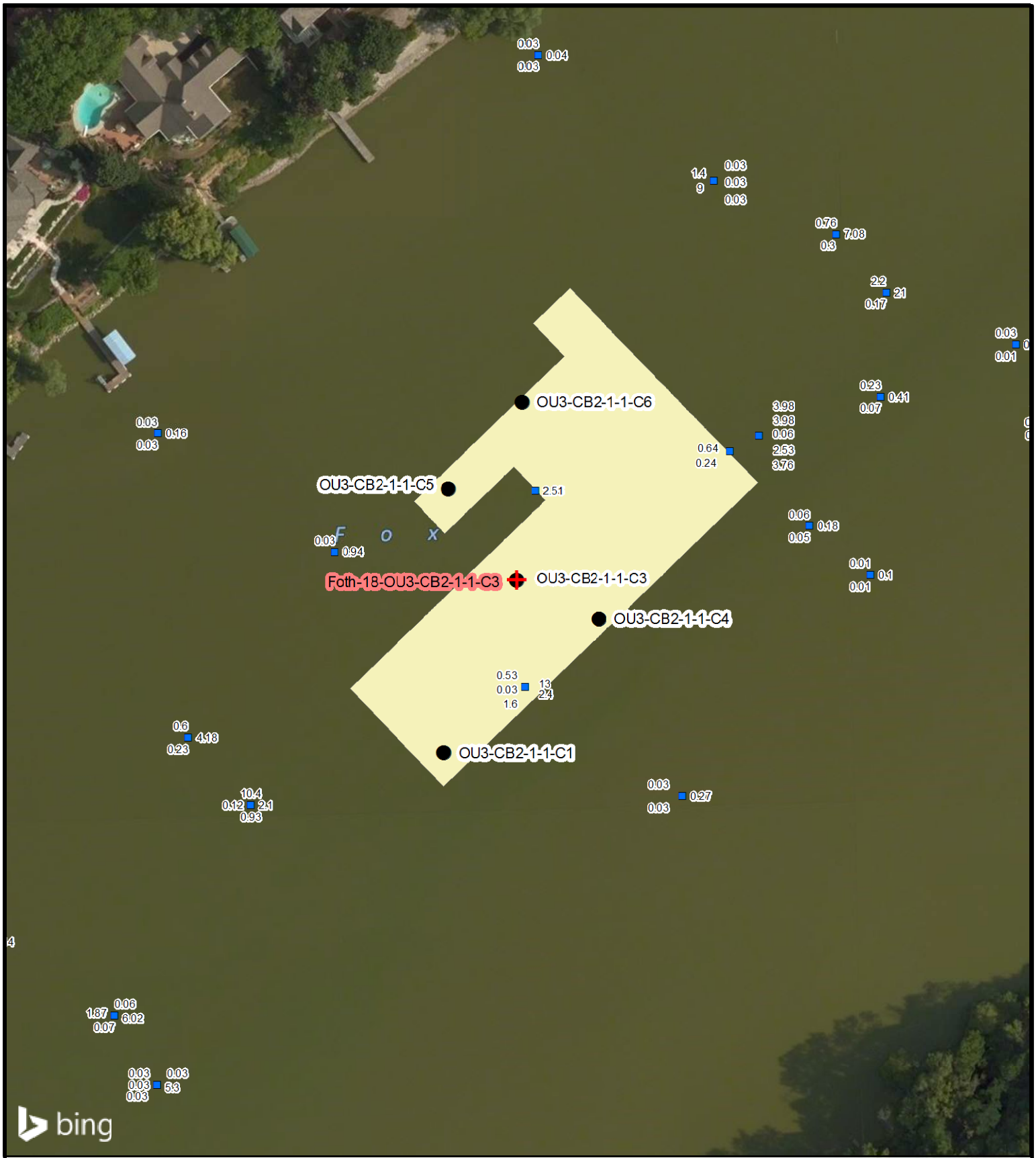
OU1-3 SAMPLING & ANALYSIS PLAN
FOX RIVER TYPE B CAP DESIGN
LOWER FOX RIVER, WISCONSIN

Foth

NOT TO SCALE

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-16 Type B Cap Design.mxd Date: 3/26/2018



LEGEND

- Proposed Chemical Isolation Layer Sample
- Original Chemical Isolation Layer Sample
- PCB (ppm) Result from Fox Core Chemistry DB
- Cap B Placement Areas

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

SOURCE:
1. Basemaps by esri
2. Foth GPS Collection

Foth

N

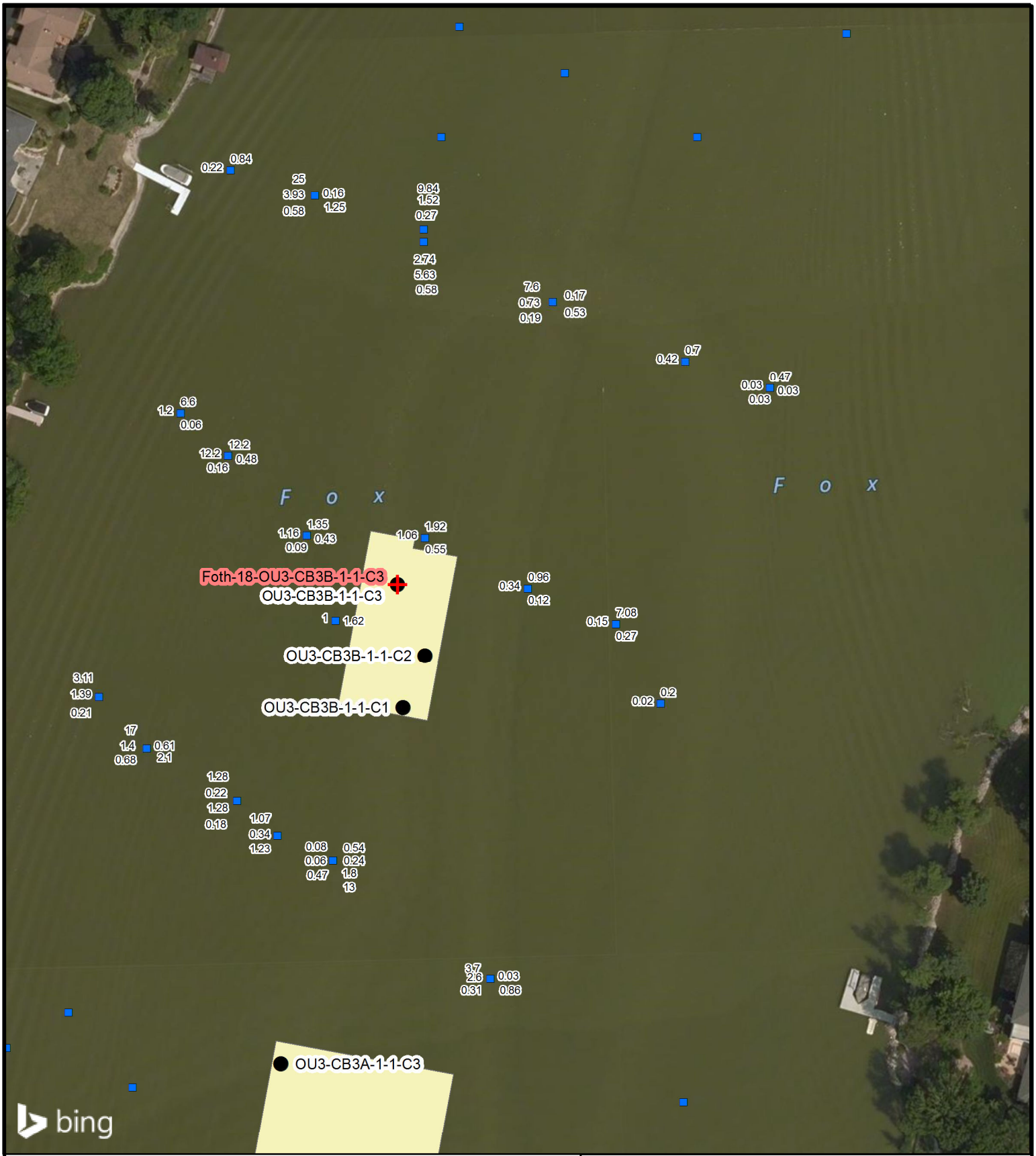
0 50 100 Feet

P.H. GLATFELTER COMPANY

FIGURE 3-17
OU1-3 SAMPLING & ANALYSIS PLAN
OU3 CHEMICAL ISOLATION LAYER
SAMPLE LOCATION - OU3-CB2
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-17 Proposed Chemical Isolation Layer Sample Location – OU3-CB2.mxd Date: 3/26/2018



LEGEND

- Proposed Chemical Isolation Layer Sample
- Original Chemical Isolation Layer Sample
- PCB (ppm) Result from Fox Core Chemistry DB
- Cap B Placement Areas

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

SOURCE:
1. Basemaps by esri
2. Foth GPS Collection

Foth

N

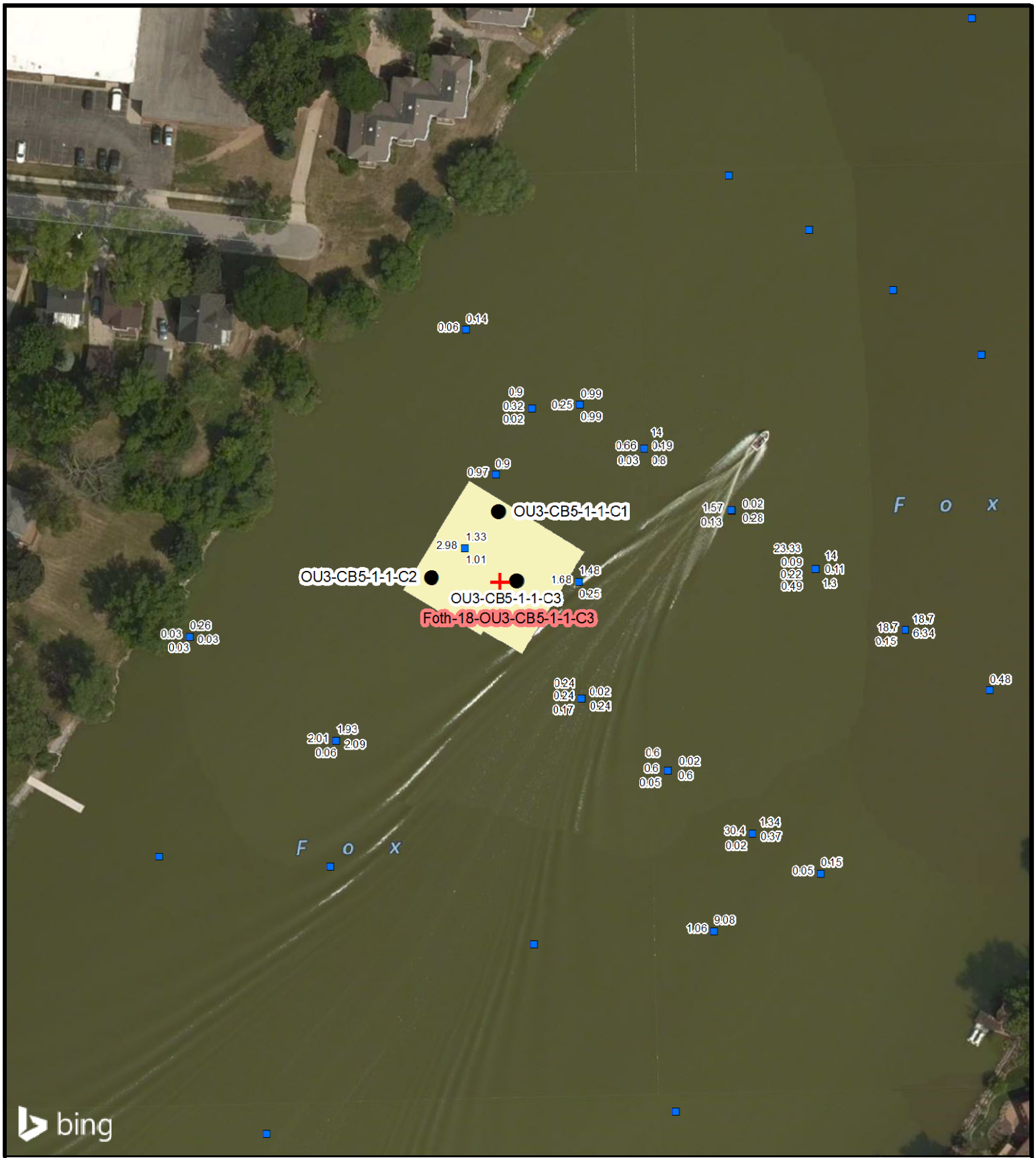
0 50 100 Feet

P.H. GLATFELTER COMPANY

FIGURE 3-18
OU1-3 SAMPLING & ANALYSIS PLAN
OU3 CHEMICAL ISOLATION LAYER
SAMPLE LOCATION - OU3-CB3B
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-18 Proposed Chemical Isolation Layer Sample Location – OU3-CB3B.mxd Date: 3/26/2018



LEGEND

- Proposed Chemical Isolation Layer Sample (Location of Actual 2012 CIL Sample)
- Original Chemical Isolation Layer Sample
- PCB (ppm) Result from Fox Core Chemistry DB
- Cap B Placement Areas

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

SOURCE:
1. Basemaps by esri
2. Foth GPS Collection

Foth

N

0 50 100 Feet

P.H. GLATFELTER COMPANY

FIGURE 3-19
OU1-3 SAMPLING & ANALYSIS PLAN
OU3 CHEMICAL ISOLATION LAYER
SAMPLE LOCATION - OU3-CB5
LOWER FOX RIVER, WISCONSIN

Date: MARCH 2018	Revision Date:	
Drawn By: DAT	Checked By: DMR	Scope: 18G007

Path: Q:\Glatfelter\18G007\GIS\mxd\LTMP\Figure 3-19 Proposed Chemical Isolation Layer Sample Location – OU3-CB5.mxd Date: 3/26/2018

Appendix A

SOP Acknowledgement Form

A-1a Location Control Using Differential Global Positioning System
A-1b Location Control Using RTK-Global Positioning System
A-2 Trace PCB Sampling of Surface Water
A-3 Water Quality Meter Use
A-4 Field Log Book
A-5 Fish Collection
A-6 Biological Tissue and Plant Preparation
A-7 Sediment Sampling Equipment Cleaning and Decontamination
A-8 Sediment Sampling – Ponar Dredge
A-9 Chemical Isolation Layer Sampling – Cap B
A-10 Vibrocore Sampling
A-11 Vacuum Push Core Sampling
A-12 Piston Core Sampling
A-13 Shipping and Packaging of Non-Hazardous Samples
A-14 Sample Chain of Custody

SOP Acknowledgement Form

The undersigned agrees as follows:

I have read and understand the attached Standard Operating Procedures that apply to the task that I am completing and agree to comply with all of its provisions.

Name	Print Name	Date

A-1a

Location Control Using Differential Global Positioning System

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Location Control Using Differential Global Positioning System

Introduction

The purpose of this Standard Operating Procedure (SOP) is to provide positioning guidelines for location control for surface water surveys and sampling techniques, while using a handheld global positioning system (GPS) unit with differential GPS (DGPS) software, capable of locating stations to within a horizontal accuracy and repeatability of ± 1 meter.

References

None.

Responsibility

The Field Supervisor will be responsible for ensuring the navigation system is checked against known benchmarks and location control data is collected at the required times and frequencies as specified in this SOP.

Personnel Qualifications/Requirements

- One person must be trained in vessel operation and station positioning.
- A minimum of two people are required to complete sampling vessel positioning.

Equipment and Supplies

- Personal protective equipment (PPE) as required by the Health and Safety Plan.
- Navigation of the sampling vessel to the predetermined sampling locations and holding sample location will be accomplished using a handheld Trimble 2005 GEOXT DGPS or equivalent navigation system; this unit is specified to provide sub-meter accuracy. This DGPS unit is capable of using either U.S. Coast Guard (USCG) beacons or Wide Area Augmentation System (WAAS) to achieve the required accuracy.
- The sampling team will also verify position with the Trimble 2005 GEOXT DGPS or equivalent. Water surface elevation or vertical measurement is not recorded with this device.
- Field Log Book or applicable field forms.

Foth Infrastructure & Environment, LLC

Procedures

Survey Datum

Location control for all sample stations will use a coordinate system referenced to the 1997 adjustments to the North American Datum (NAD) 83 (97) horizontal datum. The DGPS system will be referenced to appropriate monuments. Other datums may be used dependent upon project constraints. Be sure to identify the correct project datum prior to proceeding.

Positioning Sample Vessel

- Prior to vessel departure at each sampling transect, a calibration check shall be taken at two known benchmarks nearest to the sample locations (example: sample transect or operable unit). The acceptable tolerance for the benchmark check with the handheld DGPS unit shall be twice the instrument accuracy, or +/- 2 meters. These readings shall be recorded in a Field Log Book by a project team member and stored electronically for later download. Location readings shall be recorded and compared to published values.

- The vessel navigation and sample station positioning shall be accomplished using the DGPS methodology and the handheld display. Actual coordinates of sample station starting position shall be recorded by a project team member and stored electronically for later download. Location readings and time shall be recorded.

- The position of the DGPS unit on the vessel shall be as close to the sampling team as possible during sampling activities without compromising field operations, worker safety, or sample integrity (i.e., potential for cross-contamination).

- At a minimum, DGPS locations shall be recorded at the beginning and end of each hydrocast during water column profiling, and at the beginning and end of each water subsampling event at a particular location and depth along a sampling transect (i.e., U.S. Geological Survey [USGS] quarter-point sampling procedures or at the center of the moon pool or site of the boat at sampling location, once spudded or anchored for sediment sampling events). For prolonged sampling activities, intermediate DGPS location readings shall be recorded electronically at approximately two second intervals. These readings are collected at the end of the sampling event and used to generate drift plots. For stationary sampling (e.g., sediment sampling), DGPS coordinates shall be recorded at the center of the moon pool or side of the boat where sampling occurs once spudding or anchoring are completed.

- At the completion of sampling in each transect or operable unit, a calibration check shall be taken at one of the pre-determined benchmarks. This reading shall be recorded and compared to published values.

Foth Infrastructure & Environment, LLC

Measurement Tolerance

The field checks of DGPS locations against known benchmarks will be evaluated using the following tolerance intervals:

- Less than or equal to 2 meters – Accuracy within project control limits;
- >2 to 5 meters – Acceptable accuracy, locations of associated sampling locations will be qualified as estimated;
- >5 meters – Unacceptable accuracy, corrective action required (see next section).

Corrective Action

In the event the DGPS unit fails to agree to within 5 meters of the known locations at the two benchmarks assigned to a particular sampling station, the following corrective actions will be implemented:

- Check the DGPS unit against an alternate benchmark in case the original benchmark is compromised by interference, obstruction, or other signal deterioration;
- Wait for a stronger satellite signal and re-check the unit; and
- Obtain and check a new DGPS unit.

A-1b

Location Control Using RTK-Global Positioning System

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Location Control Using RTK-Global Positioning System

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for precise positioning of station locations that is often required to meet sampling event goals. Both accuracy (the ability to define position) and repeatability (the ability to return to a sampling station) are essential.

For marine sampling activities, with rigid specifications for both horizontal and vertical positioning accuracy/repeatability, navigation of the sampling vessel to a sampling location and final positioning will be accomplished using specialized real-time kinematic (also called "On the Fly" [OTF]) Global Positioning System (RTK-GPS), which will achieve better than ±1-m horizontal accuracy as well as the ±5-cm vertical accuracy. One advantage of the RTK-GPS methodology is that the system allows the determination of an accurate measurement of a reference elevation, and/or surface water elevation, at the time of sample acquisition. The availability of the vertical data avoids the requirement to rely on multiple water level boards and/or installation of water level gauges. The RTK-GPS will be referenced to known survey control monuments (x, y, and z) surrounding the sampling site.

References

None.

Responsibility

The Field Supervisor will be responsible for ensuring the navigation system is checked against known benchmarks and location control data is collected at the required times and frequencies as specified in this SOP.

Personnel Qualifications/Requirements

- One person must be trained in vessel operation and station positioning.
- A minimum of two people are required to complete sampling vessel positioning.

Equipment and Supplies

- Personal protective equipment as required by the Health and Safety Plan.
- Watercraft with at least three anchors or two anchoring spuds.
- RTK-GPS equipment.
- Field Log Book or applicable field forms.

Foth Infrastructure & Environment, LLC

Procedures

Survey Datum

Location control for all sample stations will use a coordinate system referenced to the 1997 adjustments to the North American Datum (NAD) 83 (97) horizontal datum. The RTK-GPS system will be referenced to appropriate monuments. Other datums may be used dependent upon project constraints. Be sure to identify the correct project datum prior to proceeding.

Positioning of the Sampling Vessel and Elevation Measurements

1. Prior to daily departure of the sampling vessel, the sampling team will be informed of the planned coring locations and the number of cores required at each location. The sampling team will ensure that there is sufficient equipment to complete the planned work aboard the sampling vessel prior to departure from the dock or launch ramp.

2. Vessel navigation and positioning shall be accomplished using RTK-GPS methodology. To achieve the precision afforded by RTK-GPS methodology, a reference station will be established at a secure shore side location directly over a control point with precisely known x, y coordinates and elevation (z) relative to the project grid and datum. The reference station transmits pseudo-range correctors to a Rover GPS receiver aboard the survey vessel. The Rover unit then computes the precise x, y, z position of the shipboard antenna, based on the transmitted correction information.

3. The RTK-GPS system antenna will be in a "transit" mount, which will allow it to be removed and manually repositioned over the sampling point to acquire final "as-collected" x, y position measurements. The transit mount will have a fixed height so that the antenna may consistently be returned to a fixed distance (height) above the vessel deck that will be used in subsequent measurement of the core and water level elevations. The height of the vessel deck, as well as the water depth, will also be used to calculate the top of sediment elevation at the sampling point.

4. The sampling vessel will transit to a sampling location directed by the RTK-GPS system. The helmsman will maneuver the vessel and inform the crew when the vessel is in position. To sample at the exact pre-plotted sampling coordinates, the mobile antenna may be repositioned directly over the moon pool (sampling port in the boat platform) for the final vessel positioning. As appropriate, either spudding or anchoring will be used to maintain vessel stability at the sampling location.

5. After the sampling vessel is anchored or spudded, the sampling team will measure and record the following:

    a. The water depth from the water surface to the lake bottom using a survey rod attached to a 6-inch diameter metal plate.

b. The thickness of soft sediment using the "poling" method (measured by pushing a probing rod with a ½ inch steel end into the sediment until refusal-applicable to sediment sampling activities only).

6. The above information will be recorded on the Core Collection and Processing Log prior to acquisition of the core sample. The Core Collection and Processing Log will also be annotated with the exact core sampling location coordinates, date, time, weather, and water surface conditions, as well as any other information or event(s) associated with the acquisition of each core sample.

To compute the surface water elevation referenced to the project datum, the height of the RTK antenna above the water surface can be subtracted from the RTK-measured elevation of the RTK antenna. To calculate the top of core elevation referenced to the project datum, the measured depth of water is subtracted from the calculated surface water elevation.

A-2

Trace PCB Sampling of Surface Water

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Trace PCB Sampling of Surface Water

Introduction

The objective of this Standard Operating Procedure (SOP) is to provide methods, procedures, and guidance for sampling trace levels of polychlorinated biphenyls (PCB) in surface waters such as lakes, streams, pits, sumps, lagoons, and similar reservoirs for environmental analysis.

This process is applicable to all Foth Infrastructure & Environment, LLC (Foth) projects where low level PCB surface water sampling will be performed and where no other project/program plan or procedure is in place to direct those activities.

These procedures are modified based on trace metal sample collection techniques. When sampling requirements indicate that both trace metal and PCBs are to be sampled, trace metals can be collected under this SOP.

References

Olson, Mark and, John F. De Wild. U.S. Geologic Survey Water Resource Division, "Low Level Collection Techniques and Species-Specific Analytical Methods for Mercury in Water, Sediment, and Biota." Reported in the U.S. Geologic Survey *Resource Investigations Report,* 99-4018B, 1999.

Telliard, William A., et al. U.S. Environmental Protection Agency, Method 1669, "Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels," July 1996.

Telliard, William A., et al. "Water Quality Criteria Levels," July 1996.

Foth, 2016. *Location Control Using Differential Global Positioning System* SOP - #3206.

Definitions

- "Clean Hands" is a gloved person (with shoulder length gloves, if needed). "Clean Hands" will only have contact with sample bottles.
- "Dirty Hands" is a gloved person and contacts all sampling material pumps and tubing.
- Composite Sample is a peristaltic pump with a flow weighted or time interval dependent sampling device that can composite samples into one container or into multiple containers enclosed within the device (i.e., ISCO sampler) or operated in manual mode to directly fill sample containers.

Foth Infrastructure & Environment, LLC

Personnel Qualifications/Requirements

As directed in the Foth Project Planning Document (PPD) and appointed by project manager (PM):

- Health and Safety Plan.
- A minimum of two people are required to complete sampling with one person trained in this sampling technique.
- A third person will be needed to operate a vessel and operate Global Positioning System (GPS).
- A boater safety course is required to operate the boat.

Equipment and Supplies

- Work boat (minimum 16 feet) cleaned prior to collecting samples, power washed inside and out if necessary. Boat should be equipped with sonar depth sounder, electric trolling motor, and downrigger.
- Proper safety precautions shall be maintained throughout sampling event including wearing of appropriate personal protective equipment (PPE), life jackets, and following all boating rules and regulations including Foth's boating Current Best Approach (CBA).
- Coolers containing sample bottles for PCB, Total Suspended Solids (TSS), and Total Organic Carbon (TOC) samples. PCB sample bottles shall be contained in inner and outer sealable plastic bags.
- Cooler of ice.
- Lab-grade or reagent-free deionized water supplied by the analytical lab for blanks.
- "PCB free" water for field decontamination procedures.
- Peristaltic pump (ISCO Sampler). Reference Owner's Manual for operations.
- Rod to measure depth and attach tubing for sample collection at predetermined depth.
- Battery: 12-volt marine to operate peristaltic pump or Honda generator.
- Trimble GEO7X GPS (DGPS), or equivalent, as the primary GPS instrument for acquiring sample station locations. (Reference: Foth SOP #3206).
- Horiba U52030 Water Quality Meter, or equivalent, will be used to take turbidity and temperature field readings. The Horiba U52030 Water Quality Meter also has a pressure transducer for measuring depth. Daily calibrations of the Horiba U52030 Water Quality Meter will occur prior to sample point data acquisition. Calibrations of all instruments shall be kept in the Field Log Book and shall contain, at a minimum, instrument serial number, make and model, manufacturer of standard(s), and standard lot number(s) and date of expiration. Calibration readings and any adjustments made to field instruments shall also be recorded. See Owner's Manual for calibration procedures. A calibration check will also be performed at the end of each day's activities to verify if any drift in the instrument readings has occurred. If unacceptable drift is detected, the drift will be recorded and equipment will be re-calibrated.

- Two sections of Teflon® lined tubing for each transect where a peristaltic pump is used. One section to be submerged to predetermined depth and the other, an approximate 4-foot section to discharge into sample bottles. A new section of tubing shall be used for each transect being sampled.
- Two-foot section of silicone tubing needed for peristaltic pump action. A new section of tubing shall be used for each transect being sampled.
- Face dust masks or full face shields may be worn by members of the sampling team if introduction of low level PCB contamination through respiration is suspected.

Procedures

Safety Note

Surface water sampling can sometimes require the use of boats or access into or across bodies of water. Observe all boating safety considerations in the Health and Safety Plan including donning of proper life jackets.

"Quarter Point" Sampling Procedures

Area-weighted composite samples will be collected on specified transects to obtain representative water concentrations averaged over the cross-section of flow. Water quality sampling transects are located to the extent possible in relatively straight reaches with simple, U-shaped cross-sections, avoiding areas with shallow benches or protrusions that could cause eddies, wind waves, or other hydraulic complications. It is assumed that the flow in these sections is relatively uniform and well mixed. In a uniform, well-mixed cross-section, an area-weighted sampling design provides a reasonable approximation of a flow-weighted design.

Representative transects are sampled in general accordance with USGS "quarter point" sampling procedures. The channel cross-sections are divided into three equal areas based on bathymetric data. Water sampling stations are positioned at the midpoint of each of the three flow areas. Multiple samples may be collected at each sampling station.

Sample Team Roles and PPE

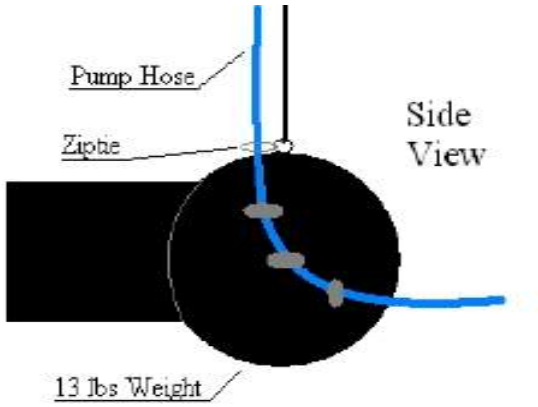
- A three person sampling team consisting of "Clean Hands," "Dirty Hands," and a boat driver who is an extra pair of hands in supporting the sampling effort.
  - All participants must wear, nitrile, or over life jackets and field clothing. Face dust mask or full face shields are recommended for all sampling team members if in PCB dust areas or if PCB inhalation is a concern.
  - "Clean Hands" is a gloved person (with shoulder length gloves, if needed) who will only have contact with sample bottles.
  - "Dirty Hands" is a gloved person who will have contact with all sampling material, pump hose, and depth rod.
  - The third person will handle driving of the boat, maintaining direction of route traveled during sampling into the waves/wind, or upstream in any current. Other duties of the third person include assisting with cooler manipulation,

controlling the Teflon® lined tubing and the laboratory-supplied "blank" water while collecting field blanks, recording DGPS coordinates, starting the peristaltic pump (ISCO Sampler) or generator, and monitoring safety conditions of sampling team during each sampling event.

Sample Collection Using Peristaltic Pump

1. Sample team shall calibrate the DGPS instrument with two known benchmarks.
2. Sample team should approach the predetermined sites using the DGPS instrument from down current or down wind to prevent vessel induced disturbance in the sampling area. No anchoring for sample collection. Sampling will take place from the bow of the boat, when possible, which should be oriented into the current or wind whenever possible. Work area shall be covered with plastic sheeting, if necessary, and duct taped to hold in place. Prepping the boat at each transect can be done on shore prior to launching.
3. Stratification measurements (such as turbidity and temperature) shall be measured at 1-meter intervals, starting at the surface and vertically measuring to within 1 meter of the bottom. DGPS measurements will be recorded at a minimum of 2-second intervals to record drift from starting position. Electronic sonar (used so as to not disturb bottom sediments) shall be used to verify total depth as the measurements are recorded. These measurements will be made before active sample collection begins for determining sample distribution. These results shall be recorded in the Field Log Book. Vessel control will be made with the engines or electric trolling motor to maintain sample collection tubing as vertical as possible and to remain as close as possible to the original starting DGPS location along each transect. Any variations in boat drift from targeted distances as a result of weather or boat traffic need to be documented in the Field Log Book.
4. Sampling equipment preparation of tubing and peristaltic pump, bottle prep, and sampling team gloving activities shall be completed before active sampling begins. Due to limited space in the boat and safety of sampling team, some of the preparation procedures can occur on shore prior to the launching of the boat. During actual collection of samples, the vessel direction must be maintained into the current or the wind with DGPS coordinates recorded.
5. All operations involving contact with sample bottle and with transfer tubing shall be handled by individuals designated as "Clean Hands" and "Dirty Hands." "Clean Hands" is responsible for all activities that involve direct contact with sample. "Dirty Hands" is responsible for all activities that do not involve direct contact with sample.
6. If collecting samples from multiple depths at a sampling station, collect water samples in order from shallow-to-deep in the water column.

7. The peristaltic pump tubing shall be deployed to a predetermined depth. To prevent the Teflon® lined tubing from curling and changing sample extraction depth, a weight or length of PVC pipe must be used to keep intake tubing at the desired depth. A downrigger with weight and tail fin is recommended to maintain sample depth and to keep intake tubing oriented in the direction of boat travel (refer to tubing attachment below). See Owner's Manual for operations of peristaltic pump.



8. Two tubing volumes shall be purged through the tubing system prior to sample collection.
9. "Dirty Hands" must open the cooler or storage container and remove the sample bottles from storage.
10. Sample bottle collection order: PCB bottle, PCB backup bottle, TSS (unpreserved bottle), TOC (sulfuric acid [H2SO4] preserved bottle).
11. Once gloves have been put on, "Clean Hands" must keep their gloved hands in view at all times.
12. "Dirty Hands" opens outer bag containing inner bag and PCB sample bottle.
13. "Clean Hands" opens inner bag and removes PCB sample bottle.
14. "Clean Hands" must keep PCB sample bottle in view at all times.
15. "Dirty Hands" reseals the outer bag containing inner bag and places back in storage container.
16. "Dirty Hands" controls the discharge hose from the peristaltic pump while "Clean Hands" opens the sample bottle cover. The sample bottle is filled after two tube volumes have been purged. The unpreserved PCB sample bottle is partially filled and rinsed with the sample water three times prior to sample collection.
17. Once "Clean Hands" replaces the sample bottle lid and returns the sample bottle to the original inner bag, "Dirty Hands" seals the outer sample bag and returns the bagged PCB sample bottle to the cooler.
18. "Dirty Hands" collects TSS and TOC samples and returns sample bottles to cooler.
19. Ice must be added to sample cooler.
20. Once all samples have been collected, the peristaltic pump can be turned off or moved to a lower depth in the water column, if required.

21. Document sample conditions, sample time, sample procedures, and any other observations pertinent to sample collection (wave action, boat activity, deviations from sampling plan). DGPS coordinates are continuously recorded during stratification measurements and sampling procedures to documentation drift around sampling station. (Reference: Foth SOP #1306)

Procedures for Additional Vertical Samples Collected at a Sample Station

- Repeat above procedure for samples at the next predetermined depth in the water column at the same sample location.
- Ensure a minimum of two tubing volumes are purged from depth before sample collection begins.
- Ensure that the bottom is not disturbed during drift by maintaining sonar depth.
- After all vertical samples are collected at sample location, rinse sample equipment with deionized water by pumping deionized water through peristaltic pump.
- Store peristaltic pump tubing in plastic bag for transport to next sample location along the transect.

Procedures for Addition Sample Stations Along a Transect

- Position the boat at the next sample location along transect.
- Repeat stratification measurements once at new sample location.
- Repeat sample collection procedures as necessary.

Decon Procedures After completing a Transect and Before Next Transect Sampling Event

- The used Teflon® lined tubing and silicone tubing shall be removed from the peristaltic pump.
- The used sampling tubing may be discarded or stored in a plastic bag and dedicated for future use along one transect.
- A decontamination area shall be determined by the sample team.
- Remove any particulate matter and other surface debris, including invasive species, from peristaltic pump and any other dedicated equipment (weights, pipes, etc.) used during the sampling event.
- Using appropriate tools such as a brush and non-phosphorus, laboratory-grade detergent, wash non-dedicated equipment and rinse with deionized water.
- Let air dry in a clean area.
- Place sampling equipment in a double bag and then in a plastic container ready for next event.

Procedures for QA Sample Collection

- For field blank samples, use laboratory-provided “blank” water and pass through a new section of tubing (Teflon® lined and silicone) prior to any sample collection.
- For replicate sample collection, sample bottle shall be alternated during sample collection.

A-3

Water Quality Meter Use

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Water Quality Meter Use

Introduction

This Standard Operating Procedure (SOP) is intended to provide general guidance and methods for using a field meter to measure water quality parameters from groundwater or surface water that is being purged, sampled, or monitored.

This procedure is applicable to all Foth projects where water quality monitoring is required using a water quality meter. The water quality meter may be a stand-alone meter or it may be a combined multi-probe unit used to measure temperature, pH, specific conductance, and/or other water quality parameters. The most common methods used for measuring water quality are instruments that measure in-situ parameters in one of the following two ways:

Water is extracted from its source using a pump and measured in a flow-through cell or in some instances captured and then measured in individual aliquots. This method is preferred when monitoring wells are sampled for laboratory analysis of chemical parameters, and groundwater purging is required.

The meter is submerged directly into the sample source, such as a monitoring well or surface water body, to collect in-situ monitoring parameters.

References

U.S. Army Corps of Engineers, 2001. *Requirements for the Preparation of Sampling and Analysis Plans*, Appendix C, EM-200-1-3, Washington, D.C.

American Society of Testing and Materials, *Standard Guide for Selection of Purging and Sampling Devices for Ground-Water Monitoring Wells*, D6634-01, West Conshohocken, PA.

American Society of Testing and Materials, *Standard Guide for Sampling Ground-Water Monitoring Wells*, D4448-01, West Conshohocken, PA.

Definitions

- Water Quality Meter – A device used to measure specific field parameters indicative of water quality, such as temperature, pH, specific conductance, and/or other parameters. The meter may be stand-alone or it may be a combined multi-probe unit.

- Pump – An electric, compressed air, or inert gas-driven device that raises liquids by means of pressure or suction. The types of pumps that should be used for water quality monitoring should be chosen based on the well size and depth, the type of contaminants, and the specific factors affecting the overall performance of the sampling or monitoring effort. The types of pumps that may be used include centrifugal, peristaltic, centrifugal submersible, gas displacement, and bladder pumps.

- pH – The negative log of the hydrogen ion concentration (-log10 [H+]); a measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The scale is 0 to 14.

- Turbidity – A measure of overall water clarity determined by measurement of the degree to which light traveling through a water column is scattered by the suspended organic (including algae) and inorganic particles. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU) but may also be measured in Jackson Turbidity Units (JTU).

- Specific Conductance (SC) – A measure of how well water can conduct an electrical current. Conductivity increases with increasing amount and mobility of ions such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron, and can be used as an indicator of water pollution. The unit of conductance is expressed as microsiemens (1/1,000,000 siemen) per centimeter, or µS/cm.

- Oxidation-Reduction (Redox) Potential (ORP) – A measure in volts of the affinity of a substance for electrons compared with hydrogen. Liquids that are more strongly electronegative than hydrogen (i.e., capable of oxidizing) have positive redox potentials. Liquids less electronegative than hydrogen (i.e., capable of reducing) have negative redox potentials. Although the standard hydrogen electrode (SHE) is the ultimate reference for all ORP measurements, in practice an ORP field measurement may be made with other electrodes, such as silver chloride. These values may be converted to SHE values.

- Dissolved Oxygen (DO) – Refers to the amount of oxygen expressed as milligrams per liter (mg/L) that is contained in particular water. The amount of oxygen that can be held by the water depends on the water temperature, salinity, purity, and pressure.

- Salinity – The amount of dissolved salts in water, generally expressed in parts per thousand (PPt).

Responsibilities

Foth employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Foth employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

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For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e., checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

Equipment

The following equipment is recommended for use in performing water quality measurements:

- Water quality meter(s)
- Spare parts such as alkaline batteries (if used) and sensor probes
- Pump and discharge hose/line for use with a flow-through cell
- Paper towels or lint-free wipes
- Deionized water
- Sample gloves
- Calibration solutions for all parameters being measured; within expiration dates
- Plastic sheeting
- Field Log Book or log sheets

Procedures

General Instructions

- Ensure that the measuring range of the instrument encompasses the expected sample concentration or units.

- Before going to the field, locate all necessary field supplies such as deionized water, calibration solutions, decontamination supplies, and spare parts.

- Consult the instrument's operation manual as well as the project-specific sampling plan to verify that you have prepared the proper equipment and supplies to successfully complete the work.

Calibration

*Calibration **must** be performed **at least once per day** during operation. Calibrate the meter according to the instrument's operating manual. If sampling and monitoring is being performed for long periods of time, periodically check the instrument calibration using the operating manual's recommended frequency.*

In order to avoid limiting the field personnel to one particular model, only general calibration instructions are presented in this procedure.

- Locate a clean, protected area in which to set up and calibrate the instrument. Ensure that sufficient supplies of de-ionized water, clean paper towels, buffer solutions, and standard solutions are available.

- Inspect the meter and probes for damage. Some of the probes are very delicate or have a thin membrane installed over the probe. Be careful when handling the meter/probes so as not to damage them. If damaged, replace probes in accordance with the instrument's operating manual or obtain a different meter.

- Turn on the meter and allow it to "warm-up" for the manufacturer-specified time (usually 15 to 30 minutes). Check the battery power to determine if the meter has sufficient power to operate for the monitoring period. Replace the batteries, if necessary.

- Calibrate the meter according to the instrument's operating manual. In general, calibration is performed by immersing the probe(s) in aliquots of calibration standard solution(s) and following certain meter keystrokes to set the calibration for each parameter. Do not immerse the probe into the stock container of the solution. Always transfer a small amount of the solution into a separate container to calibrate the probe(s). If calibrating for multiple parameters using more than one solution, be sure to wipe off and rinse the probe with deionized water between solutions.

- Recheck each parameter after calibration by immersing the probe into the calibration solution and reading it like a sample reading. If the agreement is not within 25% of the solution's known concentration, repeat the calibration process with a new solution aliquot.

- Discard the used calibration solution aliquots when finished into an appropriate waste container.

- Record the calibration data in the Field Log Book or log sheet.

Operation of the Instrument

- If using a flow-through cell system, attach the extraction pump and lines in accordance with the pump and meter manufacturer's instructions. Allow the lines to fill and the probes to become immersed before switching the instrument to its measurement mode.

- If using a down-hole system, allow a few minutes for the probe to stabilize before taking a reading.

- Operate the meter in accordance with the instrument's operating manual.
- Collect the field parameter reading(s) per the project requirements, and record them in a Field Log Book or on log sheets.
- Decontaminate the meter before collecting data from the next sample source. For a flow-through system, flush the lines with three line volumes of deionized water or replace with new ones between samples.

A-4

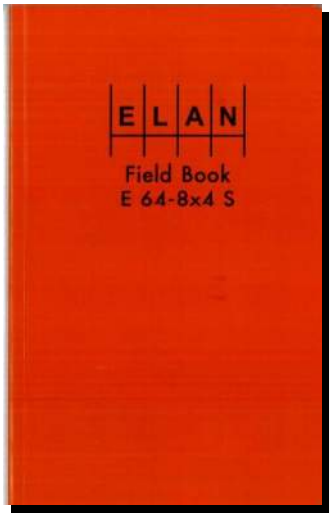
Field Log Book

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Field Log Book

Introduction



The purpose of this Standard Operating Procedure (SOP) is to set the minimum criteria for content entry and form of a Field Log Book.

Foth Infrastructure & Environment, LLC (Foth) gathers information for scientific and engineering evaluations. As part of the information gathering process, Field Log Books are often the sole source for interpretation of information and are legal documents.

The purpose of Field Log Book documentation is to collect information that is not documented in any standard form and that can be used by scientists and engineers to interpret data. Field Log Book entries show the importance of:

- Data collection objectives
- Developing and following site specific sampling plans
- Following regulatory regulations and permits
- Documenting pre-sampling preparations
- Changing environmental conditions
- Locations and types of forms used in documenting the field work of a project.

A Field Log Book entry is a process of systematic planning for determining the type, quantity, and quality of information collected that is necessary to make well-informed, valid, and defensible scientific and engineering decisions. This process is applicable during all Foth site operations. Additional requirements for documenting Field Log Books are often included in other SOPs and project-specific documentation.

Definitions

- Field Log Book – A Field Log Book is a bound notebook that is used at field sites and contains detailed information regarding site activities including dates, times, personnel names, activities conducted, equipment used, weather conditions, etc. A Field Log Book is used by a variety of different field personnel and is part of the project file. A Field Log Book is brought to the site activity. Field Log Books can be checked out from project file location for daily use. Field Log Books are kept in individual office sites when not in use.

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References

Not Applicable

Personnel Qualifications and Responsibilities

The project manager or designee is responsible for ensuring that project activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e., check prints, calculations, reports, etc.) that meet the requirements of this SOP.

Equipment and Supplies

- Site-specific plans
- Bound, 8x4 hard-covered, water-resistant Field Log Book(s) (Also available in soft-cover.)
- Indelible black ink pen
- Ruler or similar scale

Procedures

Specifications for the Field Log Book

1. Bound 8x4 book
2. Cover should have project name, project ID, and book number
3. Pages should be consecutively numbered
4. Table of contents and signature page should be on page 1
5. Name, address, and phone number(s) of key field contacts should be on page 1

Guidelines for Simplifying Entries

1. Enter procedures for the first sample point, and then reference those procedures for subsequent entries on the same day if procedures did not change.
2. To eliminate redundancy, reference other locations if information is available.

Field Log Book Documentation

Each site or operation where field activities are occurring will have Field Log Books. The details of all field activities shall be recorded in a Field Log Book. Multiple Field Log Books may be used depending upon the number of different types of field personnel conducting activities at the site.

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The following requirements must be met when using a Field Log Book:

1. Enter events and entries in chronological order.

2. Record work, observations, quantity of materials, calculations, drawings, and related information directly in the Field Log Book. If data collection forms are specified by an activity-specific work plan, the information on the form does not need to be duplicated in the Field Log Book. However, forms used to record site information must be referenced in the Field Log Book.

3. Ensure information is factual and unbiased.

4. Fill up all pages and use both sides of each page. Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made.

5. Write in black, indelible ink. Do not write in pencil unless working in wet conditions.

6. Do not erase or blot out an entry. While changes to an entry may be made before it has been signed and dated, care must be taken not to obliterate what was originally written. Indicate deletions by a putting a single line through the material to be deleted and initial and date the change.

7. Do not remove any pages from the book.

8. Do not use loose paper and copy into the Field Log Book later.

9. Record sufficient information to completely document field activities.

10. Make sure entries are neat and legible.

11. Draw a diagonal line through the remainder of the final page at the end of the day.

12. Record the following information on a daily basis:
    a. Date and time
    b. Name of individual making entry
    c. Description of activity being conducted including well, boring, sampling, location number as appropriate
    d. Unusual site conditions
    e. Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
    f. Personnel on site (Foth and non-Foth members)
    g. Level of personal protection to be used

h. Arrival/departure of site visitors
i. Arrival/departure of equipment
j. Sample pickup (chain of custody [COC]) form numbers, carrier, time, electronic location of COC)
k. Start and completion times of borehole/trench/monitoring well installation of sampling activity
l. Health and safety issues
m. Instrumentation calibration details
n. Other equipment used
o. Description of SOP followed or other procedures used
p. Description and reason of any variations from standard procedures in sampling plan
q. Tracking information for analytical sample containers and coolers
r. Reference of all standard forms used, COCs, electronic data and its location
s. Sample point condition descriptions
t. Duplicates and field blank documentation
u. Problems and solutions encountered during field activities
v. Ending calibrations
w. Delivery and handling of samples

Signing and Initialing Requirements for Field Log Book Entries:

1. Initial and date each page.

2. Sign and date the final page of entries for each day.

3. Initial and date all changes.

Multiple authors must sign out the Field Log Book by inserting the following:

Above notes authored by:
_____ (Sign name)
_____ (Print name)
_____ (Date)

4. A new author must sign and print his/her name before additional entries are made.

Entries into the Field Log Book shall be preceded with the time of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (i.e., data logger) or on a separate form required by a standard operating procedure. In such cases, the Field Log Book must reference the automatic data record or form.

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While collecting samples, note observations such as color and odor of samples collected. Indicate the locations from which samples are being taken, sample identification numbers, the order of filling bottles, sample volumes, and parameters to be analyzed. If field duplicate samples are collected, note the duplicate pair sample identification numbers. If samples are collected that will be used for matrix spike and/or matrix spike/matrix spike duplicate analysis, record that information in the Field Log Book.

A sketch of the station location may be warranted. All maps or sketches made in the Field Log Book should have descriptions of the features shown and a directional indicator. Maps and sketches should be oriented so that north is towards the top of the page.

Other events and observations that should be recorded include (but are not limited to) the following:

1. Changes in weather that impact field activities
2. Subcontractor activities
3. Deviations from procedures outlined in any governing documents, including the reason for the deviation
4. Problems, downtime, or delays
5. Upgrade or downgrade of personal protective equipment

Post-Operation

At the conclusion of each activity or phase of site work, or a complete Field Log Book, the individual responsible for the Field Log Book will ensure that all entries have been appropriately signed and dated and that corrections were made. To guard against loss of data due to damage or disappearance of Field Log Books, copies of completed Field Log Books shall be securely stored within the project master file. Field Log Books are stored in project file 14350.

Restrictions/Limitations

Field Log Books constitute the official record of on-site technical work, investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by Foth personnel and their subcontractors. They are documents that may be used in court to indicate and defend dates, personnel, procedures, and techniques employed during site activities. Entries made in the Field Log Book should be factual, clear, precise, and as non-subjective as possible. Field Log Books, and entries within, shall not to be utilized for personal use.

A-5

Fish Collection

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Fish Collection

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for fish collection.

A predominant method of fish collection is electrofishing. Gill netting, hook and line, or trawling may be substituted. If necessary, fish are composited according to an approved compositing plan.

References

Foth, 2012. *Location Control Using Differential Global Positioning System* SOP - #1306

Responsibility

Prior to electrofishing, the Field Supervisor will verify that all crew members have reviewed and become familiar with the site Health and Safety Plan (HASP) in regards to boat and electrofisher operations.

Electrofishing activities will be conducted by a crew of three. The fish collection sub consultant's Field Supervisor will be in charge of all sampling activities. Two additional crew members will participate in the boat operation and/or dipnetting activities. At all times that the boat is actively electrofishing, all crew members will wear rubber boots and the netters will wear rubber gloves rated for 5,000-volt protection.

Equipment and Supplies

Fish are collected using a boat of appropriate length and draft for site conditions fitted with a Coffelt VVP-15 electrofisher (or equivalent) to collect fish from shoreline habitats and shallow water shoals (generally less than 10 feet deep) in areas adjacent to deep water or the main channel. The Coffelt VVP-15 (or equivalent) can be set to 20-120 pulses per second (pps). Specifications of the boat and electrofishing equipment are presented in Table 1.

All vessels will have up to date U.S. Coast Guard-approved and required safety equipment, personal floatation devices (PFD), fire extinguishers, marine 5-watt output VHF communication equipment, and other equipment as described in the HASP. All personnel onboard vessels engaged in nighttime activities will wear strobe lights attached to their PFDs.

Prior to each water deployment, the Field Supervisor will confirm adequate cell phone signal and confirm the appropriate way to contact emergency personnel. Additionally, prior

to the inception of work, Field Supervisor will coordinate with onsite Project Manager, or designee, via cell phone or handheld radio, the location and duration of planned activities and confirm the Project Manager, or designee, is available for assistance in an emergency situation.

Prior to electrofishing the Field Supervisor will check through the materials and equipment check list to ensure that all gear is accounted for and in good working order and that all boat equipment required by the HASP are on board the vessel. The boat and electrofisher specifications are provided in Table 1.

Table 1

Boat and Electrofishing Equipment Specifications

Boat	Electrofisher	Other Equipment
Lowe Roughneck 2007 aluminum Jon boat	Coffelt VVP-15	Bow and stem-mounted safety switches
Length: 19.5 feet	Volts DC: 600	Circular ring and dropper electrodes
Beam: 85 inch	Pulse/second: 20-120	Bow and stem mounted collection lights
Depth: 21 in / .53 m	Pulse width: 1-7 ms	Navigation lights
Max capacity: 898 lb /568 kg	Generator: 5,000 watt	Deck work lights
Bare hull weight: 277 lb / 126 kg		Fiberglass-insulated scapping nets
Engine: 2005 Mercury 40 hp		USGS-required safety equipment
VHF marine radio: 5-watt output		100-g aerated live well
Garmin eTrex Vista HCx		

Specific electrofishing equipment will include:

- Coffelt VVP-15 with extra fuses
- Generator rated at least 4,500-watts output
- Generator to electrofisher power cord
- Foot operated voltage cut-off safety switches
- Electrofisher output power cord
- Electrode array
- Fiberglass handle dip nets
- Sets of rubber gloves rated for 5,000 volts
- Pairs of rubber boots
- 100-gallon live well
- Headlamps
- Extra lights for night electrofishing
- Handheld spotlight

Foth Infrastructure & Environment, LLC

Collection Procedures

Electrofishing

Electrofishing will be conducted at night to obtain the necessary sample sizes of each target fish species.

The electrofishing unit will be fished in a downstream direction, where appropriate. Collection procedures are as follows:

- Position the boat upstream (or downstream if needed) of the station.
- Adjust electrofisher volts, pulse rate, and pulse width settings to maintain an average 4-5 amp output.
- Record water temperature, air temperature, weather conditions, conductivity, and the electrical output of the electrofishing unit.
- Record the starting location of electrofishing station using a handheld Global Positioning System (GPS) unit with differential GPS (DGPS) software capable of delivering submeter accuracy. (Reference: Foth SOP #1306)
- Place the boat in gear, turn on the electrofishing unit and collection lights, record the start time, and proceed at a slow speed along the collection area. Use the boat to position the electrode array near any in-stream cover such as overhanging vegetation, in-stream trees, rocky substrates, etc.
- All target species within reach of the netter will be captured and placed in a 100-gallon holding tank.
- At the end of electrofishing, place the boat in neutral, turn off the electrofisher and collection lights, and record the stop time and the end location from the GPS.

Gill Netting

Gill net sampling activities will be conducted by a crew of three. A Field Supervisor will be in charge of all sampling activities. Two additional crew members will participate in the sampling activities.

Prior to Gill netting all crew members will have reviewed and be familiar with the site HASP in regards to boat operations. Gill nets will be used to sample in water depths up to approximately 30 feet, primarily in areas with slow to moderate current adjacent to deep water or the main river channel.

Gill nets will have the following specifications:

- 100 to 300 feet long x 1.0 – 3.0 inch bar mesh

Netting will be treated with a black UV protectant and algaecide. The Gill nets will be anchored at both ends. All anchors will have an attached float with the name and address of the group deploying the nets along with the Scientific Collectors License number.

All vessels will have up to date U.S. Coast Guard-approved and required safety equipment, PFD, fire extinguishers, marine 5-watt output VHF communications equipment, and other equipment as described in the HASP. All personnel onboard vessels engaged in nighttime activities will wear strobe lights attached to their PFDs.

Prior to Gill netting, the Field Supervisor will check through the materials and equipment check list to ensure that all gear is accounted for and in good working order and that all boat equipment required by the HASP are on board the vessel.

A-6

Biological Tissue and Plant Preparation

Pace Analytical Services, Inc.
1241 Bellevue Street
Green Bay, WI 54302

Phone: 920 469-2436
Fax: 920 469-8827

STANDARD OPERATING PROCEDURE

Biological Tissue, Plant, Sediment and Synthetic Material Preparation

Reference Methods: N/A

SOP NUMBER:	S-GB-L-001-REV.09
EFFECTIVE DATE:	Date of Final Signature
SUPERSEDES:	S-GB-L-001-REV.08

LOCAL APPROVAL

Nils Melberg, Laboratory General Manager — Date: 04/23/14

Kate Grams, Laboratory Quality Manager — Date: 4/22/14

Chris Haase, Department Manager — Date: 04/22/14

PERIODIC REVIEW

SIGNATURES BELOW INDICATE NO CHANGES HAVE BEEN MADE SINCE APPROVAL.

Signature	Title	Date

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Table of Contents

1. PURPOSE/IDENTIFICATION OF METHOD

1.1 The purpose of this Standard Operating Procedure (SOP) is to describe the processes utilized to grind plant, biological tissue, sediment and synthetic samples into a homogenous sample suitable for use by the organic extraction and inorganic preparation staff.

2. SUMMARY OF METHODS

2.1 Necropsy and/or filleting of whole body animals may be performed to isolate the individual organs or portions of the specimen to be homogenized and utilized for analysis.

2.2 This SOP involves instruction to chop, grind, and blend plant materials, biological tissue, sediment and synthetic materials into a homogenized sample compatible with analysis of volatile organic compounds, semivolatile organic compounds, and metals.

3. SCOPE AND APPLICATION

3.1 **Personnel:** The policies and procedures contained in this SOP are applicable to all personnel involved in the preparation of plant, biological tissue, sediment and synthetic samples.

3.2 **Parameters**: Not applicable to this SOP.

4. APPLICABLE MATRICES

4.1 This SOP is applicable to biological tissue, plant material, sediment and synthetic samples.

5. LIMITS OF DETECTION AND QUANTITATION

5.1 Not Applicable to this SOP.

6. INTERFERENCES

6.1 Solvents, reagents, glassware, and other sample processing hardware may yield discrete artifacts and/or elevated baselines causing misinterpretation of the analytical results. All of these materials must be free from interferences under the conditions of the analysis by performing method blanks.

7. SAMPLE COLLECTION, PRESERVATION, SHIPMENT AND STORAGE

7.1 Unprocessed plant and biological tissue samples must be kept frozen in their original sample containers. Synthetic materials may be kept at room temperature.

7.2 Small rodents must undergo a special procedure to destroy any Hantavirus, which may be present. Refer to the most recent version of SOP S-GB-L-002 *Small Rodent Handling and Homogenization* for details.

7.3 After processing, plant and biological tissue samples must be kept frozen in glass jars. Individual jars of samples are grouped together as appropriate and stored in a labeled cardboard box within the freezer.

7.4 Sediment samples are received at ≤6°C. After the dry and grind procedure is completed the samples are retained at room temperature.

7.5 Synthetic materials may be kept at room temperature.

8. DEFINITIONS

8.1 Refer to glossary of the most current version of the Pace Quality Manual for the terms used at Pace Analytical. When definitions are not consistent with NELAC defined terms, an explanation will be provided in this SOP.

9. EQUIPMENT AND SUPPLIES (INCLUDING COMPUTER HARDWARE AND SOFTWARE)

Table 1: Biological Tissue and Plant Material Equipment and Supplies:

Supply	Description	Vendor/ Item #
Spatula	Stainless Steel	
Spoons	Stainless Steel	
Cutting Boards	HDPE or Stainless Steel	
Knives	Heavy Bladed/Meat Cleaver: Stainless steel or titanium	
Mallets	Plastic Face, 2 – 3 pounds	
Meat Grinder	Stainless Steel	Hobart
Blender	Stainless Steel or Glass blender cup Stainless Steel Blade	Industrial Grade or equivalent
Forceps	Stainless Steel	
Scaler	Stainless Steel	
Aluminum Foil	Heavy Duty	
Pliers	Stainless Steel	
Analytical Balance	Capable to 0.001g	
Vial	40mL Clear Glass, Teflon lined septum cap	QEC
Wide-Mouth Container	4 – 16 oz Clear Glass or Amber Glass, Teflon lined cap	

Table 2: Sediment Homogenization Equipment and Supplies

Supply	Description	Vendor/ Item #
Spatula	Stainless Steel	
Mallets	Rubber Face, 2 – 3 pounds	
Rolling Pin	Marble	
Cutting Board	Slate	
Scissors	Stainless Steel	
Plastic Bags	Gallon Size, Quart Size	Ziploc or Equivalent
Aluminum Foil Tray	Heavy Duty	
Weigh Boat	Large	Big Science Inc, P/N 80060
Pliers	Stainless Steel	
Analytical Balance	Capable to 0.001g	
Ear plugs		
Dust mask		
Paper Towels	NA	Bounty or Equivalent

10. REAGENTS AND STANDARDS

Table 3: Biological Tissue and Plant Material Reagents and Standards

Supply	Description	Vendor/ Item #
Deionized Water (DI)	ASTM Type II Reagent Grade or better	
Liquid Nitrogen		
Dry Ice	For Shipping purposes	NA
Tuna	Canned	Starkist or equivalent
Chicken	Ground	
Alfalfa	Dried	
Alconox	Cleaning Solution	Fisher / 50-212-165 or equivalent
Bleach	Commercial Grade	Clorox or equivalent

Table 4: Sediment Homogenization Reagents and Standards

Supply	Description	Vendor/ Item #
Deionized Water (DI)	ASTM Type II Reagent Grade or better	
Methanol	Pesticide Grade	
Acetone	HPLC Grade	

11. CALIBRATION AND STANDARDIZATION

11.1 Refer to the current revision of S-GB-Q-030 *Support Equipment* for additional instruction on appropriate balance calibrations.

12. PROCEDURE

12.1 Biological Tissue and Plant Homogenization:

12.1.1 Clean the work area by wiping the surfaces with a damp cloth. Follow procedure outlined in SOP: S-GB-L-007 *Cleaning of Equipment Used in the Process of Homogenizing Biological Tissue, Plant, and Synthetic Materials*, most current revision or replacement, to prepare utensils and grinders for use.

12.1.2 Depending on the sample matrix and specific instructions provided by the customer, the method for ensuring homogeneity may vary. Necropsy and/or filleting of whole body animals may be performed to isolate the individual organs or portions of the specimen to be homogenized and utilized for analysis. The project manager must be contacted for clarification prior to thawing the samples if there are any questions.

12.1.3 Select a set of samples for processing. Depending on the size of the specimen, remove the samples from the freezer to allow the specimen to partially thaw. Large specimen typically need to thaw overnight at room temperature. Small specimen require a shorter amount of time and may be placed in a refrigerator overnight or thawed at room temperature for 2-3 hours during the day of processing. It is important to make sure that each specimen is not touching another specimen during the thawing process.

12.1.4 Record the date and time that the specimen are taken out to thaw in the notebook.

12.1.5 Pre-label the appropriate sized sample jars with the LIMS numbers. Samples should be placed in the appropriate sized container dependent upon the sample mass received (40mL, 4oz, 6oz, 8oz or 16oz). Transport the clean, dry utensils and pre-labeled jars to the countertop work area.

12.1.6 If the client requires an equipment blank to be processed with the samples, the same equipment which is used to process the samples must be Deionized Water (DI) rinsed prior to sample processing. Multiple equipment blanks may be processed with each batch. The equipment blank must be logged into the LIMs system to report with the sample data.

12.1.7 Once the specimen is adequately thawed, processing may begin. Compare the label on the specimen with the pre-labeled jar to verify errors have not occurred.

12.1.8 Small fish, such as minnows, are usually collected as composites and will represent a single composite sample. Large whole fish that require compositing are chopped into cubes and put through the meat grinder together (refer to 12.1.10) and aliquots of the ground tissue are blended with liquid nitrogen (refer to 12.1.11).

12.1.9 If the specimen requires filleting prior to homogenization, thaw the fish to the point that it can be cut into with a sharp clean knife. Skinning or scaling may be necessary prior to filleting the fish.

12.1.9.1 **Skinning**: Catfish, bullheads, and other fish may need to be skinned prior to removing fillets. With a sharp knife slice the skin front to back along the dorsal side of fish. Make another incision from top to bottom just behind the gills. Hold the fish head with one hand and grasp an edge of the skin just behind the gill with pliers. Peel the skin back toward the tail.

12.1.9.2 **Scaling:** If scales are to be removed prior to filleting, lay the fish flat on a cutting board. Grasp the fish with one hand and with the other hand use a scaler to scrape the scales off the fish. Work the scaler from the tail toward the head. Rinse the scales and slime from fish prior to filleting.

12.1.9.3 **Filleting:** Begin with an incision just behind the gills, cutting through the fish from back to belly. Next, make a clean cut along the dorsal ridge towards the tail. Be careful not to cut into the gut cavity. After cutting through to the tail, separate the fillet from the rib cage, peeling the fillet from the carcass with the non-cutting hand. Pick out any bones with forceps.

12.1.10 Chop large whole body specimens, plant material, or fillets into 2-3 inch cubes using a sharp knife and mallet. Smaller samples of limited quantity must be finely ground using the blender in step 12.1.11.

12.1.11 Grind the cubes in a large commercial meat grinder to coarse texture. Repeat the procedure a minimum of two times to ensure proper texture.

12.1.12 Transfer the course ground sample to a stainless steel bowl containing liquid nitrogen. Place the frozen sample in a blender cup and blend the frozen tissue to a powder consistency.

12.1.13 Samples such as eggs, insects, and small individual organs (liver, brain) may be stirred vigorously with a metal spatula in an appropriate sized container to avoid loss of sample. The technician documents that the sample was prepared in the container on the prep worksheet or notebook.

12.1.14 Transfer the blended sample into the pre-labeled jars.

12.1.15 Clean the work area and the utensils in accordance with the procedure outlined in SOP: S-GB-L-007 *Cleaning of Equipment Used in the Process of Homogenizing Biological Tissue, Plant, and Synthetic Materials,* most current revision or replacement, between samples.

12.1.16 Periodically, canned tuna, chicken, or alfalfa is homogenized using this procedure for use as a quality control matrix within the laboratory. Each analysis may require a different quality control matrix, See Section 13 for additional information.

12.1.17 Sample integrity must be maintained throughout the digestion and analytical processes, therefore samples which were blended with liquid nitrogen should be kept within a freezer at ≤0°C up until the weighing process. Samples to be analyzed by 8081A/B, 8082, 8082A, 8270C and 8270C-SIM must be weighed in the homogenization prep lab.

12.2 Sediment Homogenization Procedure (Dry-Grind Procedure).

12.2.1 Clean the work area by wiping the surfaces with Methanol. Follow procedure outlined in SOP: S-GB-O-015 *Cleaning of Glassware and Sample Processing Hardware Used in the Analysis of Semivolatile Range Organics*, most current revision or replacement, to prepare utensils and grinding equipment for use.

12.2.2 Pre-label the appropriate aluminum sample drying tray with the LIMS numbers. Double bagged client samples should be placed behind the aluminum sample drying tray. The secondary technician must verify the correct bag is placed behind the correct drying tray.

12.2.3 Remove the interior sample bag and place on top of the exterior client bag. Clean the top Ziploc portion of the bag using a methanol dampened paper towel. Rip along both side seams of the interior bag. Place the opened bag inside out slightly above the drying tray (the sample should fall from the bag into the tray). Ensure no contact occurs between the outside of the bag and the drying tray. The technician may need to manually transfer the sediment from the bag to the tray with their gloved hand. Once transferred, the sample is spread evenly throughout the bottom of the drying tray.

12.2.3.1 An aliquot of the wet sample must be taken in order to complete the dry weight analysis, please see SOP: S-GB-C-008 *Measurement of Percent Moisture in Soils and Solids* most current revision or replacement.

12.2.4 The interior sample bag is then placed bag into the exterior client bag. Both bags are then placed into a 2 gallon plastic bag labeled with the batch workorder number.

12.2.5 Prior to placing samples on the cart for transfer, clean the surface of the sample cart by sweeping it to remove visible particulates. Then wipe the surfaces clean with Methanol.

12.2.6 Place all drying trays on the clean sample cart and deliver to the drying room. Use Methanol to wipe the sample racks prior to placing the drying trays in the drying room and record the drying room temperature, which should not exceed 100 degrees Fahrenheit.

12.2.7 Samples should dry for a minimum of 8 hours or until moisture content is less than or equal to 10%. Once the sediment is adequately dried, processing may begin.

12.2.8 Clean the work area and all processing equipment with Methanol following SOP: S-GB-O-015 *Cleaning of Glassware and Sample Processing Hardware Used in the Analysis of Semivolatile Range Organics*, most current revision or replacement.

12.2.9 Obtain the appropriate number of plastic bags. For each sample, separately transfer the labels on the drying tray to the plastic bag. Immediately transfer the dried sample to the plastic bag by sliding the drying tray into the plastic bag and transferring the dried sediment.

12.2.10 Using a rubber mallet and/or a rolling pin, pulverize the sample until the sample is free-flowing in nature.

12.2.11 Transfer the labels on the processing bag to a new pre-labeled plastic bag, Immediately transfer the ground/homogenized sample to the new bag shifting all sediment to one side of the bag, and cutting one corner off with a methanol cleaned scissors.

12.2.11.1 An aliquot of the air-dried sample must be taken in order to complete the air-dry dry weight analysis, please see SOP: S-GB-C-008 *Measurement of Percent Moisture in Soils and Solids* most current revision or replacement.

12.2.12 Clean the work area and all processing equipment with Methanol following SOP: S-GB-O-015 *Cleaning of Glassware and Sample Processing Hardware Used in the Analysis of Semivolatile Range Organics*, most current revision or replacement, between samples.

12.2.13 Dried/grind samples are stored at room temperature in individually labeled boxes by Work order.

12.3 Sample Compositing Procedure for Homogenized Sediment.

12.3.1 Clean the work area by wiping the surfaces with Methanol. Follow procedure outlined in SOP: S-GB-O-015 *Cleaning of Glassware and Sample Processing Hardware Used in the Analysis of Semivolatile Range Organics*, most current revision or replacement, to prepare the work surface for use.

12.3.2 Pre-label the appropriate sample composite container with the LIMS numbers for the composite sample with one permanent label and one removable label.

12.3.3 Set out all samples that will be used to create the composite sample.

12.3.4 Transfer the Pace work order label to the composite sample container prior to the sample aliquot being taken. Weigh 20g of the first sample that will be used to create the composite sample into a large weigh boat. . Record the mass of the sample in the composite logbook. (Please see Appendix III).

12.3.5 Immediately after the sample aliquot is measured into the large weigh boat, transfer the 20g aliquot to the pre-labeled plastic Ziploc bag for the composite sample. .

12.3.6 Repeat steps 12.3.4 through 12.3.5 using a new large weigh boat each time, until all sample aliquots have been sub-sampled and placed into the composite sample container.

12.3.7 Thoroughly mix the sample in the container to create a homogenized sample.

12.3.8 Record the composite date and time in the composite logbook. The time should be the end time of the compositing process.

12.3.9 An aliquot of the air-dried sample must be taken in order to complete the air-dry dry weight analysis, please see SOP: S-GB-C-008 *Measurement of Percent Moisture in Soils and Solids* most current revision or replacement.

12.3.10 Clean the work area and all processing equipment with Methanol following SOP: S-GB-O-015 *Cleaning of Glassware and Sample Processing Hardware Used in the Analysis of Semivolatile Range Organics*, most current revision or replacement, between samples.

13. QUALITY CONTROL

13.1 Tuna is prepared as outlined in Section 12 to be utilized as the Method *Blank (MB) and Laboratory Control Spike (LCS) matrix for organic analysis by EPA 8081A/B, 8082, 8082A, 8*270C and 8270C-SIM. The tuna is an analyte free biota matrix.

13.2 Chicken is prepared as outlined in Section 12. The Chicken Blank (CB) must be prepared for every biota batch analyzed for metals analysis by EPA 6020/A, EPA 7471B and EPA 245.6. The CB will contain detectable amounts of elements such as K, Ca, Na, Mg, and P etc., and is used to ensure acceptable performance of the laboratory control spike. The chicken is also used as the matrix modifier for the Laboratory Control Spike (LCS) matrix.

13.3 Alfalfa is prepared as outlined in Section 12 to be utilized as the Method Blank (MB) and Laboratory Control Spike (LCS) matrix for organic analysis by EPA 8260B.

13.4 Sediment samples must be dried for a minimum of 8 hours until moisture content is ≤10%.

14. DATA ANALYSIS AND CALCULATIONS

14.1 Not Applicable to this SOP.

15. DATA ASSESSMENT AND ACCEPTANCE CRITERIA FOR QUALITY CONTROL MEASURES

15.1 Not Applicable to this SOP.

16. CORRECTIVE ACTIONS FOR OUT-OF-CONTROL DATA

16.1 In instances where an identified labeling error occurs, the following steps will be taken:

16.1.1 Samples will be returned to the Sample Receiving Department.

16.1.2 Client identification labels will be compared to the appropriate Chain-of-Custody (COC).

16.1.3 New labels will be generated and affixed to the correct sample containers.

16.1.4 A nonconformance report (either hardcopy or through the LabTrack System) must be generated documenting the labeling error.

17. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

17.1 Not Applicable to this SOP.

18. METHOD PERFORMANCE

18.1 There are several requirements that must be met to insure that this procedure generates accurate and reliable data. A general outline of requirements has been summarized below. Further specifications may be found in the Laboratory Quality Manual and specific Standard Operating Procedures.

18.2 The analyst must read and understand this procedure with written documentation maintained in the training file.

19. METHOD MODIFICATIONS

19.1 Not Applicable to this SOP.

20. INSTRUMENT/EQUIPMENT MAINTENANCE

20.1 Please see manual provided with blender.

21. TROUBLESHOOTING

21.1 Not Applicable to this SOP.

22. SAFETY

22.1 The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of any chemical. A reference file of Safety Data Sheets (SDS) and a formal safety plan is made available to all personnel involved in chemical analysis and should be consulted prior to handling samples and standards.

22.2 Protective eyeware, gloves, and a lab coat must be worn at all times. Hearing protection should be worn when the blender is in operation, or during sediment processing when applicable.

23. WASTE MANAGEMENT

23.1 Excess reagents, samples and method process wastes are characterized and disposed of in an acceptable manner. For further information on waste management consult S-GB-W-001, *Waste Handling and Management*, most current revision or replacement.

24. POLLUTION PREVENTION AND WASTE MANAGEMENT

24.1 The quantity of chemicals purchased is based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes reflect anticipated usage and reagent stability.

24.2 The laboratory Chemical Hygiene Plan/Health and Safety Plan contains additional information on pollution prevention.

25. REFERENCES

25.1 USEPA National Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume I: Fish Sampling and Analysis-Third Edition.

25.2 SOP S-GB-L-002 *Small Rodent Handling and Homogenization*, most current revision or replacement

25.3 SOP: S-GB-L-007 Cleaning of Equipment Used in the Process of Homogenizing Biological Tissue, Plant, and Synthetic Materials, most current revision or replacement.

26. TABLES, DIAGRAMS, FLOWCHARTS, APPENDICES, ETC

26.1 Appendix I : Biota Homogenization Log.

Green Bay
Biota Homegenization Log

Project:
Date/Time Removed to Thaw: Location: 40FRG21/Room Temperature (circle one)
Date/Time Prepped:
Prepped by:
Container Type/Lot#:

Logbook:

Sample ID	Sample Type (Fish, Eggs, etc.)	Gender (Optional) M/F/J[1]	Scales/Skin Removed (Y/N)	Whole Body/Fillet (WB/F)	Whole Clams/Shucked (WC/S)	Composite Sample (> 1 per Sample ID) (Y/N)	Nitrogen (Y/N)	Resection Performed (Y/N)[2]	Sample Comments

(1) M = Male, F = Female, J = Juvenille or Unknown Gender
(2) See Resection Worksheet#

Reviewed By

Date

26.2 Appendix II: Sediment Dry-Grind Tracking Logbook

Pace Analytical

Sediment Dry-Grind Tracking Logbook

Logbook#: ____________

Sample ID	Initials Set-up Tech	Int. 2° Rev.	Wet Wt Initials (IN)	WET WT (Batch)	Wet Wt Initals (OUT)	Air Dry Room	Air Dry Room Set-up: Initials/Date/Time In	Air Dry Room Set-up: Initials/Date/Time Out	Initials	Grind Date	Initials (IN)	DRY-DRY WT Batch	Initials (OUT)
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
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						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					

Data Entry Instructions: If an error is made while recording information, the error must be corrected by drawing a single line through the mistake, and inserting the date and initials of the person making the change at a minimum. All changes should be made by the person making the original entries to insure there is an understanding of why a change is required. Alternate personnel, such as quality or laboratory management, may make the changes in the event that the original person is not available, but this must be clearly defined.

Peer Review: ______________________ Date: ____________

26.3 Appendix III: Fox River Sediment Composite Logbook

Pace Analytical™

Logbook # _____

Fox River Sediment Air-Dried Composite Logbook

Balance ID: _____
Initials of Weighing Technician: _____
Date/Time of Composite: _____
Dry-Dry Weight of Composite Batch: _____

Composite ID:

AFFIX WORKORDER LABEL HERE

Individual Sample ID(s)	Weight of Air-Dried Sample Used to Make Composite (g)	Comments
AFFIX WORKORDER LABEL HERE		
AFFIX WORKORDER LABEL HERE		
AFFIX WORKORDER LABEL HERE		
AFFIX WORKORDER LABEL HERE		
AFFIX WORKORDER LABEL HERE		

Data Entry Instructions: If an error is made while recording information, the error must be corrected by drawing a single line through the mistake, and inserting the date and initials of the person making the change at a minimum. All changes should be made by the person making the original entries to insure there is an understanding of why a change is required. Alternate personnel, such as quality or laboratory management, may make the changes in the event that the original person is not available, but this must be clearly defined.

Peer Review: _____ Date: _____

F-GB-O-143-Rev.00 (22April2014)
Pace Analytical Services, Inc. - Green Bay

27. REVISIONS

Document Number	Reason for Change	Date
S-GB-L-001-Rev.3	Section 9 – Removed Methanol Section 11.1 – Removed to clean surface area with Methanol Section 11.0 – Clarified number of times to process through commercial meat grinder. Section 11 – Updated references. Added Appendix I: Biota Homogenization Log	07Aug2009
S-GB-L-001-Rev.4	Cover Page: Updated SOP Name to Biological Tissue, Plant, and Synthetic Material Preparation. Throughout document: Incorporated language for the homogenization of synthetic material.	02Feb2011
S-GB-L-001-Rev.05	Sections 11.1, 11.14, and 15.3: Updated reference to SOP: S-GB-L-007, *Cleaning of Equipment Used in the Process of Homogenizing Biological Tissue, Plant, and Synthetic Materials,* most current revision or replacement Appendix I: Updated Biota Prep Logbook Page	24Aug2011
S-GB-L-001-Rev.06	Section 12: Added Tuna and Chicken Blank matrices to the QC Section.	09Sep2011
S-GB-L-001-Rev.07	General: Updated SOP format Updated SOP references throughout document. Added Dry/Grind procedure for sediment processing.	08Jan2014
S-GB-L-001-Rev.08	Section 12.2.3: Added requirement to clean the top of the Ziploc bag. Section 12.2.11: Added information to cut the corner of the Ziploc bag prior to processing. Section 13.4: Added moisture requirement to less than or equal to 10%. Section 16: Added corrective actions in place of a labeling error. Section 26: Added Sediment Dry-Grind Tracking Logbook.	06Feb2014
S-GB-L-001-Rev.09	Section 12.3: Added sample compositing process. Appendix III: Added Fox River Sediment Composite Logbook.	22Apr2014

A-7

Sediment Sampling Equipment Cleaning and Decontamination

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Sediment Sampling Equipment Cleaning and Decontamination

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for decontamination of equipment used during collection and handling of sediment samples for polychlorinated biphenyls (PCB) analysis.

Equipment and Supplies

- Health and safety equipment as required in the Health and Safety Plan
- Distilled/deionized water
- Non-phosphate detergent
- Tap water
- Appropriate cleaning solvent (e.g., methanol, acetone, or hexane)
- Knife
- Scrub brushes
- Aluminum foil or sealable plastic bags
- Garbage bags
- Spray bottles
- Ziploc® type bags
- Plastic sheeting, if necessary

Procedures

Cleaning Procedures for Small Equipment and Sampling Devices

1. Follow the health and safety procedures specified in the Health and Safety Plan.

2. Reusable sampling equipment (e.g., scoops, mixing bowls, spatulas, etc.) will be cleaned following these decontamination procedures:

   a. Scrub or scrape any excess material from the equipment.

   b. Wash all small equipment and sampling devices with non-phosphate detergent and tap water.

   c. Rinse thoroughly with deionized water.

d. For equipment used for disposal profiling purposes, rinse a second time with deionized water.

e. For equipment used to process samples for other characterization purposes or for post-dredge sediment residual PCBs analysis:

i. Rinse with solvent (hexane for PCB sampling) using a plastic spray bottle.
ii. Rinse with deionized water.
iii. Collect and properly dispose of any decontamination fluids.

f. Allow to air dry and wrap in aluminum foil or place in sealed plastic bags.

3. Cleaning/decontamination will be conducted on board sampling vessels or in an appropriate decontamination area (e.g., inside the berms of a dewatering pad), as required.

Cleaning Procedures for Large Equipment (if applicable)

1. Follow the health and safety procedures specified in the Health and Safety Plan.

2. Large sampling equipment (e.g., hand augers, core samplers, ponar samplers, probing rods, etc.) will be cleaned following these decontamination procedures:

a. Wash all large sampling equipment with a high-pressure steam cleaner or water wash with non-phosphate detergent using a brush as deemed necessary to remove any particles.

b. Double rinse with deionized water.

3. Cleaning/decontamination will be conducted on board sampling vessels or in an appropriate decontamination area (e.g., inside the berms of the dewatering pad), as required.

4. Wash water is prepared using deionized water and non-phosphate (e.g., Liquinox®). This mixture is known to be environmentally safe. Therefore, used wash water is not collected for off-site disposal. All contact wash water is allowed to be returned to the resource (river, lake, impoundment).

A-8

Sediment Sampling – Ponar Dredge

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Sediment Sampling – Ponar Dredge

Introduction

The purpose of this Standard Operating Procedures (SOP) is to establish a standard procedure for the collection of sediment samples using a Ponar dredge sampling device. Procedures are described for the collection of sediments from streams and lakes. This SOP should be consulted during the preparation of any Field Sampling Plan (FSP) involving sediment collection.

Sediment collection for analysis of chemicals of concern can be accomplished using a number of mechanical devices (Ponar dredge, Eckman dredge, gravity core, piston core, vibrocore, etc). Collection of surficial sediment samples is easily accomplished using a Ponar dredge. The following procedure describes the use of a Ponar dredge.

References

American Public Health Association (APHA). *Standard Methods for the Examination of Wastewater*. 17th ed. APHA, Washington, D.C. 1989.

American Society for Testing and Materials (ASTM). *ASTM Annual Book of Standards*. Volume 11.04 Water and Environmental Technology. 1990.

Foth, 2012. *Location Control Using Differential Global Positioning System* SOP - #1306.

Foth, 2012. *Sediment Sampling Equipment Cleaning and Decontamination* SOP - #1809.

Guy, H.P. and V.W. Norman, 1969. Field Measurements for the Measurement of Fluvial Sediments. *In* Techniques of Water Resources Investigations, Book 3, Chap. C2. U.S. Geological Survey, Reston, VA.

U.S. Army Corps of Engineers, 2004. Engineering and Design, Hydrographic Surveying. Manual Number 1110-2-1003. Washington D.C.

Personnel Qualifications/Requirements

As directed in the Project Planning Document (PPD) and appointed by Project Manager:

- Health and Safety Plan.

Foth Infrastructure & Environment, LLC

- A minimum of two people are required to complete sampling.
- One person must be trained in sediment sampling devices and should have a minimum 1 year field experience using such devices.
- All field team members must have completed the 40-hour OSHA training requirements (40 CFR 1910.120).
- Boater safety required to operate boat if used.

Equipment and Supplies

- Minimum 16-foot boat and motor (work platform) with minimum of two anchors or two anchoring spuds, if boat is required.
- Personal protective equipment (as required by the Site Health and Safety Plan)
- Decontamination/cleaning equipment (non-phosphate detergent, 5-gallon buckets, scrub brush, deionized water)
- Ponar sampling device with sufficient rope to obtain depth.
- Surveyor's leveling rod (English) or pole attached to a 6-inch diameter round metal plate (overall weight should be less than 8 lbs.)
- Sediment probe (maximum 1-inch diameter), appropriate length, steel pipe (galvanized) with ½ inch outer diameter probing end at least 12 inches in length
- Tape measure
- Camera
- Permanent marker
- Pen with waterproof ink
- Sediment Core Collection and Processing Logs
- Electronic or bound Field Log Book
- Handheld Differential Global Positioning System (DGPS)
- Waders (hip or chest waders) (if necessary)
- Sample containers and cooler
- Spoons and trawls (disposable mixing and sampling utensils preferred)
- 5 gallon pails and pans for homogenizing multiple samples
- Plastic bags for lining the 5-gallon pails

Procedures

1. Occupy sample locations using a GPS with differential GPS (DGPS) software or real-time kinematic (RTK) GPS equipment. (Reference: Foth *Location Control Using Differential Global Positioning System* SOP #1306.) If sample location is not previously surveyed and marked, record coordinates from GPS on electronic or paper field form. If sample location needs to be adjusted for any reason, record new GPS coordinates and reason for off-set in electronic or bound Field Log Book or on electronic or paper field form.

2. Once at sampling location, measure the depth to soft sediment using a pole or rod attached to a 6-inch diameter plate. Record the number on the rod at the water interface

on in Field Log Book or on field form. If water depths are greater than 20 feet or velocities are excessive, a "lead line" constructed following U.S. Army Corp of Engineers' (USACE) specifications (USACE Manual #1110-2-1003) may be utilized in lieu of the pole with disc.

3. Measure the thickness of sediment using sediment probe. This is accomplished by pushing the probing rod into the sediment until refusal. Record the number on the rod at the water interface in electronic or bound Field Log Book or on electronic or paper field form and describe the sediments as soft, medium, or firm.

4. Prepare the Ponar sampling device for deployment. Remove stationary pin and replace with a spring loaded pin.

5. If wading, sample collector should position themselves downstream of the sample location so as not to disturb the sediment surface. Lower the Ponar sampler to just above the sediment surface (2-3 inches above sediment surface).

6. Once lowered to just above the sediment surface, release the Ponar sampler letting it free fall into the sediment, releasing the spring loaded pin upon impact. If the pin does not release upon impact, apply a slight "jiggling" action to release the pin.

7. Retrieve the Ponar using the attached rope. This action closes the Ponar sampler and collects the surficial sediment sample.

8. Move to a clean work area on shore or the vessel and drain the excess water from the Ponar sampler. This is achieved by carefully tipping the sampler to either side allowing the water to drain from the screened portion on top of the sampler, while minimizing any loss of sediment particles.

9. Once water is drained, two methods may be used to collect a sediment sample:

   - The first is to empty the sample contents into a clean pail (optional lining the container with a single use plastic bag to prevent cross contamination), bowl, or other container large enough to accommodate the complete sampler contents without spillage. Homogenize the sample by mixing with a large spoon or trawl. Collect sample aliquot by using a spoon to fill the appropriate sample container.

   - The second method is to remove one or both of the screened areas on the top of the Ponar sampler by sliding them out of their position. Both should be removable. Once the screens are removed homogenize the sample with an appropriate mixing tool inside of the Ponar device. Collect a sample aliquot using a spoon to fill the appropriate sample container.

Where a composited sample from multiple locations is to be generated, aliquots of equal volume, using either Method I or II, will be placed in a clean container, further homogenized; and a single sample of adequate volume will be removed from the composited mass with a clean spoon and placed in the appropriate sample container.

10. After samples are placed into sample containers, label all relevant information and place in cooler on ice for delivery or shipment to laboratory. Where allowed by regulation, return unused sample portions to the waterbody. Otherwise containerize and handle as required. Samples will be processed according to sediment compositing procedures in the appropriate Sampling and Analysis Plan.

11. Decontaminate Ponar sampler and all other sampling materials before moving to the next sampling location according to decontamination procedures presented in the *Sediment Sampling Equipment Cleaning and Decontamination* SOP - #1809, taking care that all sediments have been removed. The sampler has the choice to use a single use plastic bag to line the 5-gallon pail prior to emptying the contents of the ponar for homogenization. When the sampler chooses NOT to use the plastic bag liner, decontamination of the 5-gallon pail must be completed following the procedures mentioned above. One rinsate sample will be collected from each decontaminated sampling device as detailed in the project Sampling and Analysis Plan.

A-9

Chemical Isolation Layer Sampling – Cap B

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Chemical Isolation Layer Sampling – Cap B

Introduction

The purpose of this Standard Operating Procedures (SOP) is to establish a standard procedure for collection of chemical isolation layer (CIL) samples in Cap Type B areas of the Lower Fox River Operable Units (OU) 2-5 during long-term monitoring activities. Also included are procedures to process the samples for chemical and physical analysis.

At the time of cap placement, CIL sampling may occur in the sand layer of Cap Types B and C prior to placement of the armor (coarse aggregate) layer. During the specified long term monitoring period in each OU, caps identified as Type B or C may also require post-placement CIL monitoring. These samples would be used to verify that the placed sand CIL includes a minimum 3-inch sand layer and has no or very low polychlorinated biphenyls (PCB) concentrations, allowing it to function as designed. This SOP describes procedures to collect CIL samples from the sand layer of Type B Caps following placement of the coarse aggregate armor stone during the long-term monitoring period. Core samples will be collected at a limited number of locations to assess PCB concentrations within CIL sand core layers. This SOP will also describe procedures and methods that will be used to collect field samples, describe core samples and process samples for laboratory analysis.

References

The following document will be followed when applicable:
Tetra Tech EC, Inc., 2009. *Quality Assurance Project Plan* (*QAPP*)

Methods and procedures are defined in the following document:
Tetra Tech EC, Inc., et al., 2011. *Construction Quality Assurance Project Plan* (*CQAPP*)

Foth Infrastructure & Environment, LLC, 2012. *Health and Safety Plan* (*HASP*). June 8, 2012.

Foth, 2012. *Vibrocore Sampling* SOP - #1806 (OU2-3 project).

Foth, 2012. *Vacuum Push Core Sampling* SOP - #1804.

Foth, 2012. *Piston Core Sampling* SOP - #1805.

U.S. Army Corps of Engineers. USACE Standards, Manual # 1110-2-1003.

Foth Infrastructure & Environment, LLC

Personnel Qualifications/Requirements

For sampling, refer to the *Vibrocore Sampling* SOP - #1806, *Vacuum Push Core Sampling* SOP - #1804, and *Piston Core Sampling* SOP - #1805. Divers must have appropriate state and/or federal certifications.

Equipment and Supplies

Sampling equipment needed:

- Watercraft (sampling platform) that complies with state of Wisconsin and U.S. Coast Guard regulations equipped with a minimum of three anchors or two spuds.
- Map of Cap B area boundary and proposed sampling locations.
- Personal protective equipment (PPE) specified in the *HASP*.
- Pole, surveyor's rod, or tape measure (lead line) with maximum graduations of 0.1 foot attached to a disc (6-inch diameter) and weight no greater than 8 pounds, to determine depth from reference elevation (boat deck or water surface) to sand or armor stone surface. For high current areas or water over 20-feet deep, a lead line meeting USACE's standards (Manual # 1110-2-1003) may be deployed in lieu of the pole fitted with disc.
- Tape measure with maximum graduations of 0.25 inch to determine sand thickness
- Vibrocore sampler
- Drill and bits
- Vacuum push core sampler (check-valve type) and rod extensions (alternate)
- Fixed piston-type piston sampler and rod extensions (alternate)
- Digital camera
- Field forms
- Real-time kinematic (RTK) Global Positioning System (GPS) with horizontal accuracy of ± 1 centimeter (cm)
- Portable computer
- Two-way radios (waterproof)

Sample Processing (core characterization and PCB samples):

- PPE specified in the *HASP*
- Refrigerator with rack to store sediment cores vertically
- Sediment core cutter (hook blade, electric reciprocating cutter, or equivalent)
- Full spectrum lighting and tables to support cores
- Drill and bits
- Duct tape, permanent markers, plastic sheeting for tables
- Ruler of at least 5-foot length with maximum graduations of 0.1 foot
- Clean disposable mixing containers and spoons
- Digital camera
- Laboratory provided sample containers for PCB analysis
- Coolers and ice for sample transport to laboratory

- Receptacles for waste sediment and other solids in contact with sediment (core liners, gloves, toweling etc.)
- Detergent for reusable equipment decontamination

Procedures

Safety

All work must comply with the Foth *HASP*. The *HASP* identifies proper PPE and identifies potential site/work hazards. Subcontracted divers must provide their own HASP pertaining to aquatic operations. Daily safety meetings will be conducted before commencement of work.

Special Precautions

Most sampling will be completed in close proximity to the sampling platform (boat). The safety of all sampling crew members, divers and Agencies Oversight Team (A/OT) (if present) personnel requires an awareness of the slip, trip, and fall hazards as well as the hazards of working beneath heavy equipment and below water. Two-way radio communication with the divers and boat captain will be maintained at all times.

CIL Sample Collection

a. Sample locations for verifying PCB concentration in the CIL will be adjacent (within 3-5 feet of) locations where CIL samples were collected prior to placement of the coarse aggregate armor stone. These locations will be provided to the A/OT for approval, prior to sampling.

b. A reference elevation, either the sampling vessel deck elevation or water surface elevation, will be measured at each sample location. The depth to top armor stone and the depth to top of sand CIL, following removal or armor stone, from the reference elevation will be measured at each sample location. Reference elevation recording and depth to top of armor stone and CIL measurement will be conducted when conditions provide for a measurement accuracy that is at least within 0.1 foot. All data will be documented in an electronic database and/or on field forms.

c. Following depth measurement to the top of armor stone, divers will be deployed to carefully remove the Cap B armor stone layer, thereby exposing the sand CIL. The divers will then direct the measuring rod to the top of CIL layer to allow measurement to be taken from the reference elevation. A core sampling device, either vibrocore, vacuum push core or fixed piston sampler will then be deployed to collect an undisturbed sample of the CIL and underlying sediment with minimum 4-foot section of minimum 3-inch diameter cellulose acetate butyrate (CAB) (Lexan^{TM}) core tube. Divers will direct the

core barrel to the exposed CIL and gently place the barrel on the sand surface. Upon notification from the diver that the sampling device is appropriately located, the core device operator will advance the core device and collect a sample as detailed in the *Vibrocore Sampling* SOP - #1806; *Vacuum Push Core Sampling* SOP - #1804; or *Piston Core Sampling* SOP - #1805. Target penetration will be 24 inches below the top of CIL terminating in the soft sediment below the CIL. Upon core retrieval, the diver will place a cap on the end of the sample barrel to minimize sediment loss.

Note: In the unlikely event a vibrocore sampler proves ineffective at collecting undisturbed CIL samples, use of a vacuum push core sampler (check-valve sampler) or piston core sampler (minimum 2.5-feet long x approximate 2 to 3-inch diameter) will be attempted to collect CIL samples.

d. The top of the core tube will be capped following removal from sampler, and both caps will be duct taped. The core tube will be labeled with the location number, date, and core recovery. The core tubes will be stored vertically in the core rack on the boat, during transport to the processing facility, and in the refrigerator at the processing facility until they are prepared for logging and sampling.

Sampling Processing

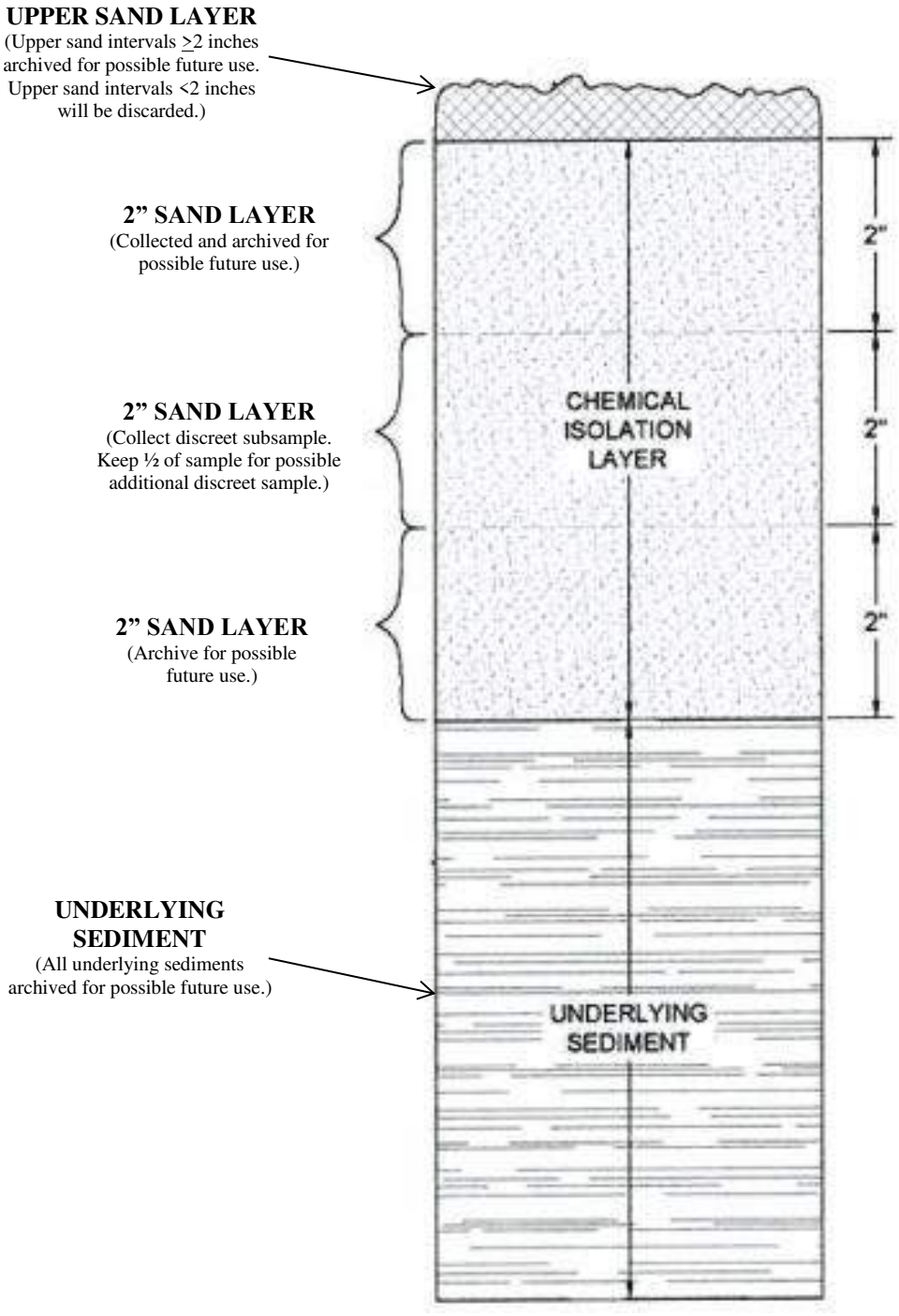
a. When the core samples are ready to be processed (prior to cutting), the top of sand surface will be marked on each core to define the undisturbed condition. Standing water will be removed from the core top of sand surface by drilling a drainage hole in the CAB. Core samples will be placed on an inclined core holder and cut laterally from top to bottom, minimizing disturbance to the sample as much as practical, to produce a split core.

b. The 2-inch sand interval between the interface of the sand CIL and the underlying sediment will be removed and archived for possible future use. Moving upward, the next 2-inch sand interval (2 to 4 inches above the interface of the sand CIL and the underlying sediment) will be a discrete subsample that will be submitted for PCB analysis (Fox River Method PCB Analysis). The work described in this paragraph will be performed on one half of the split core. The other half of the split core will be segmented into discrete subsamples matching the segments that were sent in for laboratory analysis and will be retained in the facility refrigerator until the analyses results from the primary sample have been evaluated.

c. Moving upward, the next 2-inch interval above the sampled isolation layer (4 to 6 inches above the interface of the sand CIL and the underlying sediment) will be collected and archived for possible future use.

d. Sediments below the CIL will also be collected and archived for possible future use. Particle size data from the sand interval and corresponding underlying sediment may be compared to assess particle size distribution in the CIL, if unacceptable PCB concentrations are detected in the CIL. This sampling is shown in Figure 1.

FIGURE 1



A-10

Vibrocore Sampling

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Vibrocore Sampling

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for the collection of sediment samples (or samples in sand cover/cap areas) using a vibrocore device and cellulose acetate butyrate (CAB) (Lexan^{TM}) core tubes. Procedures are described for the collection of soft sediments from the Lower Fox River. This SOP should be consulted during the preparation of any Field Sampling Plan (FSP) involving sediment collection but does not contain all of the information required for a FSP (e.g., sample size, sample location, sampling preservation, sample processing and statistical approach).

Collection of continuous undisturbed samples up to 20 feet in length in water depths from 2 feet to over 15 feet can be readily accomplished using a vibrocore (samples can be obtained in deeper water with attention to orientation of the vibrocore). The following procedure describes the use of a vibrocore with CAB core tubes.

References

American Public Health Association (APHA). *Standard Methods for the Examination of Wastewater.* 17th ed. APHA, Washington, D.C. 1989.

American Society for Testing and Materials (ASTM). *ASTM Annual Book of Standards.* Volume 11.04 Water and Environmental Technology. 1990.

Foth Infrastructure & Environment, LLC, 2015. *Project Health and Safety Plan* (*HASP*). May 7, 2015.

Guy, H.P. and V.W. Norman. 1969. Field Measurements for the Measurement of Fluvial Sediments. *In* Techniques of Water Resources Investigations, Book 3, Chap. C2. U.S. Geological Survey, Reston, VA.

Tetra Tech EC, 2014. *Poling Measurements to Estimate Soft Sediment Thickness* SOP.

U.S. Army Corps of Engineers. 2004. Engineering and Design, Hydrographic Surveying. Manual Number 1110-2-1003. Washington D.C.

Responsibilities and Qualifications

Personnel executing this protocol should be instructed in the use of the vibrocore apparatus. At least one person on the field crew should have knowledge and prior experience using the vibrocore and a minimum of two years sediment/soil sampling field experience. All field personnel must have satisfied Occupational Safety and Health Administration (OSHA)

training requirements (40 Code of Federal Regulations [CFR] 1910.120) if hazardous materials are expected. The Captain of the sampling vessel shall have successfully completed the Wisconsin Department of Natural Resources (WDNR) boater's safety course, or equivalent course offered by the U.S. Coast Guard.

Equipment and Supplies

Sediment Vibrocore Sampling

- Pontoon boat (work platform) with minimum of three anchors or two anchoring spuds.
- Personal protective equipment (PPE) as required by the *HASP*. (Tyvek suits or other similar splash resistant protective outerwear are typically worn by those handling the collected vibrocores.)
- Decontamination/cleaning equipment (non-phosphate detergent, 5-gallon buckets, scrub brush, deionized water, and on-board 12-volt pump, hose, and nozzle for initial cleaning).
- Vibrocore apparatus including mast, generator, electric winch, and hand winches.
- Hand tools including cordless impact wrench or socket wrench, cordless drill, riveting tool, hack saw, reciprocating saw, hammer, required wrenches, screwdrivers, and other misc. tools.
- CAB core tubes (3 or 4-inch outer diameter [OD]) (lengths depending on the length of core required) with "egg shell" core catchers riveted to the tubes.
- Core tube caps (two per core tube).
- Extra core catchers and rivets to attach catchers to core tubes.
- Surveyor's leveling rod (English), or equivalent, attached to a 6-inch diameter round metal plate (overall weight less than 8 lbs.). A lead line consisting of a surveyors tape attached to an 8 lb mushroom anchor will be used as an equivalent in deep water (water exceeding 20-25') and high flow areas.
- Sediment probing rod with 1-inch metal end of sufficient length to penetrate expected soft sediment thickness.
- Core tube stand. Longer tubes may be strapped securely to boat/equipment/framing in vertical orientation while awaiting transport.
- Cordless drill and ¼ inch drill bits
- Duct tape (several rolls)
- Steel tape measure with maximum 0.1 foot graduations
- Permanent markers
- Pen with waterproof ink
- Dry erase board and markers
- Sand/Sediment Core Collection and Processing Logs
- Field Log Book
- EQuIS® database system (if applicable)
- Global Positioning System (GPS)
- Waders (hip or chest waders) (if necessary)
- Digital camera

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Procedures

Preparations Prior to Sampling

a. After launching the pontoon boat, erect the vibrocore mast and secure all mast bolts.
b. Check the oil and fuel supply on the generator and outboard motors.
c. Test all mechanical equipment and make sure each is operable.
d. Inventory all tools and expendables.
e. Inventory all safety gear per the *HASP*.
f. Assemble spuds and secure spuds in spud pockets.
g. Secure vibrocore head to prevent damage or injury to personnel prior to departure.
h. Complete Daily Equipment Inspection Form.
i. Conduct a pre-launch "tool-box" safety briefing.

Obtaining Samples – General Considerations and Limitations

NOTE: At no time during the sample collection process outlined below is an employee permitted to work underneath the vibrocore sampling head while the winch is being used to raise or lower the vibrocore sampling head and attached core tube.

The vibrocore sampling head may be guided as necessary while the vibrocore head is in motion from an adjacent position not directly under the sampling unit.

a. The techniques and tools for sampling soft sediment or sand cover/cap with a core tube depend on current, depth of water, substrate characteristics, and the sampling program's objective. Once a sampling location is determined, the sampling platform (pontoon boat) is anchored or spud in-place using at least three anchors or two anchoring spuds. Typically, the boat is anchored with the front or back facing directly into the wind or current, whichever exerts a stronger force on the sampling vessel.

b. The coordinates of the actual sample location and the water surface elevation are obtained using real-time kinematic GPS (RTK GPS) with sub-meter horizontal accuracy and sub-centimeter vertical accuracy and recorded on the Sediment Core Collection and Processing Log (refer to Attachment 1). Typically, the location should be within a few feet of the proposed horizontal sample location, depending on specific project requirements. (The FSP for the OU2-3 Long-Term Monitoring Plan specifies within 5 feet of the proposed location.)

c. Measure the depth to the mud line from the sampling deck platform using a surveyor's rod, or similar device with no larger than 0.1 foot measurement graduations, attached to a 6-inch round metal plate. As a guideline, if wave action is severe, such that peak to peak fluctuations of more than 0.8 foot are observed during water depth measurement, the sampling team leader may make the decision to delay sampling until conditions

improve. In all cases when wave action is encountered, the midpoint of the fluctuating depth will be recorded as the mud line depth from the deck. Physical measurements should be completed by the sampling crew and verified (observed) by the auditing personnel. All manual measurements should be verified and agreed to by all sampling personnel prior to proceeding with additional sampling procedures. This depth will then be converted to elevation using the RTK GPS deck elevation recorded at the time of water depth measurement. The thickness of the soft sediment may be measured, if necessary to meet project objectives, using a probing rod with a 1-inch diameter metal end. The length of the metal end is to be long enough to penetrate the expected thickness of soft sediment (see *Poling Measurements to Estimate Soft Sediment Thickness* SOP [TtEC, 2011]). Sediment thickness is measured by pushing the probe rod to refusal. Both measurements are recorded on the Sediment Core Collection and Processing Log.

d. The coring device is assembled with a core tube length sized to the appropriate length based on sand or sediment thickness or the targeted core depth. The appropriate length of core tube should be cut and the core catcher riveted in-place prior to starting the field sampling. It is prudent to prepare more core tubes (approximately 10% to 20% more core tubes) than are required prior to going out in the field. If difficult sampling conditions are anticipated (e.g., presence of firm sand, gravel, cobbles, riprap, woody debris, etc.) make up additional core tubes since some tubes will likely be damaged during the sampling effort.

e. Mount the clean prepared core tube to the vibrocore--factory cut side up. Make sure the tube slides all the way up and is seated against the base of the vibrocore. Once core tube is seated, secure by tightening the bolts that hold the tube in-place. Two sampling personnel are required.

f. Measure the length of the tube and vibrocore to winch line. Add the known depth to top of the sediment to the distance the boat is above the water. Subtract the vibrocore measurement from this quantity. Mark this distance on the winch line with chalk, tape, or lumber crayon. Physical measurements should be completed by the sampling crew and verified (observed) by the auditing personnel. All manual measurements should be verified and agreed to by all sampling personnel prior to proceeding with additional sampling procedures. Lower vibrocore with the winch until mark is even with the floor. This should be the top of the sediment (mud line).

g. Guide core tube and vibrocore vertically through hatch and past the bottom of the pontoons by holding cable and guiding it. Care must be taken to prevent damaging the electrical connection to the vibrocore motor. Two sampling personnel are required.

h. When the core is in position as noted in Item f., mark the measured length of the core tube only on the cable. After slowly lowering the tip of the core tube 0.1 to 0.2 feet below the mud line, start vibration while holding onto the winch cable and keeping the

cable vertical and slightly slack while the vibrocore penetrates into the sediment. Maintain the winch line in a vertical position. Vibrate the core tube and maintain slack until the target core depth is reached. Do not advance the core tube a greater distance than its length. It is prudent to stop 3 to 4 inches short of the total core tube length. Turn off the vibrocore when the required sample depth is reached.

i. Measure and record depth of core penetration and ease or difficulty of how the core barrel penetrated. Physical measurements should be completed by the sampling crew and verified (observed) by the auditing personnel. All manual measurements should be verified and agreed to by all sampling personnel prior to proceeding with additional sampling procedures. Pull the vibrocore with the winch and guide it until it is above the floor again, being very careful not to damage the electrical cord.

j. Once the core is brought near the floor of the boat (or near the water surface), quickly place a cap on the bottom of the core tube.

k. Attach the shield to the core tube above the sediment in the tube and drill two to three 3/4-inch holes into the sides of the CAB tube approximately 1 to 2 inches above the sediment surface. Place the shield over the holes and allow the water to drain out.

l. Secure the tube using the manila rope hand winch line with two full hitch knots, then remove the tube from the vibrocore unit by cutting it with a reciprocating saw 6-8 inches above the top of sediment in the tube.

m. Secure the cap on the top of the tube and clean the outside of the tube with water. Clean with a brush, if necessary, to remove sand or sediment from the outside of the core tube.

n. Duct tape the drilled holes and around both caps to secure them. The thickness of the sediment recovered in the core tube is measured and recorded, and the contents of the core tube are described and recorded on the Sediment Core Collection and Processing Log. The core is then secured in a vertical position until removed from the sampling vessel.

    o. Determine the recovery while on the sampling vessel by measuring the sediment length in the recovered core and comparing that value to the distance the core was advanced. The recovery must meet guidelines established in the Sampling Decision Tree, unless otherwise specified. In lieu of other specified recovery requirements, a recovery of 90% or greater should be targeted. If the required recovery is not reached on the first attempt, save the first core, relocate the boat (if necessary) and resample the location following the listed procedures. If the second attempt results in a greater recovery than the first attempt, and there is a recovery of 90% or greater, sampling is complete at this location. The first core will be brought back to the processing facility and properly disposed of.

p. The core location and sampling date are recorded on the core tube caps. "Top" and "bottom" should also be noted on the respective core tube caps.

q. If cores will be processed in the laboratory, place the core tubes in a tube rack or as vertical as possible in a cooler, prior to processing, as required by the project specific FSP.

r. Cores in excess of 12 feet may need to be cut into two segments to allow for storage in the lab prior to processing. These cores will be transported to the lab in as vertical a position as practical. Once at the lab, the cores will be laid horizontally on a stable surface and the core top cap will be punctured with a drill bit to make sure the core is not pressurized. The core is then cut with a reciprocating saw into two roughly equal sections, and the ends are recapped. The new top cap of the bottom half is labeled to match the original top cap, and "1 of 2" and "2 of 2" are written on the upper and lower sections of the core, respectively.

Documentation

Observations and quantitative data collected during implementation of this sampling procedure should be recorded in one of the Field Log Book and Sediment Core Collection and Processing Log. The EQuIS® database system (by EarthSoft) is another tool that provides data in a more timely manner.

The Sediment Core Collection and Processing Log (attached) will be completed for each core location. The log will contain the following information: location, date, time, personnel, weather conditions, latitude/longitude (or other appropriate coordinate system for the state where work is being conducted), make/model of GPS equipment used, water depth, top of sediment elevation, sediment thickness (if probing is conducted), core tube I.D., sediment penetration, sediment recovery, and miscellaneous sampling information (i.e., problems encountered, etc.).

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CHECK-IN	CHECK-OUT
Time:	Time:
Ctrl Pt:	Ctrl Pt:
ΔN:	ΔN:
ΔE:	ΔE:
ΔV:	ΔV:
Tide-In:	Tide-Out:

Project Name: _____
Project Location: _____ DMU: _____
Project ID: _____

Sediment Core Collection and Processing Log

Date: _____ Time : _____

Sample Location ID:

Sampling Personnel: _____

Weather Conditions: _____

Vibrocore _____ Piston _____ RPB _____ Check Valve Sampler _____

Proposed Location Coordinates

Northing:
Easting:
Datum: Wisconsin SPC NAD 83

Offset from Proposed Coordinates

ft.		
ft.		

Actual Sampling Location

	1st Attempt	2nd Attempt	3rd Attempt
Northing:			
Easting:			
Water Elev.:			

	1st Attempt		2nd Attempt	
	Light Effort	To Refusal	Light Effort	To Refusal
Total Probed Length:				
Top of sediment depth from deck:				
Probed Sediment Thickness:				
Probing Observation:				

	1st Attempt	2nd Attempt	3rd Attempt
Sediment Core Penetration:			
Sediment Recovered:			
% Recovery:			

Field Observation

Processing Personnel: _____

Core Length (in): Core Processing (Observations) Date Processed:

Core Intervals (in)	Core Description	Core Intervals (in) top	Core Intervals (in) bottom	Sample Number

Comments:

Entered by: _____
Checked by: _____

A-11

Vacuum Push Core Sampling

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Vacuum Push Core Sampling

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for the collection of sand/sediment samples using a vacuum push corer (check-valve sampler). Procedures are described for the collection of soft sediments or sand covers/caps from streams, rivers and lakes for sand thickness verification, sediment characterization, and other quality assurance/quality control (QA/QC) verifications. This SOP should be consulted during the preparation of any Field Sampling Plan (FSP) involving sand/sediment collection but does not contain all of the information required for a FSP (e.g., sample size, sample location, and statistical approach etc.).

Sediment collection for analysis of lithology, benthic organisms, chemical content, or toxicity testing can be accomplished using a number of mechanical devices (e.g., Ponar dredge, Eckman dredge, push corer, Russian Peat Borer, vibrocorer or similar devices). Collection of soft sediment samples or sand thickness verification samples in areas where the sand overlays soft sediment is easily accomplished using a vacuum push corer. The following procedure describes the use of a vacuum push corer for collection of sand cover or soft sediment samples.

References

American Public Health Association (APHA). *Standard Methods for the Examination of Wastewater*. 17th ed. APHA, Washington, D.C. 1989.

American Society for Testing and Materials (ASTM). *ASTM Annual Book of Standards. Volume 11.04 Water and Environmental Technology*. 1990.

Guy, H.P. and V.W. Norman. 1969. Field Measurements for the Measurement of Fluvial Sediments. *In* Techniques of Water Resources Investigations, Book 3, Chap. C2. U.S. Geological Survey, Reston, VA.

Foth, 2012. *Chemical Isolation Layer Sampling – Cap B* SOP - #1811.

Foth, 2012. *Location Control Using Differential Global Positioning System* SOP - #1306.

Foth, 2012. *Location Control Using RTK- Global Positioning System* SOP - #1810.

Foth, 2012. *Sediment Sampling Equipment Cleaning and Decontamination* SOP - #1809.

U.S. Army Corps of Engineers. 2004. Engineering and Design, Hydrographic Surveying. Manual Number 1110-2-1003. Washington D.C.

Personnel Qualifications/Requirements

Personnel executing this protocol should be instructed in the use of the vacuum push corer. At least one person on the field crew should have knowledge of sediment sampling devices and a minimum of one year field experience using such devices. All field personnel must have satisfied Occupational Safety and Health Administration (OSHA) training requirements (40 [Code of Federal Regulations] CFR 1910.120) if exposure to hazardous materials are expected while conducting sampling.

Equipment and Supplies

- Minimum 16-foot boat and motor (work platform) equipped with two anchoring spuds or a minimum of three anchors.
- Boat must be equipped with appropriate equipment capable of efficiently collecting sand or sediment samples in water up to 15 feet deep (mast, winch, generator, rod extensions, etc.).
- Vacuum push corer apparatus including the core tube and rod extensions
- Surveyor's leveling rod (English) attached to a 6-inch diameter round metal plate (overall weight should be less than 8 lbs.)
- Sediment probe, appropriate length, steel pipe with ½ inch outer diameter (OD) probing end
- Duct tape (several rolls)
- Stainless steel bowls and spoons (alternative: disposable aluminum pans and wooden sterile tongue depressors) if cores are to be processed on sampling vessel
- Personal protective equipment as required by the site Health and Safety Plan
- Decontamination/cleaning equipment (non-phosphate detergent, 5-gallon buckets, scrub brush, and deionized water) (Reference: Foth SOP # 1809)
- Core processing table (if cores are to be processed on sampling vessel)
- High resolution digital camera
- Sample containers (i.e., amber glass jars or quart or gallon size Ziploc® plastic bags for polychlorinated biphenyls [PCB] analysis). Consult FSP. (If cores are to be processed on sampling vessel.)
- Cooler with ice (if samples are being retained for chemical/biological analysis)
- Steel tape measure in tenths of a foot
- Pen with waterproof ink
- Permanent marker
- Dry erase board and markers
- Waders (hip or chest waders)
- Core Collection and Processing Logs
- Labels and chain-of-custody forms (if cores are to be processed on sampling vessel)

- Field Log Book
- Global Positioning System (GPS) (Reference: Foth SOPs # 1306 and #1810)

Procedures

1. Locating Sample Stations and Preparations Prior to Sampling

   Sample stations are located using GPS. (Reference: Foth SOPs # 1306 and #1810)

   a. Check the boat engine oil and fuel supply and same for generator if so equipped.

   b. Test all mechanical equipment and make sure each is operable.

   c. Inventory all tools and expendables.

   d. Inventory all safety gear per the Health and Safety Plan (HASP).

2. Obtaining Samples – General Considerations and Limitations

   a. The techniques and tools for sampling with a vacuum push corer depend on current, depth of water, substrate characteristics, and the sampling program's objective. Once a sampling location is determined, the sampling platform (boat) is anchored or spudded in-place using at least three anchors or two spuds. Typically the boat is anchored with the front or back facing directly into the wind or current, whichever is stronger. The coordinates of the actual sample location and the water surface elevation are obtained using GPS and recorded on the Core Collection and Processing Log.

   b. Measure the water depth using a surveyor's rod attached to a 6-inch round metal plate. The depth is recorded on the Core Collection and Processing Log.

   c. The depth from the top of the sand/sediment to the deck should be marked on the vacuum push corer extension rods.

   d. The core tube is attached to the check valve with a compression fitting. Sufficient extension rods are coupled together so that the sampler can be lowered to the sand/sediment interface with the water and advanced to the required penetration depth. The sampler can be lowered by hand.

   e. With the core sampler in contact with the sand/sediment surface, use a twisting motion to gently push the core sampler into the underlying sand/sediment. The twisting motion will allow the sampler to cut into the sand/sediment with little disturbance to the surrounding material.

f. After the sampler has been pushed to the target depth, pull the vacuum push corer up to the surface. Care must be taken to keep the sampler in a vertical position. Note: When sampling sand above soft sediment, the desired depth of penetration is to have a small void space above the sand layer in the sample core and sediment present below the sand layer to ensure that the full thickness of sand has been documented. (Reference: Foth SOP # 1811, for specific requirements for Cap B chemical isolation layer [CIL] sampling.)

   If sampling for sand thickness determination, determine the thickness of sand and sediment present by measuring the amount of material present in the core. If sediment is not present under the sand layer, discard the core, and attempt another sample from within a different portion of the moon pool. If the second attempt is unsuccessful, relocate the boat in accordance with the FSP and resample the location following the listed procedures. Note suspected reasons why the sample was not recoverable on the Field Log Book.

3. Handling of Samples

   a. Once the core tube is at the surface, place a cap on the bottom end of the core tube. This will ensure that material does not fall out of the core while thickness measurements are taken. The vacuum push corer will be held vertically for sample examination.

   b. A small hole is drilled into the side of the cellulose acetate butyrate (CAB) tube approximately 1 to 2 inches above the sand/sediment surface to allow the water to drain out. The top is capped and duct tape is placed over the drilled holes and around the caps to secure them.

   c. The thickness of the sand/sediment recovered in the core tube is measured and recorded, and the contents of the core tube are described and documented on the Core Collection and Processing Log. The core is then secured in an upright position in a 5-gallon pail or cooler with holes cut in the cover, or similar device, and transported vertically to the processing facility.

   d. An estimate of compaction (% recovery) is determined by measuring the length of metered recovered in the core and comparing the value to the core advance. Collection of sediment samples in deeper water (> 15 feet) should employ other coring methods.

   e. The core location and sampling date are recorded on the core tube caps. "Top" and "bottom" should also be noted on the respective core tube caps.

f. If the desired thickness of metered being sampled is not obtained on the first attempt, a second attempt will be made 3 and 10 feet in a random direction away from the location of the first attempt. If the second attempt fails to recover a viable sample, then no recovery is reported on the Core Collection and Processing Log. In such cases, an alternative method of sample collection (e.g., vibrocore) may be directed by the Field Team Leader.

4. Processing of Samples

(For CIL core processing, refer to Foth SOP #1811.)

Sediment core samples shall be processed as soon as possible after sampling. If cores cannot be processed immediately after sampling, they shall be chilled to 4°C (short-term storage), or frozen if the sample is not to be analyzed for polychlorinated biphenyls (PCB) within the holding time of 14 days. Core samples will be processed or stored and frozen until processed in the laboratory.

If present, the light, low-percent solids surficial sediment layer, commonly referred to as the "fluff" layer, will be removed from the top of the core by using a using a syringe or pipette. An estimate of the amount (thickness) of fluff removed will be made and recorded.

The sediment thickness is measured while the sample tube is vertical and recorded on the Core Collection and Processing Log.

The sample tube is cut in half length-wise while lying horizontally using a "Zip Drill." A stainless steel knife, or similar disposable utensil, is used to scrape the smeared sediment off of a small area on the top of the sediment sample. The description of the soil/sediment core is recorded on the Core Collection and Processing Log in the following order: color, soil/sediment description, moisture content, plasticity, and density.

The top 6 inches of each core is homogenized in a stainless steel bowl using a stainless steel spoon, or similar disposable containers and utensils. A sample jar or double plastic bag is filled with the homogenized sample. The minimum sample weight required is 100 grams wet. The remainder of the core is divided into 6-inch intervals and archived for future analysis. The sample is labeled according to the FSP. The appropriate information is placed on a chain-of-custody form.

For composite samples, each core shall be processed as described above. Each secondary core is divided into 6-inch intervals. The top 6 inches of each sample (surficial interval) is segregated and homogenized as described above. The composite

sample is prepared for laboratory analysis by taking equal amounts of each of the homogenized sample intervals and compositing the samples into one sample. (Refer to the FSP for additional compositing details.) Samples shall be placed in sample jars or double Ziploc® plastic bags and labeled with sample identification per the FSP.

Field duplicate samples shall be processed per Quality Assurance Project Plan (QAPP) requirements.

Samples shall be kept at 4°C during shipment to the laboratory.

Documentation

Observations and quantitative data collected during implementation of this sampling procedure should be recorded in the field log book. Core Collection and Processing Logs will be completed for each core location. The Core Collection and Processing Logs will contain the following information: location, date, time, personnel, weather conditions, latitude, longitude, water depth, top of sediment elevation, soft sediment thickness, sediment core tube site, sediment penetration, sediment recovery, and miscellaneous sampling information (i.e., problems encountered, etc.)

A-12

Piston Core Sampling

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Piston Core Sampling

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for the collection of sediment samples (or samples from sand covers/cap areas) using a fixed piston bladder-style piston core sampling device (e.g. Eijkelkamp Beeker Sampler) and cellulose acetate butyrate (CAB) (Lexan™) core tubes in the Lower Fox River. Procedures are described for the collection of cores from soft sediments or sand layers of caps and covers. Collection of continuous undisturbed, sediment/sand samples up to 4.5 feet (ft) in length in water depths up to approximately 15 ft can be readily accomplished using the piston core sampling device. The following procedure describes the use of a piston corer with CAB core tubes.

References

American Society for Testing and Materials (ASTM). *ASTM Annual Book of Standards*. Volume 11.04 Water and Environmental Technology. 1990.

Foth, 2012. *Location Control Using Differential Global Positioning System* SOP - #1306.

Foth, 2012. *Location Control Using RTK-Global Positioning System* SOP - #1810.

Guy, H.P. and V.W. Norman. 1969. Field Measurements for the Measurement of Fluvial Sediments. *In* Techniques of Water Resources Investigations, Book 3, Chap. C2. U.S. Geological Survey, Reston, VA.

Tetra Tech EC, et al., 2013. *Quality Assurance Project Plan.*

Tetra Tech EC, 2014. *Piston Core Sampling* SOP.

Tetra Tech EC, 2014. *Poling Measurements to Estimate Soft Sediment Thickness* SOP.

Responsibilities and Qualifications

Personnel with training and experience with the piston core sampler should be responsible for sampler operation and compliance with SOP protocols. At least one person on the field crew should have knowledge and prior experience using the piston sampler and a minimum of two years sediment/soil sampling field experience. All field personnel must have satisfied Occupational Safety and Health Administration (OSHA) training requirements (40 Code of Federal Regulations [CFR] 1910.120) since hazardous materials are expected. The Captain of the sampling vessel shall have successfully completed the Wisconsin Department of Natural Resources (WDNR) boater's safety course.

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Materials

Piston Core Sampling

- Minimum 16-foot boat and motor (work platform) with minimum of three anchors or two spuds. Pontoon boat preferred.
- Personal protective equipment (as required by the Health and Safety Plan [HASP])
- Decontamination/cleaning equipment (non-phosphate detergent, 5-gallon buckets, scrub brush, deionized water and a clean garden pesticide-like sprayer, or an on board 12-volt pump, hose and nozzle for initial cleaning)
- Piston coring device including core holder, T-bar with extensions, blower pump, and rope or cable with clip
- CAB core tubes (minimum 2-inch ID; 4.5 ft lengths depending on target core length). Note: tube diameter to match equipment manufacturer's specifications.
- Core tube caps (two per core)
- Surveyor's leveling rod (English), or equivalent with maximum 0.1 ft graduations, attached to a 6-inch diameter round metal plate A lead line consisting of a surveyors tape attached to an 8 lb mushroom anchor will be used as an equivalent in deep water (water exceeding 25 ft) and high flow areas.
- Sediment probe, with 1-inch diameter metal end, of appropriate length to completely penetrate the expected thickness of soft sediment being sampled
- Core tube stand (e.g., 5-gallon bucket). Longer tubes may be strapped securely to boat/equipment/framing in vertical orientation while awaiting during transport.
- Cordless drill and ¼ inch drill bits
- Duct tape (several rolls)
- Steel tape measure with maximum 0.1 ft graduations
- Camera
- Permanent markers
- Pen with waterproof ink
- Sediment Core Collection and Processing Logs
- Field Log Book
- EQuIS® database system (if applicable)
- Real-time kinematic global positioning system (RTK GPS)
- Waders (hip or chest waders) (if necessary)

Procedures

1. Preparation prior to sampling

    a) Check the oil and fuel supply on the powered equipment.
    b) Test all mechanical equipment and make sure each is operable.
    c) Inventory all tools and expendables.
    d) Inventory all safety gear per the HASP.

e) Assemble anchoring spuds and secure spuds in spud pockets.
f) Conduct a pre-launch "tool-box" safety briefing.

2. Obtaining samples – including general considerations and limitations

a) The techniques and tools for sampling soft sediment or sand layers with a core tube depend on current, depth of water, substrate characteristics, and the sampling program's objective. Once a sampling location is determined, the sampling platform (boat) is anchored or spud in-place using at least three anchors or two spuds. Typically, the boat is anchored with the front or back facing directly into the wind or current, whichever exerts a stronger force on the sampling vessel.

b) The coordinates of the actual sample location and the water surface elevation are obtained using GPS and recorded on the Sediment Core Collection and Processing Log. A survey control point that is part of the Fox River Control Network will be used to verify equipment accuracy prior to and at the completion of each day's sampling. Location control will be based on Wisconsin State Plane coordinate system referenced to the 1997 adjustment to the North American Datum 83 (97) horizontal datum in U.S. feet. The sample point will be established as close as possible, contingent on river conditions (e.g., flow, wind, waves), but always within 10 horizontal ft of the proposed location or three feet of the infill/revisit location.

c) Measure the depth to the top of sediment or sand layer from the sampling deck platform using a surveyor's rod, or similar device with no larger than 0.1 ft graduations, attached to a 6-inch round metal plate. As a guideline, if wave action is severe, such that peak to peak fluctuations of more than 0.8 ft are observed during water depth measurement, the sampling team leader may make the decision to delay sampling until conditions improve. In all cases when wave action is encountered, the midpoint of the fluctuating depth will be recorded as the mud line depth from the deck. Physical measurements should be completed by the sampling crew and verified (observed) by the auditing personnel. All manual measurements should be verified and agreed to by all sampling personnel prior to proceeding with additional sampling procedures. This depth will then be converted to elevation using the reference elevation recorded at the time of water depth measurement.

d) The thickness of the soft sediment may be measured, if necessary to meet project objectives, using a probing rod with a 1-inch diameter metal end. The length of the metal end is to be long enough to penetrate the expected thickness of soft sediment being sampled (see *Poling Measurements to Estimate Soft Sediment Thickness* SOP [TtEC, 2014]). Sediment thickness is measured by pushing the probe rod with a light effort (one handed push) and strong effort (two handed push). The top of sediment, the light effort push and the probing rod refusal (strong effort) depth measurements are recorded on the Sediment Core Collection and Processing Log.

The piston coring device is assembled to the appropriate length based on water depth and sediment/sand layer thickness to be sampled. The core tube is placed in the piston core holder and the top of the sampler is attached to the piston core holder by two thumb screws. The rod is then screwed into the top of the sampler. Measure the distance from the top of sediment/sand layer to the deck using the pole fitted with 6-inch diameter metal plate. Measure this same distance from the tip of the sampler to a point on the T-bar. Mark this length on the T-bar with tape. Lower piston core sampler into the water until the tape mark is even with the floor. The tip of the sampler should be at the top of the sediment/sand layer. If not, re-measure and adjust the tape mark accordingly.

e) The pull rope or cable is clipped to the piston as the coring tip is lowered to the sediment/water interface. The pull rope or cable is secured to the floor of the sampling boat such that it is taut when the tip of the sampler touches the top of the sediment. Surface water is allowed to fill the top of the sample tube prior to sampling as demonstrated by the presence of bubbles appearing at the surface of the water.

f) The core barrel is pushed or driven into the substrate until refusal or until target penetration has been reached. When performed, the distance the core barrel is driven/hammered will be noted on the logs. During advancement of the core barrel, the piston is fixed in place keeping tension on the pull rope. If the piston fits too tightly in the core barrel, the core barrel will not be able to easily advance past the piston and sampling results will be affected. Therefore, the core diameter must be sized to accommodate the piston for proper use.

g) Once the piston core is pushed to refusal or desired depth, the depth of core penetration is measured and recorded.

h) Prior to raising the piston sampler to the surface, the tip bladder is inflated with the blower pump (pump run time to inflate the bladder is ± approximately 5 seconds).

i) The sampler is kept vertical as it is brought to the floor of the sampling boat. Two holes are drilled in the core tube between the top of the recovered sediment/sand and the bottom of the piston, the bottom hole no closer than ½ inch from the top of the captured material. Water is allowed to drain.

j) The piston and the top of the sampler are removed from the core holder and core.

Once the water has drained from the core, an end cap is placed on top of the core and the core is lifted from the top apparatus. Following the removal of the top, an end cap is placed on the bottom of the core. Both end caps and the drilled holes are then covered with duct tape.

k) The sampler is then decontaminated following the procedures outlined in the project *Quality Assurance Project Plan* (*QAPP*) for decontaminating non-dedicated sampling equipment. A rinsate sample also may be collected if specified in the project *QAPP*. A rinsate sample is collected by pouring deionized water over and into the top of the decontaminated sampler and collecting the rinsate with a glass jar.

l) The thickness of the sediment/sand recovered in the core is measured and recorded, and the contents of the core are described and documented on the Sediment Core Collection and Processing Log. The core is then secured in an upright position in a core rack or strapped to sturdy vessel framing in a vertical orientation.

m) Determine the recovery while on the sampling vessel by measuring the sediment length in the recovered core and comparing that value to the distance the core was advanced. The recovery must meet guidelines established in the Sampling Decision Tree, unless otherwise specified. In lieu of other specified recovery requirements, a recovery of 90% or greater should be targeted. If the required recovery is not reached on the first attempt, save the first core, relocate the boat (if necessary) and resample the location following the listed procedures. If the second attempt results in a greater recovery than the first attempt, and there is a recovery of 90% or greater, the first core will be brought back to the processing facility and properly disposed of.

n) The core location, sampling date, recovered sediment length, and tube advancement length are recorded on the core tube caps.

o) Maintain the core tubes in as vertical a position as practical during transport to the processing laboratory. If cores cannot be processed immediately, cores will be maintained on ice or in a walk-in cooler at 4ºC.

Documentation

Observations and quantitative data collected during implementation of this sampling procedure should be recorded in one of the Field Log Book and Sediment Core Collection and Processing Log.

The Sediment Core Collection and Processing Log will be completed for each core location. The log will contain the following information: location, date, time, personnel, weather conditions, latitude/longitude (or other appropriate coordinate system for the state where work is being conducted), make/model of GPS equipment used, depth from mudline to sampling deck platform, top of sediment/sand elevation, sediment/sand thickness (if probing is conducted), core tube I.D., core penetration length, recovered sediment/sand length, and miscellaneous sampling information (i.e., problems encountered, etc.).

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CHECK-IN	CHECK-OUT
Time:	Time:
Ctrl Pt:	Ctrl Pt:
ΔN:	ΔN:
ΔE:	ΔE:
ΔV:	ΔV:
Tide-In:	Tide-Out:

Project Name: _____
Project Location: _____ DMU: _____
Project ID: _____

Sediment Core Collection and Processing Log

Date: _____ Time : _____ Sample Location ID:

Sampling Personnel: _____

Weather Conditions: _____ Vibrocore ____ Piston ____ RPB ____ Check Valve Sampler ____

Proposed Location Coordinates		Offset from Proposed Coordinates	
Northing:			
Easting:		ft.	
Datum:	Wisconsin SPC NAD 83	ft.	

Actual Sampling Location	1st Attempt	2nd Attempt	3rd Attempt
Northing:			
Easting:			
Water Elev.:			

	1st Attempt		2nd Attempt	
	Light Effort	To Refusal	Light Effort	To Refusal
Total Probed Length:				
Top of sediment depth from deck:				
Probed Sediment Thickness:				
Probing Observation:				

	1st Attempt	2nd Attempt	3rd Attempt
Sediment Core Penetration:			
Sediment Recovered:			
% Recovery:			

Field Observation

Processing Personnel: _____

Core Length (in): Core Processing (Observations) Date Processed:

Core Intervals (in)	Core Description	Core Intervals (in) top	Core Intervals (in) bottom	Sample Number

Comments: _____

Entered by: _____
Checked by: _____

A-13

Shipping and Packaging of Non-Hazardous Samples

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Shipping and Packaging of Non-Hazardous Samples

Introduction

The purpose of this Standard Operating Procedure (SOP) is to provide general instructions in the packaging and shipping of non-hazardous samples. The primary use of this SOP is for the transportation of samples collected on site to be sent off site for physical, chemical, and/or radiological analysis.

Non-hazardous samples are those that do not meet any hazard class definitions found in 49 Code of Federal Regulations (CFR) 107-178, including materials designated as Class 9 materials and materials that represent Reportable Quantities (hazardous substances).

References

- 49 CFR Parts 107-178
- State Department of Transportation (DOT)
- International Air Transport Association (IATA)
- Shipping carrier instructions

Definitions

- Cooler/Shipping Container – Any hard-sided insulated container meeting any state DOT or IATA's general packaging requirements.

- Bubble Wrap – Plastic sheeting with entrained air bubbles for protective packaging purposes.

Equipment and Supplies

- Shipping container
- Samples
- Ice
- Various types of packing supplies
- Plastic bags
- Ziploc® plastic bags
- Custody seals

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Packaging

1. Follow shipping instructions from contracting lab.

2. Use tape to seal off the cooler drain on the inside and outside to prevent leakage.

3. Place packing material on the bottom of the shipping container (cooler) to provide a soft impact surface.

4. Place a 55-gallon or equivalent plastic bag into the cooler (to minimize possibility of leakage during transit).

5. Starting with the largest glass container, wrap each container with sufficient bubble wrap to ensure the best chance to prevent breakage of the container.

6. Pack the largest glass containers in bottom of the cooler, placing packing material between each of the containers to avoid breakage from bumping.

7. Double-bag the ice (chips or cubes) in gallon or quart freezer Ziploc® plastic bags and wedge the ice bags between the sample bottles. (Use "quality" ice, not ice from motel ice machine.)

8. Add bags of ice across the top of samples.

9. When sufficiently full, seal the inner protective plastic bag and place additional packing material on top of the bag to minimize shifting of containers during shipment.

10. Tape a gallon Ziploc® bag to the inside of the cooler lid, place the completed chain of custody document inside, and seal the cooler shut.

11. Tape the shipping container (cooler) shut using packing tape, duct tape, or other tear-resistant adhesive strips. Taping should be performed to ensure the lid cannot open during transport.

12. Place a custody seal on two separate portions of the cooler to provide evidence that the lid has not been opened prior to receipt by the intended recipient.

Labeling

1. "This Side Up" arrow must be adhered to all sides of the cooler.

2. The name and address of the receiver and the shipper must be on the top of the cooler.

3. The air bill must be attached to the top of the cooler.

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Shipping Documentation

1. If project has specific cooler shipment checklist requirements it shall be completed and kept in the project file. Custody seal numbers may need to be recorded and tracked.

2. Shipping tracking numbers should be kept in project file.

3. Shipping costs should be recorded and kept in project file.

A-14

Sample Chain of Custody

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Sample Chain of Custody

Introduction

As part of consulting services, Foth Infrastructure & Environment, LLC (Foth) collects a wide range of environmental samples. All samples collected must be accompanied by a chain of custody when submitted for analysis to ensure proper security and legal handling of samples.

Proper documentation of sample custody is necessary to trace a sample from point of origin through the final report or completion of the project. Requiring samples to have a chain of custody ensures proper security and legal handling of samples as they move between the different parties that are responsible for their collection and analysis. A chain of custody is prepared by completing a chain of custody record form (see Foth's form that is attached). Typically, these forms are provided by the laboratory that is providing the sample bottles and analysis. If the laboratory does not supply a form, Foth has a generic chain of custody form which can be used. Chain of custody record forms will be filled out by the sampler(s) at the time of sampling and shipping.

This process is intended to be used for both paper and electronic chain of custody forms.

References

Not applicable.

Personnel Qualifications/Requirements

The sampler(s) must be trained in properly filling out chain of custody forms.

Equipment and Supplies

- Electronic or paper copy of chain of custody form
- Pen

Procedures

Sample chain of custody documentation will be prepared by the sampler(s) immediately following the collection of samples. A chain of custody is a legal document. Therefore, it must be completed in pen. Foth also has an electronic chain of custody form that can be completed on the computer and printed. However, signatures on both electronic and paper chain of custody forms must be in ink. Once completed, the chain of custody will be placed in the master file.

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Chain of custody forms will generally include the following information:

1. A unique chain of custody number
2. Laboratory shipping address
3. If using a laboratory chain of custody, use Foth as the company name, including branch office location
4. Project contact (in most cases, that will be the lab coordinator)
5. Contact phone number
6. Project number ID
7. Project name
8. Project (site) license number (if applicable)
9. Project state
10. Name of sampler
11. Field ID and unique number (if applicable)
12. Sample description
13. Date sample collected
14. Time sample collected
15. Analyses requested
16. Sample matrix
17. Preservation of samples
18. Indicate whether or not sample was field filtered
19. Page numbers if more than one chain of custody
20. Address for where reports should be mailed
21. Address of where invoice should be sent
22. Regulatory program
23. Special quality assurance (QA) needs (turnaround time)
24. Any request for data submitted by e-mail or any other format other than printed copy
25. Laboratory receiving information section completed by the laboratory
26. Shipping method and tracking numbers
27. Signature section for transfer of custody with date and time section

After collection, samples are securely stored and packaged as required by analytical protocol until delivered to the laboratory. The chain of custody document remains with the samples during transport and serves as a written record of sample possession and transference. A sample is considered to be in custody if it is in one's possession, is locked and sealed during shipment, or is placed in a secure area limited to authorized personnel. The chain of custody must be signed and dated by everyone who takes possession of the sample. If the electronic chain of custody form is used, a minimum of two printed copies must accompany the samples to the laboratory. All copies are signed and dated during sample transfer. Laboratory personnel will note any damaged sample containers, or discrepancies between the sample label and information on the chain of custody.

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately

Page: of **COC Number:** COC-100032

Company:	Report To:	Requested Due Date:	Quote Reference:
Address:	Copy To:	*TAT:	Project Manager:
	Invoice To:		Project #:
Phone: Fax:	P.O.		Profile #:
Email Address:	Project Name:	Regulatory Agency:	Sampling Team Members:
Site License No.:	Project Number:	State Location:	

Valid Matrix Codes

Matrix	Code
Soil	S
Sediment	SE
Solid	SO
Surface Water	SW
Drinking Water	DW
Wastewater	WW
Groundwater	GW
Hazardous Liquid	H
Air	A
Oil	O
Other	X

ITEM NUMBER	SAMPLE ID	MATRIX CODE	SAMPLE TYPE G = Grab C = Composite	DATE COLLECTED MM/DD/YYYY	TIME COLLECTED (Military time)	Preservatives: # Containers	Unpreserved	H2SO4	HNO3	HCl	NaOH	Na2S2O3	Methanol	Requested Analysis	Filtered (Y/N)	REMARKS / Lab ID
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																

SHIPMENT METHOD	AIRBILL NO.	SHIPPING DATE	NO. OF COOLERS

SAMPLE CONDITION: **SAMPLE NOTES:**

Temp in C	
Received on Ice	Y / N
Sealed Cooler	Y / N
Sample Intact	Y / N

Additional Comments:

ITEM #	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER | DATE Signed: