Final Confirmation Sampling Plan

Menominee River Sediment Removal Project

Adjacent to Tyco Fire Products LP Facility
Marinette, WI

Prepared for

Tyco Fire Products LP

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CH2MHILL®

Final Confirmation Sampling Plan

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Acronyms and Abbreviations

3D	three-dimensional
COC	contaminant of concern
DMU	dredge management unit
DPT	direct-push technology
DQO	data quality objective
facility	Tyco Fire Products LP manufacturing facility in Marinette, Wisconsin
FOP	field operating procedure
FTL	field team leader
GLAOC	Great Lakes Area of Concern
GLWQA	Great Lakes Water Quality Agreement
GPS	global positioning system
HASP	health and safety plan
ID	identification
IDW	investigation-derived waste
IMI	interim measures investigation
mg/kg	milligrams per kilogram
MS	matrix spike
MSD	matrix spike duplicate
PCB	polychlorinated biphenyl
PPE	personal protective equipment
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RAL	remedial action limit
RAP	remedial action plan
SCM	semi-consolidated material
site	Tyco Fire Products LP manufacturing facility in Marinette, Wisconsin

Tyco	Tyco Fire Products LP
URS	URS Corporation
USEPA	United States Environmental Protection Agency

SECTION 1
Introduction

This confirmation sampling plan presents the procedures for the environmental sediment sampling activities that will be performed as part of the corrective action to address impacted sediment present at the Tyco Fire Products LP (Tyco) manufacturing facility in Marinette, Wisconsin (hereafter referred to as the "site" or "facility").

As part of the corrective action, performance monitoring of dredge activities is required. The removal action includes mechanical dredging of impacted soft sediment and semi-consolidated material (SCM) from the Menominee River in specific targeted dredge prisms, which were determined by the three-dimensional (3D) geostatistical model. The interpolated dredge prisms are based on the 50 milligrams per kilogram (mg/kg) remedial action level (RAL) for arsenic. In order to confirm whether the RAL of 50 mg/kg has been achieved, confirmation sampling will be conducted.

1.1 Site Setting

The site is an active manufacturing facility in the city of Marinette in northeastern Wisconsin, adjacent to the southern shore of the Menominee River (Figure 1). The property is bordered by the Menominee River to the north; the 6th Street Slip and City of Marinette property to the east; Water Street, City of Marinette property, Marinette School District property, and residential properties to the south; and Stanton Street and Marinette Marine Corporation to the west.

The facility consists of approximately 63 acres, including a manufacturing area on the western part of the property and an undeveloped area to the east, referred to as the "wetlands area." A fence surrounds both parts of the facility, and access is restricted. The facility began operations in 1915, and manufacturing entities acquired by Tyco in the 1990s produced cattle feed, refrigerants, and specialty chemicals. Arsenic-based agricultural herbicides were manufactured at the facility between 1957 and 1977. A byproduct of the manufacturing of the herbicides was a salt that contained approximately 2 percent arsenic by weight and was stockpiled at several locations on the property. Some of the arsenic subsequently entered site soil and groundwater. By 1978, the facility ceased production of arsenic-based herbicides, and since 1983 has produced only fire extinguishers and fire suppression systems.

1.2 Background

In 1987, the federal governments of the United States and Canada adopted amendments to the Great Lakes Water Quality Agreement (GLWQA). One of the amendments, called "Annex 2 of the 1987 Protocol," directed the two countries to identify areas of concern that did not meet the objectives of the GLWQA. Great Lakes Areas of Concern (GLAOCs) are severely degraded geographic areas within the Great Lakes Basin. GLAOCs are defined by the GLWQA as "geographic areas that fail to meet the general or specific objectives of the agreement where such failure has caused or is likely to cause impairment of beneficial use of the area's ability to support aquatic life." Remedial action plans (RAPs) were to be prepared for all 43 GLAOCs identified to address "beneficial use impairments." The 1990 Lower Menominee River RAP identified 6 of the GLWQA's 14 potential beneficial uses as being impaired in the Menominee River (U.S. Environmental Protection Agency [USEPA] 2010) as follows:

- Restrictions on fish and wildlife consumption
- Degradation of fish and wildlife populations
- Beach closings
- Degradation of benthos
- Restriction on dredging activities
- Loss of fish and wildlife habitat

The impairments primarily have been caused by historical discharges to the river from industrial facilities in the area. Although arsenic contamination was identified in the RAP as one of the pollutants of concern, degradation of the benthos is the only beneficial use identified by the GLWQA that can be attributed to arsenic contamination in the sediment and SCM in the Turning Basin and downstream of the facility. Other pollutants of concern identified in this GLAOC include paint sludge and coal tar. Remediation of the paint sludge site was completed in 1995 on the Michigan side. The Wisconsin Public Service Corporation Marinette Manufactured Gas Plant "Coal Tar Site" is another significant source of contamination. That site is under remedial investigation by the USEPA Superfund Division. Other pollutants (such as mercury, polychlorinated biphenyls [PCBs], and oil and grease) also have contributed to use impairments. A fish advisory is in place for mercury and PCBs.

Long-term goals of the Menominee River GLAOC (USEPA 2010) include the following:

- Protect the aquatic ecosystem of the Menominee River and Harbor from the effects of toxic and conventional pollutants
- Maintain a balanced aquatic and terrestrial community to ensure long-term health of the ecosystem
- Maintain and enhance recreational and commercial uses of the Menominee River and Harbor, consistent with the long-term maintenance of the natural resource base and a healthy economy

1.3 Summary of Recent Investigations

Investigations of environmental conditions at the facility began in 1974. Subsequently, five detailed investigations have been performed to characterize arsenic in sediment of the Menominee River adjacent to the facility.

The first was a sediment site assessment conducted in October 1996 (Dames & Moore 1996). The purpose of the assessment was to evaluate sediment contamination in the 8th Street Slip, 6th Street Slip, Turning Basin, and limited portions of the Menominee River. Elevated arsenic levels were detected in most of the sampled areas, with sediment containing arsenic concentrations up to 22,300 mg/kg in the 8th Street Slip and up to 18,200 mg/kg in the Turning Basin. Based on the results of the investigation, USEPA required that Tyco remove sediment within the 8th Street Slip.

The second sediment investigation was performed in 2000 as part of an interim measures investigation (IMI) and is summarized in the final IMI report appended to the *Summary of Findings Report* (URS Corporation [URS] 2001). The IMI included the following activities:

- Performing a hydrographic survey and sub-bottom profile survey to select soft sediment sampling locations within the Menominee River.
- Advancing and logging 20 borings to bedrock within the Menominee River to assess total arsenic concentrations in soft sediment, SCM, and glacial till units. The borings were continuously sampled, with samples for laboratory analysis of arsenic collected from each 2-foot interval.
- Collecting soft sediment samples at 24 locations within the Menominee River, Turning Basin, and South Channel to assess total arsenic concentrations. The samples were collected at 0- to 0.5-foot intervals, with additional samples collected to the bottom of the soft sediment over 2-foot intervals. Soft sediment was defined operationally as sediment that could be sampled using vibracoring equipment.
- Collecting surface water samples at the 24 soft sediment sampling locations to assess arsenic concentrations in the water column, with samples collected at the surface, mid-depth, and bottom of the water column.
- Collecting sediment pore water samples to assess total arsenic concentrations at the 24 soft sediment sampling locations.
- Performing arsenic speciation analyses on the soft sediment and pore water samples from the SCM.
- Collecting geotechnical and geochemical data to evaluate how site conditions affect the movement of arsenic throughout the Menominee River.

A third investigation was performed in late 2001 to fill data gaps for the Resource Conservation and Recovery Act facility investigation (URS 2002). The activities related to the Menominee River included the following:

- Collecting and analyzing eight soft sediment samples from two locations adjacent to the 6th Street Slip to determine whether a former channel was present adjacent to the slip. Samples were collected from the 0- to 0.5-foot depth interval and then over 2-foot intervals to the base of the soft sediment.
- Collecting and analyzing 13 soft sediment samples from five locations within the Turning Basin to further characterize sediment for a Wisconsin Department of Natural Resources dredging permit. Samples were collected from the 0- to 0.5-foot depth interval and then over 2-foot intervals to the base of the soft sediment.
- Collecting groundwater samples from 16 locations in the Menominee River. Groundwater samples were collected at 5-foot intervals, beginning at a depth of 5 feet below the sediment/water interface and continuing to the top of bedrock at each location.

A fourth investigation was performed in June 2004 to further evaluate groundwater conditions below the Menominee River (URS 2004). Sixty groundwater samples were collected from 10 locations within the river, with sampling depth intervals ranging from 5 to 40 feet below the sediment surface. Groundwater samples were analyzed for total and dissolved arsenic.

The fifth investigation was conducted in May and June 2010. Sample locations were selected, in part, using concentrations of arsenic in the soft sediment, SCM, and groundwater beneath the river from the June 2004 investigation. A total of 722 samples for total arsenic were collected and submitted for laboratory analysis. Subsets of the samples also were submitted for arsenic speciation, the State of Wisconsin NR 374 parameters (to support a dredge permit application), geotechnical analyses, and moisture content.

SECTION 2
Confirmation Sampling Rationale

2.1 Confirmation Sampling Objectives

The specific objective of this confirmation sampling plan is to provide sufficient analytical data to determine whether the RAL of 50 parts per million total arsenic has been achieved or whether an additional dredging pass (cleanup pass) is necessary. Project-specific data quality objectives (DQOs) are included within Section 1.4 of the quality assurance project plan (QAPP) submitted on July 24, 2012 (CH2M HILL 2012a).

2.2 Confirmation Sampling Approach

Each dredge phase is divided into 70- by 70-foot (4,900 square feet [0.11-acre]) dredge management units (DMUs); however, some DMUs exceed 4,900 square feet because of the irregular shoreline and dredge boundary. The DMU size of 70-by-70 feet has been selected in agreement with USEPA and is representative of half the average distance between sample locations within the remedial investigation data set used to perform the 3D geostatistical model from which the dredge prisms were created. The DMU spacing of 70-by-70 feet results in 150DMUs from which one to three sediment cores will be collected per DMU (Figures 2 through 4). A second and third sediment core will be collected within DMUs exceeding 4,900 and 9,800 square feet, respectively. The area square footage of each DMU is included within Appendix A.

The following is an outline of the approach for the sampling rationale:

- Sediment core samples will be collected continuously using direct-push technology (DPT) to glacial till material or to a maximum depth of 4 feet, whichever occurs first. Cores will be segmented into 0.5-foot intervals to allow for complete characterization of the undredged inventory and alleviate the need for additional characterization sampling if redredging is warranted. However, if the RAL concentration is not met within the upper 4 feet of undredged inventory above glacial till material, additional sampling will be required for characterization.
- The upper 0.25 foot (3 inches) of the surface interval (0 to 0.5 foot) is considered to be representative of generated dredge residuals from the mechanical dredge using an environmental clamshell bucket. Remaining sediments are considered as being representative of the undredged inventory. Therefore, the 0- to 0.5-foot sample interval is assumed to represent a 1:1 ratio of dredge residuals and undredged inventory. The determination of using 3 inches as representative of generated residuals was selected as a reasonable approximation from previous dredging projects using similar equipment and sediment characteristics.
- From *Technical Guidelines for Environmental Dredging of Contaminated Sediments* (U.S. Army Corps of Engineers 2008), it is acknowledged that sediment resuspension will

occur, but previous studies do not enable prediction of resuspension during future dredging projects because of wide variation of project-specific variables such as bucket overfilling, over-penetration, bucket speed when contacting the dredged material and moving through the water column, and dredged material properties. Studies typically determine the percent mass of residuals remaining after dredging, which includes mass residing in both generated residuals (what CH2M HILL is concerned about here) and undisturbed inventory, so an approximation based on published studies is not useful.

- The first two sample intervals (0 to 0.5 foot and 0.5 to 1 foot) will be analyzed immediately for total arsenic. Results will be dry-weight-corrected for comparison to the RAL. Remaining intervals (below 1 foot) will be archived onsite. If either the (0- to 0.5-foot or 0.5- to 1-foot intervals arsenic result is greater than the RAL, remaining DMU sample intervals (greater than 1 foot) will be analyzed.
- Only total arsenic results will be used for redredge considerations. Arsenic is co-located with remaining contaminants of concern (COCs). Removal of arsenic within sediments per the remedial action will result in removing other co-located COCs as reported within the first sediment site assessment conducted in October 1996 (Dames & Moore 1996), and therefore, arsenic is the only COC accounted for within the designed dredge prisms and remedial action.
- If redredging occurs, the DMU will be resurveyed followed by additional sampling to glacial till if the RAL concentration is not met within the upper 4 feet of sediment initially sampled. If additional sampling is performed, it will be randomized in the same manner outlined in Section 3.2.2 and not collected at the same location as the original confirmation sample. Resurveying and redredging activities will be performed by the subcontractor (Sevenson) as described within the project specifications (CH2M HILL 2012).
- Confirmation sampling for each DMU will commence once it and immediately adjacent DMUs are confirmed to be dredged to the design elevation(s) and tolerances specified in the plans and specifications. Confirmation that each DMU is ready for sampling will be performed by the dredging contractor using bathymetric surveys. Adjacent DMUs are required to be dredged before sampling the DMU of interest to alleviate the possibility of sampling sloughed material from adjacent DMUs. It is assumed that each DMU will require approximately 1 day of dredging. Dredging the DMU to be sampled and adjacent DMUs will require 4 to 6 days, at which time sampling would take place immediately. Additional dredge sequencing considerations and coordination with local vessel traffic will occur to minimize the potential effect of prop wash in DMUs to be sampled.
- Confirmation sampling is not expected to be performed following dredging of Phases I and III ,as the dredge phases target soft sediments overlying SCM known to exceed the 50 mg/kg arsenic removal criteria, which are slated for removal during Phases II and IV. Furthermore, if during confirmation sampling in Phases II, IV, and V it is visually verified that glacial till is the surficial sediment because of dredging activities, the DMU represented by that sample will be considered as having met the removal action criteria, and no confirmation samples will be analyzed.

A description of dredging Phases I through V is as follows:

- Phase I includes soft sediments within the Turning Basin.
- Phase II includes SCM within the Turning Basin.
- Phase III includes soft sediments in the Transition Areas.
- Phase IV includes SCM in the Transition Area.
- Phase V includes soft sediments in the South Channel.

The schedule showing remedial action sequencing of each phase is being updated and is not yet available. The schedule will be provided by the dredging subcontractor (Sevenson). A placeholder for the schedule has been provided within this document in Appendix B.

The minimum number of arsenic samples undergoing analysis is 364, which represents 2 samples (0- to 0.5-foot and 0.5- to 1-foot intervals) from each of the 183 sediment core location within 150 DMUs. The estimated number of archived samples is 1,098, which accounts for archiving each 0.5-foot sample interval below 1 foot to a maximum depth of 4 feet for 183 sediment core locations. The number of archived samples that will be required for analysis is dependent on the number of sample locations exceeding the RAL. Using an estimated 10 percent exceedance rate of sediment core locations results in approximately 19 core locations and analysis of 114 additional arsenic samples. Table 1 presents the number of DMUs, number of sediment core locations, initial DMU samples to be analyzed, and estimated number of archived samples pending analysis.

TABLE 1
Sampling and Analysis Scheme

Dredge Phase	No. of DMUs	No. of Sediment Core Locations	Initial DMU Samples	Estimated Archived Samples	Estimated Archived Samples for Analysis
Phase I	--	--	--	--	--
Phase II	61	67	134	402	42
Phase III	--	--	--	--	--
Phase IV	45	61	122	366	36
Phase V	44	55	110	330	36
TOTAL	**150**	**183**	**366**	**1,098**	**114**

SECTION 3

Field Operations and Procedures

This section provides an overview of the equipment, operations, and procedures for the confirmation sampling and surveying activities. It also references specific field operating procedures (FOPs) in Appendix C that provide step-by-step procedures for conducting the given field task. In instances where FOPs are not referenced, the text of that section will act as the FOP.

The following tasks will be performed to complete the investigation objectives:

- **Mobilization/Demobilization—**This task will consist of site preparation (setting up the staging area) and mobilizing equipment to the site before the field activities. Upon completion of fieldwork, personnel, equipment, and supplies will be demobilized from the site.
- **Post-Dredge Confirmation Sampling—**Confirmation sampling will be performed using DPT to obtain representative samples within a variety of sediment textural classes (soft sediment and SCM). Sampling activities will commence after the targeted material for removal has been verified by hydrographic surveys conducted by the subcontractor as described within the project specifications (CH2M HILL 2012). The sampling data collected will be used to ensure each DMU is below the arsenic action limit of 50 mg/kg. Confirmation sampling is not expected to be performed following dredging of Phases I and III, as these dredge phases target soft sediments overlying SCM known to exceed the 50 mg/kg arsenic removal criteria, which are slated for removal during Phases II and IV. Furthermore, if during confirmation sampling in Phases II, IV, and V it is visually verified that glacial till is the surficial sediment because of removal activities, the DMU represented by that sample will be considered as having met the removal action criteria, and no confirmation samples will be collected or analyzed.
- **Surveying—**Surveying of the actual sample collection locations chosen from the random selection process, as described in Section 3.2.2, will be performed concurrently with post-dredge confirmation sampling. Surveying will include the necessary measurements to determine horizontal (x, y coordinates) and vertical (z elevation) positions of each confirmation sample location.

3.1 Mobilization/Demobilization

Before initiating fieldwork, the following preparatory activities must be completed:

- Mobilize field equipment and supplies
- Set up temporary investigation-derived waste (IDW) storage equipment on sampling vessel

- Obtain and transport the identified field supplies to the site (for example, personal protective equipment [PPE], sample containers, preservatives, sample forms, and other related items) and field monitoring equipment
- Mobilize subcontractor, supplies, and materials
- Confirm that analyses are scheduled through the contracted laboratory
- Confirm that field equipment is in proper working order and has received appropriate quality control checks

During mobilization activities, the field team leader (FTL) will perform a walk-through inspection of the site. The level of health and safety protection during the mobilization activities will be Level D PPE.

When field activities conclude, the support facilities and equipment from the site will be demobilized. Equipment and tools will be properly decontaminated before they are demobilized from the area. No site restoration activities are anticipated to be necessary.

3.2 Post-Dredge Confirmation Sampling

3.2.1 Positioning of Sampling Vessel

Positioning of the vessel will be accomplished using a global positioning unit (GPS) unit capable of a horizontal accuracy of ± 3 feet. Procedures for GPS requirements and operation are in FOP-01 (Appendix C).

To meet the goals of the sampling event, efficient and precise positioning of station locations is required. Both accuracy and repeatability are essential. Navigation of the vessel to a sampling location and final positioning will be accomplished using differential GPS receivers capable of sub-meter accuracy. Once within ±10 feet of the proposed sample location coordinates, the vessel will be held in position with anchors or spud poles and the as-sampled location position will be recorded with the GPS unit.

3.2.2 Sediment Sampling Procedures

Sediment cores will be collected at up to three locations within each of the 150 DMUs during dredge Phases II, IV, and V (Figures 2, 3, and 4, respectively) depending on DMU size. DMUs exceeding 4,900 square feet will have more than one sediment core location. Collection of confirmation samples will only take place inside the dredge extent boundary (Figures 2 through 4). Proposed sediment core sample location coordinates from which random sample locations will be determined are in Appendix A

Before daily sampling activities commence, the actual sample location will be selected randomly, and revised coordinates will be generated. The random selection process for actual coring locations will be determined by randomly selecting a distance in 10-foot increments up to 40 feet in a randomly selected cardinal direction (north, south, east, or west) while maintaining the sample location within the dredge extent boundary. Once the sampling vessel is positioned within 10 feet of the randomly selected location, the x, y

coordinates and *z* elevations of each sampling location will be surveyed to meet accuracy requirements as described in Section 3.3.

Sediment cores will be collected using vessel-mounted DPT equipment using the procedures provided in FOP-02 (Appendix C). Before initiating core collection, the water depth at each location will be measured to the nearest 0.1 foot using a weighted line or a rigid measuring rod (for example, stadia pole) with a 6-inch-diameter round plate affixed to the bottom. Sediment thickness penetrated and recovered will be measured and recorded during the coring process. Each sediment core will be collected continuously in 0.5-foot sample intervals to glacial till or a maximum depth of 4 feet below the sediment surface and analyzed for total arsenic to determine if remedial action objectives have been met. If samples are collected to glacial till material, glacial till will not be sampled and care will be taken to not composite the glacial till material with overlying sediment. If more than 4 feet of sediment remains, the last sample may not be into glacial till.

Necessary measurements (for example, *x*, *y* coordinates, *z* elevations, surface elevation, depth to sediment surface, and depth of boring) will be recorded on a field form for each sampling location (Appendix D).

3.2.3 Sample Processing and Characterization Procedures

Sediment core samples will be collected in 4-foot-long disposable polycarbonate liners within a MacroCore sampler outfitted for a DPT drill rig. To retain the sediment, the sampler will be equipped with a sediment core catcher or another device designed to maximize sediment core recovery. Initially, if the sediment core recovery is less than 70 percent, then the sampling position will be offset up to 5 feet, and a second sampling attempt will be made. If no acceptable core is obtained with greater than 70 percent recovery after two attempts, the location with the greatest overall recovery will be used. If, after a representative number of locations has been sampled, the site-specific core recoveries are consistently less than 70 percent, the requirement will be revisited to determine if an adjustment to the requirement is warranted. Before making any adjustment to the acceptable sediment core recovery or sampling methods to increase recovery, USEPA will be notified and provide approval of changes before field implementation.

Sediment cores will be processed either on the vessel or at an onshore staging area by placing the sediment cores on a decontaminated processing table (or other stable surface) and slitting a section of the liner sufficient to examine and remove the sample. The sediment cores will be visually characterized for sediment type, color, moisture content, texture, particle size and shape, consistency, visible evidence of staining, and other observations (Appendix D). Digital photographs of each core sample will be taken to document the undisturbed core structure. Each photograph will include a scale (for example, tape measure), station identification (ID), and date of core collection.

3.2.4 Collection of Samples for Analysis

The individual sample intervals from each sediment core collected will be homogenized using pre-cleaned utensils and aluminum pans until a uniform texture and color is achieved. Rocks, twigs, leaves, and other debris will be removed before homogenizing the sample. Once the sediment has been thoroughly homogenized, aliquots will be transferred to the appropriate sample containers and managed as discussed in Section 4.

3.3 Surveying

To meet the goals of the sediment sampling event, precise positioning of sediment coring locations is required. Both accuracy (that is, ability to define position) and repeatability (that is, ability to return to a sampling station) are essential. Sediment sampling locations will be referenced horizontally to the Wisconsin State Plane Coordinate System, South Zone, North American Datum of 1983.

The survey equipment will be referenced to at least two onshore benchmarks as established by the sampling subcontractor (Sevenson) near the study area with known x, y coordinates and z elevation values each day before starting surveying activities. Existing onshore reference benchmarks established for hydrographic surveying will be used for surveying sediment core locations, if possible. Any additional onshore benchmarks established for use will be completed by methods determined by the subcontractor (Sevenson) as specified within the project specifications (CH2M HILL 2012). Established benchmarks will be used to survey each sediment core location to a minimum horizontal tolerance of 3 feet and a vertical tolerance of 0.1 foot. Coordinates (x, y) and elevations (z) of the benchmarks used for surveying activities will be recorded in the same coordinate system and datum as the sample locations.

Sediment surface elevation will be determined by surveying the water elevation through using a series of surveyed staff gauges in increments of 0.1 foot or by surveying the water surface at each location to the above-stated vertical tolerance of 0.1 foot. Water depth measurements will be collected using a weighted tape or survey rod capable of measuring 0.1-foot increments with a 6-inch-diameter plate affixed to the bottom of the measuring device. To derive the sediment surface elevation, the water depth measurement will be subtracted from the surveyed water elevation.

3.4 Field Equipment Decontamination

Decontamination of equipment will be performed in accordance with the following general procedures:

- Potable water rinse
- Wash in Alconox/Liquinox detergent solution
- Potable water rinse
- Methanol rinse
- Distilled water rinse
- Air-drying or drying with clean paper towels
- Storage until further use on a clean, plastic-covered surface or wrapped in aluminum foil

Nondisposable sampling equipment will be decontaminated on arrival at the site and before each use. Dedicated, single-use sampling equipment will be used during sediment sample collection and processing where possible. Portions of the sampling device that will be used at the stations will be decontaminated with a thorough scrub between stations using

Alconox/Liquinox and site water. If a methanol rinse is used, a separate container will be used to collect and segregate the methanol rinsate for separate disposal.

3.5 IDW Waste Characterization, Handling, and Disposal

IDW waste will consist of excess sediment and liquids generated during investigation and decontamination activities, as well as PPE. IDW will be segregated and initially containerized in 5-gallon buckets with Department of Transportation-approved lids on the sampling vessel. Upon arriving onto shore, the buckets will be transferred directly into the appropriate waste streams associated with the remedial action. Liquids containing the methanol rinse used for sampling equipment decontamination will be separately managed for disposal, while remaining liquids generated from sampling will be transferred directly to the onsite treatment system.

Sediments generated from sampling will be compiled with dredged sediment undergoing treatment and offsite removal. PPE and general refuse will be segregated and combined with the subcontractors appropriated waste streams generated during remedial actions activities. Because sediment and liquids generated from sampling will be the same as what is produced from the remedial action, no additional characterization sampling will be required prior to transferring into the remedial action waste streams.

SECTION 4

Sample Management

This section describes the procedures to be implemented so environmental samples are properly containerized, preserved, shipped, and otherwise handled in a manner that will maintain sample integrity. The techniques will result in representative samples and reduce the possibility of sample contamination from external sources.

4.1 Sample Nomenclature

A sample nomenclature system will be used to identify each sample, including quality assurance (QA)/quality control (QC) samples. The sample identifier will be unique for each sample, required by CH2M HILL's project-specific Microsoft Access database. The unique sample identifier will be used for tracking each sample within the chain-of-custody, database, and subsequent reports.

Each sample, regardless of analytical protocol, also will be assigned a CH2M HILL site-specific identifier, which will contain a DMU number and sample depth for subsurface sediment samples will be included on the sample label, traffic report, and chain-of-custody record.

The site-specific identifier is based on the following system:

- **Sample Type—**The first two letters indicate the type of sample location as follows:
  - SD = Sediment sample.
  - WD = IDW characterization sample. An example of the first IDW characterization sample is "WD-001" followed by "WD-002."
  - EB = Equipment blank sample. An example of the first EB sample is "EB-001" followed by "EB-002."
- **DMU—**The DMU location code consists of a three-number code coinciding with the respective DMU where the sample location was collected.
  - An example sediment sample location within DMU 2 is "SD-002."
- **Sample Depth—**The depth from which the sample was collected will be added to the station location at the end after a dash and with a forward slash (/) between the start and end depths:
  - The 0- to 0.5-foot interval at the sediment location above would be indicated as "SD-002-0.0/0.5."

- **QA/QC Identifier—**Field QA/QC samples will be identified using the following QA/QC identifiers:
  - Field duplicates, which are associated with the same station location as the native sample, will use a blind naming system on the chain of custody to the laboratory to ensure the integrity of the duplicate samples. Duplicate samples will be identified as "FD" (for field duplicate) with a subsequent number (001, 002, etc.) appended to the end. Field duplicate samples will be tracked in reference to the appropriate parent sample using an onsite sample tracking spreadsheet in accordance with Section 2.10.2 of the QAPP (CH2M HILL 2012a).

4.2 Quality Assurance/Quality Control Samples

The contracted laboratories will have a QA/QC program to ensure the reliability and validity of the analyses being performed. Field sampling precision and bias will be evaluated by collecting the QA/QC samples as described in the following subsections. The exact number of QA/QC samples (for instance, field duplicate and matrix spike [MS]/ matrix spike duplicate [MSD]) is dependent on the number of samples analyzed, which is unknown at this time because of the possibility of archived samples being analyzed and unknown variations of sediment thicknesses and recoveries. However, an approximated number of QA/QC samples has been estimated based on known sample quantities requiring immediate analysis (that is, sample intervals 0 to 0.5 foot and 0.5 to 1 foot). To ensure compliance with QA/QC sample collection frequency, the number of samples submitted for analysis will be tracked using an onsite sample tracking spreadsheet as described within Section 2.10.2 of the QAPP (CH2M HILL 2012a).

4.2.1 Field Duplicates

Field duplicate samples will be used to measure the heterogeneity of the sample matrix and the precision of the field sampling and analytical process. Field duplicate samples will be collected from the same core following sample homogenization. Duplicate samples will be collected from locations throughout the sampling area and from various depths at a frequency of 10 percent to assess sample variability resulting in approximately 37 field duplicate samples (10 percent of two sample intervals from 183 core locations).

4.2.2 Equipment Blanks

Equipment blanks will be collected and analyzed to determine whether the decontamination procedure has been adequately performed and whether cross-contamination of samples occurred from the equipment or residual decontamination solutions. A consistent volume of demonstrated analyte-free distilled and deionized water will be poured directly into or over the decontaminated sampling equipment and then collected in a sample container. One equipment blank will be collected on each day of sampling per piece of nondedicated equipment used during field activities and analyzed for the same parameters as the sediment samples.

4.2.3 Matrix Spike / Matrix Spike Duplicate

Laboratories will use MS/MSD samples to assess the precision and accuracy of sample analysis. The laboratories will fortify MS/MSD samples in accordance with the specifications of the analytical methods. Sample containers will be filled and stored in the same manner as field duplicate samples. The frequency for collection of MS/MSD samples will be at least 5 percent, resulting in approximately 19 MS/MSD samples (5 percent of two sample intervals from 183 core locations).

4.2.4 Temperature Blanks

A temperature blank will be included in each cooler to allow the laboratory receiving the shipment of samples to determine if the samples have been maintained at the proper temperature. Temperature blanks will consist of an unpreserved sample container filled with distilled water. One temperature blank will accompany each sample cooler being shipped to the laboratory.

4.3 Sample Handling, Packaging, and Shipping

Sample handling, packaging, and shipping procedures are described in FOP-03 (Appendix C). Samples will be either coordinated with an onsite mobile laboratory or delivered to an offsite laboratory via Federal Express or courier pickup. If the onsite laboratory option is used, Environmental Chemistry Consulting Services, Inc. will be the laboratory with samples analyzed for quick turnaround analysis. If Pace Analytical Services is used, a laboratory courier pickup will be arranged for next morning pickup. TestAmerica Chicago or Pittsburgh laboratories may also be used and would require samples to be sent via Federal Express.

4.3.1 Sample Containers

Certified contaminant-free sample containers will be used in this sampling effort and either purchased from an approved vendor or provided by the laboratory. Sample containers for laboratory analyses will meet or exceed USEPA requirements specified in *Specifications and Guidance for Obtaining Contaminant-Free Containers* (USEPA 1990). Containers used for sampling activities will not contain target organic and inorganic contaminants exceeding the level specified in the above-mentioned document. Specifications for the bottles will be verified by checking the supplier's certified statement and analytical results for each bottle lot. Details regarding the size, type, and sample volume requirements are located within Table 3 of the project QAPP (CH2M HILL 2012a).

4.3.2 Sample Preservation and Holding Times

Sample preservatives and sample holding times will meet the requirements set forth by USEPA. Ice will be used to maintain the internal cooler temperature at approximately 4 degrees Celsius during sample collection and shipment to the laboratory. Details regarding sample holding times are located within Table 3 of the project QAPP (CH2M HILL 2012a).

4.3.3 Sample Chain-of-Custody

Protocol for filling out the chain-of-custody form is provided in FOP-04 (Appendix C). The chain-of-custody form will be filled out to include contact information, project name, project number or task order, sample IDs, date and time collected, and analysis performed.

SECTION 5

General Field Operations

5.1 Health and Safety

CH2M HILL and its subcontractors will abide by the U.S. Occupational Safety and Health Administration regulations and the site-specific health and safety plan (HASP). General topics covered in the HASP include site location and scope of work, safety and health risk analysis, field team organization and responsibilities, PPE, site control measures, decontamination procedures, emergency response plan, employee training, and medical monitoring. The HASP will be kept onsite during all field activities and a copy will be maintained in the project files.

5.2 Field Activity Documentation

CH2M HILL will implement several procedures to document the location, media, and parameters of samples collected in the field. The procedures include recording the acquisition of each sample for laboratory analysis, photographing sediment cores, completing chain-of-custody forms for the environmental samples and field QC samples, maintaining a file of parameter data generated as a result of sampling activities, and recording field sampling location survey data. Field notes at each location may include the following information (if applicable): date, time, personnel, weather conditions, station identification, *x* coordinate, *y* coordinate, *z* elevations (top of water/ice, top of sediment), water depth, core penetration depth, and sample descriptions. The following subsections describe the sample documentation methods that will be used.

5.2.1 Field Logbook

A field logbook will be initiated at the start of the first onsite activity and maintained to document field activities throughout the field effort in accordance with FOP-05 (Appendix C).

5.2.2 Field Forms

Standard forms will be used in addition to the field logbooks to ensure necessary data are recorded consistently and provide a more detailed record. No blank spaces will appear on completed forms. If information requested is not applicable, the space will be marked with a dashed line or marked "N/A." All forms are to be completed in the field and placed in the project files. The following standard field forms will be completed as necessary and are provided in Appendix D:

- Sediment core logs will provide information necessary to document survey information (*x*, *y* coordinates and *z* elevations), sediment thickness, sediment description (texture, color, relative density, and structure), sample IDs, percent recovery, and other observations (for example, staining, odor).

5.2.3 Photographic Documentation

The FTL or designee will selectively photograph field activities, as well as each sediment core to complement descriptions of field activities in the field logbook and sediment core log descriptions. The following information will be recorded in the logbook when photographs are taken:

- Date and time
- Exposure number/roll number or digital file name
- Location of the photograph
- Description and identification of the subject
- The initials of the person who took the photograph

CH2M HILL will maintain digital picture files for reference during the project. With the submission of a final report, CH2M HILL will deliver the captioned photographs.

5.3 Field Parameter Documentation

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field logbooks and data forms. Data will be reviewed by the FTL for consistency and adherence to the site plans. Concerns identified will be corrected and incorporated into the data evaluation process.

The FTL also will review field data calculations, transfers, and interpretations conducted by the field team. Original field documents will be kept in the project file.

Field documents will be checked for the following:

- General completeness
- Readability
- Clearly stated use of appropriate procedures and modifications to sampling procedures
- Appropriate instrument calibration and maintenance records (as appropriate)
- Reasonableness of data collected
- Correctness of sample locations
- Correctness of reporting units, calculations, and interpretations

SECTION 6

References

CH2M HILL. 2012. *Solicitation No. 436069-1001 for Dredging, Stabilization and Disposal Services Sediment Removal Project at Tyco Fire Products Facility, Marinette WI.* April.

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URS Corporation (URS). 2004. *2004 RCRA Facility Investigation; Addendum No. 4; Tyco Safety Products – Ansul; Stanton Street Facility. Milwaukee, Wisconsin.* September.

Figures

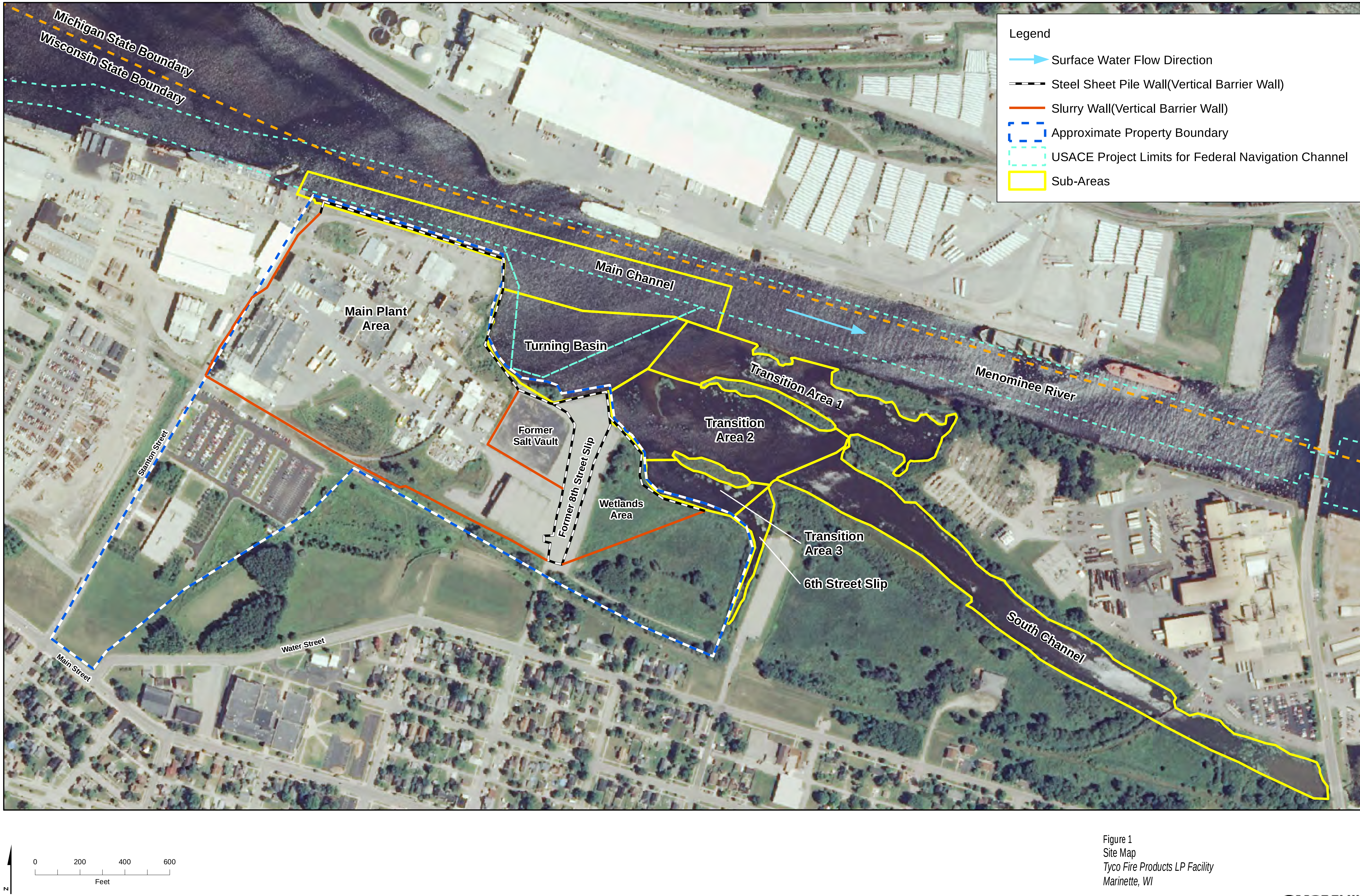
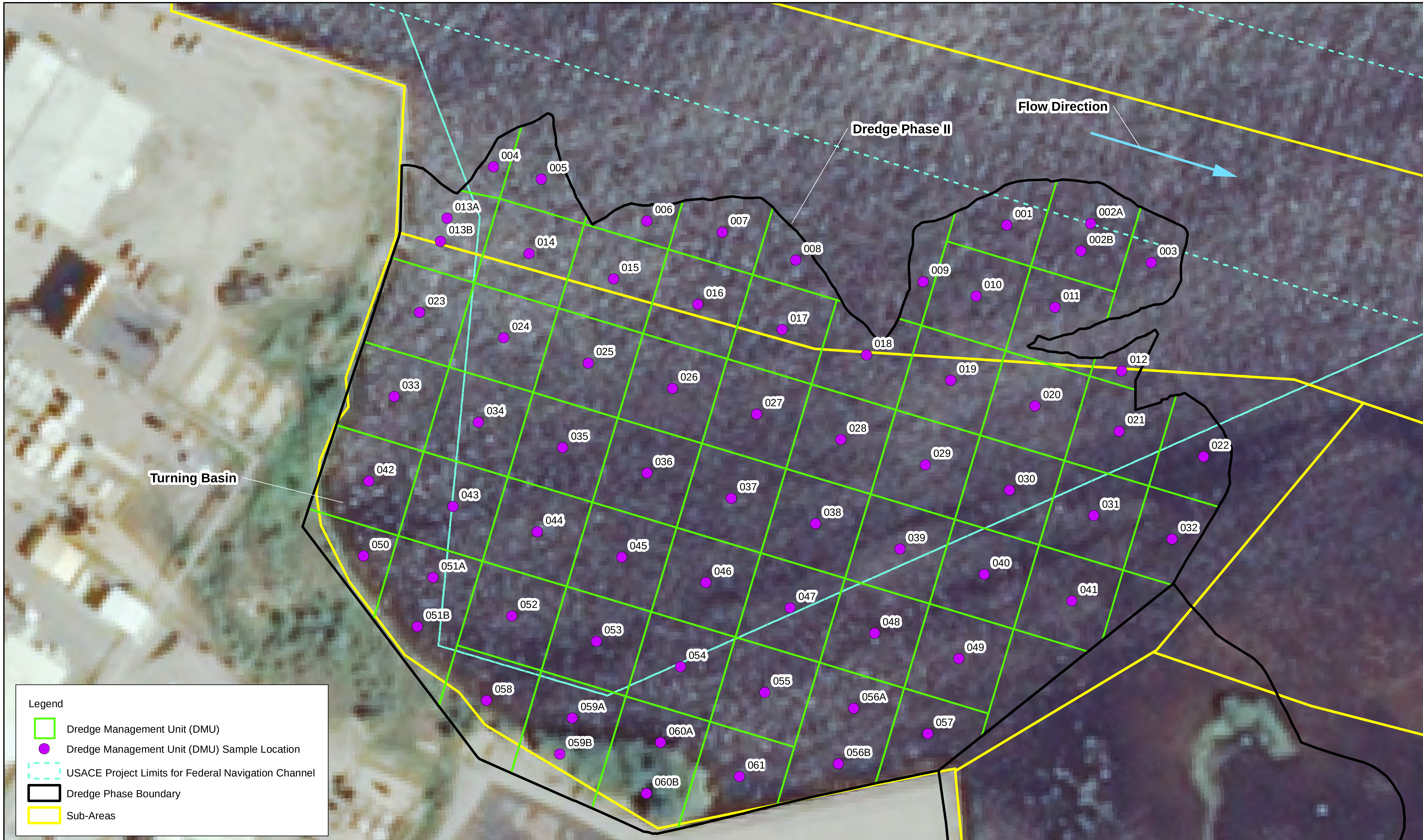


Figure 1
Site Map
Tyco Fire Products LP Facility
Marinette, WI

CH2MHILL

E:\TYCO\MAPFILES\DELIVERABLE_012312\FIGURE 01 - SITE MAP.MXD JHANSEN1 1/20/2012 3:52:06 PM



N

0 80 160

Feet

Figure 2
Phase II DMUs
Tyco Fire Products LP Facility
Marinette, WI

E:\TYCO\MAPFILES\2012\EPA_GRIDS_041612\FIGURE 02 - PHASE II DMUS.MXD JHANSEN1 3/11/2013 11:10:08 AM

CH2MHILL

Figure 3
Phase IV DMUs
Tyco Fire Products LP Facility
Marinette, WI

CH2MHILL

E:\TYCO\MAPFILES\2012\EPA_GRIDS_041612\FIGURE 03 - PHASE IV DMUS.MXD JHANSEN1 3/12/2013 12:23:17 PM

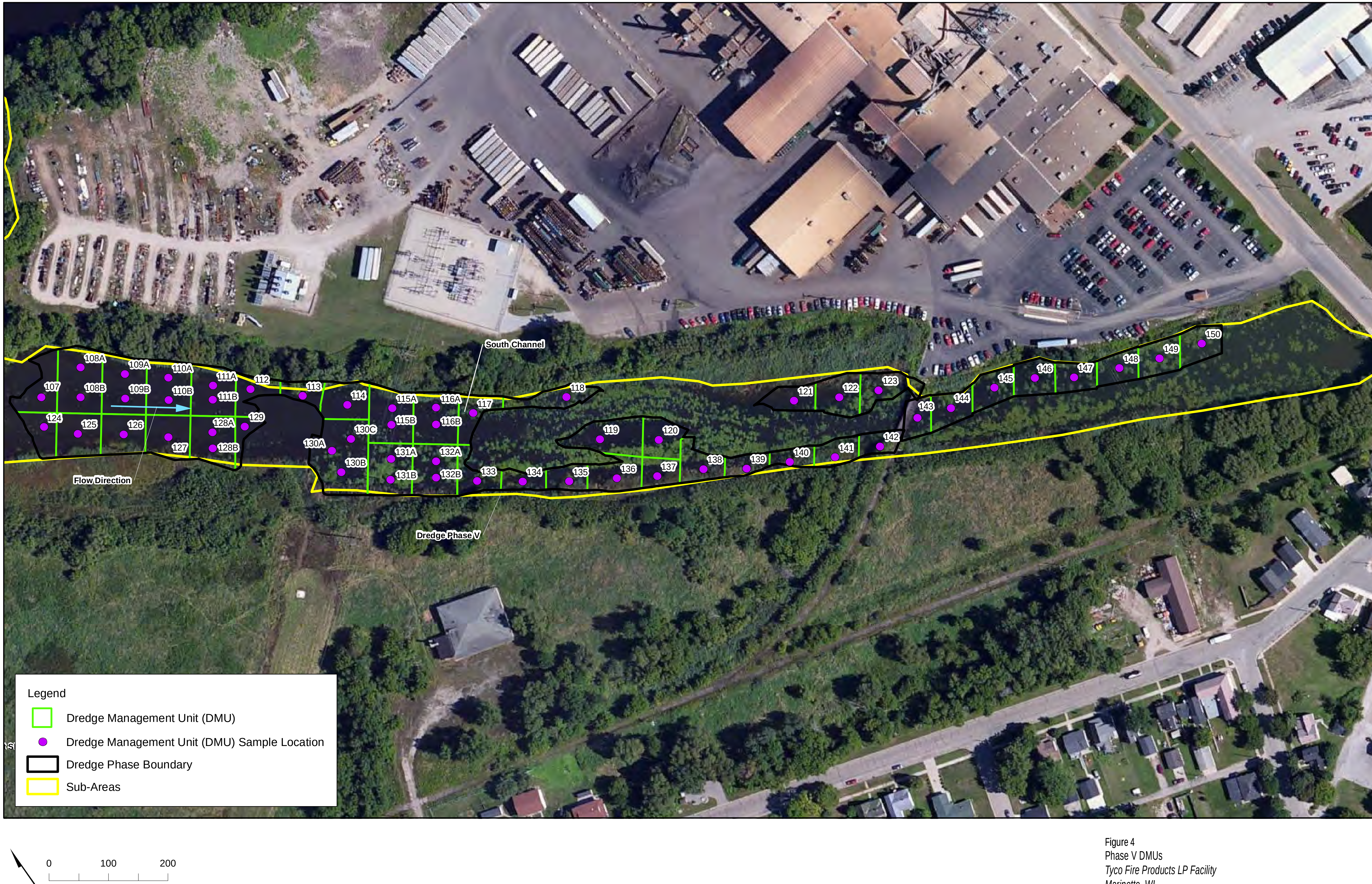


Figure 4
Phase V DMUs
Tyco Fire Products LP Facility
Marinette, WI

CH2MHILL

Appendix A
DMU Area and Sediment Core Locations

TABLE A-1

Proposed DMU Sediment Core Locations and Area

Dredge Phase	DMU	DMU Area (sf)	Location ID	Proposed X (WI SPE)	Proposed Y (WI SPE)
Phase II	1	4732	001	2585487.73	470294.13
Phase II	2	5593	002A	2585559.19	470295.45
			002B	2585550.86	470272.11
Phase II	3	3848	003	2585611.04	470262.15
Phase II	4	1572	004	2585050.26	470343.82
Phase II	5	4361	005	2585091.23	470333.47
Phase II	6	2293	006	2585181.10	470297.55
Phase II	7	4489	007	2585245.39	470287.95
Phase II	8	3243	008	2585307.86	470264.42
Phase II	9	2001	009	2585416.54	470245.80
Phase II	10	4900	010	2585461.58	470233.60
Phase II	11	4401	011	2585528.88	470224.00
Phase II	12	1490	012	2585585.65	470170.02
Phase II	13	5305	013A	2585010.85	470299.94
			013B	2585005.31	470280.28
Phase II	14	4900	014	2585080.89	470269.93
Phase II	15	4900	015	2585152.70	470248.30
Phase II	16	4900	016	2585224.51	470226.67
Phase II	17	4900	017	2585296.33	470205.04
Phase II	18	4480	018	2585368.14	470183.41
Phase II	19	4900	019	2585439.95	470161.78
Phase II	20	4900	020	2585511.77	470140.15
Phase II	21	4838	021	2585583.58	470118.52
Phase II	22	4769	022	2585655.39	470096.89
Phase II	23	4900	023	2584987.44	470219.75
Phase II	24	4900	024	2585059.26	470198.12
Phase II	25	4900	025	2585131.07	470176.49
Phase II	26	4900	026	2585202.88	470154.86
Phase II	27	4900	027	2585274.70	470133.23
Phase II	28	4900	028	2585346.51	470111.60
Phase II	29	4900	029	2585418.32	470089.97
Phase II	30	4900	030	2585490.14	470068.34
Phase II	31	4900	031	2585561.95	470046.71
Phase II	32	4190	032	2585628.50	470026.59
Phase II	33	4900	033	2584965.81	470147.94
Phase II	34	4900	034	2585037.63	470126.31
Phase II	35	4900	035	2585109.44	470104.68
Phase II	36	4900	036	2585181.25	470083.05
Phase II	37	4900	037	2585253.07	470061.42
Phase II	38	4900	038	2585324.88	470039.79
Phase II	39	4900	039	2585396.69	470018.16
Phase II	40	4900	040	2585468.51	469996.53
Phase II	41	4863	041	2585543.18	469973.98

TABLE A-1

Proposed DMU Sediment Core Locations and Area

Dredge Phase	DMU	DMU Area (sf)	Location ID	Proposed X (WI SPE)	Proposed Y (WI SPE)
Phase II	42	4900	042	2584944.18	470076.12
Phase II	43	4900	043	2585016.00	470054.49
Phase II	44	4900	044	2585087.81	470032.86
Phase II	45	4900	045	2585159.62	470011.23
Phase II	46	4900	046	2585231.44	469989.60
Phase II	47	4900	047	2585303.25	469967.97
Phase II	48	4900	048	2585375.06	469946.34
Phase II	49	4900	049	2585446.88	469924.71
Phase II	50	2998	050	2584939.71	470012.43
Phase II	51	6472	051A	2584999.02	469993.97
			051B	2584985.61	469952.15
Phase II	52	4900	052	2585066.18	469961.05
Phase II	53	4900	053	2585137.99	469939.42
Phase II	54	4900	054	2585209.81	469917.79
Phase II	55	4900	055	2585281.62	469896.16
Phase II	56	7034	056A	2585357.42	469882.50
			056B	2585344.28	469835.25
Phase II	57	4290	057	2585420.43	469860.93
Phase II	58	4816	058	2585044.55	469889.24
Phase II	59	6151	059A	2585117.69	469874.25
			059B	2585106.90	469843.61
Phase II	60	6646	060A	2585192.83	469853.28
			060B	2585180.89	469810.01
Phase II	61	4566	061	2585259.99	469824.35
Phase IV	62	3966	062	2585617.22	469942.23
Phase IV	63	3360	063	2585667.92	469920.96
Phase IV	64	2600	064	2585530.48	469882.55
Phase IV	65	4900	065	2585590.50	469881.45
Phase IV	66	4900	066	2585662.32	469859.82
Phase IV	67	4771	067	2585733.13	469836.76
Phase IV	68	3121	068	2585793.76	469807.71
Phase IV	69	5752	069A	2585495.10	469843.81
			069B	2585486.21	469817.87
Phase IV	70	4900	070	2585568.87	469809.64
Phase IV	71	4900	071	2585640.69	469788.01
Phase IV	72	4900	072	2585712.50	469766.38
Phase IV	73	4974	073A	2585775.60	469747.38
			073B	2585797.91	469740.66
Phase IV	74	6255	074A	2585478.12	469773.26
			074B	2585470.61	469731.92
Phase IV	75	4900	075	2585547.24	469737.83
Phase IV	76	4900	076	2585619.06	469716.20
Phase IV	77	4900	077	2585690.87	469694.57

TABLE A-1

Proposed DMU Sediment Core Locations and Area

Dredge Phase	DMU	DMU Area (sf)	Location ID	Proposed X (WI SPE)	Proposed Y (WI SPE)
Phase IV	78	5647	078A	2585753.97	469675.56
			078B	2585774.56	469667.92
Phase IV	79	4884	079	2585534.10	469673.09
Phase IV	80	4900	080	2585597.43	469644.38
Phase IV	81	4900	081	2585669.24	469622.75
Phase IV	82	4900	082	2585741.05	469601.12
Phase IV	83	5639	083A	2585800.98	469572.79
			083	2585821.94	469561.17
Phase IV	84	8102	084A	2585610.90	469561.34
			084B	2585656.27	469548.37
Phase IV	85	4660	085	2585719.42	469529.31
Phase IV	86	5635	086A	2585612.12	469484.67
			086B	2585638.91	469475.29
Phase IV	87	4900	087	2585697.79	469457.50
Phase IV	88	7232	088A	2585777.48	469464.99
			088B	2585769.61	469435.87
Phase IV	89	6843	089A	2585849.56	469443.55
			089B	2585841.42	469414.24
Phase IV	90	6160	090A	2585918.08	469404.08
			090B	2585910.74	469378.42
Phase IV	91	5822	091A	2585989.89	469382.45
			091B	2585982.55	469356.79
Phase IV	92	5355	092A	2586061.71	469360.82
			092B	2586054.36	469335.16
Phase IV	93	7006	093A	2586115.66	469332.70
			093B	2586147.13	469324.17
Phase IV	94	2575	094	2585625.36	469417.95
Phase IV	95	4468	096	2585676.16	469385.69
Phase IV	96	4514	097	2585747.98	469364.06
Phase IV	97	4789	098	2585819.79	469342.43
Phase IV	98	4775	099	2585892.77	469323.84
Phase IV	99	4458	100	2585963.42	469299.17
Phase IV	100	5106	101A	2586028.24	469289.65
			101B	2586043.66	469258.33
Phase IV	101	6202	102A	2586092.78	469257.64
			102B	2586128.22	469245.60
Phase IV	102	5440	103A	2586085.41	469184.09
			103B	2586113.88	469172.09
Phase IV	103	3634	104	2586088.43	469102.01
Phase IV	104	2970	105	2586064.87	469030.77
Phase IV	105	3614	105	2586218.46	469591.33
Phase IV	106	3242	106	2586154.88	469558.29
Phase V	107	4883	107	2586752.17	469268.46

TABLE A-1

Proposed DMU Sediment Core Locations and Area

Dredge Phase	DMU	DMU Area (sf)	Location ID	Proposed X (WI SPE)	Proposed Y (WI SPE)
Phase V	108	8197	108A	2586835.03	469271.51
			108B	2586806.49	469230.45
Phase V	109	7291	109A	2586889.91	469219.80
			109B	2586866.68	469185.68
Phase V	110	6809	110A	2586946.19	469172.81
			110B	2586924.88	469141.69
Phase V	111	6219	111A	2586999.99	469118.75
			111B	2586986.00	469099.77
Phase V	112	3397	112	2587048.37	469077.74
Phase V	113	2391	113	2587113.62	469018.14
Phase V	114	4784	114	2587166.56	468963.01
Phase V	115	6821	115A	2587225.48	468914.82
			115B	2587207.91	468892.73
Phase V	116	6591	116A	2587286.05	468873.36
			116B	2587269.89	468850.29
Phase V	117	3579	117	2587332.06	468829.85
Phase V	118	3783	118	2587475.82	468762.18
Phase V	119	4884	119	2587481.26	468671.91
Phase V	120	4259	120	2587562.01	468614.01
Phase V	121	3288	121	2587786.00	468537.41
Phase V	122	4803	122	2587851.50	468498.47
Phase V	123	4437	123	2587912.45	468470.36
Phase V	124	3433	124	2586727.35	469224.81
Phase V	125	4869	125	2586767.33	469182.76
Phase V	126	4895	126	2586830.13	469137.58
Phase V	127	4873	127	2586888.69	469090.75
Phase V	128	6039	128A	2586954.43	469055.08
			128B	2586939.40	469032.61
Phase V	129	1884	129	2587004.50	469031.77
Phase V	130	11055	130A	2587100.90	468914.45
			130B	2587093.52	468875.78
			130C	2587138.55	468912.46
Phase V	131	6528	131A	2587174.89	468846.18
			131B	2587153.83	468818.11
Phase V	132	6569	132A	2587234.34	468799.40
			132B	2587218.51	468776.79
Phase V	133	3469	133	2587271.91	468732.90
Phase V	134	2409	134	2587334.13	468688.26
Phase V	135	2795	135	2587398.46	468643.35
Phase V	136	4737	136	2587467.20	468601.71
Phase V	137	2960	137	2587524.77	468565.56
Phase V	138	3923	138	2587595.09	468530.95
Phase V	139	2312	139	2587655.16	468489.77

TABLE A-1

Proposed DMU Sediment Core Locations and Area

Dredge Phase	DMU	DMU Area (sf)	Location ID	Proposed X (WI SPE)	Proposed Y (WI SPE)
Phase V	140	2146	140	2587721.26	468457.37
Phase V	141	3094	141	2587787.92	468420.22
Phase V	142	2478	142	2587860.16	468391.49
Phase V	143	2917	143	2587939.43	468394.83
Phase V	144	3699	144	2587994.84	468375.88
Phase V	145	3811	145	2588074.72	468362.43
Phase V	146	4017	146	2588139.67	468336.54
Phase V	147	3309	147	2588194.29	468299.32
Phase V	148	3456	148	2588265.73	468268.46
Phase V	149	3992	149	2588330.50	468243.34
Phase V	150	3907	150	2588402.67	468222.82

Appendix B

Project Schedule

Appendix C

Field Operating Procedures

APPENDIX C

Field Operating Procedures

Appendix C presents the following field operating procedures (FOPs) to perform the confirmation sampling tasks associated with the Menominee River sediment removal adjacent to the Tyco Fire Products LP Facility.

FOP Number	Title
FOP-01	Global Positioning System Procedures and Station Positioning
FOP-02	Direct-Push Technology Drilling and Sediment Sample Collection
FOP-03	Sample Handling, Packaging, and Shipping
FOP-04	Documentation and Chain-of-Custody Procedure
FOP-05	Field Logbook

FOP-01

Global Positioning System Procedures and Station Positioning

Purpose

FOP-01 provides guidelines for the collection of horizontal coordinates during field activities using a global positioning system (GPS) unit. Accurate surveys of sampling locations and boundaries are necessary to determine precise spatial reference points for characterization of site conditions. Precise positioning of station locations is required to meet the sampling goals. Both accuracy (the ability to define position) and repeatability (the ability to return to a sampling station) are essential. Positioning for all surveys will be achieved using a GPS capable of locating stations with a horizontal accuracy and repeatability of plus or minus 1 meter.

Scope

The method described for the collection of horizontal coordinates is applicable to a Trimble Pathfinder Geo XH or comparable GPS receivers. The program precision and accuracy requirement for location coordinates is ±1 meter (3.3 feet). To achieve real-time data with a submeter accuracy level with no post-processing of data using GPS Pathfinder Office, the following criteria must be met:

- Minimum number of satellites = 4
- Maximum position dilution of precision (PDOP) = 6
- Minimum signal to noise ratio (SNR) = 4
- Minimum elevation = 15 degrees

If any of the above criteria cannot be met because of weather conditions, time of day, or obstructions of the sky such as buildings or foliage resulting in a less-than submeter accuracy, the following should be performed:

- Mark the location on the applicable aerial photograph or map and estimate the distance from two known locations and note in the field logbook so, at a minimum, a general location position can be obtained. The location also should be marked using a weighted buoy and a reading taken when conditions are optimal.

Equipment and Materials

- Trimble Pathfinder Geo XH or comparable GPS receiver and compatible data logger
- Field logbook
- Buoy with anchor and rope
- Aerial photograph or map of sampling area

Procedures and Guidelines

1. Verify the GPS horizontal datum is set to Wisconsin South Zone State Plane Coordinate System, North American Datum of 1983 (NAD83) and the vertical datum is set to North American Vertical Datum of 1988 (NAVD88).

2. Verify that the GPS is referenced to known survey control monuments (x, y, and z) surrounding the project site within the level of accuracy specified prior to field activities and upon return.

3. Place the GPS antenna over the location where coordinates are to be collected and record coordinates in the field logbook and/or log coordinates into the GPS receiver. If locations are to be logged into the receiver, readings must be collected every 5 seconds for a period of 1 minute (see manufacturer instructions on position logging). The data files recorded for each position must be named including both the sample location identification and date recorded.

4. Download the data from the GPS unit to a personal computer daily record in the field logbook or appropriate field form as they are collected.

Positioning of the Sampling Vessel

1. Before daily departure of the sampling vessel, the sampling crew will be informed of the planned sampling locations. The sampling team will verify the GPS is referenced to known survey control monuments (x, y, and z) surrounding the project site before departure from the dock or launch ramp and upon returning after sampling activities.

2. Vessel navigation and positioning will be accomplished using GPS methodology.

3. The 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-sampled" x, y position measurements.

4. The above information will be recorded on the sample log form prior to acquisition of the sample. The sample log also will be annotated with the exact sampling location coordinates, date, time, weather and water surface conditions, as well as any relevant other information associated with the acquisition of each sample.

5. Vessel anchoring will be accomplished using multiple anchors or spud poles during coring operations and the recording of position coordinates.

Reference

U.S. Environmental Protection Agency. 2008. *USEPA Interim Guidance for Developing Global Positioning System Data Collection Standard Operating Procedures and Quality Assurance Project Plans, Revision 1.0.* February.

Key Checks and Items

- Charge and check batteries daily.

FOP-02

Direct-Push Technology Drilling and Sediment Sample Collection

Purpose

FOP-02 provides a general guideline for the collection of sediment samples using direct-push technology (DPT) drilling methods. Work will be conducted from a vessel over open water.

Scope

The method described for DPT sediment sampling is applicable for sediment sampling over exposed sediments and below the sediment-water interface within a water body. Specific equipment and the responsibilities of DPT drilling subcontractors are described in the contracting documentation.

Equipment and Materials

- Drilling equipment and tools for hydraulic DPT rig using continuous samplers
- Survey rod with a 6-inch round plate affixed to the bottom
- Equipment and supplies required for logging sediment core
- Analytical sample containers and sampling supplies
- Level D personal protective equipment (PPE) plus personal flotation device (PFD)

Procedures and Guidelines

1. Position the DPT drill rig over the proposed sampling location. Record the location identification (ID), station positioning (x and y coordinates), weather conditions, personnel, and other relevant information.

2. If working from a vessel over open water, measure the depth from top of water surface to the top of sediment using a survey rod with a 6-inch-diameter round plate affixed to the bottom. Record the water depth to the nearest 0.1 foot.

3. Measure the DPT refusal depth from the water surface to obtain the total boring depth. Subtract the water depth from the total boring depth to derive the sediment thickness.

4. Ensure nondedicated downhole equipment and sampling equipment are decontaminated.

5. Wear appropriate PPE, as required by the health and safety plan. Change gloves between sampling locations.

6. Collect subsurface sediment samples continuously to the refusal depth using a MacroCore sampler with a polycarbonate liner. Between sediment core locations, decontaminate the MacroCore sampler and downhole tools.

7. Ensure the drilling operators open the polycarbonate liner once removed from the MacroCore sampler and present it to the field staff for logging and sampling. Fill the sample containers using decontaminated sampling equipment. Sediment samples for inorganic and nonvolatile organic analyses will be separated and transferred into disposable aluminum pans, homogenized by mixing with a stainless-steel spoon, and transferred to the appropriate sample container. Remove large pebbles and cobbles from the samples before placing in jars.

8. Label, handle, and store the samples according to procedures outlined in the field sampling plan (FSP). Record sampling data such as depth, time, and date as specified in the FSP. Discard unused sample according to the guidelines for investigation-derived waste (IDW) outlined in the waste management plan.

9. Advance the DPT rig to the next sampling interval after a subsurface sediment sample is collected.

10. Obtain accurate and representative sediment samples. The drilling subcontractor will be responsible for obtaining accurate and representative sediment samples, informing the geologist/field technician of changes in drilling conditions, and keeping a separate general log of the sediment core locations.

Decontamination of Drilling Rigs and Equipment

Before the onset of drilling, after each core location, and before leaving the site, heavy equipment and machinery will be decontaminated using a phosphate-free detergent solution and high-pressure hot water at a designated area. The equipment will then be rinsed with potable water. The steam cleaning area will be designed to contain decontamination wastes and wastewater, and can be a high-density polyethylene-lined, bermed pad. A pumping system will be used to convey decontamination water from the pad to the drums.

At the following times, drilling tools will be decontaminated as described above: (1) before the onset of drilling, and (2) between core locations. Decontamination will include, but is not limited to, rods, split spoons or similar samplers, coring equipment, auger bolts, augers, and casing.

Before using a sampling device such as a split-spoon sampler to collect sediment samples for physical characterization or chemical analysis, the sampler will be cleaned by scrubbing with a potable water and phosphate-free detergent solution, rinsing with potable water, and then rinsing with distilled water. If equipment has come in contact with oil or grease, rinse the equipment with methanol, and then distilled water.

Key Checks and Items

- Verify the DPT rig is clean and in proper working order.

- Monitor the DPT operator thoroughly completes the decontamination process between sampling locations. Determine if a quality control sample will be required at a sampling location (refer to the FSP).

FOP-03

Sample Handling, Packaging, and Shipping

Purpose

This procedure delineates protocols for the packing and shipping of samples to the laboratory for analysis.

Scope

This procedure is applicable for all samples collected and prepared for analysis at an offsite laboratory.

Equipment and Materials

- Waterproof hard plastic coolers
- Plastic resealable bags
- Plastic garbage bags
- Absorbent packing material (not vermiculite)
- Inert cushioning material (not vermiculite)
- Ice
- Chain-of-custody forms
- custody seals
- Airbills and shipping pouches (for example, Federal Express)
- Clear tape
- Strapping tape
- Mailing labels

Procedures and Guidelines

Prepare Bottles for Shipment

1. Arrange decontaminated sample containers in groups by sample number.
2. Check that sample container lids are tight.
3. Arrange containers in front of assigned coolers.
4. Affix appropriate adhesive labels to each container. Protect label with clear tape.
5. Enclose each sample in a clear, resealable plastic bag and ensure sample labels are visible.

Prepare Coolers for Shipment

1. Tape drains shut, inside and out.
2. Affix “This Side UP” labels on all four sides and “Fragile” labels on at least two sides of each cooler.
3. Place mailing label with laboratory address on top of the coolers.

4. Place inert cushioning material (for example, bubble wrap, preformed poly-foam liner) in the bottom of the cooler. Do not use vermiculite.

5. Place appropriate chain-of-custody records with corresponding custody seals on top of each cooler.

6. Place the samples inside a garbage bag and tie the bag.

7. Double bag and seal loose ice in resealable, plastic bags to prevent melting ice from leaking and soaking the packing material. Place the ice outside the garbage bags containing the samples. Place sufficient ice in cooler to maintain the internal temperature at 4 degrees Celsius (°C) (±2°C) during transport.

8. Fill cooler with enough absorbent material and packing material to prevent breakage of the sample bottles and to absorb the entire volume of the liquid being shipped.

9. Sign each chain-of-custody form (or obtain signature) and indicate the time and date the cooler was custody sealed.

10. Seal the laboratory copies of the chain-of-custody forms in a large resealable plastic bag and tape to the inside lid of the cooler. Retain the chain-of-custody forms. Each cooler must contain a chain-of-custody form (or forms) that correspond to the contents of the cooler.

11. Close lid and latch.

12. Peel custody seals carefully from backings and place intact over lid openings (right front and left back). Cover seals with clear protection tape.

13. Tape cooler shut on both ends, making several complete revolutions with strapping tape. **Do not** cover custody seals.

14. Relinquish to carrier (for example, Federal Express). Place airbill receipt inside the mailing envelope and send to sample documentation coordinator, along with the other documentation.

High-Concentration Samples or Nonaqueous Phase Liquid Samples

When shipping high concentration samples or samples of nonaqueous phase liquid, the CH2M HILL dangerous goods shipping handbook should be consulted for reference. In addition, the CH2M HILL dangerous goods shipping coordinator, Rob Strehlow, can be contacted at the Milwaukee, Wisconsin, equipment warehouse (414-257-4615) for assistance.

Key Checks and Items

None.

FOP-04

Documentation and Chain-of-custody Procedure

Purpose

This procedure provides a definition of "custody" and describes protocols for documenting the transfer of custody from one party to the next (for example, from the site to the laboratory). A documented custody trail is established using sample tags and a chain-of-custody form that uniquely identifies each sample container, and who has possession of it from the sample's origin to its final destination. The chain-of-custody form also describes the sampling point, date, time, and analysis parameters.

Scope

Sample personnel should be aware that a sample is considered to be in a person's custody if the sample meets the following conditions:

- It is in a person's actual possession.
- It is in view after being in a person's possession.
- It is locked up so that no one can tamper with it after it has been in physical custody.

When samples leave the custody of the sampler, the cooler must be custody-sealed and possession must be documented.

Data generated from using this procedure may be used to support the following activities: site characterization, risk assessment, and evaluation of remedial alternatives.

Equipment and Materials

- Laboratory provided chain-of-custody form
- Sample container labels
- Indelible black ink pen

Procedures and Guidelines

Chain-of-Custody Forms

The chain-of-custody form must contain the following information:

- SITE NAME/STATE: This will be "Tyco."
- PROJECT LEADER: Enter the CH2M HILL site manager's name.
- SAMPLING CO.: "CH2M HILL."
- SAMPLE NO.: This is the unique number that will be used for sample tracking.

- MATRIX: Describes the sample media (for example, sediment).
- SAMPLER NAME: The name of the sampler or sample team leader.
- SAMPLE TYPE: “Grab” or “Composite.”
- ANALYSIS: This indicates the analyses required for each sample.
- PRESERVATIVE: Document what preservative has been added to the sample (for example, “HCl,” “Ice Only,” “None”).
- SAMPLE COLLECT DATE/TIME: Use military time.
- QC TYPE: This is for field quality control only, and includes field duplicate, field blanks, equipment blanks, and trip blanks.
- SHIPPED TO: This is the laboratory name and full address, including the laboratory contact. If the contact is not known, use “Sample Custodian.”
- Although the samples are “relinquished” to the shipping carrier, the shipping carrier does not have access to the samples as long as the shipping cooler is custody sealed. Consequently, the shipping carrier does not sign the chain-of-custody form.
- SAMPLE(S) TO BE USED FOR LABORATORY QC: This identifies which samples are to be used

Key Checks and Items

- All sample containers must be properly tagged.
- Each cooler must have a chain-of-custody form and the samples in the cooler (as identified by the sample tags) must match what is on the chain-of-custody form.
- Each chain-of-custody form must be properly relinquished (signature, date, time).
- The shipping cooler must be custody sealed in at least two places.

FOP-05

Field Logbook

Purpose

This procedure delineates protocols for recording field survey and sampling information in a field logbook.

Scope

Data generated from using this procedure may be used to support site characterization, risk assessment, and evaluation of remedial alternatives.

Equipment and Materials

- Field logbook
- Indelible black ink pen

Procedures and Guidelines

All information pertinent to a field survey or sampling effort will be recorded in a bound field logbook that will be initiated at the start of the first onsite activity. The field logbook will consist of a bound notebook with consecutively numbered pages that cannot be removed. The outside front cover of the logbook will contain the project (site) name and the specific activity (for example, remedial design sampling). The inside front cover will include the following:

- Site name
- Project number
- Site manager's name and mailing address
- Sequential logbook number
- Start date and end date of logbook

Each page will be consecutively numbered, dated, and initialed. All entries will be made in indelible black ink, and all corrections will consist of line-out deletions that are initialed and dated. If only part of a page is used, the remainder of the page should have an "X" drawn across it. At a minimum, entries in the logbook will include the following:

- Time of arrival and departure of site personnel, site visitors, and equipment
- Instrument calibration information, including make, model, and serial number of the equipment calibrated
- Field observations (for example, sample description, weather, unusual site conditions or observations, sources of potential contamination)
- Detailed description of the sampling location, including a sketch

- Details of the sample site (for example, coordinates [*x*, *y*], water elevation [*z*], casing diameter and depth, integrity of the casing)
- Sampling methodology and matrix, including distinction between grab and composite samples
- Names of samplers and crew members
- Start or completion time of sample collection activities
- Field measurements (for example, water depths, sediment probe depths)
- Type of sample (for example, sediment)
- Number, depth, and volume of sample collected
- Field sample number
- Requested analytical determinations
- Sample preservation
- Quality control samples
- Sample shipment information including chain-of-custody form number, carrier, date, and time
- Health and safety issues (including level of personal protective equipment)
- Signature and date by personnel responsible for observations

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a logbook. Records should, however, contain sufficient information so that someone can reconstruct the sampling activity without relying on the collector's memory. The field team leader will keep a master list of all field logbooks assigned to the sampling crew.

Key Checks and Items

None.

Appendix D
Field Forms

SEDIMENT CORE LOG

SHEET 1 OF 1

STATION ID:

PROJECT :	TOP OF BARGE TO SED SURFACE (FT):
PROJECT NUMBER :	TOP OF BARGE TO WATER (FT) :
CONTRACTOR :	WATER DEPTH (FT) :
EQUIPMENT : Geoprobe w/macrocore sampler	TOP OF BARGE TO REFUSAL (FT) :
LOGGER :	SED THICKNESS TO REFUSAL (FT) :
DATE : START : END :	

DEPTH BELOW SURFACE (FT)	PENETRATION (FT)	RECOVERY (FT)	#/TYPE	SEDIMENT DESCRIPTION SEDIMENT TEXTURE, COLOR, RELATIVE DENSITY OR CONSISTENCY, & STRUCTURE	COMMENTS SAMPLE ID, QA/QC, ETC
0					
1					
2					
3					
4					
5					
6					
7					

NOTES :

STAFF GAUGE No. and ELEV :

STAFF GAUGE READING (FT) :

WATER ELEVATION :

SEDIMENT ELEVATION :

X - COORDINATE :

Y - COORDINATE :

Sediment Core Log Key

MAJOR DIVISIONS			GRAPHIC SYMBOL	GROUP SYMBOL	DESCRIPTION
COARSE-GRAINED MATERIAL	GRAVELS	CLEAN GRAVELS		GW	Well-graded gravel Well-graded gravel with sand
				GP	Poorly graded gravel Poorly graded gravel with sand
		GRAVELS WITH FINES		GW-GM	Well-graded gravel with silt Well-graded gravel with silt and sand
				GW-GC	Well-graded gravel with clay Well graded gravel with clay and sand
				GP-GM	Poorly graded gravel with silt Poorly graded gravel with silt and sand
				GP-GC	Poorly graded gravel with clay Poorly graded gravel with clay and sand
				GM	Silty gravel Silty gravel with sand
				GC	Clayey gravel Clayey gravel with sand
	SANDS	CLEAN SANDS		SW	Well-graded sands Well-graded sand and gravel
				SP	Poorly-graded sands Poorly graded sand with gravel
		SANDS WITH FINES		SW-SM	Well-graded sand with silt Well-graded sand with silt and gravel
				SW-SC	Well-graded sand with clay Well-graded sand with clay and gravel
				SP-SM	Poorly-graded sand with silt Poorly-graded sand with silt and gravel
				SP-SC	Poorly-graded sand with clay Poorly-graded sand with clay and gravel
				SM	Silty sand Silty sand and with gravel
				SC	Clayey sand Clayey sand and with gravel
FINE-GRAINED MATERIALS	SILTS AND CLAYS			CL	Lean clay * Lean clay with sand or gravel * Sandy lean clay * Sandy lean clay with gravel * Gravelly lean clay * Gravelly lean clay with sand
				ML	Silt * Silty with sand or gravel * Sandy silt * Sandy silt with gravel * Gravelly silt * Gravelly silt with sand
				CH	Fat clay * Fat clay with sand or gravel * Sandy fat clay * Gravelly fat clay * Gravelly fat clay with sand
				MH	Elastic silt * Elastic silt with sand or gravel * Sandy elastic silt * Sandy elastic silt with gravel * Gravelly elastic silt * Gravelly elastic silt with sand
				OL/OH	Organic silt * Organic silt with sand or gravel * Sandy organic silt * Sandy organic soil with gravel * Gravelly organic soil * Gravelly organic soil with sand

CONSISTENCY
Penetration of thumb:
<0.25 cm = hard (H)
0.25 - 2.0 cm = firm (F)
2.0 - 4.0 cm = soft (S)
>4.0 cm = very soft (VS)

CEMENTATION
N = not cemented
W = weakly cemented
M = Moderately cemented
S = Strongly cemented

STRUCTURE
H = Homogeneous
S = Stratified
L = Laminated
M = Mottled

COLOR
from Munsell chart

MAXIMUM PARTICLE SIZE
SC = Small Cobble
CP = Coarse Pebble
MP = Medium Pebble
SP = Small Pebble
CS = Coarse Sand
MS = Medium Sand
FS = Fine Sand
VFS = Very Fine Sand
Z = Silt

SA = Sub-angular
VA = Very angular

ODOR
N = None
UNC = Unclassified
S = Sulfur-like

PHC = Petroleum hydrocarbon-like

Quantifying Descriptors
Strong
Moderate
Faint

Moisture Content
Wet
Moist
Dry

well graded = poorly sorted = grains of all different sizes mixed together
poorly graded = well sorted = grains are all same size