# Memorandum

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| To: | Nate Nemani, U.S. EPA | Ref. No.: | 058502 |
| From: | John-eric Pardys/kf/18 J.E.P. | Date: | April 27, 2016 |
| CC: | Grant Trigger, RACER<br>Dave Favero, RACER | | |

**Re: Secondary Pond and Lagoon 5 Sediment Sampling Work Plan**
**RACER, Saginaw Nodular Industrial Land**
**Saginaw, Michigan**

## 1. Introduction

Revitalizing Auto Communities Environmental Response (RACER) and GHD Services, Inc. (GHD) are proposing further characterization of the sediment and underlying native material in the secondary pond and lagoon 5 at RACER's Saginaw Nodular Industrial Land (Site) in Saginaw, Michigan in order to refine the Conceptual Site Model (CSM). In addition, a portion of the secondary pond and lagoon 5 is being considered as the potential location for a mitigation wetland.

Previous sediment sampling activities were conducted in the secondary pond and lagoon 5 during the initial Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) in November 1998 and subsequently in March 2005, which included the collection of four sediment samples from four separate locations during each event. In addition, in June 2011 and March 2016, GHD conducted additional characterization of the secondary pond and lagoon 5 through the collection of 13 samples from 12 locations and 11 samples from 10 locations, respectively. The results were screened against the Michigan Department of Environmental Quality (MDEQ) cleanup criteria requirements for response activity, Groundwater to Surface Water Interface Protection Criteria. The results are summarized on Figure 1.

## 2. Sediment Characterization Scope of Work

The proposed Scope of Work for characterizing sediment and underlying material consists of the following:

- Sediment and Underlying Material Soil Characterization Sampling Locations:
  - **Sediment Cores:** One sediment core will be collected at each of the 39 locations presented on Figure 2. From each location, a sample will be collected from the top 6-inches of sediment and a composite of the remaining sediment thickness for a total of 78 sediment samples. The samples may be analyzed for TAL Metals, Formaldehyde, Total Cyanide, Ammonia, and PCBs. Sediment cores will be advanced to refusal. Based on previous bathymetric surveys, sediment thickness is anticipated to range from 0 to 3 feet.

GHD Services Inc.
14496 Sheldon Road Suite 200 Plymouth Michigan 48170 USA
**T** 734 453 5123 **F** 734 453 5201 **W** www.ghd.com

- **Underlying Material Cores for Geotechnical Analysis:** One underlying material core will be collected from the secondary pond/lagoon 5 for grain size analysis, atterberg limits, and permeability.
- **Underlying Material Samples:** A total of 39 soil samples of the underlying material directly below the sediment samples will be collected and may be analyzed for TAL Metals, Formaldehyde, Total Cyanide, Ammonia, and PCBs. Soil will be collected from the top 0 to 1-foot, below the sediment, to the extent possible.

- **Sediment Depth Measurements:** Sediment depth measurements will be collected concurrently with the sediment cores at the 39 locations. Elevations will be recorded at both the top and bottom of sediment.

A core processing area will be established on shore prior to commencing field activities. An experienced GHD field staff will be on Site to process and log the sediment cores. The contractor will transport the cores from the sample location to the core processing area. Cores will remain in a vertical position while being transported to the processing area.

A trailerable coring vessel will be utilized for sediment collection activities. The coring vessel will be positioned at each sampling location using a sub-meter Differential Global Positioning System (DPGS) with either spuds or by anchoring. All sample points will be located using sub-meter DGPS and R8 GNSS RTK GPS (referenced to NAVD88 vertical datum). The coring vessel requires 2 to 2.5 feet of water to float and 4 feet to run its engine. Water depths will be recorded using both a lead line and a calibrated fathometer. The coring vessel is outfitted with an A-Frame, electric winch, generator, and all necessary sediment collection tools. Sediment cores will be collected from each location using a Rossfelder® or PVL submersible vibracore unit. Additional sampling devices such as a van Veen sampler, Ekman and a Piston corer will be on hand to be used if necessary. Sampling will be conducted in accordance with the applicable Field Method Guideline (FMG) (FMG 16 – Lagoon and Sediment Sampling) presented in Attachment A. Sediment cores will be advanced until refusal is encountered. Penetration depth and depth of core recovery will be recorded at each sample location. This will allow for determination of percent recovery (as measured by length divided by penetration length) and sediment thickness at each location.

A photograph of the sampling vessel is provided in Attachment B. The portable barge will be floated out to the sample locations and cores will be collected using a portable manually driven vibracore.

**Field Procedures**. Sediment core samples will be collected using an electrically powered vibracorer which is lowered through the water column under winch control and penetrates the sediment by means of its weight and powered vibration.

The following steps outline the procedures for using a vibracorer in the field:

1. Maneuver the sampling vessel to the proposed sampling location using DGPS and R8 GNSS RTK GPS and deploy a marker buoy at the location; record the water depth using a lead line or calibrated fathometer.
2. Check to ensure that the clear, semi-rigid cellulose acetate butyrate (CAB) disposable tubing is securely fastened to the powerhead of the vibracorer.
3. Insert a disposable core catcher into the end of the barrel so that the catcher fingers will extend into the tubing, and then screw the cutter head onto the bottom of the core barrel until the shoulder snugs against the end of the tubing. Tighten the cutter head with a spanner or strap wrench.

4. Start the electrical generator, but **DO NOT** yet energize the corer.

5. Signal the winch operator to hoist the corer and swing it over the stern or side of the vessel at the marked sampling location. Reposition the vessel if necessary. Record the water depth using a lead line or calibrated fathometer.

6. Signal the winch operator to lower the corer through the water column. Determine the depth of the corer in the water column and track its subsequent penetration into the sediment by either marking the winch line in 1 ft increments or by attaching a flexible tape measure to the powerhead.

7. When the cutter head is within approximately 10 ft off the bottom, energize the corer by actuating the circuit breaker on the generator control panel.

8. Slow the descent speed of the corer in order to determine when the core nose enters the sediment. Maintain tension on the winch line throughout the coring process to keep the corer from toppling over. The worker monitoring the penetration of the corer into the sediment will signal the winch operator when to pay out more line.

9. When refusal is encountered or if the measured distance to the tip of the core nose indicates that project depth has been reached, stop paying out line and de-energize the corer. Do not power down the generator.

10. Signal the winch operator to bring the winch line taut. Maneuver the boom or the boat until the winch pulley is directly above the corer, as indicated by the winch line being as close to true vertical as possible.

11. Record the position of the actual coring location. The navigation antenna may be mounted on the winch boom near the pulley to place it directly over the corer.

12. Signal the winch operator to retrieve the corer. If the corer is stuck in the bottom, energize the power head while maintaining tension on the winch line. To reduce the risk of losing sediment from the core barrel, de-energize the corer as soon as it shows any sign of vertical movement. As soon as retrieval of the corer is underway, power down the generator. Swing the corer over the deck and lower it to a holding rack. Note and record the length of smearing on the outside of the core barrel, which gives an indication of the amount of penetration.

13. Use a spanner or strap wrench to unscrew the cutter head and remove it. The catcher may stay inside the cutter head or remain attached to sediment inside the tubing. Retain any sediment in the cutter head and core catcher for examination and possible use.

14. Remove the disposable catcher, if necessary, and immediately cap the bottom end of the core tubing with a plastic cap. Secure the bottom cap with duct tape. Immediately cap the top of the core liner.

15. If the core is to be cut into sections, draw a mark on the outside of the core liner where the cut will be made to cut off the bottommost section. Apply duct tape and use a permanent marker to mark the sections on both sides of the location of the future cut. Mark arrows pointing toward the top end of the core, write the core ID, write date and time, and indicate the depth interval spanned by the sections in terms of feet below mudline.

16. Cut the core at the section boundary using power shears loaded with a decontaminated blade. Another person will be at the ready to immediately cap both the exposed ends and secure with duct tape.

17. Repeat the cutting procedure if more sections need to be cut.

18. Remove the cap from the top end of the top-most section and drain the water. Draining may be accomplished by drilling a hole through the core liner just above the top of the sediment or by gently tipping the section to empty the water out the top. Care must be taken to avoid loss of sediments during decanting, particularly "soupy" sediments with high water content.

19. After decanting, cut off the excess plastic tubing, cap the end at the sediment interface, and secure the cap with duct tape.

20. Evaluate the appearance and length of the core sample by examination through the clear plastic core tubing. Note any stratigraphic intervals or other salient features on the core collection log sheet.

21. Store the core sections at 4°C (±2°C) in a refrigerator or iced cooler for subsampling and further processing (see below).

22. Complete any additional entries on the coring field form.

**Core Acceptance Criteria**. Acceptance criteria for sediment core samples are as follows:

- The core penetrated to target depth.
- The core did not suffer significant sample-induced compaction or loss of material (i.e., recovery greater than 60 percent, as measured by recovery length divided by penetration length).
- Cored material did not extend out the top of the core tube or contact any part of the sampling apparatus at the top of the core tube.
- There are no obstructions in the cored material that might have blocked the subsequent entry of sediment into the core tube, which may have resulted in an incomplete and biased core section.

**Core Processing**. The following steps outline the general procedures to be followed when cores are split, logged, and subsampled for laboratory analysis:

1. All equipment coming into contact with sediment will be decontaminated before use with each sample to avoid cross contamination.

2. Cut the core tubing longitudinally on opposite sides using power shears. Pull away the top half of the core tubing to expose the sediment sample.

3. Log and describe the sediment on a core log form according to standard ASTM soil description procedures. Core logs should include:

    a. Visual grain size classification

    b. Color

    c. Consistency (stiffness or denseness)

    d. Odor

    e. Presence of debris

    f. Presence of biological activity (e.g., detritus, shells tubes, bioturbation, live or dead organisms)

    g. Presence of oil sheen

h. Any other unusual or distinguishing characteristics

4. After the sediment description is complete, subsample the core into intervals (0-6-in and 6-in to end of sediment, based on in situ conditions). The ex situ core intervals will be corrected for compaction, and therefore may be somewhat less than these intervals in actual length.

5. Homogenize each sample interval using a stainless steel mixing spoon or an electric drill with a stainless steel paddle.

6. Collect samples of the homogenized sediment as appropriate for chemical analysis. Label sample jars and place them in refrigerators or coolers with blue ice to maintain sediment at 4°C until dispatched under chain of custody to the appropriate laboratory. Samples designated for archiving will be frozen for possible future analysis.

A field form will be completed at each sample location that will include: sample coordinates; weather; wind conditions; water depth; penetration depth; depth of core recovery; and ASTM soil description. See Attachment C.

**Chemical Analysis.** Laboratory analysis will consist of the following:

- A total of 78 sediment samples may be submitted for analysis of TAL Metals, Formaldehyde, Total Cyanide, Ammonia, and PCBs.
- A total of 39 soil (underlying material) samples may be submitted for analysis TAL Metals, Formaldehyde, Total Cyanide, Ammonia, and PCBs.
- One soil (underlying material) sample will be submitted for grain size analysis, atterberg limits, and permeability.

Samples will be placed in laboratory-supplied containers and shipped under standard chain-of-custody (COC) protocol for analysis of the parameters listed above on a two-week turn-around time (TAT).

### 2.1 Quality Assurance/Quality Control (QA/QC)

QA/QC sampling includes equipment blanks, field duplicates, and matrix spike/matrix spike duplicates (MS/MSD). Equipment blanks will be collected at a frequency of 1 per 10 samples collected, at a minimum of 1 per day. Field duplicates will be collected at a frequency of 1 per 10 samples collected. MS/MSD samples will be submitted at a frequency of 1 per 20 samples collected. It should be noted, temperature blanks are not required as samples will be shipped on ice. The following is a brief discussion defining each type of field derived QC sample that will be collected during the Site Investigation.

- **Equipment Blanks** - Equipment field blanks are defined as QA/QC samples used to determine if cleaning procedures are effective and adequate. Equipment field blanks are prepared by collecting laboratory distilled de-ionized water which has been "run through" or "poured over" the cleaned sample collection equipment. If dedicated, new sampling devices are used; an equipment blank is not required.
- **Field Duplicates** - Field duplicates will be collected and submitted to assess the potential for laboratory data inconsistency and the adequacy of the sampling and handling procedures. A duplicate sample is collected from the same source utilizing identical collection procedures and typically submitted "blind" to the laboratory by providing a false identification number. The sampling key to ensure proper sample

identification must be submitted to the appropriate personnel to enable completion of the QA/QC review process.

- **Laboratory QA/QC Sample Volumes** – MS/MSD sample volumes are additional sample aliquots provided to the laboratory to evaluate the accuracy and precision of the sample preparation and analysis technique. Typically, three times the normal sample aliquot is required to conduct MS/MSD procedures. Sample collection is identical to the technique described for collection of field duplicates. Sample labeling identifies the respective sample location and each additional container that is labeled as the "MS/MSD" volume.

## 3. Reporting

A data memorandum presenting the results of the sediment characterization will be prepared. The memorandum will include a description of the Scope of Work completed, a discussion of the sample results, tables summarizing the data collected to date from the secondary pond and lagoon 5,a comparison of the data to MDEQ GSI Protection Criteira (current and proposed), recommendations for additional characterization, if necessary, and additional supporting documentation.

## 4. Schedule

The sediment characterization is scheduled to begin on May 3, 2016 (weather dependent). An appropriate and qualified subcontractor, Normandeau Associates, Inc. (Normandeau), located at Suite 101, Building A, 400 Old Reading Pike in Stowe, Pennsylvania, will conduct sediment coring activities. It is anticipated that the sediment characterization will take approximately 5 days to complete. Data will be due from the laboratory on about May 20, 2016. A draft data memorandum will be available by approximately May 26, 2016.

SOURCES:
EXISTING GROUND CONTOURS ARE DERIVED FROM:
TOPOGRAPHY DRAWING RECEIVED FROM SANBORN
(AN AERIAL PHOTOGRAPHY COMPANY)
JANUARY 3, 1996 - STATE PLANE;
2009 SURVEY OF CLAY PILE BY SPICER;
2013 SURVEY OF SAND/CLAY PILES BY WILCOX.

| SD-239-11 | 6/30/2011 |
|---|---|
| Metals | |
| Arsenic | 5.0/6.1 |
| Cadmium | 0.72/0.67 |
| Cobalt | 5.3/5.8 |
| Copper | 30/34 |
| Mercury | 0.048 J/0.040 J |
| Selenium | 0.84/0.89 |
| Silver | 0.59/0.78 |
| Thallium | 0.17 J/0.23 |
| Zinc | 1500/980 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.2 J/2.6 J |
| Aroclor-1254 (PCB-1254) | 0.42 U/0.7 J |
| Total PCBs | 3.3 J/0.2 J |
| Wet | |
| Cyanide (total) | 0.78 U/0.74 U |

| SED-241-11 | 6/30/2011 |
|---|---|
| Metals | |
| Arsenic | 9.8 |
| Cadmium | 2.0 |
| Cobalt | 5.2 |
| Copper | 67 |
| Mercury | 0.15 |
| Selenium | 3.1 |
| Silver | 1.3 |
| Thallium | 0.86 |
| Zinc | 2100 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 4.2 J |
| Aroclor-1254 (PCB-1254) | 0.99 J |
| Total PCBs | 5.19 J |
| Wet | |
| Cyanide (total) | 3.5 |

| SED-353-16 | 3/17/2016 |
|---|---|
| Metals | |
| Arsenic | 2.0 |
| Cadmium | 7.1 |
| Copper | 2.2 U |
| Mercury | 0.018 U |
| Silver | 2.2 U |
| Zinc | 7700 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.36 |
| Aroclor-1254 (PCB-1254) | 0.16 |
| Total PCBs | 0.52 |
| SVOAs | |
| 3&4-Methylphenol | 1.4 U |
| Naphthalene | 1.4 U |
| Phenol | 1.4 U |
| Wet | |
| Formaldehyde | 64 |

| SED-351-16 | 3/17/2016 |
|---|---|
| Metals | |
| Arsenic | 3.0 U |
| Cadmium | 5.0 |
| Copper | 13 |
| Mercury | 0.012 U |
| Silver | 1.5 U |
| Zinc | 3600 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.34 |
| Aroclor-1254 (PCB-1254) | 0.075 |
| Total PCBs | 0.415 |
| SVOAs | |
| 3&4-Methylphenol | 0.65 |
| Naphthalene | 1 |
| Phenol | 1.3 |
| Wet | |
| Formaldehyde | 84 |

| H10-05 | 3/29/2005 |
|---|---|
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.15 J |
| Aroclor-1254 (PCB-1254) | 0.10 U |
| Total PCBs | 0.15 J |

| H9-05 | 3/29/2005 |
|---|---|
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.58 |
| Aroclor-1254 (PCB-1254) | 0.10 U |
| Total PCBs | 0.58 |

| SD-237-11 | 6/30/2011 |
|---|---|
| Metals | |
| Arsenic | 14 |
| Cadmium | 6.0 |
| Cobalt | 7.7 |
| Copper | 130 |
| Mercury | 0.14 |
| Selenium | 3.1 |
| Silver | 2.3 |
| Thallium | 18 U |
| Zinc | 26000 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.1 J |
| Aroclor-1254 (PCB-1254) | 0.068 J |
| Total PCBs | 0.168 J |
| Wet | |
| Cyanide (total) | 2.0 |

| H8-05 | 3/29/2005 |
|---|---|
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.54 |
| Aroclor-1254 (PCB-1254) | 0.50 U |
| Total PCBs | 0.54 |

| SD-238-11 | 6/30/2011 |
|---|---|
| Metals | |
| Arsenic | 14 |
| Cadmium | 5.2 |
| Cobalt | 8.4 |
| Copper | 120 |
| Mercury | 0.14 |
| Selenium | 2.9 |
| Silver | 1.9 |
| Thallium | 19 U |
| Zinc | 21000 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.75 U |
| Aroclor-1254 (PCB-1254) | 0.75 U |
| Total PCBs | 0.75 U |
| Wet | |
| Cyanide (total) | 2.5 |

| SD-236-11 | 6/30/2011 |
|---|---|
| Metals | |
| Arsenic | 7.7 |
| Cadmium | 1.4 |
| Cobalt | 7.3 |
| Copper | 44 |
| Mercury | 0.078 |
| Selenium | 0.89 |
| Silver | 0.58 |
| Thallium | 6.0 J |
| Zinc | 6800 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.073 J |
| Aroclor-1254 (PCB-1254) | 0.052 J |
| Total PCBs | 0.125 J |
| Wet | |
| Cyanide (total) | 0.96 U |

| H1 | 11/17/1998 |
|---|---|
| Metals | |
| Arsenic | 22/23 |
| Cadmium | 22/22 |
| Cobalt | 7/7 |
| Copper | 249/274 |
| Mercury | 0.2/0.2 U |
| Selenium | 7 J/7 J |
| Silver | 5/5 |
| Thallium | 3/3 |
| Zinc | 17900 J/21800 J |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 1.6/1.2 |
| Aroclor-1254 (PCB-1254) | 0.6/0.4 |
| Total PCBs | 2.2/1.6 |

| H2 | 11/17/1998 |
|---|---|
| Metals | |
| Arsenic | 31 |
| Cadmium | 28 |
| Cobalt | 8 |
| Copper | 323 |
| Mercury | 0.2 |
| Selenium | 9 J |
| Silver | 6 |
| Thallium | 5 |
| Zinc | 21800 J |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 4.8 |
| Aroclor-1254 (PCB-1254) | 2.2 |
| Total PCBs | 7 |

| SO-352-16 | 3/24/2016 |
|---|---|
| Metals | |
| Cadmium | 3.1 |
| Copper | 27 |
| Mercury | 0.0097 U |
| Zinc | 9300 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 3.6 |
| Aroclor-1254 (PCB-1254) | 0.85 U |
| Total PCBs | 3.6 |
| SVOAs | |
| 3&4-Methylphenol | 4.5 U |
| Naphthalene | 4.5 U |
| Phenol | 4.5 U |
| Wet | |
| Formaldehyde | 52 |

| SD-219-11 | 6/28/2011 |
|---|---|
| Metals | |
| Arsenic | 9.6 |
| Cadmium | 3.0 |
| Cobalt | 6.3 |
| Copper | 77 |
| Mercury | 0.035 J |
| Selenium | 2.3 |
| Silver | 0.78 |
| Thallium | 0.38 J |
| Zinc | 2100 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.33 J |
| Aroclor-1254 (PCB-1254) | 0.57 U |
| Total PCBs | 0.33 J |
| Wet | |
| Cyanide (total) | 1.5 |

| SED-335-16 | 3/17/2016 |
|---|---|
| Metals | |
| Arsenic | 3.1 UF1 |
| Cadmium | 7.1 |
| Copper | 1.5 UF1F2 |
| Mercury | 0.012 U |
| Silver | 1.5 UF1 |
| Zinc | 7200 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.35 |
| Aroclor-1254 (PCB-1254) | 0.075 U |
| Total PCBs | 0.35 |
| SVOAs | |
| 3&4-Methylphenol | 5.9 U |
| Naphthalene | 5.9 U |
| Phenol | 11 |
| Wet | |
| Formaldehyde | 110 |

| H4 | 11/17/1998 |
|---|---|
| Metals | |
| Arsenic | 47 |
| Cadmium | 28 |
| Cobalt | 12 |
| Copper | 382 |
| Mercury | 0.3 |
| Selenium | 17 J |
| Silver | 6 |
| Thallium | 14 |
| Zinc | 25700 J |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 1.8 |
| Aroclor-1254 (PCB-1254) | 0.7 |
| Total PCBs | 2.5 |

| H11-05 | 3/29/2005 |
|---|---|
| PCBs | |
| Aroclor-1242 (PCB-1242) | 1.3 |
| Aroclor-1254 (PCB-1254) | 0.10 U |
| Total PCBs | 1.3 |

| SD-217-11 | 6/28/2011 |
|---|---|
| Metals | |
| Arsenic | 12 |
| Cadmium | 6.9 |
| Cobalt | 6.9 |
| Copper | 110 |
| Mercury | 0.072 J |
| Selenium | 3.3 |
| Silver | 1.9 |
| Thallium | 0.83 J |
| Zinc | 6900 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.55 U |
| Aroclor-1254 (PCB-1254) | 0.55 U |
| Total PCBs | 0.057 J |
| Wet | |
| Cyanide (total) | 1.7 |

| SED-334-16 | 3/17/2016 |
|---|---|
| Metals | |
| Arsenic | 3.0 U |
| Cadmium | 6.4 |
| Copper | 1.5 U |
| Mercury | 0.012 U |
| Silver | 1.5 U |
| Zinc | 5400 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.66 |
| Aroclor-1254 (PCB-1254) | 0.34 U |
| Total PCBs | 0.66 |
| SVOAs | |
| 3&4-Methylphenol | 5.6 |
| Naphthalene | 4.4 U |
| Phenol | 14 |
| Wet | |
| Formaldehyde | 82 |

| SED-336-16 | 3/17/2016 |
|---|---|
| Metals | |
| Arsenic | 1.1 |
| Cadmium | 8.9 |
| Copper | 1.9 U |
| Mercury | 0.015 U |
| Silver | 1.9 U |
| Zinc | 8000 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.2 |
| Aroclor-1254 (PCB-1254) | 0.086 U |
| Total PCBs | 0.2 |
| SVOAs | |
| 3&4-Methylphenol | 2 U |
| Naphthalene | 2 U |
| Phenol | 2.6 |
| Wet | |
| Formaldehyde | 120 |

| SD-218-11 | 6/28/2011 |
|---|---|
| Metals | |
| Arsenic | 15 |
| Cadmium | 9.3 |
| Cobalt | 8.4 |
| Copper | 160 |
| Mercury | 0.083 J |
| Selenium | 5.1 |
| Silver | 2.8 |
| Thallium | 0.93 J |
| Zinc | 5900 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.28 J |
| Aroclor-1254 (PCB-1254) | 0.61 U |
| Total PCBs | 0.28 J |
| Wet | |
| Cyanide (total) | 1.1 |

| SO-354-16 | 3/24/2016 |
|---|---|
| Metals | |
| Cadmium | 0.15 U |
| Copper | 6.4 |
| Mercury | 0.0059 U |
| Zinc | 16 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.061 |
| Aroclor-1254 (PCB-1254) | 0.041 U |
| Total PCBs | 0.061 |
| SVOAs | |
| 3&4-Methylphenol | 0.33 U |
| Naphthalene | 0.33 U |
| Phenol | 0.33 U |
| Wet | |
| Formaldehyde | 3.6 |

| SED-337-16 | 3/24/2016 |
|---|---|
| Metals | |
| Cadmium | 0.21 |
| Copper | 5.0 |
| Mercury | 0.0078 U |
| Zinc | 110 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.15 U |
| Aroclor-1254 (PCB-1254) | 0.15 U |
| Total PCBs | 0.15 U |
| SVOAs | |
| 3&4-Methylphenol | 1.2 U |
| Naphthalene | 1.2 U |
| Phenol | 1.2 U |
| Wet | |
| Formaldehyde | 25 |

| H3 | 11/16/1998 |
|---|---|
| Metals | |
| Arsenic | 9/9 |
| Cadmium | 2/2 |
| Cobalt | 8/7 |
| Copper | 88/87 |
| Mercury | 0.2 U/0.2 U |
| Selenium | 2 UJ/2 J |
| Silver | 2 U/2 U |
| Thallium | 1 U/1 U |
| Zinc | 1850 J/1870 J |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 1.5/1.3 |
| Aroclor-1254 (PCB-1254) | 0.5/0.4 |
| Total PCBs | 2.1/1.7 |

| SD-206-11 | 6/27/2011 |
|---|---|
| Metals | |
| Arsenic | 3.8 |
| Cadmium | 0.50 |
| Cobalt | 5.1 |
| Copper | 34 |
| Mercury | 0.060 U |
| Selenium | 0.58 |
| Silver | 0.16 |
| Thallium | 0.24 |
| Zinc | 340 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.39 U |
| Aroclor-1254 (PCB-1254) | 0.39 U |
| Total PCBs | 0.048 J |
| Wet | |
| Cyanide (total) | 0.74 U |

| SED-341-16 | 3/24/2016 |
|---|---|
| Metals | |
| Cadmium | 1.5 |
| Copper | 19 F1 |
| Mercury | 0.0082 U |
| Zinc | 910 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.38 |
| Aroclor-1254 (PCB-1254) | 0.13 |
| Total PCBs | 0.51 |
| SVOAs | |
| 3&4-Methylphenol | 1.5 U |
| Naphthalene | 1.5 U |
| Phenol | 1.5 U |
| Wet | |
| Formaldehyde | 46 |

| SD-235-11 | 6/30/2011 |
|---|---|
| Metals | |
| Arsenic | 19 |
| Cadmium | 5.9 |
| Cobalt | 6.2 |
| Copper | 120 |
| Mercury | 0.17 |
| Selenium | 3.3 |
| Silver | 2.9 |
| Thallium | 5.0 J |
| Zinc | 41000 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.81 U |
| Aroclor-1254 (PCB-1254) | 0.81 U |
| Total PCBs | 0.074 J |
| Wet | |
| Cyanide (total) | 4.1 |

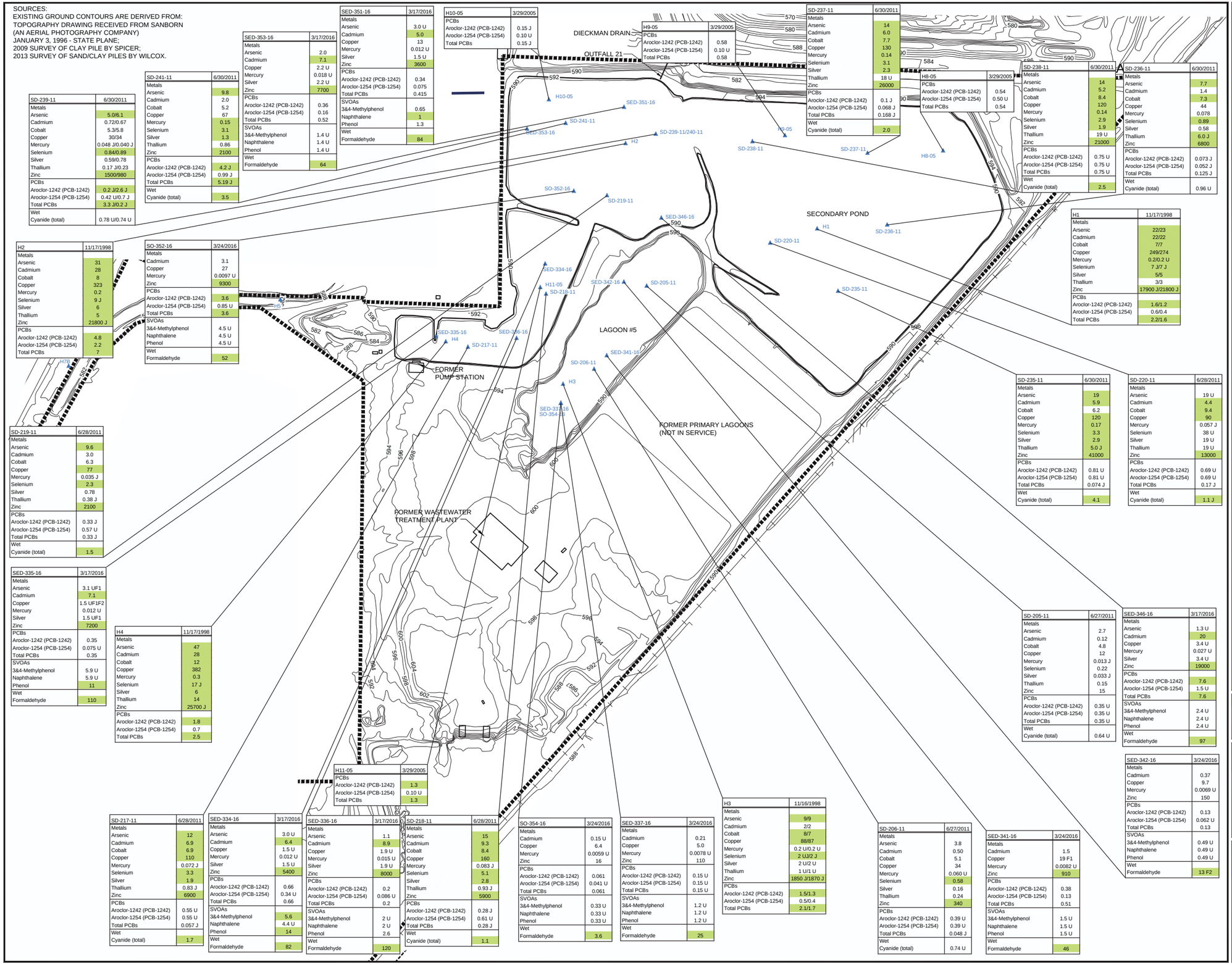
| SD-220-11 | 6/28/2011 |
|---|---|
| Metals | |
| Arsenic | 19 U |
| Cadmium | 4.4 |
| Cobalt | 9.4 |
| Copper | 90 |
| Mercury | 0.057 J |
| Selenium | 38 U |
| Silver | 19 U |
| Thallium | 19 U |
| Zinc | 13000 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.69 U |
| Aroclor-1254 (PCB-1254) | 0.69 U |
| Total PCBs | 0.17 J |
| Wet | |
| Cyanide (total) | 1.1 J |

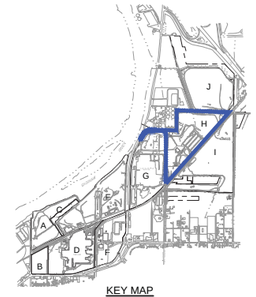
| SD-205-11 | 6/27/2011 |
|---|---|
| Metals | |
| Arsenic | 2.7 |
| Cadmium | 0.12 |
| Cobalt | 4.8 |
| Copper | 12 |
| Mercury | 0.013 J |
| Selenium | 0.22 |
| Silver | 0.033 J |
| Thallium | 0.15 |
| Zinc | 15 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.35 U |
| Aroclor-1254 (PCB-1254) | 0.35 U |
| Total PCBs | 0.35 U |
| Wet | |
| Cyanide (total) | 0.64 U |

| SED-346-16 | 3/17/2016 |
|---|---|
| Metals | |
| Arsenic | 1.3 U |
| Cadmium | 20 |
| Copper | 3.4 U |
| Mercury | 0.027 U |
| Silver | 3.4 U |
| Zinc | 19000 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 7.6 |
| Aroclor-1254 (PCB-1254) | 1.5 U |
| Total PCBs | 7.6 |
| SVOAs | |
| 3&4-Methylphenol | 2.4 U |
| Naphthalene | 2.4 U |
| Phenol | 2.4 U |
| Wet | |
| Formaldehyde | 97 |

| SED-342-16 | 3/24/2016 |
|---|---|
| Metals | |
| Cadmium | 0.37 |
| Copper | 9.7 |
| Mercury | 0.0069 U |
| Zinc | 150 |
| PCBs | |
| Aroclor-1242 (PCB-1242) | 0.13 |
| Aroclor-1254 (PCB-1254) | 0.062 U |
| Total PCBs | 0.13 |
| SVOAs | |
| 3&4-Methylphenol | 0.49 U |
| Naphthalene | 0.49 U |
| Phenol | 0.49 U |
| Wet | |
| Formaldehyde | 13 F2 |

DIECKMAN DRAIN
OUTFALL 21
SECONDARY POND
LAGOON #5
FORMER PUMP STATION
FORMER PRIMARY LAGOONS (NOT IN SERVICE)
FORMER WASTEWATER TREATMENT PLANT



KEY MAP

LEGEND

- A — INVESTIGATIVE UNIT BOUNDARY AND IDENTIFIER
- APPROXIMATE LIMITS OF RACER PROPERTY
- 590 — EXISTING GROUND CONTOUR (NGVD)
- SEDIMENT SAMPLE LOCATION

| H9-05 | 3/29/2005 | ← SAMPLE LOCATION |
|---|---|---|
| Aroclor-1242 (PCB-1242) | 0.58 | ← SAMPLE DATE |
| Aroclor-1254 (PCB-1254) | 0.10 U | ← RESULT (mg/kg) |

← PARAMETER

| Chemical Name | MDEQ DEFAULT BACKGROUND LEVELS | MDEQ GROUNDWATER SURFACE WATER INTERFACE PROTECTION CRITERIA |
|---|---|---|
| Metals | | |
| Arsenic | 5.8 | 4.6 |
| Cadmium | 1.2 | 3.7[1] |
| Cobalt | 6.8 | 2 |
| Copper | 32 | 74.73[1] |
| Mercury | 0.13 | 0.1 |
| Selenium | 0.41 | 0.4 |
| Silver | 1 | 0.1 |
| Thallium | - | 4.2 |
| Zinc | 47 | 169.2 |
| PCBs | | |
| Aroclor-1242 (PCB-1242) | - | 1[2] |
| Aroclor-1254 (PCB-1254) | - | 1[2] |
| Total PCBs | - | 1[2][3] |
| SVOAs | | |
| 3&4-Methylphenol | - | 1 |
| Naphthalene | - | 0.73 |
| Phenol | - | 9 |
| Wet | | |
| Cyanide (total) | 0.39 | 0.1 |
| Formaldehyde | - | 2.4 |

NOTES:
1. CALCULATED GSI VALUE BASED ON ASSUMED VALUE OF HARDNESS OF 154.3 mg/kg (AVERAGE CALCULATED IN THE NORTH DITCH IN 2013)
2. TSCA CRITERIA
3. TOTAL PCBS CALCULATED BY SUMMING ALL DETECTED ARCOLORS.

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

# REVITALIZING AUTOMOTIVE COMMUNITY ENVIRONMENTAL RESPONSE

SAGINAW, MICHIGAN

## SUMMARY OF EXCEEDANCES IN SEDIMENT SECONDARY POND AND LAGOONS

GHD

Source Reference:
MICHIGAN STATE PLANE SOUTH, NAD 83 USING INTERNATIONAL FEET, NGVD 88
TOPO - SANBORN, 1996

| Project Manager: | Reviewed By: | Date: | |
|---|---|---|---|
| I.R. | M.T. | APRIL 2016 | |
| Scale: | Project N°: | Report N°: | Drawing N°: |
| 1" = 200' | 58502-T02 | MEMO018 | figure 1 |

SOURCES:
EXISTING GROUND CONTOURS ARE DERIVED FROM:
TOPOGRAPHY DRAWING RECEIVED FROM SANBORN
(AN AERIAL PHOTOGRAPHY COMPANY)
JANUARY 3, 1996 - STATE PLANE;
2009 SURVEY OF CLAY PILE BY SPICER;
2013 SURVEY OF SAND/CLAY PILES BY WILCOX.

DIECKMAN DRAIN
OUTFALL 21
HACK ROAD
CITY OF SAGINAW
WASTEWATER
TREATMENT PLANT
SECONDARY POND
LAGOON #5
FORMER
PUMP STATION
FORMER PRIMARY LAGOONS
(NOT IN SERVICE)
FORMER WASTEWATER
TREATMENT PLANT

SS-1 SS-2 SS-3 SS-4 SS-5 SS-6 SS-7 SS-8 SS-9 SS-10 SS-11 SS-12 SS-13 SS-14 SS-15 SS-16 SS-17 SS-18 SS-19 SS-20 SS-21 SS-22 SS-23 SS-24 SS-25 SS-26 SS-27 SS-28 SS-29 SS-30 SS-31 SS-32 SS-33 SS-34 SS-35 SS-36 SS-37 SS-38 SS-39

H1 H2 H3 H4 H8-05 H9-05 H10-05 H11-05

SD-205-11 SD-206-11 SD-217-11 SD-218-11 SD-219-11 SD-220-11 SD-235-11 SD-236-11 SD-237-11 SD-238-11 SD-239-11/240-11 SD-241-11

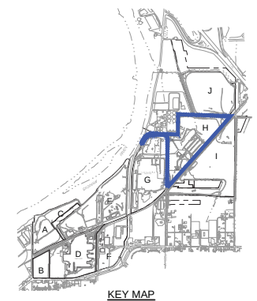
SED-334-16 SED-335-16 SED-336-16 SED-337-16 SED-341-16 SED-342-16 SED-343-16 SED-346-16 SED-351-16 SED-352-16 SED-353-16 SO-354-16

N

0 50 100 ft

LEGEND

- A-- INVESTIGATIVE UNIT BOUNDARY AND IDENTIFIER
- APPROXIMATE LIMITS OF RACER PROPERTY
- 590 EXISTING GROUND CONTOUR (NGVD)
- SEDIMENT SAMPLE LOCATION
- PCBs DETECTED IN SEDIMENTS ABOVE 1ppm
- PROPOSED ADDITIONAL SECONDARY POND AND LAGOON CHARACTERIZATION SAMPLE LOCATIONS




KEY MAP

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

# REVITALIZING AUTOMOTIVE COMMUNITY ENVIRONMENTAL RESPONSE

SAGINAW, MICHIGAN

## PROPOSED ADDITIONAL SECONDARY POND AND LAGOONS CHARACTERIZATION

GHD

Source Reference:
MICHIGAN STATE PLANE SOUTH, NAD 83 USING INTERNATIONAL FEET, NGVD 88
TOPO - SANBORN, 1996

| Project Manager: | Reviewed By: | Date: | |
|---|---|---|---|
| I.R. | M.T. | APRIL 2016 | |
| Scale: 1" = 200' | Project N°: 58502-T02 | Report N°: MEMO018 | Drawing N°: figure 2 |

# Attachment A
# Section 16.0 Lagoon and Sediment Sampling

# GHD Field Training Manual

## Section 16.0
## Lagoon and Sediment Sampling
## Standard Operating Procedures

## (T109)

200010 (2) Revision 0 – July 1, 2015

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# Forms Index


SP-02 Project Planning, Completion, and Follow Up Checklist

SP-14 Stratigraphy Log (Overburden)

SP-17 Equipment and Supply Checklist - Sediment Sampling


# Quality System Forms Index


QSF-012 Vendor Evaluation Form

QSF-014 Field Equipment Requisition Form

QSF-019 Property Access/Utility Clearance Data Sheet

QSF-021 Field Method Training Record

QSF-030 Safety and Health Schedule (Canada)

QSF-031 Safety and Health Schedule (U.S.)

# 16. Lagoon and Sediment Sampling Standard Operating Procedures

## 16.1 Introduction

Lagoon and sediment sampling is conducted to obtain samples that are representative of existing chemical and/or physical conditions of sediment and sludge. Through assessment of existing site conditions, the distribution of the constituents of concern can be determined and the potential for exposure and risks can be evaluated, including natural attenuation rates and the potential for ongoing sources. The information developed during this evaluation can then be used to determine the most appropriate type of remedial approach for the site, including no action.

Standard Operating Procedures (SOPs) are presented herein for conducting lagoon and sediment sampling. This guideline is not intended to provide the basis for designing a sampling program, but instead assumes that a sampling program has been designed, a site-specific Work Plan has been established, and that a GHD representative is preparing to mobilize to the site.

Lagoon and sediment sampling procedures vary from project to project due to different chemicals of concern, different guidance provided by the state/province where the site is located, and the specific objectives of the project. It is essential that all lagoon and sediment sampling activities conform to local, provincial/state, and federal regulations. Therefore, it is essential that the GHD representative carefully review the Work Plan requirements.

The remainder of this section is organized as follows:

- Section 16.2 Background
- Section 16.3 Prior Planning and Preparation
- Section 16.4 Safety and Health
- Section 16.5 Quality Assurance/Quality Control
- Section 16.6 Equipment Decontamination
- Section 16.7 Sample Site Selection
- Section 16.8 Sampling Equipment and Techniques
- Section 16.9 Field Notes
- Section 16.10 Follow-up Activities
- Section 16.11 References

## 16.2 Background

Sampling locations for sediment studies may be selected based on many factors, including: study objectives; tidal conditions; flow conditions; the location of point source discharges, non-point source discharges, and tributaries; the presence of structures (bridges, dams, etc.); and accessibility.

Sediment and sludge samples are collected to determine the nature of discharge impacts on sediment quality. Contaminants may become sediment bound through either deposition of

contaminated suspended sediments or by adsorption of soluble surface water constituents to sediments. Many organic chemicals are generally adsorbed to a greater degree as the fraction of organic carbon (foc) in the sediment increases.

It should be noted that sediment and sludge quality can vary substantially with depth depending on flow rates and depositional history. It is critical that sediment and sludge samples be collected from the sampling horizon identified in the Work Plan. If there is any ambiguity regarding the sediment sampling rationale, all concerns must be discussed with the Project Coordinator.

Note: It is important to obtain samples that are unimpacted by the re suspension of sediment caused by sampling activities.

## 16.3 Prior Planning and Preparation

The following shall be considered prior to lagoon and sediment sampling.

1. Review the Work Plan and Site-Specific Health and Safety Plan (HASP), project documents, historic site reports, and a site plan to become familiar with the site and surrounding area. Review and become familiar with the health and safety requirements, and discuss the work activities with the Project Coordinator.
2. Complete an Equipment Requisition Form (QSF-014) and assemble all required equipment, materials, log books, and forms. The Equipment and Supply Checklist - Sediment Sampling (Form SP-17) provides a summary of the equipment and materials typically required for Lagoon and Sediment Sampling. Form SP-02, Project Planning Completion, and Follow-Up can be used for guidance throughout the project.
3. Review the sampling locations. Sampling locations may, at times, be located on private lands. Coordination of property access should always be discussed with the Project Coordinator in advance of field activities. Have all parties been notified that sampling is scheduled? Has a Property Access/Utility Clearance Data Sheet (QSF-019) been initiated/completed for this field activity?
4. Complete a Vendor Evaluation Form (QSF-012) and file in the Project file for any Vendors that do not have full approval status or are not listed on Approved Vendor List (QSL-004). Completion of a Safety and Health Schedule (QSF-030 for Canadian Work; QSF-031 for U.S. Work) is necessary for all Vendors who complete field services. Prior to mobilization on site, the Vendor must submit the form to the Regional Safety and Health Manager for review and approval (if not already posted on QSL-004).
5. If sampling in a large area (lake, harbor, river), ensure a sufficient onshore support area is available, and efficient access to the necessary areas of the site are available. This may include a need to trailer the boat between locations.
6. Contact the GHD Chemistry Group to arrange:
    - SSOW (Simplified Scope of Work)
    - Laboratory
    - Sample containers
    - Coolers
    - Shipping details

- Sampling start date
- Expected sampling duration

7. Consider in advance of sampling whether a hazard exists due to deep/fast moving water, difficult access, and if more than two people are required. A two-person team is required for most surface water sampling activities; a Project Manager must approve a one-person sampling team. If the site conditions require the use of the life vest and safety line, the two people involved in the sampling must be competent swimmers.
8. Pre-plan the sampling sequence such that sampling commences at the furthest downstream sampling location and proceeds upstream.
9. If sampling within a navigable waterway, determine navigational requirements, and coordinate with the regulatory body (e.g., harbor master, U.S. Army Corps of Engineers).

Note: If sampling on a boat, consider space requirements for Exclusion Zone (EZ), Contaminant Reduction Zone (CRZ), and Support Zone (SZ). Also consider requirements including restrooms, weather protection, communication, etc.

## 16.4 Safety and Health

GHD is committed to conducting field activities in accordance with sound safety and health practices. GHD adheres to high safety standards to protect the safety and health of all employees, subcontractors, customers, and communities in which they work. The safety and health of our employees takes precedence over cost and schedule considerations.

Field personnel are required to implement the Safety Means Awareness Responsibility Teamwork (SMART) program as follows:

- Assure the Health and Safety Plan (HASP) is specific to the job and approved by a Regional Safety & Health Manager.
- Confirm that all HASP elements have been implemented for the job.
- A Job Safety Analysis (JSA) for each task has been reviewed, modified for the specific site conditions and communicated to all appropriate site personnel. The JSAs are a component of the HASP.
- Incorporate Stop Work Authority; Stop, Think, Act, Review (STAR) process; Safe Task Evaluation Process (STEP); Observations process; Near Loss and Incident Management process in the day-to-day operations of the job.
- Review and implement applicable sections of the GHD Safety & Health Policy Manual.
- Confirm that all site personnel have the required training and medical surveillance, as defined in the HASP.
- Be prepared for emergency situations, locating safety showers, fire protection equipment, evacuation route, rally point, and first aid equipment before you begin working, and make sure that the equipment is in good working order.
- Maintain all required Personal Protective Equipment (PPE), safety equipment, and instrumentation necessary to perform the work effectively, efficiently, and safely.

- Be prepared to call the GHD Incident Hotline at 1-866-529-4886 for all incidents involving injury/illness, property damage, and vehicle incident and/or significant Near Loss.

It is the responsibility of the Project Manager to:

- Ensure that all GHD field personnel have received the appropriate health and safety and field training and are qualified to complete the work.
- Provide subcontractors with a Job Hazard Analysis to enable them to develop their own HASP.
- Ensure that all subcontractors meet GHD's (and the Client's) safety requirements.

Sediment sampling often necessitates a flotation vessel (i.e., barge, boat, raft) and special safety equipment (i.e., life vest, safety line), should access to a stable structure not be available. Sediment sampling activities necessitates the following:

1. Field personnel shall review GHD's boating safety requirements.
2. The Project Manager shall consider the use of a licensed captain to operate work vessels on water bodies with heavy traffic (i.e., barge traffic).
3. In general, a second or even third person (i.e., a spotter on shore) will be necessary for safety reasons depending on the complexity of the sampling program, hazards at the site, and site layout.

| | |
|---|---|
| Caution: | Recovery of many sediment samplers will require a winch. Significant uplift forces exist. Ensure the winch is suitable for the recovery of the sampler and that the sampling platform is sufficiently stable to safely recover the sampler. |

## 16.5 Quality Assurance/Quality Control

A well-designed Quality Assurance/Quality Control (QA/QC) program will:

- Ensure that data of sufficient quality are obtained in order to facilitate good site management.
- Allow for monitoring of staff and contractor performance.
- Verify the quality of the data for the regulatory agency.

The QA/QC program is developed on a site-specific basis. QA/QC requirements are discussed in detail in Section 3.9.

## 16.6 Equipment Decontamination

On environmental sites, sediment sampling equipment (e.g., split spoons, trowel, spoons, shovels, bowls, dredges, corers, scoops) are typically cleaned as follows:

1. Wash with clean potable water and laboratory detergent, using a brush as necessary to remove particulates.
2. Rinse with tap water.
3. Rinse with deionized water.
4. Air dry for as long as possible.

Additional or different decontamination procedures may be necessary if sampling for some parameters, including volatile organic compounds (VOCs) and metals.

> Caution: Confirm the cleaning protocol from the Quality Assurance Project Plan (QAPP). The use of an incorrect cleaning protocol can invalidate chemical data.

## 16.7 Sample Site Selection

Before any sampling is conducted, the first requirement is to consider suitable sampling locations. Sampling locations should be selected in accordance with the Work Plan and discussed with the Project Coordinator. Wading for sediment samples in lagoons, lakes, ponds, and slow-moving rivers and streams must be done with caution since bottom deposits are easily disturbed. Sampling must only be attempted where safe conditions exist and samples must be collected from undisturbed sediments. All sediment samples are to be collected commencing with the most downstream sample to avoid sediment interference with other downstream samples. A life vest and safety line should be worn in all cases where footing is unstable or where water is fast moving or over 3 feet (0.85 m) in depth. A second person may also be required for most of the sampling scenarios.

> Note: It is critical for the sampling team to understand the data needs of the project to ensure data obtained is suitable for use. Sediment sampling activities often require multiple sampling attempts to recover sufficient sample volume for analysis. This may require samplers to move from the planned location or collect sample from a different depth interval. The amount of allowable variation from the desired location should be specified in the Work Plan and must be understood by the sampling team.

### *Rivers, Streams, and Creeks*

Sediment samples may be collected along a cross-section of a river or stream in order to adequately characterize the bed material, or from specific sediment deposits as described in the Work Plan. A common procedure is to sample at quarter points along the cross-section of the sampling site selected. Samples may be composited as described in the Work Plan. Samples of dissimilar composition (e.g., grain size, organic content) should not be combined.

Representative samples can usually be collected in portions of the surface water body that have a uniform cross-section and flow rate. Since mixing is influenced by turbulence and water velocity, the selection of a site immediately downstream of a riffle area (e.g., fast flow zone) are likely areas for deposition of sediment since the greatest deposition occurs where stream velocity slows.

A site that is clear of immediate point sources (e.g., tributaries and industrial and municipal effluents) is preferred for the collection of sediment samples unless the sampling is being performed to assess these sources.

Tributaries should be sampled as near the mouth as is feasible. However, it is important to select the sample location taking into consideration the impact that the downstream receiving water body has on the tributary flow and sediments. The downstream water body may change the water quality (salinity), temperature, or turbidity in the tributary near its mouth.

### *Lakes, Ponds, and Impoundments*

The number of sampling sites on a lake, pond, or impoundment will vary with the purpose of the investigation, as well as the size and shape of the basin. Sample selection should adequately represent the conditions of the basin. Attention must be given to identify intakes and outflows within the basin that may provide biased sample representation. Sample locations with adjacent structures (i.e., banks, piers, etc.) may also provide biased samples within active lagoons or settling ponds.

When collecting sediment samples in lakes, ponds, and reservoirs, samples should be collected at approximately the center of the water body or as directed by the Work Plan. This is also the case for reservoirs that are formed by the impoundment of rivers or streams. The coarse-grained sediments are deposited near the headwaters of the reservoir, and the fine-grained sediments near the center. The shape, inflow pattern, and circulation must be considered when selecting sediment sampling sites in lakes and reservoirs.

The number of sampling sites will vary with the purpose of the investigation, as well as the size and shape of the basin. In lakes with irregular shape, with several bays and coves that are protected from the wind, additional samples may be needed to represent sediment quality at various points in the lake. Additional samples may be taken where discharges, tributaries, and other such factors are suspected of influencing water quality.

In all instances, the sampling locations should be properly documented with field notes and photographs, as appropriate.

## 16.8 Sampling Equipment and Techniques

### 16.8.1 General

Any equipment or sampling technique(s) [e.g., stainless steel, polyvinyl chloride (PVC)] used to collect a sample is acceptable so long as it provides a sample which is representative of the area being sampled and is consistent with the Work Plan. Lagoons and/or settling ponds typically contain both liquids and solids, which may vary with depth. In addition to the sediment samples required, project-specific QA/QC samples are typically required to assess field techniques/laboratory performance. Section 3.9 outlines field derived QA/QC samples commonly required within a sampling program.

### 16.8.2 Sediment Sampling Equipment and Techniques

A variety of methods may be used to collect sediment samples from a stream, river, or lake bed. Dredging (Peterson, Ponar, Van Veen), coring and scooping are acceptable sediment sample collection techniques. Precautions shall be taken to ensure that a representative sample of the targeted sediment is collected. Caution should be exercised when wading in shallow water so as not to disturb the area to be sampled. Samplers should be selected based on the interval to be sampled, type of sediment/sludge (silt, sand, gravel), and required sample volume. More than one sampler is often required to implement a sampling program at a site. The following describes some of these methods. Manufacturers information should be consulted to determine the limitations of each type of sampling equipment.

### *Dredging*

The **Peterson dredge** is best used for rocky bottoms, in very deep water, or when the stream velocity is rapid. The dredge should be lowered slowly as it approaches the bottom, so as to not disturb the lighter sediments.

The **Ponar dredge** is similar to the Peterson dredge in size and weight. The Ponar dredge is a "clam-shell" type unit that closes on contact with the river/lake bottom. Depending on the size of the unit, a winch is required for larger units, whereas smaller units are available for lowering by a hand line. Once retrieved, the unit is opened and the sample extracted using a sample scoop or spoon. The unit has been modified by the addition of side plates and a screen on top of the sample compartment. This permits water to pass through the sampler as it descends.

The **Ponar grab** sampler functions by the use of a spring-latch-messenger arrangement. The sampler is lowered to the bottom of the water body by means of a rope, then the messenger is sent down to trip the latch causing the sampler to close on the sediments. The sampler is then raised slowly to minimize the disturbance of the lighter sediments. Sediment is then placed into a stainless steel bowl, homogenized, and placed into the appropriate sample container (if collecting for VOC parameters, fill the VOC jars before homogenization).

### *Corers*

Core samplers are used to obtain vertical columns of sediment. Many types of coring devices are available, depending on the depth of water from which the sample is to be collected, the type of bottom material, and the length of core to be obtained. They vary from hand-push tubes to weight or gravity-driven devices to vibrating penetration devices.

Coring devices are useful in contaminant monitoring due to the minimal disturbance created during descent. The sample is withdrawn intact, allowing the removal of only those layers of interest. Core liners consisting of plastic or Teflon may also be added, thereby reducing the potential for sample contamination and maintaining a stratified sample. The samples may be shipped to the lab in the tubes in which they were collected. The disadvantage of coring devices is that only a small sampling surface area and sample size is obtained, often necessitating repetitive sampling in order to collect the required amount of sediment for analysis. It is also often difficult to extract the sediment sample back out through the water column without losing the sample.

The core tube is pushed/driven into the sediment until only 4 inches (10 cm) or less of tube is above the sediment-water interface. When sampling hard or coarse sediments, a slight rotation of the tube while it is pushed will create greater penetration and reduce compaction. Cap the tube with a Teflon plug or a sheet of Teflon. The tube is then slowly withdrawn, keeping the sample in the tube. Before pulling the bottom part of the core above the water surface, it must be capped.

### *Scooping*

The easiest way to collect a sediment sample is to scoop the sediment using a stainless steel spoon or scoop. This may be done by wading into the stream or pond and, while facing upstream (into the current), scooping the sample from along the bottom in an upstream direction. This method is only practical in very shallow water.

### *Mixing*

Sediment samples collected for chemical analysis should be thoroughly mixed (except for VOCs) in a stainless steel bowl prior to placement in the appropriate sample container. Standard procedures exist for preparation of sediment samples (ASTM D3976). These should be followed or the laboratory informed of applicable procedures.

### *Air Monitoring*

Prior to sediment/sludge sampling, measure the breathing space above the sample location with a photoionization detector (PID), should the potential for volatiles be present, and use a hydrogen sulfide meter should hydrogen sulfide be present. Repeat these measurements during sampling. If either of these measurements exceed any of the air quality criteria established in the HASP, air purifying respirators (APRs) or supplied air systems will be required.

Hydrogen sulfide odors are typical in lagoons and settling ponds where decomposition with depth occurs over time.

### *Sample Location Tie-In/Surveying*

The recording of the sample locations and depth on the site plan is extremely important. This may be accomplished by manual measurement (i.e., swing ties), global positioning system (GPS) survey, or stadia methods. Manual measurements for each sample location should be tied into three permanent features (e.g., buildings, utility poles, hydrants). Diagrams with measurements should be included in the field book.

> Note: Manual field measurements are always necessary regardless of whether a survey is completed. Manual measurements allow future identification of the sample location without the need of a survey crew to locate positions using a grid system.

## 16.9 Field Notes

A bound field book is used to record daily activities, describe sampling locations and techniques, and describe photographs (if taken). Visual observations are important, as they may prove invaluable in interpreting water or sediment quality results. Observations shall include (as applicable) weather, stream flow conditions, stream physical conditions (width, depth, etc.), tributaries, effluent discharges, impoundments, bridges, railroad trestles, oil sheens, odors, buried debris, vegetation, algae, fish or other aquatic life, and surrounding industrial areas. A Stratigraphic Log (Overburden) (Form SP-14) should be utilized for lagoon sampling. The following observations should be considered:

- **Predominant Surrounding Land Use**: Observe the prevalent land use type in the vicinity (noting any other land uses in the area which, although not predominant, may potentially affect water quality).
- **Local Watershed Erosion**: The existing or potential erosion of soil within the local watershed (the portion of the watershed that drains directly into the stream) and its movement into a stream is noted. Erosion can be rated through visual observation of watershed and stream characteristics. (Note any turbidity observed during water quality assessment.)

- **Local Watershed Non-point Source Pollution**: This item refers to problems and potential problems other than siltation. Non-point source pollution is defined as diffuse agricultural and urban runoff (e.g., stormwater runoff). Other compromising factors in a watershed that may affect water quality are feedlots, wetlands, septic systems, dams and impoundments, and/or mine seepage.
- **Estimated Stream Width**: Estimate the distance from shore at a transect representative of the stream width in the area.
- **Estimated Stream Depth**: Riffle (rocky area), run (steady flow area), and pool (still area). Estimate the vertical distance from water surface to stream bottom at a representative depth at each of the three locations.
- **High Water Mark**: Estimate the vertical distance from the stream bank to the peak overflow level, as indicated by debris hanging in bank or floodplain vegetation, and deposition of silt or soil. In instances where bank overflow is rare, a high water mark may not be evident.
- **Velocity**: Record an estimate of stream velocity in a representative run area (see Section 12.0).
- **Dam Present**: Indicate the presence or absence of a dam upstream or downstream of the sampling station. If a dam is present, include specific information relating to alteration of flow.
- **Channelized**: Indicate whether the area around the sampling station is channelized.
- **Canopy Cover**: Note the general proportion of open to shaded area which best describes the amount of cover at the sampling station.
- **Sediment Odors**: Disturb sediment and note any odors described (or include any other odors not listed) which are associated with sediment in the area of the sampling station.
- **Sediment Oils**: Note the term which best describes the relative amount of any sediment oils observed in the sampling area.
- **Sediment Characteristics:** Note the grain size, color, consistency, layering, presence of biological organisms, man-made debris, etc. in accordance with standard ASTM soil description protocols.
- **Sediment Deposits**: Note those deposits described (or include any other deposits not listed) which are present in the sampling area. Also indicate whether the undersides of rocks not deeply embedded are black (which generally indicates low dissolved oxygen or anaerobic conditions).

## 16.10 Follow-up Activities

The following shall be performed once field activities are complete.

1. Equipment shall be cleaned and returned to the equipment administrator and the appropriate form dated and signed.
2. The contracted laboratory shall be notified as to when to expect sample arrival. The sample cooler shall contain the chain-of-custody form.
3. Field notes shall be sent to file and the field book stored at the GHD office.

4. At the completion of the sediment sampling program, the Project Planning, Completion and Follow-Up Checklist (Form SP-02) must be completed to document activities conducted and serves to remind personnel of the various tasks required. This form must be signed and filed at the respective field office, regional GHD office and issued to the Project Coordinator.

## 16.11 References

For additional information pertaining to this topic, the user of this manual may reference the following:


| | |
|---|---|
| ASTM D5358 | Practice for Sampling with a Dipper or Pond Sampler |
| ASTM D4489 | Practices for Sampling of Waterborne Oils |
| ASTM D3325 | Practice for the Preservation of Waterborne Oil Samples |
| ASTM D4841 | Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents |
| ASTM D4416 | Guide for Sampling Fluvial Sediment in Motion |
| ASTM D4823 | Guide for Core-Sampling Submerged, Unconsolidated Sediments |
| ASTM D3213 | Practice for Handling, Storing, and Preparing Soft Undisturbed Marine Soil |
| ASTM D3976 | Practice for Preparation of Sediment Samples for Chemical Analysis |
| ASTM E1391 | Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing |
| ASTM D4581 | Guide for Measurement of Morphologic Characteristics of Surface Water Bodies |
| ASTM D5906 | Guide for Measuring Horizontal Positioning During Measurements of Surface Water Depths |
| ASTM D5073 | Practice for Depth Measurement of Surface Water |
| ASTM D5413 | Test Methods for Measurement of Water Levels in Open-Water Bodies |

# Attachment B
# Normandeau Photos


Johnson


Johnson
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XDX-0783

# Attachment C
# Visual Classification of Sediment Core

## VISUAL CLASSIFICATION OF SEDIMENT CORE

Page _____ of _____

| | |
|---|---|
| **Project Name:** | **GHD Project No:** |
| **Project Location:** | **Date:** / / 2016 |
| **Location ID: (N):** | **Core Pushed By:** Normandeau Associates, Inc. |
| **(E):** | **Core Logged By:** |
| **Core ID:** | **Type of Core:** Vibracore |
| **Water Depth/Elevation of Core:** | **Diameter of Core:** |
| **Cored Length:** | **Other:** |
| **Core Recovery:** | |
| **No. of Attempts:** | |

| PID (PPM) | PID Interval (ft) | Sample Interval (ft) | Sample Number | Classification and Remarks (Soil Type, Main/Secondary Components, Density, Consistency, Color, Moisture Content, Odor, and Supplemental Descriptions) |
|---|---|---|---|---|
| | | | | |