River Falls Dams

Final Sediment Sampling Plan

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November 10th, 2015

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1. Introduction

The City of River Falls currently holds a license from the Federal Energy Regulatory Commission (FERC) to operate the hydroelectric facilities at the Junction Falls (Upper) and Powell Falls (Lower) Dams. The City recently completed an evaluation of the FERC relicensing process and is now pausing relicensing in order to fully evaluate alternatives and gather information to aid in the community decision process. To better understand the dam removal alternative and to fully assess risks associated with possible contamination in the existing impoundment sediment, the City of River Falls has contracted with Inter-Fluve to assess the quantity and character of the impounded sediment at both dams, and to determine the potential volume of sediment that may be evacuated or need to be excavated in the event of a dam removal.

In September 2015, Inter-Fluve staff surveyed the bathymetry and sediment depths in the impoundments at Junction Falls (Lake George) and Powell Falls (Lake Louise), and that information is presented here for review. This sediment sampling plan addresses contaminant testing and grain size analysis, both of which will aid in the development of a sediment management plan. A draft of the plan was submitted to the City and Wisconsin Department of Natural Resources (DNR). Following reviews by the City, the DNR and other residents, the draft plan was finalized in this document to be used as a basis for sampling.

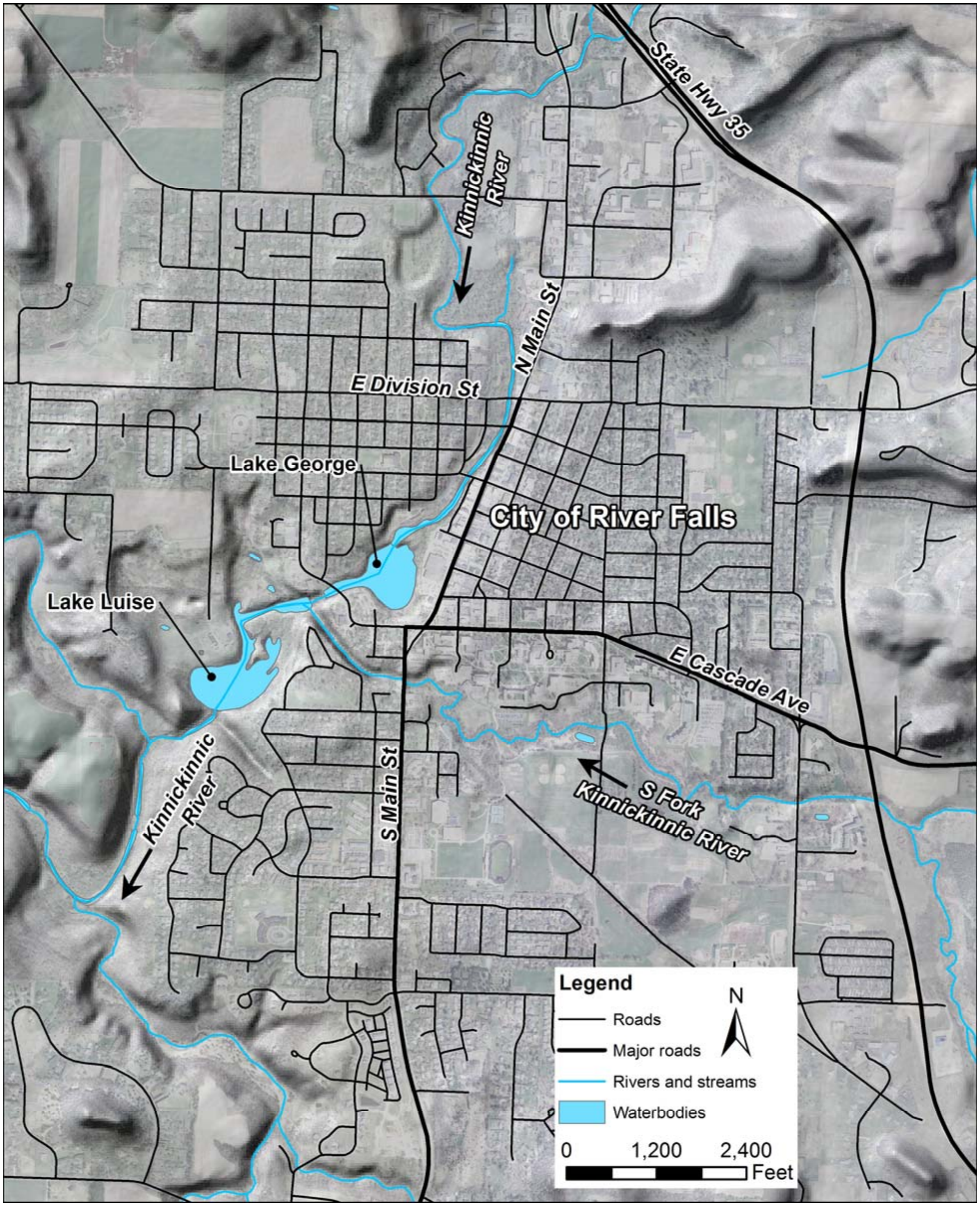


Figure 1. The Kinnickinnic River at River Falls showing the location of the two impoundments, Lake George and Lake Luise.

2. Due Diligence Summary

To determine the appropriate sediment quality testing regime, a due diligence review of potential contaminant sources was completed. Tables 2 and 3 below show a list of contaminants to be tested, and the standard tests to be performed.

We reviewed watershed land uses and potential point sources of contaminants such as large chemical users, historic spills, underground utilities and storage tanks. The Bureau for Remediation and Redevelopment Tracking System (BRRTS) is a searchable database containing information on the investigation and cleanup of potential and confirmed contamination to soil and groundwater in the State of Wisconsin. This search revealed 30 small incidents within River Falls that were addressed and closed. Additional closed sites were found throughout the watershed. Contaminants at the sites included unleaded gasoline, oil fertilizer, and VOCs. No major spills or incidents have occurred within the watershed.

No USEPA Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) or No Further Remedial Action Planned (NFRAP) sites were found. Of the 103 small waste quantity generator sites found under the Resource Conservation & Recovery Act of 1976 (RCRA), no major violations or outstanding corrections were found. There were no Superfund sites on National Priorities List (NPL).

The due diligence results indicate a likelihood of minor contamination typically found in urban areas, including heavy metals and hydrocarbons. Because we did not include an extensive review of historic landuse in River Falls, we have included a wide sweep using the Priority Pollutant Metals identified by the EPA. Polyaromatic hydrocarbons (PAHs) are ubiquitous in urban areas, and should be expected in some concentration.

The agricultural land use in the watershed suggests also testing for nutrients, nitrates, and in select areas, organochlorine pesticides and herbicides, including DDT, DDE and derivatives.

Although not commonly found in smaller urban watersheds, polychlorinated biphenyls (PCBs) can be found downstream of pre-Clean Water Act industrial sites, and have been identified as a concern of local residents. Potential PCB concentrations will be analyzed in the upper 6.0 inches of cores taken from areas that would become exposed floodplain following dam removal.

Past industrial uses in the watershed are varied. Because the analytes being examined cover a broad range of common contaminants, it is unlikely that further investigation into historical sources of contamination would be cost effective. Instead, we rely on the method of analysis and focus on the contaminants that we do find in the impoundments, if any are found.

3. Sediment Volume

3.1 METHODS

Field data collection consisted of bathymetric surveying and refusal depth probing. The bathymetric survey in Lake George involved manually surveying the channel and impoundment bed with a survey-grade rtkGPS unit. A series of 15 cross sections were surveyed to create an existing conditions surface of the bottom of the impoundment. Three additional cross sections were surveyed upstream of Lake George as sediment accumulation was evident up to the W. Maple St Bridge. At each survey location, we also measured sediment depth. This involved manually (by hand) driving a ½ inch diameter fiberglass rod into the sediment until a refusal layer was encountered. The type of material encountered at refusal was noted. Refusal material was determined by the abruptness of the rod stopping and the noise and vibration. Three classifications of material were delineated with this method based on validation at other sites: (1) cobble and larger rock, (2) gravels, and (3) sand or finer material. In locations where the pre-dam channel existed, cobble and larger rock was usually encountered at refusal. In locations that were likely floodplain areas prior to dam construction, a firm, compact layer (3) was encountered. The elevation of the refusal surface will be verified with vibracoring data during sediment sampling.

In Lake Louise, manual rtkGPS bathymetric and refusal data were collected as described for Lake George. In addition, the existing bathymetric data were supplemented with single beam sonar data to describe areas with deeper water. The sonar requires a minimum depth of three feet which was only present in the thalweg of Lake Louise. Extensive aquatic vegetation throughout the rest of Lake Louise and throughout most of Lake George prohibited further use of the sonar data.

Following field data collection, the survey data were integrated in AutoCAD® Civil3D® to create an existing conditions surface of the bottom of the impoundment and a pre-dam surface based on the refusal data. The data were adjusted using the National Geodetic Survey's Online Positioning User Service to relate the North American Vertical Datum of 1988 and the Wisconsin State Plane, Central (NAD83, US survey feet) coordinate system.

Boring data for the Winter St Bridge design were also incorporated into the digital surface models. This allowed us to extend the bathymetric and refusal surfaces in Lake George further downstream towards the dam.

Calculating the difference between the two surface models produced estimates of the total accumulated sediment volume in each impoundment. In Lake George, sediment accumulation in the three upstream cross sections was added by estimating sediment along cross sections and multiplying by reach length. We also estimated the expected volume of sediment to be mobilized if dam removal occurs. Based on reference reaches up- and downstream of the impoundments, a channel width of 55 feet was specified along the refusal surface thalweg alignment. From the edge of this expected channel, the surface was graded upwards at a 3:1 (horizontal:vertical) slope until the existing bathymetric surface was encountered. Because the impounded sediment encountered consists of highly mobile sand and finer fractions, we assume that the entire defined, post-removal channel volume will be mobilized downstream upon dam removal.

3.2 LAKE GEORGE

The total estimated volume of impounded sediment in Lake George was 149,000 cubic yards. This includes sediment between the Winter St Bridge and the E. Division St Bridge. The majority of sediments in Lake George are fine silts. As the impoundment narrows upstream of Lake George, the impounded sediments are primarily sand. Although the wetted width in this area suggests riverine conditions, there is little water surface gradient and sediments are easily deposited.

With dam removal, we expect about 58,500 cubic yards of sediment to transport downstream. It is unlikely that additional sediment would mobilize within Lake George as the east half of the impoundment refusal surface is perched relatively high compared with the thalweg along the west perimeter of the lake.

It should be noted that depth of refusal probing does not pick up all bedrock or other constraints, and is limited by point density. Any bedrock contacts, including the final waterfall crest elevation, may influence the total sediment volume. Thus, the sediment volume estimate may be conservative.

3.3 LAKE LOUISE

The total estimated volume of impounded sediment in Lake Louise was 162,000 cubic yards. Sediment grain sizes are predominantly silt but there is also more sand present than in Lake George. The more prevalent sand may be from the South Fork Kinnickinnic River that enters between the two dams. We also estimated about 58,000 cubic yards of sediment will mobilize with dam removal. The majority of this sediment is in the lower two thirds of the impoundment. In the upstream reach where the channel width is 150 ft or less, relatively little sediment is stored. Based on the presence of larger stones perched on the floodplain, it appears that this reach has been dredged in the past to deepen and straighten the channel upstream of the City's wastewater treatment plant.

It should be noted that depth of refusal probing does not pick up all bedrock or other constraints, and is limited by point density. Any bedrock contacts, including the final waterfall crest elevation, may influence the total sediment volume. Thus, the sediment volume estimate may be conservative.

4. Contaminant Sampling Plan

4.1 SEDIMENT AND POLLUTION EXPOSURE ROUTES

Sediment quality in both the mobile and immobile portions of the accumulated material is important, but the potential exposure routes are very different. The entire mobile portion of the sediment will eventually transport downstream unless it is excavated. During this transport, the material may be suspended in the water column or be transported along the channel bed during high flows while deposition would occur during low flows. Fish, macroinvertebrates and other wildlife as well as swimming, wading or boating humans may be exposed to this material and any associated pollutants. Further, pollutants that are associated with the material may end up in the food chain resulting in human exposure through ingestion. Due to these processes, the quality of the entire volume of sediment is important, and should be considered with respect to fish and wildlife as well as human incidental contact toxicity thresholds and bioaccumulation.

The immobile portion of the sediment would remain in place following dam removal and would likely be stabilized with vegetation. Though less accessible to most organisms than material that is transported in the river, there are several mechanisms for exposure to wildlife and people. Humans may come into contact with the top portion of the soil depending on proposed future land use of the newly exposed ground. Burrowing animals will come into contact with the top layers of the soil as well. Rainwater that infiltrates into these soils may pick up pollutants and carry them to the river where exposure routes would be similar to those for the mobile portion of the sediment. If the pollutant concentrations in these sediments may cause problems through any of these exposure routes, alternative sediment management methods may be warranted.

4.2 SAMPLE LOCATIONS AND METHODS

We propose collecting a total of twelve (12) impoundment sediment samples to be taken at the locations indicated in Figure 2. This includes three samples within expected mobile portions of sediment in each impoundment (6 total or 3 in each impoundment). These samples are concentrated in areas where accumulated sediment depths are greatest. Three additional samples in each proposed exposed floodplain area (6 total or 3 in each impoundment) will be tested to characterize the immobile portion of the accumulated sediment. These samples are distributed throughout the remainder of the impoundments. For each of the proposed floodplain sample locations, we will stratify the material into two sub-samples: an upper layer with the top 6 inches of sediment, and a lower layer with all sediment below 6 inches to the refusal surface. Samples will be taken to the approximate depth of refusal as measured in the initial sediment probing.

Shallow sediment samples less than 5 feet deep will be retrieved using a polycarbonate silt sampler, Wildco® hand corer with extension or other hand coring device. Samples taken in deeper sediments will be retrieved with a boat mounted vibratory core sampler, piston corer or Geoprobe® (to be completed by a geotechnical subconsultant). Sampling and lab sample processing procedures will follow Inter-Fluve's internal guidelines based on Wisconsin, Massachusetts and USEPA sediment sampling recommendations (Inter-Fluve, Inc., 2007; see appendix). Pollutants to be tested are listed in

The following details should be noted:

- PCB testing will be conducted only in the top 6 inches of the floodplain cores, and in both the upper and lower core samples near the waste water treatment facility outfall in Lake Louise.
- Organochlorine pesticide and herbicide testing will be conducted only in the upper and lower core samples near the waste water treatment facility outfall in Lake Louise.
- Thalweg cores will not be stratified.
- Control samples will not be tested unless deemed necessary following sample results.
- TCLP samples will not be sequestered or tested at this time.

Table 1. The laboratory chain of custody will be documented.

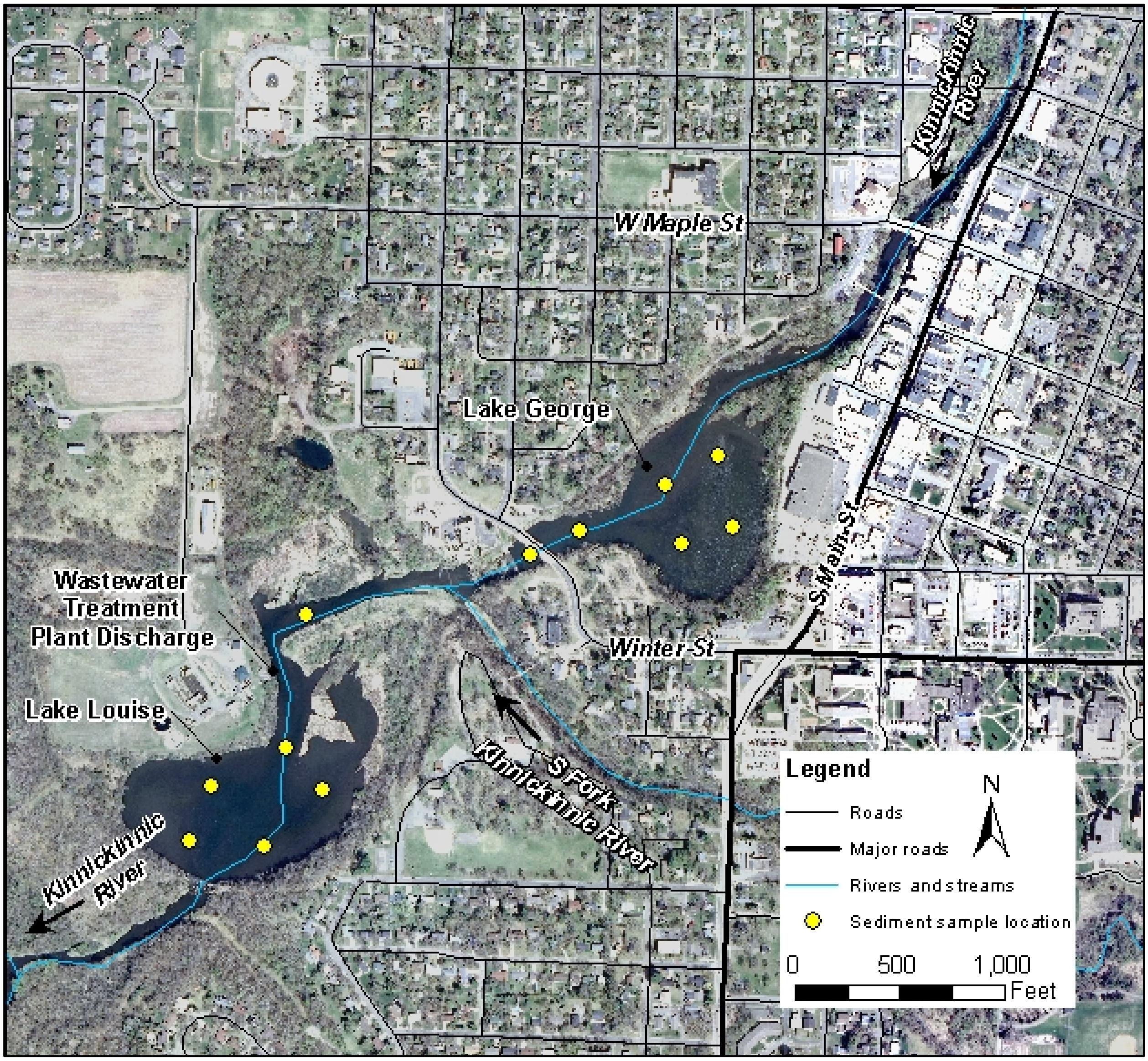


Figure 2. Proposed sediment sample locations (yellow points).

The following details should be noted:

- PCB testing will be conducted only in the top 6 inches of the floodplain cores, and in both the upper and lower core samples near the waste water treatment facility outfall in Lake Louise.

- Organochlorine pesticide and herbicide testing will be conducted only in the upper and lower core samples near the waste water treatment facility outfall in Lake Louise.
- Thalweg cores will not be stratified.
- Control samples will not be tested unless deemed necessary following sample results.
- TCLP samples will not be sequestered or tested at this time.

Table 1. Parameters to be analyzed – River Falls Dams.

Category	**Specific Parameter**
Metals	Arsenic, Cadmium, Chromium III/VI, Copper, Lead, Mercury, Nickel, Zinc
Organics	Polycyclic Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons, Organochlorine pesticides and herbicides
Nutrients	Total Phosphorous, Nitrate, Nitrite, Ammonia, Total Kjeldahl Nitrogen (TKN)
Polychorinated Biphenyls (PCBs)	To be analyzed at the wastewater treatment plant discharge location only.
Physical	Total organic carbon, moisture percent, grain size distribution, bulk density
Other	Toxicity Characteristic Leaching Procedure (TCLP), to be completed pending the initial contaminant results.

Table 3. Analytical Standards to be used

Metals*	EPA 6010C/7471
Hexavalent Chromium	EPA 3060A/7196A
Trivalent Chromium	Calc
PAHs	EPA 8310
GRO	WDNR Mod
DRO	WDNR Mod
Pesticides	EPA 8081

Herbicides	EPA 8141
TOC	L-Kahn/9060A
% Moisture	SM2540G
Grain Size (NO Hydrometer)	ASTM C136-84A
PCBs	EPA 8082
TCLP Extraction (Zero Headspace)	EPA 1311
TCLP Extraction (Non-Zero Headspace)	EPA 1311

**CT Laboratories LLC (Baraboo, WI)*

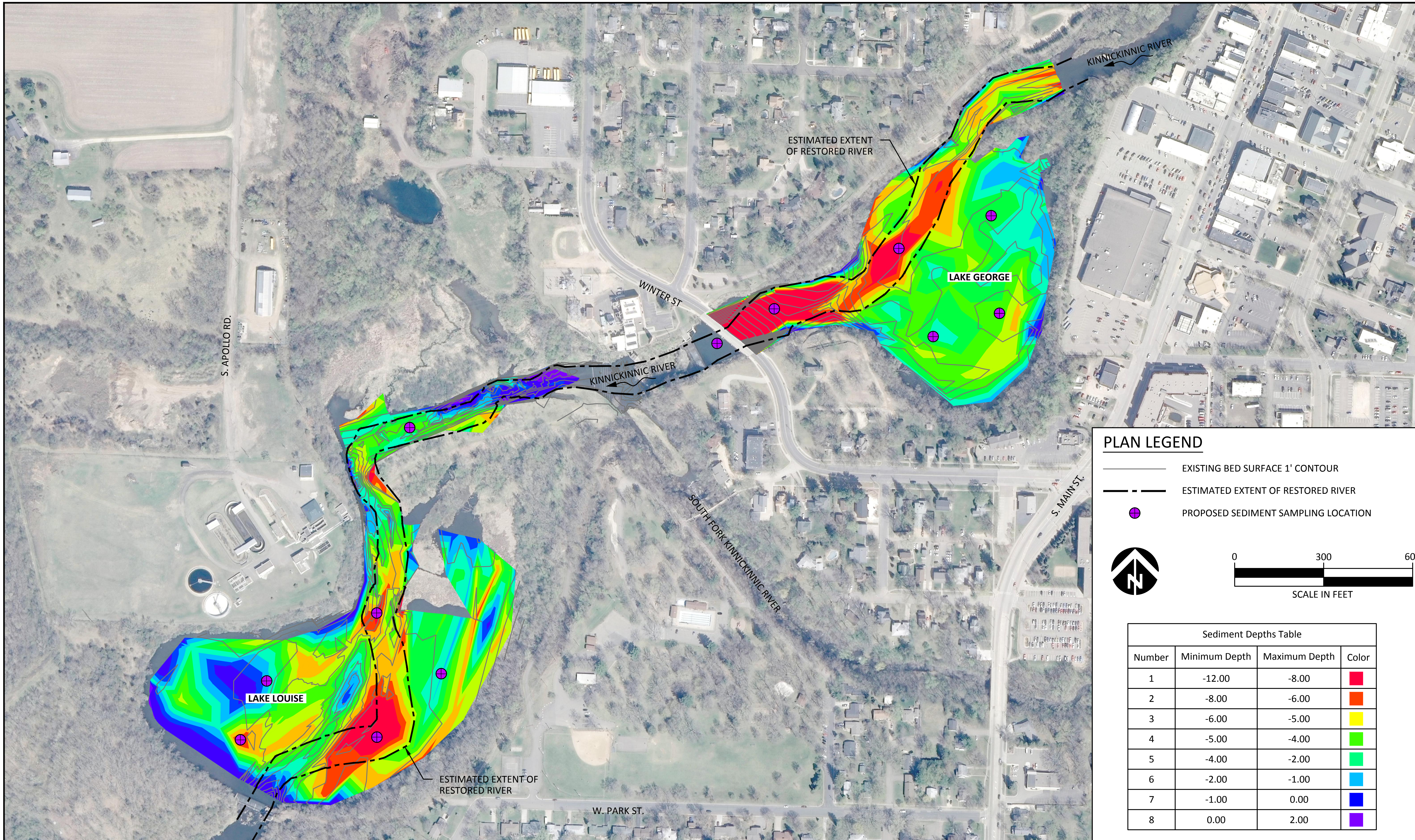
4.3 TOXICITY CHARACTERISTIC LEACHING PROCEDURES (TCLP)

TCLP testing assesses the ability of water to leach through sediment and into the groundwater. TCLP testing will only be performed for metals or organic compounds when the total concentrations in the sediment are above the theoretical levels at which the TCLP criteria may be exceeded. This will require further core sampling and laboratory analysis. For guidance, consult USEPA, Memorandum #316, "Notes on RCRA Methods and QA Activities," pp. 19-21, Gail Hanson, January 12, 1993.

5. References

Inter-Fluve, Inc. 2007. *Sediment Sampling for Dam Removal Projects – General Sample Collection Guidelines for Contaminant Testing*. Internal company protocol, Madison, WI.

Appendix A – Impoundment Sediment Depths and Proposed Sample Locations



Sediment Depths Table

Number	Minimum Depth	Maximum Depth	Color
1	-12.00	-8.00	
2	-8.00	-6.00	
3	-6.00	-5.00	
4	-5.00	-4.00	
5	-4.00	-2.00	
6	-2.00	-1.00	
7	-1.00	0.00	
8	0.00	2.00	

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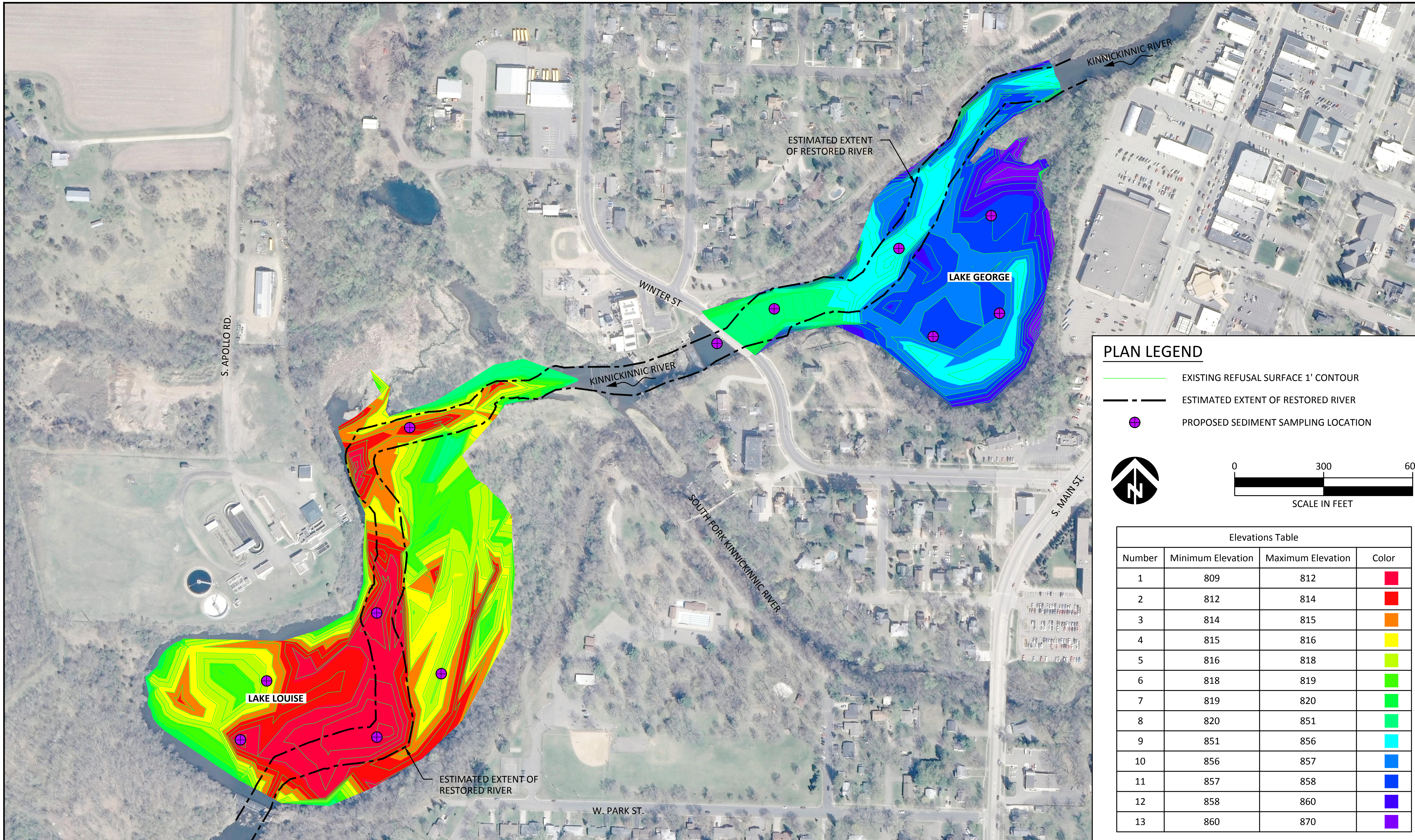
River Falls Sediment Analysis

Sediment Depths

November 3, 2015



Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
1	809	812	
2	812	814	
3	814	815	
4	815	816	
5	816	818	
6	818	819	
7	819	820	
8	820	851	
9	851	856	
10	856	857	
11	857	858	
12	858	860	
13	860	870	

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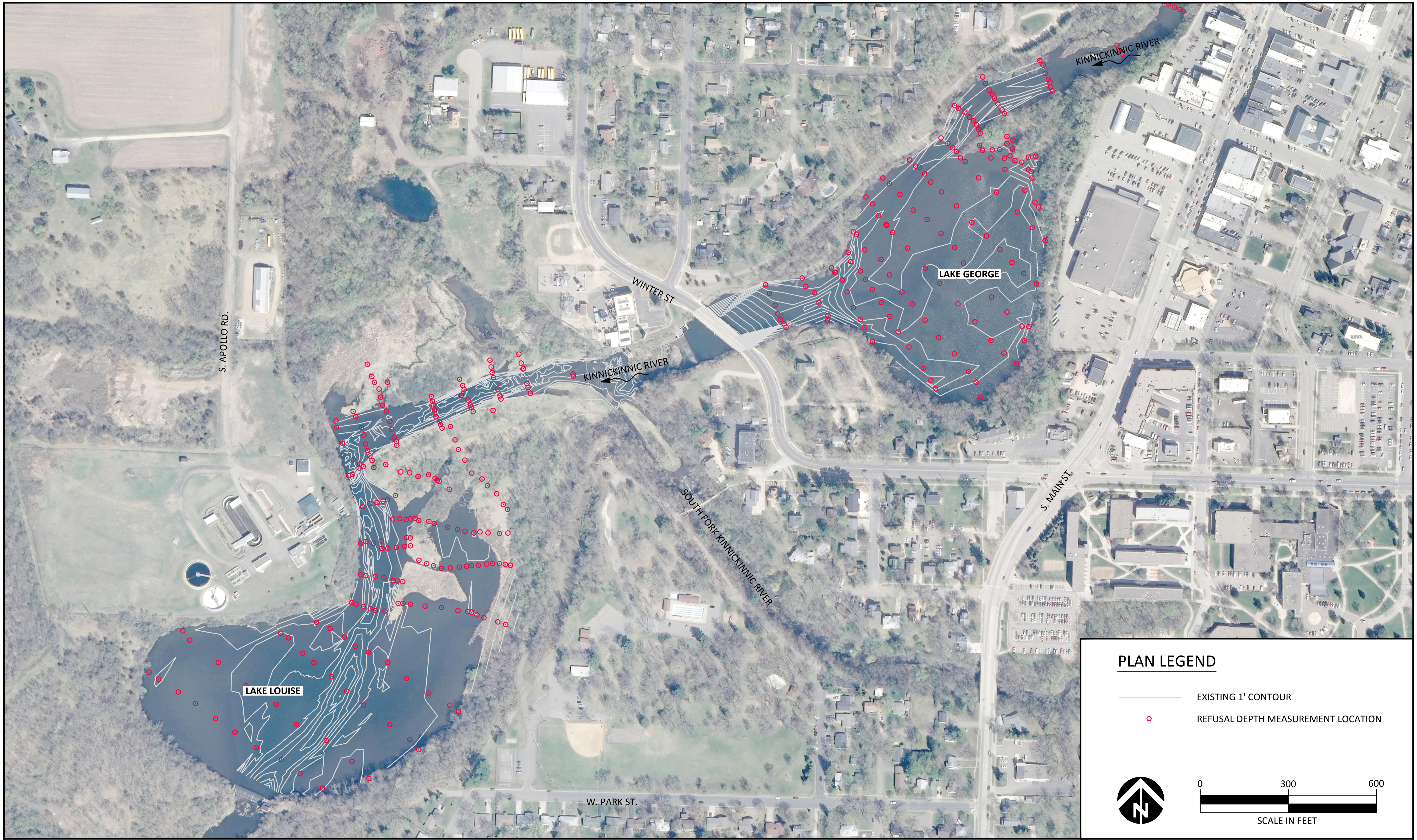
River Falls Sediment Analysis

Refusal Surface

November 3, 2015



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River Falls Sediment Analysis

Refusal Measurement Locations

November 4, 2015

Appendix B – Inter-Fluve Sediment Sampling Protocol

Sediment Sampling for Dam Removal Projects

General sample collection guidelines for contaminant testing

April 25, 2007

inter-fluve, inc.

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This document is intended as a general guideline for sampling sediment deposited upstream of dams in relation to Inter-Fluve projects involving dam removal or modification, where testing of potential contaminants is required.

These guidelines are taken largely from the State of Wisconsin sampling guidelines and are generally in accordance with standard protocols as presented in US- EPA-823-B-01-002, 2001, *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analysis: Technical Manual*. Refer to the EPA manual for a more detailed discussion of study plans, collection, and processing of samples. Individual projects and states may have specific requirements, and individual laboratories may have alternative instructions for data collection.

This document covers sampling procedures, and does not address sampling experimental design. For more detailed guidance in designing statistically robust sampling plans, consult the US EPA and the local state environmental agency.

Part 1: General Sediment Sampling Procedure

1. Scope

1.1. This section describes general procedures for sediment sampling and the use of common sediment sampling equipment. Study goals may require additional or alternate equipment or procedures other than those discussed herein. Any procedure changes should be based on sound scientific and practical reasons and should ultimately help further the goals of the study without the loss of quality assurance and control.

2. Equipment and Supplies

2.1. Below is a suggested list of equipment needed for most sediment sampling efforts. This list suggests equipment that may be necessary for your project and should not be considered exhaustive. Equipment that is specific to a specialized type of sampling may be included only in the section describing the particular type of sampling.

2.2. Equipment Checklist

- Boat, anchor, motor, gas tank, tow vehicle
- Life jackets
- Protective clothing: boots, waders, gloves, rain gear, etc.
- First aid kit
- Mobile phone
- Maps: road and site maps
- Compass and measuring equipment
- Electronic location device (Loran or GPS)
- Field notebook and field sheets
- Waterproof pens and pencils
- Field measurement equipment (temperature, dissolved oxygen, etc.)
- Sample containers
- Sample labeling tape or paper and permanent marker
- Sediment pole for measuring depth
- Coring device and dredge or grab with adequate rope and extension poles (grab is backup for corer in sandy sediments), including extension poles.
- Slide hammer for corer
- Pliers, wrenches, etc. for adjusting equipment
- Mixing bowl and spoon
- Cleaning (decontamination) supplies (non-ionic detergent, tub, brushes, etc.)
- Wash bottles
- Ice chest and ice for cooling samples
- Extra rope

2.3. Equipment suitability for chemical analysis:

2.3.1. All equipment or sample containers that will come into contact with a sediment sample for chemical analysis should be constructed of materials that will not affect the concentration of contaminants in the sediment sample. In general, sediment samples to be analyzed for metals should not touch metallic surfaces (other than stainless steel), and samples for organic analysis should not contact materials that can react with organic substances. The level of care that needs to be taken with the materials used will depend on the level and types of contaminants associated with the sediment and the quality assurance needs and study goals.

2.3.2. For **organic analysis**, equipment and containers should be constructed of: *glass, teflon, polycarbonate, nylon, aluminum, galvanized steel, stainless steel or porcelain*. *Acrylic* core tubes are also acceptable for almost all sampling needs.

2.3.3. For **inorganic analysis**, equipment and sample containers should be constructed of: *glass, teflon, polyethylene polycarbonate*, *stainless steel* or *acrylic*.

3. Basic Sediment Sampling Procedures

3.1. Preparation

3.1.1. Sampling Plan - Sampling strategy decisions and sampling locations should be made well before going into the field, and should be designed to collect quality data that will best answer the questions or meet the goals of the study or monitoring program. Reconnaissance level or statistically robust screening level plans should be in place prior to field work. Decisions should be made ahead of time about sample location, number of replicates at each site (sampling strategy), and what chemical analyses to be performed on the samples. This will help ensure that appropriate and quality samples are collected.

3.1.2. Safety - All field staff should be aware of and fully understand the possible physical and chemical safety hazards posed by any site. Precautions should be taken to prevent exposure to contaminated sediments.

3.1.3. Equipment - Make all the preparations necessary to obtain suitable collecting equipment, protective clothing, vehicle and boat. Test and calibrate any equipment according to manufacturer's instructions. Record in the field notebook information about the instrument tests and calibrations including: dates, results and person testing the equipment. It may help to label sample containers for each site prior to sampling.

3.1.4. Cleaning Equipment - All equipment should be cleaned *before going into the field and between sites and samples* to prevent contaminating sediment samples. Equipment should be washed with clean scrub brushes using a non-phosphate detergent that leaves no residue when rinsed such as Alconox powdered or Liqui-nox liquid detergent (Liqui-nox is the EPA standard detergent for sampling apparatus). To properly clean equipment, wash apparatus thoroughly with detergent, then rinse 5-6 times with tap water and 3 times with deionized/distilled water if available. Rinse the apparatus with site water before taking the first sediment sample.

3.1.5. Field Observations - Take turbidity or Secchi readings first if possible, before the sediment is suspended by other sampling procedures. Record all field measurements and observations.

3.2. General Procedures in the Field

3.2.1. Turn on any equipment that needs to warm up (like a DO meter) first or before reaching the site.

3.2.2. Make sure all equipment is clean and ready to use.

3.2.3. When working from a boat, two or three anchors or spuds driven into the sediment in shallow water will help stabilize boat in breezy, open water conditions.

3.2.4. Each grab or core attempt, whether for a composite sample or replicates, should be <u>taken from undisturbed sediment</u> at the site. Avoid disturbing sediments with a boat motor or by walking on the site. Approach sites from downstream to avoid suspending sediment into the water column over the site.

3.2.5. Have container ready to accept entire sample quickly upon retrieval.

3.2.6. Label every sample container with a permanent marker on labeling tape on the side of the jar or wherever the label will not come off accidentally. Information on the label should include: **Sample #, replicate #, date, collector name** and **analysis type** (organic, inorganic).

3.2.7. Record all site information in a field notebook or on fieldsheets before leaving site. Information usually includes: field measurements, time and date, persons collecting samples, number and types of samples taken including field blanks, etc., labels assigned to each sample, and any general observations. Keep records of all samples, how they were labeled and any blanks or controls that are submitted for analysis.

3.3. Collecting Composite Samples

3.3.1. Composite samples are generally used to estimate the average concentration of the individual samples that make up the composite. Multiple grabs or cores for a composite sample should be taken from a relatively homogeneous sediment deposit (i.e., all grabs should be of similar sand/silt content). In some cases, composite samples are needed to generate sufficient sample volume for all analyses. It is best to know the rough boundaries of the sediment deposit or "site" before sampling.

3.3.2. Place each grab or core into a single mixing bowl (made of suitable material), remove any large objects such as sticks, leaves or stones, etc. and stir thoroughly with a spoon to homogenize. A single grab or core should be mixed at least two minutes. Multiple grab or core samples should be mixed five minutes or longer if necessary.

3.3.3. Fill sample jars with the sediment mixture by placing one spoonful sequentially into each jar until the jars are full (see section on sample containers). This sub-sampling system assures that each sample container contains a sample as similar as possible to the other containers.

3.4. Collecting Replicate Samples

3.4.1. Replicate samples can be obtained at different stages of the sampling for different purposes depending on the objectives of the study. A study plan should describe where and how much replication is necessary. The procedures described here are for collecting distinct field replicate samples where the object is to determine the variability within a deposit and compare one field site to another.

3.4.2. When collecting replicate samples to statistically compare sediment deposits, sample sites within each deposit should be randomly located for statistical comparisons to be valid.

3.4.3. Be sure each sample is taken from an undisturbed area of sediment

3.4.4. If the replicate samples are fairly similar, the equipment need only be rinsed with site water between samples. But, if the replicates are not similar, and some contain significantly more fines than others, than the core tube or dredge may need to be washed with a non-ionic detergent (see equipment) and rinsed in between samples to prevent cross-contamination and to keep replicate samples independent for valid statistical analysis of the data. Use a tub of water in the boat to wash equipment to prevent getting detergent in the site water while sampling.

4. **<u>Procedures for Core and Grab Sampling Devices</u>**

4.1. Sediment samples are most commonly collected using a coring device, dredge or grab sampler. The type of collecting equipment chosen will depend on sediment texture, site location (depth and current velocity), analyses to be performed and study goals. See **References** for more detailed discussion of the pros and cons of various sampling devices.

4.2. Piston Corer

4.2.1. Preparation and Scope

4.2.1.1. A corer allows excellent quantitative and qualitative sampling to a specified sediment depth with little disturbance of the sediment water interface. Samples can be separated or stratified by depth or color/texture to analyze distinct layers of sediment, although the sediment along the side of the core may smear as the core penetrates, slightly distorting the stratification of the sediment.

4.2.1.2. A corer may not be able to penetrate and/or retain very sandy substrates. Coring in high clay-content sediments where grabs won't work is possible if the water is not too deep, but may be difficult with a push corer and may require the use of a slide hammer or vibrating corer.

4.2.1.3. A large bore corer will provide a larger volume of sediment per attempt. This is important if discreet sample replicates are desired, and enough sample must be collected for a specific analysis or test. Even with the large bore core tube, samples may need to be combined to obtain enough sediment volume for the required analyses and/or tests.

4.2.1.4. A hand-operated, 3 inch diameter core sampler with an optional piston and extensions for deeper water can be effectively used in soft sediments with some silt/clay content in water up to ~30 ft deep. Core samplers may not be able to penetrate or retain very sandy sediments.

4.2.2. Collection Procedure

4.2.2.1. This procedure can be used for a push corer with or without a piston. A piston may not be necessary in high clay sediments. Disregard directions for use of the piston if piston will not be used.

4.2.2.2. Assemble the corer. Adjust the piston (the nut on the bottom adjusts piston diameter) so that it fits snugly. If the piston is too loose, it will not stay in place until the corer reaches the sediment. If too tight, the piston will not move sufficiently when the corer is being pushed into the sediment, and compaction of the sediment core may occur.

4.2.2.3. Position the piston at the bottom of the core tube (open end), with the rope attached and threaded through the core head.

4.2.2.4. With the piston in place, let the core tube fill with water from the top, then lower the corer slowly and vertically to the sediment. If the piston falls out the bottom or moves up the core tube before reaching the sediment, tighten piston slightly and try again.

4.2.2.5. With the bottom edge of the corer and the piston in contact with the sediment in a vertical position, push the core tube into the sediment while maintaining some tension on the piston rope. The piston should remain at the sediment surface while the core tube moves into the sediment. In difficult sediments, it may be necessary to actually pull on the rope as the corer is pushed into the sediment. The object however is to maintain the piston in a fixed position at the sediment-water interface without compacting the sediment.

4.2.2.6. In hard or clay sediments where it is difficult to push the corer into the sediment by hand, a slide hammer designed specifically for the core sampler should be used. Do not pound on the core head or extension tubes with a hammer or anything else as this could break or damage the core head or other parts, and is generally less effective than the slide hammer.

4.2.2.7. After core is pushed to desired depth, pull up the corer slowly while maintaining the position of the piston by holding the piston rope in place. Even with the piston, some sediment may be lost from the bottom of the corer if the sediment is sandy. To help prevent sample loss, bring the corer into a horizontal position as it reaches the surface. A plug can also be inserted into the bottom of the sampler before removal from the water.

4.2.2.8. Place the corer on the work surface (boat or ice) over the receiving container. The sediment core can be extruded from the top or bottom of the core tube, depending on the purpose of the sample and study goals. Generally, cores collected for macroinvertebrate work should be extruded out the bottom, and cores collected for chemical analysis should be extruded out the top of the core tube if only part of the segment is needed to reduce contamination of the sample segment from other layers.

4.2.2.9. To extrude through the bottom, remove the sampler head, insert a pole through the top and push down on the piston eyebolt. Extrude the core into a waste container until the desired length of core remains, then extrude the remaining sediment into the sample container. To extrude through the top, remove the sampler head and place an extrusion pole and rubber plug at the bottom of the sampler and push sediment out through the top slowly. A premarked acrylic or polycarbonate (clear) core tube is helpful for measuring core lengths.

4.3. Grab Samplers

4.3.1. Preparation and Scope

4.3.1.1. Grab samplers rely on their own weight and gravity to penetrate the sediment as well as the leverage from the closing of the jaws. For this reason, they are not as efficient in water flowing over one meter per second. They normally take a discreet "bite" of sediment to a fairly consistent and measurable depth. Grabs often cause a shock wave upon descent which may disturb very fine sediment at the sediment-water interface.

4.3.1.2. Many grabs and dredges such as the petite Ponar and Ekman dredge can be used. These two can be hand operated from a suitably sized boat, preferably flat-bottomed. The Ponar is better suited to sampling hard or sandy sediments because of the greater ability to penetrate. The Ekman is more suited to sampling in soft sediments in low flow waters. Neither grab will effectively sample hard clays where a coring device or shovel such as a sharpshooter spade can be used.

4.3.1.3. Have a sample tub ready to receive sediment that is large enough to receive the entire contents of the sampler.

4.3.1.4. Understand and be careful of the closing mechanism and moving parts on a sampler.

4.3.2. Collection Procedure

4.3.2.1. Set closing mechanism and lower grab slowly to substrate, being careful to avoid a shock wave caused by too rapid of a descent near the sediment.

4.3.2.2. Initiate closure mechanism of grab. This is usually a messenger sent down the rope or a sharp pull on the rope.

4.3.2.3. When it feels like the grab has closed and contains sediment, raise grab at a steady rate and immediately position over large bucket. If jaws are not completely closed due to obstructions, discard entire grab contents away from sampling area and try again.

Make sure to move the sampling site at least several feet away from the previous attempt(s) to avoid sampling a disturbed area.

4.3.2.4. If the study dictates careful sampling for metals analysis, the middle portion of the sample not touching the metal grab can be collected with a teflon or plastic spoon, and the rest of the sample discarded.

4.3.2.5. Empty entire contents of grab into mixing bowl if sample needs to be mixed.

4.3.2.6. Place appropriate volume of sediment into sample container.

4.3.3. Quality Control Measures

4.3.3.1. Sediment samples should be collected from the reference or control sites first when possible to reduce the chances of cross-contamination from other sites.

4.3.3.2. All samples in a study should be handled identically, including using the same sampling equipment, stirring times, etc.

4.3.3.3. When collecting samples for chemical or toxicity tests, take appropriate measures to prevent contamination from other sources such as vehicle and boat motor exhaust or associated contaminants and other contaminated sites. The person operating the boat motor should either not handle sediment samples or make sure to put on clean gloves to prevent contamination from the motor.

5. References

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Part 2: Collecting and Processing Samples for Chemical and Physical Analysis

1. Scope

1.1. Quality data can only be obtained from environmental samples that are properly collected, preserved and promptly shipped to the laboratory for analysis. The procedures involved in this process include: 1) collecting the samples using appropriate sampling techniques; 2) selecting proper sample containers; 3) preserving the samples immediately after collection either chemically or by cooling to 4°C, whichever is appropriate; 4) clearly identifying the samples and completing the corresponding laboratory sheets; and 5) carefully packaging and promptly shipping the samples to the laboratory for analysis.

1.2. Sediments for organic and inorganic chemical analyses are most often collected using grab, dredge or core methods. The chosen method should target the goals of the study plan and complement any other biological tests that may be conducted at the site or with sediments from the site. Samples slated for different types of physical and chemical analysis may need to be collected and handled in slightly different ways. The level of precautions that must be taken to prevent contamination of samples will depend on the type of analysis to be performed and the study objectives.

2. Equipment

2.1. Sample Containers - Samples for organic analysis and inorganic (metals) analysis must be in separate containers. Containers are prepared by and should be obtained from the laboratory doing the analyses. General guidelines are as follows:

2.2. Sample Containers for Inorganic Analysis

2.2.1. Sediment samples should be submitted to the laboratory in a container appropriate for the analyses requested.

2.2.2. Metals - Samples that require metals analyses should be submitted either in 250 mL "metals" bottles or a glass quart mason jar with teflon lid. One 250 mL "metals" bottle (same as for water) provides enough sample to perform all of the routine metals analyses and solids analyses.

2.2.3. Nutrients - Samples that require nitrogen, phosphorus and solids analyses should be submitted in 250 mL "nutrient" bottles or a glass quart mason jar with teflon lid.

2.2.4. Oil & Grease - Samples for Oil & Grease are analyzed by the inorganic section and must be in a glass quart jar with a teflon lined lid. Fill jar 3/4 full or more. Separate containers for metals or nutrients are not necessary if the glass quart jar is used.

2.2.5. Additional information can be obtained from:

East Coast

Tim Byrne
GeoLabs, Inc.
Sales Director/
Environmental Scientist
45 Johnson Lane
Braintree, MA 02184
P 1-781-848-7844
F 1-781-848-7811
C 1-781-420-1178

2.3. Sample Containers for Organic Analysis

2.3.1. Soil and sediment samples should be submitted to the laboratory in a container appropriate for the analyses requested.

2.3.2. Organics (PCBs, PAHs, etc.) - Samples for all regular organics analysis should be contained in glass quart jars with teflon lined lids. Jars should be 3/4 full or more. If analyzing for semi- or volatile organics fill jar completely so no air space exists.

2.3.3. Volatile Organic Carbon (VOC) and Gasoline Range Organics (GRO) - A 60 milliliter glass vial with a septum top should be used for soil and sediment samples that are to be analyzed for VOC and GRO. The laboratory will provide three pre-weighed sample vials for each sample site. The vials should be filled with sediment to the "Fill to here---" label (approx. 25g) found on the side of each vial. A water and methanol "trip blank" will be included in each sample mailer.

2.3.4. Diesel Range Organics (DRO) - A 60 milliliter glass vial should be used for soil samples that are to be analyzed for DRO. The laboratory will provide three preweighed sample vials for each sample site. The vials should be filled with soil to the "Fill to here---" label (approx. 25g) found on the side of each vial.

2.4. Samples for Bioassays <u>and</u> Chemical and Physical analyses

2.4.1. If chemical and/or physical analyses are required on sediment samples also slated for toxicity or bioaccumulation tests, the lab can perform the sediment homogenization and fill sample jars for the chemical analyses from the same sediment that will be used for the bioassays. The testing lab should be contacted for information on appropriate sample containers and procedures.

2.5. Samples for Particle size analysis

2.5.1. Quart-size plastic bags (from the store) can be used for particle size samples. **Double bag** the sample and fill 1/2-3/4 full. Label **both** bags in permanent marker with Sample #, date and collector's name. Particle size analysis is usually contracted for every chemical analysis sample, but be sure to clarify this testing with the lab and collect sediment for this analysis.

2.6. Quality Control of Sample Containers

2.6.1. Quality control audits should be conducted for chemical analysis to verify that they are free from contaminants. These audits are performed before any bottles are approved for use. Because of the considerable effort expended in assuring the quality of sample bottles, it is important that they be used only for the parameters specified on the label.

2.6.2. To make sure appropriate procedures are used to prevent contamination, quality control information should be obtained from analysis laboratories when the contract for service is generated.

3. Cleaning Sediment Collection Equipment

3.1. The following steps for cleaning new or used sediment sampling equipment and containers are recommended by EPA (1994):

3.1.1. Soak 15 min in tap water, and scrub with detergent.

3.1.2. Rinse twice with tap water.

3.1.3. Rinse once with fresh, dilute (10% V:V) hydrochloric or nitric acid. To prepare a 10% solution of acid, add 10 ml of concentrated acid to 90 ml of deionized water.

3.1.4. Rinse twice with deionized water.

3.1.5. Rinse once with full-strength, pesticide-grade acetone (use a fume hood or canopy).

3.1.6. Rinse three times with deionized water.

3.1.7. Rinse field collection equipment with site water immediately before use. Lab equipment should be rinsed with test dilution water immediately before use in a test.

3.1.8. Clean equipment can be protected from contamination during transport (i.e., exhaust, pickup beds, boat motors, etc.) by wrapping in aluminum foil.

3.1.9. Quality control procedures to be followed at the sites should be written down for all field staff.

4. Sample Preservation

4.1. All sediment samples for chemical analysis should be preserved as soon as possible after collection by cooling to and **maintaining** a temperature of ~4°C (ice cold) by putting samples on ice in a cooler.

4.2. Keep samples shaded from sunlight to prevent breakdown of chemicals by UV light.

4.3. Ice packs should be included in each sample kit designed for VOC, GRO and DRO analysis, although samples should first be cooled to 4°C on ice. Plastic bottles can also be filled with water, frozen, and placed in the shipping container. Samples should be pre-chilled if these cooling materials are used for shipping.

4.4. For soil or sediment samples to be analyzed for GRO, it may be required to add 25 ml of premeasured methanol to two of the sample vials at the time of collection. (Vials of methanol should be provided by the lab) A third vial is used for determining moisture of the sample.

4.5. For soil samples to be analyzed for VOCs, the collector should consult the laboratory and the individual program needs for the appropriate preservation requirements which may include methanol preservation.

4.6. Contact the contracted laboratory for additional preservative requirements for specific parameter requests.

5. Packaging and Shipping

5.1. Cooling Samples

5.1.1. When cooling is required during shipping, the samples should be pre-cooled in an ice chest, and later placed in a field pack with a suitable quantity of ice or "Blue Ice". Ice should not be placed in the field pack loose. It should be securely sealed in a heavy plastic bag to prevent leakage during shipment. DO NOT USE metals bottles, nutrient bottles, or bottles designated for specific tests as ice containers.

5.2. Packing Samples

5.2.1. Properly packaging sediment samples for shipping is important for maintaining sample quality and safety of persons contacting the samples.

5.2.2. After collection, check each sample to make sure the container lid is securely closed and the sample is properly preserved. The exterior of each sample container should be wiped clean with a wet cloth.

5.2.3. Check all samples for secure, correct and complete labels that match the accompanying lab sheets (see below).

5.2.4. A whirl-pak or ziploc plastic bag should be used to protect the laboratory sheets from moisture damage during shipment. Dividers, included in the packs, help protect the sample bottles during shipment and should be used whenever possible. When sealing the field packs, secure all four sides of the lid by wrapping with reinforced tape. The tape should be completely wrapped around the pack to make sure that the lid is secure. When more than one field pack is needed to ship various sample portions from a single sampling site, tape the field packs together. This will prevent sample sorting errors and will allow the lab to match the bottles with the correct laboratory sheets.

5.2.5. A cooler lined with a polyethylene bag can be used instead of the foam pack if necessary, but be sure to pack sample jars to avoid breakage during shipping and handling.

5.3. Laboratory Sheets

5.3.1. Different laboratories may have their own lab sheets that should accompany all samples. Generally, lab sheets should include:

- Sample identification
- Sample description
- Sampling program
- Name and address of the person to whom the report should be sent
- Last name of the sample collector
- Field information
- Tests (parameters) requested

5.3.2. The laboratory sheet is an important link between the laboratory and field personnel. The laboratory relies on the sheet to obtain the information necessary to prepare and analyze the sample properly.

5.4. Shipping Samples

5.4.1. If storage time limitations are recommended for the sample parameters, coordinate with the laboratory before collecting samples to let them know the sampling schedule.

5.4.2. Alert the receiving laboratory of any samples that are known or believed to contain high levels of specific contaminants, including an estimated concentration if possible. This can be done either over the phone before the samples arrive or with an enclosed written warning. The advanced notice allows the lab to handle highly contaminated samples in a way to prevent human exposure as well as cross-contamination of samples in the lab. Additionally, the lab will be able to process and analyze the samples more quickly if they know before analysis that the contaminant concentration is high.

5.4.3. Samples should be shipped with an "overnight" mail service or personally delivered to the laboratory for temporary storage so that the samples arrive before all of the ice melts in the shipping container. Monday, Tuesday or Wednesday are the best days to ship samples to assure they do not sit in a mail room with no refrigeration over the weekend. Even "overnight mail" can take longer than 24 hours, so Thursdays can be risky. DO NOT send samples on Fridays unless you have made previous arrangements with the lab.

5.5. Shipping Safety

5.5.1. If a sample bottle seal is questionable and no additional bottles are available, place the entire bottle in a whirl-pak (250 mL bottles only). This will contain the sample and prevent any preservative from contaminating other samples in the field pack.

5.5.2. The outside of the sample containers should be completely free of contaminated material before the samples are shipped. If this is not possible, the laboratory should be made aware of these samples before shipment.

5.5.3. If the submitter believes a sample contains a Department of Transportation (DOT) regulated material or hazardous material, refer to individual state shipping guidelines for hazardous materials.

6. References

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Adapted from State of Wisconsin Sediment Sampling Guidelines