SAMPLING AND ANALYSIS PLAN
ZADOW ROAD, BONNECHERE VALLEY, ON

Project No.: CCO-23-3669

Prepared for:

The Township of Bonnechere Valley
P.O. Box 100
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Prepared by:

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January 11, 2024

McINTOSH PERRY

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1.0 INTRODUCTION

1.1 Background

McIntosh Perry (MP) was retained by the Township of Bonnechere Valley (Bonnechere Valley; the Client) to conduct a Sampling and Analysis Plan (SAP) for proposed rehabilitation work on Zadow Road, Bonnechere Valley, Ontario, involving asphalt resurfacing, selective road base reconstruction, shouldering and ditching, various culvert replacements, and signage and line markings along approximately 2.3 kilometres (km) of roadway. The roadway comprises Zadow Road, from Silver Lake Road to Ruby Road (the Project Area). The Project Area is currently occupied by a municipal roadway.

It is our understanding that the Client is currently undertaking the above-noted Project and requires the preparation of a SAP. The SAP is in general compliance with Ontario Regulation (O. Reg.) 406/19 (On-Site and Excess Soil Management) requirements for a volume of excess soils up to 8,500 m^3 and will form a portion of the tender package for the project. The material in the report reflects the best judgement of McIntosh Perry's staff in light of the information available at the time of report preparation. McIntosh Perry's Qualified Person (QP) has reviewed and confirmed this SAP.

The Assessment of Past Uses (APU) report completed by McIntosh Perry, January 11, 2024, has identified two (2) Areas of Potential Environmental Concern (APECs) with respect to the Project Area, presented in Table 1 below. McIntosh Perry has developed the following sampling program, which is intended to address specific APECs (APEC 2) as well as to provide a general characterization of soil conditions across the entire Project Area to address APEC 1.

This investigation constitutes a preliminary assessment of soil quality for a volume of excess soils up to 8,500 m^3 and has been developed for general coverage of the area. `Additional sampling (including leachate samples, depending upon the receiving site) may be required following the completion of the engineering design and if the excess soil volumes presented in this plan change. The Contractor will be responsible for ensuring the appropriate number of excess soil samples are collected during construction to meet the requirements of O. Reg. 406/19, if required.

1.2 Objectives

As per the requirements of O. Reg. 406/19, the objectives of this SAP are as follows:

- Plan an investigation that will achieve the general objectives of the excess soil management plan:
    - Through the use of an appropriate and complete information base concerning the Project Area; and
    - Through the conduct of an investigation based both on information obtained during the Assessment of Past Uses report and on the incorporation of information obtained during the subsurface investigation.

- To develop a Sampling and Analysis Plan that will adequately assess all areas of the subsurface investigation property where contaminants may be present in land or water on, in or under the property; and
- To develop a quality assurance program that is designed to effectively limit errors and bias in sampling and analysis through implementation of assessment and control measures that will ensure data are useful, appropriate, and accurate in the determination of whether the investigated property meets applicable Ontario Ministry of the Environment, Conservation and Parks (MECP) Site Condition Standards (SCS).

2.0 SAMPLING PROGRAM

2.1 Scope of the Investigation

The proposed subsurface characterization program generally complies with the requirements of O. Reg. 406/19 for a volume of excess soils up to 8,500 m^3. It will be completed to provide the Client with a general indication of the quality of soils that may become excess in the Project Area, and will consist of the following components:

- Auger hole completion; and
- Soil sampling and analysis.

2.2 Areas of Potential Environmental Concern and Contaminants of Potential Concern

Based on the Assessment of Past Uses report completed for the Project Area, the following APECs were identified:

Table 1: Areas of Potential Environmental Concern

Fig. 1 Ref.	Areas of Potential Environmental Concern (APEC)	Location of APEC	PCA	Location of APEC on Project Area	Contamination of Potential Concern	Media Potentially Impacted (Groundwater, Soil and/or Sediment)
1	APEC-1 Likely presence of fill material underlying roadways within Project Area	The Project Area, as seen in Figure 2	30. Importation of fill material of unknown quality	Within Project Area	PHCs, BTEX, PAHs, VOCs, and Metals and Inorganics	Soil and Groundwater
2	APEC-2 Staining on Pavement	Southern end of the Project Area, as seen in Figure 2	Assumed spill of unknown fluids on pavement related to roadway traffic	Within Project Area	PHCs, BTEX, and Metals and Inorganics	Soil and Groundwater

Notes: PHCs – petroleum hydrocarbons
BTEX – benzene, toluene, ethylbenzene, xylenes
PAHs – polycyclic aromatic hydrocarbons
PCBs – polychlorinated biphenyls
VOCs – Volatile Organic Compounds

The above listed items are referenced on Figure 1 (PCA/APEC).

2.3 Auger Hole Locations

A summary of the proposed auger hole locations for the Project Area are provided in Table 2 below. It is noted that the sampling plan targets the areas where the majority of excess soil generation is expected along the Project Area, including areas around culverts:

Table 2: Summary of Proposed Auger Holes and Soil Samples for Chemical Analysis			
Auger Hole (AH) ID	Sample ID	Chemical Analysis	Rationale
AH1	AH1 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area, and APEC-2
AH2	AH2 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH3	AH3 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH4	AH4 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH5	AH5 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH6	AH6 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH7	AH7 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH8	AH8 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH9	AH9 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH10	AH10 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH11	AH11 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH12	AH12 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH13	AH13 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH14	AH14 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH15	AH15 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH16	AH16 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH17	AH17 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH18	AH18 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH19	AH19 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area

Table 2: Summary of Proposed Auger Holes and Soil Samples for Chemical Analysis			
Auger Hole (AH) ID	Sample ID	Chemical Analysis	Rationale
AH20	AH20 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH21	AH21 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH22	AH22 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH23	AH23 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH24	AH24 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH25	AH25 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH26	AH26 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH27	AH27 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH28	AH28 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH29	AH29 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH30	AH30 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH31	AH31 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH32	AH32 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH33	AH33 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH34	AH34 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH35	AH35 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH36	AH36 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH37	AH37 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH38	AH38 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH39	AH39 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area

Table 2: Summary of Proposed Auger Holes and Soil Samples for Chemical Analysis			
Auger Hole (AH) ID	Sample ID	Chemical Analysis	Rationale
AH40	AH40 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH41	AH41 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
AH42	AH42 AU1	PHCs, BTEX, and Metals and Inorganics	General Characterization of imported fill/soil (APEC-1) in Project Area
TBD	QAQC1	Blind Duplicate	Minimum sample requirement 1 of 4
TBD	QAQC2	Blind Duplicate	Minimum sample requirement 2 of 4
TBD	QAQC3	Blind Duplicate	Minimum sample requirement 3 of 4
TBD	QAQC4	Blind Duplicate	Minimum sample requirement 4 of 4
TBD	mSPLP-1	mSPLP - Metals	Grab sample TBD based on “worst-case” contaminant concentration from the laboratory analysis (Minimum sample requirement 1 of 7)
TBD	mSPLP-2	mSPLP - Metals	2 of 7
TBD	mSPLP-3	mSPLP - Metals	3 of 7
TBD	mSPLP-4	mSPLP - Metals	4 of 7
TBD	mSPLP-5	mSPLP - Metals	5 of 7
TBD	mSPLP-6	mSPLP - Metals	6 of 7
TBD	mSPLP-7	mSPLP - Metals	7 of 7
TBD	TCLP-1	TCLP – Metals, Inorganics, Ignitability	Grab sample TBD based on soil cuttings generated during subsurface investigations (Minimum sample requirement 1 of 1)

A plan showing proposed borehole locations on the Project Area is appended to this report as Figure 2 (Proposed Auger Hole Locations).

2.4 Soil Samples

“Worst case” soil samples from each of the above boreholes is to be submitted for laboratory analysis. Each auger hole is proposed to be approximately 0.7 metres (m) deep, or until bedrock is encountered. All soil samples are to be analyzed for the following parameters:

- Petroleum hydrocarbons, fractions 1 through 4 (PHC F1-F4);

- Benzene, toluene, ethylbenzene, and xylenes (BTEX);
- Metals and inorganic parameters (M&I); and
- Sodium adsorption ratio (SAR) and electrical conductivity (EC).

Additionally, some soil samples are to be analyzed for the following parameters based on contaminants of potential concern identified for the Project Area:

- Volatile organic compounds (VOCs); and
- Polycyclic aromatic hydrocarbons (PAHs).

It is noted that if visual or olfactory evidence of contamination is encountered during the subsurface investigation, different or additional samples may be submitted for laboratory analysis to capture the true "worst-case" scenario with respect to potential contamination, at the discretion of the QP overseeing the sampling program.

Additionally, up to eight (8) soil samples will be submitted for leachate analysis; seven (7) modified Synthetic Precipitation Leaching Procedure (mSPLP) samples and one (1) Toxicity Characteristic Leaching Procedure (TCLP) sample. These samples will be selected based on observed "worst-case" contamination levels and/or the greatest likelihood to be contaminated; these samples may be submitted on a "hold" basis to the laboratory and analyzed after receipt of bulk analytical results to ensure that the "worst-case" samples are analyzed.

2.5 Field Screening

Given the potential presence of volatile contaminants (PHCs, VOCs), soil samples will be screened using a photoionization detector (PID) or combustible gas indicator (CGI) in an attempt to determine the "worst-case" samples for laboratory analysis. Field screening measurements will be recorded in our field notes and summarized in the Soil Characterization Report.

3.0 QUALITY ASSURANCE AND QUALITY CONTROL

A summary of quality assurance and quality control measures to be employed during the investigation is provided below.

3.1 Decontamination of Equipment

Auger holes will be advanced using conventional equipment (hand auger and hand shovel). Hand augers and hand shovels will arrive at the Site in a pre-cleaned condition. Between auger holes, the equipment will be cleaned with a brush and washed with a water and Alconox™ solution.

No other non-dedicated sampling equipment is expected to be used.

3.2 Field Duplicates

At least one (1) field duplicate sample will be collected and analysed for each ten (10) "worst-case" soil samples. Field duplicates will be analyzed for all parameters for which their corresponding samples are analyzed.

3.3 Sampling Protocols

The jars and preservatives (where applicable) used in the collection of soil samples will be supplied by the analytical laboratory. The soil samples intended to be submitted for analysis of VOCs and PHCs in the F1 fraction range will be immediately preserved in laboratory provided vials pre-charged with methanol to sequester the volatile compounds.

Soil samples will be labelled as they are collected. Samples will be stored in ice-packed coolers until the samples are transported to the laboratory for chemical analysis. Samples will be either handed over to or dropped off at the laboratory by MP personnel. Chains of Custody for the samples will be prepared using laboratory-provided Chain of Custody forms.

4.0 DATA QUALITY OBJECTIVES

The purpose of the collection of field duplicate samples is to measure the precision or reproducibility of the field and laboratory methodology used in the collection and analysis of the samples. The precision is evaluated in terms of the relative percent difference (RPD) between the analyses of the field duplicate sample and its corresponding original sample. The RPDs of the original and field duplicate samples will not be calculated in situations where one or both of the original and field duplicate samples exhibit concentrations of analyzed parameters that are below the laboratory Reporting Detection Limits (RDLs).

The RPD between the involved samples will be calculated using the following formula:

$$RPD = \frac{(A - B)}{\frac{(A + B)}{2}} \times 100\%$$

Where:
A = concentration of compound in the primary sample
B = concentration of compound in the duplicate sample

Notes:

- RPD is calculated only for result pairs with concentrations greater than 5 times of the method detection limit in both samples; and
- RPDs are not calculated where results are below the laboratory RDLs for sample pair.

The acceptable RPD limits for various analyzed groups are listed in the following table:

Parameter Group	Recommended RPD in Soil	Recommended RPD in Groundwater
PHC	30%	30%
VOCs	50%	30%
PAHs	40%	30%
PCBs	40%	30%
1,4-Dioxane	50%	30%
Dioxins/Furans	40%	30%
Organochlorine (OC) Pesticides	40%	30%
Metals	30%	20%
Hexavalent Chromium, Cr(VI)	35%	20%
Cyanide (CN–)	35%	20%

Parameter Group	Recommended RPD in Soil	Recommended RPD in Groundwater
Fraction Organic Carbon (FOC), Chloride	35%	20%
Methyl Mercury	40%	30%
Electric Conductivity	10%	-
pH	Within 0.3 pH units	-
** Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act - Laboratory Services Branch Ministry of the Environment - March 9, 2004, amended as of July 1, 2011*		

Laboratory quality control limits for duplicate, method blank, method blank spike, matrix spike and surrogate recoveries will also be reviewed.

5.0 STANDARD OPERATING PROCEDURES

McIntosh Perry has implemented a Standard Operating Procedures (SOPs) program for environmental field activities. The SOPs are regularly updated and are provided to field staff as needed. SOPs applicable to this program may include:

- SOP 1-01: Field Notes and Record Keeping
- SOP 1-02: Field Equipment
- SOP 1-03: Sample Management
- SOP 3-01: Planning a Phase Two ESA Field Program and Creating a SAP
- SOP 3-02: Naming Conventions – Boreholes, Test Pits, and Other Sampling Locations
- SOP 3-03: Naming Conventions – Individual Soil and Groundwater Samples
- SOP 3-04: Duplicate Samples
- SOP 3-05: Underground Service Locates
- SOP 3-06: Soil Sample Management and Disposal
- SOP 3-07: Cuttings and Purge Water Management
- SOP 3-14: Hand Auger and Shovel Sampling
- SOP 3-15: Sample Selection and Submission for Delineation of Contamination
- SOP 3-22: Description of Soil Samples
- SOP 3-24: Field Screening of Samples – Soil Vapour
- SOP 3-27: Phase Two ESA Report

6.0 CONCLUSIONS

This Sampling and Analysis Plan has been completed to provide the Client with a general indication of the quality of soils that may become excess in the Project Area. The proposed SAP generally complies with the O. Reg. 406/19 Regulatory requirements for up to 8,500 m^3 of excess soils that could be generated in the Project Area. Additional excess soil characterization may be required if the volumes of excess soils generated during this project exceed 8,500 m^3. The Contractor will be responsible for ensuring the appropriate number of excess soil samples are collected during construction. Based on the forementioned, the total recommended auger hole and sample numbers can be summarized as follows:

- 42 auger holes
- 42 original bulk samples
- 4 blind duplicate bulk sample
- 46 bulk samples (total)
- 8 leachate samples

7.0 LIMITATIONS

This report has been prepared, and the work referred to in this report has been undertaken by, McIntosh Perry for the Client. It is intended for the sole, and exclusive use of the Client with respect to the stated purpose of the work carried out by McIntosh Perry.

The report may not be relied upon by any other person or entity without the express written consent of McIntosh Perry. Any use which a third party makes of this report, or any reliance on decisions made based on it, without a Reliance Letter, are the responsibility of such third parties. McIntosh Perry accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report, or the information contained within it.

The investigation undertaken by McIntosh Perry with respect to this report and any conclusions or recommendations made in this report reflect McIntosh Perry's judgment based on the Site conditions observed at the time of the Site investigations, inspections, and/or sampling on the date(s) set out in this report, and on information available at the time of the preparation of this report. Conditions such as ground cover, weather, physical obstructions, etc. may influence conclusions or recommendations made in this report. McIntosh Perry does not certify or warrant the environmental status of the property.

This report has been prepared for specific application to this Site and it may be based, in part, upon visual observation of the Site, subsurface investigation at discrete locations and depths, and/or specific analysis of specific chemical parameters and materials during a specific time interval, all as described in this report. Unless otherwise stated, the findings cannot be extended to previous or future Site conditions, portions of the Site which were unavailable for direct investigation, Site locations, subsurface or otherwise, which were not investigated directly, or chemical parameters, materials, or analysis which were not addressed or performed. Substances other than those addressed by the investigation described in this report may exist at the Site, substances addressed by the investigation may exist in areas of the Site not investigated, and concentrations of substances addressed which are different than those reported may exist in areas other than the locations from which samples were taken.

If Site conditions or applicable standards change, or if any additional information becomes available at a future date, modifications to the findings, conclusions and recommendations in this report may be necessary.

8.0 SIGNATURES

We trust that this information is satisfactory for your present requirements. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Respectfully submitted,

McIntosh Perry,

Jan. 11, 2024

Pamela Muniz, G.I.T.
Environmental Scientist

Mark Priddle, P. Geo., FGC
Senior Consultant

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SAMPLING AND ANALYSIS PLAN
ZADOW ROAD, BONNECHERE VALLEY, ON

FIGURES

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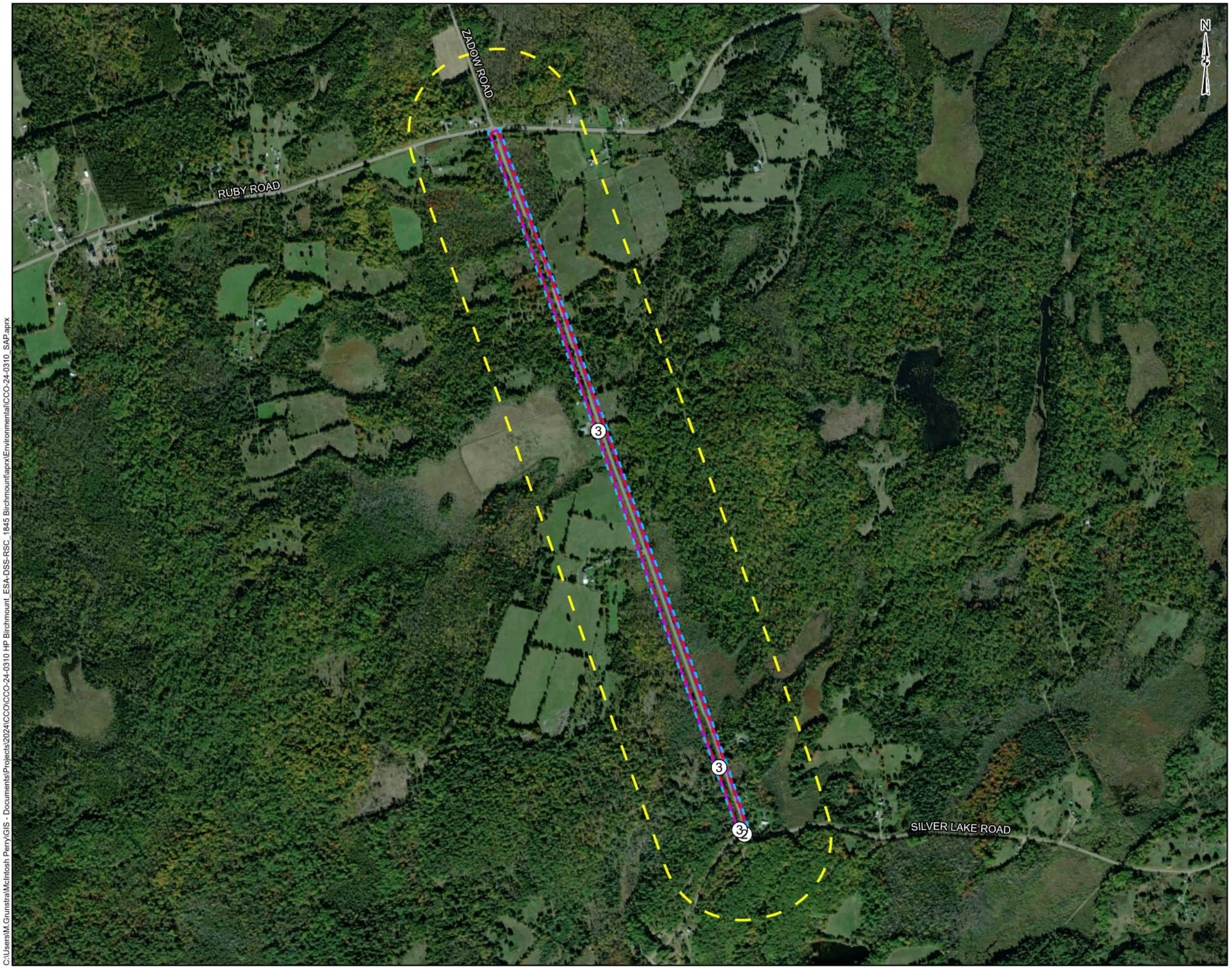

LEGEND

- Project Area
- Buffer (250 m)
- Project Area - Importation of fill material of unknown quality (PCA/APEC-1)
- **2** Project Area at Silver Lake Rd intersection - Staining on pavement (PCA/APEC-2)
- **3** West adjacent to Project Area - Presence of pole mounted transfomer (PCA)

REFERENCE

GIS data provided by the Ontario Ministry of Natural Resources and Forestry, 2023.

250 125 0 250

Scale 1:11,500 Metres

CLIENT: TOWNSHIP OF BONNECHERE VALLEY

PROJECT: SAMPLING AND ANALYSIS PLAN
ZADOW ROAD

TITLE: PCA/APEC

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PROJECT NO: CCO-23-3669		FIGURE: 1
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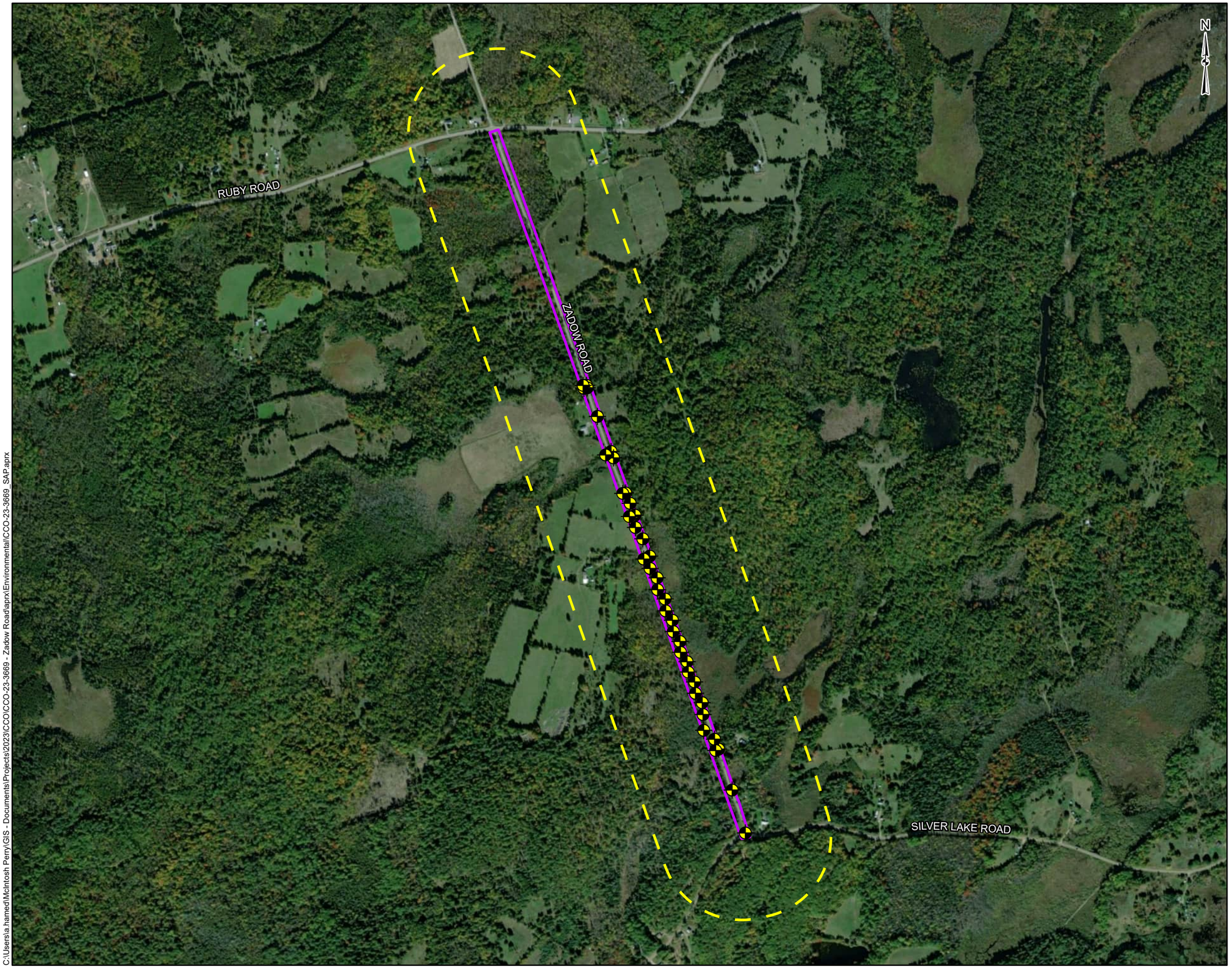

LEGEND

- Proposed Auger Hole Locations
- Project Area
- Buffer (250 m)

REFERENCE

GIS data provided by the Ontario Ministry of Natural Resources and Forestry, 2023.

250 125 0 250

Scale 1:11,500 Metres

CLIENT: TOWNSHIP OF BONNECHERE VALLEY

PROJECT: SAMPLING AND ANALYSIS PLAN
ZADOW ROAD

TITLE: PROPOSED AUGER HOLE LOCATIONS

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PROJECT NO: CCO-23-3669	FIGURE: 2
Date	Dec., 08, 2023
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SAMPLING AND ANALYSIS PLAN
ZADOW ROAD, BONNECHERE VALLEY, ON

APPENDIX A: STANDARD OPERATING PROCEDURES

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SOP 1-01: GENERAL FIELD NOTES AND RECORD KEEPING

Objective

In environmental geoscience and engineering, what we do depends on, and effects, conditions in the real world. And since our field notes are the record of our observations of, and interactions with, the real world, they are the foundation of the project. Everything depends on the quality of data collected in the field, and our ability to clearly record those data and find them when we need them.

Because we never quite know what will happen on a project, we never know when, why, and in what capacity our field notes may be called on in the future. They may be called upon in regulatory proceedings or court cases, and in this sense, they are ***legal documents***. But of equal importance is ***telling the story*** of what happened on-site and why it happened. Hard data (such as sample depths and IDs, survey data) are important, but so are weather conditions, time of arrival on-site, and information such as why a borehole was moved or terminated at a certain depth, whether a surface water location was dry or inaccessible, or whether anything interesting was going on on-site since the last time you were there. It may not seem very important now but might be more important later, especially when trying to make sense of something unexpected.

The guiding principle of your field notes should be "***memorize nothing***." Somebody unfamiliar with the project should be able to get a good idea of what was done, and the reasoning behind it, from properly collected and managed field notes.

Field notes may be recorded in field books (which may hold notes from multiple projects) or on paper pads (e.g., McIntosh Perry graph paper) or field forms (e.g., borehole log forms).

Procedure: Field Books

- Use Cansel, Duksbak, or Rite-In-The-Rain field books depending on availability and weather conditions;
- Name of field staff along with McIntosh Perry should be clearly printed on the outside and inside cover of the book. Project numbers/table of contents should also appear on the first few pages (most surveying-type field books have dedicated pages for this). A business card taped on the inside cover with clear tape is also a good idea;
- Every staff member's field books should be numbered sequentially and should show the date range in which the book was used;
- For long/ongoing projects, a dedicated project field book is recommended;
- For multiple-project field books, the following should appear at the top of every page:
    - Project number;
    - Date;
    - Name or initials; and,
    - Page number (e.g. 1 of 3, 2 of 3, 3 of 3).

- The project number need not appear on each page for project-specific field books; and,
- Pages should never be intentionally torn out of a field book. If this happens accidentally, replace the page with tape if possible, and if not, provide an explanation on the following page.

Procedure: Individual Pages or Field Forms

- If notes are being taken on paper pads or field forms, these pages should be secured within a binder or clipboard at all times, especially during windy conditions;
- Appropriate protection from weather should be provided (e.g., cover with a plastic bag if raining);
- If notes are made directly on plans, retain the plans in the project file and make reference to the plans in the project field notes. Date, project number, and name or initials should appear on each marked-up plan used in the field; and,
- Project number, date, name/initials, and page number should appear on each page as above (McIntosh Perry graph paper has fields provided for this information).

Procedure: Field Notes

- Whether using individual sheets of paper, plans, or field books, all field notes should be photocopied and/or scanned and placed/saved in the project file upon the completion of field work;
- Ink or pencil are both acceptable for field notes. If using ink, blue or black are preferable;
- Do not erase or black out any errors or corrections. Instead, strike through so that original text is legible, and provide your initials and reason for correction;
- Write notes as clearly and legibly as possible;
- Use neutral language and report facts and professional (not personal) opinions;
- For each day of field work, the following should appear on the ***first*** page of your field notes:
    - Site location (address if known), client, project description, any other information useful in uniquely identifying the site (e.g. MTO contract number);
    - Individuals on site (McIntosh Perry staff, contractors, client representatives, MOECC or MOL representatives, etc.) and time of arrival (for yourself and, if known, for others);
    - Vehicle mileage if applicable;
    - Weather conditions (e.g. overcast, -3°C, light wind from southwest);
    - Objectives/reason for visit (e.g. “McIntosh Perry staff on-site to complete drilling and monitoring well installation for Phase 2 ESA; McIntosh Perry staff on-site to complete quarterly groundwater monitoring”); and,
    - Field equipment used.

- For each day of field work, the following should appear on ***last*** page of your field notes:
    - Brief summary of work completed;
    - Summary of intentions or important tasks to be completed next day or next time on-site;
    - Time off-site (for yourself and, if known, for others); and,
    - Summary of major expenses and/or consumables used.

- To the extent that you can reasonably find out while doing your job, record who enters and leaves the site during your time there, and why (e.g., MOL staff on-site to conduct surprise inspection, MOECC staff on-site to inspect pump-and-treat system, client on-site to review progress, etc.);
- Record any instructions you receive from clients, project managers, contractors, regulatory authorities, etc., or if you are calling the office for advice, provide a brief description of questions and answers;
- Record any instructions you give to contractors, clients, etc.;
- Note the cause and duration of any delays;
- Note interaction with neighbours, public, wildlife, etc., if relevant; and,
- Note any changes to work plan (e.g., can't drill in a select location due to locates issues, can't find a MW, etc.), who (if anyone) you informed, what their response was, and how you decided to proceed.

Procedure: Field Plans

- Whenever possible, take a copy of an existing plan or air photo with you into the field to mark up. This will allow you to scale and/or orient any features observed in the field with real-world objects;
- Existing plans, air photos, or field sketches should all have the following information clearly shown:
    - Project number;
    - Date;
    - North arrow; and,
    - Your initials.
- If shooting GPS coordinates of site features, indicate waypoint identification on plan, or name your waypoints corresponding to the site features you are shooting;
- Sometimes, a field sketch must be created from scratch. Field sketches should show all relevant site features, ideally in sufficient detail to locate everything later without GPS coordinates (although shooting GPS coordinates is recommended);
- Field sketches should either be drawn to scale using graph paper (with the scale factor or scale bar, i.e., metres per square of graph paper, clearly shown), or should clearly state "not to scale" with all relevant dimensions shown; and,
- As with field notes, field sketches should be scanned upon return to the office.

Procedure: Office Notes

- Much of what goes on in the office does not need to be documented in the same level of detail as field notes. Meeting minutes are beyond the scope of this SOP, and personal timekeeping/ project notes are left to the discretion of the individual;
- However, certain things should always be documented, including:
    - Any discussions regarding change of scope or budget with the client;
    - Communication with regulatory authorities; and,
    - Contact information of key personnel.

- In this age of email, most communication of this nature can be saved in the electronic project folder. However, if you have a phone call with a client, contractor, or regulatory authority, it is best to write down a summary of the phone call or to send an email summarizing what was discussed and action items for their record and/or review.

Revision History

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Reviewed by Mark Priddle February 2018
Updated by D. Arnott March 2018

SOP 1-02: CARE, MAINTENANCE AND CALIBRATION OF FIELD EQUIPMENT

Objective

Whether we own it or rent it, it is worth the extra effort to take good care of field equipment. If we own it, it's obvious that we should take care of something we paid for. But when rental equipment is damaged, we pay for it anyway. Pine Environmental in particular keeps a close eye on the condition of their equipment. And of course, what should go without saying is that well-maintained equipment will produce the most reliable and representative field data (see SOP 1-01).

Procedure: Field Equipment Storage

- This will vary from office to office, but the general principles are the same;
- If you need a piece of equipment, don't assume it will be there. Check with your colleagues as far in advance as possible before taking it out of the office:
    - Also, if you know you need something, tell your colleagues.
- It's often preferable to rent equipment for specific jobs – water level tapes, for example – this way, the office water level tape can remain at the office in case anything comes up last-minute. Rental cost is built into the budget of most projects;
- Long-term jobs should have dedicated equipment that's kept at the job site or with the field staff responsible so it's always there when they need it; and,
- If you take something, put it back where you found it, in the condition you found it (or better).

Procedure: Field Equipment Calibration

- Most field equipment is rented on a job-specific basis, and is calibrated by the rental company prior to delivery. Equipment should come with a certificate of calibration, which should be saved in the project file;
- For equipment owned by McIntosh Perry, equipment calibration instructions are provided in equipment manuals. These should be referred to when calibrating equipment;
- If reference/standard solutions are required as part of the calibration procedure, these solutions should be kept in their provided containers. These solutions often have expiry dates (printed on containers), and should be discarded once they are expired;
- The turbidimeter requires calibration to reference standards each time it is used. Reference standards should be maintained in good condition at all times (they are kept in the equipment case) and should be cleaned with KimWipes before use (for this purpose, a stash of KimWipes should also be kept in the equipment case);
- For equipment owned by McIntosh Perry, a record of calibration should be kept, including:
    - Name and address of location (e.g., 115 Walgreen Road, Carp, ON, K0A 1L0);
    - Project number;

- Instrument information (make, model, serial number, software version, if applicable);
- Date of calibration;
- Calibration method (3-point, 2-point, single-point) and any variation from standard procedures;
- Conditions in which calibration is carried out (approx. temperature, instrument options);
- Measurements received; and,
- Name and signature of staff member performing calibration.

Procedure: Field Equipment Decontamination

- If equipment is used on a contaminated site, it should be decontaminated following use and prior to storage. It should be able to be assumed that any equipment in storage has been decontaminated. However, if there is any doubt that equipment has been decontaminated before bringing it to the next site, it should be decontaminated (preferably in the office);
- Not all equipment can or should be decontaminated using the methodology below – for example, pH or dissolved oxygen probes requiring their own storage solutions should be rinsed with deionized water only and then placed back in their storage solution (this will be specified in the equipment manual); however, the following method will work for most equipment:

  - Prepare a solution of Alconox according to the instructions on the carton;
  - Carefully wash the equipment in the Alconox solution, gently removing any visible contamination by hand or using a scrubbing tool that will not damage equipment;
  - Rinse the equipment using tap water; and,
  - Do a final rinse using deionized water.

- A record of decontamination should be maintained in the project file.

Revision History

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Updated by D. Arnott March 2018

SOP 1-03: HANDLING, STORAGE, AND SHIPMENT OF SAMPLES

Objective

Analytical testing of soil, groundwater, surface water, and asbestos samples is a critical component of much of the work we do – Phase 2 ESAs, designated substance surveys, groundwater monitoring programs for solar farms, hydrogeological investigations, landfill monitoring programs, and domestic well testing programs. Often, acquiring a sample comes at great expense – our time, travel expenses, and subcontractor costs such as drilling contractors or pump rental. It's not unusual to travel a day out and a day back for what can be as little as an hour's work to acquire a few samples (particularly for northern MTO work). If, for whatever reason, a sample can't be analyzed, or if its results are called into question and can't be relied upon, all the costs associated with acquiring those samples go out the window.

With planning and communication, it's possible to consistently obtain high-quality samples and get them to the lab within their specified hold time, at an appropriate temperature and in good condition. The following SOP outlines a few things that are helpful to remember.

When in doubt, ***talk to the laboratory***. Give them the full context of what you're trying to accomplish with your sampling program, and they will tell you what you need from their perspective. This should be done ***before you go into the field to take your samples***.

Procedure: Sample Labelling

- Sample bottles should be labelled with an indelible writing instrument. Different labs use different types of labels - sometimes pencil won't leave a mark, or pen or marker will wipe off - so see what works before you go out into the field. Test your writing out with a little water to see if it washes off, since your sample bottles will likely get wet. Most labs can pre-label bottles if sample IDs are known prior to entering the field - in this case only date and time of sample will need to be added to the label;
- Sharpies are sometimes discouraged from use for labelling bottles because they contain BTEX, but it's been our experience that writing on the exterior of the bottle won't affect the contents inside unless you get sharpie on your gloves and then handle samples (don't do this; change your gloves if you have to);
- Methanol and other chemicals from preserved laboratory vials and bottles will cause permanent marker to run. Place your soil cores within the preserved vials to prevent any splashback down the exterior of the vial which might cause the marker to run (this is also covered in various SOPs in Section 3). Be careful not to spill preservative found in these vials or water sample bottles; also do not use a sample bottle if it appears to have leaked (this is evidenced by a yellow staining on the label, or strong smell);
- Your writing must be legible by staff at the lab, or they will call you to inquire about sample IDs. Even if you can read your writing and they can't, you won't have the bottle in front of you. There's no reason to have to guess what a sample ID is;

- The following information should appear on every sample bottle, usually in lab-provided fields:
    - Sample ID;
    - Date;
    - Time (particularly important when sampling wastewater or drinking water for bacteriological parameters with short hold times);
    - Company name (McIntosh Perry); and,
    - Project number and phase.

- Sample IDs used on sample jars or bottles should be completely consistent with what appears on plans and chains of custody. Putting "BH7-1" on one and "7-1" or "BH7-SS1" on the other is unacceptable. Our sample IDs are short and simple and there's no reason not to be consistent;
- If possible, and if you're fairly certain which samples you're going to take (e.g., a landfill with set sampling locations instead of a contaminated site investigation where you're not sure what will be contaminated), label your bottles and jars ahead of time. This makes the field day quicker. Do it in the warmth of your car if you can, or as noted above have the lab pre-label the bottles;
- This isn't very common anymore, but sometimes jars or bottles don't have labels stuck on them yet. If you can, stick these on before you get out into the field (cold/wet can affect label adhesion);
- If you order pre-labelled bottles check these labels against sample locations on plans and make sure the lab labelled the bottle correctly. Re-label lab containers if necessary. If the lab has made an error, make note of which locations need to be corrected and let the lab know before the next sampling event;
- Duplicate samples should be labelled as per the conventions outlined in SOP 3-02. Make sure you record which location a field duplicate sample was taken at; and,
- Trip blanks should be provided by the laboratory and should appear on the chain of custody as they are labelled by the lab.

Procedure: Sample Handling (Transportation and Storage)

- No matter which parameters are analyzed, it's always good practice to store your samples in an ice-filled cooler for transport. Strictly speaking, you don't need a cooler if they are to be submitted within 24 hours of sampling, but sometimes complications arise unexpectedly. A cooler will keep your samples warm in the winter and cool in the summer, as well as protect the bottles from breakage when handling;
- Labs should always provide coolers. Ask the labs to underfill the coolers when they pack them with your sample bottles and send them. An underfilled cooler gives us enough room to pack them with ice;
- Ice can be bought at most variety stores, gas stations, grocery stores, etc. BUY ICE. Charge it to the job. It's worth the stop;
- If for whatever reason you can't stop for ice, and its winter, pack some sealable bags with snow or naturally-occurring ice. Try to use clean material;

- Ice should ***not*** be kept loose in coolers. Put it in Ziploc bags. Likewise, sample bottles should be kept in sealable bags (usually provided by the lab). The point of this is that sample bottles or jars should never be floating in meltwater in the bottom of the cooler. All bottles will (of course) be properly sealed, but if they're floating in meltwater, there's the chance that some could get in and contaminate your samples. Or, more likely, the lab will put a qualifier on your samples;
- If possible, especially in summer/on hot days, get ice in the morning and pre-fill/pre-chill your coolers at the beginning of the day. Get more ice at the end of the day if necessary;
- If you are submitting your samples the next day, put them in the office fridge overnight. Often, the lab ships samples with cool packs, which can be kept in the freezer until the job is done, and then put in the cooler on the day you're shipping your samples back to the lab;
- If there's no room in the fridge AND you need to keep your samples overnight/submit them the next day, get some more ice to keep them cool overnight;
- Don't leave your samples in the car overnight during winter. They might freeze and the bottles might crack;
- Bubble-wrap 40 mL vials as a minimum. Bubble wrap as many glass bottles as you have bubble wrap for. Bottles should not be rolling loose around the cooler. Ice can help to cushion bottles, and so can choosing the right sized cooler (this will somewhat depend on what the lab sends you);
- Don't write on the septa of 40 mL vials with a sharpie or other marker - this gets pierced by lab equipment, and if it's written on/contaminated, could introduce false positives to your sample;
- If shipping the coolers, indicate cooler number and total number of coolers on each cooler (e.g. 7 of 9);
- If shipping the coolers, make sure the drain plug on each cooler is closed. Couriers will not ship a leaking cooler. Theoretically, nothing should get out anyway since all your ice is in sealed bags and all your bottles are packed so as not to break, but better safe than sorry. It is also a good idea when shipping coolers long distances to line the cooler with a large garbage bag and place sealed sample and ice bags within the garbage bag and tape it shut; if an ice bag happens to break there will be no leakage from the cooler; and,
- For long distance shipping it is good practice to place ice filled bags on the bottom of the cooler, then samples bottles wrapped and sealed with bubble wrap, then another layer of ice filled bags on the top. All sealed within in a garbage bag, as noted above and then use bubble wrap or air filled bags to pad any empty voids in the cooler to prevent breakage.

Procedure: Chain of Custody Records

- Chain of Custody protocols stipulate that you have care and control of the samples you take, so don't let them out of your sight unless they're in a secure location. It's best to take them with you if you're travelling to different areas on the site. Lock your car if you stop for a coffee. Sometimes (especially with landfills) they must be left unattended in the back of a truck, but this should be avoided if possible;

- It always helps to lay your samples out when you're filling out your chain of custody - this ensures that everything on the COC is in the cooler and vice versa, and provides an extra double-check for consistency between sample containers, field notes, and COCs;
- Confirm which standards you're comparing your samples to, and whether it's in support of an RSC and/or for drinking water. For some labs, samples submitted for RSC and drinking water projects may require a certain type of COC. Noting the applicable site condition standards will determine which methods/detection limits the lab uses when analyzing your samples;
- Use AGAT for Quebec samples. Be advised that there are different parameter groups and even analytical methods (especially for PAHs) when comparing to Quebec's MDDELCC or Federal CCME criteria;
- Fill out COCs completely, and double-check anything you're not sure of with the project manager;
- If samples are to be held by the lab, indicate "HOLD" next to the sample or in the comments section on the COC. We might do this if we have taken/jarred TCLP or delineation samples, but don't know if we need them (or have client approval to bill for their analysis) until we get the results of the first few samples. If you think a sample might be analyzed, it's always safer in the hands of the lab (which is to say, it puts the liability on them);
- Fill out all fields on COCs completely. For date, etc., if you have multiple samples taken on the same date, don't use ditto marks or arrows. Write the date out completely for every sample. This takes a little extra time but shows that we are careful and thorough (and if any notes etc. are called into question/go to court, it adds credibility);
- Show the work order number, quote number, or standing offer number on the COC. Often, we will be getting a better price than the lab's standard rates, and if they don't have a reference, they may charge an increased rate;
- Sign and date the COC prior to sample pick-up or shipping, with your name and the date legibly printed as well; and,
- Avoid submitting samples for bacteriological analysis on a Friday. The analytical process takes 2 days, and not all labs have analysts on-call on the weekends, and if your sample sits all weekend, the hold time will be exceeded. Ask the lab beforehand if you have any questions. Sometimes they can accommodate us or outsource the sample. Also check with labs in areas you are not familiar working in (i.e. some labs in Mississauga ship bacteria samples to Ottawa, so bottles need to be received before 3 pm); also several labs only have depots in some areas and need to time to ship the samples to their full labs (e.g., Thunder Bay).

Procedure: Trip Blanks

- The lab will provide trip blanks for VOC analysis if requested. It is good practice to request a trip blank if you are sampling groundwater for VOCs in support of an RSC application. You will have to budget for the analysis of one more VOC sample. It is recommended that one trip blank be completed for every day of sampling, although one trip blank per project is usually fine too;
- DO NOT OPEN THE TRIP BLANKS. See SOP 3-04 for field blanks;

- Trip blanks will usually come pre-labelled by the lab. If so, use their labelling on your COC. Date will usually be "N/A". If not, name the trip blank "Trip Blank" - no need to use blind IDs; they prepared it, they know what it is; and,
- Keep your trip blank in the cooler all day as you sample. This is another good reason to pre-chill your cooler. As you add samples, if one of your samples is exuding VOCs strongly enough to contaminate other (possibly clean) samples, the trip blank will pick it up. You won't be able to rely on data from that day of sampling, but now you know and can make recommendations to sample again.

Procedure: Sample Storage (Office)

- Soil samples which are not going to be submitted should be stored in the shed in a clearly-labelled box. Samples should be held for 6 months and then discarded (this is further discussed in SOP 3-06). Boxes should contain project name and number, dates of drilling, and possibly date of projected disposal. Set an Outlook reminder for date of disposal;
- Samples which may be submitted should be kept in the fridge until they have exceeded their hold time. After that, they can go into storage boxes with the rest of the soil samples; and,
- Do not store samples at your desk and for short term storage store samples somewhere out-of-the-way where people won't trip over them.

Revision History

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SOP 3-01: PLANNING A PHASE 2 ENVIRONMENTAL SITE ASSESSMENT AND CREATING A SAMPLING AND ANALYSIS PLAN

Objective

When completing a Phase 2 ESA to O.Reg. 153/04 (as amended), a Sampling and Analysis Plan is one of the required appendices. Although these have historically not been prepared for all Phase 2 ESAs (especially in Ottawa and Kingston), it's a good practice to begin to implement, as it can help us get a clear idea of exactly what the objectives are, and give us a handy reference document in the field.

Phase 2 ESA field programs, and Sampling and Analysis Plans, are always subject to change based on field conditions.

Procedure: Planning a Phase 2 ESA

- The planning of the Phase 2 ESA begins in the proposal stage (if a Phase 2 ESA is part of the Terms of Reference for the assignment), or during the completion of the Phase 1 ESA (when the APECs are being identified);
- Confirm and clarify the scope and objectives of the Phase 2 ESA with the client, depending on the context of the report:
    - Are we recommending the Phase 2 based on a Phase 1, and are we unsure whether there is contamination? We should put our holes in the areas most likely to contain contamination, to determine whether contamination **is present or absent**;
    - Do we have some background info, or do we know there is contamination but don't know how much? We should put enough holes in to determine **the vertical and lateral extent of soil and/or groundwater contamination**. This is sometimes done as a separate "supplemental" Phase 2;
    - Make sure you discuss this with the client and understand their expectations. If we deliver a presence/absence Phase 2 when they're expecting a full delineation Phase 2, they may feel that we have not met their expectations on the assignment; and,
    - It is recommended to complete a presence/absence Phase 2 first if we are not sure samples will exceed the Site Condition Standards for Contaminants of Potential Concern. If we submit extra/delineation samples and the suspected worst-case samples are in compliance with the SCS, it's an unnecessary expenditure. However, sometimes if obvious contamination is found and SCS exceedances are certain, it's sometimes worth talking to the client and doing some more work while the drill rig is on-site. This requires budget adjustments and approvals, and is usually to be avoided.

- When doing a Phase 1 ESA site visit, if you see APECs which might require a Phase 2, make note of how accessible those APECs are to a drill rig or a backhoe for test pits. Make note of overhead services, underground services (if visible by old markings or asphalt cut), parking lanes, clearances from buildings, other constraints, etc.;

- When preparing a budget and proposal for a Phase 2 ESA, keep track of how much time you spend and build it into the quote if possible (sometimes we can charge for the Phase 2 ESA planning process if tasks are done during proposal preparation);
- Based on site conditions, determine how you are going to take your samples – drill rig or backhoe/shovel:
    - Drilled or cored boreholes are often best for the initial investigation – they have a smaller footprint, and allow for the sampling of soil AND groundwater (if wells are installed) for situations where we don't know which (if any) media are contaminated;
    - Test pits are useful for delineation programs in cases where we have shallow soil impacts but no groundwater impacts, OR for sites where we want to determine groundwater infiltration conditions in preparation for remediation (a test pit is an analogue for a small remedial excavation and will allow you to observe GW infiltration in ways that a borehole won't); and,
    - For delineation programs with shallow soil impacts, solid-stem augers or Geoprobe/Geomachine type rigs can be useful as well for many shallow, quick holes.
- Determine where your boreholes or test pits will be located, based on identified APECs (see SOP 2-01) and on site conditions. Put your proposed BHs or TPs directly in the footprint of the APEC if you can, or adjacent or as close as possible in the downgradient direction if you can't (site access constraints, operational facility, existing tank you don't want to drill through, etc.):
    - This may change sometimes once you receive your locates, and a proposed location is cleared or not. When laying out your BHs or TPs, include a few extra locations, in the event that there are utility conflicts with one or more of them.
- Determine how deep you would like your BHs or TPs to go. Usually to refusal, to intercept the GW table, or in the case of delineation Phase 2 ESAs, below the lowest observed depth of contamination. For sites with shallow bedrock or refusal expected, know that you will need to core bedrock (or drill it with an air hammer) in order to install a MW and obtain a GW sample;
- Determine which contaminants you would like to test for. This will be based on your Contaminants of Concern (see SOP 2-01);
- Regardless of your Contaminants of Concern, it is prudent to plan on submitting one (1) sample for analysis of pH (this may affect which analytical tables you use, and is especially important for RSCs) and one sample for Grain Size Analysis;
- If you have some idea of the anticipated level of contamination, plan for the appropriate level of decontamination, personal protective equipment, and cuttings management/disposal;
- After you have decided which parameters you are analyzing for, determine which laboratory you are using. Use our Standing Offer prices to determine your analytical cost, or request competitive quotes if the budget is tight;
- Start the Ontario One-Call public utility locates process. See SOP 3-05;

- Retain a drilling contractor. Give them as much detail as you can about the job, and ask them to submit a quote. Select a successful quote based on price, availability, equipment, and/or relationship with driller;
- Determine which MP field staff will complete the field program. If possible, the same staff should remain involved through the entire project for consistency and a feeling of investment;
- Determine whether any rental equipment is required to complete the job. This can be rented from PINE (or we may have it in-house);
- Ensure the availability of any in-house equipment – See SOP 1-02;
- Determine your vehicle needs, and either drive your own or rent one, per MP corporate policy;
- Procedure: Creating a Sampling and Analysis Plan;
- SAPs should be created in draft prior to the completion of field work and finalized after, for reasons discussed below;
- According to O.Reg. 153/04 (as amended), the Sampling and Analysis Plan should include the following:

    - Location, depth, and rationale for all sampling locations;
    - Quality assurance and quality control program;
    - Data quality objectives;
    - Standard operating procedures; and,
    - Descriptions of any physical impediments that interfere with or limit the ability to conduct sampling and analysis (this is one section which may change based on the results of the field investigation).

- It is useful to summarize the location, depth, and rationale for all sampling locations in tabular form. This can/will change based on the results of the field program;
- The QAQC component of the SAP should include the following:

    - Specification of minimum requirements for number, type, and frequency of field QC measures including trip blanks, field duplicates, and calibration checks on field instruments (for most of our purposes, one equipment calibration at the start of the project is sufficient);
    - Confirmation that one duplicate is submitted for every 10 samples in a given medium (see SOP 3-04);
    - Confirmation that a trip blank was submitted if VOCs were analysed (this is good practice and should be expanded from the current procedure of only submitting trip blanks for RSCs, or sites with known VOC contamination); and,
    - Statement that all non-dedicated sampling and monitoring equipment is cleaned after each use (although this info is also contained in the SOPs).

- The SAP should contain a statement of the data quality objectives for each set of field data, such that the decision making is not affected and the overall objectives of the assessment are met. This is usually stated in terms of relative percent difference (RPD). Bob/CCI have a good section for this;

- The SAP should contain, as an appendix, all SOPs pertaining to the activities undertaken as part of the Phase 2 ESA, including, as applicable:
    - Borehole drilling (MP SOP 3-07 to 3-12);
    - Excavating (MP SOP 3-13);
    - Soil sampling (MP SOP 3-14, 3-15, 3-25);
    - Field screening measurements, including calibration procedures (MP SOP);
    - Monitoring well installation (MP SOP 3-16);
    - Monitoring well development (MP SOP 3-16);
    - Field measurement of water quality indicators, including calibration procedures (MP SOP 3-20);
    - Sediment sampling (MP SOP 3-31); and,
    - Groundwater sampling (MP SOP 3-21).
- The "Location, depth, and rationale" section should include identification of and rationale and procedures for:
    - The choice of sampling system (referring sample selection rationale – judgemental, random, or grid);
    - Sample media;
    - Number of samples;
    - Sampling frequency;
    - Sampling points (in this case, refer to figures in body of report);
    - Sampling depth intervals, including the screened intervals of the monitoring wells; and,
    - Samples to be submitted for lab analysis.
- A sample Sampling and Analysis Plan will be prepared and provided shortly.

Revision History

Original material taken from 'Phase II Environmental Site Assessment Methodology, McIntosh Perry Consulting Engineers Ltd.', March 2007

SOP 3-02: NAMING CONVENTIONS FOR SAMPLING LOCATIONS

Objective

In general, the goals for the naming of new sampling stations should be clarity, consistency with previous and current work, and efficiency. What this means is, for every report we write or plan we draft, there should be no duplicate sampling location numbers (i.e. MP will drill many BH1s over many projects, but there should never be two BH1s in the same report or on the same plan that might be confused).

Existing sampling locations established by others should not be changed unless there is a very good reason to do so. If we find, for example, monitoring wells, and we do not have any information on their location names, we can assign names for the purposes of the project. It should be made clear that these were not drilled by us. See below.

Procedure: Naming Boreholes

- Boreholes should be numbered sequentially, starting with BH1, BH2, etc. No dashes or spaces;
- If multiple sites or multiple areas of a site are being investigated under the same project number, or will appear on the same plan or in the same report, you can add a two or three letter prefix, as appropriate, relating to the name of the site:

  BH1, BH2, BH3

  - See our Lanark County rails-to-trails Phase 2: The first boreholes at Pakenham, Almonte, and Carleton Place were labelled PKN-BH1, ALM-BH1, and CP-BH1, respectively:

    PKN-BH1, ALM-BH1, CP-BH1

- If others have previously done investigative work at the site, and have used different nomenclature, we can still start with BH1, etc. But if they have used BH1, etc., we can add a McIntosh Perry prefix – MP-BH1, MP-BH2, etc.:

  MP-BH1, MP-BH2, MP-BH3

- If we have completed previous work at the site, and done, say, BH1 through BH6, and we're going back to do more work, we should ideally resume with BH7, BH8, etc. We can differentiate between different drilling programs on site plans using different coloured borehole symbols corresponding to the date;
- Locations to be recorded on plan and in field book. Details in BH logs.

Procedure: Naming Environmental Monitoring Wells

- We often have environmental sites where some BHs are instrumented with MWs and some are not. NEVER re-start numbering when the first MW is installed (i.e., if collocating the first monitoring well with the BH3, do name the well MW1). Instead, label boreholes and MWs as follows:

BH1(MW), BH2, BH3(MW), BH4

- If other consultants use the MW1, MW2, MW3 convention, our BH#(MW) convention should be sufficiently clear. However, in this case, as with boreholes, it might be good to label your MWs as MP-BH#(MW):

MP-BH1(MW), MP-BH2, MP-BH3(MW), MP-BH4

- Site-specific naming conventions can be applied as above, with (MW) in brackets after those BHs in which MWs are installed:

PKN-MP-BH1(MW), ALM-MP-BH1

- It is not recommended that multiple nested piezometers or MWs be installed within the same borehole (see SOP 3-16). However, if several monitoring wells are drilled immediately adjacent to each other and completed at different depths, they are considered a "nest" and are labelled as follows:
    - Two wells (a deep and a shallow) BH1(MW)-I and BH1(MW)-II respectively:
        - "Shallow" and "deep" names can be used if there are only two wells, i.e., BH1(MW)-D and BH1(MW)-S.
    - Three wells (deep, intermediate, shallow) BH1(MW)-I, BH1(MW)-II, BH1(MW)-III respectively; and,
    - Four wells (deep, deep intermediate, shallow intermediate, shallow) BH1(MW)-I, BH1(MW)-II, BH1(MW)-III, BH1(MW)-IV.

- Locations to be recorded on plan. Details in BH logs.

Procedure: Naming Test Pits

- As with boreholes, recommend simple numbering – TP1, TP2, etc.;
- If you need to distinguish between consultants, use MP-TP1, MP-TP2, etc.;
- If you need to distinguish between sites, use site initials, e.g. CP-TP1, ALM-TP1, etc.;
- Year- and Phase-specific identifiers are not recommended;
- TP implies a test pit dug by a powered machine (backhoe or excavator), but can also be used to mean a test pit dug with a hand shovel. Grab sample (GS) is recommended for shovel sampling, but if both sample methods are used for an investigation, make sure that they are NOT both labelled as TP samples, to keep things clear; and,
- Locations to be recorded on plan. Details in TP logs.

Procedure: Naming Hydrogeological Test Wells

- As with boreholes and MWs, recommend simple numbering – TW1, TW2, etc.;
- If you need to distinguish between consultants (this is unlikely with hydrogeological investigations), use MP-TW1, MP-TW2, etc.;

- If you need to distinguish between sites use letter prefixes;
- Year- and phase-specific identifiers are not recommended;
- Recommend using TW designation for hydrogeological test wells drilled by water well drillers and constructed with 6" steel casing only – MWs constructed with PVC pipe by enviro/geo drillers should be labelled MW; and,
- Locations to be recorded on plan. Details in well logs.

Procedure: Naming Surface Water Stations

- As above, use SW1, SW2, etc.;
- Surface water sampling stations are generally used year after year at landfills, contaminated sites, etc. and are usually outlined in C of A/ECA documents, so they don't change much and we don't often add them. But the above-noted conventions for different consultants and sites should apply;
- Locations to be shown on plan. Depths to be recorded in field notes;

Procedure: Naming Domestic Water Supply Wells

- We usually don't drill these unless as TWs for a hydrogeological study, so we don't get to name them;
- When sampling, use name of occupant/resident wherever possible, or address;
- See SOP 4-02; and,
- Details, if available, incl. well tag, to be recorded.

Procedure: Naming Sediment Sample Locations

- As above, use SED1, SED2, etc.;
- The above-noted conventions for consultants, sites, years, phases should apply; and,
- Locations and depths to be shown on a plan/recorded in field notes.

Procedure: Naming Shallow Soil Grab Samples (non-stockpile)

- Often done for due diligence Phase 2 ESAs in areas of surface staining, as a practical common-sense method of seeing how deep the staining goes, whether it is surface staining or indicative of a deeper problem, etc. See SOP 3-14;
- As above, use GS1, GS2, etc.;
- The above-noted conventions for different consultants and sites should apply; and,
- Locations and depths to be shown on a plan/recorded in field notes.

Procedure: Naming Hand Auger Holes

- Often done for due diligence Phase 2 ESAs in areas of surface staining, as a practical common-sense method of seeing how deep the staining goes, whether it is surface staining or indicative of a deeper problem, etc. See SOP 3-14;
- As above, use HA1, HA2, etc. There can be multiple auger flight samples within a hand auger hole;

- The above-noted conventions for consultants, sites, years, phases should apply; and,
- Locations and depths to be shown on a plan/recorded in field notes.

Procedure: Naming Grab/Stockpile Samples

- First, name your stockpiles sequentially – SP1, SP2, etc.;
- Then, name your grab samples – SP1-G1, SP2-G3, etc.;
- If you're doing composite sampling of a stockpile, SP1-COMP etc.;
- It is unlikely we will be doing this in multiple phases or during multiple years, but whenever possible, use the above conventions re. consultants, sites, years, phases etc.;
- If material is added to a stockpile, or if it substantially changes for any reason, up to you whether you want to call it the same stockpile or a different one. This will also depend on your reason for sampling the stockpile;
- Stockpile sample density requirements are given in O.Reg. 153/04 as amended and in SOP 6-05; and,
- Locations to be shown on plan.

Procedure: Sample Locations By Others

- If our site has sampling locations installed by others, and we are adding our own sampling locations, the most important thing is to avoid duplication and confusion;
- If there are sampling locations by others, and we know what they are called, we should name our locations to avoid duplication, adding prefixes usually;
- If there are sampling locations by others and we don't know what they are called, i.e. we find some old MWs during a Phase 1 and want to show them on the plan, we should give our own locations the simplest possible names, and assign names to locations by others that don't conflict with ours; and,
- For example, the "100" series. MWs by others would become MW101, MW102, etc., and shown on legend as such.

Procedure: Laying Out Sampling Locations

- Sometimes, if drilling order is unknown, or if BH/TP/etc. locations are likely to change in the field, OR if we want to clear some extra locations during the locates phase but won't necessarily drill all of them, it helps to mark up the locations on a plan with letters – BH A, BH B, BH C, etc. – so that if they don't all get drilled, BH A becomes BH1, BH B gets dropped, BH C = BH2, etc., the people in the field and the office can still communicate with absolute clarity about particular potential/actual BH locations; and,
- If we're sure we're going to drill them all, labelling them BH1, BH2, BH3, etc. in the field is fine.

Revision History

Original November 2012
Updated by D. Arnott March 2017
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Updated by D. Arnott March 2018

SOP 3-03: NAMING CONVENTIONS FOR INDIVIDUAL SOIL AND GROUNDWATER SAMPLES

Objective

As with sampling station locations, the goals for the naming of individual samples are clarity, consistency, efficiency, and the elimination of any duplication. We need to account for every sample taken, even if it is not submitted or if it is superseded. Depth intervals do not necessarily form a part of the sample name itself, but should always be shown with samples in reports, on logs, in tables, on figures, etc.

Assume for the purposes of this SOP that all BH logs, TPs, MWs, etc. have been named in accordance with SOP 3-02.

Procedure: Naming Individual Samples - Soil

- Soil samples should reflect the way the sample was collected. This is especially important if multiple sampling methods were used at the same location – this can often happen with boreholes (we might take a grab sample from the auger flights, split spoon samples, Shelby tubes, shear vanes, and core rock all within the same BH – this isn't likely to happen, but it is possible, depending on the program);
- Samples should be numbered sequentially, no matter what type of sample they are. For example, if we take an auger flight sample and 2 split spoon samples, they would be labelled as BH1-AU1, BH1-SS2, BH1-SS3:
    - The exception to this is rock core, where sample numbering starts over again – see next section.
- Sample numbers start over again at each new borehole. That is to say, sample IDs need to be unique within the borehole, but NOT within the project, because borehole numbers are already unique within the project. Say we have two BHs, each with 6 split spoon samples:
    - Not recommended: BH1-SS1, BH1-SS2, … BH1-SS6, BH2-SS7, BH2-SS8, etc.;
    - Recommended: BH1-SS1, BH1-SS2, … BH1-SS6, BH2-SS1, BH2-SS2, etc.; and,
    - The reason for this is, when we look at sample IDs, it's easier to think of SS1, SS2, etc. as shallow samples and higher SS numbers as deeper samples. If we drill 10 boreholes and we have up to, for example, SS42, this can be confusing (is it a deep sample from an early borehole or a shallow sample from a borehole drilled later in the day?).
- Samples should be **numbered sequentially** and recorded, regardless of whether or not we retain a sample for review or submit it for analysis. Any time the driller takes a sample, we name it and record it. That being said, we should retain ALL samples for review and at least include a soil description in our logs;
- Sample depth interval is **as important as the sample ID itself**, and should be considered a part of the sample ID. There should never be any doubt at what depth a sample was taken;
- Likewise, sample date is as important as the sample ID itself;

- Auger Flight Samples – BH1-AU1, BH1-AU2, etc. Can also be taken from hand auger holes – HA1-AU1, HA1-AU2, etc.;
- Split spoon samples – BH1-SS1, BH1-SS2, etc. If a change of soil type occurs within a split spoon sampler, the sample can be recorded as, say, BH1-SS2 on the log, but the different types of soil should be bagged separately – BH1-SS2-1 for the upper part, and BH1-SS2-2 for the lower part, with depth intervals noted on the bags. This is important for samples which are to be analyzed and for delineating fill;
- Sampling tube samples (direct-push drill rig) – while these are not technically split spoon samples, we often label them SS as well. Where different soil types are encountered within a single sample, split as above (this is more likely to happen since the tubes are 4'-5' long);
- Shelby tubes or thin-wall samplers – BH1-TW1, BH1-TW2, etc. These are mainly used for geotechnical and are very unlikely to be used on an enviro job;
- Shear vanes – these are used in geotechnical boreholes sometimes – Geotech does not record them as samples, simply lists the shear strength. If doing a combined geotechnical/enviro investigation, if you want a sample, push a spoon, even if a shear vane has already been taken. Your environmental sample will be disturbed, but can then be labelled as "SS" and you will obtain more sample volume this way than if you had sampled whatever soil had adhered to the shear vane itself;
- Grab samples – usually these would be taken from an excavator bucket or with a hand shovel while digging test pits – TP1-G1, TP1-G2, etc;
- Sediment samples, stockpile samples, etc. covered under SOP 3-02; and,
- Remediation sidewall and base samples covered under SOP 6-04.

Procedure: Naming Individual Samples - Rock

- Rock core samples – BH1-RC1, BH1-RC2, etc.; and,
- In this case, we **do** start numbering over again. When we hit rock and start coring, we start with RC1.

Procedure: Naming Individual Samples – Groundwater (Brownfields)

- Groundwater samples – BH1(MW)-GW, BH2(MW)-GW, etc.; and,
- Depending on the context of the site, if multiple groundwater sampling events are anticipated, we can name GW samples sequentially – BH1(MW)-GW1 for the first event, BH1(MW)-GW2 for the second event, etc. But the problem with this is, if we sample NOT ALL of the wells on-site for a given event, and then sample ALL wells for a subsequent event, numbering might not match up.

Procedure: Naming Individual Samples – Groundwater (Landfills)

- Since landfill GW monitoring wells are sampled year after year, multiple times, we just label samples with the MW ID and date.

Procedure: Naming Individual Surface Water Samples

- As above, these are sampled year after year, so label samples with the station ID and date only.

Procedure: Naming Individual Samples - Hydrogeology

- When completing a pump test for a hydrogeological study for water supply, it is standard procedure to sample once at the beginning and once at the end. See SOP 4-07 for more details. Say our well is called TW1; we would call the sample from the start of the test TW1-1 and the sample from the end of the test TW1-2; and,
- If we go back and sample due to a coliform exceedance, we would label that sample TW1-3, etc.

Revision History

Original November 2012
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Updated by D. Arnott March 2018

SOP 3-04: DUPLICATE SAMPLES

Objective

The collection and analysis of duplicate samples is a good way to understand how reliable and repeatable our field sampling methods and laboratory analytical methods are. Ideally, two samples obtained under identical conditions and sampled for the same parameters ought to return the exact same concentrations of those parameters. This is never quite the case, but with proper field duplicate collection methods, we can get reasonably close for most parameter groups. This is a good way of increasing a client or regulator's confidence in our work, and in the case of Phase 2 ESAs being completed to MOECC standards, as well as some landfill sampling programs, the collection and submission of duplicate samples is required.

Trip blanks, as the name suggests, indicate whether any contamination or cross-contamination has been introduced to your samples on the trip from the field to the lab. They are prepared by the lab and analyzed by the lab for VOCs or BTEX, and they simply ride along in your cooler. If the trip blank has detections, it means that somewhere along the way, contamination was introduced to your samples and the results are not considered reliable. Detections in trip blanks are rare, but it does happen.

Procedure: Field Duplicate Sample Selection and Labelling

- Locations at which duplicate samples are to be taken can be determined beforehand or in the field, but the number of duplicate samples and the parameters for which the duplicates are to be analyzed should be determined before the field program begins;
- Determine the number of samples to be analyzed as part of the field program, based on the quote, the contaminants of concern, and/or the pre-set sampling program (in the case of landfill monitoring):
    - For each medium (soil, groundwater, surface water, sediment, etc.), divide the total number of samples by 10, and round up for number of duplicates. In the case of 11 or 12 samples, we can get away with 1 duplicate, but any more than that, we need a second duplicate.
- Select the location at which the duplicate sample will be analyzed (if applicable), and determine which parameters you're going to analyze the duplicate sample for:
    - For landfill sampling, the duplicate is analysed for the full set of parameters and,
    - For Phase 2 ESA sampling, the parameters analysed depend on the contaminants we expect to find. We want to try to take a duplicate sample where there will be detections – if both the duplicate and the original have all parameters below detection limits, it's of limited usefulness. So this sometimes means taking the duplicate at the most contaminated location (or location most likely to be contaminated)
- When you've decided to take a duplicate sample, label clearly in bold text on the field notes which location the duplicate sample was taken from;

- Determine with a name for the duplicate sample:
    - It is acceptable if the laboratory knows they're analysing a duplicate sample, but they should NOT know which field location the duplicate sample comes from. Therefore, give the duplicate sample a name that is easily recognized by McIntosh Perry staff as a duplicate, but that does not hint at the location at which the sample was taken;
    - For soil samples, DUP1, DUP2, etc.;
    - For groundwater samples, GW-DUP1, GW-DUP2, etc.;
    - For surface water samples, SW-DUP1, SW-DUP2, etc.;
    - Refer to the naming conventions outlined in SOP 3-01; and,
    - Can also create "fictional" locations – e.g. MW500, BH100, etc., as long as it doesn't cause confusion with any existing actual sampling locations on-site.

- Soil samples: when you have selected a soil sample for duplicate analysis, split the sample as evenly as possible into two identical sampling jars. If the sample is heterogeneous within the split spoon, try to homogenize the sample as much as possible in a plastic bag so that the original and duplicate will be as close as possible in composition;
- Groundwater samples: Fill one type of bottle at a time (i.e. fill the VOC vials of the original and duplicate first, then move on to, say, metals, PAHs, etc.). Fill the original bottle 1/3 full, then fill the duplicate bottle 1/3 full. Repeat with 2/3 full and completely full. The purpose of this is to make sure that the original and duplicate samples are as close in quality and composition as possible;
- Surface water samples: Similar to groundwater samples, except in some cases, both the original and duplicate bottle can be immersed at the same time if conditions are favourable, e.g. if it's unlikely that sediment will get into one bottle but not the other. Bottles with preservative should not be immersed but should be filled carefully, 1/3 at a time, as above;
- Tap water samples: similar to groundwater samples. See SOP 4-02; and,
- Duplicate samples should be stored in the same cooler as original samples, but not in the same bag – that would indicate to the lab which samples are duplicates.

Procedure: Trip Blanks

- Trip blanks should be ordered from the laboratory prior to setting out into the field. Order trip blanks if:
    - You are preparing a Phase 2 in support of a RSC;
    - Your project manager has stated in a quote/scope of work that trip blanks will be submitted (some larger clients require this, but it is generally good practice, especially for VOC sites where significant contamination is possible); and,
    - It is required per a landfill C of A/ECA.

- Trip blanks should be picked up the morning of sampling or the night before. They should stay cool, but it is not recommended that they sit in sample storage fridges in case they pick up any

contamination from the fridge. Ideally, the cooler should be pre-cooled and kept cool, and the trip blank should be kept in the cooler;

- Do not open the trip blank, but keep it in the same cooler as your samples, subjected to conditions identical to your samples, during the whole sampling day;
- Submit the trip blank to the lab with your samples. It is OK if your trip blank spends sometime in the fridge after sampling, as long as your samples are in there too; and,
- The trip blank should be noted on the Chain of Custody, and VOC or BTEX analysis selected.

Procedure: Lab QA/QC

- Laboratories perform their own QA/QC on samples. This is summarized in their analytical reports. There are a variety of lab QA/QC methods, including blanks, duplicates, and spikes. The lab discusses their own QA/QC and has targets for each test. If the targets are not met, the lab will indicate this on the report, and if it is likely to affect sample results, it should be mentioned in our report. The lab can often provide more discussion if necessary.

Procedure: Comparing Duplicate Samples to Site Condition Standards

- If both the original and duplicate sample at a given location are in compliance with the SCS, the location is considered to be in compliance;
- If both the original and duplicate sample at a given location exceed the SCS, the location is considered to exceed the SCS;
- If the original fails and the duplicate passes, or vice versa, either the location is considered to exceed the SCS, or a recommendation is made for further sampling:
    - In the case of a groundwater sample, it's relatively easy to re-sample the location and see if we get the same results.

Procedure: Relative Percent Difference (RPD) Calculations

- Relative percent difference (RPD) calculations are a method of comparing original and duplicate samples. RPD calculations are calculated using the following formula:

$$RPD = \left|\frac{x_1 - x_2}{(x_1 - x_2)/2}\right| \times 100\%$$

Where x_1 is the concentration of a given parameter in the original sample and x_2 is the concentration of a given parameter in the duplicate sample.

- Acceptable RPD limits for each parameter group are found in the table below:

Analysed Group	Recommended RPD in Soil*	Recommended RPD in Groundwater*
PHC	30%	30%
VOCs	50%	30%
PAHs	40%	30%
PCBs	40%	30%
1,4-Dioxane	50%	30%
Dioxins/Furans	40%	30%
OC Pesticides	40%	30%
Metals	30%	20%
Hexavalent Chromium, Cr(VI)	35%	20%
Cyanide (CN−)	35%	20%
Fraction Organic Carbon (FOC), Chloride	35%	20%
Methyl Mercury	40%	30%
Electric Conductivity	10%	-
pH	Within 0.3 pH units	-
** Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act - Laboratory Services Branch Ministry of the Environment - March 9, 2004, amended as of July 1, 2011*		

- RPD calculations are not performed where parameter concentrations are below laboratory detection limits for the original or duplicate samples;
- RPD calculations are not performed where detected parameter concentrations are less than 5 times the laboratory detection limit; and,
- Where RPD values fall outside the limits set in the above table, discuss with your project manager possible causes and/or recommendations for re-sampling.

References

O.Reg. 153/04 (as amended).

Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act - Laboratory Services Branch Ministry of the Environment - March 9, 2004, amended as of July 1, 2011.

Revision History

Updated by D. Arnott April 2017
Updated by D. Arnott March 2018

SOP 3-05: UNDERGROUND SERVICE LOCATES

Objective

Underground service locates are of critical importance for field investigations for several reasons. First, they prevent us or our subcontractors from hitting and damaging underground services when we drill or dig – this is important from a health/safety and liability perspective. Second, they instill a level of confidence in our subcontractors – many times I have seen drillers refuse to drill in a certain location because underground service locates have been incomplete. Third, an often forgotten benefit is that sometimes identifying underground service trenches can be important in understanding contaminant transport pathways at a site.

Whenever possible, the responsibility of obtaining underground service locates should be handled by the client. This is always a good idea when doing soil management work for contractors on an excavation job (they will have locates anyway for work they're doing). Solar farms where construction is ongoing will also likely have locates. When test wells are being put in for a hydrogeological study, the drillers or owner will often obtain locates. However, for most Phase 2 ESAs, especially in urban areas, obtaining locates is something our client is paying us to do. So while the locators do the actual work, we are responsible for making the request and reviewing the results in such a manner that we can protect the interests of ourselves and our clients.

Procedure: Public (One-Call) Locates

- Before calling or logging in to OneCall (Ontario) or comparable Provincial locates service, it's best to have a good idea of where your site is, what the exact limits of your area of investigation are, and approximately where you want your boreholes. This is especially important if your site consists of multiple properties;
- Know your site address and cross-streets, and the township, lot, and concession if the site does not appear to have a municipal address (this information can be obtained from survey plans, municipal restructuring maps, municipally-available GIS tools, and some layers on Google Earth – Susanne and José in Ottawa can provide help with this);
- Log in using the company login. We are considered a "contractor":
    - The following steps may vary depending on out-of-Ontario provincial underground locates services.
- Caller/contractor fields are pre-populated, so check to make sure it's up-to-date. The communication info on the left side of the page should belong to the person coordinating the locates from the office, not necessarily the field person (the locates should be done before anyone goes in the field to drill/dig;
- Select the municipality/township from the drop down menu. Begin typing, and select from the list that appears;
- For properties with a municipal address, start typing in the street and select from the list that appears. Once you select a street, it will limit your options for Intersection 1 and Intersection 2

accordingly. Start typing, and select what makes sense. The lists that appear are usually pretty complete and up-to-date;

- If your site consists of multiple parcels, click "Add" (top right) to add another address;
- Draw your property on the mapping tool which comes up. Click on the "pencil", then on the pencil drawing the polygon. Double-click to finish your polygon, and give it a label ("Lot" or "Site" usually sufficient);
- Enter your dig information. You don't have to enter length or width, but maximum depth is required. Usually enter 50 feet unless you think your boreholes will be deeper. Click "Public" or "Private" property depending on your site;
- Click "Area not marked". Often when individual locators go out to site, they will call you to discuss borehole locations, but we don't usually mark the site before we start the locates;
- Select "machine dig" as your method of excavation;
- Select "mark and fax" (these days, they mark and email instead);
- For "work to begin", leave the date that automatically populates. This is the soonest possible date that they can get the locates completed – 5 business days from the request date. Usually it takes longer than this, but we want locates as soon as possible;
- Type of work, select "bore holes";
- Save your work and submit your ticket. OneCall will email you with a summary of the utility owners which have been contacted. Make sure you receive either clearances or locate sheets from **ALL** the utility owners on the list before you start to dig or drill; and,
- For planning purposes, try to leave at least two (2) weeks between locate request date and projected drill date, plus whatever time is required for private locates.

Procedure: Private Locates, Site Meets, and Test Hole Layout

- It is our policy to request private locates for all sites unless they are remote or known conclusively never to have been developed;
- Private locates should be requested for any site with private services. These include but are not limited to:
    - Underground electrical for lighting or block heaters;
    - Gas or fuel pipes;
    - Water lines (well to building);
    - Underground electrical or gas associated with a backup generator; and,
    - Telecommunication or telemetry systems.
- For sites with septic systems, gas or fuel piping, private water services, or other potentially hard-to-trace private services, wherever possible, try to obtain a plan from the owner or client showing the location of these services. This can be of use to the locators when they're on-site;
- Contact several private locators and obtain competitive prices, or sole-source depending on relationship and project requirements (clarify with your project manager if uncertain);

- Upon award of the job (or upon receipt of a change order authorizing a Phase 2 to be completed), contact the locator who you're carrying for the assignment and tell them to proceed. Set up a time for a site meet, usually after the public locates are likely to be done;
- Tell the property owner when the private locator will be on-site, and if there's a building, make sure that the private locator will have access to the place where the water service enters/leaves the building. Sometimes they will need to hook on to the pipe to run a trace;
- This will vary from job to job, but preferably after the public locates have been completed, on the day of the site meet with the private locator, show up early and mark out your boreholes where you want them to be, based on your APECs. You may have to adjust your locations slightly based on the location of public services or other site constraints. So it's always helpful to spray or stake out a few extra boreholes in the locations you want and get the private locator to clear them all; and,
- When the private locator shows up, show them where you have marked out your boreholes and get a preliminary sense of whether the boreholes will be easy to clear. If so, you can leave site and they will send you the locate sheet. If not, stay on-site and collaboratively work out locations for the boreholes that will be clear of services AND address the APECs.

Revision History

Updated by D. Arnott April 2017
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SOP 3-06: SOIL SAMPLE MANAGEMENT AND DISPOSAL

Objective

Soil samples are collected in the field and are brought back to the office for review. Certain samples are submitted for lab analysis, but the majority of samples collected remain in the office. While it is good practice to retain samples for a period of time in case they need to be reviewed due to a development on the job, they should not be retained indefinitely. The objective of this SOP is to provide some general advice on storing samples safely and disposing of them correctly.

Procedure: Soil Sample Management and Disposal

- Following sample review and submission to the lab, remaining soil samples from a day of field work should be removed from the reviewing table as soon as possible, to leave the table clear for the next person who wishes to use it;
- Samples from a particular job (or from a particular day) should be kept together, in a cardboard box, bag, or Rubbermaid tub. The container should be labelled with the job number and date as a minimum, along with any other useful descriptive information;
- Suspected contaminated samples should be labelled as such, and kept separate from suspected clean samples if possible, to aid with correct disposal;
- Samples should be retained for a period of **six months** unless you are otherwise directed by the client or project manager;
- Samples should be stored in a designated area, easily accessible but out of the way of foot traffic and commonly-used equipment:
    - Consult with your health and safety representative regarding an appropriate location to store samples in your office.
- Stored samples should be neither a tripping hazard nor a falling/lifting hazard. The heavier the batch of samples, the closer to the ground they should be stored to minimize the potential for injury when lifting from higher shelves;
- When you put a batch of samples into storage, set an Outlook reminder for 6 months in the future, directing you to go back and dispose of those samples;
- When disposing of samples, check for visual or olfactory evidence of contamination, and review the analytical test results from the job and the borehole/test pit logs. This will give you an idea of how samples are to be disposed. At the Carp office, clean samples (in compliance with MOECC Table 1 SCS) may be placed as clean fill in wooded areas on-site; and,
- If samples are suspected to be contaminated (or confirmed based on analytical results), place them in a drum in a designated area for disposal. The drum will have to be periodically collected by a licensed contractor for disposal:

- Often, a representative sample from the drum will need to be submitted for TCLP analysis before the contractor will accept it. Sometimes the contractor will accept bulk analytical results instead of TCLP analysis.

Revision History

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SOP 3-07: MANAGEMENT OF DRILL CUTTINGS AND PURGE WATER

Objective

For the purposes of this SOP, drill cuttings are defined as overburden soil brought up on the auger flights of a conventional rig during drilling, or rock cuttings brought up by compressed air while advancing a borehole into bedrock using air percussion methods. Purge water is defined as water that is pumped from a monitoring well, either by bailer, inertial lift pump, peristaltic pump or other sampling method, during the development, purging, or sampling of the well.

Although they are often a part of a drilling and sampling program that is not paid much attention, the management of drill cuttings and purge water is important for several reasons. The first is compliance, in spirit and letter, with environmental regulations. The second is the appearance of a diligent consulting firm. Poor management of cuttings or purge water can result in client dissatisfaction on otherwise well-executed jobs.

Procedure: Field Management of Drill Cuttings

- Wherever possible, discuss with drillers what is to be done with drill cuttings before you get out into the field (don't assume drillers will bring drums, or will manage cuttings for you – they will help you move cuttings but will not find a final destination for them);
- If contamination is suspected (most/all enviro sites), arrangements should be made with the driller to place the cuttings into drums. Drillers should provide drums and should load cuttings in drums. There is often a cost associated with this, which should be provided by the drillers and included on the quote to the client;
- Drums will usually not be able to be moved once filled (without a backhoe, excavator, forklift, or other power equipment). Do not assume drillers will be able to move full drums. Place drums in a location where they are able to remain for a period of time (check this with the client) and if necessary, transport cuttings to drums via wheelbarrow (request that drillers do this);
- Label the drums at the time of drilling with contents (drill cuttings) as a minimum;
- In remote areas, cuttings do not necessarily need to be drummed, as the cost of getting the drums in and out is often prohibitive;
- If cuttings are drummed, after analytical results are received, make an assessment of what to do with the drums. Arrange this with client and get funds approved if necessary:
    - If all sample results are clean, material in drums is considered clean and may be disposed of as clean fill, however the client sees fit;
    - If sample results fail, a composite TCLP sample may be taken from the drum contents. Once the TCLP results are received, off-site disposal of the drums as contaminated material is possible. Sometimes, the client will have to register as a Waste Generator if they are not already. We can help them with this; and,

- If a remediation is to be completed at the Site, the drums can remain and the contaminated material in the drums can be hauled off-site as contaminated material concurrently with the site remediation program.

- Do not leave cuttings in a pile by the borehole, against a property line, or in plastic bags anywhere on-site;
- Do not bring cuttings back to the office for any reason (usually requires several loads by pick-up);
- Clean cuttings may be used to backfill a borehole where no MW is installed, but should be mixed with some bentonite. Do not reuse contaminated cuttings; and,
- Cuttings may be used as backfill above the screen of a monitoring well, if they are uncontaminated AND if they are mixed with some bentonite AND if there is a seal of at least 0.6 m of pure bentonite above the sandpack. This being said, this is not recommended and wells should not be constructed with cuttings if possible.

Procedure: Field Management of Purge Water

- During the drilling program, and following the receipt of any soil analytical results, make an assessment of the anticipated degree of contamination based on visual or olfactory observations, and arrange for buckets or drums to contain purge water if contamination is anticipated:

  - Soil drums may also be used to contain purge water; however, if these drums are completely full, especially with cohesive or fine-grained soils, there may not be room in the drums for purge water.

- If no contamination is anticipated, purge water may be discharged to a permeable ground surface are on-site where it will infiltrate and not cause a nuisance (this is particularly important if the purge water is silty);
- If contamination is anticipated or encountered, retain each bucket of purge water. After measuring field chemistry parameters, either seal up the buckets with provided lids (available at the hardware store), or decant each bucket into a soil cuttings drum or a dedicated drum for purge water;
- Obtain a representative sample of the purge water (if decanted into dedicated buckets or drums) and submit for laboratory analysis of contaminants of concern, if the purge water is to be hauled off-site for disposal at an approved waste disposal facility;
- Label drums or buckets as containing purge water;
- Drums and buckets containing purge water should be stored on-site in a relatively unobtrusive area, preferably as out-of-sight as possible, where they are unlikely to be hit by any vehicles (including snow ploughs) or to block any access routes; and,
- Drums containing purge water may be removed by a licensed contractor in a similar manner to cuttings. Usually, bulk analytical results must be provided to the contractor prior to disposal.

Revision History

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Updated by D. Arnott March 2018

SOP 3-14: HAND AUGER AND SHOVEL SAMPLING

Objective

Shallow soil samples taken with a hand shovel or hand auger can be useful in areas where surface staining is observed, where overburden soils are shallow, or where site conditions warrant. Hand shovel and hand auger sampling can also be used to obtain grain size analysis samples in support of septic system design.

Procedure: Soil Sampling – Hand Shovel or Hand Auger

- Hand digging is usually completed as a component of a larger subsurface investigation, and underground services are generally not present at depths shallower than 0.3-0.6 m, so underground service locates are generally not required if this is your only method of subsurface investigation. However, review locates if they are available. If you think you will be advancing a significant number of hand shovel or hand auger holes deeper than 0.6 m, it may be more cost-effective to consider retaining a backhoe or drill rig for the job;
- Locations for hand auger or hand shovel excavation are generally selected based on evidence of shallow contamination, observed surface staining, or proximity to areas of potential environmental concern. Select and stake out your hole locations – it is not recommended to mark them out with spray paint, since given the shallow nature of these holes, the spray paint may result in false positives for contaminants of concern;
- Hand auger or hand shovel holes should be named per SOP 3-02;
- Individual samples should be named per SOP 3-03;
- Dig your hole or advance your hand auger to target depth, usually until native soil is encountered or until the lower limit of suspected contamination is reached. Obtain a grab sample of each distinct stratigraphic unit encountered, or at least one sample each of suspected contaminated and suspected uncontaminated material;
- Make note of any infiltration of water, odours, organic materials, etc.;
- Bag your samples as you go. Screen your samples per SOP 3-25, and jar any selected for laboratory analysis; and,
- Backfill the hole with cuttings or excavated material upon completion. Mark with a stake if the hole is to be surveyed or located later.

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SOP 3-15: SAMPLE SELECTION AND SUBMISSION FOR CONTAMINANT DELINEATION

Objective

O.Reg. 153/04 (as amended) sets out stringent requirements for exactly when an exceedance of site condition standards by a contaminant of concern is considered delineated. MOECC's requirements concerning delineation have been extensively confirmed by discussion. However, even in cases where an RSC is not being filed, or in jurisdictions outside of Ontario (where this SOP was developed), full delineation of areas of contamination are often useful for our clients' understanding of their environmental liability, as well as for remedial cost estimates and for our own conceptual understanding of the site.

Submitting additional samples for delineation should always be discussed with your project manager. Phase 2 ESAs are usually scoped, at first at least, to determine whether a problem exists in the first place, and then if a problem is encountered, further characterization is usually done at the supplementary Phase 2 ESA stage (sometimes called a Phase 3/III ESA, but since this terminology is not recognized by MOECC, and is not used consistently (i.e. can sometimes be used to refer to a remediation), it has not been used in these SOPs). But sometimes there is room in the budget for delineation at the Phase 2 ESA stage, and sometimes we will pursue additional budget for this from the client. Test pit investigations give us particular flexibility to delineate contamination in the field. While this should be discussed with your PM, some general guidelines are provided here.

Procedure: *Sample Selection and Submission for Contaminant Delineation*

- You never know, and cannot be expected to know, which samples are contaminated before submitting them for lab analysis. Sometimes screening results can give you an idea; sometimes samples are very obviously contaminated and certain to fail standards. For the purposes of this SOP, we assume that we have a sample which we know is going to fail or which we're reasonably sure is going to fail;
- It always helps to plot your sampling locations on a plan so you can visualize how to horizontally delineate your contamination. Cross-sections are useful too for vertical delineation;
- Per Reg 153/04 (as amended), contamination must be assumed to extend vertically and horizontally from a location where a sample fails, to the next clean sample that has been submitted for lab analysis and meets standards. This is the definition of delineation that has been used here;
- Submit a sample between the contaminated sample and the next known clean sample in at least 3 directions, preferably all 4 directions, from the same stratigraphic layer in which your sample was taken (or the approximately same depth interval), AND from the stratigraphic layers above and below your sample, if applicable;
- Submit at least one sample between the dirty sample and the nearest property boundary, and preferably between the dirty sample and all property boundaries (the above 4 directional samples generally cover this). Sometimes a sample right at the property boundary will fail and this is not

possible. Once again, obtain samples from the stratigraphic layer in which your failed sample is located, AND layers above and below it:

  - If an RSC is not being filed, your professional judgement can be used about the above/below samples, but at a minimum, samples from the same stratigraphic unit/depth interval should be submitted.

- Always try to "split the difference" when adding a delineation BH/TP location between known clean and dirty samples. Put your delineation sample right in the middle if you can. If it's clean, you've halved the distance that your contam is assumed to extend. Even a dirty sample will enhance our understanding of the site; and,
- Vertical delineation cannot always be achieved in cases where contamination extends to bedrock. If you have not already done so, plan on taking a groundwater sample in this location to see if the contam extends into the bedrock aquifer (you are REQUIRED to do this if filing an RSC).

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SOP 3-22: DESCRIPTION OF SOIL SAMPLES

Objective

Within our industry, there are certain standard ways of describing soil, and the more detailed our description is and the more consistent it is with industry standards, the more useful it will be to the most people. Theoretically, soil descriptions should be consistent between Environmental and Geotechnical departments, even though we are describing soils for different reasons. The Canadian Foundation Engineering Manual (CFEM) and our own internal 'Symbols and Terms' sheets are good references.

Using the following procedure, you will be able to produce a soil description that is detailed, consistent, and understandable to a wide variety of people.

Procedure: Description of Soil Samples

- Soil samples should be collected per SOP 3-08, 3-09, 3-10, 3-13, 3-14;
- If time and field conditions permit, provide a written description of the soil sample on the field log sheet to the highest level of detail possible. Details can also be added later during office review, but because some properties will change between the field and office (such as soil structure, compactness/density, moisture content), log as much as possible as soon as possible;
- Determine the MAJOR COMPONENT of the soil sample (this will be one of the following, based on grain size: **sand, silt, clay, gravel, peat, organics, crushed stone, topsoil**, or if you are test pitting and can observe particles too big to fit in split spoon samplers or geoprobe tubes**, cobbles, and boulders**:
    - Boulders are greater than 200 mm;
    - Cobbles are between 76.2 and 200 mm;
    - Gravel is between 4.75 and 76.2 mm;
    - Sand is between 0.075 and 4.75 mm (rule of thumb – if you can see the particles or if it is not cohesive, it is sand);
    - Silt is between 0.002 and 0.075 mm;
    - Clay is less than 0.002 mm;
    - Practically, it is difficult to tell the difference between silt and clay without doing a lab hydrometer test, but here are some simple field tests that can be done:
        - Silt exhibits "dilatancy" – displays a "corn-starchy" texture and behaviour, appears to have a sheen of water when agitated and appears "dry" when pressure is exerted – clay generally does not; and,
        - Clay will smear smoothly on a nitrile glove, whereas silt will have a more irregular or floury texture when smeared.
- Determine any MINOR COMPONENTS of the soil sample. For the following examples, let's assume the soil sample is composed of sand and silt. Depending on the proportions of major and minor components, describe the soil as follows:

- >35%: “and” (“sand and silt, silt and sand”);
- 20-35%: adjective/”y” (“silty sand”);
- 10-20%: “some” (“sand, some silt”); and,
- o <10%: “trace” (“sand, trace silt”).

- Note the colour of the soil. This can be subjective, but there are a few important colours to note:
  - Grey means that the material is fresh, not weathered (freshly-placed crushed stone fill or soils that are beneath the long-term water table);
  - Orange or reddish-brown can indicate the presence of iron;
  - Purple suggests that potassium permanganate has been used as the site as a chemical oxidant; and,
  - Also note “light”, “medium”, “dark” (e.g. “light brown silty sand”).

- Determine the moisture content of the soil: “dry”, “moist”, “wet”, “saturated” (e.g., “light brown silty sand, moist”). Note that “saturated” corresponds to soils below the water table (long-term or perched);
- For cohesive soils, do a quick field Atterberg Limits test and indicate whether the soil is drier or wetter than the plastic limit (see following section). (e.g., “light brown silty clay, moist, DTPL”);
- For cohesive soils, describe the consistency of the soil, as follows. Use blow counts as a guide if split spoon samples were taken; if not, use your judgement:
  - Very soft: N value of <2;
  - Soft: N value of 2-4;
  - Firm: N value of 4-8;
  - Stiff: N value of 8-15;
  - Very stiff: N value of 15-30;
  - Hard: N value of >30; and,
  - e.g., “light brown silty clay, moist, DTPL, firm.”

- For cohesionless soils, describe the denseness of the soil, as follows. Once again, use blow counts as a guide if available, and if not, use your judgement:
  - Very loose: N value of 0-5;
  - Loose: N value of 5-10;
  - Compact: N value of 10-30;
  - Dense: N value of 30-50;
  - Very dense: N value of >50; and,
  - e.g., “light brown silty sand, moist, compact”.

- Describe any other properties observed in the soil samples:
  - “Desiccated”: usually observed in upper clay units; visible cracking, shrinkage, oxidation, etc. (applies to silt and clay);

  - "Fissured" or "blocky": having cracks and a blocky structure (applies to silt and clay);
  - "varved": having regularly alternating layers of silt and/or clay of varying colour/particle size, generally corresponding to seasonal variation;
  - "stratified": having distinct layers within the soil sample;
  - "well graded" or "poorly sorted": having a wide variety of particle sizes; and,
  - "uniformly graded" or "well sorted": predominantly one particle size.

- If possible, make an assessment of whether the material is fill or native. Fill is generally present immediately under parking structures, in landscaped/graded areas, and is often less dense or compact and has material mixed in that would not have gotten there naturally. Another good indicator of fill is if it overlies what appears to be original native ground surface (grass, organics, topsoil, etc.). This determination can be left for senior review if necessary;
- If the material is native, does it have characteristics consistent with glacial till (i.e. a wide variation in particle size inconsistent with a marine, lacustrine, fluvial, or deltaic depositional environment)? Once again, this can be left for senior review to determine, and in the final description, the material will be described as "apparent till", as the prevailing wisdom is that we should not call it till unless we've seen the glacier deposit it; and,
- Note if there is any visual or olfactory evidence of contamination in the sample (odour, sheen, staining, etc.). Also note if there are any other smells (sometimes a swampy smell may be present with organic material).

Procedure: Field Determination of Atterberg Limits

- Take a small portion of the (cohesive) soil sample in your gloved hands and roll it into a small "snake";
- If the "snake" can be rolled out until it is thinner than 3 mm without cracking or crumbling, the sample is wetter than the plastic limit (WTPL);
- If the "snake" crumbles or cracks before it is rolled out to 3 mm diameter, the sample is drier than the plastic limit (DTPL); and,
- If the sample is too wet to roll into a "snake", it is WTPL.

Revision History

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SOP 3-24: FIELD SCREENING AND SOIL VAPOUR MEASUREMENTS

Objective

We often take far more samples than there is budget to submit, and we need a way to select and narrow down samples of interest within a borehole or on a site, or sometimes to identify areas that need further investigation. While no substitute for lab analysis, it is possible through field screening and soil vapour measurements to get an idea of which samples are most likely to be contaminated. This SOP is intended to resume where SOPs 3-08, -09, and -10 leave off, with soil samples in bags ready for screening.

Procedure: Soil Screening

- Either between soil samples, between boreholes, or at the end of the day as you're deciding what to send to the lab, take a close look at the soil sample in the bag in a well-lit environment. Here are some things to look for:
    - Black colour – could be organics/peat/decomposing vegetation, could be indications of coal or combustion by-products. Odour will help you determine this ("swampy" odour is likely organics);
    - Orange/rusty colour – could be iron staining (natural or indicative of fill/debris), could be crushed brick – usually indicative of fill/impacted material, though can result from natural processes;
    - White colour – could be naturally occurring calcareous deposits (marl), especially if coupled with organic soils – could also be indicative of fill/debris/mortar/building lime, especially if "crumbly" in texture;
    - Actual visible debris (glass, wood, charcoal/coal, metal, etc.) – indicative of fill material, and if poor quality/mixed bag fill material, it's often worth testing a sample to determine proper disposal method if it's going to be shipped off site for development;
    - Yellow colour/looks like turmeric – potentially indicative of impacted fill/metals contam. Some native soils have this appearance but it's uncommon in Ottawa area;
    - Any soil overlying an organic/topsoil layer (or what appears to be original ground surface) can be considered fill – not always worth testing fill, depends on project;
    - Does it have a viscous or oily/tarry appearance? Could be a hydrocarbon; and,
    - Sticky like molasses? Could be a higher-fraction hydrocarbon like Bunker C, or coal tar, though usually not the latter (unless you have good reason to expect it).
- Make sure the samples do not freeze, or if they are cold, try to let them come up to room temperature before taking your vapour readings. If in the field, you can place the samples in your vehicle to warm up;
- Before trying to smell the sample, take a headspace vapour reading with your instrument of choice. This is very important, since VOCs may be present which are not necessarily detectable by scent, and you could avoid a potential health and safety concern if the instrument identifies high vapour levels before you smell the sample;

- Choose your vapour screening instrument, based on the APECs identified at the beginning of the project:
    - RKI Eagle – if PHCs/BTEX are the expected contaminants of concern (make sure you use this instrument in methane elimination mode, or it will pick up false positive readings from soils with higher organic content);
    - miniRAE or comparable photoionization detector (PID) for VOCs – this instrument picks up a larger range of VOCs; and,
    - Gastech/Gastechtor type analog instruments are very rare these days and generally not recommended.

- Calibrate your instrument according to manufacturers' instructions OR check that Pine/rental company has calibrated it before using it. For most jobs, the Ottawa office will rent a pre-calibrated instrument from Pine;
- Turn the instrument on and let it sit for 5 minutes or so to warm up (generally a good idea for the Eagle and the miniRAE). Screen your samples in a space that's not too enclosed, as well-ventilated as possible, and fairly free of background vapours (this is also important for your health);
- 'Zero' the instrument if the display doesn't return to zero;
- Stick the probe of the instrument into the bag. Try to close the bag around the probe as much as possible to keep ambient air from getting in. Agitate the sample and keep the probe in the bag for at least 30 seconds. Watch the display of the instrument – the readings should increase and then decline, usually within the 30-second window. Record the highest reading as the vapour reading for that sample:
    - If there are significant vapours present and the readings continue to increase after 30 seconds, keep the probe in the bag until readings peak and then begin to decline.

- It is difficult to correlate organic vapour readings to analytical results (whether a sample will pass or fail) unless you're analyzing a large number samples with the same relative proportions of contaminants. However, comparing organic vapour readings within the same site gives you an idea of which samples are more or less contaminated;
- Without sticking your nose directly in the bag, try to smell the sample. One good way to do this is to press the air out of the bag and "waft" it towards you with your hand. Smells of concern:
    - Gasoline;
    - Diesel;
    - Kerosene/paint thinner;
    - Mothballs/musty;
    - Railway ties; and,
    - Swampy smell is not usually a concern.

- A small bag of coffee beans may be kept with your field kit and sniffed periodically to "reset" your nose between sniffs of contaminated material; and,

- Select samples for lab analysis per SOP 3-15.

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SOP 3-27: PHASE 2 ENVIRONMENTAL SITE ASSESSMENT REPORTS

Objective

Standards for Phase 2 ESA reports in support of RSCs are given in great detail in O.Reg. 153/04 (as amended). While the requirements of O.Reg. 153/04 are above and beyond what may be required for simple due diligence Phase 2 ESAs, they serve as a good guideline and a good place to start. The requirements of a particular Phase 2 ESA should be discussed with your project manager at various times throughout the field work, sampling, analysis, and reporting stages, but the following sections provide some generally useful guidelines for completing Phase 2 ESAs.

Procedure: Phase 2 ESA Reporting

- Phase 2 ESAs to O.Reg. standards require a Sampling and Analysis Plan. This is ideally developed before we drill the site, and will eventually incorporate some of these SOPs. The S&AP should tell you where you are drilling, which samples you are submitting and why (general rationale OR particular depths targeted), and a general overview of field procedures. These can be created after the fact if necessary, but it is not recommended;
- Our borehole, test pit and monitoring well locations should directly correlate to APECs identified in the Phase 1 ESA. Where the exact area of the APEC cannot be drilled, we should put a borehole or TP as close to it (preferably in a downgradient direction) as possible. Make sure our rationale for this is discussed, as well as any constraints that prevent us from getting where we want to;
- APEC and PCA names and numbers should be consistent between a Phase One ESA and a Phase Two ESA. If this changes for any reason, the discrepancy must be discussed, especially if an RSC is being filed;
- Field notes and photos should be saved in the file as soon as possible after drilling, in case the field personnel responsible are assigned to another job and someone else has to write the report. Remember, your field notes must tell the entire story of what happened and why;
- The client should be notified immediately (or as soon as possible) after contamination is identified. Sometimes this can even be during drilling, if you are sure that significant contaminant (i.e., free product) is encountered (otherwise, you should wait for sample results to come back – sometimes they can be surprising). Unless you are dealing with the client directly, it is strongly recommended that you contact the PM and they contact the client, especially when bad news is involved;
- The 'Phase 1 Conceptual Site Model' and 'Phase 2 Conceptual Site Model' sections required by O.Reg. 153/04 are not recommended unless an RSC is required, as they can be redundant and confusing to the client. However, the important site features should be discussed as required, and as a minimum, the following should be stated clearly:
    - Contaminants present (SCS exceedances);
    - Areas and depths where exceedances occurred;
    - Reason for exceedances, if known;

  - Risks and/or transport pathways associated with exceedances (most of the time, no immediate risk to human or ecological health is present, but it is always worth considering); and,
  - Recommendations and/or data gaps.

- It is recommended that drafting of BH logs and figures commence as soon as possible after getting back from the field – these tools can also help you while sampling and in determining further work;
- Exceedances of SCS should be shown on at least one plan for soil and at least one plan for groundwater. If filing an RSC, MOECC requires exceedances to be broken down by parameter group (BTEX, PHCs, VOCs, PAHs, metals, etc.). They also require exceedances to be shown on a cross-section, and the vertical and horizontal extent of contamination to be shown somehow (usually with shading);
- Cross-sections are not necessarily required unless an RSC is being filed – however, depending on site context, they may be a good idea, especially if the Phase 2 ESA is being prepared in support of a remediation or Soil Management Plan;
- If a Phase 2 ESA is being prepared in support of an RSC, and a remediation was completed, O.Reg. 153/04 requires the remediation report to be submitted as an appendix of the Phase 2 ESA. When entering the names of reports in the RSC submission form, multiple Phase 2 ESA reports are permitted, and for reporting purposes, it is useful and recommended to break up the original Phase 2, the supplemental Phase 2 (if any), and the remediation report. Ensure that in one of those reports, i.e., the one summarizing or following up on the remediation, and that all samples are clean, and all concentrations of any contaminants of concern identified in the Phase 1 and Phase 2 are in compliance with the SCS:

  - o Make sure the required number of confirmatory groundwater sampling events were completed before filing RSC – one quarterly if contaminated soil and groundwater were excavated, four quarterly if any other groundwater remediation method was used.

- • A typical table of contents for a Phase 2 ESA is given in O.Reg. 153/04. Use this as a starting point and customize per the requirements of your site. If filing an RSC, it is HIGHLY recommended that you use this table of contents as closely as possible.

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