MUNICIPALITY OF RESOLUTE BAY

Environmental Monitoring Program and Quality Assurance/Quality Control Plan for Municipal Water Licence

March 2025

Document Control

Date	Document Title	Author	Details
May 2016	Hamlet of Resolute Bay Metal Waste Site Quality Assurance/Quality Control Plan	Unknown	Initial document
March 2025	Municipality of Resolute Bay Environmental Monitoring and Quality Assurance/Quality Control Plan for Municipal Water License	Government of Nunavut, Community and Government Services (GN-CGS) and Dillon Consulting Limited	Update previous document to a standardized template. Updated Figure with monitoring locations identified.

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1.0 Introduction

This quality assurance/quality control (QA/QC) plan for sampling and monitoring describes the procedures and protocols to be followed when conducting environmental sampling under the Nunavut Water Board (NWB) Water Licence monitoring program.

Although the QA/QC Plan is submitted to the NWB as a condition of the water license, it is primarily intended to be read, understood, and implemented by Municipality personnel responsible for environmental quality monitoring.

The water licence requires Hamlet personnel to adhere to these procedures, which should be applied to all water quality samples taken by the Hamlet. This document applies to the currently used infrastructure and environmental laboratory, and any changes will require this document to be updated.

Date this plan was prepared: 2025-January-28

Community:	Resolute Bay
Latitude:	73º43’01”N
Longitude:	94º58’10”W

This quality assurance/quality control (QA/QC) plan for sampling and monitoring was created to meet the requirements of the community’s water licence:

Water licence number:	3BM-RES2025
Issue date:	March 30, 2020
Expiry date:	March 29, 2025

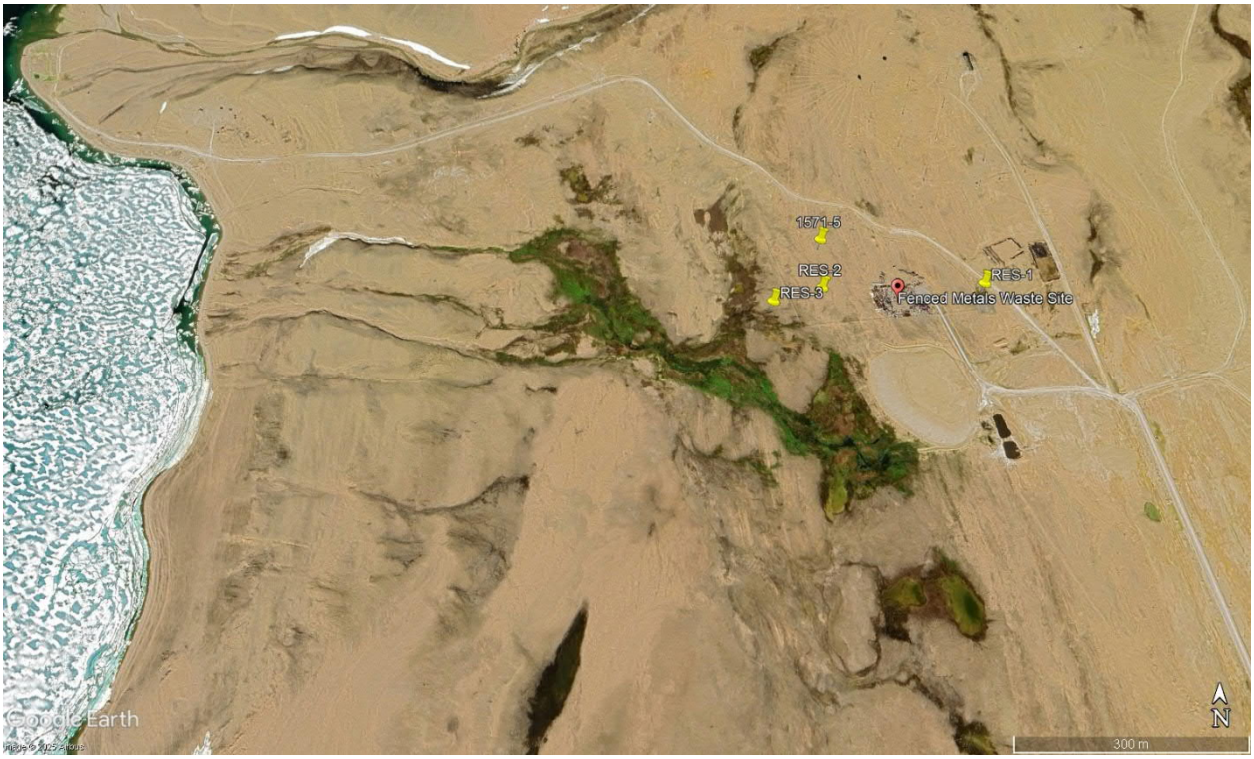


Figure 1: **Resolute Bay Monitoring Locations (Google Earth, 2025)**

2.0 Environmental Monitoring and Reporting

Part H of the NWB licence provides specific requirements for the monitoring program. Table 1 summarises the sampling locations, while Table 2 details the water quality sampling parameters.

Table 1: Water License **Sampling Locations**

Monitoring Program Station	Description	Sample Type	Frequency	Status	Coordinates
1571-5	Runoff from the Solid Waste Facilities	Leachate	Monthly, during periods of flow	Active	74°44'33.23"N 95° 0'47.58"W
RES-1	Up gradient of FMWS				74°44'30.52"N 95° 0'15.70"W
RES-2	Down-gradient of FMWS				74°44'30.09"N 95° 0'48.27"W
RES-3	Down-gradient of the FMWS				74°44'29.25"N 95° 0'58.05"W

For monitoring program locations that that are used to collect chemical data for surface water or groundwater, the parameters that will be analyzed are as follows:

Table 2: Water License Sampling Parameters

MONITORING LOCATIONS	PARAMETERS
RES-1, RES-2, RES-3, 1571-5	• BOD_5 • PAHs • BTEX • cBOD • TOC • TSS • Nitrate-Nitrite • Chloride • Sodium • Magnesium • Total Hardness • Total Arsenic • Total Cadmium • Total Cobalt • Total Copper • Total Lead • Total Mercury • Fecal Coliforms • pH • Total Phenols • Conductivity • Total Zinc • Oil and Grease • Ammonia Nitrogen • Sulphate • Potassium • Calcium • Total Alkalinity • Total Aluminum • Total Chromium • Total Iron • Total Manganese • Total Nickel

The environmental lab used to analyze the samples collected for the monitoring program must meet the accreditation requirements outlined in the community's water licence.

Proof of environmental lab's accreditation and approval letter of the QA/QC Plan is provided in Appendix B.

The address and contact information for the environmental laboratory used for analysis by Resolute Bay is:

Caduceon Laboratories Ottawa
2378 Holly Ln
Ottawa, ON
K1V 7P2
(613) 526-0123

Laboratory analyses shall meet the following standards:

- All sampling, sample preservation and analyses shall be conducted in accordance with methods prescribed in the current edition of Standard Methods for the Examination of Water and Wastewater, or by such other methods approved by the Board in writing.
- All analyses shall be performed in a laboratory accredited according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.

Reports will be distributed to the municipality, Government of Nunavut Department of Community and Government Services (GN-CGS), and the Nunavut Water Board.

Additional special conditions or requirements that have been noted in Resolute Bay's water license are as follows:

Per Part H of Water License 3BM-RES2025:

- The Licensee shall provide the GPS coordinates (in degrees, minutes and seconds of latitude and longitude) of all locations where there is a deposit of Waste and all Monitoring Program Stations.

The Licensee shall confirm the locations and GPS coordinates for all Monitoring Program Stations referred to in Part H Item 1 with an Inspector

3.0 Sampling Procedures and Protocols

To ensure quality of the monitoring program, the following procedures and protocols shall be used for field sampling. These methods are consistent with the Standard Methods for the Examination of Water and Wastewater (Eaton et al., 2005) and have been approved by the Nunavut Water Board.

3.1 Sampling Location and Frequency

The monitoring program included in the water license includes specific requirements regarding sampling locations, sampling frequency and parameters to be analyzed. These are provided in Table 1 and Table 2. Monitoring locations are shown in Figure 1.

3.2 Sample Container Selection

Sample containers vary in size and material of construction depending on the specific type of analysis to be conducted. Containers to be used shall be obtained directly from the laboratory. The laboratory will provide the correct sizes and types of bottles based on the parameters required. The sample containers for specific analysis are provided in Appendix C. The laboratory shall be contacted at least one (1) month prior to the sampling event to ensure that containers are available for sampling.

3.3 Field Sample Log

The individual collecting the samples shall record the following at each location at the time of sampling:

- Date of sampling;
- Time of sampling;
- Weather conditions;
- Monitoring Station Number (i.e., RES-1, RES-2, etc.);
- Results of any field measurements;
- Sampler shall also indicate if sample used preservatives;
- Any unusual conditions; and
- Any deviation from standard procedures.

An example Sampling Log is included in Appendix B.

3.4 General Procedures for Sample Collection

General procedures for sample collection are outlined below. Different laboratories have slightly different bottle requirements and sample handling protocols. Sampling technicians must receive site specific training and laboratory procedures must take precedence over other protocols.

- Sample Locations and Sampling Frequency – The location and frequency of each sampling option has been carefully selected, and is part of site design and layout, as well as the Water Board License. Sampling will follow their requirements. Diversions must be recorded and submitted to the Water Board for approval;
- Preparation – Approximately one (1) month prior to the sampling event the laboratory will be notified, and the required bottles, blanks, and materials assembled. Plans for rapid return of the samples prepared;
- Field Collection – At each sampling station the specified samples will be collected, and field data recorded;
- Handling Storage and Transportation –Appropriate personal protective equipment (gloves, safety glasses, etc.) will be used when handling samples. Samples will be stored a 4°C and protected from freezing until delivered to the laboratory. Chain of custody for sampling, storage, and delivery must be maintained. Laboratory sample sheets will be filled in as per laboratory protocols; and
- Delivery to Laboratory – Samples will be delivered to the laboratory in the laboratory dictated method and within the hold times specified, as much as possible.

3.5 Surface Water Sampling Procedures

All the samples taken will be grab samples. Samples will normally be taken from natural lakes, streams, treatment ponds, or process streams. Where possible, samples shall be taken from just below the surface to avoid floating debris, which may contaminate the sample.

3.5.1 Freshwater Streams, Surface Drainage, and Wetlands

Guidelines for collecting samples from streams, surface drainage, and wetlands are as follows:

- The samples shall be collected as close to the middle of the stream where water flows freely and is free of debris.
- Samples shall be collected upstream of the sampler.
- After getting into position, the sampler shall wait to allow any stirred sediment that occurred from entering the stream to settle or wash away.

- The sample bottle shall be partially filled with the water to be sampled and rinsed with the lid in place.
- Rinse water shall be emptied downstream of the sampling point, so that stream sediments remain undisturbed.
- Prior to sampling for oil/grease, bacteria, and for any bottles containing preservative, the bottles shall not be rinsed.
- If possible, bottles shall be plunged into the stream to a depth of approximately half the total stream depth and allow it to fill with the mouth of the bottle facing upstream.
- If the stream is too shallow to allow for sample bottle to be filled completely, without disturbing bottom sediment of the streambed, the sampler may use a smaller container that has been properly rinsed to transfer sample to the larger bottle.
- Do not use a smaller sample bottle containing preservatives.
- When taking the sample, sufficient room shall be left to allow for the addition of preservatives, if required.

3.5.2 Lakes or Ponds

When collecting samples from lakes or ponds, the below procedures should be followed:

- Surface sampling shall be collected using the same procedures as streams.
- Sample bottles shall be plunged to approximately 150 mm (6 inches) below the water surface.

3.6 Sample Identification

All samples collected are to be labelled according to standard identification procedures (Name of sampler, time and date of sampling, sample identifier, sampling method and type of sample). Sample labels shall be water-resistant and prepared prior to going into the field. The individual samples will be labelled with the following information:

- Sample ID #;
- Monitoring Station Name (e.g., RES-1);
- Date and time of collection;
- Parameter to be analyzed;
- Preservatives;
- Project number identifier; and
- Bottle number 1 of ___.

3.7 Sample Preservation

To obtain good results from a sampling program, timing is critical. All samples are to be shipped to the Laboratory that has been contracted to carry out the analysis the same day as they are collected. Samples must be protected from breakage and shall be shipped in an insulated cooler that can be provided by the Laboratory. If samples cannot be shipped until the next day, due to unavoidable events such as weather or mechanical problems with transport aircraft, all samples must be stored in a refrigerator at 4ºC. Samples must not be frozen.

In all cases where samples cannot be delivered to the lab on the same day, specific preservatives must be added to the samples to prevent chemical changes that may alter the concentration of the parameters of interest. The samples must be preserved within two hours of sampling. Usually, samples can be preserved away from the field at the end of the site visit. In most cases, the laboratory can fill the bottles with preservative, and then ship them to the Municipality to be filled and sent back for analysis.

3.8 Sample Transportation

The main objective of the sampler is to minimize any chemical changes to the sample between the time it is collected and delivery to the laboratory. Heat, light, and agitation can all impact the water chemistry, and the samples shall be protected from these effects.

Effluent and surface water samples shall be stored and transported at a temperature of 4ºC. Coolers and ice packs need to be available and are usually provided by the laboratory. Upon arrival at the laboratory, samples shall be refrigerated as soon as possible.

4.0 Quality Assurance and Quality Control

Quality Assurance (QA) and Quality Control (QC) are vitally important components of environmental management.

4.1 Quality Assurance

Quality Assurance (QA) is a set of operating principles that, if strictly followed during sample collection and analysis, will produce data of known and defensible quality. As such the accuracy of the analytical results can be stated with a high level of confidence. A high level of quality assurance can be achieved by applying the following principles:

- Personnel involved in water sampling and analysis are well trained;
- Facilities and equipment required for sampling are suitable, well maintained, and always kept clean;
- Standard procedures are developed and implemented for the collection, transportation, and analysis of samples, based on recognized best management practices (BMP);
- Laboratory and field instruments are calibrated according to manufacturers recommendations or recognized as good operating practice; and
- Supplies used in sampling and analysis are of consistent high quality and are not expired.

4.2 Quality Control

Quality Control (QC) is a set of specific procedures used to measure the quality of the data produced and correct deficiencies in the sampling or analyses, as they occur. Quality control is used by the analyst and sampler to achieve standards of measurement for the three principles components of quality: precision, accuracy, and reliability.

Most commercial laboratories undertake QA/QC procedures with the volume of sample sent for analysis. Reports are usually provided with the Certificates of Analysis. It is recommended that the suggested QA/QC protocols by the laboratory be followed.

To ensure that the monitoring program maintains accepted quality control, field blanks and duplicate samples should be collected. These samples are collected and analyzed for the sample parameters listed in the monitoring program in the license as part of a quality control check on monitoring activities.

4.2.1 Field Blanks

Field Blanks are samples that the lab uses to identify any environmental impacts caused during sample collection or sample transportation. Field Blanks shall accompany the sampler into the field, labelled as field blanks, preserved in the field, and submitted to the laboratory with the field samples.

4.2.2 Replicate or Duplicate Samples

Replicate or duplicate samples involves collecting more than one sample for a given sampling station subject to specific analysis. Standard procedures used for the routine sampling shall be applied. The replicate or duplicate samples are useful in identifying problems with accuracy and sampling methods.

4.3 Lab Accreditation

Analytical methods and accreditation are usually dictated by the guideline criteria being followed. In most cases, the guideline criteria are the Canadian Environmental Quality Guidelines (CCME, 2007). These guidelines specify bottles, hold times, preservatives, sampling protocols, as well as lab accreditation, and analytical methodologies. These guidelines or equivalent standard will be used. Prior to any sampling, this information should be reviewed to ensure consistency with regulation and standards. Laboratory accreditation is included in Appendix B.

5.0 Laboratory Analysis and Reporting

The laboratory will perform the analysis of all samples as outlined herein. The results shall be received by the Municipality within the time frame agreed to with the laboratory. The results shall contain the limits of detection used for analysis of each parameter as supplied by the laboratory. The Municipality may request clarification of the analysis by contacting the NWB Technical Advisor and a review of the analysis will be provided upon request. The laboratory results are compared to the limits of the Water Licence for each parameter, and/or to other comparative criteria such as the Canadian Environment Water Quality Guidelines. Results of the monitoring program are reported in the Annual Report as required in the water license. The Annual Report must be submitted by March 31 of the year following the calendar year for which the report has been submitted. The content of the Annual Report and Guideline Criteria is outlined in the following documents:

- Solid Waste Management Facility Operations and Maintenance Plan;
- Sewage Treatment Facility Operations and Maintenance Plan; and
- Water Supply Facility Operations and Maintenance Plan.

These reports will need to be updated upon NWB approval of this plan.

Appendix A

Site Drawings

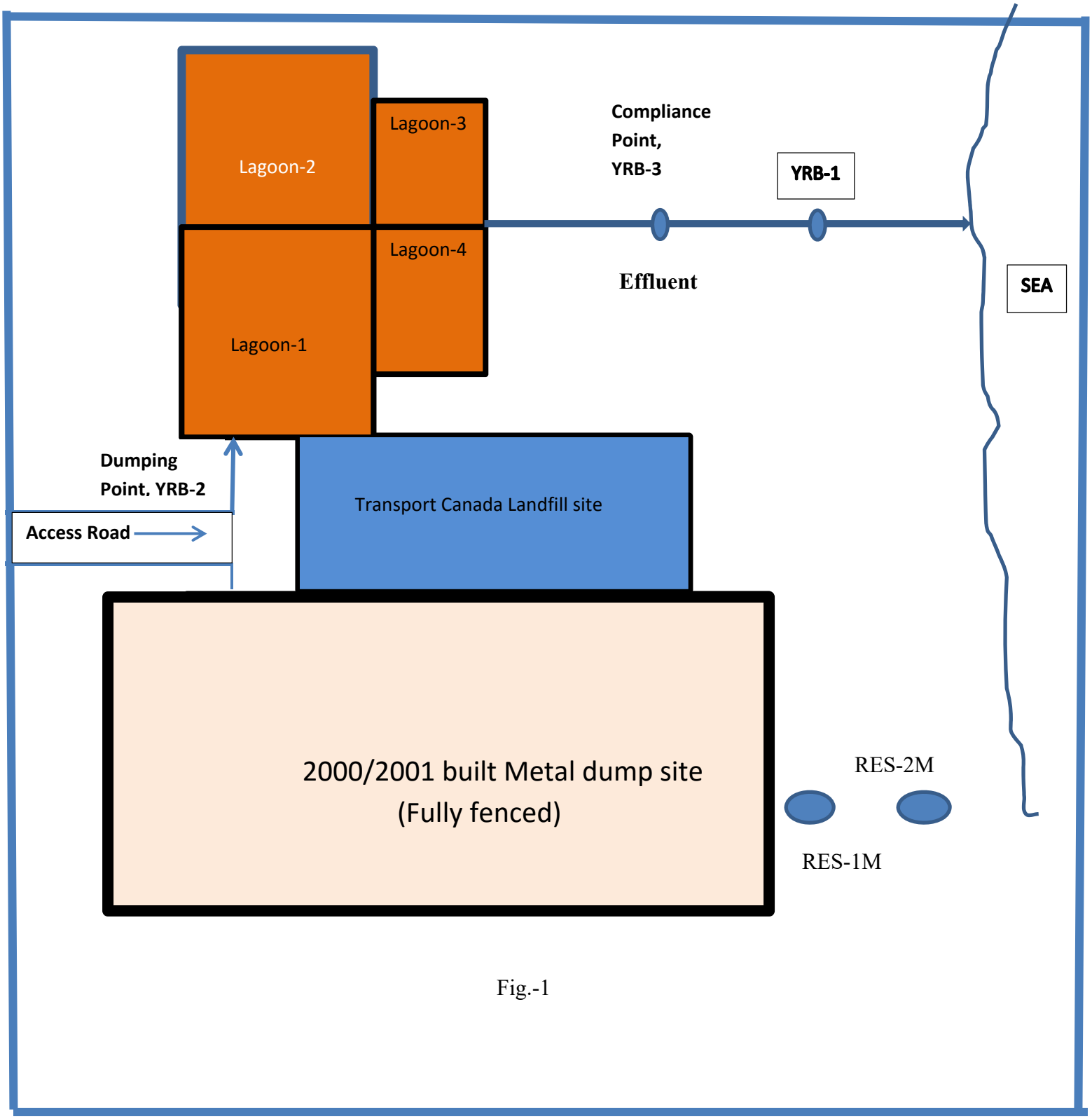

Lagoon-2
Lagoon-3
Lagoon-4
Lagoon-1
Compliance
Point,
YRB-3
YRB-1
Effluent
SEA
Dumping
Point, YRB-2
Access Road
Transport Canada Landfill site
2000/2001 built Metal dump site
(Fully fenced)
RES-2M
RES-1M

Fig.-1

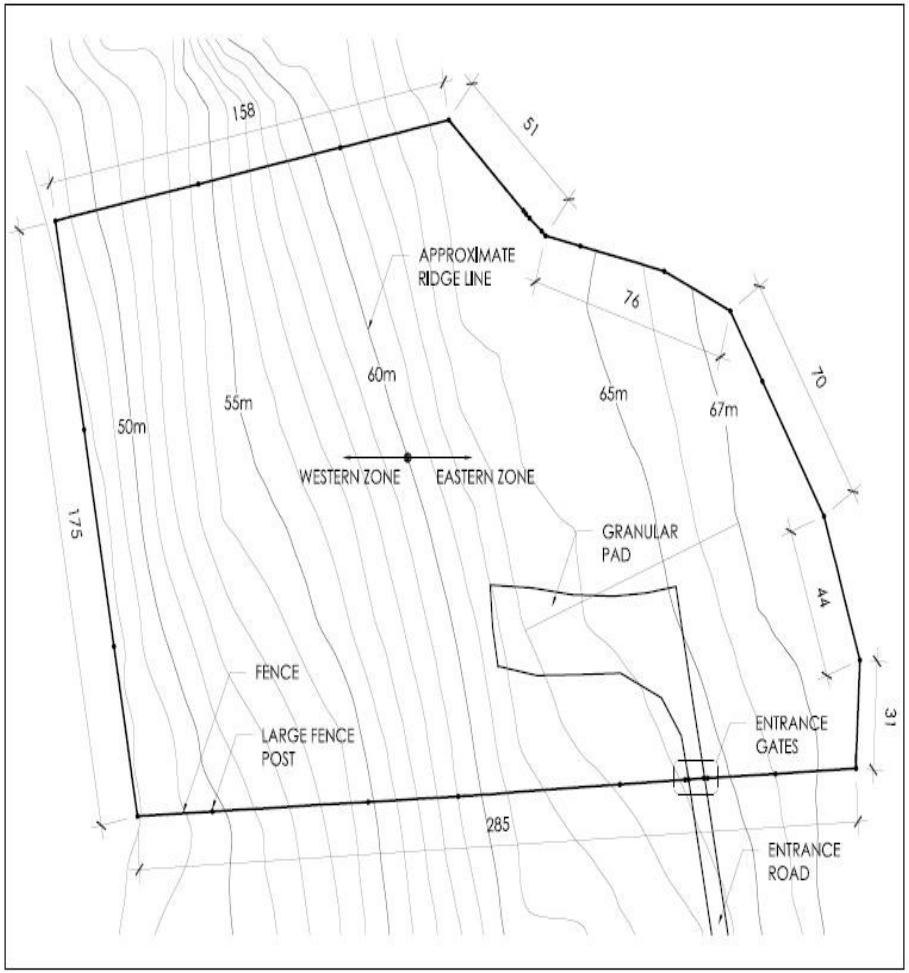


Fig.-1: Location Map of 2001 built Dump site of Hamlet of Resolute Bay

Appendix B

Laboratory ***Accreditation***

Canadian Association for Laboratory Accreditation Inc.

Certificate of Accreditation

Caduceon Environmental Laboratories (Ottawa)
Caduceon Enterprises Inc.
2378 Holly Lane
Ottawa, Ontario

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Accreditation No.:	1002644
Issued On:	11/22/2024
Accreditation Date:	1/3/2005
Expiry Date:	5/22/2027

President and CEO

This certificate is the property of the Canadian Association for Laboratory Accreditation Inc. and must be returned on request; reproduction must follow policy in place at date of issue.
For the specific tests to which this accreditation applies, please refer to the laboratory's scope of accreditation at www.cala.ca.

Appendix C

Wastewater and Leachate Sampling Guide

Instructions

1.Label all bottles prior to going to sampling site.
2.Wear gloves when sampling/handling preservatives.
3.Plunge bottle to about 15 cm below surface, avoid floating debris.
4.Fill bottles partially with water and rinse with lid in place, empty water away from sampling hole, repeat 3 times.
5.Do not rinse bottles when sampling if bottles contain preservatives.
6.If preservative is already in the bottle, fill slowly so not to wash out preservative (can use rinsed General Chemistry bottle to fill bottles with preservatives).
7.Put bottles in cooler with icepacks.
8.Place Chain of Custody (COC) form in plastic bag and put in cooler.
9.Wash hands when done handling samples.
10.Send samples to lab as soon as possible (take samples on day there is a flight). Sample should be kept in cargo cooler – **do not freeze**.
11.Notify the lab that the sample was shipped, waybill #, and when it is expected to arrive (Sabina Islam sislam@caduceonlabs.com).

Nunavut Wastewater Package

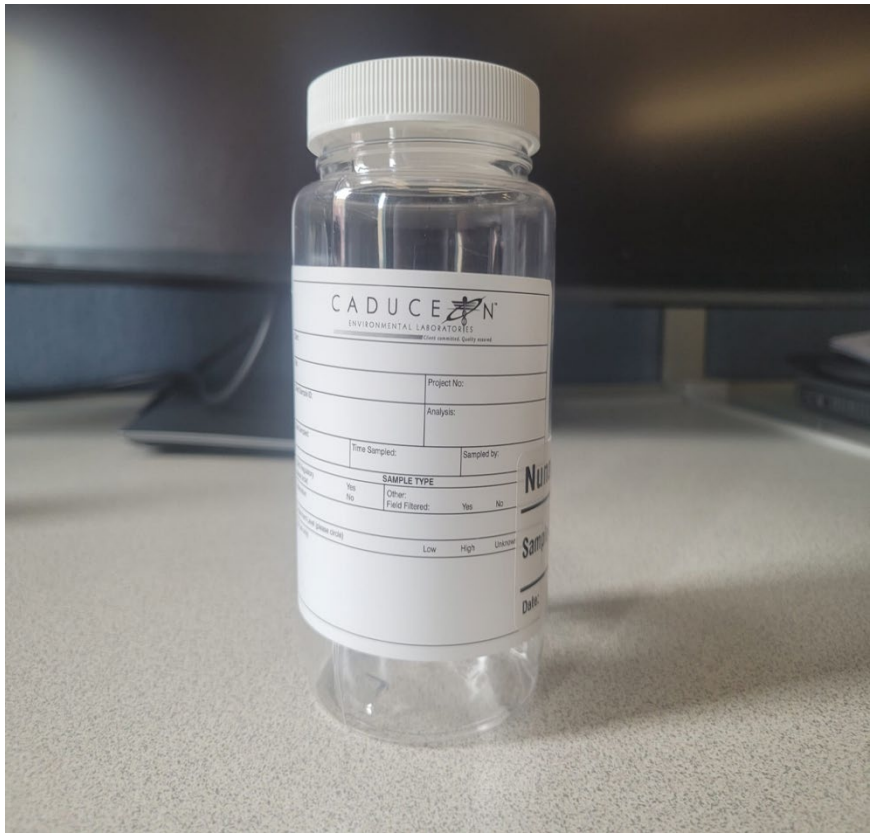


The wastewater package includes:

Test	Bottle Amounts
General Chemistry	1
Nutrients/TOC	2
Metals	1
Mercury	1
Phenols	1
Fecal Coliforms	1
Oil & Grease	1
Routine	1

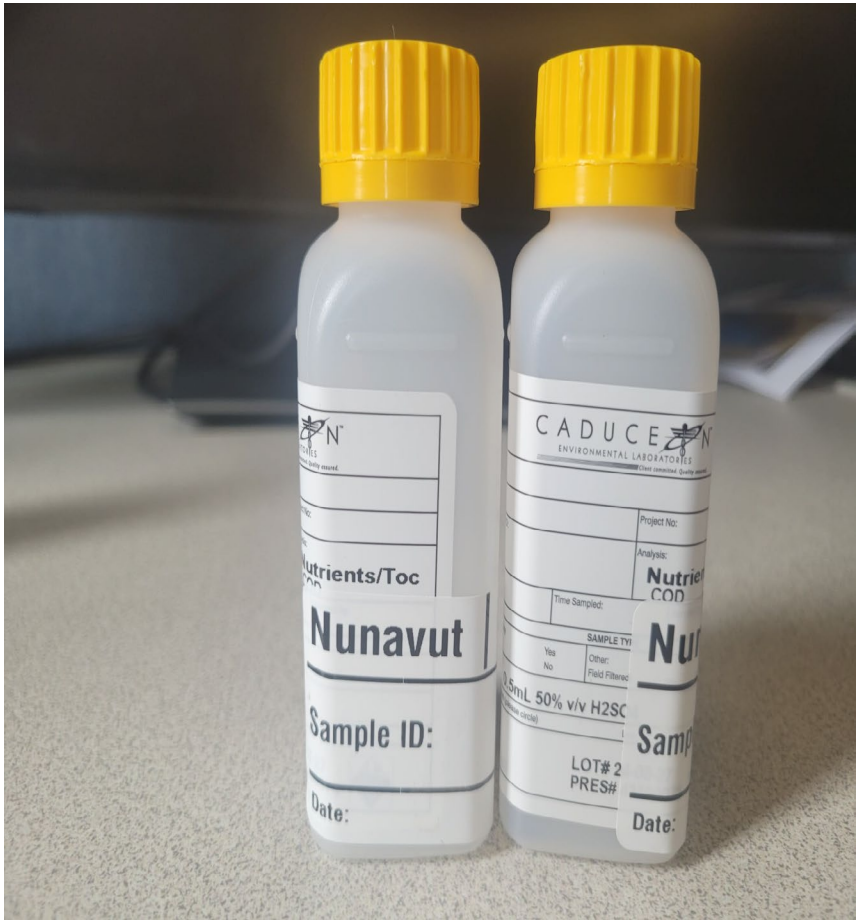
General Chemistry

- Rinse 3 times
- Fill to 95% capacity
- Cap tightly
- Store at 4°C



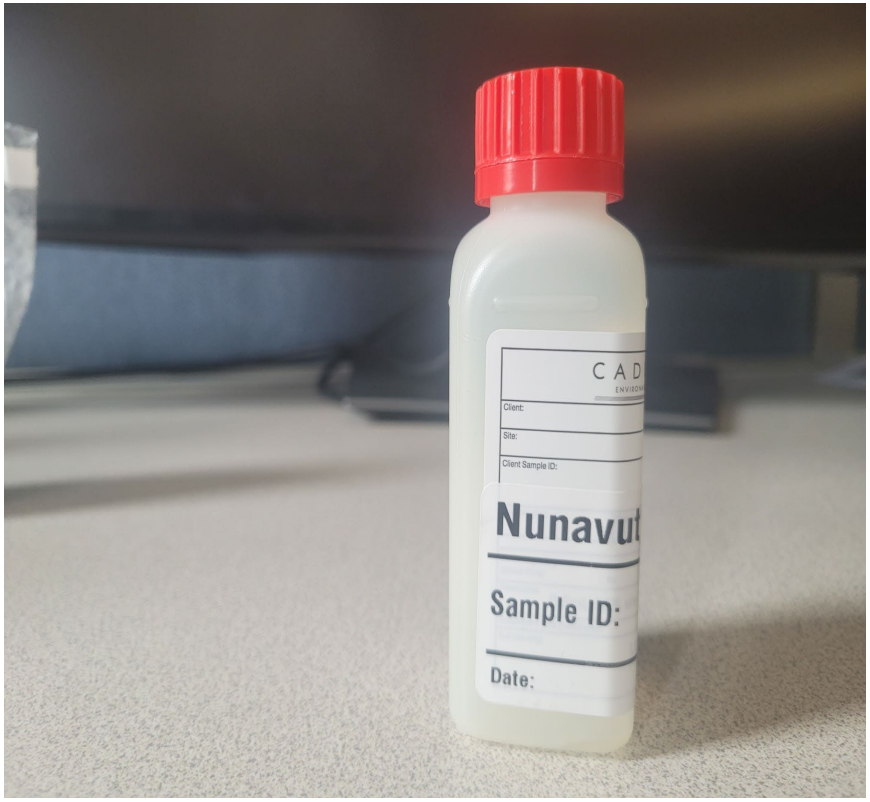
Nutrients/TOC (x2)

- Pre-charged with H_2SO_4. **Do not rinse.**
- Fill both bottles to where bottle neck begins to taper.
- Cap tightly and invert to mix.
- Store at 4°C



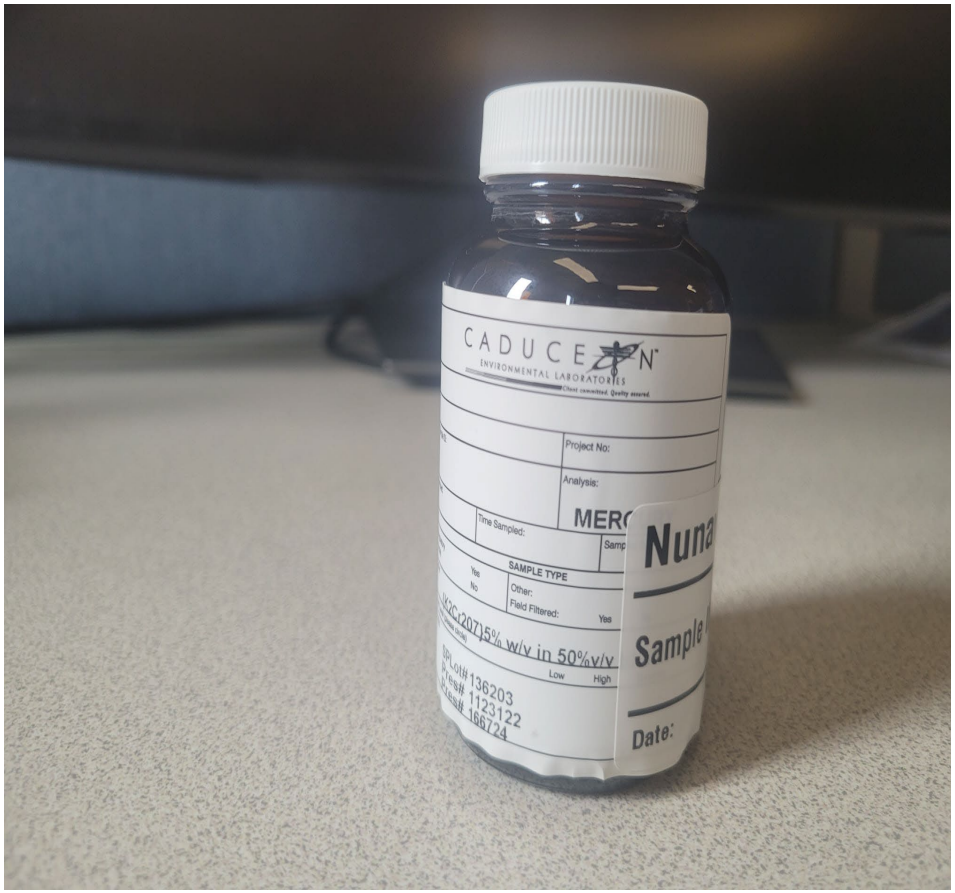
Metals

- Pre-charged with $HN0_3$. **Do not rinse.**
- Fill bottle to where bottle neck begins to taper.
- Dissolved Metals analysis requires field filtration, therefore, samples from the general chemistry bottle will be filtered at the lab and then analysed for Dissolved Metals.
- Cap tightly and invert to mix.
- Store at 4°C



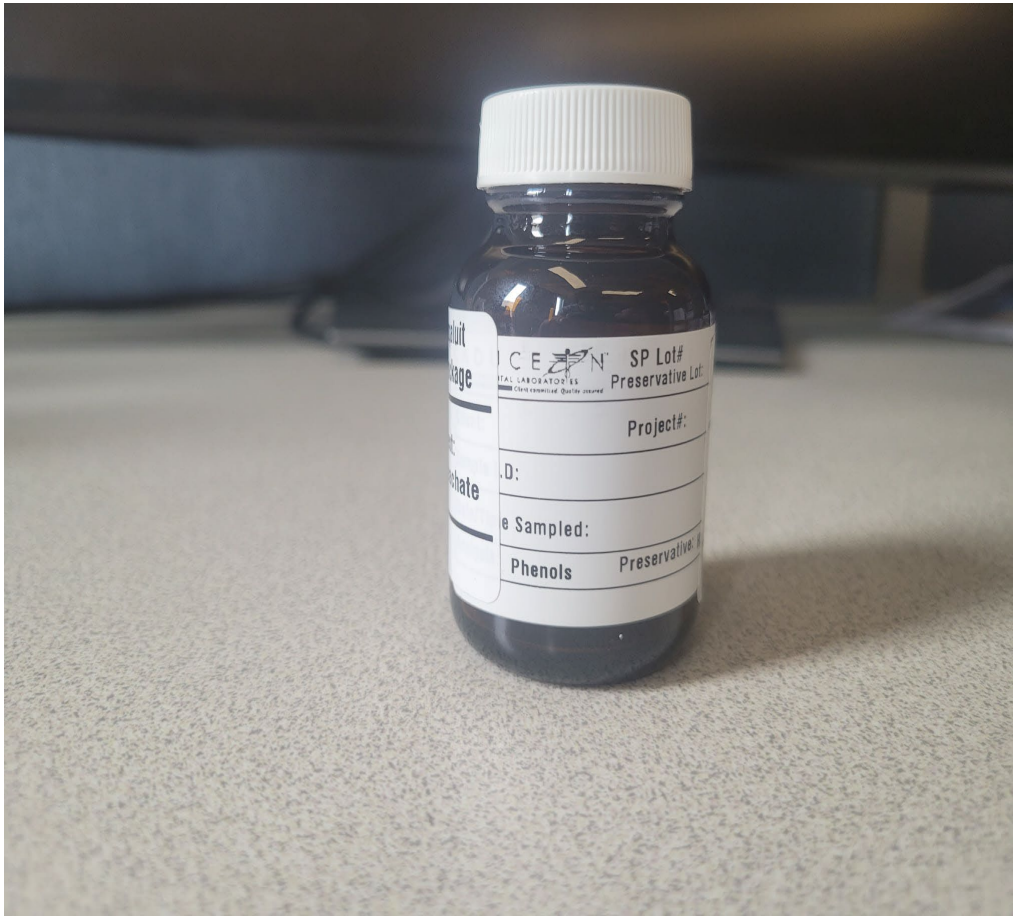
Mercury

- Pre-charged with $K_2Cr_2O_7/HNO_3$. **Do not rinse.**
- Fill to where bottle neck begins to taper.
- Cap tightly and invert to mix.
- Place in bubble wrap and seal.
- Store at 4°C



Phenols

- Pre-charged with H_2SO_4. **Do not rinse.**
- Fill to where bottle neck begins to taper.
- Cap tightly and invert to mix.
- Place in bubble wrap and seal.
- Store at 4°C.



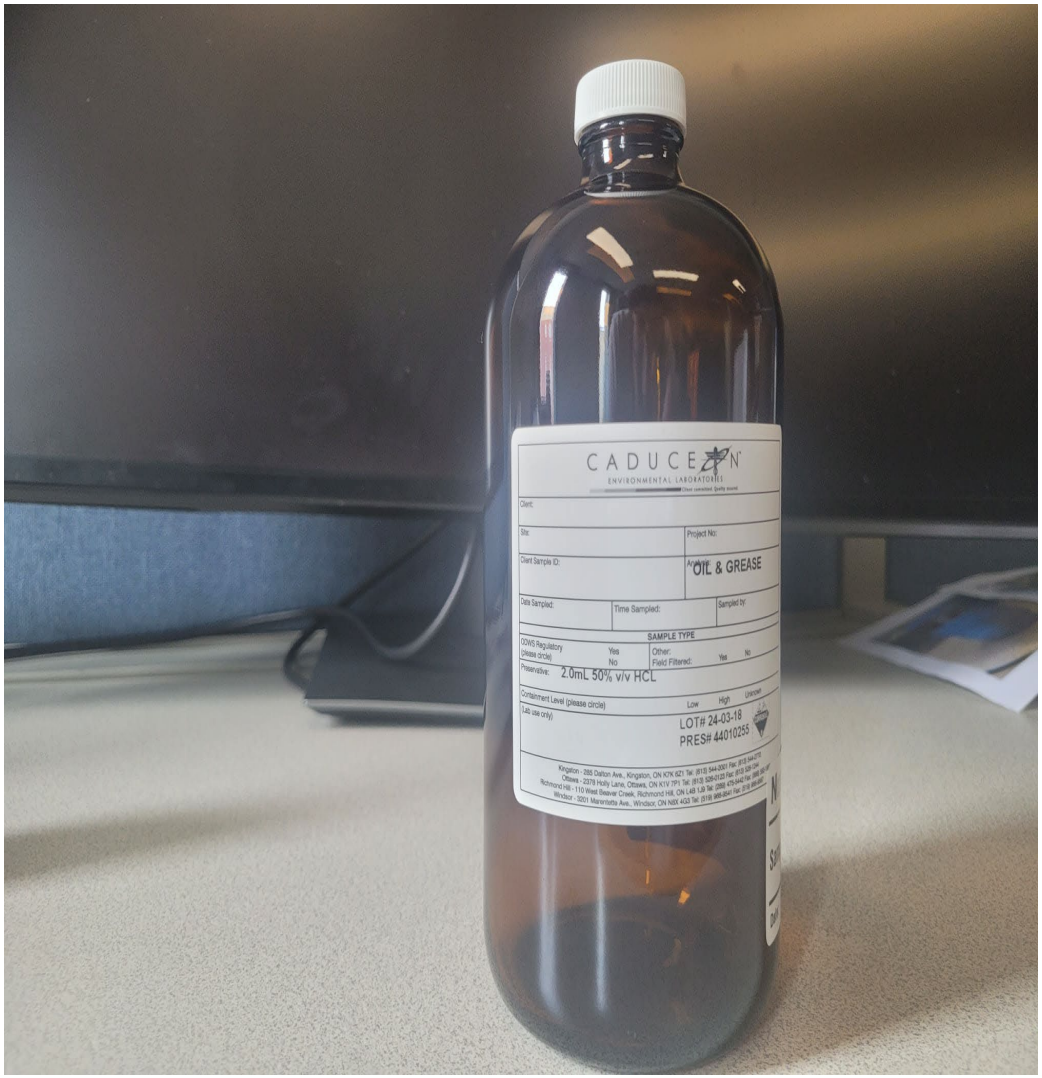
Fecal coliforms

- Pre-charged with Sodium Thiosulfate. **Do not rinse.**
- To prevent contamination, refrain from inserting your hands into the bottle, please wear gloves.
- Fill up to the 200 ml mark on the bottle.
- Cap tightly and invert to mix.
- Place in bubble wrap and seal.
- Store at 4°C.



Oil & Grease

- Pre-charged with HCL. **Do not rinse.**
- Fill to where bottle neck begins to taper.
- Cap tightly and invert to mix.
- Place in bubble wrap and seal.
- Store at 4°C



Routine

- Rinse 3 times
- Fill to 95% capacity
- Cap tightly
- Store at 4°C



Leachate Package

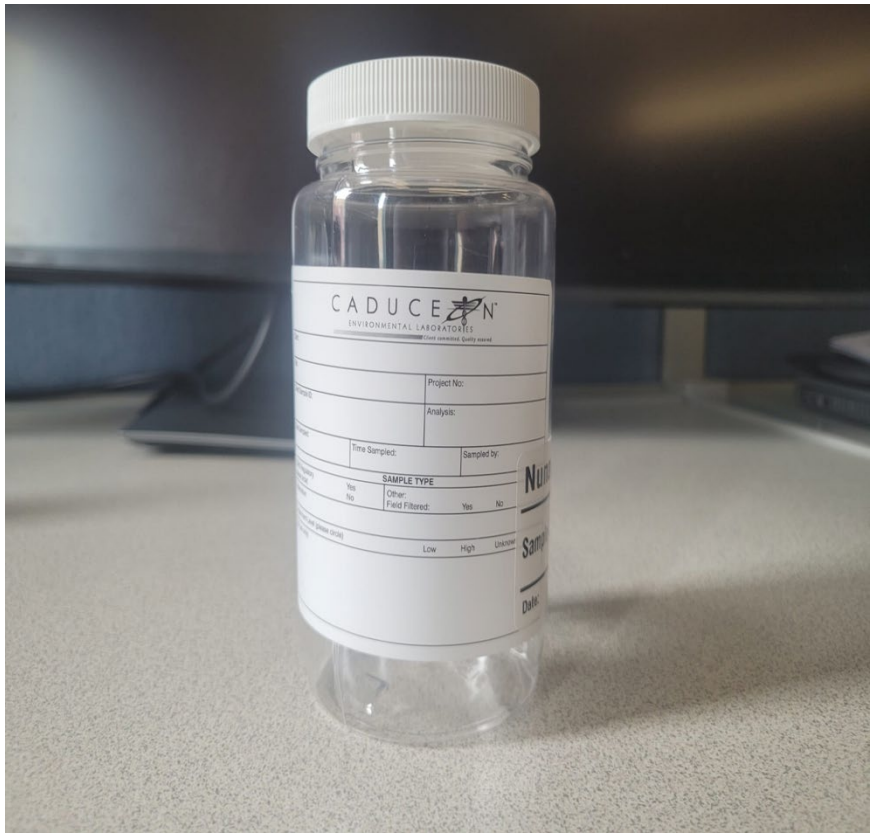


The Leachate package includes:

Test	Bottle Amounts
General Chemistry	1
Nutrients/TOC	2
Metals	1
Mercury	1
Phenols	1
Fecal Coliforms	1
Oil & Grease	1
BTEX/PHC (F1)	2
PHC F2-F4	1
PAHs	2
Routine	1

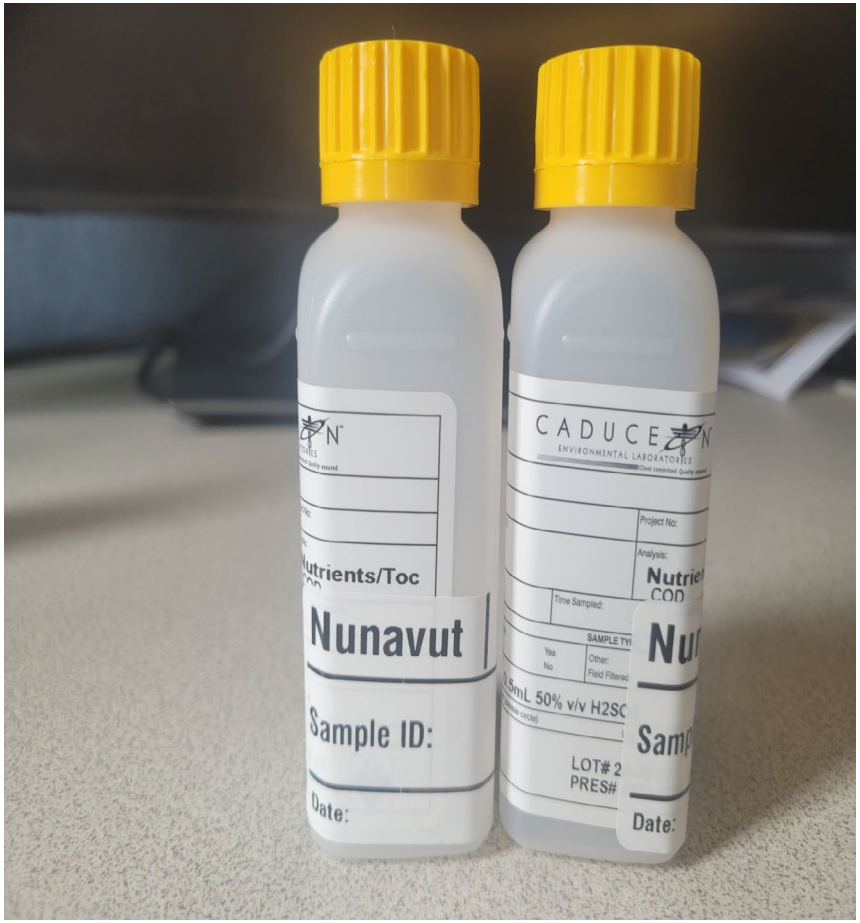
General Chemistry

- Rinse 3 times
- Fill to 95% capacity
- Cap tightly
- Store at 4°C



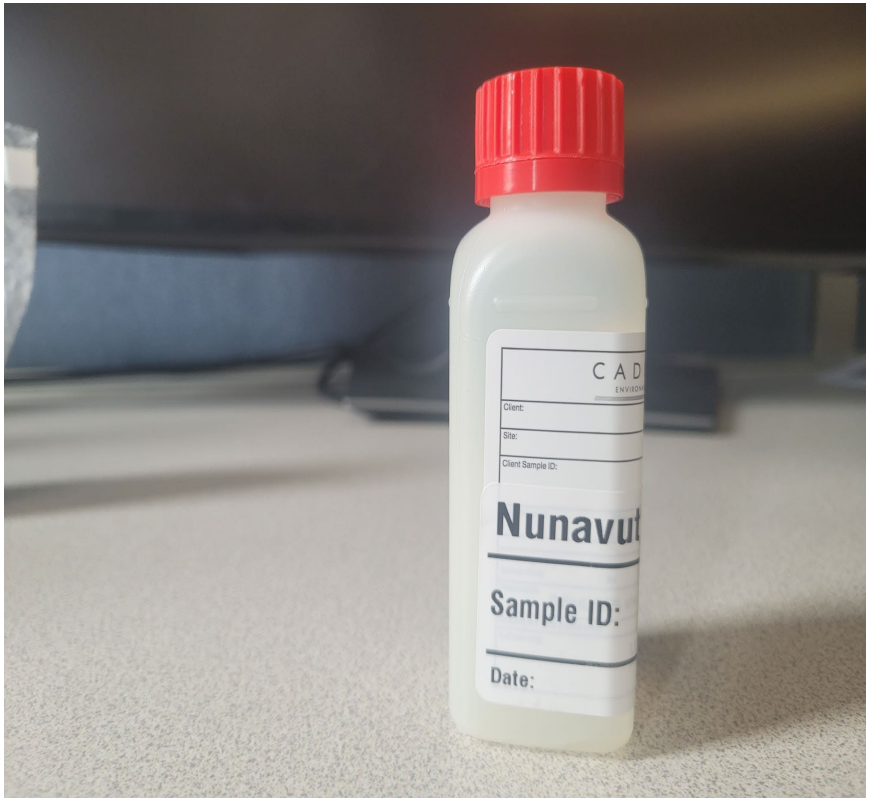
Nutrients/TOC (x2)

- Pre-charged with H_2SO_4. **Do not rinse.**
- Fill both bottles to where bottle neck begins to taper.
- Cap tightly and invert to mix.
- Store at 4°C



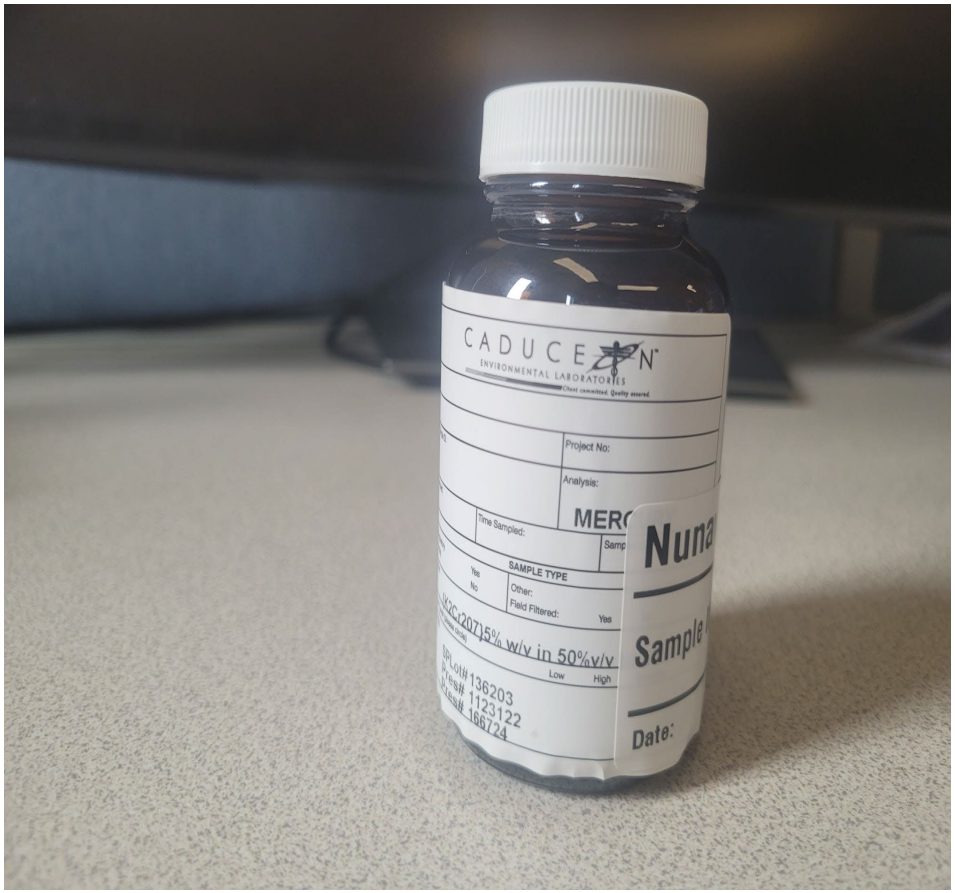
Metals

- Pre-charged with $HN0_3$. **Do not rinse.**
- Fill bottle to where bottle neck begins to taper.
- Dissolved Metals analysis requires field filtration, therefore, samples from the general chemistry bottle will be filtered at the lab and then analysed for Dissolved Metals.
- Cap tightly and invert to mix.
- Store at 4°C



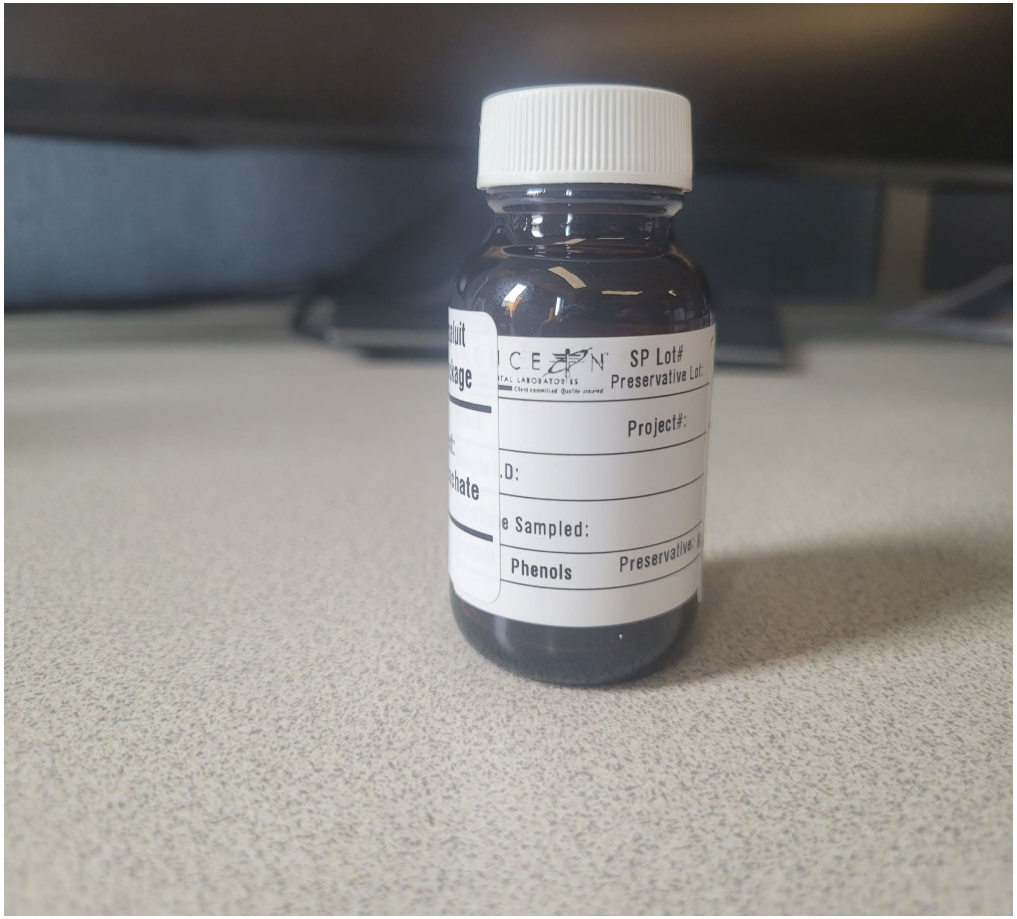
Mercury

- Pre-charged with $K_2Cr_2O_7/HNO_3$. **Do not rinse.**
- Fill to where bottle neck begins to taper.
- Cap tightly and invert to mix.
- Place in bubble wrap and seal.
- Store at 4°C



Phenols

- Pre-charged with H_2SO_4. **Do not rinse.**
- Fill to where bottle neck begins to taper.
- Cap tightly and invert to mix.
- Place in bubble wrap and seal.
- Store at 4°C.



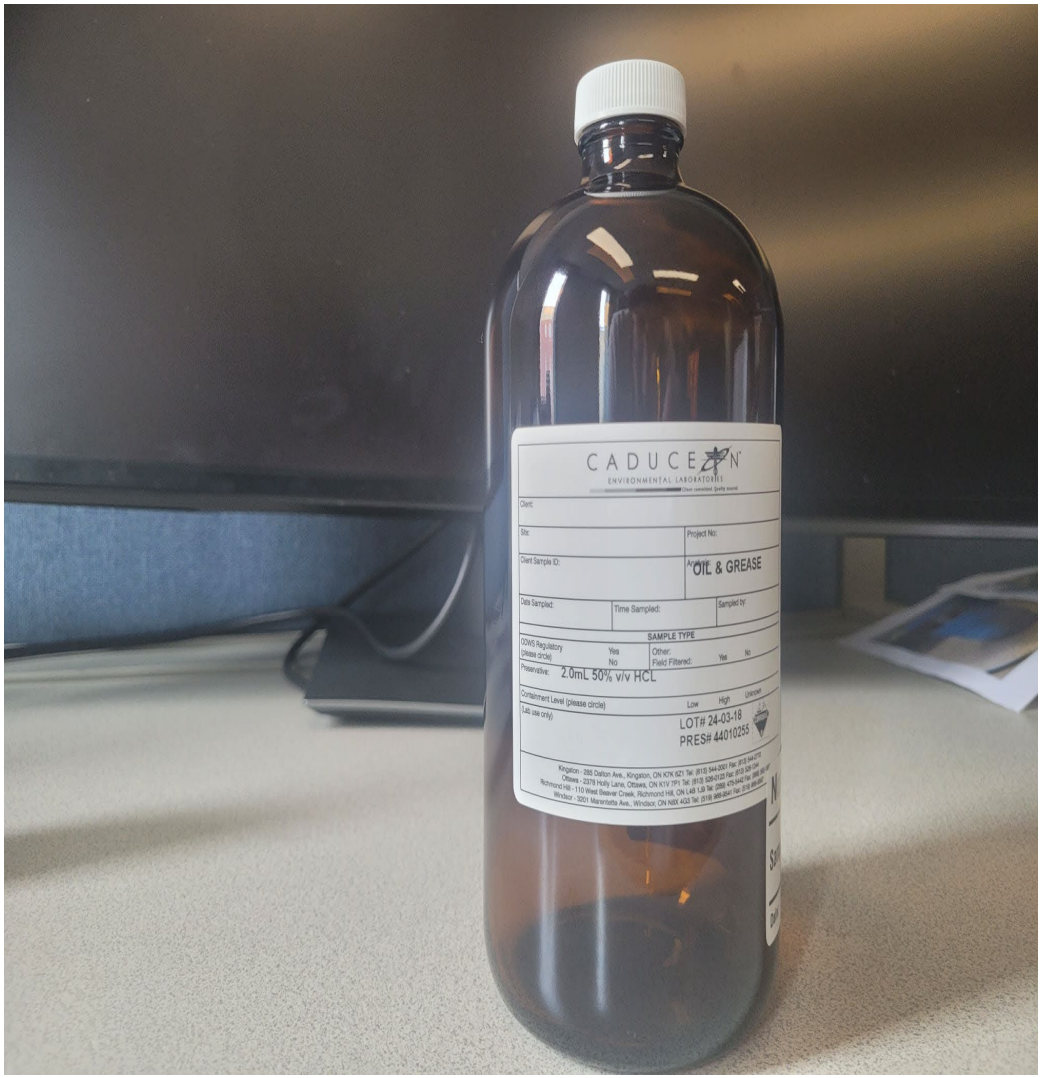
Fecal coliforms

- Pre-charged with Sodium Thiosulfate. **Do not rinse.**
- To prevent contamination, refrain from inserting your hands into the bottle, please wear gloves.
- Fill up to the 200 ml mark on the bottle.
- Cap tightly and invert to mix.
- Place in bubble wrap and seal.
- Store at 4°C.



Oil & Grease

- Pre-charged with HCL. **Do not rinse.**
- Fill to where bottle neck begins to taper.
- Cap tightly and invert to mix.
- Place in bubble wrap and seal.
- Store at 4°C



BTEX/PHC (F1)

- Pre-charged with $NaHSO_4$. **Do not rinse**.
- Fill vial until just prior to overflowing.
- There should be minimal to no headspace.
- Cap and invert the vial to verify no air space.
- If air space is present, uncap the vial and add more sample water.
- Cap tightly.
- Place in bubble wrap and seal.
- Store at 4°C



PHC (F2-F4)

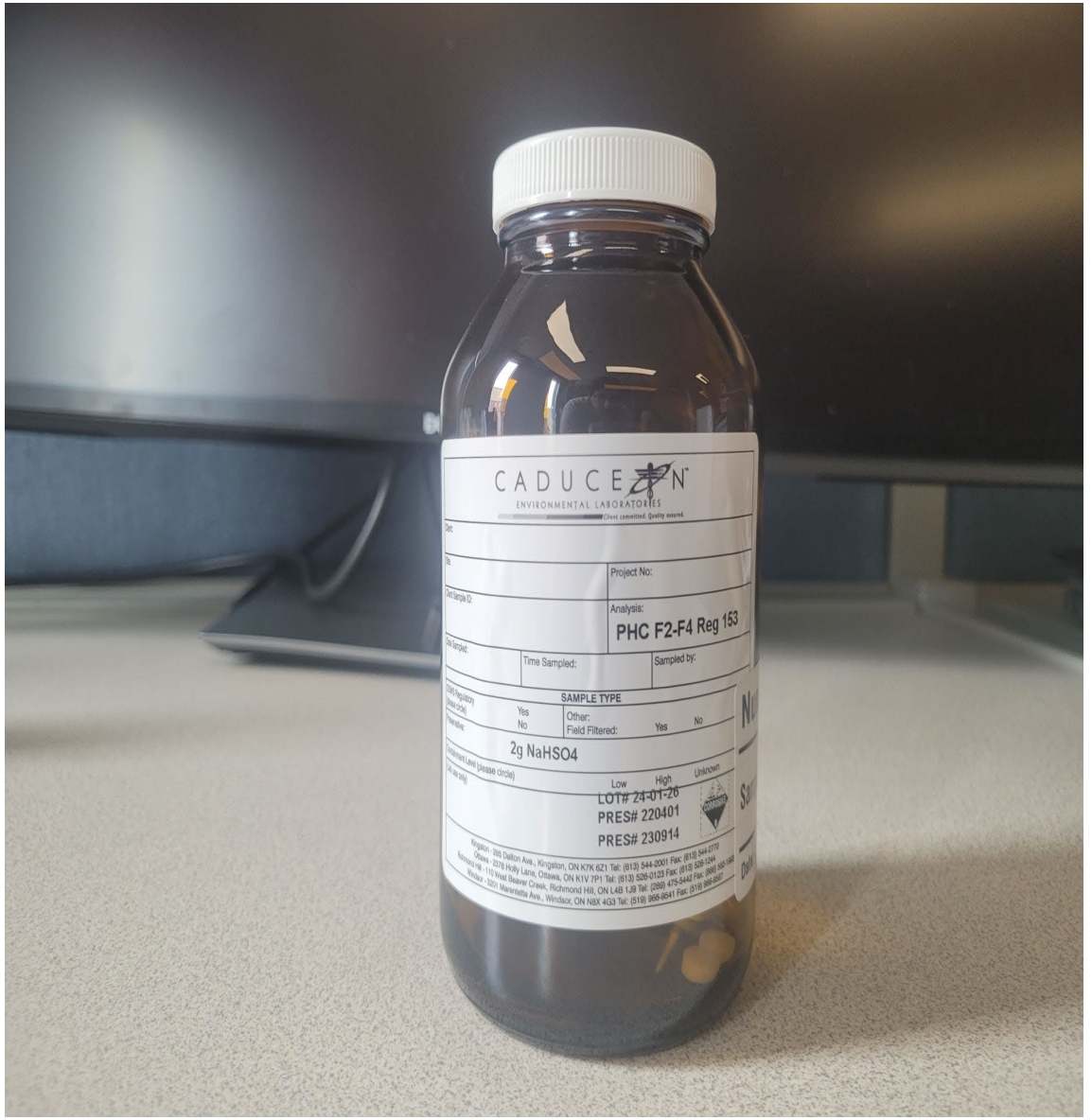
- Pre-charged with $NaHSO_4$. **Do not rinse.**

- Fill to where bottle neck begins to taper.

- Cap tightly and invert to mix.

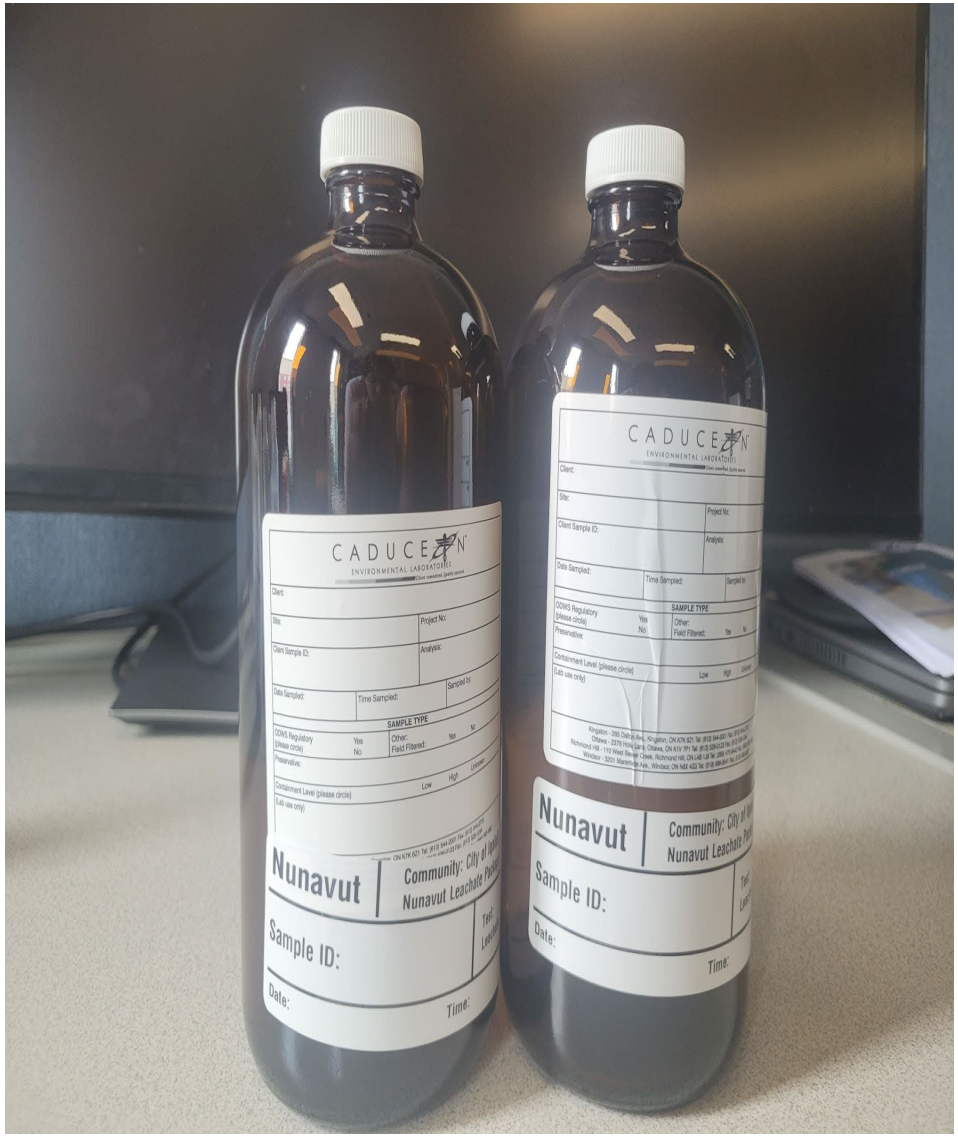
- Place in bubble wrap and seal.

- Store at 4°C



PAHs (x2)

- Rinse 3 times
- Fill to 95% capacity
- Cap tightly
- Place in bubble wrap and seal
- Store at 4°C



Routine

- Rinse 3 times
- Fill to 95% capacity
- Cap tightly
- Store at 4°C



Appendix D

Field Forms

Field Log

Name of Sampler(s): _____

Date of Sampling: _____

Time of Sampling: _____

Monitoring Station Number: _____

GPS Coordinates: N _____°_____’_____” W _____°_____’_____”

Weather Conditions: _____

Samples:

- ☐ 500 mL BOD
- ☐ 500 mL Routine
- ☐ 500 mL CBOD
- ☐ 40 mL Glass Mercury Vial + Pres
- ☐ 100 mL Amber Nutrients + Pres
- ☐ 100 mL Amber Phenols + Pres
- ☐ 250 mL Sterile Bacteria Bottle
- ☐ **2 x** 250 mL Amber Oil & Grease + Pres
- ☐ 60 mL Metals + Pres
- ☐ **3 x** 40 mL BTEX, F1 Vials + Pres
- ☐ **2 x** 100 mL Amber F2-F4 Vials + Pres
- ☐ **2 x** 250 mL Amber PAH + Pres

Other:

- ☐ _____
- ☐ _____
- ☐ _____

Other Notes: (any unusual conditions, any deviation from standard procedures, reason sample was not taken, etc.)

_____

_____

_____

_____

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