QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC) PLAN FOR THE COLLECTION OF EFFLUENT SAMPLES AT THE **FOX-5 (BROUGHTON ISLAND)** DEW LINE SITE

Revised September 2005

Prepared by:
ENVIRONMENTAL SCIENCES GROUP
for
DEFENCE CONSTRUCTION CANADA
&
UMA ENGINEERING LTD

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1. Introduction

During the clean-up of the FOX-5 DEW Line site at Broughton Island, Nunavut the collection of sewage effluent samples will only be required should the construction camp discontinue the practice of having its sewage collected and treated by the Hamlet of Qikiqtarjuaq Municipal Services.

If an on-site Sewage Disposal Facility is constructed and used, the Proposed Monitoring Program for FOX-5 states that the contents of this facility shall be analyzed once at 30 days after its establishment and a second time prior to discharge. All waste discharged from this Facility will be analyzed for the following parameters:

- Mineral oil and grease (observations of presence/absence of sheen will be made – no samples will be collected or analyzed);
- Total suspended solids (TSS);
- Biological oxygen demand (BOD_5);
- Faecal coliforms; and
- pH.

2. Sample Collection

2.1. Location

GPS coordinates of sample locations are collected and recorded. Photographs of the sample location are also taken.

2.2. Sampling Equipment

The following table summarizes the equipment and storage requirements for each water sample type collected. New bottles were used in all cases for the collection of the water samples.

Contaminant	**Container**	**Amount**	**Rinse**	**Storage**	**Special Treatment**
TSS, pH	1L Plastic Bottle	Full	No	Cool	Do not filter
BOD_5	250 mL amber glass bottle	Full – no headspace	No	Cool	Do not filter
Bacteria and coliforms	Bacti bottles (Accutest)	Full	No	Cool	Analyze within 48 hours of collection

2.3. Sampling Methods

Sample bottles will be filled completely at the time of sampling. Bottles are not to be filled progressively over the course of days. If there is not sufficient water to completely fill the bottle(s), then no water sample will be collected. The bottles are to be filled with no headspace remaining to guard against volatilization of dissolved phases. Generally, the samples will be collected immediately prior to departure from the site and submitted for analysis within 48 hours.

3. Sample Handling

3.1. Preservation

The water samples will be kept cool (approximately 4^0 C) prior to and during shipping. In general, water samples will be collected when transportation from the site will be available almost immediately after, as many types of the required analyses should be performed as quickly as possible after collection.

Ideally, samples collected for inorganic analyses should be acidified in the field, at the time of collection. However, regulations concerning the transportation of dangerous goods make supplying concentrated nitric acid in the field difficult. Where samples can not be acidified in the field, it will be requested that the samples are acidified immediately upon receipt in the lab, *prior* to decanting or sample extraction. When acidifying in the lab, the container will be rinsed with 35% HNO_3 and included with the sample.

Samples are not to be filtered at any time. If samples contain excessive sediment, the samples will simply be decanted in the southern laboratory (*following* acidification, for metal analyses) prior to analysis.

3.2. Sample Identification

Each water sample will be given a blind number that was the only number provided on the labels of samples submitted for analysis. This sample number corresponds to the number assigned to that specific sample location which will be recorded on a map and in the field notebook.

3.3. Transportation

Samples are to be shipped by guaranteed airfreight in coolers from the site to their respective accredited laboratory for analysis. Chain-of-custody forms will be filled out and checked for each sample before shipment from the North, and the contents of shipments will be verified upon receipt in the laboratory.

4. Lab Analysis

4.1. Lab Accreditation

All laboratory analysis is carried out at accredited labs. The following laboratories are the ones primarily responsible for the analysis of water samples collected at FOX-5 (Broughton Island):

1) Analytical Services Unit, Queen's University, Kingston ON; and
2) Analytical Sciences Group, Royal Military College of Canada, Kingston ON.

Proof of accreditation from these laboratories is located in Appendix A. The standard methods used by the laboratories for each of these analyses are listed in the laboratory's scope of accreditation.

4.2. Detection Limits

The following table provides a summary of the detection limits for the analysis to be performed on water samples collected at FOX-5 (Broughton Island).

Parameter	Detection Limit
Biological oxygen demand (BOD_5)	3 mg/L
Total suspended solids (TSS)	1 mg/L
Faecal coliforms	0 counts/100 mL

4.3. Methodology

The following is a summary of the methods to be used in the analysis of the water samples collected from FOX-5 (Broughton Island).

4.3.1. Total Suspended Solids

Analyses were conducted by the Analytical Services Group, Royal Military College, Kingston, Ontario. Each sample was clearly labelled and stored at low temperatures in a secured area before and after analysis.

Total suspended solids (TSS) in water were determined by filtering a sample through a 0.45-micron glass fibre filter. The filter was first dried in an oven at 105 ^{o}C for 4 hours, allowed to cool, and weighed. A measured volume of water (usually 500 mL) was poured through the filter, which was then oven-dried for 12-18 hours, cooled, and reweighed. The TSS were reported as the weight of suspended material divided by the volume of water (units of mg/L).

4.3.2. Biological Oxygen Demand (BOD_5)

Analyses were conducted by the Analytical Services Group, Royal Military College, Kingston, Ontario. Each sample was clearly labeled and stored at low temperatures in a secured area before and after analysis.

The dissolved O_2 consumed over a five-day period was used as a measure of organic matter oxidizable by biological means. Nutrients were added to each sample solution. Dissolved oxygen was determined using a probe while stirring each solution. Samples were diluted if necessary. The difference in the dissolved oxygen measured in a sample upon receipt and after five days was taken as the measure of its biological oxygen demand (BOD).

4.3.3. Analysis of Faecal Coliforms in Water

Analyses were conducted by the Analytical Services Group, Royal Military College, Kingston, Ontario. Each sample was tested for storage temperature and checked for holding time in receipt. All samples were clearly labeled and stored at low temperatures in a secured area before and after analysis. Drinking water analyses were conducted in accordance with Canadian Drinking Water Quality Guidelines and according to procedures appropriate to Ontario Reg. 169/03 (Safe Drinking Water Act, 2002).

A vacuum filtration apparatus was used to filter 100 mL of sample onto a 47 mm diameter, 0.45 µm pore size cellulose ester membrane filter. The membrane filter was then placed on a fecal coliform (FC) agar plate and incubated at 44.5 ± 0.2 °C for 24 ± 2 hours. After the incubation period, fecal coliform colony-forming units (CFU) appeared as blue colonies on the membrane filter.

The presence of any fecal coliform bacteria per 100 mL in drinking water samples is considered adverse (Table 1, Microbiological Standards of Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (MOE 2003) according to the Safe Drinking Water Act O. Reg. 169/03. Coliforms are not necessarily pathogenic, but the presence of coliforms in water samples, especially *E. coli*, is indicative of recent fecal contamination and hence the possibility of contamination by the pathogenic organisms commonly associated with fecal waste.

4.3.4. pH Measurement

Measurements on water and soil samples were conducted by the Analytical Services Group, Royal Military College, Kingston, Ontario.

Water samples were measured directly using a 50-mL sample; the pH of soil was determined by mixing 10 g of soil with 10 mL of distilled water, allowing the mixture to settle, and measuring the pH of the supernatant. The pH was measured with a Denver Instruments model 220/300729.1 pH meter and probe, relative to buffered reference standards and control.

4.4. Reporting Requirements

The following types of QA/QC samples will also be collected as part of the water sampling program. Note that if more than one type of bottle is used for each water sample, QA/QC samples will be submitted in each type of bottle used for the collection of the samples.

Field duplicates*:* Approximately 10% of the samples were collected as field duplicates. That is, two samples were collected from one sample location. These samples were handled in the same way and submitted blindly to the laboratories for analysis.

Field blanks: Field blanks consisted of distilled water and were collected to ensure that there is no corruption of samples from the sampling method. The distilled water was poured from its container into the sample container at the same time and using the same techniques as used to collect the regular water samples.

Travel blanks: The purpose of travel blanks is to ensure that there is no corruption of the sample or sample container during travel. Ideally, a full set of travel blanks should accompany each shipment of water samples. However, in cases where very few samples are shipped at a time, this guideline can be extended to a more reasonable number. Travel blanks were filled at ESG prior to leaving for the field. They were shipped with the

sample bottles, stored with the sample bottles on site, brought out to the sampling location in the field, returned to the lab, and shipped to the labs with the water samples. They should not be opened unless the other bottles or water samples are opened for some reason during shipping.

Appendix A: Proof of Laboratory Accreditation

CAEAL Directory of Laboratories

Login
Member:
Password:
Login

Home | List all | Search PT Directory | Search Accreditation Directory

Membership Number: 2709
Laboratory Name: Queen's Analytical Services Unit
Parent Institution: Queen's University
Address: Environmental Studies Biosciences Complex Kingston, Ontario K7L 3N6
Contact: Dr. Allison Rutter
Phone: (613) 533-2642
Fax: (613) 533-2897
Email: ruttera@biology.queensu.ca

Standard: Conforms with requirements of CAN-P-4D (ISO/IEC 17025)
Clients Served:
Revised On: February 21, 2005
Valid To: February 16, 2008

Click for PT Directory	Showing Accreditation Directory

Scope of Accreditation

Search Criteria - results highlighted in yellow
Laboratory Name contains "analytical services unit"

Oil
PCB - Oil (004)
ASU 04; based on EPA 8081
GC/ECD - EXTRACTION
Total PCB

Soil/Sediment
Metals - Soil (007)
ASU007; based on EPA 200.7
ICP/OES - DIGESTION
Arsenic
Cadmium
Chromium
Cobalt
Copper
Lead
Nickel
Zinc

Water (Inorganic)
Ammonia - Water (009)
ASU09; based on TECHNICON METHOD
AUTO COLOR
Ammonia

Water (Inorganic)
Dissolved Metals - Water (008)
ASU08; based on EPA 200.7
ICP/AES

Dissolved Arsenic
Dissolved Cadmium
Dissolved Chromium (High)
Dissolved Cobalt (High)
Dissolved Copper (High)
Dissolved Lead (High)
Dissolved Manganese (High)
Dissolved Nickel (High)
Dissolved Zinc (High)

Water (Inorganic)

Major Ions - Water (003)
ASU 03; based on DIONEX MANUAL
ION CHROMATOGRAPHY
Chloride
Nitrate
Nitrate plus Nitrite
Sulfate

Water (Inorganic)

Oil and Grease - Water (010)
ASU10; based on SM 5520 (20TH EDITION)
GRAVIMETRIC - EXTRACTION
Oil and Grease

Water (Inorganic)

Total Metals - Water (012)
ASU08; based on EPA 200.7
ICP/AES
Total Arsenic
Total Cadmium
Total Chromium
Total Cobalt
Total Copper
Total Lead
Total Manganese
Total Nickel
Total Zinc

Water (Organic)

Biphenyl - Water (005)
ASU 05; IN HOUSE METHOD
GC/FID - EXTRACTION
Biphenyl
Biphenyl Ether

Water (Organic)

Phenols - Water (001)
ASU 01; based on MOE METHOD 1983
AUTOANALYZER/COLORIMETRY
Phenols

CAEAL Directory of Laboratories

Login
Member:
Password:
Login

Home | List all | Search PT Directory | Search Accreditation Directory

Membership Number: 2965
Laboratory Name: RMC Analytical Services Group
Parent Institution: The Royal Military College of Canada
Address: Dept. of Chemistry & Chemical Engineering RMC, PO Box 17000 Stn. Forces Kingston, Ontario K7K 7B4
Contact: Dr. David Kelly
Phone: (613) 541-6000 Ext. 6921
Fax: (613) 545-8341
Email: david.kelly@rmc.ca

Standard: Conforms with requirements of CAN-P-4D (ISO/IEC 17025)
Clients Served: Specified Clients
Revised On: January 03, 2005
Valid To: January 03, 2008

Click for PT Directory	Showing Accreditation Directory

Scope of Accreditation

Search Criteria - results highlighted in yellow
Laboratory Name contains "analytical services group"

Oil

Total Chlorine - Oil (003)
ASG 003; based on J. RADIONAL CHEM., 50, 229-234 (1979) AND based on ANAL. CHIM. ACTA., 108, 137-147 (1979).

- NAA
- Total Chlorine

Plant Tissue

Polychorinated Biphenyls (PCB) - Plants (020)
ASG026; based on EPA 8082, EPA 680, EPA 8082, EPA 3545, EPA 3640C, FRAME, ET. AL. J. HIGH RESOL. CHROMATOGR., 19:657-668, 1996.

- Arochlors
- PCB Conegeners

Radio Chemistry

Radionuclide Activity - Biota (008)
ASG 031; based on SM AMERICAN WATER ASSN. METHOD 7120, SM FOR EXAM. OF WATER/WASTEWATER, 20TH ED., & USEPA METHOD 901.1.

- GAMMA SPECTROSCOPY
- Barium-140
- Cerium-144
- Cesium-134
- Cesium-136
- Cesium-137
- Cesium-138

Cobalt-60
Iodine-131
Iodine-132
Iodine-133
Iodine-134
Iodine-135
Lanthanum-140
Molybdenum-99
Niobium-95
Rubidium-86
Rubidium-88
Ruthenium-103
Ruthenium/Rhodium-106
Strontium-91
Tellurium-129m
Tellurium-131m
Tellurium-132
Yttrium-90m
Yttrium-91m
Zirconium-95

Soil

BTEX/Petroluem Hydrocarbons (PHC) - Soil (025)

ASG 053; based on CCME REFERENCE METHOD FOR THE CANADA-WIDE STANDARD FOR PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD 2001

GC/MS - EXTRACTION
Benzene
Ethylbenzene
F1: C6-C10
F2: C10-C16
F3: C16-C34
F4: C34-C50
m/p-xylene
o-xylene
Toluene

Soil/Sediment

Activity of Radionuclide - Soil (007)

ASG 030; based on SM AMERICAN WATER ASSN. METHOD 7120, SM FOR EXAM. OF WATER/WASTEWATER, 20TH ED., & USEPA METHOD 901.1.

GAMMA SPECTROSCOPY
Barium-140
Cerium-144
Cesium-134
Cesium-136
Cesium-137
Cesium-138
Iodine-131
Iodine-132
Iodine-133
Iodine-134
Iodine-135
Lanthanum-140
Molybdenum-99
Niobium-95
Rubidium-86
Rubidium-88
Ruthenium-103
Ruthenium/Rhodium-106
Strontium-91
Tellurium-129m
Tellurium-131m
Tellurium-132
Yttrium-90m
Yttrium-91m
Zirconium-95

Soil/Sediment

PCBs - Soil (005)

ASG 005; based on EPA 8081

GC/ECD - SOXHLET/PSE
PCBs

Soil/Sediment

Polycyclic Aromatic Hydrocarbons (PAH) - Soil (001)
ASG 002; based on EPA 8100
GC/MS - EXTRACTION
Acenaphthene
Acenaphthylene
Anthracene
Benzo (a) anthracene
Benzo (a) pyrene
Benzo (b) fluoranthene
Benzo (g,h,i) perylene
Benzo (k) fluoranthene
Chrysene
Dibenz (a,h) anthracene
Fluoranthene
Fluorene
Indeno (1,2,3 - cd) pyrene
Naphthalene
Phenanthrene
Pyrene

Soil/Sediment

Total Petroleum Hydrocarbons (TPH) - Soil (010)
ASG010; based on EPA 3550B, EPA 8015C
GC/FID - EXTRACTION
Total Petroleum Hydrocarbons

Water (Inorganic)

Alkalinity - Water (Drinking/Surface/Sewage/Ground) (013)
ASG035; based on NAQUADAT NO. 10101, EPA 310.1, SM 20TH ED. 2320
POTENTIOMETRIC
Alkalinity (pH 4.5)

Water (Inorganic)

Biochemical Oxygen Demand (BOD) - Water (Surface/Sewage/Ground) (019)
ASG042; based on NAQUADAT NO. 08201, EPA 405.1, SM 20TH ED. 5210
D.O. METER
BOD (5 day)

Water (Inorganic)

Conductivity - Water (Drinking/Surface/Sewage/Ground) (016)
ASG038; based on SM 20TH. ED. 2510, EPA 120.1
CONDUCTIVITY METER
Conductivity (25Ã?C)

Water (Inorganic)

Mercury - Water (Ground/Surface/Drinking) (011)
ASG021; based on EPA 7470A
FLOW INJECTION MERCURY SPEC
Mercury

Water (Inorganic)

Metals - Water (024)
ASG 049; based on EPA 200.8 AND SM 20TH ED. 3125
ICP/MS
Dissolved Aluminum
Dissolved Beryllium
Dissolved Boron
Dissolved Cadmium
Dissolved Chromium
Dissolved Cobalt
Dissolved Copper
Dissolved Lead
Dissolved Manganese
Dissolved Molybdenum
Dissolved Nickel
Dissolved Silver
Dissolved Strontium
Dissolved Thallium
Dissolved Tin
Dissolved Uranium
Dissolved Vanadium Parameter suspended on 5/18/2005
Total Antimony
Total Arsenic

Water (Inorganic)

pH - Water (Drinking/Surface/Sewage/Ground) (015)
ASG037; based on SM 20TH. ED. 4500-H+, EPA 150.1

pH METER
pH

Water (Inorganic)

Total Dissloved Solids (TDS) - Water (Drinking/Surface/Sewage/Ground) (018)
ASG040; based on EPA 160.1, SM 18TH ED. 2540C
GRAVIMETRIC
Total Dissolved Solids

Water (Inorganic)

Total Suspended Solids (TSS) - Water (Drinking/Surface/Sewage/Ground) (017)
ASG039; based on EPA 160.2, SM 18TH ED. 2540D
GRAVIMETRIC
Total Suspended Solids

Water (Microbiology)

Coliforms - Water (Drinking/Surface/Sewage/Ground) (014)
ASG036; based on MOE MICROMEFDC-E3407, SM 20TH ED. 9225
MEMBRANE FILTRATION (DC)
Escherichia coli (E. coli)
Total Coliforms

Water (Microbiology)

Fecal Coliforms - Water (Drinking/Surface/Sewage/Ground) (022)
ASG044; based on MOE MICROMEFDC-E3407, SM 20TH ED. 9222 D
MEMBRANE FILTRATION (m FC)
Fecal Coliforms

Water (Microbiology)

Heterotrophic Plate Count (HPC) - Water (Drinking/Surface/Sewage/Ground) (023)
ASG041; SM 20TH ED. 9215 D
MEMBRANE FILTRATION
Heterotrophic Plate Count (HPC)

Water (Organic)

Total PCB - Water (Surface/Sewage/Ground) (009)
ASG015, ASG022; based on EPA 8082, EPA 617, FRAME, ET. AL. J. HIGH RESOL. CHROMATOGR., 19: 657-668, 1996
GC/MS - EXTRACTION
Total PCB

Water (Organic)

Total PCB - Water (021)
ASG006, ASG008; based on EPA 8082, EPA 617, FRAME, ET. AL. J. HIGH RESOL. CHROMATOGR., 19: 657-668, 1996.
GC/ECD - EXTRACTION
Total PCB

Water (Organic)

Volatile Organic Compounds (VOC) - Water (Drinking/Surface/Ground) (012)
ASG023; based on EPA 624, EPA 8260B
GC/MS - PURGE AND TRAP
1,1-Dichloroethane
1,1-dichloroethylene
1,1-Dichloropropene
1,1,1-Trichloroethane
1,1,1,2,-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane
1,2-dichlorobenzene
1,2-dichloroethane
1,2-Dichloropropane
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,3-Dichlorobenzene
1,3-Dichloropropane
1,3,5-Trimethylbenzene
1,4-dichlorobenzene
2-Chlorotoluene
2,2-Dichloropropane
4-Chlorotoluene
Benzene
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform

Bromomethane
Carbon Tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Dibromomethane
Dichlorodifluoromethane
Dichloromethane Parameter suspended on 8/17/2005
Ethylbenzene
Hexachlorobutadiene
Isopropylbenzene
Isopropyltoluene
m/p-xylene
n-Butylbenzene
n-Propylbenzene
Naphthalene
o-xylene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane
Vinyl Chloride

Water (Radiochemistry)

Alpha/Beta Radiation (Swab) (004)
ASG 004; RMC-CMR LSC PROCEDURES MANUAL VER. 1.0
LIQUID SCINTILLATION COUNTING
Alpha radiation
Beta radiation

Water (Radiochemistry)

Radionuclide (Activity) - Water (006)
ASG 024; based on SM AMERICAN WATER ASSN. METHOD 7120, SM FOR EXAM. OF WATER/WASTEWATER, 20TH ED., & USEPA METHOD 901.1.
GAMMA SPECTROSCOPY
Barium-140
Cerium-144
Cesium-134
Cesium-136
Cesium-137
Cesium-138
Cobalt-60
Iodine-131
Iodine-132
Iodine-133
Iodine-134
Iodine-135
Lanthanum-140
Molybdenum-99
Niobium-95
Rubidium-86
Rubidium-88
Ruthenium-103
Ruthenium/Rhodium-106
Strontium-91
Tellurium-129m
Tellurium-131m
Tellurium-132
Yttrium-90m
Yttrium-91m
Zirconium-95

Standards Council of Canada
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Fax.: +1 613 569 7808
E-mail/Courriel : info@scc.ca
Internet: http://www.scc.ca

SCOPE OF ACCREDITATION

The Royal Military College of Canada
RMC ANALYTICAL SERVICES GROUP
Department of Chemistry and Chemical Engineering P.O. Box 17000, Station Forces
Kingston, ON
K7K 7B4

Accredited Laboratory No. 276
(Conforms with requirements of CAN−P−4D (ISO/IEC 17025), and CAN−P−1598)

CONTACT: Dr. David Kelly
TEL: (613) 541−6000 x6921
FAX: (613) 545−8341
EMAIL: david.kelly@rmc.ca

CLIENTS SERVED: All interested parties

FIELDS OF TESTING: Chemical/Physical

PROGRAM SPECIALTY AREA: Environmental

ISSUED ON: 2005−06−22

VALID TO: 2006−11−02

ENVIRONMENTAL AND OCCUPATIONAL HEALTH AND SAFETY

Environmental

Water (Microbiology)

(Coliforms − Water [014]) (OSDWA)

ASG036; based on MOE MICROMEFDC−E3407, SM 20TH ED. 9225

MEMBRANE FILTRATION (DC)
Escherichia coli (E. coli)
Total Coliforms

(Fecal Coliforms − Water [022]) (OSDWA)

ASG044; based on MOE
MICROMEFDC−E3407, SM 20TH ED. 9222
D

MEMBRANE FILTRATION (m FC)
Fecal Coliforms

(Heterotrophic Plate Count (HPC) − Water [023]) (OSDWA)

ASG041; SM 20TH ED. 9215 D

MEMBRANE FILTRATION
Heterotrophic Plate Count (HPC)

Notes:

CAN−P−4D (ISO/IEC 17025): General Requirements for the Competence of Testing and Calibration Laboratories ISO/IEC 17025−1999)

CAN−P−1598: Guidelines for Accreditation of Environmental Testing Laboratories

OSDWA: Indicates the appendix is used for the analysis of Ontario drinking water samples, which is subject to the rules and related regulations under the Ontario "Safe Drinking Water Act" (2002)

P. Paladino, P. Eng., Director, Conformity Assessment

Date: 2005−06−22

SCC 1003−15/358
CAEAL #2965
Partner: CAEAL
MOE License No.: 2264