Environment Canada Environnement Canada

# SUMMARY OF OPERATIONS AND MAINTENANCE PROCEDURES FOR SEWAGE, SOLID WASTE DISPOSAL AND WASTE TREATMENT FACILITIES

## — Eureka High Arctic Weather Station —

In support of the
Nunavut Water Board License
**No. 3BC-EUR0611**

Prepared by Environment Canada
Assets, Contracting and Environmental Management Directorate (ACEMD)

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Canada

# Control Page

On receipt of revisions and/or amendments, the Assets, Contracting and Environmental Management Directorate (ACEMD) shall complete this control page to ensure that the Summary of Operations and Maintenance Procedures for Sewage, Solid Waste Disposal and Treatment Facilities at Eureka High Arctic Weather Station (HAWS) is always current and consistently reflects the operations and activities taking place on site.

| Version | Date in Force | Expiry Date | Description / Purpose |
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| 1 | November. 23rd, 2007 | November 22nd , 2008 | Original Summary |
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# Acronyms and Symbols

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|---|---|
| ACEMD | Assets, Contracting and Environmental Management Directorate |
| BOD | Biochemical oxygen demand |
| CFC | Chlorofluorocarbon |
| HAWS | High Arctic Weather Station |
| L | Liter |
| m | Metre |
| $m^3$ | Cubic metre |
| N | North |
| PCBs | Polychlorinated biphenyls |
| PEARL | Polar Environment Atmospheric Research Lab |
| pH | Measure of acidity or alkalinity |
| PWGSC | Public Works and Government Services Canada |
| UV | Ultraviolet |
| W | West |

# 1. Introduction

This document has been produced to satisfy the requirement of the Nunavut Water Board for the terms of water license number 3BC-EUR0611, part G, section 1:

*"1. The Licensee, shall, within sixty (60) days of the issuance of this License, submit to the Board for approval, an Operation and Maintenance Manual in accordance with the "Guidelines for Preparing an Operational and Maintenance Manual for Sewage and Solid Waste Disposal Facilities", October 1996. The scope of the Plan shall be expanded to include the operation and maintenance of the Water Supply Facilities".*

The Eureka High Arctic Weather Station (HAWS) is located on the north side of Slidre Fjord, at the north-western tip of Fosheum Peninsula on Ellesmere Island at $80^{o}$ 0' N and $85^{o}$56' W.

The Eureka HAWS is a weather monitoring facility. It is operated by Environment Canada, and has been in operation since 1947. The Eureka HAWS is a centre of activity for Environment Canada, the Department of National Defence, the Polar Continental Shelf Project, and the Polar Environment Atmospheric Research Lab (PEARL). Most of the work is carried out in the short Arctic summer – June, July and August. The number of people located on-site varies between 8 and 40 (this includes the members of the Department of National Defence).

# 2. Operational Practices for Drinking Water

At Eureka HAWS, drinking water is obtained from a fresh water lagoon located near Station Creek, which is a stream, located immediately to the west of the main Station that carries melt water from ice and snow in the Arctic spring (May and June). No inhabitants reside in the Station Creek watershed.

Some concern has been raised in the past with regards to the runoff from the abandoned dump site that is located at the west end of the runway. The runoff from this part of the airport runway does flow into the Station Creek drainage basin during the spring season. But the potential for any contaminants affecting the water quality of the Creek is very low.

The Creek flows for about three to four months in an average year. The water lagoon is filled by pumping water from the creek, after the spring runoff has slowed down and the water is running clear of suspended solids. The volume of the water in the impoundment must be sufficient to supply the Eureka HAWS needs throughout the year. It is estimated that the impoundment holds approximately 12,000 $m^3$ of water. Daily consumption of water for a location such as Eureka HAWS has been estimated to be 290 L per person per day (Smith and Nahir, 2000). The volumes of water used in 2005 to 2007 by the Eureka HAWS are shown in Table 1.

**Table 1.** Volume of water used by Eureka HAWS from 2005 to 2007.

| Month | Volume ($m^3$) | | |
|---|---|---|---|
| | 2005 | 2006 | 2007 |
| January | 104.9 | 22 | 131.9 |
| February | 109.9 | 136.5 | 106.3 |
| March | 187.5 | 102.1 | 222.6 |
| April | 63.7 | 73.6 | 209.2 |
| May | 220.6 | 196.6 | 273.8 |
| June | 266.9 | 191.3 | 325.6 |
| July | 309.6 | 102.4 | 319.3 |
| August | 234.3 | 84.4 | 167.7 |
| September | 234.9 | 77.8 | 153.9 |
| October | 69.4 | 106.7 | n/a |
| November | 71.5 | 106.4 | n/a |
| December | 78.1 | 107.9 | n/a |
| **Annual Total** | **1951.3** | **1307.7** | **1910.3** |

n/a = not available

Periodic (yearly and monthly) analysis of water samples collected from the impoundment, holding tanks and from inside the Eureka HAWS indicate that the chlorination, filtration, ultraviolet (UV) and reverse-osmosis treatments of the raw water provides good quality water to the station.

Monthly drinking water sampling and analysis is carried out on-site to assess the acceptance of the treated water and to ensure no threat to the staff's health.

A schematic of the water distribution system is shown in Figure 1.

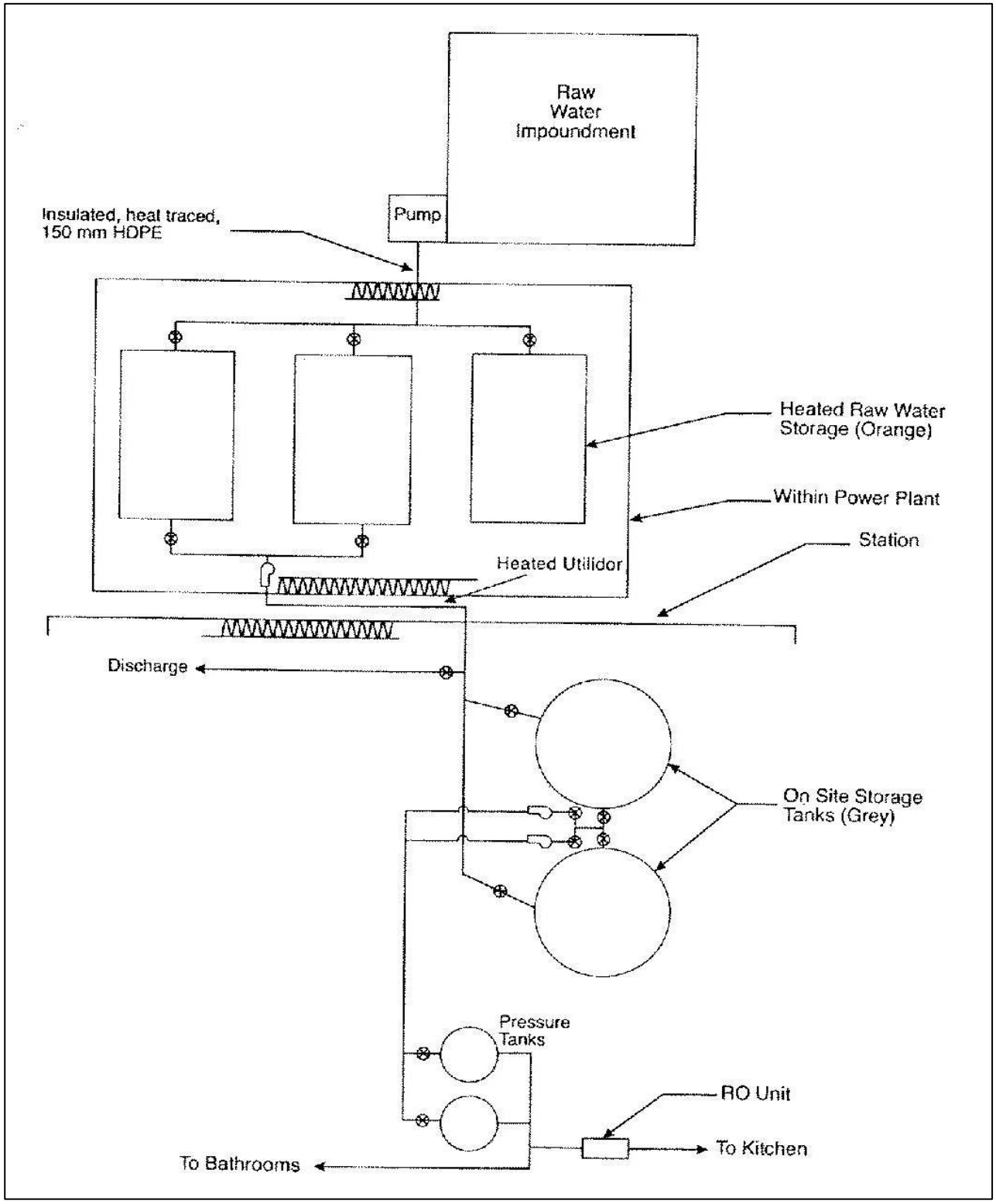


**Figure 1.** Water distribution system at Eureka HAWS.

# 3. Management of Wastewater

The following section describes the management of wastewater at Eureka HAWS.

## *3.1 General Description of the System*

The wastewater and sewage lagoon at the Eureka HAWS is a single cell, engineered retention lagoon and is located to the south of the complex in the immediate vicinity of the Fjord (Figure 2). The volume of the lagoon was estimated as follows, by using the known dimensions and by integrating these in a formula by Smith and Nahir, 2000 (Table 2):

**Table 2.** Lagoon Dimensions at Eureka HAWS.

| **Length** | |
|---|---|
| Length – South Side | 100.6 m |
| Length – North Side | 89.8 m |
| **Average Length** | **95.2 m** |

| **Width** | |
|---|---|
| Width – East Side | 19.7 m |
| Width – West Side | 24.9 m |
| **Average Width** | **22.3 m** |

| **Depth** | |
|---|---|
| **Average Depth** | **1.05 m** |

***Estimation of volume of the lagoon***

Volume = Length x Width x Depth
= 95.2 m x 22.3 m x 1.05 m
= 2229 $m^3$
= 2.23 x $10^6$ L

Maximum Daily Flow Rate (to fill the lagoon) = $\frac{\text{Volume}}{365 \text{ days}}$

$= \frac{2.23 \times 10^6 \text{L}}{365 \text{ days}}$

= 6109.6 L/day

It is estimated that a person will use 290 liters per day of water and therefore:

$= \frac{6109.6 \text{ L/day}}{290 \text{ L/day}}$

= waste from 21 people will fill the lagoon

**Figure 2.** Wastewater treatment cell at Eureka HAWS.

## *3.2 Collection into the System*

Due to the closed nature of the system, it is expected that the volume of wastewater produced will be virtually the same as the volume of the water used.

The collection of the wastewater throughout the Station occurs by gravity. All piping is located within warm portions of the facility. The wastewater is then collected in a storage tank in a separate building at the northeast corner of the complex. The collected wastewater is intermittently pumped to the lagoon when the volume of the liquid in the holding tank reaches a preset level.

## *3.3 Treatment and Discharge of the System*

Wastewater is pumped to the lagoon where solids are allowed to settle and limited decomposition takes place. A sump area was excavated in the bottom of the lagoon. This allows a large pump to be placed below the level of the actual bottom of the lagoon and pump out the content into the Fjord. The lagoon is emptied once per year at the end of the open water period (Figure 3). The timing of the discharge has been selected to allow the longest possible ice free period in the lagoon – and therefore, the longest possible period when decomposition takes place.

**Figure 3.** Lagoon Prior to emptying.

**Figure 4.** Sampling of effluent.

The pumping usually takes 12 to 14 hours. Wastewater samples are collected at the discharge pipe. The samples are collected at the time that the pumping operation starts, when the lagoon is 2/3 full, ½ full and finally 1/3 full (Figure 4). The samples are then shipped to a laboratory and analyzed for biochemical oxygen demand ($BOD_5$), total suspended solids, ammonia, fecal coliforms, pH, major cations, oil and grease and total phenols.

# 4. Disposal of Solid Waste

The active disposal ground is located at the southeast end of the runway. This location is used for all metallic waste only.
Hydrocarbon and other allied petroleum products are brought to the Station in drums (oil, gasoline, hydraulic fluid, etc.). Once the product is used up, the drums are then transferred to the crushing area, where the drums are crushed, the liquid that is left in them is collected at the time of crushing, and then the crushed barrel is placed in the disposal grounds for crushed barrels. This site was inspected by PWGSC in 1999 and found to be acceptable for holding contaminated soils and crushed drums. The barrels are not washed out prior to being crushed and placed in the disposal grounds.

## *4.1 Issues Identification*

Operational wastes include organic waste from food preparation, cardboard boxes used for food shipments, various plastics and aluminum cans from food products, office waste, etc. This type of waste is produced in small quantities continually, with an occasional increase when food shipments arrive.

## *4.2 On-site Solution – Incinerator*

The on-site incinerator is currently used to address operational wastes. Approximately three garbage bags of kitchen waste are produced daily. Two to three times a week, the heavy equipment operator takes between 10-12 bags to the incinerator for burning. The ashes from the burns are collected in empty 205L barrels and, approximately 24 barrels are filled yearly. The drums of ashes are filled outside of the incinerator building and moved with heavy equipment to the storage compound. No hazardous wastes are disposed of in the incinerator.

Food supplies on-hand may be enough to last up to eighteen months. Produce is delivered every three weeks, meat every two months and dry goods are shipped with the sea lift each season.
Considerable volumes of packaging material accompanies the food and large cardboard boxes and wooden pallets will not fit inside the incinerator without substantial effort to reduce their size, so they are burned at the landfill in open container. There is currently very little waste stream separation on-site. The opportunities to recycle items are limited and in many cases, it may be too expensive to consider back-hauling empty containers. The considerable variation in station staff numbers and personnel shifts may also preclude refilling larger containers due to the potential for spoilage.

As much material is re-used where operationally possible, and attempts are made to limit the amount of packing that is brought on-site. Station personnel are trained in day-to-day operational waste disposal procedures.

Since the drainage from the disposal grounds flows in the direction of the Fjord, concern has been raised that at the time of melt, the runoff and leachate could reach the Fjord. Due to the relatively low volume of snow that Eureka HAWS receives throughout the year, the amount of runoff from this area is minimal. In the past years, it has not been possible to collect a sample of runoff from the disposal ground, even this location is being monitored as part of the Nunavut Water Board required Surveillance Monitoring Program.

# 5. Management of Hazardous Waste

Management of hazardous waste at the Eureka HAWS is compounded due to its isolated location. Any hazardous waste that cannot be dealt with on site must be shipped south for processing (Environmental Services, PWGSC, 1998).

The majority of on-going hazardous waste generated at the Eureka HAWS involves petroleum allied products. This includes waste oil and other miscellaneous products. Waste oil is shipped south to Resolute Bay, in 205 L barrels, where it is burned in a waste oil furnace at a commercial establishment. Batteries and all fluids are removed from vehicles that have been taken out of service, and the vehicles are parked on a lot for further considerations (removal to southern recycling facilities, or other options that will become economically feasible).

Used vehicle batteries are stockpiled until a sufficient quantity is obtained. They are then shipped south to the proper handling facility. All economical means are taken advantage of to ship hazardous waste materials south to the proper handling facilities. In the recent past, refrigerants, written off CFC-containing equipment, waste oil, PCB-containing components and other type items have been sent out to the proper waste handling facilities.

# 6. References

Duong, D. and R. Kent (1996). *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories*. Government of the Northwest Territories, Municipal and Community Affairs Community Development.

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