Design Brief

Sanikiluaq Truck Fill Station

Prepared for:
Department of Community & Government Services
Government of Nunavut, Pond Inlet

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Project No: OTCD00020127A
Report date: May, 2010

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1.0 Introduction

The following report is provided as the design brief for the replacement of the water truck fill station in the Hamlet of Sanikiluaq (Hamlet). This report summarizes the various requirements to which the design must respond, together with assumptions and decisions incorporated into the design.

1.1 Background

The Hamlet is located on the north end of Flaherty Island, a large central island of the Belcher islands in Hudson Bay. The typical vegetation in the area consists of Arctic Tundra, predominately mosses and lichens. The average daily temperatures for July range from mean high and low temperatures of 25.6°C and 3.3°C, respectively. The average daily temperatures for January range from mean high and low temperatures of 22.8°C and 42.8°C respectively (N.W.T. Data Book, 1986/87).

The estimated population in 2010 based on the Community Population Projects as published by the Bureau of Statistics is 896 persons. Based on the "General Terms of Reference for Community Water and Sanitary Services Study" developed by the Department of Municipal and Community Affairs, Government of Northwest Territories the daily water consumption per person is estimated at 109 litres. This translates to a yearly water consumption of 35,500 m^3.

The Hamlet's source of domestic water is Lake Sanikiluaq which is located near the edge of the Community. Water distribution within the community is by a trucked delivery service. The water is pumped from Lake Sanikiluaq into the water trucks at the Hamlet's Truck Fill Station which is located at the edge of the lake and centrally located within the community. Current water treatment is limited to chlorination which occurs within the Truck Fill Station. The existing Truck Fill Station is approximately 30 years old.

The current truck filling capacity is 7.6 Litres/sec and intake piping capacity is 20.8 Litres/sec. The water intake is a dual inclined water line which extends from the Truck Fill Station approximately 141 metres into Lake Sanikiluaq, to a depth of approximately five metres.

2.0 Current Facilities

2.1. General

The existing truck fill station was constructed in the late 1970's. Presently, water is taken from Lake Sanikiluaq using submersible pumps located in inclined shaft intakes. Within the truck fill station a chlorine solution is added prior to discharge into water delivery trucks via a truck loading arm. The current piping and valving arrangement within the truck fill station does not permit simultaneous operation of both pumps. The design did not incorporate standby power; therefore standby heating was achieved using a fuel fired space heater.

2.2. Current Conditions

The truck fill station was visited in July 2009. During this visit it was determined that the existing facility had experienced substantial deterioration. Issues noted during the visit included:

- The external metal skin from one of the external building panels was missing.
- The entire building, including the concrete base slab, had tilted towards the front of the building.
- The tilting of the building had created some distress to the end of the intake piping within the truck fill station.
- There was no standby method of building heating.
- Only one of the pumps was serviceable. The heat trace and discharge gate valve on the non-serviceable pump was not functioning.
- Recent electrical repairs had been conducted to restore service.
- The existing inclined shaft intakes appeared to be in satisfactory condition. Required repairs were limited to short sections of insulation replacement immediately to the rear of the truck fill station building.

Based upon these observations it was concluded that the existing facility had reached the end of its useful life. It was also concluded that to satisfy current standards it was not possible to rehabilitate the existing facility. The inclined shaft intakes were felt to be in an appropriate condition that they should be retained and incorporated into the design of the replacement facility.

2.3. Short Term Rehabilitation

A program for rehabilitation targeted at improving reliability of service for the winter of 2009/10 was developed. This program included the replacement of the following equipment:

- A pair of Pleuger Model NB66-2 pumps with a 5 HP, 230 volt phase motors. These pumps are rated at 450 litres/minute (120 USGPM) at 24 metres (80 feet) of head. A description of the general arrangement of this pump, including the pump rating, is presented in Appendix A.

- Raychem 5BTV2-CT heat trace cable, together with controls.

- 75 mm gate valve.

The materials required for this short term rehabilitation program were acquired and shipped to the community by the Government of Nunavut (GN).

2.4. Siting Issues

The existing truck fill station is well situated within the community with good access to the road network. There is both an existing electrical power supply and telephone service to the site. Re-use of the existing site permits the incorporation of the existing intakes into the new facility.

3.0 Design Requirements

The Request for Proposal (RFP) provided various conditions and parameters that had to be incorporated into the design. These included:

- A pumping capacity of 1,000 litres per minute during fire suppression operations.
- Instrumentation and controls should be simple and appropriate for the project environment. The instrumentation should include water quantity measurement.

The proposal presented by Trow in response to this RFP included the following assumptions regarding the scope of the design:

- The existing building will be replaced,
- The existing intakes will be retained,
- The current level of treatment will be retained, and
- There will be no major site works.

The Water and Sewage Facilities Capital Program: Standards and Criteria included the following requirements:

- Provide finished water that meets the requirements of the Guidelines for Canadian Drinking Water.
- Provide standby chlorination equipment as a safeguard against malfunction.
- Provide an exterior truck fill arm.
- Provide standby power unless water storage for fire fighting and emergencies is provided elsewhere.
- Pump operation should be achieved using an external control station. The delivery truck driver should not be required to routinely enter the building to operate pumps.
- Measures to protect from freeze must be provided.

In addition to the above requirements, the following has been incorporated into the design.

- The facility should make efficient use of energy, with a specific emphasis upon low electrical energy consumption.
- Convenient truck entrance and manoeuvring should be incorporated into the design.

4.0 Water Pumping

In late 2009 the GN acquired a replacement water supply pump for the truck fill station. These recently acquired pumps are rated at 450 litres per minute (120 USGPM) at 24 metres (80 feet) of head. The pumps are equipped with single phase motors, which is consistent with the existing electrical supply to the site. The general details of these pumps, including rated capacity, are presented in Appendix B. It should be noted that these are the largest pumps that are available with single phase motors. During normal truck fill operations these pumps will provide approximately 500 litres per minute.

An appropriate standby generator is currently available in Sanikiluaq to support these pumps. Additionally these pumps will fit within the existing inclined shaft intakes. During normal truck fill operations these pumps will provide approximately 500 litres per minute.

During fire fighting operations a flow of 1,000 litres is required by the RFP. This can be achieved through simultaneous operation of both pumps. Modification of the current piping arrangement will be required to permit simultaneous operation of these pumps during fire fighting operations. In addition, the filters will be bypassed to reduce friction losses and increase pump discharge. Chlorination will be provided to all water pumped during fire fighting operations.

5.0 Water Treatment

5.1 Raw Water Quality

Raw water is drawn from Sanikiluaq Lake, which is situated immediately adjacent to the community. This lake was selected as the long term water source during the mid 1970's as it is sufficiently deep enough to avoid excessive freeze during the winter season. It is reported that this source has provided acceptable water quality over the service life of the existing truck fill station.

During the site visit of July 27, 2009 a water sample was obtained form the existing truck fill station. An analysis for some basic chemical parameters was conducted by Caduceon Environmental Laboratories. A copy of the laboratory report is attached in Appendix B. The raw water sample met the current Guidelines for Canadian Drinking Water Quality for all of the tested parameters. It should however be noted that the tested list of parameters does not capture the full list of parameters that is typically included among the requirements for a Water Licence.

It is noted that the single sample taken in July 2009 provided very low turbidity results (0.4 NTU). There is the potential for higher levels of turbidity at some times of the year, including spring runoff. It is also noted that a portion of the community is located within the watershed of the lake.

5.2 Water Treatment

5.2.1 Filtration

Turbidity, as reported for the sample of July 27, 2009, was less than the criteria of 1 NTU as set out in the Guidelines for Canadian Drinking Water Quality. It should be noted that this is a single result and that higher turbidity is likely at some points during the year, such as spring runoff. The Guidelines for Canadian Drinking Water Quality do not provide relief from the requirement for filtration due to low measured turbidity in source water. These guidelines include the following health related direction regarding turbidity:

"Waterworks systems that use a surface water source or a groundwater source under the direct influence of surface water should filter the source water to meet the following health-based turbidity limits..."

Turbidity criteria are provided in the guidelines for chemically assisted filtration, slow sand filtration and membrane filtration. Application of all of these processes is very challenging in Arctic communities due to the requirement to manage liquid waste streams arising from the operation of these processes.

An alternative treatment strategy has been selected that is based upon cartridge filtration. A process train consisting of 20, 5 and 1 micron filters has been selected. The intent of this

process train is to provide finished water turbidity that meets the current guidelines. It is also consistent with the current expectations of the Water Board.

5.2.2 Disinfection

Ultra-violet (UV) transmittance was tested for the sample gathered in July 2009. The reported transmittance is satisfactory for the application of UV as a disinfection method. Despite this finding it is not recommended that UV be applied. UV is not well adapted to frequent and short on-off cycles which are typical of a truck fill station. Also, UV does not provide a residual disinfectant in the finished water that reduces the risk of contamination during delivery and storage. The lack of a disinfectant residual also places in question the quality of the water held within the truck fill station piping and filters between operating cycles.

Chlorination is the current disinfection process. Local operating staff is familiar with the preparation of hypochlorite solution from the stock of dry powder stored in the community.

It is recommended that chlorination be retained for a list of factors including:

- Staff familiarity
- Process simplicity
- Presence of disinfectant residual in the fill station equipment, delivery truck and storage tanks

Consistent with current practice, calcium hypochlorite will be shipped to the community as a dry chemical in bags. A mixing tank, equipped with an electrical mixer, will be used to make up a hypochlorite solution from the dry bagged chemical. This solution is to be decanted into a storage tank for feed to the chemical metering pump. The chemical metering pump will be energized simultaneously with the submersible water supply pumps. Chemical dosing rates are to be adjusted by operating staff to obtain a suitable residual in the treated water. A separate metering pump will be provided for operation during fire service as the chlorine dose must be doubled during these operations.

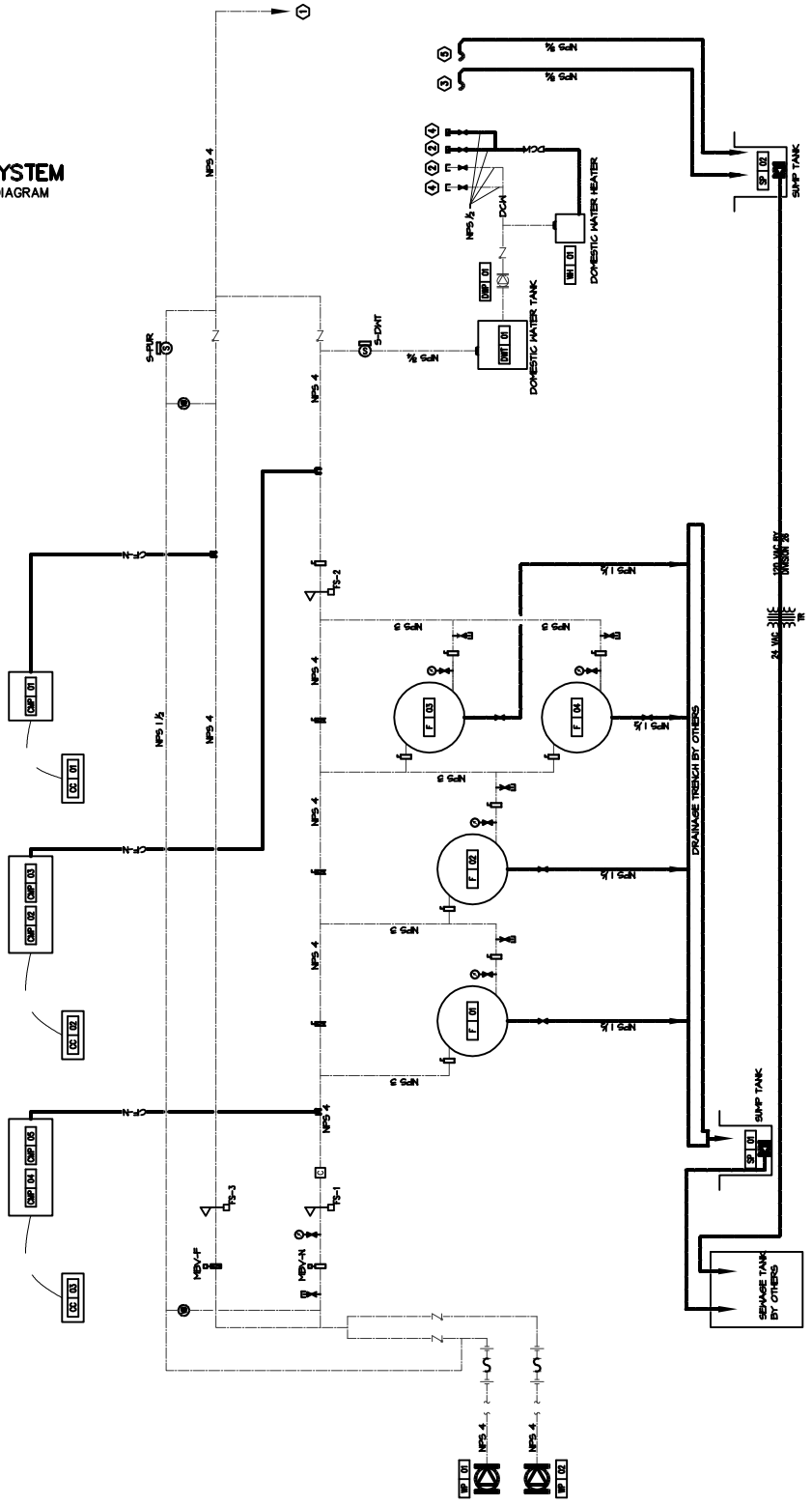
Hypochlorite solution will be metered into the potable water supply at the following locations:

- Upstream of the filter train to pre-treat and reduce the risk of contamination growth within the filters.
- Downstream of the filter train to assure a chlorine residual in the delivered water.
- Into the fire water supply because of the higher water flow rates and lack of filtration during fire fighting operations.

5.3 Summary

The schematic layout of the proposed process is depicted on Sketch 5.1.

WATER SYSTEM
HYDRAULIC DIAGRAM



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Nunavut

scale: NTS	CLIENT: GOVERNMENT OF NUNAVUT	project no.: OTCD00020127A
date: APRIL 2010	TITLE: WATER SCHEMATIC	5.1
drawn by: M.BERRIGAN		

6.0 Supporting Infrastructure

6.1 Water Intakes

The existing inclined shaft water intakes will be incorporated into the design. Replacement of these intakes would represent significant costs and would require substantial work to be conducted within the lake. Working in the lake is especially unattractive due to the risks that arise from the simultaneous use of the lake as the community water supply. The scope of improvements required for these intakes is limited to a short area of repair of the insulation and covering that is immediately to the rear of the existing truck fill station.

Incorporation of the intakes into the truck fill station will require minor realignment of approximately 10 to 15 metres of intake casing. All of this realignment will take place above the lake high water mark. A silt control barrier should be provided during this regrading and realignment.

6.2 Building

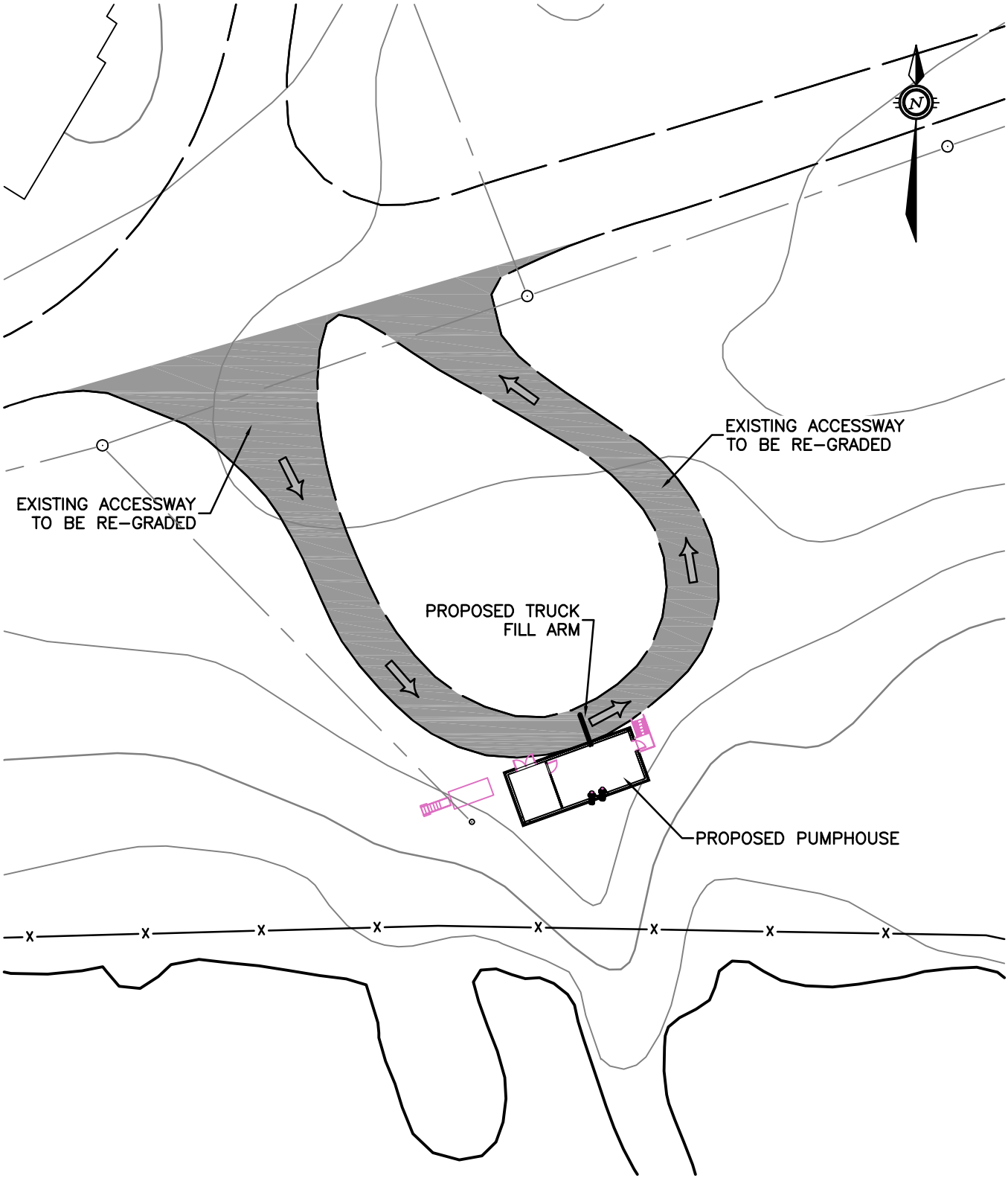
A new a larger building will be required to house the various pieces of equipment including the filters, generator, electrical supply, chlorinators and instrumentation. It is proposed that a building with an inside dimension of 11.7 metres wide by 4.8 metres be provided. This building will be constructed using a steel pipe pile foundation, wood frame, concrete floor, metal cladding and a sloped roof. A separate room will be provided for the electrical equipment and generator which will isolate potential fuels spills within the generator room. The siting of the proposed building is depicted on Sketch 6.1.

6.3 Truck Fill Arm

A truck fill arm will be secured to the building. A control station will be incorporated into the truck fill arm. A mechanism will be also provided to permit the rapid lowering and rising of the end section of the truck fill piping into the fill hatch on the top of the delivery truck tank. This mechanism will reduce potential water spillage during truck filling.

6.4 Site Works

The principal site works that must be provided relate to truck access. A looped access road under the truck fill arm will be provided. The proposed access will reduce the requirements for truck reversing as well as enhance site safety. Sketch 6.1 depicts the proposed truck access.



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Nunavut

scale 1:500	CLIENT: GOVERNMENT OF NUNAVUT	project no. OTCD00020127A
date APRIL 2010	TITLE: ACCESS ROAD / TRUCK FILL ARM	6.1
drawn by M.BERRIGAN		

6.5 Heating

It is proposed that a pair of fuel fired unit heaters be provided, with one heater in the filter room and a second heater in the generator room. The practice of electrically heating the truck fill station will be discontinued. A double walled exterior fuel storage tank will be provided.

6.6 Freeze Prevention

The segments of the proposed works that are most vulnerable to freeze are the inclined shaft intake from the lake and the truck fill arm. The truck fill arm will drain through the supply piping into the lake at the end of each pumping cycle. A valve has been incorporated into the piping to provide a vent to assure the required drainage.

Freeze protection of the intake will be achieved by draining of the piping, electric heat tracing and insulation of the intake casing pipe. The pumps will not be equipped with check valves. This will permit drainage of the supply piping into the lake at the end of each pump cycle. The portion of the piping that is located within the ice on the lake surface, or which is situated between the lake and the rear of the truck fill station is exposed to the risk of freeze. This will be equipped with heat tracing that is controlled based upon the temperature within the casing pipe. The existing casing pipe is protected with 50 mm of polyurethane foam insulation.

6.7 Plumbing

A water storage tank and pressure system is proposed. These will supply a hand wash sink, and will provide make up water for chemical mixing. Drains must be provided for the cartridge filters. These will be directed to a trench drain, which will be connected to a sump. Water pumped from this sump will be directed to a sewage storage tank equipped with an external service connection. Waste water produced at the truck fill station will be removed using the existing hamlet sewage trucks.

6.8 Electrical Power

A single phase 120/240 volt electrical supply will be used for the new truck fill station. This selection of electrical supply is based upon the re-use of recently acquired water supply pumps and the use of a suitable standby generator that is currently located in Hamlet.

7.0 Summary

The preceding report summarizes the various issues addressed during the development of the design for the replacement of the Sanikiluaq water truck fill station.

Trow Associates Inc.

REGISTERED PROFESSIONAL ENGINEER
S. L. BURDEN
LICENSEE
May 10, 2010

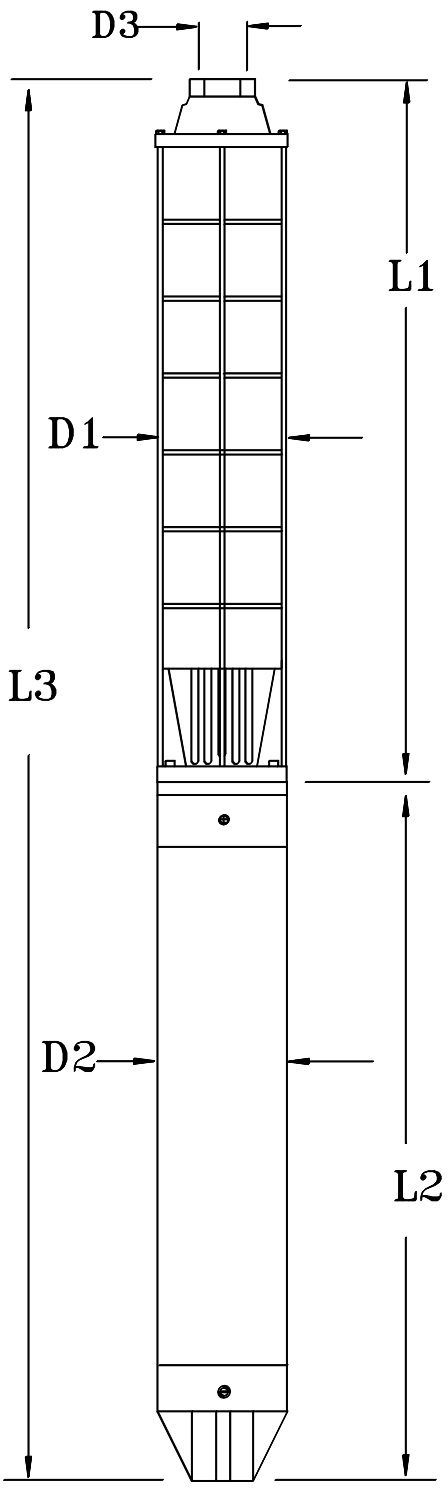
Stephen Douglas
Senior Designer
Infrastructure Services

Steven L. Burden, P.Eng.
Senior Project Manager
Infrastructure Services

PERMIT TO PRACTICE
TROW CONSULTING ENGINEERS LTD.
Signature
Date May 10, 2010
PERMIT NUMBER: P 184
The Association of Professional Engineers, Geologists and Geophysicists of the NWT / NU

Appendix A: Submersible Pump General Description

Pump Dimension Sheet



PUMP DATA

PUMP MODEL:	**NB66**
NO. STAGES:	**2**
CAPACITY (USGPM):	**120**
TDH (FEET WATER):	**80’**

MOTOR DATA

MOTOR MODEL:	**F6-5**
MOTOR HP:	**5**
MOTOR RPM:	**3450**
F.L. MOTOR EFFICIENCY:	**75%**
F.L. AMPS:	**23**
KW	**3.7**
VOLTAGE:	**230**
PHASE:	**1**
HERTZ:	**60**

LENGTH

PUMP LENGTH (IN) = L1	**13.11”**
MOTOR LENGTH (IN) = L2	**25.40”**
OVERALL LENGTH (IN) = L3	**38.51”**

DIAMETER

PUMP DIAMETER (IN) = D1	**5.65”**
MOTOR DIAMETER (IN) = D2	**5.44”**

DISCHARGE

DISCHARGE SIZE NPT (IN) = D3	**3” NPT**

WEIGHT

NET WEIGHT – PUMP & MOTOR (LBS	**131#**

Appendix B:
Laboratory Analysis

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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: 124916 **REPORT No. B09-23214**

Report To:

Trow Consulting Engineers Ltd.
154 Colonnade Rd South
Ottawa, ON, K2E 7J5
Attention: Shawn Doherty

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa, Ontario, K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 31-Jul-09
DATE REPORTED: 11-Aug-09
SAMPLE MATRIX: Surface Water

JOB/PROJECT NO.: Nunavut
P.O. NUMBER: OTCD000200172A
WATERWORKS NO.

			Client I.D.:		Surface Water			
			Sample I.D.:		B09-23214-1			
			Date Collected:		26-Jul-09			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	06-Aug-09/O	163			
Alkalinity (as CaCO3)	mg/L	5	EPA 310.2	31-Jul-09/O	58			
Conductivity	µmho/cm	1	SM 2510	31-Jul-09/O	859			
pH	pH Units		EPA 150.1	31-Jul-09/O	6.06			
Colour	TCU	1	SM 2120	06-Aug-09/O	7			
Turbidity	NTU	0.1	SM 2130	07-Aug-09/O	0.4			
UV transmittance	%		In-House	06-Aug-09/K	88.4			
Fluoride	mg/L	0.1	EPA 300.0	31-Jul-09/O	< 0.1			
Chloride	mg/L	0.5	EPA 300.0	31-Jul-09/O	202			
Nitrite (N)	mg/L	0.1	EPA 300.0	31-Jul-09/O	< 0.1			
Nitrate (N)	mg/L	0.1	EPA 300.0	31-Jul-09/O	< 0.1			
Sulphate	mg/L	1	EPA 300.0	31-Jul-09/O	47			
Calcium	mg/L	0.02	SM 3120	06-Aug-09/O	34.6			
Magnesium	mg/L	0.01	SM 3120	06-Aug-09/O	18.7			
Sodium	mg/L	0.2	SM 3120	06-Aug-09/O	96.6			
Potassium	mg/L	0.1	SM 3120	06-Aug-09/O	2.1			
Iron (Total)	mg/L	0.005	SM 3120	06-Aug-09/O	< 0.005			
Manganese (Total)	mg/L	0.001	SM 3120	06-Aug-09/O	0.005			
Silica	mg/L	0.02	SM 3120	06-Aug-09/O	0.42			
Ammonia (N)-Total	mg/L	0.01	EPA 350.2	31-Jul-09/O	< 0.01			
Total Kjeldahl Nitrogen	mg/L	0.05	EPA 351.2	05-Aug-09/O	0.26			
Organic Nitrogen	mg/L	0.05	EPA 351.2	05-Aug-09/O	0.26			
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	07-Aug-09/O	2.0			
Phenolics	mg/L	0.001	EPA 420.2	05-Aug-09/O	< 0.001			
Tannins and Lignins	mg/L	0.1	SM5500B	11-Aug-09/O	0.2			
Anion Sum	meq/L		Calc.	07-Aug-09/O	7.83			
Cation Sum	meq/L		Calc.	07-Aug-09/O	7.52			

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,P-Peterborough,M-Moncton

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Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
% Difference	%		Calc.	07-Aug-09/O	2.05			
Ion Ratio	AS/CS		Calc.	07-Aug-09/O	1.04			
Sodium Adsorption Ratio	-		Calc.	07-Aug-09/O	3.29			
TDS(ion sum calc.)	mg/L		Calc.	07-Aug-09/O	436			
Conductivity (calc.)	µmho/cm		Calc.	07-Aug-09/O	852			
TDS(calc.)/EC(actual)	-		Calc.	07-Aug-09/O	0.507			
EC(calc.)/EC(actual)	-		Calc.	07-Aug-09/O	0.991			
Langelier Index(25°C)	S.I.		Calc.	07-Aug-09/O	-2.10			

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Lab Manager - Ottawa District

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