REVIEW
of COMMUNITY WATER MANAGEMENT *and* WATER SYSTEM INFRASTRUCTURE

Aklavik, NT

A Project towards Providing Safer Drinking Water in the NWT Communities

Safe Water

Northwest Territories

Reviewed by:

Public Works and Services
Municipal and Community Affairs
Health and Social Services

September, 2003

REVIEW
of COMMUNITY WATER MANAGEMENT *and* WATER SYSTEM INFRASTRUCTURE

Aklavik, NT

Safe Water

Prepared by:

Technical Support Services
Asset Management Division
Department of Public Works and Services

Northwest Territories

June, 2003

Project Team

REVIEW
of COMMUNITY WATER MANAGEMENT *and*
WATER SYSTEM INFRASTRUCTURE

Aklavik, NT

Report Completion Dates	
Report Phase	**Date**
Field Work	February 11-14, 2003
Report Issue	July, 2003

Field Inspection/Review Staff		
Technical Staff	**Title/Organization**	**Telephone Number**
Vincent Tam (Team Leader)	Sr. Engineer, PW&S	920-7834
Loretta Ransom	Engineer, PW&S	873-7713

Questions about this report may be directed to the Field Inspection/Review Staff or to Technical Support Services at (867) 873-7834 or (867) 873-7713

Technical Support Services
Asset Management Division
Department of Public Works and Services
Third Floor - Stuart M. Hodgson Building
P.O.Box 1320, Yellowknife, NT X1A 2L9
Telephone: (867) 920-8088
Fax: (867) 873-0226

ACKNOWLEDGMENTS

PW&S Technical Support Services would like to acknowledge the following individuals who gave their time to assist with this evaluation:

- Community staff- Ms. Nellie Gruben, SAO, and Mr. David Mcleod, water delivery contractor.
- PW&S Regional staff – Mr. Archie Arey, WTP operator and Mr. Rick Adams, Community Facilities Manager.
- H&SS Regional staff – Mr. Bob Mellett, Environmental Health Officer.
- MACA Regional staff – Mr. Ron Rusnell, Municipal Works Officer.

Technical Support Services
Asset Management Division
Department of Public Works and Services
Third Floor - Stuart M. Hodgson Building
P.O.Box 1320, Yellowknife, NT X1A 2L9
Telephone: (867) 920-8088
Fax: (867) 873-0226

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

As part of the overall GNWT "Workplan towards Providing Safer Drinking Water in NWT Communities", the Departments of Public Works and Services (PW&S), Municipal and Community Affairs (MACA), and Health and Social Services (H&SS) have commenced joint reviews of community water supply systems. The aim is to ensure the safety and adequacy of all public water supply systems in non-taxed-based communities across the Northwest Territories. The scope of the review includes an assessment of existing infrastructure; roles and responsibilities; system operations, maintenance and management; and water sampling, testing and reporting. The goal is to identify potential problems and provide recommendations to improve the overall efficiency of the system as a whole.

Technical Support Services, Asset Management Division, Public Works and Services, conducted a review of the Aklavik water supply system infrastructure from February 11 - 14, 2003. The on-site review found the infrastructure in fair condition considering the age of the facility, working as designed, however, some operational difficulties and maintenance repairs are identified as detailed in the report.

The raw water quality in the Peel River, in general, meets the Guidelines for Canadian Drinking Water Quality (*GCDWQ*) for all parameters tested except turbidity, colour, iron and manganese. Turbidity has a maximum acceptable concentration of 1 NTU because of health risks. High turbidity water will interfere with the disinfection process, provide shelters and food for microorganisms and increase chlorine demand. Colour, iron and manganese on the other hand do not have maximum acceptable concentrations but rather aesthetic objectives because they are not considered as health risk at concentrations normally encountered.

The water supply system is more complex than a truckfill pumphouse because of treatment requirements to meet *GCDWQ*. The raw water supply system consists of a raw water intake system that pumps raw water to the water treatment plant. The treatment system consists of a packaged water treatment system and various chemical injection systems. The water distribution system consists of two insulated aboveground storage tanks for the treated water and a truckfill system for water delivery.

The existing intake system consists of two intakes extending approximately 80m into Peel River. The system has been modified in 2002 with a new backwash system installed to minimize the plugging of the intakes. Two aboveground storage tanks have also been installed between 2000 and 2002 to meet demand and provide pressure and flow to the new intake backwash system.

The community has an operating agreement with PW&S to operate and maintain the water supply and treatment system while the community is responsible for the distribution of potable water. PW&S is responsible for sampling and testing for regulatory compliance and obtaining Water License. All test results are forwarded to the community for information and the Regional Environmental Health Officer (EHO) for review and action if required.

Section 8, Gap Analysis gives a general overview of concerns associated with the water supply system. Detailed recommendations for the community and the GNWT are listed in Sections 9 and 10 respectively.

2. WATER SUPPLY SYSTEM

The Aklavik water supply system consists of a permanent twin intake system; a water treatment/truckfill facility and two insulated above ground treated water storage tanks. The treatment building was built in 1977 but the water treatment packaged system, intakes and storage tanks were built in 1979. In 2000-2002, two new above ground storage tanks were built to replace the two older tanks.

Raw water is pumped to the treatment facility using a submersible pump located in each of the intakes. Electric heating cables are used to prevent the intakes from freezing. Due to the heavy silt load in the river water during spring break-ups, the intakes are susceptible to clogging and back flush of the intakes is required. Prior to 2002, the back flush was by using a diesel pump and was very labour intensive and inefficient. A new back flush system was installed shortly after the two new storage tanks were installed in 2002. The back flush operation uses the pressure head and flow in the storage tanks to flush out sediments that accumulated inside the intakes. The new system has been working very well and reduced the O & M requirements.

The water treatment system consists of a pre-treatment unit called flocculator tube clarifier (FTC) and a packaged Microfloc Neptune W82 (Waterboy) plant that uses coagulation/flocculation, clarification and filtration processes to remove turbidity and colour. Treated water is then pumped to the two storage tanks adjacent to the treatment facility for storage. Freeze protection of the water in the storage tanks is achieved by maintaining positive circulation between the tanks and the water treatment facility as well as hot water injection to raise the water temperature to above 0°C. An in-line centrifugal pump is used to pump water from the storage tanks into water trucks.

Water is chlorinated after the filter for disinfection. The wastewater from the treatment system drains back to the Peel River downstream of the intakes.

The truck fill operation was designed to allow the water truck driver to activate the truckfill pump from a remote start/stop button on the exterior truckfill arm and a control panel outside the water plant.

Water Source (Peel River)

Water Treatment Plant & truckfill operation

Water delivery in the community is privatized and the contractor has three water delivery trucks, two with a 10,000 liter tank and one with a 16,000 litre tank.

3. SYSTEM LAYOUT

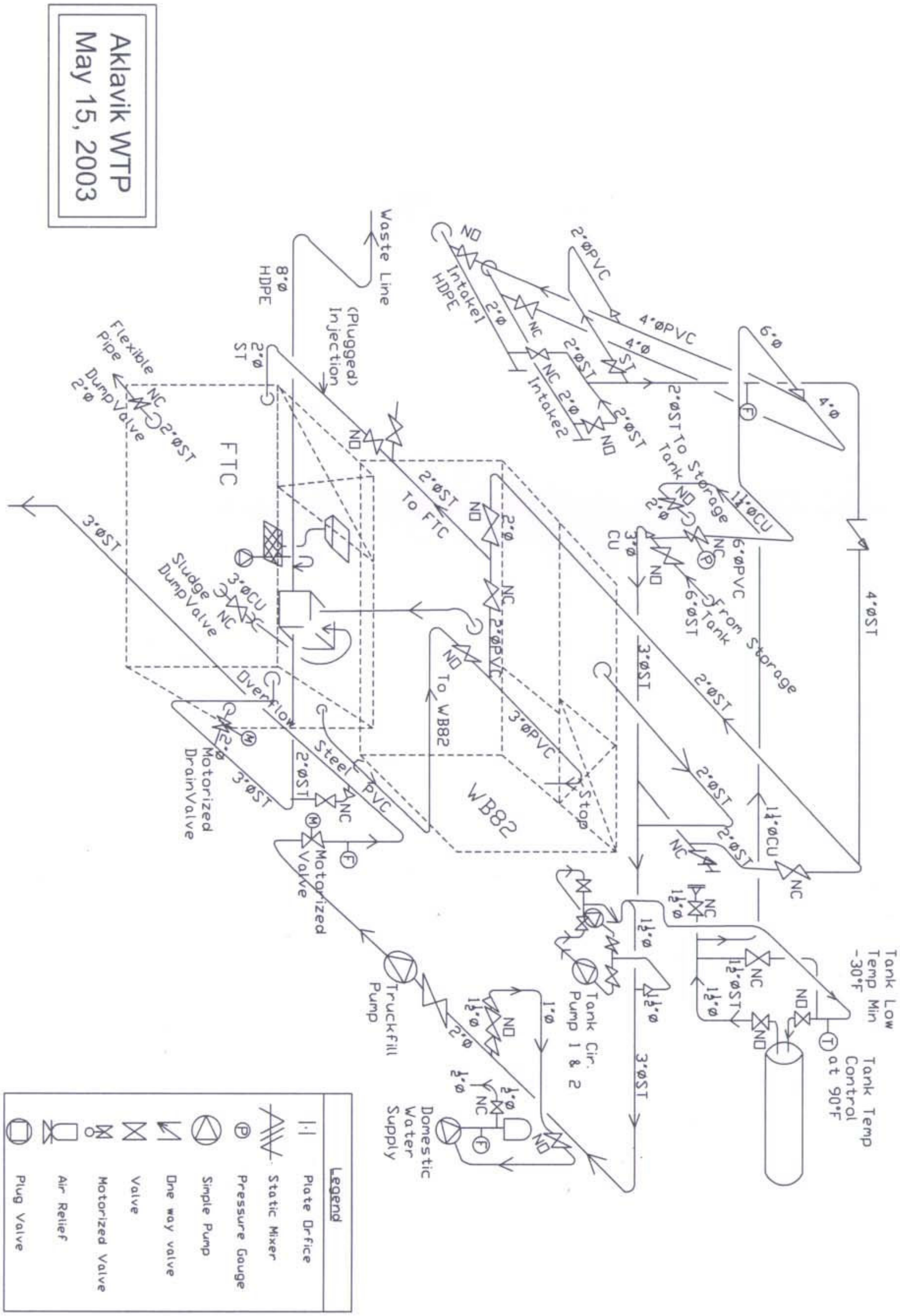

Figure 1 Process Control Schematics

Figure 3 Site Map

4. ROLES AND RESPONSIBILITIES

In the NWT, government departments, boards, and organisations have responsibilities associated with community water supplies as outlined in the following table.

Agency or Department	Function
Municipal Council	Responsible for obtaining water licence and operations and maintenance of the water supply system and infrastructure including: • Water quality sampling/testing • Monitoring treated water quality • Treatment processes, mechanical and electrical systems, building structure, inventory/supplies and general housekeeping • Water delivery and water trucks.
Municipal and Community Affairs (MACA)	1. Provided program management for water supply system planning and funding for infrastructure construction. 2. Provided funding and technical support for water truck purchase. 3. Funds the Community for system operations through the Water and Sewer Subsidy Program (WSSP) and the training and certification program for WTP operators.
Public Works and Services (PW&S)	1. Provided project management and technical support for infrastructure design and construction, and continues to provide on-going technical support/training for operations. 2. Provides training and certification to community water treatment plant operators through MACA.
Health and Social Services (H&SS)	1. As the main regulatory agency, H&SS administers the *NWT Public Health Act*, *General Sanitation*, and *Public Water Supply Regulations* to ensure safe drinking water and adherence to the *Guidelines for Canadian Drinking Water Quality (GCDWQ).* 2. All sample results (bacteriological, chemical and THMs) are sent to the Regional Environmental Health Officer (EHO) for review and action as required.
NWT Housing Corporation (NWTHC)	1. Responsible for the cleaning of house water tanks in houses owned by the Housing Authority. (Private householders are responsible for cleaning their own tanks.)
Mackenzie Valley Land and Water Board (MVLWB) Indian and Northern Affairs Canada (INAC - Federal) Department of Fisheries and Ocean (DFO-Fed) Resources Wildlife and Economic Development (RWED)	All play a role in environmental management of the watershed. • MVLWB is responsible for issuing water licenses. • Regional INAC staff monitors the performance of water treatment, solid wastes and sewage disposal systems. • DFO is responsible for fish habitat under the *Fisheries Act*. • RWED monitors contaminant spills.

Table 1 Water System Roles and Responsibilities

5. WATER SUPPLY SYSTEM COMPONENTS – DESCRIPTION

The Aklavik water supply system consists of the following sub-systems:

- Raw water source
- Raw water intake
- Water treatment
- Treated water storage
- Water treatment and distribution pumphouse

5.1 Raw Water Source

The main raw water source is Peel River. Testing completed to date indicated raw water quality was highly variable, but met Guidelines for Canadian Drinking Water Quality (GCDWQ) for all parameters tested except turbidity, colour, iron and manganese (see Table 1).

Table 1 (Samples were collected and tested in June, 1996, May, 1999 and Feb, 2003)

Parameter	Concentration	GCDWQ	
		MAC	AO
Turbidity (NTU)	3 – 363	1	
Colour (CU)	27-1652		15
Iron (mg/L)	0.51 – 2.22		0.3
Manganese (mg/L)	0.0151 – 0.532		0.05

5.2 Raw Water Intake

The water intake system was built in 1979, which consisted of two 250mm diameter 80m long partially insulated submerged HDPE series 100 carrier pipes. A 50mm diameter HDPE series 100 discharge pipe is placed inside each of the two carrier pipes and connected to a submersible pump. Raw water is pumped via one of the two submersible pumps into the treatment plant for treatment. See Section 11.0, Photos 1-4 & 8.

The two intake screens are coarse mesh galvanized screens positioned approximately 1.5m off the river bottom.

The original design had two Jacuzzi 3 HP submersible pumps model 3S4 X 11 supply raw water from the river to the treatment plant. The raw water pumps were changed to 2 – 5HP pumps in 2002. The pump motor controls are Square D with selector switches that switch from auto to hand to off positions. See Section 11.0, Photo 30.

The intakes are also equipped with electric heat trace cables for freeze protection. Heat trace cable for intake no. 1 is controlled by a heat trace controller whereas the heat trace cable for intake no. 2 has no controller except a plug and an electrical receptacle. See Section 11.0, Photo 28.

5.3 Water Treatment

The existing treatment facility has two main components, a pre-treatment unit and a conventional treatment unit, both built in 1979. The pre-treatment unit is a Neptune FTC-25H flocculator tube clarifier (FTC) for the removal of settleable solids. The main treatment unit is a Neptune Waterboy 82 packaged plant. The FTC unit consists of two unit processors: flocculation and clarification. The packaged plant consists of four unit processes: rapid mix, flocculation, sedimentation and filtration.

The four unit processes can be individually drained and cleaned if required to remove sludge or sediment build up. The operation of the water treatment system is automatic and is controlled by the control panels on the packaged plant and the FTC unit.

The treatment system was designed to treat the raw water for turbidity, colour, iron and manganese. The treated water is chlorinated after filtration prior to storage.

Various water quality testing equipment are available to the operators for testing various physical and chemical parameters. In addition, jar test equipment is available to the operators as a treatment process control tool to optimize the chemical/physical processes during changes in raw water qualities. See Section 11.0, Photo 82.

Test Equipment	Physical/Chemical Parameters
Hach DR 2000	• Colour, iron, manganese, aluminum, free and total residual chlorine
Hach 2100 Turbidimeter	• Turbidity
Hach pH meter–Sension 1	• pH
Phipps & Bird	• Jar test to optimize treatment processes

The operator indicated that he could not use the new turbidity meter. He tried to calibrate the new meter but the meter would not register any reading. The review team inspected and recalibrated the meter using available standards and restored the meter to its normal operating condition. The review team also set up the new pH meter that was brought in during the review and calibrated the meter for the operator.

5.3.1. Pretreatment

The unit consists of a flocculator tube clarifier (FTC), which has two compartments: a flocculator chamber and a tube settler clarifier with tubes arranged at 60^o to the horizontal plane. The flocculator has a variable speed motor and the controller is located in the control panel.

The original operating sequence was designed to use the FTC unit in series with the Neptune Waterboy during summer and break-up season with alum injection when the turbidity is the highest. In winter, due to lower turbidity condition, the raw water would bypass the FTC and flow directly to the Waterboy for treatment. A 75mm diameter steel pipe located near the top of the clarifier drains water to the 75mm diameter steel waste line in case of overflow. See Section 11.0, Photos 35-38.

The clarifier in the FTC unit has a 50mm diameter motorized dump valve controlled by a timer located in the control panel. The sludge and waste are drained by gravity through a 75mm diameter steel waste line into a 200mm diameter HDPE waste line and back into the river. A 25mm diameter dump valve is installed at the flocculator chamber to drain sludge from the chamber through a 25mm diameter pipe to outside.

The FTC unit was later modified and the process optimized by PW&S to improve the treatment efficiency. The modifications included the following items:

- Installed another manually controlled 75mm diameter dump valve at the clarifier unit for faster and better sludge removal. The waste is piped to a small metal rectangular box that formed part of the 200 mm diameter waste line via a flexible hose for disposal. See Section 11.0, Photos 53-54.

- The 25mm diameter valve was changed to a 50mm diameter valve for faster and better removal of sludge. See Section 11.0, Photo 55.
- A polymer (coagulant aid) injection system was added to the FTC unit to increase treatment efficiency during high silt load periods. See Section 11.0, Photo 50.

5.3.1.1. Chemical injection

Alum injection (powdered alum) is provided for initial turbidity removal during the high silt load season. Alum is injected directly into the raw water pipe upstream of the FTC unit. No mechanical mixer or static mixer is provided for thorough chemical dispersion and mixing. The chemical injection pump is a Prominent pump model C0NB0223NP106 with 23LPH. Alum is mixed and stored in the same tank. The electric mixer is mounted on top of the tank and is a Dayton model 8M133. The alum injection system has been deactivated at the time of the review. See Section 11.0, Photos 35 & 52.

Preastol is used as a coagulant aid but the injection system was shut down at the time of the review. The chemical is mixed and stored in the same tank and the mixer is top mounted and is a JL Wingert model 8AA133 mixer. The chemical pump is a Prominent pump model C0NB0223NP105.

5.3.2. Neptune Waterboy packaged plant

5.3.2.1. Flash mix

Chemical mixing is provided by hydraulic energy only. This method of mixing is not very effective in promoting quick, thorough mixing and dispersing of chemical for initial particle charge destabilization. See Section 11.0, Photos 39-40.

Alum is used as the primary coagulant and is injected directly into the flash mixer chamber and the chemical injection pump is a Prominent, model CONB0223NP10600000 pump. The chemical is mixed and stored in the same tank. The mixer is a top mounted mixer, Lightnin model X123621, 1/15hp mixer. See Section 11.0, Photo 52.

A coagulant aid (Preastol) is also added at the flash mix chamber. The chemical is mixed and stored in the same container. The chemical pump is a Premia 75 model 75ME19DAKTC4BXX pump. The mixer for mixing the chemical is mounted on the top of the tank and is a JL Winger model P-41 mixer. See Section 11.0, Photo 51.

5.3.3. Coagulation and flocculation

This unit process consists of a single flocculation chamber with paddle type stirrers mounted vertically in the chamber to provide mixing energy. See Section 11.0, Photos 40-41.

5.3.4. Sedimentation

It consists of settling tubes arranging at a 7-1/2^{o} angle to the horizontal mounted in a chamber to facilitate solids separation and removal. This process follows flocculation for the removal of floc particles. See Section 11.0, Photo 42.

5.3.5. Filtration

The unit process consists of a single filtration chamber with multi-media filter bed consist of 460mm of anthracite at the top and about 400mm of various grades of sand and 300mm of supporting gravel for removal of any carryover floc particles from the sedimentation process. It is the final polishing process prior to storage. See Section 11.0, Photos 43 & 47.

5.3.6. Backwash

The backwash operation is initiated either by headloss across the filter bed or manually by the operator. During the backwash mode, the raw water pump and all chemical injection pumps are deactivated. See Section 11.0, Photos 44-45.

The backwash pump is a Bell & Gossett pump model 2.5BB8.125, 5hp, 1750rpm, 220gpm at 60ft. The motor is a Baldor Cat no. JMM31S7T motor. See Section 11.0, Photos 39 & 41.

During the backwash operation, wastewater is removed from the process via a 200mm HDPE pipe back to the river downstream of the water intakes. See Section 11.0, Photo 48.

5.3.7. Disinfection

Granulated chlorine HTH is used for disinfection. The chemical was originally injected before the Waterboy but was changed in 1997 to post filter to minimize the formation of disinfection by products such as THMs. The operation of the chlorine injection pump is interlocked with the Waterboy control panel. The pump remains energized as long as the Waterboy is in normal filtration mode. See Section 11.0, Photo 49.

The injection pump for post chlorination is a Prominent pump. The system has a mixing tank on top of a solution tank. The mixing tank has a JT Winger top mounted mixer and the solution tank has a Reliance top mounted mixer.

5.4 Treated Water Storage

Treated water is stored in two new pre-insulated above ground steel tanks next to the water plant. One tank was installed in 2000 and the second tank was installed in 2002. The new tanks were designed to replace the two old steel tanks and to meet storage requirements. The tanks are 6.1m in height and 5.6m in diameter and are interconnected by a pipe with an isolation valve. The tanks have R20 rigid insulation on the exterior complete with 22 gauge metal cladding and are built on top of a 100mm rigid insulation on top of a gravel pad. The filling operation is controlled by floats, which regulate the treatment plant as well as the raw water pumps in the intakes. See Section 11.0, Photos 58-59.

- Each of the two tanks is equipped with an overflow pipe to drain excess water outside and also a drain valve complete with a heat trace cable to drain tank for cleaning and routine maintenance.
- The total volume of the tanks includes 60m^3 for fire and about 229m^3 for daily consumption, peak balancing and plant use.

5.5 Water Treatment and Distribution Pumphouse

The building is a 7.62m X 7.62m insulated metal structure built in 1979. The building is built on a 150mm reinforced concrete foundation. The foundation/flooring system sits on an elevated gravel pad. A 100mm layer of rigid insulation was installed approximately 300mm below the surface of the gavel pad.

The interior walls of the treatment plant area are lined with low profile metal liner all the way to the ceiling. See Section 11.0, Photos 8-9.

5.5.1. Truckfill Sub-Systems

The truckfill pump is a base mounted in-line centrifugal pump. The pump is a 3 phase WEG model 182TC-12/00 pump with a Electripower model MAR25-10 motor. The pump motor control panel is located inside the water plant. See Section 11.0, Photos 17 &32.

The pump start-stop switches are located on the outside operator panel and as well as on the truckfill arm. See Section 11.0, Photos 88 & 91.

The truckfill arm is an insulated 75mm schedule 40 steel pipe. A hose on the end of the truckfill arm facilitates truck filling. According to the WTP operator, the fill arm has been hit by water trucks a few times because the hose is too long and rigid. At the time of the review, a contractor hired by PWS was working on the fill arm. The work included reinsulating the fill arm c/w heat trace cable for freeze protection and modifying the existing fill hose to prevent further damage to the truckfill arm. See Section 11.0, Photos 89 – 90.

Flow metering and sensing equipment for the raw water and truckfill operation include Signet MK 515 paddlewheel and Signet flow indicator/totalizer. The paddlewheel senses the flow and sends signals to the flow indictor/totalizer for display and registration. See Section 11.0, Photos 9-10, 11 & 19.

5.6 Genset Building

The structure is a prefabricated metal building with R20 fibreglass insulation measured 3m by 2.4m outside dimensions. The building was built in 1986. The genset building is sited adjacent to the water treatment plant. Outside walls are made of 22gauge sheet metal and the inside walls are lined with 24 gauge steel liner. See Section 11.0, Photos 62 & 65.

The building has a concrete floor and is supported by a metal skid. The foundation/flooring system sits on an elevated gravel pad.

5.7 Storage Building

At the time of the review, a new storage building was under construction. The structure is a stick-built wood framed insulated building with vinyl sidings, wood floor, an overhead double door at the front and a single door at the side. The interior wall was unfinished compressed board. See Section 11.0, Photos 75-76 & 79-80.

The building is on wood blockings built on an elevated gravel pad.

5.8 Mechanical/Electrical Systems

5.8.1. Truckfill system

The truckfill pump is a WEG, 3 HP, 3phase, 208-230/460V @ 60hz, model 182TC-12100 in-line centrifugal pump. The motor for the pump is an Electric Power, 120V, model MAR 25-10 motor. The pump has on/off buttons mounted on a wall connected to a Struthers-Dunning relay.

5.8.2. Normal/standby power

The main power supply is three-phase 120/240V from NWTPC. The main circuit breaker is a Square D and is located in the water treatment plant. Back-up power is provided by a 30Kw Onan model DL6-15R liquid cooled standby genset. The genset also includes an Onan engine control panel mounted on the genset. Engine battery is Cat-maintenance free model 153-5700 c/w Onan automatic battery charger. A Simson Maxwell Simmax model ATS3150W/B automatic transfer switch transfers power to a circuit distribution panelboard ‘A’, after a time delay sequences when the primary power fails. See Section 11.0, Photos 26-27, 33-34, 64&70.

The new storage building has no standby power. Main power supply is from NWTPC to a panel C c/w with a main circuit breaker for distribution.

5.8.3. Heating/ventilation system

Heating system for the water plant building includes two Weil Mclain model BL-476W boilers and two unit heaters c/w fans. One furnace is the duty furnace while the other one is on standby. The unit heaters were controlled by individual Honeywell thermostats. Fuel for the heating system consists of an outside 1800L tank and a small day tank inside the building. See Section 11.0, Photos 21 - 25.

The genset building heat is provided by an electric heater controlled by a Honeywell thermostat set at 80^0F. The combustion/ventilation system for the genset consists of an outside air damper, 24V Honeywell damper controllers c/w linkages, a recirculation air damper, an exhaust air damper and a Honeywell temperature controller model T921A. The operation sequence of the dampers is controlled by the Honeywell temperature controller and the genset controller. When the genset starts, the outside air damper opens automatically to a minimum position to admit combustion air. The recirculation damper opens to allow the engine go through the warm up cycle and the exhaust damper closes. As the coolant temperature starts to rise, the intake air damper modulates when the engine reaches its normal operating temperature, the exhaust dampers opens and the recirculation damper closes to allow the ventilation air to be relieved from the building. When the building temperature increases to the preset temperature, the intake air fan energized to provide cooling air to the building. The intake air fan closes automatically when the intake air damper starts to close. See Section 11.0, Photos 65-68.

Fuel for the genset system consisted of an outside 750L steel tank inside a metal container next to the genset building. See Section 11.0, Photo 74.

Heating for the new storage building consists of a furnace with a drip burner. The fuel tank is an 1800L cylindrical steel tank mounted on an elevated steel frame next to the building. See Section 11.0, Photo 79 & 81.

5.8.4. Freeze protection

Treated water is constantly circulating between the outside tanks and the water plant with hot water injection to prevent water in the storage tanks from freezing. The freeze protection system consists of two base-mounted centrifugal pumps with one as duty pump and the other one as standby and a heat exchanger. See Section 11.0, Photos 14-16, 29 & 31.

5.8.5. Domestic water

Domestic water is provided by a Monarch base-mounted centrifugal pump system c/w a pressure tank. See Section 11.0, Photo 18.

5.8.6. Waste disposal

Waste water from the clarifier in the FTC unit and backwash waste from the Waterboy is drained into a small metal waste container and through a 200mm high density polyethylene pipe (HDPE) into the river for disposal. Waste water from the building sink is drained into a small concrete sump underneath the building concrete slab for storage. A small submersible pump with a level control pumps the waste water into the 200mm HDPE waste line for disposal. See Section 11.0, Photos 46 & 53-57.

5.8.7. Lighting

Interior lighting for the water treatment plant is overhead fluorescent; exterior lighting is low pressure sodium (LPS) and is activated by a photocell. An Emergi Lite with 2 remote heads and self-contained battery provides emergency lighting. See Section 11.0, Photo 38-39, 83 & 89.

Lighting for the genset building consists of overhead incandescent lights and an emergency light system c/w 2 heads and a battery pack. See Section 11.0, Photos 69 & 72.

Lighting for the new storage building consists of 3 LPS lights on three interior walls and an outside LPS light mounted at the mandoor c/w a motion sensor. See Section 11.0, Photos 76 & 79.

5.8.8. Alarms

The main control panel in the water treatment plant consists of the following alarms.

Condition	Light (Normal condition)	Buzzer
Low building temperature	Red	Yes
Boiler low temperature	Red	Yes
Tank low temperature	Red	Yes
Low flow heat exchanger	Red	Yes
Generator set fails	Red	Yes

Major alarms activate the lights on the alarm panel and the buzzer on the exterior of the water plant. See Section 11.0, Photos 60-61.

Building low temperature alarm for the water treatment building is controlled by a Penn temperature controller and is set at 5^0C. See Section 11.0, Photo 20.

The fuel systems for the water plant and the genset building have no level alarms.

6. WATER SYSTEM REVIEW – INFRASTRUCTURE

6.1 Raw Water Intake

- The intake system had been experiencing major clogging problems in the past due to sediment/mud accumulated inside the intake pipe especially during spring break-ups. The operator indicated that he had to backwash the intake daily and sometime every four hours during spring break-ups in order to maintain flow to the water plant. Since there was no provisions in the plant to backwash the intake casing effectively, the operator indicated that sometimes he had to use a fire truck or a diesel pump to facilitate the backwash process. That took a lot of his time to organize, operate and maintain the equipment. The frequent backwash requirements substantially reduced the filter run time, the capacity to produce treated water and increased O & M requirements.
- The intake backwash system was modified in 2002 when the new outside tanks were installed to replace the two older storage tanks. The modified backwash system consists of 150mm PVC pipes connected from the two existing intake casings to the outside storage tanks. A Signet flow sensor is installed on the PVC pipe and transmitted flow information to a Signet flow meter/totalizer for display. The backwash operation is manually initiated by the operator by opening up a normally closed valve. The system uses the water and the available pressure head in the tank to backflush the intake casings by gravity. The operator indicated that since the modification, due to the simplicity of the operation and the available pressure and flow, the backwash operation is much easier, more effective and less frequent. See Section 11.0, Photos 5, 12 & 13.
- The original heat trace cables had been replaced in 1990.

6.2 Water Treatment

6.2.1. Pretreatment

- The FTC unit was in good physical condition.
- The nominal design flow of the FTC unit is 189Lpm. The flocculator has a variable speed drive, which permits the mixer speed to be adjusted to optimize the unit process. A 50mm dump valve is installed at the base of the unit and is operated manually. The waste is directed to the outside of the building using a flexible hose.
- The clarifier has settling tubes arranged at 60^0 to the horizontal plane to promote solids separation process. A 75mm steel pipe is provided near the top of the unit to control overflow. The unit has a 75mm manually operated dump valve installed at the bottom for sludge removal. The waste is drained into a small wastewater holding tank via a flexible hose for disposal through the 200mm waste pipe into the river. The original 50mm motorized dump valve has not been used currently because of the problem with the control panel and also the operator indicated that the valve is too small to remove the sludge accumulated in the bottom.

6.2.1.1. Chemical Injection

- The alum injection system was in good operating condition. The operator indicated that the system would be converted to liquid alum injection with a new injection pump soon.
- The polymer injection system was shut down and disconnected. The operator indicated that the system is still operable.

6.2.2. Neptune Waterboy packaged plant

6.2.2.1. Flash mix

- Hydraulic energy was the only form of mixing energy available to flash mix alum. Polymer was added at the flocculation chamber.

6.2.3. Coagulation and flocculation, sedimentation and filtration

- These three unit processes were in fair physical condition although rust has been observed in the three chambers.

6.2.4. Backwash

- The unit process was in fair physical condition although rust has been observed in the chamber.

6.2.5. Disinfection

- The unit process was in fair physical condition. Refer to Section 5.3.7 for information.

6.3 Treated Water Storage

- The outside storage tanks were in very good condition, however, the foundation and the site conditions could not be confirmed due to ice and snow cover. No structural or capacity problems have been noted or reported by the operational staff.

6.4 Water Treatment and Distribution Pumphouse

- The building was in fair condition considering the age of the structure; no structural problem has been noted or reported by the operational staff. Technical Support Section carried out a technical status evaluation report on the building in February of 1997 and noted only minor repairs were required such as repairing/replacing vapour barrier and insulation.

6.4.1. Truckfill Sub-System

- Truckfill sub-systems appeared to be in fair physical condition. The operator indicated that the truckfill flow meter does not indicating or totalizing flow and it has been like that since it was installed. The review team inspected the flow sensor and meter installation, confirmed meter calibration and corrected the sensor alignment. The flow meter/sensor unit was restored and put back in service.
- Refer to section 5.5.1 for additional information.

6.5 Genset Building

- The building was in fair condition considering the age of the structure; no structural problems have been noted or reported by the operational staff.

6.6 Storage Building

- The building was under construction at the time of the review.

6.7 Mechanical/Electrical Systems

- Overall, mechanical and electrical systems appeared to be in fair condition with no serious problems. Refer to section 5.8 for information.

6.7.1. Normal/standby power

- Refer to Section 5.8.2 for information.

6.7.2. Heating/ventilation system

- Refer to Section 5.8.3 for detailed information.
- The boiler system in the water plant was in fair physical condition.
- There were two unit heaters in the water plant, one heater was working as per design while the fan motor wiring for unit heater unit # 1 by the boilers was disconnected.

6.7.3. Freeze protection

- Refer to Section 5.8.4 for information.

6.7.4. Domestic water

- Refer to Section 5.8.5 for information.

6.7.5. Waste disposal

- Refer to Section 5.8.6 for information.

6.7.6. Lighting

- Refer to Section 5.8.7 for information

6.7.7. Alarms

- Refer to Section 5.8.8 for information.

7. WATER SUPPLY REVIEW – OPERATIONS AND MAINTENANCE

7.1 Watershed and Raw Water Quality

- There were no major community complaints relating to water quality, though raw water quality parameters such as turbidity and colour varies highly with seasons and other environmental conditions.
- The community has a valid B license from Gwich'in Land and Water Board (GL&WB) to remove water from the Peel River**.** The expiry date of the water license is July 31, 2009.

7.2 Raw Water Intake

- The intake system is susceptible to loss of supply due to problems encountered as previously identified in Sections 5 & 6. The problem became less severe since PW&S modified the existing intake back flush system in 2002. No prolong disruption of service has been experienced.
- The operator indicated that due to the high silt load in the river especially during spring break-up, he has to replace the intake pumps on a regular basis. He has ordered a new intake pump to replace the one that he just replaced a few weeks ago.
- The operator noted that the heat trace cables are working as far as he knows.

7.3 Water Treatment

7.3.1. Pretreatment

- The FTC unit has an auto desludge sequence built in to its control panel but has not been used for a long time. The operator indicated that it doesn't work too well with the smaller 50mm motorized dump valve because the valve is too small and get plugged very easily. At present, the clarifier desludge process is carried out manually using the 75mm dump valve. **Recommend the following actions be considered:**
  - **Verify the auto desludge feature in the control panel and repair if required.**
  - **Either changing the 50mm motorized valve to a 75mm motorized valve so that the desludge sequence can be controlled through the FTC panel or adding a motorized actuator to the 75mm manually operated dump valve and interlocking the valve to the FTC control panel.**
- At present, the flocculator chamber in the FTC unit drains through a 50mm valve and a flexible hose to the outside of the building. This created an accumulation of sludge from time to time outside the building. **Recommend extending the drain line so that the sludge can be directed away from the building to the low- lying areas behind the building.**

7.3.2. Chemical Injection

- At the time of the review, alum was injected into the raw water line and mixed with the water using hydraulic energy. This form of mixing is not as effective as either using a mechanical mixer or static mixer. PW&S is in the process of switching from powdered alum to liquid alum to improve O & M efficiency and safety for the operator. **Recommend the alum injection system be modified to include a static mixer with alum injection point just upstream of the mixer. A sampling valve should also be installed upstream of the alum injection point to facilitate jar test for process control and optimization.**

- The polymer injection system was shut down and disconnected. **Recommend the polymer feed system be reconnected and serviced to ensure it can be reactivated if required especially during break up and high turbidity periods.**

7.3.3. Neptune Waterboy packaged plant

- The operator indicated that at present, the plant is working about 20 hour per day and the operation is mostly automatic except for the backwash cycle, which is done manually.
- **Recommend hour meters be installed on the backwash and effluent pump motors to monitor the motor run time for O & M purposes.**

7.3.3.1. Flash mix

- At the review, alum was injected into the water line coming from the FTC unit and mixed with the water using hydraulic energy. This form of mixing is not as effective as either using a mechanical mixer or static mixer. **Recommend the alum injection system be modified to include a static mixer with alum injection just upstream of the mixer. A sampling valve should also be installed upstream of the alum injection point to facilitate jar test for process control and optimization.**

7.3.4. Coagulation and Flocculation

- Refer to section 6.2 for information.

7.3.5. Sedimentation

- Refer to section 6.2 for information.

7.3.6. Filtration

- Refer to section 6.2 for information.
- **Recommend the filter bed be checked every 6 months to monitor the filter condition and any loss of filter media**.

7.3.7. Backwash

- The backwash light on the Waterboy control panel did not come on during the backwash cycle and the push to test light did not come on when pushed. **Recommend the light be checked and repaired.**
- The operator indicated that in winter he would backwash the filter up to twice a day to keep the filter bed clean as well as to keep the waste line open. In summer he would backwash the filter sometimes 4 times a day to maintain the treated water quality to meet GCDWQ especially for turbidity.
- The operator indicated that the pressure gauge used to initiate the backwash cycle does not work and he has to start the backwash cycle manually. **Recommend the pressure head loss gauge be checked and repaired.**
- The operator indicated that there are no spare backwash pump or effluent pump. **Recommend provide spare effluent and backwash pumps to minimize service interruption.**

7.3.8. Disinfection

- At the review, powdered chlorine was used to disinfect treated water but PW&S is in the process of converting the system to liquid chlorine to address safety concern and reduce operations and maintenance requirements.
- Spare chlorine injection pumps are in stock.
- The operator indicated that he usually checked free and total residual chlorine levels in the water storage tank every morning. He would also check free and total residual chlorine in the water truck twice (morning and afternoon) in one day out of a week. He did not check for free residual chlorine in the water truck that was parked overnight in the morning because the water truck was not filled at the end of a delivery day in winter. The operator indicated that the main reason for not filling the water truck is because the garage does not have enough heat to prevent the water in the truck from freezing. H&SS indicated that they have no issue with the current practice. **Recommend adequate building heat be added to the garage to allow the water truck to be filled and parked after each delivery day for fire protection purpose. Should that happen, the water in the water truck parked overnight must be tested in the morning prior to delivery and batch chlorinated if insufficient FAC is detected. (a minimum of 0.2mg/L of free available chlorine after 20 minutes of contact time).**

7.4 Treated Water Storage

- The water storage tanks are fairly new and in excellent condition.
- The level gauge for the intake backwash system did not seem to function properly. **Recommend the gauge be checked and recalibrated.**
- The operator indicated that the cleaning frequency for the new tanks would probably be once every two years.

7.5 Water Treatment and Distribution Pumphouse

- Structurally the building appears to be in good condition**.**
- The concrete floor is in fair condition.
- Site drainage could not be assessed because of heavy snow and ice cover.
- The operator indicated that the building is too small and does not have sufficient room for storage and proper O & M around the equipment. With the commissioning of the new storage building and the switching from powdered chemical to liquid chemical, it should free up some usable space.
- There were two fire extinguishers in the building, one was underneath the metal walkway at the Waterboy and the other one was left sitting on the floor by the main entrance. The one by the main entrance had a tag with an inspection date of February 2002. The one underneath the walkway could not be confirmed. **Recommend both fire extinguishers be installed in easy to reach locations and the inspection date be confirmed for the one that was placed underneath the walkway.**
- Building is kept locked while unattended.

7.5.1. Truckfill Sub-systems

- No operational problems were noted. The flow rate was measured at ~ 1000 Lpm.

- There was no spare truckfill pump on site. **Recommend a spare pump be provided to minimize service interruption.**

7.6 Genset Building

- Structurally the building appears to be in good condition**.**
- The concrete floor is in fair condition.
- Site drainage could not be assessed because of heavy snow and ice cover.
- There was a fire extinguisher mounted on a wall inside the building but without a tag stating the last inspection date. See Section 11.0, Photo 73. **Recommend the fire extinguisher be inspected and tagged.**
- Building is kept locked while unattended**.**

7.7 Storage Building

- The building was under construction at the time.

7.8 Mechanical and Electrical Systems

- Refer to section 6 for additional information. All mechanical and electrical systems appeared to be in fair operating condition.
- There were evidences of corrosion on metal process piping. **Recommend changing sections of the process piping from the raw water intake to the FTC unit and the Microfloc Waterboy from metal pipe to PVC pipes (wherever possible and practical).**
- **Recommend labels be provided to identify equipments and flow directions for O & M and trouble shooting purposes.**

7.8.1. Noraml/standby power

- The standby genset has been exercised for about 15 minutes per week and never had any problems. The meter hour on the engine control panel indicated that the total engine run time is ~ 212 hours.
- The operator noted that power outage in the community is very rare and usually do not last very long.
- The genset was field tested but the ventilation system did not operate as specified in the O & M manual. PW&S has been informed of the problem. **Recommend the operating procedures of the ventilation system be confirmed.**
- The drip pan for the genset was missing. **Recommend the drip pan be replaced.**
- The original design had a battery blanket and was thermostatically controlled by a wall thermostat. At the review, there was no battery blanket for the genset battery set. **Recommend a battery blanket be installed and restored as per original design.**

7.8.2. Heating/ventilation system

- The wiring for unit heater No. 1 at the back end of the water plant was disconnected. The water plant operator reconnected the wiring and turned up the thermostat but the heater was still not energized. PW&S was notified of the problem on site. **Recommend the system be verified and repaired or replaced if required.**

- Both the operator and his supervisor, the community facilities manager indicated that they have been having some operational problems with the burners. The burners have to be replaced frequently because of corrosion due to the moisture content in the water plant. They would like to see the boiler system be isolated from the water treatment packaged plant to minimize contact with moisture. **Recommend PWS reviews the problem with MACA to determine whether it can be addressed either as a capital or O & M issue when reviewing the space requirement issue.**

7.8.3. Freeze Protection

- At the time of the review, the heat exchange system did not appear to function properly. The three way mixing valve did not seem to respond as the temperature setting varied and the rise in temperature across the heat exchanger seemed to be too low ~ 3^0C. **Recommend the system be verified, repair or replace if required**
- The recirculation system between the outdoor storage tanks and the water plant was in good working condition. The system however, does not have any instrumentation to indicate either pressure or flow condition. **Recommend the following process controls be installed to monitor the performance and condition of the pumps: pressure gauges on both the suction and discharge side of the pumps, hour meters on both pump motors and a flow meter on the discharge header.**

7.8.4. Lighting

- One of the overhead light fixture in the genset building is missing a lamp. **Recommend the lamp be replaced.**

7.8.5. Alarms

- A fuel level gauge for the boilers in the water plant was missing a needle. **Recommend the level gauge be repaired and recalibrated to indicate fuel levels in the tank and to provide an alarm signal to the alarm panel to warn the operator of low fuel situation**.
- There was no level gauge for the genset fuel system and the operator indicated that he has to dip the tank to find out how much fuel he has. **Recommend a level gauge be installed to indicate fuel levels in the tank and to provide an alarm signal to the alarm panel to warn the operator of low fuel situation.**
- At the time of the review, the boiler low temperature alarm, the low flow heat exchanger and the genset fail alarm did not come on when tested. **Recommend the operation of the three alarm systems be verified, repair if required**. See Section 11.0, Photo 61.
- Water storage tank low temperature alarm worked when tested but the set point needed to be verified. **Recommend the set point for the low temperature alarm be checked and confirmed.**
- There are no high building temperature controller and alarm for the water treatment plant. **Recommend a high temperature controller and alarm be considered for the building.**
- There are no temperature alarms for the genset building or the new storage building. **Recommend building temperature alarms be considered for the two buildings and tied in to the main alarm panel in the water treatment plant.**

7.9 Water Quality Testing

- Table 2 lists the water quality sampling being done, along with the frequency and sample location.
- Table 3 lists the water quality sampling and testing completed at the review in the field and the treated water quality met all GCDWQ for parameters tested.

7.9.1. Chemical Testing

- All chemical testing for process control is done at the water treatment facility, normally by the water plant operator. The operator would test daily for turbidity, colour and pH on the raw water and treated water.
- The plant operator sample for FAC and total residual chlorine every morning from the storage tanks. The operator tested the water in the water truck for total residual chlorine and FAC (twice) in one day out of a week. At the review, there were no total residual chlorine reagent on site and the free residual chlorine reagents have passed the expiry date. PW&S is aware of the problem and has ordered fresh reagents. All sample results are recorded in the plant logbook. The Environment Health Officer (EHO) indicated that he is satisfied with the chlorine monitoring and testing practices.
- The review team interviewed the water truck contractor and the water plant operator to discuss the monitoring and testing of chlorine residuals especially with the first load in the morning. The water plant operator indicated that to ensure the first load has the minimum 0.2mg/L of free available chlorine, he proposed to call the contractor every morning after he tested his water for the chlorine residual levels
- . He would also assist the contractor to batch chlorinate the water in the truck if needed.

Parameter	Frequency of Testing		No. of Samples	Location
	Raw	Treated		
Bacteriological Testing[1]		Monthly	5	1 sample a week from one of the following locations: water truck, school, and water plant. 1 additional sample from the nursing station each month.
Annual Chemical[1]		Annually	1	Treated water (last sample was taken May/02)
THMs and TOCs[1]		Semi-annually	1	Last sample was taken May/02.
Water License Requirements	Annual		-	Based on DIAND's information. Last inspection was in Oct. 1999.
Free Available Chlorine[1]		2x/Day	2	Daily from the water storage tank and twice in one day out of a week from the water truck.
Total Chlorine		2x/Day	2	Daily from the water storage tank and twice in one day out of a week from the water truck.
Turbidity	Daily	Daily	1	Raw water intake/Treated water
Colour	Daily	Daily	1	Raw water intake/Treated water
pH	Daily	Daily	1	Raw water intake/Treated water

Table 2 Sampling and Testing Procedures

- The chemical testing station was found to be clean. At the time of the review, the log book was up to date with daily entries. See Section 11.0, Photos 82 – 87.
- A few laboratory items were missing for the operator to carry out process control tests. **Recommend the following laboratory items be purchased: 3 paddles for the stirrers and 6 valves for the 2L square jars for the jar test equipment, lint free wipes, brushes for cleaning sample cells, 6 samples cells for the Hach 2100P turbidimeter, two funnels and pH electrode storage solution.**
- The operator indicated that he has not been testing for iron, manganese or aluminum in the raw and treated water**.**
- **Recommendation: (for best practice & reviewed with the EHO)**
  1. **Three residual chlorine tests are required each day when the community resumes filling the water truck after each delivery day and parks in the garage for fire protection:**
     - **First thing in the morning on the truckload that sits overnight for fire protection purposes to ensure adequate FAC levels (not total residual chlorine) prior to**

[1] For regulatory compliance

delivery, with batch chlorination to increase the FAC if required. Additional test(s) may be required to confirm the batch chlorination results.

- **The second test is done 20 minutes after filling the first truck to ensure the chlorine injection pump is set properly for the day for both FAC and total residual chlorine. Additional test(s) may be required to confirm FAC levels after pump adjustments.**
- **The third test should be carried out in the afternoon to confirm the chlorine pump is still working properly (using similar procedures as per the second chlorine test).**

2. **Process control**
   - **Increase sampling/testing frequency for turbidity and colour to twice a day minimum on raw and treated water during spring break-up and summer. Treated water samples should be taken from the Waterboy and the storage tanks.**
   - **Test for iron, manganese and aluminium once a day minimum during break-up and summer and once a week during winter.**
3. **Jar test to be carried out when there is a significant change in raw water quality such as turbidity, colour, pH, iron and manganese. To facilitate jar test and sampling/testing procedures, domestic water, raw water before and after the FTC unit should be piped to the existing sink adjacent to the Waterboy.**

Date	Parameter					Comment
	Raw		Treated			
2003	Turbidity (NTU)	Colour (CU)	Turbidity (NTU)	Colour (CU)	FAC (mg/L)	GCDWQ: Turbidity < 1NTU, colour <= 15TCU
February 11	3.6	26	0.67	5		
February 12	3.04	27	1.25	9		After backwash
February 13	3.17	28	0.51	5	1.16	

Table 3 Water Quality Sampling and Testing – Field Work

7.9.2. Bacteriological Testing

- The water plant operator collects bacteriological samples once a week per month from one of the following buildings: the water treatment plant, a water truck and the school plus one additional sample per month from the Health Centre. Currently, samples are brought to the CHR and the CHR sends the samples to the Inuvik hospital for analysis.
- Responsibility to sample other public buildings has not been well defined and as a result, sampling for non-PWS buildings has not been done regularly. **Recommend H&SS reviews roles and responsibility of sampling with the community, MACA and PWS to establish a sampling protocol.**

7.9.3. Reporting

- Table 4 shows who takes the samples, who tests them, and who sees the results.
- The Environmental Health Officer (EHO) visits the community twice a year, reviews the log book on each visit, checks facility and discusses any problems with the operator or the SAO.

The EHO also sends a trip report to the SAO for information. **Recommend the trip report be also forwarded to MACA and PWS for information.**

- All test results go to the EHO. One copy of the test result will usually fax to the water plant operator and if the result indicated positive for e-coli, copies of the test result would then go to the operator's supervisor and MACA's office in Inuvik. The community will only receive bacteriological test results when there is a problem. They would then work with the EHO to resolve the problem.
- Based on DIAND's latest information, the most recent inspection by INAC was in October of 1999 and no concern with the water supply system was reported. INAC usually sends inspection report to the community for information. **Recommend inspection reports and water quality test results be forwarded automatically to MACA, PWS and H&SS.**

Sampling/ Testing	Sampled by	Tested by	Distribution of Results	Comments
Bacteriological Testing	Water Plant Operator	Inuvik Regional Hospital	H&SS Region & water plant operator	H&SS will contact the community when there is a problem
Annual Chemical	PWS	Taiga Labs	H&SS Region, PWS and Community	Last sampling date was May 2002.
THMs and TOC	PWS	Taiga Labs	H&SS Region, PWS and Community	Last sampling date was May 2002.
Sampling & Testing for Water License	-	-	INAC,SAO	The community received a report (Oct.1999) indicating everything is all right
FAC (Free Available Chlorine)	Water Plant Operator	Water Plant Operator	Truckfill log-book	EHO may review the logbook when on site.
TC (Total Chlorine)	Water Plant Operator	Water Plant Operator	Truckfill log-book	EHO may review the logbook when on site.
Turbidity, colour & pH	Water Plant Operator	Water Plant Operator	Truckfill log-book	EHO may review the logbook when on site.

Table 4 Communication and Reporting

7.10 Community Operations

- Table 5 lists water plant operating staff responsible for water supply system operations, their education, experiences and certification level. The community has an operating agreement with

PWS with charge back policy. The PWS water plant operator is responsible for the overall operations and maintenance of the water supply system. Tasks include preventative maintenance, chemical mixing, sampling and testing, routine inspections, and optimization of treatment processes. PWS will use hamlet's casual employees whenever possible to reduce operating cost.

- The annual mechanical and electrical inspections are usually carried out by a contractor. The water plant operator would do monthly checks on the generator, fire extinguishers and other minor systems such as emergency lights. The operator indicated that currently he is using the MMOS for system checks.

Name	Level of Certification	Years of Experience	Education Requirement	Reports To	Comments
Archie Arey (Water plant operator)	Level I*	15	Met	Community Facilities Manager, PWS - Inuvik	Sampling/testing, operating and maintaining subsystems and routine checks
Pat Kasook (Casual)	-	-	-	Water plant operator	Help out with the operations.

Table 5 Community Water System Operational Staff and Related Training

7.11 Training Requirements

- *The operator has completed his Introduction to Water and Sanitation training in February of 1993 and Level I Water Treatment Plant Operations in March of 1994. However, because he did not keep up with his continuing education units, he will need to be certified again. The plant operator is currently working on challenging the Class I examination and working toward his Level II certification.
- The operator indicated that he has had training in WHMIS and Transportation of Dangerous Goods.

7.12 Workplace Safety

- Material Data Safety Sheets were not available. **Recommend MSDS be posted in the water plant.**
- The eyewash station is located next to the water quality testing station. Other safety supplies such as gloves, aprons and masks are also available to the operators. **Recommend safety glasses be provided to the operator.**
- Refer to Sections 7.5 & 7.6 for fire extinguisher information.

7.13 Maintenance Management Systems

- Currently, there is a computer based MMOS set up for the water plant operation in PWS's office in Inuvik. Work orders relate to the water plant operation are generated in Inuvik's office and sent to the water plant operator including daily checks, weekly checks and monthly checks. PWS would hire contractors to carry out annual checks on the mechanical/electrical systems.

- O & M manuals are kept in the plant as well as in the office. However, they have not been kept to date. **Recommend the O & M manuals be verified to ensure all information are in order and up to date.**

7.14 Emergency/Contingency Planning

7.14.1. Loss of Water Supply Due to Intake Problems

- The operator indicated that he never had a frozen intake problem before but he would contact PWS in Inuvik for assistance if that happened.
- They would also flush the intake if the intakes were plugged due to sediments to restore supply to the water plant.

7.14.2. Loss of Process Pumps

- The operator indicated that he has a spare intake pump that he can use. He is also switching the two intake pumps on a regular basis so as to even out the wear and tear on the pumps.
- The spare pumps that the water plant has in stock are chlorine pump, alum pump and polymer pump.

7.15 Water Distribution

- The SAO was sick and the Works Foreman was not available for an interview during the review. Subsequent discussions with the SAO over the telephone suggested that there were about 760 people and about 84 private houses in the community. The SAO also noted that there were about 130 GNWT units and 10 commercial buildings. At present, the hamlet has a 5 year contract with a contractor to deliver water. The contractor delivers water seven days per week and about 9 loads a day on average. The contractor has three water trucks, one was purchased in 2001, one was purchased in 1998 and the third one was purchased around 1992. See Section 11.0, Photo 62. The two older trucks have 10,000L aluminium tanks and the newer truck has a 16,000L epoxy coated steel tank. At the review, the contractor indicated that he is using the 1998 truck to deliver water and the other two trucks serve as backups (with the 2001 truck contracted out to an oil company for water delivery).
- According to the contractor, Sunday is usually the busiest day averaged about 12 loads and after hour call out is very seldom. The water delivery schedule normally starts at 8am and ends at 4pm. The contractor indicated that their contract is based on water delivery only and does not include water sampling and testing or batch chlorination. **Recommend the community considers adding water sampling and testing and batch chlorination requirements to the contract upon renewal.**
- The water rates are set up as follows:

Economic rate	¢0.023/L
Commercial rate	¢0.0044/L (¢0.0052/L effective April 1,03 for first 90% consumption, remaining 10% is at economic rate)

- The truckfill facility is located inside the water treatment facility. See Section 11.0, Photos 17 & 89 - 92.
- All water use are metered and ticketed.

- The water trucks are usually cleaned twice per year**.**
- The community has also been using treated water fill the swimming pool in the summer about 3 loads per day**.**

7.16 Household Water Tanks

- For private homes, residents are responsible for cleaning their own water tanks. According to the plant operator, most homes have 300 gal upright HDPE tanks. Some homes have low profile tank in the crawl space.
- The hamlet cleans its own tank in the hamlet office once a year. Housing Authority cleans their house tanks once a year and PWS cleans buildings under their care once a year. **Recommend the community works with both HSS and MACA to promote public awareness the importance of regular tank cleaning.**
- The plant operator takes sample once a week as per EHO's instructions, bacteriological test results are sent to the local EHO for information and action if necessary**.** The community and PWS recieve results only when there is a problem. **Recommend the community works with MACA and H&SS to review the requirement of at least one random sample from private homes at least once a month to confirm the bacteriological quality of the water in the tanks. Consideration should include setting up an on-site testing facility such as Colilert P/A system for total coliform and e-coli.**

8. GAP ANALYSIS

The gap analysis shown in Table 6 highlights deficiencies in the existing water supply system. It is the intention of the GNWT to review and update the gap analysis annually.

AREA	GAP ANALYSIS
Roles and Responsibilities	• Links between agencies monitoring the environment (raw water source) and those responsible for providing drinking water are weak to non-existent.
Infrastructure Review	• The major concern is with the process piping and chemical mixing problem as identified in Sections 7.
Operations and Maintenance Review	• Refer to Sections 7 for recommendations to process controls and piping modifications. • Currently, the water plant does not have a certified Class II operator but PW&S is working closely with the School of Community Government to provide training to the operator for obtaining the proper certification. • O & M manuals need to be updated. • Currently, the water plant operator collects all water samples including water truck and public buildings even though they are outside PWS responsibilities. A proper sampling and testing protocol should be established to clarify roles and responsibilities of sampling, testing and reporting.

Table 6 Gap Analysis

9. RECOMMENDED COMMUNITY ACTION PLAN

Table 7 suggests a recommended action plan for the community. GNWT assistance may be required in some cases. Progress on the action plan will be reviewed annually.

#	RECOMMENDED ACTION PLAN	PRIORITY	TIME FRAME	LEAD
1	Section 7.16: continue discussions with EHO and MACA on public education regarding the cleaning of household water tanks and review sampling and testing requirements for bacteriological testing for household tanks.	High	Medium term & On-going	Community
2	Section 7.3.8: consider adding heat to the garage to allow a water truck to be filled and parked after each delivery day for fire protection purpose.	Medium	Medium term	Community
3	Section 7.15: consider adding water sampling and testing and batch chlorination requirements to the water haul contract upon renewal.	Medium	Medium term	Community
4	Section 7.9.2: work with MACA and H&SS to clarify roles and responsibilities of sampling and testing.	Medium	Medium term	Community

Table 7 Recommended Community Action Plan

10. RECOMMENDED GNWT ACTION PLAN

Table 8 suggests a recommended action plan for the GNWT to help improve the overall water supply system efficiency. The GNWT Interdepartmental Working Group on Drinking Water, together with the NWT Drinking Water Committee, intends to review progress on, and update the action plan on an annual basis.

#	RECOMMENDED ACTION PLAN	PRIORITY	TIME FRAME	LEAD
1	Section 7.11: Water plant operator certification.	High	Medium term	PW&S
2	Section 7.12: ▪ MSDS be posted in the water plant. ▪ Safety glasses be provided to the operator.	High	Short term	PW&S
3	Section 7.3.1: ▪ Restore the auto desludge feature in the control panel. ▪ Consider either changing the 50mm motorized valve to a 75mm motorized valve or adding a motorized actuator to the 75mm manually operated dump valve and interlocking the valve to the FTC control panel ▪ Extending the drain line from the FTC flocculation chamber to low lying areas behind the building.	Medium	Medium term	PW&S
4	Section 7.3.2: ▪ Add a static mixer c/w sampling point @ the FTC unit to improve chemical coagulation process and facilitate jar test procedures. ▪ Restore the polymer feed system in preparation for spring runoffs.	Medium	Medium term	PW&S
5	Section 7.3.3: ▪ Add hour meters to the backwash and effluent pump motors in the Waterboy unit to monitor motor run time. Section 7.3.3.1: ▪ Add a static mixer c/w sampling point in the Waterboy unit to improve chemical coagulation process and facilitate jar test procedures.	Medium	Medium term	PW&S
6	Section 7.3.6: monitor filter bed condition.	Medium	On-going	PW&S
7	Section 7.3.7: ▪ Repair indication lights on the Waterboy control panel and the headloss gauge ▪ Provide spare effluent and backwash pumps.	Medium	Medium term	PW&S
8	Section 7.3.8: ▪ Repair indication lights on the Waterboy control panel and the headloss gauge ▪ Provide spare effluent and backwash pumps.	Medium	Medium term	PW&S
9	Section 7.4: verify the level gauge for the outside storage tanks.	Medium	Medium term	PW&S
10	Sections 7.5 & 7.6: verify the condition of fire extinguishers and relocate the two in the water plant for easy access	Medium	Medium term	PW&S
11	Sections 7.5.1: provision of a spare truckfill pump.	Medium	Medium term	PW&S

#	RECOMMENDED ACTION PLAN	PRIORITY	TIME FRAME	LEAD
12	Section 7.8: ▪ Change existing metallic pipe to PVC pipes wherever possible. ▪ Provide labels for equipment Ids and flow directions for O & M purposes.	Medium	Medium term	PW&S
13	Section 7.8.1: verify the operation of the genset system, install a drip pan and a battery blanket.	Medium	Medium term	PW&S
14	Section 7.8.2: check the operation of unit heater #1 in the water plant. Review the burner problem in the boiler system with MACA for planning purposes.	Medium	Medium term	PW&S
15	Section 7.8.3: ▪ Verify the freeze protection system, repair if required. ▪ Install pressure gauges, hour meters and a flow meter.	Medium	Medium term	PW&S
16	Section 7.8.5: ▪ Repair level gauge for the fuel system in the WTP and provide low fuel alarms for the WTP and the genset fuel systems. ▪ Verify the following alarm conditions in the WTP: low boiler temperature, low flow heat exchanger, genset fails, water tank low temperature set point (water storage tanks), building high and low temperature. ▪ Consider adding building high temperature alarm to the WTP and building high/low temperature alarms to the genset building and the new storage building.	Medium	Medium term	PW&S
17	Section 7.9.1: ▪ Provide various laboratory equipment as per section. ▪ Review water sampling/testing requirements to follow best practice as per section.	Medium	Short term	PW&S
18	Section 7.9.2: ▪ Review roles and responsibilities for bacteriological sampling/testing with MACA, H&SS, PWS and the community. ▪ Trip report completed by EHO be forwarded to MACA and PWS for information	Medium	Medium term & On-going	H&SS
19	Section 7.9.3: improve community and interdepartmental reporting on Water License annual inspection. MACA will work with the community to forward the annual inspection report to H&SS and PW&S.	Medium	On-going	MACA
20	Section 7.13: update existing O & M manual to reflect modifications done to date.	Medium	Medium term	PW&S
21	Establish a reporting structure to alert the community and GNWT to watershed issues that may affect raw water supply. H&SS, through the Drinking Water Committee, will invite Federal and Territorial Departments responsible for watershed management to a round table discussion on reporting links.	Medium	Medium term	H&SS

#	RECOMMENDED ACTION PLAN	PRIORITY	TIME FRAME	LEAD
22	Establish links with Federal agencies to facilitate H&SS legislated input on regulation of development in the watershed. H&SS HQ will work with the appropriate Federal Agencies on watershed development issues, and will co-ordinate with MACA, PW&S and the community to ensure any concerns are addressed.	Medium	Long term	H&SS
23	Establish links between GNWT departments to facilitate H&SS input on any planning studies or projects (including modifications to existing facilities) related to water and waste or development in the watershed. MACA HQ to review Capital Plan with H&SS HQ annually. H&SS HQ will ensure Regional EHOs are informed of projects in their respective areas.	Medium	Medium term & On-going	MACA
25	Section 7.8.4: replace the missing lamp in the genset building.	Low	short term	PW&S

Table 8 Recommended GNWT Action Plan

11. APPENDIX A (PHOTOS)

11.1 Raw Water Source

Photo 1 Peel River.

11.2 Water Supply System

Photo 2 Intake lines.

Photo 3 Raw water intakes @ water plant.

Photo 4 Raw water intake @ water plant.

Photo 5 Level gauge for storage tanks.

11.3 Water Treatment Plant

Photo 6 Water Treatment Plant.

Photo 7 Water Treatment Plant.

Photo 8 Winch for pulling intake pumps.

Photo 9 Paddlewheel flowmeter – raw water.

Photo 10 Flow/totalizer meter – truckfill system.

Photo 11 Flow totalizer meter – raw water

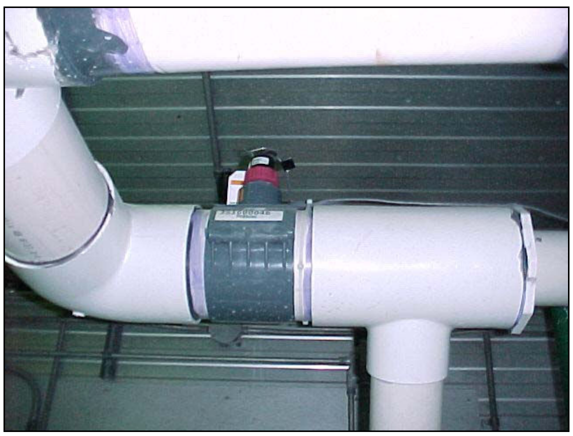

Photo 12 Intake backwash flow sensor.

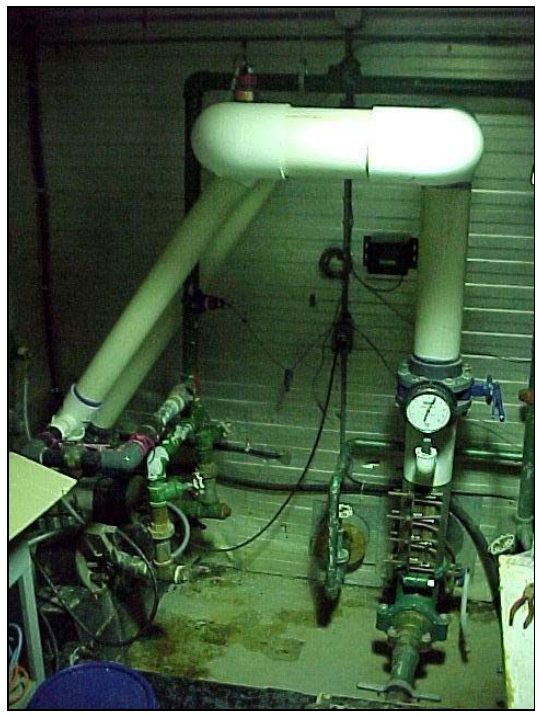

Photo 13 Intake backwash system.

Photo 14 Heat tempering system - process pipings.

Photo 15 Freeze protection – recirculation system.

Photo 16 Recirculation system to/from outside tanks.

Photo 17 Truckfill pump and pipe c/w flow sensor.

Photo 18 Domestic cold water system.

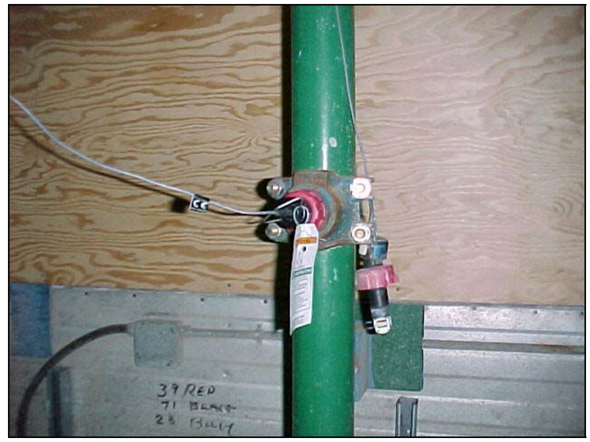

Photo 19 Truckfill flow sensor.

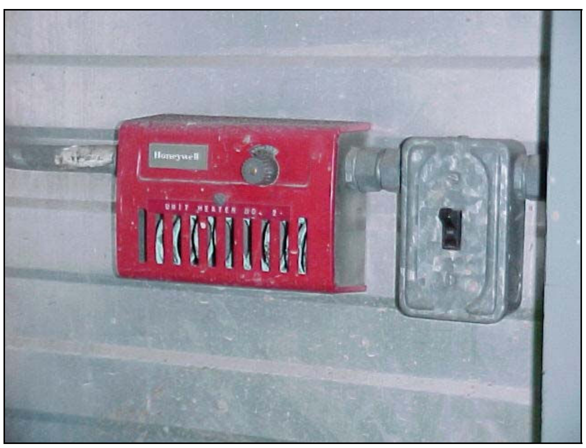

Photo 20 Low tempersture alarm – water plant.

Photo 21 Unit heater – water plant.

Photo 22 Boiler system.

Photo 23 Boiler system with process pipings.

Photo 24 Day tank for the boiler system.

Photo 25 Fuel tank for the water plant.

Photo 26 Main disconnect @ water plant.

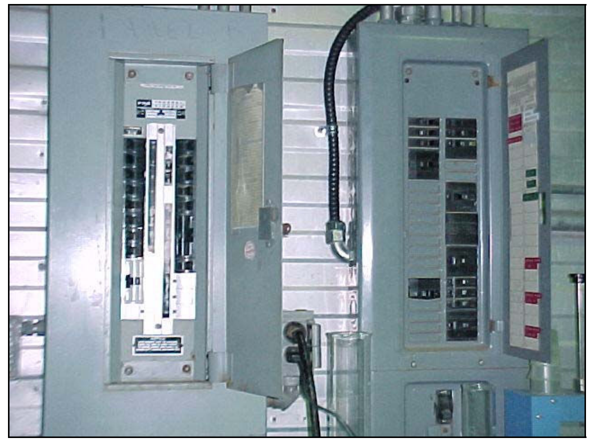

Photo 27 Electrical panels.

Photo 28 Heat trace controllers.

Photo 29 Recirculation pump motor panels – freeze protection

Photo 30 Intake pump motor control panels.

Photo 31 Truckfill pump motor control panel

Photo 32 Thermostat & boiler recirculation pump switches

Photo 33 Auto transfer switch for the genset.

Photo 34 Auto transfer switch.

11.4 Water Treatment System

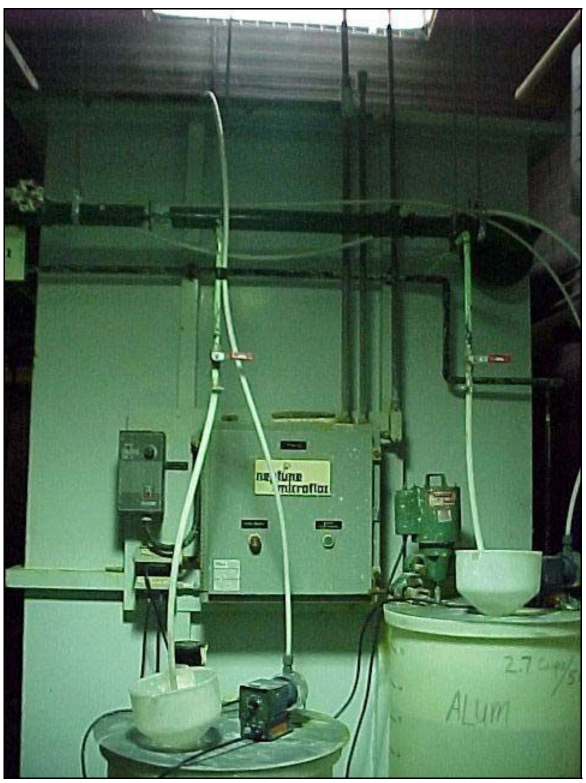

Photo 35 FTC control panel & chemical injection point.

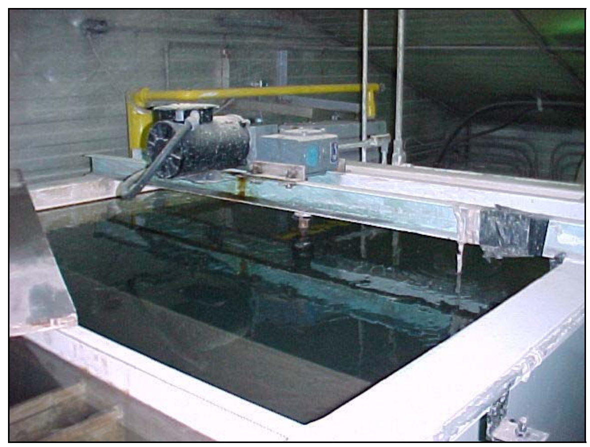

Photo 36 Flocculation chamber in the FTC unit.

Photo 37 Clarifier in the FTC unit.

Photo 38 Raw water pipe to FTC unit.

Photo 39 Neptune Microfloc Waterfloc.

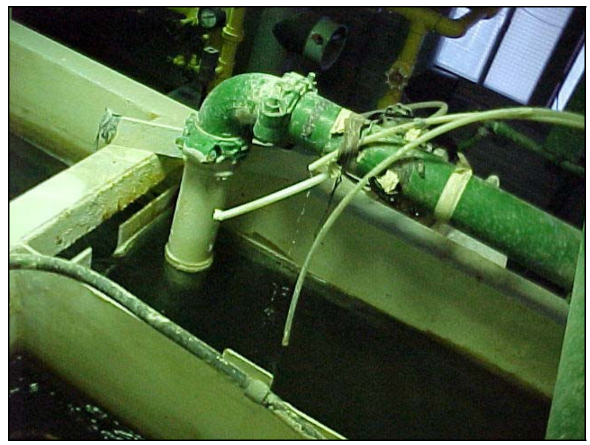

Photo 40 Flash mix chamber @ Waterboy with polymer and alum injection.

Photo 41 Flocculation chemaber.

Photo 42 Clarifier.

Photo 43 Filter bed.

Photo 44 WTP control panel.

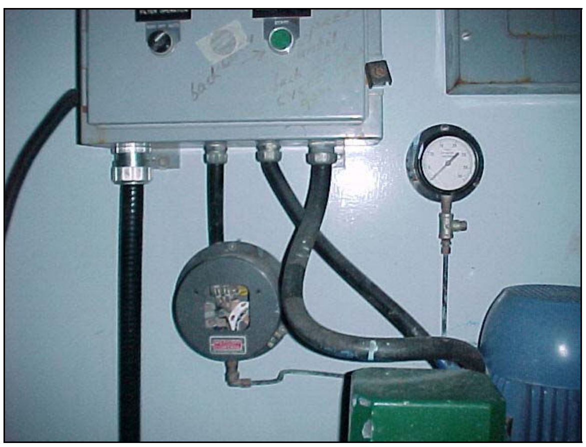

Photo 45 Headloss gauge below the Control panel.

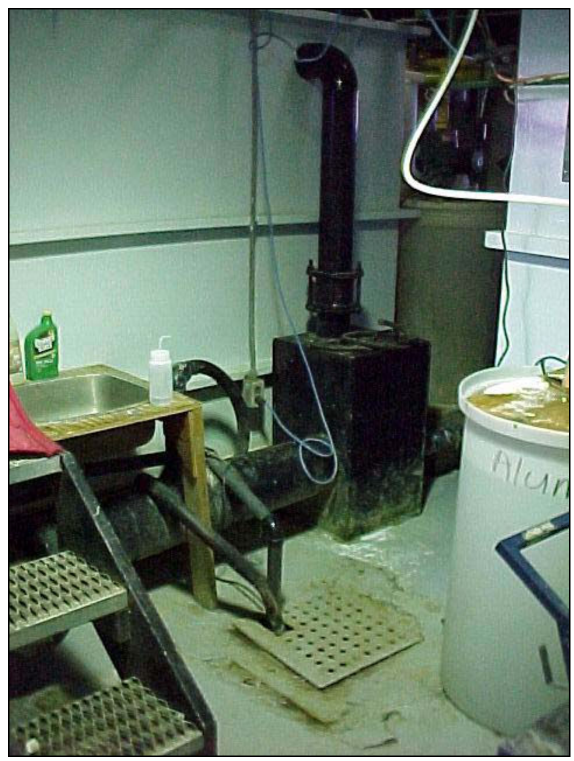

Photo 46 Waste line to remove backwash water.

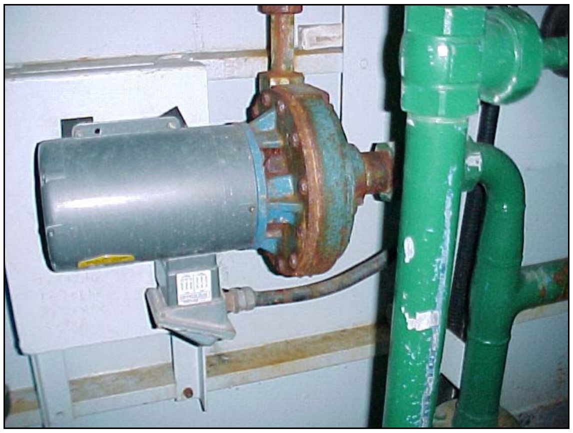

Photo 47 Waterboy effluent pump.

Photo 48 Waterboy backwash pump.

Photo 49 Powdered chlorine feed system @ Waterboy.

Photo 50 Polymer chemical system for FTC .

Photo 51 Polymer injection system for Waterboy.

Photo 52 Powdered alum injection systems (FTC & Waterboy).

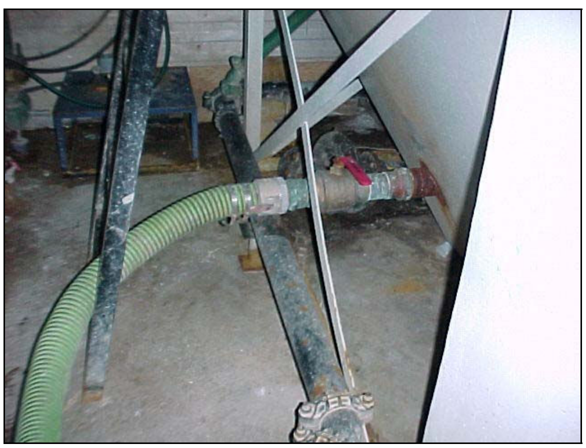

Photo 53 FTC clarifier manual dump valve & waste line.

Photo 54 Waste line from FTC clarifier to waste disposal system..

Photo 55 FTC flocculation chamber drain line to outside of WTP..

Photo 56 Building waste sump.

Photo 57 HDPE waste line to Peel River.

11.5 Treated Water Storage

Photo 58 Outside storage tanks – old.

Photo 59 New storage tanks.

11.6 Alarms

Photo 60 Audio alarm outside WTP.

Photo 61 Main alarm panel inside WTP.

11.7 Generator Building

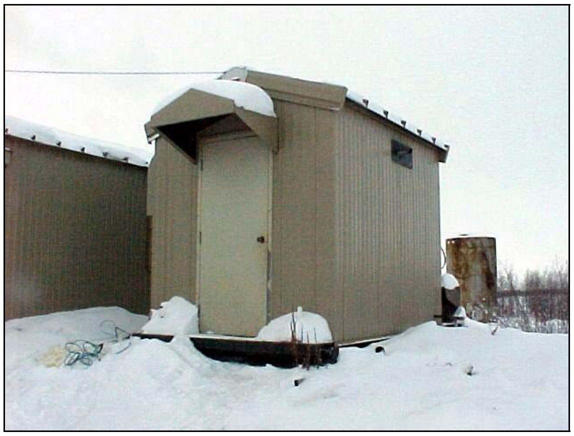

Photo 62 Genset building.

Photo 63 Genset.

Photo 64 Battery charger.

Photo 65 Electric heater for building heat, electrical sub-panel and thermostat.

Photo 66 Recirculation

Photo 67 Fresh air intake.

Photo 68 Genset engine exhaust.

Photo 69 Emergency light.

Photo 70 Genset engine and battery.

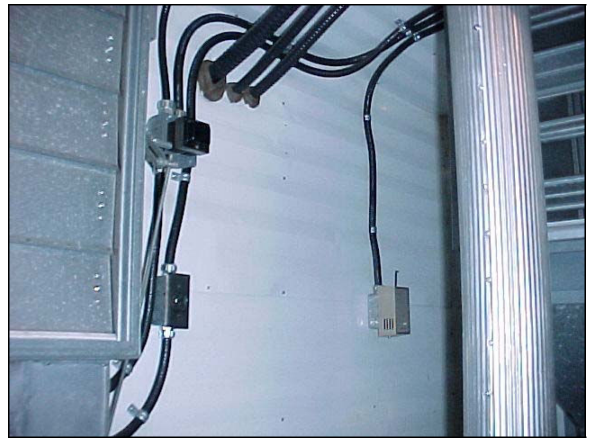

Photo 71 Thermometer controller

Photo 72 Missing light bulb.

Photo 73 Fire extinguisher.

Photo 74 Fuel tank & cooling air exhaust for genset building.

11.8 New Storage Building

Photo 75 New storage building.

Photo 76 Side entrance with security light.

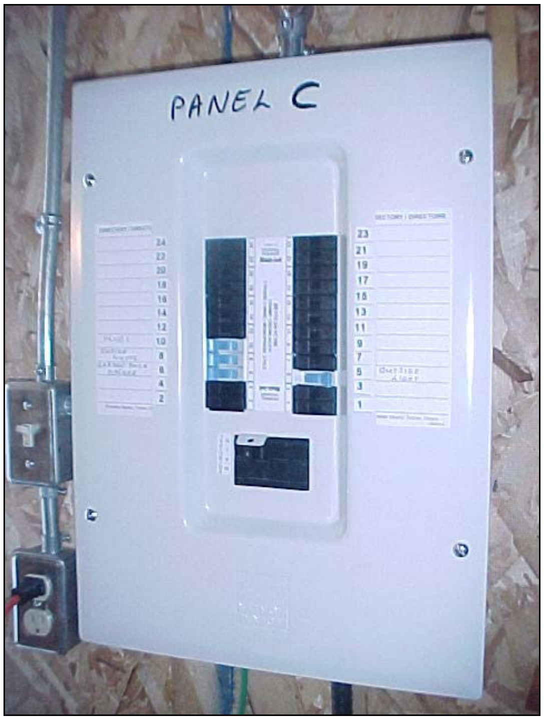

Photo 77 Electrical panel.

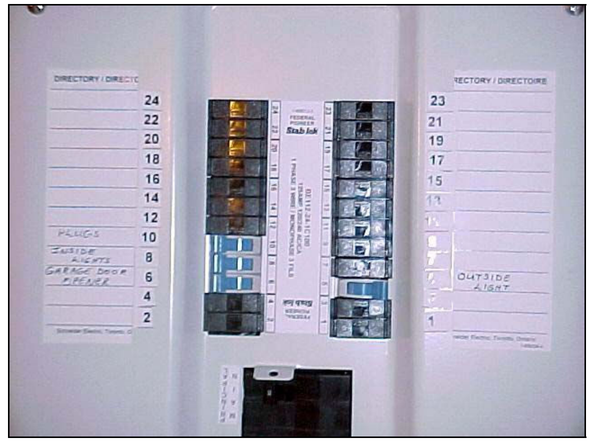

Photo 78 Electrical panel C.

Photo 79 Interior lights & drip furnace.

Photo 80 Garage door.

Photo 81 Fuel tank.

11.9 Sampling and Testing (WTP)

Photo 82 Jar test station..

Photo 83 Eyewash station & emergency light..

Photo 84 Water quality testing.

Photo 85 Log book for data recording.

Photo 86 Wash sink next to Waterboy.

Photo 87 Chemical storage.

11.10 Distribution

Photo 88 Outside truckfill panel.

Photo 89 Truckfill arm – modification under way.

Photo 90 Truckfill with rigid hose prior to modifications.

Photo 91 Truckfill operation.

Photo 92 Truckfill operation.