3. Infrastructure Descriptions

This section provides an overview of Tuktoyaktuk's water supply and waste disposal systems. See **Figure 1** for the locations of the water and waste management infrastructure described below.

3.1 Water Supply

The Hamlet's potable water supply system consists of the following elements:

- seasonal raw water supply from Kudlak Lake,
- raw water storage reservoir,
- water treatment facility and truckfill station, and
- trucked water delivery.

See **Figure 2** for the water supply site plan and **Figure 3** for water supply photographs.

3.1.1 Seasonal Raw Water Supply

Tuktoyaktuk's raw water comes from Kudlak Lake, a shallow lake located approximately 5.5 km east of the community centre and 4.5 km east of the raw water reservoir. Tuktoyaktuk's raw supply water is of good chemical quality for domestic use. The water is clear, moderately hard, well buffered, slightly alkaline, and has a moderate amount of dissolved solids.

In winter, the lake freezes deep enough that obtaining water from the lake is difficult and water quality is poor. The Hamlet uses a raw water storage reservoir to hold water for use during winter months.

The community obtains water from the lake via a high-density polyethylene pipeline. This intake line is partially submerged under Tuktoyaktuk Harbour and runs along the ground surface for the overland distance to the raw water reservoir. The intake line was replaced in October 2006 with a new 200 mm (8") diameter pipe after the old 100 mm diameter pipeline broke in the summer of 2006.

The water pumphouse at Kudlak Lake was relocated south of the previous location in April 2007.

3.1.2 Water Storage Reservoir

The water reservoir, built in 1984, is an earth structure with a capacity of approximately 90,300 m^3. The reservoir characteristics are presented in **Table 2** below.

Figure 1. Facility Locations

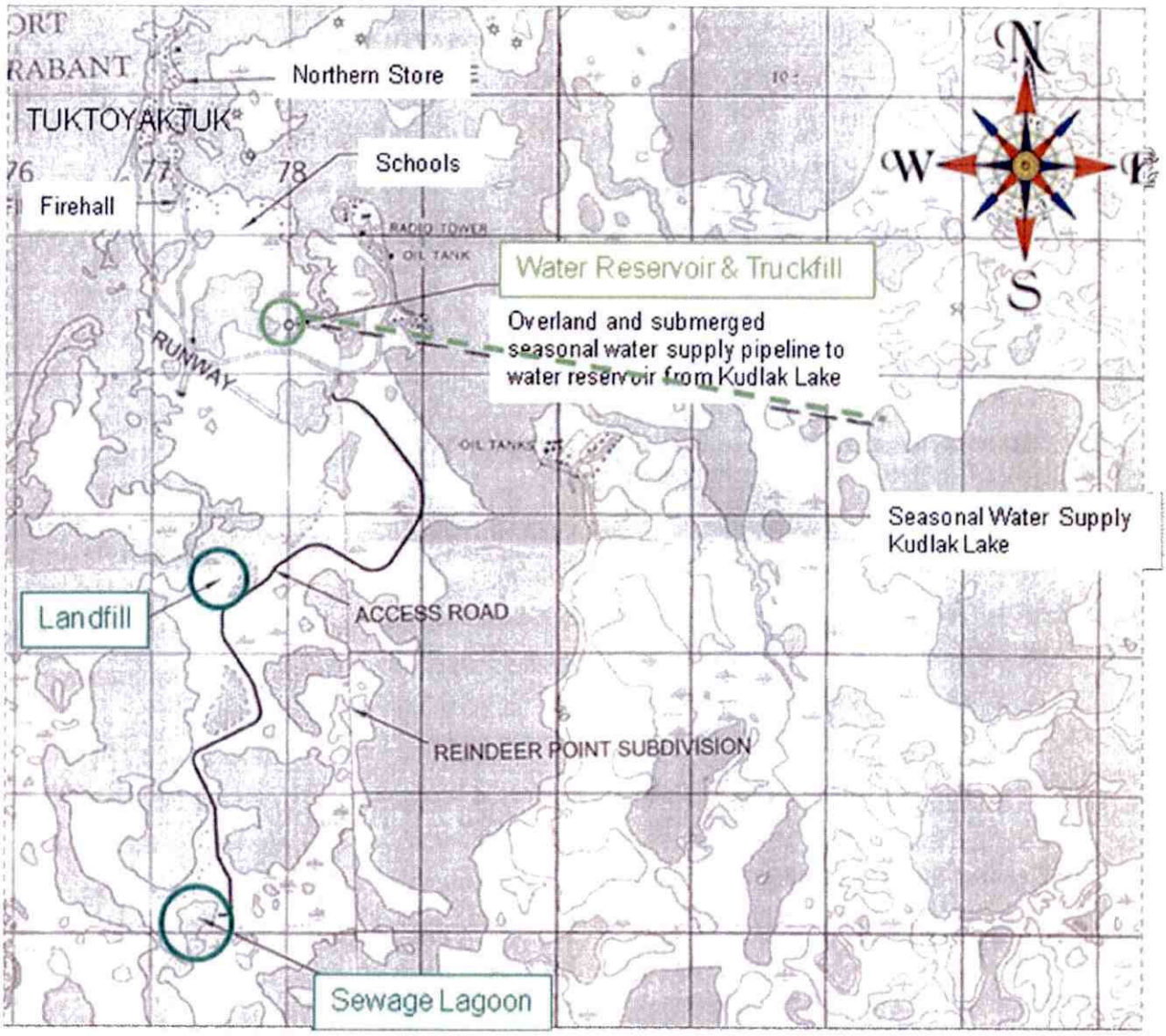
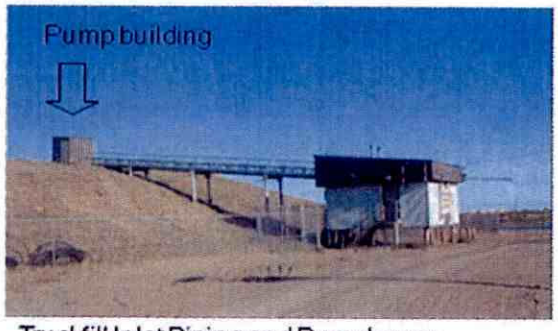


Figure 2. Water Supply Site Plan

Figure 3. Water Supply Photographs

Water reservoir



Truckfill Inlet Piping and Pumphouse (without new building)

Old Pipeline from Kudlak Lake

Water Treatment Plant and Truckfill building

Table 2: Tuktoyaktuk Water Reservoir Characteristics

Characteristic	Description
Maximum Reservoir Capacity	94,300 m^3
Usable Volume Under Ice	53,100 m^3
Maximum Water Depth	7.0 m
Design Ice Thickness	2.1 m
Dead Storage Depth	0.5 m
Freeboard	1.3 m
Full Reservoir Water Surface Dimension	102 m in diameter
Inside Slope	4:1
Liner	0.8 mm CPE with sand cover

The design capacity of the water reservoir is equivalent to consumption by 1,900 community residents and 250 camp residents.

The raw water storage reservoir is filled to capacity in the late summer of each year. This filling procedure usually takes about a week of continuous pumping of water from Kudlak Lake.

3.1.3 Water Treatment and Truckfill Station

Prior to 2009, water was treated by chlorinating with calcium hypochlorite (powdered form of chlorine) during truckfill.

A new water treatment plant and truckfill station was constructed in 2009 by Corix Water Systems. The new water treatment process includes 50 micron cartridge filters, a pressure filter, UV reactors applying a 40 mJ/cm^2 dose, and a chlorine contact chamber.

3.1.4 Distribution

Water is distributed throughout the community using water trucks operated by a private contractor. Two trucks operate seven days per week, filling individual building water tanks. Most of the existing houses have small tanks that are filled daily. Each truck has a capacity of 15, 890 L. Water deliveries are metered at the truck.

3.2 Sanitary Sewage Facility

Tuktoyaktuk's sewage is collected using trucked pumpout services. The sewage is treated at a sewage lagoon, shown in **Figures 4** and **5**, which is located approximately 3.9 km due south of the Airport Terminal Building.

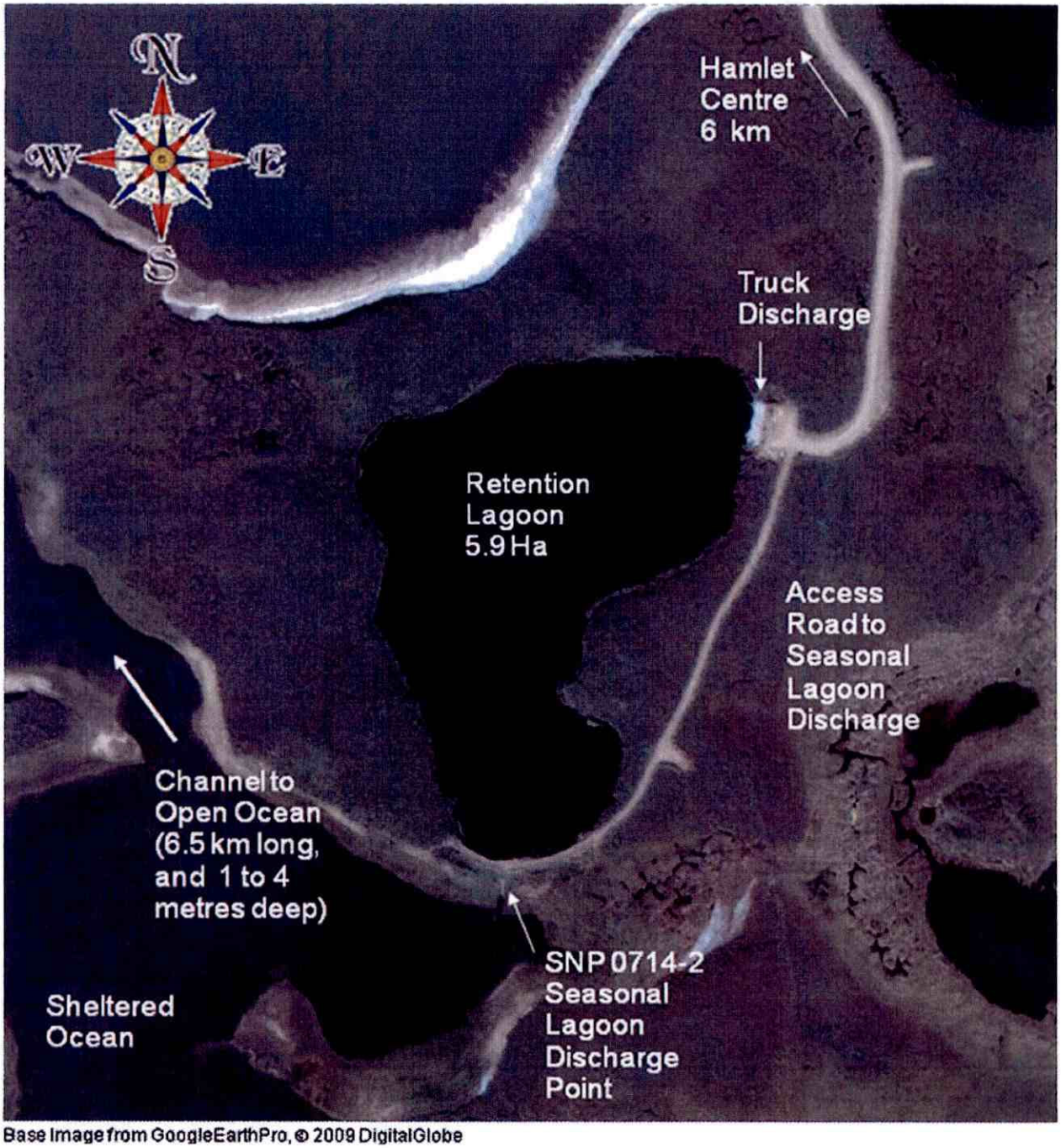
3.2.1 Trucked Sewage Pumpout

Sewage is collected by a local contractor using 15,890 L vacuum trucks. Two trucks operate seven days per week. The sewage is transferred from holding tanks in each building to a retention lagoon approximately 5 km south of the community via an all-weather gravel road.

3.2.2 Lagoon Access Road and Sewage Truck Discharge Area

The access road to the sewage lagoon is an all-weather gravel road which exits the Reindeer Point subdivision access road. The access road leads to the truck discharge area at the north end of the lagoon. A seasonal access road extends to the south end of the lagoon.

Figure 4. Sewage Lagoon Site Plan



Base Image from GoogleEarthPro, © 2009 DigitalGlobe

Figure 5a. Sewage Lagoon Photographs

View 1

View 2

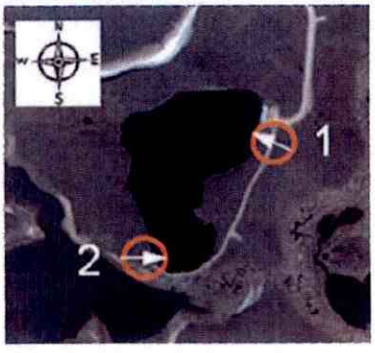


Figure 5b. Sewage Lagoon Photographs

View 3 – Discharge Structure in 2009

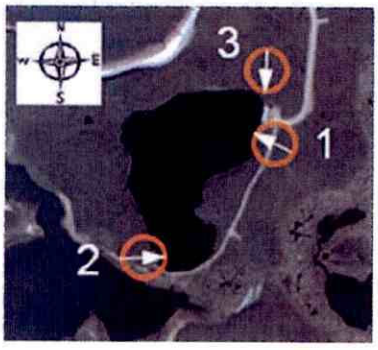
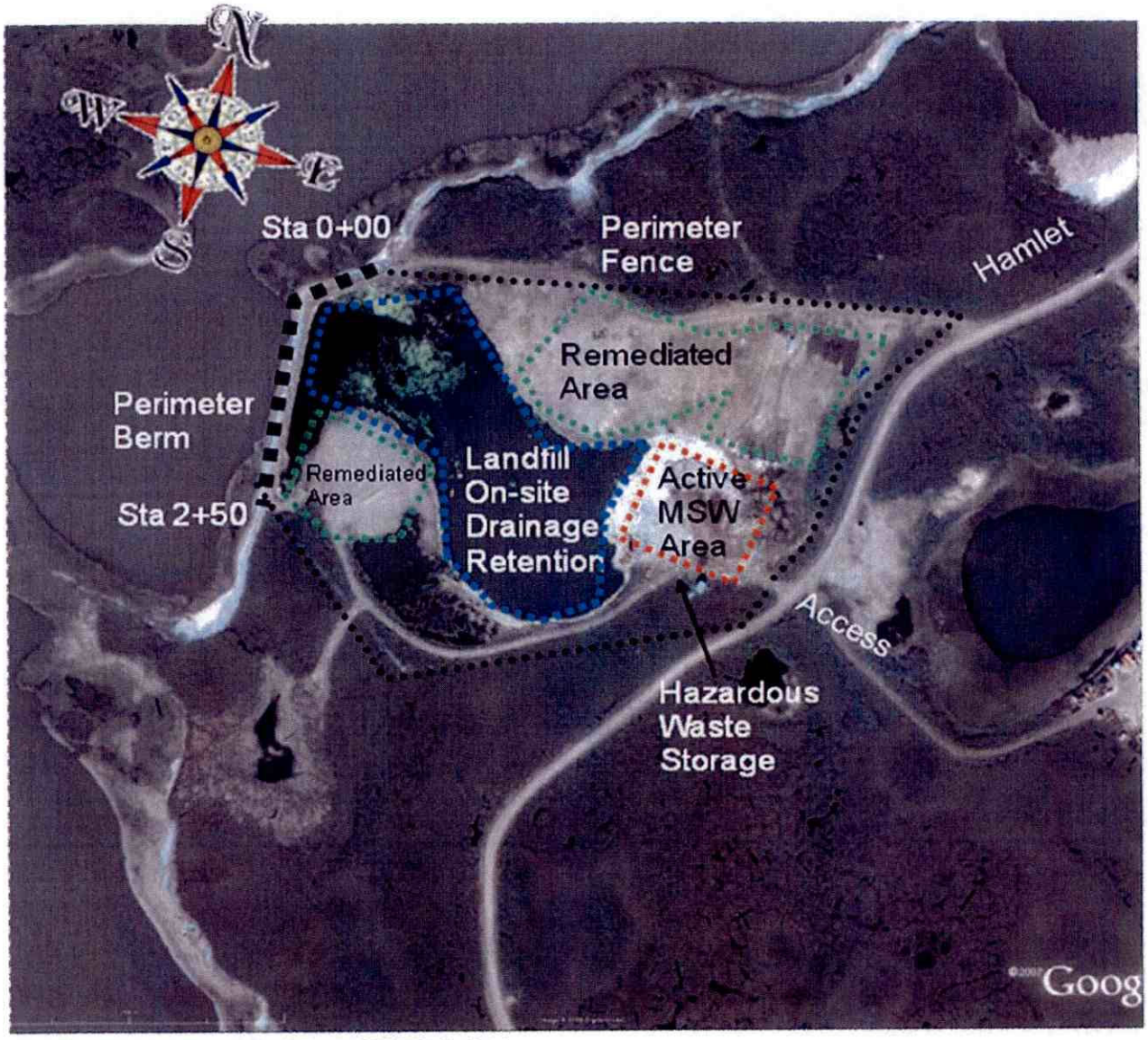


Figure 6. Landfill Site Plan

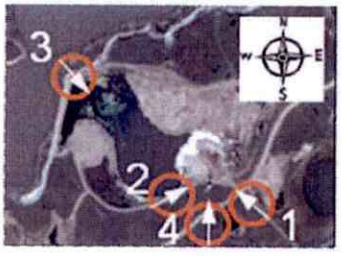


Base Image from GoogleEarthPro, © 2009 DigitalGlobe

Figure 7a. Landfill Photographs

View 1: Entrance to Municipal Solid Waste (MSW) Area

View 2: Active Municipal Solid Waste (MSW) Area



View 3: Perimeter berm

3.3.2 Solid Waste Disposal Facility

The Tuktoyaktuk Solid Waste Disposal site is a large fenced-in facility, approximately 3 km south of the Hamlet. It has been in operation since the early 1970s as a replacement to the dump formerly located at the end of the community airstrip. The facility covers an area of approximately 20 hectares, but not all of the area is currently in use.

The municipal waste area occupies an area approximately 70 m wide and 50 m long. The landfill is operated with limited compaction and limited cover.

The domestic waste area has a limited area for household hazardous waste storage, and no designated areas for waste separation. The municipal waste area is used by both the community and the local industries with no direct fee charged. There is no permanent supervision of the site, and no records of the quantities and types of waste are kept.

The Hamlet was operating a bulky metal waste area approximately 100 m wide by 100 m long. This area was remediated with complete cover in 2004. There is no designated metal waste area currently at the site.

Several old landfill areas were remediated in the north, southwest and east portions of the landfill site. These areas have been covered, with limited vegetative cover in the north and southwest areas and substantial vegetative cover in the east area.

3.3.3 Solid Waste Disposal Facility On-site Drainage Retention and Control Berm

Most of the surface area of the Solid Waste Disposal facility is covered by a lagoon containing surface runoff from the landfill. The surface runoff lagoon is retained by a 250 m long gravel and clay berm on the eastern edge of the landfill site.

The berm does not have any discharge control structure, so drainage continually accumulates. The perimeter berm also prevents the ingress of the ocean.

3.3.4 Water Pollution

The pollution factors associated with the landfill include surface water pollution, and subsurface water pollution. Surface water pollution is a concern which is managed with the on-site runoff collection within the landfill area.

3.3.5 Landfill Site Management

It has been suggested in the studies that the landfill site needs management improvements. The most significant of these improvements is that the municipal waste area requires management (signs and barricades) to limit the waste disposal area into a more manageable (smaller) area.

TUKTOYAKTUK WATER PLANT UPGRADE

RESERVOIR FILL SYSTEM

Raw water drawn from Kudlak Lake is stored in 100,500 m3 circular, single cell, above ground earthen reservoir. The reservoir has a total depth of 8.3 m, 1.2 m of which is for dead storage, 1.3 m for freeboard, 2.1 m for ice formation and 3.7 m for water storage. The active storage capacity of the reservoir is approximately 90,300 m3. The reservoir is fenced and lined with a 30 mm un-reinforced corrugated polyethylene liner. The reservoir is filled once per year, usually in September, via a 250 mm polyethylene reservoir fill line and a diesel pump.

OVERVIEW OF NEW SYSTEM

The new Water Treatment Plant is designed to treat raw water for the removal of impurities and to provide a high quality effluent for potable and domestic use. The treatment process is a completely automatic operation. The new plant consists of two parallel trains, each consisting of a pressure filter and ultraviolet (UV) disinfection reactor. The suspended solids are separated from the water as it flows through the pressure filter. The filtered water proceeds to the UV reactors where it is exposed to UV light. The UV light provides a 3 log inactivation of protozoa found in the water. As the treated water travels to the water storage tank, it is injected with sodium hypochlorite to further disinfect any other pathogens. Normally, plant operation is automatic but it can be switched to manual by the HOA switch located on the plant control panel. The design details of treatment system are given in the following table.

Overall	Nominal Design Flow:	530 L/min (140 US gpm)
	Fire Flow:	1000 L/min (264 US gpm)
	Truck Fill Flow:	1000 L/min (264 US gpm)
Pressure Filter:	Nominal Design Flow per Unit:	530 L/min (140 US gpm)
	Maximum Flow per Unit:	530 L/min (140 US gpm)
	No. of Filters:	2 (1 duty; 1 standby)
UV Reactor:	Nominal Design Flow per Unit:	530 L/min (140 US gpm)
	Maximum Flow per Unit:	1250 L/min (330 US gpm)
	No. of Units:	2 (1 duty; 1 standby)
	Log Removal for Cysts/Oocyst:	3
Chlorine Disinfection:	Virus Credit from Chlorine Disinfection:	4 log
	Minimum Design Chlorine CT:	12 mg min/L (between 0.5-30°C at pH 6-8)

Raw water is drawn from the Reservoir by the intake pump and pipeline, entering the Water Treatment Plant. The intake pumps provide water to the filter and UV treatment train and are controlled by the level of the water in the treated water storage tank. Only one supply pump is in operation at a given time. An air release/vacuum release valve, situated at the highest point between the intake pipes in the pump service building, emit air from the pipe and allow the raw water piping to drain down between pumping cycles.

Treated water is stored in a 29,123 L (7,693 US gallons) aluminum water storage tank. The water storage tank is divided into four chambers using baffles which acts as a clearwell to provide the required contact time for chlorine disinfection.

TREATED WATER SUPPLY SYSTEM – TRUCK FILL

The truckfill system is started by the operator activating the On/Off button located on the truckfill arm panel (TFP). The operator can also access the start and stop of the truck fill operation from the main control panel located inside the water treatment plant. When the operator pushes the ON button, the system signals the truck fill pump to start. The Truckfill pump will turn off once the truckfill control is deactivated by the operator pressing the OFF button.

The truck fill pump transfers the treated water from the treated water tank to the truck and is initiated by the truck operator. Before entering the water truck, the treated water is analyzed to determine if there is sufficient chlorine residual in the water. During the operation of the truckfill system, additional chlorine is injected if required to maintain the FAC residual of 0.4 mg/L. This is to ensure that after 20 minutes, there is enough chlorine residual in the water truck before water is delivered to the community.

TREATED WATER SUPPLY SYSTEM – FIRE FLOW

Fire flow rate, provided by the supply pump(s), is 1000 L/min (264 US gpm) and set by the Fire Marshall. A control switch is located on the truckfill arm will be activated and provide chlorinated raw water to the water truck, by-passing the filtration and UV treatment units. This system will only be implemented in the event of a fire and by the plant operator.

WASTEWATER SYSTEM

During the production of potable water, various types of wastewater will be generated by the plant. Wastewater generated by the process includes:

- Pressure filter backwash water;
- Pressure filter rinse water;
- General housekeeping and cleaning of lab equipment

The backwash water supply is provided from the water storage tank. Typically, a single backwash is required per day for each operating filter (1 duty, 1 standby) at a flow rate of 594 L/min (157 US gpm) for duration of about 8 minutes. Only one filter is backwashed at a time while the other filter is still producing water.

The filter backwash and rinse water flows directly to the wastewater tank. The net storage capacity of the wastewater tank is 9,550 L. Constant overflow should be avoided by having more frequent wastewater hauling and/or recycling of wastewater. The wastewater tank will be periodically emptied for off-site disposal. A level transmitter inside the

All other housekeeping wastewater - wastewater from the process floor drains and UV reactor drain - are collected by gravity and directly sent to the sump pump tank. A float switch, situated in the sump pit, will monitor the level in the sump tank and initiate the sump pump to start automatically, transferring the wastewater to the Wastewater Storage Tank.

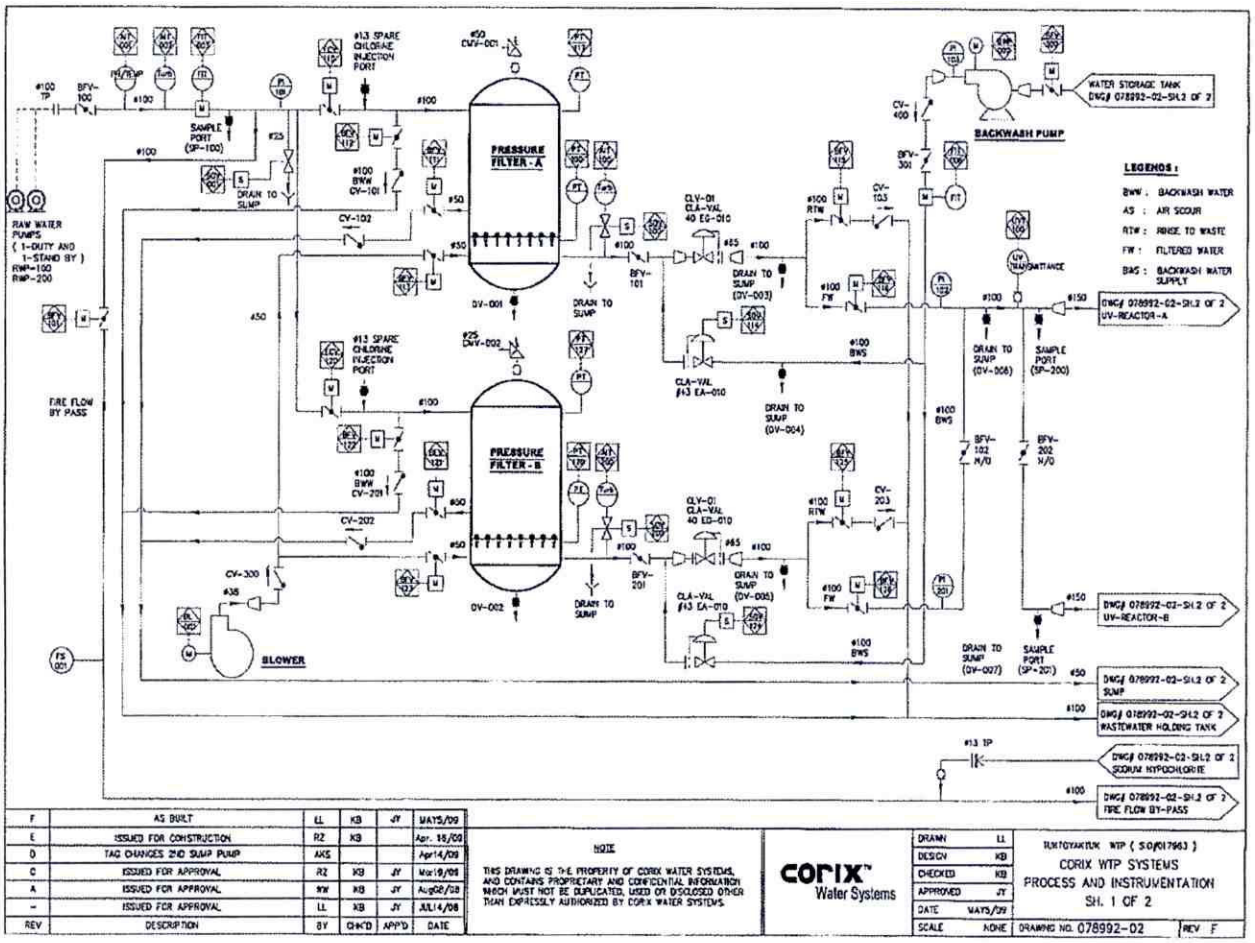
Wastewater Holding Tank will indicate when the tank is full and requires emptying. When the wastewater tank is full, it will automatically send an alarm to the Operator and will shut down the plant completely in order to avoid any further backwash water going into the tank. Only the plant will stop producing water (the truck fill operation and chlorine dosing will continue to operate) during times when the wastewater tank is full. The sump pump however, will not be stopped, as locking this pump out could result in the flooding of the entire plant. The sump pump will continue to pump water into the Wastewater Holding Tank and excess water will go out of the overflow line to the outside of the building.

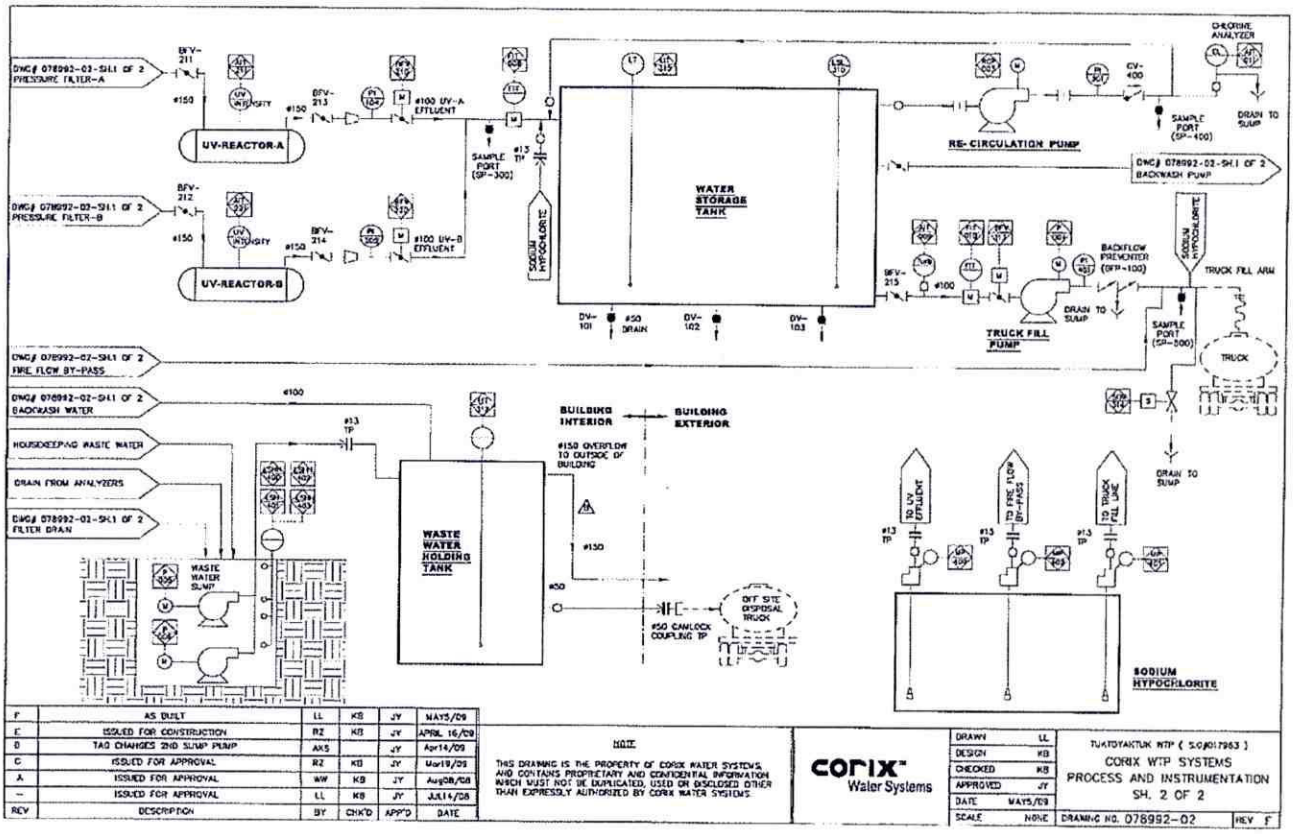
STANDBY DIESEL GENERATOR

A 50 kW diesel generator will be installed in water treatment plant to provide standby power. The diesel standby generator is design to provide power to all components in the water treatment plant.

Prime power is normally supplied by the power transmission line. During times when there is insufficient power supplied by the power utility service, such as if there is a disruption in the power lines, the automatic transfer switch 1 (ATS 1) will initiate the standby generator to start. ATS 1 will control the transfer of power from line power (Source 1) to generator power (Source 2). Once line power has returned, ATS 1 will switch back to Source 1, allow the generator to cool, and stop the generator.

PID OF NEW WATER TREATMENT PLANT





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E	ISSUED FOR CONSTRUCTION	RZ	KB	JY	APRIL 16/09
D	TAG CHANGES 2ND SUMP PUMP	AKS		JY	Apr14/09
C	ISSUED FOR APPROVAL	RZ	KB	JY	Mar19/09
A	ISSUED FOR APPROVAL	WW	KB	JY	Aug08/08
–	ISSUED FOR APPROVAL	LL	KB	JY	JULY4/08

NOTE

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DESIGN	KB
CHECKED	KB
APPROVED	JY
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SCALE	NONE

TUKTOYAKTUK WTP (S.O.#017963)

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