CE2 Engineers, Inc.

VILLAGE SAFE WATER TRIP REPORT

DATE: March 6-7, 2012 **REPORTER:** Paul Weisner, P.E.

LOCATION: Chefornak **PROJECT NO.:** AN10Q2 & 7
AN11NR4 & 9

Accompanied by: Susan Randlett, Village Safe Water

PURPOSE:

- Address sanitary survey requirements: Perform structural analysis of the deteriorated water treatment floor, and recommend urgency of repair, replacement, or abandonment.
- Examine existing City well adjacent to existing City water treatment, to provide instructions and specify parts needed; and make recommendations.
- Inspection relevant to the existing grant projects.
- Discuss the two sites for the City Washeteria with the land planner. Examine with respect to existing supplied City watering point loop water. Evaluate how the project goals can be met cost effectively, in view of the altered community infrastructure. Examine the possibility of locating a 20,000 gallon water storage tank adjacent to the Washeteria.
- Examine possible locations for a watering point for School-supplied UF/RO treated potable water.
- Investigate the space at the Clinic for an ozone disinfected washing machine for the Clinic to minimize the transmission of diseases.
- Examine existing watering points and conditions in order to formulate a plan for renovation and/or replacement.
- Observe existing "honeybucket lagoon dump and solid waste landfill.
- Formulate a plan for a wastewater lagoon based upon the inflow from the school and the proposed Washeteria. Discuss the possibility of landfilling compost waste disposal into a landfill.

CONTACTS:

City Administrator Bernard Mael
City maintenance person and water plant operator Tom Mael
IGAP Coordinator Kimberly Abraham
Land Planner Stan Nevak
City Clerk Alexandra Anderson
Gavin Dixon, Energy Auditor, ANTHC
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ACCOMPLISHMENTS (FINDINGS):

WATER TREATMENT PLANT

The existing water treatment plant is a structure that is showing its age and is almost at the end of its useful service life. The main problem of this structure is its deteriorating floor and center support beam. The floor is a series of structural panels transverse to the length of the building, consisting of ¾" plywood skins separated by 6" to 8" of urethane foam. Another layer of ¾" plywood was added to the panels on top of the floor. The floor panels were supported on 6" x 20 lb/ft wide flange beam stringers on the edges and centerline of the building, which were in turn placed on 6" pipe piles driven into the soil. On top of this floor are two boilers, some pumps and piping, a work bench, and a 4,000 gallon vertical cylindrical water storage tank, 8-ft high.

In the area of the water storage tank, the floor has rotted from being immersed continuously in the water from the sweating 4,000 gallon tank. Much of the foam insulation in the structural sandwich has become water soaked. Below are pictures of the floor from above and below.

Figure 1 - Floor in front of tank. Much of the plywood on the floor is water soaked with rotting areas above water soaked foam insulation.

The only area of separation from the wall panels and the floor panels was on the end wall immediately behind the tank where the foundation piles had

settled. This was probably due to years of backwash water being dumped under the foundation. I had noticed the backwash was being dumped under the foundation in 1998, when I first visited Chefornak.

Water treatment consists now of just pumping water from the well, putting dry chlorine in the tank, and pressurizing it into the circulating loop for the 12 existing watering points, and service connections: the Clinic, the School, and the Temporary Washeteria. The well provides the raw water supply for the school Ultra Filtration /Reverse Osmosis (UF/RO) water treatment plant.

Figure 2 - Separation of about 2 inches between the floor panels and the end wall panels. All other areas of the wall-floor interface in the building were not separated.

Figure 3 - View under the building along centerline. The area under the 4,000 gallon tank has settled several inches, most of which has occurred on the pile in the foreground under the tank. The settlement westward beyond the center of the building in the background is minimal.

Figure 4 - View from the top of the 4,000 gallon water storage tank to the building ridge beam. Settlement in the center is about 3/4" to 1" on the center column.

The water storage tank is in very poor condition, as its interior coating is failing, exposing the pumped well water to exposed steel, and making the tank a site for corrosion and possible bacterial growth.

The water treatment plant piping is operational, but old, and has been subject to some freeze-ups and near freeze-ups. One new heating boiler is hooked up and the other is non-operational. Heat for the watering point circulation is now operational (since 2005) from the new power plant, so a minimum of oil heat is now needed, mainly for space heating of the water treatment plant.

CITY WELL ADJACENT TO THE WATER TREATMENT PLANT

The city well was under about 8 ft of snowdrift when I was at the plant, but was working properly. We had not dug out the well, but I did have an image of the inside of the well head box from a sanitary survey done in November of 2011, and noticed exposed insulation and electrical wiring. There were also unplugged threaded holes in the sanitary seal of the well. The well head lid is about 4-ft square, so it will be a big effort to get the lid off to work on the wiring or the well pump this winter. Recommendations to changes to the well will be made in a later section.

BAC-T TEST AND IMPLICATIONS

The system is on a boil water notice following several positive tests for coliform. Coliform is an indicator, and is not in itself harmful. The tests were negative for E. coli and for fecal coliform. At the time of the first total coliform positive, was the chlorination system was shut down in the hope of reducing the expense of DBP texting. I recommend replacing the broken chlorine injection pump before further effort to locate the source of coliform. It is difficult to determine the source of the possible contamination. There are a number of sources that could be causing the total coliform positive, including the well, water storage tank coating, distribution piping, or watering point hoses. Since last summer, the chlorine has been mixed in a 10 gallon bucket, and then poured from 5 gallon buckets into the water tank. After a site sampling plan is complete, and a new pump has been installed, further effort to pinpoint the source of the contamination (should any remain) is warranted.

POSSIBLE SITES FOR CITY WASHETERIA

The original site for a new combined water plant/washeteria was alongside the power plant. The alternative of locating the washeteria by the Clinic was discussed because there is a short access path from the Clinic to the Airstrip. I examined all possible sites for the proposed City Washeteria with land

planner Stan Nevak. The criteria for selection were:

- Near the power plant for waste heat capture. It appears that there should be easily up to 500,000 btu/hr of waste heat available. The existing watering point water loop would take up to 200,000 btu/hr, so the permanent washeteria should have 300,000 BTU/hr available minimum for heat. 300,000 BTU/hr is equivalent to 72 gallons per day of oil use, a major savings that will help to make the Washeteria affordable.
- The site should be as central to the community if possible.
- The sewage force main from the Washeteria to the force main to the proposed lagoon should be minimal length to keep the project within budget.
- The location should be geotechnically suitable to prevent geotechnical problems with the foundation.

There are few satisfactory sites that meet these criteria. A site just north of the new clinic was a possibility, however the force main for wastewater disposal was going to be too long and expensive.

The site proposed for the grant is the only viable location: immediately north of the existing power plant and fuel tank. The washeteria hook-up to the waste heat recovery system at the power plant would be approximately a 30 foot long connection. Mr. Nevak and I discussed the abandoned buildings and power poles that will have to be removed, but the site would be viable. Clearances behind the power plant to the property line would be easier to comply with than other locations on the property, where there is no room for an additional building.

Since the project has reshaped (the City will not be storing 500,000 gallons of raw water), the community can be adequately served by a 20,000 gallon water storage tank. A 20,000 gallon tank, either horizontal or vertical, mounted on piles, could be located adjacent to the estimated 2,000 square foot Washeteria.

Figure 5 - View from east side of power plant looking northwest. An abandoned building behind the power plant is seen, while an abandoned power pole and transformer stand to its left.

WATERING POINT FOR POTABLE WATER FROM SCHOOL UF/RO PLANT

The concept of community use of the school's treated water has been under discussion for several months. While I was examining facilities, VSW Project Engineer Susan Randlett was interviewing a number of people on how they obtained water for drinking and cooking for their households. What was found from these interviews was very revealing. People used the watering points using City well water for washing, steams, and laundry. They obtained drinking water from ice chipped from tundra lakes or rainwater from the roofs of their houses. They preferred this drinking water source, but when they ran short of drinking water, they bought 1 gallon jugs of bottled water for prices ranging from $6.00 to $10.00. Few people would even consider using a school watering point, and the City's water is adequate for the utility purposes. Since their use of potable water was limited to drinking and cooking, it would seem that a single watering point dispensing high grade potable water would be sufficient to serve the community, while retaining access to the low grade water currently at the watering points.

The Chefornak School had constructed a UF/RO water treatment system that removes color and salt from the City well water, and produces top quality potable water for school use. I examined the plant during this trip, and found a location to easily connect the treated water to a single outside watering point.

VSW management has explored the possibility of facilitating an agreement between the Lower Kuskokwim School District and Chefornak for using a limited amount of potable water for a watering point. Results are encouraging, and will require further negotiations to work out important details.

Figure 6 - North side of Chefornak School UF/RO building looking across path to airport. The building is a module set on 12" pipe piles. The proposed watering point would be near the left hand center pile.

Inside the plant, 12,000 gallons of potable water is stored in three each 4,000 gallon polyethylene tanks and pressurized for school use with a constant pressure pumping system. A 1-1/2” schedule 80 PVC branch line runs from the pressure pump manifold to the filter room and supplies treated water to chemical feed vats and other parts of the treatment system after passing through a reduced pressure zone backflow preventer valve. A 1” line and additional backflow preventer could be added, as well as most components needed for the proposed watering point. The only external components of the watering point exposed outside would be a token drop for payment and an insulated water hose for delivery. There would be no potential conflicts for this additional piping in the module. The costs for the parts are estimated at $5,000, and installation would take about four days.

Figure 7 – 3 ea. 4,000 gallon tanks

Figure 8 – Pressure Pumps in School UF/RO treatment plant.

Figure 9 - View of backflow preventer for plant use. Line for watering point would run overhead to the north wall in background.

POSSIBLE INSTALLATION OF OZONE DISINFECTING WASHING MACHINE IN CLINIC

I visited the new clinic and looked at the area where Susan Randlett wanted me to investigate the location for an ozone-disinfected washing machine. The possible location is pre-plumbed and wired for a standard household washer and dryer, but no appliances are presently installed. This is a marginal location. It is located in a storage room that also contains a telecommunications room. The room is quite cramped, and the only way that this installation could be done is to use a standard household sized washer with a separate ozone generator.

Figure 10 - Chefornak Clinic Building

Figure 11 - Space for Washer. Shelf on right would have to be removed.

Figure 12 – Washer Location next to existing shelves. Not much room for anything here without modification.

EXISTING WATERING POINTS CONDITION

The existing watering points are approaching thirty years old and are showing their age. Water Operator Tom Mael and I opened one up on the northerly east-west leg of the watering point loop and examined the enclosure and the components. The enclosures had evidence of heat leaks, and the piping components of the watering point branch off the 3" HDPE loop showed signs of corrosion and age. Below are images of the watering point enclosure and interior components.

Figure 12 - Watering point exterior. This particular watering point does not suffer from the extreme drifting that other ones have encountered.

Figure 13 - Watering point mechanical interior. The interior is heated by the small electric heater on the left. The riser is 3" HDPE pipe, with a branch off to the left for flushing and for water for fires. The ROMAC clamp-on tee in the center supports the piping for the solenoid valve that delivers water to the hose outside for public water. A token box on the outside runs a timer when activated to deliver water to the customer on a timed basis. The Vise-Grip wrench was installed to hold the solenoid valve body because the valve once froze and stripped the thread in the body for the bolt.

Figure 14 – Watering point 3" HDPE riser from junction box below that connects runs of 8" x 15" arctic pipe duct for the water loop.

Figure 15 – 1-1/4" hose tap off of watering point riser.

Below is a series of images of all existing watering point structures along the watering point loop from the area of the City water treatment plant to the houses to the south end of the community. These images show the exterior condition of each watering point and the snow drifting encountered this winter.

Exteriors are fair to poor. Electrical boxes and wiring are good to poor, depending upon the individual enclosure.

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Watering Point buried in snow drift.

OBSERVATION OF EXISTING "HONEYBUCKET" LAGOON AND LANDFILL

I traveled out to these sites on the snow machine trail. There was not much to see because all of the honey bucket bags and debris are hidden by snow drifts.

Figure 16 – Honeybucket Lagoon drifted over by snow.

Figure 17 – Solid waste landfill covered with drifted snow.

CONCLUSIONS AND RECOMMENDATIONS

Susan Randlett's interviews with the public during our trip have come to some interesting and vital conclusions that need to be incorporated into design assumptions, and in recommending a financially sustainable sanitation system to meet the City Council's desire for community services.

Findings:

- People use ice and rainwater predominantly for their drinking and cooking water. Many adults like to obtain this as part of their lifestyle. They do not anticipate using school UF/RO water, however they do buy expensive jugs of bottled water at the store when they are short. School children drink the potable water provided at school, although a number of children may also consume soft drinks.
- The existing watering points are used by many residents for steams, washing, and laundry. They would like the watering points repaired and kept in service.
- The predominant method of waste disposal is the 5-gallon honeybucket. Approximately 35 buckets of urine and 5 buckets of fecal waste are generated every day. This translates to about 1200 cu ft of solid fecal waste per year.
- There are local pilot studies for urine separation and composting toilets going on presently in Chefornak. Many people are interested in the results of the studies.
- Presently, gray water from dish washing, hand washing, and laundry is disposed of on the tundra away from the house.
- People are very concerned about the cost of water and sewer and want to see something affordable and sustainable.

With these points in mind, the following recommendations are made for developing a sanitation system that will be appropriate, sustainable, and affordable for the residents of Chefornak.

Water Treatment Plant:

The City well at the northeast end of the community will be supplying water to the watering points and its respective water loop, as well as the school UF/RO plant for the foreseeable future. The floor of the existing plant is failing from rot and sediment.

It is recommended that the existing water treatment plant be replaced with a water treatment plant with a footprint of half the size of the existing plant. It would utilize the existing pilings of the west half of the existing plant. The

foundation would be steel beams on top of the existing pile caps. The foundation would be sized to support small particulate filters and a 2000-gallon polyethylene buffer tank. The plant would house watering point pressure pumps, loop circulation pumps, backup heating equipment, and chlorination equipment. Since the well water meets the requirements of 18AAC80, there would be no need to treat the utility water. The City well water would continue to be only for the watering point non potable water uses.

Water Well:
The water well would be renovated to have an insulated pipe section (8" x 18" arctic pipe) from the ground surface to the top of the well head box. The box would fit atop of the well casing and be approximately 2 ft on a side, with 4-in of polystyrene foam insulation (2" layers). The box would have a lightweight aluminum lid for top access. The wellhead would connect the well to the water treatment plant with a section of 6" x 18" arctic pipe. Heat would be provided to the well head with ¾" pex hydronic piping and backup electric heat trace.

Proposed Washeteria:
The proposed Washeteria would be a panelized building on piles similar to design to those piles on the nearby power plant. The Washeteria would use water provided by the existing City well which would be chlorinated. A 10,000 to 20,000 gallon insulated water storage tank would store potable water for Washeteria and summer community use. The Washeteria would be located behind the new power plant in the vicinity of the old power plant. In this way, abundant waste heat from the power plant could be used for building space heating and for dryer preheat. If arrangements could be made, the existing fuel tank for the power plant could be shared, with Washeteria fuel oil measured by a meter to account for use and billing. The wastewater force main could be combined with the school forcemain and both wastewater streams could flow to the proposed lagoon.

Potable Water Watering Point Located at the School UF/RO Plant Module
It is estimated that 500 gallons per day maximum of potable water be needed for the community for design year 2032 for drinking and cooking. Should residents choose to deviate from traditional water sources of ice and rain, up to 500 gallons could be supplied by installing a watering point located on the north side of the school UF/RO plant module. Should the Lower Kuskokwim School District (LKSD) and the City agree for a community watering point, a metered watering point can be installed for less than $10,000. In the summer, when the school is shut down, potable water can be obtained from stored water at the Washeteria.

Ozone Disinfected Washing Machine at the Clinic:
There is no off the shelf product to use ozone to disinfect clothing and reduce energy cost. However, since a new washeteria could be designed by Fall 2012, and in service by late Fall 2013, I do not recommend diverting the project focus. The standard ozone washer can be specified for the permanent washeteria.

Existing Watering Points and Water Loop
The existing watering point structures and related piping and electrical equipment are nearing the end of their service life. However, the insulated arctic pipe and ducts are still serviceable.

The existing watering points should be dismantled. This could be designed by Fall 2012 and in service by Fall 2013. An aluminum insulated utilidor, similar to that installed in Hooper Bay should be constructed to connect the exposed segments between the arctic pipes. A 2" HDPE riser and 1" HDPE return would come out of the utilidor in an insulated 8" x 18" arctic pipe and would act like a circulating arctic house service with pit orifice. The watering point and related piping and electrical components would fit inside of an insulated enclosure or watering point enclosure (similar to an electrical enclosure). Suitable materials for an enclosure would be fiberglass, aluminum, or stainless steel. The enclosure would be smaller than the existing watering points and would use a fraction of the electricity now used for heating the enclosures. The new watering points will have to be sited or altered to prevent them from being buried by drifting snow or damaged by snowmobiles.

Honey bucket disposal
The City Council accepted the concept of an indoor honeybucket dump station, but the community is already moving toward self-contained compost and urine diversion toilets. It seems that the one appropriate and reliable way to dispose of fecal waste is evaluate whether the material can be buried in a landfill in a sanitary manner using biodegradable bags into a landfill. There would have to be a landfill disposal plan created and a suitable site selected. If the current urine diversion toilets become more widely accepted, urine could be separated and added to the force main stream to the proposed sewage lagoon.

Wastewater Lagoon
The only BOD certain to be discharged into the future lagoon is the sewage from the school and the washeteria. The earliest construction could begin on the lagoon is December 2012. In the intervening months, the alternatives for treating the domestic BOD (landfiling, composting, and sewage lagoon) can be discussed and considered by the community. By removing much of the BOD of the waste stream to the proposed wastewater lagoon, the hydraulic flows would amount to about 3000 to 5000 gallons per day, which would make the lagoon much smaller than the initial concept. A rough estimate of BOD would be for 200 people involved in the school, which would amount to about 34 lb BOD per

day (the 65% design was to treat 99 pounds a day). These 34 pounds of BOD from the school and washeteria would require about an acre in the primary cell, and the size of the wastewater lagoon would probably be governed by 240 days of hydraulic retention, or about 2,000,000 gallons.

Other issues:

Graywater Issues at Residences

When the new laundromat is operating, the spent laundry graywater to the ground will be presumably cease. Means to dispose of the remaining domestic graywater will have to require further study to find appropriate ways to perform local treatment of graywater to minimize health hazards.

Rainwater Harvesting Issues at Residences

Residences and businesses all collect rainwater during the non-freezing times to provide drinking water. It appears that, despite the presence of fecal coliform from bird droppings on the roof, people believe they are not getting sick from this water source. However, it is recommended that the practices for collection and storage of rainwater be analyzed to see what devices or modifications would ensure that water is safe when ready for drinking. Reduce any contamination with NSF-approved plastic rain barrels and filtration to remove contaminants from captured water is also possibilities.

Wastewater Disposed of in the Kinia River from the old BIA Facilities

It was reported that some of the facilities still being used at the old BIA school site are disposing of untreated wastewater into the river. This needs to be investigated and alternate disposal solutions need to be developed.