Drinking Water Reservoir and Distribution System Cleaning Procedure for Work Camps Affected by the Fort McMurray Fire

The purpose of this guideline is to provide operators with a method to ensure that work camp cistern(s)/reservoir(s) and distribution system water that is potentially contaminated is treated and removed from the system.

Which Work Camps does this procedure apply to?

This procedure must be completed by work camps that had a cistern(s) and/or reservoir(s) filled with water supplied by the following water systems after May 3, 2016:

- Fort McMurray Regional Waterworks including
- Anzac
- Gregoire

Work Camps that have exclusively filled cistern(s) and/or reservoir(s) with water from water supplies listed below do not need to complete this procedure.

- Epcor,
- Fort McKay,
- Conklin,
- Janvier
- any other potable water supply

Procedure

The procedure requires the completion of a two step process. The first step targets the contaminated water in the work camp cistern/reservoir. The second step targets the contaminated water in the distribution system.

Before the distribution system can be cleaned through flushing, step one needs to be completed.
Step 1: Cisterns and Reservoirs

To eliminate contaminants, operators can choose to implement:

- Option A (filtration) or
- Option B (chlorine disinfection) or
- Option C (draining and refilling).

If an unapproved source such as untreated river water has been used to fill the cistern/reservoir contact your Public Health Inspector to discuss treatment.

Option A: Filtration (Installation of an Absolute 1 Micron filter)

This option requires installation of an Absolute 1 micron cartridge filter on the main distribution water line from the cistern/reservoir before water enters the first public use connection.

Operators will need to meet the following requirements:

1. Installation must include, at minimum, an absolute 1 micron cartridge filter.

2. Cartridge filters that are used must be declared by the manufacturer to meet the following:
   - **Absolute** 1 micron filtration or smaller
   - **May be** with or without NSF certification
   - the manufacturer package label or manual must state that the filter is **absolute** 1 micron or smaller. Nominal pore size rated filters are not acceptable.

3. Filters must be sized according to the maximum flow rate of the distribution system pumps and operating pressure of the system.

4. Pressure loss from installation of the filters must be assessed to ensure distribution system operation will not be significantly impacted.

5. Filter pressure must be monitored on a daily basis.

6. The filter must be installed in a location along the distribution system prior to any public use fixtures, preferably at the main central distribution header leaving the cistern / reservoir.
   
The filter must be installed as per manufacturer instructions.

7. At least one set of replacement cartridges must be available, and must meet the manufacturer cartridge housing specification.
8. Filters must be replaced at the end of their expected life which is based on volume specified by the manufacturer or when unacceptable pressures are experienced.

9. Turbidity monitoring is not required.

When is Filtration no longer required?
Filtering is no longer required after at least 10 turnovers of the water volume in the cistern/reservoir(s), or when 10 times average daily use volume is reached; whichever is greater. Documentation is required to confirm the number of turnovers.

Option B: Disinfection of Cistern / Reservoir
This option requires a disinfection procedure to be completed. Cleaning of the interior of the cistern/reservoir is not required. During the disinfection procedure, the water is unusable for normal water purposes.

During treatment, connect the distribution system to a redundant cistern/reservoir if possible or provide an alternative potable water supply. This will allow water to be available for use during the disinfection step. Note, any water connected to the distribution system will be considered non potable. Do not connect a potable water truck directly to the distribution system.

In order to maintain camp operation, fire flow must be maintained at all times and is a major consideration if implementing this option.

Procedure:
1. Determine the volume of water in the cistern/reservoir. Include the truck volume of water used for mixing in step 3.

2. Choose the concentration of chlorine that will be used for disinfection.
   a. Target concentration must be at least 25 mg/L (25 ppm).
   b. The combination of the contact time and concentration must meet a CT of 22000.

\[ \text{CT} = \text{Concentration Target (mg/L)} \times \text{Contact Time (minutes)} \]

The concentration and time used for contact must be documented.
Calculate the concentration to be added to the reservoir using the following website if help is needed.


3. Mix a slurry of chlorine and add the chlorine concentration into the reservoir prior to the truck delivery. Add the water from the truck to facilitate mixing of the reservoir. For further options on mixing, review the dechlorination procedure in Appendix A.

For example, if using sodium hypochlorite, the bleach concentration will be found on the chemical container you are using. Typical ranges are 5% (household bleach) to 12% (concentrated industrial bleach). Use NSF 60 certified chlorine bleach if possible. Stay away from scented laundry bleaches as these are non-potable. Other sources of chlorine are available such as Calcium hypochlorite.

4. Allow the disinfection to take place for at least the length of time that is determined in step 2 (through calculations).

5. Dechlorinate the cistern/reservoir (see Appendix A). Calculate the amount of chemical to add to ensure that the concentration is not more that 4ppm free available chlorine (but above the background residual so that the difference may be detected in the distribution line). Agitation will be needed to ensure mixing. Do not overdose with unnecessarily high dechlorination agent as chlorine concentration testing will be used to verify flushing is effective.

6. Document the chlorine concentration after dechlorination.

Option C: Drain and Refill Cistern/Reservoir with Potable Water

During treatment, connect the distribution system to a redundant cistern / reservoir if possible or provide an alternative potable water supply. This will allow water to be available for use during the disinfection step. Note, any water connected to the distribution system will be considered non-potable. Do not connect a potable water truck directly to the distribution system.

In order to maintain camp operation, fire flow must be maintained at all times and is a major consideration if implementing this option.

1. Drain the cistern/reservoir completely. Use a potable vacuum truck to remove all water from the bottom of the cistern.

2. NOTE: If a reservoir/cistern requires physical cleaning (ie. sediment), use the following AHS guideline: How to Clean and Disinfect a Cistern available at:
3. Rinse the cistern if it has been entered by any staff. Remove rinse water using a potable vacuum truck.

4. Fill the cistern with potable water.

**Step 2. Distribution System Flushing**

After step 1 has been completed, proceed to Step 2.

Considerations before proceeding:

- Ensure the cistern/reservoir will have enough water to carry out the flushing procedure.

- If option A (filtration) or C (Drain and Refill) has been chosen, the chlorine concentration will need to be adjusted in the cistern/reservoir so it will differ by at least 1ppm from the normal distribution concentration. As distribution systems can be complex, Appendix B provides some information on flushing estimates that can be used to help estimate the time needed to perform the distribution flushing.

- A Chlorine kit is required to complete this procedure.

- See Appendix C for a flushing diagram for a typical work camp.

The goal of this step is to turnover the water in the distribution system at least two times (as noted by AWWA). In order to meet this goal the following must be completed:

1. Identify the end(s) of the distribution lines. Identify flushing hydrants (preferred) or flushing faucets that will be used to turnover the water in the mains and headers. From this information, map out an outward progression of flushing points.

2. Estimate the volume of water in the distribution system and the estimated time to reach 1 full flush of the system using the information in Appendix B.

3. Open the flushing hydrant/faucet(s) closest to the cistern/reservoir and measure chlorine concentration until you meet the chlorine concentration target. Note the start time.

4. Confirm that the superchlorinated water has reached each end hydrant or faucet. This may be accomplished through testing using a chlorine test kit that reads in the 0-10ppm range. Mark the time it takes to reach the ends.
5. Once the chlorine target is met, work progressively outward at each flush point until you reach the end(s) of the distribution lines. Note the end time at the farthest point. Document the time it takes to finish flushing each flush point.

6. Repeat the process again for the length of time determined in the previous step, working outwards from the closest flush point to the cistern. At the end of this time period, two turnovers of water should have been achieved in the distribution system. No further chlorine testing is needed during this step.

7. Ensure that chlorine concentration levels in the cistern and the distribution system are within normal operating range ie no greater than 3ppm total chlorine before consumption.

8. Add fresh water to the cistern/reservoir as needed.

9. Once you flush out the mains and headers using the above procedure. Continue flushing the rest of the connections.
   - Flush all water-using fixtures, equipment and faucets by running them for five minutes.
   - A suggested method for flushing large buildings is as follows: start flushing faucets closest to the service connection - flushing each fixture / faucet for five minutes. Toilets need to be flushed once. The fixtures may be flushed simultaneously. Proceed to the next building, and continue the procedure until all fixtures and faucets on all floors and buildings are flushed.
   - Ensure equipment with water line connections, such as refrigerator water and ice dispensers are drained, flushed, cleaned and disinfected according to the manufacturer’s recommendations.
   - Run water softeners through a regeneration cycle according to the manufacturer’s recommendations.
   - Replace the filters on any water filtration devices, and flush the fixture according to the manufacturer’s directions.
   - Drain and refill hot water heaters that have been set below 45°C/110°F.

10. Collect two bacteriological samples at the earliest opportunity following flushing from:
   - the cistern or nearest faucet and
   - one site at an end point of the distribution system

Contact Environmental Public Health, North Zone Grande Prairie at 780-513-7517 for information and requirements on collecting bacteriological samples.

For more information, please contact your nearest Environmental Public Health office.

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<td>Lethbridge Main Office</td>
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Appendix A: Dechlorination procedure

1. Prepare a slurry of dechlorinating chemical - sodium thiosulfate is commonly used.
   
   A typical slurry contains 28.3 grams of sodium thiosulfate for every 37854 L of water to lower chlorine levels by 1ppm – follow the manufacturer instructions for proper dosing.

2. Use a metering pump to deliver the dechlorinating slurry.
   
   Water circulation could be improved by using power mixers or by dropping in several sump pumps. Move the injection point to different parts of the reservoir.

3. Recommend delivering the slurry using the following process: add 50% of the slurry to the cistern/reservoir, wait 30 min and test, add 10% of the remaining slurry, wait 30 min and test, and so on, adding 10% of the remaining slurry until it has been used up. Once you reach 10 mg/L (10 ppm) chlorine residual be very cautious. If the concentration reaches zero, it could be very difficult to raise the chlorine.

4. Test chlorine concentration at points of entry and exit (if those are the only options)

5. Use a chlorine test kit with a 0 – 10 mg/L (0-10 ppm) range to measure the progress of the dechlorination. If a higher range chlorine test kit is available, use it to monitor progress above 10ppm.
Appendix B: Estimate of Water Volume and Flushing Times in Distribution System

You may estimate the time that will be needed to achieve one flush of the entire system by using the following information. This may assist in timing the chlorine readings at the endpoints.

A. Compile distribution system information:
   - Compile information on segment lengths of mains and headers.
   - Compile information on diameters of the above mains and headers.
   - Identify the end(s) of the distribution lines.

B. Calculate Flushing Times

Use the following calculation to determine an initial flush time for one turnover through the hydrant and the time required to flush through the branches.

Calculate the time for each pipe diameter in your system and add the flush times to obtain an estimate.

\[
\text{Flush Time (min)} = \left(\frac{\text{Pipe Volume (m3)}}{1000 \text{ L/m3}}\right) \times \frac{\text{Flow Rate (L/min)}}{\text{Flow Rate (L/min)}}
\]

OR

\[
\text{Flushing time} = \frac{3.14 \times \left(\frac{\text{Connection Diameter (ft)}}{2}\right)^2 \times \text{Length (ft)}}{\text{Flow Rate (gpm)}} \times \left(\frac{7.48 \text{ gal}}{1 \text{ ft}^3}\right)
\]
Appendix C: Flushing Diagram for a Typical Work Camp

For more information, please contact your nearest Environmental Public Health office.

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