

SEASONAL WATER SYSTEM START-UP/SHUT-DOWN PROTOCOL

As the operator of a seasonal campground or recreational area, you have a responsibility to provide safe drinking water. Avoiding water quality issues, delays in providing service and inconvenience to your guests requires proper preparation for start-up and shut-down. The following guidelines have been established to ensure that seasonal drinking water systems throughout the province of Manitoba meet these requirements. These guidelines can form the basis of a site-specific plan for your water system.

Start-up:

Begin system start-up early by ordering bacteriological sampling bottles from the laboratory. Monthly Water Chlorination Reports are available for download from the forms page located here: www.manitoba.ca/drinkingwater

Prior to public use of a seasonal water system, the following procedures should be completed:

1. Flush the distribution system.
2. Clean and disinfect all holding tanks (i.e., reservoirs, chlorine contact chambers, cisterns, bulk haul containers/tanks).
3. Shock chlorinate well(s) [if part of the system] and the distribution system.
4. Receive satisfactory bacteriological testing results and begin regular sampling program.
5. Conduct other system checks and make necessary repairs.

Cautionary Notes Before Proceeding with Disinfection Procedures:

- Concentrated chlorine solutions are corrosive. Use care to avoid contact with skin or eyes.
- Follow appropriate precautions for working with electricity.
- If your well is in a well pit, do not enter without following confined entry procedures. A licensed well contractor can be called in to shock chlorinate such systems.
- Bypass water treatment devices such as softeners, RO systems, carbon filters, etc., as high chlorine dosages may damage the units. Consult your water treatment equipment suppliers.
- Remove faucet screens or aerators to avoid clogging these devices.
- Shut off hot water tanks.
- Include all connections on the water distribution system: taps, spigots, hydrants.
- Ensure fresh chlorine is used for disinfection. The recommended shelf life of sodium hypochlorite and household bleach is 90 days. Store unused or unopened chlorine in a cool, dark place. To dispose of leftover chlorine, dilute and allow enough time for it to naturally dissipate (until the chlorine odor is gone), then pour to waste.
- Dispose of chlorinated water to bare ground (e.g., gravel roads, ditches) where it won't harm vegetation or reach surface water. The water from shock chlorination procedures should not be directed to surface water (toxic to aquatic organisms) or to a septic system (may overload the system or harm the bacteria).
- If the system has not been disinfected for a long time, it may need more than one treatment.
- Shock chlorination is also recommended:
 - After construction work on the water system
 - After flooding of the well or pump house
 - For ongoing control of bacteria
 - If a positive bacteria count is found in the system
 - When water taste and odour changes

1. FLUSHING THE WATER SYSTEM

Before shock chlorinating the system it is essential to flush it to remove debris, bacteria, etc. The following sequence is suggested:

- Pressure/Storage tank: •Fill tanks and empty repeatedly until the water runs clear.
Water Treatment equipment: •Follow supplier instructions.
Piping system: •Bypass water treatment equipment and flush each outlet one by one starting with the outlet closest to your water source.
 •Turn the outlet to full flow and flush until the water runs clear.
 •Flush hot and cold water outlets separately.
 •Complete this process for every outlet.

2. CLEANING AND DISINFECTING TREATED WATER HOLDING TANKS

- ❑ Clean the water storage tank. Remove debris and scrub or hose off the interior.
- ❑ Inspect the tank for cracks or leaks around the lid or vents. Make sure the lid is tight-fitting and vents are properly screened.
- ❑ Prepare a chlorine solution by pouring 75 millilitres (mL) of household bleach (which contains approximately 5% chlorine) or 30 mL of Sodium Hypochlorite (which contains approximately 12% chlorine) into 18 litres (4 gallons) of water to provide a solution with approximately 200 mg/L (ppm or parts per million) of chlorine.
- ❑ Use the chlorine solution and a new mop or brush to wipe the inside walls and all surfaces of the storage tank that will be in contact with water. After application of the solution wait 30 minutes. Do not use the mop or brush for any other purposes.
- ❑ Flush the tank and drain it to a suitable area (as to not harm vegetation or surface water)
- ❑ Fill the tank with water. Add chlorine while the tank is filling according to the dosages provided in Table 1 or 2:

Table 1: Required chlorine dosage

Holding tanks (imperial)

Tank Volume (imp. Gallons)	Household bleach 5% Chlorine (mL)	Sodium Hypochlorite 12% Chlorine (mL)
100	90	38
500	450	190
750	675	285
1000	900	380

Table 2: Required chlorine dosage

Holding tanks (metric)

Tank Volume (Litre)	Household bleach 5% Chlorine (mL)	Sodium Hypochlorite 12% Chlorine (mL)
100	20	9
500	100	42
750	150	63
1000	200	84

- ❑ Open the tank discharge tap and let the water run to a suitable area until you can smell a chlorine odour. Shut off the tap and let the chlorine mixture stand in the system for at least 8 hours (overnight), preferably 24 hours.
- ❑ Open the tap and let the water run to a suitable area until the holding tank is drained.
- ❑ Flush the tank until you cannot smell a strong chlorine odour.

3. DISINFECTION OF A WATER SYSTEM WITH A WELL & DISTRIBUTION SYSTEM

There are two procedures available for disinfecting a well and distribution system:

- i) Shock chlorination, which involves high level chlorine disinfection, and
- ii) Partial or low level chlorination.

If a properly sized storage tank is available, full shock chlorination is always recommended.

Part 1 If Using Shock Chlorination:

- Pump at least twice the amount of water present in the well casing into a clean container that is used to hold nothing but drinking water. The volumes of water and chlorine solution required for each foot or each metre (imperial or metric units) can be estimated based on Tables 3 and 4, respectively. Thus the total volumes of water and chlorine can be calculated as per the example provided following the tables.

Table 3: Dosage of chlorine compound to disinfect per foot of water at 1000 mg/L

Well Casing Diameter (inches)	Volume of water needed per foot of water in casing (Imp. Gallons)	5% Domestic bleach needed per foot of water (mL)	12% Sodium Hypochlorite needed per foot of water (mL)
4	1.09	98.84	41.18
6	2.45	222.40	92.67
8	4.35	395.38	164.74
10	6.80	617.78	257.40
12	9.80	889.60	370.66

Table 4: Dosage of chlorine compound to disinfect per metre of water at 1000 mg/L

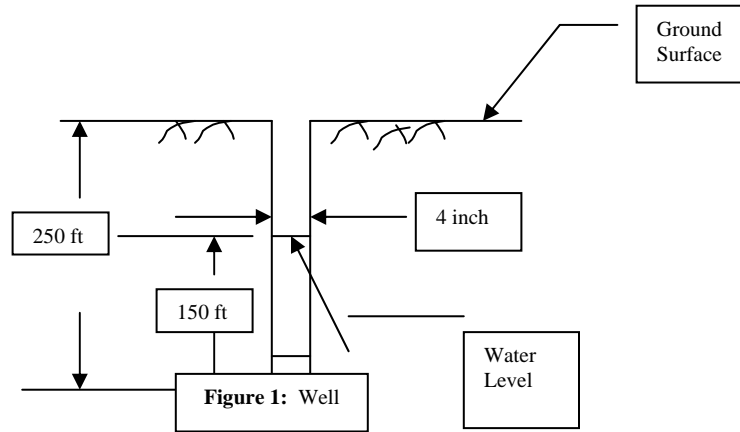
Well Casing Diameter (mm)	Volume of Water needed per metre of water in casing (L)	5% Domestic bleach needed per metre of water (mL)	12% Sodium Hypochlorite needed per metre of water (mL)
100	15.71	314.16	130.90
150	35.34	706.86	294.53
200	62.83	1256.64	523.60
250	98.18	1963.50	818.13
300	141.37	2827.44	1178.10

** For wells with a diameter of 24 inches (600 mm) or larger contact your local Drinking Water Officer or Office Of Drinking Water as these wells need modified procedures.

Example calculation:

Water Volume: If a well with a 4 inch diameter and a depth of 250 feet has its water level 100 feet below ground surface, then the volume of water needed as per above would be:

From Figure 1 and Table 3: 1.09 gal/ft x (250-100) ft = 163 gal or 733 litre (1 gal = 4.5 L)



Chlorine required: For the above example the amount of household bleach needed:

(250-100) ft x 98.84 ml/ft = 14826 ml = 14.83 litre (1000 mL = 1 litre)

For the above example the amount of Sodium Hypochlorite needed:

(250-100) ft x 41.18 ml/ft = 6177 ml = 6.18 litre (1000 mL = 1 litre)

PART 1 IF USING PARTIAL/LOW LEVEL CHLORINATION:

- This method does not guarantee that chlorine will get to the bottom of the well or into the aquifer formation. This procedure should only be adopted if full shock chlorination is not possible. The volumes of water and chlorine solution required for each foot or each metre (imperial or metric units) can be estimated based on Tables 5 and 6, respectively. Thus the total volumes of water and chlorine can be calculated as per the example provided following the tables.

Table 5: Dosage of chlorine compound to disinfect per Foot of water at 250 mg/L (imperial)

Well casing diameter (inches)	5% Domestic bleach needed per foot of water (mL)	12% Sodium Hypochlorite needed per foot of water (mL)
4	12.25	5.12
6	27.56	11.51
8	48.99	20.47
10	76.54	31.98
12	110.22	46.05

Table 6: Dosage of chlorine compound to disinfect per metre of water at 250 mg/L (metric)

Well casing diameter (mm)	5% Domestic bleach needed per metre of water (mL)	12% Sodium Hypochlorite needed per metre of water (mL)
100	39.27	16.36
150	88.36	36.82
200	157.08	65.45
250	245.44	102.27
300	353.43	147.26

** For wells with a diameter of 24 inches (600 mm) or larger contact your local Drinking Water Officer or Office Of Drinking Water as these wells need modified procedures.

Example calculation:

As presented in Tables 5 and 6, the well diameter and the height of the water column in the well casing determine the amount of chlorine needed:

If a well with a 4 inch diameter and a depth of 250 feet has its water level 100 feet below the ground surface (Figure 1), then the required amount of chlorine is as follows:

For the above example the amount of household bleach needed:

$(250-100) \text{ ft} \times 12.25 \text{ ml/ft} = 1838 \text{ ml} = 1.84 \text{ litre}$ (1000 mL = 1 litre)

For the above example the amount of Sodium Hypochlorite needed:

$(250-100) \text{ ft} \times 5.12 \text{ ml/ft} = 768 \text{ ml} = 0.77 \text{ litre}$ (1000 mL = 1 litre)

Part 2 For Either Chlorination Procedure:

- ***Bypass all water treatment equipment.***
- Pour the chlorine solution into the well using a hose while rinsing down the sides of the well casing for around 5 to 10 minutes.
- Open each faucet, hydrant or valve one by one until a strong chlorine odour is detected then close them one by one. Additional chlorine solution may need to be added if a strong chlorine odour is not detected due to chlorine demand exerted by iron, hydrogen sulfide or other contaminants.
- Once a strong chlorine odour is detected at the water outlets let the chlorine solution remain in the distribution system and in the well for 24 hours.
- Flush the system to a suitable area until you cannot smell a strong chlorine odour.
- Once chlorination procedures have been completed, backwash all filters and softeners, and flush hot water tanks. Put water treatment units back on line and turn on hot water tanks.

3. DISINFECTION OF SURFACE WATER SYSTEM OR DISTRIBUTION SYSTEM ONLY

- If your system does not include a chlorine pump and injection port, please consult with your Drinking Water Officer.
- Adjust the chlorine pump to provide either 25 mg/L (contact time 24 hours) or 100 mg/L (contact time 3 hours) of chlorine.
- Open each faucet, hydrant or valve on the distribution system one by one until a strong chlorine odour is detected then close them one by one. Additional chlorine solution may need to be added if a strong chlorine odour is not detected due to chlorine demand exerted by iron, hydrogen sulfide or other contaminants.
- Once a strong chlorine odour is detected at the water outlets let the chlorine solution remain in the distribution system as described by the contact time earlier.
- If you use 25 mg/L of chlorine, at the end of 24 hours the residual free chlorine should be at least 10 mg/L; if not, the procedure should be repeated.
- Flush the system to a suitable area until you cannot smell a strong chlorine odour.
- Once shock chlorination procedures have been completed, backwash all filters and softeners, and flush hot water tanks. Put water treatment units back on line and turn on hot water tanks.

4. **BACTERIOLOGICAL SAMPLING**

Two sets of satisfactory bacterial results **must** be received prior to allowing public access to the water. Otherwise, the system must remain posted with warning signs as issued by the Office of Drinking Water to indicate the water is not fit for human consumption.

- ❑ Take an initial set of samples after cleaning, disinfecting and thoroughly flushing the system at least **1 week prior** to your planned opening date. Resample the system after 2 days. If unsatisfactory results are obtained, repeat the disinfection procedure.
- ❑ Inform your Drinking Water Officer at least one week prior to bringing the system on line.
- ❑ Resume your regular monitoring and reporting program. If you have any questions, please contact your Drinking Water Officer.

5. **GENERAL SYSTEM CHECKS**

The following are other recommended system checks that should be performed prior to start-up:

- ❑ All valves should be exercised to ensure they are in good working order.
- ❑ Inspect well, treatment system, and distribution system components for damage (e.g., corrosion, cracking).
- ❑ Examine the well and pumphouse areas to ensure ground is sloping away and that hazardous materials are not used or stored near the pumphouse.
- ❑ Ensure pump lubricants are of a grade suitable for drinking water applications.
- ❑ Ensure no cross connections have been made to lines which could introduce contaminants into the treated water system. Install backflow prevention devices, for example hose bib vacuum breakers, to protect the potable water line from backflow of contaminated water.

Shut-down:

Freezing temperatures can lead to broken pipes, fittings, valves, standpipes and pumps. Undetected breaks can lead to contamination within your system, and hinder your ability to meet acceptable standards as a water supplier. Prior to winter freeze-up (or at the end of the recreation season), winterization procedures are required. Develop a winterization checklist. Fall is also a good time to clean chlorinators, replace filters, repair pumps, and complete general maintenance on the system.

SYSTEM BLOW-OUT PROCEDURES

Water should be drained or blown out of all pumping, treatment and storage equipment. If possible, surface water intake pipes should be brought ashore during the winter. Remember to cover/cap any exposed pipe to prevent contamination.

Distribution System

Before draining or blowing out your system, draw up a written procedure that can be followed annually by yourself or others. If you have a logical and systematic approach to blowing out your system, it will go much more quickly, smoothly and be more effective.

- ❖ At no time should a foreign liquid such as RV antifreeze be used for winterizing any part of a drinking water system. This could be a means of introducing bacterial or chemical contaminants into your water system.

If you have any questions, feel free to contact your local Drinking Water Officer
<http://www.gov.mb.ca/waterstewardship/odw/reg-contacts/index.html>