

**CORPORATION OF THE TOWN OF MARATHON
GUIDELINE**

SECTION: WORKS & OPERATIONS DEPT.	PAGE 1 OF 4
GUIDELINE: CONTINGENCY PLAN TO DISINFECT WATER MAIN WITHIN DISTRIBUTION SYSTEM	POLICY NO. <u>WO 0013</u>

PURPOSE:

To establish a contingency plan to disinfect an isolated water main within the water distribution system.

SCOPE:

For all town employees who maintain and operate the water distribution system.

PLEASE NOTE:

The installation of new water mains is always contracted out, and will not be performed by the staff of the Town of Marathon. The contractor responsible for installing any new water mains in the area will be required to provide details regarding the steps that will be taken to prevent contamination of, and properly disinfect, the new main.

GUIDELINE:

There are two events where the water distribution system will be required to be disinfected:

- 1) Repair of an existing water main
- 2) After a swabbing or pigging event

The following procedures apply primarily when existing mains are wholly or partially dewatered.

1. The chlorine contact time and dosage of FAC (free available chlorine) will be 100 mg/l of FAC for a 3 hour contact period.
2. In both cases, calcium hypochlorite will be used as the disinfection agent. Contact with organic material or high temperatures will be avoided due to the danger of fire or explosion.

NEW <input type="checkbox"/>	REVISED <input checked="" type="checkbox"/>	APPROVAL: <i>J. J. Hacio</i>
SUPERSEDES GUIDELINE DATED: <i>June 27, 2003</i>		DATE: <i>Mar 23, 2004</i>

SECTION: WORKS & OPERATIONS DEPT.	PAGE 2 OF 4
GUIDELINE: CONTINGENCY PLAN TO DISINFECT WATER MAIN WITHIN DISTRIBUTION SYSTEM	POLICY NO. <u>WO 0013</u>

3. The disinfection agent will enter into the isolated water main through the means of a fire hydrant and will be allowed to fill the water main from only one direction. Also, water will be discharged from only one fire hydrant.
4. All staff involved in the disinfection process will thoroughly review this plan and any other applicable plans and guidelines, prior to commencing work. They will provide their signature in the water distribution logbook to verify this.
5. The following steps are to be followed:
 - Once the maintenance work plan has been finalized, the water distribution operator will immediately notify the affected water users of the maintenance activity, and once the maintenance work has been completed, a boil water advisory be put in effect until further notice. The event will be communicated by means of delivering the standardized notification form to the affected customers. The Works and Operations secretary will have a digital copy of this form on file.
 - The water distribution operator in charge will isolate the section of water distribution system that requires disinfecting. This task will be completed by turning isolation valves to the "off" position in accordance with the contingency plan for main line water valve operation: Policy No. WO 0014.
 - Once all the users are notified, the volume of both the isolated water main, and the water within it, will be determined.
 - Completely fill the main to eliminate any air pockets. When this is achieved commence preliminary flushing of the main, in accordance with the guideline for the flushing water mains (Policy No. WO 0018), to remove any dirt or debris. Preliminary flushing should be accomplished at a rate of at least 0.762m/s (2.5ft/s). Table 1 of Schedule 'A' provides the flow rates required to obtain the required velocity in various pipe sizes.
 - The flow rate between the isolated water main and the discharge fire hydrant will be calculated. This can be done with the use of flow meters, measuring the time required to fill a container of a known volume, or by measuring the trajectory of the flow from the discharge fire hydrant (the appropriate calculation is provided in Equation 1 of Schedule 'B').

NEW <input type="checkbox"/>	REVISED <input checked="" type="checkbox"/>	APPROVAL: <i>J L Hacio</i>
SUPERSEDES GUIDELINE DATED:		DATE: <i>Mar 23, 2004</i>

SECTION: WORKS & OPERATIONS DEPT.	PAGE 3 OF 4
GUIDELINE: CONTINGENCY PLAN TO DISINFECT WATER MAIN WITHIN DISTRIBUTION SYSTEM	POLICY NO. <u>WO 0013</u>

- The flow rate of the disinfection injection pump will be calculated. The appropriate calculations are provided in Equations 2a), 2b), and 2c) of Schedule 'B'.
- The amount of calcium hypochlorite required will be determined. Table 2 of Schedule 'A' provides the minimum volumes of hypochlorite necessary to achieve an initial chlorine dose of 100mg/L in 100ft of main; Equation 3 of Schedule 'B' provides a formula to determine the amount of hypochlorite necessary. A premixed 65% calcium hypochlorite solution is often used for disinfection of the distribution system. This step can be omitted if a premixed solution is used.
- Mix the calcium hypochlorite and water in the mixing barrel.
- At a point no more than 3m (10ft) downstream from the main, commence injecting the calcium hypochlorite solution into the main.
- As the "slug" passes tees, crosses, etc. valves must be operated to ensure their disinfection.
- The FAC must be regularly measured as the "slug" flows through the main. If at any time the FAC drops below 50mg/L, the flow shall be stopped, and the disinfection injection pump shall be relocated to the head of the slug. As flow resumes chlorine shall be applied to restore the FAC to 100mg/L.
- Allow the heavily chlorinated water to flow into the isolated water main until it is full, as indicated by a discharge through an outlet at the end of the section. Verify that the water being discharged has a FAC of 50mg/L. If this can not be verified, additional chlorine shall be added to the system until a residual of 100mg/L is obtained in the water being discharged from the exit hydrant.
- Shut down injection system.
- Allow the isolated water main to sit for the required contact period of 3 hrs.

NEW <input type="checkbox"/>	REVISED <input checked="" type="checkbox"/>	APPROVAL: <i>J. J. Hacia</i>
SUPERSEDES GUIDELINE DATED:		DATE: <i>Mar 23, 2004</i>

SECTION: WORKS & OPERATIONS DEPT.	PAGE 1 OF 4
GUIDELINE: CONTINGENCY PLAN TO DISINFECT WATER MAIN WITHIN DISTRIBUTION SYSTEM	POLICY NO. <u>WO 0013</u>

- Once the contact time period has expired, de-chlorinate or dilute the chlorinated water if necessary. This may be required if it is not possible to discharge the highly chlorinated water to the sanitary sewer system. The appropriate doses of common neutralizing chemicals used for this purpose are provided in Table 3 of Schedule 'A'.
- If neither dechlorination nor dilution is necessary, discharge the chlorinated water into a sanitary sewer collection system. Approval must be obtained from the operators of the Water Pollution Control Plant prior to this discharge to ensure the treatment system is capable of handling the increased load; the volume of water to be discharged must be provided at this time.
- Highly chlorinated water shall be flushed from the main until chlorine residual measurements show that the chlorine residual concentration in the water leaving the main is no higher than that generally prevailing in the distribution system. The time anticipated to discharge this water can be estimated based on both the volume of the isolated main and the flow at the exit hydrant. The first chlorine residual test shall take place after the anticipated discharge time.
- Position the isolation valves in the open position in accordance with the contingency plan for main line water valve operation: Policy No. WO 0014.
- Four (4) water distribution bacteriological samples will be taken immediately at the disinfected section of the water distribution system.
 - upstream of the disinfected water main
 - downstream of the disinfected water main
 - 2 from water services connection within the disinfected water main

These water samples will be sent to an accredited laboratory for analyzes. Presently, the accredited laboratory is Enviro-Test in Thunder Bay.
- Once positive water samples are received indicating that the water is safe for consumption, the standardized notification form will be used to officially notify the water users affected that the water is safe for consumption. The Works and Operations secretary will have a digital copy of this form on file.
- The water distribution operator will record all pertinent information regarding the disinfectant event in the water distribution logbook. Information will also be recorded on the water distribution plans attached to the walls in the Works & Operations Office.

NEW <input type="checkbox"/>	REVISED <input checked="" type="checkbox"/>	APPROVAL: <i>J. J. Hacio</i>
SUPERSEDES GUIDELINE DATED:		DATE: <i>Mar 23, 2004.</i>

**CORPORATION OF THE TOWN OF MARATHON
SCHEDULE 'A'**

Table 1: Flow Required for Various Flushing Velocities

Pipe Size		Pipe Area		Flow Required for a Given Velocity					
				1ft/s (0.305m/s)		2.5ft/s (0.762m/s)		5ft/s (1.524m/s)	
				ft ²	m ²	gpm	L/s	gpm	L/s
2	5.08	0.02	0.001	10	0.63	25	1.60	50	3.20
4	10.16	0.09	0.008	40	2.50	100	6.30	200	12.60
6	15.24	0.20	0.019	90	5.70	220	13.90	440	27.80
8	20.32	0.35	0.033	155	9.80	390	24.60	780	49.20
10	25.4	0.55	0.051	245	15.50	610	38.50	1220	77.00
12	30.48	0.79	0.073	350	22.10	880	55.50	1760	111.00
14	35.56	1.07	0.099	480	30.30	1200	75.70	2400	151.40
16	40.64	1.40	0.130	625	39.40	1570	99.10	3140	198.10

Table 2: Hypochlorite Required per 100 FT of Main

Pipe Size		Total Pipe Volume		Hypochlorite Solution				Hypochlorite Granules	
				Dose	Dose	Dose	Dose	Dose	Dose
				100 mg/L	300mg/L	100 mg/L	300mg/L	100 mg/L	300mg/L
in	cm	gal	L	Gal of 5%		Gal of 12.5%		Ounces of 65%	
2	5.08	16.30	61.70	0.03	0.10	0.01	0.04	0.33	1.00
4	10.16	65.30	247.19	0.13	0.39	0.05	0.16	1.30	4.00
6	15.24	147.00	556.46	0.29	0.88	0.12	0.35	3.00	9.00
8	20.32	261.00	987.99	0.52	1.60	0.21	0.63	5.40	16.10
10	25.40	408.00	1544.45	0.82	2.40	0.33	0.98	8.40	25.10
12	30.48	587.00	2222.04	1.20	3.50	0.47	1.40	12.10	36.20
16	40.64	1044.00	3951.97	2.10	6.30	0.84	2.50	21.40	64.30

*Note: 5% chlorine solution = 50 000ppm or mg/L free chlorine.

Table 3: Amounts of Chemicals Required to Neutralize Various residual Chlorine Concentrations in 100 000 gal (378.5m³) of Water

Residual Chlorine Concentration	Sulfur Dioxide (SO ₂)		Sodium Bisulfite (NaHSO ₃)		Sodium Sulfite (Na ₂ SO ₃)		Sodium Thiosulfate (Na ₂ S ₂ O ₃ ·5H ₂ O)		
	mg/L	lb	kg	lb	kg	lb	kg	lb	kg
1		0.80	0.36	1.20	0.54	1.40	0.64	1.20	0.54
2		1.70	0.77	2.50	1.13	2.90	1.32	2.40	1.09
10		8.30	3.76	12.50	5.67	14.60	6.62	12.0	5.44
50		41.70	18.91	62.60	28.39	73.00	33.11	60.0	27.22

CORPORATION OF THE TOWN OF MARATHON
SCHEDULE 'B'

Equation 1: Flow Required for Various Flushing Velocities

$$Q = \frac{2.83 \times d^2 \times l}{\sqrt{h}}$$

Q = Flow (gpm) d = Pipe Diameter (in)

l = Distance between the discharge point, and the point where the discharging water hits the ground surface (in).

h = Height between the discharge stream and the ground surface (in). Height is measured from the middle of the width of the trajectory.

Equation 2: Flow Rate of the Disinfection Pump

a) Time required to fill the isolated main; this is also the injection time.

$$T_{\text{fill}} = \frac{V_{\text{main}}}{Q_{\text{fill}}} = T_{\text{injection}}$$

T = Time (min) V = Volume (gal)

b) Chlorine feed rate assuming 100% available chlorine.

$$Q_{\text{fill}} \text{ (gpm)} = 1440 \frac{\text{min}}{\text{day}} \times \frac{1 \text{ day}}{24 \text{ h}} \times \frac{1 \text{ MG}}{1 \times 10^6 \text{ gal}} \times 8.34 \frac{\text{lb}}{\text{gal}} \times 100 \frac{\text{mg}}{\text{L}} = Cl_{\text{feed}} \text{ (lb/h)}$$

c) Convert Cl_{feed} to $Ca\text{-hypo}_{\text{feed}}$.

$$Ca\text{-hypo}_{\text{feed}} = \frac{Cl_{\text{feed}} \text{ (lb/h)}}{\frac{(\% \text{ available chlorine})}{100}}$$

Equation 3: Minimum Amount of Hypochlorite Solution to Treat One Pipe Volume with an Initial Chlorine Dose of 100mg/L

$$V_{\text{Cl-sol}} = \frac{100 \text{ mg/L} \times V_{\text{main}}}{\text{Conc}_{\text{Cl-sol}}}$$

$V_{\text{Cl-sol}}$ = Volume of calcium hypochlorite solution (gal).

$\text{Conc}_{\text{Cl-sol}}$ = Concentration of chlorine in the calcium hypochlorite solution in mg/L.

V_{main} = Volume of the main (gal).

Please note, a 1% chlorine solution contains approximately 10 000 ppm, or 10 000 mg/L of free available chlorine. Table 2 in Schedule 'A' provides a summary of common values.