Disinfection of Water Mains

1. Purpose

The purpose of these guidelines is to ensure that all water mains are disinfected using a process that ensures the main is totally free from bacteriological contamination. This should ensure the water main can be put into service immediately after the disinfection and water quality testing process.

Content

1. Purpose .................................................................................................................. 1
2. Scope ..................................................................................................................... 1
3. Definitions ............................................................................................................ 2
4. References ............................................................................................................ 2
5. Guideline – Disinfection of Water Mains ............................................................. 2
   5.1 Construction and Maintenance Practices ....................................................... 2
       5.1.1 Pipe Cleanliness .................................................................................. 2
       5.1.2 Cleaning ............................................................................................. 3
       5.1.3 Flooding During Construction ............................................................... 3
       5.1.4 Contamination ...................................................................................... 3
   5.2 Backflow Prevention During Disinfection or Pressure Testing .................... 3
   5.3 Chlorination Methods ..................................................................................... 3
       5.3.1 Continuous Feed Method .................................................................. 3
       5.3.2 Slug Method ...................................................................................... 4
       5.3.3 Local disinfection of Piece Ins ............................................................... 4
   5.4 Flushing the Main .......................................................................................... 4
       5.4.1 Clearing the Main of Heavily Chlorinated Water ................................. 4
       5.4.2 Disposing of Heavily Chlorinated Water .............................................. 4
   5.5 Refilling the Main ............................................................................................ 4
   5.6 Water Quality Tests ....................................................................................... 4
       5.6.1 Number of Samples ............................................................................ 4
       5.6.2 Standard ............................................................................................. 5
   5.7 Water Quality Non-compliance ..................................................................... 5
       5.7.1 Reflushing .......................................................................................... 5
       5.7.2 Rechlorinating ..................................................................................... 5
   5.8 Reticulation mains < 300mm .......................................................................... 5
6. Records .................................................................................................................. 5
Appendix ..................................................................................................................... 6

2. Scope

These guidelines are presented as basic strategies to follow when disinfecting new and existing mains. It is not intended that these guidelines apply to reticulation mains smaller than 300mm. See section 5.8.
3. Definitions

Nil

4. References

AWWA Standard for Disinfecting Water Mains - Jun 1, 2005 - Ansi/AWWA C651-05
DS60 Water Supply Distribution Standard - Pipelines Other Than Reticulation (#1596425)
DS63 Water Reticulation Pipelines DN 250 and Smaller (#1648461)
Manual: Drinking Water Sampling Procedures (#1350538)
Guideline: Disposal of Highly Chlorinated / Alkaline Disinfection Water Guideline (#1082608)

5. Guideline – Disinfection of Water Mains

This guideline describes the following steps of disinfecting a water main.
- Preventing contaminating materials from entering the water main during storage, construction and maintenance.
- Removing, by flushing or other means, those materials that may have entered the water main.
- Protecting the existing distribution system from backflow due to pressure test and disinfection procedures by physical separation and/or backflow prevention devices.
- Chlorinating to negate any residual contamination.
- Flushing and, where environmentally required, dechlorinating before disposing of the disinfectant water.
- Determining the pH and bacteriological quality after flushing disinfectant water from the main.
- Final commissioning of the water main by connecting to the existing active distribution system.

5.1 Construction and Maintenance Practices

Particulate matter may contain bacteria and prevent even very high chlorine concentrations from effectively contacting and eradicating such organisms. Therefore, it is essential that the water main and its appurtenances are thoroughly cleaned before the final disinfection by chlorination.

The water main must also be kept isolated from the distribution system until satisfactory bacteriological results are achieved.

5.1.1 Pipe Cleanliness

Precautions shall be taken to protect the interior of pipes, valves and fittings against contamination. All openings in the water main shall be closed so as to minimise the entrance of foreign material and watertight plugs shall be used to eliminate the entry of groundwater, floodwater or from other sources.

Rodent proof plugs may be used during construction when the Site Manager [or equivalent] determines that watertight plugs are not practicable, as long as thorough cleaning and flushing are carried out prior to commencement of the disinfection process.

Where faecal contamination has occurred, the area must be thoroughly cleaned and disinfected using a 20 mg/L sodium hypochlorite solution.
5.1.2 **Cleaning**

All dirt entering the pipe shall be cleaned out prior to disinfection.

The cleaning method used shall not force mud or debris into the interior joint spaces and shall be acceptable to the Site Manager [or equivalent].

5.1.3 **Flooding During Construction**

If the main is flooded during construction, it shall be drained and sprayed with a solution of 20 mg/L sodium hypochlorite before main commissioning.

5.1.4 **Contamination**

If groundwater has entered the main or if in the opinion of the Site Manager [or equivalent] foreign material has entered the new and/or existing mains, the affected mains shall be disinfected by the continuous feed or slug method of chlorination and sampled as per Section 5.6 until satisfactory results are achieved.

The extent of the contamination by the ingress of groundwater or foreign material into the main shall be delineated by the nearest shut valves in the new and existing mains.

5.2 **Backflow Prevention During Disinfection or Pressure Testing**

Temporary connections to the water main for the purposes of pressure testing, disinfection and flushing, shall at all times be equipped with appropriate backflow prevention devices, such as vacuum RCD valves, and those direct temporary connections shall be disconnected when carrying out pressure testing.

5.3 **Chlorination Methods**

Disinfection effectiveness is affected by pH. If the pH of the water being used to disinfect the main is outside the range 6.5 – 8.5 the Distribution and Systems Manager, DWQB, should be contacted to determine an appropriate minimum chlorine residual.

5.3.1 **Continuous Feed Method**

This method consists of completely filling the main with highly chlorinated water, flushing the main to remove any particulates, and filling the main with potable water. At the discretion of the Site Manager [or equivalent], calcium hypochlorite tablets shall be placed in the main during construction.

Water supplied from a properly backflow protected connection to the existing distribution system shall be made to flow at a constant, measured rate into the water main.

At the point where the potable water enters the main, it shall receive a dose of sodium hypochlorite at a constant rate, such that the water will have a free chlorine residual of not less than 20 mg/L. The table in the appendix shows the amount of sodium hypochlorite required for every 100 metres of main to be disinfected.

The application of chlorine shall not cease until the entire water main is filled with heavily chlorinated water. During this time all valves, scours and hydrants shall be operated to ensure disinfection of all appurtenances and branches.

The concentration of disinfectant will depend on the time available and the activities and type of contamination that have occurred during construction or maintenance. The lowest level of disinfection shall be 20 mg/L and the main shall be allowed to sit, with the water in it, for 24 hours before scouring.
5.3.2 **Slug Method**

This method consists of placing sodium hypochlorite liquid in the main so as to achieve a concentration of not less than 20 mg/L when the main is full. Completely filling the main to remove all air pockets and flushing the main.

1. The disinfectant shall be placed at various points along the main so as to ensure that the disinfectant reaches all parts of the main at a uniform concentration. The main should contain a small amount of potable water to dilute the disinfectant as it enters the main.

2. The main shall then be filled with potable water from the existing distribution system. As the highly chlorinated water flows through the main, all valves, scours and hydrants shall be operated to ensure disinfection of all appurtenances and branches.

3. The concentration of disinfectant will depend on the time available and the activities and type of contamination that have occurred during construction or maintenance. The lowest level of disinfection shall be 20 mg/L and the main shall be allowed to sit, with the water in it, for 24 hours before scouring.

5.3.3 **Local disinfection of Piece Ins**

No foreign material or groundwater shall come in contact with the new and existing mains and the pipe joint and surrounding area plus 1 metre either side shall be sprayed with a 20 mg/L solution of sodium hypochlorite just prior to closing up.

5.4 **Flushing the Main**

5.4.1 **Clearing the Main of Heavily Chlorinated Water**

After the appropriate retention period, heavily chlorinated water should not remain in prolonged contact with the pipe. To prevent damage to the lining or corrosion to the pipe itself, the heavily chlorinated water shall be flushed from the main until the chlorine residual in the main is no higher than that generally prevailing in the distribution system.

Note: This heavily chlorinated water shall not be used or rechlorinated to disinfect the next section of water main due to the high pH that would reduce the disinfection capability of chlorine, unless pH correction is carried out.

5.4.2 **Disposing of Heavily Chlorinated Water**

The environment into which the chlorinated water is to be discharged, shall be thoroughly inspected, and if there is any possibility that damage to the environment will occur as a result of that discharge e.g. natural water course or water body, then a neutralising agent shall be applied to the water to be wasted, to completely neutralise the chlorine residual remaining in the water. Refer to Guideline: Disposal of Highly Chlorinated / Alkaline Disinfection Water Guideline.

5.5 **Refilling the Main**

The main is to be refilled with potable water.

5.6 **Water Quality Tests**

After final flushing and before the water main is connected to the distribution system a number of samples shall be collected from the main.

5.6.1 **Number of Samples**

Depending on the length of the main, bacteriological samples may be collected from the middle, beginning and end of the main. The Service Delivery Manager (or equivalent) in the region or the Senior Water Quality Consultant, DWQB in Perth should be contacted if there is doubt. Chlorine, pH, and temperature samples shall also be taken.
5.6.2 Standard

- All samples shall be taken in accordance with the Manual: Drinking Water Sampling Procedures.
- The chlorine residual after refilling shall be comparable with the residual found in the local distribution system.
- All bacteriological samples shall show the absence of coliform organisms.
- The pH shall be no higher than 8.5. However, 9.2 is acceptable if the bacteriological results are satisfactory and the main is to be put into service immediately.

5.7 Water Quality Non-compliance

5.7.1 Reflushing

If the initial disinfection fails to produce satisfactory results, then the main may be re-flushed and shall be resampled in accordance with Section 5.6.

If bacteriological results are satisfactory but the pH level is higher than 9.2, then the main shall be re-flushed and immediately put into service.

5.7.2 Rechlorinating

If the initial refushing and bacteriological resampling fails to produce satisfactory results, the main shall be rechlorinated by the continuous feed or slug method of chlorination until satisfactory results are achieved.

5.8 Reticulation mains < 300mm

Mains smaller than 300mm shall be disinfected in accordance with the requirements detailed in DS63 Water Reticulation Pipelines DN 250 and Smaller Section 4.4.8 – Disinfection Of Water Reticulation.

6. Records

Nil

<table>
<thead>
<tr>
<th>Document Revision History</th>
</tr>
</thead>
<tbody>
<tr>
<td>21/3/2002</td>
</tr>
<tr>
<td>14/10/2005</td>
</tr>
<tr>
<td>Apr 2009</td>
</tr>
<tr>
<td>June 2012</td>
</tr>
<tr>
<td>April 2015</td>
</tr>
<tr>
<td>July 2015</td>
</tr>
</tbody>
</table>
## Appendix

<table>
<thead>
<tr>
<th>NOMINAL DIAMETER (mm)</th>
<th>VOLUME IN PIPE ML OF WATER PER 100 m OF PIPE LENGTH</th>
<th>SODIUM HYPOCHLORITE 12% AVAILABLE CL₂ USE THIS No OF LITRES PER 100 m OF PIPE LENGTH AT 100mg/L</th>
<th>SODIUM HYPOCHLORITE 12% AVAILABLE CL₂ USE THIS No OF LITRES PER 100 m OF PIPE LENGTH AT 20mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>0.007</td>
<td>6</td>
<td>1.1</td>
</tr>
<tr>
<td>400</td>
<td>0.011</td>
<td>9</td>
<td>2.0</td>
</tr>
<tr>
<td>500</td>
<td>0.018</td>
<td>15</td>
<td>3.0</td>
</tr>
<tr>
<td>600</td>
<td>0.026</td>
<td>22</td>
<td>4.5</td>
</tr>
<tr>
<td>700</td>
<td>0.036</td>
<td>30</td>
<td>6.0</td>
</tr>
<tr>
<td>800</td>
<td>0.046</td>
<td>38</td>
<td>8.0</td>
</tr>
<tr>
<td>900</td>
<td>0.059</td>
<td>49</td>
<td>10.0</td>
</tr>
<tr>
<td>1000</td>
<td>0.073</td>
<td>61</td>
<td>12.0</td>
</tr>
<tr>
<td>1200</td>
<td>0.106</td>
<td>88</td>
<td>18.0</td>
</tr>
<tr>
<td>1400</td>
<td>0.144</td>
<td>120</td>
<td>24.0</td>
</tr>
<tr>
<td>1600</td>
<td>0.187</td>
<td>156</td>
<td>31.0</td>
</tr>
</tbody>
</table>