



Palmerston North City Council

Water Supply Mains Disinfection Code of Practice

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1 Introduction

This Code of Practice has been developed to ensure that works carried out on the Palmerston North City Council water supply networks follow best practices, to preserve water quality and safeguard the water system against contamination, both chemical and bacteriological.

2 Objectives

Palmerston North City Council is required by law to ensure that the water supply system is free from conditions that may be hazardous to public health.

The objectives of the Code of Practice are to:

- Prevent contamination of the water supply system by defining the minimum requirements for the disinfection of water mains;
- Prevent contamination of the water supply system by defining the minimum requirements for the disinfection of existing water mains and fittings following planned or reactive maintenance;
- Prevent contamination of the water supply system by defining required best practices for workers and materials that come in contact with water;
- Comply with regulatory requirements under:
 - » Health (Drinking Water) Amendment Act 2007;
 - » Health and Safety at Work Act 2015;
 - » Drinking Water Standards for New Zealand 2005 (Revised 2008);
 - » Resource Management Act 1991.

Follow best practice through the Guidelines for Drinking Water Quality Management New Zealand 2005 (2017 edition)

- Minimise demerit points under the requirements of:
 - » Public Health Grading of Community Drinking Water Supplies 2003

2.1 Areas of Application

- Installation of new mains and connections;
- Reticulation repairs and maintenance;
- Service connections and meters;
- Temporary supplies;
- Repairs or modifications to pipelines or connected facilities.

2.2 Roles and Responsibilities

All water supply contractors must adhere to the Disinfection Code of Practice for all work on the Palmerston North water supply network.

Palmerston North City Council may audit the disinfection practices to ensure the Code is being followed.

Contractors shall be responsible for the annual medical clearance of their water reticulation workers. Contractors shall ensure daily that their water reticulation workers are in a medically fit condition for work. Refer to section 3.2 Water Reticulation Workers – Hygiene and Health.

Any confirmed or suspected contamination to the water supply network must be reported to the Council Engineer.

2.3 Reporting

Water supply workers shall report any gastrointestinal illness (vomiting, diarrhoea etc.) or having had gastric or viral illness within two weeks leading up to work on treated water facilities to their employer. Refer to section 3.2 Water Reticulation Workers – Hygiene and Health.

2.4 Notification

Any bacteriological transgression identified as a result of testing after repair will be investigated. A true transgression will be notified to the Mid-Central District Health Board Drinking Water Assessor by the Council Engineer.

3 Water Reticulation Workers

3.1 Approved Workers

Disinfection and testing must comply with the Palmerston North City Council Water Supply Mains Disinfection Code of Practice and must be carried out by an approved person.

Approval to work on the network is provided by the Palmerston North City Council and all approved persons are required to attend a water main disinfection and services training seminar.

3.2 Hygiene and Health

Contractors and all subcontractors employed on the maintenance or repair of existing water mains and the construction of new water mains, shall have current inoculations and must obtain medical clearance to attest that they are not carriers of any waterborne disease:

- Prior to employment on the water supply system, and on an annual basis thereafter;
- Following any gastrointestinal illness (vomiting, diarrhoea etc.);
- Following overseas travel to countries with endemic waterborne disease.

This clearance shall be obtained from a licenced medical practitioner. Until clearance is obtained workers shall be placed on work not directly involving the water supply system. A high standard of personal hygiene shall be maintained by all people employed on the water supply network.

Palmerston North City Council may require water supply workers to produce a medical clearance against being carriers of potential waterborne diseases including *Shigella*, *Salmonella*, *Campylobacter*, *Hepatitis A*, *Giardia* and *Cryptosporidium*.

Water supply workers with running/septic skin infections or wounds shall not work on the supply network unless the infection or wound is effectively dressed and in a location unlikely to be immersed.

Workers previously employed on stormwater or wastewater works (reticulation and treatment) shall not work on any water supply network until medical clearance is provided as described above and new or disinfected Personal Protective Equipment (PPE) is provided for the worker(s).

4 Disinfection of Tools, Materials and Other Equipment

4.1 Vehicles

Separate vehicles must be used for water reticulation and wastewater reticulation works.

A high standard of cleanliness shall be maintained in the interiors of all vehicles used for water reticulation works. Vehicles must be equipped with sanitary wipes or antibacterial liquid for hand sanitation when working on site.

All pipes and fittings carried in or on vehicles must be boxed, capped or sealed with plastic wrapping.

4.2 Stores

A high standard of cleanliness shall be maintained in the interior of all stores.

Water supply and wastewater equipment shall be stored separately. All materials shall be stored and handled to minimise contact with foreign materials. Fittings shall be boxed, capped, sealed with plastic wrapping. Pipe ends should be capped while in storage.

During the installation of new mains, pipes ends shall be covered up at the end of each day to prevent contamination and checked for any potential contamination when work resumes.

4.3 Tools and Equipment

Separate tools and equipment must be used for water reticulation and wastewater reticulation works.

All tools used in the construction or maintenance of the main and fittings that come into contact with the treated water must have been thoroughly disinfected and sprayed or rinsed in a minimum of 0.1% chlorine solution (0.1% = 1000mg/l or g/m³ or ppm) prior to use. Disinfected tools must not be placed on the ground prior to use.

4.4 Materials

All materials used in the construction or maintenance of mains and fittings that come into contact with the treated water must be:

- Provided sealed by the manufacturer under hygienic conditions and are not uncovered until immediately before use. Capped pipes shall be delivered to the site and stored in accordance with the manufacturers recommendations ;

Or

- Thoroughly disinfected and sprayed or rinsed using a minimum of 0.1% chlorine solution prior to use. Disinfected items must not be placed directly on the ground prior to installation.

A bactericidal lubricant complying with AS/NZ4020 shall be used on all rings and gaskets coming into contact with the reticulated water.

4.5 Disinfection and Neutralising Chemicals

A minimum 0.1% chlorine solution for disinfection of tools, equipment, fittings and materials is made up using commercially available Sodium Hypochlorite solution of 15% available chlorine. A newly prepared solution shall be made available at least weekly. The old solution shall be dechlorinated and disposed of to the wastewater network.

Refer to Appendix A for chlorine solution preparation information.

Chemical neutralising of chlorine solution (de-chlorination) should only be carried out using the chemicals listed in Appendix C.

4.6 Water Tankers for Emergency Supply of Potable Water

Any tanker used to provide emergency water supply for Palmerston North City Council customers must be a tanker water carrier that only carries Class 1 (a) water as defined by the Ministry of Health.

- Class 1 (a) is water taken from a reticulated supply that complies with the Drinking Water Standards New Zealand 2005 (revised 2008) and is listed in the Register of Community Drinking Water Suppliers and Suppliers in New Zealand.

4.7 Water Tankers for Super-chlorination

The preferred option for super-chlorination is to use water chlorination tankers, which is a tanker supplier dedicated to carry only water from a source that complies with the Drinking Water Standards New Zealand 2005 (revised 2008).

If such a supplier is not available then a truck and tanker may be used provided:

- The tanker has not previously been carrying hazardous substances. This must be confirmed with records from a carrier logbook;
- A visual inspection is done to ensure the truck and tanker is clean and free of any potential source of water contamination;
- The tanker is cleaned and flushed thoroughly using potable water prior to filling;
- That all openings and connections are protected from contamination during loading, transportation and delivery, and disinfected prior to connection;
- When the tanker is filled from the Palmerston North City Council water filling point at Francis Way a suitable backflow device must be in effect. The PNCC Water Supply Bylaw prohibits Contractors taking water from PNCC fire hydrants.

5 Work Practices

Good trade practices shall always be applied in main laying, maintenance and repair procedures.

In the event of confirmed or suspected contamination of the water supply system the immediate area shall be isolated and the event escalated to the Council Engineer.

5.1 Flushing

After reticulation repairs, the main shall be thoroughly flushed in sections, using the potable water within the network. Hydrants shall be used to produce sufficient flow velocities to remove any foreign matter that may have entered the main from the break or subsequent repair. The volume of water used for flushing should be equivalent to at least three times the pipe volume in the section being flushed. Flushing should continue until the discharged water is visually clean and has the same FAC as in the adjacent section of the reticulation.

5.2 Chlorination

Each section of new water main, including fittings and service connection pipes, shall be disinfected.

The use of hypochlorite powder, granules or tablets dumped into the pipe or through hydrants is not acceptable.

The Contractor shall ensure that:

- Personnel have chemical handling training;
- Vehicles have appropriate Safety Data Sheets;
- Personnel have appropriate Personal Protective Equipment (PPE).

The pipe shall be completely drained and then slowly refilled with potable water that has been pre-mixed with chlorine in a tanker. The water shall be tested for chlorine concentration before use and contain sufficient free available chlorine (FAC) to produce a uniform concentration of between 10 -100mg/L in the pipe.

If pre-mixed chlorinated water is not used the chlorine solution must be injected at a continuous rate to ensure a concentration of 10 - 100mg/L is in contact with every part of the main. This can be achieved by pumping in the chlorine solution or by using a chlorine injector while the main is being filled.

Refer to Appendix B for Chlorine Dosage.

Chlorinated water shall be introduced at the lowest point of the section of pipe to be disinfected to ensure no air is trapped. Chlorine shall be tested and recorded along the length of the main to ensure effective distribution of chlorine.

To ensure an effective kill of microbes a Ct value of 7200 must be achieved. That is the concentration of the disinfectant (C) x the contact time in minutes (t). For example, with a chlorine concentration of 10mg/L the required contact time is 12 hours. Similarly, the contact time is 72 minutes at 100mg/L FAC. For practical purposes a suitable concentration should be selected so the main can be disinfected and the sample taken in the same working day. The pH shall also be tested and recorded.

Chlorine is to remain in the main for sufficient time to ensure a Ct value of 7200 is achieved. Contact time is calculated from:

$$7200 \div \text{Free Available Chlorine (FAC) concentration} = \text{Required time in the main in minutes}$$

The effectiveness of hypochlorite as a disinfectant is greatly reduced at pH levels above 8.0. The various water supplies under the Council jurisdiction have a pH range of 7.4 to 8.0. A pH level greater than 8.6 will not be accepted as compliant with the disinfectant requirements and the whole disinfection process must be repeated.

After the required contact time, the chlorine residual concentration must be at least 10mg/L and must be less than 100mg/L. If this requirement is not achieved, the chlorination procedure shall be repeated. Once the chlorination level is achieved the main and service connection pipes shall be flushed until the chlorine concentration of the water is between 0.2mg/L and 1.0mg/L FAC.

Water mains shall be flushed with water equivalent to three pipe volumes of section being flushed. Refer to Section 5.5 for disposal of super-chlorinated water.

The water main must be kept continually charged and remain under pressure until a permanent connection is made.

5.3 Bacteriological Sampling

Bacteriological samples shall be obtained before a new water main is put into service or a repair has been made where the pipe has been depressurised.

All water sampling for bacteriological testing is to be undertaken by the Contractor under the supervision of Council Staff or taken by Council staff if it has been agreed.

Samples are to be tested for:

Parameter	Acceptable value
E. coli	<1 per 100mL
Total Coliforms	<1 per 100mL

The tests shall be performed by an IANZ Accredited laboratory.

A copy of the test results is to be provided to the Council Engineer prior to any connection with the existing reticulated network.

If the required test results are not achieved the Council Engineer should be notified to identify remedial steps.

5.4 Disposal of Super-Chlorinated Water

Prior to discharge of chlorinated water from a disinfection process the chlorine in the main must be neutralised before the water is discharged to the receiving environment. Discharging large volumes of water into smaller watercourses may need some care to

avoid any erosion or damage to the watercourse or natural vegetation that may be present.

Discharge of water with a residual chlorine concentration into a wastewater service must meet Trade Waste requirements.

5.4.1 Chemical neutralisation or dechlorination

Refer to Appendix C for Dechlorination using sodium thiosulphate.

5.4.2 Chemical neutralisation with dechlorination mats

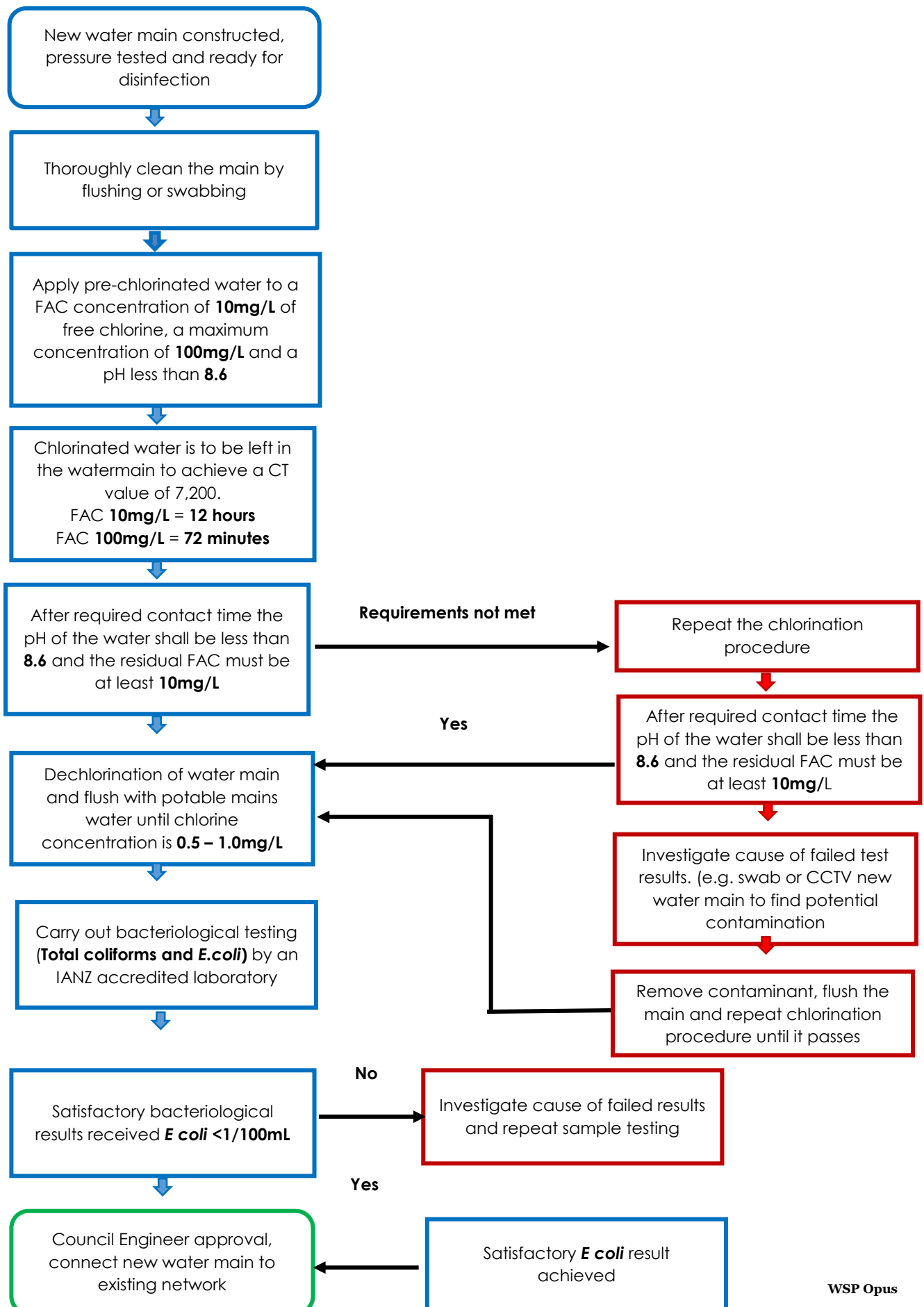
Dechlorination mats must be placed such that the channelled water does not flow outside the span of the mat, but still cover the full channel width. The channelled flow must be long enough to ensure proper mixing with Sodium Sulphite or Ascorbic Acid tablets. Typically, channelled flow height should not be more than 50mm. Sampling must be taken at least 10m downstream of the mat.

5.4.3 Chlorine dissipation

This alternative method is dealing with super-chlorinated water allows the chlorine to dissipate.

Capture the disinfected water on site prior to the discharge of chlorinated water (e.g. use a tanker). It is suggested the water is kept contained for a minimum of 2 days until the FAC is reduced to the acceptable level to allow disposal to the receiving environment or the wastewater network.

5.5 New Mains and Service Connections



5.6 Planned or Emergency Repairs

5.6.1 Repairs maintained under positive pressure

For small to medium sized leaks where there is no possibility of flow through the leak being sufficient to cause suction elsewhere in the reticulation, maintain positive pressure in the pipe to ensure that there is no opportunity for contaminated water to enter the pipe.

Excavate to below the leak and ensure trench water is kept below the pipe level prior to cutting the water off and commencing work. Draining of the line should be completed through the break into the trench. Dewatering may be necessary to control the water level. On no account should nearby hydrants or other outlets be used to assist in controlling pressure or drain the accumulated water from around the leaking section.

Ensure all surfaces of fittings and exterior of the water main are sprayed with 0.1% chlorine solution.

Following the repair, the main and consumer connections adjacent to the repair are to be thoroughly flushed.

5.6.2 Repairs under loss of pressure or possible contamination

Isolate section of main and drain through the break. Excavate to below the leak and ensure trench water is kept below the pipe level prior to cutting the water off and commencing work. Draining of the line should be completed through the break into the trench. Dewatering may be necessary to control the water level. Ensure that all pipe fittings and trench walls are disinfected using 0.1% chlorine solution.

Is contamination of the main likely?

Contamination of the main should be considered likely if:

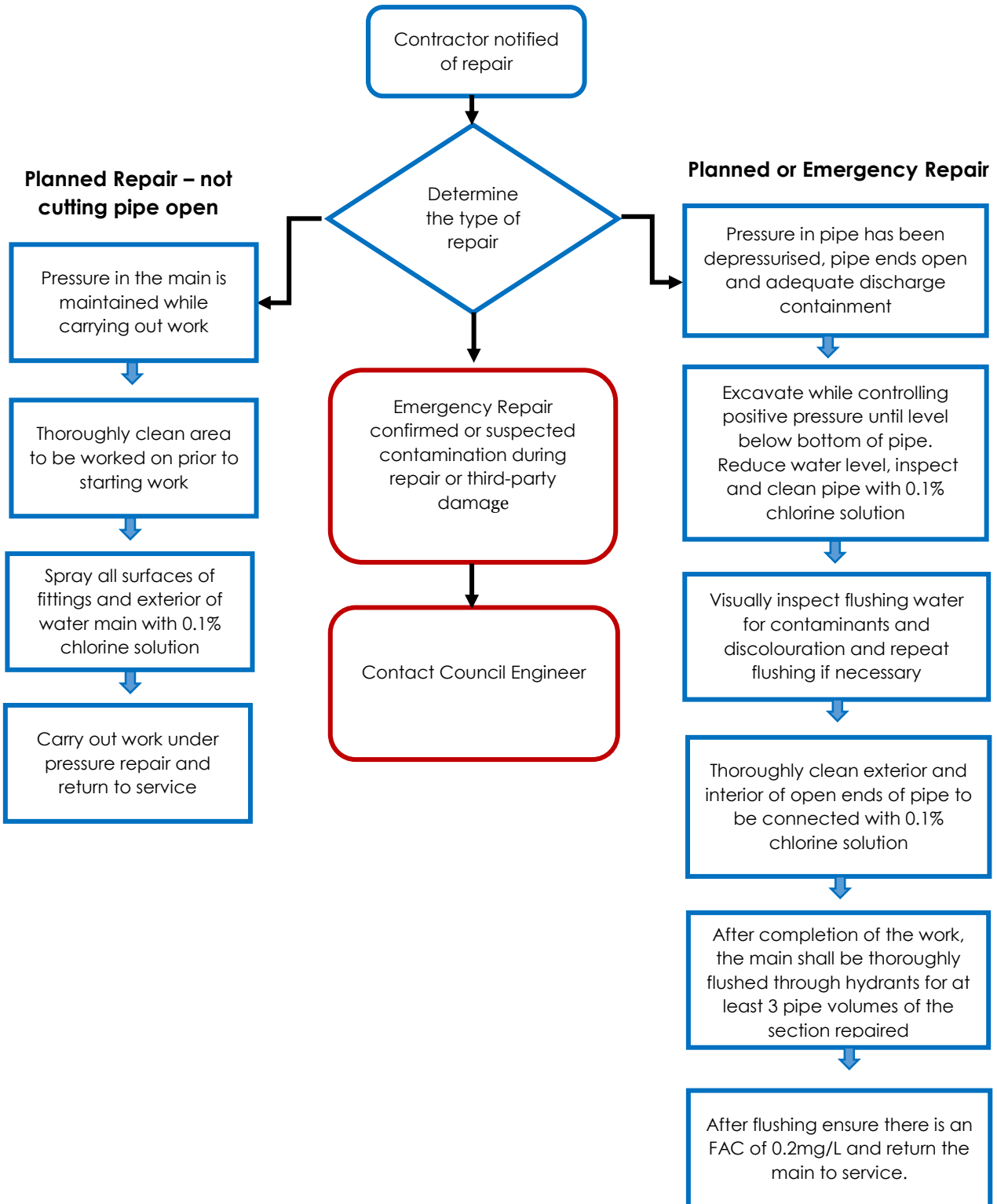
- there has been a large diameter mains rupture, causing flow levels which may have resulted in backflow occurring in nearby areas,
- any adjacent outlets such as fire hydrants have been used to assist in pipe line drainage or reducing pressure,
- if the mains pressure has been completely removed before the water level in the trench has dropped and been held below the level of the pipe.
- if any potentially contaminated water or material from any other source has been able to enter the pipe.

If contamination is likely;

- After repairing the main, apply chlorine to the main to achieve a Ct of 7200 (refer to section 5.2).
- If a boil water notification is issued due to lack of time or difficulty in the repair process, some chlorine should be applied to the main. If chlorinated water is to be conveyed to consumers the maximum FAC to be applied shall be 5mg/L.

Is mains contamination unlikely?

- If mains contamination is unlikely or if the repair is urgent, then all attempts should still be made to prevent ingress of contaminants. All accessible areas of the pipe exterior, interior and fittings should be thoroughly cleaned with a 0.1% chlorine solution.
- Thoroughly flush the main (refer to section 5.1) and effected consumer connections to waste and a FAC of 0.2 mg/L is achieved before returning to service.



6 Appendices

Appendix A – Chlorine Solution Preparation

Appendix B – Chlorine Dosing

Appendix C – De-chlorination

6.1 Appendix A – Chlorine Solution Preparation

Preparation guidelines for the preparation of a 0.1% chlorine solution using sodium hypochlorite at 15% strength.

Table 1 – Amount of 15% sodium hypochlorite solution required to be mixed with water to make a 0.1% solution

Volume of 0.1% solution required (L)	Amount of 15% sodium hypochlorite solution to be mixed with water (mL)
10	67
20	133
50	333
100	667

Calculated: We want 10L of 0.1% = 10L of 1000 mg/L = 10,000 mg

$10,000 \text{ mg} \div 150,000 \text{ mg/L (or 15\%)} = 0.067 \text{ L} \times 1000 = 67\text{mL}$

6.2 Appendix B – Chlorine Dosing

Amounts of Sodium Hypochlorite shown in Table 2 below are calculated to produce chlorine concentration of 10mg/L and 100mg/L per 1m length of main:

Table 2 – Chlorine Dosing

Pipe Nominal Diameter (mm)	Volume of water per 1m length of pipe (L)	Volume of 12% Sodium Hypochlorite (mL)		Volume of 15% Sodium Hypochlorite (mL)	
		10mg/L	100mg/L	10mg/L	100mg/l
50	2	0.16	1.6	0.13	1.3
75	4.4	0.37	3.70	0.29	2.9
100	7.9	0.66	6.58	0.52	5.2
150	17.7	1.48	14.8	1.18	11.8
200	31.4	2.60	26.0	2.09	20.9
250	49.1	4.1	40.9	3.27	32.7
300	70.7	5.89	58.90	4.71	47.1
400	125.6	10.5	104.7	8.37	83.7
500	196.3	16.36	163.6	13.09	1309
600	282.6	23.55	235.5	18.84	188.4

6.3 Appendix C – Dechlorination

Chemical neutralisation as a method of de chlorination involves dosing the water as it is being discharged from the main. The most effective and common used chemical to achieve dechlorination is Sodium Thiosulphate although there are other alternatives:

Table 3 – Chlorine Neutralisation Chemicals

Chemical Name	Chemical formula	Solubility
Sodium thiosulphate pentahydrate	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$	200g/L
Anhydrous Sodium sulphite	Na_2SO_3	26.9g in 100mL of water 20°C
Sodium Sulphite heptahydrate	$\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$	30g/100mL

6.3.1 Preparing a de-chlorinating solution

Prepare a 15% w/v solution of any of the above three chemicals, the following steps should be taken:

1. Fill the solution tank approximately 2/3 full of water,
2. Add the required amount of neutralising chemical into the tank as specified in Table 4,
3. Mix the solution until the added chemical has dissolved,
4. Add the remainder of the water and mix,
5. Stir periodically to avoid the solution stratifying.

Table 4 – Amount of chemical required for de-chlorination

Solution Volume (L)	1% Sodium Thiosulphate (kg)	5% Sodium Thiosulphate (kg)	15% Sodium Thiosulphate (kg)
100	1.0	5	15
200	2.0	10	30
300	3.0	15	45
400	4.0	20	60
500	5.0	25	75
1000	10.0	50	150

6.3.2 Dechlorinating super-chlorinated water

Table 5 – Amount of sodium thiosulphate to dechlorinate a chlorine dose of 10mg/L per metre length of pipe, based on 3 times the amount of thiosulphate to that of chlorine.

Pipe Nominal Diameter (mm)	Volume of Sodium Thiosulphate required in mL		
	1%	5%	15%
50	5.9	1.2	0.4
100	24	4.7	1.6
150	53	10.6	3.5
200	94	18.8	6.3
250	147	29.5	9.8
300	212	42.4	14
400	377	75.4	25
500	589	118	39.3
600	848	170	56.5



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