

**Code of Practice for
Disinfection of Water Systems**

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Definitions

DWSNZ	Drinking Water Standard of New Zealand
ESF	Engineering Standards Framework
FAC	Free available chlorine
Local network	Water local networks cover the reticulated distribution system from the transmission system to each property
Transmission network	Transmission network system covers the bulk conveyance of water to reservoir storage or to bulk supply points. Customers are not typically supplied directly from transmission systems
Water supply system	Watercare transmission and local network potable water supply system

Abbreviations

CCTV	Closed circuit television
DWSNZ	Drinking Water Standards of New Zealand 2005 (revised 2008)
FAC	Free available chlorine
kPa	Kilo Pascal
l or L	Litre
l/s	Litres per second
m	Metre
mg/l	Milligram per litre
ml	Millilitre
MPN	Most probable number
SDS	Safety data sheet
PPE	Personal protective equipment

1 Introduction

Watercare monitors the water quality throughout Auckland on a daily basis to ensure a minimum residual level of chlorine is maintained. A minimum level of chlorine of 0.2mg/l is required to act as a barrier to contamination and meet the requirements of the Drinking Water Standards of New Zealand (DWSNZ).

Potable water is supplied from the water treatment plants, however in some locations chlorine levels are boosted within the network.

Works carried out on the water supply network shall follow best practices as outlined in this Code of Practice in order to preserve water quality and safeguard the water system against contamination, both chemical and bacteriological.

2 Objectives

Water supply authorities are required by law to ensure that the water supply system is free from conditions that may be hazardous to public health. The Health (Drinking water) Amendment Act 2007 requires drinking water suppliers to take all practicable steps to ensure they provide an adequate supply of drinking water that complies with the New Zealand drinking water standards.

The objectives of the Code of Practice are to:

- a) Prevent contamination of the water supply system by defining the minimum requirements for the disinfection of new watermains.
- b) Prevent contamination of the water supply system by defining the minimum requirements for the disinfection of existing watermains and fittings following planned or reactive maintenance.
- c) Prevent contamination of the water supply system by defining required best practices for workers and materials that come in contact with water.
- d) Comply with regulatory requirements under:
 - Health (Drinking Water) Amendment Act 2007
 - Drinking Water Standards for New Zealand 2005 (Revised 2008)
 - Health and Safety at Work Act 2015
 - Resource Management Act 1991
- e) Follow best practice through the Guidelines for Drinking Water Quality Management for New Zealand 2005 (2016 edition).
- f) Minimise demerit points under the requirements of the Public Health Grading of Community Drinking Water Supplies 2003.

2.1 Areas of Application

- Installation of new mains and connections
- Reticulation repairs/maintenance
- Valve and hydrants inspections/repairs
- Reticulation inspections involving cutting of live mains
- Service connections and meters
- Temporary supplies
- Repair work or modification work on pipeline or connected facilities
- Water pump stations
- Reservoirs
- Transmission pipeline specific requirements
- Treated Water tanks at water treatment facilities

- Contact tanks

2.2 Deviation from standard procedures

Where there are deviations from the procedure, for example during emergency works, these works shall be fully documented with supporting information showing the alternative disinfection procedures utilised and the reasons for deviations from the standard procedures. Any changes from the standard procedure needs to be approved by the appropriate service delivery area manager prior to the disinfection being undertaken.

2.3 Roles and Responsibilities

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

Supervisors shall audit the disinfection practises to ensure the Code is being followed. Records must be kept of audit results.

Contractors shall be responsible for annual medical clearance of their water reticulation workers. Contractors shall ensure that their water reticulation workers are medically fit for work on a daily basis. Refer to [section 3.2](#) Water Reticulation Workers – Hygiene and Health.

Any problems or transgressions from the outlined procedures must be reported to the appropriate Watercare service delivery area manager without delay.

Any confirmed or suspected contamination to the water supply network must be escalated to the appropriate Watercare service delivery area manager. The area manager will then manage the incident according to the Watercare Incident Management Plan, the Watercare Water Quality Incident Response Plan and relevant Water Safety Plan.

The responsibilities of the service delivery area manager and delegated representatives are to:

- Be satisfy that disinfection of facilities is being undertaken in compliance with written procedures
- Identify any special conditions or restrictions applicable to the disinfection procedure
- Maintain a record of all disinfected facilities in their relevant area of authorisation

2.4 Reporting

Water supply workers shall report any gastrointestinal illness (e.g. vomiting, diarrhoea) or having had a 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. Medical clearance shall be provided.

All microbiological test results must be sent to the appropriate Watercare Service Delivery Manger for assessment and approval before connection work may progress.

2.5 Notification

Any perceived bacteriological transgression identified as a result of testing will be investigated by Watercare. Proven transgressions will be notified to the Auckland Drinking Water Assessor by the Watercare Water Quality and Compliance Analyst.

If E.coli contamination is detected Watercare will follow internal procedures and notify customers as required for any precautionary measures to be taken.

2.6 Assessment of Level of Risk

Disinfection is key to preventing contamination of the water supply during maintenance but isn't a substitute for incorrect procedures and poor practices.

The level of risk shall be assessed for all work carried out on the water supply system. In a local networks situation the contractor shall assess the risk of contamination on a case-by-case basis using the procedure in [section 8.1](#) and then follow the corresponding recommended disinfection procedures outlined in [sections 8.2 to 8.5](#). For transmission areas all risks are referred to the transmission service delivery point of contact for a bespoke assessment in all instances.

The procedure for work and requirement for bacteriological testing depends upon the level of risk of contamination to the water supply system.

3 Water reticulation workers

3.1 Qualifications

Water supply workers shall have completed the Level 3 National Certificate in Water Reticulation – Service Person Qualification. As a minimum the site supervisor or foreman shall hold this qualification and supervise all disinfection practises.

3.2 Hygiene and Health

Workers employed on the maintenance or repair of existing watermains and the construction of new watermains shall have current inoculations and must obtain medical clearance to attest that they are not carriers of any waterborne disease:

- a) prior to employment on the water supply system, and on an annual basis thereafter
- b) following any gastrointestinal illness (vomiting, diarrhoea etc.)
- c) 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.

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

Watercare may at any time require water supply workers to produce a medical clearance against being carriers of potentially waterborne diseases including *Shigella*, *Salmonella*, *Campylobacter*, *Hepatitis A*, *Giardia* and *Cryptosporidium*.

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

4 Disinfection of tools, material 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 fittings carried in vehicles must be boxed, capped or sealed with plastic wrapping. All pipes must be capped.

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 or sealed with plastic wrapping. All pipes shall be capped.

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 0.1% chlorine solution (1,000 mg/l) prior to use. Larger items of plant and equipment including excavators shall be steam cleaned before use on potable water works. Disinfected tools must not be placed directly on the ground prior to use.

4.4 Materials

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

1. provided sealed by the manufacturer under hygienic conditions and are not uncovered until immediately before use,

Or

2. thoroughly disinfected and sprayed or rinsed in a minimum 0.1% chlorine solution (1,000 mg/l) prior to use. Disinfected items must not be placed directly on the ground prior to installation.

All materials used must comply with Watercare's material standards. A bactericidal lubricant complying with AS/NZS4020 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% solution for disinfection of tools, equipment, fittings and materials is made up of 1 part chlorine solution (i.e. commercially available Sodium hypochlorite solution of 12-15% available chlorine) to 9 parts water and shall have a pH value of between 7 and 8. A newly prepared solution shall be made available at least weekly and the old solution disposed of after dechlorination

Chemical neutralising of chlorine solution (dechlorination) should only be carried out using the chemicals listed in [Appendix D](#).

4.6 Standpipes

All standpipes must be metered and fitted with a suitable backflow prevention device. Standpipes used by Watercare Service Delivery are not required to be fitted with a meter.

4.7 Water Tankers for Emergency Supply of Potable Water

Any tanker used to provide emergency water supply for Watercare 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 DWSNZ and is listed in the Register of Community Drinking water Supplies and Suppliers in New Zealand.

Note: Water tanker suppliers engaged by Watercare directly or Watercare contractors must be currently registered on the Ministry of Health Register of Community Drinking-water Supplies and Suppliers under the Class 1(a) category. Refer to the Ministry of Health website: www.moh.govt.nz/water

4.8 Water Tankers for Super-chlorination

The preferred option for water chlorination tankers is a tanker supplier dedicated to carry only water from a source that complies with the Drinking Water Standards New Zealand 2005.

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

- a) The tanker has not previously been carrying hazardous substances and must be confirmed with records from the carrier logbook.
- b) A visual inspection is done to ensure the truck and tanker is clean and free of any potential source of water contamination.
- c) The tanker is cleaned and flushed thoroughly using potable water prior to filling.
- d) That all openings and connections are protected from contamination during loading, transportation and delivery.
- e) When the tanker is filled from the Watercare network a suitable backflow prevention device must be fitted to the standpipe, refer to [section 4.6](#).

4.9 Bottled Water

All bottled water given to customers shall be supplied by Watercare. Bottles must have sealed caps and be stored as per the supplier's instructions, out of direct sunlight, and not used beyond the expiry date.

5 Work Practises

Good trade practices shall be applied at all times in main laying, maintenance and repair procedures.

In the event of a confirmed or suspected contamination of the water supply system the immediate area shall be isolated and escalated to the appropriate Watercare Service Delivery Area Manger.

All connecting valves used to isolate the reticulated water from a main being disinfected shall be tagged and recorded by the site supervisor responsible for the disinfection and signed off at re-commissioning.

5.1 Backflow Prevention Devices for Temporary Connections

All temporary connections of reticulated water to mains under construction and/or maintenance shall incorporate testable double check backflow prevention devices. This includes water being used for hydrostatic pressure testing, flushing and disinfection. See Figure 5.1 below for a recommended temporary set up.

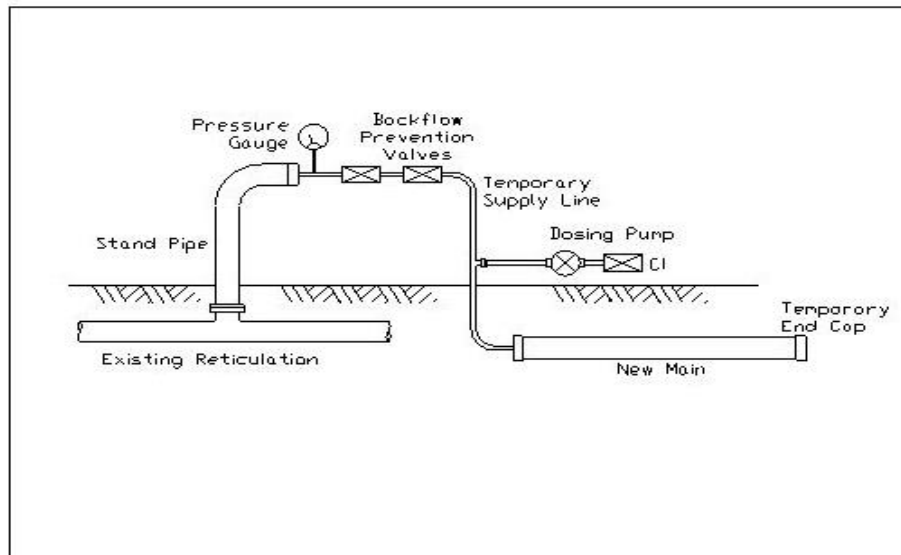


Figure 5.1: Suggested temporary flushing /dosing connection

For permanently installed backflow prevention devices refer to the Water NZ – Boundary backflow prevention for drinking water supplies, Part 2 – Code of Practice for Boundary Backflow Prevention, and the Watercare Code of Practice for Land Development and Subdivision, Chapter 6, Water.

5.2 Air Scouring

During a programme of air scouring the contractor shall ensure:

- a) A trial shutdown is completed and shutdown notifications distributed to ensure scouring operations do not adversely affect public health.
- b) All valves to be operated must be operable to contain scour waters.
- c) All service connections, where possible, are isolated before air scouring.
- d) All fittings and equipment must be disinfected with minimum 0.1% chlorine solution prior to use.
- e) The compressor pressure shall be set at 200KPa less than the mains pressure to eliminate any risk of backflow.
- f) All mains must be purged of scour waters following the air scouring to ensure mains are returned to service in a hygienic state.
- g) Scour water shall be filtered through a 12 micron filter bag to the Auckland Council requirements and discharged to the stormwater system. The scour water shall be dechlorinated to below 0.02mg/l.
- h) Chlorine residual sampling must be undertaken post scouring to confirm that sufficient disinfection (Watercare require minimum 0.5 mg/l of chlorine) is maintained before re-commissioning the scoured water mains.

6 Local networks new watermains disinfection procedure

Connecting a new network watermains to the existing reticulation is not permitted until all requirements in the following sections have been successfully completed. Refer to Figure 14.1 in [Appendix A](#) for the disinfection process flowchart.

6.1 Flushing

The main shall be thoroughly flushed in sections through hydrants, producing sufficient flow velocity to remove all foreign matter. The volume of water used must be equivalent to at least three pipe volumes. The flow of water shall be from one direction at a time and depending on the position of the flushing point(s), flushing may be required to alternate between opposite directions to ensure all of the water is completely flushed out of the pipe. The main ($\geq 50\text{mm}$ internal diameter) shall be CCTV inspected and the CCTV report verified as completely free of debris and any pipe shavings before starting chlorination. Flushing guidelines are provided in [Appendix B](#).

6.2 Chlorination

Each section of new watermain, including all fittings and service connection pipes, shall be disinfected within 10 days before being placed into service.

The pipe shall be drained completely and then slowly filled 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 25 to 50 mg/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 25 to 50mg/l is in contact with every part of the main (Refer to [Appendix C](#) for chlorine dosage). This can be achieved by pumping in the chlorine solution or by using a chlorine injector while the main is being filled with water.

The chlorinated water shall be introduced at the lowest point of the section of pipe to be disinfected to ensure that no air is trapped. Chlorine levels shall be tested and recorded along the length of the main at a minimum of 150m intervals to ensure effective distribution of the chlorine.

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

After 24 hours contact time the pH of the water shall be recorded. The effectiveness of hypochlorite as a disinfectant is greatly reduced above pH 8.0. A pH level greater than 9.0 will not be accepted as compliance with the disinfectant requirements and must be repeated using a solution with a pH less than 9.0.

After 24 hours the residual chlorine concentration must be at least 20mg/l. If this requirement is not achieved, the chlorination procedure shall be repeated. Once this requirement is achieved, the main and service connection pipes shall be flushed until the chlorine concentration of the water is between 0.5 to 1.0 mg/l (test required). Watermains shall again be flushed with water equivalent to three pipe volumes. Refer to [section 12](#) for disposal of super-chlorinated water.

Testing takes approximately 24 hours to complete and the main must be connected within 10 days of an acceptable result. Refer to [section 13](#) for test sample results. The watermain must remain charged during this time to prevent contamination.

The test results must be forwarded to Watercare Service Delivery, see [Appendix E](#) for forms.

6.3 Local Network new main connection

The connection of a new main to existing reticulation may be treated as a medium risk (refer to [Section 11.1](#) for risk classification) situation provided sanitary construction procedures are followed ensuring no contamination of either the new or existing main by foreign material or groundwater.

If the newly chlorinated main has not been connected to the existing reticulation within 10 days of chlorination, the main shall be retested for E.coli as per the initial testing. If any of the new samples fail the E.coli test the disinfection procedure must be repeated

New local network main connection procedure:

1. Excavate trench and dig sump under the section of the existing pipe to be removed to allow for the connection. The sump shall be of a depth at least 400mm.
2. Confirm that the new pipe is clear of all foreign matter and clean e.g. CCTV.
3. Shutdown and drain the connecting watermain in accordance with good practice.
4. Thoroughly clean and disinfect existing connecting pipework/fittings.
5. Any new fittings to be installed shall be kept clear of the surrounding trench material and when unwrapped placed on a clean surface (e.g. impervious plastic sheet) until installed.
6. Spray all surfaces of fittings, and wipe the interior of open ends of the new and existing watermains with a minimum 0.1% chlorine solution (Refer to [Section 4.5](#)).
7. After completion of the work, the watermain must be flushed out through hydrants downstream of the new connection. The volume of water used must be equivalent to at least three pipe volumes.

7 Local network temporary watermains disinfection procedures

When a project requires the use of a temporary watermain, all temporary fittings shall be disinfected as per [section 4.4](#) prior to connecting to the existing system (refer to Figure 14.2 in [Appendix A](#)).

7.1 Flushing

The temporary watermain shall be flushed with a volume of water equivalent to three pipe volumes of the temporary supply and flushed through all practical outlets to remove any foreign materials that may have entered during storage. The main (>100mm internal diameter) shall be CCTV inspected before chlorination. Refer to [Appendix B](#) for flushing volumes.

7.2 Chlorination

The temporary watermain and fittings shall be disinfected with a chlorine dose of 100 mg/l for a minimum period of 30 minutes. After the 30 minute contact time the water within the temporary watermain shall be retested and the residual FAC must not have dropped by more than 20mg/l. Field tests are acceptable as confirmation of the dosage.

The test results must be forwarded to Watercare Service Delivery, see [Appendix E](#) for forms.

Disposal of the super-chlorinated water shall be in accordance with the guidelines given under [section 12](#) for disposal of super-chlorinated Water.

7.3 Post Chlorination Flushing

The watermain shall be thoroughly flushed in sections from an alternative potable water source with sufficient velocity of water to remove all foreign matter. The volume of water used must be equivalent to at least three

pipe volumes. The final flushing water shall be tested for residual chlorine levels and must be between 0.5 to 1.0mg/l.

The test results must be forwarded to Watercare Service Delivery, see [Appendix E](#) for forms.

8 Local Network Disinfection Procedures for Emergency and Planned Repairs

Note: All Transmission risk scenarios are bespoke and determined on a case by case basis by Watercare Service Delivery. This section applies to local networks only.

8.1 Risk of Contamination

The procedure for work and requirement for bacteriological testing (refer to Figure 14.3 in [Appendix A](#)) depends on the level of risk of contamination to the network as per table 8.1.

All high risk situations require bacteriological testing and must be escalated as an incident to the Watercare service delivery area manager. Bacteriological test results are required before the service is placed into operation.

8.2 Local Network High Risk Situations

High risk situations are where confirmed or suspected contaminant (liquid or solid) material has made contact with the cut area of pipe or has entered the pipe or fitting, i.e. contamination has occurred via sewer, hydrocarbons, chemicals, or large amounts of ingress has occurred in the pipe.

The recommended procedure is:

- a) Escalate this incident to the appropriate Watercare service delivery area manager.
- b) Isolate the watermain to prevent further travel of the contaminated water.
- c) Isolate all affected service connections.
- d) If a service connection cannot be isolated the customer must be advised not to use water until the main has been commissioned.
- e) Tag and record all valves used to isolate.
- f) Ensure the groundwater remains well below the invert of the open pipe.
- g) Isolate and/or remove the contaminant.
- h) Thoroughly clean exterior of pipe and fittings to be connected prior to starting the repair.
- i) Wipe the interior of the open ends of the existing pipe and the new pipe with a clean rag or foam plug soaked in a minimum 0.1% chlorine solution. Wipe or spray fittings prior to installation with a minimum 0.1% chlorine solution (refer to [section 4.5](#)). Place disinfected materials onto a clean surface e.g. an impervious plastic sheet, not directly onto the ground.
- j) Water used for flushing must be fed using a remote hydrant or water tanker; not through a valve used to isolate the area.
- k) The remote hydrant or tanker used for filling the contaminated pipe should be fitted with a non-return valve or non-return configuration piping to prevent backflow of super-chlorinated water into the reticulation.
- l) After completion of the repair work the main shall be thoroughly flushed. The volume of water used must be equivalent to at least three pipe volumes. The main must be slowly charged from a remote hydrant or tanker while flushing from an open hydrant as close as possible to the opposite end.
- m) To ensure effective distribution of the chlorine, the watermain shall be charged using pre-chlorinated water to a level of 125 to 150 mg/l. When the highly chlorinated water is detected at the flushing

hydrant, close the charging valve. The sample shall be tested for Free Available Chlorine with an IANZ certified laboratory.

- n) Leave the section isolated for 60 minutes.
- o) For safe disposal of the super-chlorinated water the procedure given in the [section 12](#) must be followed.
- p) Flush the section as per the flushing guidelines ([Appendix B](#)).
- q) Check that the chlorine concentration is in the range of 0.5 to 1.0mg/l. Continue flushing if the chlorine concentration is outside this range.
- r) After flushing, obtain a water sample for bacteriological testing downstream of the repair from a hydrant or a tapping point.
- s) If in doubt of the direction of flow, take a sample from both sides of the repair.
- t) Customers' service connections are to remain closed until the results of the bacteriological testing is received by the Watercare service delivery area manager.
- u) The Watercare service delivery area manager must approve the re-commissioning of the watermain into service including the opening and flushing of the customers' service connections until the chlorine concentration is in the range of 0.5 to 1.0mg/l.
- v) All tagged valves must be signed off and reinstated following completion of the work.
- w) All actions taken during a High Risk situation must be recorded.

8.3 Bacteriological Sampling Procedure

Samples shall be obtained before the watermain is put back into service and be within the limits as per [section 13](#).

For Medium Risk situations, the existing main may be returned to service prior to the completion of laboratory bacteriological sampling in order to minimise disruption to customers. Interim site testing is required as a minimum.

For high and medium risks sampling **must** be done by an IANZ certified laboratory and sampled for: Chlorine Residual, pH, turbidity, E.coli, Total Coliforms and HPC.

Sampling must be completed by suitably trained personnel only. Where a maintenance contractor has appropriately trained personnel, samples obtained after hours for low risk may be refrigerated and stored at the maintenance contractor's premises until the laboratory opens the following day. E.coli must be analysed within 24 hours to be a valid test.

During working hours samples shall be delivered to the IANZ certified laboratory within 2 hours of the sample being collected.

9 Reservoir disinfection procedure

Additional guidance for reservoir disinfection is provided in AWWA Standard ANSI/AWWA C652-02 for "Disinfection of Water-storage Facilities". This document is available from the Watercare Services library to internal personnel.

9.1 Initial disinfection

The reservoir shall be thoroughly cleaned out and then inspected by an authorised Watercare Service Delivery representative. Disinfection shall not commence until Watercare's approval to proceed.

All equipment used in the disinfection of reservoirs, including air compressors for stirring the reservoirs, must be oil free and maintenance records for the equipment must be provided. It is not acceptable to use hire equipment for disinfecting reservoirs.

For Transmission Reservoirs:

All water transmission reservoirs will be filled and chlorinated by Watercare. Contractors are not authorised to operate valves on the transmission network.

For Network reservoirs:

Network reservoirs shall only be filled and chlorinated by a Watercare authorised contractor. The reservoir shall be partially filled to a depth of two metres with potable water supplied by Watercare via the inlet pipeline. All inlet and outlet valves on the reservoir shall then be isolated, and if practical locked, prior to disinfection starting.

Sufficient chlorine shall be added to result in a residual chlorine concentration of 2mg/l and the water left to stand for minimum 24 hours.

9.2 Reservoir filling

The chlorine concentration shall be measured at the end of the initial period and if required additional chlorine shall be added as the reservoir is filled to 100% full. The final chlorine concentration shall be within the range of 0.5 to 1.0mg/l. The reservoir shall be filled in such a way that the water is well mixed.

Chlorine tests shall be carried out with samples taken from both top and bottom sample points to confirm the actual residual chlorine concentration. If the concentration is less than the specified level, further chlorination and mixing shall be undertaken until this concentration is achieved.

9.3 Sample results and remedial actions

Having achieved the required chlorine concentration from both sample points, the water shall be sampled by an IANZ certified laboratory as early as practicable.

Samples shall achieve the acceptable results in accordance with [section 13](#) before the reservoir is placed into service. The reservoir shall be re-chlorinated and tested until the acceptable chlorine concentration level is achieved.

The test samples typically take 24 hours to process. In some instances express samples may be required (indication test) where a reservoir must be returned to service sooner. Express samples must be authorised by the Watercare service delivery area manager.

Upon completion of the procedure and the return of the reservoir to service, the documentation ([Appendix E](#)) shall be completed for networks reservoirs and provided to Watercare for record keeping. Transmission reservoirs are tested internally with using a laboratory specific form.

10 Transmission new watermain disinfection procedure

10.1 Filling and chlorination

The new watermain shall be cleaned out and inspected. The main (>100mm internal diameter) shall be CCTV inspected before chlorination.

The watermain shall be filled with potable water and sufficient chlorine added to provide a chlorine residual of minimum 5mg/l when the watermain is full. The pipe shall be filled from the lowest point and air released to prevent pockets with no contact. The method of filling shall be such that the chlorine concentration is consistent when measured at a minimum of three of points along the watermain. For pipelines longer than 500m the number of sampling points shall be nominated by Watercare Service Delivery.

Once filled, the pipeline shall be isolated to prevent any water loss and left to stand for 24 hours.

The chlorine concentration is measured at the end of this period and shall be minimum 4mg/l when measured at each end of the section being disinfected. Further chlorination and mixing shall be undertaken until the minimum residual chlorine concentration is met.

The pipeline shall be emptied and the ingress of any contaminants prevented. Refer to [section 12](#) for disposal of super-chlorinated water. The pipe is then refilled with potable water and sampled for micro-biological testing at both ends of the watermain by an IANZ certified laboratory as early as practicable, refer to [section 13](#). The watermain should be flushed until the chlorine levels are at the same level as the incoming water. This needs to be completed prior to the final microbiological testing being undertaken. The flushing is to ensure that pockets of highly chlorinated water in the watermain are flushed prior to the watermain being put into service.

10.2 Sample results and remedial actions

Testing takes approximately 24 hours to complete. The watermain must remain charged during this time to prevent contamination.

Further chlorination and mixing shall be undertaken until the minimum residual chlorine concentration is met. Seek advice from Watercare Service Delivery for other remedial steps if further chlorination is unsuccessful.

Upon completion of the procedure and commissioning of the watermain, the documentation ([Appendix E](#)) shall be completed and submitted to the Watercare service delivery area manager.

11 Transmission existing watermain disinfection procedure

11.1 Cleaning and initial filling

The pipe shall be cleaned out, flushed and then inspected. The main (>100mm internal diameter) shall be CCTV inspected before chlorination.

The areas of the watermain that have been worked on shall be swabbed with a water solution containing 3% chlorine.

11.2 Chlorination, sampling and remediation

Following swabbing, the watermain shall be filled with potable water with sufficient chlorine added to result in a final chlorine concentration along the watermain within the range of 0.5 to 1.0 mg/l. The results of testing must be submitted to the Watercare service delivery area manager for verification and approval.

After chlorination the watermain may be returned to service. Field tests of chlorine residual at the nearest bulk supply points shall be undertaken by Watercare staff immediately following the return to service.

An IANZ certified laboratory will be notified to sample the watermain the next working day, in accordance with [section 13](#), at the first meter supply point adjacent to the works section. This sampling will be arranged by Watercare Service Delivery.

If the results detailed in [section 13](#) are not achieved the Watercare Service Delivery manager shall be notified to identify remedial steps. Typically this will involve water being flushed to waste, with further laboratory tests undertaken until acceptable results are obtained.

Upon completion of the procedure and re-commissioning of the watermain, the documentation ([Appendix E](#)) shall be completed and forwarded to the Water Transmission manager in Service delivery.

12. Disposal of super-chlorinated Water

Prior to discharge of chlorinated water from a disinfection operation, the contractor shall submit a plan stating how sections E4.6.1 (permitted activities) and E4.6.2 (Standards for permitted activities) of the Auckland Unitary Plan will be met, in particular:

- Dechlorination of water
- Confirmation that the discharge will not enter any water supply catchment, Wetland, Natural Water or Natural Stream Management Area
- Prevention of erosion or scouring
- Discharge of oil, grease film, scum, or foam

Discharge of water with residual chlorine concentration into a wastewater service requires approval from Watercare Service delivery and Watercare Trade Waste. The rate of discharge to the sanitary sewer shall be limited to a maximum of 10 litres per second.

If chlorinated water cannot flow to the wastewater system by gravity, then the water shall be pumped to the sanitary sewer system, or pumped into a tanker to be disposed into a conveniently-located sanitary sewer.

If the disposal of super-chlorinated water into the sanitary sewer system or a tanker is not achievable then the water must be de-chlorinated to a maximum residual of 0.02 mg/l before dumping to ground or a stormwater system. Where Watercare has existing discharge consents the applicable consent conditions must be met. Refer to [Appendix D](#) for de-chlorination options.

The disposal plan must be acceptable to Watercare.

Following discharge of the super-chlorinated water, the main shall be flushed until a chlorine concentration of 0.5 to 1.0mg/l is achieved in the main. Refer [section 13](#) for acceptable test result levels.

13. Laboratory test results

Laboratories shall be IANZ certified.

The sample results shall be in accordance with Table 13.1 before the reservoir or pipeline will be considered satisfactory to put into service. Test results shall be returned to Watercare using the applicable forms provided in [Appendix E](#).

Table 13.1 - Acceptable laboratory test results

Parameter	Acceptable Value
Residual Chlorine (FAC)	Between 0.5 and 1.0 mg/l
Turbidity (ntu)	Less than 1 NTU
PH	Between 7.5 and 8.5
E.coli	0 per 100 ml sample
Heterotrophic Plate Count	Less than 50 cfu/ml
Taste	no adverse taste
Odour	no adverse odour

Note 1: For the disinfection of an existing watermain it is likely that the watermain will have been returned to service before the results are obtained. Field tests may be accepted for medium risk whilst waiting for laboratory results.

Note 2: Should E.coli be identified in any sample either prior to, or following the return to service of the reservoir or watermain, then the response should be as per the Drinking Water Standards for New Zealand 2005 (as amended in 2008), section 3.4.1.2.

14. APPENDIX A: Local Networks Disinfection Procedure Flow Charts

Disinfection Procedures for New Watermains

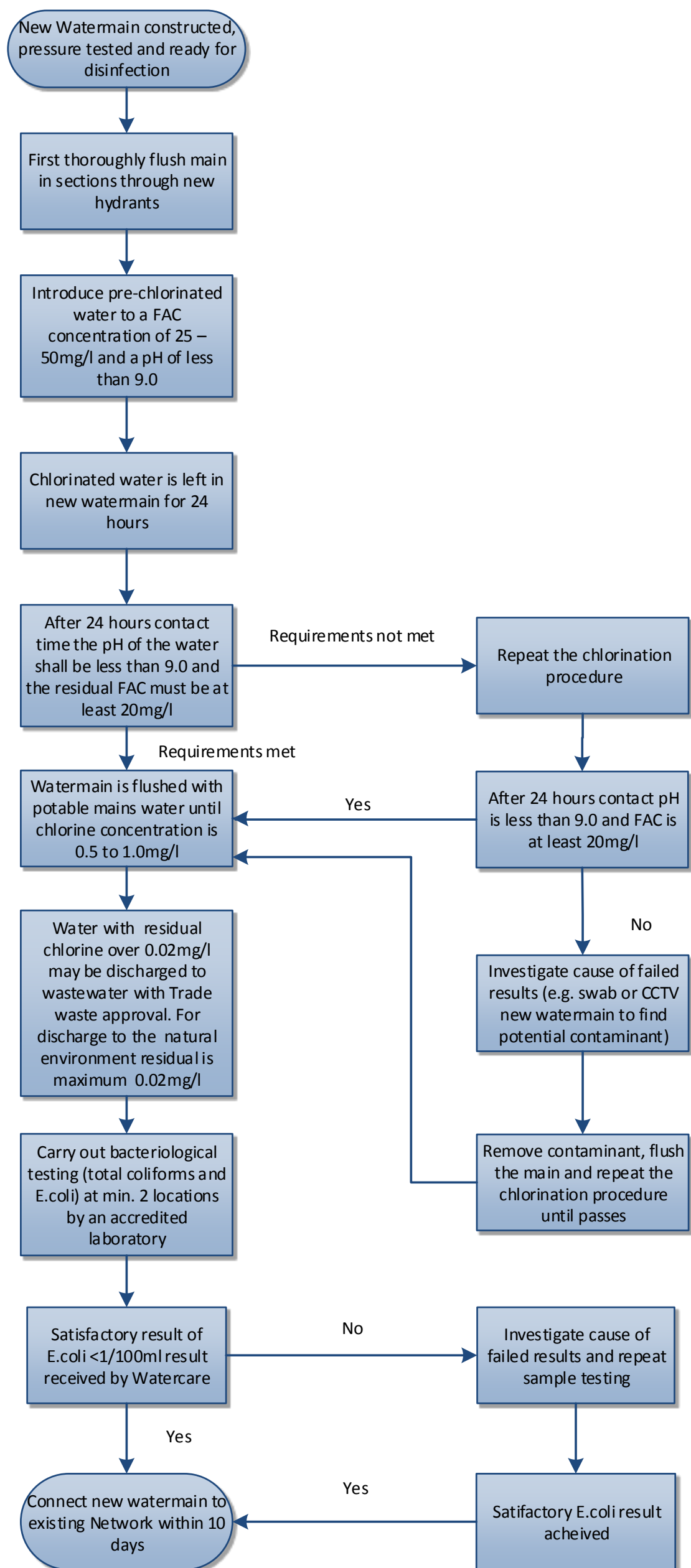


Figure 14.1

Disinfection Procedures for Temporary Watermains

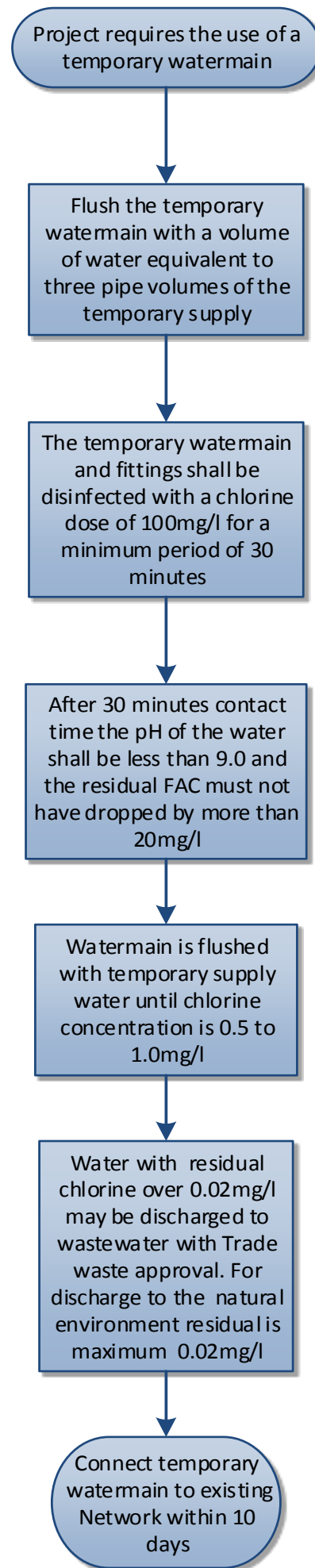


Figure 14.2

Disinfection Procedures for Emergency and Planned Repairs

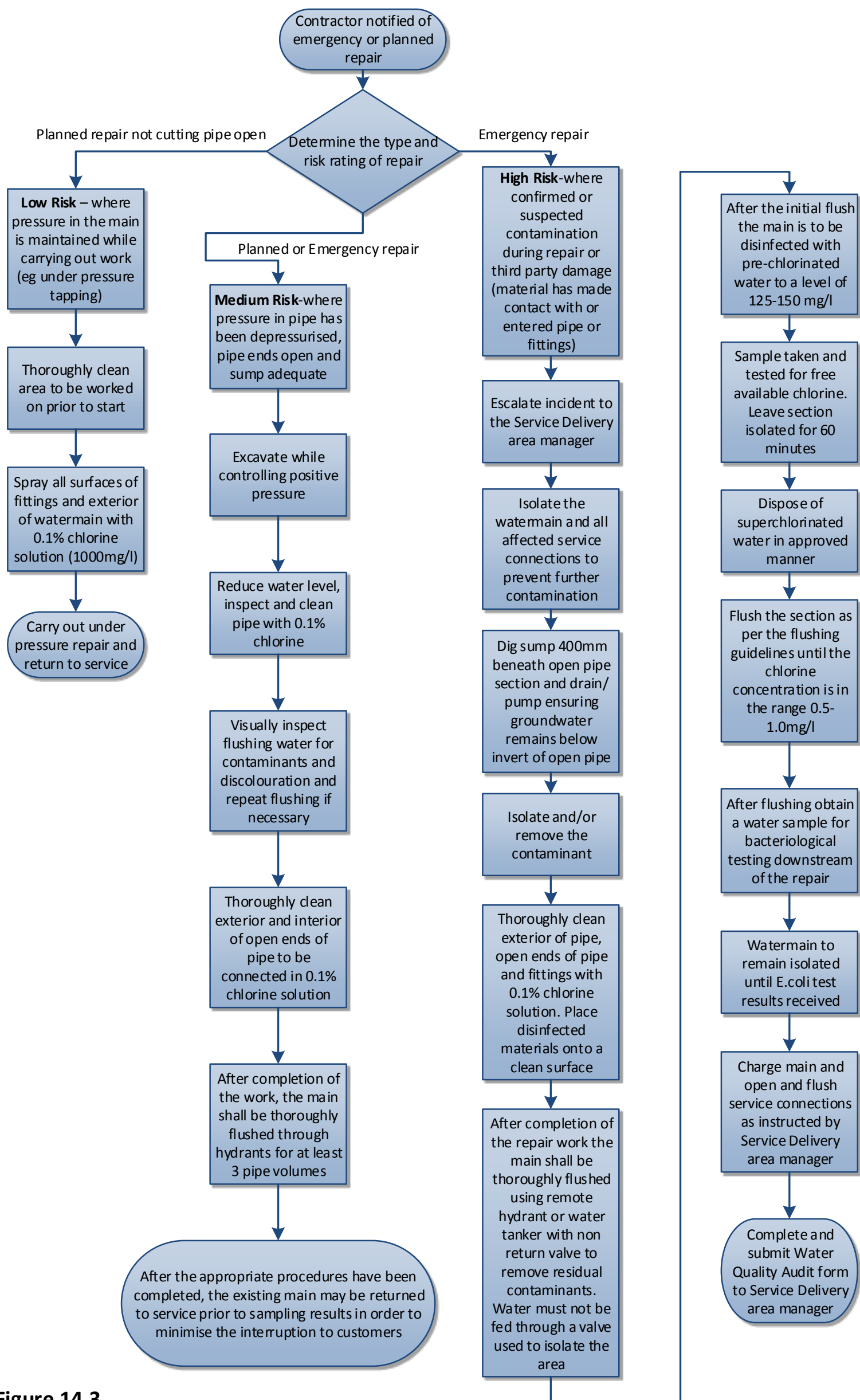


Figure 14.3

15. APPENDIX B: Flushing Guidelines

Flushing time guidelines in minutes for new works prior to disinfection

Table 15.1: Time in minutes to flush at 20 l/s

Pipe Diameter (mm)	Number of hydrants to achieve flushing velocity*	Length of Pipe			
		50m	100m	200m	500m
50	-	5	5	5	5
75	-	5	5	5	8
100	1	5	5	5	15
150	3	5	6	5	11
200	4	5	5	6	15
300	9	5	5	6	15
600	35	5	5	7	15
Pipe >600mm	Scour valve – per design	-	-	-	-

*(assumes flow rate through 75mm hydrant of 20l/s)

Note flushing rates of 5l/s and 10l/s can be used effectively on 50 and 75mm lines respectively.

16 APPENDIX C: Chlorine Dosing

Amounts of Sodium hypochlorite shown in the Table 16.1 below are calculated to produce chlorine concentration of **25 mg/l** (local networks) per 1m length of main:

Table 16.1: Chlorine Dosing

Pipe Diameter (mm)	Volume of water per 1m length of pipe (Litre)	Volume of 12% Sodium Hypochlorite (ml)	Volume of 15% Sodium Hypochlorite (ml)
50	1.96	0.41	0.33
75	4.41	0.93	0.74
100	7.85	1.64	1.31
150	17.67	3.69	2.95
200	31.41	6.55	5.24
250	49.08	10.23	8.18
300	70.68	14.73	11.78
For larger pipe sizes contact Watercare Service Delivery contact for the specific formulation			

Following completion of the repair, chlorine levels for disinfection can be tested by the maintenance crews using the field colorimetric indicator tests.

DPD Palintest for Chlorine levels 0 – 5.0mg/l

HR Palintest (Potassium Iodide) for Chlorine levels > 5.0mg/l

Note that improper or extended storage of the hypochlorite can cause a loss in available chlorine.

The maintenance contractor shall ensure that:

- Personnel have chemical handling training
- Vehicles have SDS sheets
- Contractors have appropriate PPE

17. APPENDIX D: Neutralising Chlorine

At the end of the contact time, the chlorine in the water in the new main must be neutralised before the water is discharged to the receiving environment (the street channel or stormwater system). There are three options that can be used to de-chlorinate the water:

1. Chemical Neutralisation dosing;
2. Chemical Neutralisation with dechlorination mats (where dosing at a discharge chamber is not feasible); or
3. Chlorine Dissipation.

1. CHEMICAL NEUTRALISATION

Chemical Neutralisation as a method to de-chlorinate water involves dosing to the water as it is being discharged from the main. The most effective and most commonly used chemical to achieve dechlorination is Sodium Thiosulphite though there are other alternatives:

Table 17.1: Chlorine Neutralisation Chemicals

Name	Chemical Formula	Solubility
Sodium thiosulphite 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 100g of water at 20°C
Sodium Sulphite heptahydrate	$\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$	30g/100ml

Chemical SDS sheets must be available at all times.

Procedure:

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

- Step 2. Fill the solution tank approximately 2/3 full with water
- Step 3. Add the required amount of the neutralising chemical into the tank as specified in Table 17.2
- Step 4. Mix the solution until the added chemical has dissolved
- Step 5. Add the remainder of water and mix
- Step 6. Stir periodically to avoid the solution stratifying

Table 17.2: Amounts of Chemicals Required for Chlorine Neutralisation

Solution Volume (L)	Sodium Thiosulphite (kg)	Anhydrous Sodium Sulphite (kg)	Sodium Sulphite Heptahydrate (kg)
100	15.2	15	30
200	30.3	30	60
300	45.5	45	90
400	61.0	60	120
500	76.0	75	150
600	91.3	90	180
700	106.2	105	210
800	121.2	120	240
900	136.0	135	270
1000	151.5	150	300

b. To add the neutralisation chemical to the super-chlorinated water, the following steps should be taken:

- Step 1. Calculate the flow rate required to add the neutralising chemical (refer below formula).
- Step 2. Use a calibrated dosing pump to achieve the calculated required flow rate by adjusting the speed or stroke setting of a calibration chart.
- Step 3. Verify successful neutralisation by testing for FAC (Free available chlorine). Note that the FAC of the discharged water to the environment must be <0.02mg/l.

To Calculate Flow Rate:

The following formula shows the rate at which the prepared neutralising chemical needs to be added to the water as it is being discharged from the main:

$$\text{Flow (L/hr)} = \frac{\text{FAC (g/m}^3\text{)} \times 3 \times \text{draining flow rate of chlorinated water (L/min)} \times 60\text{min/hr}}{\% \text{ Strength of the neutralising solution} \times 10,000}$$

Example:

The FAC of the super-chlorinated water to be neutralised is 20mg/l (i.e. 20g/m³). The super-chlorinated water is being discharged from the main at a flow rate of 100 L/min. The required flow rate of the 15% neutralising chemical solution is:

$$\begin{aligned} \text{Flow} &= \frac{20 \text{ g/m}^3 \times 3 \times 100 \text{ L/min} \times 60 \text{ min/hr}}{15\% \times 10,000} \\ &= 2.4 \text{ L/hr} \end{aligned}$$

2. CHLORINE NEUTRALISATION WITH DECHLOROMATS

Dechloromats must be placed such that the channelled water does not flow outside the span of the mat, but still cover the full width. The channelled flow must be long enough to ensure proper mixing with the Sodium Sulphide. Typical channelled flow height should not be more than 50mm. Sampling must be taken 10m downstream of the mat. When tablets reach half their original size it must be replaced or new tablets added.

3. CHLORINE DISSIPATION

This is an alternative method in dealing with the hyper chlorinated water which allows the chlorine to dissipate.

Capture the disinfected water on site prior to the discharge of the chlorinated water (e.g. in a tanker). It is suggested that the water is kept contained on site for a minimum of 2 days until the FAC is reduced to the acceptable level of the ultimate receiving environment.

18. APPENDIX E: Forms

Laboratory test request

Watermain

WATERMAIN SAMPLING			
To (laboratory)		From	
Date of request		Forward results to	
Sample date			
Date sample(s) to be taken			
<u>Location/Address</u>		Position of sample	
Test request			
Residual Chlorine (FAC)	<input type="checkbox"/>	Turbidity (ntu)	<input type="checkbox"/>
pH	<input type="checkbox"/>	Total Coliforms	<input type="checkbox"/>
Faecal Coliforms	<input type="checkbox"/>	Heterotrophic Plate Count	<input type="checkbox"/>
Taste	<input type="checkbox"/>	Odour	<input type="checkbox"/>
Additional information (if any)			

Laboratory test request

Network Reservoirs

RESERVOIR SAMPLING			
To (laboratory)		From	
Date of request		Forward results to	
Location and sample date			
Reservoir		Reservoir Address	
Sample date			
Sample position	Top <input type="checkbox"/> Bottom <input type="checkbox"/>		
Test request			
Top sample for:		Bottom sample for:	
Residual Chlorine (FAC) <input type="checkbox"/>	Turbidity (ntu) <input type="checkbox"/>	pH <input type="checkbox"/>	Total Coliforms <input type="checkbox"/>
Faecal Coliforms <input type="checkbox"/>	Heterotrophic Plate Count <input type="checkbox"/>	Taste <input type="checkbox"/>	Odour <input type="checkbox"/>
		Residual Chlorine (FAC) <input type="checkbox"/>	Turbidity (ntu) <input type="checkbox"/>
		pH <input type="checkbox"/>	Total Coliforms <input type="checkbox"/>
		Faecal Coliforms <input type="checkbox"/>	Heterotrophic Plate Count <input type="checkbox"/>
		Taste <input type="checkbox"/>	Odour <input type="checkbox"/>
Additional information (if any)			

New Watermain Disinfection			
GENERAL			
Facility			
Area of Operation			
INITIAL DISINFECTION			
Date watermain filled			
Chlorine type added		Amount	
RESIDUAL CHLORINE TESTING AT 100% FULL			
Test point	Initial	24 hours	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
Laboratory notification			
Date		Time	
Laboratory results acceptable (attach)		Yes <input type="checkbox"/>	No <input type="checkbox"/>
Test completed by		Position	
PLACE WATERMAIN IN SERVICE			
Watermain approved for placing into service			
Name		Position	
Signature		Date	
Watermain service connection date			

Forward to relevant Service Delivery Authorised Person when complete

Existing Watermain Disinfection			
GENERAL			
Facility			
Area of Operation			
INITIAL DISINFECTION			
Date watermain filled			
Chlorine type added		Amount	
RESIDUAL CHLORINE TESTING AT 100% FULL			
Test point	Initial	24 hours	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
	mg/l	mg/l	
Laboratory notification			
Date		Time	
Laboratory results acceptable (attach)	Yes <input type="checkbox"/> No <input type="checkbox"/>		
Test completed by		Position	
RETURN WATERMAIN TO SERVICE			
Existing Watermain approved for placing into service			
Name		Position	
Signature		Date	
Watermain service connection date			

Forward to relevant Service Delivery Authorised Person when complete

Reservoir Disinfection			
GENERAL			
Facility			
Area of Operation			
PRE-DISINFECTION INSPECTION			
Date Inspected			
Cleaned Satisfactorily	Yes <input type="checkbox"/> No <input type="checkbox"/> Action required if No (cannot progress until satisfactory):		
Inspection by		Position	
Signature			
INITIAL DISINFECTION			
Date filled (to 2m depth)			
Chlorine type added		Amount	Concentration
Measured residual chlorine at 24 hours			
Sampled by		Position	
Additional chlorine required			
Chlorine type		Amount	Concentration
TESTING AT 100% FULL			
Residual Chlorine			
Top		Bottom	
Tested by		Position	
Laboratory notification			
Date		Time	
Laboratory results acceptable (attach)	Yes <input type="checkbox"/> No <input type="checkbox"/>		
RETURN TO SERVICE			
Residual Chlorine at 24 hours prior			
Tested by		Position	
Re-chlorination steps (if done)			
Reservoir approved for return to service			
Name		Position	
Signature		Date	

Forward to relevant Service Delivery Authorised Person when complete