Appendix D
Standard Operating Procedures for Performing Construction on Pipelines

April 12, 1999

Standard Operating Procedures for Performing Construction Work on Pipelines

COPY NUMBER: 63

Purpose

The purpose of this policy is to formalize established practices of the Massachusetts Water Resources Authority to assure that proper procedures are used when performing planned construction work on pipelines used to convey potable water.

Format

Phase I - Taking Pipe Out-of-Service

- Notification of Intent to Perform Work on Pipeline
- Identification of System Components
- Regulatory Concerns
- Preparations for Initial Dewatering

Phase II - Performing Work on Pipe

- Quality Assurance/Quality Control

Phase III - Putting Pipe Back in Service

- Disinfection/Flushing
- Emergency Response Action Plan
- Preparation for Reactivating Pipe
- Reactivation of Pipe

Procedures

MWRA SOP Activity	Responsibility
Phase I - Taking Pipe Out-of-Service *Notification of Intent to Perform Work on Pipeline*	
1. Notify MWRA Valve Operations Mark Johnson, Superintendent, Distribution, (781) 396-0500.	Design Engineer to specify that contractor shall make notification(s).

MWRA SOP Activity	Responsibility
Identification of System Components	
1. Identify the portion of pipe to be taken out of service by section number and stations and the Community(ies) in which pipeline is located. (Limits of pipe to be taken out of service will, in most cases, exceed the limits of pipe on which work is to be performed.)	Design Engineer to specify with coordination with Waterworks Operations.
2. Identify all appurtenances and verify their operability. ▪ Inline Valves ▪ By-pass Valves ▪ Blow-off Valves ▪ Air Release/Anti-Vacuum Valves ▪ Meters Repair or replace all inoperable components whose successful operation is necessary to perform the scheduled work.	Design Engineer to identify appurtenances during the design process and verify operability with coordination with Waterworks Operations.
3. Identify all points of potential discharge from the portion of pipe to be taken out of service and confirm the ability to achieve a water tight shut down at these discharge points. These points of discharge may include: ▪ Inline Valves ▪ By-pass Valves ▪ Blow-off Valves ▪ Air Release/Anti-Vacuum Valves ▪ Interconnection Valves/Branch Valves	Design Engineer to identify points of potential discharge during the design process and verify operability with coordination with Waterworks Operations. Design Engineer, with coordination with Waterworks Operations, shall specify which point(s) of discharge shall not be used for discharge.
4. Select the points of discharge to be used for dewatering the selected portion of pipe.	Design Engineer shall specify which point(s) of discharge shall not be used for discharge.
5. Identify the ultimate receptor for the discharge (i.e. name of surface water or sanitary collection system to a treatment facility).	Design Engineer identifies the ultimate receptor for each potential point of discharge and specifies which point(s) of discharge/receptor(s) shall not be used.

MWRA SOP Activity	Responsibility
Regulatory Concerns	
1. Determine what Regulatory/Permit requirements will apply during initial dewatering and develop a list of emergency contacts.	The Design Engineer, with coordination with the Waterworks Planning Department, will determine the regulatory/permit requirements and specify accordingly. MWRA future NPDES pipeline dewatering permit (under negotiation) will likely determine requirements. Design Engineer will develop an emergency contact list for regulatory requirements.
2. If discharge is to a storm drain or receiving water, notify as applicable: ▪ Local Community - Department of Public Works and Board of Health ▪ Notify Conservation Commission as a courtesy (repair and maintenance activities for lawfully located water supply pipelines used for public service are exempt from filing an NOI) ▪ Other	The Design Engineer shall develop a list of "Other" agencies/groups and shall specify that the contractor provide notifications prior to discharge.
3. All discharges of contaminated water into a storm drain or receiving water are to be in accordance with applicable regulatory requirements.	The Design Engineer shall specify a requirement for the contractor to discharge in accordance with applicable regulatory requirements. In the absence of an issued NPDES pipeline dewatering permit, parameters established in the MWRA Waterworks Dechlorination Manual shall be met.
4. If discharge is to a sanitary sewer (combined or separated), provide a flow estimate and notify: ▪ Local Community ▪ MWRA Sewerage Division	The Design Engineer shall specify that the contractor is to obtain all written approvals/permits for discharge to sanitary sewer.
Preparations for Initial Dewatering	
1. Determine available method(s) of dewatering. ▪ Gravity ▪ Pumping ▪ Combination	Design Engineer will determine during design if dewatering is feasible. Design Engineer shall specify that the contractor will develop a dewatering plan.

MWRA SOP Activity	Responsibility
2. Identify Discharge Parameters: ▪ Route and final destination of discharge water ▪ Determine/Estimate discharge volume and rate ▪ Measure/Estimate discharge chlorine residual ▪ Estimate volume of dechlorination solution and dosage rate required	The Design Engineer shall determine route, destination, volume, and rate during design and specify which routes and destinations are unavailable and require the contractor to prepare a disinfection/dewatering plan. MWRA Operations will review contractor's plan. When available, MWRA NPDES pipeline dewatering permit and treatment/ monitoring requirement will become part of the Contract Documents.
3. Further investigate discharge point(s) locations and assess the following concerns: ▪ Traffic control issues/Police Details ▪ Pedestrian Safety ▪ Environmental Concerns (e.g. dechlorination, turbidity, etc.)	The Design Engineer shall investigate the points of discharge and assess during design. The Design Engineer shall specify for the contractor to provide traffic controls/police details/pedestrian safety for all activities. The Design Engineer shall specify that the contractor shall prepare a dewatering plan.
4. Prepare a time schedule for dewatering pipe.	The Design Engineer shall specify that this is part of the contractor's dewatering plan and included in the project schedule.
5. Confirm watertight shut down of all valves that will be used to isolate the pipe and use a lock out/tag out system on all valves while in their closed position.	Design Engineer shall specify the contractor is required to handle a reasonable leakage (100 gpm per isolation valve has been used). MWRA Operations will operate valves for isolation and perform lockout/tagout on isolation valves. Design Engineer shall specify that the contractor shall provide locks, tags, and chains.
6. Dewater pipe by opening selected blow-offs and manual air release valves.	MWRA Operations to operate valves. The Design Engineer shall specify that the contractor shall provide police details, traffic controls, and dewater the pipe per the approved dewatering plan.

MWRA SOP Activity	Responsibility
Phase II - Performing Work on Pipe	
Quality Assurance/Quality Control	
1. Work performed on pipe by a Contractor is to be in accordance with the Contract Specifications and documented by the following applicable checklists. Copies attached. *Form* — *Description of Work* Manual Valve Installation Checklist — Manual Valve Installation (e.g. butterfly valves, gate valves, etc.) Automatic Valve Installation Checklist — Automatic Valve Installation (e.g. air relief)	Design Engineer shall specify that SOP checklists shall be incorporated into the contractor's QA/QC plan. Resident Engineer to assure contractor in compliance with Contract Documents and contractor's QA/QC plan.
Phase III - Putting Pipe Back in Service	
Disinfection/Flushing	
1. When all work has been successfully completed and the pipe is ready to be put back in service, develop a plan for disinfecting and flushing the portion of pipe that was taken out of service.	Feasibility to be determined by the Design Engineer during design. Design Engineer shall specify that the contractor develop a disinfection plan, including methods of filling, chlorine introduction, flushing location, testing/monitoring locations, in conjunction with water disposal plan. MWRA Operations will review and provide comments to contractor's plan.
2. Disinfection/Flushing is to be performed in accordance with the latest version of AWWA C651 and MWRA Policy and Procedures for the Chlorination/Disinfection of Pipelines.	Design Engineer shall specify a requirement that the Contractor disinfect and flush in accordance with these documents.

MWRA SOP Activity	Responsibility
3. Notification of disinfection/flushing and compliance with regulatory requirements and permits are to be as outlined above for initial dewatering. Chlorinated water shall be treated to meet the discharge criteria for the receptor (i.e., storm drain, sewer, river, etc.).	Design Engineer shall specify that the contractor shall perform disinfection and flushing in accordance with regulatory requirements. Treatment of chloraminated water will be done in accordance with the MWRA NPDES pipeline dewatering permit under negotiation or in accordance with criteria identified in the MWRA Waterworks Dechlorination Manual.
4. Check that all potential points of discharge not in use for flushing within the limits of the pipe taken out-of-service are closed.	The Design Engineer shall specify that the contractor is required to check and verify, in the presence of the Resident Engineer and MWRA Operations, that valves within the contract isolation limits are in the proper position. MWRA Operations will be responsible to verify that valves outside the contract isolation limits are in the proper position. The contractor shall accompany the Resident Engineer and MWRA representatives to verify that valves are in the proper position. The contractor shall be required to develop a checklist of valves to be verified as part of the disinfection plan and included as part of the QA/QC plan.
5. All potential points of discharge are to be inspected during disinfection by personnel that are trained and equipped to report and manage an unexpected discharge/leak of chlorinated water.	The Design Engineer shall specify that the contractor is required to monitor all valves within the contract isolation limits and the point of discharge. Valves outside the contract isolation limits will be monitored by MWRA Operations.

MWRA SOP Activity	Responsibility
6. All closed valves at points of discharge not in use shall be locked out/tagged out.	The Design Engineer shall specify that the contractor is required to lock out/tag out valves within the contract limits and provide locks, tags, and chains for the MWRA to lockout valves outside the contract limits. Locks, chains, and tags will be turned over to the MWRA after completion.
7. Inspectors should be equipped with a means of communication, operating tools, maintenance tools, and chemicals for neutralizing chlorine.	The Design Engineer shall specify that the contractor is required to have equipment on site within the contract isolation limits. The MWRA will provide its inspectors with the equipment for locations outside the contract isolation limits.
Emergency Response Action Plan	
1. If, while the pipe is filled with chlorinated water for disinfecting, a leak should occur which poses a threat of accidental release to a surface water, then notify the DEP of the threat of a release within two hours of obtaining knowledge about the threat. Call the DEP Statewide 24-hour per day Emergency Number, (888) 304-1133, for reporting oil and hazardous material releases. In the Boston-Metro area within area code 617, the following number can also be used, (617) 556-1133. ▪ Immediately notify the operator of the valve supplying the water and chlorine feed to the leak and instruct to stop feeding chlorinated water. ▪ Assess the situation by making observations as to origin and discharge point of the leak and determine if a release to a surface water has occurred and if corrective action can be taken to terminate the discharge. Take corrective action as appropriate.	The Resident Engineer will notify the MWRA Construction Coordinator, who in turn will notify DEP. The Resident Engineer will develop a project specific notification list. In the event of an emergency, normal MWRA emergency protocol will be followed.

MWRA SOP Activity	Responsibility
2. If a release event has occurred to a surface water, perform remedial actions (refer to examples of remedial actions in Attachment A) to protect the environment. ▪ Within 2 hours of the event, notify the DEP of the event and action taken by calling the number(s) listed in item No. 1 above. Provide an estimate of the amount discharged and the concentration. ▪ Notify local community (Department of Public Works and Board of Health), owner, or operator that chlorinated water is being discharged to their property or facilities.	The Resident Engineer will notify the MWRA Construction Coordinator who in turn will notify DEP. The Resident Engineer will develop a notification list that will include the contractor and Resident Engineer. The Resident Engineer will also notify the project Licensed Site Professional (LSP).
3. Breaks of magnitude that are deemed a public safety hazard may involve activating an Emergency Operations Center and notifying MEMA, DEP, DPH, state police, and other agencies as directed by the local emergency response plan.	The Resident Engineer will notify MWRA Construction Coordinator, who in turn will notify others. In the event of an episode deemed to be of "immediate danger to life and health", the Resident Engineer will also call 911 immediately.
Preparation for Reactivating Pipe	
1. When the pipe has been successfully disinfected and flushed, it should be prepared to be put back in service.	MWRA Operations to operate valves.
2. Check that all potential points of discharge (valves) are in the closed position except the manual air release valves which are to be opened for filling.	The Design Engineer shall specify that the contractor shall verify all valves inside the contract isolation limits are in the proper position and include a checklist as part of the disinfection plan. MWRA Operations to verify valves outside the contract limits.
3. Use a lock out/tag out system on all valves that are to remain closed during pipe reactivation.	The Design Engineer shall specify that the contractor is required to lock out/tag out valves within the contract limits. The MWRA will lock out/tag out valves outside the contract limits.

MWRA SOP Activity	Responsibility
Reactivation of Pipe	
1. After reactivation discontinue use of lock out/tag out on closed valves.	The contractor shall be required to remove lock out/tag out valves within the contract limits. The MWRA will remove lock out/tag out valves outside the contract limits. MWRA will direct contractor to remove locks once pipe and valves are accepted and ready for service.

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ATTACHMENT A

EXAMPLES OF REMEDIAL ACTION FOR LEAKS RELEASING CHLORINATED WATER TO THE ENVIRONMENT

EXAMPLE NO. 1 - Leaking Air Release Valve

Situation: It is determined that an air release valve is leaking chlorinated water in the valve chamber. The water is spilling from the chamber into street where there are catch basins. A call has already been made to have the line shut down.

Action: Use mesh bags containing sodium thiosulfate to encircle the catch basin forming a low wall. Use additional bags to form an impoundment so that the water is collected and passes through the sodium thiosulfate for dechlorination before entering the catch basin.

EXAMPLE NO. 2 - Leaking Blowoff

Situation: It is determined that a blowoff is leaking chlorinated water directly into a storm drainage system which may be connected to a surface water. A call has already been made to have the line shut down.

Action: Determine where the nearest downstream manhole is located on the storm drainage system. Install bags of sodium thiosulfate forming a dam across the manhole and forcing the leakage to pass through the bags for dechlorination. Determine if chlorinated water has reached points downstream of the manhole and take further similar action.

EXAMPLE NO. 3 - Discharge into A Stream or Brook

Situation: It is determined that chlorinated water is discharging from a storm drain into a stream at a headwall. A call has already been made to have the line shut down.

Action: Determine a point downstream of the discharge where the stream can be blocked. Install bags of sodium thiosulfate to form a dam across the stream which forces the water through the bags for dechlorination.

MANUAL VALVE INSTALLATION CHECKLIST
(applies to Butterfly Valves, Wedge Type Gate Valves, Knife Gate Valves, Ball and Plug Type Valves).

PROJECT: _____

CONTRACTOR: _____

NAME OF CONTRACTOR'S QC/QA REPRESENTATIVE: _____

NAME OF ENGINEER'S QC/QA REPRESENTATIVE: _____

SECTION _____

ITEM	Contractor Yes	No	Date	Engineer Yes	No	Date	Remarks
Shop Drawings Approved:							
Manufacturer's Certifications Received:							
Shop Test Results Received:							
Valve Delivered to Site:							
Receipt Inspection Conducted:							
Valve as per Approved Shop Drawing:							
◦ Manufacturer:							
◦ Type & Size of Valve:							
◦ Operating Hand Confirmed:							
◦ Remove any Shipping Stops:							
◦ Confirm Valve Seat Type:							
◦ Operator Extensions on Site:							
◦ Position Indicators in Place:							
◦ Correct size Operating Nut:							
◦ Open/Close Operation Conducted:							
◦ Confirm Op. Stop & Disc Align(Open):							
◦ Confirm Op. Stop & Disc Align(Closed):							
◦ Operating Turns (Count) Confirmed:							

Appurtenances on Site: ITEM	Contractor Yes	No	Date	Engineer Yes	No	Date	Remarks
Operating Wrench (if required):							
Valve Box/Vault/MH on Site:							
Over Torque Device (if required):							
Lock Out/Tag Out Devices on Site (if required):							

NOTE: APPROVAL TO INSTALL VALVE SHALL NOT BE GRANTED UNTIL ALL OF THE ABOVE HAS BEEN CHECKED AND/ OR ACCEPTED/APPROVED.

	Contractor Yes	No	Date	Engineer Yes	No	Date	Remarks
Approval to Install Valve:							
Date Installed:							
Location of Installation:							

MANUAL VALVE INSTALLATION CHECKLIST(Continued):

SECTION _____

POST INSTALLATION CHECK LIST

ITEM	Contractor Yes	Contractor No	Contractor Date	Engineer Yes	Engineer No	Engineer Date	Remarks
Confirm Over Torque in Place (if required):							
Confirm Valve to be in CLOSED POSITION:							
Functional Test Conducted (Operate Valve):							
Satisfactory PSI & Leakage Tests Conducted:							
Install Contractor's Lock Out/ Tag Out:							
Lock Out/Tag Out keys turned over to Contractor:							

CONTRACTOR'S LOCK OUT/TAG OUT CONFIRMED BY:

_____ _____

ENGINEER'S REPRESENTATIVE (PRINT NAME) CONTRACTOR'S REPRESENTATIVE (PRINT NAME)

_____ _____

Signature of Engineer's Representative. Signature of Contractor's Representative

NOTE: TRANSMITTAL OF VALVE TO OWNER FOR NORMAL USE/OPERATION AND MAINTENANCE CANNOT TAKE PLACE UNTIL ALL OF THE ABOVE HAS BEEN CHECKED AND/ OR ACCEPTED/APPROVED.

MANUAL VALVE INSTALLATION CHECKLIST(Continued):

SECTION_____

DOCUMENTATION OF TRANSMITTAL OF VALVE LOCK OUT/TAG OUT:

The subject valve(s), listed below: has/have been inspected and tested as noted above and is ready to be transmitted to the Owner for normal use/operation and maintenance.

VALVE SIZE	VALVE TYPE	LOCATION - STATION	VALVE FUNCTION	LOCK / KEY #

On_____the valve(s) was/were confirmed to be in the CLOSED POSITION and the Contracto Lock Out/Tag Out device was removed and the Owner's Lock Out/Tag out device was installed as witnessed below.

The following personnel confirm that the subject valve is in the CLOSED POSITION and witness the change o from Contractor's Lock Out/Tag Out to the Owner's Lock Out/Tag Out :

Contractor:_____ _____ DATE:_____
Print Name/Title Signature

Engineer:_____ _____ DATE:_____
Print Name/Title Signature

Owner:_____ _____ DATE:_____
Print Name/Title Signature

END CHECK LIST

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AUTOMATIC AIR RELIEF VALVE CHECK LIST

PROJECT: _____

CONTRACTOR: _____

NAME OF CONTRACTOR'S QC/QA REPRESENTATIVE: _____
NAME OF ENGINEER'S QC/QA REPRESENTATIVE: _____

SECTION _____

ITEM	Contractor Yes	No	Date	ENGINEER Yes	No	Date	Remarks
Shop Drawings Approved:							
Manufacturer's Certifications Received:							
Shop Test Results Received: (if applicable)							
Valve Delivered to Site:							
Receipt Inspection Conducted:							
Valve as per Approved Shop Drawing:							
◦ Manufacturer:							
◦ Type & Size of Valve:							
Approval to install valve							
A valve cannot be approved for installation until all of the above has been checked and approved/accepted.							
Installation:							
Date Installed:							
Proper Location & Orientation:							
Proper size pipe tap:							
Close Nipples installed:							
Isolating Valve installed & readily accessible for operation:							
Conduct Field Functional Test							

TRANSMITTAL OF VALVE TO OWNER

The transmittal of the air release valve to the Owner shall take place concurrent with the turnover of the water main to the Owner.

END OF CHECK LIST

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Situation: It is determined that chlorinated water is discharging from a storm drain into a stream at a headwall. A call has already been made to have the line shut down.

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DECHLORINATION MANUAL

MASSACHUSETTS WATER RESOURCES AUTHORITY

Prepared By:

MWRA - Waterworks Division

Operations Department - Distribution Section

JULY 1998

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Introduction

The Massachusetts Water Resource Authority (MWRA) has initiated disinfection system changes to ensure that the water supply meets the current guidelines set forth by the Safe Drinking Water Act. In 1996 a comprehensive assessment evaluated the Authority's primary disinfection system and found that several deficiencies existed. To correct some of these deficiencies, the Authority completed the ammonia separation project at the Norumbega Reservoir in August 1997. This changed the injection point of the ammonia 1,800 feet downstream of its original injection point. With this location change and an increase in the chlorine and ammonia dosages, a higher chlorine residual is being be maintained in the distribution system. With these and other changes, higher chloramine levels will be seen throughout the MWRA system and the community distribution systems.

Chloramines in the municipal water supply can present a risk to aquatic environments. The present level of chloramines in MWRA potable water is toxic to fish and other aquatic organisms. Therefore, if potable water is released directly to the environment with no treatment, there is a potential for environmental impact.

The potential impact from a release of potable water will depend on a number of factors such as, the volume of water released, the concentration of chloramines in the water, the proximity to a water body, and the available dilution capacity in the water body. The greater the volume of chloraminated water released to the environment, and/or the greater the concentration of chloramines, the greater the risk of impact, particularly to small streams that may not be able to dilute the release.

Due to the number of factors that must be taken into account, it is very difficult to predict what effect a release of potable water will have on the receiving environment. Because of this, it is more prudent to appropriately manage releases of potable water and take preventive measures to ensure the protection of the environment.

This handbook includes guidelines that provide management measures for releases of chloraminated municipal water for various types of activities. These guidelines outline measures that can be taken to avoid releasing municipal water directly to local water bodies and provides methods for treatment of this water prior to its release.

Dechlorination

There are many reasons why potable water would be released into the environment

- Municipal Use
  - Hydrant Flow Testing
  - Hydrant Flushing
  - Storage Tank Inspection and Cleaning
  - Water Main Installation/Replacement and Maintenance
- Construction Use
- Domestic Water Use
- Industrial/Commercial Water Use

When releases from the above mentioned activities have potential to impact the environment, the chloramines must be removed from the water. This can be accomplished by adding a reducing agent such as sodium thiosulfate. Sodium thiosulfate is the most commonly used dechlorinating agent: when it is added to water containing chloramines, the chlorine is neutralized and free ammonia is produced; thus dechlorinating. When free ammonia is released into the environment, it too is potentially toxic to fish and other aquatic organisms. The ammonia produced from dechlorinating MWRA potable water would be less than 10 mg/l. This is not damaging to organisms in the receiving waters and thus does not need to be removed under most circumstances. Water quality criteria for ammonia are temperature and pH dependent, and concentrations below 10 mg/l for acute exposure should not be toxic as long as the pH of the diluted water is not greater than 8.0. If discharges have durations greater than 4 days, the potential for ammonia toxicity in the receiving water needs to be evaluated.

When releasing chloramines or utilizing reducing agents, pollutants are being added to the environment. These releases are regulated by the National Pollutant Discharge Elimination System (NPDES) program. Currently, the Authority is working with the DEP, Water Supply, and EPA to establish the requirements for release.

Dechlorinating Agents

To neutralize an oxidant, such as hypochlorous acid, a neutralizing or dechlorinating chemical can be used. Four types of dechlorinating agents have been used

sulfur dioxide (SO_2)
sodium bisulfite ($NaHSO_3$)
sodium sulfite (Na_2SO_3)
sodium thiosulfate ($Na_2S_2O_3$)

Sulfur dioxide is a gas, and as such is not routinely used, or recommended because of its hazardous nature for field dechlorination purposes. Sodium bisulfite, sodium sulfite and sodium thiosulfate have been used in field applications and are typically purchased in powdered or solid forms.

Sodium thiosulfate is the most frequently used dechlorinating agent, due to the fact that sodium sulfite or sodium bisulfite can cause an oxygen depleting environment. The toxic threshold of sodium sulfate as listed in the Material Safety Data Sheet (MSDS) is 2,600 mg/L as opposed to 24,000 mg/L for sodium thiosulfate. Sodium thiosulfate is available in both anhydrous ($Na_2S_2O_3$) and pentahydrate ($Na_2S_2O_3 \cdot 5H_2O$) forms. The difference between the two forms is that anhydrous sodium thiosulfate will dissolve much slower, and last a longer time when added to water, such as a creek. On the other hand, the pentahydrate form is already hydrated, and therefore will dissolve much faster than the anhydrous form. It is cheaper to use the less soluble anhydrous form.

It takes 1.5 parts of $Na_2S_2O_3$ to neutralize 1 part of chlorine residual. For example, if the residual chlorine in tap water was measured at 1 mg/L, it would take 1.5 lbs of sodium thiosulfate to dechlorinate 100,000 gallons. A more detailed explanation of how to prepare a neutralizing compound is shown in Planned Releases.

Appendix A lists the local sodium thiosulfate vendors and recent (1998) prices.

Other Considerations

Oxygen Depletion

Dechlorinating agents containing sulphite, such as sodium sulfite and sodium bisulfite, exert an oxygen demand on the water that it is being applied to. If excess chemical is used and it enters a creek or lake, an environmental impact can result because of a reduction in the oxygen content of the water. Care must be taken to ensure that oxygen levels are not significantly altered with the addition of such chemicals. The best way to ensure that oxygen is not depleted is to use sodium thiosulfate as a dechlorinating agent.

pH Levels

Although not specifically related to dechlorination, it should be noted that chlorine solutions (e.g. sodium hypochlorite) used to super chlorinate water mains have a very high pH level to ensure that chlorine gas does not form in the solution. Adding sodium hypochlorite to water having a low buffering capacity could cause elevated pH levels. In addition to dechlorinating this water prior to discharge, the pH level should be determined prior to discharge and, if necessary, measures taken to adjust the pH to appropriate levels. The optimum pH range is 6.5 to 9.0. If the pH requires adjusting, it can be adjusted using a tank of carbon dioxide bubbled into the water to reduce a high (basic) pH or by adding sodium bicarbonate to a low (acidic) pH.

When to Dechlorinate

In order to assess whether dechlorination is necessary during or after a water release, the following conditions should be considered:

1. the volume of chloraminated water being discharged;
2. the concentration of total residual chlorine in the water;
3. the proximity of the point of discharge to a natural aquatic system; and
4. the volume or flow of the receiving environment available to dilute the release

The type of water releases that require dechlorination can be found in Appendix A: the flow chart for mitigating the release of chloraminated water from specific types of activities. If there is any doubt as to the need to dechlorinate, it would be more prudent to dechlorinate.

If there is any question about the potential to impact the environment, the chlorine levels should be monitored at the point of discharge and in the receiving environment.

Training

It is necessary to undergo training in procedures for chlorine monitoring as well as general dechlorination methods prior the use of these methods in the field. Having a person on your staf trained in these procedures will reduce the potential for errors and frustrations associated with implementing these new procedures. A number of preventive steps can be taken to minimize the risk of environmental impact. One key step is to ensure that all employees and contractors involved in discharge activities are aware of the potential impacts of releasing tap water into the environment.

Approach to Dechlorination

Types of Responses

The methods and equipment used to dechlorinate a water release will be dependent on the type of water release encountered. For ease of discussion, three types of water releases have been defined as follows:

- Emergency
- Planned
- Permanent

During an emergency water release, such as a water main break, the location and volume of the water release are not known prior to its occurrence. Therefore, equipment, chemicals and supplies needed for dechlorination must be assembled prior to the event, and they must be ready to deploy in a very short time. Furthermore, as the conditions of the event are generally not known until a crew arrives at the site, the dechlorination method used must be relatively easy and quick to deploy in a variety of situations. See Emergency Releases for more details.

Where the location and volume of water to be released are known and can be controlled, this is referred to as a planned release. Planned releases include events such as water main flushing or hydrant flushing.

For a planned release, time is not as critical as an emergency event. Time is available for preparation at the site. In these situations, the MWRA will typically use a solution of sodium thiosulfate for dechlorination instead of the solid form. This solution is metered into the flow of the released water. Using a solution of sodium thiosulfate is much more cost effective than using bags of solid sodium thiosulfate and much less dechlorinating agent is used.

There are also situations where water will be released on a long term or permanent basis, such as in cooling water systems. To dechlorinate in these circumstances, a planned engineering approach must be used.

Planned Releases

General

The majority of situations involving the discharge of chloraminated water will be planned. Table 1 provides a list of both planned and unplanned (emergency) water discharges. Planned releases are defined as those occasions when the discharge of chloraminated water is known ahead of time, and appropriate dechlorination measures can be taken. Included are activities such as water main flushing and blow-off valve exercising.

Planned releases will discharge water to generally known locations, so that the downstream receiving water body will be known. Water flowing from hydrants (community systems) typically, will flow overland to catch basins, and will travel to the local drainage system; in some instances, there may be direct discharge to a water body. Water from the MWRA system will flow to either drainage systems, sewer systems, or directly to water bodies.

It is most desirable to discharge chloraminated water to sewer systems. If this is possible, then the discharged water does not need to be dechlorinated. Water that is discharged to drainage systems or directly to water bodies may need to be dechlorinated, see flow chart in Appendix A.

Table- 1

PLANNED DISTRIBUTION SYSTEM DISCHARGES

EVENT			DISCHARGE FLOW	DURATION	RECEPTOR	TYPE OF DISCHARGE
Hydrant Flushing	Annually	Spring/Summer	200-500 gpm	1-2 hrs	storm drain sewer surface water	planned
Hydrant Flow Testing	1/3 of hydrants in City or Town	as requested by Fire Dept. or consumer	500-3500 gpm	15 min	storm drain sewer surface water	planned
Storage Tank Inspect/Clean	2-3 years	Fall	200-500 gpm	1-4 days	storm drain sewer	planned
Construction Dewatering Flushing	monthly weekly	year round year round	150-300 gpm 200-500 gpm	1-2 days 1-4 days	sewer storm drain surface water	planned
Hydraulic Analysis (C-VALUE)	3-4 mains per year	spring/summer	500-3500gpm	1-3 hrs	storm drain sewer surface water	planned
Blow-off valve exercising	daily	year round	150-300 gpm	5-15 min	storm drain sewer surface water	planned

EMERGENCY DISTRIBUTION SYSTEM DISCHARGES

EVENT			DISCHARGE FLOW	DURATION	RECEPTOR	TYPE OF DISCHARGE
Tank Overflow	N/A	N/A	500-1000 gpm	1 day	storm drain sewer	emergency
Fire Fighting	as needed	year round	2000-5000gpm	1-3 hrs	overland storm drain	emergency
Water main break	N/A	year round	700-500 gpm	2-3 hrs	storm drain sewer surface water overland	emergency
Water main leak	N/A	year round	10-200 gpm	1 day-year	storm drain sewer surface water underground overland	emergency

Dechlorination Procedures

The key to dealing with planned releases of chlorinated water is advance planning and preparation. Adequate planning will ensure that all steps in the dechlorination process are followed, and will minimize the potential for unplanned releases or any other impacts to occur. An operations plan will be developed that will list the specific steps for the particular discharge and dechlorination. The receiving water body and the system that transports the water to it must be known, so that the discharged water can be traced to its final destination. The chlorine residual and flow rate of the water to be discharged needs to be estimated. This will allow the appropriate dechlorination solution dosing rate to be determined. The planning tasks are outlined below.

1. Identify route and final destination of discharge water.
2. Determine discharge volume.
3. Determine discharge rate.
4. Measure chlorine residual.
5. Estimate volume of dechlorination solution and dosage rate required.

A solution of sodium thiosulfate will be used for dechlorination water. The dosing rate of the solution will depend upon the flow rate and the chlorine residual of the water being discharged. Appendix C shows the dosing rate for a 6% and 10% solution of sodium thiosulfate, for given flow rates and chlorine residuals. The 10% solution is stronger than the 6% solution, and will dechlorinate water at a faster rate. The 10% solution will also dechlorinate a larger volume of water than the same amount of 6% solution. Depending upon the activity, the dechlorination solution may need to be periodically recharged. This will increase the time interval between visits to recharge the dechlorinating solution. This is important for discharges that occur for an extended period of time, as it is desirable to be able to recharge the dechlorinating solution during a normal 8-hour work day.

A portable dechlorination unit is being developed for use by the MWRA. The unit will consist of a storage tank, a dosing pump, a power source, and storage space to store bags of sodium thiosulfate. The mobile unit will be towed to the location where the dechlorinating solution is to be applied. An example of a unit used elsewhere is shown in Appendix C. The unit will dispense a sodium thiosulfate solution into the discharge water to be dechlorinated.

As previously, mentioned there are two types of sodium thiosulfate, anhydrous and pentahydrate. The anhydrous form is being used by the MWRA due to the fact that it is less expensive and it lasts longer in solution, and therefore will be effective for a longer period of time. This, too, increases the time between required visits to the dechlorinating unit in order to recharge the solution.

When using the portable dechlorination unit the following are the steps required to dechlorinate water to be discharged:

1. Review operations plan for the specific discharge requirements.
2. Confirm all required materials are available on site.
3. Confirm the chlorine residual in the discharge water.
4. Confirm the flow rate at which water is to be discharged.
5. Confirm the flow rate setting of the dosing pump.
6. Confirm the location to inject dechlorinating solution.
7. Confirm location to measure downstream chlorine residual of receiving water.
8. Mix dechlorinating solution.
9. Start application of dechlorinating solution.
10. Check downstream chlorine residual.
11. Check dechlorinating solution quantity on daily basis

It is important to review the above steps outlined prior to starting the dechlorinating operation. If all of the steps can not be confirmed, then the crew needs to contact their supervisor. Starting to attempt to dechlorinate without a location to apply the dechlorinating solution or without a location to monitor the downstream chlorine residual, for example, can cause the operations plan to fail. This could result in the inadvertent discharge of chloraminated water.

1. Review Operations Plan

The first step in the dechlorination procedure is to review the operations plan that has been developed to determine the specific requirements for the specific operation. Review of the plan will allow the personnel responsible for the work to familiarize themselves with the blow-offs to be used, the location of the water body that will receive the dechlorinated water, and the path which the discharged water will follow. As noted earlier, planning is the key element in the success of any dechlorination process. The actual dechlorination can then be accomplished by following the operations plan.

2. Confirm Materials On-Site

It is critical that all materials required be on-site prior to the start of the dechlorination process. This will prevent the process from having to be started and stopped, or for the accidental release of water that is still chloraminated. Table 2 provides the materials suggested to be used.

TABLE 2
Dechlorination Materials

* Mobile Unit with water and sodium thiosulfate
* Operations Plan
* Chlorine Residual Test Kit (Hach Color Wheel)
* Safety Goggles
* Rubber Gloves
* Dust Masks
* Material Safety Data Sheet (MSDS)
* Dechlorinating Bags

It is important to have dechlorinating bags available for planned releases in the event that an unforseen situation arises, such as the mobile unit failing.

3. Confirm Chlorine Residual of Water to be Discharged
The Total Chlorine Residual (TCR) of the water to be discharged should be determined using the test kit. This will confirm the information in the Operations Plan regarding the suggested flow rate of the dechlorinating solution.

4. Confirm the Flow Rate of the Water to be Discharged
Review the Operations Plan for the flow rate of the water to be discharged. For example, for blowoff valve exercising, it will probably be indicated by the number of turns that a blow off valve is to be opened to allow the flow of water to be discharged.

5. Confirm Flow Rate of Discharge Pump
The flow rate of the mobile dechlorinating unit discharge pump should be confirmed with the Operations Plan.

6. Confirm Location to Inject Dechlorinating Solution
Review the Operations Plan to confirm the location at which the dechlorinating solution will be injected into the discharge water. This will normally be a blow off manhole, a drain manhole, a drainage culvert, or stream/river.

7. Confirm Location to Measure Downstream Chlorine Residual
The location to monitor the total chlorine residual of the discharged water downstream of the application of the dechlorinating solution needs to be confirmed. The lack of a location at which to do this means that the success of the operation will be in jeopardy.

8. Mix Dechlorinating Solution
Mix the dechlorinating solution as outlined in the operations plan.

9. Start Dechlorinating Operation
The dechlorinating solution can now be applied in accordance with the operations plan.

10. Monitor Downstream Chlorine Residual
Take samples of the downstream water at the location(s) identified in the operations plan, and confirmed in Step 7 above. Monitor at the time intervals outlined in the plan. Record the data on the logs sheets provided with the operations plan.

11. Check Dechlorinating Solution on a Daily Basis
The quantity of the dechlorinating solution in the mobile unit should be checked daily for plans that extend beyond one days operation. This will minimize situations where the mobile unit runs out of solution.

A Standard Operating Procedure (SOP) is being developed that will be used to plan and perform dechlorination. The SOP will be provided when it is available.

Emergency Release of Chlorinated Water

Introduction:

The emergency release of chlorinated water poses some difficulties for distribution system operators. The greatest concern is the introduction of chlorinated water into natural water bodies. Preventing the release of chlorinated water is the preferred solution. Water main breaks are the unpredictable factor and thus pose the greatest threat. In order to minimize the risk of this type of release, isolation of the water main is the only real solution. Distribution operators can insure isolation and minimize the risk by knowing their systems, exercising the system and knowing the environment

Definition:

The term *emergency release* refers to the release of chlorinated water during water main breaks. Leaks in water mains will need to be evaluated by distribution supervisors to determine if dechlorination will be necessary. The need to dechlorinate will be determined by; location of the leak to natural water bodies and quantity of flow. All other operations performed by distribution system operators will be considered planned. If during an emergency release a water main needs to be de-watered, the mobile unit will be used and procedures for a planned release can be employed. Local communities will experience emergency release of chlorinated water during firefighting procedures, however the effects of this type of release have not been fully evaluated. It is currently considered that dechlorination will not be needed during firefighting procedures.

Know Your System:

The best offense is a good defense. The best defense is to know your water system. During a water main break isolation of the effected pipeline should become the priority of the distribution operator. Once a break is isolated and the flow of chlorinated water is under control the need to dechlorinate will be minimized. The only way distribution operators can effectively isolate their systems is to keep and maintain proper records of where valves are located and to be able to transfer this information to their crews. The M.W.R.A. Distribution Section relies on a detail record and record plan system and can not stress enough its importance to system operation and maintenance. The second form of defense in isolating the distribution system is reliability of the valves.

Exercising Program:

Distribution operators need to maintain a valve exercising program to build confidence and reliability within their system. A strong exercising program will assist the distribution operator in knowing how to isolate their system, where the valves are located and whether or not the valves are operable. Valves that are not operable should be scheduled for replacement. When a distribution system is in good working order and valves can be easily located, isolation will be available to stop unwanted discharges. If the pipeline break can not be isolated, dechlorination procures need to be implemented immediately. The M.W.R.A. Distribution Section has a goal of exercising every valve twice a year.

Know Your Environment:

During an emergency release of chlorinated water, distribution operators need to be aware of the final discharge point. When chlorinated water enters a water body the impact to the local environment may be significant. Large volumes of chlorinated water released into a low flow water body may cause fish kills or damage aquatic organisms. The system operators also need to locate areas where crews can test the receiving water body for the presence of chlorine during the dechlorination process. The M.W.R.A. is mapping all pipelines within close proximity of local waterways and is developing a database of blow-offs and their discharge points.

Emergency Release Response:

Distribution operators should develop an Emergency Release Response Plan. The following is an outline of a general plan and should not be considered to be adequate for all distribution systems. Distribution operators need to decide what type plan will work for their systems.

During an emergency release, response time is a critical factor. All personnel need to trained in the proper procedure. Crew vehicles should be stocked with the tools and equipment needed to respond (i.e., valve wrench, sand bags, dechlorination kit). The activities that an emergency release response may involve are: reporting, evaluation, notification, isolation - control, dechlorination, monitoring and documentation.

Reporting:
The initial report of a leak or water main break is critical to proper response. It is at this time when important information can be collected. In many cases reports of leaks or breaks are handled by a dispatcher. All municipal personnel should be instructed to notify the dispatcher or designated personnel when a leak has been discovered. It is the responsibility of the dispatcher or designated personnel to record all relevant information. In order to minimize error of reporting a call sheet or report form should be used. A leak/break report form should contain, but not be limited to:

- Person who reported break/leak
- Time of report
- Date
- Location of break/leak - Street, Town
- Nearest Cross Street
- Size of Leak - e.g., Garden Hose, Fire Hydrant, Street Completely Flooded
- Name of Person Filling Out Form

An example of a Leak/Break Report Form is in Appendix B.

After the reported leak has been documented the dispatcher will need to contact the Responsible Person (RP). The Responsible Person is the person who is responsible for the distribution system. This person may be Distribution Superintendent, Operations Manager, Chief Engineer or other similar position or designate. It is the responsibility of the RP to evaluate the report and to determine appropriate operations.

Evaluation:
Given the information collected on the report form the RP will have to evaluate the situation. If the report is during the normal working hours the RP can consult distribution staff and have crews on route. During off-hours the RP will have to rely on the information collected, knowledge of the system, maps and other operational information. Factors that may influence the plan of action are: size of leak/break, location of the main, proximity to natural water bodies. After evaluating the reported information the RP will need to determine:

- Incident level (minor, major, code level)
- Potential for discharge to natural water bodies
- Potential for safety hazard (public/workers)
- Initial plan of action
- Others to be contacted (crews, operation staff, outside agencies)

During an emergency release the RP may not be able to fully evaluate the situation until the site has been visited by the RP or a designated person. Once the situation has been evaluated the RP can tailor the response. All communication needs to be routed through the RP. The RP must assume the role of an Incident Commander and be sure that all operations and directions are directed through the RP. Once the RP has established the magnitude of the emergency, a plan of action can be implemented.

Notification:
The magnitude of the emergency will determine notification procedures. Notification may be limited to in-house staff or involve local officials, fire departments and hospitals. Breaks of a magnitude that are deemed a public safety hazard may involve activating an Emergency Operation Center and notifying MEMA, DEP, DPH, State Police or other agencies as directed under the *local emergency response plan.*

Isolation - Control:
Control of the discharge will be the primary function of first responders. In trying to control the discharge the RP will have to decide if the pipeline needs to be isolated. If the decision is made to isolate the pipeline, crew members should be directed to close the controlling valves. Crew members while on site should be instructed to divert any flow of chlorinated water away from storm drains or natural water bodies. Isolating the water main will stop the flow and reduce the risk of environmental impact however: once exposed the water main will require disinfecting. Crews can use sand bags to pool or divert water. Dechlorination should be started on the pooled or diverted water as soon as possible.

Dechlorination:

In order to dechlorinate the discharge: a dechlorinating agent needs to be introduced to the discharge flow. Fiber mesh bags with 20 lbs to 25 lbs of Anhydrous Sodium Thiosulfate can be used to dechlorinate the discharged water. Sand bags can be used to divert and pool the water. The sand bag pool can be made larger to accommodate a longer contact time. Anhydrous Sodium Thiosulfate can be placed into the pool to achieve the contact time needed. If the RP determines that a near by natural water body may have been impacted by the discharge flows Sodium Thiosulfate can be spread into the water way by hand. During dechlorinating the crew will need to monitor the process.

Example:

M.W.R.A. distribution crews have recently experienced a leak with a flow of approximately 200 g.p.m. The discharged water filled a excavation pit, flowed across the construction site, went through a line of hay bales and down a rip rap before going underground to a drain. A field test of the chlorine level after entering the rip rap showed approximately 2.0 *mg/L* . A bag of Sodium Thiosulfate Anhydrous was placed on the edge of the discharge flow. A sample of the discharged flow was taken down stream and was found to have no detectable chlorine.

Monitoring:

During dechlorination the crews need to moritor the levels of chlorine. Part of the suggested emergency response kit contents a Hach chlorine indicator. After setting up the dechlorination area the crew should obtain a chlorine reading from the discharge flow upstream from the dechlorinating agent. A second reading should be taken downstream from the dechlorinating agent and compared with the first reading. By taking reading of the chlorine levels crew members can determine if the dechlorinating agent is effective. A member of the crew should be assigned the task of documenting all activity during the process.

Documentation:

Because of the potential of introducing manmade by-products (ie: chlorine, ammonia Anhydrous Sodium Thiosulfate) into natural water bodies distribution operators need to keep records of all activity. Crews should have with them a report sheet. The report sheet should contain as mush site specific information as possible. An example of a report sheet can be found in Appendix B.

APPENDIX A

TO

MWRA DECHLORINATION MANUAL

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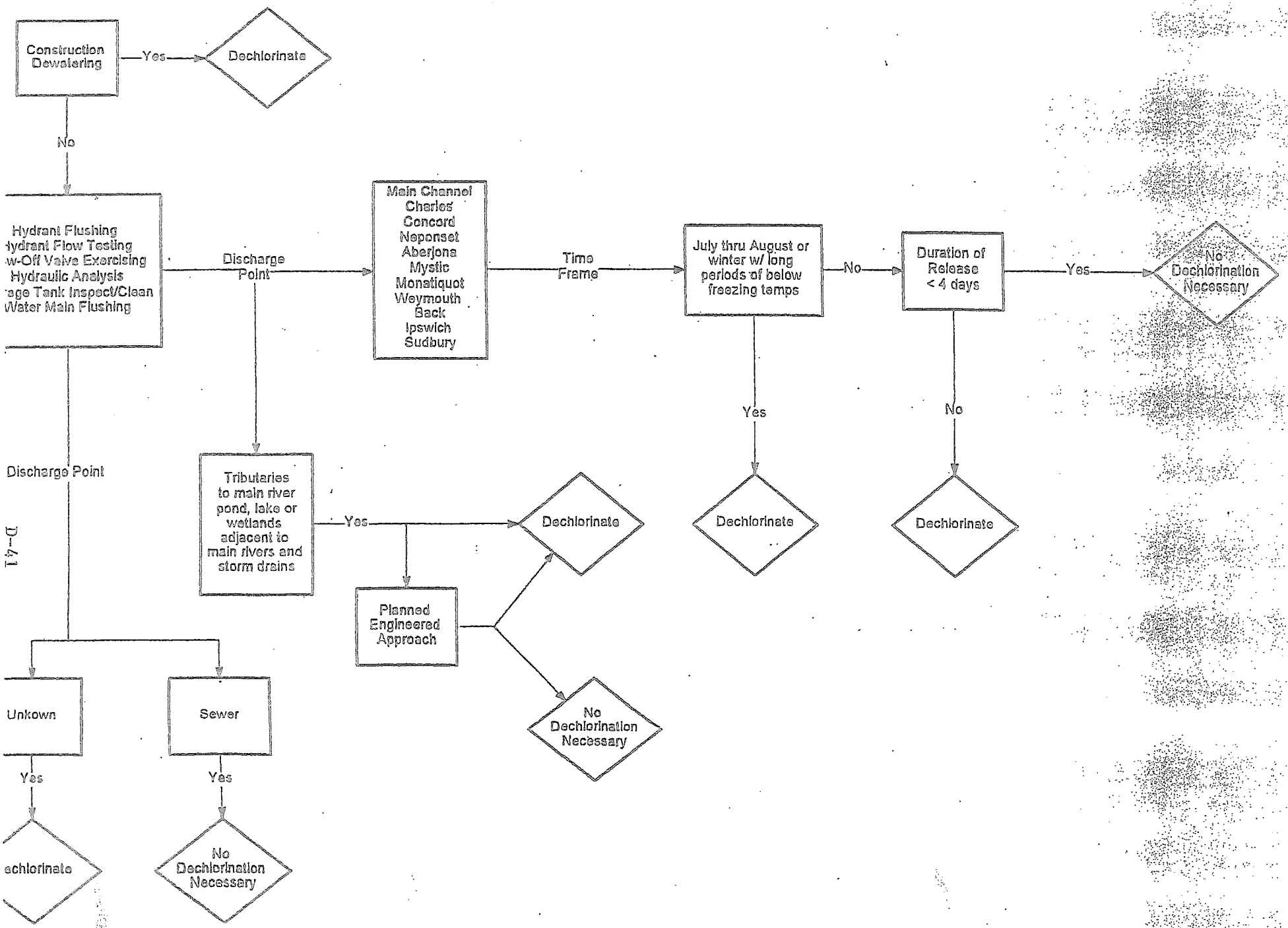
PLANNED WATER RELEASE EVENTS



SODIUM THIOSULFATE VENDORS

Name & Phone Number	Location	Cost/bag
Astro Chemical (413) 781-3130 (sold by the pallet) Contact - Kelly Walsh	Springfield	$ 0.58 per pound (Pentahydrate) $29.00 per 50-lb bag $0.61 per pound (anhydrous) $30.50 per bag
Chemical Sales & Service (508) 756-4653 Contact - Ed Christian	Worcester	$ 0.35 per pound (Pentahydrate) $17.50 per 50-lb bag $0.68 per pound (anhydrous) $34.00 per bag
George Mann, Co (800)557-2426	Providence, RI	

15014
15015

General Chemical

PRODUCT SAFETY DATA SHEET

SODIUM THIOSULFAT

A. GENERAL INFORMATION

TRADE NAME (COMMON NAME)
SODIUM THIOSULFATE, ANHYDROUS
SODIUM THIOSULFATE, CRYSTAL

☒ C.A.S. No. ☐ GENERAL PRODUCT CODE
7772-98-7 (anhydrous)

CHEMICAL NAME AND/OR SYNONYM
Sodium Thiosulfate
Sodium Thiosulfate pentahydrate
Synonyms: Sodium hyposulfite; "hypo."

FORMULA
$Na_2S_2O_3$ (anhydrous)
$Na_2S_2O_3 \cdot 5H_2O$ (pentahydrate/crystal)

MOLECULAR WEIGHT
158.11
248.18

ADDRESS (No., STREET, CITY, STATE AND ZIP CODE)
General Chemical Corporation
90 East Halsey Road
Parsippany, NJ 07054-0389

CONTACT	PHONE NUMBER	LAST ISSUE DATE	CURRENT ISSUE DATE
Manager of Product Safety	(201) 515-1840	October, 1986	May, 1996

B. FIRST AID MEASURES

EMERGENCY PHONE NUMBER
(800) 631-8050

INHALATION: Remove to fresh air. If short of breath, give oxygen, provided a qualified operator is available. If symptoms persist, get medical attention.

INGESTION: If conscious, promptly give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. If symptoms develop, get medical attention.

EYES: Flush eyes with plenty of water for at least 15 minutes. If irritation persists, get medical assistance.

SKIN: Wash with soap and water, then flush with water until all chemical is removed. Remove contaminated clothing and wash before reuse.

C. HAZARDS INFORMATION

HEALTH

INHALATION
Contact with acids releases sulfur dioxide and/or hydrogen sulfide gas which may be harmful or deadly if inhaled. Breathing product dust or mist may irritate respiratory tract.

INGESTION
Relatively low in acute toxicity but may cause irritation of the gastrointestinal tract and purging, if large quantity is ingested. Doses of 8 g/kg in rats were non-toxic upon ingestion. For summary, see Reference (a), Section J.

SKIN
Dust or mist may cause irritation from prolonged contact. Aqueous solutions may cause irritation from repeated or prolonged contact.

EYES
Dust, solutions or mist may irritate or burn the eyes and cause temporary conjunctivitis.

PERMISSIBLE CONCENTRATION: AIR (SEE SECTION J)
No OSHA/TWA or ACGIH/TLV established for Sodium Thiosulfate.
ACGIH/TLV for SO_2 is 2 ppm with STEL: 5 ppm

BIOLOGICAL
None established.

UNUSUAL CHRONIC TOXICITY
None reported.

F. HAZARDS (cont.)

FIRE AND EXPLOSION

FLASH POINT	AUTO IGNITION TEMPERATURE	FLAMMABLE LIMITS IN AIR (% BY VOL)
°C No flash point. ☐ OPEN CUP ☐ CLOSED CUP	°C Not applicable	LOWER — Not applicable UPPER — Not applicable

UNUSUAL FIRE AND EXPLOSION HAZARDS

If involved in a fire, toxic and irritating gases and residue may evolve.
See Hazardous Decomposition Products, Section G.

G. PRECAUTIONS/PROCEDURES

FIRE EXTINGUISHING AGENTS RECOMMENDED

If involved in a fire, choose extinguishing agent most suitable for type of surrounding fire.
Material itself is not combustible.

FIRE EXTINGUISHING AGENTS TO AVOID

None known.

SPECIAL FIRE FIGHTING PRECAUTIONS

Firefighters should wear self-contained, NIOSH-approved breathing apparatus to protect against any release of toxic and/or irritating fumes. Skin and eye protection should also be provided. Use water spray to keep fire-exposed containers cool and to knock down fumes.

VENTILATION

Provide local exhaust if dusty or misty conditions prevail, and if there should be a release of sulfur dioxide gas (see Section G).
Keep incompatible materials out of hoods, ducts, etc.

NORMAL HANDLING

Avoid contact with eyes, skin, clothing. Do not breathe dust or mist.
Use with adequate ventilation. Wash thoroughly after handling.

STORAGE

Store in a cool, dry area, away from acids or oxidizers.
Keep container closed when not in use and protect from physical damage.

SPILL OR LEAK (ALWAYS WEAR PERSONAL PROTECTIVE EQUIPMENT — SECTION E)

Promptly shovel or sweep up the dry chemical into an empty container with a minimum of dusting.
Cover and store as above. Cautiously spray residue with plenty of water to complete clean-up.
Contact appropriate regulatory authorities for approved method of disposal, as necessary.

SPECIAL PRECAUTIONS/PROCEDURES/LABEL INSTRUCTIONS

SIGNAL WORD - CAUTION!

Contact with acids releases irritating sulfur dioxide gas.
When dissolving and making solutions, add to water cautiously and with stirring as solutions can get hot and may spatter.

H. PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION

If dusty or misty condition prevails, use dust or mist respirator, approved by NIOSH. If sulfur dioxide should be released (see Section G), use a supplied-air respirator or self-contained breathing apparatus or other alternative choice, approved by NIOSH, as recommended for this gas [see Ref. (c)].

EYES AND FACE

If probable exposure to dust or mist of solution exists, wear chemical safety goggles and hard hat (or other head covering).
Do not wear contact lenses. Eyes must be protected as above if dissolving this material in water.

HANDS, ARMS, AND BODY

For routine product-handling or use, wear full work clothing, including long-sleeved shirt and trousers. Cotton gloves are usually adequate when handling dry product. For solutions, wear impervious gloves and apron. If contact is repeated or prolonged, wear full impervious clothing.

OTHER CLOTHING AND EQUIPMENT

F: PHYSICAL DATA

MATERIAL IS (AT NORMAL CONDITIONS):	APPEARANCE AND ODOR	
☐ LIQUID ☒ SOLID ☐ GAS ☐	White granules with no odor (anhydrous). Clear to white crystals or granules with no odor (hydrate).	
BOILING POINT ~100°C MELTING POINT (transition) 48°C	SPECIFIC GRAVITY (H_2O = 1): Anhydrous: 1.667 Hydrate: 1.685	VAPOR DENSITY (AIR = 1): Not applicable.
SOLUBILITY IN WATER (% by Weight): 42 @ 0°C (hydrate) 33 @ 0°C (anhydrous)	pH: 7.5% solution***, pH = 8.6 (approx.)	VAPOR PRESSURE (mm Hg @ 20°C) ☐ (PSIG) ☐: Not applicable
EVAPORATION RATE (Butyl Acetate = 1) ☐ (Ether = 1) ☐: Not applicable.	% VOLATILES BY VOLUME (At 20°C): Not applicable.	***Anhydrous basis.

G: REACTIVITY DATA

STABILITY	CONDITIONS TO AVOID
☐ UNSTABLE ☒ STABLE	High temperatures (above 100°C): yield sulfur dioxide gas and hazardous residue (details below).

INCOMPATIBILITY (MATERIALS TO AVOID)
Strong oxidizers: cause vigorous exothermic reactions.
Acids: release sulfur dioxide and/or hydrogen sulfide gas.
Water-reactive materials such as sodium: cause strong exothermic reaction with the hydrate.
Violent reaction with sodium nitrite when water of crystallization has been driven off by heating.

HAZARDOUS DECOMPOSITION PRODUCTS
Sulfur dioxide gas: toxic and corrosive.
Sodium sulfide residue: flammable, dangerous fire risk; strong irritant to skin and tissue; incompatible with acids.
Hydrogen sulfide gas: toxic

HAZARDOUS POLYMERIZATION	CONDITIONS TO AVOID
☐ MAY OCCUR ☒ WILL NOT OCCUR	None known.

H: HAZARDOUS INGREDIENTS (Mixtures Only)

MATERIAL OR COMPONENT / C.A.S. #	WT. %	HAZARD DATA (SEE SECT. J)
Sodium Thiosulfate / 7772-98-7 (anh)	99+	See Section C

I. ENVIRONMENTAL

DEGRADABILITY/AQUATIC TOXICITY

Degradability — not applicable (inorganic).
Aquatic Toxicity: no data found.

OCTANOL/WATER PARTITION COEFFICIENT: Unknown

EPA HAZARDOUS SUBSTANCES? (CLEAN WATER ACT SECT. 311) ☐ YES ☒ NO — IF SO, REPORTABLE QUANTITY: _____ lb — 40 CFR 116-117

WASTE DISPOSAL METHODS (DISPOSER MUST COMPLY WITH FEDERAL, STATE AND LOCAL DISPOSAL OR DISCHARGE LAWS)

Treatment or disposal of waste generated by use of this product should be reviewed in terms of applicable federal, state and loc laws and regulations. Users are advised to consult with appropriate regulatory agencies before discharge, treatment or disposal

RCRA STATUS OF UNUSED MATERIAL IF DISCARDED: Not a "hazardous waste", if discarded, unused.

HAZARDOUS WASTE NUMBER: (IF APPLICABLE) N.A. — 40 CFR 261

J. REFERENCES

PERMISSIBLE CONCENTRATION REFERENCES

None established for Sodium Thiosulfate.

REGULATORY STANDARDS

Not applicable.

D.O.T. CLASSIFICATION: Not regulated. — 49 CFR 173

GENERAL

(a) Gosselin, R.E. et al., "Clinical Toxicology of Commercial Products", 4th ed., 1976, Section II, Monograph 151; Williams & Wilkins, Baltimore (3 references).
(b) NIOSH Registry (RTECS), 1981-82, Accession No. XN6476000.
(c) NIOSH/OSHA: "Pocket Guide to Chemical Hazards".
(d Bretherick, L., "Handbook of Reactive Chemical Hazards", 2nd ed., 1979, Butterworths, Boston.
(e) Merck Index, 10th ed., 1983, Monograph 8452.

K. ADDITIONAL INFORMATION

This product is not for food or drug use.

PSDS FILE NO

ASTRO PRODUCT CODE # 15022

Material Safety Data Sheet

ASTRO CHEMICALS INC.
64-84 SHAW'S LANE
P.O. BOX 2249
SPRINGFIELD, MA 01102
413-781-7240

anhydrou sodium sulfate

North American Chemical Company
13200 Main Street
Trona, California 93562

For more detailed information on the hazards of this product, write to the address above. Technical Information Bulletin is also available. For emergency information, telephone (619) 372-2221 any time.

PRODUCT IDENTIFICATION

Brand Name ..... salt cake anhydrous sodium sulfate
Chemical Name ..... Sodium sulfate
Common Name ..... Salt cake
Formula ..... Na_2SO_4
DOT Proper Shipping Name ..... Not applicable
DOT Hazard Class ..... Not applicable
DOT I.D. Number ..... Not applicable
Reportable Quantity (RQ) .. Not applicable
CAS Number 7757-82-6

PHYSICAL AND CHEMICAL PROPERTIES

State ..... Granular solid
Melting Point C 884
Boiling Point C ..... Not applicable
Color ..... White
Odor ..... None
Bulk Density, lb/cu. ft ..... 80 to 90
Weight Per Gallon ..... Not applicable
Specific Gravity @ 20C ..... Not applicable
Water Solubility, % By Wt. @ 20C ... 18.3
Flash Point And Method ..... Not applicable
pH ..... Not applicable

HAZARDOUS INGREDIENTS

Chemical Name	Common Name	CAS Number	Hazard
Sodium sulfate	Salt cake	7757-82-6	Mild irritant to eyes, nose, and skin and a strong cathartic.

PHYSICAL HAZARD INFORMATION

Explosive: No Upper Explosive Limit: Not applicable Lower Explosive Limit: Not applicable
Pyrophoric: No
Flammable: No Flammability Class: Not applicable
Combustible: No Organic Peroxide: No
Oxidizer: No Compressed Gas: No

Reactivity: Stable at ordinary and expected temperatures and pressures.

Incompatibilities: Aluminum powder and molten sodium sulfate has exploded.

Hazardous Decomposition: Molten sodium sulfate decomposes, evolving toxic sulfur oxides.

Conditions To Avoid: Temperatures at or above the melting point.

HEALTH INFORMATION

Precautionary Information: CAUTION! May cause irritation. May be harmful if swallowed.

Symptoms Of Exposure: Burning sensation in the eyes or nose, coughing or sneezing or rash on the skin.

Restrictive Medical Conditions: Skin disorders may be aggravated by the dehydrating action of this product. Gastrointestinal and kidney disorders may be aggravated by the cathartic action of this product.

PRIMARY ROUTE(S) OF ENTRY

Inhalation (breathing), eye and skin contact and ingestion (swallowing).

TOXICITY INFORMATION

This product is of low toxicity to humans; no lethal doses for humans were reported in the literature; Oral-mouse LD_{50} 5989 mg/kg; Ivn-mouse LDLo 1220 mg/kg.

EXPOSURE LIMITS

OSHA: Not established.
ACGIH: Not established.
Other: ACGIH nuisance dust TLV-TWA is 10 mg/m^3 total dust or 5 mg/m^3 respirable dust.

Reported As A Potential Carcinogen Or Carcinogen	☒ Not Applicable ☐ OSHA	☐ National Toxicology Program ☐ International Agency For Research On Ca

PRECAUTIONS FOR SAFE HANDLING AND USE

Avoid breathing dust.
Avoid contact with eyes and skin.
Use only with adequate ventilation.
Wash thoroughly after handling.

SPILL AND LEAK PROCEDURES

Soil Release:	Shovel and sweep up into a container and reclaim for salvage value or dispose of at an industria waste facility in accordance with federal, state and local regulations.
Water Spill:	Disperse and dilute with water jets, propellers or other similar devices.
Air Spill:	Let dust settle and dispose of as in Soil Release above.
Occupational Spill:	Shovel and sweep up into a container. Reclaim for salvage value, or as permitted, small amount: may be washed to an industrial sewer.
RCRA Waste Number:	Not applicable.

ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT

Ventilation:	Use general dilution ventilation techniques.
Respirator:	Use NIOSH/MSHA approved dust and mist respirator for exposure above the nuisance dus exposure limit.
Eye Protection:	Safety glasses or vented safety goggles.
Gloves:	No special requirements. Ordinary work gloves.
Clothing:	No special requirements. Wear easily washable clothing. Change daily. Wash clothing before reuse

EMERGENCY PROCEDURES

Fire: This product is not flammable and does not support combustion.

Spill or Leak: Shovel, or sweep up and place in container for later disposal.

FIRST AID PROCEDURES

Ingestion: If swallowed, induce vomiting immediately by giving two glasses of water and sticking finge... throat. Never give anything by mouth to an unconscious person. Call a physician.

Inhalation: If inhaled, remove to fresh air.

Skin Contact: Flush with plenty of water and then wash thoroughly with soap or mild detergent and water.

Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

Note To Physician: Chemical of exposure is sodium sulfate.

DATE OF ISSUE: November 1994 DATE REVISED: November 1994 REPLACES: June

APPENDIX B

TO

MWRA DECHLORINATION MANUAL

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MASSACHUSETTS WATER RESOURCES AUTHORITY
WATERWORKS
DISTRIBUTION SECTION

LEAK - BREAK REPORT FORM

TIME:_____ DATE:_____ NAME:_____

STREET:_____ TOWN:_____

NEAREST CROSS STREET:_____

LEAK / BREAK SIZE:_____

PERSON ON CALL:_____

PERSON FILLING OUT SHEET:_____

COMMENTS:_____

_____

_____

_____

EMERGENCY RESPONSE RECORD

Equipment: Emergency Equipment and Supplies Kit (see attached)

Record the following information:

1) Time of break _____ (am/pm)

2) Personnel Contacted

MWRA	Other

3) Personnel on site

Name	Agency/Company/ MWRA Dept.

4) Chlorine residual test results (see attached table)
State units of measure and time of measurement

5) Type of dechlorinating agent used

6) Steps taken to minimize effect of break:
(berming, sandbags, etc.)

7) Location of nearest outfall:
(stream name, water body, etc.)

RECORD OF DECHLORINATION ACTIVITIES

Date (m/d/y)	Location (Address)	Estimated Flow Rate of Water (include units,ie: gallons/minute)	Total Residual Chlorine (TRC) Measured in Water (mg/L)	Amount of Dechlorinating Agent Added (# of Bags or other)	TRC Measured in Discharge Water After Dechlorinating Agent Added	TRC Measured in Receiving Stream (note if it is upstream or downstream)

Signature: _____

Print Name: _____

Date: _____

Telephone Number (Supervisor's Daytime #) : _____

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APPENDIX C

TO

MWRA DECHLORINATION MANUAL

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Explanation of Dechlorination Table

This table is based on setting up a trailer with a 55 gallon drum of solution to dechlorinate water at a given flow rate (*GPM*).

If a 55 gallon drum is used it would be filled with 45 gallons of water. This would leave room at the top of the drum to avoid spillage. A solution should be mixed to maximize the capability of the solution over time. To maximize the solution the dosage should come as close to 10% as possible. A drum of 45 gallons of water has a weight of $45_{gal} \times 8.34_{lb/gal} = 375.3_{lb}$. To make a solution of 10% by weight 37.53_{lb} of chemicals need to be added. This is an odd weight for the crews to have to handle. If 25_{lb} of chemical are used (*half of a bag*) then the % solution is $25_{lb} / 375.3_{lb} \times 100 = 6.66\%$.

Using the table 3-6 on page 22 from the Chlorine Monitoring and Dechlorination Techniques Handbook, at a TRC of $.5_{mg/L}$ and 5% solution 331_{mL} of solution are needed to neutralize $10{,}000_{gal}$ of chlorinated water, at 10% of solution only 159_{mL} are needed. How much is needed at 6.66% solution.

$$\frac{(331_{mL} - 159_{mL})}{5\%} \times 1.66\% = 57.104_{mL}$$

$$331_{mL} - 57.104_{mL} = 273.896_{mL}$$

Use 274_{mL} of 6.6% solution to neutralize 10,000 gallons of chlorinated water.

At $50_{gal/min} = 3{,}000_{gal/hr}$ it will take 3.3hr for 10,000 gallons to be discharged.

To dispense $274_{mL} / 10{,}000_{gal}$ the dosage rate would be $274_{mL} / 3.3_{hr} = 83_{mL/hr}$

This can be converted to liters per hour or gallons per hour.

Dosage Setting for 6.66% Solution (mL/hr)					
Flow (gpm)	Total Residual Chlorine (TRC)(mg/L)				
	.5	1	1.5	2.0	2.5
50	83	165.5	248.4	331.2.	414
100	164.4	330.6	496.8	662.4	828
150	246.6	495.9	745.2	993.6	1242
200	328.8	661.2	993.6	1324.8	1656
250	410.8	826.5	1242	1656	2070
300	493.2	991.8	1490.4	1987.2	2484
350	575.4	1157.1	1738.8	2318.4	2898
400	657.6	1322.4	1987.2	2649.6	3312
450	739.8	1487.7	2235.6	2980.8	3726
500	822	1653	2484	3312	4140
1000	1644	3306	4968	6624	8280
2000	3288	6612	9936	13248	16560

There are $170{,}325_{mL}$ in 45_{gal}

Hours 45 Gallons Will Last					
Flow (gpm)	Total Residual Chlorine (TRC)(mg/L)				
	.5	1	1.5	2.0	2.5
2000	51	25	17	12	10

For a 10% solution using a 50lb bag of Anhydrous Sodium Thiosulphate

50lb is 10% of 500lb. $\Rightarrow 500_{lb} \times 1_{gal} / 8.34_{lb} = 59.95_{gal}$

Use 60_{gal} of water to mix 50lb to get a 10% solution.

Dosage Setting for 10% Solution (mL/hr)					
Flow (gpm)	Total Residual Chlorine (TRC)(mg/L)				
	.5	1	1.5	2.0	2.5
50	47.7	95.4	143.1	190.8	238.5
100	95.4	190.8	286.2	381.6	477
150	143.1	286.2	429.3	572.4	715.5
200	190.8	381.6	572.4	763.2	954
250	238.5	477	715.5	954	1192.5
300	286.2	572.4	858.6	1144.8	1431
350	333.9	667.8	1001.7	1335.6	1669.5
400	381.6	763.2	1144.8	1526.4	1908
450	429.3	858.6	1287.9	1717.2	2146.5
500	477	954	1431	1908	2385
1000	954	1908	2862	3816	4770
2000	1908	3816	5724	7632	9540

$1_{gal} = 3.79_{L} \therefore 1_{gal} = 3{,}790_{mL} \qquad \Rightarrow 60_{gal} \times 3{,}790_{mL/gal} = 227{,}400mL$

Hours 60 Gallons Will Last					
Flow (gpm)	Total Residual Chlorine (TRC)(mg/L)				
	.5	1	1.5	2.0	2.5
2000	119	59	39	29	23

Table 3-5
Volume of Sodium Thiosulphate Pentahydrate and Anhydrous Sodium Thiosulphate Required to Neutralize 10,000 Litres of Chlorinated Water

Trace Residual Chlorine (TRC) (mg/L)	mL of stock solution per 10,000 litre of chlorinated water					
	2%	5%	10%	2%	5%	10%
	Sodium Thiosulphate Pentahydrate			*Anhydrous Sodium Thiosulphate*		
0.1	88.8	28.4	12.0	*44.3*	*17.3*	*8.3*
0.3	266	85.2	36.1	*133*	*52.1*	*25.0*
0.5	444	142	60.2	*223*	*87*	*41.7*
0.7	621	199	84.2	*312*	*122*	*58.4*
0.9	800	256	108	*401*	*157*	*75.3*
1	888	284	120	*445*	*174*	*83.5*
5	4440	1420	602	*2.230*	*870*	*418*
50	44.950	14.380	6.090	*22.570*	*8.810*	*4.230*

Table 3-6

Volume of Sodium Thiosulphate Pentahydrate
and Anhydrous Sodium Thiosulphate
Required to Neutralize 10,000 Gallons of Chlorinated Water

	mL of stock solution per 10,000 gallons of chlorinated water					
	2%	5%	10%	2%	5%	10%
Trace Residual Chlorine (TRC) (mg/L)	Sodium Thiosulphate Pentahydrate			*Anhydrous Sodium Thiosulphate*		
0.1	338	108	46	*169*	*66.1*	*31.8*
0.3	1,010	324	137	*508*	*198.4*	*95.3*
0.5	1,690	540	229	*847*	*331*	*159*
0.7	2,360	756	320	*1,190*	*463*	*222*
0.9	3,040	972	412	*1,520*	*595*	*286*
1	3,380	1,080	458	*1,690*	*661*	*318*
5	16,880	5,400	2,290	*8,470*	*3,310*	*1,590*
50	168,750	54,000	22,880	*84,720*	*33,070*	*15,880*

DECHLORINATION TRAILER OPERATIONS AND MAINTENANCE

(*Source:* Metropolitan Water District of Southern California, Water Quality Division, January 1987)

1.0 INTRODUCTION

This manual contains technical information on the operation and maintenance of equipment for the mobile dechlorination trailer. The primary purpose of this trailer is to eliminat any chlorine residual during discharge operations from District facilities and pipelines. The District is being required by the California Regional Water Quality Control Board to dechlorinate any chlorinated water discharged into storm drains or open channels. Other types of chemicals (su as calcium hypochlorite, flocculants, coagulants, etc.) can fed from the trailer by changing the chemical used and modifying the chemical feed system. For treatment schemes other than dechlorination, the Process Coordination Section should be consulted.

The following areas are covered in this manual: operational procedures, maintenance procedures, troubleshooting, manufacturers and descriptions of equipment, parts lists, drawings, and equipment manuals.

2.0 EQUIPMENT AND CHEMICAL REQUIREMENTS

2.1 DECHLORINATION

2.1.1 DISCHARGE SITE(S)

Steps

1. Determine the number of discharge sites.
2. Determine the number of dechlorination trailers needed for the dewatering operation.
3. Reserve dechlorination trailers through the Water Quality Division, Process Coordination Section.

2.1.2 DISCHARGE QUANTITY, RATE, AND LENGTH

Steps

1. Determine the discharge quantity (100 gal, 5 acre-feet, etc.).

2. Determine the discharge rate (100 gpm, 10 cfs, etc.).

3. Calculate the discharge length (15 min, 4 hr, etc.).

Example

$$\text{Discharge time} = \frac{\text{Discharge quantity}}{\text{Discharge rate}}$$

$$= \frac{2 \text{ af} \times 43{,}560 \text{ cf/af}}{10 \text{ cfs} \times 3{,}600 \text{ sec/hr}}$$

= 3 hr (2 hr, 25 min)
(round up to nearest hour)

2.2 CHLORINATION

2.2.1 CHLORINATION SITE(S)

Steps

1. Determine the number of chlorination sites.

2. Determine the number of dechlorination trailers required for the treatment.

3. Reserve dechlorination trailers through Water Quality Division, Process Coordination Section.

2.2.2 CHLORINATION DOSAGE, FLOW RATE, AND TREATMENT TIME

Steps

1. Determine the dosage required (1.5 mg/L, etc.).

2. Determine the flow rate of the water to be treated (30 gpm, 450 cfs, etc.).

3. Determine the treatment time (15 min, 10 hr, etc.).

2.3 OTHER APPLICATIONS

Contact the Water Quality Division, Process Coordination Section, for assistance.

3.0 CHEMICAL MIXING

3.1 SODIUM THIOSULFATE

3.1.1 QUANTITY OF DRY SODIUM THIOSULFATE REQUIRED (lb per 100 gal of water)

Steps

1. Refer to Table 1A, 1B, 1C, or 1D.
2. Find the discharge rate (gpm or cfs).
3. Find the feed rate (gpm).
4. Determine amount of sodium thiosulfate required.

Example

Discharge rate = 10 cfs

Feed rate = 4.3 gpm

Solution strength = 10 lb/100 gal water

3.1.2 QUANTITY OF SODIUM THIOSULFATE SOLUTION REQUIRED

Steps

1. Determine the discharge length (min or hr).
2. Determine the feed rate (gpm).
3. Determine the solution strength (lb per 100 gal).

Example

$$\text{Solution quantity} = \text{Discharge length} \times \text{Feed rate}$$

= 3 hr x 4.3 gpm x 60 min/hr

= 774 gal

= 800 gal (round up to nearest 100)

$$\text{Lb of sodium thiosulfate} = \frac{\text{Solution quantity} \times \text{lb}}{100 \text{ gal}}$$

$$= \frac{800 \text{ gal} \times 10 \text{ lb}}{100 \text{ gal}}$$

$$= 80 \text{ lb}$$

3.2 CALCIUM HYPOCHLORITE

3.2.1 QUANTITY OF DRY CHLORINE REQUIRED (lb per 100 gal of water)

Steps

1. Refer to Table 2A, 2B, or 2C.
2. Find the flow rate (cfs).
3. Find the feed rate (gpm).
4. Determine the amount of the dry chlorine required.

Example

Flow rate = 70 cfs

Feed rate = 1.9 gpm

Solution strength = 32 lb/100 gal water

3.2.2 QUANTITY OF CHLORINE SOLUTION REQUIRED

Steps

1. Determine how long the chlorine feed will be required (min or hr).
2. Determine the feed rate (gpm).
3. Determine the solution strength (lb/100 gal).

Example

$$\text{Solution quantity} = \text{Feed time} \times \text{Feed rate}$$

$$= 6 \text{ hr} \times 1.9 \text{ gpm} \times 60 \text{ min/hr}$$

$$= 684 \text{ gal}$$

$$= 700 \text{ gal (round up to nearest 100)}$$

3.3 OTHER CHEMICALS

Contact the Water Quality Division, Process Coordination Section, for specific mixing instructions for other treatment applications.

4.0 OPERATIONAL PROCEDURES (see Figures 1, 2, and 3)

4.1 TRAILER

Steps

1. Lower trailer onto towing vehicle (2" hitch ball required) and lock. (Be sure to put bolt through hitch lock.)

2. Raise trailer jack all the way and attach trailer jack wheel to bracket located on trailer tongue.

3. Attach both safety chains to vehicle.

4. Hook up electrical plug and breakaway wire to towing vehicle.

5. Check lights, tires, and signals on both trailer and towing vehicle. (Trailer tires = 45 to 50 psi.)

6. Check gas tank, oil, and coolant on generator and gas can before leaving for the storage location.

7. Check hoses and PVC piping for deterioration caused by sunlight, chemicals, etc.

8. Record generator meter reading before and after running.

9. Upon arrival at location, chock trailer wheels on each side, level trailer by using trailer jack, and secure four trailer stabilizing supports.

NOTE: SECT. 4.2 AND 4.3 CAN BE STARTED AT THE SAME TIME.

4.2 GENERATOR

Steps

1. Turn fuel valve ON and pull choke OUT.
2. Switch circuit breaker OFF.
3. Switch auto-throttle OFF (leave in this position).
4. Turn engine ignition key to START generator.
5. Once engine starts, push choke IN.
6. After generator has run for a minimum of 3 to 5 min, switch circuit breaker ON.
7. Additional information on the generator can be found in sections 10.1 and 11.0.

4.3 TANK

Steps

1. Disconnect one or two sections of hose from reel. Connect to a water source and to tank fill line.
2. Open valve A and source-water valve and begin filling tank.
3. Using sight gauge or totalizer meter, fill tank with required amount of water for treatment activity (min 100 gal to max 1000 gal).
4. Wearing eye protection and respirator, add appropriate amount of chemical, as previously determined.

4.4 MIXER

Steps

1. Unlock mixer shaft and adjust mixer to D-5 position by loosening Allen setscrew and then retightening.
2. Check to see that Allen setscrew on mixer mounting clamp is secure.
3. After tank has been filled with water and chemical and generator has warmed up, START mixer.

4. Switch mixer ON at control panel.

5. When chemical is totally dissolved, tur mixer OFF (normally requires 10 to 15 m of mixing).

6. After completing treatment activity, re mixer to vertical position and secure s in holding bracket.

7. Additional information on the mixer can found in sections 10.4 and 11.0.

4.5 PUMP

Steps

1. Connect hose on reel to injection point attach to spray nozzle.

2. OPEN both lower pump inlet valve C (ful and upper bypass valve B (halfway) on t before turning pump ON.

3. Check generator to make sure auto-st c. in OFF position.

WARNING: DO NOT START PUMP WITH GENERATOR AUTO SWIT "ON" POSITION, OR PUMP MOTOR DAMAGE WILL RE

4. START pump at control panel.

5. Adjust flowmeter to proper feed rate by opening valve D and partially closing by valve B.

NOTE: DO NOT CLOSE PUMP INLET VALVE C.

6. Maintain a back pressure between 40 and psi.

7. When solution level in tank reaches approximately 50 gal, pump will shut off automatically.

8. To restart pump, hold pump bypass toggle switch in ON position and START pump.

9. Continue pumping until a few inches o solution is left in tank or pressure t indication drops.

WARNING: DO NOT LET PUMP RUN DRY, OR DAMAGE WILL RES

10. Monitor treated water to verify that appropriate results are occurring.

11. Flow can be adjusted by opening or closing discharge valve D and bypass valve B.

12. STOP pump after treatment activity has been completed.

13. Additional information on the pump can be found in sections 10.5 and 11.0.

4.6 LIGHTS

Steps

1. After generator has been warmed up for 3-5 min, lights may be switched ON at control panel.

2. Switch lights OFF when no longer required.

4.7 CLEANUP

Steps

1. After treatment activity has been completed, dispose of any remaining chemical solution into a sanitary sewer.

2. Rinse out tank and rinse off trailer. (Valve E may be used during this step.)

3. Top off generator fuel tank and 5-gal fuel storage can. (Fuel should be charged to trailer property number.)

4. After generator has cooled off, replace and secure cover.

5. Secure all equipment before leaving site.

5.0 MAINTENANCE PROCEDURES

5.1 TRAILER

1. Check tires for wear and proper inflation.

2. Check lights and wiring.

3. Check all bolts and nuts for tightness.

4. Check and repack wheel bearings every 12 months.

5. Additional information can be found in section 10.1.

5.2 GENERATOR

1. Check gas, oil, coolant, and battery water levels.

2. Additional information can be found in sections 10.2 and 11.0.

5.3 TANK

1. Check fittings for cracks or leaks.

2. Check tank for cracks or leaks.

3. Additional information can be found in section 10.3.

5.4 MIXER

1. Check all Allen setscrews for tightness.

2. Check to see that shaft is not bent.

3. Additional information can be found in sections 10.4 and 11.0.

5.5 PUMP

1. Check pump and fittings for leaks.

2. Additional information can be found in sections 10.5 and 11.0.

5.6 LIGHTS

1. Check bulbs for tightness.

2. Replace with 150-watt outdoor floodlight bulbs.

6.0 TROUBLESHOOTING

6.1 REFERENCE SOURCES

Refer to equipment manuals in section 11.0.

6.2 ASSISTANCE

Contact Water Quality Division, Process Coordination Section, for assistance.

7.0 TABLES

TABLE 1A

DECHLORINATION

FEED RATES FOR SODIUM THIOSULFATE SOLUTIONS

(assuming a chlorine residual of 1.5 mg/L)

DISCHARGE RATE (cfs)	SODIUM THIOSULFATE SOLUTION (lbs per 100 gallons of water) FEED RATE (gpm)				
	500 (a)	400	300	200	100
25	--	--	--	--	1.1
50	--	--	--	1.1	2.1
75	--	--	1.1	1.6	3.2
100	--	1.1	1.4	2.1	4.3
125	1.1	1.3	1.8	2.7	5.3
150	1.3	1.6	2.1	3.2	6.4
175	1.5	1.9	2.5	3.7	7.5
200	1.7	2.1	2.9	4.3	8.6
225	1.9	2.4	3.2	4.8	9.6
250	2.1	2.7	3.6	5.3	--
275	2.4	2.9	3.9	5.9	--
300	2.6	3.2	4.3	6.4	--
325	2.8	3.5	4.6	6.9	--
350	3.0	3.7	5.0	7.5	--
375	3.2	4.0	5.3	8.0	--
400	3.4	4.3	5.7	8.6	--
425	3.6	4.5	6.1	9.1	--
450	3.8	4.8	6.4	9.6	--
475	4.1	5.1	6.8	--	--
500	4.3	5.3	7.1	--	--

Note: (a) Sodium thiosulfate may not totally dissolve except under ideal conditions.

Solution concentration (mg/L) = 1200 x (lbs of sodium thiosulfate per 100 gallons)

$$\text{Feed rate (gpm)} = \frac{\text{discharge rate (cfs)} \times 450 \times 11.4}{\text{solution concentration (mg/L)} - 11.4}$$

TABLE 18

DECHLORINATION

FEED RATES FOR SODIUM THIOSULFATE SOLUTIONS

(assuming a chlorine residual of 1.5 mg/L)

DISCHARGE RATE (cfs)	SODIUM THIOSULFATE SOLUTION (lbs per 100 gallons of water)				
	500 (a)	400	300	200	1
	FEED RATE (gpm)				
500	4.3	5.3	7.1	--	
525	4.5	5.6	7.5	--	
550	4.7	5.9	7.8	--	
575	4.9	6.1	8.2	--	
600	5.1	6.4	8.6	--	
625	5.3	6.7	8.9	--	
650	5.6	6.9	--	--	
675	5.8	7.2	--	--	
700	6.0	7.5	--	--	
725	6.2	7.7	--	--	
750	6.4	8.0	--	--	
775	6.6	8.3	--	--	
800	6.8	8.6	--	--	
825	7.1	8.8	--	--	
850	7.3	9.1	--	--	
875	7.5	9.4	--	--	
900	7.7	--	--	--	
925	7.9	--	--	--	
950	8.1	--	--	--	
975	8.3	--	--	--	
1000	8.6	--	--	--	

Note: (a) Sodium thiosulfate may not totally dissolve excep
ideal conditions.

Solution concentration (mg/L) = 1200 x (lbs of sodium thios
per 100 gallons)

$$\text{Feed rate (gpm)} = \frac{\text{discharge rate (cfs)} \times 450 \times 11.4}{\text{solution concentration (mg/L)} - 11.4}$$

TABLE 1C

DECHLORINATION

FEED RATES FOR SODIUM THIOSULFATE SOLUTIONS

(assuming a chlorine residual of 1.5 mg/L)

DISCHARGE RATE (cfs)	SODIUM THIOSULFATE SOLUTION (lbs per 100 gallons of water) FEED RATE (gpm)				
	50	25	10	5	2
1	--	--	--	--	2.1
2	--	--	--	1.7	4.3
3	--	--	1.3	2.6	6.4
4	--	--	1.7	3.4	8.6
5	--	--	2.1	4.3	--
6	--	1.0	2.6	5.1	--
7	--	1.2	3.0	6.0	--
8	--	1.4	3.4	6.9	--
9	--	1.5	3.9	7.7	--
10	--	1.7	4.3	8.6	--
11	--	1.9	4.7	9.4	--
12	1.0	2.1	5.1	--	--
13	1.1	2.2	5.6	--	--
14	1.2	2.4	6.0	--	--
15	1.3	2.6	6.4	--	--
16	1.4	2.7	6.8	--	--
17	1.5	2.9	7.3	--	--
18	1.5	3.1	7.7	--	--
19	1.6	3.3	8.1	--	--
20	1.7	3.4	8.6	--	--
21	1.8	3.6	9.0	--	--
22	1.9	3.8	9.4	--	--
23	2.0	3.9	9.8	--	--
24	2.1	4.1	--	--	--
25	2.1	4.3	--	--	--

Solution concentration (mg/L) = 1200 x (lbs of sodium thiosulfate per 100 gallons)

$$\text{Feed rate (gpm)} = \frac{\text{discharge rate (cfs)} \times 450 \times 11.4}{\text{solution concentration (mg/L)} - 11.4}$$

TABLE 1D

DECHLORINATION

FEED RATES FOR SODIUM THIOSULFATE SOLUTIONS

(assuming a chlorine residual of 1.5 mg/L)

DISCHARGE RATE (gpm)	SODIUM THIOSULFATE SOLUTION (lbs per 100 gallons of water)		
	1.0	0.5	0.1 (a)
	FEED RATE (gpm)		
25	--	--	2.6
50	--	--	5.2
75	--	--	7.9
100	--	1.9	--
125	--	2.4	--
150	--	2.9	--
175	1.7	3.4	--
200	1.9	3.9	--
225	2.2	4.4	--
250	2.4	4.8	--
275	2.6	5.3	--
300	2.9	5.8	--
325	3.1	6.3	--
350	3.4	6.8	--
375	3.6	7.3	--
400	3.8	7.7	--
425	4.1	8.2	--
450	4.3	8.7	--
475	4.6	9.2	--
500	4.8	9.7	--
525	5.0	--	--
550	5.3	--	--

Note: (a) 0.1 lb = 1.6 oz or 45.3 g

Solution concentration (mg/L) = 1200 x (lbs of sodium sulfate per 10

$$\text{Feed rate (gpm)} = \frac{\text{discharge rate (gpm)} \times 11.4}{\text{solution concentration (mg/L)} - 11.4}$$

TABLE 2A

CHLORINATION

FEED RATES FOR CALCIUM HYPOCHLORITE SOLUTIONS

(assuming a chlorine residual of 1.5 mg/L)

FLOW RATE (cfs)	CHLORINE SOLUTION (lbs per 100 gallons of water) FEED RATE (gpm)			
	128	64	32	3.2
1	--	--	--	--
2	--	--	--	--
3	--	--	--	--
4	--	--	--	1.1
5	--	--	--	1.4
6	--	--	--	1.6
7	--	--	--	1.9
8	--	--	--	2.2
9	--	--	--	2.4
10	--	--	--	2.7
20	--	--	--	5.4
30	--	--	--	8.1
40	--	--	1.1	--
50	--	--	1.4	--
60	--	--	1.6	--
70	--	--	1.9	--
80	--	1.1	2.2	--
90	--	1.2	2.4	--
100	--	1.4	2.7	--
150	1.0	2.0	4.1	--
200	1.4	2.7	5.4	--
250	1.7	3.4	6.8	--
300	2.0	4.1	8.1	--
350	2.4	4.7	9.5	--
400	2.7	5.4	--	--
450	3.0	6.1	--	--
500	3.4	6.8	--	--

$$\text{Solution concentration} = \frac{(\text{lbs. of calcium hypochlorite per 100 gal}) \times 0.65}{934}$$

$$\text{Feed rate (gpm)} = \frac{\text{flow rate (cfs)} \times 450 \times \text{dosage (mg/L)}}{\text{solution concentration} \times 1{,}000{,}000}$$

TABLE 28

CHLORINATION

FEED RATES FOR CALCIUM HYPOCHLORITE SOLUTIONS

(assuming a chlorine residual of 1.5 mg/L)

FLOW RATE (cfs)	CHLORINE SOLUTION (lbs per 100 gallons of water) FEED RATE (gpm)			
	128	64	32	5.2
500	3.4	6.8	--	
550	3.7	7.4	--	
600	4.1	8.1	--	
650	4.4	8.8	--	
700	4.7	9.5	--	
750	5.1	--	--	
800	5.4	--	--	
850	5.8	--	--	
900	6.1	--	--	
950	6.4	--	--	
1000	6.8	--	--	
1050	7.1	--	--	
1100	7.4	--	--	
1150	7.8	--	--	
1200	8.1	--	--	
1250	8.5	--	--	
1300	8.8	--	--	
1350	9.1	--	--	
1400	9.5	--	--	
1450	9.8	--	--	
1500	10.1	--	--	

$$\text{Solution concentration} = \frac{(\text{lbs. of calcium hypochlorite per 100 gal}) \times}{834}$$

$$\text{Feed rate (gpm)} = \frac{\text{flow rate (cfs)} \times 450 \times \text{dosage (m}}{\text{solution concentration} \times 1{,}000{,}00}$$

TABLE 2C

CHLORINATION

FEED RATES FOR CALCIUM HYPOCHLORITE SOLUTIONS

(assuming a chlorine residual of 1.5 mg/L)

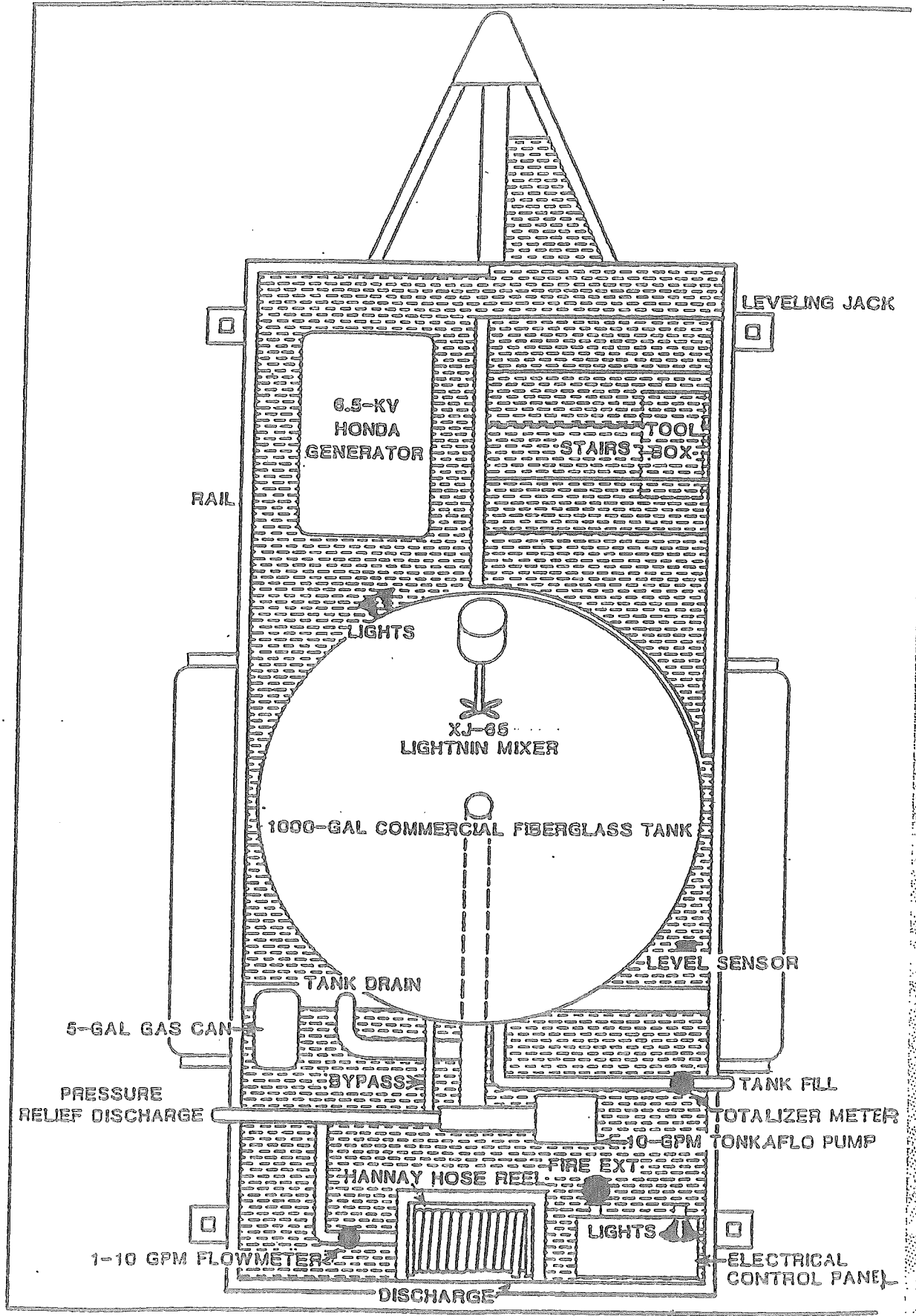
FLOW RATE (gpm)	CHLORINE SOLUTION (lbs per 100 gallons of water)			
	1.0	0.1 (a)	0.05 (b)	---
	FEED RATE (gpm)			
30	--	--	1.2	--
40	--	--	1.5	--
50	--	1.0	1.9	--
60	--	1.2	2.3	--
70	--	1.3	2.7	--
80	--	1.5	3.1	--
90	--	1.7	3.5	--
100	--	1.9	3.8	--
150	--	2.9	5.8	--
200	--	3.8	7.7	--
250	--	4.8	9.6	--
300	--	5.8	--	--
350	--	6.7	--	--
400	--	7.7	--	--
450	--	8.7	--	--
500	1.0	9.6	--	--
600	1.2	3.1	--	--
700	1.3	3.5	--	--
800	1.5	3.8	--	--
900	1.7	5.8	--	--
1000	1.9	7.7	--	--
1100	2.1	9.6	--	--
1200	2.3	--	--	--
1300	2.5	--	--	--
1400	2.7	--	--	--
1500	2.9	--	--	--
1600	3.1	--	--	--

Notes: (a) 0.1 lb = 1.6 oz or 45.3 g
(b) 0.05 lb = 0.8 oz or 22.6 g

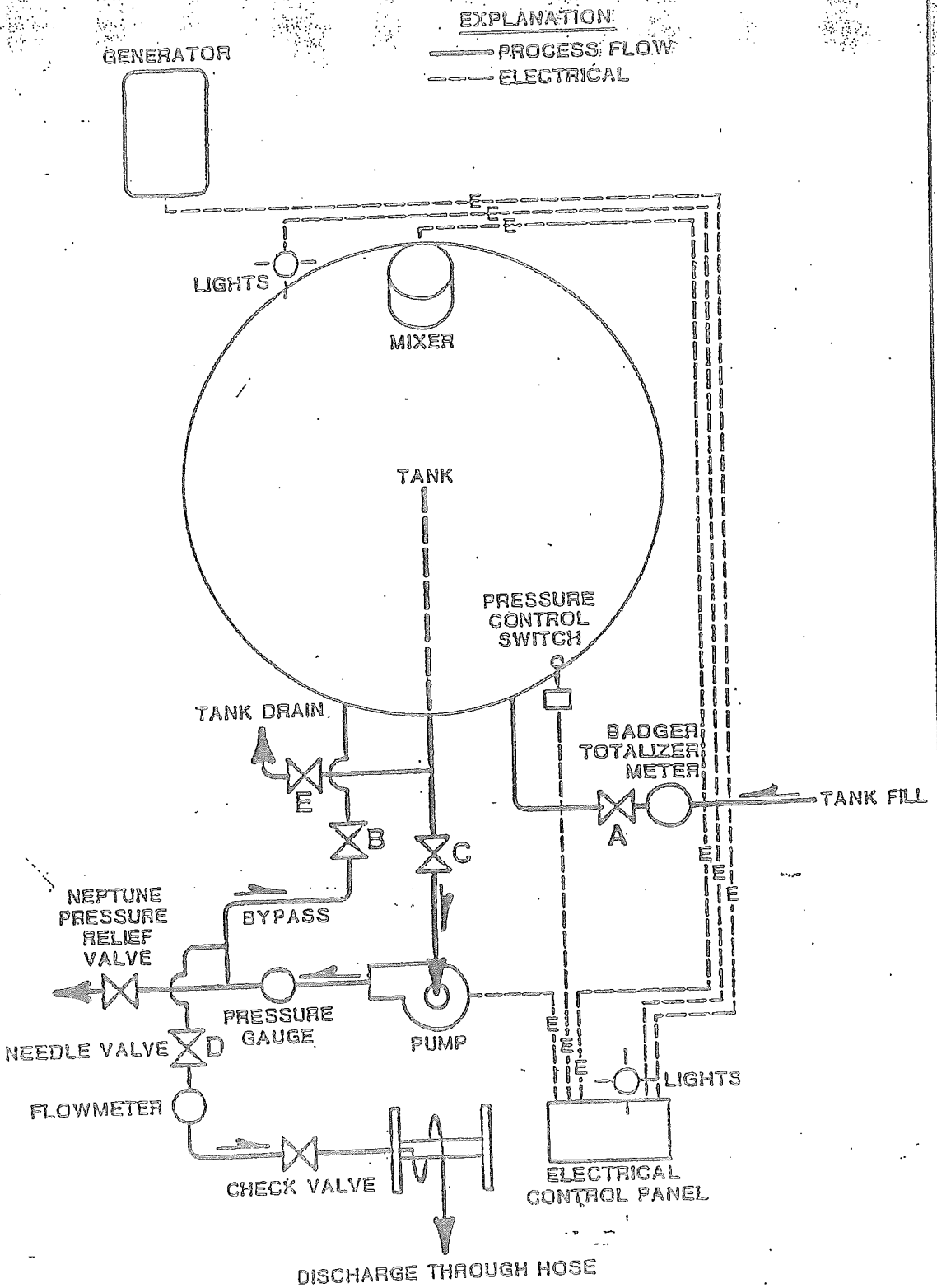
$$\text{Solution concentration} = \frac{(\text{lbs. of calcium hypochlorite per 100 gal}) \times 0.65}{834}$$

$$\text{Feed rate (gpm)} = \frac{\text{flow rate (cfs)} \times \text{dosage (mg/L)}}{\text{solution concentration} \times 1{,}000{,}000}$$

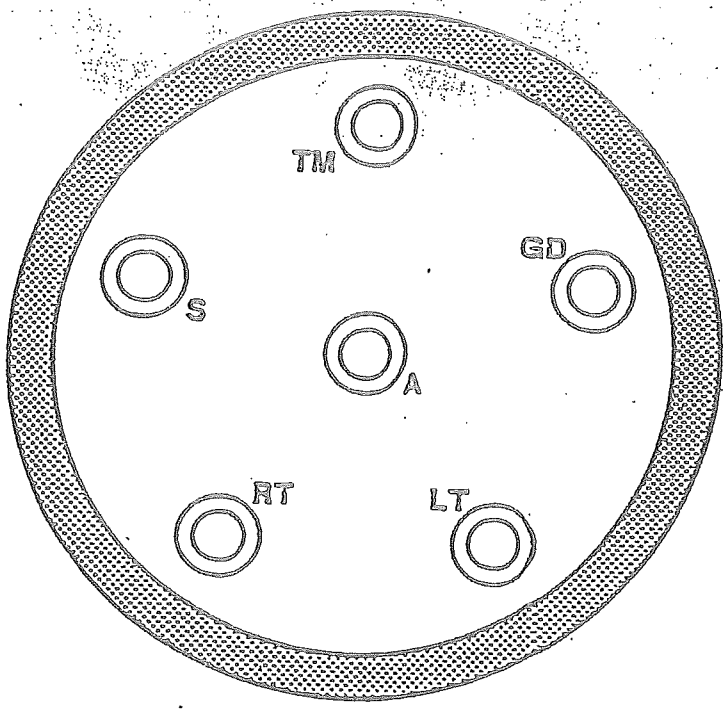
8.0 FIGURES



DECHLORINATION TRAILER
FIGURE 1



MOBILE DECHLORINATION TRAILER PROCESS DIAGRAM
FIGURE 2



NAPA ECHLIN 6-POLE TRAILER CONNECTOR SOCKET
TC 6206

EXPLANATION

A	ELECTRIC BRAKES
GD	GROUND RETURN TO TOWING VEHICLE
LT	LEFT-HAND TURN SIGNAL, BRAKE SIGNAL, AND HAZARD SIGI
RT	RIGHT-HAND TURN SIGNAL, BRAKE SIGNAL, AND HAZARD SI
S	BLANK
TM	CLEARANCE, SIDE MARKER, AND IDENTIFICATION LAMPS

CENTRAL STORES CATALOG NO. 04-247-41235

TECHNICAL ASSISTANCE:
EUGENE MAGES, EQUIPMENT MAINTENANCE, EXT. 509

DECHLORINATION TRAILER ELECTRICAL CONNECTION SOC
FIGURE 3

9.0 TOOLS AND SUPPLIES

Central Stores Stock No.	Item Description	Quantity
14-127-63531	Plastic mayonnaise can, 3 gal	4 ea
16-057-55000	Sodium thiosulfate	200 lb
17-121-60000	Calcium hyprochlorite	200 lb
18-745-10920	Oil, 30 wt	1 qt
45-043-63660	Neoprene gloves	2 pr
45-132-21800	Safety goggles	2 pr
45-755-28800	Disposable respirator	10 ea
49-193-70313	Aluminum level, 24-inch	1 ea
49-336-71060	Standard screwdriver, 6-inch	1 ea
49-564-29224	Combination wrench, 3/4-inch	1 ea
79-205-15031	Floodlight, 150 watt	2 ea
98-034-41000	Hose fitting, mender, 3/4-inch	1 ea
98-934-50806	Hose coupling, 1" MPT x 3/4" MHT	1 ea
98-934-60806	Hose reducer, 1" FPT x 3/4" MHT	1 ea
98-934-83360	Hose washers, 3/4-inch	1 pkg
98-936-30120	Adjustable hose nozzle, 3/4-inch	1 ea
N/A	Adjustable hydrant wrench	1 ea
N/A	Fire hydrant connection, 2 1/2" NSFH x 3/4" HT	1 ea
N/A	Adjustable nozzle, 3/4" HT	1 ea

10.0 MANUFACTURERS/SUPPLIERS AND DESCRIPTIONS OF EQUIPMENT

10.1 TRAILER

U-Save Trailers
3933 Mission Blvd.
Pomona, CA 91766
(714)629-4762

Size: 192"L x 78"W
Weight: 3500 lb
Type: tandem axle
Brakes: electric w/breakaway switch
Tire size: H73-15ST
Ball size: 2"

10.2 GENERATOR

American Honda
(Honda of Pomona)
1485 E. Holt Ave.
Pomona, CA 91766
(714)623-6451

Model ES6500/GX360K
6500 watts maximum
4.4 gal unleaded ga
1.5 qt oil 10W-40SA
4 hr operation time
2.1 qt coolant

10.3 TANK

Commercial Fiberglass
1854 No. Central
Compton, CA 90222
(213)637-7173

Size: 72"dia x 82"H
Cap: 1000 gal maximum
Type: Fiberglass filament-wound

10.4 MIXER

Lightning Mixers
(Duncan Engineering)
18102 Skypark South
Irvine, CA 91723
(213)944-6256

Model XJ-65
115/220 volts single phase
Shaft 66"L x 3/4"dia
A-210 propeller

10.5 PUMP

Tonka-Flo Pumps
(Huntley Engineering Sales)
10911 E. Thienes St.
South El Monte, CA 91733
(213)622-3302

Model 1809-10120
Multi-stage centrifugal
Baldor motor
2 hp single-phase
115/230 volts
Rated 10 gpm @ 100 psi

10.6 PRESSURE RELIEF VALVE

Neptune Chemical Pump Co. (Huntley Engineering Sales) 10911 E. Thienes St. South El Monte, CA 91733 (213)622-3302	Model RV-316-1 Pressure range 30-150 psi, set at 90 psi Capacity 10.5 gpm

10.7 TOTALIZER METER (INFLUENT)

Badger Meter Inc. (Selco Sales Engineering) 7580 Stage Road Buena Park, CA 90621 (213)921-0681	Model 25SC-ER-C Recordall Meter size 3/4" Flow limits 0.5-30 gpm

10.8 FLOWMETER (EFFLUENT)

Fischer & Porter 3156 E. La Palma, Unit C Anaheim, CA 92806 (213)925-0497	Series 10A2235 Ratosight Direct reading 1-10 gpm 1" NPT connection

10.9 HOSE REEL

Hannay Hose Reels (Target Chemical Co.) 17710 Studebaker Rd. Cerritos, CA 09701 (213)773-8912	Model 1526-17-18 1/2" NPT connections Minimum 100' of 3/4" hose

10.10 PRESSURE CONTROL SWITCH

United Electric Controls (Coast Electrical Supply) Montclair, CA 91763 (714)624-9061	Type J6--basic control Model 136 Stock No. 9548 Adjustable switch differential

Resources for this Handbook include the following:

1. Chlorine Monitoring and Dechlorination Techniques Handbook
2. Generic Emergency Response Plan for Chlorinated Water

The above sources were prepared for the Greater Vancouver Regional District Water Treatment Program by ENKON Environmental Limited of Victoria B.C

3. AWWA - Optimizing Chloramine Treatment
4. Sources from the Metropolitan District of Southern California