OPERATION & MAINTENANCE MANUAL

FOR THE

SAN CRISTOBAL MUTUAL DOMESTIC
WATER CONSUMERS ASSOCIATION

WATER SYSTEM

SAN CRISTOBAL, NEW MEXICO

NOVEMBER, 1986

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I. Purpose of the Manual

This manual will describe an operation and maintenance program for the San Cristobal Mutual Domestic Water Consumers Association (MDWCA) system. How much and how well this manual is used will be in direct proportion to the supervision of the operator by responsible members of the Association Board.

Proper maintenance is essential for good performance and economy of operation. An effective maintenance program is necessary to ensure that the system is kept in a highly reliable operating condition. It is the responsibility of the Board of Directors to provide sufficient funds for maintenance, repairs, spare parts, and equipment to keep the distribution system and related appurtenances operating satisfactorily.

The maintenance program should include the establishment of a control system which identifies and locates each piece of operation equipment, a description of the maintenance needs, a list of the general procedures for carrying out the job, and appropriate routine maintenance schedules should be initiated. A spare-parts inventory to facilitate advance ordering of unit parts vital to the continuous and effective operation of the system should be compiled. A large stock of all parts is unnecessary and not economical, but those most subject to wear and frequent breakage should be on hand. Spare parts may include complete meter assemblies, pits, covers and any hardware, which experience has shown, should be kept on hand.

A system for recording maintenance and repairs should be initiated. This will permit an evaulation of system performance

and of future maintenance or replacement of a part or unit with one that is more reliable.

II. Water Source

Water source is from an infiltration gallery on the San Cristobal Creek that is located approximately 1,200 feet upstream from the storage tank. The infiltration gallery must be inspected periodically to insure that the general area is free from any organic material and debris. The actual gallery consists of approximately 40 feet of 15" diameter perforated PVC pipe which is buried upstream of the gallery concrete wall and covered with 6.5 feet of washed gravel ranging in size from 1¼ inch to 1/8 inch sand, with the sand being at the top or on the river bed acting as a filter to water infiltrating below. The gallery requires no maintenance if there is no change in the water quality.

A clean-out apparatus has been installed on the perforated pipe and may be used to flush out the gallery by inserting a high pressure hose and flushing it out. Also an air vent has been installed in the gallery (opposite end of the clean-out) and a high pressure air hose may be hooked up to it to blow out the perforations on the pipe.

Water conveyance from the gallery to the storage tank is by way of a 3" PVC pipe which connects to the 15" perforated gallery collector pipe at the invert.

III. Storage Tank

The reservoir was constructed of welded steel of 3/16 inch thickness. It is equipped with a staff gauge to indicate the

level of the water in the reservoir, a 24" diameter manway, a roof hatch, inside and outside ladders with safety climbs, a vent, a knuckle bend roof, a 3" inlet, a 3" outlet, a 3" floor drain and pipe equipped with gate valves, a downward directed overflow, the three inch (3") drain line is fitted with a three inch (3") gate valve arranged to discharge on the natural ground surface away from the bottom edge of the tank. The overflow leaves the tank at a point below the junction of the roof and wall and is fastened down the side of the tank and connects to the drain line that clears the retaining wall.

The retaining wall consists of a 3/8" x 36" Steel Band, 36" larger than the diameter of the reservoir. The steel band was painted with a commercial type utility coating.

The 6" of oiled sand base were carefully placed to insure a well compacted level surface that supported the tank bottom uniformly. The sand was fairly coarse and clean to permit effective drainage. Retaining wall drainpipes were installed, one on each side.

The water tank has a capacity of 10,000 gallons, a drawing is included in Appendix 'F'. The tank should be flushed once each year by opening the drain valve and allowing the water to remove any accumulated sediment. Customers should be notified of the date and time that this maintenance will take place and the water service will be interrupted. Enough advanced notice should be given to allow the customers to prepare themselves. When the tank is empty it should be entered through the access manhole and inspected for any trash that did not flush and any

corrosion or damage that may be present. Care should be taken in the replacement of any hardware such as the over-flow pipe. Vents should be inspected to assure exclusion of insects or rodents. The tank should be disinfected upon completion of inspection.

IV. Pressure Reducing Stations

Maintenance of the pressure reducing valves is discussed in the Manufacturer's Manual; however, the valve boxes should be inspected every 3 or 4 months and any debris, etc., collected in the boxes should be removed. Pressures should be checked on the inlet and outlet of the valves and readjusted according to the following schedule:

PRV Number (see system plan)	Pressure In (psi)	Pressure Out (psi)
1	80	40
2	80	40
3	80	40
4	80	40
5	80	40

V. Distribution System

The distribution system requires little maintenance; however, the system should be inspected weekly for breaks and leaks. Should leaks occur, they should be repaired immediately using a repair clamp approved for PVC pipe. Great care should be taken in repairing the breaks so that no dirt, mud, etc. is introduced into the system. Repair clamps should be of the full circle type with opposed boltline flanges.

When using a repair clamp, the area of the pipe barrel around which the clamp will be placed should first be cleaned with a wire brush. Apply lubricant to the cleaned area. The two halves of the

clamp are then put around the pipe with the nut position on top for easy access. After the nuts have been tightened lightly, the clamp should be rotated slightly in the same direction as the overlap of the rubber lining to assure its smoothness. The nuts are then tightened so as to distribute the pull evenly on all the bolts and the repair is completed.

Flushing hydrants are 2½", post type manufactured by M & H, Style 33; 150 psi working pressure. There should be very few maintenance problems with the piping. All lines should be flushed at least annually.

The static and available pressure should be checked at least quarterly throughout the system to insure that valves are not partially closed.

Each valve should be located at least quarterly and the valve operated a minimum of two complete cycles and the valve box raised or lowered to fit any changes in ground or street elevations.

Connections to the distribution system should be made only with the knowledge and supervision of the authorized representative of the association.

VI. Meters and Altitude Valve

Monthly individual meter readings will be necessary for computation of individual water sales and billing to the customer. Readings of the master meter should also be made to check the total monthly water pumped. This information should be further analyzed to determine total monthly sales, average income per tap, and average monthly water use per tap.

The difference between total monthly water sales and total water drawn represents a combination of water lost to the system, accuracy of water meters, and accuracy of reading the meters. A variance of 10 percent is normally considered acceptable. If this difference is greater than 10 percent, the presence of leaks or unauthorized use is indicated and a thorough check of the distribution system should be made. If this difference is less than 10 percent, it is usually uneconomical to determine the point or points of loss.

A summary of all available information should be prepared and presented at the regular meetings of the Board of Directors. Continuous accurate maintenance of these records will enable the Board of Directors to determine the adequacy of the rate schedule or the feasibility of future improvements to the system. Such information would also provide a sound basis for future planning or engineering studies. Examples of the information to be furnished the Board at each meeting could be the total water drawn, total sales, number of taps, and number of delinquent tap users.

Service meters to both residential and commercial users should be provided. These meters should have shut-off valves on the upstream side of the meter. Periodically, each meter should be removed, the strainers checked and cleaned and the meter accuracy checked. If complaints of low pressure or flow are received from a customer, the meter screen should be checked. Spare parts for each meter should be available.

Altitude Valve

Maintenance of the altitude valve is carefully outlined in Appendix 'C' of this manual. The valve should be inspected periodically, adjusted as required and proper maintenance performed.

VII. Chlorination Building and Equipment

1. Building - The building is metal, factory painted and as such should require no maintenance. The building is equipped with an electric heater with automatic controls. The heater should be checked periodically to make sure it is working properly.
2. Chlorination Equipment - The chlorinator maintenance is described in the Manufacturer's Manual in Appendix 'C' of this report. The hypochlorite chemical should be stored in the building and kept free from moisture as outlined on the containers.

Miscellaneous

1. Service Connections - Service connections including saddle, service line and meters should be made by the system operator or under his direction in accordance with approved plans and specifications.
2. Records should be kept of the water usage; chemicals used, etc. on forms supplied by the EID.
3. Dead end lines should be flushed at least once each month.
4. Two samples a month should be collected from the

distribution system and sent to the State Laboratory in Albuquerque for analysis.

5. No cross-connections should be allowed in the system. A cross-connection is considered to be a connection between a public water supply and any other piping system containing a liquid or gas.
6. Chlorine residual should be checked periodically at several points in the system to insure that the required residual is maintained (0.2 mg/l).

VIII. Laws and Regulations

Laws and Regulations applying to potable drinking water supply systems in the State of New Mexico should be investigated to determine the legal responsibilities of the Board of Directors in the operation of the distribution system. These regulations are included in Appendix 'D'.

IX. Sources of Pollution or Contamination

All potential sources of pollution or contamination to the water in the distribution system should be identified and periodically checked. Current State and County laws or regulations with respect to criteria governing potable water distribution systems should be investigated.

Two of the most common sources of contamination are cross-connections to existing sources such as wells or cisterns, and breaks in the line allowing dirt to enter the system. The Association should publish regulations that will prohibit cross-connections with other sources.

X. Managerial Responsibility

Ultimately, the responsibility for managing the system and for proper operation and maintenance of the water distribution system rests with the Board of Directors. The Board will have to see that personnel capable of operating and maintaining the system are employed, and that these personnel do their jobs properly and efficiently. Adherence to the O & M Manual is strongly recommended.

XI. Records

In order to more effectively operate the water system, records should be kept of any scheduled or unscheduled maintenance functions in a booklet kept specifically for this purpose. Items that should be included among the records are:

1. The total water drawn by the system should be recorded monthly and reported to the State Engineer's Office, Bataan Memorial Building, Santa Fe, New Mexico 87503, once a year.
2. Meter information such as date installed, date removed from service, location of installation, repairs or parts required, date of any repairs, and the meter reading at the time of any repairs or changes.
3. Routine or unscheduled inspection by State Agencies.

XII. Safety and Emergency Considerations

SAFETY DISCUSSION: The safety hazards associated with water systems are varied. They run from the dangers of chlorine handling to the potential for contracting diseases. Personnel should be

made aware of all these hazards. They should be protected from these hazards to the greatest extent possible and should receive proper first aid training in the event an accident does occur. A water system with a poor safety record will generally be providing marginal service to its customers as well. This section of an O & M Manual can play an imprortant part in maintaining a water system in a sound and safe state.

The primary purpose of this chapter of an O & M Manual is to help prevent personal injury to the water system staff. To fulfill this stated purpose the safety portion of the manual informs personnel of potential hazards, preventive measures, and emergency procedures. Emphasis is placed on the specific hazards within the water system under consideration.

The water system management must assume full responsibility for the safety program within their system.

The overall dangers of accident are much the same whether in reservoirs, pressure reducing stations, valve stations or line facilities. These hazards may be classified into the following two categories:

- Physical injuries
- Bacterial infections

The telephone numbers of several local physicians, the nearest hospital, police and fire departments, ambulance services and rescue squad should be posted at each nearest phone available to personnel. The telephone number of the chlorine equipment manufacturer and the local supplier should be readily available in the event of chlorine emergency.

GENERAL SAFETY: An important aspect of system safety is the prompt reporting of personnel injuries to the water system's insurance company.

EMERGENCY DISCUSSION: Emergency conditions can be imposed on a water system by natural disasters, strikes, civil disorders and equipment failures. Emergency planning is essential to insure continued effective operation during emergencies.

This section of the O & M Manual gives the water system's emergency response plan for insuring the effective continued operation of the water system under emergency conditions imposed by catastrophe, failure of process or equipment or unavoidable shutdown of components.

Included in this manual are a list of general emergency planning considerations and checklist for preparing an emergency operating plan.

Emergency General Considerations

The following are general emergency considerations and recommendations for the system:

1. Recommend adequate regulations for water users for the protection of the water system and the public.
2. Recommend a system for maintaining adequate engineering drawings of the system.
3. Provide facilities for chlorination during emergencies affecting the system.
4. Follow procedure for notifying State Regulatory Agencies for Assistance.
5. Suggest a program to eliminate illegal connections to the water lines.

6. Recommend staffing of the system with trained personnel.

7. Outline State monthly reporting requirements for water consumption.

EMERGENCY PROGRAM OBJECTIVES: The objectives of an Emergency Operation and Response are as follows:

1. Eliminate or minimize adverse effects from emergency situations affecting the system.
2. Develop procedures for properly responding to emergencies.
3. Provide instruction for system personnel to ensure they understand their responsibilities during emergency situations.
4. Provide inventories of available emergency equipment and outline existing mutual aid agreements and contracts with outside organizations for specialized assistance.

EMERGENCY EQUIPMENT INVENTORY: An inventory should be made of equipment, materials, and chemicals that are available within the system. Using this inventory any additional emergency equipment/ supplies required may be purchased and stockpiled and/or arrangements made to obtain these items through mutual aid agreements or outside contracts.

XIII. Preserving Water System Records

It is especially important that maintenance personnel be provided with maps and current records showing location and condition of water lines. Full size copies of maps and other detail sheets should be made each year and kept in a location that is not subject

to flooding. These items are available for immediate use and can be reproduced as required. These records are readable and do not have to be processed by any further mechanical steps.

XIV. Coordinating Instructions for Local Police and Fire Departments

The system's Emergency Operating and Response Program should be coordinated with the local police and fire departments.

XV. Responsibilities of System Personnel

The municipal water system director should have overall responsibility for the emergency program. If the system is organized so that a single individual is in charge of the facilities and the water system, then this facility director has overall responsibility for the emergency program.

APPENDICES

A P P E N D I X 'A'

PAINTING OF THE WATER STORAGE RESERVOIR

General

Paint serves two purposes. It provides for an aesthetically pleasing surface through color, and it protects against corrosion of steel. All steel surfaces should be cleaned of dirt or mud, oil, grease, and any other foreign materials before paint is applied. Most paint systems require a prime coat prior to the application of the color coats. Paint should be applied in accordance with the paint manufacture's specifications.

Interior

The painting of the interior walls of a water storage tank that serves community potable water needs is regulated by the State of New Mexico Department of Health and Environment, Environmental Improvement Division. Only certain paint coatings have been approved for this purpose. Contact the Environmental Improvement Division before any paint is applied to the interior of the tank and obtain the approved coating list from them.

Federal law prohibits lead base paints from being used where they come in contact with food or liquids used in human consumption. Do not use this type of paint for the interior of the tank.

Annually, preferably during the summer, or whenever the tank is drained the interior coatings of the tank should be inspected and any areas showing failure should be removed by spot blasting, wire brushing, power sanding or any other effective means.

Consult with a reputable paint vendor before any area is repainted. Request that he provide the same type of paint as the

original or one that is compatible with it. Paints are manufactured from different type base materials such oils, coal tars, and alkyds. Each type of base material is best suited for a specific application.

When the extent of the annual repairs involves a large area, the entire interior surface should be removed, preferably by blast cleaning, and a new paint system should be provided. Because of the hazards involved, this type of work should best be done by a licensed contractor with experience.

Exterior

The exterior of the water storage reservoir will be subjected to a less corrosive environment that the interior surface. However, grafitti and other type of vandalism will require annual attention. Exterior coatings are not regulated by any governmental agencies.

A P P E N D I X 'B'

PUBLIC HEALTH AND SAFETY CRITERIA

A. Water Storage Facilities

For the preservation of public health and safety, all domestic water storage facilities shall conform to the following minimum criteria.

1. Roof Hatch or Manhole

Each facility shall be provided with a suitable roof opening near the outside tank access ladder complete with hinged cover and hasp for locking. The opening shall have a clear dimension or diameter so at least 24 inches in one direction and 15 inches in the other direction. The opening shall have a curb at least 4 inches high and the cover shall have a downward overlap of at least 2 inches.

2. Vents

Each facility shall be provided with a suitable vent above maximum water level, having a capacity to pass air so that at the maximum possible rate of water, either entering or leaving the structure, excessive pressure will not develop. The overflow pipe shall not be considered for venting purposes.

a. Screening

The vent opening shall be fitted with 16 mesh bronze or copper screen wire to prevent ingress by birds, animals or insects.

3. Overflow

Each facility shall be provided with an overflow of a capacity at least equal to the maximum quantity of water enter-

ing the facility with a water level not more than 6 inches above the weir.

4. Drain

A separate gravity tank drain shall be provided which shall be flush with the bottom; no fittings or pipe stubs shall extend or project above the floor.

5. Outlet

The outlet shall extend up through the tank floor and terminate not less than 6 inches above the tank bottom. As an alternative a suitable 6 inch silt stop may be provided.

6. Ladder

Ladders, stairways and safety climbing devices shall be provided in accordance with that current OSHA requirements.

B. Cross-Connections

As defined herein, no provisions shall be made in a public water supply system which of itself constitutes a cross-connection.

1. Definition

A cross-connection is any connection or arrangement, physical or otherwise between a potable water supply system and sanitary sewer main, lateral, service line, manhole, plumbing fixture, tank, receptacle, equipment or device, through which it may be possible for non-potable, used, unclean, polluted or contaminated water, or other substances to enter into any part of such potable water system under any condition.

2. Line Proximity

Water lines shall not be laid closer, horizontally, than 10

feet from sanitary sewer lines and the water line shall be placed at a higher elevation than the sewer line. Where the above is not physically possible, separate trenches are required and the water line shall be a minimum of 2 feet above the sewer. When water and sewer lines cross each other, the water line shall be at least 3 feet above the sewer. If this separation must be less than 3 feet, the sewer line shall be constructed of steel or ductile iron for a minimum distance of 10 feet each side of the crossing with no joint closer than 3 feet from the point of crossing. If the sewer pipe is of concrete, vitrified clay or other material not judged equivalent to steel or ductile iron it may be encased in reinforced concrete for a distance of 10 feet each side of the crossing in lieu of replacing the line with steel or ductile iron.

C. Fire Hydrants and Valves

1. AWWA Gate Valves:

Iron Body - Bronze Mounted Double Disc - Parallel Seat type are designed for long lasting, low maintenance service.

AWWA valves are recognized by the industry as the standard of durability and performance in water distribution and fire protection systems.

OPERATION OF WORK IS AS FOLLOWS:

(a) Valve Open - Discs are supported by a flange on the top wedge nut. Discs and wedging mechanism are clear of the waterway. Water pressure forces the O-ring into a positive seal. The greater the pressure, the greater the sealing force.

(b) Valve Closing - The discs move freely to a position opposite the port openings of the body, at which time the bottom wedge contacts a rib in the bottom of the valve body preventing further downward movement. During the downward movement, the discs in their collapsed position are held closely enough to the seats to shear off incrustations and barnacles from the seating surfaces.

(c) Valve Closed - Further stem movement in the closing direction causes the top wedge nut and bottom wedge to force the two side spreaders outwardly against corresponding wedges cast integrally with each disc. The wedging force is applied in opposite directions on the two sides of the top wedge nut. This results in a rotating action about the center of the stem rather than a side bending action on the stem. The side spreaders are free to adjust themselves and act as equalizers between the top wedge nut and the bottom wedge. They transfer the applied seating force from the wedges equally to four separate contact points near the outer edge of each disc.

(d) Valve Opening - The first movement of the stem lifts the top wedge nut directly away from the side spreaders. This relieves the wedging pressure, relaxing the disc mechanism before the discs begin to rise.

Further movement of the top wedge nut in the opening direction engages a lug on the top wedge nut with corresponding lugs on the discs. This way, the collapsed mechanism can be moved clear of the waterway as a unit with no abrasive action between the faces of the seat rings and disc rings.

2. AWWA Fire Hydrants:

The real test of a fire hydrant is its performance under actual operating conditions. Fire hydrant design should provide minimum pressure loss and miximum flow - right out to your pumper and hose nozzles.

A good fire hydrant combines traditional appearance with efficient, effective operational features.

Fire hydrants should comply fully with AWWA Standard C-502 and is well below the limits for pressure loss at all flow rates.

Hydrant flow ratings are established from data collected during tests conducted in the laboratory that produce actual, full flow conditions.

Before shipment, every hydrant is hydrostatically tested with the main valve to both the open and closed positions. This verifies proper hydrant operation and that all seals are water-tight to assure dependable community safety.

3. Water Hammer:

Flowing water, due to its inertia, developes sharp rises in pressure when suddenly interrupted, as by a valve being closed too quickly. The energy of the moving water column is expended in a series of sharp periodic waves of high pressure, followed by equal periods of subnormal pressure. These waves often produce a series of sounds, not unlike the blows of a hammer, from wich is derived the name "water hammer".

The initial shock wave develops the maximum pressure--each succeeding shock diminishing in intensity as the energy of the moving water is expended in overcoming the friction of the pipe wall stretching the pipe wall, and compressing the water column.

The period of time between shocks is proportional to the length of pipe ahead of the valve, and the velocity of wave propagation. The velocity of wave propagation varies for different pipes, being highest in the more rigid pipes. In ordinary sizes and thicknesses of cast iron and steel pipe used in water mains, the velocity of wave propagation is approximately 3600 to 4000 feet per second. One time period is the time required for the wave to travel the length of straight run pipe ahead of the valve and return or twice this length in feet divided by the values given above. Any valve closure in less than this time results in maximum pressure rise for the velocity interrupted.

This maximum pressure rise has been found by experiment to reach values in pounds per square inch as high as 50 to 54 times the velocity in feet per second interrupted. On this basis, a velocity of 5 feet per second closed off in less than one time period would show a peak surge pressure of from 250 to 270 p.s.i.

Severe water hammer is a serious hazard and often may cause a rupture of piping components, service pipe failures, joint failures and other damage to the system. Water hammer may be controlled by various means, such as surge supressors, relief valves, and slow closing gate or cone type valves. Moreover, complex lines complicate this problem, and a survey by engineers trained in surge control may be necessary where unusual conditions are encountered.

Kent's Handbook offers the following formula for time in seconds to close a gate valve in order that no water hammer may result.

$$T = \frac{.027LV}{P - p}$$

Where T -- time in seconds; L -- length of pipe before the valve, in feet; V -- velocity of flow; P -- pressure in pipe at no flow, p.s.i.; and p -- pressure in the pipe at full flow.

Since the first 80% of gate travel has little effect in reducing the velocity, most of the above time should be taken in the last 20% of travel or closure.

D. Well Record and Maintanance Log

A sample well log and inspection report form is recommended and follows this page.