CHAPTER 11

OPERATION AND MAINTENANCE

Chapter Outline

11.1 INTRODUCTION

The maintenance of water systems is necessary to ensure the proper operation of the facilities and to obtain the full useful life of those facilities. Water systems represent a significant investment of public capital. If a water system is allowed to fall into disrepair because of the lack of maintenance, it will not operate efficiently or as designed. Health problems and property damage may result from leaking mains or services, mainline breaks, inoperable valves or fire hydrants. The repair of failed portions of a public water system is costly, quite often equaling or exceeding the original cost of construction. Because of this it is imperative that municipalities consistently provide adequate maintenance funding and staffing to protect their investment.

System maintenance is frequently classified as preventative or corrective. Preventative maintenance involves routinely scheduled inspections of the system and the collection of data to identify problem areas. The proper documentation and analysis of collected data should be performed so that scheduled maintenance can be allocated to specific problems. As a general rule as preventative maintenance increases, the amount of corrective maintenance required decreases.

Corrective maintenance, often referred to as emergency maintenance, is typically performed when the water system fails, such as leaking mainlines, inoperable pumps, control systems or fire hydrants. Corrective maintenance requires immediate action and the City will typically pay a premium for the completion of this work.

Therefore it is important to emphasize that preventative maintenance, documentation, and program evaluation ultimately results in a lower cost to the consumer by extending the life of the distribution system components and reducing costs associated with unscheduled or emergency repairs.

11.2 WATER SYSTEM RECORD KEEPING

Record keeping is an important part of a successful operation and maintenance program. Unfortunately, record keeping is often neglected because of time and staffing limitations, and the often immediate needs of other maintenance programs. The following categories of record keeping are viewed as central to improving the long term efficiency of the operation and maintenance program.

11.2.1 Water Production

The planning elements of water system expansion and water conservation are strongly rooted in the evaluation of water system demands. The recording of daily water production and billing records provides a basis for projecting future system needs and measuring the efficacy of conservation efforts. The City should continue its good practice of diligently recording water use.

Water use data collection should include:

- Daily water production from all sources and treatment facilities
- Historical water use. Track average day, maximum day and monthly total demands.

- Unaccounted-for-water, recorded on a monthly and annual basis to include a breakdown of non-revenue water.
- Waste streams from source and treatment facilities.

11.2.2 Regulatory Record Keeping

It is the responsibility of the water system operations staff to develop and maintain records relating to the quality of the water produced as well as the condition of the physical components of the system. These requirements are detailed in OAR 333-061-0040. Regulatory records should be maintained at a convenient location within or near the area served by the water system. Table 11-1 provides an overview of record keeping requirements. Depending on the final treatment methods provided, and the future determination of whether the City's aquifer is under the direct influence of surface water, additional record keeping may be required. Operators are encouraged to review the statute for the most current compliance requirements as other rule specific requirements may apply.

Table 11-1 | General Regulatory Record Keeping Requirements

Specific Record or Report	Record Retention
Residual disinfectant measurements	2 years
Copies of public notices issued pursuant to OAR 333-061-0042 and certifications made to the DWP	3 years
Actions taken to correct violations of primary drinking water regulations	3 years[1]
Bacteriological analysis	5 years
Monitoring plans for disinfection byproducts	5 years
Consumer Confidence Reports	5 years
Records concerning variances or permits	5 years[2]
Chemical analysis, secondary contaminants, turbidity and radioactive substances results	10 years
Reports, summaries or communications on sanitary surveys	10 years
Lead and Copper Rule data	12 years

[1] Retention period begins after the last action taken with respect to the particular violation

[2] Retention period begins after the expiration of the variance or permit

The City is also encouraged to retain organized records of all correspondence with regulators, operator certificates, and the results of any comprehensive performance evaluations.

11.2.3 Operations and Maintenance Records

The City currently utilizes a comprehensive maintenance software system developed by the Hansen Software Corporation to manage operational efforts for the water and wastewater systems. This computer software tracks and schedules work orders, labor expenditures, regularly scheduled maintenance activities, inspection reports, and repairs.

It is recommended that the City utilize this software to maintain a detailed accounting of time spent on various operations and maintenance tasks. This information is helpful to establish the

need for additional staff, equipment, training or other resources that may be required to accomplish operations and maintenance programs.

The software should also be utilized to maintain a detailed inventory of facility specific maintenance records as this information will be required during future planning efforts to estimate the value and condition of City infrastructure.

11.2.4 GIS Inventory

The City currently uses ArcView software from Environmental Systems Research Institute (ESRI) and has begun to inventory, and map their installed infrastructure. A complete GIS inventory of the water system will greatly improve operational efficiency and will enhance future planning and hydraulic modeling efforts.

As is often the case with municipal systems of its size, Junction City relies on the memory and experience of staff members to provide a full account of many system details. As the City continues to grow, it becomes increasingly important that this wealth of information is transferred and organized into a formalized record keeping system. The integration of historical knowledge and mental records into a GIS system is considered to be of high value.

This report recommends that the City continue to construct a GIS inventory for the water system components to include pipes, valves, hydrants, pumps, reservoirs, water meters, and other facilities. Key elements of existing water system record drawings can be integrated into this database to provide operators with a single point resource for water system information.

11.3 WATER USE AUDIT

The definition of unaccounted-for-water is defined as water which is lost through leaks, evaporation, or use that is not recorded and/or accounted-for. Unaccounted-for-water includes distribution pipe leakage, unmetered water use such as fire fighting, hydrant flushing, overflows, and instrumentation error.

The City has not performed periodic water audits on a regular basis. It is recommended that the City begin performing annual water audits as set forth in OAR 690-086-150(4a). The City should begin with an inventory of all unmetered uses and install metering devices at these locations to the greatest extent possible. In the event metering is not feasible, estimates should be made to record the unmetered use.

A number of new water meters will be installed in the production facilities as part of the water improvement projects to follow the adoption of this report and will include the metering of all well production and pumping to waste, as well as water production and filter-to-waste at the proposed water treatment plant. The installation of these meters will allow the City to establish a monthly audit of its raw and treated water systems.

An annual water audit should utilize sum of all metered sales from each customer class and production records and should be performed in a systematic and well-documented manner to accurately quantify all authorized unmetered and unauthorized uses.

11.4 LEAK DETECTION

In 2007, Junction City provided oversight for a waterline leak location study. The two week study utilized sonic detection equipment to locate and quantify distribution system leaks at 873 discrete points comprised of hydrants, valves and water services. The study surveyed approximately 6 miles of pipe in the older portions of the distribution system in the downtown core. Water loss for the survey area was determined to be 10% to 12%.

Although no formal program currently exists, the City is making incremental progress to develop a leak detection and repair program. The current goal is to establish an annual budgetary line item of $5,000 to accomplish this.

As leaks are detected and repaired throughout the system, this information should be entered into the City's GIS system. The City should develop a map that will allow them to graphically document and track their progress and findings. The mapping should include areas that have been monitored and tested for leaks, the location of all galvanized or deteriorating pipe, and the locations of all distribution system repairs.

11.5 DISTRIBUTION SYSTEM FLUSHING PROGRAM

Maintaining water quality and preserving the hydraulic capacity of a water distribution system is a key concern for water utilities. Mineral precipitation, microbiological activity, and corrosion can all form deposits on the pipe walls and contribute to a reduction in flow and water quality. Flushing the distribution water mains is an effective way to maintain water quality and system capacity.

A properly conducted flushing program can improve water quality by restoring the disinfectant residual, reducing bacterial regrowth, dislodging biofilms, removing sediments and deposits, controlling corrosion, restoring flows and pressures, eliminating taste and odor problems, and reducing disinfectant demand throughout the system. These benefits prolong the life expectancy of the distribution system and reduce the potential for waterborne disease outbreaks.

The Public Works Department currently utilizes a flushing program to purge distribution lines with a goal of flushing the entire distribution system approximately three times per year as time permits. Dead-end line flushing also is performed as part of the general line flushing program. City staff is to be commended for regularly performing this task as it is a program that is frequently not completed in many municipalities.

The completion of a hydraulic model, prepared for the City as part of this report, presents the opportunity to optimize the flushing program by developing a comprehensive unidirectional flushing (UDF) program. Although the City currently utilizes UDF to sequentially flush each quadrant of the City it is likely that the modeling information can be used to enhance or simplify some of the flushing routines.

The central premise behind a UDF is to focus flushing energy into a single distribution line isolated from the general grid using selected valve closures. This has the advantage of achieving higher scouring velocities (on the order of 5-6 fps) and has been estimated to require 40 percent less water than a conventional flushing approach. Additionally, the sequential system-wide use of UDF permits the controlled movement of sediments from cleaned areas near the source to the periphery of the system.

The City should continue the flushing program currently in place and plan for future opportunities to utilize the modeling information to economize the process.

11.6 VALVE EXERCISING

Many components of the water system require periodic maintenance to remain functional. Valves and hydrants, in particular, must be exercised on a regular basis to ensure that they remain in operational condition. It is commonly recommended that all valves be exercised annually; however this is often times not practical due to staffing limitations. The City does not conduct valve exercising other than that performed as part of the flushing program.

A complete valve exercising program should include the following elements:

- Systematically locating and accessing all distribution system valves. Often valves boxes have been paved over or are partially buried and are difficult to locate. Valve boxes should be cleaned, adjusted and realigned as necessary to allow unobstructed access to the valve. Structurally damaged valve boxes should be replaced.
- Each valve should be operated a minimum of two full cycles and an additional cycle if the torque on the valve is high.
- Replacement of the gland packing. In many cases minor leaks in the packing will stop once the gland packing is wetted and is exercised, however the valve should be repaired if the packing is damaged and the leak does not stop.
- All data collected from the event (valve location, size, initial open/closed status, number of turns, torque—if measured, and any other anomalies) should be entered into the City's GIS database.
- Perform minor street repairs around the valve box as required.

Valve exercising should be coordinated with flushing operations to ensure that any debris in the distribution system dislodged by the valve exercising is flushed from the system.

In cases where staffing levels do not permit the execution of a full exercising program staff should focus on operating each valve greater than 12-inches on an annual basis and other system valves on a 4-year cycle.

11.7 CROSS-CONNECTION CONTROL PROGRAM

Oregon Administrative Rules 333-061-0070 through 0074 detail the requirements for a cross-connection control program. The City is required to establish a cross-connection ordinance and must submit an annual report to ODWP. Systems with more than 300 service connections are required to provide a certified tester.

The City's cross-connection control Ordinance 1014 was established on December 19, 1995. The City currently employs two certified inspectors and is responsible for inspecting new devices and installations, monitoring annual inspections, terminating water service in cases of non-compliance and compiling submitting the annual inspection report to ODWP.

The City should continue funding this program and work to integrate the location of all backflow devices into the GIS system. The identification and monitoring of high risk installations is also recommended. In some cases, high hazard assemblies are tested every six months.

11.8 MASTER METER MAINTENANCE

Master meters are installed at each of the well facilities and record the total water pumped into the distribution grid. Data from these meters is utilized in conjunction with consumed water from metered connections to establish benchmarks for water loss.

Discussions with staff indicate that these meters have not been calibrated and there is no program designated to accomplish this. It is recommended that these meters be calibrated on an annual basis to ensure that water loss and other operational decisions are being made on a sound basis.

11.9 WATER METER MAINTENANCE

The accuracy and performance of water meters is vital to utilities whose billable revenues are derived directly from the collected readings. Loss of revenue from inaccurate or broken meters can be significant and may warrant a meter testing schedule. Meters tend to underregister over time because of wear and deposits and since almost all meters loose accuracy with age, any utility can sooner or later find economic justification for meter maintenance.

Large Meters

An important part of a water utility's operations should be a systematic testing and maintenance program for its larger meters. Large meter installations typically represent a significant portion of a utility's revenue and the cost of a program that focuses on proper installation, maintenance and calibration of these larger meters is often a small compared to the potential gain in revenue. The definition of large meters is typically defined as those that are 3-inches or larger. According to data provided by the City, a total of nine large meters are currently utilized in the commercial and bulk user groups.

It is recommended that large meters be calibrated annually, and that all 2-inch meters be calibrated on a 5-year interval. Large meter installations should be inspected to confirm whether strainers, isolation valves and test ports are present. The length of exposed straight pipe in the meter set should be observed for conformance to the manufacturer's recommendation. Flow-demand recording devices can be utilized to confirm that larger meters are appropriately typed and not oversized for the service they see since significantly oversized meters can result in lost revenue because of inaccurate registration during periods of low flow. Using the correct size and type of meter for each application, combined with routine calibrations, will ensure that customers are charged equitably for water use.

Conventional Meters

The City currently utilizes an automatic meter reading system. Six years ago, the City conducted a system wide replacement of all their meters upgrading to the radio-read format. At the time of replacement, the program identified a 10-year life cycle for the new meters. The City has planned to begin incremental meter replacements in year eight.

The City should continue its meter replacement schedule and should begin recording meter location, make, type, size, and age in the GIS database along with service dates, next scheduled inspection and repair notes. This should be performed on a routine interval to ensure that meter age and maintenance history is readily known.

11.10 HYDRANT MAINTENANCE AND REPLACEMENT

Hydrants are maintained and replaced on an as needed basis as they are damaged, or as problems are identified in the flushing and hydrant testing programs. Due to budgetary constraints, there is currently no formal hydrant infill program other than the policy of replacing or augmenting hydrants as waterlines are constructed and/or replaced.

The City's Public Works Design Standards require that all new hydrants be connected to the distribution main with a minimum 6-inch diameter lateral. It is recommended that as hydrants are replaced, that the lateral is also evaluated to ensure compliance with the standard. A

Ultimately it is the community, through its economic decisions with respect to taxation that determines the standard of fire protection and coverage. To the degree that funding is available, the City is encouraged to develop an inventory of existing hydrant coverage and to integrate this in the GIS system so that future infill efforts can proceed in an logical fashion.

11.11 RESERVOIR INSPECTION AND MAINTENANCE

Reservoirs should be inspected and potentially cleaned every 2 to 5 years. This process typically requires the use of divers. Once every ten years each tank should be drained for a thorough inspection and cleaning. Structural improvements or recoating can be conducted during these periods.

It is anticipated that the existing ground storage reservoir will be taken off-line for a thorough evaluation and cleaning once the new ground storage tank is placed into service.

11.12 EMERGENCY GENERATOR MAINTENANCE

In order to provide for the reliable production and distribution of water for public use and for fire fighting, it is recommended that the City perform routine maintenance on their emergency generators. Routine maintenance of the City's back-up generators is currently contracted by the City and performed by certified technicians. The City should continue funding this program.

11.13 EMERGENCY RESPONSE PLAN

The purpose of an emergency response plan (ERP) is to provide a guideline for water system operators and emergency personnel to minimize disruption of normal services to its consumers and to provide public health protection and safety from disruptions caused by a seismic event, fire, facility failure, or other incident. The City has prepared an ERP in accordance with the regulatory requirements promulgated in the wake of Sept. 11, 2001. The emergency response plan is on file at the PWD.

The ERP identifies a command and control structure within the Public Works Department (PWD) and defines procedures for coordinating emergency responses with the municipal fire and police departments, as well as state and federal agencies as required. Training exercises and drills are performed on a regular basis for all PWD personnel who are required to respond to emergencies. These exercises are also conducted whenever staffing assignment changes are made. The City should continue its good practice of training, and work to update the ERP as the significant infrastructure improvements of this report are implemented.

11.14 STAFFING LEVELS

The Public Works Department currently employs 14 full time employees. Table 11-2 provides a summary of the employees and their current assignments.

Table 11-2 | Current Staffing Level

FTE Staff	Assignment
1	Public Works Director
1	Public Works Superintendent
2	Administrative support positions shared between water and wastewater systems
4	Split between water, wastewater and street systems (40/40/20)
3	Sanitation program
2	Parks and Recreation
1	Specialized testing for wastewater system

Of the current staff approximately 3.6 full-time equivalents (FTE) are dedicated to the water system. Based on the program evaluations previously presented in this section of the report as well as the addition of the new water treatment facility, it is estimated that between 5.5 and 6.0 FTE are required to operate and maintain the distribution system. One FTE should be added concurrent with the startup of the new treatment plant and additional staff should be hired as the recommended programs of this report are implemented, in particular as the GIS program is developed.