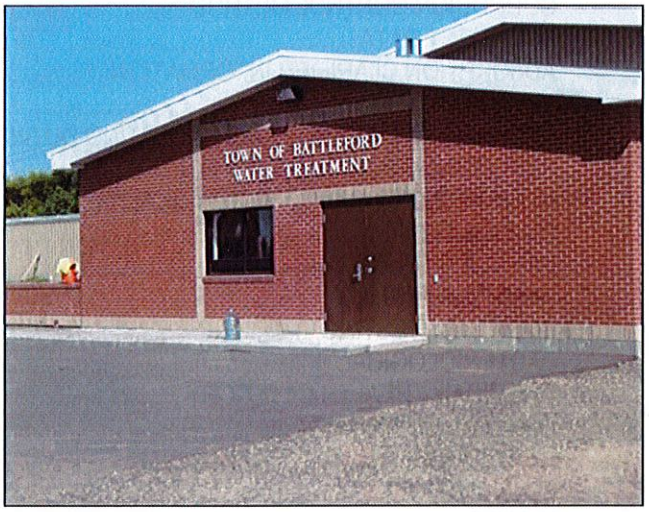
QUALITY ASSURANCE
QUALITY CONTROL

TOWN OF BATTLEFORD
UTILITY DEPARTMENT



Community/Waterworks Name	Town of Battleford
Waterworks Owner	Town of Battleford
Population	4,429 as of 2018
Source Water	Ground Water – 4 Wells Adjacent to the North Sask. River
Water Treatment Plant Location	392 25th Street West, Battleford, SK
Contact Information	Phone: 306-937-6224 and/or 306-937-6228 Cell: 306-441-7090 Fax: 306-937-5963 Email: aubrey@battleford.ca
Revised	2021-January-12

TABLE OF CONTENTS

POLICY

We, The Town of Battleford understand that supplying good quality drinking water is essential to the continued growth, prosperity, and wellbeing of our citizens. We are committed to managing all aspects of our water system effectively to provide safe and aesthetically appealing water that tastes good and is free from objectionable color or odor. It is our policy that the drinking water we provide will meet or exceed the quality provided by Acts, Regulations, and Terms and Conditions of the Permit to Operate a Waterworks.

To achieve our goals, we will:

- cooperate with the provincial government to protect our water source from contamination;
- ensure the potential risks associated with water quality are identified and assessed;
- ensure that our water supply, treatment, storage, and distribution infrastructure is properly designed, constantly maintained, and regularly evaluated and improved;
- include the drinking water quality and quantity priorities, needs, and expectations of our citizens, the provincial authorities, and our water system employees into our planning;
- develop a mechanism to ensure adequate funds are available for the water utility to maintain and improve the infrastructure, implement best practices, and ensure our water treatment employees are educated about their responsibilities and adequately trained and certified;
- establish regular verification of the quality of drinking water provided to our citizens and monitoring of the water treatment process that produce the water;
- provide community awareness about the water supply and its management by establishing and maintaining effective reporting of the water quality and timely information about the water system to our citizens;
- develop contingency plans and incident response capabilities in cooperation with provincial health authorities;
- participate in appropriate research and development activities to ensure continued understanding or drinking water quality issues and performance;
- participate in the drinking water guideline development and review process; and
- regularly assess our performance and continually improve our practices to produce good quality water.

We will develop a Drinking Water Quality Management System including an implementation plan to achieve these goals and adequately manage the risks to our drinking water quality.

All of management, and employees involved with the supply of drinking water are responsible for understanding, implementing, maintaining, and continuously improving the Drinking Water Quality Management System.

OPERATIONAL MONITORING PLAN

PROTOCOL

Operation of the community waterworks will be performed in accordance with design specifications and standard operating protocols of the waterworks industry. Further detail regarding standards operating procedures, range of operation, chemical feed, maintenance practices and intervals are outlined below.

WATER DEMAND

2020	Yearly Amount	Yearly Average	Peak Day	Usage m^3
Distributed	583093	48591	June 23, 2020	3,026
Treated	829052	69588	June 23, 2020	3,221

GROUNDWATER SUPPLY

Wells Available	Well Used	Yearly Average	Average Demand	Peak Day	Usage m^3
4A	Yes	28257	784	June 23, 2020	1,008
5	Yes	32436	818	May 25, 2020	1,061
6	Yes	30953	768	May 25, 2020	1,059
7	Yes	28332	760	May 25, 2020	1,065

WATER TREATMENT, STORAGE, AND DISTRIBUTION

Year of Construction	*Water Distribution* – 1960's with significant amount installed in 1965. Watermains – late 1960's to early 1970's. Southside was serviced in late 1960's and early to mid-1970's. *Subdivisions* – Riverbend (North End) services in mid-1970's. West Park – Development started in 1976. Battle Springs – Development started in 2007.
Year of Expansion	Water Treatment Plant 2008
Treatment Capacity m^3	5 - 6 m^3 per minute

WELLS

Maximum pumping rate at the Water Plant is limited to 12,000 LPM. Maximum treatment rate is 6,500 LPM.

Number of Wells:	4	
Pump Maintenance/Change-Out:	As Required	(Frequency)
Weathered Protection Inspection:	Disinfection every 1 -3 years	
Wellhead Protection Inspection:	Daily to weekly	(Frequency)

SUPPLY PIPELINE

Quality Support Agreement:	**None**

PRE-TREATMENT METHOD

Potassium Permanganate:	N.A.	Dosage Rate/Range
Pre-Chlorination:	N.A.	Dosage Rate/Range
Aeration:	N.A.	Dosage Rate/Range
Other:	N.A.	Dosage Rate/Range

FILTRATION

Method/Types	7 Manganese Green Sand Pressure Filters	
Capacity	7' diameters x 6' side shell	
Filtration Rate	455 LPM. /filter	
Media Type(s)	Manganese Green Sand	
Head Loss Measurement	Daily	(Frequency)
Backwash Type (Manual/Automatic)	Manual	
Backwash Frequency	Daily	
Backwash Rate	1500 – 1700 LPM	
Air Assisted Back Wash	Yes	
Media Evaluation	Yearly	(Frequency)
Media Replacement	N.A.	(Frequency)
Filter To Waste	Yes	
Filter Inspection	Yes	Yearly

FILTRATION

Methods/Types	7 Mixed Media Filters
Area	2.72m (8'-11") x 2.39m (7' – 10") =6.50 sq. m (70.0 sq. ft.)/tank
In-Service Loading	0.204m/min (5.0 gpm./sq. ft.)
Backwash Rate	0.204m/min (5.0 gpm./sq. ft. with air) 0.611m/min (15 gpm/sq. ft. water only)
Backwash Flow	1.32 m/min (350 gpm. with air) 3.97 m/min (1,050 gpm. water only)
Media	460 mm (18") of anthracite * MS-4, 230 mm (9") Silica Sand (MS-18), and 75 mm (3") Garnet
Underdrain	MULTIBLOCK underdrain with Laser Shield Media Retention Screen
Backwash Source	Filtered Water from Clear Well
Backwash Initiation	Automatically by time clock, filter head loss. High Effluent Turbidity or manually by selector switch

IRON/MANGANESE CONTROL

Method/Types	Orthophosphate (Post Filter Addition) & Potassium Permanganate (Pre-Filter Addition)	
Filtration Rate	455 LPM	Dosage Rate/Range
Potassium Chlorination	3.00 – 4.00 mg/L	Dosage Rate/Range
Pre-Chlorination	N.A.	Dosage Rate/Range
Aeration	N.A.	Dosage Rate/Range
Other – Orthophosphate	2.0 – 4.0 mg/L	Dosage Rate/Range

DISINFECTION

Method/Types	Post Chlorination
Disinfectant Used	Gas Chlorine
Dosage Rate/Range	5 – 7 mg/L
Feed Type	Regal Dual Head, Low Pressure Chlorinator/c/w 4 – 20 ma Smart Valve & Acc.

Residual Monitoring (Location)	WTP – min. 1/day Distribution Systems - 4/day (Monday-Friday), 2/day (Saturday-Sunday) Monday, Friday, 2/day Saturday/Sunday	
Water Storage Type/Size	Underground Concrete Reservoirs	
Volume of Treated Storage	Approximately 6093 m^3	
Fire Water Capacity	Approximately 6093 m^3	
Output Metering	Yes	Continuously
Output Metering Recording	Yes	Daily
Maintenance	As Required	
Inspection & Cleaning	On-Going	

WATER DISTRIBUTION SYSTEM

Piping Types	Variance – PVC, Ac, Ct	
Flushing Schedule	Yes	Annually
Form Swabbing Schedule	Not Available	
Pumping Capacity	6800 lpm – Not including Standby	
Emergency Pumping Capacity	3785 lpm	
Backflow Prevention	Yes	Inspected Annually
Hydrant Maintenance Schedule	Yes	Annually
Valve Maintenance Schedule	Yes	Inspected Annually By Contract
Repair Safety Procedures	Yes	Yearly
Line/Main Break Disinfection	Yes	
Line Main Break Sampling	Yes	
Customer Metering	Yes	Continual
Truck Fill Station	Yes	
Truck Fill Backflow	Yes	
Water Hauler Protocols	Yes	Signage

CORROSION CONTROL METHOD

Chemicals Used	Aqua Pure
Cathodic Protection	None

PERTINENT DATA

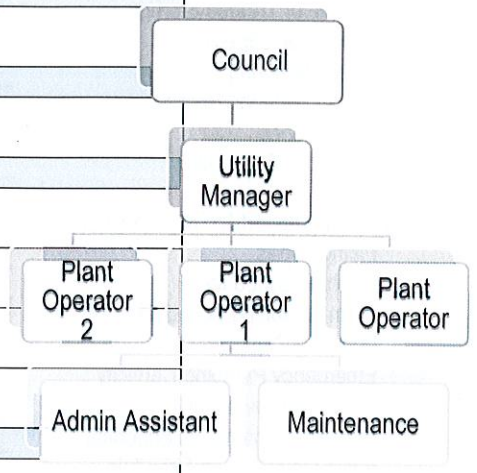
Flushing Rate	1320 LPM. /filter
Model	TR-120A (Aluminum)
Number of Tanks	4
Design Capacity	GPM: 22L/S (350 GPM)/tank
Normal Tank Size	4.42m (14'-0") Length x 2.72m (8' -11") Width x 2.57m (8' – 5") Height each
Tank Material	Martine Grade Aluminum, Grade 5086
Influent Connection Size	150 mm (6") Victaulic Groove
Effluent Backwash Supply Connection Size	200 mm (8") Victaulic Groove
Backwash Rate Connection Size	250 mm (10") Victaulic Groove
Air Wash Supply Connection Size	
Clarifier	75 (3") Flanged
Filter	100 (4") Flanged

ADSORPTION CLARIFIER INFORMATION

Area	1.36m (4' – 5 – ½") x 2.39m (7' – 10") = 3.25 sq. m (35.0 sq. ft.)/tank
In-Service Loading	0.408m/min (10.0 gpm./sq. ft.)
Flush Rate	0.326 to 0.408m/min (8 – 10 gpm./sq. ft.)
Flush Flow	6.31 L/S (100.00 GPM)
Clarifier Media	1.22m (48") depth NSF HDPE 50%/50%
Retaining Screen	Stainless Steel Screen Mesh with Aluminum I-Bar Grating
Flush Source	Influent Supply
Flush Initiation	Automatically by time clock, pressure switch or manually by selector switch

OPERATING

Waterworks Manager		
Whittleton, Aubrey	Water Distribution – Level 2 Water Treatment – Level 2	Email: aubrey@battleford.ca Work: 306-937-6228 Cell: 306-441-7090
Council Designate		
Laing, Doug	Council Designate	Email: councillorlaing@battleford.ca Work: 306-937-7741 Cell: 306-441-7706
Operators		
Day, Glenn	Water Distribution - None Water Treatment - None	Email: gkday@sasktel.net Work: 306-937-6224 Cell: 306-441-3342
Kolosnjaji, Mihajlo	Water Distribution – Level 2 Water Treatment – Level 2	Email: myke81@live.ca Work: 306-937-6224 Cell: 306-480-6113
Michelman, Mark	Water Distribution – Level 2 Water Treatment – Level 2	Email: markmichelman@sasktel.net Work: 306-937-6224 Cell: 306-441-7752
Ramac, Miron	Water Distribution – None Water Treatment – Level 3	Email: ramacmiron@yahoo.ca Work: 306-937-6224 Cell: 306-480-9703
Maintenance Personnel		
Friedrich, Colby	Water Distribution - None Water Treatment - None	Email: Colbyf@sasktel.net Work: 306-937-6224 Cell: 306-480-4544
Administrative Assistant		
Noble, Kayla	Water Distribution - None Water Treatment - None	Email: works@battleford.ca Work: 306-937-6224/306-937-6220 Cell: 306-480-6606



RECORD MAINTENANCE AND REPORTING DUTIES

The Town of Battleford shall maintain records containing the following information:

a) Total water pumped into the distribution system daily or the total raw water used
b) The types, dosages and total amounts of chemicals applied to the water for treatment
c) Locations from which samples for any tests conducted by the Town of Battleford taken in accordance with the "Permit to Operate a Waterworks" and name of personnel who conducted the sampling or testing and the results of those tests
d) Any departures from normal operating procedures that may have occurred and the time and date that they occurred
e) Any instructions that were given during operation of the Waterworks to depart from normal operating practices and the name of the person who gave the instructions
f) Any upset/bypass condition, the time and date of the upset/bypass condition and measures taken to notify others and resolve the condition
g) Any condition of low disinfectant levels, the time, date and location of occurrence and measured taken to restore disinfectant levels to required values
h) Dates and results of calibrating any metering equipment and testing instruments
i) Dates and types of maintenance performed on equipment and any actions taken to ensure the normal operation of the waterworks

The operational record or logs mentioned above are to be recorded and maintained in the following manner:

a) Operational records/logs must be made in chronological order, with dates, times, and testing locations clearly indicated
b) Entries in an operational record or log must only be made by the Town of Battleford Waterworks personnel
c) Any personnel making an entry in an operational record/log must do so in a manner that allows the person to be unambiguously identified as the maker of the entry operational record/log must be maintained on a daily basis and retained for at least five years
d) Any anomalies or instances of missing entries is an operational record/log must be accompanied by explanatory notes
e) Operational records/logs must only contain data or information that is actually observed or produced
f) Operational records/logs must not contain default values generated manually or by automated means
g) Operational records/logs maintained pursuant to clause (d) must be made available promptly on request of the minister
h) Town of Battleford Waterworks shall review the records/logs on a monthly basis to ensure that the operating parameters are being achieved and that the limits set out in the "Permit to Operate a Waterworks" are not exceeded
i) Town of Battleford Waterworks shall report the findings to the Minister as soon as it is reasonably practicable after each review required by (h) should the review of the records/logs indicate that the quality of water from the waterworks has been adversely affected, that any upset condition, bypass condition or event at the waterworks has not been reported, or that on-site water quality testing records are missing.

REPORTING AND CONSUMER REPORTING

The Town of Battleford shall ensure the following:

a) Submit the results of water sampling analysis performed in accordance

- In the case of positive bacteriological results within 24 hours following completion of the sampling analysis
- In the case of all other parameters, within 7 days following completion of the sampling analysis

b) Direct the laboratory performing water sampling analysis to submit the results within the time to the Environmental and Municipal Management Services Division

c) Report to the Minister any known or anticipated upset/bypass condition or events at or affecting a Waterworks that could adversely affect the quality of water produced by the waterworks

d) Immediately report to the Minister any instance where
- Disinfection equipment fails
- Level of disinfection identifies in the "Permit to Operate A Waterworks Appendix B" is not achieved or is not anticipated to be achieved
- Any other perimeter level identifies in "Permit to Operate A Waterworks Appendix B" is not achieved or is not anticipated to be achieved
- Any staffing changes such as retirement, suspension, resignation, scheduled absence or termination of employment of any certified waterworks distribution or waterworks treatment operator
- System depressurization has occurred

e) The Town of Battleford shall, once per calendar year, provide consumers supplied by the waterworks with a notification of the quality water produced and supplied by the waterworks in comparison with the levels set out within the permit

f) The Town of Battleford compliance with sample submission requirements described in the permit

MONITORING PLAN AND WATER QUALITY

The Town of Battleford shall ensure the following:

a) Water samples to be taken from the Waterworks to test for bacteria, turbidity, chlorine and all other parameters listed in the "Permit to Operate a Waterworks Appendix A"

b) Ensure that the water provided to consumers does not exceed the limits set out in the "Permit to Operate a Waterworks Appendix B" for bacteria, turbidity, and chemical parameters listed.

c) The Town of Battleford shall have water samples analyzed by an accredited laboratory in accordance with the Regulations.

d) The Town may perform water sampling and analysis for chlorine residuals and turbidity be means of on-site testing or be continuous water quality monitoring equipment when authorized to do so.

e) Water samples shall be taken in accordance with the instructions provided by the institution or laboratory which provides the sample bottles or containers

f) Ensure that all water quality monitoring and testing equipment be maintained and calibrated on a frequency as recommended by the manufacturer

ON-SITE TESTING

	RAW WATER	FILTRATION	DISINFECTION	DIST. SYSTEM
pH	☑	☒	☑	☑
Turbidity (or particle count)	☑		☑	☑
Total Coliforms	☑		☑	☒
Background Bacteria			☑	☒
Chemical Dosage			☑	
Flow Rate		☑	☑	
Head Loss			☑	
CT			☑	
Disinfectant Residual			☒	☒
Disinfection by Products			☑	☒
Pressure				☑

ITEMS WITH AN "☒" ARE MANDATORY

PARAMETERS TESTING

	Testing Equipment	**On-Line Monitoring Equipment**
Turbidity		☑
pH	A	
Iron	☑	
Manganese	☑	
Fluoride	Accredited Lab Tested	
Alkalinity	A	
Hardness	A	
Chlorine Residual		☑
Particle Counting	N/A	

Color	N/A
Filter Head Loss Measuring	☑
Water Meter (Raw, Filtered, Backwash, etc.)	☑

SAFETY EQUIPMENT

Gloves, aprons, goggles, eyewash, etc. — All proper Personal Protective Equipment approved and supplied to employees

LABORATORY TESTING

BACTERIOLOGICAL

The owner/operator is responsible to ensure that one hundred percent of all bacteriological samples are submitted as required. All waterworks are required to submit samples for bacteriological water quality; the frequency of monitoring depends on the population served by the waterworks.

Parameter/Location	Limit	Regular Samples Required	Regular Samples Submitted	# of Positive Regular Submitted (%)
Total Coliform	0 Organisms/100 mL	52	52	0%
E. coli	0 Organisms/100 mL	52	52	0%

CHEMICAL – HEALTH CATEGORY

All waterworks serving less than 5000 persons are required to submit water samples for SE's Chemical Health category once every 2 years. The last sample for Chemical Health analysis was required in 2019 and submitted on 2019-October-28. Sample results indicated that the provincial drinking water quality standards were not exceeded.

Parameter	Limit MAC (mg/L)	Limit IMAC (mg/L)	Sample Results	Samples Exceeding Limits
Aluminum (mg/L)			0.0011	0%
Antimony (mg/L)	0.006		<0.0002	0%
Arsenic (ug/L)	0.010		0.2	0%
Barium (mg/L)	1.0		0.11	0%
Boron (mg/L)		5.0	0.02	0%
Cadmium (mg/L)	0.005		<0.00001	0%
Chromium (mg/L)	0.05		<0.0005	0%
Copper (mg/L)			0.036	0%
Iron (mg/L)			0.0061	0%
Lead (mg/L)	0.01		<0.0001	0%
Manganese (mg/L)			0.0098	0%
Selenium (mg/L)	0.01		<0.0001	0%
Silver (mg/L)			<0.00005	0%
Uranium (ug/L)	0.02		0.2	0%
Zinc (mg/L)			0.0059	0%
Bromate	0.01		<0.005	0%
Chlorate	1.0		<0.05	0%
Chlorite	1.0		<0.05	0%

GENERAL CHEMICAL

All waterworks serving less than 5000 persons are required to submit water samples for SE's General Chemical category once every two years if a ground water source and once per three months every second year if a surface water or blended surface/groundwater source. The last sample for General Chemical analysis was required in 2019 and submitted on 2019-October-28. Sample results indicated that there were no exceedances of the provincial aesthetic objectives for the General Chemical category.

Parameter	Aesthetic Objectives * (mg/L)	Sample Results	Samples Exceeding Limits
Bicarbonate (mg/L)	No Objective	278	0%
Carbonate (mg/L)	No Objective	<1	0%
Chloride (mg/L)	250	18	0%
Hydroxide (mg/L)		<1	0%
P. Alkalinity (mg/L)	500	<1	0%
pH (pH units)	No Objective	7.84	0%
Specific Conductivity (uS/cm)	No Objective	600	0%

Sum of Ions (mg/L)		493	0%
Total Alkalinity (mg/L)		226	0%
Total Hardness (mg/L)	800	272	0%
Nitrate (mg/L)	45.0	0.48	0%
Fluoride (mg/L)	1.5	0.12	0%
Total Dissolved Solids (mg/L)	1500	381	0%
Calcium (mg/L)	No Objective	73	0%
Magnesium (mg/L)	200	22	0%
Potassium (mg/L)		2.8	0%
Sodium (mg/L)	300	22	0%
Sulfate (mg/L)	500	77	0%

PROCEDURES

FLUSHING

The following procedures are recommended for flushing operations.

- pre-plan an entire day's flushing using the available distribution system maps; consider flushing at night between midnight and 5:00 a.m. to minimize completing water demand and any inconvenience to customers;
- determine where sections of mains are to be flushed at one time, the valves to be used, and the order in which the pipelines will be flushed; develop and use typical forms as identified under the heading Flushing Procedures;
- start at or near a source of supply and work outward into the distribution system; record which wells are on-line or isolated;
- assure that an adequate amount of flushing water is available at sufficiently high pressures, that is, ensure the reservoir(s) are full; a minimum flushing velocity of 2.5 ft/sec (5 ft/sec preferred) (0.75 and 1.50 m/sec) should be used;
- prior to flushing the mains, notify all customers who will be affected of the dates and times of the flushing through billing, newspapers, and local radio and TV announcements; individually notify people who might be on dialysis machines and hospitals, restaurants, laundromats, and others who might be affected while the mains are being flushed;
- isolate the section to be flushed from the rest of the system; close the valves slowly to prevent water hammer;
- open the fire hydrant or blow off valve slowly;
- direct flushing water away from traffic, pedestrians, and private lots;
- open hydrant fully for a period long enough (5 to 10 minutes) to stir up the deposits inside the water main;
- assure that system pressures in nearby areas do not drop below 138 kPa (20 psi);
- record all pertinent data (such as valve and hydrant condition) regarding the flushing operation as well as a description of the appearance and odor of the water flushed;
- collect two water samples from each flowing hydrant, one about 2 to 3 minutes after the hydrant was opened and the second sample just before closing the hydrant; these samples allow a check on the water quality for certain basic water quality indicators (iron, chlorine residual, turbidity);
- after the flushing water becomes clear, slowly close the hydrant or blow off valves;
- in areas where the water does not become completely clear, the operator shall use judgment as to the relative color and turbidity and decide when to shut down;
- mark closed valves on a map or flushing sheet (see Flushing Procedures) when they are closed and erase marks after the valves are reopened; and
- after one section of pipe has been flushed, move onto the next section to be flushed and repeat the same procedures.

VALVES

- Routine valve inspections shall be conducted by performing the following tasks:
- verify the accuracy of the location of the valve boxes on the system map (if incorrect, change the map and update the Master Copy);
- after removing the valve box cover, inspect the stem and nut for damage or obvious leakage;
- close the valve fully and record the number of turns to the fully closed position. Always close a valve slowly to prevent water hammer;
- reopen the valve to re-establish system flows; and
- clean valve box cover seat; sometimes covers on valve boxes will come off when traffic passes over them due to dirt in the seat.

Exercising (opening and closing a valve) shall be done at the same time the valve inspection is made. Some manufacturers recommend that a valve stem never be left in a fully open or closed position. They recommend that after fully opening or closing a valve, back off the stem by one turn.

Conditions of each system will determine how often the valves needs to be exercised, in general, it is recommended that all valves be exercised at least once a year. Planned exercising of valves verifies valve location, determines whether or not the valve works, and extends valve life by helping to clean incrustations from the valve seats and gates. Any valves which do not completely close or open shall be replaced. Valves which leak around the stems need to be repacked. To determine that a valve is closed, an aqua phone or other listening device can be used. Valves need to be exercised in both directions (fully closed and fully opened) and the number of turns and direction of operation recorded. Valves operating in a direction opposite to that which is standard for the system need to be identified and this fact recorded. The condition of the valve packing, stem, stem nut, and gearing shall be noted. A timely maintenance program needs to be initiated to correct any problems found during the inspection and exercising.

An important factor in maintaining distribution system valves are the availability of current and correct maps of the distribution system. Each utility needs to verify their maps often so that it is accurate and keep the map up to date by immediately recording any changes such as replacements or additions. Some water purveyors equip their service trucks with "gate books" which carry all the pertinent valve information including location, direction of turning to close, and number of turns required.

Maintaining current records is as important as maintaining current maps. A purveyor needs to develop a valve form to track important information. The location of a valve is obtained from a controlled survey benchmark or permanent reference point. The make of valve is important because different makes have different operating characteristics. The use of a simple valve numbering system keyed to up-to-date drawings is recommended. This procedure has proven to be quite helpful in locating valves rapidly and in communicating with others about valves.

Road improvements require constant attention from water distribution system operators to ensure that valves are not lost. Valve boxes can be graded out or covered with pavement. The center lines of roads, curb lines, and right-of-way lines are not to be used as reference points for locating valves, because they can change over time.

Valves left closed in error can cause severe problems in a distribution system. Construction and maintenance crews operate valves as they do their work, and contractors and plumbers may operate valves without permission. Separate pressure zones in distribution systems may be established by closing valves, thus increasing the possibility of problems related to the incorrect use of valves. Unexplained problems with pressure and excessive operation of pumps in a given area have been traced to valves left closed or open in error. When crews change shifts during a project, valve closure and opening information shall be exchanged. Crew chiefs shall be certain all valves are restored to proper positions.

Proper advance planning is important. The valves that will be used to isolate a damaged valve shall be in good operating condition. When ordering repair parts, include the size, make, direction of opening, year of manufacture, and other pertinent information in order to assure that the correct repair parts will be received.

Until the valve is isolated and opened, it is difficult to determine what part of the valve is damaged. Therefore, have all replacement parts available before isolating the necessary section of the water main, excavating the valve, and making the repairs.

FIRE HYDRANTS

Operators responsible for hydrant inspections need to be familiar with the various types of hydrants used in their system. There are two basic types of fire hydrants, the dry barrel and wet barrel. A hydrant has four principal parts: the inlet pipe which is connected to the main water supply, the main valve, the barrel and the head. The supplier should be contacted whenever necessary to obtain descriptive literature, operation and maintenance instructions, parts manuals or assistance on particular problems.

In general, fire hydrants need to be inspected and maintained twice a year. These operations are often done in the spring and the fall. However, each hydrant needs to also be inspected after each use. Inspect dry-barrel hydrants after use, especially during freezing weather, to assure that the drain remains open when the hydrant is not in use.

An additional source of information on fire hydrants is AWWA's Manual M17, Installation, Field Testing, and Maintenance of Fire Hydrants. Some general inspection and maintenance procedures used for hydrants include:

- inspect for leakage and make corrections when necessary;
- open hydrant fully, checking;
- ease of operation;
- flush hydrant to waste (takes care for to direct flow);
- remove all nozzle caps and inspect for thread nozzle and cap threads;
- clean and lubricate outlet nozzle threads.
- replace caps, tighten with a spanner wrench, then back off on the threads slightly so that the caps will not be excessively tight but will leave sufficient frictional resistance to prevent removal by hand;
- check for any exterior obstruction that could interfere with hydrant operation during an emergency;

- check dry-barrel hydrants for proper drainage;
- clean exterior of hydrant and repaint if necessary;
- be sure that the auxiliary valve is in the fully opened position;
- if a hydrant is inoperable, tag it with a clearly visible marking and immediately report the condition of this fire hydrant to your fire department; and
- prepare a record of your inspection and maintenance operations and any repair work.

Hydrants can be partially protected against freezing by covering them with a box which can be quickly removed when the hydrant shall be used. To keep hydrants from freezing (those that won't drain in the winter due to frozen conditions), insert in the hydrant propylene glycol or some other nontoxic NSF approved substance that won't freeze or cause water quality problems. Frozen hydrants may be thawed using electric current thawing or live steam injected through a hose into the hydrant barrel.

Standardization of hydrants minimizes the requirement for stocking parts, simplifies repair procedures, and allows replacing only defective parts. Every water purveyor needs to keep a basic stock of repair parts on hand for immediate use.

Fire hydrants are usually the only part of the distribution system regularly seen by the general public. Frequent painting of hydrants creates a favorable impression and is, therefore, a public relations tool. Fire hydrant caps or guards can be installed on the tops of fire hydrants to eliminate fire hydrant vandalism.

LOCATING AND REMEDIATING LINE BREAKS

Breaks in water mains can occur at any time and every purveyor shall have an established, written response plan. After a break has been located, determine which valves must be closed to isolate the break. A good policy before shutting off any valves is to notify every consumer involved that they will be out of water for an estimated length of time. The purpose of this advance notification is to allow consumers to make any necessary preparations. If extensive damage is caused by the break (flooding and/or washouts), close the valves and isolate the section as soon as possible, even before notifying all consumers.

After the valves are closed, a trash pump can be used to drain the hole. A backhoe or other equipment can be used to dig down to the break. Before entering the hole, determine the necessary shoring needed. Use the appropriate shoring. Remove the damaged section of pipe and as much silt and debris as possible from the remaining sections of the main by flushing or other methods. Replace the damaged section of pipe and/or valves using clamps and other fittings. Flush the entire section which was isolated using hydrants or drains. Disinfect the system by following the recommended standards for disinfecting mains.

All new or repaired watermains must be disinfected according to the current edition of the AWWA Standard for Disinfecting Water Mains Standard C651-05. New lines shall be thoroughly flushed and chlorinated at a dosage of in accordance with C651-05. In short lines, and if portable chlorination equipment is not available, thorough flushing and maintenance of a free chlorine residual of 1.0 mg/L after 24 hours shall be carried out, with a test for residual chlorine being made at the end of the test period.

PROCESSES FOR DETECTING LEAKS

Leaks may originate from any weakened joint or fitting connection or from a damaged or corroded part of the pipe. Leaks are undesirable not only because they waste water, but because they can undermine pavements and other structures. Another undesirable effect of leaks is that the leak soaks the ground surrounding the pipe and, in the event, that pressure is lost in the pipe, the water, combined now with dirt and other contaminants, may backflow into the pipe.

The total amount of leakage is also affected by the type of soil surrounding the leaking pipes. In coarse soils (sands) the leakage may continue for an extended period without detection, whereas in finer soils (clays) leaks are detected sooner on the surface.
The process of locating a leak can be difficult and can become a troublesome and frustrating experience. Methods used to locate leaks include direct observation as well as use of sounding rods, listening devices, and data from a waste control study.

The simplest method of leak detection is to search for and locate wet spots which might indicate the presence of a leak. Sometimes these are reported by the system's customers. However, even if a damp spot is found, it does not necessarily mean the leak can be easily found. The leak may be located directly below the damp area or it may be meters away. Often the leak is not located where it would be expected because water follows the path of least resistance to the ground surface.
After the general location of the leak has been determined, a probe may be used to find the exact location. This probe is a sharp-pointed metal rod that is thrust into the ground and pulled up for inspection. If the rod is moist or muddy, the line of the leak is being followed. Do not probe into an area that has an electrical cable.

Listening devices are sound-intensifying equipment that is used in a systematic fashion to locate leaks. The simplest listening device is a steel bar held against the pipe or valve. The device is moved in the direction of increasing sound until the leak is found. Patented leak detectors use audio phones to pick up the sound of escaping water.

Another method for locating leaks is the use of a leak noise correlator. This instrument locates leaks by noise intensity and the time it takes for the leak sound to travel to a pair of microphones placed on fittings (fire hydrants or stop valves) on each side of a suspected leak. Leak correlators are accurate in locating a leak.

The amount of water lost from the distribution system through leakage is only one component of the system's total water losses. The total amount of water lost from a distribution system from all sources is often referred to as "unaccounted for water" or non-revenue water (NRW). The NRW is the difference between the total amount of water produced and the total amount of water consumed. The amount of unaccounted for water lost by a distribution system is usually determined by conducting a water audit.

Waste control or water audit studies are usually conducted when no specific reason can be found for a significant water loss in the system. Routine comparisons of water production and use needs to be made to determine the amount of NRW or unaccounted for water. When the loss exceeds 10 percent of the water produced corrective actions needs to be taken.

MEASUREMENTS, ALARMS, STATUS INDICATORS, ETC.

For plants of 1 ML/d (220,000 igpd) capacity and greater, the following instruments should be provided as a minimum for the relevant processes listed.

Raw Water Instrumentation:

- low-level switches to shut down the raw water pumps. These should be hard-wired to the starters;
- running and trip indication for raw water pumps; and
- raw water turbidity, pH, pressure, flow rate, and flow volume.

Filter Instrumentation:

- turbidity on each individual filter effluent and filter to waste. This can be a single instrument for each filter if piping arrangement permits;
- for constant rate filters: differential head loss across the filter media;
- filter flow rate;
- where the backwash sequence is automated, provide open and close limit switches or position on all filter valves and status on backwash equipment; and
- filter run time.

Backwash Instrumentation:

- running and trip indication for backwash pump(s);
- running and trip indication for air blowers (if air scour is used);
- backwash flow rate and flow total; and
- elapsed time since last backwash.

Clearwell and Distribution Pump Instrumentation:

- level indication for clear well and other tanks;
- running and trip indication for the distribution pumps;
- low-level switches to shut down the distribution pumps. These should be hard-wired to the motor starters;
- turbidity, chlorine residual, fluoride residual (if fluoridation is practiced), pH, pressure, flow rate, and flow total on plant discharge;
- for variable speed pumps, indicate the pump speed.

Chemical Systems:

- running and trip indication for chemical loading, batching and pumping equipment;
- low- and high-level alarms in storage bins, silos or tanks;
- level indication for tanks;
- weigh scales for hydrofluosilicic acid day tanks or storage if no day tank is used;
- weigh scales for gaseous feed chemicals such as chlorine or Sulphur dioxide;
- speed indication on variable speed pumps;
- rotameters (or other flow monitoring device) for carrier water feed systems; and
- chemical feed flow rate is desirable but not mandatory.

Miscellaneous Instrumentation:

- run time meters on all pumps and major electrically driven equipment;
- speed, run time, oil pressure and temperature gauges, fault signal switches and manual start and shut down on engines;

- where the plant is automated or operated remotely from either within the plant or outside, provide open and close limit switches or position indicators on all major valves, status on all major equipment and security instruments including door switches, building temperature switches and smoke alarms; and
- any additional instrumentation recommended by equipment manufacturers.

Alarms and Status Indication

As a minimum, the following alarms need to be provided:

- high turbidity on the raw water, clarifier effluent (if applicable), filter effluent, and plant discharge;
- high and low pressure on the raw water line;
- high flow rate on the raw water line.
- high and low level in clarifiers or flocculators;
- high torque on solids contact clarifier recirculatory and rake;
- high torque on flocculators;
- high level in filters;
- high and low level in chemical storage tanks;
- high and low chemical feed rates (if measurement is provided);
- high flow rate on each filter individually (also low flow rate on declining rate filters);
- high and low levels in each clear well, pump well, and reservoir;
- high and low pH on the raw and treated water (if on-line measurements are provided);
- high and low chlorine residual on the plant discharge (where online measurements are provided);
- high head loss on the filters (if constant rate type);
- trip or failure to run on each pump;
- high and low pressure on the plant discharge line;
- high flow rate on the plant discharge line;
- chlorine gas detection in the chlorine storage rooms;
- chlorine scale low weight (where scales are equipped with transmitters); and
- valve operation failure (where valves are provided with limit switches.

FIELD INSTRUMENTS

LEVEL INSTRUMENTS

Where access to the top of the reservoir is convenient (such as in a clear well), an ultrasonic level transmitter should be used. Where access to the bottom of the reservoir is convenient (such as at a tower or above-ground reservoir), a pressure transmitter can be used.

FLOW INSTRUMENTS

On-line flow meters should generally be one of the following types:

- turbine (or nutating disk);
- magnetic; and
- ultrasonic (either transit-time or Doppler).

All of these types of instruments can be equipped to provide both flow rate and flow total measurements.

Price, line size, flow rate, flow range, pipe material, required accuracy, and water quality will dictate the selection of the type of instrument.

WATER QUALITY INSTRUMENTS

The most frequently used water quality measurements are turbidity, pH, and chlorine residual. On-line turbidity measurement is relatively inexpensive and should be provided in any plant, on the raw water, flocculator or clarifier effluent (if applicable), each filter effluent, and final plant discharge lines. In larger plants, on-line pH and chlorine residual are generally used, but manual testing can be done in smaller plants.

PROCESS CONTROLS

PUMPING SYSTEMS

Regardless of the function of the pumping system, its control will normally be achieved through monitoring level, flow and/or pressure. The choice of control parameter(s) will depend on the system's function and features. Controls and monitoring for raw water pumping and finished water pumping are normally required.

TREATMENT PROCESSES

Two methods may be used to control the operation of travelling screens:

- simple manual start/stop which requires the presence of the operator to start and stop the screen. This method is not recommended where sudden changes in raw water quality could result in heavy debris accumulation on the screens; and

- automatic activation by differential level or time. This method uses the differential level across the screen to provide the start condition. Once started, the screen needs to be run at least one "cycle" and stop automatically when the differential level is returned to the clean screen value.

CHEMICAL FEED SYSTEMS

LIQUID/GAS CHEMICAL FEED

Basic chemical dose rate control can be achieved by flow pacing (i.e., adjusting chemical feed rate based on the flow of the stream it is to be injected into). This can be achieved using a variable speed metering pump (liquid) or flow control valve (gas) linked to a flowmeter on the receiving stream. For finer dosage adjustment, feed rate can also be controlled based on downstream instrumentation (e.g., residual chlorine analyzer providing feedback signal to chlorine dosing pump).

DRY CHEMICAL FEED

Dry chemical feed systems typically include a packaged bulk storage combination feeder and mixer. The feeder can be gravimetric or volumetric and will be controlled by a 4-20 mA signal from the flow transmitter on the plant flowmeter.

RAPID MIXING

Control of the rapid mixer will be simply on or off; the unit should operate continuously whenever the plant is in operation.

- float removal cycle.

DISINFECTION

The dosage is controlled on the basis of the measured residual; an analyzer/ controller measures the residual downstream of the point of injection and adjusts the rate of injection accordingly via a control signal to the metering pump (liquid feed) or gas flow control valve (gas feed).

CONTROL SYSTEM DOCUMENTATION

The following documents need to be provided following completion of the control system:

- record drawings to show any changes to the original design and including any drawings produced during construction;
- annotated listings of control system programs and packaged system configuration;
- manufacturer's literature for all control and instrumentation components;
- final wiring diagrams complete with wire and terminal coding;
- motor control schematics;
- instrument loop diagrams;
- panel wiring and layout details;
- PLC or DCS wiring schematics;
- instrument calibration sheets; and
- operating instructions

SIGNING

DISCUSSED: JAN. 26 ,2021

DOUG LAING
COUNCIL DESIGNATE (PRINT)

Doug Laing
COUNCIL DESIGNATE (SIGNATURE)

WHITTLETON, AUBREY
UTILITY MANAGER (PRINT)

UTILITY MANAGER (SIGNATURE)

PRESENTED AND DISCUSSED AT COUNCIL: JAN. 25 ,2021

DOUG LAING
PRESENTED BY (PRINT)

COUNCILLOR
TITLE