

City of Saskatoon
Water Treatment Plant

Operations Manual

Version 2.2



City of
Saskatoon

Water and Wastewater Treatment Branch

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1. Introduction and Overview

The City of Saskatoon is committed to providing a consistently safe and adequate supply of potable water to the residents of Saskatoon. To meet that commitment significant ongoing resources and efforts have been allocated to ensuring the Water Treatment Plant (WTP) operates safely, effectively and efficiently. The preparation of this manual is part of that effort.

The purposes of this manual include:

- to accurately and comprehensively document WTP processes, systems and equipment
- to describe the local and remote controls and systems used to operate the WTP and remote sites.
- to describe and explain operational goals, techniques and procedures necessary for successful plant operation
- to provide a training and reference resource for operations and supervisory personnel

The content, level of detail, organizational structure and style of this document have been designed to:

- provide information about the WTP
- how the processes, equipment and control systems work
- where equipment and systems are located
- what they look like

Explanations of the operational goals, operating techniques necessary to achieve those goals, and specific procedures that must be followed to accomplish them, are included in each section.

A primary goal is to assist operators with information necessary for successful operation of the WTP. However, in some cases information additional information has been included to provide background and perspective. This should assist personnel to solve difficult problems and function successfully as a team.

This first section of the document introduces the WTP commitment to vision, mission, values and policies of the WTP, information on how to use the manual, related documentation and an overview of WTP processes, personnel and operation.

1.1 Vision, Mission, Values and Policy

The Water and Wastewater Treatment Branch of the City of Saskatoon provides for the operation and maintenance of the City of Saskatoon's water and wastewater treatment, the handling and disposal of solids resulting from the treatment processes, the remote pumping facilities, and the testing and maintenance of water meters.

1.1.1 Vision

The Water and Wastewater Treatment Branch will be recognized as a leader in the utilities industry, staffed by highly qualified and trained people who strive continuously to provide exceptional high quality water and wastewater management services in a cost effective and reliable manner.

1.1.2 Mission

The Water Treatment Section exists to provide safe potable water of adequate supply and pressure, accurately monitored and controlled, for our current and future customers. The measurement of the water consumed by our customers is accurately, efficiently and effectively accomplished so as to secure cost effective delivery of potable water and wastewater treatment into the future. Quality service will be maintained and improved by striving to keep the staff and facilities current with changes in the water service industry to ensure provincial regulatory guidelines are met in a cost effective manner.

1.1.3 Values

To achieve its vision, the Water & Wastewater Treatment Branch is committed to:

- Quality Service
- Fiscal Responsibility
- High Performance
- Respect for Others
- Safe and Supportive Work Environment
- Cooperative Spirit
- Continuous Employee Development

1.1.4 Policy

The Water Treatment Plant exists to provide a dependable and adequate supply of safe, high quality, potable water to its customers. The City Ends Directive specifies that under normal operating conditions, the supply meets the following criteria:

- All conditions specified in the provincial Permit to Operate.

- Water hardness does not exceed 140 mg/L (as CaCO₃).
- Fluoride concentrations meet Saskatchewan Environment and Resource Management (SERM) guidelines.
- Hourly demands are met with a minimum pressure of 262 kPa (38 psi) at the distribution system main 93 percent of the time. Daily demands plus fire flow demands are met at a minimum pressure of 138 kPa (20 psi).
- Fire hydrants meet the minimum requirements of the Fire Underwriter's Survey 99 percent of the time.
- Water consumption is metered in accordance with American Water Works Association (AWWA) standards.

In the event of interruption in normal water supply, the following criteria are met:

- Following notification of a main break, normal service is restored within 24 hours in 95 percent of the occurrences and an alternate source is provided within eight hours in 98 percent of the occurrences.
- During treatment plant failures, storage volumes can sustain a rationed supply for 48 hours.
- During a major city wide power outage, standby equipment can sustain average annual consumption demands.

Water is supplied to SaskWater Corporation, within the terms of a Master Water Supply Agreement and in accordance with the City Policy C09-018 (Potable Waterline Connections), to serve water users outside the City's boundaries.

1.2 Using this Manual

This manual has been designed to provide a resource to operating personnel, supervisory staff and others requiring information on the equipment and processes implemented at the WTP. It may be used as a training aid, an overview of WTP operation or a resource for quick reference regarding specific details of plant equipment and operation.

To obtain a complete understanding of WTP facilities and their functionality, operating goals, techniques and procedures, and how to use the plant control systems, a thorough study of the entire manual is necessary. However, each section of the manual can also be used to research specific aspects of WTP areas, systems and operating procedures.

Version Dates

The Version Date of this document is printed on the cover page and in the footer at the bottom of each page of the manual. The date indicates when the last significant update to this copy of the manual was completed. A list of version dates for various WTP documents is maintained and posted in the WTP Control Room. To ensure the printed version you are using is the latest version, compare the Version Date of this document with the date listed in the Control Room.

1.2.1 Contents and Scope

This manual provides reference documentation related to the operation of the City of Saskatoon Water Treatment Plant's physical plant and monitoring/control systems. The manual includes:

- information on the vision, mission, values and policies of the WTP
- an overview of the scope and use of this manual
- an overview of WTP operations
- a description of the control systems and human-machine interface (HMI) used to operate and control the WTP
- sections on each area of the WTP that include information on:
 - § the purpose of the area
 - § important safety considerations
 - § the area and its process
 - § the local and remote controls and how to use them
 - § the operating goals, techniques and procedures including
 - acceptable operating parameters
 - critical control points
 - applicable government regulations
 - § a list of Related Standard Operating Procedures
 - § control system reference material

- an appendix containing miscellaneous other information

1.2.2 Area and Equipment Designations

This manual uses an updated system of designating and numbering plant equipment. The system is designed make equipment designations simple and consistent, avoiding repetitive use of long descriptions.

Historically, WTP equipment designations have been linked to their location, purpose, related plant upgrade event, and other factors. As the WTP and remote sites have evolved (over the last 90+ years) the names of areas, equipment and systems has evolved as well. For example, filter plant equipment sometimes has been designated in terms of the historical filter area additions (1911 Filter Plant, 1927 Filter Plant, 1948 Filter Plant, 1957 Filter Plant, 1964 Filter Plant). However, as the plant has evolved (some filters shut down and clearwells modified) filters have been re-designated in terms of areas: Filter Area 1, Filter Area 2 and Filter Area 3. Both of these designations are used for various purposes, making description of equipment in these areas a challenge.

The new designation/number system uses an acronym indicating the functional area of the plant, a equipment type descriptor and an equipment number. Wherever possible continuity has been maintained with the traditional system, and recognition is easy. For example, in the past, pumps have been referred to by location and number, based on the order they were installed. The last of ten High Lift area pumps is often referred to as “Number 10 (or #10) High Lift Pump”. The new system refers to this pump as: WTHL-P10. WTHL designates “Water Treatment High Lift”, P designates a pump, and 10 is the pump number.

The following tables outline the area and equipment designations used in this manual.

Area Designations

Area designations include physical plant areas and functional areas. For example, plant areas such as the QE Low Lift, Filters, High Lift are represented by acronyms. Functional areas such as Control Systems, and system distributed throughout the plant, such as Electrical Power, Plant Air and Heating, Ventilating and Air Conditioning are also represented. The Chemical Feed area has a short acronym for equipment used in general chemical feed applications (CF), and longer acronyms that represent each chemical feed area (CFxx).

Area	Designation
Control Systems	CTRL
Spur Dike Low Lift	SDLL
QE Low Lift	QELL
Screens	SCRN
WTP Low Lift	WTLL
Sand Separators	SSEP
Clarifiers	CLAR
Chlorine Contact Basin	CCBN

Area	Designation
Filters	FLTR
Clearwells	CLWL
Chemical Feed (general)	CF
Chemical Feed - Potassium Permanganate	CFPP
Chemical Feed - Ferric Sulphate	CFFS
Chemical Feed - Lime	CFLM
Chemical Feed - Carbon Dioxide	CFCD
Chemical Feed - Chlorine	CFCL
Chemical Feed - Chlorine Scrubber	CFCS
Chemical Feed - Sodium Silicofluoride	CFFL
Chemical Feed - Ammonium Hydroxide	CFAH
High Lift	WTHL
Sludge Handling	WTSH
Avenue H Reservoir	AVEH
Acadia Drive Reservoir	ACDR
42nd St Reservoir	42ND
Electrical Power	PWR
HVAC	HVAC
Plant Air	AIR
Distribution	DIST
Mini-Lab	MLAB

Equipment Designations and Numbers

Equipment designations (the second part of the designation/numbering system) utilize a mixture of traditional WTP formats and updated designations. For example, where existing WTP documentation referenced valves and water gates using RW (Raw Water), WW (Wash Water), DW (Domestic Water), etc, these designations have been retained. In cases where valves and other equipment used no common designation, a new designation has been assigned. The following table provides the equipment designations used in this manual:

Equipment	Designation
Bin Activator	A
Air Blower	AB
Air Dryer	AD
Boiler	B
Compressor	C
Chlorinator	CL
Domestic Water (also referred to as Finished Water or Potable water)	DW (usually refers to a valve)
Feeder	F
Feed Point Valve	FP

Equipment	Designation
Generator	G
Heat Exchanger	HE
Influent Water	IW
Level Measurement	L
Metering Pump	MP
Pump	P
Queen Elizabeth	QE (used to designate some valves related to the QE raw water line)
Raw Water	RW (usually refers to a valve)
Shakers (Lime bin)	S
Screen	SC
Siphon	SI
Sand Pump	SP
Tank	T
Transfer Switch	TS
Treated Water	TW (usually refers to a valve)
Valve	V
Well water or Wash Water	WW (usually refers to a valve)

Historical Timeline

Although the equipment designation system adds consistency and simplicity to equipment naming and numbering, some knowledge of the history of the WTP is also helpful in understanding the descriptions and information contained in this manual.

The following list provides an overview of significant events, key additions and upgrades that have occurred in the history of the WTP:

- 1911: Saskatoon's first water treatment plant is built
- 1926: Sedimentation Basin constructed
- 1928: Six filters added
- 1943: New river intake constructed
- 1948: 1948 Filter Plant, a chlorinator, clearwell and two sedimentation basins added
- 1950: Avenue H Reservoir constructed
- 1957: 1957 Filter Plant added
- 1960: 42nd Street Reservoir constructed
- 1961: Clarifier #1 built
- 1962: Clarifier #2 built
- 1964: Central Ave (Acadia) Reservoir and Pumphouse built
- 1964: 1964 Filter Plant added

- 1977: QE Low Lift added
- 1979: Automated Control Room
- 1984: Clarifier #3 added
- 1987: Chemical Feed Building and Lime Silos built
- 1988: Sand Separators added
- 1992: High Lift Pump #10 added
- 1998: Two standby generators added
- 2001: Chlorine scrubber added
- 2003: Clarifier #4 added
- 2005: Second floor Control Room built
- 2007: Sludge Handling Facility built

1.3 Related Documentation

The City of Saskatoon maintains a comprehensive library of related documentation as part of its drinking water quality management system. This documentation provides additional information related to the Water Treatment Plant that may be useful in understanding the overall functioning of the WTP.

Document Name / Description	Location
Standard Operating Procedures (detailed listing in next section)	Operations board room/library
Saskatchewan Environment Drinking Water Information Binder	SaskH2O.ca website
Organizational Structure – Position Descriptions and Responsibilities	Branch Manager
Utility Services Emergency On-Call Protocol – Water Treatment Plant Section	Control Room
Compromised Water Quality Communication Plan	Branch Manager and Operations Manager offices
Utility Services Department Five-Year Business Plan	Drafting library
City of Saskatoon, Water Treatment Plant Assessments and Upgrading Options	Drafting library
City of Saskatoon, Water Treatment Plant and Distribution System – Water System Assessment	Drafting library
Water Treatment Plant Status Report	Operations Manager and Maintenance Engineer offices
Water Treatment Plant – Yearly Work Plan	Operations Manager and Maintenance Engineer offices
Water Treatment Plant Operator Certification Initiative	Training Coordinator office
Environmental Management System	Environmental Programs Manager office
Permit to Operate (issued by Saskatchewan Environment)	Posted in the Lab and Control Room
The Water Regulations 2002 (Saskatchewan Environment)	SaskH2O website or Queen's Printer website
Environment Management and Protection Act (EMPA 2002)	Government of Canada website
Guideline documents	Sask Environment, Health Canada
Miscellaneous other regulatory documentation and information resources	SaskH2O website
Miscellaneous instrumentation manuals	Operations Library
Miscellaneous control systems reference manuals	Operations Library
Miscellaneous plant equipment maintenance and operation manuals (detailed list follows)	Operations Library
Plant engineering drawings	Drafting Library
Process and Instrumentation Diagrams (P&ID)	Drafting Library
Water Treatment Plant Operation Course Volumes 1 and 2 (California State University)	Training room/library
ATAP Operator Certification Exam Preparation Course Levels 1, 2, 3 and 4	Training room/library
Fifth Class Power Engineering Course Manuals 1, 2 and 3 (SAIT)	Training room/library
SAIT Instrumentation Course Manuals 1, 2 and 3 (SAIT)	Training room/library
Water and Wastewater Operations, Level 1 Volumes A and B, and Level 2 (Western Canada Water and Wastewater Association (WCWWA))	Training room/library
Water Supply Operations Series, American Water Works Association video training library	Training room/library
Miscellaneous other training support documents and resources	Training room/library

Document Name / Description	Location
Maintenance Management Work Order System	Maintenance Engineer's office
Laboratory accreditation documentation	WTP Chemical Laboratory

1.4 Overview of WTP Operations

The WTP is operated with the goal of providing safe, potable water of adequate supply and pressure to the City of Saskatoon and other customers. Operation of the WTP requires an understanding of these requirements in detail, as well as a thorough understanding of the dynamic process involved in meeting them. Plant operators must anticipate daily, weekly and seasonal demand changes and take timely action to meet them.

1.4.1 WTP Processes

The City of Saskatoon Water Treatment Plant (WTP) obtains raw water from the South Saskatchewan River, processes it and delivers finished water to the water distribution system.

Water Treatment Processes

WTP processes include:

- Pumping raw water from the South Saskatchewan River
- Screening out large solids
- Oxidation of organics
- Coagulation and hardness reduction
- Chlorination
- Fluoridation
- pH adjustment
- Filtration
- Chloramination
- Storage
- Supplying finished water to the distribution system

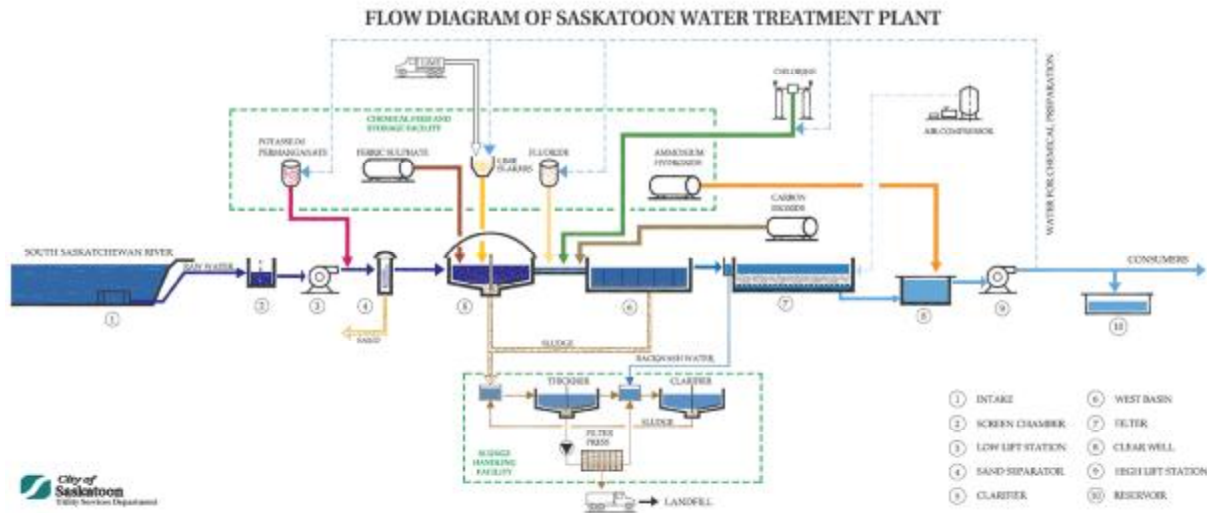


Figure 1-1 Simplified Flow Diagram of the WTP Process Areas

WTP Process Areas

The processes previously listed are accomplished in stages, in several designated areas as follows:

- The Queen Elizabeth (QE) Power Station Low Lift, usually referred to as the QE Low Lift provides raw water pumping and enables warm power plant effluent water to be mixed with river water.
- Water Treatment Plant Low Lift, usually referred to as the WTP Low Lift, also provides raw water pumping and is typically used when QE pumping is not possible or cannot supply demand.
- The Screens remove large objects from the raw water.
- The Sand Separators remove sand from the raw water.
- The Clarifiers facilitate coagulation and settling of solids.
- The Chlorine Contact Basin provides an area where chlorine can oxidize organic materials.
- The Filters remove suspended particulate matter, including parasitic cysts and bacterial cells.
- The Clearwells provide short term storage of finished water.
- The Chemical Feed System provides storage and control for the addition of a variety of chemicals used in other areas of the process.
- The High Lift area provides pumping of finished water to maintain water flow and pressure regardless of demand.
- The Sludge Handling Facility removes solids from clarifier and filter effluent flows to enable environmentally friendly disposal of these materials.

- The Avenue H Reservoir provides short term storage of finished water to facilitate the variability of water demand.
- The Acadia Drive Reservoir provides short term storage of finished water to the eastern side of the city and ensures water pressure in that area can be reliably maintained.
- The 42nd Street Reservoir provides short term storage of finished water to the northern part of the city.

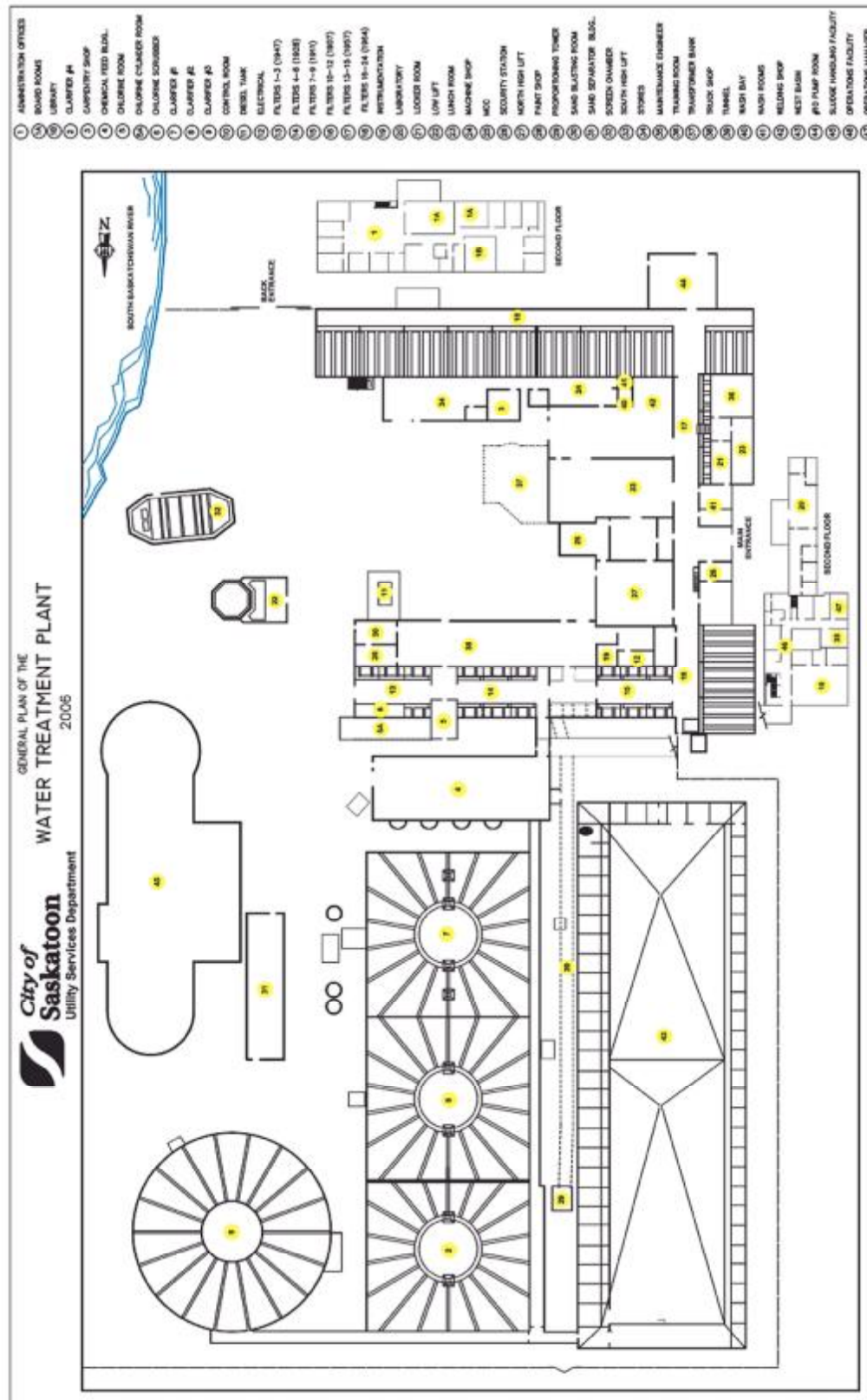


Figure 1-2 WTP Physical Layout