WATER TREATMENT PLANT EVALUATION

NOVEMBER 2017

Manchester By The Sea, Massachusetts

TATA & HOWARD

TATA & HOWARD

March 27, 2018

Ms. Carol Murray, Acting Director of Public Works
Town of Manchester by the Sea
10 Central Street
Manchester by the Sea, MA 01944

Subject: Water Treatment Plant Evaluation
Manchester by the Sea, Massachusetts
T&H No. 5215

Dear Ms. Murray:

Tata & Howard, Inc. is pleased to present this Water Treatment Plant Evaluation report for the Town of Manchester by the Sea. This project included review of available documents, data, site visits, and inventory of assets and infrastructure related to the Gravelly Pond Water Treatment Plant and Lincoln Street Well.

This report includes asset inventory, condition of assets, prioritization of recommendations, and cost estimates of recommendations. This information has been uploaded to an asset management software system: Check Up Program for Small Systems (CUPSS) which was created by the United States Environmental Protection Agency (EPA). The Town can utilize the software to monitor assets and develop a long-term maintenance and asset replacement plan. It is important that this software be updated every time there is a change in the water treatment system so that maintenance and replacement projects remain as accurate as possible.

At this time, we wish to express our appreciation to the Town of Manchester by the Sea for their participation in this study and for their help in collecting information and data. We appreciate the opportunity to assist the Town on this important project. Should you have any questions or require additional information, please do not hesitate to contact our office.

Sincerely,

TATA & HOWARD, INC.

Paul E. Cote, P.E.
Associate

Enclosure

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TABLE OF CONTENTS

Letter of Transmittal

Section - Description **Page**

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF APPENDICES

SECTION 1 – INTRODUCTION

1.1 General

Tata & Howard, Inc. was retained by the Town of Manchester by the Sea (Town) to conduct an evaluation on the Gravelly Pond Water Treatment Facility (WTP) and Lincoln Street Well (LSW). The evaluation included asset inventory, condition of assets, prioritization of recommendations, and cost estimates of recommendations. The treatment facilities are currently operated by Woodard & Curran who is under contract with the Town.

Tasks in the evaluation included the following:

- Obtained and reviewed pertinent available information regarding the existing WTP and the LSW, including water quality data, historical flow records, energy and chemical purchases, equipment replacements and upgrades over the past three years and service visits to repair, maintain or calibrate equipment and controls, contract plans and specifications, record drawings, operation and maintenance manuals, emergency response plan and other pertinent available information.

- Conducted a site visit at the facilities and interviewed operations staff to develop an inventory list of all assets and provide a general assessment of the condition of each asset.

- Developed an asset inventory for water treatment facilities and supply-well infrastructure using Excel spreadsheets. Inventory included a list of equipment, building materials, age, useful life estimates, condition, and estimated replacement year. The Excel spreadsheets were uploaded to the EPA's CUPSS program. The Town can use the program to manage asset inventory, develop budgetary plans, and develop maintenance and replacement schedules.

- Evaluated water treatment facilities and supply-well infrastructure to determine operational capabilities, age, condition, criticality, useful life, and replacement and rehabilitation needs.

- Reviewed pertinent available permits, reports, records, drawings, documentation, and data on the WTP and LSW.

- Reviewed historical raw and finished water quality for compliance with existing and pending regulatory standards and suitability of existing treatment process design.

SECTION 2 – SYSTEM INVENTORY

2.1 General

The Town owns three water sources: Gravelly Pond, LSW, and Round Pond Well No. 1. Round Pond and Gravelly Pond are located along Chebacco Road, north of Manchester by the Sea, in the Town of Hamilton. Water from Round Pond is pumped to Gravelly Pond as needed. Round Pond Well No. 1 is being evaluated under a separate study and will be excluded from this report. The LSW is located along Lincoln Street in the Town of Manchester by the Sea, between Manchester Memorial Elementary School and Manchester-Essex Regional Middle High School. Please refer to Figure No. 1 located in Appendix A for a system wide infrastructure map.

Gravelly Pond has been used as the Town's primary water supply source since the early 1900s, providing approximately 60% of the drinking water with an estimated storage capacity of 320 million gallons. It is approximately 49 acres in size and has a maximum depth of around 57 feet. According to the Town's Annual Statistical Reports (ASR) the safe yield of Gravelly Pond is 0.12 million gallons per day (mgd). The safe yield is currently being evaluated under a separate study.

The WTP was constructed and put online in May 1997. The maximum aggregate capacity of the finished water pumps is 3,000 gallons per minute (gpm) or 4.32 mgd. A Supervisory Control and Data Acquisition (SCADA) system is located at this facility and is used to operate and monitor components of the water treatment and distribution system. Refer to Figure No. 2 in Appendix A for a locus map of the WTP and raw water pump station.

2.2 Gravelly Pond Raw Water Pump Station

The water from Gravelly Pond is pumped to the WTP by the Gravelly Pond Raw Water Pump Station (GPRWPS). Water enters the raw water pump station through two intake pipes which extend into the pond. The intake pipes have T-shaped wire wound stainless steel intake screens to prevent large debris from entering the plant. The intake pipes are located at two different elevations to allow for flexibility in raw water quality. The four, vertical turbine raw water pumps each have an anti-vortex basket strainer, electric pump motor, silent check valve, motor operated flow control valve, manual butterfly valve, pressure gauge assembly, and air release valve. The pump station was constructed with two separate wet-wells that each have a level transmitter and can be connected by opening a butterfly valve. Raw water leaves the pump station through a 16-inch ductile iron pipe and enters a flow vault containing a flow tube and flow indicating transmitter. A sample water pump located in the raw water pump station is used to collect raw water quality data. The sampled water is pumped to the laboratory located in the WTP. The raw water flow vault contains injection points for sodium hypochlorite, sodium hydroxide, and potassium permanganate. None of these chemicals are currently injected at this location due to plugged feed lines. Additional assets associated with the raw water pump station include:

- 3-inch air release valve with pressure gauge assembly,
- Heating and ventilation equipment,
- A portable sump pump,
- Electrical components including a motor control center, dry-type transformer, lighting panel, power distribution panel, raw water pump control panel, security system control panel, fire alarm system control panel, and two level indicator transmitters – one for each wet-well.

2.3 Gravelly Pond WTP

From the raw water flow vault, the water travels uphill through a 16-inch diameter ductile iron pipe and enters the WTP. Upon entering the WTP, the raw water travels through a 16-inch diameter ductile iron flanged pipe, located along the ceiling of the north wall of the filter room, where it is injected with potassium permanganate prior to traveling through a static inline mixer. The raw water is then injected with aluminum sulfate and polymer at the static mixer before traveling to the east wall of the filter room where it then is split into three separate 8-inch lines that feed the contact flocculator/filter (CFF) units. Raw water flows through a butterfly valve, motor operated flow control valve, and flow element prior to the CFF unit. Upon leaving each CFF unit, the combined filter effluent travels through a motor operated flow control valve to a common pipe leading to two clearwells. This common pipe contains a flow element, air release valve, and chemical injection points for sodium hypochlorite and hydrofluorosilicic acid. Two butterfly valves provide separation between the two clearwells. The four high service pumps pump the combined filter effluent from the clearwells through a 16-inch diameter ductile iron pipe, with chemical injection points for sodium hydroxide and zinc orthophosphate, to the finished water flow vault. Each high service pump discharge pipe contains a silent check valve, electric motor, motor operated flow control valve, manual butterfly valve, pressure gauge assembly, and an air and vacuum valve. The finished water flow meter measures the flow of treated water to the distribution system.

Two motorized blower units provide air scour to each CFF unit for the backwash cycle. Air travels to both the clarifier and filter portion of each CFF unit through a 4-inch stainless steel pipe and motor operated automatic control valve. Air flow is measured upon leaving the motorized blower units in a common pipe with a flow element.

Two backwash pumps are used to backflush the CFF units, which discharge through three motor operated decant valves to the three solids settling lagoons. A motor operated filter water control valve is located outside each CFF unit and controls discharge to the lagoons. The backwash pumps each include a pressure gauge assembly, silent check valve, manually operated butterfly valve, and motor operated backwash control valve. A motor operated backwash flow control valve, and an air and vacuum valve are located on a common 12-inch ductile iron pipe that leads to the CFF units.

Filter backwash water, backflush waste, backwash waste, and filter to waste discharge are all sent to the three solids settling lagoons through a flow element, and motor operated flow control valve. The three lagoons contain a series of gate valves that control the

decant, waste, and drain piping. Recycled water is pumped back to the head of the WTP through a flow element and motor operated flow control valve prior to the static inline mixer by the recycle pump station. The recycle pump station includes two pumps. Alternatively, the lagoons may discharge to Gravelly Pond through a flow element as needed. Each lagoon is equipped with a network of underdrains that can be flushed if underdrains became clogged.

The chemical storage area of the WTP contains bulk storage tanks, day tanks, containment areas, and chemical feed pumps for each chemical. Chemicals include sodium hydroxide, sodium hypochlorite, hydrofluorosilicic acid, zinc orthophosphate, polymer, aluminum sulfate, and potassium permanganate. Each chemical injection system has either a spare or redundant pump that can feed chemicals in the event of a failure in the primary pump. Each chemical has a unique piping network, including valves. The piping and equipment associated with each chemical is as follows:

- Aluminum sulfate consists of two chemical feed pumps, one transfer pump, two bulk tanks, and one day tank.
- Hydrofluorosilicic acid consists of two chemical feed pumps, one transfer pump, one bulk tank, one day tank, and one day tank scale.
- Polymer consists of two chemical feed pumps, one liquid polymer feed pump, one transfer pump, one aging tank (with motorized mixer), and one batch tank.
- Potassium permanganate consists of two chemical feed pumps, and one bulk tank (with motorized mixer).
- Sodium hydroxide consists of three chemical feed pumps, one transfer pump, two bulk tanks, and one day tank.
- Sodium hypochlorite consists of four chemical feed pumps, one transfer pump, and two bulk tanks. The day tank for sodium hypochlorite was relocated from the original location in the chemical storage area to an area beside CFF Unit No. 230 due to chemical feed lines becoming air bound.
- Zinc orthophosphate consists of two chemical feed pumps, one transfer pump, one bulk tank (with motorized mixer), and one day tank.

Multiple sample water pumps are located throughout the filter room. SWP-201 collects water data from the vertical 16-inch raw water main located directly after the main enters the WTP. The sampled water is used to determine chemical dosage and is pumped to the laboratory. SWP-202 collects water from the 16-inch raw water main immediately following the static mixer. The sampled water is used to determine if proper treatment was achieved and is pumped to the laboratory and treated water pH analyzer. SWP-203 is located on the combined filter effluent pipe. Sampled water from this location is used to monitor treated water quality and is pumped to a turbidity analyzer. SWP-210, 220, and 230 are located on the effluent pipe of each CFF unit. Sampled water from each of these pumps flows to a turbidity analyzer. If the turbidity level is too high, a controlled shutdown of the CFF unit is initiated. A sample tap is located on the discharge piping of the high service pumps before post-treatment. Sampled water from this location flows to a chlorine analyzer. Another sample tap is located on the discharge piping of the high service pump after post-treatment. Sampled water is pumped to a turbidity analyzer, pH analyzer, and the laboratory.

Additional assets located in and around the WTP include:

- Three portable sump pumps,
- Two sanitary waste discharge pumps (with motors),
- A septic system including pump station with two pumps and one leaching bed,
- Six level elements each with a level indicator transmitter,
- Seven pressure elements each with a pressure indicator transmitter,
- 12 analysis indicating transmitters,
- Nine flow indicating transmitters,
- Three flow indicating controllers,
- Three level indicating controllers,
- Three high air pressure sensors,
- An air compressor for sprinkler system,
- A diesel fuel storage tank,
- Three emergency eyewash/shower stations,
- A 450 KW diesel generator,
- Computer based assets include: a primary computer system, back-up computer system, pipe leak monitoring system, SCADA control center, programmable logic controller (PLC), vapor sensing control box.
- HVAC assets include: motorized circulator pumps, cabinet unit heaters, unit heaters, motor operated exhaust fans, a motor operated supply fan, an oil-fired boiler, motor operated louvers, fin tube heaters, electric water heaters, and motor operated air handlers.
- Electrical assets include: main switchboard, motor control centers, electrical lines, signal lines, telephone system, current trip relays, lighting panels, power distribution panels, light fixtures and motor operated paddle fans.
- Control panels include: alum feed control panel, two automatic temperature control panels, caustic feed control panel, condenser unit control panel, day tank scale electronic read out panel, diesel fuel transfer system control panel, fan relay control panel, filterwash and clarifier flush blower control panel, filter backwash pump control panel, filter control panel, fire alarm system control panel, fuel leak monitoring system control panel, fuel overfill alarm panel, fluoride feed control panel, generator control panel, high service pump control panel, main instrument control panel, orthophosphate feed control panel, polymer chemical feed control panel, polymer make-up system control panel, potassium permanganate control panel, recycle pumps control panel, sanitary waste control panel, security system control panel, septage pump station control panel, sodium hypochlorite control panel, and airwash blower control panel.

A more detailed table depicting the raw water pump station and the WTP assets, operational capabilities, age, condition, criticality, useful life, and replacement or rehabilitation needs can be found in Appendix B.

2.4 Lincoln Street Well

The LSW was constructed in 1958 and consists of a 68-foot deep, 24-inch diameter gravel packed well. It can provide up to 40% of the Town's drinking water. It was constructed to a depth of 68 feet in a confined sand and gravel deposit, with approximately 15 feet of clay overlying the water bearing material at the well. The Massachusetts Department of Environmental Protection (MassDEP) Water Management Act approved withdrawal rate is 0.38 mgd. The LSW Chemical Feed Building was constructed in 1997. Refer to Figure No. 3 in Appendix A for a locus map of the LSW.

Raw water is pumped from the LSW with a submersible pump. The water travels through a serpentine pipe system on the LSW lot to provide adequate contact time for each of the treatment chemicals. The serpentine pipe system was constructed in 2015. The chemicals are injected in a vault located just outside of the LSW Pump Building. The four chemical injection points include sodium hydroxide, sodium hypochlorite, sodium fluoride, and a blended phosphate for corrosion control. The serpentine pipe system connects to the water main on Lincoln Street.

The chemical feed building at the LSW contains bulk storage tanks, day tanks, containment areas, and chemical feed pumps for each chemical. Chemicals include sodium hydroxide, sodium hypochlorite, sodium fluoride, and phosphate. Each chemical injection system has either a spare or redundant pump that can feed chemicals in the event of a failure in the primary pump. Each chemical has a unique piping network, including valves.

Equipment and piping associated with each chemical is as follows:

- Blended phosphate system consists of two chemical feed pumps, one transfer pump, one bulk tank (with motorized mixer), and two day tanks.
- Sodium fluoride consists of two chemical feed pumps, one transfer pump, and one bulk tank.
- Sodium hydroxide consists of two chemical feed pumps, one transfer pump, one bulk tank, and one day tank.
- Sodium hypochlorite consists of two chemical feed pumps, one transfer pump, one bulk tank, and one day tank.

Additional assets located in and around the LSW chemical feed building include:

- An emergency generator that provides back-up power to all equipment at the chemical feed building and pump building,
- A propane tank which supplies fuel to the emergency generator,
- Three emergency eyewash/shower stations,
- Solar panels that provide energy to the chemical feed building,
- Heating and Ventilation assets,
- Electrical and SCADA assets including electrical lines, signal lines, SCADA control center, PLC, lighting panel, and unit heaters.

- Control panels include a sodium fluoride and sodium hypochlorite control panel, Sodium hydroxide and phosphate control panel, security alarm control panel, and eyewash and shower relay panel.

A more detailed table depicting the raw water pump station and the LSW assets, operational capabilities, age, condition, criticality, useful life, and replacement or rehabilitation needs can be found in Appendix B. Table No. 2-1 contains operational parameters of major assets for the GWRWPS and WTP.

Table No. 2-1
Gravelly Pond RWPS and WTP
Asset Design Capacity

Plant Capacity	
Flow Rate	3.0 mgd
Raw Water Source	
Source	Gravelly Pond
Pretreatment	Sodium hydroxide
	Potassium Permanganate
	Pre-Sodium Hypochlorite
Raw Water Intakes	
Number of Intake Pipes	2 (20-Inch Diameter)
Intake Screens (T-Shaped)	2 (27-Inch Diameter)
Raw Water Pumps	
Number of Pumps	4
Type	Vertical Turbine
Flow Rate	(1) 500, (2) 750, (1) 1000 gpm
Pump Discharge Size	(3) @ 8-inch and (1) @ 10-inch
Common Discharge Pipe	16-inch
Drive Type	Constant Speed
Motor HP	(3) @ 15, (1) @ 20 HP
Motor Speed	1160 rpm
Motor Rating	460-V, 3-phase, 60 Hz
Recycle Flow	
Number of Pumps	2
Type	Submersible
Flow Rate	140 gpm
Drive Type	Constant Speed
Motor HP	7.5 HP
Motor Speed	1760 rpm
Motor Rating	460-V, 3-phase, 60 Hz

Table No. 2-1 (continued)
Gravelly Pond RWPS and WTP
Asset Design Capacity

Rapid Mixing	
Type	Static Mixer
Number	1
Primary Chemical Treatment	Aluminum Sulfate
Primary Chemical Treatment (continued)	Sodium Hypochlorite
	Sodium hydroxide
	Polymer - EC-461 or Praestol K2004
Coagulation, Flocculation, Clarification & Filtration	
Type of Package Treatment System	Microfloc "Trident" System
Model	TR-420LP
Number of Units	3
Maximum Hydraulic Capacity per Unit	1 mgd
Treatment Processes	Coagulation, Flocculation & Clarification - Upflow Adsorption
Clarifier Size	70 sq-ft
Overflow Rate	10 gpm/sq-ft
Filtration	Mixed Media - Rapid Filtration
Size	140 sq-ft
Surface Loading @ 1.0 mgd	5 gpm/sq-ft
Media	Garnett, Sand and Anthracite Coal
Media Depth	30 in. (18 in. Anthracite Coal, 9 in. Silica, 3 in. high density garnet sand
Media Effective Size	0.55 x 0.65 millimeters
Filter Backwash Pumps	
Number of Pumps	2
Type	Vertical Turbine
Number of Stages	1-each
Flow Rate	3000 gpm
Discharge Pipe	12-inch
Drive Type	Constant Speed
Motor HP	60 HP
Motor Speed	1175 rpm
Motor Rating	460-V, 3-phase, 60 Hz

Table No. 2-1 (continued)
Gravelly Pond RWPS and WTP
Asset Design Capacity

Clearwell (continued)	
Number of Basins	2
Average Dimensions	3462 sq-ft each
Maximum Water Depth	10 ft
Total Combined Volume	
5 ft depth	259,000 gal
7 ft depth	362,600 gal
8 ft depth	414,400 gal
10 ft depth	518,000 gal
Detention Time at 3 mgd Plant Flow	
5 ft depth	123 min.
7 ft depth	172 min.
8 ft depth	197 min.
10 ft depth	246 min.
Chemicals	
Influent	Sodium Hypochlorite, Hydrofluorosilicic Acid, Sodium Hydroxide
Effluent	Sodium Hydroxide, Orthophosphate
Finished Water Pumps	
Number of Pumps	4
Type	Vertical Turbine
Flow Rate	(1) 500, (2) 750, (1) 1000 gpm
Pump Discharge Size	(1) @ 8-inch, (2) @ 10-inch, and (1) 12-inch
Common Discharge Pipe	16-inch
Drive Type	Constant Speed
Motor HP	(1) @ 50, (2) @ 75, (1) @ 100 HP
Motor Speed	1770 rpm
Motor Rating	460-V, 3-phase, 60 Hz

SECTION 3 – CONDITION OF INFRASTRUCTURE

3.1 General

As a part of this evaluation, Tata & Howard, Inc. toured the GPRWPS, WTP, and LSW and had discussions with the WTP operations staff. The tour and discussions took place on June 2, 2017 and provided detailed information for the condition assessment of each asset. Assets for each facility were listed and reviewed on-site. Each asset was evaluated based on operational capabilities, age, condition, criticality, useful life, and replacement or rehabilitation needs. This information was recorded and entered into Microsoft Excel spreadsheets and uploaded into the CUPSS.

3.2 Gravelly Pond Raw Water Pump Station

The tour of the GPRWPS provided valuable insight into the daily use and condition of each asset. The pump station typically runs at 50% of its' design capacity and the two 75 HP pumps are used most of the time. The following was also observed during the visit:

- Raw Water Pump No. 110 (RWP-110) is offline and requires replacement.
- The venturi flow meter located in the raw water flow vault does not read correctly and requires replacement.
- The EIM actuators for RWP-120, RWP-130, and RWP-140 have surpassed the useful expected life and require replacement. The EIM actuator for RWP-110 has recently been replaced with a new AUMA actuator.
- The underground chemical feed lines to the GPRWPS flow vault are reported to be plugged, encased in concrete, and require investigation. Fixing this issue would increase contact time for manganese treatment and eliminate the manganese contact time issue described in Section 3.3.
- The level indicating transmitters for the level element in each wet-well are reported to be nonfunctioning and require replacement.
- Sample Water Pump No. 101 (SWP-101) is not working properly and requires replacement.
- The air release valves for RWP-110, RWP-120, RWP-130, and RWP-140 are at the end of their useful life and require replacement.
- There has been no regular, documented annual maintenance on pumps. A service/overhaul program should be implemented.
- The intake screens have not been inspected since installation. A regular, documented inspection and maintenance plan should be implemented.

3.3 Gravelly Pond Water Treatment Plant

Touring the WTP provided valuable insight into the daily use and condition of the assets. It was observed that:

- The emergency eyewash and shower stations in the filter room and chemical area are "out of service". According to operations staff, the stations are "out of service" because there was a long period of time when the boiler was not working. At the time of the boiler failure, it was decided that repairs were costly, and it was decided to

install electric heaters in the chemical room, work shop, and conference room. Repairs to the boiler were made in 2010 that reduced the boiler capacity. Due to the reduced capacity, tepid water was not available at each station. Tepid water is needed at each station to properly wash eyes in the event of an emergency. Operators currently utilize portable eyewash stations as an alternative while working in the plant. This alternative has been accepted by the operator's safety personnel. The boiler has reportedly been off line for an extended period of time. The boiler will be evaluated by an outside contractor in the near future.

- Chemical feed piping associated with sodium hydroxide are labeled as potassium hydroxide and need to be changed in the immediate future.
- The chemical loading ports located next to the loading dock are highly corroded in spots and should be upgraded to include an individual chemical delivery box for each chemical (with lock).
- High Service Pump No. 330 (HSP-330) is offline and requires repair or replacement.
- Air release valves for HSP-310, HSP 330, HSP-340, Backwash Pump No. 201 (BWP-201), and BWP-202 are defective and require replacement.
- Flow element Nos. 210 (FE-210), FE-220, and FE-230 measure flow on the influent side of each CFF and cannot be calibrated and require replacement.
- The EIM actuators for Automatic Control Valve No. 212 (ACV-212), ACV-215, ACV-222, ACV-225, ACV-232, ACV-235, Backwash Control Valve No. 214 (BWCV-214), BWCV-224, BWCV-234, Backwash Flow Control Valve No. 200, Decant Valve No. 216 (DV-216), DV-226, DV-236, Flow Control Valve No. 310 (FCV-310), FCV-320, FCV-330, FCV-340, Filtered Water Control Valve No. 213 (FWCV-213), FWCV-223, and FWCV-233 have surpassed the useful expected life and require replacement. To date EIM actuators for FCV-210, FCV-211, FCV-220, FCV-221, FCV-230, FCV-231, and Recycle Flow Control Valve No. 500 have already been replaced.
- Contact time for manganese should be increased.
- Polymer Feed Pump No. 261 (PFP-261) and PFP-262 have surpassed the useful life expectancy and require replacement.
- The combined filter effluent flow meter (FE-250) cannot be calibrated and requires replacement.
- Zinc Orthophosphate Feed Pump No. 231 (OPFP-231) and OPFP-232 have surpassed the useful life expectancy and require replacement.
- The benchtop turbidimeter has surpassed the useful life expectancy and requires replacement.
- New online pH probes should be installed to improve readings.
- The SCADA system should be upgraded.
- The sprinkler system is a dry side/wet side pressurized air system. On January 2, 2018, the fire alarm went off in the plant. There was no fire, but the dry side of the sprinkler system filled with water. The Fire Department drained the system once they arrived, but due to extremely cold temperatures the water remaining in the pipes froze causing damage to the system that was beyond repair. The entire system from the control valve must be replaced, including all the mains and sprinkler heads.
- The driveway entrance to the WTP should have a new gate which is closed and locked routinely to increase security.

- Coating systems on plant piping is flaking off and the pipes and fasteners are beginning to show signs of corrosion. The pipes need to be cleaned, coated, and re-labeled. The coating systems in the chemical containment areas and floors throughout the plant need to be cleaned and re-applied.
- There has been no regularly documented annual maintenance on pumps and there should be a service/overhaul program that is implemented.
- The septic system is due for an inspection and should be evaluated.
- There is currently no cable service at the WTP. High speed internet would improve control remotely.
- The fire alarm system, security alarm system, and lighting systems are not working properly and should be upgraded or replaced.
- The Town should review the current software for CMMS.
- The coating system is nearly completely worn off the floor of the filter room and chemical room and should be re-coated.

3.4 Lincoln Street Well

Tata & Howard, Inc. toured the LSW Chemical Feed Building and Pump Building following the GPRWPS and WTP. The tour provided valuable insight into the daily use and condition of each asset. Based on this tour, it was observed that:

- All controls are manual and should be upgraded to full automated SCADA control.
- Zinc orthophosphate needs containment structure for barrel bins.

SECTION 4 – WATER QUALITY

4.1 Raw Water Quality

In New England, surface waters tend to be soft with a near neutral pH due to the type of soils and bedrock. Groundwater sources tend to have slightly higher hardness levels compared to surface water, but not compared to the rest of the nation. Additional, naturally occurring, constituents that can be present in New England water sources, especially groundwater sources, are radon, iron, and manganese. These constituents are usually treated as needed and are not common to all water sources.

4.1.1 Gravelly Pond & Lincoln Street Well

Raw water data was requested from the Town WTP operations staff who gathered data from both Gravelly Pond and the LSW. All values in the table below are based on in-house testing. See testing results below in Table No. 4-1.

Table No. 4-1
Raw Water Data

Sources	Gravelly Pond	Lincoln Street Well
Color (PCU)	9.0	N/A
Fe (mg/L)	0.08	0.02
Mn (mg/L)	0.12	0.45
Odor (TON)	1	2
Turbidity (NTU)	0.25 - 1.30	N/A
pH	7.4	6.2

4.2 Water Treatment Chemicals

4.2.1 Gravelly Pond Water Treatment Plant

Raw water that is pumped from Gravelly Pond is treated with the chemicals listed in Table No. 4-2, along with each of the chemicals' treatment objective.

Table No. 4-2
Gravelly Pond WTP Treatment Chemicals

Chemicals	Chemical Objective
Sodium Hypochlorite	Pre – Oxidation of Iron Pre - chlorination

Table No. 4-2 (continued)
Gravelly Pond WTP Treatment Chemicals

Chemicals	Chemical Objective
Aluminum Sulfate	Particulate Removal Coagulation
Polymer	Coagulant Aid
Potassium Permanganate	Pre – oxidation of Iron and Manganese
Sodium Hypochlorite	Disinfection
Sodium Hydroxide	Corrosion Control Post - pH Adjustment
Zinc Orthophosphate	Corrosion Control
Hydrofluorosilicic Acid	Fluoridation

4.2.2 Lincoln Street Well

Raw water from the gravel packed well is treated on-site with the chemicals listed in Table No. 4-3, along with each of the chemicals' treatment objective.

Table No. 4-3
Lincoln Street Well Treatment Chemicals

Chemicals	Chemical Objective
Sodium Hydroxide	Corrosion Control pH Adjustment
Shannon Chemical Corporation's SLI-7425 (70%/30% Non-Sodium, Non-Zinc Poly-Orthophosphate Blend)	Corrosion Control
Sodium Hypochlorite	Disinfection
Sodium Fluoride	Fluoridation

4.3 Finished Water Quality

4.3.1 Gravelly Pond WTP & Lincoln Street Well

Finished water data was requested from the WTP operations staff who gathered data from both Gravelly Pond and the Lincoln Street Well. Some values in the table were taken from certified lab reports, other were taken from in-house sample records. Manganese levels have been known to vary with the seasons. See testing results below in Table No. 4-4.

Table No. 4-4
Gravelly Pond WTP Finished Water Data

Sources	Gravelly Pond	Lincoln Street Well
pH	7.3 - 7.5	7.2 - 7.5
pH Adjustment Chemical Dose (mg/L)	15 - 25	60 - 120
Total Hardness (mg/L Ca)	46.9	122.0
Turbidity (NTU)	0.06	0.24
Chlorine Product Dose (mg/L)	1.7 - 3.5	2.0 - 4.5
Corrosion Inhibitor Chemical Dose (mg/L)	3.0	0.9 - 1.3
Chloride (mg/L)	61.3	196.0
Mn (mg/L)	0.01 - 0.08	0.098
Fe (mg/L)	ND	ND
Sulfates (mg/L)	18.1	20.9
TDS (mg/L)	157.0	447.0
Total Alkalinity (mg/L HCO_3)	30.1	73.5

4.4 Potential Regulatory Implications

4.4.1 General

State and federal regulations have been adopted and subsequently amended to protect public health and to provide consistent and safe water quality from drinking water sources.

The EPA implemented the Safe Drinking Water Act (SDWA) in 1974 to regulate contaminants in public drinking water systems. The law was revised in 1986 and 1996 to include additional contaminants to be regulated, as well as mandating rules for source water protection, operator training, and capital improvements funding.

The Surface Water Treatment Rule (SWTR) was promulgated by the EPA in 1989 to protect public drinking water from waterborne microbiological pollutants such as Giardia and viruses. The rule requires that water systems filter and disinfect water from surface water sources to reduce the occurrence of microbiological contamination.

Amendments to the SDWA in 1996 require EPA to develop rules to balance the risks between microbial pathogens and Disinfection By-products (DBPs). The Stage 1 Disinfectants and Disinfection Byproduct Rule (DBPR) and Interim Enhanced Surface Water Treatment Rule (IESWTR), promulgated in December 1998, were the first phase in a rulemaking strategy required by Congress as part of the 1996 Amendments to the SDWA.

The Stage 2 DBPR and the Long Term 2 Enhanced SWTR are the second phase of rules required by Congress. These rules strengthen protection against microbial contaminants, especially *Cryptosporidium*, and at the same time, reduce potential health risks of DBPs.

An additional amendment to the SDWA of 1996 included a process to identify contaminants that could pose a threat to public health and would therefore require regulation. The Unregulated Contaminant Monitoring Rule (UCMR) collects data for contaminants that are suspected to be present in drinking water and do not have health-based standards set under the SDWA.

4.4.2 Surface Water Treatment Rule

Under the provisions of the SWTR, all public water systems using surface water supplies or groundwater supplies under the direct influence of surface water must provide disinfection. In addition, unless the water meets strict water quality criteria, filtration is required to physically remove waterborne microorganisms that are resistant to conventional disinfection practices (chlorination) and may be present in the water.

Approved filtration technologies include conventional filtration, direct filtration, diatomaceous earth filtration, slow sand filtration, and membrane filtration. Combined filtration and disinfection must achieve 99.9 percent (3-log) removal/inactivation of

Giardia and 99.99 percent (4-log) removal/inactivation of viruses. Removal credits are achieved for several water treatment processes such as sedimentation (2.5-log), dissolved air flotation (2.5-log), and direct filtration (2-log). Under the rule, 95percent of monthly filtered water turbidity samples must be less than 0.5 NTU, and the maximum allowable filtered water turbidity is 5 NTU. Inactivation credits are achieved based on the type, concentration, and dose of disinfectant, water temperature and pH, and the contact time between the disinfectant and the water prior to the first consumer tap.

The rule also required that surface water systems maintain a disinfectant residual in the water system. Unfiltered surface water systems were also required to meet certain "Avoidance Criteria" to maintain an unfiltered surface supply. In order to maintain a filtration waiver, suppliers are required to monitor for total coliform, *Giardia lamblia*, virus, and turbidity levels. In addition, the rule required watershed control monitoring to limit the contamination potential of *Giardia lamblia* cysts and viruses.

4.4.3 Ground Water Rule

As of December 2009, and under the provisions of the Ground Water Rule (GWR), all public water systems (PWS) using ground water supplies must provide disinfection, unless the ground water is under direct influence of surface water and sources are combined prior to treatment. Treated water must achieve 99.99 percent (4-log) removal/inactivation of viruses. Those that do not, must conduct "triggered monitoring" for a fecal indicator each time that a Total Coliform Rule (TCR) sample comes back positive for total coliform. Along with the sampling, a Tier 1 public notification must be distributed with an additional five water samples collected within 24 hours. Should any sample test positive the public water system may be required to provide immediate treatment or provide water from an alternative source. Any PWS that achieved 4-log removal qualifies for "compliance monitoring." Compliance monitoring includes continuous or daily monitoring of chlorine residual. Each PWS using chemical disinfectant to achieve 4-log removal shall provide sufficient contact time and complete a "Log Credit Determination Form" to determine the viral log treatment.

As required by the GWR, a PWS with less than 3,300 customers must use E. Coli as the fecal indicator. A PWS with greater than 3,300 customers must use E. Coli if E. Coli is detected in the TCR sample and if the PWS cannot identify E. Coli in the TCR sample, then enterococci can be used as a fecal indicator. The Town serves approximately 5,664 customers.

In the event that emergency treatment is needed, each groundwater source should be equipped with a raw water sample tap and chemical injection port at each well head and develop an Immediate and Long-Term Fecal Contamination Response Plan.

4.4.4 Disinfection By-Products Rule

Chemical reactions between natural organic matter (NOM) and the disinfectant chlorine can produce regulated organo-chlorine compounds called DBPs. A group of four DBPs

(chloroform, bromoform, bromodichloromethane, and dibromochloromethane, referred to as total trihalomethanes (TTHMs), are regulated under the SDWA. The MCL for TTHMs under the SDWA of 1986 was 100 µg/L, based on a running annual average (RAA) of quarterly distribution system TTHM sampling results. This MCL for TTHMs applies only to community water systems serving a population of 10,000 or more and use a disinfectant in any part of the drinking water treatment process.

The Stage 1 Disinfectants/DBP (S1D/DBPR) was promulgated by the EPA in December 1998 (Federal Register December 16, 1998), and applies to all water systems that utilize a disinfectant. Under the S1 D/DBPR the TTHM MCL was lowered to 80 µg/L, and MCLs were established for a group of five haloacetic acids (HAA5: mono-chloroacetic acid, di-chloroacetic acid, tri-chloroacetic acid, mono-acetic acid, and di-acetic acid) 60 µg/L, bromate 100 µg/L, and chlorite 1 mg/L. Compliance is determined based on a RAA of distribution system samples taken quarterly, where the number of samples taken depends on system size (Large surface water systems - 4 samples per quarter per WTP); Groundwater systems serving more than 10,000 and surface water systems serving between 500 and 9,999 - one sample per quarter per WTP; Groundwater systems serving less than 10,000 and surface water systems serving fewer than 500 - one sample per year per WTP).

Maximum residual disinfectant levels (MRDLs) for chlorine, chloramines, and chlorine dioxide are also established at 4.0 mg/L as free chlorine, 4.0 mg/L as total chlorine, and 0.8 mg/L as ClO2, respectively. In addition, the rule establishes DBP precursor removal requirements based on source and treated water quality characteristics unless strict water quality criteria are met (see Table No. 4-5 below). Large surface water systems (serving > 10,000) must have been in compliance with the new requirements by January 2002.

Table No. 4-5
TOC Removal Requirements

Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as $CaCO_3$)		
	0-60	>60-120	>120
>2.0-4.0	35%	25%	15%
>4.0-8.0	45%	35%	25%
>8.0	50%	40%	30%

The Stage 2 Disinfectants/Disinfection-by-Product Rule (S2 D/DBPR) was promulgated by EPA in August 2003 (Federal Register, August 18, 2003). The Stage 2 D/DBPR applies to all water systems using a disinfectant and establishes more stringent TTHM and HAA5 standards. All systems are required to achieve DBP goals less than the locational running annual averages (LRAAs) of 80 µg/L for TTHMs and 60 µg/L for HAA5s. The LRAA methodology is more stringent as initial regulations allowed averaging high results from one area of the water system with lower results to achieve

compliance. The new compliance rules are based on individual locations making compliance more difficult. The Town sampled for HAA5 in two locations with results of 27 and 36 ppb which is less than the 80 ppb MCL. The Town sampled for TTHM in two locations with results of 12 and 14 ppb which is less than the 60 ppb MCL. Based on fourth quarter sampling results, the Town remains in compliance with the DBP goals

4.4.5 Interim Enhanced Surface Water Treatment Rule

The IESWTR was enacted by the EPA in 1998; this added the criteria for 2-log removal of *cryptosporidium* through the implementation of watershed control measures with monitoring and enforcement. The rule also required that systems conduct disinfection profiling by monitoring daily for 12 consecutive months for *Giardia lamblia* and viruses, to determine if the current disinfection methods used at the source met *Giardia lamblia* and virus inactivation requirements. If changes to a disinfection point of injection or the type of disinfection chemical used for a surface water supply was proposed by a utility, the IESWTR requires that a disinfection benchmark be calculated to evaluate the effectiveness of any treatment changes.

A major update to the SWTR, the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) was enacted by the EPA in 2006. The LT2ESWTR was proposed to reduce disease incidence associated with Cryptosporidium and other pathogenic microorganisms in drinking water and to supplement existing regulations by targeting additional Cryptosporidium treatment requirements to higher risk systems. This proposed regulation also contains provisions to mitigate risks from uncovered finished water storage facilities and to ensure that systems maintain microbial protection as steps are taken to reduce the formation of DBPs. The LT2ESWTR applies to all systems that use surface water or ground water under the direct influence of surface water. The LT2ESWTR will be implemented concurrently with Stage 2 D/DBP Rule in order that systems not jeopardize DBP levels as a result of meeting the requirements of LT2ESWTR.
The regulation requires that surface water supplies achieve 2-log inactivation of *cryptosporidium*. In addition, it requires that unfiltered surface supply sources are treated with two disinfection methods and each separately achieves a 2-log *cryptosporidium,* 3-log *Giardia lamblia* and 4-log virus inactivation.

Under the LT2ESWTR, systems currently regulated under the SWTR will be assigned into bins based on source water Cryptosporidium monitoring.

4.4.6 Total Coliform Rule

The TCR addresses the protection against waterborne bacteria in drinking water distribution systems. Compliance with the TCR is based on distribution system sampling results and the detection of total Coliform. Coliform are a collective group of microorganisms that typically originate from the intestines of warm-blooded animals, but which may also occur naturally in the environment. Therefore, a subset of the total Coliform group (E. coli or fecal Coliform) is used to identify fecal contamination.

Water systems must collect a minimum number of distribution system samples per month based on the population served. Compliance with the TCR is based on the presence or absence of total Coliform. For water systems collecting less than 40 distribution system samples per month, no more than one sample per month can be positive for total Coliform. For water systems collecting more than 40 distribution system samples per month, compliance with the TCR is achieved if no more than 5 percent of the samples are positive. Any positive Coliform sample must be re-sampled within 24-hours and two additional samples taken (upstream and downstream of the site). A system is out of compliance if the results of repeat sampling are positive for fecal Coliform or *E. coli*, in which case the water system must contact the DWP within 24-hours and perform public notification. As approved by the MassDEP, the Town is required to collect 12 samples each month, including raw water, entry points, tanks, and distribution system samples. Best available treatment techniques for compliance with the TCR include source water protection, filtration, primary disinfection, and secondary disinfection.

The EPA has promulgated revisions to the TCR in February of 2013. The Revised Total Coliform Rule (RTCR) eliminated the MCL and public notification for Total Coliform occurrences. Under the revised rule, sampling will remain the same, but TC positive samples will require the public water supply to make an assessment of the microbial contamination, take corrective action and report to DWP. E. Coli will continue to have an MCL of 0 and confirmation sample will require Tier 1 notification of DWP and the public. Public notice will be eliminated for TC positive samples unless assessment and corrective actions are not completed. The revised TCR required that each public water system provide and implement a sampling plan by April 1, 2016. The Town received sampling plan approval from the MassDEP in July of 2015.

4.4.7 Lead and Copper Rule

The LCR was promulgated by EPA on June 6, 1991 based on the requirements of the 1986 Amendments to the SDWA. The objective of the LCR is to reduce consumer exposure to lead and copper resulting from corrosion of drinking water piping and plumbing systems. Unlike other drinking water regulations that establish maximum contaminant levels (MCLs), the LCR requires various treatment techniques including: optimal corrosion control treatment; source water treatment; public education; and lead service line replacement, which are triggered by lead and copper action levels (AL's) measured at the consumer's tap. EPA has set AL's at a 90th percentile concentration of 0.015 mg/L for lead and 1.3 mg/L for copper, respectively.

Water systems must sample tap water distribution system sites for lead and copper and for corrosion control water quality parameters based on service population. Sampling sites are selected based on an inventory of distribution system materials (lead services) and residential house age (homes built just prior to the EPA lead ban, between 1982 and 1986). Systems that comply with the 90th percentile Action Levels are eligible for reduced monitoring. Systems exceeding the lead Action Level must install optimal corrosion control, replace lead service lines, and complete a lead public education program annually.

Under the 1996 amendments to the SDWA, EPA provided several revisions to the LCR (Federal Register, January 12, 2000) including changes or additions in requirements for: the demonstration of optimal corrosion control, lead service line replacement, public education, monitoring, analytical methods, reporting and record keeping, and special primacy considerations.

The Town implements corrosion control treatment using a zinc orthophosphate at Gravelly Pond and a non-zinc poly-orthophosphate blend at the LSW to prevent corrosion and sodium hydroxide to adjust the pH. As a result, the water system has recently maintained compliance with the lead and copper rule. It is anticipated that the EPA will release changes to the lead and copper rule in January 2018. The Town should pay attention to any changes and determine if they change the compliance status.

4.4.8 Unregulated Contaminant Monitoring Rule

The 1996 Amendment requires monitoring of approximately 30 contaminants every five years. Since the creation of the UCMR, there have been four rounds of samples collected under the program. Although many of the contaminants listed may never be regulated, the list should be reviewed periodically to remain in compliance with potential for future regulations. The third and fourth round of UCMR sampling included contaminants that are currently present in the Town's finished water.

In May 2012, the EPA began the third round of the UCMR monitoring program. This round of sampling and reporting included 28 chemicals and two viruses. A chemical of particular interest to the Town is the chemical compound chlorate. Chlorate is found in systems that utilize sodium hypochlorite for disinfection. MassDEP has prepared a guidance document for reducing chlorate, please see the link below for additional information. The formation of this chemical can be reduced by following the best management practices provided in this document.
https://www.mass.gov/files/documents/2018/01/23/chloratebmp.pdf

In December 2016, EPA began the fourth round of the UCMR monitoring program. This round of sampling and reporting included manganese. Manganese is very common in both groundwater and surface waters of New England. Water produced from Gravelly Pond and at the Lincoln Street Well contains manganese. Currently, manganese is a secondary contaminant which means there is no treatment requirement. However, since manganese is now on the UCMR list, there may be future regulation and potentially changes to the acceptable level of this chemical.

4.4.9 Fluoride

The Town currently utilizes two forms of fluoride in water treatment. Hydrofluorosilicic acid is added at the WTP while sodium silica fluoride is added at the LSW. The two different forms of fluoride are used because of the locations, safety, and equipment needed to store and apply each chemical. On December 30, 2017, the fluoride bulk tank

in the WTP developed a leak. The Town is considering the option of changing from hydrofluorosilicic acid to sodium silica fluoride at this location.

4.4.10 Sanitary Survey Compliance

A sanitary survey was conducted by the MassDEP in August of 2014. The survey found the Town to be in compliance with standards, guidelines, and policies for public drinking water systems. All items identified in the previous sanitary survey had been corrected. However, there were two items that were recognized by MassDEP that should be addressed. The zinc orthophosphate drums located at the LSW do not have a secondary containment structure. A secondary containment structure should be purchased and installed to avoid any potential hazards presented by a chemical leak or spill. Secondly, there is a gap in the fence surrounding the Moses Hill Tank that has been temporarily repaired with chain link fence. This fence should be repaired to match the material and security offered by the original fence.

An updated sanitary survey was conducted in September 2017, but the final report has not been issued. Results from this investigation should be studied and corrected, if need be, to remain in compliance with MassDEP regulations.

SECTION 5 – RECOMMENDED IMPROVEMENTS

5.1 General

Assets for the GPRWPS, WTP, and LSW were gathered and evaluated for condition, redundancy, capacity, and consequence of failure. Visiting each facility provided Tata & Howard, Inc. with firsthand knowledge of the operational capabilities of each asset. Based on historical information provided by the Town, interviews with operations staff, and the facility visits, Tata & Howard, Inc. could populate Microsoft Excel files associated with the previously mentioned CUPSS program. The CUPSS program was used to compile data such as condition, redundancy, capacity, consequence of failure, installation date, and expected useful life and produce a prioritized list of improvements. The prioritized list of improvements includes dates and costs, which is beneficial to the Town for budgetary planning. Table No. 5-1 contains immediate recommendations and Table No. 5-2 contains short term prioritized recommendations including costs. The table scan be used as a guide to plan improvements and required funding.

Table No. 5-3 and 5-4 contain mid-term and long term prioritized recommendations respectively. The tables are intended to be used as a tool to improve the condition and operational aspects of each facility.

Table No. 5-1
Immediate Recommendations

Area	Item Description	Recommendation	Priority	Cost
Gravelly Pond WTP	Re-install sprinkler system	After system freeze in January 2018, re-install the sprinkler system with new low air pressure alarm	Immediate	TBD
Lincoln Street Chemical Feed Building	Zinc Orthophosphate	Containment structure is needed for Zinc Orthophosphate chemical drums	Immediate	$1,000
Gravelly Pond WTP and Lincoln Street Chemical Feed Building	Chemical Feed Piping Labels	Previously labeled potassium hydroxide needs to be labeled as sodium hydroxide to reflect current chemical	Immediate	$1,000
Gravelly Pond WTP	Chemical Loading Ports	Each chemical loading port should have individual chemical delivery box with lock and tag	Immediate	$5,000 - $10,000
Between Raw Water Pump Station and WTP	Chemical Feed Lines	Replace chemical feed lines	Immediate	$5,000 - $10,000
Gravelly Pond WTP	Boiler	TBD	Immediate	TBD
			Total:	$14,000 - $37,000

Table No. 5-2
Short Term Recommendations

Area	Item Description	Recommendation	Priority	Cost
Raw Water Pump Station	Raw Water Pump No. 110 (RWP-110)	Replace pump	Short-term	$20,000
Raw Water Pump Station	Air release valves for Raw Water Pump No. 110 (RWP-110), RWP-120, RWP-130, and RWP-140	Replace	Short-term	$4,000
Filter Room	High Service Pump No. 330 (HSP-330)	Repair or Replace	Short-term	$20,000
Filter Room	Air release valves for HSP-310, HSP-330, HSP-340, Backwash Pump No. 201 (BWP-201), and BWP-202	Replace	Short-term	$5,000
Filter Room	EIM actuators for Automatic Control Valve No. 212 (ACV-212), ACV-215, ACV-222, ACV-225, ACV-232, ACV-235, Backwash Control Valve No. 214 (BWCV-214), BWCV-224, BWCV-234, BFCV-200, Decan Valve No. 216 (DV-216), DV-226, DV-236, FCV-310, Flow Control Valve No. 320 (FCV-320), FCV-330, FCV-340, Filtered Water Control Valve No. 213 (FWCV-213), FWCV-223, and FWCV-233	Replace	Short-term	$140,000 ($7,000 each)

Table No. 5-2
Short Term Recommendations

Area	Item Description	Recommendation	Priority	Cost
Gravelly Pond WTP	Entrance Gate	Install	Short-term	$4,000
Gravelly Pond WTP	Piping Paint	Clean, re-coat, re-label	Short-term	$20,000 - $40,000
Gravelly Pond WTP	Septic System	Inspect and repair as needed	Short-term	$1,000
Gravelly Pond WTP	Fire Alarm System	Upgrade or replace	Short-term	$10,000
Gravelly Pond WTP	Security Alarm System	Upgrade or replace	Short-term	$2,500
Gravelly Pond WTP	Lighting Systems	Upgrade or replace	Short-term	$35,000 ($5,000 each)
Gravelly Pond WTP	Floor Coating, piping systems coatings and containment area coatings	Clean, re-coat	Short-term	$50,000 - $150,000
			Total:	$311,500 - $381,500

Table No. 5-3
Mid-Term Recommendations

Area	Item Description	Recommendation	Priority	Cost
Raw Water Flow Vault	Flow Element No. 100 (FE-100)	Replace with magnetic flow meter	Mid-term	$7,500
Raw Water Pump Station	EIM actuators for RWP-120, RWP-130, and RWP-140	Replace	Mid-term	$21,000 ($7,000 each)
Raw Water Pump Station	Level Indicating Transmitter No. 101 (LIT-101), LIT-102 for each level element in each wetwell	Replace each level indicating transmitter	Mid-term	$3,000
Raw Water Pump Station	Sample Water Pump No. 101 (SWP-101)	Replace	Mid-term	$1,000
Filter Room	FE-210, FE-220, and FE-230	Replace with magnetic flow meters	Mid-term	$15,000
Chemical Storage Area	Polymer Feed Pump No. 261 (PFP-261) and PFP-262	Replace with LMI pump	Mid-term	$16,000
Filter Room	Flow Element No. 250 (FE-250)	Replace with magnetic flow meter	Mid-term	$7,500
Chemical Storage Area	Zinc Orthophosphate Feed Pump No. 231 (OPFP-231) and OPFP-232	Replace with LMI pump	Mid-term	$16,000
Laboratory	Benchtop turbidimeter	Replace	Mid-term	$9,000
Laboratory/Filter Room	Online pH probes	Replace	Mid-term	$9,000
Gravelly Pond WTP	Cable service	Install high speed internet/cable service	Mid-term	$9,000
			Total:	$114,000

Table No. 5-4
Long Term Recommendations

Area	Item Description	Recommendation	Priority	Cost
Lincoln Street Well	SCADA	Upgrade controls at Pump Building and Chemical Feed Building to SCADA control	Long-term	$20,000 - $50,000
Gravelly Pond WTP	SCADA	Upgrade	Long-term	$46,000
Gravelly Pond WTP Office Side	Sprinkler System	Upgrade	Long-term	$47,000
Gravelly Pond WTP	CMMS Software	Review	Long-term	N/A
			Total:	$113,000 - $143,000

Table No. 5-5
Recommendations Summary Table

Recommendation	Cost
Immediate	$14,000 - $37,000
Short-Term	$311,500 - $381,500
Mid-Term	$114,000
Long-Term	$133,000 - $163,000
Total:	$572,500 - $695,500

Conversations with the operations staff revealed that there is no annually implemented maintenance plan for any of the pumps at the treatment facility. Each of the well pumps are inspected regularly. It is strongly recommended that a routine maintenance plan be developed to inspect and test each pump. A routine maintenance plan should keep the pump working at peak condition and increase life expectancy.

Additionally, Tata & Howard, Inc. recommends that the Town consider updating as-built drawings as well as O&M manuals to reflect current conditions at each facility. Currently, the Town possesses a 1996 bid set plan for the WTP, a 1997 bid set plan for the LSW Chemical Feed Building, and a 1998 as-built O&M manual for the WTP. Drawings cannot be located for the LSW Pump Building. Many changes have been made to each facility since their construction and updated plans and O&M manuals would provide a more organized and accurate view of each facility at the fingertips of the Town and operations staff.

Appendix A

TATA & HOWARD

Round Pond Well No. 1

Gravelly Pond Water Treatment Plant

Moses Hill Standpipe
Capacity: 1.7 mg
Overflow Elevation: 273 feet

Lincoln Street Well

HAMILTON

ESSEX

GLOUCESTER

BEVERLY

Chebacco Lake

Round Pond

Gravelly Pond

Dykes Pond: Dikes Meadow

Lily Pond: Lilly Pond

Coy Pond: Middle Pond

STATE HIGHWAY ROUTE 128

ACCESS ROAD

PINE STREET

UNKNOWN

OLD ESSEX ROAD

SCHOOL STREET

ATWATER AVENUE

GENTILES WAY

MILL STREET

FOREST LANE

LOWING PLACE ROAD

MAGNOLIA AVENUE

FOREST STREET

COLBURN ROAD

LEDGEWOOD ROAD

LEDGEWOOD CIRCLE

HAROLD STREET

PLUM HILL

ANCIENT COUNTY WAY

MACHIAS WAY

MARK STREET

HICKORY HILL ROAD

OVERLEDGE ROAD

BIRCH ROAD

SUMMER STREET

COOLIDGE POINT

RAYMOND STREET

OCEAN STREET

PRIVATE LANE

HARBORSIDE ROAD

HARRINGTON AVENUE

PINEWOOD ROAD

ANTHONY AVENUE

CROOKED LANE

PARSONS LANE

SHELLEYS LANE

WINDERMERE PARK

KNIGHT ROAD

MARBLEHEAD ROAD

PLEASANT STREET

CRAFTS COURT

LINCOLN AVENUE

ROSEDALE AVENUE

LINCOLN STREET

STANLEY AVENUE

FLATLEY AVENUE

VINE STREET

BURNHAM LANE

SUMAC LANE

KNIGHT CIRCLE

PUTNAM COURT

BROOK STREET

NORTH STREET

MORSE COURT

GRAM STREET

UNION STREET

DEER HILL ROAD

SUNSET ROCK HILL ROAD

WOODLOCH ROAD

WOODHOLM LANE

WALKER ROAD

HIGHGROVE ROAD

FORSTER ROAD

HENNAN STREET

BRIDGE STREET

HIGHLAND AVENUE

JESSEN LANE

BOARDMAN AVENUE

HARBOR STREET

TUCKS POINT ROAD

LARPAN STREET

SEA STREET

OLD NECK ROAD

EAGLE HEAD ROAD

PEQUOD AVENUE

BEACH STREET

BLOSSOM LANE

COBB AVENUE

PROCTOR STREET

MANCHESTER STREET

MITTS POINT ROAD

GALES POINT ROAD

Legend

Tank

Well

Water Main Diameter

4-inch or smaller

6-inch

8-inch

10-inch

12-inch

14-inch

16-inch

Water Distribution System
Manchester by the Sea, Massachusetts

TATA & HOWARD

Approximate Scale: 1" = 800'

March 2018

TATA & HOWARD

Date: March 2018
Approximate Scale: 1" = 200'

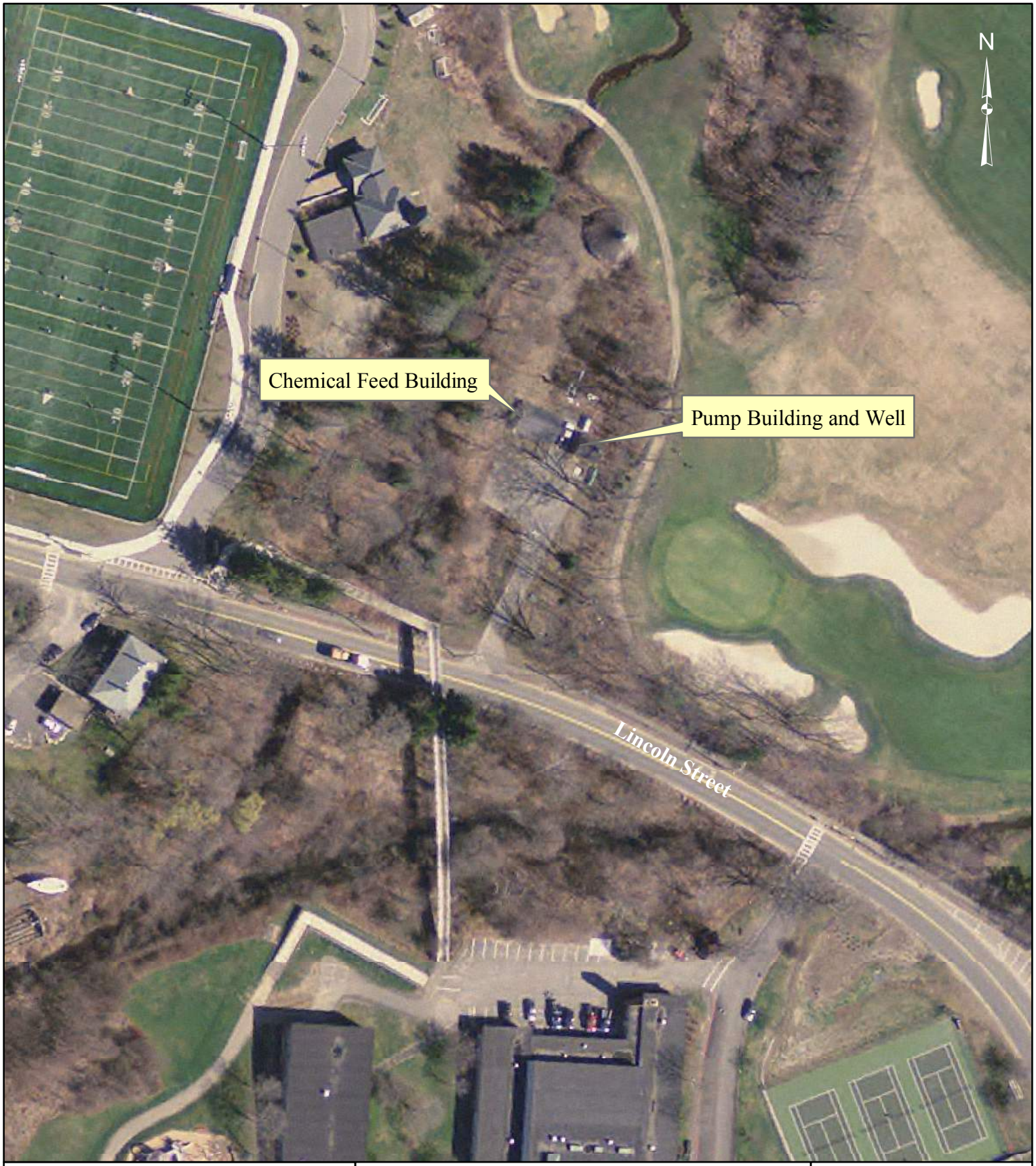
Gravelly Pond WTP Locus Map

WTP Evaluation

Manchester By The Sea, MA
Department of Public Works

Figure No.

2



TATA & HOWARD

Date: March 2018
Approximate Scale: 1" = 100'

Lincoln Street Well Locus Map

WTP Evaluation

Manchester By The Sea, MA
Department of Public Works

Figure No.

3

Appendix B

TATA & HOWARD

AssetName*	Location*	AssetCategory*	AssetType*	AssetID	Condition*	Redundancy*	Asset Status*	Capacity*	CoF*	Installation Date*	Expected UsefulLife*	Replacement Cost*
Contact Flocculator No. 1	Filter Room	Treatment	Treatment Equipment	Clarifier Unit No. 210	Good	100%	Active	Fullsized	Major	01/01/1996	30.0	$500,000.00
Contact Flocculator No. 2	Filter Room	Treatment	Treatment Equipment	Clarifier Unit No. 220	Good	100%	Active	Fullsized	Major	01/01/1996	30.0	$500,000.00
Contact Flocculator No. 3	Filter Room	Treatment	Treatment Equipment	Clarifier Unit No. 230	Good	100%	Active	Fullsized	Major	01/01/1996	30.0	$500,000.00
Filter No. 1	Filter Room	Treatment	Treatment Equipment	Filter Unit No. 210	Good	100%	Active	Fullsized	Major	01/01/1996	50.0	$100,000.00
Filter No. 2	Filter Room	Treatment	Treatment Equipment	Filter Unit No. 220	Good	100%	Active	Fullsized	Major	01/01/1996	50.0	$100,000.00
Filter No. 3	Filter Room	Treatment	Treatment Equipment	Filter Unit No. 230	Good	100%	Active	Fullsized	Major	01/01/1996	50.0	$100,000.00
In Plant Clearwell No. 1	Water Treatment Faciltiy	Treatment	Treatment Equipment	Clearwell 101	Good	100%	Active	Fullsized	Major	01/01/1996	100.0	$1,000,000.00
In Plant Clearwell No. 2	Water Treatment Faciltiy	Treatment	Treatment Equipment	Clearwell 102	Good	100%	Active	Fullsized	Major	01/01/1996	100.0	$1,000,000.00
Solids Settling Lagoon No. 1	Lagoon	Treatment	Liquid Waste Handling & Disposal		Good	100%	Active	Fullsized	Major	01/01/1996	50.0	$360,500.00
Solids Settling Lagoon No. 2	Lagoon	Treatment	Liquid Waste Handling & Disposal		Good	100%	Active	Fullsized	Major	01/01/1996	50.0	$360,500.00
Solids Settling Lagoon No. 3	Lagoon	Treatment	Liquid Waste Handling & Disposal		Good	100%	Active	Fullsized	Major	01/01/1996	50.0	$360,500.00
Static In-Line Mixer	Filter Room	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	25.0	$10,000.00
Backwash Pump No. 1	Filter Room	Treatment	Pumping Equipment	BWP-201	Poor	100%	Active	Fullsized	Major	01/01/1996	25.0	$15,000.00
Backwash Pump No. 2	Filter Room	Treatment	Pumping Equipment	BWP-202	Poor	100%	Active	Fullsized	Major	01/01/1996	25.0	$15,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	KFP-211	Good	100%	Active	Fullsized	Major	06/01/2015	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	KFP-212	Good	100%	Active	Fullsized	Major	06/01/2015	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	CFP-221	Good	100%	Active	Fullsized	Major	01/01/1996	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	CFP-222	Good	100%	Active	Fullsized	Major	01/01/1996	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	CFP-223	Good	100%	Active	Fullsized	Major	01/01/1996	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	OPFP-231	Poor	100%	Active	Fullsized	Major	01/01/1996	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	OPFP-232	Poor	100%	Active	Fullsized	Major	01/01/1996	10.0	$8,000.00
Chemical Feed Pump	Fluoride Room	Treatment	Pumping Equipment	FFP-241	Good	100%	Active	Fullsized	Major	06/01/2015	10.0	$8,000.00
Chemical Feed Pump	Fluoride Room	Treatment	Pumping Equipment	FFP-242	Good	100%	Active	Fullsized	Major	06/01/2015	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	AFP-251	Good	100%	Active	Fullsized	Major	06/01/2015	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	AFP-252	Good	100%	Active	Fullsized	Major	06/01/2015	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	PFP-261	Poor	100%	Active	Fullsized	Major	06/01/2015	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	PFP-262	Poor	100%	Active	Fullsized	Major	06/01/2015	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	HPOFP-271	Good	100%	Active	Fullsized	Major	01/01/1996	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	HPOFP-272	Good	100%	Active	Fullsized	Major	01/01/1996	10.0	$8,000.00
Chemical Feed Pump	Chemical Feed Area	Treatment	Pumping Equipment	HPOFP-273	Good	100%	Active	Fullsized	Major	01/01/1996	10.0	$8,000.00
High Service Pump No. 1 (500gpm)	Filter Room	Treatment	Pumping Equipment	HSP-310	Poor	100%	Active	Fullsized	Major	01/01/1996	25.0	$20,000.00
High Service Pump No. 2 (750gpm)	Filter Room	Treatment	Pumping Equipment	HSP-320	Poor	100%	Active	Fullsized	Major	01/01/1996	25.0	$20,000.00
High Service Pump No. 3 (750gpm)	Filter Room	Treatment	Pumping Equipment	HSP-330	Very Poor	100%	Active	Fullsized	Major	01/01/1996	25.0	$20,000.00
High Service Pump No. 4 (1000gpm)	Filter Room	Treatment	Pumping Equipment	HSP-340	Poor	50%	Active	Fullsized	Major	01/01/1996	25.0	$20,000.00
Liquid Polymer Feed Pump	Polymer Room	Treatment	Pumping Equipment		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	25.0	$5,000.00
Portable Sump Pump	Chemical Feed Area	Treatment	Pumping Equipment	SP-201A	Good	0%	Active	Fullsized	Moderate	01/01/1996	10.0	$500.00
Recycle Pump No. 1	Recycle Pump Station	Pumping Facility	Pumping Equipment	RCP-510	Good	100%	Active	Fullsized	Major	01/01/1996	25.0	$3,000.00
Recycle Pump No. 2	Recycle Pump Station	Pumping Facility	Pumping Equipment	RCP-520	Good	100%	Active	Fullsized	Major	01/01/1996	25.0	$3,000.00
Sanitary Waste Discharge Pump	Laboratory	Treatment	Pumping Equipment	SWDP-1	Good	100%	Active	Fullsized	Major	01/01/1996	25.0	$2,500.00
Sanitary Waste Discharge Pump	Laboratory	Treatment	Pumping Equipment	SWDP-2	Good	100%	Active	Fullsized	Major	01/01/1996	25.0	$2,500.00
Sample Water Pump (Precoagulated Water pH)	Filter Room	Treatment	Pumping Equipment	SWP-201	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,000.00
Sample Water Pump (Coagulated Water pH)	Filter Room	Treatment	Pumping Equipment	SWP-202	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,000.00
Sample Water Pump	Filter Room	Treatment	Pumping Equipment	SWP-203	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,000.00
Sample Water Pump	Filter Room	Treatment	Pumping Equipment	SWP-210	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,000.00
Sample Water Pump	Filter Room	Treatment	Pumping Equipment	SWP-220	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,000.00
Sample Water Pump	Filter Room	Treatment	Pumping Equipment	SWP-230	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,000.00
Septic System Pump	Water Treatment Faciltiy	Treatment	Pumping Equipment		Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Septic System Pump	Water Treatment Faciltiy	Treatment	Pumping Equipment		Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Transfer Pump	Chemical Feed Area	Treatment	Pumping Equipment	TCP-224	Good	0%	Active	Fullsized	Major	01/01/1996	10.0	$1,000.00
Transfer Pump	Chemical Feed Area	Treatment	Pumping Equipment	TOPP-233	Good	0%	Active	Fullsized	Major	01/01/1996	10.0	$1,000.00
Transfer Pump	Fluoride Room	Treatment	Pumping Equipment	TFP-243	Good	0%	Active	Fullsized	Major	01/01/1996	10.0	$1,000.00
Transfer Pump	Chemical Feed Area	Treatment	Pumping Equipment	TAP-253	Good	0%	Active	Fullsized	Major	01/01/1996	10.0	$1,000.00
Transfer Pump	Polymer Room	Treatment	Pumping Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	10.0	$1,000.00

AssetName*	Location*	AssetCategory*	AssetType*	AssetID	Condition*	Redundancy*	Asset Status*	Capacity*	CoF*	Installation Date*	Expected UsefulLife*	Replacement Cost*
Transfer Pump	Chemical Feed Area	Treatment	Pumping Equipment	THPOP-275	Good	0%	Active	Fullsized	Major	01/01/1996	10.0	$1,000.00
Air Flow Element	Filter Room	Treatment	Sensors	AIRFE-201	Good	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$2,000.00
Analysis Element	Filter Room	Treatment	Sensors	AE-201	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Analysis Element	Filter Room	Treatment	Sensors	AE-202	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Analysis Element	Filter Room	Treatment	Sensors	AE-203	Good	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Analysis Element	Filter Room	Treatment	Sensors	AE-210	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Analysis Element	Filter Room	Treatment	Sensors	AE-220	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Analysis Element	Filter Room	Treatment	Sensors	AE-230	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Analysis Element	Filter Room	Treatment	Sensors	AE-240	Good	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Analysis Element	Filter Room	Treatment	Sensors	AE-300	Good	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Analysis Element	Water Treatment Faciltiy	Treatment	Sensors	AE-301	Good	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Analysis Element	Filter Room	Treatment	Sensors	AE-302	Good	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Analysis Element	Filter Room	Treatment	Sensors	AE-303	Good	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Analysis Element	Water Treatment Faciltiy	Treatment	Sensors	AE-304	Good	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Flow Element (695 gpm)	Filter Room	Treatment	Sensors	FE-210	Very Poor	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$5,000.00
Flow Element (695 gpm)	Filter Room	Treatment	Sensors	FE-220	Very Poor	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$5,000.00
Flow Element (695 gpm)	Filter Room	Treatment	Sensors	FE-230	Very Poor	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$5,000.00
Flow Element (0 to 3000 gpm)	Filter Room	Treatment	Sensors	FE-240	Poor	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$7,500.00
Flow Element	Filter Room	Treatment	Sensors	FE-250	Very Poor	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$7,500.00
Flow Element (0 to 5000 gpm)	Finished Water Valve Vault	Treatment	Sensors	FE-300	Poor	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$10,000.00
Flow Element (0 to 100 gpm)	Filter Room	Treatment	Sensors	FE-500	Poor	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$2,500.00
Flow Element	Flow Metering Vault FE-510	Treatment	Sensors	FE-510	Poor	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$2,500.00
Level Element	Water Treatment Faciltiy	Treatment	Sensors	LE-210	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Level Element	Water Treatment Faciltiy	Treatment	Sensors	LE-220	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Level Element	Water Treatment Faciltiy	Treatment	Sensors	LE-230	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Level Element	Filter Room	Treatment	Sensors	LE-301	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Level Element	Filter Room	Treatment	Sensors	LE-302	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Level Element	Recycle Pump Station	Pumping Facility	Sensors	LE-501	Good	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Pressure Element	Filter Room	Treatment	Sensors	PE-201	Good	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Pressure Element	Filter Room	Treatment	Sensors	PE-210	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Pressure Element	Filter Room	Treatment	Sensors	PE-211	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Pressure Element	Filter Room	Treatment	Sensors	PE-220	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Pressure Element	Filter Room	Treatment	Sensors	PE-221	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Pressure Element	Filter Room	Treatment	Sensors	PE-230	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Pressure Element	Filter Room	Treatment	Sensors	PE-231	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Air and Vacuum Release Valve	Filter Room	Treatment	Valves		Very Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Air and Vacuum Release Valve	Filter Room	Treatment	Valves		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Air and Vacuum Release Valve	Filter Room	Treatment	Valves		Very Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Air and Vacuum Release Valve	Filter Room	Treatment	Valves		Very Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Air and Vacuum Release Valve	Filter Room	Treatment	Valves		Very Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Air and Vacuum Release Valve	Filter Room	Treatment	Valves		Very Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Air and Vacuum Release Valve	Filter Room	Treatment	Valves		Very Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Automatic Control Valve	Filter Room	Treatment	Valves	ACV-212	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$20,000.00
Automatic Control Valve	Filter Room	Treatment	Valves	ACV-215	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$20,000.00
Automatic Control Valve	Filter Room	Treatment	Valves	ACV-222	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$20,000.00
Automatic Control Valve	Filter Room	Treatment	Valves	ACV-225	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$20,000.00
Automatic Control Valve	Filter Room	Treatment	Valves	ACV-232	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$20,000.00
Automatic Control Valve	Filter Room	Treatment	Valves	ACV-235	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$20,000.00
Backwash Control Valve	Filter Room	Treatment	Valves	BWCV-214	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Backwash Control Valve	Filter Room	Treatment	Valves	BWCV-224	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Backwash Control Valve	Filter Room	Treatment	Valves	BWCV-234	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Backwash Flow Control Valve	Filter Room	Treatment	Valves	BWFCV-200	Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$25,000.00
Decant Valve	Filter Room	Treatment	Valves	DV-216	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Decant Valve	Filter Room	Treatment	Valves	DV-226	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Decant Valve	Filter Room	Treatment	Valves	DV-236	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Flow Control Valve	Filter Room	Treatment	Valves	FCV-210	Excellent	100%	Active	Fullsized	Moderate	10/01/2012	20.0	$25,000.00

AssetName*	Location*	AssetCategory*	AssetType*	AssetID	Condition*	Redundancy*	Asset Status*	Capacity*	CoF*	Installation Date*	Expected UsefulLife*	Replacement Cost*
Flow Control Valve	Filter Room	Treatment	Valves	FCV-211	Excellent	100%	Active	Fullsized	Moderate	02/01/2014	20.0	$25,000.00
Flow Control Valve	Filter Room	Treatment	Valves	FCV-220	Excellent	100%	Active	Fullsized	Moderate	02/01/2015	20.0	$25,000.00
Flow Control Valve	Filter Room	Treatment	Valves	FCV-221	Excellent	100%	Active	Fullsized	Moderate	02/01/2014	20.0	$25,000.00
Flow Control Valve	Filter Room	Treatment	Valves	FCV-230	Excellent	100%	Active	Fullsized	Moderate	04/01/2012	20.0	$25,000.00
Flow Control Valve	Filter Room	Treatment	Valves	FCV-231	Excellent	100%	Active	Fullsized	Moderate	02/01/2014	20.0	$25,000.00
Flow Control Valve	Filter Room	Treatment	Valves	FCV-310	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Flow Control Valve	Filter Room	Treatment	Valves	FCV-320	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Flow Control Valve	Filter Room	Treatment	Valves	FCV-330	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Flow Control Valve	Filter Room	Treatment	Valves	FCV-340	Poor	0%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Flow Control Valve	Filter Room	Treatment	Valves	FCV-500	Poor	0%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Filtered Water Control Valve	Filter Room	Treatment	Valves	FWCV-213	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$20,000.00
Filtered Water Control Valve	Filter Room	Treatment	Valves	FWCV-223	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$20,000.00
Filtered Water Control Valve	Filter Room	Treatment	Valves	FWCV-233	Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$20,000.00
Recycle Flow Control Valve	Filter Room	Treatment	Valves	RFCV-500	Excellent	0%	Active	Fullsized	Major	02/14/2014	20.0	$10,000.00
Silent Check Valve	Filter Room	Treatment	Valves		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$2,000.00
Silent Check Valve	Filter Room	Treatment	Valves		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$2,000.00
Silent Check Valve	Filter Room	Treatment	Valves		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$2,000.00
Silent Check Valve	Filter Room	Treatment	Valves		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$2,000.00
Silent Check Valve	Filter Room	Treatment	Valves		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$2,000.00
Silent Check Valve	Filter Room	Treatment	Valves		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$2,000.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-201	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-202	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-203	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-210	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-220	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-230	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-240	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-300	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-301	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-302	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-303	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Analysis Indicating Transmitter	Filter Room	Treatment	Sensors	AIT-304	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$750.00
Flow Indicating Transmitter	Filter Room	Treatment	Sensors	FIT-201	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Flow Indicating Transmitter	Filter Room	Treatment	Sensors	FIT-210	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Flow Indicating Transmitter	Filter Room	Treatment	Sensors	FIT-220	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Flow Indicating Transmitter	Filter Room	Treatment	Sensors	FIT-230	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Flow Indicating Transmitter	Filter Room	Treatment	Sensors	FIT-240	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Flow Indicating Transmitter	Filter Room	Treatment	Sensors	FIT-250	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Flow Indicating Transmitter	Finished Water Valve Vault	Treatment	Sensors	FIT-300	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Flow Indicating Transmitter	Filter Room	Treatment	Sensors	FIT-500	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Flow Indicating Transmitter	Recycle Pump Station	Pumping Facility	Sensors	FIT-510	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Level Indicator Transmitter	Water Treatment Faciltiy	Treatment	Sensors	LIT-210	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Level Indicator Transmitter	Water Treatment Faciltiy	Treatment	Sensors	LIT-220	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Level Indicator Transmitter	Water Treatment Faciltiy	Treatment	Sensors	LIT-230	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Level Indicator Transmitter	Filter Room	Treatment	Sensors	LIT-301	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Level Indicator Transmitter	Filter Room	Treatment	Sensors	LIT-302	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Level Indicator Transmitter	Recycle Pump Station	Pumping Facility	Sensors	LIT-501	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Pressure Indicator Transmitter	Filter Room	Treatment	Sensors	PIT-201	Good	0%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Pressure Indicator Transmitter	Filter Room	Treatment	Sensors	PIT-210	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Pressure Indicator Transmitter	Filter Room	Treatment	Sensors	PIT-211	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Pressure Indicator Transmitter	Filter Room	Treatment	Sensors	PIT-220	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Pressure Indicator Transmitter	Filter Room	Treatment	Sensors	PIT-221	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Pressure Indicator Transmitter	Filter Room	Treatment	Sensors	PIT-230	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Pressure Indicator Transmitter	Filter Room	Treatment	Sensors	PIT-231	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00

AssetName*	Location*	AssetCategory*	AssetType*	AssetID	Condition*	Redundancy*	Asset Status*	Capacity*	CoF*	Installation Date*	Expected UsefulLife*	Replacement Cost*
Flow Indicating Controller	Water Treatment Faciltiy	Treatment	Sensors	FIC-210	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$2,000.00
Flow Indicating Controller	Water Treatment Faciltiy	Treatment	Sensors	FIC-220	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$2,000.00
Flow Indicating Controller	Water Treatment Faciltiy	Treatment	Sensors	FIC-230	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$2,000.00
Level Indicating Controller	Water Treatment Faciltiy	Treatment	Sensors	LIC-210	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$2,000.00
Level Indicating Controller	Water Treatment Faciltiy	Treatment	Sensors	LIC-220	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$2,000.00
Level Indicating Controller	Water Treatment Faciltiy	Treatment	Sensors	LIC-230	Good	100%	Active	Fullsized	Minor	01/01/1996	15.0	$2,000.00
Backwash Air Blower	Water Treatment Faciltiy	Treatment	Treatment Equipment	BWAB-201	Good	100%	Active	Fullsized	Major	01/01/1996	20.0	$10,000.00
Backwash Air Blower	Water Treatment Faciltiy	Treatment	Treatment Equipment	BWAB-202	Good	100%	Active	Fullsized	Major	01/01/1996	20.0	$10,000.00
Air Line	Water Treatment Faciltiy	Other	Other		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$2,500.00
Chemical Lines	Water Treatment Faciltiy	Treatment	Disinfection Equipment		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$20,000.00
Alum Feed Control Panel	Chemical Feed Area	Treatment	Treatment Equipment	Alum - CP	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$10,000.00
Automatic Temperature Control Panel	Mechanical Room	Treatment	Computer Equipment / Software	ATC-1	Good	100%	Active	Fullsized	Minor	01/01/1996	20.0	$5,000.00
Automatic Temperature Control Panel	Control Room Access	Treatment	Computer Equipment / Software	ATC-2	Good	100%	Active	Fullsized	Minor	01/01/1996	20.0	$5,000.00
Back-Up Computer System	Control Room Access	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$2,500.00
Boiler	Mechanical Room	Other	Other		Good	0%	Active	Fullsized	Catastrophic	01/01/2010	20.0	$10,000.00
Caustic Feed Control Panel	Chemical Feed Area	Treatment	Treatment Equipment	KOH - CP	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$10,000.00
Condenser Unit Control Panel	Office Area	Other	Other		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$2,000.00
Day Tank Scale Electronic Read Out Panel	Fluoride Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$1,000.00
Diesel Fuel Transfer System Control Panel	Mechanical Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$1,000.00
Fan Relay Control Panel	Workshop	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$1,000.00
Filterwash and Clarifier Flush Blower Control Panel	Filter Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$50,000.00
Filter Backwash Pump Control Panel	Filter Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$50,000.00
Filter Control Panel 200	Control Room Access	Treatment	Computer Equipment / Software	FCP-200	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$50,000.00
Fire Alarm System Control Panel	Control Room Access	Treatment	Computer Equipment / Software		Poor	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$10,000.00
Fuel Leak Monitoring System Control Panel	Mechanical Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,500.00
Fuel Overfill Alarm Panel	Mechanical Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$500.00
Fluoride Feed Control Panel	Fluoride Room	Treatment	Treatment Equipment	Fluoride Feed Pump - CP	Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$10,000.00
Generator Control Panel	Electrical Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$5,000.00
High Service Pump Control Panel	Filter Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$2,500.00
Main Instrument Control Panel	Control Room Access	Treatment	Computer Equipment / Software	MICP	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$50,000.00
Main Switchboard	Electrical Room	Treatment	Computer Equipment / Software	SWBD-1	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	30.0	$50,000.00
Motor Control Center	Electrical Room	Treatment	Computer Equipment / Software	MCC-1	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	30.0	$50,000.00
Motor Control Center	Electrical Room	Treatment	Computer Equipment / Software	MCC-1A	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	30.0	$50,000.00
Motor Control Center	Electrical Room	Treatment	Computer Equipment / Software	MCC-2	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	30.0	$50,000.00
Orthophosphate Feed Control Panel	Chemical Feed Area	Treatment	Treatment Equipment	Ortho - CP	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$10,000.00
Pipe Leak Monitoring System	Electrical Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$500.00
Polymer Chemical Feed Control Panel	Polymer Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$10,000.00

AssetName*	Location*	AssetCategory*	AssetType*	AssetID	Condition*	Redundancy*	Asset Status*	Capacity*	CoF*	Installation Date*	Expected UsefulLife*	Replacement Cost*
Polymer Make-Up System Control Panel	Polymer Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$10,000.00
Potassium Permanganate Control Panel	Chemical Feed Area	Treatment	Treatment Equipment	KMnO4 - CP	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$10,000.00
Primary Computer System	Control Room Access	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$2,500.00
Recycle Pumps Control Panel	Electrical Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$2,500.00
Sanitary Waste Control Panel	Control Room Access	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$2,500.00
Security System Control Panel	Control Room Access	Treatment	Computer Equipment / Software		Poor	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$2,500.00
Septage Pump Station Control Panel	Septage Pump Station	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$2,500.00
Sodium Hypochlorite Control Panel	Distribution System	Treatment	Disinfection Equipment	Hypochlorite-CP	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$10,000.00
Telephone System	Water Treatment Faciltiy	Other	Other		Good	0%	Active	Fullsized	Minor	01/01/1996	20.0	$5,000.00
Vapor Sensing Probe Control Box	Mechanical Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Moderate	01/01/1996	20.0	$500.00
SCADA Control Center	Electrical Room	Treatment	Computer Equipment / Software		Poor	0%	Active	Fullsized	Catastrophic	01/01/1996	15.0	$50,000.00
PLC	Electrical Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	15.0	$50,000.00
Airwash Blower Control Panel	Electrical Room	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$10,000.00
Aging Tank	Polymer Room	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$1,000.00
Batch Tank	Polymer Room	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$1,000.00
Bulk Tank	Chemical Feed Area	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$5,000.00
Bulk Tank	Chemical Feed Area	Treatment	Treatment Equipment	Bulk Tank 221	Good	50%	Active	Fullsized	Moderate	01/01/1996	25.0	$5,000.00
Bulk Tank	Chemical Feed Area	Treatment	Treatment Equipment	Bulk Tank 222	Good	50%	Active	Fullsized	Moderate	01/01/1996	25.0	$5,000.00
Bulk Tank	Fluoride Room	Treatment	Treatment Equipment	Bulk Tank 241	Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$5,000.00
Bulk Tank	Chemical Feed Area	Treatment	Treatment Equipment	Bulk Tank 251	Good	50%	Active	Fullsized	Moderate	01/01/1996	25.0	$5,000.00
Bulk Tank	Chemical Feed Area	Treatment	Treatment Equipment	Bulk Tank 252	Good	50%	Active	Fullsized	Moderate	01/01/1996	25.0	$5,000.00
Bulk Tank	Chemical Feed Area	Treatment	Disinfection Equipment	Bulk Tank 271	Good	50%	Active	Fullsized	Moderate	01/01/1996	25.0	$5,000.00
Bulk Tank	Chemical Feed Area	Treatment	Disinfection Equipment	Bulk Tank 272	Good	50%	Active	Fullsized	Moderate	01/01/1996	25.0	$5,000.00
Day Tank	Chemical Feed Area	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$1,000.00
Day Tank	Chemical Feed Area	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$1,000.00
Day Tank	Fluoride Room	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$1,000.00
Day Tank	Chemical Feed Area	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$1,000.00
Day Tank	Chemical Feed Area	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$1,000.00
Day Tank Scale	Fluoride Room	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$2,500.00
Diesel Tank	Water Treatment Faciltiy	Other	Other		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$10,000.00
Polymer Feed Equipment	Polymer Room	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$30,000.00
Mixer	Polymer Room	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$2,000.00
Mixer	Chemical Feed Area	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$2,000.00
Mixer	Chemical Feed Area	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Major	01/01/1996	25.0	$2,000.00
Lighting Panel	Electrical Room	Treatment	Computer Equipment / Software	LP-1	Poor	0%	Active	Fullsized	Minor	01/01/1996	30.0	$5,000.00
Lighting Panel	Workshop	Treatment	Computer Equipment / Software	LP-2	Poor	0%	Active	Fullsized	Minor	01/01/1996	30.0	$5,000.00
Lighting Panel	Workshop	Treatment	Computer Equipment / Software	LP-3	Poor	0%	Active	Fullsized	Minor	01/01/1996	30.0	$5,000.00
Lighting Panel	Workshop	Treatment	Computer Equipment / Software	LP-4	Poor	0%	Active	Fullsized	Minor	01/01/1996	30.0	$5,000.00
Lighting Panel	Control Room	Treatment	Computer Equipment / Software	LP-5	Poor	0%	Active	Fullsized	Minor	01/01/1996	30.0	$5,000.00

AssetName*	Location*	AssetCategory*	AssetType*	AssetID	Condition*	Redundancy*	Asset Status*	Capacity*	CoF*	Installation Date*	Expected UsefulLife*	Replacement Cost*
Lighting Panel	Control Room	Treatment	Computer Equipment / Software	LP-6	Poor	0%	Active	Fullsized	Minor	01/01/1996	30.0	$5,000.00
Lighting Panel	Workshop	Treatment	Computer Equipment / Software	LP-8	Poor	0%	Active	Fullsized	Minor	01/01/1996	30.0	$5,000.00
Power Distribution Panel	Filter Room	Treatment	Computer Equipment / Software	PDP-2	Good	0%	Active	Fullsized	Moderate	01/01/1996	30.0	$50,000.00
Power Distribution Panel	Filter Room	Treatment	Computer Equipment / Software	PDP-3	Good	0%	Active	Fullsized	Moderate	01/01/1996	30.0	$50,000.00
Electric Water Heater	Control Room	Other	Other	EWH-1	Good	0%	Active	Fullsized	Minor	01/01/1996	10.0	$2,000.00
Electric Water Heater	Control Room	Other	Other	EWH-2	Good	0%	Active	Fullsized	Minor	01/01/1996	10.0	$2,000.00
Emergency Eyewash & Shower	Fluoride Room	Other	Other		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Emergency Eyewash & Shower	Chemical Feed Area	Other	Other		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Emergency Eyewash & Shower	Laboratory	Other	Other		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Generator	Office Area	Other	Other		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	30.0	$50,000.00
Water Treatment Facility Building	Building	Other	Buildings		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	100.0	$2,000,000.00
Water Treatment Facility Roof	Building	Other	Buildings		Good	0%	Active	Fullsized	Catastrophic	10/01/2015	30.0	$200,000.00
Finished Water Flow Vault	Vault	Other	Buildings		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	100.0	$10,000.00
Septic Pumping Station	Vault	Other	Buildings		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	25.0	$5,000.00
Leaching Bed	Outside WTF	Other	Other		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	25.0	$10,000.00
Septic Tank	Vault	Other	Buildings		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	30.0	$5,000.00

AssetName*	Location*	AssetCategory*	AssetType*	AssetID	Condition*	Redundancy*	Asset Status*	Capacity*	CoF*	Installation Date*	Expected Useful Life*	Replacement Cost*
Chemical Feed Pump	Lincoln Street Chem Feed Building	Treatment	Pumping Equipment	FFP-131	Good	100%	Active	Fullsized	Major	03/01/1996	10.0	$8,000.00
Chemical Feed Pump	Lincoln Street Chem Feed Building	Treatment	Pumping Equipment	FFP-132	Good	100%	Active	Fullsized	Major	03/01/1996	10.0	$8,000.00
Chemical Feed Pump	Lincoln Street Chem Feed Building	Treatment	Pumping Equipment	OPFP-141	Good	100%	Active	Fullsized	Major	03/01/1996	10.0	$8,000.00
Chemical Feed Pump	Lincoln Street Chem Feed Building	Treatment	Pumping Equipment	OPFP-142	Good	100%	Active	Fullsized	Major	03/01/1996	10.0	$8,000.00
Chemical Feed Pump	Lincoln Street Chem Feed Building	Treatment	Pumping Equipment	HPOFP-121	Good	100%	Active	Fullsized	Major	03/01/1996	10.0	$8,000.00
Chemical Feed Pump	Lincoln Street Chem Feed Building	Treatment	Pumping Equipment	HPOFP-122	Good	100%	Active	Fullsized	Major	03/01/1996	10.0	$8,000.00
Chemical Feed Pump	Lincoln Street Chem Feed Building	Treatment	Pumping Equipment	CFP-101	Good	100%	Active	Fullsized	Major	03/01/1996	10.0	$8,000.00
Chemical Feed Pump	Lincoln Street Chem Feed Building	Treatment	Pumping Equipment	CFP-102	Good	100%	Active	Fullsized	Major	03/01/1996	10.0	$8,000.00
Transfer Pump	Lincoln Street Chem Feed Building	Treatment	Pumping Equipment	TFP-100	Good	0%	Active	Fullsized	Major	03/01/1996	10.0	$1,000.00
Transfer Pump	Lincoln Street Chem Feed Building	Treatment	Pumping Equipment	TFP-120	Good	0%	Active	Fullsized	Major	03/01/1996	10.0	$1,000.00
Emergency Eyewash & Shower	Lincoln Street Chem Feed Building	Other	Other	EUS-110	Good	0%	Active	Fullsized	Major	03/01/1996	20.0	$1,000.00
Emergency Eyewash & Shower	Lincoln Street Chem Feed Building	Other	Other	EUS-120	Good	0%	Active	Fullsized	Major	03/01/1996	20.0	$1,000.00
Emergency Eyewash & Shower	Lincoln Street Chem Feed Building	Other	Other	EUS-130	Good	0%	Active	Fullsized	Major	03/01/1996	20.0	$1,000.00
Bulk Tank	Lincoln Street Chem Feed Building	Treatment	Treatment Equipment	Bulk Tank	Good	0%	Active	Fullsized	Major	03/01/1996	25.0	$5,000.00
Bulk Tank	Lincoln Street Chem Feed Building	Treatment	Treatment Equipment	Bulk Tank	Good	0%	Active	Fullsized	Major	03/01/1996	25.0	$5,000.00
Day Tank	Lincoln Street Chem Feed Building	Treatment	Treatment Equipment	Day Tank	Good	0%	Active	Fullsized	Major	03/01/1996	25.0	$5,000.00
Day Tank	Lincoln Street Chem Feed Building	Treatment	Treatment Equipment	Day Tank	Good	0%	Active	Fullsized	Major	03/01/1996	25.0	$5,000.00
Mixing Tank	Lincoln Street Chem Feed Building	Treatment	Treatment Equipment	Mixing Tank	Good	0%	Active	Fullsized	Major	03/01/1996	25.0	$5,000.00
Control Panel	Lincoln Street Chem Feed Building	Treatment	Computer Equipment / Software	CP-1	Good	0%	Active	Fullsized	Major	03/01/1996	20.0	$5,000.00
Control Panel	Lincoln Street Chem Feed Building	Treatment	Computer Equipment / Software	CP-2	Good	0%	Active	Fullsized	Major	03/01/1996	20.0	$5,000.00
Lighting Panel	Lincoln Street Chem Feed Building	Treatment	Computer Equipment / Software	LP-1	Good	0%	Active	Fullsized	Minor	03/01/1996	30.0	$5,000.00
Control Panel	Lincoln Street Chem Feed Building	Treatment	Computer Equipment / Software	CP-3	Good	0%	Active	Fullsized	Major	03/01/1996	20.0	$5,000.00
Electric Unit Heater	Lincoln Street Chem Feed Building	Other	Other	EUH-1	Good	0%	Active	Fullsized	Minor	03/01/1996	10.0	$2,000.00
Electric Unit Heater	Lincoln Street Chem Feed Building	Other	Other	EUH-2	Good	0%	Active	Fullsized	Minor	03/01/1996	10.0	$2,000.00
Motor Control Center	Lincoln Street Chem Feed Building	Treatment	Computer Equipment / Software	MCC-1	Good	0%	Active	Fullsized	Catastrophic	03/01/1996	30.0	$50,000.00
Analysis Element	Lincoln Street Chem Feed Building	Treatment	Sensors	AE-1	Good	0%	Active	Fullsized	Moderate	03/01/1996	25.0	$1,500.00
Analysis Indicating Transmitter	Lincoln Street Chem Feed Building	Treatment	Sensors	AIT-1	Good	0%	Active	Fullsized	Minor	03/01/1996	15.0	$750.00

AssetName*	Location*	AssetCategory*	AssetType*	AssetID	Condition*	Redundancy*	Asset Status*	Capacity*	CoF*	Installation Date*	Expected Useful Life*	Replacement Cost*
Solenoid Valve Relay Panel	Lincoln Street Chem Feed Building	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	03/01/1996	20.0	$1,000.00
Emergency Eyewash/Shower Relay Panel	Lincoln Street Chem Feed Building	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	03/01/1996	20.0	$1,000.00
Sodium Fluoride Chemical Feed System	Lincoln Street Chem Feed Building	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Catastrophic	03/01/1996	20.0	$10,000.00
Zinc Orthophosphate Chemical Feed System	Lincoln Street Chem Feed Building	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Catastrophic	03/01/1996	20.0	$10,000.00
Sodium Hypochlorite Chemical Feed System	Lincoln Street Chem Feed Building	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Catastrophic	03/01/1996	20.0	$10,000.00
Sodium Hydroxide Chemical Feed System	Lincoln Street Chem Feed Building	Treatment	Treatment Equipment		Good	0%	Active	Fullsized	Catastrophic	03/01/1996	20.0	$10,000.00

AssetName*	Location*	AssetCategory*	AssetType*	AssetID	Condition*	Redundancy*	Asset Status*	Capacity*	CoF*	Installation Date*	Expected Useful Life*	Replacement Cost*
Wewell No. 1	Raw Water Pump Station	Pumping Facility	Intake Structures	Wewell 101	Good	100%	Active	Fullsized	Major	01/01/1996	100.0	$200,000.00
Wewell No. 2	Raw Water Pump Station	Pumping Facility	Intake Structures	Wewell 102	Good	100%	Active	Fullsized	Major	01/01/1996	100.0	$200,000.00
Portable Sump Pump	Raw Water Pump Station	Treatment	Pumping Equipment	SP-102	Poor	0%	Active	Fullsized	Moderate	01/01/1996	10.0	$500.00
Raw Water Vertical Turbine Pump	Raw Water Pump Station	Pumping Facility	Pumping Equipment	RWP-110	Poor	100%	Active	Fullsized	Major	01/01/1996	25.0	$20,000.00
Raw Water Vertical Turbine Pump	Raw Water Pump Station	Pumping Facility	Pumping Equipment	RWP-120	Poor	100%	Active	Fullsized	Major	01/01/1996	25.0	$20,000.00
Raw Water Vertical Turbine Pump	Raw Water Pump Station	Pumping Facility	Pumping Equipment	RWP-130	Poor	100%	Active	Fullsized	Major	01/01/1996	25.0	$20,000.00
Raw Water Vertical Turbine Pump	Raw Water Pump Station	Pumping Facility	Pumping Equipment	RWP-140	Very Poor	100%	Active	Fullsized	Major	01/01/1996	25.0	$20,000.00
Sample Water Pump	Raw Water Pump Station	Pumping Facility	Pumping Equipment	SWP-101	Poor	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,000.00
Flow Element (0 to 3500 gpm)	Raw Water Flow Vault	Treatment	Sensors	FE-100	Very Poor	0%	Active	Fullsized	Moderate	01/01/1996	25.0	$7,500.00
Level Element	Raw Water Pump Station	Pumping Facility	Sensors	LE-101	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Level Element	Raw Water Pump Station	Pumping Facility	Sensors	LE-102	Good	100%	Active	Fullsized	Moderate	01/01/1996	25.0	$1,500.00
Air and Vacuum Release Valve	Raw Water Pump Station	Pumping Facility	Valves		Very Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Air and Vacuum Release Valve	Raw Water Pump Station	Pumping Facility	Valves		Very Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Air and Vacuum Release Valve	Raw Water Pump Station	Pumping Facility	Valves		Very Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Air and Vacuum Release Valve	Raw Water Pump Station	Pumping Facility	Valves		Very Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Air and Vacuum Release Valve	Raw Water Pump Station	Pumping Facility	Valves		Very Poor	0%	Active	Fullsized	Major	01/01/1996	20.0	$1,000.00
Flow Control Valve	Raw Water Pump Station	Pumping Facility	Valves	FCV-110	Excellent	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Flow Control Valve	Raw Water Pump Station	Pumping Facility	Valves	FCV-120	Very Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Flow Control Valve	Raw Water Pump Station	Pumping Facility	Valves	FCV-130	Very Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Flow Control Valve	Raw Water Pump Station	Pumping Facility	Valves	FCV-140	Very Poor	100%	Active	Fullsized	Moderate	01/01/1996	20.0	$25,000.00
Silent Check Valve	Raw Water Pump Station	Pumping Facility	Valves		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$2,000.00
Silent Check Valve	Raw Water Pump Station	Pumping Facility	Valves		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$2,000.00
Silent Check Valve	Raw Water Pump Station	Pumping Facility	Valves		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$2,000.00
Silent Check Valve	Raw Water Pump Station	Pumping Facility	Valves		Good	0%	Active	Fullsized	Major	01/01/1996	20.0	$2,000.00
Flow Indicating Transmitter	Raw Water Flow Vault	Treatment	Sensors	FIT-100	Very Poor	0%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Level Indicator Transmitter	Raw Water Pump Station	Pumping Facility	Sensors	LIT-101	Very Poor	0%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Level Indicator Transmitter	Raw Water Pump Station	Pumping Facility	Sensors	LIT-102	Very Poor	0%	Active	Fullsized	Minor	01/01/1996	15.0	$1,500.00
Fire Alarm System Control Panel	Raw Water Pump Station	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$10,000.00
Raw Water Pump Control Panel	Raw Water Pump Station	Treatment	Computer Equipment / Software	RWPCP	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$2,500.00
Security System Control Panel	Raw Water Pump Station	Treatment	Computer Equipment / Software		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	20.0	$2,500.00
Lighting Panel	Raw Water Pump Station	Treatment	Computer Equipment / Software	LP-7	Good	0%	Active	Fullsized	Minor	01/01/1996	30.0	$5,000.00
Power Distribution Panel	Raw Water Pump Station	Treatment	Computer Equipment / Software	PDP-1	Good	0%	Active	Fullsized	Moderate	01/01/1996	30.0	$50,000.00
Raw Water Flow Vault	Near Raw Water Pump Station	Other	Buildings		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	100.0	$10,000.00
Dry-type Transformer	Raw Water Pump Station	Treatment	Transformers / Switchgears / Wiring		Good	0%	Active	Fullsized	Catastrophic	01/01/1996	30.0	$10,000.00
Motor Control Center	Raw Water Pump Station	Treatment	Computer Equipment / Software	MCC-2	Good	0%	Active	Fullsized	Catastrophic	01/01/1996	30.0	$50,000.00

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