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CARBON DIOXIDE STORAGE AND CARBONIC ACID FEED EQUIPMENT
DESIGN-BUILD BID SPECIFICATIONS
For
RIVIERA BEACH, FL
WATER TREATMENT PLANT
CHLORINE SYSTEM REPLACEMENT
TOMCO$_2$ Quotation #2190-2
April 30, 2020

SCOPE

A. Work Included: This section covers the work necessary to furnish the equipment and materials required for the carbon dioxide storage, feed, and pH control system. The system, as specified herein, shall be furnished by one supplier, with at least 20 years of prior experience in supplying carbon dioxide systems of the type specified.

B. The basic system consists of the following equipment and materials:

1. One (1) TOMCO$_2$ Model 2681VA 26 ton capacity Liquid Carbon Dioxide storage tank system complete with refrigeration unit.

2. One (1) TOMCO$_2$ Model M-259, 12 kW electric vaporizer.

3. One (1) TOMCO$_2$ Model CVH-4ss CO_2 vapor heater.

4. One (1) First stage CO_2 pressure regulator.

5. Three (3) TOMCO$_2$ PSF™ carbonic acid feed panels.

6. Three (3) TOMCO$_2$ Carbonic Acid Solution Diffusers.

7. Three (3) TOMCO$_2$ pH sampling stations.

8. Instrumentation and control equipment, as specified herein.

MANUFACTURER

The Manufacturer certifies it meets or exceeds the following qualifications:

The Manufacturer is the actual manufacturer of the equipment being supplied.

The Manufacturer has successfully designed and manufactured similar equipment for the proposed application for at least 20 years.

The Manufacturer maintains a list of at least two hundred references who are current successful users of similar systems designed, assembled and furnished by the Manufacturer.

The Manufacturer has the required financial capability

The Manufacturer maintains a qualified technical engineering staff and design office.

The Manufacturer operates a physical plant and employs fabricating personnel to complete the work specified.

The Manufacturer operates an ASME Pressure Vessel Shop and employs certified welders to produce the pressure vessel to ASME standards, inspection and testing as required.

The Manufacturer has and will maintain competent service personnel to service the equipment furnished and provide post commissioning assistance.

The Manufacturer is an active member of CGA (Compressed Gas Association).

The Manufacturer of the carbon dioxide system shall be TOMCO$_2$ Systems, Loganville, GA, USA.

QUALITY ASSURANCE

The Specifications and applicable Drawings are based on equipment, products, and services offered by TOMCO$_2$ Systems, Loganville, Georgia. Changes in the dimensions, layout, or location of equipment or accessories, or type of accessories required to accommodate alternate carbon dioxide feed system manufacturers and models shall be at the Contractor’s expense. Design changes shall be performed by discipline engineers registered in the State of Florida, at Contractor’s expense. This includes all civil, structural, mechanical, electrical, or instrumentation and controls changes that may be determined necessary to accommodate the system(s) of other manufacturers. The Contractor shall also be solely responsible for all permit modifications necessary to accommodate an alternate manufacturer’s design.

STATEMENT OF CONFORMANCE

The manufacturer of the carbonic acid feed system and carbon dioxide storage equipment shall inspect the completed installation and provide written certification that the system will operate as designed and specified herein.

LIQUID CARBON DIOXIDE STORAGE TANK

The storage tank shall consist of a welded steel pressure vessel designed and constructed in accordance with Section VIII, Division 1 of the ASME “Code for Unfired Pressure Vessels”. The Manufacturer shall fabricate the pressure vessel in its own ASME pressure vessel shop. A pressure vessel manufactured by a different manufacturer from the tank supplier will not be accepted. It is the intention for the complete storage tank, pressure vessel, vaporizer and vapor heater to be fabricated by the same manufacturer in the same facility.

The storage tank shall be vertical orientation with support three legs and capable of holding 52,000 pounds of liquid carbon dioxide at 300 psig and 0°F. The tank shall have an elliptical manway installed on the shell for cleaning access and inspection of the pressure vessel. Installation including foundation, elevation, piping, wiring, and instrumentation must be performed and strictly adhered to TOMCO$_2$ recommendations and specifications.

The tank shall be insulated with a minimum of 4 inches of urethane foam insulation, which shall be covered with a 0.063” factory painted white aluminum shell. The top and bottom are to be covered with aluminum performed flanged and dished heads. The thermal conductivity (overall U-factor) for the insulated tank wall shall not be greater than 0.040 Btu per hour per square foot per °F.

The tank shall be complete with a liquid level gauge calibrated to read in pounds, 0 to 600 psig pressure gauge, level and pressure transmitters and all necessary Schedule 80 pipe connections for filling and withdrawal of CO_2 from the storage tank. Truck unloading capability consisting of CGA forged brass liquid fill and vapor balance fittings will be provided.

A complete environmentally safe R-404A refrigeration system shall be provided with the storage tank that will automatically maintain the storage tank at 0°F and 300 psig. The evaporator coil of the refrigeration unit shall be located inside of the top portion of the storage tank, with the compressor and air-cooled condensing coil mounted on a frame underneath the bottom head of the tank. The refrigeration unit shall be equipped with a condensing unit driven by a 3 HP, 480 volt, 60 cycle, 3-phase compressor and provided with a circuit breaker disconnect switch with operating handle, motor starter, and a 120-volt control voltage transformer in a NEMA 4X type 304 stainless steel electrical enclosure. The condensing unit will include a sight glass, refrigerant line, solenoid valve, expansion valve and a refrigeration coil mounted internally in the storage tank. Automatic controls shall be provided to start and stop the compressor, thereby controlling the temperature of the CO_2 in order to maintain the proper operating pressures.

The storage tank shall be protected from being subjected to pressures greater than the maximum allowable working pressure of 350 psig by means of two ASME approved, spring actuated safety relief valves and two bleeder type relief valves, complete with three way switching valves.

The tank shall be provided with a pressure switch to sound an alarm automatically in the event of excessive high or low pressure in the tank. The alarm horn and indicating lights shall be mounted on the refrigeration control panel. The panel shall be complete with an alarm silence circuit to shut off the audible alarm. Contacts shall be provided for remote indication of high and low tank pressure alarms and 4-20 mA analog outputs for tank level and pressure.

All nozzles on the vessel shall be schedule 80 stainless steel. All piping and fittings provided internal to the storage tank system shall be Schedule 80 carbon steel. All piping and fittings provided external to the vessel and supplied as part of the storage system shall be Schedule 80 type 304 stainless steel, with 2,000 psi rated threaded fittings. Type 316 stainless steel ball valves shall be provided where the connections for the liquid fill, vapor return, vaporizer, and vapor process lines connect to the tank. 1-1/2” liquid CO_2 and 1” vapor balance fill couplings shall be standard CGA brass threaded connections for CO_2 service.

The storage tank shall be provided with an enclosure which shall provide weather protection for the refrigeration unit. The enclosure shall consist of a structural frame, which shall be covered with aluminum sheet, minimum thickness 0.04 inches (1 mm). The storage tank, enclosure, frame, and other exposed metal surfaces shall be painted according to Manufacturers’ Standards.

Adequate vent area shall be provided to allow cooling air circulation for the refrigeration system. A removable cover to provide access to the refrigeration enclosure shall be provided.

The approximate overall tank dimensions are 9’-11” deep x 8’-0” wide x 31’-10” high. The shipping weight (empty) is approximately 25,000 lbs.

The storage tank shall be **Model No. 2681VA** as manufactured by $TOMCO_2$ Systems of Loganville, Georgia.

CARBON DIOXIDE ELECTRIC VAPORIZER

The tank shall be provided with one complete modular electric vaporizer unit, capable of vaporizing 325 lbs of liquid carbon dioxide per hour at 300 psig. Automatic controls shall be provided to control the vaporizer to maintain the tank pressure above 245 psig. An adjustable differential pressure switch shall activate the vaporizer at 245 psig and shall deactivate the unit at 255 psig. Liquid carbon dioxide shall be drawn off of the bottom tank, with the resulting vapor returning to the top of the tank. A purging valve for easy removal of accumulated impurities, safety controls consisting of a safety relief valve, a thermostat for overheat protection and a fused control circuit for coil protection shall be provided. Electrical requirements shall be 12 kW, 480-volt, 3-phase, 60-Hz, and shall be provided with a circuit breaker disconnect with operating handle in a NEMA 4X type 304 stainless steel electrical enclosure. The vaporizer shall be supplied as a pre-insulated modular component of the storage tank; to be field installed by the contractor next to the storage tank.

The vaporizer shall be **Model No. M-259** as manufactured by TOMCO$_2$ Systems of Loganville, Georgia.

CARBON DIOXIDE VAPOR HEATER

One (1) 4 kW carbon dioxide vapor heater shall be provided in an enclosed free standing type 304 stainless steel cabinet to heat up to 720 lb/hr of 0°F CO_2 gas to near room temperature. The vapor heater shall be rated for operation at 480 volts, single-phase, 60 Hz. The vapor heater shall be supplied complete with electronic temperature control. Operating control range shall be adjustable from 30° to 110°F. Solid high conductivity aluminum pressure castings containing the electrical resistance heaters and aluminum castings containing the stainless steel tubing for the CO_2 vapor shall be provided. An overheat device shall be supplied to shut off the heating element should the temperature reach 200°F. An automatic reset shall be supplied for restarting the heater after the overheat temperature controller has tripped out. The electrical components including through the door disconnect switch will be housed in a NEMA 12 dust-tight housing and located inside a type 304 NEMA 4X stainless steel free standing enclosure.

Vapor heater shall be **Model No. CVH-4ss** as manufactured by TOMCO$_2$ Systems of Loganville, Georgia.

FIRST STAGE PRESSURE REGULATOR

A. One (1) carbon dioxide pressure reducing regulator will be supplied, pre-installed in the CO_2 pipeline after the carbon dioxide vapor heater within the vapor heater enclosure. The regulator shall be used to reduce the pressure from approximately 300 psig to 120 psig. The regulator shall have a malleable iron body, aluminum spring case and lower case, nitrile and aluminum valve disc and holder, nylon fabric coated with nitrile diaphragm, stainless steel valve stem and valve stem guide. The outlet pressure of the regulator shall be easily adjusted through the use of an adjustment screw.

B. One (1) pressure gauge, 2-1/2" dial, 0 to 600 psig range, complete with isolation valve, shall be provided for indication of the CO_2 pressure downstream of the regulator.

C. One (1) pressure relief valve shall be provided installed in the pipeline prior to the pressure regulator. Relief valve shall be set for 450 psig.

PSF™ CARBONIC ACID FEED SYSTEM (Patent Numbers: 5487835 & 5514264)

Design Conditions:

CO_2 Feed Rate (Max.):	24/45/52 lb/hr
CO_2 Feed Rate (Min.):	6/11/13 lb/hr
Carrier water required:	24/45/52 gpm
Minimum Carrier Water Pressure:	65 psig

Three (3) TOMCO$_2$ PSF™ Carbonic Acid feed panels will be provided. All CO_2 piping and fittings will be ½ inch Type 304 stainless steel, threaded. All water piping and fittings will be 2" Schedule 10 stainless steel, welded. The enclosed panels will be free-standing and constructed of type 304 stainless steel. The carbon dioxide at 75 psig, minimum, will be diffused into the carrier water. The reasonably clean carrier water supply (taken from down stream of the carbonic acid injection point) shall be capable of providing 24/45/52 gpm at a minimum constant pressure of 65 psig (55 psi above the elevated treated water pressure) and approximately 5° C to 25° C to each panel. Electrical supply to each panel shall be 120 volts, 60 Hertz. Each panel shall be 48 inches wide x 60 inches tall. Each feed panel will contain the following:

One (1) stainless steel "Y" strainer provided on the inlet side of the CO_2 feed panel to remove any debris that might pass through the CO_2 vapor line from the storage tank and piping system.

One (1) second stage pressure reducing valve, will be supplied. The regulator will reduce the CO_2 pressure from the first stage regulator to the desired operating pressure. The regulator will have a malleable iron body, aluminum spring case and lower case, nitrile and aluminum valve disc and holder, nylon fabric coated with nitrile diaphragm, stainless steel valve stem and valve stem guide. The outlet pressure of the regulator will be easily adjusted through the use of an adjustment screw.

Two (2) Pressure gauges, 2-1/2" dial, 0-200 psi range, complete with isolation valves, shall be provided for indication of the CO_2 pressure upstream and downstream of the second stage pressure regulator.

One (1) thermal mass type indicating electronic CO_2 flow meter shall be provided. The sensor will be stainless steel with stainless steel end fittings. An LCD display will be utilized with an 4-20 mA output representing CO_2 gas flow rate in lb/hr. Accuracy of the meter will be two percent of full scale. The flow meter shall be sized to correspond with the design rate of carbon dioxide per hour. Flow meter shall be ST-100 by FCI.

One (1) pH indicating PID analyzer-controller will be provided. The controller will be complete with proportional band, integral, transit time, reset functions, set point, output indication, remote pH transmission, manual/automatic selection and hi/low pH alarms. The controller will receive an electronic signal from the pH probe on the sampling station. The controller will transmit a proportional 4-20 mA D.C. signal to the electro-pneumatic transducer. The pH controller shall be a Rosemount controller specifically designed for TOMCO$_2$ Systems.

One (1) Gas actuated (ATO) CO_2 flow control valve assembly will be provided. The pneumatically operated, spring opposed diaphragm actuator is controlled via an electronic signal from an electro-pneumatic I/P transducer. The transducer converts a DC current input signal to a directly proportional pneumatic output. The transducer is designed to accept a proportional 4-20 mA D.C. signal from the pH controller. The valve actuator will be supplied complete with a CO_2 gas regulator for utilizing the CO_2 gas at the panel as the pneumatic source. The valve body shall be 316 stainless steel.

One (1) manually operated by-pass CO_2 flow control valve will be supplied. The valve will be stainless steel construction and designed for positive control of CO_2 flow.

Three (3) CO_2 isolation valves will be supplied. The valve bodies will be of stainless steel construction with stainless steel trim. The valves will be designed specifically for CO_2 service.

Two (2) Pressure gauges, 2-1/2" dial, 0 - 160 psig range, complete with isolation valves, shall be provided for indication of the water pressure upstream and downstream of the mixers.

Two (2) in-line mixers designed to continuously mix carbon dioxide with the water will be supplied. The CO_2 vapor will be injected upstream of the mixer though a stainless steel injector. The mixers shall be constructed of PVC.

One (1) Hand/Auto/Off switch and power light will be provided on the control panel door. The switch will provide 120 Volt AC power to the electronics in the panel.

One (1) stainless steel ball check valve will be provided in the CO_2 injection line.

One (1) carrier water drain valve will be supplied. The valve body will be of stainless steel construction with stainless steel trim.

One (1) Solenoid valve shall be provided for initiating or stopping CO_2 flow to the PSF panel. The valve shall have a brass body and 120 volt AC coil. The valve shall be normally closed (energize to open - fail closed). In case of loss of power, the CO_2 solenoid will stop CO_2 flow to the panel. A manual by-pass isolation valve shall be provided to by-pass flow around the solenoid valve for manual operation.

One (1) Carrier water low pressure switch shall be provided. A low water pressure signal (dry contact) shall be provided to the plant control system.

Two (2) pressure relief valves shall be provided for protection of the PSF Panel components. The valves shall have a brass body and stainless steel spring. Safety relief valves shall be set to relieve at 150 psig and 50 psig.

Three (3) alarm lights will be provided on the control panel door. The lights will indicate a low carrier water pressure, high pH and low pH. Light module shall be NEMA 4X rated.

One (1) electric panel heater shall be provided for minimizing moisture condensation on the PSF panel components. Heater shall be Hoffman Series, 400 Watts, 115 volts.

All necessary panel valves, safeties, gauges, pipe, pipe fittings, etc. will be included as part of the PSF Carbonic Acid feed system panel.

CARRIER WATER PUMP SKIDS

Three (3) Carrier water pumps will be provided with the PSF Panel for pressurizing and circulating lower pressure (45 psig minimum) finished, filtered water to the PSF panels. The pumps shall be vertical, Multi-stage, centrifugal design with the pumps installed near the PSF feed panels. Each pump shall be capable of delivering 24/45/52 gpm carrier water at 70 ft head. The pumps shall be 316 stainless steel construction. Each pump shall have a 480-volt, 3-phase, 60 hz, TEFC, 3500 RPM, 1 or 2 HP premium efficiency Baldor motor. The pumps shall be mounted on a base frame with manual motor starters and electrical enclosures. Pumps shall be Goulds model 5SV or 10SV. Pump connections shall be 300 Lb. 1-1/4 inch or 2-inch RF flanged inline suction and discharge. Pumps must be provided with 45 psi net positive suction head.

Each pump shall be provided with the following components mounted on the pump skid:

One (1) NEMA 4X type 304 stainless steel electrical enclosure containing fusible disconnect switch a manual motor starter, Symcom pump protector, control transformer, Hand/Off/Remote selector switch, reset push button and time elapsed hour meter shall be provided with each pump. Dry contacts shall be provided for acceptance of a remote start/stop signal from the plant control system. The panels will be pre-installed on the pump skid.

Two (2) Isolation valves shall be provided for isolation of each pump. Valves shall be stainless steel.

One (1) Check valve shall be provided at the pump discharge. Check valve to be bronze, brass or cast iron construction.

Two (2) Pressure gauges, 2-1/2" dial, 0 - 160 psig range, complete with isolation valves, shall be provided for indication of the water pressure upstream and downstream of the pump.

Components to be pre-installed with each pump and piped with type 304 stainless steel piping and fittings.

CARBONIC ACID DIFFUSERS (Patent Numbers: 6637731 & 6767008)

Three (3) TOMCO$_2$ Carbonic Acid solution diffusers will be supplied to inject solution into the clarifier effluent water pipes. The diffusers will be constructed of type 304 stainless steel and provided with 1-1/2 inch and 2-inch 150# connection flanges and 3-inch mounting flanges. Each diffuser shall be designed for the full flow of solution – 24/45/52 gpm. The diffusers are to be field installed by the contractor.

Three (3) Pressure gauges, 2-1/2" dial, 0 - 160 psig range, complete with isolation valves, shall be provided for indication of the water pressure just prior to the solution diffusers. The pressure gauges are to be field installed by the contractor.

pH SAMPLING STATIONS

Three (3) TOMCO$_2$ pH sampling stations will be supplied to measure the pH of a representative sample from each 20/24/36-inch water line prior to the filters. Each sampling station will be constructed of Type 316 stainless steel and consist of a 1" schedule 10 welded piping and isolation valves. A type 316 stainless steel manual flow control valve and polycarbonate flow indicator will be provided. The assembly shall be mounted on a type 316 stainless steel back plate suitable for wall mounting.

Three (3) pH electrode assemblies will be provided. Each electrode assembly will include a pH glass electrode, a reference electrode, a thermo-compensator and a preamplifier, all enclosed in a corrosion-proof PEEK body. Each electrode assembly will be located in the sample lines, 60 to 90 seconds downstream of the CO_2 application points for measurement of the pH, and then transmits the pH measurement signal to the pH analyzer/controller on the respective PSF panel. Each electrode assembly will be complete with 10 meters of cable and insertion hardware for mounting on a 1-1/2 inch nozzle on a spool piece in each sample line. The electrodes shall be Rosemount. Type 304 stainless steel sampling wand (for insertion into the process water pipeline a minimum of 40 feet downstream of the solution injection point) shall be provided for each sampling station.

I/O SIGNALS

The following signals shall be exchanged between the storage tank, PSF local control panel and plant control system:

From the CO_2 storage tank to the plant control system:

- CO_2 tank low pressure alarm
- CO_2 tank high pressure alarm
- CO_2 tank level (4-20 mA)
- CO_2 tank pressure (4-20 mA)

From the plant control system to the PSF control panel:
- PSF panel selected (on/off)

From the PSF control panel to the plant control system:
- Carrier water low pressure alarm
- Process pH (4-20 mA)
- CO_2 flow rate (4-20 mA)

The above components will be factory assembled and all field connections clearly marked. The entire assembly shall be shop tested, calibrated and shipped to the job-site in one shipment. Commissioning, start-up and training by a TOMCO$_2$ factory technician in no more than 2 trips will be provided. Detailed drawings, parts list and operating manuals are provided as part of the equipment package. A One-year equipment warranty will be provided from the date of start-up and acceptance of this equipment.

ITEMS NOT INCLUDED WITH PROPOSED EQUIPMENT

a) Foundation, concrete pad or anchor bolts for the equipment.

b) Electrical wire, junction boxes, main disconnects or conduit for the equipment.

c) Erection and installation; however, complete erection and installation drawings will be provided.

d) Interconnecting CO_2 piping between the storage tank and the feed panels.

e) Interconnecting solution piping between the feed panels and the solution diffusers.

f) Piping supports or wall sleeves for field piping.

g) Crane and rigging to unload the equipment at the jobsite

h) Liquid CO_2 for the storage tank.

i) Carrier water supply.

j) Interconnecting insulated CO_2 feed and return piping between the CO_2 storage receiver and vaporizer.

k) Interconnecting copper instrument tubing between the CO_2 storage receiver and vaporizer panel.

l) Interconnecting pipe, fittings and valves between the carrier water supply, pumps and the feed panels.

m) Sample pump or sampling pipe to the pH sampling station and to drain.

n) Vent piping from the feed panels to the outdoors.

o) Spare Parts.

p) CO_2 detector or monitor (if located indoors).

q) pH signal cable and junction box between the pH probes and the feed panels.

r) Any special fill connections or regulator assemblies required by the CO_2 supplier.

s) Any additional instrumentation or requirement not specified herein.

t) Taxes, fees, duties, licenses or any other fees.

u) Bid bond, supply bond or any other type bonds.

XXXX END OF SECTION XXXX

Technical Memorandum

1475 Centrepark Boulevard, Suite 210
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Phone: 561-515-6247

Prepared for: Riviera Beach Utilities Special District

Project Title: Chemical Feed Systems Design Criteria

Purchase Order No.: 20193791

Project No.: 153934

Design Criteria Technical Memorandum No. 1

Subject: Design-Build Criteria for Chemical Feed System Improvements

Date: June 01, 2020

To: Dierdre Jacobs.

From: Nigel O. Grace, P.E.

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Limitations:

This document was prepared solely for Riviera Beach Utility District in accordance with professional standards at the time the services were performed and in accordance with the contract between Riviera Beach Utility District and Brown and Caldwell dated August 20, 2018. This document is governed by the specific scope of work authorized by Riviera Beach Utility District; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Riviera Beach Utility District and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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Table of Contents

List of Figures

List of Tables

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Section 1: Introduction

1.1 Objectives

The City of Riviera Beach Utilities Special District (RBUSD) owns and operates a Water Treatment Plant (WTP), located at 600 West Blue Heron Boulevard, Riviera Beach, Florida 33404. A site map of the WTP highlighting pertinent facilities referenced herein is provided below.

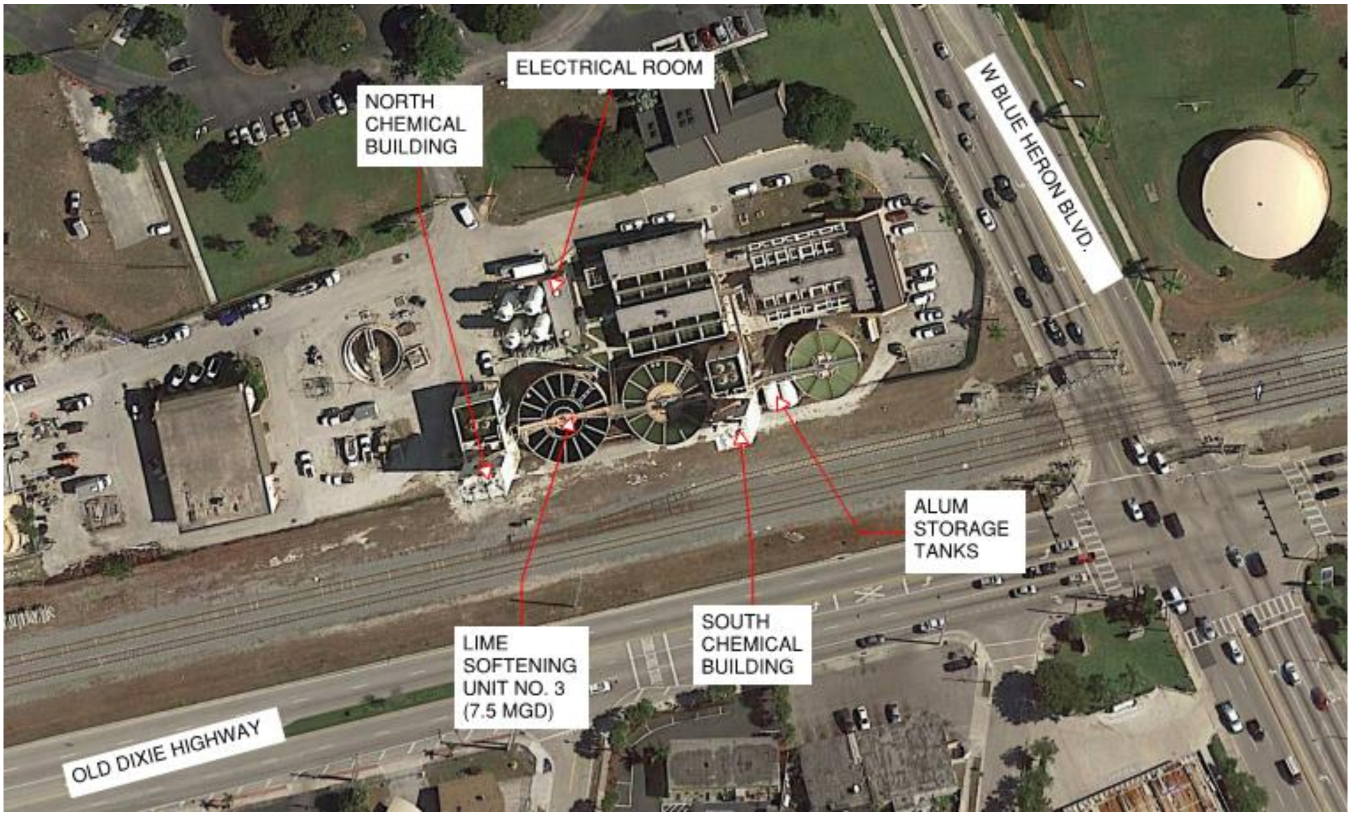

Figure 1-1. Site Map and Project Areas

The City utilizes gaseous chlorine and ammonia for chloramination disinfection which is constrained in its ability to automatically control the dosing and ratio of chlorine and ammonia application. The existing gas chlorination system is located in the structurally compromised North Chemical Building (NCB) and the ammonia feed system is located in the South Chemical Building (SCB). The City's overarching goal is to eliminate the continued use of gaseous chlorine and ammonia and consolidate disinfection in the SCB to phase out continued operations that rely on the NCB. Other NCB chemical feed systems that will be permanently consolidated in the SCB (or elsewhere) include the existing lime feed system (inoperable) and polymer feed system (already temporarily relocated). The lime feed system will be upgraded and configured to allow for the controlled application of lime to each of three existing lime softening units and additional treatment capabilities will be provided to achieve pH control/stabilization of softened water. Existing electrical motor control equipment housed in the NCB will also be replaced at a new location.

The City's goal is to eventually convert from the use of ammonia gas to the alternative use of liquid ammonium sulfate (LAS). However, with the elimination of operational use of the NCB and resulting consolidation of chemical feed systems in the SCB, adequate space in the SCB is not available to accommodate a LAS system currently. Consequently, to expedite the functional improvements of the chloramination process, the continuing use of ammonia gas will be retained for an undefined period until alternate accommodations may be made. In the interim, upgrades will be made to the existing gas ammonia feed system to improve controls and operational/excursion monitoring unless an LAS system alternative is agreed upon. Space utilization and ancillary improvements to the SCB as well as monitoring, controls, operator notification and supporting utility requirements for each chemical system.

The City intends to use the services of Design-Build firms to develop the detailed design requirements and implement the recommended improvements. Consequently, the objective of this Technical Memorandum is to develop the conceptual design criteria for the work to be assigned to others for implementation. Pursuant to Florida Statutes 287.055, "*the purpose of the design criteria package is to furnish sufficient information to permit design-build firms to prepare a bid or a response to an agency's request for proposal, or to permit an agency to enter into a negotiated design-build contract*". The following project implementation packages are expected to be assigned for design/implementation by selected firms (note – the City reserves the right to reassign or delete projects):

Design-Build Package No.1

1. Sodium hypochlorite feed system
2. Ammonia system improvements
3. Polymer system improvements
4. Lime Softener No. 3 influent modifications
5. Flow metering, water quality monitoring and control improvements
6. Plant Water Improvements
7. General improvements to SCB (egress, ventilation, eyewash stations, windows, etc.)
8. Ancillary improvements – piping, injection points, supports, painting, color coding/labels/signs, etc.

Design-Build Package No. 2

1. Standalone lime system capable of feeding all softening units
2. Retrofit existing lime system (in SCB) to establish capability of feeding the North Softening Unit
3. Replacement of electrical gear currently housed in NCB
4. Recarbonation system
5. Ancillary improvements – piping, injection points, supports, painting, color coding/labels/signs, etc.

Implementation of the above-noted packages shall be coordinated to facilitate required sequence of construction, avoid potential for conflicts between contractors and support required phasing as may be directed by the City. Additional work, not defined herein, that may be implemented, at the City's sole discretion, in future construction packages include the following:

1. Stabilization and/or demolition/reconstruction of the North Chemical Building;
2. Rehabilitation of lime softening units (LS) No. 1 and 2
3. Implementation of improvements to existing filtration system;
4. Implementation of improvements to main electrical service and standby generator;

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5. Implementing mixing improvements to ground storage tank;
6. Other facility improvements.

1.2 General Requirements

Each Contractor shall consider pertinent requirements included in Sections of this TM that apply to general requirements of the proposed work. General requirements include but are not limited to:

1. Materials selection
2. Layout of proposed systems to minimize interference with existing systems
3. Safety considerations (e.g. arc flash, lightning, personal protective equipment (PPE) requirements, labeling of panels, handrails, etc.)
4. Ancillary systems (alarms, safety interlocks, operator notification, supports, etc.)
5. Code compliance (e.g. electrical standards, Florida Building Code)
6. Supporting utilities (e.g. plumbing, electrical, availability and adequacy of plant/process water)
7. Spare parts recommended by manufacturer

Section 2: Design Flows

This section summarizes the criteria relative to design flows proposed improvements.

2.1 Plant Design Flow Conditions

Table 2-1 presents recent actual and design flows for the plant wide raw water supply and finished water. These flows do not reflect intra-process flows that will impact the chemical feed systems design that will vary for each process location. The proposed annual average day design flow is based on the South Florida Water Management District (SFWMD) water use permit, where 9.08 MGD is the annual surficial withdrawal allocation. The existing permitted plant capacity is 17.5 MGD (on a maximum daily flow (MDF) basis). The highest MDF that may be supported by the existing permitted water use allocation is estimated to be 13.6 MGD or rounded to 14.0 MGD, assuming a max day to average day peaking factor of 1.5 and no process water loss.

Table 2-1. Summary of Flows Based on 2016-2019 MOR Data

Condition	Observed Raw Water Flows (MGD)	Observed Treated Water Flows (MGD)	Proposed Design Flow (MGD)	Comments
Minimum Flow	4.78	4.61	Less than 3	Impacts normal metering turndown. Factors in different softening unit capacities.
Annual Average Day Flow	8.28	7.83	9.08	Average from 2016 to 2019. Assess chemical storage adequacy.
Maximum Day Flow	11.16	11.53	See note	Impacts normal max chemical feed rate – design requirement shall be determined for each application point.
Design Flow	n/a	n/a	14.0-17.5*	*Design flow may be limited by chemical feed storage. Design capacity may be less than nominal rated capacity but no less than 14.0 MGD.

Note: Maximum design flow varies for each injection point depending on flow range.

Figure 2-1 is a simplified overview of the water treatment plant process flow diagram. The varying capacities of the lime softening (LS) units and the Save All Basin recycle stream will impact the control of chemical feed systems.

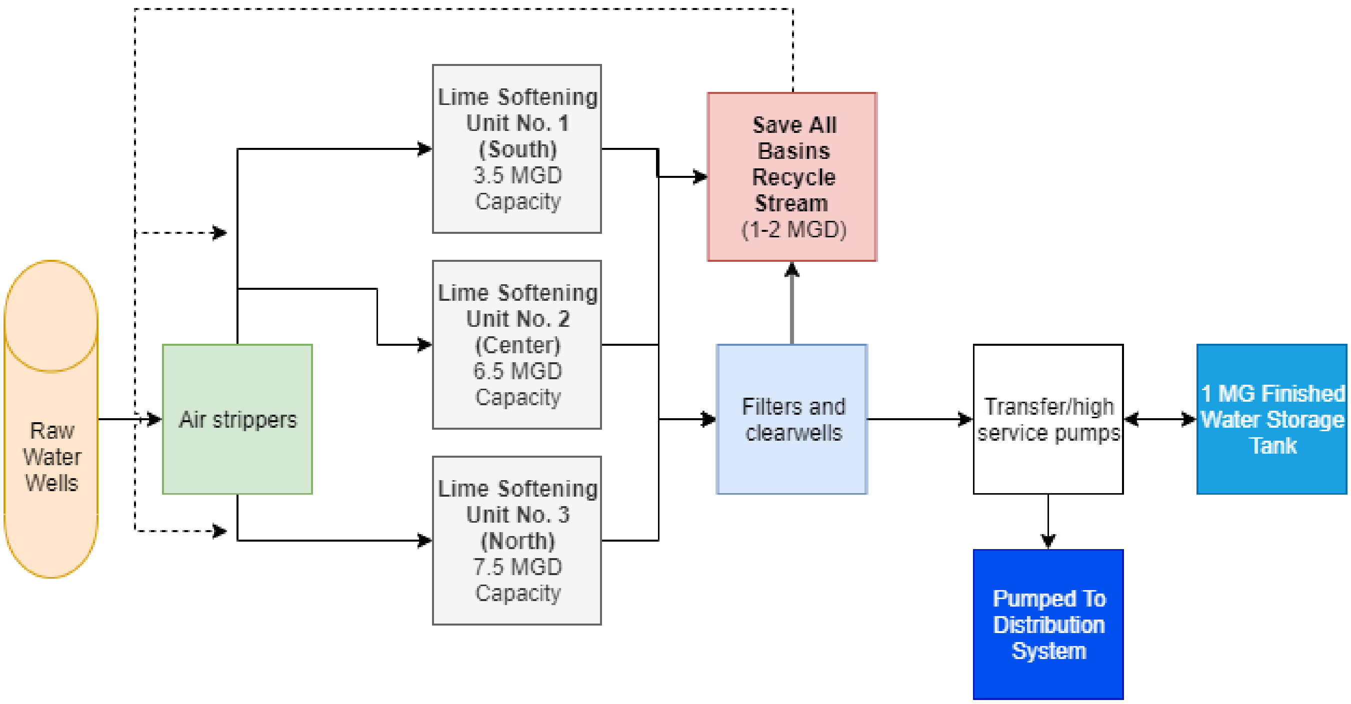

Figure 2-1. Overview of Water Treatment Plant Process Flow Diagram

Section 3: Chemical Feed Systems Design Criteria

For each chemical feed system, all structural, electrical, controls, site/civil, piping, mechanical, safety components and ancillary systems required to deliver a fully functional system that complies with applicable codes and standards shall be developed and applied to the delivery of the proposed system. This includes equipment vendor and material selection, adequate process water supply, utilities and other requirements to achieve a fully functional system.

The conceptual design criteria provided herein are minimum requirements to guide the Contractor's design efforts and are not intended to be comprehensive in scope. Furthermore, the indicated arrangement may have been configured around one specific system vendor; however, such conceptual arrangement is not intended to limit the Contractor's consideration of other alternatives that are cost effective and meet the City's functional requirements. During the preliminary design development phase, the Contractor is encouraged to identify and present to the City alternative approaches that offer the potential to add value.

3.1 Historical Raw Water Quality Data

Table 3-1 contains an overall range of raw water quality data from the water treatment plant monthly operations reports, based on January, April, July and October datasets from each year. Raw water samples are collected pre-stripping from the air stripper basin. The range is comparable to the 2011 average raw water data from the Water and Wastewater Master Plan and 2015 raw water sampling data from TestAmerica and Jupiter Environmental Laboratories.

Table 3-1. 2017-2019 WTP MOR Historical Raw Water Quality Ranges

Parameter	2017-2019 Overall Range	
	Min	Max
pH	7	7.9
M.O. Alkalinity (mg/l)	204	300
Calcium Hardness (mg/l)	236	320
Magnesium Hardness (mg/l)	6	22
CO2 Calc. (mg/l)	2	55
Iron as Fe (mg/l)	0.05	0.9
Color	14	67

3.2 Chemical Dosages

This subsection identifies the design minimum, average and maximum dosage for each chemical feed system. The target chemical dosages were established based on a combination of historical plant operating records, recommendations established in the City's Master Plan, published manufacturer recommended dosage guidelines, and supplemental tests conducted with the objective of validating treatment requirements. The recommended chemical dosages and supporting assumptions are provided below in Table 3-2.

Table 3-2. Recommended Chemical Dosage Range				
Chemical	Design Dosage Range, mg/L			Comments/Assumptions
	Min	Avg	Max	
Sodium Hypochlorite (primary dosage points)	4	6	12	Breakpoint chlorination not targeted, except for periods of free chlorine maintenance flush. Dosages are consistent with MOR records and validated by jar testing. Average dose to be used to size storage inventory and min/max dosages used to size metering pumps.
Sodium Hypochlorite (secondary dosage points)	0.1	varies	8	To serve as backup to primary pumps and trim application.
Ammonia Gas	0.1	0.8	1.0	Recommended range typical for achieving a target chloramine residual of 3 to 5 mg/L at the point of entry at a maximum chlorine to ammonia-N ratio of 5:1. Assumes negligible background ammonia in treated water prior to ammonia application. Actual dose will be reduced by an amount equal to background ammonia after air stripping.
Lime	80	130	150	Dosage range correlates with RTW modeling results and jar testing results.
Polymer	0.3	0.6	1.5	Maximum dose allowed is consistent with manufacturer's published limit and average/min levels are consistent with typical range utilized by WTP.
Carbon Dioxide	5	12	20	Target dose to reduce softened water pH to the range of 8.3 to 8.5.

Water treatment chemicals are divided into six incompatible groups: Acids, Bases, Salts & Polymers, Adsorption Powders, Oxidizing Powders, and Compressed Gases. The currently considered WTP chemicals for RBUSD below:

- Sodium Hypochlorite is a base (Group II)
- Calcium Hydroxide (Hydrated Lime) is a base (Group II)
- Polymer is in Group III (Salts and Polymers)
- Ammonia and carbon dioxide are compressed gases (Group VI). It should be noted that each compressed gas should have its own separate storage/feed area

Contractor shall follow appropriate requirements and best practices pertaining to chemical compatibility, for example, the following are minimum EPA requirements that apply to the storage of various WTP chemicals:

1) Do not store liquid chemicals and dry chemicals together regardless of which compatibility group they fall into.
2) Do not store chemicals from different compatibility groups together.
3) Do not store products such as paint, antifreeze, detergent, oil, grease, fuel, solvent, and beverages in the same area as water treatment chemicals.

3.3 Lime Feed System

Currently the water treatment plant has two functioning Wallace and Tiernan paste slakers in the South Chemical Building (SCB). The existing system is not capable of dosing lime to the north lime softening unit (No. 3), does not have adequate storage capacity, and is unreliable and constrained in its ability to control the delivery of lime to a target pH set point in each operating lime softening unit. The goals of the proposed improvements are to:

1) Expedite retrofit improvements to the existing system that will facilitate the dosing of lime to each softening unit. This improvement is required to establish the capability to soften in the north softening unit in the interim period until a new lime feed system is installed;
2) Install a new lime storage and feed system that will serve primary operating duty with the retrofitted existing system be retained in a standby capacity.

Table 3-3 provides an overview of the lime system injection points applicable to both the retrofit and new lime feed system.

Table 3-3. Lime System Injection Points

Injection Point Number	Location Description	Function
1	South Softener No. 1	Softening
2	Central Softener No. 2	Softening
3	North Softener No. 3	Softening

3.3.1 Retrofit of Existing Lime Feed System

The Contractor shall install a slurry holding tank, feed pumps, conveyance piping and related appurtenances to permit the controlled delivery of slaked lime to each lime softening treatment unit. Contractor shall assess the feasible options for cost effectively achieving this objective in a manner that may be implemented on an expedited basis (by June 2020). Optional locations for siting the required equipment include: 1) the first floor in an area that will also house the proposed sodium hypochlorite feed system; 2) the second floor in the area below the lime slakers; 3) other location in the SCB identified by Contractor that is compatible with proposed use. The reconfigured existing lime feed system will be maintained in a standby mode to temporarily feed lime in event the operation of the proposed system is interrupted.

3.3.2 New Lime Feed System

Contractor shall design, furnish and install a standalone lime storage, slaking and metering system that is capable of controlled delivery of slaked lime to the three existing lime softening units. The feed system shall be controlled in proportion to flow at an operator selected dose required to meet target pH. The settled water pH in each softening unit shall be continuously monitored and reported locally and remotely via the SCADA system.

The plan is to construct two new lime silo/slaker units, similar to those shown in Figure 3-1. Each unit will contain the components necessary to act as a standalone system: quicklime storage, feeder, grit removal, slaker, slurry holding tank, slurry pump, and controls. The slurry pump will maintain slurry in suspension at the manufacturer's recommended minimum velocity within a loop passing over all three lime softening units. Dosing assemblies would control the flow of slurry from the loop to each lime softening unit. Subject to funding limitations, the proposed units may be implemented in a phased manner with the existing retrofitted unit serving as a standby feed system. The proposed units would have automated equipment to be added to the Water Treatment Plant SCADA system to allow for remote monitoring, setpoint determination, alarm annunciation and operation from the plant control room. Additionally, each unit is to have all major components for lime slaking and slurry delivery, including quicklime storage, holding tank, and slurry pump, so that there is 1 duty and 1 standby unit. Some equipment, such as the grit removal system and lime slurry dosing assemblies, may be shared by both units.

Figure 3-1. Example of stand-alone lime slaking system from RDP Tekkem

Two general locations are under consideration for the silos, as shown in Figure 3-2. The footprint for both silos sited together is anticipated to be about 20’ by 50’. Location 1 is a footprint over a dirt area which has miscellaneous purposes, such as space for chemical truck maneuvering after delivering quicklime. Location 2 is a footprint which requires demolition of the abandoned sludge thickener.

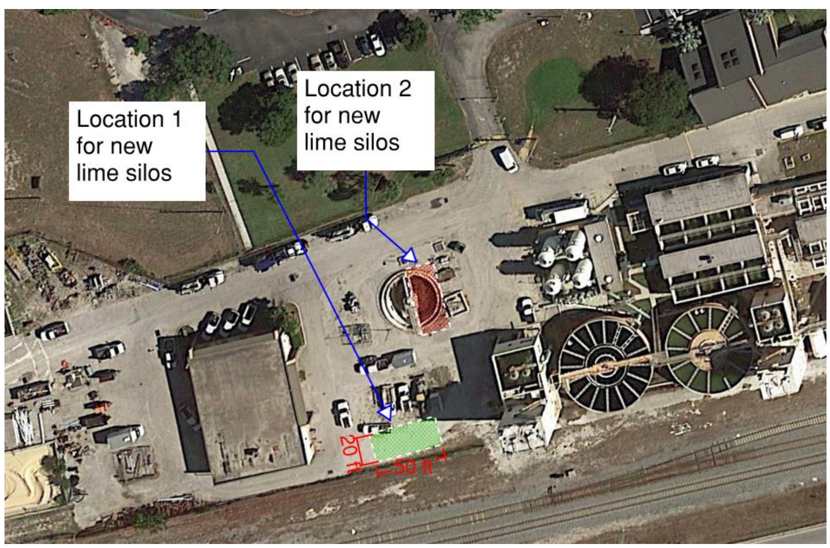

Figure 3-2. Potential Locations for Standalone Lime System.

Both locations will have to be researched and refined further to determine if they meet certain criteria, including but not limited to:

1. Setback requirements
2. Accessible by quicklime trucks
3. Grit removal
4. Suitable distance from the North Chemical Building in the event it undergoes demolition

5. Suitable for slurry piping and dosing assemblies reaching all three lime softening units
6. Suitable for utility connection

The design criteria presented in this section was based on historical data and jar testing data conducted on raw water from the Air Stripper Basin in the Water Treatment Plant. For the last several years, the RBUSD did not soften 100 percent of the raw water supply and general inconsistencies exist in the recorded flows and chemical consumption that makes historical data unreliable for determining design requirements. While not reliably metered, raw water bypass flow is estimated by plant operating staff to range from 1 to 4 mgd. Consequently, among the sources of information reviewed, the jar testing conducted was selected as a conservative indicator of expected lime dosages required for a range of softened water pH values. Based on the jar testing results shown in Figure 3-3, a quicklime dosage between 100-200 mg/l would lead to settled water pH levels between 8.3 to 10.1. The plant targets a softened water pH in the range of 6.5 to 8.5, however, due to limitations of the existing lime feed system, consistent operation within the target range is a challenge to achieve. Currently, the plant relies on its post softening chlorination (using gas) to lower the treated water pH to the finished water pH range of 8.0 to 8.5 that has historically been targeted by plant operators. With the planned replacement of the gas chlorine system with sodium hypochlorite, the pH reduction benefit provided by the current use of chlorine gas for secondary disinfection will no longer be available. Consequently, a carbon dioxide feed system is also recommended for post-softening pH adjustment (discussed in a subsequent Section).

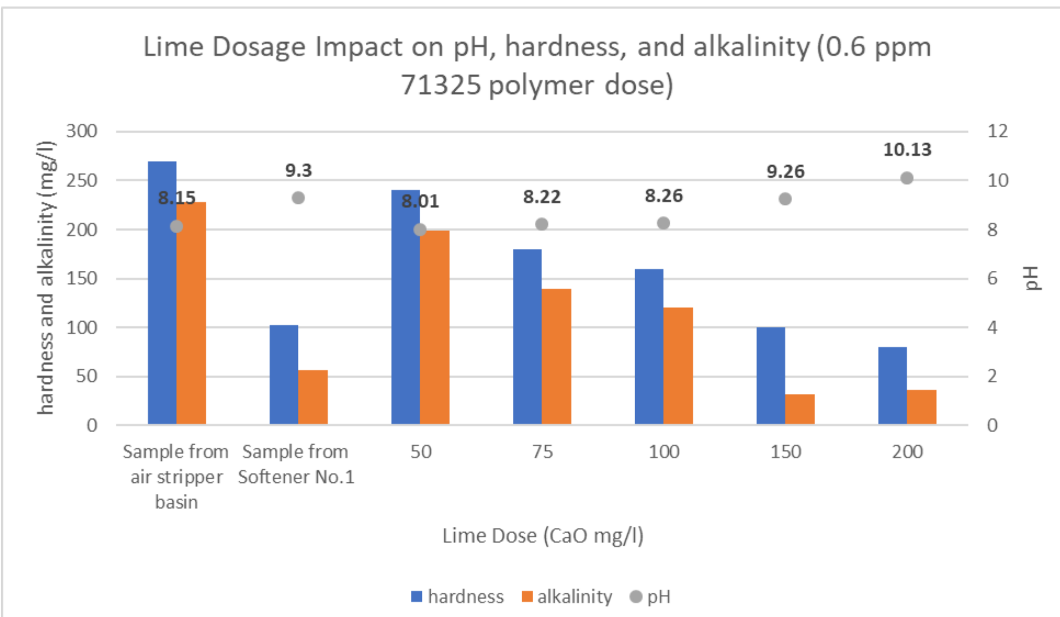

Figure 3-3. Lime Dosage Jar Testing Data

The average chemical feed requirements calculations indicate a feed rate that is likely more than the historical feed rate of 5000 pounds quicklime per day from 2018 to 2019. Therefore, the impact on sludge handling, tendency for calcium scale formation, and operating expenses are important considerations that could potentially limit the allowable operating regime. A separate analysis of the sludge handling system (beyond the scope of this effort) is required to assess its capacity to handle increased sludge production. It is further noted that improvements to the sludge handling system are beyond the scope of proposed improvements.

Table 3-4 provides an overview of the anticipated equipment in a new standalone silo system which would contain two interconnected silos with the majority of equipment in each silo. The type of equipment selected will depend on the vendor selected and client preferences.

Table 3-4. Lime System Equipment Sizing

Parameter	Value	Comments
Quicklime Storage Silos		
Number of Silos	2	1 duty + 1 standby
Minimum Silo Capacity, Each (tons)	86	30-days of storage, average chemical feed conditions
Lime Slakers		
Type	Batch or Paste	Depends on client preference and vendor. Able to meet design flow and dosage conditions.
Number of slakers	2	1 duty + 1 standby
Slaker Capacity (lb/hr)	1,000	1 slaker suitable to handle plant design capacity
Slurry Holding Tanks		
Number of Tanks	2	1 duty + 1 standby
Tank Volume, Each (gal)	1000	Based on average chemical feed conditions. At least 2 hours of detention time. Equipped with mixers.
Slurry Pumps		
Type	Rubber lined centrifugal pump	Suited for lime slurry and able to maintain minimum velocity to prevent lime settling in pipes.
Number of Pumps	2	1 duty + 1 standby
Feed Point Dosing Assembly		
Number of Assemblies	3	One for each softening unit mixing zone

Suitable Materials of Construction: for the slurry loop piping is PVC and/or reinforced rubber hose (EPDM, reinforced with synthetic fiber and wire); and unpainted 304 stainless steel for slaker, feeder, holding tank, grit remover conveyor (painted carbon steel is low cost alternative but may not be as durable as stainless steel under abrasive conditions).

3.4 Polymer System

Originally polymer was provided at the WTP as a coagulant aid (previously Aluminum Sulfate). RBUSD has discontinued the use of Aluminum Sulfate and currently polymer is used as the sole coagulant. The existing Polymer Feed System is temporarily housed on the first floor of the South Chemical Building and needs to be relocated. The system was originally located in the North Chemical Building and some of the inoperable equipment has remained there.

This project will be to provide in-kind replacement of the Polymer Feed System with all new equipment. The new Polymer Feed System will be located on the first floor of the South Chemical Building in the previous location of the WTP's main generator. New Yard Piping will also be installed to route polymer to the designated injection points. The Polymer Feed System will utilize 55-gallon drums for polymer delivery (as with the current system). These drums will be placed on scales and neat polymer transferred, mixed and diluted into an aging tank for a minimum of 30 minutes of aging and distribution as a diluted solution to the injection points summarized in Table 3-5. Containment will be provided to contain 150% of the volume of the aging tank. Each injection point will be fed by a single feed pump with a single installed backup available for the largest pump out of service. The feed system will be appropriately manifolded to allow for the backup pump to feed any disinfection point desired.

Table 3-5. Polymer System Injection Points

Injection Point Number	Location Description	Function
1	North Softener	Coagulation
2	Central Softener	Coagulation
3	South Softener	Coagulation

The Polymer Feed and Storage Facility will consist of Two Scales for the storage of 55-gallon drums with an additional dedicated storage area for an additional four (4) full 55-gallon drums and three (3) empty drums. Peristaltic pumps will transfer neat polymer to a mini polymer feeder that properly mix and dilute the polymer to approximately a 0.5% delivered solution strength. This solution will be stored in an aging tank with a mixer from which the diluted solution will be pumped by additional diaphragm metering pumps to the injection points. The aging tank must be of a size to allow for at least 30 minutes of aging. The system must have a potable water feed to allow for dilution of polymer. A layout of the storage facility is shown in Attachment B, Conceptual Drawings, Figure B-3.

The dosages are based on historical data reported by RBUSD staff and polymer demand studies performed by Nalco (Polymer vendor) in cooperation with RBUSD staff. Neat Polymer is delivered with a 35% active polymer but the determined feed rates are for the neat solution as delivered. Likewise, the delivered solution is diluted to 0.5% of which 35% of that is active polymer. The calculations performed in this section are based on the above facts and should be updated by the design engineer to reflect final design conditions. The estimated dosages for polymer (Section 3.2) are provided from field test performed by Nalco and RBUSD. Estimated flows are provided in Section 2.

Table 3-6 summarizes the major equipment for the Polymer Feed Facilities.

Table 3-6. Polymer System Equipment Summary		
Parameter	**Value**	**Comments**
Polymer Scales		
Number of Scales	2	1 duty + 1 standby
Delivered Neat Polymer	55-gallon drums	55 gallon drums are placed on scales
Required Drum Storage	6 drums	Room for at least 4 full drums to be stored off the scales with additional storage space for 3 empty drums
Transfer Pumps (Neat Polymer)		
Type	Peristaltic	Sized to feed Mini Feeder
Number of Pumps	2	1 + 1 standby (on alternate scale). Pumps / scales alternate as active
Pump Capacity	TBD (typically 0.3 – 0.9gph)	To be determined by Design Consultant
Mini Feed / Dilution System		
Type	Mini Polymer Feeder	Nalco MPF100 or approved equal
Number of Mini Feeders	2	1 duty + 1 spare (shelf spare).
Mini Feeder Capacity	4gpm	To be confirmed by Design Consultant
Control Center		Required for control (120 VAC)
Aging Tank		
Number of Tanks	2	FRP Tank with baffle / 2" outlet, appropriate inlet and 3" overflow
Tank Size [gal]	350	Must allow for 30 minutes of aging at maximum feed rate
Probe	Level Probe	Linked to Controller for Mini Feeder
Metering Pumps		
Type	Diaphragm	
Number of Pumps	4	3 duty + 1 standby (can feed any injection point)
Pump Size	TBD	To be determined by Design Consultant for all Injection Points
Pump Control	Flow Paced	Pumps will be controlled by PLC and flow based from a selected flow meter (selected by operator)

Materials of construction must be compatible with up to 50 percent active polymer solution.

3.5 Recarbonation System

Currently disinfection at the WTP is provided by a gaseous chlorine system located in the North Chemical Building and an anhydrous ammonia system with rotameters located on the second floor of the South Chemical Building. RBUSD has decided to replace gaseous chlorine with sodium hypochlorite. The use of chlorine gaseous chlorine works to reduce pH while sodium hypochlorite will increase pH. Additionally, having the flexibility to soften at higher pH levels is desirable. Thus, it has been decided to utilize a recarbonation system to control and reduce the pH of the treated water.

This project will be to provide a recarbonation system. The main system will be located adjacent to the new lime system. New Yard Piping, Chemical Injectors and ancillary recarbonation systems (Pressure Feed Panels, pH probes, etc.) will also be installed to provide a system to reduce the pH as desired. The recarbonation system will provide carbon dioxide to the injection points summarized in Table 3-7. Due to the effluent pipe constraints the dosage will likely be flow paced instead of pH based. The feed system will be appropriately manifolded to allow for a backup feed to any CO2 Injection point desired if the primary feeder is disabled.

Table 3-7. Recarbonation System Injection Points

Injection Point Number	Location Description	Function
C1	North Clarifier Water Effluent Box	pH Control
C2	Center Clarifier Water Effluent Box	pH Control
C3	South Clarifier Water Effluent Box	pH Control

The storage tank, chiller, evaporator, feed panel and ancillary equipment and controls will be located adjacent to the new lime silos. The solution pressure feed panels will be located on the second floor in the ammoniator room as shown in Attachment B, Figure B-6. pH probes will be located as required throughout the WTP in order to provide pH samples for process control for the above listed injection points.

Table 3-8 summarizes the recarbonation system equipment for pH control to meet a target pH of 8.5 after lime softening. Minimum tank capacity is based on the average dosage shown in Section 3.2 and should be confirmed by the design engineer based on the anticipated average lime dosage and sodium hypochlorite dosage.

Table 3-8. Recarbonation System Equipment Summary		
Parameter	**Value**	**Comments**
CO_2 System		
Number of Tanks	1 (Insulated)	Comes as system
Min. Tank Capacity, Each (gals)	14 Tons	Storage capacity to be confirmed by design engineer
Minimum Days of Storage	30	
Refrigeration System	1	Enclosed in Prefinished Aluminum Equipment Enclosure with Tank
Vaporizer System	1	Enclosed in Prefinished Aluminum Equipment Enclosure with Tank
CO_2 Feed System		
Type	Pressure Solution Feed Panel (PSF)	Sized for each Injection Point
Number PSF	3	Require Feed Water System
PSF Capacity	TBD	To be determined by Design Consultant for all Injection Points
pH Probe Assembly Panels	3	Located to sample water from each injection point location
Feed Point Dosing Assembly		
Number of Assemblies	3	One for each Injection Point + 2 shelf spares

Materials of construction must be compatible with up to 100 percent carbon dioxide.

3.6 Sodium Hypochlorite Feed System

Currently disinfection at the WTP is provided by a gaseous chlorine system located in the North Chemical Building. RBUSD made the decision to move away from chlorine gas to sodium hypochlorite (SHC) for disinfection and previously considered a larger scale disinfection system. With the current expectations of relocating the WTP, RBUSD has decided to implement a smaller scale sodium hypochlorite system that is expected to serve as the WTP's disinfection system for the next five or so years while plans for a new WTP are implemented.

This project will be to provide a new sodium hypochlorite storage tanks and feed facility (Disinfection Facility). New Yard Piping and Chemical Injectors will also be installed to route and inject sodium hypochlorite into the designated injection points. The feed facility will be housed on the first floor of the South Chemical Building and the storage tanks located outside adjacent to the southwest corner of the South Chemical Building. Bulk sodium hypochlorite from this facility will be used for primary and secondary disinfection at the WTP with the sole utilization of chloramines. RBUSD decided that the operation utilizing free chlorine was not desired and is not part of the storage requirements. The Disinfection Facility will provide sodium hypochlorite to various injection points summarized in Table 3-9. Each primary of secondary injection point will be feed by a single pump with a single installed backup available for the largest pump out of service. The feed system will be appropriately manifolded to allow for the backup pump to feed any disinfection point desired.

Additional backup pump may be deemed to be required by the design engineer depending on sizing and turndown ability of the various pumps assigned to the different injection points (with varying feedrates).

Table 3-9. Sodium Hypochlorite System Injection Points

Injection Point Number	Location Description	Pipeline Size	Function
1	Air Strippers Raw Water Influent	30	Tower Maintenance
2	North Influent Basin Raw Water Influent	24	Primary Application
3	South Influent Basin Raw Water Influent	24	Primary Application
4	Recycle Water	10	Primary Application
5	Return Backwash Water	10	Filter Maintenance
6	South Softener Effluent (No.1)	30	Primary Application (alternate)
7	Central Softener Effluent (No.2)	36	Primary Application (alternate)
8	North Softener Effluent (No.3)	30	Primary Application (alternate)
9	1MG Storage Tank Return Water	20	Trim
10	High Service Pump Clearwell	trench	Trim
11	Finished Water Discharge	30	Trim

The sodium hypochlorite storage and feed facility will consist of two storage tanks in a concrete containment area with a canopy cover that is located adjacent to a feed pump room housed in an enclosed existing building (1st floor of the South Chemical Building). The walls of the containment area and finished floor of the feed pump room will be at an elevation sufficient to meet current regulatory requirements. The facility will be located on the south portion of the WTP within and adjacent to the South Chemical Building. The storage tanks will have the ability to be filled by tanker trucks with access from the west side of the WTP property's fence line as is currently done for existing lime deliveries. A locked gate will be provided at the fill points to allow the quick connections to be accessed from the ROW while being located within the WTP property line and fence. The feed pumps and ancillary equipment and controls will be located in the existing South Chemical Building in the western room on the first floor. The facility will require potable water for safety showers, eyewash stations, and hose bibb. A layout of the storage facility is shown in Attachment B, Conceptual Drawings, Figure B-4 and B-5.

Sodium Hypochlorite is assumed to be delivered at 12.5% trade for all calculations performed in this section. The estimated dosage for normal operation is provided in Section 3.2. Estimated flows are provided in Section 2.

Table 3-10 summarizes the major equipment for the Sodium Hypochlorite Feed Facilities.

Table 3-10. Sodium Hypochlorite System Equipment Summary		
Parameter	**Value**	**Comments**
Sodium Hypochlorite Storage Tanks		
Number of Tanks	2	2 preferred over 1 larger tank
Min Tank Capacity, Each (gals)	5,400	Max Month Average Day Flow
Minimum Days of Storage	4	
Bag Filters	2	One for each Tank Fill Line
Tank Drain	2	One for each tank. Each tank can be independently drained while other tank remains in service
Sodium Hypochlorite Feed Pumps		
Type	Gear Pumps	Sized for each Injection Point
Number of Pumps	7	To be confirmed by Design Consultant. Depends on how pumps and injection points are routed.
Feed Point Dosing Assembly		
Number of Assemblies	13	One for each Injection Point + 2 shelf spares

Materials of construction must be compatible with up to 15 percent sodium hypochlorite solution. Storage tanks should be made of either Cross-linked HDPE or fiberglass reinforced plastic (FRP), yard piping will be Schedule 80 polyvinyl chloride (PVC) piping. Valves will be PVC with compatible gasket material and properly vented. Containment areas will be concrete with chemical resistant protective coatings applied.

3.7 Gaseous Ammonia System Improvements

Currently disinfection at the WTP is provided by a gaseous chlorine system located in the North Chemical Building and an anhydrous ammonia system with rotameters located on the second floor of the South Chemical Building. Although the intent of this project is to maintain the anhydrous ammonia system, it's RBUSD's goal to implement Liquid Ammonium Sulfate (LAS) instead if feasible.

This project will be to provide in-kind replacement ammoniators to be located on the second floor of the South Chemical Building but in a different location (eastern portion of building rather than the western portion). New Yard Piping and Chemical Injectors will also be installed to route and inject ammonia into the designated injection points. The existing ammonia storage tank located to the south of the Southernmost softener will remaining in use and provide the ammonia storage for this system. The ammoniators will provide gaseous ammonia to the injection points summarized in Table 3-11. Each injection point will be feed by a single pump with a single installed backup available for the largest pump out of service. The feed system will be appropriately manifolded to allow for the backup pump to feed any disinfection point desired.

Table 3-11. Ammonia System Injection Points			
Injection Point Number	Location Description	Pipeline Size	Function
A1	North Influent Basin Raw Water Influent	24	Primary Application
A2	South Influent Basin Raw Water Influent	24	Primary Application
A3	High Service Pump Clearwell	trench	Primary Application
A4	Finished Water Discharge	30	Secondary Application

The feedersand ancillary equipment and controls will be located in the existing South Chemical Building in the eastern room on the second floor as shown in Attachment B, Figure B-6.

Estimated flows are provided from Section 2. Daily storage is provided by the existing 1000 gallon anhydrous ammonia storage tank located adjacent and south of the southernmost softener.

Table 3-12 summarizes the major equipment for the ammonia system. Materials of construction must be compatible with up to 100 percent anhydrous ammonia. Yard piping will be Schedule 80 PVC Double wall containment piping for 1-inch Schedule 40 Black Iron pipe. Valves will be suitable for gaseous ammonia.

Table 3-12. Ammonia System Equipment Summary		
Parameter	Value	Comments
Gas Feed Systems (Ammoniators)		
Type	Gas Feeder	One per Injection Point. Sized for each Injection Point(V10K or approved equal with optional fully automatic control by process controller)
Number of Ammoniators	4	3 duty + 1 standby
Feed Point Dosing Assembly		
Number of Assemblies	4	One for each Injection Point + 1 shelf spare (Table 3-6-1)
Water Booster Pumps	TBD	Related to Plant Water Improvements to ensure adequate water pressure in potable water main.

3.8 South Chemical Building Modifications

This section identifies modifications to the South Chemical Building that are required to accommodate the proposed chemical feed systems. Occupancy of the South Chemical Building is not expected to change following the chemical feed system improvements. Generally, the scope of improvements includes the following:

1. Installation of interior walls, where indicated or needed to separate incompatible uses
2. Ventilation improvements for each chemical feed area
3. Installation of modified/new access doors and associated appurtenances (e.g. lighting), where indicated or needed to meet ingress/egress requirements
4. Installation of eyewash stations where indicated with local/remote notification of activation
5. Replacement of windows and doors with suitably rated for hurricane impact, where needed

The selected DB Contractor shall be responsible for field measurements, code analysis, development of design details and implementation of required improvements. Testing has not been conducted to determine the presence of lead paint or asbestos. Contractor shall conduct its own testing to determine occurrence and appropriate mitigation measures as part of the proposed work.

Section 4: Functional Requirements of Chloramination System

The integrated functional operation of the sodium hypochlorite and gaseous ammonia (or LAS) feed systems is presented in this section. To provide for coordinated chloramination improvements, this section summarizes the functional requirements of an integrated feed system and conceptually defines how the systems are intended to operate under normal situations. The proposed process flow diagram in Attachment B presents a schematic representation of the process locations to be monitored for each water quality parameter. The scope of services shall include the design of instrument installation, power supply, and SCADA system integration. Instruments shall be housed in panels that provide shielding from direct exposure to sunlight and shall be suitable for the service environment.

4.1 Normal Operation of Chloramination System

The proposed chloramination system is configured to provide for the controlled application of sodium hypochlorite (SHC) and ammonia in several locations within the treatment process. However, under normal application, only a limited number of dosage application locations are expected to be utilized. Locations not utilized for normal operation are provided to improve operating flexibility and periodically facilitate maintenance application of SHC. At each application point, there are intra-process flow differences to account for as shown in Figure 2-1.

The functional description that defines the intended normal operating procedure for the SHC and ammonia systems is summarized below:

4.1.1 Raw Water Application

a. SHC dosage point is provided for occasional maintenance application.

b. Addition of ammonia is not required.

c. Provide online water quality monitoring (total chlorine residual or oxidation-reduction potential (ORP) to provide operator feedback.

4.1.2 Pre-Lime Softening (LS) Application

This will be the primary application point for SHC.

a. SHC dose (or target residual) will be operator adjustable and will be controlled by flow pace with residual trim.

b. Breakpoint chlorination will not be targeted under normal operation. Ammonia will be applied only to the extent required to prevent/quench formation of free chlorine residual and in operator selectable ratio to chlorine residual (or applied SHC dose).

c. Water quality monitoring for total/free ammonia and chlorine residual will be conducted for process monitoring, reporting and control purposes.

4.1.3 Post-LS – Pre-Filtration Application

a. The flexibility to apply SHC at the discharge of each LS unit is provided. This is intended to be a secondary application of SHC that will not be used for normal operation.

b. Conditions that may trigger the application of SHC include periodic conversion to free chlorine for maintenance of biological activity in the filters.

c. While intended for periodic operation, at the operator's discretion, the flexibility exists to routinely apply SHC to restore total chlorine residual depletion across the lime softening units.

d. Applied SHC dose will be controlled by flow pacing with capability for residual trim.

e. The flexibility to alternatively apply ammonia post softening is provided.

4.1.4 Post Filtration Application

a. Apply SHC upstream from the high service pumping wetwell and monitor chlorine and ammonia residuals in the HSP discharge.

b. Applied SHC dose will be controlled to meet operator adjustable residual setpoint by flow pacing (combined filter effluent flow) with capability for residual trim.

c. Ammonia dose capability will be available in standby mode to provide trim application where required to quench free chlorine residual detected in the finished water.

4.2 Maintenance Operating Modes

The proposed SHC system is configured to provide the plant operators the flexibility to periodically apply SHC for process water quality maintenance. Typical maintenance objectives might include the control of algae and other biological growth in unit processes inclusive of air strippers, filters and process piping. Maintenance operating modes incorporated into the proposed design include the following:

4.2.1 Raw Water Application of Chlorine

This is not a preferred operating mode due to the potential impact of raw water hydrogen sulfide and iron levels on required chlorine dose. Should the operation of the air strippers indicate the need for maintenance intervention, a more appropriate approach would be to remove each unit from service and conduct cleaning protocols that may include the use of acid and high strength chlorine rinses.

4.2.2 Free Chlorination of Filters

Two modes of free chlorinating filters for maintenance purposes are provided:

a. Establish free chlorine residual after one or more lime softening units to carry a free residual across the aligned filters. Quench free chlorine residual with ammonia post-filtration.

b. Establish free chlorine residual in backwash supply to permit individual filters to be periodically chlorinated for biofilm control.

4.2.3 Post-Ground Storage Tank Application

a. Apply SHC downstream from the GST to provide trim to make up residual depletion that occurs in storage.

b. Free ammonia residual monitoring will be provided to serve as the basis for controlling application of SHC trim dose. Note - ammonia trim capabilities are not required (assumes ammonia residual depletion would be due to nitrification in the GST that will require other measures to mitigate).

Refer to Attachment B for the updated process flow diagram that indicates the recommended chemical application and monitoring locations required to support the indicated maintenance operating modes.

4.3 Online Monitoring Capabilities for Routine Control of SHC and Ammonia

Online water quality monitoring capabilities shall be established to allow for data trending, excursion detection/notification and automated process control of chemical feed processes. The term “process” WQ monitoring, as used herein, is distinguished from “compliance” WQ monitoring in that the collected data is used for operational controls and not compliance reporting purposes. Depending on the placement of monitoring instruments and application, both process control and compliance objectives may be achieved by the same instrument.

The following online monitoring instruments may be considered for use where indicated to achieve the functional objectives of the chloramination process. A summary of the recommended online analyzers is provided in Table 4-1.

Table 4-1. Summary of Water Quality Monitoring Instruments

Analyte	Instrument Model/Mfg. or Equal	Comments
Free Chlorine Residual, mg/L	CL17 Chlorine (Free) Analyzer/Hach	Use for process monitoring/control and compliance reporting. Uses reagent and requires periodic maintenance; interference possible
Total Chlorine Analyzer, mg/L	CL17 Chlorine (Free) Analyzer/Hach	Use for process monitoring/control and compliance reporting. Uses reagent and requires periodic maintenance
Free/Total Ammonia and Monochloramine Residual, mg/L	5500sc Ammonia Monochloramine Analyzer/Hach	Use for process monitoring/control. Uses reagents; requires periodic maintenance
Free/Total Ammonia, Total Chloramine and Monochloramine, mg/L	Chemscan 2150S/ASA Analytics	Use for multi-parameter process monitoring. Uses reagents and requires periodic maintenance

Downstream from each ammonia injection point, after sufficient mixing is achieved, online monitoring shall be installed to confirm that the operational objective is achieved. Specifically, the primary process objective of ammonia application is to quench or prevent the formation of a free chlorine residual while at the same time, minimizing the resulting formation of a free ammonia residual. The Hach 5500sc analyzer (or alternatively the Chemscan 2150) was identified as a suitable selection for monitoring total and free ammonia residual.

4.4 Online Monitoring of Settled Lime Softened Water

Each lime softening unit shall be equipped for the monitoring of settled water pH which shall be reported locally and remotely to the SCADA systems.

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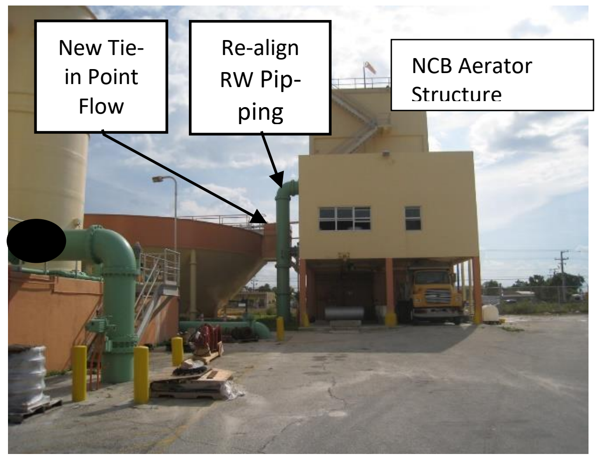
Section 5: WTP Piping and Flow Metering Improvements

Modifications to the existing process piping and flow metering arrangement are required to support the flow proportional control of chemical dosage delivery to target application points. For some process streams, existing flow meters are inoperable and must be replaced. In other cases, unmetered streams are to be equipped with flow meters to facilitate process monitoring and automated flow passed dose control.

The design details of this Section are to be developed by the assigned DB firm. All guidance provided below is intended to be preliminary and subject to independent validation during design development.

5.1 Piping Modifications

The influent piping to Lime Softening Unit #3 discharges to an aeration structure that is an integral part of the structurally compromised North Chemical Building (refer to photograph). The required work includes the following:



1. Disconnect piping that connects to the existing aeration structure
2. Realign piping to connect to and discharge into the influent receiving forebay of Lime Softening Unit No. 3. (LS No. 3), including the recycle stream.
3. Install replacement flow meter in vertical riser of raw water influent to LS No. 3 (addressed in subsequent section)
4. Consider impact on change in hydraulic grade on post-aeration transfer pumps and options for maintaining flow split among the three softening units.
5. Conduct field measurements to validate dimensions, pipe sizes, demolition limits, tie-in locations, fittings and appurtenances and required to complete the work.

Active operations are currently conducted out of the NCB with the gaseous chlorine system being in the immediate vicinity of the piping modification to be conducted. The work area is also located within a restricted area around the NCB that is vulnerable to falling debris from the structurally compromised building. LS No. 3 is currently out of service for structural rehabilitation and is expected to remain out of service until the piping modifications are completed and the ability to feed lime to the unit is established (discussed in a subsequent section). In event the unit is operational when work is to be performed, the DB firm shall provide the RBUSD with 14 days' notice prior to planned commencement of work.

5.2 Flow Metering Locations

This subsection summarizes flow metering improvements to support the automated flow proportional control of all chemical feed systems inclusive of sodium hypochlorite, ammonia (or LAS), lime, polymer and other systems that may be implemented in the future. An overall process flow schematic indicating the location of each new flow meter is shown in Attachment B, Conceptual Drawings.

The flow meter type and minimum operating range for each flow meter are summarized below in Table 5-1. All flow meters shall be located for maintenance accessibility and shall be configured with upstream and downstream clearance that are consistent with manufacturer's recommendations.

Table 5-1. Summary of Flow Meters

Meter #	Meter Type	Flow Range, mgd		Application/Location
		Min	Max	
1	Magnetic	3.5	17.5	Pre stripping Raw water (RW) flow
2	Magnetic	Less than 3	10	Post stripping RW flow to LS No. 1 and 2
3	Magnetic	Less than 3	7.5	Post stripping RW flow to LS No. 3
4	Magnetic	Less than 3	3.5	Post-aeration RW influent to LS No. 1 (to remain in service)
5	Magnetic	0	3	Save-all recycled flow to pre-aerators for LS No.1 and 2. Currently pump cycled on/off.
6	Existing	0	9	Filter backwash flow meter (to remain in service). Check operation in field.
7	Magnetic	Less than 3	17.5	Finished water flow to distribution system
8	Magnetic	0	9	Finished water flow to Ground Storage Tank
9	Magnetic	0	9	Finished water flow by gravity from Ground Storage Tank

Section 6: Electrical Relocation

As previously discussed, critical plant functions are being discontinued in the North Chemical Building and replacement components a being installed elsewhere in the plant. The electrical equipment in the second floor of the North Chemical Building currently feeds a variety of equipment/structures as shown in Figures 6-1 and 6-, including well pumps, gear for Lime Softening Unit No. 3, compressors, maintenance building, and save all basin. The electrical feed is to be relocated to allocated space in the electrical room adjacent to the air strippers, as shown in Figure 1-1 and Attachment B. Conceptual Drawings, Figure B-7 also includes a potential alternative to relocating the electrical feed to the air stripper room – an outdoor walk-in electrical enclosure that could be sited adjacent to the new lime silos. The main disconnect switch for Service No. 3 and ATS-4 are located in the existing Air Stripper Building Electrical Room, shown in Figure 6-3.

Figure 6-1. MCC-3 in poor condition on West Wall

Figure 6-2. PLCs in North Chemical Building on South Wall

Figure 6-3. Interior of air stripper electrical room during 2019 Site Visit

Section 7: Implementation Considerations

The following summarizes the key implementation sequence considerations for the proposed improvements at the City's WTP:

1. Compromised North Chemical Building (NCB) Mitigation: projects associated with systems in the North Chemical Building to be prioritized, particularly chlorine replacement, electrical relocation, and raw water influent modification.
2. Expedite Lime Softening Unit No. 3 startup: retrofit lime system, influent modifications, raw water flow meter replacement should be completed prior to scheduled rehabilitation (separate project) and startup estimated to occur in August 2020.
3. Retrofit lime system completed prior to startup of rehabilitated Lime Softening Unit No. 3 and before construction of sodium hypochlorite system begins in the South Chemical Building (SCB).
4. Switching from chlorine gas to sodium hypochlorite startup to be coordinated with recarbonation system for pH control. Testing the combined impact of the retrofit lime system and sodium hypochlorite system on pH prior to decommissioning the chlorine system is recommended.
5. SCADA integration to occur after new flow meters and chemical feed systems installed.
6. Decommission and demolition of North Chemical Building chlorine feed system, abandoned electrical equipment and potentially the building to follow after the sodium hypochlorite feed system startup, Lime Softener No. 3 influent modifications and electrical equipment relocation.
7. Parking – the proposed improvements will not impact parking requirements for the project site
8. Stormwater Management – the proposed improvements will not increase the impervious area of the project site by a significant amount and will not impact stormwater management requirements
9. Each DB firm shall conduct topographic, utility location, and other surveys as required by permitting agencies and deemed necessary for completion of its work.
10. DB firm shall develop all design requirements required to coordinate and permit the work to meet the functional requirements, solicit the City's input on the preliminary design requirements and incorporate agreed on preferences of the City.

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Section 8: Supplemental Information

The following information is available for general reference:

1) As-builts: 1964 water treatment plant improvements, 1991 standby power improvements
2) Existing Surveys: 2014 survey by Engenuity

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Attachment A: Photo Catalog of Proposed Chemical Injection Points

Photographs provided for flow meters, sodium hypochlorite and ammonia injection points

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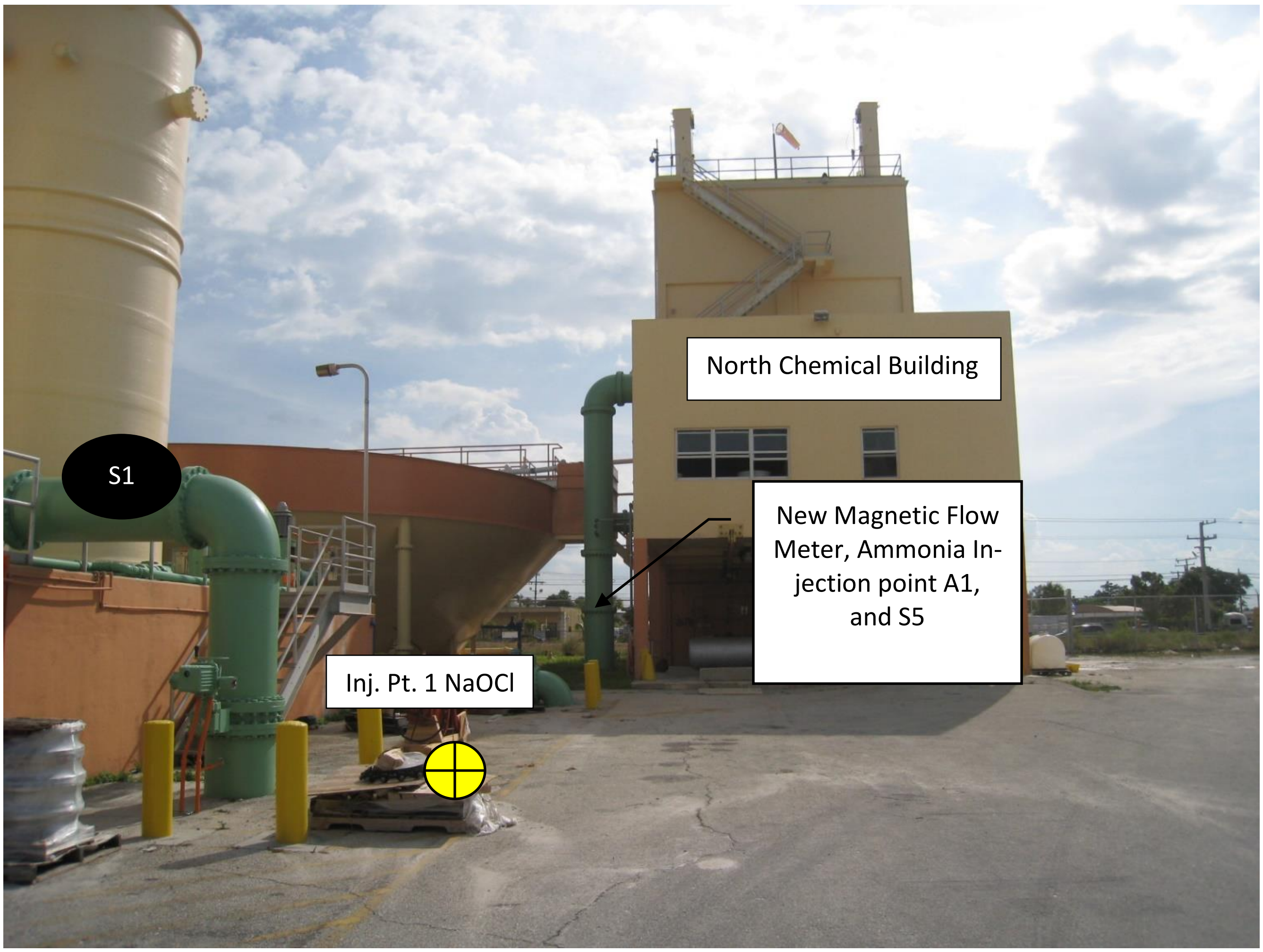

Figure A-1. Raw Water Influent Piping to Packed Tower Scrubbers and North Chemical Building in Background

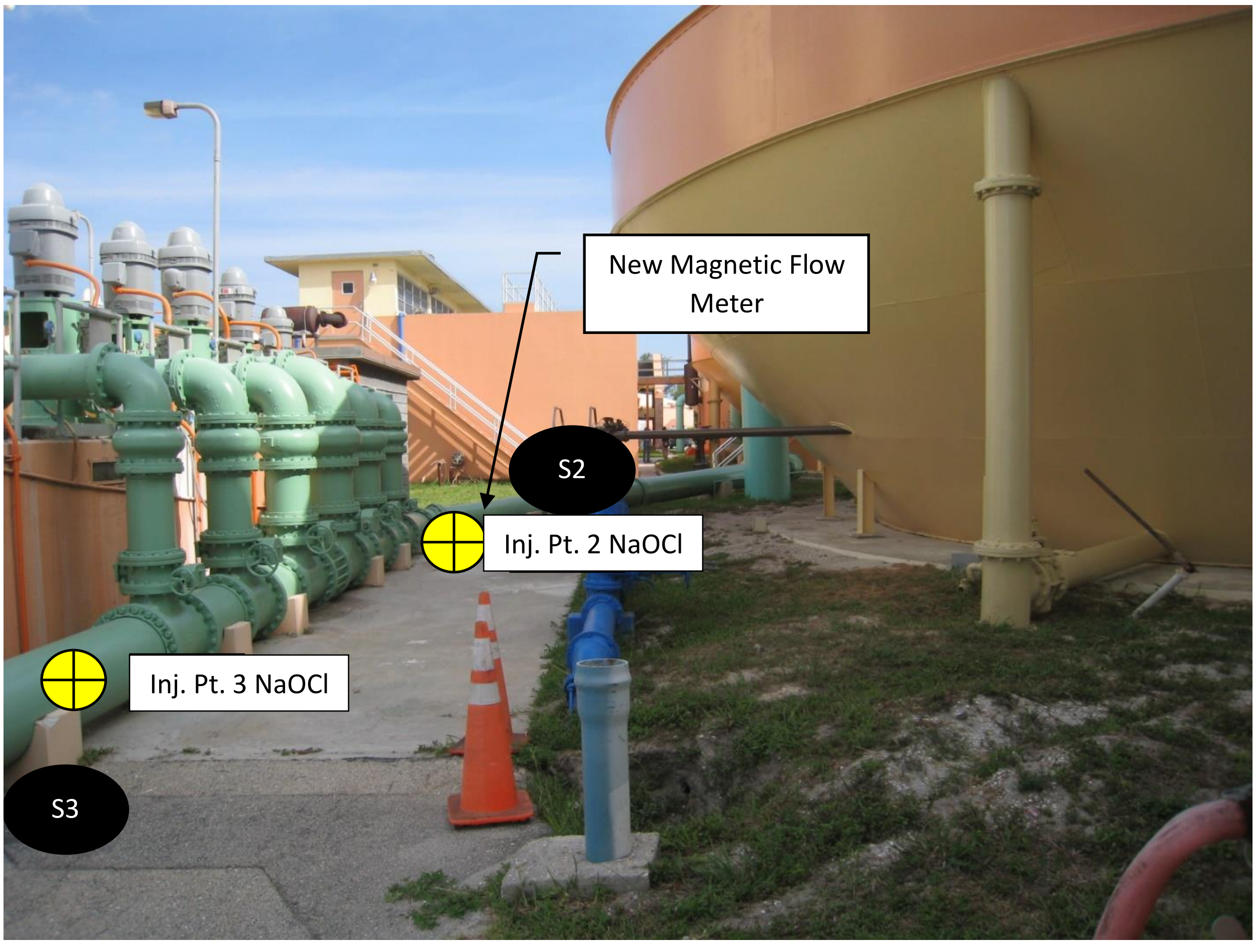

Figure A-2. Packed Tower Scrubber Discharge Transfer Pumps and Piping

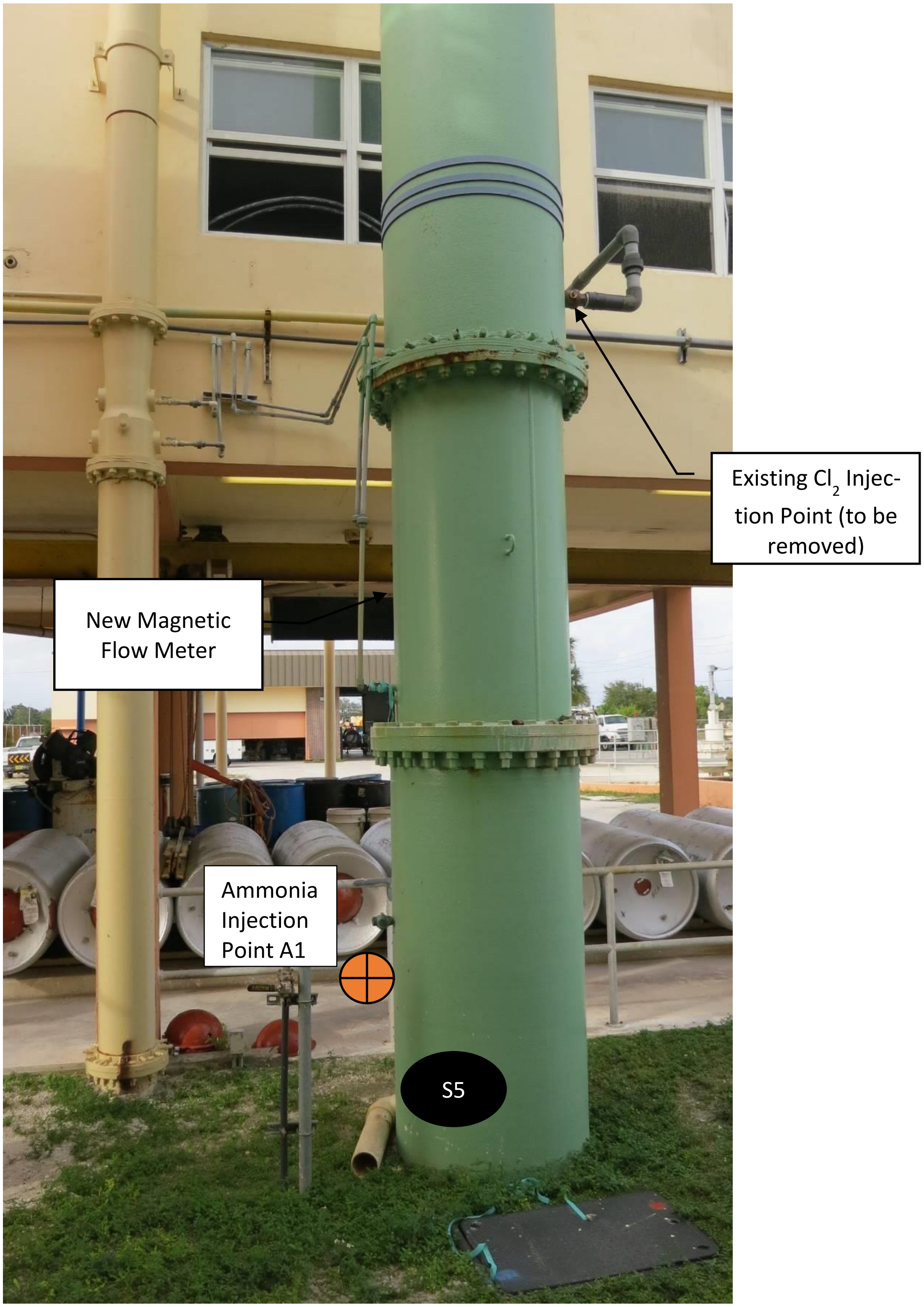

Figure A-3. Riser Pipe to Influent Basin North Chemical Building

Figure A-4. Influent Pipe to South Chemical Building Influent Basin

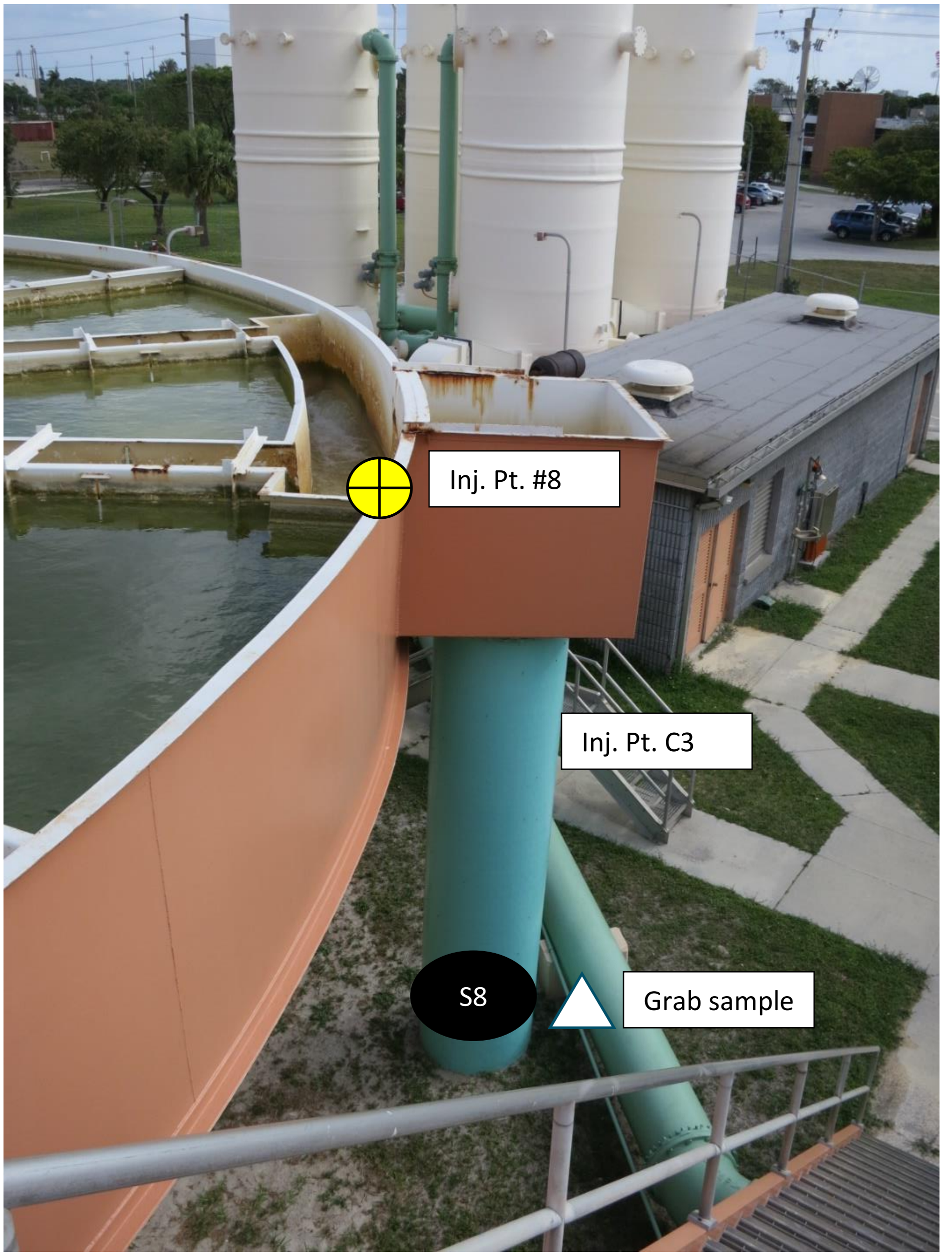

Figure A-5. Discharge Box and Pipe from Softener No. 03 (typical arrangement for all softeners)

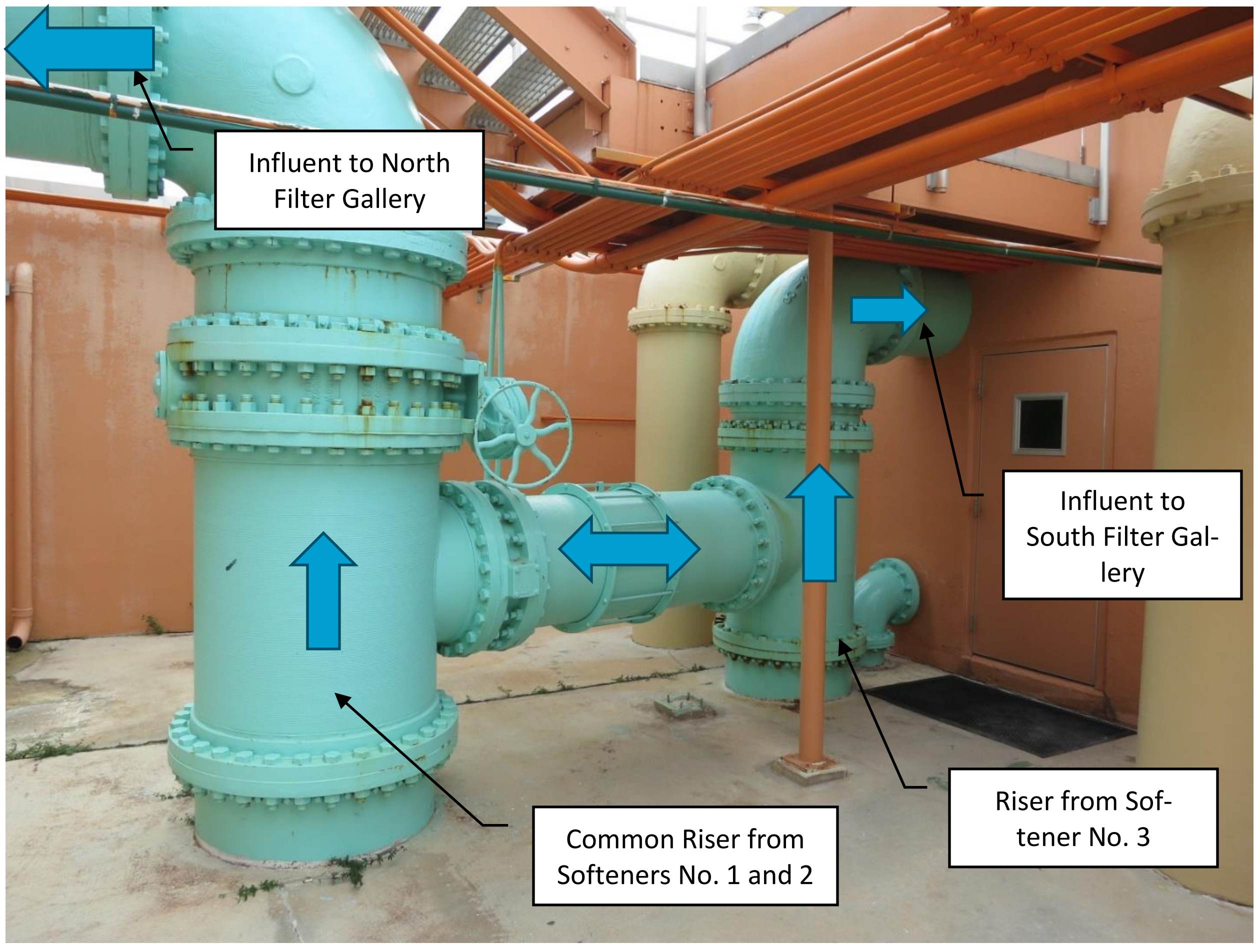

Figure A-6. Influent pipes to North Filter Gallery (south side) and South Filter Gallery (north side)

Figure A-7. Influent pipe (south side) of North Filter Gallery

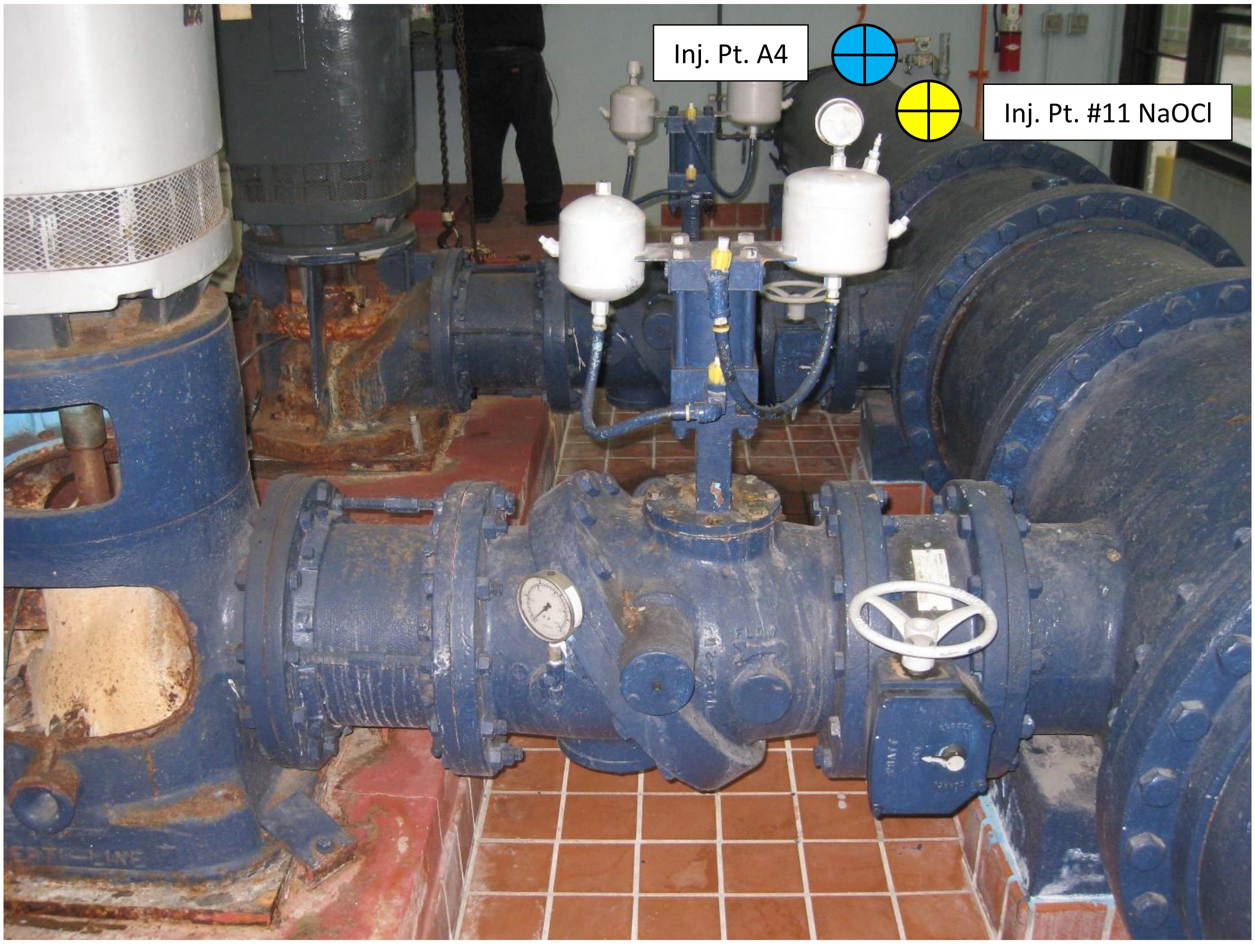

Figure A-8. High Service Pump Room

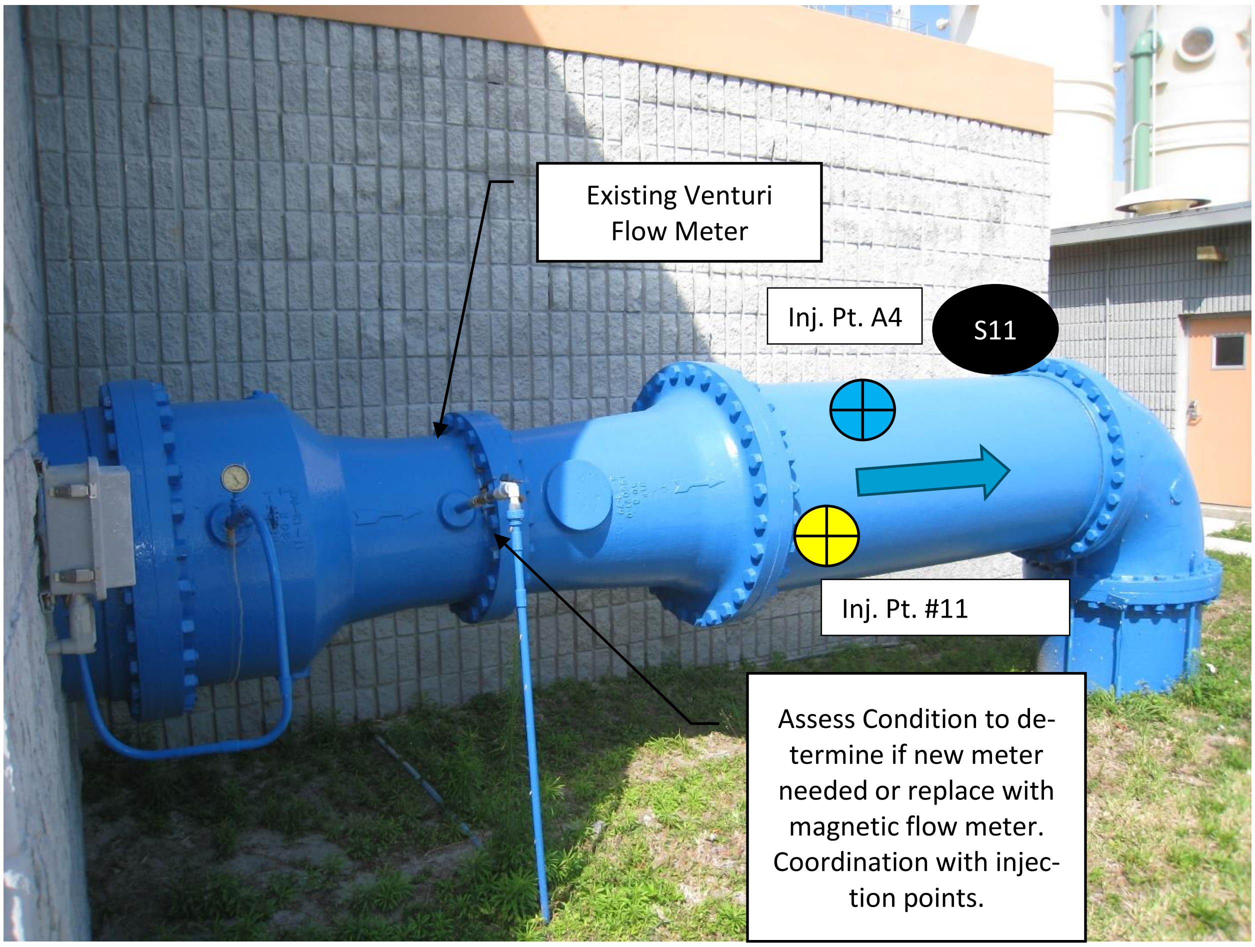

Figure A-9. Finished Water Discharge WM and Flow Meter

Figure A-10. Transfer and Backwash Pumps (South end of High Service Pump Room)

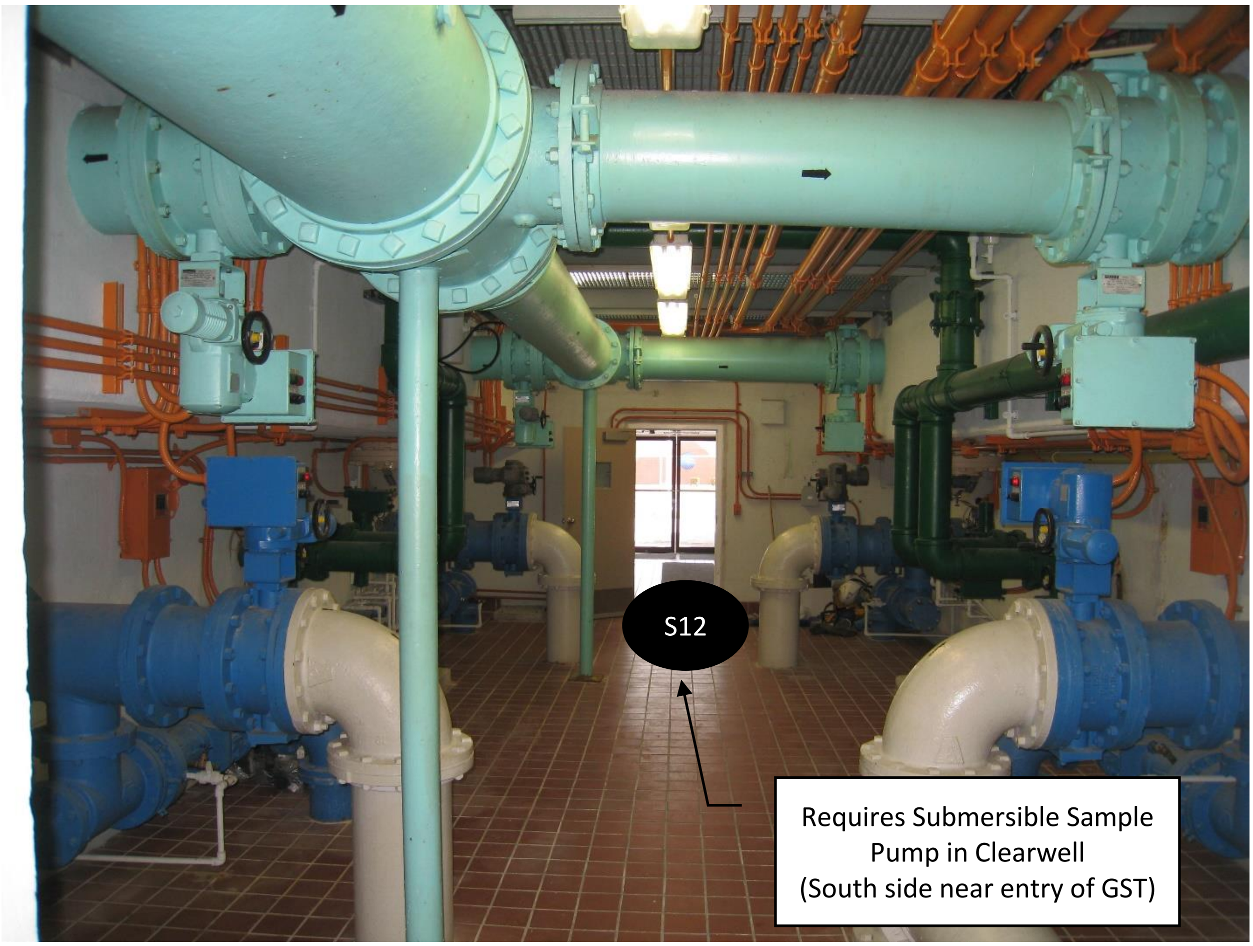

Figure A-11. South Filter Gallery (South Side looking south)

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Attachment B: Conceptual Drawings

1) Existing Process Flow Diagram (B-1)
2) Proposed Process Flow Diagram (B-2)
3) Polymer System (B-3)
4) Sodium Hypochlorite System (B-4 and B-5)
5) PSF Panels and Ammoniators (B-6)
6) Electrical Relocation Layout (B-7)

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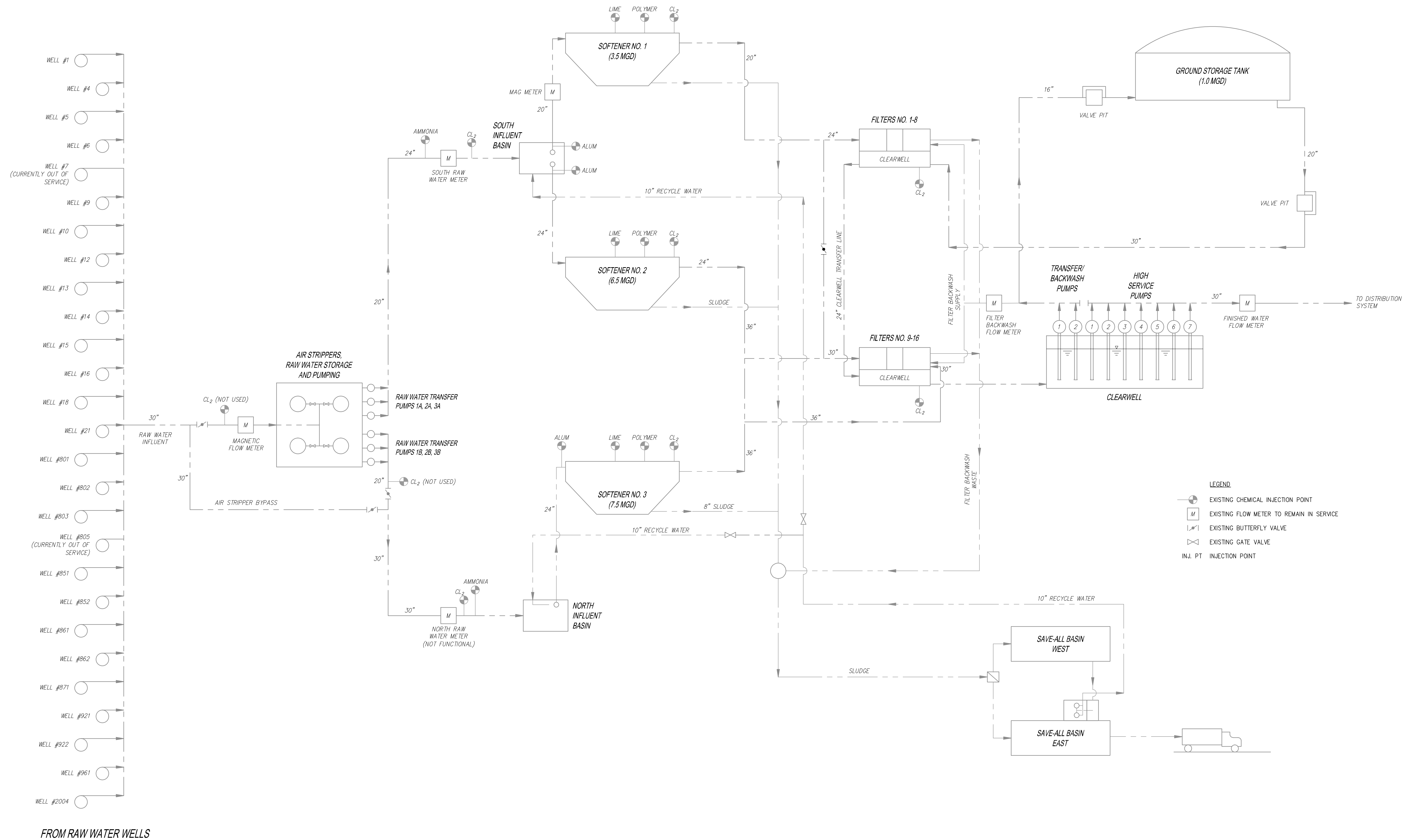
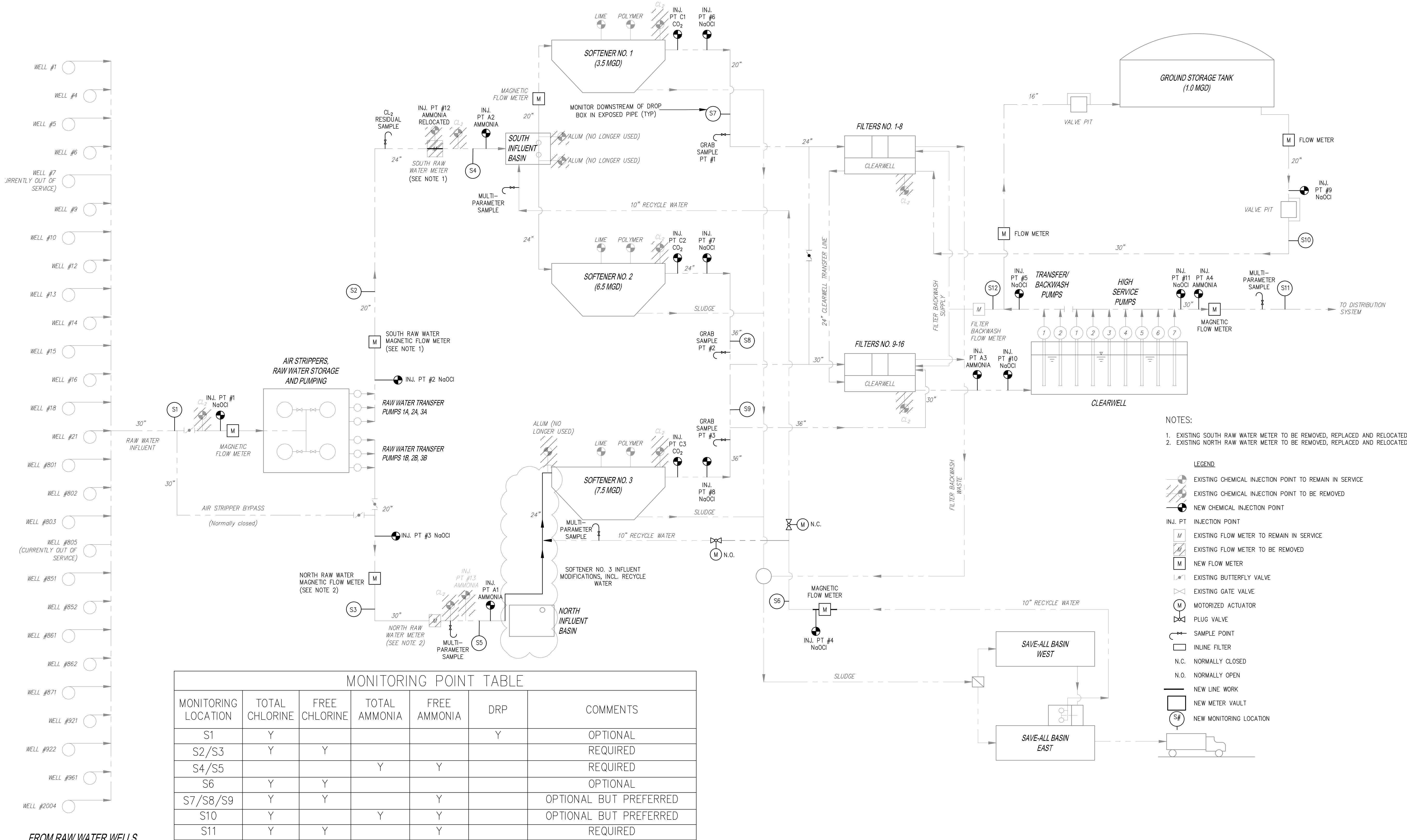


EXISTING PROCESS FLOW DIAGRAM

FIGURE B-1



NOTES:

1. EXISTING SOUTH RAW WATER METER TO BE REMOVED, REPLACED AND RELOCATED.
2. EXISTING NORTH RAW WATER METER TO BE REMOVED, REPLACED AND RELOCATED.

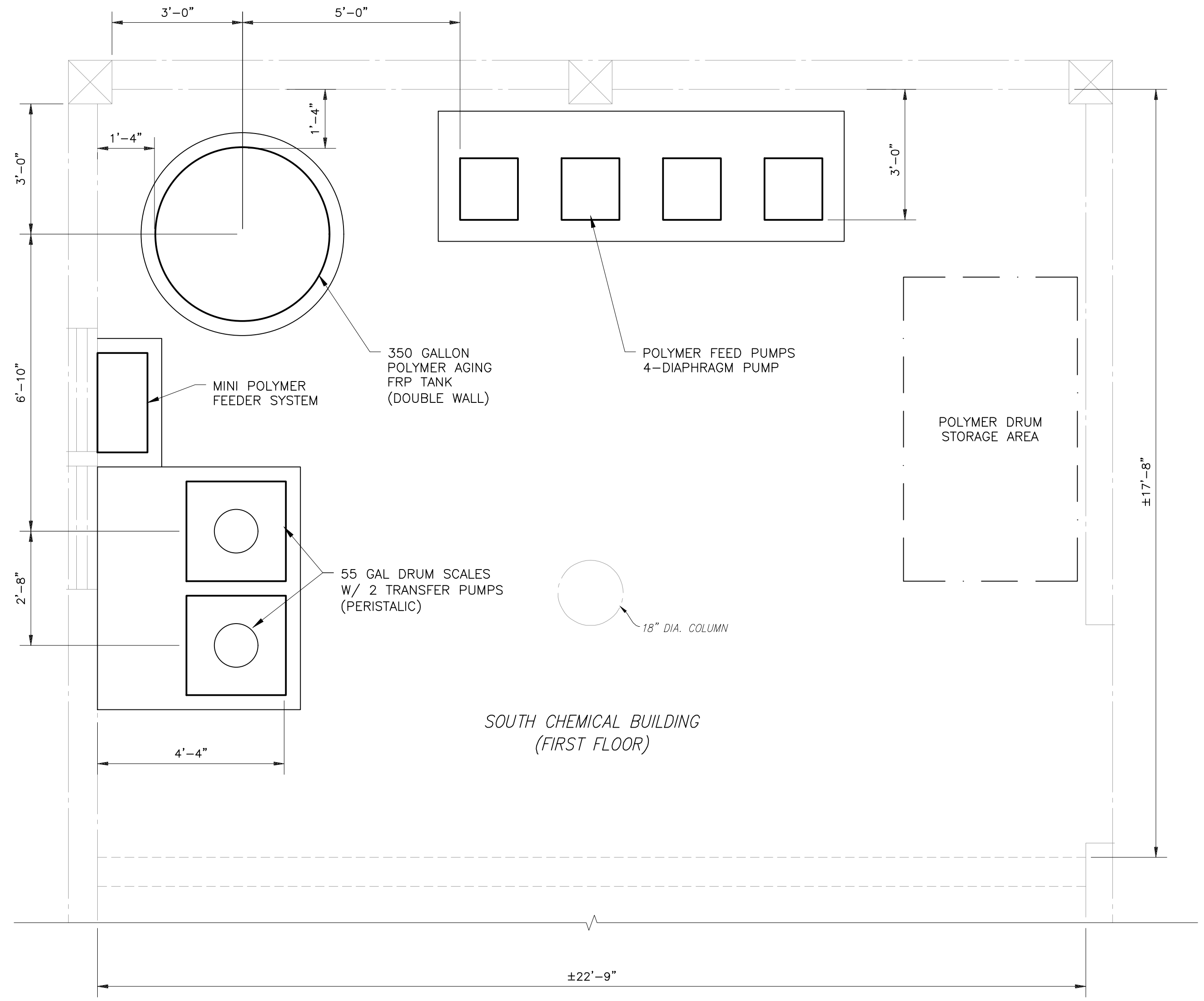
MONITORING POINT TABLE

MONITORING LOCATION	TOTAL CHLORINE	FREE CHLORINE	TOTAL AMMONIA	FREE AMMONIA	DRP	COMMENTS
S1	Y				Y	OPTIONAL
S2/S3	Y	Y				REQUIRED
S4/S5			Y	Y		REQUIRED
S6	Y	Y				OPTIONAL
S7/S8/S9	Y	Y		Y		OPTIONAL BUT PREFERRED
S10	Y		Y	Y		OPTIONAL BUT PREFERRED
S11	Y	Y		Y		REQUIRED
S12		Y				OPTIONAL BUT PREFERRED

PROPOSED PROCESS FLOW DIAGRAM

FIGURE B-2

NOTE: THIS FIGURE IS FOR CONCEPTUAL PURPOSES ONLY AND IS NOT PRESCRIPTIVE.



POLYMER SYSTEM
PLAN
1/2" = 1'-0"

CONCEPTUAL
LAYOUT

WATER TREATMENT
PLANT
CHEMICAL SYSTEMS

POLYMER
SYSTEM
PLAN

FIGURE B-3

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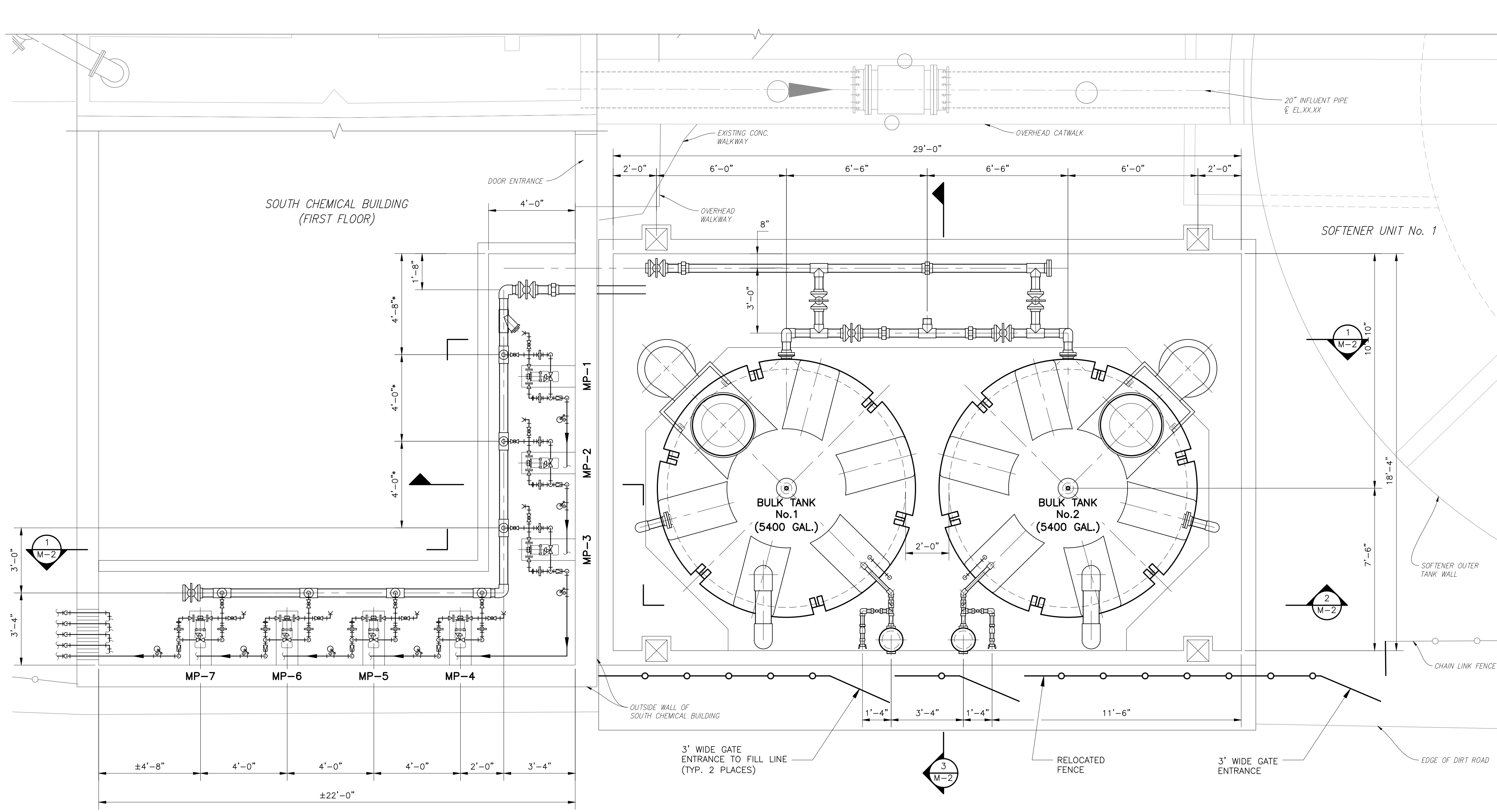
NOTE: THIS FIGURE IS FOR CONCEPTUAL PURPOSES ONLY AND IS NOT PRESCRIPTIVE.



PLAN
3/8" = 1'-0"

CONCEPTUAL LAYOUT

WATER TREATMENT PLANT CHEMICAL SYSTEMS

SODIUM HYPOCHLORITE TANKS AND PUMPS PLAN

FIGURE B-4

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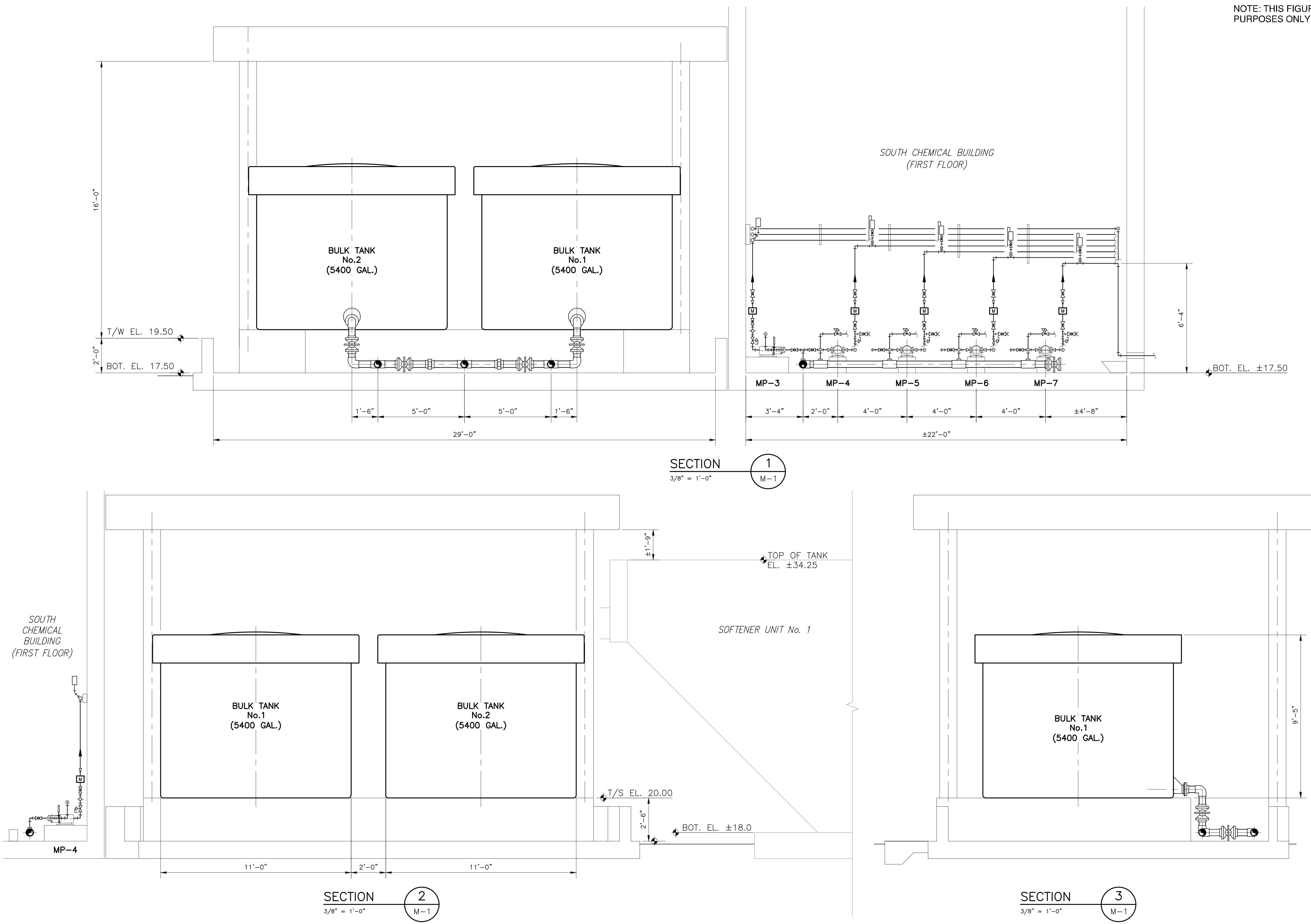
NOTE: THIS FIGURE IS FOR CONCEPTUAL PURPOSES ONLY AND IS NOT PRESCRIPTIVE.



CONCEPTUAL LAYOUT

WATER TREATMENT PLANT CHEMICAL SYSTEMS

SODIUM HYPOCHLORITE TANKS AND PUMPS SECTIONS

FIGURE B-5

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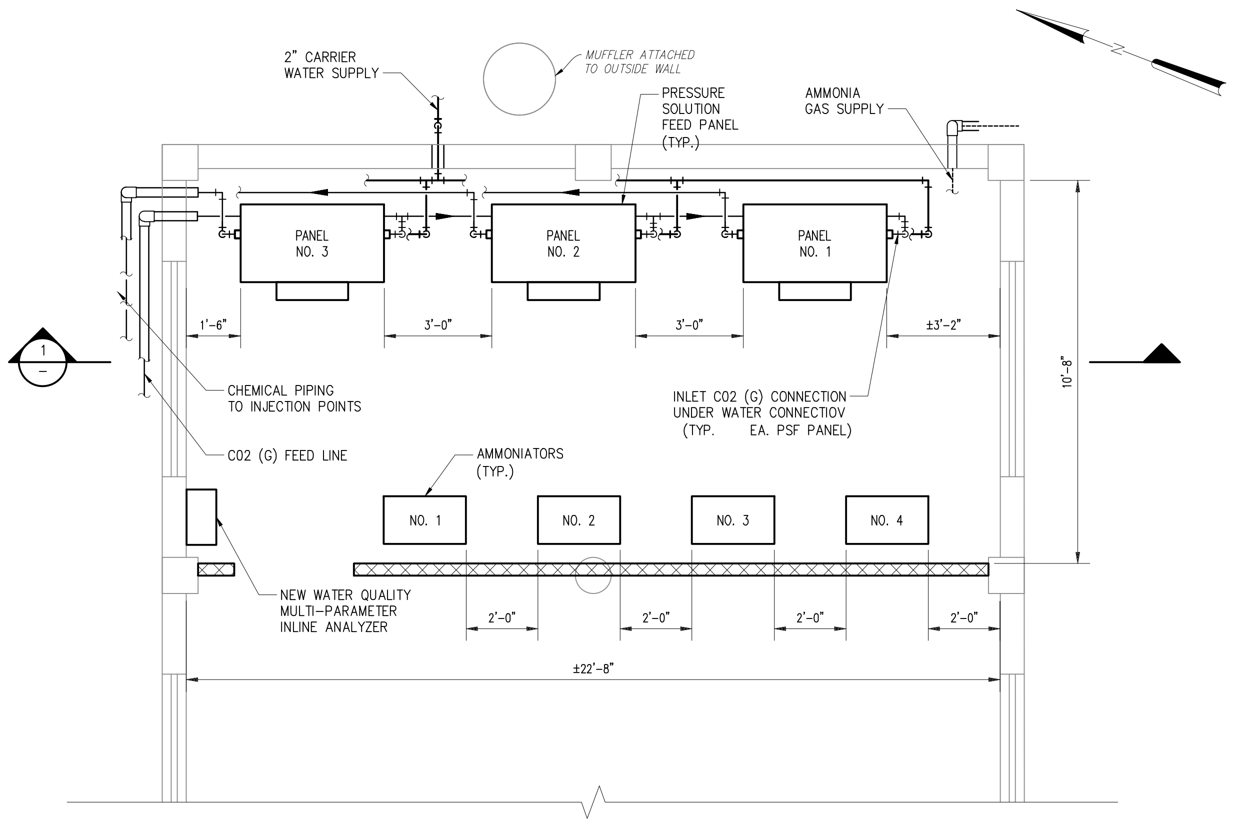
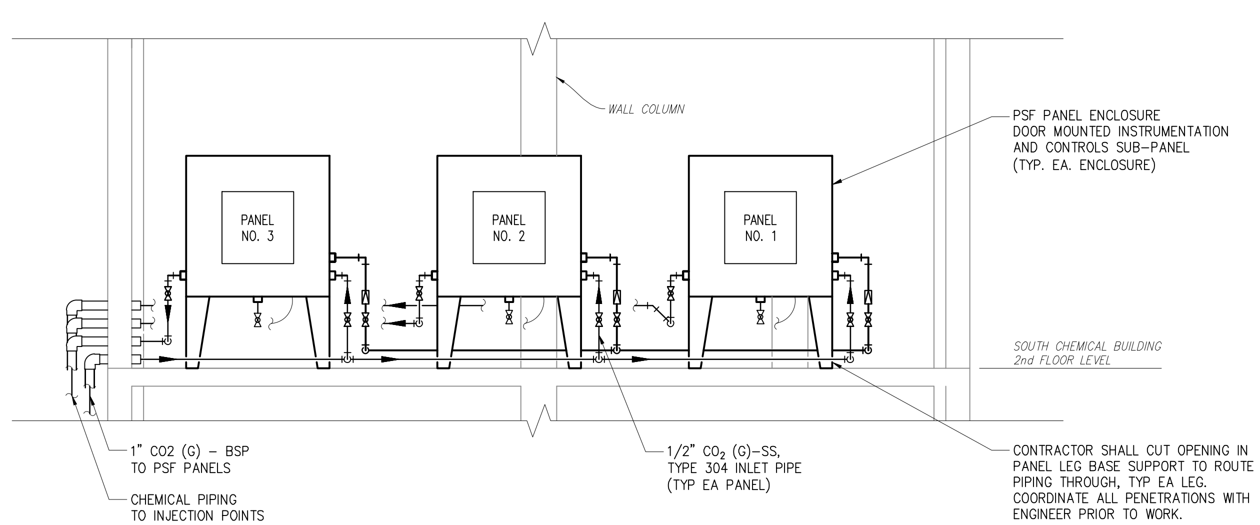
NOTE: THIS FIGURE IS FOR CONCEPTUAL PURPOSES ONLY AND IS NOT PRESCRIPTIVE.



AMMONIATORS
(SOUTH CHEMICAL BUILDING)
PLAN
3/8" =1'-0"

NOTES:

1. EXISTING 2" CL_2 INJECTION PIPE TAP TO BE REUSED FOR CL_2 AND AMMONIA RESIDUAL SAMPLE POINT TAP TO ANALYZER. CONTRACTOR TO FIELD VERIFY EXISTING PIPE TAP SIZE.



SECTION 1
3/8" = 1'-0"

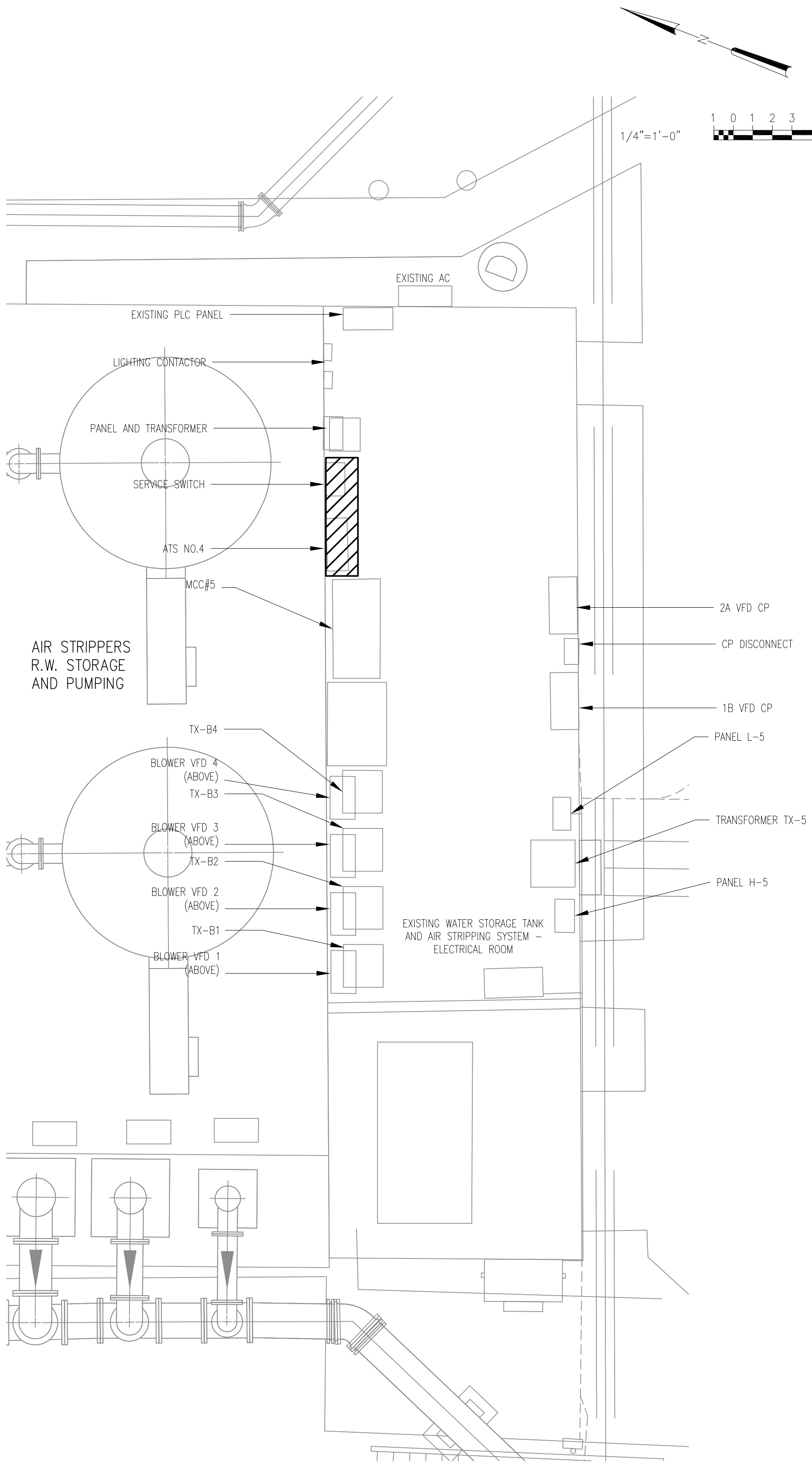
CONCEPTUAL LAYOUT

WATER TREATMENT PLANT CHEMICAL SYSTEMS

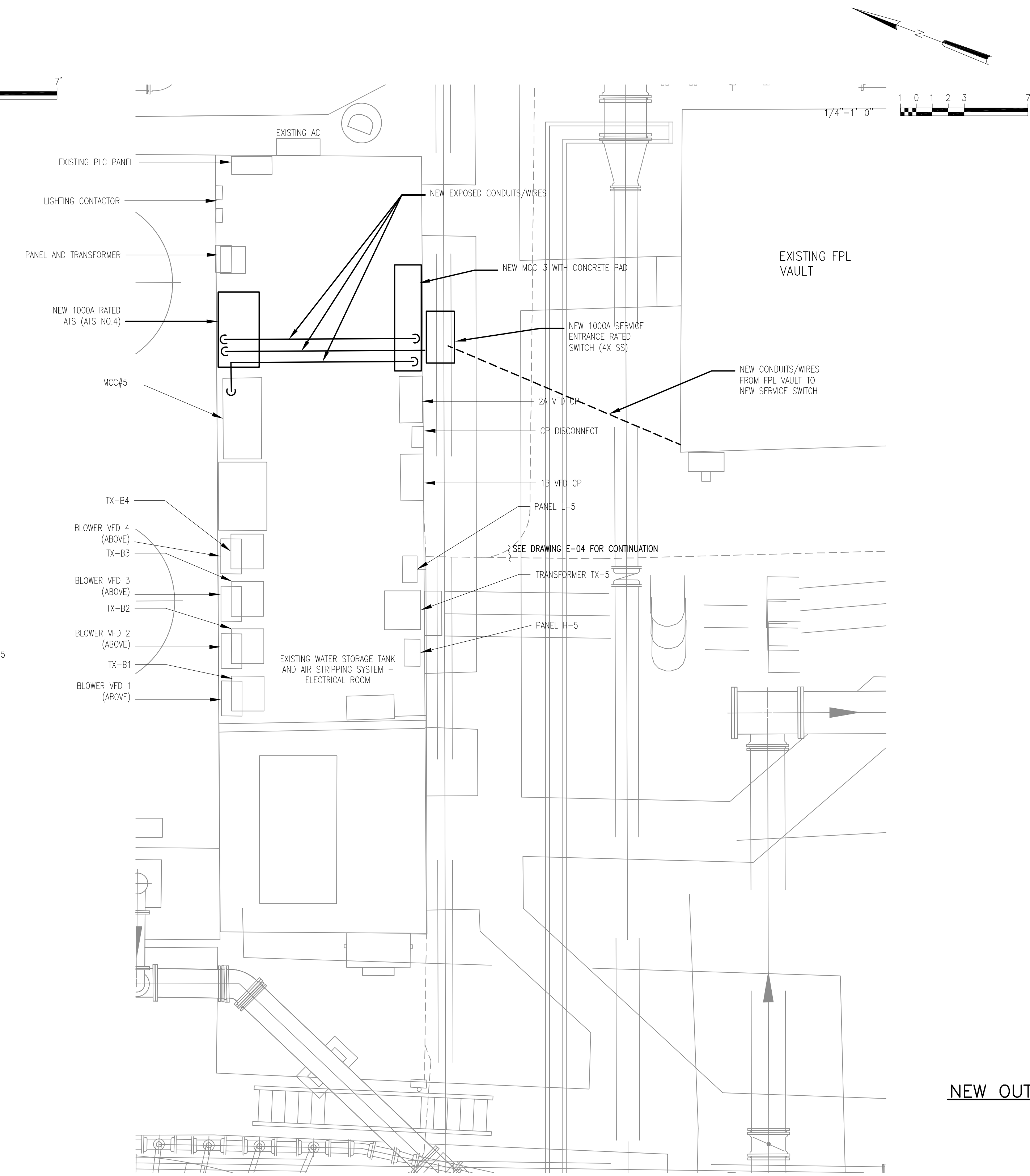
PSF PANELS AND GASEOUS AMMONIA SYSTEM IMPROVEMENTS

FIGURE B-6

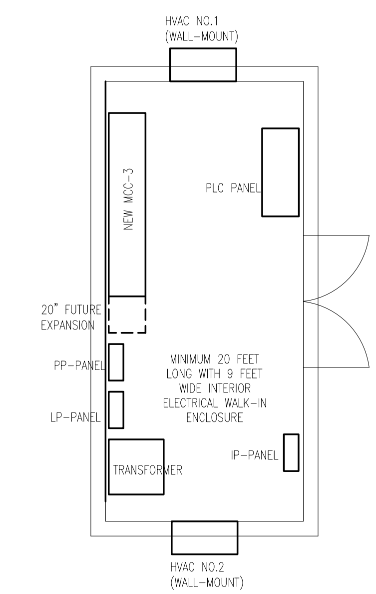
NOTE: THIS FIGURE IS FOR CONCEPTUAL PURPOSES ONLY AND IS NOT PRESCRIPTIVE.



EXISTING AIR STRIPPING SYSTEM – ELECTRICAL DEMOLITION
1/4" = 1'-0"



EXISTING AIR STRIPPING SYSTEM – PROPOSED ELECTRICAL LAYOUT
1/4" = 1'-0"



NEW OUTDOOR WALK–IN ELECTRICAL ENCLOSURE
1/4" = 1'-0"

EXISTING AIR STRIPPER BUILDING ELECTRICAL ROOM LAYOUT	FIGURE B-7

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