



AGENDA

INFRASTRUCTURE COMMISSION

Infrastructure Commission : September 25, 2025 at 6:00 PM
Village Hall 740 Hillgrove Avenue, Western Springs, IL 60558

A. Call to Order

B. Approval of Minutes

1. Infrastructure Commission Meeting Minutes 7/29/2025

C. Public Comment

D. New Business

1. Presentation on Water and Sewer Rate Study by Baxter & Woodman
2. Water Treatment Plant Assessment by Carollo Engineering

E. Other Business

1. Water System Update

F. Adjournment

Individuals with disabilities who plan to attend / participate in this meeting and who require accommodations to allow them to observe and participate, or who have questions regarding accessibility of the meeting or facilities, are requested to contact Jill Izzo at 708-246-1800, extension 127.

Infrastructure Commission Meeting
Tuesday, July 29, 2025, 6:00 p.m.
Village Hall Board Room
740 Hillgrove Avenue
Western Springs IL 60558

Call to Order: 6:04 p.m.

Commission Chair-Shawn Murphy Presiding

Commission Members Present:

Shawn Murphy – Chairman
Tom Mitoraj – Commission Member
Eric Haas – Commission Member
Dan Lewis-Commission Member
Dan Ciecko-Commission Member

Commission Members Absent:

Tom Kelleher
Michael Prim

Present:

Scott Lewis, Village Trustee
Heidi Rudolph, Village President

Staff Present:

Matthew Supert Director of Municipal Services
Inga Cebelis, Staff Engineer
Christopher Breakey, PW Superintendent
Ron Derengowski- Water Plant Superintendent
Diana Puga, Municipal Services Coordinator
Jenny Pesek, Administrative Assistant-MS

Roll Call

As noted above.

Approval of Minutes:

Chair Murphy motioned to approve the minutes from May 6, 2025, seconded by Commissioner Dan Ciecko. Motion passed unanimously on a voice vote.

Public Comment: None

New Business:

Update on Referendum Capital Projects

Director Matthew Supert reported the Village has started discussion with the engineering firms to complete project scoping reports. Once scoping proposals are completed by the firms, a joint follow-up meeting will be held in the fall to discuss and review project timelines. No recommended motion currently.

2025 Capital Projects Update

Springdale Drainage Improvement Project

Director Supert reported to the Commission this project started the week of June 16, 2025. It includes the development of a detention basin in Springdale Park and the installation of a new storm sewer and water main in portions of the Springdale subdivision along 51st and Howard Avenue. Excavation is currently underway.

Grand Avenue Sidewalk Installation (Forest Hills)

Staff Engineer Inga Cebelis reported this project includes construction of a new sidewalk to fill in the gaps that existed along the east side of Grand Avenue between 51st and 55th Street. This project started in June and parkway restoration should be completed in the fall. Also, ADA improvements and street striping. Substantially completed in July 2025. She stated overall the resident feedback has been good.

45th Street Resurfacing Project

Staff Engineer Cebelis reported that this work started in June and includes the grinding and resurfacing of 45th street from Wolf Rd to Gilbert, partial curb and gutter replacement.

Hampton Avenue Project

Staff Engineer Cebelis reported this project to resurface Hampton Avenue started in June, to avoid conflicts with Laidlaw School. Curb, gutter and other concrete work were completed in early July and landscape and parkway restoration in August.

Burlington Avenue Improvements Project

Director Supert reported the improvements are now substantially completed. The project was split into two phases. Work completed included removal of old raised planter beds and replacement with new at grade planter beds with plants and trees. We are looking for new benches and trash bins using TIF funds. Continue landscaping with pots, trees and power washing sidewalks. Discussion continued with options and suggestions. Grand to Wolf (Phase 1 Fall 2024) Central to Wolf (Phase 2 Summer 2025).

1. The replacement of the water main and streetscape in the Central business district.
2. The rehabilitation of the roadway between Central and Wolf Rd.

Water System Update

Superintendent Ron Derengowski reported that the Water Plant Open House was held on May 7, 2025, and was a successful event with approximately 100 residents and guests that attended. The 2024 Consumer Confidence Report was mailed to the community at the end of June. It is an annual report that is required by the EPA.

Municipal Services received a boring report from Midland Standard Engineering and Testing that was performed on June 26, 2025. The purpose of this report was to determine the various components of the soil, and subgrade materials to provide for our design engineering firm V3. Bid opening August 4, 2025.

Well #3 Surplus Motor

On June 30, 2025, the mercury material from the surplus well #3 motor was properly reused, recycled or reclaimed within all federal and state laws.

Carollo Engineers is completing the water plant assessment and evaluation of the Amiad performance. This is an iron removal system.

Phase 1 Lead Replacement begins on Thursday July 17, 2025. The Village staff will meet with HR Green and Millenium for the pre-con meeting to replace 42 lead service lines. The Village was finally approved for the loan. A letter was mailed to the 42 homes that will be receiving the new copper service line.

Gilbert Avenue at Cossitt and Elm Avenues-Pedestrian Study Update

Staff Engineer Cebelis reported that the Village has hired Baxter & Woodman consulting engineers to conduct a traffic study focusing on 2 key intersection along Gilbert Ave at Cossitt Avenue and Elm Avenue. This has been in response to resident concerns about limited pedestrian crossing options, particularly for LTHS students. The study is currently underway, and this also requires coordination and cooperation with the Village of LaGrange.

Schedule for the Next Meeting

The Infrastructure Commission next meeting tentative 9/16/2025 & 10/14/2025 6pm

Adjourn

Chair, Shawn Murphy, Chairman motioned to adjourn meeting, seconded by Commission member Eric Haas. Motion passed unanimously on a voice vote.

Meeting adjourned at 7:14 p.m.

Respectfully Submitted:

Jenny Pesek



AGENDA ITEM SUMMARY

INFRASTRUCTURE COMMISSION

Infrastructure Commission : September 25, 2025

AGENDA ITEM D.1.

To: Infrastructure Commission

From: Matthew Supert, Director of Municipal Services, John Mastandona, Director of Finance

CC: Ellen Baer, Village Manager

RE: Presentation on Water and Sewer Rate Study by Baxter & Woodman

Recommendation

N/A

Summary

Representatives from Baxter & Woodman will be in attendance to present preliminary findings and recommendations for a water and sewer rate study. Baxter & Woodman will be presenting a walkthrough of the rate model that is being developed to identify changes needed to the water/sewer usage rate. The presentation will include an overall presentation of the concepts and data used and incorporated.

Financial Impact

N/A

Recommended Motion

N/A

Strategic Plan Alignment

- Infrastructure Improvements
- Financial Sustainability

File Attachments

None



AGENDA ITEM SUMMARY

INFRASTRUCTURE COMMISSION

Infrastructure Commission : September 25, 2025

AGENDA ITEM D.2.

To: Infrastructure Commission

From: Matthew Supert, Director of Municipal Services, Ronald Derengowski, Water Plant Superintendent

CC: Ellen Baer, Village Manager

RE: Water Treatment Plant Assessment by Carollo Engineering

Recommendation

Summary

Attached for the Commission's review is the completed facility and equipment assessment of the Village's Water Treatment Plant by Carollo Engineers. The assessment was completed in late spring and the gathered data identifies capital improvement projects for the treatment plant in several capital timeline targets along with cost estimates for budgeting purposes.

Several assets within the plant were identified for immediate attention, most notably the replacement of the Amiad Iron Removal filters. While they have an estimated eight years of life remaining they have been identified as a prior item in previous capital replacement targets due to their age, limited parts/support and their design and service based out of Israel. Additional items included for immediate attention include Well #1, which is currently undergoing a decommissioning study with Baxter & Woodman.

The attached report includes a cover memo with summary information pages 1-9, outlining replacement targets for the near (<1), short (2-5), mid (6-10), and long (>10) term ranges. Price estimates included in the report are in current dollar figures and do not account for cost or inflationary changes. The supplemental pages in the report include the condition assessment forms for each asset that was reviewed as part of the study.

Financial Impact

N/A

Recommended Motion

N/A

Strategic Plan Alignment

Infrastructure Improvements

File Attachments

1. Water Plant Treatment Assessment 2025 by Carollo - Summary Memo
2. Alternatives to Amiad Iron Removal System - Report
3. Preliminary Asset Replacement Cost Schedule

VILLAGE OF WESTERN SPRINGS

Western Springs Water Treatment Plant Condition Assessment

Project No.: 203678-00

Date: August 6, 2025

Prepared By: Patricia Oka

Reviewed By: Thomas F. Seacord

Subject: Assessment Summary – Village of Western Springs
Water Supply and Treatment Infrastructure

This document is released for the purpose of information exchange review and planning only under the authority of
Thomas F. Seacord,
August 6, 2025,
Illinois PE #062-066180.

On May 15-16, 2025, Carollo Engineers conducted a comprehensive condition assessment of the Village of Western Springs' (Village) water supply and treatment infrastructure. The data gathered has been used to identify and categorize capital projects based on projected implementation timelines: near term (0-1 year), short term (2-5 years), mid term (6-10 years), long term (11-20 years), and extended term/newly replaced (20+ years). These categories include associated cost estimates to support budget planning and replacement scheduling.

Out of 160 total assets evaluated, 21 were excluded from further analysis due to either inaccessibility or decommissioning.

Critical assets requiring immediate attention:

- **Uninterrupted Power Supply (UPS) - Instrumentation Room:** Rated "Very Poor/Non-performing" with an estimated remaining life of less than one year. This asset requires immediate replacement.
- **Motor Control Center (MCC) 1:** Originally installed in 1980, this MCC has exceeded its useful life and should be prioritized for replacement.
- **Deep Well 1 - Pump:** Currently unreliable and poorly performing, with less than one year of useful life remaining. The Village plans to fully replace this well with Well 5, which, in emergency, can feed the reservoir by bypassing the treatment. Design work is reportedly underway to connect Well 5 directly to the treatment trains.
- **Amiad Iron Removal Filters:** While all four Amiad filters are functioning well and remain in good condition, their limited local support and the difficulty in sourcing replacement parts render them "Obsolete." Rather than waiting until they reach the end of their service life (eight years), the Village plans to move forward with replacement in the near term, installing a simpler and more maintainable system to enhance uptime, minimize maintenance delays, and ensure long-term reliability.

Key considerations and opportunities:

- **Obsolete Assets:** Several assets are identified as obsolete, which may result in higher replacement costs due to the need for custom fabrication or compatibility modifications.

- **Redundancy:** Assets with no redundancy should be reviewed to evaluate the criticality of their functions. Where possible, redundancy should be implemented to reduce the risk of service interruptions.
- **Cost Optimization:** Consider enhanced maintenance strategies for long-term assets to potentially extend their useful life, defer replacement, and optimize capital expenditures.

Table 1 and Figure 1 provide an overview of the total number of assets and estimated costs considered in future planning. Detailed breakdowns by timeframe are presented in Tables 2 through 5. Summaries of the condition of each asset can be found in Attachment A.

Table 1 Overview of Future Asset Replacement Projects

Replacement Timeframe	Number of Assets	Number of Assets in Cost Category				
		\$0 - \$5,000	\$5,000 - \$9,999	\$10,000 - \$49,999	\$50,000 - \$99,999	\$100,000+
Near Term	15	1	2	3	0	9
Short Term	21	7	2	6	0	6
Mid Term	47	11	10	19	1	6
Long Term	42	3	14	15	5	5
Extended Term	15	0	0	7	7	1
Total	140	22	28	50	13	27

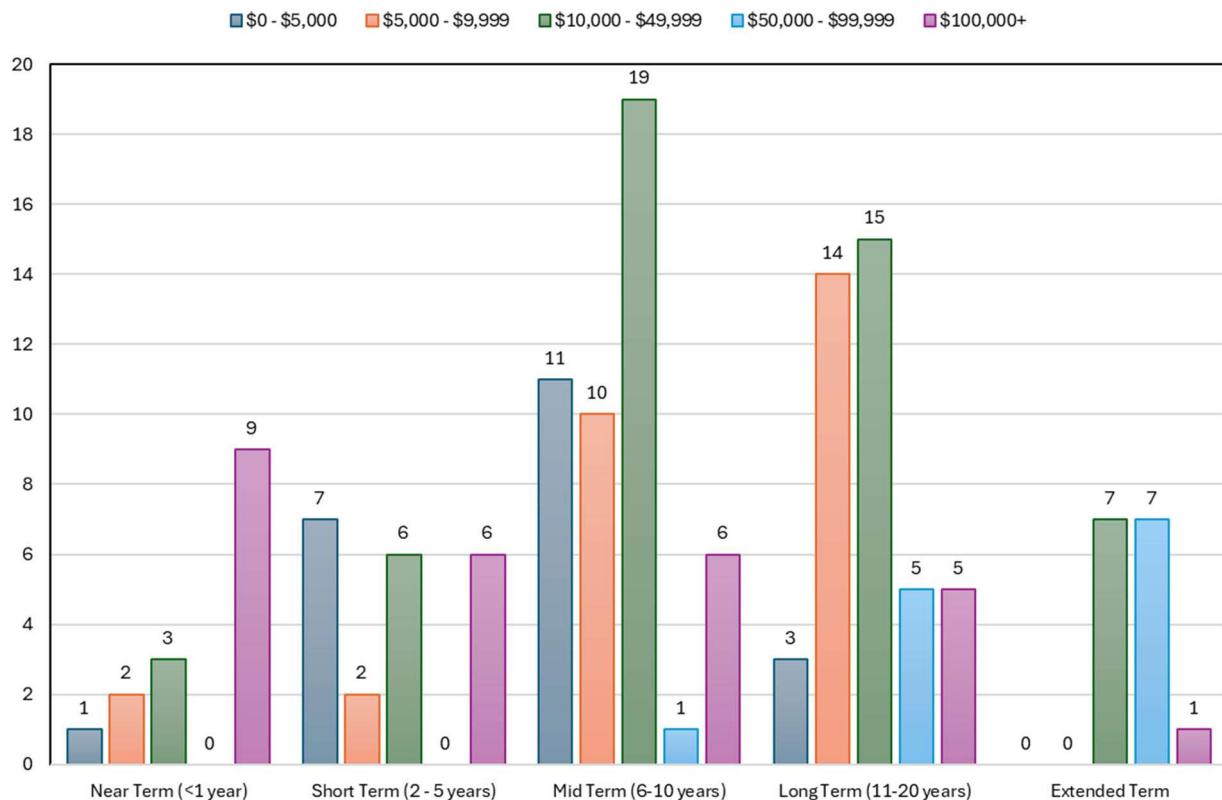


Figure 1 Asset Replacement Cost Distribution

Table 2 List of Near Term (<1 Year) Replacement Projects

Asset_Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
Amiad Iron Removal Filter No. 1	Treatment	Mechanical	5 - < 1 yr	5 - \$100,000+
Amiad Iron Removal Filter No. 2	Treatment	Mechanical	5 - < 1 yr	5 - \$100,000+
Amiad Iron Removal Filter No. 3	Treatment	Mechanical	5 - < 1 yr	5 - \$100,000+
Amiad Iron Removal Filter No. 4	Treatment	Mechanical	5 - < 1 yr	5 - \$100,000+
Deep Well 5 - Surface Piping	Supply/Source	Mechanical	5 - < 1 yr	5 - \$100,000+
Deep Well 3 - Surface Check Valve	Supply/Source	Mechanical	5 - < 1 yr	1 - \$0 - \$5,000
Deep Well 3 - Motor Starter	Supply/Source	Electrical	5 - < 1 yr	2 - \$5,000 - \$9,999
ATS - Deep Well 3	Supply/Source	Electrical	5 - < 1 yr	2 - \$5,000 - \$9,999
UPS - Instrumentation Room	Treatment	Electrical	5 - < 1 yr	3 - \$10,000 - \$49,999
Deep Well 3 - Surface Piping	Supply/Source	Mechanical	5 - < 1 yr	3 - \$10,000 - \$49,999
Deep Well 1 - Surface Piping	Supply/Source	Mechanical	5 - < 1 yr	3 - \$10,000 - \$49,999
MCC 1	Treatment	Electrical	5 - < 1 yr	5 - \$100,000+
RO 3 Membrane Elements	Treatment - RO Filtration	Mechanical	5 - < 1 yr	5 - \$100,000+
RO 4 Membrane Elements	Treatment - RO Filtration	Mechanical	5 - < 1 yr	5 - \$100,000+
Deep Well 1 - Groundwater Well	Supply/Source	Structural	5 - < 1 yr	5 - \$100,000+

Notes:

ATS - automatic transfer switch; RO - reverse osmosis; yr - year

Table 3 List of Short Term (2-to-5-Year) Replacement Projects

Asset_Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
Sump Pump - Elevated Storage Tank	Treatment	Mechanical	4 - < 5 yrs	1 - \$0 - \$5,000
Sump Pump - Deep Well 1	Supply/Source	Mechanical	4 - < 5 yrs	1 - \$0 - \$5,000
Sump Pump - Basement - Raw Water Room	Treatment	Mechanical	4 - < 5 yrs	1 - \$0 - \$5,000
Sump Pump - Basement - Porch LL	Treatment	Mechanical	4 - < 5 yrs	1 - \$0 - \$5,000
Sump Pump - Pipe Gallery	Treatment	Mechanical	4 - < 5 yrs	1 - \$0 - \$5,000
Deep Well 4 - Surface Check Valve	Supply/Source	Mechanical	4 - < 5 yrs	1 - \$0 - \$5,000
Deep Well 3 - Level Instrument	Supply/Source	Instrumentation	4 - < 5 yrs	1 - \$0 - \$5,000
Deep Well 1 - Flow Meter	Supply/Source	Instrumentation	4 - < 5 yrs	2 - \$5,000 - \$9,999
Deep Well 4 - Level Instrument	Supply/Source	Instrumentation	4 - < 5 yrs	2 - \$5,000 - \$9,999
Booster Pump 4 - Motor	Treatment	Electrical	4 - < 5 yrs	3 - \$10,000 - \$49,999
Booster Pump 3 - Motor	Treatment	Electrical	4 - < 5 yrs	3 - \$10,000 - \$49,999
Low Voltage Transformer - Deep Well 3	Supply/Source	Electrical	4 - < 5 yrs	3 - \$10,000 - \$49,999
Water Heater - Heater Room Basement	Treatment	Mechanical	4 - < 5 yrs	3 - \$10,000 - \$49,999
Booster Pump 4 - Pump	Treatment	Mechanical	4 - < 5 yrs	3 - \$10,000 - \$49,999
Deep Well 4 - Surface Piping	Supply/Source	Mechanical	4 - < 5 yrs	3 - \$10,000 - \$49,999
Generator - Deep Well 3	Supply/Source	Electrical	4 - < 5 yrs	5 - \$100,000+
Deep Well 4 - Pump	Supply/Source	Mechanical	4 - < 5 yrs	5 - \$100,000+
Deep Well 1 - Pump	Supply/Source	Mechanical	4 - < 5 yrs	5 - \$100,000+
Deep Well 3 - Pump	Supply/Source	Mechanical	4 - < 5 yrs	5 - \$100,000+
Deep Well 3 - Groundwater Well	Supply/Source	Structural	4 - < 5 yrs	5 - \$100,000+
Deep Well 4 - Groundwater Well	Supply/Source	Structural	4 - < 5 yrs	5 - \$100,000+

Notes:

LL - lower level

Table 4 List of Mid Term (6-to-10-Year) Replacement Projects

Asset_Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
Sump Pump - Basement - Pump Room	Treatment	Mechanical	3 - < 10 yrs	1 - \$0 - \$5,000
Hoist - Level 1 - Foyer	Treatment	Mechanical	3 - < 10 yrs	1 - \$0 - \$5,000
Air Compressor Air Dryer	Treatment	Mechanical	3 - < 10 yrs	1 - \$0 - \$5,000
Expansion Tank Boiler Room Basement	Supply/Source	Mechanical	3 - < 10 yrs	1 - \$0 - \$5,000
Antiscalant Day Tank	Treatment	Mechanical	3 - < 10 yrs	1 - \$0 - \$5,000
Air Compressor	Treatment	Mechanical	3 - < 10 yrs	1 - \$0 - \$5,000
Caustic Soda - Day Tank	Treatment - Caustic Soda	Structural	3 - < 10 yrs	1 - \$0 - \$5,000
Corrosion Inhibitor - Bulk Tank 1	Treatment - Corrosion Inhibitor	Structural	3 - < 10 yrs	1 - \$0 - \$5,000
Sodium Hypochlorite - Bulk Tank	Treatment - Sodium Hypochlorite	Structural	3 - < 10 yrs	1 - \$0 - \$5,000
Sodium Hypochlorite - Day Tank	Treatment - Sodium Hypochlorite	Structural	3 - < 10 yrs	1 - \$0 - \$5,000
Flushing Tank for Amiad	Treatment	Structural	3 - < 10 yrs	1 - \$0 - \$5,000
Concentrate Pump 2 - Motor	Treatment - Concentrate	Electrical	3 - < 10 yrs	2 - \$5,000 - \$9,999
High Service Pump 1 Panel - Soft Starter	Distribution	Electrical	3 - < 10 yrs	2 - \$5,000 - \$9,999
High Service Pump 2 Panel - Soft Starter	Distribution	Electrical	3 - < 10 yrs	2 - \$5,000 - \$9,999
High Service Pump 3 Panel - Soft Starter	Distribution	Electrical	3 - < 10 yrs	2 - \$5,000 - \$9,999
Concentrate Pump 1 - Motor	Treatment - Concentrate	Electrical	3 - < 10 yrs	2 - \$5,000 - \$9,999
MWRD Meter	Treatment	Instrumentation	3 - < 10 yrs	2 - \$5,000 - \$9,999
RO4 Concentrate Flow Control Valve	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	2 - \$5,000 - \$9,999
Stainless Steel Hatches (WTP Porch)	Treatment	Mechanical	3 - < 10 yrs	2 - \$5,000 - \$9,999
Flushing Water Booster Pump No. 1	Treatment	Mechanical	3 - < 10 yrs	2 - \$5,000 - \$9,999
Flushing Water Booster Pump No. 2	Treatment	Mechanical	3 - < 10 yrs	2 - \$5,000 - \$9,999
ATS - Deep Well 4	Treatment	Electrical	3 - < 10 yrs	3 - \$10,000 - \$49,999
RO Feed Pump 3 - Motor	Treatment - RO Filtration	Electrical	3 - < 10 yrs	3 - \$10,000 - \$49,999
RO Feed Pump 4 - Motor	Treatment - RO Filtration	Electrical	3 - < 10 yrs	3 - \$10,000 - \$49,999
CIP Pump VFD Control Cabinet	Treatment - CIP	Electrical	3 - < 10 yrs	3 - \$10,000 - \$49,999

Asset_Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
CIP - Pump Motor	Treatment - CIP	Electrical	3 - < 10 yrs	3 - \$10,000 - \$49,999
ATS - Deep Well 4	Supply/Source	Electrical	3 - < 10 yrs	3 - \$10,000 - \$49,999
Corrosion Inhibitor - Metering Pump No. 1	Treatment - Corrosion Inhibitor	Mechanical	3 - < 10 yrs	3 - \$10,000 - \$49,999
Booster Pump 3 - Pump	Treatment	Mechanical	3 - < 10 yrs	3 - \$10,000 - \$49,999
Corrosion Inhibitor - Metering Pump No. 2	Treatment - Corrosion Inhibitor	Mechanical	3 - < 10 yrs	3 - \$10,000 - \$49,999
RO 3 Feed Water Cartridge Filter	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	3 - \$10,000 - \$49,999
CIP - Pump	Treatment - CIP	Mechanical	3 - < 10 yrs	3 - \$10,000 - \$49,999
Hot Water Unit Heater - CIP Room	Treatment	Mechanical	3 - < 10 yrs	3 - \$10,000 - \$49,999
Concentrate Pump 1 - Pump	Treatment - Concentrate	Mechanical	3 - < 10 yrs	3 - \$10,000 - \$49,999
Water Heater - Utility/Meter Room	Treatment	Mechanical	3 - < 10 yrs	3 - \$10,000 - \$49,999
Antiscalant Feed Pump No. 1	Treatment	Mechanical	3 - < 10 yrs	3 - \$10,000 - \$49,999
Concentrate Pump 2 - Pump	Treatment - Concentrate	Mechanical	3 - < 10 yrs	3 - \$10,000 - \$49,999
RO 4 Feed Water Cartridge Filter	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	3 - \$10,000 - \$49,999
Caustic Soda - Bulk Tank 1	Treatment - Caustic Soda	Structural	3 - < 10 yrs	3 - \$10,000 - \$49,999
Caustic Soda - Bulk Tank 2	Treatment - Caustic Soda	Structural	3 - < 10 yrs	3 - \$10,000 - \$49,999
CIP - Cartridge Filter Vessel	Treatment - CIP	Mechanical	3 - < 10 yrs	4 - \$50,000 - \$99,999
Generator - Deep Well 4	Supply/Source	Electrical	3 - < 10 yrs	5 - \$100,000+
RO Feed Pump 4 - Pump	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	5 - \$100,000+
Standby RO Feed Water Cartridge Filter	Treatment	Mechanical	3 - < 10 yrs	5 - \$100,000+
RO Feed Pump 3 - Pump	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	5 - \$100,000+
RO 2 Feed Water Cartridge Filter	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	5 - \$100,000+
CIP - Bulk Tank	Treatment - CIP	Structural	3 - < 10 yrs	5 - \$100,000+

Notes:

CIP - clean-in-place; MWRD - Metro Water Reclamation District; VFD - variable frequency drive; WTP - water treatment plant

Table 5 List of Long Term (11-to-20-Year) Replacement Projects

Asset_Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
Surge Protection Device	Treatment	Electrical	2 - < 20 yrs	1 - \$0 - \$5,000
Well 4 Feed Pump Breakers	Treatment	Electrical	2 - < 20 yrs	1 - \$0 - \$5,000
Antiscalant Bulk Tank No. 1	Treatment - Antiscalant	Structural	2 - < 20 yrs	1 - \$0 - \$5,000
CIP - Main Control Breaker	Treatment - CIP	Electrical	2 - < 20 yrs	2 - \$5,000 - \$9,999
High Service Pump 2 - Motor	Distribution	Electrical	2 - < 20 yrs	2 - \$5,000 - \$9,999
High Service Pump 1 - Motor	Distribution	Electrical	2 - < 20 yrs	2 - \$5,000 - \$9,999
Utility Main Breaker	Treatment	Electrical	2 - < 20 yrs	2 - \$5,000 - \$9,999
Well 3 Feed Pump Breakers	Treatment	Electrical	2 - < 20 yrs	2 - \$5,000 - \$9,999
Generator Main Breaker	Treatment	Electrical	2 - < 20 yrs	2 - \$5,000 - \$9,999
High Service Pump 3 - Motor	Distribution	Electrical	2 - < 20 yrs	2 - \$5,000 - \$9,999
Motor Control Panel	Supply/Source	Electrical	2 - < 20 yrs	2 - \$5,000 - \$9,999
Caustic Soda - Day Tank - Digital Level Indicator	Treatment - Caustic Soda	Instrumentation	2 - < 20 yrs	2 - \$5,000 - \$9,999
RO 4 Combined Permeate Flow Meter	Treatment - RO Filtration	Instrumentation	2 - < 20 yrs	2 - \$5,000 - \$9,999
CIP - Temperature Sensor	Treatment - CIP	Instrumentation	2 - < 20 yrs	2 - \$5,000 - \$9,999
RO 3 Concentrate Flow Control Valve	Treatment - RO Filtration	Mechanical	2 - < 20 yrs	2 - \$5,000 - \$9,999
Sodium Hypochlorite - Chemical Feed Pump	Treatment - Sodium Hypochlorite	Mechanical	2 - < 20 yrs	2 - \$5,000 - \$9,999
Deep Well 5 - Surface Check Valve	Supply/Source	Mechanical	2 - < 20 yrs	2 - \$5,000 - \$9,999
CIP - Main Control Panel	Treatment - CIP	Electrical	2 - < 20 yrs	3 - \$10,000 - \$49,999
HRG - Ground Fault Indicators - Deep Well 4	Supply/Source	Electrical	2 - < 20 yrs	3 - \$10,000 - \$49,999
Deep Well 5 - VFD	Supply/Source	Electrical	2 - < 20 yrs	3 - \$10,000 - \$49,999
RO 4 VFD Control Cabinet	Treatment - RO Filtration	Electrical	2 - < 20 yrs	3 - \$10,000 - \$49,999
Deep Well 5 - SWBD	Supply/Source	Electrical	2 - < 20 yrs	3 - \$10,000 - \$49,999
RO 3 VFD Control Cabinet	Treatment - RO Filtration	Electrical	2 - < 20 yrs	3 - \$10,000 - \$49,999
RO 3 Combined Permeate Flow Meter	Treatment - RO Filtration	Instrumentation	2 - < 20 yrs	3 - \$10,000 - \$49,999
CIP - Flow Meter	Treatment - CIP	Instrumentation	2 - < 20 yrs	3 - \$10,000 - \$49,999
High Service Pump 1 - Pump	Distribution	Mechanical	2 - < 20 yrs	3 - \$10,000 - \$49,999
Hoist - Level 1 - Membrane Room	Treatment	Mechanical	2 - < 20 yrs	3 - \$10,000 - \$49,999
Caustic Soda - Chemical Feed Pump	Treatment - Caustic Soda	Mechanical	2 - < 20 yrs	3 - \$10,000 - \$49,999

Asset_Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
Antiscalant Feed Pump No. 2	Treatment	Mechanical	2 - < 20 yrs	3 - \$10,000 - \$49,999
Deep Well 4 - Surge Tank	Supply/Source	Mechanical	2 - < 20 yrs	3 - \$10,000 - \$49,999
High Service Pump 2 - Pump	Distribution	Mechanical	2 - < 20 yrs	3 - \$10,000 - \$49,999
High Service Pump 3 - Pump	Distribution	Mechanical	2 - < 20 yrs	3 - \$10,000 - \$49,999
Generator - WTP	Treatment	Electrical	2 - < 20 yrs	4 - \$50,000 - \$99,999
Plant Effluent Flow Meter	Treatment	Instrumentation	2 - < 20 yrs	4 - \$50,000 - \$99,999
Instrumentation Room - Analyzers and Sensors	Treatment	Instrumentation	2 - < 20 yrs	4 - \$50,000 - \$99,999
Iron Removal Backwash Tank	Treatment	Structural	2 - < 20 yrs	4 - \$50,000 - \$99,999
Reservoir	Treatment	Structural	2 - < 20 yrs	4 - \$50,000 - \$99,999
Laboratory Equipment	Treatment	Instrumentation	2 - < 20 yrs	5 - \$100,000+
Deep Well 5 - Pump	Supply/Source	Mechanical	2 - < 20 yrs	5 - \$100,000+
Elevated Storage Tank	Storage	Structural	2 - < 20 yrs	5 - \$100,000+
Deep Well 5 - Groundwater Well	Supply/Source	Structural	2 - < 20 yrs	5 - \$100,000+
Standpipe	Treatment	Structural	2 - < 20 yrs	5 - \$100,000+

Notes:

HRG - high resistance grounding; SWBD - switchboard

Table 6 List of Extended Term/Newly Replaced (20+-Year) Replacement Projects

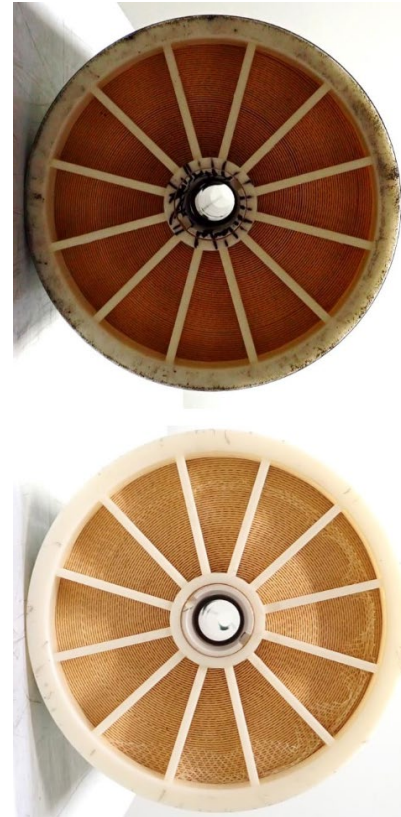
Asset_Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
Deep Well 5 - Flow Meter	Supply/Source	Instrumentation	1 - > 20 yrs	3 - \$10,000 - \$49,999
Deep Well 4 - Flow Meter	Supply/Source	Instrumentation	1 - > 20 yrs	3 - \$10,000 - \$49,999
RO 4 Stage 2 Permeate Flow Meter	Treatment - RO Filtration	Instrumentation	1 - > 20 yrs	3 - \$10,000 - \$49,999
RO 3 Stage 2 Permeate Flow Meter	Treatment - RO Filtration	Instrumentation	1 - > 20 yrs	3 - \$10,000 - \$49,999
RO 3 Concentrate Flow Meter	Treatment - RO Filtration	Instrumentation	1 - > 20 yrs	3 - \$10,000 - \$49,999
Caustic Soda - Bulk Tank - Digital Level Indicator	Treatment - Caustic Soda	Instrumentation	1 - > 20 yrs	3 - \$10,000 - \$49,999
RO 4 Concentrate Flow Meter	Treatment - RO Filtration	Instrumentation	1 - > 20 yrs	3 - \$10,000 - \$49,999
Deep Well 1 RTU1 cabinet	Supply/Source	Instrumentation	1 - > 20 yrs	4 - \$50,000 - \$99,999
SCADA RIO Control Cabinet	Treatment	Instrumentation	1 - > 20 yrs	4 - \$50,000 - \$99,999
Deep Well 3 - Flow Meter	Supply/Source	Instrumentation	1 - > 20 yrs	4 - \$50,000 - \$99,999
Deep Well 3 RTU cabinet	Supply/Source	Instrumentation	1 - > 20 yrs	4 - \$50,000 - \$99,999
Electrical System/SCADA Cabinet - Antiscalant Chemical System	Treatment	Instrumentation	1 - > 20 yrs	4 - \$50,000 - \$99,999
Deep Well 4 RTU cabinet	Supply/Source	Instrumentation	1 - > 20 yrs	4 - \$50,000 - \$99,999
Deep Well 5 RTU cabinet	Supply/Source	Instrumentation	1 - > 20 yrs	4 - \$50,000 - \$99,999
SCADA Main Control Cabinet	Treatment	Instrumentation	1 - > 20 yrs	5 - \$100,000+

Notes:

RIO - remote input/output; RTU - remote terminal unit; SCADA - supervisory control and data acquisition



Western Springs Water Treatment Plant Condition Assessment



TECHNICAL MEMORANDUM

ALTERNATIVES TO AMIAD IRON REMOVAL SYSTEM

July 2025 / DRAFT





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This document is released for the purpose of information exchange review and planning only under the authority of Thomas F. Seacord, July 21, 2025, Illinois PE #062-066180.

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Abbreviations

AC	alternating current
Carollo	Carollo Engineers
CEISM	Chromatic Elemental Imaging
DC	direct current
diam	diameter
EDS	Energy Dispersive Spectroscopy
gpm	gallons per minute
kW	kilowatt
L	length
LS	lost samples
LPRO	low-pressure reverse osmosis
µg/L	micrograms per liter
mgd	million gallons per day
mg/L	milligrams per liter
No.	number
NSF/ANSI	NSF International/American National Standards Institute
NTU	nephelometric turbidity unit
#/mL	number per milliliter
φ	phase
pCi/L	picocuries per liter of air
psi	pounds per square inch
psig	pounds per square inch gauge
RO	reverse osmosis
sq ft	square feet
TDS	total dissolved solids
TSS	total suspended solids
U.S.	United States
VoWS	Village of Western Springs
WTP	water treatment plant

SECTION 1 INTRODUCTION

The Village of Western Springs (VoWS) provides drinking water to approximately 13,300 residents. VoWS's current water production infrastructure includes four groundwater wells, a central treatment plant, and three storage tanks. In 2013, VoWS completed a major upgrade of its treatment plant, transitioning from a lime softening process to a low-pressure reverse osmosis (LPRO) system. The upgrade included the installation of an iron removal system, membrane cartridge filtration, and the LPRO units.

Since the transition, the VoWS has encountered persistent challenges in operating and maintaining the iron removal system—an Amiad Water Systems model AMF-370K. These challenges are primarily due to limited domestic support and extended lead times for replacement parts, as Amiad's manufacturing and support operations are based in Israel. Additionally, concerns have been raised about the system's treatment performance, particularly in relation to Well Number (No.) 3, where downstream cartridge filters require frequent replacement, suggesting suboptimal treatment efficiency.

Given these operational and logistical concerns, the VoWS engaged Carollo Engineers (Carollo) to conduct a comprehensive treatment assessment with the intent of identifying a suitable, equal-performance replacement for the existing Amiad filters. This report has been prepared to meet the following objectives:

1. **Assess** the overall treatment performance of the existing process train relative to the plant's treatment goals and identify potential areas for improvement.
2. **Evaluate** alternative iron removal technologies available in the market, with a specific focus on local support availability and spare parts accessibility.
3. **Recommend** the most appropriate replacement technology through a detailed comparison and performance-based evaluation of viable alternatives.

While the primary focus of this project is the evaluation and replacement of the current iron removal system, it is essential to understand the performance limitations of the downstream treatment processes. This broader context is critical for accurately assessing the role and effectiveness of the iron removal system as a pre-treatment step within the overall water treatment process.

SECTION 2 EXISTING SYSTEM OVERVIEW AND EVALUATION

2.1 Water Supply System

The VoWS' water system is supplied by four groundwater wells: Well Number (No.) 1, Well No. 3, Well No. 4, and Well No. 5:

- Well No. 1 is currently designated for emergency use only, due to its limited production capacity of 780 gallons per minute (gpm) and poor water quality. Well No. 1 historically produces water with high total hardness (>900 milligrams per liter (mg/L)) and high iron concentration.

- Well No. 3 and Well No. 4 serve as the primary production wells, each delivering approximately 1,000 gpm. These wells have comparable water quality and operate as the main sources for the treatment plant.
- Well No. 5, drilled in 2020 and commissioned in 2021, currently bypasses the treatment system and discharges directly into the reservoir at the water treatment plant (WTP). However, VoWS is actively working on infrastructure improvements to route Well No. 5 to the headworks of the WTP for full treatment.

Table 1 summarizes the available groundwater supply and their production rates.

Table 1 VoWS' Production Well Rates and Status

Well ID	Capacity (mgd)	Production Rate (gpm)	Status
Well No. 1	1.123	780	Emergency
Well No. 3	1.656	1,150	Primary
Well No. 4	1.476	1,025	Primary
Well No. 5	1.728	–	Secondary

Notes:
 mgd - million gallons per day.

2.2 Water Treatment Plant Overview

The VoWS WTP is designed to treat a total flow of approximately 2.8 mgd. The facility is equipped with two parallel treatment trains, one dedicated to each of the primary production wells (Well No. 3 and Well No. 4). Each train consists of a duty-standby iron removal system, a membrane cartridge filtration unit, and a two-stage LPRO system. Currently, the plant provides reverse osmosis (RO) treatment to only a portion of the raw water supply from each well, approximately 65 percent and 55 percent of the flows from Well No. 3 and Well No. 4, respectively.

The remaining untreated raw water bypasses the treatment process and is blended with the treated (filtered) water downstream in a common header. This blended stream is then disinfected and stored in a 500,000-gallon finished water reservoir. Figure 1 illustrates the process flow of the VoWS water production system. The following sub-sections provide technical overviews of the main processes in the treatment plant.

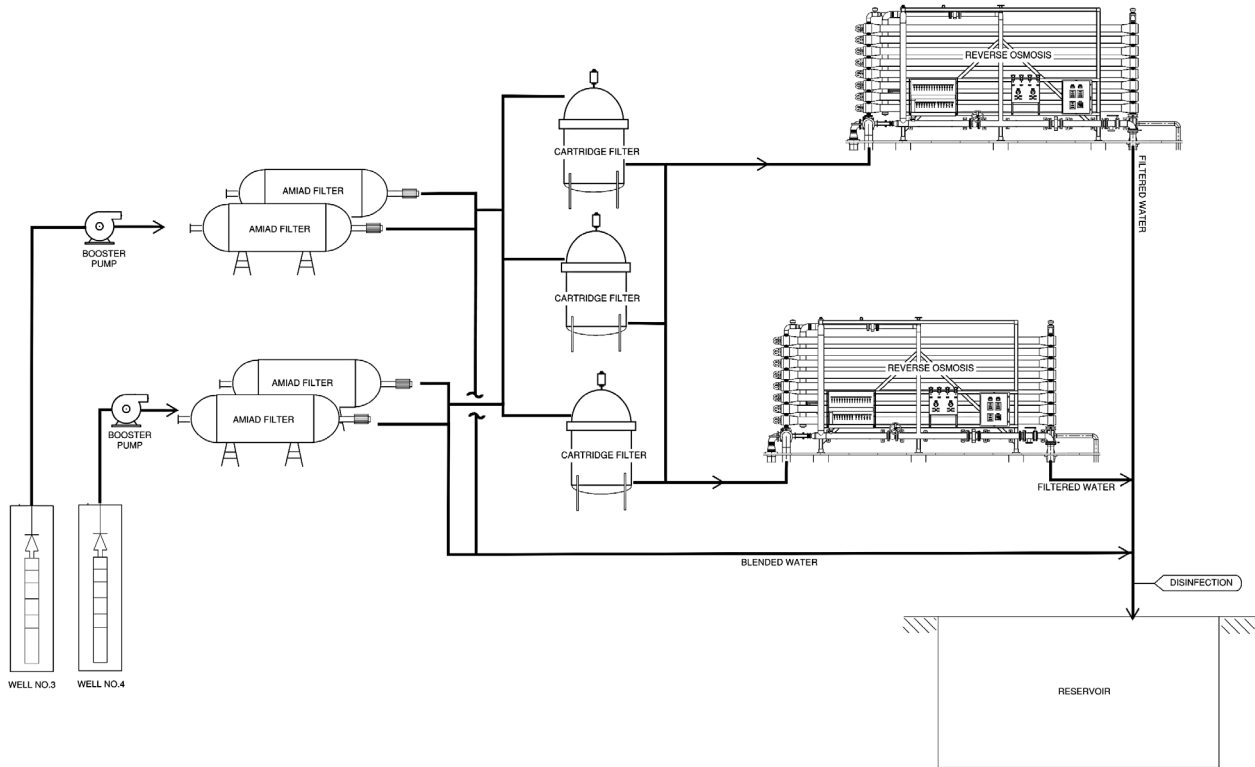


Figure 1 Process Flow Diagram VoWS Western Springs Water System

2.2.1 Iron Removal System

The iron removal in the treatment plant is provided by Amiad Water Systems, which is a globally recognized water filtration supplier with applications spanning across industrial, municipal, and agricultural industries. Amiad's headquarter is located in Kibbutz Amiad, Israel, and operates several manufacturing facilities around the world, including locations in Israel, the United States (U.S.), China, and Australia.

The installed unit is model AMF-370K. It is a self-cleaning, microfiber filter with a filtration degree as fine as 2-micron. Each treatment train is equipped with two duty-standby filters which share a flushing water tank and duty-standby flushing booster pumps. Feed pressure into the filter is provided by the Well No. 3 and Well No. 4 booster pumps (P-1100-3 and P-1100-4). Filtrate from the Amiad system feeds the membrane cartridge vessels upstream of the LPRO trains; however, the spent backwash is sent into the WTP's concentrate waste tank. Figure 2 illustrates the main process components of the Amiad filter and Table 2 summarizes the technical specification of the existing Amiad filter.

The AMF filter removes suspended particles from raw water using multi-layered microfiber cassettes attached to collector pipes [1]. During filtration, particulates in the raw water accumulate on the microfiber layers, creating a differential pressure across the filter. When the differential pressure reaches a preset threshold of 3 psi, a self-cleaning cycle is initiated. At this point, the inlet valve [3] and outlet valve [4] close, and the drain valve [5] opens to empty the vessel.

Pressurized water from a booster pump is then delivered into the shuttle pipe [7], where flush nozzles [8] are mounted. These nozzles travel along the shuttle pipe, spraying high-powered jets to clean both sides

of the microfiber cassettes and dislodge trapped debris. Once the nozzles reach the end of a row, a turn mechanism indexes the filter package to the next row of cassettes, and the nozzles reverse direction to clean the opposite side. This process continues until all 35 rows of cassettes have been cleaned.

Upon completion, the drain valve closes, and the inlet valve reopens to refill the vessel. Before resuming normal filtration, the system performs a filter-to-waste step, during which residual contaminants that may have entered the collector pipes during the flush are removed. Once the filter-to-waste cycle is complete, the filter-to-waste valve [9] closes, and the outlet valve reopens, returning the filter to normal operation.

As described above, filtration is non-continuous during the backwash cycle. The system currently requires one to two backwashes a day, with each cycle taking about 30 minutes to complete. Clean-in-place cleaning is conducted every 5 weeks, which includes 1 hour of soaking with heated oxalic acid (100 degrees Fahrenheit) followed with 1.5 hours of recirculation, and 30 minutes of flushing. The system uses pneumatic actuated valves, which are currently the sole users of the compressor in the treatment plant.

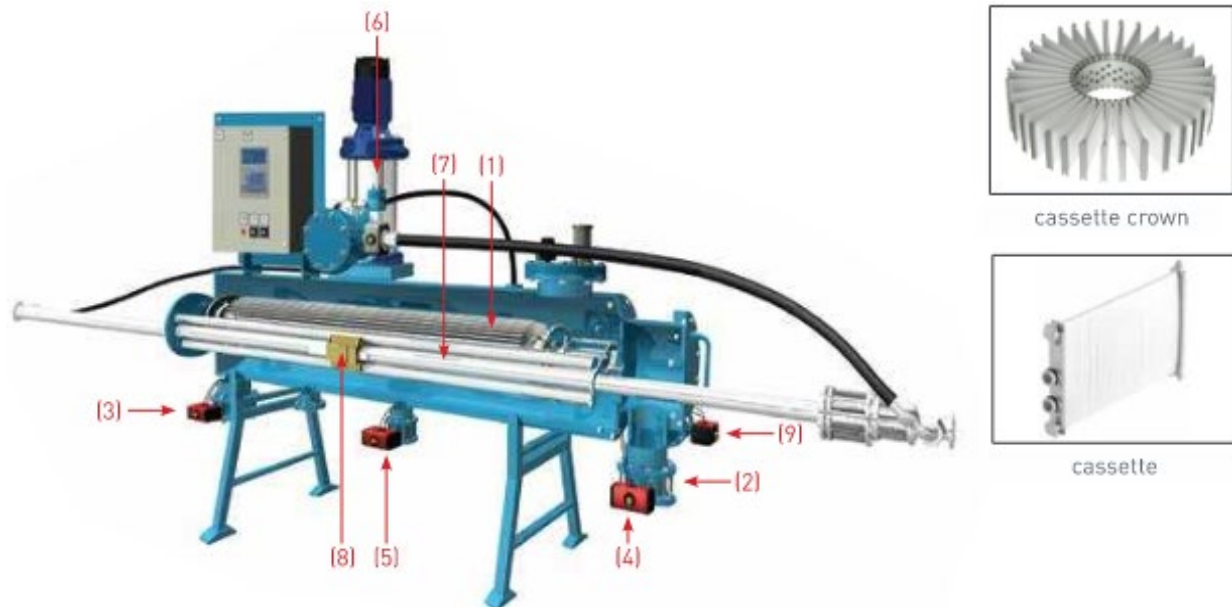


Figure 2 Illustration of Existing Amiad AMF-370K Filter Process Components

Table 2 Technical Specification of Existing Amiad AMF-370K Filters

Parameter	Value
Iron Removal System	
Make and Model	Amiad AMF-370K
Number of Units Installed per Train	2 (duty-standby)
Filtration Degree, microns	2
Nozzle Protection Filter, micron	200 (self-cleaning)
Number of Cassette Units	3,640
Filtration Area, sq ft	398.2
Flowrate, mgd	1.8

Parameter	Value
Minimum Inlet Pressure, psig	50
Pressure Drop, psig	3 to 6
Number of Backwash per Day	1 to 2
Flushing Water Booster Pumps	
Make and Model	Grundfos CR-20
Number of Installed Units	2 (duty-standby)
Flush Flow, gpm	88.0
Motor Type	Soft Starter
Rated Operation Voltage	220 to 480V, 50/60Hz, 3φ
Power Consumption, kW	12 kW
Flushing Water Tank	
Volume, gallons	1,200
Number of Installed Units	1
Compressor	
Make and Model	Ingersoll Rand 2545E10
Number of Installed Units	1
Compressed Air Supply, psig	87 to 116

Notes:

Hz - hertz; kW - kilowatt; φ - phase; psig - pounds per square inch gauge; sq ft - square feet; V - volt.

2.2.2 Cartridge Filters

The cartridge filters protect the RO system from any remaining sand or silt that may have passed through the Amiad system and can blind the membrane. The vessels contain 70 1-micron filter cartridges. The WTP is equipped with three cartridge filter vessels, one for each treatment train with one standby vessel.

Table 3 summarizes the technical specification of the existing cartridge filter treatment system.

Table 3 Technical Specification Existing Cartridge Filters

Parameter	Value
Cartridge Filter Vessels	
Make and Model	DynaPure Filtration CF-70-5-150-8-SS6L
Number of Installed Units	3
Number of Cartridges per Vessel	70
Capacity per Vessel, mgd	1.8
Cartridge Filter Elements	
Filter Media	Melt blown polypropylene
Filtration Degree, microns	1

2.2.3 LPRO System

The LPRO system provides treatment to remove dissolved ions in the water such as calcium, iron, manganese, fluoride, radium. The installed LPRO trains operate in a 2-stage configuration with a 14:7 array for the Well No. 3 LPRO train, and a 16:8 array for the Well No. 4 LPRO train. Table 4 summarizes the technical specification of the existing LPRO system.

Table 4 Technical Specification Existing LPRO System

Parameter	Value	
Trains		
Train No.	Well 3 Train	Well 4 Train
Array configuration	14:7	16:8
Capacity, mgd	0.85	1.19
Membrane Vessels		
Make	Protec Arisawa	
Diameter, inches	8	
Operating Pressure Range, psi	150 to 600	
Membrane Elements		
Make and model	Toray TMH-20A400C	
AElement Material	Cross Linked Fully Aromatic Polyamide Composite	
Filtration Area, sq ft	400	
Maximum Pressure Drop (element/vessel), psi	15/50	
Operating Pressure Range, psi	100 to 365	
Total Installed Elements	168 (2 systems)	

Notes:

psi - pounds per square inch.

2.3 Raw Water Quality

The VoWS's water sources have historically exhibited elevated concentrations of naturally occurring radioactive contaminants, iron, and water hardness (e.g., calcium). Elevated concentrations of gross alpha, radium-226 and radium-228, indicate the presence of radioactive contaminants exceeding the limits established by the National Primary Drinking Water Regulations. Gross alpha particle concentrations typically range from 15 to 30 picocuries per liter of air (pCi/L), surpassing the regulatory limit of 15 pCi/L. Similarly, combined radium-226 and radium-228 concentrations consistently exceed the 5 pCi/L limit.

In addition to radiological concerns, groundwater samples have shown elevated iron concentrations, approaching the secondary maximum contaminant level of 300 micrograms per liter (µg/L). The groundwater is also characterized by high hardness, frequently exceeding 200 mg/L. Notably, emergency Well No. 1 has recorded the highest hardness level, exceeding 900 mg/L. Table 5 summarizes the raw water quality of the active production wells from October 23, 2024, sampling. As Well No. 1 is no longer in service and is scheduled to be replaced by Well No. 5, its water quality is excluded from this analysis.

Table 5 VoWS Raw Water Quality: Well 3, Well 4, and Well 5 (October 2024)

Parameter	Units	Regulatory Limit	Well No. 3	Well No. 4	Well No. 5
Calcium	mg/L	--	92	68	78
Hardness (as CaCO ₃)	mg/L	--	345	248	228
Iron	ug/L	300	204	223	299
Manganese	µg/L	--	15.2	9.95	10.9
Alkalinity (as CaCO ₃)	mg/L	--	280	300	272
Fluoride	mg/L	4	1.07	1.44	1.03
Alpha, Gross	pCi/L	15	31.1 (+/- 2.75)	19.9 (+/- 2.73)	14.7 (+/- 2.41)
Radium-226	pCi/L	5	5.87 (+/- 1.05)	5.03 (+/- 1.10)	3.40 (+/- 1.00)
Radium-228	pCi/L	5	4.30 (+/- 0.62)	3.76 (+/- 0.616)	2.17 (+/- 0.485)
TDS	mg/L	500	512	518	436
Lithium	µg/L	--		108	67.8

Notes:

CaCO₃ - calcium carbonate; TDS - total dissolved solids.

2.4 Evaluation of Existing Amiad Filter

On May 14, 2025, Carollo completed a treatment sampling program at the water treatment plant with the assistance of the VoWS staff. The treatment program consists of field measurements as well as third party laboratory (Avista) analyses. In total, nine field measurements, 36 laboratory water samples, one cartridge filter element, and one membrane element were collected.

The objectives of the sampling program were as follows:

1. Assess baseline water quality and exhibit differences in performance during varying operational conditions:
 - a. Raw water quality at steady state versus well start-up.
 - b. Treatment performance a pre- versus post- Amiad backwash.
2. Evaluate the effectiveness of the existing iron removal system as a pre-treatment for the LPRO system by evaluating feed versus filtered water quality and conducting an autopsy on both a cartridge filter element and the lead element of the LPRO system.

The following subsections present the methodology and findings of the sampling program.

2.4.1 Sampling Methodology

2.4.1.1 Water Sample Collection

Key treatment points, including well discharge (raw water), Amiad filtrate, and cartridge effluent, were sampled before and after a filter backwash. Due to limited accessibility, the Amiad backwash stream was excluded from the sampling.

Pre-backwash samples were collected under steady-state conditions, representing the system's baseline loading prior to backwashing. Post-backwash sampling was carried out at progressively longer intervals throughout the day to observe the filter's maturation and determine how long it takes to return to producing filtrate with stable water quality.

A total of 36 water samples were collected and submitted to Avista for particle count, turbidity, and total suspended solids (TSS). In addition, a single cartridge effluent sample was tested for general mineral composition to characterize the feed water entering the LPRO system; however, 19 samples were compromised during transport and excluded from the analysis. These lost samples are denoted with an "LS" in Table 6, which summarizes all submitted samples and their respective analyses.

Table 6 Submitted Laboratory Samples

Well ID	Sample Name	Raw Water	Amiad Filtrate	Cartridge Effluent
Well 3	Pre-Backwash	✓	LS	LS
	1 minute	LS	LS	LS
	1 hour	LS	✓	LS
	End of Day	LS	LS	LS
Well 4	Pre-Backwash	LS	✓	✓
	1 minute	LS	LS	✓
	5 minutes	LS	✓	✓
	10 minutes	LS	✓	✓
	40 minutes	✓	✓	✓
	1 hour	✓	LS	✓
	3 hours	LS	LS	LS
	End of Day	✓	✓	✓

To account for the risk of oxidation during transport, in-situ field measurements were performed on the raw water samples to capture accurate turbidity and TDS values immediately at pump start-up and throughout the day.

On the day of sampling, Well No. 3 was taken offline several hours in advance to allow oxidized particulates to settle within the well casing, intentionally creating a turbidity spike upon reactivation. This approach enabled collection of a representative "start-up" sample and helped track water quality stabilization over time. In contrast, Well No. 4 remained in continuous operation for several hours before sampling, allowing it to reach steady-state conditions. This provided a valuable comparison for evaluating water quality under normal, uninterrupted pumping conditions.

2.4.1.2 Membrane Cartridge Filter Collection

The cartridge filter from Well No. 3 treatment train was extracted and submitted to Avista's laboratory for foulant analysis. This treatment train is understood to represent the more challenging scenario of the two trains, as cartridge replacements for Well No. 3 occur approximately every 20 days, compared to 3 months

for Well No. 4. The significantly shorter lifespan of the Well No. 3 cartridge suggests higher fouling potential and makes it a suitable candidate for this analysis.

2.4.1.3 Lead LPRO Element Collection

One lead LPRO membrane elements was extracted from Well No. 4 treatment train and submitted to Avista's laboratory for an autopsy.

2.4.2 Results and Discussion

2.4.2.1 Water Quality Analysis

Results from both the laboratory analysis and field measurements are presented in Table 7 through Table 10 for Well No. 3 and Well No. 4 treatment trains. Refer also to Appendix A for Avista's Water Analysis Report.

Well No. 4 was sampled under steady operating conditions. The raw water from Well No. 4 exhibited a particle count of approximately 974 number per milliliter (#/mL) and a turbidity of 2.58 nephelometric turbidity unit (NTU) versus 0.22 NTU measured in the field. The discrepancy in turbidity values confirm that oxidization occurred during transit. The TDS was measured at 635 mg/L, and TSS was 4.2 mg/L.

Well No. 3 was sampled during a start-up event. A higher particle count of 2,037 #/mL and turbidity of 2.11 NTU versus 2.01 NTU measured in the field. The closely aligned turbidity values indicate that the water surge created during the start-up was sufficient to fully oxidize the dissolved iron and manganese present in the water and turned it into particulates form. Additionally, the TDS was relatively high at 902 mg/L, and TSS was measured at 7.6 mg/L. The elevated turbidity and TSS concentrations suggest that the water quality of Well No. 3 during start-up is notably poor.

Filtrate analysis indicated a significant improvement in water quality following filtration by Amiad. The particle count dropped sharply to 27.8 #/mL and turbidity fell to 0.126 NTU. Iron removal in pre-treatment was observed by comparing iron concentration in raw water (200 to 300 µg/L per Table 5) and in cartridge effluent (130 µg/L). No significant improvements in TSS were observed from this assessment. This could be attributed to sampling inconsistency or post-cartridge filtration particulate shedding.

2.4.2.2 Cartridge Filter Analysis

The cartridge filter (Figure 3) displayed external fouling characterized by an orange-colored, fine-granular substance, which was more concentrated on one end. Despite the external buildup, the internal filter fibers remained unaffected, as the foulant did not penetrate into the core structure. Advanced imaging techniques, including Chromatic Elemental Imaging (CEISM) and Energy Dispersive Spectroscopy (EDS), identified iron and bio-slime as the primary foulants. Elemental analysis showed that iron was the most abundant component at 30.86 percent by weight, followed closely by carbon and oxygen. Lesser amounts (<10 percent) of phosphorous, calcium, silicon, and magnesium were also present. Refer to Appendix B for Avista's Cartridge Filter Analysis Report.

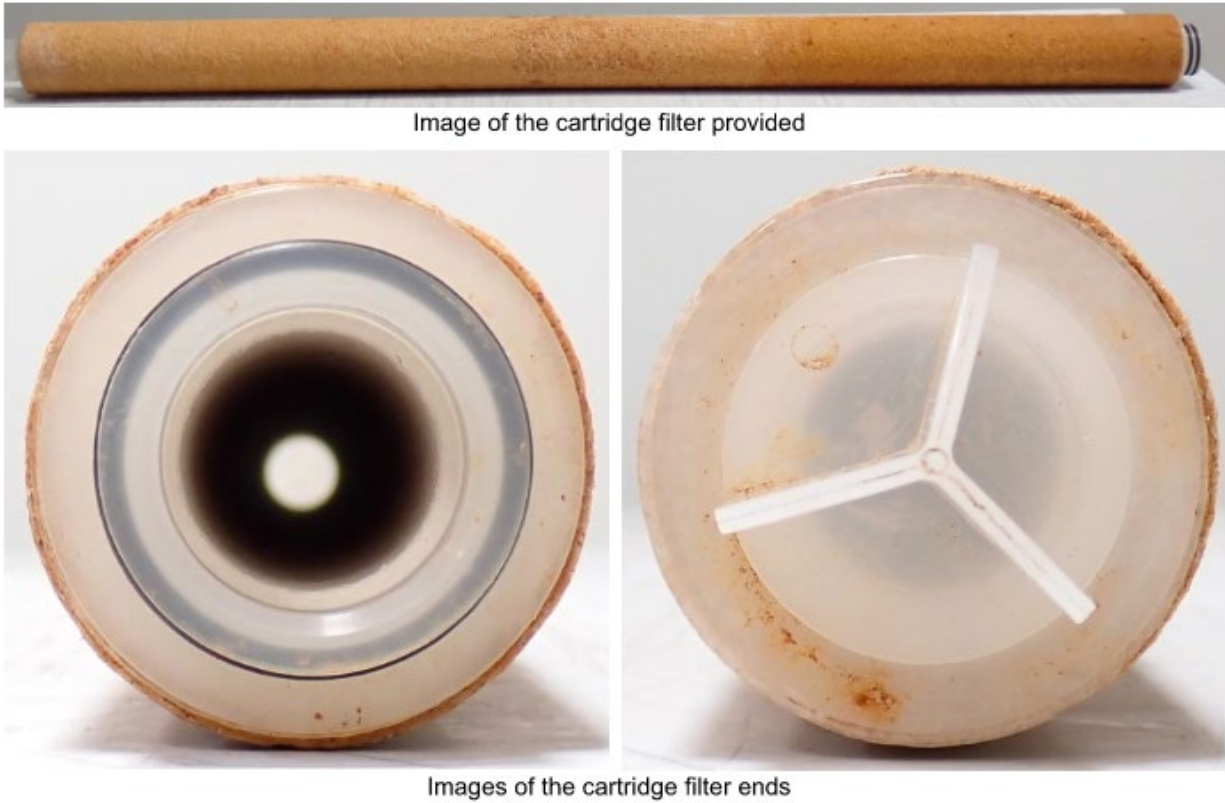


Figure 3 Cartridge Filter Exhibiting Orange-Colored Foulant Exterior Surface

2.4.2.3 Membrane Element Autopsy

The autopsy indicated that the membrane element was fouled with bio-slime, clay, colloidal silica, iron, and microorganisms. This result was supported by Fourier Transfer Infrared Spectroscopy and elemental imaging through CEISM and EDS, which all identified layers of composed bio-slime, clay (aluminum silicate), colloidal silica, iron, and microorganisms. A cleaning study was conducted using a two-step chemical cleaning process: RoClean P903 and RoClean P111. The cleaning regimen successfully removed all visible foulant and restore rejection performance to 99.6 percent. Refer to Appendix C for Avista's Membrane Element Autopsy Report.

2.4.2.4 Results Summary and Conclusions

Although the Amiad filter provides effective particulate removal from the raw water, it alone does not appear to offer adequate protection against iron for the downstream treatment processes. Analysis of the cartridge filter revealed evidence of mixed fouling, consisting of both organic and inorganic materials. The dominant inorganic foulants were iron and calcium phosphate, accompanied by moderate biological activity. In contrast, the RO membrane element showed predominant fouling by organic substances, including bio-slime and microbial residues.

To improve overall system performance, VoWS may consider enhancing the pre-treatment process by reducing the filtration micron rating, such as through the incorporation of microfiltration (MF) membranes or media-based filtration technologies. Greensand filtration, in particular, offers the added benefit of oxidizing and removing both iron and manganese, while simultaneously reducing particulate loading.

In addition to equipment upgrades, adjustments to operational practices may also help stabilize feedwater quality. Specifically, implementing longer flushing-to-waste periods following well start-up events could mitigate the effects of elevated turbidity and suspended solids typically observed during those transitions. These combined improvements would contribute to extending cartridge filter life, reducing membrane fouling, and enhancing the overall efficiency and reliability of the treatment process.

Table 7 Laboratory Analysis Results Well No. 3

Sample Name	Particle Count (#/ml) ⁽¹⁾			Turbidity (NTU)			TSS (mg/L)		
	Raw Water	Amiad Filtrate	Cartridge Effluent	Raw Water	Amiad Filtrate	Cartridge Effluent	Raw Water	Amiad Filtrate	Cartridge Effluent
Pre-Backwash	2,037	LS	LS	2.11	LS	LS	7.6	LS	LS
1 minute	LS	LS	LS	LS	LS	LS	LS	LS	LS
1 hour	LS	25	LS	LS	0.12	LS	LS	ND	LS
End of Day	LS	LS	LS	LS	LS	LS	LS	LS	LS
Total # of Samples	1	1	0	1	1	0	1	0	0

Notes:

ND - Not Detected.

(1) Particle count for particles in 2- to 50-micron range.

Table 8 Well No. 3 Raw Water Field Measurements

Time Post Well Flush	No. 1 NTU	No. 2 NTU	NTU Average	TDS (mg/L)
0 minutes	2.00	2.01	2.005	902
30 minutes	0.709	0.609	0.659	624
35 minutes	0.54	0.529	0.5345	616
1.5 hours	0.479	0.478	0.4785	591
2.5 hours (End of Day)	0.424	0.323	0.3735	590
		Minimum	0.37	590
		Average	0.46	599
		Maximum	2.005	902

Table 9 Laboratory Analysis Results from Well No. 4

Sample Name	Particle Count (#/ml) ⁽¹⁾			Turbidity (NTU)			TSS (mg/L)		
	Raw Water	Amiad Filtrate	Cartridge Effluent	Raw Water	Amiad Filtrate	Cartridge Effluent	Raw Water	Amiad Filtrate	Cartridge Effluent
Pre-Backwash	LS	7	29	LS	0.09	0.13	LS	ND	NA
1 minute	LS	LS	19	LS	LS	0.1	LS	LS	ND
5 minutes	LS	114	19	LS	0.16	0.15	LS	5.7	ND
10 minutes	LS	6	2	LS	0.09	0.08	LS	5.1	ND
40 minutes	764	6	104	2.59	0.22	0.21	5.4	ND	ND
1 hour	1406	LS	3	2.79	LS	0.08	4.2	LS	5.1
3 hours	LS	LS	LS	LS	LS	LS	LS	LS	LS
End of Day	753	6	3	2.35	0.07	0.07	ND	ND	ND
Total No. of Samples	3	5	7	3	5	7	2	2	1
Minimum	753	6	2	2.35	0.07	0.07	4.20	5.10	-
Average	974	28	26	2.58	0.13	0.12	4.20	5.10	5.10
Maximum	1,406	114	104	2.79	0.22	0.21	4.20	5.10	-

Notes:

NA – Not Analyzed.

(1) Particle count for particles in 2- to 50-micron range.

Table 10 Well No. 4 Raw Water Field Measurements

Sampling Time	#1 NTU	#2 NTU	NTU Average	TDS (mg/L)
10 minutes	0.317	0.235	0.276	646
30 minutes	0.197	0.187	0.192	657
50 minutes	0.193	0.194	0.1935	648
6 hours (End of Day)	0.21	0.19	0.2	590
		Minimum	0.19	590
		Average	0.22	635
		Maximum	0.28	657

SECTION 3 IRON REMOVAL DESIGN CRITERIA

The design criteria for the new iron removal system are influenced by several key factors, including space limitations, hydraulic conditions, required filtration efficiency, flow rates, and preferences related to operation and maintenance. This section provides a detailed discussion of each of these considerations.

3.1 Performance Specifications

The existing Amiad iron removal system has been in service since the VoWS' WTP was upgraded in 2013. Over that period of time the performance of the Amiad systems 2-micron screens can be measured by the cartridge filter run times and, to a lesser degree, the frequency of membrane clean-in-place:

- The cartridge filters for the Well 3 LPRO process train have typically required replacement every 3 weeks, while the Well 4 LPRO process train cartridge filters require replacement every 12 weeks.
- Membrane cleanings are performed every 3 months.

A replacement iron removal system needs to perform at least equal to the existing system, and preferably better, with a strong preference for improved operational outcomes. In particular, the new system should aim to extend the cartridge filter replacement interval for the Well No. 3 LPRO process train, which currently requires frequent changeouts. With these goals in mind, Table 11 summarizes the design criteria for the replacement iron removal system.

Table 11 Iron Removal System Design Criteria

System Parameter	Existing System	Upgraded System (Minimum Requirements)
Iron Removal System		
Capacity per Train, mgd	1.8	1.8
Number of Units Installed per Train	2 (duty-standby)	2 (duty-standby)
Degree of Filtration, microns	2	2
Certification	NSF/ANSI 61	NSF/ANSI 61
Filtration Mode	Self-Cleaning Non-Continuous	Self-Cleaning Continuous or Non-Continuous
Maximum Pressure Drop, psi	6	6
Inlet Pressure (typical), psi	95	95
Typical Feed Water Quality		
Total Iron, mg/L	300	300
Particle Count, #/mL	2,000	2,000
Total Suspended Solids, mg/L	7.6 ⁽¹⁾	7.6 ⁽¹⁾
Turbidity, NTU	2.0 ⁽¹⁾	2.0 ⁽¹⁾

Notes:

NSF/ANSI - NSF International/American National Standards Institute.

(1) Based on recent field measurements as summarized in Table 8 and Table 10.

3.2 Space Constraints

The existing Amiad filters are currently occupying both floors of the northwest portion of the building. Filters for Well No. 3 are located on the first floor and filters for Well No. 4 are located on the second floor. Both rooms are almost identical in size, measuring 17 feet, 7 inches wide by 33 feet, 10 inches long in total area. The first floor has a shorter ceiling height than the second floor, measuring 8 feet, 8 inches and 10 feet, 10 inches to the underside of the steel structure of the ceiling. There is existing infrastructure, such as heating, ventilation, and air conditioning ducting and structural support columns, which will limit the actual available space for the new system. Figure 4 depicts the iron removal room on the first floor to showcase the general space that is available for the new system.

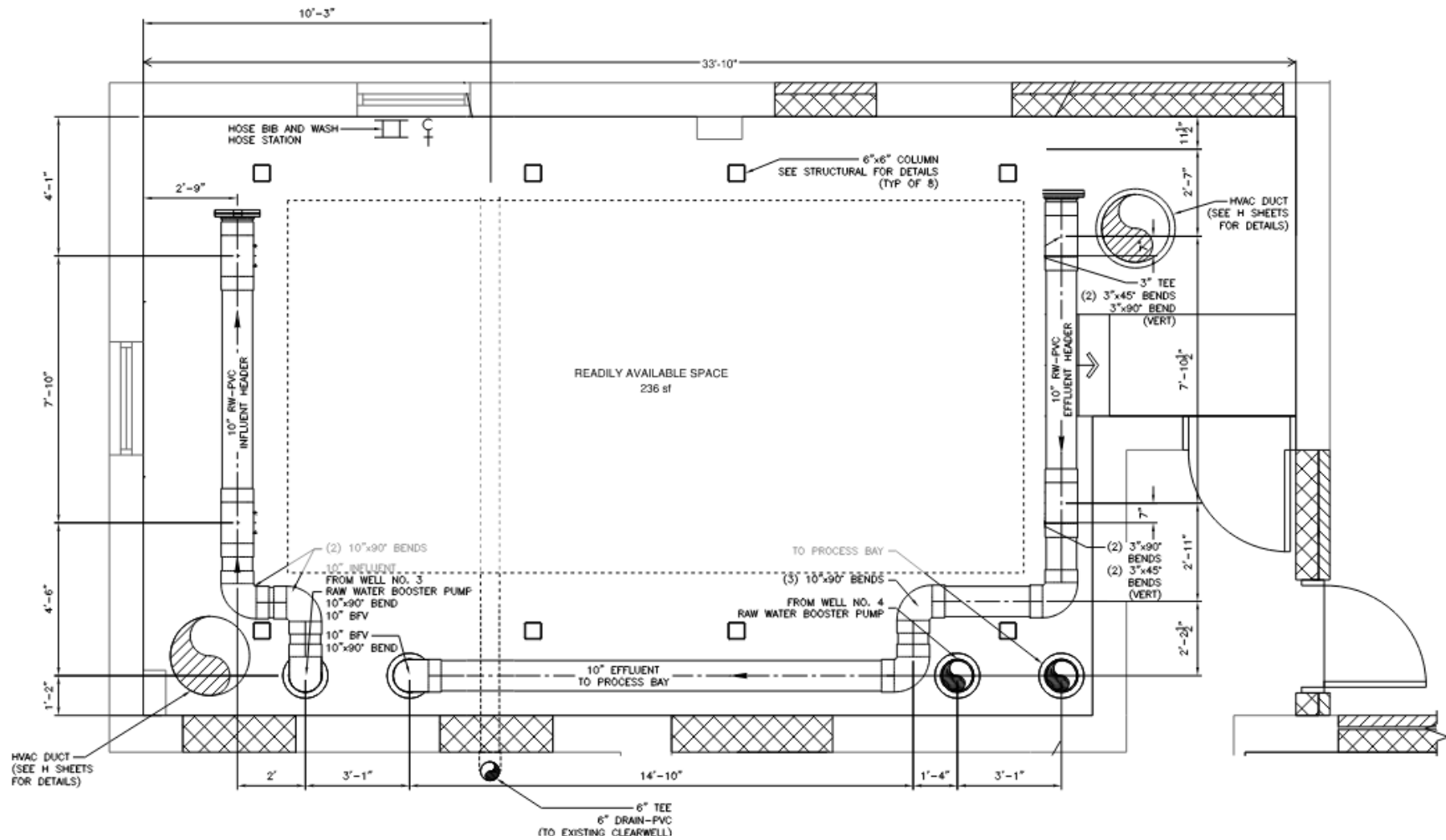


Figure 4 Typical Room Layout and Available Space New Iron Removal System

3.3 Operation and Maintenance Considerations

The VoWS has expressed interest in replacing the current filtration unit with a simpler and more maintainable system. Ideally, the new system would not require a compressor. The current Amiad system is the sole user of the compressor installed on the first floor, inside the Well No. 3 iron removal system room.

The VoWS has also requested that the recommended manufacturer have a local technical service presence and readily available spare parts. One of the key challenges with the existing Amiad filter system is the difficulty in sourcing technical support and replacement parts. Due to the parts being manufactured and shipped from Israel, lead times have been consistently long, leading to extended periods of downtime during maintenance or failure events.

This lack of local support and spare part availability presents a significant risk to the VoWS's operational resilience. Any disruption in system performance, even routine maintenance, can result in prolonged outages, undermining water treatment reliability. By selecting a system supported by regional service teams and stocked with local spare parts, the VoWS can improve system uptime, reduce maintenance delays, and ensure more dependable operation over the long term.

SECTION 4 TECHNOLOGY SELECTION

4.1 Market Offerings

A high-level review of water treatment technologies that are generally comparable to the existing Amiad system used by the VoWS was conducted. Eight major filtration manufacturers were identified. The primary selection criteria included a filtration degree of at least 2 microns or finer and certification under NSF/ANSI Standard 61 for use in drinking water applications.

The technologies reviewed featured a range of filtration elements, including microsand media, multimedia filters, and various types of wire screen configurations such as mesh, multi-layered sintered screens, and wedge-wire screens. All systems evaluated were self-cleaning and designed for continuous filtration, aligning with operational efficiency requirements. Among the eight iron removal technologies identified, only four offered filtration capabilities of at least 2 microns. Of those four, just two systems were confirmed to have NSF 61 certification - Forsta's Low Pressure Series and Tekleen's ABW Series. Both Forsta and Tekleen are automatic self-cleaning filters with comparable mode of operations and specification. An in-depth technology review on this type of filter is provided in Section 4.2.

This process of elimination narrows the pool of viable solutions, underscoring the limited market availability of high-performance, certified systems suitable for fine particulate removal in drinking water treatment. Table 12 provides a summary of the nine reviewed iron removal technologies, including their filtration ratings and NSF 61 certification status.

Table 12 Reviewed Viable Market Offerings Iron Removal Systems

Manufacturer	Model	Filter Element	Filter Rating micron	NSF 61	Self-Cleaning Continuous Filtration
Evoqua	Vortisand - Multimedia Filters	Microsand	0.5	-	✓
Eaton	F-Series, Tubular Backwashing Filter	Wire-mesh, Fabric, or Slot-type	2	-	✓
	AFR-Series, Tubular Backwashing Filter		2	-	✓
Forsta	Low Pressure Series	Sintered screen	2	✓	✓
Tekleen	ABW Series	Sintered screen	2	✓	✓
Orival	Automatic Self-Cleaning Filter	Wire-mesh	5	-	✓
Boll	Aquaboll	Wire-mesh	10	-	✓
Evoqua	VAF	Wire-mesh	10	✓	✓
Fluid Engineering	Eliminator	Wedge-wire screen	76	✓	✓

4.2 Technology Review of Self-Cleaning Filters

Both technologies from Forsta and Tekleen are fully automated, self-cleaning filtration systems which are designed to operate continuously without stopping production during periodic backwash cycles. The system consists of a coarse pre-screen, a 2-micron fine screen, a flush valve, a hydraulic-driven cleaning arm, a differential pressure probe, and a controller. Unlike the existing Amiad, the system does not require a separate flushing system and offers the use of electric actuators on isolating valves.

For high-production applications, multiple filters can be stacked vertically and connected to a common inlet header to minimize overall system footprint. Each filter is equipped with a dedicated inlet and outlet that can be fitted with isolating valves. This configuration allows operators to adjust the number of filters in operation based on real-time water quality conditions and flow demands. It also enables individual units to be taken offline for maintenance or inspection without interrupting overall system production, thereby enhancing operational flexibility and system reliability. Figure 5 depicts a Tekleen installation for Pepsi in Arizona.



Figure 5 Typical Configuration Stacked Filters (Tekleen, Arizona)

The following subsections discuss the two operating modes of the system.

4.2.1 Normal Filtration Cycle

During standard operation, influent water enters the filter body through the inlet connection and gets filtered by a coarse protection screen, which traps large debris and protects the internal components. The pre-filtered water then flows into the center of the filter chamber and passes outward through the fine stainless-steel screen. This screen, with a filtration degree of 2 microns, captures finer suspended solids. The filtered water exits the unit through the outlet connection. Over time, particulate matter builds up on the internal surface of the fine screen, leading to a gradual increase in differential pressure across the inlet and outlet.

4.2.2 Automatic Backwash Cycle

When the differential pressure reaches a predefined setpoint, or a programmed time interval, the system automatically triggers a self-cleaning backwash cycle. This process begins with the opening of the flush valve, which causes a rapid drop in pressure within the hydraulic motor chamber. This pressure drop creates a localized low-pressure zone (vacuum) inside the particle remover assembly, enabling the system to effectively dislodge and extract the debris adhering to the fine screen. Backwash waste is drawn through a series of suction nozzles, which are mounted on a rotating scanning arm driven by the hydraulic motor. Figure 6 highlights the main components of the filter and flow direction during normal operation.

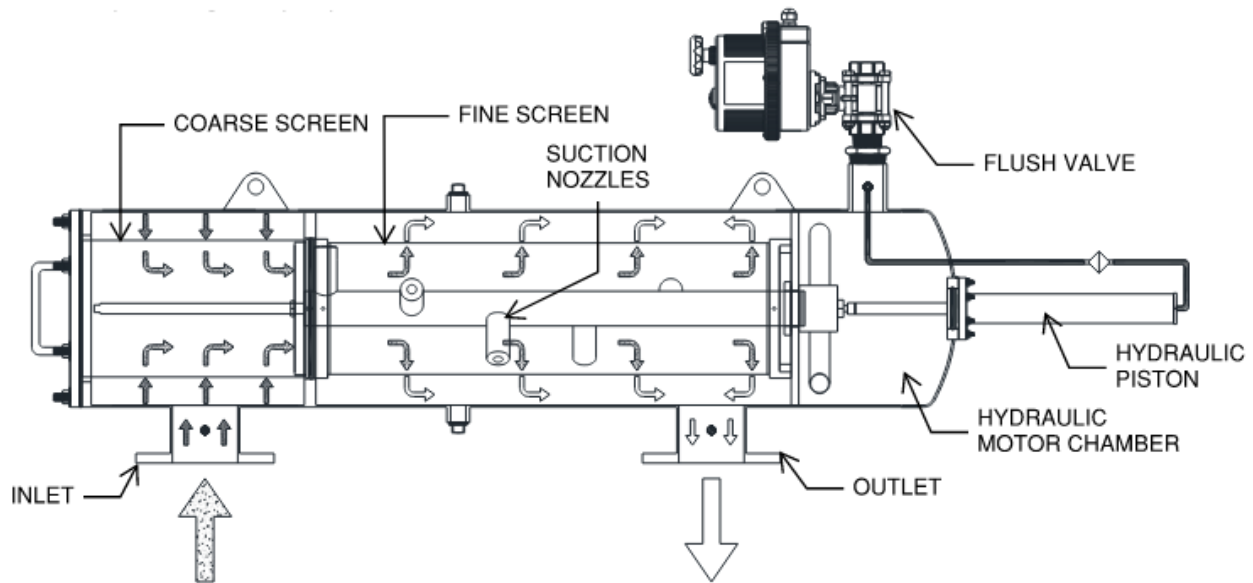


Figure 6 Main Components and Flow Path of Self-Cleaning Filter

4.2.3 Technology Comparison

Given the capacity and filtration degree, Forsta recommends two trains per well, with each containing four to eight filters, whereas Tekleen recommends a single train of six filters. The significant discrepancy in the number of filters should be resolved through a pilot study to validate actual performance and requirements. A key operational difference between the two systems lies in pressure requirements. Forsta operates at a minimum inlet pressure of 30 psi, compared to Tekleen's 70 psi. Given that the existing

booster pumps supply 95 psi to the current Amiad filters, both systems are compatible with the existing infrastructure.

In terms of design and materials, Forsta offers a larger active filtration area (139 sq ft versus 112 sq ft) and uses more corrosion-resistant stainless steel 316 screens compared to Tekleen's 304. However, Forsta requires a higher flush flow (220 gpm versus 280 gpm) and longer flush duration (20 to 30 seconds versus Tekleen's 6 to 8 seconds), resulting in significantly higher flushing volume per cycle (110 gallons versus 37 gallons).

From a logistical standpoint, both companies are headquartered in Los Angeles; however, Tekleen maintains a support branch in Chicago which may provide faster regional assistance and improved responsiveness for the VoWS. Lead times for both systems are comparable, though Tekleen offers an expedited 8-week delivery if in stock. Table 13 compares the self-cleaning filters that are viable for the VoWS's pre-treatment application.

From a cost perspective, the two systems have different price ranges. A Forsta system consisting of four trains of ten filters, complete with isolating valves and backwash controllers, is estimated to cost approximately \$840,000 or equivalent to \$84,000 per installed filter. In contrast, a Tekleen system with two trains of six filters, including comparable appurtenances and controls, is estimated at \$216,000 or equivalent to \$18,000 per installed filter. Table 14 compares the supply costs of the two systems.

Table 13 Comparison between Forsta and Tekleen Self-Cleaning Filters

Evaluation Parameter	Forsta	Tekleen
Model	Low Pressure Series - D8-LP180X10	ABW4-XLP
Capacity, gpm	1,300	1,300
Filtration Degree, microns	2	2
Number of Units, each	2 trains of 4 to 8 filters	1 train of 6 filters
Dimensions		
Weight of the system (FULL), pounds	8,000	12,500
Diam by L, inch	12.75 diam by 107 L	12.75 diam by 106 L
Required clearance, inch	54 L	48.5 L
Filter inlet diam, inch	6 to 8	4
Filter outlet diam, inch	6 to 8	4
Minimum Working Pressure, psig	≥30 psi	≥70 psi
Power Requirement	Controller – 110 V / 1φ Flush Valve – 24 VDC	Controller – 110 V / 1φ Flush Valve – 24 VAC/VDC or 12 DC
Filter Properties		
SA per Screen, sq ft	9.25	8
Active Filtration Area, sq ft	139	112
Screen Material	Stainless steel 316	Stainless steel 304
% Removal	90%	95% - 97%
Protection Screen, inch	1/4 (removable)	1/4 (removable)

Evaluation Parameter	Forsta	Tekleen
Flushing System		
Flushing Arm	hydraulic	hydraulic
Flush Valve Size, inch	2	2
Flush Flow, gpm	220	280
Flush Duration, seconds	20 to 30	6 to 8
Flushing Volume, gallons/unit	110	37
Local Support and Supply Lead Times		
Headquarter	Los Angeles	Los Angeles
Place of Manufacturing	Los Angeles	U.S., Asia, Africa
Location of Spare Parts	Los Angeles	Los Angeles
Nearest Location of Local Vendor Representatives	Los Angeles	Chicago
Supply Lead Time (weeks) From Approval of Shop Drawings	12 weeks	12 to 16 weeks (8 weeks if in stock)
Pilot System Rental and Support		
Capacity / Rental Fees	200 gpm / \$20,000 per 3 months 30 gpm / \$4,600 per 3 months	300 gpm / \$2,158 per 3 months

Notes:

DC - direct current; diam- diameter; L - length; VAC - Volts alternating current; VDC - Volts direct current.

Table 14 Vendor Supply Cost Comparison – July 2025

Item	Forsta		Tekleen	
	Quantity	Total	Quantity	Total
Automatic Filter	4x 10 Filters	\$760,000	2x 6 Filters	\$190,000
Backwash Controller	4	\$80,000	2	\$10,000
Isolating Valves	4x 20 Valves	Included	2x 12 Valves	\$16,000
Total Supply Cost		\$840,000		\$216,000

Both Forsta and Tekleen offer self-cleaning filtration technologies that meet the VoWS treatment goals, operational preferences, and certification requirements. While each system has unique characteristics related to footprint, flushing volume, and support logistics, both are considered viable replacement options for the existing Amiad filter system. Final selection should be informed by pilot testing results, site-specific operational considerations, and project funding priorities.

A minimum of 3 months of pilot work is recommended to validate the performance of the system, in particular the number of installed filters and the number of backwashes required in a day to maintain capacity. Pilot units can be rented from either vendor, with rental pricing provided in Table 13. To support performance evaluation, third-party laboratory analysis should be included in the project budget. At the very minimum, this should cover TSS, particle count, and general water quality parameters. Table 15 provides an estimate for a weekly laboratory analysis over a 3-month piloting period across all relevant treatment streams, including influent, effluent, and backwash. Also provided in Table 15 is the estimated

labor and engineering effort for the 3-month pilot work. The total direct cost of the pilot study is estimated at approximately \$50,000.

Table 15 Direct Costs of the Pilot Study

Parameter	Quantity	Unit Price	Total
Water Quality Analysis			
Total Suspended Solids	36	\$25	\$900
Particle Count (2 to 50 microns)	36	\$50	\$1,800
Water Analysis	12	\$550	\$6,600
Sub-Total Water Analysis Expenses			\$10,000
Pilot System Rental Fee			\$20,000⁽¹⁾
Engineering Effort			\$20,000
TOTAL ESTIMATED DIRECT COST			\$50,000

Notes:

(1) The rental equipment fee is based on Forsta's rental fee, which is the more expensive of the two (Table 13).

4.3 Conceptual Design and Configuration

New self-cleaning filtration systems will be installed in the designated filter rooms for Well No. 3 and Well No. 4. Each well will be equipped with two parallel filter racks, each containing up to ten self-cleaning filter units arranged in a vertically stacked configuration, which is the maximum number that can be accommodated in the available space. This configuration provides flexibility for future expansions or capacity adjustments. The high-end assumption on the number of filters is also considered appropriate for this stage to budget for space and funds until a pilot study is performed and can validate the actual number of filters required for effective performance.

Each filter unit will be equipped with isolating inlet and outlet valves to enable individual filter isolation for servicing or operational adjustments without interrupting the overall filtration process. These isolating valves may be fitted with electric actuators to allow for remote operation and integration with the facility's supervisory control and data acquisition system. The combination of isolating valves and automated control functionality will allow plant operators to adjust the number of filters in service at any given time and to provide maintenance to any given filters without interrupting production.

To the extent possible, the existing 10-inch influent and effluent headers will be reused to minimize demolition and piping replacement requirements. Currently, raw water is conveyed into the filter room via a 10-inch PVC influent header that enters from the floor at the southwest corner of the room. This header then transitions to an overhead run along the west wall of the room. The vertical riser section of this pipe will be preserved and modified with a tee at the ceiling level to branch feed flow into the second rack from the west side.

Filtered effluent will be collected at the opposite end of each rack (north side) and routed back to the existing 10-inch effluent header. This header currently wraps around the east side of the room and will be reused to convey treated water downstream with minimal changes to the existing infrastructure. Backwash waste from each unit will be conveyed to drain to the existing 4-inch process drains in the room which reports to the Concentrate Tank. Figure 7 depicts the general arrangement of the self-cleaning filter system typical for Well No. 3 and Well No. 4, whereas Figure 8 and Figure 9 provide section views of the filter system. All existing process equipment and piping are shown in grey to highlight the recommended change. Refer to Appendix D2 and Appendix D5 for vendor cutsheets.

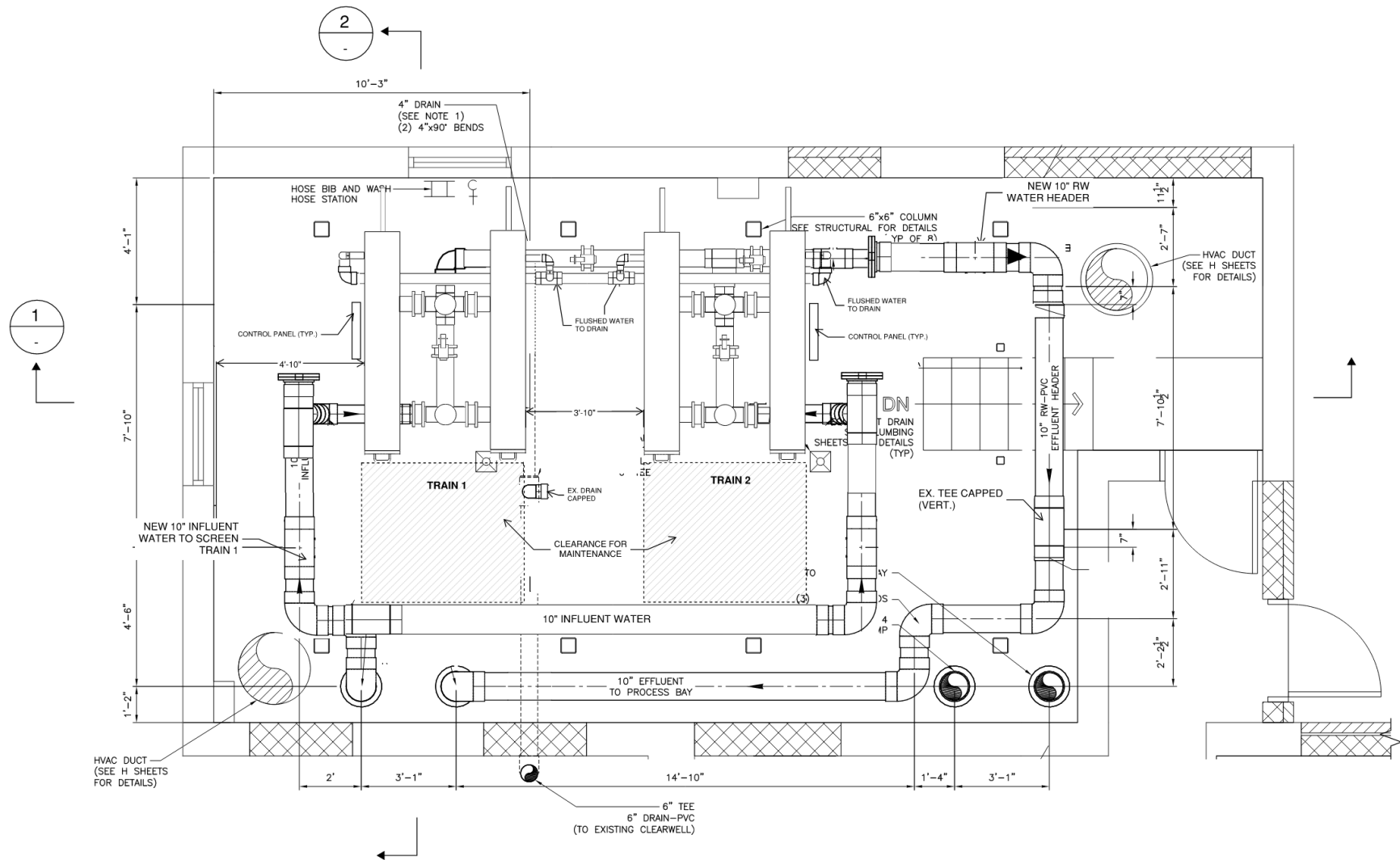


Figure 7 Typical General Arrangement First and Second Floor (Not to Scale)

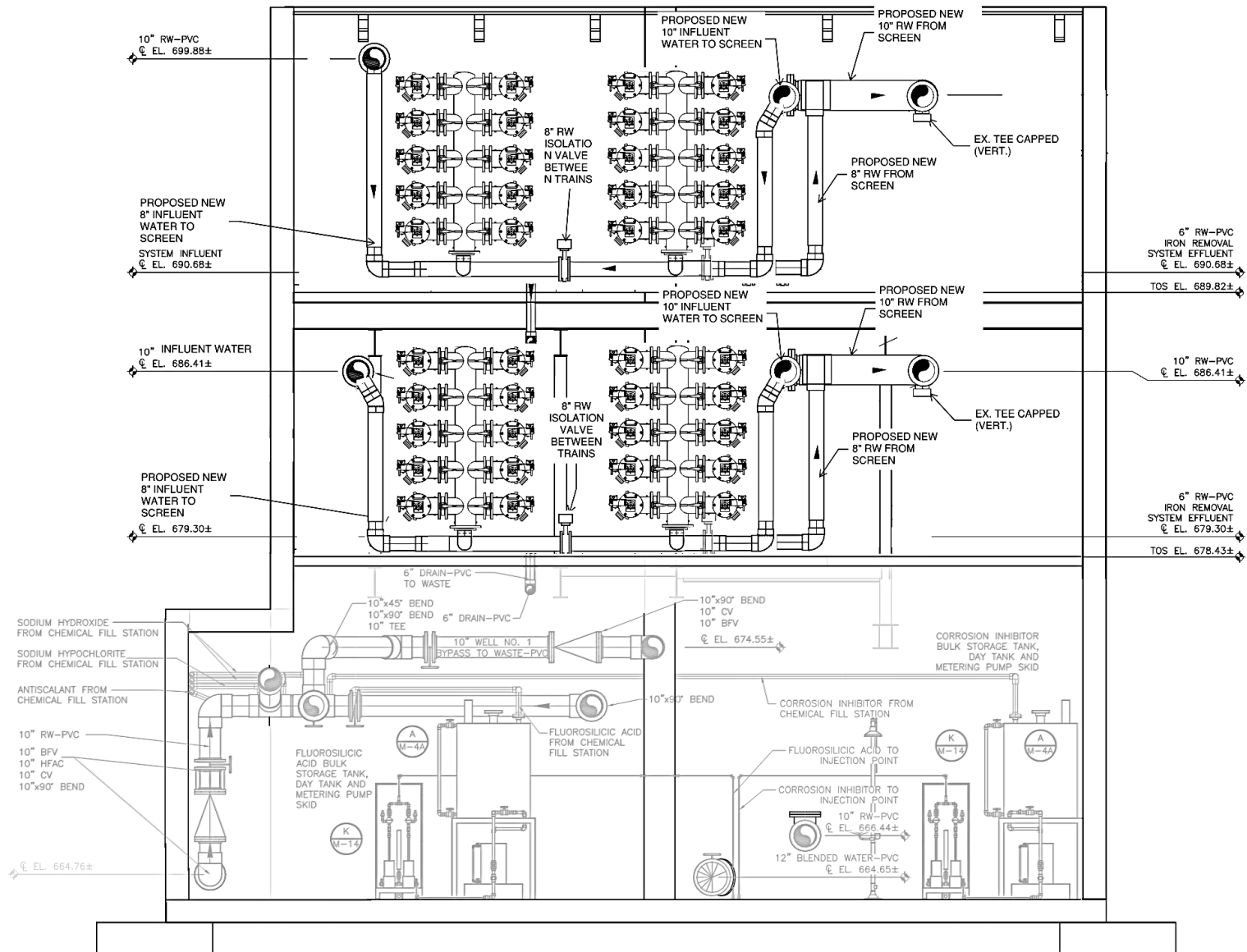


Figure 8 Section 1

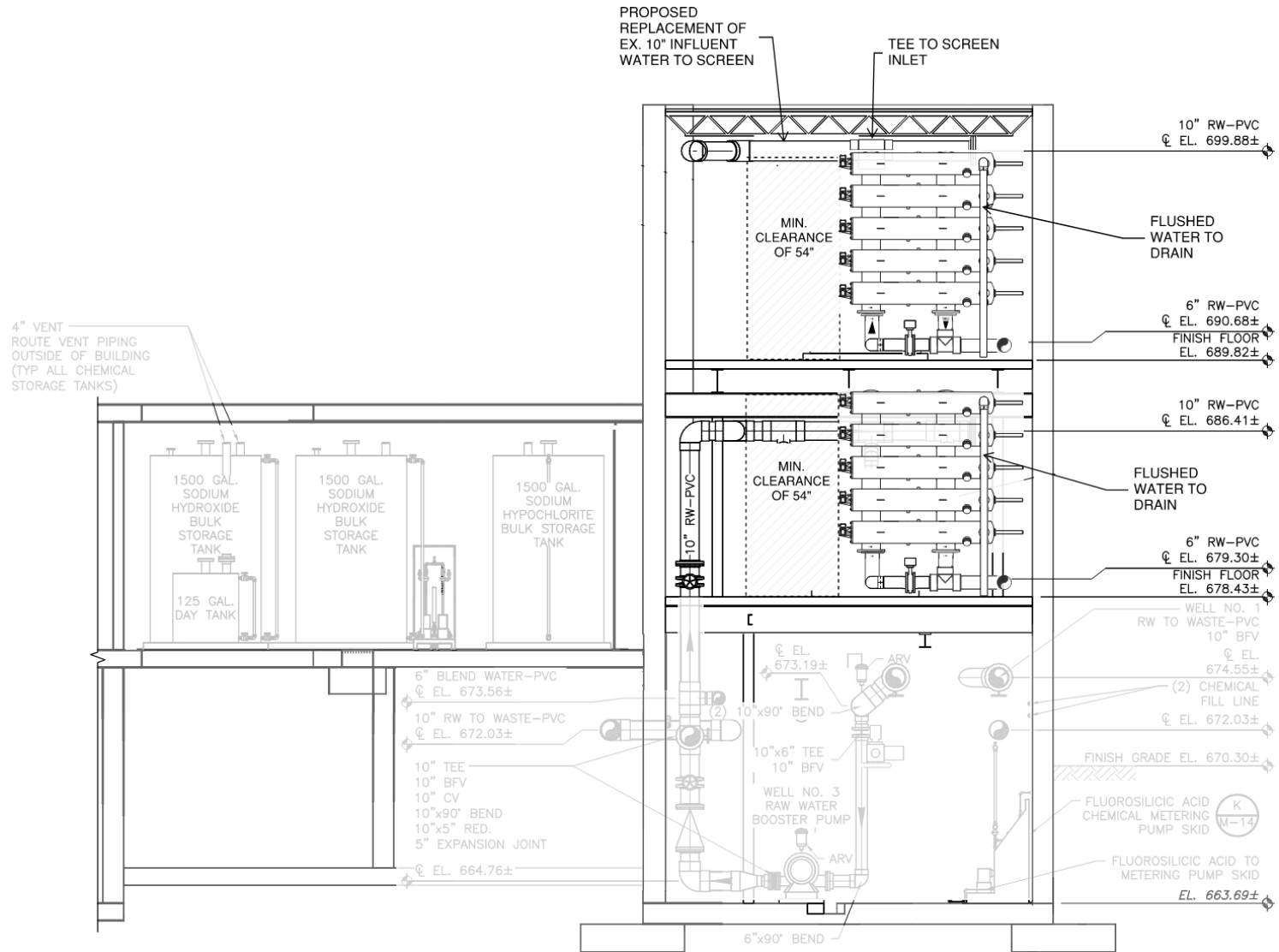


Figure 9 Section 2

4.4 Class 3 Cost Estimation

Class 3 cost estimations for the replacement of Amiad filters with Forsta and Tekleen self-cleaning filters for Well No. 3 and No. 4 are presented in Table 16 with an expected accuracy range of 30 percent (based on the AACE International), rounded up to the nearest ten thousand dollars. Forsta’s estimation was based on two racks of ten filters per well, whereas Tekleen’s estimation was based on a single rack of six per well. Both systems are to be equipped with individual isolating valves. Ten is the maximum number of filters that can be accommodated within the available space, as discussed in Section 4.3. The high-end assumption is considered appropriate pending the results of a pilot study, which will validate the actual number of filters required for effective performance.

Where possible, quantity takeoffs were completed for all elements shown in the proposed design drawings and vendor estimates were obtained for the recommended iron removal system. For all items known to exist but not defined in the project drawings, allowance was applied using experience and values from past projects. A 12 percent engineering services and 10 percent construction contingency are applied on the estimated capital costs. A 3.4 percent price escalation to mid-point is included in the estimation based on a 4-month construction period with a starting date in September 2026.

Table 16 Class 3 Capital Cost Estimation for Replacement Existing Amiad with Forsta and Tekleen Self-Cleaning Filters

Category	FORSTA		TEKLEEN	
	Level 3 Estimate	% Distribution	Level 3 Estimate	% Distribution
General Requirements	\$130,000	7%	\$50,000	7%
Building Demolition/ Reconstruction	\$30,000	2%	\$30,000	5%
Process Mechanical	\$1,170,000	63%	\$417,000	67%
Electrical and Instrumentation	\$530,000	28%	\$133,000	21%
Sub-Total Direct Cost	\$1,860,000	100%	\$640,000	100%
Class 3 Contingency	\$560,000	30%	\$200,000	
General Contractor Overhead, Profit and Risk	\$365,000	15%	\$130,000	
Escalation to Mid-Point	\$100,000	3.4%	\$40,000	
Total Estimated Construction Cost	\$2,890,000		\$1,010,000	
Engineering Fees	\$580,000	20%	\$210,000	
Pilot Study Direct Cost	\$50,000		\$50,000	
Owner's Reserve for Change Orders	\$290,000	10%	\$110,000	
Total Project Budget	\$3,810,000		\$1,380,000	

Project funding must be carefully reviewed prior to making specific financial decisions. A breakdown of the cost is available in Appendix E1 and Appendix E2 for Forsta and Tekleen, respectively.

SECTION 5 CONCLUSIONS AND RECOMMENDATIONS

The VoWS' current iron removal system, an Amiad AMF-370K microfiber filter, has proven effective at removing particulates from raw groundwater but, due to historic service issues, presents a reliability concern. Frequent maintenance issues, limited domestic support, and extended lead times for replacement parts warrant replacement consideration. Performance data further indicate that the existing system could be improved to reduce the need for cartridge filter replacement and RO membrane cleanings, particularly in the Well No. 3 treatment train.

A thorough evaluation of alternative technologies was conducted, focusing on systems that (at minimum) meet the current performance of the Amiad filters, operational needs of the VoWS, and space constraints. Among the options reviewed, only Forsta and Tekleen self-cleaning filters were found to provide comparable filtration performance (2 microns), NSF/ANSI 61 certification, and a fully automated cleaning process. Both systems offer continuous filtration with significant operational flexibility, including modular stacking, local support and/or domestically sourced spare parts, and reduced backwash volumes. Each vendor's solution presents trade-offs in terms of pressure requirements, flushing volume, and material specifications, which are detailed in Section 4.

Based on the conceptual design, it is recommended that each treatment train be equipped with two parallel filter racks, each capable of supporting five to ten vertically stacked self-cleaning filters. This layout allows for a flexible number of filters in operation. Reuse of existing headers, drains, and structural space will help reduce capital costs and construction impacts. To validate design assumptions and ensure optimal filter performance under site-specific conditions, a pilot study is recommended before proceeding with full-scale implementation. The direct cost of a 3-month pilot study is estimated at approximately \$30,000, assuming the more expensive rental unit from Forsta and weekly water quality analyses by a third-party laboratory. This step will provide operational confidence, refine sizing and controls, and support an informed selection between the two leading technologies. A Class 3 cost estimate has been developed for budgeting purposes, and careful consideration should be given to securing funding and scheduling construction activities to align with operational priorities.

APPENDIX A

WATER QUALITY ANALYSIS REPORT

Particle Count & Turbidity

 Customer: Carollo Engineers - Boise, ID

 Date: 5/30/2025

 Site: --

 WO#: 060324-1

Parameter	Well 4 Amiad: 5 Min Filtrate Results	Well 4 Amiad: 10 Min Filtrate Results	Well 4 Amiad: 40 Min Filtrate Results	Well 4 Amiad: EOD Filtrate Results	Detection Limit
Particle Count	114	6	6	6	# Particles/mL in 2 – 50 µm
Turbidity	0.16	0.09	0.22	0.07	0.01 NTU
TSS	5.7	5.1	ND*	ND	3 mg/L

ND – None Detected

Parameter	Well 4 Amiad: Pre- Backwash Filtrate Results	Well 4 Amiad: 40 Min RW Results	Well 4 pre- Backwash Cartridge Eff Results	Well 4 Cartridge: 1 Min Effluent Results	Detection Limit
Particle Count	7	764	29	19	# Particles/mL in 2 – 50 µm
Turbidity	0.09	2.59	0.13	0.10	0.01 NTU
TSS	ND	5.4	NA*	ND	3 mg/L

NA – Not Analyzed

Parameter	Well 4 Cartridge: 5 Min Effluent Results	Well 4 Cartridge: 10 Min Effluent Results	Well 4 Cartridge: 40 Min Effluent Results	Well 4 Cartridge: 60 Min Effluent Results	Detection Limit
Particle Count	19	2	104	3	# Particles/mL in 2 – 50 µm
Turbidity	0.15	0.08	0.21	0.08	0.01 NTU
TSS	ND	ND	ND	5.1	3 mg/L

Parameter	Well 4 Cartridge: EOD Effluent	Well 4 RW - 1 HR	Well 4 RW - EOD	Detection Limit
	Results	Results	Results	
Particle Count	3	1406	753	# Particles/mL in 2 – 50 µm
Turbidity	0.07	2.79	2.35	0.01 NTU
TSS	ND	4.2	ND	3 mg/L

Parameter	Well 3 Amiad: 1 HR. Filtrate	Well 3 Pre-Backwash: RW	Detection Limit
	Results	Results	
Particle Count	25	2037	# Particles/mL in 2 – 50 µm
Turbidity	0.12	2.11	0.01 NTU
TSS	ND	7.6	3 mg/L

APPENDIX B

CARTRIDGE ANALYSIS REPORT

COMPLETED FOR:

Carollo Engineers – Boise, ID

06/03/2025

WO#060324-2

EXECUTIVE SUMMARY

Background Carollo Engineers – Boise, ID provided (1) spun-bonded cartridge filter to Avista. Below is a summary of the analysis.

Inspection The cartridge filter exterior was coated in orange-colored foulant that was heavier on one end. The foulant was fine-granular in texture and easily scrapable. Imaging of the filter ends and dissection into the filter confirmed the foulant material did not penetrate through to the interior portions of the fiber.

Foulant Analysis The scrapable foulant material had a moisture content of 13% and an organic content of 39%, indicating the foulant was a mixture of organic and inorganic material. Microscope analysis of the scrapable foulant displayed amorphous inorganic material, bio-slime, translucent crystals and Gram-positive bacteria. Moderate aerobic bacteria activity was observed. Chromatic Elemental ImagingSM (CEISM) of the filter exterior revealed a mixture of iron, calcium phosphate and bio-slime.

Analysis Conclusion The cartridge filter was fouled primarily fouled with a mixture of iron, calcium phosphate and bio-slime.

The following key will be used throughout the report to demonstrate whether the observation is within or outside normal conditions or if the test was not carried out.



Within normal conditions



Outside normal conditions



Not tested

INSPECTION

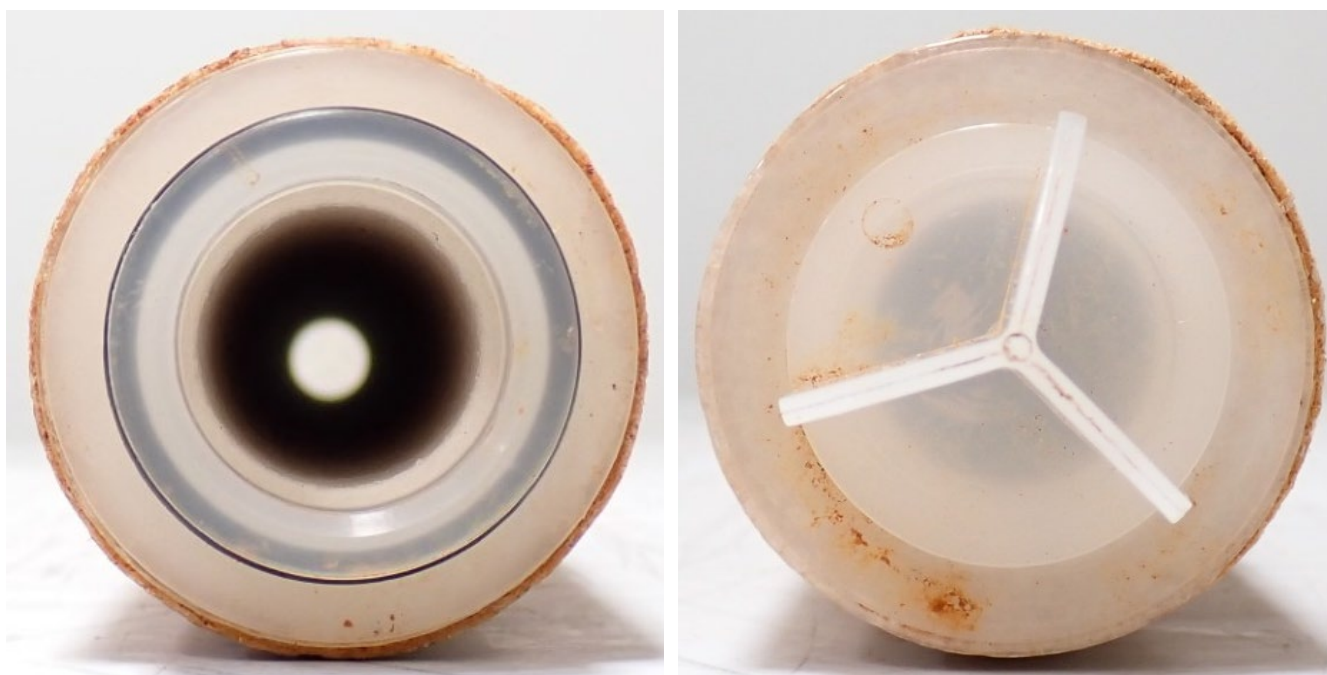
The exterior, ends and internal layers of the cartridge filter are inspected for:

- Foulant – can cause elevated pressures
- Damage – can lead to a bypass of particulate material

◆ **Results:** The cartridge filter exterior was coated in orange-colored foulant material that was heavier towards one end of the filter. The foulant was fine-granular in texture, and portions of the foulant were removable via scraping. Imaging of the filter ends and dissection into the filter confirmed the foulant did not penetrate through to the interior portions of the fiber.



Image of the cartridge filter provided



Images of the cartridge filter ends



Close-up image of filter exterior



Image of sampling areas and interior portions of the filter

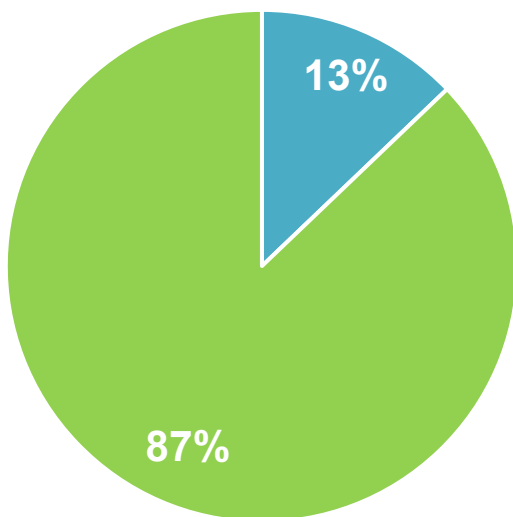
FOULANT ANALYSIS

Foulant Composition Testing is performed to determine the composition of the foulant:

- Moisture Content – the portion of the foulant that is water. Biological materials tend to have higher moisture contents (>95%)
- Organic Content – the portion of the foulant composed of carbon, which ignites during testing
- Inorganic Content – the portion of the foulant not composed of carbon and does not ignite during testing

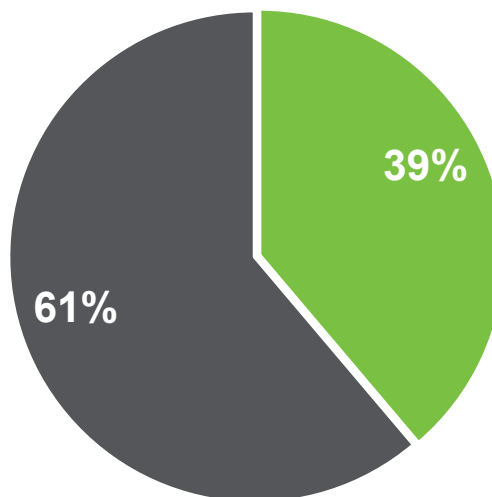
◆ **Results:** The scrapable foulant had a moisture content of 13% and an organic content of 39%, indicating that the foulant was a mixture of organic and inorganic material.

Moisture Content



■ Water ■ Sample

Organic Content

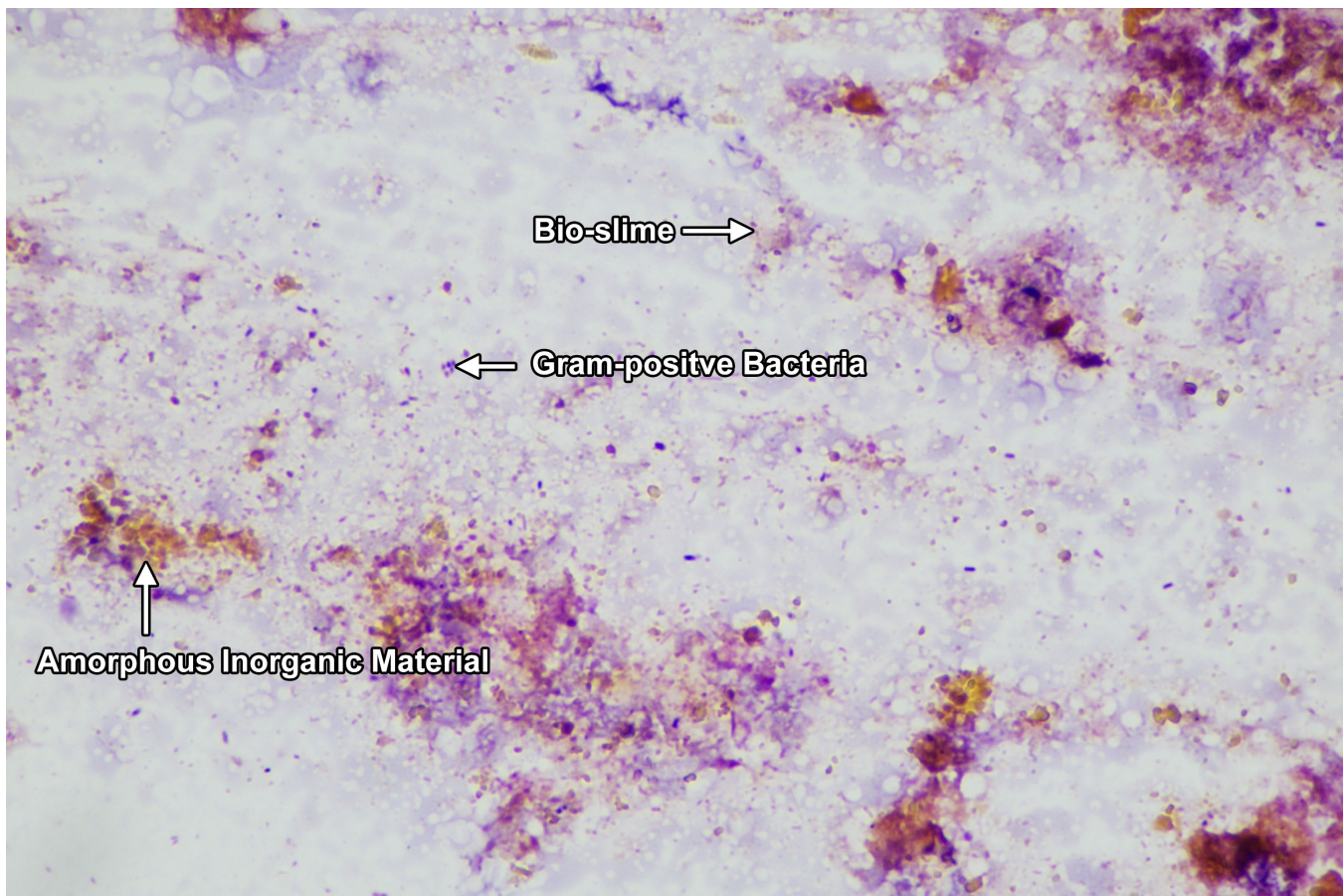


■ Organic ■ Inorganic

Microscope Analysis is performed on Gram-stained foulant samples using a light microscope at 1000x using an oil immersion lens. Gram-positive bacteria are stained purple while Gram-negative bacteria are stained pink. The following organic and inorganic components can be identified:

- Organics: Bio-slime, humic/fulvic acid, bacteria, yeast, mold, nematodes, microorganism shells
- Inorganics: inorganic material (e.g. metals, clays), translucent crystals, particles

◆ **Results:** Microscope analysis of the scrapable foulant material displayed amorphous inorganic deposits, bio-slime, translucent crystals, and Gram-positive bacteria.



Light microscope image (1000x) of the scrapable foulant from the cartridge filter

Biological Activity Testing gives a semi-quantitative result for live aerobic bacteria and yeast/mold content of a sample. Greater colony density, measured in colony-forming units (CFU)/ml, indicates a more biologically active sample.

- Higher biological activity is associated with more biological fouling
- The biological activity rating references are available in [Appendix I](#) on page 13.

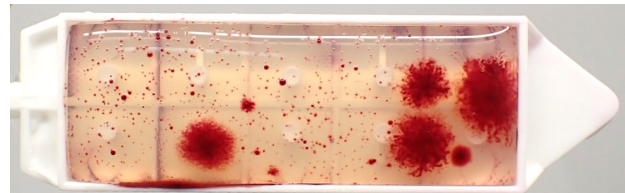
◆ Results: Highlighted in the table below.

Biological Activity Rating	Aerobic Bacteria	Yeast/Mold
Low	0 – 100	0 – 100
Moderate	100 – 10,000	100 – 10,000
High	10,000 – 1,000,000	10,000 – 1,000,000
Very High	1,000,000 – TNTC	1,000,000 – TNTC

Before Incubation



After Incubation



Aerobic Bacteria



Yeast/Mold

Testing for Carbonates and Metals is performed by applying several drops of dilute hydrochloric acid (HCl) to the foulant surfaces.

- Effervescing (bubbling) – positive for carbonates
- Yellow color change – positive for the presence of metals.

◆ Results: Acid testing displayed a yellow color change, indicating the presence of metals.

Before HCl



After HCl

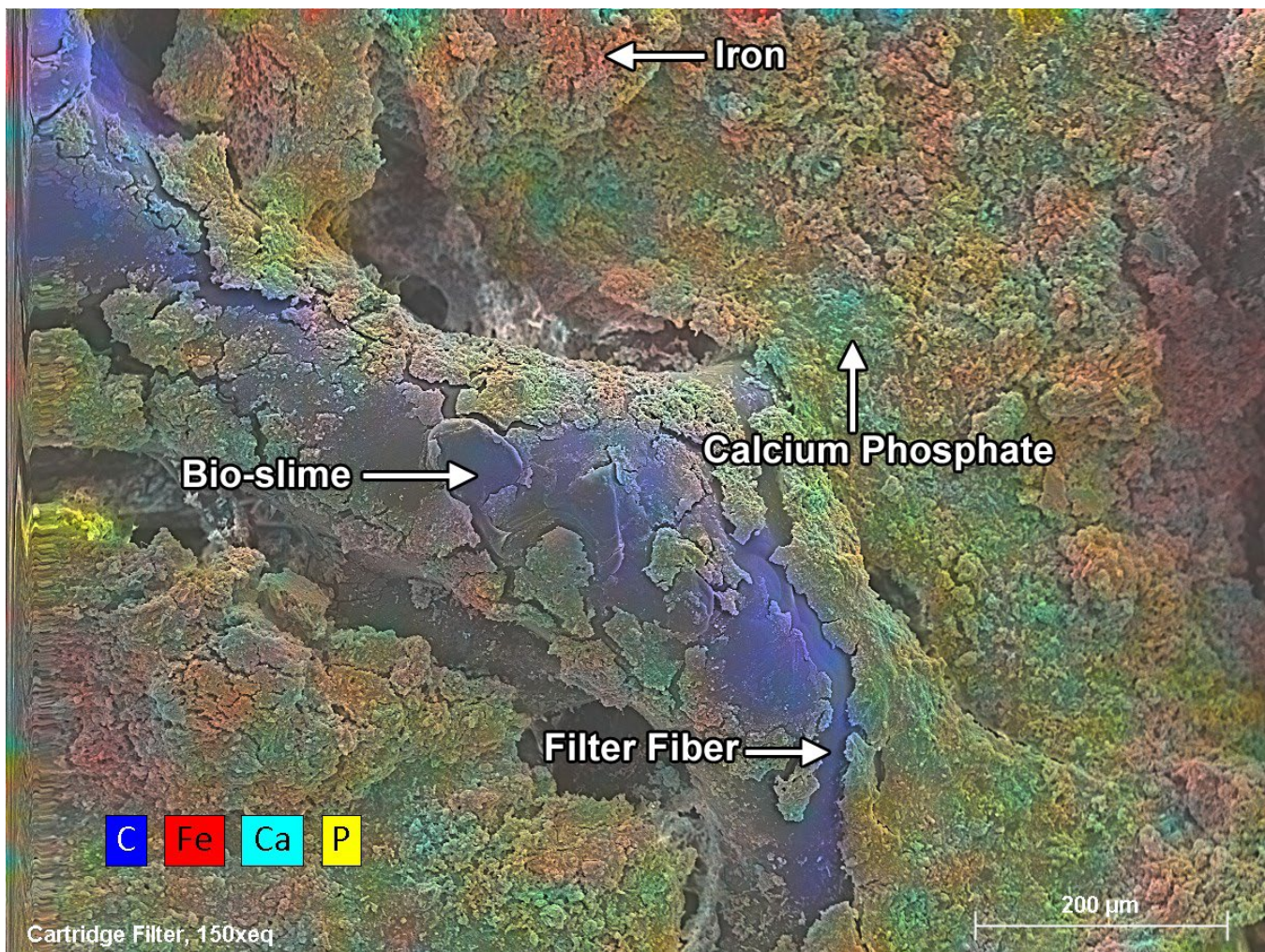


Acid test reaction

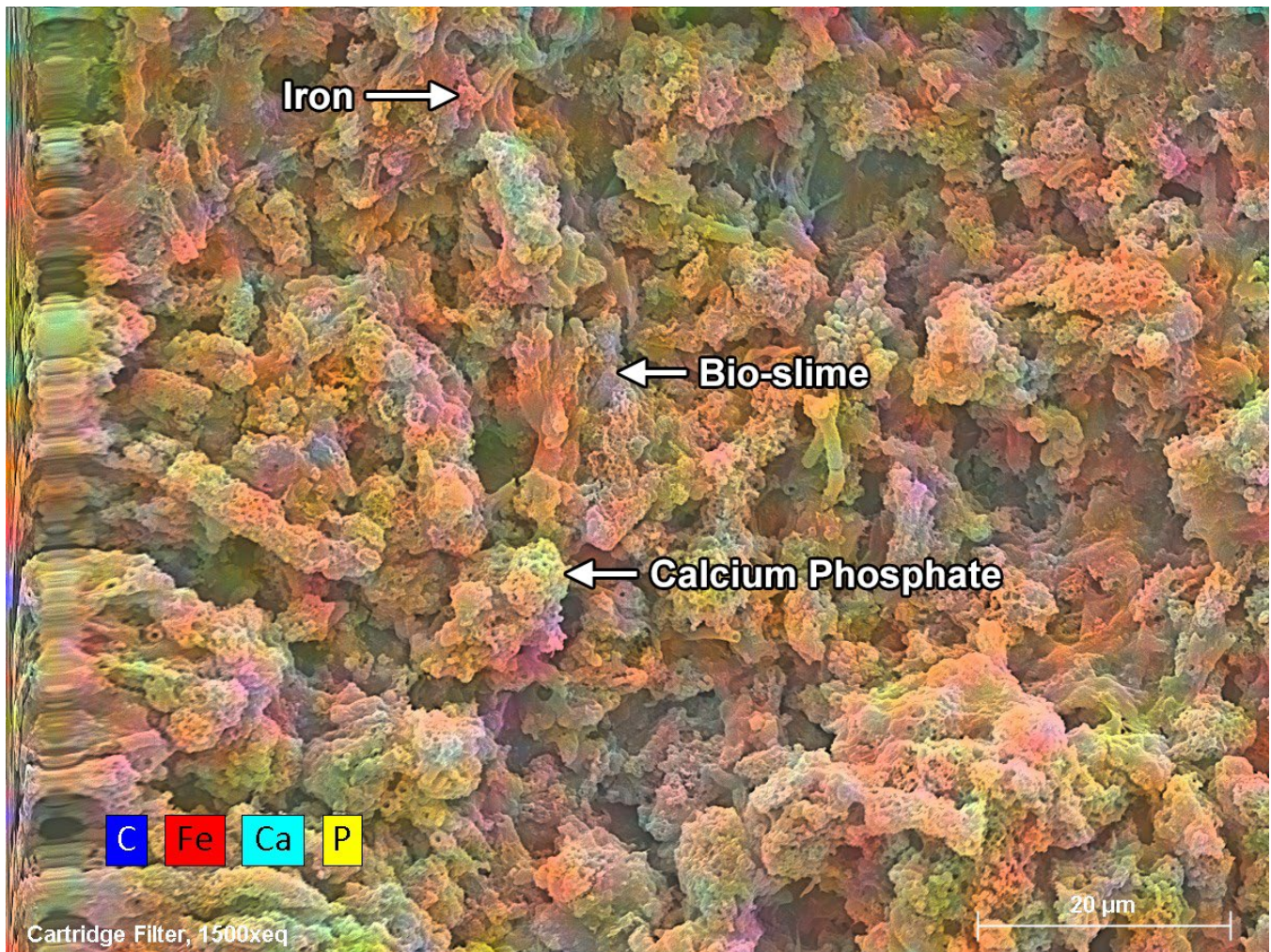
Filter Surface Imaging and Elemental Composition Testing is used to identify foulants and the degree of fouling. This is accomplished using Chromatic Elemental ImagingSM (CEISM) and Energy Dispersive Spectroscopy (EDS) Analysis.

- CEI – high-resolution imaging technique that assigns elements colors to show the spatial distribution, interaction and relative concentration of elements in sample
- EDS – provides the relative concentrations of elements present in a sample

◆ **Results:** CEI of the filter exteriors revealed the presence of iron (red) coating the filter fibers. Deposits of calcium phosphate (green, caused by mixture of light blue and yellow) and bio-slime (smooth material composed of carbon – dark blue) were also observed. The cartridge filter fibers (carbon – dark blue) were visible beneath and between the foulant layer.



CEI image (150x) of the cartridge filter exterior with labels



CEI image (1500x) of the cartridge filter exterior with labels

◆ Results: EDS analysis performed on the cartridge filter exterior identified iron as the primary inorganic element present. Lesser amounts of phosphorous, calcium, silicon, magnesium and a trace amount (<0.50 wt%) of sodium were also detected. Carbon is typically attributed to the filter material; however, a portion is contributed by foreign organic material (e.g. bio-slime).

Elements	Cartridge Filter Exterior (Weight Percent, wt%)
Carbon	30.32
Oxygen	24.61
Iron	30.86
Phosphorous	6.52
Calcium	4.44
Silicon	1.75
Magnesium	1.08
Sodium	0.42

CERTIFICATION BY LABORATORY

Report Number	Report Content	Report Date
WO#060324-2	Cartridge Filter Analysis	06/03/2025

We the undersigned being the technical specialists in membrane autopsy and related testing procedures and protocol for Avista Technologies certify to the best of our knowledge and belief that the tests listed in this report have been conducted following Avista’s standard testing practices and that the results are accurate and complete.

Date: 06/03/2025

Signed:

Jaime La Cuesta

Jaime La Cuesta
Technical Services Manager

Olivia Staton

Olivia Staton
Laboratory Services Technician I

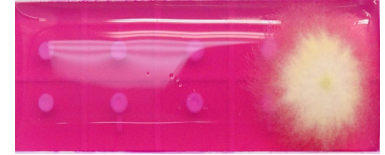
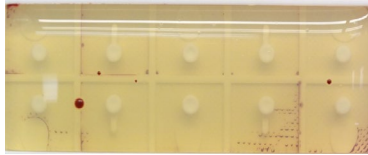
APPENDIX I. BIOLOGICAL ACTIVITY RATINGS

Aerobic Bacteria

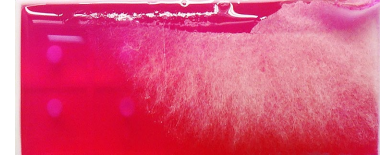
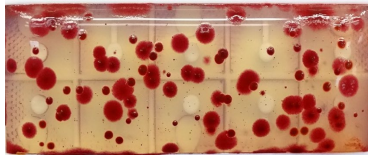
Yeast

Mold

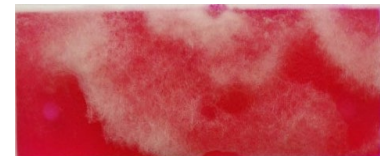
Low



Moderate



High



APPENDIX C

MEMBRANE AUTOPSY REPORT

Membrane Autopsy

Avista™ Membrane Treatment Solutions

COMPLETED FOR:

Carollo Engineers

Serial Number 2190531452

First Stage – Lead Element

07/01/2025

WO #060324-3

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EXECUTIVE SUMMARY

Background Carollo Engineers provided (1) Toray TMH20A-400C reverse osmosis (RO) element to Kurita America, Inc. for a full membrane autopsy. The position of element Serial Number (SN) 2190531452 was First Stage, Lead Element. Below is a summary of the analysis.

Initial Element Testing The element produced normal flow, lower than normal rejection (98.9%) and a differential pressure (DP) of 3 psi. The element passed integrity testing, indicating the absence of damage to the internal mechanical components.

External Inspection The external components (fiberglass casing, permeate tube, anti-telescope devices (ATDs)) were in good condition.

Internal Inspection Scroll gapping and feed spacer extrusion were observed on the feed and concentrate scroll ends, respectively. Several black-colored particles were observed on the feed scroll end. Gelatinous, tan-colored foulant material coated the membrane surfaces. The remaining internal components (feed spacers, glue lines, permeate carriers and membrane backings) were in good condition.

Foulant Analysis The wet foulant density was measured as 0.13 mg/cm². The foulant had a moisture content of 87% and an organic content of 79%, indicating it was primarily organic material. High aerobic bacteria activity was observed. Microscope analysis identified bio-slime, particles and Gram-negative bacteria. Chromatic Elemental ImagingSM (CEISM) revealed the foulant as a mixture of bio-slime, clay (aluminum silicate), colloidal silica, iron and microorganisms.

Flat Sheet Performance and Cleaning Study Flat sheet samples harvested from the full element produced normal permeability and 98.7% rejection. As permeability was within the manufacturer's specified range, cleaning efficiency was based on visual foulant removal. Complete visual foulant removal was achieved using RoClean P903 (2% by weight in RO/DI water, heated to approximately 35 degrees Celsius and circulated) for 2 hours followed by RoClean P111 (2% by weight in RO/DI water, heated to approximately 35 degrees Celsius and circulated) for 4 hours.


Flat Sheet Damage Fujiwara testing was negative for the presence of halogens in the membrane structure.

Autopsy Conclusion The element was fouled with bio-slime, clay, colloidal silica, iron and microorganisms. Complete visual foulant removal was achieved during the cleaning study.


INITIAL ELEMENT TESTING

Element Weight can be indicative of the degree of fouling.

- New elements weigh approximately 30 to 35 pounds
- Elements in excess of 50 pounds cannot be wet tested

 Results: 34 lbs.

Full Element Performance Testing results were normalized to the manufacturer’s published test conditions.

 Results: The element produced normal flow, lower than normal rejection (98.9%) and a differential pressure (DP) of 3 psi.

LG Chem LG BW 400 ES	Flow (gpm)	Rejection (%)	Pressure Drop (psi)
SN 2190531452	7.04	98.9	3
Manufacturer’s Specifications	6.11 – 9.17	99.0 - 99.3	≤15

The following key will be used throughout the report to demonstrate whether the observation is within or outside normal conditions or if the test was not carried out.



Within normal conditions



Outside normal conditions

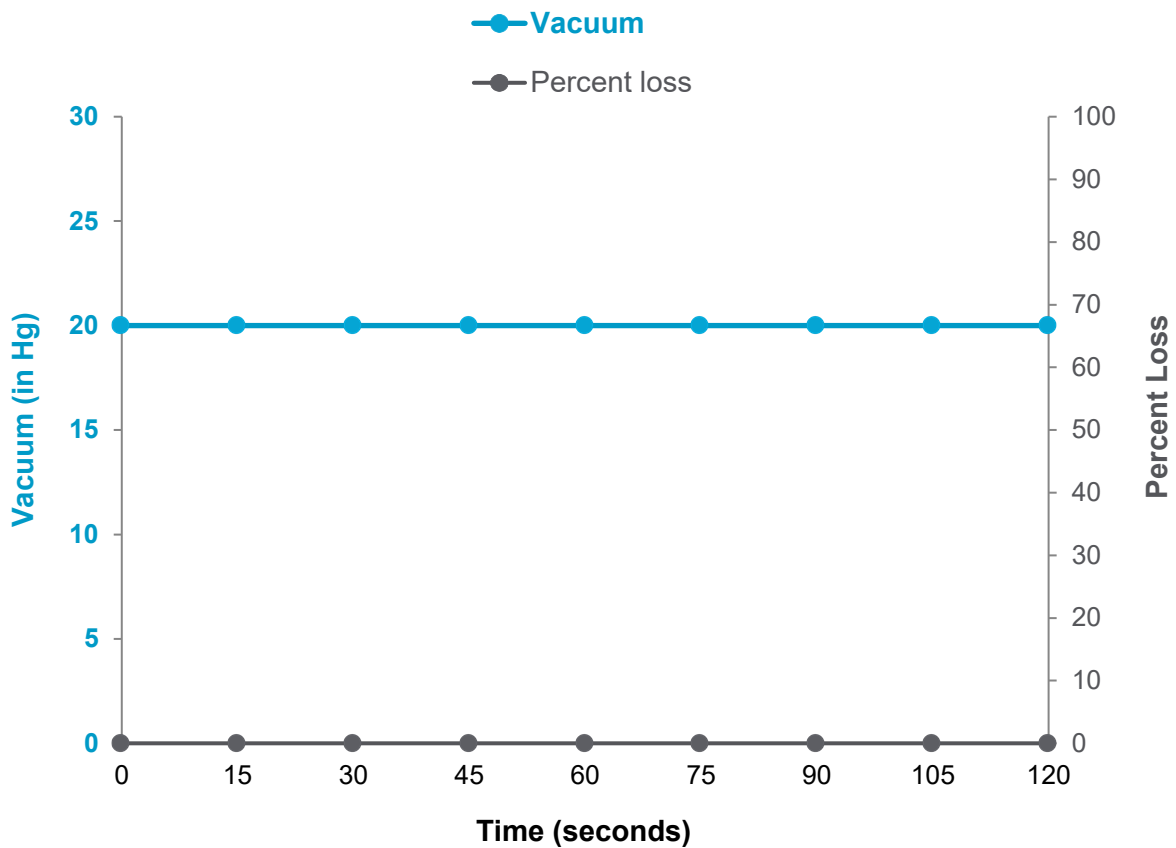


Not tested

Integrity Testing is performed to identify mechanical damage to the internal components of the spiral wound element.

- The permeate tube is sealed and a vacuum of approximately 20 in Hg is applied and monitored for 120 seconds
- Any loss of vacuum indicates the presence of damage; however, losses of over 35% of the vacuum suggests severe mechanical damage

Results: The element maintained the vacuum, indicating the absence of mechanical damage to the internal components.



INSPECTION

A thorough inspection of the internal and external components is performed. Membrane construction diagrams are available in [Appendix I](#) on page 23 for review.

Fiberglass Casing stabilizes the various membrane components in their correct position for optimum performance. It is inspected for:

- Damage – indicates rough handling or excessive differential pressure from heavy fouling

Results: The fiberglass casing was in good mechanical condition.



Fiberglass casing of SN 2190531452

Brine Seal stabilizes the various membrane components in their correct position for optimum performance. It is inspected for:

- Damage – can allow more water to flow across the exterior of the casing

Results: A brine seal was not provided for inspection.

Permeate Water Tube is a pipe that is located at the center of the element. It contains lines of holes and is bonded to each membrane leaf, allowing permeate water to travel from the leaves into the permeate water tube to be collected. It is inspected for:

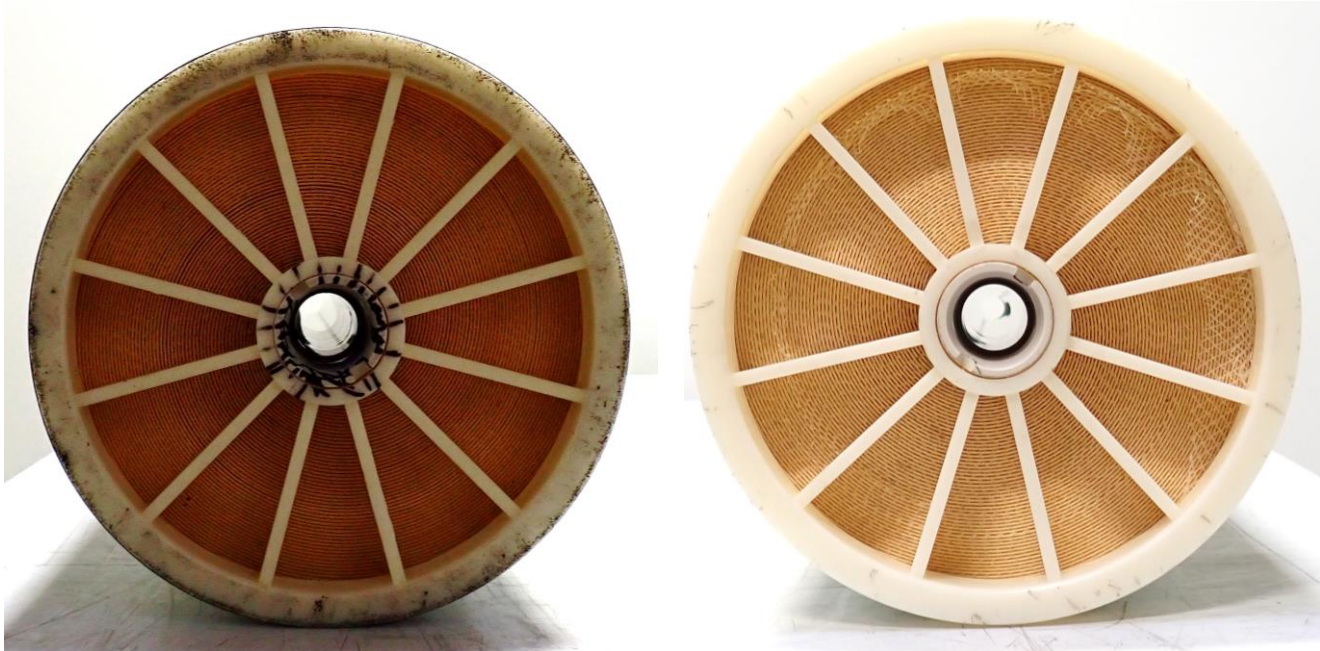
- Foulant – suggests feedwater bypass
- Damage – can lead to o-ring failure or feedwater bypass

Results: The permeate water tube was free of damage.

Anti-Telescope Devices (ATDs) stabilize the components of the element and help to prevent shifting of the internal mechanical components under pressure, also known as telescoping. They are inspected for:

- Foulant – severe fouling can block feed flow and contribute to elevated differential pressure
- Damage – indicates rough handling

Results: The ATDs were in good physical condition.



Feed (left) and concentrate (right) ATDs of SN 2190531452

Scroll Ends should be flush with evenly spaced membrane leaves free of debris. The scroll ends are inspected for:

- Foulant – can cause elevated differential pressures
- Scroll gapping and feed spacer extrusion – can lead to uneven hydraulics (high flow/low flow regions), increases cleaning difficulty
- Telescoping – axial shift of the membrane leaves from the outer diameter of the element towards the permeate water tube, commonly caused by excessive fouling and can increase cleaning difficulty

Results: Scroll gapping and feed spacer extrusion were observed on the feed and concentrate scroll ends, respectively. Several black-colored particles were observed on the feed scroll end.

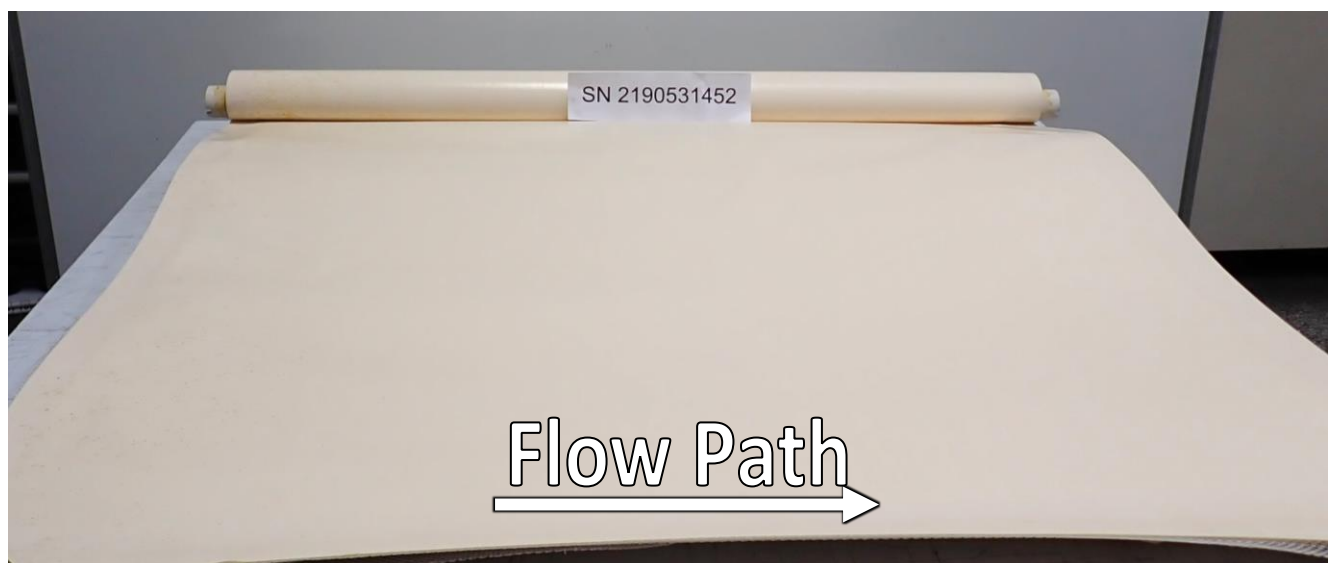


Feed (left) and concentrate (right) scroll ends of SN 2190531452

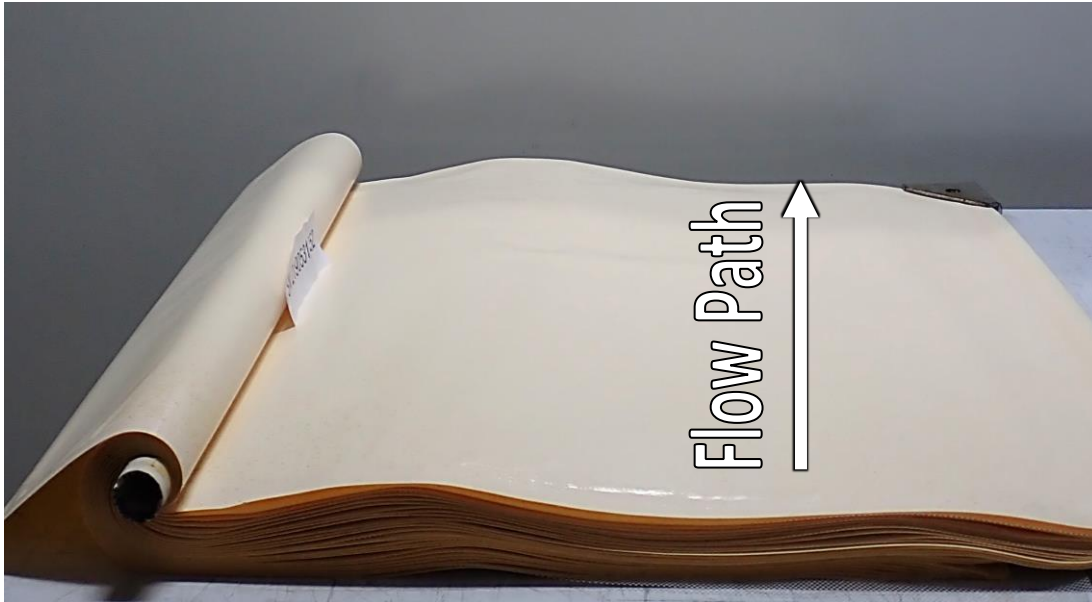
Membrane Surfaces should be uniform and shiny. They are inspected for:

- Foulant – can cause elevated differential pressures, loss in permeate flow and loss in rejection
- Creasing of the membrane surface – more common in the presence of gapping, feed spacer extrusion and telescoping, can cause loss in rejection
- Delamination – lifting of the thin-film membrane from the support layer which is often caused by positive pressure on the permeate side of the element, causes loss in rejection

◆ **Results:** The exposed membrane surfaces were coated with gelatinous, tan-colored foulant material. The foulant was evenly distributed and removable via scraping. Upon closer inspection, there were also black-colored particles.



Exposed membrane surface of SN 2190531452



Exposed membrane surface from feed end of SN 2190531452

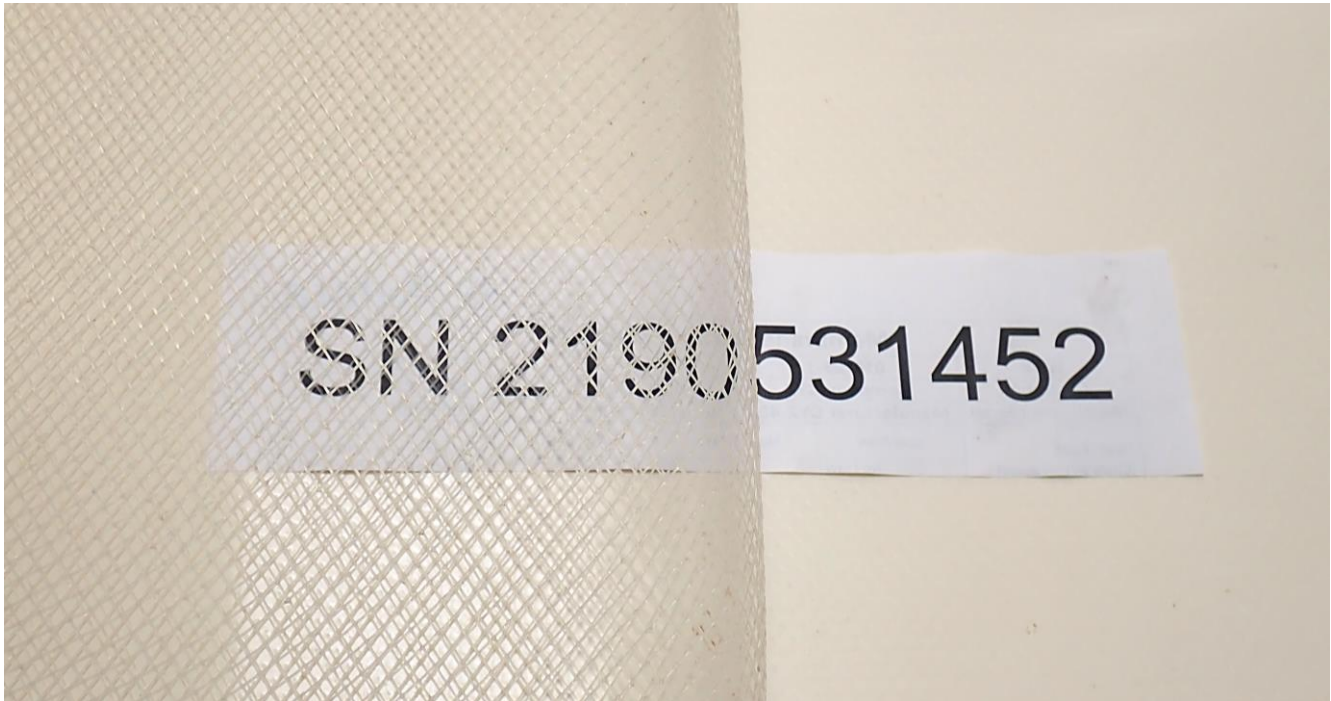


Foulant scraped on one membrane leaf of SN 2190531452

Feed Spacers are composed of plastic net material designed to separate the membrane leaves, forming a flow path, and to promote turbulence within the feed water channels. They are inspected for:

- Foulant – can block the feed channels, causing elevated differential pressure
- Damage – fouling can cause deformation of the material, disrupting the hydraulics of the membrane and increasing cleaning difficulty

Results: The feed spacers of the element were absent of notable foulant and blockage.



Feed spacer of SN 2190531452

Glue Lines separate the feed and permeate streams on three sides of membrane leaves. They are inspected for:

- Glue flaps – excess membrane material closest to the end of the element, can block feed channels leading to elevated differential pressure
- Pouching – commonly a result of severe delamination, can lead to feedwater bypass

Results: The glue lines displayed no visible defects or damages.

Permeate Carriers and Membrane Backings are the components of the permeate side of the element. They are inspected for:

- Foulant – indicates a bypass of feedwater

Results: The permeate carriers and membrane backings showed no visible signs of feedwater bypass.

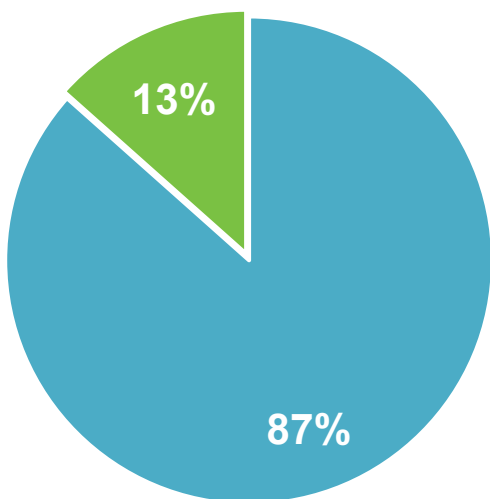
FOULANT ANALYSIS

Foulant Density Measurement and Composition Testing is performed to quantify degree of fouling, which contributes to full element differential pressure, and determine the composition of the foulant:

- Moisture Content – the portion of the foulant that is water. Biological materials tend to have higher moisture contents (>95%)
- Organic Content – the portion of the foulant composed of carbon, which ignites during testing
- Inorganic Content – the portion of the foulant not composed of carbon and does not ignite during testing

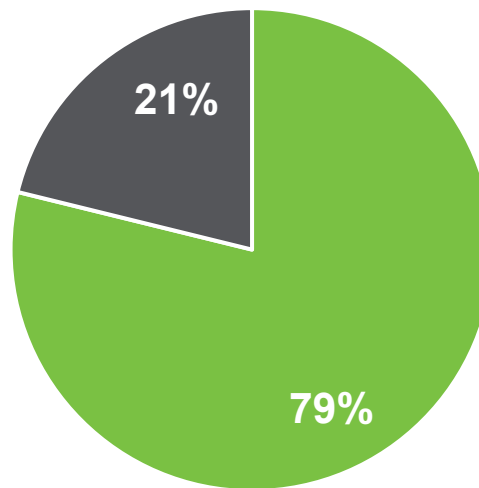
◆ **Results:** The wet foulant density was measured as 0.13 mg/cm². The foulant had a moisture content of 87% and an organic content of 79%, indicating it was primarily organic material.

Moisture Content



■ Water ■ Sample

Organic Content

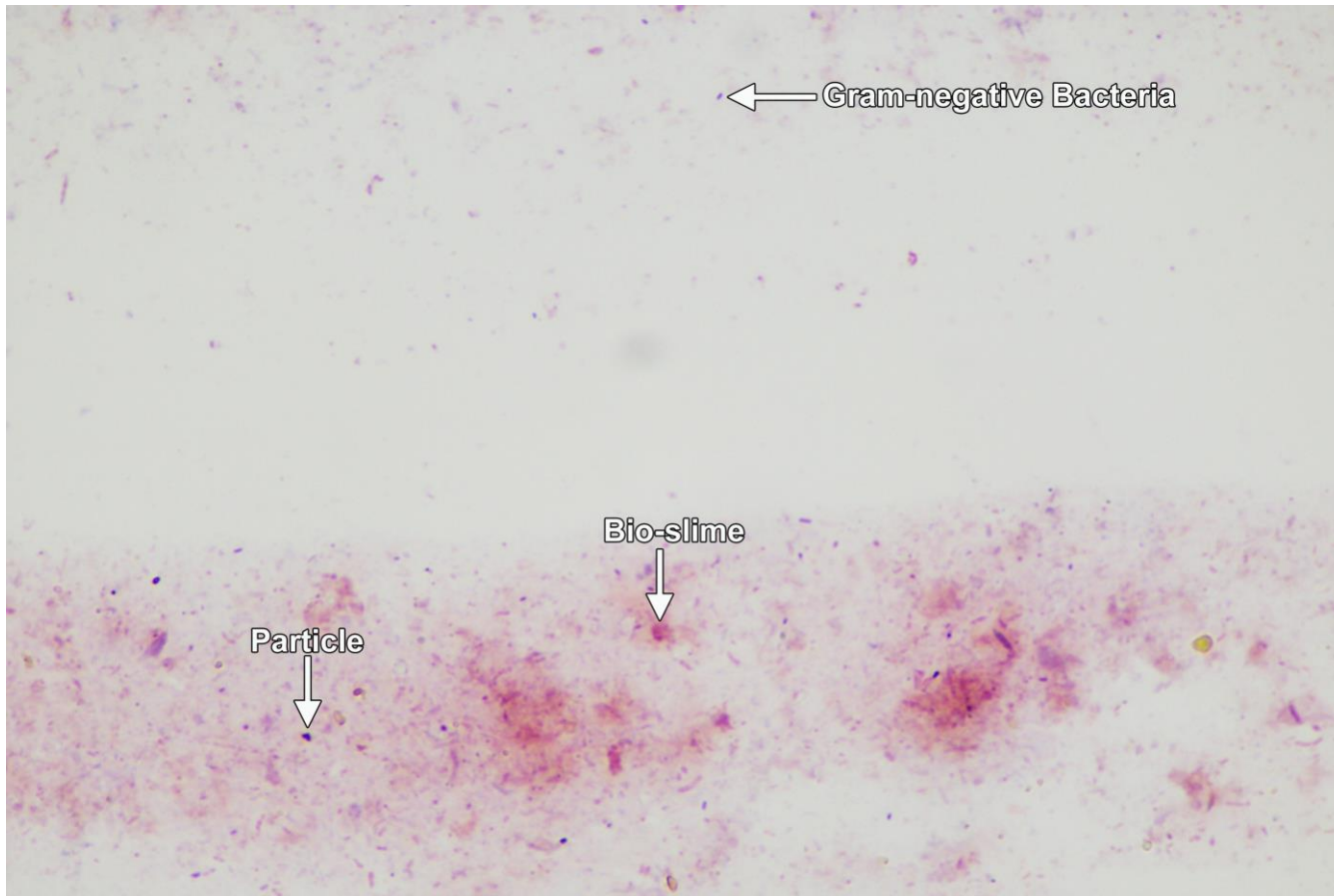


■ Organic ■ Inorganic

Microscope Analysis is performed on Gram-stained foulant samples using a light microscope at 1000x using an oil immersion lens. Gram-positive bacteria are stained purple while Gram-negative bacteria are stained pink. The following organic and inorganic components can be identified:

- Organics: Bio-slime, humic/fulvic acid, bacteria, yeast, mold, nematodes, microorganism shells
- Inorganics: inorganic material (e.g. metals, clays), translucent crystals, particles

◆ **Results:** Microscope analysis identified bio-slime, particles and Gram-negative bacteria.



Light microscope image (1000x) of foulant scraped from SN 2190531452

Biological Activity Testing gives a semi-quantitative result for live aerobic bacteria and yeast/mold content of a sample. Greater colony density, measured in colony-forming units (CFU)/ml, indicates a more biologically active sample.

- Higher biological activity is associated with more biological fouling
- The biological activity rating references are available in [Appendix II](#) on page 24.

◆ Results: Highlighted in the table below.

Biological Activity Rating	Aerobic Bacteria	Yeast/Mold
Low	0-100	0-100
Moderate	100-10,000	100-10,000
High	10,000-1,000,000	10,000-100,000
Very High	1,000,000-TNTC	100,000-TNTC

Before Incubation



After Incubation



Aerobic Bacteria



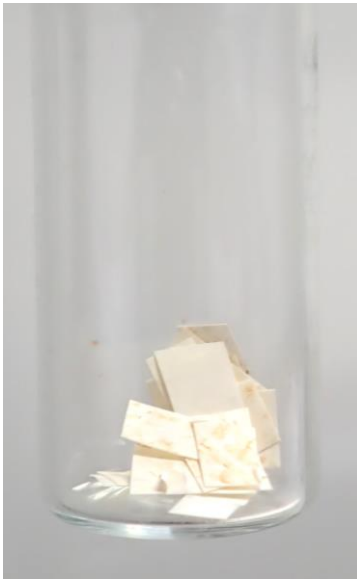
Yeast/Mold

Testing for Carbonates and Metals is performed by applying several drops of dilute hydrochloric acid (HCl) to the foulant surfaces.

- Effervescing (bubbling) – positive for carbonates
- Yellow color change – positive for the presence of metals.

◆ Results: Acid testing displayed a yellow color change, indicating the presence of metals.

Before HCl



After HCl

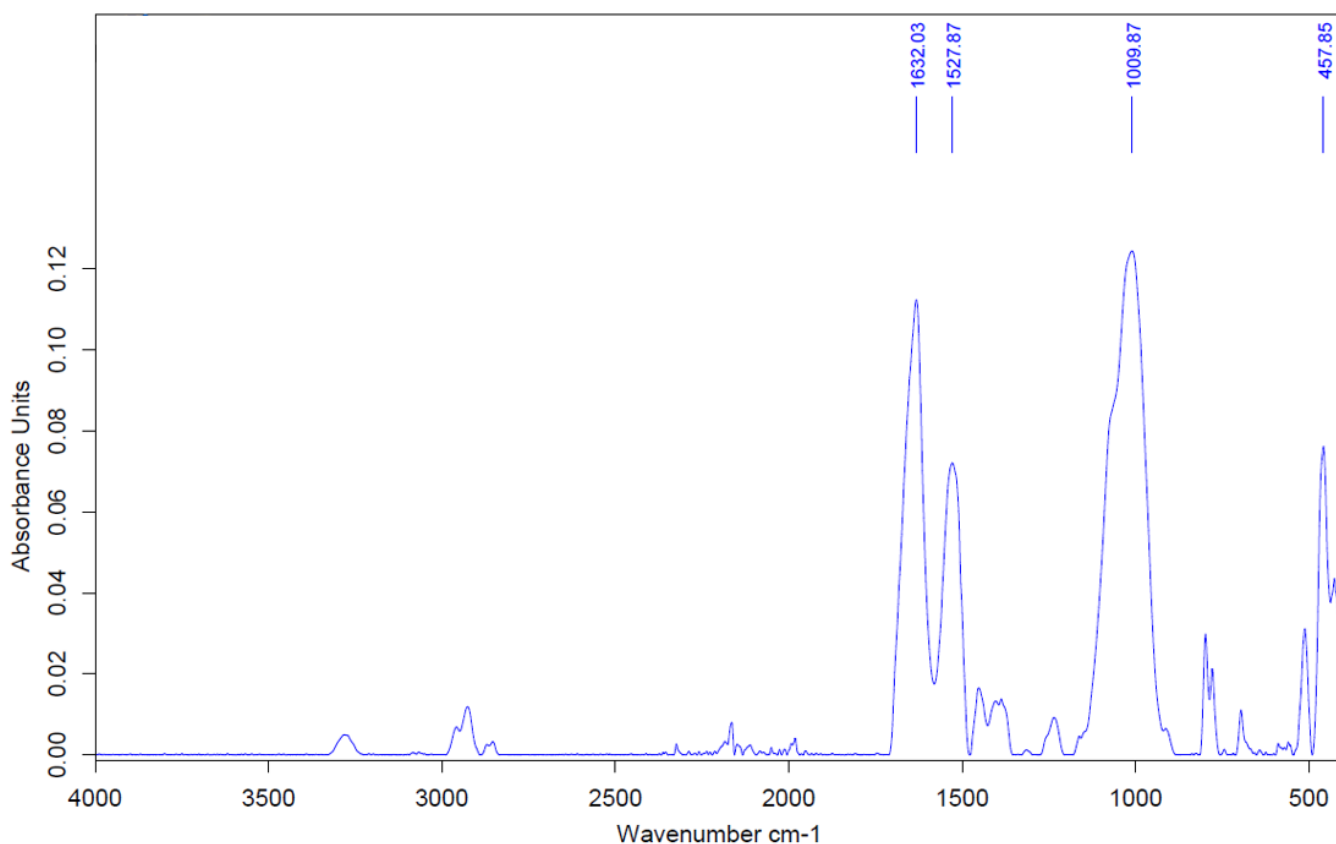


Acid test reaction

Fourier Transform Infrared Spectroscopy (FT-IR) Analysis produces a spectrum for the foulant that is compared to an extensive FT-IR library of known foulants to identify specific compounds (functional groups). FT-IR is performed on either a harvested sample of the foulant or directly on the membrane surface if sufficient harvestable material is not present.

◆ **Results:** FT-IR performed on a sample of the foulant identified peaks associated with clay/silica, organics and proteins.

Compound	Wavelength (cm ⁻¹)
Clay/Silica	1000
Organics (bio-slime)	1100 – 900
Proteins (amino acids from microorganisms)	1650 – 1500

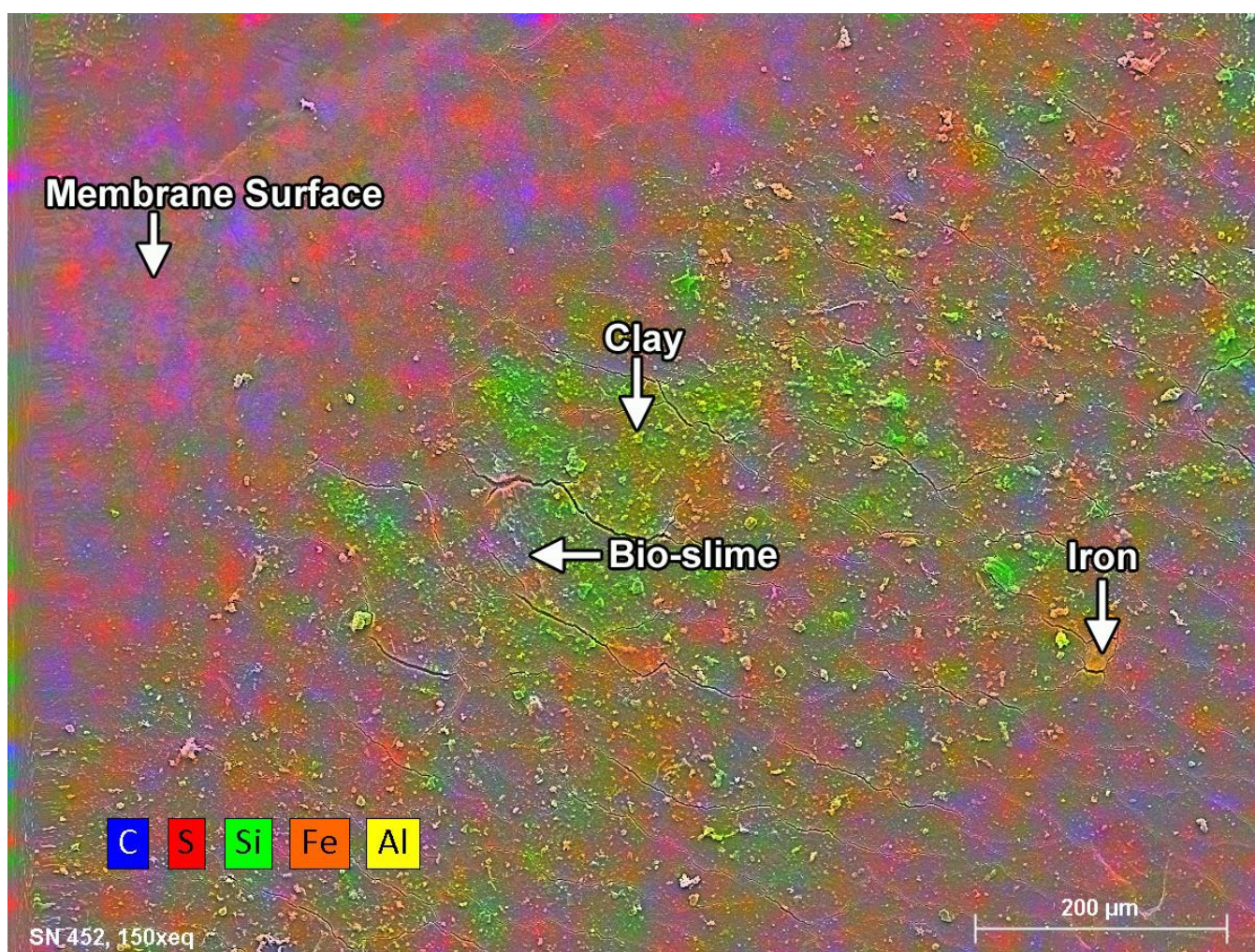


FT-IR spectral image of foulant removed from the membrane surface of SN 2190531452

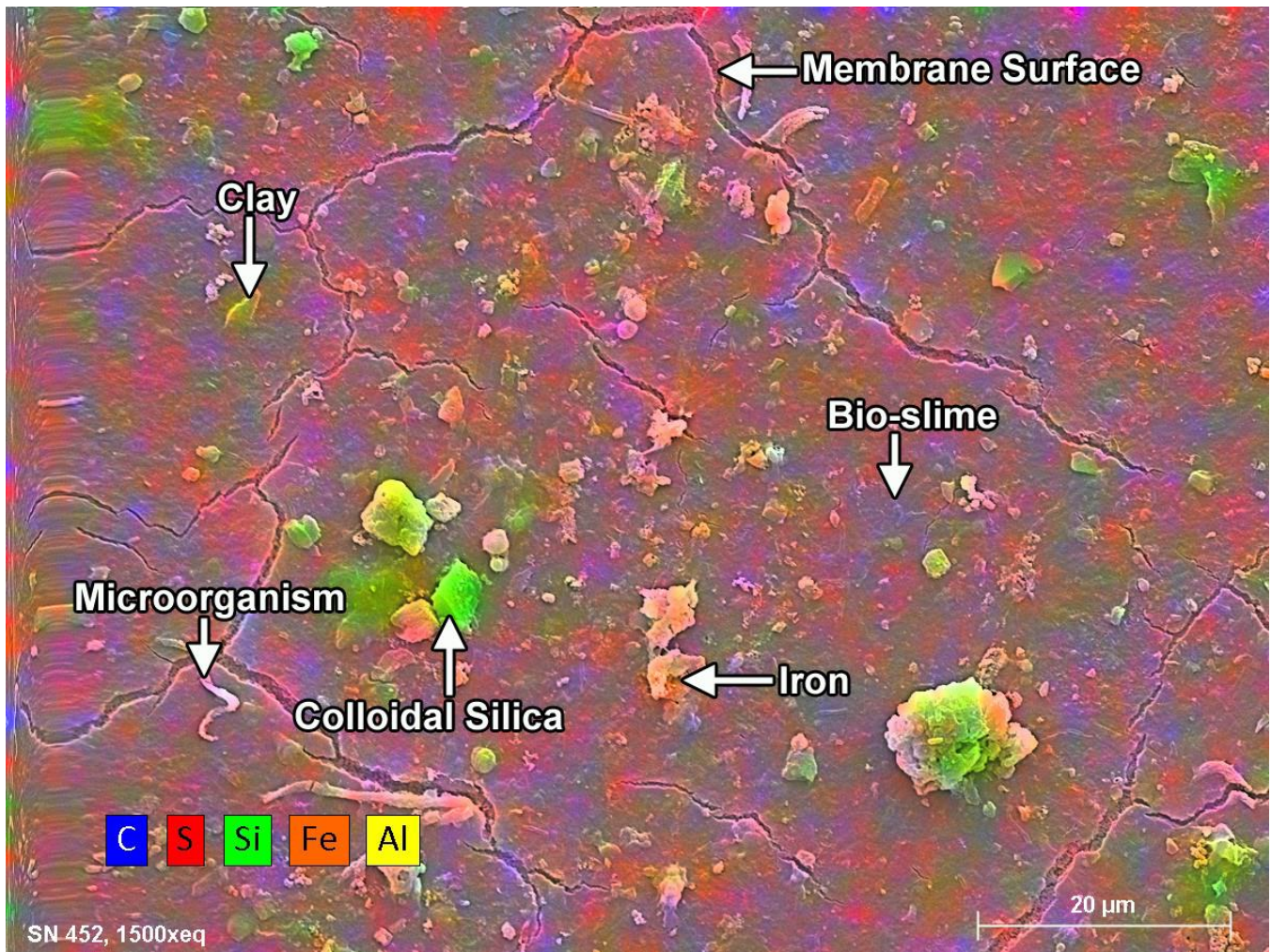
Membrane Surface Imaging and Elemental Composition Testing is used to identify foulants and the degree of fouling. This is accomplished using Chromatic Elemental ImagingSM (CEISM) and Energy Dispersive Spectroscopy (EDS) Analysis.

- CEI – high-resolution imaging technique that assigns elements colors to show the spatial distribution, interaction and relative concentration of elements in sample
- EDS – provides the relative concentrations of elements present in a sample

◆ **Results:** CEI revealed the foulant layer as a mixture of bio-slime (smooth, carbon-rich material) and clay (aluminum silicate – mixture of yellow and green). Colloidal silica (green), iron (orange) and microorganisms were also observed. The membrane surface (sulfur – red) was visible in areas where the foulant was less thick.



CEI image (150x) of the membrane surface with labels



CEI image (1500x) of the membrane surface with labels

◆ Results: EDS analysis identified silicon and iron as the dominant inorganic elements present on the membrane surfaces. Lesser amounts of calcium, aluminum and potassium were also noted. Carbon is contributed by the membrane materials; however a portion may be attributed to foreign organic material (e.g. bio-slime). Sulfur is attributed to the membrane materials (polysulfone).

Elements	SN 2190531452 (Weight Percent, wt%)	New Membrane (Weight Percent, wt%)
Carbon	58.69	40.00 – 60.00
Oxygen	23.91	30.00 – 40.00
Sulfur	8.45	5.00 – 9.00
Silicon	4.03	--
Iron	2.84	--
Calcium	0.77	--
Aluminum	0.75	--
Potassium	0.56	--

FLAT SHEET PERFORMANCE AND CLEANING STUDY

Flat Sheet Cleaning Study is performed in a cell test apparatus to determine the most effective cleaning regimen for overall improvement in permeability, rejection and visual foulant removal.

- Flat sheet normalized permeability and rejection before and after cleaning are calculated and compared to the manufacturer’s specification for new membranes of the same model
- Calculations are performed using industry standard water passage coefficient (A value) and salt passage coefficient (B value) and converted for ease of understanding. A and B values are available upon request

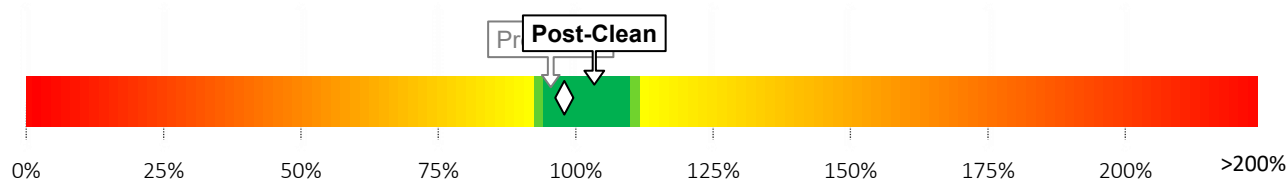
Results: Flat sheet samples harvested from the element produced normal permeability and 98.7% rejection. As permeability was within the manufacturer’s specified range cleaning efficiency was based on visual foulant removal. The following cleaning regimen achieved complete visual foulant removal:

- 1) RoClean P903 (2% by weight in RO/DI water, 35 degrees Celsius and circulated) for 2 hours
- 2) RoClean P111 (2% by weight in RO/DI water, 35 degrees Celsius and circulated) for 4 hours

Toray TMH20A-400C	Permeability	Rejection (%)
Full Element	Normal	98.9
Pre-Clean Flat Sheet	Normal	98.9
Post-Clean Flat Sheet	Normal	99.6
Manufacturer’s Specification	2.09 to 3.13E-04	99.0 to 99.3

Permeability (% of Normal)

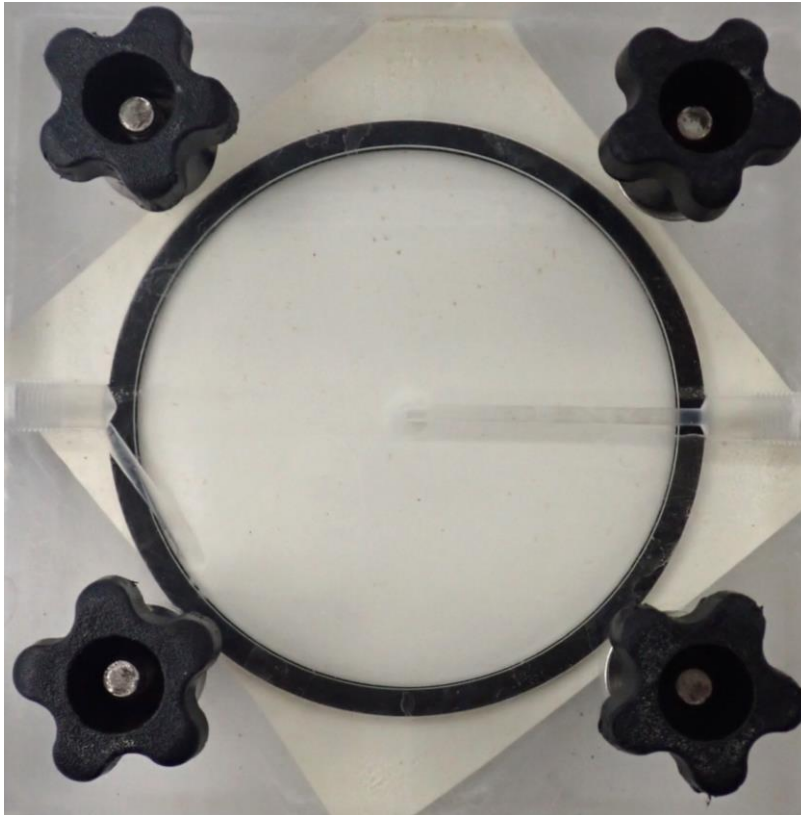
◇ Full Element



Rejection (%)

◇ Full Element





Pre-clean flat sheet



Post-clean flat sheet

TESTING FOR FLAT SHEET DAMAGE

Fujiwara Testing is a qualitative analysis which determines if a polyamide (PA) thin-film membrane has been exposed to halogen (e.g. chlorine, bromine, or iodine) oxidation. Exposure to halogens is progressively damaging to PA membranes, causing increases in flow and losses in permeate quality.

Results: Fujiwara testing was negative for the presence of halogens (e.g. chlorine) in the membrane structure.

Dye Testing is used to identify the presence and extent of chemical and/or physical damage to membrane flat sheet samples.

- Uneven dye uptake – indicates physical damage
- Even dye uptake – indicates chemical damage
- Dye penetration to the membrane backing – indicates severe damage

Results: Dye testing was not performed as flat sheet rejection was within the manufacturer's specified range.

CERTIFICATION BY LABORATORY

Report Number	Report Content	Element Serial Number	Report Date
WO#060324-3	Standard Spiral Autopsy	2190531452	07/01/2025

We the undersigned being the technical specialists in membrane autopsy and related testing procedures and protocol for Avista Technologies certify to the best of our knowledge and belief that the tests listed in this report have been conducted following Avista’s standard testing practices and that the results are accurate and complete.

By signing this certificate neither the laboratory employees nor their employer makes any warranty, expressed or implied, concerning the cleaning study results.

Date: 07/01/2025

Signed:

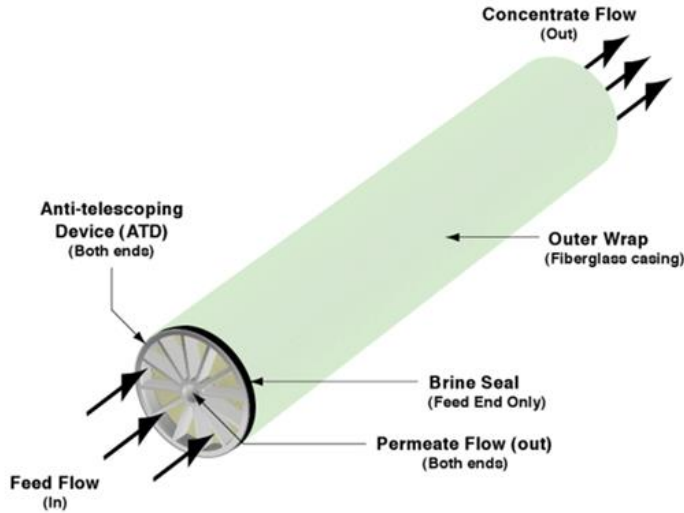
Jaime La Cuesta

Jaime La Cuesta
Manager, Membrane Services

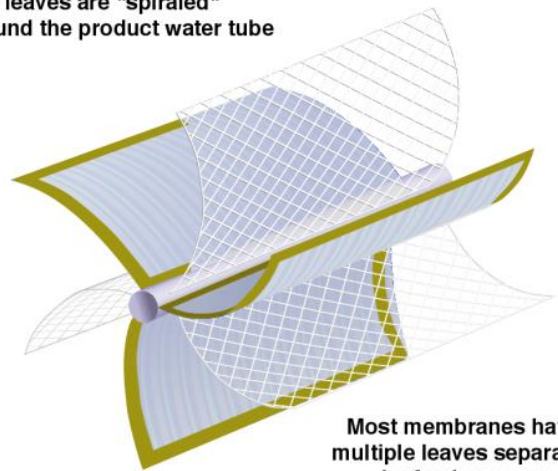
Erica Robles

Erica Robles
Membrane Analyst

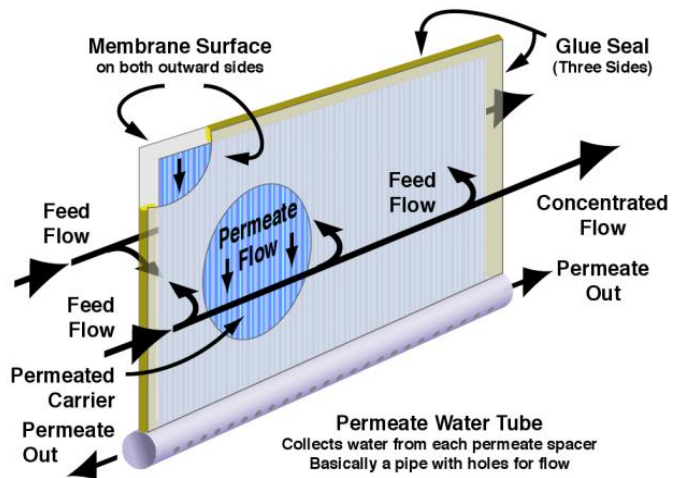
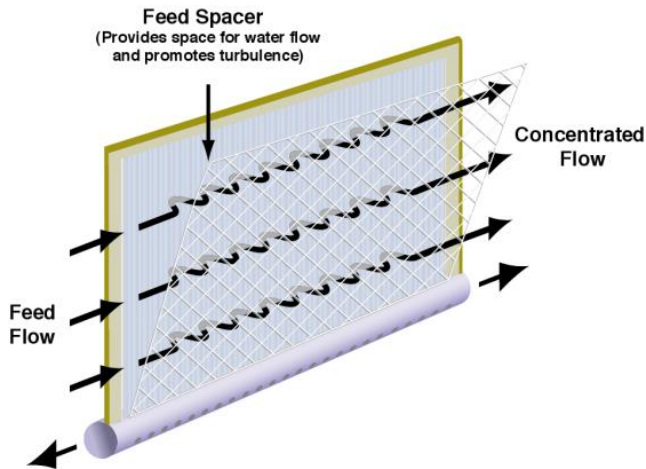
APPENDIX I. MEMBRANE CONSTRUCTION DIAGRAMS



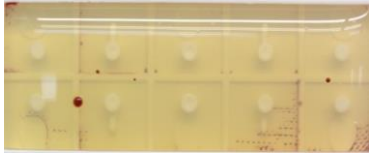


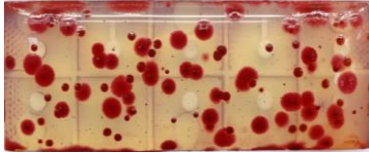
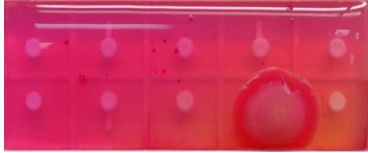
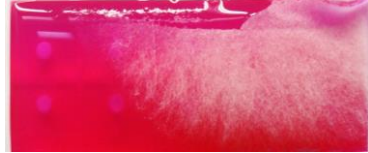



The leaves are "spiraled" around the product water tube



Most membranes have multiple leaves separated by feed spacers



APPENDIX II. BIOLOGICAL ACTIVITY RATINGS

	Aerobic Bacteria	Yeast	Mold
Low			
Moderate			
High			

APPENDIX D

VENDOR CUT SHEETS

Forsta Filters Inc.,
10856 Vanowen St,
North Hollywood, California, 91605,
United States
Phone 3108377177, Fax 310-837-6477

Created Date:04-30-2025

Customer Information
Carollo Kevin Fitzgerald
kfitzgerald@carollo.com +1229-630-2125

Application Information
Ground water filtration 1300 gpm X 2 2 microns to replace an Amiad. Each train will have 1+1 configuration with 100% standby or the customer can choose to have 15 screens online and 5 screens on standby
TSS is between 4.2-7.6ppm

Item Part Number	Description	Quantity	Unit Price	Total
D8-LP180X10-ISO	Motor-driven automatic self-cleaning filter made from stainless steel 304. 8" inlet/outlet flanges, ten 2" electric flushing valves. Max. 150 psi. Max 150F. The filter comes equipped with ten 2 micron high porosity stainless steel 316L screens 92.5 sq ft each. 3000lb. The filter comes with 8" isolation valves on the inlet/outlet of each screen so that each filter can be serviced individually.	4	189,450	\$757,800
EC-16-110	Automatic backwash controller for Forsta self cleaning water filters. Initiates cleaning cycle for up to 16 filters in parallel by pressure differential, periodic or manual activation. 110 VAC input/ 24 VAC output, weather resistant enclosure. Includes ...	4	19,450	\$77,800
Engineer	Application engineer with automatic water filtration experience will oversee the start up of the filter and train employees on the operation and maintenance.	1	3,250	\$3,250
2 Year Spare Parts - D-LP180	1.7-180-UHMWPE Hydraulic Motor Chamber Bushing \$155.00 4 \$620.00 1.8-180/LP180 Hydraulic Motor Chamber Bushing O-Ring \$23.00 4 \$92.00 13.1-LP180/LP180C DC Motor \$2,296.30 4 \$9,185.20 13.2-LP180-316L Leading Bolt \$12.00 4 \$48.00 13.3-LP180-DEL Particle Remover Adaptor \$150.00 4 \$600.00 13.4-LP180-316L Particle Remover Adaptor Bolt \$12.00 4 \$48.00 13.6-LP180/LP180C-316L Motor Drive Shaft \$144.00 4 \$576.00 13.7-LP180/LP180C-316L Compression Packing Housing \$112.00 4 \$448.00 13.8-LP180 Compression Packing Rope \$29.00 4 \$116.00 13.9S DC Motor Drive \$679.00 1 \$679.00 16-1/4 Mini Filter \$29.00 4 \$116.00 17-Fitting/Tubing Fitting Tube \$58.00 4 \$232.00 18-D/P-HK-ASSEMBLY Pressure Differential Switch \$311.00 1 \$311.00 3.5-D-180 Suction Nozzles \$58.00 28 \$1,624.00 4-180-316L/PE Stainless Steel Bushing \$167.00 4 \$668.00 5-A/B/D-180/LP180 Housing Seal \$52.00 4 \$208.00 6-A/B/D-180/LP180 Screen O-Ring \$35.00 8 \$280.00 7-180-316L-VES Stainless Steel Spacer \$145.00 4 \$580.00 8.9-180-316 Piston Shaft Tip \$102.00 4 \$408.00 8K-180 Piston Repair Kit \$125.00 4 \$500.00	4	17,339	\$69,356

Item Part Number	Description	Quantity	Unit Price	Total
Section Subtotal		13		\$908,206
			Items Total	\$908,206
			Shipping & Handling Charges	15,000
			Pre Tax Total	\$923,206
			Tax(0)%	\$0
			GRAND TOTAL(\$)	\$923,206

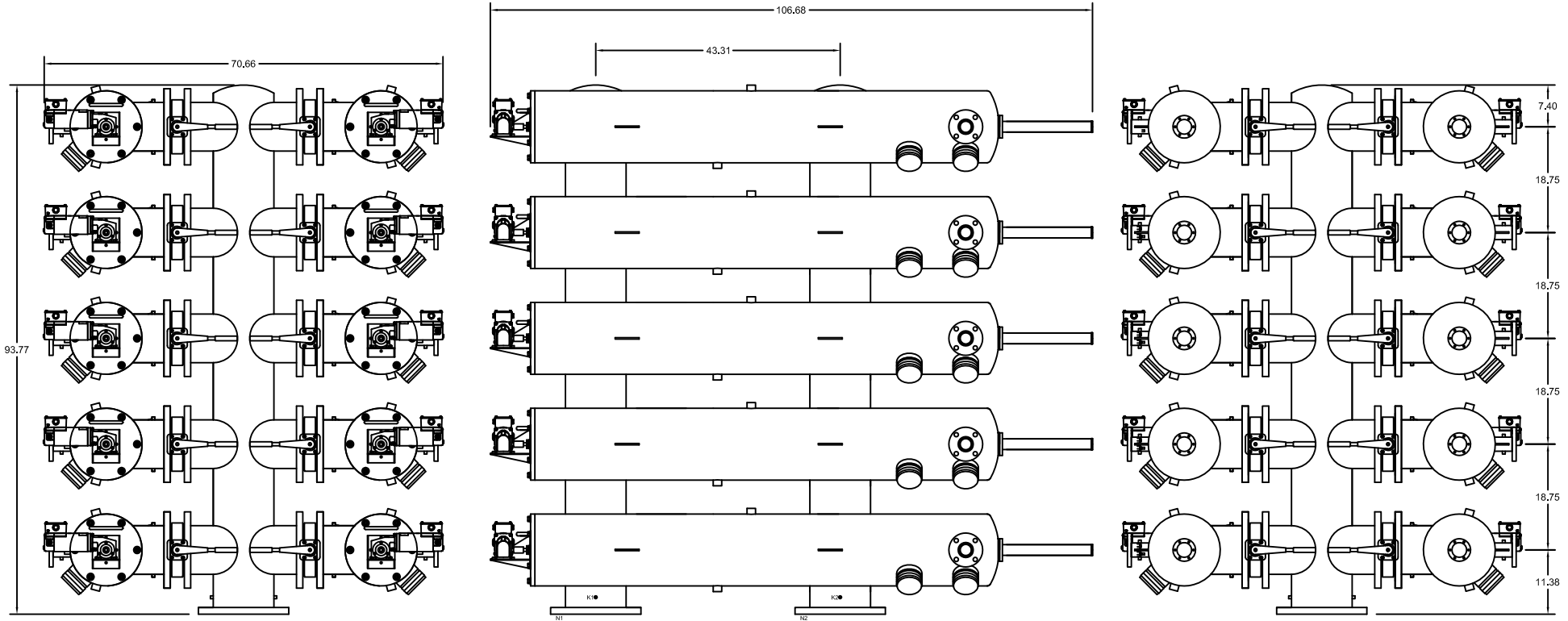
Terms and Conditions

Lead Time: 14-16 Weeks
 Payment Terms: 30% Deposit / 70 % net 30 days
 Shipping Via: Truck
 Shipping Terms: Ex-Works IL (Customer to provide address)
 Quotes are valid for thirty (30) days. Delivery Subject to availability.
 Pumps, Valves, and Custom Fabricated Items are Non-Returnable
 Filters and Filter Parts Only Returnable Within 90 Days of the Ship Date with Forsta Authorization and Subject to Restocking Fee

www.forstafilters.com

Today's Date:07-09-2025

Filter Body Automatic Self-Cleaning Screen Water Filter Vessel Constructed From Stainless Steel Grade 304 43.31" Flange Spacing Design Pressure 150 PSI Design Temperature 150°F	Fine Screen Element Screen Constructed From Stainless Steel Grade 316L or Better Multi-Layer Diffusion Bonded Wire Mesh Screen Area 9.25 ft ² 1331 in ² 92.5 ft ² Total Screen Area Degree of Filtration: XXXμ (Micron)	Coarse Screen Element Screen Constructed From Stainless Steel Grade 316L or Better Coarse Pattern Perforated Plate Screen Area 4.2 ft ² 606 in ²	Flush Valve 2" FNPT Electric Ball Valve 1000 PSI Pressure Rating Stainless Steel Grade 316 Stem Stainless Steel Grade CF8M Ball and Housing PTFE Seats 24VAC Actuator, 1.5 Sec Cycle NEMA 6P/7D Enclosure
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NOZZLE	DESCRIPTION	SIZE	QTY	FILTER PERFORMANCE		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS ANGULAR .XX +.05 ±0.5 DEG. .XXX ±.01	FORSTA FILTERS Self Cleaning Water Filters				
N1	INLET	8" 150#	1	MAX FLOW RATE (gpm)	2,700		D8-LP180X10 GENERAL ARRANGEMENT DRAWING				
N2	OUTLET	8" 150#	1	SCREEN AREA (ft. ²)	92.5 (10x9.25)						
N3	FLUSH OUTLET	2" FNPT	10	MAX TEMP. (°F)	150	SIZE	FSCM NO.	DWG NO.	D8-LP180X10	REV	0
N4	SERVICE PORT	4" VIC	20	MAX PRES. (psi)	150	SCALE 3.50					
N5	COUPLING	1" FNPT	20	VESSEL EMPTY WEIGHT (lbs)	3,200	SHEET 1 of 1					
K1	HYD CONNECTION	¼" FNPT	2	APPROX FULL WEIGHT (lbs)	5,800	Appendix D2-1					
K2	HYD CONNECTION	¼" FNPT	2								
K3	HYD CONNECTION	¼" FNPT	20								



QUOTE

Tekleen, Automatic Filters, LLC
 9816 Arlee Ave
 Santa Fe Springs, CA, 90670
 Phone: 800-336-1942

Quote Nbr.: **QT085747**
 Date: 7/11/2025
 Sales Person: Youssef Elias
 For: Patricia Oka
 Email: POka@carollo.com
 Office:

This quote is valid for 30 days

Web: www.tekleen.com

FOR:	SHIP TO:
Carollo	Carollo
US	14755 Preston Rd Ste 500
	Dallas, TX, 75254-9152, US

APPLICATION DETAIL

Name:	Drinking Water Facility Amiad caseette filter replacement 2μ			Comments:
Application:	Prefiltration (R/O)	Water Source:	Groundwater	
Flow Rate (GPM):	1300	Micron:	2μ	
Pressure (PSI):	80-95 psi	Location:		

NO.	ITEM	DESCRIPTION	QTY	UOM	PRICE	AMOUNT
1	ABW4-XLP-A	Automatic Filter SST 304 NSF-61. 4" inlet/outlet ANSI class 150# flanges, 2" flushing ball valve. Designed in accordance with ASME pressure vessel Code, Section VIII Div I for 150 psi, 160°F. 8.0 SQFT screen. 2μ	6	EACH	15,925.00	\$95,550.00
2	GB8-110V-8	Electronic Backwash Controller in SST 304 enclosure. It will control up to 8 filters in parallel. rinsing the filters one at a time by differential pressure, timer, or manual. Complete with D/P sensor, counter, and emergency alarm. 110VAC.	1	EACH	3,925.00	\$3,925.00
3	8-4-MAN-B01	Valve - 4" Butterfly Valve with Manual Handle	12	EACH	650.00	\$7,800.00
4	WARRANTY	This filter and it's components are complete with a one year limited manufacturers warrantee excluding freight & labor from the date of the start up. Screen bursting pressure is 80 psig (5.5 bar) Differential. Unless otherwise noted.	0	EACH	0.00	\$0.00

Payment Terms: Due Upon Receipt

Delivery: Stock - subject to prior sale.

Shipment: Prepay and Add

Via: Best Way

Subtotal: 107,275.00

Tax: 0.00

Total (USD): 107,275.00

Appendix D3

Page: 1 of 1



QUOTE

Tekleen, Automatic Filters, LLC
 9816 Arlee Ave
 Santa Fe Springs, CA, 90670
 Phone: 800-336-1942

Quote Nbr.: QT086726
 Date: 7/11/2025
 Sales Person: Youssef Elias
 For: Patricia Oka
 Email: POka@carollo.com
 Office:

This quote is valid for 30 days

Web: www.tekleen.com

FOR:	SHIP TO:
Carollo	Carollo
US	14755 Preston Rd Ste 500 Dallas, TX, 75254-9152, US

APPLICATION DETAIL

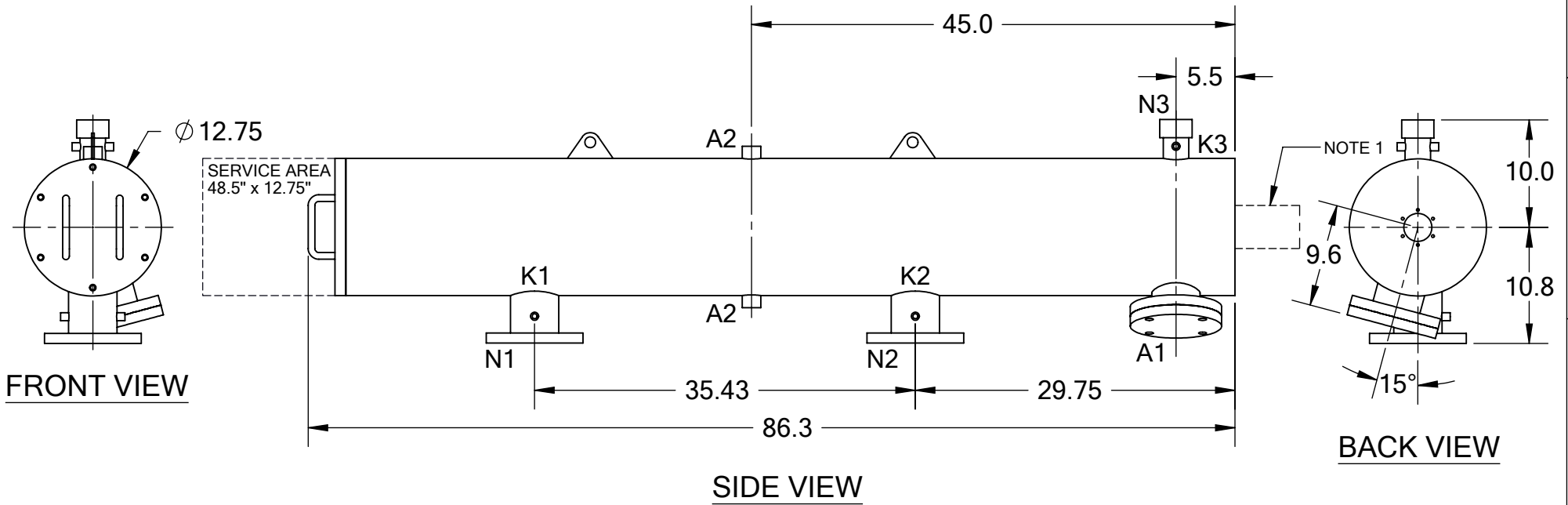
Name:	ABW4-XLP Rental		
Application:	Water Source:	Comments:	
Flow Rate (GPM):	Micron:		
Pressure (PSI):	Location:		

NO.	ITEM	DESCRIPTION	QTY	UOM	PRICE	AMOUNT
1	ABW4-XLP-RENTAL	Automatic Filter SST 304 NSF-61. 4" inlet/outlet ANSI class 150# flanges, 2" flushing ball valve. Designed in accordance with ASME pressure vessel Code, Section VIII Div I for 150 psi, 160°F. 8.0 SQFT screen. 2μ	0	EACH	0.00	\$.00
2	GB6-110V-10	Electronic Backwash Controller in weather proof NEMA 3 box. Rinsing by differential pressure, timer, or manual. Backwash counter and emergency alarm. 110VAC 10 amp,output 24VAC,12"x9"x7", 6#	0	EACH	0.00	\$.00
3	WARRANTY	This filter and it's components are complete with a one year limited manufacturers warrantee excluding freight & labor from the date of the start up. Screen bursting pressure is 80 psig (5.5 bar) Differential. Unless otherwise noted.	0	EACH	0.00	\$.00
4	RENTAL	Rental 90 day rental of 1x ABW4-XLP filter, 1x controller. \$719.3 per month for equipment only. First month paid in full. The last 2 months of pilot rental can be applied to the purchase of appropriately sized filter. \$2157.9 total for 90 days.	1	EACH	2,158.00	\$2,158.00

Payment Terms: Due Upon Receipt

Delivery:	Stock - subject to prior sale.	Subtotal:	2,158.00
Shipment:	Prepay and Add	Tax:	0.00
Via:	Best Way	Total (USD):	2,158.00

REVISIONS				
REV.	ZONE	DESCRIPTION	DATE	INITIAL
1	1B, 2B	CHANGED "WORKING" TO "DESIGN" & TEMPERATURE FROM 200°F TO 160°F IN TECHNICAL DATA TABLE.	09/27/12	S.P.
2	7D	ADDED NOTE 1.	10/17/14	M.S.



TECHNICAL DATA

FLOW RATE	MAX. 800 GPM (182 m ³ /hr)
SCREEN SIZE	___ MICRON
SCREEN AREA	8.0 SQ. FEET
DESIGN TEMPERATURE	160 °F
DESIGN PRESSURE	150 PSI
EMPTY WEIGHT	~325 LBS.
FULL WEIGHT	~625 LBS.

NOTES:

- PLEASE ALLOW ~20" ADDITIONAL TO INSTALL AND REMOVE THE PISTON ASSEMBLY TO THE BACKSIDE OF THE FILTER.

NOZZLE	CONNECTION	TYPE	SIZE	RATING	TOLERANCES (UNLESS OTHERWISE SPECIFIED)	 TEKLEEN <i>Automatic Filters Inc.</i> 2672 S. LA CIENEGA BLVD. LOS ANGELES, CA 90034 MAIN: (310) 839-2828 FAX: (310) 839-6878
A1	SERVICE PORT	FLANGED	3.5" ASA	CL. #150 F.F. w/ Blind		
A2	PRESSURE RELEASE	THREADED	1" NPT(2)		MATERIAL: SST	TITLE:
K1	HIGH PRESSURE CONN.	THREADED	1/4" NPT(2)		DRAWN BY: S. PERKINSON	ABW4-XLP FILTER, CUT DRAWING
K2	LOW PRESSURE CONN.	THREADED	1/4" NPT(2)	CLASS #150 F.F.S.O.	DATE: 06/24/11	DRAWING NUMBER
K3	HYDRAULIC CONN.	THREADED	1/4" NPT(2)	CLASS #150 F.F.S.O.	SCALE: 1:14 SHEET: 1 OF 1	ABW-4XLP-CUT-01
N1	INLET	FLANGED	4" ASA			REV
N2	OUTLET	FLANGED	4" ASA			2
N3	FLUSH OUTLET	THREADED	2" NPT			

APPENDIX E

CLASS 3 COST ESTIMATION

PROJECT SUMMARY

Project: VWS Condition Assessment - FORSTA
 Client: Village of Western Springs
 Location: Western Springs, IL
 Zip Code: 60558

Estimate Class: Class 5
 PIC: TS
 PM: PO
 Date: July 17, 2025
 By: GAK

Carollo Job # 203678

Reviewed: PO

NO.	DESCRIPTION	TOTAL
01	Civil	\$30,000
02	Process Mechanical	\$1,170,000
03	Structural	\$0
04	EI&C	\$530,000
TOTAL DIRECT COST		\$1,730,000
General Costs	7.0%	\$130,000
	Subtotal	\$1,860,000
Contingency	30.0%	\$560,000
	Subtotal	\$2,420,000
General Contractor Overhead, Profit & Risk	15.0%	\$365,000
	Subtotal	\$2,785,000
Escalation to Mid-Point	3.4%	\$100,000
	Subtotal	\$2,885,000
Sales Tax (Based on)	0.0%	\$0
	Subtotal	\$2,885,000
Bid Market Allowance	0.0%	\$0
TOTAL ESTIMATED CONSTRUCTION COST		\$2,890,000
Engineering, Legal & Administration Fees	20.0%	\$580,000
Pilot Study Direct Cost		\$50,000
Owner's Reserve for Change Orders	10.0%	\$290,000
TOTAL ESTIMATED PROJECT COST		\$3,810,000
<p><i>The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.</i></p>		

PROJECT SUMMARY

Project: VWS Condition Assessment - TEKLEEN
 Client: Village of Western Springs
 Location: Western Springs, IL
 Zip Code: 60558

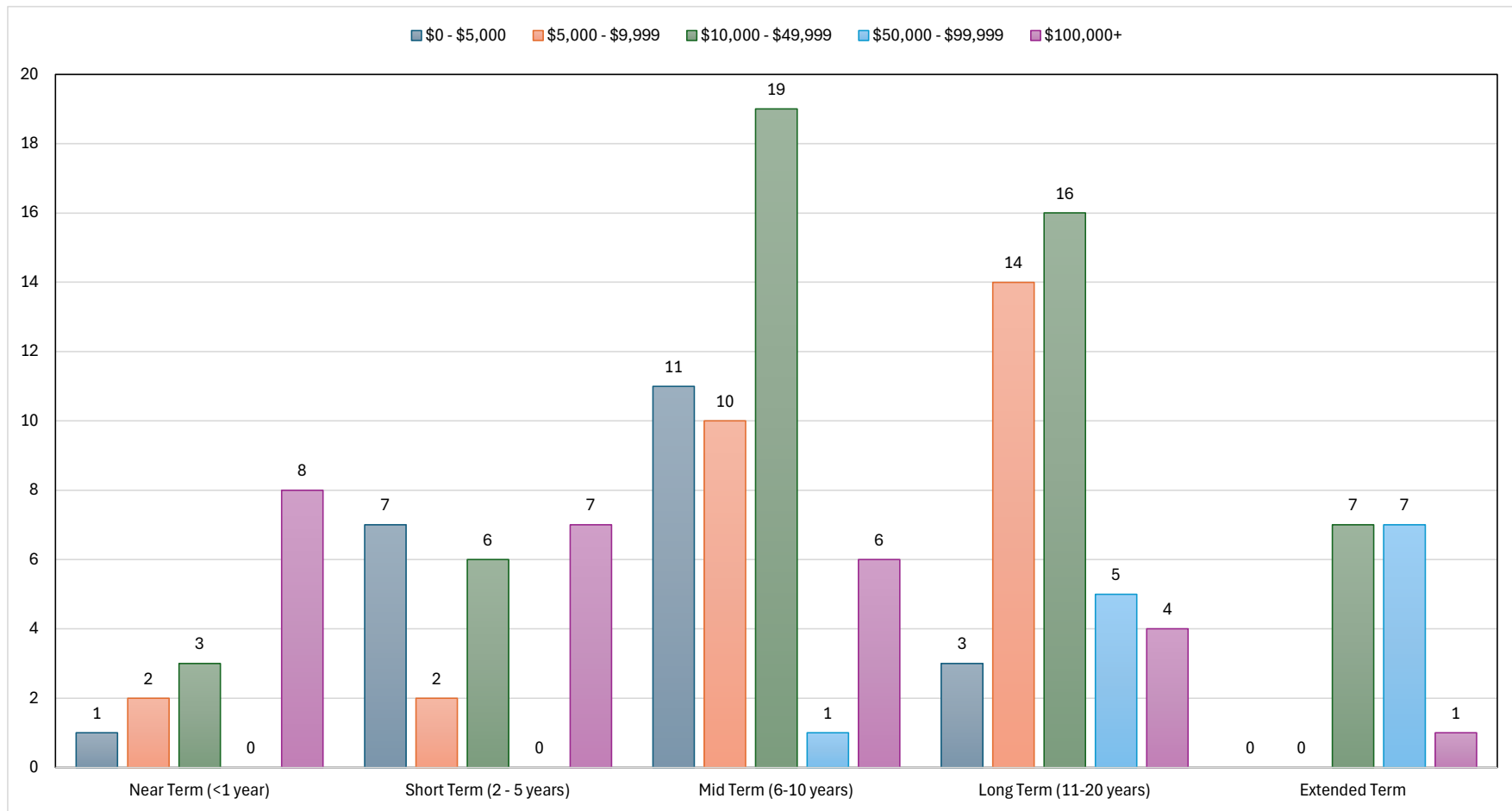
Estimate Class: Class 5
 PIC: TS
 PM: PO
 Date: July 19, 2025
 By: GAK

Carollo Job # 203678

Reviewed: PO

NO.	DESCRIPTION	TOTAL
01	Civil	\$30,000
02	Process Mechanical	\$420,000
03	Structural	\$0
04	EI&C	\$140,000
TOTAL DIRECT COST		\$590,000
General Costs	7.0%	\$50,000
	Subtotal	\$640,000
Contingency	30.0%	\$200,000
	Subtotal	\$840,000
General Contractor Overhead, Profit & Risk	15.0%	\$130,000
	Subtotal	\$970,000
Escalation to Mid-Point	3.4%	\$40,000
	Subtotal	\$1,010,000
Sales Tax (Based on)	0.0%	\$0
	Subtotal	\$1,010,000
Bid Market Allowance	0.0%	\$0
TOTAL ESTIMATED CONSTRUCTION COST		\$1,010,000
Engineering, Legal & Administration Fees	20.0%	\$210,000
Pilot Study Direct Cost		\$50,000
Owner's Reserve for Change Orders	10.0%	\$110,000
TOTAL ESTIMATED PROJECT COST		\$1,380,000
<p><i>The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.</i></p>		

Category	\$0 - \$5,000	\$5,000 - \$9,999	\$10,000 - \$49,999	\$50,000 - \$99,999	\$100,000+	Total
Near Term (<1 year)	1	2	3	0	8	14
Short Term (2 - 5 years)	7	2	6	0	7	22
Mid Term (6-10 years)	11	10	19	1	6	47
Long Term (11-20 years)	3	14	16	5	4	42
Extended Term	0	0	7	7	1	15
Total	22	28	51	13	26	140



Asset Name	Type	Discipline	Estimated Life Remaining	Estimated Replacement Cost	Description
MCC 1	Treatment	Electrical	5 - < 1 yr	\$ 450,000	
RO 3 Membrane Elements	Treatment - RO Filtration	Mechanical	5 - < 1 yr	\$ 200,000	
RO 4 Membrane Elements	Treatment - RO Filtration	Mechanical	5 - < 1 yr	\$ 200,000	
Deel Well 5 - Surface Piping	Supply/ Source	Mechanical	5 - < 1 yr	TBD	Pending assessment by Baxter & Woodman
Amiad Iron Removal Filter No. 1	Treatment	Mechanical	5 - < 1 yr	\$ 1,100,000	
Amiad Iron Removal Filter No. 2	Treatment	Mechanical	5 - < 1 yr	\$ 1,100,000	
Amiad Iron Removal Filter No. 3	Treatment	Mechanical	5 - < 1 yr	\$ 1,100,000	
Amiad Iron Removal Filter No. 4	Treatment	Mechanical	5 - < 1 yr	\$ 1,100,000	
Generator - Deep Well 3	Supply/ Source	Electrical	4 - < 5 yrs	\$ 600,000	
Deep Well 4 - Pump	Supply/ Source	Mechanical	4 - < 5 yrs	\$ 600,000	
Deep Well 1 - Pump	Supply/ Source	Mechanical	4 - < 5 yrs	\$ 100,000	Pending confirmation/assessment by Baxter & Woodman
Deep Well 1 - Groundwater Well	Supply/ Source	Structural	4 - < 5 yrs	\$ 100,000	Pending confirmation/assessment by Baxter & Woodman
Deep Well 3 - Pump	Supply/ Source	Mechanical	4 - < 5 yrs	\$ 600,000	
Deep Well 3 - Groundwater Well	Supply/ Source	Structural	4 - < 5 yrs	\$ 2,000,000	
Deep Well 4 - Groundwater Well	Supply/ Source	Structural	4 - < 5 yrs	\$ 2,000,000	
Generator - Deep Well 4	Supply/ Source	Electrical	3 - < 10 yrs	\$ 600,000	
RO Feed Pump 4 - Pump	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	\$ 400,000	
Standby RO Feed Water Cartridge Filter	Treatment	Mechanical	3 - < 10 yrs	\$ 100,000	
RO Feed Pump 3 - Pump	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	\$ 400,000	
RO 2 Feed Water Cartridge Filter	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	\$ 100,000	
CIP - Bulk Tank	Treatment - Clean-in-Place	Structural	3 - < 10 yrs	\$ 250,000	
Deep Well 5 - Pump	Supply/ Source	Mechanical	2 - < 20 yrs	\$ 600,000	
Elevated Storage Tank	Storage	Structural	2 - < 20 yrs	\$ 8,000,000	Placeholder - pending confirmation from GC (\$4M supply + install)
Deep Well 5 - Groundwater Well	Supply/ Source	Structural	2 - < 20 yrs	\$ 2,000,000	
Standpipe	Treatment	Structural	2 - < 20 yrs	\$ 20,000,000	Placeholder - pending confirmation from GC (\$10M supply + install)
SCADA Main Control Cabinet	Treatment	Instrumentation	1 - > 20 yrs	\$ 500,000	

Asset Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
Deep Well 3 - Surface Check Valve	Supply/ Source	Mechanical	5 - < 1 yr	1 - \$5,000
Deep Well 3 - Motor Starter	Supply/ Source	Electrical	5 - < 1 yr	2 - \$10,000
ATS - Deep Well 3	Supply/ Source	Electrical	5 - < 1 yr	2 - \$10,000
UPS - Instrumentation Room	Treatment	Electrical	5 - < 1 yr	3 - \$50,000
Deep Well 3 - Surface Piping	Supply/ Source	Mechanical	5 - < 1 yr	3 - \$50,000
Deep Well 1 - Surface Piping	Supply/ Source	Mechanical	5 - < 1 yr	3 - \$50,000
MCC 1	Treatment	Electrical	5 - < 1 yr	5 - \$450,000
RO 3 Membrane Elements	Treatment - RO Filtration	Mechanical	5 - < 1 yr	5 - \$200,000
RO 4 Membrane Elements	Treatment - RO Filtration	Mechanical	5 - < 1 yr	5 - \$200,000
Amiad Iron Removal Filter No. 1	Treatment	Mechanical	5 - < 1 yr	5 - \$ 1,100,000
Amiad Iron Removal Filter No. 2	Treatment	Mechanical	5 - < 1 yr	5 - \$ 1,100,000
Amiad Iron Removal Filter No. 3	Treatment	Mechanical	5 - < 1 yr	5 - \$ 1,100,000
Amiad Iron Removal Filter No. 4	Treatment	Mechanical	5 - < 1 yr	5 - \$ 1,100,000
Deep Well 5 - Surface Piping	Supply/ Source	Mechanical	5 - < 1 yr	5 - \$100,000+

Count Total	14
1 - \$5,000	1
2 - \$10,000	2
3 - \$50,000	3
4 - \$100,000	0
5 - \$100,000+	8

Asset Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
Sump Pump - Elevated Storage Tank	Treatment	Mechanical	4 - < 5 yrs	1 - \$5,000
Sump Pump - Deep Well 1	Supply/ Source	Mechanical	4 - < 5 yrs	1 - \$5,000
Sump Pump - Basement - Raw Water Room	Treatment	Mechanical	4 - < 5 yrs	1 - \$5,000
Sump Pump - Basement - Porch LL	Treatment	Mechanical	4 - < 5 yrs	1 - \$5,000
Sump Pump - Pipe Gallery	Treatment	Mechanical	4 - < 5 yrs	1 - \$5,000
Deep Well 4 - Surface Check Valve	Supply/ Source	Mechanical	4 - < 5 yrs	1 - \$5,000
Deep Well 3 - Level Instrument	Supply/ Source	Instrumentation	4 - < 5 yrs	1 - \$5,000
Deep Well 1 - Flow Meter	Supply/ Source	Instrumentation	4 - < 5 yrs	2 - \$10,000
Deep Well 4 - Level Instrument	Supply/ Source	Instrumentation	4 - < 5 yrs	2 - \$10,000
Booster Pump 4 - Motor	Treatment	Electrical	4 - < 5 yrs	3 - \$50,000
Booster Pump 3 - Motor	Treatment	Electrical	4 - < 5 yrs	3 - \$50,000
Low Voltage Transformer - Deep Well 3	Supply/ Source	Electrical	4 - < 5 yrs	3 - \$50,000
Water Heater - Heater Room Basement	Treatment	Mechanical	4 - < 5 yrs	3 - \$50,000
Booster Pump 4 - Pump	Treatment	Mechanical	4 - < 5 yrs	3 - \$50,000
Deep Well 4 - Surface Piping	Supply/ Source	Mechanical	4 - < 5 yrs	3 - \$50,000
Generator - Deep Well 3	Supply/ Source	Electrical	4 - < 5 yrs	5 - \$600,000
Deep Well 4 - Pump	Supply/ Source	Mechanical	4 - < 5 yrs	5 - \$600,000
Deep Well 1 - Pump Abandonment	Supply/ Source	Mechanical	4 - < 5 yrs	5 - \$100,000
Deep Well 1 - Groundwater Well Abandonment	Supply/ Source	Structural	4 - < 5 yrs	5 - \$100,000
Deep Well 3 - Pump	Supply/ Source	Mechanical	4 - < 5 yrs	5 - \$600,000
Deep Well 3 - Groundwater Well	Supply/ Source	Structural	4 - < 5 yrs	5 - \$2,000,000
Deep Well 4 - Groundwater Well	Supply/ Source	Structural	4 - < 5 yrs	5 - \$2,000,000

Count Total	22
1 - \$5,000	7
2 - \$10,000	2
3 - \$50,000	6
4 - \$100,000	0
5 - \$100,000+	7

Asset Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
Sump Pump - Basement - Pump Room	Treatment	Mechanical	3 - < 10 yrs	1 - \$5,000
Hoist - Level 1 - Foyer	Treatment	Mechanical	3 - < 10 yrs	1 - \$5,000
Air Compressor Air Dryer	Treatment	Mechanical	3 - < 10 yrs	1 - \$5,000
Expansion Tank Boiler Room Basement	Supply/ Source	Mechanical	3 - < 10 yrs	1 - \$5,000
Antiscalant Day Tank	Treatment	Mechanical	3 - < 10 yrs	1 - \$5,000
Air Compressor	Treatment	Mechanical	3 - < 10 yrs	1 - \$5,000
Caustic Soda - Day Tank	Treatment - Caustic Soda	Structural	3 - < 10 yrs	1 - \$5,000
Corrosion Inhibitor - Bulk Tank 1	Treatment - Corrosion Inhibitor	Structural	3 - < 10 yrs	1 - \$5,000
Sodium Hypochlorite - Bulk Tank	Treatment - Sodium Hypochlorite	Structural	3 - < 10 yrs	1 - \$5,000
Sodium Hypochlorite - Day Tank	Treatment - Sodium Hypochlorite	Structural	3 - < 10 yrs	1 - \$5,000
Flushing Tank for Amiad	Treatment	Structural	3 - < 10 yrs	1 - \$5,000
Concentrate Pump 2 - Motor	Treatment - Concentrate	Electrical	3 - < 10 yrs	2 - \$10,000
High Service Pump 1 Panel - Soft Starter	Distribution	Electrical	3 - < 10 yrs	2 - \$10,000
High Service Pump 2 Panel - Soft Starter	Distribution	Electrical	3 - < 10 yrs	2 - \$10,000
High Service Pump 3 Panel - Soft Starter	Distribution	Electrical	3 - < 10 yrs	2 - \$10,000
Concentrate Pump 1 - Motor	Treatment - Concentrate	Electrical	3 - < 10 yrs	2 - \$10,000
MWRD Meter	Treatment	Instrumentation	3 - < 10 yrs	2 - \$10,000
RO4 Concentrate Flow Control Valve	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	2 - \$10,000
Stainless Steel Hatches (WTP Porch)	Treatment	Mechanical	3 - < 10 yrs	2 - \$10,000
Flushing Water Booster Pump No. 1	Treatment	Mechanical	3 - < 10 yrs	2 - \$10,000
Flushing Water Booster Pump No 2	Treatment	Mechanical	3 - < 10 yrs	2 - \$10,000
ATS - Deep Well 4	Treatment	Electrical	3 - < 10 yrs	3 - \$50,000
RO Feed Pump 3 - Motor	Treatment - RO Filtration	Electrical	3 - < 10 yrs	3 - \$50,000
RO Feed Pump 4 - Motor	Treatment - RO Filtration	Electrical	3 - < 10 yrs	3 - \$50,000
Clean-in-Place Pump VFD Control Cabinet	Treatment - Clean-in-Place	Electrical	3 - < 10 yrs	3 - \$50,000
CIP - Pump Motor	Treatment - Clean-in-Place	Electrical	3 - < 10 yrs	3 - \$50,000
ATS - Deep Well 4	Supply/ Source	Electrical	3 - < 10 yrs	3 - \$50,000
Corrosion Inhibitor - Metering Pump No. 1	Treatment - Corrosion Inhibitor	Mechanical	3 - < 10 yrs	3 - \$50,000
Booster Pump 3 - Pump	Treatment	Mechanical	3 - < 10 yrs	3 - \$50,000
Corrosion Inhibitor - Metering Pump No. 2	Treatment - Corrosion Inhibitor	Mechanical	3 - < 10 yrs	3 - \$50,000
RO 3 Feed Water Cartridge Filter	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	3 - \$50,000
CIP - Pump	Treatment - Clean-in-Place	Mechanical	3 - < 10 yrs	3 - \$50,000
Hot Water Unit Heater - CIP Room	Treatment	Mechanical	3 - < 10 yrs	3 - \$50,000
Concentrate Pump 1 - Pump	Treatment - Concentrate	Mechanical	3 - < 10 yrs	3 - \$50,000
Water Heater - Utility/ Meter Room	Treatment	Mechanical	3 - < 10 yrs	3 - \$50,000
Antiscalant Feed Pump No. 1	Treatment	Mechanical	3 - < 10 yrs	3 - \$50,000
Concentrate Pump 2 - Pump	Treatment - Concentrate	Mechanical	3 - < 10 yrs	3 - \$50,000
RO 4 Feed Water Cartridge Filter	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	3 - \$50,000
Caustic Soda - Bulk Tank 1	Treatment - Caustic Soda	Structural	3 - < 10 yrs	3 - \$50,000
Caustic Soda - Bulk Tank 2	Treatment - Caustic Soda	Structural	3 - < 10 yrs	3 - \$50,000
CIP - Cartridge Filter Vessel	Treatment - Clean-in-Place	Mechanical	3 - < 10 yrs	4 - \$100,000
Generator - Deep Well 4	Supply/ Source	Electrical	3 - < 10 yrs	5 - \$600,000
Standby RO Feed Water Cartridge Filter	Treatment	Mechanical	3 - < 10 yrs	5 - \$100,000
RO Feed Pump 4 - Pump	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	5 - \$400,000
RO Feed Pump 3 - Pump	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	5 - \$400,000
RO 2 Feed Water Cartridge Filter	Treatment - RO Filtration	Mechanical	3 - < 10 yrs	5 - \$400,000
CIP - Bulk Tank	Treatment - Clean-in-Place	Structural	3 - < 10 yrs	5 - \$250,000

Count Total	47
1 - \$5,000	11
2 - \$10,000	10
3 - \$50,000	19
4 - \$100,000	1
5 - \$100,000+	6

Asset Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
Surge Protection Device	Treatment	Electrical	2 - < 20 yrs	1 - \$5,000
Well 4 Feed Pump Breakers	Treatment	Electrical	2 - < 20 yrs	1 - \$5,000
Antiscalant Bulk Tank No. 1	Treatment - Antiscalant	Structural	2 - < 20 yrs	1 - \$5,000
CIP - Main Control Breaker	Treatment - Clean-in-Place	Electrical	2 - < 20 yrs	2 - \$10,000
High Service Pump 2 - Motor	Distribution	Electrical	2 - < 20 yrs	2 - \$10,000
High Service Pump 1 - Motor	Distribution	Electrical	2 - < 20 yrs	2 - \$10,000
Utility Main Breaker	Treatment	Electrical	2 - < 20 yrs	2 - \$10,000
Well 3 Feed Pump Breakers	Treatment	Electrical	2 - < 20 yrs	2 - \$10,000
Generator Main Breaker	Treatment	Electrical	2 - < 20 yrs	2 - \$10,000
High Service Pump 3 - Motor	Distribution	Electrical	2 - < 20 yrs	2 - \$10,000
Motor Control Panel	Supply/ Source	Electrical	2 - < 20 yrs	2 - \$10,000
Caustic Soda - Day Tank - Digital Level Indicator	Treatment - Caustic Soda	Instrumentation	2 - < 20 yrs	2 - \$10,000
RO 4 Combined Permeate Flow Meter	Treatment - RO Filtration	Instrumentation	2 - < 20 yrs	2 - \$10,000
CIP - Temperature Sensor	Treatment - Clean-in-Place	Instrumentation	2 - < 20 yrs	2 - \$10,000
RO 3 Concentrate Flow Control Valve	Treatment - RO Filtration	Mechanical	2 - < 20 yrs	2 - \$10,000
Sodium Hypochlorite - Chemical Feed Pump	Treatment - Sodium Hypochlorite	Mechanical	2 - < 20 yrs	2 - \$10,000
Deep Well 5 - Surface Check Valve	Supply/ Source	Mechanical	2 - < 20 yrs	2 - \$10,000
CIP - Main Control Panel	Treatment - Clean-in-Place	Electrical	2 - < 20 yrs	3 - \$50,000
HRG - Ground Fault Indicators - Deep Well 4	Supply/ Source	Electrical	2 - < 20 yrs	3 - \$50,000
Deep Well 5 - VFD	Supply/ Source	Electrical	2 - < 20 yrs	3 - \$50,000
RO 4 VFD Control Cabinet	Treatment - RO Filtration	Electrical	2 - < 20 yrs	3 - \$50,000
Deep Well 5 - SWBD	Supply/ Source	Electrical	2 - < 20 yrs	3 - \$50,000
RO 3 VFD Control Cabinet	Treatment - RO Filtration	Electrical	2 - < 20 yrs	3 - \$50,000
RO 3 Combined Permeate Flow Meter	Treatment - RO Filtration	Instrumentation	2 - < 20 yrs	3 - \$50,000
CIP - Flow Meter	Treatment - Clean-in-Place	Instrumentation	2 - < 20 yrs	3 - \$50,000
High Service Pump 1 - Pump	Distribution	Mechanical	2 - < 20 yrs	3 - \$50,000
Hoist - Level 1 - Membrane Room	Treatment	Mechanical	2 - < 20 yrs	3 - \$50,000
Caustic Soda - Chemical Feed Pump	Treatment - Caustic Soda	Mechanical	2 - < 20 yrs	3 - \$50,000
Antiscalant Feed Pump No. 2	Treatment	Mechanical	2 - < 20 yrs	3 - \$50,000
Deep Well 4 - Surge Tank	Supply/ Source	Mechanical	2 - < 20 yrs	3 - \$50,000
High Service Pump 2 - Pump	Distribution	Mechanical	2 - < 20 yrs	3 - \$50,000
High Service Pump 3 - Pump	Distribution	Mechanical	2 - < 20 yrs	3 - \$50,000
Generator - WTP	Treatment	Electrical	2 - < 20 yrs	4 - \$100,000
Plant Effluent Flow Meter	Treatment	Instrumentation	2 - < 20 yrs	4 - \$100,000
Instrumentation Room - Analyzers and Sensors	Treatment	Instrumentation	2 - < 20 yrs	4 - \$100,000
Iron Removal Backwash Tank	Treatment	Structural	2 - < 20 yrs	4 - \$100,000
Reservoir	Treatment	Structural	2 - < 20 yrs	4 - \$100,000
Laboratory Equipment	Treatment	Instrumentation	2 - < 20 yrs	3 - \$50,000
Deep Well 5 - Pump	Supply/ Source	Mechanical	2 - < 20 yrs	5 - \$600,000
Elevated Storage Tank	Storage	Structural	2 - < 20 yrs	5 - \$8,000,000
Deep Well 5 - Groundwater Well	Supply/ Source	Structural	2 - < 20 yrs	5 - \$2,000,000
Standpipe	Treatment	Structural	2 - < 20 yrs	5 - \$20,000,000

Count Total	42
1 - \$5,000	3
2 - \$10,000	14
3 - \$50,000	16
4 - \$100,000	5
5 - \$100,000+	4

Asset Name	Type	Discipline	Estimated Life Remaining	Replacement Cost
Deep Well 5 - Flow Meter	Supply/ Source	Instrumentation	1 - > 20 yrs	3 - \$50,000
Deep Well 4 - Flow Meter	Supply/ Source	Instrumentation	1 - > 20 yrs	3 - \$50,000
RO 4 Stage 2 Permeate Flow Meter	Treatment - RO Filtration	Instrumentation	1 - > 20 yrs	3 - \$50,000
RO 3 Stage 2 Permeate Flow Meter	Treatment - RO Filtration	Instrumentation	1 - > 20 yrs	3 - \$50,000
RO 3 Concentrate Flow Meter	Treatment - RO Filtration	Instrumentation	1 - > 20 yrs	3 - \$50,000
Caustic Soda - Bulk Tank - Digital Level Indicator	Treatment - Caustic Soda	Instrumentation	1 - > 20 yrs	3 - \$50,000
RO 4 Concentrate Flow Meter	Treatment - RO Filtration	Instrumentation	1 - > 20 yrs	3 - \$50,000
Deep Well 1 RTU1 cabinet	Supply/ Source	Instrumentation	1 - > 20 yrs	4 - \$100,000
SCADA RIO Control Cabinet	Treatment	Instrumentation	1 - > 20 yrs	4 - \$100,000
Deep Well 3 - Flow Meter	Supply/ Source	Instrumentation	1 - > 20 yrs	4 - \$100,000
Deep Well 3 RTU cabinet	Supply/ Source	Instrumentation	1 - > 20 yrs	4 - \$100,000
Electrical System / SCADA Cabinet - Antiscalant Chemical System	Treatment	Instrumentation	1 - > 20 yrs	4 - \$100,000
Deep Well 4 RTU cabinet	Supply/ Source	Instrumentation	1 - > 20 yrs	4 - \$100,000
Deep Well 5 RTU cabinet	Supply/ Source	Instrumentation	1 - > 20 yrs	4 - \$100,000
SCADA Main Control Cabinet	Treatment	Instrumentation	1 - > 20 yrs	5 - \$500,000

Count Total	15
1 - \$5,000	0
2 - \$10,000	0
3 - \$50,000	7
4 - \$100,000	7
5 - \$100,000+	1



AGENDA ITEM SUMMARY

INFRASTRUCTURE COMMISSION

Infrastructure Commission : September 25, 2025

AGENDA ITEM E.1.

To: Infrastructure Commission

From: Ronald Derengowski, Water Plant Superintendent

CC: Matthew Supert, Director of Municipal Services, Ellen Baer, Village Manager

RE: Water System Update

Recommendation

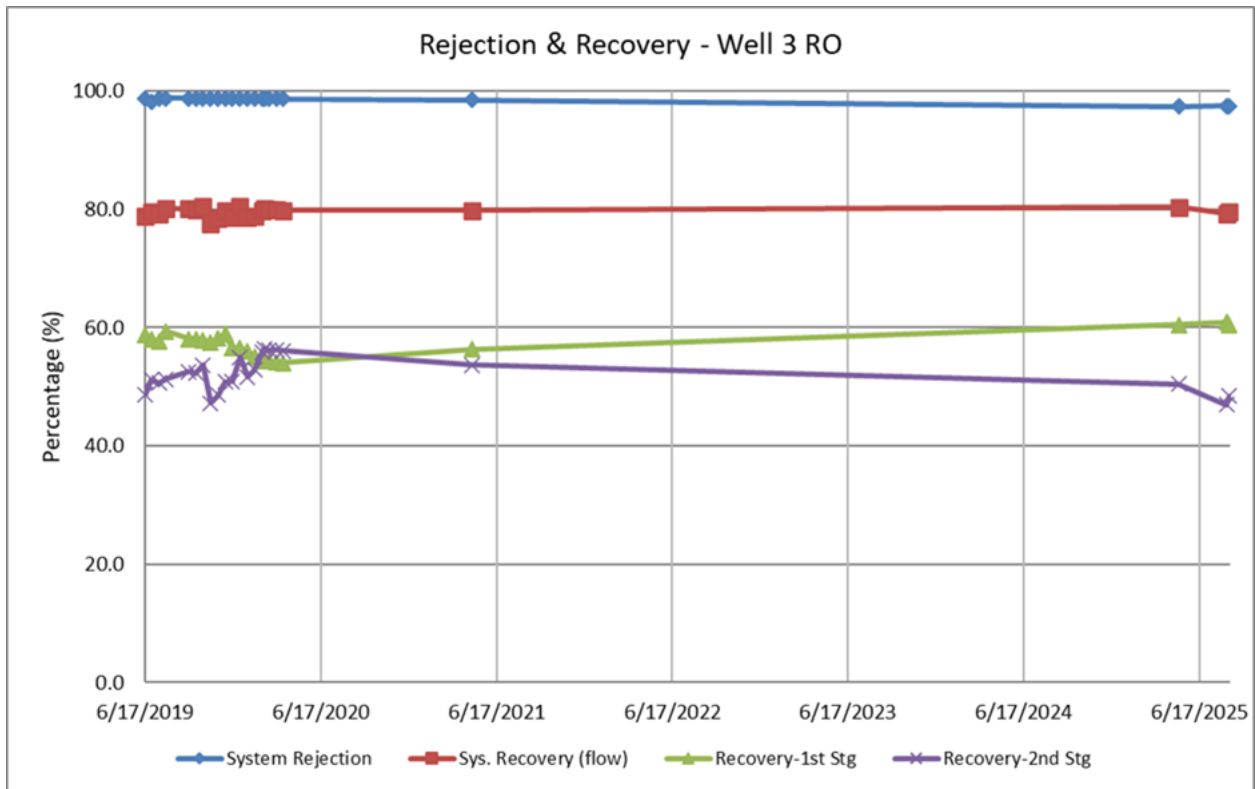
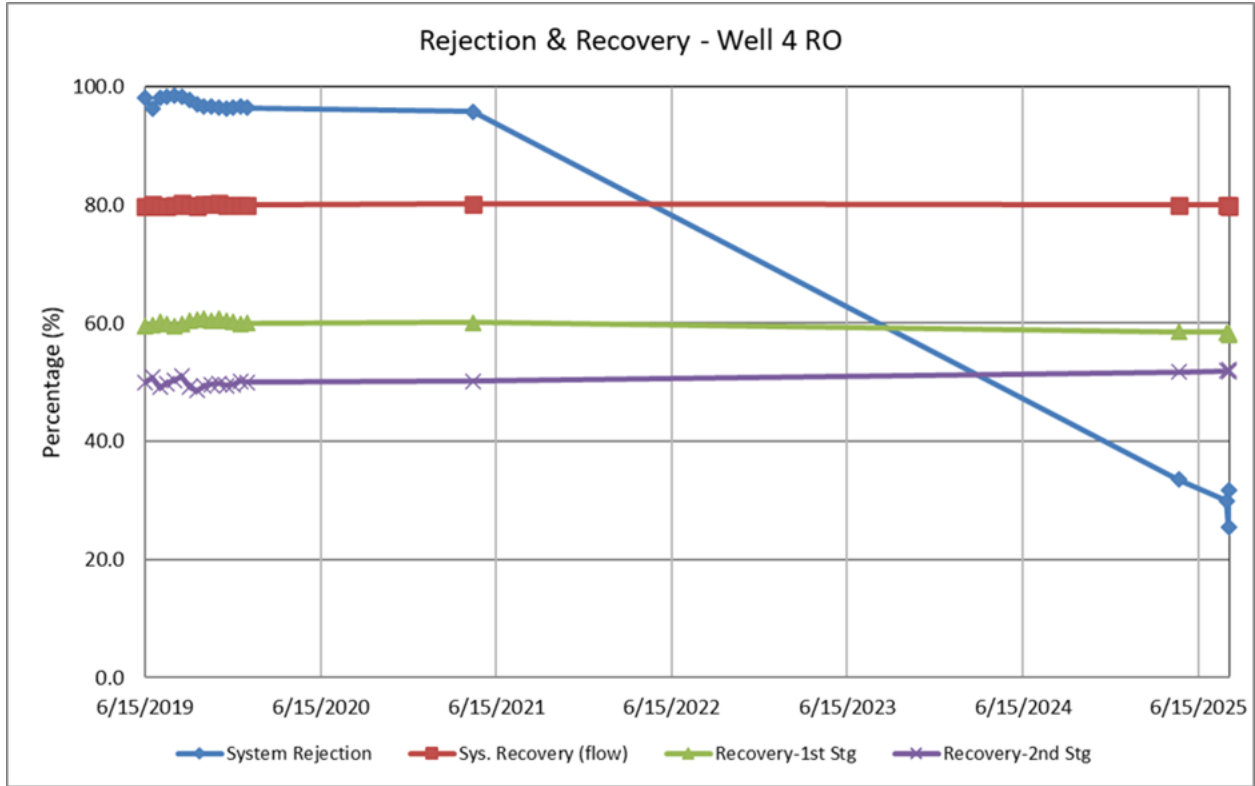
Administrative Report on the water system: July–September 2025. No action at this time.

Summary

Replacement Need for Membranes on Reverse Osmosis Well 4 Skid

Over the past 3 years, the rejection and recovery of the membrane cartridges has decreased in the reverse osmosis skid that treats the raw water from Well 4. It is highly recommended that the membranes of the unit be replaced to optimize the treatment process. Since maintenance and replacement of the cartridges will be over \$25,000.00, the Village will proceed with the Request for Proposals in September for the replacement and installation of the cartridges and will bring the recommendation and cost to the Public Works and Water Committee and the Village Board in October.

As you will see below, the data shows the rejection and recovery for Well 3 and Well 4 and the difference between the two units.



Fire Hydrant Painting

Go Painters were in town and completed painting 200 fire hydrants. Hydrants undergo sandblasting to remove the old paint and a primer is applied. The final coat of paint (Federal Safety Yellow) is then administered. Private hydrants are distinguished red and hydrants off transmission mains to the water plant are painted blue.

Springdale Water Main Update

As part of the Springdale Park Detention Basin and Watermain Project, PCE has installed approximately 1440 linear feet of 8" ductile water main. This new water main is all of 52nd Street from Caroline Avenue to Howard Avenue and then continuing down Howard Avenue to 54th Place. Service connections to the new main will occur in the near future but will be operational for fire protection.

Eaton 1600 Amp Breaker

On Monday, August 25, 2025, Eaton installed the new main 1600 AMP breaker at the Water Treatment Plant. This required coordination with ComEd for a temporary disconnection while the new breaker was installed. The successful installation had minimal downtime in operations.

Phase 2 IEPA Loan Application

The Village will be submitting the loan application for the phase 2 lead service line replacements. The Finance and Municipal Services Departments, along with HR Green will be finalizing the loan amount and contingencies for the application. This will be presented for recommendation and approval at the October Board cycles. HR Green is confident that as Western Springs continues to move the project forward with all necessary documentation and plans, the Village should be in a good position to receive bypass funds after January 1, 2026.

Lead Service Line Replacements

As of 9/19/2025, Millennium Contracting has completed 16 out of the 42 lead service lines that are being replaced as part of the Phase 1 CY 24-25 LSLR project. Costs of the overall project may be reduced as certain installations have found existing copper from the water main to the b-box on past road and infrastructure projects.

53rd Street Water Main Replacement Project

It is anticipated that the 53rd Street Water Main replacement project will begin the week of October 6th. Temporary Easement Agreements are currently being generated and distributed to the four residences and the two homeowner associations impacted by the project.

Financial Impact

Recommended Motion

Strategic Plan Alignment

File Attachments

None