

MAP and PLAN 202(b)

ENGINEERING REPORT

OAKRIDGE WATER DISTRICT IMPROVEMENTS
PFAS TREATMENT

Public Water System ID# NY 5918395

TOWN OF LEWISBORO
Westchester County, New York

Prepared for:

TOWN OF LEWISBORO
11 Main Street
South Salem, New York 10590

Prepared by:

DELAWARE ENGINEERING, D.P.C.
28 Madison Ave. Extension
Albany, New York 12304



May 2021

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1.0 Executive Summary

The purpose of this Engineering Report is to document planned improvements to the Oakridge Water District water treatment plant located at 400 Oakridge Drive, South Salem.

The project is required to treat and remove a group of carcinogenic bioaccumulating chemicals generally known as PFAS. In February of 2021, concentrations of PFAS were found in all five of the water supply wells and Well #6 was above maximum contaminant levels (MCLs) and the District was issued a Notice of Violation by the Westchester County Department of Health (WCDOH) on March 1, 2021. The WCDOH has required the District to develop a plan to address the water quality violations by May 31, 2021. Appendix A includes a copy of the Notice of Violation. Additionally, in May the second quarterly samples were collected and the test results showed that Wells #2, #6, and #7 had levels above the MCL.

The project proposes the design and construction of an expansion to the water treatment plant to further treat the water from all of the existing wells with the use of carbon filtration (GAC). The 40-foot by 38-foot expansion of the water plant will further require improvements to the booster pumps, treatment chemicals, valves, meters, and other appertences.

2.0 Project Background & History

2.1 Site Information

The Oakridge Water District serves approximately 900 people in the Oakridge development and surrounding area located on Route 123 in the Town of Lewisboro, Westchester County, New York.

At the location of the water treatment plant, the topography gently slopes upward to the northwest. The water treatment facilities are located on the southwest side of the Oakridge Drive development. To the east of the treatment plant is a recreational facility, apartment complexes and a man-made pond central to the development. To the west is a forested low rocky outcrop.

2.2 Geologic conditions

Major soil types in the vicinity include the Charlton-Chatfield Complex, 0 to 15 percent slopes, very rocky and Urban land-Charlton complex, 3 to 8 percent slopes. The Charlton-Chatfield complex consists of gravelly fine sandy loam, well drained, with a depth to restrictive layer of more than 80 inches. To the west of the project is the Chatfield-Hollis-Rock outcrop, 0 to 15 percent slopes, very rocky.

2.3 Environmental resources

The man-made pond within the Oakridge development flows to an unnamed stream (Class A) tributary to the Siscowit Reservoir to the southwest, part of the Connecticut water supply system.

There are state wetlands to the north, south and southeast of the water treatment facilities. The facility is within the NYS DEC buffer area of the palustrine forested, seasonally flooded wetland complex to the south.

There are no critical habitats or endangered species in the vicinity as mapped by the NYS DEC Enviromapper.

2.4 Floodplain considerations

The project area is in Zone X, minimal flood risk area, as on FIRM Panel 36119C0185F, effective 9/28/2007.

2.5 Cultural Resources

The New York State Office of Parks, Recreation and Historic Preservation concluded that this project will have no impact on archaeological and/or historic resources listed in or eligible for the New York State and National Registers of Historic Places (letter 8/10/2018).

3.0 Ownership & Service Area

The Town of Lewisboro owns the water system and water plant known as the Oakridge Water District (District). Included in the distribution area are 278 condominiums, 22 single-family residences, a commercial area plus a new section of approximately 40 townhomes. Source water is drawn from a system of five ground water wells. All supply lines from the wells are connected to a common header and flow into the treatment facility through a 4-inch PVC main.

3.1 Existing Facilities

The existing water treatment plant consists of five raw water supply wells, mix media filters, and green sand filtration to remove high levels of iron and manganese.

The water is disinfected with sodium hypochlorite and pumped to the 95,000-gallon water storage tank.

The system flows for typical average over 50,000 gpd.

	2018	2019	2020
Total Annual Flow	<i>18,314,000 Gallons</i>	<i>18,187,000 Gallons</i>	<i>19,853,000 Gallons</i>
Average Gallons per Month	<i>1,526,167 Gallons</i>	<i>1,515,583 Gallons</i>	<i>1,654,417 Gallons</i>
Average Gallons per Day	<i>50,872 GPD</i>	<i>50,519 GPD</i>	<i>55,147 GPD</i>

3.2 Need for Project

The project is required to treat and remove a group of carcinogenic bioaccumulating chemicals generally known as PFAS. In February and May 2021, concentrations of PFAS were found in all five of the water supply wells and Well #2, Well #6, and Well #7 were above maximum contaminant levels (MCLs). After the February test results, the District was issued a Notice of Violation by the Westchester County Department of Health (WCDOH) on March 1, 2021. The WCDOH has required the District to develop a plan to address the water quality violations by May 31, 2021. Appendix A includes a copy of the Notice of Violation.

PFOA levels ranged from 6.13 up to 11.4 ppt

PFOS levels ranged from 3.87 up to 15.5 ppt

Appendix B includes the water quality data from the wells.

3.3 Capacity Development

The facility has sufficient water supply for the District. The water treatment plant and the water system are operated by VRI and is staffed with certified water treatment plant operators.

The Town's DPW oversees VRI's operation of the plant and ensures that there are sufficient funds to operate the facility.

The Capacity Development Program Evaluation Form is attached in Appendix G.

4.0 Alternative Analysis

4.1 Description

As required by New York State water quality standards, the District sampled all of its water supply wells in February and May of 2021. It was discovered that all five the wells had PFAS and Well #2, Well #6, and Well #7 had PFOS and/or PFOA above the maximum contaminate level of 10 ppt.

The plant has a capacity of 75,000 gpd.

Each of the mixed media filters and the green sand filters have a capacity of 140 gpm, per treatment train.

Well capacities are as follows:

- Well #2- 21.5 GPM
- Well #4- 33 GPM
- Well #5- 35 GPM
- Well #6- 24 GPM
- Well #7- 33 GPM

The wells are typically operated in two groups. wells 2, 4 & 7 or 2, 6 & 7 are run together, for a combined average GPM of 80-90. Well #5 is not normally used because it has a much higher iron levels than the rest of the wells.

Each treatment train has a flow reducer to limit the flow to a maximum of 140 gpm. This allows all the wells to be on, if needed, and not exceed the rated capacity of each treatment train.

4.2 No Action Alternative

The water district took the highest contaminated well out of service and sampled the PFAS levels in the combined remaining wells. By taking Well #6 out of service, the PFAS levels are below the MCL of 10 ppt.

However, keeping Well #6 off line permanently is not a solution because it would leave the district short of the required water supply.

Additionally, sampling collected on May 5, 2021 showed PFAS above the MCL for Well #2, Well #6, and Well #7.

Therefore, the no action alternative is not feasible.

4.3 Add GAC Filtration Alternative

GAC filtration is an established method for the removal of PFAS to non-detection levels (below 2 ppt). It is a well establish best technology available for this type of treatment. For the flows at

Oakridge 75,000 gpd and operating range of 80 to 140 gpm, a Calgon Model 8 two vessel system with 20,000# of F400 GAC in each vessel is recommended.

Redundancy will be achieved by having two vessels each one with the full capacity of the wells (140 gpm). The vessels will be able to run in parallel or in series. Normal operation will be in series and parallel operation will be used when one vessel is down because of the need to change media or other maintenance.

Additionally, the WTP has TOC in the 1.5 to 3 mg/l range. Total organic carbon (TOC) is presumed to be the precursor of THMs formed after chlorination during water treatment, and TOC is readily removed by granular activated carbon (GAC).

By using GAC filters for PFAS removal, the reduction of total organic carbon (TOC) prior to disinfection is also expected to nearly eliminated the precursors of THM and address this water quality problem for the District.

Appendix C includes product information for the GAC treatment system. Figure 3 shows the needed GAC equipment.

4.4 Ion Exchange Alternative

Ion exchange treatment requires a resin specifically manufactured for removal of PFAS. Purolite is an ion exchange resin that is a single use PFAS-selective resin (PFA694E).

Based on a flow rate range of 35 gpm minimum to 140 gpm maximum, an AdEdge treatment skid Model APU-4896-2-LL-MVH, 2 x 48" dia x 96" high filter to operate in lead/lag is recommended.

The water entering the ion exchange treatment must go through pre-treatment to remove oxidants (chlorine and permanganate), iron and manganese, TOC, and suspended solids.

A 5-micron filter is needed to address the suspended solids and there is existing iron and manganese treatment at the WTP. However, the treatment system will still need to address the TOC (1.5 to 3 mg/l) and the potential for oxidants to be present in the influent to the ion exchange system.

Because of the constraints on the water quality entering the ion exchange system and the water quality at the plant, it is likely that the ion exchange treatment would experience premature failure and breakthrough of the PFAS. This condition would lead to more frequent media exchanges than predicted under ideal conditions.

Appendix D includes product information for this proposed equipment. Figure 4 shows the required Ion Exchange treatment units.

4.5 RO Alternative

RO treatment has been shown to filter out PFAS. However, there are many obstacles to using and RO system to treat PFAS at a small municipal WTP. RO is sensitive to the presence of iron and manganese, and oxidants. RO has recovery of 90 to 95% which means 5 to 10% of the pumped well water would be returned to the wastewater plant with elevated levels of PFAS that would flow through the WWTP and be discharged to the stream.

Additionally, we reached out to several manufactures and suppliers of RO treatment systems and they all responded that RO is not a viable alternative for Oakridge WTP due to the low flows and water quality.

Thus, RO is not a viable alternative.

4.6 Additional Upgrades

The WTP will need to address some additional upgrades to expand its treatment process. They include:

- Replacing the booster pumps in-kind
- Replacing the jockey pump in-kind
- Replacing the high flow pump and add a 2nd pump in-kind
- Replacing influent flow meter in-kind
- New effluent master meter
- Replacing static mixers
- Replacing injection quills
- Replace piping and lower to a workable level (4 to 5 feet above FF) to allow safe access to valves.
- Additional instrumentation and controls
- Chemical storage area

4.7 Cost Estimate

Appendix E includes a detailed breakdown of the expected capital costs to implement the improvements at the water treatment plant.

Alternative 1, GAC Treatment, capital costs are summarized as follows:

- \$158,000 -Site Work
- \$405,000 – Building Work
- \$254,000 - Piping
- \$512,500 – GAC Filters
- \$162,000 – Pumps and Misc Equipment
- \$224,000 – 15% Contingency
- \$224,000 – 15% Engineering
- \$1,939,500 - Total

Alternative 2, Ion Exchange Treatment, capital cost are summarized as follows:

- \$158,000 -Site Work
- \$405,000 – Building Work
- \$254,000 - Piping
- \$380,000 – GAC Filters
- \$162,000 – Pumps and Misc Equipment
- \$204,000 – 15% Contingency
- \$204,000 – 15% Engineering
- \$1,767,000 - Total

Both the GAC media and the Ion Exchange media cost approximately \$30,000. Because of the water quality at the Oakridge Plant (TOC, oxidants, iron, hardness) the expected life of the ion exchange media is expected to be six months vs 18 months for GAC.

The present worth analysis of the two alternatives is as follows:

GAC Treatment Alternative	Ion Exchange Alternative
Capital Cost - \$1,939,500	Capital Cost -\$1,767,000
Annual Media Cost - \$20,000	Annual Media Cost - \$60,000
	Annual Cartridge Cost - \$10,000
20-year cost =\$2,339,500	20-year Cost =\$3,167,000

4.8 Non-Monetary Factors

RO is a non-feasible alternative.

Ion Exchange can remove PFAS but because of the water quality at the Oakridge Water Plant (TOC, Ion and Manganese, Chlorine, Permanganate, suspended solids), this alternative could be unreliable.

GAC filters are a proven technology that removes TOC and is forgiving for water quality issues that exist at Oakridge. Thus, it is expected to be the more reliable treatment method.

5.0 Recommended and Selected Alternatives

Treating PFAS with GAC filtration is the recommended alternative. It provides the most reliable treatment alternative at the lowest present worth cost.

A system of two GAC filters each one with 100% capacity will be provided. The filters will be piped to allow for operation in series or parallel. The normal operation will be series to provide the greatest level of treatment to ensure PFAS is removed to non-detection levels.

The water plant will be able to operate as usual with three wells on at a time and have the ability to run all five wells at the same time.

The existing treatment plant will be expanded to accommodate the proposed equipment as shown in Figure 2 and Figure 5.

5.1 Project Cost

The total project cost is \$1,939,500. The Town has applied and will continue to apply for grants and DWSRF financing for the project.

If no grants are obtained, the total capital costs will be paid by a municipal bonds. The debt service would be paid by the 340 water users of Oakridge Water District. At 20 years, using an annual interest rate of 4%, the annual payment is approximately \$142,711.80.

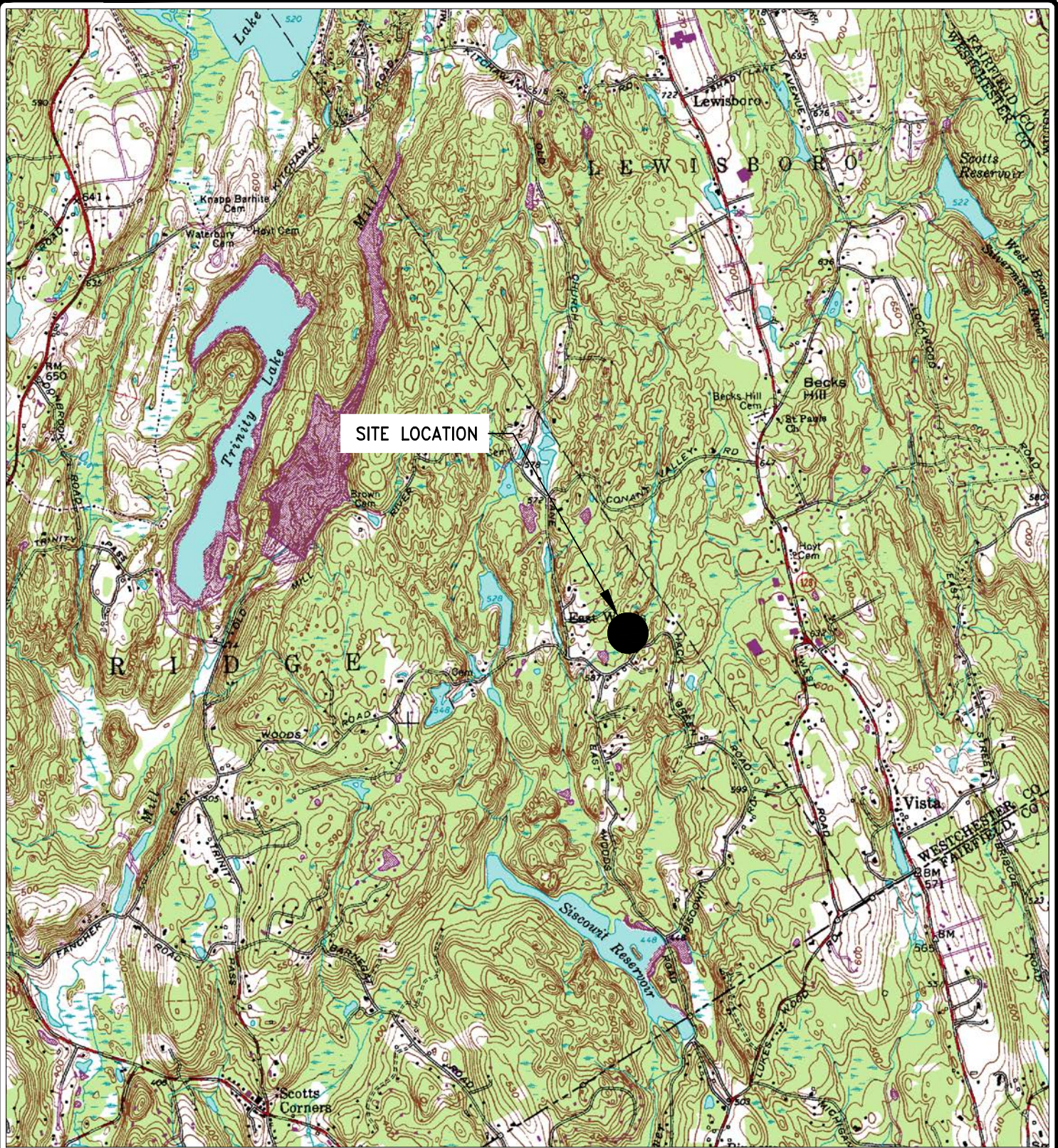
The current water rates that are assessed quarterly for a typical water user are \$55 base; \$7 per 1,000 gallons for first 7,000 gallons; \$8 per 1,000 gallons for over 7,000 gallons to 27,000 gallons; \$9 per 1,000 gallons above 27,000 gallons.

For a typical residential condominium that uses 80,000 gallons per year, the proposed project would increase their yearly water cost from approximately \$664.00 to \$1,084.

5.2 Project Schedule

The proposed project schedule is as follows:

- Submit Engineering Report to WCDOH by 5/31/2021
- Receive WCDOH approval of Report by 12/31/2021
- Authorize Design by 12/31/2021
- Submit Design to WCDOH by 5/1/2022
- Receive WCDOH approval of design plans by 12/31/2022
- Authorize Bids by 12/31/2022
- Receive Bids by 3/1/2023
- Issue notice to Proceed by 4/1/2023
- Start construction by 5/1/2023
- Complete construction by 12/31/2023



SITE LOCATION MAP

REVISIONS		
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DATE:	5/27/2021
DRAWN BY:	
SCALE:	1:2400
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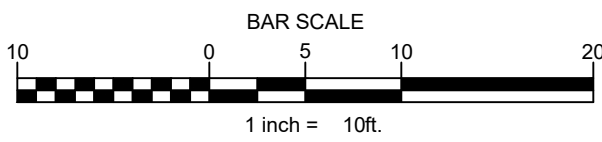
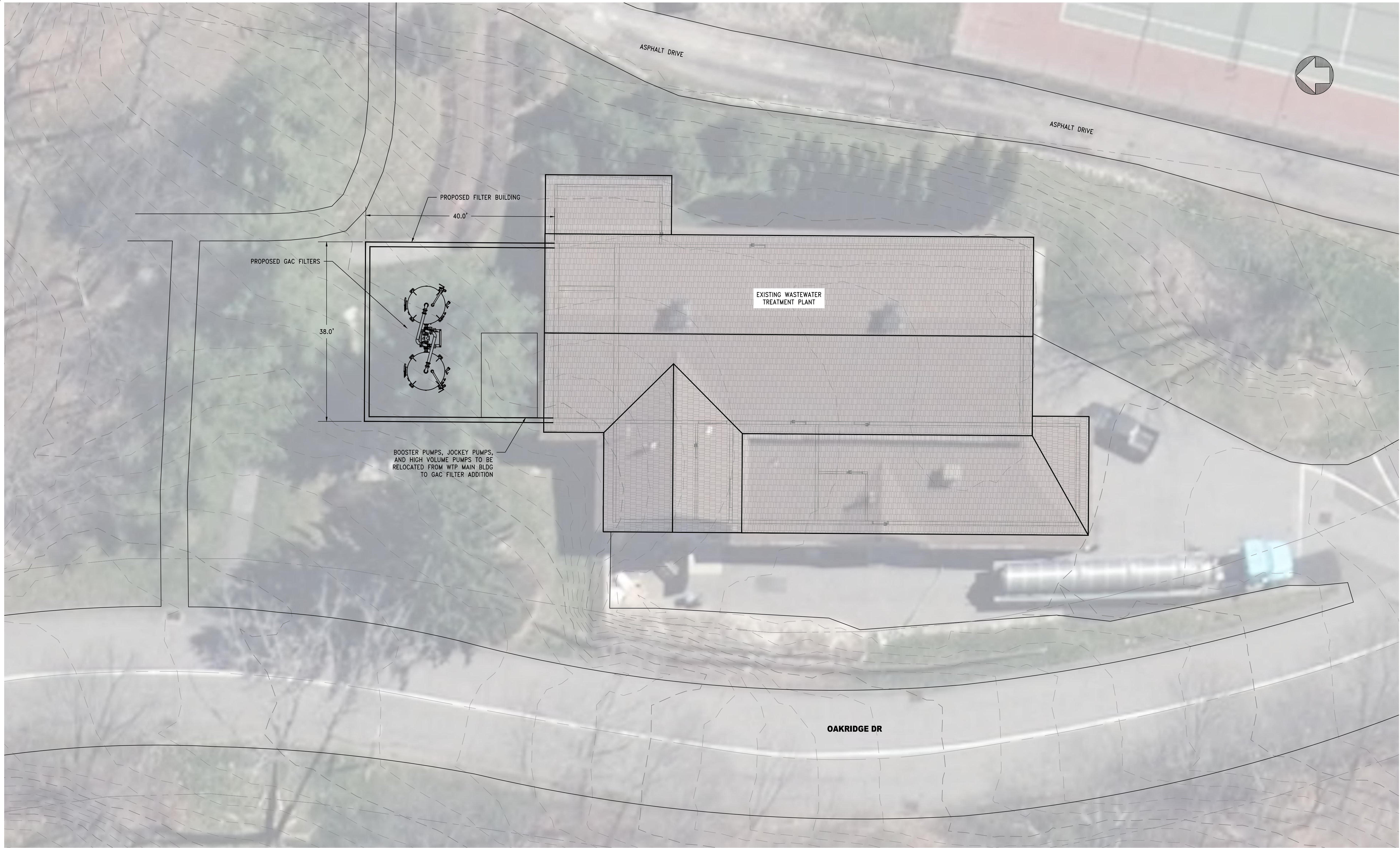
28 MADISON AVENUE EXTENSION, ALBANY, NY 12203 - 518.452.1290
55 SOUTH MAIN ST, ONEONTA, NY 13820 - 607.432.8073
31 NORTH MAIN STREET, LIBERTY, NY 12754 - 845.747.9952
6 TOWNSEND STREET, WALTON, NY 13856 - 607.865.9235
16 EAST MARKET ST., RED HOOK, NY 12571 - 518.452.1290
548 BROADWAY, MONTICELLO, NY 12701 - 845.791.7777

SHEET NO:

FIGURE 1

TOWN OF LEWISBORO, NY
OAKRIDGE WATER DISTRICT
WTP UPGRADE PROJECT

H:\Drawings\Lewisboro-Oakridge\WTP Upgrades\GAC\Figure #2.dwg



DATE: 5/27/2021
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REVIEWED BY:
PROJECT NO.: XXXXXX
FILE:

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55 SOUTH MAIN ST. ONEONTA, NY 13820 - 607.432.8073
31 NORTH MAIN STREET, LIBERTY, NY 12754 - 845.747.9862
1600 W. STATE STREET, ALBANY, NY 12206 - 518.452.1290
16 EAST MARKET ST. RED HOOK, NY 12571 - 518.452.1290
548 BROADWAY, MONTICELLO, NY 12051 - 845.791.7777

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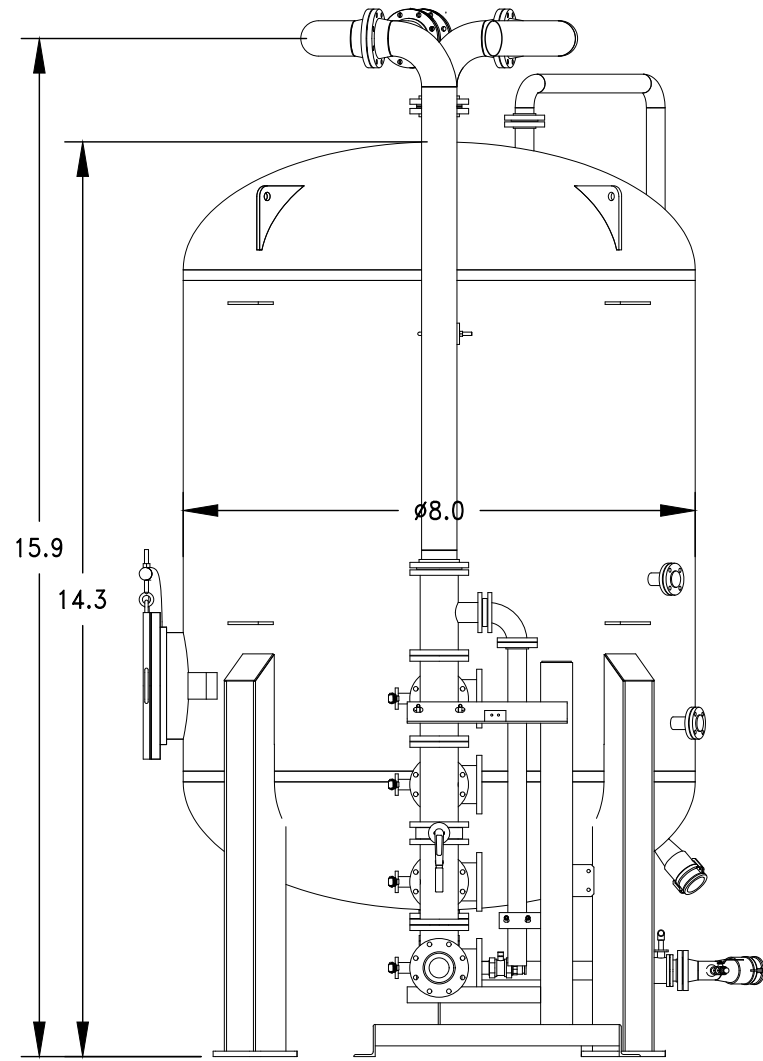
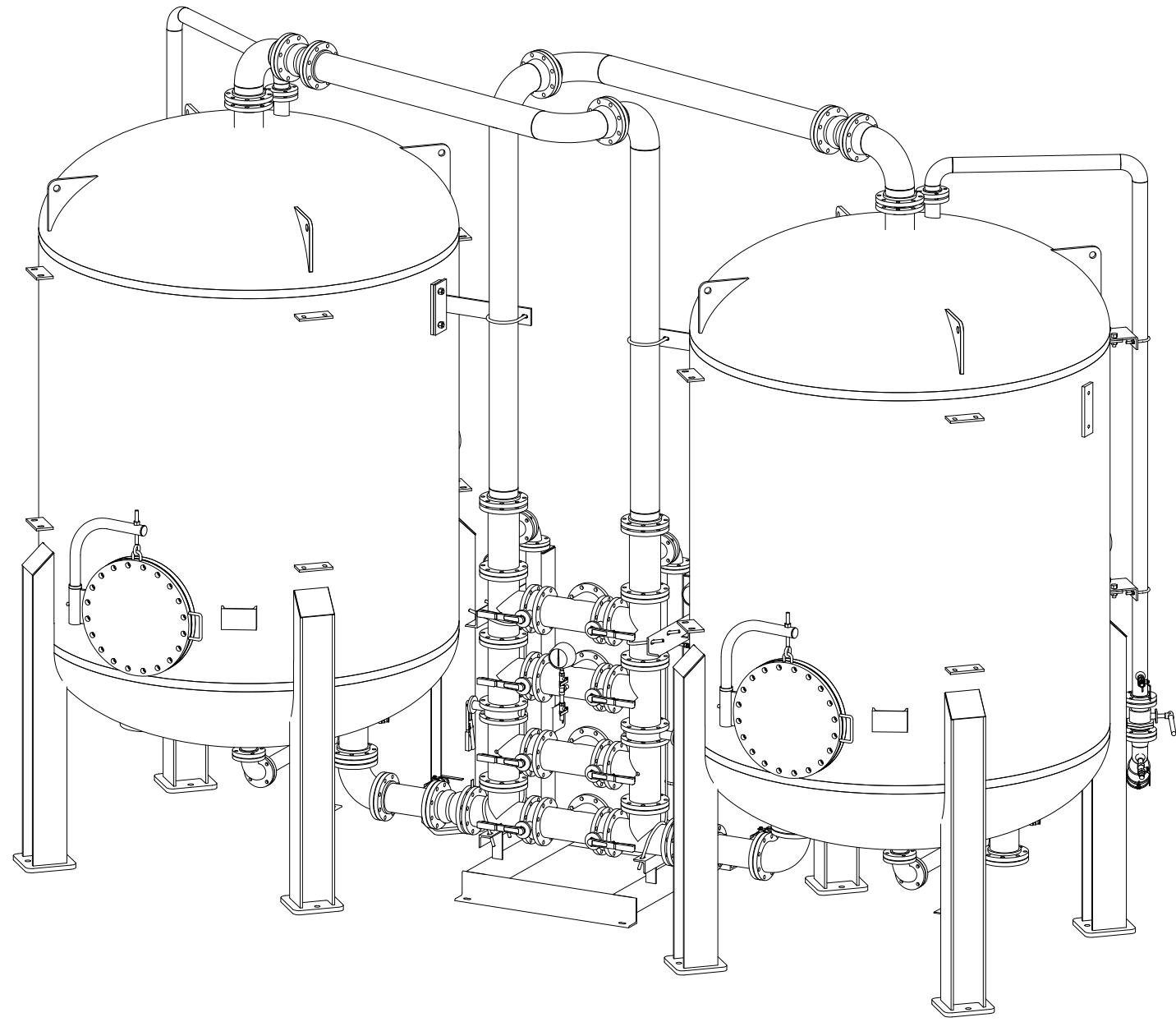
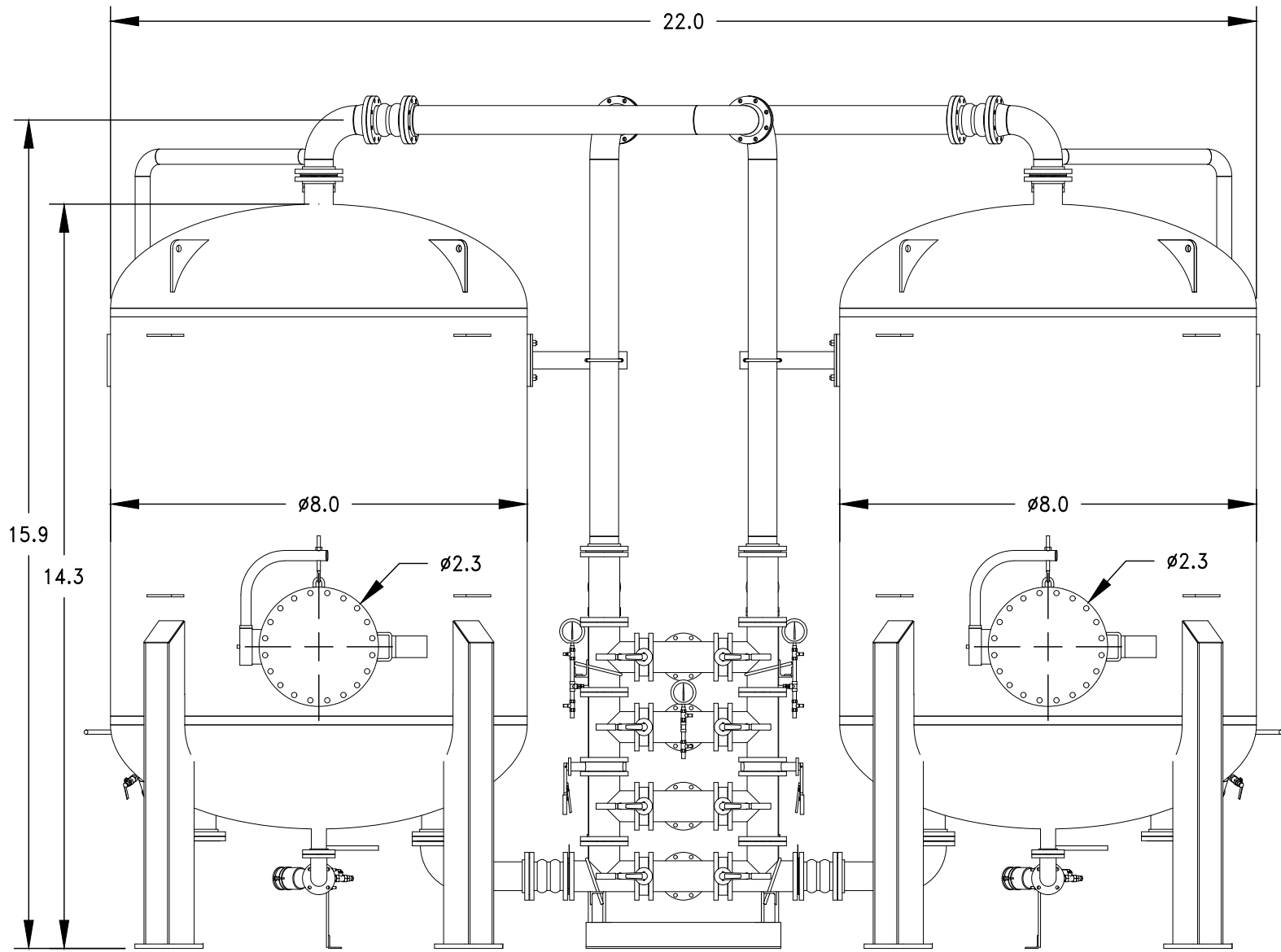
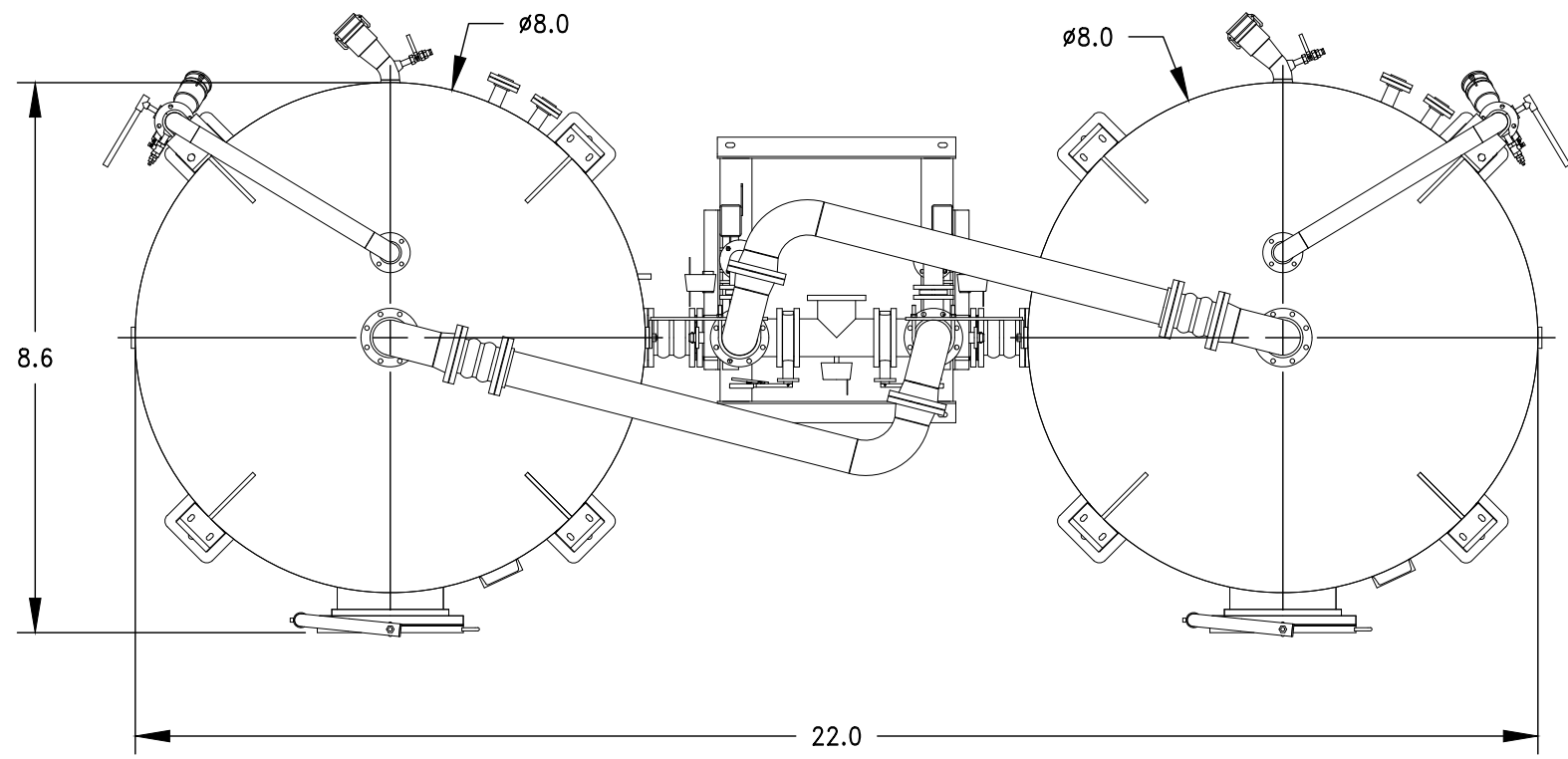
TOWN OF LEWISBORO, NY
OAKRIDGE WATER DISTRICT
WTP UPGRADE PROJECT

SITE PLAN

SHEET:
FIG #2

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1
FIG #3 ALT #1 - GAC TREATMENT
SCALE: 1" = 3'

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311 NORTH MAIN STREET, LIBERTY, NY 12754 - 845.747.8962
100 WEST MAIN STREET, CANTON, NY 13616 - 518.452.1290
16 EAST MARKET STREET, RED HOOK, NY 12571 - 518.452.1290
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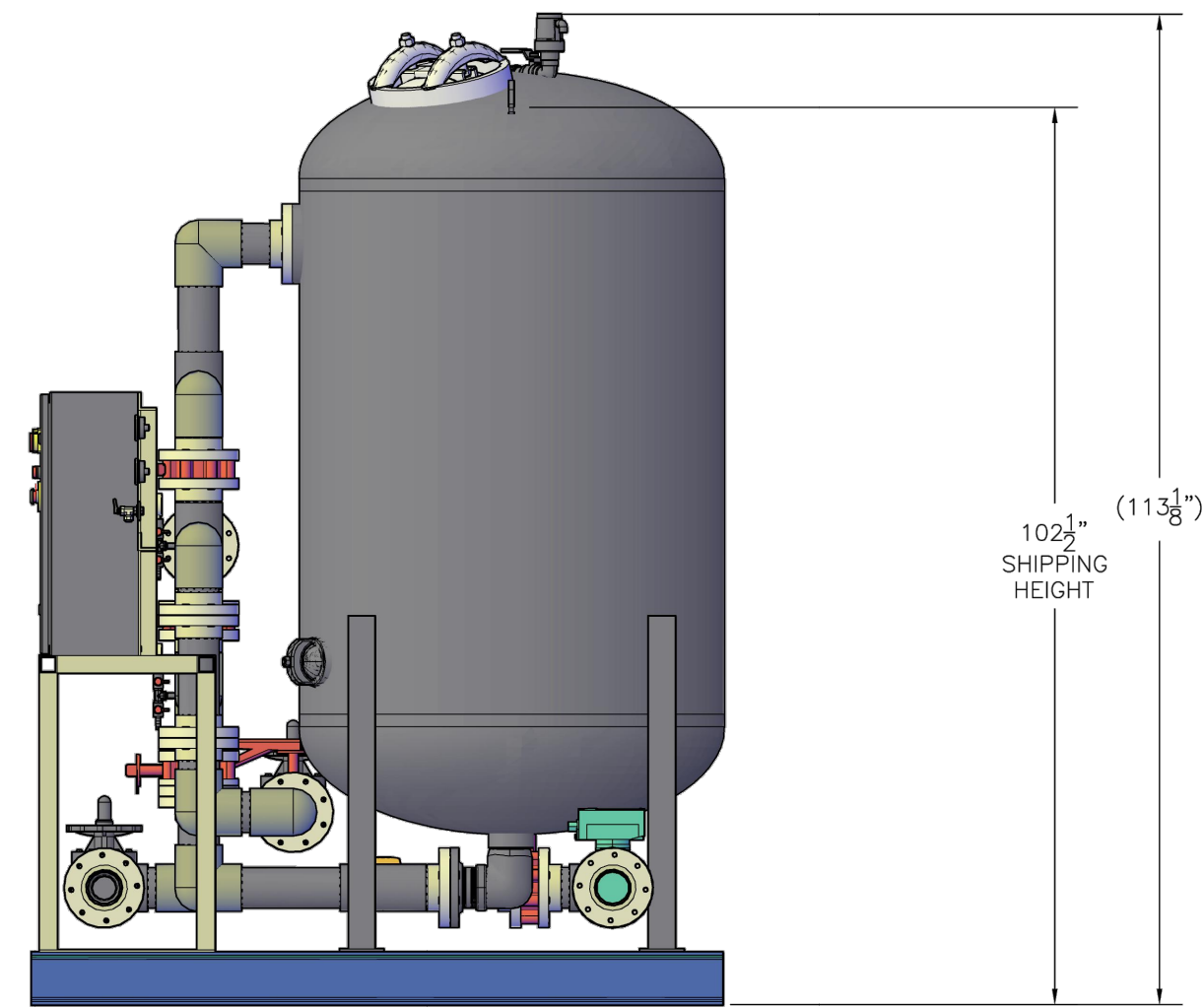
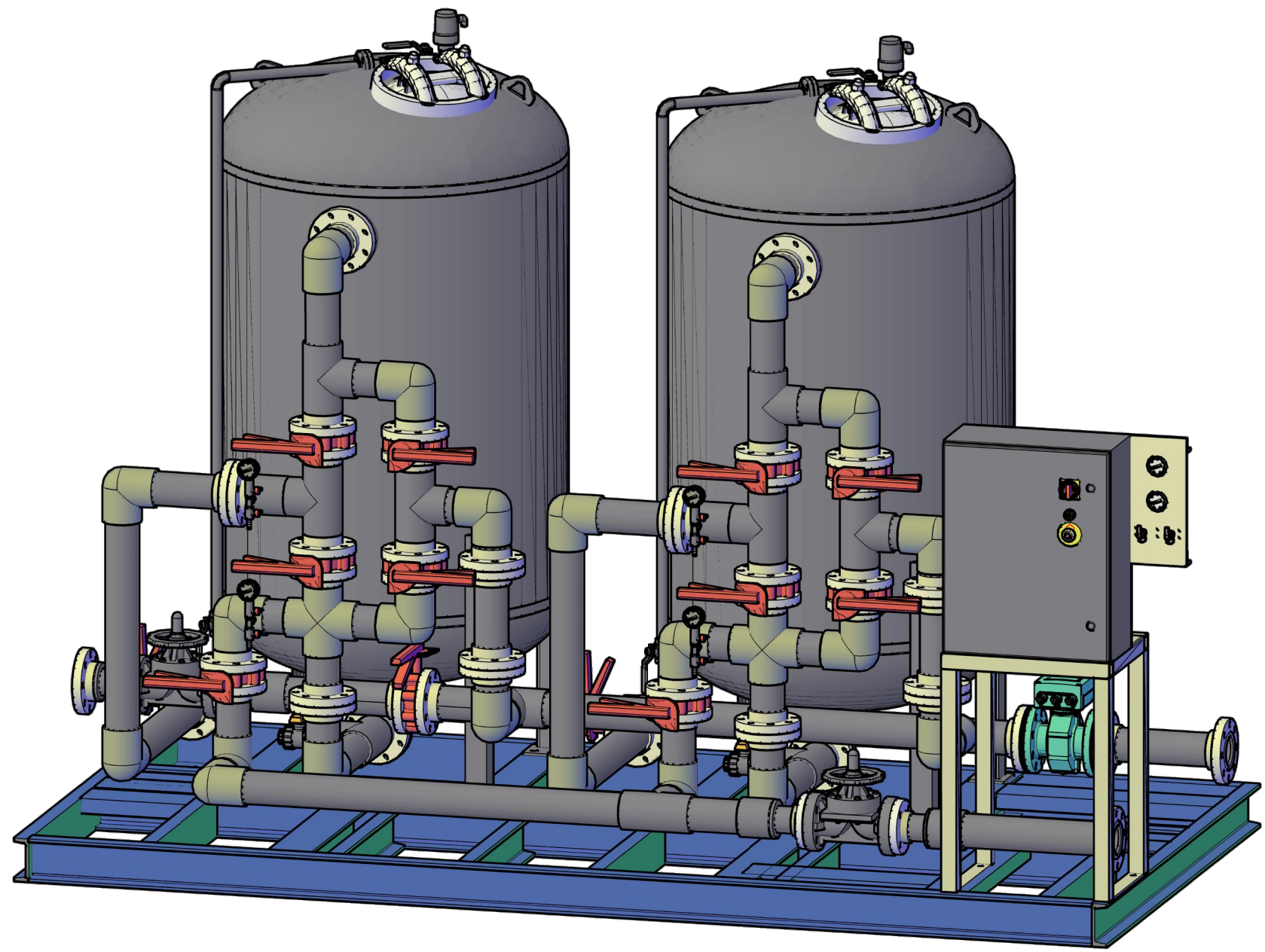
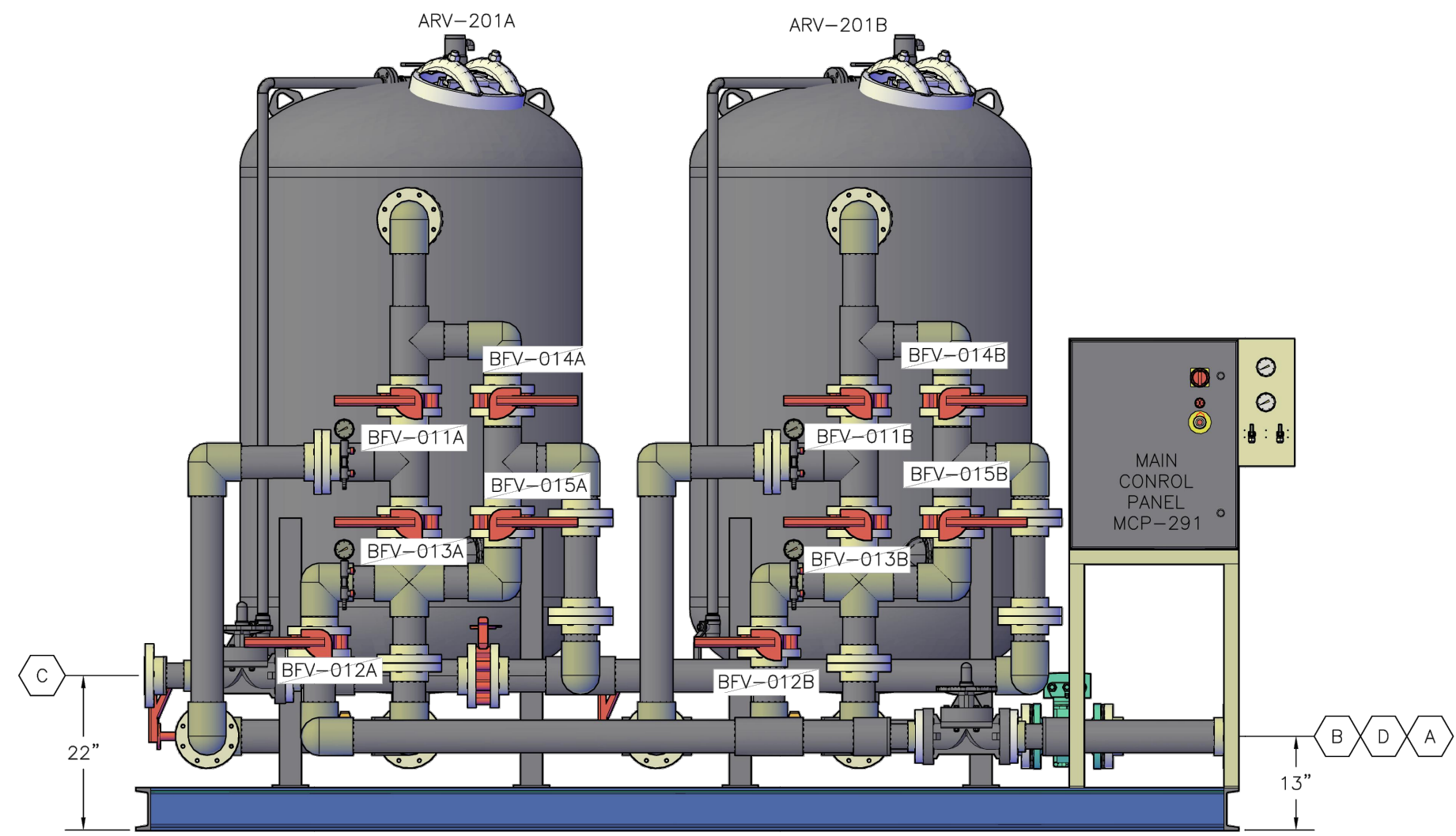
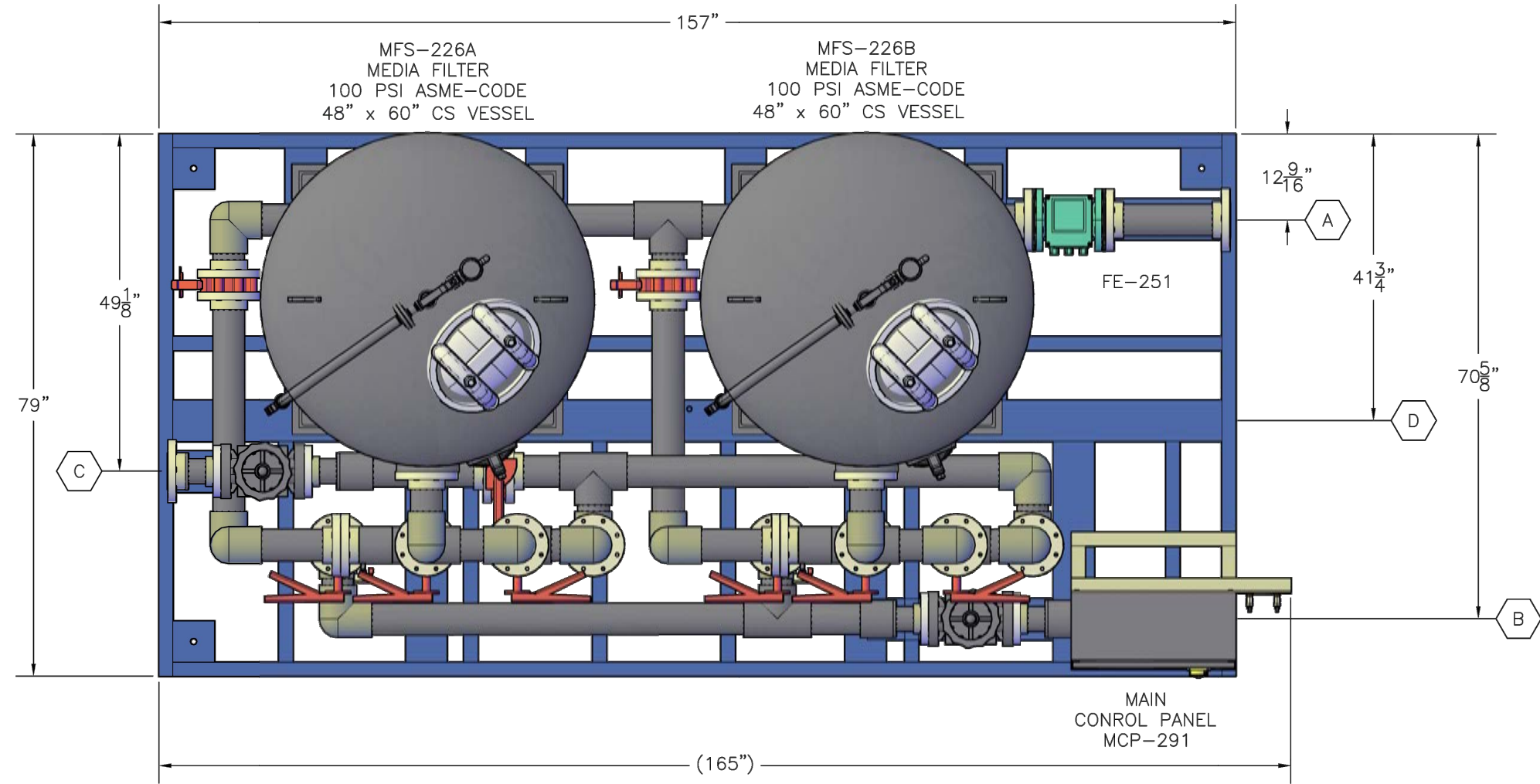
TOWN OF LEWISBORO, NY
OAKRIDGE WATER DISTRICT
WTP UPGRADE PROJECT

ALT #1 - GAC TREATMENT

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FIG #3

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1
FIG #4 ALT #2 - ION EXCHANGE TREATMENT
SCALE: 1" = 10'

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31 NORTH MAIN STREET, LIBERTY, NY 12754 - 545.747.8962
16 EAST MARKET ST. RED HOOK, NY 12571 - 518.452.1290
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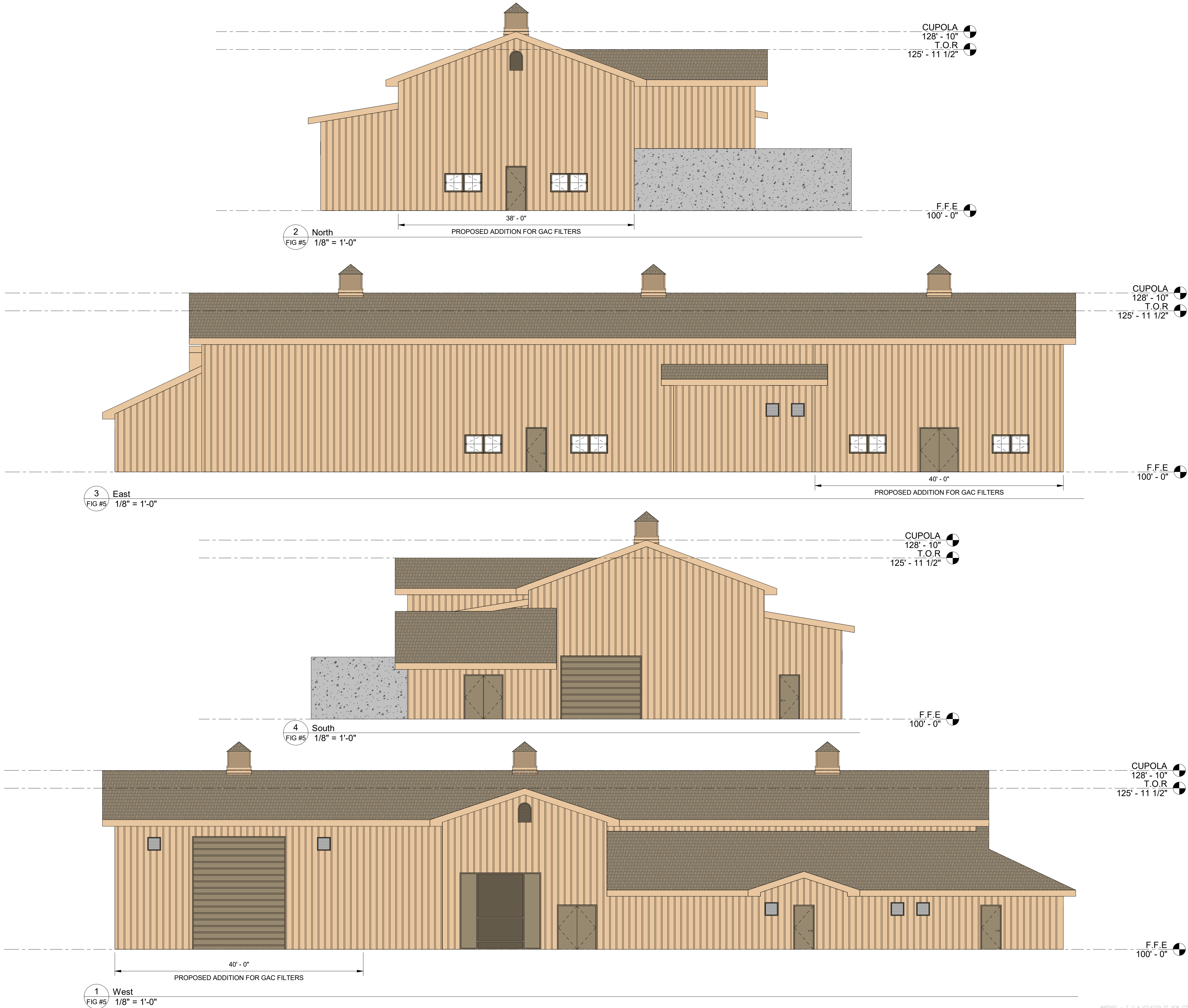
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NO.	DESCRIPTION

TOWN OF LEWISBORO, NY
OAKRIDGE WATER DISTRICT
WTP UPGRADE PROJECT

ALT #2 - ION EXCHANGE
TREATMENT

SHEET:
FIG #4

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55 SOUTH MAIN STREET, ONEONTA, NY 13320 - 607.432.8073
1000 WEST 10TH STREET, ALBANY, NY 12206 - 518.452.1290
8100 SEASIDE DRIVE, ALBANY, NY 12206 - 518.452.1290
16 EAST MARKET ST., RED HOOK, NY 12571 - 518.452.1290
548 BROADWAY, MONTICELLO, NY 12701 - 845.791.7777

NO.	DATE	DESCRIPTION

TOWN OF LEWIBORO, NY
OAKRIDGE WATER DISTRICT
WTP UPGRADE PROJECT

PROPOSED WTP
BUILDING ADDITION

WARNING - IT IS A VIOLATION OF NEW YORK EDUCATION LAW SECTION 2203.2, FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR, TO ALTER THIS DOCUMENT IN ANY WAY. IF ALTERED, THE ALTERING PERSON SHALL COMPLY WITH THE REQUIREMENTS OF NEW YORK EDUCATION LAW, SECTION 2203.2.

APPENDIX A

Town of Lewisboro
Oakridge Water District
WCDOH Notice of Violation

March 1, 2021
NOTICE OF VIOLATION
New York State Sanitary Code, 10 NYCRR Part 5

Mr. JOEL SMITH
PO Box 500
11 Main Street
SOUTH SALEM, NY 10590

Re: 02 - MCL, AVERAGE
Violation ID: 2021 1123
Determination Date: March 1, 2021
OAKRIDGE WATER DISTRICT
PWS ID: NY5918395
Lewisboro (T), WESTCHESTER County

Dear Mr. JOEL SMITH;

THIS IS A BASIC VIOLATION REPORT.

Violation ID: 2021 1123
Determination Date: 3/1/2021
Violation Type:
Name: 02 - MCL, AVERAGE
Analyte Group: PERFLUOROCTANE SULFONIC ACID (PFOS) - 2805
Analyte Name: PERFLUOROCTANE SULFONIC ACID (PFOS)
Analyte Code: 2805
Compliance Period Begin: 1/1/2021
Compliance Period End: 3/31/2021
Violation Period Begin Date: 1/1/2021
Violation Period End Date: 3/31/2021



3/15/21

JOEL
TONY

George Latimer
County Executive

Sherlita Antler, M.D.
Commissioner of Health

March 1st, 2021

Town of Lewisboro
11 Main St
South Salem, NY 10590
Attn: The Honorable Peter H. Parsons, Town Supervisor

RE: Violation ID: 2021 1123
PFOS MCL Violation
Oakridge Water Company
Lewisboro (T)
PWS ID: NY 5918395

Dear Supervisor Parsons:

A review of Perfluorooctanesulfonic acid (PFOS), Perfluorooctanoic acid (PFOA), and 1,4-Dioxane sampling results for the 1st quarter 2021 monitoring period for the above referenced public water supply revealed that the PFOS level exceeded the Maximum Contamination Level (MCL) of 0.0000100 milligrams per liter (mg/L) with an average value for the quarter of 0.0000145 mg/L. This constitutes non-compliance with Part 5, Subpart 5-1, Section 5-1.52, Table 3 of the New York State Sanitary Code (NYSSC).

You are reminded that Tier 2 Public Notification must be made within thirty (30) days from the date of this notice in accordance with Part 5, Subpart 5-1, Section 5-1.52 Table 13 and 5-1.78 of the NYSSC. Further, certification that the above notification was made and a copy of such notifications must be provided to the Department within ten (10) days of the completion of the notification requirement. A draft of the notice must be submitted to this Department for review prior to distribution.

Please find the attached Notice of Violation form generated by the New York State Department of Health Safe Drinking Water Information System (SDWIS) and recorded on its database.

In light of the above, it is requested that a proposal to provide a corrective action to the above MCL violations must be submitted to this Department no later than May 31, 2021.

Should you have any questions or require additional information, please contact Chika Amasiani at (914) 864-7338 or the undersigned at (914) 864-7348.

Very truly yours,

Zaw T. Thein, P.E.
Associate Engineer
Bureau of Environmental Quality

ZT:CA

Department of Health
25 Moore Avenue
Mount Kisco, New York 10549

Telephone: (914) 864-7348

Fax: (914) 813-4691



APPENDIX B

Town of Lewisboro
Oakridge Water District

PFAS Sampling Data



ANALYTICAL REPORT

Lab Number:	L2123480
Client:	Envirotest Laboratories Inc. 315 Fullerton Avenue Newburgh, NY 12550
ATTN:	Debra Bayer
Phone:	(845) 562-0890
Project Name:	VRI-LEWISBORO/OAKRIDGE DW
Project Number:	42002044
Report Date:	05/21/21

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Certifications & Approvals: MA (M-MA030), NH NELAP (2062), CT (PH-0141), DoD (L2474), FL (E87814), IL (200081), LA (B5084), ME (MA00030), MD (350), NJ (MA015), NY (11627), NC (685), OH (CL106), PA (68-02089), RI (LAQ00299), TX (T104704419), VT (VT-0015), VA (460194), WA (C954), US Army Corps of Engineers, USDA (Permit #P330-17-00150), USFWS (Permit #206964).

320 Forbes Boulevard, Mansfield, MA 02048-1806
508-822-9300 (Fax) 508-822-3288 800-624-9220 - www.alphalab.com

Project Name: VRI-LEWISBORO/OAKRIDGE DW
Project Number: 42002044

Lab Number: L2123480
Report Date: 05/21/21

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2123480-01	WELL 2 (420-196710-1)	DW	Not Specified	05/05/21 13:20	05/06/21
L2123480-02	WELL 2 FIELD BLANK (420-196710-2)	FIELD REAGENT BLANK	Not Specified	05/05/21 13:20	05/06/21
L2123480-03	WELL 4 (420-196710-3)	DW	Not Specified	05/05/21 12:50	05/06/21
L2123480-04	WELL 4 FIELD BLANK (420-196710-4)	FIELD REAGENT BLANK	Not Specified	05/05/21 12:50	05/06/21
L2123480-05	WELL 5 (420-196710-5)	DW	Not Specified	05/05/21 13:05	05/06/21
L2123480-06	WELL 5 FIELD BLANK (420-196710-6)	FIELD REAGENT BLANK	Not Specified	05/05/21 13:05	05/06/21
L2123480-07	WELL 6 (420-196710-7)	DW	Not Specified	05/05/21 13:25	05/06/21
L2123480-08	WELL 6 FIELD BLANK (420-196710-8)	FIELD REAGENT BLANK	Not Specified	05/05/21 13:25	05/06/21
L2123480-09	WELL 7 (420-196710-9)	DW	Not Specified	05/05/21 12:45	05/06/21
L2123480-10	WELL 7 FIELD BLANK (420-196710-10)	FIELD REAGENT BLANK	Not Specified	05/05/21 12:45	05/06/21

Project Name: VRI-LEWISBORO/OAKRIDGE DW
Project Number: 42002044

Serial_No:05212110:24
Lab Number: L2123480
Report Date: 05/21/21

SAMPLE RESULTS

Lab ID: L2123480-01
Client ID: WELL 2 (420-196710-1)
Sample Location: Not Specified

Date Collected: 05/05/21 13:20
Date Received: 05/06/21
Field Prep: Not Specified

Sample Depth:

Matrix: Dw
Analytical Method: 133,537.1
Analytical Date: 05/14/21 18:50
Analyst: LV

Extraction Method: EPA 537.1
Extraction Date: 05/14/21 11:05

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by EPA 537.1 - Mansfield Lab						
Perfluorooctanoic Acid (PFOA)	10.2		ng/l	1.89	0.632	1
Perfluorooctanesulfonic Acid (PFOS)	13.9		ng/l	1.89	0.632	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro-n-[1,2-13C2]hexanoic Acid (13C-PFHxA)	89		70-130
Tetrafluoro-2-heptafluoropropoxy-[13C3]-propanoic acid (13C3-HFPO-DA)	74		70-130
Perfluoro-n-[1,2-13C2]decanoic Acid (13C-PFDA)	81		70-130
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	87		70-130

Project Name: VRI-LEWISBORO/OAKRIDGE DW
Project Number: 42002044

Serial_No:05212110:24
Lab Number: L2123480
Report Date: 05/21/21

SAMPLE RESULTS

Lab ID: L2123480-03
Client ID: WELL 4 (420-196710-3)
Sample Location: Not Specified

Date Collected: 05/05/21 12:50
Date Received: 05/06/21
Field Prep: Not Specified

Sample Depth:

Matrix: Dw
Analytical Method: 133,537.1
Analytical Date: 05/14/21 19:07
Analyst: LV

Extraction Method: EPA 537.1
Extraction Date: 05/14/21 11:05

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
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Perfluorinated Alkyl Acids by EPA 537.1 - Mansfield Lab

Perfluorooctanoic Acid (PFOA)	7.26		ng/l	1.92	0.642	1
Perfluorooctanesulfonic Acid (PFOS)	5.38		ng/l	1.92	0.642	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro-n-[1,2-13C2]hexanoic Acid (13C-PFHxA)	97		70-130
Tetrafluoro-2-heptafluoropropoxy-[13C3]-propanoic acid (13C3-HFPO-DA)	80		70-130
Perfluoro-n-[1,2-13C2]decanoic Acid (13C-PFDA)	93		70-130
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	89		70-130

Project Name: VRI-LEWISBORO/OAKRIDGE DW
Project Number: 42002044

Serial_No:05212110:24
Lab Number: L2123480
Report Date: 05/21/21

SAMPLE RESULTS

Lab ID: L2123480-05
Client ID: WELL 5 (420-196710-5)
Sample Location: Not Specified

Date Collected: 05/05/21 13:05
Date Received: 05/06/21
Field Prep: Not Specified

Sample Depth:

Matrix: Dw
Analytical Method: 133,537.1
Analytical Date: 05/14/21 19:25
Analyst: LV

Extraction Method: EPA 537.1
Extraction Date: 05/14/21 11:05

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by EPA 537.1 - Mansfield Lab						
Perfluorooctanoic Acid (PFOA)	8.95		ng/l	1.83	0.610	1
Perfluorooctanesulfonic Acid (PFOS)	4.97		ng/l	1.83	0.610	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro-n-[1,2-13C2]hexanoic Acid (13C-PFHxA)	88		70-130
Tetrafluoro-2-heptafluoropropoxy-[13C3]-propanoic acid (13C3-HFPO-DA)	74		70-130
Perfluoro-n-[1,2-13C2]decanoic Acid (13C-PFDA)	94		70-130
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEIFOSAA)	94		70-130

Project Name: VRI-LEWISBORO/OAKRIDGE DW
Project Number: 42002044

Serial_No:05212110:24
Lab Number: L2123480
Report Date: 05/21/21

SAMPLE RESULTS

Lab ID: L2123480-07
Client ID: WELL 6 (420-196710-7)
Sample Location: Not Specified

Date Collected: 05/05/21 13:25
Date Received: 05/06/21
Field Prep: Not Specified

Sample Depth:

Matrix: Dw
Analytical Method: 133,537.1
Analytical Date: 05/14/21 19:42
Analyst: LV

Extraction Method: EPA 537.1
Extraction Date: 05/14/21 11:05

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
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Perfluorinated Alkyl Acids by EPA 537.1 - Mansfield Lab

Perfluorooctanoic Acid (PFOA)	9.06		ng/l	1.84	0.615	1
Perfluorooctanesulfonic Acid (PFOS)	12.7		ng/l	1.84	0.615	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro-n-[1,2-13C2]hexanoic Acid (13C-PFHxA)	95		70-130
Tetrafluoro-2-heptafluoropropoxy-[13C3]-propanoic acid (13C3-HFPO-DA)	79		70-130
Perfluoro-n-[1,2-13C2]decanoic Acid (13C-PFDA)	99		70-130
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEIFOSAA)	110		70-130

Project Name: VRI-LEWISBORO/OAKRIDGE DW
Project Number: 42002044

Serial_No:05212110:24
Lab Number: L2123480
Report Date: 05/21/21

SAMPLE RESULTS

Lab ID: L2123480-09
Client ID: WELL 7 (420-196710-9)
Sample Location: Not Specified

Date Collected: 05/05/21 12:45
Date Received: 05/06/21
Field Prep: Not Specified

Sample Depth:
Matrix: Dw
Analytical Method: 133,537.1
Analytical Date: 05/14/21 20:00
Analyst: LV

Extraction Method: EPA 537.1
Extraction Date: 05/14/21 11:05

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by EPA 537.1 - Mansfield Lab						
Perfluorooctanoic Acid (PFOA)	10.1		ng/l	1.82	0.609	1
Perfluorooctanesulfonic Acid (PFOS)	3.98		ng/l	1.82	0.609	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro-n-[1,2-13C2]hexanoic Acid (13C-PFHxA)	96		70-130
Tetrafluoro-2-heptafluoropropoxy-[13C3]-propanoic acid (13C3-HFPO-DA)	78		70-130
Perfluoro-n-[1,2-13C2]decanoic Acid (13C-PFDA)	94		70-130
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	91		70-130

ANALYTICAL REPORT

Job Number: 420-190968-1

Job Description: VRI - Lewisboro/Oakridge 5918395 DW

For:

VRI Environmental Services

PO Box 943

Millbrook, NY 12545

Attention: Melissa Toro

Signature

Debra Bayer

Customer Service Manager

dbayer@envirotestlaboratories.com

02/28/2021

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EnviroTest Laboratories, Inc. Certifications and Approvals: NYSDOH 10142, NJDEP NY015, CTDOH PH-0554

Envirotest Laboratories

315 Fullerton Avenue, Newburgh, NY 12550

Tel (845) 562-0890 Fax (845) 562-0841 www.envirotestlaboratories.com



ANALYTICAL REPORT

Lab Number:	L2107123
Client:	Envirotest Laboratories Inc. 315 Fullerton Avenue Newburgh, NY 12550
ATTN:	Debra Bayer
Phone:	(845) 562-0890
Project Name:	VRI-LEWISBORO/OAKRIDGE 5918395
Project Number:	42002044
Report Date:	02/27/21

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Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com



Project Name: VRI-LEWISBORO/OAKRIDGE 5918395
Project Number: 42002044

Lab Number: L2107123
Report Date: 02/27/21

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2107123-01	WELL 6 (420-190968-1)	DW	Not Specified	02/11/21 11:15	02/12/21
L2107123-02	FIELD BLANK (420-190968-2)	FIELD REAGENT BLANK	Not Specified	02/11/21 00:00	02/12/21

Project Name: VRI-LEWISBORO/OAKRIDGE 5918395
Project Number: 42002044

Serial_No:02272119:55
Lab Number: L2107123
Report Date: 02/27/21

SAMPLE RESULTS

Lab ID: L2107123-01
Client ID: WELL 6 (420-190968-1)
Sample Location: Not Specified

Date Collected: 02/11/21 11:15
Date Received: 02/12/21
Field Prep: Not Specified

Sample Depth:

Matrix: Dw
Analytical Method: 133.537.1
Analytical Date: 02/19/21 18:01
Analyst: LV

Extraction Method: EPA 537.1
Extraction Date: 02/19/21 06:55

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by EPA 537.1 - Mansfield Lab						
Perfluorooctanoic Acid (PFOA)	11.4		ng/l	1.97	0.614	1
Perfluorooctanesulfonic Acid (PFOS)	15.5		ng/l	1.97	0.484	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro-n-[1,2-13C2]hexanoic Acid (13C-PFHxA)	103		70-130
Tetrafluoro-2-heptafluoropropoxy-[13C3]-propanoic acid (13C3-HFPO-DA)	93		70-130
Perfluoro-n-[1,2-13C2]decanoic Acid (13C-PFDA)	100		70-130
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	96		70-130

ANALYTICAL REPORT

Job Number: 420-188704-1

Job Description: VRI - Lewisboro/Oakridge 5918395 DW

For:
VRI Environmental Services
PO Box 943
Millbrook, NY 12545

Attention: Melissa Toro

Debra Bayer

Customer Service Manager

dbayer@envirotestlaboratories.com

02/06/2021

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EnviroTest Laboratories, Inc. Certifications and Approvals: NYSDOH 10142, NJDEP NY015, CTDOPH PH-0554

Envirotest Laboratories

315 Fullerton Avenue, Newburgh, NY 12550

Tel (845) 562-0890 Fax (845) 562-0841 www.envirotestlaboratories.com



ANALYTICAL REPORT

Lab Number:	L2101092
Client:	Envirotest Laboratories Inc. 315 Fullerton Avenue Newburgh, NY 12550
ATTN:	Debra Bayer
Phone:	(845) 562-0890
Project Name:	VRI-LEWISBORO/OAKRIDGE 5918395
Project Number:	42002044
Report Date:	01/28/21

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508-822-9300 (Fax) 508-822-3288 800-624-9220 - www.alphalab.com



Project Name: VRI-LEWISBORO/OAKRIDGE 5918395
Project Number: 42002044

Lab Number: L2101092
Report Date: 01/28/21

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2101092-01	WELL 2 (420-188704-1)	DW	Not Specified	01/06/21 13:35	01/08/21
L2101092-02	WELL 4 (420-188704-2)	DW	Not Specified	01/06/21 13:00	01/08/21
L2101092-03	WELL 5 (420-188704-3)	DW	Not Specified	01/06/21 13:10	01/08/21
L2101092-04	WELL 6 (420-188704-4)	DW	Not Specified	01/06/21 13:20	01/08/21
L2101092-05	WELL 7 (420-188704-5)	DW	Not Specified	01/06/21 12:55	01/08/21
L2101092-06	WELL 2 FIELD BLANK (420-188704-6)	FIELD REAGENT BLANK	Not Specified	01/06/21 13:25	01/08/21
L2101092-07	WELL 4 FIELD BLANK (420-188704-7)	FIELD REAGENT BLANK	Not Specified	01/06/21 13:00	01/08/21
L2101092-08	WELL 5 FIELD BLANK (420-188704-8)	FIELD REAGENT BLANK	Not Specified	01/06/21 13:10	01/08/21
L2101092-09	WELL 6 FIELD BLANK (420-188704-9)	FIELD REAGENT BLANK	Not Specified	01/06/21 13:20	01/08/21
L2101092-10	WELL 7 FIELD BLANK (420-188704-10)	FIELD REAGENT BLANK	Not Specified	01/06/21 12:55	01/08/21

Project Name: VRI-LEWISBORO/OAKRIDGE 5918395
Project Number: 42002044

Lab Number: L2101092
Report Date: 01/28/21

SAMPLE RESULTS

Lab ID: L2101092-01 R
Client ID: WELL 2 (420-188704-1)
Sample Location: Not Specified

Date Collected: 01/06/21 13:35
Date Received: 01/08/21
Field Prep: Not Specified

Sample Depth:

Matrix: Dw
Analytical Method: 133,537.1
Analytical Date: 01/12/21 10:53
Analyst: LV

Extraction Method: EPA 537.1
Extraction Date: 01/10/21 10:45

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by EPA 537.1 - Mansfield Lab						
Perfluorooctanoic Acid (PFOA)	6.75		ng/l	1.82	0.569	1
Perfluorooctanesulfonic Acid (PFOS)	9.81		ng/l	1.82	0.449	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro-n-[1,2-13C2]hexanoic Acid (13C-PFHxA)	85		70-130
Tetrafluoro-2-heptafluoropropoxy-[13C3]-propanoic acid (13C3-HFPO-DA)	81		70-130
Perfluoro-n-[1,2-13C2]decanoic Acid (13C-PFDA)	70		70-130
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEFOSAA)	78		70-130

Project Name: VRI-LEWISBORO/OAKRIDGE 5918395
Project Number: 42002044

Serial_No: 01282110:14
Lab Number: L2101092
Report Date: 01/28/21

SAMPLE RESULTS

Lab ID: L2101092-02
Client ID: WELL 4 (420-188704-2)
Sample Location: Not Specified

Date Collected: 01/06/21 13:00
Date Received: 01/08/21
Field Prep: Not Specified

Sample Depth:

Matrix: Dw
Analytical Method: 133.537.1
Analytical Date: 01/12/21 04:07
Analyst: LV

Extraction Method: EPA 537.1
Extraction Date: 01/10/21 10:45

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by EPA 537.1 - Mansfield Lab						
Perfluorooctanoic Acid (PFOA)	7.94		ng/l	1.99	0.622	1
Perfluorooctanesulfonic Acid (PFOS)	3.67		ng/l	1.99	0.490	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro-n-[1,2-13C2]hexanoic Acid (13C-PFHxA)	87		70-130
Tetrafluoro-2-heptafluoropropoxy-[13C3]-propanoic acid (13C3-HFPO-DA)	94		70-130
Perfluoro-n-[1,2-13C2]decanoic Acid (13C-PFDA)	70		70-130
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEFOSAA)	79		70-130

Project Name: VRI-LEWISBORO/OAKRIDGE 5918395
Project Number: 42002044

Serial_No:01282110:14
Lab Number: L2101092
Report Date: 01/28/21

SAMPLE RESULTS

Lab ID: L2101092-03
Client ID: WELL 5 (420-188704-3)
Sample Location: Not Specified

Date Collected: 01/06/21 13:10
Date Received: 01/08/21
Field Prep: Not Specified

Sample Depth:

Matrix: Dw

Extraction Method: EPA 537.1

Analytical Method: 133,537.1
Analytical Date: 01/12/21 04:15
Analyst: LV

Extraction Date: 01/10/21 10:45

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by EPA 537.1 - Mansfield Lab						
Perfluorooctanoic Acid (PFOA)	6.13		ng/l	1.85	0.576	1
Perfluorooctanesulfonic Acid (PFOS)	4.51		ng/l	1.85	0.454	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro-n-[1,2-13C2]hexanoic Acid (13C-PFHxA)	78		70-130
Tetrafluoro-2-heptafluoropropoxy-[13C3]-propanoic acid (13C3-HFPO-DA)	69	Q	70-130
Perfluoro-n-[1,2-13C2]decanoic Acid (13C-PFDA)	95		70-130
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	82		70-130

Project Name: VRI-LEWISBORO/OAKRIDGE 5918395
Project Number: 42002044

Serial No: 01282110:14
Lab Number: L2101092
Report Date: 01/28/21

SAMPLE RESULTS

Lab ID: L2101092-04
Client ID: WELL 6 (420-188704-4)
Sample Location: Not Specified

Date Collected: 01/06/21 13:20
Date Received: 01/08/21
Field Prep: Not Specified

Sample Depth:

Matrix: Dw
Analytical Method: 133.537.1
Analytical Date: 01/12/21 04:24
Analyst: LV

Extraction Method: EPA 537.1
Extraction Date: 01/10/21 10:45

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by EPA 537.1 - Mansfield Lab						
Perfluorooctanoic Acid (PFOA)	8.12		ng/l	1.82	0.568	1
Perfluorooctanesulfonic Acid (PFOS)	13.5		ng/l	1.82	0.448	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro-n-[1,2-13C2]hexanoic Acid (13C-PFHxA)	88		70-130
Tetrafluoro-2-heptafluoropropoxy-[13C3]-propanoic acid (13C3-HFPO-DA)	84		70-130
Perfluoro-n-[1,2-13C2]decanoic Acid (13C-PFDA)	75		70-130
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	103		70-130

Project Name: VRI-LEWISBORO/OAKRIDGE 5918395
Project Number: 42002044

Serial_No:01282110:14
Lab Number: L2101092
Report Date: 01/28/21

SAMPLE RESULTS

Lab ID: L2101092-05 R
Client ID: WELL 7 (420-188704-5)
Sample Location: Not Specified

Date Collected: 01/06/21 12:55
Date Received: 01/08/21
Field Prep: Not Specified

Sample Depth:

Matrix: Dw
Analytical Method: 133,537.1
Analytical Date: 01/12/21 11:11
Analyst: LV

Extraction Method: EPA 537.1
Extraction Date: 01/10/21 10:45

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by EPA 537.1 - Mansfield Lab						
Perfluorooctanoic Acid (PFOA)	7.98		ng/l	1.80	0.561	1
Perfluorooctanesulfonic Acid (PFOS)	4.06		ng/l	1.80	0.442	1

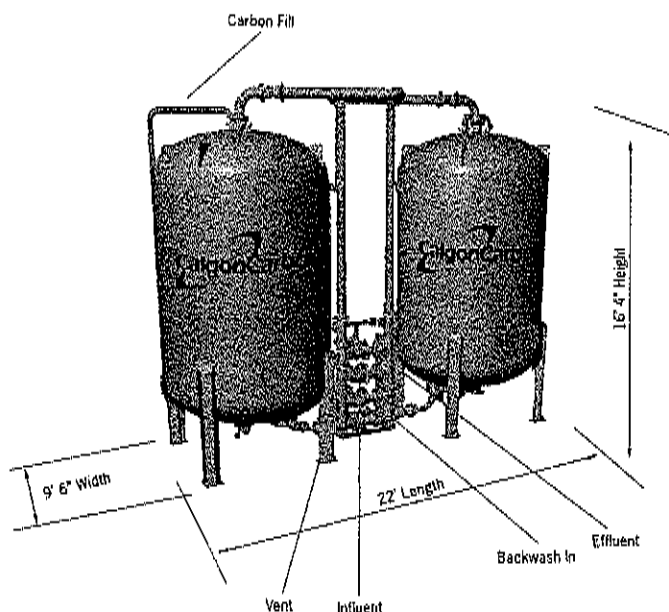
Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro-n-[1,2-13C2]hexanoic Acid (13C-PFHxA)	87		70-130
Tetrafluoro-2-heptafluoropropoxy-[13C3]-propanoic acid (13C3-HFPO-DA)	75		70-130
Perfluoro-n-[1,2-13C2]decanoic Acid (13C-PFDA)	72		70-130
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	77		70-130

APPENDIX C

Town of Lewisboro
Oakridge Water District
GAC Filter Equipment

MODEL 8

Modular Carbon Adsorption System



Description

The Calgon Carbon Model 8 is an adsorption system designed for the removal of dissolved organic compounds from water or other liquids using granular activated carbon. The modular design concept allows for selection of options or alternate materials to best meet the requirements of the site and treatment application.

The Model 8 system is delivered as two adsorbers and a separate compact center piping network and interconnecting piping requiring minimal space and field assembly. The pre-engineered Model 8 design assures that adsorption system functions can be performed with the system as provided. The design has the benefit of Calgon Carbon's extensive expertise and has been proven in numerous applications. The engineering package can be provided quickly and the system expedited through Calgon Carbon's production capabilities.

The process piping network for the Model 8 offers operation of the two adsorbers in parallel or two-stage series flow, with either adsorber in the lead position. The piping can also isolate either adsorber for carbon exchange or backwash operations, while maintaining flow through the other adsorber. In addition, the Calgon Carbon underdrain design provides for efficient use of the carbon through uniform collection of water at the bottom of the bed; and even distribution of backwash water to minimize carbon bed disturbance.

The Model 8 system is designed for use with Calgon Carbon's closed loop carbon exchange service. Using specially designed carbon transport trailers, the spent carbon can be removed from the adsorber via a pressurized carbon-water slurry; and fresh carbon refilled in the same manner. This closed loop transfer is accomplished without exposure of personnel to either spent or fresh carbon. Calgon Carbon can also manage the disposition of the spent carbon. It is typically returned to Calgon Carbon for reactivation, avoiding the need for the site to arrange for disposal.

Carbon Adsorbers

MODEL 8

Carbon steel ASME code stamped pressure vessels

Internal vinyl ester lining (25-35 mils) to protect carbon steel surfaces

Suitable for potable water and most liquid applications

Internal underdrain with stainless steel slotted septa for water collection and backwash distribution

Standard Adsorption System Piping

Schedule 40 carbon steel piping with cast iron fittings

Cast iron or steel wafer butterfly valves in process piping

Polypropylene lined steel pipe for resin discharge pipe

Full bore stainless steel ball valves for resin and discharge piping

Pressure gages to measure pressure drop across system and each adsorber

Rupture discs open to each vessel for emergency pressure relief

System External Coating

High solids epoxy paint system

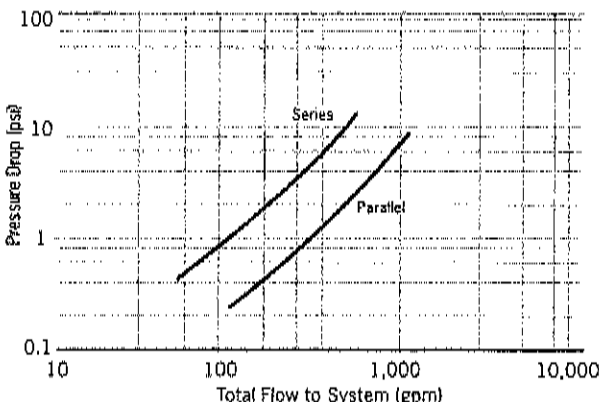
Typical System Options

In-bed water sample collection probes

System skid, shipped separately, upon which system components can be assembled

Pressure Drop Curve

F300 Carbon, 55°F, 4" Steel Pipe



Dimensions and Field Conditions	MODEL 8
Adsorber Vessel Diameter	8 ft (2,440 mm)
Process and Backwash Piping	6" (4" option)
Influent/Effluent Connections	6" 125# ANSI flange
Backwash/Vent Connections	6" 125# ANSI flange
Utility Water Connection	3/4" hose connection
Utility Air Connection	3/4" hose connection
Carbon Hose Connections	4" Kamlock type
Adsorber Side Manway	20" round flanged with davit
Adsorber Shipping Weight	16,000 lbs empty (7,300 kg)
System Operating Weight	92,000 lbs (41,800 kg)

Operating Conditions	MODEL 8
Carbon per Adsorber	10,000 lbs (9,080 kg)
Pressure Rating	125 psig (862 kPa)
Temperature Rating	150 deg F max (65°C)
Pressure Relief	Graphite rupture disc
Backwash Rate	Typical 500 gpm (25% expansion)
Carbon Transfer	Air pressurized slurry transfer
Utility Air	100 scfm at 30 psig (reduce to 15 psig for trailer)
Utility Water	100 gpm at 30 psig
Freeze Protection	None provided; enclosure or protection recommended

Calgon Carbon Systems and Services

The Model 8 system is designed for a variety of higher pressure water or process liquid applications at moderate flowrates. Calgon Carbon Corporation offers a wide range of carbon adsorption systems and services for a range of water or liquid flow rates and carbon usages to meet specific applications.

Calgon Carbon also provides additional services for support of water treatment systems, including supply of virgin and reactivated grades of granular activated carbon, or exchange of carbon in the treatment system, including disposal or reactivation of the spent activated carbon.

Safety Message

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable federal and state requirements. Please refer to the MSDS for all up to date product safety information.



Making Water and Air Safer and Cleaner

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Your local representative

Model 12-40 Adsorption System for use with Granular Activated Carbon

PART 1 General

1.01 Section Includes

- A. Adsorption System Description
- B. Adsorption System Specifications
- C. Installation and Start-up Services

1.02 References

- A. ASME Section VIII, Division 1 – American Society of Mechanical Engineers Boiler and Pressure Vessel Code
- B. ASME/ANSI B16.5 – American Society of Mechanical Engineers/American National Standard Institute
- C. U.S. Food and Drug Administration, 21 CFR 175.300 and 177.2420
- D. Steel Structures Painting Council Surface preparation Specifications and National Association of Corrosion Engineers
- E. ASME Section II, American Society of Mechanical Engineers – Materials, Parts A, B & C
- F. American Society of Testing Materials (ASTM)
- G. American Water Works Association (AWWA) – B604, Standard for Granular Activated Carbon
- H. ANSI/NSF Standard Drinking Water System Components – Health Effects

1.03 System Description

- A. Calgon Carbon Corporation will furnish the Model 12-40 Carbon Adsorption System described herein (for installation by others). The complete adsorption system includes the following.
 - a. Carbon adsorbers with internals for carbon retention
 - b. Activated carbon
 - c. Influent, effluent and backwash piping with valves
 - d. Carbon fill and discharge piping with valves
 - e. Vent and pressure relief piping
 - f. Water piping and utility connections
 - g. Accessories as shown below
 - h. Manufacturer's services
- B. The vessels, piping, valves, and carbon function as a system and are the end products of Calgon Carbon Corporation to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.
- C. There will be one (1) Model 12-40 carbon adsorption system as delineated below:

System Number	Quantity	System Flow Rate GPM ¹ (EBCT –minutes)	Pressure Drop – Normal Operation PSI	Pressure Drop Backwash Operation PSI
1	One (1)	700 (30)	10 -12	20

¹ The maximum flow rate through the system is set by the Empty Bed Contact Time (EBCT) required to meet the treatment objective of the specific application, the mechanical design and available pressure drop.

1.04 Supplier's Qualifications

- A. Supplier of the adsorption system shall have the following minimum qualifications:
 - a. At least 20 years of experience successfully supplying both adsorption systems and GAC to treat water with flow rates greater than 500 gpm average daily flow.
 - b. Must own and operate an equipment fabrication facility with capabilities to both fabricate the equipment per applicable ASME code and finish lining and paint in a single facility.
 - c. Must own and operate at least two (2) GAC production facilities in the United States to guarantee the source of supply of activated carbon.

1.05 Submittals

- A. One submittal package with the following information will be provided for approval by the Owner. Fabrication will begin upon receipt of Owner's approval.
 - a. Adsorber vessel specifications and drawing including design pressure, dimensions, and capacity.
 - b. System flow diagram showing all valves, components, instrumentation and utilities.
 - c. System general arrangement showing dimensions, weights, and elevations including influent, effluent, backwash, and carbon exchange pipe connection locations.
 - d. Pressure drop information across the system.
 - e. Specification of the granular activated carbon to be utilized in the system.
 - f. Material specifications for pipe, fittings and instrumentation.
 - g. Specifications for vessel lining.
 - h. Specifications for vessel painting.
- B. The system Operating & Maintenance Manual will be provided upon completion of the project/shipment of the system.

PART 2 Products

2.01 General

- A. The Contract Documents indicate specific required features of the equipment, but do not purport to cover all details of design and construction.

2.02 Carbon Adsorber Vessels

- A. The carbon adsorbers are **Model 12-40 Carbon Adsorption Vessels**, as designed by Calgon Carbon Corporation to meet the following specifications.
- B. The carbon adsorber vessels are fabricated of carbon steel, conforming to ASTM A516 grade 70, 12'-0" diameter by 16'-0" straight side height with 2:1 elliptical top and bottom heads. Each vessel will be sized to contain 40,000 pounds of GAC and to accommodate approximately 30% bed expansion within the straight side of the vessel using Filtrasorb 400AR GAC². The vessels are designed, constructed and stamped in accordance with ASME Section VIII, Division 1 and registered with the National Board for a design pressure rating of 125 psig at 140°F. Each vessel will be provided with one (1) 20" diameter round manway located on the lower straight side portion of the vessel and one 14" x18" elliptical manway located on the bottom head. The vessels will be free standing utilizing four (4) structural steel support legs. The vessel will be provided with four (4) lift lugs located on the top head and one tailing lug on the bottom head.

² The percent bed expansion will vary depending on the apparent density of the GAC selected for a specific application.

- C. The structural aspects of the vessel will be sufficient to meet the International Building Code - IBC 2012 requirements of $S_s = 1.5$, Site Class D, $I = 1.25$. Calgon Carbon Corporation can submit detailed calculations on request illustrating the seismic characteristics of the proposed vessel.
- D. Each vessel will be designed with an underdrain system that provides uniform distribution of the treated water using a minimum of one (1) septa nozzle for every nominal square foot of vessel cross section, facilitates GAC removal without the need to open the manway to manually hose out the remaining spent GAC, and allows replacement of the septa without the need to remove external piping. The septa will be designed to contain the GAC within the adsorber and be constructed of polypropylene (pp) material.
- E. The vessel will be provided with the following nozzles:
 - a. One (1) 4" nozzle on the top head of the vessel for GAC fill.
 - b. Two (2) nozzles for GAC discharge. One (1) 6" GAC discharge nozzle is located on the vessel side wall and one (1) 4" centered on the bottom head.
 - c. One (1) 8" influent nozzle located on the top head constructed of stainless steel and provided with an internal flange to support the inlet distributor.
 - d. One (1) 8" effluent nozzle located on the bottom head.
 - e. Three (3) 2" sample nozzles located on the side wall.
 - f. One (1) 2" cone vent nozzle located on the lower side wall
- F. All surfaces will be degreased prior to sandblasting. The adsorber internal surface that will be lined will be blasted to a white metal finish (SSPC-SP5) to provide a 3 to 4 mil anchor pattern. The exterior surfaces of the adsorber will be prepared by blasting per SSPC-SP7.
- G. The interior surfaces of the vessel will be lined. The surfaces above the internal cone with a nominal lining thickness of 35 to 45 mil dry film (dft) and the surfaces under the internal cone bottom a nominal lining thickness of 10 to 12 mil dft. The lining material is a vinyl ester combined with a special curing system and inert flake pigment that meets the requirements of the U. S. Federal Register, Food and Drug Regulations Title 21, Paragraphs 175.300 and 177.2420 and the requirements of ANSI 61 when applied and cured per the manufacturer's requirements.
- H. The exterior surface of the adsorbers will be painted to a dry film thickness of 5 to 7 mil with a high solids epoxy (gray color) paint material.

2.03 Process and Utility Piping

- A. The process and utility piping on the adsorption system will include influent water to the system, treated water (effluent), backwash water supply and discharge, adsorber vent lines and granular activated carbon fill and discharge piping.
- B. The influent and effluent pipe network allows series (lead/lag) and parallel only operating modes. Lead/lag operation allows either; a) flow from the influent flange, to Adsorber A, to the pipe module, to Adsorber B, to the pipe module then to the effluent flange, or b) flow from the influent flange, to Adsorber B, to the pipe module, to Adsorber A, to the pipe module then to the effluent flange. The change in flow pattern is accomplished with a change of valve positions. The purpose of lead/lag operation allows an adsorber to act as an on-line backup and/or provides for sufficient contact time to allow adsorption of the contaminants of concern.
- C. Process piping (influent, effluent and backwash) will be 8" diameter, constructed of schedule 40 carbon steel, ASTM A53 Grade B materials with 125# ASTM A126 Class B cast iron flanged fittings.
- D. Vent piping will be 3" diameter, constructed of schedule 40 carbon steel, ASTM A53 Grade B materials.

- E. Carbon fill piping will be 4" diameter, constructed of schedule 40 carbon steel, ASTM A53 Grade B materials.
- F. Carbon discharge piping will be 4" diameter, constructed of schedule 40 polypropylene lined carbon steel, ASTM 53 Grade B materials with ppl lined flanged fittings. The connection at the vessel side wall will be a 4"x 6" ppl lined fitting. There are a total of two (2) GAC discharge lines per vessel.
- G. The vessel must be designed with an adjustable GAC removal system to allow for removal of the spent in 20,000 lb increments.
- H. Utility piping will be constructed of threaded schedule 80 carbon steel, ASTM 53 Grade B materials.
- I. All piping surfaces will be prepared by blasting per SSPC-SP7.
- J. The exterior surface of the piping will be painted to a dry film thickness of 5 to 7 mil with a high solids epoxy (gray color) paint material prior to assembly to ensure minimum oxidation at flanged connections.
- K. The piping network will be provided with a structural steel support frame for support of the piping module.

2.04 Process and Utility Valves

- A. The process and utility piping, excluding GAC fill and discharge piping will be equipped with butterfly valves for flow control. A total of ten (10) 8" diameter butterfly valves will be supplied to accommodate the process and backwash control functions. Two (2) valves are needed for backwash control, two (2) valves are needed for influent isolation, two (2) valves for effluent isolation, two (2) valve for staging of the vessels and two (2) valves for the vent function.
- B. The influent, effluent, and backwash control valves will be a cast iron wafer type body butterfly valve with aluminum-bronze disc, BUNA-N seats and stainless steel shaft to mate to 150 pound ANSI flanges. The valves are rated for 200 psig in closed position at 180°F, and meet or exceed section 5.0 of AWWA specification C-504-87.
- C. The carbon fill and discharge valves are 4" diameter full port ball valves, 316 stainless steel construction with TFE seats and seals. A total of four (4) valves are supplied, two (2) for carbon fill and two (2) for carbon discharge.
- D. Utility valves for the compressed air supply will be bronze or brass or barstock brass body regular port ball valves.

2.05 Instrumentation

- A. Instrumentation will be accessible from grade.
- B. Pressure relief will be provided by a 3" rupture disk constructed of impervious graphite and designed to relieve pressure at the design pressure of the vessel and at the maximum flow to the system. The rupture disks will be mounted off the vessel vent line and vent to atmosphere. A total of two (2) will be provided for the system.
- C. Each vessel will be provided with an indicating differential pressure switch, 4" diameter dial, scaled for 20-0-20psi. The switch is rated at 1.0 amp @ 115 volts AC for remote indication. A total of two (2) will be provided for the system³.
- D. The process piping will be equipped with pressure gauges to indicate the pressure entering and exiting each adsorber and to provide information on pressure drop across each adsorber and the system. The pressure gauges will have 4 1/2" face diameter with a stainless steel bourdon tube in a phenolic case housing (1 to 160 psig range). A total of three (3) will be provided for the system.

³ The dP switches should be wired by the customer to a control system to provide an alarm on high differential pressure.

- E. The process piping will be equipped with sample taps to enable sampling of the water entering and exiting each adsorber. A total of three (3) will be provided for the system.
- 2.06 Miscellaneous
- A. Each vessel will be provided with an inlet distribution system connected to the inlet nozzle consisting of multiple radial arms. Each arm is drilled along its length to facilitate even distribution of water during normal operation and collection of backwash water. The assembly will be constructed using 304 stainless steel.
 - B. The carbon fill and discharge will be fitted with hose connections, such that carbon transfer to and from the adsorbers can be facilitated using carbon transfer hoses. These connectors will be 4" Quick Disconnect Adaptors constructed of aluminum as manufactured by Dover Corp. as Kamlock connectors or equal.
 - C. Two (2) flush connections will be provided on each GAC fill line, one upstream and one downstream of the valve. One (1) flush connection will be provided on each GAC discharge line, downstream of the valve. The connections will be welded into the steel or stainless steel pipe or screwed into solid propylene "spacers" for the lined pipe. Flush connections will consist of a short section of ¾" pipe, a ¾" full port ball valve and a ¾" quick disconnect adaptor to match with water hose fittings.
 - D. Each vessel will be provided with one (1) 8" stainless steel effluent strainer basket mounted in the effluent line from the vessel. The basket strainer shall be constructed of 316 stainless 14 gage plate with 1/8" diameter holes drilled on 3/16" centers, covered with 40 mesh 316 stainless steel screen and topped by a 4 mesh 316 stainless steel support screen (0.063" wire diameter). A total of two (2) will be provided for the system.
 - E. The influent and effluent pipe for each vessel will be provided with a molded neoprene reinforced rubber expansion joint which allows 4 way movement and 30° angular misalignment. A total of four (4) will be provided for the system.
- 2.01 Granular Activated Carbon – 80,000# Total (40,000# per vessel).
- 2.02 Virgin GAC shall be Filtrisorb 400AR as manufactured by Calgon Carbon Corporation or Approved Equal.
- 2.03 The GAC shall be manufactured in the United States of America.
- 2.04 The GAC shall be manufactured by a producer certified for ISO 9001:2000 quality standards and at the specific plant or site holding such certification. A copy of the valid certificate must be submitted with bid. It is understood that ANSI/NSF assures the GAC against toxicological hazards only. ISO 9001:2000 Certification assures the GAC of consistent conformance to stated product quality and standards listed in the specifications.
- 2.05 The GAC shall comply with AWWA B-604 - 96.
- 2.06 The GAC shall comply with NSF 61.
- 2.07 Each vessel shall be supplied with 40,000# Acid Rinsed GAC.
- 2.08 The GAC shall conform to Food Chemical Codex when tested under the conditions of the test outlined in the Food Chemical Codex, Third Edition.
- 2.09 The GAC must be an agglomerated bituminous coal based product with petroleum and coal based pitch binders sized to a granular form prior to baking and activation, broken pellets will not be accepted. Lignite, peat, wood, coconut, sub-bituminous based or direct activated GAC will not be accepted.
- 2.10 The GAC shall be capable of removing turbidity, color, tastes, odors and other organic contamination from previously pretreated by conventional water treatment processes.

- 2.11 Data showing successful application of the GAC in municipal water plants including turbidity and organic contamination shall be submitted with bid.
- 2.12 Bidder shall indicate the source of coal, carbon manufacturing location, the agglomeration/thermal process and capacity of the manufacturing facility. The (Engineer/City) reserve the right to inspect the GAC manufacturing and thermal processing facility.
- 2.13 Product shall be Acid Rinsed (AR) GAC to meet or exceed the following:

<u>Product Specification</u>	<u>Value</u>	<u>Test Method</u>
Iodine Number (mg/g), min.	950	TM-4, ASTM D4607
Moisture, weight %, max.	2	TM-1, ASTM D2867
Effective size, mm	0.55 – 0.75	TM-47, ASTM D2862
Uniformity Coefficient, max.	1.9	TM-47, ASTM D2862
Abrasion No., min.	75	TM-9, AWWA B604
Trace Capacity Number, mg/cc	10	TM-79, TM-85 (converted to TCN)
Screen Size (US Sieve), weight %		
* Larger than No. 12, max.	5.0	TM-8, ASTM D2862
* Smaller than No. 40, max.	4.0	TM-8, ASTM D2862
<u>Typical Property</u>	<u>Value</u>	
Apparent Density, g/cc	0.54	TM-7, ASTM D2862
Ash	10%	TM-5, ASTM D2860
Water Soluble Ash	<1%	AWWA B604
Non-Wettable	<1%	AWWA B604

2.14 GAC Delivery

- The GAC delivery shall be under the direct supervision of the GAC manufacturer's employee, having a minimum of 5 years experience in performing carbon exchanges. Supervision by a third party or agent is not allowed.
- Bidder shall submit resumes of supervisors capable of performing carbon exchanges, indicating qualifications, years of experience and location.
- GAC shall be transported, delivered and placed in a careful manner to exclude all dust, dirt or deleterious material and to prevent physical damage to the particles.
- Before delivery occurs, a Certificate of Analysis shall be provided for the GAC being delivered. Engineer can take random samples of GAC media for analysis to confirm it meets all specification parameters. Tests can be performed on the GAC including, but not limited to, iodine, ash, and apparent density. Failure of the samples to meet the above specifications shall be cause for rejection and the Contractor shall remove such media from the site and provide media that meets specification.
- The preferred method for spent carbon removal is to be completed hydraulically using bulk truck slurry method.
- Bidder shall submit a detailed description for carbon exchange procedures.
- Failure to provide the information requested will be considered non-responsive and the bid rejected.

PART 3 Execution

3.01 Calgon Carbon Services

- A. Calgon Carbon will assign a Project Manager (PM) to facilitate the execution of the project. The PM will interface with the customer for both the technical and commercial aspects of the project.
- B. Calgon Carbon will provide an Engineering Submittal Package as outlined in paragraph 1.05A
- C. Calgon Carbon will supply Operation and Maintenance Instructions upon completion of the project/shipment of the system.
- D. A manufacturer's trained specialists, experienced in the installation of the Calgon Carbon's Adsorption Systems, and with at least five (5) years of field experience will be present at the job site and/or classroom designated by the Owner/Contractor to provide the following services:
 - Inspection of the installed equipment
 - Supervision of carbon loading
 - Start-up assistance
 - Troubleshooting
 - Operator training
- E. Calgon Carbon will retain design and fabrication documentation for a minimum period of seven (7) years following completion of the project.

3.02 Services By Others

- A. The site or designated contractor will be responsible for installation and site services, typically including:
 - 1. Site preparation, foundation design and foundation installation
 - 2. Receipt, off-loading (and storage) of adsorption system equipment
 - 3. Installation of adsorption system equipment
 - 4. Connection of the dP switch to an alarm system
 - 5. Provision of a means to keep the vessel flooded in all operating modes⁴
 - 6. Any hydrostatic test of the installed (assembled) system at the site
 - 7. System connection to existing infrastructure
 - 8. System disinfection prior to initial fill of carbon
 - 9. Utilities for bulk loading of GAC (compressed air, clean water source, backwash water disposal)
 - 10. Operation of the system during carbon fill operation
 - 11. Mechanical startup of the system

⁴ Customer should review piping and determine if an anti-siphon loop is necessary to maintain flooded conditions in the adsorber.

APPENDIX D

Town of Lewisboro
Oakridge Water District
Ion Exchange Treatment Equipment

WATER SOLUTIONS

Treating Drinking Water for PFAS



Purofine® PFA694E

Tackle PFAS Contamination Before it's a Big Problem for Your Treatment Plant.

Purofine PFA694E is a specially developed ion exchange resin with high selectivity for poly- and perfluoroalkyl substances (PFAS) such as PFOA and PFOS. The resin effectively removes contamination and makes public drinking water cleaner and safer.

- 5 to 10 times more capacity for short- & long-chain contaminants than granular activated carbon (GAC)
- Shorter contact time;
1.5 – 3 mins. vs. 10 – 13 mins. for GAC
- Reduced analytical costs
- For use as a primary removal or polishing system
- Compliant with: 41 CFR §173.25–NSF ANSI 61

Purofine PFA694E is a proprietary resin with the dual removal mechanisms of ion exchange and adsorption technology built into each bead for maximum uptake of PFAS. Water treated with this resin will consistently achieve non-detectable levels of both short- and long-chain PFAS—including PFOA and PFOS—that are well below the current Health Advisory recommendations set by the US Environmental Protection Agency and state regulations.

Extensive laboratory and pilot testing conducted by universities in both the United States and Europe has proven the effectiveness of Purofine PFA694E technology for highly effective contaminant removal, ensuring that your system will remain in compliance year after year.

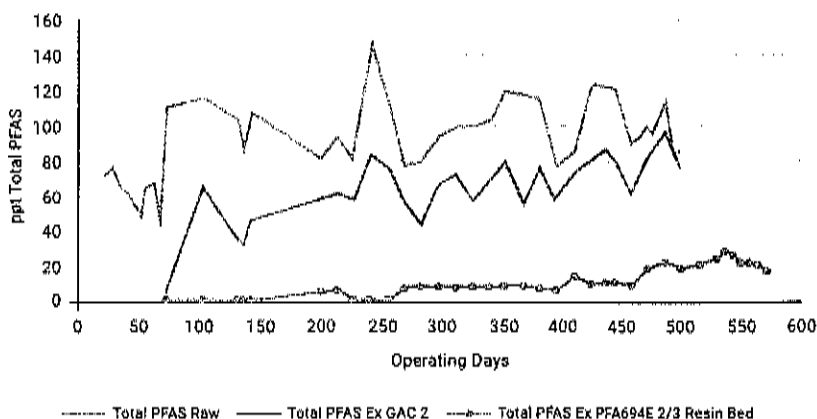
Purofine PFA694E is a robust resin that operates efficiently at higher linear velocities and with shorter contact times than carbon. This translates to lower capital costs for municipal and community water treatment systems as resin has a longer in-service life, requires a smaller system footprint and headspace, and needs less media installed to achieve superior results.

Purofine® PFA694E Resin Performance vs. Granular Activated Carbon

With higher capacity and longer in-service life, Purofine® PFA694E removes more PFAS over a longer period of time before requiring a change-out of the media.

This saves you time and money while enabling you to provide cleaner, safer water to your customers.

Total PFAS Removal
Bituminous GAC vs PFA694E resin



Purolite® Potable Water

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Uzbekistan

Purolite—the leading manufacturer of quality ion exchange, catalyst, adsorbent and specialty high-performance resins—is the only company that focuses 100% of its resources on the development and production of resin technology.

We're ready to solve your process challenges. For further information on Purolite products and services, visit www.purolite.com or contact your nearest Technical Sales Office.

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P-000086-NPOLD-0120-R5-ENG-PCO

APPENDIX E

Town of Lewisboro
Oakridge Water District
Cost Estimates

Project Name: Oakridge PFAS Upgrades

Project# :

Date: 5/26/2021

Prepared By: R. Flores



Delaware Engineering, D.P.C.

Conceptual Cost Opinion Oakridge Water System PFAS GAC Treatment								
ID	Description	Quantity	Units	Materials	Labor	Equipment	Total Unit Cost	Subtotals
1	Site Work							
1.1	Mobilization	1	LS		\$40,000.00		\$40,000.00	\$40,000.00
1.2	Sedimentation and Erosion Control	1	LS	\$1,000.00	\$5,000.00		\$6,000.00	\$6,000.00
1.3	Site Excavation	1	LS		\$40,000.00		\$40,000.00	\$40,000.00
1.4	Yard Piping	1	LS	\$2,000.00	\$60,000.00		\$62,000.00	\$62,000.00
1.5	Restoration	1	LS		\$10,000.00		\$10,000.00	\$10,000.00
								\$158,000.00
2	GAC Building							
2.1	Foundation	1	LS	\$25,000.00	\$25,000.00		\$50,000.00	\$50,000.00
2.2	Slab and Equipment Pad	1	LS	\$10,000.00	\$15,000.00		\$25,000.00	\$25,000.00
2.3	Building	1	LS	\$100,000.00	\$200,000.00		\$300,000.00	\$300,000.00
2.4	Doors and Windows	1	LS	\$20,000.00	\$10,000.00		\$30,000.00	\$30,000.00
								\$405,000.00
3	Piping							
3.1	Process Piping	1	LS	\$45,000.00	\$15,000.00		\$60,000.00	\$60,000.00
3.2	Flow Meter	1	LS	\$3,500.00	\$3,500.00		\$7,000.00	\$7,000.00
3.3	Backflow Preventor	1	LS	\$5,000.00	\$2,000.00		\$7,000.00	\$7,000.00
3.4	Backwash tank and pumps	1	LS	\$40,000.00	\$20,000.00		\$60,000.00	\$60,000.00
3.5	Piping	1	LS	\$20,000.00	\$40,000.00		\$60,000.00	\$60,000.00
3.6	Electrical	1	LS	\$30,000.00	\$30,000.00		\$60,000.00	\$60,000.00
								\$254,000.00
4	GAC Filters							
4.1	20,000 Lbs GAC System	1	LS	\$320,000.00	\$100,000.00	\$10,000.00	\$430,000.00	\$430,000.00
4.2	GA Carbon - Filtrasorb 400	1	LS	\$30,000.00	\$2,500.00		\$32,500.00	\$32,500.00
4.3	Manifold System	1	LS	\$40,000.00	\$10,000.00		\$50,000.00	\$50,000.00
								\$512,500.00
5	Pumps							
5.1	Jockey	1	EA	\$7,000.00	\$5,000.00		\$12,000.00	\$12,000.00
5.2	Booster	2	EA	\$15,000.00	\$15,000.00		\$30,000.00	\$60,000.00
5.3	High Flow	2	EA	\$30,000.00	\$15,000.00		\$45,000.00	\$90,000.00
								\$162,000.00
	Cost Summary							

2021 Construction Cost Subtotal **\$1,491,500.00**

15% Contingency **\$ 224,000.00**

15% Engineering (Preliminary, Design, Construction) **\$ 224,000.00**

Project Costs **\$1,939,500.00**

Project Name: Oakridge PFAS Upgrades

Project# :

Date: 5/26/2021

Prepared By: R. Flores



Delaware Engineering, D.P.C.

Conceptual Cost Opinion Oakridge Water System PFAS Ion Exchange Treatment								
ID	Description	Quantity	Units	Materials	Labor	Equipment	Total Unit Cost	Subtotals
1	Site Work							
1.1	Mobilization	1	LS		\$40,000.00		\$40,000.00	\$40,000.00
1.2	Sedimentation and Erosion Control	1	LS	\$1,000.00	\$5,000.00		\$6,000.00	\$6,000.00
1.3	Site Excavation	1	LS		\$40,000.00		\$40,000.00	\$40,000.00
1.4	Yard Piping	1	LS	\$2,000.00	\$60,000.00		\$62,000.00	\$62,000.00
1.5	Restoration	1	LS		\$10,000.00		\$10,000.00	\$10,000.00
								\$158,000.00
2	Treatmente Building							
2.1	Foundation	1	LS	\$25,000.00	\$25,000.00		\$50,000.00	\$50,000.00
2.2	Slab and Equipment Pad	1	LS	\$10,000.00	\$15,000.00		\$25,000.00	\$25,000.00
2.3	Building	1	LS	\$100,000.00	\$200,000.00		\$300,000.00	\$300,000.00
2.4	Doors and Windows	1	LS	\$20,000.00	\$10,000.00		\$30,000.00	\$30,000.00
								\$405,000.00
3	Piping							
3.1	Process Piping	1	LS	\$45,000.00	\$15,000.00		\$60,000.00	\$60,000.00
3.2	Flow Meter	1	LS	\$3,500.00	\$3,500.00		\$7,000.00	\$7,000.00
3.3	Backflow Preventor	1	LS	\$5,000.00	\$2,000.00		\$7,000.00	\$7,000.00
3.4	Backwash tank and pumps	1	LS	\$40,000.00	\$20,000.00		\$60,000.00	\$60,000.00
3.5	Piping	1	LS	\$20,000.00	\$40,000.00		\$60,000.00	\$60,000.00
3.6	Electrical	1	LS	\$30,000.00	\$30,000.00		\$60,000.00	\$60,000.00
								\$254,000.00
4	Ion Exchange Filters							
4.1	Cartrige Filters	1	LS	\$30,000.00	\$15,000.00		\$45,000.00	\$45,000.00
4.2	Ion Exchange Filters - (2) 4' dim by 8' H	1	LS	\$145,000.00	\$75,000.00		\$220,000.00	\$220,000.00
4.3	Piping	1	LS	\$20,000.00	\$20,000.00		\$40,000.00	\$40,000.00
4.4	Electric and controls	1	LS	\$30,000.00	\$15,000.00		\$45,000.00	\$45,000.00
4.5	Media	1	LS	\$30,000.00			\$30,000.00	\$30,000.00
								\$380,000.00
5	Pumps							
5.1	Jocky	1	EA	\$7,000.00	\$5,000.00		\$12,000.00	\$12,000.00
5.2	Booster	2	EA	\$15,000.00	\$15,000.00		\$30,000.00	\$60,000.00
5.3	High Flow	2	EA	\$30,000.00	\$15,000.00		\$45,000.00	\$90,000.00
								\$162,000.00
	Cost Summary							

2021 Construction Cost Subtotal **\$1,359,000.00**

15% Contingency **\$ 204,000.00**

15% Engineering (Preliminary, Design, Construction) **\$ 204,000.00**

Project Costs **\$1,767,000.00**