ENVIRONMENTAL PARTNERS

MEMORANDUM

Date: March 30, 2020

To Keith Nastasia, DPW Director – Town of Randolph

Chris Pellitteri, DPW Director – Town of Holbrook

From Helen Gordon, PE, BCEE, Adam Kran, PE and Alysa Longo – Environmental Partners

CC John Caruso, Plant Manager – Joint Water Board Water Treatment Plant

Subject Joint Water Board WTP – PFAS Investigations – Alternatives Analysis

Background

Environmental Partners has completed an assessment of several alternative systems for PFAS removal at the Joint Water Board Water Treatment Plant (JWBWTP). The following options were evaluated on the basis of installation cost, effectiveness at removing PFAS, and operations and maintenance costs over a period of four years until the Tri-Town Regional Water Treatment Plan (TTRWTP) is commissioned:

- Silo and slurry eductor powder activated carbon system;
- Big bag unloader and slurry eductor powder activated carbon system;
- Retrofit existing filters with granular activated carbon media;
- Granular activated carbon vessels; and
- Ion exchange resin vessels.

In addition, EP assessed whether each alternative was available for rental or purchase, and identified availability and lead times of each system. A summary of each alternative, our analysis, and an opinion of probable cost is included here for your review. Once you have had an opportunity to review the analysis, we would like to schedule a meeting to discuss the alternatives.

Alternatives Analysis

Purchase a Silo and Slurry Eductor PAC System

Activated carbon is widely used to remove PFAS from drinking water, typically in the form of granular activated carbon (GAC) within pressure vessels. However, where a high removal efficiency is not required powder activated carbon (PAC) has been shown to achieve the necessary levels of PFAS removal. At the JWBWTP, initial PFAS testing in August 2019 detected 26.87 ppt (as the sum of 6 PFAS compounds of interest) at the raw water intake. This is approximately 35% above the current Massachusetts ORSG of 20 ppt (proposed MCL of 20 ppt), requiring a low removal efficiency and indicating that PAC may be an appropriate product to reduce PFAS levels.

EP identified a silo and slurry eductor PAC system which can inject a PAC slurry into the plant's raw water piping, without creating a hazardous, dusty environment for operators. Additionally, operation of this system requires minimal manual labor, includes instrumentation for PAC dose control, and the installation requires minimal plant upgrades. The bulk storage silo is a 36-foot high, 12' diameter, steel skirt-supported tank. The slurry eductor system, installed underneath the silo within its steel skirt, creates a continuous PAC slurry which would be piped to the WTP building and injected prior to the mixing chamber and sedimentation basin. The JWBWTP site presents some challenges to locating a new PAC silo, but for the purposes of this report and opinion of probable cost, it is assumed the silo can be installed next to the existing washwater tank as shown in the attached Figure 1.

A detailed opinion of probable cost for the silo and slurry eductor system is included in Attachment A, with a summary provided in the table below. All costs included in this memo are based on the Fourth Quarter 2019 Turner Building Cost Index of 1177. This alternative has the lowest installation cost, which includes an estimate for engineering design, permitting, and construction administration work.

Table 1: Purchase of Silo & Slurry Eductor PAC System	
Cost of Installation:	$555,730.00
Cost of Operation & Maintenance:	$996,130.00
Total Cost Over Four Years:	**$1,551,860.00**

It should be noted that the opinion of probable cost and recommendation is based on jar testing conducted at the Braintree WTP, which treats water from the same source as the JWBWTP (Great Pond). It is recommended that further jar testing be conducted to confirm the optimal dose and PAC product for the JWBWTP, which will help to finalize the equipment sizing and operation and maintenance cost.

Although the system itself does not require additional labor for the plant staff it will most likely increase the frequency of sedimentation basin cleanings, which require the lagoon be drained down and the entire plant shut down. Currently these cleanings are necessary every ten weeks, and require payment of overtime for additional staff support during the cleaning at off peak (late night hours) flow. Based on the Braintree WTP jar tests, it is anticipated that the installation of the silo and slurry eductor system could require the sedimentation basins be cleaned every five weeks, and the cost of these additional cleanouts are included in the operation and maintenance cost above.

The use of PAC will increase the WTP's residuals production beyond the capacity of the existing lagoon. An estimate of the additional residuals management cost was included in the O&M cost, assuming a minimum of two dewatering geotubes will be required onsite, but further investigation is needed to better determine what additional volume will be produced. Any additional disposal costs would increase the operations and maintenance costs of this alternative.

The silo and eductor system will require eighteen (18) weeks for fabrication and delivery. The estimated installation time upon delivery of the equipment is two weeks. This is assuming the site modifications, including grading and installation of the concrete pad are completed before delivery. The additional installation work required upon delivery includes: lifting the silo into position; assembling the discharge system, ladder, and guardrails; connecting the dry powder system to the slurry system, and; connecting the slurry system to the treatment plant. The slurry system is provided fully fabricated and skid-mounted, ready to be connected via a 1-inch Schedule 80 PVC pipe.

Rent a Big Bag Unloader and Slurry Eductor PAC System

If the Joint Water Board (JWB) is more interested in renting a PAC system for the approximately four years it will be in operation, EP recommends a big bag unloader in place of the silo. The unloader is designed to discharge "supersacs" of PAC, up to two tons in weight. Again, this system eliminates the need for operators to manually add PAC. Instead, the unloader automatically discharges PAC to the slurry eductor system, without compacting the product and without releasing dust. The slurry is then piped to the WTP building and injected prior to the mixing chamber and sedimentation basin. Both the unloader and eductor system would be installed outside of the WTP within a protective shed. Figure 1 identifies potential locations for the system, including above the sedimentation basin. Structural analysis of the existing basin is required to confirm whether it can support the PAC system as well as the loads associated with delivery vehicles.

A detailed opinion of probable cost for renting the system is included in Attachment A, and a summary is provided in the table below. This alternative has one of the lowest operation and maintenance costs and one of the lowest installation costs. The installation cost includes an estimate for engineering design, permitting, and construction administration work.

Table 2: Rent Big Bag Unloader & Slurry Eductor PAC System	
Cost of Installation:	$698,400.00
Cost of Operation & Maintenance:	$960,710.00
Total Cost Over Four Years:	**$1,659,110.00**

Again, jar testing should be conducted to identify an optimal PAC product and dose for PFAS removal. Based on jar testing conducted at the Braintree WTP, a high dose of PAC is expected to be needed to keep PFAS levels below the 20 ppt standard. This will result in increased residuals production and will require more frequent sedimentation basin cleanouts. An estimate of these additional residuals management costs are included in the O&M cost, assuming that sedimentation basin cleanouts are necessary every five weeks and that a minimum of two dewatering geotubes will be required onsite.

Further investigation is needed to better determine what additional volume will be produced, and any additional disposal costs would increase the operations and maintenance costs of this alternative.

Currently, there are no big bag unloader units available. Fabrication and delivery of an unloader and slurry educator system will take 10-12 weeks. Additional work required for installation of this unit includes some site grading, installation of a shed to protect the equipment from weather exposure, and installation of the injection piping to the WTP building. The total estimated installation time after delivery is one week, assuming that the site work and prefabrication of the shed all take place before the system is delivered.

Retrofit Existing Filters with GAC Media

The JWBWTP has eight conventional dual media gravity filters containing carbon, sand, and gravel. The existing carbon in each filter could be removed and replaced with approximately 35 inches of GAC. The addition of the GAC would be sufficient to effectively reduce PFAS during filtration. If MassDEP is willing to allow blending to lower PFAS levels, the JWB can consider replacing the media in only four of the eight filters, and the total opinion of probable cost to retrofit the filters can be reduced by approximately half.

A detailed opinion of probable cost for retrofitting all eight of the filters is attached and a summary is provided in the table below. Retrofitting the filters has one of the lowest installation costs, including an estimate for engineering design, permitting, and construction administration work. The installation cost carries approximately $150,000 for minor underdrain repairs in all eight filters. However, due to the age of the filters it is likely that once the existing media is removed, significant repairs will be required in each of the filters. If these more significant repairs are required, the installation cost could double. This alternative also has the highest operation and maintenance costs over four years of use because the GAC media will reach its PFAS adsorption capacity and require the media be changed out approximately every six months to prevent bleed through.

Table 3: Retrofit 8 Filters with GAC Media	
Cost of Installation:	$922,870.00
Cost of Operation & Maintenance:	$4,235,030.00
Total Cost Over Four Years:	**$5,157,900.00**

This opinion of probable cost assumes that 100% of the WTP's flow will be treated with GAC filters. As a potential alternative, a portion of the flow can be filtered through new GAC media and then blended with flow from the existing filters. If demonstration or pilot testing indicate that blending is a viable method of reducing PFAS levels in the finished water, than the total installation cost and operation and maintenance cost would be lower. Currently, the Braintree WTP is considering retrofitting one of its existing filters with GAC media and running a demonstration test to evaluate whether one GAC filter can provide adequate PFAS removal when blended with effluent from the existing filters.

The media could be delivered within two to three weeks, and the retrofit could begin almost immediately, one filter at a time, without requiring the plant to shut down.

Installation of GAC Vessels

GAC contactor vessels are the most common units being used for PFAS removal for both surface water and groundwater sources. Installed post-filtration, two trains including a lead and a lag vessel would be required to meet the plant's flow and water quality goals. The JWBWTP site presents some challenges to locating these vessels, but for the purposes of this report and opinion of probable cost, it is assumed both trains could be installed above the existing sedimentation basin (as shown in Figure 2), but further structural analysis is required to confirm whether the basin can support the GAC vessels as well as the loads associated with GAC media delivery vehicles.

The GAC vessels can operate without PFAS breakthrough for approximately twice as long as the retrofitted filters. After the initial virgin material is changed out, it can be regenerated offsite and then reused at the plant. Additionally, there is the potential for these vessels to be reused as redundant equipment at the future TTRWTP, although there is more analysis required to confirm this.

These vessels are available for both purchase and rental, with only a $65,000.00 installation cost difference between the two. The installation cost also includes an estimate for engineering design, permitting, and construction administration work for both alternatives. A summary is provided below, with a more detailed opinion of probable cost attached. The vessels have the lowest operation and maintenance cost since they do not require any maintenance work outside of semi-annual backwashes and media replacement approximately every 14 months.

It was assumed that the GAC vessels will require backwashing twice a year. These backwashes will minimally increase the WTP's current residuals production beyond the capacity of the existing lagoon. An estimate of the additional residuals management cost was included in the O&M cost, assuming a minimum of two dewatering geotubes will be required onsite (as shown in Figure 2), but further investigation is needed to better determine what additional volume will be produced. Any added disposal costs would increase the operations and maintenance costs of this alternative. In addition, these vessels require a large amount of process piping to connect to the WTP, as well as expensive wet well and pumping upgrades to intercept the existing filtered water pipeline.

Table 4: Purchase GAC Vessels	
Cost of Installation:	$1,994,160.00
Cost of Operation & Maintenance:	$474,400.00
Total Cost Over Four Years:	**$2,468,560.00**

Table 5: Rent GAC Vessels	
Cost of Installation:	$1,929,160.00
Cost of Operation & Maintenance:	$474,400.00
Total Cost Over Four Years:	**$2,403,560.00**

Vessels for rent are often available immediately, and vessels for purchase can be fabricated in 14 weeks. There is at least one month of work required for curing the concrete pad before installation, and at least one month of work required for the piping modifications and connections to the existing plant after delivery.

Installation of IX Resin Vessels

Ion exchange (IX) resin vessels are similar to the GAC vessels in that they will require similar piping, wet well, and pumping modifications. The resin still requires periodic change outs, but will last almost twice as long as the GAC media and is guaranteed by the resin manufacturer to reduce PFAS levels to 10 ppt or less. However, once the IX resin has experienced breakthrough, it cannot be regenerated. Also, the IX resin system only requires one treatment train, including one lead and one lag vessel. Because the IX resin system has a smaller footprint with only two vessels, it can be located to the west of the existing clearwell or next to the existing washwater tank (Figure 1). Alternatively, the vessels could be installed above the existing sedimentation basin, but further structural analysis is required to confirm whether the basin can support the IX resin vessels and the loads associated with resin delivery vehicles.

These units are available for both rent and purchase. They are the two most expensive alternatives to install, with the additional piping requirements of the permanent system making it more costly than the rental. The installation cost also includes an estimate for engineering design, permitting, and construction administration work for both alternatives. Although the IX resin requires less frequent change outs than GAC media, it is a more expensive material and results in two of the higher operation and maintenance costs over a four year period, with the rental units requiring less maintenance than the permanent system. Similar to the GAC vessels, it was assumed the IX resin vessels will require backwashing approximately twice a year. Backwashing the IX resin vessels will increase the WTP's residuals production beyond the capacity of the existing lagoon, requiring a minimum of two dewatering geotubes onsite. An estimate of the additional residuals management cost was included in the O&M cost, but further investigation is needed to better determine the volume of residuals that will be produced. Any added disposal costs would increase the operations and maintenance costs of this alternative. A summary is provided below, with a more detailed opinion of probable cost attached.

Note that four vessels in two lead-lag trains are included in the purchase option, compared to six lead vessels included in the rental option. This affects both the volume and frequency of resin replacement, as well as the footprint of each option. The rental vessels will be provided in two separate 40-feet long by 8-feet wide trailers, making it more difficult to find a location at the JWBWTP for installation. The only onsite location with adequate space for the two rental trailers is above the existing sedimentation basin, but a structural analysis of the existing tank is required to confirm whether it can support the trailer and media delivery vehicles.

Table 6: Purchase IX Resin Vessels	
Cost of Installation:	$4,530,300.00
Cost of Operation & Maintenance:	$1,452,770.00
Total Cost Over Four Years:	**$5,983,070.00**

Table 7: Rent IX Resin Containers	
Cost of Installation:	$4,330,190.00
Cost of Operation & Maintenance:	$1,163,640.00
Total Cost Over Four Years:	**$5,493,070.00**

The containers for rent are typically available immediately, and vessels for purchase will take 35 weeks to fabricate. There is at least one month of work required for curing the concrete pad before installation, and at least one month of work required after delivery for the piping modifications and connections to the existing treatment plant. There is also potential for these vessels to be reused at the future TTRWTP, although there is more analysis required to confirm this.

Summary

EP ranked each of the alternatives on the basis of installation cost, operations and maintenance costs over a period of four years, and on each system's PFAS reduction effectiveness. The rankings are included below, with number one being the most desirable system and number seven being the least desirable in each given category.

Table 8: Ranking by Installation Cost
1. Purchase silo & slurry eductor PAC system
2. Rent unloader & slurry eductor PAC system
3. Retrofit 8 filters with GAC
4. Rent GAC vessels
5. Purchase GAC Vessels
6. Rent IX resin containers
7. Purchase IX resin vessels

Table 9: Ranking by O&M Cost
1. Purchase *or* Rent GAC vessels
2. Rent unloader & slurry eductor PAC system
3. Purchase silo & slurry eductor PAC system
4. Rent IX resin containers
5. Purchase IX resin vessels
6. Retrofit 8 filters with GAC

Table 10: Ranking by PFAS Reduction Effectiveness
1. Purchase *or* Rent IX resin system
2. Purchase *or* Rent GAC vessels
3. Retrofit 8 filters with GAC
4. Purchase *or* Rent slurry eductor PAC system

To more easily compare the total costs of each alternative, the table below includes installation cost, operation and maintenance costs, and the total costs over four years for each system.

Table 11: Summary of Opinion of Probable Costs			
	Installation	O&M Over 4 Years	**Total**
Purchase silo & slurry eductor PAC system	$555,730.00	$996,130.00	**$1,551,860.00**
Rent big bag unloader & slurry eductor PAC system	$698,400.00	$960,710.00	**$1,659,110.00**
Rent GAC vessels	$1,929,160.00	$474,400.00	**$2,403,560.00**
Purchase GAC vessels	$1,994,160.00	$474,400.00	**$2,468,560.00**
Retrofit 8 filters with GAC	$922,870,00	$4,235,030.00	**$5,157,900.00**
Rent IX resin containers	$4,330,190.00	$1,163,640.00	**$5,493,830.00**
Purchase IX resin vessels	$4,530,300.00	$1,452,770.00	**$5,983,070.00**

In addition to these categories, the pros and cons of each alternative was analyzed and a list is included below.

	Pros	Cons
Purchase silo & slurry eductor PAC system	- Lowest installation cost - Low O&M cost	- Requires high PAC dosage to reduce PFAS - Additional residuals management costs - Requires 18 weeks to fabricate - Increased residuals production will result in more frequent Sedimentation Basin cleanouts and requires dewatering geotubes
Rent unloader & slurry eductor PAC system	- Low installation cost - Low O&M cost	- Requires high PAC dosage to reduce PFAS - Additional residuals management costs - No slurry units are currently available, would require 10-12 weeks to fabricate - Increased residuals production will result in more frequent Sedimentation Basin cleanouts and requires dewatering geotubes
Retrofit 8 filters with GAC	- GAC media is readily available and can be delivered in 2-3 weeks - Filters can be retrofitted & operational sooner than other alternatives - Potential for blending can reduce total costs	- Highest O&M cost
Purchase GAC vessels	- Lowest O&M cost - Media can be regenerated - Can be fabricated in 14 weeks	- High installation cost - Installation will require at least 1-2 months of site work and piping modifications - Increased residuals production will require dewatering geotubes
Rent GAC vessels	- Lowest O&M cost - Media can be regenerated - Units for rent are immediately available	- High installation cost - Installation will require at least 1-2 months of site work and piping modifications - Increased residuals production will require dewatering geotubes
Purchase IX resin vessels	- Can reduce PFAS to below 10 ppt	- Highest installation cost - High O&M cost - Requires 35 weeks to fabricate in addition to at least 1-2 months of site work and piping modifications - Resin cannot be regenerated - Increased residuals production will require dewatering geotubes
Rent IX resin containers	- Can reduce PFAS to below 10 ppt - Units for rent are immediately available	- High installation cost - High O&M cost - Installation will require at least 1-2 months of site work and piping modifications - Resin cannot be regenerated - Increased residuals production will require dewatering geotubes

Conclusions

Upon completing our assessment of interim PFAS reduction systems, EP has identified both pros and cons associated with each proposed alternative. The slurry eductor PAC systems, in combination with the big bag unloader or the silo, may be the most advantageous based on the installation and operations and maintenance costs. However, the additional labor involved in more frequent sedimentation basin cleanings may outweigh those cost savings.

The site constraints and limited capacity for additional residuals management make the addition of dewatering geotubes necessary for almost all alternatives. The installation of these geotubes eliminates some available space for the larger systems such as the GAC or IX resin vessels.

EP recommends that the JWB begin discussions with the Tri-Town Board of Water Commissioners, recommending preliminary investigations into the source of PFAS within Great Pond. Potential identification and remediation of pollutants is always a preference to implementation of treatment processes at municipal water treatment plants. If a source and responsible party can be identified, costs of either remediation or treatment could be assessed against the responsible party.

Once you have had an opportunity to review the analysis and recommendation for a new PFAS removal system, EP would like to schedule a meeting to discuss these alternatives at your earliest convenience.

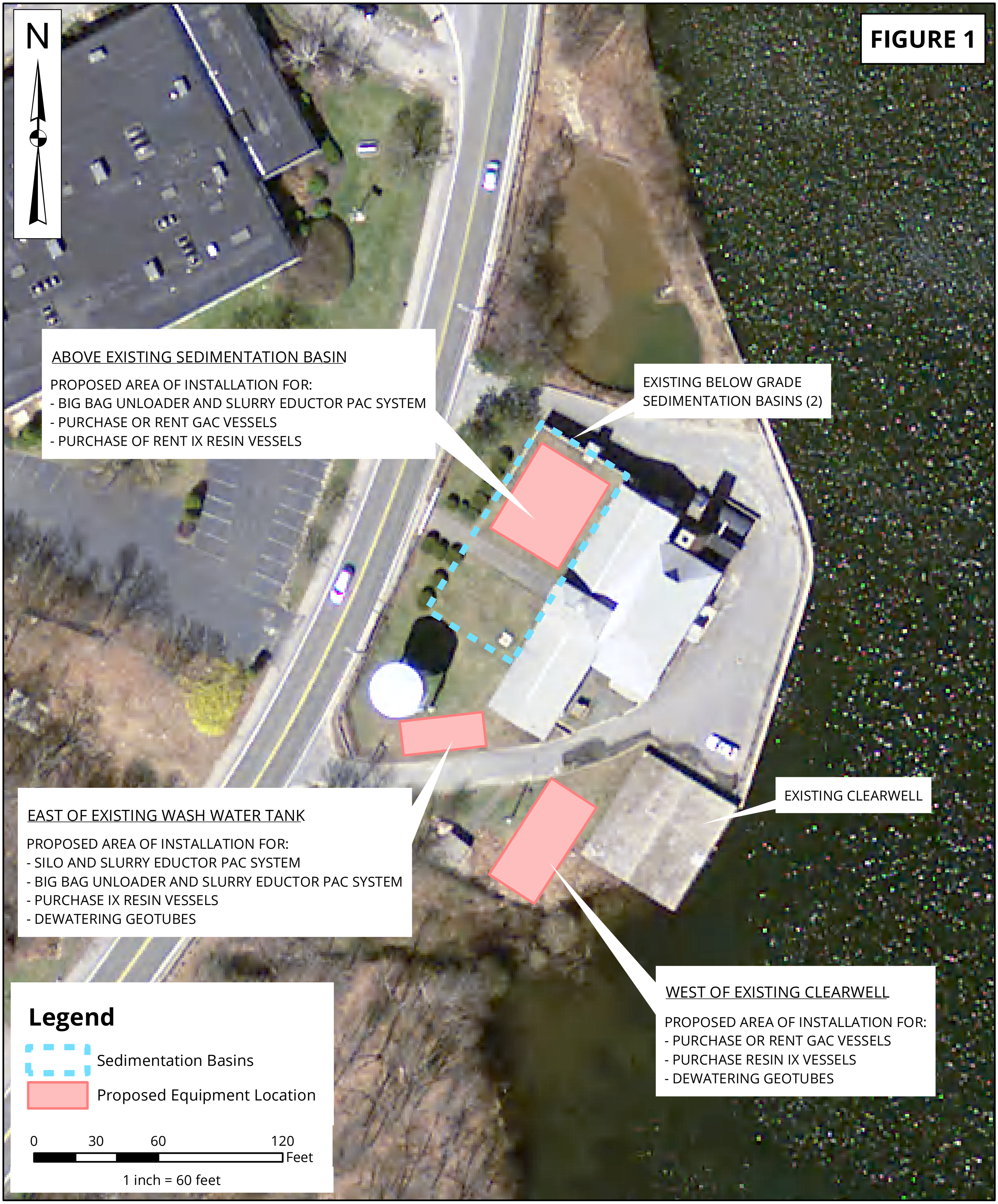
Attachments

Figure 1 – Proposed Area of Installation

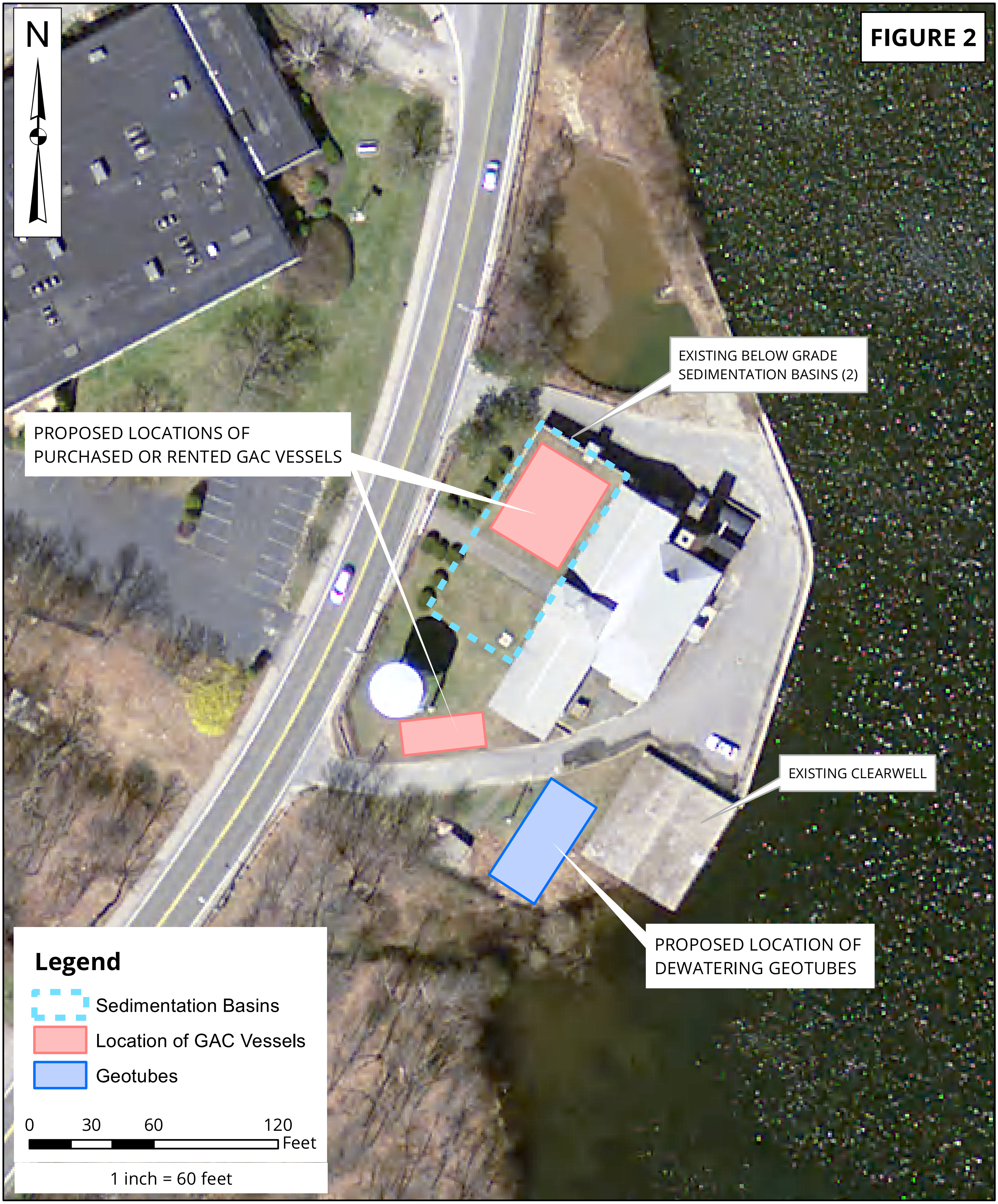
Figure 2 – Proposed Layout of GAC Vessels and Geotubes

Attachment A – Opinion of Probable Costs

Attachment B – Equipment Cut sheets



Proposed Areas of Installation
Randolph/Holbrook Joint Water Board WTP
PFAS Investigation
March 2020



Proposed Layout of GAC Vessels and Geotubes
Randolph/Holbrook Joint Water Board WTP
PFAS Investigation
March 2020

ATTACHMENT A

Opinion of Probable Costs

Randolph/Holbrook Joint Water Board Water Treatment Plant
PFAS Removal System
Engineers Opinion of Probable Cost

Purchase Silo System & Slurry Eductor PAC System						
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost of Installation:						
Silo and Slurry Eductor System	EA	1	$245,100.00	$163,400.00	$81,700.00	$245,100.00
Site Grading	SY	16	$15.00	$10.00	$5.00	$240.00
Equipment Pad	CY	5	$450.00	$300.00	$150.00	$2,250.00
1" Sch. 80 PVC Piping	LF	100	$52.00	$40.00	$12.00	$5,200.00
Pipe Insulation	LF	100	$2.00	$1.00	$1.00	$200.00
Misc. Piping, Fittings, & Appurtenances	LS	1	$5,000.00	$2,500.00	$2,500.00	$5,000.00
Electrical Work	LS	1	$38,500.00	15%		$38,500.00
Instrumentation Wiring and SCADA Programming	LS	1	$25,500.00	10%		$25,500.00
Geotubes	EA	2	$10,000.00	$6,000.00	$4,000.00	$20,000.00
				Subtotal	*$*	*341,990.00*
				30% Contingency	*$*	*102,597.00*
				Installation Subtotal	*$*	*444,587.00*
				25% Engineering [1]	*$*	*111,146.75*
				Total Cost of Installation	***$***	***555,730.00***
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost to Operate:						
Year 1 - Operation & Maintenance[2]	LS	0	$22,000.00	$7,500.00	$14,500.00	$0.00
Year 1 - Powder Activated Carbon	LS	1	$77,450.00	$77,450.00	$0.00	$77,450.00
Year 1 - Residuals Management[3]	LS	1	$111,400.00	$0.00	$111,400.00	$111,400.00
Year 2 - Operation & Maintenance	LS	1	$22,500.00	$7,500.00	$15,000.00	$22,500.00
Year 2 - Powder Activated Carbon	LS	1	$84,300.00	$84,300.00	$0.00	$84,300.00
Year 2 - Residuals Management[3]	LS	1	$115,350.00	$0.00	$115,350.00	$115,350.00
Year 3 - Operation & Maintenance[2]	LS	0	$23,000.00	$7,500.00	$15,500.00	$0.00
Year 3 - Powder Activated Carbon	LS	1	$91,150.00	$91,150.00	$0.00	$91,150.00
Year 3 - Residuals Management[3]	LS	1	$119,300.00	$0.00	$119,300.00	$119,300.00
Year 4 - Operation & Maintenance	LS	1	$23,500.00	$7,500.00	$16,000.00	$23,500.00
Year 4 - Powder Activated Carbon	LS	1	$98,000.00	$98,000.00	$0.00	$98,000.00
Year 4 - Residuals Management[3]	LS	1	$123,250.00	$0.00	$123,250.00	$123,250.00
				Subtotal	*$*	*866,200.00*
				15% Contingency	*$*	*129,930.00*
				Total Cost of Operation	***$***	***996,130.00***

Notes:

1. Cost of Engineering will vary based on the bidding requirements, and may be reduced if the project is bid with an Emergency Waiver.

2. Where the Estimated Cost is $0.00, there are no costs associated with operation, maintenance, or residuals management anticipated for that year.

3. Cost of residuals management due to the addition of PAC is subject to change: current assumption is based on emptying two geotubes each year and doubling the frequency of sedimentation basin cleanouts.

ENVIRONMENTAL PARTNERS

Randolph/Holbrook Joint Water Board Water Treatment Plant
PFAS Removal System
Engineers Opinion of Probable Cost

Rent Unloader & Slurry Eductor PAC System						
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost of Installation:						
PAC Shed	LS	1	$35,000.00	$25,000.00	$10,000.00	$35,000.00
Big Bag Hopper and Slurry Eductor System	EA	1	$258,720.00	$235,200.00	$23,520.00	$258,720.00
1" Sch. 80 PVC Piping	LF	200	$52.00	$40.00	$12.00	$10,400.00
Pipe Insulation	LF	200	$2.00	$1.00	$1.00	$400.00
Equipment Pad	CY	5	$52.50	$35.00	$17.50	$262.50
Electrical Work	LS	1	$60,000.00	20%		$60,000.00
Instrumentation Wiring and SCADA Programming	LS	1	$45,000.00	15%		$45,000.00
Geotubes	EA	2	$10,000.00	$6,000.00	$4,000.00	$20,000.00
				Subtotal	*$*	*429,782.50*
				30% Contingency	*$*	*128,934.75*
				Installation Subtotal	*$*	*558,717.25*
				25% Engineering [1]	*$*	*139,679.31*
				Total Cost of Installation	***$***	***698,400.00***
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost to Operate:						
Year 1 - Operation & Maintenance[2]	LS	0	$7,400.00	$2,500.00	$4,900.00	$0.00
Year 1 - Powder Activated Carbon	LS	1	$77,450.00	$77,450.00	$0.00	$77,450.00
Year 1 - Residuals Management[3]	LS	1	$111,400.00	$0.00	$111,400.00	$111,400.00
Year 2 - Operation & Maintenance	LS	1	$7,500.00	$2,500.00	$5,000.00	$7,500.00
Year 2 - Powder Activated Carbon	LS	1	$84,300.00	$84,300.00	$0.00	$84,300.00
Year 2 - Residuals Management[3]	LS	1	$115,350.00	$0.00	$115,350.00	$115,350.00
Year 3 - Operation & Maintenance[2]	LS	0	$7,600.00	$2,500.00	$5,100.00	$0.00
Year 3 - Powder Activated Carbon	LS	1	$91,150.00	$91,150.00	$0.00	$91,150.00
Year 3 - Residuals Management[3]	LS	1	$119,300.00	$0.00	$119,300.00	$119,300.00
Year 4 - Operation & Maintenance	LS	1	$7,700.00	$2,500.00	$5,200.00	$7,700.00
Year 4 - Powder Activated Carbon	LS	1	$98,000.00	$98,000.00	$0.00	$98,000.00
Year 4 - Residuals Management[3]	LS	1	$123,250.00	$0.00	$123,250.00	$123,250.00
				Subtotal	*$*	*835,400.00*
				15% Contingency	*$*	*125,310.00*
				Total Cost of Operation	***$***	***960,710.00***

Note:

1. *Cost of Engineering will vary based on the bidding requirements, and may be reduced if the project is bid with an Emergency Waiver.*
2. *Where the Estimated Cost is $0.00, there are no costs associated with operation, maintenance, or residuals management anticipated for that year.*
3. *Cost of residuals management due to the addition of PAC is subject to change: current assumption is based on emptying two geotubes each year and doubling the frequency of sedimentation basin cleanouts.*

ENVIRONMENTAL PARTNERS

Randolph/Holbrook Joint Water Board Water Treatment Plant
PFAS Removal System
Engineers Opinion of Probable Cost

Retrofit Filters with GAC						
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost of Installation:						
35" GAC Media	LB	218,785	$1.92	$1.00	$0.92	$420,067.20
Removal and Legal Disposal of Spent Anthracite	CY	35	$510.00	$0.00	$510.00	$17,850.00
Filter Repairs	EA	8	$16,250.00	$12,500.00	$3,750.00	$130,000.00
				Subtotal	*$*	*567,917.20*
				30% Contingency	*$*	*170,375.16*
				Installation Subtotal	*$*	*738,292.36*
				25% Engineering [1]	*$*	*184,573.09*
				Total Cost of Installation	***$***	***922,870.00***
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost to Operate:						
Year 1 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 1 - Spent GAC Media Replacement[3]	LS	1	$499,865.00	$218,785.00	$281,080.00	$499,865.00
Year 2 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 2 - Spent GAC Media Replacement[3]	LS	2	$514,860.95	$225,348.55	$289,512.40	$1,029,721.90
Year 3 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 3 - Spent GAC Media Replacement[3]	LS	2	$530,306.78	$232,109.01	$298,197.77	$1,060,613.56
Year 4 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 4 - Spent GAC Media Replacement[3]	LS	2	$546,215.98	$239,072.28	$307,143.71	$1,092,431.96
				Subtotal	*$*	*3,682,632.42*
				15% Contingency	*$*	*552,394.86*
				Total Cost of Operation	***$***	***4,235,030.00***

Notes:
1. Cost of Engineering will vary based on the bidding requirements, and may be reduced if the project is bid with an Emergency Waiver.
2. Where the Estimated Cost is $0.00, there are no costs associated with operation and maintenance anticipated for that year.
3. Further water quality testing is needed to confirm GAC bed life.

ENVIRONMENTAL PARTNERS

Randolph/Holbrook Joint Water Board Water Treatment Plant
PFAS Removal System
Engineers Opinion of Probable Cost

Purchase New GAC Units						
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost of Installation:						
Site Grading	SY	75	$15.00	$10.00	$5.00	$1,125.00
Wet Well and Filter Effluent Piping Upgrades	LS	1	$150,000.00	$100,000.00	$50,000.00	$150,000.00
Equipment Pad	CY	25	$450.00	$300.00	$150.00	$11,250.00
GAC Filter and Media	EA	4	$181,500.00	$165,000.00	$16,500.00	$726,000.00
Exterior Piping	LS	1	$198,800.00	$152,800.00	$46,000.00	$198,800.00
Electrical Work	LS	1	$70,000.00	$40,000.00	$30,000.00	$70,000.00
Instrumentation Wiring and SCADA Programming	LS	1	$50,000.00	$30,000.00	$20,000.00	$50,000.00
Geotubes	EA	2	$10,000.00	$6,000.00	$4,000.00	$20,000.00
				Subtotal	*$*	*1,227,175.00*
				30% Contingency	*$*	*368,152.50*
				Installation Subtotal	*$*	*1,595,327.50*
				25% Engineering [1]	*$*	*398,831.88*
				Total Cost of Installation	***$***	***1,994,160.00***
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost to Operate:						
Year 1 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 1 - Spent GAC Media Replacement[2]	LS	0	$60,000.00	$45,000.00	$15,000.00	$0.00
Year 1 - Residuals Management[3]	CY	80	$80.00	$0.00	$80.00	$6,400.00
Year 2 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 2 - Spent GAC Media Replacement	LS	2	$61,800.00	$46,350.00	$15,450.00	$123,600.00
Year 2 - Residuals Management[3]	CY	80	$90.00	$0.00	$90.00	$7,200.00
Year 3 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 3 - Spent GAC Media Replacement	LS	2	$63,670.00	$47,750.00	$15,920.00	$127,340.00
Year 3 - Residuals Management[3]	CY	80	$100.00	$0.00	$100.00	$8,000.00
Year 4 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 4 - Spent GAC Media Replacement	LS	2	$65,590.00	$49,190.00	$16,400.00	$131,180.00
Year 4 - Residuals Management[3]	CY	80	$110.00	$0.00	$110.00	$8,800.00
				Subtotal	*$*	*412,520.00*
				15% Contingency	*$*	*61,878.00*
				Total Cost of Operation	***$***	***474,400.00***

Notes:
1. Cost of Engineering will vary based on the bidding requirements, and may be reduced if the project is bid with an Emergency Waiver.
2. Where the Estimated Cost is $0.00, there are no costs associated with operation, maintenance, or media replacement anticipated for that year.
3. Cost of residuals management due to backwashing GAC vessels is subject to change: current assumption is based on emptying two geotubes every year.

ENVIRONMENTAL PARTNERS

Randolph/Holbrook Joint Water Board Water Treatment Plant
PFAS Removal System
Engineers Opinion of Probable Cost

Rent New GAC Units						
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost of Installation:						
Site Grading	SY	75	$15.00	$10.00	$5.00	$1,125.00
Wet Well and Filter Effluent Piping Upgrades	LS	1	$150,000.00	$100,000.00	$50,000.00	$150,000.00
Equipment Pad	CY	25	$450.00	$300.00	$150.00	$11,250.00
GAC Filter System	EA	4	$136,500.00	$120,000.00	$16,500.00	$546,000.00
GAC Media	EA	4	$35,000.00	$25,000.00	$10,000.00	$140,000.00
Exterior Piping	LS	1	$198,800.00	$152,800.00	$46,000.00	$198,800.00
Electrical Work	LS	1	$70,000.00	$40,000.00	$30,000.00	$70,000.00
Instrumentation Wiring and SCADA Programming	LS	1	$50,000.00	$30,000.00	$20,000.00	$50,000.00
Geotubes	EA	2	$10,000.00	$6,000.00	$4,000.00	$20,000.00
					Subtotal	*$ 1,187,175.00*
					30% Contingency	*$ 356,152.50*
					Installation Subtotal	*$ 1,543,327.50*
					25% Engineering [1]	*$ 385,831.88*
					Total Cost of Installation	***$ 1,929,160.00***
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost to Operate:						
Year 1 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 1 - Spent GAC Media Replacement[2]	LS	0	$60,000.00	$45,000.00	$15,000.00	$0.00
Year 1 - Residuals Management[3]	CY	80	$80.00	$0.00	$80.00	$6,400.00
Year 2 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 2 - Spent GAC Media Replacement	LS	2	$61,800.00	$46,350.00	$15,450.00	$123,600.00
Year 2 - Residuals Management[3]	CY	80	$90.00	$0.00	$90.00	$7,200.00
Year 3 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 3 - Spent GAC Media Replacement	LS	2	$63,670.00	$47,750.00	$15,920.00	$127,340.00
Year 3 - Residuals Management[3]	CY	80	$100.00	$0.00	$100.00	$8,000.00
Year 4 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 4 - Spent GAC Media Replacement	LS	2	$65,590.00	$49,190.00	$16,400.00	$131,180.00
Year 4 - Residuals Management[3]	CY	80	$110.00	$0.00	$110.00	$8,800.00
					Subtotal	*$ 412,520.00*
					15% Contingency	*$ 61,878.00*
					Total Cost of Operation	***$ 474,400.00***

Notes:
1. Cost of Engineering will vary based on the bidding requirements, and may be reduced if the project is bid with an Emergency Waiver.
2. Where the Estimated Cost is $0.00, there are no costs associated with operation, maintenance, or media replacement anticipated for that year.
3. Cost of residuals management due to backwashing GAC vessels is subject to change: current assumption is based on emptying two geotubes every year.

ENVIRONMENTAL PARTNERS

Randolph/Holbrook Joint Water Board Water Treatment Plant
PFAS Removal System
Engineers Opinion of Probable Cost

Purchase New Ion Exchange Resin Units						
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost to Operate:						
Site Grading	SY	75	$15.00	$10.00	$5.00	$1,125.00
Wet Well and Filter Effluent Piping Upgrades	LS	1	$150,000.00	$100,000.00	$50,000.00	$150,000.00
Equipment Pad	CY	35	$450.00	$300.00	$150.00	$15,750.00
IX Filter Vessel	EA	4	$260,000.00	$245,000.00	$15,000.00	$1,040,000.00
IX Resin (Per Vessel)	EA	4	$279,000.00	$264,000.00	$15,000.00	$1,116,000.00
Exterior Piping	LS	1	$325,000.00	$250,000.00	$75,000.00	$325,000.00
Electrical Work	LS	1	$70,000.00	$40,000.00	$30,000.00	$70,000.00
Instrumentation Wiring and SCADA Programming	LS	1	$50,000.00	$30,000.00	$20,000.00	$50,000.00
Geotubes	EA	2	$10,000.00	$6,000.00	$4,000.00	$20,000.00
				Subtotal	*$*	*2,787,875.00*
				30% Contingency	*$*	*836,362.50*
				Installation Subtotal	*$*	*3,624,237.50*
				25% Engineering [1]	*$*	*906,059.38*
				Total Cost of Installation	***$***	***4,530,300.00***
Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		**Estimated Cost**
				Material	Labor	
Cost to Operate:						
Year 1 - Operation & Maintenance	LS	1	$12,000.00	$10,000.00	$2,000.00	$12,000.00
Year 1 - Spent Resin Replacement[2]	EA	0	$279,000.00	$264,000.00	$15,000.00	$0.00
Year 1 - Residuals Management[3]	CY	80	$80.00	$0.00	$80.00	$6,400.00
Year 2 - Operation & Maintenance	LS	1	$12,060.00	$10,000.00	$2,060.00	$12,060.00
Year 2 - Spent Resin Replacement	EA	2	$287,370.00	$271,920.00	$15,450.00	$574,740.00
Year 2 - Residuals Management[3]	CY	80	$90.00	$0.00	$90.00	$7,200.00
Year 3 - Operation & Maintenance	LS	1	$12,120.00	$10,000.00	$2,120.00	$12,120.00
Year 3 - Spent Resin Replacement[2]	EA	0	$296,000.00	$280,080.00	$15,920.00	$0.00
Year 3 - Residuals Management[3]	CY	80	$100.00	$0.00	$100.00	$8,000.00
Year 4 - Operation & Maintenance	LS	1	$12,180.00	$10,000.00	$2,180.00	$12,180.00
Year 4 - Spent Resin Replacement	EA	2	$304,890.00	$288,490.00	$16,400.00	$609,780.00
Year 4 - Residuals Management[3]	CY	80	$110.00	$0.00	$110.00	$8,800.00
				Subtotal	*$*	*1,263,280.00*
				15% Contingency	*$*	*189,492.00*
				Total Cost of Operation	***$***	***1,452,770.00***

Notes:
1. Cost of Engineering will vary based on the bidding requirements, and may be reduced if the project is bid with an Emergency Waiver.
2. Where the Estimated Cost is $0.00, there are no costs associated with operation, maintenance, or resin replacement anticipated for that year.
3. Cost of residuals management due to backwashing IX resin vessels is subject to change: current assumption is based on emptying two geotubes every year.

ENVIRONMENTAL PARTNERS

Randolph/Holbrook Joint Water Board Water Treatment Plant
PFAS Removal System
Engineers Opinion of Probable Cost

Rent Ion Exchange Resin Units

Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		Estimated Cost
				Material	Labor	
Cost to Operate:						
Site Grading	SY	75	$15.00	$10.00	$5.00	$1,125.00
Wet Well and Filter Effluent Piping Upgrades	LS	1	$150,000.00	$100,000.00	$50,000.00	$150,000.00
Equipment Pad	CY	35	$450.00	$300.00	$150.00	$15,750.00
IX Filter Container	EA	2	$893,375.00	$893,375.00		$1,786,750.00
IX Resin (Per Container)	EA	2	$186,153.00	$186,153.00		$372,306.00
Exterior Piping	LS	1	$198,800.00	$152,800.00	$46,000.00	$198,800.00
Electrical Work	LS	1	$70,000.00	$40,000.00	$30,000.00	$70,000.00
Instrumentation Wiring and SCADA Programming	LS	1	$50,000.00	$30,000.00	$20,000.00	$50,000.00
Geotubes	EA	2	$10,000.00	$6,000.00	$4,000.00	$20,000.00
				Subtotal	*$*	*2,664,731.00*
				30% Contingency	*$*	*799,419.30*
				Installation Subtotal	*$*	*3,464,150.30*
				25% Engineering [1]	*$*	*866,037.58*
				Total Cost of Installation	***$***	***4,330,190.00***

Work Item Description	Unit of Measure	Approx. Quantity	Unit Price	Unit Price		Estimated Cost
				Material	Labor	
Cost to Operate:						
Year 1 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 1 - Spent Resin Replacement[2]	EA	0	$231,160.00	$186,160.00	$45,000.00	$0.00
Year 1 - Residuals Management[3]	CY	80	$80.00	$0.00	$80.00	$6,400.00
Year 2 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 2 - Spent Resin Replacement	EA	2	$238,100.00	$191,750.00	$46,350.00	$476,200.00
Year 2 - Residuals Management[3]	CY	80	$90.00	$0.00	$90.00	$7,200.00
Year 3 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 3 - Spent Resin Replacement[2]	EA	0	$245,260.00	$197,510.00	$47,750.00	$0.00
Year 3 - Residuals Management[3]	CY	80	$100.00	$0.00	$100.00	$8,000.00
Year 4 - Operation & Maintenance[2]	LS	0	$0.00	$0.00	$0.00	$0.00
Year 4 - Spent Resin Replacement	EA	2	$252,630.00	$203,440.00	$49,190.00	$505,260.00
Year 4 - Residuals Management[3]	CY	80	$110.00	$0.00	$110.00	$8,800.00
				Subtotal	*$*	*1,011,860.00*
				15% Contingency	*$*	*151,779.00*
				Total Cost of Operation	***$***	***1,163,640.00***

Notes:
1. Cost of Engineering will vary based on the bidding requirements, and may be reduced if the project is bid with an Emergency Waiver.
2. Where the Estimate Cost is $0.00, there are no costs associated with operation, maintenance, or resin replacement anticipated for that year.
3. Cost of residuals management due to backwashing IX resin vessels is subject to change: current assumption is based on emptying two geotubes every year.

ENVIRONMENTAL PARTNERS

ATTACHMENT B

Equipment Cutsheets

PAC Silo

Bulk Storage Silo

Powder handling expert

Wastewater Treatment | Water Treatment | Flue Gas Treatment

Bulk Storage Steel Silo

Bulk storage silos made of steel are the perfect solution to store powdered reagents like hydrated lime, activated carbon, soda ash, and many other dry chemical powders. The cylindrical shape and the conical bottom allow a complete discharge of the product when combined with a mechanical arch breaker.

With a volume ranging from 200 to 7,000 ft^3, Sodimate helps to choose the right diameter and height of silos to comply with the technical definition of the customer.

Silos can be legged with a steel frame, with a skirt (to implement a room) or attached on a pad to be suspended through a concrete ceiling.

Advantages:

- Custom made silos in one-piece construction
- Protective linings and coatings
- ASME certification
- On-site delivery and installation
- Huge storage capacity
- Low maintenance cost

Sodimate®

Powder handling expert

Wastewater Treatment | Water Treatment | Flue Gas Treatment

Redundancy with stairway to access on both roofs

Skirted silo with stairway

Legged silo

Optional features:

- Load cells
- Skirt (room under the silo)
- Insulation
- Junction box at the ground level
- Safety cage OSHA compliant
- Stairway OSHA compliant
- Heater and thermostat
- Lighnting
- Specific color and lining
- Explosion proof vent

SILO HEIGHT(ft)

	300 ft³	500 ft³	750 ft³	1000 ft³	1500 ft³	2500 ft³	3500 ft³	5000 ft³
Ø10 ft	18'6"	21'1"	24'3"					
Ø12 ft			22'9"	25'1"	27'7"	38'6"	47'6"	60'11"
Ø14 ft						34'1"	40'8"	50'5"

*Height and capacity vary regarding the silo volume

Load cells for skirted silo

2950 W. Chicago Ave., Ste 205, Chicago IL 60622
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www.sodimate-inc.com

PAC Slurry Eductor

Sodimate®

Powder handling expert

Slurry Eductor

Waste water Treatment

Water Treatment

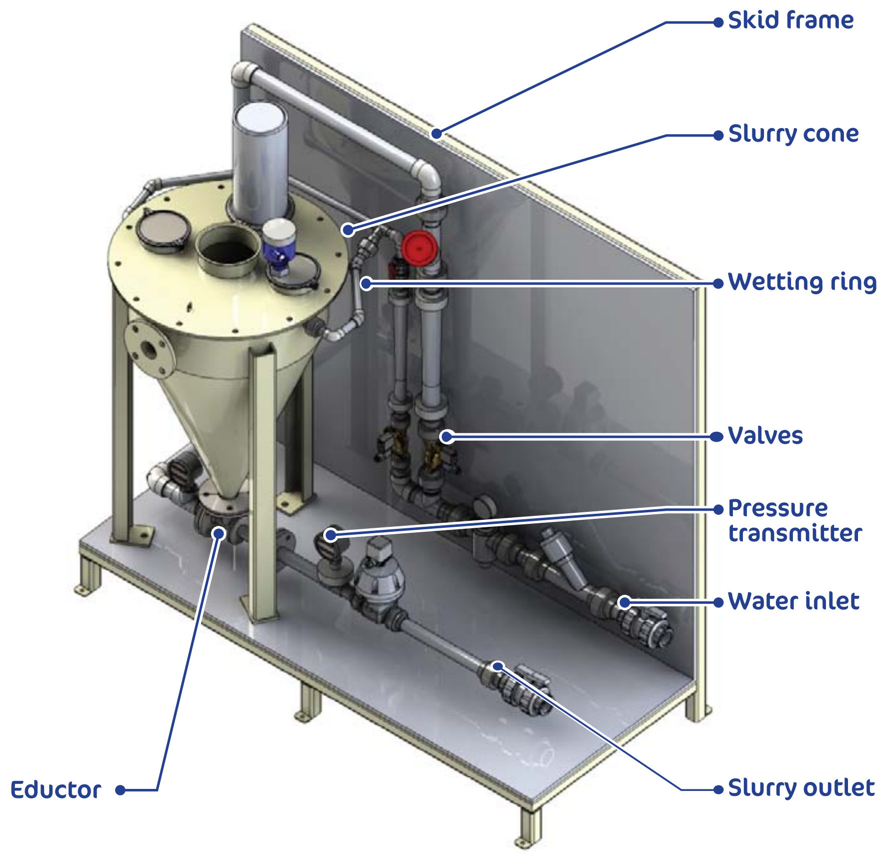
Flue Gas Treatment

Slurry Eductor

Sodimate liquid/slurry eductors have been installed with a broad range of products such as micro sand, limestone, powder activated carbon, etc.

Applications of Sodimate slurry eductors range from adding a few pounds per hour to transporting over thousands of pounds per hour.

Sodimate Slurry eductor eliminates the use of slurry mixing tank, reduces the electrical consumption and floor footprint. The resulting slurry can be transfer horizontally and vertically with few pound of pressure at the process end injection point.



Advantages

- Dust free
- Long transfer distances with elevations and back pressure
- Low energy consumption
- Can be mounted on a skid
- Optional instrumentation

Sodimate®

Powder handling expert

Wastewater Treatment | Water Treatment | Flue Gas Treatment

Operation Principle

Sodimate slurry eductors use water or other liquids under pressure as the motive fluid, and operate on the venturi principle to mix dry chemicals into slurries.

Water is constantly injected inside the slurry cone to provide instantaneous hydration, reduce dust, and avoid clumps and 'fish-eyes'. The high-velocity jet of liquid from the eductor nozzle creates a vacuum, which causes the suction of the mixed liquid.

Eductors are an ideal way to continuously produce solutions or well blended slurries and are commonly used in chemical, food, power, pharmaceutical, and waste water applications.

The slurry eductor can be supplied with all necessary flow, pressure, control and regulation instrumentation.

Features

- **Slurry transfer without mixing tank**
- **Can be adapted to existing process**
- **Dust free unit system**

Options

- **Contact parts made of stainless steel**
- **Explosion proof instrumentation**
- **Skid mounted system**

Examples of transferred products
Powder activated carbon
Polymer
Soda Ash
Microsand

Ejector Size	Powder throughput
1"	2.2 gpm max
2"	4.4 gpm max
3"	11 gpm max
4"	22 gpm max

2950 W. Chicago Ave., Ste 205, Chicago IL 60622
Tel: 773-665-8800 Fax: 773-665-8805
www.sodimate-inc.com

PAC Big Bag Unloader

Sodimate®

Powder handling expert

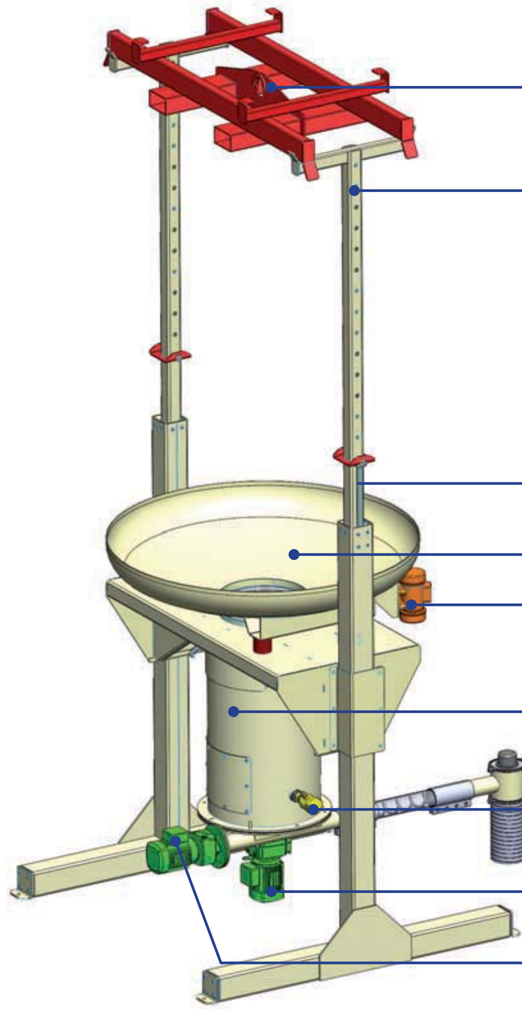
Big Bag Unloader

Wastewater Treatment | Water Treatment | Flue Gas Treatment

Discharger and Feeder for Big Bags / Bulk Bags / FIBC :

The Big Bag Unloader is engineered to discharge up to 2 ton supersacs, ensuring an automatic and complete discharge of the dry chemical without product compaction.

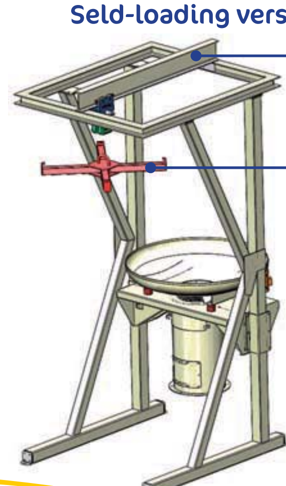
The structure of the unloader can accept big bags loaded by forklift or can integrate manual or electrical hoists.



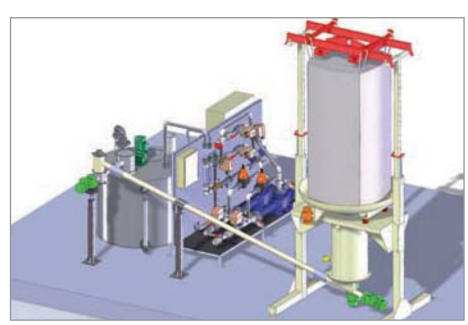
Advantages:

- Compact unit
- Suitable for bulk bags up to 2 tons
- Easy assembly
- Easy-to-use
- Rental units available
- Complete emptying of bulk bag
- Optimized dust control
- Self-loading version available with integrated hoist

Seld-loading version :



Installation Example:



Sodimate

Powder handling expert

Wastewater Treatment

Water Treatment

Flue Gas Treatment

Operation:

The big bag is supported by two telescopic, spring-loaded arms and loaded on a vibrating dish that only vibrates when the sensor detects a lack of product in the hopper.

This sequence ensures the complete emptying of the bag and signals the operator when it is time to replace it.

The unit also comes equipped with Sodimate's mechanical arch-breaker and volumetric screw feeder. The screw feeder can be flexible or connected to an inclined conveyor to transfer the product vertically to the discharge point.

Products
Quicklime
Hydrated Lime
Powdered Activated Carbon (PAC)
Sodium Bicarbonate
Microsand
Soda Ash
Polymers
Plastic Pellets

Specifications:

- **Fabrication material: carbon steel, stainless steel 304/316**
- **Single or multiple screw feeders**
- **Big bags up to 2 tons**

Options :

- **Isolation diaphragm valve**
- **Dust collector**
- **Big Bag opening knife**
- **Load cells (gravimetric)**
- **Electrical hoist and trolley**
- **Explosion proof unit**

Screw Feeder type	Feedrate *
1½ "	1 ¾ ft^3/hr max.
2 "	15 ft^3/hr max.
3 "	50 ft^3/hr max.
3 ¼"	80 ft^3/hr max.
4 "	130 ft^3/hr max.
5 "	450 ft^3/hr max.

* feedrate may vary according to product and density

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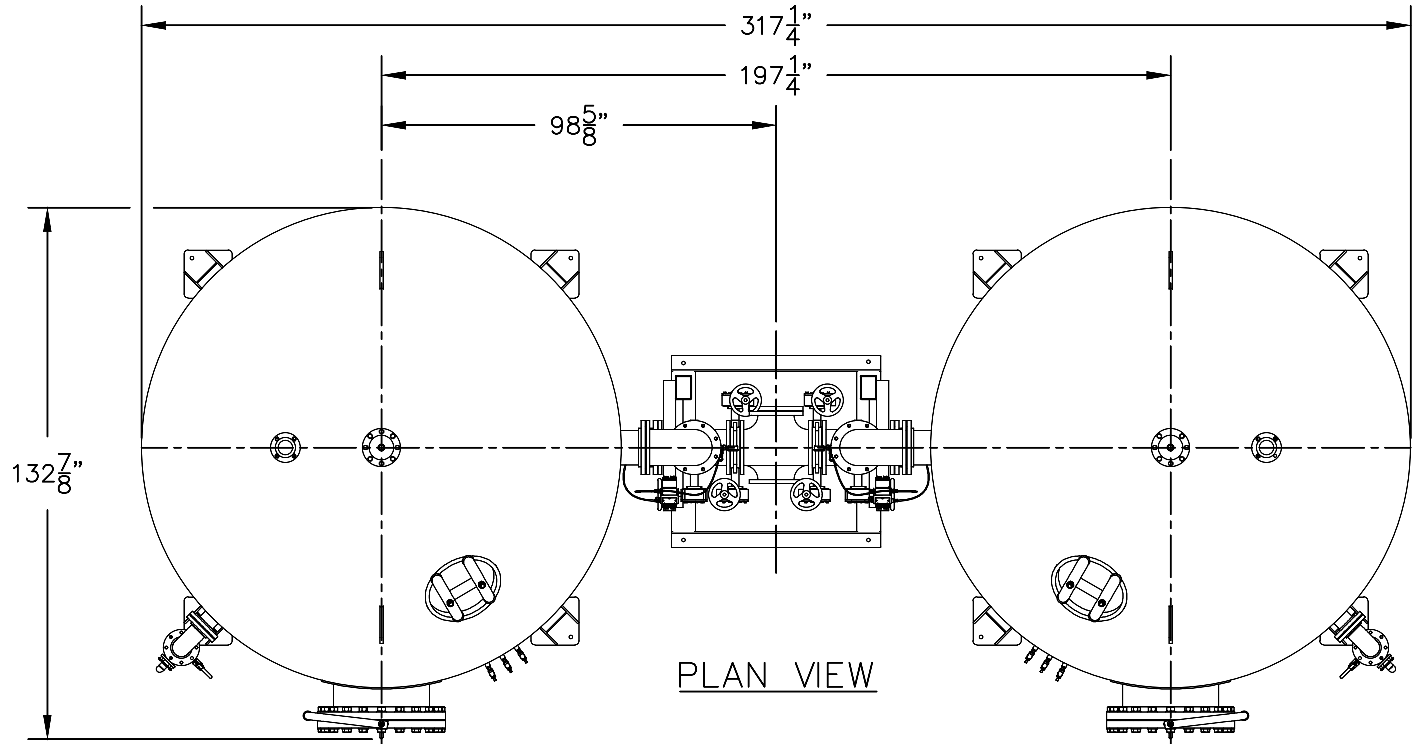
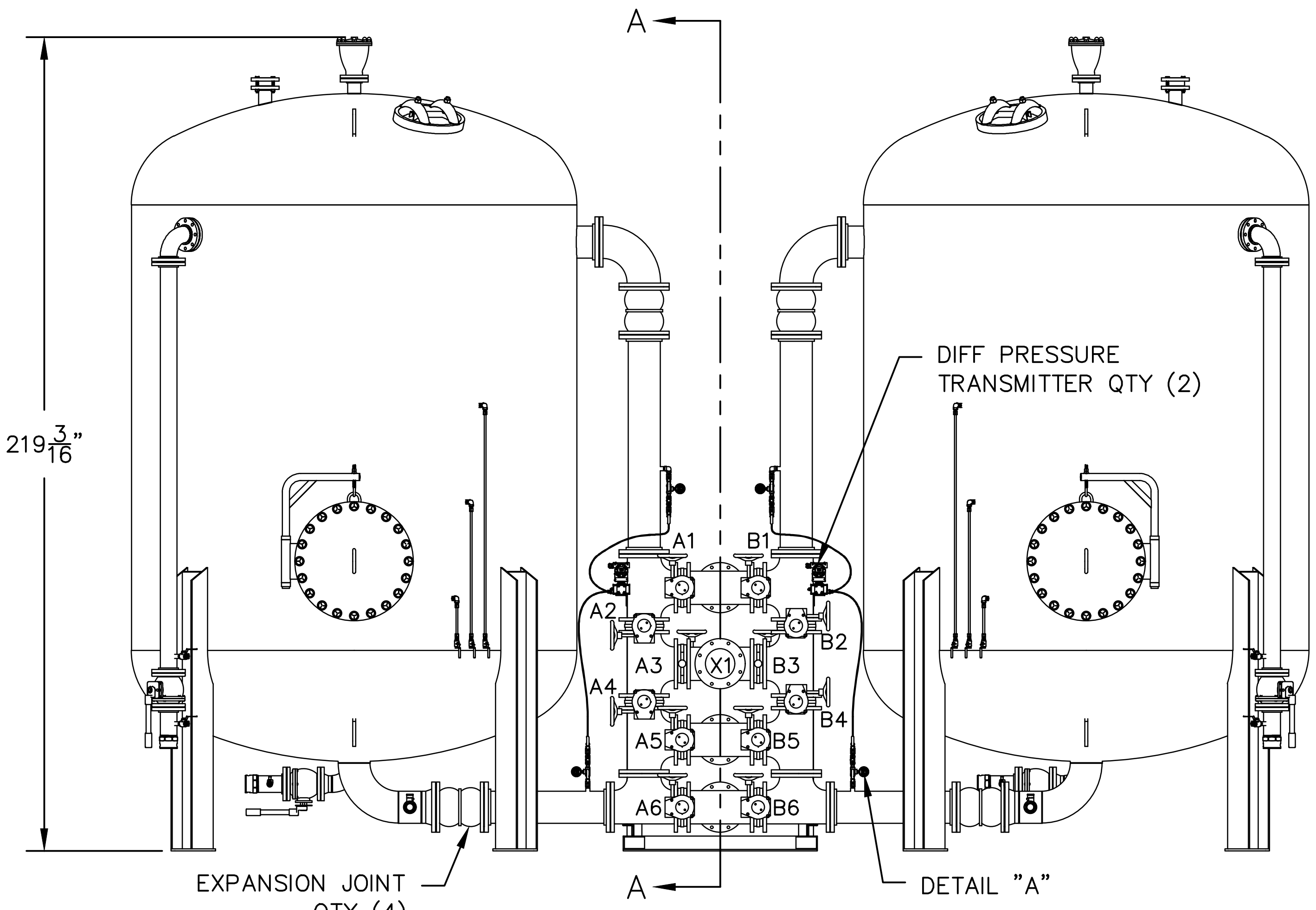
GAC Vessels



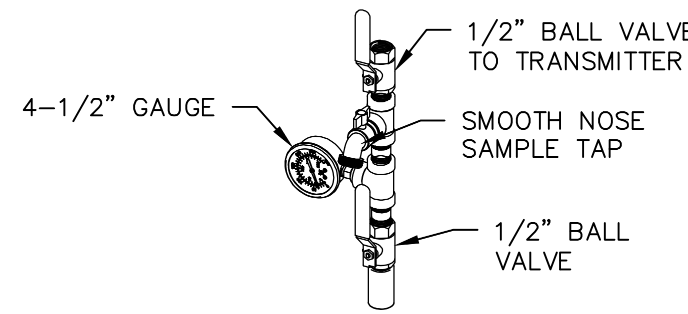
PLAN VIEW

ADSORBER "A"

ADSORBER "B"



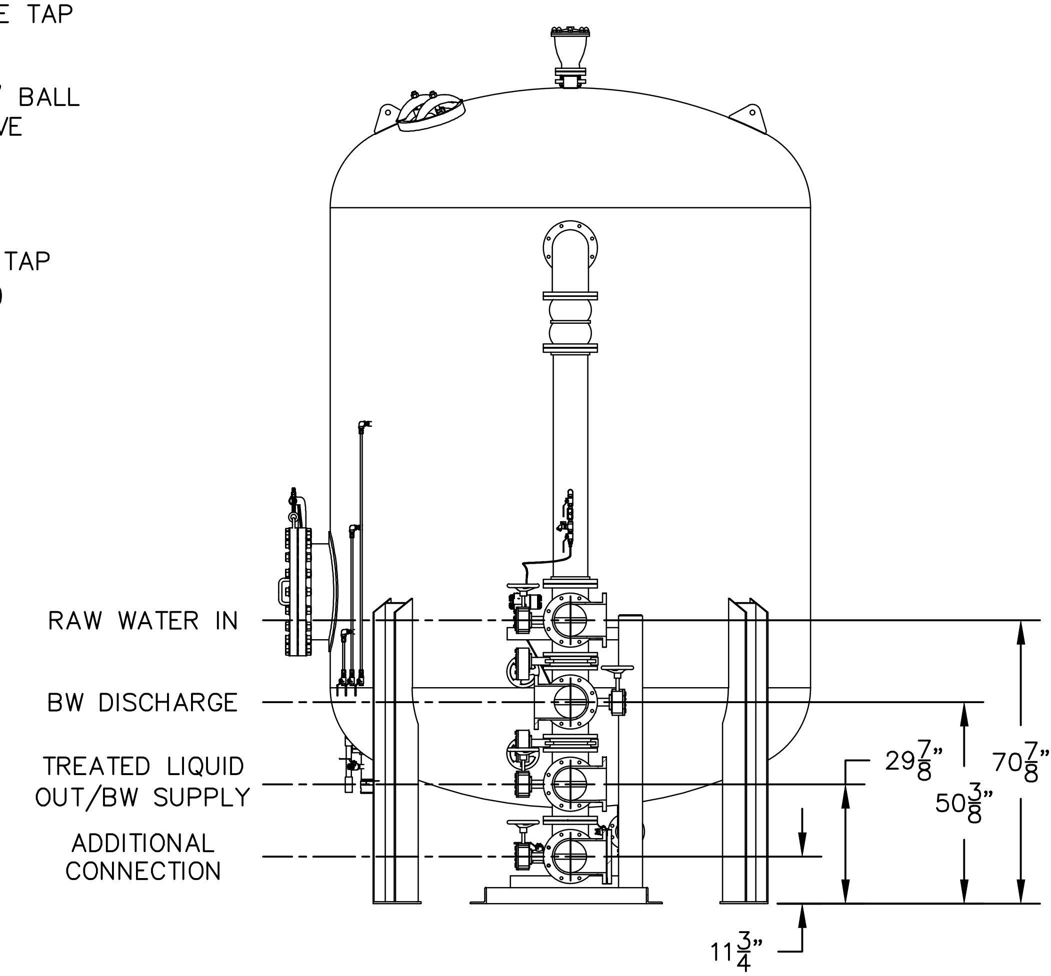
FRONT ELEVATION



DETAIL "A"

1/2" PRESSURE/SAMPLE TAP

SCALE: 1"=1' QTY (4)



SECTION A-A

VALVE OPERATION MODE													
MODE OF OPERATION	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	X1
UNIT A (ONLY) OPERATION	OPEN	CLOSED	CLOSED	CLOSED	OPEN	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED
UNIT B (ONLY) OPERATION	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	OPEN	CLOSED	CLOSED	CLOSED	OPEN	CLOSED	CLOSED
SERIES FLOW OPERATION UNIT A TO UNIT B	OPEN	CLOSED	OPEN	OPEN	CLOSED	CLOSED	CLOSED	OPEN	OPEN	CLOSED	OPEN	CLOSED	CLOSED
SERIES FLOW OPERATION UNIT B TO UNIT A	CLOSED	OPEN	OPEN	CLOSED	OPEN	CLOSED	OPEN	CLOSED	OPEN	OPEN	CLOSED	CLOSED	CLOSED
PARALLEL FLOW OPERATION UNIT A & B	OPEN	CLOSED	CLOSED	CLOSED	OPEN	CLOSED	OPEN	CLOSED	CLOSED	CLOSED	OPEN	CLOSED	CLOSED
UNIT A ONLY BACKWASH	CLOSED	OPEN	OPEN	CLOSED	OPEN	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	OPEN
UNIT B ONLY BACKWASH	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	OPEN	OPEN	CLOSED	OPEN	CLOSED	OPEN
UNIT A FILTER TO WASTE	OPEN	CLOSED	OPEN	OPEN	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	OPEN
UNIT B FILTER TO WASTE	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	OPEN	CLOSED	OPEN	OPEN	CLOSED	CLOSED	OPEN

NOTES

1. ALL FLANGE PATTERNS STRADDLE PLANT NORTH CENTERLINE
2. ALL SYSTEM PROCESS VALVES TO BE BRAY SERIES 30, CAST IRON w/ HAND WHEEL OPERATOR
3. DIFFERENTIAL PRESSURE TRANSMITTERS TO BE SIEMENS SISTRANS P DS III MOUNTED ON A 3-WAY VALVE MANIFOLD
4. ALL ELEVATIONS MARKED FROM TOP OF FOUNDATION PAD
5. VALVE X1 INSTALLED ON SITE

tetraSOLV FILTRATION

1424 ABRAHAM DRIVE
ANDERSON, INDIANA 46013

Ph: (765) 643-3941
Fx: (765) 643-3949

REV NO	REVISION NOTE	DATE	SIGNATURE
1	MOD BW ORIENTATION, COMBINED TREATED OUT/BW SUPPLY, SHELL HT	11/12/19	SDB
2			
3			
4			
5			

CUSTOMER BARNSTABLE	JOB # TBD	DATE 10/21/2019	SCALE 1/4"=1'
DESIGNED BY S.BLITCHINGTON	SYSTEM_ASSEMBLY		
APPROVED BY –	QUANTITY 4	UNITS IPS	DRAWING # D-3,R-1

IX Resin Containers for Rental

REV	DESCRIPTION	ECO	DWN	APVD	DATE	CHKD
C	REVISED AS NOTED	–	SJ	HG	02AUG12	KW
B	REVISED AS NOTED	–	DJS	HG	09JUL12	JC
A	INITIAL RELEASE	–	BN	HG	11MAY12	JC

TOLERANCES UNLESS NOTED
DECIMALS .X ± .XX ± 0.50 .XXX ±
ANGLES ± 0.5
FRAC ± ?"

DIMENSIONS IN INCHES DO NOT SCALE

THIRD ANGLE

DRAWN BY BN	DATE 03APR12
CHECKED BY JC	DATE 16MAY12
APPROVED BY KW	DATE 11MAY12
APPROVED BY HG	DATE 11MAY12

GE
Water & Process Technologies
GLOBAL HEADQUARTERS : TREVOSE, PA USA +1-215-355-3300 WWW.GEWATER.COM

CLIENT/JOB: GE MOBILE WATER AUTOFILTER 3X7

FILE: AUTOCAD

TITLE: GENERAL ARRANGEMENT SYS,PRETREATMENT,BWRO,CE

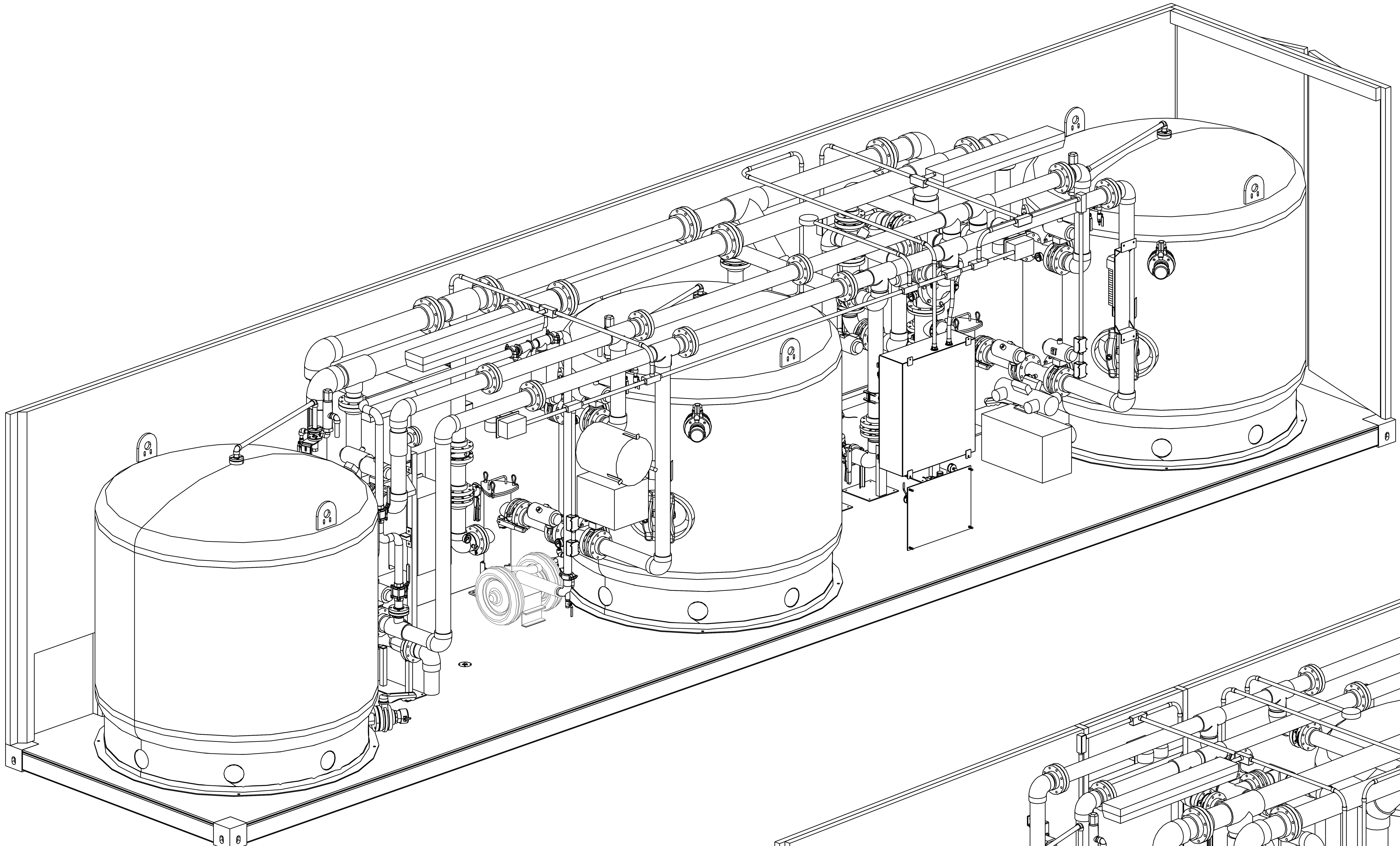
MATERIAL: 500208A-PG-02

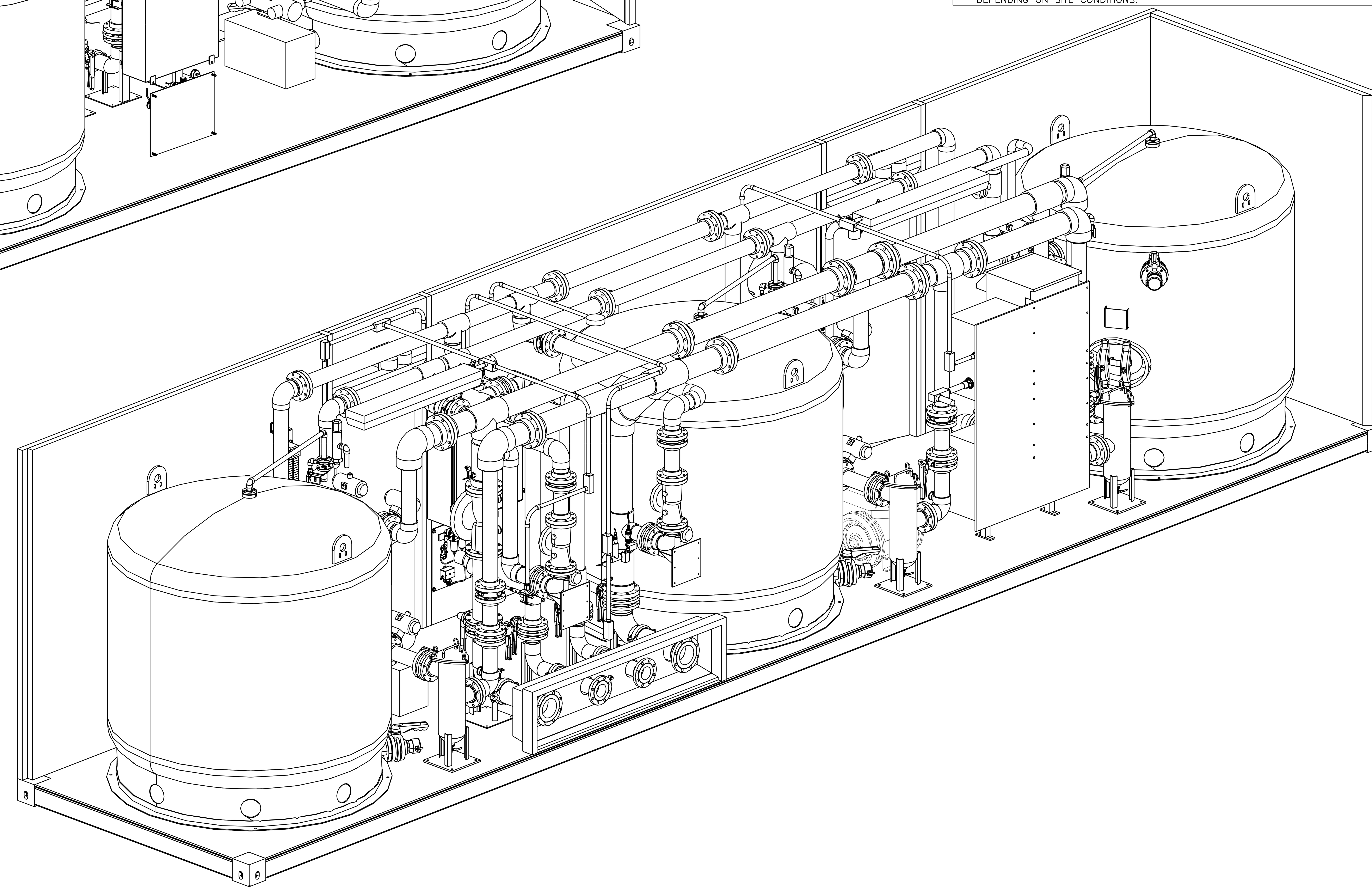
SIZE	DRAWING NO.	REV
D	500208A-PG-02	C

PROJECT: 500208

SCALE: 1:16

P/N 1161662-RHP01





NOTES:

1. CONNECTION TABLE

ITEM	DESCRIPTION	MATERIAL	TYPE	SIZE
A	FEED INLET	SS316L	150# FLANGE	6.00
B	PRODUCT OUTLET	SS316L	150# FLANGE	6.00
C	BRINE INLET	SS316L	150# FLANGE	4.00
D	WASTE OUTLET	SS316L	150# FLANGE	4.00
E	INSTRUMENT AIR INLET	316	FPT	0.5

2. SHIPPING WEIGHT – 30,000 LBS (13,608 KG).
   SHIPPING WEIGHT WITH MEDIA – 60,000 LBS (27,211 KG).
3. OPERATING WEIGHT – 95,000 LBS (43,100 KG).
4. QUANTITY REQUIRED: 1 ASSEMBLY AS SHOWN.
5. PLUMBING RUN \ EQUIPMENT TABLE:

FIND NO.	PART NUMBER	QTY.	DESCRIPTION	U/M
1	3030555	1	CONTAINER,40',BWRO PT	EA
2	3031213	3	VESSEL,MMF,84X53.5,CS,BW,SUBC,PAINT	EA
3	500203A–PP–03	6	PLMB,PVC,3.0",MEDIA OUTLET	EA
4	500208A–PP–01	1	PLMB,PVC,6.0",FEED	EA
5	500208A–PP–02	1	PLMB,CPVC,4.0",BACKWASH OUT	EA
6	500208A–PP–03	1	PLMB,PVC,4.0",BRINE IN	EA
7	500208A–PP–04	1	PLMB,316,2.0",AIR BLOWER	EA
8	500208A–PP–05	1	PLMB,PVC,6.0",PRODUCT	EA
9	500208A–PP–06	3	PLMB,316,1.0",VENT	EA
10	500208A–PP–07	1	ASSEMBLY,PH ANALYZER,M800	EA

6. ALL DIMENSIONS IN INCHES.
7. REFERENCE – PROCESS AND INSTRUMENTATION DIAGRAM : 500208A–AP–01
8. COMPRESSOR (PN:500208A–101) AND HEATER (PN:500208A–201) WILL BE LOCATED DEPENDING ON SITE CONDITIONS.

REV	DESCRIPTION	ECO	DWN	APVD	DATE	CHKD
C	REVISED AS NOTED	–	SJ	HG	02AUG12	KW
B	REVISED AS NOTED	–	DJS	HG	09JUL12	JC
A	INITIAL RELEASE	–	BN	HG	11MAY12	JC

TOLERANCES UNLESS NOTED
DECIMALS: .X ± / .XX ± 0.50 / .XXX ±
ANGLES: ± 0.5
FRAC: ± ?"

DIMENSIONS IN INCHES
DO NOT SCALE
THIRD ANGLE

		DATE
DRAWN BY	BN	03APR12
CHECKED BY	JC	16MAY12
APPROVED BY	KW	11MAY12
APPROVED BY	HG	11MAY12

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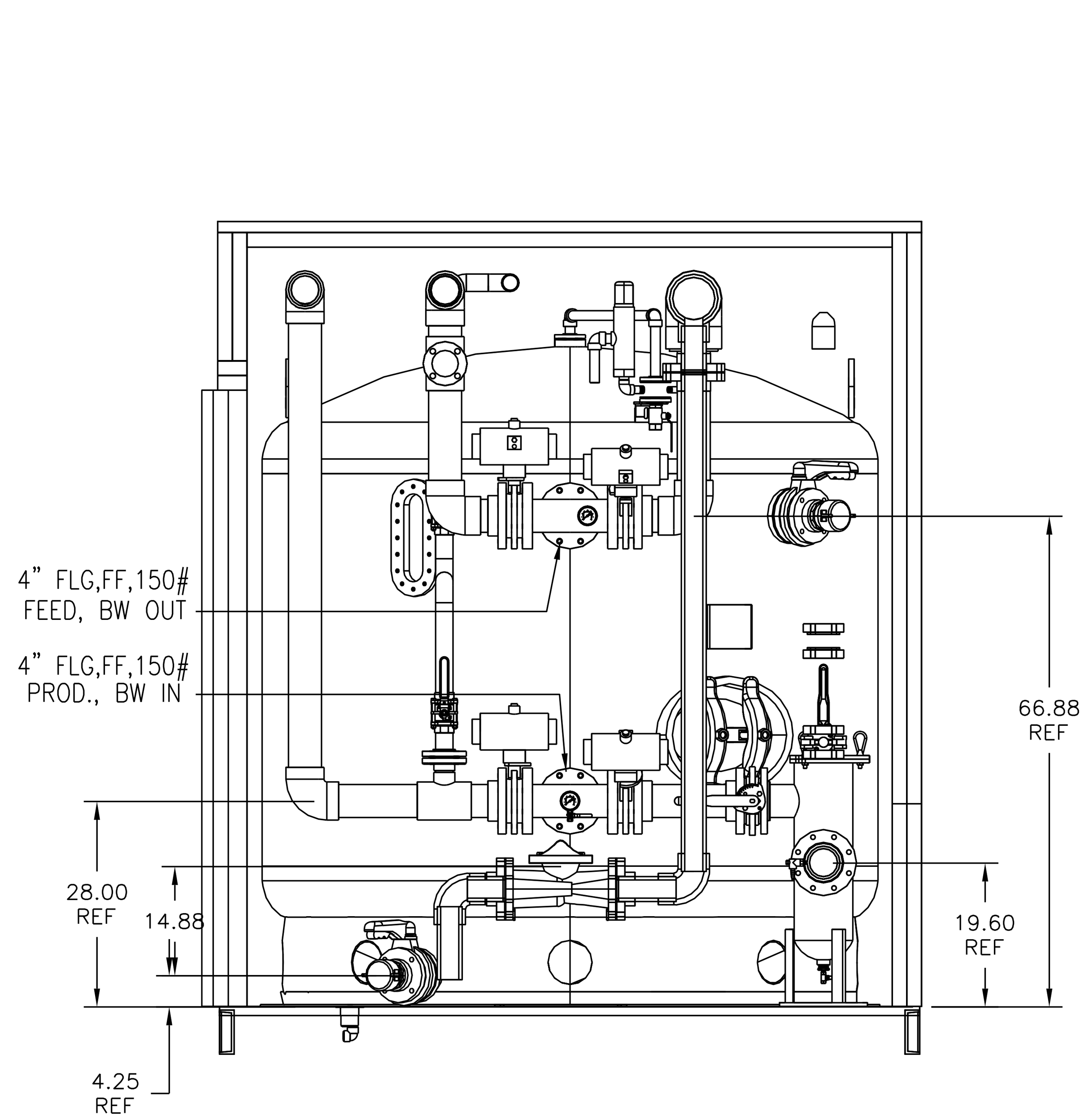
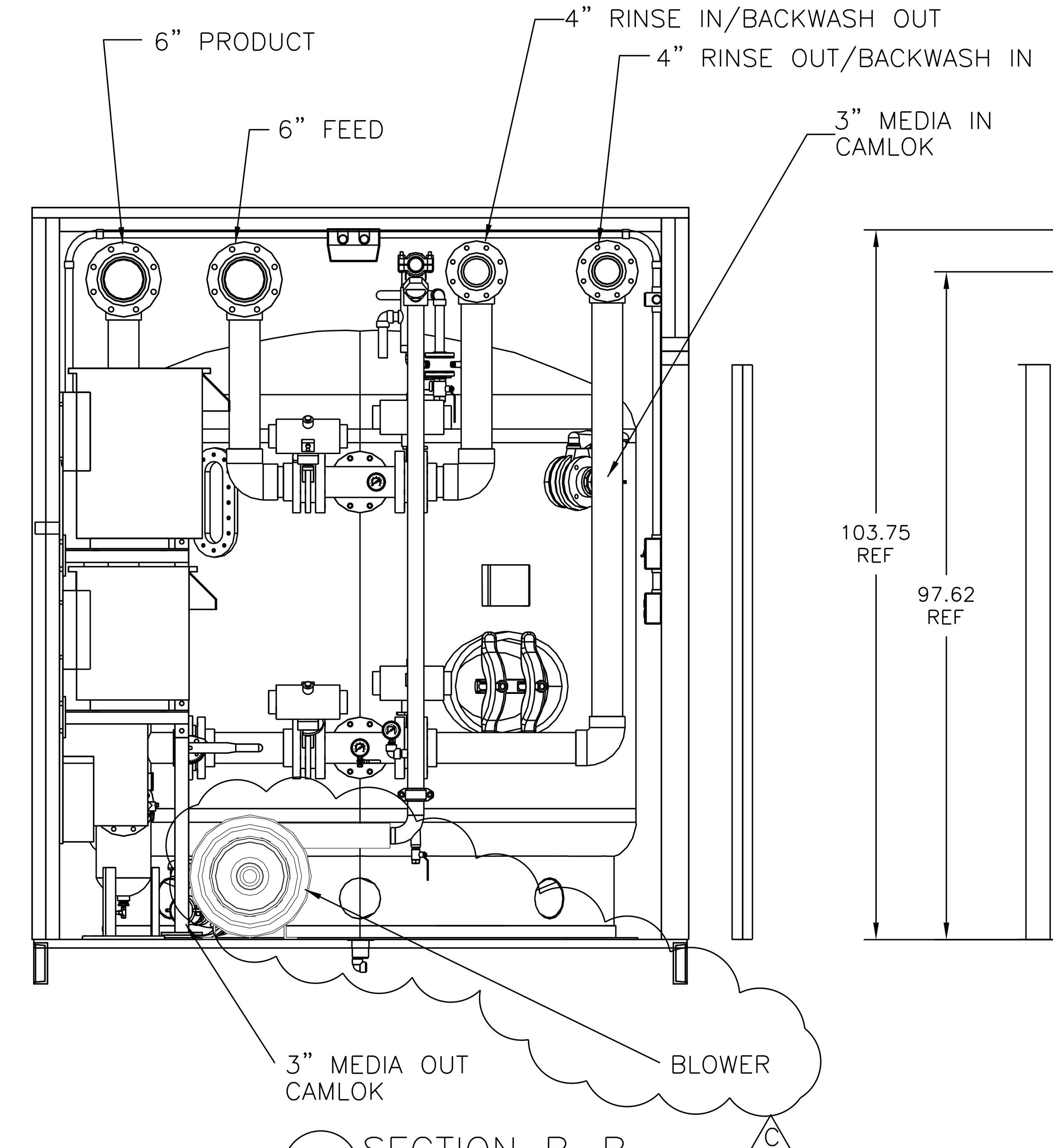
TITLE: GENERAL ARRANGEMENT SYS,PRETREATMENT,BWRO,CE
MATERIAL: 500208A–PG–02

SIZE: D | DRAWING NO.: 500208A–PG–02 | REV: C
PROJECT: 500208
SCALE: 1:16 | SHEET 2 OF 3

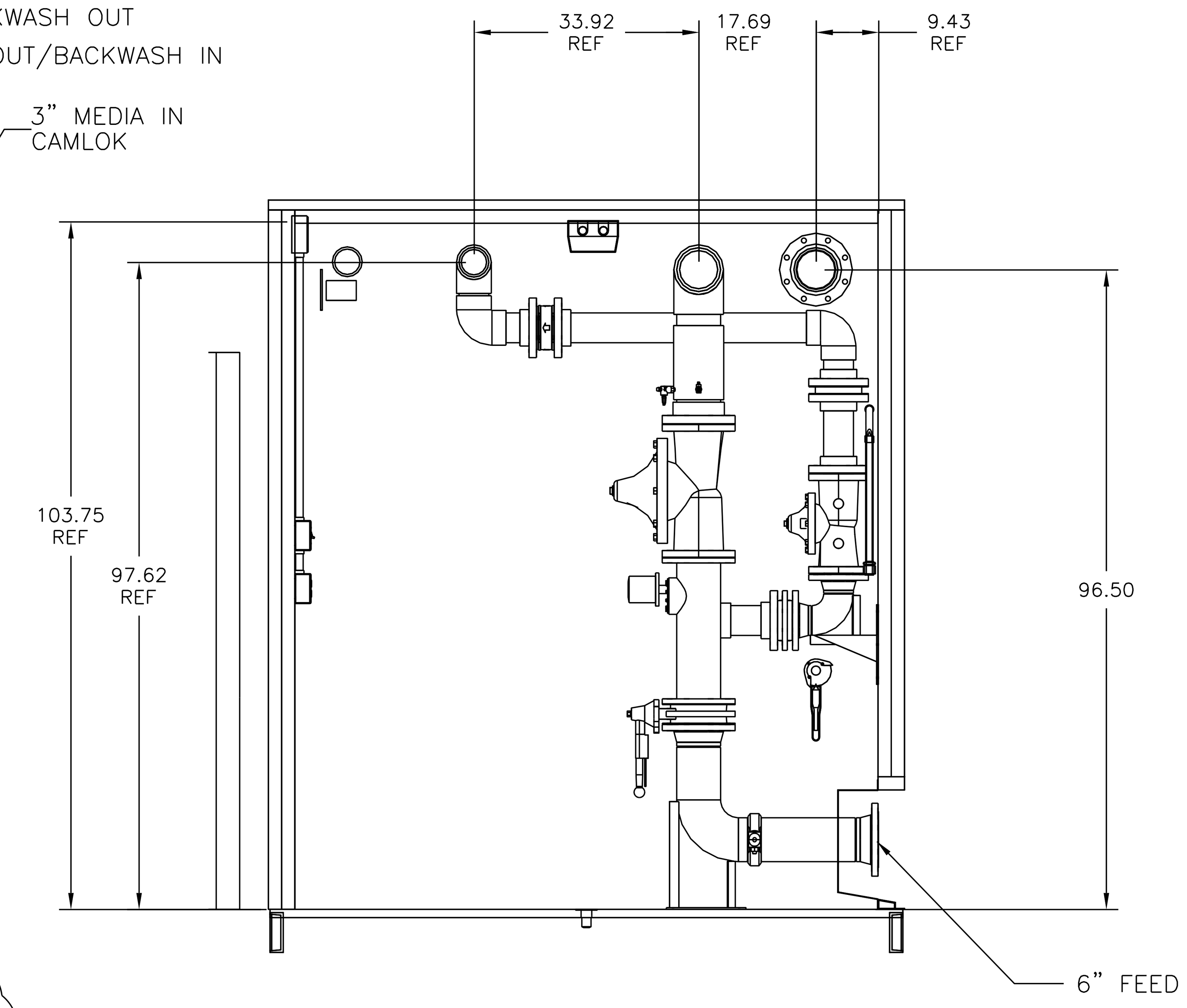
P/N 1161662–RHP01



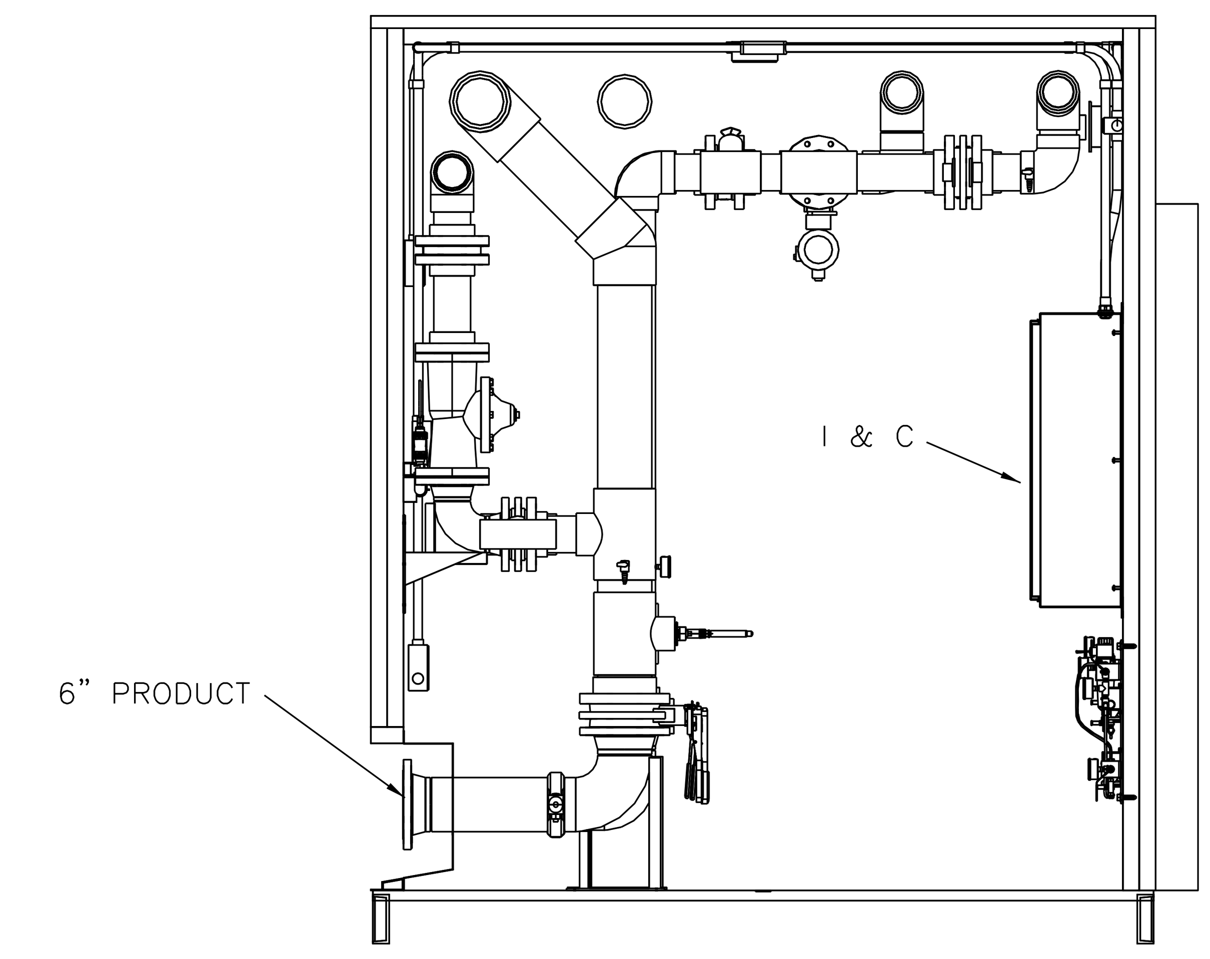
SECTION A-A
SCALE: 1:20
(A / SHT.1)



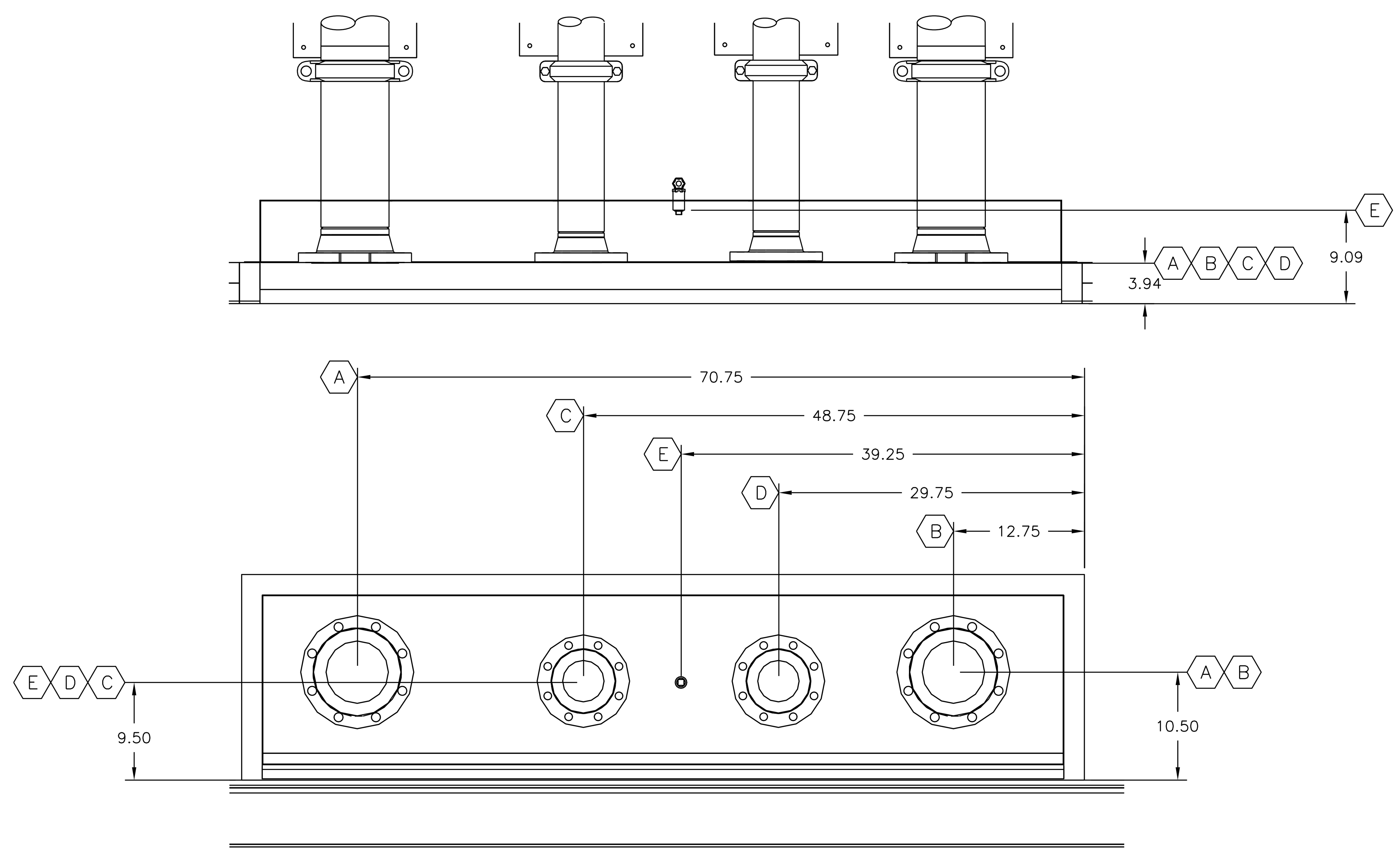
SECTION B-B
SCALE: 1:20
(B / SHT.1)



SECTION C-C
SCALE: 1:20
(C / SHT.1)



SECTION D-D
SCALE: 1:20
(D / SHT.1)



SECTION F-F
SCALE: 1:10
(F / SHT.1)

REV	DESCRIPTION	ECO	DWN	APVD	DATE	CHKD
C	REVISED AS NOTED	–	SJ	HG	02AUG12	KW
B	REVISED AS NOTED	–	DJS	HG	09JUL12	JC
A	INITIAL RELEASE	–	BN	HG	11MAY12	JC

TOLERANCES UNLESS NOTED
DECIMALS: .X ± / .XX ± 0.50 / .XXX ±
ANGLES: ± 0.5
FRAC: ±1/2"
DIMENSIONS IN INCHES
DO NOT SCALE
THIRD ANGLE

DRAWN BY: BN	DATE: 03APR12
CHECKED BY: JC	DATE: 16MAY12
APPROVED BY: KW	DATE: 11MAY12
APPROVED BY: HG	DATE: 11MAY12

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CLIENT/JOB: GE MOBILE WATER AUTOFILTER 3X7
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TITLE: GENERAL ARRANGEMENT SYS,PRETREATMENT,BWRO,CE
MATERIAL: 500208A-PG-02

SIZE: D | DRAWING NO.: 500208A-PG-02 | REV: C
PROJECT: 500208
SCALE: AS NOTED | SHEET 3 OF 3

P/N 1161662-RHP01