City of Longview

1525 Broadway
Longview, WA 98632
www.ci.longview.wa.us

Council Workshop

City Council

Mayor Don Jensen
Council Member Ken Botero
Council Member Chet Makinster
Council Member Steve Moon
Council Member Scott Vydra
Mayor Pro Tem Michael Wallin
Council Member MaryAlice Wallis

Thursday, March 7, 2019 | **6:00 PM** | **2nd Floor, City Hall**

NOTICE IS HEREBY GIVEN, in accordance with RCW Chapter 42.30, that the City Council of the City of Longview, Washington, will conduct a joint meeting with the Beacon Hill Water & Sewer District Commissioners in the Longview City Hall Training Room, 1525 Broadway, Longview, on Thursday, March 7, at 6:00 p.m. The topics of discussion follow. Final disposition shall be taken on no other matter.

The City Hall is accessible for persons with disabilities. Special equipment to assist the hearing impaired is also available. Please contact the City Executive Offices at 360.442.5004 48 hours in advance if you require special accommodations to attend the meeting.

1. **CALL TO ORDER**

2. **ROLL CALL**

3. **WORKSHOP**

19-00038 MINT FARM REGIONAL WATER TREATMENT PLANT – REVERSE OSMOSIS TREATMENT

RECOMMENDED ACTION:
For information and discussion.

19-00039 WATER SUPPLY WELLHEAD PROTECTION PROGRAM UPDATE

RECOMMENDED ACTION:
For information and discussion

4. ADJOURNMENT

NEXT REGULAR COUNCIL MEETINGS:
THURSDAY, MARCH 14, 2019 - 7:00 P.M.
THURSDAY, MARCH 28, 2019 - 7:00 P.M.

NEXT COUNCIL WORKSHOPS:
THURSDAY, MARCH 21, 2019 - 6:00 P.M. MINT FARM PHASE II UPDATE

City of Longview

Agenda Summary

MINT FARM REGIONAL WATER TREATMENT PLANT – REVERSE OSMOSIS TREATMENT

RECOMMENDED ACTION:
For information and discussion.

MINT FARM REGIONAL WATER TREATMENT PLANT – REVERSE OSMOSIS TREATMENT

COUNCIL INITIATIVE ADDRESSED:
Provide sustainable water quality and environmental infrastructure.

CITY ATTORNEY REVIEW: N/A

SUMMARY STATEMENT:
Council requested a workshop to discuss reverse osmosis treatment of the water supply. This topic was last considered at a joint workshop with Beacon Hill Water and Sewer District commissioners held on July 6, 2017, at the decision was made to take no further action at that time. Attached for your information are the meeting minutes from that workshop, along with the workshop material.

RECOMMENDED ACTION:
For information and discussion.

STAFF CONTACT:
Jeff Cameron, Public Works Director

Attachments:

1. July 6 2017 Joint Workshop Minutes - Silica Removal Options
2. Council Presentation - Silica Technologies 07.06.2017 FINAL
3. June 22 2017 Silica Removal Agenda Summary
4. Evaluation of Silica Removal Alternatives_CH2MHill FINAL
5. Evaluation of Silica Removal Alternatives Attachments

City of Longview

1525 Broadway
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Minutes - Final

City Council

Mayor Don Jensen
Council Member Ken Botero
Council Member Chet Makinster
Council Member Mary Jane Melink
Council Member Steve Moon
Council Member Scott Vydra
Mayor Pro Tem Michael Wallin

Thursday, July 6, 2017 | **6:00 PM** | **2nd Floor, City Hall**

JOINT MEETING WITH BEACON HILL WATER & SEWER DISTRICT

NOTICE IS HEREBY GIVEN, in accordance with RCW Chapter 42.30, that the City Council of the City of Longview, Washington, will conduct a joint workshop session with the Beacon Hill Water & Sewer District in the Longview City Council Chamber, 1525 Broadway, Longview, on Thursday, July 6, at 6:00 p.m. The topics of discussion follow. Final disposition shall be taken on no other matter.

The City Hall is accessible for persons with disabilities. Special equipment to assist the hearing impaired is also available. Please contact the City Executive Offices at 360.442.5004 48 hours in advance if you require special accommodations to attend the meeting.

1. CALL TO ORDER

Mayor Jensen called the joint meeting with Beacon Hill Water & Sewer District to order at 5:59 p.m.

2. ROLL CALL

Present: 6 - Mayor Don Jensen, Council Member Botero, Council Member Makinster, Council Member Melink, Council Member Moon and Council Member Vydra

Excused: 1 - Mayor Pro Tem Wallin

BEACON HILL WATER & SEWER DISTRICT COMMISSIONERS AND STAFF PRESENT

Commissioner Monte Roden; Commissioner Bonnie Decius; Commissioner Keath Huff; and General Manager Dell Hillger were present.

CITY OF LONGVIEW STAFF PRESENT

City Manager Dave Campbell; Assistant City Manager Kurt Sacha; City Clerk Kaylee Cody; City Attorney Jim McNamara; Public Works Director Jeff Cameron; Engineer Amy Blain; Human Resources Director Chris Smith; and Risk & Safety Manager Brian Loos.

3. CHANGES TO THE AGENDA

4. CITY MANAGER'S REPORT

17-4966 **EVALUATION OF TREATMENT TECHNOLOGIES FOR SILICA REMOVAL AT THE MINT FARM REGIONAL WATER TREATMENT PLANT**

COUNCIL STRATEGIC INITIATIVE ADDRESSED:
Provide sustainable water quality and environmental infrastructure.

CITY ATTORNEY REVIEW: N/A

SUMMARY STATEMENT:
In June, staff presented the results of an evaluation of available water treatment technologies for silica removal to the Water Operating Board, Beacon Hill Water and Sewer District (BHWSD) Board of Commissioners, and City Council. Based on effectiveness, cost, benefits and impacts, discussion focused on three short-listed alternatives: electrocoagulation, precipitation, and reverse osmosis.

On June 5, the Water Operating Board (WOB) reviewed the documents prepared by CH2MHill and considered the short-listed alternatives. As the policy board for the water treatment plant, its members were tasked with making a recommendation regarding adding silica removal treatment. The WOB deferred a Go/No-Go decision to the City Council and BHWSD Commissioners, but voted 2:1 in favor of precipitation as the preferred method for silica removal if the City Council and Board of Commissioners decide to proceed.

On June 21, staff presented an overview of short-listed silica removal alternatives, including the basic process, costs, rate impacts, water quality, pros/cons and projected timeline, to the BHWSD Board of Commissioners. As joint owner of the water treatment plant, the Participants' Agreement governing operation and construction of the plant specifies that BHWSD and the City Council must mutually agree to install additional treatment. After discussing the treatment alternatives, the BHWSD Commissioners chose not to take formal action until after the City Council reviewed the information. However, based on their customer experience, complaint volume, and tolerance for rate increases, the BHWSD Commissioners indicated they were leaning toward not installing silica removal treatment due to the cost to its customers.

On June 22, the silica removal information was presented to the City Council. The outcome of the WOB and BHWSD board meetings was shared, along with the results of the 2014 customer survey showing the level of support for possible water rate increases at the time of the survey. The City Council

voted to hold a joint meeting with the BHWSD Board to discuss the alternatives prior to making a decision.

After consulting with state auditor staff, the City has the option to install silica removal treatment without participation from BHWSD. However, exercising this option requires concurrence from BHWSD in order to amend the Participants' Agreement provisions for cost-sharing and ownership. And solo action would incur greater rate impacts for our customers since BHWSD customers would not share in the cost of the project.

Rate impacts were calculated by CH2MHill using life cycle cost divided by Equivalent Residential Units (ERU's), where one ERU represents the average volume of water consumed per day by a single family residence. The City has 13,504 water user connections which account for 21,942 ERU's. When the rate impacts were first reported, CH2MHill erroneously calculated the impact based only on Longview's total ERUs and neglected to include BHWSD ERUs. After correcting this calculation to include BHWSD's 3,893 water user connections which account for 4,476 ERU's, the corrected monthly cost per ERU for the short-listed options is estimated as follows:

Joint Project - City and BHWSD
$10.19/mo for Precipitation
$10.26/mo for Electrocoagulation
$12.83/mo for Reverse Osmosis

Should the City decide to proceed with silica removal without BHWSD financial participation, the monthly cost per ERU for the short-listed options is estimated as follows:

City-Only Project
$12.23/mo for Precipitation
$12.32/mo for Electrocoagulation
$15.41/mo for Reverse Osmosis

Any one of these costs would be in addition to treatment plant costs currently included in a customer's water bill.

FINANCIAL SUMMARY:
No funds have been allocated for further evaluation or constructing and operating silica removal treatment. Because the Mint Farm water treatment plant produces potable water meeting all federal and state regulations, it is unlikely this project would be awarded grants or low interest loans. All costs would be paid by BHWSD and/or City of Longview water utility customers.

RECOMMENDED ACTION:
Provide direction to staff regarding silica removal. Options include:

Discontinue further action - Do not remove silica
Decide to install silica removal and proof one or more alternatives for final design

Solicit customer opinions
Negotiate with BHWSD to allow City to install silica removal without BHWSD funding
Other

STAFF CONTACT:
Jeff Cameron, Public Works Director

Attachments: Presentation - Silica Technologies 07.06.17
June 22 2017 Silica Removal Agenda Summary
Evaluation of Silica Removal Alternatives_CH2MHill FINAL
Evaluation of Silica Removal Alternatives Attachments

City of Longview Engineer Amy Blain presented a staff report.

The Longview City Council & Beacon HIll Water & Sewer District Commissioners discussed the presented information. The consensus was to take no further action regarding silica removal at this time.

A motion was made by Council Member Melink, seconded by Council Member Vydra, to discontinue further action. The motion carried by the following vote:

Ayes: 5 - Mayor Don Jensen, Council Member Botero, Council Member Makinster, Council Member Melink and Council Member Vydra

Nayes: 1 - Council Member Moon

5. ADJOURNMENT

The joint meeting adjourned at 6:47 p.m.

NEXT REGULAR COUNCIL MEETINGS:
THURSDAY, JULY 27, 2017 - 7:00 P.M.
THURSDAY, AUGUST 10, 2017 - 7:00 P.M.

NEXT COUNCIL WORKSHOPS:
TUESDAY, JULY 18, 2017 - 6:00 P.M. POST-SESSION LEGISLATIVE UPDATE W/ MARK BROWN/DISCUSSION AND REVIEW OF SISTER CITY RELATIONSHIP

MINT FARM
WATER TREATMENT PLANT

1

TREATMENT TECHNOLOGIES EVALUATION
FOR
SILICA REMOVAL

JULY 6, 2017

Technologies for Silica Removal

3

Treatment Goal: 20-25 ppm silica concentration in finished water

Total Plant Capacity: 17.4 MGD

Volume Treated: 12 MGD to 17.4 MGD; treat portion required to meet goal

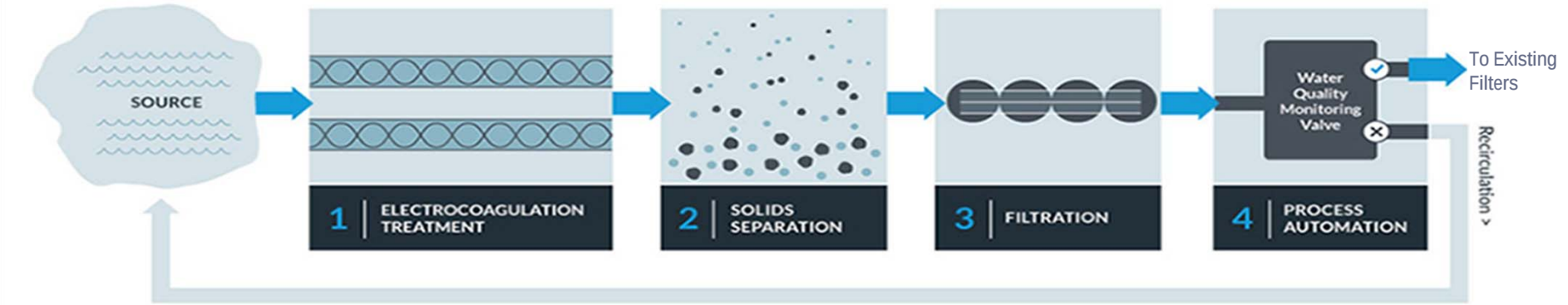
Short Listed Alternatives:

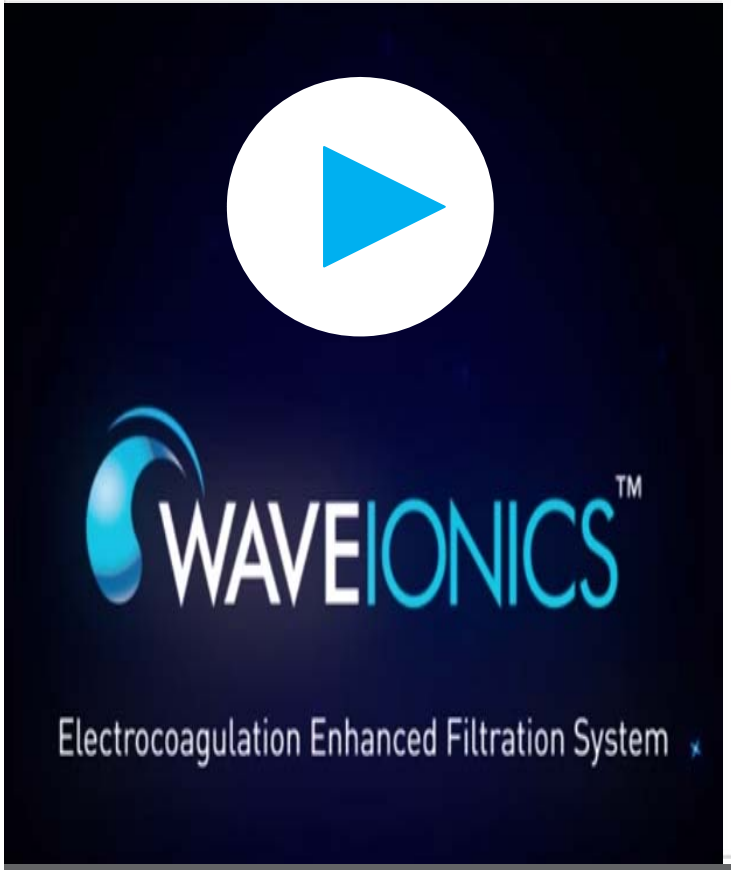
- Electrocoagulation
- Precipitation
- Reverse Osmosis

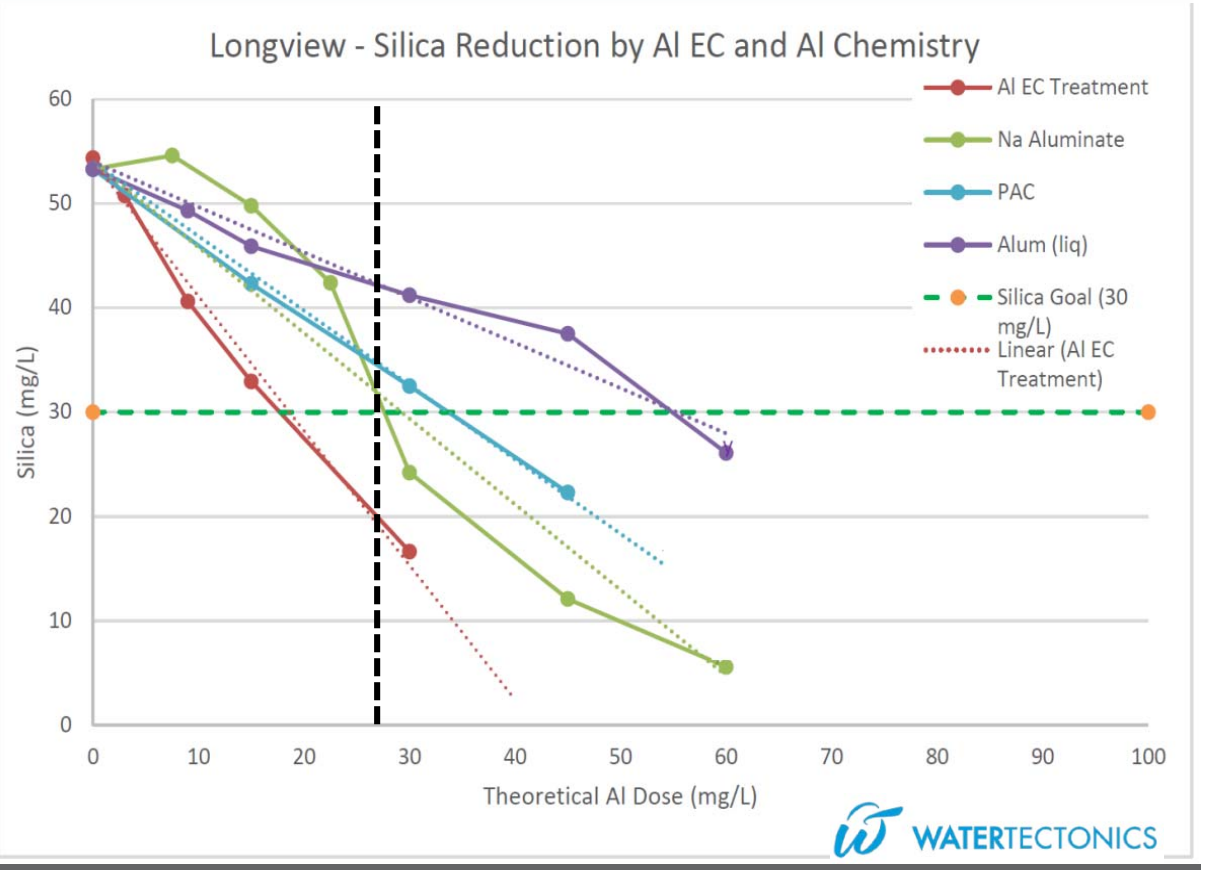
Eliminated from Consideration:

- ~~Lime Softening~~
- ~~Ion Exchange~~
- ~~Activated Alumina~~

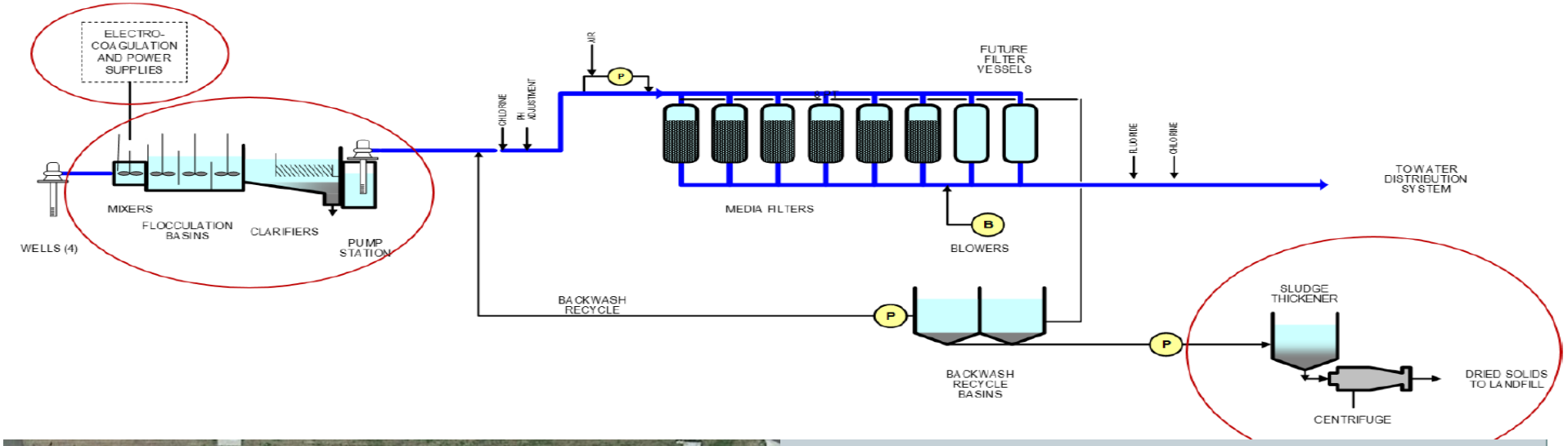
Silica Removal by Electrocoagulation





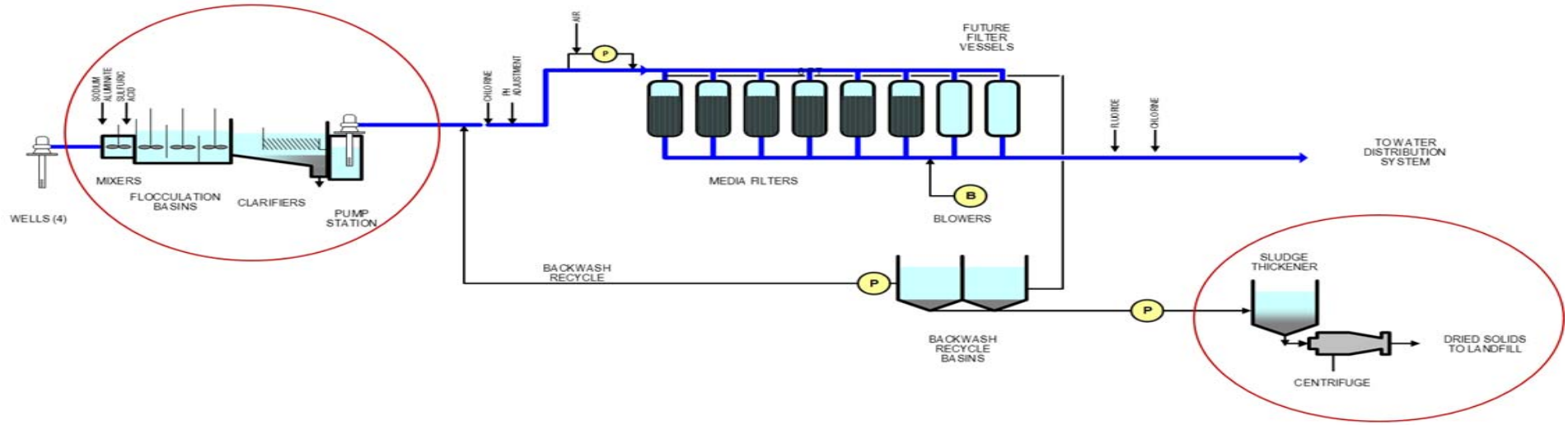


Silica Removal by Electrocoagulation



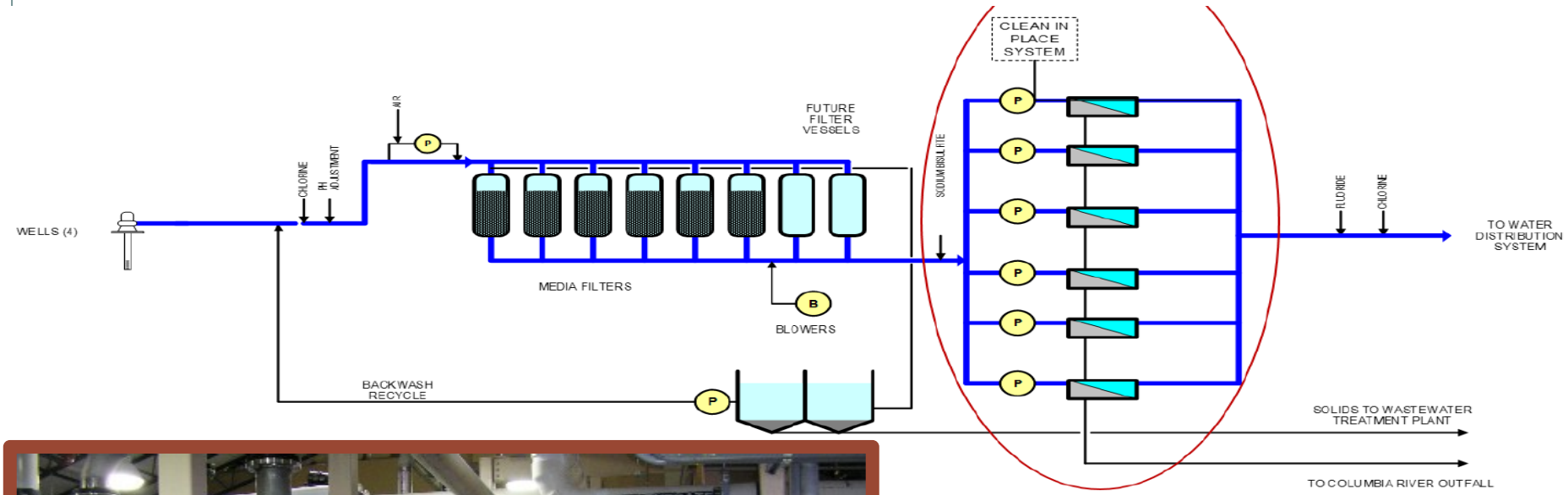
- New EC building
  - 12 megacells
  - 12 power supplies
- 2 treatment trains
  - Rapid mix → floc basin → clarifiers
- In-plant pump station
- Sludge dewatering
  - Dry solids to landfill

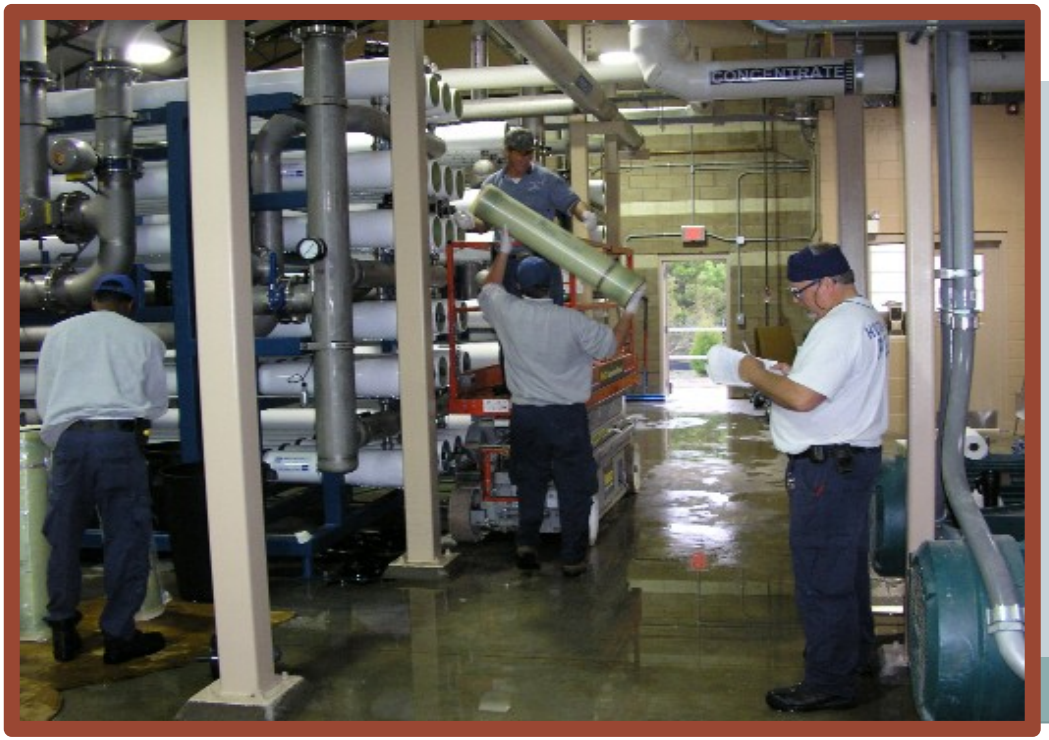
Silica Removal by Precipitation



- New chem feed building
  - Sodium Aluminate (precipitate Si)
  - Sulfuric Acid (reduce pH)
- 2 treatment trains
  - Rapid mix → floc basin → clarifiers
- In-plant pump station
- Sludge dewatering
  - Dry solids to landfill

Silica Removal by Reverse Osmosis





- New building for RO membranes
- Treat 75%, blend 25%
- No secondary pumping
- Sodium bisulfite for dechlorination
- Columbia River outfall for liquid waste

Finished Water Quality Summary

(mg/L)	Existing	EC	Precip	RO (75:25)	Fishers Lane
Dissolved Solids	223	223	333	55.8	~55
Aluminum	0.0028	0.11	0.24	0.0	< 0.05
Calcium	30.4	23	24	7.8	7.1
Magnesium	8.8	5.2	7.4	2.2	1.53
Iron	0.01	0.01	0.01	0.01	< 0.02
Manganese	0.004	0.004	0.004	0.0	< 0.005
Silica	54.4	19.9	12	14.5	23.9
Sodium	14.4	14.4	54	4.5	6.8
Hardness	108	108	108	27	33
Alkalinity	102	102	136	25.5	26

	Electrocoagulation	Precipitation	Reverse Osmosis
Capital Cost	$27.7 M	$19.9 M	$28.2 M
O&M Cost	$0.9 M/year	$1.3 M/year	$1.5 M/year
20-Yr Cost	$65.0 M	$64.6 M	$81.3 M
Cost/ERU	$12.32/month	$12.23/month	$15.41/month
Corrected*	**$10.26/month**	**$10.19/month**	**$12.83/month**
Pros			
Cons			

** CH2M used 22,000 ERU. Corrected to 26,400 combined ERU's for City of Longview and BHWSD*

	Electrocoagulation	Precipitation	Reverse Osmosis
Capital Cost	$27.7 M	$19.9 M	$28.2 M
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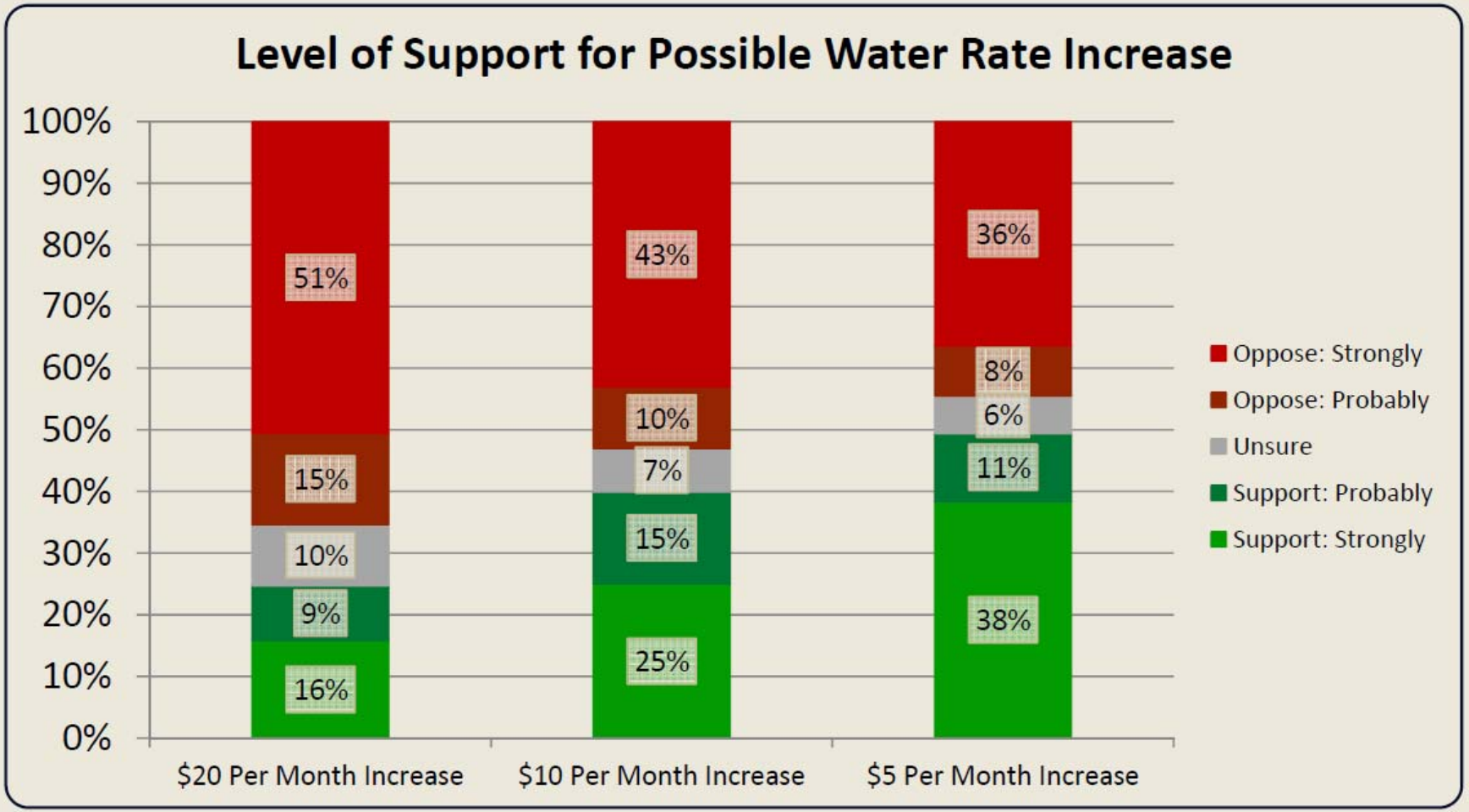
Cost/ERU	$12.32/month	$12.23/month	$15.41/month
Corrected*	**$10.26/month**	**$10.19/month**	**$12.83/month**
Pros	☺ Cutting edge ☺ Alternative to bulk chemical storage & feed ☺ May provide 4-log removal	☺ Proven technology ☺ Quicker to implement	☺ Removes Ca, Mg, H2S, Organic N ☺ Closest resemblance to Fishers Lane treated water
Cons	● Not NSF certified ● Typical Use < 1 MGD; scaled up system not yet proven ● Frequent anode cell replacement ● Won't remove Ca, Mg ● Double pumping ● Aluminum residual	● Higher chemical use ● Won't remove Ca, Mg ● Double pumping ● Aluminum residual ● Increased sodium ● Increased TDS	● 5-yr membrane life ● 30% waste stream ● Disposal methods ● Removes good stuff! ● Reduced alkalinity

** CH2M used 22,000 ERU. Corrected to 26,400 combined ERU's for City of Longview and BHWSD*

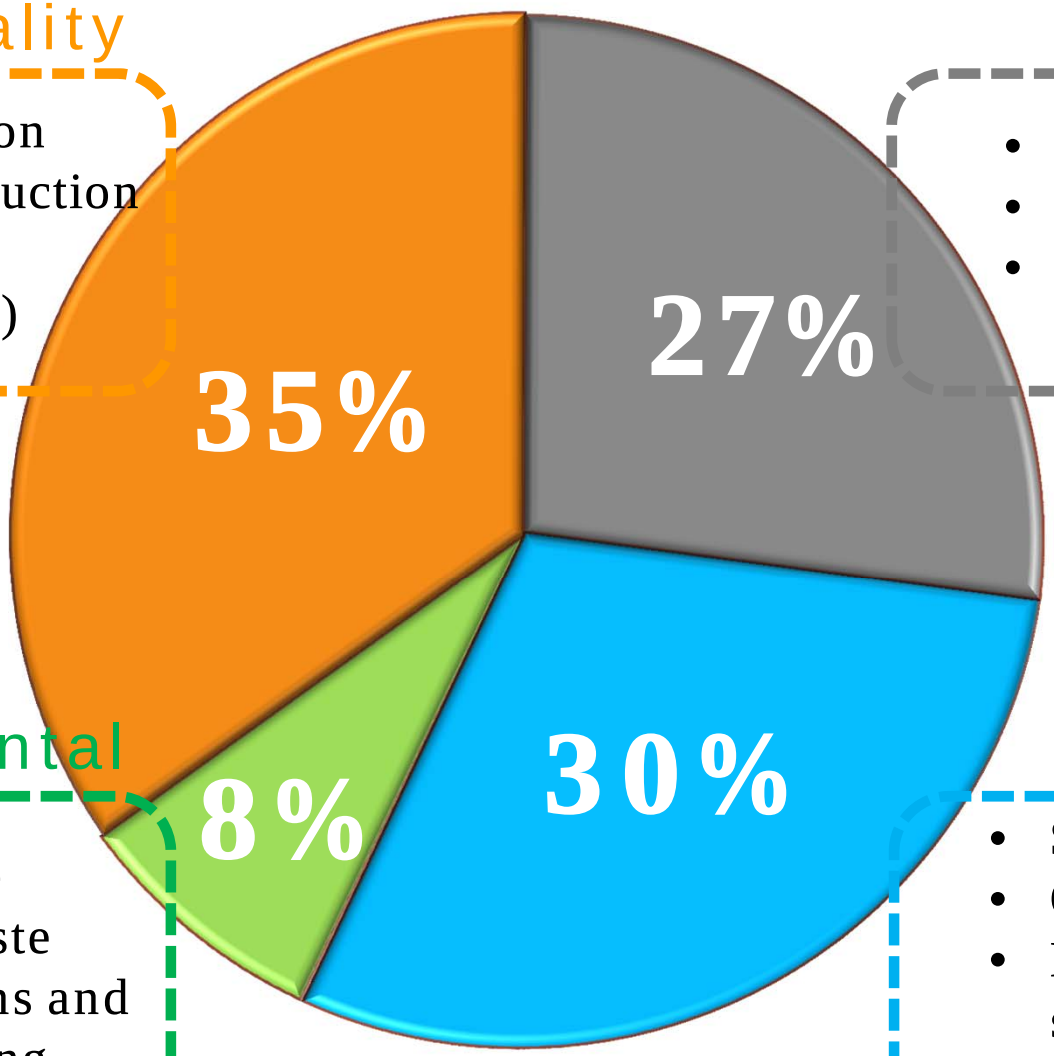
LEVEL OF SUPPORT FOR WATER RATE INCREASE

PROMPTED QUESTION: RESIDENTIAL

Nov-2014



Alternatives Evaluation Process



Water Quality

- Silica reduction
- Hardness reduction
- Other benefit (or detriment)

Economic

- Capital Cost
- O&M Cost
- Rate impacts

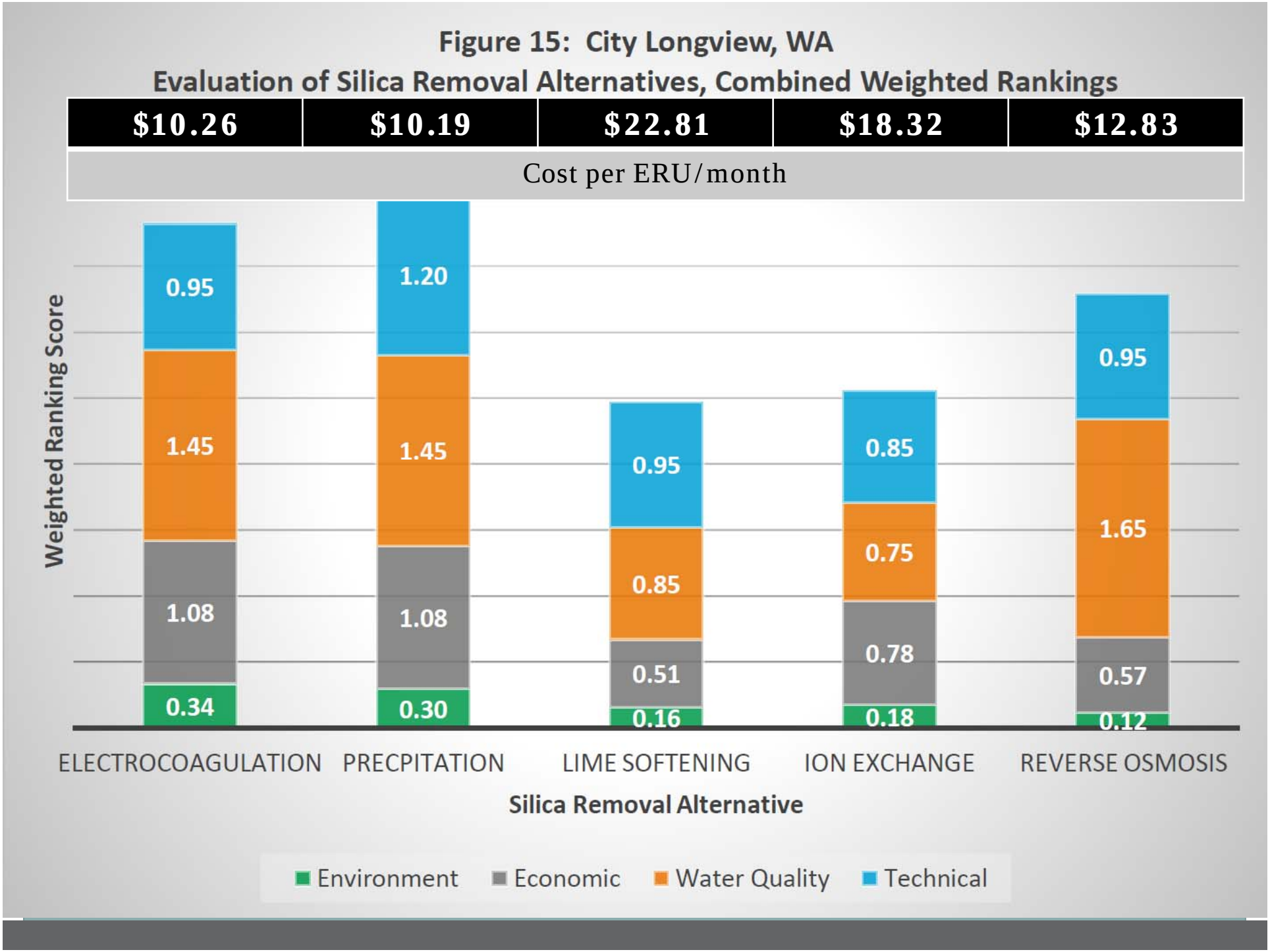
Environmental

- Chemical use
- Resource waste
- Waste streams and solids handling

Technical

- Safety
- Operability
- Distribution system impacts
- Expandability

Figure 15: City Longview, WA
Evaluation of Silica Removal Alternatives, Combined Weighted Rankings



Implementation Schedule

#	Task	Months to Complete	Complete
0	Decision	1	Aug-2017
1	Hire Consultant	3	Oct-2017
2	Pilot Testing	2-6	Feb-2018
3	Project Report	2	Feb-2018
4	DOH Approval	6-12	Feb-2019
5	Final Design	6	Aug-2018
6	Permitting	3	Nov-2018
7	Site Preload	9-12	May-2019
8	Construction	12	May-2020
9	Implementation	6	Dec-2020

Board Discussion

- Water Operating Board .....June 5, 2017
  - Role: Policy Board per Participants' Agreement
  - Task: Review CH2M report;
    Make recommendation regarding silica removal
  - Action: Deferred to Council and BHWSD on decision to proceed
    Precipitation preferred method if "Yes" to proceed
    2:1 vote (BHWSD rep voted No)

- Beacon Hill Board of Commissioners....June 21, 2017
  - Role: Joint Owner
  - Task: Review CH2M report;
    Make recommendation regarding silica removal
  - Action: No action taken – leaning toward no silica removal
    Willing to meet with Council

Council Discussion

- Provide direction to staff regarding silica removal options:
  - Discontinue further action - do not remove silica
  - Solicit customer opinions
    - Telephone survey
    - Ballot measure (council resolution due August 1)
  - Decide to install silica removal treatment
    - Proof one of more alternatives for design report
      - Select consultant and technology vendor via competitive process
      - Pilot test at larger scale
      - Pipe loop test to determine distribution system impacts
      - Qualititative testing
  - Other?

..Title

EVALUATION OF TREATMENT TECHNOLOGIES FOR SILICA REMOVAL AT THE MINT FARM REGIONAL WATER TREATMENT PLANT

COUNCIL STRATEGIC INITIATIVE ADDRESSED:

Provide sustainable water quality and environmental infrastructure.

CITY ATTORNEY REVIEW: N/A

SUMMARY STATEMENT:

The decision to cease further investigation of alternate sources of drinking water supply was coupled with a commitment to optimize water quality from the Mint Farm water treatment plant. In November 2016, staff was directed to pursue dissolved oxygen (DO) addition to address taste and odor issues; and to evaluate treatment options for silica removal to address spotting issues.

For DO, an invitation to bid will be advertised this month to construct an air injection DO system at the Mint Farm water treatment plant. Pending final project approval from the Department of Health, construction is expected to be complete by the end of this year. After completion, DO levels will be incrementally increased over a period of up to 9 months. Introduced slowly, DO will help harden existing pipe scale, reduce iron release, inhibit hydrogen sulfide reversion and formation of disinfection byproducts, and eventually temper our dependency on chlorine to maintain chemical stability in the distribution system.

Silica removal remains the more complicated issue. The white spots left behind when water evaporates consist of hardness (calcium and magnesium) and silica. Hardness can be wiped off but silica deposits can be difficult if not impossible to remove. To reduce spotting, a 75% reduction of silica is recommended to approximate the concentration customers previously experienced from the Cowlitz River. With that goal in mind, six treatment technologies were evaluated at bench test level to determine their effectiveness, cost, impacts and benefits. Using a triple bottom line evaluation approach, the better options for silica removal were narrowed to electrocoagulation, precipitation, and reverse osmosis. Options eliminated from consideration include lime softening, ion exchange, and adsorption using activated alumina.

A 20-year life cycle cost was developed for each of the alternatives based on annualized capital investment and annual expenses for operation and maintenance. The potential rate impact to customers was determined by the life cycle cost spread amongst all customers, and is reported as monthly cost per Equivalent Residential Units (ERU) where one ERU is defined as the average amount of water consumed by a single family residence in one day. With capital costs ranging from approximately $20-28 million, and annual O&M cost on the order of $1-1.5 million, the estimated monthly cost per ERU for the three short listed options is as follows:

$12.23/mo for Precipitation
$12.32/mo for Electrocoagulation
$15.41/mo for Reverse Osmosis

Any of these monthly costs would be in addition to the existing Mint Farm water treatment plant costs included in a customer's water bill.

Any selected silica removal option will require additional testing for regulatory approval and to prevent unintended consequences. Staff projects it will take 24-30 months to pilot, design, permit, construct and implement any of the options. Each treatment option presents inherent advantages and disadvantages which translate to differences in water quality, environmental, operability, and distribution system impacts. In addition to cost and rate impacts, the decision making process should carefully consider all of these factors, as well as the no-action alternative not to install silica removal treatment.

In accordance with the terms of the Participant's Agreement between the City and Beacon Hill Water and Sewer District (BHWSD), BHWSD own approximately 15% of the Mint Farm Regional Water Treatment Plant and BHWSD board of commissioner concurrent is necessary to construct additional treatment processes. The BHWSD board is scheduled to consider silica removal options at their meeting on June 21. Depending on BHWSD board action at that meeting, a joint meeting between the city council and BHWSD board may be prudent to mutually discuss this treatment decision.

FINANCIAL SUMMARY:
No funds have been allocated for further evaluation or constructing and operating silica removal treatment. Because the Mint Farm water treatment plant produces potable water meeting all federal and state regulations, it is unlikely this project would be awarded grants or low interest loans. All costs would be paid by City and BHWSD water utility customers.

RECOMMENDED ACTION:
Provide direction to staff regarding silica removal; some options require BHWSD concurrence. Options include:

Discontinue further action – do not remove silica
Schedule joint meeting with BHWSD board to discuss silica removal
Proof one or more alternatives
Select alternative and begin design/construction
Solicit customer opinions
Other

STAFF CONTACT:
Jeff Cameron, Public Works Director

Evaluation of Silica Removal Alternatives Mint Farm Regional Water Treatment Plant

PREPARED FOR:	City of Longview, WA & Beacon Hill Water and Sewer District
PREPARED BY:	CH2M
DATE:	May 18, 2017
PROJECT NUMBER:	650582.03.35.13.03
REVISION NO.:	5

Introduction

The City of Longview (City) and Beacon Hill Water and Sewer District (District), of Washington State developed the Mint Farm Regional Water Treatment Plant (MFRWTP) which includes a new groundwater wellfield, and treatment facilities for iron and manganese removal from the source water. The Mint Farm supply began operating on January 31, 2013. Soon thereafter, some customers began experiencing objectionable taste, odor and color of their drinking water when the new source was introduced, replacing the previous surface water supply system. The City and District received extensive customer input and conducted water quality monitoring, flushing, distribution system ice pigging, and in some cases, main replacement to address many of the concerns.

Most of the discoloration problems were addressed in 2013. However, concerns remained over taste and odors and silica coating on glassware, showerheads, appliances, and other products the water contacted and was allowed to dry upon.

The taste and odor issues were identified as most likely the result of chlorinating organic nitrogen compounds in the well water, and hydrogen sulfide reversion from polysulfide compounds in customer's premise piping where reducing conditions may be present.

As a result, the City and District decided to install a system to add dissolved oxygen to the water supply to mitigate both the taste and odor issues and provide additional stability to distribution system pipe scaling potential.

To address the silica issues, the City and District requested an alternatives treatment strategies evaluation including laboratory testing be conducted to determine potential solutions to reduce the silica entering into the distribution system from the groundwater supply. Upon discussion with the City and the District, it was decided to conduct an evaluation of the following five treatment alternatives:

1. Electrocoagulation
2. Aluminum precipitation
3. Lime softening
4. Reverse osmosis
5. Ion exchange

Bench (Laboratory) testing using water from the MFRWTP was conducted on the first four alternatives in order to witness and document the effectiveness of each treatment process and to provide information in order to determine the appropriate size of capital facilities and determine ongoing O&M needs. Ion Exchange effectiveness and costs were developed using two ion exchange models developed by the

DOW Chemical Company and Purolite and were not bench tested. Each of the alternatives are discussed below.

Introduction to Silica Removal

The groundwater supply for the MFRWTP is provided by water pumped from the underground formation known as the Columbia River Basalt group. This formation is a large igneous formation that underlies a large area of the Pacific Northwest, including the Columbia River channel, in Oregon and Washington States[1]. Silicon concentrations in the Columbia River Basalts are approximately 50% of the minerals makeup.[1]

Total silica measured in water is in either the reactive or colloidal form. The City of Longview has tested for reactive silica and colloidal silica and has found that in the Mint Farm supply, all of the measureable silica is in the reactive form.

The reactive portion of the total dissolved silica can be measured using the standard molybdate colorimetric test. The reactive form is silicon dioxide dissolved in water, creating the compound monosilicic acid (H_4SiO_4), as shown in Equation 1:

$$SiO_2 + 2H_2O \; H_4SiO_4 \qquad \textit{Eq. 1}$$

Silica is relatively un-ionized at most natural pH levels, but can dissociate to $H_3SiO_4^-$, as shown in equation 2, at pH above 9.

$$pK_a = \frac{[H_3SiO_4^-][H^+]}{[H_4SiO_4]} = 9 \text{ to } 10, \text{ depending on the silica concentration.} \qquad \text{Eq. 2}$$

Monosilicic acid attracts four additional water molecules beyond the two that make up part of the molecular structure in the hydrated state. The structure exists as shown in Figure 1.

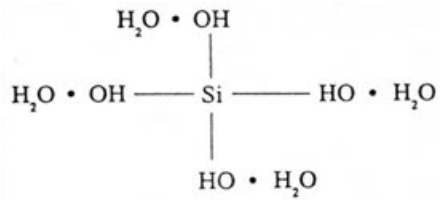


Figure 1. Monosilicic acid structure[2]

The colloidal species is generally thought to be either silicon that has polymerized with multiple units of silicon dioxide, or silicon that has formed loose bonds with organic compounds or with other complex inorganic compounds -- usually aluminum and calcium oxide structures.

Silica Treatment Options

Several technologies have been used for silica removal in industrial water applications, and some in municipal applications. Treatment systems to remove silica in municipal applications nearly always have other treatment objectives like softening or total dissolved solids reduction. The City of Longview's objective is solely the reduction in silica content, but some of the treatment options provide these additional benefits.

The treatment technologies investigated included electrocoagulation – filtration, precipitation-filtration, lime softening, reverse osmosis, and ion exchange. Each of these technologies has its benefits and drawbacks as discussed below.

Electrocoagulation

Electrocoagulation has been used for several years in reverse osmosis (RO) pretreatment, cooling tower, and produced water applications[6]. WaterTectonics, of Everett, WA also has optimized removal using the addition of aluminum precpitates[7]. Other vendors also provide equipment for EC treatment, although WaterTectonics was consulted due to their locale, and sites that have their system installed in SW Washington.

Precipitation

Sandia National Laboratories[4] recently tested a number of precipitates for silica removal in cooling tower water, including aluminum sulfate, aluminum chloride, sodium molybdate, polyaluminum chloride, magnesium chloride, lime softening and sodium aluminate. The results showed that several precipitates could achieve greater than 75% removal, as shown in Table 1.

Table 1

Sandia National Laboratory Silica Precipitants that achieved greater than 75% Removal

Precipitant	Best % Silica Removed	Efficiency as ppm SiO2/ppm Al	Optimizing Conditions	Other Considerations
Sodium Molybdate*	95%	0.05	pH<4	Expensive
PAX 18 (Proprietary polyaluminum chloride)	99%	0.43	pH 8.0 – 8.2	Proprietary, large NaOH demand
$AlCl_3$** (Aluminum chloride)	92-98%	0.41 – 0.44	pH 8.0 – 8.2	Acidifying, NaOH demand
$NaAlO_2$ (Sodium aluminate)	94%	0.47	pH 8.0 -8.2	Slightly alkalizing, small H_2SO_4 demand

*Sodium Molybdate and another precipitate (PAX10) were only tested on concentrated tower water, while data from other candidates comes from tap water. Larger amounts of SiO_2 are available for capture from tower water. (PAX10 did not remove more than 50% of the silica)

**The efficiency range for AlCl3 reflects difference between alkali pretreatment (pH >11) or not, with the pretreatment giving a slightly better outcome

Lime Softening

Lime softening has been widely used in industrial applications, primarily for cooling tower and boiler feed applications. In lime softening, silica is removed by adsorption onto magnesium precipitates, which generally occur at higher pH (above 10.5, and often require addition of a magnesium source)[2]. The most efficient way to add magnesium is through the addition of magnesium chloride.

Reverse Osmosis

Reverse osmosis (RO) works effectively for silica removal for both colloidal and reactive forms. Membrane fouling is an issue above 200 ppm in the concentrate, so multiple stages are difficult to implement, and the concentrate volumes are often large (20 to 30% of the feed rate).

Ion Exchange

Ion Exchange has been used effectively for silica removal[5]. Silica can only be removed in its ionized state, so pH adjustment above 9.5 is required. Strong base anion exchange resin in the hydrogen form is the most effective means of removal. Removal efficiencies and selectivity are similar to bicarbonate alkalinity. A specific type of two stage ion exchange has been developed, and it is referred to as a *desilicizer.* An anion desilicizer consists of a strong cation exchange resin in the sodium form (a water softener) followed by a strong base anion exchange resin in the hydroxide form. Demineralizers are also used for silica removal. Each type of ion exchange is subject to resin fouling from silica and can experience chromatographic peaking as sulfate, nitrate, chloride or other more selective anions displace the silica.

Bench Testing

Bench testing of Electrocoagulation, Lime Softening, Precipitation, and flow through testing of Reverse Osmosis membranes, using water collected from the Mint Farm, and their abilities to remove Silica are discussed below. Based on the previous water supply from the Fishers Lane Water Treatment Plant where Silica content was approximately 20 to 25 mg/L, the goal set for these treatment evaluations was to obtain a 50 to 75-percent reduction of Silica delivered from the Mint Farm supply system. This meant the goal of Silica content after treatment would be 14 to 28 mg/L.

Electrocoagulation Bench Testing (by Vendor)

Electrocoagulation has been used extensively in water treatment for mining water treatment, oil and gas produced water, industry process, industrial wastewater and stormwater applications, but there are very few municipal installations that use electrocoagulation for drinking water treatment. Because of that limited experience, the City contracted with a leading electrocoagulation company; WaterTectonics, of Everett, WA to conduct bench testing and help in developing Capital and Operations and Maintenance (O&M) costs for this option. Their testing report is included as Attachment A to this technical memorandum.

WaterTectonics (WT) testing used a bench-top EC unit, using aluminum (AL) anodes. In addition, WT checked the EC results using chemical precipitation with multiple aluminum based coagulants. Raw and filtered water samples were obtained from the City of Longview for the testing. 500 milliliter (mL) samples were tested using batch treatment laboratory scale EC at a constant current and varying treatment times. WT calculated theoretical Al doses based on their EC treatment conditions. Chemical precipitation was conducted in a similar manner. The pH was corrected to the City's treatment goal of approximately 7.7. Rapid mixing and flocculation were simulated in the 500 mL sample jars, then the samples were allowed to settle and the supernatant was filtered using 8 micron filter paper. Figure 2 shows the results of the EC silica reduction of treated water. Figure 3 shows the comparison of the EC results with multiple precipitates used by WT.

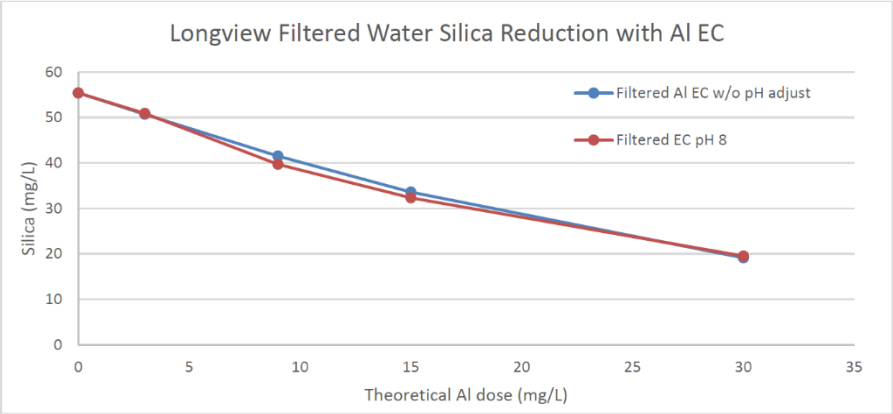


Figure 2 – WaterTectonics Bench Scale EC treatment of Longview Filtered Water for Silica Reduction

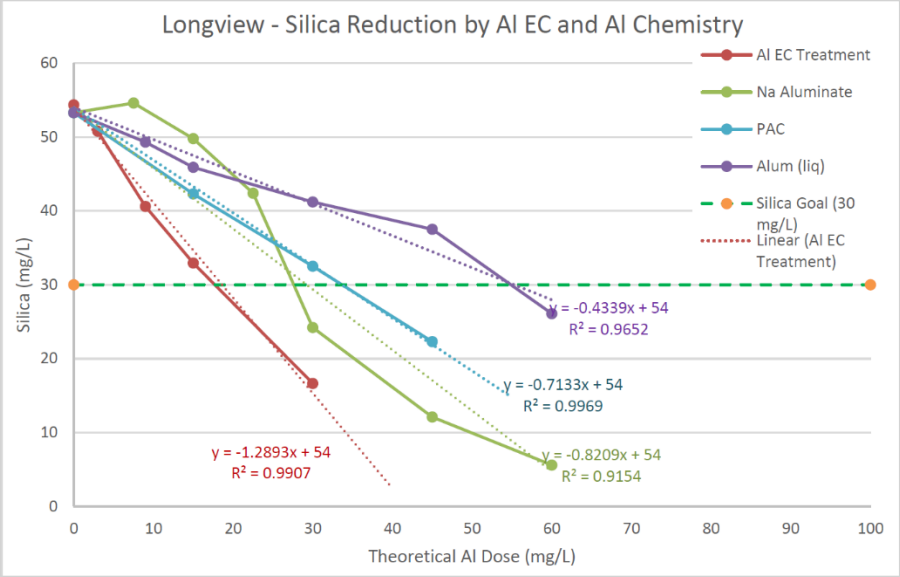


Figure 3 – WaterTectonics Bench Scale EC and Chemical treatment comparison

The results indicate that EC was more effective than Chemical Precipitation when comparing them on the basis of Aluminum dose. The EC treatment also did not require pH adjustment as the chemical treatment alternatives did.

The silica goal, as shown as the green dashed line on Figure 3, represents approximately a 50% reduction in silica from the Mint Farm system, but the testing clearly shows that removal of 75% or greater can be obtained.

CH2M Bench Testing

CH2M also obtained samples of raw water and filtered water from the Mint Farm system. Raw water was used for testing the lime softening and precipitation options, whereas the filtered water was used for the reverse osmosis flow through testing.

Water Characterization

The characterization of raw and filtered waters as currently treated, is shown in Table 2.

Table 2. Mint Farm Raw Water and Filtered Water Characterization

Parameter	Units	Raw Water	Filtered Water
Barium	µg/L	13.6	19.8
Boron	µg/L	<100 U	29.3 J
Calcium	µg/L	33,000	30,400
Iron	µg/L	957	<10.0 U
Magnesium	µg/L	9,140	8,770
Manganese	µg/L	630	0.41 J
Potassium	µg/L	3,960	4,110
Total Silica	µg/L	56,900	54,300
Reactive Silica	µg/L	59,000 S	68,000 S
Sodium	µg/L	11,700	14,400
Strontium	µg/L	93.2	92.5
Hardness, Ca	mg/L as $CaCO_3$	82.4	75.9
Hardness, Mg	mg/L as $CaCO_3$	37.6	36.1
Hardness, total	mg/L as $CaCO_3$	120	112
Alkalinity, total	mg/L as $CaCO_3$	47.3	102
Alkalinity, bicarbonate	mg/L as $CaCO_3$	<5.00 U	102
pH	Units	7.45	7.5
Turbidity	NTU	3.78	0.31
Conductivity	µS/cm	296	305
Total Dissolved Solids	mg/L	211	223
Ammonia	mg/L-N	0.16	<0.10 U
Nitrate	mg/L-N	<0.010 U	0.0098 J
Nitrite	mg/L-N	<0.010 U	<0.0030 U
TKN	mg/L-N	0.52	0.26
Chloride	mg/L	28.4	32.2
Sulfate	mg/L	1.08	1.18
Fluoride	mg/L	<0.20 U	0.19 J
TOC	mg/L	1.52	1.04
Hardness, Ca	mg/L as $CaCO_3$	86	80.0
Hardness, Mg	mg/L as $CaCO_3$	32	28.0
Hardness, total	mg/L as $CaCO_3$	118	108
J	= Estimated value below reporting limit.		
S	Reactive Silica is a wet chemistry method that is not as accurate as the method for measuring Total Silica. These results indicate that essentially all of the Total Silica is in the reactive or ionized form.		
U	= Not detected at specified detection limit.		

Laboratory Materials

Reagents used in the bench testing are included in Attachment B, along with all of the bench testing results conducted by CH2M. Bench tests were conducted using 2 liter cells and a Phipps & Bird six-gang Jar Tester. Rapid mixing was simulated using 300 revolutions per minute (RPM) for 1 minute. Three stage flocculation was simulated at 60, 40 and 20 RPM for 10 minutes per stage. Flocculation observations and photos are included in Attachment B.

Lime Softening

Figure 4 shows the results of lime softening jar tests without magnesium chloride addition. Silica was slightly removed as pH increased from 10.2 to 11, but none of the results achieved 50% or 75% removal.

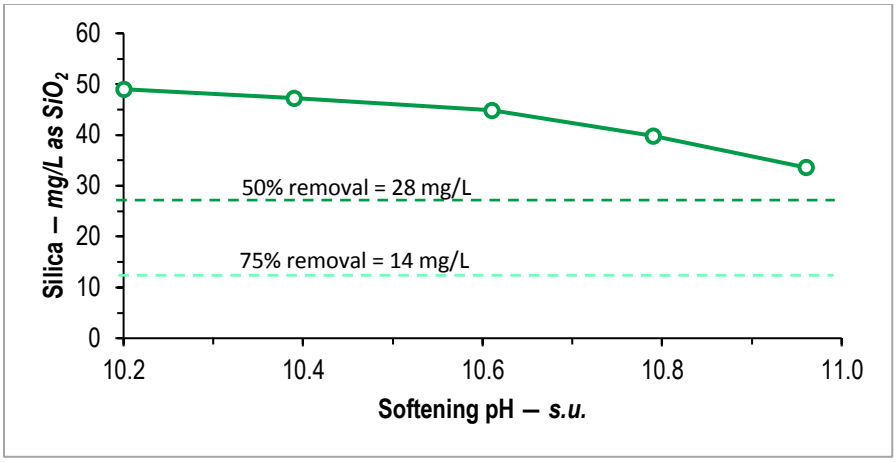


Figure 4, Silica removal vs pH of lime softening, no magnesium chloride removal

The second set of jar tests was performed with lime softening at pH 11 and the addition of 50 mg/L of magnesium chloride as magnesium. The mixing was varied from 15 minutes to 120 minutes. Figure 5 shows the silica concentration for the various mixing times. The figure shows that lime softening with magnesium chloride reduced silica by at least 50% after 30 minutes of mixing time, but even with 120 minutes of mixing, 75% removal was not achieved. Finished water pH was calculated using WaterPro™ software with carbon dioxide reduction. The resulting softened water at pH 7.8 was approximately 80 mg/L as $CaCO_3$, which represents a 33% reduction from the raw water.

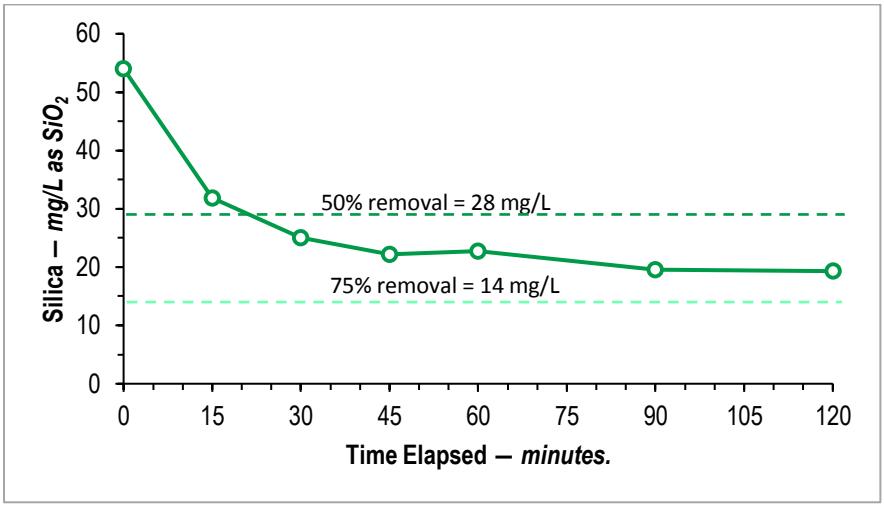


Figure 5. Reactive silica with lime softening and magnesium chloride addition, various mixing times

Precipitation

Jar tests were conducted using sodium aluminate and aluminum sulfate (alum). The best results were obtained with pH adjustment to approximately 8.0 to 8.2. Figure 6 shows the precipitation results for alum and sodium aluminate. The sodium aluminate reduced silica by more than 75% for each of the three doses shown (40, 80 and 120 mg/L as Al). The alum significantly reduced silica, but not as effectively as sodium aluminate. Sodium aluminate increases pH, so pH reduction was accomplished with sulfuric acid. Alum lowers the pH, so pH adjustment was conducted with sodium hydroxide.

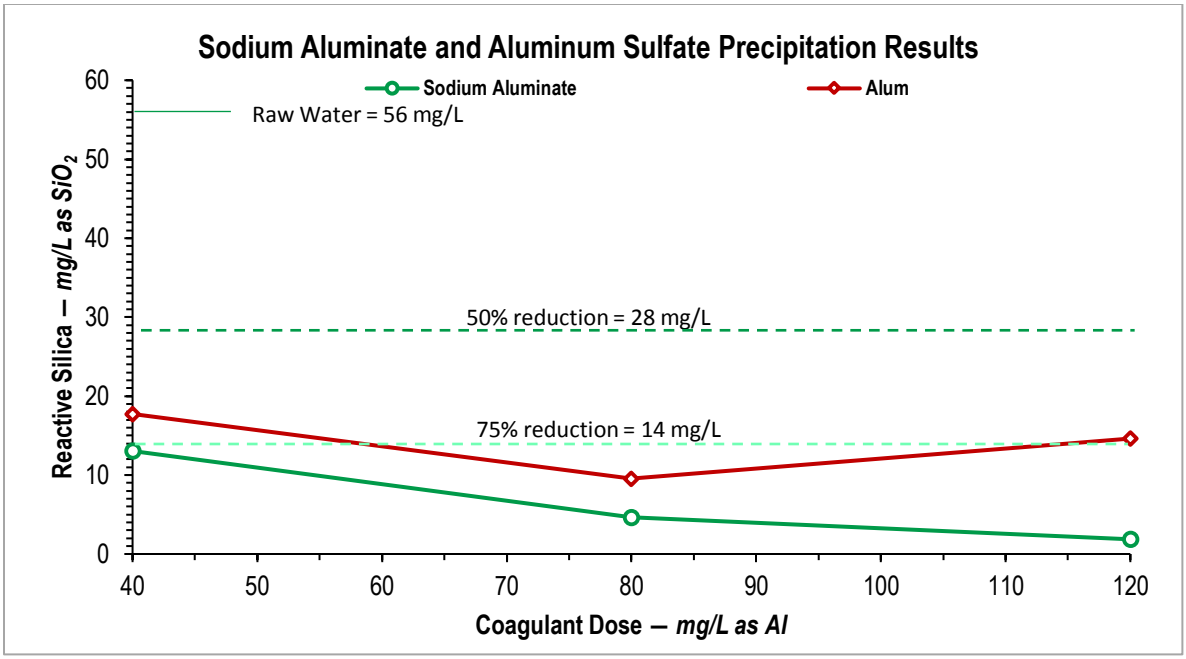


Figure 6. Silica levels with Precipitation using Aluminum Sulfate and Sodium Aluminate with pH adjustment

Reverse Osmosis

Reverse osmosis was tested using a flow through RO skid, shown in Figure 7. The RO membrane was a Hydronautics model ESPA2-2540 cartridge. This membrane is a low pressure RO membrane, typically used for brackish water treatment. Typical feed pressures are 200 to 300 psi. The molecular weight cutoff for this membrane is 50 daltons, so it is expected to remove silica, but may not remove salts. The reactive silica and total dissolved solids (TDS) in the Feed water (pre-RO filtered water from the Mint Farm WTP), Permeate (post-RO finished water to customers) and the Concentrate (waste stream), are shown in Figure 8. A comparison of water quality for each of the three RO water streams is included in Table 3. The RO membrane essentially removed all of the silica from the feed stream, and all of the TDS. The RO membrane was operated at a 61% recovery rate. This recovery rate means that 39% of the feed water was expelled as concentrate, or as a waste stream. In some low salt RO applications the recovery rate can be much lower, however with silica there are concerns over membrane fouling, and this recovery rate would also be expected at full scale.

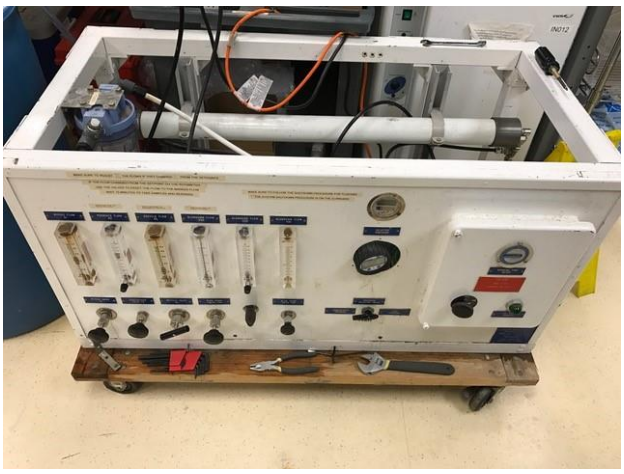


Figure 7. Flow through RO Skid with Hydronautics ESPA2-2450 RO cartridge

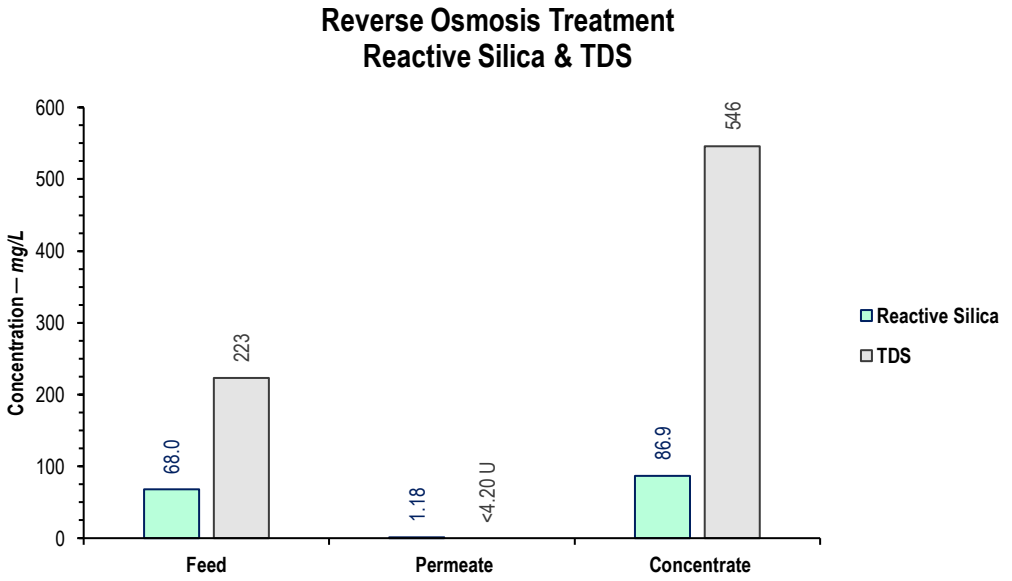


Figure 8. Silica and Total Dissolved Solids for Reverse Osmosis feed, permeate and concentrate streams

Table 3. Comparison of RO Feed Water, Permeate, and Concentrate Streams

Parameter	Units	RO Feed — *61% Recovery*	RO Permeate — *61% Recovery*	RO Concentrate — *61% Recovery*
Barium	µg/L	19.8	<0.25 U	68.2
Boron	µg/L	29.3 J	21.2 J	37.3 J
Calcium	µg/L	30,400	<200 U	82,500
Iron	µg/L	<10.0 U	<10.0 U	<10.0 U
Magnesium	µg/L	8,770	52.2 J	22,900
Manganese	µg/L	0.41 J	<0.025 U	1.23
Potassium	µg/L	4,110	300 J	10,500
Total Silica	µg/L	54,300	1,190	145,000
Reactive Silica	µg/L	68,000 S	1,180 S	86,900 S
Sodium	µg/L	14,400	1,160	35,200
Strontium	µg/L	92.5	<2.50 U	238
Hardness, Ca	mg/L as $CaCO_3$	75.9	<0.50 U	206
Hardness, Mg	mg/L as $CaCO_3$	36.1	0.21	94.3
Hardness, total	mg/L as $CaCO_3$	112	0.21	300
Alkalinity, total	mg/L as $CaCO_3$	102	<5.00 U	251
Alkalinity, bicarbonate	mg/L as $CaCO_3$	102	<5.00 U	251
pH	Units	7.5	7.9	7.0
Turbidity	NTU	0.31	0.15	0.49
Conductivity	µS/cm	305	8.16	749
Total Dissolved Solids	mg/L	223	<4.20 U	546
Ammonia	mg/L-N	<0.10 U	<0.10 U	<0.10 U
Nitrate	mg/L-N	0.0098 J	<0.0028 U	0.014
Nitrite	mg/L-N	<0.0030 U	<0.0030 U	<0.0030 U
TKN	mg/L-N	0.26	0.24	0.79
Chloride	mg/L	32.2	0.89	84.8
Sulfate	mg/L	1.18	0.72	3.04
Fluoride	mg/L	0.19 J	0.065 J	0.51
TOC	mg/L	1.04	<0.20 U	2.56
Calcium	mg/L	32.0	0.40	84.9
Magnesium	mg/L	6.80	<0.24 U	18.5
J	= Estimated value below reporting limit.			
S	=Reactive Silica is measured through wet chemistry and is not as accurate as the Total Silica test. Reactive Silica is used to determine how much of the Total Silica is ionized.			
U	= Not detected at specified detection limit.			

Conceptual Designs and Cost Estimates

The current Mint Farm Water Regional Water Treatment Plant process flow diagram is shown in Figure 9. Conceptual designs and cost estimates are provided herein for the following treatment options:

1. Electrocoagulation
2. Aluminum precipitation
3. Lime softening
4. Reverse osmosis
5. Ion exchange

Each of these options, along with modified process flow diagrams to show how the options are integrated into the existing Mint Farm plant, are discussed below. In order to evaluate all of the options on an even platform, several cost assumptions have been made and are applied to each option.

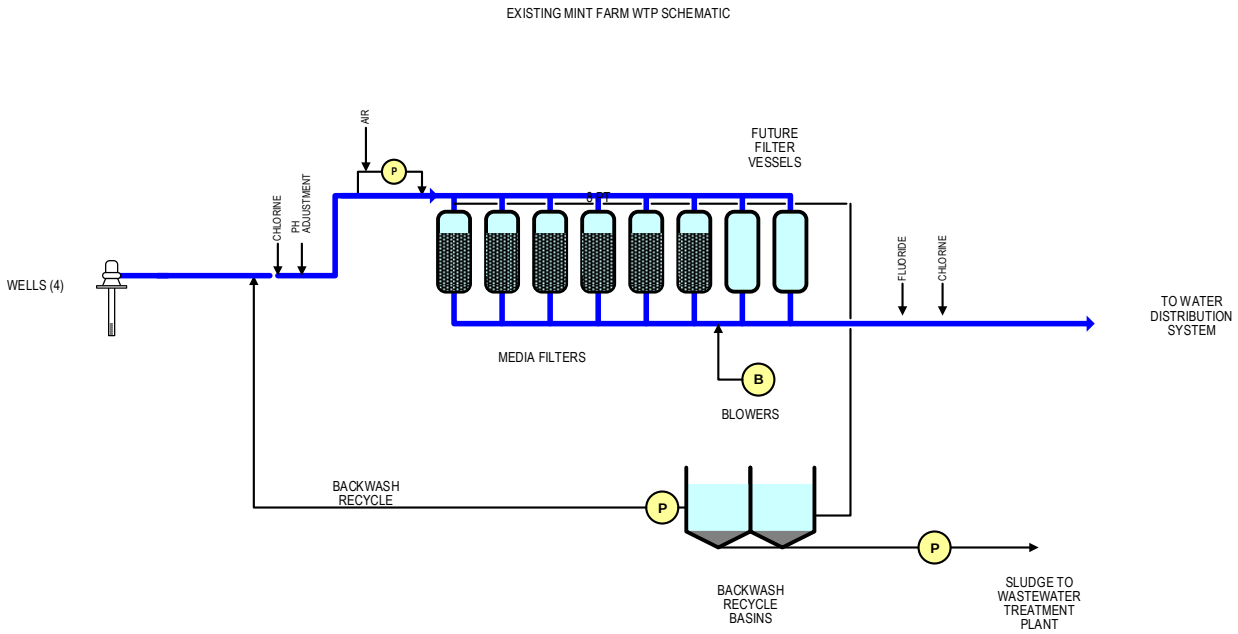


Figure 9. Existing Mint Farm Regional Water Treatment Plant Process Schematic

Electrocoagulation

WaterTectonics provided capital equipment costs, which are included in Attachment A. The modified process flow diagram is shown in Figure 10. New equipment includes:

- Twelve electrocoagulation cells (10 online and 2 redundant), which would be housed in a new CMU building
- Twelve power supplies
- An inline (in pipe) rapid mixer, in a CMU building
- Two trains of flocculation basins with 30 minutes of hydraulic residence time, covered
- Two trains of high rate clarifiers using lamella plates, covered
- In plant pump station in a CMU building
- Sludge thickener and dewatering (centrifuge with polymer feed) in a CMU building

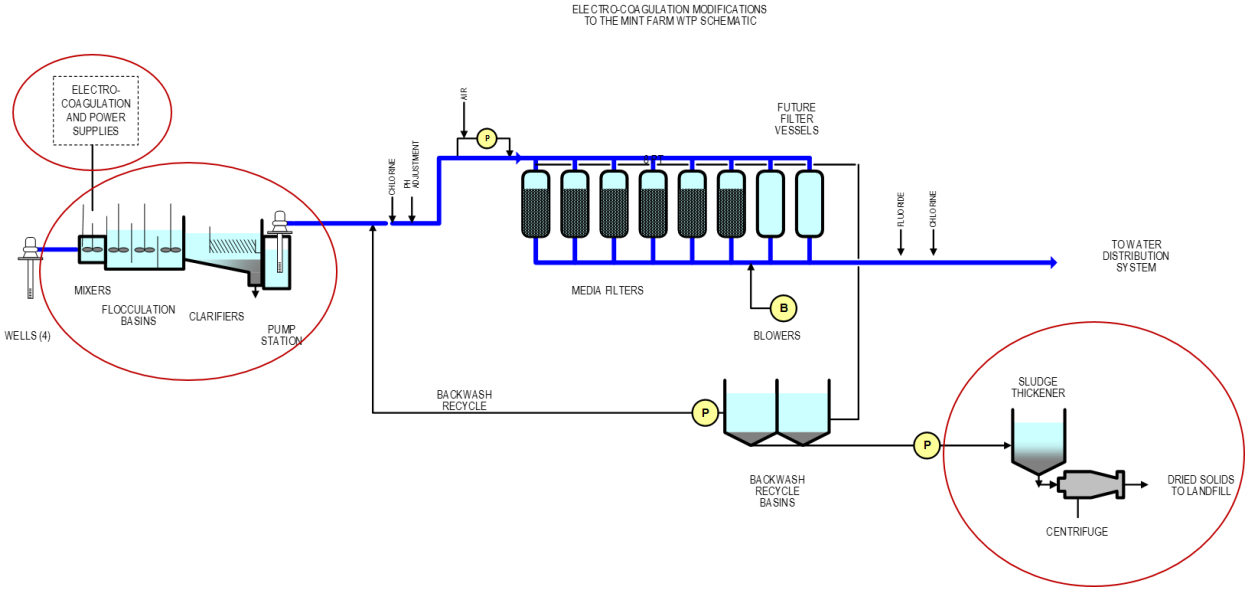


Figure 10. Electrocoagulation Modification to the Mint Farm Regional Water Treatment Plant

Precipitation

The precipitation modification for silica is shown in Figure 11, and includes the following modifications.

- A new chemical feed building (CMU building) with sodium aluminate and sulfuric acid feed systems
- An inline (in pipe) rapid mixer, in a CMU building
- Two trains of flocculation basins with 30 minutes of hydraulic residence time, covered
- Two trains of high rate clarifiers using lamella plates, covered
- In plant pump station in a CMU building
- Sludge thickener and dewatering (centrifuge with polymer feed) in a CMU building

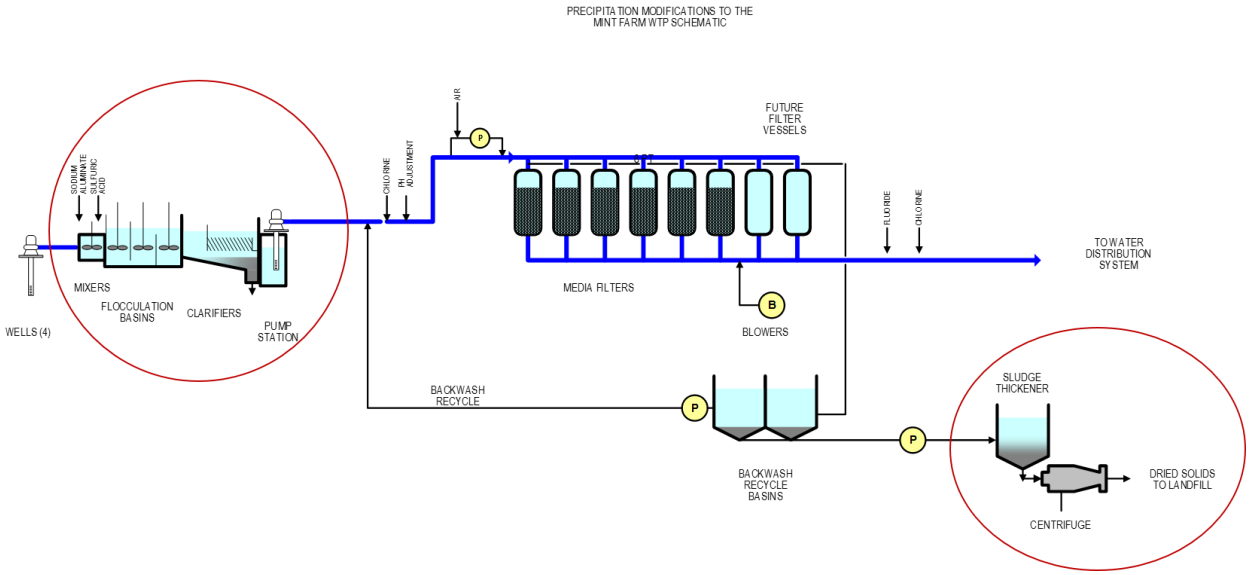


Figure 11. Precipitation Modification to the Mint Farm Water Treatment Plant

Lime Softening

Lime softening modifications are shown in Figure 12 and include the following modifications:

- A new chemical feed building (CMU) with lime, soda ash and magnesium chloride feed systems
- Two center-feed, upflow, sludge contact clarifiers
- In plant pump station in a CMU building
- Sludge thickener and dewatering (centrifuge with polymer feed) in a CMU building

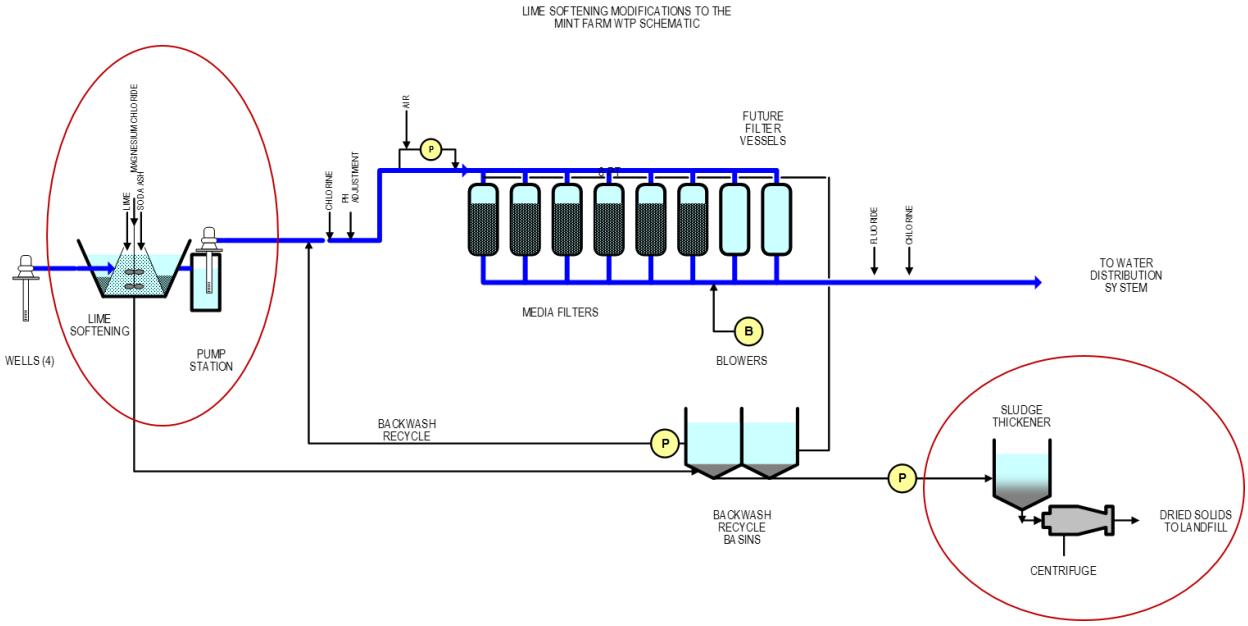


Figure 12, Lime Softening Modifications to the Mint Farm Regional Water Treatment Plant

Ion Exchange

Ion exchange modifications to the Mint Farm Water Treatment Plant are shown in Figure 13, and include the following:

- Cation and anion exchange softeners
- Regeneration equipment for salt and sodium hydroxide
- Well pump modifications

It is assumed that the ion exchange system will be a pressure filter system, requiring modifications to the well pumps to provide an additional 50 feet of total dynamic head, thereby not requiring intermediate pumping. In addition, this alternative assumes the liquid regeneration waste will be conveyed to the sanitary sewer (TDS of the waste stream is estimated at 15,000 mg/L).

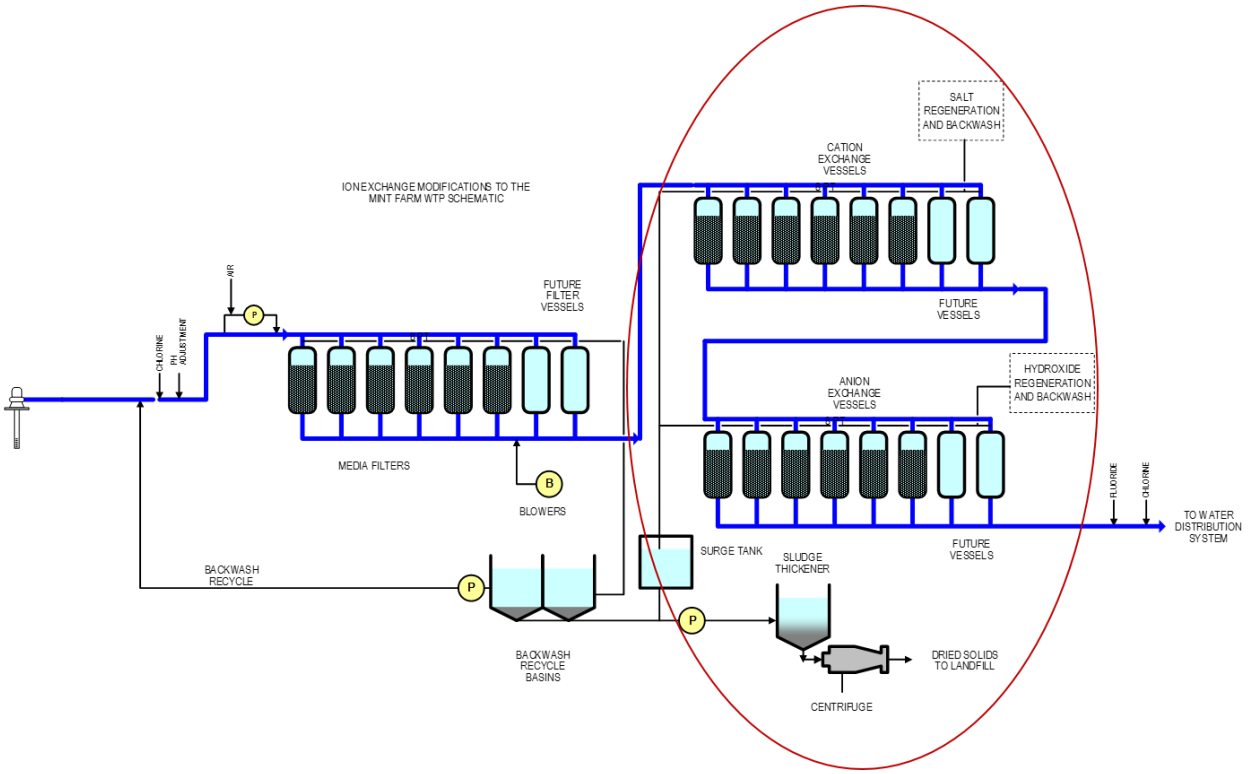


Figure 13. Ion Exchange modifications to the Mint Farm Water Regional Treatment Plant

Reverse Osmosis

The reverse osmosis modifications to the Mint Farm water treatment plant are shown in Figure 14, and include:

- Single Stage, Low Pressure RO, with clean in place system, energy recovery, and in plant pumping system, sized for 9 mgd permeate (12 mgd) feed and blended 75% RO water with 25% filtered water in a CMU building.
- A discharge pipe, and outfall to the Columbia River, which will require a new NPDES discharge permit.
- A sodium bisulfite feed system for de-chlorination prior to the RO system.

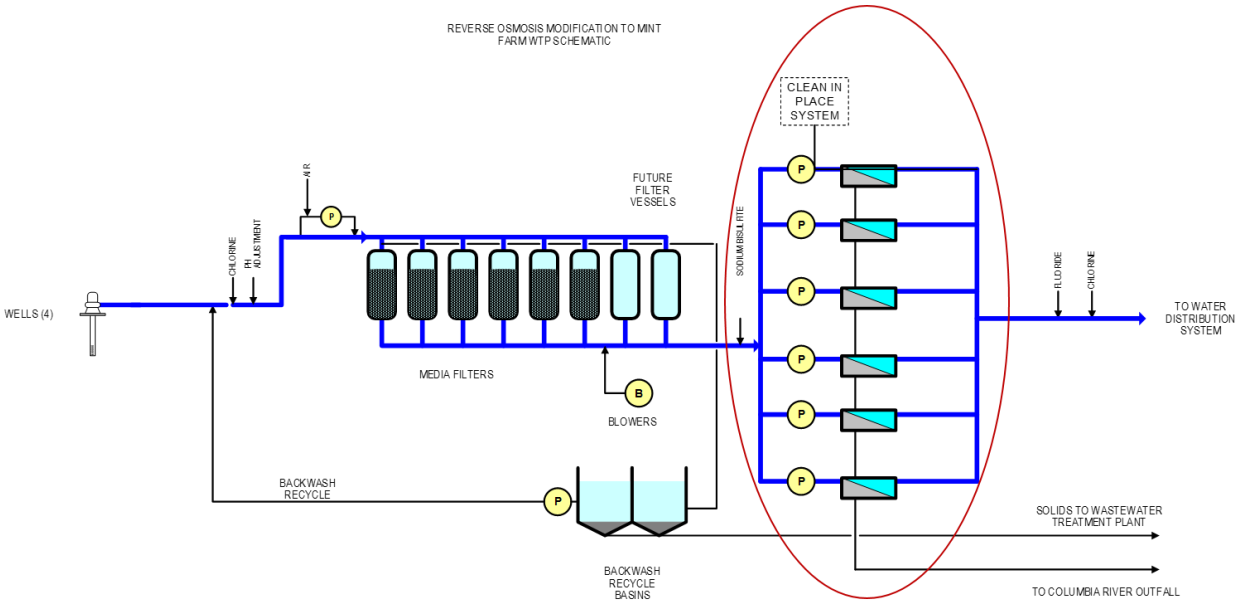


Figure 14. Reverse Osmosis Modifications to the Mint Farm Regional Water Treatment Plant

Cost Estimates

Cost estimates were prepared for each of the five alternatives for silica removal:

1. Electrocoagulation
2. Aluminum precipitation
3. Lime softening
4. Reverse osmosis
5. Ion exchange

Capital costs are presented first, followed by annual operations and maintenance costs (O&M) and then a 20-year lifecycle cost assessment.

Capital Cost Estimates

Cost assumptions for all alternatives

The following cost assumptions are provided for all options. Cost Estimate Details are shown in Attachment C.

- All facilities are housed in a CMU Building, except for flocculation and clarification facilities, which are concrete basins with building covers on top of the basins.
- Capital facilities are sized for 12 mgd.
- Capital and O&M costs are developed in March 2017 dollars.
- The construction cost index for Vancouver, WA was used (98.1% of national average).
- Tax has been included at 8.1% of the construction subtotal.
- Equipment installation was assumed to be 25% of the equipment purchase cost.
- Contractor markups are a total of 18% of the construction subtotal, and include mobilization, bonding and insurance (5%), profit (5%) and overhead (8%).
- Contingency is estimated at 25% of the total construction cost.
- Engineering, Services during construction, commissioning and start up are estimated at 20% of the construction cost including contingency.
- Capital cost financing is based on 20 years with an annual percentage rate of 4%.
- Ground improvements using preloading was assumed to be required at a cost of $500,000 for each alternative.

Capital cost estimates are summarized in Table 4. Detailed Cost estimates are included as Attachment C.

Table 4. Capital Cost Estimates for Mint Farm Water Treatment Plant Modifications for Silica Removal

Treatment Alternative	Electro-coagulation	Precipitation	Lime Softening	Ion Exchange	Reverse Osmosis
Preloading	500,000	500,000	500,000	500,000	500,000
Well Pump Modifications				700,000	
Electrocoagulation	5,665,000*				
Rapid Mix	550,000	550,000			
Flocculation	698,000	698,000			
Clarifier	2,317,000	2,317,000			
Chemical Feed		905,000	1,792,000		301,000
Ion Exchange				9,110,000	
Solids Contact Clarifier			1,702,000		
Pump Station	777,000	777,000	777,000		
Reverse Osmosis/Pumps System					14,661,000
Sludge Thickener	844,000	1,147,000	1,409,000		
Dewatering	4,226,000	4,320,000	4,691,000		
Outfall, Transmission					393,000
Subtotal	15,577,000	11,214,000	10,871,000	10,310,000	15,855,000
Contractor Markups (18%)	2,804,000	2,019,000	1,957,000	1,856,000	2,854,000
Contingency (25%)	3,894,000	2,804,000	2,718,000	2,578,000	3,964,000
Tax (8.1%)	1,262,000	908,000	881,000	835,000	1,284,000
Construction Subtotal	**23,537,000**	**16,945,000**	**16,427,000**	**15,579,000**	**23,957,000**
Location Adjustment Cost (98.1% of Construction Subtotal)	23,090,000	16,623,000	16,115,000	15,283,000	23,502,000
Design, SDC, Start-up (20%)	4,618,000	3,325,000	3,223,000	3,057,000	4,700,000
Total	**$27,708,000**	**$19,948,000**	**$19,338,000**	**$18,340,000**	**$28,202,000**

* - See Detail provided in Table 5

The capital costs were developed using CH2M's parametric cost estimating system. The cost estimates utilize materials estimates for each unit process as shown in Attachment C. The cost estimating program does not include unit processes for Electrocoagulation, therefore a User Defined tab was developed for this unit process. The Electrocoagulation capital cost estimate includes the summary costs shown in Table 5 which includes information provided by WaterTectonics. In addition, the electro-coagulation process produces less solids, so the gravity thickener and dewatering unit process costs were reduced.

Table 5. Summary Costs for Electrocoagulation Unit Process

Cost Item	Cost Estimate*
Excavation, Foundations and Site-work	$12,000
Concrete for foundations and floors	92,000
Masonry (CMU) Building	780,000
Electrocoagulation Cells and Power Supplies (mid-point of high and low estimate provided by WaterTectonics)	2,650,000
EC Cells and Power Supplies Installation (25%)	663,000
Instrumentation and Control	280,000
Conveying Systems (Crane)	4,000
Mechanical	620,000
Electrical MCC Panels	286,000
Allowance for Miscellaneous items	278,000
Unit Process Total	**$5,665,000**

* Costs are rounded to the nearest $1,000.

Annual O&M Costs

Annual O&M costs were calculated based on the following assumptions:

- The average water treatment plant flow used was 4 mgd.
- One additional Full Time Equivalent operator would be required for each alternative.
- One FTE costs $108,000 per year in wages and benefits.
- Power costs were calculated at $0.08/kwh
- Consumable costs were provided for the EC anodes and the RO membranes only.
- Chemical costs are the same for each alternative which use chemicals.
- All other items were expected to last through the 20 year life cycle.
- Electrocoagulation (EC) consumables are based on costs provided by WaterTectonics at a unit cost of $11,021 per unit, and a consumption rate of 0.43/3 = 0.143 per day
- RO membranes replacement was estimated every 5 years at a total cost of $2,200,000
- Hauling and disposal of solids was calculated at $75 per ton
- Solids content of residuals was assumed to be 50%

Chemical costs and doses were calculated as shown in Table 6. Annual O&M Cost estimates for the first year are provided in Table 7.

Table 6. Annual Chemical Cost and Doses for Each Treatment Alternative

Chemical Name	Cost per dry ton		Electro-coagulation	Precipitation	Lime Softening	Ion Exchange	Reverse Osmosis
Sodium Aluminate, as Al	$1,692	Dose, mg/L		40			
		Cost per Yr		$618,000			
Sulfuric Acid	$392	Dose, mg/L		98			20
		Cost per Yr		$507,000			$151,000
Sodium Hypochlorite	$2,213	Dose, mg/L					2.5
		Cost per Yr					$107,000
Carbon Dioxide	$59	Dose, mg/L			80		
		Cost per Yr			$70,000		
Sodium Hydroxide	$1,226	Dose, mg/L				113	25
		Cost per Yr				$2,671,000	$591,000
Lime, Hydrated	$331	Dose, mg/L			80		
		Cost per Yr			$510,000		
Soda Ash	$298	Dose, mg/L			50		
		Cost per Yr			$287,000		
Magnesium Chloride	$845	Dose, mg/L			199		
		Cost per Yr			$3,241,000		
Sodium Chloride	$110	Dose, mg/L				133	
		Cost per Yr				$282,000	
Sodium Bisulfite	$1,090	Dose, mg/L					2.5
		Cost per Yr					$53,000
Total Chemical Cost Per Year (2017)			**$0**	**$ 1,125,000**	**$1,125,000**	**$4,108,000**	**$2,953,000**

Table 7. Annual O&M Costs for Silica Removal Alternatives (2017)

Alternative	Electro-coagulation	Precipitation	Lime Softening	Ion Exchange	Reverse Osmosis
Power Cost	$159,000	$1,000	$2,000	$2,000	$33,000
Labor Cost	108,000	108,000	108,000	108,000	108,000
Chemical Cost	-	1,125,000	4,108,000	2,953,000	902,000
Consumables Cost	577,000	-	-	-	440,000
Residuals Disposal Cost	59,000	77,000	105,000	255,500	
Total Annual O&M Cost	**$903,000**	**$1,311,000**	**$4,323,000**	**$3,319,000**	**$1,483,000**

Life Cycle Costs

Life Cycle Costs for operating the system for 20 years are presented in Table 8. This analysis includes the assumption that City/District would finance the new treatment for 20 years, with a financing of the capital cost at 4% interest, and inflation rate for the O&M costs at 3%, and assuming no increase in water demand (additional treatment needs). As shown, the lowest alternative lifecycle cost is Precipitation, although the lifecycle cost for Electrocoagulation is essentially the same.

Table 8. 20 Year Life Cycle Costs for Mint Farm Modifications, Silica Removal

Alternative	Electrocoagulation	Precipitation	Lime Softening	Ion Exchange	Reverse Osmosis
Annualized Capital Cost	$2,039,000	$1,468,000	$1,423,000	$1,349,000	$2,075,000
Annual O&M Cost	903,000	1,311,000	4,323,000	3,319,000	1,483,000
20-Year Life Cycle Cost	$65,044,000	$64,587,000	$144,621,000	$116,163,000	$81,349,000
Monthly cost per ERU – (Year 1)	$12.32	$12.23	$27.39	$22.00	$15.41

Monthly costs per ERU are based on a total of 22,000 ERU's between the City and District.

Evaluation Criteria

To provide a decision model, an evaluation method using non-financial criteria was developed. The criteria and weighting factors were provided by the City and District staff. Evaluations were scored by CH2M staff. The core evaluation criteria and weightings are shown in Table 9.

Environmental criteria were weighted as eight percent of the total and was comprised of chemical use, waste streams, and resources waste or carbon footprint. Economic Criteria was weighted at twenty seven percent of the total and included capital, annual O&M, and customer affordability. Water Quality Aesthetics and Health was weighted at thirty five percent of the total and included silica reduction, hardness reduction, and secondary impacts. Technical criteria was weighted at thirty percent of the total and included operability and reliability of the process, safety, distribution system impacts, and the overall footprint or site impact.

Table 9 – Evaluation Criteria and Weighting for Silica Removal Treatment Options

No.	Evaluation Criteria	Weighting Factor
1	Environment	**8%**
	a. Chemical use	2%
	b. Waste streams, solids handling, disposal methods (Columbia River outfall)	4%
	c. Resource waste - water use/inefficiency (RO), electricity (double pumping), carbon footprint	2%
2	Economic	**27%**
	a. Capital Cost	8%
	b. O&M Cost	8%
	c. Rate impacts (ability to fund)	11%
3	WQ Aesthetics/Health	**35%**
	a. Silica reduction	25%
	b. Hardness reduction	5%
	c. Secondary benefit or detriment (chloramine removal vs. mineral stripping)	5%
4	Technical	**30%**
	a. Operability & Reliability (proven technology)	10%
	b. Safety	5%
	c. Distribution system impacts	5%
	d. Ability to add WTP and/or silica removal capacity; Wellfield encroachment	10%

Evaluation of the Alternatives

Alternatives were rated 1 to 5 for each evaluation criteria. 1 was the worst outcome and a rating of 5 was the best outcome. The results of the evaluation are summarized in Table 10. Electrocoagulation was rated highest for chemical use (for lack thereof), followed by Precipitation and Reverse Osmosis. Lime softening and Ion Exchange were ranked the lowest.

For waste streams, Electrocoagulation and Precipitation were rated the highest. Lime softening and Ion Exchange were rated lower because of large amounts of sludge and regeneration waste, respectively. Reverse Osmosis was rated the lowest.

For efficiency, the ratings were similar to the waste streams ratings, with the exception of Ion Exchange which got a slightly higher rating since most of its regeneration waste is salt or chemical and not water.

Capital costs, O&M costs and rate impacts were rated based on their actual costs, discussed previously.

Silica reduction ratings were based on the testing conducted, with the exception of Ion Exchange, which was rated based on experience with Ion Exchange and demineralization systems at full scale operations.

Hardness reduction was also based on the testing results, and full-scale experience for Ion Exchange. Secondary benefits were rated highest for Lime Softening and Reverse Osmosis, based on the removal of organic nitrogen and other materials during pilot testing (note at full scale, Reverse Osmosis would include a 25% bypass, so some raw water minerals would still be present). Ion Exchange was rated the lowest, because the process would include the replacement of calcium and magnesium with sodium.

Electrocoagulation was rated the highest for safety, based primarily on the reduced amount of chemicals required, compared to the other options.

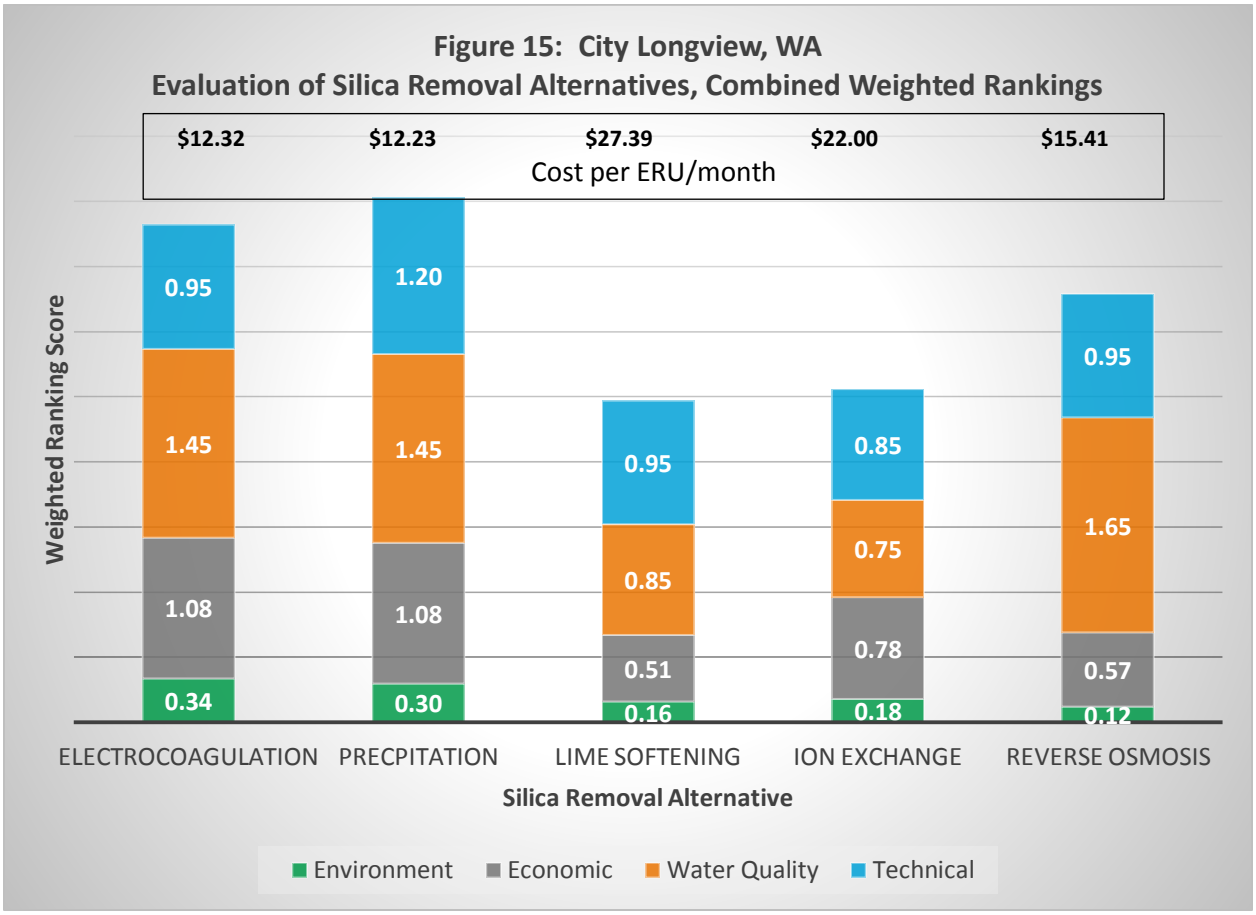
Distribution system impacts were very similar to the secondary benefit scores.

Footprints (building sizes) were rated based on their conceptual design footprints.

Table 10 – Evaluation Ratings (5 is best, 1 is worst)

No.	Evaluation Criteria	Weighting Factor	Electrocoagulation	Precipitation	Lime Softening	Ion Exchange	Reverse Osmosis
1	**Environment**	**8%**					
	a. Chemical use	2%	5	3	2	2	3
	b. Waste streams, solids handling, disposal methods (Columbia River outfall)	4%	4	4	2	2	1
	c. Resource waste - water use/inefficiency (RO), electricity (double pumping), carbon footprint	2%	4	4	2	3	1
2	**Economic**	**27%**					
	a. Capital Cost	8%	3	4	4	5	2
	b. O&M Cost	8%	5	4	1	2	1
	c. Rate impacts (ability to fund)	11%	4	4	1	2	3
3	**WQ Aesthetics/Health**	**35%**					
	a. Silica reduction	25%	5	5	2	2	5
	b. Hardness reduction	5%	1	1	3	4	4
	c. Secondary benefit or detriment (organic nitrogen removal vs. mineral stripping)	5%	3	3	4	1	4
4	**Technical**	**30%**					
	a. Operability & Reliability (proven technology)	10%	2	5	3	3	3
	b. Safety	5%	4	3	3	2	3
	c. Distribution system impacts	5%	3	3	4	1	4
	d. Ability to add WTP and/or silica removal capacity; Wellfield encroachment impact	10%	4	4	3	4	3

The individual ratings were then multiplied by their weighting factor to provide a weighted score. The combined weighted scores are shown in Figure 15, summarized by each category of evaluation criteria. Figure 15 also includes the cost per equivalent residential unit (ERU) per month.



Design Criteria and Plant Layout for Top Two Alternatives

As Electrocoagulation and Precipitation are both the lower cost and highest non-financial ranked alternatives, these two options were taken to the next step of further evaluation. Table 11 lists the preliminary design criteria for the silica removal facilities using Precipitation or Electrocoagulation. Both the precipitation and the electrocoagulation alternatives share the same design criteria for rapid mixing, flocculation, clarification, pumping and solids handling.

Table 11 – Preliminary Design Criteria for Silica Removal Facilities, Initial Capacity 12 MGD, Expandable to 18 MGD

Item	Precipitation	Electrocoagulation
Rapid Mix, Flocculation and Clarification		
Rapid Mix, No Trains	2	2
Mixer HP, each	10	10
Velocity Gradient, G sec^{-1}	2,000	2,000

Item	Precipitation	Electrocoagulation
Mag meter, No	1	1
Flow control Valve, No.	1	1
Hoist, No	1	1
Building for Rapid Mixing	CMU, 880 SF	CMU, 880 SF
Flocculation Trains, No	2	2
Hydraulic Detention Time, min	20 at max flow	20 at max flow
Stages, No.	2	2
Flocculator, Type	Vertical Paddle Wheel	Vertical Paddle Wheel
Cover for Floc Basins	Roof Shelter, 1800 SF	Roof Shelter, 1800 SF
Lamella Plate Settler, No Trains	2	2
Plate dimensions	10' x 5'	10' x 5'
Plate loading rate, gpm/sf	0.3	0.3
Sludge Collector, No.	1 per train	1 per train
Side Water Depth	15'	15'
Cover	Roof Shelter, 6,300 SF	Roof Shelter, 6,300 SF
Chemical Building		
No. Chemicals Added	2	
Sodium Aluminate Bulk Tanks, No.	2 – 12' by 16'	
Sodium Aluminate Chemical Pumps, No.	2	
Sodium Aluminate Solution Strength	48%	
Storage at average flow, Days	36	
Sulfuric Acid Bulk Tanks, No.	2	
Sulfuric Acid Chemical Pumps, No.	2	
Sulfuric Acid Solution Strength	93%	
Storage at average flow, Days	40	
Electrocoagulation Building		
No. of Power Supplies		12
No. of Electrocoagulation Cells		12
Building Size, Sq ft		5,000
Solids Handling		
Gravity Thickener, No	2	2
Sludge Depth, ft	5	5
Clearwater Depth, ft	10	10
Diameter, ft each	55	55
Loading rate, gpd/sf	300	300
Influent solids conc., %	0.25%	0.25%
Sludge Building, sq ft	CMU, 860 Sq ft	CMU, 860 Sq ft
Centrifuge, No	2	2
Inlet Sludge Concentration, %	3%	3%
Dewatered Cake, % solids	25%	25%
Polymer Dose, lbs/ton	10 to 20	10 to 20
Polymer Storage	3 – 400 gallon totes	3 – 400 gallon totes
Polymer Storage at average flow, days	40	40
Truck lane, length x width	70' x 20'	70' x 20'
Pump Station		
No. Pumps	3	3
Capacity, Each	6 mgd	6 mgd
Total, Dynamic Head, Ft	60	60
Pump Station Building	CMU, 600 sq ft	CMU, 600 Sq Ft

A general arrangement of facilities is shown on Figure 16 for the precipitation alternative. Figure 17 shows the general arrangement for the electrocoagulation alternative.

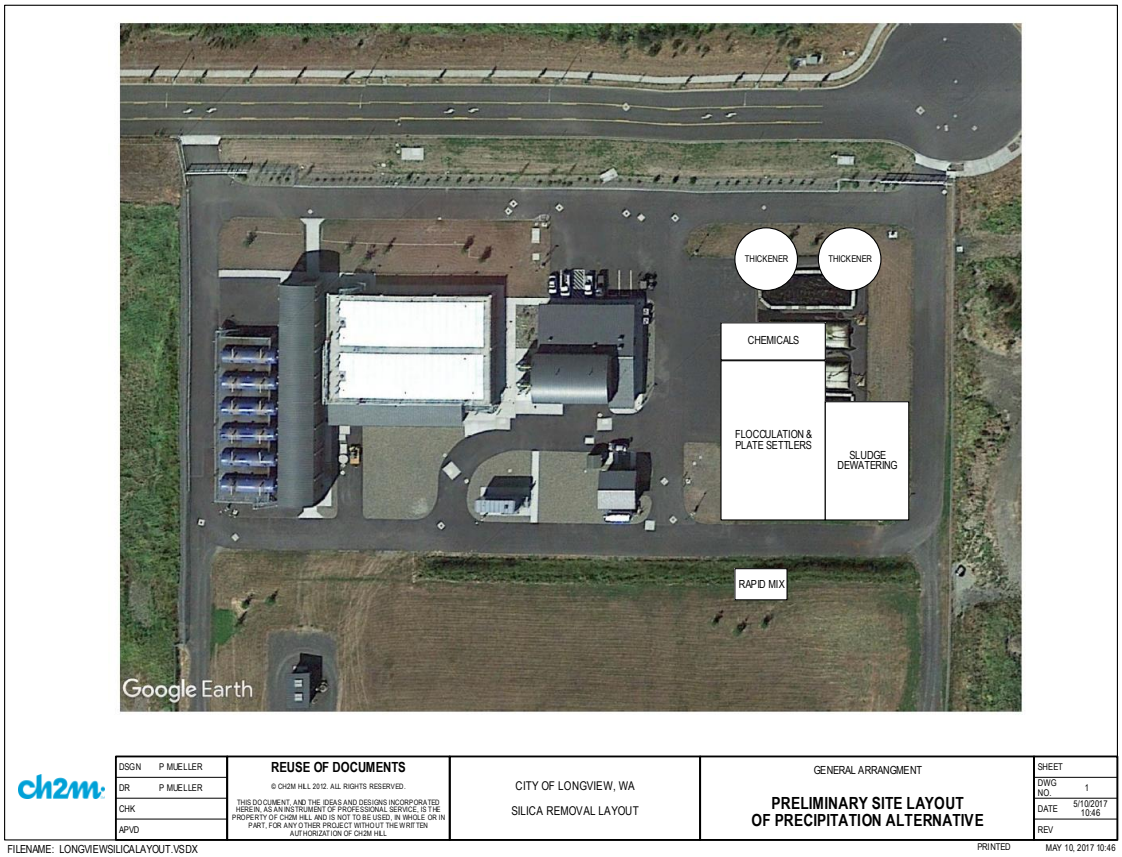


Figure 16 – Preliminary Layout of Silica Removal Facilities using Precipitation

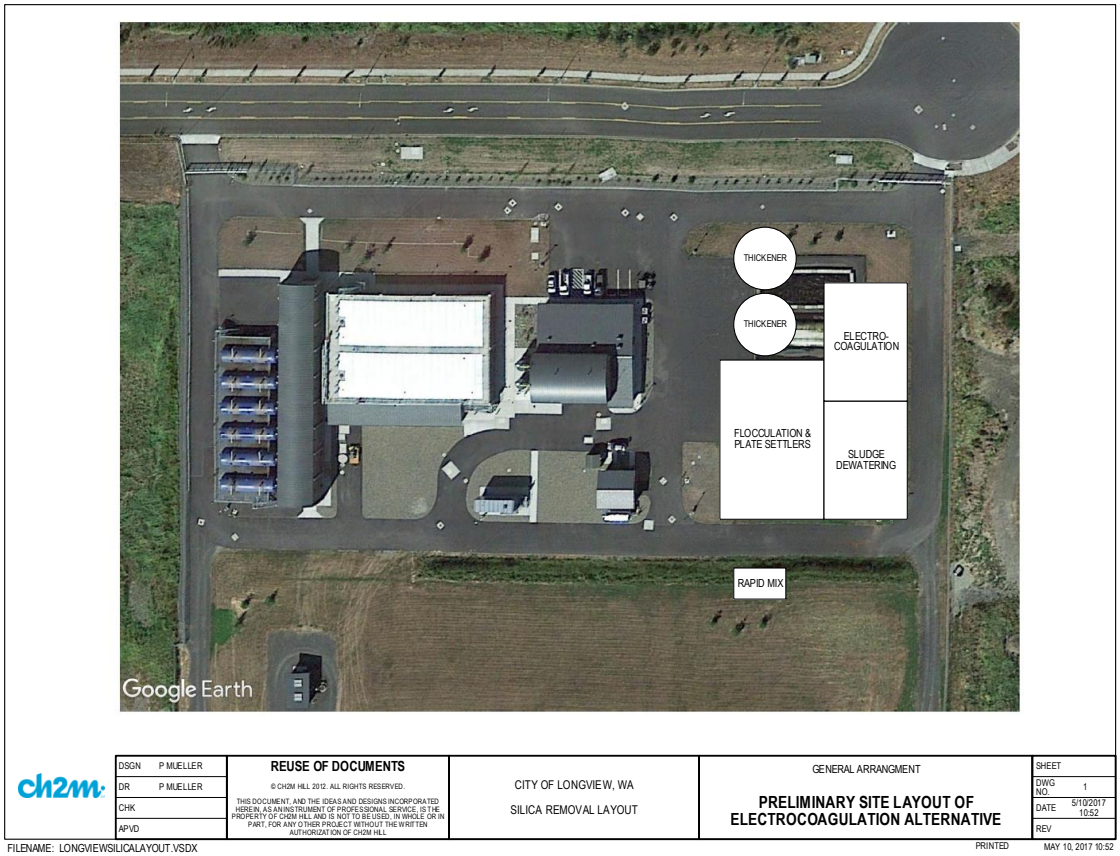


Figure 17 – Preliminary Layout of Silica Removal Facilities using Electrocoagulation

Recommendation

It is noted that the Electrocoagulation and Precipitation alternative treatment processes have weighted rankings and costs that are essentially similar. The Precipitation alternative has been used extensively by municipal systems to treat multiple types of water, and by many industries specifically for silica removal. The Precipitation alternative, however, requires more chemicals for treatment than does the Electrocoagulation option.

Electrocoagulation applications in municipal systems are very rare. The National Sanitation Foundation, which is the organization that certifies elements and chemicals used in drinking water treatment as safe, does not even have a category developed for Electrocoagulation. The Washington State Department of Health Drinking Water Program (WDOH) will require NSF or ANSI certification of all elements used in the water treatment plant that are in contact with drinking water. Obtaining ANSI or NSF certification is not viewed as a fatal flaw, because it is believed that certification could be obtained, although it would take time to acquire such status. Rather, the lack of certification demonstrates how relatively new, the Electrocoagulation technology is to the drinking water industry. Further, Electrocoagulation has not been used in the capacity needed for the Mint Farm system. If Electrocoagulation were chosen, this would be the largest application developed.

It is our recommendation that if the City and District wish to further evaluate Electrocoagulation treatment, that significant due diligence should be performed before proceeding with design of this alternative. Large scale industrial sites should be visited, a plan for ANSI/NSF certification should be developed by one or more potential equipment suppliers, as well as obtaining an understanding of how the equipment suppliers will scale up equipment from their traditional market. A pilot test would also be recommended for longer term demonstration of Electrocoagulation performance.

Precipitation could proceed directly to a project report for WDOH approval followed by design of the facility. Additional bench testing would be beneficial to identify a chemical feed system which can be optimized or if alternative pH adjustment approaches like carbon dioxide would be effective. Based on these considerations, precipitation is the recommended alternative for implementation of silica removal, especially if treatment is desired to be accomplished in the near term.

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6. Baygents, J. C., and Farrell, J., Electrocoagulation and Water Sustainability, Silica and Hardness Control, Department of Chemical and Environmental Engineering, University of Arizona, June 26, 2008.
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ATTACHMENTS

Evaluation of Silica Removal Alternatives
Mint Farm Regional Water Treatment Plant

PREPARED FOR:	City of Longview, WA & Beacon Hill Water and Sewer District
PREPARED BY:	CH2M
DATE:	May 18, 2017
PROJECT NUMBER:	650582.03.35.13.03
REVISION NO.:	5

Attachment A

WATERTECTONICS

Longview, WA

Electrocoagulation: Silica Reduction in Municipal Water Supply

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Treatability Summary

December 9, 2016

6300 Merrill Creek Pkwy, Suite C-100 Everett, WA 98203 T 425.349.4200 F 425.349.4890 www.watertectonics.com

Introduction

WaterTectonics (WT) conducted a treatability study for the City of Longview, Washington testing the efficacy of WaveIonics Electrocoagulation (EC) to reduce/remove silica to less than 30 mg/L (Table 1) in the existing municipal water supply. In addition, WaterTectonics benchmarked electrocoagulation's efficacy against chemical treatment utilizing multiple different chemicals containing aluminum which is a known process for silica reduction. Linear regression equations were calculated for each data set to establish an aluminum dosage and associated cost for each treatment to reduce silica to 30 mg/L. The projected operating cost for EC and each chemical treatment tested are presented in this report. The report's conclusion illustrates the two lowest operational costs for reducing silica to 30 mg/L is utilizing EC and Sodium Aluminate.

The design of testing, focused on dissolved silica removal by co-precipitation with aluminum EC as well as co-precipitation with multiple chemicals for comparison. WT utilized published data (Sandia 2011) and its past testing experience in conducting its treatability tests to document the efficacy of EC and PAC for the removal of dissolved silica through a co-precipitated process utilizing aluminum hydroxide in either a formulated chemical or an electro-chemical reaction. Lastly, WT examined the efficacy of treatment, by EC and the other chemicals, by also treating samples that had been filtered and chlorinated by the City's current treatment process.

In Table 1, are the measured parameters with maximum contaminant levels (MCLs) and secondary maximum contaminant levels (SMCLs).

Table 1 City of Longview, WA treatment goals, MCL's and SMCL's.

Parameter	Unit	Treatment Goal	MCL	SMCL
Aluminum	mg/L	-	-	0.05 to 0.2
Arsenic	mg/L	-	0.01	-
Calcium	mg/L	-	-	-
Iron	mg/L	-	-	0.3
Magnesium	mg/L	-	-	-
Manganese	mg/L	-	0.05	-
pH	s.u.			6.5 – 8.5
Silica, Dissolved	mg/L	30	-	-
Hardness	mg CaCO3/L	-	-	-
Total Alkalinity	mg CaCO3/L	-	-	-

Methods

WT received samples from two different locations within the treatment process. City of Longview provided five gallons of raw well water prior to any of the municipality's existing pretreatment processes and fifteen gallons of water post pre-treatment that includes prechlorination and filtration with greensand. The filtered water was collected prior to final pH adjustment with sodium hydroxide and any fluoridation.

A five-gallon bucket of sample was thoroughly mixed prior to beginning the treatability testing. The samples were treated using batch treatment laboratory-scale EC. 500 mL samples were tested at different levels of EC treatment by maintaining the current and varying the treatment time. Based on Faraday's Law, this created the scenario to examine how different theoretical aluminum dosages would impact the reduction of Silica with electrocoagulation. Similarly, testing was also conducted with Kemira PAX-XL8 polyaluminum chloride (PAC) dosing aluminum at the same theoretical equivalent to the EC samples. The testing utilizing PAC also required the addition of sodium hydroxide in order to maintain the pH close to 7.7, the City's target pH for corrosion control.

All samples were rapid mixed followed by slow mixing and settling. After settling, the supernate was filtered through 8 µm paper filters using a vacuum apparatus simulating granular media filtration. Aluminum concentrations ranged from 3 mg/l to 30 mg/L for EC treatments and 3 mg/l to 90 mg/L for PAC treatments. All samples were tested for the parameters listed in Appendix A.

Results

Electrocoagulation

Raw Water

In the initial raw water sample, iron and manganese oxidized in the water sample bucket after it had been opened for a few days. As a result, a fresh 10-gallon sample of raw water was collected on October 25, 2016 to complete the treatability testing. The two raw water samples were analyzed and were found to have similar influent and treated water quality (Table 2,Table 3).

Beaker testing was initially conducted with 30 mg/L Al EC using the raw water sample. The 30 mg/L Al EC set was also tested with chlorination using sodium hypochlorite dosed at 5 mg Cl_2/L, simulating the existing prechlorination step in the water treatment process. Following EC and stirring a large floc formed that settled leaving a clear supernate (Figure 1). Testing with filtered water determined that a 30 mg/L Al EC treatment was required to meet the water quality goal. Two liters of raw water were treated with 30 mg/L Al EC for the final treatment with and without oxidation using sodium hypochlorite. Silica concentrations were well below the 30 mg/L goal in all testing when a 30 mg/L Al EC treatment was applied (Table 4). Oxidation did not affect silica removal.

The existing site process includes prechlorination to oxidize arsenic, iron, and manganese prior to greensand filtration. WT tested oxidation as a pretreatment to simulate site conditions and determine how EC with oxidation affected the removal of arsenic, iron, and manganese with basic filtration instead of greensand. MCL's and SMCL's for measured parameters are provided in Table 1. Aluminum concentrations were below the upper limit for the SMCL. Arsenic was below the MCL in the raw and treated samples. Iron was non-detect and well below the SMCL in both treated samples. Manganese had the best reduction following EC with oxidation but was still above the MCL in the treated sample. Manganese above the MCL was expected without greensand filtration.

Table 2 WaterTectonics analytical test results for City of Longview – raw water collected October 4, 2016.

Parameter	Unit	Raw - Influent	Raw – 30 mg/L Al EC	Raw – 30 mg/L Al EC with oxidation
pH	s.u.	7.19	7.53	7.6
Conductivity	µS/cm	218.8	181	231
Turbidity	NTU	1.83	0.19	0.33
Dissolved Oxygen	mg/L	9.55	7.93	8.62
Silica	mg/L SiO2	52.3	20.4	23.3

Table 3 WaterTectonics analytical test results for raw water collected October 25, 2016.

Parameter	Unit	Raw - Influent	Raw – 30 mg/L Al EC	Raw – 30 mg/L Al EC with oxidation
pH	s.u.	7.01	7.59	7.66
Conductivity	µS/cm	226	190.9	213.7
Turbidity	NTU	2.97	0.57	0.31
Dissolved Oxygen	mg/L	7.88	9.73	10.68
Silica	mg/L SiO2	53.3	17.2	13.7

Table 4 Third party laboratory analytical test results for raw water collected October 25, 2016.

Parameter	Unit	Raw - Influent	Raw – 30 mg/L Al EC	Raw – 30 mg/L Al EC with oxidation
Aluminum	mg/L	ND (< 0.040)	0.11	0.17
Arsenic	mg/L	0.005	0.0044	ND (< 0.003)
Calcium	mg/L	27	23	25
Iron	mg/L	1.1	ND (< 0.050)	ND (< 0.050)
Magnesium	mg/L	6.6	5.3	5.4
Manganese	mg/L	0.59	0.29	0.18
Silica, Dissolved	mg SiO2/L	51	16	12
Hardness	mg CaCO3/L	94.56	79.23	84.64
Total Alkalinity	mg CaCO3/L	110	82	90

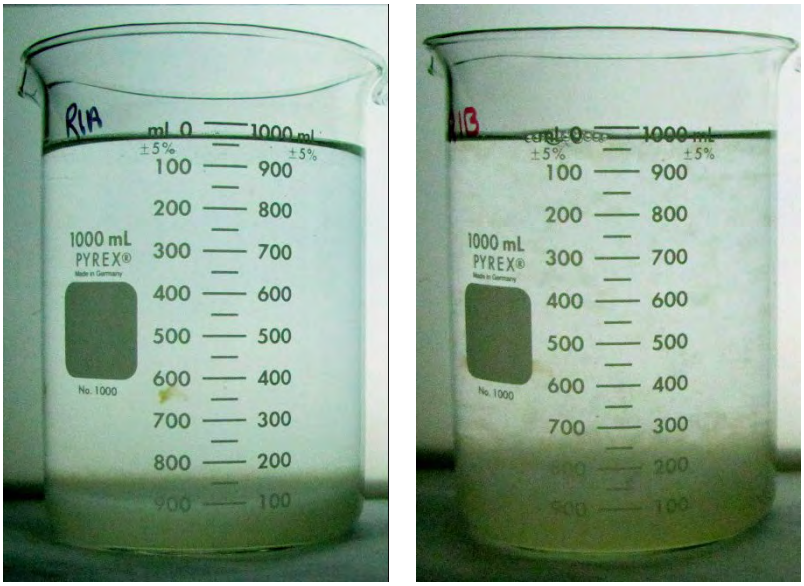


Figure 1 City of Longview Raw Water 30 mg/L Al EC Treatments, without oxidation (left), with oxidation (right).

Filtered Water

The filtered water was used to develop a silica removal curve based off of 3, 9, 15, and 30 mg/L Al EC treatments. The filtered water was selected for this broader effort because of the volume available for testing. Following EC treatment and mixing a large floc formed with increasing volume that settled after floc development (Figure 2). The data indicates that the optimal EC aluminum dose is between 15 and 30 mg/L with or without pH adjustment (Figure 3, Table 5, Table 6).

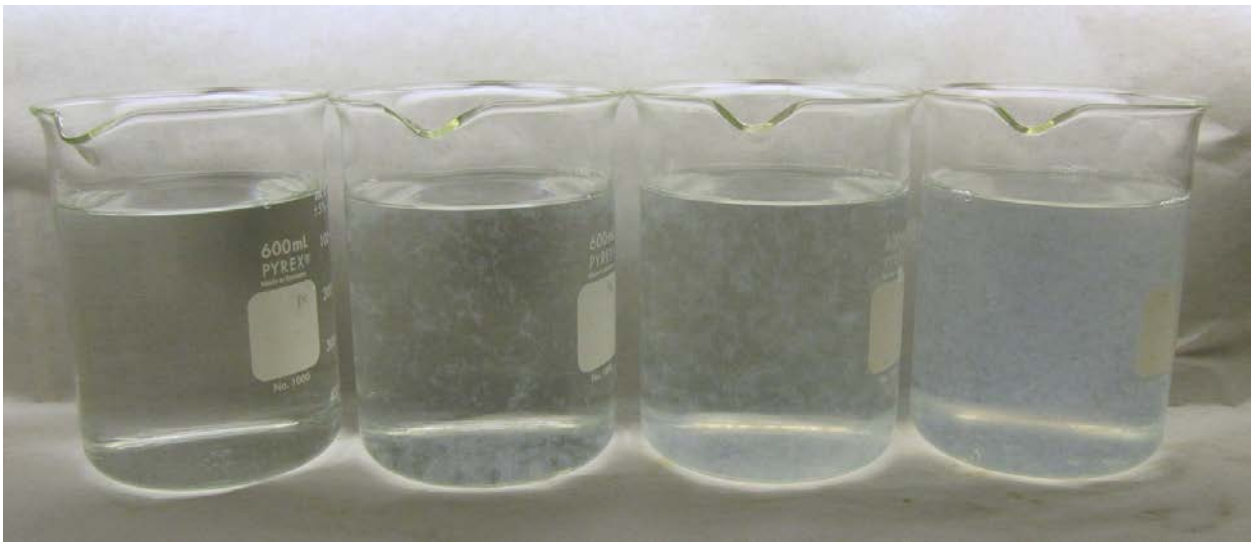


Figure 2 City of Longview Filtered Water Treatments from left to right: 3, 9, 15, and ds30 mg/L Al EC before settling.

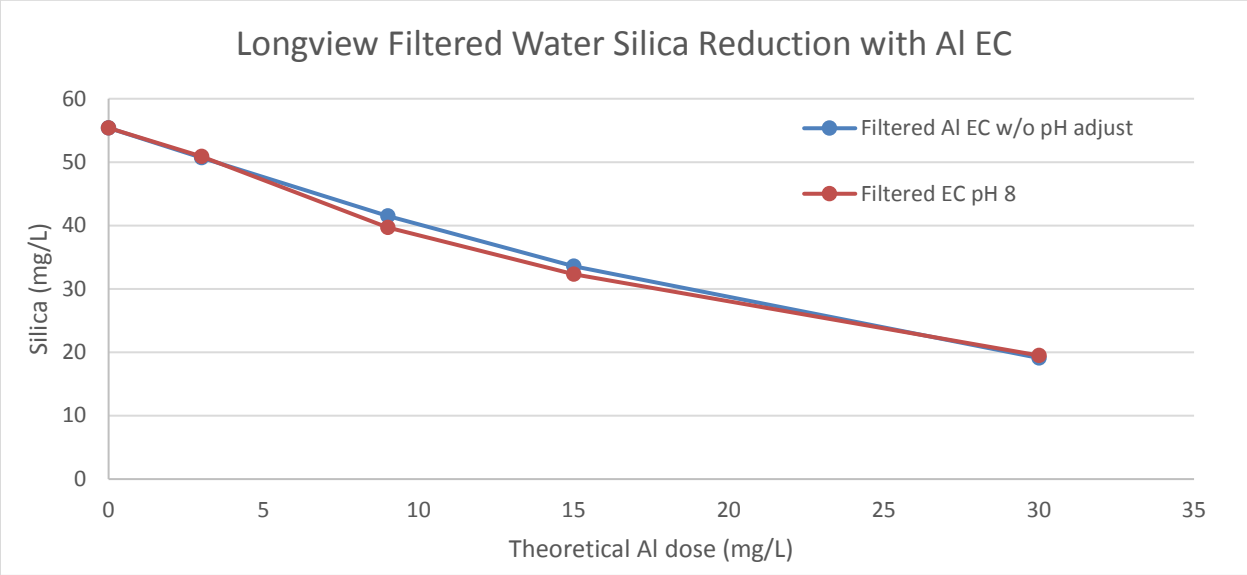


Figure 3 Longview filtered water silica reduction with Aluminum EC.

Table 5 WaterTectonics analytical test results for City of Longview – Filtered water EC treatability without pH adjustment.

Parameter	Unit	Filtered Influent	3 mg/L Al EC	9 mg/L Al EC	15 mg/L Al EC	30 mg/L Al EC
pH	s.u.	7.41	7.68	7.63	7.63	7.47
Conductivity	µS/cm	230	227	221	211.8	201.1
Turbidity	NTU	0.43	0.45	0.45	0.39	0.33
Dissolved Oxygen	mg/L	8.53	9.08	9.12	8.93	7.87
Silica	mg SiO2/L	55.4	50.7	41.5	33.6	19.1

Table 6 WaterTectonics analytical test results for City of Longview – Filtered water EC treatability with pH adjustment to 8 before EC.

Parameter	Unit	Filtered Influent pH adjusted	3 mg/L Al EC	9 mg/L Al EC	15 mg/L Al EC	30 mg/L Al EC
pH	s.u.	8.02	8.01	7.79	7.7	7.57
Conductivity	µS/cm	230	230	223	217.5	205.9
Turbidity	NTU	0.43	1.18	0.87	0.72	0.77
Dissolved Oxygen	mg/L	8.53	8.88	8.78	8.5	7.49
Silica	mg SiO2/L	55.4	50.9	39.7	32.3	19.5

A dosage of 30 mg/L AL EC was selected as the optimal treatment and a 2L sample of water was treated for third party verification of silica removal and additional parameters. A large floc formed that settled (Figure 4). Silica was below 30 mg/L with the 30 mg/L Al EC treatment (Table 7, Table 8). Aluminum was below the upper limit for the SMCL in the treated sample but above the lower value indicating that the coagulation and filtration process may need to be optimized. Arsenic, iron, and manganese were all below the MCLs and SMCLs in the filtered influent and did not increase following EC treatment.

Figure 4 City of Longview Filtered Water 30 mg/L Al EC Treatment.

Table 7 WaterTectonics analytical test results for City of Longview – Filtered water EC treatability testing.

Parameter	Unit	Filtered - Influent	Filtered – 30 mg/L Al EC
pH	s.u.	7.41	7.33
Conductivity	µS/cm	230	206.7
Turbidity	NTU	0.43	0.27
Dissolved Oxygen	mg/L	8.53	10.44
Silica	mg SiO2/L	55.4	19.9

Table 8 Third party laboratory analytical test results for City of Longview - Filtered water EC treatability testing.

Parameter	Unit	Filtered - Influent	Filtered – 30 mg/L Al EC
Aluminum	mg/L	ND (< 0.100)	0.11
Arsenic	mg/L	0.0026	ND (< 0.003)
Calcium	mg/L	27	23
Iron	mg/L	ND (< 0.050)	ND (< 0.050)
Magnesium	mg/L	6	5.2
Manganese	mg/L	ND (< 0.010)	ND (< 0.008)

Parameter	Unit	Filtered - Influent	Filtered – 30 mg/L Al EC
Silica, Dissolved	mg SiO2/L	47	19
Hardness	mg CaCO3/L	92.1	78.82
Total Alkalinity	mg CaCO3/L	110	88

Polyaluminum Chloride Treatments

Samples were treated with Kemira PAX-XL8 polyaluminum chloride (PAC) for comparison to EC treatment with the same theoretical aluminum concentrations as the EC treatments (Figure 5). PAC treatment formed a large floc that settled similarly to the EC treatments (Figure 6). Silica removal required higher theoretical aluminum doses when treated with PAC compared to EC. Initially the filtered sample was used for the PAC testing (Table 9, Table 10). The results showed decreasing pH and minimal silica removal at doses equivalent to Al EC treatment. Slightly better silica removal was observed with pH raised to 8 using sodium chloride after adding the PAC but silica was still well above the 30 mg/L treatment goal with up to 30 mg/L theoretical Al dosing.

Increased PAC dosing with pH adjustment was tested on the fresh raw water sample to determine the concentration that could meet the treatment goal (Table 11). 38 mg/L PAC dosing with pH adjustment met the silica removal goal compared to 20 mg/L Al EC. The pH dropped below 5 with the highest PAC doses.

Conductivity increased with the additional of PAC. A large floc formed with mixing that settled (shown before settling in Figure 6).

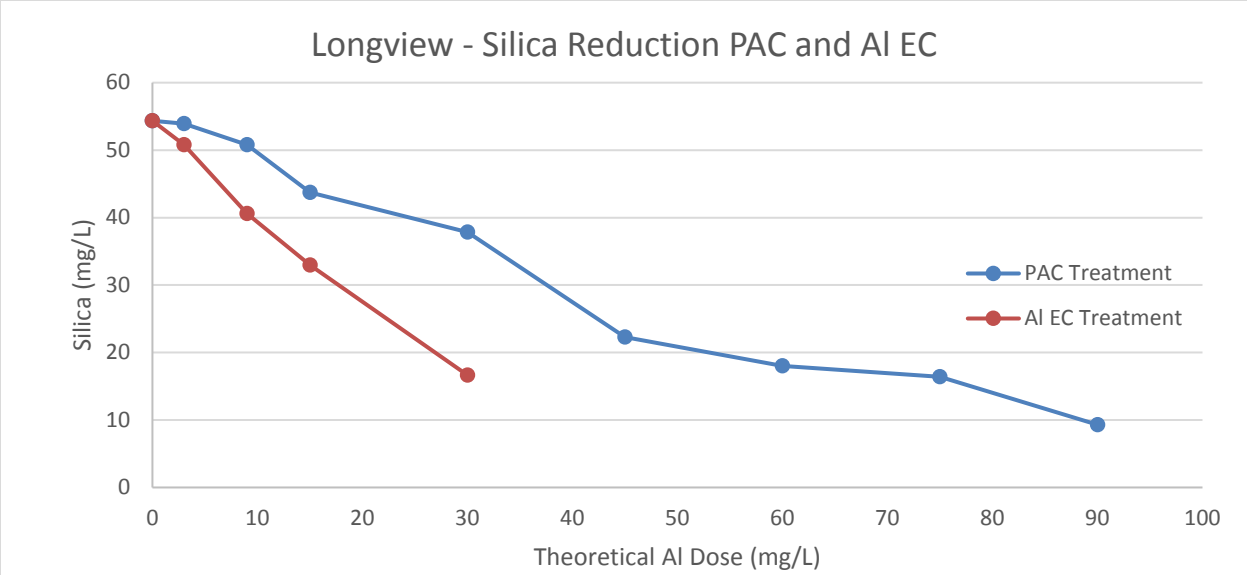


Figure 5 City of Longview average silica removal PAC vs Al EC.

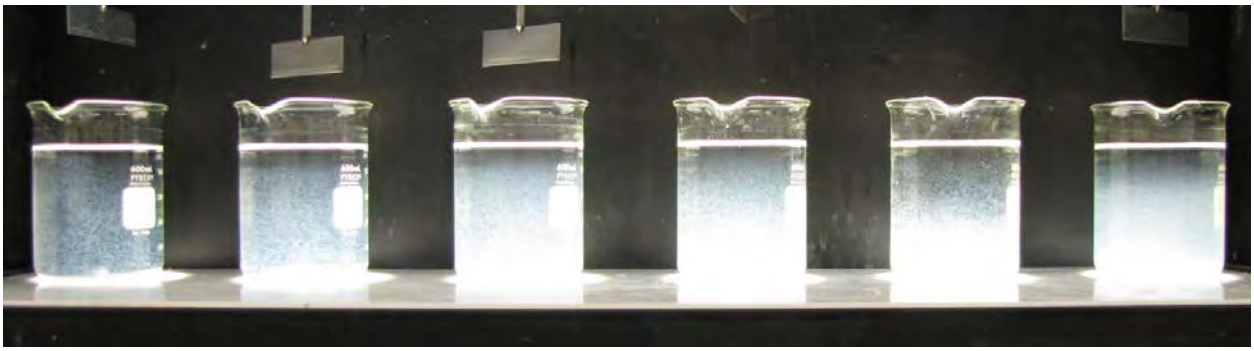


Figure 6 City of Longview - Raw water PAC treatments from left to right: 15, 30, 45, 60, 75, and 90 mg/L Al.

Table 9 WaterTectonics analytical test results for filtered water PAC testing without pH adjustment.

Parameter	Unit	Filtered Influent	3mg/L Al PAC	9 mg/L Al PAC	15 mg/L Al PAC	30 mg/L Al PAC
pH	s.u.	7.41	7.41	7.3	7.17	6.81
Conductivity	µS/cm	230	244	264	284	339
Turbidity	NTU	0.43	1.07	0.52	0.34	0.43
Dissolved Oxygen	mg/L	8.53	8.7	8.72	8.66	8.69
Silica	mg/L SiO2	55.4	54.6	51.4	49.7	45.5

Table 10 WaterTectonics analytical test results for filtered water PAC testing with pH adjusted to ~8.

Parameter	Unit	Filtered Influent	3 mg/L Al PAC	9 mg/L Al PAC	15 mg/L Al PAC	30 mg/L Al PAC
pH	s.u.	7.41	7.8	7.84	7.87	7.93
Conductivity	µS/cm	230	255	292	363	450
Turbidity	NTU	0.43	0.48	0.57	0.73	0.5
Dissolved Oxygen	mg/L	8.53	8.77	8.8	8.73	8.75
Silica	mg/L SiO2	55.4	53.2	50.2	39.2	35.5

Table 11 WaterTectonics analytical test results for raw water PAC testing with pH adjusted to ~8.

Parameter	Unit	Raw Influent	15 mg/L Al PAC	30 mg/L Al PAC	45 mg/L Al PAC	60 mg/L Al PAC	75 mg/L Al PAC	90 mg/L Al PAC
pH	s.u.	7.01	7.01	6.79	7.61	7.56	7.27	6.46
Conductivity	µS/cm	226	335	432	548	645	769	761
Turbidity	NTU	2.97	0.32	0.28	0.3	0.2	0.29	0.4
Dissolved Oxygen	mg/L	7.88	8.51	8.53	8.54	8.54	8.31	8.53
Silica	mg/L SiO2	53.3	42.3	32.5	22.3	18	16.4	9.3

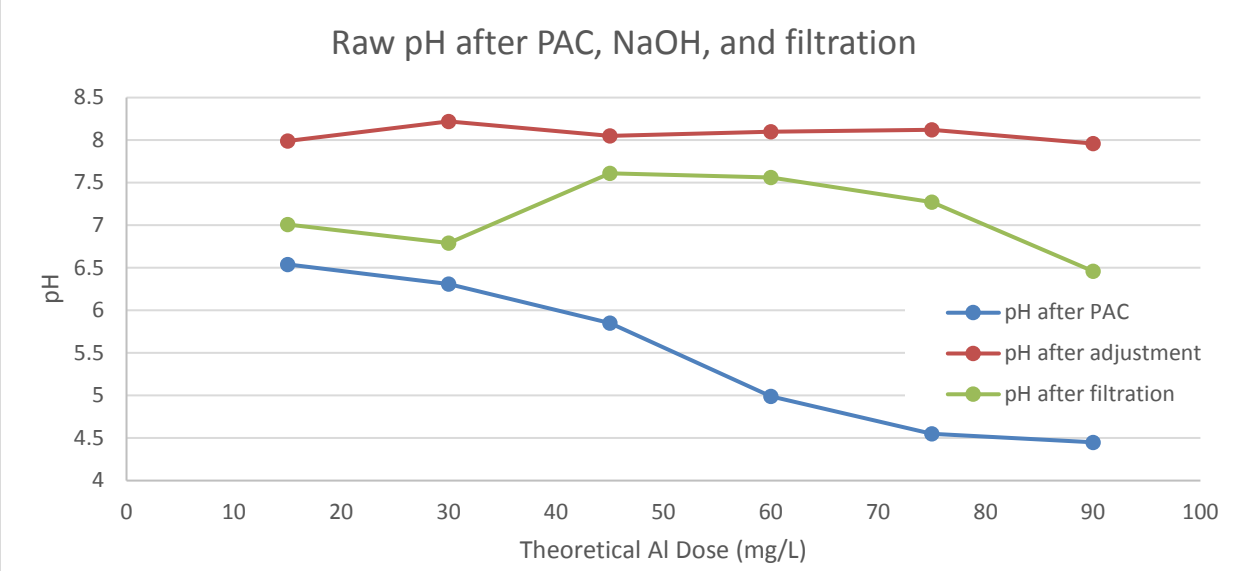


Figure 7 City of Longview raw water pH adjustment with PAC treatments

Operational Cost Estimate

Calculating the required dosage to reduce silica to 30 mg/L, operation costs were estimated EC, PAC, Alum (aluminum sulfate) and Sodium Aluminate. With the exception of EC, all other chemicals tested required pH amendment following dosage, the cost associated to the amendment was included as part of the operating cost. Sodium Hydroxide and Sulfuric Acid were used to adjust the pH to 7.7 for the testing. Linear regression equations were calculated for each data sets and added to the graphical data presented in Figure 8.

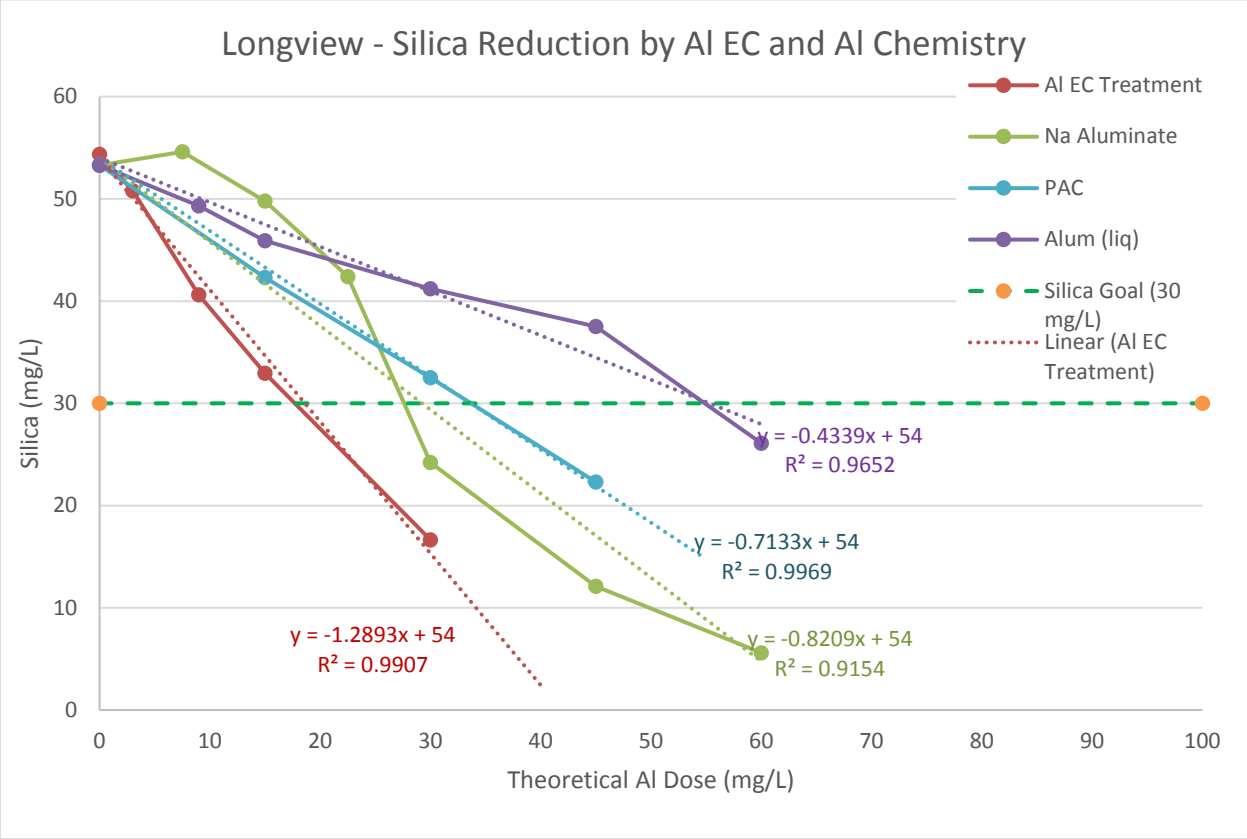


Figure 8 - Silica Reduction and Regression Calculations

These treatment dosages were calculated using linear equations as the minimum dosage required to reduce silica to 30 mg/L. The EC costs were estimated at the aluminum dosage of 18.5 mg/L. The Sodium Aluminate treatment costs were calculated at 29.2 mg/L. The PAC treatment costs were estimated at an aluminum dosage of 33.7 mg/L. The Aluminum Sulfate treatment costs were estimated at an aluminum dosage of 55.3 mg/L.

Table 12 Operational Costs for EC Treatment at 18.5 mg/L Aluminum.

Consumables	Units	Units/day	Unit Cost*	Daily Cost	Volume Cost**
Aluminum EC Cells	Each	0.43	$11,021	$4,765	$0.40/Kgal
Power* **	kWh	16,283	$0.070	$1,134	$0.09/Kgal
Total Cost	$			$10,852	$0.49/Kgal

* Based on bulk pricing from regional suppliers (based on a WT EC cell design).

** Based on 12 MGD.

*** Estimated on the preliminary cell design and the average power cost over the life of the cell.

Table 13 Operational Costs for Sodium Aluminate Treatment at 29.2 mg/L Aluminum.

Consumables	Units	Units/day	Unit Cost*	Daily Cost	Volume Cost**
Sodium Aluminate (Dry)	lbs	8,891	$0.57	$5,103	$0.43/Kgal
Sulfuric Acid (98% H2SO4)	lbs	12,010	$0.10	$1,201	$0.10/Kgal
Total Cost	$			$25,245	$0.53/Kgal

* Based on bulk pricing from regional suppliers.

** Based on 12 MGD.

Table 14 Operational Costs for 50% PAC Treatment at 33.7 mg/L Aluminum.

Consumables	Units	Units/day	Unit Cost*	Daily Cost	Volume Cost**
Polyaluminum Chloride (50% PAC)	lbs	27,082	$0.31	$8,395	$0.70/Kgal
Caustic (50% NaOH)	lbs	5,254	$0.15	$788	$0.07/Kgal
Total Cost	$			$25,245	$0.77/Kgal

* Based on bulk pricing from regional suppliers.

** Based on 12 MGD.

Table 15 Operational Costs for Aluminum Sulfate (Alum) Treatment at 55.3 mg/L Aluminum.

Consumables	Units	Units/day	Unit Cost*	Daily Cost	Volume Cost**
Aluminum Sulfate (dry Alum)	lbs	147,692	$0.07	$10,741	$0.90/Kgal
Caustic (50% NaOH)	lbs	34,528	$0.15	$5,179	$0.43/Kgal
Total Cost	$			$25,245	$1.33/Kgal

* Based on bulk pricing from regional suppliers.

** Based on 12 MGD.

Conclusion

Both EC, sodium aluminate, aluminum sulfate and PAC were effective in reducing silica in a coagulation/flocculation process. The dosage of aluminum is lower for the EC process and it did not affect the pH. Aluminum sulfate and PAC coagulation consumes alkalinity and lowers pH. The aluminum sulfate and PAC processes will require adjustment of the pH with a caustic chemical to raise the pH. The sodium aluminate increases pH and will require pH adjustment with an acid. Since PAC is a formulated chemical that requires the addition of chloride, the subsequent impact on the water quality as a result of the increased TDS from the chloride should be studied further. The EC 3rd party Aluminum data was below the upper limit for the SMCL in the treated sample but above the lower value indicating that the coagulation and filtration process may need to be optimized.

The results showed that silica reduction was equally effective in both the raw and treated water samples. Treatment of the raw water is most likely preferable since an oxidation and coagulation process will help reduce the iron and manganese and filtration will be required after the floc has been separated. Evaluation of additional benefits from treatment such as further reduction of heavy metals and/or bacteria was not a part of the scope for this feasibility report, but certainly should be considered in any future testing. Academic reports and WT's testing has shown the EC process to produce a 3-4 log reduction in bacteria and viruses. If piloting is conducted, this reduction should be studied and quantified and as a result there may be an economic benefit of lower chlorination dosages.

The operational costs were estimated at the theoretical values based on the laboratory collected data. Based on this data, EC shows a cost and operational advantages over the aluminum-based chemicals tested. EC estimated operational cost are lower than the sodium aluminate chemical option, but the calculated operational costs are close enough that our recommendation is that both approaches are tested in a scaled side-by-side field evaluation.

References

Stewart, T., Nyman, M., & Altman, S. J. (2011). *Coagulation Chemistries for Silica Removal from Cooling Tower Water* (No. SAND2011-0800). Sandia National Laboratories.

Appendix A – Analytical Test Methods and Detection Limits

Table A Water Tectonics analytical test methods and detection limits.

Parameter	Unit	Method	Detection Limit
pH	standard units	Hach HQ40d meter	N/A
Conductivity	µS/cm	Hach HQ40d meter	N/A
Turbidity	NTU	Hach 2100P meter	0.01
Dissolved Oxygen	mg/L	Hach HQ40d meter	0.1
Silica	mg/L as SiO_2	Hach Method 8185	1

Table B Third party laboratory test methods and detection limits.

Parameter	Unit	Method	Detection Limit
Aluminum	mg/L	EPA 200.8	0.040
Alkalinity	mg/L	SM 2320B	2.0 – 3.0
Arsenic	mg/L	EPA 200.8	0.003
Calcium	mg/L	EPA 6010C	1
Iron	mg/L	EPA 6010C	0.050
Magnesium	mg/L	EPA 6010C	1
Manganese	mg/L	EPA 200.8	0.008
Silica, Dissolved	mg/L as SiO_2	EPA 200.7	2.1

Appendix B – Budgetary Capital Estimate

Capital Budgetary Estimate

At the customer's request, WaterTectonics has developed a budgetary estimate for the capital equipment required for this EC and chemical process solutions developed in the treatability study. The existing process currently used for treatment of the well water is shown in Figure 9.

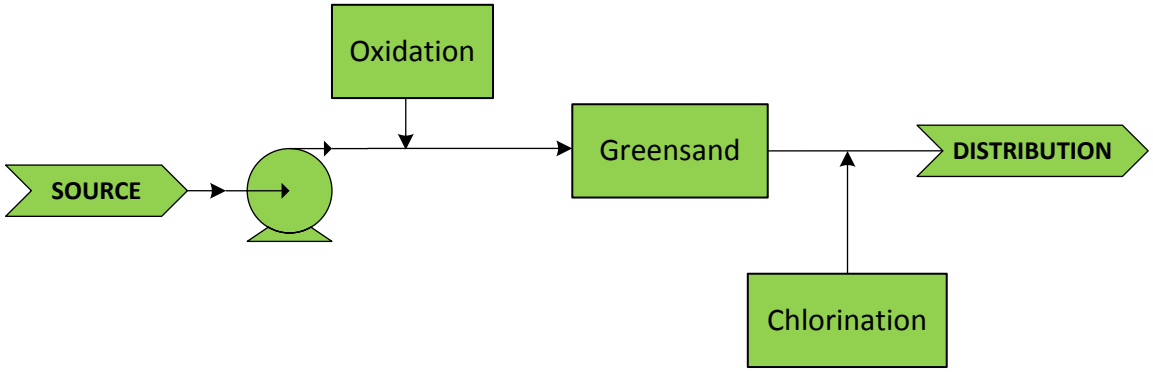


Figure 9 - Current Groundwater Treatment Process

To remove the silica in the groundwater using either, EC or an aluminum based chemical, coagulation and flocculation will occur and thus, supporting clarification and filtration is recommended. For the purposes of this budgetary estimate the follow process flow was developed for the EC and chemical solutions.

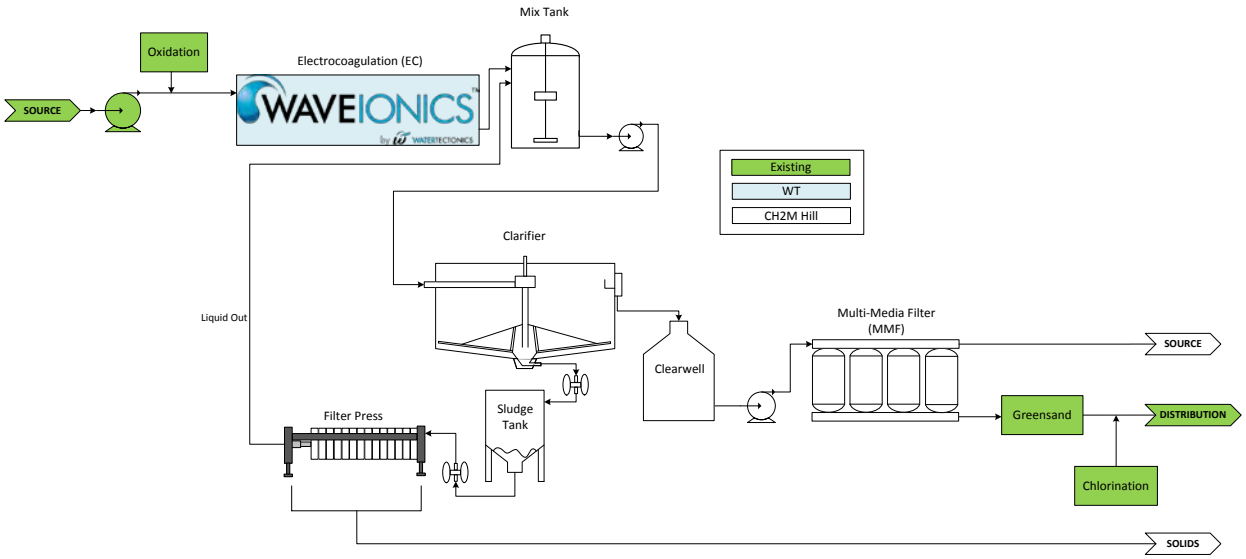


Figure 10 - EC Process Flow Diagram

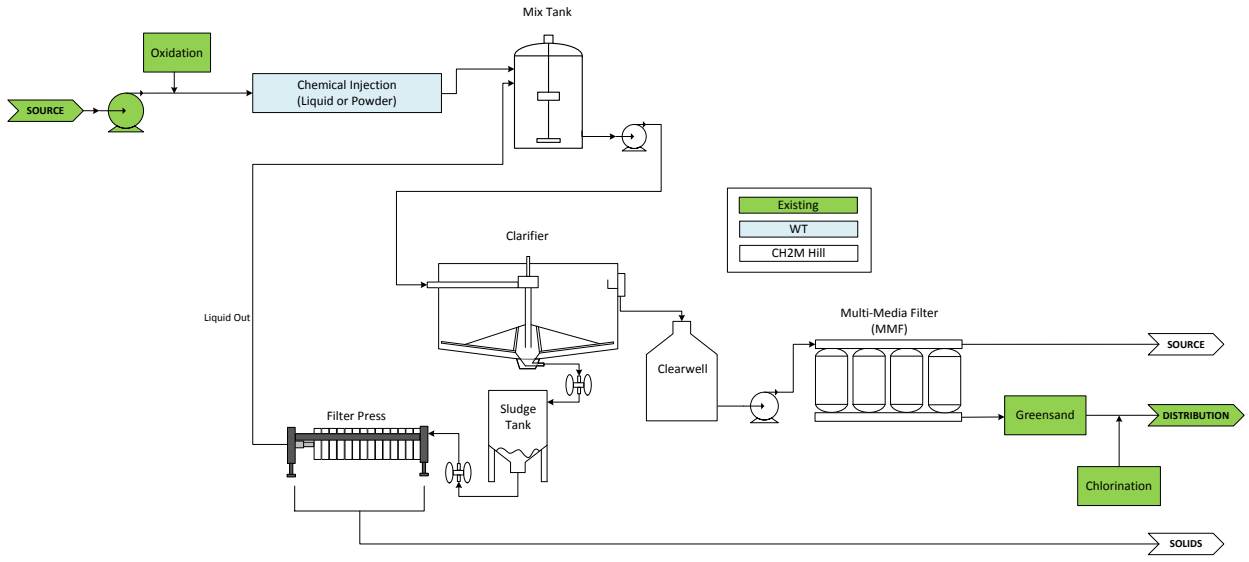


Figure 11 - Chemical Process Flow Diagram

For budgetary purposes, it is assumed that the process component (specifically the mix tank, clarifier, clearwell, multimedia filters, sludge tank and filter press) will be the same for either proposed process solutions. As a result, the primary difference is between the capital cost for an EC system versus a chemical dosing and storage system. Based on our experience and past projects, our proposed budgetary pricing for a process flow at 12MGD is outlined in the table below.

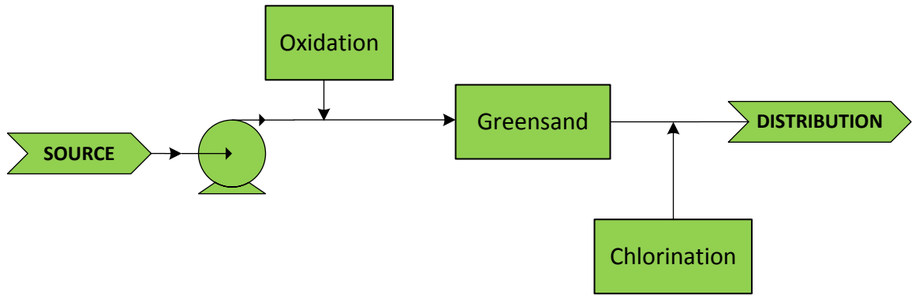
Table 16 Capital Cost Estimate.

Description	Capital Estimate Low	Capital Estimate High	Depreciated Cost of Capital (High)
Option 1 - EC Equipment 12 EC Cells (10 online, 2 Redundant Power supplies (1 per cell)	$2,100,000	$3,200,000	$160,000/year $0.04/Kgal
Option 2 - Chemical Equipment Off-loading Liquid Storage 20,000 gallons Dry Storage, 80,000 lbs Chemical make-down system Redundant Chemical dosing systems	$1,500,000	$2,300,000	$115,000/year $0.03/Kgal
Process Equipment Flocculation Clarification Filtration Dewatering	$6,000,000	$10,000,000	$500,000/year $0.11/Kgal

Note: Depreciation cost were evaluated on 20year, straight line method, 0% APR.

Existing
Proposed

REVISIONS			
REV	DESCRIPTION	DATE	INITIALS
1	Original	11/28/16	JEA
2			
3			
4			



WATERTECTONICS					
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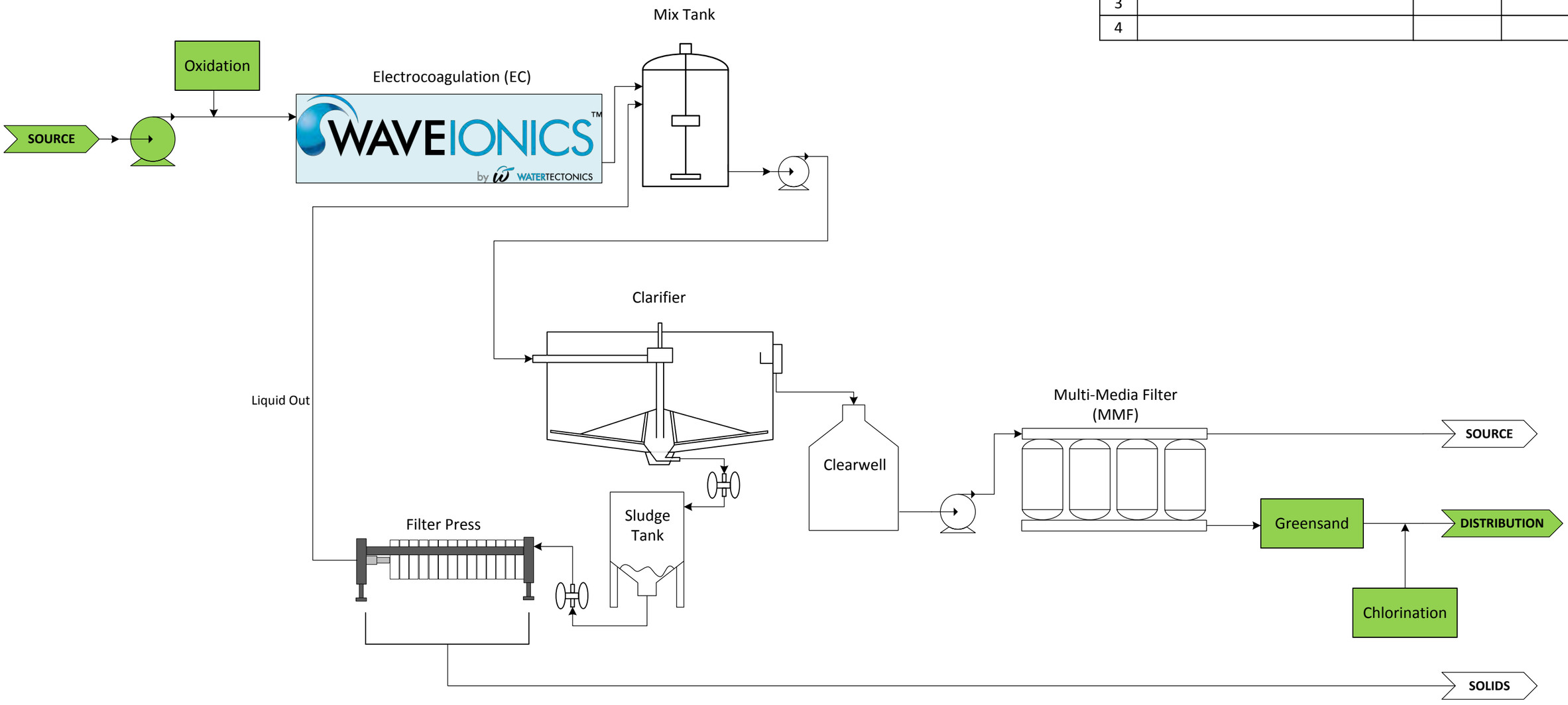
DRAWN	J. Aylesworth	11x17		PFD - Longview	1
ISSUED	11/28/16	SCALE	1/8" = 1'-0"	SHEET	1 OF 3

Existing
WT
CH2M Hill

REVISIONS			
REV	DESCRIPTION	DATE	INITIALS
1	Original	11/28/16	JEA
2			
3			
4			



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Existing
WT
CH2M Hill

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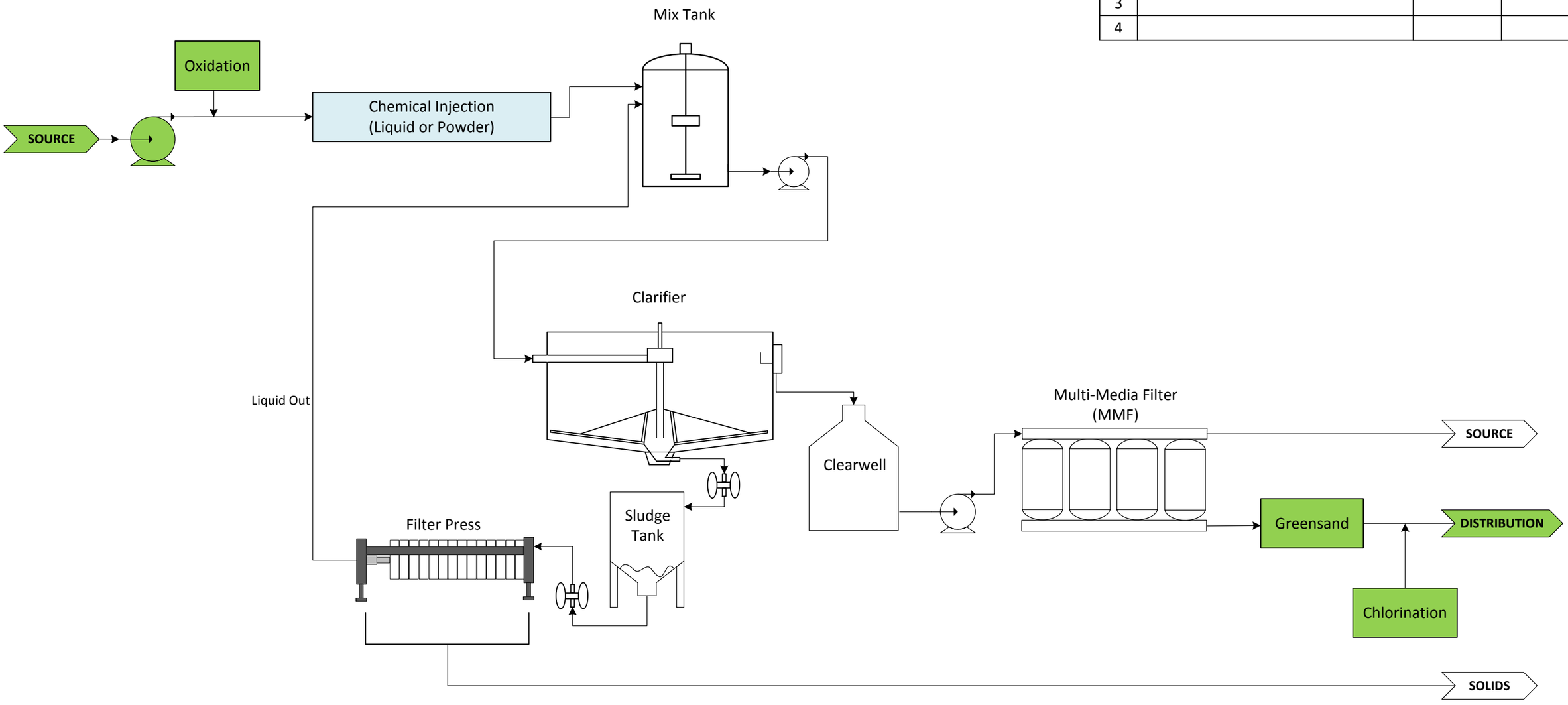

WATERTECTONICS

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ISSUED	11/28/16	SCALE	1/8" = 1'-0"	SHEET	3 OF 3

Attachment B

ch2m:

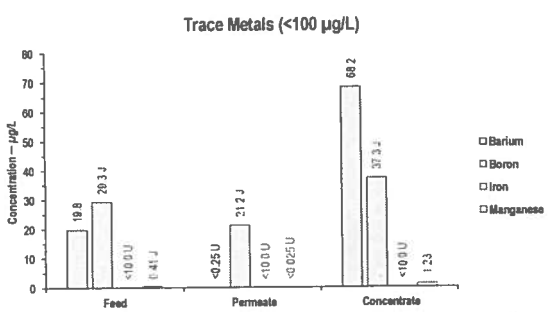
Sample Information				
Project Name		Longview RO		
Project Number		156197.00.JT		
Sample Description		Mint Farm Groundwater		
RO Stream		RO Feed — *61% Recovery*	RO Permeate — *61% Recovery*	RO Concentrate — *61% Recovery*
Sample Name		LV-RO Feed	LV-RO Perm	LV-RO Conc.
Sample Collection Date		11/29/2017	1/10/2017	1/10/2017
Bulk Sample ID		Q362002	Q362002	Q362002
Characterization Lab ID		R104501	R104502	R104503
Total Metals Analysis				
Barium	µg/L	19.8	<0.25 U	68.2
Boron	µg/L	29.3 J	21.2 J	37.3 J
Calcium	µg/L	30,400	<200 U	82,500
Iron	µg/L	<10.0 U	<10.0 U	<10.0 U
Magnesium	µg/L	8,770	52.2 J	22,900
Manganese	µg/L	0.41 J	<0.025 U	1.23
Potassium	µg/L	4,110	300 J	10,500
Silica	µg/L	54,300	1,190	145,000
Sodium	µg/L	14,400	1,160	35,200
Strontium	µg/L	92.5	<2.50 U	238
Hardness, Ca	mg/L as $CaCO_3$	75.9	<0.50 U	206
Hardness, Mg	mg/L as $CaCO_3$	36.1	0.21	94.3
Hardness, total	mg/L as $CaCO_3$	112	0.21	300
General Chemistry Analysis				
Alkalinity, total	mg/L as $CaCO_3$	102	<5.00 U	251
Alkalinity, bicarbonate	mg/L as $CaCO_3$	102	<5.00 U	251
pH	Units	7.5	7.9	7.0
Turbidity	NTU	0.31	0.15	0.49
Conductivity	µS/cm	305	8.16	749
Total Dissolved Solids	mg/L	223	<4.20 U	546
Ammonia	mg/L-N	<0.10 U	<0.10 U	<0.10 U
Nitrate	mg/L-N	0.0098 J	<0.0028 U	0.014
Nitrite	mg/L-N	<0.0030 U	<0.0030 U	<0.0030 U
TKN	mg/L-N	0.26	0.24	0.79
Chloride	mg/L	32.2	0.89	84.8
Sulfate	mg/L	1.18	0.72	3.04
Fluoride	mg/L	0.19 J	0.065 J	0.51
TOC	mg/L	1.04	<0.20 U	2.56
Reactive Silica	mg/L	68.0	1.18	86.9
Treatability Analysis				
Hardness, Ca	mg/L as $CaCO_3$	80.0	1.00	212
Hardness, Mg	mg/L as $CaCO_3$	28.0	<1.00 U	76
Hardness, total	mg/L as $CaCO_3$	108	1.00	288
Calcium	mg/L	32.0	0.40	84.9
Magnesium	mg/L	6.80	<0.24 U	18.5
Chlorine Demand	mg/L as Cl_2			

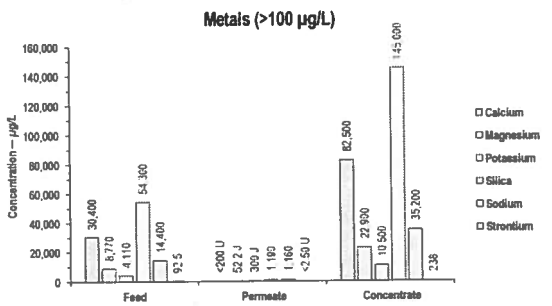
J = Estimated value below reporting limit.

E = Estimated value above calibration range.

U = Not detected at specified detection limit.

ch2m:


Trace Metals (<100 µg/L)
Concentration – µg/L
Feed
Permeate
Concentrate
Barium
Boron
Iron
Manganese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Concentration – µg/L
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Concentrate
Calcium
Magnesium
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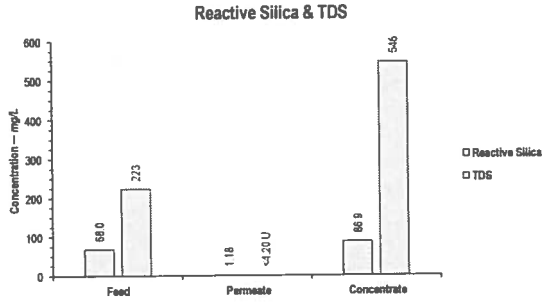
Silica
Sodium
Strontium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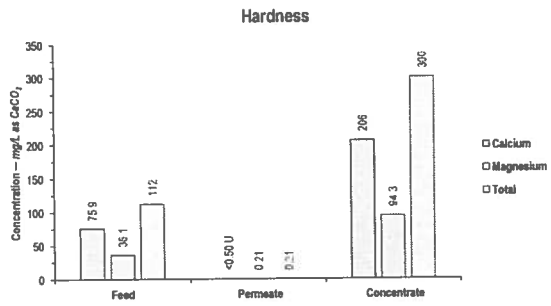
Permeate
Concentrate
Reactive Silica
TDS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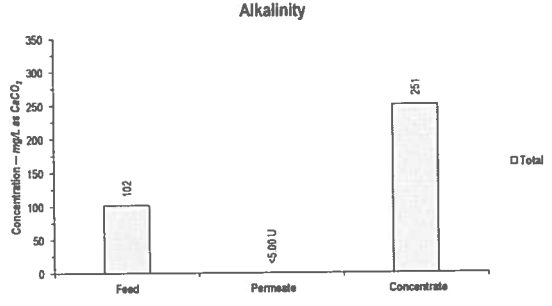
Feed
Permeate
Concentrate
Calcium
Magnesium
Total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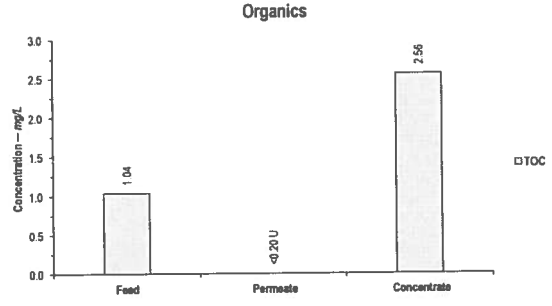
Feed
Permeate
Concentrate
Total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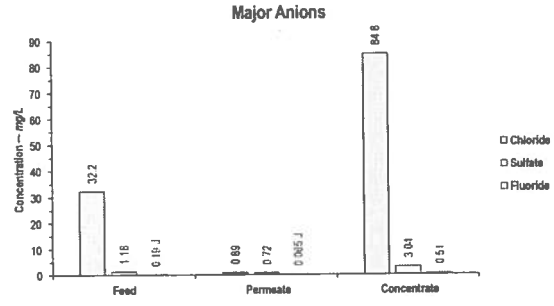
Concentration – mg/L
Feed
Permeate
Concentrate
TOC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Concentration – mg/L
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Permeate
Concentrate
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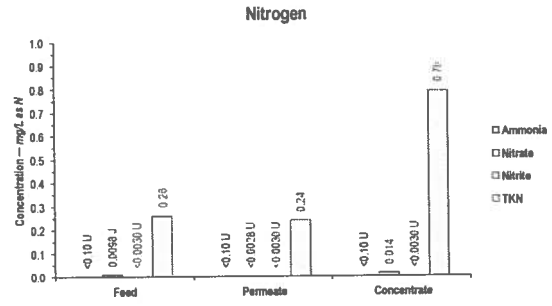
Sulfate
Fluoride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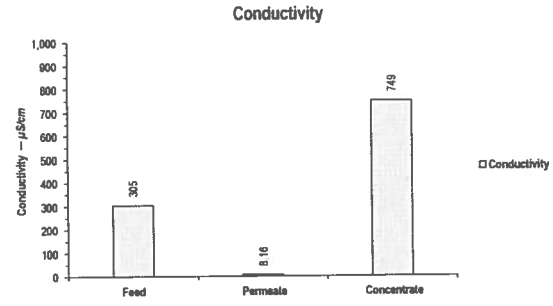
Feed
Permeate
Concentrate
Ammonia
Nitrate
Nitrite
TKN


Conductivity
Conductivity – µS/cm
Feed
Permeate
Concentrate
Conductivity

ch2m:

Manufacturer	Model	Area
Hydranautics	ESPA2-2540	20 sq. ft

Date: 1/10/17
NaCl Solution: 1,500 mg/L
Model No. ESPA2-2540
Serial No. 11898945

Sample Name	Lab ID SDG	Time hh:mm	Feed Pressure psi	Feed Temerature °C	Permeate Flow gph	Concentrate Flow gpm	Feed Conductivity µS/cm	Concentrate Conductivity µS/cm	Permeate Conductivity µS/cm	Feed pH s.u.	Concentrate pH s.u.	Permeate pH s.u.	Temperature Correction Factor	Recovery %	Conductivity Feed Brine µS/cm	Osmotic Pressure psi	Net Driving Pressure psi	Specific Flux gfd/psi	Salt Rejection %
NaCl Testing																			
–	–	11:00	106	22.4	12.5	1.18	2,990	3,930	32.4	n/a	n/a	n/a	1.08	15%	3,240	19.4	86.4	0.19	99.8%
–	–	11:15	105	23.4	12.5	1.18	2,970	3,380	30.7	n/a	n/a	n/a	1.05	15%	3,218	19.3	85.7	0.18	99.8%
–	–	11:30	104	24.3	12.5	1.18	2,980	3,400	30.2	n/a	n/a	n/a	1.02	15%	3,229	19.4	84.2	0.18	99.8%
–	–	11:45	101	25.2	12.5	1.18	2,970	3,420	30.2	n/a	n/a	n/a	0.99	15%	3,218	19.3	81.5	0.18	99.8%
Rejection Test 15% Recovery																			
–	–	13:55	95.1	21.6	12.5	1.18	306	349	5.42	n/a	n/a	n/a	1.11	15%	332	1.99	93.1	0.18	99.6%
–	–	14:10	93.0	21.9	12.5	1.18	307	351	5.19	n/a	n/a	n/a	1.10	15%	333	2.00	91.0	0.18	99.6%
–	–	14:25	92.5	22.3	12.5	1.18	309	352	5.08	n/a	n/a	n/a	1.09	15%	335	2.01	90.5	0.18	99.6%
–	–	14:40	92.3	22.6	12.5	1.18	308	351	4.99	n/a	n/a	n/a	1.08	15%	334	2.00	90.3	0.18	99.6%
Rejection Test 61% Recovery																			
–	–	15:00	85.8	23.1	12.5	0.14	307	748	8.22	n/a	n/a	n/a	1.06	61%	472	2.83	83.0	0.19	99.6%
–	–	15:15	85.0	23.4	12.5	0.14	304	748	8.49	n/a	n/a	n/a	1.05	61%	468	2.81	82.2	0.19	99.6%
–	–	15:30	85.0	23.8	12.5	0.14	304	750	8.12	n/a	n/a	n/a	1.04	61%	468	2.81	82.2	0.19	99.6%
LV-RO	R104501,02,03	15:45	84.5	24.0	12.5	0.14	305	749	8.16	7.5	7.9	7.0	1.03	61%	469	2.82	81.7	0.19	99.6%

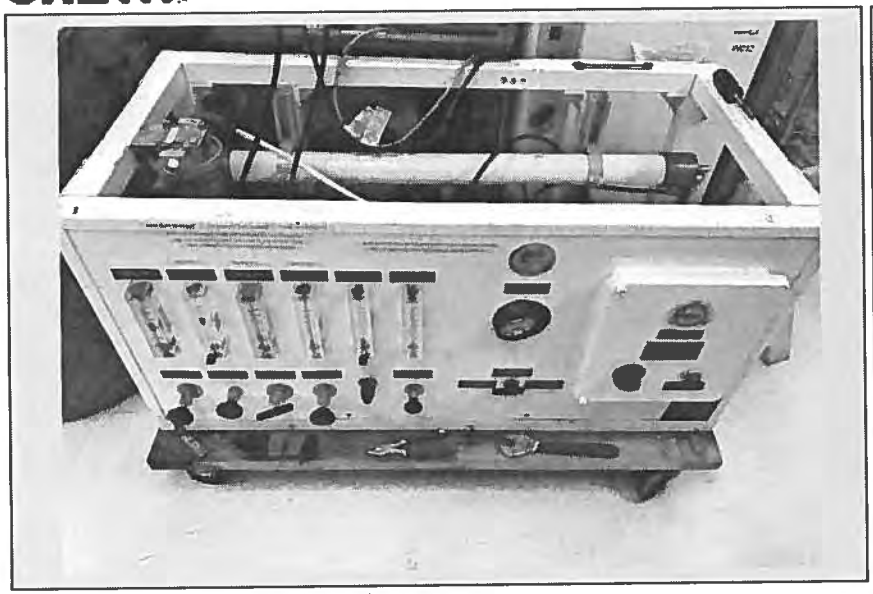


Photo 1: Front view of the RO Skid used in testing.

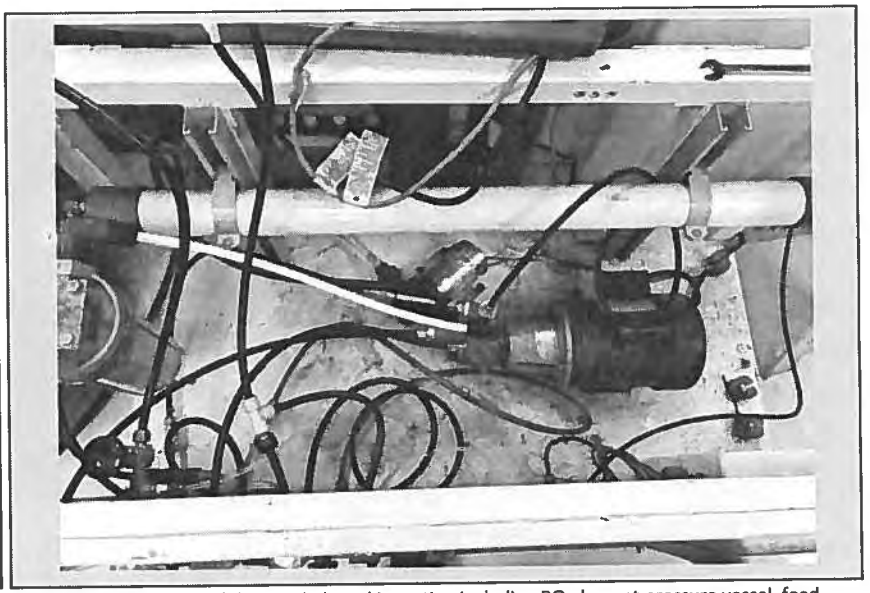


Photo 2: Inside view of the RO Skid used in testing including RO element pressure vessel, feed pump, booster pump and pre-filter.

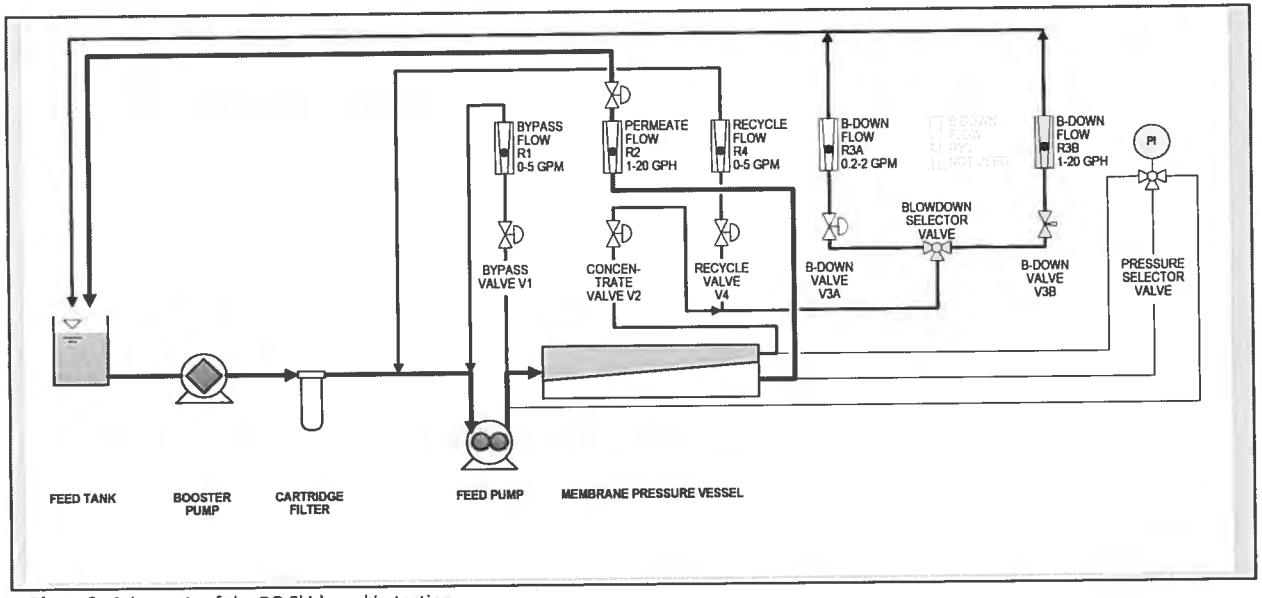


Photo 3: Schematic of the RO Skid used in testing.

Gravity Pipe - Outfall

Is this Pipeline Segment Included in the Project? Yes

Cost Estimate Quantity Units (English or Metric)? **English**

User Inputs:	Value	Symbol	Comment	Red Flags	Comment	User Comments
Gravity Pipe - Outfall						
Segment Description:	Outfall					
1.) Is this segment Tunneled or Open Cut?	Open Cut					
2.) Input Segment Length (feet)	2,000	L	USER INPUT			
3.) Pipe 1:						
Input Type of Pipe Material	PVC SDR 35		USER INPUT			
Input Inside Pipe Diameter (inches)	24	P1	Note: Data Range is 6" - 24"			
Input Pipe Wall Thickness (inches per each wall)	1.50					
Input Pipe Fitting Allowance (Low, Medium, High)	Low		Low = approximately 8 fittings per mile Medium = approximately 12 fittings per mile High = approximately 20 fittings per mile			
4.) Is there a parallel Pipe 2 ?	No		Low = approximately 8 fittings per mile Medium = approximately 12 fittings per mile High = approximately 20 fittings per mile			
5.) Is there a parallel Pipe 3 ?	No		Low = approximately 8 fittings per mile Medium = approximately 12 fittings per mile High = approximately 20 fittings per mile			
6.) Input Pipe Cover Depth (feet)	6	D				
7.) Input Space Between Trench Wall & Pipe (inches)	18	S1	Suggested Minimum Space: 18"			
8.) Input Space Between Multiple Pipes (inches)	12	S2				
9.) Are the Pipes Concrete Encased?	No		If "Yes", the model does concrete encasement for the entire length of the segment			
10.) Input Pipe Bedding Thickness (inches)	6	BT	Suggested Minimum Thickness: 6"			
11.) Input Thickness of Pipe Zone Above Pipe (inches)	12	PZAP	Suggested Minimum Thickness: 12"			
Trench Information:						
Trench Depth (ft)	7.75	TD				
Straight Wall Trench Depth (ft)	4.00	SWTD				
Trench Width at Bottom of Trench (ft)	5.25	W1				
Trench Width at Top of Trench (ft)	12.75	W2				
Is Trench Box Used?	No					
Is Wood Shoring Used?	No					
Is Wood Sheet Piling Used?	No					
12.) Is Wood Shoring Required for SWTD < 4'?	No		TRENCH BOX is used for Straight Wall Trench Depths (SWTD) greater than 4' and less than 8'. WOOD SHORING is used for SWTD greater than or equal to 8' and less than or equal to 20'. WOOD SHEET PILING is used for SWTD greater than 20'			
13.) Vertical Depth Dimension (feet)	4	SWTD	TRENCH BOX is used for Straight Wall Trench Depths (SWTD) greater than 4' and less than 8'. WOOD SHORING is used for SWTD greater than or equal to 8' and less than or equal to 20'. WOOD SHEET PILING is used for SWTD greater than 20'			
14.) Side Slope (Horizontal to Vertical)	1.00	SS				
15.) Bedding Material	Imported					
16.) Pipe Zone Backfill Material	Native					
17.) Trench Zone Backfill Material	Native	TZBF				
18.) Site Condition Factors	Low Urban		Assumes 3" asphalt pavement, low level of traffic control and low level of utility interference			
19.) Trench Dewatering	User Specific		For other types of dewatering (Ground Freezing, Well Points, Sheet Pile & Interior Well Points), contact a CH2M HILL professional estimator.			
20.) Supplemental Factors	None					
21.) Appurtenances *(Note to User: Review the appurtenance drawings)*:	Quantity	Size (inches)	Lump Sum Cost per Each (includes installation)	Description		
Manholes:						
Small - 48"						
Medium - 60"						
Large - 72" and Larger	4					
Drop Manhole						
Service Laterals:						
Service Lateral						
Catch Basins:						
Gutter Style						
Open Area (Parking Lot)						
Other Facilities:						
User Defined 1						
User Defined 2						
User Defined 3						
User Defined 4						
User Defined 5						

Unit Cost Database:

Item	Unit	$/Unit	Reference	Data Range	
Pipe 1:					
Hobas Pipe Material Cost	LF	$46.09		Note: Data Range is 6" - 100"	
Vylon Material Pipe Cost	LF	$34.27		Note: Data Range is 21" - 54"	
PVC - SDR 35 Total Installed Pipe Cost	LF	$30.58		Note: Data Range is 6" - 24"	
RCP - ASTM C76 Total Installed Pipe Cost	LF	$74.74		Note: Data Range is 6" - 108"	
HDPE - Hancor Blue Seal Pipe Material Cost	LF	$34.19		Note: Data Range is 4" - 60"	
Vitrified Clay Pipe Material Cost	LF	$78.66		Note: Data Range is 6" - 42"	
PVC Labor Cost	LF	$8.11		Note: Data Range is 6" - 24"	
RCP Labor Cost	LF	$26.36		Note: Data Range is 6" - 108"	
Hobas Labor Cost	LF	$22.29			
User Defined: (Be sure to include an installation factor in User Defined formula)					
Pipe System #1 [for example: = (21.443 * pipe 1 diameter) - 13.184]	LF		Pipe 1 Diameter:>>>>>>	24	Be sure to include an installation factor.
Pipe System #2 [for example: = (21.443 * pipe 1 diameter) - 13.184]	LF				
Pipe System #3 [for example: = (21.443 * pipe 1 diameter) - 13.184]	LF				
Pipe System #4 [for example: = (21.443 * pipe 1 diameter) - 13.184]	LF				
Pipe 2:					
Hobas Pipe Material Cost	LF	-$38.96		Note: Data Range is 6" - 100"	
Vylon Material Pipe Cost	LF	-$33.44		Note: Data Range is 21" - 54"	
PVC - SDR 35 Total Installed Pipe Cost	LF	$14.89		Note: Data Range is 6" - 24"	
RCP - ASTM C76 Total Installed Pipe Cost	LF	-$7.26		Note: Data Range is 6" - 108"	
HDPE - Hancor Blue Seal Pipe Material Cost	LF	$7.65		Note: Data Range is 4" - 60"	
Vitrified Clay Pipe Material Cost	LF	$18.30		Note: Data Range is 6" - 42"	
PVC Labor Cost	LF	$4.69		Note: Data Range is 6" - 24"	
RCP Labor Cost	LF	$9.98		Note: Data Range is 6" - 108"	
Hobas Labor Cost	LF	$4.69			
User Defined: (Be sure to include an installation factor in User Defined formula)					
Pipe System #1 [for example: = (21.443 * pipe 2 diameter) - 13.184]	LF		Pipe 2 Diameter:>>>>>>	12	Be sure to include an installation factor.
Pipe System #2 [for example: = (21.443 * pipe 2 diameter) - 13.184]	LF				
Pipe System #3 [for example: = (21.443 * pipe 2 diameter) - 13.184]	LF				
Pipe System #4 [for example: = (21.443 * pipe 2 diameter) - 13.184]	LF				
Pipe 3:					
Hobas Pipe Material Cost	LF	$3.07		Note: Data Range is 6" - 100"	
Vylon Material Pipe Cost	LF	$0.41		Note: Data Range is 21" - 54"	
PVC - SDR 35 Total Installed Pipe Cost	LF	$22.74		Note: Data Range is 6" - 24"	
RCP - ASTM C76 Total Installed Pipe Cost	LF	$33.74		Note: Data Range is 6" - 108"	
HDPE - Hancor Blue Seal Pipe Material Cost	LF	$20.93		Note: Data Range is 4" - 60"	
Vitrified Clay Pipe Material Cost	LF	$48.48		Note: Data Range is 6" - 42"	
PVC Labor Cost	LF	$8.40		Note: Data Range is 6" - 24"	
RCP Labor Cost	LF	$19.16		Note: Data Range is 6" - 108"	
Hobas Labor Cost	LF	$8.40			
User Defined: (Be sure to include an installation factor in User Defined formula)					
Pipe System #1 [for example: = (21.443 * pipe 3 diameter) - 13.184]	LF		Pipe 3 Diameter:>>>>>>	18	Be sure to include an installation factor.
Pipe System #2 [for example: = (21.443 * pipe 3 diameter) - 13.184]	LF				
Pipe System #3 [for example: = (21.443 * pipe 3 diameter) - 13.184]	LF				
Pipe System #4 [for example: = (21.443 * pipe 3 diameter) - 13.184]	LF				
Excavating, Chain Trencher, 6" wide, 60" deep, including backfill and compaction	LF	$1.07	RSM 02315-620-2300		
Trench Excavation (1-4 feet Deep), 3/8 cy tractor loader / backhoe	CY	$7.18	RSM 02315-610-0050	150 cy/day	
Trench Excavation (4-8 feet Deep) 1/2 cy hyd backhoe	CY	$8.71	RSM 02315-610-0090	200cy/day	
Trench Excavation (8-10 feet Deep) 3/4 cy hyd backhoe	CY	$6.31	RSM 02315-610-0500	225 cy/day	
Trench Excavation (10-14 feet Deep) 1 cy hyd backhoe	CY	$4.29	RSM 02315-610-0910	360 cy/day	
Trench Excavation (14-20 feet Deep) 1-1/2 cy hyd backhoe	CY	$3.71	RSM 02315-610-1310	480 cy/day	
Trench Excavation (20-24 feet Deep) 2-1/2 cy hyd backhoe	CY	$3.38	RSM 02315-610-1344	785 cy/day	
Trench Excavation with Trench Box (8-10 feet Deep), 3/4 cy excavator	CY	$7.39	RSM 02315-610-1362	212 cy/day	
Trench Excavation with Trench Box (10-14 feet Deep), 1 cy excavator	CY	$5.00	RSM 02315-610-1375	338 cy/day	
Trench Excavation with Trench Box (14-20 feet Deep), 1-1/2 cy excavator	CY	$4.25	RSM 02315-610-1382	451 cy/day	
Trench Excavation with Trench Box (20-24 feet Deep), 2-1/2 cy excavator	CY	$3.80	RSM 02315-610-1388	719 cy/day	
Bedding - Native	CY	$20.29	Dave Hedglin (includes Place & Compact)		
Bedding - Imported	CY	$43.70	Dave Hedglin (includes Material and Place & Compact)		
Bedding - CDF	CY	$90.53	Dave Hedglin (includes Material and Place & Compact)		
Pipe Zone Backfill - Native	CY	$28.38	Dave Hedglin (includes Place & Compact)		
Pipe Zone Backfill - Imported	CY	$48.78	Dave Hedglin (includes Material and Place & Compact)		
Pipe Zone Backfill - CDF	CY	$90.53	Dave Hedglin (includes Material and Place & Compact)		
Reinforced Concrete Pipe Encasement	CY	$422.23			
Trench Zone Backfill - Native	CY	$10.81	Dave Hedglin (includes Place & Compact)		
Trench Zone Backfill - Imported	CY	$29.34	Dave Hedglin (includes Material and Place & Compact)		
Trench Zone Backfill - CDF	CY	$90.53	Dave Hedglin (includes Material and Place & Compact)		
Haul Excavated Material (12cy dump truck, 2 miles round trip)	CY	$5.24	RSM 02315-490-0400		
Haul Excavated Material (20cy dump truck, 5 miles round trip)	CY	$6.05	RSM 02315-490-1245		
Dewatering:					
Trench Dewatering	LF	$5.67	Custom Spec		
Shoring:					
Wood Shoring (for SWTD ≥ 8' and ≤ 20')	SF	$1.09	RSM 02315-610-1391		
Wood Sheet Piling (for SWTD greater than 20')	SF	$11.36	RSM 02250-400-4500		
Micro tunneling:					
Micro tunneling, 24"-48" OD	LF	$938.58	RSM 02441-400-0100		
Micro tunneling, 30" OD, Adverse Conditions	LF	$1,407.87	RSM 02441-4000-110		
Micro tunneling Mobilization	LS	$134,082.84	RSM 02441-400-1100		
Horizontal Boring:					
Horizontal Boring, Roadwork, 1/2" thick wall, 24" diameter casing	LF	$322.82	RSM 02441-300-0100		
Horizontal Boring, Roadwork, 1/2" thick wall, 36" diameter casing	LF	$439.20	RSM 02441-300-0200		
Horizontal Boring, Roadwork, 1/2" thick wall, 48" diameter casing	LF	$534.44	RSM 02441-300-0300		
Horizontal Boring, Railroad, 24" diameter	LF	$395.62	RSM 02441-300-0500		
Horizontal Boring, Railroad, 36" diameter	LF	$478.30	RSM 02441-300-0600		
Horizontal Boring, Railroad, 48" diameter	LF	$607.44	RSM 02441-300-0700		
Horizontal Boring, Jacking Pits	EA	$19,552.88	RSM 02445-300-1100		
Appurtenances:					

Manholes:							
Small - 48"	EA	$8,852.69					
Medium - 60"	EA	$9,965.49					
Large - 72" and Larger	EA	$12,826.08					
Drop Manhole	EA	$9,789.87					
Service Laterals:							
Service Lateral	EA	$3,501.17					
Catch Basins:							
Gutter Style	EA	$6,347.99					
Open Area (Parking Lot)	EA	$8,706.83					
Global Difficulty Factors:							
Erosion Control		0.90	Open Country with erosion control (hydro-seeding)				
Forested Land		1.18	Clearing and stump removal required, low or no traffic control & utility interference				
Gravel Roads		0.90	No traffic control, low or no utility interference				
High Urban		1.32	Assumes asphalt pavement, high level of traffic control and high level of utility interference				
Low Urban		1.00	Assumes 3" asphalt pavement, low level of traffic control and low level of utility interference				
Medium Urban		1.19	Assumes asphalt pavement, medium level of traffic control and medium level of utility interference				
Open Country		0.74	Open country, natural restoration, no or low traffic control and no or low utility interference				
Tunneled Crossings		4.00					
User Defined 1		0.75	GDF Description UD 1				
User Defined 2		0.81	GDF Description UD 2				
Supplemental Factors:							
Groundwater Control		1.30					
None		1.00					
Rock Excavation		1.40					
User Defined 1		1.21	SF Description UD 1				
User Defined 2		1.17	SF Description UD 2				

Estimating Calculations:							
Is this segment Tunneled? (1 = Yes, 0 = No)	0						
Is this Segment Open Cut? (1 = Yes, 0 = No)	1						
Are Pipes Concrete Encased? (0= Yes, 1= No)	1						
Pipe 1 Diameter (inches)	27.00	P1					
Pipe 1 Diameter (ft)	2.25						
Pipe 1 Area (sf/LF)	7.07						
Is Pipe 1 DI? (1 = Yes, 0 = No)	0						
Is Pipe 1 Steel? (1 = Yes, 0 = No)	0						
Is there Pipe 2? (1 = Yes, 0 = No)	0						
Pipe 2 Diameter (inches)	14.00	P2					
Pipe 2 Diameter (ft)	1.17						
Pipe 2 Area (sf/LF)	3.67						
Is Pipe 2 DI? (1 = Yes, 0 = No)	0						
Is Pipe 2 Steel? (1 = Yes, 0 = No)	0						
Is there Pipe 3? (1 = Yes, 0 = No)	0						
Pipe 3 Diameter (inches)	20.00	P3					
Pipe 3 Diameter (ft)	1.67						
Pipe 3 Area (sf/LF)	5.24						
Is Pipe 3 DI? (1 = Yes, 0 = No)	0						
Is Pipe 3 Steel? (1 = Yes, 0 = No)	0						
Maximum Pipe Diameter (ft)	2.25						
Pipe Trench							
Is Trench Box Used? (SWTD >4' and <8') (1 = Yes, 0 = No)	0				Trench Box Not Used		
Is Wood Shoring Used? (SWTD ≥ 8' and ≤ 20') (1 = Yes, 0 = No)	0						
Is Wood Sheet Piling used? (SWTD > 20') (1=Yes, 0 = No)	0						
Is Wood Shoring Used for SWTD < 4'? (1 = Yes, 0 = No)	0						
Total Pipe Length (ft)	2,000	L					
Bedding Thickness (ft)	0.50	BT					
Pipe Zone Above Pipe (ft)	1.00	PZAP					
Trench Depth (Pipe Cover Depth + Pipe Diameter + Bedding Thickness) (ft)	7.75	TD					
Pipe Zone (Pipe Diameter + Pipe Zone Above Pipe)	3.25	PZ					
Trench Width at Bottom of Trench (ft)	5.25	W1					
Straight Wall Trench Depth (ft)	4.00	SWTD					
Total Straight Trench Excavation Quantity (TD * W * Length) (cy)	3,013.89						
Side Slope Depth (Trench Depth - Bedding Thickness - Vertical Depth feet)	3.75	SSD					
Side Slope Multiplier	1.00	SS					
Total Sloped Excavation (cy)	1,041.67						
Total Excavation (cy)	4,055.56						
Total Pipe Bedding Quantity (cy)	194.44						
Total Pipe 1 Volume (cy)	294.52						
Total Pipe 2 Volume (cy)	0.00						
Total Pipe 3 Volume (cy)	0.000						
Total Pipe Zone Quantity (cy)	969.36						
Total Trench Zone Quantity (cy)	3,086.19						
Trench Width at Top of Trench (ft)	12.75	W2					
Area of Surface Restoration (sy)	2,833.33						
Common Excavation Unit Cost (per CY, No Trench Box)	$6.31						
Common Excavation Unit Cost (per CY, with Trench Box)	$7.39						

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
Gravity Pipe - Outfall							
Excavation:							
'Pipe Trench -- Trench Box Not Used	4,542	CY	3472.78	m3	$6.31	$28,661	
Pipe Bedding:							
Imported	194	CY	148.66	m3	$43.70	$8,498	
Pipe Zone Backfill:							
Native	969	CY	741.13	m3	$25.36	$24,587	
Trench Zone Backfill:							
Native	3,086	CY	2359.56	m3	$10.81	$32,756	
Concrete Encasement (Includes Bedding and Pipe Zone)	0	CY	0.00	m3	$402.25	$0	
Load and Haul Away Excess Excavated Material	487	CY	372.08	m3	$8.24	$3,038	
Pipe:							
Pipe 1 (PVC SDR 35, 24 inch diameter)	2,000	LF	609.60	m	$330.50	$61,175	
Pipe 2 (None)	0	LF	0.00	m	$14.89	$0	
Pipe 3 (None)	0	LF	0.00	m	$33.74	$0	

Pipe Fittings:							
Pipe 1 Fitting Allowance: Low	5.0%				$61,175.29	$3,059	
Pipe 2 Fitting Allowance: Low	0.0%				$0.00	$0	
Pipe 3 Fitting Allowance: High	0.0%				$0.00	$0	
T-Lock Lining for RCP Pipe:							
Pipe 1	0	LF	0.00	m	$99.10	$0	
Pipe 2	0	LF	0.00	m	$28.24	$0	
Pipe 3	0	LF	0.00	m	$57.68	$0	
Dewatering:							
Trench Dewatering	2,000	LF	609.60	m	$5.67	$11,345	
Shoring:							
Wood Shoring (for SWTD ≥ 8' and ≤ 20')	0	SF	0.00	m2	$1.03	$0	
Wood Sheet Piling (for SWTD greater than 20')	0	SF	0.00	m2	$11.30	$0	
Surface Restoration:							
Asphalt Paving Repair (3" thick):							
Saw Cut Existing Pavement	4,000	LF	1219.20	m	$1.39	$5,578	
Remove Existing Pavement	2,833	SY	2369.03	m2	$5.07	$14,365	
Haul Debris to Dump	236	CY	180.52	m3	$10.02	$2,365	
Dump Charge	236	CY	180.52	m3	$105.57	$24,925	
Asphalt Paving Repair	25,500	SF	2369.03	m2	$4.01	$102,291	
Subtotal						$322,642	
Global Difficulty Factor (Low Urban)	100%				$322,641.53	$322,642	
Appurtenances:							
Manholes:							
Small - 48"	0	EA			$6,652.69	$0	
Medium - 60"	0	EA			$9,985.49	$0	
Large - 72" and Larger	4	EA			$12,826.06	$51,304	
Drop Manhole	0	EA			$9,789.87	$0	
Service Laterals:							
Service Lateral	0	EA			$5,501.17	$0	
Catch Basins:							
Gutter Style	0	EA			$6,347.99	$0	
Open Area (Parking Lot)	0	EA			$8,706.93	$0	
Other Facilities:							
User Defined 1 ()	0	EA			$0.00	$0	
User Defined 2 ()	0	EA			$0.00	$0	
User Defined 3 ()	0	EA			$0.00	$0	
User Defined 4 ()	0	EA			$0.00	$0	
User Defined 5 ()	0	EA			$0.00	$0	
Subtotal - Appurtenances						$51,304	
Tunnel:							
Casing	0	LF	0.00	m	$938.53	$0	
Carrier	0	LF	0.00	m	$375.41	$0	
Jacking Shaft:							
Shoring	0	SF	0.00	m2	$139.35	$0	
Tremie	0	CY	0.00	m3	$263.95	$0	
Riser	0	LF	0.00	m	$0.00	$0	
Exc. & Backfill	0	CY	0.00	m3	$0.00	$0	
Receiving Shaft:							
Shoring	0	SF	0.00	m2	$84.73	$0	
Tremie	0	CY	0.00	m3	$263.95	$0	
Riser	0	LF	0.00	m	$0.00	$0	
Exc. & Backfill	0	CY	0.00	m3	$0.00	$0	

USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST
Red Flags:						
River Crossings	0		0		$0.00	$0
Detours	0		0		$0.00	$0
Utility Conflicts	0		0		$0.00	$0
Existing Pipe Removal	0		0		$0.00	$0
Item 1 Description	0		0		$0.00	$0
Item 2 Description	0		0		$0.00	$0
Item 3 Description	0		0		$0.00	$0
Item 4 Description	0		0		$0.00	$0
Item 5 Description	0		0		$0.00	$0
Item 6 Description	0		0		$0.00	$0
Item 7 Description	0		0		$0.00	$0
Item 8 Description	0		0		$0.00	$0
Item 9 Description	0		0		$0.00	$0
Item 10 Description	0		0		$0.00	$0
Item 11 Description	0		0		$0.00	$0
Item 12 Description	0		0		$0.00	$0
Item 13 Description	0		0		$0.00	$0
Item 14 Description	0		0		$0.00	$0
Item 15 Description	0		0		$0.00	$0
Subtotal - All						$373,946
Allowance for Misc Items	5%				$373,945.86	$18,697
Subtotal						$392,643
Ground Water Control (User Specific)	0%				$392,643.15	$0
Supplemental Factor (None)	100%				$392,643.15	$392,643
TOTAL						$392,643
Gravity Pipe - Outfall	2,000	LF	$196.32	$392,643		
Segment Cost with Standard Additional Project Costs Added	2,000	LF	$196.32	$392,643		
Segment Cost with Standard Additional Project Costs and Contractor Markups Added	2,000	LF	$292.22	$584,433		
Segment Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	2,000	LF	$286.68	$573,350		
Segment Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	2,000	LF	$286.68	$573,350		

Sample Information		
Project Name		Longview RO
Project Number		156197.00.JT
Sample Description		Mint Farm Groundwater
Sample Collection Date		11/29/2016
Bulk Sample ID		Q362001
Characterization Lab ID		Q386201, R100201
Total Metals Analysis		
Barium	µg/L	13.6
Boron	µg/L	<100 U
Calcium	µg/L	33,000
Iron	µg/L	957
Magnesium	µg/L	9,140
Manganese	µg/L	630
Potassium	µg/L	3,960
Silica	µg/L	56,900
Sodium	µg/L	11,700
Strontium	µg/L	93.2
Hardness, Ca	mg/L as $CaCO_3$	82.4
Hardness, Mg	mg/L as $CaCO_3$	37.6
Hardness, total	mg/L as $CaCO_3$	120
General Chemistry Analysis		
Alkalinity, total	mg/L as $CaCO_3$	47.3
Alkalinity, bicarbonate	mg/L as $CaCO_3$	<5.00 U
pH	Units	7.45
Turbidity	NTU	3.78
Conductivity	µS/cm	296
Total Dissolved Solids	mg/L	211
Ammonia	mg/L-N	0.16
Nitrate	mg/L-N	<0.010 U
Nitrite	mg/L-N	<0.010 U
TKN	mg/L-N	0.52
Chloride	mg/L	28.4
Sulfate	mg/L	1.08
Fluoride	mg/L	<0.20 U
TOC	mg/L	1.52
Reactive Silica	mg/L	59.0
Treatability Analysis		
Hardness, Ca	mg/L as $CaCO_3$	86
Hardness, Mg	mg/L as $CaCO_3$	32
Hardness, total	mg/L as $CaCO_3$	118
Chlorine Demand	mg/L-Cl_2	

J = Estimated value below reporting limit.

E = Estimated value above calibration range.

U = Not detected at specified detection limit.

ch2m:

REAGENT PREPARATION

Reagent Type:	Sodium Aluminate
Vendor:	Kemira
Reagent Name:	SAX-20
Reagent Concentration:	10.6 %
Specific Gravity:	1.48 g/mL
Reagent Concentration:	156,859 mg/L
Stock Solution Basis:	as Al
Prepared Solution Basis:	as Al
Prepared Reagent Concentration:	10,000 mg/L
Target Prepared Solution Volume:	100 mL
Total Volume Stock Solution:	6.38 mL of product
Total Mass Stock Solution:	9.46 g of product
Date of Preparation:	1/5/2017
Analyst:	AMB

Reagent Type:	Alum
Vendor:	Kemira
Reagent Name:	ALS
Reagent Concentration:	48.8 %
Specific Gravity:	1.33 g/mL
Reagent Concentration:	648,508 mg/L
Stock Solution Basis:	as $Al_2(SO_4)_3*14H_2O$
Prepared Solution Basis:	as $Al_2(SO_4)_3*14H_2O$
Prepared Reagent Concentration:	10,000 mg/L
Target Prepared Solution Volume:	100 mL
Total Volume Stock Solution:	1.54 mL of product
Total Mass Stock Solution:	2.05 g of product
Date of Preparation:	1/5/2017
Analyst:	AMB

Reagent Type:	Magnesium Chloride
Prepared Solution Basis:	$MgCl_2$
Prepared Reagent Concentration:	10,000 mg/L
Target Prepared Solution Volume:	100 mL
Total Mass to Add:	1.00 g of product
Date of Preparation:	1/6/2017
Analyst:	BJS

Reagent Type:	Lime
Prepared Solution Basis:	$Ca(OH)_2$
Prepared Reagent Concentration:	10,000 mg/L
Target Prepared Solution Volume:	100 mL
Total Mass to Add:	1.00 g of product
Date of Preparation:	1/6/2017
Analyst:	BJS

**Reagents prepared fresh each day as needed.

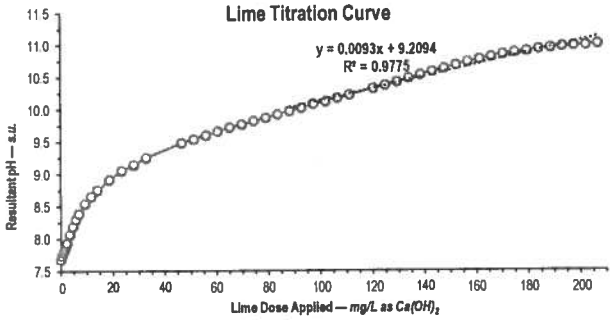
ch2m: LIME TITRATION

Sample Name	Longview Mint Farm Groundwater
ASL ID	Q362001
Collection Date	11/29/2016
Test Date	1/4/2017
Analyst	AMB

Lime Strength	12 g/L as Ca(OH)2
Sample Volume	0.50 L

Lime Volume mL	Total Sample Volume L	Lime Dose mg/L as $Ca(OH)_2$	Resultant pH s.u.
0.00	0.50	0.00	7.68
0.02	0.50	0.47	7.74
0.04	0.50	0.93	7.79
0.06	0.50	1.40	7.84
0.08	0.50	1.87	7.89
0.10	0.50	2.34	7.94
0.15	0.50	3.50	8.07
0.20	0.50	4.67	8.19
0.25	0.50	5.84	8.30
0.30	0.50	7.01	8.39
0.40	0.50	9.34	8.54
0.50	0.50	11.7	8.65
0.60	0.50	14.0	8.75
0.80	0.50	18.7	8.91
1.00	0.50	23.3	9.05
1.20	0.50	28.0	9.14
1.40	0.50	32.6	9.25
2.00	0.50	46.6	9.48
2.20	0.50	51.2	9.54
2.40	0.50	55.8	9.60
2.60	0.50	60.5	9.66
2.80	0.50	65.1	9.72
3.00	0.50	69.7	9.77
3.20	0.50	74.3	9.82
3.40	0.50	78.9	9.87
3.60	0.50	83.5	9.92
3.80	0.50	88.1	9.97
4.00	0.50	92.7	10.02
4.20	0.50	97.3	10.08
4.40	0.50	102	10.12
4.60	0.50	107	10.17
4.80	0.50	111	10.22
5.20	0.51	120	10.32
5.40	0.51	125	10.37
5.60	0.51	129	10.42
5.80	0.51	134	10.48
6.00	0.51	139	10.53
6.20	0.51	143	10.58
6.40	0.51	148	10.63
6.60	0.51	152	10.68
6.80	0.51	157	10.73
7.00	0.51	161	10.77
7.20	0.51	166	10.81
7.40	0.51	170	10.85
7.60	0.51	175	10.88
7.80	0.51	180	10.90
8.00	0.51	184	10.93
8.20	0.51	189	10.95
8.40	0.51	193	10.97
8.60	0.51	198	10.98
8.80	0.51	202	10.99
9.00	0.51	207	11.01

Original Characterization Analysis		SDG No. Q386201
pH	s.u.	7.45
Turbidity	NTU	3.78
Conductivity	mS/cm	296
Titration Starting Conditions		
Initial Sample pH	s.u.	7.66
Initial Temperature	°C	20.2
$MgCl_2$ Addition	mg	98.2
pH after magnesium	s.u.	7.68



Linear Trendline from pH 9.97-11.01		
Slope		0.0093
Intercept		9.2094
R_2		0.9775
Calculated Lime Dose to Reach Target pH		
Target pH 10.2	mg/L as $Ca(OH)_2$	106.5
Target pH 10.4	mg/L as $Ca(OH)_2$	128.0
Target pH 10.6	mg/L as $Ca(OH)_2$	149.5
Target pH 10.8	mg/L as $Ca(OH)_2$	171.0
Target pH 11.0	mg/L as $Ca(OH)_2$	192.5

ch2m: JAR TEST No. 1

Test Information		Raw Water Characterization		
Project Name	Longview RO	Temperature	°C	21.0 °C
Source	Mint Farm Groundwater	pH	s.u.	7.45
Sample Location	MFRWTP	Turbidity	NTU	3.78
Sample Date/Time	11/29/2016	Alkalinity, total	mg/L as $CaCO_3$	47.3
Project Number	156197.00 JT	TOC	mg/L	1.52
Series Number	JT-1	Silica	mg/L	56.9
Analyst	BJS	Reactive Silica	mg/L	59.0
Test Date/Time	1/6/2017	Conductivity	µS/cm	296

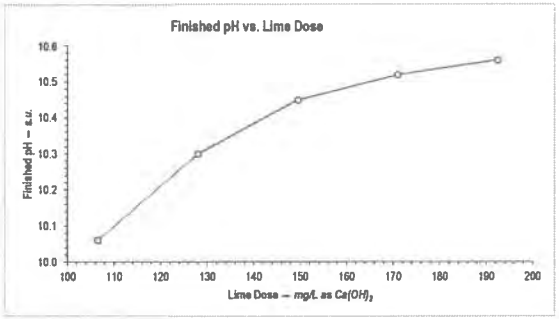
Test Objectives

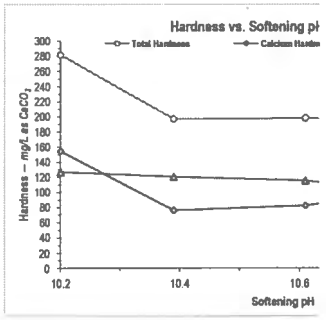
75% silica removal via lime softening

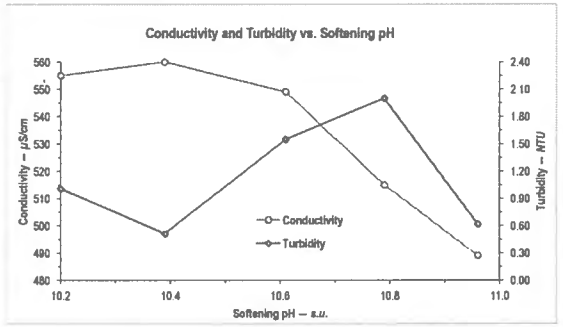
Reagent Characteristics

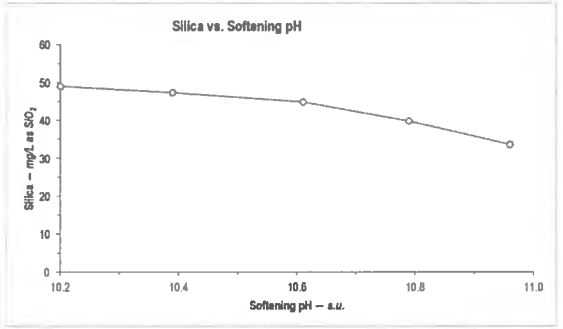
Type		Magnesium	Lime	Coagulant	Coagulant	
Chemical		$MgCl_2$	$Ca(OH)_2$	Sodium Aluminate	Alum	
Stock Strength		10.000 mg/L	10.000 mg/L	10.000 mg/L	10.000 mg/L	
Stock Reagent Basis		$MgCl_2$	$Ca(OH)_2$	$NaAlO_2$	$Al_2(SO_4)_3 * 14H_2O$	
Jar #		1	2	3	4	5
Target pH	Units	10.2	10.4	10.6	10.8	11.0
Volume		2.0 L				
Magnesium as Mg	Stock Added	39.2 mL				
	Dose, mg/L	50				
as $MgCl_2$	Dose, mg/L	196				
Lime	Stock Added	21.3 mL	25.6 mL	29.9 mL	34.2 mL	38.5 mL
as $Ca(OH)_2$	Dose, mg/L	106.5	128.0	149.5	171.0	192.5
pH during mixing	Units	10.20	10.39	10.61	10.79	10.96
Rapid Mix	RPM	300				
	Duration	1 min				
Flocculation	RPM	60/40/20				
	Velocity Gradient	52 / 31 / 13 sec^{-1} for 20° C				
	Total Duration	30				
	Duration per Stage	10/10/10 min				
Floc Observations (See "JT-1 Photos" Tab)		Large quantity of large, white floc	Large quantity of large, white floc	Large quantity of large, white floc	Large quantity of large, white floc; hazy white appearance between floc	Large quantity of large, white floc; hazy white appearance between floc
Settling Period		30 minutes				
Settling Observations (See "JT-1 Photos" Tab)		Fast settling: floc is high density, slightly brownish yellow in color, not easily broken or disturbed; supernatant is clear and uncolored.				

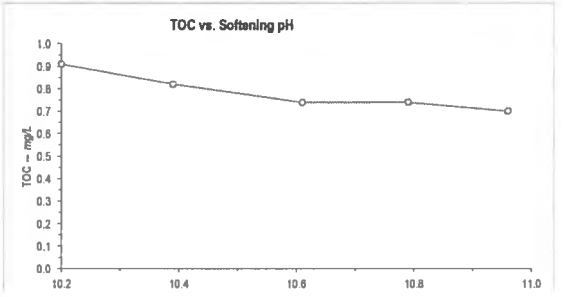
		Supernatant - Filtered (Whatman 40)				
LAB ID (SDG)		R103201	R103202	R103203	R103204	R103205
pH	Units	10.06	10.30	10.45	10.52	10.56
Turbidity	NTU	1.01	0.52	1.55	2.00	0.62
Conductivity	µS/cm	555	560	549	515	489
TOC	mg/L	0.91	0.82	0.74	0.74	0.70
Reactive Silica	mg/L as SiO_2	56.2	51.0	47.2	43.8	37.5
Silica	mg/L as SiO_2	49.0	47.3	44.9	39.8	33.6
Silica Removal	% Removal	13.9	16.9	21.1	30.1	40.9
Calcium	mg/L	62.0	30.6	33.0	40.4	46.9
Magnesium	mg/L	30.8	29.3	28.1	23.7	18.2
Hardness, Ca	mg/L as $CaCO_3$	155	76	82	101	117
Hardness, Mg	mg/L as $CaCO_3$	127	121	116	98	75
Hardness, total	mg/L as $CaCO_3$	282	197	198	198	192
Alkalinity, total	mg/L as $CaCO_3$					
Alkalinity, phenolphthalein	mg/L as $CaCO_3$					
Alkalinity, bicarbonate	mg/L as $CaCO_3$					
Alkalinity, carbonate	mg/L as $CaCO_3$					
Alkalinity, hydroxide	mg/L as $CaCO_3$					
Total Dissolved Solids	mg/L					
Ammonia	mg/L-N					
Nitrate	mg/L-N					
Nitrite	mg/L-N					
TKN	mg/L-N					
Chloride	mg/L					
Sulfate	mg/L					
Fluoride	mg/L					
Chlorine Demand	mg/L-Cl_2					











ch2m: JAR TEST No. 1 PHOTOGRAPHS- Lime Test

Photo 1: Jars 1 and 2 end of floc stage 1 (60 RPM)

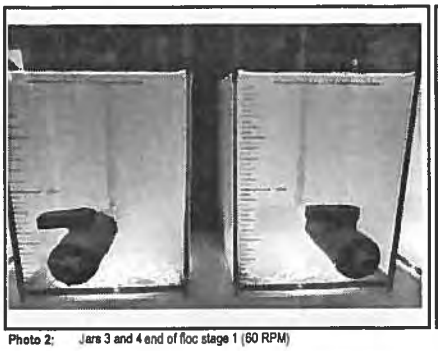


Photo 2: Jars 3 and 4 end of floc stage 1 (60 RPM)

Photo 3: Jar 5 end of floc stage 1 (60 RPM)

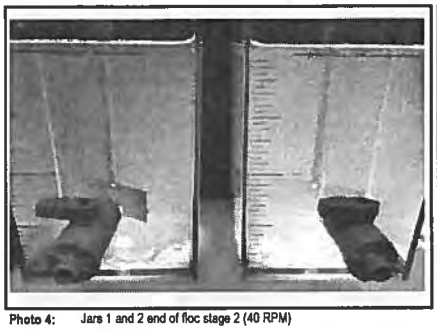


Photo 4: Jars 1 and 2 end of floc stage 2 (40 RPM)

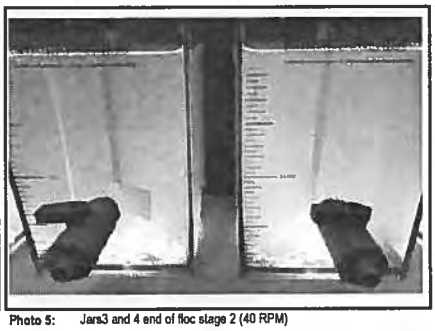


Photo 5: Jars3 and 4 end of floc stage 2 (40 RPM)

Photo 6: Jar 5 end of floc stage 2 (40 RPM)

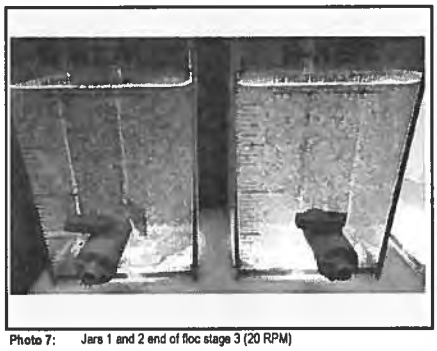


Photo 7: Jars 1 and 2 end of floc stage 3 (20 RPM)

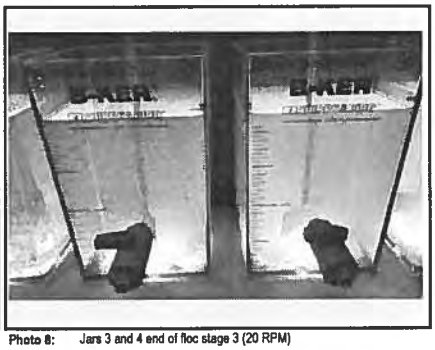


Photo 8: Jars 3 and 4 end of floc stage 3 (20 RPM)

Photo 9: Jar 5 end of floc stage 3 (20 RPM)

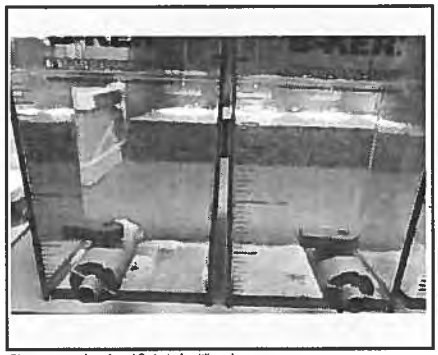


Photo 10: Jars 1 and 2 start of settling phase

Photo 11: Jars 3 and 4 start of settling phase

Photo 12: Jar 5 start of settling phase

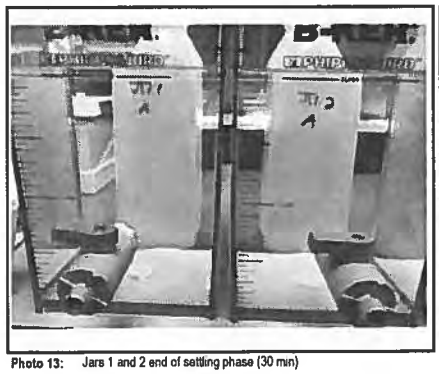


Photo 13: Jars 1 and 2 end of settling phase (30 min)

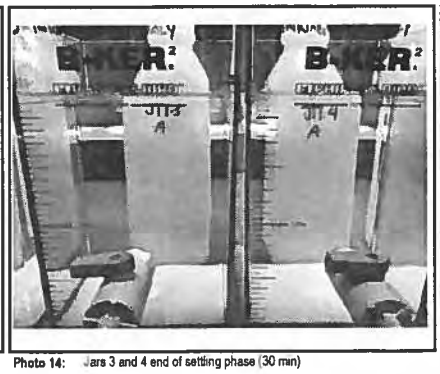


Photo 14: Jars 3 and 4 end of settling phase (30 min)

Photo 15: Jar 5 end of settling phase (30 min)

ch2m: *JAR TEST No. 2*

Test Information		Raw Water Characterization		
Project Name	Longview RO	Temperature	°C	21.0 °C
Source	Mint Farm Groundwater	pH	s.u.	7.45
Sample Location	MFRWTP	Turbidity	NTU	3.78
Sample Date/Time	11/29/2016	Alkalinity, total	mg/L as $CaCO_3$	47.3
Project Number	156197.00.JT	TOC	mg/L	1.52
Series Number	JT-2	Silica	mg/L	56.9
Analyst	AMB	Reactive Silica	mg/L	50.0
Test Date/Time	1/5/2017 12:01	Conductivity	µS/cm	296

Test Objectives

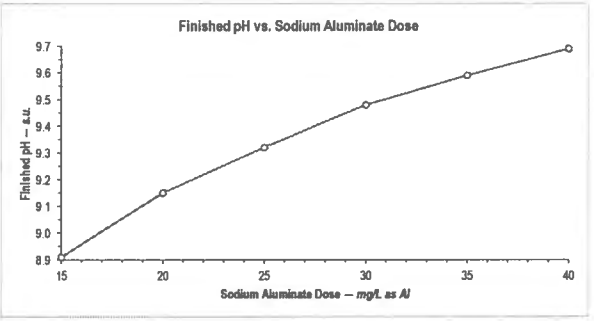
75% silica removal via sodium aluminate coagulation/flocculation

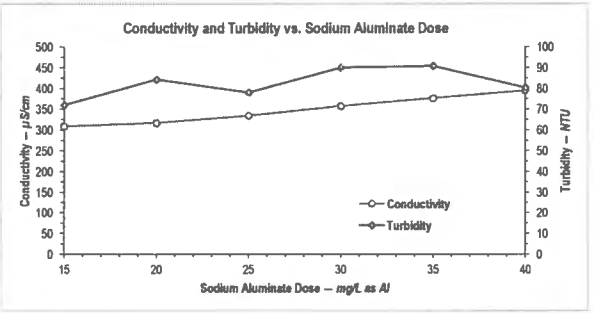
Reagent Characteristics

Type		Magnesium	Lime	Coagulant	Coagulant		
Chemical		$MgCl_2$	$Ca(OH)_2$	Sodium Aluminate	Alum		
Stock Strength		10.000 mg/L	10.000 mg/L	10,000 mg/L	10,000 mg/L		
Stock Reagent Basis		$MgCl_2$	$Ca(OH)_2$	as Al	$Al_2(SO_4)_3 \cdot 14H_2O$		
Jar #		1	2	3	4	5	6
LAB ID (SDG)		R102001	R102002	R102003	R102004	R102005	R102006
Initial pH	Units	7.5	7.5	7.6	7.6	7.5	7.5
Volume		2.0 L					
Sodium Aluminate as Al	Stock Added	3.00 mL	4.00 mL	5.00 mL	6.00 mL	7.00 mL	8.00 mL
	Dose, mg/L	15.0	20.0	25.0	30.0	35.0	40.0
pH during mixing	Units	8.80	9.03	9.19	9.31	9.39	9.51
Rapid Mix	RPM	300 rpm					
	Duration	1 min					
Flocculation	RPM	60 / 40 / 20 rpm					
	Velocity Gradient	52 / 31 / 13 sec^{-1} for 20° C					
	Total Duration	30 min					
	Duration per Stage	10 / 10 / 10 min					
Floc Observations (See "JT-2 Photos" Tab)		No observable floc formation- supernat less hazy than other jars	No observable floc formation- supernat hazy	No observable floc formation- supernat. hazy	No observable floc formation- supernat hazy	No observable floc formation- supernat. hazy. Near end of first floc stage, 1-2 white grains of precipitate noticable on bottom of jar; grains goneduring last floc stage.	No observable floc formation- supernat hazy. Near end of first floc stage, 5-6 white grains of precipitate noticable on bottom of jar; grains gone during last floc stage
Settling Period		30 minutes					
Settling Observations (See "JT-2 Photos" Tab)		No observable settling or clearing of supernatant					

Supernatant - Filtered (Whatman 40)

pH	Units	8.91	9.15	9.32	9.48	9.59	9.69
Turbidity	NTU	71.9	84.3	78.0	90.0	90.8	80.3
Conductivity	µS/cm	309	317	334	357	376	395
TOC	mg/L	1.66	1.73	1.85	1.92	2.11	2.43
Reactive Silica	mg/L as SiO_2	48.0	51.8	47.8	46.4	51.6	47.2
Silica	mg/L as SiO_2	44.3	44.9	41.7	43.0	43.4	40.9
Silica Removal	% Removal	22.1	21.1	26.7	24.4	23.7	28.1
Calcium	mg/L	28.0	28.1	27.2	27.5	27.2	26.5
Magnesium	mg/L	8.14	8.09	7.99	7.84	7.79	7.65
Alkalinity, total	mg/L as $CaCO_3$						
Alkalinity, bicarbonate	mg/L as $CaCO_3$						
Total Dissolved Solids	mg/L						
Ammonia	mg/L-N						
Nitrate	mg/L-N						
Nitrite	mg/L-N						
TKN	mg/L-N						
Chloride	mg/L						
Sulfate	mg/L						
Fluoride	mg/L						
Chlorine Demand	mg/L-Cl_2						





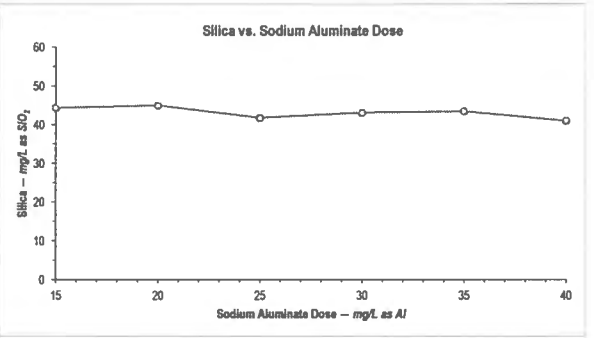



Photo 1: Jars 1 and 2 pre-test

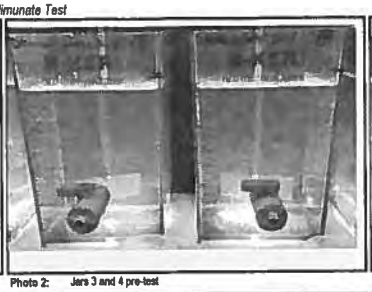


Photo 2: Jars 3 and 4 pre-test

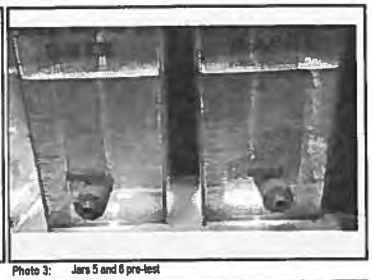


Photo 3: Jars 5 and 6 pre-test

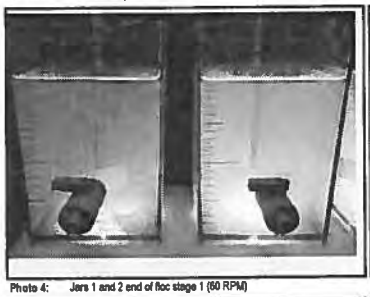


Photo 4: Jars 1 and 2 end of floc stage 1 (60 RPM)

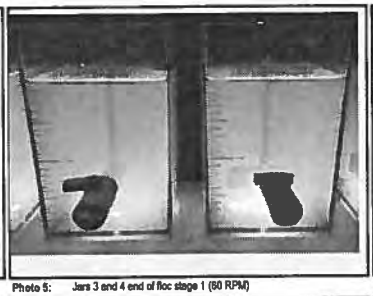


Photo 5: Jars 3 and 4 end of floc stage 1 (60 RPM)

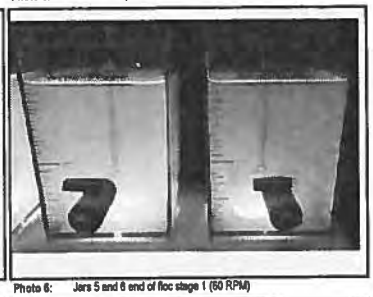


Photo 6: Jars 5 and 6 end of floc stage 1 (60 RPM)

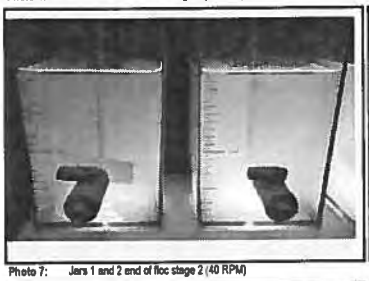


Photo 7: Jars 1 and 2 end of floc stage 2 (40 RPM)

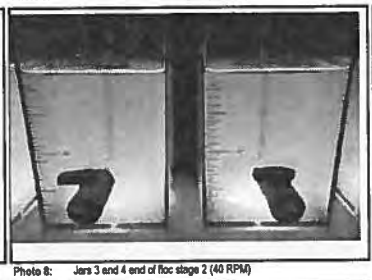


Photo 8: Jars 3 and 4 end of floc stage 2 (40 RPM)

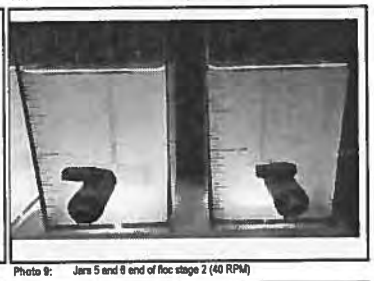


Photo 9: Jars 5 and 6 end of floc stage 2 (40 RPM)

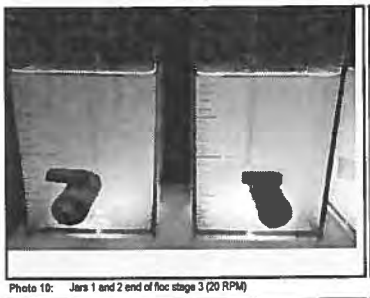


Photo 10: Jars 1 and 2 end of floc stage 3 (20 RPM)

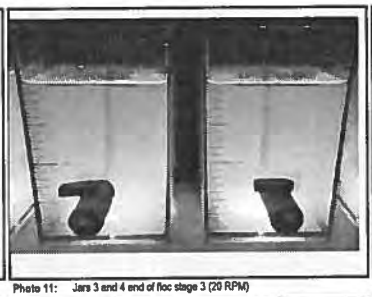


Photo 11: Jars 3 and 4 end of floc stage 3 (20 RPM)

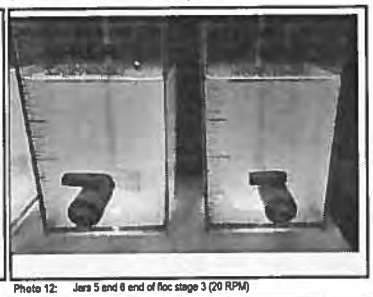


Photo 12: Jars 5 and 6 end of floc stage 3 (20 RPM)

Photo 13: Jars 1 and 2 start of settling phase

Photo 14: Jars 3 and 4 start of settling phase

Photo 15: Jars 5 and 6 start of settling phase

Photo 16: Jars 1 and 2 end of settling phase (30 min)

Photo 17: Jars 3 and 4 end of settling phase (30 min)

Photo 18: Jars 5 and 6 end of settling phase (30 min)

ch2m

JAR TEST No. 3

Test Information		Raw Water Characterization		
Project Name	Longview RO	Temperature	°C	21.0 °C
Source	Mint Farm Groundwater	pH	s.u.	7.45
Sample Location	MFRWTP	Turbidity	NTU	3.78
Sample Date/Time	11/29/2016	Alkalinity, total	mg/L as $CaCO_3$	47.3
Project Number	156197.00.JT	TOC	mg/L	1.52
Series Number	JT-3	Silica	mg/L	56.9
Analyst	AMB	Reactive Silica	mg/L	59.0
Test Date/Time	1/5/2017 15:54	Conductivity	µS/cm	296

Test Objectives

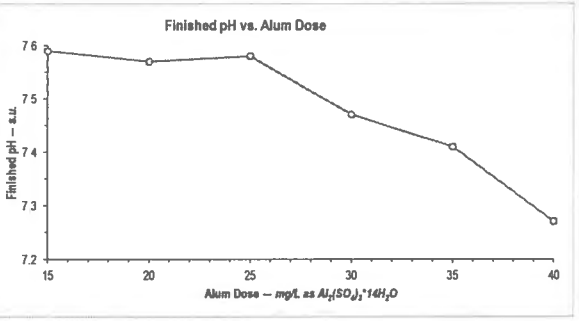
75% silica removal via aluminum sulfate coagulation/flocculation

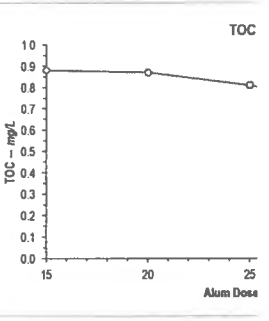
Reagent Characteristics

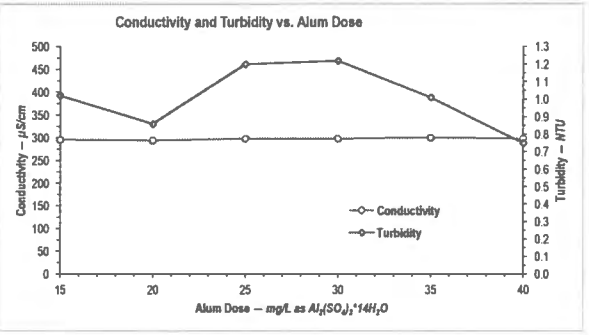
Type		Magnesium	Lime	Coagulant	Coagulant		
Chemical		$MgCl_2$	$Ca(OH)_2$	Sodium Aluminate	Alum		
Stock Strength		10,000 mg/L	10,000 mg/L	10,000 mg/L	10,000 mg/L		
Stock Reagent Basis		$MgCl_2$	$Ca(OH)_2$	$NaAlO_3$	$Al_2(SO_4)_3 * 14H_2O$		
Jar #		1	2	3	4	5	6
LAB ID (SDG)		R102007	[redacted] R102008	R102009	R102010	R102011	R102012
Initial pH	Units	7.7	7.7	7.7	7.7	7.7	7.7
Volume		2.0 L					
Alum	Stock Added	3.00 mL	4.00 mL	5.00 mL	6.00 mL	7.00 mL	8.00 mL
as Al	Dose, mg/L	1.36	1.81	2.26	2.71	3.17	3.62
as $Al_2(SO_4)_3 * 14H_2O$	Dose, mg/L	**15**	**20**	**25**	**30**	**35**	**40**
pH after Addition	Units	7.43	7.37	7.30	7.23	7.17	7.05
Rapid Mix	RPM	300 rpm					
	Duration	1 min					
Flocculation	RPM	60/40/20 rpm					
	Velocity Gradient	52 / 31 / 13 sec^{-1} for 20° C					
	Total Duration	30 min					
	Duration per Stage	10/10/10 min					
Floc Observations Stage 1 (See "JT-3 Photos" Tab)		Medium quantity white-clear pin floc; supernat. hazy	Large quantity white-clear pin floc; supernat. hazy	Large quantity white-clear pin floc; supernat hazy	Large quantity white-clear pin floc; supernat. hazy	Large quantity white-clear pin floc; supernat. hazy	Large quantity white-clear pin floc, supernat hazy
Floc Observations Stage 2		Large quantity medium size floc, clear supernat.	Large quantity medium size floc; clear supernat.	Large quantity medium size floc, clear supernat.	Large quantity medium size floc, clear supernat.	Large quantity medium size floc; clear supernat.	Very large quantity small size floc; clear supernat.
Floc Observations Stage 3		Large quantity large size floc, clear supernat.	Large quantity large size floc; clear supernat	Large quantity large size floc; clear supernat.	Very large quantity medium size floc, clear supernat.	Very large quantity medium size floc, clear supernat	Very large quantity medium size floc; clear supernat.
Settling Period		30 minutes					
Settling Observations (See "JT-3 Photos" Tab)		Large quantity of fast settling pale yellow colored floc					

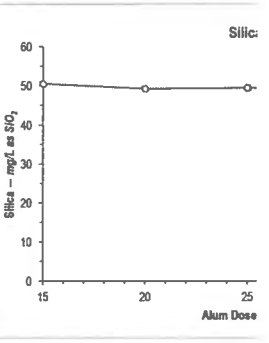
Supernatant Filtered (Whatman 40)

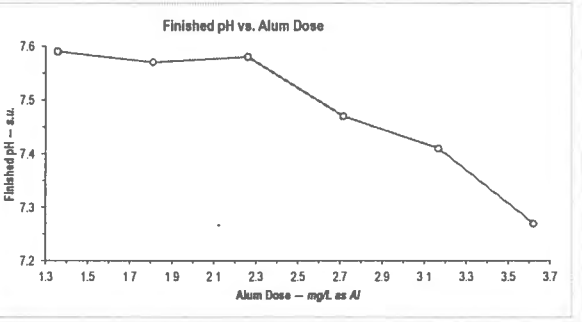
pH	Units	7.6	7.6	7.6	7.5	7.4	7.3
Turbidity	NTU	1.02	0.860	1.20	1.22	1.01	0.748
Conductivity	µS/cm	296	294	298	298	300	298
TOC	mg/L	0.88	0.87	0.81	0.73	0.82	0.70
Reactive Silica	mg/L as SiO_2	56.6	53.8	56.0	56.2	54.2	54.2
Silica	mg/L as SiO_2	50.5	49.2	49.4	48.8	48.8	47.5
Silica Removal	% Removal	11.2	13.5	13.2	14.2	14.2	16.5
Calcium	mg/L	29.5	29.1	29.2	29.2	29.1	28.6
Magnesium	mg/L	8.50	8.46	8.60	8.46	8.57	8.39
Alkalinity, total	mg/L as $CaCO_3$						
Alkalinity, bicarbonate							
Total Dissolved Solids	mg/L						
Ammonia	mg/L-N						
Nitrate	mg/L-N						
Nitrite	mg/L-N						
TKN	mg/L-N						
Chloride	mg/L						
Sulfate	mg/L						
Fluoride	mg/L						
Chlorine Demand	mg/L-Cl_2						

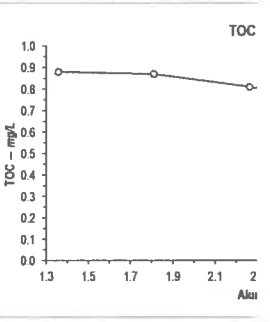


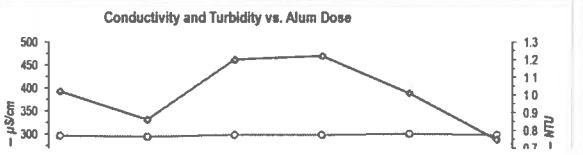


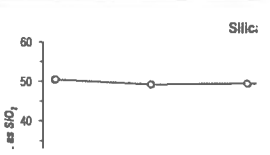












ch2m: JAR TEST No. 3 PHOTOGRAPHS- Aluminum Sulfate Test


Photo 1: Jars 1 and 2 pre-test

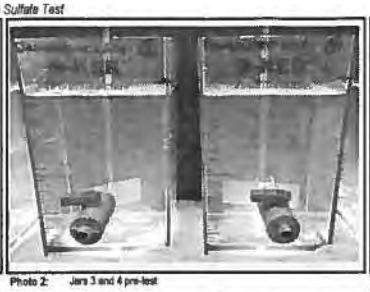


Photo 2: Jars 3 and 4 pre-test

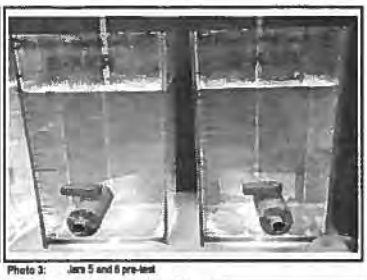


Photo 3: Jars 5 and 6 pre-test

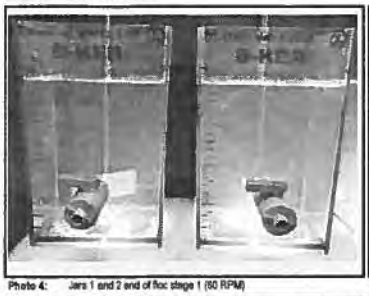


Photo 4: Jars 1 and 2 end of floc stage 1 (60 RPM)

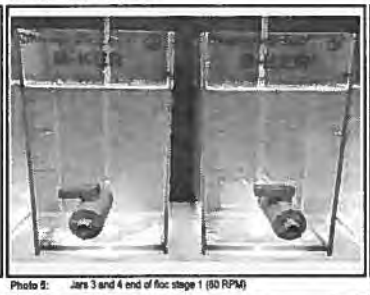


Photo 5: Jars 3 and 4 end of floc stage 1 (60 RPM)

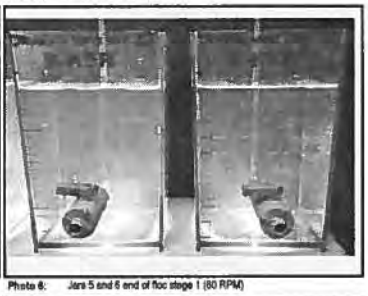


Photo 6: Jars 5 and 6 end of floc stage 1 (60 RPM)


Photo 7: Jars 1 and 2 end of floc stage 2 (40 RPM)

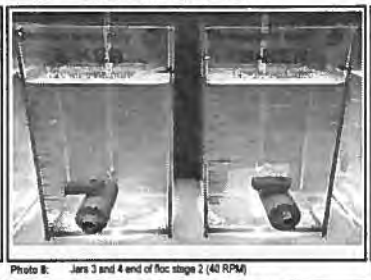


Photo 8: Jars 3 and 4 end of floc stage 2 (40 RPM)

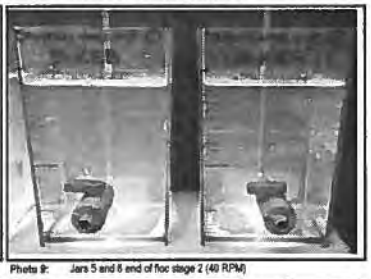


Photo 9: Jars 5 and 6 end of floc stage 2 (40 RPM)

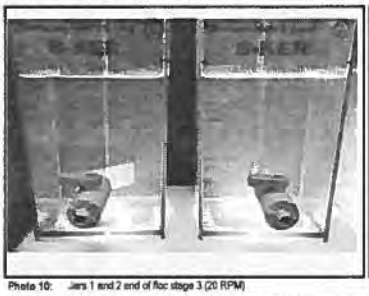


Photo 10: Jars 1 and 2 end of floc stage 3 (20 RPM)

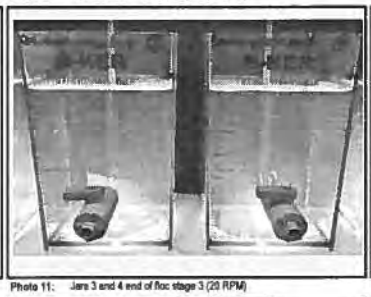


Photo 11: Jars 3 and 4 end of floc stage 3 (20 RPM)

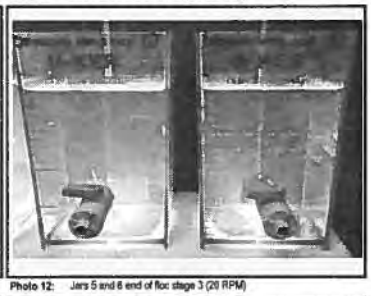


Photo 12: Jars 5 and 6 end of floc stage 3 (20 RPM)

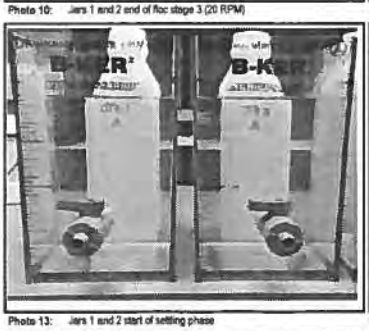


Photo 13: Jars 1 and 2 start of settling phase


Photo 14: Jars 3 and 4 start of settling phase

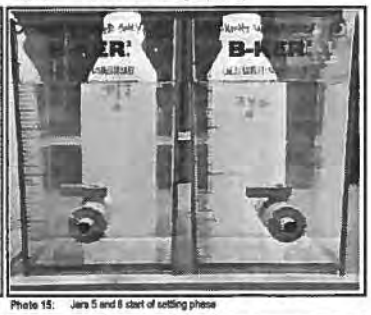


Photo 15: Jars 5 and 6 start of settling phase


Photo 16: Jars 1 and 2 end of settling phase (30 min)

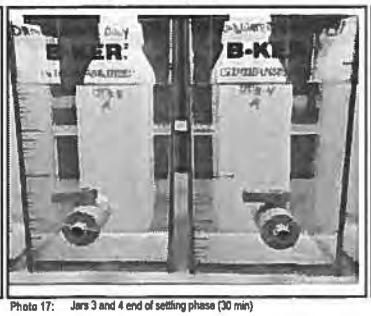


Photo 17: Jars 3 and 4 end of settling phase (30 min)

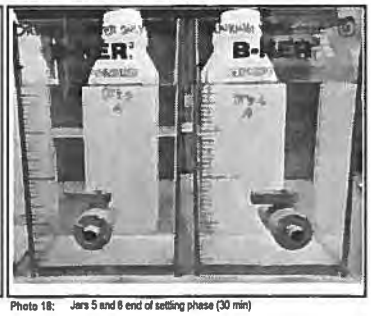


Photo 18: Jars 5 and 6 end of settling phase (30 min)

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JAR TEST No. 4

Test Information		Raw Water Characterization		
Project Name	Longview RO	Temperature	°C	21.0 °C
Source	Mint Farm Groundwater	pH	s.u.	7.45
Sample Location	MFRWTP	Turbidity	NTU	3.78
Sample Date/Time	11/29/2016	Alkalinity, total	mg/L as $CaCO_3$	47.3
Project Number	156197.00.JT	TOC	mg/L	1.52
Series Number	JT-4	Silica	mg/L	56.9
Analyst	AMB	Reactive Silica	mg/L	59.0
Test Date/Time	1/20/2017 16:30	Conductivity	µS/cm	296

Test Objectives

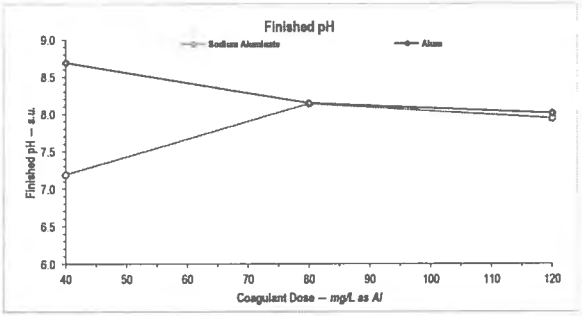
75% silica removal via coagulation/flocculation

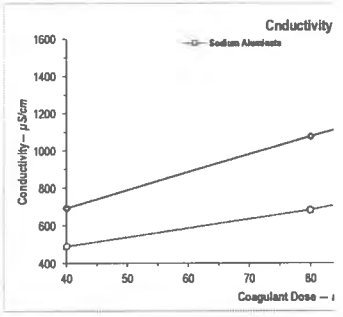
Reagent Characteristics

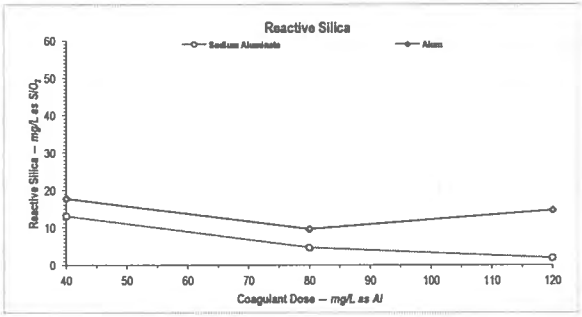
Type		Magnesium	Lime	Coagulant	Coagulant	Acid	Caustic
Chemical		$MgCl_2$	$Ca(OH)_2$	Sodium Aluminate	Alum	Sulfuric Acid	Sodium Hydroxide
Stock Strength		10.000 mg/L	10.000 mg/L	156,859 mg/L	58,684 mg/L	1.0 N	1.0 N
Stock Reagent Basis		as $MgCl_2$	as $Ca(OH)_2$	as Al	as Al	as H_2SO_4	as NaOH
Jar #		1	2	3	4	5	6
LAB ID (SDG)		R112901	R112902	R112903	R112904	R112905	R112906
Target pH	Units	8.0-8.2	8.0-8.2	8.0-8.2	8.0-8.2	8.0-8.2	8.0-8.2
Volume		2.0 L					
Sodium Aluminate	Stock Added	0.51 mL	1.02 mL	1.53 mL			
as Al	Dose, mg/L	40.0	80.0	120			
Alum	Stock Added				1.36 mL	2.73 mL	4.09 mL
as Al	Dose, mg/L				40.0	80.0	120
Sulfuric Acid	Stock Added	4.00 mL	7.70 mL	13.5 mL			
as H_2SO_4	Dose, mg/L	98.1	189	331			
Sodium Hydroxide	Stock Added				9.00 mL	16.7 mL	24.7 mL
as NaOH	Dose, mg/L				180	334	494
pH during mixing	Units	7.85	8.16	8.09	8.93	8.33	7.55
Rapid Mix	RPM	300 rpm					
	Duration	1 min					
Flocculation	RPM	60 / 40 / 20 rpm					
	Velocity Gradient	52 / 31 / 13 sec^{-1} for 20° C					
	Total Duration	30 min					
	Duration per Stage	10 / 10 / 10 min					
Floc Observations (See "JT-4 Photos" Tab)		Large quantity of large floc formations; Water not visible between flocs.	Large quantity of large floc formations; Water not visible between flocs.	Large quantity of large floc formations; Water not visible between flocs.	Large quantity of very large floc formations, Water not visible between flocs	Large quantity of very large floc formations, Water not visible between flocs.	Large quantity of very large floc formations. Water not visible between flocs
Settling Period		30 minutes					
Settling Observations (See "JT-4 Photos" Tab)		Moderate to fast settling; water looks clear and uncolored.	Moderate to fast settling; water looks clear and uncolored.	Moderate to fast settling; water looks clear and uncolored.	Very fast settling, water looks clear and uncolored.	Very fast settling; water looks clear and uncolored	Very fast settling, water looks clear and uncolored.

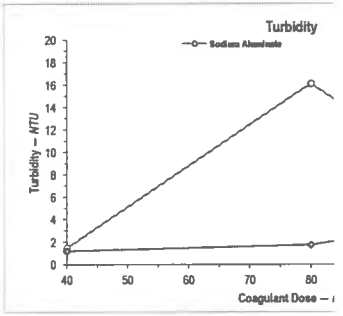
Supernatant = Filtered (Whatman 40)

pH	Units	7.2	8.1	7.9	8.7	8.2	8.0
Turbidity	NTU	1.44	16.1	1.28	1.19	1.72	4.90
Conductivity	µS/cm	489	662	943	692	1,076	1,430
TOC	mg/L	1.39	1.43	1.35	0.41	0.36	0.33
Reactive Silica	mg/L as SiO_2	13.0	4.66	1.86	17.7	9.55	14.6
Silica (EPA 200.7)	mg/L as SiO_2	12.0	3.6	3.0	17.9	15.9	15.1
Silica Removal	% Removal	78.9	93.8	94.8	68.5	72.1	73.5
Calcium (EPA 200.7)	mg/L	24.4	20.2	21.6	24.8	27.8	27.0
Magnesium (EPA 200.7)	mg/L	7.42	5.92	6.13	6.82	7.42	6.40
Alkalinity, total	mg/L as $CaCO_3$						
Alkalinity, bicarbonate	mg/L as $CaCO_3$						
Total Dissolved Solids	mg/L						
Ammonia	mg/L-N						
Nitrate	mg/L-N						
Nitrite	mg/L-N						
TKN	mg/L-N						
Chloride	mg/L						
Sulfate	mg/L						
Fluoride	mg/L						
Chlorine Demand	mg/L-Cl_2						









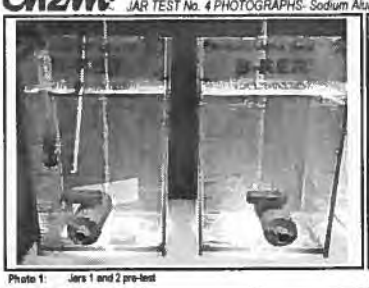


Photo 1: Jars 1 and 2 pre-test

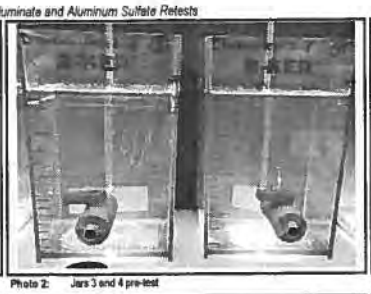


Photo 2: Jars 3 and 4 pre-test

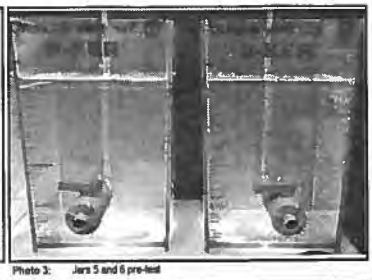


Photo 3: Jars 5 and 6 pre-test


Photo 4: Jars 1 and 2 end of floc stage 1 (60 RPM)

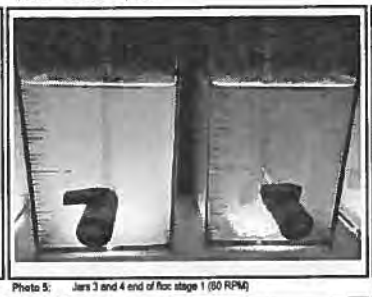


Photo 5: Jars 3 and 4 end of floc stage 1 (60 RPM)

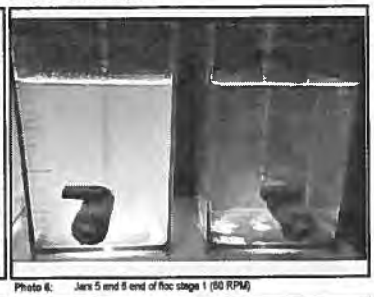


Photo 6: Jars 5 and 6 end of floc stage 1 (60 RPM)

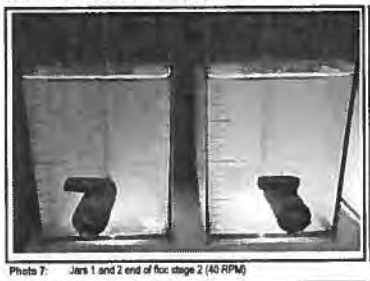


Photo 7: Jars 1 and 2 end of floc stage 2 (40 RPM)

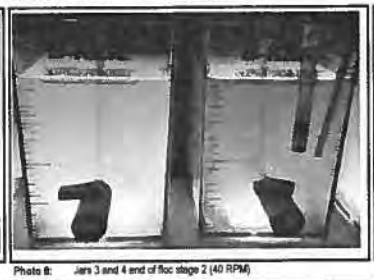


Photo 8: Jars 3 and 4 end of floc stage 2 (40 RPM)

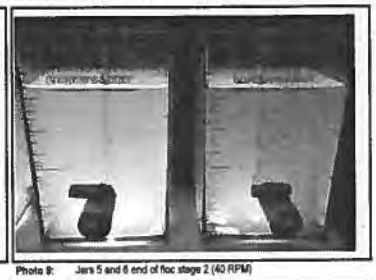


Photo 9: Jars 5 and 6 end of floc stage 2 (40 RPM)


Photo 10: Jars 1 and 2 end of floc stage 3 (20 RPM)

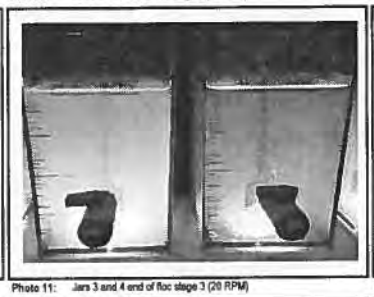


Photo 11: Jars 3 and 4 end of floc stage 3 (20 RPM)

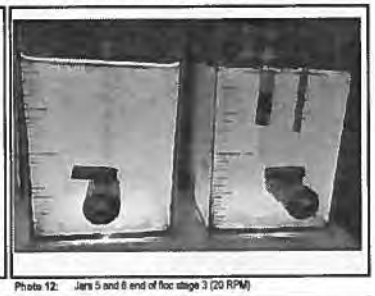


Photo 12: Jars 5 and 6 end of floc stage 3 (20 RPM)

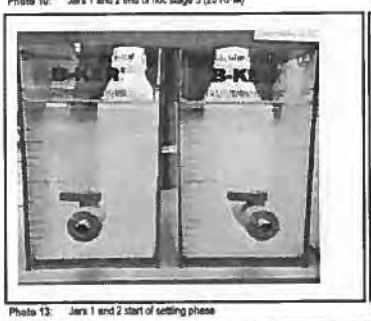


Photo 13: Jars 1 and 2 start of settling phase

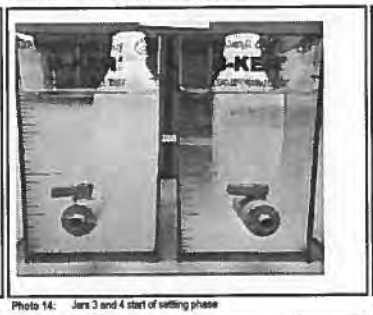


Photo 14: Jars 3 and 4 start of settling phase


Photo 15: Jars 5 and 6 start of settling phase

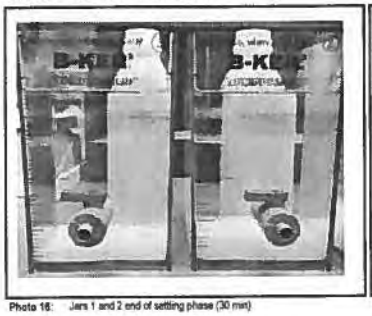


Photo 16: Jars 1 and 2 end of settling phase (30 min)


Photo 17: Jars 3 and 4 end of settling phase (30 min)


Photo 18: Jars 5 and 6 end of settling phase (30 min)

ch2m

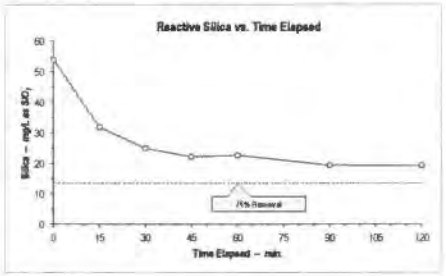
JAR TEST No. 5

Test Information			Raw Water Characterization		
Project Name		Longview RO	Temperature	°C	21.0 °C
Source		Mint Farm Groundwater	pH	s.u.	7.45
Sample Location		MFR/WTP	Turbidity	NTU	3.78
Sample Date/Time		11/29/2016	Alkalinity, total	mg/L as $CaCO_3$	47.3
Project Number		156197.00 JT	TOC	mg/L	1.52
Series Number		JT-5	Reactive Silica	mg/L	58.0
Analyst		AMB	Reactive Silica, 0.45 um filt	mg/L	54.0
Test Date/Time		1/25/2017	Conductivity	µS/cm	284

Test Objectives
75% silica removal via lime softening

Reagent Characteristics						
Type		Magnesium	Lime	Coagulant	Coagulant	
Chemical		$MgCl_2$	$Ca(OH)_2$	Sodium Aluminate	Alum	
Stock Strength		10,440 mg/L	10,400 mg/L	10,000 mg/L	10,000 mg/L	
Stock Reagent Basis		$MgCl_2$	$Ca(OH)_2$	$NaAlO_2$	$Al_2(SO_4)_3 * 14H_2O$	
Jar #		1	2	3	4	5
Target pH	Units	11.0				
Volume		2.0 L				
Magnesium as Mg	Stock Added	37.5 mL				
	Dose, mg/L	50				
as $MgCl_2$	Dose, mg/L	198				
Lime	Stock Added	46.0 mL				
as $Ca(OH)_2$	Dose, mg/L	239				
Mixing	RPM	50				
	Duration	120 min				
pH during mixing	Units	11.0				
Floc Observations (See "JT-5 Photos" Tab)		Large quantity of pin floc with hazy supernat, progressed to very large quantity of pin floc by 45 min of mixing; then, large quantity of medium size floc with hazy supernat through the end of mixing phase.				
Settling Period		30 minutes				
Settling Observations (See "JT-5 Photos" Tab)		Fast settling high density floc with clear supernat, though some floc remained suspended in the supernat through the 30 min settling phase.				

Treatability Analyses						
Reactive Silica, 0.45 µm filtered, 0 min.	mg/L as SiO_2	54.0				
Reactive Silica, 0.45 µm filtered, 15 min.	mg/L as SiO_2	31.8				
Reactive Silica, 0.45 µm filtered, 30 min.	mg/L as SiO_2	25.0				
Reactive Silica, 0.45 µm filtered, 45 min.	mg/L as SiO_2	22.2				
Reactive Silica, 0.45 µm filtered, 60 min.	mg/L as SiO_2	22.7				
Reactive Silica, 0.45 µm filtered, 90 min.	mg/L as SiO_2	19.5				
Reactive Silica, 0.45 µm filtered, 120 min.	mg/L as SiO_2	19.3				
Reactive Silica, Settled; Whatman 40 filt.	mg/L as SiO_2	19.3				
Silica Removal	% Removal	64.3				
Supernatant - Filtered (Whatman 40)						
LAB ID (SDG)		R115301				
pH	Units	10.4				
Turbidity	NTU	0.30				
Conductivity	µS/cm	445				
TOC	mg/L	0.67				
Reactive Silica	mg/L as SiO_2	19.1				
Silica (EPA 200.7)	mg/L as SiO_2	19.0				
Silica Removal	% Removal	68				
Calcium (EPA 200.7)	mg/L	57.7				
Magnesium (EPA 200.7)	mg/L	2.93				
Hardness, Ca (EPA 200.7)	mg/L as $CaCO_3$	144				
Hardness, Mg (EPA 200.7)	mg/L as $CaCO_3$	12.1				
Hardness, total (EPA 200.7)	mg/L as $CaCO_3$	156				
Hardness, Ca (HACH)	mg/L as $CaCO_3$	150				
Hardness, Mg (HACH)	mg/L as $CaCO_3$	12.0				
Hardness, total (HACH)	mg/L as $CaCO_3$	162				
Alkalinity, total	mg/L as $CaCO_3$					
Alkalinity, phenolphthalein	mg/L as $CaCO_3$					
Alkalinity, bicarbonate	mg/L as $CaCO_3$					
Alkalinity, carbonate	mg/L as $CaCO_3$					
Alkalinity, hydroxide	mg/L as $CaCO_3$					
Total Dissolved Solids	mg/L					
Ammonia	mg/L-N					
Nitrate	mg/L-N					
Nitrite	mg/L-N					
TKN	mg/L-N					
Chloride	mg/L					
Sulfate	mg/L					
Fluoride	mg/L					
Chlorine Demand	mg/L Cl_2					



ch2m: JAR TEST No. 5 PHOTOGRAPHS- Lime Softening Kinetics Test

Photo 1: JT5.1 pre-test (Left); T0, post $MgCl_2$ and lime addition (Right).

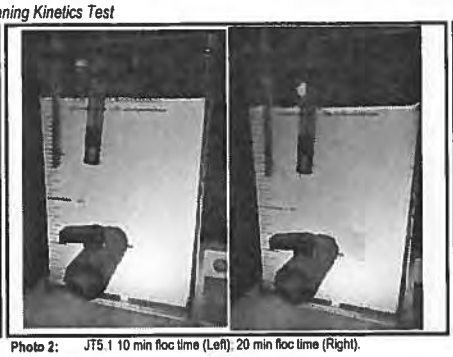


Photo 2: JT5.1 10 min floc time (Left); 20 min floc time (Right).

Photo 3: JT5.1 30 min floc time (Left); 40 min floc time (Right).

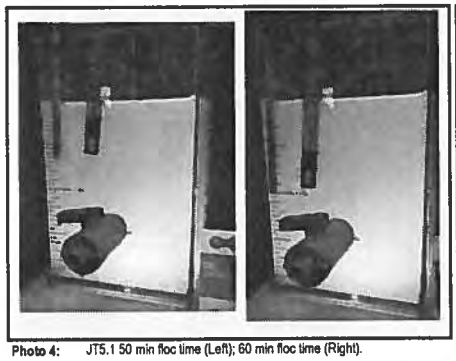


Photo 4: JT5.1 50 min floc time (Left); 60 min floc time (Right).

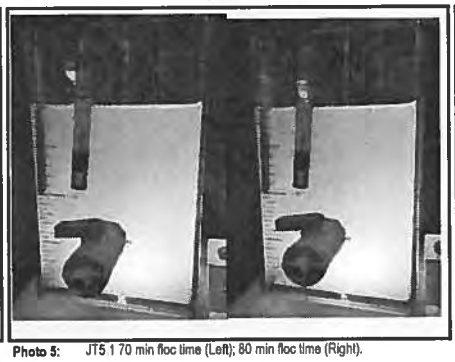


Photo 5: JT5.1 70 min floc time (Left); 80 min floc time (Right).

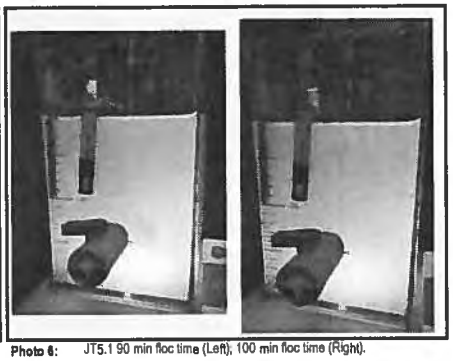


Photo 6: JT5.1 90 min floc time (Left); 100 min floc time (Right).

Photo 7: JT5.1 110 min floc time (Left); 120 min floc time (Right).

Photo 8: JT5.1 start of settling

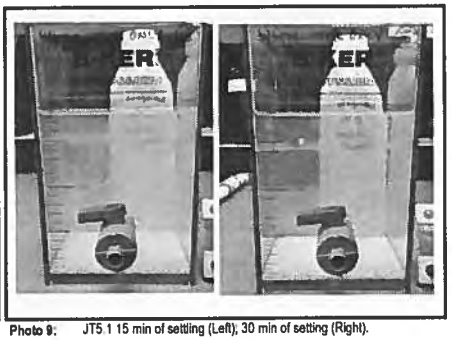


Photo 9: JT5.1 15 min of settling (Left); 30 min of setting (Right).

Attachment C

OVERALL FACTORS

Printed by:

Project Name and Project Type

Project Name:	Longview
Project Number:	
Project Manager:	Phelps
Estimator:	Odell
Project Description:	Option 1 - Precip

Default Factor / Project Location

Project Location (Country):	USA
Project Location (State):	WASHINGTON
Project Location (City):	Vancouver WA
Location Adjustment Factor:	98.1

** Warning: Consult a CH2M professional cost estimator before using a location adjustment factor other than 100.0**

Cost Basis (Month/Year)

Select Month:	January
Select Year:	2016

* Note: Select current month/year for which cost estimate is to be based.

**Note: Provisions for escalating costs to the mid-point of construction have been removed from CPES and replaced with estimating the current value.

Markups

Overhead:	8.00	Default: 10%
Profit:	5.00	Default: 5%
Mob/Bond/Insurance:	5.00	Default: 5%
Contingency:	25.00	Default: 30%

Copy Data From Other Active CPES

Additional Project Costs

To Calculator

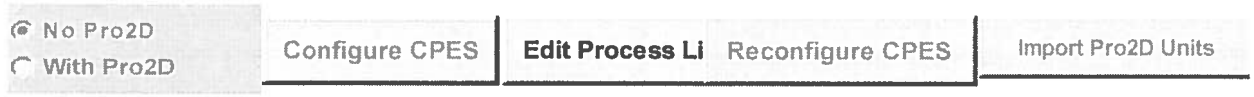
Demolition:		%	LS
Overall Sitework:		%	LS
Plant Computer System:		%	LS
Yard Electrical:		%	LS
Yard Piping:		%	LS
User Defined Item 1:	Tax	8.90 %	LS
User Defined Item 2:	UD #2 Default Description	%	LS
User Defined Item 3:	UD #3 Default Description	%	LS

Tax

Tax is Applied to this Percent of Total Project Cost:	%
Tax Rate:	0.00 %

Non-Construction Costs

Permitting:		0.00 %
Engineering:		10.00 %
Services During Construction:		7.00 %
Commissioning & Startup:		3.00 %
Land / ROW:		0.00 %
Legal / Admin:		0.00 %
Other:	Other Default Description	0.00 %



Liquids Train
Unit Process

Residuals Train
Unit Process

E, C,

User Defined Facility

Is This Facility Included in My Project? Yes

Parametric Inputs	Value	User Comments
EC and Power Units, Low	2.1 million	
EC and Power Units, High	3.2 million	
CMU Building 100' by 50'	5000 sq ft	
1 foot excavation		

COST ESTIMATE

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
SITEWORK:							
Excavation	185.19	CY	141.58	m3	$6.35	$1,176	02E
Structural Backfill	185.19	CY	141.58	m3	$48.10	$8,907	02SB
Backfill	0.00	CY	0.00	m3	$7.80	$0	02B
Haul Excess	185.19	CY	141.58	m3	$7.80	$1,445	02HE
Allowance for Misc Items	5%				$11,528.09	$576	
Subtotal						$12,104	
CONCRETE:							
Foundation	55.56	CY	42.48	m3	$393.62	$21,868	03F
Slab on Grade	185.19	CY	141.58	m3	$356.31	$65,983	03S
Walls	0.00	CY	0.00	m3	$704.01	$0	03W
Walls	0.00	CY	0.00	m3	$704.01	$0	03W
Walls	0.00	CY	0.00	m3	$704.01	$0	03W
Walls	0.00	CY	0.00	m3	$704.01	$0	03W
Walls	0.00	CY	0.00	m3	$1,121.35	$0	03B
Beams	0.00	CY	0.00	m3	$1,121.35	$0	03B
Beams	0.00	CY	0.00	m3	$1,121.35	$0	03ES
Elevated Slab	0.00	CY	0.00	m3	$1,121.35	$0	03ES
Elevated Slab	0.00	CY	0.00	m3	$1,121.35	$0	
Allowance for Misc Items	5%				$87,851	$4,393	
Subtotal						$92,244	
MASONRY:							
Type of Building Construction:	Moderate						
Building	5000.00	SF	464.52	m2	$156.08	$780,416	04BM
Subtotal						$780,416	
METALS:							
Grating	0.00	SF	0.00	m2	$85.85	$0	05G
Handrail	0.00	LF	0.00	m	$85.85	$0	05H
Stairs	0.00	Risers			$468.25	$0	05S
Allowance for Misc Items	5%				$0.00	$0	
Subtotal						$0	
WOOD & PLASTIC:							
Item 1	0.00	EA			$0.00	$0	
Item 2	0.00	EA			$0.00	$0	
Item 3	0.00	EA			$0.00	$0	
Item 4	0.00	EA			$0.00	$0	
Item 5	0.00	EA			$0.00	$0	
Allowance for Misc Items	5%				$0.00	$0	
Subtotal						$0	
THERMAL & MOISTURE PROTECTION:							
Item 1	0.00	EA			$0.00	$0	
Item 2	0.00	EA			$0.00	$0	
Item 3	0.00	EA			$0.00	$0	
Item 4	0.00	EA			$0.00	$0	
Item 5	0.00	EA			$0.00	$0	
Roof Hatch (4' x 6', double leaf)	0.00	EA			$2,809.50	$0	07RH1
Roof Hatch (2' x 2', double leaf)	0.00	EA			$468.25	$0	07RH2
Allowance for Misc Items	5%				$0.00	$0	
Subtotal						$0	
DOORS & WINDOWS:							
Item 1	0.00	EA			$0.00	$0	
Item 2	0.00	EA			$0.00	$0	
Item 3	0.00	EA			$0.00	$0	
Item 4	0.00	EA			$0.00	$0	
Item 5	0.00	EA			$0.00	$0	
Allowance for Misc Items	5%				$0.00	$0	
Subtotal						$0	
EQUIPMENT:							
EC and Power - Mid Range Cost 2.65 million	1.00	EA			$2,650,000.00	$2,650,000	
Installation	1.00	EA			$662,500.00	$662,500	
Equipment Item 3	0.00	EA			$0.00	$0	
Equipment Item 4	0.00	EA			$0.00	$0	
Equipment Item 5	0.00	EA			$0.00	$0	
Equipment Item 6	0.00	EA			$0.00	$0	
Equipment Item 7	0.00	EA			$0.00	$0	
Equipment Item 8	0.00	EA			$0.00	$0	

Equipment Item 9	0.00	EA			$0.00	$0	
Equipment Item 10	0.00	EA			$0.00	$0	
Allowance for Misc Items	5%				$3,312,500.00	$165,625	
Subtotal						$3,478,125	
I&C:							
50000.00	1.00	EA			$50,000.00	$50,000	
Item 2	0.00	EA			$0.00	$0	
Item 3	0.00	EA			$0.00	$0	
Item 4	0.00	EA			$0.00	$0	
Item 5	0.00	EA			$0.00	$0	
Allowance for Misc Items	5%				$50,000.00	$2,500	
Subtotal						$52,500	
CONVEYING SYSTEMS:							
Monorail Hoist (3 Ton)	1.00	EA			*$3,863.06*	$3,863	*14MH*
Hoist Rail	0.00	LF	0.00	m	*$39.02*	$0	*14MR*
Allowance for Misc Items	5%				$3,863.06	$193	
Subtotal						$4,056	
MECHANICAL:							
Allowance for Misc Items	1.00	EA			$50,000.00	$50,000	
Equipment Item 2	0.00	EA			$0.00	$0	
Equipment Item 3	0.00	EA			$0.00	$0	
Equipment Item 4	0.00	EA			$0.00	$0	
Equipment Item 5	0.00	EA			$0.00	$0	
Equipment Item 6	0.00	EA			$0.00	$0	
Equipment Item 7	0.00	EA			$0.00	$0	
Equipment Item 8	0.00	EA			$0.00	$0	
Equipment Item 9	0.00	EA			$0.00	$0	
Equipment Item 10	0.00	EA			$0.00	$0	
Allowance for Misc Items	5%				$50,000.00	$2,500	
Subtotal						$52,500	
USER DEFINED ESTIMATE ITEMS:	**QUANT (ENGLISH)**	**UNIT (ENGLISH)**	**QUANT (METRIC)**	**UNIT (METRIC)**	**$/UNIT**	**TOTAL COST**	
MCC Panels	15.00		0.00		$4,000.00	$60,000	
Item 2 Description	0.00		0.00		$0.00	$0	
Item 3 Description	0.00		0.00		$0.00	$0	
Item 4 Description	0.00		0.00		$0.00	$0	
Item 5 Description	0.00		0.00		$0.00	$0	
Item 6 Description	0.00		0.00		$0.00	$0	
Item 7 Description	0.00		0.00		$0.00	$0	
Item 8 Description	0.00		0.00		$0.00	$0	
Item 9 Description	0.00		0.00		$0.00	$0	
Item 10 Description	0.00		0.00		$0.00	$0	
Item 11 Description	0.00		0.00		$0.00	$0	
Item 12 Description	0.00		0.00		$0.00	$0	
Item 13 Description	0.00		0.00		$0.00	$0	
Item 14 Description	0.00		0.00		$0.00	$0	
Item 15 Description	0.00		0.00		$0.00	$0	
Subtotal						$60,000	
Subtotal						$4,531,945	
ALLOWANCES:		User Override					
Finishes Allowance	2.00%		$5,664,932	$113,299			
I&C Allowance	4.00%		$5,664,932	$226,597			
Mechanical Allowance	10.00%		$5,664,932	$566,493			
Electrical Allowance	4.00%		$5,664,932	$226,597			
Facility Cost				**$5,664,932**			
Facility Cost with Standard Additional Project Costs Added				**$5,664,932**			
Facility Cost with Standard Additional Project Costs and Contractor Markups Added				**$8,432,016**			
Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)				**$8,271,925**			
Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added				**$8,271,925**			

Circular Clarifier

PROCESS DESIGN CRITERIA

Is This Facility Included in My Project? Yes

If this is a Seawater Desalination Application, the materials in contact with seawater need to be corrosion resistant.

Process User Inputs	Value (English)	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
Circular Clarifier							
1) Is this a Seawater Desalination Application?	No	Y/N					
2) Has the USER Contacted Equipment Suppliers to Obtain Equipment Quotes?	No	Y/N					Fixed
3) Input Total Plant Flow	12.00	mgd	45.42	ML/d			
4) Input Number of Circular Clarifiers	1	#					
Calculate Flow per Clarifier	12 00	mgd	45,424 94	m3/d			
5) Input Clarifier Hydraulic Loading Rate	800.00	gpd/sf	117,348.00	m/d			Typically 400 to 800 gpd/sf for metal salt coagulation
Calculate Clarifier Diameter Each Based on Hydraulic Loading Rate	138 20	ft	42,122 65	mm			
6) Input Clarifier Side Water Depth	12.00	ft	3,657.60	mm			Typically 12 to 16 feet
7) Input Free Board	2.00	ft	609.60	mm			Typically 1 to 3 feet
Calculate Total Clarifier Depth	14 00	ft	4,267 20	mm			
8) Input Clarifier Wall Height above Grade	2.00	ft	609.60	mm			
Calculate Wall Burial Depth	12 00	ft	3,657 60	mm			
Clarifier Peripheral Weir Launder Sizing							
Convert Each Clarifier Flow Rate from MGD to CFS	18 57	cfs	525 75	L/s	Q, cfs		
9) Input Velocity	5.00	fps	1.52	m/s	V		Typically < 5 fps
Calculate Area (Q cfs / V)	3 71	sf	0 34	m2			
Launder Freeboard	1 00	ft	304 80	mm			Fixed
10) Input Launder Width	2.00	ft	609.60	mm			
Calculate Launder Height Excluding Freeboard	1 86	ft	565 91	mm			
Calculate Launder Height Including Freeboard	2 86	ft	870 71	mm		OKAY	Should be ≤ 5 ft

Estimating Dimensions:	Value English	Unit (English)	Value (Metric)	Unit (Metric)	Name	Comment	Red Flags
Total Number of Clarifiers	1	#					
Clarifier (dimensions per each):							
Perimeter Wall Inside Diameter	138 20	ft	42,122 65	mm			
Perimeter Wall Outside Diameter	140 20	ft	42,732 25	mm			
Perimeter Wall Height	14 00	ft	4,267 20	mm			
Wall Footer Thickness	16.00	in	406.40	mm		Model based on 16"	
Wall Footer Thickness	1 33	ft	406 40	mm			
Slab on Grade Thickness	6.00	in	152.40	mm		Model based on 6"	
Slab on Grade Thickness	0 50	ft	152 40	mm			
Center Cone Outside Diameter	6 17	ft	1,879 60	mm		Fixed	
Center Cone Inside Diameter	3 50	ft	1,066 80	mm		Fixed	
Center Cone Slab on Grade Thickness	16.00	in	406.40	mm		Model based on 16"	
Center Cone Slab on Grade Thickness	1 33	ft	406 40	mm			
Center Cone Wall Height	2.33	ft	710.18	mm		Model based on 2 33	
Center Cone Wall Thickness	16.00	in	406.40	mm		Model based on 16"	
Center Cone Wall Thickness	1 33	ft	406 40	mm			
Launder Elevated Slab Width	3.33	in	84.58	mm		Model based on 3 33	
Launder Elevated Slab Thickness	12.00	ft	3,657.60	mm		Model based on 12"	
Launder Elevated Slab Thickness	1 00	ft	304 80	mm			
Launder Wall Diameter	131 54	ft	40,092 68	mm			
Launder Wall Height	2 86	ft	870 71	mm			
Launder Wall Thickness	8.00	in	203.20	mm		Model based on 8"	
Launder Wall Thickness	0 67	ft	203 20	mm			
Perimeter Wall Thickness	12.00	in	304.80	mm		Model based on 12"	
Perimeter Wall Thickness	1 00	ft	304 80	mm			
Floor Slope Factor	1 03					Fixed	
Side Slope Depth Factor	0 23					Fixed	
Side Slope Factor	4 29					Fixed	
Excavation Diameter	149 20	ft	45,475 45	mm			
Cone Excavation Depth	17 37	ft	5,295 09	mm			

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
SITEWORK:							
Clarifiers							
Excavation	12,902	CY	9,864 42	m3	*$8.35*	$81,903	
Imported Structural Backfill	665	CY	508.62	m3	*$48.10*	$31,998	
Native Backfill	909	CY	695 10	m3	*$7.80*	$7,095	
Haul Excess	11,993	CY	9,169.32	m3	*$7.80*	$93,595	
Allowance for Misc Items	5%				$214,592.05	$10,730	
Subtotal						$225,322	
CONCRETE:							
Clarifiers:							
Wall Footers	120	CY	91 46	m3	*$393.62*	$47,088	
Slanted Slab on Grade	285	CY	218 19	m3	*$393.62*	$112,336	
Slanted Floor Grout (2" thick)	15,411	SF	1,431 72	m2	*$22 27*	$343,169	
Center Cone Slab on Grade	1 47	CY	1 13	m3	*$393.62*	$581	
Center Cone Walls	2 23	CY	1 70	m3	*$704.01*	$1,569	
Perimeter Walls	228	CY	174 61	m3	*$704.01*	$160,779	
Launder Elevated Slab	54	CY	40 94	m3	*$1,121.35*	$60,044	
Launder Wall	29	CY	22 29	m3	*$704.01*	$20,520	
Concrete Fill	9	CY	6 82	m3	*$351 19*	$3,134	
Allowance for Misc Items	5%				$749,221 27	$37,461	
Subtotal						$786,682	
METALS:							
Clarifiers:							
Walkway Grating (3' wide, steel support beams supplied by mechanism mfr)	421	SF	39 07	m2	*$85.85*	$36,106	
Walkway Handrail	280	LF	85.46	m	*$85.85*	$24,071	

Stairway	3	Risers			$468.25	$1,405	
Allowance for Misc Items	10%				$61,581.63	$6,158	
Subtotal						$67,740	
THERMAL & MOISTURE PROTECTION:							
Concrete Liner	0	SF	0.00	m2	$16.00	$0	
Allowance for Misc Items	10%				$0.00	$0	
Subtotal						$0	
EQUIPMENT:							Budgetary Quote: (CPES will automatically add Installation Factor)
Clarifier Drive Mechanism	1	EA			$209,285.80	$209,286	
Allowance for Misc Items	10%				$209,285.80	$20,929	
Subtotal						$230,214	
USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST	
Item 1 Description	0.00		0.00		0.00	$0	
Item 2 Description	0.00		0.00		0.00	$0	
Item 3 Description	0.00		0.00		0.00	$0	
Item 4 Description	0.00		0.00		0.00	$0	
Item 5 Description	0.00		0.00		0.00	$0	
Item 6 Description	0.00		0.00		0.00	$0	
Item 7 Description	0.00		0.00		0.00	$0	
Item 8 Description	0.00		0.00		0.00	$0	
Item 9 Description	0.00		0.00		0.00	$0	
Item 10 Description	0.00		0.00		0.00	$0	
Item 11 Description	0.00		0.00		0.00	$0	
Item 12 Description	0.00		0.00		0.00	$0	
Item 13 Description	0.00		0.00		0.00	$0	
Item 14 Description	0.00		0.00		0.00	$0	
Item 15 Description	0.00		0.00		0.00	$0	
Subtotal						$0	
Subtotal						$1,309,958	
ALLOWANCES:		User Override					
Finishes Allowance	2.00%		$1,701,244	$34,025			
I&C Allowance	8.00%		$1,701,244	$136,100			
Mechanical Allowance	5.00%		$1,701,244	$85,062			
Electrical Allowance	8.00%		$1,701,244	$136,100			
					Facility Cost Name		
Facility Cost	12,000,000	GPD	$0.14	$1,701,244	CCCFC01		
Facility Cost with Standard Additional Project Costs Added	12,000,000	GPD	$0.14	$1,701,244	CCCFC02		
Facility Cost with Standard Additional Project Costs and Contractor Markups Added	12,000,000	GPD	$0.21	$2,532,361	CCCFC03		
Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	12,000,000	GPD	$0.21	$2,484,314	CCCFC05		
Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	12,000,000	GPD	$0.21	$2,484,314	CCCFC06		

Pump Station

In-Plant Pump Station

Is This Facility Included in My Project? Yes

Notes to Designer:

This mini-model is based on development of either a submersible or vertical turbine pump station with pumps less than 100 and 1,000 HP each, respectively. For larger HP pumps, get project specific pump and AFD budget quotes.

If this is a Seawater Application, the materials in contact with seawater need to be corrosion resistant.

Process User Inputs:	Value (English)	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
Input Pump Station Type	Submersible	Type			TYP		
Is this Facility Included in a Seawater Treatment Train?	No	Y/N					
Input Maximum Pump Station Flow	12.00	mgd	45.42	ML/d	Qmax		
Conversion of Maximum Pump Station Flow	18.57	cfs	525.75	L/s	Qmax, cfs		
Given: Pump Station Discharge Center Line = 0.00 ft							
Input Maximum Suction Lift for Vertical Turbine Pump Station or Wetwell Operating Water Depth for Submersible Pump Station	15.00	ft	4,572.00	mm	MSL		
Input Maximum Discharge Lift	250.00	ft	76,200.00	mm	MDL		
Input Maximum Pump Station Yard Piping Discharge Header Velocity, and Individual Pump Discharge Lateral Velocity	5.00	fps	1.52	m/s	PSHV	OKAY	Typically 2 - 7 fps
Calculate I-P P.S. Discharge Header Pipe Size	26.09	in	662.75	mm	PSHD		
Use this Standard Diameter for Discharge Header Pipe Size	24.00	in	609.60	mm	PSHDS		
Calculate Maximum PSHV using real pipe size	5.91	fps	1.80	m/s	maxPSHV		
Input Length of I-P Pump Station Force Main	3,000.00	ft	914,400.00	mm	LPSF		Confirm with Hydraulic Analysis
Input Equivalent Length of I-P Pump Station Force Main Minor Losses	50.00	ft	15,240.00	mm	MPSF		Preliminary assumption of MPSF = 50% * LPSF
Input Hazen Williams Pipe Friction Coefficient	110.00				HWFC		Typically HWFC = 100.
Calculate Maximum High Service Water Forcemain Dynamic Headloss = (LPSF + MPSF) * 4.73 * (Q max, cfs)^1.85 / ((HWFC)^1.85 * (PSHDS / 12)^4.87	18.35	ft	5594.29	mm	maxFMDH		Should be ≤ 25% of static lift. If > 25%, reduce velocity or increase static lift.
Calculate Total Maximum Dynamic Headloss	283.35	ft	86366.29	mm	maxTDH		Calculated
Input Pump Efficiency	75.00%				PE	OKAY	Typically 0.70 to 0.80
Wetwell							
Input Minimum Wet Well Detention Time	3.00	min					Typically minimum of 5 min for pump control
Calculate Wetwell Operational Capacity (each)	25000.00	gal	94.64	m3			
Does Wet Well Have a Liner?	No	Y/N					
Calculate Wet Well Liner Surface Area	0.00	sf					
Is Pump Station Inside a Building?	Yes	Y/N					

Input Pump Information	Capacity (English)	Units (English)	Capacity (Metric)	Units (Metric)	AFD? (Yes or No)	Calculate Individual Pump GPM	Calculate Individual Pump BHP
Active Pump # 1	2.00	mgd	7.57	ML/d	No	1388.88	132.51
Active Pump # 2	0.00	mgd	0.00	ML/d	No	0.00	0.00
Active Pump # 3	0.00	mgd	0.00	ML/d	No	0.00	0.00
Active Pump # 4	0.00	mgd	0.00	ML/d	No	0.00	0.00
Active Pump # 5	0.00	mgd	0.00	ML/d	No	0.00	0.00
Active Pump # 6	0.00	mgd	0.00	ML/d	No	0.00	0.00
Active Pump # 7	0.00	mgd	0.00	ML/d	No	0.00	0.00
Active Pump # 8	0.00	mgd	0.00	ML/d	No	0.00	0.00
Active Pump # 9	0.00	mgd	0.00	ML/d	No	0.00	0.00
Active Pump # 10	0.00	mgd	0.00	ML/d	No	0.00	0.00
Calculate Total Active Pumps Capacity	2.00					1388.88	132.51
Calculate Standby Pump Capacity = Max Pump	2.00				No	1388.88	132.51
Calculate Total P.S. Capacity	4.00					2777.76	265.01
Calculate Total Number of Pumps (Active & Standby)							
Clearance Around Pumps	3.50	ft	1,066.80	mm	PC	Fixed	

Process User Inputs:	Value (English)	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
Calculate Pump Station Dimensions Based on Hydraulic Institute Standards (based on Largest Capacity Pump):							
Calculate Distance from Inlet Pipe to Back Wall of Wet Well Behind Pumps	7.08	ft	2159.00	mm	A		
Calculate Distance from Pump Suction Centerline to Back Wall of Wet Well	1.25	ft	381.00	mm	B		
Calculate Distance from Wet Well Floor to Suction Bell	0.75	ft	228.60	mm	C		
Calculate Minimum Water Depth in Wet Well	4.83	ft	1473.20	mm	H		
Calculate Distance Between Pump Centerlines	5.00	ft	1524.00	mm	S		
Calculate Wet Well Width = S * (Total Number of Pumps)	10.00	ft	3048.00	mm	W		
Calculate Wet Well Length = Maximum of (PC * 2) or A	7.08	ft	2159.00	mm	LWW		
Wet Well Free Board	2.00	ft	609.60	mm	FB		Fixed
Calculate Wet Well Side Water Depth = MSL + H - Discharge Flange -Elevated Slab - FB for Vertical Turbine or MSL for Submersible	15.00	ft	4572.00	mm			
Calculate Wet Well Water Volume	25000.00	gal	94.64	m3	WWV		
Calculate Wet Well Volume to Largest Pump Capacity Ratio	18.00				WWV		Ratio should be 2 or greater
Wetwell Dimensions							
Calculate Pump Station Width	15.83	ft	4826.00	mm	WWW		
Calculate Pump Station Length	14.07	ft	4289.04	mm	WWL		
Calculate Wet Well Side Water Depth (based on pumps)	17.00	ft	5181.60	mm	SWD		
Influent Pipe & Motorized Gate Valve:							
Input Maximum Influent Pipe Velocity	4.00	fps	1.22	m/s	IPV		Typically 2 - 7 fps
Calculate I-P P.S. Influent Pipe Size = [(Qmax, cfs/IPV)*4/PI]^1/2*12	29.17	in	740.98	mm	IPD		
Use this Standard Diameter for I-P P.S. Influent Pipe, and Gate Valve	30.00	in	762.00	mm	IPDS		
Discharge Header Pipe Vault:							
Input Clear Distance Around Discharge Header Pipe	3.00	ft	914.40	mm	DPC		Typically > = 3'
Input Depth of Motor Control Center Equipment	2.00	ft	610.00	mm	MCC	OKAY	Typically = 1' - 2.5'
Maximum Velocity Through Discharge Header within Pump Station and Downstream Flow Meter Vault	12.00	fps	3.66	m/s	PDHV		Valid Range: ≤ 15 fps

Calculate Discharge Header Diameter within Pump Station =[(Qmax, cfs/PDHV)*4/PI]^1/2*12	16.84	in	427.81	mm	PDHD		
Use this Standard Diameter for Discharge Header Diameter within Pump Station	16.00	in	406.40	mm	FCVSD		
Pump Station Depth of Burial:							
Input Pump Station Depth of Burial	2.00	ft	609.60	mm	DB		
Input Cutback Slope	1.00	:1					Cutback slope should be 1 for depth of burial ≤ 5 ft, an least 1.5:1 for depth of buri 5 ft.
Input Over Excavation Depth	1.00	ft	0.00	mm	OEXD		

Estimating Dimensions:	Value English	Unit (English)	Name	Unit (Metric)	Name	Red Flags	Comment
Wetwell:							
Width	15.83	ft	4826.00	mm	W		
Length = LWW	14.07	ft	4289.04	mm	LWW		
Wall Height = MSL + H	17.00	ft	5181.60	mm			
Slab on Grade Width	19.83	ft	6045.20	mm			
Slab on Grade Length	18.07	ft	5508.24	mm			
Slab on Grade Thickness	12.00	in	304.80	mm			Model based on 12"
Slab on Grade Thickness	1.00	ft	304.80	mm			
Wall Thickness	12.00	in	304.80	mm	TWWW		Model based on 12"
Wall Thickness	1.00	ft	304.80	mm			
Discharge Header Pipe Vault							
Width	15.83	ft	4826.00	mm			
Length = Discharge Header Pipe Diameter + (Clearance Around Pipe * 2) + Depth of Motor Control Center Equipment	10.00	ft	3048.00	mm	LDHPV		
Wall Height = Discharge Header Pipe Diameter + (Clearance Around Pipe * 2)	8.00	ft	2438.40	mm	HDHPV		
Slab on Grade Width	19.83	ft	6045.20	mm			
Slab on Grade Length	12.00	ft	3657.60	mm			
Slab on Grade Thickness	12.00	in	304.80	mm			Model based on 12"
Slab on Grade Thickness	1.00	ft	304.80	mm			
Wall Thickness	12.00	in	304.80	mm			Model based on 12"
Wall Thickness	1.00	ft	304.80	mm			
Operating Floor							
Width	15.83	ft	4826.00	mm			
Elevated Slab Width	17.83	ft	5435.60	mm			
Elevated Slab Length = LWW + LDPV + (TWWW * 3)	27.07	ft	8251.44	mm			
Elevated Slab Thickness	12.00	in	304.80	mm			Model based on 12"
Elevated Slab Thickness	1.00	ft	304.80	mm			
Overall Dimensions:							
Building Width	17.83	ft	5435.60	mm			
Building Length	27.07	ft	8251.44	mm			
Building Depth	17.00	ft	5181.60	mm			
Excavation Width	19.83	ft	6045.20	mm			
Excavation Length	18.07	ft	5508.24	mm			
Excavation Depth	5.00	ft	1524.00	mm			

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
SITEWORK:							
Excavation	113.65	CY	86.89	m3	*$6.35*	$721	
Imported Structural Backfill	26.55	CY	20.30	m3	*$48.10*	$1,277	
Native Backfill	35.10	CY	26.83	m3	*$7.80*	$274	
Haul Excess	78.55	CY	60.06	m3	*$7.80*	$613	
Allowance for Misc Items	5%				$2,885.39	$144	
Subtotal						$3,030	
CONCRETE:							
Wet Well:							
Foundation	13.27	CY	10.15	m3	*$393.62*	$5,225	
Perimeter Walls	47.73	CY	36.49	m3	*$704.01*	$33,604	
Operating Floor:							
Elevated Slab (Including floor over Discharge Header Vault)	17.88	CY	13.67	m3	*$1,121.35*	$20,050	
Pump Pads	0.53	CY	0.40	m3	*$356.31*	$188	
Other Equipment Pads	1.00	CY	0.76	m3	*$356.31*	$356	
Discharge Pipe Vault:							
Slab on Grade	8.81	CY	6.74	m3	*$356.31*	$3,141	
Walls	12.99	CY	9.93	m3	*$704.01*	$9,143	
Allowance for Misc Items	5%				$71,707.64	$3,585	
Subtotal						$75,293	
MASONRY:	Moderate						
CMU Building	482.78	SF	44.85	m2	*$156.08*	$75,353	
Subtotal						$75,353	
METALS:							
Checker Plate Over Intake Pipe Gate = (Diameter of Influent Pipe +2') * (2 Feet Wide) (sf)	9.00	SF	0.84	m2	*$85.85*	$773	
Checker Plate Over Discharge Pipe Header = ((Discharge Pipe Diameter * 2) * ("S" * Total Number of Pumps)	40.00	SF	3.72	m2	*$85.85*	$3,434	
Ladder	17.00	VLF	5.18	VLM	*$117.84*	$2,003	
Allowance for Misc Items	10%				$6,209.77	$621	
Subtotal						$6,831	
THERMAL & MOISTURE PROTECTION:							
Wet Well Liner	0.00	SF	0.00	m2	$16.00	$0	
Allowance for Misc Items	10%				$0.00	$0	
Subtotal						$0	

							Budgetary Quote: (CPES will automatically add Installation Factor)
EQUIPMENT:							
Size of Sluice Gate (per side in inches)	30.00	in	762.00	mm			
Sluice Gate	1	EA			*$10,742.68*	$10,743	
Pumps:							
Active Pump # 1	132.51	hp	98.81	kW	*$744.69*	$98,676	
Active Pump # 2	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 3	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 4	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 5	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 6	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 7	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 8	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 9	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 10	0.00	hp	0.00	kW	*$0.00*	$0	
Standby Pump	132.51	hp	98.81	kW	*$744.69*	$98,676	
AFD's							
Active Pump # 1	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 2	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 3	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 4	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 5	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 6	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 7	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 8	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 9	0.00	hp	0.00	kW	*$0.00*	$0	
Active Pump # 10	0.00	hp	0.00	kW	*$0.00*	$0	
Standby Pump	0.00	hp	0.00	kW	*$0.00*	$0	
Allowance for Misc Items	10%				$197,352.39	$19,735	
Subtotal						$227,830	

USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST	
Item 1 Description	0.00		0.00		0.00	$0	
Item 2 Description	0.00		0.00		0.00	$0	
Item 3 Description	0.00		0.00		0.00	$0	
Item 4 Description	0.00		0.00		0.00	$0	
Item 5 Description	0.00		0.00		0.00	$0	
Item 6 Description	0.00		0.00		0.00	$0	
Item 7 Description	0.00		0.00		0.00	$0	
Item 8 Description	0.00		0.00		0.00	$0	
Item 9 Description	0.00		0.00		0.00	$0	
Item 10 Description	0.00		0.00		0.00	$0	
Item 11 Description	0.00		0.00		0.00	$0	
Item 12 Description	0.00		0.00		0.00	$0	
Item 13 Description	0.00		0.00		0.00	$0	
Item 14 Description	0.00		0.00		0.00	$0	
Item 15 Description	0.00		0.00		0.00	$0	
Subtotal						$0	
Subtotal						$388,337	

ALLOWANCES:		User Override					
Finishes Allowance	2.00%		$776,674	$15,533			
I&C Allowance	8.00%		$776,674	$62,134			
Mechanical Allowance	25.00%		$776,674	$194,169			
Electrical Allowance	15.00%		$776,674	$116,501			
Facility Cost	265	Total Pump HP	$2,930.70	$776,674			
Facility Cost with Standard Additional Project Costs Added	265	Total Pump HP	$2,930.70	$776,674			
Facility Cost with Standard Additional Project Costs and Contractor Markups Added	265	Total Pump HP	$4,362.45	$1,156,107			
Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	265	Total Pump HP	$4,279.68	$1,134,172			
Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	265	Total Pump HP	$4,279.68	$1,134,172			

User Defined Facility

Parametric Inputs	Value	User Comments

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
SITEWORK:							
Excavation	0.00	CY	0.00	m3	$6.35	$0	02E
Structural Backfill	0.00	CY	0.00	m3	$48.10	$0	02SB
Backfill	0.00	CY	0.00	m3	$7.80	$0	02B
Haul Excess	0.00	CY	0.00	m3	$7.80	$0	02HE
Allowance for Misc Items	5%				$0.00	$0	
Subtotal						$0	
CONCRETE:							
Foundation	0.00	CY	0.00	m3	$393.62	$0	03F
Slab on Grade	0.00	CY	0.00	m3	$356.31	$0	03S
Walls	0.00	CY	0.00	m3	$704.01	$0	03W
Walls	0.00	CY	0.00	m3	$704.01	$0	03W
Walls	0.00	CY	0.00	m3	$704.01	$0	03W
Walls	0.00	CY	0.00	m3	$704.01	$0	03W
Beams	0.00	CY	0.00	m3	$1,121.35	$0	03B
Beams	0.00	CY	0.00	m3	$1,121.35	$0	03B
Elevated Slab	0.00	CY	0.00	m3	$1,121.35	$0	03ES
Elevated Slab	0.00	CY	0.00	m3	$1,121.35	$0	03ES
Allowance for Misc Items	5%				$0	$0	
Subtotal						$0	
MASONRY:							
Type of Building Construction:	Moderate						
Building	0.00	SF	0.00	m2	$156.08	$0	04BM
Subtotal						$0	
METALS:							
Grating	0.00	SF	0.00	m2	$85.85	$0	05G
Handrail	0.00	LF	0.00	m	$85.85	$0	05H
Stairs	0.00	Risers			$468.25	$0	05S
Allowance for Misc Items	5%				$0.00	$0	
Subtotal						$0	
WOOD & PLASTIC:							
Item 1	0.00	EA			$0.00	$0	
Item 2	0.00	EA			$0.00	$0	
Item 3	0.00	EA			$0.00	$0	
Item 4	0.00	EA			$0.00	$0	
Item 5	0.00	EA			$0.00	$0	
Allowance for Misc Items	5%				$0.00	$0	
Subtotal						$0	
THERMAL & MOISTURE PROTECTION:							
Item 1	0.00	EA			$0.00	$0	
Item 2	0.00	EA			$0.00	$0	
Item 3	0.00	EA			$0.00	$0	
Item 4	0.00	EA			$0.00	$0	
Item 5	0.00	EA			$0.00	$0	
Roof Hatch (4' x 6', double leaf)	0.00	EA			$2,809.50	$0	07RH1
Roof Hatch (2' x 2', double leaf)	0.00	EA			$468.25	$0	07RH2
Allowance for Misc Items	5%				$0.00	$0	
Subtotal						$0	
DOORS & WINDOWS:							
Item 1	0.00	EA			$0.00	$0	
Item 2	0.00	EA			$0.00	$0	
Item 3	0.00	EA			$0.00	$0	
Item 4	0.00	EA			$0.00	$0	
Item 5	0.00	EA			$0.00	$0	
Allowance for Misc Items	5%				$0.00	$0	
Subtotal						$0	
EQUIPMENT:							
Equipment Item 1	0.00	EA			$0.00	$0	
Equipment Item 2	0.00	EA			$0.00	$0	
Equipment Item 3	0.00	EA			$0.00	$0	
Equipment Item 4	0.00	EA			$0.00	$0	
Equipment Item 5	0.00	EA			$0.00	$0	
Equipment Item 6	0.00	EA			$0.00	$0	
Equipment Item 7	0.00	EA			$0.00	$0	
Equipment Item 8	0.00	EA			$0.00	$0	

Centrifuge Solids Dewatering Facility

Is This Facility Included In My Project? Yes

Process User Inputs:	Value (English)	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
Dry Solids Production							
Input Design Plant Flow Rate	12.00	mgd	45.42	ML/d			Enter plant flow rate for which dewatering equipment/system shall be sized.
Input Average Annual Plant Flow Rate	4.00	mgd	15.14	ML/d			Enter plant flow rate for calculating average annual production of solids.
Input Design Raw Water Turbidity	1.00	NTU					Enter raw water turbidity for which dewatering equipment/system shall be sized.
Input Average Annual Raw Water Turbidity	1.00	NTU					Enter raw water turbidity for calculating average annual production of solids
Input Fraction of Turbidity to Contribute to Solids	1.00	mg/L/NTU					Typically 1 to 2
Input Design Raw Water Color	1.00	CU					Enter raw water color for which dewatering equipment/system shall be sized.
Input Average Annual Raw Water Color	1.00	CU					Enter raw water color for calculating average annual production of solids.
Input Fraction of Color to Contribute to Solids	0.05	mg/L/CU					Typically 0.02 to 0.1
Select Coagulant Used for Raw Water	Aluminum Sulfate	Type					
Input Design Coagulant Dose	40.00	mg/L					Enter coagulant dose for which dewatering equipment/system shall be sized.
Input Average Annual Coagulant Dose	40.00	mg/L					Enter coagulant dose for calculating average annual production of solids.
Fraction of Coagulant to Contribute to Solids	0.44						Typical Value = 0.44 based on 3 waters of hydration for the most probable solid Al(OH)3*3H2O.
Optional: Input Fraction of Coagulant to Contribute to Solids (overwrites above calculations)							
Input Total Design Polymer Dose (coagulation, flocculation, filter aids)		mg/L					Enter polymer dose for which dewatering equipment/system shall be sized.
Input Total Average Annual Polymer Dose (coagulation, flocculation, filter aids)		mg/L					Enter polymer dose for calculating average annual production of solids.
Input Design Raw Water Iron	2.00	mg/L					Enter raw water iron for which dewatering equipment/system shall be sized.
Input Average Annual Raw Water Iron	1.00	mg/L					Enter raw water iron for calculating average annual production of solids.
Input Iron Factor that Contributes to Solids	2.00						Typical Value = 2
Input Design Raw Water Manganese	0.50	mg/L					Enter raw water manganese for which dewatering equipment/system shall be sized.
Input Average Annual Raw Water Manganese	0.50	mg/L					Enter raw water manganese for calculating average annual production of solids.
Input Manganese Factor that Contributes to Solids	2.00						Typical Value = 2
Input Design PAC Dose		mg/L					Enter PAC dose for which dewatering equipment/system shall be sized.
Input Average Annual PAC Dose		mg/L					Enter PAC dose for calculating average annual production of solids.
Input Design Carbonate Hardness Concentration to be Removed via Softening	40.00	mg/L as CaCO3					Enter carbonate hardness removed for which dewatering equipment/system shall be sized.
Input Average Annual Carbonate Hardness Concentration to be Removed via Softening		mg/L as CaCO3					Enter carbonate hardness removed for calculating average annual production of solids.
Input Carbonate Hardness Factor that Contributes to Solids	1.00	(mg of softening solids produced per mg of hardness removed)					Typical Value: 1 for sodium hydroxide softening, 2 for lime softening.
Input Design Non-Carbonate Hardness Concentration to be Removed via Softening	40.00	mg/L as CaCO3					Enter non-carbonate hardness removed for which dewatering equipment/system shall be sized.
Input Average Annual Non-Carbonate Hardness Concentration to be Removed via Softening	40.00	mg/L as CaCO3					Enter non-carbonate hardness removed for calculating average annual production of solids.
Input Non-Carbonate Hardness Factor that Contributes to Solids	1.00	(mg of softening solids produced per mg of hardness removed)					Typical Value: 1 for sodium hydroxide softening; 1 for soda ash softening.
Calculate Design Solids Removed	103.55	mg/L					
Calculate Design Daily Dry Solids Production	10373.29	lb/d	4705.25	kg/d			Calculated on a dry weight basis.
Optional: Input Design Daily Dry Solids Production (overwrites above calculations)		lb/d	0.00	kg/d			Overrides cell above. Calculated on a dry weight basis.
Calculate Average Annual Solids Removed	61.65	mg/L					
Calculate Average Annual Daily Dry Solids Production	2056.64	lb/d	932.88	kg/d			Calculated on a dry weight basis
Optional: Input Average Annual Daily Dry Solids Production (overwrites above calculations)		lb/d	0.00	kg/d			Overrides cell above. Calculated on a dry weight basis
Centrifuge Dewatering Sizing							
Input % Dry Solids in Sludge to Centrifuges	2.00%	%					Typically from Gravity Thickener at 2% to 5%
Input Number of Days per Week Centrifuges Will Be Operated	5.00	days					1 to 7, often 5 days
Input Number of Hours per Day Centrifuges Will Be Operated	8.00	hours					1 to 24, often 8 hours
Calculate Required Gravity Thickener Dry Solids Storage (dry)	27662.11	lb	12547.32	kg			
Calculate Thickened Sludge Density	63.12	lb/cf	1011.07	kg/m3			
Calculate Required Gravity Thickener Sludge Storage Volume	21912.62	cf	620.50	m3			
Calculate Required Gravity Thickener Sludge Storage Volume	163917.80	gal	620.50	m3			For information, see cell C34 in the Gravity Thickener model for the volume (in gallons) of sludge.
Calculate Required Centrifuge Dewatering Rate	179.29	gpm	40.72	m3/hr			
Input Number of Duty Centrifuges	1	#					Toggle number of duty centrifuges to select optimum centrifuge configuration
Input Number of Standby Centrifuges	1	#					Typically 0 or 1

Total Number of centrifuges	2	#					
Loading, hydraulic (each)	179.29	gpm	40.72	m3/hr			
Loading, dry solids (each)	1815.33	lb/hr	823.42	kg/hr			
Centrifuge Selection							
Input Sludge Type	Ferric						
Case No.	2.00						Number used for selection of centrifuge
Expected Feed Solids	1-3% DS						
Polymer Consumption	15-30 lb/ton DS						DS = dry solids
Cake Solids	20-25% DS						DS = dry solids
Capture Efficiency	95.00%						
Centrifuge Selection	4.00						Number used for selection of centrifuge
Model No. (Andritz)	D5						The service numbers for each model have a level of conservativism already in them.
Capacity	135	gpm	30.66	m3/hr			Contact Andritz for actual model selection. There are several versions of each model that changes the capacity ranges for each.
Bowl Diameter	20.50	in	520.70	mm			
Length	180.00	in	4572.00	mm			
Width	52.00	in	1320.80	mm			
Height	62.00	in	1574.80	mm			
Power, Main Drive	100.00	hp	74.57	kW			
Power, Back Drive	20.00	hp	14.91	kW			
Weight	14766.00	lb	6697.74	kg			Be sure to provide access to the centrifuges on the second floor.
Chemical Storage and Feed							
Input Chemical Name	Liquid Polymer	Type					Typically Liquid Polymer, but if Dry Polymer is used, use the Dry Polymer Model
Is this Chemical System to be included?	Yes	Y/N					
Input Percent Active Chemical	40.00%	%					If Liquid Polymer, typically 30% to 50%
Input Bulk Chemical Specific Gravity	1.10	#					If Liquid Polymer, typically 1.1
Active Chemical Concentration, lb/gallon	3.67	lb/gal	439.71	kg/m3			
Choose Chemical Delivery Method	Tote	Type					
Bulk Delivery Volume (Tank Truck, Totes, Drums), gallons	300.00	gal	1.14	m3			
Input Number of Simultaneous Application Points	1	#					
CHEMICAL DOSES:							
Input Minimum Dose (per ton of dry solids)	10.00	lb/t	6.80	kg/t			Typically 5 to 15 lb dry polymer per ton of dry solids (2.5 to 7.5 kg/t).
Input Average Dose (per ton of dry solids)	15.00	lb/t	9.07	kg/t			Typically 10 to 20 lb dry polymer per ton of dry solids (5.0 to 10.0 kg/t).
Input Maximum Dose (per ton of dry solids)	20.00	lb/t	11.34	kg/t			Typically 15 to 25 lb dry polymer per ton of dry solids (7.5 to 12.5 kg/t).
Minimum Chemical Usage	72.61	lb/d	32.94	kg/d			Usage rate on operating days.
Average Chemical Usage	108.92	lb/d	49.41	kg/d			Usage rate on operating days.
Maximum Chemical Usage	145.23	lb/d	65.87	kg/d			Usage rate on operating days.
Chemical Metering Rates per Simultaneous Operating Pump:							
Minimum Rate	2.47	gph	9.36	L/h			Usage rate when operating.
Average Rate	3.71	gph	14.04	L/h			Usage rate when operating.
Maximum Rate	4.95	gph	18.73	L/h			Usage rate when operating.
Calculate Chemical Metering Pump Flow Turndown (should be < 20, if > 20, proceed with caution)	2.00	1					Should be < 20, if ≥ 20, proceed with caution.
Input Number of Days of Storage at Avg. Flow/Dose for Chemical	30.00	days					Includes non-operating days.
Calculate Number of Operating Days of Storage	21.43	days					Includes only operating days.
Calculate Storage Volume for Pretreatment @ Avg. Flow/Dose	636.03	gal	2.41	m3			
Calculate Bulk Delivery Volume * 1.5 (for Truck Delivery Only)	0.00	gal	0.00	m3			
Maximum of Above Two Volumes	636.03	gal	2.41	m3			
Maximum Volume in	85.03	cf	2.41	m3			
BULK TANKS:							
Input Number of Tanks	0	#					
Input Tank Diameter	10.00	ft	3,048.00	mm			
Calculate Height of Tanks	0.00	ft	0.00	mm			
Use this Tank Height (Liquid Height * 1.2)	0.00	ft	0.00	mm			
Input Number of Rows of Tanks	1	#					
Calculate Number of Tanks per Row	0	#					
Input Tank Material (FRP, PE (Polyethylene), PLS (Phenolic Lined Steel))	FRP	Type					
Input Clear Distance Around BulkTanks, Totes or Drums	4.00	ft	1,219.20	mm	CDT		
TOTES & DRUMS:							
Calculate Number of Totes or Drums	3	each					
Will Totes or Drums be Stored by Stacking on Top of Each Other?	No	Y/N					
Input Number of Rows of Totes or Drum Pallets	1	#					
Calculate Number of Totes or Drum Pallets on Floor per Row	3.00	#					
Length of Each Tote	4.00	ft	1219.20	mm			Fixed
Width of Each Tote	4.00	ft	1219.20	mm			Fixed
Length and Width of Each Drum Pallet	5.00	ft	1524.00	mm			Fixed
CHEMICAL FEED SYSTEMS:							
Select Chemical Feed Method	Polymer Blend Unit	Type					If using polymer, a Polymer Blend Unit is recommended.
Calculate Number of Active Chemical Feed Systems	1	#					
Input Number of Standby Chemical Feed Systems	1	#					
Calculate Total Number of Chemical Feed Systems	2	#					
Input Clear Distance Around Chemical Feed Systems	4.00	ft	1,219.20	mm			
Length of Chemical Feed Systems	2.50	ft	762.00	mm			
Width of Chemical Feed Systems	3.33	ft	1015.90	mm			
Width of Stair Access	3.50	ft	1066.80	mm			Fixed
CONTAINMENT AREA:							
Calculate Containment Area Internal Length	28.00	ft	8534.40	mm			
Calculate Containment Area Internal Width	26.00	ft	7924.80	mm			
Calculate Fire Sprinkler Water Volume (0.2 gpm/sf for 20 min.)	2912.00	gal	11.02	m3			

Calculate 120% of One Storage Tank Volume	360 00	gal	1 36	m3			
Calculate 30% of All Tank Volume	90 00	gal	0 34	m3			
Maximum of Above Two Volumes	360 00	gal	1 36	m3			
Calculate Maximum Volume + Fire Flow Volume	3272 00	gal	12 39	m3			
Calculate Maximum Volume + Fire Flow Volume	437.40	cf	12 39	m3			
Calculate Containment Wall Height (including 6" Freeboard)	1 10	ft	335 53	mm			
Dewatering Building							
Truck Lane Length	68.00	ft	20,726.40	mm	DWB-TLL		Typically 68 ft for full container truck or roll-off.
Truck Lane Width	20.00	ft	6,096.00	mm	DWB-TLW		Typically ≥ 16 ft for full container truck or roll-off.
First Floor Height	24.00	ft	7,315.20	mm	DWB-FFH		Typically ≥ 22 ft
Number of Truck Lanes	2.00	#					Typically 2.
Offset Between Centrifuges	5.00	ft	1,524.00	mm	CN-OS		Typically ≥ 4 ft for access.
Centrifuge Offset from Wall (width direction in relationship to the centrifuges)	5.00	ft	1,524.00	mm	CN-OEW		Typically ≥ 4 ft for access.
Centrifuge Offset from Wall (length direction in relationship to centrifuges)	17.00	ft	5,181.60	mm	CN-ONW		Typically = 17 ft for proper alignment over truck bays.
Input Stair Tread Width	3.50	ft	1,066.80	mm			Typically ≥ 3 5 ft.
Calculate Stairwell Width	8 00	ft	2438 40	mm	DWB-SW		
Calculate Stairwell Length	25 50	ft	7772 40	mm	DWB-SL		
Dewatering Building Width	68 67	ft	20929 60	mm	DWB-W		
Dewatering Building Length	77 50	ft	23622 00	mm	DWB-L		
Conveyor Equipment							
Centrifuge Conveyor Length	0 00	ft	0 00	mm	CON-CNL		
Centrifuge Conveyor Width or Diameter	10.00	in	254.00	mm	CON-CNW		Verify with conveyor vendor
Conveyor Truck Lane Length	40.00	ft	12,192.00	mm	CON-TLL		Typically 40 ft
Calculate Conveyor Truck Lane Width	10 00	in	254 00	mm	CON-TLW		
% Dry Solids Capture by Centrifuge	95 00%						
% Dry Solids in Centrifuge Cake	20 00%						
Calculate the Centrifuge Dry Solids Production Rate (dry)	1724 56	lb/hr	782 25	kg/hr			
Calculate the Cake Density	70 42	lb/cf	1128 07	kg/m3			Assumes density of dried solids of 145 lb/cf.
Calculate the Centrifuge Cake Solids Production Rate	8622 80	lb/hr	3911 24	kg/hr			
Calculate Truck Loads	0 18	per hour					
Calculate the Centrifuge Cake Volume Production Rate	122 44	cf/hr	3 47	m3/hr			
Calculate Total Yearly Wet Mass of Sludge (per year)	8992 35	tons	8157720 07	kg			
Calculate Total Design Yearly Wet Sludge Volume	9458 50	cy	7231 54	m3			
Calculate Average Annual Wet Sludge Volume	1875 27	cy	1433 75	m3			
Calculate Number of Gates per Truck Conveyor	6	#					Assumes 6 ft on center
Input Depth of Burial		ft	0.00	mm	DB		
Input Cutback Slope	1.00	:1					Cutback slope should be 1 1 for depth of burial ≤ 5 ft, and at least 1 5 1 for depth of burial > 5 ft.
Input Over Excavation Depth	1.00	ft	0.00	mm	OEXD		

Mechanical Sizing Requirements:

Pipe Name	Input Velocity	Unit (English)	Input Velocity	Unit (Metric)	Standard Pipe Size	Unit (English)	Nominal Pipe Size
Centrifuge Feed Header	5.00	fps	1.52	m/s	4 00	in	100 00
Centrifuge Feed Lateral	5.00	fps	1.52	m/s	4 00	in	100 00
Centrifuge Drain Lateral/Header	5.00	fps	1.52	m/s	4 00	in	100 00
Centrifuge Decant Header	5.00	fps	1.52	m/s	4 00	in	100 00
Centrifuge Decant Lateral	5.00	fps	1.52	m/s	4 00	in	100 00

Mechanical Material Requirements:

Pipe Name	Pipe ID	Installation Type	Pipe Material	Pipe Lining Material	Pipe Coating Material	Comments	Red Flags
Centrifuge Feed Header	CFH	Exposed	DI	Cement Mortar	Tape Coating		
Centrifuge Feed Lateral	CFL	Exposed	Steel	Cement Mortar	Paint		
Centrifuge Drain Lateral/Header	CD	Exposed	Steel	Cement Mortar	Paint		
Centrifuge Decant Header	CDH	Exposed	Steel	Cement Mortar	Paint		
Centrifuge Decant Lateral	CDL	Exposed	Steel	Cement Mortar	Paint		

Electrical User Inputs and Sizing Requirements:

Is this a "Critical" Facility (requiring standby power)?	No	Y/N
Is there SWGR?	No	

Electrical Equipment Lengths:

Item	Quantity	HP per Each	AFD's Required?	MCC Spaces for Motor Starters	MCC Spaces for AFD's less than 50hp)	MCC Spaces for Breakers	MCC Total MCC Spaces
Centrifuges (Active)	1	100.00	No	3.00	0.00	0.00	
Centrifuges (Standby)	1	100.00	No	3.00	0.00	0.00	
Centrifuge Conveyor Belt	0	3.00	No	0.00	0.00	0.00	
Truck Conveyor Belt	2	3.00	No	4.00	0.00	0.00	
User Defined Item #1	0	0.00	No	0.00	0.00	0.00	
User Defined Item #2	0	0.00	No	0.00	0.00	0.00	
TOTAL		206.0		10.00	0.00	0.00	10.00

Electrical Equipment Widths:

Equipment	Depth (ft)
MCC	1.67
Small AFD's	0.00
Large AFD's	0.00
Switchgear	0.00
Maximum Depth	1.67

Clear Distances:

Clear Distance	Width	Length	Comment				
CD1		3.00	Clear Distance between wall and MCC	Typically 3 feet			
CD2		1.00	Clear Distance between MCC and Small AFD	Typically 1 foot			
CD3		0.00	Clear Distance between Small AFD and Large AFD	Typically Zero			
CD4		0.00	Clear Distance between Large AFD and Switchgear	Typically Zero			

CD5		0.00	Clear Distance between Switchgear and Contingency Space	Typically Zero			
CD6	4.00		Clear Distance behind Switchgear (If there is no Switchgear, this distance will be Zero)				
CD7	3.00		Clear Distance in front of Equipment	Typically 3 feet			
Contingency Length		0.00	Contingency length	Typically Zero			
Electric Room Length (ft):							
CD1	3.00						
MCC	8.33						
CD2	1.00						
Small AFD's	0.00						
CD3	0.00						
Large AFD's	0.00						
CD4	0.00						
Swithgear	0.00						
CD5	0.00						
Contingency	0.00						
Total Length	12.33						
Electric Room Width (ft):							
CD6	0.00	If there is no switchgear, this distance will be Zero.					
Maximum Equipment Depth	1.67						
CD7	3.00						
Total Width	4.67						
Estimating Dimensions:	**Value English**	**Unit (English)**	**Value (Metric)**	**Unit (Metric)**	**Name**	**Red Flags**	**Comment**
Centrifuge Building							
Building Length	77.50	ft	23622.00	mm			
Building Width	68.67	ft	20929.60	mm			
Slab on Grade Length	81.50	ft	24841.20	mm			
Slab on Grade Width	72.67	ft	22148.80	mm			
Excavation Length	85.50	ft	26060.40	mm			
Excavation Width	76.67	ft	23368.00	mm			
Excavation Depth	3.50	ft	1066.80	mm			
Stair Height	24.00	ft	7315.20	mm			
Slab on Grade Thickness	18.00	in	457.20	mm			Model based on 18"
Slab on Grade Thickness	1.50	ft	457.20	mm			
Wall Thickness	12.00	in	304.80	mm			Model based on 12"
Wall Thickness	1.00	ft	304.80	mm			
Elevated Slab Thickness	12.00	in	304.80	mm			Model based on 12"
Elevated Slab Thickness	1.00	ft	304.80	mm			
Chemical Containment Wall Thickness	8.00	in	203.20	mm			
Chemical Containment Wall Thickness	0.67	ft	203.20	mm			

Description	**Quantity (English)**	**Unit (English)**	**Quantity (Metric)**	**Unit (Metric)**	**$/Unit**	**Total Cost**	**User Over-Write**
SITEWORK:							
Excavation	1034.09	CY	790.62	m3	*$8.35*	$6,564	
Imported Structural Backfill	485.56	CY	371.23	m3	*$48.10*	$23,355	
Native Backfill	73.58	CY	56.25	m3	*$7.80*	$574	
Haul Excess	960.52	CY	734.37	m3	*$7.80*	$7,496	
Allowance for Misc Items	5%				$37,989.65	$1,899	
Subtotal						$39,889	
CONCRETE:							
Centrifuge Building Slab on Grade	329.02	CY	251.55	m3	*$356.31*	$117,232	
Elevated Slab	208.07	CY	159.08	m3	*$1,121.35*	$233,324	
Equipment Pads	6.32	CY	4.83	m3	*$356.31*	$2,252	
Allowance for Misc Items	5%				$352,808.12	$17,640	
Subtotal						$370,449	
MASONRY:	Moderate						
CMU Building	10643.33	SF	988.80	m2	*$156.08*	$1,661,246	
Subtotal						$1,661,246	
METALS:							
Stairway	72	Risers			*$468.25*	$33,714	
Guardrail	310.00	LF	94.49	m	*$26.07*	$8,082	
Allowance for Misc Items	10%				$41,795.74	$4,180	
Subtotal						$45,975	
EQUIPMENT:							**Budgetary Quote: (CPES will automatically add Installation Factor)**
Centrifuges	2	EA			*$720,288.34*	$1,440,577	
Liquid Polymer Feed System	2	EA			*$6,391.52*	$12,783	
Shaftless Screw Conveyer	80.00	ft	24.38	m	*$2,162.58*	$173,006	
Allowance for Misc Items	10%				$1,626,365.99	$162,637	
Subtotal						$1,789,003	Total Horsepower >>>>
							Percent On-Line Factor >>>>
I&C:							Effective On-Line Horsepower >>>>
Instruments							
Centrifuge Feed Header Magmeter (CFH, 4 inch)	1	EA			$3,837.50	$3,838	
Isolation Valve Actuators (Electric)	6	EA			*$6,007.16*	$36,043	
Slide Gate Actuators	14	EA			$2,607.02	$36,498	
Number of Analog I/O Counts	2	EA			$247.67	$495	
Number of Digital I/O Counts	120	EA			$58.66	$7,039	
Number of Local Panels	2	EA			$12,253.00	$24,506	
Number of PLC's	1	EA			$13,035.11	$13,035	
I&C Conduit Wire	2131.50	LF	649.68	m	$11.30	$24,089	
Allowance for Misc Items	5%				$145,543.21	$7,277	
Subtotal						$152,820	
							Percent On-Line Factor >>>>
CONVEYING SYSTEMS:							Effective On-Line Horsepower >>>>
Bridge Crane (8 Ton)	1	EA			*$66,120.59*	$66,121	
Bridge Crane Rail	155.00	LF	47.24	m	*$34.34*	$5,323	
Allowance for Misc Items	10%				$71,443.78	$7,144	
Subtotal						$78,588	

MECHANICAL:							
Pipe:							
Centrifuge Feed Header (CFH, DI, 4 inch, Exposed)	131.42	LF	40.06	m	$32.50	$4,271	
Centrifuge Feed Lateral (CFL, Steel, 4 inch, Exposed)	10.33	LF	3.15	m	$86.65	$895	
Centrifuge Drain Lateral/Header (CD, Steel, 4 inch, Exposed)	141.75	LF	43.21	m	$86.65	$12,282	
Centrifuge Decant Header (CDH, Steel, 4 inch, Exposed)	131.42	LF	40.06	m	$86.65	$11,387	
Centrifuge Decant Lateral (CDL, Steel, 4 inch, Exposed)	10.33	LF	3.15	m	$86.65	$895	
Elbows:							
Centrifuge Feed Header (CFH, DI, 4 inch)	3	EA			$682.15	$2,046	
Centrifuge Feed Lateral (CFL, Steel, 4 inch)	2	EA			$521.82	$1,044	
Centrifuge Drain Lateral/Header (CD, Steel, 4 inch)	3	EA			$521.82	$1,565	
Centrifuge Decant Header (CDH, Steel, 4 inch)	5	EA			$521.82	$2,609	
Centrifuge Decant Lateral (CDL, Steel, 4 inch)	2	EA			$521.82	$1,044	
End Caps:							
Centrifuge Feed Header (CFH, DI, 4 inch)	0	EA			$169.29	$0	
Centrifuge Feed Lateral (CFL, Steel, 4 inch)	0	EA			$169.29	$0	
Centrifuge Drain Lateral/Header (CD, Steel, 4 inch)	0	EA			$169.29	$0	
Centrifuge Decant Header (CDH, Steel, 4 inch)	0	EA			$169.29	$0	
Centrifuge Decant Lateral (CDL, Steel, 4 inch)	0	EA			$169.29	$0	
Tee:							
Centrifuge Feed Header (CFH, DI, 4 inch)	1	EA			$1,132.70	$1,133	
Centrifuge Feed Lateral (CFL, Steel, 4 inch)	0	EA			$1,188.91	$0	
Centrifuge Drain Lateral/Header (CD, Steel, 4 inch)	1	EA			$1,188.91	$1,189	
Centrifuge Decant Header (CDH, Steel, 4 inch)	1	EA			$1,188.91	$1,189	
Centrifuge Decant Lateral (CDL, Steel, 4 inch)	0	EA			$1,188.91	$0	
Valves:							
Centrifuge Feed Header (CFH, DI, 4 inch)	0	EA			$3,321.81	$0	
Centrifuge Feed Lateral (CFL, Steel, 4 inch)	2	EA			$3,816.47	$7,633	
Centrifuge Drain Lateral/Header (CD, Steel, 4 inch)	2	EA			$3,816.47	$7,633	
Centrifuge Decant Header (CDH, Steel, 4 inch)	0	EA			$3,816.47	$0	
Centrifuge Decant Lateral (CDL, Steel, 4 inch)	2	EA			$3,816.47	$7,633	
Slide Gates:							
Centrifuge Conveyor Solids Gates (10 in)	2	EA			$923.17	$1,846	
Truck Conveyor Solids Gates (10 in)	12	EA			$923.17	$11,078	
Allowance for Misc Items	5%				$77,372.74	$3,869	
Subtotal						$81,241	
ELECTRICAL:							
# MCC Sections	5	EA			$8,044.96	$40,225	
Switchgear	0	EA			$37,006.81	$0	
Adjustable Frequency Drives							
Centrifuges (Active) (100 hp each)	0	EA			$20,598.08	$0	
Centrifuges (Standby) (100 hp each)	0	EA			$20,598.08	$0	
Centrifuge Conveyor Belt (3 hp each)	0	EA			$8,677.31	$0	
Truck Conveyor Belt (3 hp each)	0	EA			$8,677.31	$0	
Electrical Conduit & Wire	406.00	LF	123.75	m	$11.30	$4,588	
Allowance for Misc Items	10%				$44,813.18	$4,481	
Subtotal						$49,294	
USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST	
Item 1 Description	0.00		0.00		0.00	$0	
Item 2 Description	0.00		0.00		0.00	$0	
Item 3 Description	0.00		0.00		0.00	$0	
Item 4 Description	0.00		0.00		0.00	$0	
Item 5 Description	0.00		0.00		0.00	$0	
Item 6 Description	0.00		0.00		0.00	$0	
Item 7 Description	0.00		0.00		0.00	$0	
Item 8 Description	0.00		0.00		0.00	$0	
Item 9 Description	0.00		0.00		0.00	$0	
Item 10 Description	0.00		0.00		0.00	$0	
Item 11 Description	0.00		0.00		0.00	$0	
Item 12 Description	0.00		0.00		0.00	$0	
Item 13 Description	0.00		0.00		0.00	$0	
Item 14 Description	0.00		0.00		0.00	$0	
Item 15 Description	0.00		0.00		0.00	$0	
Subtotal						$0	
Subtotal						$4,268,506	
ALLOWANCES:		User Override					
Finishes Allowance	2.00%		$4,690,666	$93,813			
I&C Allowance	2.00%		$4,690,666	$93,813			
Mechanical Allowance	3.00%		$4,690,666	$140,720			
Electrical Allowance	2.00%		$4,690,666	$93,813			
					Facility Cost Name		
Facility Cost	10,373	Dry Pounds per Day	$452.19	$4,690,666	SCEFC01		
Facility Cost with Standard Additional Project Costs Added	10,373	Dry Pounds per Day	$452.19	$4,690,666	SCEFC02		
Facility Cost with Standard Additional Project Costs and Contractor Markups Added	10,373	Dry Pounds per Day	$673.10	$6,982,219	SCEFC03		
Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	10,373	Dry Pounds per Day	$660.32	$6,849,742	SCEFC05		
Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	10,373	Dry Pounds per Day	$660.32	$6,849,742	SCEFC06		

Gravity Thickener

Gravity Thickener

PROCESS DESIGN CRITERIA

Is This Facility Included in My Project? Yes

Process User Inputs:	Value (English)	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
Solids Production:							
Input Plant Flow Rate	12.00	mgd	45.42	ML/d			
Input Raw Water Turbidity	1.00	NTU					Typically 1 to 2
Input Fraction of Turbidity to Contribute to Solids	1.00	mg/L/NTU					
Input Raw Water Color		CU					Typically 0 02 to 0 1
Input Fraction of Color to Contribute to Solids	0 05	mg/L/CU					
Input Alum Dose	40.00						
Input Fraction of Alum to Contribute to Solids	0.44						Typical Value = 0 44 based on 3 waters of hydration for the most probable solid Al(OH)3 3H2O
Input Ferric Chloride Dose		mg/L					
Fraction of Ferric Chloride to Contribute to Solids	0.99						Typical Value = 0 99 based on 3 waters of hydration for the most probable solid Fe(OH)3 3H2O
Input Total Polymer Dose (coagulation, flocculation, filter aids)		mg/L					
Input Raw Water Iron		mg/L					
Input Iron Factor	2.00						Typical Value = 2
Input Raw Water Manganese		mg/L					
Input Manganese Factor	2.00						Typical Value = 2
Input PAC Dose		mg/L					
Input Carbonate Hardness Concentration to be Removed via Softening	40.00	mg/L as CaCO3					
Input Carbonate Hardness Factor (mg of softening solids produced per mg of hardness removed)	1.00						Typical Value: 1 for sodium hydroxide softening, 2 for lime softening
Input Non-Carbonate Hardness Concentration to be Removed via Softening	40.00	mg/L as CaCO3					
Input Non-Carbonate Hardness Factor (mg of softening solids produced per mg of hardness removed)	1.00						Typical Value: 1 for sodium hydroxide softening; 1 for soda ash softening.
Calculate Solids Removed	98 60	mg/L					
Calculate Dry Residual Solids Produced	9867 89	lb/d	4476 00	kg/d			
Optional: Input Daily Dry Solids Production (overwrites above calculations) (dry)		lb/d	503.94	kg/d			
Gravity Thickener Sizing & Sludge Storage:							
Input Number of On-Line Thickeners	1	#					Typically 1
Input Number of Standby Thickeners	1	#					Typically 0 25% tyo 0 75%
Input % Dry Solids in Sludge to Thickeners	0.25%	%					
Calculate Total Sludge Flow Rate	473280 00	gpd	1791 56	m3/d			
Calculate Sludge Flow to Each Thickener	473280 00	gpd	1791 56	m3/d			
Calculate Dry Solids Flow to Each Thickener	9867 89	lb/d	4476 00	kg/d			
Input Thickener Hydraulic Loading Rate	300.00	gpd/sf	44,005.50	m/d			Typically 100 to 300 gpd/sf for metal salt coagulant sludges
Input Thickener Solids Loading Rate	10.00	lb/d/sf	4.54	kg/d/m2			Typically 5 to 10 lb/sf/d
Calculate Thickener Diameter Each Based on Hydraulic Loading Rate	44 62	ft	13660 56	mm			
Calculate Thickener Diameter Each Based on Solids Loading Rate	35 45	ft	10803 94	mm			
Calculate Thickener Diameter Each (maximum of above)	44 82	ft	13660 56	mm			
Input Thickened Sludge % Dry Solids	2.00%	%					Typically 2% to 5% for metal salt coagulant sludges treated with polymer
Calculate Thickened Sludge Density	63 12	lb/cf	1011 07	kg/m3			
Input Days of Thickened Sludge Storage in Thickener	1.00	days					Typically 0 to 3 days (long weekend)
Calculate Thickened Sludge Storage Depth	4 95	ft	1510 26	mm			If Sludge Storage depth is greater than desired: 1.) Reduce days of storage or 2.) Decrease controlling thickener loading rate criteria input.
Calculate Total Thickened Sludge Storage Volume	58474 29	gal	221 35	m3			
Input Clear Water Depth Above Sludge Line	10.00	ft	3,048.00	mm			Typically 8 to 11 feet
Input Free Board	2.00	ft	609.60	mm			Typically 1 to 3 feet
Calculate Total Thickener Depth	16 95	ft	5167 86	mm			
Input Thickener Wall Height Above Grade	0.00	ft	0.00	mm			
Calculate Wall Burial Depth	16 95	ft	5167 86	mm	DB		
Gravity Thickener Peripheral Weir Launder Sizing:							
Calculate Total Flow Rate of all Thickeners	0 47	mgd	1791 56	m3/d	QT		
Calculate Flow Rate of Each Active Thickener	0 47	mgd	1791 56	m3/d	Q mgd		
Convert Each Thickener Flow Rate	0 73	cfs	20 74	L/s	Q cfs		
Input Velocity in Launder	5.00	fps	1.52	m/s	V		Typically < 5 fps
Calculate Area (Q cfs / V)	0 15	sf	0 01	m2			
Launder Freeboard	1 00	ft	304 80	mm			Fixed
Input Launder Width	2.00	ft	609.60	mm			
Calculate Launder Height Excluding Freeboard	0 07	ft	22 32	mm			
Calculate Launder Height Including Freeboard	1 07	ft	327 12	mm			Should be ≤ 5 ft.
Thickened Sludge Pump Sizing:							
Calculate Thickened Sludge Flow from Each Thickener	58474 29	gpd	221 35	m3/d			
Calculate Thickener Decant Flow from Each Thickener	414805 71	gpd	1570 21	m3/d			
Number of Progressive Cavity Thickened Sludge Pumps per Thickener	2	#					Fixed: 1 duty and 1 standby
Calculate Number of Thickened Sludge Pumps	4	#					
Calculate Thickened Sludge Pump Capacity Each	40 61	gpm	153 71	L/min			
Input Thickened Sludge Pump Total Dynamic Head (TDH)	60.00	ft	18,288.00	mm			
Calculate Thickened Sludge Pump Horsepower (each)	0 82	hp	0 61	kW			
Input Distance between Thickener and Sludge Pump Pad	16.00	ft	4,876.80	mm			Minimum of 10 ft
Input Sludge Pump Length (progressive cavity)	8.50	ft	2,590.80	mm			Typically 8 5 ft
Input Sludge Pump Width (progressive cavity)	2.00	ft	609.60	mm			Typically 2 0 ft
Input Stagger Distance Between Sludge Pump Centerlines - Length	8.50	ft	2,590.80	mm			Typically equal to sludge pump length
Input Distance Between Sludge Pump Centerlines (width) and Around Pumps for Access	4.50	ft	1,371.60	mm			Typically 4.5 ft for access
Include the Cost of a Building Over Sludge Pump Station?	Yes	Y/N					
Input Cutback Slope	1.50	1					Cutback slope should be 1 1 for depth of burial ≤ 5 ft, and at least 1 5 1 for depth of burial > 5 ft.
Input Over Excavation Depth	1.00	ft	0.00	mm	OEXD		

Mechanical Sizing Requirements: Pipe Name	Input Velocity	Unit (English)	Input Velocity	Unit (Metric)	Standard Pipe Size	Unit (English)	Nominal Pipe Size

Unthickened Sludge Influent Pipe	3.00	fps	0.91	m/s	8 00	in	200 00
Decant Pipe	5.00	fps	1.52	m/s	6 00	in	150 00
Thickened Sludge Suction Pipe	3.00	fps	0.91	m/s	4 00	in	100 00
Thickened Sludge Discharge Pipe	3.00	fps	0.91	m/s	4 00	in	100.00

Mechanical Material Requirements:

Pipe Name	Pipe ID	Installation Type	Pipe Material	Pipe Lining Material	Pipe Coating Material	Comments	Red Flags
Unthickened Sludge Influent Pipe	USP	Buried	DI	Cement Mortar	Tape Coating		
Unthickened Sludge Influent Pipe	USP	Encased	DI	Cement Mortar	Fusion Bonded Epoxy		
Unthickened Sludge Influent Pipe	USP	Submerged	DI	Cement Mortar	Fusion Bonded Epoxy		
Decant Pipe	DSP	Buried	DI	Cement Mortar	Tape Coating		
Decant Pipe	DSP	Exposed	DI	Cement Mortar	Paint		
Decant Pipe	DSP	Encased	DI	Cement Mortar	Fusion Bonded Epoxy		
Thickened Sludge Suction Pipe	TSSP	Encased	DI	Cement Mortar	Fusion Bonded Epoxy		
Thickened Sludge Suction Pipe	TSSP	Exposed	Steel	Cement Mortar	Paint		
Thickened Sludge Discharge Pipe	TSDP	Exposed	DI	Cement Mortar	Paint		

Electrical User Inputs and Sizing Requirements:

Is this a "Critical" Facility (requiring standby power)?	No	Y/N
Is there SWGR?	No	

Electrical Equipment Lengths:

Item	Quantity	HP per Each	AFD's Required?	MCC Spaces for Motor Starters	MCC Spaces for AFD's less than 50hp)	MCC Spaces for Breakers	MCC Total MCC Spaces
Thickened Sludge Pumps (Active)	2.00	0.82	Yes	0.00	6.00	4.00	
Thickened Sludge Pumps (Standby)	2.00	0.82	No	4.00	0.00	0.00	
Gravity Thickener Rake Mechanism	2.00	1.00	No	4.00	0.00	0.00	
User Defined Item #1	0.00	0.00	No	0.00	0.00	0.00	
User Defined Item #2	0.00	0.00	No	0.00	0.00	0.00	
TOTAL		5.3		8.00	6.00	4.00	18.00

Electrical Equipment Widths:

Equipment	Depth (ft)
MCC	1.67
Small AFD's	0.00
Large AFD's	0.00
Switchgear	0.00
Maximum Depth	1.67

Clear Distances:

Clear Distance	Width	Length	Comment			
CD1		3.00	Clear Distance between wall and MCC	Typically 3 feet		
CD2		1.00	Clear Distance between MCC and Small AFD	Typically 1 foot		
CD3		0.00	Clear Distance between Small AFD and Large AFD	Typically Zero		
CD4		0.00	Clear Distance between Large AFD and Switchgear	Typically Zero		
CD5		0.00	Clear Distance between Switchgear and Contingency Space	Typically Zero		
CD6	4.00		Clear Distance behind Switchgear (If there is no Switchgear, this distance will be Zero)			
CD7	3.00		Clear Distance in front of Equipment	Typcally 3 feet		
Contingency Length		0.00	Contingency length	Typically Zero		

Electric Room Length (ft)

CD1	3.00
MCC	10.00
CD2	1.00
Small AFD's	0.00
CD3	0.00
Large AFD's	0.00
CD4	0.00
Swithgear	0.00
CD5	0.00
Contingency	0.00
Total Length	14.00

Electric Room Width (ft):

CD6	0.00	If there is no switchgear, this distance will be Zero.
Maximum Equipment Depth	1.67	
CD7	3.00	
Total Width	4.67	

Estimating Dimensions:	Value English	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
Total Number of Thickeners	2 00	#					
Gravity Thickener (dimensions per each):							
Perimeter Wall Inside Diameter	44 82	ft	13660 56	mm			
Perimeter Wall Outside Diameter	46 82	ft	14270 16	mm			
Perimeter Wall Height	16 95	ft	5167 86	mm			
Wall Footer Thickness	16.00	in	406.40	mm			Model based on 16"
Wall Footer Thickness	1 33	ft	406 40	mm			
Slab on Grade Thickness	6.00	in	152.40	mm			Model based on 6"
Slab on Grade Thickness	0 50	ft	152 40	mm			
Center Cone Outside Diameter	6 17	ft	1879 60	mm			Fixed
Center Cone Inside Diameter	3 50	ft	1066 80	mm			Fixed
Center Cone Slab on Grade Thickness	16.00	in		mm			Model based on 16"
Center Cone Slab on Grade Thickness	1 33	ft	406 40	mm			
Center Cone Wall Height	2.33	ft	59.18	mm			Model based on 2 33'
Center Cone Wall Thickness	16.00	in	406.40	mm			Model based on 16"
Center Cone Wall Thickness	1 33	ft	406 40	mm			
Launder Elevated Slab Width	2.00	ft	50.80	mm			Model based on 2'
Launder Elevated Slab Thickness	12.00	in	304.80	mm			Model based on 12"
Launder Elevated Slab Thickness	1 00	ft	304 80	mm			
Launder Wall Diameter	40 82	ft	12441 36	mm			
Launder Wall Height	1 07	ft	327 12	mm			
Launder Wall Thickness	8.00	in	203.20	mm			Model based on 8"
Launder Wall Thickness	0 67	ft	203 20	mm			
Perimeter Wall Thickness	12.00	in	304.80	mm			Model based on 12"
Perimeter Wall Thickness	1 00	ft	304 80	mm			

Floor Slope Factor	1.03						Fixed
Side Slope Depth Factor	0.23						Fixed
Side Slope Factor	4.29						Fixed
Excavation Diameter	55.82	ft	17013.36	mm			
Cone Excavation Depth	8.50	ft	2590.61	mm			
Perimeter Wall Excavation Depth (Includes Over Excavation)	19.29	ft	5879.06	mm			
Thickened Sludge Pump Slab:							
Length	26.00	ft	7924.80	mm			Fixed
Width	30.50	ft	9296.40	mm			
Slab on Grade Length	28.00	ft	8534.40	mm			
Slab on Grade Width	32.50	ft	9906.00	mm			
Slab Thickness	16.00	in	406.40	mm			Model based on 16"
Slab Thickness	1.33	ft	406.40	mm			
Excavation Length	32.00	ft	9753.60	mm			
Excavation Width	36.50	ft	11125.20	mm			
Excavation Depth	3.33	ft	1016.00	mm			
Electrical Room:							
Length	14.00	ft	4267.20	mm			
Width	4.67	ft	1422.40	mm			
Slab on Grade Length	16.00	ft	4876.80	mm			
Slab on Grade Width	6.67	ft	2032.00	mm			
Slab on Grade Thickness	18.00	in	457.20	mm			Model based on 18"
Slab on Grade Thickness	1.50	ft	457.20	mm			
Excavation Length	20.00	ft	6096.00	mm			
Excavation Width	10.67	ft	3251.20	mm			
Excavation Depth	3.50	ft	1066.80	mm			

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
SITEWORK:							
Gravity Thickener:							
Excavation	8,550.26	CY	6537.16	m3	$6.35	$54,277	
Imported Structural Backfill	372.46	CY	284.75	m3	$48.10	$17,915	
Native Backfill	3,624.42	CY	2771.07	m3	$7.80	$28,286	
Haul Excess	4,925.86	CY	3766.09	m3	$7.80	$38,442	
Thickened Sludge Pump Slab:							
Excavation	208.86	CY	159.68	m3	$7.80	$1,630	
Imported Structural Backfill	100.94	CY	77.17	m3	$48.10	$4,855	
Native Backfill	42.28	CY	32.33	m3	$7.80	$330	
Haul Excess	166.58	CY	127.36	m3	$7.80	$1,300	
Electrical Room:							
Excavation	54.35	CY	41.55	m3	$7.80	$424	
Imported Structural Backfill	19.75	CY	15.10	m3	$48.10	$950	
Native Backfill	20.87	CY	15.96	m3	$7.80	$163	
Haul Excess	33.48	CY	25.60	m3	$7.80	$261	
Allowance for Misc Items	5%				$148,833.18	$7,442	
Subtotal						$156,275	
CONCRETE:							
Gravity Thickener:							
Wall Footers	79.90	CY	61.09	m3	$393.62	$31,450	
Slanted Slab on Grade	60.03	CY	45.90	m3	$393.62	$23,629	
Slanted Floor Grout (2" thick)	3,241.64	SF	301.16	m2	$22.27	$72,185	
Center Cone Slab on Grade	2.95	CY	2.26	m3	$393.62	$1,161	
Center Cone Walls	4.46	CY	3.41	m3	$468.25	$2,088	
Perimeter Walls	184.72	CY	141.23	m3	$863.35	$122,538	
Launder Elevated Slab	20.86	CY	15.95	m3	$780.42	$16,279	
Launder Wall	6.80	CY	5.20	m3	$780.42	$5,304	
Concrete Fill	3.48	CY	2.66	m3	$351.19	$1,221	
						$0	
Thickened Sludge Pump Slab:							
Slab on Grade	44.94	CY	34.36	m3	$356.31	$16,012	
Electrical Room:						$0	
Slab on Grade	5.93	CY	4.53	m3	$393.62	$2,333	
Allowance for Misc Items	5%				$294,198.37	$14,710	
Subtotal						$308,908	
METALS:							
Gravity Thickener:							
Walkway Grating (3' wide, steel support beams supplied by mechanism mfr)	280.91	SF	26.10	m2	$85.85	$24,115	
Walkway Handrail	187.27	LF	57.08	m	$85.85	$16,077	
Stairway	0	Risers			$468.25	$0	
Allowance for Misc Items	10%				$40,191.37	$4,019	
Subtotal						$44,211	
MASONRY:	Moderate						
Thickened Sludge Pump Building	793.00	SF	73.67	m2	$156.08	$123,774	
Electrical Room	65.33	SF	6.07	m2	$156.08	$10,197	
Subtotal	858.33					$133,971	
EQUIPMENT:							Budgetary Quote: (CPES will automatically add Installation Factor)
Gravity Thickener Drive Mechanism (1 hp each)	2	EA			$118,519.13	$237,038	
Thickened Sludge Pumps (Active, Progressive Cavity Pumps 1 hp each)	2	EA			$5,740.23	$11,480	
Thickened Sludge Pumps (Standby, Progressive Cavity Pumps 1 hp each)	2	EA			$5,740.23	$11,480	
Allowance for Misc Items	10%				$248,518.72	$24,852	
Subtotal						$284,851	
I&C:							
Instruments							
Thickened Sludge Discharge Pipe Magmeter (TSDP, 4 inch)	2	EA			$6,419.30	$12,839	
Isolation Valve Actuators (Electric)	6	EA			$6,007.16	$36,043	
Level Transmitters	2	EA			$8,044.98	$16,090	
Number of Analog I/O Counts	5	EA			$247.67	$1,238	
Number of Digital I/O Counts	36	EA			$58.66	$2,112	
Number of Local Panels	2	EA			$12,253.00	$24,506	
Number of PLC's	1	EA			$13,035.11	$13,035	
I&C Conduit Wire	908.18	LF	276.81	m	$11.30	$10,264	
Allowance for Misc Items	5%				$116,126.38	$5,806	
Subtotal						$121,933	
MECHANICAL:							
Pipe:							
Unthickened Sludge Influent Pipe (USP, Buried, 8 inch, DI)	33.91	LF	10.34	m	$65.00	$2,204	
Unthickened Sludge Influent Pipe (USP, Encased, 8 inch, DI)	0.00	LF	0.00	m	$65.00	$0	
Unthickened Sludge Influent Pipe (USP, Submerged, 8 inch, DI)	44.82	LF	13.66	m	$65.00	$2,913	
Decant Pipe (DSP, Buried, 8 inch, DI)	2.00	LF	0.61	m	$48.75	$98	
Decant Pipe (DSP, Exposed, 8 inch, DI)	33.91	LF	10.34	m	$48.75	$1,653	
Decant Pipe (DSP, Encased, 8 inch, DI)	0.00	LF	0.00	m	$48.75	$0	
Thickened Sludge Suction Pipe (TSSP, Encased, 4 inch, DI)	76.82	LF	23.41	m	$32.50	$2,497	
Thickened Sludge Suction Pipe (TSSP, Exposed, 4 inch, Steel)	49.50	LF	15.09	m	$86.65	$4,289	
Thickened Sludge Discharge Pipe (TSDP, Exposed, 4 inch, DI)	48.00	LF	14.63	m	$32.50	$1,560	

Elbows:							
Unthickened Sludge Influent Pipe (USP, Buried, 8 inch, DI)	2	EA			$1,364.31	$2,729	
Unthickened Sludge Influent Pipe (USP, Encased, 8 inch, DI)	0	EA			$1,364.31	$0	
Unthickened Sludge Influent Pipe (USP, Submerged, 8 inch, DI)	6	EA			$1,364.31	$8,186	
Decant Pipe (DSP, Buried, 6 inch, DI)	2	EA			$1,023.23	$2,046	
Decant Pipe (DSP, Exposed, 6 inch, DI)	0	EA			$1,023.23	$0	
Decant Pipe (DSP, Encased, 6 inch, DI)	0	EA			$1,023.23	$0	
Thickened Sludge Suction Pipe (TSSP, Encased, 4 inch, DI)	0	EA			$682.15	$0	
Thickened Sludge Suction Pipe (TSSP, Exposed, 4 inch, Steel)	2	EA			$521.82	$1,044	
Thickened Sludge Discharge Pipe (TSDP, Exposed, 4 inch, DI)	2	EA			$682.15	$1,364	
End Caps:							
Unthickened Sludge Influent Pipe (USP, Buried, 8 inch, DI)	0	EA			$338.59	$0	
Unthickened Sludge Influent Pipe (USP, Encased, 8 inch, DI)	0	EA			$338.59	$0	
Unthickened Sludge Influent Pipe (USP, Submerged, 8 inch, DI)	0	EA			$338.59	$0	
Decant Pipe (DSP, Buried, 6 inch, DI)	0	EA			$253.94	$0	
Decant Pipe (DSP, Exposed, 6 inch, DI)	0	EA			$253.94	$0	
Decant Pipe (DSP, Encased, 6 inch, DI)	0	EA			$253.94	$0	
Thickened Sludge Suction Pipe (TSSP, Encased, 4 inch, DI)	4	EA			$169.29	$677	
Thickened Sludge Suction Pipe (TSSP, Exposed, 4 inch, Steel)	0	EA			$169.29	$0	
Thickened Sludge Discharge Pipe (TSDP, Exposed, 4 inch, DI)	2	EA			$169.29	$339	
Tee:							
Unthickened Sludge Influent Pipe (USP, Buried, 8 inch, DI)	0	EA			$2,265.40	$0	
Unthickened Sludge Influent Pipe (USP, Encased, 8 inch, DI)	0	EA			$2,265.40	$0	
Unthickened Sludge Influent Pipe (USP, Submerged, 8 inch, DI)	0	EA			$2,265.40	$0	
Decant Pipe (DSP, Buried, 6 inch, DI)	2	EA			$1,699.05	$3,398	
Decant Pipe (DSP, Exposed, 6 inch, DI)	0	EA			$1,699.05	$0	
Decant Pipe (DSP, Encased, 6 inch, DI)	0	EA			$1,699.05	$0	
Thickened Sludge Suction Pipe (TSSP, Encased, 4 inch, DI)	2	EA			$1,132.70	$2,265	
Thickened Sludge Suction Pipe (TSSP, Exposed, 4 inch, Steel)	2	EA			$1,188.91	$2,378	
Thickened Sludge Discharge Pipe (TSDP, Exposed, 4 inch, DI)	2	EA			$1,132.70	$2,265	
Valves:							
Unthickened Sludge Influent Pipe (USP, Buried, 8 inch, DI)	0	EA			$6,643.21	$0	
Unthickened Sludge Influent Pipe (USP, Encased, 8 inch, DI)	0	EA			$6,643.21	$0	
Unthickened Sludge Influent Pipe (USP, Submerged, 8 inch, DI)	2	EA			$6,643.21	$13,286	
Decant Pipe (DSP, Buried, 6 inch, DI)	0	EA			$4,982.41	$0	
Decant Pipe (DSP, Exposed, 6 inch, DI)	0	EA			$4,982.41	$0	
Decant Pipe (DSP, Encased, 6 inch, DI)	0	EA			$4,982.41	$0	
Thickened Sludge Suction Pipe (TSSP, Encased, 4 inch, DI)	0	EA			$3,321.61	$0	
Thickened Sludge Suction Pipe (TSSP, Exposed, 4 inch, Steel)	2	EA			$3,816.47	$7,633	
Thickened Sludge Discharge Pipe (TSDP, Exposed, 4 inch, DI)	2	EA			$3,321.61	$6,643	
Allowance for Misc Items	5%				$69,467.81	$3,473	
Subtotal						$72,941	
ELECTRICAL:							
# MCC Sections	6	EA			$8,044.96	$48,270	
Switchgear	0	EA			$37,006.81	$0	
Adjustable Frequency Drives							
Thickened Sludge Pumps (Active) (1 hp each)	2	EA			$8,409.44	$16,819	
Thickened Sludge Pumps (Standby) (1 hp each)	0	EA			$8,409.44	$0	
Gravity Thickener Rake Mechanism (1 hp each)	0	EA			$8,431.62	$0	
Electrical Conduit & Wire	237.64	LF	72.43	m	$11.30	$2,686	
Allowance for Misc Items	10%				$67,774.27	$6,777	
Subtotal						$74,552	
USER DEFINED ESTIMATE ITEMS:	**QUANT (ENGLISH)**	**UNIT (ENGLISH)**	**QUANT (METRIC)**	**UNIT (METRIC)**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0.00		0.00		0.00	$0	
Item 2 Description	0.00		0.00		0.00	$0	
Item 3 Description	0.00		0.00		0.00	$0	
Item 4 Description	0.00		0.00		0.00	$0	
Item 5 Description	0.00		0.00		0.00	$0	
Item 6 Description	0.00		0.00		0.00	$0	
Item 7 Description	0.00		0.00		0.00	$0	
Item 8 Description	0.00		0.00		0.00	$0	
Item 9 Description	0.00		0.00		0.00	$0	
Item 10 Description	0.00		0.00		0.00	$0	
Item 11 Description	0.00		0.00		0.00	$0	
Item 12 Description	0.00		0.00		0.00	$0	
Item 13 Description	0.00		0.00		0.00	$0	
Item 14 Description	0.00		0.00		0.00	$0	
Item 15 Description	0.00		0.00		0.00	$0	
Subtotal						$0	
Subtotal						$1,197,642	
ALLOWANCES:		User Override					
Finishes Allowance	2.00%		$1,408,990	$28,180			
I&C Allowance	4.00%		$1,408,990	$56,360			
Mechanical Allowance	5.00%		$1,408,990	$70,450			
Electrical Allowance	4.00%		$1,408,990	$56,360			
					Facility Cost Name		
Facility Cost	946,560	GPD	$1.49	$1,408,990	SGTFC01		
Facility Cost with Standard Additional Project Costs Added	946,560	GPD	$1.49	$1,408,990	SGTFC02		
Facility Cost with Standard Additional Project Costs and Contractor Markups Added	946,560	GPD	$2.22	$2,097,331	SGTFC03		
Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	946,560	GPD	$2.17	$2,057,537	SGTFC05		
Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	946,560	GPD	$2.17	$2,057,537	SGTFC06		

RAPID MIX

Rapid Mixing - Inline

Assumptions:

- Based on Denver Water Reuse Project
- 2 Basins @ 15 MGD each
- One chemical per each rapid mixer
- *If this is a Seawater Desalination Application, the materials in contact with seawater need to be corrosion resistant.*

INLINE MECHANICAL RAPID MIXING

Process User Inputs	Value (English)	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
Is this a Seawater Desalination Application?	No	Y/N					
Has the USER Contacted Equipment Suppliers to Obtain Equipment Quotes?	No	Y/N					Fixed
Total Plant Flow	12.00	mgd	45.42	ML/d			If using Lamella Plate Clarifier, the Rapid Mixing Total Plant Flow should equal the Lamella Plate Clarifier Total Plant Flow. For information, the Lamella Plate Total Plant Flow can be found in the Lamella Clarifier model cell C13.
Conversion of Total Plant Flow	18.57	cfs	0.53	m3/s			
Number of Trains	1	#				OKAY	
Calculate Plant Flow per Train = QS/#T (cfs)	18.57	cfs	0.53	m3/s			
Number of Standby Trains	0	#					Default is 0. Maximum is 2
Total Number of Trains (Active and Standby)	1	#					
Input Rapid Mix Velocity Gradient	2,000.00	sec-1				OKAY	Typically 1,000 to 3,000 sec-1
Input Wire to Water Rapid Mix Energy Input Efficiency	60%						
Input Min Water Temperature	32.00	degrees F	0.00	degrees C		OKAY	
Water Viscosity	0.0000374	lb•s/sf	1.79	cP			From Lookup Table
Calculate Volume = PI * (MSD /12)^2 /4 * 1.5 * MD /12	18.41	cf	0.52	m3			
Calculate HP = (VG)^2 * Mu * V / E / 550	9.00	hp	6.71	kW			
Is the Rapid Mix Facility covered? ("Yes" or "No")	Yes	Y/N					
Input Structure Burial Depth (ft)	0.00	ft	914.40	mm			
Input Clear Distance Between Pipe Trains & Internal Walls (ft)	5.00	ft	1,524.00	mm	CDBT		Typically 4 to 6 feet
Number of Analyzers: (total facility)							
pH / Temperature	1	#					
Turbidity	0	#					
Streaming Current Detector	1	#					
UV Absorbance	0	#					
Conductivity	0	#					
Input Cutback Slope	1.00	:1					Cutback slope should be 1:1 for depth of burial ≤ 5 ft, and at least 1.5:1 for depth of burial > 5 ft.
Input Over Excavation Depth	1.00	ft	2.00	mm	OEXD		

Mechanical Sizing Requirements:

Pipe Name	Input Velocity	Unit (English)	Input Velocity	Unit (Metric)	Standard Pipe Size	Unit (English)	Nominal Pipe Size
Rapid Mix Pipe	5.00	fps	1.52	m/s	30.00	in	750.00
Flow Control Pipe	15.00	fps	4.57	m/s	16.00	in	400.00

Mechanical Material Requirements:

Pipe Name	Pipe ID	Installation Type	Pipe Material	Pipe Lining Material	Pipe Coating Material	Red Flags	Comments
Rapid Mix Pipe	RW	Exposed	Steel	Cement Mortar	Paint		
Flow Control Pipe	FCP	Exposed	Steel	Cement Mortar	Paint		

Electrical User Inputs and Sizing Requirements:

Is this a "Critical" Facility (requiring standby power)?	No	Y/N
Is there SWGR?	No	

Item	Quantity	HP per Each	AFD's Required?	MCC Spaces for Motor Starters	MCC Spaces for AFD's less than 50hp)	MCC Spaces for Breakers	Total MCC Spaces
Mechanical Mixers	1.00	9.00	No	2.00	0.00	0.00	
User Defined Item #1	0.00	0.00	No	0.00	0.00	0.00	
User Defined Item #2	0.00	0.00	No	0.00	0.00	0.00	
User Defined Item #3	0.00	0.00	No	0.00	0.00	0.00	
TOTAL		9.00		2.00	0.00	0.00	2.00

Electrical Equipment Widths:

Equipment	Depth (ft)
MCC	1.67
Small AFD's	0.00
Large AFD's	0.00
Switchgear	0.00
Maximum Depth	1.67

Clear Distances:

Clear Distance	Width	Length	Comment
CD1		3.00	Clear Distance between wall and MCC. Typically 3 feet

	B	C	D	E	F	G	H	I
72	CD2		1.00	Clear Distance between MCC and Small AFD	Typically 1 foot			
73	CD3		0.00	Clear Distance between Small AFD and Large AFD	Typically Zero			
74	CD4		0.00	Clear Distance between Large AFD and	Typically Zero			
75	CD5		0.00	Clear Distance between Switchgear and Contingency Space	Typically Zero			
76	CD6	4.00		Clear Distance behind Switchgear (If there is no Switchgear, this distance will be Zero)				
77	CD7	3.00		Clear Distance in front of Equipment	Typcally 3 feet			
78	Contingency Length		0.00	Contingency length	Typically Zero			
79								
80	Electric Room Length (ft):							
81	CD1	3.00						
82	MCC	8.33						
83	CD2	1.00						
84	Small AFD's	0.00						
85	CD3	0.00						
86	Large AFD's	0.00						
87	CD4	0.00						
88	Swithgear	0.00						
89	CD5	0.00						
90	Contingency	0.00						
91	Total Length	12.33						
92								
93	Electric Room Width (ft):							
94	CD6	0.00	If there is no switchgear, this distance will be Zero.					
95	Maximum Equipment Depth	1.67						
96	CD7	3.00						
97	Total Width	4.67						
98								

99	Estimating Dimensions (per trian):	Value English	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
100	Rapid Mix Pipe Elbow Length	4.34	ft	1,321.31	mm			Lookup Value
101	Rapid Mix Isolation Valve Length	1.00	ft	304.80	mm			Lookup Value
102	Rapid Mix - Flow Control Reducer Length	4.67	ft	1,422.40	mm			
103	Flowmeter Length	2.00	ft	609.60	mm			Lookup Value
104	Flow Control Valve Length	0.67	ft	203.20	mm			Lookup Value
105								
106	Slab on Grade:							
107	Concrete Thickness (Inches)	12.00	in	304.80	mm			Model based on 12"
108	Concrete Thickness (Feet)	1.00	ft	304.80	mm	RMISGT		
109	Slab on Grade Length	54.59	ft	16,638.02	mm			
110	Slab on Grade Width	12.50	ft	3,810.00	mm			
111	Footing:							
112	Footing Thickness (Inches)	12.00	in	304.80	mm			Model based on 12"
113	Footing Thickness (Feet)	1.00	ft	304.80	mm	RMIFTT		
114	Footing Width (Inches)	24.00	in	609.60	mm			Fixed
115	Footing Width (Feet)	2.00	ft	609.60	mm			
116	Stem Walls:							
117	Wall Thickness (Inches)	12.00	in	304.80	mm			Model based on 8"
118	Wall Thickness (Feet)	1.00	ft	304.80	mm	RMIWST		
119	Wall Height (Feet)	0.00	ft	0.00	mm	DB		
120								
121	Overall Dimensions:							
122	SOG Length (Feet)	54.59	ft	16,638.02	mm	SOGL		
123	SOG Width (Feet)	12.50	ft	3,810.00	mm	SOGW		
124	Building Length (SOGL +(SWT*2)) (Feet)	56.59	ft	17,247.62	mm	BL		
125	Building Width (SOGW + (SWT*2)) (Feet)	14.50	ft	4,419.60	mm	BW		
126	Electrical Room Length (Feet)	12.33	ft	3,759.20	mm			
127	Electrical Room Width (Feet)	4.67	ft	1,422.40	mm			
128	Excavation Length (BL + 4) (Feet)	60.59	ft	18,466.82	mm			
129	Excavation Width (BW + 4) (Feet)	18.50	ft	5,638.80	mm			
130	Excavation Depth (SWH + FT + 1 + Over Exc) (Feet)	3.00	ft	914.40	mm			
131								

133	Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
134								
135	SITEWORK:							
136	Excavation	169.01	CY	129.22	m3	*$8.35*	$1,073	
137	Imported Structural Backfill	83.03	CY	63.48	m3	*$48.10*	$3,994	
138	Native Backfill	26.36	CY	20.16	m3	*$7.80*	$206	
139	Haul Excess	142.65	CY	109.06	m3	*$7.80*	$1,113	
140	Allowance for Misc Items	5%				$6,385.37	$319	
141	Subtotal						$6,705	
142								
143	CONCRETE:							
144	Wall Footing	10.53	CY	8.05	m3	*$356.31*	$3,752	
145	Stem Walls	0.00	CY	0.00	m3	*$704.01*	$0	
146	Slab on Grade	25.27	CY	19.32	m3	*$356.31*	$9,004	
147	Pipe Supports	7.00	EA			$520.28	$3,642	
148	Electrical Room Slab on Grade	2.13	CY	1.63	m3	*$356.31*	$760	
149	Allowance for Misc Items	5%				$17,158.36	$858	
150	Subtotal						$18,016	
151								
152	MASONRY:	Moderate						
153	CMU Building	820.51	SF	76.23	m2	*$156.08*	$128,067	
154	Electrical Room	57.56	SF	5.35	m2	*$156.08*	$8,983	
155	Subtotal	878.06					$137,051	
156								
157	EQUIPMENT							Budgetary Quote: (CPES wi automatically add Installatio Factor)
158	Inline Mixer (30-inch)	1.00	EA			*$50,241.95*	$50,242	
159	Allowance for Misc Items	10%				$50,241.95	$5,024	
160	Subtotal						$55,266	

	B	C	D	E	F	G	H	I
161								
162	INSTRUMENTS & CONTROLS:							
163	Instruments							
164	Mag Meter (16-inch)	1.00	EA			$15,442.50	$0	$0.00
165	pH / Temperature	1.00	EA			$2,482.89	$2,483	
166	Turbidity	0.00	EA			$3,715.89	$0	
167	Streaming Current Detector	1.00	EA			$12,667.81	$12,668	
168	UV Absorbance	0.00	EA			$25,849.09	$0	
169	Conductivity	0.00	EA			$2,440.67	$0	
170	Sample Panels	1.00	EA			$4,682.50	$4,682	
171	Isolation Valve Actuators	2.00	EA			*$6,007.16*	$12,014	
172	Flow Control Valve Actuators	1.00	EA			*$6,007.16*	$6,007	
173	Number of Analog I/O Counts	7.20	EA			*$247.67*	$1,783	
174	Number of Digital I/O Counts	16.80	EA			*$58.66*	$985	
175	Number of PLC's	1.00	EA			*$12,253.00*	$12,253	
176	I&C Conduit & Wire	396.11	LF	120.73	m	*$11.30*	$4,477	
177	Allowance for Misc Items	10%				$57,352.92	$5,735	
178	Subtotal						$63,088	
179								
180	CONVEYING SYSTEMS:							
181	Monorail Hoist (3 Ton)	1.00	EA			*$66,120.59*	$66,121	
182	Hoist Rail	73.84	LF	22.51	m	*$34.34*	$2,536	
183	Allowance for Misc Items	10%				$68,656.38	$6,866	
184	Subtotal						$75,522	
185								
186	MECHANICAL:							
187	Pipe:							
188	Rapid Mix Pipe (30-inch, RW, Exposed ,Steel ,Cement Mortar ,Paint)	25.00	LF	7.62	m	*$649.84*	$16,246	
189	Flow Control Pipe (16-inch, FCP, Exposed ,Steel ,Cement Mortar ,Paint)	10.67	LF	3.25	m	*$346.58*	$3,697	
190	Elbows:							
191	Rapid Mix Pipe (30-inch)	2.00	EA			*$3,913.66*	$7,827	
192	Valves:							
193	Rapid Mix Isolation Valves (30-inch)	2.00	EA			*$28,623.54*	$57,247	
194	Flow Control Valve (16-inch)	1.00	EA			*$15,265.89*	$15,266	
195	Allowance for Misc Items	10%				$100,283.29	$10,028	
196	Subtotal						$110,312	
197								
198	ELECTRICAL:							
199	MCC's							
200	Sections	5.00	EA			*$8,044.96*	$15,000	$15,000.00
201	AFD's							
202	Mechanical Mixers (9 hp each)	0.00	EA			*$9,414.68*	$0	
203	Switchgear							
204	Units	0.00	EA			*$37,006.81*	$0	
205	Electrical Conduit & Wire	56.59	LF	17.25	m	*$11.30*	$640	
206	Allowance for Misc Items	10%				$15,639.51	$1,564	
207	Subtotal						$17,203	
208								
209	**USER DEFINED ESTIMATE ITEMS:**	**QUANT (ENGLISH)**	**UNIT (ENGLISH)**	**QUANT (METRIC)**	**UNIT (METRIC)**	**$/UNIT**	**TOTAL COST**	
210	Item 1 Description	0.00		0.00		0.00	$0	
211	Item 2 Description	0.00		0.00		0.00	$0	
212	Item 3 Description	0.00		0.00		0.00	$0	
213	Item 4 Description	0.00		0.00		0.00	$0	
214	Item 5 Description	0.00		0.00		0.00	$0	
215	Item 6 Description	0.00		0.00		0.00	$0	
216	Item 7 Description	0.00		0.00		0.00	$0	
217	Item 8 Description	0.00		0.00		0.00	$0	
218	Item 9 Description	0.00		0.00		0.00	$0	
219	Item 10 Description	0.00		0.00		0.00	$0	
220	Item 11 Description	0.00		0.00		0.00	$0	
221	Item 12 Description	0.00		0.00		0.00	$0	
222	Item 13 Description	0.00		0.00		0.00	$0	
223	Item 14 Description	0.00		0.00		0.00	$0	
224	Item 15 Description	0.00		0.00		0.00	$0	
225	Subtotal						$0	
226								
227	Subtotal						$483,163	
228								
229	ALLOWANCES		User Override					
230	Finishes Allowance	2.00%		$549,049	$10,981			
231	I&C Allowance	5.00%		$549,049	$27,452			
232	Mechanical Allowance	0.00%		$549,049	$0			
233	Electrical Allowance	5.00%		$549,049	$27,452			
234						Facility Cost Name		
235	Facility Cost	12,000,000	GPD	$0.05	$549,049	RMIFC01		
236	Facility Cost with Standard Additional Project Costs Added	12,000,000	GPD	$0.05	$549,049	RMIFC02		
237	Facility Cost with Standard Additional Project Costs and Contractor Markups Added	12,000,000	GPD	$0.07	$817,279	RMIFC03		
238	Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	12,000,000	GPD	$0.07	$801,772	RMIFC05		
239	Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	12,000,000	GPD	$0.07	$801,772	RMIFC06		

Flocculation

Flocculation (Horizontal Paddle Wheel Flocculation for Downstream Sedimentation)

Assumptions.

Based on Denver Water Reuse Project

2 Basins @ 15 MGD each

If this is a Seawater Desalination Application, the materials in contact with seawater need to be corrosion resistant.

NOTE TO USER: The Lamella Plate Clarifier should be sized before working on the Flocculation model.

Process User Inputs	Value (English)	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
Is this a Seawater Desalination Application?	No	Y/N					
Has the USER Contacted Equipment Suppliers to Obtain Equipment Quotes?	No	Y/N					
Input Total Flocculation Flow Rate	12.00	mgd	45.42	ML/d			
Conversion of Total Flocculation Flow Rate	8,333.28	gpm	525.75	L/s			
Conversion of Total Flocculation Flow Rate	18.57	cfs	0.53	m3/s			
Input Number of Active Flocculation Trains	2	#					
Input Number of Standby Flocculation Trains	0	#					Typically 0.
Calculate Total Number of Flocculation Trains	2	#			NT		
Input Flocculation Detention Time	20.00	min					
Input Number of Flocculation Basin Stages per Train	2	#			NFS		Valid Range: 1 - 6.
Calculate Flocculation Basin Water Volume per Train	11,139.98	cf	315.45	m3			
Calculate Flocculation Stage Water Volume	5,569.99	cf	157.72	m3			
Select Flocculation Baffle Type	O/U	Type					
Input Flocculation Basin Inflow Weir Head if Submerged Baffling Selected	1.50	ft	457.20	mm			
Calculate Flocculation Basin Inflow Weir Length	0.00	ft	0.00	mm	WL		
Input Internal Flocculation Basin / Stage Width per Train = Lamella Plate Clarifier Train Width (W)	15.00	ft	4,572.00	mm	IBW		If using DAF Clarifier, the Floccula Basin / Stage Width should equal DAF Clarifier Stage Width. For information, the DAF Clarifier Sta Width can be found in the DAF m cell C23. Lamella Clarifier Width c be found in cell C46 of the Lamell Clarifier model.
Calculate Stage Length	19.27	ft	5,873.49	mm	SL		
Calculate Side Water Depth	19.27	ft	5,873.49	mm	SWD		Equal to Stage Length.
Input Flocculator Equipment Type	VP	Type					For VP and VT, the flocculation st length must be less than 20-feet.
Input Flocculator Equipment Width	0.00	ft	0.00	mm	EW		
Number of Baffle Walls per Train	1	#					
Include Influent Channel?	No	Y/N					
Input Influent Channel Width	0.00	ft	0.00	mm	ICW		Valid Range: 1-3 ft.
Calculate Internal Flocculation Basin Length per Train	39.54	ft	12,051.79	mm	IBL		
Input Basin Freeboard	3.00	ft	609.60	mm	FB		Valid Range: 1-3 ft.
Calculate Basin Depth	22.27	ft	6,787.89	mm			Flocculation Basin BD should be than or equal to lamella clarifier B not, add more trains and / or more stages
Input Perimeter Operator Deck Walkway Width	4.00	ft	1,219.20	mm	WWW		Typically 4 to 8 ft.
Input Central Operator Deck Walkway Width	4.00	ft	1,219.20	mm	WWWC		Typically 8 to 12 ft.
Include Building over Basin?	No	Y/N					
Input Structure Depth of Burial	0.00	ft	0.00	mm			
Input Cutback Slope	1.00	:1					Cutback slope should be 1:1 for d of burial ≤ 5 ft, and at least 1.5:1 f depth of burial > 5 ft.
Input Over Excavation Depth	1.00	ft	0.00	mm			
For Horizontal Paddle Wheel, Input Number of Mixers per Stage	5	#			NPS		
Calculate Number of Flocculation Basin Recycle Streams	0						
Calculate Flocculator Shaft Diameter	0.00	ft	0.00	mm			
Conversion from Inches to Feet	0.00	ft	0.00	mm	FDW		
Input Paddle Width	0.00	in	0.00	mm			
Conversion from Inches to Feet	0.00	ft	0.00	mm	PW		
Calculate Paddle Length	0.00	ft	0.00	mm	PL		Valid Range: 9 to 25 ft.
Calculate Area Displaced	0.00	ft	0.00	mm	PD		
For Vertical Paddle Wheel or Vertical Turbine, Calculate Number of Mixers per Stage	1	#					
For Vertical Paddle Wheel or Vertical Turbine, Calculate Number of Mixers per Train	2	#					
For Vertical Paddle Wheel or Vertical Turbine, Calculate Total Number of Mixers per All Trains	4	#					
For Vertical Paddle Wheel or Vertical Turbine, Calculate Mixer Diameter, Each	9.00	ft	2,743.20	mm	MD		
For Vertical Paddle Wheel or Vertical Turbine, Calculate Distance Between Mixers	3.00	ft	914.40	mm	DBM		
Input Stage 1 Velocity Gradient	60.00	sec-1					
Input Stage 2 Velocity Gradient	40.00	sec-1					
Input Stage 3 Velocity Gradient	25.00	sec-1					
Input Stage 4 Velocity Gradient	0.00	sec-1					
Input Stage 5 Velocity Gradient	0.00	sec-1					
Input Stage 6 Velocity Gradient	0.00	sec-1					
Input Wire to Water Flocculation Energy Input Efficiency	75%	%					
Input min water temperature	32.00	degrees F	0.00	degrees C			Valid Range: 0 - 39 deg C
Water Viscosity	0.0000374	lb*s/sf	1.79	cP			From Lookup Table
Calculate Stage 1 Power per Mixer	2.00	hp	1.49	kW			
Calculate Stage 2 Power per Mixer	1.00	hp	0.75	kW			
Calculate Stage 3 Power per Mixer	0.00	hp	0.00	kW			
Calculate Stage 4 Power per Mixer	0.00	hp	0.00	kW			
Calculate Stage 5 Power per Mixer	0.00	hp	0.00	kW			
Calculate Stage 6 Power per Mixer	0.00	hp	0.00	kW			

	B	C	D	E	F	G	H	I
73	Electrical User Inputs and Sizing Requirements:							
74	Is this a "Critical" Facility (requiring standby power)?	No	Y/N					
75	Is there SWGR?	No						
76								MCC
77	Item	Quantity	HP per Each	AFD's Required?	MCC Spaces for Motor Starters	MCC Spaces for AFD's less than 50hp)	MCC Spaces for Breakers	Total MCC Spaces
78	Flocculation Mixers Stage 1 (total facility)	2.00	2.00	Yes	0.00	6.00	4.00	
79	Flocculation Mixers Stage 2 (total facility)	2.00	1.00	Yes	0.00	6.00	4.00	
80	Flocculation Mixers Stage 3 (total facility)	0.00	0.00	Yes	0.00	0.00	0.00	
81	Flocculation Mixers Stage 4 (total facility)	0.00	0.00	No	0.00	0.00	0.00	
82	Flocculation Mixers Stage 5 (total facility)	0.00	0.00	No	0.00	0.00	0.00	
83	Flocculation Mixers Stage 6 (total facility)	0.00	0.00	No	0.00	0.00	0.00	
84	User Defined Item #1	0.00	0.00	No	0.00	0.00	0.00	
85	User Defined Item #2	0.00	0.00	No	0.00	0.00	0.00	
86	User Defined Item #3	0.00	0.00	No	0.00	0.00	0.00	
87	TOTAL		6.00		0.00	12.00	8.00	20.00
88								
89	Electrical Equipment Widths:							
90	Equipment	Depth (ft)						
91	MCC	1.67						
92	Small AFD's	0.00						
93	Large AFD's	0.00						
94	Switchgear	0.00						
95	Maximum Depth	1.67						
96								
97	Clear Distances:							
98	Clear Distance	Width	Length	Comment				
99	CD1		3.00	Clear Distance between wall and MCC	Typically 3 feet			
100	CD2		1.00	Clear Distance between MCC and Small AFD	Typically 1 foot			
101	CD3		0.00	Clear Distance between Small AFD and Large AFD	Typically Zero			
102	CD4		0.00	Clear Distance between Large AFD and Switchgear	Typically Zero			
103	CD5		0.00	Clear Distance between Switchgear and Contingency Space	Typically Zero			
104	CD6	4.00		Clear Distance behind Switchgear (If there is				
105	CD7	3.00		Clear Distance in front of Equipment	Typically 3 feet			
106	Contingency Length		0.00	Contingency length	Typically Zero			
107								
108	Electric Room Length (ft)							
109	CD1	3.00						
110	MCC	10.00						
111	CD2	1.00						
112	Small AFD's	0.00						
113	CD3	0.00						
114	Large AFD's	0.00						
115	CD4	0.00						
116	Swithgear	0.00						
117	CD5	0.00						
118	Contingency	0.00						
119	Total Length	14.00						
120								
121	Electric Room Width (ft)							
122	CD6	0.00	If there is no switchgear, this distance will be Zero.					
123	Maximum Equipment Depth	1.67						
124	CD7	3.00						
125	Total Width	4.67						
126								
127	Estimating Dimensions (per trian):	Value English	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
128								
129	Influent Channel:							
130	Slab on Grade:							Use Wall Thickness Spreadsheet to Adjust Based on Overall Wall Height and Depth of Burial
131	Concrete Thickness	24.00	in	609.60	mm			Model based on 24"
132	Concrete Thickness	0.00	ft	0.00	mm	TICS0G		
133	SOG Length	0.00	ft	0.00	mm			
134	SOG Width	0.00	ft	0.00	mm			
135	Channel Walls:							Use Wall Thickness Spreadsheet to Adjust Based on Overall Wall Height and Depth of Burial
136	Concrete Thickness	18.00	in	457.20	mm			Model based on 18"
137	Concrete Thickness	0.00	ft	0.00	mm	TWIC		
138	Wall Length	0.00	ft	0.00	mm			
139	Wall Height	0.00	ft	0.00	mm			
140	Elevated Slab:							
141	Concrete Thickness	12.00	in	304.80	mm			Model based on 12"
142	Concrete Thickness	0.00	ft	0.00	mm			
143	Elevated Slab Length	0.00	ft	0.00	mm			
144	Elevated Slab Width	0.00	ft	0.00	mm			
145								
146	Flocculation Basin:							
147	Slab on Grade:							Use Wall Thickness Spreadsheet to Adjust Based on Overall Wall Height and Depth of Burial
148	Concrete Thickness	24.00	in	609.60	mm			Model based on 24"
149	Concrete Thickness	2.00	ft	609.60	mm	TFBSOG		
150	SOG Length	43.04	ft	13,118.59	mm			
151	SOG Width	38.50	ft	11,734.80	mm			
152	Basin Walls:							Use Wall Thickness Spreadsheet to Adjust Based on Overall Wall Height and Depth of Burial
153	Concrete Thickness	18.00	in	457.20	mm			Model based on 18"
154	Concrete Thickness	1.50	ft	457.20	mm	TWFB		

	B	C	D	E	F	G	H	I
155	Wall Length	153.12	ft	46,670.96	mm			If flocc basin shares a common wa with downstream facility, then common wall is counted with downstream facility.
156	Wall Height	22.27	ft	6,787.89	mm			
157	Baffle Walls:							
158	Concrete Thickness	12.00	in	304.80	mm			Model based on 12"
159	Concrete Thickness	1.00	ft	304.80	mm	BWTF		
160	Wall Width per Train	15.00	ft	4,572.00	mm	BWL		
161	Quantity of Over Baffle Walls per Train	0	#					
162	Quantity of Under Baffle Walls per Train	1	#					
163	Quantity of Under Baffle Walls per Train	0	#					
164	Over Baffle Wall Length per Facility	0.00	ft	0.00	mm			
165	Under Baffle Wall Length per Facility	30.00	ft	9,144.00	mm			
166	Serpentine Baffle Wall Length per Facility	0.00	ft	0.00	mm			
167	Over Baffle Wall Height	17.27	ft	5,263.89	mm			Assumes top of wall 2 ft below WS
168	Under Baffle Wall Height	21.27	ft	6,483.09	mm			Assumes bottom of wall 1 ft above basin floor.
169	Serpentine Baffle Wall Height	0.00	ft	0.00	mm			
170	Elevated Slab:							
171	Concrete Thickness	12.00	in	304.80	mm			Model based on 12"
172	Concrete Thickness	1.00	ft	304.80	mm	TESLC		
173	Center Walkway:							
174	Elevated Slab Width	4.00	ft	1,219.20	mm			
175	Elevated Slab Length per 2 Trains	31.54	ft	9,613.39	mm			
176	Elevated Slab Length per Facility	31.54	ft	9,613.39	mm			
177	Perimeter and Baffle Wall Walkway:							
178	Elevated Slab Width at Perimeter	5.50	ft	1,676.40	mm			Includes basin wall thickness.
179	Elevated Slab Length at Perimeter per Facility	132.08	ft	40,257.97	mm			
180	Elevated Slab Width at Baffle Wall	4.00	ft	1,219.20	mm			For VP and VT flocc basin mixing only.
181	Elevated Slab Length at Baffle Wall per Facility	16.50	ft	5,029.20	mm			For VP and VT flocc basin mixing only.
182								
183	Electrical Room Slab on Grade:							
184	Concrete Thickness	12.00	in	304.80	mm			Model based on 12"
185	Concrete Thickness	1.00	ft	304.80	mm			
186								
187	Overall Dimensions:							
188	Total Basin/Building Length	41.04	ft	12,508.99	mm	TBL		
189	Total Basin/Building Width	34.50	ft	10,515.60	mm	TBW		
190	SOG Length	43.04	ft	13,118.59	mm			
191	SOG Width	38.50	ft	11,734.80	mm			
192	Electrical Room Length	14.00	ft	4,267.20	mm			
193	Electrical Room Width	4.67	ft	1,422.40	mm			
194	Excavation Length	47.04	ft	14,337.79	mm			
195	Excavation Width	42.50	ft	12,954.00	mm			
196	Excavation Depth	3.00	ft	914.40	mm			
197								
198								

199	Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
200								
201	SITEWORK:							
202	Excavation	282	CY	215.77	m3	*$6.35*	$1,792	
203	Imported Structural Backfill	148	CY	113.22	m3	*$48.10*	$7,123	
204	Native Backfill	30	CY	22.82	m3	*$7.80*	$233	
205	Haul Excess	252	CY	192.95	m3	*$7.80*	$1,970	
206	Allowance for Misc Items	5%				$11,116.99	$556	
207	Subtotal						$11,673	
208								
209	CONCRETE:							
210	Influent Channel:							
211	Foundation	0	CY	0.00	m3	*$393.62*	$0	
212	Walls	0	CY	0.00	m3	*$704.01*	$0	
213	Elevated Slab	0	CY	0.00	m3	*$1,121.35*	$0	
214	Flocc Basin							
215	Foundation	123	CY	93.84	m3	*$393.62*	$48,315	
216	Basin Walls	189	CY	144.84	m3	*$704.01*	$133,369	
217	Over Baffle Wall	0	CY	0.00	m3	*$704.01*	$0	
218	Under Baffle Wall	24	CY	18.07	m3	*$704.01*	$16,638	
219	Serpentine Baffle Wall	0	CY	0.00	m3	*$704.01*	$0	
220	Elevated Slab	34	CY	26.01	m3	*$1,121.35*	$38,151	
221	Flocc Bearing Supports	0	EA			$0.00	$0	
222	Electrical Room							
223	Slab on Grade	2	CY	1.85	m3	*$356.31*	$862	
224	Allowance for Misc Items	5%				$237,334.97	$11,867	
225	Subtotal						$249,202	
226								
227	MASONRY:	Moderate						
228	CMU Building	0	SF	0.00	m2	*$156.08*	$0	
229	Electrical Room	65	SF	6.07	m2	*$156.08*	$10,197	
230	Subtotal	65					$10,197	
231								
232	METALS:							
233	Aluminum Handrail	339	LF	103.40	m	*$85.85*	$29,122	
234	Stairs (1 set per basin)	70	RISERS			*$468.25*	$32,688	
235	Allowance for Misc Items	10%				$61,810.80	$6,181	
236	Subtotal						$67,992	
237								
238	WOODS & PLASTICS:							
239	FRP Weir	30	LF	9.14	m	$39.02	$1,171	
240	FRP Ladder	4	EA			$2,259.38	$9,038	
241	Allowance for Misc Items	5%				$10,208.15	$510	
242	Subtotal						$10,719	
243								
244	THERMAL & MOISTURE PROTECTION:							
245	Concrete Liner	0	SF	0.00	m2	$16.00	$0	

	B	C	D	E	F	G	H	I
246	Allowance for Misc Items	10%				$0.00	$0	
247	Subtotal						$0	
248								
249	DOORS & WINDOWS							
250	Stainless Steel Door (2' x 2') for O/U Baffling	0	EA			$1,248.67	$0	
251	Stainless Steel Door (7' x 2.5') for O/U Baffling	2	EA			$5,462.91	$10,926	
252	Stainless Steel Door (2' x 2') for Serpentine Baffling	0	EA			$1,248.67	$0	
253	Allowance for Misc Items	5%				$10,925.83	$546	
254	Subtotal						$11,472	
255								
256	EQUIPMENT:							Budgetary Quote: (CPES will automatically add Installation Factor)
257	Horizontal Paddle Wheel Flocculation Mechanism (Paddles & Drives)	0	LF	0.00	m	*$0.00*	$0	
258	Vertical Paddle Wheel Flocculation Mechanism (Paddles & Drives)	4	EA			*$33,159.54*	$132,638	
259	Vertical Turbine Flocculation Mechanism (Turbines & Drives)	0	hp	0.00	kW	*$0.00*	$0	
260	Vertical Turbine Flocculator VFD's	0	hp	0.00	kW	*$0.00*	$0	
261	Fabricated Slide Gate	2	EA			*$7,208.60*	$14,417	
262	Allowance for Misc Items	10%				$147,055.34	$14,706	
263	Subtotal						$161,761	
264								
265	ELECTRICAL:							
266	*MCC's*							
267	Sections	6	EA			*$8,044.96*	$48,270	
268	*AFD's*							
269	Flocculation Mixers Stage 1 (total facility) (2 hp each)	2	EA			*$8,554.42*	$17,109	
270	Flocculation Mixers Stage 2 (total facility) (1 hp each)	2	EA			*$8,431.52*	$16,863	
271	Flocculation Mixers Stage 3 (total facility) (0 hp each)	0	EA			*$8,308.63*	$0	
272	Flocculation Mixers Stage 4 (total facility) (0 hp each)	0	EA			*$8,308.63*	$0	
273	Flocculation Mixers Stage 5 (total facility) (0 hp each)	0	EA			*$8,308.63*	$0	
274	Flocculation Mixers Stage 6 (total facility) (0 hp each)	0	EA			*$8,308.63*	$0	
275	*Switchgear*							
276	Units	0	EA			*$37,006.81*	$0	
277	Electrical Conduit & Wire	308	LF	93.88	m	*$11.30*	$3,481	
278	Allowance for Misc Items	10%				$85,722.47	$8,572	
279	Subtotal						$94,295	
280								
281	INSTRUMENTS & CONTROLS:							
282	Instruments							
283	Level Switch	2	EA			*$651.76*	$1,304	
284	Number of Analog I/O Counts	10	EA			*$247.67*	$2,378	
285	Number of Digital I/O Counts	24	EA			*$58.66*	$1,408	
286	Number of PLC's	1	EA			*$12,253.00*	$12,253	
287	I&C Conduit & Wire	414	LF	126.19	m	*$11.30*	$4,679	
288	Allowance for Misc Items	10%				$22,020.71	$2,202	
289	Subtotal						$24,223	
290								
291	USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST	
292	Item 1 Description	0.00		0.00		0.00	$0	
293	Item 2 Description	0.00		0.00		0.00	$0	
294	Item 3 Description	0.00		0.00		0.00	$0	
295	Item 4 Description	0.00		0.00		0.00	$0	
296	Item 5 Description	0.00		0.00		0.00	$0	
297	Item 6 Description	0.00		0.00		0.00	$0	
298	Item 7 Description	0.00		0.00		0.00	$0	
299	Item 8 Description	0.00		0.00		0.00	$0	
300	Item 9 Description	0.00		0.00		0.00	$0	
301	Item 10 Description	0.00		0.00		0.00	$0	
302	Item 11 Description	0.00		0.00		0.00	$0	
303	Item 12 Description	0.00		0.00		0.00	$0	
304	Item 13 Description	0.00		0.00		0.00	$0	
305	Item 14 Description	0.00		0.00		0.00	$0	
306	Item 15 Description	0.00		0.00		0.00	$0	
307	Subtotal						$0	
308								
309	Subtotal						$641,533	
310								
311	ALLOWANCES:		User Override					
312	Finishes Allowance	2.00%		$697,318	$13,946			
313	I&C Allowance	2.00%		$697,318	$13,946			
314	Mechanical Allowance	2.00%		$697,318	$13,946			
315	Electrical Allowance	2.00%		$697,318	$13,946			
316						Facility Cost Name		
317	Facility Cost	12,000,000	GPD	$0.06	$697,318	FCPFC01		
318	Facility Cost with Standard Additional Project Costs Added	12,000,000	GPD	$0.06	$697,318	FCPFC02		
319	Facility Cost with Standard Additional Project Costs and Contractor Markups Added	12,000,000	GPD	$0.09	$1,037,983	FCPFC03		
320	Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	12,000,000	GPD	$0.08	$1,018,289	FCPFC05		
321	Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	12,000,000	GPD	$0.08	$1,018,289	FCPFC06		

Clarifier

	B	C	D	E	F	G	H	I
1	**Lamella Clarifier**							
2								
3								
4	Assumptions:							
5								
6	Based on Denver Water Reuse Project							
7	2 Basins @ 15 MGD each							
8	*If this is a Seawater Desalination Application, the materials in contact with seawater need to be corrosion resistant.*							
9								
10								
11	**Process User Inputs**	**Value (English)**	**Unit (English)**	**Value (Metric)**	**Unit (Metric)**	**Name**	**Red Flags**	**Comment**
12	Is this a Seawater Desalination Application?	No	Y/N					
13	Has the USER Contacted Equipment Suppliers to Obtain Equipment Quotes?	No	Y/N					Fixed
14	Total Plant Flow	12.00	mgd	45.42	ML/d			
15	Conversion of Total Plant Flow	8,333.28	gpm	525.75	L/s			
16	Input Number of Active Trains	2	#					
17	Input Number of Standby Trains	0	#					Typically 0
18	Calculate Total Number of Trains	2	#			NT		
19	Total Plate Length	9.75	ft	2,971.80	mm	TPL		MRI = 9.75 ft
20	Wet Plate Length	9.75	ft	2,971.80	mm			MRI = 9.75 ft
21	Plate Width	5.04	ft	1,536.80	mm	PW		MRI = 5.042 ft
22	Plate Angle	55.00	degrees					Fixed
23	Conversion of Plate Angle	0.96	radians			PAR		
24	Effective Plate Area	95.00%	%					Parkson GEWE or MRI = 95%
25	Calculate Projected Effective Plate Area	26.79	sf	2.49	m2			
26	Projected Plate Hydraulic Loading Rate	0.30	gpm/sf	0.75	m/h			Valid Range < = 0.40 gpm/sf
27	Calculate Number of Plates per Train	518.49	#					
28	Perpendicular Plate Spacing	2.44	in	61.98	mm			Typically 2.44 in
29	Conversion of Plate Spacing	0.20	ft	61.98	mm	PSF		
30	Plate Thickness	0.70	mm	0.70	mm	PT		Fixed
31	Conversion of Plate Thickness	0.00	ft	0.70	mm			
32	Number of Plates per Row	160	#			PPR		Valid Range 0 - 200
33	Plate Effluent Channel Width	1.50	ft	457.20	mm	EFW		Fixed
34	Conversion of Total Plant Flow	18.57	cfs	0.53	m3/s			
35	Calculate Plant Flow per Train	9.28	cfs	0.26	m3/s			
36	Calculate Plant Flow per Row	2.32	cfs	0.07	m3/s			
37	Calculate Velocity per Row	0.13	fps	0.04	m/s			Should be ≤ 0.2 fps. If not, reduce Number of Plates per Row (#P/R)
38	Additional Length for Sludge Removal Mechanism and Stable Inflow (varies by manufacturer, MRI typically adds 15 feet)	15.00	ft	1,536.80	mm			MRI = 15 ft
39	Calculate Internal Basin Length	60.68	ft	18,493.95	mm	PRL	Warning! Basin length greater than recommended maximum of 40 ft.	Must be less than 40 ft to allow cl span of plate system without intermediate supports that compl structural design and sludge colle integration
40	Calculate No. of Rows per Train	4	#			PRT		
41	No. of Effluent Channels)	4	#					
42	Input Perimeter Operator Deck Walkway Width	4.00	ft	1,219.20	mm	WWW		Typically 4 to 8 ft.
43	Input Central Operator Deck Walkway Width	4.00	ft	1,219.20	mm			Typically 8 to 12 ft.
44	Sludge Collector Removal Opening Width	4.00	ft	1,219.20	mm	OW		Typically 4 to 6 ft.
45	Plate Removal Opening Width	1.00	ft	304.80	mm	POW		Typically 0.5 to 1 ft.
46	Calculate Internal Basin Width	41.17	ft	12,548.01	mm	IBW		Should be ≤ 120 ft. If not, add mo Trains and / or add more Plates p Row
47	Minimum Clearance Beneath Plate System	5.00	ft	1,828.80	mm	MCB		Valid range 3-10 ft.
48	Freeboard	2.00	ft	609.60	mm	FB		
49	Calculate Basin Depth	16.99	ft	5,177.56	mm			
50	Input Structure Depth of Burial	0.00	ft		mm			
51	Select # of Sludge Collectors per Train	2	#					Sludge collector flow = 250 gpm.
52	Sludge Collector Curb Width	12.00	in	304.80	mm			Fixed
53	Conversion of Sludge Collector Curb Width	1.00	ft	304.80	mm			
54	Sludge Collector Distance from Wall or Curb	12.00	in	304.80	mm			Fixed
55	Conversion of Sludge Collector Distance from Wall or Curb	1.00	ft	304.80	mm			
56	Calculate Sludge Collector Width	27.84	ft	8,484.98	mm			Acceptable range of values is 8-3
57	Include Influent Channel?	Yes	Y/N					
58	Combined Influent Channel Width	3.00	ft	914.40	mm	CICW		
59	Include Effluent Channel?	Yes	Y/N					
60	Combined Effluent Channel Width	3.00	ft	914.40	mm	CEWW		Valid range ≥ 3 ft.
61	Include Building over Basin?	No	Y/N					
62	Input Cutback Slope	1.00	:1					Cutback slope should be 1:1 for d of burial ≤ 5 ft, and at least 1.5:1 f depth of burial > 5 ft.
63	Input Over Excavation Depth	1.00	ft	0.00	mm			
64	**Mechanical Sizing Requirements:**							
65	**Pipe Name**	**Input Velocity**	**Unit (English)**	**Input Velocity**	**Unit (Metric)**	**Standard Pipe Size**	**Unit (English)**	**Nominal Pipe Size**
66	Solids Collection Pipe	6.00	fps	1.83	m/s	4.00	in	100.00
67								
68	**Mechanical Material Requirements:**							
69	**Pipe Name**	**Pipe ID**	**Installation Type**	**Pipe Material**	**Pipe Lining Material**	**Pipe Coating Material**	**Pipe Diameter**	**Pipe Length**
70	Solids Collection Pipe	USL	Immersed	Steel	None	None	4.00	407.37
71								
72	**Electrical User Inputs and Sizing Requirements:**							
73	24.) Is this a "Critical" Facility (requiring standby power)?	No	Y/N					
74	25.) Is there SWGR?	No						
75								MCC
76	**Item**	**Quantity**	**HP per Each**	**AFD's Required?**	**MCC Spaces for Motor Starters**	**MCC Spaces for AFD's less than 50hp**	**MCC Spaces for Breakers**	**Total MCC Spaces**
77	Sludge Collectors (total facility)	4.00	1.00	No	8.00	0.00	0.00	
78	User Defined Item #1	0.00	0.00	No	0.00	0.00	0.00	
79	User Defined Item #2	0.00	0.00	No	0.00	0.00	0.00	

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80	User Defined Item #3	0.00	0.00	No	0.00	0.00	0.00	
81	TOTAL		4.00		8.00	0.00	0.00	8.00
82								
83	Electrical Equipment Widths:							
84	Equipment	Depth (ft)						
85	MCC	1.67						
86	Small AFD's	0.00						
87	Large AFD's	0.00						
88	Switchgear	0.00						
89	Maximum Depth	1.67						
90								
91	Clear Distances:							
92	Clear Distance	Width	Length	Comment				
93	CD1		3.00	Clear Distance between wall and MCC	Typically 3 feet			
94	CD2		1.00	Clear Distance between MCC and Small AFD	Typically 1 foot			
95	CD3		0.00	Clear Distance between Small AFD and Large AFD	Typically Zero			
96	CD4		0.00	Clear Distance between Large AFD and Switchgear	Typically Zero			
97	CD5		0.00	Clear Distance between Switchgear and Contingency Space	Typically Zero			
98	CD6	4.00		Clear Distance behind Switchgear (If there is				
99	CD7	3.00		Clear Distance in front of Equipment	Tyipcally 3 feet			
100	Contingency Length		0.00	Contingency length	Typically Zero			
101								
102	Electric Room Length (ft):							
103	CD1	3.00						
104	MCC	8.33						
105	CD2	1.00						
106	Small AFD's	0.00						
107	CD3	0.00						
108	Large AFD's	0.00						
109	CD4	0.00						
110	Swithgear	0.00						
111	CD5	0.00						
112	Contingency	0.00						
113	Total Length	12.33						
114								
115	Electric Room Width (ft):							
116	CD6	0.00	If there is no switchgear, this distance will be Zero					
117	Maximum Equipment Depth	1.67						
118	CD7	3.00						
119	Total Width	4.67						
120								
121	**Estimating Dimensions (per train):**	**Value English**	**Unit (English)**	**Value (Metric)**	**Unit (Metric)**	**Name**	**Red Flags**	**Comment**
122								
123	Influent Channel:							
124	Slab on Grade:							Model based on 24"
125	Concrete Thickness	24.00	in	584.20	mm			
126	Concrete Thickness	2.00	ft	609.60	mm	TSOGIC		
127	SOG Length	6.50	ft	1,981.20	mm			
128	SOG Width	90.84	ft	27,686.81	mm			
129	Walls:							Model based on 18"
130	Concrete Thickness	18.00	in	457.20	mm			
131	Concrete Thickness	1.50	ft	457.20	mm	TWIC		
132	Wall Length	179.67	ft	54,764.03	mm			
133	Wall Height	16.99	ft	5,177.56	mm			
134	Elevated Slab:							Model based on 12"
135	Concrete Thickness	12.00	in	304.80	mm			
136	Concrete Thickness	1.00	ft	304.80	mm	TESIC		
137	Elevated Slab Length	6.00	ft	1,828.80	mm			
138	Elevated Slab Width	86.84	ft	26,467.61	mm			
139								
140	Lamella Clarifier Basin:							
141	Slab on Grade:							Model based on 24"
142	Concrete Thickness	24.00	in	304.80	mm			
143	Concrete Thickness	2.00	ft	609.60	mm	TSOGLC		
144	SOG Length	67.68	ft	20,627.55	mm			
145	SOG Width	90.84	ft	27,686.81	mm			
146	Walls:							Model based on 18"
147	Concrete Thickness	18.00	in	457.20	mm			
148	Concrete Thickness	1.50	ft	457.20	mm	TWLC		
149	Wall Length	200.03	ft	60,968.26	mm			
150	Wall Height	16.99	ft	5,177.56	mm			
151	Elevated Slab:							Model based on 12"
152	Concrete Thickness	12.00	in	304.80	mm			
153	Concrete Thickness	1.00	ft	304.80	mm	TESLC		
154	Elevated Slab Width	4.00	ft	1,219.20	mm			
155	Center Walkway:							
156	Elevated Slab Width	4.00	ft	1,219.20	mm	WWWC		
157	Elevated Slab Length per 2 Trains	60.68	ft	18,493.95	mm			
158	Elevated Slab Length per Facility	60.68	ft	18,493.95	mm			
159	Perimeter Walkway:							Includes basin wall thickness
160	Elevated Slab Width	5.50	ft	1,676.40	mm			
161	Elevated Slab Length per Facility	121.35	ft	36,987.90	mm			
162								
163	Effluent Channel:							
164	Slab on Grade:							Model based on 24"
165	Concrete Thickness	24.00	in	609.60	mm			
166	Concrete Thickness	2.00	ft	609.60	mm	TSOGEC		
167	SOG Length	6.50	ft	1,981.20	mm			
168	SOG Width	90.84	ft	27,686.81	mm			
169	Walls:							Model based on 18"
170	Concrete Thickness	18.00	in	457.20	mm			

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171	Concrete Thickness	1.50	ft	457.20	mm	TWEC		
172	Wall Length	173.67	ft	52,935.23	mm			
173	Wall Height	16.99	ft	5,177.56	mm			
174	Elevated Slab:							
175	Concrete Thickness	12.00	in	304.80	mm			Model based on 12"
176	Concrete Thickness	1.00	ft	304.80	mm	TESEC		
177	Elevated Slab Length	6.00	ft	1,828.80	mm			
178	Elevated Slab Width	86.84	ft	26,467.61	mm			
179								
180	Electrical Room Slab on Grade:							
181	Concrete Thickness	12.00	in	304.80	mm			Model based on 12"
182	Concrete Thickness	1.00	ft	304.80	mm			
183								
184	Overall Dimensions:							
185	Total Basin/Building Length	72.68	ft	22,151.55	mm	LTB		
186	Total Basin/Building Width	86.84	ft	26,467.61	mm	WTB		
187	SOG Length	76.68	ft	23,370.75	mm			
188	SOG Width	90.84	ft	27,686.81	mm			
189	Electrical Room Length	12.33	ft	3,759.20	mm			
190	Electrical Room Width	4.67	ft	1,422.40	mm			
191	Excavation Length	80.68	ft	24,589.95	mm			
192	Excavation Width	94.84	ft	28,906.01	mm			
193	Excavation Depth	4.00	ft	1,219.20	mm			
194								
195								
196	**Description**	**Quantity (English)**	**Unit (English)**	**Quantity (Metric)**	**Unit (Metric)**	**$/Unit**	**Total Cost**	**User Over-Write**
197								
198	SITEWORK:							
199	Excavation	2,772	CY	2,119.32	m3	*$8.35*	$17,596	
200	Imported Structural Backfill	1,133	CY	866.60	m3	*$48.10*	$54,520	
201	Native Backfill	208	CY	159.04	m3	*$7.80*	$1,623	
202	Haul Excess	2,564	CY	1,960.28	m3	*$7.80*	$20,009	
203	Allowance for Misc Items	5%				$93,748.87	$4,687	
204	Subtotal						$98,436	
205								
206	CONCRETE:							
207	Influent Channel:							
208	Foundation	44	CY	33.44	m3	*$393.62*	$17,216	
209	Channel Walls	170	CY	129.64	m3	*$704.01*	$119,370	
210	Elevated Slab	19	CY	14.75	m3	*$1,121.35*	$21,639	
211	Basin							
212	Foundation	455	CY	348.15	m3	*$393.62*	$179,242	
213	Channel Walls	189	CY	144.32	m3	*$704.01*	$132,893	
214	Elevated Slab	34	CY	25.77	m3	*$1,121.35*	$37,799	
215	Concrete Curb (8" X 8")	82	LF	25.10	m	*$39.02*	$3,213	
216	Effluent Channel:							
217	Foundation	44	CY	33.44	m3	*$393.62*	$17,216	
218	Walls	164	CY	125.31	m3	*$704.01*	$115,383	
219	Elevated Slab	19	CY	14.75	m3	*$1,121.35*	$21,639	
220	Electrical Room							
221	Slab on Grade	2	CY	1.63	m3	*$356.31*	$760	
222	Allowance for Misc Items	5%				$666,367.42	$33,318	
223	Subtotal						$699,686	
224								
225	MASONRY:	Moderate						
226	CMU Building	0	SF	0.00	m2	*$156.08*	$0	
227	Electrical Room	58	SF	5.35	m2	*$156.08*	$8,983	
228	Subtotal	58					$8,983	
229								
230	METALS:							
231	Aluminum Handrail	699	LF	213.18	m	*$85.85*	$60,040	
232	Allowance for Misc Items	10%				$60,040.38	$6,004	
233	Subtotal						$66,044	
234								
235	WOODS & PLASTICS:							
236	FRP Ladder	4	EA			*$1,723.37*	$6,893	
237	Allowance for Misc Items	5%				$6,893.49	$345	
238	Subtotal						$7,238	
239								
240	THERMAL & MOISTURE PROTECTION:							
241	Concrete Liner	0	SF	0.00	m2	$16.00	$0	
242	Allowance for Misc Items	10%				$0.00	$0	
243	Subtotal						$0	
244								
245	EQUIPMENT							Budgetary Quote: (CPES wi automatically add Installatio Factor)
246	Lamella Clarifier	29,240	SF	2,716.45	m2	*$23.07*	$674,484	
247	Fabricated Slide Gate	2	EA			*$7,208.60*	$14,417	
248	Hoseless Sludge Collector	4	EA			*$79,294.55*	$317,178	
249	Allowance for Misc Items	10%				$1,006,079.50	$100,608	
250	Subtotal						$1,106,687	
251								
252	INSTRUMENTS & CONTROLS:							
253	Instruments							
254	Turbidimeters	4	EA			*$3,715.89*	$14,864	
255	Number of Analog I/O Counts	5	EA			*$247.67*	$1,189	
256	Number of Digital I/O Counts	24	EA			*$58.66*	$1,408	
257	Number of PLC's	1	EA			*$12,253.00*	$12,253	
258	I&C Conduit & Wire	695	LF	211.74	m	*$11.30*	$7,851	
259	Allowance for Misc Items	10%				$37,564.14	$3,756	
260	Subtotal						$41,321	
261								
262	MECHANICAL:							
263	Solids Collection Pipe (4-inch, USL , Immersed , Steel)	407	LF	124.17	m	*$78.46*	$31,961	
264	Solids Collection Pipe Elbows	16	EA			*$521.82*	$8,349	
265	Mud Valves	4	EA			*$2,341.25*	$9,365	
266	Allowance for Misc Items	10%				$49,675.02	$4,968	
267	Subtotal						$54,643	
268								
269	ELECTRICAL:							
270	MCC's							
271	Sections	5	EA			*$8,044.96*	$40,225	
272	AFD's							
273	Sludge Collectors (total facility) (1 hp each)	0	EA			*$8,431.52*	$0	
274	Switchgear							
275	Units	0	EA			*$37,006.81*	$0	

	B	C	D	E	F	G	H	I
196	**Description**	**Quantity (English)**	**Unit (English)**	**Quantity (Metric)**	**Unit (Metric)**	**$/Unit**	**Total Cost**	**User Over-Write**
276	Electrical Conduit & Wire	347	LF	105.87	m	311.70	$3,925	
277	Allowance for Misc Items	10%				$44,150.28	$4,415	
278	Subtotal						$48,565	
279								
280	USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST	
281	Item 1 Description	0.00		0.00		0.00	$0	
282	Item 2 Description	0.00		0.00		0.00	$0	
283	Item 3 Description	0.00		0.00		0.00	$0	
284	Item 4 Description	0.00		0.00		0.00	$0	
285	Item 5 Description	0.00		0.00		0.00	$0	
286	Item 6 Description	0.00		0.00		0.00	$0	
287	Item 7 Description	0.00		0.00		0.00	$0	
288	Item 8 Description	0.00		0.00		0.00	$0	
289	Item 9 Description	0.00		0.00		0.00	$0	
290	Item 10 Description	0.00		0.00		0.00	$0	
291	Item 11 Description	0.00		0.00		0.00	$0	
292	Item 12 Description	0.00		0.00		0.00	$0	
293	Item 13 Description	0.00		0.00		0.00	$0	
294	Item 14 Description	0.00		0.00		0.00	$0	
295	Item 15 Description	0.00		0.00		0.00	$0	
296	Subtotal						$0	
297								
298	Subtotal						$2,131,604	
299								
300	ALLOWANCES:		User Override					
301	Finishes Allowance	2.00%		$2,316,961	$46,339			
302	I&C Allowance	2.00%		$2,316,961	$46,339			
303	Mechanical Allowance	2.00%		$2,316,961	$46,339	Includes Drain, USL, SA (Sample) piping		
304	Electrical Allowance	2.00%		$2,316,961	$46,339			
305						Facility Cost Name		
306	Facility Cost	12,000,000	GPD	$0.19	$2,316,961	CLCFC01		
307	Facility Cost with Standard Additional Project Costs Added	12,000,000	GPD	$0.19	$2,316,961	CLCFC02		
308	Facility Cost with Standard Additional Project Costs and Contractor Markups Added	12,000,000	GPD	$0.29	$3,448,877	CLCFC03		
309	Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	12,000,000	GPD	$0.28	$3,383,440	CLCFC05		
310	Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	12,000,000	GPD	$0.28	$3,383,440	CLCFC06		

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	B	C	D	E	F	G	H	I
1	***Brackish Water Reverse Osmosis with Turbocharger***							
2	PROCESS DESIGN CRITERIA							
3								
4								
5								
6	**BRACKISH WATER REVERSE OSMOSIS SYSTEM**							
7	Assumes the use of either a turbocharger or no energy recovery device. Assumes vessels are connected via multiports to Subtrain Headers. Assumes 8", 16" or 18" membrane elements							
8	**Process User Inputs:**	**Value (English)**	**Unit (English)**	**Value (Metric)**	**Unit (Metric)**	**Name**	**Comment**	**Red Flags**
9	BRACKISH WATER RO TRAIN							
10	Input Desired Membrane System Permeate Capacity	8.00	mgd	34.67	ML/d			
11	Input Number of Active Membrane Trains	8.00	#					
12	Input Number of Standby Membrane Trains	1.00	#				Typically 1	
13	Calculate Total Number of Membrane Trains	9.00	#					
14	Calculate RO/NF Train Permeate Capacity (each)	1.00	mgd				Maximum allowable train sizes for BWRO are 5.0 mgd for 8" membrane elements and 12.5 mgd for large diameter elements. Assume train size of 10 mgd for large diameter reuse applications	OKAY
15	Input Number of Rows of Membrane Skids	1.00	#					
16	Calculate Number of Membrane Skids per Row	9.00	#					
17	Calculate Number of Rows Full with Membrane Skids	1.00	#					
18	Calculate Number of Available Spaces for Future Membrane Skids	0.00	#					
19	Calculate Number of Active High Pressure Membrane Feed Pumps	8.00	#				Equals the number of active membrane trains	
20	Calculate Number of Standby High Pressure Membrane Feed Pumps	1.00	#				Equals the number of standby membrane trains	
21	Calculate Total Number of High Pressure Membrane Feed Pumps	9.00	#					
22	Input Type of Energy Recovery Device Used?	Interstage Booster Pump	Type					
23	Input Number of Stages per Train	2.00	#				Typically 2-stages for brackish groundwater (or up to 85% recovery with 7 elements/pressure vessels); and 3-stage for surface water or wastewater tertiary effluent (or up to 90% recovery with 8 elements/pressure vessel)	
24	Input RO/NF Train Average "Target" Membrane Flux Rate	15.00	gfd	25.47	Lmh		Typically 10 gfd for tertiary effluent, 12 gfd for surface water, 15 gfd for groundwater. Verify with membrane principal technologist	
25	Calculated RO/NF Average Train Flux	13.16	gfd					
26	Input Diameter of Membrane Element (each)	18.00	in	457.20	mm		8", 16" and 18" elements available	Adjust for large diameter
27	Input Length of Membrane Element (each)	61.00	in	1,548.40	mm		40", 60" and 61" available	Adjust for large diameter
28	Input Membrane Element Area (each)	2,850.00	sf	264.77	m2		Assume 400 sf for 8" x 40" element; Assume 1,600 sf for 16" x 40" element; Assume 2,850 sf for 18" x 61" element. Verify with membrane principal technologist	Information for commonly used membranes is provided in Cells C28:V38
29	Input Number of 40"-long Membrane Elements per Pressure Vessel	8.00	#				For 8" and 16" elements: Commonly 6, 7 or 8. Typically, 6 elements/PV for 2-stage and recovery of 65-75%. 7 elements/PV for 2-stage and recovery of 75-85%. Typically 6 elements/PV for 3-stage and recovery 75-90% For 18" elements: Typically use 4 or 5	Adjust for large diameter
30	Input RO/NF Train Permeate Water Recovery (Permeate/Feed Flow Ratio)	78.00%	%				Typically 75% to 85% for all applications, but varies due to scaling potential of feed water. Verify with membrane principal technologist, pilot testing, and/or similar experience	
31	Calculate Membrane Train Feed Rate (each)	1666.67	gpm	105.15	L/s			
32	Calculate Membrane Train Permeate Rate (each)	1250.00	gpm	78.86	L/s			
33	Calculate Membrane Train Concentrate Rate (each)	416.67	gpm	26.29	L/s			
34	Input Membrane Element Life	5.00	years				Typically 5 yrs for composite membranes	
35	Input RO/NF Train Feed Pressure Required at End of Membrane Life	300.00	psi	1,378.96	kPa		For NF and TDS<750, typically 125 psi. For RO, typically 150 to 300 psi for TDS < 2,000 mg/L, 300 to 400 psi for 2,000 mg/L < TDS < 10,000 mg/L. Verify with RO/NF vendor performance projection models. Include affect of permeate pressure.	
36	Input Minimum Feed Pump Suction Pressure	15.00	psi	103.42	kPa		Commonly 15-30 psi	
37	Input Average Pressure as a Percentage of Pressure at End of Membrane Life	70.00%	%				Verify with membrane principal technologist. Used to determine average electrical consumption over life-cycle of facility	
38	Calculate Average Feed Pressure over Life Cycle of Facility	199.50	psi	1375.50	kPa			
39	Input Number of Chemical Cleanings per Year	2.00	#				Typically 2 cleanings per year for groundwater, 4 per year for surface water and 6 per year for tertiary effluent.	
40	Is a Spent Cleaning Chemical Neutralization System Included?	No	Y/N					
41								
42	Process Cartridge Filters							
43	Are Cartridge Filters Used as Part of Membrane Pre-treatment?	No	Y/N					
44	Type of Cartridge Filter being Utilized	Horizontal					Fixed at Horizontal	
45	Input Number of Filter Cartridge Replacements per Year	6.00	#				Typically 6-12 per year	
46	Input Cartridge Filter Manufacturer	Parker	Type					
47	Input Model Number for Cartridge Filter (Fil-Trek)	GLH44-189-4-14	Model				Based on Fil-Trek Horizontal Cartridge Filters	
48	Input Cartridge Filter Vessel Material of Construction	SST316	Type				Based on information from Fil-Trek	ONLY SST316L Available
49	Input Model Number for Cartridge Filter (Parker)	MP176H-4-14-FK1	Model				Based on Parker Horizontal Cartridge Filters	
50	Input Average Loading Rate for Cartridge Filters, All Filters in Operation (flow per 10-inch cartridge)	4.00	gpm	0.25	L/s		Ranges from 3-5 gpm per 10-inch cartridge. Default is 4.0 gpm per 10-inch cartridge with all filters in operation	
51	Input Maximum Loading Rate for Cartridge Filters, with One Filter Out of Service (flow per 10-inch cartridge)	5.00	gpm	0.32	L/s		Default is 5.0 gpm per 10-inch cartridge with standby filters out of service	
52	Calculate Number of Filter Elements per Housing	176.00	#				Default is Fil-Trek horizontal cartridge filters. 189 filter elements for Fil-Trek horizontal cartridge filters. Parker horizontal cartridge filters has 231 filter elements per housing	
53	Calculate Length of Filter Elements	40.00	in	1016.00	mm			
54	Calculate Total Number of Filter Cartridges	0.00	#					
55	Calculate Total Number of Filter Cartridges Replacements per Year	0.00	#					
56	Calculate Cartridge Filtration Housing Width (each)	3.51	ft	1068.40	mm	CFW	Based on information from Fil-Trek	
57	Calculate Cartridge Filtration Housing Length (each)	6.23	ft	1898.65	mm	CFL	Based on Parker Horizontal Cartridge Filters	
58	Input Number of Standby Cartridge Filter Housings	1.00	#				Typically 1	
59	Calculate Total Number of Horizontal Cartridge Filtration Housings	0.00	#					
60	Input Number of Rows of Cartridge Filter Housings	2.00	#				Typically 1	
61	Calculate Number of Cartridge Filter Housings per Row	0.00	#					
62	Cartridge Filters Area Requirements							
63	Input Clear Distance between Cartridge Filters and Membrane Trains Pipe Trench	2.00	ft	609.60	mm	D1A		
64	Calculate Clear Distance between Cartridge Filters	0.00	ft	0.00	mm	D1B		
65	Calculate Cartridge Filter Housing Height	0.00	ft	0.00	mm	CFH		
66	Are Cartridge Filter Housing Inlet/Outlet on the Same Trench?	Yes	Y/N				Typically Yes	
67								
68	Bypass Blend Pipeline							
69	Is Bypass Blend to be Included?	Yes	Y/N					
70	Input Bypass Blend Flow	3.00	mgd	11.36	ML/d			
71	Are Cartridge Filters Used?	No	Y/N					
72	Type of Cartridge Filter being Utilized	Horizontal					Fixed at Horizontal	
73	Input Number of Filter Cartridge Replacements per Year	6.00	#				Typically 6-12 per year	
74	Input Cartridge Filter Manufacturer	Parker	Type					
75	Input Model Number for Cartridge Filter (Fil-Trek)	GLH44-189-4-14	Model				Based on Fil-Trek Horizontal Cartridge Filters	
76	Input Cartridge Filter Vessel Material of Construction	SST316	Type				Based on information from Fil-Trek	ONLY SST316L Available
77	Input Model Number for Cartridge Filter (Parker)	MP8SH-4-18FK1	Model				Based on Parker Horizontal Cartridge Filters	
78	Input Average Loading Rate for Cartridge Filters, All Filters in Operation (flow per 10-inch cartridge)	3.00	gpm	0.19	L/s		Ranges from 3-5 gpm per 10-inch cartridge. Default is 4.0 gpm per 10-inch cartridge with all filters in operation	

	B	C	D	E	F	G	H	I
79	**Input Maximum Loading Rate for Cartridge Filters, with One Filter Out of Service (flow per 10-inch cartridge)**	5.00	gpm	0.32	L/s		Default is 5.0 gpm per 10-inch cartridge with standby filters out of service	
80	Calculate Number of Filter Elements per Housing	58.00	#				Default is Fil-Trek horizontal cartridge filters. 189 filter elements for Fil-Trek horizontal cartridge filters. Parker horizontal cartridge filters has 231 filter elements per housing	
81	Calculate Length of Filter Elements	40.00	in	1016.00	mm			
82	Calculate Total Number of Filter Cartridges	0.00	#					
83	Calculate Total Number of Filter Cartridges Replacements per Year	0.00	#					
84	Calculate Cartridge Filtration Housing Width (each)	2.51	ft	763.80	mm	CFW	Based on information from Fil-Trek	
85	Calculate Cartridge Filtration Housing Length (each)	5.69	ft	1733.55	mm	CFL	Based on Parker Horizontal Cartridge Filters	
86	**Input Number of Standby Cartridge Filter Housings**	0.00	#				Typically 0	
87	Calculate Total Number of Horizontal Cartridge Filtration Housings	0.00	#					
88								
89	**Static Mixer**							
90	**Is Static Mixer Used for Blending of Pre-treatment Chemicals?**	No	Y/N				1 per Row of RO Skids	
91	Calculate Total Number of Inline Static Mixers	0.00	#				Based on Komax and Kenics motionless mixers	
92	**Input Static Mixer Manufacturer**	Komax	Type					
93	Calculate Maximum Water Flow per Inline Static Mixer	#DIV/0!	mgd					
94	Calculate Static Mixer Length	0.00	ft	0.00	mm	SML	Provided by Equipment Vendor	
95	Calculate Static Mixer Diameter	0.00	in	0.00	mm		Provided by Equipment Vendor	
96	**Input Clear Distance between Cartridge Filters and Static Mixer and between Static Mixer and Membrane Trains**	10.00	ft	2,438.40	mm	DS	Typically 2 to 3 pipe diameters	N/A
97								
98	**Membrane Trains**							
99	Calculate Total Number of Active Membrane Trains	5.00	#					
100	Calculate RO Membrane Area per Train	120000.00	sf	11148.38	m2			
101	Calculate Initial Estimate of Number of Pressure Vessels per Train	5.26	#					
102	Calculate Initial Estimate of Number of Stage 1 Pressure Vessels	3.51	#					
103	Calculate Number of Stage 1 Pressure Vessels per Train	4.00	#					
104	Calculate Number of Stage 2 Pressure Vessels per Train	2.00	#					
105	Calculate Number of Stage 3 Pressure Vessels per Train	0.00	#					
106	Calculate Total Number of Pressure Vessels per Train	6.00	#					
107	Calculate Number of Stage 1 Membrane Elements per Train	32.00	#					
108	Calculate Number of Stage 2 Membrane Elements per Train	16.00	#					
109	Calculate Number of Stage 3 Membrane Elements per Train	0.00	#					
110	Calculate Total Number of Membrane Elements per Train	48.00	#					
111	Calculate Number of Membrane Elements in Active Trains	240.00	#					
112	Calculate Total Number of Membrane Elements in All Trains	288.00	#					
113	**Input Number of Pressure Vessels Stacked in Vertical Position per Train**	6.00	#			PVV	For 8" membrane elements: Typically 6 or less for access to membranes, but will allow up to 12 For 16" membrane elements: Typically up to 7 For 18" membrane elements: Typically up to 6	
114	**Input Number of Pressure Vessels Stacked in Horizontal Position per Subtrain**	4.00	#			PVHS	Typically 6 for 8" membrane elements and 4 for 16" or 18" membrane elements	OKAY
115	Calculate Total Number of Subtrains Needed	0.25	#			NS		
116	Calculate Number of Subtrains Needed for 1st Stage Vessels	0.17	#			NS1		OKAY
117	Calculate Number of Subtrains Needed for 2nd Stage Vessels	0.08	#			NS2		
118	Calculate Number of Subtrains Needed for 3rd Stage Vessels	0.00	#			NS3		
119	Calculate Number of Subtrains Full with Pressure Vessels	0.00	#					
120	Calculate Number of Pressure Vessels per Full Subtrain	24.00	#					
121	Calculate Number of Potential Future Pressure Vessels to be Installed in Partially Full Subtrain	18.00	#					
122	Calculate % of Empty Connections Available for Adding Pressure Vessels in the Future	3.00	%					
123	Calculate Feed Flow per Subtrain	6666.67	gpm	420.80	L/s			
124	Calculate Pipe Diameter of Each Subtrain Feed Header	12.00	in	304.80	mm	ROSL		
125	Horizontal Distance Between Pressure Vessel Centerlines in Train	2.00	ft	609.60	mm	PVH	Typically 1.25 for 8" PVs and 2.0 for 16" and 18" PVs. Assumes a clearance between PVs of 6 inches	
126	Calculate Outside Diameter of Pressure Vessel	23.10	in	586.74	mm	PVD	Assume 11" for 8-inch PVs, 19.5" for 16-inch PVs and 23.1 for 18-inch PVs	
127	Calculate Horizontal Distance between Centerline of Subtrain Header and Centerline of First Pressure Vessel	1.54	ft	468.63	mm	SHPV		
128	**Input Clear Distance between Membrane Subtrains in a Row**	3.00	ft	914.40	mm	COST	Typically 2 ft for 8" elements and 3 ft for 16" and 18" elements	Adjust for large diameter
129	Calculate Membrane Train Width	47.67	ft	14528.80	mm	MTW		
130	Calculate Membrane Subtrain Width	9.00	ft	2743.20	mm	MSTW		
131	Calculate Membrane Train Length	9.00	ft	2743.20	mm	MTL		
132	**Input Vertical Distance from Floor Slab to Centerline of Lowest Pressure Vessel in Subtrain**	2.29	ft	670.86	mm	FSCV	Typically 3' for 8" elements, 3'-8" for 16" elements and 3'-10" for 18" elements	Adjust for large diameter
133	Calculate Vertical Distance Between Pressure Vessel Centerlines in Subtrain	2.33	ft	711.20	mm	PVV	Typically 17 inches for 8" elements, 24 inches for 16" elements and 28 inches for 18" elements. Assumes a clearance between pressure vessels of 6 inches	
134	Calculate Membrane Train Height	14.83	ft	4519.93	mm	MTH		
135	**Input Clear Distance between Membrane Trains in a Row**	8.00	ft	2,438.40	mm	DS	Typically 8 to 10 feet	
136	**Input Clear Distance from Building Wall to Outside Membrane Train - Feed Pump Side (Width Dimension)**	10.00	ft	3,048.00	mm	DT	Typically 10 to 12 feet	
137	**Input Clear Distance between Rows of Membrane Skids**	8.00	ft	2,438.40	mm		Typically 8 to 10 feet	
138	**Input Clear Distance from Building Wall to Outside Membrane Train - Energy Recovery Device Side (Width Dimension)**	10.00	ft	3,048.00	mm	DA	Minimum 4 feet for Dow and Koch Membranes assuming membrane loading is done on the opposite side of trains	
139	**Input Clear Distance from Last RO Train to Building Wall (Length Dimension)**	8.00	ft	2,438.40	mm	D11	Typically 6 to 12 feet (D8 + 2 ft)	OKAY
140	**Input Clear Distance from RO Feed Pump to Building Wall (Width Dimension)**	4.00	ft	1,524.00	mm	D10	Typically 4 to 5 feet	
141	Calculate Clear Distance from Membrane Trains to Building Wall	9.50	ft	2895.60	mm	D3 + HPPL + D9		
142	Calculate Clear Distance from Membrane Trains to Building Wall for Building Sizing Purposes	10.00	ft	3048.00	mm	D4	Greater of D4 or D3 + HPPL + D10	
143								
144	**Turbocharger for Interstage Pressure Boost (ERD)**							
145	Calculate Total Concentrate Flow to Energy Recovery Device(s)	416.67	gpm	26.29	L/s			
146	**Input Turbocharger for Interstage Pressure Boost Model**	LPT-600	Model				Based on information from Pump Engineering	
147	Target Concentrate Flow per Energy Recovery Device	529.20	gpm	33.39	L/s		Assumes a target flow of 88.2% of the maximum flow	
148	Maximum Concentrate Flow per Energy Recovery Device	600.00	gpm	37.85	L/s		Based on information from Pump Engineering	
149	Calculate Total Number of Energy Recovery Devices per Train	0.00	#				Should be equal to 1	OKAY
150	**Input Clear Distance between Membrane Train and Energy Recovery Devices**	2.00	ft	304.80	mm	D3A	Typically 8" to 1 foot	
151	**Energy Recovered by the Turbocharger**							
152	Concentrate Flow to Device	416.67	gpm	26.29	L/s			
153	**Input RO Concentrate Pressure Entering the Turbocharger**	200.00	psi	1,241.06	kPa		Based on RO projections	
154	**Input LPT Hydraulic Transfer Efficiency**	70.00%	%				Based on information from PEI, see LPT hydraulic transfer efficiency chart on Cells K137,P161	
155	Calculate Energy Recovered by the Device	47.65	hp	35.53	kW			
156	Calculate Efficiency of the Energy Recovery Device	86.24%	%					
157	**Energy Recovery Area Requirements**							
158	Calculate Energy Recovery Device Width, if Used	0.00	ft	0.00	mm	ERW		
159	Calculate Energy Recovery Device Length, if Used	0.00	ft	0.00	mm	ERL		
160	Calculate Energy Recovery Device Height, if Used	0.00	ft	0.00	mm	ERH		
161								
162	**Interstage Pressure Booster Pump**							
163	Calculate Number of Active Booster Pumps	5.00	#					
164	Calculate Booster Pump Flow Rate (each)	791.67	gpm				Based on RO projections	
165	**Input Booster Pump TDH**	60.00	psi					
166	**Input Booster Pump Efficiency**	75.00%	%					
167	**Input Motor Efficiency of Booster Pump**	96.00%	%					
168	**Is an Adjustable Frequency Drive (AFD) Used?**	Yes	Y/N				Typically 95%	
169	**Input AFD Efficiency**	96.00%	%					
170	**Input Safety Margin Allocated in Pump Design Brake Horsepower**	1.00						
171	Calculate Wire to Water Efficiency for Booster Pumps	0.68	%					
172	Calculate Booster Pump Horsepower (each)	30.79	hp	22.96	kW			

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173	Calculate Motor Power Consumption for Booster Pump (each)	34.11	hp	25.44	kW			
174	Calculate Total Power of Booster Pumps (ALL ACTIVE Pumps)	204.68	hp	152.63	kW			
175	**Interstage Pressure Booster Pump Area Requirements**							
176	**Input Pump Model Number**	F2200_HP100 / CRN90	Model					
177	Calculate Individual Pump Sizing Flow	800.00	gpm					
178	Calculate Individual Pump Sizing Horsepower	50.00	hp					
179	**Input Booster Pump Pad Width**	2.00	ft	601.42	mm		If not known, use dimensions for RO feed pump	
180	**Input Booster Pump Pad Length**	9.00	ft	762.00	mm		If not known, use dimensions for RO feed pump	
181	**Input Booster Pump and Motor Height**	8.00	ft	2,389.63	mm		If not known, use dimensions for RO feed pump	
182	**Input Clear Distance between Membrane Train and Interstage Booster Pump**	3.00	ft	914.40	mm	D3B	Typically 3 feet	
183								
184	**High Pressure RO Feed Pumps Calculations**							
185	Calculate Number of Active High Pressure Membrane Feed Pumps	5.00	#					
186	Calculate RO Feed Pump Flow Rate (each)	1600.07	gpm	105.15	L/s			
187	Calculate RO Feed Pump TDH	285.00	psi	1965.01	kPa			
188	**Input RO Feed Pump Efficiency**	86.00%	%					
189	**Input Motor Efficiency of RO Feed Pump**	96.00%	%					
190	**Is an Adjustable Frequency Drive (AFD) Used?**	Yes	Y/N					
191	**Input AFD Efficiency**	98.00%	%					
192	**Input Safety Margin Allocated in Pump Design Brake Horsepower**	1.08					Typically 95%	
193	Calculate Wire to Water Efficiency for High Pressure Membrane Feed Pumps	0.74	%					
194	Calculate RO High Pressure Feed Pump Horsepower (each)	346.35	hp	258.28	kW			
195	Calculate Required RO High Pressure Feed Pump Horsepower including Savings from Energy Recovery Device	298.70	hp	222.74	kW			
196	Calculate Motor Power Consumption for RO High Pressure Feed Pump (each)	224.59	hp	167.48	kW			
197	Calculate Total Power of RO High Pressure Feed Pumps (ALL ACTIVE Pumps)	1122.94	hp	837.38	kW			
198	**Brackish Water RO High Pressure Feed Pump Area Requirements**							
199	Calculate Pump Model Number	F1750_HP250 / Model 10JKH					Based on information from Weir	
200	Calculate Individual Pump Sizing Flow	1750.00	gpm	110.41	L/s			
201	Calculate Individual Pump Sizing Horsepower	250.00	hp	186.42	kW			
202	Calculate Pump Inlet Diameter	18.50	in	469.90	mm		Based on information from Weir	
203	Calculate Pump Discharge Diameter	10.00	in	254.00	mm		Based on information from Weir	
204	Calculate RO High Pressure Feed Pump Pad Length (each)	2.50	ft	762.00	mm	HPPL	Based on information from Weir	
205	Calculate RO High Pressure Feed Pump Pad Width (each)	2.17	ft	660.40	mm	HPPW	Based on information from Weir	
206	Calculate RO High Pressure Feed Pump and Motor Height (each)	7.84	ft	2390.90	mm	HPPH	Based on information from Weir	
207	**Input Clear Distance between Membrane Train and High Pressure Feed Pumps**	3.00	ft	914.40	mm	D3	Typically 3 feet	
208	**Common High Pressure RO Feed Spare Pump**							
209	**Is a Common RO Feed Spare Pump Included?**	No	Y/N					
210								
211	**Permeate Flushing Area**							
212	**Is Permeate Flushing Capability to be Provided?**	Yes	Y/N				Typically provided for surface water applications. For groundwater, many use feed water flush instead.	
213	**Is Flushing Tank on a Side Stream or Full Stream? (Side/Full)**	Side	Type					
214	**Input Flushing Flow Rate per Vessel**	40.00	gpm	2.52	L/s		Typically 40 gpm for 8" elements, 160 gpm for 16" elements and 200 gpm for 18" elements	Adjust for large diameter
215	**Input Number of Trains to be Flushed with Permeate Upon Shutdown**	2.00	#				Typically a maximum of 2	
216	Calculate Volume per Vessel	537.58	gal	2.03	m3			
217	**Input Specific Throughput per Vessel (Vessel Volumes)**	2.00					Typically 2	
218	Calculate Flushing Volume per Train	6450.95	gal	24.42	m3		Based on total number of vessels per train, number of membrane elements per vessel, standard element length of 40" or 61" and 2 times the vessel volume for flushing	
219	Calculate Flushing Tank Volume based on Number of Vessels to be Flushed	12901.91	gal	48.84	m3			
220	**Input HRT for Permeate Flushing Tank**	5.00	min				Use 15 minutes for permeate capacities less than 10 mgd. Use 10 minutes for permeate capacities less than 30 mgd. Use 5 minutes for permeate capacities over 30 mgd	
221	Calculate Permeate Flushing Tank Volume	31750.00	gal	118.29	m3			
222	**Input Number of Flushing Tanks of Equal Size**	1.00	#					
223	Calculate Flushing Tank Volume (each)	12901.91	gal	48839.04	L			
224	Conversion of Total Flushing Tank Volume from Gallons to CF	1724.73	cf	48.84	m3			
225	**Input Flushing Tank Freeboard**	2.00	ft	609.60	mm	FB	Typically 2 feet	
226	**Input Circular or Rectangular Type ("Circular" or "Rectangular")**	Circular						
227	**Input Height to Width Ratio or Height to Diameter Ratio**	1.20						
228	**Input Length to Width Ratio (for Rectangular Tanks)**	1.00						
229	For Circular Tank, Calculate Flushing Tank Diameter	12.00	ft	3657.60	mm	FTL & FTW		
230	For Circular Tank, Calculate Flushing Tank Side Water Depth	15.25	ft	4648.20	mm	SWD		
231	For Circular Tank, Calculate Flushing Tank Total Height	17.25	ft	5257.80	mm	FTH		
232	For Rectangular Tank, Calculate Flushing Tank Length	0.00	ft	0.00	mm	FTL		
233	For Rectangular Tank, Calculate Flushing Tank Width	0.00	ft	0.00	mm	FTW		
234	For Rectangular Tank, Calculate Flushing Tank Side Water Depth	0.00	ft	0.00	mm	SWD		
235	For Rectangular Tank, Calculate Flushing Tank Total Height	0.00	ft	0.00	mm	FTH		
236	**Input Clear Distance between Flushing Tanks & Pumping Systems**	8.00	ft	3,048.00	mm	D8	Typically 10 feet	
237	**Flushing Pumps**							
238	**Flushing Pump Type**	Horizontal Centrifugal					Fixed	
239	**Number of Active Flushing Pumps**	1.00	#				Fixed	
240	**Input Number of Standby Flushing Pumps**	1.00	#				Typically 1	
241	Calculate Number of Standby Flushing Pumps	1.00	#					
242	Calculate Total Number of Flushing Pumps	2.00	#					
243	Calculate Required Flushing Flow	80.00	gpm	5.05	L/s		Calculated based on total number of stage 2 pressure vessels per train	
244	Calculate Flush Pump Flow (each)	80.00	gpm	5.05	L/s		Calculated based on total number of stage 2 pressure vessels per train	
245	**Input Flushing Pump Efficiency**	70%	%					
246	**Input Motor Efficiency of Flushing Pump**	96%	%					
247	**Is Adjustable Frequency Drive (AFD) Used?**	Yes	Y/N					
248	**Input AFD Efficiency**	98%	%				Typically 95%	
249	**Input Safety Margin Allocated in Pump Design Brake Horsepower**	1.16						
250	Calculate Wire to Water Efficiency for Flushing Pumps	0.70	%					
251	**Input Flushing Pump TDH**	140.00	ft	42,672.00	mm		Typically 140 ft	
252	Calculate Flushing Pump Brake Horsepower (each)	10.00	hp	7.46	kW			
253	Calculate Motor Power Consumption for Flushing Pump (each)	4.05	hp	3.02	kW			
254	Calculate Total Power of Flushing Pump (ALL ACTIVE Pumps)	4.05	hp	3.02	kW			
255	Calculate Flushing Pump Pad Length (each)	(3.40)	ft	(1035.42)	mm	FPL		
256	Calculate Flushing Pump Pad Width (each)	(0.38)	ft	(118.44)	mm	FPW		
257	Calculate Flushing Pump Pad Height (each)	(0.71)	ft	(217.96)	mm	FPH		
258	**Input Clear Distance between Flushing, Permeate Transfer, & Neutralization Pump Pads**	3.00	ft	1,634.00	mm	D9	Typically 3 to 6 feet	
259								
260	**Permeate Transfer Pumps**							
261	**Permeate Transfer Pump Type**	Horizontal Centrifugal					Fixed	
262	**Are Permeate Transfer Pumps Included?**	No	Y/N				Typically not necessary	
263	**Input Number of Active Permeate Transfer Pumps**	0.00	#					Number of Active Pumps should be "0"
264	**Input Number of Standby Permeate Transfer Pumps**	0.00	#				Typically 1	
265	Calculate Total Number of Permeate Transfer Pumps	0.00	#					
266	Calculate Membrane Permeate Transfer Pumps Flow Rate (each)	0.00	gpm	0.00	L/s		Calculated based on desired permeate flow rate	
267	**Input Permeate Transfer Pump Efficiency**	70%	%					
268	**Input Motor Efficiency of Permeate Transfer Pump**	96%	%					
269	**Is Adjustable Frequency Drive (AFD) Used?**	Yes	Y/N					
270	**Input AFD Efficiency**	98%	%				Typically 95%	
271	**Input Safety Margin Allocated in Pump Design Brake Horsepower**	1.16						
272	Calculate Wire to Water Efficiency for Permeate Transfer Pumps	0.60	%					
273	**Input Permeate Transfer Pump TDH**	85.00	ft	25,908.00	mm		Typically 85 ft	

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274	Calculate Permeate Transfer Pump Brake Horsepower (each)	0.00	hp	0.00	kW			
275	Calculate Motor Power Consumption for Permeate Transfer Pump (each)	0.00	hp	0.00	kW			
276	Calculate Motor Power Consumption for Permeate Transfer Pump (ALL ACTIVE PUMPS)	0.00	hp	0.00	kW		Based on active pumps	
277	Calculate Permeate Transfer Pump Pad Length (each)	0.00	ft	0.00	mm	TPL		
278	Calculate Permeate Transfer Pump Pad Width (each)	0.00	ft	0.00	mm	TPW		
279	Calculate Permeate Transfer Pump Pad Height (each)	0.00	ft	0.00	mm	TPH		
280								
281	**Clean-In-Place System**							
282	**Is Clean-In-Place Capability to be Provided?**	Yes	Y/N					
283	**Input Unit Flow Rate for Cleaning Pressure Vessels**	40.00	gpm	2.52	L/s		Typically 40 gpm for 8" elements, 150 gpm for 16" elements and 200 gpm for 18" elements	Adjust for large diameter
284	**Is Cleaning going to be Performed at the Train, Half Train, or Subtrain Level?**	Subtrain	Type				Based on total number of vessels per train or per subtrain	
285	**Is a Common Access Platform Included for Access to CIP Tank(s)?**	Yes	Y/N				Typically Yes	
286	**Is Space for a Scissor Lift to be Provided?**	No	Y/N				Typically Yes for small plants	
287	**Is a Monorail Hoist Required for Handling Dry CIP Chemicals Supersacks?**	Yes	Y/N				Typically No for small plants	
288	**Input Clear Distance between All CIP Components**	4.00	ft	1,828.80	mm	D7	Typically 4 to 8 feet	
289	**Input Clear Distance between CIP Tanks, if more than One**	8.00	ft	2,438.40	mm	D7A	Typically 8 to 8 feet	
290	**Input Clear Distance between CIP Tank and Building Wall on the Side with Access to Supersacks**	8.00	ft	2,438.40	mm	D7B	Typically 10 feet, enough space to maneuver a forklift or scissor lift	OKAY
291	**Input Common Access Platform Total Width**	6.00	ft	1,828.80	mm	D7C	Typically 6 feet	OKAY
292	Calculate Number of Vessels to be Cleaned Simultaneously	24.00	#					
293	Calculate Membrane Train Cleaning Solution Rate & Solution Recirculation Pump Capacity (each)	960.00	gpm	60.57	L/s		Calculated based on total number of pressure vessels and a flushing flow rate of 40 gpm per pressure vessel	
294	Calculate Cleaning Solution Recirculation Pump Capacity	960.00	gpm	60.57	L/s			
295	Calculate Total Volume of Vessels Cleaned Simultaneously	12901.91	gal	48839.04	L			
296	Calculate Pipe Diameter for Cleaning Recirculation Pipe	10.00	in	254.00	mm		Based on a target velocity of 7 fps	
297	Estimate Volume of Cleaning Solution based on Distance to Farthest RO Train	2355.38	gal	8916.08	L			
298	Estimate Volume of Cleaning Solution based on Average Distance to RO Trains	1962.82	gal	7430.06	L			
299	**Input Excess Volume Factor Required for Cleaning Solution Wasting**	1.20					Initial 20% of cleaning solution will be wasted rather than recycled	
300	**Input Cleaning Solution Tank HRT**	3.00	min				Typically 1-3 min	
301	Calculate Minimum Volume Inside CIP Tank Required for Pump Suction	2880.00	gal	10901.99	L		Based on HRT	
302	Calculate Design Cleaning Volume Required	21188.74	gal	80208.12	L		Based on an individual chemical clean per train or subtrain. May need to be repeated for each chemical per train or subtrain	
303	Calculate Average Cleaning Volume Required	20717.67	gal	78424.91	L		Based on an individual chemical clean per train or subtrain. May need to be repeated for each chemical per train or subtrain	
304	**Cleaning Solution Recirculation Pumps Sizing**							
305	**Input Number of Active Cleaning Solution Recirculation Pumps**	1.00	#				Typically 1	
306	**Input Number of Standby Cleaning Solution Recirculation Pumps**	1.00	#				Typically 0	
307	Calculate Total Number of Cleaning Solution Recirculation Pumps	2.00	#					
308	**Input Cleaning Solution Recirculation Pump Efficiency**	75%	%					
309	**Input Motor Efficiency of Cleaning Solution Recirculation Pump**	96%	%					
310	**Is Adjustable Frequency Drive (AFD) Used?**	Yes	Y/N					
311	**Input AFD Efficiency**	98%	%				Typically 95%	
312	**Input Safety Margin Allocated in Pump Design Brake Horsepower**	1.15						
313	Calculate Wire to Water Efficiency for Cleaning Solution Recirculation Pumps	0.70	%					
314	**Input Cleaning Solution Recirculation Pump TDH**	140.00	ft	42,672.00	mm		Typically 140 feet	
315	Calculate Cleaning Solution Recirculation Pump Horsepower	60.00	hp	44.74	kW			
316	Calculate Motor Power Consumption for Cleaning Solution Recirculation Pump (each)	48.61	hp	36.25	kW			
317	Calculate Motor Power Consumption for Cleaning Solution Recirculation Pump (ALL ACTIVE PUMPS)	48.61	hp	36.25	kW			
318	Calculate Cleaning Solution Recirculation Pump Pad Length (each)	3.59	ft	1094.68	mm	CPL		
319	Calculate Cleaning Solution Recirculation Pump Pad Width (each)	2.71	ft	824.70	mm	CPW		
320	Calculate Cleaning Solution Recirculation Pump Pad Height (each)	2.08	ft	634.48	mm	CPH		
321								
322	**Cleaning Solution Tank Sizing**							
323	Calculate Total Cleaning Solution Tank Volume	21188.74	gal	80208.12	L			
324	Conversion of Total Cleaning Solution Tank Volume from Gallons to CF	2832.52	cf	80.21	m3			
325	**Input Number of Cleaning Solution Tanks of Equal Size**	2.00	#					
326	Calculate Cleaning Solution Tank Volume (each)	10594.37	gals	0.00	L			
327	Conversion of Cleaning Solution Tank Volume from Gallons to CF	1416.26	cf	40.10	m3			
328	**Input Cleaning Solution Tank Freeboard**	2.00	ft	609.60	mm	FB	Typically 2 feet	
329	**Input Circular or Rectangular Type ("Circular" or "Rectangular")**	Circular	Type					
330	**Input Depth to Width Ratio or Depth to Diameter Ratio**	1.20						
331	**Input Length to Width Ratio**	1.00						
332	For Circular Tank, Calculate Cleaning Tank Diameter	11.00	ft	3352.80	mm	CTL & CTW		
333	For Circular Tank, Calculate Cleaning Tank Side Water Depth	14.90	ft	4542.36	mm	SWD		
334	For Circular Tank, Calculate Cleaning Tank Total Height	16.90	ft	5151.96	mm	CTH		
335	For Rectangular Tank, Calculate Cleaning Tank Length	0.00	ft	0.00	mm	CTL		
336	For Rectangular Tank, Calculate Cleaning Tank Width	0.00	ft	0.00	mm	CTW		
337	For Rectangular Tank, Calculate Cleaning Tank Side Water Depth	0.00	ft	0.00	mm	SWD		
338	For Rectangular Tank, Calculate Cleaning Tank Total Height	0.00	ft	0.00	mm	CTH		
339	**CIP Tank Mixer Sizing**							
340	Calculate Solution Tank Mixer Horsepower (each)	13.00	hp	9.69	kW		Based on velocity gradient of 500 inverse seconds at 25 deg C	
341	**CIP Solution Heater Sizing**							
342	**Will a Heater be Used to Increase Temperature of CIP Cleaning Solution?**	Yes	Y/N				Suggest adding heater when design water temperature is below 20 deg C	
343	**Input Minimum Initial Cleaning Solution Temperature**	32.00	degrees F	0.00	degrees C		Use lowest water temperature	
344	**Input Maximum Target Cleaning Solution Temperature**	104.00	degrees F	40.00	degrees C		Warm CIP solution, 90 to 100 degrees F, produces siginificantly better cleaning	
345	**Input Total Number of Hours Required to Heat Cleaning Solution**	6.00	hr				Typically 1 to 4 hours	
346	Calculate CIP Heater Size (each)	353.44	kW				Includes a safety margin of 1.25	
347	Calculate Total Time per Year CIP Heater is Operating	90.00	hr/year					
348	Calculate Effective Horsepower of CIP Heater (each)	5.35	hp	3.99	kW		Average HP of CIP heater assuming constant operation	
349	Calculate Total Number of CIP Heaters	4.00	#				Same as number of cleaning solution tanks	
350	**Cleaning Solution Cartridge Filters**							
351	**Input Cartridge Filter Manufacturer**	Parker	Type					
352	**Type of Cartridge Filter being Utilized**	Vertical					Fixed at Vertical	
353	Calculate Number of Cleaning Solution Filter Cartridge Replacements per Year	24.00	#			Unique to CIP	CIP cartridge filter elements are not changed out between 1st stage cleaning, 2nd stage cleaning and 3rd stage cleaning with the SAME chemical	
354	**Input Model Number for Filter Vessel (Fil-Trek)**	L40-163-4-12F	Model				Based on Fil-Trek vertical cartridge filters	
355	**Input Model Number for Filter Vessel (Parker)**	MP178-4-14PC2	Model				Based on Parker vertical cartridge filters	
356	**Input Average Loading Rate for Cartridge Filters, All Filters in Operation (flow per 10-inch cartridge)**	4.00	gpm	0.25	L/s		Ranges from 3-5 gpm per 10-inch cartridge. Default is 4.0 gpm per 10-inch cartridge with all filters in operation	
357	**Input Maximum Loading Rate for Cartridge Filters, with One Filter Out of Service (flow per 10-inch cartridge)**	5.00	gpm	0.32	L/s		Default is 5.0 gpm per 10-inch cartridge with standby filters out of service	
358	Calculate Number of Filter Elements per Housing	178.00	#				Based on Parker vertical cartridge filters	
359	Calculate Length of Filter Elements	40.00	in	1016.00	mm			
360	**Input Number of Standby Cleaning Solution Cartridge Filter Housings**	0.00	#			Unique to CIP	Typically 0	
361	Calculate Number of Vertical Cleaning Solution Cartridge Filtration Housings	1.00	#			Unique to CIP		OKAY
362	Calculate Total Number of Vertical Cleaning Solution Cartridge Filter Housings	1.00	#			Unique to CIP		
363	Calculate Cartridge Filtration Housing Diameter (each)	3.51	ft	1068.40	mm	CCFL/CCFW	Based on manufacturer's information	
364	Calculate Cartridge Filtration Housing Height (each)	9.83	ft	2997.20	mm	CCFH	Based on manufacturer's information	

	B	C	D	E	F	G	H	I
365	Calculate Total Number of Filter Cartridges	176.00	#					
366	Calculate Total Number of Filter Cartridges Replacements per Year	4224.00	#					
367	**CIP Solution Chiller Sizing**							
368	**Will a Chiller be Used to Decrease Temperature of CIP Cleaning Solution?**	No	Y/N				Suggest adding chiller when design water temperature is above 40 deg C	
369	**Input Maximum Initial Cleaning Solution Temperature**	104.00	degrees F	40.00	degrees C			
370	**Input Minimum Target Cleaning Solution Temperature**	86.00	degrees F	30.00	degrees C		Warm CIP solution, 90 to 100 degrees F, produces significantly better cleaning	
371	**Input Total Number of Hours Required to Cool Cleaning Solution**	6.00	hr					
372	Calculate CIP Chiller Size	299213.10	BTU/hr	87.69	kW		Includes a safety margin of 1.25.	
373	Calculate CIP Chiller Size	87.63	kW				Includes a safety margin of 1.25.	
374	Calculate Total Time per Year CIP Chiller is Operating	0.00	hr/year					
375	Calculate Effective Horsepower of CIP Chiller	0.00	hp	0.00	kW		Average HP of CIP chiller assuming constant operation	
376	**Chiller Area Requirements**							
377	Calculate Chiller Length	0.00	ft	0.00	mm	CHL		
378	Calculate Chiller Width	0.00	ft	0.00	mm	CHW		
379	Calculate Chiller Height	0.00	ft	0.00	mm	CHH		
380	**Dry Chemicals Solution Preparation Tank Sizing**							
381	**Is a Dilution Tank included to prepare Dry CIP Chemicals?**	No	Y/N				Typically 'No'	
382	Calculate Total Dry Chemicals Solution Preparation Tank Volume	1058.44	gal	4010.41	L		Calculated. Tank volume is assumed to be 1/10 of the CIP tank volume	
383	**Number of Dry Chemicals Solution Preparation Tanks of Equal Size**	0.00	#				Fixed	
384	Calculate Dry Chemicals Solution Preparation Tank Volume (each)	0.00	gal	0.00	L			
385	Conversion of Total Dry Chemicals Solution Preparation Tank Volume from Gallons to CF	0.00	cf	0.00	m3		1/8 of liquid cleaning solution tank volume	
386	**Input Dry Chemicals Solution Preparation Tank Freeboard**	2.00	ft	609.60	mm	FB	Typically 2 feet	
387	**Input Circular or Rectangular Type ("Circular" or "Rectangular")**	Circular	Type					
388	**Input Depth to Width Ratio or Depth to Diameter Ratio**	1.20						
389	**Input Length to Width Ratio**	1.00						
390	For Circular Tank, Calculate Dry Chemicals Solution Preparation Tank Diameter	0.00	ft	0.00	mm	DTW & DTL		
391	For Circular Tank, Calculate Dry Chemicals Solution Preparation Tank Side Water Depth	0.00	ft	0.00	mm	SWD		
392	For Circular Tank, Calculate Dry Chemicals Solution Preparation Tank Total Height	0.00	ft	0.00	mm	DTH		
393	For Rectangular Tank, Calculate Dry Chemicals Solution Preparation Tank Length	0.00	ft	0.00	mm	DTL		
394	For Rectangular Tank, Calculate Dry Chemicals Solution Preparation Tank Width	0.00	ft	0.00	mm	DTW		
395	For Rectangular Tank, Calculate Dry Chemicals Solution Preparation Tank Side Water Depth	0.00	ft	0.00	mm	SWD		
396	For Rectangular Tank, Calculate Dry Chemicals Solution Preparation Tank Total Height	0.00	ft	0.00	mm	DTH		
397	**Dry Chemicals Mixer Sizing**							
398	Calculate Solution Tank Mixer Horsepower (each)	0.00	hp	0.00	kW		Based on velocity gradient of 500 inverse seconds at 25 deg C	
399	**Dry Chemicals Heater Sizing**							
400	**Will a Heater be Used to Increase Temperature of CIP Cleaning Solution?**	No	Y/N				Suggest adding heater when design water temperature is below 20 deg C	
401	**Input Minimum Initial Cleaning Solution Temperature**	50.00	degrees F	10.00	degrees C			
402	**Input Maximum Target Cleaning Solution Temperature**	104.00	degrees F	40.00	degrees C			
403	**Input Total Number of Hours Required to Heat Cleaning Solution**	6.00	hr					
404	Calculate CIP Heater Size	0.00	kW				Includes a safety margin of 1.25	
405	Calculate Total Time per Year CIP Heater is Operating	0.00	hr/year					
406	Calculate Effective Horsepower of CIP Heater	0.00	hp	0.00	kW		Average HP of dry chemicals solution preparation tank heater assuming constant operation	
407	**Dry Chemicals Transfer Pumps Sizing (from solution preparation tank to CIP tank)**							
408	**Number of Active Dry Chemicals Transfer Pumps**	0.00	#				Fixed	
409	**Input Dry Chemicals Transfer Pumps Efficiency**	70.00%	%					
410	**Input Motor Efficiency of Dry Chemicals Transfer Pump**	90.00%	%					
411	**Is Adjustable Frequency Drive (AFD) Used?**	No	Y/N				Default is No	
412	**Input AFD Efficiency**	96.00%	%				Typically 95%	
413	**Input Safety Margin Allocated to Pump Design Brake Horsepower**	1.15						
414	Calculate Wire to Water Efficiency for High Pressure Membrane Feed Pumps	0.63	%					
415	**Input Transfer Time from Dry Chemicals Solution Preparation Tank to CIP Tank**	15.00	min				Typically 15 min	
416	Calculate Dry Chemicals Transfer Pumps Flow Rate	0.00	gpm	0.00	L/s			
417	**Input Dry Chemicals Transfer Pumps TDH**	20.00	ft	6.096.00	mm			
418	Calculate Dry Chemicals Transfer Pump Horsepower	0.00	hp	0.00	kW			
419	Calculate Motor Power Consumption for Dry Chemicals Transfer Pump (each)	0.00	hp	0.00	kW			
420	Calculate Total Power of Dry Chemicals Transfer Pumps (ALL ACTIVE PUMPS)	0.00	hp	0.00	kW			
421	Calculate Dry Chemicals Transfer Pump Pad Length (each)	0.00	ft	0.00	mm	DPL		
422	Calculate Dry Chemicals Transfer Pump Pad Width (each)	0.00	ft	0.00	mm	DPW		
423	Calculate Dry Chemicals Transfer Pump Pad Height (each)	0.00	ft	0.00	mm	DPH		
424	**Cleaning Chemicals Sizing and Consumption**							
425	**Will Citric Acid be Used for Membrane Cleaning?**	Yes	Y/N				Used to Remove Inorganic Foulants	
426	**Input Concentration of Citric Acid for Membrane Cleaning**	2.00%	%				Typically 2%	
427	**Input Number of Cleaning Segments Same Citric Acid Solution Used**	1.00	#				If unknown, use 1	
428	Calculate Annual Weight of Citric Acid Used for Membrane Cleaning (100% lb)	51835.61	lb	23512.24	kg			
429	Calculate Weight of Citric Acid Used for Each Membrane Train Cleaning (100% lb)	4319.63	lb	1959.35	kg			
430	Calculate Number of 2000-lb Dry Citric Acid Crystal Pallettes to Support Two Membrane Train Cleanings	5.00	#					
431	**Equivalent Weight of Citric Acid**	64.04	g/eq				Fixed	
432	**Will Sodium Hydroxide be Used for Membrane Cleaning?**	Yes	Y/N					
433	**Input Concentration of Sodium Hydroxide for Membrane Cleaning**	0.10%	%				Typically 0.1%	
434	**Input Number of Cleaning Segments Same Sodium Hydroxide Solution Used**	1.00	#				If unknown, use 1	
435	Calculate Annual Weight of Sodium Hydroxide Used for Membrane Cleaning (100% lb)	2581.78	lb	1175.61	kg			
436	Calculate Weight of Sodium Hydroxide Used for Each Membrane Train Cleaning (100% lb)	215.98	lb	97.97	kg			
437	Calculate Number of 55-gallon Drums of 50% Sodium Hydroxide to Support Two Membrane Train Cleanings	2.00	#					
438	**Equivalent Weight of Sodium Hydroxide**	40.00	g/eq				Fixed	
439	**Will Hydrochloric Acid be Used for Membrane Cleaning?**	No	Y/N				Typically Not Used	
440	**Input Concentration of Hydrochloric Acid for Membrane Cleaning**	0.20%	%				Typically 0.2%	
441	**Input Number of Cleaning Segments Same Hydrochloric Acid Solution Used**	1.00	#				If unknown, use 1	
442	Calculate Annual Weight of Hydrochloric Acid Used for Membrane Cleaning (100% lb)	0.00	lb	0.00	kg			
443	Calculate Weight of Hydrochloric Used for Each Membrane Train Cleaning (100% lb)	0.00	lb	0.00	kg			
444	Calculate Number of 55-gallon Drums of 37% Hydrochloric Acid to Support Two Membrane Train Cleanings	0.00	#					
445	**Equivalent Weight of Hydrochloric Acid**	36.50	g/eq				Fixed	
446	**Will Trisodium Phosphate be Used for Membrane Cleaning?**	No	Y/N					
447	**Input Concentration of Trisodium Phosphate for Membrane Cleaning**	1.00%	%				Typically 1%	
448	**Input Number of Cleaning Segments Same Trisodium Phosphate Solution Used**	1.00	#				If unknown, use 1	
449	Calculate Annual Weight of Trisodium Phosphate Used for Membrane Cleaning (100%)	0.00	lb	0.00	kg			
450	Calculate Weight of Trisodium Phosphate Used for Each Membrane Train Cleaning (100%)	0.00	lb	0.00	kg			
451	Calculate Number of 2000-lb Dry Trisodium Phosphate Pallettes to Support Two Membrane Train Cleanings	0.00	#					
452	**Will Sodium Tripolyphosphate be Used for Membrane Cleaning?**	Yes	Y/N				Used to Remove Inorganic Foulants	
453	**Input Concentration of Sodium Tripolyphosphate for Membrane Cleaning**	1.00%	%				Typically 1%	
454	**Input Number of Cleaning Segments Same Sodium Tripolyphosphate Solution Used**	1.00	#				If unknown, use 1	
455	Calculate Annual Weight of Sodium Tripolyphosphate Used for Membrane Cleaning (100%)	25917.80	lb	11756.12	kg			
456	Calculate Weight of Sodium Tripolyphosphate Used for Each Membrane Train Cleaning (100%)	2158.82	lb	979.68	kg			
457	Calculate Number of 2000-lb Dry Sodium Tripolyphosphate Pallettes to Support Two Membrane Train Cleanings	3.00	#					
458	**Will Sodium EDTA be Used for Membrane Cleaning?**	Yes	Y/N				Used to Remove Organic Foulants	
459	**Input Concentration of Sodium EDTA for Membrane Cleaning**	1.00%	%				Typically 1%	

	B	C	D	E	F	G	H	I
460	Input Number of Cleaning Segments Same Sodium EDTA Solution Used	1.00	#				If unknown, use 1	
461	Calculate Annual Weight of Sodium EDTA Used for Membrane Cleaning (100%)	25917.80	lb	11756.12	kg			
462	Calculate Weight of EoSum EDTA Used for Each Membrane Train Cleaning (100%)	2159.82	lb	979.68	kg			
463	Calculate Number of 2000-lb Dry Sodium EDTA Pallettes to Support Two Membrane Train Cleanings	3.00	#					
464	Other Liquid CIP Chemical 1							
465	Input Other Chemical's Name	Acid X						
466	Will this Chemical be Used for Membrane Cleaning?	No	Y/N					
467	Input Equivalent Weight of Chemical	49.00	g/eq				Calculate by dividing the molar mass of the chemical by the number of charges in ionic form	
468	Which chemical does this replace of the above choices?	Hydrochloric Acid						
469	Input Concentration of Chemical	1.00%	%					
470	Input Number of Consecutive Trains Cleaned with Same Chemical Solution	1.00	#				If unknown, use 1	
471	Calculate Annual Weight of Chemical Used for Membrane Cleaning (100%)	0.00	lb	0.00	kg			
472	Calculate Weight of Chemical Used for Each Membrane Train Cleaning (100%)	0.00	lb	0.00	kg			
473	Calculate Number of 55-gallon Drums of X% Chemical to Support Two Membrane Train Cleanings	0.00	#					
474	Other Liquid CIP Chemical 2							
475	Input Other Chemical's Name	Acid Y						
476	Will this Chemical be Used for Membrane Cleaning?	No	Y/N					
477	Input Equivalent Weight of Chemical	49.00	g/eq				Calculate by dividing the molar mass of the chemical by the number of charges in ionic form	
478	Which chemical does this replace of the above choices?	Hydrochloric Acid						
479	Input Concentration of Chemical	1.00%	%					
480	Input Number of Consecutive Trains Cleaned with Same Chemical Solution	1.00	#				If unknown, use 1	
481	Calculate Annual Weight of Chemical Used for Membrane Cleaning (100%)	0.00	lb	0.00	kg			
482	Calculate Weight of Chemical Used for Each Membrane Train Cleaning (100% lb)	0.00	lb	0.00	kg			
483	Calculate Number of 55-gallon Drums of Y% Chemical to Support Two Membrane Train Cleanings	0.00	#					
484	Other Dry CIP Chemical 1							
485	Input Other Chemical's Name	Sodium dodecilsulphonate						
486	Will this Chemical be Used for Membrane Cleaning?	Yes	Y/N					
487	Input Equivalent Weight of Chemical	49.00	g/eq					
488	Which chemical does this replace of the above choices?	Trisodium Phosphate						
489	Input Concentration of Chemical	1.00%	%					
490	Input Number of Consecutive Trains Cleaned with Same Chemical Solution	1.00	#					
491	Calculate Annual Weight of Chemical Used for Membrane Cleaning (100%)	25917.80	lb	11756.12	kg			
492	Calculate Weight of Chemical Used for Each Membrane Train Cleaning (100% lb)	2159.82	lb	979.68	kg			
493	Calculate Number of 2000-lb Dry Chemical Z Pallettes to Support Two Membrane Train Cleanings	3.00	#					
494	Pretreatment Chemical Storage							
495	Chemical	Sulfuric Acid	Hydrochloric Acid	Scale Inhibitor	Other Pretreatment Chemical 1	Other Pretreatment Chemical 2		
496	Is this Chemical Used for CIP?	No	No	No	No	No		
497	Is this Chemical Used for Pretreatment?	Yes	No	Yes	No	No		
498	Equivalent Weight of Chemical	49.00	36.50	0.00	0.00	0.00		
499	Input Percent Active Chemical	93%	37%	100%	100%	25%	HCl concentration can either be 33% or 37%	
500	Input Bulk Chemical Specific Gravity	1.83	1.19	1.19	1.19	1.19		
501	Active Chemical Concentration (lb/gallon	14.19	3.67	9.17	9.17	2.29		
502	Choose Chemical Delivery Method	Tank Truck	Tank Truck	Tank Truck	Tank Truck	Tank Truck		
503	Bulk Delivery Volume (Tank Truck, Totes, Drums), gallons	2048.46	4534.19	4305.17	4305.17	4305.17		
504	Pretreatment Flow (mgd)	12.00	12.00	12.00	12.00	12.00		
505	Input Number of Simultaneous Application Points	1.00	1.00	1.00	1.00	1.00		
506	Input Chemical Dosages:							
507	Input Minimum Dose (mg/L)	10.00	10.00	2.00	2.00	0.00		
508	Input Average Dose (mg/L)	20.00	15.00	2.50	2.50	0.00		
509	Input Maximum Dose (mg/L)	30.00	20.00	3.50	3.00	0.00		
510	Minimum Chemical Usage (lb/day)	1000.80	0.00	200.16	0.00	0.00		
511	Average Chemical Usage (lb/day)	2001.60	0.00	250.20	0.00	0.00		
512	Maximum Chemical Usage (lb/day)	3002.40	0.00	350.28	0.00	0.00		
513	Chemical Metering Rates per Simultaneous Operating Pump							
514	Minimum Rate (gal/hr)	2.84	0.00	0.91	0.00	0.00		
515	Average Rate (gal/hr)	5.68	0.00	1.14	0.00	0.00		
516	Maximum Rate (gal/hr)	8.51	0.00	1.59	0.00	0.00		
517	Calculate Chemical Metering Pump Flow Turndown (should be < 20, if > 20, proceed with caution)	3.00	0.00	1.75	0.00	0.00		
518	Input Number of Days of Storage for Pretreatment (days)	30.00	30.00	30.00	30.00	30.00		
519	Calculate Storage Volume for Pretreatment @ Avg FlowDose (gallons)	4230.57	0.00	818.18	0.00	0.00		
520	Calculate Bulk Delivery Volume * 1.5 (for Truck Delivery Only in gallons)	4422.69	6801.28	7357.75	7357.75	7357.75		
521	Maximum of Above Two Volumes (gallons)	4422.69	6801.28	7357.75	7357.75	7357.75		
522	Maximum Volume in (cf)	591.23	909.29	983.59	983.59	983.59		
523	BULK TANKS:							
524	Input Number of Tanks (each)	1.00	1.00	1.00	1.00	1.00		
525	Input Tank Diameter (ft)	14.00	10.00	10.00	10.00	10.00		
526	Calculate Height of Tanks (ft)	3.84	11.58	12.52	12.52	12.52		
527	Use this Tank Height (Liquid Height * 1.2) (ft)	5.00	14.00	15.00	15.00	15.00		OKAY
528	Input Number of Rows of Tanks (each)	1.00	1.00	1.00	1.00	1.00		
529	Calculate Number of Tanks per Row	1.00	0.00	1.00	0.00	0.00		
530	Input Tank Material (FRP, PE (Polyethylene), PLS (Phenolic Lined Steel))	PLS	PLS	FRP	FRP	FRP		
531	Input Clear Distance Around BulkTanks, Totes, or Drums (CDT)	5.00	4.00	4.00	4.00	4.00		
532	TOTES & DRUMS:							
533	Calculate Number of Totes or Drums (each)	0.00	0.00	0.00	0.00	0.00		
534	Input Number of Totes or Drum Pallets Stacked Vertically	2.00	2.00	2.00	2.00	2.00		
535	Input Number of Totes or Drum Pallets on Floor Horizontally	2.00	2.00	2.00	2.00	2.00		
536	Calculate Number of Rows of Totes or Drum Pallets	0.00	0.00	0.00	0.00	0.00		
537	Length of Each Tote (ft, Fixed)	0.00	0.00	0.00	0.00	0.00		
538	Width of Each Tote (ft, Fixed)	0.00	0.00	0.00	0.00	0.00		
539	Length and Width of Each Drum Pallet (ft, Fixed)	0.00	0.00	0.00	0.00	0.00		
540	METERING PUMPS:							
541	Calculate Number of Active Pretreatment Metering Pumps (each)	1.00	0.00	1.00	0.00	0.00		
542	Calculate Number of Standby Pretreatment Metering Pumps (each)	1.00	0.00	1.00	0.00	0.00		
543	Calculate Total Number of Pretreatment Metering Pumps (each)	2.00	0.00	2.00	0.00	0.00		
544	Input Clear Distance Around Metering Pumps	4.00	4.00	3.00	4.00	4.00		
545	Length Metering Pumps	3.00	3.00	3.00	3.00	3.00	Fixed	
546	Width of Metering Pumps	1.50	1.50	1.50	1.50	1.50		
547	Width of Stair Access	4.00	0.00	4.00	0.00	0.00	Fixed	
548	Input Common Chemical Access Corridor Width	0.00	0.00	0.00	0.00	0.00	0.00	
549	Is Chemical Facility Covered?	Yes	Yes	Yes	Yes	Yes		
550	CONTAINMENT AREA:							
551	Calculate Containment Area Length (ft)	24.00	0.00	18.00	0.00	0.00	42.00	
552	Calculate Containment Area Width (ft)	39.00	0.00	31.00	0.00	0.00		
553	Calculate Fire Sprinkler Water Volume (gal) (0.2 gpm/sf for 20 min)	3744.00	0.00	2232.00	0.00	0.00		
554	Calculate 120% of One Storage Tank Volume (gal)	6909.22	9870.31	11280.36	11280.36	11280.36		
555	Calculate 30% of All Tank Volume (gal)	1727.30	2467.58	2820.09	2820.09	2820.09		
556	Maximum of Above Two Volumes (gal)	6909.22	9870.31	11280.36	11280.36	11280.36		
557	Calculate Maximum Volume + Fire Flow Volume (gal)	10653.22	9870.31	13512.36	11280.36	11280.36		
558	Calculate Maximum Volume + Fire Flow Volume (cf)	1424.13	1319.47	1806.34	1507.96	1507.96		
559	Calculate Containment Wall Height (including 6" Freeboard) (ft)	2.02	0.00	3.74	0.00	0.00		
560	Cleaning Chemical Storage							
561	Dry CIP Chemicals	Citric Acid	Trisodium Phosphate	Sodium Tripolyphosphate	Sodium dodecilsulphonate			
562	Is this Chemical Used for CIP?	Yes	No	Yes	Yes			
563	Is this Chemical Used for Pretreatment?	No	No	No	No			
564	Equivalent Weight of Chemical	64.04	N/A	N/A	40.00			
565	Input Percent Active Chemical	100%	98%	85%	80%			
566	Input Chemical Bulk Density (lb/cf)	48.00	50.00	60.00	55.00			

	B	C	D	E	F	G	H	I
567	Choose Chemical Delivery Method	Super Sack	Super Sack	Super Sack	Super Sack			
568	Bulk Delivery Volume (Truck, Super Sacks, Bags) (cf)	41.67	40.00	33.33	50.00			
569	Calculate Bulk Storage Mass per CIP Event (tons)	12.96	0.00	7.62	8.10			
570	Calculate Bulk Storage Volume per CIP Event (cf)	539.95	0.00	254.10	294.52			
571	Calculate Bulk Delivery Volume * 1.5 for Truck Delivery Only (cf)	0.00	0.00	0.00	0.00			
572	Maximum of Above Two Volumes (cf)	539.95	0.00	254.10	294.52			
573	Input Number of Bulk Storage Silos (each)	1.00	1.00	1.00	1.00			
574	Input Silo Diameter (ft)	11.00	10.00	10.00	10.00			
575	Calculate Height of Silos (ft)	0.00	0.00	0.00	0.00			
576	Calculate Number of Super Sacks or Bags (each)	12.96	0.00	7.62	8.10			
577	Input Clear Distance Around Silos, Super Sacks or Bag Pallets (ft)	4.00	4.00	4.00	4.00			
578	Input Number of Super Sacks or Bag Pallets Stacked Vertically	2.00	2.00	2.00	2.00			
579	Input Number of Super Sacks or Bag Pallets on Floor Horizontally	6.00	4.00	4.00	4.00			
580	Calculate Number of Rows of Super Sacks or Bag Pallets	2.00	0.00	1.00	2.00			
581	Is Chemical Facility Covered?	Yes	Yes	Yes	Yes			
582	Liquid CIP Chemicals	Sodium Hydroxide	Hydrochloric Acid	Sodium EDTA	Acid X	Acid Y		
583	Is that Chemical Used for CIP?	Yes	No	Yes	No	No		
584	Is that Chemical Used for Pretreatment?	No	No	No	No	No		
585	Equivalent Weight of Chemical	40.00	36.50	N/A	40.00	40.00		
586	Input Percent Active Chemical	50%	37%	98%	40%	40%	NaOH concentration can either be 25% or 50%	
587	Input Bulk Chemical Specific Gravity	1.54	1.19	0.85	1.10	1.10		
588	Active Chemical Concentration, lb/gallon	6.42	3.87	4.77	3.67	3.67		
589	Calculate Chemical Bulk Density (lb/cf)	48.04	27.47	25.69	27.48	27.48		
590	Choose Chemical Delivery Method	Tote	Tank Truck	Tank Truck	Tank Truck	Tank Truck		
591	Bulk Delivery Volume (Tank Truck, Totes, Drums), gallons	300.00	4534.19	8501.05	4905.17	4905.17		
592	Calculate Bulk Storage Mass per CIP Event (tons)	0.65	0.00	8.48	0.00	0.00		
593	Calculate Bulk Storage Volume per CIP Event (cf)	26.98	0.00	383.14	0.00	0.00		
594	Calculate Bulk Delivery Volume * 1.5 for Truck Delivery Only (cf)	0.00	908.20	1684.53	983.59	983.59		
595	Maximum of Above Two Volumes (cf)	26.98	908.20	1684.53	983.59	983.59		
596	BULK TANKS:							
597	Input Number of Tanks (each)	1.00	1.00	1.00	1.00	1.00		
598	Input Tank Diameter (ft)	9.00	10.00	13.00	12.00	12.00		
599	Calculate Height of Tanks (ft)	0.00	11.53	12.54	8.70	8.70		
600	Use this Tank Height (Liquid Height * 1.2) (ft)	0.00	14.00	16.00	11.00	11.00		OKAY
601	Input Number of Rows of Tanks (each)	1.00	1.00	1.00	1.00	1.00		
602	Calculate Number of Tanks per Row	0.00	0.00	1.00	0.00	0.00		
603	Input Tank Material (FRP, PE (Polyethylene), PLS (Phenolic Lined Steel))	FRP	PLS	FRP	FRP	FRP		
604	Input Clear Distance Around BulkTanks, Totes, or Drums (CDT)	3.00	4.00	5.00	4.00	4.00		
605	TOTES & DRUMS:							
606	Calculate Number of Totes or Drums (each)	1.00	0.00	0.00	0.00	0.00		
607	Input Number of Totes or Drum Pallets Stacked Vertically	1.00	2.00	2.00	2.00	2.00		
608	Input Number of Totes or Drum Pallets on Floor Horizontally	4.00	2.00	2.00	2.00	2.00		
609	Calculate Number of Rows of Totes or Drum Pallets	1.00	0.00	0.00	0.00	0.00		
610	Length of Each Tote (ft, Fixed)	4.00	0.00	0.00	0.00	0.00		
611	Width of Each Tote (ft, Fixed)	4.00	0.00	0.00	0.00	0.00		
612	Length and Width of Each Drum Pallet (ft, Fixed)	4.00	0.00	0.00	0.00	0.00		
613	TRANSFER PUMPS:							
614	Calculate Number of Active Chemical Transfer Pumps (each)	1.00	0.00	1.00	0.00	0.00		
615	Input Number of Standby Chemical Transfer Pumps	0.00	0.00	0.00	0.00	0.00		
616	Calculate Total Number of Chemical Transfer Pumps (each)	1.00	0.00	1.00	0.00	0.00		
617	Input Time to Transfer 1/2 of the Bulk Storage Volume to the Solution Preparation Tank (each, hours)	1.00	1.00	1.00	1.00	1.00		
618	Calculate Total Chemical Transfer Pump Design Capacity (gph)	100.90	0.00	6225.79	0.00	0.00		
619	Calculate Chemical Transfer Pump Capacity (each, gph)	100.90	0.00	6225.79	0.00	0.00		
620	Input Clear Distance Around Transfer Pumps	3.00	4.00	4.00	4.00	4.00		
621	Length of Chemical Transfer Pumps (ft)	3.00	0.00	3.00	0.00	0.00	Fixed	
622	Width of Chemical Transfer Pumps (ft)	1.50	0.00	1.50	0.00	0.00	Fixed	
623	Width of Side Access	4.00	0.00	4.00	0.00	0.00	Fixed	
624	Input Common Chemical Access Corridor Width	0.00	0.00	0.00	0.00	0.00	0.00	
625	Is Chemical Facility Covered?	Yes	Yes	Yes	No	Yes		
626	CONTAINMENT AREA:							
627	Calculate Containment Area Length (ft)	22.00	0.00	23.00	0.00	0.00	45.00	
628	Calculate Containment Area Width (ft)	18.00	0.00	30.00	0.00	0.00		
629	Calculate Fire Sprinkler Water Volume (gal) (0.2 gpm/sf for 20 min)	1408.00	0.00	2760.00	0.00	0.00		
630	Calculate 120% of One Storage Tank Volume (gal)	360.00	9870.31	19063.80	11167.55	11167.55		
631	Calculate 30% of All Tank Volume (gal)	90.00	2467.58	4765.95	2791.89	2791.89		
632	Maximum of Above 2 Volumes (gal)	360.00	9870.31	19063.80	11167.55	11167.55		
633	Calculate Maximum Volume + Fire Flow Volume (gal)	1768.00	9870.31	21823.80	11167.55	11167.55		
634	Calculate Maximum Volume + Fire Flow Volume (cf)	236.35	1319.47	2917.42	1492.88	1492.88		
635	Calculate Containment Wall Height (including 6" Freeboard) (ft)	1.17	0.00	4.73	0.00	0.00		
636	Neutralization Chemicals							
637	Calculate Annual Excess of Acid Equivalents with respect to Base Equivalents	337.759	eq					
638	Input Neutralizing Acid (if needed)	Sulfuric Acid					Typically Sulfuric Acid	
639	Input Neutralizing Acid's Equivalent Weight	49.00	g/eq				Use 49 if Sulfuric Acid is used for neutralization	
640	Calculate Annual Weight of Neutralizing Acid (100% lb)	0.00	lb	0.00	kg			
641	Calculate Weight of Neutralizing Acid for Each Membrane Train Cleaning (100% lb)	0.00	lb	0.00	kg			
642	Calculate Number of 55-gallon Drums of 93% Sulfuric Acid to Support Two Membrane Train Cleaning Neutralizations	0.00						
643	Input Neutralizing Base (if needed)	Caustic Soda					Typically Caustic Soda	
644	Input Neutralizing Base Equivalent Weight	40.00	g/eq				Use 40 if Caustic Soda is used for neutralization	
645	Calculate Annual Weight of Neutralizing Base (100% lb)	29285.24	lb	13510.36	kg			
646	Calculate Weight of Sodium Hydroxide Used for Each Membrane Train Cleaning (100% lb)	2482.10	lb	1125.86	kg			
647	Calculate Number of 55-gallon Drums of 50% Sodium Hydroxide to Support Two Membrane Train Cleaning Neutralizations	18.00						
648	Neutralization Chemicals Storage Area Requirements							
649	Calculate Neutralization Chemicals Storage Area Length	5.66	ft	1724.21	mm	NCSL	Based on 4-55 gallon drums per 48"x48" pallet; Drums 42" high; and stack pallettes two high	
650	Calculate Neutralization Chemicals Storage Area Width	5.66	ft	1724.21	mm	NCSW		
651	Calculate Neutralization Chemicals Storage Area Height	8.00	ft	2438.40	mm	NCSH		
652	Spent Chemicals Neutralization Tank Sizing							
653	Input Number of RO Trains Used for Sizing of Spent Chemicals Neutralization Tank	1.00	#				Equal to the number of trains selected for CIP	
654	Input Number of Different Chemical Cycles being Used (e.g. acid cycle, caustic cycle, detergent cycle)	2.00	#				Typically use two: one acid cycle plus one combined caustic & detergent cycle	
655	Calculate Volume of Spent Cleaning Chemical Neutralization Tank	65873.77	gal	249359.34	L		Includes clean water rinsing (flushing) volume per each chemical cycle	
656	Input Number of Spent Cleaning Neutralization Tanks of Equal Size	2.00	#					ERROR
657	Calculate Spent Chemicals Neutralization Tank Volume (each)	32936.88	gal	124679.67	L			
658	Conversion of Total Spent Cleaning Chemicals Neutralization Tank Volume from Gallons to CF	4403.02	cf	124.68	m3			
659	Input Spent Cleaning Chemicals Neutralization Tank Freeboard	2.00	ft	609.60	mm	FB	Typically 2 feet	
660	Input Circular or Rectangular Type ("Circular" or "Rectangular")	Circular	Type					
661	Input Depth to Width Ratio or Depth to Diameter Ratio	1.20						
662	Input Length to Width Ratio	1.00						
663	Input Depth of Cleaning Tank Burial	0.00	ft	0.00	mm	DB		
664	For Circular Tank, Calculate Spent Cleaning Chemicals Neutralization Tank Diameter	17.00	ft	5181.60	mm	NTW & NTL		
665	For Circular Tank, Calculate Spent Cleaning Chemicals Neutralization Tank Side Water Depth	19.40	ft	5912.59	mm	SWD		
666	For Circular Tank, Calculate Spent Cleaning Chemicals Neutralization Tank Total Height	21.40	ft	6522.19	mm	NTH		
667	For Rectangular Tank, Calculate Spent Cleaning Chemicals Neutralization Tank Length	0.00	ft	0.00	mm	NTL		
668	For Rectangular Tank, Calculate Spent Cleaning Chemicals Neutralization Tank Width	0.00	ft	0.00	mm	NTW		
669	For Rectangular Tank, Calculate Spent Cleaning Chemicals Neutralization Tank Side Water Depth	0.00	ft	0.00	mm	SWD		
670	For Rectangular Tank, Calculate Cleaning Tank Total Height	0.00	ft	0.00	mm	NTH		

	B	C	D	E	F	G	H	I
671	**Spent Chemicals Neutralization Pumps Sizing**							
672	Calculate Spent Chemicals Neutralization Pump Station Flow	3293.09	gpm	207.80	L/s	Qmax		
673	**Are Spent Chemicals Neutralization Pumps Included?**	Yes	Y/N					
674	**Spent Chemicals Neutralization Pumps Type**	Centrifugal					Fixed	
675	**Input Time to Empty the Spent Cleaning Chemicals Neutralization Tank**	2.00	hr				Typically 2 hours	
676	**Input Number of Turnovers per Hour**	3.00	#				Typically 3	
677	**Input Number of Active Spent Chemicals Neutralization Pumps**	2.00	#					OKAY
678	**Input Number of Standby Spent Chemicals Neutralization Pumps**	1.00	#				Typically 1	
679	Calculate Total Number of Spent Chemicals Neutralization Pumps	3.00	#					
680	Calculate Spent Chemical Neutralization Flow (each)	1646.54	gpm	103.90	L/s			
681	**Input Spent Chemicals Neutralization Pump Efficiency**	78.00%	%					
682	**Input Motor Efficiency of Spent Chemicals Neutralization Pump**	96.00%	%					
683	**Is an Adjustable Frequency Drive (AFD) Used?**	No	Y/N					
684	**Input AFD Efficiency**	100.00%	%				Typically 95%	
685	**Input Safety Margin Allocated in Pump Design Brake Horsepower**	1.15						
686	Calculate Wire to Water Efficiency for Spent Chemicals Neutralization Pumps	0.71	%					
687	**Input Cleaning Solution Recirculation Pump TDH**	70.00	ft	21,336.00	m		Typically 70 feet	
688	Calculate Spent Chemicals Neutralization Pump Horsepower	50.00	hp	37.28	kW			
689	Calculate Motor Power Consumption for Spent Chemicals Neutralization Pump (each)	40.86	hp	30.47	kW			
690	Calculate Total Power of Spent Chemicals Neutralization Pumps (ALL ACTIVE PUMPS)	81.71	hp	60.93	kW			
691	Calculate Spent Chemicals Neutralization Pump Pad Length (each)	7.98	ft	2427.26	mm	NPL		
692	Calculate Spent Chemicals Neutralization Pump Pad Width (each)	3.87	ft	1178.82	mm	NPW		
693	Calculate Spent Chemicals Neutralization Pump Pad Height (each)	3.01	ft	1099.24	mm	NPH		
694	**Cleaning Segments Calculations**							
695	Calculate Number of Cleaning Segments per Train per Cleaning Event per Cleaning Chemical	1.25	#				Assumes 1 cleaning segment per stage and a limit of 100 pressure vessels per cleaning segment.	
696	Calculate Number of Cleaning Segments per Cleaning Event for Entire Plant	7.50	#					
697	Calculate Total Average Volume of Cleaning Solution per Cleaning Segment	20717.87	gal	78424.91	L			
698	Calculate Total Volume of each Chemical Cleaning Solution used for Plant Cleaning	155382.51	gal	588186.79	L			
699	Calculate Total Annual Volume of each Chemical Cleaning Solution	310765.02	gal	1176373.58	L			
700								
701	**Membrane Pilot Skid Area Requirements**							
702	**Is Membrane Pilot Skid Required?**	Yes	Y/N					
703	**Input Membrane Pilot Skid Length**	25.00	ft	6,096.00	mm	PSL	Generally 20 feet to include all required components	
704	**Input Membrane Pilot Skid Width**	25.00	ft	6,096.00	mm	PSW	Generally 20 feet to include all required components	
705	**Input Membrane Pilot Skid Height**	10.00	ft	3,048.00	mm	MSH		
706								
707	**Membrane Trains Pipe Trench Area Requirements**							
708	Calculate Reverse Osmosis Influent Header Diameter	30.00	in	762.00	mm			
709	Calculate RO Permeate Header to Flush Tank Diameter	24.00	in	609.60	mm			
710	Calculate Permeate Flushing Header Diameter	10.00	in	254.00	mm			
711	Calculate RO Brine Header Diameter	16.00	in	406.40	mm			
712	Calculate Cleaning Solution Supply Header Diameter	10.00	in	254.00	mm			
713	Calculate Permeate Cleaning Solution Return Header Diameter	3.00	in	76.20	mm			
714	Calculate Brine Cleaning Solution Return Header Diameter	10.00	in	254.00	mm			
715	**Input Clear Distance Between Pipes in Gallery**	0.50	ft	152.40	mm		Typically 0.5 to 1 foot	
716	**Input Clear Distance Between Pipes and Trench Walls**	0.50	ft	152.40	mm		Typically 0.5 to 1 foot	
717	Calculate Minimum Membrane Trains Pipe Trench Width	13.00	ft	3962.40	mm	TW2		
718	**Input Clear Distance Between Bottom of Largest Pipe Header and Pipe Trench Bottom**	1.00	ft	304.80	mm		Typically 1 foot	
719	Calculate Clear Distance Between Top of Largest Pipe Header and Top of Pipe Trench	5.00	ft	1524.00	mm		Typically 2 pipe diameters of the largest pipe inside the trench	
720	Calculate Minimum Membrane Trains Pipe Trench Depth	8.50	ft	2590.80	mm	TD2		
721								
722	**Construction-Related Inputs:**							
723	**Input Process Building Depth of Burial**	0.00	ft		mm			
724	**Input Roll-Up Door Width**	14.00	ft	4267.20	mm	RUD		
725	**Is CIP Area Covered?**	Yes	Y/N					
726	**Is Flushing System Area Covered?**	Yes	Y/N					
727	**Is Chemical Neutralization Area Covered?**	Yes	Y/N					
728	**Is Pilot Skid Area Covered?**	Yes	Y/N					
729	**Input Single Entry Door Width**	4.00	ft	1219.20	mm	SED	Typically 3 to 4 feet	
730	**Input Double Entry Door Width**	6.00	ft	1828.80	mm	DED	Typically 5 to 8 feet	
731	**Input Number of Additional Roll Up Doors**	1.00	#					
732	Calculate Number of Same Size Membraine Train Roll Up Doors	6.00	#				Equal to the total number of membrane trains	
733	Calculate Total Number of Same Size Roll Up Doors in the Building	7.00	#					
734	**Input Number of Same Size Single Entry Doors in the Building**	3.00	#					
735	**Input Number of Same Size Double Entry Doors in the Building**	1.00	#				Typically include at least one double door for the electrical room	
736								
737	**Inputs for Other Areas Inside this Module:**							
738	**Are other spaces (office, control room, lab) to be included?**	Yes	Y/N					
739	**Input Space Requirements for Control Room**	150.00	sf	13.94	m2			
740	**Input Number of Offices Desired**	2.00	#				Assumes 100 sf of office space per office	
741	Calculate Space Requirements for Offices	200.00	sf	18.58	m2			
742	**Input Space Requirements for Storage Room**	150.00	sf	13.94	m2			
743	**Input Space Requirements for Wet Laboratory**	250.00	sf	23.23	m2			
744	**Input Space Requirements for Restrooms**	250.00	sf	23.23	m2			
745	**Input Space Requirements for Other Rooms**	150.00	sf	13.94	m2		Includes conference room, break room and other spaces	
746	**Input Length to Width Ratio for Control Room**	1.50	#				Should be equal to the ratios for the storage room and other rooms	
747	Calculate Control Room Length	15.00	ft	4572.00	mm			
748	Calculate Control Room Width	10.00	ft	3048.00	mm			
749	**Input Length to Width Ratio for Office Space**	2.00	#				Should be equal to the ratios for the Laboratory and restrooms	
750	Calculate Office Space Length	20.00	ft	6096.00	mm			
751	Calculate Office Space Width	10.00	ft	3048.00	mm			
752	**Input Length to Width Ratio for Storage Room**	1.50	#				Should be equal to the ratios for the control room and other rooms	OKAY
753	Calculate Storage Room Length	17.32	ft	5279.29	mm			
754	Calculate Storage Room Width	11.55	ft	3519.53	mm			
755	**Input Length to Width Ratio for Laboratory Room**	2.00	#				Should be equal to the ratios for the office space and restrooms	OKAY
756	Calculate Laboratory Room Length	22.36	ft	6815.54	mm			
757	Calculate Laboratory Room Width	11.18	ft	3407.77	mm			
758	**Input Length to Width Ratio for Restrooms**	2.00					Should be equal to the ratios for the office space and the laboratory	
759	Calculate Restrooms Length	22.36	ft	6815.54	mm			
760	Calculate Restrooms Width	11.18	ft	3407.77	mm			
761	**Input Length to Width Ratio for Other Rooms**	1.50					Should be equal to the ratios for the control room and storage room	
762	Calculate Other Rooms Length	15.00	ft	4572.00	mm			
763	Calculate Other Rooms Width	10.00	ft	3048.00	mm			
764	**Calculations for Each Side of the Hallway**							
765	Calculate Other Spaces Length	17.32	ft	5279.29	mm			
766	Calculate Other Spaces Width	32.36	ft	9863.54	mm			
767	**Input Hallway Width**	6.00	ft	1,828.80	mm		Typically 4 to 8 feet	
768	Calculate Hallway Length	32.36	ft	9863.54	mm			
769	Calculate Hallway Area	161.80	sf	15.03	m2			
770								
771	**Mechanical - Process Pipe Sizing**							
772	Number of Active RO Trains (for pipe sizing)	5.00	#					
773	Number of Standby RO Trains	1.00	#					
774	Total Number of RO Trains (for pipe quantity)	6.00	#					
775	Number of Rows of RO Skids	1.00	#					
776	Number of RO Skids per Row	6.00	#					
777	Permeate Flow per Train	1.80	mgd	6.81	ML/d			
778	Permeate Flow for 1st Stage Vessels per Train	1.26	mgd	4.77	ML/d			
779	Permeate Flow for 2nd Stage Vessels per Train	0.54	mgd	2.04	ML/d			
780	Permeate Flow for 3rd Stage Vessels per Train	0.00	mgd	0.00	ML/d			
781	Permeate Recovery	0.75	%					
782	Number of Equal Flow Cartridge Filters Installed (including standby)	0.00	#					
783	Number of Equal Flow Bypass Blend Cartridge Filters Installed (including standby)	0.00	#					
784	Total Number of RO Sub Trains per Skid	0.25	#					

	B	C	D	E	F	G	H	I
785	Number of 1st Stage Sub Trains per Skid	0.17	#					
786	Number of 2nd Stage Sub Trains per Skid	0.08	#					
787	Number of 3rd Stage Sub Trains per Skid	0.00	#					
788	Number of Vessels Being Cleaned at Once	24.00	#					
789	Calculate Total Permeate Flow	9.00	mgd	34.07	ML/d			
790	Calculate Total Permeate Flow per Row of RO Skids	9.00	mgd	34.07	ML/d			
791	Calculate Total Feedwater Flow	12.00	mgd	45.42	ML/d			
792	Calculate Total Feedwater Flow per Row of RO Skids	12.00	mgd	45.42	ML/d			
793	Calculate Feedwater Flow for 1st Stage Vessels per Train	2.40	mgd	9.08	ML/d			
794	Calculate Feedwater Flow for 2st Stage Vessels per Train	1.14	mgd	4.32	ML/d			
795	Calculate Feedwater Flow for 3rd Stage Vessels per Train	0.00	mgd	0.00	ML/d			
796	Calculate Brine Flow Out of 1st Stage Vessels per Train	1.14	mgd	4.32	ML/d			
797	Calculate Brine Flow Out of 2nd Stage Vessels per Train	0.60	mgd	2.27	ML/d			
798	Calculate Brine Flow Out of 3rd Stage Vessels per Train	0.00	mgd	0.00	ML/d			
799	Calculate Cartridge Filter Flow per Filter	0.00	mgd	0.00	ML/d			
800	Cleaning Solution Flow Rate for 8" Elements	960.00	gpm	60.57	L/s			
801	Cartridge Filters Included? (1="Yes", 0="No)	0.00	Y/N					
802	Bypass Blend Flow	3.00	mgd	11.36	ML/d			
803								
804	Pipe Name	Pipe ID	Flow, mgd	Input Velocity - Typically 8 fps or less	Unit (English)	Input Velocity	Unit (Metric)	Pipe Size, Inches
805	Cartridge Filtration Influent Header	CFIH	0.00	4.00	fps	1.22	m/s	8.00
806	Cartridge Filtration Influent Lateral	CFIL	0.00	7.00	fps	2.13	m/s	0.00
807	Cartridge Filtration Effluent Lateral	CFEL	0.00	7.00	fps	2.13	m/s	0.00
808	Cartridge Filtration Effluent Header	CFEH	0.00	4.00	fps	1.22	m/s	0.00
809	Reverse Osmosis Influent Dump Header	ROIDH	12.00	4.00	fps	1.22	m/s	30.00
810	Reverse Osmosis Influent Header	ROIH	12.00	4.00	fps	1.22	m/s	30.00
811	High Pressure Pump Suction	HPPS	2.40	7.00	fps	2.13	m/s	10.00
812	High Pressure Pump Discharge	HPPD	2.40	7.00	fps	2.13	m/s	10.00
813	Low Pressure Brine Outlet (ERD Discharge)	LPBRO	0.60	7.00	fps	2.13	m/s	6.00
814	Reverse Osmosis Influent Lateral (1st Stage)	ROIL1	2.40	8.00	fps	1.82	m/s	12.00
815	Reverse Osmosis Influent Lateral (2nd Stage)	ROIL2	1.14	7.00	fps	2.13	m/s	8.00
816	Reverse Osmosis Influent Lateral (3rd Stage)	ROIL3	0.00	7.00	fps	2.13	m/s	0.00
817	Reverse Osmosis Influent Skid Sub Lateral (1st Stage)	ROISL1	2.40	5.00	fps	1.52	m/s	12.00
818	Reverse Osmosis Influent Skid Sub Lateral (2nd Stage)	ROISL2	1.14	7.00	fps	2.13	m/s	8.00
819	Reverse Osmosis Influent Skid Sub Lateral (3rd Stage)	ROISL3	0.00	7.00	fps	2.13	m/s	0.00
820	Brine Skid Sub Lateral (1st Stage)	BSL1	1.14	5.00	fps	1.52	m/s	10.00
821	Brine Skid Sub Lateral (2nd Stage)	BSL2	0.60	3.00	fps	0.91	m/s	8.00
822	Brine Skid Sub Lateral (3rd Stage)	BSL3	0.00	3.00	fps	0.91	m/s	0.00
823	Brine Lateral (1st Stage)	BL1	1.14	4.00	fps	1.22	m/s	10.00
824	Brine Lateral (2nd Stage)	BL2	0.60	3.00	fps	0.91	m/s	8.00
825	Brine Lateral (3rd Stage)	BL3	0.00	3.00	fps	0.91	m/s	0.00
826	Brine Header	BH	3.60	4.00	fps	1.22	m/s	16.00
827	Permeate Lateral (1st Stage)	PL1	1.29	5.00	fps	1.52	m/s	10.00
828	Permeate Lateral (2nd Stage)	PL2	0.54	5.00	fps	1.52	m/s	6.00
829	Permeate Lateral (3rd Stage)	PL3	0.00	5.00	fps	1.52	m/s	0.00
830	Permeate Header to Flush Tank	PHFT	9.00	5.00	fps	1.52	m/s	24.00
831	Cleaning Solution Pump Suction Header	CSPSH	1.38	5.00	fps	1.52	m/s	10.00
832	Cleaning Solution Pump Suction Lateral	CSPSL	1.38	5.00	fps	1.52	m/s	10.00
833	Cleaning Solution Pump Discharge Lateral	CSPDL	1.38	5.00	fps	1.52	m/s	10.00
834	Cleaning Solution Pump Discharge Header	CSPDH	1.38	5.00	fps	1.52	m/s	10.00
835	Cleaning Solution Pump Reinvte	CSPR	1.38	5.00	fps	1.52	m/s	10.00
836	Cleaning Solution Cartridge Filtration Influent Lateral	CSCFIL	1.38	5.00	fps	1.52	m/s	10.00
837	Cleaning Solution Cartridge Filtration Effluent Lateral	CSCFEL	1.38	5.00	fps	1.52	m/s	10.00
838	Cleaning Solution Supply Header	CSSH	1.38	5.00	fps	1.52	m/s	10.00
839	Cleaning Solution Supply Lateral	CSSL	1.38	5.00	fps	1.52	m/s	10.00
840	Brine Cleaning Solution Return Header	BCSRH	1.38	5.00	fps	1.52	m/s	10.00
841	Brine Cleaning Solution Return Lateral	BCSRL	1.38	5.00	fps	1.52	m/s	10.00
842	Permeate Cleaning Solution Return Header	PCSRH	0.14	5.00	fps	1.52	m/s	3.00
843	Permeate Cleaning Solution Return Lateral	PCSRL	0.14	5.00	fps	1.52	m/s	3.00
844	Permeate Flushing Line	PFL	1.38	5.00	fps	1.52	m/s	10.00
845	Bypass Blend Cartridge Filter Influent	BBCFIL	3.00	7.00	fps		m/s	12.00
846	Bypass Blend Cartridge Filter Effluent	BBCFEL	3.00	7.00	fps		m/s	12.00
847	Bypass Blend Line	BBL	3.00	8.00	fps		m/s	12.00
848	Common Spare High Pressure Pump Suction	CSHPPS	0.00	7.00	fps		m/s	0.00
849	Common Spare High Pressure Pump Discharge	CSHPPD	0.00	7.00	fps		m/s	0.00
850								
851	Estimating Dimensions:	Value English	Unit (English)	Value Metric	Unit (Metric)	Name	Comment	Red Flags
852	Building Width Dimensions							
853	Main Process Cartridge Filter Vessel Length	6.23	ft	1898.65	mm	CFL		
854	Clear Distance Around Cartridge Filters	2.00	ft	609.60	mm	D1A		
855	CIP Cartridge Filter Vessel Width/Diameter	3.51	ft	1068.40	mm	CCFW		
856	Roll-Up Door Width Between CF and RO	14.00	ft	4267.20	mm	RUD		
857	Length of High Pressure Pump	2.50	ft	762.00	mm	HPPL		
858	Clear Distance Between HPP and ERU	3.00	ft	914.40	mm	D3		
859	Energy Recovery Unit Width	0.00	ft	0.00	mm	ERW		
860	Clear Distance Between ERU and RO Train	0.00	ft	0.00	mm	D3A		
861	Clear Distance Between Interstage Booster Pump and RO Train	3.00	ft	914.40	mm	D3B		
862	Membrane Train Width	47.67	ft	14528.80	mm	MTW		
863	Pilot Skid Width	25.00	ft	7620.00	mm	PSW		
864	Chiller Width	0.00	ft	0.00	mm	CHW		
865	Clear Distance Around All CIP Components	4.00	ft	1219.20	mm	D7		
866	Clear Distance between CIP Tanks	8.00	ft	2438.40	mm	D7A		
867	Clear Distance between CIP Tank and Building Wall on the Side with Access to Supersacks	8.00	ft	2438.40	mm	D7B		
868	Common Access Platform Width to CIP Tank(s)	6.00	ft	1828.80	mm	D7C		
869	Cleaning Pump Width	2.71	ft	824.70	mm	CPW		
870	Cleaning Solution Tank Width	11.00	ft	3352.80	mm	CTW		
871	Flushing Tank Width	12.00	ft	3657.60	mm	FTW		
872	Flushing Pump Length	(3.40)	ft	(1035.42)	mm	FPL		
873	Permeate Transfer Pump Length	0.00	ft	0.00	mm	TPL		
874	Neutralization Tank Width	17.00	ft	5181.60	mm	NTW		
875	Neutralization Pump Length	7.98	ft	2427.26	mm	NPL		
876	Dry Chemical Transfer Pump Length	0.00	ft	0.00	mm	DPL		
877	Dry Chemical Solution Tank Length	0.00	ft	0.00	mm	DTL		
878	Building Length Dimensions							
879	Clear Distance Around Cartridge Filters	0.00	ft	0.00	mm	D1B		
880	Clear Distance from Membrane Train to Wall (Feed Pump Side)	10.00	ft	3048.00	mm	D4		
881	Clear Distance from Membrane Train to Wall (Feed Pump Side)	10.00	ft	3048.00	mm	D4	Used in Building Calculations	
882	Clear Distance from Membrane Train to Wall (ERD Side)	10.00	ft	3048.00	mm	D4A		
883	Clear Distance from Feed Pump to Building Wall	4.00	ft	1219.20	mm	D10		
884	Clear Distance from Mixer to Membrane Train and Mixer to Cartridge Filters	10.00	ft	3048.00	mm	D5		
885	Clear Distance from Last RO Train to Building Wall	8.00	ft	2438.40	mm	D11		
886	Static Mixer Length	0.00	ft	0.00	mm	SML		
887	Membrane Train Length	9.00	ft	2743.20	mm	MTL		
888	Energy Recovery Unit Length	0.00	ft	0.00	mm	ERL		
889	Clear Distance Between Membrane Trains	8.00	ft	2438.40	mm	D6		
890	Width of High Pressure Pump	2.17	ft	660.40	mm	HPPW		
891	Cleaning Pump Length	3.59	ft	1094.88	mm	CPL		
892	Main Process Cartridge Filter Vessel Width	3.51	ft	1068.40	mm	CFW		
893	CIP Cartridge Filter Vessel Length/Diameter	3.51	ft	1068.40	mm	CCFL		
894	Pilot Skid Length	25.00	ft	7620.00	mm	PSL		
895	Flushing Tank Length	12.00	ft	3657.60	mm	FTL		
896	Clear Distance Between Flushing & Neutralization Tanks	8.00	ft	2438.40	mm	D8		
897	Clear Distance Around Flushing, Permeate Transfer, & Neutralization Pumps	3.00	ft	914.40	mm	D9		
898	Flushing Pump Width	(10.38)	ft	(116.44)	mm	FPW		
899	Permeate Transfer Pump Width	0.00	ft	0.00	mm	TPW		
900	Chiller Length	0.00	ft	0.00	mm	CHL		
901	Cleaning Tank Length	11.00	ft	3352.80	mm	CTL		
902	Neutralization Tank Length	17.00	ft	5181.60	mm	NTL		
903	Neutralization Pump Width	3.67	ft	1118.62	mm	NPW		
904	Dry Chemical Transfer Pump Width	0.00	ft	0.00	mm	DPW		
905	Dry Chemical Solution Tank Width	0.00	ft	0.00	mm	DTW		
906	Building Height Dimensions							
907	Energy Recovery Unit Height	0.00	ft	0.00	mm	ERH		
908	High Pressure Pump Height	7.84	ft	2390.90	mm	HPPH		
909	High Pressure Brine Inlet Above Floor	1.50	ft	457.20	mm	HPBRIH		
910	Membrane Train Height	14.83	ft	4519.93	mm	MTH		
911	Permeate Header to Dump Above Floor	14.83	ft	4519.93	mm	PHDH		
912	Reverse Osmosis Influent Lateral Above Floor	16.33	ft	4977.13	mm	ROILH		
913	Brine Lateral Above Floor	16.33	ft	4977.13	mm	BLH		
914	Reverse Osmosis Influent Header Above Floor	17.83	ft	5434.33	mm	ROIHH		
915	Cleaning Solution Supply Above Floor	17.83	ft	5434.33	mm	CSSHH		

	B	C	D	E	F	G	H	I
916	Brine Cleaning Solution Return Above Floor	17.83	ft	5434.33	mm	BCSRH		
917	Permeate Header to Flush Tank Above Floor	17.83	ft	5434.33	mm	PHFTH		
918	Reverse Osmosis Influent Dump Line Above Floor	20.83	ft	6348.73	mm	ROIDLH		
919	CIP Cartridge Filter Height	9.83	ft	2997.20	mm	CCFH		
920	Cleaning Pump Discharge Header Above Floor	12.83	ft	3911.60	mm	CSPDHH		
921	Cleaning Tank Height	16.90	ft	5151.98	mm	CTH		
922	Main Process Cartridge Filter Height	0.00	ft	0.00	mm	CFH		
923	Flushing Tank Height	17.25	ft	5257.80	mm	FTH		
924	Flushing Pump Height	(0.71)	ft	(217.68)	mm	FPH		
925	Permeate Transfer Pump Height	0.00	ft	0.00	mm	TPH		
926	Chiller Height	0.00	ft	0.00	mm	CHH		
927	Cleaning Pump Height	2.08	ft	634.46	mm	CPH		
928	Neutralization Tank Height	21.40	ft	6522.19	mm	NTH		
929	Neutralization Pump Height	3.61	ft	1099.24	mm	NPH		
930	Dry Chemical Solution Tank Height	0.00	ft	0.00	mm	DTH		
931	Dry Chemical Transfer Pump Height	0.00	ft	0.00	mm	DPH		
932	Pilot Membrane Skid Height	10.00	ft	3048.00	mm	MSH		
933	Individual Membrane Train Dimensions							
934	Number of Pressure Vessels Stacked in Vertical Position per Train (each)	6.00	#			PVV		
935	Number of Pressure Vessels Stacked in Horizontal Position per Subtrain (each)	4.00	#			PVHS		
936	Horizontal Distance Between Pressure Vessel Centerlines in Train	2.00	ft	609.60	mm	PVH		
937	Outside Diameter of Pressure Vessel	23.10	in	586.74	mm	PVD		
938	Horizontal Distance between Centerline of Subtrain Header and Centerline of First Pressure Vessel	1.54	ft	468.63	mm	SHPV		
939	Clear Distance between Membrane Subtrains in a Row	3.00	ft	914.40	mm	CDST		
940	Membrane Train Width	47.67	ft	14528.80	mm	MTW		
941	Membrane Subtrain Width	9.00	ft	2743.20	mm	SSTW		
942	Membrane Train Length	9.00	ft	2743.20	mm	MTL		
943	Vertical Distance from Floor Slab to Centerline of Lowest Pressure Vessel in Subtrain	2.20	ft	670.56	mm	FSCV		
944	Vertical Distance Between Pressure Vessel Centerlines in Subtrain	2.33	ft	711.20	mm	PVV		
945	Membrane Train Height	14.83	ft	4519.93	mm	MTH		
946	Electrical Room Dimensions							
947	Clear Distance from Wall to MCC	2.00	ft	609.60	mm	CD1		
948	MCC Length	31.67	ft	9652.00	mm	MCC		
949	Clear Distance between MCC and Small AFD's	1.00	ft	304.80	mm	CD2		
950	Small AFD Length	44.84	ft	13666.27	mm	SAFD		
951	Clear Distance between Small AFD's and Large AFD's	3.00	ft	914.40	mm	CD3		
952	Large AFD Length	0.00	ft	0.00	mm	LAFD		
953	Clear Distance between Large AFD's and Switchgear	3.00	ft	914.40	mm	CD4		
954	Switchgear Length	0.00	ft	0.00	mm	SWGRW		
955	Clear Distance from Switchgear to Contingency Length	3.00	ft	914.40	mm	CD5		
956	Contingency Length	10.00	ft	3048.00	mm	CONT		
957	Clear Distance behind Widest Electrical Equipment	0.00	ft	0.00	mm	CD6		
958	Largest Depth of Electrical Equipment	2.08	ft	635.00	mm	SWGRD		
959	Clear Distance in Front of Electrical Equipment	9.00	ft	2743.20	mm	CD7		
960								
961	**EQUIPMENT SUMMARY:**							
962	Equipment Item	Quantity	HP per Each		Dimensions per Each (ft)			
963			Design	Average	Length	Width	Height	Diameter
964	Pumps:							
965	High Pressure Membrane Feed Pumps (Active)	3.00	346.35	224.59	2.50	2.17	7.84	
966	High Pressure Membrane Feed Pumps (Standby)	1.00	346.35		2.50	2.17	7.84	
967	Interstage Booster Pumps (Active)	3.00	30.79	34.11	3.00	2.60	8.00	
968	Interstage Booster Pumps (Standby)	1.00	30.79		3.00	2.60	8.00	
969	Flushing Pumps (Active)	1.00	10.00	4.05	(3.40)	(0.34)	(0.71)	
970	Flushing Pumps (Standby)	1.00	10.00		(3.40)	(0.34)	(0.71)	
971	Permeate Transfer Pumps (Active)	0.00	0.00	0.00	0.00	0.00	0.00	
972	Permeate Transfer Pumps (Standby)	0.00	0.00		0.00	0.00	0.00	
973	Cleaning Solution Recirculation Pump (Active)	1.00	60.00	48.61	3.58	2.71	2.08	
974	Cleaning Solution Recirculation Pump (Standby)	1.00	60.00		3.58	2.71	2.08	
975	Dry Chemicals Transfer Pump (Active)	0.00	0.00	0.00	0.00	0.00	0.00	
976	Spent Chemicals Neutralization Pumps (Active)	2.00	50.00	40.88	7.98	3.67	3.61	
977	Spent Chemicals Neutralization Pumps (Standby)	1.00	50.00		7.98	3.67	3.61	
978	Pretreatment Chemical Metering Pumps:							
979	Sulfuric Acid Active Metering Pump	1.00	1.00		3.00	3.00	1.50	
980	Sulfuric Acid Standby Metering Pump	1.00	1.00		3.00	3.00	1.50	
981	Hydrochloric Acid Active Metering Pump	0.00	0.00		3.00	3.00	1.50	
982	Hydrochloric Acid Standby Metering Pump	0.00	0.00		3.00	3.00	1.50	
983	Scale Inhibitor Active Metering Pump	1.00	1.00		3.00	3.00	1.50	
984	Scale Inhibitor Standby Metering Pump	1.00	1.00		3.00	3.00	1.50	
985	Other Chemical 1 Active Metering Pump	0.00	0.00		3.00	3.00	1.50	
986	Other Chemical 1 Standby Metering Pump	0.00	0.00		3.00	3.00	1.50	
987	Other Chemical 2 Active Metering Pump	0.00	0.00		3.00	3.00	1.50	
988	Other Chemical 2 Standby Metering Pump	0.00	0.00		3.00	3.00	1.50	
989	Liquid CIP Chemical Transfer Pumps:							
990	Sodium Hydroxide Active Transfer Pump	1.00	0.38		3.00	1.50	1.50	
991	Sodium Hydroxide Standby Transfer Pump	0.00	0.00		3.00	1.50	1.50	
992	Hydrochloric Acid Active Transfer Pump	0.00	0.00		0.00	0.00	1.50	
993	Hydrochloric Acid Standby Transfer Pump	0.00	0.00		0.00	0.00	1.50	
994	Sodium EDTA Active Transfer Pump	1.00	23.58		3.00	1.50	1.50	
995	Sodium EDTA Standby Transfer Pump	0.00	0.00		3.00	1.50	1.50	
996	Other Chemical 3 Active Transfer Pump	0.00	0.00		0.00	0.00	1.50	
997	Other Chemical 3 Standby Transfer Pump	0.00	0.00		0.00	0.00	1.50	
998	Other Chemical 4 Active Transfer Pump	0.00	0.00		0.00	0.00	1.50	
999	Other Chemical 4 Standby Transfer Pump	0.00	0.00		0.00	0.00	1.50	
1000	Energy Recovery Devices (Turbocharger):							
1001	Turbocharger for Interstage Pressure Boost (Active)	0.00	0.00	0.00	0.00	0.00	0.00	
1002	Turbocharger for Interstage Pressure Boost (Standby)	0.00	0.00	0.00	0.00	0.00	0.00	
1003	Tanks:			Tank Material				
1004	Flushing Tanks	1.00	FRP	(FRP, Polyethylene, Phenolic Lined Steel)	0.00	0.00	17.25	12.00
1005	Cleaning Solution Tanks	2.00	FRP	(FRP, Polyethylene, Phenolic Lined Steel)	0.00	0.00	18.90	11.00
1006	Dry Chemicals Solution Preparation Tanks	0.00	FRP	(FRP, Polyethylene, Phenolic Lined Steel)	0.00	0.00	0.00	0.00
1007	Neutralization Tanks	2.00	FRP	(FRP, Polyethylene, Phenolic Lined Steel)	0.00	0.00	21.40	17.00
1008	Pretreatment Chemicals Bulk Storage Tanks:							
1009	Sulfuric Acid	1.00	PLS	(FRP, Polyethylene, Phenolic Lined Steel)			5.00	14.00
1010	Hydrochloric Acid	0.00	PLS	(FRP, Polyethylene, Phenolic Lined Steel)			14.00	10.00
1011	Scale Inhibitor	1.00	FRP	(FRP, Polyethylene, Phenolic Lined Steel)			16.00	10.00
1012	Other Chemical 1	0.00	FRP	(FRP, Polyethylene, Phenolic Lined Steel)			16.00	10.00
1013	Other Chemical 2	0.00	FRP	(FRP, Polyethylene, Phenolic Lined Steel)			16.00	10.00
1014	Liquid CIP Chemicals Bulk Storage Tanks:							
1015	Sodium Hydroxide	0.00	FRP	(FRP, Polyethylene, Phenolic Lined Steel)			0.00	9.00
1016	Hydrochloric Acid	0.00	PLS	(FRP, Polyethylene, Phenolic Lined Steel)			14.00	10.00
1017	Sodium EDTA	1.00	FRP	(FRP, Polyethylene, Phenolic Lined Steel)			18.00	13.00
1018	Other Chemical 3	0.00	FRP	(FRP, Polyethylene, Phenolic Lined Steel)			11.00	12.00
1019	Other Chemical 4	0.00	FRP	(FRP, Polyethylene, Phenolic Lined Steel)			11.00	12.00
1020	Dry CIP Chemicals Bulk Storage Silos:							
1021	Citric Acid	0.00					0.00	11.00
1022	Trisodium Phosphate	0.00					0.00	10.00
1023	Sodium Tripolyphosphate	0.00					0.00	10.00
1024	Other Chemical 5	0.00					0.00	10.00
1025	Mixers:							
1026	CIP Tank Mixers	2.00	13.00					
1027	Dry Chemicals Mixers	0.00	0.00					
1028	Heaters & Chillers:							
1029	CIP Heaters	4.00	388 kw per each	5.35				
1030	CIP Chillers	0.00	299213 BTU/hr each	0.00	0.00	0.00	0.00	
1031	Dry Chemicals Heater	0.00	0 kw per each	0.00				
1032								
1033	**ELECTRICAL EQUIPMENT ROOM SIZING MODEL:**							
1034								MCC
1035	Item	Quantity	HP per Each	AFD's Required?	MCC Spaces for Motor Starters	MCC Spaces for AFD's less than 50hp)	MCC Spaces for Breakers	Total MCC Spaces

	B	C	D	E	F	G	H	I
1034	High Pressure Membrane Feed Pumps (Active)	5.00	348.38	Yes	0.00	0.00	25.00	
1035	High Pressure Membrane Feed Pumps (Standby)	1.00	348.35	Yes	0.00	0.00	5.00	
1036	Interstage Booster Pumps (Active)	5.00	30.79	Yes	0.00	30.00	10.00	
1037	Interstage Booster Pumps (Standby)	1.00	30.79	Yes	0.00	6.00	2.00	
1040	Flushing Pumps (Active)	1.00	10.00	Yes	0.00	4.00	2.00	
1041	Flushing Pumps (Standby)	1.00	10.00	Yes	0.00	4.00	2.00	
1042	Permeate Transfer Pumps (Active)	0.00	0.00	Yes	0.00	0.00	0.00	
1043	Permeate Transfer Pumps (Standby)	0.00	0.00	Yes	0.00	0.00	0.00	
1044	Cleaning Solution Recirculation Pump (Active)	1.00	60.00	Yes	0.00	0.00	2.00	
1045	Cleaning Solution Recirculation Pump (Standby)	1.00	60.00	Yes	0.00	0.00	2.00	
1046	Dry Chemicals Transfer Pump (Active)	0.00	0.00	No	0.00	0.00	0.00	
1047	Spent Chemicals Neutralization Pumps (Active)	2.00	50.00	No	6.00	0.00	0.00	
1048	Spent Chemicals Neutralization Pumps (Standby)	1.00	50.00	No	3.00	0.00	0.00	
1049	Sulfuric Acid Active Metering Pump	1.00	1.00	No	2.00	0.00	0.00	
1050	Sulfuric Acid Standby Metering Pump	1.00	1.00	No	2.00	0.00	0.00	
1051	Hydrochloric Acid Active Metering Pump	0.00	0.00	No	0.00	0.00	0.00	
1052	Hydrochloric Acid Standby Metering Pump	0.00	0.00	No	0.00	0.00	0.00	
1053	Scale Inhibitor Active Metering Pump	1.00	1.00	No	2.00	0.00	0.00	
1054	Scale Inhibitor Standby Metering Pump	1.00	1.00	No	2.00	0.00	0.00	
1055	Other Chemical 1 Active Metering Pump	0.00	0.00	No	0.00	0.00	0.00	
1056	Other Chemical 1 Standby Metering Pump	0.00	0.00	No	0.00	0.00	0.00	
1057	Other Chemical 2 Active Metering Pump	0.00	0.00	No	0.00	0.00	0.00	
1058	Other Chemical 2 Standby Metering Pump	0.00	0.00	No	0.00	0.00	0.00	
1060	Sodium Hydroxide Active Transfer Pump	1.00	8.38	No	2.00	0.00	0.00	
1061	Sodium Hydroxide Standby Transfer Pump	0.00	0.00	No	0.00	0.00	0.00	
1061	Hydrochloric Acid Active Transfer Pump	0.00	0.00	No	0.00	0.00	0.00	
1062	Hydrochloric Acid Standby Transfer Pump	0.00	0.00	No	0.00	0.00	0.00	
1063	Sodium EDTA Active Transfer Pump	1.00	23.58	No	3.00	0.00	0.00	
1064	Sodium EDTA Standby Transfer Pump	0.00	0.00	No	0.00	0.00	0.00	
1065	Other Chemical 3 Active Transfer Pump	0.00	0.00	No	0.00	0.00	0.00	
1066	Other Chemical 3 Standby Transfer Pump	0.00	0.00	No	0.00	0.00	0.00	
1067	Other Chemical 4 Active Transfer Pump	0.00	0.00	No	0.00	0.00	0.00	
1068	Other Chemical 4 Standby Transfer Pump	0.00	0.00	No	0.00	0.00	0.00	
1069	CIP Tank Mixers	2.00	13.00	No	6.00	0.00	0.00	
1070	CIP Heaters	4.00	520.91	No	48.00	0.00	0.00	
1071	Dry Chemicals Mixers	0.00	0.00	No	0.00	0.00	0.00	
1072	Dry Chemicals Heater	0.00	0.00	No				
1073	TOTAL		4191.29		79.00	44.00	50.00	170.00
1074	Total Connected Load	4890.44						
1075								
1076	Electrical Equipment Widths:							
1077	Equipment	Depth (ft)						
1078	MCC	1.67						
1079	Small AFD's	2.08						
1080	Large AFD's	0.00						
1081	Switchgear	0.00						
1082	Maximum Depth	2.08						
1083	Clear Distances:							
1084	Description	Symbol	Width (ft)	Length (ft)	Suggested Value (ft)	Comment		
1085	Clear Distance from Wall to MCC (ft)	CDEL1		2.00	2.00	Clear Distance between wall and MCC		
1086	Clear Distance between MCC and Small AFD's (ft)	CDEL2		1.00	1.00	Clear Distance between MCC and Small AFD		
1087	Clear Distance between Small AFD's and Large AFD's (ft)	CDEL3		3.00	3.00	Clear Distance between Small AFD and Large AFD		
1088	Clear Distance between Large AFD's and Switchgear (ft)	CDEL4		3.00	3.00	Clear Distance between Large AFD and Switchgear		
1089	Clear Distance from Switchgear to Contingency Length (ft)	CDEL5		3.00	3.00	Clear Distance between Switchgear and Contingency Space		
1090	Clear Distance behind Widest Electrical Equipment (ft)	CDEL6	4.00		4.00	Clear Distance behind Switchgear (if there is no Switchgear, this distance will be Zero)		
1091	Clear Distance in Front of Electrical Equipment	CDEL7	9.00		9.00	Clear Distance in front of Equipment		
1092	Contingency Length (ft)	CONT		10.00	10.00	Contingency length		
1093	Electric Room Length (ft):							
1094	CD1	2.00						
1095	MCC	31.67						
1096	CD2	1.00						
1097	Small AFD's	44.64						
1098	CD3	3.00						
1099	Large AFD's	0.00						
1100	CD4	3.00						
1101	Switchgear	0.00						
1102	CD5	3.00						
1103	Contingency	10.00						
1104	Total Length	44.64						
1105	Electric Room Width (ft):							
1106	CD6	0.00				If there is no switchgear, this distance will be Zero.		
1107	Maximum Equipment Depth	2.08						
1108	CD7	9.00						
1109	Total Width	20.08						
1110								
1111	**FACILITY DIMENSION CALCULATIONS FOR CHEMICAL ROOM:**							
1112	Estimating Calculations for Chemical Room (Pretreatment Chemicals)	Sulfuric Acid	Hydrochloric Acid	Scale Inhibitor	Other Pretreatment Chemical 1	Other Pretreatment Chemical 2		
1113	Logic Tests ("1" = Yes, "0" = No):							
1114	Is "Other" Chemical Used for Pretreatment? (1 = Yes 0 = No)	0	0	0	0	0		
1115	Is this Chemical Feed System included for Pretreatment?	1	0	1	0	0	2	
1116	Is the Method of Delivery "Tank Truck"?	1	1	1	1	1		
1117	Is Chemical Facility Covered? (1 = Yes, 0 = No)	1	1	1	1	1	5	
1118	Number of Bulk Tanks (each)	1	0	1	0	0		
1119	Diameter of Bulk Tank (ft)	14.00	10.00	10.00	10.00	10.00		
1120	Height of Bulk Tank (ft)	5.00	14.00	16.00	16.00	16.00		
1121	Volume of Each Bulk Tank (gallons)	5757.68	8225.26	9400.30	9400.30	9400.30		
1122	Bulk Tank Material	PLS	PLS	FRP	FRP	FRP		
1123	Length of Module (Tank Truck) (ft)	24.00	0.00	18.00	0.00	0.00	42	
1124	Length of Module (Tote) (ft)	0.00	0.00	0.00	0.00	0.00	-	
1125	Length of Module (Drum) (ft)	0.00	0.00	0.00	0.00	0.00	-	
1126	Width of Module (Tank Truck) (ft)	39.00	0.00	31.00	0.00	0.00	39	
1127	Width of Module (Tote) (ft)	0.00	0.00	0.00	0.00	0.00	-	
1128	Width of Module (Drum) (ft)	0.00	0.00	0.00	0.00	0.00	-	
1129	Area of Module (SF)	936.00	0.00	558.00	0.00	0.00		
1130	Number of Bulk Tanks (each)	1.00	0.00	1.00	0.00	0.00		
1131	Diameter of Bulk Tank (ft)	14.00	0.00	10.00	0.00	0.00		
1132	Volume of Each Bulk Tank (gallons)	4422.89	0.00	7357.75	0.00	0.00		
1133	Bulk Tank Material	PLS	PLS	FRP	FRP	FRP		
1134	Total Number of Metering Pumps (Pretreatment)	2.00	0.00	2.00	0.00	0.00		
1135	Containment Wall Height (Feet)	2.02	0.00	3.74	0.00	0.00		
1136	Slab and Containment Wall							
1137	Input Slab on Grade Thickness	8.00	in	304.80	mm		Model based on 9"	
1138	Slab on Grade Thickness	0.75	ft	228.60	mm			
1139	Input Containment Wall Thickness	8.00	in	203.20	mm		Model based on 8"	
1140	Containment Wall Thickness	0.67	ft	203.20	mm			
1141	Chemical Room Corridor							
1142	Chemical Room Corridor Length	42.00	ft	12801.60	mm			
1143	Chemical Room Corridor Width	0.00	ft	0.00	mm			
1144	Chemical Room Corridor Area	0.00	sf	0.00	m2			
1145	Chemical Room Overall Slab Dimensions (including Corridor):							
1146	Total Chemical Room Length	42.00	ft	12801.60	mm			
1147	Total Chemical Room Width (for purposes of calculating Excavation)	39.00	ft	11887.20	mm			
1148	Chemical Room Excavation Length	48.00	ft	14630.40	mm			
1149	Chemical Room Excavation Width	45.00	ft	13716.00	mm			
1150	Chemical Room Excavation Depth	2.75	ft	838.20	mm			
1151	Total Chemical Room Area	1838.00	sf	152.18	m2			
1152	Chemical Room Overall Building Dimensions (including Corridor):							
1153	Total Chemical Room Covered Length	42.00	ft	12801.60	mm			
1154	Total Chemical Room Covered Width (for purposes of calculating Excavation)	39.00	ft	11887.20	mm		Assumes corridor is covered	
1155	Total Chemical Room Covered Area	1838.00	sf	152.18	m2			
1156	Estimating Calculations for Chemical Room (Dry CIP Chemicals)	Citric Acid	Trisodium Phosphate	Sodium Tripolyphosphate	Sodium dodecilsulophonate			
1157	Logic Tests ("1" = Yes, "0" = No):							
1158	Is "Other" Chemical Used for CIP? (1 = Yes, 0 = No)	1	1	1	1			
1159	If "Other" Chemical is Used, Which Chemical Does it Replace for CIP? (0 = Replaced Chemical)	1	0	1	1			
1160	Is this Chemical Feed System Included for CIP?	1	0	1	1		3	
1161	Is the Method of Delivery "Truck"?	0	0	0	0			
1162	Is the Method of Delivery "Super Sack"?	1	1	1	1			

	B	C	D	E	F	G	H	I
1163	Is the Method of Delivery "Bags"?	0	0	0	0			
1164	Is Chemical Facility Covered? (1 = Yes, 0 = No)	1	1	1	1			
1165	Silo Scenario:							
1166	Length of Module through Silos (ft)	0.00	0.00	0.00	0.00		-	
1167	Width of Module (ft)	0.00	0.00	0.00	0.00		-	
1168	Super Sack Scenario:							
1169	Length of Module (ft)	32.00	24.00	24.00	24.00		104	
1170	Width of Module (ft)	16.00	4.00	8.00	12.00		16	
1171	Bag Scenario:							
1172	Length of Module (ft)	0.00	0.00	0.00	0.00		-	
1173	Width of Module (ft)	0.00	0.00	0.00	0.00		-	
1174	Length of Selected Module (ft)	32.00	0.00	24.00	24.00		80	
1175	Width of Selected Module (ft)	16.00	0.00	8.00	12.00		16	
1176	Area of Module (SF)	512.00	0.00	192.00	288.00			
1177	Slab and Building Wall							
1178	Slab on Grade Thickness	9.00	in	304.80	mm		Model based on 9"	
1179	Slab on Grade Thickness	0.75	ft	228.60	mm			
1180	Building Wall Thickness	8.00	in	203.20	mm		Model based on 8"	
1181	Building Wall Thickness	0.67	ft	203.20	mm			
1182	Chemical Room Overall Slab and Building Dimensions							
1183	Total Chemical Room Length	80.00	ft	24384.00	mm			
1184	Total Chemical Room Width (for purposes of calculating Excavation)	16.00	ft	4876.80	mm			
1185	Chemical Room Excavation Length	86.00	ft	26212.80	mm			
1186	Chemical Room Excavation Width	22.00	ft	6705.60	mm			
1187	Chemical Room Excavation Depth	2.75	ft	838.20	mm			
1188	Total Chemical Room Area	1280.00	sf	118.92	m2			
1189	Chemical Room Overall Building Dimensions							
1190	Total Chemical Room Covered Length	80.00	ft	24384.00	mm			
1191	Total Chemical Room Covered Width (for purposes of calculating Excavation)	16.00	ft	4876.80	mm			
1192	Total Chemical Room Covered Area	1280.00	sf	118.92	m2			
1193	Estimating Calculations for Chemical Room (Liquid CIP Chemicals)	Sodium Hydroxide	Hydrochloric Acid	Sodium EDTA	Acid X	Acid Y		
1194	*Logic Tests ("1" = Yes, "0" = No):*							
1195	Is "Other" Chemical Used for CIP? (1 = Yes, 0 = No)	0	0	0	0	0		
1196	If "Other" Chemical is Used, Which Chemical Does it Replace for CIP? (0 = Replaced Chemical)	1	0	1	1	1		
1197	Is this Chemical Feed System Included for CIP?	1	0	1	0	0	2	
1198	Is the Method of Delivery "Tank Truck"?	0	1	1	1	1		
1199	Is Chemical Facility Covered? (1 = Yes, 0 = No)	1	1	1	0	1	4	
1200	Number of Bulk Tanks (each)	1	1	1	1	1		
1201	Diameter of Bulk Tank (ft)	9.00	10.00	13.00	12.00	12.00		
1202	Height of Bulk Tank (ft)	0.00	14.00	16.00	11.00	11.00		
1203	Volume of Each Bulk Tank (gallons)	0.00	8225.26	15886.50	9308.29	9308.29		
1204	Bulk Tank Material	FRP	PLS	FRP	FRP	FRP		
1205	Length of Module (Tank Truck) (ft)	0.00	0.00	23.00	0.00	0.00	23	
1206	Length of Module (Tote) (ft)	22.00	0.00	0.00	0.00	0.00	22	
1207	Length of Module (Drum) (ft)	0.00	0.00	0.00	0.00	0.00	-	
1208	Width of Module (Tank Truck) (ft)	0.00	0.00	30.00	0.00	0.00	30	
1209	Width of Module (Tote) (ft)	16.00	0.00	0.00	0.00	0.00	16	
1210	Width of Module (Drum) (ft)	0.00	0.00	0.00	0.00	0.00	-	
1211	Area of Module (SF)	352.00	0.00	690.00	0.00	0.00		
1212	Number of Bulk Tanks (each)	0.00	0.00	1.00	0.00	0.00		
1213	Diameter of Bulk Tank (ft)	0.00	0.00	13.00	0.00	0.00		
1214	Volume of Each Bulk Tank (gallons)	0.00	0.00	12451.58	0.00	0.00		
1215	Bulk Tank Material	NA	PLS	FRP	FRP	FRP		
1216	Total Number of Metering Pumps (CIP)	1.00	0.00	1.00	0.00	0.00		
1217	Containment Wall Height (Feet)	1.17	0.00	4.73	0.00	0.00		
1218	Slab and Containment Wall							
1219	Slab on Grade Thickness	9.00	in	304.80	mm		Model based on 9"	
1220	Slab on Grade Thickness	0.75	ft	228.60	mm			
1221	Containment Wall Thickness	8.00	in	203.20	mm		Model based on 8"	
1222	Containment Wall Thickness	0.67	ft	203.20	mm			
1223	Chemical Room Corridor							
1224	Chemical Room Corridor Length	45.00	ft	13716.00	mm			
1225	Chemical Room Corridor Width	0.00	ft	0.00	mm			
1226	Chemical Room Corridor Area	0.00	sf	0.00	m2			
1227	Chemical Room Overall Slab Dimensions (Including Corridor)							
1228	Total Chemical Room Length	45.00	ft	13716.00	mm			
1229	Total Chemical Room Width (for purposes of calculating Excavation)	30.00	ft	9144.00	mm			
1230	Chemical Room Excavation Length	51.00	ft	15544.80	mm			
1231	Chemical Room Excavation Width	36.00	ft	10972.80	mm			
1232	Chemical Room Excavation Depth	2.75	ft	838.20	mm			
1233	Total Chemical Room Area	1350.00	sf	125.42	m2			
1234	Chemical Room Overall Building Dimensions (Including Corridor)							
1235	Total Chemical Room Covered Length	45.00	ft	13716.00	mm			
1236	Total Chemical Room Covered Width (for purposes of calculating Excavation)	30.00	ft	9144.00	mm		Assumes corridor is covered	
1237	Total Chemical Room Covered Area	1350.00	sf	125.42	m2			
1238	COST TABLE FOR TANKS & PUMPS:	Unit Cost						
1239	Tanks (Installed Cost per Gallon)							
1240	FRP	$ 2.32						
1241	Polyethylene (PE)	$ 2.11						
1242	Phenolic Lined Steel (PLS)	$ 6.01						
1243	Chemical Feed Pumps (Cost per Each)	$ 7,991.46						
1244								
1245	**Estimating Dimensions:**	**Value English**	**Unit (English)**	**Value Metric**	**Unit (Metric)**	**Name**	**Comment**	**Red Flags**
1246	Preliminary Calculations							
1247	Cartridge Filters Area Dimensions							
1248	Cartridge Filter Row Width	8.23	ft	2.51	m			
1249	Cartridge Filter Row Length	0.00	ft	0.00	m			
1250	Number of Rows of Cartridge Filter Housings	2.00	#					
1251	Inlet/Outlet on Same Trench?	Yes	Y/N					
1252								
1253	Cartridge Filter Inlet/Outlet Pipe Trench Calculations							
1254	Trench Width	8.00	ft	2.44	m	CFTW		
1255	Trench Length	0.00	ft	0.00	m	CFTL		
1256	Trench Depth	10.50	ft	3.20	m	CFTD	Same as process pipe trench	
1257								
1258	Membrane Skids Area Length							
1259	Number of Rows of Membrane Skids	1.00	#					
1260	Number of Membrane Skids per Row	8.00	#					
1261	Membrane Skids Row Width	67.67	ft	20.62	m			
1262	Membrane Skids Row Length	112.00	ft	34.14	m			
1263								
1264	CIP System Area							
1265	# of CIP Tanks	2.00	#					
1266	Space for Scissor Lift?	No	Y/N					
1267	Common Access Platform	Yes	Y/N					
1268	Width of Common Access Platform	6.00	ft	1.83	m			
1269	# of CIP Pumps	2.00	#					
1270	# of CIP Cartridge Filter Housings	1.00	#					
1271								
1272	Building Areas							
1273	Membrane Area Length	112.00	ft	34.14	m	MAL		
1274	Membrane Area Width	67.67	ft	20.62	m	MAW		
1275	Membrane Area	7578.67	sf	704.08	m2			
1276								
1277	Cartridge Filters Area Length	0.00	ft	0.00	m	CFAL		
1278	Cartridge Filters Area Width	24.48	ft	7.45	m	CFAW		
1279	Cartridge Filters Area	0.00	sf	0.00	m2			
1280								
1281	Electrical Room Length	44.64	ft	13.61	m	TERL		
1282	Electrical Room Width	20.08	ft	6.12	m	TERW		
1283	Electrical Room Area	896.52	sf	83.29	m2			
1284								
1285	CIP Area Length	40.10	ft	12.22	m	CIPAL		
1286	CIP Area Width	42.00	ft	12.80	m	CIPAW		
1287	CIP Area	1852.25	sf	172.08	m2			

	B	C	D	E	F	G	H	I
1288								
1289	Pretreatment Liquid Chemicals Area	1638.00	sf	152.18	m2			
1290								
1291	CIP Liquid Chemicals Area	1350.00	sf	125.42	m2			
1292								
1293	CIP Dry Chemicals Area	1280.00	sf	118.92	m2			
1294								
1295	Chemical Neutralization System Area	0.00	sf	0.00	m2			
1296								
1297	Flushing System and Permeate Transfer Area	468.00	sf	43.48	m2			
1298								
1299	Pilot Skid Area	961.00	sf	89.28	m2			
1300								
1301	Other Areas Length	39.84	ft	12082.58	mm	OAL		
1302	Other Areas Width	32.36	ft	9863.54	mm	OAW		
1303	Other Areas Area	1282.81	sf	119.18	m2			
1304								
1305	Total Building Area	17307.25	sf	1607.90	m2			
1306								
1307	Slab Areas							
1308	Membrane Building Area	7942.00	sf	737.84	m2			
1309								
1310	CIP System Area	1852.25	sf	172.08	m2			
1311								
1312	Cartridge Filter Area	52.92	sf	4.92	m2			
1313								
1314	Electrical Room Area	1029.97	sf	95.69	m2			
1315								
1316	Pretreatment Liquid Chemicals Area Length	42.00	ft	12801.60	mm	PLCAL		
1317	Pretreatment Liquid Chemicals Area Width	39.00	ft	11887.20	mm	PLCAW		
1318	Pretreatment Liquid Chemicals Area	1638.00	sf	152.18	m2			
1319								
1320	CIP Liquid Chemicals Area Length	45.00	ft	13716.00	mm	CLCAL		
1321	CIP Liquid Chemicals Area Width	30.00	ft	9144.00	mm	CLCAW		
1322	CIP Liquid Chemicals Area	1350.00	sf	125.42	m2			
1323								
1324	CIP Dry Chemicals Area Length	80.00	ft	24384.00	mm	CDCAL		
1325	CIP Dry Chemicals Area Width	16.00	ft	4876.80	mm	CDCAW		
1326	CIP Dry Chemicals Area	1280.00	sf	118.92	m2			
1327								
1328	Chemical Neutralization System Area Length	0.00	ft	0.00	mm	CNAL		
1329	Chemical Neutralization System Area Width	0.00	ft	0.00	mm	CNAW		
1330	Chemical Neutralization System Area	0.00	sf	0.00	m2			
1331								
1332	Flushing System and Permeate Transfer Area Length	18.00	ft	5486.40	mm	FSPTAL		
1333	Flushing System and Permeate Transfer Area Width	26.00	ft	7924.80	mm	FSPTAW		
1334	Flushing System and Permeate Transfer Area	468.00	sf	43.48	m2			
1335								
1336	Pilot Skid Area Length	31.00	ft	9448.80	mm	PSAL		
1337	Pilot Skid Area Width	31.00	ft	9448.80	mm	PSAW		
1338	Pilot Skid Area	961.00	sf	89.28	m2			
1339								
1340	Total Slab Area	18521.22	sf	1534.87	m2			
1341								
1342	Slab on Grade Areas and Excavation Calculations							
1343	Membrane Area Slab on Grade Length	116.00	ft	35.36	m			
1344	Membrane Area Slab on Grade Width	71.67	ft	21.84	m			
1345	Membrane Area Slab on Grade Area	8313.33	sf	772.33	m2			
1346								
1347	CIP System Area Slab on Grade Length	44.10	ft	13.44	m			
1348	CIP System Area Slab on Grade Width	46.00	ft	14.02	m			
1349	CIP System Building Slab on Grade Area	2028.45	sf	188.45	m2			
1350								
1351								
1352	Cartridge Filter Area Slab on Grade Length	4.00	ft	1.22	m			
1353	Cartridge Filter Area Slab on Grade Width	28.48	ft	8.67	m			
1354	Cartridge Filter Building Slab on Grade Area	113.83	sf	10.58	m2			
1355								
1356	Electrical Room Slab on Grade Length	48.84	ft	14.83	m			
1357	Electrical Room Slab on Grade Width	24.08	ft	7.34	m			
1358	Electrical Room Slab on Grade Area	1171.41	sf	108.83	m2			
1359								
1360	Pretreatment Liquid Chemicals Area Slab on Grade Length	46.00	ft	14.02	m			
1361	Pretreatment Liquid Chemicals Area Slab on Grade Width	43.00	ft	13.11	m			
1362	Pretreatment Liquid Chemicals Area Slab on Grade Area	1978.00	sf	183.76	m2			
1363								
1364	CIP Liquid Chemicals Area Slab on Grade Length	49.00	ft	14.94	m			
1365	CIP Liquid Chemicals Area Slab on Grade Width	34.00	ft	10.36	m			
1366	CIP Liquid Chemicals Area Slab on Grade Area	1666.00	sf	154.78	m2			
1367								
1368	CIP Dry Chemicals Area Slab on Grade Length	84.00	ft	25.60	m			
1369	CIP Dry Chemicals Area Slab on Grade Width	20.00	ft	6.10	m			
1370	CIP Dry Chemicals Area Slab on Grade Area	1680.00	sf	156.08	m2			
1371								
1372	Chemical Neutralization System Area Slab on Grade Length	4.00	ft	1.22	m			
1373	Chemical Neutralization System Area Slab on Grade Width	4.00	ft	1.22	m			
1374	Chemical Neutralization System Area Slab on Grade Area	16.00	sf	1.49	m2			
1375								
1376	Flushing System and Permeate Transfer Area Slab on Grade Length	22.00	ft	6.71	m			
1377	Flushing System and Permeate Transfer Area Slab on Grade Width	30.00	ft	9.14	m			
1378	Flushing System and Permeate Transfer Area Slab on Grade Area	660.00	sf	61.32	m2			
1379								
1380	Pilot Skid Area Slab on Grade Length	35.00	ft	10.67	m			
1381	Pilot Skid Area Slab on Grade Width	35.00	ft	10.67	m			
1382	Pilot Skid Area Slab on Grade Area	1225.00	sf	113.81	m2			
1383								
1384	Other Areas Slab on Grade Length	43.84	ft	13.30	m			
1385	Other Areas Slab on Grade Width	36.36	ft	11.08	m			
1386	Other Areas Slab on Grade Area	1586.82	sf	147.42	m2			
1387								
1388	Total Slab on Grade Area	18410.40	sf	1710.38	m2			
1389								
1390	Input Slab on Grade Thickness	12.00	in	304.80	mm		Model based on 12"	
1391	Slab on Grade Thickness	1.00	ft	304.80	mm			
1392	Input Overexcavation Depth	1.00	ft	304.80	mm			
1393								
1394	Process Building Excavation Depth	2.00	ft	609.60	mm			
1395	Electrical Room Excavation Depth	2.00	ft	609.60	mm			
1396	Pipe Trench Excavation Depth	10.50	ft	3200.40	mm			
1397	Input Cutback Slope	1.50	:1				Default is 1.5:1	
1398	Input Equipment Pad Thickness	1.00	ft	304.80	mm			
1399	Input Chemical Bulk Storage Pad Thickness	3.00	ft	914.40	mm			
1400								
1401	Pipe Trenches.							
1402	Membrane Pipe Trench:							
1403	Trench Length	112.00	ft	34137.60	mm			
1404	Width	13.00	ft	3962.40	mm	TW2		
1405	Depth	8.50	ft	2590.80	mm	TD2		
1406	Input Trench Wall Thickness	12.00	in	304.80	mm		Model based on 12"	
1407	Trench Wall Thickness	1.00	ft	304.80	mm			
1408	Input Building Wall Thickness	12.00	in	304.80	mm		Model based on 12"	
1409	Building Wall Thickness	1.00	ft	304.80	mm			
1410	Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
1411								
1412	SITEWORK							
1413	Membrane Area:							

	B	C	D	E	F	G	H	I
1414	Excavation	608.06	CY	464.90	m3	$6.35	$3,860	
1415	Imported Structural Backfill	504.10	CY	385.41	m3	$48.10	$24,247	
1416	Native Backfill	38.81	CY	29.68	m3	$7.80	$303	
1417	Haul Excess	569.25	CY	435.22	m3	$7.80	$4,443	
1418	Pipe Trench Area:							
1419	Excavation	1602.95	CY	1225.55	m3	$8.35	$10,176	
1420	Imported Structural Backfill	124.44	CY	95.14	m3	$48.10	$5,986	
1421	Native Backfill	777.88	CY	594.73	m3	$7.80	$6,071	
1422	Haul Excess	825.06	CY	630.82	m3	$7.80	$6,439	
1423	CIP System Area:							
1424	Excavation	190.71	CY	145.81	m3	$8.35	$1,211	
1425	Imported Structural Backfill	150.26	CY	114.88	m3	$48.10	$7,227	
1426	Native Backfill	20.02	CY	15.31	m3	$7.80	$156	
1427	Haul Excess	170.88	CY	130.50	m3	$7.80	$1,332	
1428	Cartridge Filter Area:							
1429	Excavation	17.52	CY	13.40	m3	$8.35	$111	
1430	Imported Structural Backfill	8.43	CY	6.45	m3	$48.10	$408	
1431	Native Backfill	7.21	CY	5.51	m3	$7.80	$56	
1432	Haul Excess	10.31	CY	7.88	m3	$7.80	$80	
1433	Electrical Room:							
1434	Excavation	115.28	CY	88.14	m3	$8.35	$732	
1435	Imported Structural Backfill	86.77	CY	66.34	m3	$48.10	$4,174	
1436	Native Backfill	16.16	CY	12.36	m3	$7.80	$129	
1437	Haul Excess	99.12	CY	75.79	m3	$7.80	$774	
1438	Pretreatment Liquid Chemicals Area:							
1439	Excavation	186.25	CY	142.40	m3	$8.35	$1,182	
1440	Imported Structural Backfill	148.52	CY	112.02	m3	$48.10	$7,047	
1441	Native Backfill	19.78	CY	15.12	m3	$7.80	$154	
1442	Haul Excess	166.47	CY	127.28	m3	$7.80	$1,299	
1443	CIP Liquid Chemicals Area							
1444	Excavation	158.67	CY	121.47	m3	$8.35	$1,009	
1445	Imported Structural Backfill	123.41	CY	94.35	m3	$48.10	$5,936	
1446	Native Backfill	18.44	CY	14.10	m3	$7.80	$144	
1447	Haul Excess	140.43	CY	107.37	m3	$7.80	$1,096	
1448	CIP Dry Chemicals Area							
1449	Excavation	165.26	CY	126.35	m3	$8.35	$1,049	
1450	Imported Structural Backfill	124.44	CY	95.14	m3	$48.10	$5,986	
1451	Native Backfill	23.11	CY	17.67	m3	$7.80	$180	
1452	Haul Excess	142.15	CY	108.68	m3	$7.80	$1,109	
1453	Chemical Neutralization System Area							
1454	Excavation	3.32	CY	2.54	m3	$8.35	$21	
1455	Imported Structural Backfill	1.19	CY	0.91	m3	$48.10	$57	
1456	Native Backfill	1.78	CY	1.36	m3	$7.80	$14	
1457	Haul Excess	1.54	CY	1.18	m3	$7.80	$12	
1458	Flushing System and Permeate Transfer Area:							
1459	Excavation	67.70	CY	51.76	m3	$8.35	$430	
1460	Imported Structural Backfill	48.88	CY	37.38	m3	$48.10	$2,352	
1461	Native Backfill	11.56	CY	8.83	m3	$7.80	$90	
1462	Haul Excess	56.14	CY	42.92	m3	$7.80	$438	
1463	Pilot Skid Area:							
1464	Excavation	119.05	CY	91.02	m3	$8.35	$759	
1465	Imported Structural Backfill	90.74	CY	69.38	m3	$48.10	$4,365	
1466	Native Backfill	15.56	CY	11.89	m3	$7.80	$121	
1467	Haul Excess	103.50	CY	79.13	m3	$7.80	$809	
1468	Other Areas:							
1469	Excavation	151.56	CY	115.87	m3	$8.35	$982	
1470	Imported Structural Backfill	117.54	CY	89.87	m3	$48.10	$5,654	
1471	Native Backfill	17.78	CY	13.59	m3	$7.80	$139	
1472	Haul Excess	133.78	CY	102.28	m3	$7.80	$1,044	
1473	Allowance for Misc Items	5%				$121,361.97	$6,068	
1474	Subtotal						$127,430	
1475								
1476	CONCRETE							
1477	Slab on Grade:							
1478	Process Building	681.87	CY	521.32	m3	$356.31	$242,954	
1479	Trench Walls:							
1480	Cartridge Filters and Membrane Pipe Trench	70.52	CY	53.92	m3	$704.01	$48,645	
1481	Equipment Pads:							
1482	Pumps:							
1483	High Pressure Membrane Feed Pumps (Active)	1.00	CY	0.77	m3	$356.31	$357	
1484	High Pressure Membrane Feed Pumps (Standby)	0.20	CY	0.15	m3	$356.31	$71	
1485	Interstage Booster Pumps (Active)	1.44	CY	1.10	m3	$356.31	$515	
1486	Interstage Booster Pumps (Standby)	0.29	CY	0.22	m3	$356.31	$103	
1487	Flushing Pumps (Active)	0.05	CY	0.04	m3	$356.31	$17	
1488	Flushing Pumps (Standby)	0.05	CY	0.04	m3	$356.31	$17	
1489	Permeate Transfer Pumps (Active)	0.00	CY	0.00	m3	$356.31	$0	
1490	Permeate Transfer Pumps (Standby)	0.00	CY	0.00	m3	$356.31	$0	
1491	Cleaning Solution Recirculation Pump (Active)	0.36	CY	0.28	m3	$356.31	$128	
1492	Cleaning Solution Recirculation Pump (Standby)	0.36	CY	0.28	m3	$356.31	$128	
1493	Dry Chemicals Transfer Pump (Active)	0.00	CY	0.00	m3	$356.31	$0	
1494	Spent Chemicals Neutralization Pumps (Active)	2.16	CY	1.66	m3	$356.31	$771	
1495	Spent Chemicals Neutralization Pumps (Standby)	1.08	CY	0.83	m3	$356.31	$386	
1496	Pretreatment Chemical Metering Pumps:							
1497	Sulfuric Acid Active Metering Pump	1.00	CY	0.76	m3	$356.31	$355	
1498	Sulfuric Acid Standby Metering Pump	1.00	CY	0.76	m3	$356.31	$356	
1499	Hydrochloric Acid Active Metering Pump	0.00	CY	0.00	m3	$356.31	$0	
1500	Hydrochloric Acid Standby Metering Pump	0.00	CY	0.00	m3	$356.31	$0	
1501	Scale Inhibitor Active Metering Pump	1.00	CY	0.76	m3	$356.31	$356	
1502	Scale Inhibitor Standby Metering Pump	1.00	CY	0.76	m3	$356.31	$356	
1503	Other Chemical 1 Active Metering Pump	0.00	CY	0.00	m3	$356.31	$0	
1504	Other Chemical 1 Standby Metering Pump	0.00	CY	0.00	m3	$356.31	$0	
1505	Other Chemical 2 Active Metering Pump	0.00	CY	0.00	m3	$356.31	$0	
1506	Other Chemical 2 Standby Metering Pump	0.00	CY	0.00	m3	$356.31	$0	
1507	Liquid CIP Chemical Transfer Pumps:							
1508	Sodium Hydroxide Active Transfer Pump	0.50	CY	0.38	m3	$356.31	$178	
1509	Sodium Hydroxide Standby Transfer Pump	0.00	CY	0.00	m3	$356.31	$0	
1510	Hydrochloric Acid Active Transfer Pump	0.00	CY	0.00	m3	$356.31	$0	
1511	Hydrochloric Acid Standby Transfer Pump	0.00	CY	0.00	m3	$356.31	$0	
1512	Sodium EDTA Active Transfer Pump	0.50	CY	0.38	m3	$356.31	$178	
1513	Sodium EDTA Standby Transfer Pump	0.00	CY	0.00	m3	$356.31	$0	
1514	Other Chemical 3 Active Transfer Pump	0.00	CY	0.00	m3	$356.31	$0	
1515	Other Chemical 3 Standby Transfer Pump	0.00	CY	0.00	m3	$356.31	$0	
1516	Other Chemical 4 Active Transfer Pump	0.00	CY	0.00	m3	$356.31	$0	
1517	Other Chemical 4 Standby Transfer Pump	0.00	CY	0.00	m3	$356.31	$0	
1518	Tanks:							
1519	Flushing Tanks	4.19	CY	3.20	m3	$356.31	$1,492	
1520	Cleaning Solution Tanks	21.12	CY	16.15	m3	$356.31	$7,525	
1521	Dry Chemicals Solution Preparation Tanks	0.00	CY	0.00	m3	$356.31	$0	
1522	Neutralization Tanks	16.81	CY	12.85	m3	$356.31	$5,991	
1523	Pretreatment Chemicals Bulk Storage Tanks							
1524	Sulfuric Acid	17.10	CY	13.08	m3	$356.31	$6,094	
1525	Hydrochloric Acid	0.00	CY	0.00	m3	$356.31	$0	
1526	Scale Inhibitor	8.73	CY	6.67	m3	$356.31	$3,109	
1527	Other Chemical 1	0.00	CY	0.00	m3	$356.31	$0	
1528	Other Chemical 2	0.00	CY	0.00	m3	$356.31	$0	
1529	Liquid CIP Chemicals Bulk Storage Tanks							
1530	Sodium Hydroxide	0.00	CY	0.00	m3	$356.31	$0	
1531	Hydrochloric Acid	0.00	CY	0.00	m3	$356.31	$0	
1532	Sodium EDTA	14.75	CY	11.28	m3	$356.31	$5,255	
1533	Other Chemical 3	0.00	CY	0.00	m3	$356.31	$0	
1534	Other Chemical 4	0.00	CY	0.00	m3	$356.31	$0	
1535	Pretreatment Chemicals Containment Area Walls:							
1536	Sulfuric Acid	6.29	CY	4.81	m3	$557.50	$3,506	
1537	Hydrochloric Acid	0.00	CY	0.00	m3	$557.50	$0	
1538	Scale Inhibitor	9.04	CY	6.91	m3	$557.50	$5,041	
1539	Other Chemical 1	0.00	CY	0.00	m3	$557.50	$0	
1540	Other Chemical 2	0.00	CY	0.00	m3	$557.50	$0	
1541	Liquid CIP Chemicals Containment Area Walls							

	B	C	D	E	F	G	H	I
1542	Sodium Hydroxide	2.20	CY	1.68	m3	$557.50	$1,229	
1543	Hydrochloric Acid	0.00	CY	0.00	m3	$557.50	$0	
1544	Sodium EDTA	12.37	CY	9.46	m3	$557.50	$6,809	
1545	Other Chemical 3	0.00	CY	0.00	m3	$557.50	$0	
1546	Other Chemical 4	0.00	CY	0.00	m3	$557.50	$0	
1547	Allowance for Misc Items	5%				$343,014.32	$17,151	
1548	Subtotal						$360,185	
1549								
1550	MASONRY	Materials						
1551	CMU Building Over Membrane and Other Covered Areas	17307.25	SF	1607.90	m2	$168.98	$2,701,371	
1552	Subtotal	17307.25	SF	1607.90	m2		$2,701,371	
1553								
1554	METALS							
1555	Grating Over Pipe Tranches.							
1556	Cartridge Filter and Membrane Pipe Trench	1456.00	SF	135.27	m2	$85.85	$124,991	
1557	Metal Stairways							
1558	Pretreatment and Liquid CIP Chemicals	8.00	EA			$17,873.00	$14,884	
1559	Allowance for Misc Items	10%				$139,975.43	$13,998	
1560	Subtotal						$153,973	
1561								
1562	DOORS & WINDOWS							
1563	Roll-Up Doors (14' wide)	7.00	EA			$3,486.15	$24,403	
1564	Single Entry Doors (4' wide)	3.00	EA			$983.16	$2,949	
1565	Double Entry Doors (8' wide)	1.00	EA			$1,474.74	$1,475	
1566	Allowance for Misc Items	10%				$28,827.27	$2,883	
1567	Subtotal						$31,710	
1568								
1569	EQUIPMENT							
1570	*Equipment Purchase Prices (Installation Cost is NOT included):*							
1571	Reverse Osmosis Train:							Equipment Purchase Price Over Write:
1572	Skids & Manifold Piping	6.00	LS			$352,469.76	$2,114,818	
1573	Pressure Vessels (for 18 inch membranes)	36.00	EA			$10,812.89	$389,264	
1574	Membrane Elements (18 inches in diameter)	288.00	EA			$3,604.30	$1,036,038	
1575	Cartridge Filters (0 gpm)	0.00	EA			$17,643.63	$0	
1576	Bypass Blend Cartridge Filters (0 gpm)	0.00	EA			$42,124.26	$0	
1577	CIP Cartridge Filters (960 gpm)	1.00	EA			$59,724.26	$59,724	
1578	Pumps:							
1579	High Pressure Membrane Feed Pumps (Active) (346 hp each)	5.00	EA			$176,834.95	$883,174	
1580	High Pressure Membrane Feed Pumps (Standby) (346 hp each)	1.00	EA			$176,834.95	$176,835	
1581	Interstage Booster Pumps (Active) (31 hp each)	5.00	EA			$26,816.53	$134,083	
1582	Interstage Booster Pumps (Standby) (31 hp each)	1.00	EA			$26,816.53	$26,817	
1583	Flushing Pumps (Active) (10 hp each)	1.00	EA			$80,449.58	$80,450	
1584	Flushing Pumps (Standby) (10 hp each)	1.00	EA			$80,449.58	$80,450	
1585	Permeate Transfer Pumps (Active) (0 hp each)	0.00	EA			$0.00	$0	
1586	Permeate Transfer Pumps (Standby) (0 hp each)	0.00	EA			$0.00	$0	
1587	Cleaning Solution Recirculation Pump (Active) (60 hp each)	1.00	EA			$33,212.01	$33,212	
1588	Cleaning Solution Recirculation Pump (Standby) (60 hp each)	1.00	EA			$33,212.01	$33,212	
1589	Dry Chemicals Transfer Pump (Active) (0 hp each)	0.00	EA			$28,788.27	$0	
1590	Spent Chemicals Neutralization Pumps (Active) (50 hp each)	2.00	EA			$0.00	$0	
1591	Spent Chemicals Neutralization Pumps (Standby) (50 hp each)	1.00	EA			$0.00	$0	
1592	Pretreatment Chemical Metering Pumps:							
1593	Sulfuric Acid Active Metering Pump (1 hp each)	1.00	EA			$7,991.45	$7,991	
1594	Sulfuric Acid Standby Metering Pump (1 hp each)	1.00	EA			$7,991.45	$7,991	
1595	Hydrochloric Acid Active Metering Pump (0 hp each)	0.00	EA			$7,991.45	$0	
1596	Hydrochloric Acid Standby Metering Pump (0 hp each)	0.00	EA			$7,991.45	$0	
1597	Scale Inhibitor Active Metering Pump (1 hp each)	1.00	EA			$7,991.45	$7,991	
1598	Scale Inhibitor Standby Metering Pump (1 hp each)	1.00	EA			$7,991.45	$7,991	
1599	Other Chemical 1 Active Metering Pump (0 hp each)	0.00	EA			$7,991.45	$0	
1600	Other Chemical 1 Standby Metering Pump (0 hp each)	0.00	EA			$7,991.45	$0	
1601	Other Chemical 2 Active Metering Pump (0 hp each)	0.00	EA			$7,991.45	$0	
1602	Other Chemical 2 Standby Metering Pump (0 hp each)	0.00	EA			$7,991.45	$0	
1603	Liquid CIP Chemical Transfer Pumps:							
1604	Sodium Hydroxide Active Transfer Pump (0 hp each)	1.00	EA			$28,788.27	$28,788	
1605	Sodium Hydroxide Standby Transfer Pump (0 hp each)	0.00	EA			$28,788.27	$0	
1606	Hydrochloric Acid Active Transfer Pump (0 hp each)	0.00	EA			$28,788.27	$0	
1607	Hydrochloric Acid Standby Transfer Pump (0 hp each)	0.00	EA			$28,788.27	$0	
1608	Sodium EDTA Active Transfer Pump (24 hp each)	1.00	EA			$28,788.27	$28,788	
1609	Sodium EDTA Standby Transfer Pump (0 hp each)	0.00	EA			$28,788.27	$0	
1610	Other Chemical 3 Active Transfer Pump (0 hp each)	0.00	EA			$28,788.27	$0	
1611	Other Chemical 3 Standby Transfer Pump (0 hp each)	0.00	EA			$28,788.27	$0	
1612	Other Chemical 4 Active Transfer Pump (0 hp each)	0.00	EA			$28,788.27	$0	
1613	Other Chemical 4 Standby Transfer Pump (0 hp each)	0.00	EA			$28,788.27	$0	
1614	Energy Recovery Devices (Turbocharger):							
1615	Turbocharger for Interstage Pressure Boost (Active) (0 hp each)	0.00	EA			$42,207.63	$0	
1616	Turbocharger for Interstage Pressure Boost (Standby) (0 hp each)	0.00	EA			$42,207.63	$0	
1617	Tanks:							
1618	Flushing Tanks (12902 gallons each)	1.00	EA			$33,064.77	$33,065	
1619	Cleaning Solution Tanks (10594 gallons each)	2.00	EA			$29,783.97	$59,568	
1620	Dry Chemicals Solution Preparation Tanks (0 gallons each)	0.00	EA			$14,721.18	$0	
1621	Neutralization Tanks (32937 gallons each)	2.00	EA			$61,550.00	$123,100	
1622	Pretreatment Chemicals Bulk Storage Tanks							
1623	Sulfuric Acid (5758 gallons each)	1.00	EA			$34,587.33	$34,587	
1624	Hydrochloric Acid (8225 gallons each)	0.00	EA			$49,410.48	$0	
1625	Scale Inhibitor (9400 gallons each)	1.00	EA			$17,782.87	$17,783	
1626	Other Chemical 1 (9400 gallons each)	0.00	EA			$17,782.87	$0	
1627	Other Chemical 2 (9400 gallons each)	0.00	EA			$17,782.87	$0	
1628	Liquid CIP Chemicals Bulk Storage Tanks							
1629	Sodium Hydroxide (0 gallons each)	0.00	EA			$0.00	$0	
1630	Hydrochloric Acid (8225 gallons each)	0.00	EA			$49,410.48	$0	
1631	Sodium EDTA (15887 gallons each)	1.00	EA			$28,437.22	$28,437	
1632	Other Chemical 3 (9306 gallons each)	0.00	EA			$17,608.17	$0	
1633	Other Chemical 4 (9306 gallons each)	0.00	EA			$17,608.17	$0	
1634	Dry CIP Chemicals Bulk Storage Silos							
1635	Citric Acid (0 cf each)	0.00	EA			$0.00	$0	
1636	Trisodium Phosphate (0 cf each)	0.00	EA			$0.00	$0	
1637	Sodium Tripolyphosphate (0 cf each)	0.00	EA			$0.00	$0	
1638	Other Chemical 5 (0 cf each)	0.00	EA			$0.00	$0	
1639	Mixers							
1640	Static Mixer	0.00	EA			$0.00	$0	
1641	CIP Tank Mixers (13 hp each)	2.00	EA			$33,105.33	$78,211	
1642	Dry Chemicals Mixers (0 hp each)	0.00	EA			$0.00	$0	
1643	Heaters & Chillers:							
1644	CIP Heaters (386 kw per each)	4.00	EA			$104,208.68	$417,124	
1645	Dry Chemicals Heater (0 kw per each)	0.00	EA			$0.00	$0	
1646	CIP Chillers (299213 BTU/hr each)	0.00	BTU/hr			$0.00	$0	
1647								
1648	Equipment Installation Factor							Equipment Installation Factor Percentage:
1649	Equipment Installation Factor (Default = 20% * Equipment Purchase Price)	20%				$5,927,230.40	$1,185,446	
1650	Allowance for Misc Items	2%				$5,927,230.40	$118,543	
1651	Subtotal						$7,231,221	
1652								
1653	I&C							
1654	Instruments							
1655	Flow Elements	20.00	EA			$8,584.58	$171,692	
1656	Isolation Valve Actuators (Electric)	84.00	EA			$6,007.16	$504,602	
1657	Isolation Valve Actuators (Pneumatic)	0.00	EA			$6,007.16	$0	
1658	Conductivity Meters	18.00	EA				$0	
1659	Turbidymeters	6.00	EA				$0	
1660	Temperature Elements	6.00	EA				$0	
1661	pH Meters	8.00	EA				$0	
1662	ORP Meters	12.00	EA				$0	
1663	Pressure Indicators Transmitters	12.00	EA			$8,445.21	$101,343	
1664	Pressure Elements	38.00	EA			$783.77	$26,743	
1665	Level Indicator Transmitters	5.00	EA			$8,022.95	$40,115	
1666	Chemical Tank Radar Level Transmitters	3.00	EA			$977.63	$2,933	
1667	Chemical Tank Beacon	3.00	EA			$977.63	$2,933	
1668	Drum or Tote Weigh Scale	0.00	EA			$1,323.30	$0	
1669	Metering Pump Discharge Pressure Switch	2.00	EA			$651.78	$1,304	
1670	Chemical Magmeters	2.00	EA			$651.78	$1,304	
1671	Sump Pump Float Switch	6.00	EA			$325.44	$1,955	

	B	C	D	E	F	G	H	I
1672	Eyewash Station	8.00	EA			$977.43	$7,821	
1673	Number of Analog I/O Counts	182.00	EA			$247.87	$45,075	
1674	Number of Digital I/O Counts	504.00	EA			$58.66	$29,584	
1675	Number of Local Panels	8.00	EA				$0	
1676	Number of PLC's	2.00	EA			$10,035.00	$20,070	
1677	I&C Conduit Wire	41662.33	LF	12759.84	m	$11.30	$473,105	
1678	Allowance for Misc Items	2%				$1,438,556.66	$28,731	
1679	Subtotal						$1,465,288	
1680								
1681	CONVEYING SYSTEMS							
1682	CIP System Monorail Hoist for Supersacks	1.00	EA			$3,863.06	$3,863	
1683	CIP System Hoist Rail	38.00	LF	11.58	m	$39.02	$1,483	
1684	Bridge Crane	1.00	EA			$86,120.69	$86,121	
1685	Bridge Crane Rail	112.00	LF	34.14	m	$34.34	$3,846	
1686	Allowance for Misc Items	5%				$75,312.88	$3,766	
1687	Subtotal						$79,079	
1688								
1689	MECHANICAL							
1690	Pipe:							
1691	Cartridge Filtration Influent Header (CFIH, 0 inch, FRP)	0.00	LF	0.00	m	$0.00	$0	
1692	Cartridge Filtration Influent Lateral (CFIL, 0 inch, FRP)	0.00	LF	0.00	m	$0.00	$0	
1693	Cartridge Filtration Effluent Lateral (CFEL, 0 inch, FRP)	0.00	LF	0.00	m	$0.00	$0	
1694	Cartridge Filtration Effluent Header (CFEH, 0 inch, FRP)	0.00	LF	0.00	m	$0.00	$0	
1695	Reverse Osmosis Influent Dump Header (ROIDH, 30 inch, FRP)	13.00	LF	3.96	m	$378.14	$4,916	
1696	Reverse Osmosis Influent Header (ROIH, 30 inch, FRP)	114.00	LF	34.75	m	$378.14	$43,108	
1697	High Pressure Pump Suction (HPPS, 10 inch, FRP)	141.50	LF	43.13	m	$121.78	$17,229	
1698	High Pressure Pump Discharge (HPPD, 10 inch, Duplex SST)	18.00	LF	5.49	m	$712.38	$12,823	
1699	Low Pressure Brine Outlet (ERD Discharge) (LPBRO, 8 inch, Duplex SST)	104.00	LF	31.70	m	$403.87	$41,982	
1700	Reverse Osmosis Influent Lateral (1st Stage) (ROIL1, 12 inch, Duplex SST)	36.00	LF	10.97	m	$866.74	$31,203	
1701	Reverse Osmosis Influent Lateral (2nd Stage) (ROIL2, 8 inch, Duplex SST)	18.00	LF	5.49	m	$568.03	$10,044	
1702	Reverse Osmosis Influent Lateral (3rd Stage) (ROIL3, 0 inch, Duplex SST)	0.00	LF	0.00	m	($59.40)	$0	
1703	Reverse Osmosis Influent Skid Sub Lateral (1st Stage) (ROISL1, 12 inch, Duplex SST)	97.98	LF	29.86	m	$0.00	$0	
1704	Reverse Osmosis Influent Skid Sub Lateral (2nd Stage) (ROISL2, 8 inch, Duplex SST)	97.98	LF	29.86	m	$0.00	$0	
1705	Reverse Osmosis Influent Skid Sub Lateral (3rd Stage) (ROISL3, 0 inch, Duplex SST)	0.00	LF	0.00	m	$0.00	$0	
1706	Brine Skid Sub Lateral (1st Stage) (BSL1, 10 inch, Duplex SST)	97.98	LF	29.86	m	$0.00	$0	
1707	Brine Skid Sub Lateral (2nd Stage) (BSL2, 8 inch, Duplex SST)	97.98	LF	29.86	m	$0.00	$0	
1708	Brine Skid Sub Lateral (3rd Stage) (BSL3, 0 inch, Duplex SST)	0.00	LF	0.00	m	$0.00	$0	
1709	Brine Lateral (1st Stage) (BL1, 10 inch, Duplex SST)	54.00	LF	16.46	m	$712.38	$38,469	
1710	Brine Lateral (2nd Stage) (BL2, 8 inch, Duplex SST)	410.98	LF	125.27	m	$558.03	$229,334	
1711	Brine Lateral (3rd Stage) (BL3, 0 inch, Duplex SST)	0.00	LF	0.00	m	($59.40)	$0	
1712	Brine Header (BH, 16 inch, Duplex SST)	102.00	LF	31.09	m	$1,175.45	$119,896	
1713	Permeate Lateral (1st Stage) (PL1, 10 inch, FRP)	339.23	LF	103.40	m	$121.76	$41,304	
1714	Permeate Lateral (2nd Stage) (PL2, 8 inch, FRP)	13.50	LF	4.11	m	$70.48	$952	
1715	Permeate Lateral (3rd Stage) (PL3, 0 inch, FRP)	0.00	LF	0.00	m	($6.43)	$0	
1716	Permeate Header to Flush Tank (PHFT, 24 inch, FRP)	202.15	LF	61.61	m	$301.23	$60,892	
1717	Cleaning Solution Pump Suction Header (CSPSH, 10 inch, FRP)	4.00	LF	1.22	m	$121.76	$487	
1718	Cleaning Solution Pump Suction Lateral (CSPSL, 10 inch, FRP)	4.00	LF	1.22	m	$121.78	$487	
1719	Cleaning Solution Pump Discharge Lateral (CSPDL, 10 inch, FRP)	5.35	LF	1.63	m	$121.76	$652	
1720	Cleaning Solution Pump Discharge Header (CSPDH, 10 inch, FRP)	11.34	LF	3.46	m	$121.78	$1,381	
1721	Cleaning Solution Pump Recycle (CSPR, 10 inch, FRP)	20.90	LF	6.37	m	$121.76	$2,545	
1722	Cleaning Solution Cartridge Filtration Influent Lateral (CSCFIL, 10 inch, FRP)	4.00	LF	1.22	m	$121.78	$487	
1723	Cleaning Solution Cartridge Filtration Effluent Lateral (CSCFEL, 10 inch, FRP)	4.00	LF	1.22	m	$121.76	$487	
1724	Cleaning Solution Supply Header (CSSH, 10 inch, FRP)	107.75	LF	32.84	m	$121.78	$13,120	
1725	Cleaning Solution Supply Lateral (CSSL, 10 inch, FRP)	25.50	LF	7.77	m	$121.76	$3,105	
1726	Brine Cleaning Solution Return Header (BCSRH, 10 inch, FRP)	132.60	LF	40.42	m	$121.78	$16,145	
1727	Brine Cleaning Solution Return Lateral (BCSRL, 10 inch, FRP)	47.40	LF	14.45	m	$121.76	$5,772	
1728	Permeate Cleaning Solution Return Header (PCSRH, 3 inch, FRP)	132.60	LF	40.42	m	$32.03	$4,247	
1729	Permeate Cleaning Solution Return Lateral (PCSRL, 3 inch, FRP)	160.74	LF	48.99	m	$32.03	$5,148	
1730	Permeate Flushing Line (PFL, 10 inch, FRP)	112.24	LF	34.21	m	$121.78	$13,666	
1731	Bypass Blend Cartridge Filter Influent (BBCFIL, 12 inch, FRP)	0.00	LF	0.00	m	$147.40	$0	
1732	Bypass Blend Cartridge Filter Effluent (BBCFEL, 12 inch, FRP)	0.00	LF	0.00	m	$147.40	$0	
1733	Bypass Blend Line (BBL, 12 inch, FRP)	30.00	LF	9.14	m	$147.40	$4,422	
1734	Common Spare High Pressure Pump Suction (CSHPPS, 0 inch, FRP)	0.00	LF	0.00	m	($6.43)	$0	
1735	Common Spare High Pressure Pump Discharge (CSHPPD, 0 inch, Duplex SST)	0.00	LF	0.00	m	($59.40)	$0	
1736								
1737	Fittings:							
1738	Cartridge Filtration Influent Header (CFIH, 0 inch, FRP)	0.00	EA			$0.00	$0	
1739	Cartridge Filtration Influent Lateral (CFIL, 0 inch, FRP)	0.00	EA			$0.00	$0	
1740	Cartridge Filtration Effluent Lateral (CFEL, 0 inch, FRP)	0.00	EA			$0.00	$0	
1741	Cartridge Filtration Effluent Header (CFEH, 0 inch, FRP)	0.00	EA			$0.00	$0	
1742	Reverse Osmosis Influent Dump Header (ROIDH, 30 inch, FRP)	3.00	EA			$1,512.57	$4,538	
1743	Reverse Osmosis Influent Header (ROIH, 30 inch, FRP)	2.00	EA			$1,512.57	$3,025	
1744	High Pressure Pump Suction (HPPS, 10 inch, FRP)	0.00	EA			$487.04	$0	
1745	High Pressure Pump Discharge (HPPD, 10 inch, Duplex SST)	6.00	EA			$2,935.81	$17,615	
1746	Low Pressure Brine Outlet (ERD Discharge) (LPBRO, 6 inch, Duplex SST)	18.00	EA			$1,630.32	$29,346	
1747	Reverse Osmosis Influent Lateral (1st Stage) (ROIL1, 12 inch, Duplex SST)	0.00	EA			$3,588.55	$0	
1748	Reverse Osmosis Influent Lateral (2nd Stage) (ROIL2, 8 inch, Duplex SST)	24.00	EA			$2,283.07	$54,794	
1749	Reverse Osmosis Influent Lateral (3rd Stage) (ROIL3, 0 inch, Duplex SST)	0.00	EA			($327.90)	$0	
1750	Reverse Osmosis Influent Skid Sub Lateral (1st Stage) (ROISL1, 12 inch, Duplex SST)	0.00	EA			$0.00	$0	
1751	Reverse Osmosis Influent Skid Sub Lateral (2nd Stage) (ROISL2, 8 inch, Duplex SST)	0.00	EA			$0.00	$0	
1752	Reverse Osmosis Influent Skid Sub Lateral (3rd Stage) (ROISL3, 0 inch, Duplex SST)	0.00	EA			$0.00	$0	
1753	Brine Skid Sub Lateral (1st Stage) (BSL1, 10 inch, Duplex SST)	0.00	EA			$0.00	$0	
1754	Brine Skid Sub Lateral (2nd Stage) (BSL2, 8 inch, Duplex SST)	0.00	EA			$0.00	$0	
1755	Brine Skid Sub Lateral (3rd Stage) (BSL3, 0 inch, Duplex SST)	0.00	EA			$0.00	$0	
1756	Brine Lateral (1st Stage) (BL1, 10 inch, Duplex SST)	6.00	EA			$2,935.81	$17,615	
1757	Brine Lateral (2nd Stage) (BL2, 8 inch, Duplex SST)	12.00	EA			$2,283.07	$27,397	
1758	Brine Lateral (3rd Stage) (BL3, 0 inch, Duplex SST)	0.00	EA			($327.90)	$0	
1759	Brine Header (BH, 16 inch, Duplex SST)	0.00	EA			$4,094.03	$0	
1760	Permeate Lateral (1st Stage) (PL1, 10 inch, FRP)	12.00	EA			$487.04	$5,844	
1761	Permeate Lateral (2nd Stage) (PL2, 8 inch, FRP)	8.00	EA			$281.93	$1,692	
1762	Permeate Lateral (3rd Stage) (PL3, 0 inch, FRP)	0.00	EA			($25.73)	$0	
1763	Permeate Header to Flush Tank (PHFT, 24 inch, FRP)	5.00	EA			$1,204.91	$6,025	
1764	Cleaning Solution Pump Suction Header (CSPSH, 10 inch, FRP)	1.00	EA			$487.04	$487	
1765	Cleaning Solution Pump Suction Lateral (CSPSL, 10 inch, FRP)	0.00	EA			$487.04	$0	
1766	Cleaning Solution Pump Discharge Lateral (CSPDL, 10 inch, FRP)	2.00	EA			$487.04	$974	
1767	Cleaning Solution Pump Discharge Header (CSPDH, 10 inch, FRP)	0.00	EA			$487.04	$0	
1768	Cleaning Solution Pump Recycle (CSPR, 10 inch, FRP)	4.00	EA			$487.04	$1,948	
1769	Cleaning Solution Cartridge Filtration Influent Lateral (CSCFIL, 10 inch, FRP)	1.00	EA			$487.04	$487	
1770	Cleaning Solution Cartridge Filtration Effluent Lateral (CSCFEL, 10 inch, FRP)	1.00	EA			$487.04	$487	
1771	Cleaning Solution Supply Header (CSSH, 10 inch, FRP)	5.00	EA			$487.04	$2,435	
1772	Cleaning Solution Supply Lateral (CSSL, 10 inch, FRP)	0.00	EA			$487.04	$0	
1773	Brine Cleaning Solution Return Header (BCSRH, 10 inch, FRP)	5.00	EA			$487.04	$2,435	
1774	Brine Cleaning Solution Return Lateral (BCSRL, 10 inch, FRP)	12.00	EA			$487.04	$5,844	
1775	Permeate Cleaning Solution Return Header (PCSRH, 3 inch, FRP)	5.00	EA			$128.10	$641	
1776	Permeate Cleaning Solution Return Lateral (PCSRL, 3 inch, FRP)	12.00	EA			$128.10	$1,537	
1777	Permeate Flushing Line (PFL, 10 inch, FRP)	1.00	EA			$487.04	$487	
1778	Bypass Blend Cartridge Filter Influent (BBCFIL, 12 inch, FRP)	0.00	EA			$589.59	$0	
1779	Bypass Blend Cartridge Filter Effluent (BBCFEL, 12 inch, FRP)	0.00	EA			$589.59	$0	
1780	Bypass Blend Line (BBL, 12 inch, FRP)	1.00	EA			$589.59	$590	
1781	Common Spare High Pressure Pump Suction (CSHPPS, 0 inch, FRP)	0.00	EA			($25.73)	$0	
1782	Common Spare High Pressure Pump Discharge (CSHPPD, 0 inch, Duplex SST)	0.00	EA			($327.90)	$0	
1783								
1784	Valves:							
1785	Cartridge Filtration Influent Header (CFIH, 0 inch,)	0.00	EA			$0.00	$0	
1786	Cartridge Filtration Influent Lateral (CFIL, 0 inch,)	0.00	EA			$0.00	$0	
1787	Cartridge Filtration Effluent Lateral (CFEL, 0 inch,)	0.00	EA			$0.00	$0	
1788	Cartridge Filtration Effluent Header (CFEH, 0 inch,)	0.00	EA			$0.00	$0	
1789	Reverse Osmosis Influent Dump Header (ROIDH, 30 inch,)	1.00	EA			$22,555.29	$22,555	
1790	Reverse Osmosis Influent Header (ROIH, 30 inch,)	0.00	EA			$22,555.29	$0	
1791	High Pressure Pump Suction (HPPS, 10 inch,)	6.00	EA			$7,224.55	$43,347	
1792	High Pressure Pump Discharge (HPPD, 10 inch, SST Teflon Lined)	0.00	EA			$7,224.55	$0	
1793	Low Pressure Brine Outlet (ERD Discharge) (LPBRO, 6 inch, SST Teflon Lined)	6.00	EA			$4,158.40	$24,950	
1794	Reverse Osmosis Influent Lateral (1st Stage) (ROIL1, 12 inch, SST Teflon Lined)	6.00	EA			$8,757.62	$52,546	

	B	C	D	E	F	G	H	I
1793	Reverse Osmosis Influent Lateral (2nd Stage) (ROIL2, 8 inch, SST Teflon Lined)	6.00	EA			$5,691.47	$34,149	
1794	Reverse Osmosis Influent Lateral (3rd Stage) (ROIL3, 0 inch, SST Teflon Lined)	0.00	EA			($440.82)	$0	
1795	Reverse Osmosis Influent Skid Sub Lateral (1st Stage) (ROISL1, 12 inch, SST Teflon Lined)	0.00	EA			$0.00	$0	
1796	Reverse Osmosis Influent Skid Sub Lateral (2nd Stage) (ROISL2, 8 inch, SST Teflon Lined)	0.00	EA			$0.00	$0	
1797	Reverse Osmosis Influent Skid Sub Lateral (3rd Stage) (ROISL3, 0 inch, SST Teflon Lined)	0.00	EA			$0.00	$0	
1798	Brine Skid Sub Lateral (1st Stage) (BSL1, 10 inch, SST Teflon Lined)	0.00	EA			$0.00	$0	
1799	Brine Skid Sub Lateral (2nd Stage) (BSL2, 8 inch, SST Teflon Lined)	6.00	EA			$0.00	$0	
1800	Brine Skid Sub Lateral (3rd Stage) (BSL3, 0 inch, SST Teflon Lined)	0.00	EA			$0.00	$0	
1801	Brine Lateral (1st Stage) (BL1, 10 inch, SST Teflon Lined)	6.00	EA			$7,224.55	$43,347	
1802	Brine Lateral (2nd Stage) (BL2, 8 inch, SST Teflon Lined)	6.00	EA			$5,691.47	$34,149	
1803	Brine Lateral (3rd Stage) (BL3, 0 inch, SST Teflon Lined)	0.00	EA			($440.82)	$0	
1804	Brine Header (BH, 16 inch, SST Teflon Lined)	0.00	EA			$11,823.77	$0	
1805	Permeate Lateral (1st Stage) (PL1, 10 inch,)	6.00	EA			$7,224.55	$43,347	
1806	Permeate Lateral (2nd Stage) (PL2, 6 inch,)	6.00	EA			$4,158.40	$24,950	
1807	Permeate Lateral (3rd Stage) (PL3, 0 inch,)	0.00	EA			($440.82)	$0	
1808	Permeate Header to Flush Tank (PHFT, 24 inch,)	1.00	EA			$17,966.07	$17,966	
1809	Cleaning Solution Pump Suction Header (CSPSH, 10 inch,)	1.00	EA			$7,224.55	$7,225	
1810	Cleaning Solution Pump Suction Lateral (CSPSL, 10 inch,)	1.00	EA			$7,224.55	$7,225	
1811	Cleaning Solution Pump Discharge Lateral (CSPDL, 10 inch,)	2.00	EA			$7,224.55	$14,449	
1812	Cleaning Solution Pump Discharge Header (CSPDH, 10 inch,)	0.00	EA			$7,224.55	$0	
1813	Cleaning Solution Pump Recycle (CSPR, 10 inch,)	2.00	EA			$7,224.55	$14,449	
1814	Cleaning Solution Cartridge Filtration Influent Lateral (CSCFIL, 10 inch,)	1.00	EA			$7,224.55	$7,225	
1815	Cleaning Solution Cartridge Filtration Effluent Lateral (CSCFEL, 10 inch,)	1.00	EA			$7,224.55	$7,225	
1816	Cleaning Solution Supply Header (CSSH, 10 inch,)	0.00	EA			$7,224.55	$0	
1817	Cleaning Solution Supply Lateral (CSSL, 10 inch,)	6.00	EA			$7,224.55	$43,347	
1818	Brine Cleaning Solution Return Header (BCSRH, 10 inch,)	1.00	EA			$7,224.55	$7,225	
1819	Brine Cleaning Solution Return Lateral (BCSRL, 10 inch,)	6.00	EA			$7,224.55	$43,347	
1820	Permeate Cleaning Solution Return Header (PCSRH, 3 inch,)	0.00	EA			$1,858.79	$0	
1821	Permeate Cleaning Solution Return Lateral (PCSRL, 3 inch,)	6.00	EA			$1,858.79	$11,153	
1822	Permeate Flushing Line (PFL, 10 inch,)	1.00	EA			$7,224.55	$7,225	
1823	Bypass Blend Cartridge Filter Influent (BBCFIL, 12 inch,)	0.00	EA			$8,757.62	$0	
1824	Bypass Blend Cartridge Filter Effluent (BBCFEL, 12 inch,)	0.00	EA			$8,757.62	$0	
1825	Bypass Blend Line (BBL, 12 inch,)	1.00	EA			$8,757.62	$8,758	
1826	Common Spare High Pressure Pump Suction (CSHPPS, 0 inch,)	0.00	EA			($440.82)	$0	
1827	Common Spare High Pressure Pump Discharge (CSHPPD, 0 inch, SST Teflon Lined)	0.00	EA			($440.82)	$0	
1828	Allowance for Misc Items	2%				$1,430,689.77	$28,614	
1829	Subtotal						$1,459,304	

LIQUID CHEM 1

Liquid Chemical Storage & Feed - (Aluminum Sulfate (Alum))

Located in Chemical Building A

Is the Facility Storage Only (no metering pumps)?	No	Y/N					
		Overwrite Value					
Select Chemical	Aluminum Sulfate (Alum)		Select "Other" from the drop down list if using a different chemical.				
Percent Active Chemical % w/w	48.50%		This is the intended feed strength to the process. Inputting a value in the yellow cell overwrites the cell in column "C"				For Fluoride systems, concentration must include the Available Fluoride Ion (AFI) concentration. Typically 79.2% AFI for 23% as HFA. (e.g., 23% as HFA x 79.2% AFI = 18.22% as F)
Active Chemical Form for Dosage Basis	Al2(SO4)3-14H2O		Inputting a value in the yellow cell overwrites the cell in column "C"				
Bulk Chemical Specific Gravity	1.34		Inputting a value in the yellow cell overwrites the cell in column "C"				
Active lb/gal solution	5.42	lb/gal	649.48	kg/m3			
Process User Inputs:	**Value (English)**	**Unit (English)**	**Value (Metric)**	**Unit (Metric)**	**Name**	**Red Flags**	**Comment**
FLOW AND CHEMICAL ADDITION							
Application #1							
1.) Minimum flow to application point	4.00	mgd	15.14	ML/d			Input the flow that the selected dose will be applied to.
2.) Average flow to application point	4.00	mgd	15.14	ML/d			Input the flow that the selected dose will be applied to.
3.) Maximum flow to applicatoin point	12.00	mgd	45.42	ML/d			Input the flow that the selected dose will be applied to.
4.) Minimum chemical addition	40.00	mg/L					Input the dose that corresponds to the flow input above.
5.) Average chemical addition	40.00	mg/L					Input the dose that corresponds to the flow input above.
6.) Maximum chemical addition	80.00	mg/L					Input the dose that corresponds to the flow input above.
7.) Input Number of Equal Simultaneous Application Points	1	#					
8.) Hours of addition per day	24.00	hr					Input the total number of hours that the chemical is fed during the day.
Application #2							
9.) Minimum flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
10.) Average flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
11.) Maximum flow to applicatoin point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
12.) Minimum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
13.) Average chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
14.) Maximum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
15.) Input Number of Equal Simultaneous Application Points	0	#					
16.) Hours of addition per day	0.00	hr					Input the total number of hours that the chemical is fed during the day.
Application #3							
17.) Minimum flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
18.) Average flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
19.) Maximum flow to applicatoin point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
20.) Minimum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
21.) Average chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
22.) Maximum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
23.) Input Number of Equal Simultaneous Application Points	0	#					
24.) Hours of addition per day	0.00	hr					Input the total number of hours that the chemical is fed during the day.
CHEMICAL QUANTITIES AND FLOW							
Application Point #1 Chemical Usage							
Minimum as "dry" chemical	1334.40	lb/d	605.27	kg/d			
Average as "dry" chemical	1334.40	lb/d	605.27	kg/d			
Maximum as "dry" chemical	8008.40	lb/d	3631.64	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump:							
Minimum at feed concentration	10.26	gph	38.83	L/h			
Average at feed concentration	10.26	gph	38.83	L/h			
Maximum at feed concentration	61.55	gph	232.98	L/h			
Calculate Chemical Metering Pump Flow Turndown	6.00	1					Should be < 20:1, if ≥ 20:1, proceed with caution.
Application Point #2 Chemical Usage							
Minimum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Average as "dry" chemical	0.00	lb/d	0.00	kg/d			
Maximum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump:							
Minimum at feed concentration	0.00	gph	0.00	L/h			
Average at feed concentration	0.00	gph	0.00	L/h			
Maximum at feed concentration	0.00	gph	0.00	L/h			
Calculate Chemical Metering Pump Flow Turndown	0.00	1					Should be < 20:1, if ≥ 20:1, proceed with caution.
Application Point #3 Chemical Usage							
Minimum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Average as "dry" chemical	0.00	lb/d	0.00	kg/d			
Maximum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump:							
Minimum at feed concentration	0.00	gph	0.00	L/h			
Average at feed concentration	0.00	gph	0.00	L/h			

Maximum Applied Concentration	0.00	ppm	0.00	mg/L			
Calculate Chemical Metering Pump Flow Turndown	0.00	:1					Should be < 20:1, if > 20:1, proceed with caution
Whole Plant Chemical Usage for Storage Calcs:							
Minimum	1334.40	lb/d	605.27	kg/d			
Average	1334.40	lb/d	605.27	kg/d			
Maximum	8006.40	lb/d	3631.64	kg/d			
Max Flow Average Dose Daily Usage	4003.20	lb/d					
Whole Plant # of Days of Storage							
Maximum Flow and Average Dose	30.00	days					
CHEMICAL STORAGE INPUTS							
25.) Flow used to calculate storage requirements	Maximum	Type					
26.) Chemcial application used to calculate storage requirements	Average	Type					
27.) Input Minimum Number of Days of Storage	30.00	days					
Minimum Storage Volume	22157.25	gal	83.87	m3			
28.) Choose Chemical Delivery Method	Tank Truck	Type					
Bulk Delivery Volume (Tank Truck, Totes, Drums)	4,026.63	gal	15.24	m3			Assumes 45,000 lb per Tank Truck
Optional: Input Bulk Delivery Volume for Selected Delivery Method (overwrites above calculation)		gal		m3			Not typically used. Use with caution.
Calculate Bulk Delivery Volume * 1.5 (for Truck Delivery Only)	6,039.94	gal	22.86	m3			
Maximum of Above Delivery and Storage Volumes	2961.99	cf	83.87	m3			
BULK TANKS:							
29.) Input Number of Tanks	2	#					
30.) Input Tank Diameter	12.00	ft	3,657.60	mm	BTD		Greater than 14' tank diameter will requ on-site tank fabrication. Maximum diameter allowed for this model is 14'
Calculate Liquid Height of Tanks	13.09	ft	3991.32	mm			
Use this Tank Height (Liquid Height * 1.2)	16.00	ft	4876.80	mm		**Verify tank height in relationship to the facility structure. Add more tanks or increase diameter if needed.**	Verify tank height within the facility. If indoors, typically 4' lower than the roof framing structure. Assumes extra 20% volume needed for each tank for head space and outlet connection elevation.
Calculate Usable Volume of Each Bulk Tank	11280.36	gal	42.70	m3			Assumes 20% of the volume of each ta is not usable (needed for head space a outlet connection elevation).
Calculate Volume of Each Bulk Tank	13536.43	gal	51.24	m3			
31.) Input Number of Rows of Tanks	1	#					
Calculate Number of Tanks per Row	2	#					
32.) Input Tank Material (FRP, PE (Polyethylene), PLS (Phenolic Lined Steel))	FRP	Type					Typically FRP
33.) Input Clear Distance Around BulkTanks, Day Tanks, Totes or Drums	4.00	ft	1,219.20	mm	CDT		Typically ≥ 3 ft
Calculate Actual Number of Days of Storage	30.55	days					For bulk tanks, assumes 20% of the volume of each tank is not usable (nee for head space and outlet connection elevation).
TOTES & DRUMS:							
Calculate Number of Totes or Drums	0	#					
34.) Input Number of Rows of Totes or Drums	1	#					
Calculate Number of Totes or Drums per Row	0	#					
Length of Each Tote	0.00	ft	0.00	mm			Fixed
Width of Each Tote	0.00	ft	0.00	mm			Fixed
Diameter of Each Drum	0.00	ft	0.00	mm			Fixed
DAY TANKS:							
35.) Are Day Tanks Required?	No	Y/N					Rule: Day Tanks are only available wh the Delivery Method = "Tank Truck".
36.) Input Number of Day Tanks	2	#					Suggest 2 Day Tanks
Calculate Day Tank Volume based on Max Flow/Dose (per tank)	0.00	gal	0.00	m3			
Convert Day Tank Volume (per each)	0.00	cf	0.00	m3			
Calculate Day Tank Diameter (per each)	0.00	ft	0.00	mm	DTD		
Calculate Day Tank Height (per each)	0.00	ft	0.00	mm			Assumption: H = 2 * D
TRANSFER & METERING PUMPS:							
Number of Transfer Pumps	0	#					Fixed
37.) Input Time to Fill Day Tank	20.00	min					Typically fill all day tanks in 20 min
Calculate Number of Active Metering Pumps	1	#					Rule: One active metering pump per e application point.
Calculate Number of Standby Metering Pumps	1	#					Rule: One standby metering pump per each application
38.) Input Number of Additional Standby Metering Pumps	0	#					
Calculate Total Number of Metering Pumps	2	#					
39.) Input Clear Distance Around Transfer and Metering Pumps	3.00	ft	914.40	mm	CDP		Typically ≥ 4 ft
Length of Transfer and Metering Pumps	3.00	ft	914.40	mm			Fixed. Conservatively assumes Pulsafeeder metering pump type
FACILITY SIZING:							
40.) Is this Chemical Room Part of a Multiple Chemical Facility?	Yes	Y/N					
41.) Is this Chemical Room Considered the "Start Point" for this Chemical Facility?	Yes	Y/N					There should only be one "start point" p chemical facility. Recommend choosin the facility with the greatest width as th "start point".
42.) If this is Part of a Multiple Chemical Facility and is the "Start Point", Input the Summation of Total Number of Pumps from the Other Chemical Rooms Here	4	#					Total number of pumps is listed in row of the liquid chemical facility, rows 140 151, and 162 of the dry chemical faciit and row 122 of the potassium permanganate facility
43.) Input Common Chemical Access Corridor Width	8.00	ft	2,438.40	mm			Input zero if a corridor is not required. Assumes Chem facilities are in series Chem facilities are in parallel, input 1/2 total corridor width.
44.) Is Corridor Covered?	Yes	Y/N					
45.) Select Chemical Facility Covering	Building						
46.) Select Chemical Area for this Chemical	A						Only used to help CPES user organize chemicals when multiple chemical buildings are used. Has no impact on sizing calculations or cost.
CONTAINMENT AREA:							
Are Stairs Required into Containment Area?	Yes	Y/N					Typically not needed for tote and drum storage areas.
Is Grating Required in Containment Area?	Yes	Y/N					Typically not needed for tote and drum storage areas.
Width of Stair Access	4.00	ft	1219.20	mm	WS		Fixed
Calculate Containment Area Length	36.00	ft	10972.80	mm			

Calculate Containment Area Width	33 00	ft	10058 40	mm		Note: verify that this dimension matches the Containment Area Width on the other chemical rooms in this facility. If not, input the larger value in the user overwrite on the room with the shorter dimension	
47) Optional: User Overwrite of Containment Area Width		ft	2,438.40	mm			
Calculate Fire Sprinkler Water Volume	4752 00	gal	17 99	m3			Assumes 0 2 gpm/sf for 20 min if chemical installed inside a building. If chemical is outside or under a canopy, assume no fire sprinkler water volume.
Calculate 120% of One Storage Tank Volume	16243 71	gal	61 49	m3			
Calculate 30% of All Tank Volume	8121 86	gal	30.74	m3			
Calculate Maximum Volume + Fire Flow Volume	20995 71	gal	79.48	m3			
Tank Pads Volume	678 58	cf	19 22	m3			
Tank Pads Volume	5076 16	gal	19 22	m3			
Calculate Maximum Volume + Fire Flow Volume + Tank Pad Volume	26071 87	gal	98 69	m3			
Calculate Maximum Volume + Fire Flow Volume + Tank Pad Volume	3485 30	cf	98 69	m3			
Calculate Containment Wall Height (including freeboard)	3 43	ft	1046 81	mm		Note: verify that this dimension matches the Containment Wall Height on the other chemical rooms in this facility. If not, input the larger value in the user overwrite on the room with the shorter dimension	120% of 1 tank volume or 30% of all tank volume whichever is greater + fire flow volume + 6" freeboard. Should be ≤ 4 5'.
48.) Optional: User Overwrite of Containment Wall Height		ft		mm			
49) Input Depth of Burial	0.00	ft	0.00	mm	DB		
50.) Input Cutback Slope	1.00	:1					Cutback slope should be 1:1 for depth of burial ≤ 5 ft, and at least 1.5:1 for depth of burial > 5 ft.
51.) Input Over Excavation Depth	1.00	ft	0.00	mm	OEXD		

Mechanical Sizing Requirements:

Pipe Name	Input Velocity	Unit (English)	Input Velocity	Unit (Metric)	Standard Pipe Size	Unit (English)	Nominal Pipe Size
Chemical Transfer Pump Suction Header Piping	5.00	fps	1.52	m/s	1.00	in	25 00
Chemical Transfer Pump Discharge Header Piping	6.00	fps	1.83	m/s	1.00	in	25 00
Chemical Metering Pump Suction Header Piping	5.00	fps	1.52	m/s	1.00	in	25 00
Chemical Metering Pump Discharge Header Piping	6.00	fps	1.83	m/s	1.00	in	25 00

Mechanical Material Requirements:

Pipe Name	Pipe ID	Installation Type	Pipe Material	Pipe Lining Material	Pipe Coating Material	Pipe Length	# Elbows
Chemical Transfer Pump Suction Header Piping	CTSH	Exposed	PVC	NA	NA	0.00	0.00
Chemical Transfer Pump Discharge Header Piping	CTDH	Exposed	PVC	NA	NA	0.00	0.00
Chemical Metering Pump Suction Header Piping	LCSH	Exposed	PVC	NA	NA	69.00	8.00
Chemical Metering Pump Discharge Header Piping	LCDH	Exposed	PVC	NA	NA	69.00	8.00
						L+W	#MP*4

Electrical User Inputs and Sizing Requirements:

52.) Is this a "Critical" Facility (requiring standby power)?	No	Y/N
53.) Is there SWGR?	No	

Electrical Equipment Lengths:

Item	Quantity	HP per Each	AFD's Required?	MCC Spaces for Motor Starters	MCC Spaces for AFD's less than 50hp)	MCC Spaces for Breakers	MCC Total MCC Spaces
Metering Pumps	6.00	0.50	No	12.00	0.00	0.00	
User Defined Item #1	0.00	0.00	No	0.00	0.00	0.00	
User Defined Item #2	0.00	0.00	No	0.00	0.00	0.00	
User Defined Item #3	0.00	0.00	No	0.00	0.00	0.00	
TOTAL		3.00		12.00	0.00	0.00	12.00

Electrical Equipment Widths:

Equipment	Depth (ft)
MCC	1.67
Small AFD's	0.00
Large AFD's	0.00
Switchgear	0.00
Maximum Depth	1.67

Clear Distances:

Clear Distance	Width	Length	Comment	
CD1		3.00	Clear Distance between wall and MCC	Typically 3 feet
CD2		1.00	Clear Distance between MCC and Small AFD	Typically 1 foot
CD3		0.00	Clear Distance between Small AFD and Large AFD	Typically Zero
CD4		0.00	Clear Distance between Large AFD and Switchgear	Typically Zero
CD5		0.00	Clear Distance between Switchgear and Contingency Space	Typically Zero
CD6	4.00		Clear Distance behind Switchgear (If there is no Switchgear, this distance will be Zero)	
CD7	3.00		Clear Distance in front of Equipment	Typically 3 feet
Contingency Length		0.00	Contingency length	Typically Zero

Electric Room Length (ft):

CD1	3.00
MCC	8.33
CD2	1.00
Small AFD's	0.00
CD3	0.00
Large AFD's	0.00
CD4	0.00
Swithgear	0.00
CD5	0.00
Contingency	0.00
Total Length	12.33

Electric Room Width (ft):

CD6	0.00	If there is no switchgear, this distance will be Zero.
Maximum Equipment Depth	1.67	
CD7	3.00	
Total Width	4.67	

COST TABLE FOR TANKS & PUMPS:	Unit Cost
Tanks (Installed Cost per Gallon)	
FRP	$2.18
Polyethylene (PE)	$ 2.11
Phenolic Lined Steel (PLS)	$6.01
Chemical Feed Pumps (Cost per Each)	$7,991.45

Estimating Dimensions:	Value English	Unit (English)	Value (Metric)	Unit (Metric)	Name	Comment	Red Flags
Logic Tests ("1" = Yes, "0" = No):							
Is this Chemical Feed System included?	1						
Is the Method of Delivery "Tank Truck"?	1						
Is Day Tank Required? (1 = Yes, 0 = No)	0						
Tank Truck without Day Tank (True or False)	TRUE						
Tank Truck with Day Tank (True or False)	FALSE						
Tank Truck without Day Tank (1 = Yes, 0 = No)	1					Tank Truck without Day Tank	
Tank Truck with Day Tank (1 = Yes, 0 = No)	0					Tank Truck without Day Tank	
Is the Method of Delivery "Tote"?	0					Tote	
Is the Method of Delivery "Drum"?	0					Drum	
Length of Module (Tank Truck)	36.00	ft	10972.80	mm			
Length of Module (Tote)	0.00	ft	0.00	mm			
Length of Module (Drum)	0.00	ft	0.00	mm			
Width of Module (Tank Truck without Transfer Pump and Day Tank)	33.00	ft	10058.40	mm			
Width of Module (Tank Truck with Transfer Pump and Day Tank)	0.00	ft	0.00	mm			
Width of Module (Tote)	0.00	ft	0.00	mm			
Width of Module (Drum)	0.00	ft	0.00	mm			
Area of Module	0.00	sf	0.00	m2			
Number of Bulk Tanks (each)	2	#					
Diameter of Bulk Tank	12.00	ft	3657.60	mm			
Volume of Each Bulk Tank	13536.43	gal	51.24	m3			
Bulk Tank Material	FRP	Type					
Number of Day Tanks (each)	0	#					
Diameter of Day Tank	0.00	ft					
Volume of Each Day Tank	0.00	gal	0.00	m3			
Number of Transfer Pumps	0	#					
Transfer Pump Capacity (each)	0.00	gpm	0.00	l/min		Assume fill each tank in 20 min	
Number of Metering Pumps	2	#					
Module Covered? ("1" = YES, "0" = NO)	0						
If Module Exists, Is it Covered? ("1" = Yes, "0" = No)	0						
Containment Wall Height	3.43	ft	1046.61	mm			
Slab on Grade Thickness	9.00	in	228.60	mm		Model based on 9"	
Slab on Grade Thickness	0.75	ft	228.60	mm			
Containment Wall Thickness	8.00	in	203.20	mm		Model based on 8"	
Containment Wall Thickness	0.67	ft	203.20	mm			
Tank Pad / Metering Pump Pad Height	3.00	ft	914.40	mm	EPH		
Corridor							
Length	36.00	ft	10972.80	mm			
Width	8.00	ft	2438.40	mm			
Area	288.00	sf	26.76	m2			
Corridor Covered? ("1" = YES, "0" = NO)	1						
Electrical Room:							
Slab on Grade:							
Length	13.67	ft	4165.60	mm			
Width	6.00	ft	1828.80	mm			
Concrete Thickness	12.00	in	304.80	mm		Model based on 12"	
Concrete Thickness	1.00	ft	304.80	mm			
Walls:							
Height = FBD	10.00	ft				Fixed	
Concrete Thickness	8.00	in	203.20	mm		Model based on 8"	
Concrete Thickness	0.67	ft	203.20	mm			
Overall Dimensions							
Containment Area Length	36.00	ft	10972.80	mm			
Containment Area Width	33.00	ft	10058.40	mm			
Containment Area	1188.00	sf	110.37	m2			
Corridor Area Length	36.00	ft	10972.80	mm			
Corridor Area Width	8.00	ft	2438.40	mm			
Corridor Area	288.00	sf	26.76	m2			
Electrical Area Length	13.67	ft	4165.60	mm			
Electrical Area Width	6.00	ft	1828.80	mm			
Electrical Room Area	82.00	sf	7.62	m2			
Chemical Facility Area	1558.00	sf	144.74	m2			
Covered Chemical Area (Building)	1558.00	sf	144.74	m2			
Covered Chemical Area (Canopy)	0.00	sf	0.00	m2			
Total Covered Area	1640.00	sf	152.36	m2			
Excavation Depth	1.75	ft	533.40	mm			

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
SITEWORK:							
Excavation	122.88	CY	93.95	m3	$6.35	$780	
Imported Structural Backfill	115.41	CY	88.24	m3	$48.10	$5,551	
Native Backfill	8.73	CY	6.68	m3	$7.80	$68	
Haul Excess	114.15	CY	87.27	m3	$7.80	$891	
Allowance for Misc Items	5%				$7,290.08	$365	
Subtotal						$7,655	
CONCRETE:							
Slab on Grade	39.70	CY	30.35	m3	$356.31	$14,145	
Containment Walls	11.70	CY	8.95	m3	$704.01	$8,237	
Bulk Tank Pads	44.66	CY	34.16	m3	$356.31	$15,920	
Day Tank Pads	0.00	CY	0.00	m3	$356.31	$0	
Transfer Pump Pads	0.00	CY	0.00	m3	$356.31	$0	
Metering Pump Pads	1.33	CY	1.02	m3	$356.31	$475	
Corridor							
Slab on Grade	10.00	CY	7.65	m3	$356.31	$3,563	
Electrical Room							
Slab on Grade	3.04	CY	2.32	m3	$356.31	$1,082	
Allowance for Misc Items	5%				$43,421.81	$2,171	
Subtotal						$45,593	
MASONRY:	Moderate						
Chemical Building	1558.00	SF	144.74	m2	$187.30	$291,813	
Electrical Room	82.00	SF	7.62	m2	$156.08	$12,799	
Subtotal	1640.00					$304,612	
METALS:							
Canopy	0.00	SF	0.00	m2	$39.18	$0	
Metal Stairway	1	EA			$7,804.18	$7,804	
Grating	1	EA			$1,873.00	$1,873	
Allowance for Misc Items	10%				$9,677.18	$968	
Subtotal						$10,645	
EQUIPMENT:							Budgetary Quote: (CPES will automatically add installation Fact
Bulk Tank	2	EA			$29,518.84	$59,038	
Day Tank	0	EA			$0.00	$0	
Transfer Pump	0	EA			$0.00	$0	

Metering Pump	2	EA			$7,991.45	$15,983	
Allowance for Misc Items	10%				$75,020.57	$7,502	
Subtotal						$82,523	
INSTRUMENTS & CONTROLS:							
Instruments							
Chemical Tank Radar Level Transmitters	2	EA			$977.63	$1,955	
Chemical Tank Beacons	2	EA			$977.63	$1,955	
Day Tank Differential Pressure Transmitter	0	EA			$977.63	$0	
Drum or Tote Weigh Scale	0	EA			$1,303.51	$0	
Metering Pump Discharge Pressure Switch	2	EA			$651.76	$1,304	
Magmeter	1	EA			$651.76	$652	
Sump Pump Float Switch	1	EA			$325.88	$326	
Eyewash	1	EA			$977.63	$978	
Number of Analog I/O Counts	6	EA			$247.67	$1,486	
Number of Digital I/O Counts	20	EA			$58.66	$1,173	
Number of Local Panels	1	EA			$12,253.00	$12,253	
Number of PLCs	1	EA			$13,035.11	$13,035	
I&C Conduit & Wire	324.00	LF	98.76	m	$11.30	$3,662	
Allowance for Misc Items	10%				$38,778.25	$3,878	
Subtotal						$42,656	
MECHANICAL:							
Pipe							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0.00	LF	0.00	m	$12.29	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0.00	LF	0.00	m	$12.29	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	69.00	LF	21.03	m	$12.29	$848	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	69.00	LF	21.03	m	$12.29	$848	
Elbows							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$9.43	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$9.43	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	8	EA			$9.43	$75	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	8	EA			$9.43	$75	
Tees							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$9.81	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$9.81	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	2	EA			$9.81	$20	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	2	EA			$9.81	$20	
End Caps							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$5.29	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$5.29	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	2	EA			$5.29	$11	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	2	EA			$5.29	$11	
Valves							
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	0	EA			$53.55	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	0	EA			$53.55	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	4	EA			$53.55	$214	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC, V-902, Diaphragm)	4	EA			$53.55	$214	
Allowance for Misc Items	10%				$2,335.31	$234	
Subtotal						$2,569	
ELECTRICAL:							
# MCC Sections	5	#			$8,044.98	$40,225	
Switchgear	0	EA			$37,006.81	$0	
Adjustable Frequency Drives							
Metering Pumps	0	EA			$8,370.07	$0	
User Defined Item #1	0	EA			$8,308.63	$0	
User Defined Item #2	0	EA			$8,308.63	$0	
User Defined Item #3	0	EA			$8,308.63	$0	
Electrical Conduit & Wire	216.00	LF	65.84	m	$11.30	$2,441	
Allowance for Misc Items	10%				$42,665.90	$4,267	
Subtotal						$46,932	
USER DEFINED ESTIMATE ITEMS:	**QUANT (ENGLISH)**	**UNIT (ENGLISH)**	**QUANT (METRIC)**	**UNIT (METRIC)**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0.00				0.00	$0	
Item 2 Description	0.00				0.00	$0	
Item 3 Description	0.00				0.00	$0	
Item 4 Description	0.00				0.00	$0	
Item 5 Description	0.00				0.00	$0	
Item 6 Description	0.00				0.00	$0	
Item 7 Description	0.00				0.00	$0	
Item 8 Description	0.00				0.00	$0	
Item 9 Description	0.00				0.00	$0	
Item 10 Description	0.00				0.00	$0	
Item 11 Description	0.00				0.00	$0	
Item 12 Description	0.00				0.00	$0	
Item 13 Description	0.00				0.00	$0	
Item 14 Description	0.00				0.00	$0	
Item 15 Description	0.00				0.00	$0	
Subtotal						$0	
Subtotal						$543,184	
ALLOWANCES:		User Override					
Finishes Allowance	2.00%		$603,538	$12,071			
I&C Allowance	2.00%		$603,538	$12,071			
Mechanical Allowance	4.00%		$603,538	$24,142			
Electrical Allowance	2.00%		$603,538	$12,071			
					Facility Cost Name		
Facility Cost	1,558	Building SF	$387.38	$803,538	CFLFC01		
Facility Cost with Standard Additional Project Costs Added	1,558	Building SF	$387.38	$803,538	CFLFC02		
Facility Cost with Standard Additional Project Costs and Contractor Markups Added	1,558	Building SF	$576.63	$898,388	CFLFC03		
Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	1,558	Building SF	$565.69	$881,342	CFLFC05		
Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	1,558	Building SF	$565.69	$881,342	CFLFC06		

LIQUID CHEM 2

Liquid Chemical Storage & Feed - ()							
Located in Chemical Building B							
Is This Facility Included in My Project? Yes							
Is the Facility Storage Only (no metering pumps)?	No	Y/N					
		Overwrite Value					
Select Chemical	Other		Select "Other" from the drop down list if using a different chemical.				
Percent Active Chemical % w/w	30 00%	30.00%	This is the intended feed strength to the process. Inputting a value in the yellow cell overwrites the cell in column "C".				For Fluoride systems, concentration m include the Available Fluoride Ion (AFI) concentration Typically 79 2% AFI for as HFA. (e g , 23% as HFA x 79.2% A 18 22% as F)
Active Chemical Form for Dosage Basis	CaO	CaO	Inputting a value in the yellow cell overwrites the cell in column "C"				
Bulk Chemical Specific Gravity	10 00	10.00	Inputting a value in the yellow cell overwrites the cell in column "C"				
Active lb/gal solution	25 02	lb/gal	2998 06	kg/m3			
Process User Inputs:	**Value (English)**	**Unit (English)**	**Value (Metric)**	**Unit (Metric)**	**Name**	**Red Flags**	**Comment**
FLOW AND CHEMICAL ADDITION							
Application #1							
1) Minimum flow to application point	4.00	mgd	15.14	ML/d			Input the flow rate at the selected dose w applied to
2) Average flow to application point	4.00	mgd	15.14	ML/d			Input the flow that the selected dose w applied to
3) Maximum flow to applicatoin point	12.00	mgd	45.42	ML/d			Input the flow that the selected dose w applied to
4) Minimum chemical addition	239.00	mg/L					Input the dose that corresponds to the input above
5) Average chemical addition	239.00	mg/L					Input the dose that corresponds to the input above
6) Maximum chemical addition	239.00	mg/L					Input the dose that corresponds to the input above.
7) Input Number of Equal Simultaneous Application Points	1	#					
8) Hours of addition per day	24.00	hr					Input the total number of hours that the chemical is fed during the day.
Application #2							
9) Minimum flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose w applied to Enter 0 if Unit Process is no included.
10.) Average flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose w applied to Enter 0 if Unit Process is no included.
11) Maximum flow to applicatoin point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose w applied to Enter 0 if Unit Process is no included
12.) Minimum chemical addition	0.00	mg/L					Input the dose that corresponds to the input above
13.) Average chemical addition	0.00	mg/L					Input the dose that corresponds to the input above
14) Maximum chemical addition	0.00	mg/L					Input the dose that corresponds to the input above
15.) Input Number of Equal Simultaneous Application Points	0	#					
16) Hours of addition per day	0.00	hr					Input the total number of hours that the chemical is fed during the day.
Application #3							
17) Minimum flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose w applied to Enter 0 if Unit Process is no included.
18.) Average flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose w applied to Enter 0 if Unit Process is no included
19) Maximum flow to applicatoin point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose w applied to Enter 0 if Unit Process is no included
20) Minimum chemical addition	0.00	mg/L					Input the dose that corresponds to the input above
21) Average chemical addition	0.00	mg/L					Input the dose that corresponds to the input above
22.) Maximum chemical addition	0.00	mg/L					Input the dose that corresponds to the input above
23.) Input Number of Equal Simultaneous Application Points	0	#					
24) Hours of addition per day	0.00	hr					Input the total number of hours that the chemical is fed during the day.
CHEMICAL QUANTITIES AND FLOW							
Application Point #1 Chemical Usage:							
Minimum as "dry" chemical	7973 04	lb/d	3616 51	kg/d			
Average as "dry" chemical	7973 04	lb/d	3616 51	kg/d			
Maximum as "dry" chemical	23919 12	lb/d	10849 53	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump:							
Minimum at feed concentration	13 28	gph	50 26	L/h			
Average at feed concentration	13 28	gph	50 26	L/h			
Maximum at feed concentration	39 83	gph	150 79	L/h			
Calculate Chemical Metering Pump Flow Turndown	3 00	1					Should be < 20 1, if ≥ 20 1 proceed w caution
Application Point #2 Chemical Usage:							
Minimum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Average as "dry" chemical	0.00	lb/d	0.00	kg/d			
Maximum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump:							
Minimum at feed concentration	0.00	gph	0.00	L/h			
Average at feed concentration	0.00	gph	0.00	L/h			
Maximum at feed concentration	0.00	gph	0.00	L/h			
Calculate Chemical Metering Pump Flow Turndown	0.00	1					Should be < 20 1, if ≥ 20 1, proceed w caution
Application Point #3 Chemical Usage:							
Minimum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Average as "dry" chemical	0.00	lb/d	0.00	kg/d			
Maximum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump:							
Minimum at feed concentration	0.00	gph	0.00	L/h			
Average at feed concentration	0.00	gph	0.00	L/h			

Maximum [illegible] concentration	0.05	ppb	0.00	L/h			
Calculate Chemical [illegible] Pump [illegible]	0.00	:1					Should be < 20:1, If ≥ 20:1, Proceed with caution.
Whole Plant Chemical Usage for Storage Calcs:							
Minimum	7973.04	lb/d	3616.51	kg/d			
Average	7973.04	lb/d	3616.51	kg/d			
Maximum	23919.12	lb/d	10849.53	kg/d			
Max Flow Average Dose Daily Usage	23919.12	lb/d					
Whole Plant # of Days of Storage							
Maximum Flow and Average Dose	30.00	days					
CHEMICAL STORAGE INPUTS							
25.) Flow used to calculate storage requirements	Maximum	Type					
26.) Chemcial application used to calculate storage requirements	Average	Type					
27.) Input Minimum Number of Days of Storage	30.00	days					
Minimum Storage Volume	26660.00	gal	108.57	m3			
28.) Choose Chemical Delivery Method	Tank Truck	Type					Assumes 45,000 lb per Tank Truck.
Bulk Delivery Volume (Tank Truck, Totes, Drums)	539.57	gal	2.04	m3			
Optional: Input Bulk Delivery Volume for Selected Delivery Method (overwrites above calculation)		gal		m3			Not typically used. Use with caution.
Calculate Bulk Delivery Volume * 1.5 (for Truck Delivery Only)	809.35	gal	3.06	m3			
Maximum of Above Delivery and Storage Volumes	3833.98	cf	108.57	m3			
BULK TANKS:							
29.) Input Number of Tanks	1	#					
30.) Input Tank Diameter	12.00	ft	3,657.60	mm	BTD		Greater than 14' tank diameter will require on-site tank fabrication. Maximum diameter allowed for this model is 14'.
Calculate Liquid Height of Tanks	33.90	ft	10332.61	mm			
Use this Tank Height (Liquid Height * 1.2)	41.00	ft	12496.80	mm		Verify tank height in relationship to the facility structure. Add more tanks or increase diameter if needed.	Verify tank height within the facility. If indoors, typically 4' lower than the roof framing structure. Assumes extra 20% volume needed for each tank for head space and outlet connection elevation.
Calculate Usable Volume of Each Bulk Tank	28905.91	gal	109.42	m3			Assumes 20% of the volume of each tank is not usable (needed for head space and outlet connection elevation).
Calculate Volume of Each Bulk Tank	34687.10	gal	131.30	m3			
31.) Input Number of Rows of Tanks	1	#					
Calculate Number of Tanks per Row	1	#					Typically FRP
32.) Input Tank Material (FRP, PE (Polyethylene), PLS (Phenolic Lined Steel))	FRP	Type					
33.) Input Clear Distance Around BulkTanks, Day Tanks, Totes or Drums	4.00	ft	1,219.20	mm	CDT		Typically ≥ 3 ft
Calculate Actual Number of Days of Storage	30.24	days					For bulk tanks, assumes 20% of the volume of each tank is not usable (needed for head space and outlet connection elevation).
TOTES & DRUMS:							
Calculate Number of Totes or Drums	0	#					
34.) Input Number of Rows of Totes or Drums	1	#					
Calculate Number of Totes or Drums per Row	0	#					
Length of Each Tote	0.00	ft	0.00	mm			Fixed
Width of Each Tote	0.00	ft	0.00	mm			Fixed
Diameter of Each Drum	0.00	ft	0.00	mm			Fixed
DAY TANKS:							
35.) Are Day Tanks Required?	No	Y/N					Rule: Day Tanks are only available when the Delivery Method = "Tank Truck".
36.) Input Number of Day Tanks	2	#					Suggest ≥ Day Tanks
Calculate Day Tank Volume (based on Max Flow/Dose)	0.00	gal	0.00	m3			
Convert Day Tank Volume	0.00	cf	0.00	m3			
Calculate Day Tank Diameter	0.00	ft	0.00	mm	BTD		
Calculate Day Tank Height	0.00	ft	0.00	mm			Assumption: H = 2 * D
TRANSFER & METERING PUMPS:							
Number of Transfer Pumps	0	#					Fixed
37.) Input Time to Fill Day Tank	20.00	min					Typically fill all day tanks in 20 min
Calculate Number of Active Metering Pumps	1	#					Rule: One active metering pump per each application point.
Calculate Number of Standby Metering Pumps	1	#					Rule: One standby metering pump per each application
38.) Input Number of Additional Standby Metering Pumps	0	#					
Calculate Total Number of Metering Pumps	2	#					
39.) Input Clear Distance Around Transfer and Metering Pumps	4.00	ft	1,828.80	mm	CDP		Typically ≥ 4 ft
Length of Transfer and Metering Pumps	3.00	ft	914.40	mm			Fixed. Conservatively assumes Pulsafeeder metering pump type.
FACILITY SIZING:							
40.) Is this Chemical Room Part of a Multiple Chemical Facility?	Yes	Y/N					
41.) Is this Chemical Room Considered the "Start Point" for this Chemical Facility?	No	Y/N					There should only be one "start point" per chemical facility. Recommend choosing the facility with the greatest width as the "start point".
42.) If this is Part of a Multiple Chemical Facility and is the "Start Point", Input the Summation of Total Number of Pumps from the Other Chemical Rooms Here							Total number of pumps [illegible]
43.) Input Common Chemical Access Corridor Width	0.00	ft		mm			Input zero if a corridor is not required. Assumes Chem facilities are in series. If Chem facilities are in parallel, input 1/2 total corridor width.
44.) Is Corridor Covered?	Yes	Y/N					
45.) Select Chemical Facility Covering	Building						
46.) Select Chemical Area for this Chemical	B						Only used to help CPES user organize chemicals when multiple chemical buildings are used. Has no impact on sizing calculations or cost.
CONTAINMENT AREA:							
Are Stairs Required into Containment Area?	Yes	Y/N					Typically not needed for tote and drum storage areas.
Is Grating Required in Containment Area?	Yes	Y/N					Typically not needed for tote and drum storage areas.
Width of Stair Access	4.00	ft	1219.20	mm	WS		Fixed
Calculate Containment Area Length	20.00	ft	6096.00	mm			

Calculate Containment Area Width	35.00	ft	10668.00	mm		Note: verify that this dimension matches the Containment Area Width on the other chemical rooms in this facility. If not, input the larger value in the user overwrite on the room with the shorter dimension	
47.) Optional: User Overwrite of Containment Area Width		ft	2,438.40	mm			
Calculate Fire Sprinkler Water Volume	2800.00	gal	10.60	m3			Assumes 0.2 gpm/sf for 20 min if chem installed inside a building. If chemical is outside or under a canopy, assume no sprinkler water volume.
Calculate 120% of One Storage Tank Volume	41624.52	gal	157.57	m3			
Calculate 30% of All Tank Volume	10406.13	gal	39.39	m3			
Calculate Maximum Volume + Fire Flow Volume	44424.52	gal	168.17	m3			
Tank Pads Volume	339.29	cf	9.61	m3			
Tank Pads Volume	2538.08	gal	9.61	m3			
Calculate Maximum Volume + Fire Flow Volume + Tank Pad Volume	46962.60	gal	177.77	m3			
Calculate Maximum Volume + Fire Flow Volume + Tank Pad Volume	6277.99	cf	177.77	m3			
Calculate Containment Wall Height (including freeboard)	9.47	ft	2886.01	mm		Note: verify that this dimension matches the Containment Wall Height on the other chemical rooms in this facility. If not, input the larger value in the user overwrite on the room with the shorter dimension	120% of 1 tank volume or 30% of all ta volume whichever is greater + fire flow volume + 6" freeboard. Should be ≤ 4
48.) Optional: User Overwrite of Containment Wall Height		ft	2,438.40	mm			
49.) Input Depth of Burial	0.00	ft	0.00	mm	DB		
50.) Input Cutback Slope	1.00	:1					Cutback slope should be 1:1 for depth burial ≤ 5 ft, and at least 1.5:1 for depth burial > 5 ft.
51.) Input Over Excavation Depth	1.00	ft	0.00	mm	OEXD		

Mechanical Sizing Requirements:

Pipe Name	Input Velocity	Unit (English)	Input Velocity	Unit (Metric)	Standard Pipe Size	Unit (English)	Nominal Pipe Size
Chemical Transfer Pump Suction Header Piping	2.00	fps	0.61	m/s	1.00	in	25.00
Chemical Transfer Pump Discharge Header Piping	6.00	fps	1.83	m/s	1.00	in	25.00
Chemical Metering Pump Suction Header Piping	2.00	fps	0.61	m/s	1.00	in	25.00
Chemical Metering Pump Discharge Header Piping	6.00	fps	1.83	m/s	1.00	in	25.00

Mechanical Material Requirements:

Pipe Name	Pipe ID	Installation Type	Pipe Material	Pipe Lining Material	Pipe Coating Material	Pipe Length	# Elbows
Chemical Transfer Pump Suction Header Piping	CTSH	Exposed	PVC	NA	NA	0.00	0.00
Chemical Transfer Pump Discharge Header Piping	CTDH	Exposed	PVC	NA	NA	0.00	0.00
Chemical Metering Pump Suction Header Piping	LCSH	Exposed	PVC	NA	NA	55.00	8.00
Chemical Metering Pump Discharge Header Piping	LCDH	Exposed	PVC	NA	NA	55.00	8.00
						L+W	#MP*4

Electrical User Inputs and Sizing Requirements:

52.) Is this a "Critical" Facility (requiring standby power)?	No	Y/N
53.) Is there SWGR?	No	

Electrical Equipment Lengths:

Item	Quantity	HP per Each	AFD's Required?	MCC Spaces for Motor Starters	MCC Spaces for AFD's less than 50hp)	MCC Spaces for Breakers	MCC Total MCC Spaces
Metering Pumps	0.00	0.50	No	0.00	0.00	0.00	
User Defined Item #1	0.00	0.00	No	0.00	0.00	0.00	
User Defined Item #2	0.00	0.00	No	0.00	0.00	0.00	
User Defined Item #3	0.00	0.00	No	0.00	0.00	0.00	
TOTAL		0.00		0.00	0.00	0.00	0.00

Electrical Equipment Widths:

Equipment	Depth (ft)
MCC	0.00
Small AFD's	0.00
Large AFD's	0.00
Switchgear	0.00
Maximum Depth	0.00

Clear Distances:

Clear Distance	Width	Length	Comment	
CD1		3.00	Clear Distance between wall and MCC	Typically 3 feet
CD2		1.00	Clear Distance between MCC and Small AFD	Typically 1 foot
CD3		0.00	Clear Distance between Small AFD and Large AFD	Typically Zero
CD4		0.00	Clear Distance between Large AFD and Switchgear	Typically Zero
CD5		0.00	Clear Distance between Switchgear and Contingency Space	Typically Zero
CD6	4.00		Clear Distance behind Switchgear (If there is no Switchgear, this distance will be Zero)	
CD7	3.00		Clear Distance in front of Equipment	Typically 3 feet
Contingency Length		0.00	Contingency length	Typically Zero

Electric Room Length (ft):

CD1	3.00
MCC	0.00
CD2	1.00
Small AFD's	0.00
CD3	0.00
Large AFD's	0.00
CD4	0.00
Swithgear	0.00
CD5	0.00
Contingency	0.00
Total Length	0.00

Electric Room Width (ft):

CD6	0.00	If there is no switchgear, this distance will be Zero.
Maximum Equipment Depth	0.00	
CD7	3.00	
Total Width	0.00	

COST TABLE FOR TANKS & PUMPS:	Unit Cost
Tanks (Installed Cost per Gallon)	
FRP	$2.06
Polyethylene (PE)	$ 2.11
Phenolic Lined Steel (PLS)	$6.01
Chemical Feed Pumps (Cost per Each)	$7,991.45

Estimating Dimensions:	Value English	Unit (English)	Value (Metric)	Unit (Metric)	Name	Comment	Red Flags
Logic Tests ("1" = Yes, "0" = No):							
Is this Chemical Feed System included?	1						
Is the Method of Delivery "Tank Truck"?	1						
Is Day Tank Required? (1 = Yes, 0 = No)	0						
Tank Truck without Day Tank (True or False)	TRUE						
Tank Truck with Day Tank (True or False)	FALSE						
Tank Truck without Day Tank (1 = Yes, 0 = No)	1						
Tank Truck with Day Tank (1 = Yes, 0 = No)	0					Tank Truck without Day Tank	
Is the Method of Delivery "Tote"?	0					Tank Truck without Day Tank	
Is the Method of Delivery "Drum"?	0					Tote	
Length of Module (Tank Truck)	20.00	ft	6096.00	mm		Drum	
Length of Module (Tote)	0.00	ft	0.00	mm			
Length of Module (Drum)	0.00	ft	0.00	mm			
Width of Module (Tank Truck without Transfer Pump and Day Tank)	35.00	ft	10668.00	mm			
Width of Module (Tank Truck with Transfer Pump and Day Tank)	0.00	ft	0.00	mm			
Width of Module (Tote)	0.00	ft	0.00	mm			
Width of Module (Drum)	0.00	ft	0.00	mm			
Area of Module	0.00	sf	0.00	m2			
Number of Bulk Tanks (each)	1	#					
Diameter of Bulk Tank	12.00	ft	3657.60	mm			
Volume of Each Bulk Tank	34687.10	gal	131.30	m3			
Bulk Tank Material	FRP	Type					
Number of Day Tanks (each)	0	#					
Diameter of Day Tank	0.00	ft					
Volume of Each Day Tank	0.00	gal	0.00	m3			
Number of Transfer Pumps	0	#					
Transfer Pump Capacity (each)	0.00	gpm	0.00	l/min			
Number of Metering Pumps	2	#				Assume fill each tank in 20 min	
Module Covered? ("1" = YES, "0" = NO)	0						
If Module Exists, Is it Covered? ("1" = Yes, "0" = No)	0						
Containment Wall Height	9.47	ft	2886.01	mm			
Slab on Grade Thickness	9.00	in	228.60	mm		Model based on 9"	
Slab on Grade Thickness	0.75	ft	228.60	mm			
Containment Wall Thickness	8.00	in	203.20	mm		Model based on 8"	
Containment Wall Thickness	0.67	ft	203.20	mm			
Tank Pad / Metering Pump Pad Height	3.00	ft	914.40	mm			
Corridor					EPH		
Length	20.00	ft	6096.00	mm			
Width	0.00	ft	0.00	mm			
Area	0.00	sf	0.00	m2			
Corridor Covered? ("1" = YES, "0" = NO)	1						
Electrical Room:							
Slab on Grade:							
Length	0.00	ft	0.00	mm			
Width	0.00	ft	0.00	mm			
Concrete Thickness	12.00	in	304.80	mm			
Concrete Thickness	1.00	ft	304.80	mm		Model based on 12"	
Walls:							
Height = FBD	10.00	ft					
Concrete Thickness	8.00	in	203.20	mm		Fixed	
Concrete Thickness	0.67	ft	203.20	mm		Model based on 8"	
Overall Dimensions							
Containment Area Length	20.00	ft	6096.00	mm			
Containment Area Width	35.00	ft	10668.00	mm			
Containment Area	700.00	sf	65.03	m2			
Corridor Area Length	20.00	ft	6096.00	mm			
Corridor Area Width	0.00	ft	0.00	mm			
Corridor Area	0.00	sf	0.00	m2			
Electrical Area Length	0.00	ft	0.00	mm			
Electrical Area Width	0.00	ft	0.00	mm			
Electrical Room Area	0.00	sf	0.00	m2			
Chemical Facility Area	700.00	sf	65.03	m2			
Covered Chemical Area (Building)	700.00	sf	65.03	m2			
Covered Chemical Area (Canopy)	0.00	sf	0.00	m2			
Total Covered Area	700.00	sf	65.03	m2			
Excavation Depth	1.75	ft	533.40	mm			

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
SITEWORK:							
Excavation	57.80	CY	44.19	m3	$6.35	$367	
Imported Structural Backfill	51.85	CY	39.64	m3	$48.10	$2,494	
Native Backfill	6.24	CY	4.77	m3	$7.80	$49	
Haul Excess	51.56	CY	39.42	m3	$7.80	$402	
Allowance for Misc Items	5%				$3,312.07	$166	
Subtotal						$3,478	
CONCRETE:							
Slab on Grade							
Containment Walls	23.77	CY	18.17	m3	$356.31	$6,468	
Bulk Tank Pads	17.53	CY	13.41	m3	$704.01	$12,344	
Day Tank Pads	22.34	CY	17.08	m3	$356.31	$7,960	
Transfer Pump Pads	0.00	CY	0.00	m3	$356.31	$0	
Metering Pump Pads	0.00	CY	0.00	m3	$356.31	$0	
Corridor	1.33	CY	1.02	m3	$356.31	$475	
Slab on Grade	0.00	CY	0.00	m3	$356.31	$0	
Electrical Room							
Slab on Grade	0.00	CY	0.00	m3	$356.31	$0	
Allowance for Misc Items	5%				$29,247.16	$1,462	
Subtotal						$30,710	
MASONRY:	Moderate						
Chemical Building	700.00	SF	65.03	m2	$187.30	$131,110	
Electrical Room	0.00	SF	0.00	m2	$156.08	$0	
Subtotal	700.00					$131,110	
METALS:							
Canopy	0.00	SF	0.00	m2	$39.18	$0	
Metal Stairway	1	EA			$7,804.16	$7,804	
Grating	1	EA			$1,873.00	$1,873	
Allowance for Misc Items	10%				$9,677.16	$968	
Subtotal						$10,645	
EQUIPMENT:							Budgetary Quote: (CPES will automatically add Installation Factor)
Bulk Tank	1	EA			$71,337.89	$71,338	
Day Tank	0	EA			$0.00	$0	
Transfer Pump	0	EA			$0.00	$0	

Metering Pump	2	EA			$7,991.46	$15,983
Allowance for Misc Items	10%				$87,320.78	$8,732
Subtotal						$96,053
INSTRUMENTS & CONTROLS:						
Instruments					$977.63	$978
Chemical Tank Radar Level Transmitters	1	EA			$977.63	$978
Chemical Tank Beacons	1	EA			$977.63	$0
Day Tank Differential Pressure Transmitter	0	EA			$1,303.51	$0
Drum or Tote Weigh Scale	0	EA			$651.76	$1,304
Metering Pump Discharge Pressure Switch	2	EA			$651.76	$652
Magmeter	1	EA			$325.88	$326
Sump Pump Float Switch	1	EA			$977.63	$978
Eyewash	1	EA			$247.87	$1,238
Number of Analog I/O Counts	5	EA			$58.66	$997
Number of Digital I/O Counts	17	EA			$12,253.00	$12,253
Number of Local Panels	1	EA			$13,035.11	$13,035
Number of PLCs	1	EA			$1,581.30	$1,582
I&C Conduit & Wire	140.00	LF	42.67	m	$34,319.88	$3,432
Allowance for Misc Items	10%					$37,752
Subtotal						
MECHANICAL:						
Pipe					$12.29	$0
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0.00	LF	0.00	m	$12.29	$0
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0.00	LF	0.00	m	$12.29	$676
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	55.00	LF	16.76	m	$12.29	$676
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	55.00	LF	16.76	m		
Elbows					$9.43	$0
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$9.43	$0
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$9.43	$75
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	8	EA			$9.43	$75
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	8	EA				
Tees					$9.81	$0
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$9.81	$0
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$9.81	$20
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	2	EA			$9.81	$20
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	2	EA				
End Caps					$5.29	$0
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$5.29	$0
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$5.29	$11
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	2	EA			$5.29	$11
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	2	EA				
Valves					$53.55	$0
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	0	EA			$53.55	$0
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	0	EA			$53.55	$214
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	4	EA			$53.55	$214
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC, V-902, Diaphragm)	4	EA			$1,991.26	$199
Allowance for Misc Items	10%					$2,190
Subtotal						
ELECTRICAL:					$8,044.96	$0
# MCC Sections	0	#			$37,008.81	$0
Switchgear	0	EA				
Adjustable Frequency Drives					$8,370.07	$0
Metering Pumps	0	EA			$8,308.83	$0
User Defined Item #1	0	EA			$8,308.83	$0
User Defined Item #2	0	EA			$8,308.83	$0
User Defined Item #3	0	EA			$11.36	$0
Electrical Conduit & Wire	0.00	LF	0.00	m	$0.00	$0
Allowance for Misc Items	10%					$0
Subtotal						

USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST
Item 1 Description	0.00				0.00	$0
Item 2 Description	0.00				0.00	$0
Item 3 Description	0.00				0.00	$0
Item 4 Description	0.00				0.00	$0
Item 5 Description	0.00				0.00	$0
Item 6 Description	0.00				0.00	$0
Item 7 Description	0.00				0.00	$0
Item 8 Description	0.00				0.00	$0
Item 9 Description	0.00				0.00	$0
Item 10 Description	0.00				0.00	$0
Item 11 Description	0.00				0.00	$0
Item 12 Description	0.00				0.00	$0
Item 13 Description	0.00				0.00	$0
Item 14 Description	0.00				0.00	$0
Item 15 Description	0.00					$0
Subtotal						$311,937

Subtotal						
		User Override				
ALLOWANCES:						
Finishes Allowance	2.00%		$346,597	$6,932		
I&C Allowance	2.00%		$346,597	$6,932		
Mechanical Allowance	4.00%		$346,597	$13,864		
Electrical Allowance	2.00%		$346,597	$6,932		
					Facility Cost Name	
Facility Cost	700	Building SF	$495.14	$346,597	CFLFC01	
Facility Cost with Standard Additional Project Costs Added	700	Building SF	$495.14	$346,597	CFLFC02	
Facility Cost with Standard Additional Project Costs and Contractor Markups Added	700	Building SF	$737.03	$515,921	CFLFC03	
Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	700	Building SF	$723.05	$506,133	CFLFC05	
Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	700	Building SF	$723.05	$506,133	CFLFC06	

Liquid Chemical Storage & Feed - (Sulfuric Acid)
Located in Chemical Building C

Is the Facility Storage Only (no metering pumps)?	No	Y/N					
		Overwrite Value					
Select Chemical	Sulfuric Acid		Select "Other" from the drop down list if using a different chemical.				
Percent Active Chemical, % w/w	93 00%		This is the intended feed strength to the process. Inputting a value in the yellow cell overwrites the cell in column "C"				For Fluoride systems, concentration must include the Available Fluoride Ion (AFI) concentration. Typically 79 2% AFI for 23% as HFA. (e.g., 23% as HFA x 79.2% AFI = 18 22% as F)
Active Chemical Form for Dosage Basis	H2SO4		Inputting a value in the yellow cell overwrites the cell in column "C"				
Bulk Chemical Specific Gravity	1 83		Inputting a value in the yellow cell overwrites the cell in column "C"				
Active lb/gal solution	14 19	lb/gal	1700 80	kg/m3			
Process User Inputs:	**Value (English)**	**Unit (English)**	**Value (Metric)**	**Unit (Metric)**	**Name**	**Red Flags**	**Comment**
FLOW AND CHEMICAL ADDITION							
Application #1							
1) Minimum flow to application point	4.00	mgd	15.14	ML/d			Input the flow that the selected dose will be applied to.
2.) Average flow to application point	4.00	mgd	15.14	ML/d			Input the flow that the selected dose will be applied to.
3) Maximum flow to applicatoin point	12.00	mgd	45.42	ML/d			Input the flow that the selected dose will be applied to.
4) Minimum chemical addition	80.00	mg/L					Input the dose that corresponds to the flow input above.
5) Average chemical addition	80.00	mg/L					Input the dose that corresponds to the flow input above.
6) Maximum chemical addition	80.00	mg/L					Input the dose that corresponds to the flow input above.
7) Input Number of Equal Simultaneous Application Points	1	#					
8) Hours of addition per day	24.00	hr					Input the total number of hours that the chemical is fed during the day
Application #2							
9) Minimum flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
10) Average flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
11) Maximum flow to applicatoin point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
12) Minimum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
13) Average chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
14) Maximum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
15) Input Number of Equal Simultaneous Application Points	0	#					
16) Hours of addition per day	0.00	hr					Input the total number of hours that the chemical is fed during the day
Application #3							
17) Minimum flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
18) Average flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
19.) Maximum flow to applicatoin point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
20.) Minimum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
21) Average chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
22.) Maximum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
23.) Input Number of Equal Simultaneous Application Points	0	#					
24) Hours of addition per day	0.00	hr					Input the total number of hours that the chemical is fed during the day.
CHEMICAL QUANTITIES AND FLOW							
Application Point #1 Chemical Usage:							
Minimum as "dry" chemical	2688 80	lb/d	1210 55	kg/d			
Average as "dry" chemical	2688 80	lb/d	1210 55	kg/d			
Maximum as "dry" chemical	8066 40	lb/d	3631 64	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump:							
Minimum at feed concentration	7 83	gph	29 66	L/h			
Average at feed concentration	7 83	gph	29 66	L/h			
Maximum at feed concentration	23 50	gph	88 97	L/h			
Calculate Chemical Metering Pump Flow Turndown	3 00	1					Should be < 20:1, If ≥ 20:1, proceed with caution.
Application Point #2 Chemical Usage:							
Minimum as "dry" chemical	0 00	lb/d	0 00	kg/d			
Average as "dry" chemical	0 00	lb/d	0 00	kg/d			
Maximum as "dry" chemical	0 00	lb/d	0 00	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump:							
Minimum at feed concentration	0 00	gph	0 00	L/h			
Average at feed concentration	0 00	gph	0 00	L/h			
Maximum at feed concentration	0 00	gph	0 00	L/h			
Calculate Chemical Metering Pump Flow Turndown	0 00	1					Should be < 20:1, If ≥ 20:1, proceed with caution.
Application Point #3 Chemical Usage:							
Minimum as "dry" chemical	0 00	lb/d	0 00	kg/d			
Average as "dry" chemical	0 00	lb/d	0 00	kg/d			
Maximum as "dry" chemical	0 00	lb/d	0 00	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump:							
Minimum at feed concentration	0 00	gph	0 00	L/h			
Average at feed concentration	0 00	gph	0 00	L/h			

LIQUID CHEM 3

Maximum allowed concentration	0.00	ppb	0.00	L/hr			
Calculate Chemical Metering Pump Flow Turndown	0.00	:1					Should be < 20:1, if > 20:1, proceed w/ caution
Whole Plant Chemical Usage for Storage Calcs:							
Minimum	2688 80	lb/d	1210 55	kg/d			
Average	2688 80	lb/d	1210 55	kg/d			
Maximum	8006 40	lb/d	3631 64	kg/d			
Max Flow Average Dose Daily Usage	8006 40	lb/d					
Whole Plant # of Days of Storage							
Maximum Flow and Average Dose	30 00	days					
CHEMICAL STORAGE INPUTS							
25.) Flow used to calculate storage requirements	Maximum	Type					
26.) Chemcial application used to calculate storage requirements	Average	Type					
27.) Input Minimum Number of Days of Storage	30.00	days					
Minimum Storage Volume	16922 26	gal	64 06	m3			
28.) Choose Chemical Delivery Method	Tank Truck	Type					
Bulk Delivery Volume (Tank Truck, Totes, Drums)	2,948 46	gal	11 16	m3			Assumes 45,000 lb per Tank Truck
Optional: Input Bulk Delivery Volume for Selected Delivery Method (overwrites above calculation)		gal		m3			Not typically used Use with caution
Calculate Bulk Delivery Volume * 1.5 (for Truck Delivery Only)	4,422 69	gal	16.74	m3			
Maximum of Above Delivery and Storage Volumes	2262 18	cf	64 06	m3			
BULK TANKS:							
29.) Input Number of Tanks	1	#					
30.) Input Tank Diameter	12.00	ft	3,657.60	mm	BTD		Greater than 14' tank diameter will req on-site tank fabrication. Maximum diameter allowed for this model is 14'.
Calculate Liquid Height of Tanks	20 00	ft	6096 62	mm			
Use this Tank Height (Liquid Height * 1 2)	25 00	ft	7620 00	mm		Verify tank height in relationship to the facility structure. Add more tanks or increase diameter if needed.	Verify tank height within the facility. If indoors, typically 4' lower than the roof framing structure. Assumes extra 20% volume needed for each tank for head space and outlet connection elevation.
Calculate Usable Volume of Each Bulk Tank	17625 56	gal	66.72	m3			Assumes 20% of the volume of each t is not usable (needed for head space a outlet connection elevation)
Calculate Volume of Each Bulk Tank	21150 67	gal	80 06	m3			
31.) Input Number of Rows of Tanks	1	#					
Calculate Number of Tanks per Row	1	#					
32.) Input Tank Material (FRP, PE (Polyethylene), PLS (Phenolic Lined Steel))	FRP	Type					Typically FRP
33.) Input Clear Distance Around BulkTanks, Day Tanks, Totes or Drums	4.00	ft	1,219.20	mm	CDT		Typically ≥ 3 ft
Calculate Actual Number of Days of Storage	31.25	days					For bulk tanks, assumes 20% of the volume of each tank is not usable (nee for head space and outlet connection elevation)
TOTES & DRUMS:							
Calculate Number of Totes or Drums	0	#					
34.) Input Number of Rows of Totes or Drums	1	#					
Calculate Number of Totes or Drums per Row	0	#					
Length of Each Tote	0.00	ft	0.00	mm			Fixed
Width of Each Tote	0.00	ft	0.00	mm			Fixed
Diameter of Each Drum	0.00	ft	0.00	mm			Fixed
DAY TANKS:							
35.) Are Day Tanks Required?	No	Y/N					Rule: Day Tanks are only available wh the Delivery Method = "Tank Truck".
36.) Input Number of Day Tanks	2	#					Suggest 2 Day Tanks
Calculate Day Tank Volume based on Max Flow/Dose (per tank)	0.00	gal	0.00	m3			
Convert Day Tank Volume (per tank)	0.00	cf	0.00	m3			
Calculate Day Tank Diameter (per each)	0.00	ft	0.00	mm	DTD		
Calculate Day Tank Height (per each)	0.00	ft	0.00	mm			Assumption: H = 2 * D
TRANSFER & METERING PUMPS:							
Number of Transfer Pumps	0	#					Fixed
37.) Input Time to Fill Day Tank	20.00	min					Typically fill all day tanks in 20 min
Calculate Number of Active Metering Pumps	1	#					Rule: One active metering pump per a application point.
Calculate Number of Standby Metering Pumps	1	#					Rule: One standby metering pump per each application
38.) Input Number of Additional Standby Metering Pumps	0	#					
Calculate Total Number of Metering Pumps	2	#					
39.) Input Clear Distance Around Transfer and Metering Pumps	3.00	ft	914.40	mm	CDP		Typically ≥ 4 ft
Length of Transfer and Metering Pumps	3 00	ft	914 40	mm			Fixed. Conservatively assumes Pulsafeeder metering pump type.
FACILITY SIZING:							
40.) Is this Chemical Room Part of a Multiple Chemical Facility?	Yes	Y/N					
41.) Is this Chemical Room Considered the "Start Point" for this Chemical Facility?	No	Y/N					There should only be one "start point" chemical facility. Recommend choosin the facility with the greatest width as th "start point"
42.) If this is Part of a Multiple Chemical Facility and is the "Start Point", Input the Summation of Total Number of Pumps from the Other Chemical Rooms Here		#					Total number of pumps is listed in row of the liquid chemical facility, rows 140, 161, and 182 of the dry chemical facilit and row 122 of the potassium permanganate facility
43.) Input Common Chemical Access Corridor Width	0.00	ft		mm			Input zero if a corridor is not required. Assumes Chem facilities are in series. Chem facilities are in parallel, input 1/2 total corridor width.
44.) Is Corridor Covered?	Yes	Y/N					
45.) Select Chemical Facility Covering	Building						
46.) Select Chemical Area for this Chemical	C						Only used to help CPES user organize chemicals when multiple chemical buildings are used. Has no impact on sizing calculations or cost.
CONTAINMENT AREA:							
Are Stairs Required into Containment Area?	Yes	Y/N					Typically not needed for tote and drum storage areas.
Is Grating Required in Containment Area?	Yes	Y/N					Typically not needed for tote and drum storage areas.
Width of Stair Access	4 00	ft	1219 20	mm	WS		Fixed
Calculate Containment Area Length	20 00	ft	6096.00	mm			

Calculate Containment Area Width	33.00	ft	10058.40	mm		Note: verify that this dimension matches the Containment Area Width on the other chemical rooms in this facility. If not, input the larger value in the user overwrite on the room with the shorter dimension	
47.) Optional: User Overwrite of Containment Area Width		ft	2,438.40	mm			
Calculate Fire Sprinkler Water Volume	2640.00	gal	9.99	m3			Assumes 0.2 gpm/sf for 20 min if chemical installed inside a building. If chemical is outside or under a canopy, assume no fire sprinkler water volume.
Calculate 120% of One Storage Tank Volume	25380.80	gal	96.08	m3			
Calculate 30% of All Tank Volume	6345.20	gal	24.02	m3			
Calculate Maximum Volume + Fire Flow Volume	28020.80	gal	106.07	m3			
Tank Pads Volume	339.29	cf	9.61	m3			
Tank Pads Volume	2538.08	gal	9.61	m3			
Calculate Maximum Volume + Fire Flow Volume + Tank Pad Volume	30558.88	gal	115.68	m3			
Calculate Maximum Volume + Fire Flow Volume + Tank Pad Volume	4085.13	cf	115.68	m3			
Calculate Containment Wall Height (including freeboard)	6.69	ft	2038.99	mm		Note: verify that this dimension matches the Containment Wall Height on the other chemical rooms in this facility. If not, input the larger value in the user overwrite on the room with the shorter dimension	120% of 1 tank volume or 30% of all tank volume whichever is greater + fire flow volume + 6" freeboard. Should be ≤ 4.5'
48.) Optional: User Overwrite of Containment Wall Height		ft	2,438.40	mm			
49.) Input Depth of Burial	0.00	ft	0.00	mm	DB		
50.) Input Cutback Slope	1.00	:1					Cutback slope should be 1:1 for depth of burial ≤ 5 ft, and at least 1.5:1 for depth of burial > 5 ft.
51.) Input Over Excavation Depth	1.00	ft	0.00	mm	OEXD		

Mechanical Sizing Requirements:

Pipe Name	Input Velocity	Unit (English)	Input Velocity	Unit (Metric)	Standard Pipe Size	Unit (English)	Nominal Pipe Size
Chemical Transfer Pump Suction Header Piping	2.00	fps	0.61	m/s	1.00	in	25.00
Chemical Transfer Pump Discharge Header Piping	6.00	fps	1.83	m/s	1.00	in	25.00
Chemical Metering Pump Suction Header Piping	2.00	fps	0.61	m/s	1.00	in	25.00
Chemical Metering Pump Discharge Header Piping	6.00	fps	1.83	m/s	1.00	in	25.00

Mechanical Material Requirements:

Pipe Name	Pipe ID	Installation Type	Pipe Material	Pipe Lining Material	Pipe Coating Material	Pipe Length	# Elbows
Chemical Transfer Pump Suction Header Piping	CTSH	Exposed	PVC	NA	NA	0.00	0.00
Chemical Transfer Pump Discharge Header Piping	CTDH	Exposed	PVC	NA	NA	0.00	0.00
Chemical Metering Pump Suction Header Piping	LCSH	Exposed	PVC	NA	NA	53.00	8.00
Chemical Metering Pump Discharge Header Piping	LCDH	Exposed	PVC	NA	NA	53.00	8.00
						L+W	#MP*4

Electrical User Inputs and Sizing Requirements:

52.) Is this a "Critical" Facility (requiring standby power)?	No	Y/N
53.) Is there SWGR?	No	

Electrical Equipment Lengths:

Item	Quantity	HP per Each	AFD's Required?	MCC Spaces for Motor Starters	MCC Spaces for AFD's less than 50hp)	MCC Spaces for Breakers	MCC Total MCC Spaces
Metering Pumps	0.00	0.50	No	0.00	0.00	0.00	
User Defined Item #1	0.00	0.00	No	0.00	0.00	0.00	
User Defined Item #2	0.00	0.00	No	0.00	0.00	0.00	
User Defined Item #3	0.00	0.00	No	0.00	0.00	0.00	
TOTAL		0.00		0.00	0.00	0.00	0.00

Electrical Equipment Widths:

Equipment	Depth (ft)
MCC	0.00
Small AFD's	0.00
Large AFD's	0.00
Switchgear	0.00
Maximum Depth	0.00

Clear Distances:

Clear Distance	Width	Length	Comment	
CD1		3.00	Clear Distance between wall and MCC	Typically 3 feet
CD2		1.00	Clear Distance between MCC and Small AFD	Typically 1 foot
CD3		0.00	Clear Distance between Small AFD and Large AFD	Typically Zero
CD4		0.00	Clear Distance between Large AFD and Switchgear	Typically Zero
CD5		0.00	Clear Distance between Switchgear and Contingency Space	Typically Zero
CD6	4.00		Clear Distance behind Switchgear (If there is no Switchgear, this distance will be Zero)	
CD7	3.00		Clear Distance in front of Equipment	Tyipcally 3 feet
Contingency Length		0.00	Contingency length	Typically Zero

Electric Room Length (ft):

CD1	3.00
MCC	0.00
CD2	1.00
Small AFD's	0.00
CD3	0.00
Large AFD's	0.00
CD4	0.00
Swithgear	0.00
CD5	0.00
Contingency	0.00
Total Length	0.00

Electric Room Width (ft):

CD6	0.00	If there is no switchgear, this distance will be Zero.
Maximum Equipment Depth	0.00	
CD7	3.00	
Total Width	0.00	

COST TABLE FOR TANKS & PUMPS:	Unit Cost
Tanks (Installed Cost per Gallon)	
FRP	$2.11
Polyethylene (PE)	$ 2.11
Phenolic Lined Steel (PLS)	$6.01
Chemical Feed Pumps (Cost per Each)	$7,991.45

Estimating Dimensions:	Value English	Unit (English)	Value (Metric)	Unit (Metric)	Name	Comment	Red Flags
Logic Tests ("1" = Yes, "0" = No):							
Is this Chemical Feed System Included?	1						
Is the Method of Delivery "Tank Truck"?	1						
Is Day Tank Required? (1 = Yes, 0 = No)	0						
Tank Truck without Day Tank (True or False)	TRUE						
Tank Truck with Day Tank (True or False)	FALSE						
Tank Truck without Day Tank (1 = Yes, 0 = No)	1					Tank Truck without Day Tank	
Tank Truck with Day Tank (1 = Yes, 0 = No)	0					Tank Truck without Day Tank	
Is the Method of Delivery "Tote"?	0					Tote	
Is the Method of Delivery "Drum"?	0					Drum	
Length of Module (Tank Truck)	20 00	ft	6096 00	mm			
Length of Module (Tote)	0 00	ft	0 00	mm			
Length of Module (Drum)	0 00	ft	0 00	mm			
Width of Module (Tank Truck without Transfer Pump and Day Tank)	33 00	ft	10058 40	mm			
Width of Module (Tank Truck with Transfer Pump and Day Tank)	0 00	ft	0 00	mm			
Width of Module (Tote)	0 00	ft	0 00	mm			
Width of Module (Drum)	0 00	ft	0 00	mm			
Area of Module	0 00	sf	0 00	m2			
Number of Bulk Tanks (each)	1	#					
Diameter of Bulk Tank	12 00	ft	3657 60	mm			
Volume of Each Bulk Tank	21150 67	gal	80 06	m3			
Bulk Tank Material	FRP	Type					
Number of Day Tanks (each)	0	#					
Diameter of Day Tank	0 00	ft					
Volume of Each Day Tank	0 00	gal	0 00	m3			
Number of Transfer Pumps	0	#					
Transfer Pump Capacity (each)	0 00	gpm	0 00	l/min		Assume fill each tank in 20 min	
Number of Metering Pumps	2	#					
Module Covered? ("1" = YES, "0" = NO)	0						
If Module Exists, Is It Covered? ("1" = Yes, "0" = No)	0						
Containment Wall Height	6 69	ft	2038 99	mm			
Slab on Grade Thickness	9.00	in	228.60	mm		Model based on 9"	
Slab on Grade Thickness	0 75	ft	228 60	mm			
Containment Wall Thickness	8.00	in	203.20	mm		Model based on 8"	
Containment Wall Thickness	0 67	ft	203 20	mm			
Tank Pad / Metering Pump Pad Height	3.00	ft	914.40	mm	EPH		
Corridor							
Length	20 00	ft	6096 00	mm			
Width	0 00	ft	0.00	mm			
Area	0 00	sf	0 00	m2			
Corridor Covered? ("1" = YES, "0" = NO)	1						
Electrical Room							
Slab on Grade:							
Length	0 00	ft	0 00	mm			
Width	0 00	ft	0 00	mm			
Concrete Thickness	12.00	in	304.80	mm		Model based on 12"	
Concrete Thickness	1 00	ft	304 80	mm			
Walls							
Height = FBD	10 00	ft				Fixed	
Concrete Thickness	8.00	in	203.20	mm		Model based on 8"	
Concrete Thickness	0 67	ft	203 20	mm			
Overall Dimensions							
Containment Area Length	20 00	ft	6096 00	mm			
Containment Area Width	33 00	ft	10058 40	mm			
Containment Area	660 00	sf	61 32	m2			
Corridor Area Length	20 00	ft	6096 00	mm			
Corridor Area Width	0 00	ft	0 00	mm			
Corridor Area	0 00	sf	0 00	m2			
Electrical Area Length	0 00	ft	0 00	mm			
Electrical Area Width	0 00	ft	0 00	mm			
Electrical Room Area	0 00	sf	0 00	m2			
Chemical Facility Area	660 00	sf	61 32	m2			
Covered Chemical Area (Building)	660 00	sf	61 32	m2			
Covered Chemical Area (Canopy)	0 00	sf	0 00	m2			
Total Covered Area	660 00	sf	61 32	m2			
Excavation Depth	1 75	ft	533 40	mm			

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
SITEWORK:							
Excavation	54.64	CY	41 78	m3	$6.35	$347	
Imported Structural Backfill	48.89	CY	37 38	m3	$48.10	$2,352	
Native Backfill	6.01	CY	4.60	m3	$7.80	$47	
Haul Excess	48.63	CY	37 18	m3	$7.80	$380	
Allowance for Misc Items	5%				$3,124.86	$156	
Subtotal						$3,281	
CONCRETE:							
Slab on Grade	22.47	CY	17 18	m3	$356.31	$8,006	
Containment Walls	12.06	CY	9.22	m3	$704.01	$8,489	
Bulk Tank Pads	22.34	CY	17 08	m3	$356.31	$7,960	
Day Tank Pads	0.00	CY	0.00	m3	$356.31	$0	
Transfer Pump Pads	0.00	CY	0.00	m3	$356.31	$0	
Metering Pump Pads	1.33	CY	1.02	m3	$356.31	$475	
Corridor							
Slab on Grade	0.00	CY	0.00	m3	$356.31	$0	
Electrical Room							
Slab on Grade	0.00	CY	0.00	m3	$356.31	$0	
Allowance for Misc Items	5%				$24,929.74	$1,246	
Subtotal						$26,176	
MASONRY:	Moderate						
Chemical Building	660.00	SF	61 32	m2	$187.30	$123,618	
Electrical Room	0.00	SF	0.00	m2	$156.08	$0	
Subtotal	660.00					$123,618	
METALS:							
Canopy	0.00	SF	0.00	m2	$39.18	$0	
Metal Stairway	1	EA			$7,804.16	$7,804	
Grating	1	EA			$1,873.00	$1,873	
Allowance for Misc Items	10%				$9,677.16	$968	
Subtotal						$10,845	
EQUIPMENT							Budgetary Quote: (CPES will automatically add installation Factc
Bulk Tank	1	EA			$44,573.70	$44,574	
Day Tank	0	EA			$0.00	$0	
Transfer Pump	0	EA			$0.00	$0	

Metering Pump	2	EA			$7,991.45	$15,983	
Allowance for Misc Items	10%				$60,556.59	$6,056	
Subtotal						$66,612	
INSTRUMENTS & CONTROLS:							
Instruments							
Chemical Tank Radar Level Transmitters	1	EA			$977.63	$978	
Chemical Tank Beacons	1	EA			$977.63	$978	
Day Tank Differential Pressure Transmitter	0	EA			$977.63	$0	
Drum or Tote Weigh Scale	0	EA			$1,303.51	$0	
Metering Pump Discharge Pressure Switch	2	EA			$651.76	$1,304	
Magmeter	1	EA			$651.76	$652	
Sump Pump Float Switch	1	EA			$325.88	$326	
Eyewash	1	EA			$977.63	$978	
Number of Analog I/O Counts	5	EA			$247.67	$1,238	
Number of Digital I/O Counts	17	EA			$58.66	$997	
Number of Local Panels	1	EA			$12,253.00	$12,253	
Number of PLCs	1	EA			$13,035.11	$13,035	
I&C Conduit & Wire	140.00	LF	42.67	m	$11.30	$1,582	
Allowance for Misc Items	10%				$34,319.88	$3,432	
Subtotal						$37,752	
MECHANICAL:							
Pipe							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0.00	LF	0.00	m	$12.29	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0.00	LF	0.00	m	$12.29	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	53.00	LF	16.15	m	$12.29	$651	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	53.00	LF	16.15	m	$12.29	$651	
Elbows							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$9.43	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$9.43	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	8	EA			$9.43	$75	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	8	EA			$9.43	$75	
Tees							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$9.81	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$9.81	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	2	EA			$9.81	$20	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	2	EA			$9.81	$20	
End Caps							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$5.29	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$5.29	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	2	EA			$5.29	$11	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	2	EA			$5.29	$11	
Valves							
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	0	EA			$53.55	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	0	EA			$53.55	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	4	EA			$53.55	$214	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC, V-902, Diaphragm)	4	EA			$53.55	$214	
Allowance for Misc Items	10%				$1,942.11	$194	
Subtotal						$2,136	
ELECTRICAL:							
# MCC Sections	0	#			$8,044.98	$0	
Switchgear	0	EA			$37,006.81	$0	
Adjustable Frequency Drives							
Metering Pumps	0	EA			$8,370.07	$0	
User Defined Item #1	0	EA			$8,308.63	$0	
User Defined Item #2	0	EA			$8,308.63	$0	
User Defined Item #3	0	EA			$8,308.63	$0	
Electrical Conduit & Wire	0.00	LF	0.00	m	$11.30	$0	
Allowance for Misc Items	10%				$0.00	$0	
Subtotal						$0	
USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST	
Item 1 Description	0.00				0.00	$0	
Item 2 Description	0.00				0.00	$0	
Item 3 Description	0.00				0.00	$0	
Item 4 Description	0.00				0.00	$0	
Item 5 Description	0.00				0.00	$0	
Item 6 Description	0.00				0.00	$0	
Item 7 Description	0.00				0.00	$0	
Item 8 Description	0.00				0.00	$0	
Item 9 Description	0.00				0.00	$0	
Item 10 Description	0.00				0.00	$0	
Item 11 Description	0.00				0.00	$0	
Item 12 Description	0.00				0.00	$0	
Item 13 Description	0.00				0.00	$0	
Item 14 Description	0.00				0.00	$0	
Item 15 Description	0.00				0.00	$0	
Subtotal						$0	
Subtotal						$270,221	
ALLOWANCES:		User Override					
Finishes Allowance	2.00%		$300,245	$6,005			
I&C Allowance	2.00%		$300,245	$6,005			
Mechanical Allowance	4.00%		$300,245	$12,010			
Electrical Allowance	2.00%		$300,245	$6,005			
					Facility Cost Name		
Facility Cost	660	Building SF	$454.92	$300,245	CFLFC01		
Facility Cost with Standard Additional Project Costs Added	660	Building SF	$454.92	$300,245	CFLFC02		
Facility Cost with Standard Additional Project Costs and Contractor Markups Added	660	Building SF	$677.16	$446,925	CFLFC03		
Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	660	Building SF	$664.31	$438,446	CFLFC05		
Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	660	Building SF	$664.31	$438,446	CFLFC06		

DRY CHEM 1

Dry Chemical Storage & Feed - (Sodium Carbonate)

Located in Stand Alone Chemical Building

Is This Facility Included in My Project? Yes

		Overwrite Value	
Chemical	Sodium Carbonate		Select "Other" from the drop down list if using a different chemical
Percent Active Chemical	99.0%		Inputting a value in the yellow cell overwrites the cell in column "C"
Active Chemical Form for Dosage Basis	Na2CO3		Inputting a value in the yellow cell overwrites the cell in column "C"
Bulk Density, lb/cf	65.0		Inputting a value in the yellow cell overwrites the cell in column "C"
Active lb/gal solution	0.10		Typical range for solution strength of this chemical is 0.1 to 0.5
Calculate Solution Strength	1.20%		This is the intended feed strength to the process

Process User Inputs:	Value (English)	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
FLOW AND CHEMICAL ADDITION							
Application #1							
1.) Minimum flow to application point	4.00	mgd	15.14	ML/d			Input the flow that the selected dose w be applied to
2.) Average flow to application point	4.00	mgd	15.14	ML/d			Input the flow that the selected dose w be applied to.
3.) Maximum flow to application point	12.00	mgd	45.42	ML/d			Input the flow that the selected dose w be applied to.
4.) Minimum chemical addition	120.00	mg/L					Input the dose that corresponds to the flow input above.
5.) Average chemical addition	120.00	mg/L					Input the dose that corresponds to the flow input above.
6.) Maximum chemical addition	120.00	mg/L					Input the dose that corresponds to the flow input above.
7.) Input Number of Equal Simultaneous Application Points	1	#					
8.) Hours of addition per day	24	hr					Input the total number of hours that th chemical is fed during the day.
Application #2							
9.) Minimum flow to application point		mgd		ML/d			Input the flow that the selected dose w be applied to. Enter 0 if Unit Process i not included.
10.) Average flow to application point		mgd		ML/d			Input the flow that the selected dose w be applied to. Enter 0 if Unit Process i not included.
11.) Maximum flow to applicatoin point		mgd		ML/d			Input the flow that the selected dose w be applied to. Enter 0 if Unit Process i not included.
12.) Minimum chemical addition		mg/L					Input the dose that corresponds to the flow input above.
13.) Average chemical addition		mg/L					Input the dose that corresponds to the flow input above.
14.) Maximum chemical addition		mg/L					Input the dose that corresponds to the flow input above.
15.) Input Number of Equal Simultaneous Application Points		#					
16.) Hours of addition per day		hr					Input the total number of hours that th chemical is fed during the day.
Application #3							
17.) Minimum flow to application point		mgd		ML/d			Input the flow that the selected dose w be applied to. Enter 0 if Unit Process i not included.
18.) Average flow to application point		mgd		ML/d			Input the flow that the selected dose w be applied to. Enter 0 if Unit Process i not included.
19.) Maximum flow to applicatoin point		mgd		ML/d			Input the flow that the selected dose w be applied to. Enter 0 if Unit Process i not included.
20.) Minimum chemical addition		mg/L					Input the dose that corresponds to the flow input above.
21.) Average chemical addition		mg/L					Input the dose that corresponds to the flow input above.
22.) Maximum chemical addition		mg/L					Input the dose that corresponds to the flow input above.
23.) Input Number of Equal Simultaneous Application Points		each					
24.) Hours of addition per day		hr					Input the total number of hours that th chemical is fed during the day.
CHEMICAL QUANTITIES AND FLOW							
Application Point #1 Chemical Usage:							
Minimum as "dry" chemical	4003.20	lb/d	1815.82	kg/d			
Average as "dry" chemical	4003.20	lb/d	1815.82	kg/d			
Maximum as "dry" chemical	12009.60	lb/d	5447.46	kg/d			
Minimum Plant Water Flow	27.80	gpm	105.23	L/min			
Average Plant Water Flow	27.80	gpm	105.23	L/min			
Maximum Plant Water Flow	83.40	gpm	315.70	L/min			
Chemical Metering Rates per Simultaneously Operating Pump							
Minimum at feed concentration	1668.00	gph	6314.07	L/h			
Average at feed concentration	1668.00	gph	6314.07	L/h			
Maximum at feed concentration	5004.00	gph	18942.20	L/h			
Calculate Chemical Metering Pump Flow Turndown	3.00						Should be < 20. If > = 20, proceed with caution
Application Point #2 Chemical Usage:							
Minimum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Average as "dry" chemical	0.00	lb/d	0.00	kg/d			
Maximum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Minimum Plant Water Flow	0.00	gpm	0.00	L/min			
Average Plant Water Flow	0.00	gpm	0.00	L/min			
Maximum Plant Water Flow	0.00	gpm	0.00	L/min			
Chemical Metering Rates per Simultaneously Operating Pump							
Minimum at feed concentration	0.00	gph	0.00	L/h			
Average at feed concentration	0.00	gph	0.00	L/h			
Maximum at feed concentration	0.00	gph	0.00	L/h			

Calculate Chemical Metering Pump Flow Turndown	0.00						Should be < 20; if > = 20, proceed with caution
Application Point #3 Chemical Usage							
Minimum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Average as "dry" chemical	0.00	lb/d	0.00	kg/d			
Maximum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Minimum Plant Water Flow	0.00	gpm	0.00	L/min			
Average Plant Water Flow	0.00	gpm	0.00	L/min			
Maximum Plant Water Flow	0.00	gpm	0.00	L/min			
Chemical Metering Rates per Simultaneously Operating Pump							
Minimum at feed concentration	0.00	gph	0.00	L/h			
Average at feed concentration	0.00	gph	0.00	L/h			
Maximum at feed concentration	0.00	gph	0.00	L/h			
Calculate Chemical Metering Pump Flow Turndown	0.00						Should be < 20; if > = 20, proceed with caution
Whole Plant Chemical Usage for Storage Calcs							
Minimum	4003 20	lb/d	1815.82	kg/d			
Avurage	4003 20	lb/d	1815 82	kg/d			
Maximum	12009 60	lb/d	5447 46	kg/d			
Max Flow Averagu Dose Daily Usage	12009 60	lb/d	5447 46	kg/d			
CHEMICAL STORAGE INPUTS							
25.) Flow used to calculate storage requirements	Average	Type					
26.) Chemcial application used to calculate storage requirements	Average	Type					
27.) Number of days of storage	30.00	days					
28.) Choose Chemical Delivery Method	Supersack						
Storage Mass	120096 00	lb	54474 63	kg			
Bulk Delivery Mass	2000 00	lb	907 18	kg			Fixed
Bulk Delivery Storage Required	46 15	cf	1 31	m3			
Maximum Storage Required	1847 63	cf	52 32	m3			
SILO STORAGE CALCULATIONS							
29.) Input Number of Silos	2	#			#S		
30.) Input Diameter of Silo	14.00	ft	4267.20	mm	SD		
Maximum Number of Pumps Per Silo	0.00	#				Error: You are trying to put too many pumps underneath each silo. You must increase the number of silos or diameter of each silo for this general arrangement to apply.	
Straight Wall Height of Storage Cylinder	0.00	ft	0.00	mm	CSWH		
Height of Storage Cone	0.00	ft	0.00	mm	SCH		
Volume of Storage in Cone	0.00	cf	0.00	m3			
Hopper and Meter System Height	0.00	ft	0.00	mm	SHH		Fixed
Dust Collector Height	0.00	ft	0.00	mm	DCH		Fixed
Total Silo Height	0.00	ft	0.00	mm			
31.) Number of Rows of Silos	1	#					
Calculate Number of Silos Per Row	0.00	#					
32.) Input Clear Distance Between Silo Rows	15.00	ft		mm	DDR		Typically > 8 ft; if a access road is desired > 24 ft
33.) Input Clear Distance Between Silos	15.00	ft		mm	DDS		Typically > 8 ft
SUPERSACK STORAGE CALCULATIONS							
Length and Width of Supersack	4 00	ft	1219 20	mm	SSLW		Fixed
Height of Supersack	4 00	ft	1219 20	mm	SSH		Fixed
Number of Supersacks Needed	51 00	#			SSNUM		
34.) Number of Rows of Supersacks	2	#			#R		
35.) Number of Supersacks, Stacked	1	#			#SS		
Number of Supersacks Per Row	31 00	#			#SPR		
36.) Input Clear Distance Between Cycle Bins	3.00	ft	914.40	mm	CDSS		Typically ≥ 3 ft
HOPPER FEED SYSTEM CALCULATIONS							
37.) Max Hopper Plant Water Flow Rate	100.00	gpm	378 54	L/min			Fixed
Flow Rate Needed for Max Flow Conditions	83 40	gpm	315 70	L/min		OKAY	
Calculate Number of Hoppers	1 00	#					Typically 1 for Silo system and 2 for other systems
Dry Capacity of Each Hopper	2000 00	lb	907 18	kg			
Hopper Length	5 33	ft	1624 58	mm	LFS		Fixed
Hopper Width	5 33	ft	1624 58	mm	WFS		Fixed
Height From Floor to Top of Feed System	17 29	ft	5269 99	mm	FSH		Fixed
38.) Input Clear Distance Around Hopper	3.00	ft	3.00	mm	CDH		Typically ≥ 3 ft
SOLUTION TANKS:							
Calculate Volume of Each Solution Tank	75 00	gal	283 91	L			
Calculate Volume of Solution Storage Required	10 03	cf	0 28	m3			
Number of Solution Tanks	1 00	#			#T		
Calculate Circular Tank Diameter	0.00	ft	0.00	mm	STD		Circular tank for Silo/truck delivery system
Solution Tank Length/Width	2 75	ft	838.20	mm	TLW		Square tank for supersack/hopper system
Use this Tank Height (Liquid Height * 1.2)	2 00	ft	609 60	mm	STH		Verify tank height within the facility. If indoors, typically 4' lower than the roof framing structure.
Calculate Number of Hours of Solution Storage Required At Max Flow and Max Dose	0 01	hrs					
Solution Tank Distance from Silo Wall	2 00	ft	609 60	mm	STCD		Fixed
Clear Distance from Pumps to Edge of Silo	4 56	ft	1390 65	mm	SPCD		
39.) Input Clear Distance Around Transfer Pumps for SuperSack System	4.00	ft	1,828.80	mm	CDP		Typically ≥ 3ft
Transfer Pumps - Application #1							
Transfer Pump Type	Watson Marlow	Type				Fixed	
Transfer Pump Model	SPX 50						
Number of Active Transfer Pumps	1 00	#					
Number of Standby Transfer Pumps	1 00	#					
Total Number of Transfer Pumps	2 00	#			#FP1		
Calculate Max Transfer Pump Flow Rate (each)	83 40	gpm	5 26	L/s			
Calculate Transfer Pump Brake Horsepower	5 50	hp	4 10	kW			
Calculate Transfer Pump Pad Length	2 88	ft	876 30	mm	FPL1		
Calculate Transfer Pump Pad Width	2 75	ft	838 20	mm	FPW1		
Calculate Transfer Pump Height	2 65	ft	807 72	mm	FPH1		
Transfer Pumps - Application #2							
Transfer Pump Type	Watson Marlow	Type				Fixed	
Transfer Pump Model	NEMA 2	#					
Input Number of Active Transfer Pumps	0 00	#					
Input Number of Standby Transfer Pumps	0 00	#					
Total Number of Transfer Pumps	0 00	#			#FP2		

Calculate Max Transfer Pump Flow Rate (each)	0.00	gpm	0.00	L/s			
Calculate Transfer Pump Brake Horsepower	0.65	hp	0.48	kW			
Calculate Transfer Pump Pad Length	0.74	ft	225.55	mm	FPL2		
Calculate Transfer Pump Pad Width	0.76	ft	230.12	mm	FPW2		
Calculate Transfer Pump Height	0.43	ft	132.08	mm	FPH2		
Transfer Pumps - Application #3							
Transfer Pump Type	Watson Marlow	Type				Fixed	
Transfer Pump Model	NEMA 2	#					
Input Number of Active Transfer Pumps	0.00	#					
Input Number of Standby Transfer Pumps	0.00	#					
Total Number of Transfer Pumps	0.00	#			#FP3		
Calculate Max Transfer Pump Flow Rate (each)	0.00	gpm	0.00	L/s			
Calculate Transfer Pump Brake Horsepower	0.65	hp	0.48	kW			
Calculate Transfer Pump Pad Length	0.74	ft	225.55	mm	FPL3		
Calculate Transfer Pump Pad Width	0.76	ft	230.12	mm	FPW3		
Calculate Transfer Pump Height	0.43	ft	132.08	mm	FPH3		
FACILITY SIZING:							
40.) If this is a Supersack Application, is this Chemical Room Part of a Multiple Chemical Facility?	No	Y/N					
41.) Is this Chemical Room Considered the "Start Point" for this Chemical Facility?	No	Y/N					There should only be one "start point" chemical facility. Recommend choosir the facility with the greatest width as t "start point"
42.) If this is Part of a Multiple Chemical Facility and is the "Start Point", Input the Summation of Total Number of Pumps from the Other Chemical Rooms Here		#					Total number of pumps is listed in row 114 of the liquid chemical facility, row 140, 151, and 162 of the dry chemical facility, and row 122 of the potassium permanganate facility
43.) Input Common Chemical Access Corridor Width	6.00	ft		mm	CW		Input zero if a corridor is not required
44.) Is Corridor Covered?	Yes	Y/N					
45.) Is Chemical Facility Covered?	Yes	Y/N					
46.) Select Chemical Building for this Chemical	None						This is for the user to organize the chemicals
CONTAINMENT AREA:							
Calculate Containment Area Length	140.00	ft	42672.00	mm	ICL		
Calculate Containment Area Width	19.21	ft	5853.68	mm	ICW		
47.) Optional: User Overwrite of Containment Area Width		ft	2,438.40	mm			
Calculate Containment Area Diameter	N/A	ft	#VALUE!	mm	CAD		
Calculate Fire Sprinkler Water Volume	10754.80	gal	40.71	m3			assumes 0.2 gpm/sf for 20 min
Calculate 120% of One Storage Tank Volume	90.00	gal	0.34	m3			
Calculate 30% of All Tank Volume	22.50	gal	0.09	m3			
Calculate 20 Minutes of Maximum Plant Water	1668.00	gal	6.31	m3			
Calculate Maximum Volume + Fire Flow Volume	1660.69	cf	47.03	m3			
Calculate Containment Wall Height (including freeboard)	1.12	ft	340.68	mm			120% of 1 tank volume or 30% of all t volume whichever is greater + fire flow volume + 6" freeboard.
48.) Optional: User Overwrite of Containment Wall Height		ft	2,438.40	mm			
49.) Input Depth of Burial	0.00	ft	1,828.80	mm	DB		
50.) Input Cutback Slope	1.00	:1					Cutback slope should be 1:1 for depth burial ≤ 5 ft, and at least 1.5:1 for dept of burial > 5 ft.
51.) Input Over Excavation Depth	1.00	ft	609.60	mm	OEXD		
Mechanical Sizing Requirements:							
Pipe Name	Input Velocity	Unit (English)	Input Velocity	Unit (Metric)	Standard Pipe Size	Unit (English)	Nominal Pipe Size
Chemical Transfer Pump Suction Header Piping	2.00	fps	0.61	m/s	4.50	in	100.00
Chemical Transfer Pump Discharge Header Piping	6.00	fps	1.83	m/s	2.50	in	50.00
Plant Water Pipe	5.00	fps	4.83	m/s	1.00	in	25.00
Mechanical Material Requirements:							
Pipe Name	Pipe ID	Installation Type	Pipe Material	Pipe Lining Material	Pipe Coating Material	Pipe Length	# Elbows
Chemical Transfer Pump Suction Header Piping	LCSH	Exposed	PVC	NA	NA	159.21	8
Chemical Transfer Pump Discharge Header Piping	LCDH	Exposed	FRP	NA	NA	159.21	12
Plant Water Pipe	PW	Exposed	PVC	NA	NA	19.98	2
Electrical User Inputs and Sizing Requirements:							
52.) Is this a "Critical" Facility (requiring standby power)?	No	Y/N					
53.) Is there SWGR?	No						
Electrical Equipment Lengths:							MCC
Item	Quantity	HP per Each	AFD's Required?	MCC Spaces for Motor Starters	MCC Spaces for AFD's less than 50hp)	MCC Spaces for Breakers	Total MCC Spaces
Transfer Pumps - Aplication #1	2	5.50	No	4.00	0.00	0.00	
Transfer Pumps - Aplication #2	0	0.65	No	0.00	0.00	0.00	
Transfer Pumps - Aplication #3	0	0.65	No	0.00	0.00	0.00	
Hoppers	1	1.00	No	2.00	0.00	0.00	
TOTAL				6.00	0.00	0.00	6.00
Electrical Equipment Widths:							
Equipment	Depth (ft)						
MCC	1.67						
Small AFD's	0.00						
Large AFD's	0.00						
Switchgear	0.00						
Maximum Depth	1.67						
Clear Distances:							
Clear Distance	Width	Length					
CD1		3.00	Typically 3 feet				
CD2		1.00	Typically 1 foot				
CD3		0.00	Typically Zero				
CD4		0.00	Typically Zero				
CD5		0.00	Typically Zero				
CD6	0.00		If there is no switchgear, this distance will be Zero.				
CD7	3.00		Typically 3 feet				
Contingency Length		0.00	Typically Zero				
Electric Room Length (ft):							
CD1	3.00						
MCC	6.33						
CD2	1.00						
Small AFD's	0.00						
CD3	0.00						
Large AFD's	0.00						
CD4	0.00						
Swithgear	0.00						
CD5	0.00						
Contingency	0.00						
Total Length	12.33						

Electric Room Width (ft):							
CD6	0.00	If there is no switchgear, this distance will be Zero					
Maximum Equipment Depth	1.67						
CD7	3.00						
Total Width	4.67						
Estimating Dimensions:	**Value English**	**Unit (English)**	**Value (Metric)**	**Unit (Metric)**	**Name**	**Comment**	**Red Flags**
Containment Area:							
Silo:							
Number of Silos	0	#					
Silo Diameter	0.00	ft	0.00	mm			
Foundation Thickness	24.00	in	609.60	mm		Model based on 18"	
Foundation Thickness	0.00	ft	0.00	mm			
Containment Wall Thickness	8.00	in	203.20	mm		Model based on 8"	
Containment Wall Thickness	0.00	ft	0.00	mm			
Foundation Diameter	0.00	ft	0.00	mm			
Containment Wall Height	0.00	ft	0.00	mm			
Excavation Diameter	0.00	ft	0.00	mm			
Excavation Depth	0.00	ft	0.00	mm			
Supersack:							
Containment Area Length	140.00	ft	42672.00	mm			
Containment Area Width	19.21	ft	5853.68	mm			
Containment Area Slab on Grade Length	141.33	ft	43078.40	mm			
Containment Area Slab on Grade Width	20.54	ft	6260.08	mm			
Containment Area Excavation Length	145.33	ft	44297.60	mm			
Containment Area Excavation Width	24.54	ft	7479.28	mm			
Containment Wall Height	1.12	ft	340.66	mm			
Slab on Grade Thickness	9.00	in	228.60	mm		Model based on 9"	
Slab on Grade Thickness	0.75	ft	228.60	mm			
Containment Wall Thickness	8.00	in	203.20	mm		Model based on 8"	
Containment Wall Thickness	0.67	ft	203.20	mm			
Corridor:							
Corridor Area Length	140.00	ft	42672.00	mm			
Corridor Area Width	6.00	ft	1828.80	mm			
Corridor Area Slab on Grade Length	141.33	ft	43078.40	mm			
Corridor Area Slab on Grade Width	8.00	ft	2438.40	mm			
Corridor Area Excavation Length	145.33	ft	44297.60	mm			
Corridor Area Excavation Width	12.00	ft	3657.60	mm			
Electrical Room:							
Electrical Area Length	13.67	ft	4165.60	mm			
Electrical Area Width	6.00	ft	1828.80	mm			
Electrical Area Slab on Grade Length	15.67	ft	4775.20	mm			
Electrical Area Slab on Grade Width	8.00	ft	2438.40	mm			
Electrical Area Excavation Length	19.67	ft	5994.40	mm			
Electrical Area Excavation Width	12.00	ft	3657.60	mm			
Slab on Grade Thickness	12.00	in	304.80	mm		Model based on 12"	
Slab on Grade Thickness	1.00	ft	304.80	mm			
Walls:							
Height = FBD	10.00	ft				Fixed	
Concrete Thickness	8.00	in	203.20	mm		Model based on 8"	
Concrete Thickness	0.67	ft	203.20	mm			
Containment + Corridor Excavation Area (Excludes Electrical Room)	3528.70	ft	1075547.76	mm			
Excavation Depth	1.75	ft	533.40	mm			
Covered Building Area	3528.70	sf	327.83	m2			

Description	**Quantity (English)**	**Unit (English)**	**Quantity (Metric)**	**Unit (Metric)**	**$/Unit**	**Total Cost**	**User Over-Write**
SITEWORK:							
Silo:							
Excavation	0.00	CY	0.00	m3	*$6.35*	$0	
Imported Structural Backfill	0.00	CY	0.00	m3	*$48.10*	$0	
Native Backfill	0.00	CY	0.00	m3	*$7.80*	$0	
Haul Excess	0.00	CY	0.00	m3	*$7.80*	$0	
Supersack:							
Excavation	812.54	CY	621.23	m3	*$6.35*	$5,158	
Imported Structural Backfill	786.70	CY	601.48	m3	*$48.10*	$37,840	
Native Backfill	585.48	CY	447.63	m3	*$7.80*	$4,569	
Haul Excess	227.06	CY	173.60	m3	*$7.80*	$1,772	
Electrical Room:							
Excavation	21.15	CY	16.17	m3	*$6.35*	$134	
Imported Structural Backfill	17.48	CY	13.37	m3	*$48.10*	$841	
Native Backfill	3.59	CY	2.75	m3	*$7.80*	$28	
Haul Excess	17.56	CY	13.43	m3	*$7.80*	$137	
Allowance for Misc Items	5%				$50,479.36	$2,524	
Subtotal						$53,003	
CONCRETE:							
Silo:							
Concrete Foundation	0.00	CY	0.00	m3	*$393.62*	$0	
Concrete Containment Walls	0.00	CY	0.00	m3	*$704.01*	$0	
Supersack:							
Slab on Grade:							
Containment Area	80.63	CY	61.65	m3	*$393.62*	$31,739	
Corridor	31.41	CY	24.01	m3	*$393.62*	$12,363	
Containment Walls	8.79	CY	6.72	m3	*$704.01*	$8,186	
Hopper Pads	1.05	CY	0.80	m3	*$356.31*	$375	
Metering Pump Pads	0.59	CY	0.45	m3	*$356.31*	$209	
Electrical Room:							
Slab on Grade	4.64	CY	3.55	m3	*$393.62*	$1,827	
Allowance for Misc Items	5%				$52,698.32	$2,635	
Subtotal						$55,333	
MASONRY:	Moderate						
Silo Containment Area	0.00	SF	0.00	m2	*$19.55*	$0	
Containment Area	2902.75	SF	269.67	m2	*$156.08*	$453,071	
Corridor	1130.67	SF	105.04	m2	*$156.08*	$176,478	
Electrical Room	125.33	SF	11.64	m2	*$156.08*	$18,562	
Subtotal	4158.75					$649,111	
METALS:							
Metal Stairway	2	EA			*$7,804.16*	$15,608	
Grating	1	EA			*$1,873.00*	$1,873	
Allowance for Misc Items	10%				$17,481.32	$1,748	
Subtotal						$19,229	

EQUIPMENT:							Budgetary Quote: (CPES will automatically add Installation Fact
Silo(s)	0	EA			$523,541.19	$0	
Hopper Feeder System	1	EA			$203,347.71	$203,348	
Transfer Pump- Application 1	2	EA			$19,865.51	$39,731	
Transfer Pump- Application 2	0	EA			$7,508.22	$0	
Transfer Pump- Application 3	0	EA			$7,508.22	$0	
Allowance for Misc Items	10%				$243,078.72	$24,308	
Subtotal						$267,387	
MECHANICAL:							
Pipe							
Chemical Transfer Pump Suction Header Piping-LCSH (4.5-inch, Exposed, PVC)	159.21	LF	48.53	m	$29.80	$4,713	
Chemical Transfer Pump Discharge Header Piping-LCDH (2.5-inch, Exposed, FRP)	159.21	LF	48.53	m	$23.06	$3,672	
Plant Water Pipe-PW (1-inch, Exposed, PVC)	19.98	LF	6.09	m	$12.29	$245	
Elbows							
Chemical Transfer Pump Suction Header Piping-LCSH (4.5-inch, Exposed, PVC)	8	EA			$90.98	$728	
Chemical Transfer Pump Discharge Header Piping-LCDH (2.5-inch, Exposed, FRP)	12	EA			$198.74	$2,385	
Plant Water Pipe-PW (1-inch, Exposed, PVC)	2	EA			$9.43	$19	
Tees							
Chemical Transfer Pump Suction Header Piping-LCSH (4.5-inch, Exposed, PVC)	2	EA			$133.95	$268	
Chemical Transfer Pump Discharge Header Piping-LCDH (2.5-inch, Exposed, FRP)	1	EA			$289.66	$290	
Plant Water Pipe-PW (1-inch, Exposed, PVC)	0	EA			$9.81	$0	
Valves							
Chemical Transfer Pump Suction Header Piping-LCSH (4.5-inch, Exposed, PVC, V-902, Diaphragm)	2	EA			$2,491.50	$4,983	
Chemical Transfer Pump Discharge Header Piping-LCDH (2.5-inch, Exposed, FRP, V-902, Diaphragm)	2	EA			$1,384.17	$2,768	
Plant Water Pipe-PW (1-inch, Exposed, PVC, V-902, Diaphragm)	1	EA			$563.67	$554	
Allowance for Misc Items	10%				$20,624.11	$2,062	
Subtotal						$22,687	
ELECTRICAL:							
# MCC Sections	5	#			$8,044.96	$40,225	
Switchgear	0	EA			$37,006.81	$0	
Adjustable Frequency Drives							
Transfer Pumps - Aplication #1	0	EA			$8,984.55	$0	
Transfer Pumps - Aplication #2	0	EA			$8,388.51	$0	
Transfer Pumps - Aplication #3	0	EA			$8,388.51	$0	
Hoppers	0	EA			$8,431.52	$0	
Electrical Conduit & Wire	420.00	LF	128.02	m	$11.30	$4,747	
Allowance for Misc Items	10%				$44,971.40	$4,497	
Subtotal						$49,469	
USER DEFINED ESTIMATE ITEMS:	**QUANT (ENGLISH)**	**UNIT (ENGLISH)**	**QUANT (METRIC)**	**UNIT (METRIC)**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0.00		0.00		0.00	$0	
Item 2 Description	0.00		0.00		0.00	$0	
Item 3 Description	0.00		0.00		0.00	$0	
Item 4 Description	0.00		0.00		0.00	$0	
Item 5 Description	0.00		0.00		0.00	$0	
Item 6 Description	0.00		0.00		0.00	$0	
Item 7 Description	0.00		0.00		0.00	$0	
Item 8 Description	0.00		0.00		0.00	$0	
Item 9 Description	0.00		0.00		0.00	$0	
Item 10 Description	0.00		0.00		0.00	$0	
Item 11 Description	0.00		0.00		0.00	$0	
Item 12 Description	0.00		0.00		0.00	$0	
Item 13 Description	0.00		0.00		0.00	$0	
Item 14 Description	0.00		0.00		0.00	$0	
Item 15 Description	0.00		0.00		0.00	$0	
Subtotal						$0	
Subtotal						$1,116,219	
ALLOWANCES:		User Override					
Finishes Allowance	2.00%		$1,240,243	$24,805			
I&C Allowance	2.00%		$1,240,243	$24,805			
Mechanical Allowance	4.00%		$1,240,243	$49,610			
Electrical Allowance	2.00%		$1,240,243	$24,805			
					Facility Cost Name		
Facility Cost	**4,159**	**Building SF**	**$298.22**	**$1,240,243**	CFDFC01		
Facility Cost with Standard Additional Project Costs Added	**4,159**	**Building SF**	**$298.22**	**$1,240,243**	CFDFC02		
Facility Cost with Standard Additional Project Costs and Contractor Markups Added	**4,159**	**Building SF**	**$443.92**	**$1,846,145**	CFDFC03		
Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	**4,159**	**Building SF**	**$435.50**	**$1,811,118**	CFDFC05		
Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	**4,159**	**Building SF**	**$435.50**	**$1,811,118**	CFDFC06		

LIQUID CHEMLY

Liquid Chemical Storage & Feed - (Aluminum Sulfate (Alum))

Located in Stand Alone Chemical Building

Is This Facility Included in My Project? Yes

Is the Facility Storage Only (no metering pumps)?	No	Y/N					
		Overwrite Value					
Select Chemical	Aluminum Sulfate (Alum)	magchloride	Select "Other" from the drop down list if using a different chemical.	ERROR: Cell C7 should be 'Other', or Cell D7 should be			
Percent Active Chemical % w/w	75.00%	75.00%	This is the intended feed strength to the process. Inputting a value in the yellow cell overwrites the cell in column "C"				For Fluoride systems, concentration must include the Available Fluoride ion (AFI) concentration. Typically 79.2% AFI for 23% as HFA. (e.g. 23% as HFA x 79.2% AFI = 18.22% as F)
Active Chemical Form for Dosage Basis	mgcl	mgcl	Inputting a value in the yellow cell overwrites the cell in column "C"				
Bulk Chemical Specific Gravity	3.00	3.00	Inputting a value in the yellow cell overwrites the cell in column "C"				
Active lb/gal solution	18.77	lb/gal	2248.54	kg/m3			

Process User Inputs:	Value (English)	Unit (English)	Value (Metric)	Unit (Metric)	Name	Red Flags	Comment
FLOW AND CHEMICAL ADDITION							
Application #1							
1) Minimum flow to application point	4.00	mgd	15.14	ML/d			Input the flow that the selected dose will be applied to
2) Average flow to application pont	4.00	mgd	15.14	ML/d			Input the flow that the selected dose will be applied to.
3) Maximum flow to applicatoin point	12.00	mgd	45.42	ML/d			Input the flow that the selected dose will be applied to.
4) Minimum chemical addition	50.00	mg/L					Input the dose that corresponds to the flow input above.
5.) Average chemical addition	50.00	mg/L					Input the dose that corresponds to the flow input above.
6) Maximum chemical addition	50.00	mg/L					Input the dose that corresponds to the flow input above.
7) Input Number of Equal Simultaneous Application Points	1	#					
8.) Hours of addition per day	10.00	hr					Input the total number of hours that the chemical is fed during the day
Application #2							
9) Minimum flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
10) Average flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
11) Maximum flow to applicatoin point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
12.) Minimum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
13) Average chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
14) Maximum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
15) Input Number of Equal Simultaneous Application Points	0	#					
16.) Hours of addition per day	0.00	hr					Input the total number of hours that the chemical is fed during the day
Application #3							
17) Minimum flow to application pont	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
18.) Average flow to application point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
19) Maximum flow to applicatoin point	0.00	mgd	0.00	ML/d			Input the flow that the selected dose will be applied to. Enter 0 if Unit Process is not included.
20.) Minimum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
21) Average chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
22.) Maximum chemical addition	0.00	mg/L					Input the dose that corresponds to the flow input above.
23.) Input Number of Equal Simultaneous Application Points	0	#					
24) Hours of addition per day	0.00	hr					Input the total number of hours that the chemical is fed during the day
CHEMICAL QUANTITIES AND FLOW							
Application Point #1 Chemical Usage							
Minimum as "dry" chemical	695.00	lb/d	315.25	kg/d			
Average as "dry" chemical	695.00	lb/d	315.25	kg/d			
Maximum as "dry" chemical	2085.00	lb/d	945.74	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump							
Minimum at feed concentration	3.70	gph	14.02	L/h			
Average at feed concentration	3.70	gph	14.02	L/h			
Maximum at feed concentration	11.11	gph	42.06	L/h			
Calculate Chemical Metering Pump Flow Turndown	3.00	1					Should be < 20:1. If ≥ 20:1, proceed with caution.
Application Point #2 Chemical Usage							
Minimum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Average as "dry" chemical	0.00	lb/d	0.00	kg/d			
Maximum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump							
Minimum at feed concentration	0.00	gph	0.00	L/h			
Average at feed concentration	0.00	gph	0.00	L/h			
Maximum at feed concentration	0.00	gph	0.00	L/h			
Calculate Chemical Metering Pump Flow Turndown	0.00	1					Should be < 20:1. If ≥ 20:1, proceed with caution.
Application Point #3 Chemical Usage							
Minimum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Average as "dry" chemical	0.00	lb/d	0.00	kg/d			
Maximum as "dry" chemical	0.00	lb/d	0.00	kg/d			
Chemical Metering Rates per Simultaneously Operating Pump							
Minimum at feed concentration	0.00	gph	0.00	L/h			
Average at feed concentration	0.00	gph	0.00	L/h			

Maximum of [illegible] concentration	0.00	ppb	0.00	[illegible]			
Calculate Chemical Metering Pump Flow Turndown	0.00	:1					Should be < 20:1, X ≥ 20:1, proceed w/ caution)
Whole Plant Chemical Usage for Storage Calcs:							
Minimum	695 00	lb/d	315 25	kg/d			
Average	695 00	lb/d	315 25	kg/d			
Maximum	2085 00	lb/d	945.74	kg/d			
Max Flow Average Dose Daily Usage	2085 00	lb/d					
Whole Plant # of Days of Storage							
Maximum Flow and Average Dose	12 50	days					
CHEMICAL STORAGE INPUTS							
25.) Flow used to calculate storage requirements	Maximum	Type					
26.) Chemcial application used to calculate storage requirements	Average	Type					
27.) Input Minimum Number of Days of Storage	30.00	days					
Minimum Storage Volume	3333 33	gal	12 62	m3			
28.) Choose Chemical Delivery Method	Tank Truck	Type					
Bulk Delivery Volume (Tank Truck, Totes, Drums)	1,798 56	gal	6 81	m3			Assumes 45,000 lb per Tank Truck.
Optional: Input Bulk Delivery Volume for Selected Delivery Method (overwrites above calculation)		gal		m3			Not typically used. Use with caution.
Calculate Bulk Delivery Volume * 1 5 (for Truck Delivery Only)	2,697 84	gal	10 21	m3			
Maximum of Above Delivery and Storage Volumes	445 60	cf	12 62	m3			
BULK TANKS:							
29.) Input Number of Tanks	1	#					
30.) Input Tank Diameter	8.00	ft	2,438.40	mm	BTD		Greater than 14' tank diameter will req on-site tank fabrication. Maximum diameter allowed for this model is 14'
Calculate Liquid Height of Tanks	8 86	ft	2702 04	mm			
Use this Tank Height (Liquid Height * 1 2)	11 00	ft	3352 80	mm			Verify tank height within the facility. If indoors, typically 4' lower than the roof framing structure. Assumes extra 20% volume needed for each tank for head space and outlet connection elevation.
Calculate Usable Volume of Each Bulk Tank	3448 78	gal	13 05	m3			Assumes 20% of the volume of each t is not usable (needed for head space outlet connection elevation).
Calculate Volume of Each Bulk Tank	4138 13	gal	15 66	m3			
31.) Input Number of Rows of Tanks	1	#					
Calculate Number of Tanks per Row	1	#					
32.) Input Tank Material (FRP, PE (Polyethylene), PLS (Phenolic Lined Steel))	FRP	Type					Typically FRP
33.) Input Clear Distance Around BulkTanks, Day Tanks, Totes or Drums	4.00	ft	1,219.20	mm	CDT		Typically ≥ 3 ft
Calculate Actual Number of Days of Storage	31 02	days					For bulk tanks, assumes 20% of the volume of each tank is not usable (nee for head space and outlet connection elevation).
TOTES & DRUMS:							
Calculate Number of Totes or Drums	0	#					
34.) Input Number of Rows of Totes or Drums	1	#					
Calculate Number of Totes or Drums per Row	0	#					
Length of Each Tote	0.00	ft	0.00	mm			Fixed
Width of Each Tote	0.00	ft	0.00	mm			Fixed
Diameter of Each Drum	0.00	ft	0.00	mm			Fixed
DAY TANKS:							
35.) Are Day Tanks Required?	No	Y/N					Rule: Day Tanks are only available wh the Delivery Method = "Tank Truck".
36.) Input Number of Day Tanks	2	#					Suggest 2 Day Tanks
Calculate Day Tank Volume based on Max Flow/Dose (per tank)	0.00	gal	0.00	m3			
Convert Day Tank Volume (per each)	0.00	cf	0.00	m3			
Calculate Day Tank Diameter (per each)	0.00	ft	0.00	mm	BTD		
Calculate Day Tank Height (per each)	0.00	ft	0.00	mm			Assumption: H = 2 * D
TRANSFER & METERING PUMPS:							
Number of Transfer Pumps	0	#					Fixed
37.) Input Time to Fill Day Tank	20.00	min					Typically fill all day tanks in 20 min
Calculate Number of Active Metering Pumps	1	#					Rule: One active metering pump per e application point.
Calculate Number of Standby Metering Pumps	1	#					Rule: One standby metering pump per each application
38.) Input Number of Additional Standby Metering Pumps	0	#					
Calculate Total Number of Metering Pumps	2	#					
39.) Input Clear Distance Around Transfer and Metering Pumps	3.00	ft	914.40	mm	CDP		Typically ≥ 4 ft
Length of Transfer and Metering Pumps	3 00	ft	914 40	mm			Fixed. Conservatively assumes Pulsafeeder metering pump type
FACILITY SIZING:							
40.) Is this Chemical Room Part of a Multiple Chemical Facility?	Yes	Y/N					
41.) Is this Chemical Room Considered the "Start Point" for this Chemical Facility?	No	Y/N					There should only be one "start point" p chemical facility. Recommend choosing the facility with the greatest width as the "start point"
42.) If this is Part of a Multiple Chemical Facility and is the "Start Point", Input the Summation of Total Number of Pumps from the Other Chemical Rooms Here		#					Total number of pumps is listed in row [illegible] of the liquid chemical facility, rows 150, 151, and 152 of the dry chemical facility and row 122 of the potassium permanganate facility.
43.) Input Common Chemical Access Corridor Width	0.00	ft		mm			Input zero if a corridor is not required. Assumes Chem facilities are in series. Chem facilities are in parallel, input 1/2 total corridor width.
44.) Is Corridor Covered?	Yes	Y/N					
45.) Select Chemical Facility Covering	Building						
46.) Select Chemical Area for this Chemical	None						Only used to help CPES user organize chemicals when multiple chemical buildings are used. Has no impact on sizing calculations or cost.
CONTAINMENT AREA:							
Are Stairs Required into Containment Area?	Yes	Y/N					Typically not needed for tote and drum storage areas.
Is Grating Required in Containment Area?	Yes	Y/N					Typically not needed for tote and drum storage areas.
Width of Stair Access	4 00	ft	1219 20	mm	WS		Fixed
Calculate Containment Area Length	16 00	ft	4876 80	mm			

Calculate Containment Area Width	29 00	ft	8839.20	mm		Note: verify that this dimension matches the Containment Area Width on the other chemical rooms in this facility. If not, input the larger value in the user overwrite on the room with the shorter dimension	
47.) Optional: User Overwrite of Containment Area Width		ft	2,438.40	mm			
Calculate Fire Sprinkler Water Volume	1856 00	gal	7 03	m3			Assumes 0 2 gpm/sf for 20 min if chemical installed inside a building. If chemical is outside or under a canopy, assume no fire sprinkler water volume.
Calculate 120% of One Storage Tank Volume	4983 36	gal	18 79	m3			
Calculate 30% of All Tank Volume	1240 84	gal	4 70	m3			
Calculate Maximum Volume + Fire Flow Volume	6819 36	gal	25 81	m3			
Tank Pads Volume	150 80	cf	4 27	m3			
Tank Pads Volume	1128 04	gal	4 27	m3			
Calculate Maximum Volume + Fire Flow Volume + Tank Pad Volume	7947 39	gal	30 08	m3			
Calculate Maximum Volume + Fire Flow Volume + Tank Pad Volume	1062 41	cf	30 08	m3			
Calculate Containment Wall Height (including freeboard)	2 79	ft	850 29	mm		Note: verify that this dimension matches the Containment Wall Height on the other chemical rooms in this facility. If not, input the larger value in the user overwrite on the room with the shorter dimension	120% of 1 tank volume or 30% of all tank volume whichever is greater + fire flow volume + 6" freeboard. Should be ≤ 4.5'.
48.) Optional: User Overwrite of Containment Wall Height		ft	2,438.40	mm			
49.) Input Depth of Burial	0.00	ft	0.00	mm	DB		
50.) Input Cutback Slope	1.00	:1					Cutback slope should be 1:1 for depth of burial ≤ 5 ft, and at least 1.5:1 for depth of burial > 5 ft.
51.) Input Over Excavation Depth	1.00	ft	0.00	mm	OEXD		

Mechanical Sizing Requirements:

Pipe Name	Input Velocity	Unit (English)	Input Velocity	Unit (Metric)	Standard Pipe Size	Unit (English)	Nominal Pipe Size
Chemical Transfer Pump Suction Header Piping	2.00	fps	0.61	m/s	1 00	in	25 00
Chemical Transfer Pump Discharge Header Piping	6.00	fps	1.83	m/s	1 00	in	25 00
Chemical Metering Pump Suction Header Piping	2.00	fps	0.61	m/s	1 00	in	25 00
Chemical Metering Pump Discharge Header Piping	6.00	fps	1.83	m/s	1 00	in	25 00

Mechanical Material Requirements:

Pipe Name	Pipe ID	Installation Type	Pipe Material	Pipe Lining Material	Pipe Coating Material	Pipe Length	# Elbows
Chemical Transfer Pump Suction Header Piping	CTSH	Exposed	PVC	NA	NA	0.00	0.00
Chemical Transfer Pump Discharge Header Piping	CTDH	Exposed	PVC	NA	NA	0.00	0.00
Chemical Metering Pump Suction Header Piping	LCSH	Exposed	PVC	NA	NA	45.00	8.00
Chemical Metering Pump Discharge Header Piping	LCDH	Exposed	PVC	NA	NA	45.00	8.00
						L+W	#MP*4

Electrical User Inputs and Sizing Requirements:

52.) Is this a "Critical" Facility (requiring standby power)?	No	Y/N
53.) Is there SWGR?	No	

Electrical Equipment Lengths:

Item	Quantity	HP per Each	AFD's Required?	MCC Spaces for Motor Starters	MCC Spaces for AFD's less than 50hp)	MCC Spaces for Breakers	MCC Total MCC Spaces
Metering Pumps	0.00	0.50	No	0.00	0.00	0.00	
User Defined Item #1	0.00	0.00	No	0.00	0.00	0.00	
User Defined Item #2	0.00	0.00	No	0.00	0.00	0.00	
User Defined Item #3	0.00	0.00	No	0.00	0.00	0.00	
TOTAL		0.00		0.00	0.00	0.00	0.00

Electrical Equipment Widths:

Equipment	Depth (ft)
MCC	0.00
Small AFD's	0.00
Large AFD's	0.00
Switchgear	0.00
Maximum Depth	0.00

Clear Distances:

Clear Distance	Width	Length	Comment	
CD1		3 00	Clear Distance between wall and MCC	Typically 3 feet
CD2		1 00	Clear Distance between MCC and Small AFD	Typically 1 foot
CD3		0 00	Clear Distance between Small AFD and Large AFD	Typically Zero
CD4		0.00	Clear Distance between Large AFD and Switchgear	Typically Zero
CD5		0 00	Clear Distance between Switchgear and Contingency Space	Typically Zero
CD6	4 00		Clear Distance behind Switchgear (if there is no Switchgear, this distance will be Zero)	
CD7	3 00		Clear Distance in front of Equipment	Typically 3 feet
Contingency Length		0.00	Contingency length	Typically Zero

Electric Room Length (ft)

CD1	3.00
MCC	0.00
CD2	1.00
Small AFD's	0.00
CD3	0.00
Large AFD's	0.00
CD4	0.00
Swithgear	0.00
CD5	0.00
Contingency	0.00
Total Length	0.00

Electric Room Width (ft):

CD6	0.00	If there is no switchgear, this distance will be Zero.
Maximum Equipment Depth	0.00	
CD7	3.00	
Total Width	0.00	

COST TABLE FOR TANKS & PUMPS:	Unit Cost
Tanks (Installed Cost per Gallon)	
FRP	$2.84
Polyethylene (PE)	$ 2.11
Phenolic Lined Steel (PLS)	$8.01
Chemical Feed Pumps (Cost per Each)	$7,991.45

Estimating Dimensions:	Value English	Unit (English)	Value (Metric)	Unit (Metric)	Name	Comment	Red Flags
Logic Tests ("1" = Yes, "0" = No):							
Is this Chemical Feed System Included?	1						
Is the Method of Delivery "Tank Truck"?	1						
Is Day Tank Required? (1 = Yes, 0 = No)	0						
Tank Truck without Day Tank (True or False)	TRUE						
Tank Truck with Day Tank (True or False)	FALSE						
Tank Truck without Day Tank (1 = Yes, 0 = No)	1					Tank Truck without Day Tank	
Tank Truck with Day Tank (1 = Yes, 0 = No)	0					Tank Truck without Day Tank	
Is the Method of Delivery "Tote"?	0					Tote	
Is the Method of Delivery "Drum"?	0					Drum	
Length of Module (Tank Truck)	16.00	ft	4876.80	mm			
Length of Module (Tote)	0.00	ft	0.00	mm			
Length of Module (Drum)	0.00	ft	0.00	mm			
Width of Module (Tank Truck without Transfer Pump and Day Tank)	29.00	ft	8839.20	mm			
Width of Module (Tank Truck with Transfer Pump and Day Tank)	0.00	ft	0.00	mm			
Width of Module (Tote)	0.00	ft	0.00	mm			
Width of Module (Drum)	0.00	ft	0.00	mm			
Area of Module	0.00	sf	0.00	m2			
Number of Bulk Tanks (each)	1	#					
Diameter of Bulk Tank	8.00	ft	2438.40	mm			
Volume of Each Bulk Tank	4136.13	gal	15.66	m3			
Bulk Tank Material	FRP	Type					
Number of Day Tanks (each)	0	#					
Diameter of Day Tank	0.00	ft					
Volume of Each Day Tank	0.00	gal	0.00	m3			
Number of Transfer Pumps	0	#					
Transfer Pump Capacity (each)	0.00	gpm	0.00	l/min		Assume fill each tank in 20 min	
Number of Metering Pumps	2	#					
Module Covered? ("1" = YES, "0" = NO)	0						
If Module Exists, Is it Covered? ("1" = Yes, "0" = No)	0						
Containment Wall Height	2.79	ft	850.29	mm			
Slab on Grade Thickness	9.00	in	228.60	mm		Model based on 9"	
Slab on Grade Thickness	0.75	ft	228.60	mm			
Containment Wall Thickness	8.00	in	203.20	mm		Model based on 8"	
Containment Wall Thickness	0.67	ft	203.20	mm			
Tank Pad / Metering Pump Pad Height	3.00	ft	914.40	mm	EPH		
Corridor							
Length	16.00	ft	4876.80	mm			
Width	0.00	ft	0.00	mm			
Area	0.00	sf	0.00	m2			
Corridor Covered? ("1" = YES, "0" = NO)	1						
Electrical Room:							
Slab on Grade:							
Length	0.00	ft	0.00	mm			
Width	0.00	ft	0.00	mm			
Concrete Thickness	12.00	in	304.80	mm		Model based on 12"	
Concrete Thickness	1.00	ft	304.80	mm			
Walls:							
Height = FBD	10.00	ft				Fixed	
Concrete Thickness	8.00	in	203.20	mm		Model based on 8"	
Concrete Thickness	0.67	ft	203.20	mm			
Overall Dimensions							
Containment Area Length	16.00	ft	4876.80	mm			
Containment Area Width	29.00	ft	8839.20	mm			
Containment Area	464.00	sf	43.11	m2			
Corridor Area Length	16.00	ft	4876.80	mm			
Corridor Area Width	0.00	ft	0.00	mm			
Corridor Area	0.00	sf	0.00	m2			
Electrical Area Length	0.00	ft	0.00	mm			
Electrical Area Width	0.00	ft	0.00	mm			
Electrical Room Area	0.00	sf	0.00	m2			
Chemical Facility Area	464.00	sf	43.11	m2			
Covered Chemical Area (Building)	464.00	sf	43.11	m2			
Covered Chemical Area (Canopy)	0.00	sf	0.00	m2			
Total Covered Area	464.00	sf	43.11	m2			
Excavation Depth	1.75	ft	533.40	mm			

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost	User Over-Write
SITEWORK:							
Excavation	39.40	CY	30.12	m3	$8.35	$250	
Imported Structural Backfill	34.37	CY	26.28	m3	$48.10	$1,853	
Native Backfill	5.10	CY	3.90	m3	$7.80	$40	
Haul Excess	34.30	CY	26.22	m3	$7.80	$266	
Allowance for Misc Items	5%				$2,210.79	$111	
Subtotal						$2,321	
CONCRETE:							
Slab on Grade	16.47	CY	12.59	m3	$356.31	$5,868	
Containment Walls	4.20	CY	3.21	m3	$704.01	$2,958	
Bulk Tank Pads	12.57	CY	9.61	m3	$356.31	$4,477	
Day Tank Pads	0.00	CY	0.00	m3	$356.31	$0	
Transfer Pump Pads	0.00	CY	0.00	m3	$356.31	$0	
Metering Pump Pads	1.33	CY	1.02	m3	$356.31	$475	
Corridor							
Slab on Grade	0.00	CY	0.00	m3	$356.31	$0	
Electrical Room							
Slab on Grade	0.00	CY	0.00	m3	$356.31	$0	
Allowance for Misc Items	5%				$13,776.70	$689	
Subtotal						$14,468	
MASONRY:	Moderate						
Chemical Building	464.00	SF	43.11	m2	$187.30	$86,907	
Electrical Room	0.00	SF	0.00	m2	$156.08	$0	
Subtotal	464.00					$86,907	
METALS:							
Canopy	0.00	SF	0.00	m2	$39.18	$0	
Metal Stairway	1	EA			$7,804.16	$7,804	
Grating	1	EA			$1,873.00	$1,873	
Allowance for Misc Items	10%				$9,677.16	$968	
Subtotal						$10,645	
EQUIPMENT:							Budgetary Quote: (CPES wi automatically add Installation Fa
Bulk Tank	1	EA			$10,932.59	$10,933	
Day Tank	0	EA			$0.00	$0	
Transfer Pump	0	EA			$0.00	$0	

Metering Pump	2	EA			$7,991.45	$15,983	
Allowance for Misc Items	10%				$26,915.49	$2,692	
Subtotal						$29,607	
INSTRUMENTS & CONTROLS:							
Instruments							
Chemical Tank Radar Level Transmitters	1	EA			$977.63	$978	
Chemical Tank Beacons	1	EA			$977.63	$978	
Day Tank Differential Pressure Transmitter	0	EA			$977.63	$0	
Drum or Tote Weigh Scale	0	EA			$1,303.51	$0	
Metering Pump Discharge Pressure Switch	2	EA			$651.76	$1,304	
Magmeter	1	EA			$651.76	$652	
Sump Pump Float Switch	1	EA			$325.88	$326	
Eyewash	1	EA			$977.63	$978	
Number of Analog I/O Counts	5	EA			$247.67	$1,238	
Number of Digital I/O Counts	17	EA			$58.66	$997	
Number of Local Panels	1	EA			$12,253.00	$12,253	
Number of PLCs	1	EA			$13,035.11	$13,035	
I&C Conduit & Wire	112.00	LF	34.14	m	$11.30	$1,266	
Allowance for Misc Items	10%				$34,003.44	$3,400	
Subtotal						$37,404	
MECHANICAL:							
Pipe							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0.00	LF	0.00	m	$12.29	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0.00	LF	0.00	m	$12.29	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	45.00	LF	13.72	m	$12.29	$553	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	45.00	LF	13.72	m	$12.29	$553	
Elbows							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$9.43	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$9.43	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	8	EA			$9.43	$75	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	8	EA			$9.43	$75	
Tees							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$9.81	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$9.81	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	2	EA			$9.81	$20	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	2	EA			$9.81	$20	
End Caps							
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA			$5.29	$0	
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA			$5.29	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	2	EA			$5.29	$11	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	2	EA			$5.29	$11	
Valves							
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	0	EA			$53.55	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	0	EA			$53.55	$0	
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	4	EA			$53.55	$214	
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC, V-902, Diaphragm)	4	EA			$53.55	$214	
Allowance for Misc Items	10%				$1,745.51	$175	
Subtotal						$1,920	
ELECTRICAL:							
# MCC Sections	0	#			$8,044.96	$0	
Switchgear	0	EA			$37,006.81	$0	
Adjustable Frequency Drives							
Metering Pumps	0	EA			$8,370.07	$0	
User Defined Item #1	0	EA			$8,308.63	$0	
User Defined Item #2	0	EA			$8,308.63	$0	
User Defined Item #3	0	EA			$8,308.63	$0	
Electrical Conduit & Wire	0.00	LF	0.00	m	$11.30	$0	
Allowance for Misc Items	10%				$0.00	$0	
Subtotal						$0	
USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST	
Item 1 Description	0.00				0.00	$0	
Item 2 Description	0.00				0.00	$0	
Item 3 Description	0.00				0.00	$0	
Item 4 Description	0.00				0.00	$0	
Item 5 Description	0.00				0.00	$0	
Item 6 Description	0.00				0.00	$0	
Item 7 Description	0.00				0.00	$0	
Item 8 Description	0.00				0.00	$0	
Item 9 Description	0.00				0.00	$0	
Item 10 Description	0.00				0.00	$0	
Item 11 Description	0.00				0.00	$0	
Item 12 Description	0.00				0.00	$0	
Item 13 Description	0.00				0.00	$0	
Item 14 Description	0.00				0.00	$0	
Item 15 Description	0.00				0.00	$0	
Subtotal						$0	
Subtotal						$183,272	
ALLOWANCES:		User Override					
Finishes Allowance	2.00%		$203,635	$4,073			
I&C Allowance	2.00%		$203,635	$4,073			
Mechanical Allowance	4.00%		$203,635	$8,145			
Electrical Allowance	2.00%		$203,635	$4,073			
					Facility Cost Name		
Facility Cost	464	Building SF	$438.87	$203,635	CFLFC01		
Facility Cost with Standard Additional Project Costs Added	464	Building SF	$438.87	$203,635	CFLFC02		
Facility Cost with Standard Additional Project Costs and Contractor Markups Added	464	Building SF	$853.27	$303,118	CFLFC03		
Facility Cost, Contractor Markups, and Location Adjustment Factor Added (excluding ALL Additional Project Costs)	464	Building SF	$640.88	$297,367	CFLFC05		
Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added	464	Building SF	$640.88	$297,367	CFLFC06		

City of Longview

Agenda Summary

WATER SUPPLY WELLHEAD PROTECTION PROGRAM UPDATE

RECOMMENDED ACTION:
For information and discussion

WATER SUPPLY WELLHEAD PROTECTION PROGRAM UPDATE

COUNCIL INITIATIVE ADDRESSED:
Provide sustainable water quality and environmental infrastructure.

CITY ATTORNEY REVIEW: N/A

SUMMARY STATEMENT:
Staff will provide an update on the wellhead protection program for the Mint Farm Regional Water Treatment Plant water supply, and potential future activities in the area. Attached for your information is a memorandum presenting our evaluation of the results of the May 2018 sentry well sampling, along with a summary of the test results for sentry well DW-1. All test result summaries and actual laboratory data are posted on the City's website. The October 2018 test results are being evaluated and information will be posted on the City's website upon conclusion of the evaluation.

RECOMMENDED ACTION:
For information and discussion.

STAFF CONTACT:
Jeff Cameron, Public Works Director

Attachments:

1. Tech Memo MAY 2018 Sampling Event 2.12.2019
2. WHPP - Tableau Results Summary (DMW-1) FINAL
3. MFRWTP Groundwater Monitoring Wells Map
4. Wellhead Protection Area Map

Technical Memorandum
Groundwater Quality Sampling, May 2018 Monitoring Event

Date: February 12, 2019
By: Amy Blain, P.E., City of Longview
Subject: Groundwater Quality Sampling, May 2018 Monitoring Event

This memorandum summarizes the results of groundwater monitoring and sampling conducted in May 2018 for the Mint Farm Regional Water Treatment Plant aquifer as part of the Wellhead Protection Program (WHPP). Untreated groundwater from the aquifer is tested approximately every six months to confirm consistent water quality and monitor potential contaminant migration from nearby industry using a series of wells in and surrounding the Mint Farm for advance detection.

ACTIVITIES CONDUCTED FOR THE MAY 2018 MONITORING EVENT

Activities completed for this sampling event were conducted in accordance with *Technical Memorandum 2, Water Quality Sampling Protocol (Kennedy/Jenks, 28 April 2009)* and *Technical Memorandum, Monitoring Well Analytes and Department of Health Test Panels (Kennedy/Jenks, 1 March 2013)*, plus supplemental activities identified by staff. Activities included:

- Collecting groundwater samples from sentinel wells DW-1, DW-2, DW-5, DW-6, DW-7, and DW-9 on May 7 and 8, 2018. Wells were purged prior to sample collection to stabilize pH, temperature, conductivity and dissolved oxygen levels.

- Submitting groundwater samples to ALS Environmental (ALS), an EPA-certified laboratory, to be analyzed for constituents currently regulated by state and federal drinking water standards, unregulated contaminants of interest, and contaminants specific to historical and industrial activity in or near the Mint Farm.

- Reviewing and compiling analytical results into Tableau Software, a live data engine that allows information to be visually displayed, trended and geographically linked such that large volumes of data can be easily interpreted and monitored.

- Preparing this summary memorandum.

DATA QUALITY

For quality assurance, all analyses were performed in accordance with National Environmental Laboratory Accreditation Program standards. Based on review of the laboratory reports, it is my opinion the analytical data received are of acceptable quality for their intended use and appropriate corrective action was taken where needed to prevent analytical bias.

RESULTS OF GROUNDWATER QUALITY SAMPLING

Certified lab reports for groundwater samples collected during this sampling event are attached. Results were reviewed and compared to screening levels which have been established in accordance with state and federal drinking water rules, guidelines, health advisories and reporting levels. Not all screening levels are health-based – some are based on aesthetic impacts. If no published guidelines exist, no screening level was established.

Alkalinity, turbidity, color and hardness were found to exceed their screening levels in the majority of the wells. These parameters relate to general chemistry and their respective screening levels are not health-risk based. They do not pose a health threat.

Iron and manganese were also found to exceed their screening levels in all of the wells. Neither is regulated for health effects but both have a non-mandatory secondary drinking water standard to prevent undesireable tastes and odors. The Mint Farm water treatment process consistently removes iron and manganese to one order of magnitude below their respective secondary maximum contaminant level.

No other anomolies were noted and no other analytes were detected above their respective screening levels in any of the wells.

RESULTS OF DATA ANALYSIS

Using Tableau analytical software, updated bar graphs were generated showing every analyte that has been detected in each monitoring well sampled for wellhead protection program starting in 2010. These graphs were reviewed to look for significant changes or general trends in individual contaminant levels that might indicate a potential problem. Wells DW-1, DW-7 and DW-9 are extremely stable with very little change in overall chemistry. Wells DW-2 and DW-5 also continue to be stable with just slight increases in alkalinity and/or hardness. Well DW-6 showed significant increases in hardness, chloride, conductivity and total dissolved solids beginning in 2013 and peaking in 2016; DW-6 now appears to have plateaued and constituent concentrations are slowly returning to more moderate levels.

Additionally, five year rolling averages were calculated for all analytes detected in each of the wells. Looking at rolling averages is a way to smooth out short-term fluctuations and highlight longer-term trends. The rolling averages were also compared to benchmark values defined by the results of the Nov-2012 sampling event just prior to start-up of the Mint Farm RWTP. No significant trends or observations are reported at this time.

Reports generated for DMW-1 using Tableau Software are included as attachments. Reports generated for the other sentinel wells will be published on the City's webpage for its wellhead protection program at https://www.mylongview.com/484/Wellhead-Protection-Program.

GROUNDWATER ELEVATION MONITORING

The sentinel wells are equipped with transducers which continuously collect and record water level information. Transducer data is periodically downloaded and compiled to evaluate the potential for declining water levels and diminished capacity of the Mint Farm aquifer. Transducer data was not analyzed for this report but will be evaluated as part of the next monitoring event.

ATTACHMENTS

- Attachment A: Tableau workbook containing the following reports:
  - Semi-Annual Sampling Results (DW-1)
  - Analyte Screening Levels
  - Analytes Found Below Screening Levels (DW-1)
  - Analytes Found Above Screening Levels (DW-1)
  - Criticality of Screening Level Exceedances (DW-1)
  - Analyte Criticality Rankings
  - Average Analyte Values (DW-1)

- Attachment B: Analytical reports from ALS Group USA, Corp. dba ALS Environmental

REFERENCES

- *Kennedy/Jenks Consultants Technical Memorandum 2, Water Quality Sampling Protocol. Kennedy/Jenks Consultants, 28 April 2009*

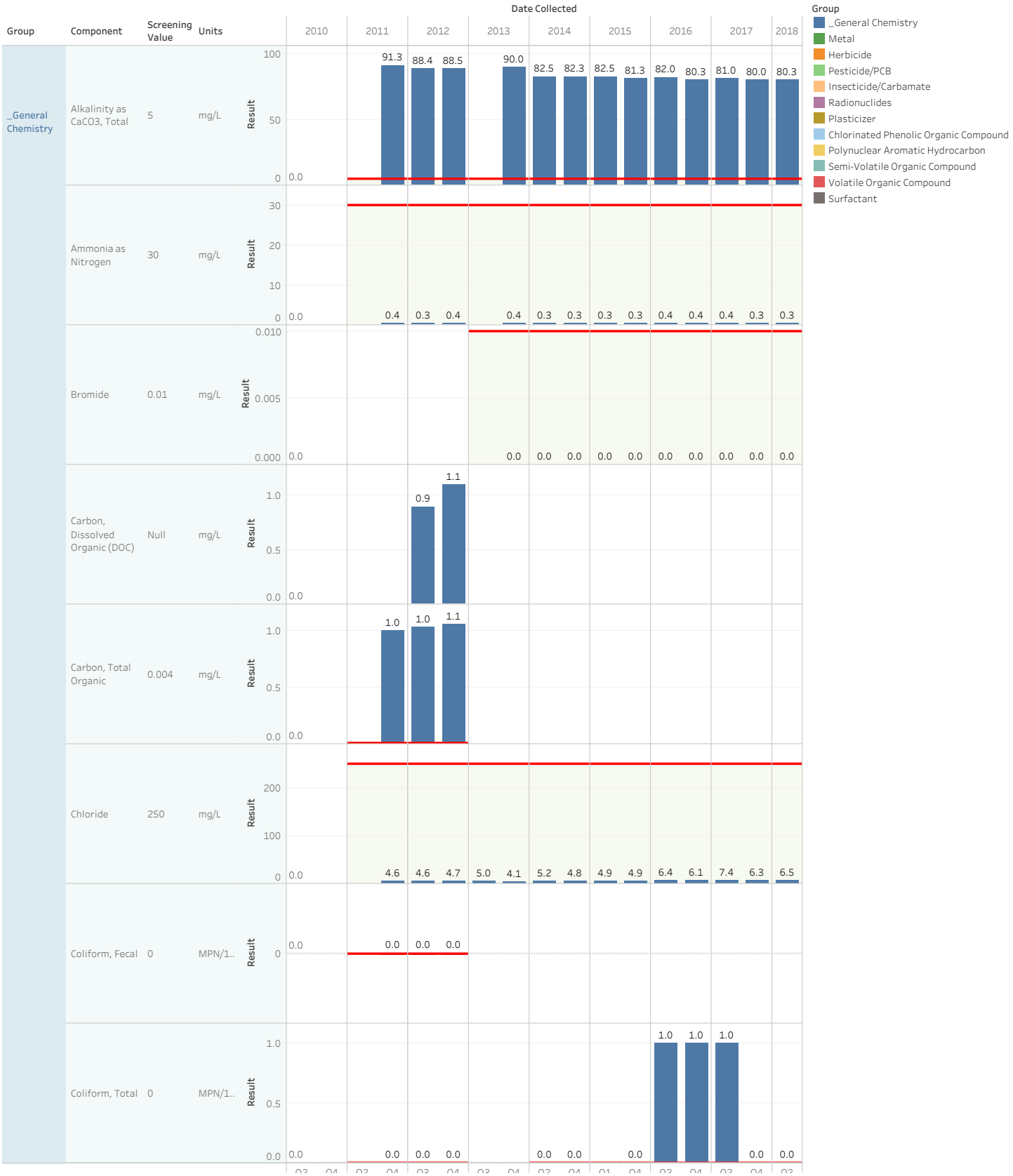
- *Preliminary Design Report (PDR Part 2) for the City of Longview Mint Farm Regional Water Treatment Plant and Well Field, Part 2A: Hydrogeologic Characterization of the Mint Farm Area. Kennedy/Jenks Consultants 0997003.00, March 2010*

- *2012 Comprehensive Water System Plan, Section 5: Source Water – Wellhead Protection Program. Kennedy/Jenks Consultants 1197009.00, August 2012*

- *Technical Memorandum, Monitoring Well Analytes and Department of Health Test Panels (Kennedy/Jenks 0997003*01, 1 March 2013)*

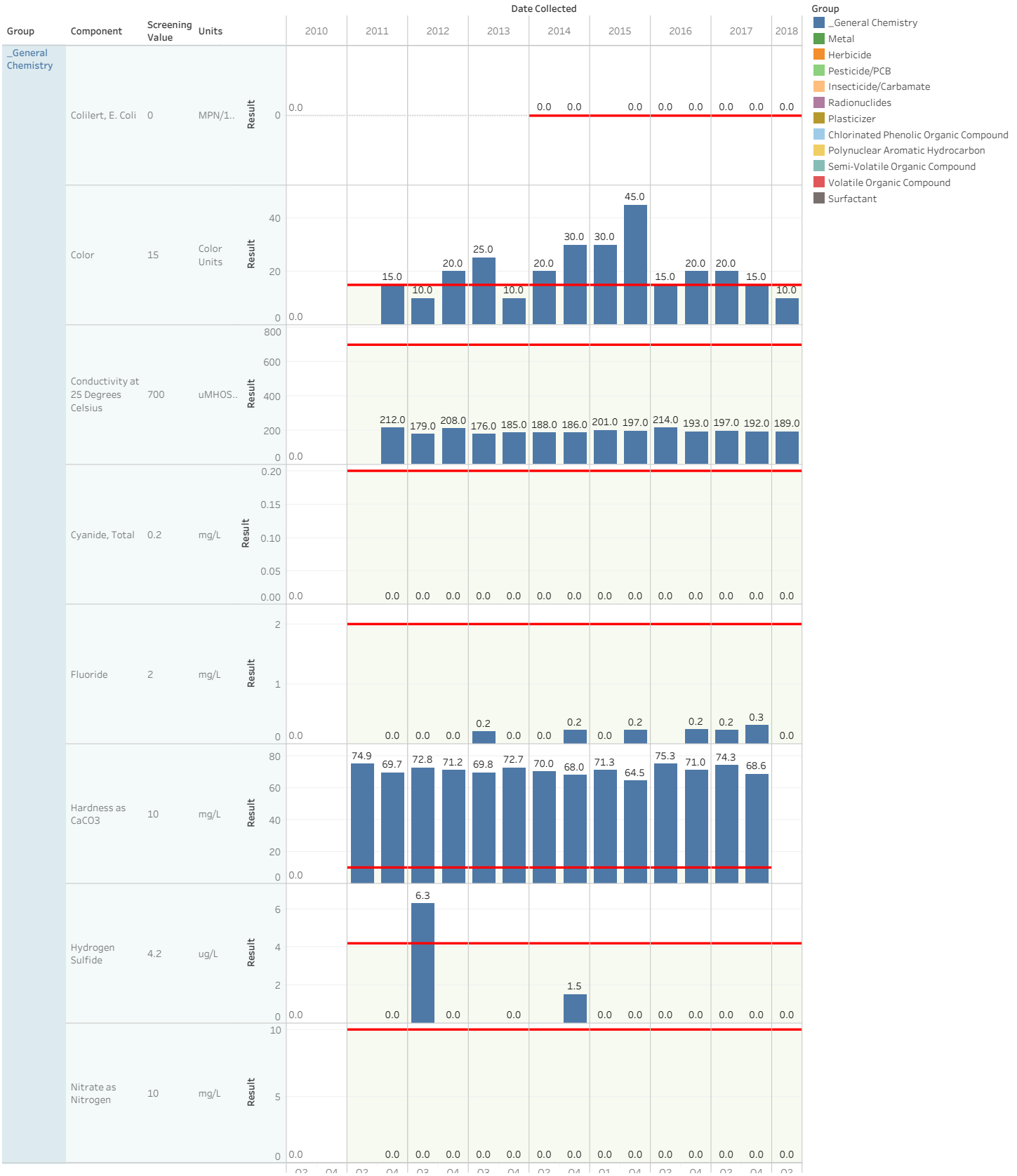
- *WHPP Analyte List and Screening Levels; Intertox Inc., 18 April 2018.*

Semi-Annual Sampling Results for DMW-1



Sum of Result for each Date Collected Quarter broken down by Date Collected Year vs. Group, Component, Screening Value and Units. Color shows details about Group. The marks are labeled by sum of Result. The view is filtered on Component and Group. The Component filter keeps 250 of 250 members. The Group filter keeps 12 of 12 members.

Semi-Annual Sampling Results for DMW-1



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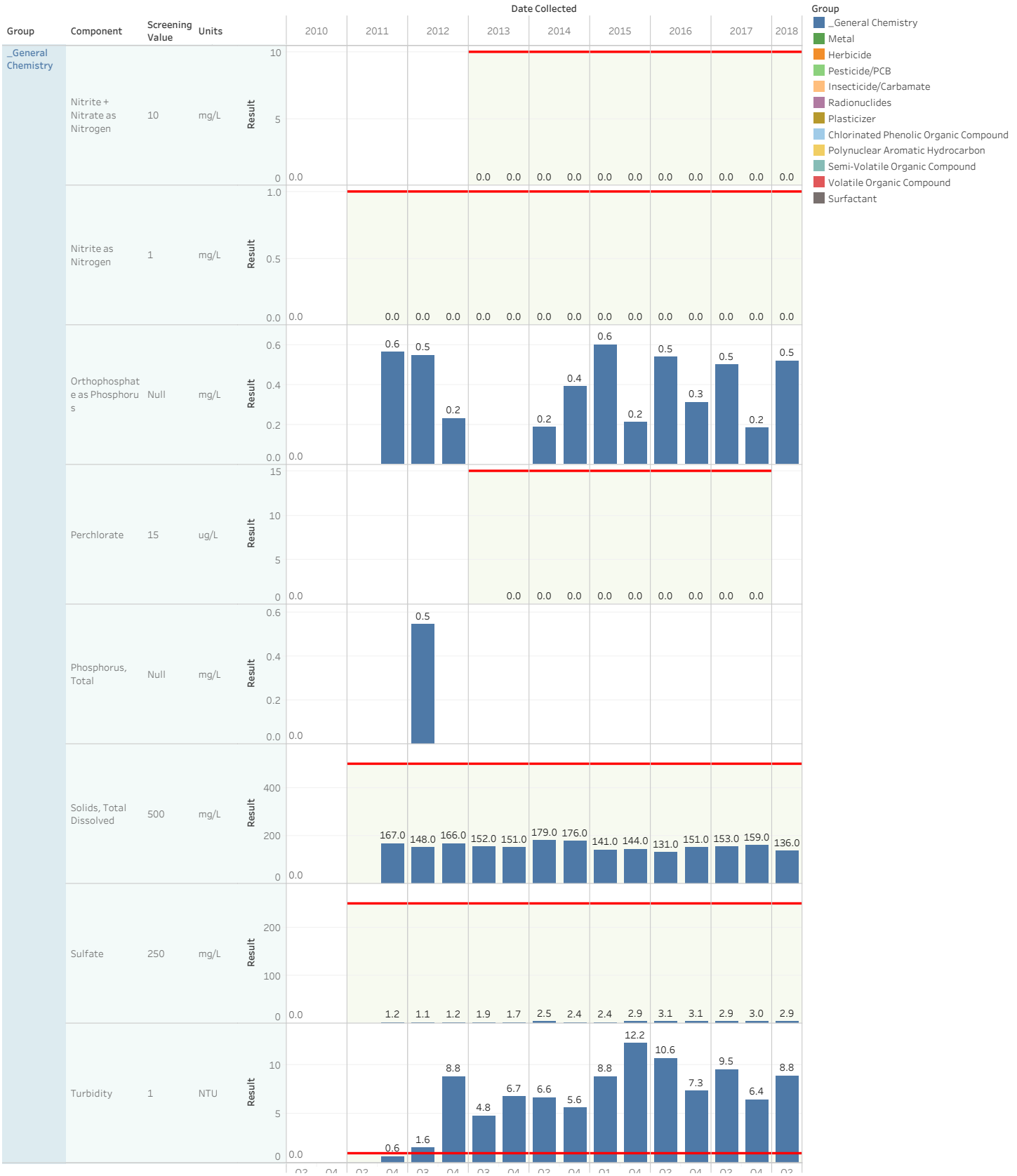

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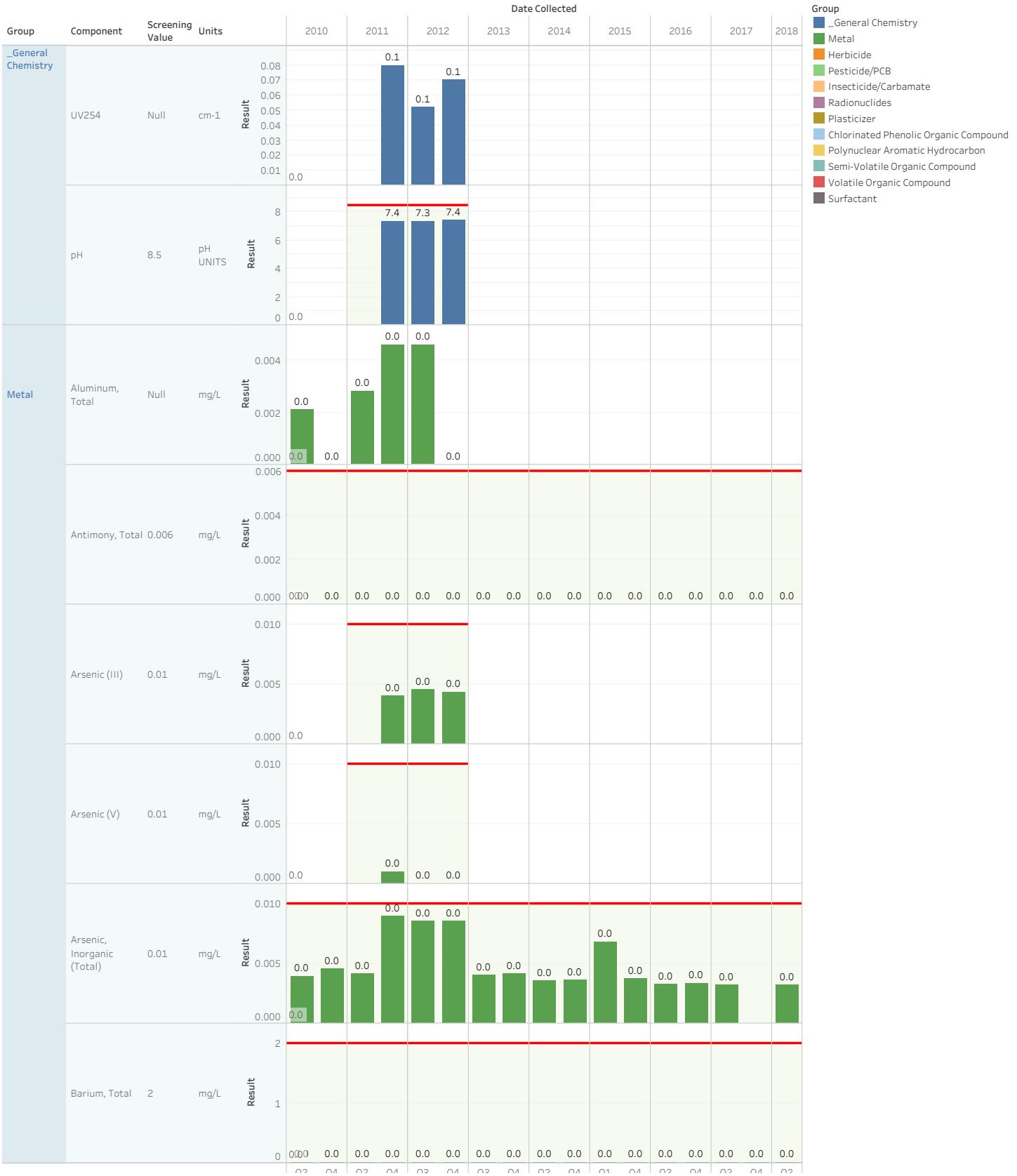

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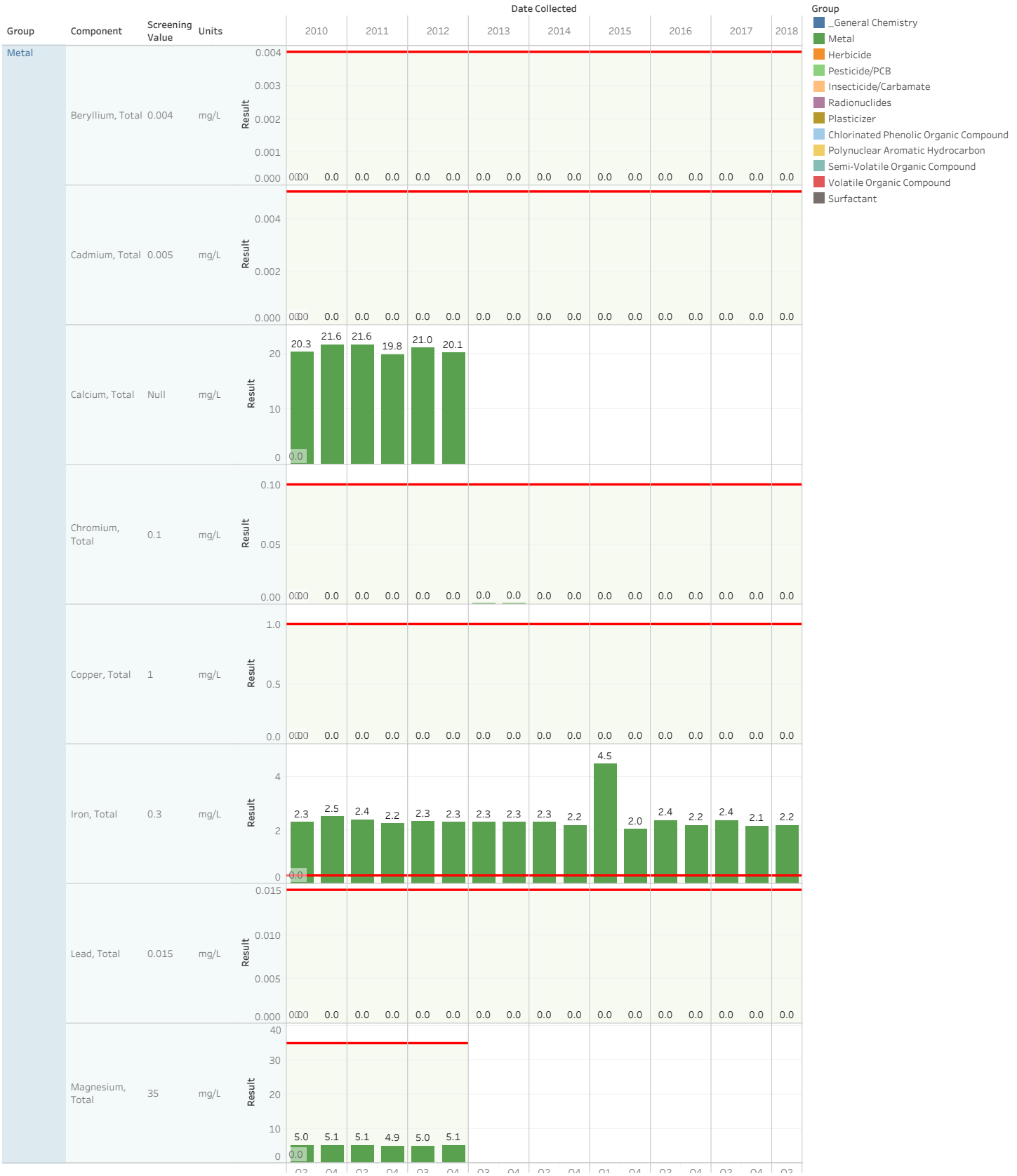

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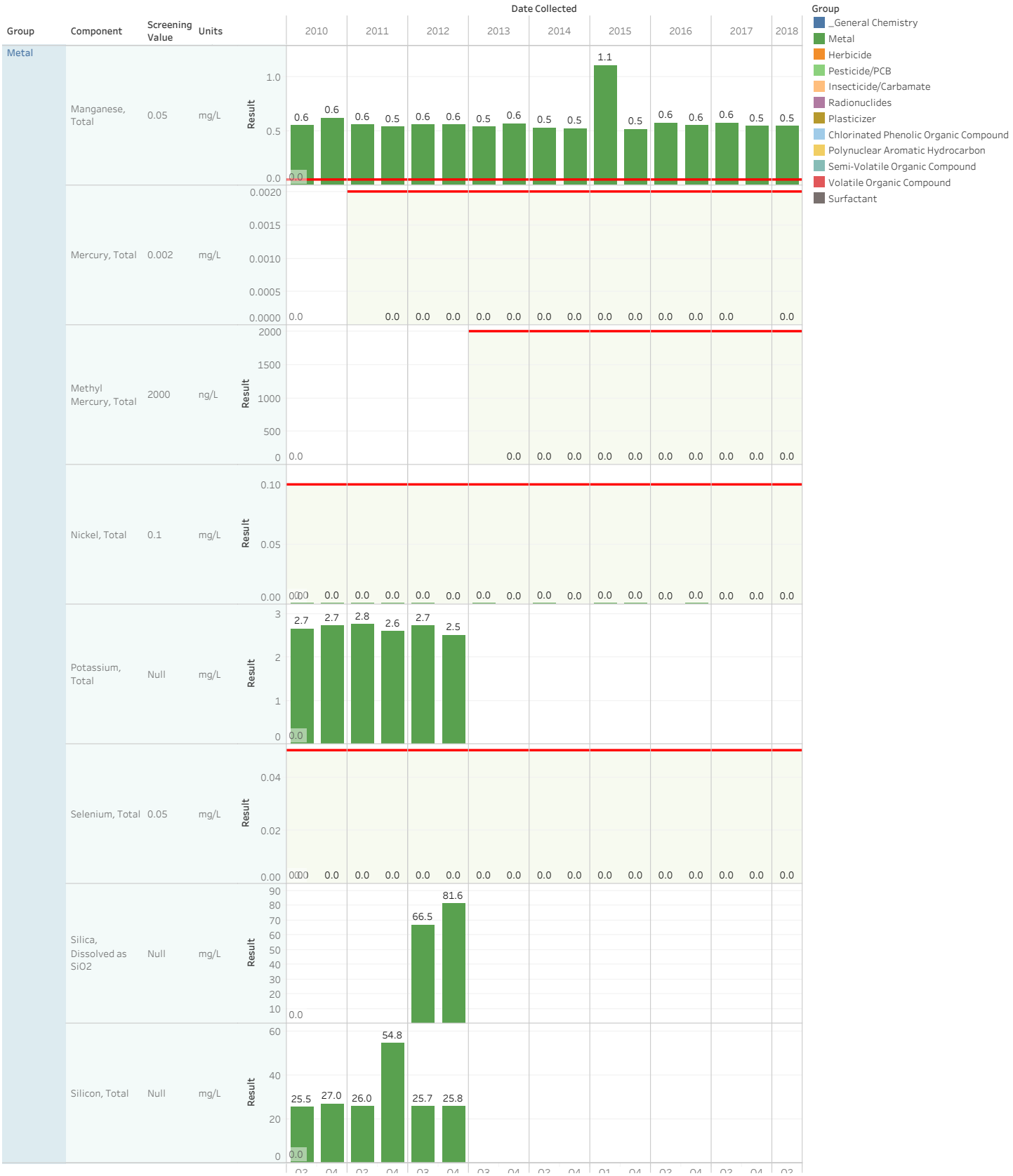

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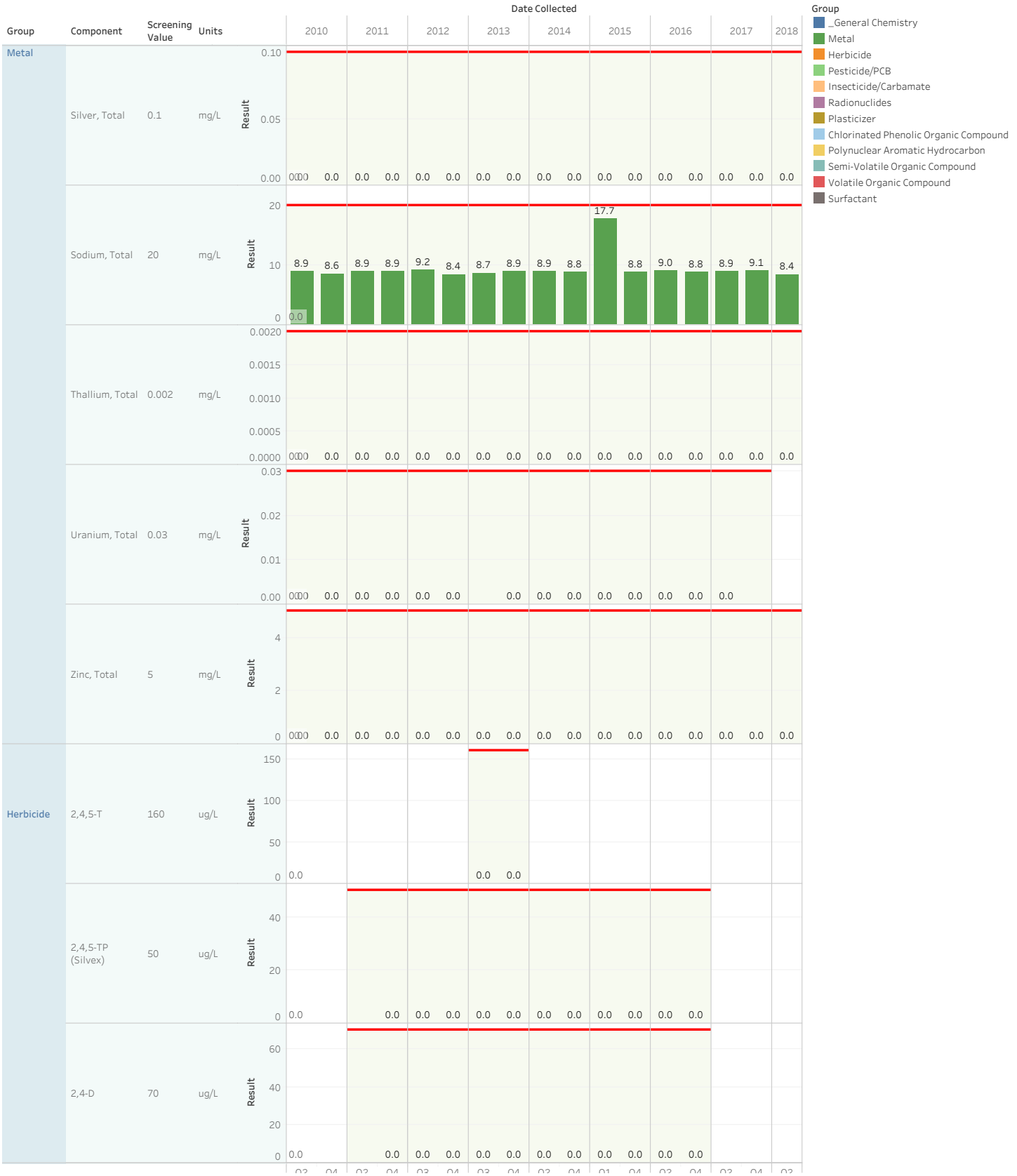

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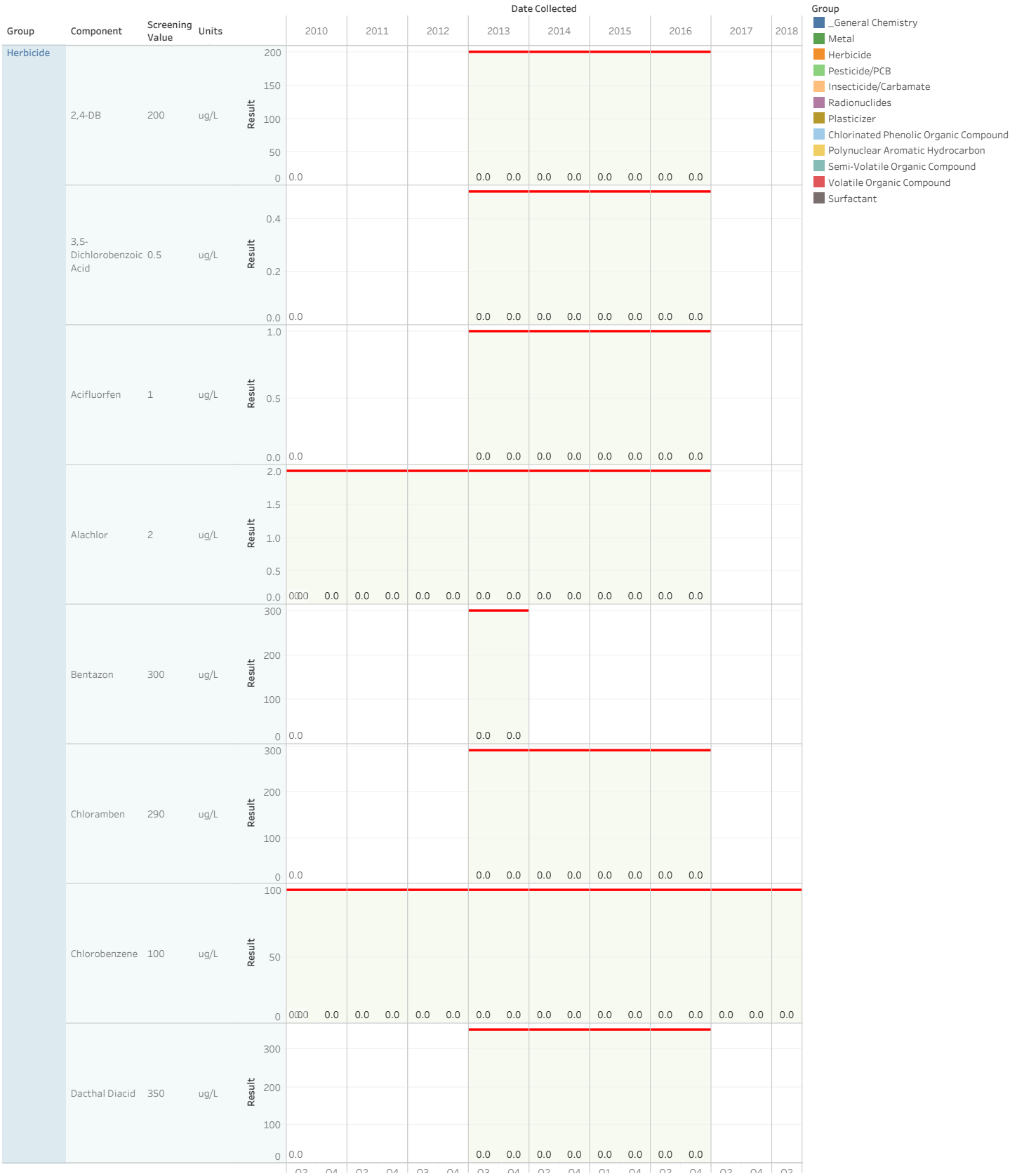

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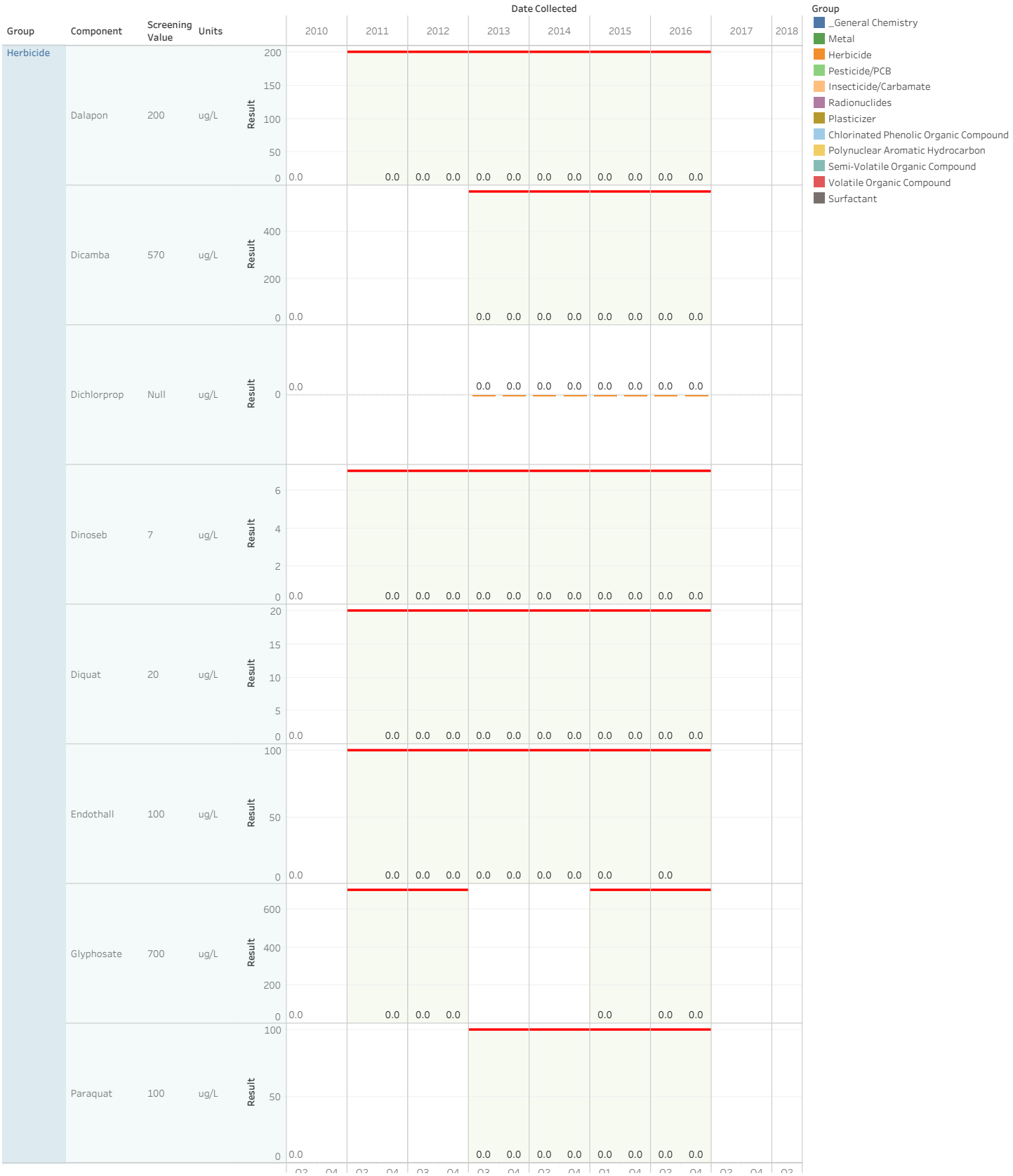

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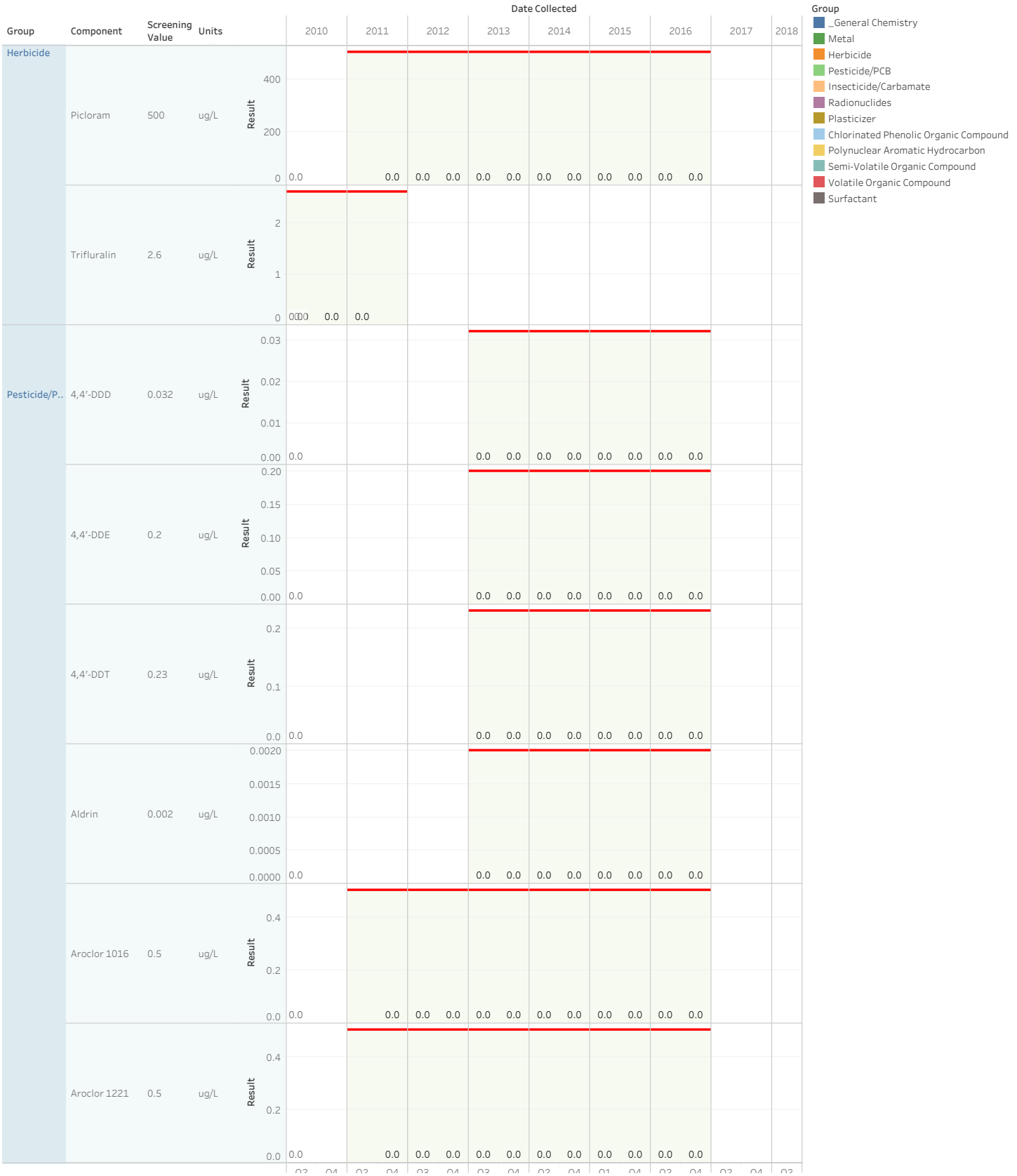

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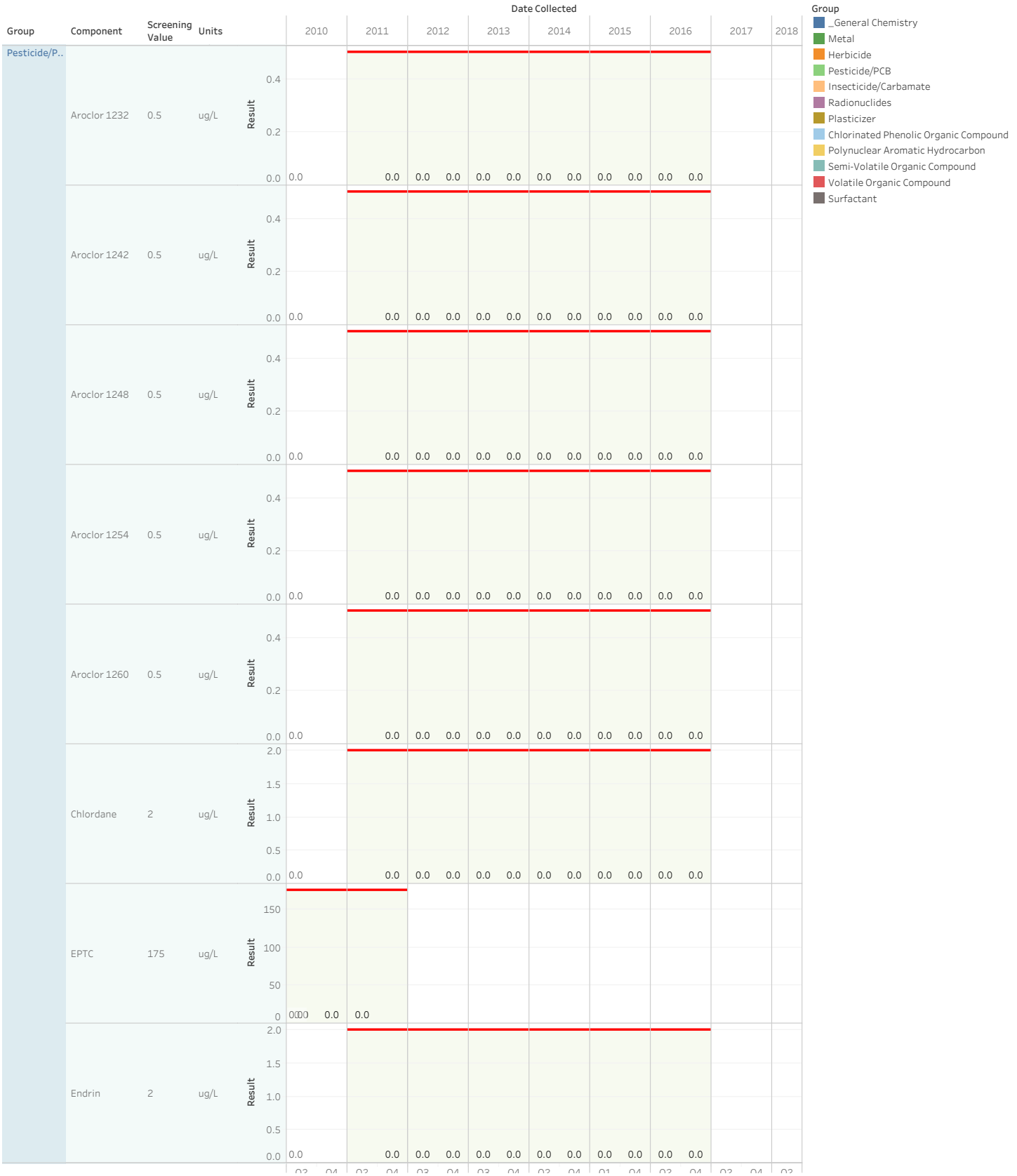

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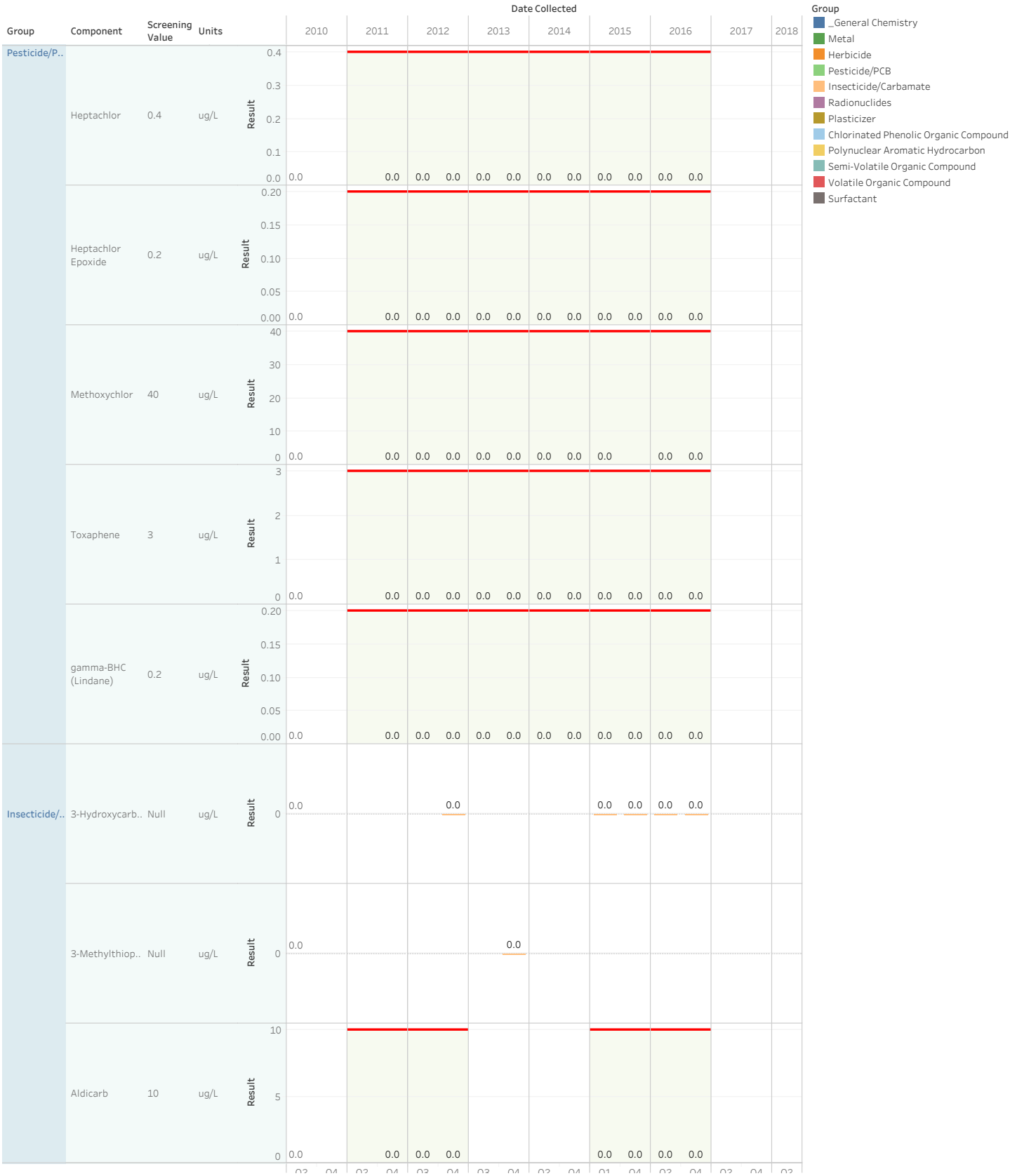

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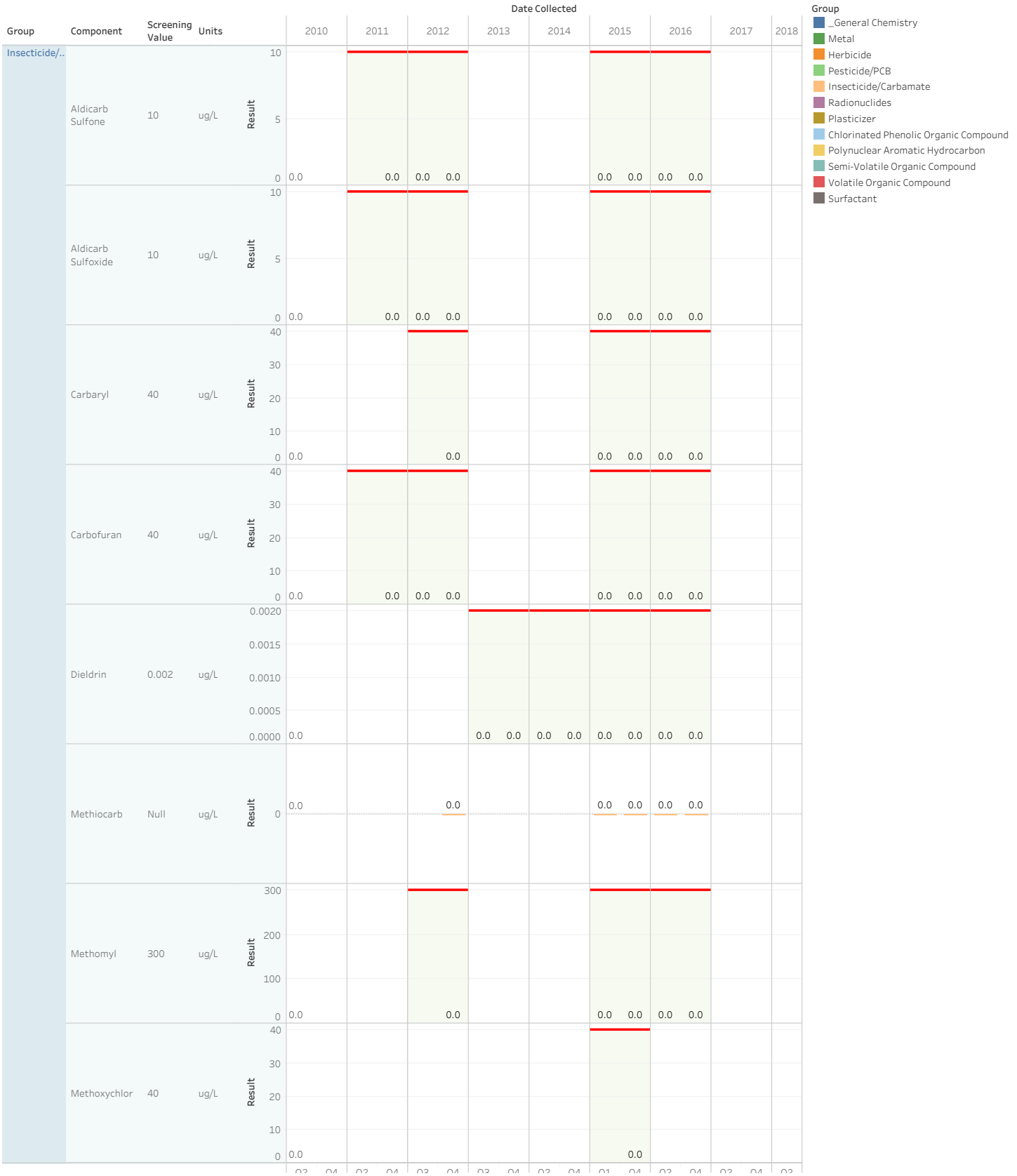

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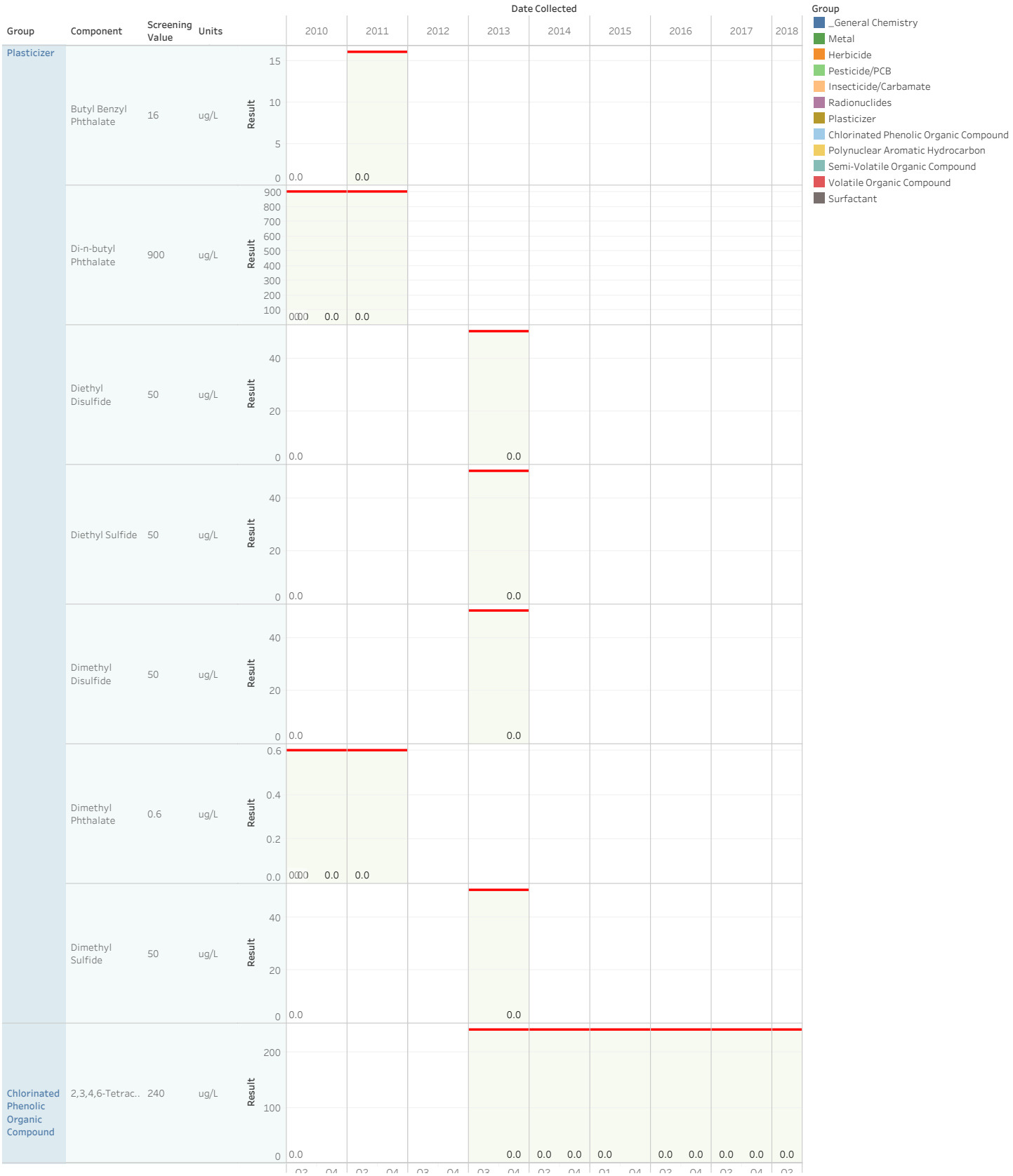

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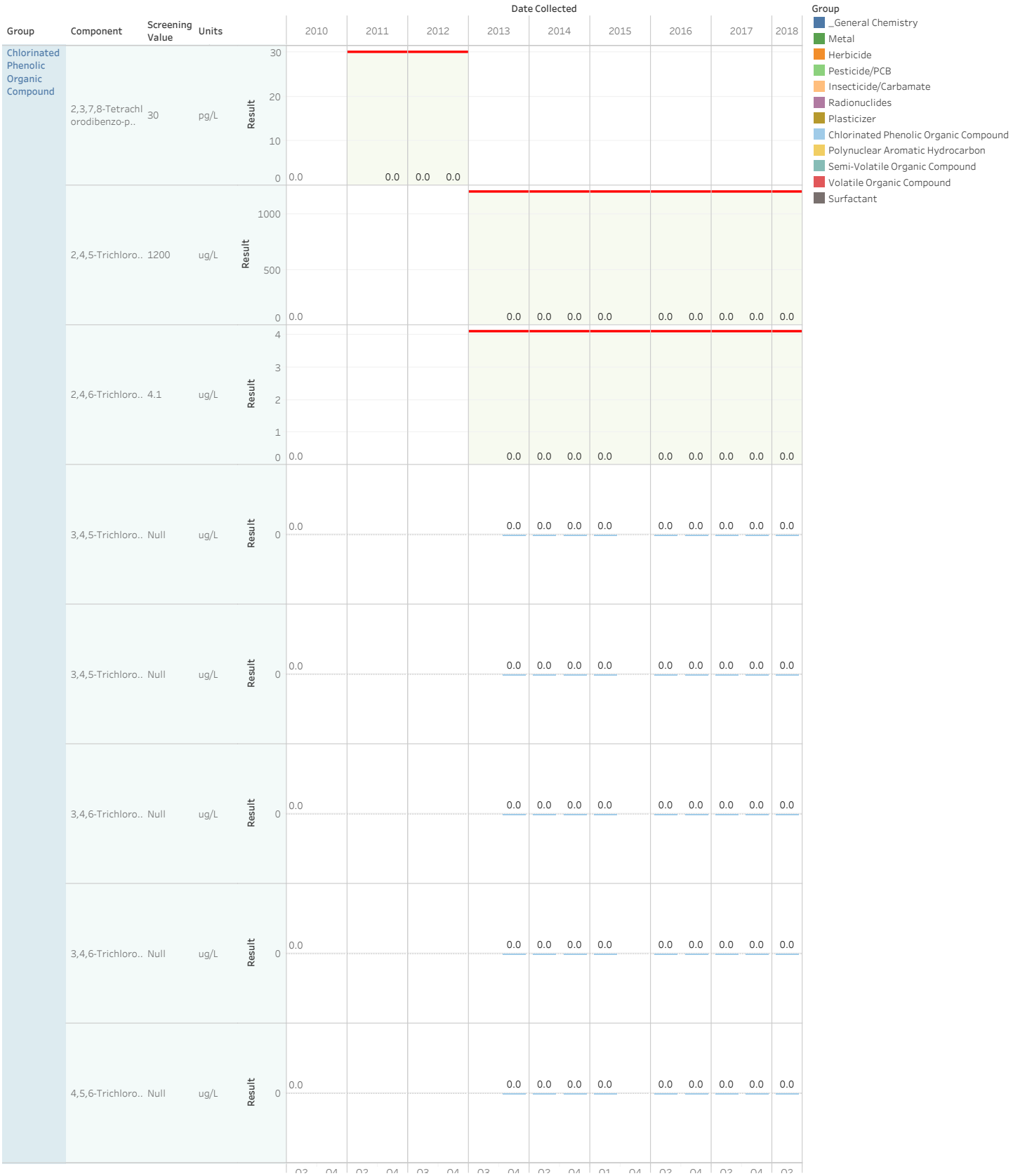
Semi-Annual Sampling Results for DMW-1



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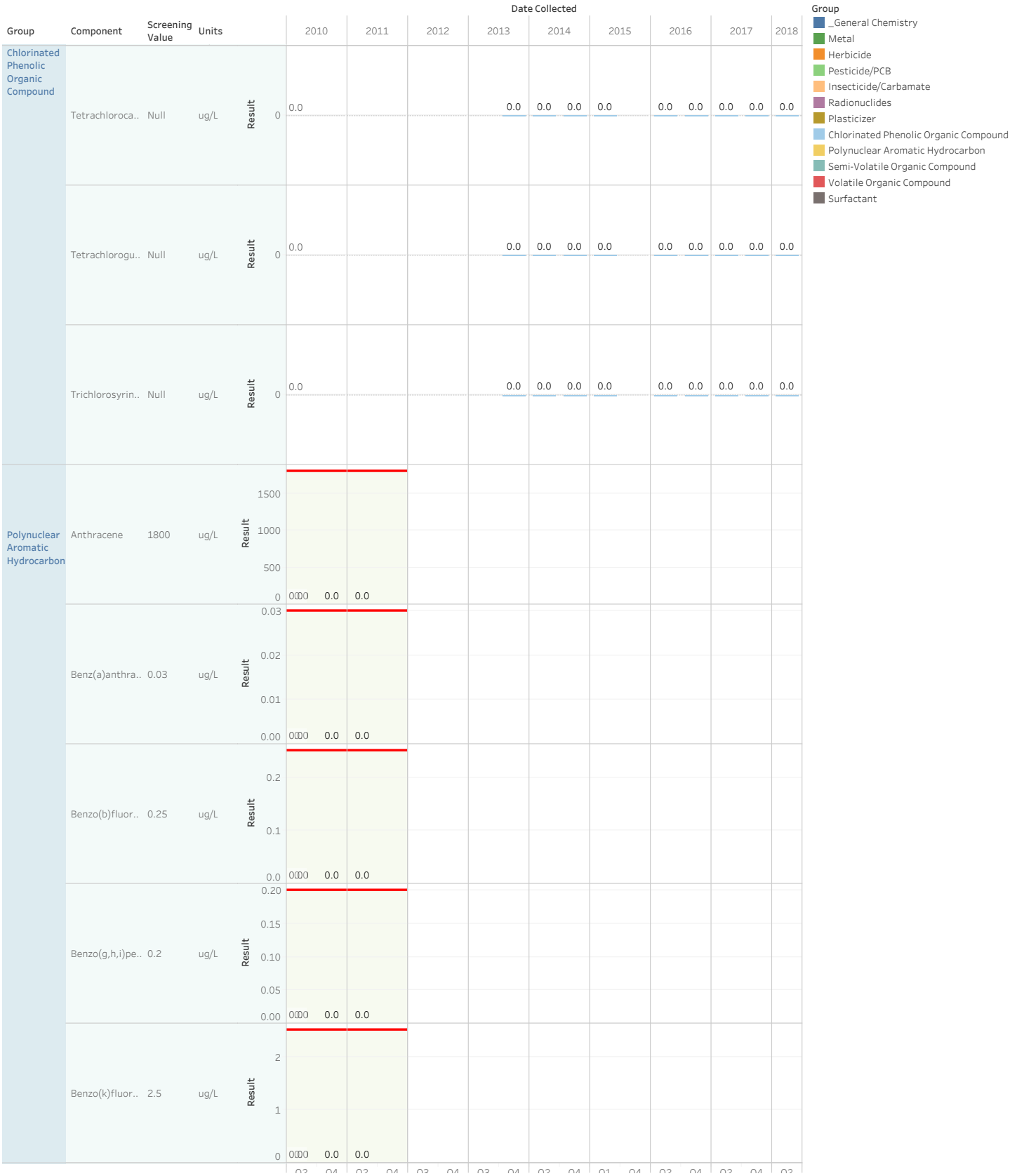

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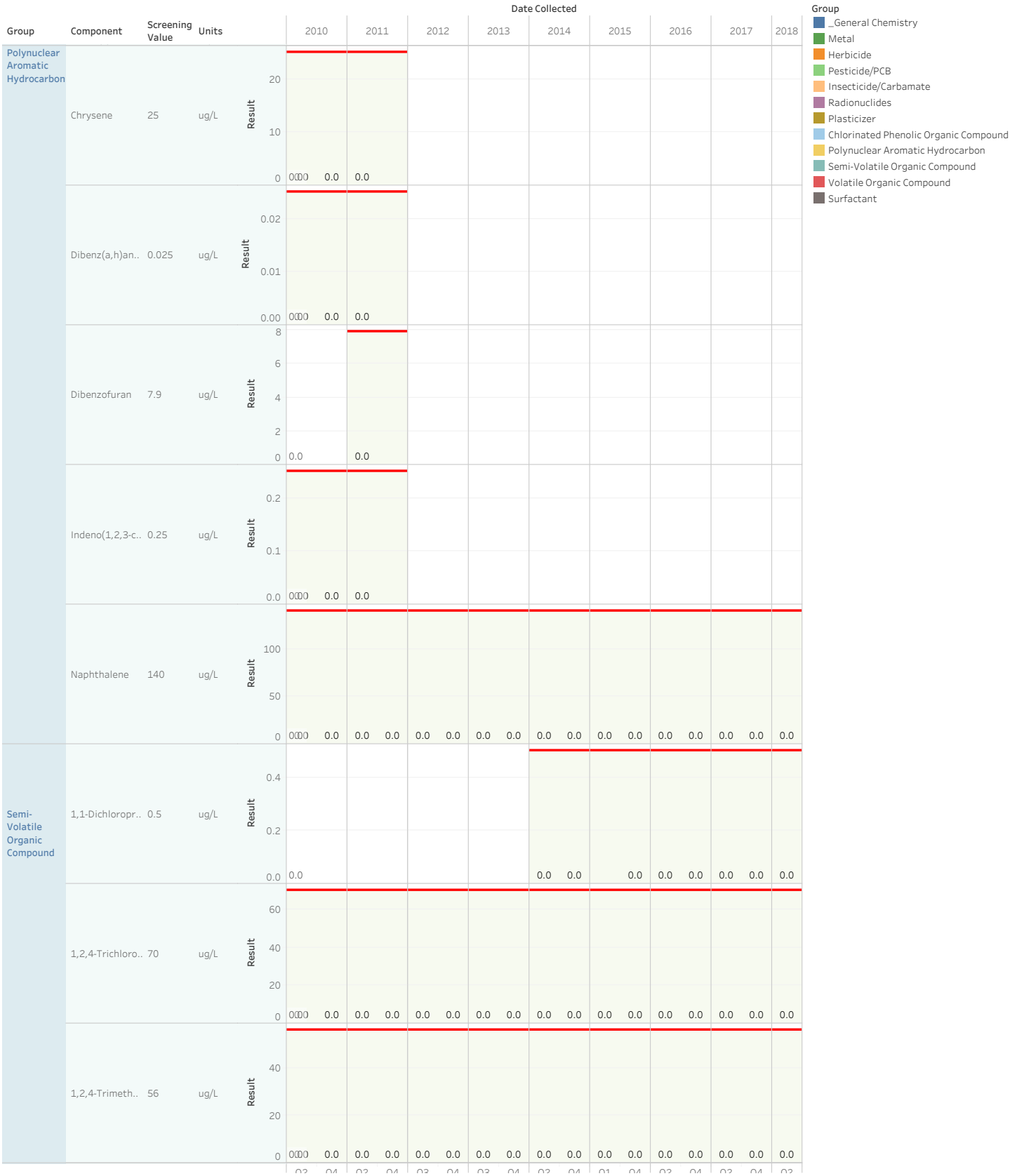

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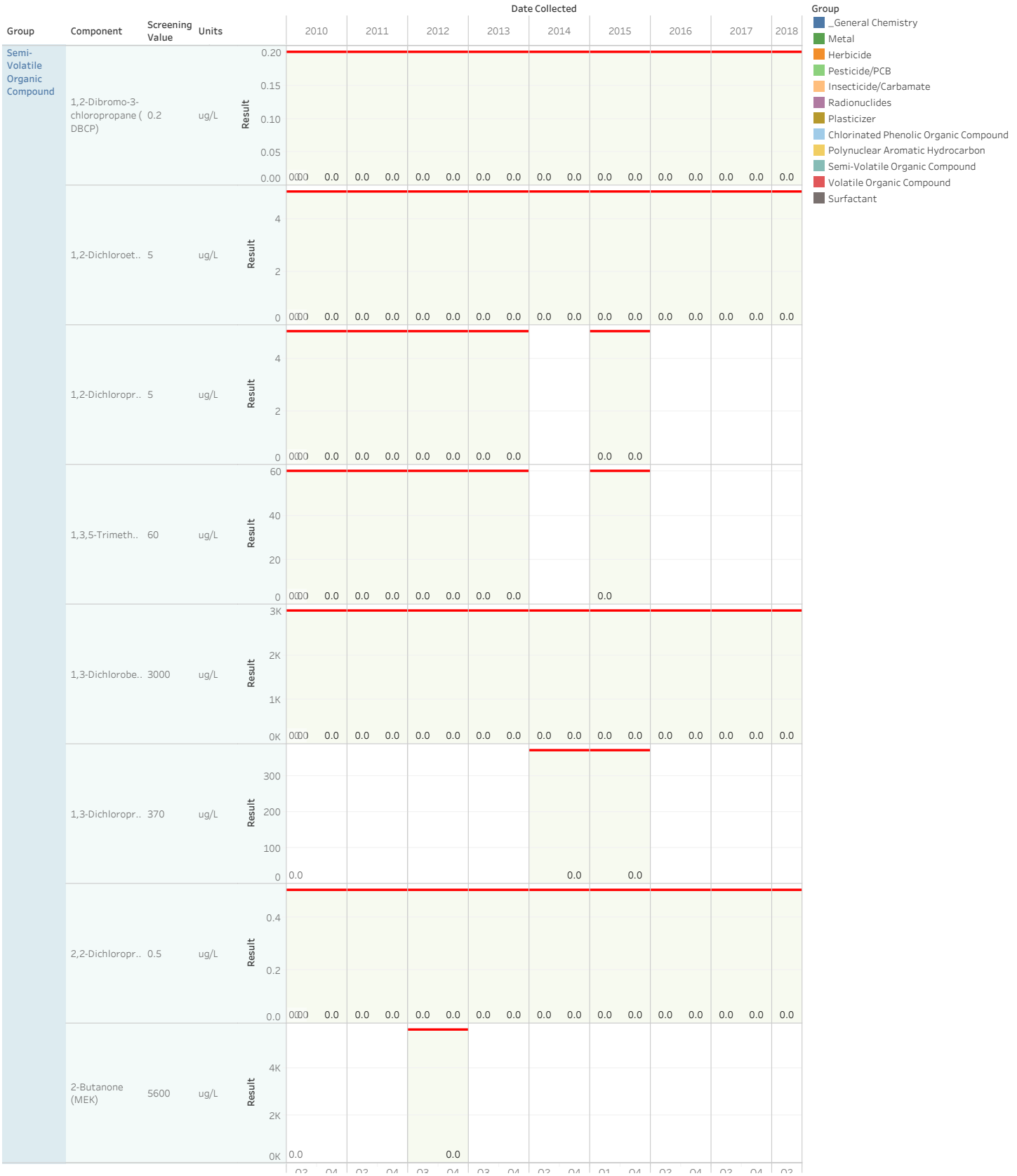

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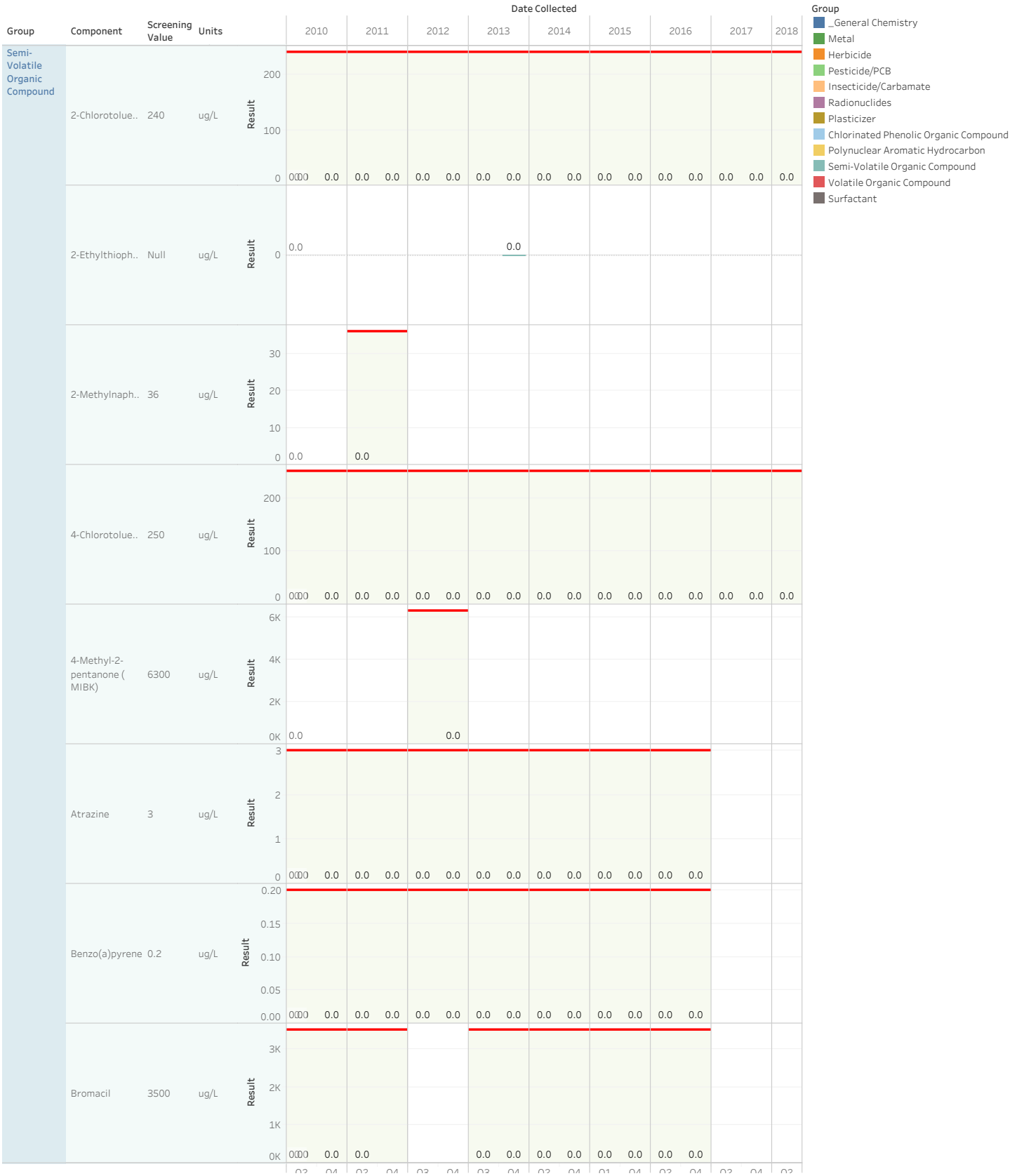

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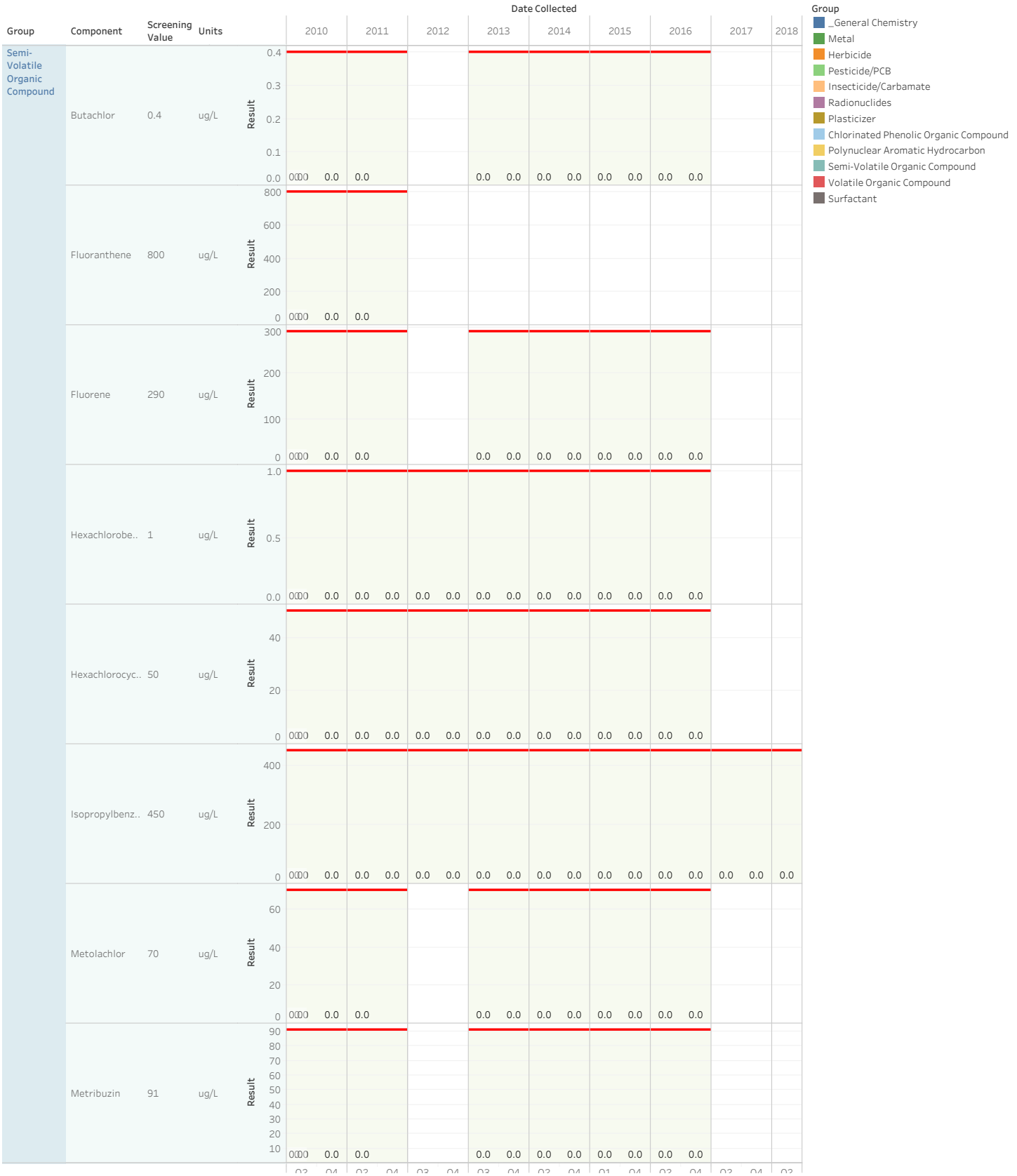

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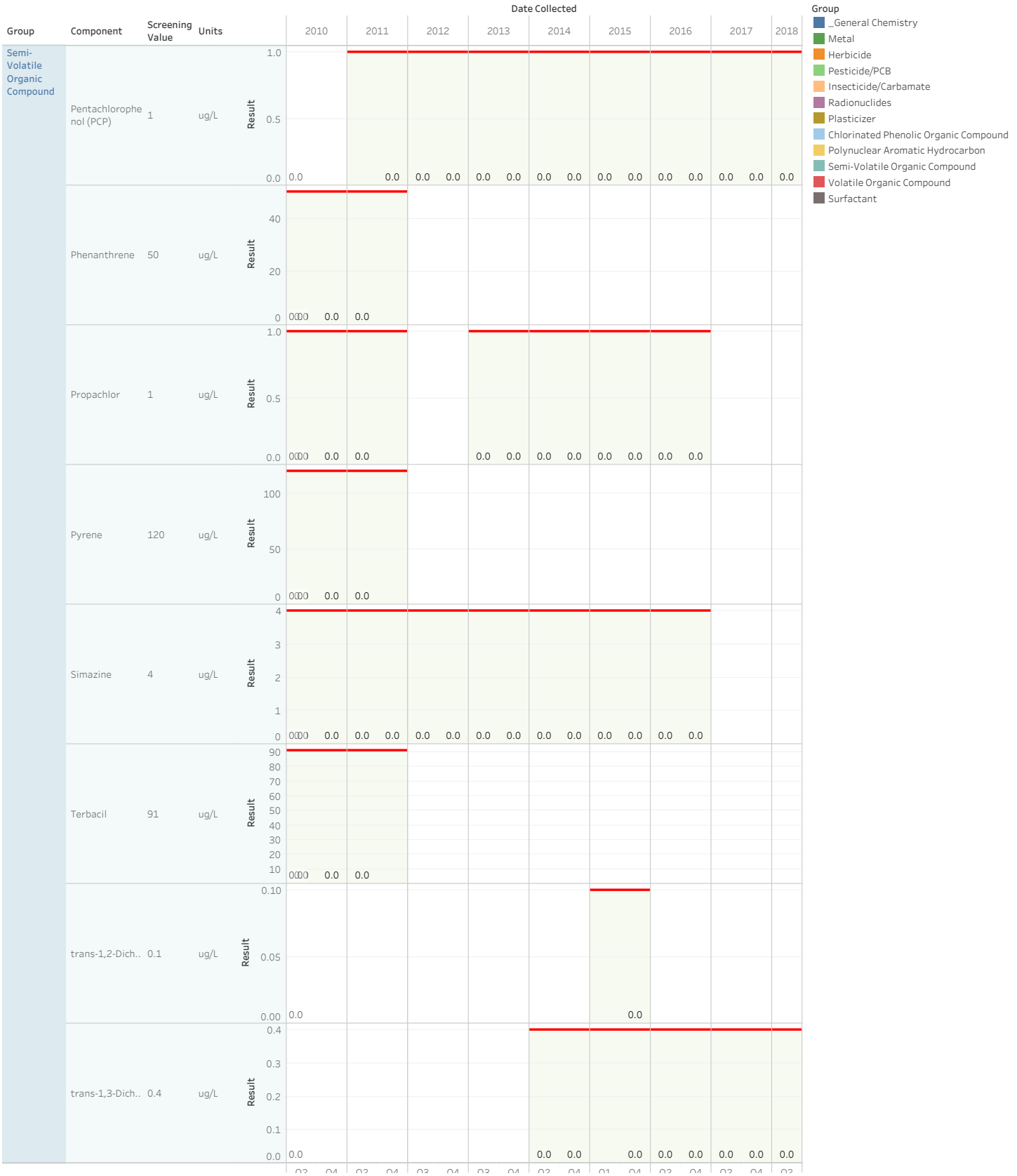

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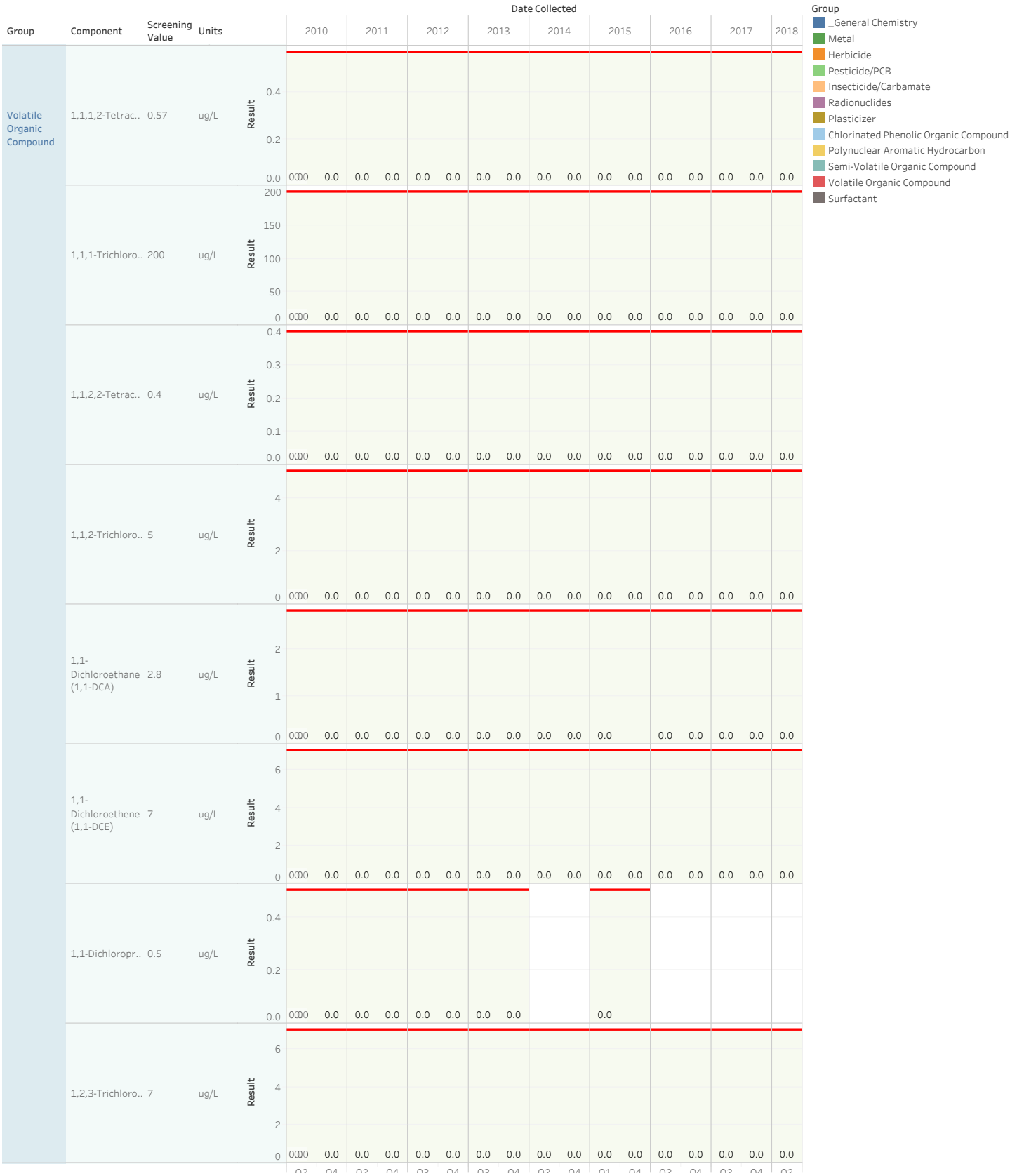

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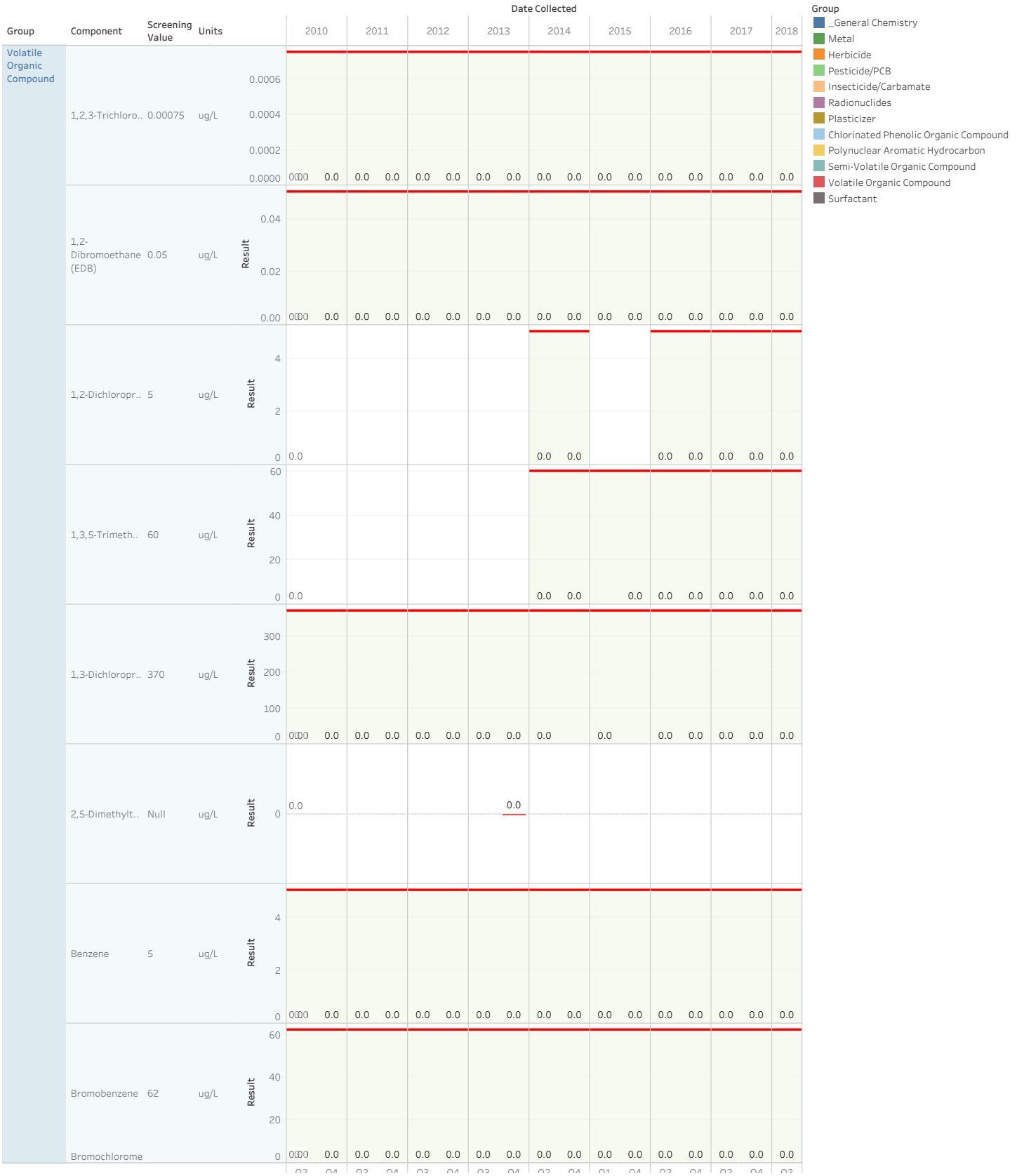

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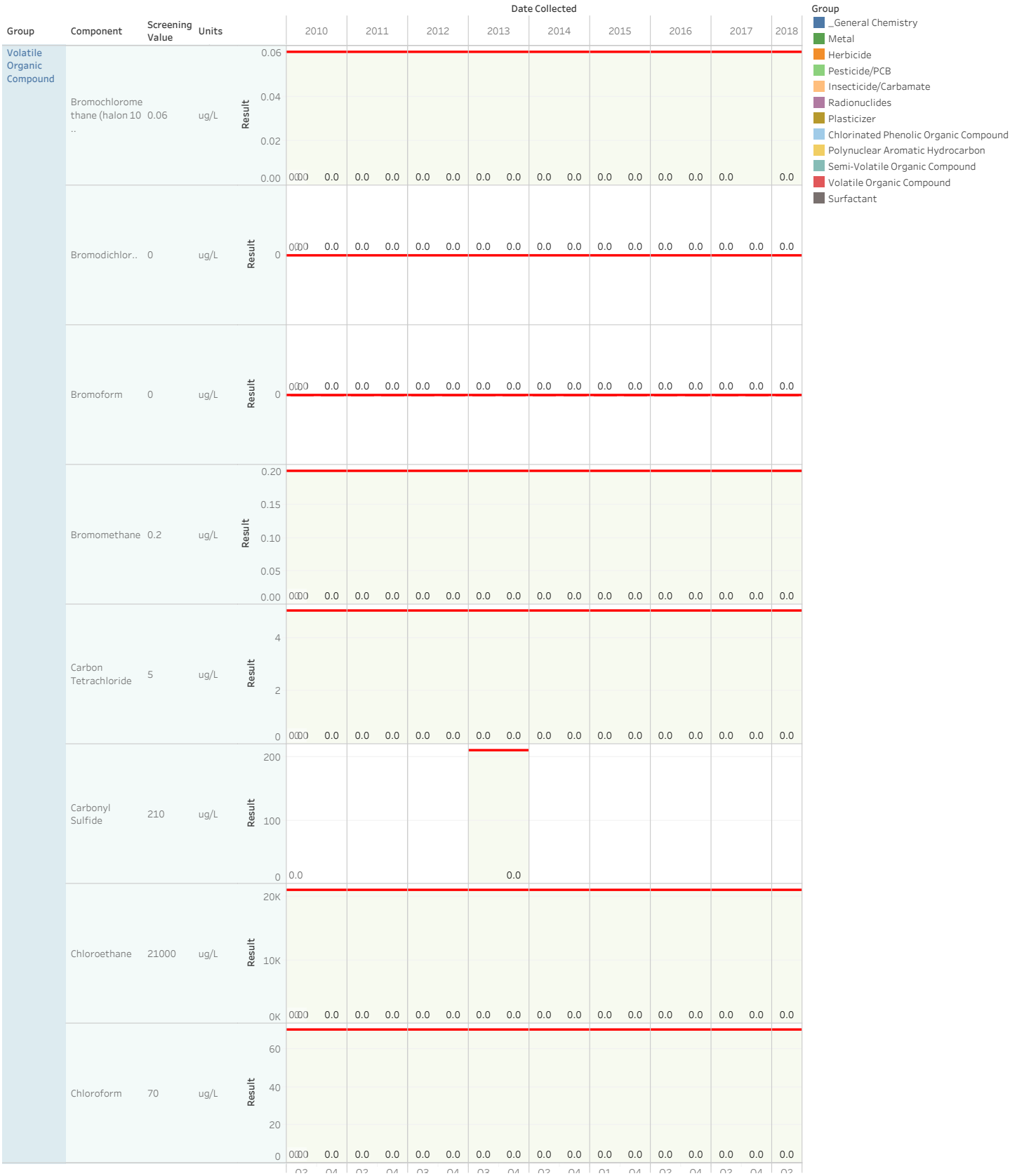

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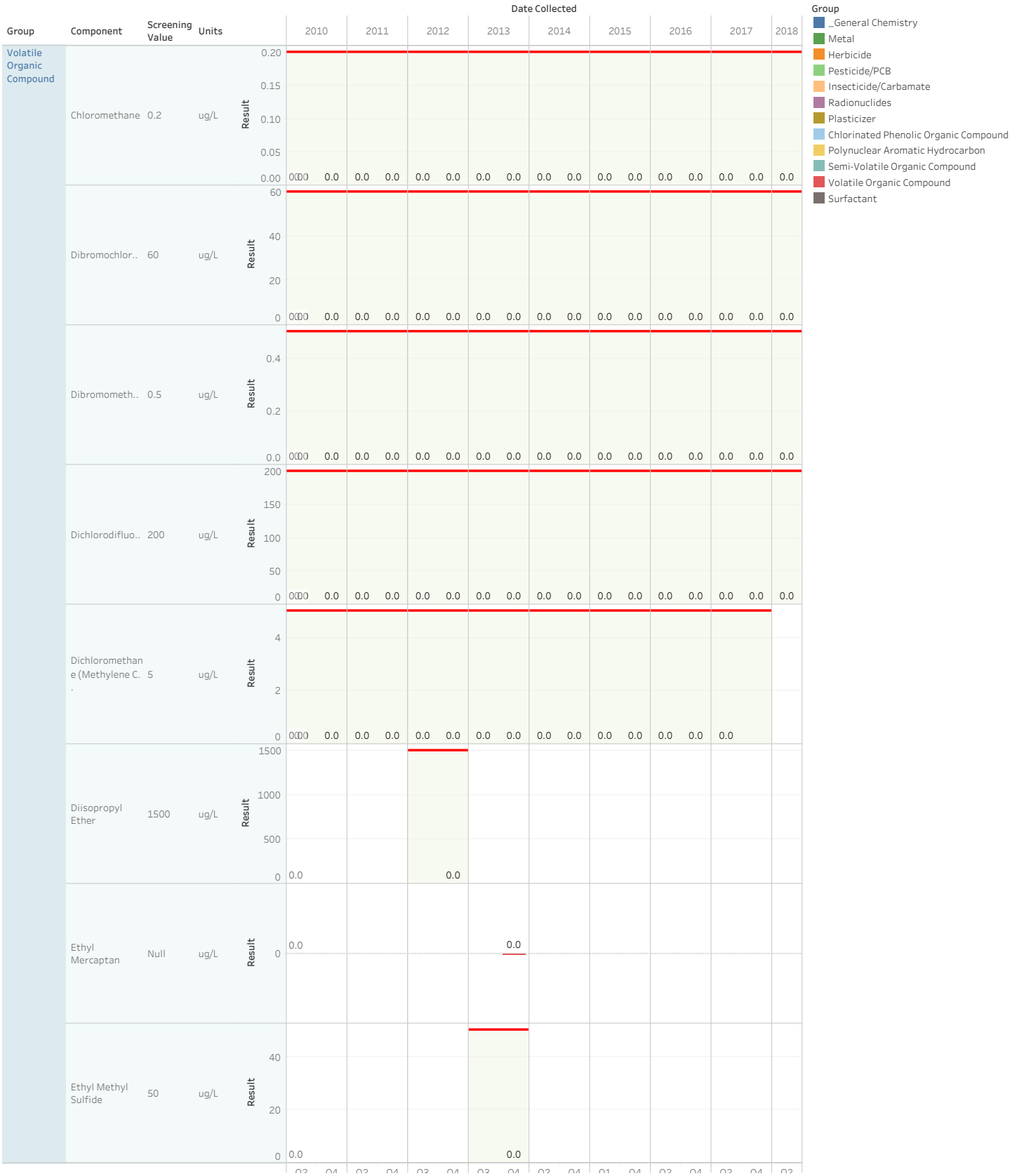

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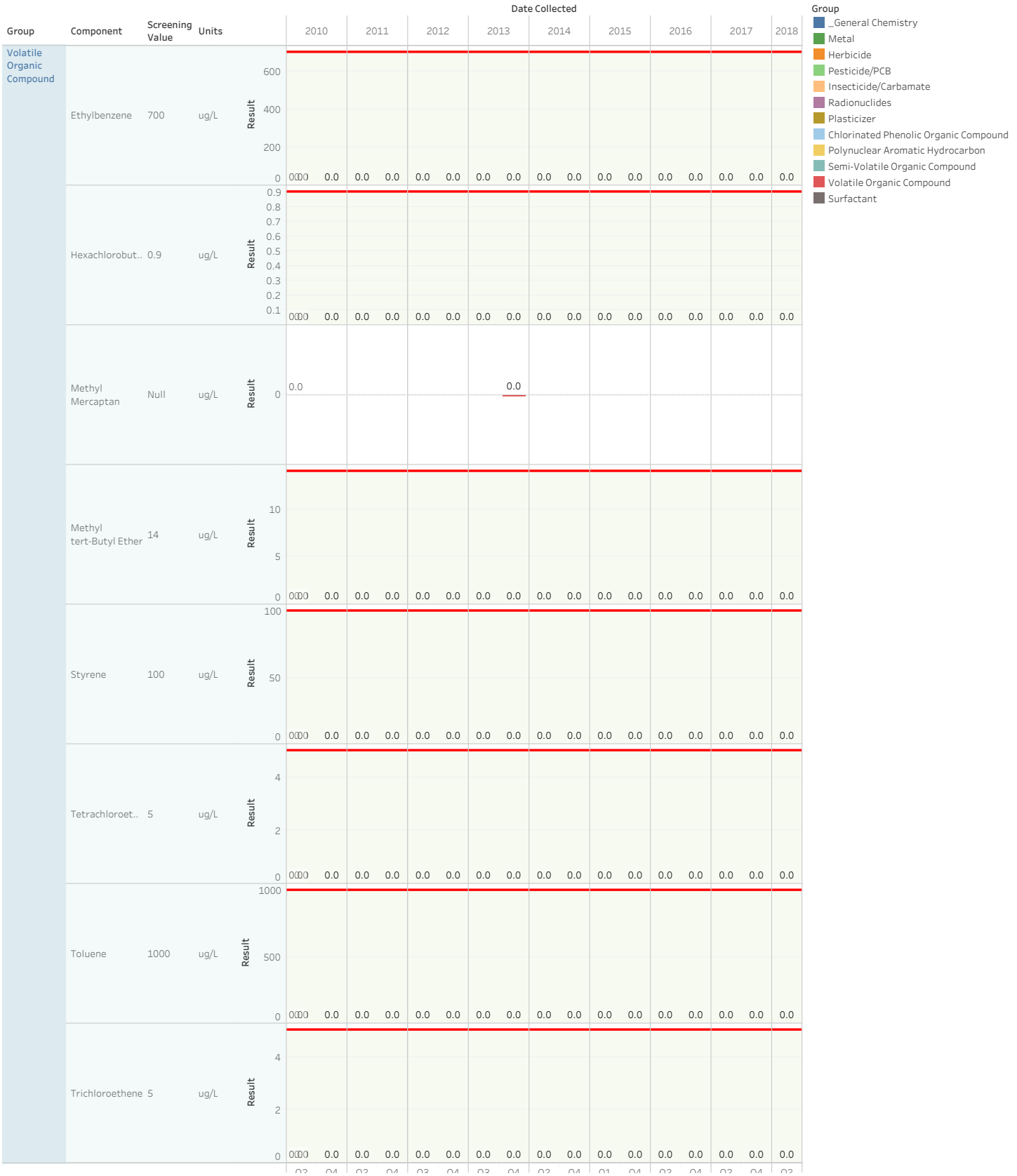

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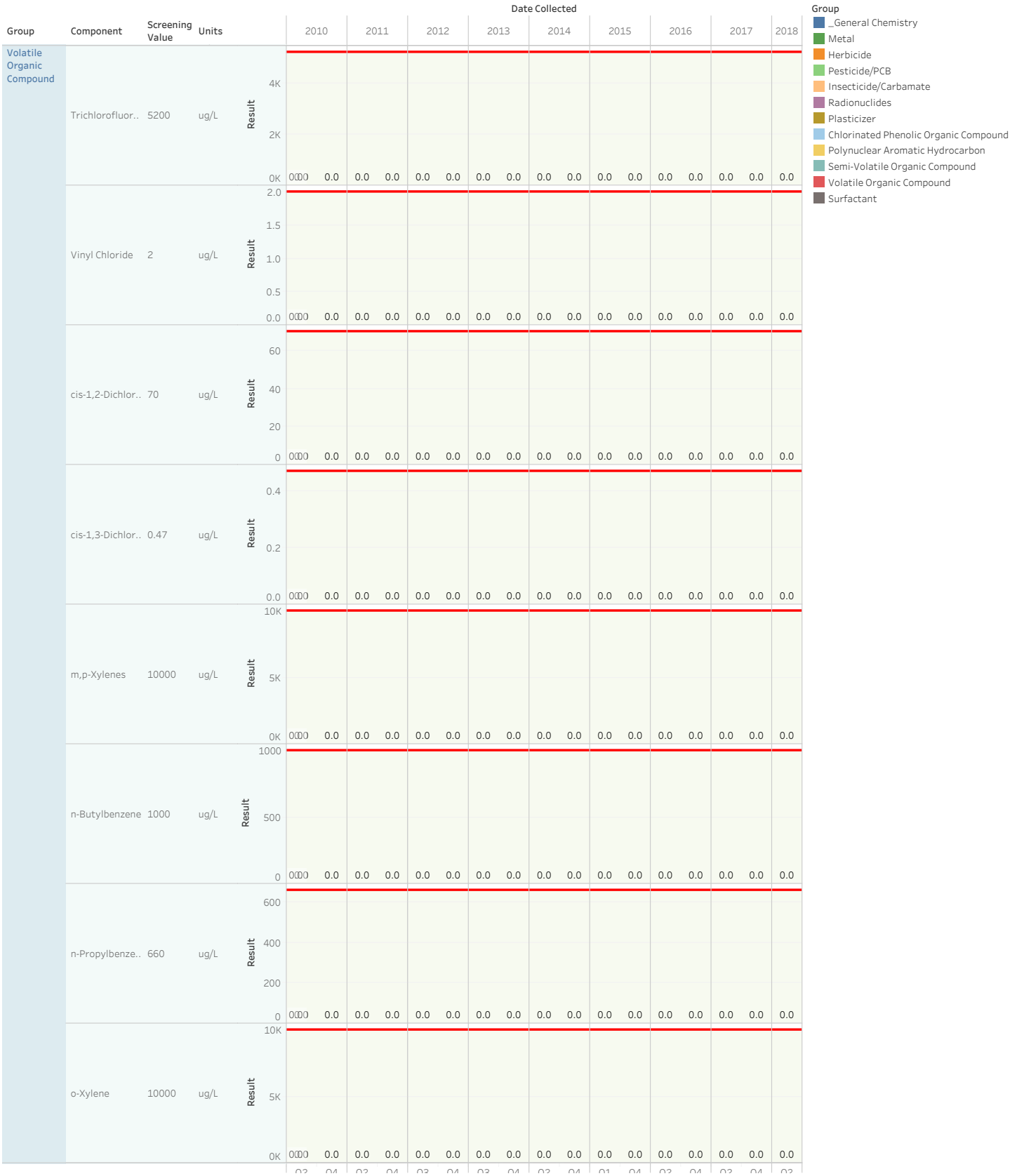

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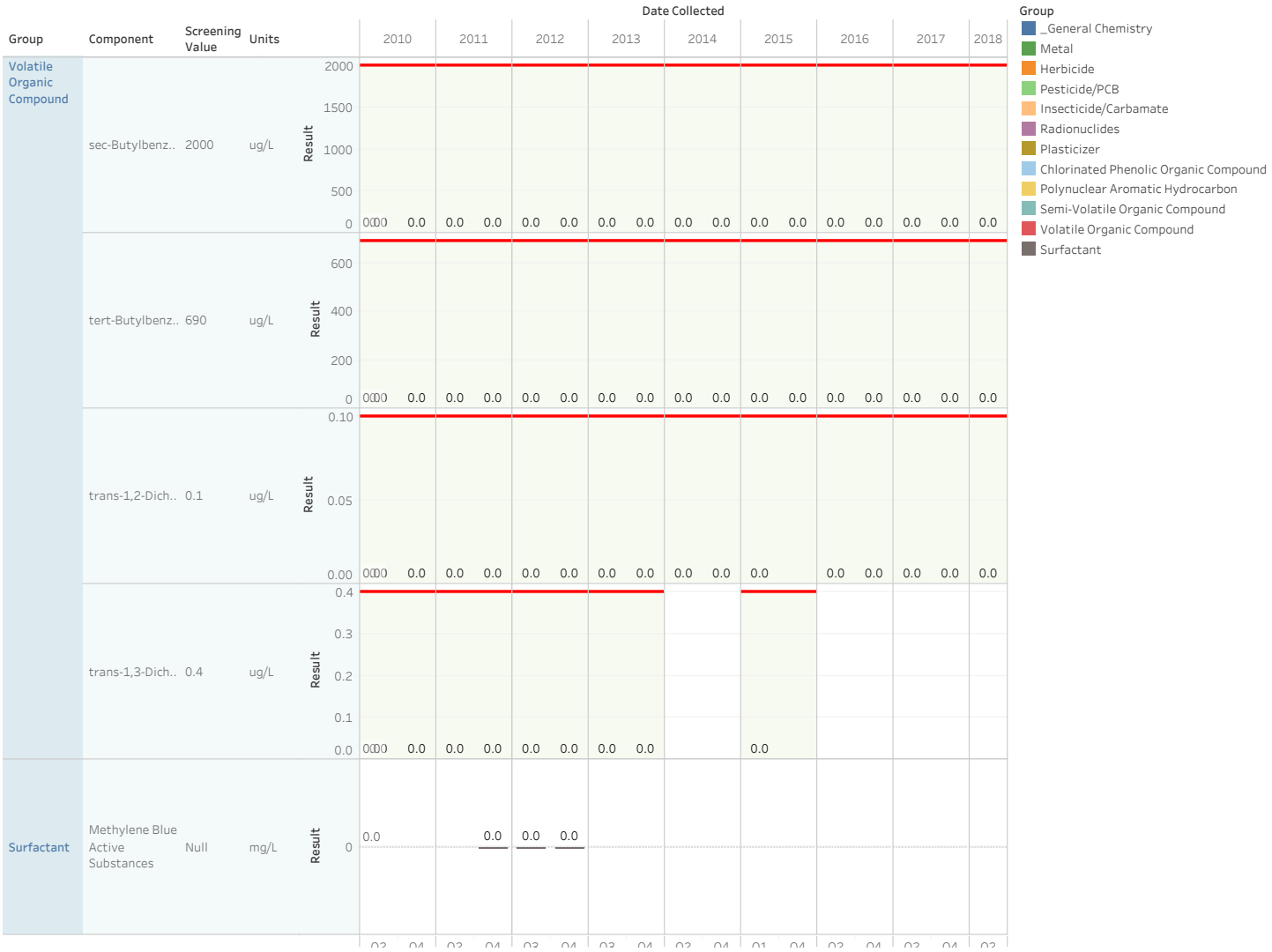

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Analyte Screening Levels

Group	Component	Units	Screening Value	Criticality	NONE	NYDEC	USEPA	WSDOH
_General Chemistry	Alkalinity as CaCO3, Total	mg/L	5	Low				■
	Ammonia as Nitrogen	mg/L	30	Moderate			■	
	Bromide	mg/L	0.01	Critical			■	
	Carbon, Dissolved Organic (DOC)	mg/L	Null	Low	■			
	Carbon, Total Organic	mg/L	0.004	Low			■	
	Chloride	mg/L	250	Low			■	
	Coliform, Fecal	MPN/100mL	0	Critical			■	
	Coliform, Total	MPN/100mL	0	Critical			■	
	Colilert, E. Coli	MPN/100mL	0	Critical			■	
	Color	Color Units	15	Low				■
	Conductivity at 25 Degrees Celsi..	uMHOS/cm	700	Low				■
	Cyanide, Total	mg/L	0.2	Critical			■	
	Fluoride	mg/L	2	Moderate			■	
	Hardness as CaCO3	mg/L	10	Low				■
	Hydrogen Sulfide	ug/L	4.2	Moderate			■	
	Nitrate as Nitrogen	mg/L	10	Critical				■
	Nitrite + Nitrate as Nitrogen	mg/L	10	Critical				■
	Nitrite as Nitrogen	mg/L	1	Critical				■
	Orthophosphate as Phosphorus	mg/L	Null	Low	■			
	Perchlorate	ug/L	15	High			■	
	Phosphorus, Total	mg/L	Null	Low	■			
	Solids, Total Dissolved	mg/L	500	Low			■	
	Sulfate	mg/L	250	Low			■	
	Turbidity	NTU	1	Low			■	
	UV254	cm-1	Null	Low	■			
	pH	pH UNITS	8.5	Low			■	
Metal	Aluminum, Total	mg/L	Null	Low			■	
	Antimony, Total	mg/L	0.006	Critical				■
	Arsenic (III)	mg/L	0.01	Critical				■
	Arsenic (V)	mg/L	0.01	Critical				■
	Arsenic, Inorganic (Total)	mg/L	0.01	Critical				■
	Barium, Total	mg/L	2	Critical				■
	Beryllium, Total	mg/L	0.004	Critical				■
	Cadmium, Total	mg/L	0.005	Critical				■
	Calcium, Total	mg/L	Null	Low	■			
	Chromium, Total	mg/L	0.1	Critical				■
	Copper, Total	mg/L	1	Low			■	
	Iron, Total	mg/L	0.3	Low				■
	Lead, Total	mg/L	0.015	Critical			■	
	Magnesium, Total	mg/L	35	Low		■		
	Manganese, Total	mg/L	0.05	Low				■
	Mercury, Total	mg/L	0.002	Critical				■
	Methyl Mercury, Total	ng/L	2000	High			■	
	Nickel, Total	mg/L	0.1	Critical				■
	Potassium, Total	mg/L	Null	Low	■			
	Selenium, Total	mg/L	0.05	Critical				■
	Silica, Dissolved as SiO2	mg/L	Null	Low	■			
	Silicon, Total	mg/L	Null	Low	■			
	Silver, Total	mg/L	0.1	Moderate				■
	Sodium, Total	mg/L	20	Low			■	
	Thallium, Total	mg/L	0.002	Critical				■
	Uranium, Total	mg/L	0.03	Critical			■	
	Zinc, Total	mg/L	5	Low				■
Herbicide	2,4,5-T	ug/L	160	High			■	
	2,4,5-TP (Silvex)	ug/L	50	Critical			■	
	2,4-D	ug/L	70	Critical			■	
	2,4-DB	ug/L	200	High			■	
	3,5-Dichlorobenzoic Acid	ug/L	0.5	High				■
	Acifluorfen	ug/L	1	High			■	
	Alachlor	ug/L	2	Critical			■	
	Bentazon	ug/L	300	High			■	
	Chloramben	ug/L	290	High			■	
	Chlorobenzene	ug/L	100	Critical			■	
	Dacthal Diacid	ug/L	350	High			■	
	Dalapon	ug/L	200	Critical			■	
	Dicamba	ug/L	570	Moderate			■	
	Dichlorprop	ug/L	Null	Moderate	■			
	Dinoseb	ug/L	7	Critical			■	
	Diquat	ug/L	20	Critical			■	
	Endothall	ug/L	100	Critical			■	
	Glyphosate	ug/L	700	Critical			■	
	Paraquat	ug/L	100	Moderate			■	
	Picloram	ug/L	500	Critical			■	
	Trifluralin	ug/L	2.6	Critical			■	
Pesticide/..	4,4'-DDD	ug/L	0.032	Critical			■	
	4,4'-DDE	ug/L	0.2	Critical			■	
	4,4'-DDT	ug/L	0.23	Critical			■	

Screening Level Type
- No guideline
- Maximum Contaminant Level
- Maximum Contaminant Level Goal
- Secondary Maximum Contaminant Level
- State Reporting Level
- Treatment Technique
- Ambient Water Quality Standard
- Drinking Water Equivalent Level
- Unregulated Contaminant Monitoring Rule
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Screening Level Type (color) broken down by Source vs. Group, Component, Units, Screening Value and Criticality. The view is filtered on Component, Screening Level Type, Group and Source. The Component filter keeps 250 of 250 members. The Screening Level Type filter keeps 13 of 13 members. The Group filter keeps 12 of 12 members. The Source filter keeps NONE, NYDEC, USEPA and WSDOH.

Analyte Screening Levels

Group	Component	Units	Screening Value	Criticality	NONE	NYDEC	USEPA	WSDOH
Pesticide/..	Aldrin	ug/L	0.002	Critical			■	
	Aroclor 1016	ug/L	0.5	Critical			■	
	Aroclor 1221	ug/L	0.5	Critical			■	
	Aroclor 1232	ug/L	0.5	Critical			■	
	Aroclor 1242	ug/L	0.5	Critical			■	
	Aroclor 1248	ug/L	0.5	Critical			■	
	Aroclor 1254	ug/L	0.5	Critical			■	
	Aroclor 1260	ug/L	0.5	Critical			■	
	Chlordane	ug/L	2	Critical			■	
	EPTC	ug/L	175	Moderate			■	
	Endrin	ug/L	2	Critical			■	
	Heptachlor	ug/L	0.4	Critical			■	
	Heptachlor Epoxide	ug/L	0.2	Critical			■	
	Methoxychlor	ug/L	40	Critical			■	
	Toxaphene	ug/L	3	Critical			■	
	gamma-BHC (Lindane)	ug/L	0.2	Critical			■	
Insecticid..	3-Hydroxycarbofuran	ug/L	Null	High	■			
	3-Methylthiophene	ug/L	Null	High	■			
	Aldicarb	ug/L	10	Moderate			■	
	Aldicarb Sulfone	ug/L	10	Moderate			■	
	Aldicarb Sulfoxide	ug/L	10	Moderate			■	
	Carbaryl	ug/L	40	Critical			■	
	Carbofuran	ug/L	40	Critical			■	
	Dieldrin	ug/L	0.002	Critical			■	
	Methiocarb	ug/L	Null	Moderate	■			
	Methomyl	ug/L	300	Moderate			■	
	Methoxychlor	ug/L	40	Critical			■	
	Parathion	ug/L	86	Critical			■	
	Propoxur	ug/L	40	Moderate			■	
Radionucli..	Alpha, Gross	pCI/L	15	Critical			■	
	Beta, Gross	pCI/L	50	Critical				■
	Radium-226	pCI/L	5	Critical			■	
	Radium-228	pCI/L	5	Critical			■	
Plasticizer	Bis(2-ethylhexyl) Adipate	ug/L	400	Critical			■	
	Bis(2-ethylhexyl) Phthalate	ug/L	6	Critical			■	
	Butyl Benzyl Phthalate	ug/L	16	Critical			■	
	Di-n-butyl Phthalate	ug/L	900	High			■	
	Diethyl Disulfide	ug/L	50	High		■		
	Diethyl Sulfide	ug/L	50	High		■		
	Dimethyl Disulfide	ug/L	50	High		■		
	Dimethyl Phthalate	ug/L	0.6	Moderate				■
	Dimethyl Sulfide	ug/L	50	High		■		
Chlorinated Phenolic Organic Compound	2,3,4,6-Tetrachlorophenol	ug/L	240	High			■	
	2,3,7,8-Tetrachlorodibenzo-p-di..	pg/L	30	Critical			■	
	2,4,5-Trichlorophenol	ug/L	1200	High			■	
	2,4,6-Trichlorophenol	ug/L	4.1	Critical			■	
	3,4,5-Trichlorocatechol	ug/L	Null	High	■			
	3,4,5-Trichloroguaiacol	ug/L	Null	High	■			
	3,4,6-Trichlorocatechol	ug/L	Null	High	■			
	3,4,6-Trichloroguaiacol	ug/L	Null	High	■			
	4,5,6-Trichloroguaiacol	ug/L	Null	High	■			
	Tetrachlorocatechol	ug/L	Null	High	■			
	Tetrachloroguaiacol	ug/L	Null	High	■			
	Trichlorosyringol	ug/L	Null	High	■			
Polynuclear Aromatic Hydrocarb..	Anthracene	ug/L	1800	Moderate			■	
	Benz(a)anthracene	ug/L	0.03	Critical			■	
	Benzo(b)fluoranthene	ug/L	0.25	Critical			■	
	Benzo(g,h,i)perylene	ug/L	0.2	Critical			■	
	Benzo(k)fluoranthene	ug/L	2.5	High			■	
	Chrysene	ug/L	25	High			■	
	Dibenz(a,h)anthracene	ug/L	0.025	Critical			■	
	Dibenzofuran	ug/L	7.9	High			■	
	Indeno(1,2,3-cd)pyrene	ug/L	0.25	High			■	
	Naphthalene	ug/L	140	Moderate			■	
Semi-Volatile Organic Compound	1,1-Dichloropropene	ug/L	0.5	High				■
	1,2,4-Trichlorobenzene	ug/L	70	Critical			■	
	1,2,4-Trimethylbenzene	ug/L	56	High			■	
	1,2-Dibromo-3-chloropropane (D..	ug/L	0.2	Critical			■	
	1,2-Dichloroethane	ug/L	5	Critical			■	
	1,2-Dichloropropane	ug/L	5	Critical			■	
	1,3,5-Trimethylbenzene	ug/L	60	High			■	
	1,3-Dichlorobenzene	ug/L	3000	High			■	
	1,3-Dichloropropane	ug/L	370	High			■	
	2,2-Dichloropropane	ug/L	0.5	High				■
	2-Butanone (MEK)	ug/L	5600	High			■	
	2-Chlorotoluene	ug/L	240	High			■	
	2-Ethylthiophene	ug/L	Null	High	■			

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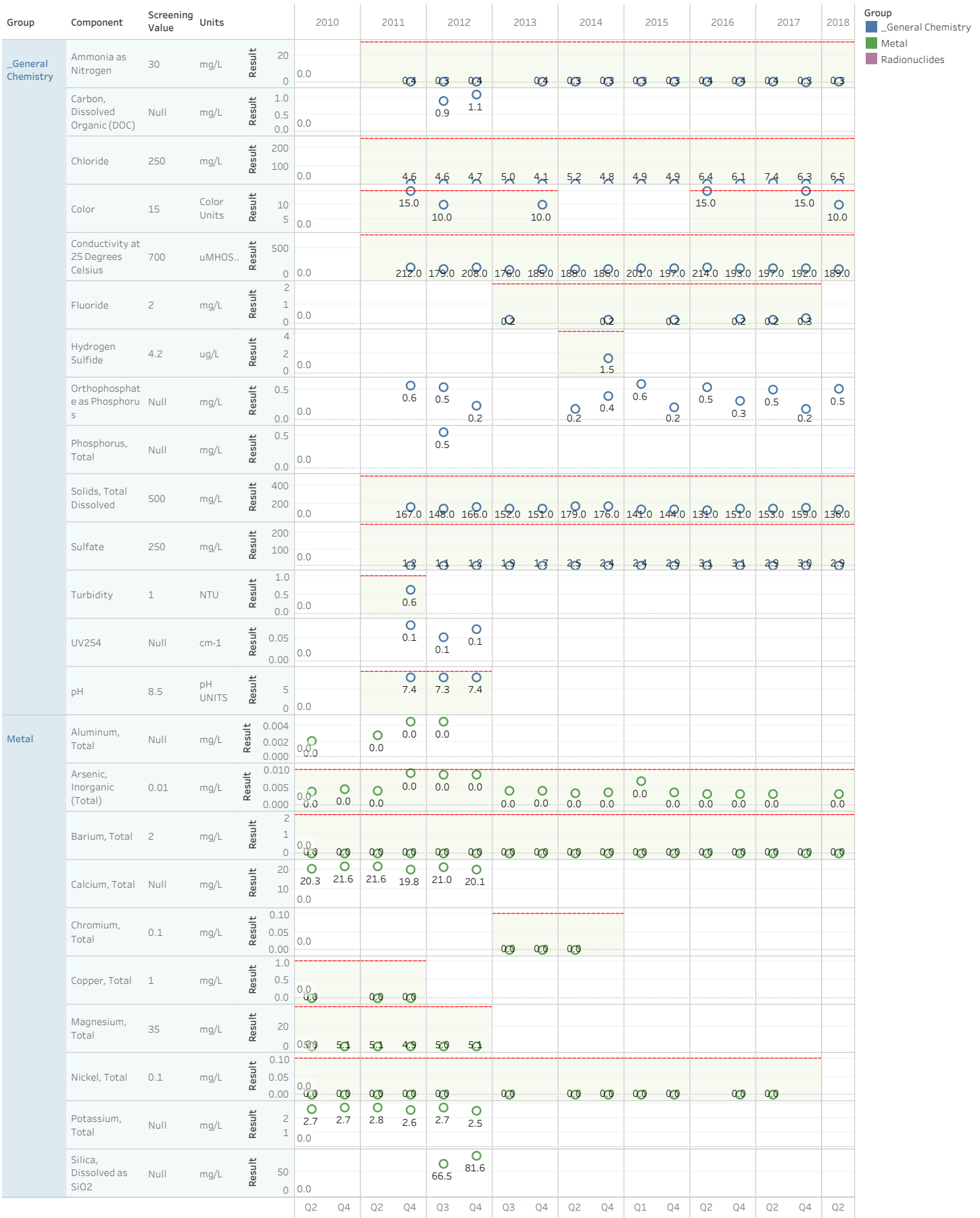
Analyte Screening Levels

Group	Component	Units	Screening Value	Criticality
Semi-Volatile Organic Compound	2-Methylnaphthalene	ug/L	36	High
	4-Chlorotoluene	ug/L	250	High
	4-Methyl-2-pentanone (MIBK)	ug/L	6300	High
	Atrazine	ug/L	3	Critical
	Benzo(a)pyrene	ug/L	0.2	Critical
	Bromacil	ug/L	3500	High
	Butachlor	ug/L	0.4	High
	Fluoranthene	ug/L	800	High
	Fluorene	ug/L	290	High
	Hexachlorobenzene	ug/L	1	Critical
	Hexachlorocyclopentadiene	ug/L	50	Critical
	Isopropylbenzene	ug/L	450	High
	Metolachlor	ug/L	70	Critical
	Metribuzin	ug/L	91	Moderate
	Pentachlorophenol (PCP)	ug/L	1	Critical
	Phenanthrene	ug/L	50	Moderate
	Propachlor	ug/L	1	Critical
	Pyrene	ug/L	120	Moderate
	Simazine	ug/L	4	Critical
	Terbacil	ug/L	91	Moderate
	trans-1,2-Dichloroethene	ug/L	0.1	Critical
	trans-1,3-Dichloropropene	ug/L	0.4	Critical
Volatile Organic Compound	1,1,1,2-Tetrachloroethane	ug/L	0.57	Critical
	1,1,1-Trichloroethane	ug/L	200	Critical
	1,1,2,2-Tetrachloroethane	ug/L	0.4	Critical
	1,1,2-Trichloroethane	ug/L	5	Critical
	1,1-Dichloroethane (1,1-DCA)	ug/L	2.8	Critical
	1,1-Dichloroethene (1,1-DCE)	ug/L	7	Critical
	1,1-Dichloropropene	ug/L	0.5	High
	1,2,3-Trichlorobenzene	ug/L	7	High
	1,2,3-Trichloropropane	ug/L	0.00075	Critical
	1,2-Dibromoethane (EDB)	ug/L	0.05	Critical
	1,2-Dichloropropane	ug/L	5	Critical
	1,3,5-Trimethylbenzene	ug/L	60	High
	1,3-Dichloropropane	ug/L	370	High
	2,5-Dimethylthiophene	ug/L	Null	High
	Benzene	ug/L	5	Critical
	Bromobenzene	ug/L	62	High
	Bromochloromethane (halon 10..	ug/L	0.06	High
	Bromodichloromethane	ug/L	0	Critical
	Bromoform	ug/L	0	Critical
	Bromomethane	ug/L	0.2	High
	Carbon Tetrachloride	ug/L	5	Critical
	Carbonyl Sulfide	ug/L	210	High
	Chloroethane	ug/L	21000	Critical
	Chloroform	ug/L	70	Critical
	Chloromethane	ug/L	0.2	High
	Dibromochloromethane	ug/L	60	Critical
	Dibromomethane	ug/L	0.5	High
	Dichlorodifluoromethane	ug/L	200	Moderate
	Dichloromethane (Methylene Ch..	ug/L	5	Critical
	Diisopropyl Ether	ug/L	1500	High
	Ethyl Mercaptan	ug/L	Null	High
	Ethyl Methyl Sulfide	ug/L	50	High
	Ethylbenzene	ug/L	700	Critical
	Hexachlorobutadiene	ug/L	0.9	Critical
	Methyl Mercaptan	ug/L	Null	High
	Methyl tert-Butyl Ether	ug/L	14	Critical
	Styrene	ug/L	100	Critical
	Tetrachloroethene	ug/L	5	Critical
	Toluene	ug/L	1000	Critical
	Trichloroethene	ug/L	5	Critical
	Trichlorofluoromethane	ug/L	5200	Moderate
	Vinyl Chloride	ug/L	2	Critical
	cis-1,2-Dichloroethene	ug/L	70	Critical
	cis-1,3-Dichloropropene	ug/L	0.47	High
	m,p-Xylenes	ug/L	10000	Critical
	n-Butylbenzene	ug/L	1000	High
	n-Propylbenzene	ug/L	660	High
	o-Xylene	ug/L	10000	Critical
	sec-Butylbenzene	ug/L	2000	High
	tert-Butylbenzene	ug/L	690	High
	trans-1,2-Dichloroethene	ug/L	0.1	Critical
	trans-1,3-Dichloropropene	ug/L	0.4	Critical
Surfactant	Methylene Blue Active Substanc..	mg/L	Null	Low

Screening Level Type
- No guideline
- Maximum Contaminant Level
- Maximum Contaminant Level Goal
- Secondary Maximum Contaminant Level
- State Reporting Level
- Treatment Technique
- Ambient Water Quality Standard
- Drinking Water Equivalent Level
- Unregulated Contaminant Monitoring Rule
- Health Advisory
- Human Health Benchmark
- Interim Health Advisory
- Regional Screening Level for Tapwater

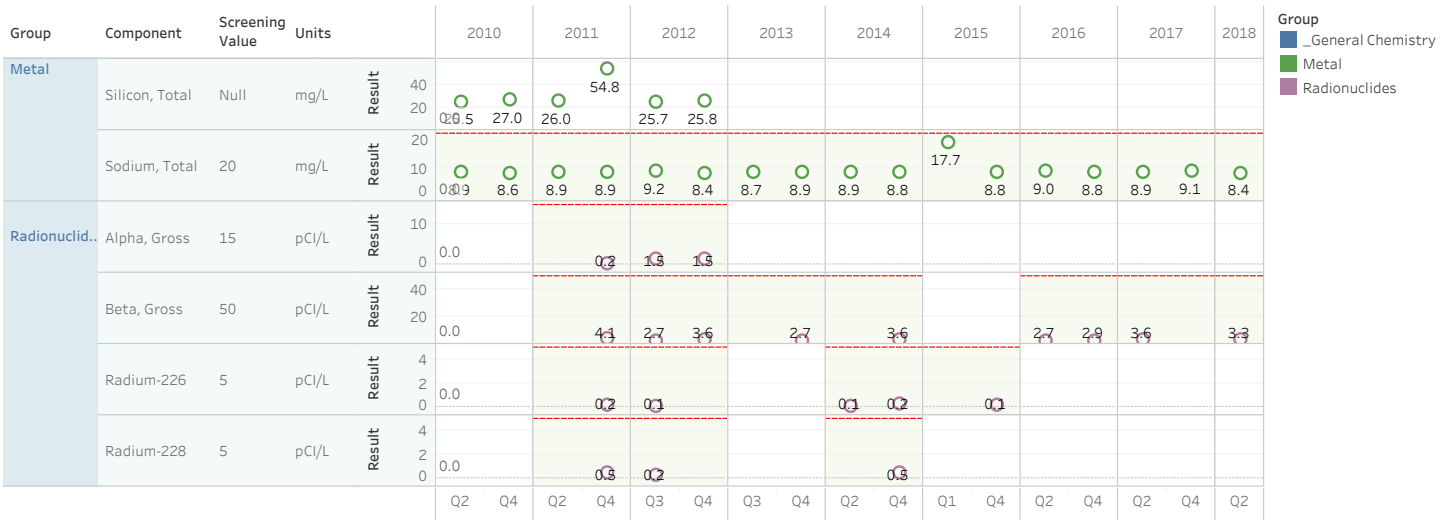
Screening Level Type (color) broken down by Source vs. Group, Component, Units, Screening Value and Criticality. The view is filtered on Component, Screening Level Type, Group and Source. The Component filter keeps 250 of 250 members. The Screening Level Type filter keeps 13 of 13 members. The Group filter keeps 12 of 12 members. The Source filter keeps NONE, NYDEC, USEPA and WSDOH.

Analytes Found Below Screening Level in DMW-1..... (Detections)



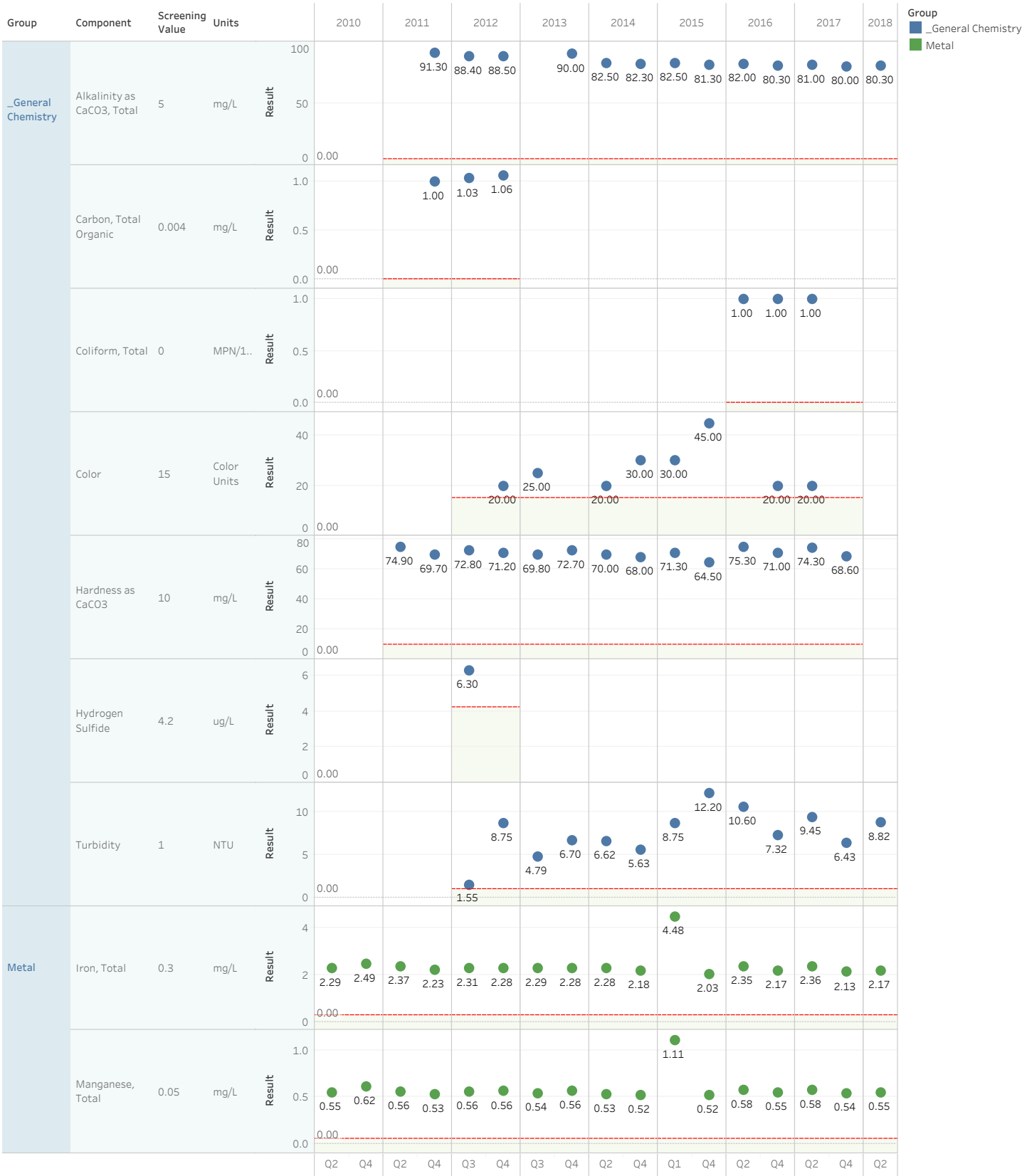
Sum of Result for each Date Collected Quarter broken down by Date Collected Year vs. Group, Component, Screening Value and Units. Color shows details about Group. The marks are labeled by sum of Result. The data is filtered on Step 1: Compare Result to Screening Level, which keeps Null and DETECTED. The view is filtered on Component, which excludes Null, Arsenic (III) and Arsenic (V).

Analytes Found Below Screening Level in DMW-1..... (Detections)



Sum of Result for each Date Collected Quarter broken down by Date Collected Year vs. Group, Component, Screening Value and Units. Color shows details about Group. The marks are labeled by sum of Result. The data is filtered on Step 1: Compare Result to Screening Level, which keeps Null and DETECTED. The view is filtered on Component, which excludes Null, Arsenic (III) and Arsenic (V).

Analytes Found Above Screening Level in DMW-1.....(Exceedances)



Group	Component	Screening Value	Units	2010	2011	2012	2013	2014	2015	2016	2017	2018
_General Chemistry	Alkalinity as CaCO3, Total	5	mg/L	0.00	91.30	88.40 88.50	90.00	82.50 82.30	82.50 81.30	82.00 80.30	81.00 80.00	80.30
	Carbon, Total Organic	0.004	mg/L	0.00	1.00	1.03 1.06						
	Coliform, Total	0	MPN/1..	0.00						1.00 1.00	1.00	
	Color	15	Color Units	0.00		20.00	25.00	20.00 30.00	30.00 45.00	20.00	20.00	
	Hardness as CaCO3	10	mg/L	0.00	74.90 69.70	72.80 71.20	69.80 72.70	70.00 68.00	71.30 64.50	75.30 71.00	74.30 68.60	
	Hydrogen Sulfide	4.2	ug/L	0.00		6.30						
	Turbidity	1	NTU	0.00		1.55 8.75	4.79 6.70	6.62 5.63	8.75 12.20	10.60 7.32	9.45 6.43	8.82
Metal	Iron, Total	0.3	mg/L	0.00	2.29 2.49	2.37 2.23	2.31 2.28	2.29 2.28	2.28 2.18	4.48 2.03	2.35 2.17	2.36 2.13	2.17
	Manganese, Total	0.05	mg/L	0.00	0.55 0.62	0.56 0.53	0.56 0.56	0.54 0.56	0.53 0.52	1.11 0.52	0.58 0.55	0.58 0.54	0.55

Sum of Result for each Date Collected Quarter broken down by Date Collected Year vs. Group, Component, Screening Value and Units. Color shows details about Group. The marks are labeled by sum of Result. The data is filtered on Step 1: Compare Result to Screening Level, which keeps EXCEEDANCE. The view is filtered on Component, which keeps 250 of 250 members.

Criticality of Screening Level Exceedances in DMW-1

Sum of Result for each Date Collected Quarter broken down by Date Collected Year vs. Group, Component, Screening Value and Units. Color shows details about Criticality. The marks are labeled by sum of Result. The data is filtered on Step 1: Compare Result to Screening Level and Action (Component (Analyte Summary),Criticality,Group). The Step 1: Compare Result to Screening Level filter keeps EXCEEDANCE. The Action (Component (Analyte Summary),Criticality,Group) filter keeps 229 members. The view is filtered on Component, which keeps 250 of 250 members.

Analyte Criticality Rankings

_General Chemistry	Alkalinity as CaCO3, Total	Low	●
	Ammonia as Nitrogen	Moderate	●
	Bromide	Critical	●
	Carbon, Dissolved Organic (DOC)	Low	●
	Carbon, Total Organic	Low	●
	Chloride	Low	●
	Coliform, Fecal	Critical	●
	Coliform, Total	Critical	●
	Colilert, E. Coli	Critical	●
	Color	Low	●
	Conductivity at 25 Degrees Celsius	Low	●
	Cyanide, Total	Critical	●
	Fluoride	Moderate	●
	Hardness as CaCO3	Low	●
	Hydrogen Sulfide	Moderate	●
	Nitrate as Nitrogen	Critical	●
	Nitrite + Nitrate as Nitrogen	Critical	●
	Nitrite as Nitrogen	Critical	●
	Orthophosphate as Phosphorus	Low	●
	Perchlorate	High	●
	pH	Low	●
	Phosphorus, Total	Low	●
	Solids, Total Dissolved	Low	●
	Sulfate	Low	●
	Turbidity	Low	●
	UV254	Low	●
Volatile Organic Compound	1,1-Dichloroethane (1,1-DCA)	Critical	●
	1,1-Dichloroethene (1,1-DCE)	Critical	●
	1,1-Dichloropropene	High	●
	1,1,1-Trichloroethane	Critical	●
	1,1,1,2-Tetrachloroethane	Critical	●
	1,1,2-Trichloroethane	Critical	●
	1,1,2,2-Tetrachloroethane	Critical	●
	1,2-Dibromoethane (EDB)	Critical	●
	1,2-Dichloropropane	Critical	●
	1,2,3-Trichlorobenzene	High	●
	1,2,3-Trichloropropane	Critical	●
	1,3-Dichloropropane	High	●
	1,3,5-Trimethylbenzene	High	●
	2,5-Dimethylthiophene	High	●
	Benzene	Critical	●
	Bromobenzene	High	●

Criticality
- Low
- Moderate
- High
- Critical

Criticality (color) broken down by Group, Component (Analyte Summary) and Criticality. The data is filtered on Component and Full Criticality Legend. The Component filter keeps 250 of 250 members. The Full Criticality Legend filter keeps CRITICAL, HIGH, LOW and MEDIUM.

Analyte Criticality Rankings

Volatile Organic Compound	Bromochloromethane (halon 1011)	High	●
	Bromodichloromethane	Critical	●
	Bromoform	Critical	●
	Bromomethane	High	●
	Carbon Tetrachloride	Critical	●
	Carbonyl Sulfide	High	●
	Chloroethane	Critical	●
	Chloroform	Critical	●
	Chloromethane	High	●
	cis-1,2-Dichloroethene	Critical	●
	cis-1,3-Dichloropropene	High	●
	Dibromochloromethane	Critical	●
	Dibromomethane	High	●
	Dichlorodifluoromethane	Moderate	●
	Dichloromethane (Methylene Chloride)	Critical	●
	Diisopropyl Ether	High	●
	Ethyl Mercaptan	High	●
	Ethyl Methyl Sulfide	High	●
	Ethylbenzene	Critical	●
	Hexachlorobutadiene	Critical	●
	m,p-Xylenes	Critical	●
	Methyl Mercaptan	High	●
	Methyl tert-Butyl Ether	Critical	●
	n-Butylbenzene	High	●
	n-Propylbenzene	High	●
	o-Xylene	Critical	●
	sec-Butylbenzene	High	●
	Styrene	Critical	●
	tert-Butylbenzene	High	●
	Tetrachloroethene	Critical	●
	Toluene	Critical	●
	trans-1,2-Dichloroethene	Critical	●
	trans-1,3-Dichloropropene	Critical	●
	Trichloroethene	Critical	●
	Trichlorofluoromethane	Moderate	●
	Vinyl Chloride	Critical	●
Surfactant	Methylene Blue Active Substances	Low	●
Semi-Volatile Organic Compound	1,1-Dichloropropene	High	●
	1,2-Dibromo-3-chloropropane (DBCP)	Critical	●
	1,2-Dichloroethane	Critical	●
	1,2-Dichloropropane	Critical	●
	1,2,4-Trichlorobenzene	Critical	●

Criticality
- Low
- Moderate
- High
- Critical

Criticality (color) broken down by Group, Component (Analyte Summary) and Criticality. The data is filtered on Component and Full Criticality Legend. The Component filter keeps 250 of 250 members. The Full Criticality Legend filter keeps CRITICAL, HIGH, LOW and MEDIUM.

Analyte Criticality Rankings

Semi-Volatile Organic Compound	1,2,4-Trimethylbenzene	High	●
	1,3-Dichlorobenzene	High	●
	1,3-Dichloropropane	High	●
	1,3,5-Trimethylbenzene	High	●
	2-Butanone (MEK)	High	●
	2-Chlorotoluene	High	●
	2-Ethylthiophene	High	●
	2-Methylnaphthalene	High	●
	2,2-Dichloropropane	High	●
	4-Chlorotoluene	High	●
	4-Methyl-2-pentanone (MIBK)	High	●
	Atrazine	Critical	●
	Benzo(a)pyrene	Critical	●
	Bromacil	High	●
	Butachlor	High	●
	Fluoranthene	High	●
	Fluorene	High	●
	Hexachlorobenzene	Critical	●
	Hexachlorocyclopentadiene	Critical	●
	Isopropylbenzene	High	●
	Metolachlor	Critical	●
	Metribuzin	Moderate	●
	Pentachlorophenol (PCP)	Critical	●
	Phenanthrene	Moderate	●
	Propachlor	Critical	●
	Pyrene	Moderate	●
	Simazine	Critical	●
	Terbacil	Moderate	●
	trans-1,2-Dichloroethene	Critical	●
	trans-1,3-Dichloropropene	Critical	●
Radionuclid..	Alpha, Gross	Critical	●
	Beta, Gross	Critical	●
	Radium-226	Critical	●
	Radium-228	Critical	●
Polynuclear Aromatic Hydrocarbon	Anthracene	Moderate	●
	Benz(a)anthracene	Critical	●
	Benzo(b)fluoranthene	Critical	●
	Benzo(g,h,i)perylene	Critical	●
	Benzo(k)fluoranthene	High	●
	Chrysene	High	●
	Dibenz(a,h)anthracene	Critical	●
	Dibenzofuran	High	●

Criticality
- Low
- Moderate
- High
- Critical

Criticality (color) broken down by Group, Component (Analyte Summary) and Criticality. The data is filtered on Component and Full Criticality Legend. The Component filter keeps 250 of 250 members. The Full Criticality Legend filter keeps CRITICAL, HIGH, LOW and MEDIUM.

Analyte Criticality Rankings

Polynuclear Aromatic Hydrocarbon	Indeno(1,2,3-cd)pyrene	High	●
	Naphthalene	Moderate	●
Plasticizer	Bis(2-ethylhexyl) Adipate	Critical	●
	Bis(2-ethylhexyl) Phthalate	Critical	●
	Butyl Benzyl Phthalate	Critical	●
	Di-n-butyl Phthalate	High	●
	Diethyl Disulfide	High	●
	Diethyl Sulfide	High	●
	Dimethyl Disulfide	High	●
	Dimethyl Phthalate	Moderate	●
	Dimethyl Sulfide	High	●
Pesticide/P..	4,4'-DDD	Critical	●
	4,4'-DDE	Critical	●
	4,4'-DDT	Critical	●
	Aldrin	Critical	●
	Aroclor 1016	Critical	●
	Aroclor 1221	Critical	●
	Aroclor 1232	Critical	●
	Aroclor 1242	Critical	●
	Aroclor 1248	Critical	●
	Aroclor 1254	Critical	●
	Aroclor 1260	Critical	●
	Chlordane	Critical	●
	Endrin	Critical	●
	EPTC	Moderate	●
	gamma-BHC (Lindane)	Critical	●
	Heptachlor	Critical	●
	Heptachlor Epoxide	Critical	●
	Methoxychlor	Critical	●
	Toxaphene	Critical	●
Metal	Aluminum, Total	Low	●
	Antimony, Total	Critical	●
	Arsenic (III)	Critical	●
	Arsenic (V)	Critical	●
	Arsenic, Inorganic (Total)	Critical	●
	Barium, Total	Critical	●
	Beryllium, Total	Critical	●
	Cadmium, Total	Critical	●
	Calcium, Total	Low	●
	Chromium, Total	Critical	●
	Copper, Total	Low	●
	Iron, Total	Low	●

Criticality
- Low
- Moderate
- High
- Critical

Criticality (color) broken down by Group, Component (Analyte Summary) and Criticality. The data is filtered on Component and Full Criticality Legend. The Component filter keeps 250 of 250 members. The Full Criticality Legend filter keeps CRITICAL, HIGH, LOW and MEDIUM.

Analyte Criticality Rankings

Metal	Lead, Total	Critical	●
	Magnesium, Total	Low	●
	Manganese, Total	Low	●
	Mercury, Total	Critical	●
	Methyl Mercury, Total	High	●
	Nickel, Total	Critical	●
	Potassium, Total	Low	●
	Selenium, Total	Critical	●
	Silica, Dissolved as SiO2	Low	●
	Silicon, Total	Low	●
	Silver, Total	Moderate	●
	Sodium, Total	Low	●
	Thallium, Total	Critical	●
	Uranium, Total	Critical	●
	Zinc, Total	Low	●
Insecticide/..	3-Hydroxycarbofuran	High	●
	3-Methylthiophene	High	●
	Aldicarb	Moderate	●
	Aldicarb Sulfone	Moderate	●
	Aldicarb Sulfoxide	Moderate	●
	Carbaryl	Critical	●
	Carbofuran	Critical	●
	Dieldrin	Critical	●
	Methiocarb	Moderate	●
	Methomyl	Moderate	●
	Methoxychlor	Critical	●
	Parathion	Critical	●
	Propoxur	Moderate	●
Herbicide	2,4-D	Critical	●
	2,4-DB	High	●
	2,4,5-T	High	●
	2,4,5-TP (Silvex)	Critical	●
	3,5-Dichlorobenzoic Acid	High	●
	Acifluorfen	High	●
	Alachlor	Critical	●
	Bentazon	High	●
	Chloramben	High	●
	Chlorobenzene	Critical	●
	Dacthal Diacid	High	●
	Dalapon	Critical	●
	Dicamba	Moderate	●
	Dichlorprop	Moderate	●

Criticality
- Low
- Moderate
- High
- Critical

Criticality (color) broken down by Group, Component (Analyte Summary) and Criticality. The data is filtered on Component and Full Criticality Legend. The Component filter keeps 250 of 250 members. The Full Criticality Legend filter keeps CRITICAL, HIGH, LOW and MEDIUM.

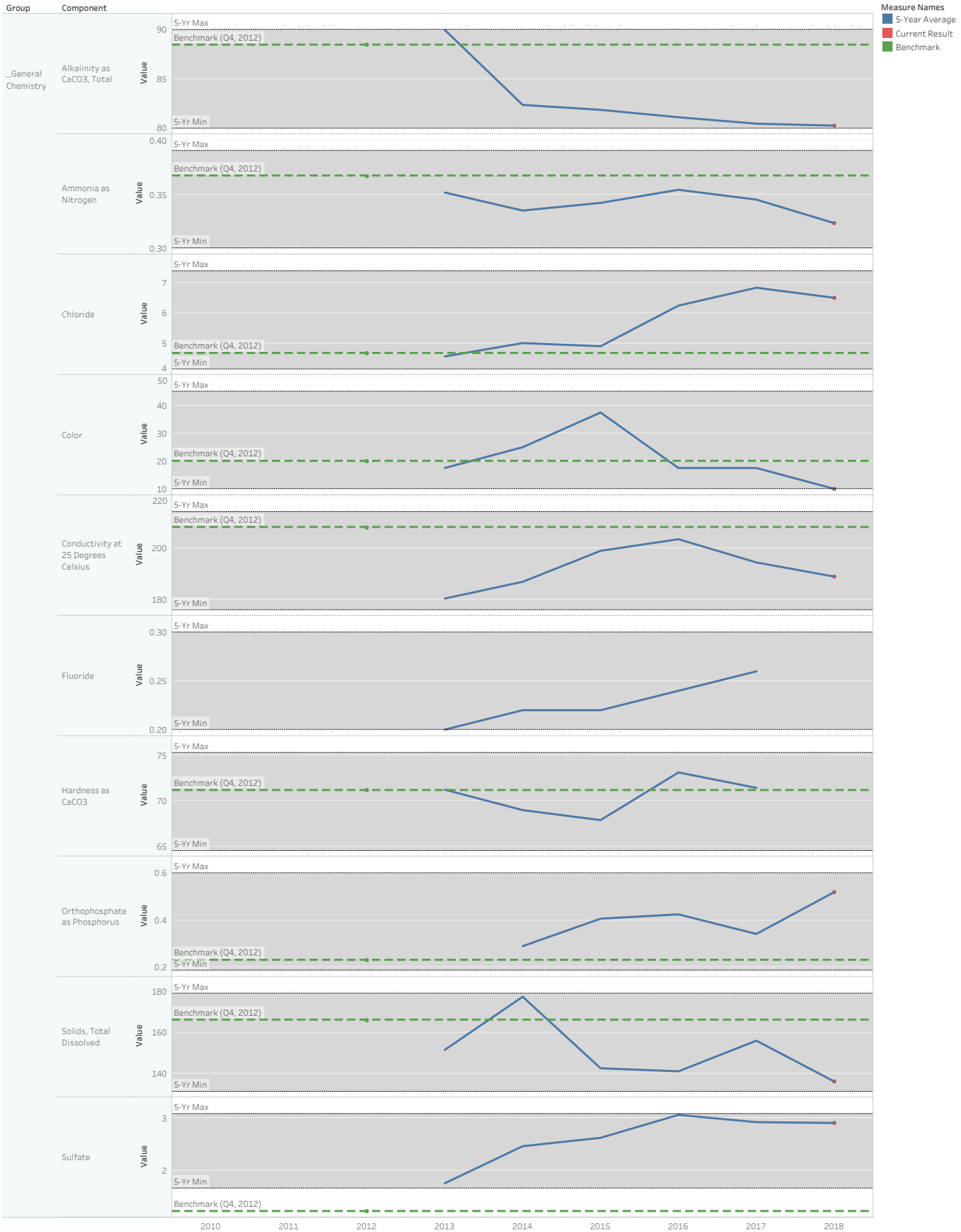
Analyte Criticality Rankings

Herbicide	Dinoseb	Critical	●
	Diquat	Critical	●
	Endothall	Critical	●
	Glyphosate	Critical	●
	Paraquat	Moderate	●
	Picloram	Critical	●
	Trifluralin	Critical	●
Chlorinated Phenolic Organic Compound	2,3,4,6-Tetrachlorophenol	High	●
	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TC..	Critical	●
	2,4,5-Trichlorophenol	High	●
	2,4,6-Trichlorophenol	Critical	●
	3,4,5-Trichlorocatechol	High	●
	3,4,5-Trichloroguaiacol	High	●
	3,4,6-Trichlorocatechol	High	●
	3,4,6-Trichloroguaiacol	High	●
	4,5,6-Trichloroguaiacol	High	●
	Tetrachlorocatechol	High	●
	Tetrachloroguaiacol	High	●
	Trichlorosyringol	High	●

Criticality
- Low
- Moderate
- High
- Critical

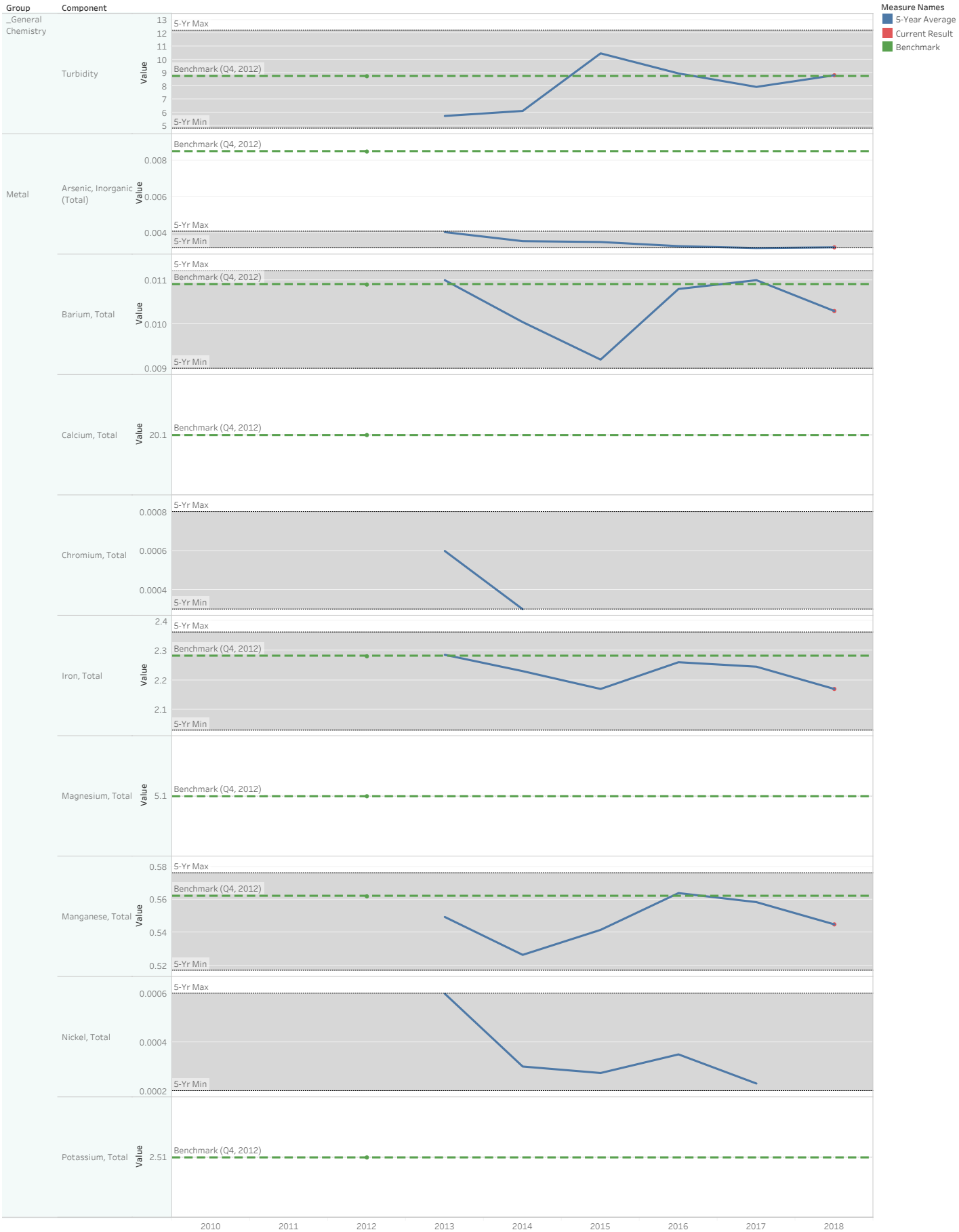
Criticality (color) broken down by Group, Component (Analyte Summary) and Criticality. The data is filtered on Component and Full Criticality Legend. The Component filter keeps 250 of 250 members. The Full Criticality Legend filter keeps CRITICAL, HIGH, LOW and MEDIUM.

Average Analyte Levels for DMW-1



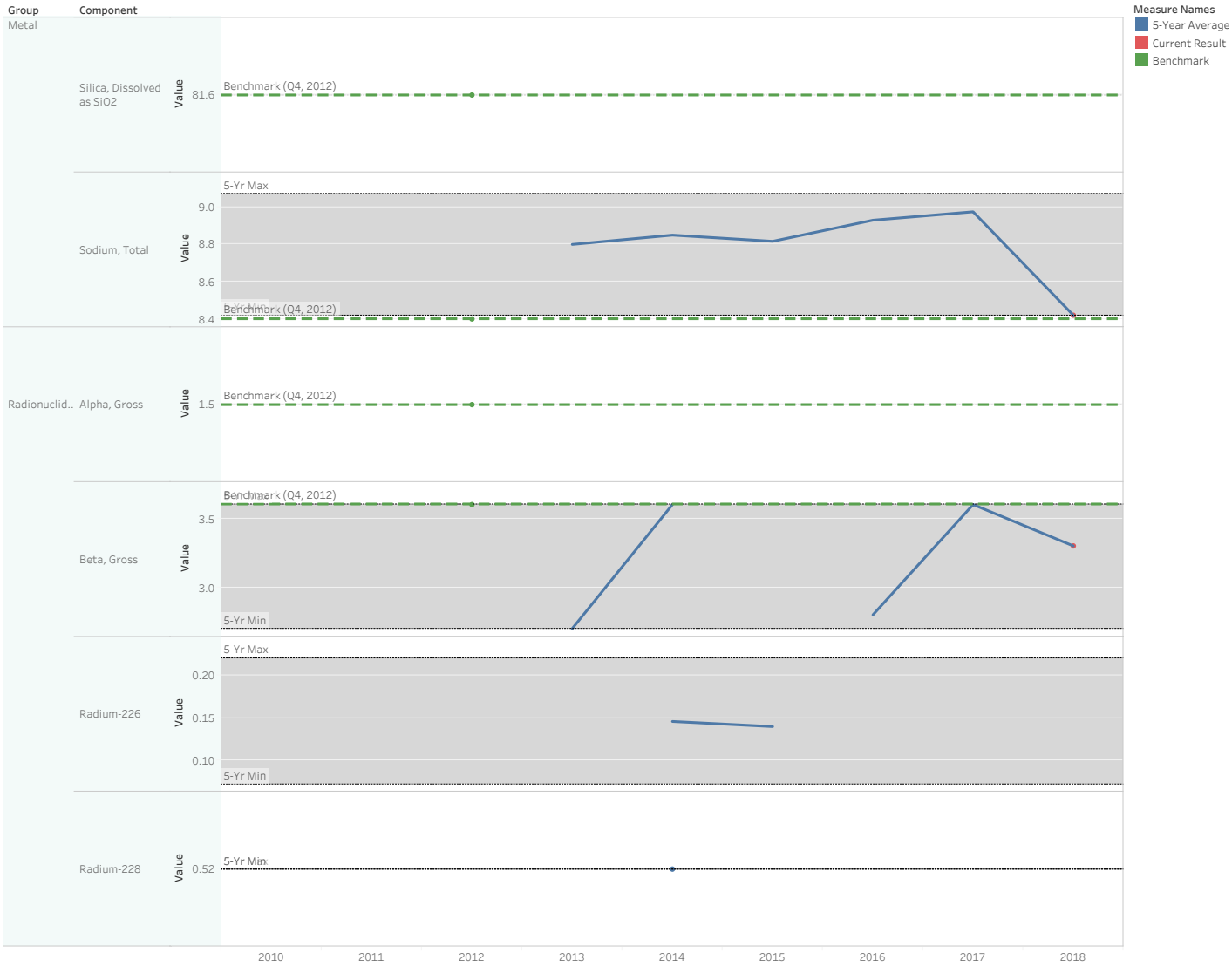
The trends of 5-Year Average, Benchmark and Current Result for Date Collected Year broken down by Group and Component. Color shows details about 5-Year Average, Benchmark and Current Result. The data is filtered on Step 1: Compare Result to Screening Level, which keeps Null, DETECTED and EXCEEDANCE. The view is filtered on Component, which keeps 237 of 250 members.

Average Analyte Levels for DMW-1



The trends of 5-Year Average, Benchmark and Current Result for Date Collected Year broken down by Group and Component. Color shows details about 5-Year Average, Benchmark and Current Result. The data is filtered on Step 1: Compare Result to Screening Level, which keeps Null, DETECTED and EXCEEDANCE. The view is filtered on Component, which keeps 237 of 250 members.

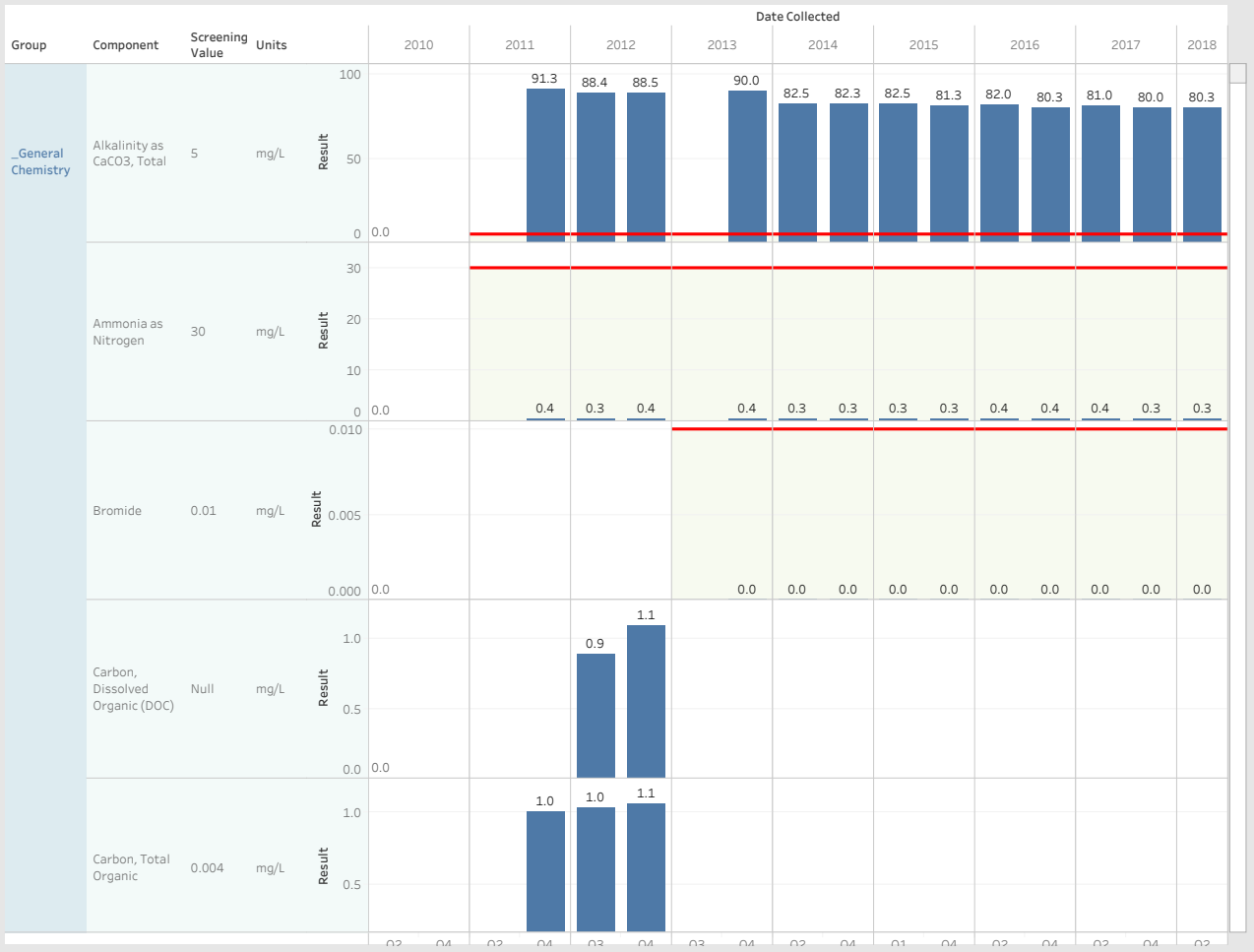
Average Analyte Levels for DMW-1



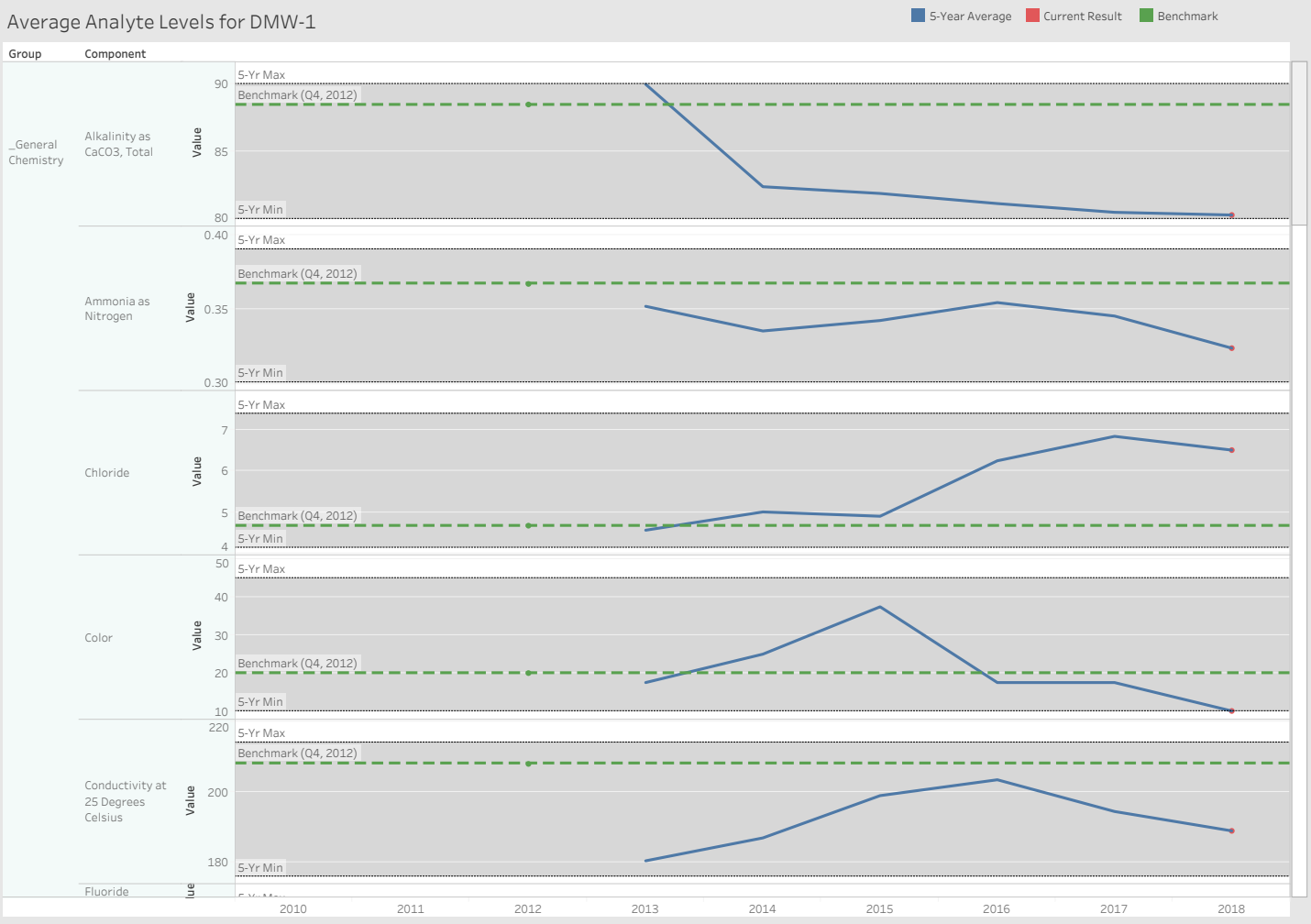
The trends of 5-Year Average, Benchmark and Current Result for Date Collected Year broken down by Group and Component. Color shows details about 5-Year Average, Benchmark and Current Result. The data is filtered on Step 1: Compare Result to Screening Level, which keeps Null, DETECTED and EXCEEDANCE. The view is filtered on Component, which keeps 237 of 250 members.

DMW-1

Semi-Annual Sampling Results for DMW-1

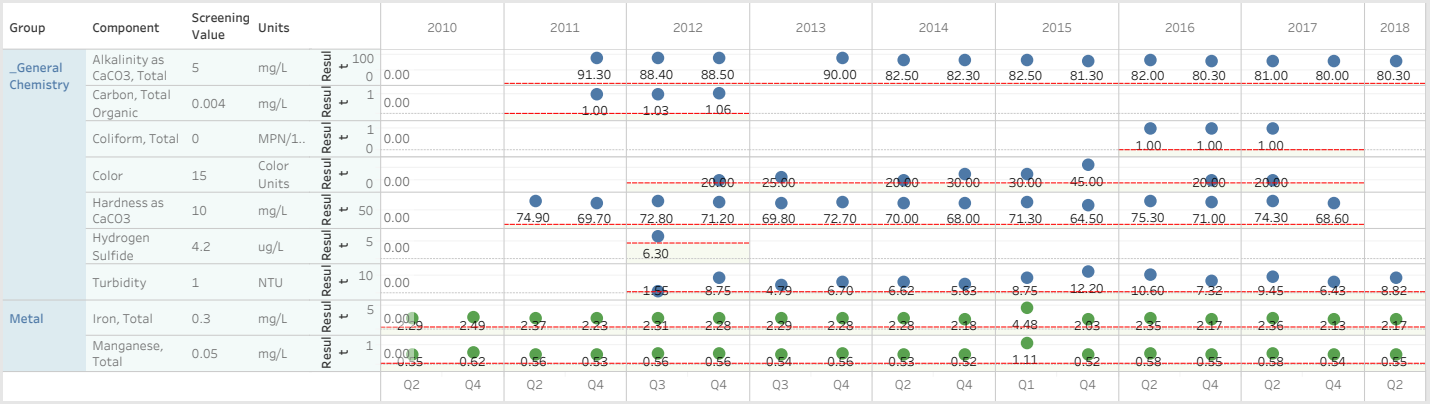


DMW-1


Average Analyte Levels for DMW-1
5-Year Average
Current Result
Benchmark
Group
Component
_General Chemistry
Alkalinity as CaCO3, Total
Ammonia as Nitrogen
Chloride
Color
Conductivity at 25 Degrees Celsius
Fluoride
Value
5-Yr Max
Benchmark (Q4, 2012)
5-Yr Min
90
85
80
0.40
0.35
0.30
7
6
5
4
50
40
30
20
10
220
200
180
2010
2011
2012
2013
2014
2015
2016
2017
2018

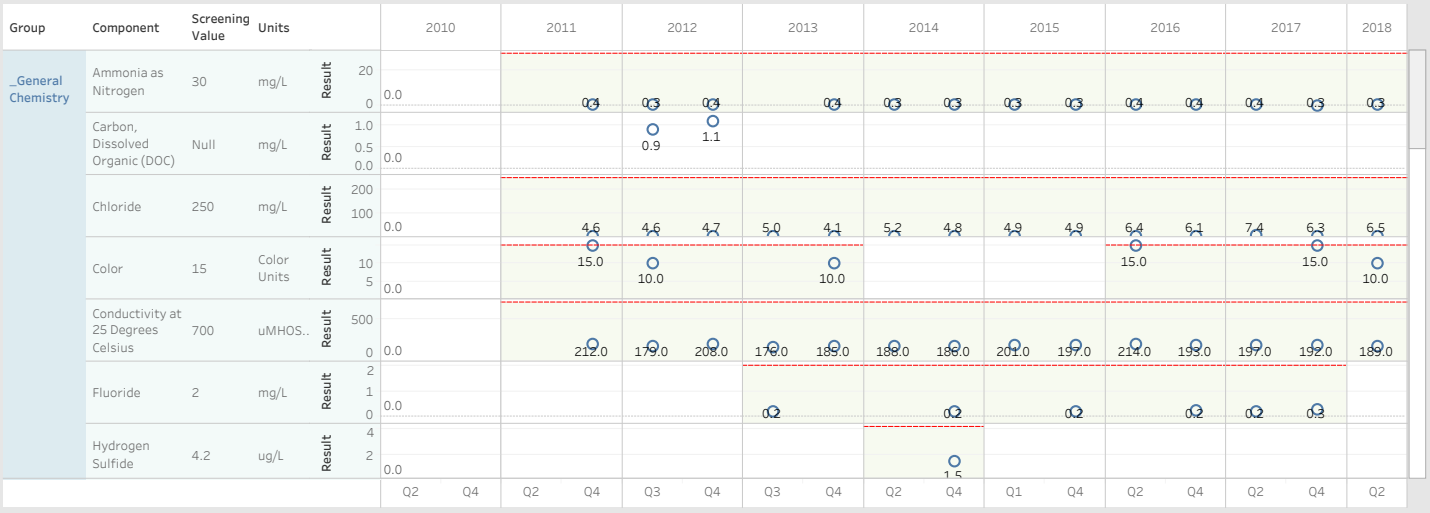
DMW-1

Analytes Found Above Screening Level in DMW-1.....(Exceedances)



Group	Component	Screening Value	Units	2010	2011	2012	2013	2014	2015	2016	2017	2018
_General Chemistry	Alkalinity as CaCO3, Total	5	mg/L	0.00	91.30	88.40, 88.50	90.00	82.50, 82.30	82.50, 81.30	82.00, 80.30	81.00, 80.00	80.30
	Carbon, Total Organic	0.004	mg/L	0.00	1.00	1.03, 1.06						
	Coliform, Total	0	MPN/1..	0.00						1.00, 1.00	1.00	
	Color	15	Color Units	0.00		20.00	25.00	20.00, 30.00	30.00, 45.00	20.00	20.00	
	Hardness as CaCO3	10	mg/L	0.00	74.90, 69.70	72.80, 71.20	69.80, 72.70	70.00, 68.00	71.30, 64.50	75.30, 71.00	74.30, 68.60	
	Hydrogen Sulfide	4.2	ug/L	0.00		6.30						
	Turbidity	1	NTU	0.00	1.65	8.75	4.79, 6.70	6.62, 5.63	8.75, 12.20	10.60, 7.32	9.45, 6.43	8.82
Metal	Iron, Total	0.3	mg/L	0.00	2.29, 2.49, 2.37, 2.23	2.31, 2.28	2.29, 2.28	2.28, 2.18	4.48, 2.03	2.35, 2.17	2.36, 2.13	2.17
	Manganese, Total	0.05	mg/L	0.00	0.55, 0.62, 0.56, 0.53	0.56, 0.56	0.54, 0.56	0.53, 0.52	1.11, 0.52	0.58, 0.55	0.58, 0.54	0.55
				Q2 Q4	Q2 Q4	Q3 Q4	Q3 Q4	Q2 Q4	Q1 Q4	Q2 Q4	Q2 Q4	Q2

Analytes Found Below Screening Level in DMW-1..... (Detections)



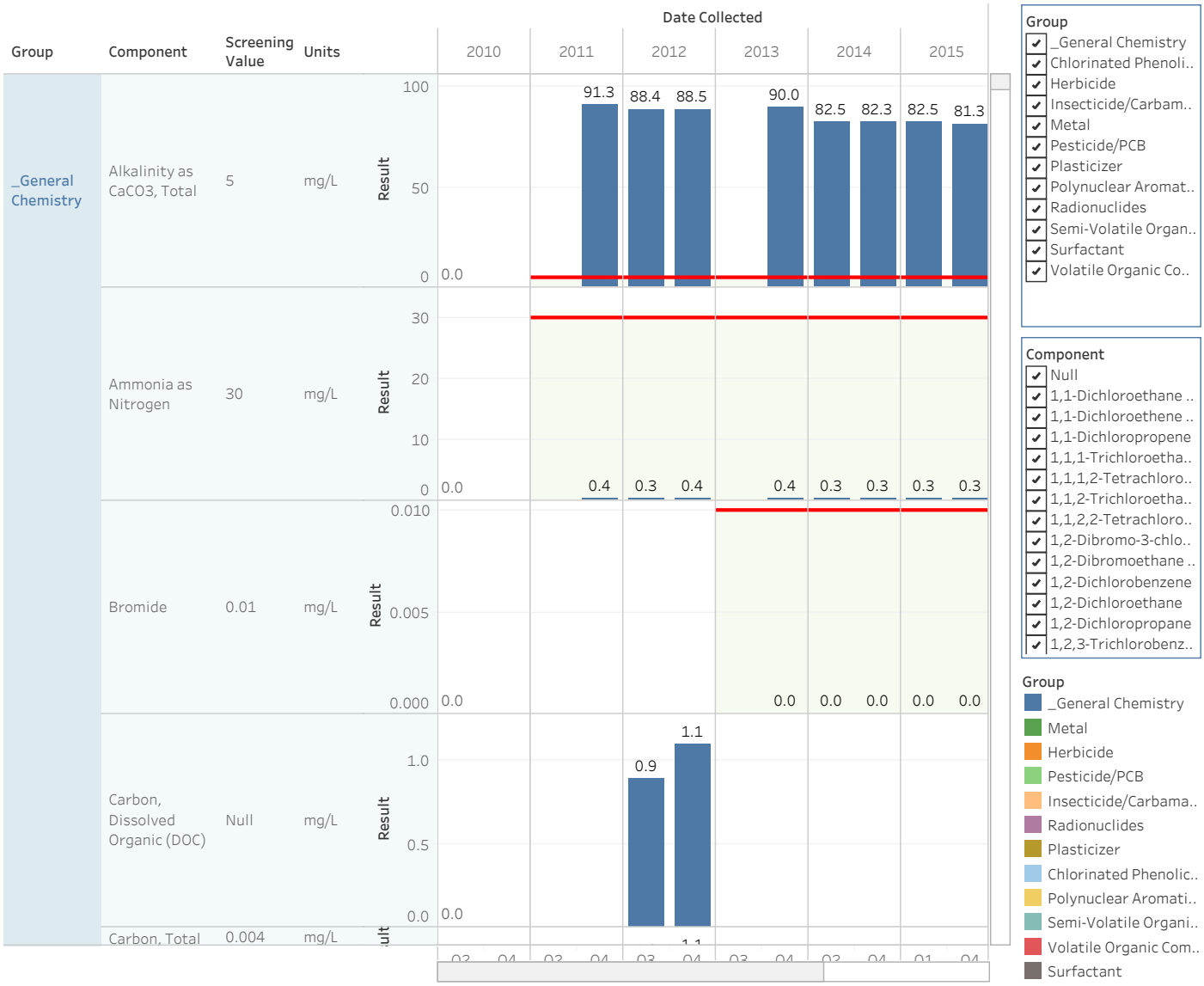
Group	Component	Screening Value	Units	2010	2011	2012	2013	2014	2015	2016	2017	2018
_General Chemistry	Ammonia as Nitrogen	30	mg/L	0.0	0.4	0.3, 0.4	0.4	0.3, 0.3	0.3, 0.3	0.4, 0.4	0.4, 0.3	0.3
	Carbon, Dissolved Organic (DOC)	Null	mg/L	0.0		0.9, 1.1						
	Chloride	250	mg/L	0.0	4.6	4.6, 4.7	5.0, 4.1	5.2, 4.8	4.9, 4.9	6.4, 6.1	7.4, 6.3	6.5
	Color	15	Color Units	0.0	15.0	10.0	10.0			15.0	15.0	10.0
	Conductivity at 25 Degrees Celsius	700	uMHOS..	0.0	212.0	179.0, 208.0	176.0, 189.0	188.0, 188.0	201.0, 197.0	214.0, 193.0	197.0, 192.0	189.0
	Fluoride	2	mg/L	0.0			0.2	0.2	0.2	0.2	0.2, 0.3	
	Hydrogen Sulfide	4.2	ug/L	0.0				1.5				
				Q2 Q4	Q2 Q4	Q3 Q4	Q3 Q4	Q2 Q4	Q1 Q4	Q2 Q4	Q2 Q4	Q2

DMW-1

Criticality of Screening Level Exceedances in DMW-1

DMW-1

WHPP Database | Screening Values | Detections | Exeedances | Criticality



DMW-1

WHPP Database | Screening Values | Detections | Exeedances | Criticality

Group	Component	Units	Screening Value	Criticality	NONE	NYDEC	USEPA
_General Chemistry	Alkalinity as CaCO3, Total	mg/L	5	Low			
	Ammonia as Nitrogen	mg/L	30	Moderate			
	Bromide	mg/L	0.01	Critical			
	Carbon, Dissolved Organic (DOC)	mg/L	Null	Low	■		
	Carbon, Total Organic	mg/L	0.004	Low			
	Chloride	mg/L	250	Low			
	Coliform, Fecal	MPN/100mL	0	Critical			
	Coliform, Total	MPN/100mL	0	Critical			
	Colilert, E. Coli	MPN/100mL	0	Critical			
	Color	Color Units	15	Low			
	Conductivity at 25 Degrees Celsi..	uMHOS/cm	700	Low			
	Cyanide, Total	mg/L	0.2	Critical			
	Fluoride	mg/L	2	Moderate			
	Hardness as CaCO3	mg/L	10	Low			
	Hydrogen Sulfide	ug/L	4.2	Moderate			
	Nitrate as Nitrogen	mg/L	10	Critical			
	Nitrite + Nitrate as Nitrogen	mg/L	10	Critical			
	Nitrite as Nitrogen	mg/L	1	Critical			
	Orthophosphate as Phosphorus	mg/L	Null	Low	■		
	Perchlorate	ug/L	15	High			
	Phosphorus, Total	mg/L	Null	Low	■		
	Solids, Total Dissolved	mg/L	500	Low			
	Sulfate	mg/L	250	Low			
	Turbidity	NTU	1	Low			
	UV254	cm-1	Null	Low	■		
	pH	pH UNITS	8.5	Low			
Metal	Aluminum, Total	mg/L	Null	Low			
	Antimony, Total	mg/L	0.006	Critical			
	Arsenic (III)	mg/L	0.01	Critical			
	Arsenic (V)	mg/L	0.01	Critical			
	Arsenic, Inorganic (Total)	mg/L	0.01	Critical			
	Barium, Total	mg/L	2	Critical			
	Beryllium, Total	mg/L	0.004	Critical			
	Cadmium, Total	mg/L	0.005	Critical			
	Calcium, Total	mg/L	Null	Low	■		
	Chromium, Total	mg/L	0.1	Critical			
	Copper, Total	mg/L	1	Low			

Source
- ☑ NONE
- ☑ NYDEC
- ☑ USEPA
- ☑ WSDOH

Screening Level Type
- ☑ Ambient Water Qua..
- ☑ Drinking Water Equ..
- ☑ Health Advisory
- ☑ Human Health Benc..
- ☑ Interim Health Advi..
- ☑ Maximum Contamin..
- ☑ Maximum Contamin..
- ☑ No guideline

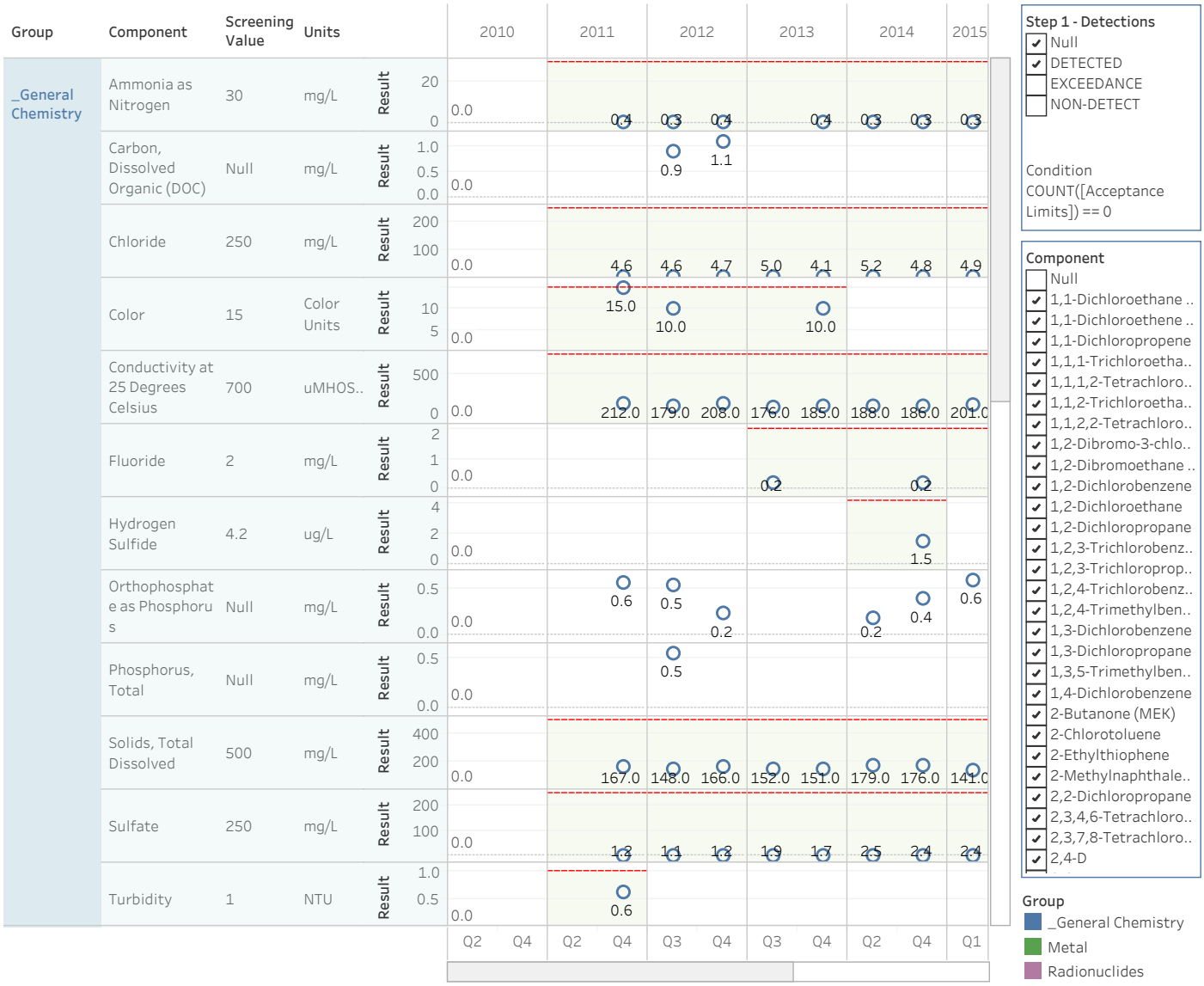
Group
- ☑ _General Chemistry
- ☑ Chlorinated Phenoli..
- ☑ Herbicide
- ☑ Insecticide/Carbam..
- ☑ Metal
- ☑ Pesticide/PCB
- ☑ Plasticizer
- ☑ Polynuclear Aromat..

Component
- ☑ Null
- ☑ 1,1-Dichloroethane ..
- ☑ 1,1-Dichloroethene ..
- ☑ 1,1-Dichloropropene
- ☑ 1,1,1-Trichloroetha..
- ☑ 1,1,1,2-Tetrachloro..
- ☑ 1,1,2-Trichloroetha..
- ☑ 1,1,2,2-Tetrachloro..

Screening Level Type
- No guideline
- Maximum Contamin..
- Maximum Contamin..
- Secondary Maximum..
- State Reporting Level
- Treatment Technique
- Ambient Water Quali..

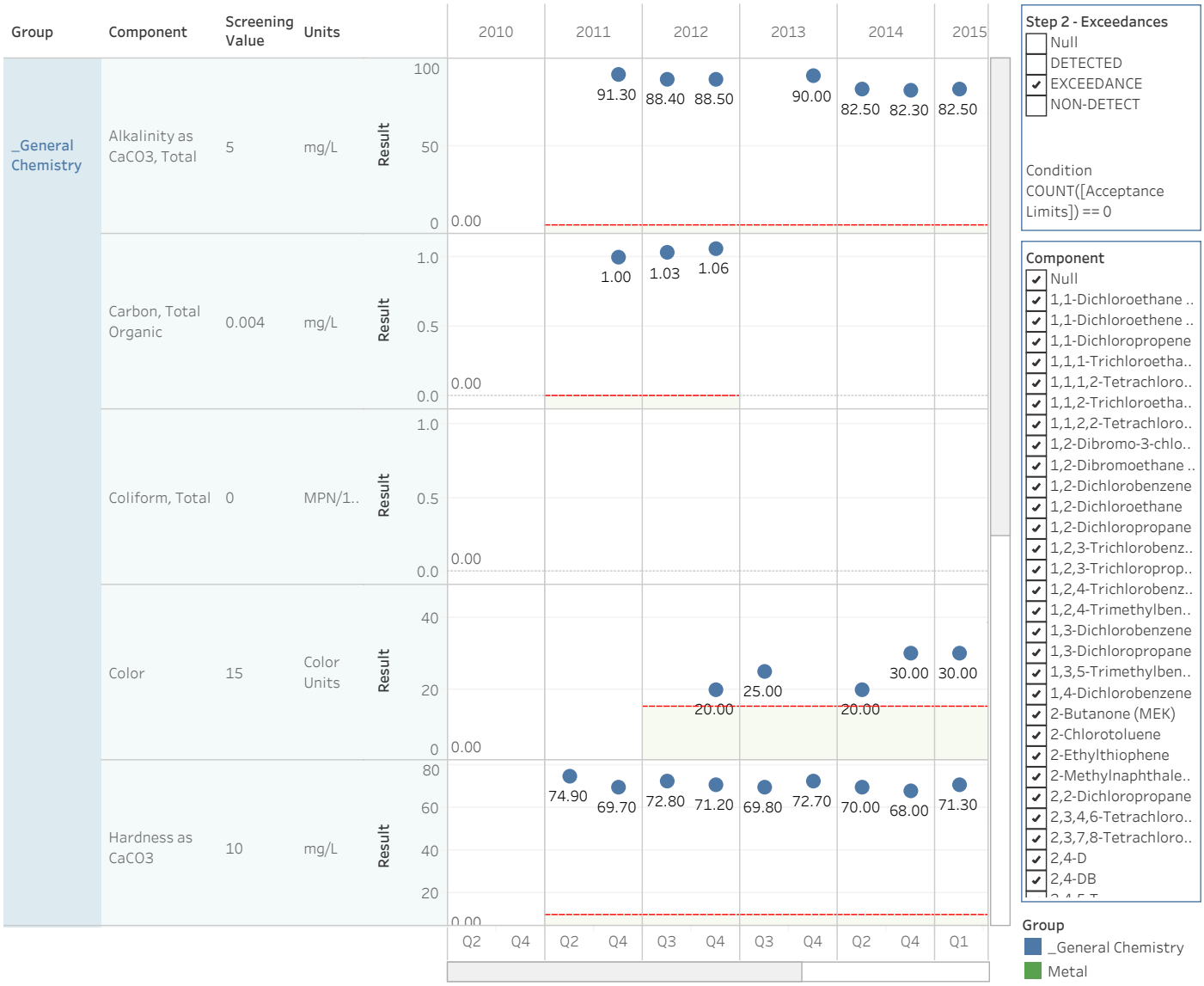
DMW-1

WHPP Database | Screening Values | Detections | Exeedances | Criticality



DMW-1

WHPP Database | Screening Values | Detections | Exeedances | Criticality

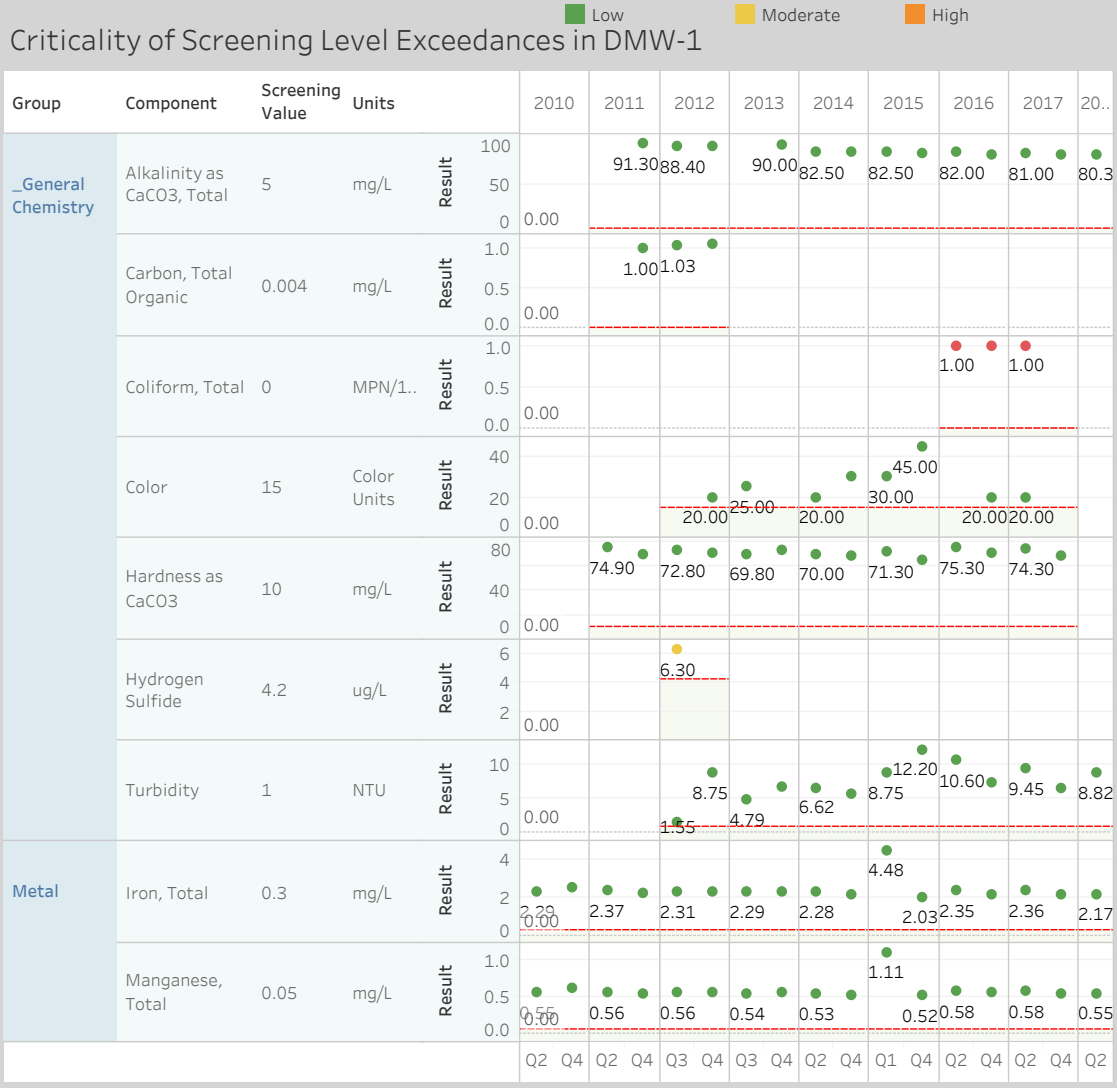


DMW-1

Criticality of Screening Level Exceedances in DMW-1

Low Moderate High

Group	Component	Screening Value	Units
_General Chemistry	Alkalinity as CaCO3, Total	5	mg/L
	Carbon, Total Organic	0.004	mg/L
	Coliform, Total	0	MPN/1..
	Color	15	Color Units
	Hardness as CaCO3	10	mg/L
	Hydrogen Sulfide	4.2	ug/L
	Turbidity	1	NTU
Metal	Iron, Total	0.3	mg/L
	Manganese, Total	0.05	mg/L



_General Chemistry	Alkalinity as Ca
	Ammonia as Nit
	Bromide
	Carbon, Dissolv
	Carbon, Total O
	Chloride
	Coliform, Fecal
	Coliform, Total
	Colilert, E. Coli
	Color
	Conductivity at
	Cyanide, Total
	Fluoride
	Hardness as Ca
	Hydrogen Sulfi
	Nitrate as Nitro
	Nitrite + Nitrat
	Nitrite as Nitro
	Orthophosphat
	Perchlorate
	pH
	Phosphorus, To
	Solids, Total Dis
	Sulfate
	Turbidity
	UV254
Volatile Organic Compound	1,1-Dichloroeth
	1,1-Dichloroeth
	1,1-Dichloropro
	1,1,1-Trichloroe
	1,1,1,2-Tetrach
	1,1,2-Trichloroe
	1,1,2,2-Tetrach
	1,2-Dibromoeth
	1,2-Dichloropro
	1,2,3-Trichlorob
	1,2,3-Trichlorop
	1,3-Dichloropro

Sheet 8

Component (Analyte Sum..	Criticality	Group	
	Null	Null	Abc
1,1-Dichloroethane (1,1-D..	Critical	Volatile Organic Compound	Abc
1,1-Dichloroethene (1,1-D..	Critical	Volatile Organic Compound	Abc
1,1-Dichloropropene	High	Semi-Volatile Organic Co..	Abc
		Volatile Organic Compound	Abc
1,1,1-Trichloroethane	Critical	Volatile Organic Compound	Abc
1,1,1,2-Tetrachloroethane	Critical	Volatile Organic Compound	Abc
1,1,2-Trichloroethane	Critical	Volatile Organic Compound	Abc
1,1,2,2-Tetrachloroethane	Critical	Volatile Organic Compound	Abc
1,2-Dibromo-3-chloroprop..	Critical	Semi-Volatile Organic Co..	Abc
1,2-Dibromoethane (EDB)	Critical	Volatile Organic Compound	Abc
1,2-Dichloroethane	Critical	Semi-Volatile Organic Co..	Abc
1,2-Dichloropropane	Critical	Semi-Volatile Organic Co..	Abc
		Volatile Organic Compound	Abc
1,2,3-Trichlorobenzene	High	Volatile Organic Compound	Abc
1,2,3-Trichloropropane	Critical	Volatile Organic Compound	Abc
1,2,4-Trichlorobenzene	Critical	Semi-Volatile Organic Co..	Abc
1,2,4-Trimethylbenzene	High	Semi-Volatile Organic Co..	Abc
1,3-Dichlorobenzene	High	Semi-Volatile Organic Co..	Abc
1,3-Dichloropropane	High	Semi-Volatile Organic Co..	Abc
		Volatile Organic Compound	Abc
1,3,5-Trimethylbenzene	High	Semi-Volatile Organic Co..	Abc
		Volatile Organic Compound	Abc
2-Butanone (MEK)	High	Semi-Volatile Organic Co..	Abc
2-Chlorotoluene	High	Semi-Volatile Organic Co..	Abc
2-Ethylthiophene	High	Semi-Volatile Organic Co..	Abc
2-Methylnaphthalene	High	Semi-Volatile Organic Co..	Abc
2,2-Dichloropropane	High	Semi-Volatile Organic Co..	Abc
2,3,4,6-Tetrachlorophenol	High	Chlorinated Phenolic Orga..	Abc
2,3,7,8-Tetrachlorodibenz..	Critical	Chlorinated Phenolic Orga..	Abc
2,4-D	Critical	Herbicide	Abc
2,4-DB	High	Herbicide	Abc
2,4,5-T	High	Herbicide	Abc
2,4,5-TP (Silvex)	Critical	Herbicide	Abc
2,4,5-Trichlorophenol	High	Chlorinated Phenolic Orga..	Abc
2,4,6-Trichlorophenol	Critical	Chlorinated Phenolic Orga..	Abc
2,5-Dimethylthiophene	High	Volatile Organic Compound	Abc
3-Hydroxycarbofuran	High	Insecticide/Carbamate	Abc
3-Methylthiophene	High	Insecticide/Carbamate	Abc
3,4,5-Trichlorocatechol	High	Chlorinated Phenolic Orga..	Abc
3,4,5-Trichloroguaiacol	High	Chlorinated Phenolic Orga..	Abc
3,4,6-Trichlorocatechol	High	Chlorinated Phenolic Orga..	Abc
3,4,6-Trichloroguaiacol	High	Chlorinated Phenolic Orga..	Abc

The view is broken down by Component (Analyte Summary), Criticality and Group.

Sheet 8

Component (Analyte Sum..	Criticality	Group	
3,5-Dichlorobenzoic Acid	High	Herbicide	Abc
4-Chlorotoluene	High	Semi-Volatile Organic Co..	Abc
4-Methyl-2-pentanone (M..	High	Semi-Volatile Organic Co..	Abc
4,4'-DDD	Critical	Pesticide/PCB	Abc
4,4'-DDE	Critical	Pesticide/PCB	Abc
4,4'-DDT	Critical	Pesticide/PCB	Abc
4,5,6-Trichloroguaiacol	High	Chlorinated Phenolic Orga..	Abc
Acifluorfen	High	Herbicide	Abc
Alachlor	Critical	Herbicide	Abc
Aldicarb	Moderate	Insecticide/Carbamate	Abc
Aldicarb Sulfone	Moderate	Insecticide/Carbamate	Abc
Aldicarb Sulfoxide	Moderate	Insecticide/Carbamate	Abc
Aldrin	Critical	Pesticide/PCB	Abc
Alkalinity as CaCO3, Total	Low	_General Chemistry	Abc
Alpha, Gross	Critical	Radionuclides	Abc
Aluminum, Total	Low	Metal	Abc
Ammonia as Nitrogen	Moderate	_General Chemistry	Abc
Anthracene	Moderate	Polynuclear Aromatic Hyd..	Abc
Antimony, Total	Critical	Metal	Abc
Aroclor 1016	Critical	Pesticide/PCB	Abc
Aroclor 1221	Critical	Pesticide/PCB	Abc
Aroclor 1232	Critical	Pesticide/PCB	Abc
Aroclor 1242	Critical	Pesticide/PCB	Abc
Aroclor 1248	Critical	Pesticide/PCB	Abc
Aroclor 1254	Critical	Pesticide/PCB	Abc
Aroclor 1260	Critical	Pesticide/PCB	Abc
Arsenic (III)	Critical	Metal	Abc
Arsenic (V)	Critical	Metal	Abc
Arsenic, Inorganic (Total)	Critical	Metal	Abc
Atrazine	Critical	Semi-Volatile Organic Co..	Abc
Barium, Total	Critical	Metal	Abc
Bentazon	High	Herbicide	Abc
Benz(a)anthracene	Critical	Polynuclear Aromatic Hyd..	Abc
Benzene	Critical	Volatile Organic Compound	Abc
Benzo(a)pyrene	Critical	Semi-Volatile Organic Co..	Abc
Benzo(b)fluoranthene	Critical	Polynuclear Aromatic Hyd..	Abc
Benzo(g,h,i)perylene	Critical	Polynuclear Aromatic Hyd..	Abc
Benzo(k)fluoranthene	High	Polynuclear Aromatic Hyd..	Abc
Beryllium, Total	Critical	Metal	Abc
Beta, Gross	Critical	Radionuclides	Abc
Bis(2-ethylhexyl) Adipate	Critical	Plasticizer	Abc
Bis(2-ethylhexyl) Phthala..	Critical	Plasticizer	Abc
Bromacil	High	Semi-Volatile Organic Co..	Abc

The view is broken down by Component (Analyte Summary), Criticality and Group.

Sheet 8

Component (Analyte Sum..	Criticality	Group	
Bromide	Critical	_General Chemistry	Abc
Bromobenzene	High	Volatile Organic Compound	Abc
Bromochloromethane (hal..	High	Volatile Organic Compound	Abc
Bromodichloromethane	Critical	Volatile Organic Compound	Abc
Bromoform	Critical	Volatile Organic Compound	Abc
Bromomethane	High	Volatile Organic Compound	Abc
Butachlor	High	Semi-Volatile Organic Co..	Abc
Butyl Benzyl Phthalate	Critical	Plasticizer	Abc
Cadmium, Total	Critical	Metal	Abc
Calcium, Total	Low	Metal	Abc
Carbaryl	Critical	Insecticide/Carbamate	Abc
Carbofuran	Critical	Insecticide/Carbamate	Abc
Carbon Tetrachloride	Critical	Volatile Organic Compound	Abc
Carbon, Dissolved Organi..	Low	_General Chemistry	Abc
Carbon, Total Organic	Low	_General Chemistry	Abc
Carbonyl Sulfide	High	Volatile Organic Compound	Abc
Chloramben	High	Herbicide	Abc
Chlordane	Critical	Pesticide/PCB	Abc
Chloride	Low	_General Chemistry	Abc
Chlorobenzene	Critical	Herbicide	Abc
Chloroethane	Critical	Volatile Organic Compound	Abc
Chloroform	Critical	Volatile Organic Compound	Abc
Chloromethane	High	Volatile Organic Compound	Abc
Chromium, Total	Critical	Metal	Abc
Chrysene	High	Polynuclear Aromatic Hyd..	Abc
cis-1,2-Dichloroethene	Critical	Volatile Organic Compound	Abc
cis-1,3-Dichloropropene	High	Volatile Organic Compound	Abc
Coliform, Fecal	Critical	_General Chemistry	Abc
Coliform, Total	Critical	_General Chemistry	Abc
Colilert, E. Coli	Critical	_General Chemistry	Abc
Color	Low	_General Chemistry	Abc
Conductivity at 25 Degree..	Low	_General Chemistry	Abc
Copper, Total	Low	Metal	Abc
Cyanide, Total	Critical	_General Chemistry	Abc
Dacthal Diacid	High	Herbicide	Abc
Dalapon	Critical	Herbicide	Abc
Di-n-butyl Phthalate	High	Plasticizer	Abc
Dibenz(a,h)anthracene	Critical	Polynuclear Aromatic Hyd..	Abc
Dibenzofuran	High	Polynuclear Aromatic Hyd..	Abc
Dibromochloromethane	Critical	Volatile Organic Compound	Abc
Dibromomethane	High	Volatile Organic Compound	Abc
Dicamba	Moderate	Herbicide	Abc
Dichlorodifluoromethane	Moderate	Volatile Organic Compound	Abc

The view is broken down by Component (Analyte Summary), Criticality and Group.

Sheet 8

Component (Analyte Sum..	Criticality	Group	
Dichloromethane (Methyl..	Critical	Volatile Organic Compound	Abc
Dichlorprop	Moderate	Herbicide	Abc
Dieldrin	Critical	Insecticide/Carbamate	Abc
Diethyl Disulfide	High	Plasticizer	Abc
Diethyl Sulfide	High	Plasticizer	Abc
Diisopropyl Ether	High	Volatile Organic Compound	Abc
Dimethyl Disulfide	High	Plasticizer	Abc
Dimethyl Phthalate	Moderate	Plasticizer	Abc
Dimethyl Sulfide	High	Plasticizer	Abc
Dinoseb	Critical	Herbicide	Abc
Diquat	Critical	Herbicide	Abc
Endothall	Critical	Herbicide	Abc
Endrin	Critical	Pesticide/PCB	Abc
EPTC	Moderate	Pesticide/PCB	Abc
Ethyl Mercaptan	High	Volatile Organic Compound	Abc
Ethyl Methyl Sulfide	High	Volatile Organic Compound	Abc
Ethylbenzene	Critical	Volatile Organic Compound	Abc
Fluoranthene	High	Semi-Volatile Organic Co..	Abc
Fluorene	High	Semi-Volatile Organic Co..	Abc
Fluoride	Moderate	_General Chemistry	Abc
gamma-BHC (Lindane)	Critical	Pesticide/PCB	Abc
Glyphosate	Critical	Herbicide	Abc
Hardness as CaCO3	Low	_General Chemistry	Abc
Heptachlor	Critical	Pesticide/PCB	Abc
Heptachlor Epoxide	Critical	Pesticide/PCB	Abc
Hexachlorobenzene	Critical	Semi-Volatile Organic Co..	Abc
Hexachlorobutadiene	Critical	Volatile Organic Compound	Abc
Hexachlorocyclopentadie..	Critical	Semi-Volatile Organic Co..	Abc
Hydrogen Sulfide	Moderate	_General Chemistry	Abc
Indeno(1,2,3-cd)pyrene	High	Polynuclear Aromatic Hyd..	Abc
Iron, Total	Low	Metal	Abc
Isopropylbenzene	High	Semi-Volatile Organic Co..	Abc
Lead, Total	Critical	Metal	Abc
m,p-Xylenes	Critical	Volatile Organic Compound	Abc
Magnesium, Total	Low	Metal	Abc
Manganese, Total	Low	Metal	Abc
Mercury, Total	Critical	Metal	Abc
Methiocarb	Moderate	Insecticide/Carbamate	Abc
Methomyl	Moderate	Insecticide/Carbamate	Abc
Methoxychlor	Critical	Insecticide/Carbamate	Abc
		Pesticide/PCB	Abc
Methyl Mercaptan	High	Volatile Organic Compound	Abc
Methyl Mercury, Total	High	Metal	Abc

The view is broken down by Component (Analyte Summary), Criticality and Group.

Sheet 8

Component (Analyte Sum..	Criticality	Group	
Methyl tert-Butyl Ether	Critical	Volatile Organic Compound	Abc
Methylene Blue Active Su..	Low	Surfactant	Abc
Metolachlor	Critical	Semi-Volatile Organic Co..	Abc
Metribuzin	Moderate	Semi-Volatile Organic Co..	Abc
n-Butylbenzene	High	Volatile Organic Compound	Abc
n-Propylbenzene	High	Volatile Organic Compound	Abc
Naphthalene	Moderate	Polynuclear Aromatic Hyd..	Abc
Nickel, Total	Critical	Metal	Abc
Nitrate as Nitrogen	Critical	_General Chemistry	Abc
Nitrite + Nitrate as Nitrog..	Critical	_General Chemistry	Abc
Nitrite as Nitrogen	Critical	_General Chemistry	Abc
o-Xylene	Critical	Volatile Organic Compound	Abc
Orthophosphate as Phosp..	Low	_General Chemistry	Abc
Paraquat	Moderate	Herbicide	Abc
Parathion	Critical	Insecticide/Carbamate	Abc
Pentachlorophenol (PCP)	Critical	Semi-Volatile Organic Co..	Abc
Perchlorate	High	_General Chemistry	Abc
pH	Low	_General Chemistry	Abc
Phenanthrene	Moderate	Semi-Volatile Organic Co..	Abc
Phosphorus, Total	Low	_General Chemistry	Abc
Picloram	Critical	Herbicide	Abc
Potassium, Total	Low	Metal	Abc
Propachlor	Critical	Semi-Volatile Organic Co..	Abc
Propoxur	Moderate	Insecticide/Carbamate	Abc
Pyrene	Moderate	Semi-Volatile Organic Co..	Abc
Radium-226	Critical	Radionuclides	Abc
Radium-228	Critical	Radionuclides	Abc
sec-Butylbenzene	High	Volatile Organic Compound	Abc
Selenium, Total	Critical	Metal	Abc
Silica, Dissolved as SiO2	Low	Metal	Abc
Silicon, Total	Low	Metal	Abc
Silver, Total	Moderate	Metal	Abc
Simazine	Critical	Semi-Volatile Organic Co..	Abc
Sodium, Total	Low	Metal	Abc
Solids, Total Dissolved	Low	_General Chemistry	Abc
Styrene	Critical	Volatile Organic Compound	Abc
Sulfate	Low	_General Chemistry	Abc
Terbacil	Moderate	Semi-Volatile Organic Co..	Abc
tert-Butylbenzene	High	Volatile Organic Compound	Abc
Tetrachlorocatechol	High	Chlorinated Phenolic Orga..	Abc
Tetrachloroethene	Critical	Volatile Organic Compound	Abc
Tetrachloroguaiacol	High	Chlorinated Phenolic Orga..	Abc
Thallium, Total	Critical	Metal	Abc

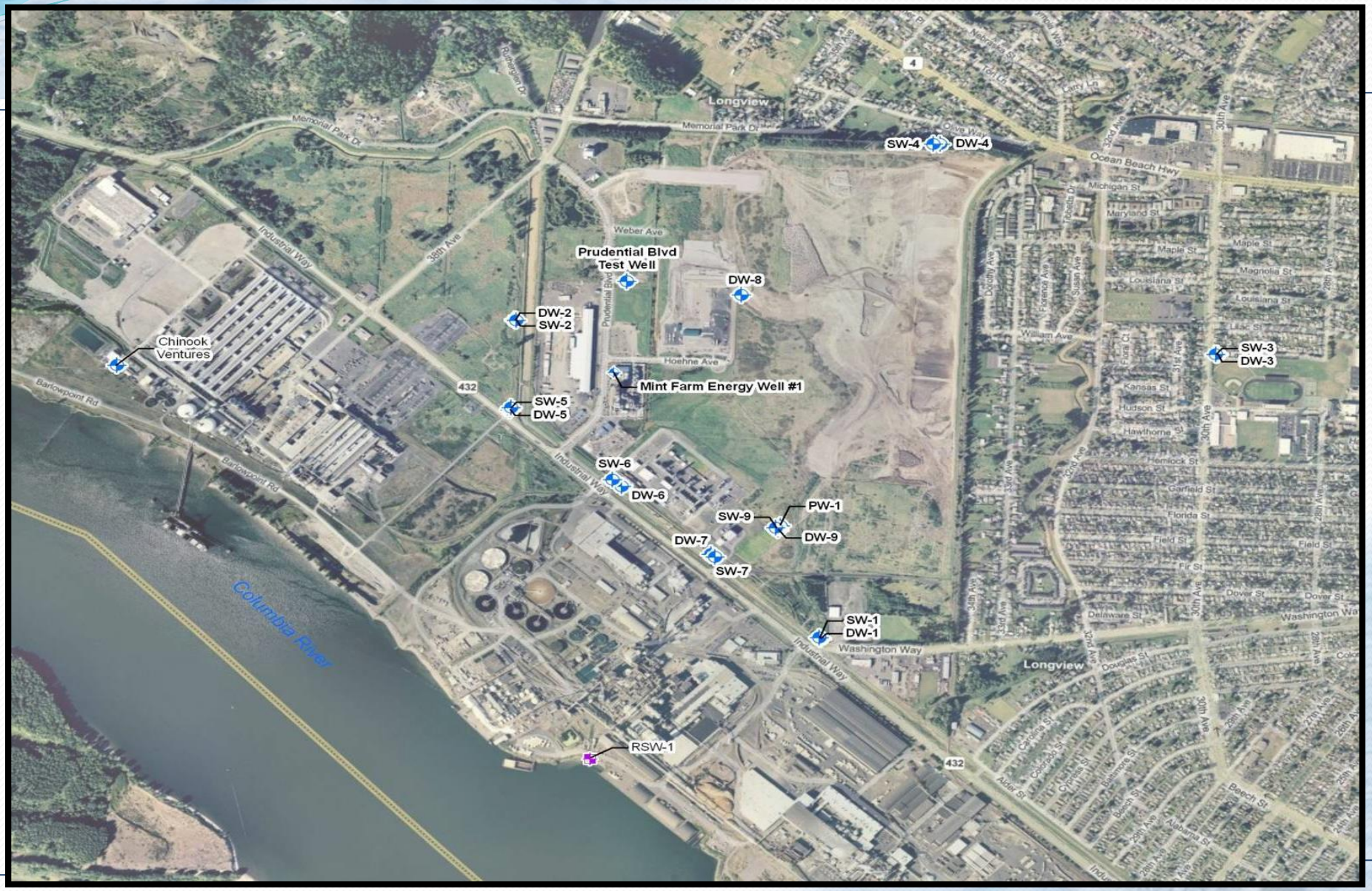
The view is broken down by Component (Analyte Summary), Criticality and Group.

Sheet 8

Component (Analyte Sum..	Criticality	Group	
Toluene	Critical	Volatile Organic Compound	Abc
Toxaphene	Critical	Pesticide/PCB	Abc
trans-1,2-Dichloroethene	Critical	Semi-Volatile Organic Co..	Abc
		Volatile Organic Compound	Abc
trans-1,3-Dichloropropene	Critical	Semi-Volatile Organic Co..	Abc
		Volatile Organic Compound	Abc
Trichloroethene	Critical	Volatile Organic Compound	Abc
Trichlorofluoromethane	Moderate	Volatile Organic Compound	Abc
Trichlorosyringol	High	Chlorinated Phenolic Orga..	Abc
Trifluralin	Critical	Herbicide	Abc
Turbidity	Low	_General Chemistry	Abc
Uranium, Total	Critical	Metal	Abc
UV254	Low	_General Chemistry	Abc
Vinyl Chloride	Critical	Volatile Organic Compound	Abc
Zinc, Total	Low	Metal	Abc

The view is broken down by Component (Analyte Summary), Criticality and Group.

GROUNDWATER MONITORING WELLS



The City of Longview Washington

Longview Mint Farm

Wellhead Protection Area Boundary

N

3608 ft

CityGIS